NATIONAL HIGH
MAGNETIC
FIELD LABORATORY

2020 Annual Report

1800 E. Paul Dirac Drive
Tallahassee, FL 32310

NationalMagLab.org

2020 Annual Report

Produced by

National High Magnetic Field Laboratory

DIRECTOR
Gregory S. Boebinger

DEPUTY LAB DIRECTOR
Eric Palm

CHIEF SCIENTIST
Laura Greene

USER PROGRAM CHIEF OF STAFF
Anke Toth

Copy Editors
Evangeline Coker and Mike Mitchell
FSU Office of Research Development

This document is available in
alternative formats upon request.
Contact Anke Toth for
assistance via
atoth@magnet.fsu.edu

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DIRECTOR'S EXECUTIVE SUMMARY

It has become a cliché to say that 2020 was a year unlike any other, but as SARS-CoV2 spread across the globe in the spring, operations at the MagLab were impacted like many organizations around the world. Our staff began working remotely in March 2020 and, after new COVID-safety measures were implemented, on-site research activities were able to restart after only a brief disruption.

THE USER PROGRAM

Despite a global pandemic, the MagLab continued to serve scientists from across the globe in 2020, advancing society's understanding of new materials, energy solutions, and the science that underlies life. Nearly 1,500 researchers, students and technicians conducted experiments across the lab in 2020 – many remotely due to travel restrictions and social distancing measures.

To meet user needs despite COVID, the lab created new opportunities for researchers to access our fleet of world-record magnets. About eight percent of users sent samples to the lab to run their experiments. Some users worked seamlessly with on-site user support scientists through collaboration carts, specially-created mobile tools to allow geographically-distributed researchers the feeling of being on-site. Other users were able to remotely control their experiment, operating their magnet from a remote location. And still others were able to access MagLab data sets to conduct their own independent research.

Remarkably, the National MagLab's user community continued to expand with new researchers using the facility to investigate interdisciplinary scientific questions that span the spectrum – from physics to biology, chemistry to engineering. Of the 384 principal investigators in 2020, nearly 20 percent were new to the MagLab user facility that they accessed to conduct their research. More than 700 users, about 47 percent of the lab's total user community, were students and postdocs. More than 28 percent of the National MagLab's users who chose to identify were females and nearly 9 percent identified as a minority.

National MagLab users remained exceptionally positive about their experience in 2020. A user survey conducted in June continues to show overwhelming satisfaction:

- 96% external users are satisfied with the performance of the facilities and equipment
- 97% external users are satisfied with the assistance provided by technical staff
- 93% external users are satisfied with the proposal process

Across the National MagLab's seven user facilities, enhancements and upgrades were made in 2020 that improved the user experience and experimental environment. These enhancements included:

- The High B/T Facility expanded to encompass three separate laboratories, nearly doubling lab space. The new High Bay Convergence Laboratory features ground floor space for up to four high-field magnet stations and a mezzanine to support student training and instrumentation development. In 2020, this area was configured for two wide-bore NMR-quality superconducting magnets - an 18.8T, 89mm (800MHz ^{1}H) magnet, expected on site in March 2021, and an existing 9.4T, 89mm (400MHz ^{1}H) magnet, which was moved to this space in 2020 and is expected to be operating in 2021.
- A new 75T duplex magnet at the Pulsed Field Facility was launched in February 2020. This duplex magnet features two independent coils, each powered by a different subsystem of the 16kV, 4MJ capacitor bank and a modular design that reduces the voltage needed and provides more design flexibility to maximize magnetic fields with a short cooling time (~1hr) between pulses.
- DC Field Facility created collaboration carts to give users access to a magnet cell during remote experiments. These carts consist of a computer, monitor, two high-definition cameras with pan, tilt and zoom functionality and a low power Bluetooth headset that

allow MagLab staff handsfree communication as they are working with remote users during their magnet time.

- An upgrade was made to the AMRIS NMR console for the 600MHz systems to enhance multireceive capabilities.
- In EMR, integration of an arbitrary waveform generator (AWG) capability and upgrade of the user interface were made on HiPER. The new AWG capability enables arbitrary shaped high-power waveforms, including chirped pulses spanning a 1GHz (94.0±0.5GHz) bandwidth, enabling wideband excitation and implementation of state-of-the-art pulse schemes (e.g., chirp echo Fourier transform EPR) akin to what is possible in NMR.
- In 2020, the ICR facility developed a new ion loading technique called "chimeric ion loading" that saves valuable acquisition time, decreases sample consumption, and improves top-down protein sequence coverage.
- AMRIS began construction of Low-E MAS probes at 800MHz to enhance high field capabilities.
- Three NMR probes were developed, including two for the SCH (3.2mm HX, middle-γ, ν_X = ^{15}N-^{71}Ga; 3.2mm HX, low-γ, ν_X = ^{103}Rh-^{15}N) and one for the 800 (1.3mm HX(Y), in testing).
- MagLab electrical engineers and scientific staff made significant progress on a power supply upgrade project, including development of a prototype MOSFET bank test rig to validate calculations and simulations of power output, response to control signals, thermal transfer and heat sink performance, frequency response and noise levels.
- The ICR facility reports ultrahigh resolving power ion isolation by SWIFT on a 21T Fourier transform ion cyclotron resonance (FTICR) mass spectrometer.
- The NMR 800#2 console was upgraded to a Bruker NEO, and the 900 console is in the process of being upgraded with a NEO console as well, along with a significant upgrade in the gradient and shim system (450V/300A) and shimming capabilities for *in vivo* MRI/S. With multiple channels and transceiver capabilities, this will offer enhanced capabilities in a new super-wide configuration to augment the existing microimaging and SSNMR applications

USER RESEARCH

In 2020, users published 485 peer-reviewed papers, many in significant journals like *Science*, *Nature*, *Physical Review Letters*, *Energy Fuels*, *Analytical Chemistry*, *and the Proceedings of the National Academy of Sciences*. A complete database of user publications can be found at https://nationalmaglab.org/research/publications-all/peer-reviewed-publications . Important discoveries include:

- The 32T all-superconducting magnet facilitated its first condensed matter NMR experiments on the potential quantum spin-nematic compound β-$TeVO_4$.
- ^{17}O ssNMR was used for the identification and assignment of a "wire" of water molecules involved in hydrogen bonding with carbonyl groups in gramicidin-A, shedding new insight on their dynamics in the central channel of the protein.
- Using a technique called matrix-assisted laser desorption ionization (or MALDI) for the first time on the 21T ICR magnet, researchers were able identify and map the special distribution of tiny, distinct lipids from very thin slices of healthy rats' brains, demonstrating the ability to separate two molecules with a difference in molecular weight of 0.00179 daltons.
- Researchers were the first to discover a quantum fluid—fractional quantum Hall states, one of the most delicate phases of matter—in a monolayer 2D semiconductor, a finding that could provide a unique test platform for future applications in quantum computing.
- The existence of a spin diffusion barrier (*i.e.*, slower nuclear spin polarization diffusion around bis-nitroxides) was demonstrated for the first time under MAS-DNP conditions, using the MAS DNP NMR platform during 2020.

- ICR researchers showed that exposure to sun and water causes thousands of chemicals to leach from roads into the environment.
- Using the duplex magnet at Pulsed Field Facility, the Kondo (insulating) gap was closed, enabling the study of the high-field metallic state of YbB_{12}. Comparing the frequency of the quantum oscillations in both the insulating and metallic state, researchers concluded that all observed oscillations were originating from the same quasiparticle band.
- AMRIS users cultured cells containing glucose to compare metabolism in healthy liver hepatocytes and a hepato-carcinoma cell line. Data suggests that deuterated water (HDO) production could be used as a surrogate for glucose uptake, which is the metric measured in FDG-PET diagnoses of cancer, without exposure to radioactive isotopes.
- In EMR, the first transition metal complexes featuring mixed fluorido-cyanido ligands, *trans*-$[M^{IV}F_4(CN)_2]^{2-}$ (M = Re, Os) were isolated thanks to a novel synthetic approach relying on silicon-mediated fluoride abstraction.
- Using a new 'smart' technique developed by PFF scientists for measuring non-linear transport in pulsed magnetic fields, critical currents in cuprates, iron- and new nickel-based superconductors have been studied up to 65T.
- In an EMR study, the dynamical generation of spin currents using an antiferromagnetic material has been demonstrated for the first time, enabling spin pumping at sub-terahertz frequencies – more than two orders of magnitude faster than ferromagnetic spintronics devices.
- A novel ultra-low temperature NMR experiment has been conducted at High B/T to observe Luttinger liquid physics in a one-dimensional system consisting of ^{3}He atoms confined to tubular nanostructured MCM-41.
- In an analysis of breast cancer cell lysate, ICR users performed collision-induced dissociation (CID) and electron-transfer dissociation (ETD) on each precursor on timescale compatible with chromatography, and improved mean sequence coverage dramatically (CID-only 15% vs chimeric 33%).
- Combining pulse magnetic fields and THz time-domain spectroscopy, PFF users were able to study the cyclotron resonance (CR) of holes in the normal state of high-quality thin films of optimally doped $La_{2-x}Sr_xCuO_4$, the first measurement of a cyclotron mass in this family of cuprate superconductors.
- The Consortium for Top-Down Proteomics launched a study to assess the current state of top-down mass spectrometry (TD MS) and middle-down mass spectrometry (MD MS) for characterizing monoclonal antibody (mAb) primary structures, including their modifications. The total sequence coverage obtained for the ETD/PTR MS/MS data collected off the 21T FT-ICR MS system in the ICR facility was the highest achieved from a single experiment in the study.
- Using DC Field Facility's 35T resistive magnet coupled with an advanced cryogenic system and piezo cantilever to measure the magnetization of the material via torque, users were able to explore a topological semimetal by determining the electron-electron interactions in $SrZnSb_2$ through the mapping of the Fermi surface in high magnetic fields.
- ICR researchers collected water samples daily over a 6-day storm from small drainage areas of varying landcover to see how the concentration and type of carbon changed over the course of a storm. Results showed that the amount and type of carbon in the stream changed dramatically during the storm and originated from different areas of the landscape. The flow of water through the soil also changed during the storm and was related to the type and amount of carbon entering the stream. Storm events not only impact carbon entering the stream but also may impact its transfer to coastal marine ecosystems
- AMRIS users examined the effect of a ketogenic diet on de novo lipogenesis in the liver tissue of mice fed one of three diets: low fat, high fat, or HF plus increased branched-chain amino acids diet.

- Through the use of ultrafast spectroscopy, DC Field users discovered that aggregates of aromatic chromophores can act as molecular solenoids that enhance or quench observed magnetic field effects. Currents of several nanoamperes were shown to be induced in the aromatic light. This research opens a window into a new realm of potential materials that could be utilized for multifunctional magnetic technologies.
- Users performed measurements on a two-dimensional Wigner Crystal using a specially-designed rotator stage for measurements in a tilted magnetic field at ultra-low temperatures at the High B/T facility and observed the crystal transforming gradually through an intermediate state where it mixes with liquid. This research suggests that two-dimensional Wigner Crystal to liquid transition is not a direct first order transition and that intermediate mixture phase formation may be a general aspect of strongly interacting low dimensional systems, providing insights to other quantum phase transitions in many-body electronic systems.

More user research as well as research highlights from our in-house research teams are featured on our website https://nationalmaglab.org/research/publications-all/science-highlights-all and in our news articles https://nationalmaglab.org/news-events/news.

ADVANCEMENTS IN MAGNET-MAKING

Thanks to a proposal funded by the National Science Foundation in late 2019 (NSF/DMR #1938789), the conceptual design of a REBCO-based all-superconducting 40T magnet with a bore size of 34mm continued in 2020. Despite COVID's impact on the 40T test coil schedule, the lab completed testing three coils this year including a *mini fatigue test coil* to investigate the HTS coil performance under fatigue operation, a *multitape insulated test coil* that was successfully tested up to a field of 11T in a 12T background field (23T total) to demonstrate two-in-hand coil-winding and fatigue lifetime, and a *resistive insulation Petten test coil* to investigate the quench protection of a resistive-insulated coil with a controlled contact resistance between turns compared to an ideal no-insulation coil. Based on these test coils and additional screening current modeling and contact resistance control and quench protection work, a full design proposal has now been submitted the NSF's Mid-Scale research Infrastructure program for the Preliminary and Final Design Phases.

The 32T all-superconducting magnet completed commissioning and is now providing DC Field Facility users a sustained high field environment with lower field ripple and electronic noise than resistive or hybrid magnets.

At the Pulsed Field Facility, efforts are also under way for a 60T mid-pulse magnet to provide users with a three times longer pulse duration (300msec pulse length, FWHM ~ 70msec) than what is available with existing 65T magnets. This magnet is currently in the prototype and testing phase. Preliminary designs for an 85T duplex magnet that leverages an upgraded capacitor system are now complete, with expected final designs in 2021. In 2020 upgraded versions of the 100 T's coils 1 and 2 were fabricated using high-strength, nano-structured Cu-Nb conductor developed by the MagLab in collaboration with our commercial partner, Nano-Electro. This new conductor is approximately 50% stronger than the wires used in the existing version and will be used on the 100T when rotor repairs are complete.

Materials development for magnet applications continues to advance with important developments in Bi-2212, Fe-based, Nb_3Sn superconductors, and qualification of REBCO from multiple suppliers, as well as reinforcing materials for pulsed and SC magnets. Tests of high-temperature superconducting REBCO tapes at 4.2K showed resistance to cyclic loading, demonstrating that it is a promising material for designing HTS magnets of the future. Engineers received $1.5 million from the U.S. Department of Energy to fund continued research on niobium-tin (Nb_3Sn). Additional collaborations with industry, academic and government groups, including the high-energy physics community, continues, particularly in the area of developing higher current-density LTS and HTS superconductors. The MagLab also continues to be one of the four central players in the Magnet Development Program (MDP) funded by the DOE Office of High Energy Physics (HEP) to drive ultra-high field dipole magnet technology.

BROADENING PARTICIPATION & BUILDING THE STEM PIPELINE

Before COVID made in-person events impossible, the National MagLab hosted about 10,000 visitors to a special 25th anniversary Open House event in February 2020. Visitors enjoyed special time-themed demonstrations, were invited to a Travel-Through-Time Scavenger Hunt, and predicted the future in a Time Vault that will be opened at the MagLab's 50th Open House in 2045.

During the 2019-2020 school year, outreach was provided to more than 5,300 students in Florida. In lieu of in-person summer camps, the MagLab hosted a 10-week virtual Summer Exploration Series for middle and high school students that highlighted different research areas of the MagLab with live and asynchronous programming. The 2020 Middle School Mentorship and High School Externship Programs were both converted to a virtual format where nearly 30 students were able to have an impactful science experience while maintaining COVID safety protocols. Beyond traditional programs, the MagLab website and YouTube channel saw expanded audiences as COVID impacted in-person learning and changed where people accessed educational information. The website received nearly 1.6 million pageviews in 2020, many to the education-based content and YouTube videos had more than 33 million impressions and 2.2 million views. Educational research on the MagLab's SciGirls coding camp in 2020 also yielded a framework to better understand how to encourage girls and underrepresented minorities in STEM's most male-dominated field, computer science.

In 2020, 54 scientists and staff reported outreach to the community reaching nearly 2,000 people. MagLab staff also gave 164 lectures, talks and presentations to organizations around the country and the world, more than 67% which were conducted virtually due to COVID. The MagLab hosted an in-person Winter Theory School and Convergence in High Magnetic Fields symposium in January 2020 as well as a virtual User Committee Workshop and Applied Superconductivity Conference later in the year.

CULTIVATING A SAFE AND HEALTHY LAB ENVIRONMENT

This year, with strong support from our host institutions, the National MagLab's health and safety team were at the forefront as COVID mitigation measures were put into place to ensure the safety of users, staff, contractors and visitors. Working together with Public Affairs and key personnel from across the lab, the safety department created a MagLab-specific COVID training that all employees and staff were required to take before entry was permitted. A special committee was formed to review projects and personnel and grant access to the lab for key research duties. Specific COVID protocols have evolved throughout the year, but a focus on key health and safety measures like handwashing, staying home when you are sick and respecting others' personal space will remain.

In 2020, the MagLab strategically invested nearly $50,000 for safety-related equipment, supplies, training and processes including personal protective equipment, equipment used to lockout/tagout and verify hazardous energy sources, fall protection, and COVID-related supplies. The MagLab developed a new safety device to ensure that the power supplies are disconnected and isolated from the magnet before any maintenance or construction work begins on the magnets without exposing workers to any sort of high voltage hazard. This new safety device enables technical work on magnet systems with uninsulated conductors by making certain that the power source is physically disconnected from the magnet.

LOOKING AHEAD

The MagLab will continue to provide access to world-unique high field environments to diverse users from around the world. Upgrades to the Pulsed Field Facility's power infrastructure will provide a new 30kV-1.2MJ capacitor bank by the end of 2021. Preliminary designs for an 85T duplex magnet using the upgraded capacitor system have been completed and will be further refined to a final design in early 2021 with testing in early 2022. A 9.4T (400MHz) magnet in High B/T Facility's new High Bay Convergence Laboratory will host users in 2021 and a second instrument – a 18.8T (800Mhz) magnet – will arrive on-site in the coming months.

In the EMR facility, ongoing efforts aimed at commissioning an EPR capability in the 36T high-resolution SCH magnet will continue in 2021 with a plan to commence EMR user operations in the SCH in 2022. Through a NIH P41 technology development grant, AMRIS is constructing a next-generation HTS cryoprobe that we anticipate will be available to users by the end of 2021.

A bank of chilled water pumps in the DC Field Facility will be replaced during the 2021 annual maintenance shutdown to supply additional water flow through the magnet cooling water heat exchangers and improve temperature stability of the magnet cooling water loops as the pumps turn on and off depending on the heat load.

A design proposal has now been submitted the NSF's Mid-Scale research Infrastructure program for the Preliminary and Final Design Phases of the 40T all-superconducting magnet. If this is successful, it will last five years, and an Implementation proposal will be submitted to the Mid-Scale program in 2025 for the construction of the magnet.

All MagLab user facilities and in-house research groups continue to advance the development of new instrumentation to serve our growing user community. Please explore the detailed information available in the individual chapters that follow and across our website at https://nationalmaglab.org/

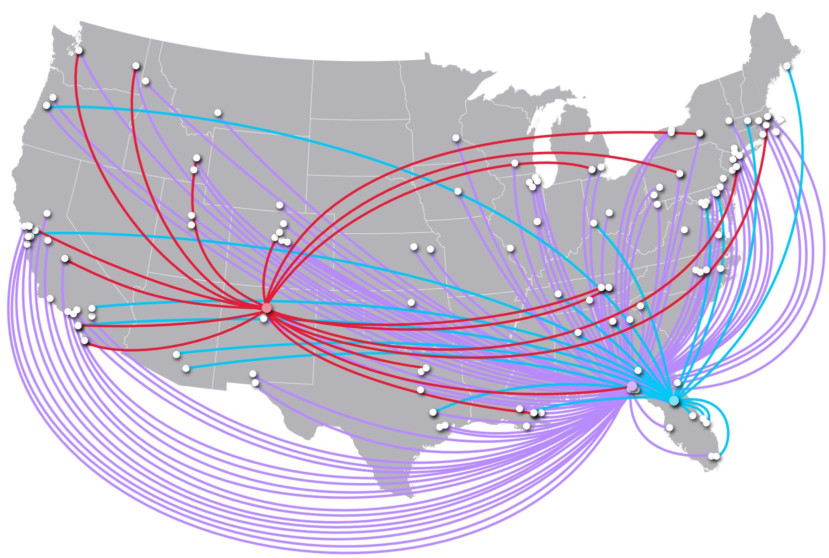
2020

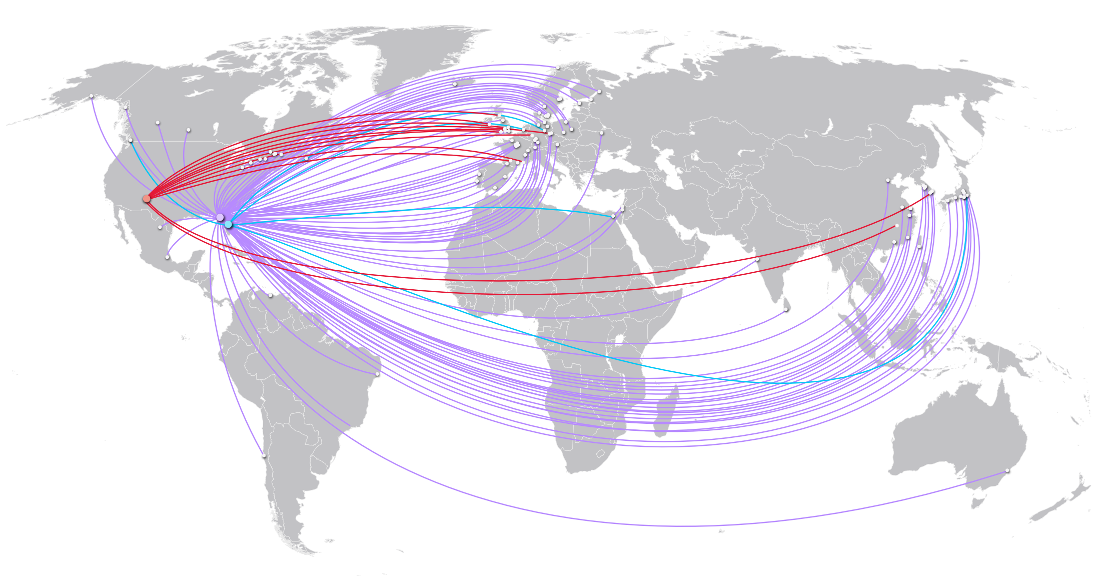
AT A GLANCE

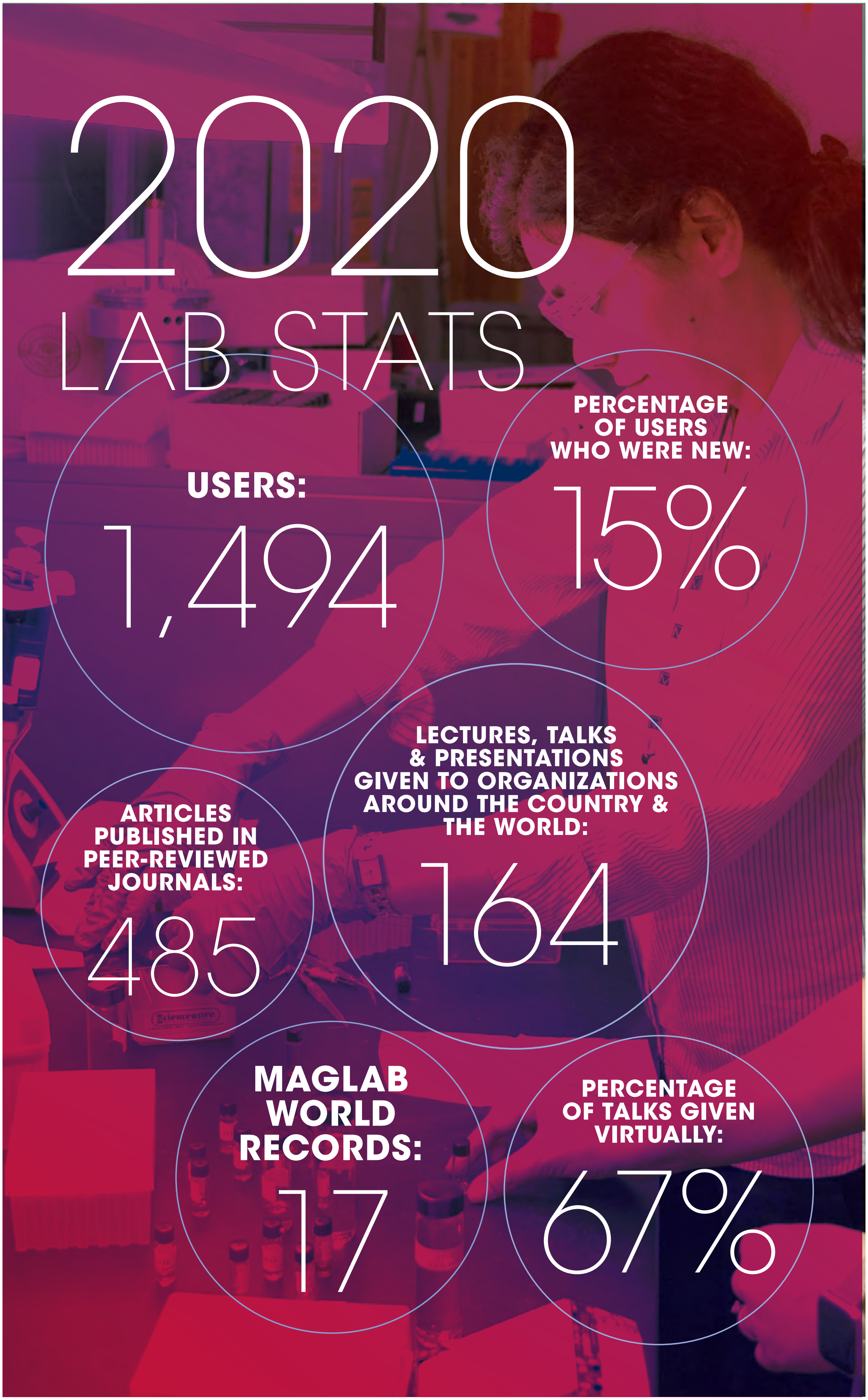
SCIENCE KNOWS NO BOUNDARIES

Seeking the most powerful magnetic fields on Earth, scientists and engineers from around the world conduct their experiments at the National MagLab. In 2020, our **1,494** users represented **272** universities, government labs and private companies worldwide.

78% UNIVERSITIES **14%** GOVERNMENT LABS **8%** INDUSTRY





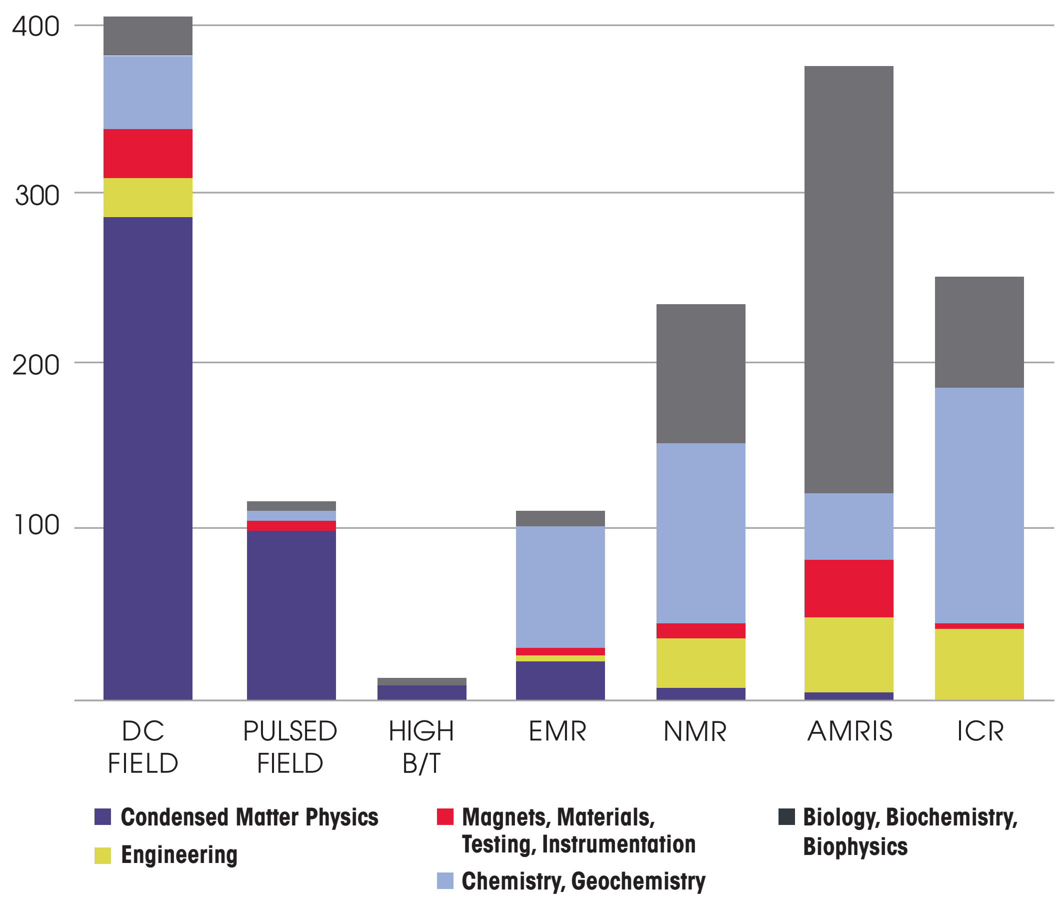

2020
LAB STATS
USERS:
1,494
PERCENTAGE OF USERS WHO WERE NEW:
15%
LECTURES, TALKS & PRESENTATIONS GIVEN TO ORGANIZATIONS AROUND THE COUNTRY & THE WORLD:
164
ARTICLES PUBLISHED IN PEER-REVIEWED JOURNALS:
485
MAGLAB WORLD RECORDS:
17
PERCENTAGE OF TALKS GIVEN VIRTUALLY:
67%

WHO OUR USERS ARE

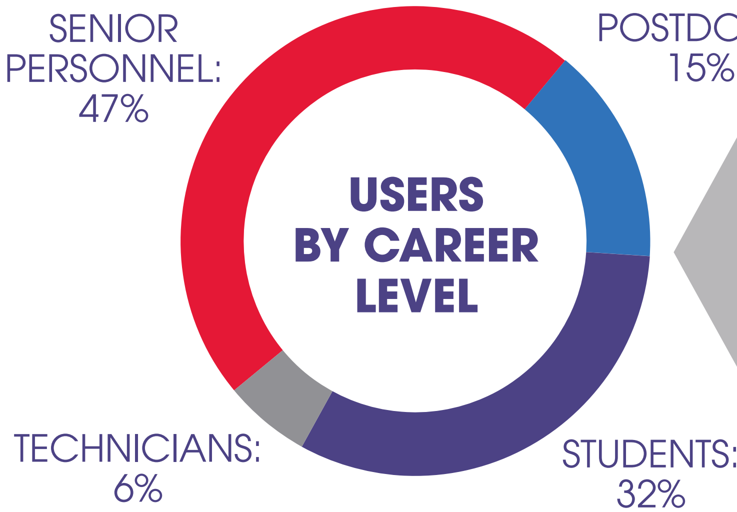
High magnetic fields are a powerful research tool across many disciplines leading to groundbreaking discoveries that impact your life. The lab comprises 7 distinct user facilities that offer our researchers a wide range of research capabilities:

- **DC Field**
  Steady, continuous magnetic fields up to 45 T
- **Pulsed Field**
  Short, ultra-powerful magnetic fields up to 100 T
- **High B/T**
  Magnetic fields up to 15 T combined with ultra-cold temperatures of 0.4 mK
- **Electron Magnetic Resonance (EMR)**
  Magnetic resonance techniques associated with the electron
- **Nuclear Magnetic Resonance (NMR)**
  Solid & solution state NMR & animal imaging
- **Advanced Magnetic Resonance Imaging & Spectroscopy (AMRIS)**
  High-resolution solution and solid-state, NMR, animal imaging & human imaging
- **Ion Cyclotron Resonance (ICR)**
  Ultra-high resolution and high mass accuracy Fourier transform ion cyclotron resonance (FT-ICR) mass spectrometry

2020 USERS BY DISCIPLINE



39% OF STUDENT USERS ARE FEMALE. & **18%** OF POSTDOC USERS ARE FEMALE.



USERS BY FACILITY

DC FIELD - **404**
PULSED FIELD - **110**
HIGH B/T - **10**
EMR - **112**
NMR - **234**
AMRIS - **373**
ICR - **251**

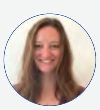
WHAT OUR USERS SAY

96% of users were satisfied with performance of the facilities & equipment.

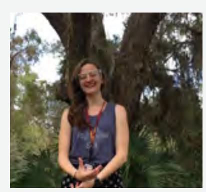
97% of users were satisfied with the assistance provided by MagLab technical staff.

93% of users were satisfied with the proposal process.

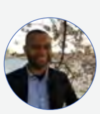
Data reflects external users only. All users were surveyed anonymously.



Leah Schaffer — University of Wisconsin – Madison
Visiting the MagLab was one of my favorite weeks of grad school!! They showed me all the different magnets, helped me generate great data, and even took photos of me by my favorite tree while we waited for samples to centrifuge. 🤓



Mikey Wojnar — Northwestern University
I am SO EXCITED for this paper - I have only the best memories of going to @NationalMagLab and @argonne (right before shutdown!) to collect data. I have had so much fun collaborating with and learning from all of these amazing scientists. The science is better because of it.



Thomas A. Searles, PhD. — Howard University
Crazy to think last year this time I was @NationalMagLab doing a magnetoPL experiment on 2D heterostructures... yeah I still dabble in the lab... the run went extremely well not due to me but more the sample; need to go back when it's normal to finish that up .

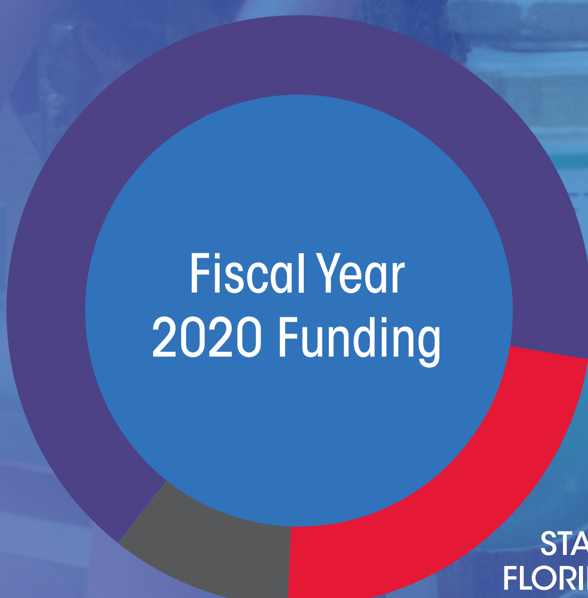
INVESTING IN THE FUTURE

The National MagLab is funded by the National Science Foundation and the state of Florida, making you a stakeholder in our science. In return for your investment, we are positively impacting the nation's economy and making critical discoveries that will lead to the technologies of tomorrow.

BUDGET

TOTAL BUDGET: $ 55,041,846

NSF CORE GRANT: **67%**
$36,780,000



Physics & Materials Research: **48%**
Magnets, Materials & Engineering: **22%**
Chemistry: **10%**
Biology & Biochemistry: **8%**
Management & Administration: **10%**
Education & Diversity: **2%**

STATE OF FLORIDA: **23%**
$ 12,768,577

AFFILIATED INDIVIDUAL INVESTIGATOR AWARDS*: **10%**
$ 5,493,269

*New 2020 awards from funding other than the NSF core grant and state of Florida.

ECONOMIC IMPACT

RETURN ON INVESTMENT

IN THE U.S., THE MAGLAB
ANNUALLY GENERATES
$709 million
in economic output

more than
4,550 jobs

→

OVER THE NEXT 20 YEARS,
PROJECTED TO GENERATE
$14.2 billion
in economic output

more than
91,000 jobs

$1 → **$6.44**

INVESTED BY THE NSF CORE GRANT

ECONOMIC ACTIVITY GENERATED
IN THE STATE OF FLORIDA

Source: The Center for Economic Forecasting, Florida State University, 2019

CROSS-SECTOR PARTNERS

Our researchers and staff develop partnerships and collaborations with private sector industries, universities, national labs and international organizations to help bring new technologies closer to the marketplace.

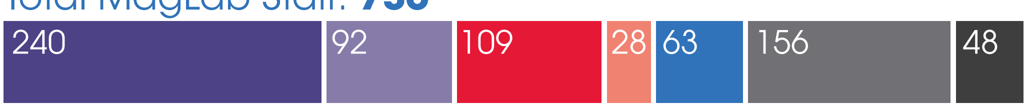
100+ PATENTS over the lab's lifetime

High magnetic field research can impact dozens of industrial sectors including **computer & electronic product manufacturing,** **clean energy,** and **pharmaceuticals.**

MAGLAB STAFF

The MagLab employs a diverse workforce that includes scientists, machinists, engineers, administrators, writers and even artists.

Total MagLab Staff: **736**



- Senior Personnel: **240**
- Other Professional: **92**
- Support Staff - Technical/ Managerial: **109**
- Support Staff - Clerical: **28**
- Postdoctoral: **63**
- Graduate Student: **156**
- Undergraduate Student: **48**

40% **of MagLab students are female.**

SPARKING CURIOSITY

Whether in a traditional classroom setting or on our website, within the walls of our lab or in universities around the globe, the National MagLab is committed to sharing our passion for science. We are growing the next generation of scientists and inspiring all individuals about the magic of discovery in high magnetic fields.

Before Florida was impacted by COVID-19, the MagLab hosted an in-person Open House event in celebration of the lab's **25th anniversary** with more than

10,000 VISITORS

28,000

YouTube subscribers added, bring our total subcriber number to over **130K!**

115

K-12 students in virtual mentorship or camp programs, **56%** of whom were from underrepresented minority groups.

1.59 MILLION+

website pageviews, with views to education sections of the website **increasing 45%** in 2020 compared to 2019.

1. Laboratory Management

1.1. ORGANIZATION

The Florida State University (FSU), the University of Florida (UF) and Los Alamos National Laboratory (LANL) jointly operate the National High Magnetic Field Laboratory (NHMFL or MagLab) for the National Science Foundation (NSF) under a cooperative agreement that establishes the Lab's goals and objectives. FSU, as the signatory of the agreement, is responsible for establishing and maintaining administrative and financial oversight of the Lab and ensuring that the operations are in line with the objectives outlined in the cooperative agreement.

The structure of the MagLab is shown in the three subsequent figures below. Figure 1.1 illustrates the external oversight and advisory committees, as well as the three internal committees that provide guidance to MagLab leadership.

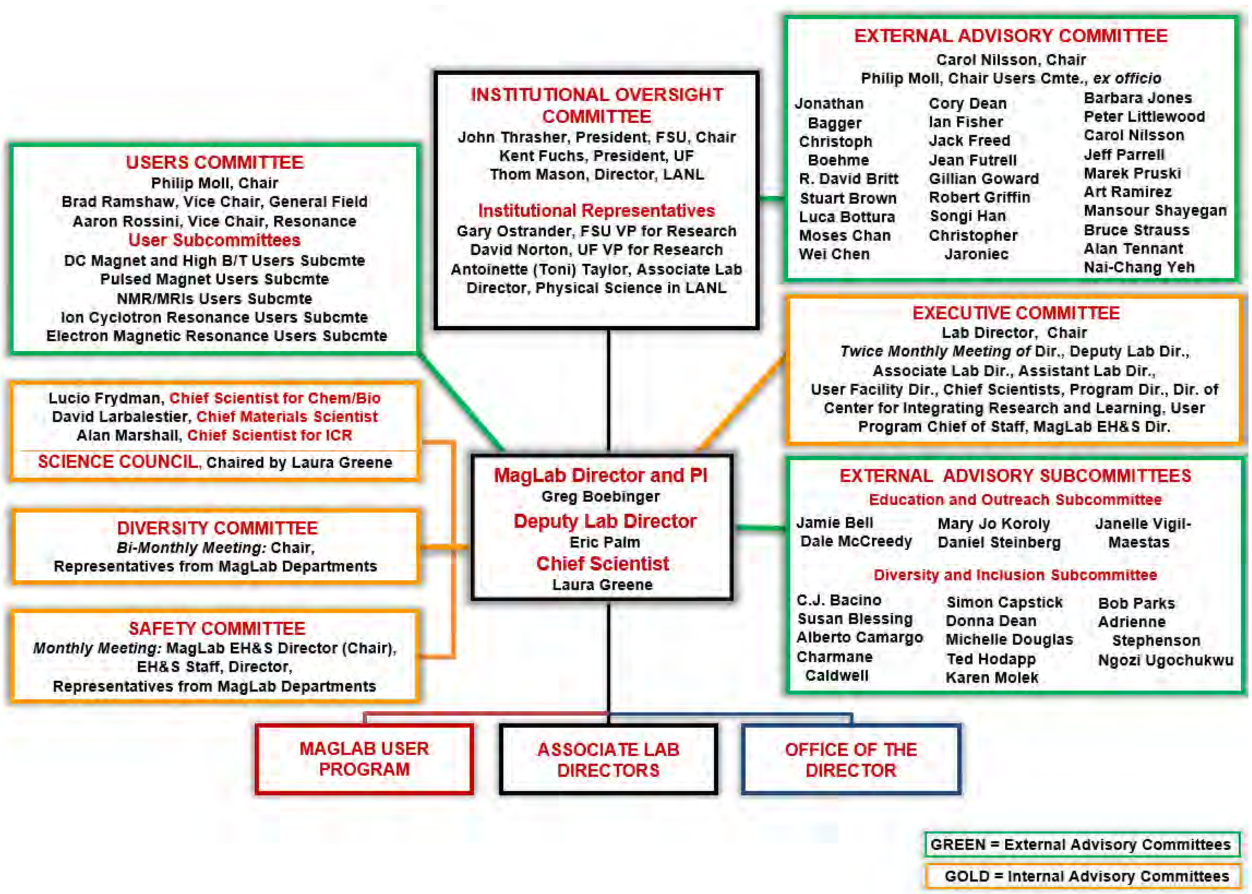


Figure 1.1: Advisory Committees of the MagLab, showing internal and external advisory committees (as of December 2020).

Greg Boebinger is the Director of the MagLab and PI of the cooperative agreement. Together, the Director, Deputy Laboratory Director, Eric Palm, and Chief Scientist, Laura Greene, function as a team to provide management oversight for the Laboratory. Lab Leadership — consists of the MagLab Director, Deputy Lab Director, Chief Scientists, Associate Lab Directors and MagLab Facility Directors. Robert Schurko became the new Director for NMR Facility replacing Tim Cross.

The Executive Committee meets monthly to discuss Lab-wide as well as program–specific issues. The Lab's scientific direction is overseen by the Science Council, a multidisciplinary "think tank" group of distinguished faculties from all three sites. Two external committees meet regularly to provide critical advice on important issues. The **External Advisory Committee**, made up of representatives from academia, government and industry, offers advice on matters critical to the successful management of the Lab. The **User Committee**, which reflects the broad range of scientists who conduct research at the Lab, provides guidance on the development and use of facilities and services in support of the work of those scientists. These committees are further described below.

Figure 1.2 shows the structure of the user program with its seven user facilities – DC Field Facility, Pulsed Field Facility, High B/T Facility, Electron Magnetic Resonance Facility, Nuclear Magnetic Resonance and Magnetic Resonance Imaging at Florida State University and at University of Florida and Ion Cyclotron Resonance.

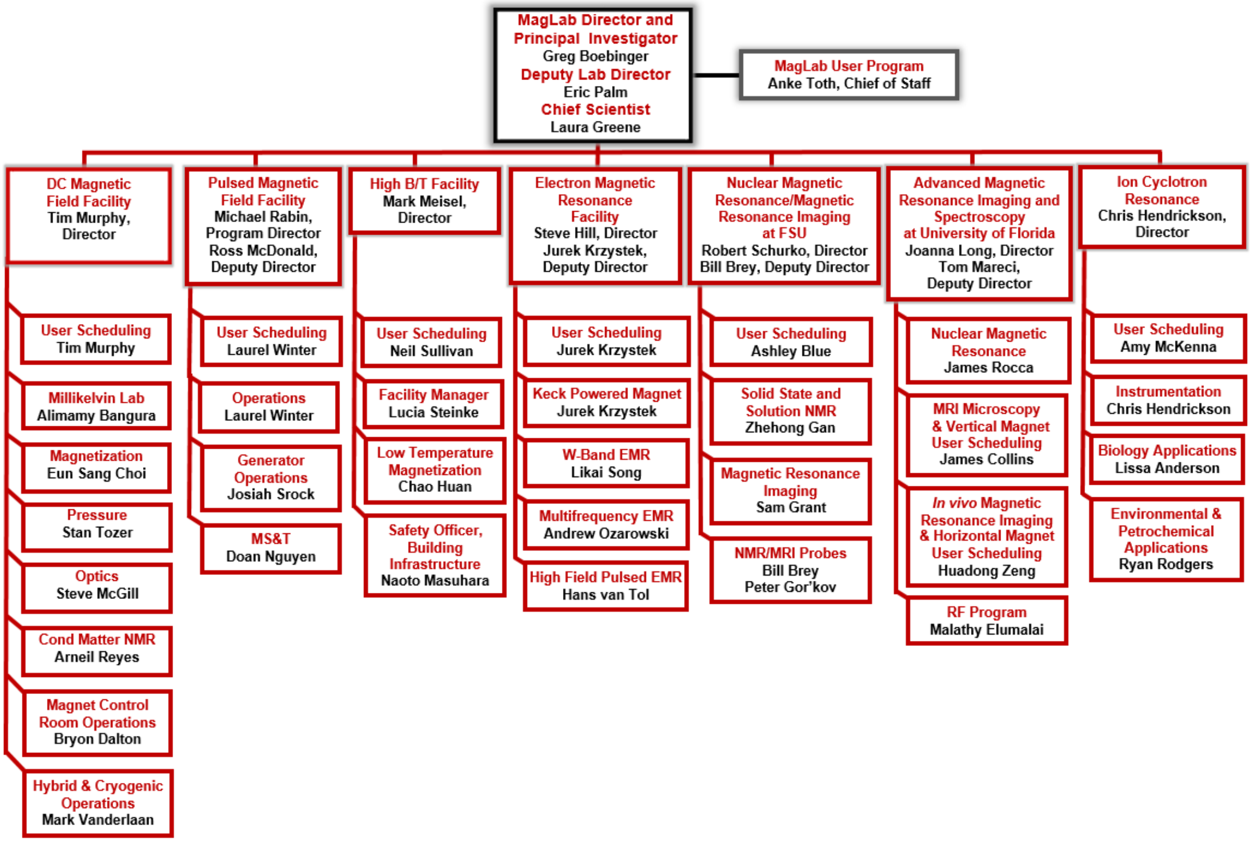


Figure 1.2: MagLab User Program (as of December 2020)

Figure 1.3 below displays the internal, operational organization of the Laboratory. It includes the seven user facilities, all Associate Lab Directors as well as the Office of the Director structure.

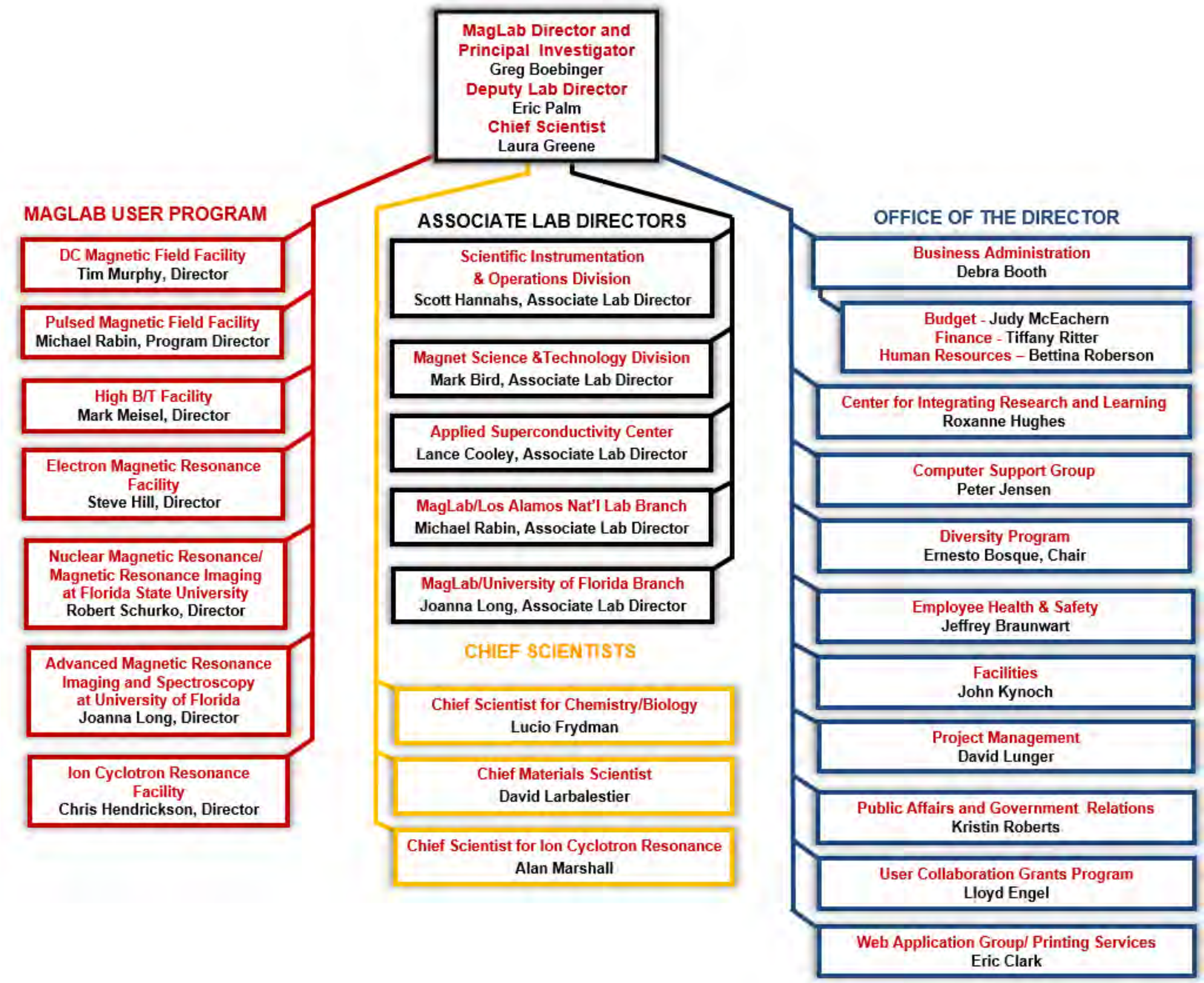


Figure 1.3: MagLab Organizational Chart (as of December 2020)

1.2. EXTERNAL ADVISORY COMMITTEE

The External Advisory Committee is made up of representatives from academia, government and industry. This committee offers advice on matters critical to the successful management of the lab.

External Advisory Committee Chair

- Carol Nilsson—Swedish National Infrastructure for Biological Mass Spectrometry

User Committee Chair (ex officio member of EAC)

- Nat Fortune—Smith College

Biology and Chemistry Subcommittee

- R. David Britt—UC-Davis
- Wei Chen—University of Minnesota
- Jean Futrell—Battelle
- Gillian R. Goward—McMaster University
- Robert Griffin—MIT
- Songi Han—UC-Santa Barbara
- Christopher Jaroniec—Ohio State University
- Marek Pruski—Ames Lab

Condensed Matter Subcommittee

- Christoph Boehme—University of Utah
- Stuart Brown—UC-Los Angeles
- Moses Chan—Penn State University
- Cory Dean—City College of New York
- Ian Fisher—Stanford University
- Barbara A. Jones—IBM Almaden Research Center
- Art Ramirez—UC-Santa Cruz
- Mansour Shayegan—Princeton University
- Nai-Chang Yeh—California Institute of Technology

Magnet Technology and Materials Subcommittee

- Luca Bottura—Magnets, Superconductors and Cryostats
- Jeff Parrell—Oxford Superconducting Technology

Science Management

- Jonathan Bagger—TRIUMF
- Peter Littlewood—University of Chicago
- Bruce P. Strauss—U.S. Department of Energy
- Alan Tennant—Oak Ridge National Laboratory

1.3. USER COMMITTEE

The MagLab's User Committee represents the MagLab's broad, multidisciplinary user community and advises the Lab's leadership on all issues affecting users of our facilities. The User Committee is elected from the user base of the MagLab. Each facility has a subcommittee elected by its users to represent their interests to the MagLab. DC Field and High B/T facilities have a single, combined subcommittee representing the two user facilities. Likewise, the NMR facilities at UF and FSU have a single, combined subcommittee. Pulsed Field, ICR and EMR facilities have their individual subcommittees. Each subcommittee then elects members to represent it on the User Executive Committee. This User Executive Committee elects a chair and two vice chairs. The DC Field/High B/T Advisory Committee, the Pulsed Field Advisory Subcommittee, the EMR Advisory Subcommittee, the NMR/MRI Advisory Committee and the representative from the ICR Advisory Committee met via zoom September 16-18, 2020, to discuss the state of the Laboratory and provide feedback to the NSF and MagLab management. The 2020 User Advisory Committee Report has been made available on our website.

DC Field/High B/T Advisory Subcommittee

- Nat Fortune, Chair—Smith College*
- Philip Moll—Max Planck Institute*
- Joseph G. Checkelsky—Massachusetts Institute of Technology
- Ben Hunt—Carnegie Mellon
- Jane Musfeldt—University of Tennessee
- Raivo Stern—National Institute of Chemical Physics & Biophysics
- Jairo Velasco—University of California, Santa Cruz
- Andrea Young—UC-Santa Barbara
- Matt Yankowitz—University of Washington

EMR Advisory Sub-committee

- Troy Stich—Wake Forest University*
- Rodolphe Clerac—Centre de Recherche Paul Pascal
- Stergios Piligkos—University of Copenhagen
- Joshua Telser—Roosevelt University
- Joseph Zadrozny—Colorado State University

ICR Advisory Sub-committee

- Kristina Hakansson—University of Michigan*
- Jack Beauchamp—California Institute of Technology

- Rene Boiteau—Oregon State University
- Ying Ge—University of Wisconsin
- Franklin Leach—University of Georgia
- Paul Thomas—Northwestern University

NMR/MRI Advisory Subcommittee

- Len Mueller—UC-Riverside*
- Aaron Rossini—Iowa State University*
- Christian Bonhomme—Laboratoire de Chimie de la Matière Condensée de Paris
- Brian Hansen—Aarhus University
- Vladimir Michaelis—University of Alberta
- Doug Morris—National Institutes of Health
- Dylan Murray—UC-Davis
- Thoralf Niendorf—Max Delbruck Center for Molecular Medicine
- Anant Paravastu—Georgia Tech

Pulsed Field Advisory Subcommittee

- Nicholas P. Butch—NIST Center for Neutron Research*
- Adam Aczel—Oak Ridge National Laboratory
- Krzysztof Gofryk—Idaho National Laboratory
- Brad Ramshaw—Cornell University
- Zhiqiang Mao—Tulane University
- Priscila Rosa—Los Alamos National Laboratory

*Note: * Are members of the User Executive Committee*

1.4. PERSONNEL

As of January 1, 2021, the MagLab is comprised of 736 people who work at its three sites and are paid by NSF use grant, State of Florida funding, individual investigator awards, as well as home institutions and other sources. A list of MagLab personnel is presented in Appendix I.

Principal Investigators

- Gregory Boebinger (PI)—Director/Professor
- Joanna Long (Co-PI)—Program Director, AMRIS, UF
- Alan Marshall (Co-PI)—Chief Scientist for Ion Cyclotron Resonance
- Eric Palm (Co-PI)—Deputy Lab Director
- Michael Rabin (Co-PI)—Program Director, LANL

User Facility Directors

- Advanced Magnetic Resonance Imaging and Spectroscopy Facility (UF) —Joanna Long
- DC Field Facility (FSU)—Tim Murphy
- Electron Magnetic Resonance Facility (FSU)— Stephen Hill
- High B/T Facility (UF)—Mark Meisel
- Ion Cyclotron Resonance Facility (FSU)—Chris Hendrickson
- Nuclear Magnetic Resonance (FSU)—Robert Schurko
- Pulsed Field Facility (LANL)—Michael Rabin

Of 736 people, senior personnel represent the largest group at 33%, followed by graduate students at 21%, technical support staff at 15%, other professionals at 12%, post docs at 9%, undergraduate students at 6% and clerical support staff at 4%. The total distribution appears in Figure 1.4.

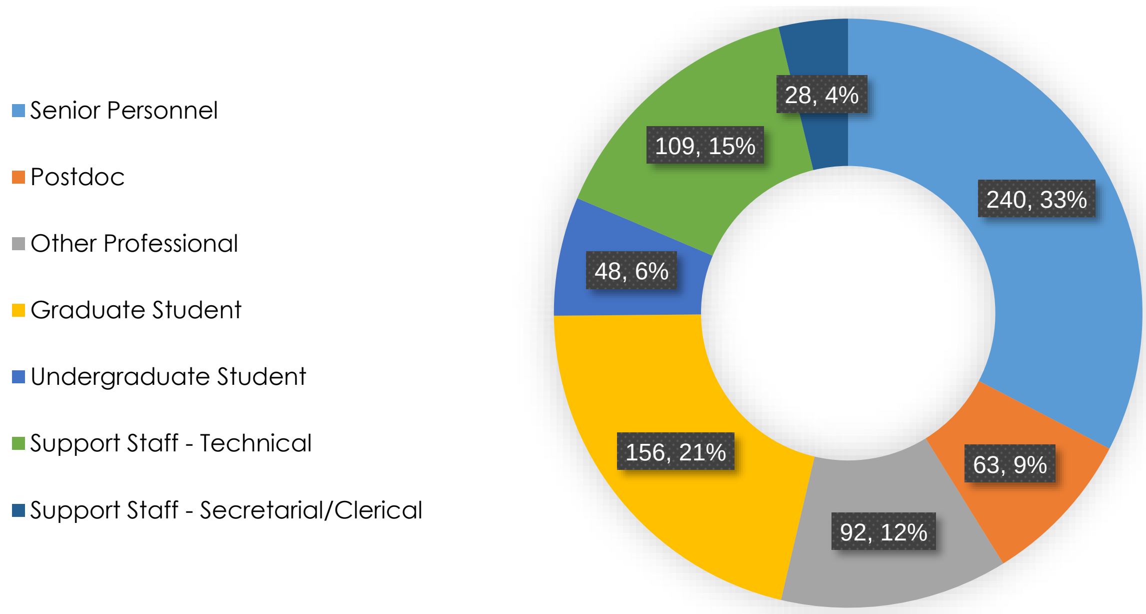


Figure 1.4: MagLab Position Distribution (as of January 1, 2021)

Overall distribution of diversity for all three sites of the MagLab includes: 47.4% white males, 21.9% Asian males and females, 18.1% white females, 6.3% black or African American, and 0.7% American Indian. The distribution by diversity appears in Figures 1.5 and 1.6.

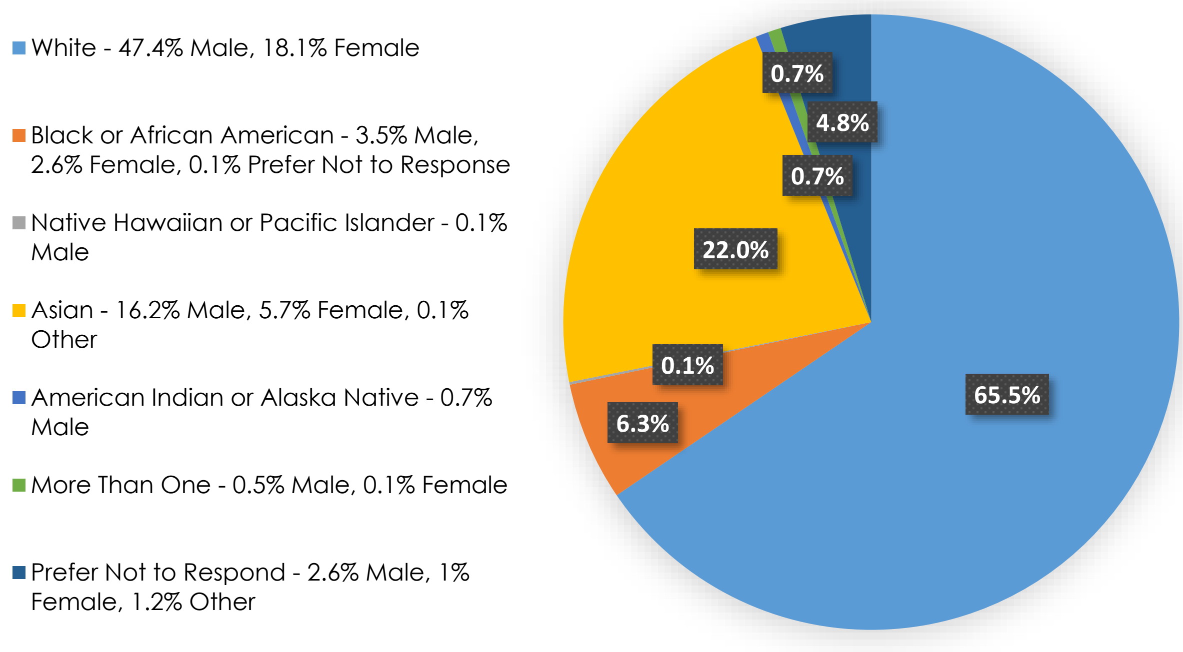


Figure 1.5: MagLab Distribution by Race (as of January 1, 2021).

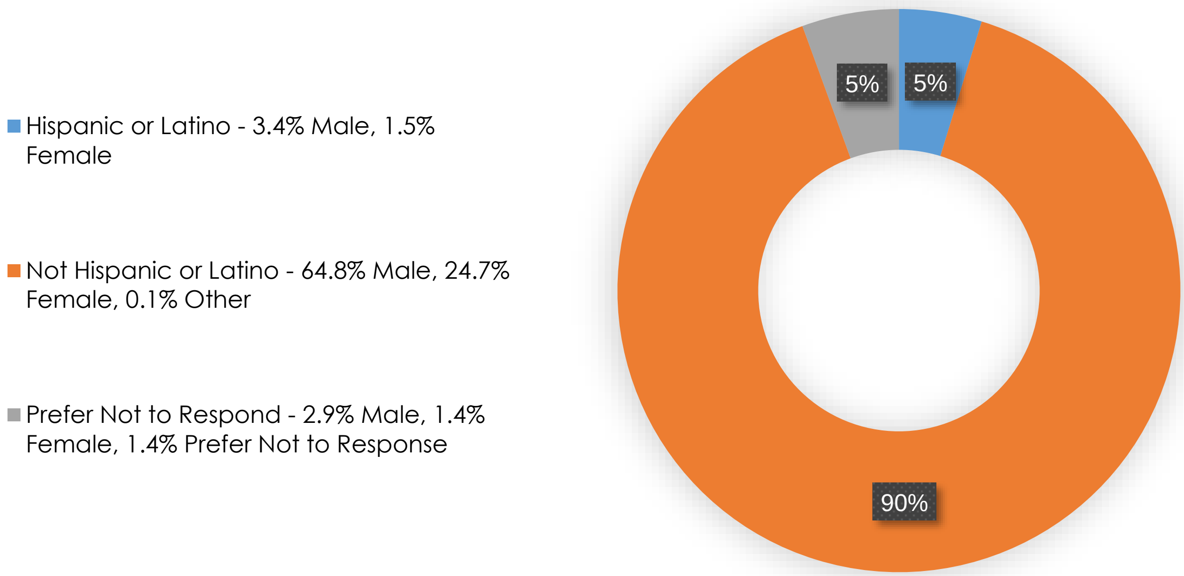


Figure 1.6: MagLab Distribution by Ethnicity (as of January 1, 2021).

1.5. DIVERSITY ACTION PLAN

The MagLab is committed to diversity and inclusion in the STEM workforce at the MagLab and throughout the nation. To accomplish this goal, our efforts are focused on: **outreach** to underrepresented and underserved populations in STEM from K-early career scientists; utilizing best practices in our **hiring** strategies to improve the representation of underrepresented minority groups (including women) at the lab and in the STEM workforce; and creating a climate where all personnel feel that they have equal opportunities to career development and **mentoring** leading them to want to remain at the lab/within the STEM workforce (**retention**). As part of this strategic plan, the diversity committee structures its budget and subcommittees to align with these efforts. The MagLab Diversity Committee meets quarterly to discuss issues facing the lab. The members of the MagLab Diversity Committee in 2020 can be found in **Table 1.1** (***new members**):

Table 1.1: 2020 MagLab Diversity Committee members

Greg Boebinger, Director of MagLab Ernesto Bosque, Diversity Committee Chair			
FSU Site:		UF Site:	LANL Site:
Erick Arroyo *	Amy McKenna	Malathy Elumalai	You Lai
Ryan Baumbach	Jennifer Neu	Mark Meisel *	Kirk Post
Alfie Brown	Martha L. Chacon Patino		John Singleton
Whitney Brown *	Zeljka Popovic (Graduate Student) *		Amanda Valdez *
Huan Chen *	Bettina Roberson		Laurel Winter *
Shalinee Chikara *	Kari Roberts		
Jonathan Cooper (Graduate Student) *	Kristin Roberts		
Dave Graf	Komalavalli Thirunavukkuarasu		
Elizabeth Green *	Anke Toth		
Laura Greene	Hans van Tol		

Greg Boebinger, Director of MagLab Ernesto Bosque, Diversity Committee Chair			
FSU Site:		UF Site:	LANL Site:
Jason Kitchen	Kaya Wei		
Walter Lee *	Yan Xin		
Emma Martin (Undergraduate) *			

Outreach

The MagLab supported several outreach workshops in 2020 -
(1) Each year, the National Mentoring Community (NMC) holds a conference with resources and workshops for both mentors and mentees, with the purpose of fostering community and empowering mentors with the tools to more effectively support their students. The 2020 NMC conference, held in partnership with the National Society of Black Physicists and the National Society of Hispanic Physicists, took place from February 6 to 8 at the University of Central Florida in Orlando, with more than 120 attendees.
(2) Running on five consecutive years, the MagLab helped to sponsor and provide role models for the annual Santa Fe, NM, Expanding Your Horizons Workshop held in February 2020. Over 240 attendees, of which 69.9% were from underrepresented minorities in STEM.

Hiring

The Diversity Committee has two subcommittees that are responsible for overseeing recruitment and hiring procedures. The first of these is the Compliance Subcommittee, chaired by Jason Kitchen. The role of the Diversity Compliance Subcommittee is to help coordinate the efforts of faculty hiring committees in the search for diverse candidates, particularly from underrepresented-in-STEM groups. The Compliance Subcommittee meets with the chair of each hiring committee at the outset of a position search, screens the position advertisement for gender bias verbiage, ensures that all members of a hiring committee have been trained for best practices in successfully staging diversity-promoting candidate searches, and that advertisements are sent to networks that reach underrepresented groups. Before hiring committees make a final offer to a candidate, they send the Compliance Subcommittee a summary of the candidate interviewing and selection process.

At the close of 2020, there remain eight active MagLab searches, including seven which started in 2019 and one from 2018. These searches were from the departments MS&T, ICR, NMR, and CIRL. In 2020, two of the active searches were completed. The first resulted in a promotion of a diverse Visiting Scientist member to a Research Faculty role, and among the nine candidates for the ladder position (for the role of Assistant in Research), two were diversity candidates and were both interviewed. Despite a hiring freeze across the lab for much of the year due to uncertainty related to the COVID pandemic, the careers section of the website earned 32,700 page views in 2020.

Broadening Participation

The Diversity Committee started a series of Town Hall Style Open Conversations, where all of our work force was invited to sign into a zoom meeting and discuss climate and work condition related topics. A list of the Open Conversations is listed below with the key topics for each in Table 1.2.

Additionally, a smaller focused workgroup has been formed to participate in the American Physical Society – Inclusion, Diversity, and Equity Alliance (IDEA). This team is comprised of 13 individuals across all three MagLab sites, ranging from Faculty, Scientific Staff, Graduate Students, and an Undergraduate Student. Shared leadership and other best approaches to improving diversity and equity efforts are shared and worked on across dozens of scientific institutions.

Table 1.2: Open conversation topics

Dates held	Main Topic	Hosts from
7/9/2020	General Open Discussion How to Include Diversity in Recruitment	DC Fields and ICR
7/23/2020	General Open Discussion Why Diversity and Equity are Important	CMS, Safety, and DC Fields
8/7/2020	History of Diversity in STEM and Work/Life Balance	Graduate Students
8/21/2020	Sexual Harassment and Title IX, Identifying and Addressing Issues	CMS, DC Fields, and an invited host from the FSU Title IX office as well as an invited private practice psychologist
11/4/2020	Mentoring: What is it?	High B/T, LANL, FSU Graduate and undergraduate students

The Diversity Committee also piloted additional support and an expansion of the InternFSU program to neighboring minority serving institutions, including Tallahassee Community College (TCC) and Florida Agricultural and Mechanical University (FAMU). In our pilot year, and before the pandemic lockdowns began, three students were supported, 2 from TCC and 1 from FAMU.

The MagLab recognizes the extra demands outside of a research career placed on caregivers of children and other dependents. For caregivers, travel to the MagLab in order conduct experiments or to conferences to disseminate research findings often incurs extra costs for dependent care. In place since 2011, the MagLab's Dependent Care Travel Grant (DCTG) program offers up to $800 per year for travel expenses for MagLab scientists traveling to conferences or MagLab users traveling to any of the three MagLab facilities. One DCTG was awarded in early 2020.

1.6. SAFETY

A central focus of all activities conducted at the MagLab is to ensure employees, users, visitors, and contractors are provided with a safe and educational environment. The MagLab's Environmental, Health and Safety team works collaboratively with management, researchers, staff, and users, as well as with other public and private entities, to proactively mitigate hazards in our industrial, laboratory, and office settings. The MagLab Safety Department is integrated with Florida State University's Central Environmental Health and Safety Department. This integration provides substantial support to existing safety programs at the MagLab. Areas of integration and support include Chemical Safety, Laboratory Safety, Biological Safety, Radiation Safety, Industrial Hygiene, Fire Safety, Environmental Compliance and Building Code Compliance (Figure 1.7). The MagLab uses Integrated Safety Management (ISM) to integrate safety, health

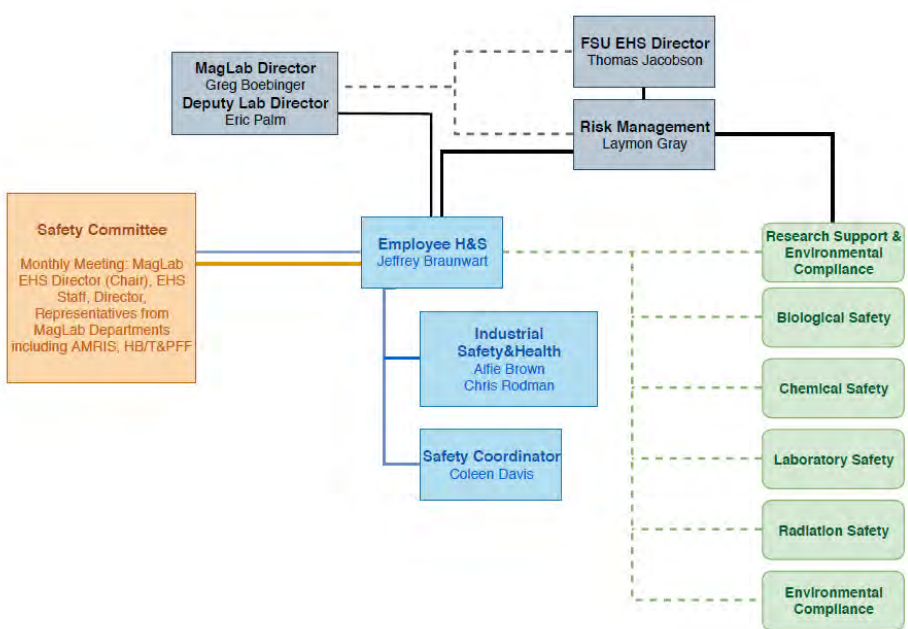


Figure 1.7: Environmental Health & Safety (EHS) Organization Chart

requirements and controls into daily work activities to ensure the protection of the MagLab Community. The MagLab continues to foster a sustainable and strong Safety Culture. Examples of the activities that contribute to our commitment to a strong Safety Culture at the MagLab are listed below:

a. Safety is viewed as an investment not a cost.
b. Management drives and is actively involved in promoting our Safety Culture.
c. Quarterly Safety Meetings are conducted by the Director of the MagLab to address lab-wide safety issues and initiatives.
d. The Director of the MagLab and Director of Safety routinely walk through lab areas to engage researchers, staff, and users, and to observe ongoing work. New Employee Orientation and New Employee safety training is provided to all incoming employees with their supervisor with specific emphasis on our ISM System. New employees are taught that safety is the top priority at the MagLab, to have a questioning attitude about their safety and about our Stop Work Policy and no-fault self-reporting near miss and accident policy.

Investments in Safety

Our investments in safety equipment and materials along with management support and employee involvement demonstrates our strong commitment to sensibly utilize resources in a manner that protect all MagLab personnel, property and the environment. In 2020, the MagLab strategically invested just under $50,000 for safety-related equipment, supplies, training and processes. Some of the key investments included personal protective equipment, equipment used to lockout/tagout and verify hazardous energy sources, fall protection, and COVID-related supplies.

Safety Support and Coordination with FSU Main Campus Safety Team

Safety at the MagLab is supported by a dedicated on-site team as well the Florida State University (FSU) Environmental, Health and Safety Department team. The two teams work together to provide comprehensive integrated safety support to all activities at the MagLab. Machine Shop, Biosafety, Laboratory, Laser, and Radiation inspections were conducted and completed with team members from both groups. The two teams also work together to provide safety training.

Committees

Safety committees are an integral part of the MagLab's ISM. Committees meet to discuss and address safety concerns and provide program reviews.

The following is a list of committees.

- Directors Monthly Safety Committee (includes representative from UF and LANL Facilities)
- Safety Concerns Committee
- Lock/Tag Verification Committee
- Cryogen Safety Committee
- Laser Safety Committee

Meetings in 2020 took place via Zoom because of COVID and were very successful, and participation levels increased. Members of these committees also form subcommittees as needed based on the need to address specific safety issues.

Safety Highlights

COVID Training and Building Access

With the COVID pandemic in full swing, the MagLab needed to take extra precautions to protect its employees. There were mandated requirements by states, counties, and local municipalities, and the MagLab was affected by all of these. Users and visitors were not allowed access during these mandates. However, essential personnel still needed to access the MagLab for specific and critical duties. The safety department, with the help of Public Affairs, created a MagLab-specific COVID training that all employees and staff were required to take before entry was given. The MagLab created a COVID team to review projects and personnel, and grant authorization to those who were given permission to come to the lab to perform research and their duties. Safety was an integral part of this team as the facility was on "lockdown," and the safety department acted as the "gate keeper" for training, entry, and COVID-related questions. These COVID safety protocols have evolved with time, and they are reviewed at the start of group meetings that are held on a weekly or bi-weekly basis. Some of these safety protocols are still in place and could change in the future.

Annual Maintenance Shutdown

During November and December, the MagLab performed its annual maintenance shutdown. This year was especially difficult to plan because of limitations on gatherings, the uncertainty of the schedule and learning how to work under pandemic rules. Beginning in June, planning meetings were held to discuss work plans, safety equipment needs, organization of lockout/tagout boards and contractor coordination. Jobs were selected and scheduled to minimize the number of personnel working in the same areas and to minimize interaction between staff and contractors.

Extensive annual maintenance occurred including helium liquefier maintenance, regeneration of the water treatment resin, breaker testing and exercising, transformer testing, capacitor yard maintenance and pump maintenance. The air handlers for the power supplies were completely overhauled, and the cooling tower had extensive wood replacement completed. The PVC helium vacuum system was replaced with stainless steel piping, which will improve recovery and reduce contamination of the helium. Lastly, several jobs were completed that would allow work on the PS Upgrade project during 2021 without interrupting operations.

The greatest challenge during the shutdown was to carefully coordinate all work activities among many workgroups to ensure safety remained the top priority. To facilitate safe work, each morning all workgroups met remotely over Zoom to review and discuss each group's planned work for the day, and lockout statuses and plans. Immediately after the online meeting, employees in charge of contractors briefed them on information relevant to their work. This facilitated communication among workgroups prior to initiating tasks to ensure jobs were safely coordinated and all safety hazards were communicated. Also discussed were any difficulties or lessons learned from the previous workday. During the shutdown, we had several instances where key employees either contracted COVID or were required to quarantine due to contact tracing. Fortunately, we were able to juggle the schedule or fill in for these employees to keep work moving safely forward. Although there were numerous interdependent work processes and workgroups involved with the shutdown, using ISM, all employees and contractors safely completed their assigned work activities.

Novel Safety System to Verify Absence of **Voltage on the MagLab's 20 Kiloamp / 720 Volt Resistive** Magnet Bus

Because the MagLab's resistive and hybrid magnets use high-current / high-voltage DC power supplies to energize our magnets, we must be absolutely sure that the power supplies are disconnected and isolated from the magnet before any maintenance or construction work begins on the magnets. The MagLab developed a new safety device to provide this capability without exposing workers to any sort of high voltage hazard. This new safety device enables technical work on magnet systems with uninsulated conductors by making certain that the power source is physically disconnected from the magnet.

It is important for the MagLab to comply with safety standards from the Occupational Safety and Health Administration (OSHA). The MagLab scientific user facility combines state-of-the-art scientific instrumentation with industrial scale infrastructure to produce the highest magnetic fields in the world. This results in unique and extraordinary equipment needs, often requiring in-house technological developments due to a lack of commercial, off-the-shelf solutions. The skill and expertise of MagLab user facility engineers made the development of this one-of-a-kind safety system possible. This safety system passed an external expert review.

User Facility Safety

The MagLab's User facilities (DC Field, Pulsed Field, High B/T, NMR, AMRIS, EMR and ICR) provide support to internal and external users. To facilitate their visit, users are assigned online training modules that are specific to the experiment they are conducting, and the hazards associated with each facility they will be working in. These are generally coordinated several weeks prior to their arrival if they are an external user. Internal users complete the required training prior to receiving authorization to start work. When users arrive at the facility, they receive hands-on training that is specific to each location and discuss any potential safety concerns with user support. While at each facility, users are assigned an in-house scientist and support technician to ensure both technical and safety needs are met. Non-routine and any particularly hazardous activities are completed by trained and experienced facility technicians to minimize risks to users. While the COVID pandemic has affected our user programs, these safety requirements are still in place and will continue to be in place along with COVID safety requirements and training.

1.7. BUDGET

The National High Magnetic Field Laboratory, along with its seven user programs, is primarily funded by the National Science Foundation. Other operating funds are provided through the participating institutions: The Florida State University, the University of Florida, and the Los Alamos National Laboratory. Additionally, faculty and staff have been very successful in securing individual research funding for specific areas of research from a wide variety of sources, including federal, State, and private sectors.

The National Science Foundation Division/Directorate approved the MagLab's facilities award for 2018-2022 on March 23, 2018.

For the Calendar Year 2020, NSF provided an operating budget of $36,780,000.

Table 1.3 represents the budget allocation and percentage of the total budget to each division of the MagLab, and Table 1.4 summarizes the MagLab's budget position as of December 31, 2020. The report includes our annual funding per our Cooperative Agreement.

Table 1.3: NSF Budget by NHMFL Division

Division/Program	CY 2020 Total Funding ($)	Budget (%)
Operations/Safety	1,041,175	2.83%
DC Field Facility	7,353,648	19.99%
Magnet Science & Technology	5,144,835	13.99%
NMR	1,500,093	4.08%
ICR	1,730,000	4.70%
EMR	910,864	2.48%
CIRL and REU	570,061	1.55%
ASC	2,210,154	6.01%
Electricity & Gases	4,945,588	13.45%
LANL	8,780,333	23.87%
UF High B/T	644,948	1.75%
UF - AMRIS	918,352	2.50%
Diversity	80,000	0.22%
User Collaboration Grants Program	949,949	2.58%
Total	36,780,000	100.00%

Table 1.4: NSF Budget & Expenses - Calendar Year 2020

Expense Classification	Budget ($)	Disbursed and Encumbered ($)	Balance as of 12/31/2020 ($)
Salaries and Fringe	10,451,647	13,522,581	(3,070,934)
Equipment	320,855	1,995,283	(1,674,428)
Subawards	10,745,784	11,561,370	(815,586)
Other Direct Costs	7,043,054	4,836,173	2,206,881
Subtotal	28,561,340	31,915,407	(3,354,067)
Indirect Cost	8,218,660	7,172,387	1,046,273
Total Direct and Indirect Cost	36,780,000	39,087,794	(2,307,794)

1.8. MAGLAB COST RECOVERY REPORT

Seldom does the MagLab incur costs due to resources used for companies doing proprietary research. On occasion, companies will need access to the unique equipment at the MagLab, and they will contract for the use of said equipment. The MagLab has established procedures to accumulate and report costs continuously and consistently for all such contracts based on an agreed upon schedule of fees and costs to cover the use of such equipment that involves proprietary research. During 2020, the MagLab recovered a total of $603.08 from private industry, Rosemount Nuclear Instruments, Inc., for the use of NSF-funded equipment/software during the period of performance of our Federal award.

1.9. COVID RESPONSE

On June 18, 2020, the Office of Management and Budget issued Memorandum 20-26, Extension of Administrative Relief for Recipients and Applicants of Federal Financial Assistance Directly Impacted by COVID-19 due to Loss of Operations. This memorandum authorized federal award agencies to provide specific relief to recipients including allowability of salaries and other project activities (2 CFR § 200.403, 2 CFR § 200.404, 2 CFR § 200.405). The administrative relief authorized in this memorandum expires on September 30, 2020.

Additionally, Memorandum 20-26 reminded agencies of their existing flexibility to issue exceptions on a case-by-case basis in accordance with 2 CFR § 200.102, Exceptions. 2 CFR § 200.102 (b) states: "b) Exceptions on a case-by-case basis for individual non-Federal entities may be authorized by the Federal awarding agency or cognizant agency for indirect costs, except where otherwise required by law or where OMB or other approval is expressly required by this part." The MagLab, operating under the flexibility authorized in M-20-26, Allowability of Salaries and Other Project Activities (2 CFR § 200.403, 2 CFR § 200.404, 2 CFR § 200.405), was able to keep its employees in paid status utilizing remote work options, flex work hours and utilization of leave hours.

For those who were unable to perform work under the award, FSU allowed FFCRA through April 30, 2020. All of our workers were either able to work from home or were able to use FFCRA. Since this time, we have had our workers who could productively work from home do so, and those who could not have come in to work while wearing masks and appropriately social distancing. Supervisors have utilized flexible schedules to allow workers to maintain social distancing and also to accommodate other issues such as childcare, eldercare and school support needs.

1.10. INDUSTRIAL PARTNERS AND COLLABORATIONS

The MagLab collaborated with dozens of companies, national/international labs, universities and community groups in 2020. In addition, several spinoff companies continued to operate in 2020.

INDUSTRY

Advanced Conductor Technologies, Boulder, CO: The Applied Superconductivity Center and the Magnet Science and Technology division of the MagLab are collaborating with Advanced Conductor Technologies on the development and testing of Coated Conductor Stranded Cable (CCSC), using multi-layer spiraling tapes around a core, for magnet applications. Danko van der Laan, Director of the company and associated with NIST/University of Colorado Boulder, is developing compact cables based on REBCO coated conductors, a high temperature superconductor. The ongoing collaboration on measurements of HTS cables at low temperature and high magnetic fields (4K and 20T in Cell 4) continues to set new benchmarks for peak current, current density, bend radius and ramp rates. *(MagLab contact: Ulf Trociewitz, ASC)*

ATI metals, Pittsburgh, PA: The Applied Superconductivity Center is collaborating with ATI metals in the development of new Nb alloys for the Nb_3Sn superconducting wire fabrication to be used for accelerator magnets like the Future Circular Collider (FCC) to be built at CERN. *(MagLab contacts: David C. Larbalestier, Chiara Tarantini, Shreyas Balachandran, ASC)*

Bridge12 Technologies Inc., Framingham, MA: Bridge12 is a small business specialized in the design and manufacturing of active and passive high frequency microwave components. The EMR division is collaborating with Bridge12 on novel designs of high field in-situ EPR spectrometers, as well as working together on future development of high frequency gyrotrons for DNP. *(MagLab contact: Stephen Hill and Thierry Dubroca, EMR)*

Bruker EAS GmbH, Hanau, Germany: Bruker EAS is manufacturing accelerator quality Nb_3Sn strands based on the powder-in-tube process that have the potential to provide the performance necessary for higher magnetic field upgrades to the Large Hadron Collider at CERN. The Applied Superconductivity Center collaborated with Bruker and CERN to optimize the performance of the wire utilizing the electromagnetic testing and advanced microstructural and microchemical analysis facilities at the MagLab. *(MagLab contacts: Chiara Tarantini, Peter J. Lee and David C. Larbalestier, ASC)*

Bruker Biospin Corp., Billerica, MA: The EMR and NMR groups have entered into a collaborative effort with Bruker Biospin regarding the Dynamic Nuclear Polarization (DNP) program. In particular, the effort aims at improving Bruker's recently acquired products (395GHz gyrotron, 600MHz/14.1T DNP probe) beyond their normal commercial uses by making technical modifications. The modifications allow the DNP instruments to be more user program friendly without voiding the warranty. *(MagLab contact: Stephen Hill, EMR)*

Bruker Biospin Corp., Billerica, MA: Investigators from MagLab facilities at UF and FSU collaborate with technical staff at Agilent on two NIH-funded projects to develop improved superconductive cryogenic probes for solution NMR. *(MagLab contacts: William Brey, NMR and Matthew Merritt, AMRIS)*

Bruker OST, Carteret, NJ: Bruker OST is manufacturing accelerator quality Nb_3Sn strands based on the restacked-rod process that provide the production conductor for the High-Luminosity Upgrade of the Large Hadron Collider at CERN. The Applied Superconductivity Center oversees conductor production on behalf of the upgrade project, and ASC and the Magnet Science and Technology divisions perform quality verification utilizing the electromagnetic testing facilities at the MagLab. *(MagLab contacts: Lance Cooley, ASC; Jun Lu, MS&T)*

Bruker-OST, Carteret, NJ: Extensive collaborations exist between ASC and BOST on both Nb_3Sn and Bi-2212 conductor development, aided by direct support of R&D on these materials from DOE-High Energy Physics to ASC PIs and to BOST through the Conductor Development Program managed out of Lawrence Berkeley National Laboratory. Through these collaborations, BOST has been able to develop the most advanced Nb_3Sn and Bi-2212 conductors produced. *(MagLab contacts: Lance Cooley, David C. Larbalestier, Eric Hellstrom, Peter J. Lee, Chiara Tarantini, Jianyi Jiang, ASC)*

Criotec Impianti & ENEA, Italy: The MagLab is collaborating with Criotec Impianti, an Italian cryogenic systems manufacturing company, and ENEA, an Italian Fusion Energy Research Organization, to jacket the cable-in-conduit superconductor for the outsert coils of the series-connected hybrid magnets. This work includes the welding and inspection of the stainless-steel conduit, insertion of the cabled superconductor strands into the conduit, and compaction of the assembled conductor to a rectangular cross-section. *(MagLab contact: Iain R. Dixon, MS&T)*

Danfoss Turbocor, Tallahassee, FL: Danfoss Turbocor Inc. is a company specializing in compressors, particularly the totally oil-free compressors. The compressors are specifically designed for the heating, ventilation, air conditioning and refrigeration (HVACR) industry and need high performance soft and hard magnet materials. The company and the laboratory have a joint research project on selection, characterization and development of permanent magnet materials and structural materials for high performance and environmentally friendly compressors. *(MagLab contact: Ke Han, MS&T)*

DMS South Bailey Tool and Manufacturing (BTM), Lancaster, TX: BTM is a specialty tool and die company that produces complicated metal components by seamless forming and additive manufacturing techniques. The MagLab is collaborating with BTM to investigate complex cavity resonator shapes using bronze and other materials that facilitate the formation of Nb_3Sn superconductor under a grant from the US Department of Energy. The components delivered from BTM are coated with niobium and converted to Nb_3Sn using thin-film coating facilities in the Applied Superconductivity Center. *(MagLab contact: Lance Cooley, ASC)*

Energy to Power Solutions, Tallahassee, FL: The MS&T division has partnered with Energy to Power Solutions and secured a Small Business Incentive for Research grant from the US Department of Energy to develop technology suitable for HTS split magnets suitable for fields higher than 20T. *(MagLab contact: Iain R. Dixon)*

HC Starck, Newton, MA: The Applied Superconductivity Center is collaborating with HC Starck in the development of new Nb alloys for the Nb_3Sn superconducting wire fabrication to be used for accelerator magnets like the Future Circular Collider (FCC) to be built at CERN. *(MagLab contacts: David C. Larbalestier, Chiara Tarantini, Shreyas Balachandran, ASC)*

Hyper Tech Research Inc., Columbus, OH: Hyper Tech Research Inc. develops and manufactures MgB_2 superconducting wires for MRI applications. In this collaboration, the Magnet Science and Technology division measures critical current of MgB_2 wires developed by Hyper Tech Research. The critical current measurements are performed at 4.2K and in 0 – 10T magnetic fields. *(MagLab contact: Jun Lu, MS&T)*

Hyper Tech Research Inc., Columbus, OH: The Applied Superconductivity Center is collaborating with HTRI on the development of a new generation of Nb_3Sn wires with high critical current density for the next generation of higher magnetic field accelerator magnets as part of the US-Magnet Development Program. *(MagLab contacts: David C. Larbalestier, Chiara Tarantini, Shreyas Balachandran and Peter J. Lee, ASC)*

Mevion Medical Systems, Littleton, MA: Mevion is a pioneer in the development of proton radiation therapy systems for the non-invasive treatment of cancer. The center of the systems is the proton accelerator that utilizes low temperature superconductors. The MagLab provides engineering support to Mevion by assisting in qualification testing of full-scale high current superconductors in background fields at low temperatures. The tests require the MagLab's unique test facility designed for tests of large conductors in a 12T split solenoid superconducting magnet system. *(MagLab contact: Bob Walsh, MS&T)*

nGiMat LLC, Lexington, KY: nGiMat LLC is a small business specializing in manufacturing oxides nanopowders, and insulation of superconducting wires. MagLab collaborates with nGiMat LLC on a small business innovation research grant funded by US Department of Energy. The goal of this research is to improve the quality of ceramic insulation for $Bi_2Sr_2CaCu_2O_{8-x}$ superconducting wire. *(MagLab contact: Jun Lu, MS&T)*

Nikon, Melville, NY: The MagLab maintains close ties with Nikon on the development of an educational and technical support microscopy website, including the latest innovations in digital-imaging technology. As part of the collaboration, the MagLab is field-testing new Nikon equipment and developing new methods of fluorescence microscopy. *(MagLab contact: Eric Clark, Optical Microscopy)*

Olympus Corp., Tokyo, Japan: Investigators at the MagLab have been involved in collaboration with engineers at Olympus to develop and test new optical microscopy systems for education and research. In addition to pacing the microscope prototypes through basic protocols, the Optical Microscopy group is developing technical support and educational websites as part of the partnership. *(MagLab contact: Eric Clark, Optical Microscopy)*

Oxford Instruments, Abingdon, UK: Oxford Instruments delivered a 15T large-bore low temperature superconductor magnet to the MagLab that was combined with 17T YBCO-coated conductor coil developed by the MagLab to create the first 32T all-superconductor magnet. In case of a quench, the LTS and HTS coils interact in a complex manner. The quench protection systems for the individual coil sets are inter-dependent. This could not be handled by routine specifications in a standard vendor relationship. Therefore, Oxford Instruments and the MagLab worked closely together to develop quench protection for the combined system to ensure compatibility of the coil sets and developed a numerical code to model quench in combined YBCO-LTS magnets. Additionally, Oxford Instruments Nanoscience worked with MagLab personnel to specify, design and construct a custom top-loading dilution refrigerator for the 32T magnet system. Coupling the ultra-low temperatures of a dilution refrigerator with the 32T superconducting magnet creates a unique system for scientists to explore material properties. *(MagLab contact: Tim Murphy, DC Field)*

Oxford Instruments Superconducting Technology, Carteret, NJ: Oxford Instruments Superconducting Technology (OST) is one of the major manufacturers of superconducting wires. In this collaboration, the Magnet Science and Technology division measures hysteresis loss of Nb_3Sn wires developed by OST. The hysteresis loss measurements are performed at 4.2K and in 0 – 5TK magnetic fields by a vibrating sample magnetometer. *(MagLab contact: Jun Lu, MS&T)*

Phoenix NMR, LLC, Loveland, CO: Phoenix NMR used the NMR Dynamic Nuclear Resonance facility to test a commercial DNP probe. *(MagLab Contact: Fred Mentink, NMR)*

Revolution NMR LLC, Fort Collins, CO: Revolution NMR has licensed from FSU the Low-E probe technology developed at MagLab in order to fabricate static NMR probes for biological (protein) samples. Additionally, the MagLab's NMR instrumentation program and Revolution NMR collaborate on the development of stators for magic angle spinning NMR. *(MagLab contact: Peter Gor'kov, NMR)*

SuperPower Inc., Schenectady, NY: The Applied Superconductivity Center and the Magnet Science and Technology division of the MagLab are collaborating with SuperPower Inc. on the characterization of YBCO coated conductors. This material has the potential to transform the field of high-field superconducting magnet technology and is in an early stage of commercialization. The MagLab will work to improve our understanding of this product in support of the MagLab 32T project as well as to provide guidance to SuperPower on enhancing the quality of their product. The MagLab has also taken the lead in encouraging a Coated Conductor Round Table of users of coated conductors at which much information about the long length performance of coated conductors has been shared. *(MagLab contacts: David C. Larbalestier, Dmytro Abraimov and Jan Jaroszynski, ASC)*

SupraMagnetics Inc., Plantsville, CT: The Applied Superconductivity Center participated in the development of a superconducting Nb_3Sn wire that uses artificial flux-pinning centers to achieve high critical current densities. The MagLab provides microstructural and microchemical support for this work. *(MagLab contact: Peter J. Lee, ASC)*

Thomas Keating LtD, UK: The EMR group has entered into a partnership with Thomas Keating (TK) LtD in the UK as part of its program aimed at developing a new characterization tool, Dynamic Nuclear Polarization Nuclear Magnetic Resonance (DNP - NMR) at high fields (14.1T / 600MHz). TK draws on tool-making skills to design and develop quasi-optical Terahertz systems and subsystems. *(MagLab contact: Stephen Hill, EMR)*

ThermoFisher Scientific, Waltham, MA: The ICR Facility is collaborating with ThermoFisher Scientific and the University of Virginia (Charlottesville, VA) to use advanced control of proton transfer reactions to manipulate ion charge states for improved sensitivity (e.g., for proteomics and other biological applications). Further, this collaboration seeks to couple the latest Thermofisher Scientific mass spectrometry platforms with the Maglab's high field Fourier Transform ion cyclotron resonance (FT-ICR) instruments. (*MagLab contact: Chris Hendrickson, ICR)*

Urban Mining Company, San Marcos, TX: Scientists and engineers from Urban Mining Company came to the MagLab to study the complete magnetization loop of the rare-earth permanent magnet alloys which they are developing. Urban mining specializes in recovering rare-earth magnetic material from recycled electronics and processing that material into new magnets for use in industry. *(MagLab contact: Tim Murphy, DC Field)*

Virginia Diodes Inc., Charlottesville, VA: VDI is a technology company specialized in high frequency microwave sources and detectors. The EMR division collaborates with VDI on the development of microwave sources for high-sensitivity high-field EPR spectroscopy. These new sources allow the MagLab to stay at the forefront of high field EPR instrumentation. The development of high-power solid-state sources for DNP at very high magnetic fields (>30T) is also being planned. *(MagLab contact: Stephen Hill and Thierry Dubroca, EMR)*

Waters Corporation, Miford, MA: The ICR and Future Fuels Institute are a Waters Corporation, Center of Innovation and collaborate on advances in instrumentation for biological and petroleum applications. Instrument and ion source advances are provided to both facilities before their commercial release and allow for applications development well before mainstream introduction. *(MagLab Contact: Ryan Rodgers, ICR)*

Zeiss Micro Imaging, Thornwood, NY: The Optical Microscopy group at the MagLab is negotiating a contract with Zeiss on the development of an educational and technical support microscopy website, including the latest innovations in digital imaging technology. As part of the collaboration, microscopists are field-testing new Zeiss equipment and developing new methods of fluorescence microscopy. *(MagLab contact: Eric Clark, Optical Microscopy)*

NATIONAL OR INTERNATIONAL LABORATORIES AND INSTITUTES

Advanced Photon Source, Argonne National Laboratory, Lemont, IL: The Applied Superconductivity Center is collaborating APS to perform Extended X-ray absorption fine structure (EXAFS) characterization on Nb_3Sn superconducting wires in order to locate the substitution sites of the dopants and to correlate them with the superconducting performance. *(MagLab contacts: Chiara Tarantini, ASC)*

CERN, Geneva, Switzerland: The Large Hadron Collider (LHC) at CERN uses a 27km ring of superconducting magnets based on Nb-Ti to accelerate particles in the world's largest and most powerful collider, but plans to increase the energy capability of LHC will require higher magnetic fields. Moreover, the planned Future Circular Collider (FCC) at CERN will be realized in a 100km ring of Nb_3Sn and HTS magnets. The Applied Superconductivity Center is collaborating with CERN to fabricate, characterize and optimize a new generation of accelerator quality Nb_3Sn strands that have the potential to provide the performance necessary for the LHC upgrades and the FCC realization. *(MagLab contacts: David C. Larbalestier, Chiara Tarantini and Peter J. Lee, ASC)*

Dana-Farber Cancer Institute, Boston, MA: Current collaboration between Dana-Farber Cancer Institute and the Magnetic Lab is aimed at determining the molecular details of HIV envelope protein gp41 using electron paramagnetic resonance methods. Other goals include characterization of antibody-induced structural changes of gp41 and developing optimized vaccine immunogens by structural approaches. *(MagLab contact: Likai Song, EMR)*

EUCARD2 (European Collaboration for Accelerator R&D), Geneva, Switzerland: EUCARD2 is a European Framework collaboration of about 10 European labs aimed at developing kiloamp high temperature superconductor cables for future application to a high energy LHC. The European emphasis is on Roebel cables of REBCO coated conductors, but an equally attractive cable for accelerator purposes is a round wire cable made in the Rutherford style out of Bi-2212 ($Bi_2Sr_2CaCu_2O_{8-x}$). This conductor has been developed at the MagLab under DOE-HEP support in the context of the Bismuth Strand and Cable Collaboration (BSCCo) that unites the MagLab, BNL, FNAL, LBNL and OST in a team developing this material for accelerator use. The MagLab is now the US point of contact for collaborations between EUCARD2 and the US program. *(MagLab contacts: David C. Larbalestier, ASC)*

Fermilab, Batavia, IL: The Applied Superconductivity Center is collaborating with Fermilab on the development of a new generation of Nb_3Sn wires with high critical current density for the next generation of higher magnetic field accelerator magnets as part of the US-Magnet Development Program. (*MagLab contacts: David C. Larbalestier, Chiara Tarantini, Shreyas Balachandran and Peter J. Lee, ASC)*

Fermi National Accelerator Laboratory (FNAL), Batavia, IL: Applied Physics and Superconducting Technology Division, Magnet Systems Department of FNAL manages Nb_3Sn wire procurement for LHC high luminosity upgrade, MS&T physical property measurement lab is contracted by FNAL to measure critical current and residual-resistance-ratio of Nb_3Sn wires as a part of the quality verification program. This collaboration started in 2015 and will continue through the end of 2021. *(MagLab contact: Jun Lu, MS&T)*

Facility for Rare Isotope Beams (FRIB), East Lansing, MI: FRIB at Michigan State University collaborated with MS&T physical property measurement lab on high critical current measurement of NbTi wires up to 3000A. *(MagLab contact: Jun Lu, MS&T)*

Fusion and Fission Energy and Science Division, Oak Ridge National Laboratory (ORNL), Oak Ridge, TN: The MS&T's Electro-Mechanical Properties Lab is one of the United States' primary materials research and qualification laboratories that specializes in low temperature superconductor and structural materials testing in support of high-field superconducting magnets. The MagLab has a long-term relationship with ORNL and its US-ITER program to provide engineering support that will continue in the post-ITER fusion program era. The funding for this research is provided by US-DOE and ORNL. *(MagLab contact: Bob Walsh, MS&T)*

Helmholtz Zentrum Berlin, Berlin, Germany: The MagLab has partnered with the Helmholtz Zentrum Berlin (HZB) to develop the highest field magnet worldwide for neutron scattering at HZB. In March 2007, HZB (formerly the Hahn-Meitner Institute) signed an agreement with Florida State University Magnet Research and Development Inc. The magnet is intended to provide 25T on-axis using 4.4MW of DC power and have upstream and downstream scattering angles of 30 degrees. The magnet reached 26T on October 16, 2014. Since then it has been moved from the test site into the neutron guide hall and served the first users in July 2015. We are now discussing an agreement for assistance with ongoing operations and maintenance. *(MagLab contact: Mark D. Bird, MS&T)*

HL-LHC Accelerator Upgrade Project (AUP), Geneva, Switzerland: The AUP is the US contribution to the High-Luminosity Upgrade of the Large Hadron Collider. All the magnets are Nb_3Sn; there is no HTS. AUP will deliver new quadrupole magnets, 20 magnets x 4 coils = 80 coils measuring 4.2m long at 11.4T field and 1.9K, that intensify the focus of the CERN proton beams at the ATLAS and CMS intersection regions, and new crab cavities that rotate the beam slightly and ensure that collisions are head-on even when the focusing magnets are highly converging. These new elements will make physics happen 10 times faster than before (new physics being proportional to luminosity). The Hi-Lumi project in European accounting is around CHF 2.2 billion, AUP cost is $225 million, and MagLab oversees a $25 million component to procure 10 tons (7 tons have been delivered as of Feb 2021) of the highest-performing Nb_3Sn conductor ever made, and verify its quality by testing critical current and other properties. The AUP is supported by the DOE Office of Science. The AUP team consists of six US laboratories and two universities: Fermilab, Brookhaven National Laboratory, Lawrence Berkeley National Laboratory, SLAC National Accelerator Laboratory, Thomas Jefferson National Accelerator Facility (all DOE national laboratories), the National High Magnetic Field Laboratory, Old Dominion University and the University of Florida. *(MagLab contacts: Lance Cooley and David C. Larbalestier, ASC)*

International Thermonuclear Experimental Reactor (ITER International Organization), Cadarache, France; US-ITER Project Office, Oak Ridge, TN; University of Twente, Enschede, the Netherlands: The Applied Superconductivity Center played a major role in helping ITER-IO understand the properties of the cables being wound into the Central Solenoid (CS) and the Tokamak Field (TF) coils. A central task has been the disassembly and metallographic analysis of the prototype Cable-in-Conduit-Conductors (CICCs) needed for TF and CS coils after testing in the SULTAN facility in conditions designed to simulate ITER operations. Many of these conductors Toroidal Field (ITER Organization) and Central Solenoid (US-ITER) CICCs typically suffered significant performance degradation during cyclic loading and occasional warm-up and cool-down cycles. The tests performed at the MagLab were able to identify many of the causes for this degradation and were instrumental in developing new cable patterns that resolved the degradation. This work was collaborative with groups at CEA-Cadarache, the University of Twente in the Netherlands and US-ITER. *(MagLab contacts: Peter J. Lee and David C. Larbalestier, ASC)*

International Thermonuclear Experimental Reactor (ITER), US-ITER Project Office, Oak Ridge National Laboratory (ORNL), Oak Ridge, TN: The United States is part of an exciting international collaboration to demonstrate the feasibility of an experimental fusion reactor that is under construction in France. The MS&T's Mechanical Properties Lab is the US-ITER primary materials research and qualification laboratory supporting the US effort. The Tokamak machine consists of three types of very large, complex superconducting magnets that all utilize Cable-in-Conduit Conductors (CICC) as the main structural components. Another important component for stress management of the Central Solenoid is a massive CS pre-compression structure (Tie Plates). The conduit and tie plate alloys, and their welds, are being studied and characterized here to ensure their performance and reliability. The funding for this research is provided by US-DOE, US-ITER Project Office at ORNL. In addition, MS&T's physical property measurement lab has been preparing Nb_3Sn wire samples as witness for heat treatment ITER central solenoid modules. The MagLab subsequently measures critical current of these heat treatment witness samples. *(MagLab contacts: Bob Walsh & Jun Lu MS&T)*

Japan Proton Accelerator Research Complex (J-PARC), Japan: The Applied Superconductivity Center ASC is collaborating with the Japan Proton Accelerator Research Complex J-PARC to perform neutron-diffraction experiments on RRP® Nb_3Sn wires to find the origin of the strain irreversibility cliff in these conductors and to identify the different phases present in the conductor after heat-treatments. This collaboration also includes Kozo Osamura from the Research Institute for Applied Sciences RIAS (Kyoto, Japan) and Shutaro Machiya from Daido University (Nagoya, Japan). Work from this collaboration will expand to also include other conductors currently being developed such as Nb_3Sn containing additional pinning centers. *(MagLab contact: Najib Cheggour and Peter J. Lee, ASC)*

Jefferson Lab, Newport News, VA: Recently, Nitrogen and Titanium doping have emerged as highly effective methods of improving the quality factor on Nb SRF cavities; the Applied Superconductivity Center is working with scientists at Jefferson Lab to evaluate the interaction between prior cold-work and doping treatment of Nb samples and their influence on the superconducting properties. Doping is carried out at Jefferson Lab and superconducting property measurements, including magneto optical imaging area carried out at the MagLab. *(MagLab contact: Peter J. Lee, ASC)*

Jefferson Lab, Newport News, VA: Jefferson Lab are developing the next generation of Nb film coated Cu RF cavities, and the Applied Superconductivity Center is assisting with the microstructural characterization of single-cell Cu cavities fabricated using a cathodic-arc-discharge (CAD) coating of Nb onto Cu. *(MagLab contact: Peter J. Lee, ASC)*

Key Laboratory of Electromagnetic Processing of Materials, Northeastern University, Shenyang, China: The collaboration between the Northeastern University and the MagLab is related to the magnetic field impact on fabrication of high strength conductors and magnetic materials. Two graduate students visited the MagLab between 2019 and 2020. They published three joint papers between 2019 and 2021. *(MagLab contact: Ke Han, MS&T)*

Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea: Professor **Hyoungsoon Choi's group at the Korea Institute of Science and Technology (KAIST) has developed** a co-operative agreement with Professor Yoonseok Lee and the National High Magnetic Field Laboratory's High B/T Facility for the study and development of the design of coolant materials used in nuclear demagnetization refrigerators. The collaboration focuses on the techniques and expertise required to produce high residual resistant ratios for the metallic materials used for the coolants and the associated components. KAIST is a leading center for ultra-low temperature research in Korea. *(MagLab contacts: Yoonseok Lee, High B/T)*

Large Accelerator Project for the HiLumi upgrade of the CERN LHC, Brookhaven National Lab, Upton, NY: Accelerator magnets based on Nb_3Sn wires are required to provide the increased magnetic fields for the next LHC upgrade. The Applied Superconductivity Center is collaborating with Brookhaven National Lab to understand the design and heat treatment optimization of accelerator magnet quality strand fabricated by the internal Sn process with a view to driving high current density strands to smaller filament sizes. Close collaboration with the R&D billets being manufactured for LARP under the Conductor Development Program of DOE High Energy Physics is a key part of the work. This work concluded in 2017 when the Hi-Lumi Upgrade project formally began. *(MagLab contacts: Chiara Tarantini, Peter J. Lee and David C. Larbalestier, ASC)*

Lawrence Berkeley Laboratory, Accelerator, Berkeley, CA: The Applied Superconductivity Center (ASC) is collaborating with the Lawrence Berkeley National Laboratory (LBNL) to test strain properties of high-performance RRP® Nb_3Sn wires to be used in the LBNL Test Facility Dipole Project (TFD). This collaboration will explore the strain sensitivity of a specific Nb_3Sn conductor to help LBNL researchers decide early in the project whether this conductor is suitable for TFD. *(MagLab contact: Najib Cheggour, ASC)*

Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA: Division of Accelerator Technology and Applied Physics collaborated with MS&T physical property measurement lab in thermal properties measurements of a polymer composite material that is used in development of the accelerator magnets. *(MagLab contact: Jun Lu, MS&T)*

Lawrence Berkeley Laboratory, Accelerator Technology & Applied Physics Division, Berkeley, CA: MagLab - MS&T's Electro-Mechanical Properties group specializes in low temperature structural materials testing in support of DOE High-Luminosity LHC Accelerator Upgrade Project (AUP). The MagLab performs low temperature mechanical tests and microstructural evaluation of structural aluminum alloys and composites that are critical to the safe/reliable operation of large accelerator magnets being constructed for the project. *(MagLab contact: Bob Walsh, MS&T)*

Lawrence Livermore National Laboratory, Livermore, CA: The Applied Superconductivity Center and the Magnet Science and Technology division of the MagLab are collaborating with researchers at Lawrence Livermore National Laboratory to develop cavity resonators and magnets for the Advanced Dark Matter Experiment. Fabrication and microstructural characterization facilities in the ASC are used to investigate Nb_3Sn and other superconducting coatings for use in cavities. Magnet Science and Technology consultation related to very large and high field detector magnets is ongoing. *(MagLab contacts: Lance Cooley, ASC; Mark D. Bird, MS&T)*

Los Alamos National Laboratory Community Programs Office, Los Alamos, NM: CIRL works closely with our counterpart, the Los Alamos National Laboratory Community Programs Office. Over the last year, the MagLab has developed a partnership to share information and resources on our educational activities. The community programs office has a large staff that oversees more than 15 different educational/ community outreach programs including the Bradbury Museum. *(MagLab contact: Carlos R. Villa, Educational Programs)*

Los Angeles County Museum of Natural History, Los Angeles, CA: The collaboration between the IVPP and the MagLab is related to the investigation of Late Cenozoic Vertebrate Paleontology and Paleoenvironments of the Tibetan Plateau (China). Stable isotopic compositions of the samples collected in this project are analyzed in the Geochemistry Laboratories in the MagLab. *(MagLab contact: Yang Wang, Geochemistry Program)*

School of Mechanical Engineering and Automation, Fuzhou University, Fuzhou, China: The collaboration between the Fuzhou University and the MagLab is related to the characterization of high strength conductors. *(MagLab contact: Ke Han, MS&T)*

South Florida Water Management District (SFWMD), West Palm Beach, FL: The collaboration between the SFWMD and the MagLab is related to the investigation of land-use and change on food web structure and mercury cycling in the Everglades. Isotopic compositions of the samples collected in this project were analyzed in the Geochemistry Laboratories in the MagLab. *(MagLab contact: Yang Wang, Geochemistry Program)*

Thomas Jefferson National Accelerator Facility, Newport News, VA: Large-grain Nb has become a viable alternative to fine-grain Nb for the fabrication of superconducting radio-frequency cavities. The MagLab collaborated with engineers at Jefferson Lab to evaluate the effect of thermal processing and grain size on the mechanical properties of Nb. The mechanical properties evaluation was carried out at MS&T's Mechanical Properties Lab. (*MagLab contact: Bob Walsh, MS&T*) Nitrogen surface treatments has emerged as a highly effective method of improving the quality factor on Nb SRF cavities; the Applied Superconductivity Center is working with scientists at Jefferson Lab to evaluate the interaction between prior cold-work and doping treatment of Nb samples and their influence on the superconducting properties. Doping, heat treatment and cavity testing are carried out at Jefferson Lab, and superconducting property measurements, including magneto optical imaging, as well as microstructural and microchemical analyses are carried out at the MagLab. *(MagLab contact: Peter J. Lee, ASC)*

US Magnet Development Program (MDP), Berkeley, CA: The US Magnet Development Program aggressively pursues the development of superconducting accelerator magnets that operate as closely as possible to the fundamental limits of superconducting materials and at the same time minimize or eliminate the need to break in a magnet in a series of steps to achieve its design field strength. MDP looks forward 15-30 years at accelerators that might be built. CERN is already thinking about a Future Circular Collider at 10x the energy than the present LHC, i.e. > 100TeV, in the 2050 timeframe. An important thing about the FCC is that it is constrained by mountains, and to get to 100TeV, the envisioned Nb_3Sn technology, which as a limit at ~16T, must be replaced by or combined with HTS to get to 20T. However, while MDP partners closely with CERN, the technology being developed is generic, and it is important to note that the physics reach of an accelerator scales with the ring diameter and the field strength. MagLab's major developments to date include pioneering Bi-2212 magnet technology and its high-pressure, high-temperature reaction and demonstrating several Bi-2212 coils, demonstrating REBCO cables, and leading the national conductor development effort. LBNL serves as the host institution for the MDP organization. *(MagLab contacts: Lance Cooley and David C. Larbalestier, ASC)*

Woods Hole Oceanographic Institution (WHOI), Falmouth, MA: The collaboration between WHOI and the MagLab is related to ocean crust formation. WHOI is providing samples and analyses of abyssal peridotites, which are analyzed for Hf, Nd and Osisotopic composition. The MagLab also participates in seagoing expeditions. One has been to the mid-Atlantic Ridge; another is planned to the Marion Rise on the southwest Indian Ridge. Samples collected from these expeditions will be analyzed at both the MagLab and WHOI. *(MagLab contact: Vincent Salters, Geochemistry Program)*

Woods Hole Oceanographic Institution (WHOI), Falmouth, MA: As part of FSU's Gulf Research Initiative Consortium, the MagLab collaborates with Christopher Reddy and Robert Nelson at WHOI in characterization of petroleum oil spills at the molecular level, by gas chromatography x gas chromatography and FT-ICR mass analysis. Characterization of the 2010 Macondo wellhead oil has been completed, and current research focuses on subsequent physical, chemical, and biological changes as the spill propagates into the environment. *(MagLab contact: Ryan Rodgers, ICR)*

UNIVERSITIES

Florida State University, College of Education, Tallahassee, FL: The Center for Integrating Research & Learning works closely with faculty from the FSU College of Education to network and strengthen programs on campus and at the lab. The MagLab utilizes the expertise of FSU faculty for research projects and recruits graduate students from FSU departments to conduct research on CIRL programs. *(MagLab contact: Roxanne Hughes, Educational Programs)*

Michigan State University, Lansing, MI: The Applied Superconductivity Center is collaborating with Michigan State University on a DOE funded project to study the impact of grain boundaries and associated microstructural defects on the performance of superconducting cavities using the advance microstructural, microchemical, and electromagnetic characterization techniques and expertise available in the MagLab. *(MagLab contact: Peter J. Lee, ASC)*

Nagoya University, Nagoya, Japan & Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany: The Applied Superconductivity Center is collaborating with Nagoya University and the Karlsruhe Institute of Technology in the investigation of iron-based superconducting thin films in order to establish their intrinsic properties and determine their potential for applications using electromagnetic characterization techniques also in high field and expertise available in the MagLab. *(MagLab contact: Chiara Tarantini, ASC)*

Osaka City University, Japan: The EMR group received joint funding with the University of Modena in Italy and Osaka City University in Japan through an International Program sponsored by the Air Force's Asian Office of Aerospace Research and Development (AOARD). This joint program focuses on quantum properties of molecular magnets. A cooperative agreement between Osaka City University and Florida State University has been established in order to formalize this collaboration. *(MagLab contact: Stephen Hill, EMR)*

Radboud University, Nijmegen, The Netherlands: The MagLab has partnered with the High Magnetic Field Lab in The Netherlands to develop a 45T hybrid magnet using only 24MW of power. The project was funded by the Dutch government in 2006, and in 2012 an agreement was signed for the MagLab to play a leading role in the development of the Nb_3Sn cable-in-conduit superconducting coil for this magnet system. This will be the fourth hybrid outsert to be developed at the MagLab (MagLab 45T, HZB, FSU SCH, Nijmegen), and the Dutch lab will benefit from our extensive experience. When complete, it is expected to be one of three 45T systems worldwide. The CICC coil has been delivered to Nijmegen. The Nijmegen lab is building the cryostat and resistive coils. *(MagLab contact: Mark D. Bird, MS&T)*

Shanghai University, Shanghai, China: The collaboration between the Shanghai University and the MagLab is related to the solidification of metallic materials. Two scientists from Shanghai University visited the MagLab in 2019 as visiting scholars for one year to do research on microstructure of high strength materials. They have published five joint papers between 2019 and 2020. *(MagLab contact: Ke Han, MS&T)*

St. Andrews University, UK: The EMR group has an ongoing partnership with St. Andrews University in the UK, involving the development of a high-power (1kW) high-frequency (94GHz) pulsed EPR spectrometer (HiPER) for its user program. *(MagLab contact: Stephen Hill, EMR)*

Texas A&M University, College Station, TX: Texas A&M University has fabricated Nb and Ta sheets, rods and tubes with ultra-fine grain size and controlled textures useful for Nb_3Sn wires and SRF cavities by using the Equal Channel Angular Extrusion (ECAE) process; the Applied Superconductivity Center has provided microstructural characterization of this material. *(MagLab contact: Shreyas Balachandran, Peter J. Lee, ASC)*

Tokyo University of Agriculture and Technology, Japan: The Applied Superconductivity Center is collaborating with TUAT in the investigation of iron-based superconducting bulks in order to establish their intrinsic properties and determine their potential for applications using electromagnetic characterization techniques also in high field and expertise available in the MagLab. *(MagLab contact: Chiara Tarantini, ASC)*

University of Cambridge, UK: The MS&T division is collaborating with the University of Cambridge to develop high-current coils based on high temperature superconductors driven by a flux pump. This collaboration involves Cambridge developing flux pumps that are able to provide more energy to the load than traditional systems and the MagLab developing high-current HTS coils. *(MagLab contact: Thomas Painter)*

University of Colorado Boulder, Boulder, CO: The NIST-Boulder electromechanical testing facilities were the primary location for the determination of the strain sensitivity of a wide range of superconducting wires, and these important instruments have been transferred to the Applied Superconductivity Center so that this critical work can be continued. *(MagLab contact: Najib Cheggour, ASC)*

University of Edinburgh, UK: The EMR group received funding through a joint program between the National Science Foundation and the Engineering and Physical Sciences Research Council in the UK, enabling an International Collaboration with the Chemistry Department at the University of Edinburgh, Scotland. This joint program involved the development of high-pressure/High-field EPR techniques. *(MagLab contact: Stephen Hill, EMR)*

University of Modena, Italy: The EMR group received joint funding with the University of Modena in Italy and Osaka City University in Japan through an International Program sponsored by the Air Force's Asian Office of Aerospace Research and Development (AOARD). This joint program focuses on quantum properties of molecular magnets. *(MagLab contact: Stephen Hill, EMR)*

University of Oxford, UK: The Applied Superconductivity Center is collaborating with University of Oxford in the investigation of doped Nb_3Sn superconducting wires in order to determine by atom probe tomography the elemental distribution of dopants and their effect on the superconducting properties. *(MagLab contact: Chiara Tarantini, ASC)*

University of Texas, Arlington, TX: The Applied Superconductivity Center is working with Choong-Un Kim and his research group to understand electrochemical methods to apply refractory metals to copper and copper alloys. Kim's team have unique expertise in preparing non-aqueous methods that ensure very little oxygen is incorporated into the refractory metals, using expertise developed for semiconductor inter-connections. The MagLab's microstructural and electromagnetic characterization facilities are used to evaluate the quality of coatings and their properties, including potential use as a superconducting material in a cavity resonator. *(MagLab contact: Lance Cooley, ASC)*

COMMUNITY GROUPS AND EDUCATIONAL GROUPS

American Physical Society – Committee on the Status of Women in Physics, College Park, MD: This committee works to improve the representation and experiences of women in physics. The MagLab has engaged with this group for external reviews and advice. In addition, Dr. Hughes has served as a member of the committee and continues to help with Site Visits. *(MagLab contact: Roxanne Hughes, Educational Programs)*

American Physical Society - Forum on Outreach and Engaging the Public, College Park, MD: The Forum's goal is to increase the public's awareness of physics. CIRL works with this group to utilize best practices and engage in international discussions around physics outreach. *(MagLab contact: Roxanne Hughes, Educational Programs)*

Big Bend/Leon Association of Science Teachers (BLAST), Tallahassee, FL: The Big Bend/Leon Association of Science Teachers (BLAST) is a group that brings together formal and informal science educators to establish lines of communication among all persons involved in science education in the North Florida community and foster life-long interest in the sciences. They do this by coordinating services most conducive to outstanding science educators, including hosting workshops and presentations that aim to increase the knowledge and skills of science teachers. Additionally, they recognize outstanding achievements in science instruction and provide monetary support for science teacher and student projects. *(MagLab contact: Carlos R. Villa, Educational Programs)*

CAISE - Center for the Advancement of Informal Science Education (CAISE), Washington, DC: CAISE works in collaboration with the National Science Foundation (NSF) Advancing Informal STEM Learning (AISL) Program to strengthen and advance the field of professional informal science education and its infrastructure by providing resources for practitioners, researchers, evaluators and STEM-based professionals. CAISE also facilitates conversation, connection and collaboration across the ISE field — including in media (TV, radio and film), science centers and museums, zoos and aquariums, botanical gardens and nature centers, cyberlearning and gaming, and youth, community, and out of school time programs. The Center for Integrating Research & Learning (CIRL) has worked with CAISE to provide advice for reaching Principal Investigators and improving the evaluation of broader impacts. *(MagLab contact: Roxanne Hughes, Educational Programs)*

Community Classroom Consortium, Tallahassee, FL: The Community Classroom Consortium (CCC) is a coalition of more than thirty cultural, scientific, natural history and civic organizations in North Florida and South Georgia that provide educational experiences and resources to the public, especially K-12 teachers and students. Representatives from CIRL and Public Affairs represent the Lab on the board of this organization and as general members. *(MagLab contact: Kari Roberts, Educational Programs)*

Florida Afterschool Network, Tallahassee, FL: The Florida Afterschool Network (FAN) is an organization that is working toward creating and sustaining a statewide infrastructure to establish collaborative public and private partnerships that connect local, state, and national resources supporting afterschool programs that are school-based or school-linked; develop quality afterschool standards that are endorsed and promoted by statewide stakeholders and through Florida Afterschool Network; and promote public awareness and advocate for policy that expands funding, quality improvement initiatives and accessibility of afterschool programs. The Center for Integrating Research & Learning is a member of the advisory council for this organization. *(MagLab contact: Carlos R. Villa, Educational Programs)*

Florida Association of Science Teachers (FAST), Tallahassee, FL: FAST is a diverse group of teachers, scientists, science educators, science supervisors, curriculum designers, administrators and educational business partners who have a common goal of improving education for students in the state of Florida. FAST provides a way for all members to keep up with what is happening in education in Florida and across the United States. *(MagLab contact: Carlos R. Villa, Educational Programs)*

Future Physicists of Florida, Tallahassee, FL: Future Physicists of Florida is an organization dedicated to recognizing talented middle school math and science students and providing educational guidance to these students to prepare them for careers in physics and engineering. CIRL is a partner in the organization. *(MagLab contact: Carlos R. Villa, Educational Programs)*

Inclusive Graduate Education Network (IGEN), College Park, MD: The MagLab has worked with IGEN to beta test a mentor training for mentors at national labs. MagLab staff will be able to participate in the final curriculum to strengthen the quality of mentorship at the MagLab. *(MagLab contact: Roxanne Hughes or Kari Roberts, Educational Programs)*

Leon County Schools, Tallahassee, FL: CIRL works closely with Leon County Schools (LCS) through our K-12 outreach and our middle school mentorship program. In 2014, CIRL staff worked with Title I elementary school teachers from LCS to develop and facilitate a year-long teacher professional development that culminated in a STEM challenge for students. *(MagLab contact: Roxanne Hughes or Carlos R. Villa, Educational Programs)*

Los Angeles County Museum of Natural History, Los Angeles, CA: The collaboration between the IVPP and the MagLab is related to the investigation of Late Cenozoic Vertebrate Paleontology and Paleoenvironments of the Tibetan Plateau (China). Stable isotopic compositions of the samples collected in this project are analyzed in the Geochemistry Laboratories in the MagLab. *(MagLab contact: Yang Wang, Geochemistry Program)*

National Girls Collaborative Project, Seattle, WA: This is a national nonprofit organization that works to improve girls' interest in and access to STEM programs and careers. CIRL has utilized their publications and webinars for best practices in STEM education. CIRL's research has also informed their work. *(MagLab contact: Roxanne Hughes or Kari Roberts, Educational Programs)*

National Postdoc Association, Washington, DC: The National Postdoc Association (NPA) advocates for postdoctoral scholars at a national level and coordinates an annual meeting of postdoctoral scholars, their mentors and postdoctoral affairs staff. Florida State University is an affiliate member, so all postdocs at the FSU branch receive complementary membership to the NPA. Additionally, representatives from the lab attend the annual meeting regularly to stay up-to-date on the latest issues and initiatives related to postdoctoral affairs. The NPA provides direct support to postdocs through professional development and a virtual career center. (*MagLab contact: Kari Roberts, Educational Programs*)

SciGirls National, Saint Paul, MN: This program is run by Twin Cities Public Television and provides both programming and resources for educators and girls to increase their interest and sense of belonging in STEM. CIRL utilizes these resources to train our summer camp educators and local teachers. In addition, CIRL's research has informed the SciGirls program and curriculum. *(MagLab contact: Roxanne Hughes, Educational Programs)*

Supporting Teachers to Encourage the Pursuit of Undergraduate Physics (STEP UP), Miami, FL: STEP UP is a national community of physics teachers, researchers and professional societies. They have designed high school physics lessons to empower teachers, create cultural change, and inspire young women to pursue physics in college. It is supported by NSF, APS Physics, AAPT and FIU. *(MagLab contact: Carlos R. Villa, Educational Programs)*

WFSU-TV, Tallahassee, FL: The Center for Integrating Research & Learning partners with WFSU-TV, the area's public television station, to administer SciGirls. The program includes two summer camps for middle school girls with an interest in science. The collaboration between the MagLab and WFSU-TV has resulted in a successful partnership that has lasted over a decade. *(MagLab contact: Roxanne Hughes, Educational Programs)*

SPIN OFFS OF RESEARCH LABORATORIES AND CORPORATIONS

Center for Advanced Power Systems (CAPS), Tallahassee, FL: The Center for Advanced Power Systems (CAPS) is a multidisciplinary research center organized to perform basic and applied research to advance the field of power systems technology. CAPS emphasis is on application to electric utility, defense, and transportation, as well as developing an education program to train the next generation of power systems engineers. The research focuses on electric power systems modeling and simulation, power electronics and machines, control systems, thermal management, cyber-security for power systems, high temperature superconductor characterization and electrical insulation research. *(MagLab contact: Greg Boebinger)*

Future Fuels Institute, Tallahassee, FL: The Future Fuels Institute (FFI) was established to enhance the existing Ion Cyclotron Resonance (ICR) Program at the MagLab to deal specifically with bio- and fossil fuels, particularly for heavy oils and synthetic crudes. Supported by sponsoring companies and collaborative entities (instrument companies, universities, and research institutes), the FFI works to develop and advance novel techniques for research applications and industrial problem solving. Recent research has focused on biofuels and recycling efforts for petroleum-based materials (plastics). The institute also serves as a training center for fuel-related science and technology. It is currently part of an international joint laboratory (iC2MC), funded by Total Global. (*MagLab contact/ Director: Ryan Rodgers*)

High-Performance Materials Institute (HPMI), Tallahassee, FL: The High-Performance Materials Institute (HPMI) is a multidisciplinary research institute for research and education in the field of advanced materials. Currently, HPMI is involved in four primary technology areas: High-Performance Composite and Nanomaterials, Structural Health Monitoring, Multifunctional Nanomaterials Advanced Manufacturing and Process Modeling. Over the last several years, HPMI has proven a number of technology concepts that have the potential to narrow the gap between research and practical applications of nanotube-based materials. These technologies include magnetic alignment of nanotubes, fabrication of nanotube membranes or buckypapers, production of nanotube composites, modeling of nanotube-epoxy interaction at the molecular level, and characterization of SWNT nanocomposites for mechanical properties, electrical conductivity, thermal management, radiation shielding and EMI attenuation. *(MagLab contact: Greg Boebinger)*

MagCorp, Tallahassee, FL: MagCorp is a new Tallahassee company that facilitates access to the world's leading magnetic experts to solve real world industrial problems. MagCorp was created to meet industry needs for feasibility studies, prototyping, and product development while eliminating the confusion that can come from partnering with academic institutions and research foundries. MagCorp is the world's one-stop shop for magnet science solutions and is the essential conduit between the private & government sectors and the National High Magnetic Field Lab. Leveraging completely new client & partner facing business models, MagCorp has already begun to attract industry to Tallahassee and put it on the map as the emerging magnetic capital of the world. (*MagLab contact: Greg Boebinger*)

MAXIKAT, Inc., Tallahassee, FL: Maxikat is a spinoff company that performs data analysis for petroleum industry. It was formed in 2015. *(MagLab contact: Vladislav Lobodin)*

Omics LLC, Tallahassee, FL: Omics LLC is a spinoff company that serves the data analysis and interpretation needs of the high-resolution mass spectrometry market. It was formed more than fifteen years ago and has grown over the years to address a wider analytical community. *(MagLab contact: Ryan Rodgers)*

2. User Facilities

2.1. USER PROGRAM

Proposal Review Process

Across all seven facilities, proposals for magnet time are submitted online via https://users.magnet.fsu.edu and reviewed in accordance with the MagLab User Proposal Policy. In brief, each user facility has a User Proposal Review Committee (UPRC) comprised of at least seven members, with more external members than internal. UPRC memberships are treated confidentially by the laboratory but are available for review by NSF and MagLab advisory committees. Proposal reviews are conducted in strict confidence and are based on two criteria: (1) the scientific and/or technological merit of the proposed research and (2) the "broader impacts" of the proposed work. They are graded online according to a scale, ranging from "A" (Proposal is high quality and magnet time must be given a high priority) to "C" (Proposal is acceptable and magnet time should be granted at MagLab discretion) to "F" (Proposal has little/no merit and magnet time should not be granted). The Facility Directors merge the UPRC recommendations with the availability and scheduling of specific magnets, experimental instrumentation, and user support scientists and make recommendations for magnet time assignments to the MagLab Director. The MagLab Director is responsible for final decisions on scheduling of magnet time based on these recommendations. All 2020 User Proposals can be found in Appendix V.

User Funding Opportunities

Dependent Care Travel Grant

The MagLab recognizes the extra demands outside of a research career placed on caregivers of children and other dependents. For caregivers, travel to the MagLab to conduct experiments or to conferences to disseminate research findings often incurs extra costs for dependent care. In place since 2011, the MagLab's Dependent Care Travel Grant (DCTG) program offers up to $800 per year for travel expenses for MagLab scientists traveling to conferences or MagLab users traveling to any of the three MagLab facilities. One DCTG was awarded early in 2020.

First Time User Support

The MagLab is charged by NSF with developing and maintaining facilities for magnet-related research that are open to all qualified scientists and engineers through a peer-reviewed proposal process. Facilities are generally available to users without cost. In an effort to encourage new research activities, first-time users are provided financial support for travel expenses. International users are provided $1,000 of support and domestic users are provided $500 of support for their travel costs. This funding is provided by the State of Florida and is available for Tallahassee user facilities only.

Visiting Scientist Program

In 2020, the number of requests to and approvals for the Visiting Scientist Program were limited by the COVID pandemic. The Program provided financial support of $7,400 for two research projects on a competitive basis. To apply for support from the Visiting Scientist Program, interested researchers are required to submit an application and a proposal that will be reviewed by appropriate facility directors and scientist at the MagLab. All requests for support must be submitted online at https://vsp.magnet.fsu.edu/

User Collaboration Grants Program (UCGP)

The NSF charged the MagLab with developing an internal grants program that utilizes the MagLab facilities to carry out high quality research at the forefront of science and engineering, and advances the facilities and their scientific and technical capabilities. UCGP, established in 1996, stimulates magnet and facility development and provides intellectual leadership for research in magnetic materials and phenomena.

The UCGP strongly encourages collaboration between MagLab scientists and external users of MagLab facilities. Projects are also encouraged to drive new or unique research, serving as seed money to develop initial data leading to external funding of a larger program. In accord with NSF policies, the MagLab cannot fund clinical studies.

A total of 23 UCGP solicitations have now been completed with a total of 590 pre-proposals being submitted for review. Of the 590 proposals, 310 were selected to advance to the second phase of review, and 140 were funded (24% of the total number of submissions). The UCGP has been highly successful as a mechanism for supporting outstanding projects in the various areas of research pursued at the laboratory. It uses a two-stage proposal review process handled by means of a web-based system. Proposal review is done by a combination of internal and external reviewers. Details of the process and review criteria are available on the website.

1. 2020 UGCP Solicitation and Awards

The most recent solicitation, announced in March 2020, is complete, and its awards were issued in January 2021.

Of the 13 pre-proposals received the committee recommended that 10 pre-proposals move to the full proposal state. Of the 10 full proposals, five were awarded. A breakdown of the review results is presented in Tables 2.1 and 2.2.

Table 2.1: UCGP Proposal Solicitation Results – 2020

Research Area	Pre-Proposals Submitted	Pre-Proposals Proceeding to Full Proposal	Projects Funded
Condensed Matter Science	5	5	3
Biological & Chemical Sciences	5	4	2
Magnet & Magnet Materials Technology	3	1	0
Total	13	10	5

Table 2.2: UCGP Funded Projects from 2020 Solicitation.

Principal Investigator	MagLab Institution	Project Title	Funded
Ali Bangura	FSU	Probing exotic quasiparticles in calorimetric and thermal transport experiments at ultra-low temperatures	$220,394
Chad Weisbrod	FSU	Data Independent Acquisition-Mass Spectrometry Using Ultra-High Magnetic Field FT-ICR	$195,094
Thomas Mareci	UF	Cryo-cooled MR Coils for Low-Gamma NMR Imaging and Spectroscopy at High Magnetic Fields.	$209,839
Lucia Steinke	FSU	Probing exotic quasiparticles in calorimetric and thermal transport experiments at ultra-low temperatures	$191,850
Xiao-Xiao Zhang	FSU	Probing dark exciton dynamics in monolayer semiconductors under high magnetic field	$200,000

2. Future Solicitations

No solicitation will be offered in 2021. The next solicitation announcement is planned to occur around April of 2022 with funding in early 2023.

3. Results Reporting

To assess the success of the UCGP, reports were requested in January 2020, on grants issued from the five solicitations which had start dates from 2015 through 2020. At the time of the reporting, some of these grants were in progress, and some had been completed. For this "retrospective" reporting, PIs were asked to include external grants, MagLab facilities enhancements, and publications that were generated by the UCGP. Since UCGP grants are intended to seed new research through high risk initial study or facility enhancements, principal investigators (PIs) were allowed and encouraged to report results that their UCGP grant had made possible, even if these were obtained after the term of the UCGP grant was complete. Reports from 25 awards were included in the results given here.

The PIs reported:

- 30 Lab enhancements, which are listed in Table 2.3 below.
- At least partial support for four undergraduate researchers, 43 grad students and 18 postdocs.
- 21 funded external grants, which were seeded by results from UCGP awards. The total dollar value of the external grants was $41.8M. Grants to MagLab institutions and those of user-collaborators were included.
- 139 publications, many in high profile journals, including six in *JACS*, one in *Nature*, nine in *Nature Communications*, one in *Nature Quantum Materials*, three in *Nature Physics*, four in *Physical Review Letters*, three in *PNAS* and one in *Science*.

Table 2.3: Facility Enhancements Reported from 2014-2019 UCGP Solicitations

Enhancement and Available Date	Users *
Software to model proteins of bacteria from isotopically depleted media (1/20)	1
PEPPI-MS for eluting proteins from polyacrylamide gels	2
GUPPI software for proteonomic analysis	1
3 GPa proximity detectors (7/19)	1
Tunnel diode oscillator to 7 GPa (12/19)	1
Modified 1800 C tube furnace for molten metal flux growth of uranium compounds (1/15)	7
Development of capabilities for hazardous substance handling (1/15)	4
System for continuous flow 97% para enrichment at 30K (12/19)	3
Time-domain THz spectroscopy using TOPTICA Teraflash system (11/17)	3
0.75mm 100kHz Magic-Angle Spinning H_{XY} triple-resonance probe (6/19)	2
Coil winder for AC susceptibility (10/16)	5
Hybrid piston cylinder cell (10/16)	2
Two-element surface quadrature 1H coil and linear 1H birdcage coil (12/14)	2
Diffusion-weighted relaxation-enhanced spectroscopy (8/16)	5
Chemical Shift saturation transfer relaxation-enhanced spectroscopy (8/16)	1
High-temperature, high-resolution NMR (11/16)	9
Two-channel homodyne pulsed NMR spectrometer (9/17)	1
Customized Razorbill piezo for uniaxial strain, for 31T (6/19)	3
Piezoelectric strain device for pulse fields	1
Torque magnetometer for critical current measurements (10/20)	2
FPGAs for faster resistive critical current measurement	1
Superconducting transformer for 45kA test of superconducting cable (9/20)	1
Pulsed field set up for thin film samples in exchange gas (3/16)	2

Enhancement and Available Date	Users *
Instrumentation and software for measurements of high resistance tunnel junctions (2/21)	2
Low T NMR probes with *in situ* stress/strain mechanism+1kW 1GHz NMR amp (11/16)	14
Electrocrystallization facility for BEDT-TTF, or ET (6/15)	7
MALDI ionization source (8/19)	1
mK faraday Force magnetometer (6/15)	1
Pulsed EPR at 395GHz (5/18)	3
Quasioptical beam transport in MAS DNP 600MHz NMR (11/17)	12

* *Number of external users (PIs or private companies only) reported to have used the enhancement.*

Annual User Survey

The MagLab conducted its tenth annual user survey between June 1, 2020, and June 30, 2020. This annual survey assists all seven facilities in responding to user needs, improving facilities and services, and guides the MagLab in setting priorities and planning for the future. This request was sent to all MagLab User Principal Investigators (PI) and to their collaborators who received magnet time between June 1, 2019, and March 1, 2020, including PIs who sent samples where the experiment was performed by laboratory staff scientists. Due to COVID impacts, the MagLab only surveyed users through March 1 instead of the usual end of May. From 1,006 eligible users, we received feedback from 243 (24.2%) users. 20% of all external users responded to the survey. All user responses were treated as confidential. Figures 2.1-2.7 exclude internal responses.

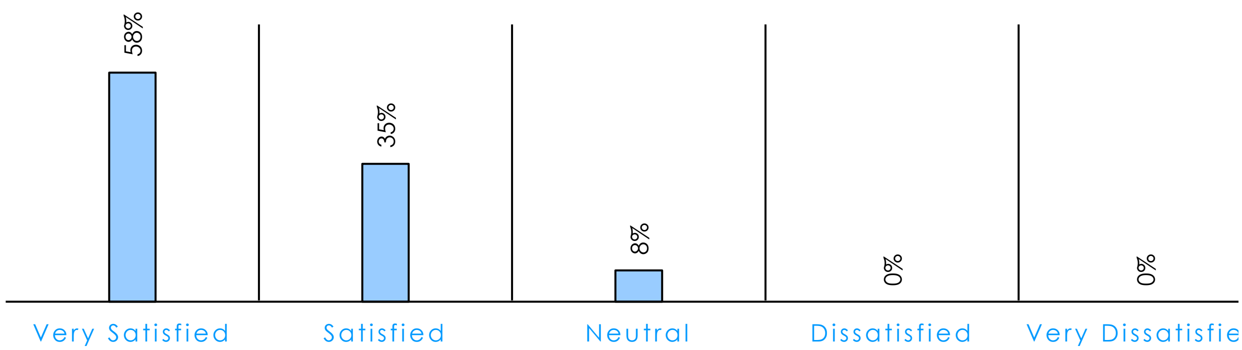


Figure 2.1: 93% of external users were satisfied or very satisfied with the proposal process (e.g., submission, review).

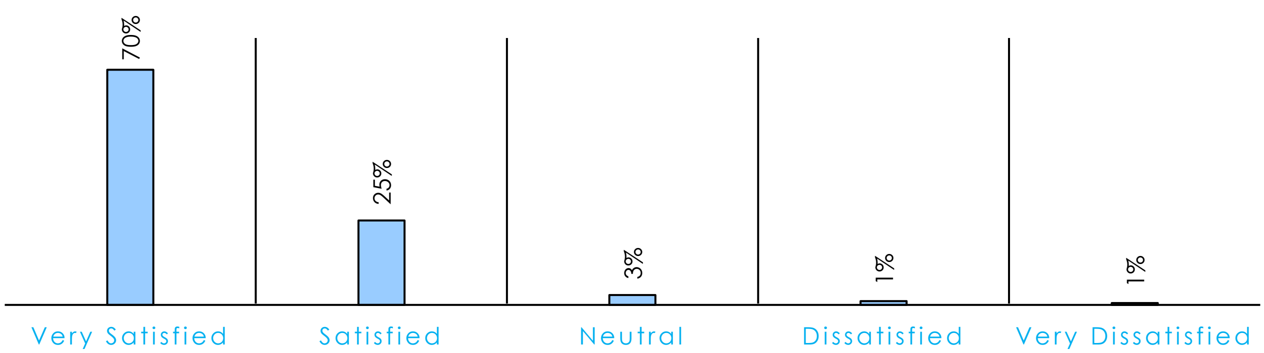


Figure 2.2: 95% of external users were satisfied or very satisfied with the availability of the facilities and equipment.

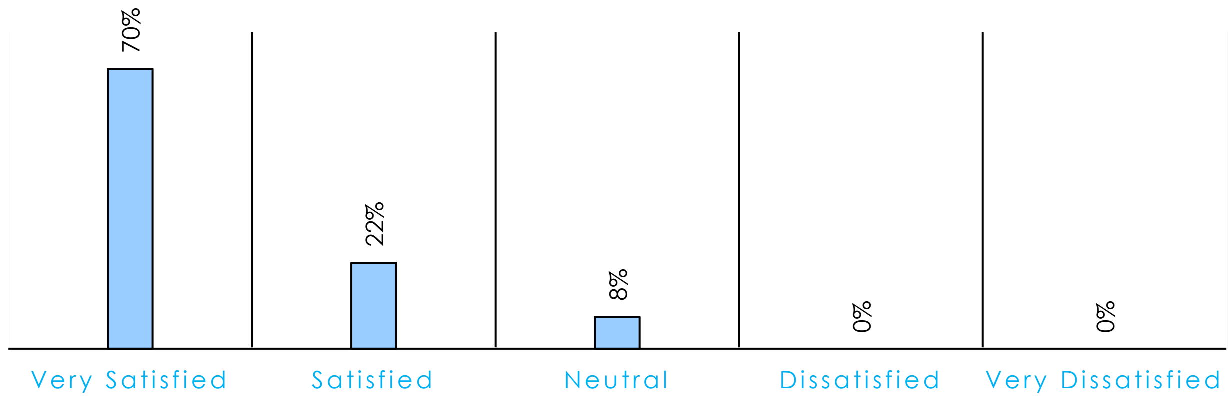


Figure 2.3: 92% of external users were satisfied or very satisfied with user friendliness of training and safety procedure.

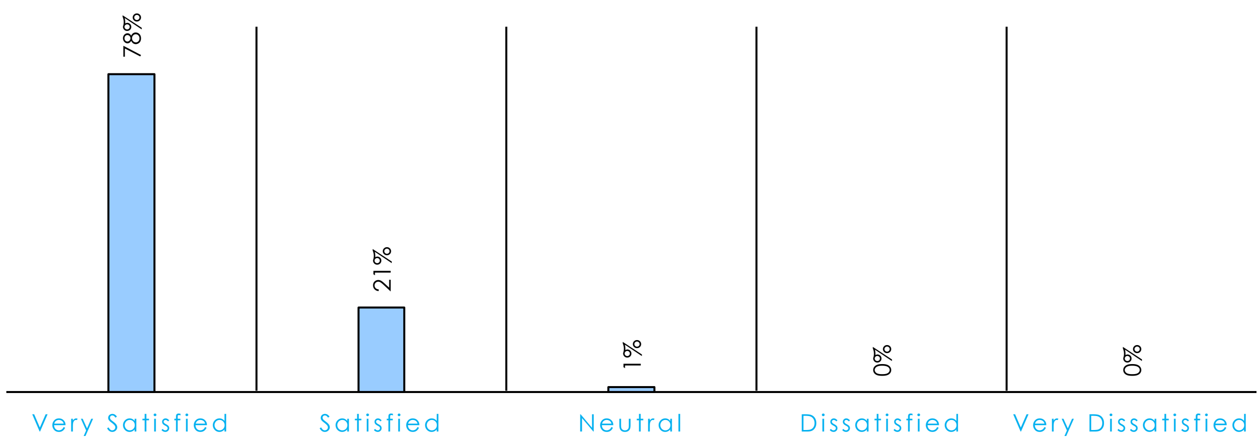


Figure 2.4: 99% of external users were satisfied or very satisfied with the overall safety at the MagLab.

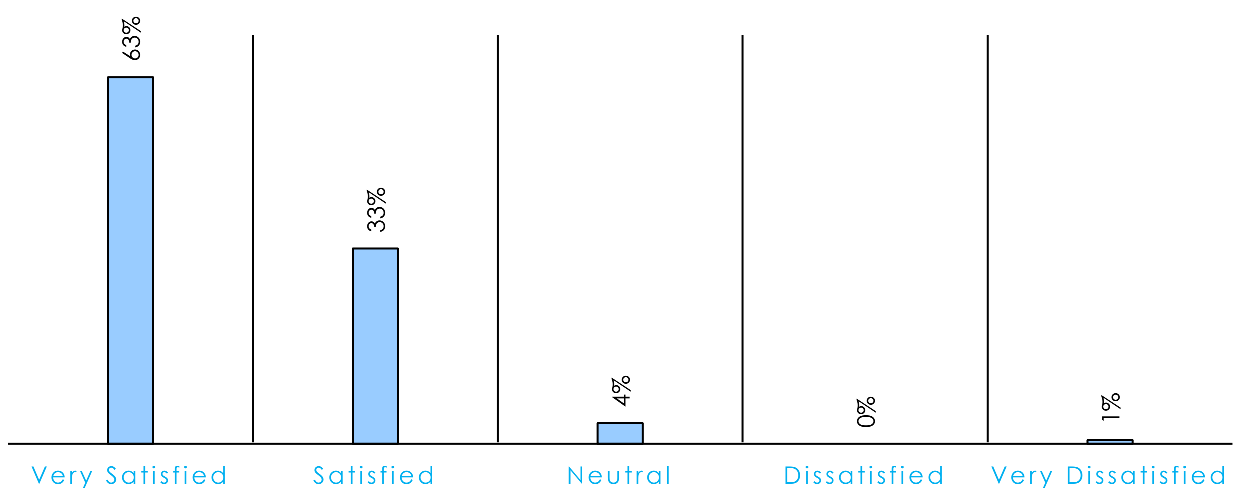


Figure 2.5: 96% of external users were satisfied or very satisfied with the performance of facilities and equipment (e.g., were they maintained to specifications for intended use, ready when scheduled, etc.).

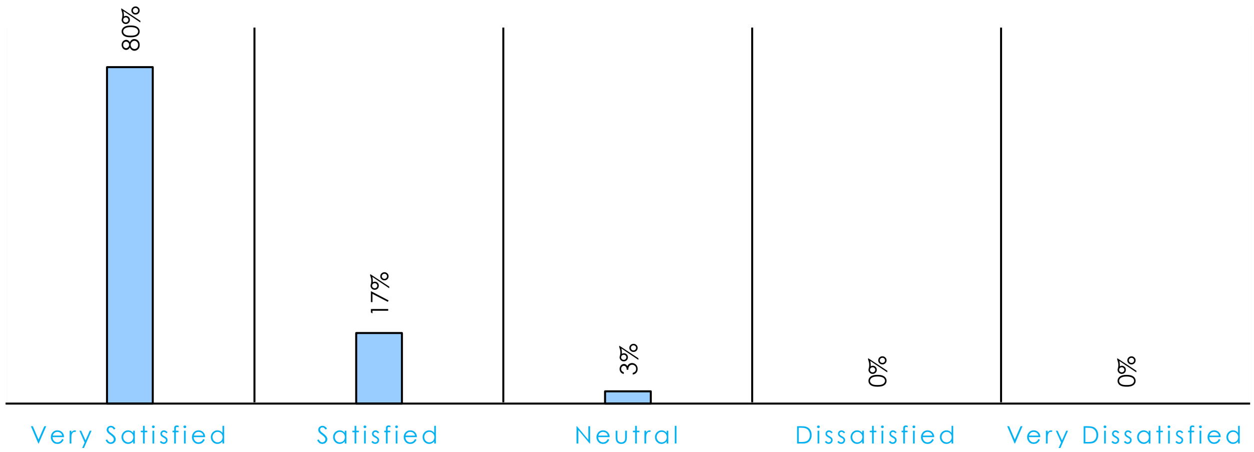


Figure 2.6: 97% of external users were satisfied or very satisfied with the assistance provided by MagLab facilities technical staff.

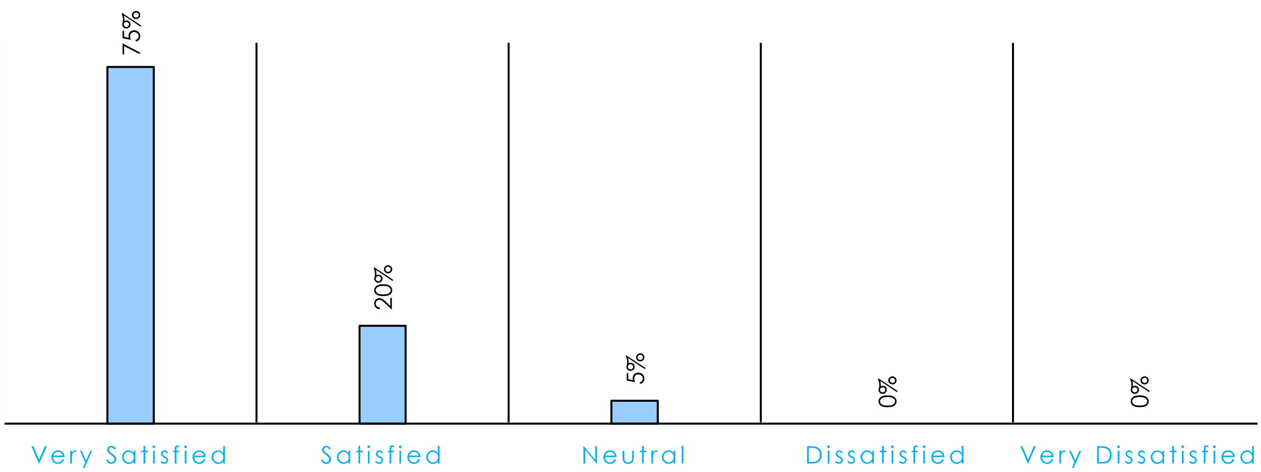


Figure 2.7: 95% of external users were satisfied or very satisfied with the assistance provided by MagLab facilities administrative staff.

2.2. SEVEN USER FACILITIES

The geographical distribution of our users' organizations can be found on our website.

1. AMRIS Facility

The AMRIS Facility at the University of Florida supports nuclear magnetic resonance spectroscopy (NMR) and magnetic resonance imaging (MRI) studies of chemical compounds, biomolecular systems, tissues, small animals, large animals, and humans. We offer fourteen systems with different magnetic fields and configurations to users for magnetic resonance experiments. AMRIS has fourteen professional staff members to assist users, maintain instrumentation, build new coils and probes and help with administration.

Unique Aspects of Instrumentation Capabilities

Several AMRIS instruments offer users unique capabilities: the 750MHz wide bore provides outstanding high-field imaging for excised tissues and small animals, as well as diffusion measurements with gradient strengths up to 30T/m; the 11.1T horizontal MRI has a large 400mm bore size and gradient strengths up to 1.5T/m; the 600MHz 1.5-mm HTS cryoprobe is the most mass-sensitive NMR probe in the world for ^{13}C detection and is ideal for natural products research; the 5T DNP polarizer enables both fundamental studies of DNP mechanisms down to 1.2K as well as *in vivo* metabolism measurements when coupled to either the 4.7T or 11.1T systems. The 3.35T DNP polarizer enables perfused organ studies in the newly installed wide bore 600MHz system. These systems support a broad range of science, including natural product identification, membrane protein structure determination, cardiac studies in animals and humans, and correlation of neural structures with brain function and chemistry (Table 2.4).

Table 2.4: NMR & MRI Systems in the AMRIS Facility at UF in Gainesville

^{1}H Frequency	Field (T), Bore (mm)	Homogeneity	Measurements
800MHz	18.8, 63	1ppb	Solution/solid-state NMR and HR-MAS
800MHz	18.8, 54	1ppb	Solution NMR (Cryoprobe)
750MHz	17.6, 89	1ppb	Solution/solid-state NMR and MRI
600MHz	14.1, 51	1ppb	NMR, microimaging, hyperpolarization
600MHz	14.1, 89	1ppb	NMR and hyperpolarization
600MHz	14.1, 54	1ppb	Solution NMR (CryoProbe)
600MHz	14.1, 54	1ppb	Solution NMR (HTS Cold Probe)
500MHz	11.7, 54	1ppb	Solution/solid-state NMR
470MHz	11.1, 400	0.1ppm	DNP, MRI and NMR of animals
212MHz	5.0, 89	1ppm	DNP polarization
200MHz	4.7, 330	0.1ppm	DNP, MRI and NMR of animals
143MHz	3.35, 52	1ppm	DNP polarization
128MHz	3.0, 900 (600 for subjects)	0.1ppm	MRI/S of humans, large animals
128MHz	3.0, 900 (700 for subjects)	0.1ppm	MRI/S of humans

Facility Developments and Enhancements

Full user operations were offered on the 600MHz wide bore (89mm) and 800MHz narrow bore (54mm) systems installed in November 2019. A specialized QNP switch, enabling $^{19}F/^{1}H$ or ^{19}F/BB experiments on the WB600, and a 5mm cryoprobe on the 800 system ensure these high field NMR systems offer the latest in sensitivity and pulse sequence capabilities. All of our NMR systems can be run remotely by users and two systems now have sample changers to enhance user throughput. A 3.0T Philips Ingenia Elition X, 70cm bore MRI scanner was installed in May 2020, as a direct replacement for a previous 60cm Philips system. It features a 70cm bore and includes the latest acquisition techniques for human MRI research, including multinuclear capabilities, functional MRI (fMRI), advanced diffusion imaging (dMRI), magnetic resonance elastography (MRE), spectroscopy (MRI/S), and whole-body scanning. The extra space better accommodates in-bore equipment and provides a more comfortable environment for subjects. Throughout 2020, all high field systems (≥11.7T) were kept in operation with users sending samples to our staff, and experiments collected through remote access to the operating systems.

Major Research Activities and Discoveries/ Research Highlights

In spite of the challenges posed by the COVID pandemic, our users were able to continue to collect data through the tireless efforts of AMRIS staff who provided on-site support while users mailed samples to us. Local graduate students and postdoctoral fellows continued developing DNP and *in vivo* spectroscopy techniques for metabolic studies. Many users pursued quantitative studies for metabolomics and structural biology. AMRIS facility users reported 43 peer-reviewed publications and 15 theses and dissertations for 2020. Two notable examples are listed below.

$[^2H_7]$Glucose and Deuterium MR Can Detect Cancer Metabolism by Formation of HDO

Rohit Mahar, Patrick Donabedian, and Matthew E. Merritt, Department of Biochemistry and Molecular Biology, College of Medicine, University of Florida, Gainesville, FL, USA

Funding: NHMFL NSF DMR-1644779 (G. Boebinger) & the State of Florida, NIH P41-122698, 5U2CDK119889, and NIH R01-105346

R. Mahar, P.L. Donabedian, and M.E. Merritt, HDO production from [2H7]glucose Quantitatively Identifies Warburg Metabolism, Scientific Reports, 10, 8885 (2020). doi.org/10.1038/s41598-020-65839-8

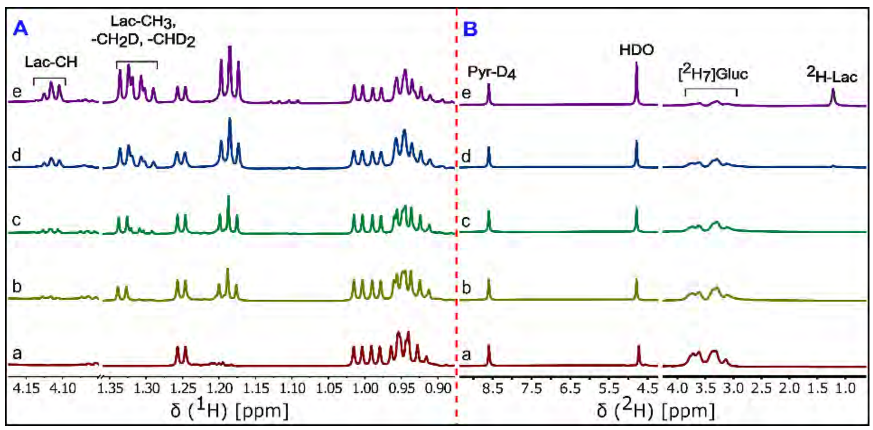


Figure 2.8: (top) Metabolism of $[^2H_7]$glucose, with red dots marking the presence of ^2H, and larger dots indicating two ^2H atoms. HDO can be produced at multiple steps in the glycolytic pathway. Some enzymes promote exchange as opposed to one way flux, which amplifies HDO production; **(bottom, left)** ^1H NMR spectra showing the production of deuterated lactate as detected in the ^1H spectrum; **(bottom, right)** ^2H NMR spectrum showing glucose consumption, ^2H-lactate production, and HDO production.

Cancer is typically diagnosed and staged using positron emission tomography with radiolabeled fluorodeoxyglucose, or $[^{18}F]$FDG-PET. The use of radioactive isotopes prevents its serial use in staging cancer progression or in the pediatric population. Magnetic resonance imaging (MRI) is not often recognized as a metabolically sensitive technique, but with the addition of stable isotopes, like deuterium, the chemical selectivity of MR allows for quantitative assessment of metabolic flux, important to distinguishing cancerous cells and understanding cancer progression.

We cultured cells in media containing $[^2H_7]$glucose to compare metabolism in healthy liver hepatocytes and a hepato-carcinoma cell line (HUH-7). **Figure 2.8 (top)** shows the metabolic pathways in glycolysis that produce deuterated water (HDO). Using ^1H **(bottom-left)** and ^2H **(bottom-right)** NMR spectroscopy we monitored the production of deuterated lactate and HDO from the glucose. The signal from natural abundance HDO is observed at the beginning of the experiment with the signal increasing as deuterated glucose is consumed. [$^2H_7$]glucose metabolism produces at least twice the number of ^2H spins for detection compared to a [6,6-$^2H_2$]glucose tracer previously used in humans. Metabolism can be assessed by imaging the highest intensity peak in the spectrum, offering an optimal signal-to-noise ratio.

This initial data suggests that HDO production could therefore be used as a surrogate for glucose uptake, which is the metric measured in FDG-PET diagnoses of cancer, without exposure to radioactive isotopes.

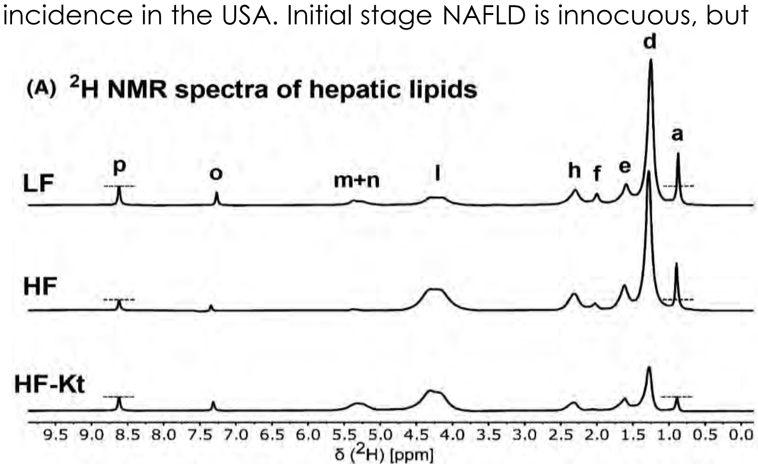
Assessing Lipid Synthesis with ^2H Magnetic Resonance in a Model of Non-Alcoholic Fatty Liver Disease (NAFLD)

M.S. Muyyarikkandy[1], M. McLeod[2], M. Maguire[1], R. Mahar[2], N. Kattapuram[1], C. Zhang[1], C. Surugihalli[1],
V. Muralidan[1], K. Vavilikolanu[1], C.E. Mathews[2], M.E. Merritt[2], and N.E. Sunny[1]
[1] University of Maryland, College Park, MD; [2] University of Florida, Gainesville, FL
Funding: G.S. Boebinger (NSF DMR-1644779); N. Sunny and M.E. Merritt (NIH R01DK112865)
Muyyarikkandy MS, McLeod M, Maguire M, et al. Branched chain amino acids and carbohydrate restriction exacerbate ketogenesis and hepatic mitochondrial oxidative dysfunction during NAFLD. The FASEB Journal. 2020;00:1–18. https://doi.org/10.1096/fj.202001495R

Non-alcoholic Fatty Liver Disease (NAFLD) is a metabolic dysregulation of fatty acid synthesis and oxidation that leads to lipid accumulation in the liver. NAFLD is a burgeoning world health issue, with a current estimate of 25% incidence in the USA. Initial stage NAFLD is innocuous, but in a sub-population of ~10%, it can progress from simple steatosis to non-alcoholic steatohepatitis, which can lead to liver failure and the need for transplant.

Prior work focused primarily on the metabolic effects of increasing levels of circulating fatty acids on the accumulation of hepatic lipid stores. Here, we further examine the effect of a ketogenic diet on de novo lipogenesis (DNL) in the liver tissue of mice fed one of three diets: low fat (LF), high fat (HF), or HF plus increased branched-chain amino acids (HF-Kt) diet (as shown in Figure 2.9, top).

The chemical selectivity of deuterium magnetic resonance (DMR) allows detection of site specific ^2H enrichment in liver fats after exposure to 1% D_2O added to the drinking water for four days. DNL is accurately determined by the enrichment achieved at the methyl position of the fatty acids (labeled a). This methyl peak can only be labeled if the entire fatty acid was synthesized from the



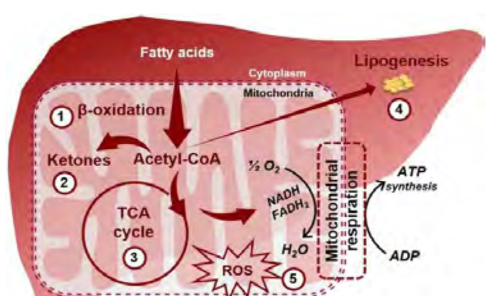


Figure 2.9: (top) DMR spectra of extracted hepatic fatty acids shows that treatment with a ketogenic (HF-Kt) diet slows DNL (peak a) when compared to low fat (LF) and high fat (HF) diets. (bottom) Overall hepatic metabolism is significantly altered by the diet. Despite the beneficial effects on DNL, the HF-Kt diet causes increased reactive oxygen species (ROS) production in the liver.

most basic starting element, acetyl-CoA. This data shows addition of a ketogenic diet in the context of high fats significantly slows the DNL process.

Using MR estimates of DNL, as well as mass spectrometry-based estimates of TCA cycle turnover (bottom panel), we can directly assay the changes in central hepatic metabolism. While the HF-Kt diet slows DNL, it also has complicated multi-factorial effects on hepatic energy homeostasis. Future work will develop DMR for in vivo use.

Facility Plans and Directions

In spite of the COVID pandemic and continued challenging budgetary climate, our users have consistently and successfully pursued federal funding to support their research programs in addition to assisting the AMRIS facility in writing proposals to upgrade instrumentation. The successful partnership of the MagLab user program with individual investigator research grants also provides constant scientific motivation for our technology development. In 2020 we were awarded an NIH grant to upgrade the NMR console on one of our 600 MHz systems; the console will be installed in spring 2021 to enhance our multireceive capabilities. We also began construction of Low-E MAS probes at 800MHz to enhance our high field capabilities. Through our NIH P41 technology development grant we are constructing a next-generation HTS cryoprobe that we anticipate will be available to users by the end of 2021.

Outreach to Generate New Proposals-Progress on STEM and Building User Community

As a result of the COVID pandemic, most of the typical AMRIS outreach venues for 2020 were inaccessible due to restricted access for anyone immediately outside the bubble of essential staff. These restrictions were in place in Gainesville starting March 13 through year end. Online outreach was possible for locations where employees were approved to return to their worksites starting in June, provided individuals could comply with all masking and distancing requirements. Although our outreach numbers were reduced by 2/3 of their normal values due to the COVID pandemic, we were still able to reach more than 875 individuals at 13 locations throughout the year. If there is a positive impact we can take away from this pandemic, it made us realize just how well virtual platforms can help us to expand our outreach and user programs beyond those individuals in our immediate travel area.

Prior to the shutdown period, our AMRIS Research and Outreach Coordinator, Amy Howe, visited 23 classrooms at five schools within a 60-mile radius of Gainesville, reaching 379 students with in-classroom, hands-on education about magnets and the scientific method. All these local schools were classified as Title 1 schools for 2020, so our events were able to reach a diverse population of students. Other Alachua County Schools' events, such as the carnivals, science career nights, and STEM/STEAM family events, were cancelled following the COVID shutdown. Therefore, we did not have our normal opportunities to converse with greater numbers of K-12 students and family members.

Tours of the AMRIS Facility were also extremely limited, since news of the potential pandemic began to spread as early as mid-January 2020. Prior to the official policies restricting visitor access, we were able to accommodate four local high school students for a tour with AMRIS-affiliate Glenn Walter, offered as part of the Florida Regional Junior Science, Engineering, and Humanities Symposium (JSEHS). We also had 21 undergraduate biochemistry students in three groups tour the facility in early February, as organized through Director Joanna Long and our staff members Huadong Zeng and James Collins. Unfortunately, their school semester was pushed online less than one month later, so these students were not able to return for in-person use of our magnet systems; these facility access restrictions remained in effect throughout the remainder of calendar year 2020. Some of these students may have been approved for on-site research projects, but they were not tracked as part of our outreach activities.

Also in February, we hosted an exhibit booth at the Biophysical Society annual conference event in San Diego, CA, where Amy Howe was able to speak with approximately 200 undergraduate, graduates, and professional members, specifically those interested in high magnetic fields and magnetic resonance research. Back in Gainesville, staff scientists James Collins and Jim Rocca, along with facility engineer Malathy Elumalai, hosted an exhibit booth at the UF College of Medicine Research Poster Showcase, where they spoke with approximately 50 undergraduates who were there to present their research projects; the attendance at this event was less than half of that for previous years, likely due to the increasing concerns regarding COVID spread within the state of Florida.

Because of COVID, we were unable to hold the Women in Science and Engineering (WiSE) Girls Spring Break Camp, which would otherwise have been a week long day-camp that brings middle school girls from the surrounding Alachua County to the University of Florida to learn about a variety of different science careers through hands-on activities. AMRIS typically hosts these girls for one day during that week but was unable to do so when all in-person activities on campus were cancelled starting in March.

We also cancelled our very popular, in-person RF Coil Building Workshop at the AMRIS Facility. Normally, five participants travel here for a 5-day activity course to learn the physics behind MRI, RF coil theory, and how to build MRI RF coils. We developed video modules that will be used to hold this workshop as an online tutorial session in 2021; these videos will continue to be updated and used as preparatory modules for future workshop participants, assuming that this will return to an in person event as soon as visitor policies allow us to do so. Our summer 2020 REU program was similarly cancelled.

As we adapted to the pandemic, we pursued virtual outreach methods and videoconferencing. A 5-minute video tour was posted onto our facility website to reach visitors who could not travel to the facility. AMRIS and HBT collaborated to hold a "Quantum Spin Coherence Workshop" just prior to the MagLab 2020 Users Committee Meeting, during which we debuted our facility tour video and taught a group of 160 graduate students, postdocs, and professionals about quantum spin techniques. Throughout the summer and fall, staff hosted several short, informal tutorial and training sessions for new users introducing them to NMR and covering biomolecular NMR techniques and practices. These sessions ranged from 2-4 hours and enabled students to work in real time on operating the instruments and collecting data. School outreach activities in Fall 2020 resumed via virtual workshops. Amy Howe delivered classroom material kits for her magnet demos that could be sterilized between uses. She worked with the schools to offer interactive outreach to an additional 67 students in 4 classrooms through Zoom sessions. This method of contact is likely to continue beyond 2020, as an outreach option for students in physically remote or health-sensitive situations that would otherwise restrict visitor access.

Facility Operations Schedule

The AMRIS facility normally operates year-round, except during the last week of December when the University of Florida is shut down. Vertical instruments for *ex vivo* samples are scheduled 24/7, including holidays and weekends. Horizontal instruments operate primarily 8-12hrs/day, 5days/week due to the difficulty in running animal or human studies overnight. Due to the COVID pandemic, the University was closed from March 23 through June 1 to everyone except essential personnel for mandatory maintenance procedures. Beginning in late May, COVID testing was made available for faculty, students, and staff applying to return to work on campus. A slow ramp up of on campus operations proceeded throughout the fall. Due to AMRIS staff being classified as essential personnel and their ability to operate instruments remotely, NMR operations were able to continue at ~80-90% of our normal levels. All experiments involving animal or human subjects were on hold from March until July. Operations the remainder of the year were at ~50% of our normal levels. No external user travel to our facility was allowed the remainder of the year.

2. DC Field Facility

The DC Field Facility in Tallahassee serves a large and diverse user community by providing continuously variable magnetic fields in a range and quality unmatched anywhere in the world. The DC Field user community is made up of undergraduate students, graduate students, post docs and senior investigators from around the United States, and the world. State-of-the-art instrumentation is developed and coupled to these magnets through the efforts of our expert scientific and technical staff. The users of the DC Field Facility are supported throughout their visit by the scientific, technical and administrative staff to ensure that their visit is as productive as possible. The interaction between the MagLab scientific and technical staff with the students, post docs and senior investigators who come to the DC Field Facility to perform their research results in a continuous mix of scientific ideas and advanced techniques that are passed both to and from users.

Unique Aspects of Instrumentation Capabilities

Table 2.5: DC Field Magnets

FLORIDA-BITTER and HYBRID MAGNETS		
Field, Bore, (Homogeneity)	Power (MW)	Supported Research
45T, 32mm, (25ppm/mm) 41.5T, 32mm, (25ppm/mm) 36T, 40mm, (1ppm/mm)[2] 35T, 32mm (x2) 31T, 32mm to 50mm[1] (x2) 25T, 32mm bore (with optical access ports)[3]	30.4 32 14 19.2 18.4 27	Magneto-optics – ultra-violet through far infrared; Magnetization; Specific heat; Transport – DC to microwaves; Magnetostriction; High Pressure; Temperatures from 3mK to 1500K; Dependence of optical and transport properties on field, orientation, etc.; Materials processing; Wire, cable, and coil testing. NMR, EMR, and sub/millimeter wave spectroscopy.
SUPERCONDUCTING MAGNETS		
Field (T), Bore (mm)	Sample Temperature	Supported Research
32T, 34mm 18/20T, 52mm 18/20T, 52mm 17.5T, 47mm 10T, 34mm[3] 9T, 25mm[4] 7T, 7mm[4]	14mK – 300K 20mK – 1K 0.3K – 300K 4K – 300K 0.3K – 300K 2.0K – 325K 2.0K – 325K	Magneto-optics – ultra-violet through far infrared, Magnetization, Specific heat, Transport – DC to microwaves, Magnetostriction; High pressure, Temperatures from 20mK to 300K, Dependence of optical and transport properties on field, orientation, etc. Low to medium resolution NMR, EMR, and sub/millimeter wave spectroscopy.

[1] A coil for modulating the magnetic field and a coil for superimposing a gradient on the center portion of the main field are wound on 32mm bore tubes.

[2] Higher homogeneity magnet for magnetic resonance measurements.
[3] Optical ports at field center with 4 ports each 11.4° vertical x 45° horizontal taken off of a 5mm sample space.
[4] Quantum Design PPMS and MPMS user "on-ramp" magnet systems.

Table 2.5 lists the magnets in the DC Field Facility. The MagLab leads the world in available continuous magnetic field strength, number of high field DC magnets available to users and accessibility for scientific research. The 45T hybrid magnet is the highest field DC magnet in the world, which is reflected in the number of proposals from PIs located internationally. The 41.5T resistive magnet is the highest field resistive magnet in the world. The 36T Series Connected hybrid magnet features two configurations: a 40mm bore, with 1ppm homogeneity for chem/bio NMR experiments and a 48mm bore with 20ppm homogeneity for condensed matter physics experiments in a top-loading cryogenic system. The 35T, 32mm bore and 31T, 50mm bore resistive magnets are coupled to top loading cryogenic systems that have impressive performance, flexibility and ease of use. The 25T Split-Helix magnet is the highest field direct optical access / scattering magnet in the world. With 4 optical ports located at field center each having a 11.4° vertical x 45° horizontal taken off of a 5mm opening, the ability to perform ultrafast, time resolved and x-ray scattering experiments are now a reality at high magnetic fields. The 32T, 34mm bore all-superconducting magnet saw its first use by an external user in 2020 for condensed matter NMR experiments on a quantum spin-nematic compound.

Facility Developments and Enhancements

Progress on Power Supply Upgrade Project

In spite of the COVID laboratory shutdown MagLab electrical engineers and scientific staff were able to make significant progress on the power supply upgrade project during the several months when remote work was the only option. When the lab was able to bring a limited number of staff back the design and drawings for the prototype MOSFET bank test rig were submitted to the machine shop and assembly of the completed parts began in late fall. This prototype test bank, shown in Figure 2.10, allows our engineers and scientists to test a single bank of MOSFET modules with granular detail. This is done to validate calculations and simulations of power output, response to control signals, thermal transfer and heat sink performance, frequency response and noise levels.

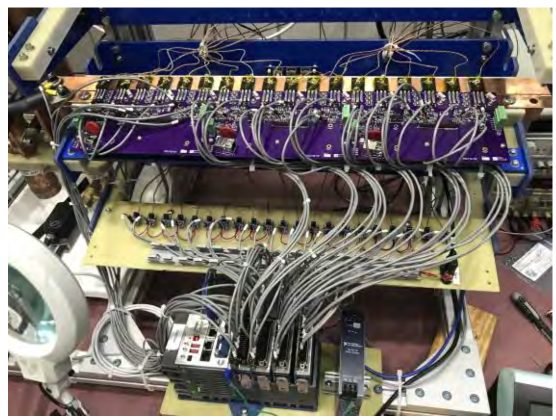


Figure 2.10: MOSFET bank testing setup.

Communications Carts

The COVID pandemic forced the DC Field Facility to make a number of changes to how we operate. One of the biggest changes is enabling users to run their high field experiments while remaining at their home institutions. Prior to the pandemic, research groups would travel to the MagLab for experiments as this is the optimum way to ensure measurements proceed as expected and address issues with sample preparation as they arise. Additionally, the students and postdocs gain valuable experience in experimental techniques during their time at the MagLab. In order to continue a partial level of user operations, during COVID travel restrictions, Alexey Suslov put together a combination of equipment and software that would give users audio and video access to a magnet cell during the experiment with the hands-on work performed by MagLab scientists and technicians. These carts, Figure 2.11, consist of a computer + monitor, two high-definition cameras with pan, tilt and zoom functionality and a low power Bluetooth headset that allows the MagLab staff handsfree communication as they are working with the users during magnet time. The prototype cart very quickly became an indispensable part of experimental setups, and two additional carts were built and placed into service. We anticipate the communication carts to remain useful in the future as they can be used by PIs and members of the research group that do not travel to the MagLab for experiments.

Figure 2.11: Remote participation communication cart.

32T Superconducting Magnet (SCM-32T) sees its first user experiment.
The 32T all-superconducting magnet was used for condensed matter NMR experiments on the potential quantum spin-nematic compound β-$TeVO_4$. This material was chosen since an initial set of data had previously been collected in the 36T series connected hybrid (SCH) which allowed the users to fill in gaps in the data taken in the SCH and MagLab scientists were able to compare the performance of the 32T magnet to the SCH. The 32T all-superconducting magnet performed well and the data taken, Figure 2.12, matched with and was complementary to the prior work done in the SCH. Due to travel restrictions resulting from the COVID pandemic, the experiment was performed by MagLab scientists Arneil Reyes and Liz Green with remote participation from National Institute of Chemical Physics and Biophysics, Estonia by the user, Raivo Stern.

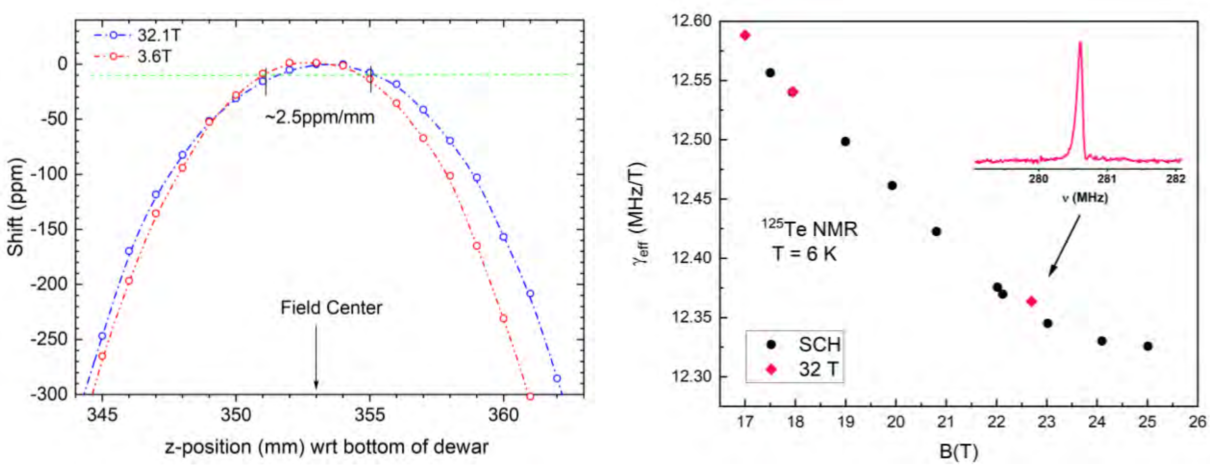


Figure 2.12: (Left) Magnet field profile in the z-axis at 32.1T and 3.6T by use of 63Cu NMR. (Right) 125Te spectral line and effective gamma with respect to magnetic field. Black circles are from the 36T Series Connected Hybrid while the pink diamonds are from the 32T.

Major Research Activities and Discoveries/ Research Highlights

The scientific directions taken by the users of the DC Field Facility touched on several topics in condensed matter physics, materials science, chemistry and biology in 2020.
Non-magnetic aromatic molecules which form molecular solenoids in high fields were studied in the 25T Split-Helix magnet. Through the use of ultrafast spectroscopy users from Princeton University

discovered that aggregates of aromatic chromophores can act as molecular solenoids, **Figure 2.13**, that enhance or quench observed magnetic field effects. Currents of several nanoamperes were shown to be induced in the aromatic light. This research opens a window into a new realm of potential materials that could be utilized for multifunctional magnetic technologies. This work was published in the *Proceedings of the National Academies of Science.*

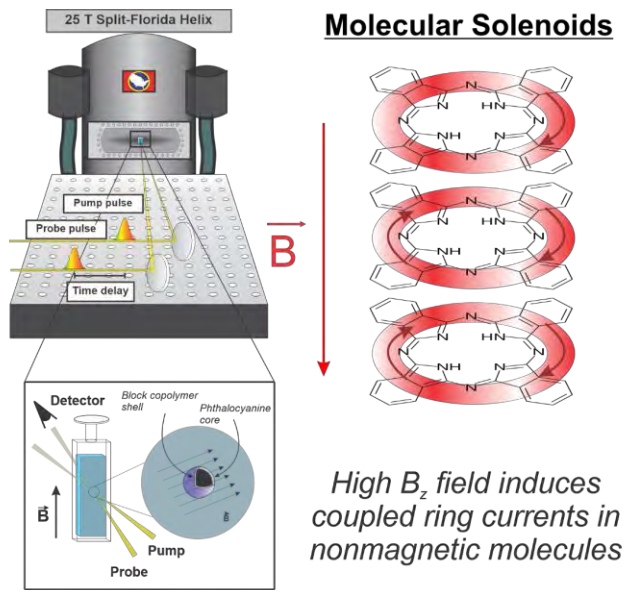
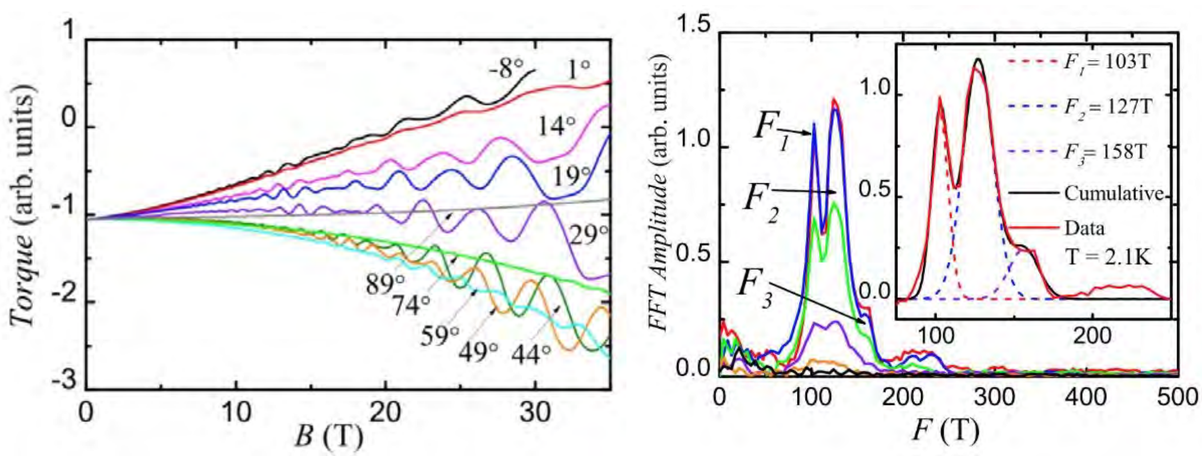


Figure 2.13: Schematic of experimental setup and induced currents in molecular rings.

The exploration of a topological semimetal in high magnetic fields by determining the electron-electron interactions in $SrZnSb_2$ was accomplished through the mapping of the Fermi surface in high magnetic fields. The work by users from the University of California utilized one of the DC Field Facility's 35T resistive magnets coupled with an advanced cryogenic system and piezo cantilever to measure the magnetization of the material via torque. Results from some of the measurements are shown in **Figure 2.14**. Two of the four observed orbits were found to be topologically non-trivial with the most likely explanation being that the charge carriers in these



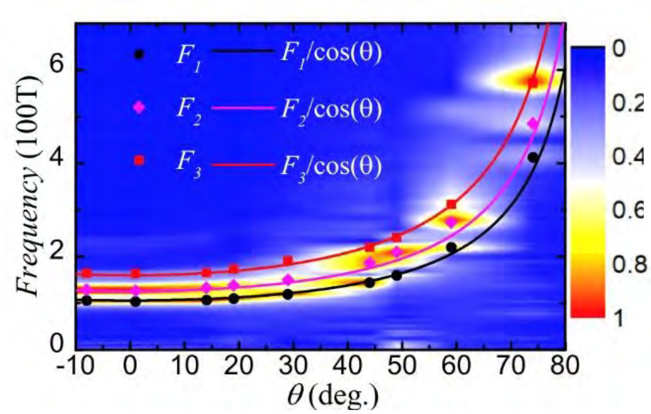


Figure 2.14: a) Raw quantum oscillation data as a function of angle. b) Fast Fourier transform of raw data at fixed angle showing the temperature dependence of the electron orbits. c) Frequency dependence of the electron orbits as a function of angle.

two orbits are Dirac quasiparticles. Topological semimetals and other topological materials comprise an exciting new area of research in condensed matter physics because they host a variety of quantum mechanical states which are observable on a macroscopic scale and are stable to high temperatures. Thus, topological materials raise the possibility of exploiting quantum mechanics to make devices with new functionalities that work at room temperature. The results of this work were published in *Physical Review B.*

Facility Plans and Directions

The bank of six secondary chilled water pumps will be replaced during the 2021 annual maintenance shutdown. These pumps circulate the 40F water produced by the chillers through the magnet cooling water heat exchangers. The current pumps have reached the end of their service lifetimes and we will need to be able to supply additional water flow through the magnet cooling water heat exchangers once a second 34MW water-cooled magnet is added. Eight new pumps will be installed and will feature soft-start capability which brings the pump speed up slowly, extending the life of the pump and improving temperature stability of the magnet cooling water loops as the pumps turn on and off depending on the heat load.

Power supply upgrade project. Following successful testing of the 1 and 3-bar MOSFET banks, MagLab Engineers and Scientists will assemble and test a ¼-power version of a full-size active filter in cell 13. This will allow full-feature testing of all the active filter subsystems as well as the Model 42 power supply controller. The completion of these tests will mark an important milestone in the project as it will fully validate the system design and mark the beginning of the construction phase.

Outreach to Generate New Proposals-Progress on STEM and Building User Community

Both the DC Field Facility and its users were greatly impacted by the COVID pandemic in 2020. In addition to the shutdown of the MagLab facilities, nearly all of our users' laboratories at their home institutions were shut down for some period of time during 2020. This greatly hindered their ability to take advantage of available magnet time when the DC Field Facility was able to resume operations. This impacted both our current user base and our ability to reach out to potential new users as travel was not possible. Normally we host a booth at the annual APS March Meeting, but due to the unfolding COVID pandemic the March Meeting in Denver was cancelled as were a significant number of other conferences that MagLab staff would normally travel to.

Appendix 2, Table 10, shows the DC Field Facility attracted *20 new PIs in 2020.* Of that number 13 were new to the MagLab. This is in addition to the 41 new PIs reported last year (2019) and 51 reported in 2018.

The annual DC Field Facility MagLab User Summer School had to be cancelled due to the lockdown order that was in effect in the early summer and the travel ban which followed. In 2021 we will hold a remote version featuring the lectures and discussions between attendees and staff. We plan to resume hands-on practical exercises and in-person events in 2022.

Facility Operations Schedule

At the heart of the DC Field Facility are the four 14MW, low noise, DC power supplies. Each 20MW or 28MW resistive magnet requires two power supplies to run, the 45T hybrid and the 41.5T resistive magnets each require three power supplies, and the 36T Series Connected Hybrid requires one power supply. Thus, the DC Field Facility operates in the following manner: in a given week there can be four resistive magnets + five superconducting magnets operating or the 45T hybrid/41.5T resistive, series connected hybrid, two resistive magnets and five superconducting magnets. The water-cooled DC resistive and hybrid magnets operated for 28 weeks in 2020 with a 5-week shutdown for infrastructure maintenance and upgrades from November 16 to December 20 and a 1-week shutdown period for the university mandated holiday break from December 21, 2020 to

January 4, 2021. The five superconducting magnets operated for 43 weeks out of the year with staggered maintenance periods as required. The daily operation schedule for the resistive and hybrid magnets is as follows: 7 hours/day on Monday and 21 hours/day Tuesday-Friday. The superconducting magnets operate 24 hours/day 7 days/week.

The effects of the COVID pandemic resulted in a shutdown of the superconducting and water-cooled magnets from April 6 until June 1 when limited superconducting magnet operations were restarted with a limited personnel presence. The week of July 20 limited water-cooled magnet operations were started, and full superconducting and 50% water-cooled magnet operations were commenced on July 27. This coincided with our ability to populate the facility with 50% of our normal workforce.

3. EMR Facility

Electron Magnetic Resonance (EMR) covers a variety of magnetic resonance techniques associated with the electron. The most widely employed is Electron Paramagnetic/Spin Resonance (EPR/ESR), which can be performed on anything that contains unpaired electron spins. EPR/ESR has thus proven to be an indispensable tool in a large range of applications in physics, materials science, chemistry, and biology, including studies of impurity states, molecular clusters, molecular magnets; antiferromagnetic/ferromagnetic compounds in bulk, as well as thin films and nanoparticles; natural or induced radicals, optically excited paramagnetic states, electron spin-based quantum information devices; transition-metal based catalysts; and for structural and dynamical studies of metalloproteins, spin-labeled proteins, and other complex bio-molecules and their synthetic models.

Unique Aspects of Instrumentation Capabilities

The EMR facility at the MagLab offers users several home-built, high-field, and multi-high-frequency instruments covering the continuous frequency range from 9GHz to ~1THz. Several transmission probes are available for continuous-wave (CW) measurements, which are compatible with a range of magnets at the Lab, including the highest field 45T hybrid. Some of the probes can be configured with resonant cavities, providing enhanced sensitivity as well as options for *in-situ* rotation of single-crystal samples in the magnetic field, and the simultaneous application of pressure (up to ~3GPa). Quasi-optical (QO) reflection spectrometers are also available in combination with high-resolution 12 and 17T superconducting magnet systems; a simple QO spectrometer has also been developed for use in the resistive and hybrid magnets (up to 45T). EMR staff members can assist users in the DC field facility using broadband tunable homodyne and heterodyne spectrometers as well. Moreover, frequency coverage up to ~180THz (6,000cm^{-1}) is now possible through collaboration with staff in the DC field facility using broadband Fourier transform infrared spectrometers to acquire EPR spectra in the frequency domain – so-called far-infrared magneto-spectroscopy (FIRMS).

In addition to CW capabilities, the MagLab EMR group boasts the highest frequency pulsed EPR spectrometer in the world, operating at 120, 240, 336GHz, and now 316 and 395GHz with < 100ns time resolution. A quasi-optical 94GHz spectrometer (HiPER) with 1ns time resolution was recently upgraded for high power (1kW) operation. A commercial Bruker Elexsys 680 operating at 9/94GHz (X-/W-band) is also available upon request. This unique combination of CW and pulsed instruments may be used for a large range of applications in addition to EPR, including the study of optical conductivity, electron cyclotron resonance and Dynamic Nuclear Polarization.

Finally, the EMR group collaborates with the NMR program in developing instrumentation for high-field DNP-enhanced NMR studies of solids and solution samples at fields up to 14.1T. The centerpiece of this installation is a quasi-optical EPR spectrometer based on a 395GHz high-power CW gyrotron source.

Facility Developments and Enhancements

The pandemic inevitably curtailed efforts directed towards facility enhancements during 2020. One of the main casualties was the planned development and testing of a 970GHz / 36T EPR setup for use in the Series Connected Hybrid (SCH) resonance magnet. These efforts have been set back by about a year, with further delays anticipated due to the backlog of magnet time requests to the DC facility in 2021. As of May 2021, development of the new capability has been completed, and we hope to test the system towards the end of 2021 or early in 2022.

One project that was not significantly affected by the pandemic was the integration of an arbitrary waveform generator (AWG) capability and upgrade of the user interface on HiPER. Software development for the user interface was contracted out to Femi Instruments, LLC, a company specializing in the development of standardized user interfaces for EPR spectrometers, and the work was performed in collaboration with two postdocs in the EMR group, Jonathan (Jon) Marbey and Krishnendu (Krish) Kundu. Apart from about six weeks in March and April, Krish and Jon were able to work unimpeded on HiPER through much of 2020, practicing social distancing by alternating tasks, which included running user experiments in parallel with development and testing. The main goal of this upgrade involves replacing the original pulse generating front-end of the spectrometer with a completely separate and independent multiplier chain fed by a Keysight 12 bit, 12GSa/s AWG. As of May 2021, the integration and software development has been completed and is now ready for user operations.

The new AWG capability on HiPER enables generation of arbitrary shaped high-power waveforms, including chirped pulses spanning a 1GHz (94.0±0.5GHz) bandwidth, enabling wideband excitation and implementation of state-of-the-art pulse schemes, e.g., chirp echo Fourier transform EPR, akin to what is possible in NMR. Initial demonstrations of these new capabilities were presented at the International Magnetic Resonance Conference on Methods and Applications (ICONS-Discussions, 2021), February 10-12, 2021.

The hiring of postdoc Marcus Giansiracusa, as planned in the Facility Plans section of our 2019 report, was unfortunately delayed and ultimately canceled due to COVID; His travel from the UK and eventual appointment proved impossible. Fortunately, Jonathan Marbey completed his graduate studies in April 2020, and he was immediately appointed as an EMR postdoc. In this capacity, he was able to fulfill many of the duties that would have been assigned to Marcus. This also provided employment to Dr. Marbey at a time when securing a postdoc elsewhere would have been impossible (see further details below). Jon recently moved on to a new postdoctoral position at the Laboratory for Physical Sciences at the University of Maryland.

Major Research Activities and Discoveries

43 peer-reviewed journal articles were reported by our users during the past year, up from 29 the previous year, which was impacted by disruption in operations due to construction in the EMR lab during 2018 and 2019. As usual, the quality of publications in 2020 was exceptionally high, including articles in the following journals: Science (1); Nature Chemistry (1); J. Am. Chem. Soc. (3); Angew. Chem. (1); Chem. Sci. (1); Phys. Rev. Lett. (2); J. Phys. Chem. Lett. (1); Chem. Comm. (1); Inorg. Chem. (10); Dalton Trans. (1); Physical Review (3); J. Phys. Chem. C (1); and Inorganic Chemistry Frontiers (2). Projects in the facility spanned a range of disciplines, from applied materials research to studies of proteins.

The EMR Program has also continued to support efforts associated with several major center-type research initiatives and international collaborations involving multiple universities. These include: the DOE funded Energy Frontier Research Center for Molecular Magnetic Quantum Materials (M^2QM) based at the University of Florida (PI and Director – Hai-Ping Cheng; Associate Director – Stephen Hill), with co-PIs at the University of Central Florida, Florida State University, UTEP, Caltech and Los Alamos National Laboratory; an AFOSR funded Multidisciplinary University Research Initiative focusing on Terahertz Electronics Based on Antiferromagnets, headquartered at the University of Central Florida (PI – Enrique del Barco), with co-PIs at New York University, Oakland University, The Ohio State University, UC Riverside and UC Santa Cruz; and an AFOSR funded international network focusing on Molecular Quantum Technologies involving Florida State university, the University of Modena and Reggio Emilia in Italy, and Osaka City University in Japan. In particular, M^2QM supports an EMR postdoc, Daphne Lubert-Perquel, and two graduate students working in the EMR group.

The EMR Director also successfully applied to the NSF during 2020 for funding to support a trilateral international collaboration involving FSU, University College Dublin in Ireland (Professor Grace Morgan), and Queens University Belfast in Northern Ireland (Professor Steven Bell). This three-year project, entitled Molecular Magnetoelectric Materials, will support joint research activities and exchanges of personnel.

We have selected three 2020 scientific achievements to highlight in the next section of this report. The highlighted work, published in Angewandte Chemie, Science and the Journal of the American Chemical Society, involved a truly international mix of users from Bordeaux (France), Sun Yat-Sen University (China), the Technical University of Denmark, the University of Basque Country (Spain), IIS Bangalore (India), UC Berkeley, the University of Central Florida, UC Santa Cruz, UC Riverside, the Norwegian University of Science and Technology, Northeastern University (China), Max Planck Institute for Coal Research and the Bulgarian Academy of Sciences.

Research Highlights

High-Field EPR Studies of Anisotropic Molecular Magnetic Building Blocks: The fundamental coordination chemistry of 4d and 5d transition metal ions remains much less explored and underdeveloped in comparison to the lighter 3d congeners. However, recent results showing the promise of heavier transition metal ions in advanced inorganic and molecule-based materials has sparked interest in engineering their physical properties, notably their magnetic anisotropy.

This study reports the first transition metal complexes featuring mixed fluorido-cyanido ligands, ***trans***-$[M^{IV}F_4(CN)_2]^{2-}$ (M = Re, Os), which were isolated thanks to a novel synthetic approach relying on silicon-mediated fluoride abstraction (see Figure 2.15 – top). A strong and significant enhancement of the magnetic anisotropy for the Re^{IV} complex, as compared to the parent $[ReF_6]^{2-}$ anion, is demonstrated by combined analysis of high-field electron paramagnetic resonance (HF-EPR) spectroscopy (see lower part of Figure 2.15) and magnetization measurements.

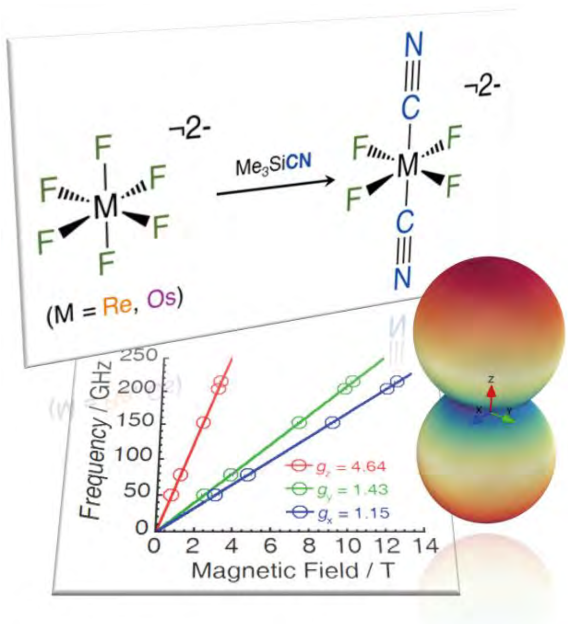


Figure 2.15. (top) Schematic illustrating the novel silicon-mediated fluoride abstraction method, resulting in *trans*-$[M^{IV}F_4(CN)_2]^{2-}$. (lower left) Frequency vs. field plot of HF-EPR peak positions from which the anisotropic Landé *g*-tensor (lower-right) can be deduced for the M = Re^{IV} spin $S = {}^3/_2$ compound.

This ligand field engineering methodology paves the way toward the realization of new transition metal complexes and building-blocks featuring extremely strong magnetic anisotropy for the design of high-performance molecule-based magnetic materials.

This work research was led by researchers at the University of Bordeaux in France, in collaboration with scientists at Sun Yat-Sen University (China), the Technical University of Denmark, the University of Basque Country (Spain), IIS Bangalore (India), UC Berkeley.

Citation: J.-L. Liu, K.S. Pedersen, S.M. Greer, A. Mondal, S. Hill, F. Wilhelm, A. Rogalev, A. Tressaud, E. Durand, J.R. Long, R. Clérac, ***Access to Heteroleptic Fluorido-Cyanido Complexes with a Large Magnetic Anisotropy via Fluoride Abstraction***, Angew. Chem. 59, 10306 – 10310 (2020); DOI: 10.1002/anie.201914934

High-Field Spin-Charge Interconversion at sub-Terahertz Frequencies: Injection of spin currents into a ferromagnetic material can induce spin dynamics that can be employed to control its magnetic state, allowing spintronics operations at gigahertz frequencies. The reciprocal effect, spin pumping, converts magnetization dynamics into spin currents in an adjacent material. Both effects have been used interchangeably to advance the field of spintronics.

In this study, the dynamical generation of spin currents using an antiferromagnetic material has been demonstrated for the first time, enabling spin pumping at sub-terahertz frequencies – more than two orders of magnitude faster than ferromagnetic spintronics devices. The unique spectrometers available in the EMR facility at the MagLab were essential for this work since the typical spin dynamics of antiferromagnets lie in the terahertz range (see **Figure 2.16**), while magnetic tuning of these dynamics within antiferromagnetic ordered phases requires high magnetic fields.

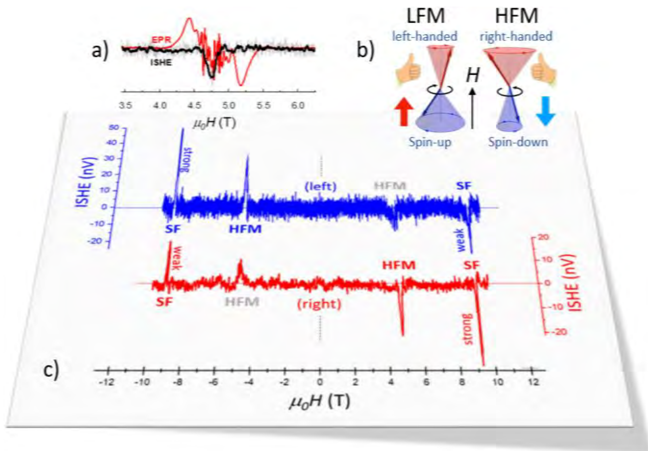


Figure 2.16 (a) Spectroscopic (EPR) and electrical (Inverse spin Hall effect - ISHE) signals measured in a thin-film heterostructure composed of an antiferromagnet (MnF_2) and a heavy metal (Pt) using right-handed circularly polarized electromagnetic waves at a frequency of 0.4THz. **(b)** Illustration of the two main chiral modes of the uniaxial antiferromagnet MnF_2. **(c)** Side-by-side comparison of the electrical signals observed for different circular polarization handiness (right and left) of the electromagnetic waves. The high-frequency (HFM) right-handed antiferromagnetic mode can be selectively induced by changing the handedness of the circularly polarized electromagnetic waves or the polarity of the applied magnetic field.

The demonstration of coherent sub-terahertz spin pumping using antiferromagnets opens the door to devices operating at frequencies that are two to three orders of magnitude higher than current spintronics technologies, with broader impacts in a diverse range of applications, from magnetic recording to medicine and communications.

This work was led by researchers at the University of Central Florida, in collaboration with scientists at UC Santa Cruz, UC Riverside, the Norwegian University of Science and Technology, Northeastern University (China).

Citation: P. Vaidya, S. A. Morley, J. van Tol, Y. Liu, R. Cheng, A. Brataas, D. Lederman, and E. del Barco, *Subterahertz spin pumping from an insulating antiferromagnet*, Science 368, 160 – 165 (2020).

Strong Magnetic Coupling in Ni_4 Clusters through Direct Metal-Metal Bonds: Magnetic molecules that retain their magnetization below a characteristic blocking temperature (T_B) – so-called single-molecule magnets (SMMs) – are of great interest for future information storage technologies. Prior attempts at coupling multiple anisotropic magnetic ions have involved weak superexchange interactions mediated via non-magnetic bridging atoms. This study demonstrates direct metal-metal orbital overlap in a series of M_4 (M = Ni, Cu) clusters, resulting in itinerant electron magnetism similar to metallic ferromagnets.

High-field electron paramagnetic resonance (HFEPR) measurements were performed on neutral and cationic forms of $[Ni_4(NP^tBu_3)_4]^{0/+}$ (^tBu = *tert*-butyl, see **Figure 2.17** below) in order to accurately ascertain the spin ground states and interaction parameters associated with these new SMMs. High-fields and frequencies were essential due to very large spectral splittings resulting from strong magnetic anisotropy.

The combination of HFEPR and magnetic data with correlated electronic structure calculations provides fundamental insights into the electronic itinerancy and strong ferromagnetic coupling in molecules featuring direct metal-metal orbital overlap. As such, these investigations suggest new strategies for designing SMMs with strongly coupled giant spin ground states and enhanced blocking temperatures.

This work was led by researchers at the University of California, Berkeley, in collaboration with scientists at Max Planck Institute for Coal Research and the Bulgarian Academy of Sciences.

Citation: K. Chakarawet, M. Atanasov, J. Marbey, P. C. Bunting, F. Neese, S. Hill, J. R. Long, Strong Electronic and Magnetic Coupling in M_4 (M = Ni, Cu) Clusters via Direct Orbital Interactions Between Low-Coordinate Metal Centers, J. Am. Chem. Soc. 142, 19161 – 19169 (2020); DOI: 10.1021/jacs.0c08460

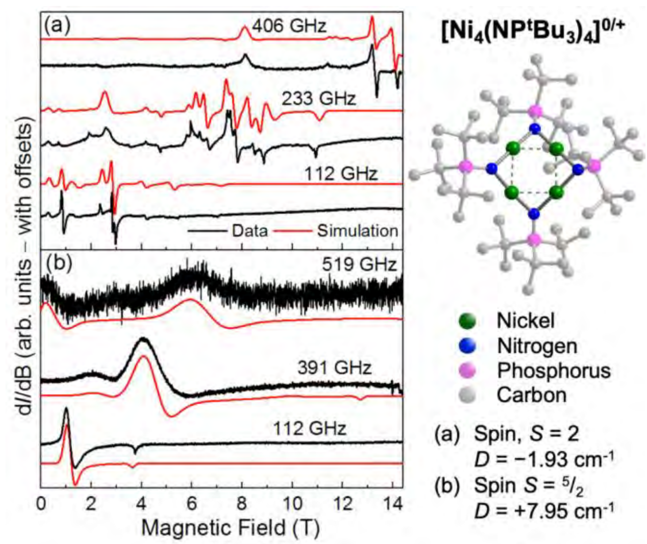


Figure 2.17: (Left) Multi-frequency, derivative-mode (d*I*/dB, where *I* is transmitted intensity) HFEPR spectra for powder samples of (a) neutral and (b) cationic $[Ni_4(NP^tBu_3)_4]^{0/+}$; spectral simulations are included with the experimental data. (Right) Molecular structure along with the deduced spin states and axial zero-field splitting parameters, *D*, a measure of the associated magnetic anisotropy.

Facility Plans and Directions

Our 2021 plans involve two new hires. The first will permanently fill the Visiting Research Faculty position currently occupied by Thierry Dubroca. This position will support ongoing collaborative efforts between the EMR and NMR groups in support of a high-field Dynamic Nuclear Polarization user program. The position will be advertised during the summer, with a start date in the early fall. In addition, a postdoctoral position supported on an external grant will also be filled in July 2021, by Dr. Elvin Salerno. Dr. Salerno completed his PhD as an NSF Fellow at the University of Michigan with Prof. Vincent Pecoraro. He also recently completed an International Chateaubriand Fellowship at Universite Paris-Saclay with MagLab user Talal Mallah.

As noted above, ongoing efforts aimed at commissioning an EPR capability in the 36T high-resolution SCH magnet will continue in 2021. This effort is being spearheaded by EMR Engineer, Bianca Trociewitz, together with Research Faculty Jurek Krzystek and Thierry Dubroca. Our current plan involves commencing user operations in the SCH during 2022.

Outreach to Generate New Proposals-Progress on STEM and Building User Community

In spite of the pandemic, operations continued during 2020, with users sending samples so that measurements could be performed by EMR Staff Scientists. Although recruiting efforts were hampered due to limitations on travel, significant efforts were made to let users know that the MagLab EMR program remained open for business. As can be seen from the Facility Operations Schedule below, spectrometer usage remained strong. Moreover, it was still possible to recruit several new users during the year. The total number of proposals that received magnet time during 2020 was 45 (down from 62 in 2019), of which 8 PIs were first time users, meaning that >20% of our users were new to the program. Meanwhile, the EMR program assisted 121 individual researchers in 2020 (down from 161 in 2019), of which 19 were first time users. Of course, no users visited the facility after March 2020. Prior to this, a PhD student from the University of Copenhagen spent a month at the facility as part of a formal exchange program. This visit was sadly cut short when travel restrictions were put into place.

Members of the EMR group continue to make aggressive efforts to advertise the facility at regional, national, and international workshops and conferences, as well as via seminars at universities around the globe. Most of these activities during 2020 were held virtually, and the EMR

Director gave five virtual presentations in 2020 highlighting the MagLab, with several more in 2021. These presentations gave particular emphasis on the fact that users could send samples.

Members of the EMR group also served on the organizing committees for the following events: the pre-pandemic Conference on Magnetism in North America (MAGNA) held at St. Simons Island, Feb. 21 – 24, 2020; the 2020 International Conference on Molecule-based Magnets (ICMM), organized by the University of Manchester, UK, which will now be held virtually in June 2021; the 2020 Pacifichem conference in Honolulu, Hawaii, which has been delayed until December 2021; and the 2020/2021 Rocky Mountain Conferences on Magnetic Resonance, which were eventually cancelled.

Finally, the EMR Director has been very active in assisting current and potential future users in the development of research proposals to US (and overseas) funding agencies, for continued support of activities requiring use of the MagLab EMR facilities. These efforts have been particularly intensive during the past year due to the strong emphasis on quantum sciences, an area of intense activity for many EMR users. Some of these activities have the potential to support MagLab EMR personnel and can also be expected to bring many new users to the facility.

Facility Operations Schedule

As noted elsewhere in this report, operations in the EMR program were obviously impacted due to the pandemic during 2020. However, overall activity was maintained at roughly 75% compared to recent years through users sending their samples for measurement by MagLab EMR staff and students. In order to handle the increased volume and frequency of sample shipments, several new cryogenic shipping dewars were purchased in order to handle the increasing number of sensitive samples under study by EMR users. This enabled multiple users to ship samples during a given timeframe, for parallel study on different instruments within the facility.

Overall, the EMR user facility was down for about 10 weeks from March to May, with activities ramping up during the summer, reaching close to 100% normal operation in the fall. The workhorse 17T homodyne spectrometer operated for a total of 170 days during 2020, an increase compared to 2019 (135 days) due to the construction that took place in the EMR lab that year. However, it is down from ~300 days in a normal year, i.e., ~60% of normal operation. Meanwhile, the 12.5T heterodyne spectrometer logged 124 days of usage, down from an average of ~180 days in recent years, i.e., usage was about 66% of normal operations.

A total of 238 days was logged on the high-power pulsed 94GHz EPR spectrometer, HiPER, essentially unchanged from 236 days in 2019 and slightly down from the 258 days reported in 2018. This instrument is in a different location from the lab that was impacted by construction in 2020 and operated at close to 100%. It should be noted that 81 days were devoted to testing, maintenance and methods development. However, this is quite typical of a normal year due to the significant methods development associated with this unique, cutting-edge spectrometer. Indeed, significant in-house methods development was included in the plan when integrating HiPER into user operations, as much of the cost of the instrument was covered by funding separate from the MagLab core. Therefore, HiPER essentially operated at normal (100%) capacity during 2020.

The commercial Bruker E680 spectrometer logged 170 days during 2020, down from 234 days in 2019, i.e., 73% of normal usage. While much of the reduction was due to reduced operations at the height of the pandemic, this ageing instrument also suffered a component failure that took time to repair due to the impacts of the pandemic on the vendor. The instrument is shared between the FSU Biology Department and the EMR user program. Only 30% of the machine time was originally designated for the MagLab user program. However, just 53 days were allocated to local users, maintenance and methods development in 2020. Consequently, almost half of a full year (including weekends and holidays) was made available to external users, significantly exceeding the original 30% allocation.

Finally, we note that the Mössbauer instrument was taken out of service in 2018 and is no longer available to users (see 2018 annual report). As a whole, the four instruments offered by the EMR User Program were significantly oversubscribed by ~36% in 2020, i.e., 960 days were requested and only 704 total days allocated.

4. High B/T Facility

Unique Aspects of Instrumentation Capabilities

The High B/T Facility, located on the University of Florida campus, offers users a safe, diverse, and inclusive atmosphere for performing research in high magnetic fields (up to 16.5T) and at ultralow temperatures (down to 0.5mK) with an ultraquiet electromagnetic interference (EMI) environment. The Microkelvin Laboratory, the historic core of the High B/T Facility, is a separate, specially designed and built building with Tempest-quality shielded rooms to specifically afford access to the extremes of ultralow temperatures and high magnetic fields. Two demagnetization cryostats, one employing a PrN_5 + Cu stage while the other uses a pure Cu stage, provide the main access to the unique environments. A third bay, scheduled to open in 2022, is being modernized to provide access to these extremes of parameter space to provide users with a nimble environment required for the study of modern quantum materials and devices.

Facility Developments and Enhancements

During 2020, and despite the pandemic and its protocols, the High B/T Facility expanded to encompass three separate laboratories, increasing the lab space from 5700ft^2 to almost 9000ft^2. The High Bay Convergence Laboratory (HBCL) is a new MagLab asset, provided in 2020 by UF to the MagLab's High B/T and AMRIS Facilities (Figure 2.18). The HBCL features ground floor space for siting up to four high-field magnet stations and a 2000ft^2 mezzanine to support student training and instrumentation development. In 2020, the HBCL was being configured to operate two wide-bore NMR-quality superconducting magnets, an 18.8T, 89mm (800MHz ^{1}H) magnet, purchased by UF and arriving on site in March 2021 and an existing 9.4T, 89mm (400MHz ^{1}H) magnet, which was moved to this space in 2020 and was expected to be operating in 2021.

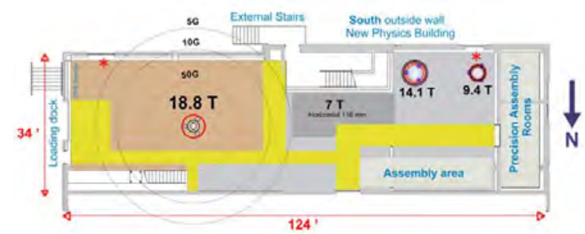


Figure 2.18: MagLab High Bay Convergence Lab (HBCL) at UF. Located in the Physics Building (NPB), the locations for four superconducting magnets are shown, and the 9.4T instrument is in place while the 18.8 T magnet is being assembled. The yellow stripes indicate space to be kept clear for delivery, movement, and safety. At the left end of the lab is the high bay region (~28ft x 50ft with a 22ft high ceiling) that is equipped with a 10-ton crane. The rest of the space has a 14ft high ceiling and a mezzanine above to support work benches for student training and instrumentation development.

Located in the Physics Building (NPB), the locations for four superconducting magnets are shown, and the 9.4T instrument is in place while the 18.8T magnet is being assembled. The yellow stripes indicate space to be kept clear for delivery, movement, and safety. At the left end of the lab is the high bay region (~28ft x 50ft with a 22ft high ceiling) that is equipped with a 10-ton crane. The rest of the space has a 14ft high ceiling and a mezzanine above to support work benches for student training and instrumentation development.

In March 2020, a Fast-Turnaround Facility, which was located in Williamson Hall adjacent to the Microkelvin Laboratory, was operating down to 50mK and providing magnetic fields up to 10T. This instrument was available for sample and signal verification tests to confirm the appropriate dynamic range required for the experiment. Due to the pandemic and scheduling constraints, this instrument was closed and is being relocated to the main Physics Building, near the HBCL (Figure 2.19), and revitalized to provide temperatures to below 20mK while in magnetic fields of 10 or 16T, depending on the arrangements still being configured.

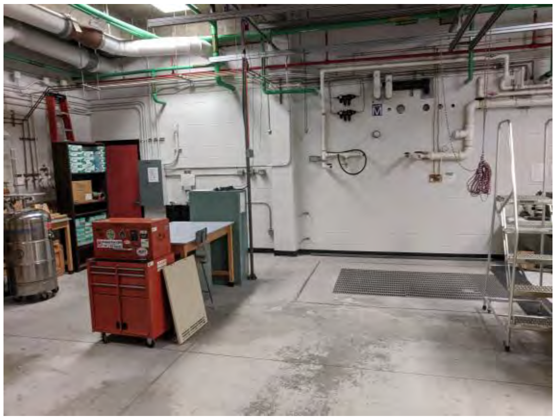


Figure 2.19: An August 2020 view of the future location of the Fast-Turnaround Facility in NPB B135. A 10ft deep, 3ft wide floor pit is visible.

Major Research Activities and Discoveries

Incipient formation of Wigner Crystal in Strongly Interacting Two-dimensional Holes (Richard L.J. Qiu, Chieh-Wen Liu, Xuan P.A. Gao, Case Western Reserve University; Loren N. Pfeiffer and Ken W. West, Princeton University; and Andrew J. Woods, Alessandro Serafin, and Jian-Sheng Xia, MagLab HBT and UF Physics)

In two-dimensional electron systems, the ground state is expected to be an ordered electronic crystal (or Wigner crystal) when the Coulomb repulsion energy is strong enough. Identifying the two-dimensional quantum Wigner crystal and understanding how this unique quantum state transitions to the electron liquid phase have been a long-standing challenge in condensed matter physics. Low density two-dimensional holes in high mobility GaAs quantum wells were used to increase the Coulomb to Fermi energy ratio to 20-30, approaching the theoretical limit of the Wigner Crystal. The sample was measured in the MagLab High B/T facility on a specially designed rotator stage for measurements in a tilted magnetic field at ultra-low temperatures to separately control the perpendicular and parallel magnetic fields to investigate the spin and orbital effects on the interaction driven Wigner crystallization (Figure 2.20). The two-dimensional Wigner Crystal was observed as a reentrant insulating phase (RIP) from magneto-resistance data. The Wigner Crystal transforms gradually through an intermediate state where it mixes with liquid, and spin polarization is found to enhance the Wigner Crystal formation. This research suggests that two-dimensional Wigner Crystal to liquid transition is not a direct first order transition and suggests that intermediate mixture phase formation may be a general aspect of strongly interacting low dimensional systems, providing insights to other quantum phase transitions in many-body electronic systems.

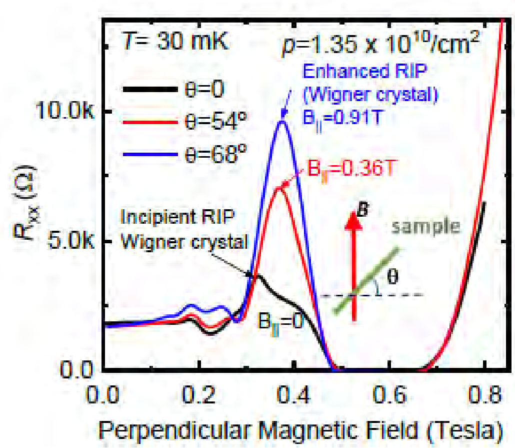


Figure 2.20: For two-dimensional holes not yet crystallized into a Wigner Crystal, a small peak due to the incipient reentrant insulating phase (RIP) is observed in the magneto-resistance data. A parallel magnetic field enhances the RIP and pushes the system towards WC by polarizing the spin.

Quantum Fluids in one-dimension: NMR Studies (Huan Chao, Johnny Adams, and Neil Sullivan, MagLab HBT and UF Physics; Donald Candela, University of Massachusetts, Amherst) A novel ultra-low temperature NMR experiment has been conducted to observe Luttinger liquid physics in a one-dimensional system consisting of ^{3}He atoms confined to tubular nanostructured MCM-41. The tubes had characteristic lateral dimensions of 24 Å and were coated with a monolayer of ^{4}He to further restrict the behavior to one-dimension. The experiment focused on low linear densities near $n = 0.1$ (Å)$^{-1}$ corresponding to a Fermi temperature $T_F \approx 0.1$K.

This quantum regime is known as a "Bose gas" for which unique Luttinger dynamics are predicted with NMR spin lattice relaxation rates varying linearly with temperature. No other simple gas-like system has this property at very low temperatures. The low densities pose a challenge to attain the sensitivity needed at low temperatures and the ultra-quiet environment of the High B/T Facility was critical for this experiment. A unique double-resonance NMR probe (see Figure 2.21) was developed for the experiment and allowed for the study of the dynamics at more than one Larmor frequency. This probe can also be used to study other nuclei added to the sample such as ^{195}Pt or ^{63}Cu for thermometry.

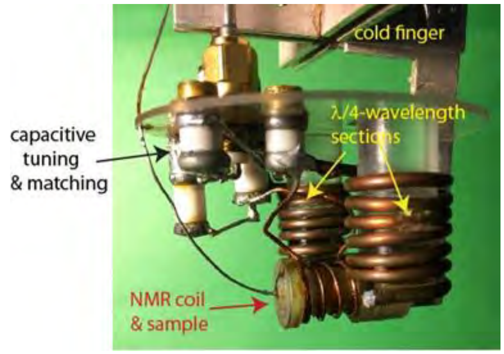


Figure 2.21: Ultra-low temperature double-resonance probe that was operated on Bay 2 for the study of one-dimensional ^3He.

One characteristic feature of the reduced dimensionality observed at low temperatures was a non-exponential NMR relaxation. This behavior is not unexpected for one-dimensional systems for which general arguments [B. Cowan, Nuclear Magnetic Resonance and Relaxation, Cambridge University Press, 1997] show that the transverse correlation functions for simple dipolar magnetic interactions (that vary as r_{ij}^{-3}) lead to relaxation rates of the form $exp[-(t/\tau)^{1/2}]$, where t is time and τ is an associated time constant. It is noteworthy that a simple exponential relaxation is expected only in three-dimensions. The experimental results at low temperatures do reveal a stretched exponential $exp[-(t/\tau)^{\alpha}]$ with the exponent α varying from 0.8 at $2T_F$ to 0.4 at $0.5T_F$ but rising on further cooling to 1.0 at $0.05T_F$. A stretched exponential relaxation was also observed by Matsushita *et al.* [Y. Matsushita *et al.*, J. Low Temp. Phys. 183,251 (2016) and QFS 2019 unpublished] for ^3He at higher temperatures but constrained to FSM-16. The relaxation times reach a maximum at a temperature near $2T_F$ as expected in an ideal one-dimensional system because there are just two Fermi points at k_F (rather than a Fermi line or surface as in higher dimensions).

Facility Plans and Directions

Table 2.6 summarizes the present and future capabilities, which are described later in this section. Proposals for magnet time may be submitted at any time, and contact/discussions with staff is recommended prior to submission. Users work with the staff scientists to mount and tune the experiments on site, and when the experiments begin, most users have the staff perform the instant-to-instant steps while the users are consulting from off-site locations. This arrangement is particularly effective when the experiments span long periods of time due to the nature of these experiments at the extremes of parameter space.

A new Assistant Scientist line was provided by the University of Florida as part of the initiative to open the third bay in the Microkelvin Laboratory. The search for this non-tenure accruing faculty position was authorized in Fall 2019, and the recommendations of the search committee were presented to the faculty in early January 2020. In early February 2020, Rasul Gazizulin, then a member of the CNRS low temperature and high magnetic field team in Grenoble, France, accepted the position. Although his original start date was anticipated in early November 2020, a combination of conditions arising from the pandemic and the evolving Visa polices has delayed his arrival, which is now anticipated in 2021.

Table 2.6: The instrumentation available in the MagLab High B/T Facility tabulated, and their unique combination of temperature, magnetic field, and techniques are highlighted. Specialty shielding and filtering of the equipment provides the ultraquiet electromagnetic interference environment.

Equipment	Features	Supported Research
Bay 3: 16.5T superconducting magnet, 20mm dia. sample space	Temperatures ≤ 1mK, by 8T demag of $PrNi_5$ + Cu stage.	Magnetization, quantum transport, torsional oscillator, viscosity, specific heat, dielectric, MEMS
Bay 2: 8T superconducting magnet, 32mm dia. sample space	Temperatures ≤ 0.5mK, by 8T demag of Copper stage.	NMR, quantum transport, ultrasound, capacity, pressure cell, thermal transport
Bay 1: 8T superconducting magnet, 32mm dia. sample space	Added 2020, Update/Revisions in progress, specs TBA for "nimble" instrument, to open 2022.	Planned: quantum transport with rotation, novel magnetometry, scanning probes
Annex: 10 T superconducting magnet, 25mm dia. sample space	Retired March 2020 – Renovated and revitalized version to NPB 135, near HBCL, for 2021 operation. Temperatures ≤ 20mK in 10T / 16T for fast- turnaround sample/cell transfer to Bays 1-3.	Exploratory, novel technique development, sample/cell verification prior to use on Bays 1-3
High Bay Convergence Lab: 18.8T and 9.4T (89mm, room-temp bores)	Added 2020, providing AMRIS and High B/T teams common space and resources. 9.4T to operate in 2021 and 18.8T to operate in 2022.	Probe development for DNP NMR imaging, new refrigeration with enhanced magneto-caloric effect, materials growth far from equilibrium

Outreach to Generate New Proposals-Progress on STEM and Building User Community

In February 2020, Mark Meisel and Naoto Masuhara led a facility tour for 14 high school students as part of the Florida Regional Junior Science, Engineering, and Humanities Symposium. High B/T Scientist Lucia Steinke was the representative at "Talk Science with Her" as part of the United Nations International Women's Week, an event to celebrate the achievements of women in the sciences. Lucia spoke directly with at least 45 people over the two-hour event.

In March 2020, the pandemic perturbed the typical in-person, outreach activities for the rest of the year. Nevertheless, Lucia Steinke successfully recruited and engaged a second year UF Physics graduate student who is now a member of her research team. Similarly, Mark Meisel engaged two UF Physics undergraduates in data analysis activities via online only interactions, with one student starting in Summer 2020 and the other in the Fall 2020. Both students continued their work through December 2020.

In September 2020, Mark Meisel developed a 5-minute video tour to reach visitors who could not travel to the facility. Joanna Long (AMRIS) and Mark co-hosted an online only "Quantum Spin Coherence Workshop" as part of the MagLab 2020 Users Committee Meeting, during which they debuted their respective facilities' tour videos and facilitated a workshop for 160 graduate students, postdocs, and professionals located within Florida and around the world. Lecturers at this Users Workshop provided instruction on software, hardware and data handling in materials research, with applications of interest to a broad group of MagLab users and collaborators.

Throughout 2020, members of the High B/T Facility used their time to become more actively involved in the inclusion, diversity, and equity discussions about changing the culture in and beyond the workplace. Specifically, Mark Meisel engaged in AIP TEAM-UP Project with the UF

Physics IDEA committee and in the APS IDEA network through the MagLab Diversity Committee. Connectivity to research teams at Howard University were initiated and will continue.

Facility Operations Schedule

On March 23, 2020, the University of Florida closed its campus and limited activities to essential personnel only. All of the High B/T Facility operations were closed at that time, and a reasonable time was allowed for staff to come to campus to safely stop laboratory operations. In late May 2020, a partial return to campus was permitted (Figure 2.22), but sufficient supplies of liquid helium were not available until mid-July 2020, when Bay 2 was restarted immediately. Bay 3 started a month later after an extended revision to remove legacy connections to the low temperature regions, as it was the first full opening of the instrument since Lucia Steinke started in October 2019. As stated previously, the Fast-Turnaround instrument was run up to the shut-done and then it was decided to close it for its relocation and revitalization when it will be reopened in the Physics Building in 2021. Finally, the cancellation of the APS March 2020 Meeting in Denver severely limited our opportunities to engage with new and continuing users. From March to December 2020, no external users were allowed to come to our facility, nor could we host any speakers with potential interest who could give seminars in our department and visit the facilities.

Figure 2.22: July 2021 view of the corridor between the Bay 3 (left) and Bay 2 (right) shielded rooms in the Microkelvin Laboratory. The dilution refrigerator and vacuum plumbing are seen before they pass through an opening to the pumps and containers in the lower floor. As part of the "disinfect/sanitize" protocols, a freshness was restored to the facility.

5. ICR Facility

During 2020, the Fourier Transform Ion Cyclotron Resonance (ICR) Mass Spectrometry program continued instrument and technique development as well as pursuing novel applications of FT-ICR mass spectrometry. These methods are made available to external users through the NSF National High-Field FT-ICR Mass Spectrometry Facility. The facility features eight staff scientists who support instrumentation, software, biological, petrochemical, and environmental applications, as well as a machinist, technician, and several rotating postdocs who are available to collaborate and/or assist with projects.

Figure 2.23: Picture of the 21T FT-ICR mass spectrometer.

Unique Aspects of Instrumentation Capabilities

The Ion Cyclotron Resonance facility provides sample analysis that requires the ultrahigh resolution ($m/\Delta m_{50\%}$ > 1,000,000 or more at *m/z* 500, where $\Delta m_{50\%}$ is the full mass spectral peak width at half-maximum peak height) and parts-per-billion mass accuracy only achievable by FT-ICR MS coupled to high magnetic fields. The facility's four FT-ICR mass spectrometers feature high magnetic fields (as high as 21T) and are compatible with multiple ionization and fragmentation techniques (Table 2.7).

Table 2.7: ICR systems at the Magnet Lab in Tallahassee

Field (T), Bore (mm)	Homogeneity	Ionization Techniques
21, 123	< 1ppm	ESI, APPI, MALDI
14.5, 104	1ppm	ESI, APPI, MALDI
9.4, 220	1ppm	ESI, APPI

Facility Developments and Enhancements

In 2015, the ICR facility commissioned the first 21T Fourier transform ion cyclotron resonance mass spectrometer. The 21T magnet is the highest field superconducting magnet ever used for FT-ICR and features high spatial homogeneity, high temporal stability, and negligible liquid helium consumption (Figure 2.23) (*J. Am. Soc. Mass Spectrom.*, 26, 1626-1632 (2015)).

Mass resolving power of 150,000 (m/Δm50%) is achieved for bovine serum albumin (66kDa) for a 0.38 second detection period (see Figure 2.24), and greater than 2,000,000 resolving power is achieved for a 12 second detection period. Externally calibrated broadband mass measurement accuracy is typically less than 150ppb rms, with resolving power greater than 300,000 at m/z 400 for a 0.76 second detection period and 2,400,000 at m/z 400 for a 6.1 second detection period. Combined analysis of electron transfer and collisional dissociation spectra results in 68% sequence coverage for carbonic anhydrase. The instrument is part of the NSF High-Field FT-ICR User Facility and is available free of charge to qualified users, with optimized experimental conditions for complex mixture analysis, including ultrahigh resolution ion isolation via SWIFT (*Anal. Chem.*, 92, 3213-3219 (2020), MALDI imaging (*Anal. Chem.* 92, 3133-3142 (2020), and complex mixture analysis (*Anal. Chem.*, 90, 2041-2047 (2018). The instrument includes a commercial dual linear quadrupole trap front end that features high sensitivity, precise control of trapped ion number, and collisional and electron transfer dissociation. A third linear quadrupole trap offers high ion capacity and ejection efficiency, and rf quadrupole ion injection optics deliver ions to a novel dynamically harmonized ICR cell.

FT-ICR mass spectrometry has become the method of choice for detailed chemical characterization of natural complex mixtures. The high mass-resolving power, mass accuracy, and dynamic range of FT-ICR enable resolution and confident elemental formula assignment for tens of thousands of unique components in complex organic mixtures.

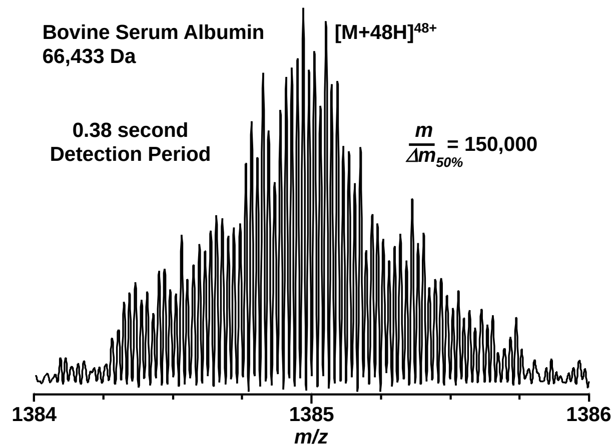


Figure 2.24: Single-scan electrospray FT-ICR mass spectrum of the isolated 48+ charge state of bovine serum albumin following a 12s detection period. Mass resolving power is approximately 2,000,000, and the signal-to-noise ratio of the most abundant peak is greater than 500:1.

An actively-shielded 14.5T, 104mm bore system offers high mass measurement accuracy (<300 parts-per-billion rms error), scan rate, and mass resolving power. The spectrometer features electrospray, atmospheric pressure photoionization (APPI), atmospheric pressure chemical ionization sources (APCI); linear quadrupole trap for external ion storage, mass selection, and collisional dissociation (CAD); and automatic gain control (AGC) for accurate and precise control of charge delivered to the ICR cell. The combination of AGC and high magnetic field make sub-ppm mass accuracy routine without the need for an internal calibrant. Mass resolving power > 200,000 at m/z 400 is achieved at one scan per second.

The 9.4T, passively-shielded, 220mm bore system offers a unique combination of mass resolving power ($m/\Delta m$ = 8,000,000 at mass 9,000 Da) and dynamic range (>10,000:1), as well as high mass range, mass accuracy, dual-electrospray source for accurate internal mass calibration, efficient tandem mass spectrometry (as high as MS^8), and long ion storage period (*J. Am. Soc. Mass Spectrom.*, 31, 1783-1802 (2020); *Anal. Chem.*, 92, 12193-12200(2020). to the instrument is ideal for direct infusion analysis of compositionally complex organic mixtures such as dissolved organic matter (*Proc. Natl. Acad. Sci. USA*, 115, 549-554 (2018); *Glob. Chang. Biol.*, 26, 1374-1389 (2020); *Water Res.*, 169, 115201 (2020); *Env. Sci. Technol.*, 54, 16249-16259 (2020); *Geochim. Cosmochim. Acta.*, 273, 163-176 (2020; *Pure Appl. Chem.* 92, 1447-1467 (2020), biofuels (*Ind. Crop. Prods.*, 150, 112311 (2020); *Sustain. Energy Fuels*, 4, 2404-2410 (2020); *Energy Fuels*, 34, 16181-16186 (2020), emerging contaminants (*Nat. Rev. Earth Environ.*, 1, 237-250 (2020); *Env. Sci. Technol.*, 54, 8830-8836 (2020); *Env. Sci. Technol.*, 54, 9374-9386 (2020); and petroleum fractions (*Energy Fuels*, 34, 3013-3030 (2020); (*Energy Fuels*, 34, 8308-8315 (2020), because those mixtures are replete with mass “splits” that are readily separated and identified by FT-ICR MS *(Energy Fuels*, 34, 13903-13915 (2020)). The magnet is passively shielded to allow proper function of all equipment and safety for users. The system features external mass selection prior to ion injection for further increase in dynamic range and rapid (~100ms time scale) MS/MS (*Anal. Chem.*, 75, 3256-3262 (2003)), with ultrahigh resolution ion isolation via stored waveform inverse Fourier transform (SWIFT) followed by

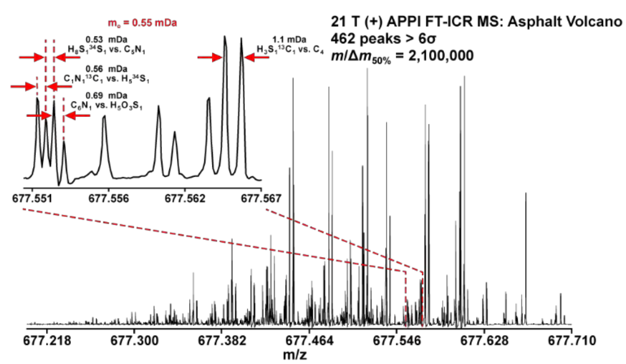


Figure 2.25: Mass scale expanded segment of 21T (+) APPI FT-ICR mass spectrum of an asphalt volcano sample after ion trap isolation. Inset illustrates the need for ultrahigh mass-resolving power to resolve ions with a mass difference on the order of the mass of an electron (m_e = 0.55mDa).

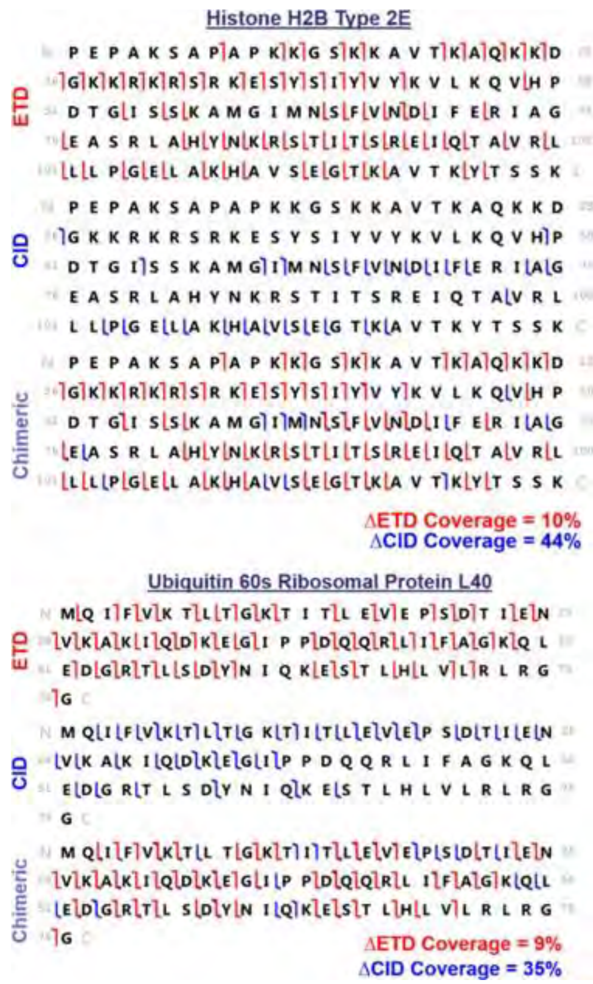


Figure 2.26: Sequence coverage maps for both histone H2B type 2-E (Q16778) and ubiquitin 60s ribosomal protein L40 (P62987) constructed from data acquired using either ETD, CID, or chimeric modes. These sequence coverage maps illustrate the complementarity of CID vs ETD and reveal that this complementarity is preserved during chimeric ion loading. Improvements in sequence coverage using chimeric ion loading over either ETD or CID are reported.

infrared multiphoton (IRMPD) dissociation (*Energy Fuels*, 34, 3013-3030 (2020)).

Major Research Activities and Discoveries/Research Highlights

Complex mixture analysis - The high mass-resolving power, mass accuracy, and dynamic range of FT-ICR enable resolution and confident elemental formula assignment for tens of thousands of unique components in complex organic mixtures. Here, we present complex mixture characterization on the newly developed MagLab 21T FT-ICR mass spectrometer. Combined with absorption-mode data processing, mass resolving power increases as much as a factor of 2 higher than conventional magnitude-mode display, an improvement otherwise requiring a more expensive increase in magnetic field strength. The mass spectrum shown in Figure 2.25 represents the most peaks resolved and identified in a single spectrum of any kind, and represents the highest broadband resolving power for any petroleum mass spectrum, and emphasizes the need for ultrahigh resolving power achievable only by 21T FT-ICR MS sufficient to separate isobaric overlaps prevalent in complex seep samples (Figure 2.25, *Anal. Chem.*, 90, 2041-2047 (2018)).

Biological applications of FT-ICR MS include top-down (*Proteomics*, 19, 1800361 (2019)) proteomic analyses of rare proteoforms involved in cancer (*Clin. Chem. Lab. Med.*, 59, 653-661 (2020)), sequence determination of monoclonal antibodies (*J. Am. Soc. Mass Spectrom.*, 31, 1783-1802 (2020)), construction of proteoform families by accurate intact mass (*J. Proteome Res.*, 20, 317-325 (2020)), development of novel ion manipulation strategies for top-down MS (*Anal. Chem.*, 92, 12193-12200 (2020)), and rapid and accurate diagnosis of hemoglobinopathies from 1µL of blood (*Clinical Chem.*, 65, 986-994 (2019)). High quality data from intact proteins provides a truly molecular-level understanding of phenotype, but requires ultrahigh mass resolving power, mass accuracy, sensitivity, and spectral acquisition rate. The 21T Fourier transform ion cyclotron resonance (FT-ICR) mass spectrometer provides all these capabilities. In 2020, the ICR facility utilized 21T FT-ICR to analyze product ions derived from the application of multiple dissociation techniques and/or multiple precursor ions within a single transient acquisition. This ion loading technique, which we call, "chimeric ion loading", saves valuable acquisition time, decreases sample consumption, and improves top-down protein sequence coverage (Figure 2.26). In an analysis of breast cancer cell lysate, we performed collision-induced dissociation (CID) and electron-transfer dissociation (ETD) on each precursor on timescale compatible with chromatography, and improved mean sequence coverage dramatically (CID-only 15% vs chimeric 33%). This approach can also be utilized to multiplex the acquisition of product ion spectra of multiple charge states from a single protein precursor or multiple ETD/proton-transfer reactions (PTR) reaction periods. The analytical utility of chimeric ion loading is demonstrated for top-down proteomics, but it is also likely to be impactful for tandem mass spectrometry applications in other areas (*Anal. Chem.*, 92, 12193-12200 (2020).

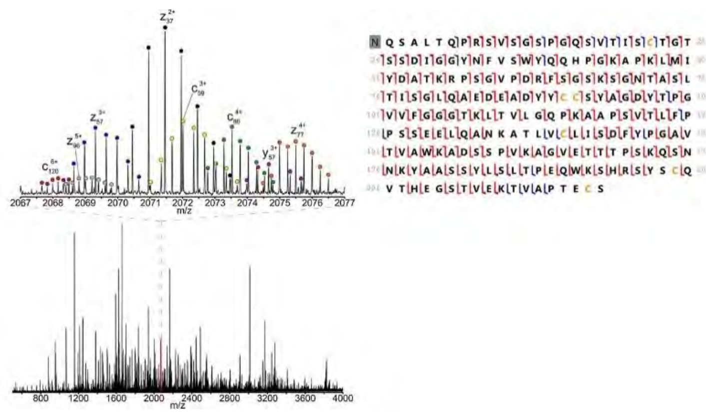


Figure 2.27: (Left) Example of an MD MS application to mAb analysis: sequencing of a light chain of recombinant human mAb with a 21T ESI FT-ICR MS employing ETD/PTR MS/MS (group 8). The inset shows an expanded view of a tandem mass spectrum with isotopic envelopes of product ions assigned and color coded for facile visualization. (Right) Total sequence coverage of 85% achieved for the analysis of the disulfide bond-reduced light chain of recombinant human mAb with a 21T ESI FT-ICR MS (group 8), based on middle-down MS/MS (combination of results from two tandem mass spectra). Included are product ions identified from CID/PTR MS/MS (10 transients averaged, b/y-ions, cleavage sites shown in blue) and of ETD/PTR MS/MS (10 transients averaged, c/z-ions, cleavage sites shown in red).

The Consortium for Top-Down Proteomics (www.topdownproteomics.org) launched a study to assess the current state of top-down mass spectrometry (TD MS) and middle-down mass spectrometry (MD MS) for characterizing monoclonal antibody (mAb) primary structures, including their modifications. To meet the needs of the rapidly growing therapeutic antibody market, it is important to develop analytical strategies to characterize the heterogeneity of a therapeutic product's primary structure accurately and reproducibly. The major objective of the study was to determine whether current TD/MD MS technologies and protocols can add value to the more commonly employed bottom-up (BU) approaches with regard to confirming protein integrity, sequencing variable domains, avoiding artifacts, and revealing modifications and their locations. The total sequence coverage obtained for the ETD/PTR MS/MS data collected off the 21T FT-ICR MS system in the ICR facility depicted in Figure 2.27 was the highest achieved from a single experiment in the study. (*J. Am. Soc. Mass Spectrom.*, 31, 1783-1802 (2020).

The, 9.4T and 14.5T instruments are primed for immediate impact in environmental and petrochemical analysis, where previously intractably complex mixtures are common. The field of "petroleomics" has been developed largely due to the unique ability of high-field FT-ICR mass spectrometry to resolve and identify all of the components in complex environmental and petrochemical samples (*Waste Manage.*, 106, 88-98 (2020), *Environ. Sci. Technol.*, 54, 9968-9979 (2020); *Energy Fuels*, 34, 4721-4726 (2020), *Environ. Sci. Technol.*, 54, 2500-2509 (2020); *J. Geophys. Res-Biogeo.*, 125, e2020JG005804 (2020), *Energy Fuels*, 34, 12449-12456 (2020).

Stored waveform inverse Fourier transform (SWIFT) is a versatile method to generate complex isolation/ejection waveforms for precursor isolation prior to tandem mass spectrometry experiments. In 2020, the ICR facility reports ultrahigh resolving power ion isolation by SWIFT on a 21T Fourier transform ion cyclotron resonance (FTICR) mass spectrometer.

Individual histone proteoforms are isolated (0.6m/z isolation window) with near 100% efficiency using a 52ms SWIFT isolation, followed by incell fragmentation by ultraviolet photodissociation (UVPD). Ion isolation resolving power of 175 000 ($m/\Delta m$) is demonstrated by isolation of individual peaks at a spacing of 0.0034 Da at m/z 597 from a complex mixture of Canadian bitumen. An

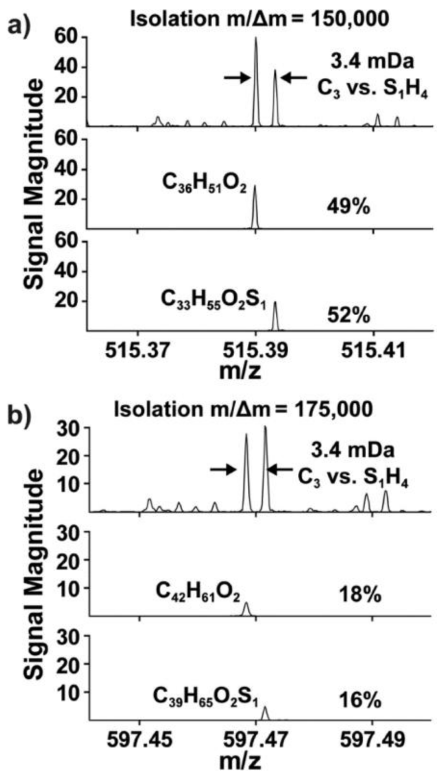


Figure 2.28: Ultrahigh ion isolation resolving power of ions that differ in mass by 3.4mDa from (-) ESI of Athabasca Canadian bitumen. (A) 16MB SWIFT was used to isolate two ions that require an isolation resolving power of 150,000 at m/z 515, with ~50% isolation efficiency. (B) 32MB SWIFT was used to isolate two ions that require an isolation resolving power of 175,000 at m/z 597, with ~17% isolation efficiency.

individual m/z ion, which corresponds to a single elemental composition, from a complex mixture is isolated and fragmented by infrared multiphoton dissociation (IRMPD). (Figure 2.28, *Anal. Chem.*, 92, 3213-3219 (2020).

Dissolved Organic Matter (DOM) consists of soluble organic materials derived from the partial decomposition of organic materials (*Water. Res.*, 169, 115201 (2020); *Front. Earth Sci.*, 8 (2020); *Chemosphere*, 243, 125399(2020); *Geochim. Cosmochem. Acta*,, 273, 163-176 (2020); *Environ. Sci. Technol.* 54, 16249-16259 (2020); *Global Biogeochem. Cy.*, 34, e2019GB006495 (2020); *Environ. Res.* 181, 108915 (2020); *Limnol. Oceanogr.*, 65, 1764-1780 (2020); *Global Biogeochem. Cy.*, 26, 1374-1389 (2020); *Front. Microbiol.*, 11, (2020); *Mar. Environ. Res.*, 162, 105130 (2020); *J. Geophys. Res.-Biogeosci.*, 125, e2020JG005804 (2020). Specifically, streams transport large amounts of terrestrially derived carbon to the ocean, especially during large rainstorms. We collected water samples daily over a 6-day storm from small drainage areas of varying landcover to see how the concentration and type of carbon changed over the course of a storm. Our results show that the amount and type of carbon in the stream changed dramatically during the storm and originated from different areas of the landscape. The flow of water through the soil also changed during the storm and was related to the type and amount of carbon entering the stream. Storm events not only impact carbon entering the stream but also may impact its transfer to coastal marine ecosystems. Climate in the study region is projected to become warmer and wetter in the coming decades. These shifts in climate could lead to more carbon export during storms, especially during winter because of more precipitation falling as rain rather than snow. Ultrahigh resolution mass spectrometry showed that stream water DOM exported from the upland forest contained the greatest molecular diversity of the three landscape types and had the largest changes in composition over the storm suggesting that the wetland-dominated subcatchments were less compositionally diverse with regard to soil DOM pools active during the storm. A PCA of C concentration and DOM composition showed differences in water entering the stream from different landscape types and at different time points during the storm. Furthermore, the upland forest stream had the greatest percent relative abundance of CHON, CHOS, and CHONS containing molecular formulae, HUPs formulae, and $HCO3^-$, while Fish Creek fell between the wetland sites and upland forest along Axis 1. (*J.* Geophys. Res. Biogeosci., 125, e2020JG005804 (2020)).

Of the estimated 5 million barrels of crude oil released into the Gulf of Mexico from the 2010 Deepwater Horizon oil spill, a fraction washed ashore onto sandy beaches from Louisiana to the Florida panhandle. In 2020, several studies investigated the quantity of DOC and quality of DOM compounds that are produced when thin oil films were subjected to sunlight over time as well as their potential toxicity. There is a general paucity of laboratory studies surrounding the characterization, transformation, and toxicity of DOMHC produced from the photodissolution of petroleum. Identifying the optical and molecular composition of DOMHC and how it changes over time can lead to important inferences about how it influences bioavailability, dissolution, and toxicity in the environment. (*Nat. Rev. Earth Environ.*,1, 237-250 (2020); *Earth Planet. Sci. Lett.*, 545, (2020); *Env. Sci. Technol.*, 54, 8830-8836 (2020); *Env. Sci. Technol.*, 54, 9968-9979 (2020); *Environ. Sci. Process Impacts*, 22, 2313-2321 (2020).

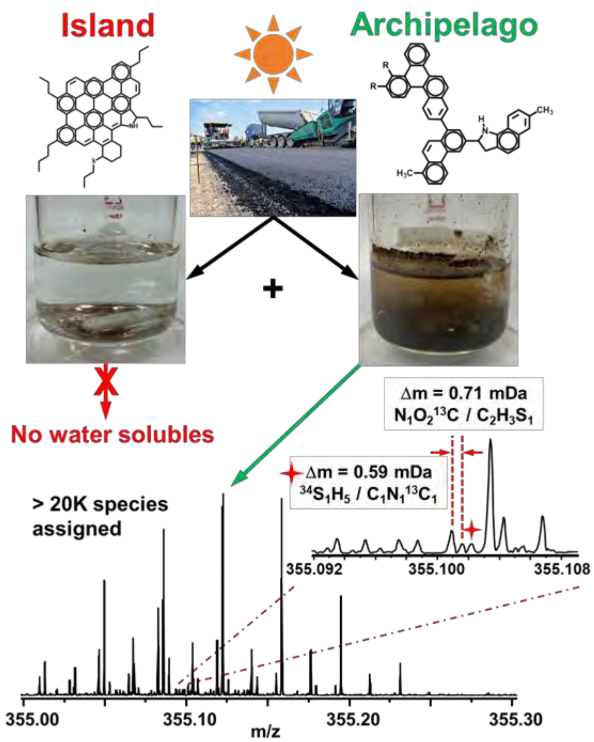


Figure 2.29: A recent MagLab study revealed the potential of asphalt cement (used in road paving) to generate water soluble species after photoirradiation (Energy Fuels¸ 34, 14493-14504 (2020) An internally developed extrography separation method (Energy Fuels¸ 34, 3013-3030 (2020); Energy Fuels¸ 32, 314-328 (2018)) allows for the isolation of structurally defined fractions (island, single- (top, left) and archipelago, multi-core (top, right)) from asphaltenes, which comprises up to 20wt% asphalt cement (top, center). The separation and subsequent photoirradiation enables the determination of the potential of each structural motif to generate water soluble contaminants. Photoirradiation of each asphaltene structural motifs reveals that single aromatic core molecules (island) do not generate appreciable amounts of DOC, whereas the multi-core (archipelago) molecules generate large amounts of DOC (tea-stained water, right). Subsequent FT-ICR mass spectral analysis of the water characterizes the tens-of-thousands water soluble species generated by the photoirradiation of the archipelago asphaltenes. Analysis of the starting materials (top right) and photoproducts (bottom) is possible only by FT-ICR MS.

Dissolved Organic Carbon (DOC) contributions from the built environment. Asphaltenes are high-boiling and recalcitrant compounds that are generally minor components of crude oil (~0.1–15.0wt %) but dominate the composition of heavily weathered spilled petroleum. These solid residues exhibit a high structural complexity, comprised of polycyclic aromatic hydrocarbons (PAHs) that are a mixture of single-core (island) and multicore (archipelago) structural motifs. The mass fraction of each motif is sample-dependent. Thus, knowledge of a potential structural dependence (single- versus multicore) on the production of water-soluble species from asphaltene samples is key to understanding the contribution of photochemically generated dissolved organic matter from oil spills. In this work, asphaltene samples with enriched mass fractions of either island (single-core) or archipelago (multicore) structural motifs are photo-oxidized on artificial seawater with a solar simulator. Molecular characterization of oil- and water-soluble photoproducts, conducted by Fourier transform ion cyclotron resonance mass spectrometry, reveals that island motifs exhibit very limited production of water-soluble species, and their oil-soluble products reflect the molecular composition of the starting material. Conversely, archipelago motifs yield a water-soluble compositional continuum of O_x, S_xO_y, and N_xO_y containing hydrocarbons species that exhibit the typical molecular fingerprint of DOM. The lower carbon number and aromaticity of the archipelago-derived asphaltene photoproducts suggest the occurrence of photofragmentation (or photolysis) reactions. To investigate the possibility of the opposite reaction (photopolymerization), the photo-oxidation of small PAHs isolated from a low-boiling petroleum distillation cut was also performed. It yielded water-soluble compounds with carbon number and aromaticity up to 2-fold higher than the starting material, strongly suggesting that polymerization (addition reactions) occurs. Collectively, the results indicate that the presence of archipelago motifs and the occurrence of cracking/polymerization reactions are central in the production of dissolved organic matter from fossil fuels (Figure 2.29) *(Energy Fuels¸ 34, 3013-3030 (2020); Energy Fuels¸ 34, 14493-14504 (2020)*.

Facility Plans and Directions

The ICR facility will continue to improve mass spectrometer performance and expand user access to the world's first 21T FT-ICR mass spectrometer. Current development projects include triple frequency detection in a dynamically harmonized cell for three-fold improvement in mass resolving power or measurement speed, proton transfer reactions and parallel ion parking for increased sensitivity and lower detection limit for large proteins and their fragments, and interface of the MagLab ICR systems with a newer commercial front-end.

Outreach to Generate New Proposals-Progress on STEM and Building User Community

The ICR program had 14 new principal investigators in 2020. The ICR program also enhanced its undergraduate research and outreach program for one undergraduate scientist from Florida A&M University, who was able to participate in research virtually due to COVID restrictions. The ICR program in 2020 supported the attendance of research faculty; postdoctoral associates; and graduate, undergraduate, and high school students at numerous virtual national conferences.

Facility Operations Schedule

The ICR facility usually operates year-round, but this year, due to COVID restrictions, it shifted from on-site users to users sending samples for data acquisition by internal ICR support staff and was able to maintain an active user program with minimal downtime. In addition, the lab-wide power outage December 16 -20, 2020 required all ICR instruments to be shut down with no instrument usage during that time.

6. NMR Facility

The NMR/MRI User Program at the MagLab in Tallahassee (FSU) is partnered with the AMRIS User Program in Gainesville (UF). Major research areas in Tallahassee include solid-state NMR (ssNMR) of biosolids and materials, magnetic-resonance imaging (MRI) of animals, and solution NMR of biomolecules. There are fourteen NMR platforms on site, including several flagship instruments such as (i) the 36T Series Connected Hybrid (SCH) platform, which operates at 1.5GHz for ^{1}H NMR; (ii) the 14.1T (600MHz) dynamic nuclear polarization (DNP) NMR platform, which provides unprecedented signal enhancements, especially for high surface area samples; (iii) one 19.6T (830MHz) and two 18.8T (800MHz) platforms, which are configured for biosolids and materials ssNMR, as well as methods development and staging of experiments for the SCH; and (iv) the 21.1T (900MHz) platform, which is currently the highest-field MRI/S instrument in existence. These platforms are coupled with some of the best NMR probes in the world, which are designed and constructed by our NMR Technology Group. Annually, the NMR/MRI user program, which is run by our NMR Instrument Managers, serves ca. 250-300 users from around the world, including PIs, students, postdocs, and technicians. The Covid pandemic (along with console installations and issues with powering the SCH) resulted in a relatively minor decrease in the number of user hours (ca. 15-20% overall); while no external users were permitted on site, we continued to support them remotely in 2020. Remarkably, a record number of peer-reviewed publications came out of the NMR/MRI User Program in 2020 (81 – up from 54 in 2019).

Unique Aspects of Instrumentation Capabilities

SCH. The SCH was in its second year of user operation in 2020; unfortunately, instrument time was limited by both the pandemic and subsequent failure of the helium-liquefier turbine and a local substation transformer. Fortunately, the SCH is scheduled to come back online in July 2021, with biosolids ssNMR projects to be given high priority. Nonetheless, the 13 publications that came out in 2020 reveal the true power of the SCH, proving it to be incredibly useful for the study of half-integer quadrupolar nuclei (*i.e.*, nuclear spins of 3/2, 5/2, 7/2, and 9/2, which constitute 73% of NMR-active nuclides in the Periodic Table) in a wide range of materials. Applications in this area will ramp up in 2021 for materials like metal-organic frameworks (MOFs), catalysts, and biosolids such as metalloproteins, including those with challenging low-g nuclei such as ^{67}Zn. We took advantage of the pause in SCH operations to improve both the hardware and algorithms used for field regulation to reduce short- and long-term field fluctuations. We also continued the development of new fast magic-angle spinning (FMAS) probes for ^{1}H indirect detection (ID) experiments at lower fields, in part, as staging for similar probe development on the SCH. We plan to have these capabilities ready to go when the SCH is back online, opening new possibilities for ultra-high field (UHF), high-resolution ^{1}H, ^{13}C, and ^{15}N ssNMR of biosolids (*vide infra*).

DNP. The DNP platform, a joint effort between NMR, AMRIS, and EMR that opened for users in 2018, has yielded 18 publications over the past two years, with more forthcoming in 2021 (four published so far). Due to the expertise and diligence of Drs. Fred Mentink-Vigier and Thierry Dubroca, the DNP had a slight increase in user hours in 2020, and several new PIs/research groups were recruited. New DNP probes were developed by Dr. Faith Scott under the supervision of Mr. Peter Gor'kov, and will be ready for use in 2021 (*vide infra*). The unique DNP platform is comprised of DNP MAS NMR and Overhauser DNP instruments (two separate 600MHz magnets), which receive microwave irradiation via a quasi-optical table (built in-house) that splits the gyrotron microwave beam. The DNP can be operated continuously (24/7) for up to three weeks at a time, unlike any other DNP platform in the world. Finally, a benchtop EPR spectrometer and tabletop MAS spinner for screening of samples were also installed.

Facility Developments and Enhancements

Probes. The probes designed by the *NMR Technology Group* are a major factor in setting the MagLab apart from other facilities around the world, keeping our user program on the cutting edge. This team, led by Dr. Bill Brey and Mr. Peter Gor'kov, designs, manufactures, and implements probes of very high quality. They provide versatile tuning configurations for multinuclear ssNMR, low-*E* coils for lossy biosolids samples, and some of the best rf circuits and coils for detection of weak NMR signals. In 2020, three probes were developed, including two for the SCH (3.2mm HX, middle-γ, v_X = ^{15}N-^{71}Ga; 3.2mm HX, low-γ, v_X = ^{103}Rh-^{15}N) and one for the 800 (1.3mm HX(Y), in testing). In addition, several probes built in 2019 are routinely used across multiple platforms, including an 800MHz 0.75mm HXY MAS probe for indirect ^{1}H detection (spinning up to 100kHz) and an SCH 5.0mm HX static probe for biosolids and materials. An 800MHz 3.2mm broadband HX MAS probe is under construction, as well as a 3.2mm HXY MAS probe for the 600MHz DNP platform, and 1.3 and 1.9mm HXY DNP probes are in the design phase. We also continued the sponsored development of high-temperature superconducting (HTS) probes for solutions NMR applications at AMRIS and elsewhere. Probes currently in development have several times the *Q* factors of those of the previous generation and promise to have much higher sensitivity.

Platform upgrades. Aside from the construction of new probes, there are several major developments that were completed in 2020 and/or started in 2020 and extended into 2021. The 800#2 console was upgraded to a Bruker NEO, and the 900 console is in the process of being upgraded with a NEO console as well, along with a significant upgrade in the gradient and shim system (450 V/300 A) and shimming capabilities for *in vivo* MRI/S. With multiple channels and transceiver capabilities, this will offer enhanced capabilities in a new super-wide configuration to augment the existing microimaging and SSNMR applications. Once user operations have resumed, spectroscopy on the SCH will benefit from the work of Prof. Jeff Schiano (Penn State) and his students to improve field regulation. Careful measurements and analysis of the gain and phase responses of the field regulation system have enabled them to develop algorithms to better compensate for fluctuations in cooling water temperature. In addition, Drs. Bill Brey and Ilya Litvak have worked to reduce long-term drift by improving the stability of the low-noise electronics in the field regulation system.

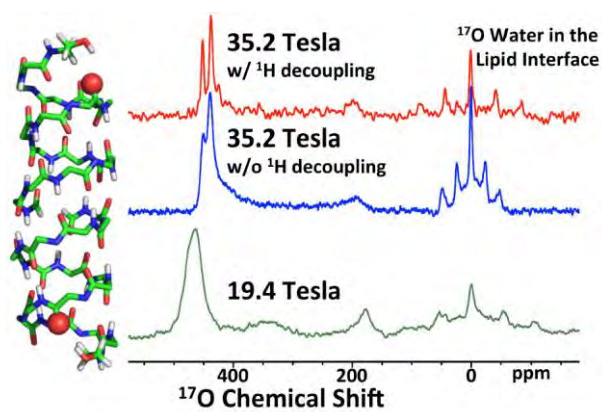


Figure 2.30: ^{17}O SSNMR spectra of Leu$_{10}$ gramicidin-A acquired at 35.2T (without and without ^{1}H decoupling) have much higher resolution than those acquired at 19.4T.

Major Research Activities and Discoveries/ Research Highlights

Several major publications stemmed from studies of half-integer quadrupolar nuclei on the SCH platform, not only due to the scaling of signal proportional to B_0^2, but also because central transition (+½ ↔ –½) pattern breadths scale as B_0^{-1}, which provides unparalleled resolution. For instance, ^{17}O (I = 5/2) ssNMR was used for the identification and assignment of a "wire" of water molecules involved in hydrogen bonding with carbonyl groups in gramicidin-A (**Figure 2.30**), shedding new insight on their dynamics in the central channel of the protein [Paulino, J. *et al. PNAS* 2020, ***117***, 11908, DOI]. ^{17}O multiple-quantum MAS (MQMAS) ssNMR was able to resolve 12 magnetically non-equivalent oxygen sites in α-Mg formate MOFs (with and without solvent), allowing for detailed structural characterization that is impossible at lower fields [Martins, V. *et al. J. Am. Chem. Soc.* 2020, ***142***, 14877, DOI]. 2D ^{17}O double-quantum (DQ)-single-quantum (SQ) experiments were used to probe connectivities and proximities between oxygen sites in γ-Al_2O_3, one of the most widely used catalytic support materials, in order to gain an understanding of the relationship between its structure and function [Wang, Q. *et al. Nat. Comm.* 2020, 11, 3620, DOI]. ^{67}Zn (I = 5/2) ssNMR was used to characterize short -range structural disorder in zeolitic imidazolate framework (ZIF) glasses, revealing reduction of tetrahedral symmetry of the Zn sites at the atomic level upon progression from a crystalline phase to a glass [Madsen, R. S. K. *et al. Science* 2020, *367*, 1473, DOI]. Finally, 1D ^{11}B (I = 3/2) MAS NMR, along with 2D ^{1}H-^{11}B and ^{11}B-^{11}B DQ-SQ correlation experiments, allowed for an in depth study of structure and connectivity of boron species in h-BN nanotubes used as an oxidative catalyst (spent *h*-BNNT), boron-substituted MCM-22 zeolite (B-MWW), and silica-supported boron oxide (B/SiO_2) [Dorn, R. W. et al. *ACS Catal.* 2020, *10*, 13852, DOI] (Figure 2.31).

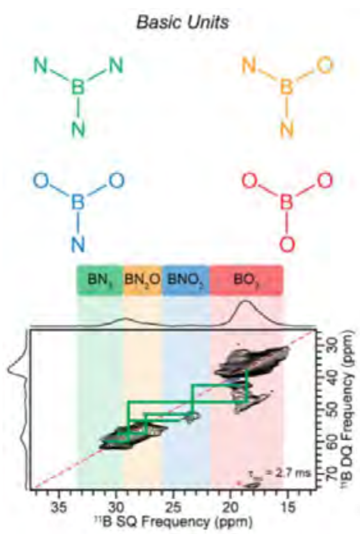


Figure 2.31: Basic boron-centered units in spent *h*-BNNT and its 2D ^{11}B dipolar DQ-SQ NMR spectra (ν_{rot} = 18kHz), which reveals connectivities between units.

The existence of a spin diffusion barrier (*i.e.*, slower nuclear spin polarization diffusion around bis-nitroxides) was demonstrated for the first time under MAS-DNP conditions, using the MAS DNP NMR platform during 2020. This was in large part due to control of the microwave beam on a ms timescale [Stern, Q. *Et al. Science Adv.* 2021, *7*, eabf5735, DOI]. On our 500, 600, 800, 830, and 900MHz platforms, numerous studies of biosolids and materials, along with methods development papers, were published. For instance, high-resolution multinuclear (^{1}H, ^{31}P, $^{6,7}Li$, ^{27}Al, ^{71}Ga) ssNMR experiments conducted on energy materials have contributed to improved fundamental understanding of the local bonding environments that govern ion transport [Wu, N. *et al. J. Am. Chem. Soc.* 2020, *142*, 2497, DOI] and electron mobility [Huang, W. *et al. PNAS* 2020, *117*, 18231, DOI], leading to insights into performance improvement of technologically important materials for rechargeable batteries, thin film transistors, and dielectrics.

Facility Plans and Directions

Dr. Tim Cross, the long-time director and original designer of the NMR Facility, retired in 2020; Dr. Robert Schurko, a faculty member in the Department of Chemistry and Biochemistry and an expert in ssNMR of materials and NMR methods development, took over as director in May 2020. In 2020, we also conducted interviews for three positions, including an RF/MRI engineer and two Research Faculty (to support SCH and MRI user activities). We have identified a candidate for the RF/MRI engineer position (commencing June 2021); however, other searches are ongoing, as travel restrictions have made on-site interviews impossible for most candidates.

Several new initiatives were kicked off in 2020 and are actively being pursued via external funding opportunities, which augment core funding from the NSF Renewal. These include (i) the development of a 400MHz DNP NMR platform that utilizes a 5 W klystron as a µwave source (NSF-MRI, with EMR, under review); (ii) collaborations with C.M. Physics on development of ultra-wideline NMR techniques at 30+ T (as well as future UHF DNP operations; core funding, in progress); (iii) a proposal for ultra-low temperature closed He loop DNP operations at 600MHz (core funding, with EMR, in progress); (iv) conversion of an 800MHz solutions NMR spectrometer to solids capability and repositioning of solution NMR operations at 750MHz in the Department of Chemistry and Biochemistry at FSU (core funding, in progress); (v) a proposal for an 800MHz DNP system for biosolids NMR (NSF R1 midscale, with AMRIS/U. Florida, under review); and (vi) a proposal for the development of multifilament HTSs for UHF NMR magnets (NIH RO1, with Applied Superconductivity, under review). We also submitted a pre-proposal for a 1.2GHz ssNMR platform in Tallahassee (NSF R1 midscale, unsuccessful – but we will try in the R2 competition next year) and continued to plan for UHF microimaging and small-animal MRI operations on the SCH platform.

Outreach to Generate New Proposals-Progress on STEM and Building User Community

User recruitment was for the most part conducted virtually during 2020, via lectures and posters at national and international online conferences, as well as the usual email solicitations and a limited number of sponsorships. In 2020, we started to conduct inventories of all of the spectrometers, probes, and related hardware - we are still in the process of translating this to an overhauled web site and redesigning our pages in the ELEVATE information booklet as well. As a result of this work, we have up-to-date descriptions of all spectrometers and probes available to our users, along with active projects, and interesting items about ongoing research at the MagLab. Schurko reinitiated online group meetings and has invited several high-profile speakers (and potential collaborators); these activities continue in 2021. In 2021, we plan on resuming workshops on topics like RF circuits, DNP, and NMR on the SCH. Finally, in late 2020, the online ***Fields*** magazine featured a ***Wizard of Oz***-themed story on ssNMR of MOFs conducted by members of our NMR user program [https://bit.ly/3brqXli]; not only was there positive feedback from the general public, but this article attracted several prominent members of the MOF/crystal engineering community to initiate development of projects at the MagLab.

STEM outreach was challenging due to the pandemic, but most of our team participated in the MagLab Open House in February 2020, and many have moved to virtual activities (***e.g.***, Drs. Faith Scott and Rob Schurko provided virtual tours for the Women in Math, Science & Engineering (WIMSE) Program; Dr. Ilya Litvak organized an online science fair for elementary schoolchildren; Drs. Faith Scott and Sam Grant participated in MagLab's 2020 Summer Exploration Series; Drs. Schepkin and Grant presented an MRI of Veggies guessing game [https://bit.ly/3fgJnwE] and DNA extraction from fruit [https://bit.ly/3fjV5GH], respectively, at the Virtual Open House; and finally, Grant presented work from the 900 UWB magnet as part of the lab-wide tour of the MagLab for the ScienceWriters 2020 Conference, as well as providing a webinar based on his research involving non-proton MRI generated using the 900 platform [https://bit.ly/3fhWgGP]). We plan to ramp up interactions with local schools and organizations and provide more virtual tours and STEM events over the coming year. We hope to offer a workshop at an upcoming User Advisory Committee or External Advisory Committee meeting.

Facility Operations Schedule

In pre-pandemic years, our fleet of high-field NMR spectrometers, including 800#1, 800#2, 830, 900, 600#1, and 600#2, operate 24/7 close to 365 days per year; user hours decreased slightly in 2020 due to the COVID pandemic, and remote operations continued almost unabated, thanks to the efforts of Drs. Zhehong Gan, Ivan Hung, Riqiang Fu, and Sungsool Wi. Likewise, Dr. Grant conducted MRI experiments on the 900 (first *ex vivo* and then *in vivo*) continuously throughout the COVID-related shutdown. For NMR experimentation, the SCH is normally allocated 30 weeks of magnet time annually, with *ca*. 20 hours/week at full field. The 600 DNP runs *ca*. 250+ days per year (with downtimes for maintenance). MAS-DNP experiments require on-site personnel and was therefore prevented from use between March and June 2020. However, this time frame was used to carry out essential maintenance on the instrument – notably, the refurbishing of a helium compressor (from April to August 2020). The system was reopened for users in August 2020.

7. Pulsed Field Facility

The Pulsed Field Facility (PFF) is located in Los Alamos, New Mexico, at Los Alamos National Laboratory (LANL). The utilization of LANL and U.S. Department of Energy (DOE) assets enable us to provide world record pulsed magnetic fields to our international community of users – from undergraduate students through senior investigators. We provide our users with both robust scientific instrumentations engineered to operate in the transient pulsed magnetic field environment, and the support of scientists who are active researchers with expertise in high magnetic field-driven science. Our users also benefit from the strong complementary expertise and diagnostic capabilities of the DC Facility; often both facilities contribute to a given user's research. The two MagLab *facilities are further connected by a common application process for the DC and PFF, by which experiments can be requested at either location under a single overarching scientific proposal.*

Unique Aspects of Instrumentation Capabilities

Table 2.8: Pulsed field magnets available to users at the MagLab-PFF.

Capacitor Driven Pulsed Magnets				
Magnet System	Field	Bore	Duration (FWHM)	Supported Research*
Cell 1 Cell 2 Cell 3 Cell 4	65T	15mm	20ms	Magneto-optics (IR through UV) Magnetization (susceptibility, extraction, torque) Magnetotransport (DC – MHz, GHz Conductivity) Pulse Echo Ultrasound Spectroscopy Fiber Bragg Grating Dilatometry Polarization, Magnetocaloric Temperature environments from 350mK to 300K For compatible techniques: Pressures up to 9GPa and in-situ sample rotation
Duplex Cell	75T	15mm	5ms	Same as above
Cell 5	31.5T	15mm	1ms	Magneto-optics (THz, free space)
Single Turn	300T	10mm	3μs	IR and FIR Transmission, FBG Dilatometry, Inductive Contactless Conductivity
Generator Driven Magnets				
Magnet System	Field	Bore	Duration (FWHM)	Supported Research*
100T Multi-shot	101T	10mm	15ms	All techniques listed above
60T Controlled Waveform	60T	32mm	100ms (plateau)	Magnetothermal studies (heat capacity and magnetocaloric) FIR and THz optics Larger Sample Volumes

*We will dedicate resources to work with users to develop and field new/novel techniques as needed in our magnet systems.

Table 2.8 lists the pulsed magnets available to users of the PFF. At the heart of the PFF's magnet activities is a fully multiplexed (recently updated from 6 to 8 output) computer controlled, 4MJ (32mF @ 16kV) capacitor bank. This capacitor bank is responsible for serving approximately 150 unique users per year with thousands of ~20 millisecond-long magnet pulses, which provide fields up to 65T. Additionally, this capacitor bank provides power to our newest short-pulse magnet, a 75T duplex magnet which is now available for users. Beyond our 65T short-pulse magnets, we provide users with access to the highest nondestructive magnetic fields in the world. The 100T multi-shot magnet is the first and only magnet in the world to successfully perform a magnetic field pulse to 100T in a nondestructive manner. The energy necessary – hundreds of megajoules – to run this highest field magnet is provided by LANL's 1.4GW AC generator, a unique pulsed power supply. The AC rectification of the generator output enables the control of the pulsed power waveform, allowing for the optimization of the associated magnet systems – the 100T multi-shot magnet and 60T controlled waveform ("Long Pulse") magnet – and sample diagnostics. Beyond 100T, users have access to the semi-destructive 300T Single Turn magnet system (development and installation funding provided by LANL), which provides users with access to fields in excess of 100T; routinely pulsed up to 170T with a pulse duration of 6 microseconds.

Facility Developments and Enhancements

Inspection of the 1.4GW motor-generator's rotor in 2020 found a flaw in the conductor, which lead to the disassembly and inspection of the entire rotor with the intention to rewind it with new copper and insulation. This work was performed in the spring/summer of 2020. However, a subsequent internal flaw was found in the metal forging of the rotor, which will require a completely new rotor to be forged and wound to return the motor-generator to service. Since this finding, LANL and the PFF's management teams have been working on the necessary steps to procure a new rotor to allow for the return of our generator driven magnet operations.

While the generator is being repaired progress has continued on upgrades to the 100T outsert coils 1 and 2, where the winding and epoxy impregnation was successfully completed in 2020 by the magnet winding facility in Tallahassee. These upgraded coils, which were re-designed and wound with high-strength, nano-structured Cu-Nb conductor – about 50% stronger than the glidcop AL60 wires used in previous versions – are expected to add about 2T to the outsert field, decreasing the operating risk and increasing the lifetime of the 100T outsert magnet. The final steps of overwrapping the coils will be completed before the generator is back online. Upgrades to coils 3 and 4 for 60T Long Pulse (LP) are also progressing, with the completion of the winding and impregnation stages. A new path forward on the production of the large cross-section AL60 conductors needed for coil 7 of the 60T LP has been determined, which will lead to the production of enough conductor to wind the coil before the generator comes back online.

With the 100T and 60T LP offline, the NSF supported Magnet Surge has enabled the PFF to quickly design and construct capacitor bank driven magnets that will help fulfill some of the experimental needs of our users while the rotor is repaired. One such magnet, our 75T duplex magnet, has been providing users with fields up to 75T since February 2020 (Figure 2.32). This duplex magnet has two independent coils, each powered by a different subsystem of our 16kV, 4MJ capacitor bank – 1MJ and 3MJ to drive the inner and outer coil respectively. The modular design of the magnet reduces the voltage needed and provides more design flexibility to maximize the generated magnetic fields, while the cooling space between the inner and outer coils enables a short cooling time (~1hr) between pulses.

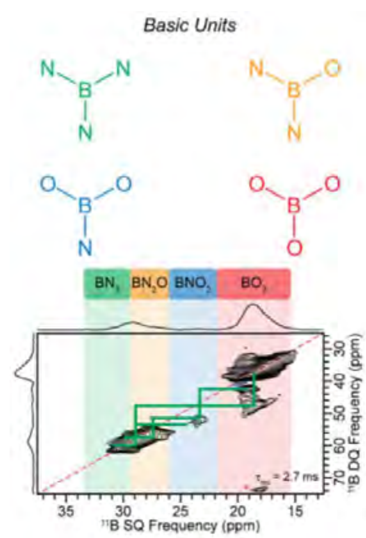


Figure 2.32: PFF postdocs prepare the duplex for a user experiment.

Major Research Activities and Discoveries

With the introduction of our newest capacitor bank driven magnet, the 75T duplex, our users have been able to resume high field studies beyond 65T here at the PFF. One of the first experiments to make use of this magnet was led by researchers at the University of Michigan to study the unusual high field metallic state of the Kondo Insulator YbB_{12}. Despite being an insulator, magnetic quantum oscillations, suggestive of a Fermi surface, have been detected in this material, leading to a number of exotic theoretical predictions. Using the duplex magnet, the Kondo (insulating) gap was closed, enabling the study of the high-field metallic state (Figure 2.33). Comparing the frequency of the quantum oscillations in both the insulating and metallic state, researchers concluded that all observed oscillations were originating from the same quasiparticle band. These results suggest a two-fluid picture in YbB_{12} that includes charge-neutral fermions – contributing little or nothing to the charge transport – coexisting with normal (charged-fermion) electrons, providing strong constraints for existing theoretical models used to describe this material. For more detail see: Z. Xiang, L. Chen, K.-W. Chen, C. Tinsman, Y. Sato, T. Asaba, H. Lu, Y. Kasahara, M. Jamie, F. Balakirev, F. Iga, Y. Matsuda, J. Singleton, and L. Li "Unusual high-field metal in a Kondo insulator", Nature Physics (2021) doi.org/10.1038/s41567-021-01216-0.

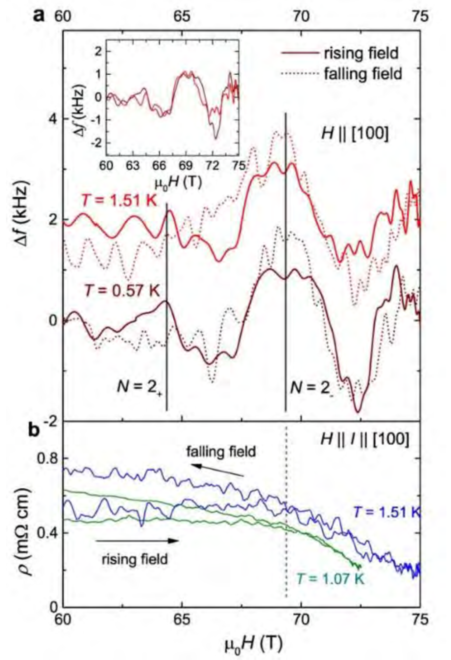


Figure 2.33: a) RF measurements of YbB_{12} obtained in the duplex magnet. The lowest pair of Landau levels (N = ±2) are shown. The insert shows a small amplitude difference of the N = ±2 levels between T=0.57K and 1.51K suggesting a non-diverging quasiparticle mass. b) Magnetoresistance measurements show A downward kink at ~ 68T and coincides with the N=-2 sublevel. This slope change may indicate a crossover to an unknown high-field state.

Research Science Highlights

Smart non-linear transport helps users expand frontiers of superconductors

M. Leroux, F. F. Balakirev, M. Miura, K. Agatsuma, L. Civale, and B. Maiorov, *Phys. Rev. Appl.* 11, 054055 (2019).

Using a new 'smart' technique developed by PFF scientists for measuring non-linear transport in pulsed magnetic fields, critical currents in cuprates, iron- and new nickel-based superconductors have been studied up to 65T. This new technique has attracted many users both here in the USA, as well as Europe and Japan. Non-linear transport can be used to study many systems such as topological materials and charged density waves. In superconductors, measurements of non-linear electrical transport can reveal important information about their current-carrying properties. However, during these measurements, sudden changes in sample voltage near the superconducting transition can destroy the sample. Thus, until now transport experiments of superconductors in pulsed field have been limited to very low currents. To solve this problem, a new technique was developed using fast programmable gate arrays (FPGAs) that varies the current in response to changing sample voltage in less than 10ns, allowing measurements of several non-destructive current-voltage curves in a single 65T magnetic field pulse (~ 50ms). These measurements ultimately unveiled novel dynamic vortex responses as a consequence of fast-changing pulsed magnetic fields (Figure 2.34).

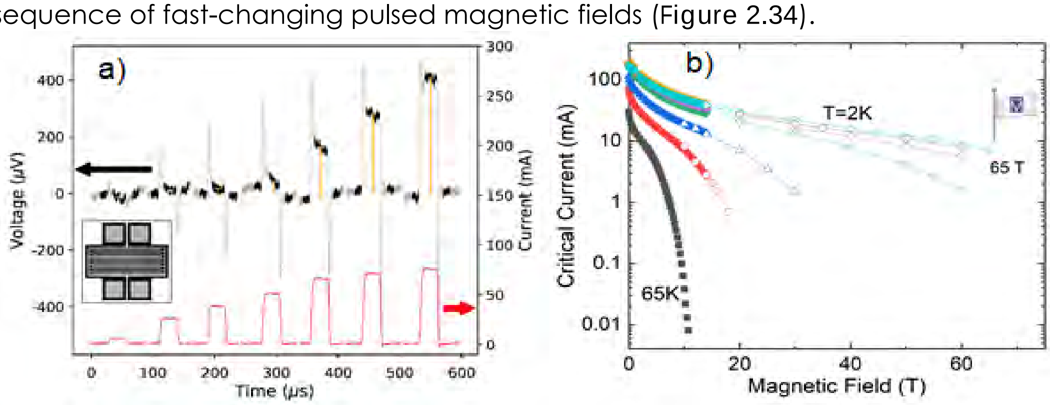


Figure 2.34: (a) Fast programmable gate arrays (FPGA) were used to produce current-voltage (I-V) curves at peak field of 30T during a magnet pulse by using short pulses of current. (b) Critical current vs. magnetic field at different temperature for a superconducting $YGdBa_2Cu_3O_7$ thin film.

Observation of cyclotron resonance and measurement of the hole mass in optimally doped $La_{2-x}Sr_xCuO_4$

K. W. Post, A. Legros, D. G Rickel, J. Singleton, R. D. McDonald, X. He, I. Bozovic, X. Xu, X. Shi, N. P. Armitage, and S. A. Crooker, *Phys. Rev. B* 103, 134515 (2021).

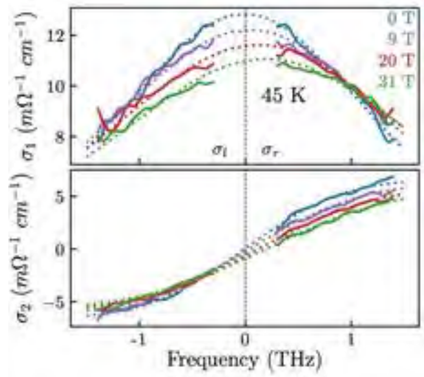


Figure 2.35: Optical conductivity from LSCO up to 31T at 45K. A clear cyclotron shift is observed, along with broadening and an amplitude reduction. The dashed lines are fit to a cyclotron-active two-fluid model.

Cyclotron resonance (CR) studies complement existing experimental methods for measuring the band structure of metals, such as angle-resolved photoemission, quantum oscillation studies, and heat capacity, and help to disentangle the important role of electronic correlations in high temperature superconducting cuprates (HTSCs). Unfortunately, direct detection of CR in these materials has proven challenging due to the relatively heavy carrier masses, short scattering times, and the high magnetic fields needed (many tens of tesla) to detect CR in the superconducting low temperature state. By combining pulse magnetic fields and THz time-domain spectroscopy researchers and users of the PFF were able to study the cyclotron resonance (CR) of holes in the normal state of high-quality thin films of optimally doped $La_{2-x}Sr_xCuO_4$ (x = 0.16) (Figure 2.35). Since quantum oscillations have never been detected in $La_{2-x}Sr_xCuO_4$, even to fields up to 80T and temperatures down to 4K, this is the first measurement of a cyclotron mass in this family of cuprate superconductors. These results open the door to studies aimed at characterizing the degree to which electron-electron interactions influence carrier masses in cuprate superconductors.

Facility Plans and Directions

New 30kV, 1.2MJ capacitor bank

Funding from the Magnet Surge has also enabled the PFF to upgrade its power infrastructure with the planned commissioning of a new 30kV, 1.2MJ capacitor bank in 2022. The new capacitor bank will be integrated with the existing 16kV, 4MJ bank allowing for the development of higher field capacitor bank-driven duplex magnets. Preliminary designs for an 85T duplex magnet are complete, with expected final designs in 2021. In addition to providing users with fields above 75T, the development of a higher field duplex magnet will help the PFF establish the technology and in-house experimental technique development that is necessary for realizing higher field 100T inserts.

Generator subsystem activities

During the generator downtime, the PFF's power delivery team is reviewing all motor-generator subsystems and developing a plan for future maintenance and upgrades that will ensure reliable operation of the entire system once the rotor is returned. Importantly work has also begun on the final steps of a multi-year project to replace the drive and exciter (Figure 2.36), two major components of the motor-generator system which had reached their end of life.

Figure 2.36: The new exciter being unpacked before installation.

Development of 60T Mid-pulse magnet

Efforts are under way for the development of a 60T Mid-Pulse (MP) magnet to fulfill some of the experimental needs formerly met by the 60T LP. Although shorter in duration than the 60T LP, the 60T MP will provide users with an approximately 3x longer pulse duration (300msec pulse length, FWHM ~ 70msec, Figure 2.37) than what is available with the 65T magnets. This magnet is currently in the prototype and testing phase.

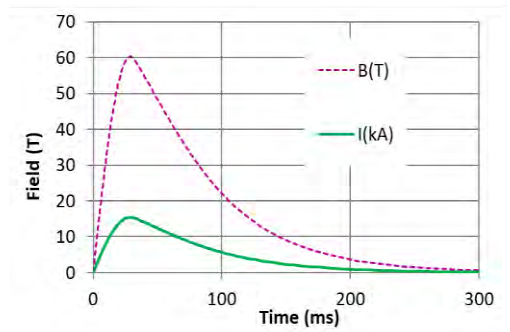


Figure 2.37: Proposed field vs time profile for the newly designed 60T mid-pulse magnet.

Outreach to Generate New Proposals-Progress on STEM and Building User Community

Despite the reduction in in-person outreach events, PFF staff took part in a number of outreach activities throughout the year, including the fourth annual Los Alamos National Laboratory Summer Physics Camp for Young Women, a free camp that introduces young women from Northern New Mexico communities to STEM disciplines via hand-on experiments and lectures. During this camp, which was held via video conference, PFF scientist Vivien Zapf spent several hours with students sharing about the MagLab, giving a lecture on electricity and magnetism, and helping the students building different electrical and magnetic devices. Due to the shift to online outreach, staff scientist and PFF user program director Laurel Winter spoke about her career path and the PFF as part of the MagLab Summer Exploration Series hosted by the MagLab-Center for Integrated Research and Learning (CIRL), an online science enrichment program for middle and high school students around the country.

Facility Operations Schedule

Jointly with the DC Facility, the PFF solicits proposals through a common call three times a year to streamline the application process and ensure availability of resources (both staff scientists and magnets). Hours of operation for the capacitor bank driven pulsed magnets are Monday through Friday, 8:00am to 7:00pm, with extended after-hours until 11:00pm upon request. Maintenance is scheduled each Monday from 8:00am to 10:00am, or on an as needed basis. Generally, no more than three pulsed magnets (including the duplex) are scheduled for a user experiment in given week to enable rapid turnaround and continuation of an experiment following a magnet failure. Due to the COVD-19 pandemic user operations were suspended from Mid-March through June; thereafter user operations resumed in a reduced capacity of two pulsed magnets in operation a week. These were run entirely virtually, with users participating remotely in the planning, while the experiments were run by on-site user support staff. Users are anticipated to remain offsite until at least the middle of 2021.

3. Education and Outreach

3.1. EDUCATION AND OUTREACH

Despite the unique challenges brought on by a world-changing pandemic, the Center for Integrating Research and Learning (CIRL) successfully continued our efforts to build the STEM workforce through programs, evaluation, and research. Because this year has been different from previous years, the structure of our chapter will be slightly different. Our K-12 educational outreach programs (field-trips, classroom visits) were not affected until the last two months of the school year so we will discuss those efforts first. Then we will discuss the programs that we created and/or altered to address the needs of students and postdocs and the constraints of the pandemic. Finally, our evaluation and research efforts provided much needed insights into the impact, and potential, of virtual education and outreach programs.

The MagLab's work towards building the STEM workforce would not be possible without the dedication of CIRL staff whose leadership and expertise allows us to provide high-quality, research-based programs in education, evaluation and research. CIRL staff had several noteworthy accomplishments in 2020, including:

- Carlos R. Villa (K-12 Education Director) continued his term as the regional chair for the Florida Association of Science Teaching, leading science education efforts across the state and nationally. He also continues to serve on the board of the local Big Bend/Leon Association of Science Teachers.
- Kari Roberts (CIRL Evaluator) continued her terms on both the FSU ORCID committee and Postdoctoral Affairs committee, wherein she utilizes data gathered for MagLab programs to inform decisions at the institutional level.
- Dr. Roxanne Hughes (Director of CIRL) was elected as vice chair to the American Physical Society's Forum on Outreach and Engaging the Public, wherein she will use CIRL's research to inform national efforts for physics educational outreach.

K-12 Programs for Students

CIRL provides three different forms of educational outreach to K-12 classrooms: (1) educational kits that teachers can borrow and use to supplement their teaching; (2) CIRL Staff and MagLab scientists' visits to local classrooms; and (3) field trips to the MagLab. These programs are facilitated by our K-12 Education Director, Carlos. Classroom outreach aims to both teach students about the research being done at the MagLab and build excitement about STEM topics through engagement

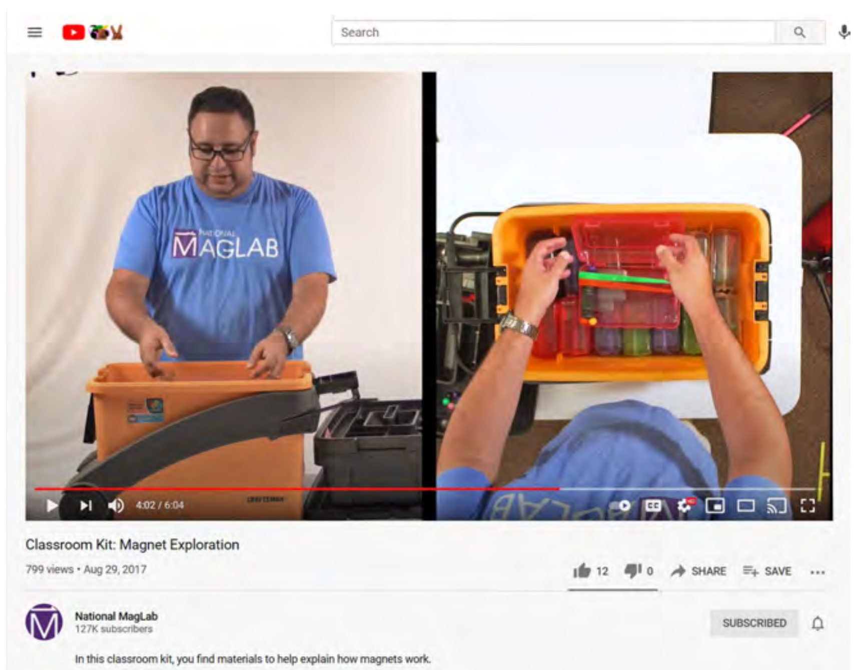


Figure 3.1: Video demonstrations for the classroom kits feature MagLab educators showing how the materials are packed, and how they can be used in the classroom.

in hands-on science activities. Each activity includes an overview of the MagLab and the types of research conducted there, and an introduction to a specific topic followed by an open-ended inquiry activity. Each visit concludes with a review of the phenomena demonstrated during the activity, and a question-and-answer session.

1. Loaner Kits for Classrooms

To increase access to our K-12 outreach efforts, CIRL created duplicate sets of the materials needed for our outreach activities. These kits are available at no cost upon request and are mailed to the requesting teacher anywhere in the US. Each set of materials is supplemented with a printed version of our Pre- and Post- visit activities, as well as directions for accessing an online video that models the use of the materials (Figure 3.1). This allows teachers to borrow and use the same materials Carlos uses during our extremely popular outreach activities, and significantly broadens our outreach capacity. During the 2019-2020 school year, 12 teachers requested kits, of which 50% were at Title I schools. The most popular requested activity was *Build an Electromagnet*, making up 42% of all the loaner kit requests.

2. Classroom Outreach

Tallahassee, FL

Classroom educational outreach is recorded based on the school year as opposed to the calendar year. Teachers can request on-site field trips for their students, or they can request that Carlos come to their classroom to conduct a MagLab lesson. During the 2019-2020 school year[1], Carlos provided outreach to 4,904 students. Of these students, 62.3% were enrolled at Title I schools[2]. During this school year, almost two-thirds of our outreach occurred on site through field trips and tours of the Tallahassee facilities. The most requested activities in 2019-2020 were *Build an Electromagnet* for the fifth year in a row, followed by *Electricity*, *Static*, *and Currents*, and *Nature of Science*[3]. Most participating classrooms came from elementary schools (34%), followed by middle schools (24%), and high school classes (11%). The remaining 31% was made up of mixed grade classes. Participating schools came from 16 different school districts in Florida and Georgia.

Gainesville, FL

The High B/T Facility and the Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS) Facility at the University of Florida also provided classroom outreach throughout the 2019-2020 year, conducted and facilitated by Amy Howe. Over 400 students participated in hands-on materials with UF Staff, all from Title I schools. For the 2019-20 school year only two activities were requested: *Magnet Exploration* (33%) and *Build an Electromagnet* (67%). Approximately 75% of these lessons were presented to elementary students, and the remaining 25% of the presentations made to high school students. In addition to classroom visits, the UF staff also participated in science fairs, science nights, and career panels, including Talk Science with Her at First Magnitude brewery in Gainesville, held in conjunction with the United Nations International Day of Women and Girls in Science.

Los Alamos, NM

As with elsewhere, the 2020 pandemic prevented staff at the Pulsed Field Facility (PFF) from going local into classrooms and partaking in local community events. Despite this shut down, staff scientist Vivien Zapf was still able to give a virtual electricity and magnetism demonstration to a group of 20 girls as part of a local Northern New Mexico Summer Physics Camp for Young Women. The switch to virtual events allowed PFF staff to participate in programs that reached students across the nation. For example, Dr. Zapf took part in a career panel for women in STEM held

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[1] The 2019-2020 school year was shortened due to the closure of in-person schooling as a precautionary measure in the early stages of the COVID pandemic. This caused the pause of the MagLab's in-person classroom outreach and field trip programs until conditions allow for safe visitations. The date of the last in-person outreach program offered in 2020 was on March 5th.

[2] A Title I school is a school receiving federal funds for low-income students determined by the number of students enrolled in the free and reduced lunch program.

[3] For more information on the activities listed and all of CIRL's outreach activities please visit the outreach website: https://nationalmaglab.org/education/teachers/classroom-outreach-2.

virtually by the University of California. And staff scientist and PFF education representative were able to participate in the MagLab Summer Exploration series hosted by CIRL, where she spoke about her career path and the PFF for middle and high school students.

3. Fieldtrips

One of our goals for 2019-2020 was to increase visits of school groups to the MagLab. Despite the disruptions resulting from COVID, 59.3% of all educational outreach included field trip visits to the MagLab. Figure 3.3 shows the percentage of classroom and on-site outreach over the past six years. Figure 3.2 shows Carlos engaging a school group in a hands-on demonstration of electromagnetism, an example of a typical field trip activity. Students then participate in a scientist-led tour. Introducing them to potential role models and teaching them about the research being conducted at the MagLab. This form of outreach continues to be a way to introduce new audiences to the MagLab with 79.1% of fieldtrip students indicating that their fieldtrip was their first time at the MagLab.

Figure 3.2: CIRL Director of K-12 Programs discusses electromagnets with a group of students during a MagLab field trip.

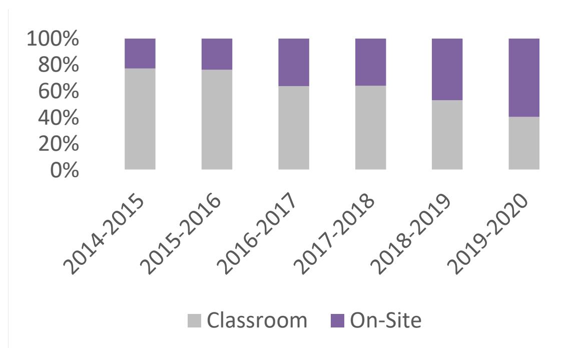


Figure 3.3: Percentage of classroom and on-site outreach over past six years.

4. Communicating Outreach: MagLab Educators Club

The MagLab Educators Club is CIRL's primary method of distributing announcements about our outreach programs and opportunities to the local and international community of education professionals. In addition, this year the Educator's Club members were sent information and resources that provided online content to assist recipients in virtual teaching, and invitations to join in the virtual workshops that were offered. The mailing list was also operated through an email automation software for the first time, which allowed CIRL to create visually stunning emails and helped to track their effectiveness. Currently the Educator's Club has over 500 members and averages more than 1,000 reads (including email forwards to students and parents) demonstrating the high level of interest in MagLab programs.

K-12 Outreach Response to COVID

1. Initial COVID Response Spring 2020: Virtual Presentations

When schools shut down across the country in March 2020, CIRL was able to respond immediately to help teachers, students and parents with online activities that could supplement their science learning. Carlos held three workshops for parents and teachers to assist them in doing science with their children in March and April. In the virtual *Encouraging a Sense of Wonder: Science for Young Learners*, Carlos showed parents questioning techniques to inspire their young children to look at the world around them through a scientist's eyes. Examples were given on how toys can be used to model physics and how they can help their children create investigations using common items around the home. A second session, entitled *SciGirls STEM* was offered to educate parents on the gender gap in STEM careers and provide activities and mindsets that can improve girls' interest and sense of belonging in STEM. This session was modeled after the national SciGirls program, for which Carlos is a certified SciGirls instructor. The third presentation, *A STEP UP Workshop*, was part of *STEP UP*, a national initiative to increase the participation of girls in physics. Carlos is a *STEP UP* Ambassador, and as such, collaborates with a national community of physics teachers to deliver high school physics lessons to empower teachers, create cultural change, and inspire young women to pursue physics in college. During this presentation Carlos guided participating teachers through two lessons that could be used in their classrooms to help students reflect on the careers available to physicists and the ways in which girls can feel empowered to pursue these fields.

2. Summer 2020

Summer Exploration Series. Almost immediately after the call to shift to remote learning, CIRL began working on a safe program option to replace our in-person summer camps. The result was the MagLab Summer Exploration Series (SES) - an interactive virtual STEM program for middle and high school students. This 10-week program highlighted different research areas of the MagLab with live and asynchronous options for participants. All live activities were conducted via Zoom, which provided a platform for students to actively participate in sessions from any location. To accommodate all schedules, sessions were recorded and linked on the MagLab website. Since traditional summer camps can play a crucial role in maintaining youth's interest in STEM, the Summer Exploration Series was designed with the same goals as our summer camps: to maintain interest in STEM and engage youth in activities that connected them with STEM professionals and authentic STEM challenges. Each week focused on a specific research topic. Mondays were devoted to an introduction of the topic and the weekly challenge, along with SES hosts Carlos and Roxanne Hughes and a scientist or engineer who works in an area related to the week's topic. On Tuesdays, participants were given links to MagLab tutorials and videos to help them with their challenge. Many of these websites were educational content on Magnet Academy that connected with the topic of the week. On Wednesdays, Ask Me Anything interviews were conducted with a MagLab scientist or engineer. Participants were invited to ask the scientist or engineer questions about anything at all, ranging from their favorite part of their job, to their snack of choice. On Thursdays, participants viewed a prerecorded career interview. Finally, on Fridays, the hosts would showcase the challenges submitted by participants that week. Table 3.1 presents the full list of topics and presenters. At the conclusion of the program, students were mailed prizes for their participation in the challenges.

Table 3.1: Summer Exploration Series Topic and MagLab Staff Participation

Dates	***Topic***	***MagLab Guests***
Week 1	MagLab Overview	Alfie Brown (Safety), Tim Murphy (DC Field)
Week 2	Introductory Physics	Rachel Richardson (CMS Student), Shalinee Chikara (DC Field)
Week 3	Electromagnetism	Tim Murphy (DC Field), Dave Graf (DC Field), Laurel Winter (Pulse Field)
Week 4	Magnet Science & Technology	Todd Adkins (MS&T), Kikelomo Ijagbemi (MS&T Student), Tom Painter (MS&T)
Week 5	Engineering at the MagLab	Bryon Dalton (Magnet Operations), Morgan Oliff (Machine Shop), Thierry DuBroca (EMR)
Week 6	Superconductors & Cryogenics	Ernesto Bosque (ASC), Daniel Davis (ASC), Wei Guo (Cryogenics) Jamel Ali (Condensed Matter)
Week 7	Materials Science	Alyssa Henderson (Materials), Abiola Oloye (ASC Student), Jun Lu (MS&T), Elizabeth Green (DC Field)

Dates	Topic	MagLab Guests
Week 8	Biomedical & Pharmaceutical	Faith Scott (NMR), Huan Chen (ICR), Sam Grant (NMR)
Week 9	Biology & Chemistry	Martha Chacon (ICR), David Hike (NMR Student), Ryan Baumbach (Condensed Matter)
Week 10	Environmental & Earth/Space Science	Pete Morton (Geochemistry), Sydney Niles (ICR), Munir Humayun (Geochemistry)

Magnet Academy. The Magnet Academy is the outreach portion of the MagLab's website. Magnet Academy provides lesson plans, science demonstrations, and interactive activities for teachers, students, and parents. This page became a vital part of the Summer Exploration Series, with many of Tuesday's links connecting to tutorials, videos, or articles in Magnet Academy. Additionally, teachers used many of the videos during distance learning to demonstrate scientific principles. Table 3.2 shows the increase in page views for Magnet Academy over the previous year. Overall traffic increased dramatically in 2020, up more than 50% from 2019. The Try *This at Home* and *Watch and Play* sections each had a significant increase of traffic, 68% and 74% respectively. The highest increase was for the *Follow the Links* section, which saw an increase in views of 130%.

Table 3.2: Pageviews for Magnet Academy

MagLab Magnet Academy Section	2019 Pageviews	2020 Pageviews	Change
Magnet Academy	662,868	1,000,436	+50.92%
Watch & Play	380,179	662,502	+74.26%
Learn the Basics	36,234	37,011	+2.14%
Explore History	169,935	172,126	+1.29%
Try This at Home	45,332	76,479	+68.70%
Plan a Lesson	18,225	26,314	+44.38%
Follow the Links	3,446	7,949	+130.67%

SciGirls STEM Adventures. One of our longest running middle school programs is our SciGirls summer camps. In 2020, CIRL worked with our partner WFSU to create a television program to bring the message of SciGirls to our local Tallahassee community. Thanks to a generous donation from ATKINS Engineering, we were able to produce five 30-minute programs that highlighted local STEM education organizations, starting with the MagLab. Each episode included footage of the STEM organization, an interview with a female scientist role model, an interview with a SciGirls alumna that is now working in a STEM career, and a hands-on activity which was pre-recorded and conducted by a recent SciGirls alumna. Figure 3.4 shows a screenshot of Nia Terry a Tallahassee High School student (SciGirls 2019) interviewing Maati McKinney currently attending Spelman College in Atlanta (SciGirls 2011).

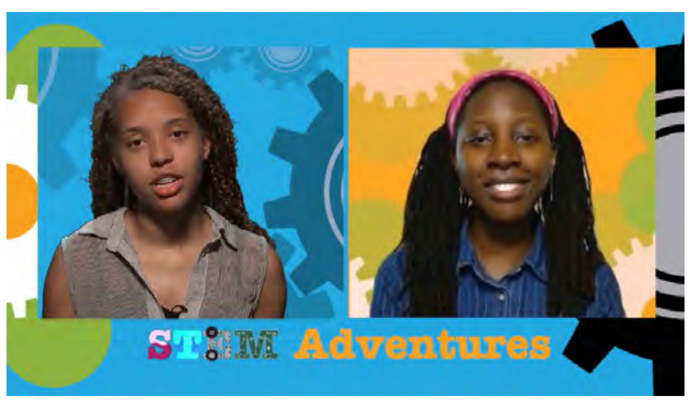


Figure 3.4: SciGirls alums Nia Terry (left) and Maati McKinney (right) discuss Maati's experience as a mathematics major at Spellman College.

3. Fall 2020

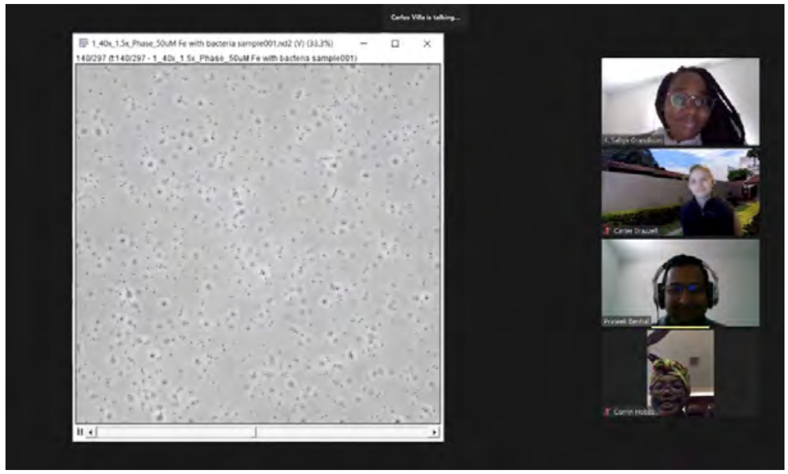


Figure 3.5: Middle School Mentorship students analyze motility of salmonella data during an experiment done through Zoom.

Middle School Mentorship. One of CIRL's premier educational and mentoring programs is our Middle School Mentorship program wherein local Tallahassee students are paired with a MagLab scientist to work on a research project for a full semester. In the Fall of 2020, CIRL transitioned the highly competitive MagLab Middle School Mentorship Program to an online format to enable students to have a science experience while maintaining social distancing protocols. The program included 17 students from 12 middle schools in Leon and Gadsden counties (FL), while 11 MagLab staff participated as mentors in this program. Mentors were able to translate the mentorship experience into the virtual space using two approaches: 1) working as a group to develop an experiment that the mentor would run, followed by students analyzing the resulting data with input from their mentor; and 2) working together online with materials that were sent to the students' homes as their mentors guided them through video conferencing. All of these mentors were incredibly creative and flexible as we worked through a unique form of mentoring.

Carlos facilitated weekly Zoom meetings wherein students met with their mentors every Friday morning for the entire fall semester. The program culminated in a virtual poster presentation session attended by the students' family, teachers, principals, and mentors. A full list of 2020 participants and their projects can be found on our website and in Table 3.3 below. A screenshot of two students working with their mentors can be seen in Figure 3.5.

Table 3.3: Middle School Mentorship 2020

Students & School	Research Area	Mentors
Selena Humayun (Swift Creek Middle) Khamari Williams *(Florida A&M University School)*	Building an efficient DC Motor	Elizabeth Green
Alisa Gubanova (Florida State University School) Jonjon She (Deerlake Middle)	Optimization of Electromagnets using different materials	Daniel Davis
Blake Rehbein *(Tallahassee School of Math and Science)* Kayla Washington *(Gadsden Elementary Magnet School)*	Coding Physics	Dmitry Semenov
Anthony Jimenez *(Fort Braden School)* Toshmon Stevens II *(Raa Middle)*	Everyday Materials: Microstructural Analysis	Abiola Oloye
Carter Brazzell (School of Arts and Sciences) Corrin Hobbs *(Florida A&M University School)*	Comparing the Motility of Salmonella typhimurium Before and After Ingesting Iron	Jamel Ali, Prateek Benhal, & Saliya Grandison
Sagar Bhat *(Fairview Middle)* Nishi Bhanderi (Maclay) Liliana Vizcarrondo (Montford Middle)	Quantum Computing	Paul Eugenio
Samitha Balireddy *(Fairview Middle)* Nicole Beam (Swift Creek Middle)	Exploration of Ultra-Low-Noise DC Power Supply	Guangxin Ni & Christina Schiffert
Sofia Evers (Maclay) Viswa Janapati *(Fairview Middle)*	Classification of Unknown Materials using the Experimental Method	Robert Walsh

Note: *Italics denote Title I schools*

High School Externship. In 2020, CIRL formalized the High School Externship program to facilitate an increased number of extern opportunities for local high school students. Several high schools in the Tallahassee area offer externship programs where students receive coaching on working in a professional setting through a course at their school, and are placed with a professional in their community to gain real-world experience in a field in which they are interested. CIRL partnered with these local high schools to provide placements for students looking for an externship opportunity in science and engineering. Local high school students contacted Kari to express their interest in securing an externship placement at the MagLab. She helped each interested student identify a potential mentor, then coached the students on how to contact and make connection with potential mentors. Twelve students are currently participating in this program. During the school year, CIRL has helped mentors develop projects for the students that align with their interest and ability levels, provided guidance to the mentors on mentoring in a virtual environment, and connected students to additional resources as needed. Externship students will continue working with their mentor through the spring semester of 2021 and will present a final poster describing the work they have done with their mentor over the course of the school year. A full list of students and mentors are presented in Table 3.4.

Table 3.4: High School Externship 2020-2021

Student	School	Mentors
Nicholas Bosque	Lincoln High School	Dmitry Semenov
Spencer Gibbs	Maclay School	Kaya Wei
Aaron Hoak	Lawton Chiles High School	Jun Lu
Antariksha Krishnan	Lawton Chiles High School	Rama
Annette Lu	Maclay School	Ilya Litvak
Alexus Manners	Lincoln High School	Martha Chacon Patino
Katie Matthews	Maclay School	Jamel Ali
McKenna Parker	Lincoln High School	Martha Chacon Patino
Vamsi Posinasetty	*James S. Rickards High School*	Kari Roberts
Timi Sobanjo	Lawton Chiles High School	Jamel Ali
Azaria Varnado	Lawton Chiles High School	Bianca Trociewicz
Audrey Wright	Lawton Chiles High School	Tom Painter

Note: *Note: Schools in italics are Title I schools*

Although we were able to hold three virtual K-12 programs in 2020, we made the decision to cancel the following programs: Research Experience for Undergraduates, Research Experience for Teachers. In discussions with our scientist mentors and local administrators we felt that these research experience programs were most impactful when participants can come and work side-by-side with scientists at the MagLab. Many of our scientist mentors did not believe that they could transition to virtual programming in time for the summer. To honor their time and research priorities, we believed that canceling the summer in-person programs was the safest option for everyone. Despite the cancellation of summer camps and the REU and RET programs, the diversity of participants in the remaining virtual programs was worth of highlighting and can be found in Table 3.5.

Table 3.5: Demographics for Programs held in 2020

	Total	% Women	% African American	% Hispanic	% American Indian/Native Hawaiian
Middle School Mentorship (Fall 2020)	17 middle school students	47.1%	23.5%	17.6%	0%
Externship (2021-2022 academic year)	12 high school students	58.3%	16.7%	8.3%	8.3%

	Total	% Women	% African American	% Hispanic	% American Indian/Native Hawaiian
Summer Exploration Series (Summer 2020)	86 K-12 students	39.0%	16.9%	7.2%	4.8%

Graduate Students and Postdocs

Prior to March 2020 CIRL provided traditional, in-person support through professional development and mentoring for MagLab graduate students and postdocs, including one in-person workshop for these early career scientists. Kari tailored the Inclusive Graduate Education Network (IGEN) training that she participated in at the National Postdoc Association meeting for MagLab mentees and mentors. CIRL's workshop, *Optimizing Mentoring Relationships by Aligning Expectations*, covered key issues for mentors and mentees, such as how to set expectations and goals for a mentoring relationship. It also provided a space for mentees and their mentors to develop tools and strategies for maximizing their relationship to accomplish their goals while at the lab. The workshop was positively received, and both mentees and mentors expressed interest in seeing more of the curriculum. Roxanne Hughes and Kari have been working with representatives from the Center for the Improvement of Mentored Experiences in Research (CIMER) who are leading an NSF funded effort to update the IGEN curriculum for national labs. Throughout 2020, they worked with representatives from Argonne National Lab and NASA Jet Propulsion Lab to adapt the IGEN mentoring curriculum and piloted the updated curriculum with a small group of MagLab faculty in November 2020.

Scientist Outreach

In 2020, 54 scientists and staff reported conducting outreach to communicate information about the MagLab to the community. Together, these scientists reached 1,942 people in 2020, the majority (54.4%) of which were K12 students. Of the 54 scientists who conducted outreach in 2020, 32 conducted long-term outreach working with K12 or undergraduate students. These scientists mentored a total of 57 individuals this year. Of these individuals, 40 (70.2%) were matched with their mentor through a CIRL program.

Figure 3.6: Julia Smith asks two young STEM learners questions during MagLab Science Night at the Library in January 2020.

One of our most noteworthy examples of this was *Julia Smith*, DC Field, who partnered with the Leon County Public Library to host a monthly science night at the Leon County main library branch. Two science nights were hosted in-person in January and February 2020. Figure 3.6 shows one of these science nights. At these sessions, community members participated in a hands-on science activity led by Julia Smith. For the 2020-2021 school year, Julia Smith has translated these science nights into virtual outreach programs for families and students. Julia Smith presents an activity via a live Zoom session, and attending students are encouraged to try the activity on their own. Any student who completes the activity and sends Julia Smith a photo, video, or description of their results receives a prize.

Evaluation and Research

1. Evaluation

Evaluation for MagLab educational programs is conducted by Kari Roberts, using the latest guidance and best practices for evaluation as outlined by experts in evaluation and the social sciences, and the National Science Foundation. All education programs at the lab are evaluated, and results are shared with program managers every year to allow for data-driven decision-making in planning programs for future years. Primary metrics for each program are determined based on the program's goals and mission and measured using appropriate methodology. Evaluation methodology for each program conducted in 2020 is described briefly below in Table 3.6.

Table 3.6: Evaluation Description for MagLab Education and Outreach Programs

Program	Form of Evaluation
Classroom outreach	Post-survey to teachers after outreach conducted (formative evaluation), post-survey to students who come to the lab for outreach.
Summer Exploration Series	Weekly surveys to participants, post-program survey, and web platform metrics which measure student's attendance in SES events, engagement at SES events, participant satisfaction, and participant knowledge of new topics and careers.
Middle School Mentorship	Pre-/Post-survey measuring STEM Identity, STEM Self-Efficacy, perceptions of scientists and science careers.
Graduate Student/Postdoc Professional Development	Survey to current postdocs in conjunction with the lab's climate survey to determine professional development needs and assess mentoring and regular tracking of graduate students and postdocs to determine career trajectories.
Winter Theory School	Post-survey assessing participants perceived value of the Winter Theory School and how they will apply what they learned in the program.
Open House	Post-experience surveys and brief interviews given to attendees of the annual Open House to assess perceived benefits of the annual Open House and provide feedback for future years.

The pivot to online programming in 2020 posed new challenges for program evaluation of informal science education (ISE) programs. ISE summer programs across the country, including those in CIRL, were required to rapidly shift focuses and formats. Program evaluation design traditionally shifts with programs as they change, and rapid changes in programs required an equally rapid shift in program evaluation methodology. Thanks to the structure of CIRL and the center's history of commitment to data-driven decision making and program design, we were able to maintain the established rigor in program evaluation design at a time when other centers were not. The program that marked the most significant change to its pre-COVID counterpart was the Summer Exploration Series (SES). Kari worked in tandem with the SES program director and Roxanne Hughes to develop an appropriate evaluation methodology as the program took shape and evolved.

The primary goals of the SES evaluation plan were to:

1. Assess whether the program goals had been met.
2. Measure the attendance and engagement for each activity in the program.
3. Measure student perceptions of each activity in the program.
4. Provide data-driven suggestions for improving the program should CIRL choose to run the program again in future years.

In order to accomplish these goals, the evaluation plan leveraged several data sources, each of which is presented in Table 3.7.

Table 3.7: Summer Exploration Series Evaluation Tools and Metrics

Tool	Frequency and Timing	Associated Metrics
Program Registration Form	Students completed this form one time at the beginning of their participation.	Demographics
End of Week Survey	Students completed this survey once per week, at the end of each week of the 10-week program.	Student Satisfaction, Attendance, Student Learning
End of Program Survey	Students completed this survey once at the end of the program. This survey was combined with the Week 10 weekly survey.	Student Satisfaction
YouTube Metrics	Metrics were pulled by the manager of the MagLab YouTube channel once per week, for the previous week's metrics.	Attendance and Engagement
Zoom Attendance Reports	Attendance reports were downloaded after each session and reviewed by the evaluator once per week	Attendance
Zoom Chat Transcripts	Chat transcripts were downloaded after each session and reviewed by the evaluator once per week	Engagement
Weekly Challenge Submissions	Program Manager uploaded the submissions each week and reviewed by the evaluator once per week	Attendance

Operational definitions for attendance and engagement were developed prior to the start of the program. Calculation of these metrics leveraged YouTube metrics, Zoom reports (attendance and chat), and the weekly challenge submissions. Table 3.8 reports which data collection methods were used to measure attendance and engagement for each element of the SES program.

Table 3.8: Evaluation Data Collection

Program Element	Operational Definition of Attendance	Data Source for Attendance	Operational Definition of Engagement	Data Source for Engagement
MWF Live Sessions	Attendance count at live session	Zoom attendance summary	Number of relevant questions asked by students	Zoom chat transcript
Tuesday Links Exploration	Count of students who self-reported that they completed the Tuesday activity on the weekly survey	YouTube metrics	Audience Retention/ average percent of video watched in each week (Monday to Sunday of each week)	YouTube metrics
Thursday Career Videos	Unique viewers of the videos in each week (Monday to Sunday of the week)	YouTube metrics	Audience Retention/ average percent of video watched in each week (Monday to Sunday of each week)	YouTube metrics
Weekly Challenge	Count of challenge submissions for each week	Challenge submissions	None	None

The final evaluation plan resulted in the collection of rich quantitative and qualitative evaluation data which provided valuable feedback on all elements of the program (both during and after the program concluded), as well as insights into the success of the program overall. At the conclusion of the program, CIRL was able to use the results of the evaluation to make data-driven decisions on how this program should be modified in the future. Additionally, the unique experience of evaluating a program in a purely virtual setting yielded valuable insights on how traditional evaluation methodology can be adapted to provide feedback to informal educators who continue to navigate an uncertain future with virtual programming. CIRL plans to disseminate the lessons learned from the evaluation of the SES plan to a national audience via publications and conference presentations in 2021.

2. Educational Research

A cornerstone of CIRL's programs is that they are developed based on research conducted by CIRL staff. Our research not only informs our MagLab programs but adds to scholarship for K-16 informal STEM education and mentoring programs nationally. In 2020, Roxanne Hughes continued to lead CIRL's research efforts focusing on the impact of informal STEM education programs on participants' STEM identity. In 2020, CIRL staff had two publications that added to the STEM identity dialogue.

- Hughes, R., Schellinger, J., Billington, B., Britsch, B., & Santiago, A. (2020). A Summary of Effective Gender Equitable Teaching Practices in Informal STEM Education Spaces. Journal of STEM Outreach, 3(1). https://www.jstemoutreach.org/article/18529-a-summary-of-effective-gender-equitable-teaching-practices-in-informal-stem-education-spaces
- Hughes, R., Schellinger, J., & Roberts, K. (2020). The Role of Recognition in Disciplinary Identity for Girls. Journal of Research on Science Teaching. DOI:10.1002/tea.21665

In 2020, Roxanne Hughes became a co-PI on an NSF Quantum Convergence grant. She is working along with Tim Murphy and Amy McKenna as well as the lead PIs at Morgan State University to develop a quantum literacy curriculum for K-12, undergraduates, and vocational students to broaden participation of underrepresented racial minorities in the quantum workforce. She was selected to be a part of this effort because her STEM identity research informs the development of programs that help marginalized students to thrive, not just survive, in STEM.

Public Outreach

Public outreach is run by the MagLab's Public Affairs team who continued to build broad trust and appreciation for science across all audiences throughout 2020. Public Affairs promotes the MagLab's work through news media coverage, events (both in-person and virtual), videos, interactive content, social media, and our print magazine (*fields*).

In 2020, the MagLab posted 14 news stories and was included in more than 250 media articles reaching more than 506 million readers in Forbes, Business Insider, Scientific American and other local and national news outlets.

1. Website & Social Media

In 2020, the MagLab website received 1.59 million total pageviews, a 12% increase from 2019. The website also saw growth in key analytics for engagement, including a 17% increase in number of sessions, and a 13% increase in unique pageviews. The average time spent on page also increased by 18 seconds, an important indicator of engagement with page content.

Sections of the site, by percentage of all pageviews (Jan-Dec 2020):

Education	65.00
User Facilities	7.50
Homepage	6.00
About	4.98
News/Events	3.00
Research	2.45
Magnet Development	2.20
Staff	2.00
Personnel/Publication Database	1.95
User Resources	1.00

Throughout 2020, sections of the website with more education-based content experienced substantial growth as COVID impacted schools and changed where people accessed information. In particular, the Education section's pageviews increased 44.8% compared to 2019, a result of CIRL's efforts to move previously in-person content online coupled with a sudden increased demand for online learning. Meanwhile, the About section saw a 2% increase compared to 2019, for an overall increase of 137% since 2015. We also recorded our highest amount of weekly traffic ever in the one-week period of April 26-May 2 with nearly 50,000 page views. Similarly, April 2020 yielded our highest ever monthly traffic with over 182,000 page views, 24% higher than the same period in 2019.

To meet our audiences changing needs due to the expanded COVID pandemic, the MagLab's Public Affairs team also provided new and innovative online content in 2020 including downloadable Zoom backgrounds, virtual puzzles, SciBall trading cards, Combatting COVID feature stories, and a feature about what happens when scientists are out of the lab. Collectively, this new content has more than 5,100 pageviews.

The MagLab's social media accounts continued to grow and reach new and diverse audiences as well. Facebook followers grew 6.5% in 2020 and posts on the lab's Facebook account reached diverse audiences by age and gender (Figure 3.7). Likewise, the more than 550 tweets on the MagLab's Twitter account reached over 1 million people in 2020 with nearly 400 new followers added.

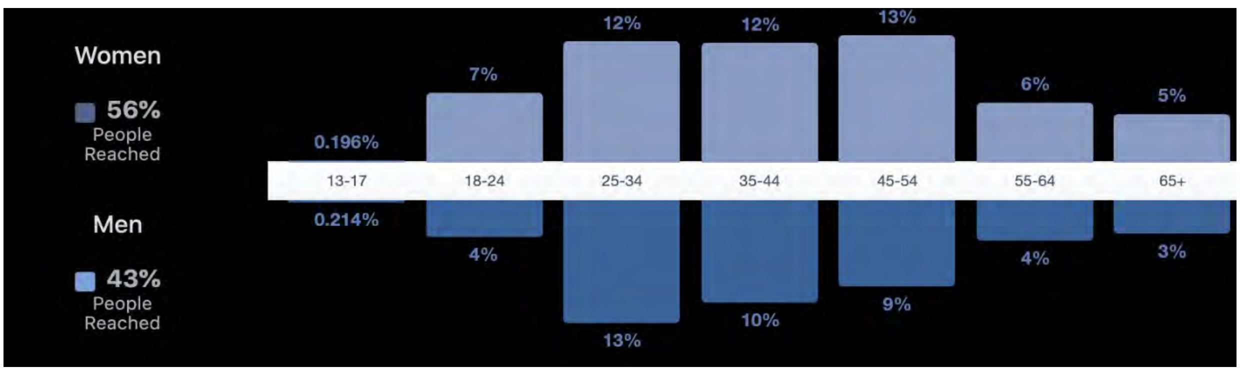


Figure 3.7: Breakdown of audience reached through Facebook posts (which is different from followers or fans).

The lab's LinkedIn account also gained over 460 followers and our LinkedIn posts in 2020 reached more than 105,000 people across diverse career levels and categories (Figure 3.8).

Followers on Instagram and Pinterest also continued to grow. The lab's Pinterest account skews younger with more than 50% aged 18-34, with a nearly 54% female audience.

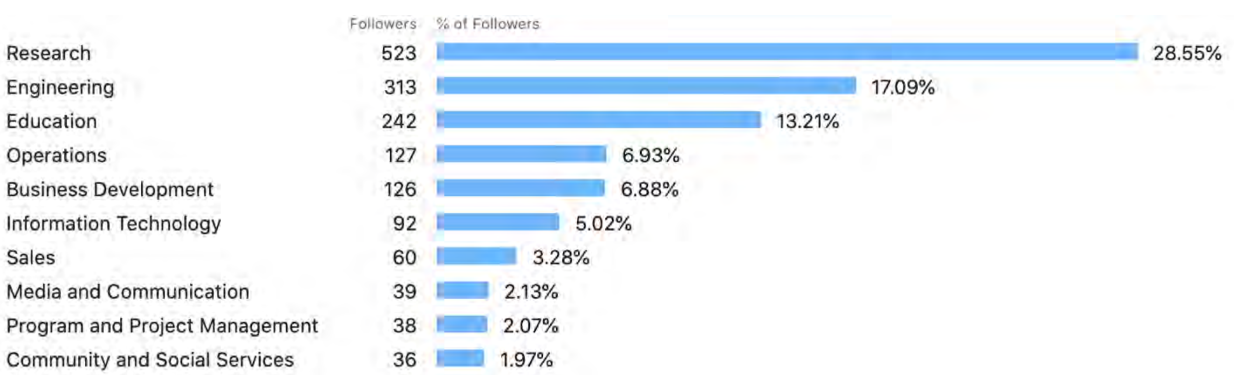


Figure 3.8: LinkedIn followers by career category 2020.

MagLab videos received more than 33 million impressions on YouTube in 2020 and were viewed 2.2 million times (Figure 3.9). The lab's YouTube channel added 28,500 subscribers and nearly 73,000 hours of MagLab videos were watched in 2020. As COVID shuttered schools in Spring 2020, demand for MagLab videos grew substantially. From March 1st-June 1st we had:

- 7.2 Million impressions
    - 14% higher than the same period in 2019
    - 24% higher than the first quarter of 2020
- 507,000 views
    - 13% higher than same period last year
    - 40% higher than first quarter of 2020
- 17.5K hours of watch time
    - 9% higher than same period last year
    - 41% higher than first quarter of 2020

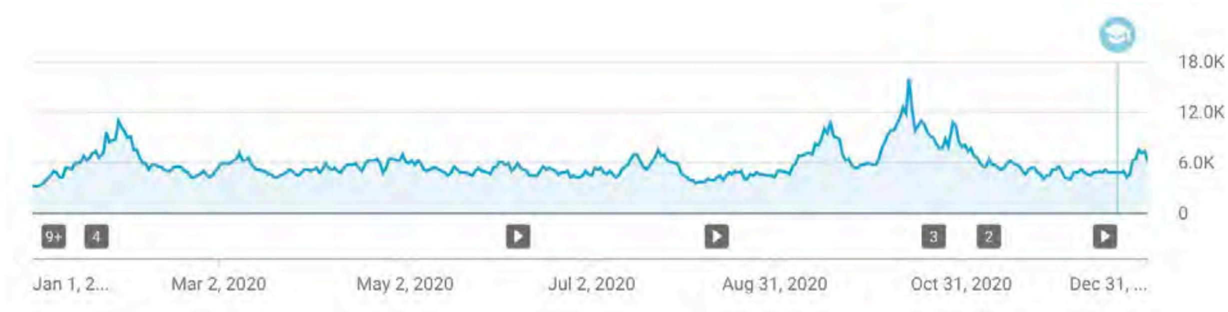


Figure 3.9 YouTube views throughout 2020.

Other peaks in views coincide with the release of new videos and schools restarting in the fall. Nearly 15% of the MagLab's YouTube watchers are female and audiences come from all ages and around the world (Figure 3.10). Outside of the United States, the MagLab's YouTube audience is mostly from India, The Philippines, Indonesia, Pakistan, Bangladesh, United Kingdom, Canada, Malaysia, Turkey, and Sri Lanka.

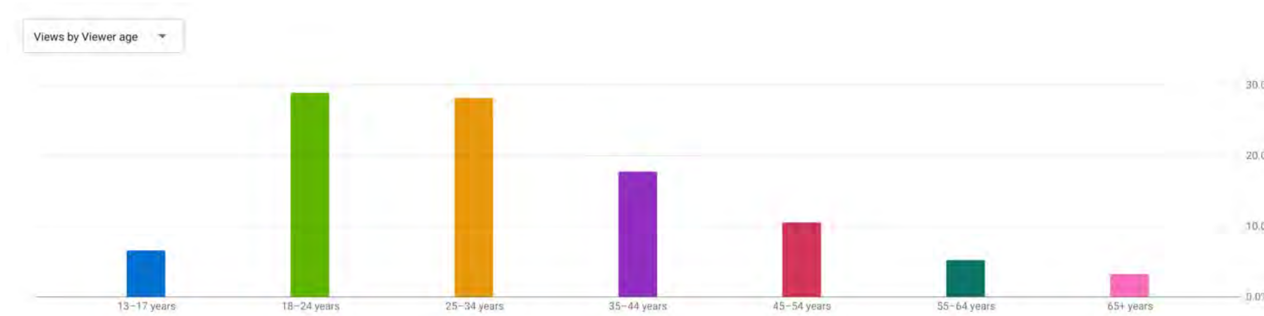
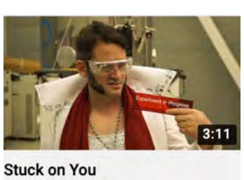


Figure 3.10 YouTube viewers by age, 2020.



The most popular videos on the MagLab's YouTube channel continue to be the See-Thru Science video series which shows viewers what electricity and magnetism might look like if they weren't invisible. In 2020, the lab released 28 new videos including an Elvis parody music video called "Stuck on You" which earned 41,000 impressions and about 2,000 views.

2. Events

Before Florida was impacted by COVID, The MagLab was fortunate to host an in-person Open House event in celebration of the lab's 25th anniversary in February 2020, prior to being impacted by COVID. With a special "time" theme, more than 10,000 visitors enjoyed classic MagLab demos and dozens of new experiences including the ability to turn back time with a laminar flow demo, timed radar races, ancient geological samples, how everything from your body's circadian rhythm to atomic clocks tick, and some special Dr. Who demos. Visitors of all ages were also invited to a Travel-Through-Time Scavenger Hunt, and to predict the future in a Time Vault that will be opened at the MagLab's 50th Open House in 2045 (Figure 3.11).

Figure 3.11 Pictures from 2020 Open House on February 22.

As the continuing COVID pandemic changed the nature of "events," the MagLab partnered with local organizations to offer special events in the online space including a TechTopic talk hosted by the Leon County Research and Development Authority on thermo-electric materials and several Museum Mixology virtual lectures hosted by the Tallahassee Museum on topics ranging from asphaltenes to Earth's ancient crust.

3. Fields Magazine

Stories of high field science from across the globe continued to be featured in fields magazine in 2020 (Figure 3.12). While the COVID pandemic changed the lab's print distribution plans, two new issues were released in 2020 and the fields website earned more than 10,500 pageviews. These issues featured environmental stories on PFAS and asphaltene work at the MagLab as well as features on magnetic fields for recycling in Europe and a look at the worldwide work on metal organic frameworks.

Figure 3.12 Covers of two issues of fields release in 2020.

3.2. CONFERENCES AND WORKSHOP

Each year, the National MagLab hosts or sponsors a variety of workshops and conferences related to high magnetic field research (Table 3.9). While the COVID pandemic altered some of the MagLab's offerings, we are proud to have pivoted many of our meetings to still offer them in the virtual space.

Table 3.9: List of 2020 sponsored workshops and conferences

Event	Date	Location	Description	Attendees	In Person/ Virtual
Theory Winter School	Jan 6 to 10, 2020	Tallahassee, FL	The National MagLab held its 8th Theory Winter School focused on Quantum Matter Without Quasiparticles. This development shed new light on open questions of quantum criticality, unconventional superconductivity, and new types of topological phases	80	In person

Event	Date	Location	Description	Attendees	In Person/ Virtual
			of matter. The tentative topics of the school include electron transport without quasiparticles, Sachdev-Ye-Kitaev models, novel phases in twisted bilayer graphene, fraction topological phases, deconfined quantum criticality, and many-body localization.		
Convergence Research in High Magnetic Fields	Jan 9 & 10, 2020	Tallahassee, FL	A scientific symposium and festschrift celebration to honor Greg Boebinger and his contributions to convergence research in high magnetic fields in celebration of his 60^{th} birthday.	119	In person
User Workshop	Sept 14 & 15, 2020	N/A	A two-day workshop on the topic of quantum spin coherence featuring talks from across the MagLab's user community.	160	Virtual
User Committee Meeting	Sept 16 to 18, 2020	N/A	An annual meeting of users who represent the laboratory's broad multidisciplinary user community and advises lab leadership on all issues affecting users of our facilities.	120	Virtual
Applied Super-conductivity Conference	Oct 24 to Nov 7, 2020	N/A	An important meeting for the electronics, large scale, and materials fields within the applied superconductivity community. The conference featured 1357 presentations (486 contributed/ invited talks, 856 posters/ invited posters, and nine plenary talks) during the five days of the conference. More than 500 manuscripts were submitted for peer review in the Special Issue of the IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY; An exhibition took place during the conference with the participation of 63 companies from 15 countries.	1,630 from 39 countries (370 of whom were students)	Virtual

3.3. BROADENING OUTREACH

In addition to the Diversity and Education sections of this report which speak to the MagLab's work to broaden participation through education and outreach, MagLab staff regularly take advantage of conferences and workshops to share information about the lab's user program with diverse researchers from around the globe. Each talk, presentation, poster or abstract opportunity provides the chance for scientists to learn more about the lab's research capabilities and broaden our user program to new scientists from across disciplines and career level – from graduate students and postdocs to tenure track faculty.

In 2020, MagLab staff gave 164 lectures, talks and presentations to organizations around the country and the world (Figure 3.13). Because of the global impacts of COVID, many national and international meetings were cancelled or pivoted to the virtual space. As such, more than 67% (110) of the 2020 MagLab presentations were conducted virtually (Figure 3.14), but the MagLab is proud to have continued the important work to broaden participation through outreach and presentations at prominent meetings and conferences including the 259th

Figure 3.13 Breakdown of 2020 Presentations given virtually or in-person.

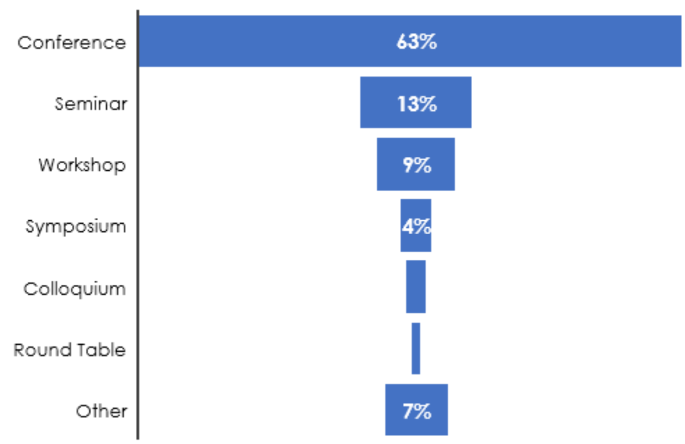


Figure 3.14 2020 Presentation types.

ACS National Meeting and Expo, the 61st Experimental NMR Conference, ASC 2020, the 2020 Gulf of Mexico Oil Spill and Ecosystem Science Conference, ASMS 2020, Biomedical Engineering Society Virtual Annual Meeting, 51st Lunar and Planetary Science Conference, Conference for Undergraduate Women in Physics (CuWiP) and Low Temperature/High Field Superconductor Workshop.

4. In-house Research

Cryogenics

1. CRYOGENICS

The Cryogenics Laboratory located at the National High Magnetic Field Laboratory is a fully developed facility for conducting low temperature experimental research and development. A number of specialized experimental equipment are available in the lab, which include the Cryogenic Helium Experimental Facility (CHEF) for horizontal single and two-phase heat transfer and flow research, the Liquid Helium Flow Visualization Facility (LHFVF) for high Reynolds number superfluid helium (He II) pipe flow visualization research, the Laser Induced Fluorescence Imaging Facility (LIFIF) for high precision molecular tagging velocimetry measurement in both gaseous and liquid helium, and the Cryogenic Magnetic Levitation Facility (CMLF) for studying cryogenic fluid hydrodynamics in controlled gravity environment. The laboratory supports in-house development projects as well as contracted scientific work directed by Prof. Guo in the Mechanical Engineering department at the FAMU/FSU College of Engineering. Currently, the three major research foci of the cryogenics lab include: 1) fundamental turbulence and heat transfer research in cryogenic helium; 2) quench spot detection for accelerator cavities; 3) catastrophic loss of vacuum in liquid helium cooled pipes. These research activities are supported by external funding agencies including the National Science Foundation, the Department of Energy, the Army Research Office, and our industrial partners.

Turbulence research with He II

Many flows in nature have extremely high Reynolds (Re) or Rayleigh (Ra) numbers, such as those generated by flying aircraft and atmospheric convection. Better understanding of these flows can have profound positive impacts on everyday life, such as improving the design of energy efficient applications and our understanding of climate change. To achieve large Re values in a laboratory, the common route is to increase the characteristic length of the flow, which normally requires the construction of expensive and energy consuming large-scale flow facilities and wind tunnels. An alternative method is to use a fluid material with very small kinematic viscosity. At the cryogenics lab, we adopt helium-4 as the working fluid. Helium-4 has extremely small kinematic viscosity (3 orders of magnitudes smaller than that for air) which enables the generation of highly turbulent flows in compact table-top equipment. Furthermore, when helium-4 is cooled below about 2.17K, it undergoes a phase transition into a superfluid phase (He II), which consists of two miscible fluid components: a viscous normal component and an inviscid superfluid fluid component. Turbulence in He II is a cutting-edge research area that is important both in fundamental science and in practical applications of He II as a coolant. In order to make quantitative flow field measurements, we have developed two powerful flow visualization techniques. One is the molecular-line tagging velocimetry technique, which is developed based on tracking thin lines of He II excimer tracers created via femtosecond-laser field ionization of helium atoms. A particle tracking velocimetry (PTV) method in He II using seeded micron-sized frozen hydrogen particles has also been developed and implemented (see Figure 4.1). The application of these techniques to the study of heat-induced

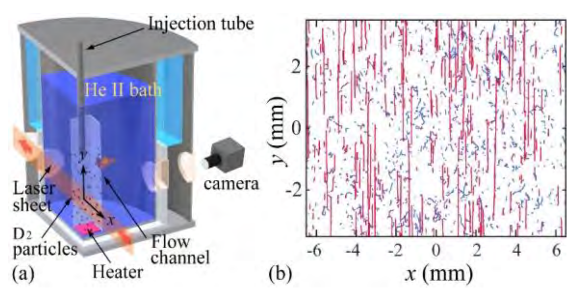


Figure 4.1: (a) A schematic diagram of our PTV counterflow setup. (b) Representative tracks obtained at 1.85K and 38mW/cm^2 for particles trapped on vortices (blue) and entrained by the normal fluid (red).

counterflow in He II has revealed a novel form of turbulence, the characterization of which is critical for the development of a theoretical model that could describe the complex two-fluid dynamics in various quantum fluids systems. We have also designed and fabricated sophisticated towed-grid system for studying turbulence in He II generated via mechanical forcing. This system has allowed us to examine both the vortex dynamics and the motion of the thermal component in He II, which has led to a number of publications:

- X. Wen, S. Bao, L. McDonald, J. Pierce, G.L. Greene, L. Crow, X. Tong, A. Mezzacappa, R. Glasby, W. Guo, and M.R. Fitzsimmons, "Imaging fluorescence of $^4He_2$ excimers created by neutron capture in liquid helium II", Phys. Rev. Lett., 124 , 134502 (2020). Selected as Editor's Suggestion.
- S. Yui, H. Kobayashi, M. Tsubota, and W. Guo, "Fully coupled dynamics of the two fluids in superfluid 4He: Anomalous anisotropic velocity fluctuations in counterflow", Phys. Rev. Lett, 124, 155301 (2020).
- H. Sanavandi, S. Bao, Y. Zhang, R. Keijzer, W. Guo†, and L. N. Cattafesta III, "A cryogenic-helium pipe flow facility with unique double-line molecular tagging velocimetry capability", Rev. Sci. Instrum., 91, 053901 (2020).
- Y. Tang, S. Bao, T. Kanai, and W. Guo†, "Statistical Properties of Homogeneous and Isotropic Turbulence in He II Measured via Particle Tracking Velocimetry", Phys. Rev. Fluids, 5, 084602 (2020).

Quench spot detection for accelerator cavities

Many modern particle accelerators utilize superconducting ratio-frequency (SRF) cavities, cooled by He II, to accelerate charged particles. There is a strong demand to reach ever higher accelerating fields in these cavities so that the particles can gain higher energies over shorter distances. The prospect of shorter accelerator beamlines is very significant due to the high costs of typical accelerators. The maximum accelerating field of SRF cavities is limited by cavity quenching caused by Joule heating from tiny resistive defects near the cavity surface (i.e., quench spots). By locating and subsequently removing the defects, the maximum accelerating field can be significantly improved. Therefore, a long-standing research effort in the accelerator field is to develop reliable methods to detect those sub-millimeter defects. Our lab is active in developing novel technologies for surface quench spot detection based on our molecular tagging flow visualization in He II. We have conducted a proof-of-concept experiment using a miniature heater to simulate a quench spot and have demonstrated hot-spot detection with an unprecedented resolution. Recently, an imaging scheme for hot spot detection in 3D space is developed. Our work has the potential to advance the state-of-the-art of accelerator cavity diagnostics. Recent papers include:

- S. Bao and W. Guo, "Quench spot detection for superconducting accelerator cavities via flow visualization in superfluid helium-4", Phys. Rev. Applied, 11, 044003 (2019).
- S. Bao, T. Kanai, Y. Zhang, L. N. Cattafesta III, W. Guo, "Stereoscopic detection of hot spots in superfluid helium-4 for accelerator-cavity diagnosis", Int. J. Heat Mass Tran., 161, 120259 (2020).

Loss-of-vacuum heat and mass transfer

SRF cavities in linear accelerators are operated with high vacuum inside, while being immersed in a bath of LHe (typically He II around 2K). A string of SRF cavities housed in a cryomodule essentially forms a long LHe cooled vacuum tube (i.e., the beamline tube). An accelerator can experience a catastrophic breakdown if the cavities accidently lose their vacuum to the surrounding atmosphere. To understand this vacuum break process and to aid the development of accelerator cryogenics safety protocols, our lab has launched a project to study nitrogen gas propagation in a purposely designed helium-cooled tube system and has developed a theoretical model to interpret the gas dynamics and the heat transfer process. Recent representative publications include:

- N. Garceaua, S. Bao, and W. Guo, "Heat and mass transfer during a sudden loss of vacuum in a liquid helium cooled tube - Part I: Interpretation of experimental observations", Int. J. Heat Mass Tran., 129, 1144-1150 (2019).
- S. Bao, N. Garceau, and W. Guo, "Heat and mass transfer during a sudden loss of vacuum in a liquid helium cooled tube - Part II: Theoretical modeling", Int. J. Heat Mass Tran., 146, 118883 (2020).

In the reporting period, we have also conducted numerical study of merging rotating superfluids. When rotating classical fluids merge together, the viscous shear force at the interface can lead to the formation of vortical structures [28], the drifting of which assists angular momentum (AM) advection from one fluid body to another. However, for invisid quantum fluids such as He II or Bose-Einstein condensates (BECs), little is known on what flow structures may form at the interface and how the AM transfer is achieved. We conducted numerical studies of the merging dynamics of a rotating BEC with a static BEC in both 2D and 3D space. During the condensate merging, we observed the spontaneous formation of spiral soliton lines in the 2D case and corkscrew-shaped soliton sheets in the 3D cases (see Figure 4.2). These soliton structures enable fast AM transfer, even in the absence of fluid advection and vortex drifting. A close examination of the flow field around these soliton structures reveals strikingly that their sharp endpoints (2D case) or edge lines (3D case) can induce flows like a point vortex or a vortex line but effectively with a fraction of a quantized circulation. Furthermore, we discovered that the AM transfer is achieved via a novel mechanism: the soliton structures can exert a torque that directly creates AM in the initially static BEC and annihilates AM in the rotating BEC. These discoveries not only enrich our knowledge of BEC merging dynamics but may also benefit the study of various other rotating superfluid systems, such as the merging of spinning neutron stars and the collision of revolving galactic dark matter halos that are believed to form BECs. Relevant publications include:

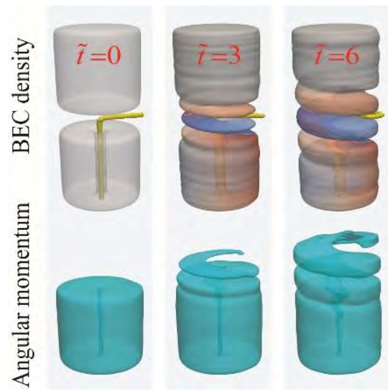


Figure 4.2: Time evolution of the density and angular momentum in the merging of a rotating BEC with an initially static BEC.

- T. Kanai, W. Guo†, M. Tsubota, and D. Jin, "Torque and Angular Momentum Transfer in Merging Rotating Bose-Einstein Condensates", Phys. Rev. Lett., 124, 105302 (2020).
- T. Kanai, W. Guo†, and M. Tsubota, "Merging of rotating Bose-Einstein condensates", J. Low Temp. Phys., 195, 37-50 (2019).

On the education side, our research has allowed us to educate both graduate and undergraduate students, as well as postdoc researchers. Over the past a few years, we have engaged more than 10 undergraduate students (including four females) and six graduate students in our quantum fluids research. These graduate students include Jian Gao, Brian Mastracci, Andrew Wray, Toshiaki Kanai, and visiting students Alex Marakov (from University of Florida) and Emil Varga (from Charles University in Prague). The training that these students have received makes them well-prepared for their careers. Jian, Brian, and Andrew are research scientists at the Facility for Rare Isotope Beams, the Jefferson National Lab, and the Lawrence Livermore National Lab, respectively. Alex joined the quantum computing team at Northrop Grumman, and Emil is now a postdoc at University of Alberta. Toshiaki will continue to be supported in the proposed research. Among the undergraduate students, Onyewychi Ebere has been recruited as a graduate student at Florida A&M University, an HBCU.

Geochemistry

2. GEOCHEMISTRY

Overview

The facility primarily investigates natural processes, both recent and ancient, through the analysis of trace element contents and isotopic compositions.

Introduction

The Geochemistry Program's main funding is through grants from the Geoscience directorate at NSF and NASA. On average, the program has fifteen active grants with an average budget per grant of $100,000/year. All tenure-track faculty have their appointments in FSU's College of Arts and Sciences. This year, Geochemistry Program member Jeremy Owens was named Sloan Research Fellow. The fellowship is awarded to early career scientists who are selected based on their scientific accomplishments, creativity and potential for innovative research. Challenges related to the COVID crisis included restricted laboratory activities and a post doc detained while on a scientific expedition due to travel restrictions. We were not able to host outside users, involve undergraduate students or mentor high and middle school students.

The facility has seven mass spectrometers, which are available to outside users. Three instruments are single collector inductively coupled plasma mass spectrometers for elemental analysis, one of which is dedicated to *in-situ* trace element analyses on solid materials using laser ablation. The other two are dedicated to elemental analyses of solutions. The facility has four mass spectrometers dedicated to determination of isotopic compositions. One is a multi-collector inductively coupled plasma mass spectrometer (NEPTUNE) used for determination of isotopic abundances of metals. A second is a thermal ionization multi collector mass spectrometer, which is mainly used for Sr-isotopic compositions. The third mass spectrometer is designed for the measurement of the light stable isotope compositions (C, N O). A fourth mass spectrometer is dedicated to sulfur isotope analyses.

Publications and Outreach

The program members have published 31 peer-reviewed publications and an even greater number of presentations at meetings and invited presentations at other institutions. Almost all of those were done virtually. The program normally involves a large number of undergraduate students as well as REU summer interns in its research. However, this past year's activity was limited.

Science Highlights

Ocean deoxygenation related to modern climate change has become an increasingly urgent issue. There is an increased need to better constrain low but non-zero oxygen concentrations using sedimentary geochemical tracers to provide evidence for past natural variations. To date, most redox proxies are not sensitive to such variations. Our research investigates the vanadium (V) isotope variations of modern marine sediments deposited under a range of redox environments (Wu et al., 2020 *Geochim. Cosmochim. Acta*). Our results document how changes in local redox conditions impart a significant isotopic fractionation from seawater as recorded in the local sedimentary V isotopic signature. Our results highlight the direct link between authigenic marine sedimentary V isotope compositions and the overlying local redox conditions. This investigation of V isotopes in modern marine environments provides an initial framework for the utilization of V isotopes. This work will help to investigate ancient climate events to better constrain ranges and rates of natural variation in oxygen contents of our oceans to potentially constrain future implications.

A second highlight concerns the work of post doc Shuying Yang published in *Science Advances* showing that recycled oceanic crust plays an important role in the chemical enrichment of volcanic rocks with implications for the history of plate tectonics on Earth. The planet is encircled by a 40,000km chain of underwater volcanoes that erupt basalt and build the oceanic crust in all ocean basins. The chemistry of these basaltic lavas exhibits a distinct depletion in elements that readily enter melt from the mantle that form the Earth's crust. Such incompatible elements are partly stored in the continental crust over billions of years and partly recycled back into the mantle by plate tectonics. Yang et al. developed a chemical fingerprint for the recycled crust using the ratio of the abundances of germanium (Ge) and silicon (Si). Recycled crust melting beneath the ridges retains Ge preferentially to Si, and these melts extract incompatible elements from the recycled crust. Addition of melts derived from recycled crust compensates, even over-compensates, for the losses of incompatible elements in the mantle source creating chemical-enriched lavas. Yang et al. calibrated the amount of recycled crust estimated from the Ge/Si ratio to a more abundant dataset of potassium and titanium in lavas to estimate the global extent of recycled crust beneath the oceanic ridges. That number is vital to understanding how long plate tectonics has operated on Earth. The final word on the history of plate tectonics may not have been written, but the Ge/Si ratio is a new chemical proxy that allows us to finally get an empirical handle on that long-vexing question.

A third highlight is our research related to coastal shorelines and shelves that show to play major transformative roles in the supply of bioactive trace metal nutrients to the open ocean. In a series of four papers published by Morton and colleagues in late 2019 and 2020, continental shelves adjacent to the Arctic and western North Pacific margins were found to release high concentrations of redox active metals such as Fe, Mn, and Co to the ocean but trap other metals like V near the coast. Coastal currents transported these enriched plumes hundreds of km from their origin, but concentrations steadily decreased with distance as the dissolved metals were transformed to the particulate phases through geochemical and biological processes. In general, these authigenic and biogenic particles eventually settle out of the water column to the benthic sediments, but biologically produced organic ligands could interrupt this process by preserving the metals in the dissolved fraction and prevent their transformation to settling particles. Furthermore, the enriched plumes followed along isopycnal or isohaline surfaces, allowing the circulation of these metals to be traced throughout the different ocean basins in specific water masses.

Progress on Stem and Building the User Community

The facility is open to users of all disciplines, and we have a long-time collaboration with the USGS and the South Florida Water Management District. Due to the COVID restrictions the number of outside users, undergraduate students and 9-12 students we mentor was limited. Graduate student users are 65% female. Within the area of Geosciences, the faculty has collaborations with researchers throughout the US, Europe as well as Asia. The disciplines for which we do service analyses at a more local level range from magnet science to pharmacy and anthropology.

3. CMS/ UF PHYSICS/ UF CHEMISTRY

CMS

CMS

Here we present a few exciting research discoveries from both our teaching and research MagLab faculty that are not driven by our users but by our faculty themselves. The strength of our MagLab faculty's in-house science is crucial to the success of our user facility. Our faculty are internationally known for their front-line science, which leads to a world-class scientific environment, which drives innovation for our user program. Our international acclaim brings new users and stresses the eminence of our MagLab. There are many more examples of exciting in-house research than shown here – these were chosen for impact and breadth, as decided by our chief scientist.

We begin with some examples of our in-house theoretical research in condensed matter sciences and note that each research topic is directly related to MagLab work, focused on our users across all three of our campuses. The broad range of this theoretical research reflects the breadth of our users, domestic and international. We start with studies of correlation and dynamics in strongly correlated quantum systems, modeling results from a wide range of experimental *techniques. Next, some of our users are particularly strong in developing materials for quantum computation, and we report on the development of new analytic tools for designing pulse sequences for spin-based quantum computing. Innovative theoretical work on topological materials has been reported including bound vortices, quantum Hall states, symmetry breaking, Dirac node braiding, and coulombic effects in twisted bilayer graphene. Theoretical research has also been accomplished on the Mott transition in 1D quantum spin liquids, Cooper pairing symmetry in the two-dimensional Hubbard model, and the physical and magnetotransport properties of InAs/GaSb superlattices are explored.*

Condensed Matter Theory at FSU and UF

1. Correlations and Dynamics in Strongly Correlated Electron Systems

Summary
We are pursuing the study of correlations and dynamics in strongly correlated quantum systems. Many aspects of our work have involved close collaboration with experimentalists and have utilized computational tools to predict or explain the outcomes of experiments such as neutron scattering, torque magnetometry and terahertz optics. Our work involves extensive use of resources at the research computing center (RCC) and the Planck computing cluster at FSU. Systems of interest include: 1) spin orbit coupled pyrochlore systems (see work on $Yb_2Ti_2O_7$ in PNAS [1] and PRB [2] with C. Broholm's group); we have recently studied the pseudo spin-1/2 spin liquid system $Ce_2Zr_2O_7$ (unpublished with A. Nevidomskyy and R. Moessner, led by postdoc Anish Bhardwaj), 2) S=1 chain material $NiNb_2O_6$ (see PRL with P.Armitage's group [3]) with student Prakash Sharma and postdoc Kyungmin Lee (unpublished) and 3) S=1 kagome antiferromagnet $Na_2Ti_3Cl_8$ (see PRL [4] with collaborators T. Birol, A. Paul and C. Chung). See Figure 4.3 for representative results published in 2020.

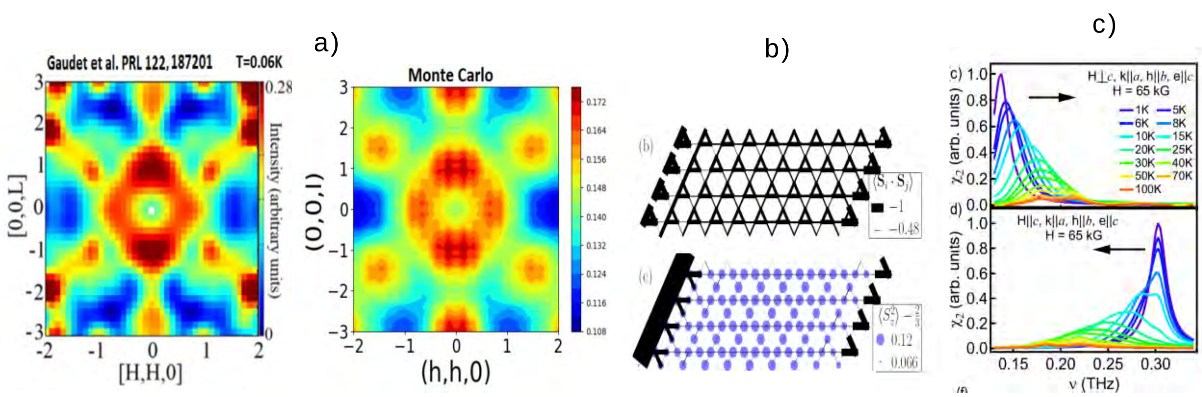


Figure 4.3: (a) Results of the comparison between neutron scattering data and theory for the spin-orbit coupled pyrochlore $Yb_2Ti_2O_7$ [see Ref. [1]] (b) Results from an investigation of the spin-1 kagome material $Na_2Ti_3Cl_8$. A model Hamiltonian was studied with DMRG and was shown to harbor both trimerized/valence bond (top) and spin nematic phases (bottom) [see Ref. [4]] (c) Results of finite temperature Lanczos simulations showing the temperature dependent shift in the dynamical susceptibility of a ferromagnetic spin chain with onsite anisotropy.[see Ref. [3]]

Acknowledgements
The National High Magnetic Field Laboratory is supported by the National Science Foundation (NSF) through NSF/DMR-1157490/1644779 and the State of Florida. In addition, I acknowledge the support of the NSF CAREER grant "CAREER: Towards Predictive Modeling of Emergent Correlations and Dynamics in Strongly Interacting Quantum Matter" DMR 2046570.

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2. Efficient Two-Qubit Pulse Sequences Beyond CNOT [1]

Zeuch, D. (FSU, Physics); Bonesteel, N.E. (FSU, Physics)

Introduction

Electron spins in neighboring quantum dots can be coherently controlled by adiabatically switching on and off, or "pulsing", the exchange interaction between them. If logical qubits are encoded using three spin-1/2 quantum dots then it is known that such exchange pulsing is sufficient for universal quantum computation [2].

Designing sequences of exchange pulses to carry out two qubit quantum gates on the six spins forming two three-spin qubits is a surprisingly difficult problem. The most efficient known two-qubit gate sequence for a controlled-NOT gate (CNOT), due to Fong and Wandzura [3], was found by a numerical brute force search that offered little insight into its derivation.

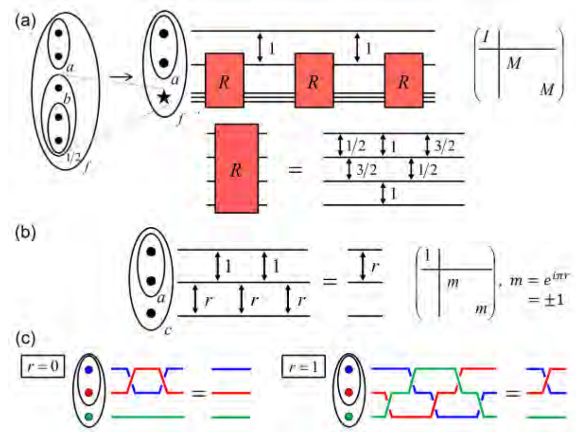

Figure 4.4: "Reverse engineering" of the Fong-Wandzura sequence. Horizontal lines represent spins, vertical double arrowed lines indicate exchange pulses labeled by duration in units of π/J, and time flows from left to right. (a) Fong-Wandzura CNOT sequence acting on 5 of the 6 spins associated with two 3-spin qubits with a repeating patterns of pulses grouped into the box R; (b) simpler three spin sequence where the pulse r is either the identity or a simple swap and so squares to the identity in the same way that the pulses in the box R square to the identity; (c) simple sequences of spin exchanges which determine the result of carrying out sequence (b) on three spins. We show in [1] that the simplified sequence (b) determines entirely the effect of the full two-qubit sequence in (a). By modifying the simple three spin sequences at the "bottom" of this construction and working our way back "up," we have constructed entirely new sequences for arbitrary controlled rotation gates (see [1] for details).

Results and Discussion

In [1] we have "reverse engineered" the Fong-Wandzura sequence in order to understand its structure (building on earlier work of [4]). The key steps in this reverse engineering are shown in Figure 4.4. This deconstruction of the sequence allowed us to modify it and produce entirely new sequences that can be used to carry out arbitrary controlled-rotation gates, not just CNOT gates. These gates are useful for a number of quantum algorithms, (e.g., Shor's famous factoring algorithm, and some proposed quantum simulation algorithms [5]). Our new sequences for these gates can be shown to be "optimal" in a certain sense.

Conclusions

We have developed new analytic tools for designing efficient pulse sequences for spin-based quantum computing using control of the exchange interaction as a resource. As the quality of spin qubits continues to improve, it is likely these and related sequences will become useful in the actual implementation of simple quantum algorithms in these systems in the near future.

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[3] Fong, B.H. and Wandzura, S.M., Quantum Information & Computation 11, 1003-1018 (2011).
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3. Bound fermion states in pinned vortices in the surface states of a superconducting topo-logical insulator [1]

Deng, H. (FSU, Physics); Bonesteel, N.E. (FSU, Physics); Schlottmann, P. (FSU, Physics)

Introduction

The possibility of realizing Majorana zero modes at surfaces of strong topological insulators (TI) due to the proximity of an s-wave superconductor (S) was first proposed by Fu and Kane [2]. In this scenario, a zero mode forms within the normal core of a superconducting vortex at the TI-S interface. In addition to this zero mode, finite energy bound states also form within the core. Understanding these bound states will be important for any potential future application of Majorana zero modes to quantum computation. While these bound states have previously been studied numerically (see, e.g. [3]), here we study them essentially analytically. Our results provide us with convenient expressions for experimentally measurable quantities such as the local density of states (LDOS) and form the starting point for direct perturbative calculations of the energy shifts due to a small magnetic field.

Method

We use the method originally employed in the classic work of Caroli, de Gennes and Matricon [3] for a vortex line in a three-dimensional superconductor [4]. The Bogoliubov-de Gennes equations are solved (i) for small distances (compared to the correlation length ξ) from the core of the vortex, where the superconductor order parameter can be neglected, and (ii) for larger distances, still smaller than ξ, but where the order parameter needs to be taken into account. These two solutions are then matched at an intermediate radius. The matching condition determines the value of the energy of the bound state inside the vortex core.

Results and Discussion

Using this approach, we obtain analytical expressions both for the energy spectrum and the wave functions associated with the bound states. These wave functions consist of products of a Bessel function and an exponential decay as function of the distance to the core of the vortex. The

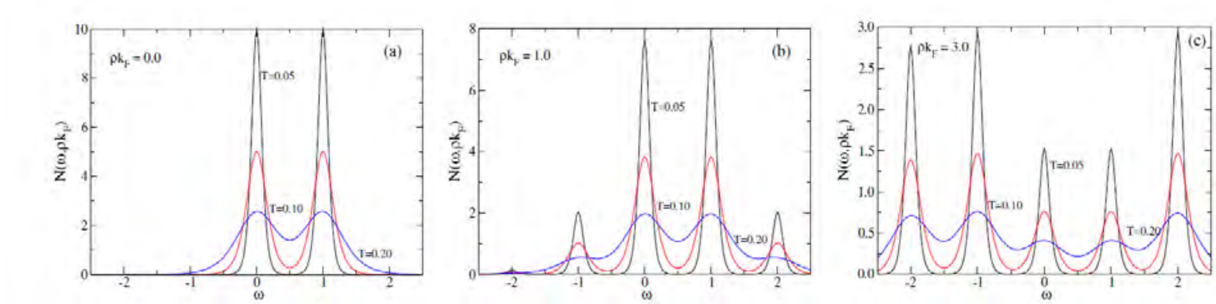

Figure 4.5: Local density of states (LDOS) of the bound states in the vortex as a function of energy ω for three distances ρ from the center of the core: (a) $\rho k_F = 0.0$, (b) at $\rho k_F = 1.0$ and (c) $\rho k_F = 3.0$. The three curves in each panel represent different temperatures: T = 0.05 (black), T = 0.1 (red) and T = 0.2 (blue) with all energies expressed in units of Δ^2/E_F. The LDOS is in arbitrary units but the same for all three panels. (See [1] for more details).

results can then be used to determine an analytic expression of the LDOS for the bound states (see, e.g. Figure 4.5), a quantity which is, in principle, experimentally accessible via STM [5]. Our analytic results form a basis for further perturbative calculations such as determining the energy shift of the bound states with a small magnetic field.

Conclusions Our analytic results for the energy spectrum of bound states within a vortex core provides convenient analytic expressions for physically measurable quantities such as the LDOS. In a larger context, our results provide a context for exploring the question of how the gaps to these bound states can be raised – thus minimizing their effect on any future application for quantum computation – by, for example, reducing the Fermi energy so that it nears the Dirac point, although a full analysis of this effect will require going beyond the approximations used in this work.

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[5] See, e.g., Wang, D., et al., Science 362, 333 (2018).

4. Quantum Hall States and Their Interfaces

Kun Yang and Li Chen (MagLab); Wei Zhu (West Lake Univ.); Donna Sheng (Calstate North Ridge)

Introduction

Quantum Hall states are the very first topological states of matter. Edges and interfaces are windows that allow us to peek into their bulk topological properties. In the past year we studied the interface between the Pfaffian and anti-Pfaffian quantum Hall states that are relevant to the 5/2 fractional quantum Hall state, which is the leading candidate of a non-Abelian quantum Hall state that is of very strong current interest. We also constructed a new family of quantum Hall states at filling factor 2/5.

Methods of Theoretical Studies and Results

In Ref. [1] we used DMRG to study the Pfaffian/anti-Pfaffian interface and found a quantized dipole moment density of the interface, which is tied to the mismatch of the Hall viscosity of the two states separated by the interface. This is a general result applicable to all quantum Hall interfaces, but particularly important for the 5/2 physics as this means disorder potential couples to the dipole moment and can thus induce domains of the Pfaffian and anti-Pfaffian in the 5/2 system. This is one of the very few explanations of the experimentally observed thermal Hall conductivity. Our result thus lends considerable support to this scenario, which was purely speculative before our work.

In Ref. [2] we used conformal field theory to construct a new family of quantum Hall states at filling factor 2/5, whose topological properties share some similarity (like edge modes) with the standard Jain state, but different in a number of important ways, including shift and Hall viscosity, as well as and multibody relative angular momenta. Physically the new states can be understood as composite fermion integer quantum Hall states realized by occupying Landau levels different from the lowest two (as in the Jain state). This points to the richness of quantum Hall states that were not anticipated previously.

Conclusions

We have performed comprehensive theoretical and numerical studies on quantum Hall states and their interfaces. We studied general interfaces, and the Pfaffian/anti-Pfaffian interface in particular. Our results shed considerable light on their topological properties, and their relevance in samples with disorder.

Acknowledgements

This work was supported by NSF and DOE.

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5. Diagnosis of explicit symmetry breaking in the tight-binding constructions for symmetry -protected topological systems

Oskar Vafek (MagLab) and Xiaoyu Wang (MagLab)

Introduction

It has been well established that for symmetry-protected topological systems, the nontrivial topology prevents a real space representation using exponentially localized Wannier wave functions (WFs) in all directions, unless the protecting symmetry is sacrificed as an on-site transformation. This makes it challenging to determine the symmetry of various physical observables represented using such WFs. In this work, we propose a practical method for overcoming such challenges using the Kane-Mele model as a concrete example. We present a systematic procedure for diagnosing the symmetry of any observables, as well as a method for constructing symmetric operators up to arbitrary truncation accuracy.

Methods of Theoretical Studies and Results

For a set of isolated electron bands with nontrivial topology, it is possible to achieve a real space representation using exponentially localized Wannier functions (WFs) in all directions, provided that the protecting symmetry is sacrificed as a site-local transformation. As a result, under any scheme of truncation, the representation of any local and symmetric operator using these WFs inevitably breaks the protecting symmetry explicitly. This has led to debates on the validity of tight-binding implementations for symmetry-protected topological systems.

Using the Kane-Mele model and the Su-Schrieffer-Heger model as examples, we presented a quantitative discussion of the severity of the degree of symmetry breaking. We showed that the exponential localization of the WFs guarantees that the symmetry properties for an intrinsically symmetric operator are retained with exponential accuracy. More precisely, the accuracy of symmetry is bounded by the absolute accuracy of the truncation up to a nonuniversal constant. As a result, a tight-binding implementation should ***not*** lead to significant issues, as long as the interesting physics occurs at an energy scale larger than the exponentially small energy scale where symmetry breaking effects are important. This latter energy scale can always be made sufficiently small by increasing the real space truncation length-scale.

Conclusions

We developed a practical method for overcoming challenges associated with using real space Wannier representation of symmetry protected topologically non-trivial systems, using Kane-Mele model as a concrete example. We also presented a systematic procedure for diagnosing the symmetry of any observables, as well as a method for constructing symmetric operators up to arbitrary truncation accuracy.

Acknowledgements

This work was supported by NSF.

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6. Non-Abelian Dirac node braiding and near-degeneracy of correlated phases at odd integer filling in magic-angle twisted bilayer graphene

Oskar Vafek (MagLab) and Jian Kang (MagLab -> Soochow U.)

Introduction

Since the discovery of correlated insulating phases and superconductivity (SC) in magic-angle twisted bilayer graphene (TBG) and other moiré systems, tremendous theoretical effort has been devoted toward understanding the properties and the mechanisms of these correlated electron phenomena. Two entirely different insulating phases have been observed at the filling of $v = 3$: the (quantum) anomalous Hall (QAH) state when one of the layers of the TBG is aligned with the hexagonal boron nitride (hBN) substrate, and a gapped insulating state without the hBN alignment and without anomalous Hall conductance. The former is easy to understand; the latter is much less understood.

Methods of Theoretical Studies and Results

We used the density matrix renormalization group (DMRG) to study the correlated electron states favored by the Coulomb interaction projected onto the narrow bands of twisted bilayer graphene within a spinless one-valley model. The Hilbert space of the narrow bands is constructed from a pair of hybrid Wannier states with opposite Chern numbers, maximally localized in one direction and Bloch extended in another direction. Depending on the parameters in the Bistritzer-Macdonald model, the DMRG in this basis determines the ground state at one particle per unit cell to be either the quantum anomalous Hall (QAH) state or a state with zero Hall conductivity which is nearly a product state. Based on this form, we then apply the variational method to study their competition, thus identifying three states: the QAH, a gapless C_2T -symmetric nematic, and a gapped C_2T -symmetric stripe.

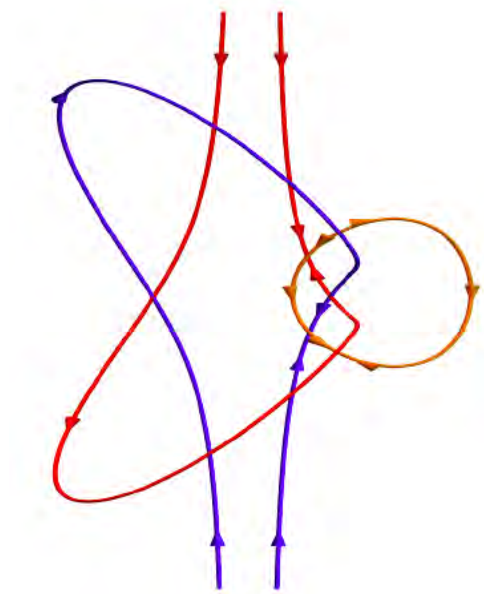

Figure 4.6: The "world lines" of the Dirac nodes as a function of the parameters of the C_2T -symmetric model with matching colors for the nodes. The arrows of the colored curves represent the topological charges of the corresponding nodes.

In the chiral limit, the energies of the two C_2T -symmetric states are found to be significantly above the energy of the QAH. However, all three states are nearly degenerate at the realistic parameters of the Bistritzer-Macdonald model. The single-particle spectrum of the nematic contains either a quadratic node or two close Dirac nodes near G. Motivated by the Landau level degeneracy found in this state, we propose it to be the state observed at the charge neutrality point once spin and valley degeneracies are restored.

The optimal period for the C_2T stripe state is found to be two-unit cells. In addition, using the fact that the topological charge of the nodes in the C_2T -nematic phase is no longer described simply by their winding numbers once the translation symmetry is broken, but rather by certain elements of a non-Abelian group that was recently pointed out, we identified the mechanism of the gap opening within the C_2T stripe state. Although the nodes at the Fermi energy are locally stable, they can be annihilated after braiding with other nodes connecting them to adjacent (folded) bands. Therefore, if the translation symmetry is broken, the gap at one particle per unit cell can open even if the system preserves the C_2T and valley U(1) symmetries, and the gap to remote bands remains open (Figure 4.6).

Conclusions

While the Dirac nodes in the C_2T -nematic phase have been assumed to be generally protected by C_2T and valley U(1) symmetries, we found that these nodes can be lifted by only breaking the moiré translation symmetry, without breaking the C_2T and valley U(1) symmetries, and without closing the gap to the remote bands. Our calculation shows that a gapped C_2T period-2 stripe state is nearly degenerate with the QAH and C_2T -nematic states, and thus is a candidate state for the ground state at the filling of $v = 3$ without the hBN alignment. We presented an analysis of the topological properties of the Dirac nodes in the C_2T -nematic state. During the transition from the C_2T -nematic state to the C_2T -symmetric period- 2 stripe state, remarkably, the topological charge associated with these nodes should not be described by their (Abelian) winding number,

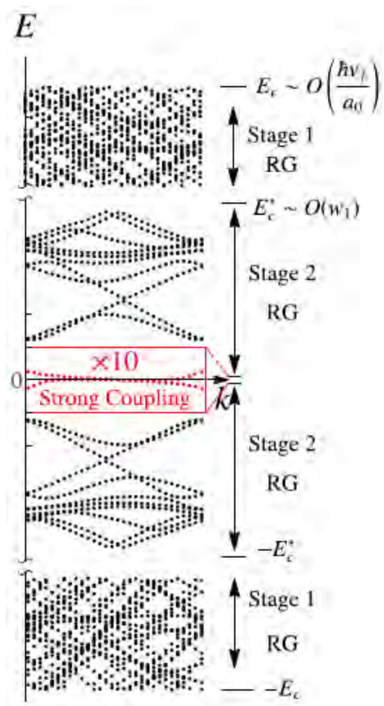

Figure 4.7: Schematic illustration of the two stage RG procedure for arriving at the strong coupling limit.

but by elements of (non-Abelian) Salingaros vee group of real Clifford algebra *C*0,3. Since it is a non-Abelian group, the topological charge of these nodes depends on how they are braided with other nodes away from the CNP. Therefore, a gap at CNP can be opened even without breaking the C_2T and valley U(1) symmetries.

Acknowledgements
This work was supported by NSF.

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7. Renormalization Group Study of Hidden Symmetry in Twisted Bilayer Graphene with Coulomb Interactions

Oskar Vafek (MagLab) and Jian Kang (MagLab -> Soochow U.)

Introduction

Magic angle twisted bilayer graphene has attracted a lot of attention since it was shown to host correlated phases, including superconductivity in 2018. Here, we developed a novel two stage renormalization group which connects the continuum Hamiltonian for twisted bilayer graphene at length scales shorter than the moire superlattice period to the Hamiltonian for the active narrow bands only which is valid at distances much longer than the moire period. This also allowed us to calculate exactly the exciton energy spectrum from the Coulomb interactions projected onto the renormalized narrow bands.

Methods of Theoretical Studies and Results

In Ref. [1] we developed a renormalization group (RG) approach to the Coulomb interactions in the twisted bilayer graphene and show that the AB region tunneling (w1) renormalizes in precisely such a way as to compensate for the growth of Fermi velocity vF making the magic angle largely insensitive to the effective dielectric constant ϵ. Interestingly, we find that w0 does not renormalize due to Coulomb interactions. Therefore, the ratio w0/w1 shrinks, and the system flows closer to the chiral limit described by Tarnopolsky, Kruchkov, and Vishvanath in their 2019 PRL. As illustrated in Figure 4.7, the flow from a high energy (with the UV cutoff Ec), where the Coulomb interaction and w0, w1 are perturbative, to a low energy of the narrow bands where neither is, crosses over to a regime where the effects of w0 and w1 become nonperturbative, but the Coulomb interaction is still perturbative. This happens at the energy scale E*c ~ O(w1), marking the beginning of the second stage of our RG; we demonstrated that the second stage seamlessly connects to the first stage even if E*c changes. In the second stage, we numerically integrate out the two most remote bands, one above and one below the charge neutrality, rotate the remaining states to diagonalize the renormalized kinetic energy, and re-express the interaction in terms of the rotated states, iterating the procedure until we reach the narrow bands. If the resulting narrow bands' bandwidth (or, more precisely the root mean square of the renormalized kinetic energy dispersion) is much smaller than the interaction (or more precisely, the particle-hole charge gap), as we find

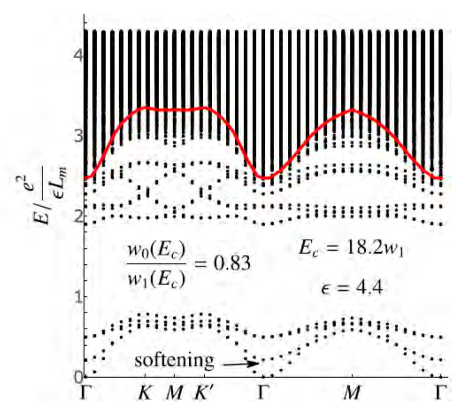

Figure 4.8: The strong coupling exciton spectrum after stage 1 and 2 RG. The red curve is the onset of the particle-hole continuum.

it is near the magic angle, the final step is treated nonperturbatively in the Coulomb interaction, i.e., by solving the interaction-only problem (strong coupling limit) and then treating the renormalized kinetic energy terms as a perturbation. In the final step, we also computed the single particle and charge neutral collective modes (shown in the Figure 4.8).

Conclusions

The Coulomb RG induced softening of the hidden symmetry collective modes suggests that they may not be frozen out even at few tens of Kelvin. Our results offer a significant shift of perspective in that the chiral limit—previously considered unphysical—gains the status of an attractive mid-IR RG fixed point.

Acknowledgements

This work was supported by the NSF.

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8. Approaching the Mott transition: theory vs. experiment

PI: Vladimir Dobrosavljevic (FSU/Physics- MagLab). These studies were done in collaboration with several experimental groups, also involving FSU graduate student Yuting Tan, who carried out most theory calculations, together with the PI.

Introduction

The Mott metal-insulator transition (MIT) stands out among the key unresolved phenomena in interacting electron systems. At low temperatures magnetic instabilities typically mask the Mott MIT; the antiferromagnetic ground state dominates the low-energy excitations. To circumvent this problem, we study Mott insulators that are currently under scrutiny for their quantum spin liquid ground state (QSL) as a result of large geometrical frustration. The absence of anti-ferromagnetism enables us to investigate the genuine Mott state down to T → 0, and in doing so to test various theoretical ideas and scenarios. This program was carried out in several systems that display Mott-like physics in absence of magnetic order, where we show that most experimental features can be described, in surprising detail, within appropriate applications of Dynamical Mean-Field Theory (DMFT).

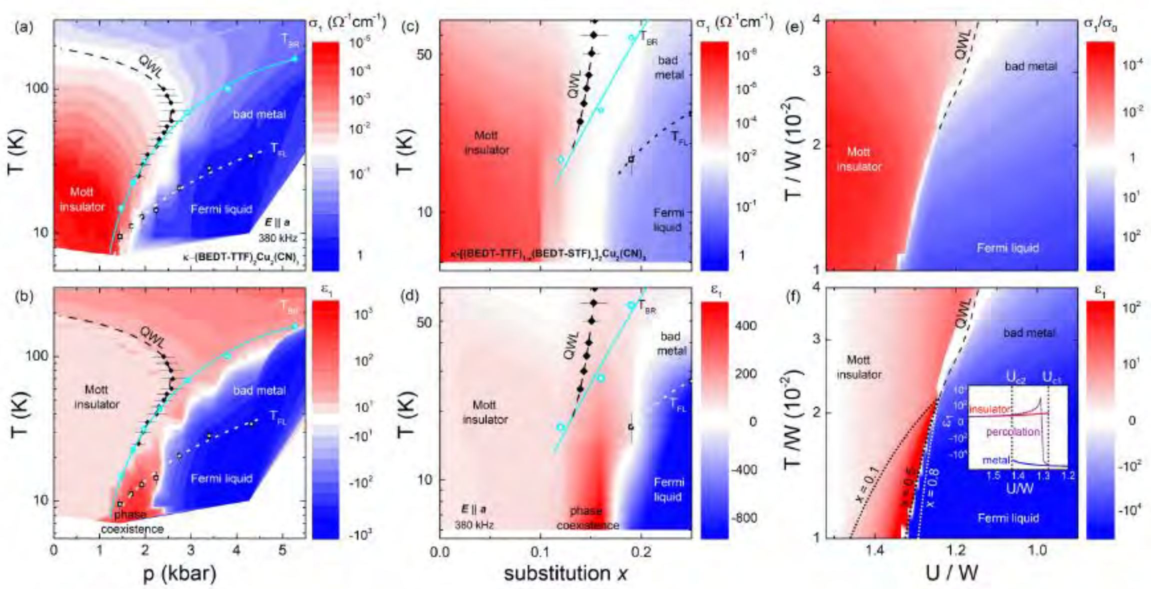

Figure 4.9: Phase diagram of kappa-(BEDT-TTF)$_2$Cu$_2$(CN)$_3$ when tuned through the Mott MIT [1] by physical pressure (a,b) or chemical substitution (c,d), compared with hybrid DMFT calculations as a function of correlation strength U=W (e,f).

Inhomogeneous Electronic states in spin-liquid Mott organics materials

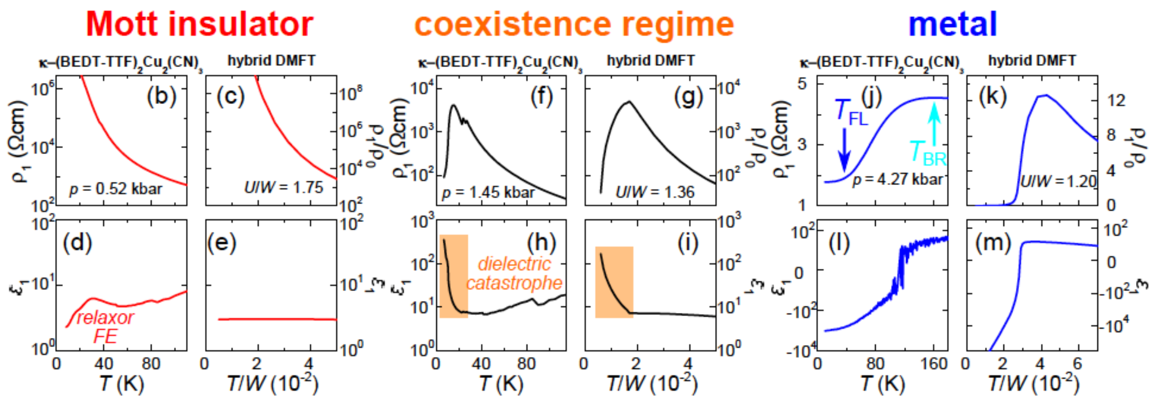

Figure 4.10: The Mott-insulating state (b-e) yields thermally activated resistivity and small, positive values of the dielectric permittivity. While the permittivity indicates a reduction with cooling when metallic clusters percolate, is strongly increased upon entering the metal-insulator phase coexistence region (f-i). In contrast, the correlated metallic state (j-m) in the heavy quasiparticle regime exhibits Fermi-liquid properties with a quadratic temperature dependence of the resistivity at low temperatures, accompanied by large negative values of the dielectric permittivity [2].

Coulomb repulsion among conduction electrons in solids hinders their motion and leads to a rise in resistivity. A regime of electronic phase separation is expected at the first-order phase transition between a correlated metal and a paramagnetic Mott insulator, but remains unexplored experimentally as well as theoretically nearby $T = 0$. We approach this issue [1,2] by assessing the complex permittivity via dielectric spectroscopy, which provides vivid mapping (Figure 4.9) of the Mott transition and deep insight into its microscopic nature. Our experiments utilizing both physical pressure and chemical substitution consistently reveal a strong enhancement of the quasi-static dielectric constant ε_1 when correlations are tuned through the critical value. All experimental trends are captured by dynamical mean-field theory of the single-band Hubbard model supplemented by percolation theory (Figure 4.10). Our findings suggest a similar "dielectric catastrophe" in many other correlated materials and explain previous observations that were assigned to multiferroicity or ferroelectricity.

Mott Quantum Criticality in two-dimensional electron systems in semiconductors

The possibility of the strong electron-electron interaction driven insulating phase from the metallic phase in two-dimensions has been suggested for clean systems without intentional disorder, but its rigorous demonstration is still lacking. Here, we examine [1] the finite-temperature transport behavior of a few layered-MoS_2 material in the vicinity of the density-driven metal-insulator transition (MIT), revealing previously overlooked universal features characteristic of strongly correlated electron systems. Our scaling analysis, based on the Wigner-Mott theoretical viewpoint supplemented with DMFT, conclusively demonstrates that the transition is driven by strong electron-electron interactions and not disorder, in striking resemblance to what is seen in other Mott systems. Our results provide compelling evidence that transition-metal dichalcogenides provide an ideal testing ground for the study of strong correlation physics, which should open an exciting avenue for future research, making a parallel with recent advances in twisted bilayer graphene. Very similar results were also found [2] in a strongly interacting two-dimensional electron system in ultra-clean SiGe/Si/SiGe quantum wells, establishing the universality of interaction-driven MITs, with features displaying all features expected from the DMFT standpoint.

Acknowledgements

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9. Pairing in the two-dimensional Hubbard model from weak to strong coupling

The Hubbard model is the simplest model that is believed to exhibit superconductivity arising from purely repulsive interactions and has been extensively applied to explore a variety of unconventional superconducting systems. A collaborative team including UF Physics members performs intensive extensions of the model to further probe the evolution of the leading superconducting instabilities of the single-orbital Hubbard model on a two-dimensional square lattice as a function of onsite Coulomb repulsion ***U*** and band filling by calculating the irreducible particle-particle scattering vertex obtained from dynamical cluster approximation(DCA) calculations. These results are compared to both perturbative Kohn-Luttinger (KL) theory as well as the widely used random phase approximation (RPA) spin-fluctuation pairing scheme [1]. While there is general agreement that the leading Cooper pairing instability of the Hubbard model close to half-filling is the $d_{x^2-y^2}$ state, and work on the ***t-J*** model valid in this regime corresponding to very large ***U*** suggests the same, rather less is known consensually about the rest of the Hubbard model pairing phase diagram, including fillings far from ***n***=1 and intermediate to strong ***U***. These regimes are not simply of academic interest but may well represent reasonable descriptions of a variety of unconventional superconductors, including cuprates, organic Bechgaard salts, heavy fermion materials, iron-based superconductors, and ultracold fermionic gases.

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10. Structural, morphological and magnetotransport properties of composite semiconducting and semimetallic InAs/GaSb superlattices

Arsenide and antimonide-based semiconductor heterostructures have attracted attention for many years as technological cornerstones for emerging, high-performance nanoscale devices. In particular, extensive research efforts have been dedicated to type-II broken-gap InAs/GaSb heterostructures where the superlattice (SL) periodicity can modify the band structure, resulting in either a semiconducting (energy gap, $E_G>0$) or semimetallic ($E_G<0$) material system. In this work, an InAs/GaSb double-period superlattice structure was grown by solid-source molecular beam epitaxy using valved cracker sources for both arsenic and antimony. The structural, morphological, and magnetotransport characteristics were investigated by high-resolution X-ray diffraction, transmission electron microscopy, and transport measurements as a function of temperature and magnetic field [1]. Specifically, in-plane magnetotransport was performed over a variable temperature range down to 390mK and in magnetic fields up to 9 T, and numerical analysis reveals the presence of at least two carrier populations, (see Figure 4.11). The higher-mobility carriers exhibit Shubnikov-de Haas oscillations, testifying to the crystalline quality of the heterostructure and interfaces.

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Condensed Matter at UF

1. Inelastic neutron scattering study of the anisotropic S=1 spin chain [Ni(HF$_2$)(3-Clpyridine)$_4$]BF$_4$

Spin chains have played a foundational role in understanding many-body physics in the quantum regime, and an important example is the isotropic S=1 antiferromagnetic system that does not have an analytical solution and possesses a nondegenerate gapped ground state known as the Haldane phase. Real systems have anisotropy which complicates the simple description, and an interesting case is the material [Ni(HF$_2$)(3-Clpyridine)$_4$]BF$_4$, which is known as NBCT. Motivated to clarify the nature of the high magnetic field and low temperature response of this system, an intriguing discovery was made at ultralow magnetic fields. Specifically, using the High B/T Facility Fast-Turnaround Instrument, NBCT was shown to be close to a quantum phase boundary as inferred from isothermal magnetization studies, down to 50mK, that placed an upper limit for a possible critical magnetic field (which could indicate the existence of a gap) of 35 ± 10mT [1]. These results were included in a request for neutron beam time so inelastic scatting experiments could be performed down to 70mK [2]. The experimental data were combined with DMRG numerical studies, see Figure 4.12, to characterize the anisotropic crystalline distortions that provide the basis of an unusual magnetic phase diagram [2].

This is an example of UF Physics, leveraging MagLab HBT at UF and MagLab EMR in Tallahassee results [1] to gain access to inelastic neutron scattering beam time at Oak Ridge National Laboratory.

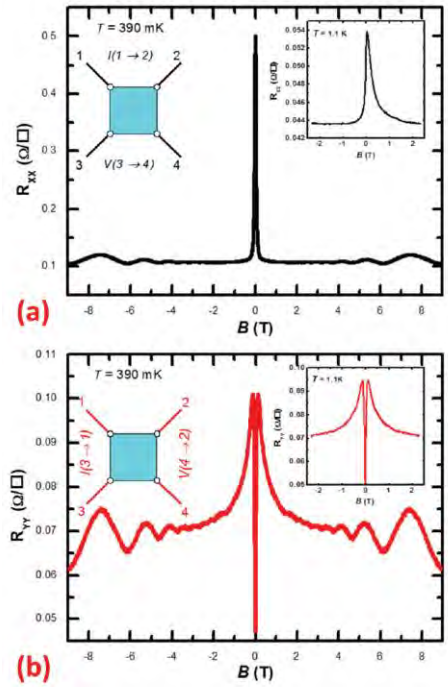

Figure 4.11: (a) In-plane longitudinal resistivity (component R_{XX} of the magnetoresistance matrix) vs. B, up to B = 9T and at T = 390mK. The right inset shows R_{XX} at T = 1.1K, where a large negative magnetoresistance is observed for |B| < 0.3T. For B > 2.5T, Shubnikov-de Haas oscillations appear. (b) In-plane longitudinal resistivity in the direction orthogonal to panel (a) (component R_{YY}) vs. B, up to B = 9T and at T = 390mK. The right inset shows R_{YY} at T = 1.1K, and the abrupt magnetoresistance is reduced at T = 1.1K (inset) compared to T = 390mK (main panel). For B > 1.7T, Shubnikov-de Haas oscillations again appear, testifying of a carrier population with high mobility. [1]

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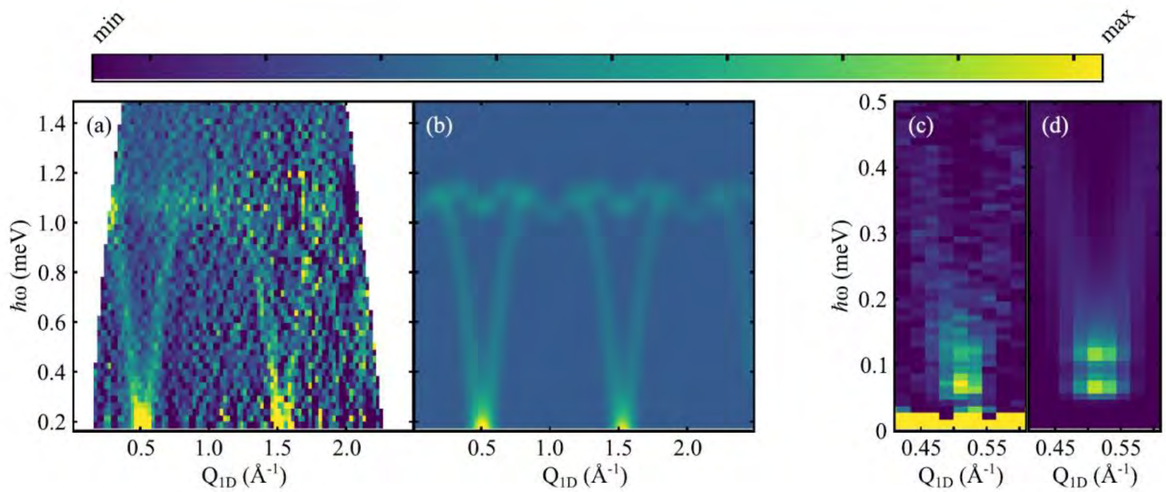

Figure 4.12: a) The WSe_2 monolayer-on-fiber assembly used for optical absorption studies in 60T. b) Discrete jumps in the absorption indicate emptying and spontaneous filling of specific valley LLs. c) Schematic depicting spontaneous valley polarization, driven by electron interactions.

2. Pressure-induced suppression of ferromagnetism in $CePd_2P_2$

When a ferromagnetic transition is suppressed by a clean control parameter such as pressure, typically, the second-order phase transition changes to first order to a critical value of the control parameter and the transition abruptly drops toward 0K. As the system approaches the critical point in a second-order phase transition, fluctuations in the order parameter extend to larger and larger length scales, while the order parameter varies smoothly between the ordered and disordered phases. An example is the correlated electron material $CePd_2P_2$ that orders ferromagnetically at 29K. Prior work by Lai et al. [1] found evidence for a ferromagnetic quantum critical point induced by chemical compression via substitution of Ni for Pd. However, disorder effects due to the chemical substitution interfere with a simple analysis of the possible critical behavior. A collaboration between MagLab sites in Tallahassee and Gainesville allowed for a "multimessenger" study of the temperature—pressure—magnetic-field phase diagram of single crystals of $CePd_2P_2$ to 25 GPa using a combination of resistivity, magnetic susceptibility, and x-ray diffraction measurements [2]. This investigation of parameter space showed the ferromagnetism appears to be destroyed near 12 GPa, as shown in Figure 4.13, without any change in the crystal structure [2].

This is an example of UF Physics, MagLab – Tallahassee, MagLab High B/T Facility, and a MagLab Collaborative Grant Program.

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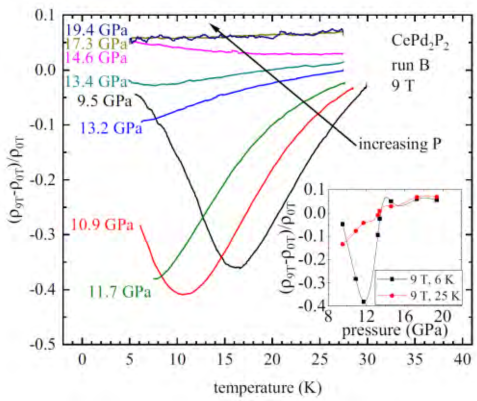

Figure 4.13: Magnetoresistance as a function of temperature for $CePd_2P_2$ at varying pressures. At low pressure, magnetoresistance is negative and possesses a clear valley near the transition temperature for a given pressure. Above about 12 GPa, however, this feature vanishes, and as pressure increases further, magnetoresistance shifts from negative to positive above about 13.4 GPa. The inset shows magnetoresistance as a function of pressure at 6K and 25K, which is above the critical temperature, the magnetoresistance starts negative and gradually increases, becoming positive at higher pressures. The 6 K data shows a deep minimum at 11.7 GPa, near the critical pressure where the magnetic order appears to vanish. [2]

Condensed Matter at LANL

1. Spontaneous Valley Polarization of Interacting Carriers in a Monolayer Semiconductor

Li, J., Goryca, M., Stier, A., Crooker, S. A. (MagLab-LANL); Wilson, N. P., Xu, X. (University of Washington)

Electron-electron (*e-e*) interactions underpin many interesting phenomena in 2D layers of mobile charges, including the fractional quantum Hall effect, spin textures (skyrmions), and quantum Hall ferromagnetism. These phenomena arise from the Coulomb repulsion between charges, which in turn typically enhances the susceptibility of spin or related pseudospin (e.g., valley, layer, subband) degrees of freedom, and can even cause instabilities and spontaneous transitions to broken symmetry phases. Such interactions have been studied in 2D electron and hole gases (2DEGs, 2DHGs) in conventional Si, GaAs, and AlAs semiconductors (and also in graphene), usually deep in the quantum regime at high magnetic fields B where only a few Landau levels (LLs) are occupied. Studies in tilted B have proven indispensable in these materials, because they provide a means to tune orbital (cyclotron) and spin (Zeeman) energies independently, thereby allowing to align LLs with different quantum numbers, so that *e-e* interactions can manifest most clearly. In the newer family of monolayer transition-metal dichalcogenide (TMD) semiconductors such as MoS_2 and WSe_2, recent advances in material quality have enabled high-mobility 2DEGs and 2DHGs. Owing to large carrier masses and reduced dielectric screening, *e-e* interactions are anticipated to be strong, even at high carrier densities. Of particular interest, band extrema lie at the inequivalent *K* and *K'* points (valleys) of the Brillouin zone, providing exciting opportunities to study both spin and valley degrees of freedom in doped monolayer systems. However, because spins in TMD monolayers are locked out-of-

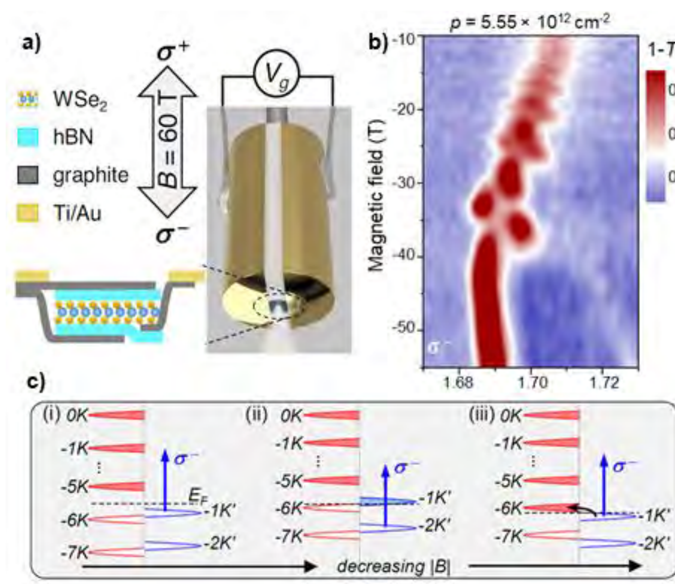

Figure 4.14: a) The WSe_2 monolayer-on-fiber assembly used for optical absorption studies in 60T. b) Discrete jumps in the absorption indicate emptying and spontaneous filling of specific valley LLs. c) Schematic depicting spontaneous valley polarization, driven by electron interactions.

plane by strong spin-orbit coupling, tilted-B methods cannot align LLs with different valley-spin index. To date this has limited studies of predicted valley-spin instabilities and phase transitions arising from e-e interactions.

We report magnetoabsorption spectroscopy of gated WSe_2 monolayers in high magnetic fields up to 60T. When doped with a 2D Fermi sea of mobile holes, well-resolved sequences of optical transitions are observed in both circular polarizations, which unambiguously reveal the number of filled LLs in each of the *K* and *K'* valleys. This reveals the interaction-enhanced valley Zeeman energy, which is found to be highly tunable with hole density. We exploit this tunability to align the LLs in *K* and *K'* and find that the 2D hole gas becomes unstable against small changes in LL filling and can spontaneously valley polarize. These results cannot be understood within a single-particle picture, highlighting the importance of exchange interactions in determining the ground state of 2D carriers in monolayer semiconductors (Figure 4.14).

Acknowledgements

The NHMFL is supported by NSF through NSF/DMR-1644779 and the State of Florida.

References

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2. Thermal and magnetoelastic properties of *α*-$RuCl_3$ in the field-induced low-temperature states

Schönemannn, R. Weickert, F. Jaime, M. (LANL, MPA-MAGLAB); Imajo, S. Kindo, K. (U. Tokyo, ISSP); Yan, J. Mandrus, D.G. Nagler, S.E. (ORNL); Takano, Y. (UF, Physics); Brosha, E.L. (LANL, MPA-11); Rosa, P.F.S. (LANL, MPA-CMMS)

Introduction

The proposal that Mott insulators with a strong spin-orbit coupling and the correct geometry provide a promising platform for the realization of the sought after Kitaev quantum spin liquid (QSL) [1, 2] has led to a significant ongoing research effort into the layered antiferromagnet (AFM) a-$RuCl_3$. Results from thermal Hall effect [3], neutron scattering [4] and other experimental probes indicate evidence for a field-induced (proximate) QSL phase in a narrow field range 7-10 T above the suppression of the AFM order. In this work we investigate the temperature-field phase diagram of a-$RuCl_3$ via magnetocaloric effect and fiber Bragg grating (FBG) dilatometry measurements.

Experimental

Thermal expansion and magnetostriction measurements on a-$RuCl_3$ were obtained with an optical FBG method, allowing detection of relative changes in the in-plane sample dimensions $\Delta L/L_0$ with a resolution of 10^{-8}, in a superconducting magnet system with fields up to 14T. Magnetocaloric measurements were done in a MagLab's 65T short pulse magnet. An AuGe thin film thermometer was directly deposited on the sample surface ensuring excellent thermal coupling to the sample and high sensitivity at low temperatures.

Results and Discussion

The zero-field coefficient of thermal expansion vs temperature shows a sharp transition into the AFM ordered state around 7K in accordance with the reported (H,T) phase diagram. We also observe a Schottky-like anomaly in applied fields H > 7T originating from a spin gap that evolves with H^3 – resembling the expected field dependence of the Majorana fermion gap in the pure Kitaev model.

Magnetostriction measurements $\Delta L/L_0$ vs H carried out within the AFM state display two distinct features around 6T and 7T (Figure 4.15 (a)) originating from a transition between differently stacked AFM layers (6T) and the transition to the proposed (proximate) Kitaev QSL phase at 7T.

The same transitions are evident in the magnetocaloric measurements under quasi-adiabatic and quasi-isothermal conditions. Remarkably the magnetocaloric reveals a crossover from a reversible behavior at higher temperatures to a dominantly irreversible behavior at temperatures below 1K evidenced by pronounced sample heating at the transition temperatures during the field up- and down-sweep (Figure 4.15 (b)). This indicates the presence of irreversible processes at the phase boundary between the AFM and the proposed (proximate) QSL state possibly induced by AFM domain movement and/or a first order phase transition, which would lead to a breakdown of quantum critical behavior at low temperatures.

Our measurements do not show evidence for a phase transition between the (proximate) QSL and a polarized paramagnetic phase above 7T. Therefore, our results place strong constraints on any theory put together to explain quantum critical behavior and the phenomenology of a QSL phase in α-$RuCl_3$ [5].

Acknowledgements

The National High Magnetic Field Laboratory is supported by NSF through NSF/DMR-1157490/1644779 and the State of Florida. This material is based upon work supported by the Department of Energy (DOE), Office of Science, National Quantum Information Science Research Centers; Los Alamos Laboratory Directed Research and Development program through project 20210064DR; the Gordon and Betty Moore Foundation's EPiQS Initiative, Grant No. GBMF9069; the DOE, Office of Science, Basic Energy Sciences, Materials Sciences and Engineering Division; the DOE Office of Science, Basic Energy Sciences, Division of Scientific User Facilities and the MagLab UCGP program.

References

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[2] Jackeli. G. and Khaliullin, G. Phys. Rev. Lett. **102**, 017205 (2009).
[3] Kasahara, Y., et al. Nature **559**, 227-231 (2018).
[4] Banerjee, A., et al. Nat. Mater **15**, 733-740 (2016).
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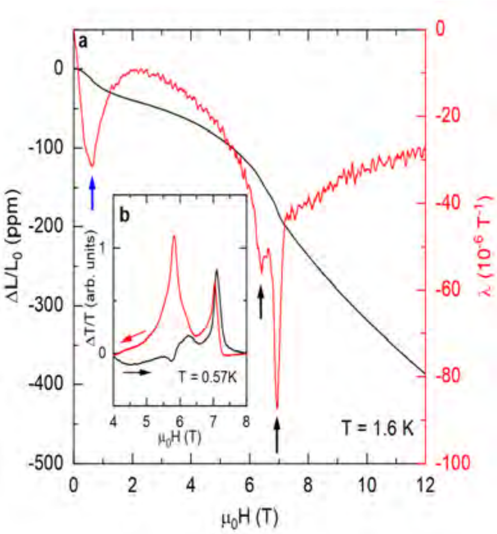
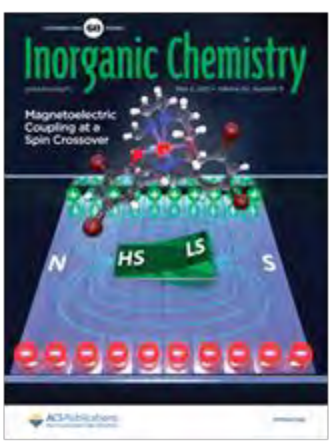


Figure 4.15: (a) Magnetostriction $\Delta L/L_0$ (black) and magnetostriction coefficient λ (red) as a function of magnetic field. (b) Relative change of the sample temperature vs. magnetic field under quasi isothermal conditions.

3. Magnetoelectric coupling at spin crossovers



V. B. Jakobsen, C. T. Kelly, G. G. Morgan (UC Dublin, Chemistry), J.-X. Yu, D.-T. Chen, J. Gu, J. Chen, J. Jiang, L. Zhang, Y. Yu, X.-G. Zhang, H. P. Cheng (UF, Physics), E. Dobbelaar (U. Kaiserslautern, Chemistry), E. Trzop, E. Collet (U. Rennes), X. Ding, F. Weickert, S. Chikara, and V. S. Zapf (MagLab-PFF)

Introduction

We investigate the ability of magnetic field-induced spin crossovers (SCO) in 3d transition metals to couple to changes in the electric polarization. Magnetoelectric (ME) coupling between magnetic properties and electric polarization have been long studied primarily in (anti)ferromagnetic oxides. Here we explore a different route to ME coupling, where we use SCO in molecular materials instead of long-range order in inorganic oxides. We have found ME couplings within 10% of the record for any compound in three Mn^{3+} molecular compounds, as well as novel states of matter including transitions between Jahn Teller (JT) solid, liquid and gas states emerging both at low and high fields. SCO occur in certain 3d transition metals when the total electronic spin state S changes due to electrons changing orbitals. Such SCOs have dramatic effects on the lattice and electronic properties since the bond lengths of the 3d ion change by up to 10%, particularly when the SCO toggles a JT effect. SCO are common in compounds containing organic ligands with transition temperatures between ~50-400K since soft lattices can more easily accommodate the strain that accompanies the spin state change without self-destruction.

Experimental

Two Mn^{3+} SCO compounds that show spin crossovers between 40 and 140K were synthesized, characterized for structural, electric and magnetic properties, and modelled with analytical and first-principles approaches.[1-3] In particular, low and high-field measurements of the magnetization and electric polarization at the MagLab-PFF and MagLab-Tallahassee investigated the ability of SCO to induce different electrically polar phases. High-field phase diagrams were extracted up to 45T (DC) and 65T (pulsed), and the phase diagrams comprising different structural, magnetic and electric phases were identified.

Results and Discussion

In two Mn^{3+} SCO compounds, spin crossovers triggered 2nd and 1st order structural phase transitions between different polar and nonpolar phases, which created effective ME couplings within 10% of the record for any material. These transitions were induced by changes in temperature and magnetic field and explored up to 65T. Since the different Mn^{3+} low (S = 1) and high (S = 2) states carry different JT distortions, new JT phases of matter were identified in one compound[4,5] in which JT distortions with three degenerate choices of orientation form ordered state with solid and liquid properties, and also carry electric polarizations, thus creating different electrically polar, antipolar phases. The dynamic JT state at high temperatures is identified as a JT gas with paraelectric properties. Finally, the coupling among symmetry-breaking or non-symmetry breaking spin state, ferroelastic and ferroelectric order parameters was identified for each compound.

Conclusions

In conclusion, SCO can trigger structural phase transitions in molecular Mn3+ compounds with different electrically polar properties and thereby induce ME coupling. This research direction is promising for creating coupling between magnetic, electric and structural degrees of freedom.

Acknowledgements

The NHMFL is supported by NSF through NSF/DMR-1157490/1644779 and the State of Florida. Scientific research was funded by the Center for Molecular Magnetic Quantum Materials (M2QM), an Energy Frontier Research Center funded by the DOE, Office of Science BES DE-SC0019330; the LANL Laboratory-Directed Research and Development program; Science Foundation Ireland (SFI) 12/IP/1703; Irish Research Council GOIPG/2016/73 fellowship; and Danish travel grants for VBJ.[1-3]

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[3] S. Chikara, J. Gu, X.-G. Zhang, H.-P. Cheng, N. Smythe, J. Singleton, B. Scott, E. Krenkel, J. Eckert, and V. S. Zapf "Magnetoelectric behavior via a spin state transition," Nature Comm. 10, 4043 (2019).

4. Scale-invariant magnetic anisotropy in $RuCl_3$

$RuCl_3$ is a primary contender for hosting a Kitaev-like spin-liquid state. An important aspect of this correlated spin state is that, at least in the theoretical model, it is controlled by a single energy scale, the exchange interactions. Study of magnetic response in this system in a broad range of magnetic fields and temperatures below exchange interaction energy allows insight into the strongly correlated spin state in $RuCl_3$ and its potential relation to the physics of spin-liquids. Here report measurements of magnetic anisotropy in a broad range of magnetic fields and temperatures in single-crystal $RuCl_3$. The observed magnetic response is scale-invariant in the sense that in a broad range of magnetic fields and temperatures it does not show any direct dependence on an energy scale associated with exchange interactions. Such scale-invariance is characteristic of a non-interacting collection of spins—however, in the strongly coupled spin system, such scale-invariance indicates a strongly correlated spin state, somewhat analogous to quantum criticality where characteristic energy scale is driven to zero by strong electronic correlations.

This work is a result of three years of development of resonant magnetotropic magnetometry where magnetic anisotropy in the sample is inferred from the frequency shift of small cantilever on which the sample is mounted. This measurement produces the magnetotropic coefficient, the angular derivative of magnetic torque. The detailed description of the technique will be published elsewhere (Figure 4.16).

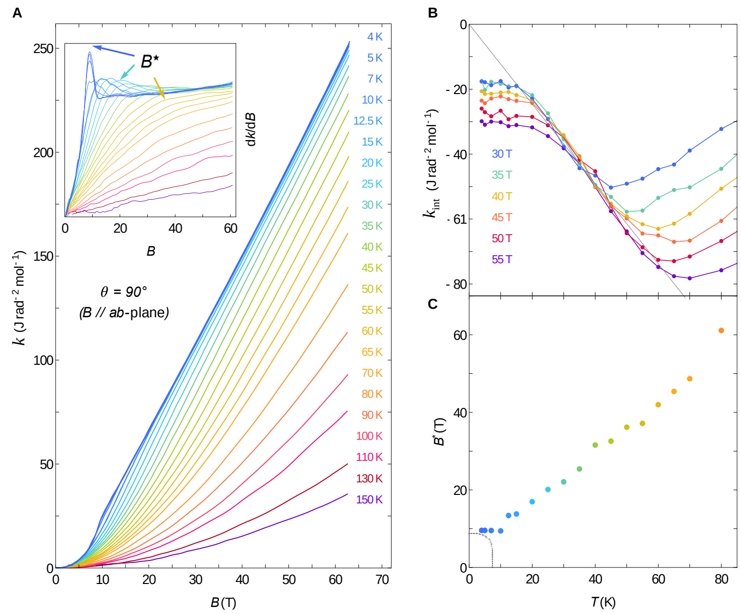

Figure 4.16: Measurements of magnetic anisotropy in $RuCl_3$. (A) Magnetic field dependence of the magnetotropic coefficient up to 64T showing linear-in-magnetic field behavior in the entire magnetic field range (down to AFM transition) at the lowest temperature and quadratic-in-field dependence at the highest temperature. Inset: Field dependence of the slope, dk/dB. B* indicates magnetic field of the crossover from B^2 to linear-in-B behavior. (B) Temperature dependence of the zero-field intercept of the extrapolated high-field behavior of the magnetotropic coefficient. The intercept is linear in temperature indicating scale-invariant behavior of magnetic anisotropy in a broad range of temperatures and magnetic fields. (C) Temperature dependence of the crossover field B*. The linear-in-T dependence in a broad temperature range is only cut off by AFM transition at low temperatures.

Reference

K.A. Modic, R.D. McDonald, Y. Lai, J.C. Palmstrom, D. Graf, M.-K. Chan, F. Balakirev, G.S. Boebinger, J.B. Betts, M. Schmidt, D.A. Sokolov, P.J.W. Moll, B.J. Ramshaw, A. Shekhter, *Nature Physics* 17, 240 (2020), Scale-invariant magnetic anisotropy in $RuCl_3$.

Acknowledgements

The National High Magnetic Field Laboratory is supported by NSF through NSF/DMR-1157490/1644779 and the State of Florida.

5. Thermodynamic evidence for a two-component superconducting order parameter in Sr_2RuO_4

The nature, and even the symmetry, of the superconducting order parameter in Sr_2RuO_4 is not established and is a subject of active research. Although multiple theoretical and experimental investigations point to unconventional –p-wave-superconductivity in Sr_2RuO_4, recent NMR suggest otherwise because they fail to detect the expected signature of the time-reversal breaking in the superconducting state. Symmetry-resolved measurements of elastic moduli can determine the dimensionality of the order parameter, whether it is single or multi-component, and, potentially, resolve a question of time-reversal breaking. Resonant ultrasound measurements in this work address directly the dimensionality of the superconducting order parameter in Sr_2RuO_4. Compelling evidence is found for the multicomponent, possibly p-wave, superconducting order parameter in Sr_2RuO_4. Specifically, analysis of the elastic shear moduli shows a discontinuous jump in c_{66} across the superconducting transition. Such behavior of the shear modulus in the tetragonal Sr_2RuO_4 can only occur if the superconducting order parameter belongs to one of the two-dimensional irreducible representations of the stress in the tetragonal crystal. This is consistent with the p-wave superconductivity and it rules out several broadly discussed alternatives (Figure 4.17).

Reference

S. Ghosh, A. Shekhter, F. Jerzembeck, N. Kikugawa, D.A. Sokolov, M. Brando, A.P. Mackenzie, C.W. Hicks, B.J. Ramshaw, *Nature Physics* 17, 199 (2020), Thermodynamic evidence for a two-component superconducting order parameter in Sr_2RuO_4

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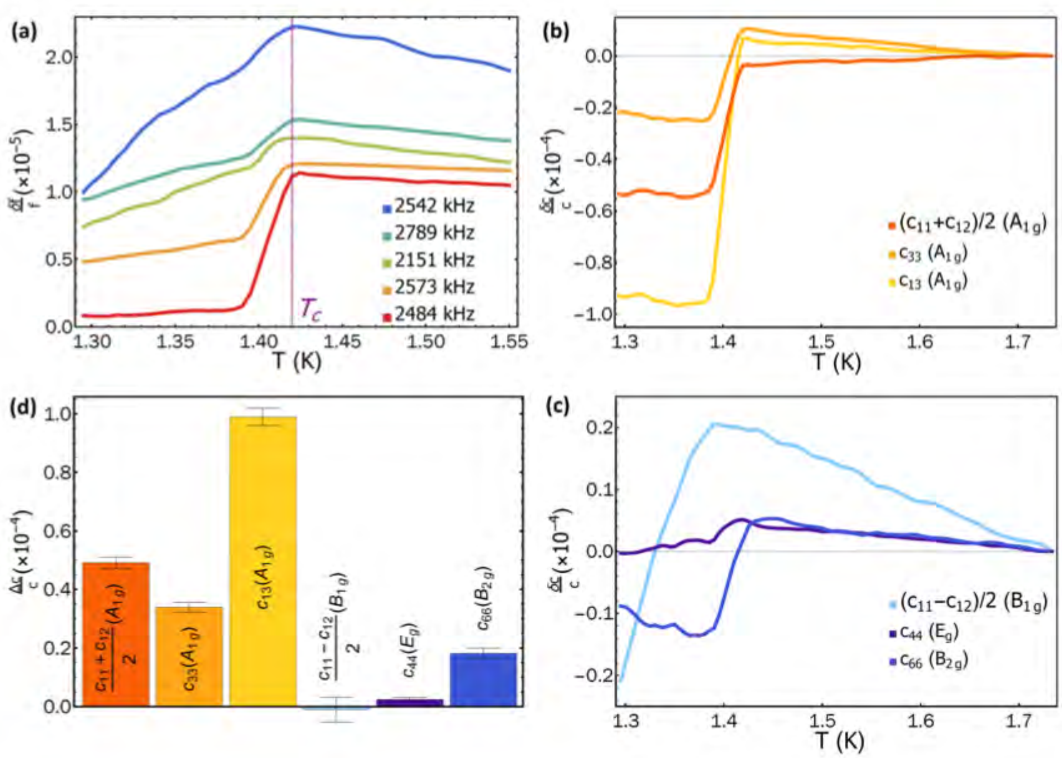

Figure 4.17: Measurements of elastic moduli in Sr_2RuO_4. (a) Temperature dependence of the frequency shift for several mechanical resonances. (b) Behavior of three compressional elastic moduli across the superconducting transition. All compressional elastic moduli must exhibit a discontinuous jump, whether the order parameter is single or multi-component, as is observed. (c) However, the discontinuous jump in the shear moduli is warranted only for multi-component order parameter. In Sr_2RuO_4 the elastic modulus c_{66} exhibits the jump across the superconducting transition, ruling out single-component order parameters. (d) Elative magnitude of the jump across the superconducting transition. The jump in c_{66} is comparable in magnitude to the jump in compressional elastic moduli.

6. Quantum criticality at the extremities of a CDW phase in $HgBa_2CuO_4$

The physics of the anomalous metallic state in the high-temperature superconductors is believed to be driven by quantum criticality, however, the nature of such connection and the detailed mechanism of the metallic conductivity are not well understood. Analysis of Hall coefficient in a broad doping range within a context of conventional fermi liquid theory can help identify the marker of the quantum critical point expected at the critical doping. In this work, we report measurements of the Hall coefficient at low temperature and very high magnetic fields in the high-temperature superconductor $HgBa_2CuO_4$ to address this question. We find the signature of the fermi surface collapse at the critical doping, consistent with some scenarios of metallic quantum criticality (Figure 4.18).

Reference

M.-K. Chan, R.D. McDonald, J.B. Betts, A. Shekhter, E.D. Bauer, N. Harrison, *PNAS* 117, 9782 (2020), Quantum criticality at the extremities of a CDW phase in $HgBa_2CuO_{4+\delta}$.

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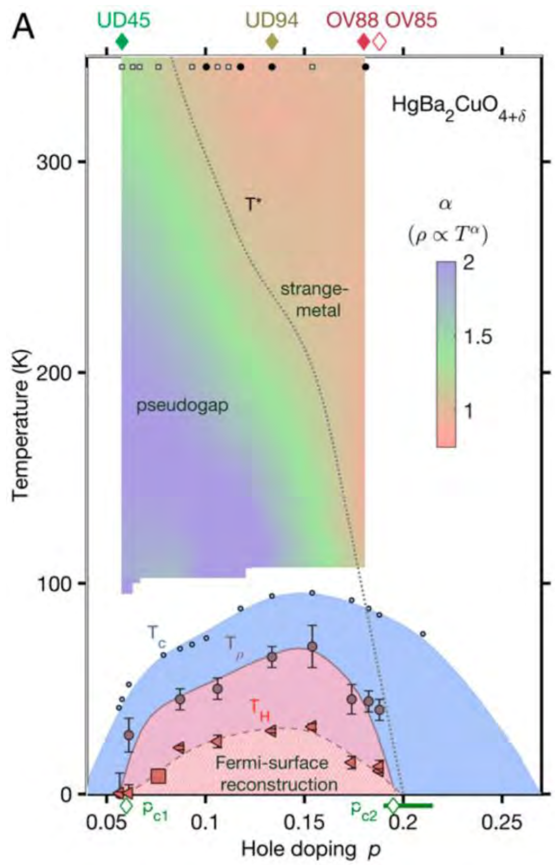

Figure 4.18: Doping-temperature phase diagram of the cuprates. The temperature T_H of the sign-change in the Hall coefficient can be used as a marker for the Fermi-surface reconstruction. Our measurement shows zero-temperature collapse of T_H at the critical doping, indicating the direct impact of the quantum criticality in cuprates on the character of the charge carriers on the Fermi surface.

7. One-component order parameter in URu_2Si_2 uncovered by resonant ultrasound spectroscopy and machine learning

Here we address a long-standing question of the symmetry of the hidden order in the heavy fermion URu_22Si_2 using symmetry-resolved resonant ultrasound measurements. These measurements provide a compelling evidence for the single-component order parameter in the hidden order phase of URu_2Si_2 (Figure 4.19).

Reference

S. Ghosh, M. Matty, R. Baumbach, E.D. Bauer, K.A. Modic, A. Shekhter, J.A. Mydosh, E.-A. Kim, B.J. Ramshaw, *Science Adv.* 6, eaaz4074 (2020), One-component order parameter in URu_2Si_2 uncovered by resonant ultrasound spectroscopy and machine learning

Acknowledgements

The National High Magnetic Field Laboratory is supported by NSF through NSF/DMR-1157490/1644779 and the State of Florida.

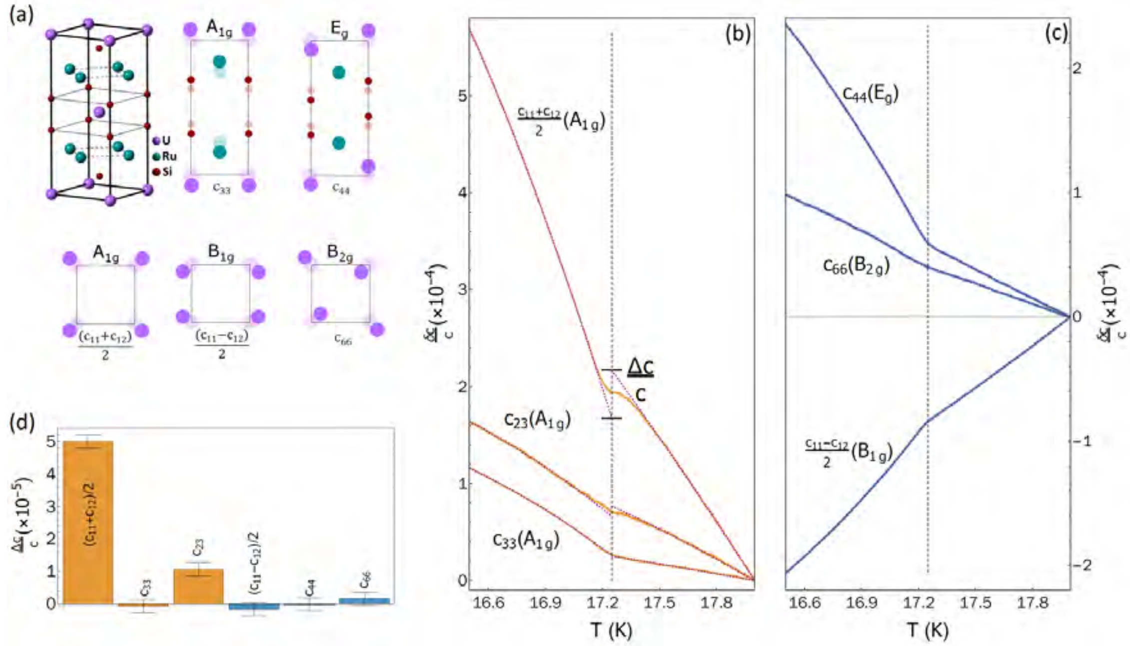

Figure 4.19: Resonant ultrasound measurements in URu_2Si_2 across the hidden order phase boundary. (a) Sketch of the irreducible components of the strain/stress tensor in the tetragonal lattice of in URu_2Si_2. (b) Temperature dependence of the compressional elastic moduli showing discontinuous jump at the hidden order transition. (c) Temperature dependence of three shear moduli showing no jump across the hidden order boundary. (d) Relative magnitude of the jump in the six elastic moduli of in URu_2Si_2.

8. GaN/AlGaN 2DEGs in the Quantum Regime: Magneto-transport and Photoluminescence to 60T

Crooker, S. A.; McDonald, R. D.; Doorn, J. L.; Zimmermann, I.; Lai, Y.; Winter, L. E. (MagLab-LANL)
Lee, M.; Ren, Y.; Cho, Y. J.; Ramshaw, B. J., Xing, H. G.; Jena, D. (Cornell University)

The wide-bandgap semiconductor GaN is a foundational material for solid-state lighting and high-power electronics. Furthermore, the two-dimensional electron gas (2DEG) that forms naturally at GaN/AlGaN heterointerfaces is of interest for high-electron mobility transistors. 2DEG structures grown by molecular-beam epitaxy (MBE) have exhibited electron mobilities exceeding 10^5 cm^2/Vs, galvanizing interest in quantum phenomena and novel electron correlations in GaN-based materials. Indeed, transport measurements have shown a robust integer quantum Hall effect in GaN/AlGaN heterojunctions, and an indication of a fractional quantum Hall state (filling factor $\nu=5/3$) was reported by Manfra et al. nearly two decades ago. In comparison with the more widely studied GaAs-based 2DEGs, electrons in GaN 2DEGs have significantly heavier masses (~$0.24m_0$ vs. ~$0.07\ m_0$ in GaAs), and the dielectric constant is smaller (ε~9.5 in GaN vs. ~13 in GaAs), so that enhanced electron-electron interactions are expected.

However, peak mobilities in GaN-based 2DEGs are, to date, typically achieved at large electron densities n_e ~ $10^{12}/cm^2$, so that high magnetic fields B>40T are required to reach the "quantum limit" where $\nu < 1$. Such large B are (just) within reach of modern superconducting-resistive hybrid magnet technologies but are routinely exceeded by pulsed magnets. Pulsed fields can therefore enable detailed studies of high-density 2DEGs, including not only transport but also optical measurements that probe the response of the 2DEG to a photogenerated hole, which have historically proven to be a powerful tool to measure screening and many-body effects in GaAs- and ZnO-based systems.

Using high magnetic fields up to 60T, we report magneto-transport and photoluminescence (PL) studies of a GaN/AlGaN 2DEG grown by MBE. Transport measurements demonstrate that the quantum limit can be exceeded ($\nu < 1$) and show evidence for the $\nu = 2/3$ fractional quantum Hall state (see Figure 4.20). Simultaneous optical and transport measurements reveal synchronous quantum oscillations of both the PL intensity and longitudinal resistivity in the integer quantum Hall regime. PL spectra directly reveal the dispersion of occupied Landau levels in the 2DEG and therefore the electron mass. Persistent photodoping effects are also investigated. These results demonstrate the utility of high (pulsed) magnetic fields for detailed measurements of quantum phenomena in high-density 2DEGs.

Acknowledgements

The NHMFL is supported by NSF through DMR-1644779 and the State of Florida.

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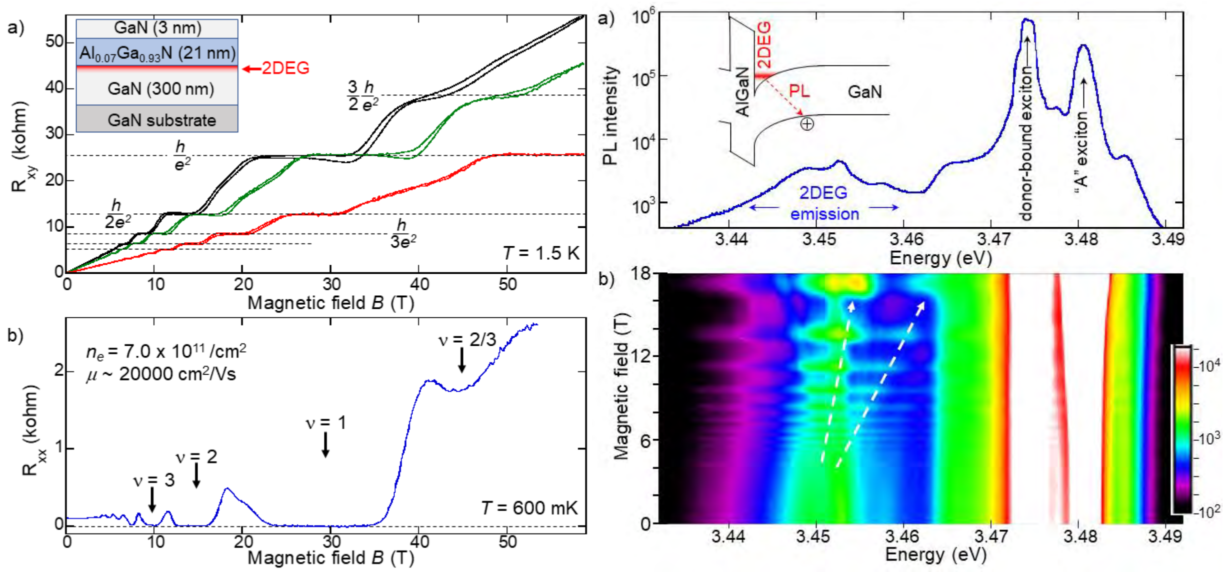

Figure 4.20: Left: Transverse and longitudinal resistivity of the GaN/AlGaN 2DEG structure, to 60T. The black trace was acquired after 3 days in the dark, and the quantum limit is achieved at ~27 T. The fractional $\nu = 2/3$ state is observed. Red trace was acquired after illuminating briefly with white light (note that n_e approximately doubled). Right: PL spectrum at 1.5K. The color map shows intensity oscillations of the 2DEG PL, which track the SdH oscillations of R_{xx} measured in transport.

Condensed Matter at FSU

1. Interplay of Charge and Spin Orders with High-Temperature Superconductivity in La-Based Cuprates at High Magnetic Fields

In underdoped cuprates, the relationship between the pseudogap, superconductivity, and charge and spin ordering has been of key interest. Since high magnetic fields (*H*) are commonly used to suppress superconductivity and probe the nature of this unusual normal state, one of the central issues is to understand the interplay of superconductivity with charge and spin orders in the limit of high magnetic fields. However, the upper critical field (H_{c2}) or the extent of superconducting (SC) phase with vortices, a type of topological excitations, has been controversial. A group led by MagLab scientist Dragana Popović performed a comprehensive series of experiments using several complementary electrical transport techniques on underdoped La-214 cuprates, including those in which charge and spin orders appear in the form of stripes that are most pronounced for doping x~1/8. This study, which is of unprecedented scope, establishes a robust phase diagram for superconducting vortices in underdoped cuprates (Figure 4.21). It finds that, while the vortex phase diagram of underdoped cuprates is not very sensitive to the details of the charge orders, quantum fluctuations and disorder play a key role as temperature $T \rightarrow 0$. The presence of stripes, on the other hand, seems to alter the nature of the anomalous normal state, such that the high-field ground state is a metal, as opposed to an insulator [1].

In the same stripe-ordered cuprates, the group also revealed much-needed transport signatures of the elusive pair-density wave (PDW) state in the regime where superconductivity is destroyed by phase fluctuations, at fields $H < H_{c2}$. These findings have broad implications for cuprate physics because they do not support a scenario in which the PDW correlations are responsible for the pseudogap [2].

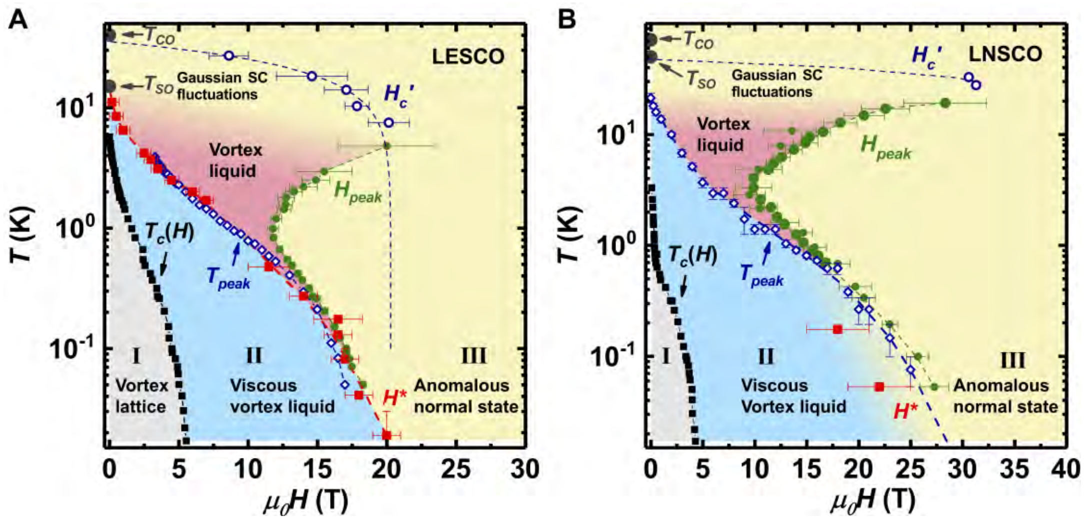

Figure 4.21: In-plane transport T-H phase diagram of striped cuprates with $H \,||\, c$ axis. (A) $La_{1.7}Eu_{0.2}Sr_{0.1}CuO_4$ (LESCO); (B) $La_{1.48}Nd_{0.4}Sr_{0.12}CuO_4$ (LNSCO). $T_c(H)$ (black squares) mark the boundary of the pinned vortex lattice, which is a superconductor with the in-plane resistivity $\rho_{ab}=0$ for all $T<T_c(H)$ [region I; $T_c(H)>0$]. $H^*(T)$ symbols mark the boundary of the viscous vortex liquid, in which dV/dI (V-voltage, I-current) is non-Ohmic [for $H<H^*(T)$] and which freezes into a vortex glass at $T=T_c=0$; dashed red line guides the eye. Ohmic behavior is found at $H>H^*(T)$. $H^*(T=0)$ thus corresponds to the upper critical field H_{c2}. $H_{peak}(T)$ (green dots) represent fields above which the magnetoresistance (MR) changes from positive to negative. The region $H^*<H<H_{peak}$, in which the MR is positive but transport is Ohmic, is identified as the vortex liquid. $T_{peak}(H)$ (open blue diamonds) track the positions of the peak in $\rho_{ab}(T)$. $H_c'(T)$ is the field above which SC fluctuations are not observed; Gaussian fluctuations of the SC amplitude and phase are expected at the highest T and $H<H_c'(T)$. The highest field region (III) corresponds to the H-revealed normal state. The dashed line in (A) is a fit with $\mu_0 H_c'[T] = 20.3[1-(T[K]/35.4)^2]$. In (B), SC fluctuations vanish between 33K and 48K for H=0, and the dashed line is a guide to the eye. Zero-field values of T_{SO} and T_{CO}, the onset temperatures of spin and charge orders, respectively, are also shown; both spin and charge stripes are known to be enhanced by H. Except for $T_c(H)$, lines do not represent phase boundaries, but finite-temperature crossovers.

Acknowledgements

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2. Origin of gaplike behaviors in URu_2Si_2: Combined study via quasiparticle scattering spectroscopy and resistivity measurements

Shengzhi Zhang (MagLab & FSU, Physics); Greta Chappell (MagLab & FSU, Physics); Naveen Pouse (UC San Diego, Physics); Ryan E. Baumbach (MagLab & FSU, Physics); M. Brian Maple (UC San Diego, Physics); Laura H. Greene (MagLab & FSU, Physics); Wan Kyu Park (MagLab)

Introduction

Despite decades of intensive research, whether the hidden order (HO) in Uru_2Si_2 is primarily associated with itinerant or localized electrons remains to be unambiguously determined. In addition, gap values extracted from different measurements are somewhat discrepant, presumably because different gaplike behaviors may reflect different aspects of the HO problem.

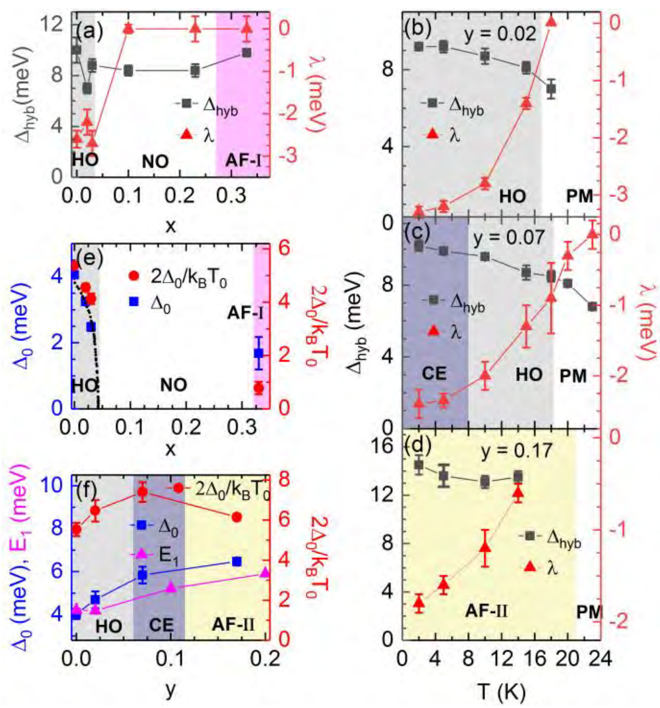

Figure 4.22: Gap values extracted from the QPS (a – d) and resistivity (e – f) data on $URu_2Si_{2-x}P_x$ and $URu_{2-y}Fe_ySi_2$ single crystals. Labels at the bottom denote different regions in the phase diagram (see the text). PM denotes the paramagnetic state. Δ_{hyb} and λ are the hybridization gap and the renormalized *f*-level, respectively, obtained from the QPS data. Δ_0 is the zero-temperature gap in the bosonic excitations extracted from the temperature-dependent resistivity. All lines are a guide to the eye. (a) Δ_{hyb} and λ at 2K as a function of x in $URu_2Si_{2-x}P_x$. The hybridization gap is observed in all phases including the NO. (b) – (d) Δ_{hyb} and λ as a function of temperature for different y in $URu_{2-y}Fe_ySi_2$. The hybridization gap opens well above the ordering temperature. (e) Δ_0 and its mean-field ratio as a function of x in $URu_2Si_{2-x}P_x$. T_0 is the ordering temperature. The NO data are fit well to the Fermi liquid expression without the bosonic excitation term. (f) Δ_0 and its mean-field ratio as a function of y in $URu_{2-y}Fe_ySi_2$. Δ_0 and E_1, the gap detected in inelastic neutron scattering [6], show similar dependence on y. The mean field ratio is quite different between AF-I and AF-II, suggesting that these two antiferromagnetic orders are of different nature.

Experiments and Data Analysis

To address these outstanding questions, we performed a combined study via quasiparticle scattering spectroscopy (QPS) and electrical resistivity measurements [1] on the polished (001) surface of $Uru_2Si_{2-x}P_x$ [2] and $Uru_{2-y}Fe_ySi_2$ [3] single crystals, whose ground state spans a wide range of the phase space: HO, no order (NO), and an antiferromagnetic phase (AF-I) for the P substitution; HO, coexisting (CE) region, and another antiferromagnetic phase (AF-II) for the Fe substitution. The QPS and *dc* resistance data were analyzed using the models proposed by Maltseva et al. [4] and Jobiliong et al. [5], respectively, the latter assuming gapped bosonic excitations as the major scattering source in the ordered state.

Results and Discussion

A hybridization gap is observed in all five phases including the NO region [Figures 4.22 (a) – (d)], with minimal change upon crossing the phase boundary. This indicates that the opening of a hybridization gap itself is not associated with the ordering and thus localized electrons must be the major player. The temperature dependence of the resistivity including the jump at the transition temperature is well reproduced by the Jobiliong et al. model. The extracted gap [Figure 4.22 (e) & (f)] reveals that the two antiferromagnetic phases (AF-I & AF-II) are of different nature. In $URu_{2-y}Fe_ySi_2$, it matches with the E_1 gap detected by inelastic neutron scattering [6].

Conclusions

The orderings in URu_2Si_2 are likely due to localized electrons and the gaplike behaviors in many physical properties can be explained by considering the gapped bosonic excitations in such ordered states. Our results suggest that the multitude of *f* electrons in URu_2Si_2 may play intriguing roles leading to intertwined orders (HO and AF), whose analogs can be found in other correlated systems.

Acknowledgements

This work was supported by the NSF/DMR-1704712. The work at the NHMFL was partly supported by the NSF/DMR-1644779 and the State of Florida and partly by the FSU startup funds under Award No. 0000028452. The work at UCSD was supported by the DOE-BES-DMSE under Award No. DEFG02-04-ER46105 and by the NSF/DMR-1206553.

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3. Influence of hydrostatic pressure on hidden order, the Kondo lattice, and magnetism in $URu_2Si_{2-x}P_x$

Chappell, G. L., (MagLab, FSU Physics), Gallagher, A (MagLab, FSU Physics), Graf, D. (MagLab), Riseborough, P (Temple University), Baumbach, R. E. (MagLab, FSU Physics)

Introduction

URu_2Si_2 is well known as a strongly correlated electron Kondo lattice that hosts (i) the enigmatic hidden order (HO) state near $T_0 \approx 17.4K$ and (ii) superconductivity (SC) below $T_c = 1.5K$ [1]. However, even after substantial efforts, the HO state and its relationship to more common ordered states such as magnetism remain unclear. Earlier works where the ground state is tuned using pressure, chemical substitution, and applied magnetic fields have provided insights, but are often difficult to understand because they simultaneously tune multiple connected factors. To avoid this complexity, the chemical substitution series $URu_2Si_{2-x}P_x$ was recently investigated [2], where it was proposed that the primary tuning parameter is a combination of s/p-site electron doping and lattice compression. In the current study, we investigate the influence of applied pressure in this series [3]. These results provide new insights to the quasi-universal phase diagram that results from electron-like substitution (Si→P and Ru→Co/Ir) and may also point the way towards stabilizing HO in related uranium based Kondo lattice compounds that exhibit magnetism in their natural form.

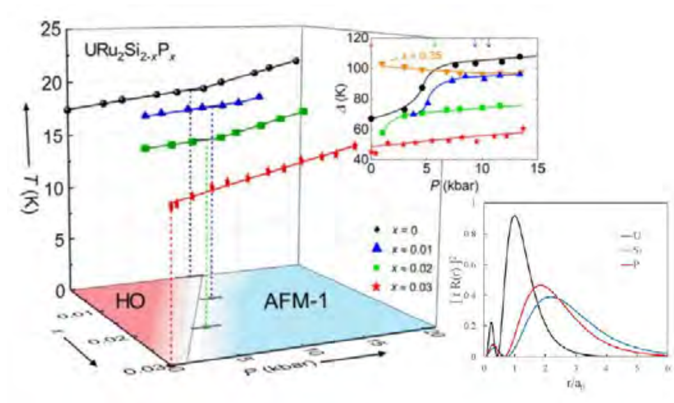

Figure 4.23: Temperature-concentration-pressure (T-x-P) phase diagram for $URu_2Si_{2-x}P_x$ showing the phase boundaries for the low x hidden order and antiferromagnetic phases. (top inset) The energy gap parameter Δ, extracted from fits to the low temperature electrical resistivity data. (bottom inset) The radial probability distribution for U, Si, and P expressed in atomic units determined using a tight binding Hartree-Fock approximation.

Experimental

Electrical resistivity ρ(T) measurements were performed on single crystal specimens of $URu_2Si_{2-x}P_x$ with the current applied along the crystalline ab-plane in a Quantum Design Physical Property Measurement System (PPMS) at temperatures T= 1.8K - 300K. Applied pressures up to 20.5 kbar were achieved using a double-wall beryllium copper clamped piston cylinder cell and a quasi-hydrostatic pressure environment was provided with Daphne 7575 oil.

Results and Discussion

Within the chemical substitution series $URu_2Si_{2-x}P_x$, there is an evolution in the ground-state behavior from hidden ordered (HO) for x ≲ 0.03, to Kondo lattice behavior with no ordering (NO) for 0.03 ≲ x ≲ 0.26, to antiferromagnetism (AFM-2) for 0.26 ≲ x ≲ 0.5 [2]. To better understand what factors, control this behavior, temperature-dependent electrical resistivity measurements were performed. Specimens in the HO x region show similarities to the parent compound, where (i) HO transforms into antiferromagnetism (AFM-1) at a critical pressure (P_c) and (ii) P_c decreases with increasing x and collapses towards P = 0 near x ≈ 0.03 (Figure 4.23 left). At larger x, no pressure induced phase transitions are observed in the NO x region, and the AFM-2 state is only weakly suppressed by P. Measurements further reveal that AFM-1 and AFM-2 are distinct from each other. Calculations of the wave functions using the tight-binding Hartree-Fock approximation were performed and show (i) that the radial probability distributions for the phosphorus ions are more tightly bound than those for the silicon and (ii) that the energy difference between the orbitals decreases with increasing x (Figure 4.23 bottom inset).

Conclusions

Based on our measurements and calculations, we conclude that the cumulative effect of Si→P substitution is to (i) decrease the hybridization strength, which correlates with the weakening of HO and (ii) at large x, additional effects such as electrical charge tuning also play an important role in determining the ground-state behavior.

Acknowledgements

This work was performed at the National High Magnetic Field Laboratory, which is supported by NSF Cooperative Agreement No. DMR-1644779 and the State of Florida. Synthesis of crystalline materials and their characterization was supported by the Center for Actinide Science and Technology (CAST), an Energy Frontier Research Center (EFRC) funded by the DOE, Office of Science, Basic Energy Sciences (BES), under Award No. DE-SC0016568.

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4. Superconductivity in a uranium containing high entropy alloy

Nelson, W. N. (MagLab, FSU Physics), Chemey, A. T. (FSU Chemistry),Hertz, M. (FSU Chemistry), Choi, E (MagLab), Graf, D. (MagLab), Latturner (FSU Chemistry), Albrecht-Schmitt, T. E. (FSU Chemistry), Wei, K. (MagLab), Baumbach, R. E. (MagLab, FSU Physics)

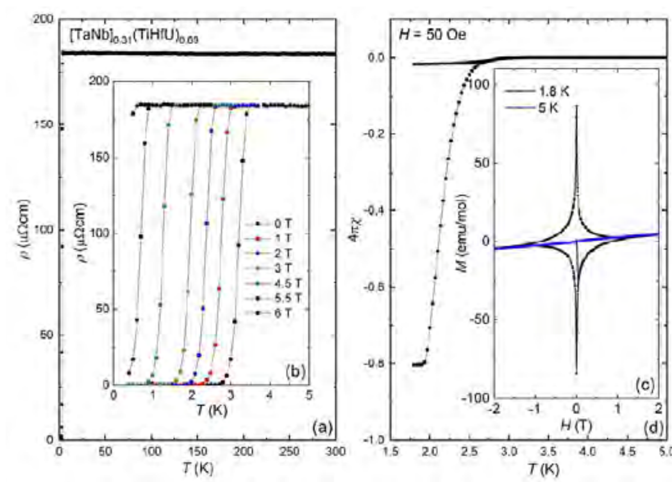

Figure 4.24: Summary of electrical transport ρ (T) and magnetization data 4πχ and M for $[TaNb]_{0.31}(TiUHf)_{0.69}$. (a.b) ρ (T) showing the transition to the zero resistance state near T_c = 3.1 K and its suppression with increasing magnetic field H. (c,d) 4πχ vs T collected for H = 50 Oe and M vs H at 1.8K.

Introduction

High entropy alloys (HEA) are multicomponent mixtures of randomly combined elements where, instead of producing disordered mixtures of lower order crystalline compounds (binaries, ternaries, etc.), solid solutions with simple structures (e.g., body center cubic) are formed [1–5]. Many attractive behaviors are observed in HEAs, including fracture resilience at cryogenic temperatures, excellent mechanical properties at elevated temperatures, high strength, and high resistance to radiation damage. An emerging class of HEAs are those hosting 4d and 5d transition metals that exhibit phonon mediated superconductivity with large upper critical fields [5]. Importantly, many HEAs are functional in multiple distinct ways, making them attractive as candidates for a variety of applications, e.g., as next generation wires for superconducting magnets or for use under extreme conditions. Here we report the discovery of superconductivity in an f-electron containing HEA, $[TaNb]_{0.31}(TiUHf)_{0.69}$, which is also the first to include an actinide ion [6].

Experimental

Polycrystalline specimens were produced using the arc furnace method. Powder x-ray diffraction and energy dispersive spectroscopy measurements were used to determine the structure and chemical composition. Temperature and magnetic field dependent magnetization, electrical resistivity, thermopower, thermal conductivity, and heat capacity measurements were performed using a Quantum Design Magnetic Properties Measurement System and Physical Properties measurement system for temperatures 1.8K < T < 300K and H < 9T.

Results and Discussion

Similar to the Zr analogues $[TaNb]_{1-x}(TiZrHf)_x$ [5], $[TaNb]_{0.31}(TiUHf)_{0.69}$ [6] crystallizes in a body-centered cubic lattice with the lattice constant a = 3.41(1) Å and exhibits phonon mediated superconductivity with a transition temperatures $T_c \approx 3.2$ K and upper critical fields $H_{c2} \approx 6.4$ T (Figure 4.24). Like other HEA superconductors, this occurs in a highly disordered environment, which likely provides pinning centers for superconducting vortices. Bulk electrical transport, magnetization, heat capacity, thermopower, and thermal conductivity measurements reveal other similarities to the Zr-analogues, where it is seen that the f-electrons are delocalized and that the chemical disorder results in a large and nearly temperature independent electrical resistivity and a small thermal conductivity. $[TaNb]_{0.31}(TiUHf)_{0.69}$ thus emerges as a representative of what likely is a much larger family of actinide materials that may be of importance for both technological (e.g., development of durable waste forms) and basic science (reservoir for superconductivity) reasons.

Conclusions

These measurements indicate that $[TaNb]_{0.31}(TiUHf)_{0.69}$ is a disordered type II superconductor that is described by the BCS theory within the weak electron-phonon coupling regime, similar to what was earlier reported for the Zr-containing analogues. This is consistent with the conclusion that the uranium f-electrons are delocalized and do not (i) carry a well-defined magnetic moment or (ii) result in strong electronic correlations.

Acknowledgements

Synthesis and material characterization were supported by CAST, an EFRC funded by the DOE under Award DE-SC0016568. Kaya Wei acknowledges support from the Jack E. Crow NHMFL postdoctoral fellowship. This work was performed at the NHMFL which is supported by NSF Cooperative Agreement DMR-1644779 and the State of Florida.

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5.Enhanced spin correlations in the Bose-Einstein condensate compound $Sr_3Cr_2O_8$

Nomura, T., Skourski, Y., Gorbunov, D., Yasin, S., Wosnitza, J. and Zherlitsyn, S. (HLD-EMFL and ct.qmat); Quintero-Castro, D.L. and Islam, A. T. M. N. (Helmholtz-Zentrum Berlin für Materialien und Energie); Zvyagin A.A. (Max-Planck-Institut für Physik komplexer Systeme and ILTPE of the NAS of Ukraine); Suslov, A.V. (FSU, MagLab); Kindo, J.K., and Kohama, Y. (University of Tokyo, ISSP); Lake, B. (Institut für Festkörperphysik); and Jaime M. (LANL, MPA-Maglab and Physikalisch-Technische Bundesanstalt)

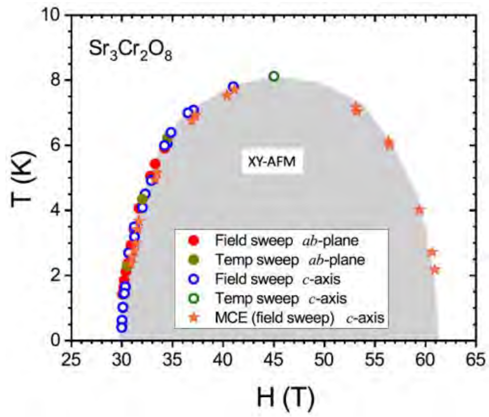

Figure 4.25: (H, T) phase diagram from dilatometry and sound velocity data in DC magnetic fields along the ab-plane and along the c-axis, and magnetocaloric effect data in pulsed magnetic fields.

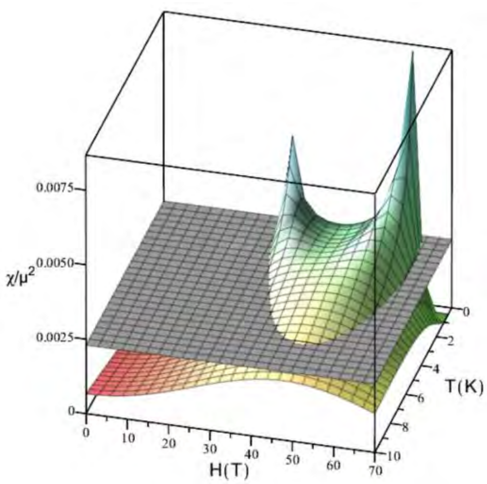

Figure 4.26: Calculated temperature and magnetic-field dependence of the magnetic susceptibility in $Sr_3Cr_2O_8$ per spin. The intersection with the gray plane represents the critical (H_c, T_c) line and qualitatively agrees with Figure 4.25.

Introduction

Enhanced spin correlations are key to understand phase transitions and specific types of order, among myriads, in magnetic systems. They help us classify critical phenomena that are oblivious to microscopic details, allowing predictions for bigger and perhaps more consequential systems. By studying the thermal and sound propagation properties of spin states in $Sr_3Cr_2O_8$ and their coupling to the crystal lattice, some of the strongest spin correlations in any members of the quantum magnetism family of compounds are found, in the absence of any indication of frustration or reduced dimensionality. [1]

Experimental, Results and Discussion

High-quality single-crystal samples of the spin-dimer system $Sr_3Cr_2O_8$ were grown using the floating-zone technique. Spin-lattice effects in this material were studied by means of ultrasound and dilatometry techniques in dc-field 35 T and 45 T magnets at MagLab, Tallahassee, FL; and by magnetocaloric-effect experiments in pulsed 60 T magnets at ISSP, University of Tokyo, Japan.

Combined experimental (Figure 4.25) and modeling (Figure 4.26) studies allowed us to probe and explain the spin-correlated regime in the proximity of the field-induced XY-type antiferromagnetic (XY-AFM) order also referred to as a Bose-Einstein condensate of magnons. We found that the XY-AFM state is presented by a dome phase diagram, whereas paramagnetic, spin gapped dimer, spin-correlated, and spin-saturated states take place around the dome (not detailed here). The reported minimalistic quasi-one-dimensional phenomenology is consistent with a "passive" crystal lattice that acts as a silent witness to the mechanisms driven by magnetic correlations.

Acknowledgements

Work at *the NHMFL was supported by NSF through NSF/DMR-1644779, the State of Florida*, and the DOE Office of Basic Energy Science Project No. "Science at 100 T".

The research was partially supported by the DFG (Grant No. SFB 1143), the Würzburg-Dresden Cluster of Excellence on Complexity and Topology in Quantum Matter (EXC 2147, Project No. 390858490), by the BMBF via DAAD (Project No. 57457940), and Dresden High Magnetic field

Laboratory (HLD) at Helmholtz-Zentrum Dresden-Rossendorf (HZDR), member of the European Magnetic Field Laboratory (EMFL).

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6. Experimental protection of quantum coherence by using a phase-tunable image drive

S. Bertaina (CNRS-Marseille, France), H. Vezin (CNRS-Lille, France), H. de Raedt (U. of Groningen, The Netherlands), I. Chiorescu (FSU- MagLab)

Introduction

A method to increase the coherence time of a qubit up to its relaxation time has been introduced and verified experimentally on several diluted quantum spins. The work has been published in [1].

Experimental

Data taken at CNRS-Lille, France, using a conventional pulse ESR spectrometer Bruker E680 equipped with an incoherent electron double resonance (ELDOR) bridge and a coherent arbitrary waveform generator (AWG) bridge. Numerical analysis involved the use of the QuTip package.

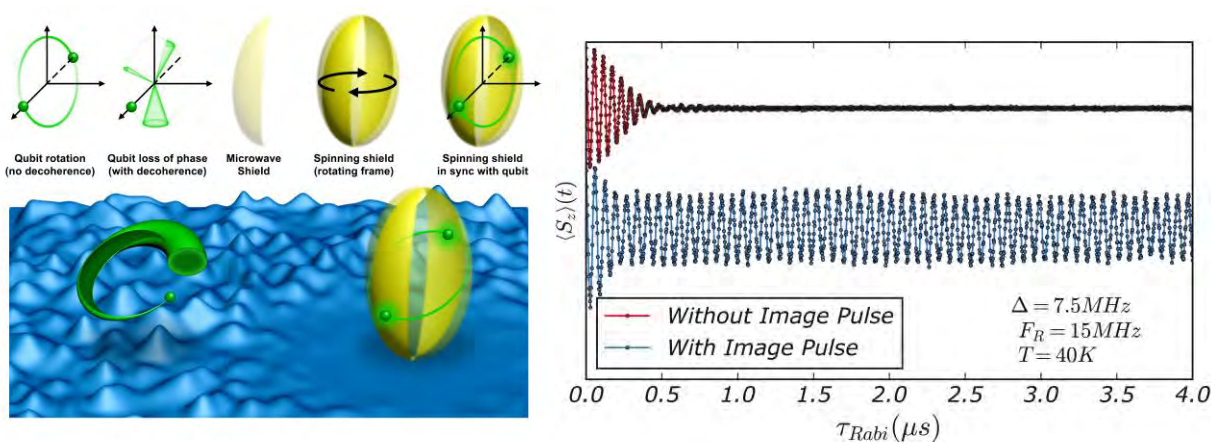

Figure 4.27: (left) Artist representation (by J. Kevin – MagLab) of the principle introduced in this work. The qubit phase information is shown by the green ball in a circular motion. The fast dephasing in the absence of the commensurate microwave shield is due to the interaction with various decoherence sources (shown as rough waters). However, when the shield is applied, the decoherence sources (shown by calm waters underneath) are no longer disturbing the qubit phase information. The top figures indicate the qubit and shield rotation in the rotating frame (Bloch sphere); the commensurate aspect of the motion is shown by the green ball glowing every time the shield and qubit meet. (right) Measurement performed on a Gd spin system, with (blue) and without (red) the Floquet microwave shield (from [1]).

Results and Discussion

The principle of the method is given in Figure 4.27 (left) and verified on diamond P1 defects (S = 1/2), Mn^{2+} impurities in MgO (S = 5/2) and Gd^{3+} impurities in $CaWO_4$ (S = 7/2). A typical result is shown in Figure 4.27 (right), from [1], whereby "image pulse" is the microwave shield introduced in Figure 4.27 (see [1] for details).

In Figure 4.27 (left) the top figures show the motion of a qubit (green ball) without and with a specially designed Floquet microwave shield (in yellow). The motions of the qubit and shield are commensurate, shown by the green ball glowing each time the two meet. Without a shield, the qubit phase information is lost in a disc-like pattern due to decoherence sources ("rough waters" underneath, on left) while with the shield on, the decoherence sources are managed and the coherence is preserved up to qubit's energy relaxation time.

The example shown in Figure 4.27 (right) details the quantum Rabi oscillations of a Gd3+ spin with (blue) and without (red) the microwave shield in place. The maximum coherence times presented in [1] extend to 15 microseconds, which is the maximum allowed by the Bruker setup.

Conclusions

We have introduced a universal method allowing to protect the qubit coherence; the method is demonstrated on several quantum spin systems.

Acknowledgements

Work supported by the CNRS infrastructure RENARD (award IR-RPE CNRS 3443). Partial support by the NSF DMR-1644779 and the State of Florida is acknowledged.

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7. Site-specific spectroscopic measurement of spin and charge in $(LuFeO_3)_m/(LuFe_2O_4)_1$ multiferroic superlattices

Fan, S. (U. of Tenn., Knoxville, Physics); Das, H. (Tokyo Inst. Of Tech.); Rébola, A. (Instituto de Fisica Rosario-CONICET); Smith, K.A. (U. of Tenn., Knoxville, Chemistry); Mundy, J. and Brooks, C. (Harvard); Holtz, M.E., Muller, D.A., and Fennie, C.J. (Cornell); Ramesh, R. (UC, Berkeley); Schlom, D.G. (Cornell); McGill, S.A. (MagLab); Musfeldt, J.L. (U. of Tenn., Knoxville, Physics & Chemistry)

Introduction

We develop a method for extracting interface spectra (+ magnetization) in multiferroic superlattices and employ this approach to reveal precisely how enhanced Lu layer distortion increases the Curie temperature.

Experimental

We performed magnetic circular dichroism measurements (MCD) in the 25 T Split-Florida Helix magnet. Access to the unique Split-Florida Helix magnet at the National High Magnetic Field Laboratory was crucial to this work because MCD is sensitive to field direction. The high coercivity of these superlattices also requires a large ±25 T field to close the magnetic hysteresis loop.

Results and Discussion

Figure 4.28 summarizes the magnetic circular dichroic responses of all superlattices [1]. Three Fe-related excitations are assigned in the dichroic spectra based upon their energies and intensities. Constant energy cuts of the dichroic spectra reveal optical hysteresis loops. We extract the interface response by subtracting the spectra of the end members in proper proportion. In addition to the dramatic intensity change above 2 eV, analysis of the interface spectra at different characteristic energies reveals that increased Lu-layer distortion selectively enhances the spin-up charge transfer. Because the dichroic signal is proportional to magnetization, this implies that enhanced magnetization in the $LuFe_2O_4$ layers boosts the Curie temperature in these multiferroic superlattices.

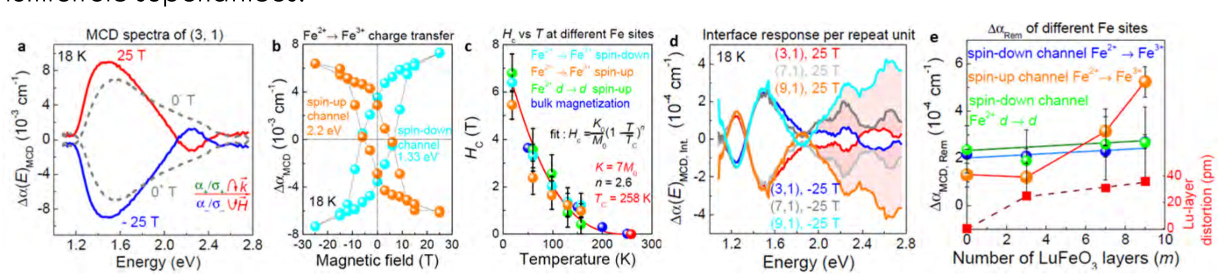

Figure 4.28: (a) MCD of the (3,1) superlattice at ±25T and ± 0T. (b) Optical hysteresis for the spin-up and spin-down channel $Fe^{2+} \rightarrow Fe^{3+}$ charge transfer excitations. (c) Coercivity vs. *T* for different Fe-related excitations. (d) Interface MCD spectra for (3,1), (7,1), and (9,1) superlattices. (e) Remnant field vs. *m* for different Fe-related excitations.

Conclusions

Understanding the inner workings of multiferroic interface materials is in its infancy, and the spectroscopic decomposition method that we report is a powerful means to learn about how they track with site-specific understanding directly at the interface. Analogous opportunities exist to exploit interface materials to enhance spintronics and photonics. As a result, there is broad utility in revealing interface dynamics well beyond the multiferroics community.

Acknowledgements

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8. Ring currents modulate optoelectronic properties of aromatic chromophores at 25T

Kudisch, B. (Princeton U.); Maiuri, M. and Moretti, L. (Princeton U. and Politechnico di Milano); Oviedo, M.B. (Princeton U., UC Riverside, and Universidad Nacional de Cordoba); Wang, L., Oblinsky, D.G., and Prud'homme, R.K. (Princeton U.); Wong, B.M. (UC Riverside); McGill, S.A. (MagLab); and Scholes, G.D. (Princeton U.)

Introduction

Magnetic fields are powerful, incisive scientific tools to investigate and manipulate the properties of next-generation quantum materials. Many organic systems studied so far have intrinsic magnetism which leads to straightforward Zeeman interactions in applied magnetic fields. However, we have observed magnetic-induced effects in the photo-physics of *diamagnetic* organic molecules which expands the scope of candidate materials that may be considered for multifunctional devices.

Experimental

We used the Ultrafast Optics instrumentation at the MagLab in conjunction with the 25 T Split-Florida Helix Magnet to measure the time-resolved, sub-picosecond, photo-excited absorbance dynamics of copper phthalocyanine nanoparticles, as well as a few other systems, in high magnetic fields.

Results and Discussion

Using the 25T Split-Florida Helix Magnet, we confirmed our theoretical prediction that a strong magnetic field applied on organic aromatic molecules affects their optoelectronic properties. Aromatic ring currents induced by the applied fields were shown to modulate not only the light absorbing properties of the model aromatic chromophore, but also its subsequent ultrafast

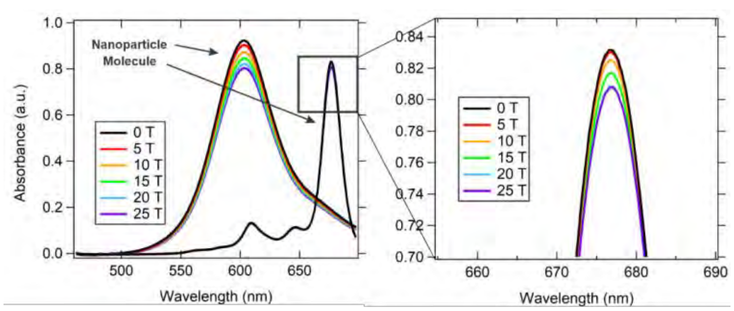

Figure 4.29: High magnetic field modulates the absorption properties by more than 10% at 25 T in molecular nanoparticles.

dynamics after light absorption, graphically shown in Figure 4.29 and Figure 4.30. This magnetic field sensitivity was also demonstrated to be enhanced by molecular aggregation in certain packing arrangements, analogous to a quantum molecular solenoid. [1]

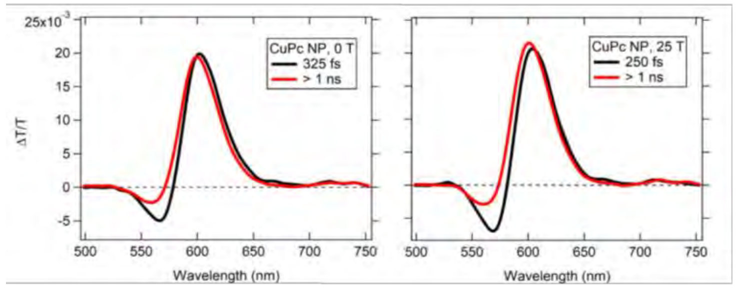

Figure 4.30: Subpicosecond intersystem crossing rate modulation at 25T.

Conclusions

Despite modern society's reliance on the interconversion of magnetic fields and circular electron currents, most attempts to design magnetosensitive organic devices rely on materials already possessing intrinsic magnetism since they will obviously be affected by magnetic fields. Discovering that magnetic field-induced ring currents in "nonmagnetic" aromatic chromophores not only exist but are also controllable by both magnetic field strength and simple material properties greatly expands the scope of materials that should be considered for multifunctional magnetic technologies.

Acknowledgements

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9. Probing Dielectric Transition and Molecular Dynamics in Metal Organic Framework $[(CH)_3NH_2]Mg(HCOO)_3$ Using NMR

Ramakrishna S.K. (FSU, Chemistry & MagLab); Kundu K (MagLab), Bindra J. K. (MagLab), Locicero S.A. (UF, Chemistry), Talham D.R. (UF, Chemistry & MagLab), Reyes A.P (MagLab), Fu R. (MagLab), Dalal N, (MagLab)

Introduction

The mechanism of the electric phase transition in metal organic framework (MOF) multiferroics with the general formula $[(CH)_3NH_2]M(HCOO)_3$, where M is the metal cation, is studied using multinuclear (^{15}N, ^{13}C, ^{25}Mg) NMR technique. [1-3] Chemical shifts for M=Mg MOF near the phase transition (270K) and the correlation time of the carbon and nitrogen atom in the MOF cavity were measured and analyzed using BPP theory. The evolution of the ^{13}C, ^{15}N spectra indicate that the phase transition is prominently governed by the dynamics of the DMA^+ cations.

Experimental We used 17T at the condensed matter physics NMR facility and 600MHz, 830MHz Bruker high-resolution NMR instruments at the high-resolution NMR facility at MagLab to obtain the spectra, chemical shifts and spin-lattice relaxation T_1. We used a Bruker Magic Angle Spinning (MAS) unit with 3.2mm rotor spinning at 14KHz.

Results and Discussion

Figure 4.31 a shows the evolution of the ^{13}C CP/MAS NMR spectra of methyl carbons in the Mg-MOF as a function of temperature. A single resonance is observed above the phase transition temperature, implying that DMA^+ cations are in a disordered motional state averaging the chemical shifts. As the temperature is lowered, additional two peaks appear and gradually gain in intensities while the center peak intensity decreases. The emergence of the doublet in the low-temperature phase indicates that the DMA^+ cation is displaced from its center in the cavity such that the two methyl groups in the DMA^+ cation become chemically inequivalent. Similar behavior is exhibited by the formate carbons which also shows a single resonance above the phase transition temperature (Figure 4.31 b). The case for ^{15}N shows a single peak corresponding to the NH_2 group in the cavity (Figure 4.32 a). The phase transition was observed through the change in its chemical shift as well as linewidth. This is consistent with the theory that the nitrogen atoms are disordered over three different positions due to the weak hydrogen bonds above the phase transition resulting in motionally-narrowed line. Below the phase transition, the motion of the DMA^+ ion slows down as it localizes into one of the three positions in the lattice, such that the ^{15}N linewidth becomes broader. A first-order phase transition is evidenced by the temperature dependent relaxation time T_1 of ^{15}N across the phase transition (Figure 4.32 b). At higher temperatures, the T_1 relaxation is ten times faster than at lower temperatures. The two regions above and below the phase transitions were fitted separately using a BPP model. The activation energy and single particle correlation time were found to be 28.6 ± 8.3kJ/mol and 1.5 ± 6.0 × 10^{-14} respectively.

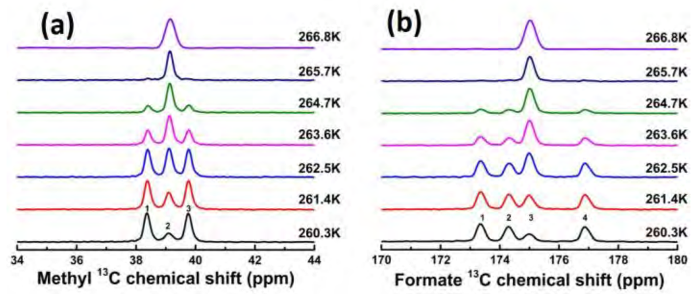

Figure 4.31: ^{13}C spectra (a) of the dimethylammonium cation and (b) of the format framework.

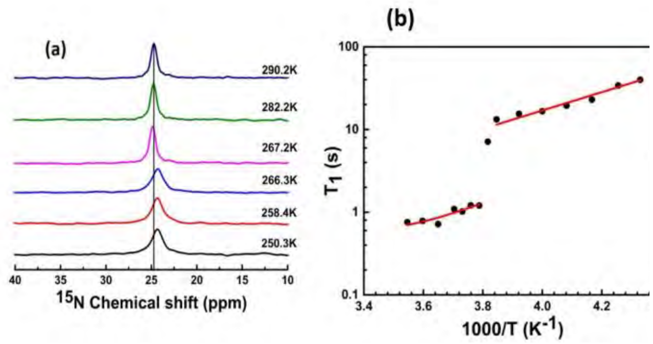

Figure 4.32: (a) ^{15}N spectra in $[(CH_3)_2NH_2]Mg(HCOO)_3$ and (b) its *T*-dependent T_1 relaxation. Red line shows fit to the BPP model.

Conclusion

The changes in the spectra of ^{13}C, ^{15}N indicate that the phase transition is prominently governed by the dynamics of the DMA^+ cations. From the fitting of T_1 experimental data to BPP relaxation model, the correlation time is in reasonable agreement with the values found using other techniques. [4]

Acknowledgements

All NMR experiments were carried out at the National High Magnetic Field Lab (NHMFL) supported by the NSF Cooperative Agreement DMR-1644779 and the State of Florida.

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Magnets and Materials

4. MAGNETS AND MAGNET MATERIALS

A central part of the MagLab's Mission is to develop, operate, and maintain the new magnet systems that enable a world-leading high-magnetic-field user program.

For twenty-six years, the MagLab's user facilities were based on copper alloys and low-temperature superconducting (LTS) materials. In 2020 the MagLab commissioned its first magnet using High Temperature Superconducting (HTS) materials, a 32T magnet, presently the highest field superconducting (SC) magnet worldwide. This magnet is the product of a development effort that started at a low level in 2007 when the first coil was tested using a novel form of REBCO (rare earth barium copper oxide, $REBa_2Cu_3O_7$) on a high strength Hastelloy substrate and electroplated copper stabilizer. It received some external funding with a Major Research Instrumentation grant in 2009. The more than $16M needed to develop the technology and deliver the working system is an indication of the tremendous amount of development that went into characterizing the conductor, developing an insulation system, joints, terminals, winding technology, quench-protection technology and controls system. The presently operational user magnet provides field approaching that of our workhorse resistive magnets (35T in 32mm room-temperature bore) while having lower field ripple, electronic noise, and consuming approximately 20MW less power. While eight resistive magnets share two pairs of power supplies, the 32T SC magnet is expected to eventually be running 24/7, like the other (20T) SC magnets in the milliKelvin facility, thereby providing a 60% field increase for this class of magnet.

While this magnet produced a remarkable 7T more field than any other SC magnet worldwide when it was first tested in 2017, this is not the end of the story, rather just the beginning. The MagLab has initiated development of a 40T SC magnet using similar REBCO technology. While several other labs and commercial firms are now developing or producing ultra-high field (UHF) magnets using the HTS materials, the MagLab has been leading the development of improved Bi-2212 ($Bi_2Sr_2CaCu_2O_{10}$) conductor and coils, which show great potential for future UHF SC magnets, particularly for nuclear magnetic resonance and ion-cyclotron resonance.

In 2018, the generator that powers the 100T multi-shot (100TMS) and 60T long-pulse (60TLP) magnets was damaged and was taken out of service for repair. To continue to provide state-of-the-art facilities to users of the pulsed field facility, a "Magnet Surge" project was introduced to accelerate the development of capacitor-driven magnets at the 75T level in short-pulses (now operational) and the 60T level with longer pulses (to be operational in summer 2021).

Materials development for magnet applications continues to advance with important developments in Bi-2212, Fe-based, Nb_3Sn superconductors, and qualification of REBCO from multiple suppliers, as well as reinforcing materials for pulsed and SC magnets.

Collaborations with leading industry, academic and government groups are synergistic with the materials and magnets science driver, and our report describes work in this broader context as well. Collaboration with the high-energy physics community continues, particularly regarding development of higher current-density superconductors, both LTS and HTS. The MagLab is one of the four central players in the Magnet Development Program (MDP) funded by the DOE Office of High Energy Physics (HEP) to drive ultra-high field dipole magnet technology.

Superconducting Magnets & Materials

32T

The MagLab has the world's highest field all-superconducting (SC) magnet in user service! The 32T all-SC magnet is now operational in the millikelvin facility which is part of the DC field facility at the FSU branch of the MagLab (Figure 4.33). It consists of an outer set of coils using low temperature superconducting (LTS) materials developed by Oxford Instruments that provides 15T in a 25cm cold bore and an inner set of coils using high temperature superconducting (HTS) materials developed in-house that provides 17T in a 3cm bore.

The 32T SC magnet reached field for the first time at the end of 2017. During partial dis-assembly and relocation from the test site to the user facility in early 2018, some damage was noticed at the ends of the coils due to unexpected motion of the end flanges. A few components were re-designed and subjected to fatigue testing during 2018. The magnet was re-assembled and ready for operations by early 2019. While the controls, power, and protection systems had been operational in late 2017 for system testing, they were not in a state suitable for operation by external users; they could only be operated by the individual who had led the development of the protection system. This person left to take a job elsewhere in mid-2018. A replacement did not arrive until mid-2019. By August 2020 the control, power and protection systems were in a state that allowed users to initiate operations at fields up to 26T in September 2020. In early 2021, operations commenced at fields up to 32T.

Figure 4.33: The first users of the 32T magnet performing NMR measurements of a frustrated magnet system in September 2020.

40T

The MagLab has initiated the development of a 40T superconducting (40T SC) magnet. This project is being undertaken in a series of phases as used by NSF for projects valued >$4M. The Research and Development phase began in September 2018. The Conceptual Design phase started in December 2019 (Award number: NSF/DMR #1938789) [1]. A Design proposal has now been submitted the NSF's Mid-Scale research Infrastructure program for the Preliminary and Final Design Phases. If this is successful, it will last five years, and an Implementation proposal will be submitted to the Mid-Scale program in 2025 for the construction of the magnet.

The objective of the conceptual design grant was to create a conceptual design of a robust all-superconducting magnet with peak field well in excess of 32T (a.k.a. 40T) and a bore size of 34mm. If funded, the 40T SC magnet will be installed in the milliKelvin building of the DC Field facility at the FSU branch of the MagLab, near the existing 32T SC magnet. The 40T SC magnet will provide a very low noise environment for experiments lasting days at a time, surpassing the time available from present-day powered (resistive and hybrid) magnets. Upon its commissioning, the 40T SC magnet will become a flagship in the MagLab's suite of high-field magnets that exist to serve the User Community.

In 2009 when the 32T SC magnet project started, the only viable superconducting material was REBCO tape and the only coil technology that had been identified used pancake winding with inter-turn insulation. This "I-REBCO" approach was used in the 32T magnet. Since then, a version of REBCO coil without insulation (NI-REBCO) has been used to build several test coils including one at the MagLab that reached 45.5T. In addition, Bi-2212 and Bi-2223 have made a lot pf progress and seemed worth considering for a 40T SC magnet. During the R&D phase, these four options plus a layer-wound REBCO version (Integrated Coil Form or ICF) were investigated. Partway through the R&D phase it was decided that the only two options that showed potential to produce viable designs for reliable 40 T magnets by the end of the second year of work were the I-REBCO and NI-REBCO double-pancake approaches.

The I-REBCO approach evolved into a version using multiple tapes wound in parallel (a simple cable) and is referred to as Multi-Tape Insulated (MTI-) REBCO. The NI-REBCO approach has evolved into a more general concept with controlled inter-turn resistance (Resistive-Insulation, or RI-) REBCO. These two technologies were considered in the Conceptual Design Phase. The major activities for the conceptual designs consist of validation of the technologies needed for the 40T magnet via components and subscale coil testing, development of HTS coil design codes benchmarked against the test coil results, and optimization of the 40T magnet design. The paragraphs below highlight the achievements in 2020.

It is intended that the magnet will survive 20 years of operation. It is anticipated that it might cycle to full field and back to zero field as many as 50,000 times over its lifetime. Data on the fatigue life of REBCO conductors suited for the 40T was insufficient, so we performed extensive tests on the fatigue life of REBCO tapes. Figure 4.34 shows how many cycles a short sample of tape will survive at various levels of mechanical strain applied at 77K. As is typical for fatigue data, there is significant scatter in the data. Test results suggest that tapes operated at 0.45% strain or less will survive 50,000 cycles.

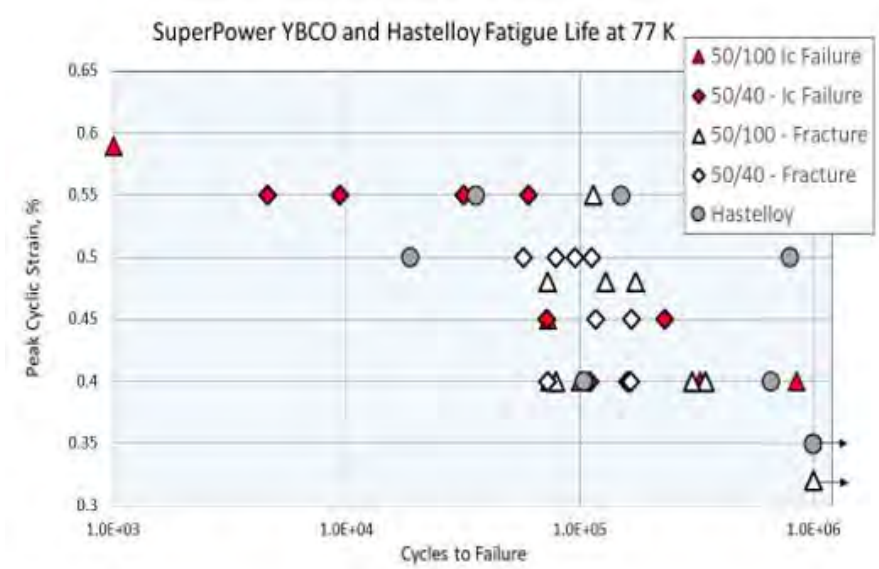

Figure 4.34 shows test results for fatigue of REBCO and Hastelloy tapes at 77K (load-control tension-tension fatigue, r= 0.1). In the legend, "X/Y" indicates REBCO composite tapes that include X microns of Hastelloy substrate and Y microns of copper cladding. "Ic failure" indicates the critical current dropped 10% or more. "Fracture" indicates the material broke.

To confirm that measurements made at 77K are relevant for 4.2K applications, a reduced set of fatigue measurements were made at 4.2K. Multiple samples of REBCO tapes were cycled up to 50,000 and 250,000 cycles at 0.4% peak strain. Their critical current (I_C) was measured before and after cyclic operation. There was no obvious I_c drop at 50,000 cycles and about 7% I_c drop at 250,000 cycles. A miniature coil was fabricated with strain gauges on the outermost turn and cycled 24,000 times without failure in a 12T background field. It exceeded 0.5% strain on each cycle.

In the 32T SC magnet, the ratio of operating current, I_{op}, to critical current, I_c, ranges between 10% and 30%. For the 40T SC magnet, we intend to operate between 50% and 70% of I_c for three reasons: (1) to reduce the temperature margin and the resulting energy required to achieve quench protection; (2) to reduce the screening current magnitude and resulting strain [2]; and (3) to reduce the peak transient current in RI-REBCO coils during quench, as predicted by quench simulations [3]. Achieving a uniform I_{op}/I_c requires grading the I_c of the REBCO tapes with high I_c at the end where the component of field normal to the tapes is high and low I_c near the mid-plane where the normal component of field is small.

Graded conductor was not available commercially in 2018 when our R&D phase started. We explored two ways to grade the I_c. One is by collaborating with the commercial suppliers of REBCO tape to help them produce different grades of tape by controlling the thickness of the superconductor layer. The other is to anneal the tapes or pancakes in-house to reduce the I_c after tapes arrive from suppliers. Two suppliers, Superpower and SuperOx, have been receptive to the idea of developing graded tapes. We ordered 3.3km of graded tape from Superpower for use in test coils. It has been received and characterized. A factor of 3.6 variation in I_c was attained over these samples. It was found that the I_c can be reduced to 30% of the standard tapes. Further efforts are needed to improve the I_c reproducibility and overall stability REBCO tape production.

The test results will enable us to establish a database of the I_c of REBCO tape for the design of future REBCO coils. An additional 6 km of I_c graded tapes has been ordered in 2020 and more data will be collected on them. These tapes will be used for test coils in 2021 and 2022.

Designing, building, and operating reduced-scale coils (test coils) in a parameter space similar to where the real 40T coils will operate is key to validating the reliability of the 40 T SC magnet design. There are two main types of testing. Fatigue tests focus on operating at similar mechanical stress and/or strain as the real coil for thousands of cycles. Quench tests focus on operating at similar I_{op}/I_c as the real coils and are intentionally quenched repeatedly. The goal is to also have similar current density in the copper stabilizer after quench starts as the real coils will.

Multiple test coils were planned in the 40T project, ranging from small scale coil (less than a few hundred meters conductor length) to mid-scale coil (1 to 2km conductor length including splices). Despite COVID's impact on the test coil schedule, we have completed testing of three coils in 2020.

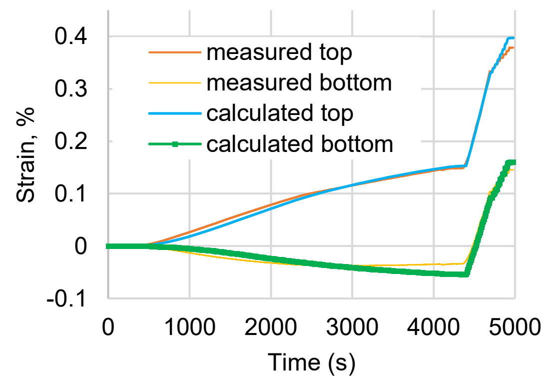

Figure 4.35: Measured and computed hoop strain ($\sigma_{\theta\theta}$) evolution at points 1mm above and below the mid-plane of the conductor of the mini-fatigue coil at the MagLab.

- *Mini fatigue test coil*: As described above, we completed the fabrication and testing of one miniature fatigue coil. This coil was to investigate the HTS coil performance under fatigue operation. This coil reached 24,000 cyclic operation with a peak strain of more than 0.5% without observing degradation. The coil test results also showed excellent agreement between computed and measured strains in REBCO coils, shown in Figure 4.35. This was accomplished by coupling the rotation due to screening currents into the angle between the field and the tape and the resulting calculation of screening current [2].
- *Multi Tape Insulated Test Coil 0 (MTI-TC0):* REBCO tape is known to have local defects. In an effort to mitigate the potential impact of such defects on the 40T SC magnet, the MagLab has adopted a two-in-hand winding technique for insulated coil applications. In such an approach, a two-tape turn can be operating at 70% of I_c, but a single tape could have a small defect reducing its local I_c by 60% while the turn (and magnet) can still reach full current. The MagLab's first test coil, MTI Test Coil Zero (MTI-TC0), was fabricated and tested. It consisted of eight double pancakes and demonstrated two-in-hand coil-winding as well as fatigue lifetime. Figure 4.36 shows the assembled test coil. The coil was successfully tested up to a field of 11T in a 12T background field (23T total) and was cycled 225 times up to 450A, which corresponds to a measured strain of 0.4% 1 mm above the mid-plane of the tape on the outermost turn of the end pancake. The test demonstrated that two-in-hand winding can perform well and provide high stability. The successful test of MTI-TC0 enables us to pursue two-in-hand winding technology in the next test coil, MTI-TC1, which should operate at a significantly high I_{op}/I_c and also graded conductor.

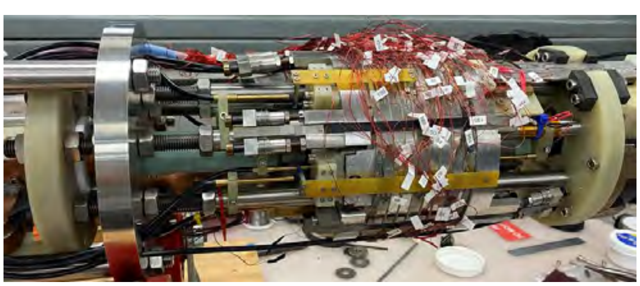

Figure 4.36: Assembled MTI-TC0 with instrumentation

- *Resistive Insulation Petten Test Coil 3 (RI-PTC3):* Test Coil RI-PTC3 was to investigate the quench protection of an RI coil with a controlled contact resistance between turns compared with an ideal No Insulation (NI) coil. It consists of 6 double pancakes, and Figure 4.37 shows the fabricated test coil. The contact resistance in RI-PTC3 was measured and is on the order of 10mΩ-cm[2] which is 3 orders of magnitude larger than that of a usual NI coil. The coil was quenched at an operating current of 400A at a central field of 9.2T in which 6.5T was provided by the background field. The quench propagation was successfully recorded, and the process is very fast (40ms) as anticipated (shown in Figure 4.38). The test results also confirmed the unbalanced force (measured by load sensors) and the large induced quench transient current (detected by pickup coils) during quench in an RI coil.

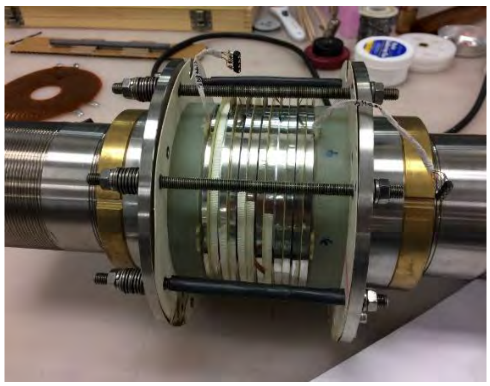

Figure 4.37: RI-PTC3 prior to testing.

- *Modeling of screening currents in REBCO coils:* REBCO tape is a broad conductor. In the 32T SC and 40T SC magnets it is used in the form of a 4.1mm wide tape. In a high field solenoid there is typically a radial component of field, B_r, nearly everywhere in the coil. In a REBCO coil, this radial component of field is normal to the broad face of the tape. When the magnet is energized, screening currents are induced in the tape to cancel this radial component of field. These screening currents interact with the axial component of field, B_z, to produce local Lorentz forces. Because the screening currents on the two edges of the tape have opposite sign but the same magnitude, the resulting Lorentz forces also have opposite sign. Although the net force on the conductor is zero, there is a net twisting torque on each turn.

The first attempt to compute the strain due to this torque was published by the MagLab in 2018. Since then the numerical model has been improved by including the fact that rotation of the tapes due to the diamagnetic torque changes the angle between the field and the tape and resulting induced current. The new software has been benchmarked against stain gauge measurements (Fig X3) and measured Screening Current Induced Field (SCIF) shown in Figure 4.39.

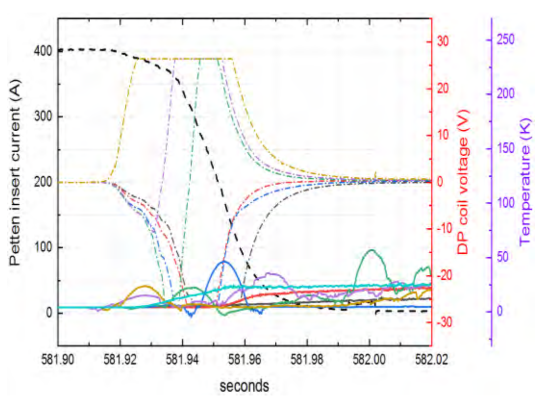

Figure 4.38: Quench propagation of PTC3.

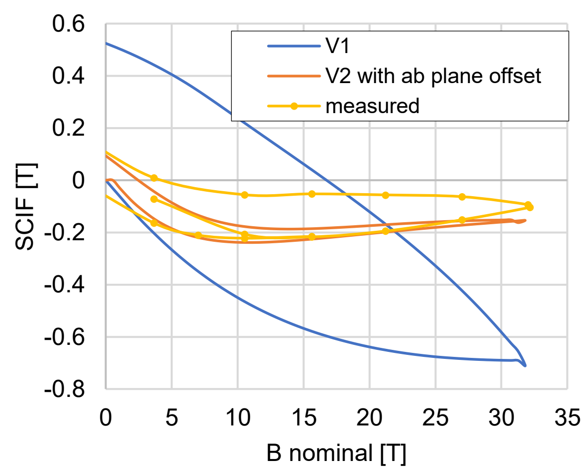

Figure 4.39: The difference between the actual magnetic field (including the effects of screening currents) and that without screening currents is referred to as Screening Current Induced Field (SCIF). Shown above are the actual SCIF in the 32T magnet as measured via NMR, the computed SCIF using the traditional approach that ignores the rotation of the tape (V1), and the newer MagLab computation that includes the rotation of the tape and the mis-alignment of the ab-plane of the REBCO (V2).

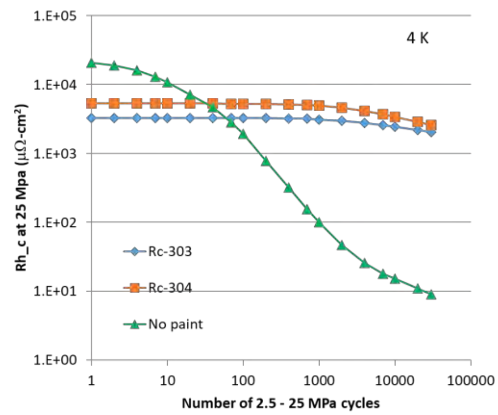

Figure 4.40: Inter-turn resistance versus cyclic loading of wet silver paint (Rc-303 and Rc-304) and stainless steel (No paint) when placed between two pieces of REBCO tape.

As mentioned above, the new code has been benchmarked against the measured strains in the mini-fatigue coil with excellent agreement. It has also been benchmarked against the measured strain in PTC-1 and the measured screening-current induced field in the 32T SC user magnet. Being able to predict the strain in the conductor is critical to predicting the lifetime of the 40T SC magnet.

- *Contact resistance control for RI coils* The MagLab has demonstrated that for the Ni-REBCO concept to become viable for large coils, the inter-turn resistance needs to be controlled [3,4,5]. Extensive work has been undertaken attempting to provide consistent control of the inter-turn resistance were [2]. In 2020, a breakthrough was made: the variation in inter-turn resistance during cyclic loading can be reduced from a factor of 1,000 to a factor of 2 by using wet silver paint, as shown in Figure 4.40.

- *Conceptual Design of the 40T SC magnet* Figure 4.41 shows a vertical section of the Conceptual Design of the 40T SC magnet. It includes an LTS outsert consisting of two NbTi and two Nb_3Sn coils providing 12T in a 32cm bore and an HTS insert consisting of three REBCO coils that provides 28T in a 3cm bore. There are two versions of the HTS insert, one based on MTI-REBCO and one based on RI-REBCO. The major difference between the MTI design and RI design are the surface treatment of the turns: insulating versus a controlled resistance and the resulting differences in the quench protection technologies. Assuming that the NSF funds the Mid-Scale Design proposal, a choice between the MTI and RI versions will be made in September 2022. The MTI coil quench protection will be similar to the 32T quench protection system except that the power supply for the quench heaters will use a Pulse Forming Network instead of a lead-acid battery bank. The RI coil quench protection requires new development which is underway. The copper current density, J_{Cu}, in the 40T design is more than 700A/mm^2 and this is significantly larger than that of the 32T SC magnet (410A/mm^2). The stress analyses and quench analyses were performed for the conceptual designs. Currently the designed peak hoop strain with screening current is around 0.45%. We will continue to optimize the 40T design to reduce the strain to a level of 0.4%.

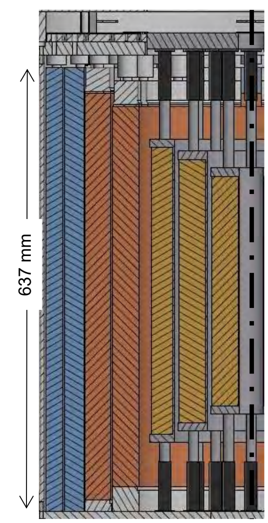

Figure 4.41: 40T Conceptual magnet design. REBCO sections in yellow; Nb_3Sn in orange; NbTi in blue.

References for 40T SC Magnet

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Bi-2212 coils

Development of Bi-2212 conductor and coil technology is being pursued to enable both high field solenoids and accelerator magnets such as dipoles and quadrupoles for the Future Circular Collider (FCC) and similar applications. While high field solenoids have already been put into service using REBCO tape, Bi-2212 conductor has significant advantages that might enable it to displace REBCO for these applications. It is available in continuous lengths of up to 2km of length compared with less than 0.3km for REBCO. Longer lengths of conductor can result in fewer joints, faster assembly, and lower costs for magnets of the same size and field. It is a round wire with largely decoupled fine (~15 micron diameter) and twisted filaments with a versatile architecture that is macroscopically electro-magnetically isotropic which simplifies coil design. As a round wire it can be easily cabled to provide the high-current conductor frequently required for large-scale coils. Twisting enables low ac losses and the fine filaments mean low SCIF compared with REBCO.

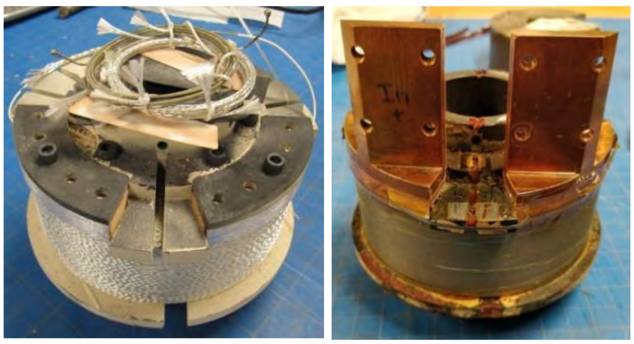

Figure 4.42: Left: The Pup-9 coil right after heat treatment. No signs of leakage are visible on the coil. The curled-up wire on top of the coil are the pig-tails extending from the coil terminals that are located right under the greyish cover plates. Right image shows the same coil after full instrumentation with all of the voltage taps and copper terminal extensions right after the epoxy impregnation step and ready for characterization.

These advantages, however, come at the price of low mechanical strength and stiffness of the bare conductor compared with REBCO (but still comparable to those of Nb_3Sn strand) and the need for a complex reaction process after winding.

Ten years ago, the current density of Bi-2212 wire was too low to compete with that of REBCO for high field magnets. A MagLab-led effort funded largely by the DOE-HEP's MDP developed the understanding of how to make high critical current density, J_c, by using an over-pressure heat treatment (OPHT) that has been made routine here at the MagLab, first in 3 to 5cm diameter and then 14cm diameter furnaces in which many solenoids and racetrack-shaped coils have been successfully reacted in recent years. (The racetrack coils are part of HEP's MDP in collaboration with Lawrence Berkeley National Laboratory.)

The main focus in 2020 was the Pup-9 Bi-2212 test coil (Figure 4.42 and Table 4.1) that was intended to explore the uniformity of I_c of the Bi-2212 wire throughout the coil as well as demonstrate a new reinforcement scheme, terminal design, and an updated vacuum-pressure impregnation (VPI) approach.

Table 4.1: Pup-9 coil specifications.

Pup 9		
Wire	Product No.	PMM180410-1
	Powder	nGimat 116 (85 x 18)
	Insulation	In-house coating+mullite braid
	Diameter [mm]	Φ 1.0 (bare) / Φ 1.2 (ins.)
ID ; OD ; Height [mm]		44.5 ; 113.9 ; 40.7
Turn ; Layer (Total)		30 ; 26 (772)
Magnet constant [mT/A]		11.303
Center field @ 100 A [T]		1.13
Inductance [mH]		31.5
Conductor length [m]		~ 200
Status		Tested

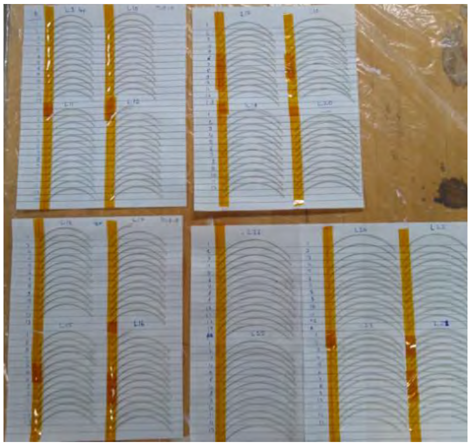

Figure 4.43: Left: Systematically extracted short samples from coil Pup-9 in preparation for short sample transport characterization. Right: A selection of J_e data measured from these samples.

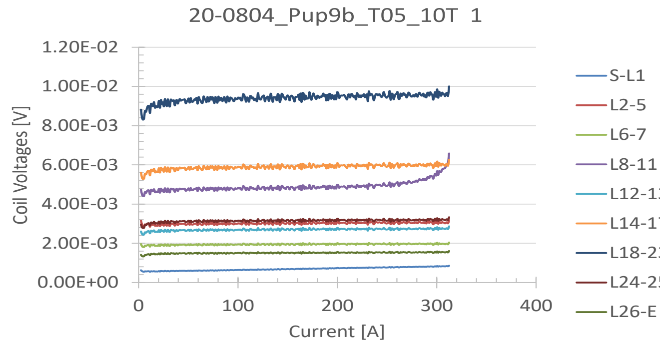

Figure 4.44: Voltage traces of consecutive layers in Pup-9 at 10T background field. The early transition somewhere within layers L8-11 is clearly visible.

The coil did well regarding uniformity of critical current. As the coil was built, extra wire was left extending from the terminals (pig-tails). Prior to reaction of the coil, witness samples of wire were placed at strategic locations around the coil. After the coil was reacted, the critical currents of the pig-tails and witness samples were measured to confirm a successful heat-treatment. After the coil had been completed and tested, nearly 200 short samples were meticulously extracted from the coil as shown in Figure 4.43. The critical current of these samples is being measured to confirm that it is uniform throughout the coil. Approximately 10% of the samples have been measured with good results so far, confirming the updated VPI approach.

The coil reached 300A in a 10T background field as shown in Figure 4.44 (~60% of the goal). The increasing voltage was seen between layers eight and eleven, nowhere near a terminal, so it seems the new terminal design is working well also. Upon dis-assembly, it was confirmed that the terminals were not damaged, but the coil had delaminated between layers eight and nine, which is now understood to likely be due to stress concentration due to the new reinforcement scheme.

A variety of conductor and coil reinforcement strategies exist for Bi-2212, and an important task ahead of us is to find and apply the most suitable of these strategies for our coils.

As we move forward, a major goal is to resolve the challenges associated with reinforcing the coils and enable Bi-2212 coils to become viable for magnets operating above 20 T. To this end, we partnered with Cryomagnetics, of Oak Ridge, Tennessee, and submitted a Phase I Small Business Innovation Research Proposal in 2018. This evolved into a Phase II grant in 2019 which has led to a Phase IIa proposal in 2021. Figure 4.45 shows a vertical section of the 25T SC magnet that is intended to be the result of this grant. The red outer coils will provide 17T and be provided by Cryomagnetics using Nb-Ti and Nb_3Sn. The blue inner coil will provide 8 T and be provided by the MagLab using Bi-2212. Cryomagnetics intends to offer similar magnets on a commercial basis in the future.

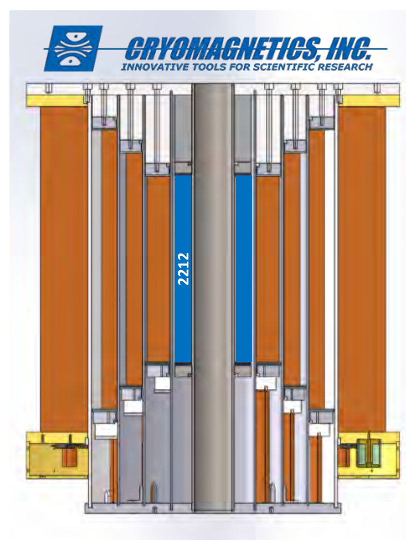

Figure 4.45: Sketch of a 25T magnet system to be developed in collaboration with Cryomagnetics Inc., which includes an 8T Bi-2212 coil.

In order to refine quench management methods, we continued basic stability margin analysis of Bi-2212 in comparison with LTS conductors. This comparison highlighted the large stability of Bi-2212 in round wire form and particularly in a cable. The margin analysis was also used as a tool to understand Lumped-Element Dynamic Electro-Thermal (LEDET) quench simulations of energy extraction [1] and coupled loss induced quench (CLIQ) protection of Bi-2212 magnets [2]. To further refine our understanding of the stray-capacitance heat detection technique that can be used for quench-detection, we implemented stray-capacitance monitoring in three Bi-2212 magnet geometries in partnership with our LBNL collaborators [3-4]. Monitoring for global changes with sensors on the mechanical structures of the magnets, a quench response comparable to voltage signals was produced without the drawbacks of inductive effects. An example of this is shown in Figure 4.46 for a Bi-2212 canted cosine theta (CCT) coil. Stray capacitance sensors were also demonstrated in a single racetrack coil, showing clear localization of normal zones induced by a heater as well as symmetric responses to the predictable normal zone locations from exceeding the critical current in the highest field region of the windings. We have begun procurement of varistor type energy extraction units and will evaluate them with upcoming test coils including solenoids, so that we can continue to utilize simple quench management even at higher inductances, which is possible due to the medium enthalpy margin of Bi-2212, which is situated between that of LTS and REBCO tapes.

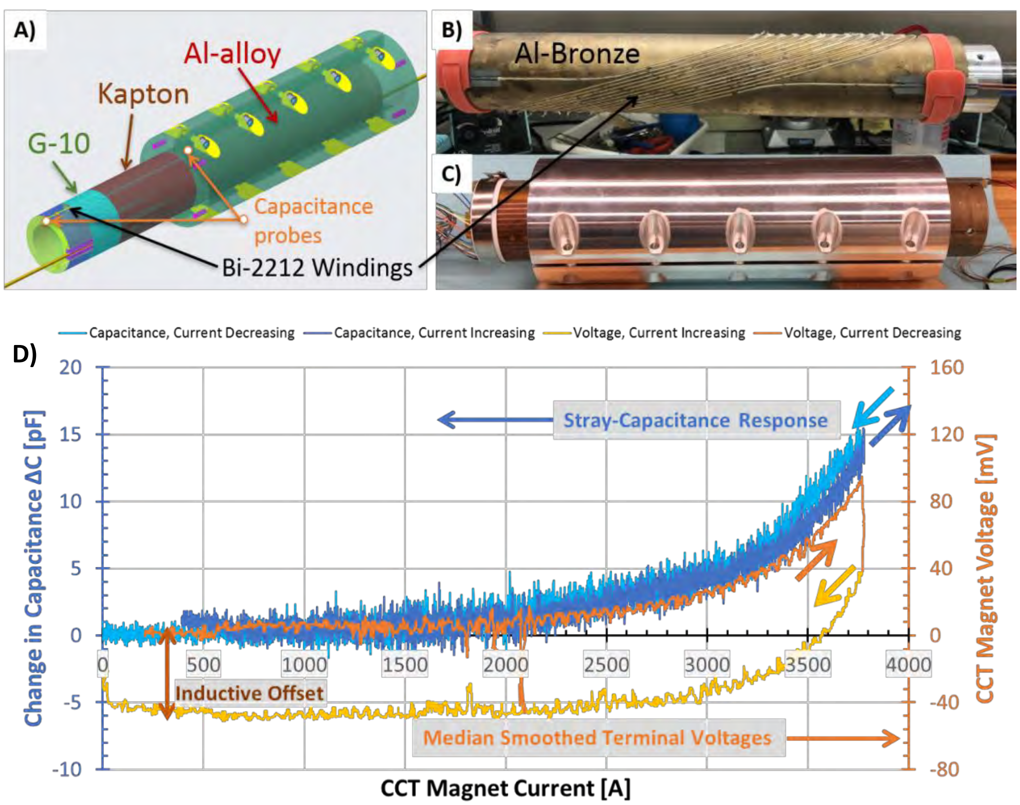

Figure 4.46: A) Sketch of a Bi-2212 cable wound Canted Cosine Theta Outer Layer coil (CCT-OL) assembly showing dielectric layers, metallic structures, and capacitance probe locations. B) Reacted Bi-2212 CCT-OL windings on an aluminum-bronze mandrel. C) The fully assembled and instrumented CCT-OL coil. D) Change in capacitance (blue) of the and median smoothed terminal voltage (orange/yellow) for a ramp of the CCT-OL magnet up to 93% of the quench current and back down without tripping the quench protection voltage criterion.

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[3] D. Davis, T. Shen, M. Marchevsky, and E. Ravaioli, "Stray-Capacitance as a Simple Tool for Monitoring and Locating Heat Generation Demonstrated in Three HTS Magnets," IEE-TAS, vol. Submitted 21 December 2020.

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2212 conductors

Under our DOE-HEP contract to thoroughly understand Bi-2212 conductor technology, we address the powder, the manufactured conductor and its reaction by OP-HT into final conductor form. Recently, the small company Engi-Mat has been making powder that enables about 60% higher *Jc* than the previously favored supplier and this has been sent to the MagLab for assessment of its uniformity via Scanning Electron Microscopy (SEM) analysis prior to being shipped to Bruker OST (B-OST) to fabricate Bi-2212 round wires. Samples of the wire are then typically sent to the MagLab for reaction under OP-HT to evaluate the performance of the resulting wire. Figure 4.47 shows the current density of the whole wire, J_E, as a function of the maximum temperature during OP-HT, T_{max}, for one of these wires that was drawn to three diameters. J_E for all three diameters exhibits a plateau over a relatively wide T_{max} range of ~9°C. Interestingly, J_E for the smallest wires, 0.8 and 0.9mm diameter, shows a peak at low T_{max} that is ~40% greater than the plateau. We have seen this J_E peak for many 0.8 and 0.9mm diam. wires over the past 3 years and believe it is related to the filament architecture, specifically the filament cross sectional area and separation.

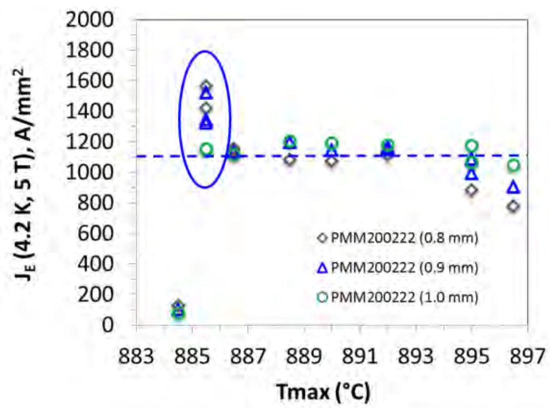

Figure 4.47: J_E – T_{max} plot for wire fabricated from Engi-Mat powder by B-OST. The plateau J_E is ~1100A/mm^2. The J_E peak is ~40% greater than the plateau.

To understand if it is possible to increase the J_E plateau to equal the peak, we began studying the filament architecture, how it changes during the OP-HT, and how these changes affect J_E. To do these studies, we designed and built an OP quench furnace, which came online in 2020, to freeze in the high-temperature filament architecture at any point during the OP-HT for study at room temperature.

We began by examining the filament microstructure of as-drawn wire. Figure 4.48a shows the bundles of filaments within the wire have three different shapes – tetragonal, pentagonal, and hexagonal (4, 5, and 6 respectively in Figure 4.48). Quantitative analysis of the filaments showed different filament characteristics in each of the three bundle types. Surprisingly, very few of the filaments are round.

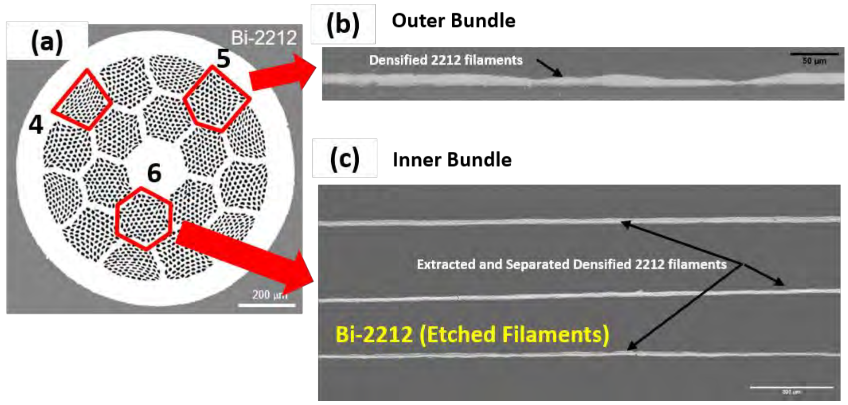

Figure 4.48: (a) Cross section of as-drawn wire showing three bundle types – tetragonal, pentagonal, and hexagonal. (b) and (c) Filaments extracted from as-drawn wire showing the varying filament area, which is particularly evident in the filament extracted from an outer bundle (b).

We also measured the cross-sectional area of individual filaments as a function of position along the length of the as-drawn wire and found that it varies along the length of the wire. To directly observe these variations, we etched away the Ag sheath and extracted filaments from as-drawn wire, which are shown in Figures 4.48 b and c. The extracted filaments show significant changes in the filament area that we believe lead to even greater filament non-uniformities during the OP-HT, which degrades J_C. The quantitative studies show that the tetragonal bundles have the smallest filament area and also the smallest separation between filaments of the three bundle types. Our OP quench studies show that in the tetragonal bundles the filaments bonded together faster, and more filaments bonded together than in the other two bundle types. This increased filament bonding suggests that J_E in the tetragonal bundles is degraded relative to the other two bundles. We are sharing these quantitative results with B-OST to develop more uniform filament architectures that should increase J_E.

Fe-based conductors

Fe-based superconductors, and in particular K-doped $BaFe_2As_2$ (K-Ba122), are materials of interest for possible future high-field applications. However, the critical current density (J_c) in polycrystalline Ba122 is still quite low, and connectivity issues are suspected to be responsible. In the last year we focused on high-purity processing and synthesis of K-Ba122 bulk samples by using high purity precursors and a high-performance glovebox, which minimizes oxygen and moisture exposure [1]. The obtained samples were free of oxygen and secondary phase segregations at grain boundaries, which are typically recognized as a cause of current-blocking effects. Although our careful

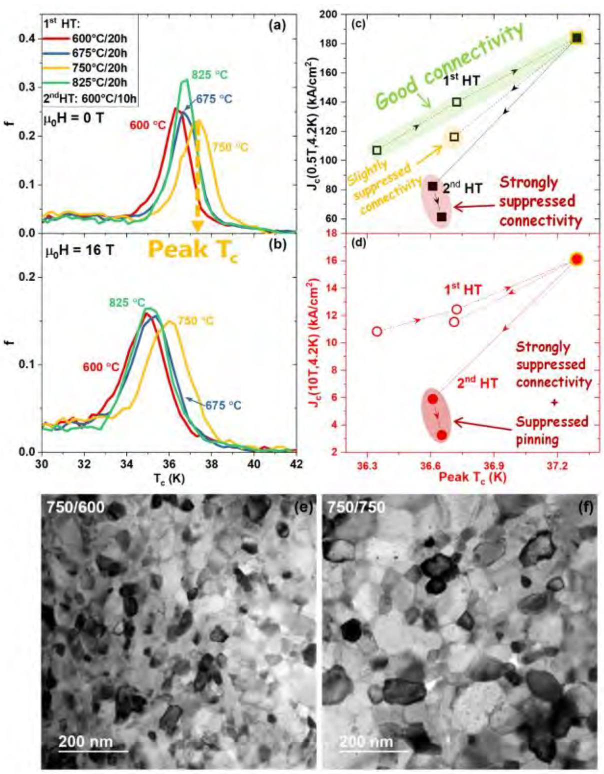

Figure 4.49: FBS1 (a) Superconducting characterizations and microstructure of K-doped $BaAs_2Fe_2$ samples after different heat treatments. (a-b) T_c-distributions at 0 and 16T determined by specific heat of four samples that underwent a 1st heat treatment (HT) at different temperatures and the same 2nd HT. (c-d) Correlation between the low/high-field J_c and the peak position of the T_c-distribution revealing the positive and negative effect of different heat treatments on the connectivity and pinning performance (the arrows show the increasing HT temperature). (e-f) Transmission Electron Microscopy microstructure of the best and worst samples in terms of J_c performance (figures from ref. [2]).

processing results in an increase in J_c, significant property variations were observed depending on the heat treatment (HT) procedure. For this reason, we performed detailed characterization on samples that underwent two separate heat treatments at various temperatures between 600 and 825°C and investigated their effects.

We performed specific heat characterization up to 16T in order to determine the T_c-distributions of each sample (same examples are shown in Figure 4.49 a-b) and we compared them with magnetic T_c and J_c characterizations (Figure 4.49 c-d), and Transmission-Electron-Microscopy (TEM) microstructures (Figure 4.49 e-f) [2]. Interestingly, we found no direct correlation between the magnetic T_c and J_c, whereas the specific heat T_c-distributions did provide valuable insights. In fact, the best J_c-performing sample, heat treated first at 750°C and then at 600°C, has the peak of the T_c-distributions at the highest temperatures and the least field sensitivity, thus maximizing H_{c2}. We also observed that the magnetic T_c onset was always significantly lower than the specific heat T_c: although we partially ascribe the lower magnetization T_c to the small grain size (< *l*, the penetration depth) of the K-Ba122 phase. This behavior also implies the presence of some grain-boundary barriers to current flow. Comparing the T_c-distribution with J_c (Figure 4.49 c-d), our systematic study reveals that increasing the 1st heat treatment temperature up to 750°C (with a fixed 2nd HT at 600°C) improves the connectivity and J_c (data shaded in green), whereas above this temperature we observed a slight suppression in performance. On the other hand, increasing the 2nd HT temperature above 600°C (after a fixed 1st HT at 750°C) significantly compromises the connectivity and suppresses the vortex pinning properties (data shaded in red). We conclude that high-purity precursors and clean processing are not yet enough to overcome all J_c limitations. However, our study suggests that a higher temperature T_c-distribution, a larger H_{c2} and a better connectivity could be achieved by lowering the second heat treatment temperature below 600 °C, leading consequently to a higher J_c.

References for Fe-based conductors

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Low temperature superconducting materials

In recent years there has been an increasing international effort to improve the performance of Nb_3Sn superconducting strand for high field applications, in particular for the fabrication of conductors suitable for the realization of the Future Circular Collider (FCC) at CERN. This challenging task has led to the investigation of new routes to advance the high-field pinning properties, the irreversibility and the upper critical fields. We have pioneered the addition of hafnium to the standard Nb-4Ta precursor alloy and shown that this new alloy combination is particularly promising. In this work we investigated the intrinsic properties of the Ta-Hf doped Nb_3Sn phase to understand the origin of the Hf-induced improvement in the properties. From a Ta-Hf-doped Nb_3Sn wire manufactured at the Applied Superconductivity Center, we extracted a thin lamella from its A15 layer by Focused Ion Beam (FIB) and fabricated a microcircuit (the Scanning-Electron Microscopy [SEM] image of the sample is shown in the inset of Figure 4.50). Transport properties were performed up to 16T in order to determine the H_{c2} temperature dependence (Figure 4.50 a reports the in-field resistive transitions) and to determine the field dependence of the pinning force F_p (Figure 4.50 b). We estimated H_{c2}(0 K) to be 30.8T, ~1T higher than the values obtained for just Ta-doped Nb_3Sn, and, even more importantly, we found that the position of the F_p maximum at 4.2K exceeds 6T, which is a significantly higher field with respect to the typical ~4.5-4.7T of the only Ta-doped material. This shift suggests that the performance is enhanced by the presence of HfO_2 nanoparticles and by an increase in the grain boundary density produced by the hafnium, both of which can act as effective pinning centers. The decrease in grain size was indeed observed by SEM, and we also verified that the nanoparticle size is dependent on the reaction heat treatment (RHT) temperature. Although they cannot be directly observed for low-to-moderate temperature RHT (such as 670°C), we were able to infer their presence using another technique, Extended X-ray Absorption Fine Structure (EXAFS) spectroscopy, performed on the same wire at the Advanced Photon Source - Argonne National Laboratory. EXAFS spectroscopy, in fact, revealed that most of the hafnium is present as HfO_2 and no detectable amount is entering the A15 structure.

These results show that Hf addition can significantly improve the high-field performance of Nb_3Sn, bringing its properties closer to the FCC requirements. This work also led to the industrial production of a new Nb-4Ta-1Hf alloy to be used in the realization of high critical-current-density Nb_3Sn wires and several wire manufactures around the world have started using it to develop new high-performance conductors.

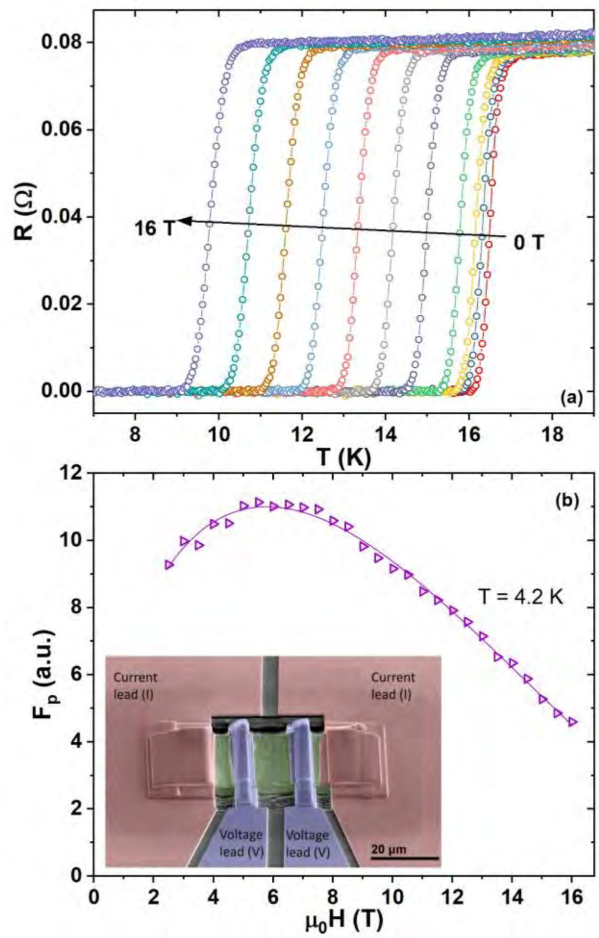

Figure 4.50: LTS-1. Superconducting characterizations of a Ta-Hf-doped Nb_3Sn microbridge realized by "FIB"-ing the sample from the A15 layer of wire. The false-colored SEM image of the microbridge is shown in the inset. (a) Temperature dependence of resistive transitions at different magnetic field (data taken at 0 T, 0.5T, 1T, 2T and every 2T up to 16T). (b) Field-dependence of the pinning force F_p obtained at 4.2K

Structural materials for magnets

Low-temperature superconducting and pulsed high-field magnets need similar reinforcement materials. These materials must provide the mechanical properties that are required for reliable operation of the magnets which are typically used at cryogenic temperatures. Properties of Nitronic-40 stainless steel in both as-forged and heat-treated conditions were studied, carefully assessing its potential for use at both cryogenic and room temperatures. Heat treatment at 673K for 30 minutes was applied to the steel to simulate the proposed insulation-curing process to be used for pulsed magnets. After our Nitronic 40 samples were heat-treated, we found that the yield and ultimate strengths at 77K had decreased slightly to as shown in Figure 4.51, indicating that heat treatment had reduced the dislocation density somewhat [1]. Strength values increased thereafter as temperature decreased to cryogenic levels. Magnetic permeability (μ) measurements taken near the fracture region of our samples showed increased μ values after cryogenic deformation, indicating that stronger martensite may have formed, which may reduce fracture toughness [2]. When we evaluated the fracture toughness test data, we concluded that the materials were still suitable for use as reinforcements in high field magnets.

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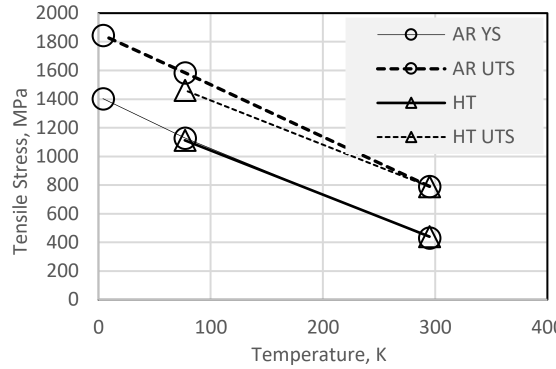

Figure 4.51: Plot shows an almost linear relationship between strength and temperature for both as-received forged Nitronic-40 and the subsequent heat-treated version.

Resistive magnets & materials

Pulsed magnets

The generator that powers the 100T Multi-Shot (100TMS) magnet and 60T Long Pulse (60TLP) magnet was damaged in March of 2018. In addition to the major undertaking of repairing the generator, which is presently underway, the MagLab also initiated a "Magnet Surge" project to provide two alternatives to the 100TMS and 60TLP magnets on very short notice: (1) a 75T Duplex (75TD) and (2) a 60T Mid-Pulse (60TMP).

By a "duplex" magnet we mean one that uses two capacitor banks to power two independent nested coils, unlike our other capacitor-driven magnets that use a single capacitor bank. This additional degree of freedom in the design allows better optimization of the objective function. More specifically, the outer and inner coils can have different pulse durations which means different inductances, current densities and heating rates (Figure 4.52).

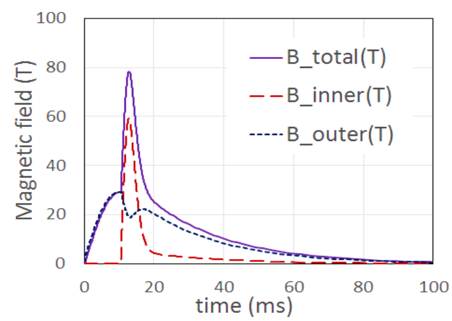

Figure 4.52: Magnetic field waveforms of the duplex magnet, showing the contributions to the total magnetic field from the inner and outer coils. The total magnetic field reaches 76.8T.

The Pulsed Field Facility (PFF) at LANL successfully developed 75T duplex magnet using existing 16kV, 4MJ capacitor bank (cap-bank) [1]. The 4MJ cap-bank was reconfigured into two sub-systems, 1MJ and 3MJ cap-banks, to respectively drive the inner and the outer coil of the duplex magnet. A Metal Oxide Varistor (MOV) bank which can absorb up to 5MJ was built and connected in parallel to the outer coil to protect the capacitor banks and their associated electrical components from the overvoltage in the case of fault condition [2].

The magnet was tested to maximum field of 76.8T and has been safely serving users with magnetic fields up to 75T since February 2020 (Figure 4.53). The magnet has a modular design with cooling space between the inner and outer coils, enabling a short cooling time (~ 1 hour) between the pulses and cost-effective operation, since we expect to save/reuse the larger, more expensive outer coil if the inner coil, which is designed to operate at much higher stress level, fails. The first set of user experiments using this magnet has produced cutting-edge high field science which was published in Nature Physics [3]. The successful demonstration of duplex magnet technology opens a new opportunity for the PFF to develop a duplex insert for the 100TMS magnet system to go beyond the present record of high magnetic field and maintain the MagLab's leadership in creating high fields for science.

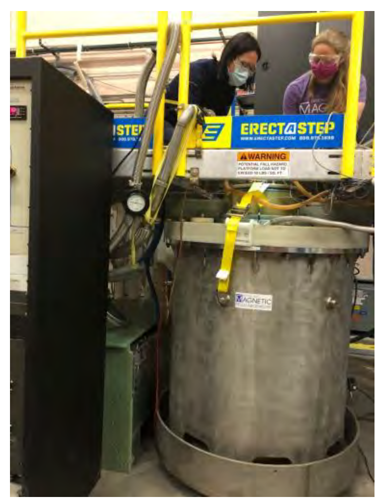

Figure 53: Users setting up their experiments in duplex magnets.

In 2020, the magnet team developed and built the 60TMP magnet which remains at >90% of full-field for three as long as a standard 65T pulsed magnet (Figure 4.54). The magnet used hard copper CDA107 wire and fabricated by a new continuous winding technique which enable us to reduce the fabrication time by a half. At peak magnetic fields of 60T, the magnet stores 2.3MJ. The magnet was installed in December 2020 and has been in the commissioning phase since then. The magnet is expected to start serving users in the summer of 2021.

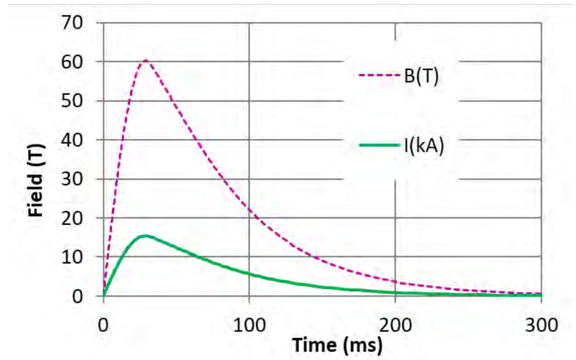

Figure 4.54: Waveforms of magnetic field and driving current for the 60T mid-pulsed magnet being developed at the PFF. At 60T the magnet pulse length of 60T pulses is about 300ms considerably longer than our standard capacitor driven magnets.

The Magnet Surge project also enabled the PFF to upgrade its power infrastructure with a new 30kV-1.2MJ capacitor bank. The bank was ordered and is expected to be commissioned by the end of November, 2021. The new capacitor bank will be integrated with the existing 16kV-4MJ bank to allow us to develop a still higher field, capacitor-driven duplex magnet. The preliminary design for an 85-T duplex magnet using the upgraded capacitor system was completed and will be further refined to the final design in the first half of 2021. We plan to build the first 85T duplex to test with the new 30kV capacitor in the first quarter of 2022.

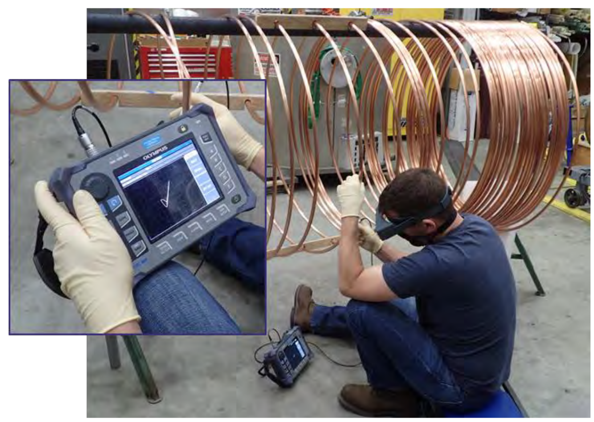

Figure 4.55: PFF4. Inspection of the precursor material for Coil 7 of the 60T CW magnet. The inset photograph shows the eddy current response to a detected inclusion, which is subsequently removed.

The large generator-driven coils of the 60TLP and outsert of the 100TMS are now being fabricated at the FSU branch of the MagLab. Eddy-current inspection of the conductor is performed three times for each piece of conductor: once on the extruded pre-cursor prior to final wire-drawing (Figure 4.55), once after final wire-drawing, and a final time after the coil is wound (Figure 4.56).

In 2020 upgraded versions of coils 1 and 2 of the outsert were fabricated. These new coils used high-strength, nano-structured Cu-Nb conductor developed by the MagLab in collaboration with our commercial partner, Nano-Electro. This new conductor is approximately 50% stronger than the glidcop AL60 wires used in the existing version. The upgraded coils #1 and 2 are expected to provide more conservative operating margin, which will increase the lifetime of the 100T outsert magnet. The LANL magnet team plans to install the stainless steel 301 strip and Zylon fiber reinforcement to these coils in 2022. The upgraded coils then will be installed and commissioned when the generator returns to service.

Coils 3, 4, and 7 of the 60T long pulse magnet have worn out and need to be replaced. Conductor inspection, winding and epoxy-impregnation of these coils has also been completed at the FSU branch of the MagLab. The coils are now ready for installation of the Zylon fiber reinforcement. In 2020, MagLab researchers tested and confirmed a new route to fabricate large cross-section Cu+alumina conductors for coil #7 of the 60TCW magnet by using more hot-extrusion to produce a precursor of smaller diameter than was used in the past. This then requires less wire drawing to reach final form, thereby reducing the probability of developing internal Chevron cracks in the final conductors. With the new route, we expect to be able to produce enough high-quality conductors for coil # 7 in 2021 and complete the fabrication of the coil in the first half of 2022, ensuring the 60T CW magnet is ready for users when the generator is back online.

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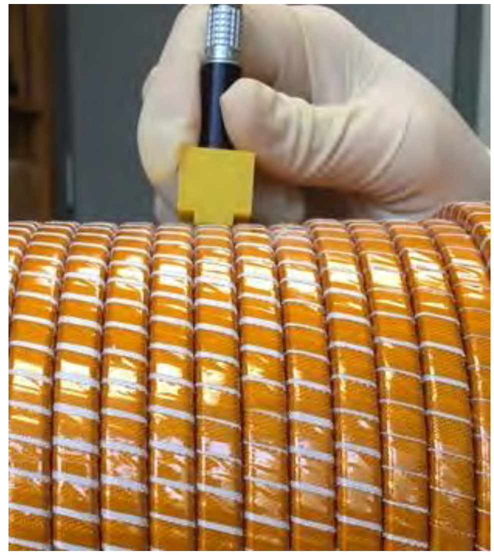

Figure 4.56: The conductor of a large pulsed coil is inspected after winding to verify that no cracking occurred during the winding process.

High strength high conductivity materials

The fabrication of our high-strength conductors for high-field pulsed magnets typically includes: consolidation or solidification; forging and/or extrusion; aging, restacking, and/or annealing; and wire drawing. Precipitates or particles of ~50 nm spacing are required to immobilize atomic-scale dislocations and reach the wire strength required for next-generation pulsed magnets.

Most of the pulsed magnets at the MagLab include some conductor made from copper dispersion strengthened with alumina. In this conductor, the alumina particles are hard particles that are formed during the consolidation stage and maintain their size and shape throughout processing. For many years it has been known that this material reaches its maximum strength after a relatively low amount of cold work. Recently, MagLab researchers discovered a 500-fold variation in the size of alumina particles (from 10 nm to 5µm) in this material as shown in Figure 4.57. We believe the larger particles prevent this material from reaching its full potential as a conductor for pulsed magnets. For many years, the Cu+alumina conductor was consolidated and extruded at one commercial supplier and then shipped directly to another one for final wire drawing. Recently the MagLab started to inspect the pre-cursor after extrusion and before wire-drawing. Surface flaws >100 microns were identified in most precursors. Non-destructive testing methods have now been developed for use on the pre-cursors and the surface flaws are now removed at the MagLab prior to final wire drawing [1]. The MagLab is now also

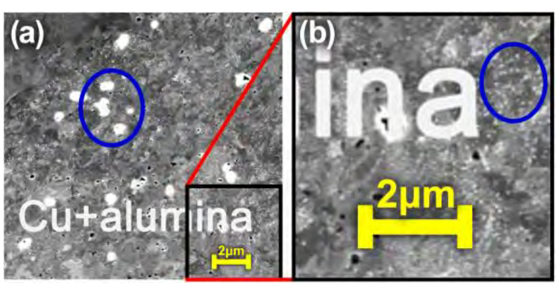

Figure 4.57: Scanning electron microscope image of the micro-structure of a present-day Cu-alumina conductor. The white spots in blue circles are (a) four micron-sized and (b) dozens of nano-scale alumina particles. For Cu+alumina to be suitable for use in a 120T magnet, this 500-fold variation in size must be reduced by eliminating the large particles.

collaborating with the commercial consolidating and extrusion firm to identify the source and reduce the prevalence of these surface flaws.

We also used our newly developed parameters to make and inspect two spools of continuous-length conductors (longer than 200 meters with cross-section area of 71mm^2) for coil #7 to be used in the rebuilding of our 60T long-pulsed magnet. Our optimization has given us a better understanding of the relationship between critical properties and particle distribution in composite conductors. This paves the way for future manufacture of high-quality, high-strength conductors for use in other pulsed magnets.

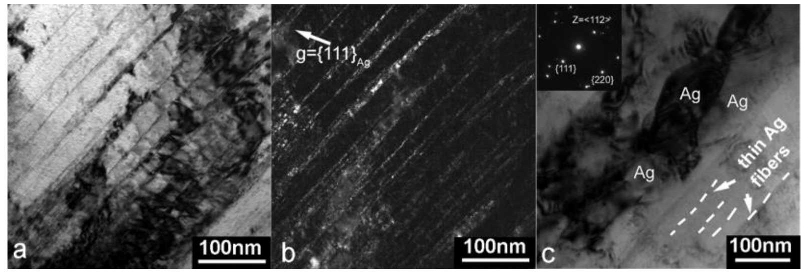

Figure 4.58: TEM observation of the microstructure in the as-drawn Cu-Ag wire. a. Bright field image showing the Cu/Ag lamellar structure in proeutectic component with Zone axis close to <011>. b. Dark field image from the same region in a showing Ag fibers using the {111} Ag diffraction spot. c. evident strain field around Ag-rich eutectic component. Dislocations were observed at the Cu/Ag interfaces. A selected area diffraction pattern in c inset indicates no cube-on-cube orientation relationship between Cu and Ag phase in eutectic region. The dash lines represents the fine Ag fibers in the proeutectic component. The poor contrast in the proeutectic component is the result of the orientation difference between the proeutectic and eutectic components.

Unlike Cu+alumina, Cu-Ag composites have not been traditionally used pulsed magnets. MagLab researchers have recently been able to alter the activation energies and reaction temperatures required to increase the volume of fine-to-coarse precipitates by a factor of four by doping the composite with a third alloying element [2]. Consequently, Cu-Ag now shows potential for use in pulsed magnets. We subjected our aged Cu–Ag composite ingots to cold drawing to create high-strength nanostructured wires with both Cu-rich pro-eutectic and Ag-rich eutectic components. These wires reached strength values greater than 900MPa, greater than that of the strongest Cu-alumina alloy. The maximum true strain for achieving high strength of 900 MPa was only 4.8, allowing us to fabricate wire with a cross-section area around 17mm^2 from relatively small ingots (diameter ~50mm). During drawing, a fine lamellar structure (average spacing 20 ± 6nm) developed in the pro-eutectic component, which contained a high density of Ag fibers (average diameter below 5nm) embedded in the matrix. In the eutectic component, a relatively coarse structure developed, with an average Ag grain size around 100nm (**Figure 4.58**). The result of such a bimodal size of Ag fibers was ultra-high bending plasticity, i.e., the drawn wires tolerated 59% bending strain at the outermost edge, 15 times the tensile elongation of the composites (3.6%). This ultra-high plasticity should allow us to make a coil as small as 6.4mm diameter using a 3mm-thick wire without causing instability [3]. This feature provides us an option to build pulsed magnets with fields higher than 100T.

References for high-strength, high-conductivity materials

[1] J. Lu, T. Adkins, I. Dixon, D. Nguyen, K. Han, IEEE Transactions on Applied Superconductivity 30 (2020) 1-5.

[2] Zhao CC, Zuo XW, Wang EG, Niu RM, Han K. *Simultaneously increasing strength and electrical conductivity in nanostructured Cu-Ag composite* Materials Science and Engineering a-Structural Materials Properties Microstructure and Processing 652:296-304, 2016. DOI:10.1016/j.msea.2015.11.067.

[3] R. Niu, K. Han, Z. Xiang, L. Qiao, T.M. Siegrist, Journal of Materials Science 55 (2020) 15167-15182.

DC resistive

2020 has been a very successful fourth year of operation of the MagLab's 36T, 1ppm Series-Connected Hybrid magnet, the world's highest field 1ppm magnet. The resistive insert for this magnet provides 23T while operating in the background 13T provided by the superconducting outsert. The insert has now accumulated more than 3,100 hours of operation over a four-year period without any maintenance. Most of the MagLab's resistive magnets running at similar stress levels require replacement after two or three years. The reduced maintenance requirements for this magnet are believed to be due to the fact that it is primarily used for NMR, which results in very fewer high field sweeps and fewer fatigue cycles per day of operation than is experienced by other high field magnets.

The MagLab installed a 20T, 195mm bore resistive magnet in 1998. It was used extensively as a test facility for test coils for the 32T SC magnet development effort. In 2016, it was taken out of service to allow the housing and outer coils to be used in a new 41.5T, 32mm bore magnet which is now fully operational as the highest field resistive magnet worldwide. In 2020, a detailed disk and coil design, as well as a cost plan, was developed for a replacement large bore magnet to exploit the higher power now available from the power supplies. The new magnet is expected to provide 10% higher field (22T vs 20T of the old magnet) while also providing higher reliability. Construction of the new magnet is not yet funded.

In 2020, the dc resistive magnet operations were greatly reduced compared to typical years due to the COVID pandemic. While commercial production of spare parts was maintained at a level close to that of normal years, less on-site work in the magnet shop building and installing spare coils was required.

5. Publications

The Laboratory continued its strong record of publishing, with 485 articles appearing in peer-reviewed scientific and engineering journals in 2020. Among these, 433 acknowledge NSF support for the operation of the NHMFL and 237 (49 percent) appeared in significant journals.

Table 5.1 provides an overview about NSF-acknowledged peer-reviewed and significant peer reviewed publications by division then non-NSF funded units.

Table 5.1: Submitted peer-reviewed publications from OPMS live database. The point-in-time snapshot was on May 17, 2021. A total number of publications per year should NOT be drawn from this report because a submitter may, as appropriate, link a publication to two or more facilities. We note that the State of Florida contributes significantly to NHMFL and hired faculty at UF and FSU to enhance NHMFL programs. Publications from these professors are included as they significantly enhance the NHMFL research effort and are listed here in the UF physics and CMT/E categories.

Facility	2020 Peer Reviewed	2020 Significant Peer Reviewed	Acknowledges Core Grant
AMRIS Facility at UF	43	11	35
DC Field Facility at FSU	129	85	126
EMR Facility at FSU	43	21	43
High B/T Facility at UF	1	-	1
ICR Facility at FSU	52	26	52
NMR Facility at FSU	80	34	76
Pulsed Field Facility at LANL	34	26	33
ASC	24	19	22
MS & T	36	20	35
Education at FSU	3	-	3
CMT/E	46	36	NA[1]
Geochemistry Facility	16	1	NA[1]
MBI at UF	37	1	NA[1]
UF Physics	9	4	NA[1]

[1]Research not funded by NSF.

433 of the 485 publications acknowledge NSF support for the operation of the MagLab. Table 5.2 summarizes the publications generated by external users and in-house research activities. A detailed list of these publications can be found below Table 5.2.

Table 5.2: Overview of publications generated by external users and in-house research activities. A total number of publications per year should NOT be drawn from this report because a submitter may, as appropriate, link a publication to two or more facilities.

Facility	All Internal Authors		Internal Corresponding Author(s) with External Co Authors		External Corresponding Author(s) with Internal Co Authors		All External Authors		Totals		Total
	NSF Core Grant Cited	NSF Core Grant Not Cited	NSF Core Grant Cited	NSF Core Grant Not Cited	NSF Core Grant Cited	NSF Core Grant Not Cited	NSF Core Grant Cited	NSF Core Grant Not Cited	NSF Core Grant Cited	NSF Core Grant Not Cited	Pubs for (selected period)
AMRIS Facility at UF	-	-	10	3	18	4	7	1	35	8	43
DC Field Facility at FSU	2	-	18	-	91	3	15	-	126	3	129
EMR Facility at FSU	-	-	4	-	37	-	2	-	43	-	43
High B/T Facility at UF	-	-	1	-	-	-	-	-	1	-	1
ICR Facility at FSU	5	-	6	-	40	-	1	-	52	-	52
NMR Facility at FSU	9	-	15	-	47	4	5	-	76	4	80
Pulsed Field Facility at LANL	4	-	11	-	18	1	-	-	33	1	34
ASC	5	-	8	1	9	1	-	-	22	2	24
MS & T	13	-	13	-	9	1	-	-	35	1	36
Education at FSU	1	-	1	-	-	-	1	-	3	-	3
CMT/E[1]	10	-	19	-	14	2	1	-	44	2	46
Geochemistry Facility[1]	2	-	3	1	9	1	-	-	14	2	16
MBI at UF[1]	-	-	1	3	1	10	5	17	7	30	37
UF Physics[1]	-	-	5	-	2	1	1	-	8	1	9
Total of Publications	46	-	97	8	257	26	33	18	433	52	485
% of Publications	9%	0%	20%	2%	53%	5%	7%	4%	89%	11%	100%

[1]Research not funded by NSF.

Besides 485 peer reviewed publications, the following other products have also been published at the MagLab in 2020:

- Books: 5
- Patents: 3
- Disseminations: 19
- Awards: 9
- Grants: 12
- M.S. Theses: 20
    - Local: 11
    - External: 9
- Ph.D. Theses: 85
    - Local: 26
    - External: 59

AMRIS

AMRIS

Publications generated by facilities: AMRIS Facility at UF (43)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Aydemir, T.B.; Thorn, T.L.; Ruggiero, C.H.; Pompilus, M.; Febo, M.; Cousins, R.J.,	*Intestine-specific deletion of metal transporter Zip14 (Slc39a14) causes brain manganese overload and locomotor defects of manganism*	American Journal of Physiology-Gastrointestinal and Liver Physiology	318	4	G673-G681	10.1152/ajpgi.00301.2019	Yes
Baniani, A.; Berens, S.J.; Rivera, M.P.; Lively, R.P.; Vasenkov, S.,	*Potentials and challenges of high-field PFG NMR diffusion studies with sorbates in nanoporous media*	Adsorption		Aug	1--17	10.1007/s10450-020-00255-y	Yes
Barter, J.; Kumar, A.; Rani, A.; Colon-Perez, L.M.; Febo, M.; Foster, T.C.,	*Differential Effect of Repeated Lipopolysaccharide Treatment and Aging on Hippocampal Function and Biomarkers of Hippocampal Senescence*	Molecular Neurobiology	57		4045-4059	10.1007/s12035-020-02008-y	Yes
Berens, S.J.; Yahya, A.; Fang, J.; Angelopoulos, A.; Nickels, J.D.; Vasekov, S.,	*Transition between Different Diffusion Regimes and Its Relationship with Structural Properties in Nafion by High Field Diffusion NMR in Combination with Small-Angle X-ray and Neutron Scattering*	Journal of Physical Chemistry B	124	40	8943--8950	10.1021/acs.jpcb.0c07249	Yes
Bogoian, H.R.; King, T.Z.; Turner, J.A.; Semmel, E.S.; Dotson, V.M.,	*Linking depressive symptom dimensions to cerebellar subregion volumes in later life*	Translational Psychiatry	10	1	1--8	10.1038/s41398-020-00883-6	Yes
Bousquet, M.S.; Ratnayake, R.; Pope, J.L.; Chen, Q.Y.; Zhu, F.C.; Chen, S.X.; Carney, T.J.; Gharaibeh, R.Z.; Jobin, C.; Paul, V.J.; Luesch, H.,	*Seaweed natural products modify the host inflammatory response via Nrf2 signaling and alter colon microbiota composition and gene expression*	Free Radical Biology and Medicine	146		306--323	10.1016/j.freeradbiomed.2019.09.013	No
Brumley, D.A.; Gunasekera, S.P.; Chen, Q.Y.; Paul, V.J.; Luesch, H.,	*Discovery, Total Synthesis, and SAR of Anaenamides A and B: Anticancer Cyanobacterial Depsipeptides with a Chlorinated Pharmacophore*	Organic Letters	22	11	4235-4239	10.1021/acs.orglett.0c01281	No
Chu, W.T.; DeSimone, J.C.; Riffe, C.J.; Liu, H.; Chakrabarty, P.; Giasson, B.I.; Vedam-Mai, V.; Vaillancourt, D.E.,	*α-Synuclein Induces Progressive Changes in Brain Microstructure and Sensory-Evoked Brain Function That Precedes Locomotor Decline*	Journal of Neuroscience	40	34	6649--6659	10.1523/JNEUROSCI.0189-20.2020	Yes
Du, Y.; Behera, R.; Maligal-Ganesh, R.; Chen, M.; Chekmenev, E.; Huang, W.; Bowers, C.,	*Cyclopropane Hydrogenation vs Isomerization over Pt and Pt--Sn Intermetallic Nanoparticle Catalysts: A Parahydrogen Spin-Labeling Study*	Journal of Physical Chemistry C	124	15	8304--8309	10.1021/acs.jpcc.0c02493	Yes
Du, Y.; Zhou, R.; Ferrer, M.; Chen, M.; Graham, J.; Malphurs, B.; Labbe, G.; Huang, W.; Bowers, C.,	*An Inexpensive Apparatus for up to 97% Continuous-Flow Parahydrogen Enrichment Using Liquid Helium*	Journal of Magnetic Resonance	321		106869	10.1016/j.jmr.2020.106869	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Febo, M.; Perez, P.D.; Ceballos-Diaz, C.; Colon-Perez, L.M.; Zeng, H.D.; Ofori, E.; Golde, T.E.; Vaillancourt, D.E.; Chakrabarty, P.,	*Diffusion magnetic resonance imaging-derived free water detects neurodegenerative pattern induced by interferon-γ*	Brain Structure and Function	225	1	427-439	10.1007/s00429-019-02017-1	Yes
Febo, M.; Rani, A.; Yegla, B.; Barter, J.; Kumar, A.; Wolff, C.A.; Esser, K.; Foster, T.C.,	*Longitudinal Characterization and Biomarkers of Age and Sex Differences in the Decline of Spatial Memory*	Frontiers in Aging Neuroscience	12		340	10.3389/fnagi.2020.00034	No
Flint, J.J.; Menon, K.; Hansen, B.; Forder, J.R.; Blackband, S.J.,	*Visualization of Live, Mammalian Neurons During Kainate-Infusion Using Magnetic Resonance Microscopy*	NeuroImage	219		116997	10.1016/j.neuroimage.2020.116997	Yes
Forman, E.M.; Baniani, A.; Fan, L.; Ziegler, K.J.; Zhou, E.K.; Zhang, F.Y.; Lively, R.P.; Vasenkov, S.,	*Relationship between ethane and ethylene diffusion inside ZIF-11 crystals confined in polymers to form mixed-matrix membranes*	Journal of Membrane Science	593		117440	10.1016/j.memsci.2019.117440	Yes
Gatto, R.G.; Weissmann, C.; Amin, M.; Finkielsztein, A.; Sumagin, R.; Mareci, T.H.; Uchitel, O.D.; Magin, R.L.,	*Assessing neuraxial microstructural changes in a transgenic mouse model of early stage Amyotrophic Lateral Sclerosis by ultra-high field MRI and diffusion tensor metrics*	Animal Models and Experimental Medicine	3	2	117-129	10.1002/ame2.12112	Yes
Jaiswal, M.; Tran, T.T.; Li, Q.; Yan, X.; Zhou, M.; Kundu, K.; Fanucci, G.E.; Guo, Z.,	*A metabolically engineered spin-labeling approach for studying glycans on cells*	Chemical Science	11	46	12522-12532	10.1039/D0SC03874A	Yes
Jiang, G.D.; Zhang, P.L.; Ratnayake, R.; Yang, G.; Zhang, Y.; Zuo, R.; Powell, M.; Huguet-Tapia, J.C.; Abboud, K.A.; Dang, L.H.; Teplitski, M.; Paul, V.; Xiao, R.; Ahammad, K.H.; Zaman, U.; Hu, Z.Q.; Cao, S.G.; Luesch, H.; Ding, Y.,	*Fungal Epithiodiketopiperazines Carrying α,β-Polysulfide Bridges from Penicillium steckii YE, and Their Chemical Interconversion*	ChemBioChem	22	2	416-422	10.1002/cbic.202000403	No
Kelley, R.C.; McDonagh, B.; Brumback, B.; Walter, G.A.; Vohra, R.; Ferreira, L.F.,	*Diaphragm weakness and proteomics (global and redox) modifications in heart failure with reduced ejection fraction in rats*	Journal of Molecular and Cellular Cardiology	139		238-249	10.1016/j.yjmcc.2020.02.002	Yes
Lyu, S.; Xing, H.; DeAndrade, M.P.; Perez, P.D.; Yokoi, F.; Febo, M.; Walters, A.S.; Li, Y.Q.,	*The role of BTBD9 in the cerebellum, sleep-like behaviors and the restless legs syndrome*	Neuroscience	440		85-96	10.1016/j.neuroscience.2020.05.021	Yes
Magdoom, K.N.; Sarntinoranont, M.; Mareci, T.H.,	*An MRI-based switched gradient impulse response characterization method with uniform eigenmode excitation*	Journal of Magnetic Resonance	313		106720	10.1016/j.jmr.2020.106720	Yes
Mahar, R.; Donabedian, P.L.; Merritt, M.E.,	*HDO production from [$^2H_7$] glucose Quantitatively*	Nature Scientific Reports	10	1	8885	10.1038/s41598-020-65839-8	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
	Identifies Warburg Metabolism						
Meyerspeer, M.; Boesch, C.; Cameron, D.; Dezortova, M.; Forbes, S.C.; Heerschap, A.; Jeneson, J.A.L.; Kan, H.M.E.; Kent, J.; Layec, G.; Prompers, J.J.; Reyngoudt, H.; Sleigh, A.; Valkovic, L.; Kemp, G.J.; Baligand, C.; Carlier, P.G.; Chatel, B.; Damon, B.; Heskamp, L.; Hajek, M.; Jooijmans, M.; Krssak, M.; Reichenbach, J.; Schmid, A.; Slade, J.; Vandenborne, K.H.E.; Walter, G.A.; Willis, D.,	*^{31}P magnetic resonance spectroscopy in skeletal muscle: Experts' consensus recommendations*	NMR in Biomedicine	Special		1--22	10.1002/nbm.4246	No
Morla, L.; Shore, O.; Lynch, I.; Merritt, M.E.; Wingo, C.,	*A non-invasive method to study evolution of extracellular fluid volume in mice using time domain nuclear magnetic resonance.*	American Journal of Physiology-Renal Physiology	319	1	F115-124	10.1152/ajprenal.00377.2019	No
Muyyarikkandy, M.S.; McLeod, M.; Maguire, M.; Mahar, R.; Kattapuram, N.; Zhang, C.E.; Surugihalli, C.; Muralidaran, V.; Vavilikolanu, K.; Mathews, C.E.; Merritt, M.E.; Sunny, N.E.,	*Branched chain amino acids and carbohydrate restriction exacerbate ketogenesis and hepatic mitochondrial oxidative dysfunction during NAFLD*	FASEB Journal	34	11	14832-14849	10.1096/fj.202001495R	Yes
Myer, C.; Abdelrahman, L.; Banerjee, S.; Khattri, R.; Merritt, M.E.; Junk, A.; Lee, R.; Bhattacharya, S.,	*Aqueous humor metabolite profile of pseudoexfoliation glaucoma is distinctive*	Molecular Omics	16	5	425-435	10.1039/C9MO00192A	Yes
Nasser, A.A.; Eissa, I.H.; Oun, M.R.; El-Zahabi, M.A.; Taghour, M.S.; Belal, A.; Saleh, A.M.; Mehany, A.B.M.; Luesch, H.; Mostafa, A.E.; Afifi, W.M.; Rocca, J.R.; Mahdy, H.,	*Discovery of new pyrimidine-5-carbonitrile derivatives as anticancer agents targeting EGFR ^{WT} and EGFR ^{T790M}*	Organic and Biomolecular Chemistry	18	38	7608-7634	10.1039/d0ob01557a	Yes
Norwood, V.M.; Brice-Tutt, A.C.; Eans, S.O.; Stacy, H.M.; Shi, G.; Ratnayake, R.; Rocca, J.R.; Abboud, K.A.; Li, C.; Luesch, H.; McLaughlin, J.P.; Huigens, R.W.,	*Preventing Morphine Seeking Behavior through the Re-engineering of Vincamine's Biological Activity*	Journal of Medicinal Chemistry	63	10	5119-5138	10.1021/acs.jmedchem.9b01924	Yes
Pei, Y.; Chen, M.; Zhong, X.; Zhao, T.; Ferrer, M.; Maligal-Ganesh, R.; Ma, T.; Zhang, B.; Qi, Z.; Zhou, L.; Bowers, C.; Liu, C.; Huang, W.,	*Pairwise semi-hydrogenation of alkyne to cis-alkene on platinum-tin intermetallic compounds*	Nanoscale Research Letters	12	15	8519--8524	10.1039/D0NR00920B	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Pompilus, M.; Colon-Perez, L.M.; Grudny, M.M.; Febo, M.,	*Contextual experience modifies functional connectome indices of topological strength and efficiency*	Scientific Reports	10	1	1--5	10.1038/s41598-020-76935-0	Yes
Punchi Hewage, A.N.; Fontenot, L.; Guidry, J.; Weldeghiorghis, T.; Mehta, A.K.; Donnarumma, F.; Rivera, M.,	*Mobilization of Iron Stored in Bacterioferritin Is Required for Metabolic Homeostasis in Pseudomonas aeruginosa*	Pathogens	9	12	980	10.3390/pathogens9120980	Yes
Reddy, K.R.; Vardanyan, L.; Hu, J.; Villapando, O.; Bhomia, R.K.; Smith, T.; Harris, W.G.; Newman, S.,	*Soil phosphorus forms and storage in stormwater treatment areas of the Everglades: Influence of vegetation and nutrient loading*	Science of the Total Environment	725		138442	10.1016/j.scitotenv.2020.138442	Yes
Saleh, M.G.; Wang, M.; Mikkelsen, M.; Hui, S.C.N.; Oeltzschner, G.; Boissoneault, J.; Stennett, B.; Edden, R.A.E.; Porges, E.C.,	*Simultaneous edited MRS of GABA, glutathione, and ethanol*	NMR in Biomedicine	33	4	e4227	10.1002/nbm.4227	Yes
Sambuco, N.; Bradley, M.M.; Herring, D.R.; Lang, P.J.,	*Common circuit or paradigm shift? The functional brain in emotional scene perception and emotional imagery*	Psychophysiology	57	4	e13522	10.1111/psyp.13522	Yes
Song, B.; Choi, D.; Xin, Y.; Bowers, C.R.; Hagelin-Weaver, H.,	*Ultra-Low Loading Pt/CeO2 Catalysts: Ceria Facet Effect Affords Improved Pairwise Selectivity for Parahydrogen Enhanced NMR*	Angewandte Chemie				10.1002/anie.202012469	Yes
Spearman, B.S.; Agrawal, N.K.; Rubiano, A.; Simmons, C.S.; Mobini, S.; Schmidt, C.E.,	*Tunable methacrylated hyaluronic acid-based hydrogels as scaffolds for soft tissue engineering applications*	Journal of Biomedical Materials Research Part A	108	2	279-291	10.1002/jbm.a.36814	Yes
Tomitaka, A.; Arami, H.; Ahmadivand, A.; Pala, N.; McGoron, A.J.; Takemura, Y.; Febo, M.; Nair, M.,	*Magneto-plasmonic nanostars for image-guided and NIR-triggered drug delivery*	Scientific Reports	10	1	1--10	10.1038/s41598-020-66706-2	Yes
Tran, N.; Mentink-Vigier, F.; Long, J.R.,	*Dynamic Nuclear Polarization of Biomembrane Assemblies*	Biomolecules	10	9	1246	10.3390/biom10091246	Yes
Tran, T.T.; Liu, Z.L.; Fanucci, G.E.,	*Conformational landscape of non-B variants of HIV-1 protease: A pulsed EPR study*	Biochemical and Biophysical Research Communications	532	2	219-224	10.1016/j.bbrc.2020.08.030	No
Van Aalst, E.; Yekefallah, M.; Mehta, A.K.; Eason, I.; Wylie, B.,	*Codon Harmonization of a Kir3.1-KirBac1.3 Chimera for Structural Study Optimization*	Biomolecules	10	3	430	10.3390/biom10030430	Yes
von Morze, C.; Engelbach, J.; Reed, G.; Chen, A.; Quirk, J.; Blazey, T.; Mahar, R.; Malloy, C.; Garbow, J.; Merritt, M.E.,	*15N-carnitine, a novel endogenous hyperpolarized MRI probe with long signal lifetime*	Magnetic Resonance in Medicine	ePub		1--7	10.1002/mrm.28578	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Wilkes, B.J.; Bass, C.; Korah, H.; Febo, M.; Lewis, M.H.,	*Volumetric magnetic resonance and diffusion tensor imaging of C58/J mice: neural correlates of repetitive behavior*	Brain Imaging and Behavior	14	6	2084-2096	10.1007/s11682-019-00158-9	Yes
Xing, H.; Andrud, K.W.; Soti, F.; Rouchaud, A.; Jahn, S.C.; Lu, Z.; Cho, Y.H.; Habibi, S.; Corsino, P.; Slavov, S.; Rocca, J.R.; Lindstrom, J.S.; Lukas, R.J.; Kem, W.,	*A Methyl Scan of the Pyrrolidinium Ring of Nicotine Reveals Significant Differences in Its Interactions with α7 and α4β2 Nicotinic Acetylcholine Receptors*	Molecular Pharmacology	97	6	1--58	10.1124/mol.119.118786	No
Ziegler, E.W.; Brown, A.B.; Nesnas, N.; Chouinard, C.; Mehta, A.K.; Palmer, A.G.,	*β-Cyclodextrin encapsulation of synthetic AHLs: drug delivery implications and quorum-quenching exploits.*	ChemBioChem	ePub		1--12	10.1002/cbic.202000773	Yes

Publications generated by facilities: DC Field Facility at FSU (129)

DC Field

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Arnold, F.; Naumann, M.; Rosner, H.; Kikugawa, N.; Graf, D.E.; Balicas, L.; Terashima, T.; Uji, S.; Takatsu, H.; Khim, S.; Mackenzie, A.P.; Hassinger, E.,	*Fermi surface of $PtCoO_2$ from quantum oscillations and electronic structure calculations*	Physical Review B	101		195101	10.1103/PhysRevB.101.195101	Yes
Ashbrook, S.E.; Dawson, D.M.; Gan, Z.; Hooper, J.E.; Hung, I.; Macfarlane, L.E.; McKay, D.; McLeod, L.K.; Walton, R.I.,	*Application of NMR Crystallography to Highly Disordered Templated Materials: Extensive Local Structural Disorder in the Gallophosphate GaPO-34A*	Inorganic Chemistry	59	16	11616-11626	10.1021/acs.inorgchem.0c01450	Yes
Bristow, M.; Reiss, P.; Haghighirad, A.A.; Zajicek, Z.; Singh, S.J.; Wolf, T.; Graf, D.E.; Knafo, W.; McCollam, A.; Coldea, A.I.,	*Anomalous high-magnetic field electronic state of the nematic superconductors $FeSe_{1-x}S_x$*	Physical Review Research	2		13309	10.1103/PhysRevResearch.2.013309	Yes
Cao, G.; Zheng, H.; Zhao, H.; Ni, Y.; Pocs, C.A.; Zhang, Y.; Ye, F.; Hoffmann, C.; Wang, X.; Lee, M.; Hermele, M.; Kimchi, I.,	*Quantum liquid from strange frustration in the trimer magnet Ba4Ir3O10*	Nature Partner Journals Quantum Materials	5		26	10.1038/s41535-020-0232-6	Yes
Cao, Y.; Dzuba, B.; Magill, B.A.; Senichev, A.; Nguyen, T.; Diaz, R.E.; Manfra, M.J.; McGill, S.A.; Garcia, C.; Khodaparast, G.A.; Malis, O.,	*Photoluminescence study of non-polar m-plane InGaN and nearly strain-balanced InGaN/AlGaN superlattices*	Journal of Applied Physics	127	18	185702	10.1063/5.0003740	Yes
Chan, M.K.; McDonald, R.; Ramshaw, B.J.; Betts, J.; Shehter, A.; Bauer, E.D.; Harrison, N.,	*Extent of Fermi-surface reconstruction in the high-temperature superconductor $HgBa_2CuO_{4+\delta}$*	Proceedings of the National Academy of	117		9782	10.1073/pnas.1914166117	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
		Sciences of the USA					
Chapai, R.; Browne, D.A.; Graf, D.E.; DiTusa, J.F.; Jin, R.,	*Quantum oscillations with angular dependence in PdTe2 single crystals*	Journal of Physics-Condensed Matter	33		35601	10.1088/1361-648X/abb548	Yes
Chappell, G.L.; Gallagher, A.; Graf, D.E.; Riseborough, P.; Baumbach, R.,	*Influence of hydrostatic pressure on hidden order, the Kondo lattice, and magnetism in* $URu_2Si_{2-x}P_x$	Physical Review B	102		245152	10.1103/PhysRevB.102.245152	Yes
Che, H.; Zhao, Z.Y.; Rao, X.Y.; Chu, G.L.; Li, N.; Chu, W.J.; Gao, P.; Yue, X.Y.; Zhou, Y.; Li, Q.J.; Huang, Q.; Choi, E.S.; Han, Y.Y.; He, Z.Z.; Zhou, H.D.; Zhao, X.; Sun, X.F.,	*Absence of long-range order in an XY pyrochlore antiferromagnet Er2AlSbO7*	Physical Review Materials	4		54406	10.1103/PhysRevMaterials.4.054406	Yes
Che, S.; Shi, Y.; Yang, J.; Tian, H.; Chen, R.; Taniguchi, T.; Watanabe, K.; Smirnov, D.; Lau, C.N.; Shimshoni, E.; Murthy, G.; Fertig, H.,	*Helical Edge States and Quantum Phase Transitions in Tetralayer Graphene*	Physical Review Letters	125		36803	10.1103/PhysRevLett.125.036803	Yes
Chen, K.; Horstmeier, S.; Nguyen, V.; Bin, W.; Crossley, S.; Pham, T.; Gan, Z.; Hung, I.; White, J.,	*Structure and Catalytic Characterization of a Second Framework Al(IV) Site in Zeolite Catalysts Revealed by NMR at 35.2 T*	Journal of the American Chemical Society	142	16	7514-7523	10.1021/jacs.0c00590	Yes
Das, P.; Nash, J.; Webb, M.; Burns, R.; Mapara, V.N.; Ghimire, G.; Divan, R.; Rosenmann, D.; Karaiskaj, D.; McGill, S.A.; Sumant, A.; Dai, Q.; Ray, P.; Tawade, B.V.; Raghavan, D.; Karim, A.; Pradhan, N.R.,	*High Broadband Photoconductivity of few-layered* MoS_2 *Field-effect Transistor Measured in Multi-terminal Method: Effect of Contact Resistance*	Nanoscale	12		22904-22916	10.1039/D0NR07311C	Yes
Davydov, A.B.; Oveshnikov, L.N.; Suslov, A.; Ril, A I.; Marenkin, S.F.; Aronzon, B.A.,	*Superconductivity in Thin Films of the Dirac Semimetal* Cd_3As_2	Physics of the Solid State	62	3	419-422	10.1134/S1063783420030063	Yes
Dhital, C.; DiTusa, J.F.,	*Entropic signatures of the skyrmion lattice phase in* $MnSi_{1-x}Al_x$ *and* $Fe_{1-y}Co_ySi$	Physical Review B	102		224408	10.1103/PhysRevB.102.224408	Yes
Ding, L.; Lee, M.; Hong, T.; Dun, Z.; Sinclair, R.; Chi, S.; Agrawal, H.; Choi, E.S.; Chakoumakos, B.; Zhou, H.D.; Cao, H.,	*Noncollinear magnetic structure and magnetoelectric coupling in buckled honeycomb* $Co_4Nb_2O_9$*:A single-crystal neutron diffraction study*	Physical Review B	102		174443	10.1103/PhysRevB.102.174443	Yes
Ding, L.; Lee, M.S.; Choi, E.S.; Zhang, J.; Wu, Y.; Sinclair, R.; Chakoumakos, B.; Chai, Y.; Zhou, H.D.; Cao, H.,	*Large spin-driven dielectric response and magnetoelectric coupling in the buckledhoneycomb* $Fe_4Nb_2O_9$	Physical Review Materials	4		84403	10.1103/PhysRevMaterials.4.084403	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Drichko, I.L.; Smirnov, I.YU.; Suslov, A.; Nestoklon, M.O.; Kamburov, D.; Baldwin, K.W.; Pfeiffer, L.N.; West, K.W.; Golub, L.E.,	*Electronic band structure in n-type GaAs/AlGaAs wide quantum wells in tilted magnetic field*	Journal of Physics-Condensed Matter	32	3	35303	10.1088/1361-648x/ab4a51	Yes
Elatresh, S.F.; Hossain, M.; Bhowmick, T.; Grockowiak, A.; Cai, W.; Coniglio, W.; Tozer, S.W.; Ashcroft, N.W.; Bonev, S.A.; Deemyad, S.; Hoffmann, R.,	*Fermi surface studies of the low-temperature structure of sodium*	Physical Review B: Rapid Comm/ Letters	101		220103	10.1103/PhysRevB.101.220103	Yes
Elmslie, T.A.; VanGennep, D.; Bi, W.; Lai, Y.; Weir, S.T.; Vohra, Y.K.; Baumbach, R.E.; Hamlin, J.J.,	*Pressure-induced suppression of ferromagnetism in $CePd_2P_2$*	Physical Review B	102		125146	10.1103/PhysRevB.102.125146	Yes
Fan, S.; Das, H.; Rebola, A.; Smith, K.A.; Mundy, J.; Brooks, C.; Holtz, M.E.; Muller, D.A.; Fennie, C.J.; Ramesh, R.; Schlom, D.G.; McGill, S.A.; Musfeldt, J.,	*Site-specific spectroscopic measurement of spin and charge in (LuFeO3)m/(LuFe2O4)1 multiferroic superlattices*	Nature Communications	11		5582	10.1038/s41467-020-19285-9	Yes
Frachet, M.; Vinograd, I.; Zhou, R.; Benhabib, S.; Wu, S.; Mayaffre, H.; Kramer, S.; Ramakrishna, S.K.; Reyes, A.P.; Debray, J.; Kurosawa, T.; Momono, N.; Oda, M.; Komiya, S.; Ono, S.; Horio, M.; Chang, J.; Proust, D.; LeBoeuf, D.; Julien, M. H.,	*Hidden magnetism at the pseudogap critical point of a cuprate superconductor*	Nature Physics	16		1064-1068	10.1038/s41567-020-0950-5	Yes
Galstyan, E.; Pratap, R.; Majkic, G.; Kochat, M.; Abraimov, D.V.; Jaroszynski, J.; Selvamanickam, V.,	*In-field critical current and pinning mechanisms at 4.2 K of Zr-added REBCO coated conductors*	Superconductor Science and Technology	33	7	74007	10.1088/1361-6668/ab90c6	Yes
Ghosh, S.; Shehter, A.; Jerzembeck, F.; Kikugawa, N.; A Sokolov, D.; Brando, M.; Mackenzie, A.P.; W Hicks, C.; Ramshaw, B.,	*Thermodynamic evidence for a two-component superconducting order parameter in Sr2RuO4*	Nature Physics	16		1	10.1038/s41567-020-1032-4	Yes
Gui, X.; Chang, T.R.; Wei, K.; Daum, M.J.; Graf, D.E.; Baumbach, R.; Mourigal, M.; Xie, W.,	*A Novel Magnetic Material by Design: Observation of Yb^{3+} with Spin-1/2 in Yb_xPt_5P*	American Chemical Society Central Science	6		2023-2030	10.1021/acscentsci.0c00691	Yes
Gunatilleke, W.D.C.B.; Hobbis, D.; Poddig, H.; Tinkess, A.; Beekman, M.; Wang, H.; Wei, K.; Baumbach, R.; Nolas, G.S.,	*Structural, Electronic, and Thermal Properties of $CdSnAs_2$*	Inorganic Chemistry	59		3079-3084	10.1021/acs.inorgchem.9b03424	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Haley, S.; Weber, S.; Cookmeyer, T.; Parker, D.; Maniv, E.; Maksimovic, N.; John, C.; Doyle, S.; Maniv, A.; Ramakrishna, S.K.; Reyes, A.P.; Singleton, J.; Moore, J.; Neaton, J.; Analytis, J.,	*Half-magnetization plateau and the origin of threefold symmetry breaking in an electrically switchable triangular antiferromagnet*	Physical Review Research	2		43020	10.1103/PhysRevResearch.2.043020	Yes
Hartstein, M.; Liu, H.; Hsu, Y.; Tan, B.S.; Ciomaga Hatnean, M.; Balakrishnan, G.; Sebastian, S.E.,	*Intrinsic Bulk Quantum Oscillations in a Bulk Unconventional Insulator SmB6*	iScience	23	11	101632	10.1016/j.isci.2020.101632	Yes
Haskel, D.; Fabbris, G.; Kim, J.H.; Veiga, L.I.; Mardegan, J.L.; Escanhoela, C.A.; Chikara, S.; Struzhkin, V.; Senthil, T.; Kim, B.J.; Cao, G.; Kim, J.W.,	*Possible quantum paramagnetism in compressed* Sr_2IrO_4	Physical Review Letters	124		67201	10.1103/PhysRevLett.124.067201	No
Hassan, N.M.; Thirunavukkuarasu, K.; Lu, Z.; Smirnov, D.; Zhilyaeva, E.I.; Torunova, S.; Lyubovskaya, R.N.; Drichko, N.,	*Melting of charge order in the low-temperature state of an electronic ferroelectric-like system*	Nature Partner Journals Quantum Materials	5	1	15	10.1038/s41535-020-0217-5	Yes
Hertz, M.B.; Baumbach, R.; Latturner, S.E.,	*Flux Synthesis of MgNi2Bi4 and Its Structural Relationship to NiBi3*	Journal of Biological Inorganic Chemistry	59	6	3452-3458	10.1021/acs.inorgchem.9b03196	Yes
Hobbis, D.; Shi, W.; Popescu, A.; Wei, K.; Baumbach, R.; Wang, H.; Woods, L.M.; Nolas, G.S.,	*Synthesis, transport properties and electronicstructure of p-type* $Cu_{1+x}Mn_{2-x}InTe_4$ *(x = 0, 0.2,0.3)*	Dalton Transactions	49		2273-2279	10.1039/c9dt04069b	Yes
Hu, X.; Small, M.; Kim, K.; Kim, K.; Bhattarai, K.; Polyanskii, A.A.; Radcliff, K.; Jaroszynski, J.J.; Bong, U.; Hwan Park, J.; Hahn, S.; Larbalestier, D.C.,	*Analyses of the plastic deformation of coated conductors deconstructed from ultra-high field test coils*	Superconductor Science and Technology	33	9	95012	10.1088/1361-6668/aba79d	Yes
Hu, Z.; Du, Q.; Liu, Y.; Graf, D.E.; Petrovic, C.,	*High Fermi velocities and small cyclotron masses in LaAlGe*	Applied Physics Letters	117	22	222410	10.1063/5.0035445	Yes
Hu, Z.; Graf, D.E.; Liu, Y.; Petrovic, C.,	*Three-dimensional Fermi surface and small effective masses in* Mo_8Ga_{41}	Applied Physics Letters	116	20	202601	10.1063/5.0005177	Yes
Huang, S.; Xing, L.; Chapai, R.; Nepal, R.; Jin, R.,	*Thermal transport, magnetism, and quantum oscillations in Weyl semimetal BaMnSb2*	Physical Review Materials	4		65001	10.1103/PhysRevMaterials.4.065001	Yes
Hughey, K.; Harms, N.; O'Neal,, K.; Clune, A.; Monroe, J.; Blockmon, A.; Landee, C.; Liu, Z.; Ozerov, M.; Musfeldt, J.,	*Spin−Lattice Coupling Across the Magnetic Quantum-Phase Transition in Copper-Containing Coordination Polymers*	Inorganic Chemistry	59		2127	10.1021/acs.inorgchem.9b02394	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Jiang, N.; Ramanathan, A.; Baumbach, R.; La Pierre, H.S.,	*Synthesis of a d^2 kagome lattice antiferromagnet, $(CH_3NH_3)_2NaV_3F_{12}$*	Chemical Science	11		11811-11817	10.1039/D0SC03323E	Yes
Jiang, Y.; Asmar, M.M.; Han, X.; Ozerov, M.; Smirnov, D.; Salehi, M.; Oh, S.; Jiang, Z.; Tse, W.; Wu, L.,	*Electron Hole Asymmetry of Surface States in Topological Insulator Sb_2Te_3 Thin Films Revealed by Magneto-Infrared Spectroscopy*	American Chemical Society Nano Letters	20	6	4588-4593	10.1021/acs.nanolett.0c01447	Yes
Jiang, Y.; Wang, J.; Zhao, T.; Dun, Z.L.; Huang, Q.; Wu, X.S.; Mourigal, M.; Zhou, H.D.; Pan, W.; Ozerov, M.; Smirnov, D.; Jiang, Z.,	*Unraveling the Topological Phase of $ZrTe_5$ via Magnetoinfrared Spectroscopy*	Physical Review Letters	125		46403	10.1103/PhysRevLett.125.046403	Yes
Ju, L.; Wang, L.; Liu, X.; Moon, S.; Ozerov, M.; Lu, Z.; Taniguchi, T.; Watanabe, K.; Mueller, E.; Zhang, F.; Smirnov, D.; Rana, F.; McEuen, P.L.,	*Unconventional valley-dependent optical selection rules and landau level mixing in bilayer graphene*	Nature Communications	11	1	2941	10.1038/s41467-020-16844-y	No
Kang, M.; Ye, L.; Fang, S.; You, J.; Levitan, A.; Han, M.; Facio, J.I.; Jozwiak, C.; Bostwick, A.; Rotenberg, E.; Chan, M.; McDonald, R.; Graf, D.E.; Kaznatcheev, K.; Vescovo, E.; Bell, D.C.; Kaxiras, E.; van den Brink, J.; Richter, M.; Prasad Ghimire, M.; Checkelsky, J.G.; Comin, R.,	*Dirac fermions and flat bands in the ideal kagome metal FeSn*	Nature Materials	19	2	163--169	10.1038/s41563-019-0531-0	Yes
Kar, S.; Sai Sandra, J.; Luo, W.; Yerraguravagari, V.; Galstyan, E.; Jaroszynski, J.J.; Abraimov, D.V.; Majkic, G.; Selvamanickam, V.,	*Progress in scale-up of REBCO STAR™ wire for canted cosine theta coils and future strategies with enhanced flexibility*	Superconductor Science and Technology	33	9	94001	10.1088/1361-6668/ab9e41	Yes
Kealhofer, D.A.; Galletti, L.; Schumann, T.; Suslov, A.; Stemmer, S.,	*Topological Insulator State and Collapse of the Quantum Hall Effect in a Three-Dimensional Dirac Semimetal Heterojunction*	Physical Review X	10		11050	10.1103/PhysRevX.10.011050	Yes
Kinsler, C.; Zheng, Q.; Huang, Q.; Choi, E.S.; Yan, J.; Zhou, H.D.; Mandrus, D.; Keppens, V.,	*Synthesis, characterization, and single-crystal growth of a high-entropy rare-earth pyrochlore oxide*	Physical Review Materials	4		104411	10.1103/PhysRevMaterials.4.104411	Yes
Klamm, B.E.; Albrecht-Schmitt, T.E.; Baumbach, R.; Billow, B.S.; White, F.D.; Kozimor, S.A.; Scott, B.L.; Tondreau, A.M.,	*Employing Lewis Acidity to Generate Bimetallic Lanthanide Complexes*	Inorganic Chemistry	59	13	8642-8646	10.1021/acs.inorgchem.0c00775	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Krzystek, J.; Schnegg, A.; Aliabadi, A.; Holldack, K.; Stoian, S.A.; Ozarowski, A.; Hicks, S.D.; Abu-Omar, M.M.; Thomas, K.E.; Gosh, A.; Caulfield, K.P.; Tonzetich, Z.J.; Telser, J.,	*Advanced paramagnetic resonance studies on manganese and iron corroles with a formal d4 electron count*	Inorganic Chemistry	59	2	1075-1090	10.1021/acs.inorg-chem.9b02635	Yes
Kudisch, B.; Maiuri, M.; Moretti, L.; Oviedo, M.B.; Wang, L.; Oblinsky, D.G.; Prud'homme, R.K.; Wong, B.M.; McGill, S.A.; Scholes, G.D.,	*Ring currents modulate optoelectronic properties of aromatic chromophores at 25 T*	Proceedings of the National Academy of Sciences of the USA	117	21	11289-11298	10.1073/pnas.1918148117	Yes
Kumar, P.; SantaLucia, D.J.; Kaniewska-Laskowska, K.; Lindeman, S.V.; Ozarowski, A.; Krzystek, J.; Ozerov, M.; Telser, J.; Berry, J.F.; Fiedler, A.T.,	*Probing the Magnetic Anisotropy of Co(II) Complexes Featuring Redox-Active Ligands*	Inorganic Chemistry	59	22	16178-16193	10.1021/acs.inorg-chem.0c01812	Yes
Kwan, Y.H.; Reiss, P.; Han, Y.; Bristow, M.; Prabhakaran, D.; Graf, D.E.; McCollam, A.; Parameswaran, S.A.; Coldea, A.I.,	*Quantum oscillations probe the Fermi surface topology of the nodal-line semimetal CaAgAs*	Physical Review Research	2		12055	10.1103/PhysRevResearch.2.012055	Yes
Lai, B.; Singh, S.; Bindra, J.; Saraj, C.; Shukla, A.; Yadav, T.; Wu, W.; McGill, S.; Dalal, N.; Srivastava, A.; Guo, C.,	*Hydrogen evolution reaction from bare and surface-functionalized few-layered MoS2 nanosheets in acidic and alkaline electrolytes*	Materials Today Chemistry	14		100207	10.1016/j.mtchem.2019.100207	No
Lai, Y.; Wei, K.; Chappell, G.L.; Diaz, J.; Siegrist, T.M.; Moll, P.J.W.; Graf, D.E.; Baumbach, R.,	*Tuning the structural and antiferromagnetic phase transitions in UCr_2Si_2: Hydrostatic pressure and chemical substitution*	Physical Review Materials	4		75003	10.1103/PhysRevMaterials.4.075003	Yes
Lee, M.; Chen, Q.; Choi, E.S.; Huang, Q.; Wang, Z.; Ling, L.; Qu, Z.; Wang, G.; Ma, J.; Aczel, A.A.; Zhou, H.D.,	*Magnetoelectric effect arising from a field-induced pseudo Jahn-Tellerdistortion in a rare-earth magnet*	Physical Review Materials	4		94411	10.1103/PhysRevMaterials.4.094411	Yes
Lesseux, G.G.; Sakai, H.; Hattori, T.; Tokunaga, Y.; Kambe, S.; Kuhns, P.L.; Reyes, A.P.; Thompson, J.D.; Pagluso, P.G.; Urbano, R.R.,	*Orbitally defined field-induced electronic state in a Kondo lattice*	Physical Review B	101		165111	10.1103/PhysRevB.101.165111	Yes
Li, N.; Huang, Q.; Yue, X.Y.; Chu, W.J.; Chen, Q.; Choi, E.S.; Zhao, X.; Zhou, H.D.; Sun, X.F.,	*Possible itinerant excitations and quantum spinstate transitions in the effective spin-1/2triangular-lattice antiferromagnet Na2BaCo(PO4)2*	Nature Communications	11		4216	10.1038/s41467-020-18041-3	Yes
Li, S.; Drueke, E.; Porter, Z.; Jin, W.; Lu, Z.; Smirnov, D.; Merlin, R.; Wilson, S.D.; Sun, K.; Zhao, L.,	*Symmetry-Resolved Two-Magnon Excitations in a Strong Spin-Orbit-Coupled Bilayer Antiferromagnet*	Physical Review Letters	125		87202	10.1103/PhysRevLett.125.087202	Yes

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Lin, W.C.; Campbell, D.J.; Ran, S.; Liu, I.L.; Kim, H.; Nevidomsky, A.H.; Graf, D.E.; Butch, N.P.; Paglione, J.,	*Tuning magnetic confinement of spin-triplet superconductivity*	Nature Partner Journals Quantum Materials	5	1	68	10.1038/s41535-020-00270-w	Yes
Liu, C.; Humbert, V.F.C.; Bretz-Sullivan, T.M.; Wang, G.; Hong, D.; Wrobel, F.; Zhang, J.; Hoffman, J.D.; Pearson, J.E.; Jiang, J.S.; Chang, C.; Suslov, A.; Mason, N.; Norman, M.R.; Bhattacharya, A.,	*Observation of an antiferromagnetic quantum critical point in high-purity LaNiO3*	Nature Communications	11		1402	10.1038/s41467-020-15143-w	Yes
Liu, E.; van Baren, J.; Liang, C.; Taniguchi, T.; Watanabe, K.; Gabor, N.M.; Chang, Y.; Lui, C.,	*Multipath Optical Recombination of Intervalley Dark Excitons and Trions in Monolayer WSe_2*	Physical Review Letters	124		196802	10.1103/PhysRevLett.124.196802	Yes
Liu, E.; van Baren, J.; Taniguchi, T.; Watanabe, K.; Chang, Y.; Lui, C.,	*Landau-Quantized Excitonic Absorption and Luminescence in a Monolayer Valley Semiconductor*	Physical Review Letters	124		97401	10.1103/PhysRevLett.124.097401	Yes
Liu, J.L.; Pedersen, K.; Greer, S.; Oyarzabal, I.; Mondal, A.; Hill, S.; Wilhelm, F.; Rogalev, A.; Tressaud, A.; Durand, E.; Long, J.; Clerac, R.,	*Access to Heteroleptic Fluorido-Cyanido Complexes with a Large Magnetic Anisotropy via Fluoride Abstraction*	Angewandte Chemie	59		10306-10310	10.1002/ange.201914934	Yes
Liu, X.; Hao, Z.; Khalaf, E.; Lee, J.Y.; Ronen, Y.; Yoo, H.; Najafabadi, D.H.; Watanabe, K.; Taniguchi, T.; Vishwanath, A.; Kim, P.,	*Tunable spin-polarized correlated states in twisted double bilayer graphene*	Nature	583		221-225	10.1038/s41586-020-2458-7	Yes
Madsen, R.; Qiao, A.; Sen, J.; Hung, I.; Chen, K.; Gan, Z.; Sen, S.; Yue, Y.,	*Ultrahigh-field ^{67}Zn NMR reveals short-range disorder in zeolitic imidazolate framework glasses*	Science	367		1473-1476	10.1126/science.aaz0251	Yes
Magill, B.A.; Thapa, S.; Holleman, J.; McGill, S.A.; Munekata, H.; Stanton, C.J.; Khodaparast, G.A.,	*Magnetic field enhanced detection of coherent phonons in a GaMnAs/GaAs film*	Physical Review B	102		45306	10.1103/PhysRevB.102.045306	Yes
Majkic, G.; Pratap, R.; Paidpilli, M.; Galstyan, E.; Kochat, M.; Goel, C.; Kar, S.; Jaroszynski, J.J.; Abraimov, D.V.; Selvamanickam, V.,	*In-field critical current performance of 4.0 μm thick film REBCO conductor with Hf addition at 4.2 K and fields up to 31.2 T*	Superconductor Science and Technology	33	7	07LT03	10.1088/1361-6668/ab9541	Yes
Maniv, A.; Reyes, A.P.; Ramakrishna, S.K.; Graf, D.E.; Huq, A.; Potashnikov, D.; Rivin, O.; Pesach, A.; Tao, Q.; Rosen, J.; Felner, I.; Caspi, E.N.,	*Microscopic evidence for Mn-induced long range magnetic ordering in MAX phase compounds*	Journal of Physics-Condensed Matter	33	2	25803	10.1088/1361-648X/abb998	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Mayen, L.; Jensen, N.; Laurencin, D.; Marsan, O.; Bonhomme, C.; Gervais, C.; Smith, M.; Coelho, C.; Laurent, G.; Trebosc, J.; Gan, Z.; Chen, K.; Rey, C.; Combes, C.; Soulié, J.,	*A soft-chemistry approach to the synthesis of amorphous calcium ortho/pyrophosphate biomaterials of tunable composition*	Acta Materialia	103		333-345	10.1016/j.actbio.2019.12.027	Yes
Modic, K.; McDonald, R.; Lai, Y.; Palmstrom, J.C.; Graf, D.E.; Chan, M.K.; Balakirev, F.; Boebinger, G.S.; Betts, J.; Schmidt, M.; Sokolov, D.A.; Moll, P.J.W.; Ramshaw, B.; Shehter, A.,	*Scale-invariant magnetic anisotropy in RuCl3 at high magnetic fields*	Nature Physics	1		1	10.1038/s41567-020-1028-0	Yes
Moseley, D.; Stavretis, S.; Zhu, Z.; Guo, M.; Brown, C.; Ozerov, M.; Cheng, Y.; Daemen, L.; Richardson, R.; Knight, G.; Thirunavukkuarasu, K.; Ramirez-Cuesta, A.; Tang, J.; Xue, Z.,	*Inter-Kramers Transitions and Spin–Phonon Couplings in a Lanthanide-Based Single-Molecule Magnet*	Inorganic Chemistry	59	7	5218-5230	10.1021/acs.inorgchem.0c00523	Yes
Mozaffari, S.; Aryal, N.; Schoenemann, R.U.; Chen, K.; McCandless, G.T.; Chan, J.Y.; Manousakis, E.; Balicas, L.,	*Multiple Dirac nodes and symmetry protected Dirac nodal line in orthorhombic α-RhSi*	Physical Review B	102		115131	10.1103/PhysRevB.102.115131	Yes
Nakajima, Y.; Metz, T.; Eckberg, C.; Kirshenbaum, K.; Hughes, A.; Wang, R.; Wang, L.; Saha, S.R.; Liu, I.L.; Butch, N.P.; Campbell, D.; Eo, Y.; Graf, D.E.; Liu, Z.; Borisenko, S.V.; Zavalij, P.Y.; Paglione, J.P.,	*Quantum-critical scale invariance in a transition metal alloy*	Communications Physics	3	1	181	10.1038/s42005-020-00448-5	Yes
Nelson, W.L.; Chemey, A.T.; Hertz, M.; Choi, E.; Graf, D.E.; Latturner, S.; Albrecht-Schmitt, T.E.; Wei, K.; Baumbach, R.,	*Superconductivity in a uranium containing high entropy alloy*	Nature Scientific Reports	10	1	4717	10.1038/s41598-020-61666-z	Yes
Nelson, W.L.; Jayasinghe, A.S.; Graf, D.E.; Latturner, S.; Baumbach, R.,	*Electronic and magnetic properties of $EuNi_{2-\delta}Sb_2$ structural variants*	Journal of Physics-Condensed Matter	32	31	315801	10.1088/1361-648x/ab849c	Yes
Neu, J.N.; Graf, D.E.; Wei, K.; Gaiser, A.; Xin, Y.; Lai, Y.; Albrecht-Schmitt, T.E.; Baumbach, R.; Singh, D.J.; Siegrist, T.M.,	*Superstructures and Superconductivity Linked with Pd Intercalation in $Nb_2Pd_xSe_5$*	Chemistry of Materials	32	0	8361	10.1021/acs.chemmater.0c02291	Yes
Niu, C.; Qiu, G.; Wang, Y.; Zhang, Z.; Si, M.; Wu, W.; Peide, D.,	*Gate-tunable strong spin-orbit interaction in two-dimensional tellurium probed by weak antilocalization*	Physical Review B: Rapid Comm/ Letters	101	20	205414	10.1103/PhysRevB.101.205414	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Nomura, T.; Skourski, Y.; Quintero-Castro, D.L.; Zvyagin, A.A.; Suslov, A.; Gorbunov, D.; Yasin, S.; Wosnitza, J.; Kindo, K.; Islam, A.T.M.N.; Lake, B.; Kohama, Y.; Zherlitsyn, S.; Jaime, M.,	*Enhanced spin correlations in the Bose-Einstein condensate compound Sr_3Cr_2O_8*	Physical Review B	102		165144	10.1103/PhysRevB.102.165144	Yes
Ok, J.; Kwon, C.; Kohama, Y.; You, J.; Park, S.; Kim, J.; Jo, Y.J.; Choi, E.S.; Kindo, K.; Kang, W.; Kim, K.; Moon, E.G.; Gurevich, A.V.; Kim, J.,	*Observation of in-plane magnetic field induced phase transitions in FeSe*	Physical Review B	101	22	224509	10.1103/PhysRevB.101.224509	Yes
Opherden, D.; Nizar, N.; Richardson, K.; Monroe, J.; Turnbull, M.; Polson, M.; Vela, S.; Blackmore, W.; Goddard, P.; Singleton, J.; Choi, E.; Xiao, F.; Williams, R.; Lancaster, T.; Pratt, F.; Blundell, S.; Skourski, Y.; Uhlarz, M.; Ponomaryov, A.; Zvyagin, S.; Wosnitza, J.; Beinitz, M.; Heinmaa, I.; Stern, R.; Kuehne, H.; Landee, C.,	*Open Access Extremely well isolated two-dimensional spin-12 antiferromagnetic Heisenberg layers with a small exchange coupling in the molecular-based magnet CuPOF*	Physical Review B	102		64431	10.1103/PhysRevB.102.064431	Yes
Oveshnikov, L.; Davydov, A.; Suslov, A.; Ril`, A.; Marenkin, S.; Vasiliev, A.; Aronzon, B.,	*Superconductivity and Shubnikov - de Haas effect in polycrystalline Cd_3As_2 thin films*	Nature Scientific Reports	10		4601	10.1038/S41598-020-61376-6	Yes
Palacios, M.A.; Díaz-Ortega, I.F.; Nojiri, H.; Suturina, E.A.; Ozerov, M.; Krzystek, J.; Colacio, E.,	*Tuning magnetic anisotropy by the π-bonding features of the axial ligands and the electronic effects of gold(I) atoms in 2D $\{Co(L)_2[Au(CN)_2]_2\}_n$ metal-organic frameworks with field-induced single-ion behavior*	Inorganic Chemistry Frontiers	7		4611-4630	10.1039/D0QI00996B	Yes
Pan, L.; Grutter, A.; Zhang, P.; Che, X.; Nozaki, T.; Stern, A.; Street, M.; Zhang, B.; Casas, B.W.; He, Q.; Choi, E.; Disseler, S.M.; Gilbert, D.A.; Yin, G.; Shao, Q.; Deng, P.; Wu, Y.; Liu, X.; Kou, X.; Masashi, S.; Han, X.; Binek, C.; Chambers, S.; Xia, J.; Wang, K.L.,	*Observation of Quantum Anomalous Hall Effect and Exchange Interaction in Topological Insulator/Antiferromagnet Heterostructure*	Advanced Materials	32	34	2001460	10.1002/adma.202001460	Yes
Pan, L.; Liu, X.; He, Q.; Stern, A.; Yin, G.; Che, X.; Shao, Q.; Zhang, P.; Deng, P.; Yang, C.; Casas, B.W.; Choi, E.; Xia, J.; Kou, X.; Wang, K.L.,	*Probing the low-temperature limit of the quantum anomalous Hall effect*	Science Advances	6	25	eaaz3595	10.1126/sciadv.aaz3595	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Pan, W.; Reno, J.L.; Reyes, A.P.,	*Enhanced stability of quantum Hall skyrmions under radio-frequency radiations*	Scientific Reports	10	5-Jan	7659	10.1038/s41598-020-64505-3	Yes
Pikulski, M.; Shiroka, T.; Casola, F.; Reyes, A.P.; Kuhns, P.L.; Wang, S.; Ott, H.R.; Mesot, J.,	*Two coupled chains are simpler than one: field-induced chirality in a frustrated spin ladder*	Scientific Reports	10		15862	10.1038/s41598-020-72215-z	Yes
Pocs, C.A.; Leahy, I.A.; Zheng, H.; Cao, G.; Choi, E.; Do, S.; Choi, K.; Normand, B.; Lee, M.,	*Giant thermal magnetoconductivity in $CrCl_3$ and a general model for spin-phonon scattering*	Physical Review Research	2		13059	10.1103/PhysRevResearch.2.013059	Yes
Qiu, G.; Niu, C.; Wang, Y.; Si, M.; Zhang, Z.; Wu, W.; Ye, P.D.,	*Quantum Hall effect of Weyl fermions in n-type semiconducting tellurene*	Nature Nanotechnology	15		585–591	10.1038/s41565-020-0715-4	Yes
Ratkovski, D.R.; Balicas, L.; Bangura, A.; Machado, F.; Rezende, S.,	*Thermal transport in yttrium iron garnet at very high magnetic fields*	Physical Review B	101		174442	10.1103/PhysRevB.101.174442	Yes
Reiss, P.; Graf, D.E.; Haghighirad, A.A.; Knafo, W.; Drigo, L.; Bristow, M.; Schofield, A.J.; Coldea, A.I.,	*Quenched nematic criticality and two superconducting domes in an iron-based superconductor*	Nature Physics	16	1	89-94	10.1038/s41567-019-0694-2	Yes
Ribak, A.; Skiff, R.; Mograbi, M.; Rout, P.; Fischer, M.; Ruhman, J.; Chashka, K.; Dagan, Y.; Kanigel, A.; Ribak, A.; Skiff, R.; Mograbi, M.; Rout, P.; Fischer, M.; Ruhman, J.; Chashka, K.; Dagan, Y.; Kanigel, A.,	*Chiral superconductivity in the alternate stacking compound 4Hb-TaS_2*	Science Advances	6	13	eaax9480	10.1126/sciadv.aax9480	Yes
Rõõm, T.; Viirok, J.; Peedu, L.; Nagel, U.; Farkas, D.G.; Szaller, D.; Kocsis, V.; Bordács, S.; Kézsmárki, I.; Kamenskyi, D.L.; Engelkamp, H.; Ozerov, M.; Smirnov, D.; Krzystek, J.; Thirunavukkuarasu, K.; Ozaki, Y.; Tomioka, Y.; Ito, T.; Datta, T.; Fishman, R.S.,	*Magnetoelastic distortion of multiferroic BiFeO3 in the canted antiferromagnetic state*	Physical Review B	102		214410	10.1103/PhysRevB.102.214410	Yes
Sakai, H.; Tokunaga, Y.; Haga, Y.; Kambe, S.; Ramakrishna, S.K.; Reyes, A.P.; Rosa, P.F.; Ronning, F.; Thompson, J.; Fisk, Z.; Bauer, E.,	*^{33}S Nuclear Magnetic Resonance Spectra of uranium disulfide β-US_2*	JPS Conference Proceedings	30		11169	10.7566/JPSCP.30.011169	Yes
Shao, Y.; Rudenko, A.N.; Hu, J.; Sun, Z.; Zhu, Y.; Moon, S.; Millis, A.J.; Yuan, S.; Lichtenstein, A.I.; Smirnov, D.; Mao, Z.Q.; Katsnelson, M.I.; Basov, D.N.,	*Electronic correlations in nodal-line semimetals*	Nature Physics	16	6	636-641	10.1038/s41567-020-0859-z	Yes
Shen, L.; Wang, Y.; Du, J.; Chen, K.; Lin, Z.; Wen, Y.; Hung, I.; Gan, Z.; Peng, L.,	*Probing Interactions of γ-Alumina with Water via Multinuclear Solid-State NMR Spectroscopy*	ChemCatChem	12		1569-1574	10.1002/cctc.201901838	Yes

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Shi, Q.; Shih, E.M.; Gustafsson, M.V.; Rhodes, D.A.; Kim, B.; Watanabe, K.; Taniguchi, T.; Papic, Z.; Hone, J.; Dean, C.R.,	*Odd- and even-denominator fractional quantum Hall states in monolayer WSe2.*	Nature Nanotechnology	15		569-573	10.1038/s41565-020-0685-6	Yes
Shi, Z.; Baity, P.G.; Sasagawa, T.; Popovic, D.,	*Vortex phase diagram and the normal state of cuprates with charge and spin orders*	Science Advances	6		eaay8946	10.1126/sciadv.aay8946	Yes
Shi, Z.; Baity, P.G.; Terzic, J.; Sasagawa, T.; Popovic, D.,	*Pair density wave at high magnetic fields in cuprates with charge and spin orders*	Nature Communications	11		3323	10.1038/s41467-020-17138-z	Yes
Shi, Z.; Kuhn, S.J.; Flicker, F.; Helm, T.; Lee, J.; Steinhardt, W.; Dissanayake, S.; Graf, D.E.; Ruff, J.; Fabbris, G.; Haskel, D.; Haravifard, S.,	*Incommensurate two-dimensional checkerboard charge density wave in the low-dimensional superconductor* $Ta_4Pd_3Te_{16}$	Physical Review Research	2		42042	10.1103/PhysRevResearch.2.042042	Yes
Skoropata, E.; Nichols, J.; Ok, J.; Chopdekar, R.V.; Choi, E.; Rastogi, A.; Sohn, C.; Gao, X.; Yoon, S.; Farmer, T.; Desautels, R.D.; Choi, Y.; Haskel, D.; Freeland, J.W.; Okamoto, S.; Brahlek, M.; Lee, H.,	*Interfacial tuning of chiral magnetic interactions for large topological Hall effects in LaMnO3/SrIrO3 heterostructures*	Science Advances	6	27	eaaz3902	10.1126/sciadv.aaz3902	Yes
Spackova, J.; Fabra, C.; Mittelette, S.; Gaillard, E.; Chen, C.; Cazals, G.; Lebrun, A.; Scene, S.; Berthomieu, D.; Chen, K.; Gan, Z.; Gervais, C.; Metro, T.; Laurencin, D.,	*Unveiling the Structure and Reactivity of Fatty-Acid Based (Nano)materials Thanks to Efficient and Scalable 17O and 18O-Isotopic Labeling Schemes*	Journal of the American Chemical Society	142	50	21068-21081	10.1021/jacs.0c09383	Yes
Sprague-Piercy, M.A.; Bierma, J.C.; Crosby, M.G.; Carpenter, B.P.; Takahashi, G.R.; Paulino, J.; Hung, I.; Zhang, R.; Kelly, J.E.; Kozlyuk, N.; Chen, X.; Butts, C.T.; Martin, R.W.,	*The Droserasin 1 PSI: A Membrane-Interacting Antimicrobial Peptide from the Carnivorous Plant Drosera capensis*	Biomolecules	10	7	1069	10.3390/biom10071069	Yes
Suchalkin, S.; Ermolaev, M.; Valla, T.; Kipshidze, G.; Smirnov, D.; Moon, S.; Ozerov, M.; Jiang, Z.; Jiang, Y.; Svensson, S.; Sarney, W.; Belenky, G.,	*Dirac energy spectrum and inverted bandgap inmetamorphic InAsSb/InSb superlattices*	Applied Physics Letters	116		32101	10.1063/1.5128634	Yes
Switlicka, A.; Machura, B.; Penkala, M.; Bienko, A.; Bienko, D.C.; Titis, J.; Rajnak, C.; Boca, R.; Ozarowski, A.,	*Slow magnetic relaxation in hexacoordinated cobalt(ii) field-induced single-ion magnets*	Inorganic Chemistry Frontiers	7		2637-2650	10.1039/D0QI00257G	Yes

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Telesio, F.; Hemsworth, N.; Dickerson, W.; Petrescu, M.; Tayari, V.; Yu, O.; Graf, D.E.; Serrano-Ruiz, M.; Caporali, M.; Peruzzini, M.; Carrega, M.; Szkopek, T.; Heun, S.; Gervais, G.,	*Nonclassical Longitudinal Magnetoresistance in Anisotropic Black Phosphorus*	Physica Status Solidi RRL	14	2	1900347	10.1002/pssr.201900347	Yes
Tin, P.; Stavretis, S.E.; Ozerov, M.; Krzystek, J.; Ponomaryov, A.N.; Zvyagin, S.A.; Wosnitza, J.; Chen, C.C.; Chen, P.P.Y.; Telser, J.; Xue, Z.L.,	*Advanced Magnetic Resonance Studies of Tetraphenylporphyrinatoiron(III) Halides*	Applied Magnetic Resonance	51	11	1411-1432	10.1007/s00723-020-01236-8	Yes
Tran, T.T.; Pocs, C.A.; Zhang, Y.; Winiarski, M.J.; Sun, J.; Lee, M.; McQueen, T.M.,	*Spinon excitations in the quasi-one-dimensional S = 1/2 chain compound* $Cs_4CuSb_2Cl_{12}$	Physical Review B	101		235107	10.1103/PhysRevB.101.235107	Yes
Vakaliuk, O.; Werfel, F.; Jaroszynski, J.; Halbedel, B.,	*Trapped field potential of commercial Y-Ba-Cu-O bulk superconductors designed for applications*	Superconductor Science and Technology	33	9	95005	10.1088/1361-6668/ab9fc4	Yes
Vanderlaan, M.; Brumm, T.,	*Supercritical helium expansivity effects on magnet protection*	Advances in Cryogenic Engineering	755		12130	10.1088/1757-899X/755/1/012130	Yes
Vasquez, G.; Wei, K.; Choi, E.S.; Baumbach, R.; Latturner, S.E.,	*Magnesium-Based Flux Growth and Structural Relationships of a Large Family of Tetrelide Semimetals*	Crystal Growth and Design	20		2632–2643	10.1021/acs.cgd.0c00012	Yes
Viciano-Chumillas, M.; Blondin, G.; Clemancey, M.; Krzystek, J.; Ozerov, M.; Armentano, D.; Schnegg, A.; Lohmiller, T.; Telser, J.; Lloret, F.; Cano, J.,	*Single-Ion Magnetic Behaviour in an Iron(III) Porphyrin Complex: A Dichotomy Between High Spin and 5/2–3/2 Spin Admixture*	Chemistry a European Journal	26		14242-14251	10.1002/chem.202003052	Yes
Wang, Q.; Li, W.; Hung, I.; Mentink-Vigier, F.; Wang, X.; Qi, G.; Wang, X.; Gan, Z.; Xu, J.; Deng, F.,	*Mapping the oxygen structure of γ-Al2O3 by high-field solid-state NMR spectroscopy*	Nature Communications	11	1	3620	10.1038/s41467-020-17470-4	Yes
Wang, T.; Li, Z.; Lu, Z.; Li, Y.; Miao, S.; Lian, Z.; Meng, Y.; Blei, M.; Taniguchi, T.; Watanabe, K.; Tongay, S.; Yao, W.; Smirnov, D.; Zhang, C.; Shi, S.,	*Observation of Quantized Exciton Energies in Monolayer WSe2 under a Strong Magnetic Field*	Physical Review X	10		21024	10.1103/PhysRevX.10.021024	Yes
Wang, T.; Miao, S.; Li, Z.; Meng, Y.; Lu, Z.; Lian, Z.; Blei, M.; Taniguchi, T.; Watanabe, K.; Tongay, S.; Smirnov, D.; Shi, S.,	*Giant Valley-Zeeman Splitting from Spin-Singlet and Spin-Triplet Interlayer Excitons in WSe2/MoSe2 Heterostructure*	American Chemical Society Nano Letters	20	1	694	10.1021/acs.nanolett.9b04528	Yes
Weiland, A.; Wei, K.; McCandless, G.T.; Felder, J.B.; Eddy, L.J.; Baumbach, R.; Chan, J.Y.,	*Strongly correlated electron behavior in a new member of the* $A_{n+1}B_nX_{3n+1}$ *homologous series:* $Ce_7Co_6Ge_{19}$	Physical Review Materials	4		74408	10.1103/PhysRevMaterials.4.074408	Yes

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Weiss, J.D.; van der Laan, D.C.; Hazelton, D.; Knoll, A.; Carota, G.; Abraimov, D.V.; Francis, A.; Small, M.A.; Bradford, G.; Jaroszynski, J.J.,	*Introduction of the next generation of CORC® wires with engineering current density exceeding 650 A mm^{-2} at 12 T based on SuperPower"s ReBCO tapes containing substrates of 25 µm thickness*	Superconductor Science and Technology	33	4	44001	10.1088/1361-6668/ab72c6	Yes
Widener, C.; Bone, A.; Ozerov, M.; Richardson, R.; Lu, Z.; Thirunavukkuarasu, K.; Smirnov, D.; Chen, XUE.TAI.; Xue, ZI.LIANG.,	*Direct Observation of Magnetic Transitions in a Nickel(II) complex with Large Anisotropy*	Chinese Journal of Inorganic Chemistry	36	6	1149-1156	10.11862/CJIC.2020.126	Yes
Xin, Y.; Stolt, I.; Song, Y.; Dai, P.; Halperin, W.P.,	*Stripe antiferromagnetism and disorder in the Mott insulator $NaFe_{1-x}Cu_xAs$ ($x\lesssim0.5$)*	Physical Review B	101		64410	10.1103/PhysRevB.101.064410	Yes
Xing, J.; Feng, E.; Liu, Y.; Emmanouilidou, E.; Hu, C.; Liu, J.; Graf, D.E.; Ramirez, A.P.; Chen, G.; Cao, H.; Ni, N.,	*Nèel-type antiferromagnetic order and magnetic field--temperature phase diagram in the spin-1/2 rare-earth honeycomb compound $YbCl_3$*	Physical Review B	102		14427	10.1103/PhysRevB.102.014427	Yes
Xu, K.J.; Chen, S.D.; He, Y.; He, J.; Tang, S.; Jia, C.; Ma, E. Y.; Mo, S.K.; Lu, D.H.; Hashimoto, M.; Devereaux, T. P.; Shen, Z.X.,	*Metallic surface states in a correlated d-electron topological Kondo insulator candidate FeSb2*	Proceedings of the National Academy of Sciences of the USA	117	27	15409-15413	10.1073/pnas.2002361117	Yes
Xu, X.; Peng, X.; Rochester, J.; Lee, J.; Sumption, M.,	*High critical current density in internally-oxidized Nb3Sn superconductors and its origin*	Scripta Materialia	186		317 - 320	10.1016/j.scriptamat.2020.05.043	Yes
Xu, X.; Sumption, M.D.; Lee, J.; Rochester, J.; Peng, X.,	*Persistent compositions of non-stoichiometric compounds with low bulk diffusivity: A theory and application to Nb3Sn superconductors*	Journal of Alloys and Compounds	845		156182	10.1016/j.jallcom.2020.156182	Yes
Yang, H.; Singh, B.; Lu, B.; Huang, C.; Bahrami, F.; Chiu, W.; Graf, D.E.; Huang, S.; Wang, B.; Lin, H.; Torchinsky, D.; Bansil, A.; Tafti, F.,	*Transition from intrinsic to extrinsic anomalous Hall effect in the ferromagnetic Weyl semimetal $PrAlGe_{1-x}Si_x$*	APL Materials	8	1	11111	10.1063/1.5132958	Yes
Yang, J.; Wang, K.; Che, S.; Tuchfeld, Z.J.; Watanabe, K.; Taniguchi, T.; Shcherbakov, D.; Moon, S.; Smirnov, D.; Chen, R.; Bockrath, M.; Lau, C.,	*Equilibration and filtering of quantum Hall edge states in few-layer black phosphorus*	Physical Review Materials	4		114008	10.1103/PhysRevMaterials.4.114008	Yes
Yang, M.; Robert, C.; Lu, Z.; Van Tuan, D.; Smirnov, D.; Marie, X.; Dery, H.,	*Exciton valley depolarization in monolayer transition-metal dichalcogenides*	Physical Review B	101		115307	10.1103/PhysRevB.101.115307	Yes

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Yuan Huang, K.; Shi, Y.; Srpcic, J.; D Ainslie, M.; Kumar Namburi, D.; R Dennis, A.; Zhou, D.; Boll, M.; Filipenko, M.; Jaroszynski, J.; Hellstrom, E.; A Cardwell, D.; Hay Durrell, J.,	*Composite stacks for reliable > 17 T trapped fields in bulk superconductor magnets*	Superconductor Science and Technology	33		103471	10.1088/1361-6668/ab5e12	Yes
Yuan, X.; Zhang, C.; Zhang, Y.; Yan, Z.; Lyu, T.; Zhang, M.; Li, Z.; Song, S.; Zhao, M.; Leng, P.; Ozerov, M.; Chen, X.; Wang, N.; Shi, Y.; Yan, H.; Xiu, F.,	*The discovery of dynamic chiral anomaly in a Weyl semimetal NbAs*	Nature Communications	11		1259	10.1038/s41467-020-14749-4	Yes
Zhang, S.; Chappell, G.L.; Pouse, N.; Baumbach, R.; Maple, M.B.; Greene, L.H.; Park, W.K.,	*Origin of gaplike behaviors in URu_2Si_2: Combined study via quasiparticle scattering spectroscopy and resistivity measurements*	Physical Review B: Rapid Comm/ Letters	102	8	81101	10.1103/PhysRevB.102.081101	Yes
Zheng, W.; Schoenemann, R.U.; Mozaffari, S.; Chiu, Y.C.; Goraum, Z.B.; Aryal, N.; Manousakis, E.; Siegrist, T.M.; Wei, K.; Balicas, L.,	*Bulk Fermi surfaces of the Dirac type-II semimetallic candidate $NiTe_2$*	Physical Review B	102		125103	10.1103/PhysRevB.102.125103	Yes
Zhu, Y.; Gui, X.; Wang, Y.; Graf, D.E.; Xie, W.; Hu, J.; Mao, Z.,	*Evidence from transport measurements for YRh_6Ge_4 being a triply degenerate nodal semimetal*	Physical Review B	101		35133	10.1103/PhysRevB.101.035133	Yes
Zhu, Y.; Singh, B.; Wang, Y.; Huang, C.; Chiu, W.; Wang, B.; Graf, D.E.; Zhang, Y.; Lin, H.; Sun, J.; Bansil, A.; Mao, Z.,	*Exceptionally large anomalous Hall effect due to anticrossing of spin-split bands in the antiferromagnetic half-Heusler compound TbPtBi*	Physical Review B: Rapid Comm/ Letters	101		161105	10.1103/PhysRevB.101.161105	Yes
Zolnhofer, E.M.; Wijeratne, G.B.; Jackson, T.A.; Fortier, S.; Heinemann, F.W.; Meyer, K.; Krzystek, J.; Ozarowski, A.; Mindiola, D.J.; Telser, J.,	*Electronic structure and magnetic properties of a titanium(II) coordination complex*	Inorganic Chemistry	59	9	6187-6201	10.1021/acs.inorgchem.0c00311	Yes

Publications generated by facilities: EMR Facility at FSU (43)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
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Aryal, C.; Bui, N.N.; Khadka, N.K.; Song, L.; Pan, J.P.,	*The helix 0 of endophilin modifies membrane material properties and induces local curvature*	Biochimica et Biophysica Acta Biomembranes	1862	10	183397	10.1016/j.bbamem.2020.183397	Yes

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Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Bindra, J.; Singh, K.; van Tol, J.; Dalal, N.; Strouse, G.,	*Spin Dynamics in Mn: ZnSe Quantum Dots: A Pulsed High-Frequency EPR Study*	Journal of Physical Chemistry C	124	35	19348--19354	10.1021/acs.inorgchem.0c01231	Yes
Bone, A.N.; Stavretis, S.E.; Krzystek, J.; Liu, Z.; Chen, Q.; Gai, Z.; Wang, X.; Steren, C.A.; Powers, X.B.; Podlesnyak, A.A.; Chen, X.T.; Telser, J.; Zhou, H.; Xue, Z.L.,	*Manganese tetraphenylporphyrin bromide and iodide. Studies of structures and magnetic properties*	Polyhedron	184		114488	10.1016/j.poly.2020.114488	Yes
Chakarawet, K.; Atanasov, M.E.; Marbey, J.; Bunting, P.C.; Neese, F.; Hill, S.; Long, J.R.,	*Strong Electronic and Magnetic Coupling in M_4 (M = Ni, Cu) Clusters via Direct Orbital Interactions Between Low-Coordinate Metal Centers*	Journal of the American Chemical Society	142		19161-19169	10.1021/jacs.0c08460	Yes
Chen, J.; Hu, C.; Stanton, J.F.; Hill, S.; Cheng, H.; Zhang, X.,	*Decoherence in Molecular Electron Spin Qubits: Insights from Quantum Many-Body Simulations*	Journal of Physical Chemistry Letters	11	0	2074-2078	10.1021/acs.jpclett.0c00193	Yes
Das Gupta, S.; Stewart, R.; Chen, D.; Abboud, K.A.; Cheng, H.P.; Hill, S.; Christou, G.,	*Long-Range Ferromagnetic Exchange Interactions Mediated by Mn-Ce^{IV}-Mn Superexchange Involving Empty 4f Orbitals*	Inorganic Chemistry	59	13	8716-8726	10.1021/acs.inorgchem.0c00332	Yes
Fataftah, M.S.; Bayliss, S.L.; Laorenza, D.W.; Wang, X.; Phelan, B.T.; Wilson, C.B.; Mintun, P.J.; Kovos, B.D.; Wasielewski, M.R.; Han, S.; Sherwin, M.S.; Awschalom, D.D.; Freedman, D.E.,	*Trigonal Bipyramidal V^{3+} Complex as an Optically AddressableMolecular Qubit Candidate*	Journal of the American Chemical Society	142		20400-20408	10.1021/jacs.0c08986	Yes
Fleming, C.; Chung, D.; Ponce, S.; Brook, D. J. R.; DaRos, J.; Das, R.; Ozarowski, A.; Stoian, S.,	*Valence tautomerism in a cobalt-verdazyl coordination compound*	Chemical Communications	56	32	4400-4403	10.1039/d0cc01770a	Yes
Goodwin, C.A.P.; Giansiracusa, M.J.; Greer, S.M.; Nicholas, H.M.; Evans, P.; Vonci, M.; Hill, S.; Chilton, N.F.; Mills, D.P.,	*Isolation and electronic structures of derivatized manganocene, ferrocene and cobaltocene anions*	Nature Chemistry	13		243-248	10.1038/s41557-020-00595-w	Yes
Greer, S.; Gramigna, K.; Thomas, C.; Stoian, S.; Hill, S.,	*Insights into Molecular Magnetism in Metal-Metal Bonded Systems as Revealed by a Spectroscopic and Computational Analysis of Diiron Complexes*	Inorganic Chemistry	59		18141-18155	10.1021/acs.inorgchem.0c02605	Yes
Gumerova, N.I.; Roller, A.; Giester, G.; Krzystek, J.; Cano, J.; Rompel, A.,	*Incorporation of Cr(III) into a Keggin polyoxometalate as a chemical strategy to stabilize a labile CrIIIO4 tetrahedral conformation and promote unattended single-ion magnet properties*	Journal of the American Chemical Society	142	7	3336-3339	10.1021/jacs.9b12797	Yes

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Impert, O.; Kozakiewicz, A.; Wrzeszcz, G.; Katafias, A.; Bienko, A.; van Eldik, R.; Ozarowski, A.,	*Characterization of a Mixed-Valence Ru(II)/Ru(III) Ion-Pair Complex. Unexpected High-Frequency Electron Paramagnetic Resonance Evidence for Ru(III)/Ru(III) Dimer Coupling*	Inorganic Chemistry	59		8609-8619	10.1021/acs.inorgchem.0c01068	Yes
Jackson, C.E.; Lin, C.; van Tol, J.; Zadrozny, J.M.,	*Orientation dependence of phase memory relaxation in the V(IV) ion at high frequencies*	Chemical Physics Letters	739		137034	10.1016/j.cplett.2019.137034	Yes
Jaiswal, M.; Tran, T.T.; Li, Q.; Yan, X.; Zhou, M.; Kundu, K.; Fanucci, G.E.; Guo, Z.,	*A metabolically engineered spin-labeling approach for studying glycans on cells*	Chemical Science	11	46	12522-12532	10.1039/D0SC03874A	Yes
Kaniewska, K.; Ponikiewski, Ł.; Szynkiewicz, N.; Cieślik, B.; Pikies, J.; Krzystek, J.; Dragulescu-Andrasi, A.; Stoian, S.A.; Grubba, R.,	*Homoleptic mono-, di-, and tetra-iron complexes featuring phosphido ligands: a synthetic, structural, and spectroscopic study*	Dalton Transactions	49		10091-10103	10.1039/D0DT01503B	Yes
Kinyon, J.S.; Clark, R.; Dalal, N.S.; Wang, Z.; van Tol, J.; Rakvin, B.,	*High-frequency EPR study of the unusual multiferroic NH_4CuCl_3*	Polyhedron	177		114255	10.1016/j.poly.2019.114255	Yes
Krzystek, J.; Schnegg, A.; Aliabadi, A.; Holldack, K.; Stoian, S.A.; Ozarowski, A.; Hicks, S.D.; Abu-Omar, M.M.; Thomas, K.E.; Gosh, A.; Caulfield, K.P.; Tonzetich, Z.J.; Telser, J.,	*Advanced paramagnetic resonance studies on manganese and iron corroles with a formal d4 electron count*	Inorganic Chemistry	59	2	1075-1090	10.1021/acs.inorgchem.9b02635	Yes
Kumar, P.; SantaLucia, D.J.; Kaniewska-Laskowska, K.; Lindeman, S.V.; Ozarowski, A.; Krzystek, J.; Ozerov, M.; Telser, J.; Berry, J.F.; Fiedler, A.T.,	*Probing the Magnetic Anisotropy of Co(II) Complexes Featuring Redox-Active Ligands*	Inorganic Chemistry	59	22	16178-16193	10.1021/acs.inorgchem.0c01812	Yes
Lee, I.; Utermohlen, F.G.; Weber, D.; Hwang, K.; Zhang, C.; van Tol, J.; Goldberger, J.E.; Trivedi, N.; Hammel, P.C.,	*Fundamental Spin Interactions Underlying the Magnetic Anisotropy in the Kitaev Ferromagnet CrI3*	Physical Review Letters	124	1	17201	10.1103/PhysRevLett.124.017201	Yes
Li, J.; Yin, L.; Xiong, S.; Wu, X.; Yu, F.; Ouyang, Z.; Xia, Z.; Zhang, Y.; van Tol, J.; Song, Y.; Wang, Z.,	*Controlling Electron Spin Decoherence in Nd-based Complexes via Symmetry Selection*	iScience	23	3	100926	10.1016/j.isci.2020.100926	Yes
Liu, J.L.; Pedersen, K.; Greer, S.; Oyarzabal, I.; Mondal, A.; Hill, S.; Wilhelm, F.; Rogalev, A.; Tressaud, A.; Durand, E.; Long, J.; Clerac, R.,	*Access to Heteroleptic Fluorido-Cyanido Complexes with a Large Magnetic Anisotropy via Fluoride Abstraction*	Angewandte Chemie	59		10306-10310	10.1002/ange.201914934	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Manson, J. L.; Manson, Z. E.; Sargent, A.; Villa, D. Y.; Etten, N. L.; Blackmore, W. J.; Curley, S. P.; Williams, R. C.; Brambleby, J.; Goddard, P. A.; Ozarowski, A.; Wilson, M. N.; Huddart, B. M.; Lancaster, T.; Johnson, R. D.; Blundell, S. J.; Bendix, J.; Wheeler, K. A.; Lapidus, S. H.; Xiao, F.; Birnbaum, S.M.; Singleton, J.,	*Enhancing easy-plane anisotropy in bespoke Ni(II) quantum magnets*	Polyhedron	180		114379	10.1016/j.poly.2020.114379	Yes
Obaleye, J.; Ajibola, A.; Bernardus, V.; Hosten, E.C.; Ozarowski, A.,	*Synthesis, spectroscopic, structural and antimicrobial studies of a dimeric complex of copper(II) with trichloroacetic acid and metronidazole*	Inorganica Chimica Acta	503		119404	10.1016/j.ica.2019.119404	Yes
Palacios, M.A.; Díaz-Ortega, I.F.; Nojiri, H.; Suturina, E.A.; Ozerov, M.; Krzystek, J.; Colacio, E.,	*Tuning magnetic anisotropy by the π-bonding features of the axial ligands and the electronic effects of gold(I) atoms in 2D $\{Co(L)_2[Au(CN)_2]_2\}_n$ metal-organic frameworks with field-induced single-ion behavior*	Inorganic Chemistry Frontiers	7		4611-4630	10.1039/D0QI00996B	Yes
Plugis, N.M.; Rudd, N.D.; Krzystek, J.; Swenson, D.C.; Telser, J.; Larrabee, J.A.,	*Cobalt(II) scorpionate complexes as models for cobalt-substituted zinc enzymes: electronic structure investigation by magnetic circular dichroism*	Journal of Inorganic Biochemistry	203		110876	10.1016/j.jinorgbio.2019.110876	Yes
Premuzic, D.; Holynska, M.; Ozarowski, A.; Pietzonka, C.; Roseborough, A.; Stoian, S.A.,	*Model Dimeric Manganese(IV) Complexes Featuring Terminal Tris-hydroxotetraazaadamantane and Various Bridging Ligands*	Inorganic Chemistry	59	15	10768-10784	10.1021/acs.inorgchem.0c01242	Yes
Reinholdt, A.; Pividori, D.; Laughlin, A.L.; DiMucci, I.M.; MacMillan, S.N.; Jafari, M.G.; Gau, M.R.; Carroll, P.J.; Krzystek, J.; Ozarowski, A.; Telser, J.; Lancaster, K.M.; Meyer, K.; Mindiola, D.J.,	*A mononuclear and high-spin tetrahedral Ti(II) complex*	Inorganic Chemistry	59	24	17834–17850	10.1021/acs.inorgchem.0c02586	Yes
Rõõm, T.; Viirok, J.; Peedu, L.; Nagel, U.; Farkas, D.G.; Szaller, D.; Kocsis, V.; Bordács, S.; Kézsmárki, I.; Kamenskyi, D.L.; Engelkamp, H.; Ozerov, M.; Smirnov, D.; Krzystek, J.; Thirunavukkuarasu, K.; Ozaki, Y.; Tomioka, Y.; Ito, T.; Datta, T.; Fishman, R.S.,	*Magnetoelastic distortion of multiferroic BiFeO3 in the canted antiferromagnetic state*	Physical Review B	102		214410	10.1103/PhysRevB.102.214410	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Saber, M.R.; Thirunavukkuarasu, K.; Greer, S.; Hill, S.; Dunbar, K.R.,	*Magneto-Structural and EPR Studies of Anisotropic Vanadium trans-Dicyanide Molecules*	Inorganic Chemistry	59	18	13262-13269	10.1021/acs.inorg-chem.0c01595	Yes
Sanakis, Y.; Krzystek, J.; Maganas, D.; Grigoropoulos, A.; Ferentinos, E.; Kostakis, M.G.; Petroulea, V.; Pissas, M.; Thirunavukkuarasu, K.; Wernsdorfer, F.; Neese, W.; Kyritsis, P.,	*Magnetic Properties and Electronic Structure of the S = 2 Complex [Mn(III)(OPPh2)2N3] Showing Field-Induced Slow Magnetization Relaxation*	Inorganic Chemistry	59	18	13281-13294	10.1021/acs.inorg-chem.0c01636	Yes
Sanakis, Y.; Pisas, M.; Krzystek, J.; Ozarowski, A.; Telser, J.; Raptis, R.G.,	*Ferromagnetically-coupled, triangular [Bu4N]2[Cu3(μ3-Br)2(μ-4-O2N-pz)3Br3 complex revisited: The effect of coordinated halides on spin relaxation properties*	Polyhedron	177		114258	10.1016/j.poly.2019.114258	Yes
Sarkis, C.L.; Rau, J.G.; Sanjeewa, L.D.; Powell, M.; Kolis, J.; Marbey, J.; Hill, S.; Rodriguez-Rivera, J.A.; Nair, H.S.; Yahne, D.R.; Säubert, S.; Gingras, M.J.P.; Ross, K.A.,	*Unravelling competing microscopic interactions at a phase boundary: A single-crystal study of the metastable antiferromagnetic pyrochlore* $Yb_2Ge_2O_7$	Physical Review B	102		134418	10.1103/PhysRevB.102.134418	Yes
Soler, M.; Mahalay, P.; Wernsdorfer, W.; Lubert-Perquel, D.V.; Huffman, J.C.; Abboud, K.A.; Hill, S.; Christou, G.,	*Extending the family of reduced* $[Mn_{12}O_{12}(O_2CR)_{16}(H_2O)_x]^{n-}$ *complexes, and their sensitivity to environmental factors*	Polyhedron	195		114968	10.1016/j.poly.2020.114968	Yes
Stetsiuk, O.; Plyuta, N.; Avarvari, N.; Goreshnik, E.; Kokozay, N.; Petrusenko, S.; Ozarowski, A.,	*Mn(III) Chain Coordination Polymers Assembled by Salicylidene-2-ethanolamine Schiff Base Ligands: Synthesis, Crystal Structures, and HFEPR Study*	Crystal Growth and Design	20	3	1491-1502	10.1021/acs.cgd.9b01150	Yes
Switlicka, A.; Machura, B.; Penkala, M.; Bienko, A.; Bienko, D.C.; Titis, J.; Rajnak, C.; Boca, R.; Ozarowski, A.,	*Slow magnetic relaxation in hexacoordinated cobalt(ii) field-induced single-ion magnets*	Inorganic Chemistry Frontiers	7		2637-2650	10.1039/D0QI00257G	Yes
Teixeira, F.J.; Flores, L.S.; Escobar, L.B.L.; dos Santos, T.C.; Yoshida, M.I.; Reis, M.S.; Hill, S.; Ronconi, C.M.; Corrêa, C.C.,	*3D interpenetrated Co(II) coordination polymer: synthesis, crystal structure, magnetic and adsorption properties*	Inorganica Chimica Acta	511		119791	10.1016/j.ica.2020.119791	Yes
Tin, P.; Stavretis, S.E.; Ozerov, M.; Krzystek, J.; Ponomaryov, A.N.; Zvyagin, S.A.; Wosnitza, J.; Chen, C.C.; Chen, P.P.Y.; Telser, J.; Xue, Z.L.,	*Advanced Magnetic Resonance Studies of Tetraphenylporphyrinatoiron(III) Halides*	Applied Magnetic Resonance	51	11	1411-1432	10.1007/s00723-020-01236-8	Yes
Vaidya, P.; Morley, S.A.; van Tol, J.; Liu, Y.; Cheng, R.; Brataas, A.; Lederman, D.; del Barco, E.,	*Subterahertz spin pumping from an insulating antiferromagnet*	Science	368	6487	160--165	10.1126/science.aaz4247	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Viciano-Chumillas, M.; Blondin, G.; Clemancey, M.; Krzystek, J.; Ozerov, M.; Armentano, D.; Schnegg, A.; Lohmiller, T.; Telser, J.; Lloret, F.; Cano, J.,	*Single-Ion Magnetic Behavior in an Iron(III) Porphyrin Complex: A Dichotomy Between High Spin and 5/2–3/2 Spin Admixture*	Chemistry a European Journal	26		14242-14251	10.1002/chem.202003052	Yes
Williams, R.C.; Blackmore, W.J.; Curley, S.P.; Lees, M.R.; Birnbaum, S.M.; Singleton, J.; Huddart, B.M.; Hicken, T.J.; Lancaster, T.; Blundell, S.J.; Xiao, F.; Ozarowski, A.; Pratt, F.L.; Voneshan, D.J.; Giguchia, Z.; Baines, C.; Schlueter, J.A.; Villa, D.Y.; Manson, J.L.; Goddard, P.A.,	*Near-ideal molecule-based Haldane spin chain*	Physical Review Research	2		13082	10.1103/PhysRevResearch.2.013082	Yes
Wojnar, M. K.; Laorenza, D. W.; Schaller, R. D.; Freedman, D. E.,	*Nickel(II) Metal Complexes as Optically Addressable Qubit Candidates*	Journal of the American Chemical Society	142		14826-14830	10.1021/jacs.0c06909	Yes
Zolnhofer, E.M.; Wijeratne, G.B.; Jackson, T.A.; Fortier, S.; Heinemann, F.W.; Meyer, K.; Krzystek, J.; Ozarowski, A.; Mindiola, D.J.; Telser, J.,	*Electronic structure and magnetic properties of a titanium(II) coordination complex*	Inorganic Chemistry	59	9	6187-6201	10.1021/acs.inorgchem.0c00311	Yes

High B/T

Publications generated by facilities: High B/T Facility at UF (1)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Huan, C.; Adams, J.; Lewkowitz, M.; Masuhara, N.; Candela, D.; Sullivan, N.S.,	NMR Studies of the Dynamics of 1D 3He in 4He Plated MCM-41	Journal of Low Temperature Physics	201		146	10.1007/s10909-020-02358-w	Yes

ICR

Publications generated by facilities: ICR Facility at FSU (52)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Acevedo, N.; Moulian, R.; Chacon Patino, M.L.; Mejia, A.; Radji, S.; Daridon, J.L.; Barrère-Mangote, C.; Giusti, P.; Rodgers, R.P.; Piscitelli, V.; Castillo, J.; Carrier, H.; Bouyssiere, B.,	*Understanding Asphaltene Fraction Behavior through Combined Quartz Crystal Resonator Sensor, FT-ICR MS, GPC ICP HR-MS, and AFM Characterization. Part I: Extrography Fractionations*	Energy and Fuels	34	11	13903-13915	10.1021/acs.energyfuels.0c02687	Yes
Ballard, D.A.; Chacon Patino, M.L.; Qiao, P.; Roberts, K.J.; Rae, R.;	*Molecular Characterization of Strongly and Weakly*	Energy and Fuels	34	11	13966-13976	10.1021/acs.energyfuels.0c02752	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Dowding, P.J.; Xu, Z.; Harbottle, D.,	*Interfacially Active Asphaltenes by High-Resolution Mass Spectrometry*						
Bowman, A.P.; Blakney, G.T.; Hendrickson, C.L.; Ellis, S.R.; Heeren, R.M.A.; Smith, D.F.,	*Ultra-High Mass Resolving Power, Mass Accuracy, and Dynamic Range MALDI Mass Spectrometry Imaging by 21-T FT-ICR MS*	Analytical Chemistry	92	4	3133-3142	10.1021/acs.analchem.9b04768	Yes
Casas-Ruiz, J.P.; Spencer, R.G.M.; Guillemette, F.; von Schiller, D.; Obrador, B.; Podgorski, D.C.; Kellerman, A.M.; Hartmann, J.; Gomez-Gener, L.; Sabater, S.; Marce, R.,	*Delineating the Continuum of Dissolved Organic Matter in Temperate River Networks*	Global Biogeochemical Cycles	34	8	e2019GB006495	10.1029/2019GB006495	Yes
Chacon Patino, M.L.; Moulian, R.; Barrère-Mangote, C.; Putman, J.; Weisbrod, C.; Blakney, G.T.; Bouyssiere, B.; Rodgers, R.P.; Giusti, P.,	*Compositional Trends for Total Vanadium Content and Vanadyl Porphyrins in Gel Permeation Chromatography Fractions Reveal Correlations Between Asphaltene Aggregation and Ion Production Efficiency in Atmospheric Pressure Photoionization*	Energy and Fuels	34	12	16158-16172	10.1021/acs.energyfuels.0c03349	Yes
Chacon Patino, M.L.; Niles, S.; Marshall, A.G.; Hendrickson, C.L.; Rodgers, R.P.,	*Role of Molecular Structure in the Production of Water-Soluble Species by Photo-oxidation of Petroleum*	Environmental Science and Technology	54	16	9968-9979	10.1021/acs.est.0c01158	Yes
Chacon Patino, M.L.; Smith, D.F.; Hendrickson, C.L.; Marshall, A.G.; Rodgers, R.P.,	*Advances in Asphaltene Petroleomics. Part 4. Compositional Trends of Solubility Subfractions Reveal that Polyfunctional Oxygen-Containing Compounds Drive Asphaltene Chemistry*	Energy and Fuels	34	3	3013-3030	10.1021/acs.energyfuels.9b04288	Yes
Cheng, F.; Dehghanizadeh, M.; Audu, M.A.; Jarvis, J.M.; Holguin, O.; Brewer, C.E.,	*Characterization and Evaluation of Guayule Processing Residues as Potential Feedstock for Biofuel and Chemical Production*	Industrial Crops and Products	150		112311	10.1016/j.indcrop.2020.112311	Yes
Cui, Z.; Cheng, F.; Jarvis, J.M.; Brewer, C.E.; Jena, U.,	*Roles of Co-solvents in Hydrothermal Liquefaction of Low-Lipid, High-Protein Algae*	Bioresource Technology	310		123454	10.1016/j.biortech.2020.123454	Yes
Dehghanizadeh, M.; Cheng, F.; Jarvis, J.M.; Holguin, F.O.; Brewer, C.E.,	*Characterization of Resin Extracted from Guayule (Parthenium Argentatum): A Dataset Including GC-MS and FT-ICR MS*	Data in Brief	31		105989	10.1016/j.dib.2020.105989	Yes
Drake, T.W.; Podgorski, D.C.; Dinga, B.; Chanton, J.P.; Six, J.; Spencer, R.G.M.,	*Land-use Controls on Carbon Biogeochemistry in Lowland Streams of the Congo Basin*	Global Change Biology	26	3	1374-1389	10.1111/gcb.14889	Yes
Fathabad, S.G.; Tabatabai, B.; Walker, D.; Chen, H.; Lu, J.; Aslan, K.; Uddin, J.; Ghann, W.; Sitther, V.,	*Impact of Zero-Valent Iron Nanoparticles on Fremyella diplosiphon Transesterified Lipids and Fatty Acid Methyl Esters*	American Chemical Society Omega	5		12166-12173	10.1021/acsomega.0c00566	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Fellman, J.B.; Hood, E.; Behnke, M.I.; Welker, J.M.; Spencer, R.G.M.,	*Stormflows Drive Stream Carbon Concentration, Speciation and Dissolved Organic Matter Composition in Coastal Temperate Rainforest Watersheds*	Journal of Geophysical Research Biogeosciences	125		e2020JG005804	10.1029/2020JG005804	Yes
Glattke, T.; Chacon Patino, M.L.; Marshall, A.G.; Rodgers, R.P.,	*Molecular Characterization of Photochemically Produced Asphaltenes via Photooxidation of Deasphalted Crude Oils*	Energy and Fuels	34	11	14419-14428	10.1021/acs.energyfuels.0c02654	Yes
He, L.; Rockwood, A.L.; Agarwal, A.M.; Anderson, L.C.; Weisbrod, C.; Hendrickson, C.L.; Marshall, A.G.,	*Top-down proteomics—A Near-future Technique for Clinical Diagnosis*	Annals of Translational Medicine	8	4	136	10.21037/atm.2019.12.67	Yes
Johansen, C.; Marcelloni, L.; Natter, M.; Silva, M.; Woosley, M.; Woolsey, A.; Diercks, A.R.; Hill, J.; Viso, R.; Marty, E.; Lobodin, V.V.; Shedd, W.; Joye, S.B.; MacDonald, I.R.,	*Hydrocarbon Migration Pathway and Methane Budget for a Gulf of Mexico Natural Seep Site: Green Canyon 600*	Earth and Planetary Science Letters	545	1	116411	10.1016/j.epsl.2020.116411	Yes
Johnston, S.E.; Striegl, R.G.; Bogard, M.J.; Dornblaser, M.M.; Butman, D.E.; Kellerman, A.M.; Wickland, K.P.; Podgorski, D.C.; Spencer, R.G.M.,	*Hydrologic Connectivity Determines Dissolved Organic Matter Biogeochemistry in Northern High-latitude Lakes*	Limnology and Oceanography	65	8	1764-1780	10.1002/lno.11417	Yes
Kujawinski, E.B.; Reddy, C.M.; Rodgers, R.P.; Thrash, J.C.; Valentine, D.L.; White, H.K.,	*The First Decade of Scientific Insights from the Deepwater Horizon Oil Release*	Nature Reviews Earth and Environment	1		237-250	10.1038/s43017-020-0046-x	Yes
Kurek, M.R.; Poulin, B.A.; McKenna, A.M.; Spencer, R.G.M.,	*Deciphering Dissolved Organic Matter: Ionization, Dopant, and Fragmentation Insights via Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry*	Environmental Science and Technology	54	24	16249-16259	10.1021/acs.est.0c05206	Yes
Leewis, M.C.; Berlemont, R.; Podgorski, D.C.; Srinivas, A.; Zito, P.; Spencer, R.G.M.; McFarland, J.; Douglas, T.A.; Conaway, C.H.; Waldrop, M.; Mackelprang, R.,	*Life at the Frozen Limit: Microbial Carbon Metabolism Across a Late Pleistocene Permafrost Chronosequence*	Frontiers in Microbiology	11		1753	10.3389/fmicb.2020.01753	Yes
Letourneau, M.L.; Hopkinson, B.M.; Fitt, W.K.; Medeiros, P.M.,	*Molecular composition and biodegradation of loggerhead sponge Spheciospongia vesparium exhalent dissolved organic matter*	Marine Environmental Research	162		105130	10.1016/j.marenvres.2020.105130	Yes
Li, R.; Zhang, Z.; Chen, H.; McKenna, A.M.; Chen, G.; Li, L.; Tang, Y.,	*Speciation and Conversion of Carbon and Nitrogen in Young Landfill Leachate During Anaerobic Biological Pretreatment*	Waste Management	106		88-98	10.1016/j.wasman.2020.03.011	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Liberatore, H.K.; Westerman, D.C.; Allen, J.M.; Plewa, M.J.; Wagner, E.D.; McKenna, A.M.; Weisbrod, C.; McCord, J.P.; Liberatore, R.J.; Burnett, D.B.; Cizmas, L.H.; Richardson, S.D.,	*High-Resolution Mass Spectrometry Identification of Novel Surfactant-Derived Sulfur-Containing Disinfection By-Products from Gas Extraction Wastewater*	Environmental Science and Technology	54	15	9374-9386	10.1021/acs.est.0c01997	Yes
Liu, P.; Gao, X.; Lundin, V.; Shi, C.; Adem, Y.; Lin, K.; Jiang, G.; Kao, Y.H.; Yang, F.; Michels, D.; Marshall, A.G.; Zhang, H.M.,	*Probing the Impact of the Knob-into-Hole Mutations on the Structure and Function of a Therapeutic Antibody*	Analytical Chemistry	92	1	1582-1588	10.1021/acs.analchem.9b04855	Yes
McDonough, L.K.; O'Carroll, D.M.; Meredith, K.; Andersen, M.S.; Brügger, C.; Huang, H.; Rutlidge, H.; Behnke, M.I.; Spencer, R.G.M.; McKenna, A.M.; Marjo, C.E.; Oudone, P.; Baker, A.,	*Changes in Groundwater Dissolved Organic Matter Character in a Coastal Sand Aquifer Due to Rainfall Recharge*	Water Research	169		115201	10.1016/j.watres.2019.115201	Yes
McDonough, L.K.; Rutlidge, H.; O'Carroll, D.M.; Andersen, M.S.; Meredith, K.; Behnke, M.I.; Spencer, R.G.M.; McKenna, A.M.; Marjo, C.E.; Oudone, P.; Baker, A.,	*Characterisation of Shallow Groundwater Dissolved Organic Matter in Aeolian, Alluvial and Fractured Rock Aquifers*	Geochimica et Cosmochimica Acta	273		163-176	10.1016/j.gca.2020.01.022	Yes
Moulian, R.; Chacon Patino, M.L.; Lacroix-Andrivet, O.; Mounicou, S.; Mendes-Siqueira, A.L.; Afonso, C.; Rodgers, R.P.; Giusti, P.; Bouyssiere, B.; Barrère-Mangote, C.,	*Speciation of Metals in Asphaltenes by High-performance Thin-layer Chromatography and Solid-liquid Extraction Hyphenated with Elemental and Molecular Identification*	Energy and Fuels	34	10	12449-12456	10.1021/acs.energyfuels.0c02525	Yes
Moulian, R.; Le Maitre, J.; Leroy, H.; Rodgers, R.P.; Bouyssiere, B.; Afonso, C.; Giusti, P.; Barrère-Mangote, C.,	*Chemical Characterization Using Different Analytical Techniques to Understand Processes: The Case of the Paraffinic Base Oil Production Line*	Processes	8	11	1472	10.3390/pr8111472	Yes
Niles, S.; Chacon Patino, M.L.; Marshall, A.G.; Rodgers, R.P.,	*Molecular Composition of Photooxidation Products Derived from Sulfur-Containing Compounds Isolated from Petroleum Samples*	Energy and Fuels	34	11	14493-14504	10.1021/acs.energyfuels.0c02869	Yes
Niles, S.; Chacon Patino, M.L.; Putnam, S.P.; Rodgers, R.P.; Marshall, A.G.,	*Characterization of an Asphalt Binder and Photoproducts by Fourier Transform Ion Cyclotron Resonance Mass Spectrometry Reveals Abundant Water-Soluble Hydrocarbons*	Environmental Science and Technology	54	24	8830-8836	10.1021/acs.est.0c02263	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Niles, S.; Chacon Patino, M.L.; Smith, D.F.; Rodgers, R.P.; Marshall, A.G.,	*Comprehensive Compositional and Structural Comparison of Coal and Petroleum Asphaltenes Based on Extrography Fractionation Coupled with Fourier Transform Ion Cyclotron Resonance MS and MS/MS Analysis*	Energy and Fuels	34	2	1492-1505	10.1021/acs.energyfuels.9b03527	Yes
Putman, J.; Moulian, R.; Barrère-Mangote, C.; Rodgers, R.P.; Bouyssiere, R.; Giusti, P.; Marshall, A.G.,	*Probing Aggregation Tendencies in Asphaltenes by Gel Permeation Chromatography. Part 1: Online Inductively Coupled Plasma Mass Spectrometry and Offline Fourier Transform Ion Cyclotron Resonance Mass Spectrometry*	Energy and Fuels	34	7	8308-8315	10.1021/acs.energyfuels.0c01522	Yes
Putman, J.; Moulian, R.; Smith, D.F.; Weisbrod, C.; Chacon Patino, M.L.; Corilo, Y.E.D.; Blakney, G.T.; Rumancik, L.E.; Barrère-Mangote, C.; Rodgers, R.P.; Giusti, P.; Marshall, A.G.; Bouyssiere, B.,	*Probing Aggregation Tendencies in Asphaltenes by Gel Permeation Chromatography. Part 2: Online Detection by Fourier Transform Ion Cyclotron Resonance Mass Spectrometry and Inductively Coupled Plasma Mass Spectrometry*	Energy and Fuels	34	9	10915-10925	10.1021/acs.energyfuels.0c02158	Yes
Rodriguez-Cardona, B.M.; Coble, A.A.; Wymore, A.S.; Kolosov, R.; Podgorski, D.C.; Zito, P.; Spencer, R.G.M.; Prokushkin, A.S.; McDowell, W.H.,	*Wildfires Lead to Decreased Carbon and Increased Nitrogen Concentrations in Upland Arctic Streams*	Scientific Reports	10		8722	10.1038/s41598-020-65520-0	Yes
Schaffer, L.V.; Anderson, L.C.; Butcher, D.S.; Shortreed, M.R.; Miller, R.M.; Pavelec, C.; Smith, L.M.,	*Construction of Human Proteoform Families from 21 Tesla Fourier Transform Ion Cyclotron Resonance Mass Spectrometry Top-Down Proteomic Data*	Journal of Proteome Research	20	1	317-325	10.1021/acs.jproteome.0c00403	Yes
Sert, M.F.; D'Andrilli, J.; Gründger, F.; Niemann, H.; Granskog, M.A.; Pavlov, A.K.; Ferré, B.; Silyakova, A.,	*Compositional Differences in Dissolved Organic Matter Between Arctic Cold Seeps Versus Non-Seep Sites at the Svalbard Continental Margin and the Barents Sea*	Frontiers in Earth Science	8		599	10.3389/feart.2020.552731	Yes
Smith, D.F.; Blakney, G.T.; Beu, S.C.; Anderson, L.C.; Weisbrod, C.D.; Hendrickson, C.L.,	*Ultrahigh Resolution Ion Isolation by Stored Waveform Inverse Fourier Transform 21 T Fourier Transform Ion Cyclotron Resonance Mass Spectrometry*	Analytical Chemistry	92	4	3213-3219	10.1021/acs.analchem.9b04954	Yes
Srzentić, K., et all	*Inter-laboratory Study for Characterizing Monoclonal Antibodies by Top-Down and Middle-Down Mass Spectrometry*	Journal of the American Society for Mass Spectrometry	31	9	1783-1802	10.1021/jasms.0c00036	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Takemori, A.; Butcher, D.S.; Harman, V.M.; Brownbridge, P.; Shima, K.; Higo, D.; Ishizaki, J.; Hasegawa, H.; Suzuki, J.; Yamashita, M.; Loo, J.A.; Ogorzalek, R.R.; Beynon, R.J.; Anderson, L.C.; Takemori, N.,	*PEPPI-MS: Polyacrylamide Gel-based Prefractionation for Analysis of Intact Proteoforms and Protein Complexes by Mass Spectrometry*	Journal of Proteome Research	19	9	3779-3791	10.1021/acs.jproteome.0c00303	Yes
Valencia, A.; Ordonez, D.; Wen, D.; McKenna, A.M.; Chang, N.B.; Wanielista, M.P.,	*The Interaction of Dissolved Organic Nitrogen Removal and Microbial Abundance in Iron-filings Based Green Environmental Media for Stormwater Treatment*	Environmental Research	188		109815	10.1016/j.envres.2020.109815	Yes
Wang, H.; Lu, L.; Chen, H.; McKenna, A.M.; Lu, J.; Jin, S.; Zuo, Y.; Rosario-Ortiz, F.L.; Ren, Z.,	*Molecular Transformation of Crude Oil Contaminated Soil after Bioelectrochemical Degradation Revealed by FT-ICR Mass Spectrometry*	Environmental Science and Technology	54	4	2500-2509	10.1021/acs.est.9b06164	Yes
Ware, R.; Rodgers, R.P.; Marshall, A.G.; Mante, O.D.; Dayton, D.C.; Verdier, S.; Gabrielsen, J.; Rowland, S.M.,	*Detailed Chemical Composition of an Oak Biocrude and its Hydrotreated Product Determined by Positive Atmospheric Pressure Photoionization Fourier Transform Ion Cyclotron Resonance Mass Spectrometry*	Sustainable Energy and Fuels	4		2404-2410	10.1039/C9SE00837C	Yes
Ware, R.; Rodgers, R.P.; Marshall, A.G.; Mante, O.D.; Dayton, D.C.; Verdier, S.; Gabrielsen, J.; Rowland, S.M.,	*Tracking Elemental Composition through Hydrotreatment of an Upgraded Pyrolysis Oil Blended with a Light Gas Oil*	Energy and Fuels	34	12	16181-16186	10.1021/acs.energyfuels.0c02437	Yes
Weisbrod, C.; Anderson, L.C.; Greer, J.B.; DeHart, C.J.; Hendrickson, C.L.,	*Increased Single-Spectrum Top-Down Protein Sequence Coverage in Trapping Mass Spectrometers with Chimeric Ion Loading*	Analytical Chemistry	92	18	12193-12200	10.1021/acs.analchem.0c01064	Yes
Wen, D.; Ordonez, D.; McKenna, A.M.; Chang, N.B.,	*Fate and Transport Processes of Nitrogen in Biosorption Activated Media for Stormwater Treatment at Varying Field Conditions of a Roadside Linear Ditch*	Environmental Research	181		108915	10.1016/j.envres.2019.108915	Yes
Wen, D.; Ordonez, D.; Valencia, A.; McKenna, A.M.; Chang, N.B.,	*Copper Impact on Enzymatic Cascade and Extracellular Sequestration via Distinctive Pathways of Nitrogen Removal in Green Sorption Media at Varying Stormwater Field conditions*	Chemosphere	243		125399	10.1016/j.chemosphere.2019.125399	Yes
Williams, H.N.; Chen, H.,	*Environmental Regulation of the Distribution and Ecology of Bdellovibrio and Like Organisms*	Frontiers in Microbiology	11		2670	10.3389/fmicb.2020.545070	Yes
Zhang, Y.; Siskin, M.; Gray, M.R.; Walters, C.C.; Rodgers, R.P.,	*Mechanisms of Asphaltene Aggregation: Puzzles and a New Hypothesis*	Energy and Fuels	43	8	9094–9107	10.1021/acs.energyfuels.0c01564	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Zhang, Z.; Xiong, Y.; Chen, H.; Tang, Y.,	*Understanding the Composition and Spatial Distribution of Biological Selenate Reduction Products for Potential Selenium Recovery*	Environmental Science and Technology	6	8	2153-2163	10.1039/D0EW00376J	Yes
Zherebker, A.; Kim, S.; Schmitt-Kopplin, P.; Spencer, R.G.M.; Lechtenfeld, O.; Podgorski, D.C.; Hertkorn, N.; Harir, M.; Nurfajin, N.; Koch, B.; Nikolaev, E.N.; Shirshin, E.A.; Berezin, S.A.; Kats, D.S.; Rukhovich, G.D.; Perminova, I.V.,	*Interlaboratory Comparison of Humic Substances Compositional Space as Measured by Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (IUPAC Technical Report)*	Pure and Applied Chemistry	92	9	1447-1467	10.1515/pac-2019-0809	Yes
Zito, P.; Podgorski, D.C.; Bartges, T.E.; Guillemette, F.; Roebuck, Jr., A.; Spencer, R.G.M.; Rodgers, R.P.; Tarr, M.A.,	*Sunlight Induced Molecular Progression of Oil Into Oxidized Oil Soluble Species, Interfacial Material, and Dissolved Organic Matter*	Energy and Fuels	34	4	4721-4726	10.1021/acs.energyfuels.9b04408	Yes
Zito, P.; Smith, D.F.; Cao, X.; Ghannam, R.; Tarr, M.A.,	*Barium Ion Adduct Mass Spectrometry to Identify Carboxylic Acid Photoproducts from Crude Oil–water Systems Under Solar Irradiation*	Environmental Science Process Impacts	22	12	2313-2321	10.1039/D0EM00390E	Yes

Publications generated by facilities: NMR Facility at FSU (80)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Affram, K.; Smith, T.; Helsper, S.; Rosenberg, J.T.; Han, B.; Trevino, J.; Agyare, E.,	*Comparative study on contrast enhancement of Magnevist and Magnevist-loaded nanoparticles in pancreatic cancer PDX model monitored by MRI*	Cancer Nanotechnology	2020	11	61	10.1186/s12645-020-00061-9	Yes
Altenhof, A.; Jaroszewicz, M.J.; Lindquist, A.W.; Foster, L.D.D.; Veinberg, S.L.; Schurko, R.W.,	*Practical Aspects of Recording Ultra-Wideline NMR Patterns Under Magic-Angle Spinning Conditions*	Journal of Physical Chemistry C	124		14730-14744	10.1021/acs.jpcc.0c04510	Yes
Amouzandeh, G.; Mentink-Vigier, F.; Helsper, S.; Bagdasarian, F.A.; Rosenberg, J.T.; Grant, S.C.,	*Magnetic resonance electrical property mapping at 21.1 T: a study of conductivity and permittivity in phantoms, ex vivo tissue and in vivo ischemia*	Physics in Medicine and Biology	65	5	55007	10.1088/1361-6560/ab3259	Yes
Ashbrook, S.E.; Dawson, D.M.; Gan, Z.; Hooper, J.E.; Hung, I.; Macfarlane, L.E.; McKay, D.; McLeod, L.K.; Walton, R.I.,	*Application of NMR Crystallography to Highly Disordered Templated Materials: Extensive Local Structural Disorder in the Gallophosphate GaPO-34A*	Inorganic Chemistry	59	16	11616-11626	10.1021/acs.inorgchem.0c01450	Yes

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Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Cai, S.; Hao, S.; Luo, Z.; Li, X.; Hadar, I.; Bailey, T.P.; Hu, X.; Uher, C.; Hu, Y.; Wolverton, C.; Dravid, V.P.; Kanatzidis, M.G.,	*Discordant nature of Cd in PbSe: off-centering and core–shell nanoscale CdSe precipitates lead to high thermoelectric performance*	Energy and Environmental Science	13	1	200--211	10.1039/C9EE03087E	Yes
Chakraborty, A.; Deligey, F.; Quach, J.; Mentink-Vigier, F.; Wang, P.; Wang, T.,	*Biomolecular complex viewed by dynamic nuclear polarization solid-state NMR spectroscopy*	Biochemical Society Transactions	48	3	1089-1099	10.1042/BST20191084	Yes
Chaudhary, B.P.; Zoetewey, D.; Mohanty, S.,	*1H, 13C, 15N resonance assignments and secondary structure of yeast oligosaccharyltransferase subunit Ost4 and its functionally important mutant Ost4V23D*	Biomolecular NMR Assignments	14		205-209	10.1007/s12104-020-09946-7	Yes
Chen, C.; Gaillard, E.; Mentink-Vigier, F.; Chen, K.; Gan, Z.; Gaveau, P.; Rebiere, B.; Berthelot, R.; Florian, P.; Bonhomme, C.; Smith, M.; Metro, T.; Alonso, B.; Laurencin, D.,	*Direct 17 O Isotopic Labeling of Oxides Using Mechanochemistry*	Journal of Biological Inorganic Chemistry	59	18	13050-13066	10.1021/acs.inorgchem.0c00208	Yes
Chen, K.,	*A Practical Review of NMR Lineshapes for Spin-1/2 and Quadrupolar Nuclei in Disordered Materials*	International Journal of Molecular Sciences	21		5666	10.3390/ijms21165666	Yes
Chen, K.; Horstmeier, S.; Nguyen, V.; Bin, W.; Crossley, S.; Pham, T.; Gan, Z.; Hung, I.; White, J.,	*Structure and Catalytic Characterization of a Second Framework Al(IV) Site in Zeolite Catalysts Revealed by NMR at 35.2 T*	Journal of the American Chemical Society	142	16	7514-7523	10.1021/jacs.0c00590	Yes
Chien, P.; Griffith, K.J.; Liu, H.; Gan, Z.; Hu, Y.,	*Recent Advances in Solid-State Nuclear Magnetic Resonance Techniques for MaterialsResearch*	Annual Review of Materials Research	50	1	493--520	10.1146/annurev-matsci-091019-011049	Yes
Chien, P.; Harada, J.K.; Liu, H.; Patel, S.; Huang, C.; Rondinelli, J.M.; Poeppelmeier, K.R.; Hu, Y.,	*Microscopic Insights into the Reconstructive Phase Transition of KNaNbOF5 with 19F NMR Spectroscopy*	Chemistry of Materials	32	13	5715-5722	10.1021/acs.chemmater.0c01439	Yes
Conti III, C.R.; Quiroz-Delfi, G.I.; Schwarck, J.S.; Chen, B.; Strouse, G.F.,	*Carrier Density, Effective Mass, and Nuclear Relaxation Pathways in Plasmonic Sn:In2O3 Nanocrystals*	Journal of Physical Chemistry C	124		28220-28229	10.1021/acs.jpcc.0c09448	Yes
Dahal, S.R.; Lewellen, J.L.; Chaudhary, B.P.; Mohanty, S.,	*1H, 13C, and 15N resonance assignment and secondary structure of the pheromone-binding protein2 from the agricultural pest Ostrinia furnacalis (OfurPBP2)*	Biomolecular NMR Assignments	14		115-118	10.1007/s12104-020-09930-1	Yes
Dasari, A.K.R.; Hung, I.; Michael, B.; Gan, Z.; Kelly, J.W.; Connors, L.H.; Griffin, R.G.; Lim, K.,	*Structural Characterization of Cardiac Ex Vivo Transthyretin Amyloid: Insight into the Transthyretin Misfolding Pathway In Vivo*	Journal of Nutritional Biochemistry	59	19	1800--1803	10.1021/acs.biochem.0c00091	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Ding, X.Y.; Fu, R.; Tian, F.,	*De novo resonance assignment of the transmembrane domain of LR11/SorLA in E. coli membranes*	Journal of Magnetic Resonance	310		106639	10.1016/j.jmr.2019.106639	Yes
Dorn, R.W.; Cendejas, M.C.; Chen, K.; Hung, I.; Altvater, N.R.; McDermott, W.P.; Gan, Z.; Hermans, I.; Rossini, A.J.,	*Structure Determination of Boron-Based Oxidative Dehydrogenation Heterogeneous Catalysts With Ultrahigh Field 35.2 T ^{11}B Solid-State NMR Spectroscopy*	American Chemical Society Catalysis	10		13852-13866	10.1021/acscatal.0c03762	Yes
Drover, M.W.; Dufour, M.C.; Lesperance-Nantau, L.A.; Noriega, R.P.; Levin, K.; Schurko, R.W.,	*Octaboraneyl Complexes of Nickel: Monomers for Redox-Active Coordination Polymers*	Chemistry a European Journal	26	49	11180-11186	10.1002/chem.202001218	Yes
Feng, X.; Chien, P.; Patel, S.; Wang, Y.; Hu, Y.,	*Enhanced Ion Conduction in $Li_{2.5}Zn_{0.25}PS_4$ via Anion Doping*	Chemistry of Materials	32	7	3036--3042	10.1021/acs.chemmater.0c00025	Yes
Feng, X.; Chien, P.; Wang, Y.; Patel, S.; Wang, P.; Liu, H.; Immediato-Scuotto, M.; Hu, Y.,	*Enhanced ion conduction by enforcing structural disorder in Li-deficient argyrodites $Li_{6-x}PS_{5-x}Cl_{1-x}$*	Energy Storage Materials	30		67--73	10.1016/j.ensm.2020.04.042	Yes
Fernando, L.D.; Zhao, W.; Dickwella Widanage, M.C.; Mentink-Vigier, F.; Wang, T.,	*Solid-state NMR and DNP investigations of carbohydrates and cell-wall biomaterials*	eMagRes	9	3	-	10.1002/9780470034590.emrstm1624	Yes
Fu, R.; Miao, Y.; Qin, H.; Cross, T.A.,	*Observation of the Imidazole-Imidazolium Hydrogen Bonds Responsible for Selective Proton Conductance in the Influenza A M2 Channel*	Journal of the American Chemical Society	142		2115-2119	10.1021/jacs.9b09985	Yes
Ghaffari, H.; Grant, S.C.; Petzold, L.R.; Harrington, M.G.,	*Regulation of CSF and Brain Tissue Sodium Levels by the Blood-CSF and Blood-Brain Barriers During Migraine*	Frontiers in Computational Neuroscience	14		4	10.3389/fncom.2020.00004	No
Ghosh, R.; Madrid, C.L.; Frederick, K.K.,	*Segmental Labeling: Applications to Protein NMR and DNP*	eMagRes	9		71-80	10.1002/9780470034590.emrstm1613	Yes
Guo, C.; Wu, J.; Rosenberg, J.T.; Roussel, T.; Cai, S.; Cai, C.,	*Fast chemical exchange saturation transfer imaging based on PROPELLER acquisition and deep neural network reconstruction*	Magnetic Resonance in Medicine	84	6	3192	10.1002/mrm.28376	Yes
Hicks, A.; Escobar Bravo, C.A.; Cross, T.A.; Zhou, H.,	*Sequence-Dependent Correlated Segments in the Intrinsically Disordered Region of ChiZ*	Biomolecules	10	6	946	10.3390/biom10060946	Yes
Holmes, S.; Engl, O.G.; Srnec, M.N.; Madura, J.D.; Quinones, R.; Harper, J.K.; Schurko, R.W.; Iuliucci, R.J.,	*Chemical Shift Tensors of Cimetidine Form A Modeled with Density Functional Theory Calculations: Implications for NMR Crystallography*	Journal of Physical Chemistry A	124		3109-3119	10.1021/acs.jpca.0c00421	Yes
Holmes, S.; Vojvodin, C.; Schurko, R.W.,	*Dispersion-Corrected DFT Methods for Applications in NMR Crystallography*	Journal of Physical	124		10312-10323	10.1021/acs.jpca.0c06372	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
		Chemistry A					
Huang, W.; Chien, P.; McMillen, K.; Patel, S.; Tedesco, J.; Zeng, L.; Mukherjee, S.; Wang, B.; Chen, Y.; Wang, G.; Wang, Y.; Gao, Y.; Bedzyk, M.J.; DeLongchamp, D.M.; Hu, Y.; Medvedeva, J.E.; Marks, T.J.; Facchetti, A.,	*Experimental and theoretical evidence for hydrogen doping in polymer solution-processed indium gallium oxide*	Proceedings of the National Academy of Sciences of the USA (PNAS)	117	31	18231--18239	10.1073/pnas.2007897117	Yes
Hung, I.; Altenhof, A.R.; Schurko, R.W.; Bryce, D.L.; Hee Han, O.C.; Gan, Z.,	*Field-stepped ultra-wideline NMR at up to 36 T: On the inequivalence between field and frequency stepping*	Magnetic Resonance in Chemistry	0		0	10.1002/mrc.5128	Yes
Hung, I.; Gan, Z.,	*High Resolution NMR of S = 3/2 Quadrupole Nuclei by Detection of Double-Quantum Satellite-Transitions via Protons*	Journal of Physical Chemistry Letters	11	12	4734--4740	10.1021/acs.jpclett.0c01236	Yes
Hung, I.; Gan, Z.,	*Low-power STMAS - breaking through the limit of large quadrupolar interactions in high-resolution solid-state NMR spectroscopy*	Physical Chemistry Chemical Physics	22	37	21119-21123	10.1039/d0cp04274a	Yes
Hung, I.; Gor'kov, P.L.; Gan, Z.,	*Using the heteronuclear Bloch-Siegert shift of protons for B-1 calibration of insensitive nuclei not present in the sample*	Journal of Magnetic Resonance	310		106636	10.1016/j.jmr.2019.106636	Yes
Janani, H.; Alamo, R.G.,	*Effect of melt miscibility, polymorphism, and crystal morphology on tensile deformation of blends of isotactic polypropylene and propylene-1-hexene random copolymers*	Polymer Crystallization	3		e10111	10.1002/pcr2.10111	Yes
Karimineghlani, P.; Zheng, J.; Hu, Y.; Sukhishvili, S.,	*Solvation and diffusion of poly(vinyl alcohol) chains in a hydrated inorganic ionic liquid*	Physical Chemistry Chemical Physics	22		17705--17712	10.1039/D0CP02679D	No
Kleimaier, D.; Schepkin, V.D.; Hu, R.; Schad, L.,	*Protein conformational changes affect the sodium triple-quantumMR signal*	NMR in Biomedicine	33	10	12-Jan	10.1002/nbm.4367	Yes
Kleimaier, D.; Schepkin, V.D.; Nies, C.; Gottwald, E.; Schad, L.,	*Intracellular Sodium Changes in Cancer Cells using aMicrocavity Array-Based Bioreactor System andSodium Triple-Quantum MR Signal*	Processes	8	1267	19-Jan	10.3390/pr8101267	Yes
Leftin, A.; Rosenberg, J.T.; Yuan, X.; Ma, T.; Grant, S.C.; Frydman, L.,	*Multiparametric classification of sub-acute ischemic stroke recovery with ultrafast diffusion, 23Na, and MPIO-labeled stem cell MRI at 21.1 T*	NMR in Biomedicine	33	2	e4186	10.1002/nbm.4186	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Liu, X.; Zhong, G.; Xiao, Z.; Zheng, B.; Zuo, W.; Zhou, K.; Liu, H.; Liang, Z.; Xiang, Y.; Chen, Z.; Ortiz, G.F.; Fu, R.; Yang, Y.,	*Al and Fe-containing Mn-based layered cathode with controlled vacancies for high-rate sodium ion batteries*	Nano Energy	76		104997	10.1016/j.nanoen.2020.104997	Yes
Madsen, R.; Qiao, A.; Sen, J.; Hung, I.; Chen, K.; Gan, Z.; Sen, S.; Yue, Y.,	*Ultrahigh-field ^{67}Zn NMR reveals short-range disorder in zeolitic imidazolate framework glasses*	Science	367		1473-1476	10.1126/science.aaz0251	Yes
Martins, V.; Xu, J.; Hung, I.; Gan, Z.; Gervais, C.; Bonhomme, C.; Huang, Y.,	*^{17}O solid-state NMR at ultrahigh magnetic field of 35.2 T: Resolution of inequivalent oxygen sites in different phases of MOF MIL-53(Al)*	Magnetic Resonance in Chemistry	0		0	10.1002/mrc.5122	Yes
Martins, V.; Xu, J.; Wang, X.; Chen, K.; Hung, I.; Gan, Z.; Gervais, C.; Bonhomme, C.; Jiang, S.; Zheng, A.; Lucier, B.; Huang, Y.,	*Higher Magnetic Fields, Finer MOF Structural Information*	Journal of the American Chemical Society	142	35	14877 – 14889	10.1021/jacs.0c02810	Yes
Marxsen, S.F.; Häuβler, M.; Mecking, S.; Alamo, R.G.,	*Isothermal Step Thickening in a Long-Spaced Aliphatic Polyester*	Polymer	191		122282	10.1016/j.polymer.2020.122282	Yes
Mayen, L.; Jensen, N.; Laurencin, D.; Marsan, O.; Bonhomme, C.; Gervais, C.; Smith, M.; Coelho, C.; Laurent, G.; Trebosc, J.; Gan, Z.; Chen, K.; Rey, C.; Combes, C.; Soulié, J.,	*A soft-chemistry approach to the synthesis of amorphous calcium ortho/pyrophosphate biomaterials of tunable composition*	Acta Materialia	103		333-345	10.1016/j.actbio.2019.12.027	Yes
Mentink-Vigier, F.,	*Optimizing nitroxide biradicals for cross-effect MAS-DNP: the role of g -tensors"" distance*	Physical Chemistry Chemical Physics	22		3643-3652	10.1039/C9CP06201G	Yes
Ngatia, L.; De Oliveira, L.; Betiku, O.; Fu, R.; Moriasi, D.; Steiner, J.; Verse, A.; Taylor, R.,	*Relationship of arsenic and chromium availability with carbon functionalgroups, aluminum and iron in Little Washita River Experimental WatershedReservoirs, Oklahoma, USA*	Ecotoxicology and Environmental Safety	207		111468	10.1016/j.ecoenv.2020.111468	Yes
O'Keefe, C.A.; Motillo, C.; Fabian, L.; Friscic, T.; Schurko, R.W.,	*NMR-Enhanced Crystallography Aids Open Metal-Organic Framework Discovery Using Solvent-Free Accelerated Aging*	Chemistry of Materials	32		4273-4281	10.1021/acs.chemmater.0c00894	Yes
Paulino, J.; Yi, M.; Hung, I.; Gan, Z.; Wang, X.; Chekmenev, E.Y.; Zhou, H.; Cross, T.A.,	*Functional stability of water wire-carbonyl interactions in an ion channel*	Proceedings of the National Academy of Sciences of the USA (PNAS)	117	22	11908-11915	10.1073/pnas.2001083117	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Pavuluri, K.D.; Rosenberg, J.T.; Helsper, S.; Bo, S.; McMahon, M.T.,	*Amplified detection of phosphocreatine and creatine after supplementation using CEST MRI at high and ultrahigh magnetic fields*	Journal of Magnetic Resonance	313		106703	10.1016/j.jmr.2020.106703	Yes
Ren, M.; Chen, X.; Sang, Y.; Alamo, R.G.,	*Comparative Effects on Recrystallization of Melt-Memory and Liquid-Liquid Phase Separation in Ziegler-Natta and Metallocene Ethylene Copolymers with Bimodal Comonomer Composition Distribution*	Industrial and Engineering Chemistry Research	59		19260−19271	10.1021/acs.iecr.0c03647	Yes
Schwartz, A.B.; Kapur, A.; Huang, Z.; Anangi, R.; Spear, J.M.; Stagg, S.; Fardone, E.; Dekan, Z.; Rosenberg, J.T.; Grant, S.C.; King, G.F.; Mattoussi, H.; Fadool, D.A.,	*Olfactory bulb targeted QD bioconjugate and Kv1.3 blocking peptide improve metabolic health in obese male mice*	Journal of Neurochemistry			online	10.1111/jnc.15200	Yes
Shen, L.; Wang, Y.; Du, J.; Chen, K.; Lin, Z.; Wen, Y.; Hung, I.; Gan, Z.; Peng, L.,	*Probing Interactions of γ-Alumina with Water via Multinuclear Solid-State NMR Spectroscopy*	ChemCatChem	12		1569-1574	10.1002/cctc.201901838	Yes
Spackova, J.; Fabra, C.; Mittelette, S.; Gaillard, E.; Chen, C.; Cazals, G.; Lebrun, A.; Scene, S.; Berthomieu, D.; Chen, K.; Gan, Z.; Gervais, C.; Metro, T.; Laurencin, D.,	*Unveiling the Structure and Reactivity of Fatty-Acid Based (Nano)materials Thanks to Efficient and Scalable 17O and 18O-Isotopic Labeling Schemes*	Journal of the American Chemical Society	142	50	21068-21081	10.1021/jacs.0c09383	Yes
Sprague-Piercy, M.A.; Bierma, J.C.; Crosby, M.G.; Carpenter, B.P.; Takahashi, G.R.; Paulino, J.; Hung, I.; Zhang, R.; Kelly, J.E.; Kozlyuk, N.; Chen, X.; Butts, C.T.; Martin, R.W.,	*The Droserasin 1 PSI: A Membrane-Interacting Antimicrobial Peptide from the Carnivorous Plant Drosera capensis*	Biomolecules	10	7	1069	10.3390/biom10071069	Yes
Stirk, A.J.; Wilson, B.H.; O'Keefe, C.A.; Amarne, H.; Zhu, K.; Schurko, R.W.; Loeb, S.J.,	*Applying reticular synthesis to the design of Cu-based MOFs with mechanically interlocked linkers*	Nano Research	14	2	417--422	10.1007/s12274-020-3123-z	Yes
Sysoev, V.O.; Kato, M.; Sutherland, L.; Hu, R.; McKnight, S.L.; Murray, D.T.,	*Dynamic structural order of a low-complexity domain facilitates assembly of intermediate filaments*	Proceedings of the National Academy of Sciences of the USA (PNAS)	117	38	23510-23518	10.1073/pnas.2010000117	Yes
Tan, C.; Chen, Y.; Peng, X.; Chen, Z.; Cai, S.; Cross, T.A.; Fu, R.,	*Revealing weak histidine ^{15}N homonuclear scalar couplings using Solid-State Magic-Angle-Spinning NMR spectroscopy*	Journal of Magnetic Resonance	316		106757	10.1016/j.jmr.2020.106757	Yes
Thomas, J.; Ramaswamy, V.; Johnston, T.; Belc, D.C.;	*Modeling the Resonance Shifts Due to Coupling Between HTS Coils in NMR Probes*	Journal of Physics:	1559		12022	10.1088/1742-6596/1559/1/012022	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Freytag, N.; Hornak, L.A.; Edison, A.S.; Brey, W.W.,		Conference Series					
Tran, N.; Mentink-Vigier, F.; Long, J.R.,	*Dynamic Nuclear Polarization of Biomembrane Assemblies*	Biomolecules	10	9	1246	10.3390/biom10091246	Yes
Venkatesh, A.; Hung, I.; Boteju, K.C.; Sadow, A.D.; Gor'kov, P.L.; Gan, Z.; Rossini, A.J.,	*Suppressing 1H Spin Diffusion in Fast MAS Proton Detected Heteronuclear Correlation Solid-State NMR Experiments*	Solid State Nuclear Magnetic Resonance	105		101636	10.1016/j.ssnmr.2019.101636	Yes
Venkatesh, A.; Luan, X.; Perras, F.A.; Hung, I.; Huang, W.; Rossini, A.J.,	*t1-Noise Eliminated Dipolar Heteronuclear Multiple-Quantum Coherence Solid-State NMR Spectroscopy*	Physical Chemistry Chemical Physics	22		20815-20828	10.1039/D0CP03511D	Yes
Vugmeyster, L.; Ostrovsky, D.; Fu, R.,	*Deuteron Quadrupolar Chemical Exchange Saturation Transfer (Q-CEST) Solid-State NMR for Static Powder Samples: Approach and Applications to Amyloid-β Fibrils*	ChemPhysChem	21		220-231	10.1002/cphc.201901053	Yes
Wang, L.S.; Patel, S.V.; Sanghvi, S.S.; Hu, Y.; Haile, S.M.,	*Structure and Properties of Cs7(H4PO4)(H2PO4)8: A New Superprotonic Solid Acid Featuring the Unusual Polycation (H4PO4)+*	Journal of the American Chemical Society	142	47	19992--20001	10.1021/jacs.0c08870	No
Wang, P.; Liu, H.; Patel, S.; Feng, X.; Chien, P.; Wang, Y.; Hu, Y.,	*Fast Ion Conduction and Its Origin in* $Li_{6-x}PS_{5-x}Br_{1+x}$	Chemistry of Materials	32	9	3833–3840	10.1021/acs.chemmater.9b05331	Yes
Wang, Q.; Li, W.; Hung, I.; Mentink-Vigier, F.; Wang, X.; Qi, G.; Wang, X.; Gan, Z.; Xu, J.; Deng, F.,	*Mapping the oxygen structure of γ-Al2O3 by high-field solid-state NMR spectroscopy*	Nature Communications	11	1	3620	10.1038/s41467-020-17470-4	Yes
Wi, S.; Frydman, L.,	*An Efficient, Robust New Schemefor Establishing Broadband Homonuclear Correlationsin Biomolecular Solid State NMR*	ChemPhysChem	21		12-Jan	10.1002/cphc.201901071	Yes
Wijesekara, A.V.; Venkatesh, A.; Lampkin, B.J.; VanVeller, B.; Lubach, J.W.; Nagapudi, K.; Hung, I.; Gor'kov, P.L.; Gan, Z.; Rossini, A.J.,	*Fast Acquisition of Proton-Detected HETCOR Solid-State NMR Spectra of Quadrupolar Nuclei and Rapid Measurement of NH Bond Lengths by Frequency Selective HMQC and RESPDOR Pulse Sequences*	Chemistry a European Journal	26	35	7881-7888	10.1002/chem.202000390	Yes
Wilson, B.H.; Gholami, G.; Zhu, K.; O'Keefe, C.A.; Schurko, R.W.; Loeb, S.J.,	*Exploring the Dynamics of Zr-Based Metal-organic Frameworks Containing Mechanically Interlocked Molecular Shuttles*	Faraday Discussions	225		358-370	10.1039/D0FD00004C	No
Wilson, B.H.; Vojvodin, C.; Gholami, G.; Abdulla, L.M.; O'Keefe, C.A.; Schurko, R.W.; Loeb, S.J.,	*Precise Spatial Arrangement and Interaction between Two Different Mobile Components in a Metal-Organic Framework*	Chem	7		10-Jan	10.1016/j.chempr.2020.11.009	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Wu, J.; Zhang, X.F.; Zheng, S.Y.; Liu, H.D.; Wu, J.P.; Fu, R.; Li, Y.X.; Xiang, Y.X.; Liu, R.; Zuo, W.H.; Cui, Z.H.; Wu, Q.H.; Wu, S.Q.; Chen, Z.H.; Liu, P.; Yang, W.L.; Yang, Y.,	*Tuning Oxygen Redox Reaction through the Inductive Effect with Proton Insertion in Li-Rich Oxides*	American Chemical Society Applied Materials and Interfaces	12		7277-7284	10.1021/acsami.9b21738	Yes
Wu, N.; Chien, P.; Li, Y.; Dolocan, A.; Xu, H.; Xu, B.; Grundish, N.S.; Jin, H.; Hu, Y.; Goodenough, J.B.,	*Fast Li^+ Conduction Mechanism and Interfacial Chemistry of a NASICON/Polymer Composite Electrolyte*	Journal of the American Chemical Society	142	5	2497--2505	10.1021/jacs.9b12233	Yes
Wu, N.; Chien, P.; Qian, Y.; Li, Y.; Xu, H.; Grundish, N.S.; Xu, B.; Jin, H.; Hu, Y.; Yu, G.; Goodenough, J.B.,	*Enhanced Surface Interactions Enable Fast Li+ Conduction in Oxide/Polymer Composite Electrolyte*	Angewandte Chemie	132		9-Feb	10.1002/ange.201914478	Yes
Xiang, Y.; Zheng, G.; Liang, Z.; Jin, Y.; Liu, X.; Chen, S.; Zhou, K.; Zhu, J.; Lin, M.; He, H.; Wan, J.; Yu, S.; Zhong, G.; Fu, R.; Li, Y.; Yang, Y.,	*Visualizing the growth process of sodium microstructures in sodium batteries by in-situ ^{23}Na MRI and NMR spectroscopy*	Nature Nanotechnology	15		883-890	10.1038/s41565-020-0749-7	Yes
Ycas, P.D.; Wagner, N.; Olsen, N.M.; Fu, R.; Pomerantz, W.C.K.,	*2-Fluorotyrosine is a valuable but understudied amino acid for protein-observed 19F NMR*	Journal of Biomolecular NMR	74		61-69	10.1007/s10858-019-00290-0	Yes
Yuan, B.; Hung, I.; Gan, Z.; Sen, S.,	*Chemical order in binary Se-Te glasses: Results from high-resolution 2D ^{77}Se and ^{125}Te MATPASS NMR spectroscopy*	Journal of Non-Crystalline Solids	544		120212	10.1016/j.jnoncrysol.2020.120212	Yes
Zhang, P.J.; Tang, X.Y.; Wang, Y.D.; Wang, X.; Gao, D.X.; Li, Y.P.; Zheng, H.Y.; Wang, Y.J.; Wang, X.X.; Fu, R.; Tang, M.; Ikeda, K.; Miao, P.; Hattori, T.; San-Furukawa, A.; Tulk, C.A.; Molaison, J.J.; Dong, X.; Li, K.; Ju, J.; Mao, H.K.,	*Distance-Selected Topochemical Dehydro-Diels−Alder Reaction of 1,4-Diphenylbutadiyne toward Crystalline Graphitic Nanoribbons*	Journal of the American Chemical Society	142		17662-17669	10.1021/jacs.0c08274	Yes
Zhang, X.; Marxsen, S.F.; Ortmann, P.; Mecking, S.; Alamo, R.G.,	*Crystallization of Long-Spaced Precision Polyacetals II: Effect of Polymorphism on Isothermal Crystallization Kinetics*	Macromolecules	53		7899-7913	10.1021/acs.macromol.0c01443	Yes
Zhuang, X.; Patel, S.; Zhang, C.; Wang, B.; Chen, Y.; Liu, H.; Dravid, V.P.; Yu, J.; Hu, Y.; Huang, W.; Facchetti, A.; Marks, T.J.,	*Frequency-Agile Low-Temperature Solution-Processed Alumina Dielectrics for Inorganic and Organic Electronics Enhanced by Fluoride Doping*	Journal of the American Chemical Society	142	28	12440–12452	10.1021/jacs.0c05161	Yes
Zuo, W.; Qiu, J.; Liu, X.; Ren, F.; Liu, H.; He, H.; Luo, C.; Li, J.; Ortiz, G.F.; Duan, H.; Liu, J.; Wang, M.; Li, Y.; Fu, R.; Yong, Y.,	*The stability of P2-layered sodium transition metal oxides in ambient atmospheres*	Nature Communications	11		3544	10.1038/s41467-020-17290-6	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Zuo, W.H.; Luo, M.Z.; Liu, X.S.; Wu, J.; Liu, H.D.; Li, J.; Winter, M.; Fu, R.; Yang, W.L.; Yang, Y.,	*Li-rich cathodes for rechargeable Li-based batteries: reaction mechanisms and advanced characterization techniques*	Energy and Environmental Science	13		4450-4497	10.1039/d0ee01694b	Yes

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Publications generated by facilities: Pulsed Field Facility at LANL (34)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Chan, M.K.; McDonald, R.; Ramshaw, B.J.; Betts, J.; Shehter, A.; Bauer, E.D.; Harrison, N.,	*Extent of Fermi-surface reconstruction in the high-temperature superconductor $HgBa_2CuO_{4+δ}$*	Proceedings of the National Academy of Sciences of the USA (PNAS)	117		9782	10.1073/pnas.1914166117	Yes
Crooker, S.; Lee, M.; McDonald, R.; Doorn, J.L.; Zimmermann, I.; Lai, Y.; Winter, L.; Ren, Y.; Cho, Y.; Ramshaw, B. J.; Xing, H. G.; Jena, D.,	*GaN/AlGaN 2DEGs in the quantum regime: Magneto-transport and photoluminescence to 60 tesla*	Applied Physics Letters	117		262105	10.1063/5.0033047	Yes
Fuhr, A.; Yun, H.J.; Crooker, S.; Klimov, V.,	*Spectroscopic and Magneto-Optical Signatures of Cu1+ and Cu2+ Defects in Copper Indium Sulfide Quantum Dots*	American Chemical Society Nano	14		2212	10.1021/acsnano.9b09181	Yes
Götze, K.; Pearce, M.J.; Goddard, P.; Jaime, M.; Maple, M.B.; Sasmal, K.; Yanagisawa, T.; McCollam, A.; Khouri, T.; Ho, P.C.; Singleton, J.,	*Unusual phase boundary of the magnetic-field-tuned valence transition in CeOs4Sb12*	Physical Review B	101		75102	10.1103/PhysRevB.101.075102	Yes
Haley, S.; Weber, S.; Cookmeyer, T.; Parker, D.; Maniv, E.; Maksimovic, N.; John, C.; Doyle, S.; Maniv, A.; Ramakrishna, S.K.; Reyes, A.P.; Singleton, J.; Moore, J.; Neaton, J.; Analytis, J.,	*Half-magnetization plateau and the origin of threefold symmetry breaking in an electrically switchable triangular antiferromagnet*	Physical Review Research	2		43020	10.1103/PhysRevResearch.2.043020	Yes
Hartstein, M.; Hsu, Y.T.; Modic, K.A.; Porras, J.; Loew, T.; Le Tacon, M.; Zuo, H.; Wang, J.; Zhu, Z.; Chan, M.K.; McDondald, R.D.; Lonzarich, G.G.; Keimer, B.; Sebastian, S.E.; Harrison, N.,	*Hard antinodal gap revealed by quantum oscillations in the pseudogap regime of underdoped high-Tc superconductors*	Nature Physics	16		841–847	10.1038/s41567-020-0910-0	Yes
Hayes, I.M.; Maksimovich, N.; Lopez, G. N.; Chan, M. K.; Ramshaw, B. J.; McDonald, R.; Analytis, J.,	*Superconductivity and quantum criticality linked by the Hall effect in a strange metal*	Nature Physics	2677	17	5-Jan	10.1038/s41567-020-0982-x	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Helm, T.; Grockowiak, A.; Balakirev, F.; Singleton, J.; Betts, J.; Shirer, K. W.; Koenig, M.; Foerster, T.; Bauer, E. D.; Ronning, F.; Tozer, S.W.; Moll, P. J.,	*Non-monotonic pressure dependence of high-field nematicity and magnetism in $CeRhIn_5$*	Nature Communications	11		3482	10.1038/s41467-020-17274-6	Yes
Jakobsen, V.; Chikara, S.; Yu, J.X.; Dobbelaar, E.; Kelly, C.T.; Ding, X.; Weickert, F.; Trzop, E.; Collet, E.; Cheng, H.P.; Morgan, G.G.; Zapf, V.,	*Giant Magnetoelectric Coupling and Magnetic-Field-Induced Permanent Switching in a Spin Crossover Mn(III) Complex*	Inorganic Chemistry	0c02789		0c02789	10.1021/acs.inorgchem.0c02789	Yes
Jang, S.; Denlinger, J.D.; Allen, J.W.; Zapf, V.; Maple, M.B.; Kim, J.; Jang, B.; Shim, J.,	*Evolution of the Kondo lattice electronic structure above the transport coherence temperature*	Proceedings of the National Academy of Sciences of the USA (PNAS)	117	38	23467-23476	10.1073/pnas.2001778117	Yes
Jin, H.; Janicke, M.; Crooker, S.; Klimov, V.; Goryca, M.M.,	*Exploiting Functional Impurities for Fast and Efficient Incorporation of Manganese into Quantum Dots*	Journal of the American Chemical Society	142		18160	10.1021/jacs.0c08510	Yes
Kang, M.; Ye, L.; Fang, S.; You, J.; Levitan, A.; Han, M.; Facio, J.I.; Jozwiak, C.; Bostwick, A.; Rotenberg, E.; Chan, M.; McDonald, R.; Graf, D.E.; Kaznatcheev, K.; Vescovo, E.; Bell, D.C.; Kaxiras, E.; van den Brink, J.; Richter, M.; Prasad Ghimire, M.; Checkelsky, J.G.; Comin, R.,	*Dirac fermions and flat bands in the ideal kagome metal FeSn*	Nature Materials	19	2	163--169	10.1038/s41563-019-0531-0	Yes
Khan, M. A.; Chang, P.; Ghimire, N.; Bhattacharya, A.; Jiang, J. S.; Singleton, J.; Mitchell, J. F.,	*Fermi surface topology and nontrivial Berry phase in the flat-band semimetal Pd3Pb*	Physical Review B	101		245113	10.1103/PhysRevB.101.245113	Yes
Li, J.; Goryca, M.M.; Wilson, N.; Stier, A.; Xu, X.; Crooker, S.,	*Spontaneous Valley Polarization of Interacting Carriers in a Monolayer Semiconductor*	Physical Review Letters	125		147602	10.1103/PhysRevLett.125.147602	Yes
Lu, J.; Adkins, T.; Dixon, I.R.; Nguyen, D.N.; Han, K.,	*Nondestructive Testing of High Strength Conductors for High Field Pulsed Magnets*	IEEE Transactions on Applied Superconductivity	30	4	6900405	10.1109/TASC.2020.2980525	Yes
Maksimovic, N.; Hayes, I.; Nagarajan, V.; Analytis, J.; Koshelev, A.; Singleton, J.; Lee, Y.; Schenkel, T.,	*Magnetoresistance Scaling and the Origin of H-Linear Resistivity in BaFe2(As1−xPx)2*	Physical Review X	10		41062	10.1103/PhysRevX.10.041062	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Manson, J. L.; Manson, Z. E.; Sargent, A.; Villa, D. Y.; Etten, N. L.; Blackmore, W. J.; Curley, S. P.; Williams, R. C.; Brambleby, J.; Goddard, P. A.; Ozarowski, A.; Wilson, M. N.; Huddart, B. M.; Lancaster, T.; Johnson, R. D.; Blundell, S. J.; Bendix, J.; Wheeler, K. A.; Lapidus, S. H.; Xiao, F.; Birnbaum, S.M.; Singleton, J.,	*Enhancing easy-plane anisotropy in bespoke Ni(II) quantum magnets*	Polyhedron	180		114379	10.1016/j.poly.2020.114379	Yes
Michel, J.; Nguyen, D.N.; Lucero, J.D.,	*Design, Construction, and Operation of New Duplex Magnet at Pulsed Field Facility-NHMFL*	IEEE Transactions on Applied Superconductivity	30	4	500105	10.1109/TASC.2020.2970670	Yes
Modic, K.; McDonald, R.; Lai, Y.; Palmstrom, J.C.; Graf, D.E.; Chan, M.K.; Balakirev, F.; Boebinger, G.S.; Betts, J.; Schmidt, M.; Sokolov, D.A.; Moll, P.J.W.; Ramshaw, B.; Shehter, A.,	*Scale-invariant magnetic anisotropy in RuCl3 at high magnetic fields*	Nature Physics	1		1	10.1038/s41567-020-1028-0	Yes
Morgan, G.; Jakobsen, V.B.; Trzop, E.; Gavin, L.C.; Dobbelaar, E.; Chikara, S.; Ding, X.N.; Esien, K.; Müller-Bunz, H.; Felton, S.; Zapf, V.; Collet, E.; Carpenter, M.A.,	*Stress-induced Domain Wall Motion in a Ferroelastic Mn3+ Spin Crossover Complex*	Angewandte Chemie	59	32	13305-13312	10.1002/anie.202003041	Yes
Nguyen, D.N.; Vo, T.D.,	*Comprehensive Finite Element Modeling for Pulsed Magnet Design Using COMSOL and Java*	IEEE Transactions on Applied Superconductivity	30	4	4900605	10.1109/TASC.2020.2971935	Yes
Niu, Q.; Yu, W.; Aulestia, E.; Hu, Y.; Lai, K.; Kotegawa, H.; Matsuoka, E.; Sugawara, H.; Tou, H.; Sun, D.; Balakirev, F.F.; Yanase, Y.; Goh, S.K.,	*Nonsaturating large magnetoresistance in the high carrier density nonsymmorphic metal CrP*	Physical Review B: Rapid Comm/Letters	99	12	125126	10.1103/PhysRevB.99.125126	Yes
Opherden, D.; Nizar, N.; Richardson, K.; Monroe, J.; Turnbull, M.; Polson, M.; Vela, S.; Blackmore, W.; Goddard, P.; Singleton, J.; Choi, E.; Xiao, F.; Williams, R.; Lancaster, T.; Pratt, F.; Blundell, S.; Skourski, Y.; Uhlarz, M.; Ponomaryov, A.; Zvyagin, S.; Wosnitza, J.; Beinitz, M.; Heinmaa, I.;	*Open Access Extremely well isolated two-dimensional spin-12 antiferromagnetic Heisenberg layers with a small exchange coupling in the molecular-based magnet CuPOF*	Physical Review B	102		64431	10.1103/PhysRevB.102.064431	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Stern, R.; Kuehne, H.; Landee, C.,							
Schoenemann, R.U.; Imajo, S.; Weickert, D.F.; Yan, J.Q.; Mandrus, D.G.; Takano, Y.; Brosha, E.L.; Rosa, P.F.S.; Nagler, S.E.; Kindo, K.; Jaime, M.,	*Thermal and magnetoelastic properties of alpha-RuCl3 in the field-induced low-temperature states*	Physical Review B	102	21	214432	10.1103/PhysRevB.102.214432	Yes
Shornikova, E.; Yakovlev, D.; Crooker, S.; Bayer, M.,	*Negatively Charged Excitons in CdSe Nanoplatelets*	American Chemical Society Nano Letters	20		1370	10.1021/acs.nanolett.9b04907	Yes
Singleton, J.,	*Temperature scaling behavior of the linear magnetoresistance observed in high-temperature superconductors*	Physical Review Materials	4		61801	10.1103/PhysRevMaterials.4.061801	Yes
Singleton, J.; Schmidt, A.C.; Bailey, C.B.; Wigger, J.M.; Krawczyk, F.,	*Information Carried by Electromagnetic Radiation Launched from Accelerated Polarization Currents*	Physical Review Applied	14		64046	10.1103/PhysRevApplied.14.064046	Yes
Walmsley, P.; Aeschlimann, S.; Straquadine, J.A.W.; Giraldo Gallo, P.L.; Riggs, S.C.; Chan, M.K.; McDonald, R.; Fisher, I.R.,	*Magnetic breakdown and charge density wave formation: A quantum oscillation study of the rare-earth tritellurides*	Physical Review B	102	15-Apr	45150	10.1103/PhysRevB.102.045150	Yes
Wildes, A.R.; Lancon, D.; Chan, M.; Weickert, F.; Harrison, N.; Simonet, V.; Zhitomirsky, M.E.; Gvozdikova, M.V.; Ziman, T.; Ronnow, H.M.,	*High field magnetization of FePS3*	Physical Review B	101		24415	10.1103/PhysRevB.101.024415	Yes
Williams, R.C.; Blackmore, W.J.; Curley, S.P.; Lees, M.R.; Birnbaum, S.M.; Singleton, J.; Huddart, B.M.; Hicken, T.J.; Lancaster, T.; Blundell, S.J.; Xiao, F.; Ozarowski, A.; Pratt, F.L.; Voneshan, D.J.; Giguchia, Z.; Baines, C.; Schlueter, J.A.; Villa, D.Y.; Manson, J.L.; Goddard, P.A.,	*Near-ideal molecule-based Haldane spin chain*	Physical Review Research	2		13082	10.1103/PhysRevResearch.2.013082	Yes
Willis, X.; Ding, X.N.; Singleton, J.; Balakirev, F.,	*Cryogenic goniometer for measurements in pulsed magnetic fields fabricated via additive manufacturing technique*	Review of Scientific Instruments	91		36102	10.1063/1.5125792	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Xiao, F.; Blackmore, W.; Huddart, B.; Gomilsek, M.; Hicken, T.; Baines, C.; Baker, P.; Pratt, F.; Blundell, S.; Lu, H.; Singleton, J.; Gawryluk, D.; Turnbull, M.; Kramer, K.; Goddard, P.; Lancaster, T.,	*Magnetic order and disorder in a quasi-two-dimensional quantum Heisenberg antiferromagnet with randomized exchange*	Physical Review B	102		174429	10.1103/PhysRevB.102.174429	Yes
Yokosuk, M.O.; Kim, H.S.; Hughey, K.D.; Kim, J.; Stier, A.; O'Neil, K.R.; Crooker, S.; Haule, K.; Vanderbilt, D.; Musfeldt, J.L.,	*Nonreciprocal directional dichroism of a chiral magnet in the visible range*	Nature Partner Journals Quantum Materials (npj)	5		20	10.1038/s41535-020-0224-6	Yes
Yu, J.; Chen, D.; Gu, J.; Chen, J.; Jiang, J.; Zhang, L.; Yu, Y.; Zhang, X.; Zapf, V.; Cheng, H.,	*Three Jahn-Teller States of Matter in Spin-Crossover System Mn(taa)*	Physical Review Letters	124		227201	10.1103/PhysRevLett.124.227201	No

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Publications generated by facilities: ASC (24)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Bai, H.; Bird, M.D.; Cooley, L.; Dixon, I.R.; Kim, K.L.; Larbalestier, D.C.; Marshall, W.S.; Trociewitz, U.P.; Weijers, H.W.; Abraimov, D.V.; Boebinger, G.S.,	*The 40 T Superconducting Magnet Project at the National High Magnetic Field Laboratory*	IEEE Transactions on Applied Superconductivity	30	4	5-Jan	10.1109/TASC.2020.2969642	Yes
Bhattarai, K.; Kim, K.L.; Kim, K.; Radcliff, K.; Hu, X.; Im, C.; Painter, T.A.; Dixon, I.R.; Larbalestier, D.C.; Lee, S.G.,	*Understanding quench in no-insulation (NI) REBCO magnets through experiments and simulations*	Superconductor Science and Technology	33		35002	10.1088/1361-6668/ab6699	Yes
Francis, A.; Abraimov, D.V.; Viouchkov, Y.L.; Su, Y.; Kametani, F.; Larbalestier, D.C.,	*Development of general expressions for the temperature and magnetic field dependence of the critical current density in coated conductors with variable properties*	Superconductor Science and Technology	33	4	44011	10.1088/1361-6668/ab73ee	Yes
Galstyan, E.; Pratap, R.; Majkic, G.; Kochat, M.; Abraimov, D.V.; Jaroszynski, J.; Selvamanickam, V.,	*In-field critical current and pinning mechanisms at 4.2 K of Zr-added REBCO coated conductors*	Superconductor Science and Technology	33	7	74007	10.1088/1361-6668/ab90c6	Yes
Hossain, S.I.; Jiang, J.; Trociewitz, U.P.; Lu, J.; Bosque, E.; Kim, Y.K.; Larbalestier, D.C.; Hellstrom, E.,	*A study on the extent of Ag protrusions in different TiO_2-coated Bi-2212 wires*	IOP Conference Series: Materials Science and Engineering	756		12017	10.1088/1757-899X/756/1/012017	Yes

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Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Hu, X.; Small, M.; Kim, K.; Kim, K.; Bhattarai, K.; Polyanskii, A.A.; Radcliff, K.; Jaroszynski, J.J.; Bong, U.; Hwan Park, J.; Hahn, S.; Larbalestier, D.C.,	*Analyses of the plastic deformation of coated conductors deconstructed from ultra-high field test coils*	Superconductor Science and Technology	33	9	95012	10.1088/1361-6668/aba79d	Yes
Jaroszynski, J.,	*A new no-insulation REBCO magnet of 32 T class*	Superconductor Science and Technology	33	8	80501	10.1088/1361-6668/ab9686	Yes
Kametani, F.; Su, Y.; Collantes, Y.; Pak, C.; Tarantini, C.; Larbalestier, D.C.; Hellstrom, E.,	*Chemically degraded grain boundaries in fine-grain Ba0.6K0.4Fe2As2 polycrystalline bulks*	Applied Physics Express	13		113002	10.35848/1882-0786/abbfdf	Yes
Kang, J.; Kim, J.; Ryan, P.J.; Xie, L.; Guo, L.; Sundahl, C.; Schad, J.; Campbell, N.; Collantes, Y.; Hellstrom, E.; Rzchowski, M.S.; Eom, C.,	*Superconductivity in undoped $BaFe_2As_2$ by tetrahedral geometry design*	Proceedings of the National Academy of Sciences of the USA (PNAS)	117	35	21170	10.1073/pnas.2001123117	Yes
Kar, S.; Sai Sandra, J.; Luo, W.; Yerraguravagari, V.; Galstyan, E.; Jaroszynski, J.J.; Abraimov, D.V.; Majkic, G.; Selvamanickam, V.,	*Progress in scale-up of REBCO STAR wire for canted cosine theta coils and future strategies with enhanced flexibility*	Superconductor Science and Technology	33	9	94001	10.1088/1361-6668/ab9e41	Yes
Kim, K.; Bhattarai, K.; Kim, K.L.; Bai, H.; Dixon, I.R.; Painter, T.A.; Bong, U.; Larbalestier, D.C.; Hahn, S.,	*Design and Performance Estimation of a 20 T 46 mm No-Insulation All-REBCO User Magnet*	IEEE Transactions on Applied Superconductivity	30	4	1–5	10.1109/TASC.2020.2975166	Yes
Kim, S.; Larbalestier, D.C.,	*Influence of variable Ca-doping on the critical current density of low-angle grain boundaries in $YBa_2Cu_3O_{7-d}$*	Journal of Applied Physics	128	10	103905	10.1063/5.0016157	Yes
Majkic, G.; Pratap, R.; Paidpilli, M.; Galstyan, E.; Kochat, M.; Goel, C.; Kar, S.; Jaroszynski, J.J.; Abraimov, D.V.; Selvamanickam, V.,	*In-field critical current performance of 4.0 μm thick film REBCO conductor with Hf addition at 4.2 K and fields up to 31.2 T*	Superconductor Science and Technology	33	7	07LT03	10.1088/1361-6668/ab9541	Yes
Matras, M.; Jiang, J.; Trociewitz, U.P.; Larbalestier, D.C.; Hellstrom, E.,	*Process to densify Bi2Sr2CaCu2O X round wire with overpressure before coil winding and final overpressure heat treatment*	Superconductor Science and Technology	33	2	25010	10.1088/1361-6668/ab5ad6	Yes
Pak, C.; Su, Y.; Collantes, Y.; Tarantini, C.; Hellstrom, E.; Larbalestier, D.C.; Kametani, F.,	*Synthesis routes to eliminate oxide impurity segregation and their influence on intergrain connectivity in K-doped $BaFe_2As_2$ polycrystalline bulks*	Superconductor Science and Technology	33		84202	10.1088/1361-6668/aba01a	Yes
Pallecchi, I.; Tarantini, C.; Hänisch, J.; Yamamoto, A.,	*Preface to the special issue 'Focus on 10 Years of Iron-Based Superconductors*	Superconductor Science and	33		90301	10.1088/1361-	No

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
		Technology				6668/ab9ad2	
Radcliff, K.J.; Walsh, R.P.; Larbalestier, D.C.; Hahn, S.,	*The Effect of Reinforcement Substrate Alloy Selection on Mechanical Properties of REBCO Coated Conductors*	IOP Conference Series: Materials Science and Engineering	756	1	12023	10.1088/1757-899X/756/1/012023	Yes
Segal, C.; Barth, C.; Falorio, I.; Zurita, A.C.; Ballarino, A.; Chaud, X.; Tarantini, C.; Lee, P.J.; Larbalestier, D.C.,	*Evidence of Kramer extrapolation inaccuracy for predicting high field Nb_3Sn properties*	Journal of Physics: Conference Series	1559		12062	10.1088/1742-6596/1559/1/012062	Yes
Seo, S.; Noh, H.; Li, N.; Jiang, J.; Tarantini, C.; Shi, R.; Jung, S.G.; Oh, M.J.; Liu, M.; Lee, J.; Gu, G.; Jo, Y.; Park, T.; Hellstrom, E.; Gao, P.; Lee, S.,	*Artificially engineered nanostrain in FeSexTe1-x superconductor thin films for supercurrent enhancement*	Nature Publishing Group (NPG) Asia Materials	12		7	10.1038/s41427-019-0186-y	Yes
Vakaliuk, O.; Werfel, F.; Jaroszynski, J.; Halbedel, B.,	*Trapped field potential of commercial Y-Ba-Cu-O bulk superconductors designed for applications*	Superconductor Science and Technology	33	9	95005	10.1088/1361-6668/ab9fc4	Yes
van der Laan, D.C.; Weiss, J.D.; Trociewitz, U.P.; Abraimov, D.V.; Francis, A.; Gillman, J.; Davis, D.S.; Kim, Y.K.; Griffin, V.S.; Miller, G.E.; Weijers, H.W.; Cooley, L.D.; Larbalestier, D.C.; Wang, X.R.,	*A CORC® cable insert solenoid: the first high-temperature superconducting insert magnet tested at currents exceeding 4 kA in 14 T background magnetic field*	Superconductor Science and Technology	33	5	05LT03	10.1088/1361-6668/ab7fbe	Yes
Wang, X.; Abraimov, D.V.; Arbelaez, D.; J Bogdanof, T.; Brouwer, L.; Caspi, S.; R Dietderich, D.; DiMarco, J.; Francis, A.; Garcia Fajardo, L.; B Ghiorso, W.; A Gourlay, S.; C Higley, H.; Marchevsky, M.; A Maruszewski, M.; S Myers, C.; O Prestemon, S.; Shen, T.; Taylor, J.; Teyber, R.; Turqueti, M.; van der Laan, D.; D Weiss, J.,	*Development and performance of a 2.9 Tesla dipole magnet using high-temperature superconducting CORC® wires*	Superconductor Science and Technology	34	1	15012	10.1088/1361-6668/abc2a5	No
Weiss, J.D.; van der Laan, D.C.; Hazelton, D.; Knoll, A.; Carota, G.; Abraimov, D.V.; Francis, A.; Small, M.A.; Bradford, G.; Jaroszynski, J.J.,	*Introduction of the next generation of CORC® wires with engineering current density exceeding 650 A mm^{-2} at 12 T based on SuperPower"s ReBCO tapes containing substrates of 25 μm thickness*	Superconductor Science and Technology	33	4	44001	10.1088/1361-6668/ab72c6	Yes

MS&T

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Yuan Huang, K.; Shi, Y.; Srpcic, J.; D Ainslie, M.; Kumar Namburi, D.; R Dennis, A.; Zhou, D.; Boll, M.; Filipenko, M.; Jaroszynski, J.; Hellstrom, E.; A Cardwell, D.; Hay Durrell, J.,	*Composite stacks for reliable > 17 T trapped fields in bulk superconductor magnets*	Superconductor Science and Technology	33		103471	10.1088/1361-6668/ab5e12	Yes

Publications generated by facilities: MS & T (36)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Afaneh, T.; Fryer, A.; Xin, Y.; Hyde, R.H.; Kapuruge, N.; Gutiérrez, H.R.,	*Large-Area Growth and Stability of Monolayer Gallium Monochalcogenides for Optoelectronic Devices*	American Chemical Society Applied Nano Materials	3	8	7879-7887	10.1021/acsanm.0c01369	Yes
Bai, H.; Bird, M.D.; Cooley, L.; Dixon, I.R.; Kim, K.L.; Larbalestier, D.C.; Marshall, W.S.; Trociewitz, U.P.; Weijers, H.W.; Abraimov, D.V.; Boebinger, G.S.,	*The 40 T Superconducting Magnet Project at the National High Magnetic Field Laboratory*	IEEE Transactions on Applied Superconductivity	30	4	5-Jan	10.1109/TASC.2020.2969642	Yes
Bao, S.; Garceau, N.; Guo, W.,	*Heat and mass transfer during a sudden loss of vacuum in a liquid helium cooled tube - Part II: Theoretical modeling*	International Journal Heat and Mass Transfer	146		118883	10.1016/j.ijheatmasstransfer.2019.118883	Yes
Bao, S.; Kanai, T.; Zhang, Y.; Cattafesta, L.N.; Guo, W.,	*Stereoscopic detection of hot spots in superfluid 4He (He II) for accelerator-cavity diagnosis*	International Journal Heat and Mass Transfer	161		120259	10.1016/j.ijheatmasstransfer.2020.120259	Yes
Bhattarai, K.; Kim, K.L.; Kim, K.; Radcliff, K.; Hu, X.; Im, C.; Painter, T.A.; Dixon, I.R.; Larbalestier, D.C.; Lee, S.G.,	*Understanding quench in no-insulation (NI) REBCO magnets through experiments and simulations*	Superconductor Science and Technology	33		35002	10.1088/1361-6668/ab6699	Yes
Bonilla, M.; Kolekar, S.; Li, J.F.; Xin, Y.; Coelho, P.M.; Lasek, K.; Zberecki, K.; Lizzit, D.; Tosi, E.; Lacovig, P.; Lizzit, S.; Batzill, M.,	*Compositional Phase Change of Early Transition Metal Diselenide (VSe_2 and $TiSe_2$) Ultrathin Films by Post-growth Annealing*	Advanced Materials Interfaces	7	15	2000497	10.1002/admi.202000497	Yes
Engstrand, T.; Wei, K.; Baumbach, R.; Xin, Y.; Latturner, S.,	*Structural Disorder in Intermetallic Boride $Pr_{21}M_{16}Te_6B_{30}$ (M = Mn, Fe): A Transition Metal Cluster and Its Evil Twin*	Inorganic Chemistry	59		2484-2494	10.1021/acs.inorgchem.9b03358	Yes
Garceau, N.; Bao, S.; Guo, W.,	*Effect of mass flow rate on gas propagation after vacuum break in a liquid helium cooled tube.*	IOP Conference Series: Materials Science and Engineering	755		12112	10.1088/1757-899x/755/1/012112	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Guo, W.; Golov, A.,	*Shape fluctuations and optical transition of He∗2 excimer tracers in superfluid 4He*	Physical Review B	101		64515	10.1103/PhysRevB.101.064515	Yes
Han, K.; Lu, J.; Toplosky, V.; Niu, R.; Goddard, R.E.; Xin, Y.; Walsh, R.; Dixon, I.R.,	*Properties of Selected High-Strength Composite Conductors With Different Strengthening Components*	IEEE Transactions on Applied Superconductivity	30	4	4301305	10.1109/TASC.2020.2981270	Yes
Juarez, E.B.; Trillaud, F.; Zermeno, F.; Weijers, H.W.; Bird, M.D.,	*Screening Currents and Hysteresis Losses in the REBCO Insert of the 32 T All-Superconducting Magnet Using T-A Homogenous Model*	IEEE Transactions on Applied Superconductivity	30	4	5-Jan	10.1109/TASC.2020.2969865	Yes
Kanai, T.; Guo, W.; Tsubota, M.; Jin, D.,	*Torque and Angular Momentum Transfer in Merging Rotating Bose-Einstein Condensates*	Physical Review Letters	124		105302	10.1103/PhysRevLett.124.105302	Yes
Kim, K.; Bhattarai, K.; Kim, K.L.; Bai, H.; Dixon, I.R.; Painter, T.A.; Bong, U.; Larbalestier, D.C.; Hahn, S.,	*Design and Performance Estimation of a 20 T 46 mm No-Insulation All-REBCO User Magnet*	IEEE Transactions on Applied Superconductivity	30	4	1–5	10.1109/TASC.2020.2975166	Yes
Kolb-Bond, D.; Berrospe-Juarez, E.; Bird, M.D.; Dixon, I.R.; Weijers, H.W.; Trillaud, F.; Zermeno, V.M.R.; Grilli, F.,	*Computing Strains Due to Screening Currents in REBCO Magnets*	IEEE Transactions on Applied Superconductivity	30	4	5-Jan	10.1109/TASC.2020.2979396	Yes
Lasek, K.; Coelho, P.M.; Zberecki, K.; Xin, Y.; Kolekar, S.K.; Li, J.; Batzill, M.,	*Molecular Beam Epitaxy of Transition Metal (Ti-, V-, and Cr-) Tellurides: From Monolayer Ditellurides to Multilayer Self-Intercalation Compounds*	American Chemical Society Nano	14		8473-8484	10.1021/acsnano.0c02712	Yes
Lu, J.; Adkins, T.; Dixon, I.R.; Nguyen, D.N.; Han, K.,	*Nondestructive Testing of High Strength Conductors for High Field Pulsed Magnets*	IEEE Transactions on Applied Superconductivity	30	4	6900405	10.1109/TASC.2020.2980525	Yes
Lu, J.; Choi, E.S.; Zhou, H.,	*Erratum: Physical properties of Hastelloy® C-276 at cryogenic temperatures [J. Appl. Phys. 103, 064908 (2008)]*	Journal of Applied Physics	127		39901	10.1063/1.5141940	Yes
Lu, J.; Xin, Y.; Lochner, E.J.; Radcliff, K.; Levitan, J.W.,	*Contact resistivity due to oxide layers between two REBCO tapes*	Superconductor Science and Technology	33	4	45001	10.1088/1361-6668/ab714d	Yes
Mao, P.; Xin, Y.; Han, K.; liu, Z.; yang, Z.,	*Formation of long-period stacking-ordered (LPSO) structures and microhardness of as-cast Mg-4.5 Zn6Y alloy*	Materials Science and Engineering A	777		139019	10.1016/j.msea.2020.139019	Yes
Marshall, W.S.; Gavrilin, A.V.; Kolb-Bond, D.J.; Radcliff, K.; Walsh, R.P.,	*Composite Mechanical Properties of Coils Made With Nickel-Alloy Laminated Bi-2223 Conductors*	IEEE Transactions on Applied Superconductivity	30	4	4-Jan	10.1109/TASC.2020.2970388	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Neu, J.N.; Graf, D.E.; Wei, K.; Gaiser, A.; Xin, Y.; Lai, Y.; Albrecht-Schmitt, T.E.; Baumbach, R.; Singh, D.J.; Siegrist, T.M.,	*Superstructures and Superconductivity Linked with Pd Intercalation in $Nb_2Pd_xSe_5$*	Chemistry of Materials	32	0	8361	10.1021/acs.chemmater.0c02291	Yes
Niu, R.; Han, K.; Xiang, Z.; Qiao, L.; Siegrist, T.M.,	*Ultra-high local plasticity in high-strength nanocomposites*	Journal of Materials Science	55		15183 – 15198	10.1007/s10853-020-05097-1	Yes
Pak, C.; Su, Y.; Collantes, Y.; Tarantini, C.; Hellstrom, E.; Larbalestier, D.C.; Kametani, F.,	*Synthesis routes to eliminate oxide impurity segregation and their influence on intergrain connectivity in K-doped $BaFe_2As_2$ polycrystalline bulks*	Superconductor Science and Technology	33		84202	10.1088/1361-6668/aba01a	Yes
Radcliff, K.J.; Walsh, R.P.; Larbalestier, D.C.; Hahn, S.,	*The Effect of Reinforcement Substrate Alloy Selection on Mechanical Properties of REBCO Coated Conductors*	IOP Conference Series: Materials Science and Engineering	756	1	12023	10.1088/1757-899X/756/1/012023	Yes
Sanavandi, H.; Bao, S.; Zhang, Y.; Keijzer, R.; Guo, W.; Cattafesta, L.N.,	*A cryogenic-helium pipe flow facility with unique double-line molecular tagging velocimetry capability*	Review of Scientific Instruments	91	5	53901	10.1063/5.0008117	Yes
Sonnenschein, V.; Tsuji, Y.; Kokuryu, S.; Kubo, W.; Suzuki, S.; Tomita, H.; Kiyanagi, Y.; Iguchi, T.; Matsushita, T.; Wada, N.; Kitaguchi, M.; Shimizu, H.M.; Hirota, K.; Shinohara, T.; Hiroi, K.; Hayashida, H.; Guo, W.; Ito, D.; Saito, Y.,	*An experimental setup for creating and imaging 4He2∗ excimer cluster tracers in superfluid helium-4 via neutron-3He absorption reaction*	Review of Scientific Instruments	91	3	33318	10.1063/1.5130919	No
Tang, Y.; Bao, S.; Kanai, T.; Guo, W.,	*Statistical properties of homogeneous and isotropic turbulence in He II measured via particle tracking velocimetry*	Physical Review Fluids	5		84602	10.1103/PhysRevFluids.5.084602	Yes
Toth, J.; Bole, S.T.,	*Conceptual Design for a Next Generation Resistive Large Bore Magnet at the NHMFL*	IEEE Transactions on Applied Superconductivity	30	4	4-Jan	10.1109/TASC.2020.2964219	Yes
Walsh, R.P.; Radcliff, K.; Lu, J.; Han, K.,	*The low temperature mechanical properties of a Nitronic 40 forging*	IOP Conference Series: Materials Science and Engineering	756	756	12001	10.1088/1757-899X/756/1/012001	Yes
Wen, X.; Bao, S.; McDonald, L.; Pierce, J.; Greene, G.L.; Crow, L.; Tong, X.; Mezzacappa, A.; Glasby, R.; Guo, W.; Fitzsimmons, M.R.,	*Imaging Fluorescence of He ∗2 Excimers Created by Neutron Capture in Liquid Helium II*	Physical Review Letters	124		134502	10.1103/PhysRevLett.124.134502	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Worku, M.; Tian, Y.; Zhou, C.K.; Lin, H.R.; Chaaban, M.; Xu, L.J.; He, Q.Q.; Beery, D.; Zhou, Y.; Lin, X.S.; Su, Y.F.; Xin, Y.; Ma, B.,	*Hollow metal halide perovskite nanocrystals with efficient blue emissions*	Science Advances	6	17	eaaz5961	10.1126/sciadv.aaz5961	Yes
Xiao, H.; zheng, S.; Xin, Y.; Xu, J.; Han, K.; Li, H.; Zhai, Q.,	*Characterization of Microstructure in High-Hardness Surface Layer of Low-Carbon Steel*	Metals	10	8	995	10.3390/met10080995	Yes
Yu, H.; Lu, J.,	*Superconducting Transformer for Superconducting Cable Testing up to 45 kA*	IEEE Transactions on Applied Superconductivity	30	4	5500204	10.1109/TASC.2020.2972502	Yes
Yui, S.; Kobayashi, H.; Tsubota, M.; Guo, W.,	*Fully Coupled Two-Fluid Dynamics in Superfluid ⁴He: Anomalous Anisotropic Velocity Fluctuations in Counterflow*	Physical Review Letters	124		155301	10.1103/PhysRevLett.124.155301	Yes
Zhao, J.; Yu, J .; Han, K.; Zhong, H .; Li, R.; Zhai, Q.,	*Effect of Coil Configuration Design on Al Solidified Structure Refinement*	Metals	10	1	53	10.3390/met10010153	Yes
Zhu, W.; Sheng, D.N.; Yang, K.,	*Topological Interface between Pfaffian and Anti-Pfaffian Order in v=5/2 Quantum Hall Effect*	Physical Review Letters	125		146802	10.1103/PhysRevLett.125.146802	Yes

Publications generated by facilities: Education at FSU (3)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Dhital, C.; Pham, D.; Lawal, T.; Bucholz, C.; Poyraz, A.; Zhang, Q.; Nepal, R.; Jin, R.; Rai, R.,	*Crystal and magnetic structure of polar oxide HoCrWO6*	Journal of Magnetism and Magnetic Materials	514		167219	10.1016/j.jmmm.2020.167219	Yes
Hughes, R.; Schellinger, J.; Billington, B.; Britsch, B.; Santiago, A.,	*A Summary of Effective Gender Equitable Teaching Practices in Informal STEM Education Spaces*	Journal of STEM Outreach	3	1	9	10.15695/jstem/v3i1.16	Yes
Hughes, R.; Schellinger, J.; Roberts, K.L.,	*The Role of Recognition in Disciplinary Identity for Girls*	Journal of Research on Science Teaching	58	3	420-455	10.1002/tea.21665	Yes

Publications generated by facilities: CMT/E (46)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Bertaina, S.U.; Vezin, H.; De Raedt, H.; Chiorescu, I.,	*Experimental protection of quantum coherence by using a phase-tunable image drive*	Scientific Reports	10	1	21643	10.1038/s41598-020-77047-5	Yes
Chauhan, P.; Mahmood, F.;	*Tunable Magnon Interactions in a Ferromagnetic Spin-1 Chain*	Physical Review Letters	124		37203	10.1103/PhysRevLett.124.037203	Yes

Education

CMT/E

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Changlani, H.J.; Koohpayeh, S.M.; Armitage, N.P.,							
Chen, K.; Chappell, G.L.; Zhang, S.; Lan, W.; Besara, T.; Huang, K.; Graf, D.E.; Balicas, L.; Reyes, A.P.; Baumbach, R.,	*Superconductivity in single crystals of $ZrP_{1.27}Se_{0.73}$*	Physical Review B	102		144522	10.1103/PhysRevB.102.144522	Yes
Chen, L.; Yang, K.,	*Construction of a series of new ν = 2/5 fractional quantum Hall wave functions by conformal field theory*	Physical Review B	102		115132	10.1103/PhysRevB.102.115132	Yes
Christensen, M.H.; Wang, X.; Schattner, Y.; Berg, E.; Fernandes, R.M.,	*Modeling Unconventional Superconductivity at the Crossover between Strong and Weak Electronic Interactions*	Physical Review Letters	125		247001	10.1103/PhysRevLett.125.247001	Yes
Engstrand, T.; Wei, K.; Baumbach, R.; Xin, Y.; Latturner, S.,	*Structural Disorder in Intermetallic Boride $Pr_{21}M_{16}Te_6B_{30}$ (M = Mn, Fe): A Transition Metal Cluster and Its Evil Twin*	Inorganic Chemistry	59		2484-2494	10.1021/acs.inorgchem.9b03358	Yes
Gorfien, M.; Wang, H.; Chen, L.; Rahmani, H.; Yu, J.; Zhu, P.; Chen, J.; Wang, X.; Zhao, J.; Cao, J.,	*Nanoscale thermal transport across an GaAs/AlGaAs heterostructure interface*	Structural Dynamics	7		25101	10.1063/1.5129629	Yes
Hassan, N.M.; Thirunavukkuarasu, K.; Lu, Z.; Smirnov, D.; Zhilyaeva, E.I.; Torunova, S.; Lyubovskaya, R.N.; Drichko, N.,	*Melting of charge order in the low-temperature state of an electronic ferroelectric-like system*	Nature Partner Journals Quantum Materials (npj)	5	1	15	10.1038/s41535-020-0217-5	Yes
Jaroszynski, J.,	*A new no-insulation REBCO magnet of 32 T class*	Superconductor Science and Technology	33	8	80501	10.1088/1361-6668/ab9686	Yes
Ju, L.; Wang, L.; Liu, X.; Moon, S.; Ozerov, M.; Lu, Z.; Taniguchi, T.; Watanabe, K.; Mueller, E.; Zhang, F.; Smirnov, D.; Rana, F.; McEuen, P.L.,	*Unconventional valley-dependent optical selection rules and landau level mixing in bilayer graphene*	Nature Communications	11	1	2941	10.1038/s41467-020-16844-y	No
Kang, J.; Vafek, O.,	*Non-Abelian Dirac node braiding and near-degeneracy of correlated phases at odd integer filling in magic-angle twisted bilayer graphene*	Physical Review B	102		35161	10.1103/PhysRevB.102.035161	Yes
Lee, K.; Melendrez, R.; Pal, A.; Changlani, H.J.,	*Exact three-colored quantum scars from geometric frustration*	Physical Review B: Rapid Comm/Letters	101		241111	10.1103/PhysRevB.101.241111	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Lee, S.; Zhou, C.; Neu, J.N.; Beery, D.; Arcidiacono, A.; Chaaban, M.; Lin, H.; Gaiser, A.; Chen, B.; Albrecht-Schmitt, T.E.; Siegrist, T.M.; Ma, B.,	*Bulk Assemblies of Lead Bromide Trimer Clusters with Geometry-Dependent Photophysical Properties*	Chemistry of Materials	32	1	374-380	10.1021/acs.chemmater.9b03893	Yes
Lesseux, G.G.; Sakai, H.; Hattori, T.; Tokunaga, Y.; Kambe, S.; Kuhns, P.L.; Reyes, A.P.; Thompson, J.D.; Pagluso, P.G.; Urbano, R.R.,	*Orbitally defined field-induced electronic state in a Kondo lattice*	Physical Review B	101		165111	10.1103/PhysRevB.101.165111	Yes
Li, S.; Drueke, E.; Porter, Z.; Jin, W.; Lu, Z.; Smirnov, D.; Merlin, R.; Wilson, S.D.; Sun, K.; Zhao, L.,	*Symmetry-Resolved Two-Magnon Excitations in a Strong Spin-Orbit-Coupled Bilayer Antiferromagnet*	Physical Review Letters	125		87202	10.1103/PhysRevLett.125.087202	Yes
Lin, Z.; Li, Z.; Deng, H.; Liu, T.; Shi, G.; Bonesteel, N.E.; Schlottmann, P.U.; Li, Y.; Xiong, P.,	*Giant enhancement of the in-plane critical field for thin Al films via proximity coupling to a topological insulator*	Physical Review B	102		144518	10.1103/PhysRevB.102.144518	No
LoCicero, S.A.; Averback, C.M.; Shumnyk, U.; Choi, E.; Talham, D.R.,	*Particle Size Effects on the Order-Disorder Phase Transition in [(CH3)2NH2]Mg(HCOO)3*	Journal of Physical Chemistry C	124	38	21113-21122	10.1021/acs.jpcc.0c04505	Yes
Lu, J.; Choi, E.S.; Zhou, H.,	*Erratum: "Physical properties of Hastelloy® C-276™ at cryogenic temperatures" [J. Appl. Phys. 103, 064908 (2008)]*	Journal of Applied Physics	127		39901	10.1063/1.5141940	Yes
Moon, B.; Han, G.; Radonjic, M.M.; Ji, H.; Dobrosavljevic, V.,	*Quantum critical scaling for finite-temperature Mott-like metal-insulator crossover in few-layered MoS2*	Physical Review B	102		245424	10.1103/PhysRevB.102.245424	Yes
Mozaffari, S.; Aryal, N.; Schoenemann, R.U.; Chen, K.; McCandless, G.T.; Chan, J.Y.; Manousakis, E.; Balicas, L.,	*Multiple Dirac nodes and symmetry protected Dirac nodal line in orthorhombic α-RhSi*	Physical Review B	102		115131	10.1103/PhysRevB.102.115131	Yes
Neu, J.N.; Graf, D.E.; Wei, K.; Gaiser, A.; Xin, Y.; Lai, Y.; Albrecht-Schmitt, T.E.; Baumbach, R.; Singh, D.J.; Siegrist, T.M.,	*Superstructures and Superconductivity Linked with Pd Intercalation in* $Nb_2Pd_xSe_5$	Chemistry of Materials	32	0	8361	10.1021/acs.chemmater.0c02291	Yes
Paul, A.; Chung, C.; Birol, T.; Changlani, H.J.,	*Spin-lattice Coupling and the Emergence of the Trimerized Phase in the S=1 Kagome Antiferromagnet Na2Ti3Cl8*	Physical Review Letters	124		167203	10.1103/PhysRevLett.124.167203	Yes
Ratkovski, D.R.; Balicas, L.; Bangura, A.; Machado, F.; Rezende, S.,	*Thermal transport in yttrium iron garnet at very high magnetic fields*	Physical Review B	101		174442	10.1103/PhysRevB.101.174442	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Saubert, S.; Scheie, A.; Duvinage, C.; Kindervater, J.; Zhang, S.; Changlani, H.J.; Xu, G.; Koohpayeh, S.M.; Tchernyshyov, O.; Broholm, C.L.; Pfleiderer, C.,	*Orientation dependence of the magnetic phase diagram of $Yb_2Ti_2O_7$*	Physical Review B	101		174434	10.1103/PhysRevB.101.174434	Yes
Scheie, A.; Kindervater, J.; Zhang, S.; Changlani, H.J.; Sala, G.; Ehlers, G.; Heinemann, A.; Tucker, G.S.; Koohpayeh, S.M.; Broholm, C.,	*Multiphase magnetism in Yb2Ti2O7*	Proceedings of the National Academy of Sciences of the USA (PNAS)	117	44	27245-27254	10.1073/pnas.2008791117	Yes
Sen, S.; Vidhyadhiraja, N.S.; Miranda, E.; Dobrosavljevic, V.; Ku, W.,	*Fragility of the Kondo insulating gap against disorder: Relevance to recent puzzles in topological Kondo insulators*	Physical Review Research	2		33370	10.1103/PhysRevResearch.2.033370	Yes
Shao, Y.; Rudenko, A.N.; Hu, J.; Sun, Z.; Zhu, Y.; Moon, S.; Millis, A.J.; Yuan, S.; Lichtenstein, A.I.; Smirnov, D.; Mao, Z.Q.; Katsnelson, M.I.; Basov, D.N.,	*Electronic correlations in nodal-line semimetals*	Nature Physics	16	6	636-641	10.1038/s41567-020-0859-z	Yes
Shashkin, A.A.; Melnikov, M.Y.; Dolgopolov, V.T.; Radonjic, M.M.; Dobrosavljevic, V.; Huang, S.H.; Liu, C.W.; Zhu, A.Y.; Kravchenko, S.V.,	*Manifestation of strong correlations in transport in ultraclean SiGe/Si/SiGe quantum wells*	Physical Review B: Rapid Comm/Letters	102		81119	10.1103/PhysRevB.102.081119	Yes
Shi, Q.; Shih, E.M.; Gustafsson, M.V.; Rhodes, D.A.; Kim, B.; Watanabe, K.; Taniguchi, T.; Papic, Z.; Hone, J.; Dean, C.R.,	*Odd- and even-denominator fractional quantum Hall states in monolayer WSe2.*	Nature Nanotechnology	15		569-573	10.1038/s41565-020-0685-6	Yes
Shi, Z.; Baity, P.G.; Sasagawa, T.; Popovic, D.,	*Vortex phase diagram and the normal state of cuprates with charge and spin orders*	Science Advances	6		eaay8946	10.1126/sciadv.aay8946	Yes
Shi, Z.; Baity, P.G.; Terzic, J.; Sasagawa, T.; Popovic, D.,	*Pair density wave at high magnetic fields in cuprates with charge and spin orders*	Nature Communications	11		3323	10.1038/s41467-020-17138-z	Yes
Suarez-Villagran, M.Y.; Mitsakos, N.; Lee, T.; Dobrosavljevic, V.; Miller, J.H.; Miranda, E.,	*Two-dimensional disordered Mott metal-insulator transition*	Physical Review B	101		235112	10.1103/PhysRevB.101.235112	Yes
Ungor, O.; Phan, H.; Choi, E.; Roth, J.K.; Shatruk, M.,	*Magnetism and electrical conductivity of molecular semiconductor, [Fe(DMF)4(TCNQ)2](TCNQ)2, with fractionally charged TCNQ units*	Journal of Magnetism and Magnetic Materials	497		165984	10.1016/j.jmmm.2019.165984	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Vafek, O.; Kang, J.,	*Renormalization Group Study of Hidden Symmetry in Twisted Bilayer Graphene with Coulomb Interactions*	Physical Review Letters	125		257602	10.1103/PhysRevLett.125.257602	Yes
Wang, T.; Li, Z.; Lu, Z.; Li, Y.; Miao, S.; Lian, Z.; Meng, Y.; Blei, M.; Taniguchi, T.; Watanabe, K.; Tongay, S.; Yao, W.; Smirnov, D.; Zhang, C.; Shi, S.,	*Observation of Quantized Exciton Energies in Monolayer WSe2 under a Strong Magnetic Field*	Physical Review X	10		21024	10.1103/PhysRevX.10.021024	Yes
Wang, T.; Miao, S.; Li, Z.; Meng, Y.; Lu, Z.; Lian, Z.; Blei, M.; Taniguchi, T.; Watanabe, K.; Tongay, S.; Smirnov, D.; Shi, S.,	*Giant Valley-Zeeman Splitting from Spin-Singlet and Spin-Triplet Interlayer Excitons in WSe2/MoSe2 Heterostructure*	American Chemical Society Nano Letters	20	1	694	10.1021/acs.nanolett.9b04528	Yes
Wang, X.; Li, J.; Cao, J.,	*Coherent phonon generation in laser-heated gold nanofilm*	Journal of Chemical Physics	152		124704	10.1063/1.5137818	Yes
Wang, X.; Vafek, O.,	*Diagnosis of explicit symmetry breaking in the tight-binding constructions for symmetry-protected topological systems*	Physical Review B	102		75142	10.1103/PhysRevB.102.075142	Yes
Yang, K.,	*Phase-space quantum mechanics as a Landau-level problem*	Physical Review A	102		12222	10.1103/PhysRevA.102.012222	Yes
Yang, M.; Robert, C.; Lu, Z.; Van Tuan, D.; Smirnov, D.; Marie, X.; Dery, H.,	*Exciton valley depolarization in monolayer transition-metal dichalcogenides*	Physical Review B	101		115307	10.1103/PhysRevB.101.115307	Yes
Yu, Y.; Brown, S.; Raghu, S.; Yang, K.,	*Critical temperature Tc and Pauli limited critical field of Sr2RuO4: Uniaxial strain dependence*	Physical Review B	102		14509	10.1103/PhysRevB.102.014509	Yes
Zeuch, D.; Bonesteel, N.E.,	*Efficient two-qubit pulse sequences beyond CNOT*	Physical Review B	102		75311	10.1103/PhysRevB.102.075311	Yes
Zhang, F.; Zheng, W.; Lu, Y.; Pabbi, L.; Fujizawa, K.; Elias, A.L.; Binnion, A.R.; Granzier-Nakajima, T.; Zhang, T.; Lei, Y.; Lin, Z.; Hudson, E.W.; Sinnott, S.B.; Balicas, L.; Terrones, M.,	*Superconductivity enhancement in phase-engineered molybdenum carbide/disulfide vertical heterostructures*	Proceedings of the National Academy of Sciences of the USA (PNAS)	117	33	19685-19693	10.1073/pnas.2003422117	Yes
Zheng, C.; Yang, K.; Wan, X.,	*Thouless conductances of a three-dimensional quantum Hall system*	Physical Review B	102		64208	10.1103/PhysRevB.102.064208	Yes
Zheng, W.; Schoenemann, R.U.; Mozaffari, S.; Chiu, Y.C.; Goraum, Z.B.; Aryal, N.; Manousakis, E.; Siegrist, T.M.; Wei, K.; Balicas, L.,	*Bulk Fermi surfaces of the Dirac type-II semimetallic candidate $NiTe_2$*	Physical Review B	102		125103	10.1103/PhysRevB.102.125103	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Zhou, C.; Lee, S.; Lin, H.; Neu, J.N.; Chaaban, M.; Xu, L.; Arcidiacono, A.; He, Q.; Worku, M.; Ledbetter, L.; Lin, X.; Schlueter, J.A.; Siegrist, T.M.; Ma, B.,	*Bulk Assembly of Multicomponent Zero-Dimensional Metal Halides with Dual Emission*	American Chemical Society Materials Letters	2	4	376-380	10.1021/acsmaterialslett.0c00011	Yes

Publications generated by facilities: Geochemistry Facility (16)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Abadi, M.; Owens, J.D.; Liu, X.; Them, T.; Cui, X.; Heavens, N.; Soreghan, G.,	*Atmospheric dust stimulated marine primary productivity during Earth's penultimate icehouse*	Geology	48	3	247--251	10.1130/G46977.1	No
Abshire, M.L.; Owens, J.D.; Cofrancesco, J.; Inthorn, M.; Riedinger, N.,	*Geochemical Signatures for Redepositional Environments: The Namibia Continental Margin*	Marine Geology	429		106316	10.1016/j.margeo.2020.106316	Yes
Bowman, C.N.; Lindskog, A.; Kozik, N.; Richbourg, C.; Owens, J.D.; Young, S.A.,	*Integrated sedimentary, biotic, and paleoredox dynamics from multiple localities in southern Laurentia during the late Silurian (Ludfordian) extinction event*	Palaeogeography, Palaeoclimatology, Palaeoecology	553		109799	10.1016/j.palaeo.2020.109799	Yes
Bryant, R.N.; Jones, C.; Raven, M.R.; Owens, J.D.; Fike, D.A.,	*Shifting modes of iron sulfidization at the onset of OAE-2 drive regional shifts in pyrite δ34S records*	Chemical Geology	553		119808	10.1016/j.chemgeo.2020.119808	Yes
Bundy, R.M.; Tagliabue, A.; Hawco, N.J.; Morton, P.; Twining, B.S.; Hatta, M.; Noble, A.E.; Cape, M.R.; John, S.G.; Cullen, J.T.; Saito, M.A.,	*Elevated sources of cobalt in the Arctic Ocean*	Journal of Geophysical Research Biogeosciences	17	19	4745--4767	10.5194/bg-17-4745-2020	Yes
Fan, H.; Nielsen, S.; Owens, J.D.; Auro, M.; Shu, Y.; Hardisty, D.; Horner, T.; Bowman, C.N.; Young, S.A.; Wen, H.,	*Constraining oceanic oxygenation during the Shuram excursion in South China using thallium isotopes*	Geobiology	18	3	348--365	10.1111/gbi.12379	Yes
Gong, Y.; Wang, Y.Q.; Wang, Y.; Mao, F.; Bai, B.; Wang, H.; Qian, L.; Jin, X.; Wang, X.; Meng, J.,	*Dietary adaptations and paleoecology of Lophialetidae (Mammalia: Tapiroidea) from the Eocene of the Erlian Basin, China: Combined evidence from mesowear and stable isotope analyses.*	Palaeontology	63	4	547-564	10.1111/pala.12471	Yes
Hawkings, J.R.; Skidmore, M.L.; Wadham, J.L.; Priscu, J.C.; Morton, P.L.; Hatton, J.E.; Gardner, C.B.; Kohler, T.J.; Stibal, M.; Bagshaw, E.A.; Steigmeyer, A.; Barker, J.; Dore, J.E.; Lyons, W.B.; Tranter, M.;	*Enhanced trace element mobilization by Earth's ice sheets*	Proceedings of the National Academy of Sciences of the USA (PNAS)	117	50	31648-31659	10.1073/pnas.2014378117	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Spencer, R.G.M.; SALSA Science Team, .,							
Jensen, L.T.; Morton, P.L.; Twining, B.S.; Heller, M.I.; Hatta, M.; Measures, C.I.; John, S.G.; Zhang, R.; Pinedo-Gonzalez, P.; Sherrell, R.M.; Fitzsimmons, J.N.,	*A comparison of marine Fe and Mn cycling: US GEOTRACES GN01 Western Arctic case study*	Geochimica et Cosmochimica Acta	288		138--160	10.1016/j.gca.2020.08.006	Yes
Ostrander, C.M.; Owens, J.D.; Nielsen, S.G.; Lyons, T.W.; Shu, Y.; Chen, X.; Sperling, E.A.; Jiang, G.; Johnston, D.T.; Sahoo, S.K.; Anbar, A.D.,	*Thallium isotope ratios in shales from South China and northwestern Canada suggest widespread O2 accumulation in marine bottom waters was an uncommon occurrence during the Ediacaran Period*	Chemical Geology	557		119856	10.1016/j.chemgeo.2020.119856	Yes
Wang, J.; Zhou, H.; Salters, V.J.; Dick, H.J.B.; Standish, J.J.; Wang, C.,	*Trace element and isotopic evidence for recycled lithosphere at basalts from 48°E to 53°E, Southwest Indian Ridge*	Journal of Petrology	61		0	10.1093/petrology/egaa068	Yes
Willig, M.; Stracke, A.; Beier, C.; Salters, V.J.,	*Constraints on mantle evolution from Ce-Nd-Hf isotope systematics*	Geochimica et Cosmochimica Acta	272		36-53	10.1016/j.gca.2019.12.029	Yes
Wu, F.; Owens, J.D.; Scholz, F.; Huang, L.; Li, S.; Riedinger, N.; Peterson, L.; German, C.; Nielsen, S.,	*Sedimentary vanadium isotope signatures in low oxygen marine conditions*	Geochimica et Cosmochimica Acta	284		134-155	10.1016/j.gca.2020.06.013	No
Wu, X.; Zhang, L.; Hu, B. X.; Wang, Y.; Xu, Z.,	*Isotopic and hydrochemical evidence for the salinity origin in the coastal aquifers of the Pearl River Delta, Guangzhou, China.*	Journal of Contaminant Hydrology	235		103732	10.1016/j.jconhyd.2020.103732	Yes
Yang, S.; Humayun, M.; Salters, V.J.,	*Elemental constraints on the amount of recycled crust in the generation of mid-ocean ridge basalts (MORB)*	Science Advances	6	26	eaba2923	10.1126/sciadv.aba2923	Yes
Young, S.A.; Benayoun, E.; Kozik, N.; Hints, O.; Martma, T.; Bergström, S.T.; Owens, J.D.,	*Marine redox variability from Baltica during extinction events in the latest Ordovician--early Silurian*	Palaeogeography, Palaeoclimatology, Palaeoecology	554		109792	10.1016/j.palaeo.2020.109792	Yes

Publications generated by facilities: MBI at UF[1] (37)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Albizu, A.; Fang, R.; Indahlastari, A.; O'Shea, A.; Stolte, S.; See, K.; Boutzoukas, E.; Kraft, J.; Nissim, N.; Woods, A.,	*Machine learning and individual variability in electric field characteristics predict tDCS treatment response*	Brain Stimulation	13	6	1753--1764	10.1016/j.brs.2020.10.001	No

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Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Archer, D.B.; Mitchell, T.; Burciu, R.G.; Yang, J.; Nigro, S.; Quattrone, AL.; Quattrone, AN.; Jeromin, A.; McFarland, N.R.; Okun, M.S.; Vaillancourt, D.E.,	*Magnetic Resonance Imaging and Neurofilament Light in the Differentiation of Parkinsonism*	Movement Disorders	35	8	1388-1395	10.1002/mds.28060	No
Barnard, A.M.; Willcocks, R.J.; Triplett, W.T.; Forbes, S.C.; Daniels, M.J.; Chakraborty, S.; Lott, D.J.; Senesac, C.R.; Finanger, E.L.; Harrington, A.T.; Tennekoon, G.; Arora, H.; Wang, D.J.; Sweeney, H.L.; Rooney, W.D.; Walter, G.A.; Vandenborne, K.,	*MR biomarkers predict clinical function in Duchenne muscular dystrophy*	Neurology	94	9	e897-e909	10.1212/WNL.0000000000009012	No
Bikson, M.; et all	*Guidelines for TMS/tES clinical services and research through the COVID-19 pandemic*	Brain Stimulation	13	4	1124-1149	10.1016/j.brs.2020.05.010	No
Bogoian, H.R.; King, T.Z.; Turner, J.A.; Semmel, E.S.; Dotson, V.M.,	*Linking depressive symptom dimensions to cerebellar subregion volumes in later life*	Translational Psychiatry	10	1	1--8	10.1038/s41398-020-00883-6	Yes
Boissoneault, J.; Penza, C.W.; George, S.Z.; Robinson, M.E.; Bishop, M.D.,	*Comparison of brain structure between pain-susceptible and asymptomatic individuals following experimental induction of low back pain*	Spine Journal	20	2	292-299	10.1016/j.spinee.2019.08.015	Yes
Boissoneault, J.; Sevel, L.; Stennett, B.; Alappattu, M.; Bishop, M.; Robinson, M.,	*Regional increases in brain signal variability are associated with pain intensity reductions following repeated eccentric exercise bouts*	European Journal of Pain	24	4	e1532	10.1002/ejp.1532	Yes
Boissoneault, J.; Stennett, B.; Robinson, M.E.,	*Acute alcohol intake alters resting state functional connectivity of nucleus accumbens with pain-related corticolimbic structures*	Drug and Alcohol Dependence	207		107811	10.1016/j.drugalcdep.2019.107811	No
Bril, F.; Barb, D.; Lomonaco, R.; Lai, J.; Cusi, K.,	*Change in hepatic fat content measured by MRI does not predict treatment-induced histological improvement of steatohepatitis*	Journal of Hepatology	72	3	401--410	10.1016/j.jhep.2019.09.018	No
Bril, F.; McPhaul, M.J.; Caulfield, M.P.; Clark, V.C.; Soldevilla-Pico, C.; Firpi-Morell, R.J.; Lai, J.P.; Shiffman, D.; Rowland, C.M.; Cusi, K.,	*Performance of Plasma Biomarkers and Diagnostic Panels for Nonalcoholic Steatohepatitis and Advanced Fibrosis in Patients With Type 2 Diabetes*	Diabetes Care	43	2	290--297	10.2337/dc19-1071	No
Britton, M.; Porges, E.; Bryant, V.; Cohen, R.,	*Neuroimaging and Cognitive Evidence for Combined HIV-Alcohol Effects on the Central Nervous System: A Review*	Alcoholism Clinical and Experimental Research			14530	10.1111/acer.14530	No

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Bryant, V.; Gullett, J.; Porges, E.; Cook, R.; Bryant, K.; Woods, A.; Williamson, J.; Ennis, N.; Cohen, R.,	*History of Alcohol Consumption and HIV Status Related to Functional Connectivity Differences in the Brain During Working Memory Performance*	Current HIV Research	18	3	181-193	10.2174/1570162X18666200217100123	No
Chen, Q.Y.; Luo, D.; Seabra, G.M.; Luesch, H.,	*Ahp-Cyclodepsipeptides as tunable inhibitors of human neutrophil elastase and kallikrein 7: Total synthesis of tutuilamide A, serine protease selectivity profile and comparison with lyngbyastatin 7*	Bioorganic and Medicinal Chemistry	28	23	115756	10.1016/j.bmc.2020.115756	No
Clark, D.J.; Manini, T.M.; Ferris, D.P.; Hass, C.J.; Brumback, B.A.; Cruz-Almeida, Y.; Pahor, M.; Reuter-Lorenz, P.A.; Seidler, R.D.,	*Multimodal imaging of brain activity to investigate walking and mobility decline in older adults (mind in motion study): Hypothesis, theory, and methods*	Frontiers in Aging Neuroscience	11		358	10.3389/fnagi.2019.00358	No
Diaz-Manera, J.; Walter, G.A.; Straub, V.,	*Skeletal muscle magnetic resonance imaging in Pompe disease*	Muscle and Nerve	ePub		11-Jan	10.1002/mus.27099	No
Forbes, S.C.; Arora, H.; Willcocks, R.J.; Triplett, W.T.; Rooney, W.D.; Barnard, A.M.; Alabasi, U.; Wang, D.J.; Lott, D.J.; Senesac, C.R.; Harrington, A.T.; Finanger, E.L.; Tennekoon, G.I.; Brandsema, J.; Daniels, M.J.; Sweeney, H.L.; Walter, G.A.; Vandenborne, K.H.E.,	*Upper and Lower Extremities in Duchenne Muscular Dystrophy Evaluated with Quantitative MRI and Proton MR Spectroscopy in a Multicenter Cohort*	Radiology	295	3	616-625	10.1148/radiol.2020192210	Yes
Gullett, J.M.; O'Shea, A.; Lamb, D.G.; Porges, E.C.; O'Shea, D.M.; Pasternak, O.; Cohen, R.A.; Woods, A.J.,	*The Association of White Matter Free Water with Cognition in Older Adults*	NeuroImage	219		117040	10.1016/j.neuroimage.2020.117040	No
Hausman, H.K.; O'Shea, A.; Kraft, J.N.; Boutzoukas, E.M.; Evangelista, N.D.; Van Etten, E.J.; Bharadwaj, P.K.; Smith, S.G.; Porges, E.; Hishaw, G.A.; Wu, S.; DeKosky, S.; Alexander, G.E.; Marsiske, M.; Cohen, R.; Woods, A.J.,	*The Role of Resting-State Network Functional Connectivity in Cognitive Aging*	Frontiers in Aging Neuroscience	12		177	10.3389/fnagi.2020.00177	No
Judge, S.M.; Deyhle, M.R.; Neyroud, D.; Nosacka, R.L.; D'Lugos, A.C.; Cameron, M.E.; Vohra, R.S.; Smuder, A.J.; Roberts, B.M.; Callaway, C.S.; Underwood, P.W.; Chrzanowski, S.M.; Batra, A.; Murphy, M.E.; Heaven, J.D.; Walter,	*MEF2c-Dependent Downregulation of Myocilin Mediates Cancer-Induced Muscle Wasting and Associates with Cachexia in Patients with Cancer*	Cancer Research	80	9	1861--1874	10.1158/0008-5472.CAN-19-1558	No

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
G.A.; Trevino, J.G.; Judge, A.R.,							
Kraft, J.N.; O'Shea, A.; Albizu, A.; Evangelista, N.D.; Hausman, H.K.; Boutzoukas, E.; Nissim, N.R.; Van Etten, E.J.; Bharadwaj, P.K.; Song, H.; Smith, S.G.; Porges, E.; DeKosky, S.; Hishaw, G.A.; Wu, S.; Marsiske, M.; Cohen, R.; Alexander, G.E.; Woods, A.J.,	*Structural Neural Correlates of Double Decision Performance in Older Adults*	Frontiers in Aging Neuroscience	12		278	10.3389/fnagi.2020.00278	No
Lins-Austin, B.; Patel, S.; Mietzsch, M.; Brooke, D.; Bennett, A.; Venkatakrishnan, B.; Van Vliet, K.; Smith, A.N.; Long, J.R.; McKenna, R.; Potter, M.; Byrne, B.; Boye, S.L.; Bothner, B.; Heilbronn, R.; Agbandje-McKenna, M.,	*Adeno-associated virus (AAV) Capsid stability and liposome remodeling during Endo/Lysosomal pH trafficking*	Viruses	12	6	668	10.3390/v12060668	No
Lott, D.; Taivassalo, T.; Cooke, K.; Park, H.; Moslemi, Z.; Batra, A.; Forbes, S.C.; Byrne, B.; Walter, G.A.; Vandenborne, K.H.E.,	*Safety, feasibility, and efficacy of strengthening exercise in Duchenne muscular dystrophy*	Muscle and Nerve			27137	10.1002/mus.27137	Yes
Makwana, B.; Tart-Zelvin, A.; Xu, X.M.; Gunstad, J.J.; Cote, D.M.; Poppas, A.; Cohen, R.A.; Sweet, L.H.,	*Cerebrovascular Perfusion among Older Adults with and Without Cardiovascular Disease*	Journal of Neuroimaging	30	6	851-856	10.1111/jon.12757	No
McCrae, C.S.; Curtis, A.F.; Miller, M.B.; Nair, N.; Rathinakumar, H.; Davenport, M.; Berry, J.R.; McGovney, K.; Staud, R.; Berry, R.; Robinson, M.,	*Effect of cognitive behavioral therapy on sleep and opioid medication use in adults with fibromyalgia and insomnia*	Journal of Sleep Research	29	6	e13020	10.1111/jsr.13020	No
Meyerspeer, M.; Boesch, C.; Cameron, D.; Dezortova, M.; Forbes, S.C.; Heerschap, A.; Jeneson, J.A.L.; Kan, H.M.E.; Kent, J.; Layec, G.; Prompers, J.J.; Reyngoudt, H.; Sleigh, A.; Valkovic, L.; Kemp, G.J.; Baligand, C.; Carlier, P.G.; Chatel, B.; Damon, B.; Heskamp, L.; Hajek, M.; Jooijmans, M.; Krssak, M.; Reichenbach, J.; Schmid, A.; Slade, J.; Vandenborne, K.H.E.; Walter, G.A.; Willis, D.,	*^{31}P magnetic resonance spectroscopy in skeletal muscle: Experts' consensus recommendations*	NMR in Biomedicine	Special		22-Jan	10.1002/nbm.4246	No

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Nigro, S.; Antonini, A.; Vaillancourt, D.E.; Seppi, K.; Ceravolo, R.; Strafella, A.P.; Augimeri, A.; Quattrone, AN.; Morelli, M.; Weis, L.; Fiorenzato, E.; Biundo, R.; Burciu, R.G.; Krismer, F.; McFarland, N.R.; Mueller, C.; Gizewski, E.R.; Cosottini, M.; Del Prete, E.; Mazzucchi, S.; Quattrone, AL.,	*Automated MRI Classification in Progressive Supranuclear Palsy: a Large International Cohort Study*	Movement Disorders	35	6	976-983	10.1002/mds.28007	No
Povazan, M.; et all	*Comparison of multivendor single-voxel MR spectroscopy data acquired in healthy brain at 26 sites*	Radiology	295	1	171-180	10.1148/radiol.2020191037	No
Quattrone, A.; Antonini, A.; Vaillancourt, D.; Seppi, K.; Ceravolo, R.; Strafella, A.; Morelli, M.; Nigro, S.; Vescio, B.; Bianco, M.; Vasta, R.; Arcuri, P.; Weis, L.; Fiorenzato, E.; Biundo, R.; Burciu, R.; Krismer, F.; McFarland, N.; Mueller, C.; Gizewski, E.; Cosottini, M.; Del Prete, E.; Mazzucchi, S.; Quattrone, A.,	*A New MRI Measure to Early Differentiate Progressive Supranuclear Palsy From De Novo Parkinson''s Disease in Clinical Practice: An International Study*	Movement Disorders	ePub		10-Jan	10.1002/mds.28364	No
Rooney, W.D.; Berlow, Y.A.; Triplett, W.T.; Forbes, S.C.; Willcocks, R.J.; Wang, D.J.; Arpan, I.; Arora, H.; Senesac, C.; Lott, D.J.; Tennekoon, G.; Finkel, R.; Russman, B.S.; Finanger, E.L.; Chakraborty, S.; O'Brien, E.; Moloney, B.; Barnard, A.; Sweeney, H.L.; Daniels, M.J.; Walter, G.A.; Vandenborne, K.H.E.,	*Modeling disease trajectory in Duchenne muscular dystrophy*	Restorative Neurology and Neuroscience	94	15	e1622 -- e1633	10.1212/WNL.0000000000009244	No
Salazar, A.P.; Hupfeld, K.E.; Lee, J.K.; Beltran, N.E.; Kofman, I.S.; De Dios, Y.E.; Mulder, E.; Bloomberg, J.J.; Mulavara, A.P.; Seidler, R.D.,	*Neural Working Memory Changes During a Spaceflight Analog With Elevated Carbon Dioxide: A Pilot Study*	Frontiers in Systems Neuroscience	14		48	10.3389/fnsys.2020.00048	No
Saleh, M.G.; Wang, M.; Mikkelsen, M.; Hui, S.C.N.; Oeltzschner, G.; Boissoneault, J.; Stennett, B.; Edden, R.A.E.; Porges, E.C.,	*Simultaneous edited MRS of GABA, glutathione, and ethanol*	NMR in Biomedicine	33	4	e4227	10.1002/nbm.4227	Yes
Sambuco, N.; Bradley, M.M.; Herring, D.R.; Lang, P.J.,	*Common circuit or paradigm shift? The functional brain in emotional scene*	Psychophysiology	57	4	e13522	10.1111/psyp.13522	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
	perception and emotional imagery						
Sevel, L.; Boissoneault, J.; Alappattu, M.J.; Bishop, M.D.; Robinson, M.E.,	*Training Endogenous Pain Modulation: A Preliminary Investigation of Neural Adaptation Following Repeated Exposure to Clinically-Relevant Pain*	Brain Imaging and Behavior	14	3	881-896	10.1007/s11682-018-0033-8	No
Sevel, L.; Stennett, B.; Schneider, V.; Bush, N.; Nixon, S.J.; Robinson, M.; Boissoneault, J.,	*Acute Alcohol Intake Produces Widespread Decreases in Cortical Resting Signal Variability in Healthy Social Drinkers*	Alcoholism Clinical and Experimental Research	44	7	1410-1419	10.1111/acer.14381	No
Terry, E.; Tanner, J.; Cardoso, J.; Sibille, K.; Lai, S.; Deshpande, H.; Deutsch, G.; Goodin, B.; Bradley, L.; Price, C.C.; Fillingim, R.B.; Team, U.,	*Associations of pain catastrophizing with pain-related brain structure in individuals with or at risk for knee osteoarthritis: Sociodemographic considerations*	Brain Imaging and Behavior	ePub		9-Jan	10.1007/s11682-020-00372-w	No
Thompson, P.M.; et all	*ENIGMA and global neuroscience: A decade of large-scale studies of the brain in health and disease across more than 40 countries*	Translational Psychiatry	10	1	28-Jan	10.1038/s41398-020-0705-1	No
Yacoubi, B.; Casamento-Moran, A.; Burciu, R.G.; Subramony, S.H.; Vaillancourt, D.E.; Christou, E.A.,	*Temporal invariance in SCA6 is related to smaller cerebellar lobule VI and greater disease severity*	Journal of Neuroscience Research	40	8	1722-1731	10.1523/JNEUROSCI.1532-19.2019	No

Publications generated by facilities: UF Physics (9)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Du, Y.; Behera, R.; Maligal-Ganesh, R.; Chen, M.; Chekmenev, E.; Huang, W.; Bowers, C.,	*Cyclopropane Hydrogenation vs Isomerization over Pt and Pt--Sn Intermetallic Nanoparticle Catalysts: A Parahydrogen Spin-Labeling Study*	Journal of Physical Chemistry C	124	15	8304--8309	10.1021/acs.jpcc.0c02493	Yes
Du, Y.; Zhou, R.; Ferrer, M.; Chen, M.; Graham, J.; Malphurs, B.; Labbe, G.; Huang, W.; Bowers, C.,	*An Inexpensive Apparatus for up to 97% Continuous-Flow Parahydrogen Enrichment Using Liquid Helium*	Journal of Magnetic Resonance	321		106869	10.1016/j.jmr.2020.106869	Yes
Elmslie, T.A.; VanGennep, D.; Bi, W.; Lai, Y.; Weir, S.T.; Vohra, Y.K.; Baumbach, R.E.; Hamlin, J.J.,	*Pressure-induced suppression of ferromagnetism in* $CePd_2P_2$	Physical Review B	102		125146	10.1103/PhysRevB.102.125146	Yes
Huan, C.; Adams, J.; Lewkowitz, M.; Masuhara, N.; Candela, D.; Sullivan, N.S.,	*NMR Studies of the Dynamics of 1D 3He in 4He Plated MCM-41*	Journal of Low Temperature Physics	201		146	10.1007/s10909-020-02358-w	Yes
Huan, C.; Hamida, J.A.; Sullivan, N.S.,	*NMR studies of the dynamics of HD adsorbed in MCM-41*	Microporous	294		109921	10.1016/j.micromeso.2019.109921	Yes

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Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
		and Mesoporous Materials					
Pajerowski, D.M.; Manson, J.L.; Herbrych, J.; Bendix, J.; Podlesnyak, A.A.; Cain, J.M.; Meisel, M.W.,	*Inelastic neutron scattering study of the anisotropic S = 1 spin chain [Ni(HF$_2$)(3-Clpyridine)$_4$]BF$_4$*	Physical Review B	101		94431	10.1103/PhysRevB.101.094431	Yes
Pei, Y.; Chen, M.; Zhong, X.; Zhao, T.; Ferrer, M.; Maligal-Ganesh, R.; Ma, T.; Zhang, B.; Qi, Z.; Zhou, L.; Bowers, C.; Liu, C.; Huang, W.,	*Pairwise semi-hydrogenation of alkyne to cis-alkene on platinum-tin intermetallic compounds*	Nanoscale Research Letters	12	15	8519--8524	10.1039/D0NR00920B	Yes
Romer, A.T.; Maier, T.A.; Kreisel, A.; Eremin, I.; Hirschfeld, P.J.; Andersen, B.M.,	*Pairing in the two-dimensional Hubbard model from weak to strong coupling*	Physical Review Research	2		13108	10.1103/PhysRevResearch.2.013108	No
Song, B.; Choi, D.; Xin, Y.; Bowers, C.R.; Hagelin-Weaver, H.,	*Ultra-Low Loading Pt/CeO2 Catalysts: Ceria Facet Effect Affords Improved Pairwise Selectivity for Parahydrogen Enhanced NMR*	Angewandte Chemie				10.1002/anie.202012469	Yes

Books, Chapters, Reviews and Other One-Time Publications (5)

Authors	Title	Facility
Bird, M.D.,	*Ultra-High Field Solenoids and Axion Detection*	MS & T
Pradhan, N.R.; Thantirige, R.; Patil, P.D.; McGill, S.A.; and Talapatra, S.,	*Chapter 6: Electronic and optoelectronic properties of the heterostructure devices composed of two-dimensional layered materials*	DC Field Facility
Pradhan, Nihar R.; Thantirige, Rukshan; Patil; Prasanna D.;McGill; Stephen A. and Tallapatra, Saikat,	*Electronic and optoelectronic properties of the heterostructure devices composed of two-dimensional layered materials*	DC Field Facility
Singleton, J.,	*Nineteenth Century Small Organ Design on the Other Side of the Pond*	Pulsed Field Facility at LANL
Sitther, V.; Tabatabai, B.; Fathabad, S.G.; Gichuki, S.; Chen, H. and Arumanayagam, C.S.,	*Cyanobacteria as a Biofuel Source: Advances and Applications*	ICR Facility

Patents & Other Products (3)

Authors	Title	Facility
Bowers, C.R.; Zhao, W.,	*Methods and systems for producing, using, and administering hyperpolarized fluids (US Patent App. 16/753,875)*	AMRIS Facility at UF, UF Physics
Chang, N.-B.; Wanielista, M.P.,	*Iron Fillings-based Green Environmental Media for Nutrient Removal and Methods of Use*	ICR Facility
Pradhan, Nihar and McGill, Stephen A.,	*Phase Modulators Based On Ambipolar Field-Effect Transistors, US Patent 10,854,740*	DC Field Facility

Internet Disseminations (19)

Authors	Title	Facility
Cheggour, N. and Marks, E.L.,	*On the Need for Protocols and Standard Procedures for Studying Ic(strain) in Bi-2212 Wires*	MS & T, Applied Superconductivity Center

Authors	Title	Facility
Grissonnanche G.; Fang Y.; Legros A.; Verret S.; Laliberté F.; Collignon C.; Zhou J.; Graf D.; Goddard P.; Taillefer L.; Ramshaw B.J.,	*Measurement of the Planckian scattering rate*	DC Field Facility, CMT/E, MS & T
Grockowiak D.; Ahart M.; Helm T.; Coniglio W.A.; Kumar R.; Somayazulu M.; Meng Y.; Oliff M.; Williams V.; Ashcroft N.W.; Hemley R.J.; Tozer S.W.,	*Hot Hydride Superconductivity above 550 K*	DC Field Facility, CMT/E
Haley, S.C.; Maniv, E.; Cookmeyer, T.; Maksimovic, N.; Parker, D.E.; John, C.; Doyle, S.; Weber, S.F.; Neaton, J.B.; Singleton, J.; Analytis, J.G.,	*Half-magnetization plateau and the origin of threefold symmetry breaking in an electrically-switchable triangular antiferromagnet*	Pulsed Field Facility at LANL
Khan, M.A.; Chang, P.; Ghimire, N.; Bretz-Sullivan, T.M.; Bhattacharya, A.; Jiang, J.S.; Singleton, J.; Mitchell, J.F.,	*Fermi surface topology and non-trivial Berry phase in the flat-band semimetal Pd3Pb*	Pulsed Field Facility at LANL
Liu X.; Wang Z.; Watanabe K.; Taniguchi T.; Vafek O.; Li J.I.A.,	*Tuning electron correlation in magic-angle twisted bilayer graphene using Coulomb screening*	CMT/E
Liu, C.; Humbert, V.F.C.; Bretz-Sullivan, T.M.; Wang, G.; Hong, D.; Wrobel, F.; Zhang, J.; Hoffman, J.D.; Pearson, J.E.; Jiang, J.S.; Chang, C.; Suslov, A.; Mason, N.; Norman, M.R. and Bhattacharya, A.,	*Observation of an antiferromagnetic quantum critical point in high-purity LaNiO3*	DC Field Facility
Maksimovic, N.; Hayes, I.M.; Nagarajan, V.; Koshelev, A.E.; Singleton, J.; Lee, Y.; Schenkel, T.; Analytis, J.G,	*Magnetoresistance scaling, disorder, `hot spots' and the origin of T-linear resistivity in BaFe2(As1−xPx)2*	Pulsed Field Facility at LANL
Modic K.A.; McDonald R.D.; Ruff J.P.C.; Bachmann M.D.; Lai Y.; Palmstrom J.C.; Graf D.; Chan M.; Balakirev F.F.; Betts J.B.; Boebinger G.S.; Schmidt M.; Sokolov D.A.; Moll P.J.W.; Ramshaw B.J.; Shekhter A.,	*Scale-Invariance of a Spin Liquid in High Magnetic Fields*	DC Field Facility, Pulsed Field Facility at LANL, CMT/E
Opherden, D.; Nizar, N.; Richardson, K.; Monroe, J.C.; Turnbull, M.M.; Polson, M.; Vela, S.; Blackmore, W.J.; Goddard, P.A.; Singleton, J.; Choi, E.S.; Xiao, F.; Williams, R.C.; Lancaster, T.; Pratt, F.L.; Blundell, S.J.; Skourski, Y.; Uhlarz, M.; Ponomaryov, A.N.; Zvyagin, S.A.; Wosnitza,J.; Baenitz , M.; Heinmaa.I.; Stern,R.; Kühne, H.; Landee, C.P.,	*Extremely well-isolated 2D spin-1/2 antiferromagnetic Heisenberg layers with small exchange coupling in the molecular-based magnet CuPOF*	Pulsed Field Facility at LANL
Post, K.W.; Legros, A.; Rickel, D.G.; Singleton, J.; McDonald, R.D.; He, X.; Bozovic, I.; Xu, X.; Shi, X.; Armitage, N.P.; Crooker, S.A.,	*Observation of cyclotron resonance and measurement of the hole mass in optimally-doped La2−xSrxCuO4*	Pulsed Field Facility at LANL
Qiu, R.L.J.; Liu, C.-W.; Woods, A.J.; Serafin, A.; Xia, J.-S.; Pfeiffer, L.N.; West, K.W. and Gao, X.P.A.,	*Incipient Formation of the Reentrant Insulating Phase in a Dilute 2D Hole System with Strong Interactions*	UF Physics
Sarkar T.; Poniatowski N.R.; Higgins J.S.; Mandal P.R.; Chan M.K.; Greene R.L.,	*Strange Metallic Transport in the Antiferromagnetic Regime of Electron Doped Cuprates*	Pulsed Field Facility at LANL
Schepkin, V.D.,	*Analytical tool for in vivo magnetic resonance signals*	NMR Facility
Singleton, J.; Schmidt, A.; Bailey, C.; Wigger, J. and Krawczyk, F.,	*Information carried by electromagnetic radiation launched from accelerated polarization currents*	Pulsed Field Facility at LANL
Sun D.; Minkov V.S.; Mozaffari S.; Chariton S.; Prakapenka V.B.; Eremets M.I.; Balicas L.; Balakirev F.F.,	*High-temperature superconductivity on the verge of a structural instability in lanthanum superhydride*	Pulsed Field Facility at LANL, CMT/E
Sun, D.; Naud, M.F.; Nguyen, D.N.; Betts, J.B.; Singleton, J. and Balakirev, F.F.,	*Composite Pressure Cell for Pulsed Magnets*	Pulsed Field Facility at LANL
Wang X.; Cao J.; Lu Z.; Cohen A.; Kitadai H.; Li T.; Wilson M.; Lui C.H.; Smirnov D.; Sharifzadeh S.; Ling X.,	*Spin-Induced Linear Polarization of Excitonic Emission in Antiferromagnetic van der Waals Crystals*	DC Field Facility, CMT/E

Authors	Title	Facility
Xiao, F.; Blackmore, W.J.; Huddart, B.M.; Gomilek, M.; Hicken, T.J.; Baines, C.; Baker, P.J.; Pratt, F.L.; Blundell, S.J.; Lu, H., Singleton, J.; Gawryluk, D.; Turnbull, M.M.; Krämer, K.W.; Goddard, P.A.; Lancaster, T.,	*Magnetic order and disorder in a quasi-two-dimensional quantum Heisenberg antiferromagnet with randomized exchange*	Pulsed Field Facility at LANL

Awards (9)

Authors	Title	Facility
Balicas, L.	*Divisional Associate Editor for Physical Review Letters*	DC Field Facility, CMT/E
Chen, H.	*The Dr. Martin Luther King Jr. Distinguished Service Award*	ICR Facility
Jaime, M.	*Fellow, American Association for the Advancement of Science (AAAS)*	Pulsed Field Facility at LANL
Jaime, M.	*Vice-Chair, GMAG Topical Group, American Physical Society*	Pulsed Field Facility at LANL
Larbalestier, D.	*Fellow of the Royal Academy of Engineering*	Applied Superconductivity Center
Niles, S.	*2020 FSU Analytical Chemistry Graduate Student Award*	ICR Facility
Popovic, D.	*AAAS, Member of the Electorate Nominating Committee of the Section on Physics*	DC Field Facility, CMT/E
Popovic, D.	*Full Member, Sigma Xi, The Scientific Research Honor Society*	DC Field Facility, CMT/E
Zapf, V.S.	*Subject area lead, Quantum Spin Liquids, "Quantum Science Center" Department of Energy Quantum information Sciences center*	Pulsed Field Facility at LANL

Grants (12)

Authors	Title	Facility
Dean, D., Zapf, V.S. and others	*Quantum Science Center*	Pulsed Field Facility at LANL
Helsper, S.	*Investigation into hMSC-derived therapy in ischemic stroke at high field MR imaging and spectroscopy*	NMR Facility
Hill, S.	*U.S.-Ireland R&D Partnership: Molecular Magnetoelectric Materials*	EMR Facility
McKenna, A.M.	*Ultrahigh-Resolution Fourier-Transform Ion Cyclotron Resonance Mass Spectrometry for Fingerprinting, Source Tracking, and Allocation of Per- and Polyfluoroalkyl Substances (PFASs)*	ICR Facility
Park, W. K. and Greene, L. H.	*Electron tunneling spectroscopy of the novel pairing state in the 1-1-5 heavy fermions and possible topological Kondo insulator YbB12*	CMT/E
Park, W. K.	*Electron Tunneling Spectroscopy under High Magnetic Fields*	DC Field Facility
Sachs, J. and Atwood, A.	*Collaborative Research: Response of the Tropical Pacific to the Abrupt Climate Change Event 8,200 Years Ago*	Geochemistry Facility
Schurko, R.W.	*Solid-State Nuclear Magnetic Resonance (NMR) Spectroscopy of Unreceptive Nuclei from Across the Periodic Table*	NMR Facility
Shatruk, M. and Hill, S.	*Spin-State Switching and Conductivity in Metal Complexes with Non-Innocent Ligands*	EMR Facility
Tang, Y., Chen., H. and Chen, G.	*Selenium recovery from wastewater based on exclusively extracellular selenium nanoparticles production*	ICR Facility
Williams, H.N., Chen, H., Stukel, M., Kranz, S. and Abdullah, A.	*Excellence in Research Collaborative Proposal: Impact of Multiple Micropredators on Marine Bacterial Communities and their Prey Lysis Products*	ICR Facility
Xu, J. and Gan, Z.	*Methodology of High-Field Solid-State NMR and Its Applications in Heterogeneous Catalysis*	NMR Facility

M.S. Degrees (local) (11)

Authors	Title	Facility	University	Department
Behnke, Megan	*Dissolved Organic Matter Sources in Glacierized Watersheds Delineated Through Compositional and Carbon Isotopic Modeling*	ICR Facility	FSU	Earth, Ocean & Atmospheric Science
Conti, Carl	*ssNMR Methods for Elucidating Structure-Property Relationships in Plasmonic Semiconductor Nanocrystals*	NMR Facility	FSU	Chemistry & Biochemistry
Crawford-Goss, Ian Taylor	*Superconductivity in cerium containing high entropy alloys*	DC Field Facility	FSU	Physics
Dragone, Richard Joseph	*Effects of Aging on Risky Decision Making and Brain Functional Connectivity in a Rat Model*	AMRIS Facility at UF	UF	Neuroscience
Li, Wenbo	*Insights iInto Organic Matter Sources in Glacier Environments*	ICR Facility	FSU	Earth, Ocean & Atmospheric Science
Macy, Juan	*Unconventional Anomalous Hall Effect and Anomalous Nernst Effect in Fe3GeTe2 and Fe5GeTe2*	CMT/E	FSU	Physics
Mejia Marin, Juan Jose	*Ferromagnetism in the hexagonal cage-like compounds: Sm6(Mo,W)4Al43*	DC Field Facility	FSU	Physics
Peng, Qingqing	*Solution NMR Studies on the C Terminus of Adhesin P1 from Streptococcus mutans*	AMRIS Facility at UF	UF	Biochemistry and Molecular Biology
Polk, Rebecca	*The Effect of Oxytocin on Mentalizing in Aging: A Brain-Behavior Analysis*	AMRIS Facility at UF	UF	Psychology
Rogers, Jennifer	*Changes to Modern and Aged Dissolved Organic Matter Inputs into the Kolyma River*	ICR Facility	FSU	Earth, Ocean & Atmospheric Science
Turner, Sean	*Hemispheric Contributions to Cognition in Epilepsy*	AMRIS Facility at UF	UF	Clinical and Health Psychology

M.S. Degrees (external) (9)

Authors	Title	Facility	University	Department
Arreola, Jenette	*Transthyretin Amyloidosis: Proteolytic cleavage accelerates G53A TTR misfolding and aggregation*	NMR Facility	East Carolina University	Chemistry
Coffey, Nicole	*Controls on the Chemical Composition of the Surface Microlayer of Delaware Bay*	ICR Facility	University of Delaware	Earth, Ocean, & Environment
Dwivedi, Anand	*Nuclear Magnetic Resonance under Extreme Conditions*	DC Field Facility, NMR Facility	University of Wisconsin Milwaukee	Physics
Gan, Josephine	*Investigation of the Electronic Structures of Heterobimetallic Mn/Fe Oxidases: Computational study on the R2-like Ligand Binding Oxidases*	EMR Facility	The Ohio State University	Chemistry and Biochemistry
Gan, Yunqiao	*Investigation of the Electronic Structures of Heterobimetallic Mn/Fe Oxidases: A Computational Study on the R2-like Ligand Binding Oxidases*	EMR Facility	The Ohio State University	Chemistry and Biochemistry
Mazur, Agnieszka	*Cobalt(II) coordination compounds in the construction of molecular magnetic materials.*	DC Field Facility	University of Wroclaw	Faculty of Chemistry

Authors	Title	Facility	University	Department
Ruiz Zamora, Evelin	*Deshidratación-deciclización de tetrahidrofurano para la producción de 1,3-butadieno como materia prima de bio-neumáticos, usando zeolitas spp como catalizador*	NMR Facility	Autonomous University of Nuevo León	Facultad de Ciencia Químicas
Widener, Chelsea	*Spectroscopic Studies of Metal Complexes with Large Magnetic Anisotropy*	DC Field Facility, EMR Facility	University of Tennessee	Chemistry
Wijesekara, Anuradha	*Improved characterization of pure and formulated active pharmaceutical ingredients by fast magic angle spinning solid-state NMR spectroscopy*	NMR Facility	Iowa State University	Chemistry

Ph.D. Degrees (local) (26)

Authors	Title	Facility	University	Department
Ahmed, Nur	*Isotope analysis and groundwater modeling for advanced understanding of lake water and groundwater mixing through lake sinkholes in north Florida.*	Geochemistry Facility	FSU	EOAS & NHMFL
Amin, Manish	*Advancements in Diffusion Weighted Imaging Acquisition and Analysis*	AMRIS Facility at UF	UF	Physics
Banan, Guita	*Development of a Multiband Magnetic Resonance Electrical Impedance Tomography Technique*	AMRIS Facility at UF	UF	Physics
Barry, Kevin	*The Highly Anisotropic Phase Diagram of Ho2Ti2O7: Bulk Single Crystals and Thin Films*	DC Field Facility, CMT/E	FSU	Physics
Berens, Samuel J	*Fundamental understanding of diffusion properties in membranes and molecular sieves by high field diffusion NMR*	AMRIS Facility at UF	UF	Chemical Engineering Department
Bo, Ke	*Neural Mechanism of Affective Scene Perception*	AMRIS Facility at UF	UF	Biomedical Engineering
Chiu, Yu Che	*De Haas-van Alphen and Magneto-Transport properties on Topological Nodal line semimetals ZXT (X = Si, Fe; M = Se, Te)*	CMT/E	FSU	Physics
Das Gupta, Sayak	*Polynuclear cerium/manganese/oxo clusters: synthetic, structural, and magnetic studies*	EMR Facility	UF	Chemistry
Ellis, Matthew	*Understanding magnetic and optical properties of lanthanide-doped oxide nanospinels and heterometallic formate metal-organic frameworks*	DC Field Facility	FSU	Chemistry and Biochemistry
Frazier, Ian	*UF Restricted Data. Title unavailable until 2022. Topic: neuroimaging (fMRI)*	AMRIS Facility at UF	UF	Psychology
Henderson, Alyssa	*Geomtric Frustration in Magnetic Systems: A Path to Quantum Materials*	CMT/E	FSU	Physics
Hertz, Mary	*Explorations in metal flux synthesis: From layered materials to f-block chemistry*	DC Field Facility	FSU	Chemistry
Hicks, Alan	*On the Application of Molecular Dynamics Simulations To The Study of Intrinsically Disordered Proteins*	NMR Facility	FSU	Physics

Authors	Title	Facility	University	Department
Lu, Zhengguang	*Magneto-spectroscopy of excitons in two dimensional semiconductors*	DC Field Facility, CMT/E	FSU	Physics
Marbey, Jonathan	*Investigation of molecule-based magnetic materials via EPR spectroscopy*	EMR Facility	FSU	Physics, Informatics and Mathematics
Mendoza, Luis	*Pairing and Pair Breaking in Bilayer Composite Fermion Metals*	CMT/E	FSU	Physics
Meyyappan, Sreenivasan	*Neuronal Mechanisms of Spatial and Feature Attention Control*	AMRIS Facility at UF	UF	Biomedical Engineering
Niles, Sydney	*Fourier-Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) For Characterization of Oxygenated Fossil Fuels in the Environment*	ICR Facility	FSU	Department of Chemistry
Potter, Wesley	*Synthesis of actinide materials: Metal flux and supercritical reactions*	DC Field Facility	FSU	Chemistry
Putman, Jonathan	*Chromatographic Methods and Characterization Techniques for Petroleum Products*	ICR Facility	FSU	Chemistry
Siva Kumar, Shruti	*Identifying Early Markers of Subclinical Cardiac and Pulmonary Radiation Toxicity in Breast Cancer*	AMRIS Facility at UF	UF	Biomedical Engineering
Thompson, Christie	*Magnetic Anisotropy and Noncollinear Spin Textures in CoV2O4 Thin Films*	DC Field Facility, CMT/E	FSU	Materials Science and Engineering
Tran, Trang Theresa	*Investigating Polymorphism-Induced Conformational Changes in HIV-1 Protease by Pulsed Electron Paramagnetic Resonance and Molecular Dynamics*	AMRIS Facility at UF	UF	Chemistry
Wang, Wei En	*Neural Dynamics of Pain and Motor Function in Chronic Musculoskeletal Pain*	AMRIS Facility at UF	UF	Applied Physiology and Kinesiology
Zhang, Chuck	*Characterization of Functional Proteins for Drug Research*	AMRIS Facility at UF	UF	Medicinal Chemistry
Zheng, Jin	*Solid-State NMR Studies of Li-Ion Transport in Composite Electrolytes and Lithiation Mechanisms of Organic Electrodes*	NMR Facility	FSU	Chemistry and Biochemistry

Ph.D. Degrees (external) (59)

Authors	Title	Facility	University	Department
Ajaero, Chukwuemeka	*Molecular Characterization Of The Fate And Kinetics Of Oil Sand Process-Affected Water (OSPW) Naphthenic Acid Fraction Compounds (NAFCs) In Constructed Wetland Treatment System*	ICR Facility	University of Regina, Regina, SK, Canada	Environmental Systems Engineering
Bachmann, Maja	*Manipulating Anisotropic Transport and Superconductivity by Focused Ion Beam Microstructuring*	Pulsed Field Facility at LANL	University of St. Andrews	Physics
Bader, Samuel	*GaN-on-AlN as a platform for high-voltage complementary electronics*	DC Field Facility	Cornell University	Applied Physics
Burch, Ashlyn	*Photoexcitiation Dynamics in Optimally Doped LSCO Thin Films Under Applied Magnetic Field*	DC Field Facility	University of Alabama at Birmingham	Physics
Celestine, Michael	*Synthesis, Characterization, and Kinetics Studies of New Cobalt Complexesfor the Production of H_2 in Acidic Media*	EMR Facility	Old Dominion University	Chemistry and Biochemistry

Authors	Title	Facility	University	Department
Celik, Dogan	*ynthesis, Characterization, and Kinetics Studies of New Cobalt Complexesfor the Production of H2 in Acidic Media*	EMR Facility	Old Dominion University	Chemistry and Biochemistry
Chakarawet, Khetpakorn	*Magnetic Direct Exchange and Heavy Atom Effects on Slow Magnetic Relaxation in Transition Metal Single-Molecule Magnets*	EMR Facility	University of California, Berkeley	College of Chemistry
Chen, Lu	*Study of Thermal and Magnetic Properties in Strongly Correlated Materials*	DC Field Facility, Pulsed Field Facility at LANL	University of Michigan	Department of Physics
Chuang, Ya-Wen	*Exploring Magnetism in Van der Waals 2D Materials and Heterostructures*	DC Field Facility	Penn State University	Physics
Cui, Zheng	*Co-Hydrothermal Liquefaction of Wastewater Treatment Microalgae and Bio-Crude Oil Catalytic Upgrading to Produce Biofuels*	ICR Facility	New Mexico State University	Chemical and Materials Engineering
Devlin, Kasey	*Structure, Magnetism, and Thermoelectric Properties of Solid-Solution Zintl Phases*	DC Field Facility	University of California Davis	Chemistry Department
Du, Jia-Hua	*Solid-State NMR Studies of Defects on MgO*	NMR Facility	Nanjing University	School of Chemistry and Chemical Engineering
Dzsaber, Sami	*The Weyl-Kondo semimetal Ce3Bi4Pd3*	Pulsed Field Facility at LANL	Vienna University of Technology (TU Wien)	Physics
Elinburg, Jessica	*Synthesis, Characterization, and Reactivity of Sn and V=O Perfluoropinacolate Complexes and Magnetic Properties of a Mn6 Cluster Supported by Perfluoropinacolate*	EMR Facility	Boston University	Chemistry
Emmanouilidou, Eve	*Search for topological semimetal and topological superconductor candidates*	DC Field Facility	university of california, los angeles	Physics and Astronomy
Fan, Shiyu	*Spectroscopy of multiferroic superlattices*	DC Field Facility	University of Tennessee	Physics
Garg, Uma	*Effects of Intercalation and de-intercalation in Layered Materials: from Topological Insulators to Battery Cathodes*	DC Field Facility	University of Wisconsin Milwaukee	Physics
Girod, Clément	*Chaleur spécifique à basse température dans l'état normal des cuprates supraconducteurs*	DC Field Facility	Universite de Sherbrooke	Physics
Gould, Colin Alexander	*Design and Synthesis of High-Performance Lanthanide-Based Single-Molecule Magnets*	EMR Facility	University of California, Berkeley	College of Chemistry
Harrison, Andrew	*Self-Assembled Metal Nanoparticle/Polymer Nanocomposites as Nanoreactors for One-Pot Reactions*	NMR Facility	Virginia Commonwealth University	Chemical and Life Science Engineering
Hemsworth, Nicholas	*Exfoliation and Magnetotransport of Two-Dimensional Black Phosphorus and Antimony*	DC Field Facility	McGill University	Electrical and Computer Engineering
Hossain, Md Shafayat	*Spontaneous ferromagnetism in two-dimensional electron systems*	DC Field Facility	Princeton University	Electrical Engineering
Huang, Silu	*Electrical, Magnetic, and Thermal Properties of Semimetallic XMnPn2 (X = Ba, Eu, Pn = Sb, Bi)*	DC Field Facility	Louisiana State University	Physics and Astronomy

Authors	Title	Facility	University	Department
Jakobsen, Vibe Boel	*Preparation of New Molecular Magnetic Materials*	Pulsed Field Facility at LANL	University College Dublin	School of Chemistry
Kealhofer, David	*Topological surface states in cadmium arsenide (001) thin films*	DC Field Facility	University of California, Santa Barbara	Physics
Kisgeropoulos, Effie	*From Structure to Function: Utilizing the Biophysical Toolbox to Interrogate a Novel Class of Mn/Fe Proteins*	EMR Facility	The Ohio State University	Chemistry and Biochemistry
Kochat, Mehdi	*Study of Flux Pinning in Thick Film REBCO Coated Conductors over a Wide Range of Magnetic Fields and Temperatures*	DC Field Facility	University of Houston	Mechanical Engineering
Kudisch, Bryan	*New directions in the ultrafast spectroscopy of organic chromophores*	DC Field Facility	Princeton University	Chemistry
Letourneau, Maria	*Dissolved Organic Matter Dynamics in Coastal Aquatic Systems*	ICR Facility	University of Georgia	Marine Sciences
Li, Yanan	*Lattice and Charge Order in Bi-based Topological Insulators*	DC Field Facility, NMR Facility	University of Wisconsin Milwaukee	Physics
Maillard, Julien	*Chemical Composition of the Titan's Haze by Ion Mobility Coupled to High Résolution Mass Spectrometry*	ICR Facility	Versailles Saint-Quentin-en-Yvelines University	LATMOS
Makhankova, Valeriya,	*Heterometallic compounds based on 3d-metals with N-, O-donor ligands: synthetic approaches, crystal structure, properties. (Habilitation Thesis)*	EMR Facility	Taras Shevchenko National University of Kyiv	Chemistry
Meyer, Sven	*Introduction of quasi-multilayer pulsed laser deposition for enhanced superconducting properties of Ba(Fe0.92Co0.08)2As2 thin lms*	DC Field Facility	Karlsruhe Institute of Technology	Institute for Technical Physics
Moulian, Remi	*Characterization of Metal Species of Asphaltenes and Their Interactions in Heavy Oil Cuts Applied to Hydrodemetallation*	ICR Facility	Université de Pau et des Pays de l'Adour	IPREM
Palmstrom, Johanna	*Elastoresistance of iron based superconductors*	DC Field Facility, Pulsed Field Facility at LANL	Stanford	Applied Physics
Plyuta, Nataliya	*Coordination compounds based on 3d-metals with multidentate N- or N,O-donor ligands: synthesis, structure and properties.*	EMR Facility	Taras Shevchenko National University of Kyiv	Chemistry
Ratkovski, Danilo	*Measurements of the thermal conductivity in YIG at low temperatures and high magnetic fields*	DC Field Facility	Universidade Federal de Pernambuco	Physics
Rodriguez-Cardona, Bianca	*Carbon and Nitrogen Dynamics in Fluvial Systems Across Biomes*	ICR Facility	University of New Hampshire	Earth and Environmental Sciences
Rosenberg, Elliott	*Multipolar Order and Fluctuations in TmAg2 and YbRu2Ge2*	DC Field Facility	Stanford	Applied Physics
Schaffer, Leah V	*Integrated Proteomic Strategies for Proteoform Discovery*	ICR Facility	University of Wisconsin-Madison	Chemistry
Schmidt, Andrea	*Theoretical and Experimental Studies of the Emission of Electromagnetic Radiation by Superluminal Polarization Currents*	Pulsed Field Facility at LANL	University of New Mexico	Electrical and Computing Engineering

Authors	Title	Facility	University	Department
Shen, Bin	*Studies of pressure-induced quantum phase transitions*	DC Field Facility	Zhejiang University	Physics
Shen, Jiahui	*Solid-state 17O NMR studies of glucose and development of 17O NMR as a new probe of glucose metabolism in HeLa cancer cells*	NMR Facility	Queen's University	Chemistry
Shen, Li	*17O Solid-State NMR Studies of the Surface Structure of Zirconia and Alumina Nanomaterials*	NMR Facility	Nanjing University	School of Chemistry and Chemical Engineering
Shih, En-Min	*Low-Temperature Transport Study of Transition Metal Dichalcogenide Heterostructures*	DC Field Facility	Columbia University	Physics
Siegried, Peter Eilbacher	*Uniaxial Strain Dependence of Resistivity and Electronic Transport with Non-Trivial Spin Textures in Magnetic Materials*	DC Field Facility	Univ of Colorado - Boulder	Physics
Straquadine, Joshua	*Evolution of the Charge Density Wave State in the Rare Earth Tritellurides under uniaxial stress and Disorder*	Pulsed Field Facility at LANL	Stanford	Applied Physics
Telford, Evan	*Magnetotransport Studies of Correlated Electronic Phases in Van der Waals Materials*	DC Field Facility	Columbia University	Physics
Thorarinsdottir, Agnes Eva	*Control of Electronic Spin in the Design of Transition Metal-Based Bioresponsive Magnetic Resonance Imaging Probes and Metal-Organic Magnets*	AMRIS Facility at UF	Northwestern University	Chemistry
Vakaliuk, Oleksii	*Novel Lorentz Force Velocimetry system based on bulk high-temperature superconductors*	DC Field Facility	Technische Universität Ilmenau	Institute for Material Engineering and Institute for Micro- and Nano-technologies
Venkatesh, Amrit	*Opening up the periodic table for solid-state NMR spectroscopy with fast magic angle spinning and proton detection*	NMR Facility	Iowa State University	Chemistry
Wan, Fang	*Chemical Doping and Superconducting Phase Formation in Magnesium Diboride*	DC Field Facility	The Ohio State University	Materials Science
Wang, Yangyang	*Structure and Dynamics of Tryptophan Synthase Intermediates Via NMR-Crystallography*	NMR Facility	University of California - Riverside	Chemistry
Witwicki, Maciej	*Explanation of the molecular properties and reactivity of the oxygen, oxygen-nitrogen and phosphorus radicals - EPR spectroscopy and molecular modeling (Habilitation Thesis)*	EMR Facility	Wroclaw University	Chemistry
Wu, Fan	*Studies of electronic correlations, magnetism and topology in rare-earth pnictides*	Pulsed Field Facility at LANL	Zhejiang University	Department of Physics
Ye, Linda	*Topology and Correlation in Kagome Lattice Metals*	DC Field Facility, Pulsed Field Facility at LANL	Massachusetts Institute of Technology	Physics

Authors	Title	Facility	University	Department
Zhange, Yongjun	*Exploration of new magnetic quantum critical materials*	DC Field Facility	Zhejiang University	Physics
Zhao, Xinglin	*Activation and conversion of light alkane over Gallium modified ZSM-5 zeolites as studied by solid state NMR spectroscopy*	NMR Facility	University of Chinese Academy of Sciences	Chemistry
Zhu, Weidi	*Rheology and Relaxation in As-Se Glass-forming Liquids*	NMR Facility	University of California, Davis	Materials Science and Engineering

Appendix 1 - Personnel

2020 MagLab Leadership

First Name	Last Name	Position Title	Department
Ernesto	Bosque	Research Faculty I	ASC
Lance	Cooley	Professor	ASC
David	Larbalestier	Professor	ASC
Lucio	Frydman	Professor	CIMAR
Christopher	Hendrickson	Research Faculty III	CIMAR
Alan	Marshall	Professor	CIMAR
Robert	Schurko	Professor	CIMAR
Lloyd	Engel	Research Faculty III	Condensed Matter Science
Stephen	Hill	Professor	Condensed Matter Science
Timothy	Murphy	Research Faculty III	Condensed Matter Science
Scott	Hannahs	Research Faculty III	DC Instrumentation
Gregory	Boebinger	Professor	Director's Office
Jeffrey	Braunwart	Assistant Director, Science & Research	Director's Office
Roxanne	Hughes	Research Faculty II	Director's Office
Eric	Palm	Research Faculty III	Director's Office
Bettina	Roberson	Assistant Director, Administrative Services	Director's Office
Kristin	Roberts	Director of Public Affairs	Director's Office
Michael	Rabin	Research Faculty III	LANL
Mark	Bird	Research Faculty III	Magnet Science & Technology
Debra	Booth	Business Systems Director	Management and Administration
Eric	Clark	Assistant Director, Technology Services	Management and Administration
Laura	Greene	Professor	Management and Administration
Peter	Jensen	Network Administrator	Management and Administration
John	Kynoch	Assistant Director	Management and Administration
David	Lunger	Director, Project Management	Management and Administration
Judy	McEachern	Assistant Director, Business Systems	Management and Administration
Tiffany	Ritter	Assistant Director, UBA Program	Management and Administration
Joanna	Long	Professor	UF
Mark	Meisel	Professor	UF

Applied Superconductivity Center

First Name	Last Name	Position Title	Department
Connie	Linville	Administrative Specialist	ASC
Fumitake	Kametani	Assistant Professor	ASC
Natalie	Arnett	Associate Professor	ASC

First Name	Last Name	Position Title	Department
Sastry	Pamidi	Associate Professor	ASC
Felicia	Rogers	Coordinator, Administrative Services	ASC
Shah	Alam	Graduate Research Assistant	ASC
Shaon	Barua	Graduate Research Assistant	ASC
Santosh	Chetri	Graduate Research Assistant	ASC
Jonathan	Cooper	Graduate Research Assistant	ASC
Kadisha	Culpepper	Graduate Research Assistant	ASC
Ashleigh	Francis	Graduate Research Assistant	ASC
S	Imam	Graduate Research Assistant	ASC
Andre	Juliao	Graduate Research Assistant	ASC
D'Andra	Moxey	Graduate Research Assistant	ASC
Abiola	Oloye	Graduate Research Assistant	ASC
Yavuz	Oz	Graduate Research Assistant	ASC
Nawaraj	Paudel	Graduate Research Assistant	ASC
Virginia	Phifer	Graduate Research Assistant	ASC
Michael	Small	Graduate Research Assistant	ASC
Patrick	Murphy	Laboratory Assistant / Technician	ASC
Ryker	Mullinix	Laboratory Assistant / Technician 2	ASC
Emma	Martin	Laboratory Assistant II	ASC
Anatolii	Polyanskii	Magneto Optical Research Specialist	ASC
Kayla	Hancock	Office Assistant	ASC
Daniel	Davis	Postdoctoral Associate	ASC
Xinbo	Hu	Postdoctoral Associate	ASC
Chongin	pak	Postdoctoral Associate	ASC
Christopher	Segal	Postdoctoral Associate	ASC
Wenura	Withanage	Postdoctoral Associate	ASC
Seungyong	Hahn	Professor	ASC
Eric	Hellstrom	Professor	ASC
Audra	Barnes	Research Assistant	ASC
Griffin	Bradford	Research Assistant	ASC
Evan	Miller	Research Assistant	ASC
Brian	Vail	Research Assistant	ASC
Charles	English	Research Engineer	ASC
James	Gillman	Research Engineer	ASC
Youngjae	Kim	Research Faculty I	ASC
Najib	Cheggour	Research Faculty II	ASC
Chiara	Tarantini	Research Faculty II	ASC
Dmytro	Abraimov	Research Faculty III	ASC
Jianyi	Jiang	Research Faculty III	ASC
Peter	Lee	Research Faculty III	ASC

First Name	Last Name	Position Title	Department
Ulf	Trociewitz	Research Faculty III	ASC
Van	Griffin	Sr. Research Associate	ASC
Jozef	Kvitkovic	Sr. Research Associate	ASC
William	Starch	Sr. Research Associate	ASC
Kwangmin	Kim	Visiting Associate In Research	ASC
Kwang	Lok	Visiting Associate In Research	ASC
Shreyas	Balachandran	Visiting Research Faculty I	ASC

CIMAR

CIMAR

First Name	Last Name	Position Title	Department
Rufina	Alamo	Professor	CIMAR
Adam	Altenhof	Graduate Research Assistant	CIMAR
Lissa	Anderson	Research Faculty I	CIMAR
Jacob	Athey	Undergrad Research Assistant	CIMAR
Frederick	Bagdasarian	Graduate Research Assistant	CIMAR
Heather	Barnes	Program Assistant	CIMAR
Daniel	Barzycki	Graduate Research Assistant	CIMAR
Jamini	Bhagu	Graduate Research Assistant	CIMAR
Gregory	Blakney	Research Faculty II	CIMAR
Ashley	Blue	Technical/Research Designer	CIMAR
Shefik	Bowen	Graduate Research Assistant	CIMAR
Charles	Brenner	Undergraduate Research Assistant	CIMAR
William	Brey	Research Faculty III	CIMAR
David	Butcher	Postdoctoral Associate	CIMAR
Martha	Chacon	Research Faculty I	CIMAR
Kuizhi	Chen	Postdoctoral Associate	CIMAR
Yudan	Chen	Postdoctoral Associate	CIMAR
Huan	Chen	Research Faculty I	CIMAR
Timothy	Cross	Visiting Scientist/Researcher	CIMAR
Lauren	Daley	Undergraduate Research Assistant	CIMAR
Cameron	Davis	Laboratory Assistant / Technician	CIMAR
Michael	Deck	Graduate Research Assistant	CIMAR
Amari	DeLeon	Undergraduate Research Assistant	CIMAR
Mary	Desilets	Administrative Support Assistant	CIMAR
Richard	Desilets	Technical/Research Designer	CIMAR
Zachary	Dowdell	Graduate Research Assistant	CIMAR
Carl	Fleischer	Graduate Student	CIMAR
Joseph	Frye	Graduate Research Assistant	CIMAR
Riqiang	Fu	Research Faculty III	CIMAR
Zhehong	Gan	Research Faculty III	CIMAR

First Name	Last Name	Position Title	Department
Taylor	Glattke	Graduate Research Assistant	CIMAR
Blaine	Gordon	Graduate Research Assistant	CIMAR
Peter	Gor'kov	Sr. Research Associate	CIMAR
Mackenzie	Graham	Undergraduate Research Assistant	CIMAR
Samuel	Grant	Associate Professor	CIMAR
Daniel	Hallinan	Assistant Professor	CIMAR
Julia	Hartzog	Undergraduate Student	CIMAR
Shannon	Helsper	Graduate Research Assistant	CIMAR
David	Hike	Graduate Research Assistant	CIMAR
Samuel	Holder	Graduate Research Assistant	CIMAR
Sean	Holmes	Postdoctoral Associate	CIMAR
Yan-Yan	Hu	Assistant Professor	CIMAR
Ivan	Hung	Associate In Research	CIMAR
Krista	Jemmott	Program Associate	CIMAR
Taylor	Johnston	Graduate Research Assistant	CIMAR
James	Kimball	Graduate Research Assistant	CIMAR
Jason	Kitchen	NMR Engineer	CIMAR
Yuan	Lin	Graduate Research Assistant	CIMAR
Ilya	Litvak	Associate In Research	CIMAR
Haoyu	Liu	Graduate Research Assistant	CIMAR
Jie	Lu	Research Assistant	CIMAR
Wenping	Mao	Visiting Assistant In Research	CIMAR
Amy	McKenna	Research Faculty III	CIMAR
Frederic	Mentink-Vigier	Research Faculty II	CIMAR
Yimin	Miao	Postdoctoral Associate	CIMAR
Anna	Mills	Graduate Research Assistant	CIMAR
Hadi	Mohammadigoushki	Assistant Professor	CIMAR
Kimberly	Mozolic	Sr. Administrative Specialist	CIMAR
Sydney	Niles	Graduate Research Assistant	CIMAR
Melaine	Oliveira	Postdoctoral Associate	CIMAR
Sawankumar	Patel	Graduate Research Assistant	CIMAR
Austin	Peach	Graduate Research Assistant	CIMAR
Zeljka	Popovic	Graduate Research Assistant	CIMAR
Jonathan	Putman	Graduate Research Assistant	CIMAR
Anna	Pyayt	Associate Professor	CIMAR
Huajun	Qin	Associate in Research	CIMAR
John	Quinn	Research Engineer	CIMAR
Steven	Ranner	Research Engineer	CIMAR
Kiaura	Reed	Undergraduate Research Assistant	CIMAR
Ralm	Ricarte	Assistant Professor	CIMAR

First Name	Last Name	Position Title	Department
Dayna	Richter	Graduate Research Assistant	CIMAR
Ryan	Rodgers	Research Faculty III	CIMAR
Alyssa	Rose	Graduate Research Assistant	CIMAR
Victor	Schepkin	Research Faculty II	CIMAR
Faith	Scott	Postdoctoral Associate	CIMAR
Micah	Silverman	Undergraduate Research Assistant	CIMAR
Robert	Silvers	Assistant Professor	CIMAR
Robert	Smith	Graduate Student	CIMAR
Karl	Smith	Postdoctoral Associate	CIMAR
Murari	Soundararajan	Postdoctoral Associate	CIMAR
Jeremy	Thomas	Graduate Research Assistant	CIMAR
Cameron	Vojvodin	Graduate Research Assistant	CIMAR
Pengbo	Wang	Graduate Research Assistant	CIMAR
Nicolena	Weaver	Undergraduate Student	CIMAR
Chad	Weisbrod	Research Faculty I	CIMAR
Sungsool	Wi	Research Faculty II	CIMAR
Xuegang	Yuan	Postdoctoral Associate	CIMAR
Rongfu	Zhang	Postdoctoral Associate	CIMAR

Condensed Matter Science

First Name	Last Name	Position Title	Department
Aisha	Qureshi	Administrative Assistant	Condensed Matter Science
Abigail	Centers	Application Developer/Designer	Condensed Matter Science
Jamel	Ali	Assistant Professor	Condensed Matter Science
Christianne	Beekman	Assistant Professor	Condensed Matter Science
Hitesh	Changlani	Assistant Professor	Condensed Matter Science
Hanwei	Gao	Assistant Professor	Condensed Matter Science
Stephen	Hennigar	Assistant Professor	Condensed Matter Science
Chen	Huang	Assistant Professor	Condensed Matter Science
Mainak	Mookherjee	Assistant Professor	Condensed Matter Science
Guangxin	Ni	Assistant Professor	Condensed Matter Science
Lea	Nienhaus	Assistant Professor	Condensed Matter Science
William	Oates	Assistant Professor	Condensed Matter Science
Mykhailo	Shatruk	Assistant Professor	Condensed Matter Science
Sebastian	Stoian	Assistant Professor	Condensed Matter Science
Komalavalli	Thirunavukkuarasu	Assistant Professor	Condensed Matter Science
Zhibin	Yu	Assistant Professor	Condensed Matter Science
Changchun	Zeng	Assistant Professor	Condensed Matter Science
Alexey	Kovalev	Associate in Research	Condensed Matter Science
Petru	Andrei	Associate Professor	Condensed Matter Science

CMS

First Name	Last Name	Position Title	Department
Biwu	Ma	Associate Professor	Condensed Matter Science
Tanya	Peres	Associate Professor	Condensed Matter Science
Subramanian	Ramakrishnan	Associate Professor	Condensed Matter Science
Oskar	Vafek	Associate Professor	Condensed Matter Science
Mei	Zhang	Associate Professor	Condensed Matter Science
Md.	Alamgir	Graduate Research Assistant	Condensed Matter Science
Kevin	Barry	Graduate Research Assistant	Condensed Matter Science
Alexander	Bieber	Graduate Research Assistant	Condensed Matter Science
Nicole	Burnett	Graduate Research Assistant	Condensed Matter Science
Greta	Chappell	Graduate Research Assistant	Condensed Matter Science
Josiah	Cochran	Graduate Research Assistant	Condensed Matter Science
Melissa	Davis	Graduate Research Assistant	Condensed Matter Science
Haoyun	Deng	Graduate Research Assistant	Condensed Matter Science
Liyu	Dong	Graduate Research Assistant	Condensed Matter Science
Paul	Eugenio	Graduate Research Assistant	Condensed Matter Science
Aubrey	Farrell	Graduate Research Assistant	Condensed Matter Science
KEKE	FENG	Graduate Research Assistant	Condensed Matter Science
Giovanni	Franco-Rivera	Graduate Research Assistant	Condensed Matter Science
Matthew	Freeman	Graduate Research Assistant	Condensed Matter Science
Jorge	Galeano	Graduate Research Assistant	Condensed Matter Science
Carlos	Garcia	Graduate Research Assistant	Condensed Matter Science
Tyler	Gregory	Graduate Research Assistant	Condensed Matter Science
Brittany	Grimm	Graduate Research Assistant	Condensed Matter Science
Clemente	Guzman	Graduate Research Assistant	Condensed Matter Science
Roneisha	Haney	Graduate Research Assistant	Condensed Matter Science
Wai-Ga	Ho	Graduate Research Assistant	Condensed Matter Science
Jade	Holleman	Graduate Research Assistant	Condensed Matter Science
Claire	Jolowsky	Graduate Research Assistant	Condensed Matter Science
Mehmet	Kaplan	Graduate Research Assistant	Condensed Matter Science
Aikaterini	Katafygi	Graduate Research Assistant	Condensed Matter Science
Pak	Ki	Graduate Research Assistant	Condensed Matter Science
Sangsoo	Kim	Graduate Research Assistant	Condensed Matter Science
Sanath	Kumar	Graduate Research Assistant	Condensed Matter Science
Haoran	Li	Graduate Research Assistant	Condensed Matter Science
Mengtian	Liu	Graduate Research Assistant	Condensed Matter Science
Juan	Macy	Graduate Research Assistant	Condensed Matter Science
Pengsu	Mao	Graduate Research Assistant	Condensed Matter Science
Masoud	Mardani	Graduate Research Assistant	Condensed Matter Science
Lingrui	Mei	Graduate Research Assistant	Condensed Matter Science
Ronald	Melendrez	Graduate Research Assistant	Condensed Matter Science

First Name	Last Name	Position Title	Department
Katelyn	Miller	Graduate Research Assistant	Condensed Matter Science
Alex	Moon	Graduate Research Assistant	Condensed Matter Science
Seongphill	Moon	Graduate Research Assistant	Condensed Matter Science
William	Nelson	Graduate Research Assistant	Condensed Matter Science
Jennifer	Neu	Graduate Research Assistant	Condensed Matter Science
Diana	Odhiambo	Graduate Research Assistant	Condensed Matter Science
Olatunde	Oladehin	Graduate Research Assistant	Condensed Matter Science
Abiodun	Oluwalowo	Graduate Research Assistant	Condensed Matter Science
Ankit	Patel	Graduate Research Assistant	Condensed Matter Science
Bal	Pokharel	Graduate Research Assistant	Condensed Matter Science
Marquese	Pollard	Graduate Research Assistant	Condensed Matter Science
Tej	Poudel	Graduate Research Assistant	Condensed Matter Science
David	Quashie	Graduate Research Assistant	Condensed Matter Science
Breigh	Renner	Graduate Research Assistant	Condensed Matter Science
Laylah	Roberts	Graduate Research Assistant	Condensed Matter Science
Alexander	Roubos	Graduate Research Assistant	Condensed Matter Science
Benny	Schundelmier	Graduate Research Assistant	Condensed Matter Science
Annie	Scutte	Graduate Research Assistant	Condensed Matter Science
Prakash	Sharma	Graduate Research Assistant	Condensed Matter Science
Lily	Stanley	Graduate Research Assistant	Condensed Matter Science
Robert	Stewart	Graduate Research Assistant	Condensed Matter Science
Yuting	Tan	Graduate Research Assistant	Condensed Matter Science
Christie	Thompson	Graduate Research Assistant	Condensed Matter Science
Okten	Ungor	Graduate Research Assistant	Condensed Matter Science
Manoj	Vinayaka	Graduate Research Assistant	Condensed Matter Science
Matthew	Wadsworth	Graduate Research Assistant	Condensed Matter Science
Ruojun	Wang	Graduate Research Assistant	Condensed Matter Science
Yuxin	Wang	Graduate Research Assistant	Condensed Matter Science
Biwen	Zhang	Graduate Research Assistant	Condensed Matter Science
Wenkai	Zheng	Graduate Research Assistant	Condensed Matter Science
Arshad	Javed	Grants Compliance Analyst	Condensed Matter Science
Abhisek	Basu	Postdoctoral Associate	Condensed Matter Science
Prateek	Benhal	Postdoctoral Associate	Condensed Matter Science
Anish	Bhardwaj	Postdoctoral Associate	Condensed Matter Science
Nhat	Bui	Postdoctoral Associate	Condensed Matter Science
Brian	Casas	Postdoctoral Associate	Condensed Matter Science
Shantanu	Chakraborty	Postdoctoral Associate	Condensed Matter Science
Ravichandran	Honnavally	Postdoctoral Associate	Condensed Matter Science
Yuxuan	Jiang	Postdoctoral Associate	Condensed Matter Science
Manjodh	Kaur	Postdoctoral Associate	Condensed Matter Science

First Name	Last Name	Position Title	Department
Soojeong	Kim	Postdoctoral Associate	Condensed Matter Science
Krishnendu	Kundu	Postdoctoral Associate	Condensed Matter Science
Kyungmin	Lee	Postdoctoral Associate	Condensed Matter Science
Daphne	Lubert-Perquel	Postdoctoral Associate	Condensed Matter Science
Jonathan	Marbey	Postdoctoral Associate	Condensed Matter Science
Shirin	Mozaffari	Postdoctoral Associate	Condensed Matter Science
Vincent	Obiozo	Postdoctoral Associate	Condensed Matter Science
Jeongmin	Park	Postdoctoral Associate	Condensed Matter Science
Shivani	Sharma	Postdoctoral Associate	Condensed Matter Science
Jasminka	Terzic	Postdoctoral Associate	Condensed Matter Science
Kwok	Wai	Postdoctoral Associate	Condensed Matter Science
Xiaoyu	Wang	Postdoctoral Associate	Condensed Matter Science
Youcheng	Wang	Postdoctoral Associate	Condensed Matter Science
Li	Xiang	Postdoctoral Associate	Condensed Matter Science
Thomas	Albrecht-Schmitt	Professor	Condensed Matter Science
Nicholas	Bonesteel	Professor	Condensed Matter Science
Jianming	Cao	Professor	Condensed Matter Science
Irinel	Chiorescu	Professor	Condensed Matter Science
Naresh	Dalal	Professor	Condensed Matter Science
Vladimir	Dobrosavljevic	Professor	Condensed Matter Science
Piotr	Fajer	Professor	Condensed Matter Science
Jin	Gyu	Professor	Condensed Matter Science
Efstratios	Manousakis	Professor	Condensed Matter Science
Pedro	Schlottmann	Professor	Condensed Matter Science
Theo	Siegrist	Professor	Condensed Matter Science
Kun	Yang	Professor	Condensed Matter Science
Renee	Luallen	Program Coordinator	Condensed Matter Science
Sergio	Arana	Research Assistant	Condensed Matter Science
Caleb	Betts	Research Assistant	Condensed Matter Science
Lucas	Braga	Research Assistant	Condensed Matter Science
Casey	Cargill	Research Assistant	Condensed Matter Science
Michael	Cho	Research Assistant	Condensed Matter Science
Matthew	DeJong	Research Assistant	Condensed Matter Science
Nathaniel	Falb	Research Assistant	Condensed Matter Science
David	Gordon	Research Assistant	Condensed Matter Science
Saliya	Grandison	Research Assistant	Condensed Matter Science
Bobby	Haney	Research Assistant	Condensed Matter Science
Darnell	Houck	Research Assistant	Condensed Matter Science
Jeremy	Jack	Research Assistant	Condensed Matter Science
John	Jacke	Research Assistant	Condensed Matter Science

First Name	Last Name	Position Title	Department
Sean	Jackson	Research Assistant	Condensed Matter Science
Eliana	Karr	Research Assistant	Condensed Matter Science
Shannon	Kelley	Research Assistant	Condensed Matter Science
Jason	Kuszynski	Research Assistant	Condensed Matter Science
Ashlyn	Langford	Research Assistant	Condensed Matter Science
Maria	Laura	Research Assistant	Condensed Matter Science
Meghan	Leger	Research Assistant	Condensed Matter Science
Peter	McGoron	Research Assistant	Condensed Matter Science
Elizabeth	Meinert-Spyker	Research Assistant	Condensed Matter Science
Bianca	Mitchell	Research Assistant	Condensed Matter Science
Paige	Nielsen	Research Assistant	Condensed Matter Science
Luis	Saucedo	Research Assistant	Condensed Matter Science
Madison	Sayles	Research Assistant	Condensed Matter Science
Christina	Schiffert	Research Assistant	Condensed Matter Science
Sofia	Torino	Research Assistant	Condensed Matter Science
Qi	Wang	Research Assistant	Condensed Matter Science
Ty	Wilson	Research Assistant	Condensed Matter Science
John	Wise	Research Assistant	Condensed Matter Science
Michael	Yu	Research Assistant	Condensed Matter Science
Bianca	Trociewitz	Research Engineer	Condensed Matter Science
Shalinee	Chikara	Research Faculty I	Condensed Matter Science
Elizabeth	Green	Research Faculty I	Condensed Matter Science
Lin	Jiao	Research Faculty I	Condensed Matter Science
Mykhaylo	Ozerov	Research Faculty I	Condensed Matter Science
Arkady	Shehter	Research Faculty I	Condensed Matter Science
Julia	Smith	Research Faculty I	Condensed Matter Science
Kaya	Wei	Research Faculty I	Condensed Matter Science
Alimamy	Bangura	Research Faculty II	Condensed Matter Science
Ryan	Baumbach	Research Faculty II	Condensed Matter Science
William	Coniglio	Research Faculty II	Condensed Matter Science
David	Graf	Research Faculty II	Condensed Matter Science
Wan	Kyu	Research Faculty II	Condensed Matter Science
Eric	Lochner	Research Faculty II	Condensed Matter Science
Likai	Song	Research Faculty II	Condensed Matter Science
Luis	Balicas	Research Faculty III	Condensed Matter Science
Jan	Jaroszynski	Research Faculty III	Condensed Matter Science
Jerzy	Krzystek	Research Faculty III	Condensed Matter Science
Stephen	McGill	Research Faculty III	Condensed Matter Science
Andrzej	Ozarowski	Research Faculty III	Condensed Matter Science
Dragana	Popovic	Research Faculty III	Condensed Matter Science

First Name	Last Name	Position Title	Department
Arneil	Reyes	Research Faculty III	Condensed Matter Science
Eun	Sang	Research Faculty III	Condensed Matter Science
Dmitry	Smirnov	Research Faculty III	Condensed Matter Science
Alexey	Suslov	Research Faculty III	Condensed Matter Science
Stanley	Tozer	Research Faculty III	Condensed Matter Science
Johan	van	Research Faculty III	Condensed Matter Science
Jason	Parness	Technician	Condensed Matter Science
Thierry	Dubroca	Visiting Research Faculty I	Condensed Matter Science
Nihar	Pradhan	Visiting Research Faculty I	Condensed Matter Science
Haidong	Zhou	Visiting Research Faculty I	Condensed Matter Science
John	Schlueter	Visiting Scientist/Researcher	Condensed Matter Science

DC Instrumentation

First Name	Last Name	Position Title	Department
Harsha	Ravindra	Associate in Research	DC Instrumentation
Karl	Schoder	Associate in Research	DC Instrumentation
Dionne	Soto	Associate in Research	DC Instrumentation
Michael	Steurer	Associate in Research	DC Instrumentation
Heinrich	Boenig	Engineer	DC Instrumentation
James	Powell	Research Engineer	DC Instrumentation
Eric	Stiers	Research Engineer	DC Instrumentation
Vaughan	Williams	Research Engineer	DC Instrumentation
Mark	Vanderlaan	Research Engineer, Cryogenic Operations	DC Instrumentation
Yanjun	Shi	Research Faculty I	DC Instrumentation
Bobby	Pullum	Scientific & Research Technician	DC Instrumentation
Troy	Brumm	Scientific Research Specialist	DC Instrumentation
Bryon	Dalton	Scientific Research Specialist	DC Instrumentation
Larry	Gordon	Scientific Research Specialist	DC Instrumentation
Glover	Jones	Scientific Research Specialist	DC Instrumentation
Scott	Maier	Scientific Research Specialist	DC Instrumentation
Daniel	McIntosh	Scientific Research Specialist	DC Instrumentation
Robert	Nowell	Scientific Research Specialist	DC Instrumentation
Edward	Rubes	Scientific Research Specialist	DC Instrumentation
Dmitry	Semenov	Scientific Research Specialist	DC Instrumentation
Sujana	Sri	Scientific Research Specialist	DC Instrumentation
Robert	Carrier	Technical/Research Designer	DC Instrumentation
Daniel	Freeman	Technical/Research Designer	DC Instrumentation
Michael	Hicks	Technical/Research Designer	DC Instrumentation
Morgan	Oliff	Technical/Research Designer	DC Instrumentation
Joel	Piotrowski	Technical/Research Designer	DC Instrumentation

DC Instrumentation

First Name	Last Name	Position Title	Department
Christopher	Thomas	Technical/Research Designer	DC Instrumentation
Jesus	Torres	Technical/Research Designer	DC Instrumentation
William	Brehm	Technician/Research Designer	DC Instrumentation
David	Sloan	Technician/Research Designer	DC Instrumentation

Director's Office

First Name	Last Name	Position Title	Department
Sarah	Whitman	Animal Lab Tech	Director's Office
Nilubon	Tabtimtong	Application Developer Designer	Director's Office
Charles	Coshatt	Assistant Animal Lab Tech	Director's Office
Marvin	Woods	Assistant Director of Research Support	Director's Office
Laymon	Gray	Assistant Director Safety & Security	Director's Office
Jaime	White-James	Assistant Director, Laboratory Animal Resources	Director's Office
Crystal	Brown	Assistant Lab Animal tech	Director's Office
Christopher	Garye	Assistant Lab Animal Tech	Director's Office
Ashley	Gray	Assistant Biological Safety Officer	Director's Office
Benjamin	Arline	Assistant Chemical Safety Officer	Director's Office
Andrew	Davis	Assistant Chemical Safety Officer	Director's Office
Richard	Le	Biological Safety Officer	Director's Office
Neely	Lewis	Building Code Inspector	Director's Office
Tom	Deckert	Building Code, Assistant Director Environmental Health & Safety Campus	Director's Office
Kari	Roberts	Business Analyst	Director's Office
Renee	Murray	Chemical Safety Officer	Director's Office
Christian	Strickland	Chemical Safety Technician	Director's Office
Murray	Gibson	Clerk	Director's Office
Kurt	Hodges	Coordinator, Animal Welfare Compliance	Director's Office
Johnathan	Parker	Critical Systems	Director's Office
Stephen	Dyal	Critical Systems Technician	Director's Office
Thomas	Williams	Critical Systems Technician	Director's Office
William	Hill	Director of LAR	Director's Office
Thomas	Jacobson	Director, EH&S FSU	Director's Office
Dwayne	Mahony	EHS Building Inspector	Director's Office
Curt	Rogers	EHS Fire Tech	Director's Office
Matthew	Maleszewski	EHS Technician	Director's Office
Sam	Sevor	Fire Safety Coordinator	Director's Office
Michael	Bryan	Fire Safety Tech	Director's Office
Thomas	Brasher	Fire Systems Technician	Director's Office
Matt	Howell	Fire Systems Technician	Director's Office
Corey	Furbee	Fire Tech	Director's Office

First Name	Last Name	Position Title	Department
Morgan	White	Fire-Plans Examiner/Inspector	Director's Office
Raymond	Allen	FSU Fire Tech	Director's Office
Darren	Dime	FSU Fire Tech	Director's Office
Mark	Klawinski	Industrial Hygienist	Director's Office
Jason	Marconnet	Industrial Hygienist	Director's Office
Alfie	Brown	Industrial Safety & Health Eng.	Director's Office
Christopher	Rodman	Industrial Safety & Health Eng.	Director's Office
Seyedehsahar	Mohammadi	Industrial Safety Hygienist	Director's Office
Jason	Nipper	Lab Animal Technologist	Director's Office
Matthieu	Dumont	Licensing Manager	Director's Office
Caroline	McNiel	Media Specialist	Director's Office
Glenda	Herrera-Gray	Occ. Health & Safety Specialist	Director's Office
Lou	Plansoen	Occ. Health & Safety Specialist	Director's Office
Carlos	Villa	Outreach Coordinator	Director's Office
Jennifer	Schellinger	Postdoctoral Associate	Director's Office
Colleen	Davis	Program Coordinator	Director's Office
Kristen	Coyne	Program Manager	Director's Office
Anke	Toth	Program Manager	Director's Office
Laurie	Whetstone	Quality Control Program Coordinator	Director's Office
Jason	Johnson	Radiation Safety Officer	Director's Office
Debin	Hammons	Receptionist	Director's Office
Yusuf	Qureshi	Receptionist	Director's Office
Ekaterina	Semenova	Receptionist	Director's Office
Albert	Migliori	Research Faculty III	Director's Office
Lezlee	Richerson	Sr. Administrative Specialist	Director's Office
Alyssa	Troy	Undergraduate Research Intern	Director's Office
Stephen	Bilenky	Videographer	Director's Office
Norman	Anderson	VP Research	Director's Office

Management and Administration

First Name	Last Name	Position Title	Department
Darian	Davis	AC Technician	Management and Administration
Daniel	Price	AC Technician	Management and Administration
Marsha	Jones	Accounting Assistant	Management and Administration
Angelena	Lang	Accounting Assistant	Management and Administration
Shauna	Walsh	Accounting Specialist	Management and Administration
Karen	Joiner	Admin Support Assistant	Management and Administration
Whitney	Brown	Administrative Specialist	Management and Administration
Dorothy	Gray	Administrative Specialist	Management and Administration
Holly	Stafford	Administrative Support Assistant	Management and Administration

Management/ Admin

First Name	Last Name	Position Title	Department
Damaris	Cobb	Asset Management Specialist	Management and Administration
Karol	Bickett	Budget Analyst	Management and Administration
Walter	Lee	Budget Analyst	Management and Administration
William	Barker	Campus Service Assistant	Management and Administration
Scott	Hermance	Campus Service Assistant	Management and Administration
Catalina	Torres	Clerk	Management and Administration
Cary	Winkler	Controls / Alarm Systems Technician	Management and Administration
Harry	Dickie	Custodial Supervisor	Management and Administration
Keri	McDaniel	Energy Specialist	Management and Administration
Aaron	Young	Engineer Technician	Management and Administration
Marshall	Wood	Facilities Electrical Supervisor	Management and Administration
Sean	Coyne	Facilities Engineer	Management and Administration
Kevin	Gamble	Facilities Superintendent	Management and Administration
Clyde	Rea	FSU MRD Affiliate	Management and Administration
Jay	Luedecke	FSU project manager	Management and Administration
Shengzhi	Zhang	Graduate Research Assistant	Management and Administration
Rodney	Shreve	Industrial Engineer	Management and Administration
Austin	Stafford	Intern	Management and Administration
Rob	Allen	ITS Technician	Management and Administration
Jackie	Bucheck	Lab Program and Air Resources Manager	Management and Administration
Marcela	Castano	Maintenance Engineer	Management and Administration
Micheal	Ivester	Maintenance Mechanic	Management and Administration
Steve	Johnson	Maintenance Mechanic	Management and Administration
Don	Pagel	Maintenance Mechanic	Management and Administration
Robert	Perkins	Maintenance Mechanic	Management and Administration
Billy	Phinazee	Maintenance Mechanic	Management and Administration
Anderson	Poole	Maintenance Mechanic	Management and Administration
Daniel	Preston	Maintenance Mechanic	Management and Administration
Ryan	Porter	Maintenance Supervisor	Management and Administration
Raymond	Cone	Mechanical Assistant	Management and Administration
John	Childs	Media Specialist (Graphic Artist)	Management and Administration
Kevin	John	Media Specialist (Graphic Artist)	Management and Administration
Richard	Ludlow	Media Specialist (Graphic Artist)	Management and Administration
Becky	Price	Network Architect	Management and Administration
Monroe	Walker	Network Specialist	Management and Administration
Miranda	Hacker	Office Administrator	Management and Administration
Andrew	Sapronetti	Office Administrator	Management and Administration
Judeth	Jean	Office Assistant	Management and Administration
Tra	Hunter	Plant Engineer	Management and Administration
William	Enfinger	Plumber	Management and Administration

First Name	Last Name	Position Title	Department
Ronald	Wallace	Plumber	Management and Administration
Philip	Hill	Program Associate	Management and Administration
Kenneth	Braverman	Research Assistant	Management and Administration
Ermal	Liko	Scientific & Research Technician	Management and Administration
Dustin	Stevens	Scientific & Research Technician	Management and Administration
Christopher	Oxendine	Scientific & Research Technician	Management and Administration
Russ	Cooper	Senior Electrician FSU Campus	Management and Administration
Jacqueline	Kornegay	Senior Financial Specialist	Management and Administration
Matthew	Kirschner	Systems Programmer	Management and Administration
Andrew	Rettig	Technical Support Analyst	Management and Administration
Cristina	Alonso	Technology Specialist	Management and Administration
James	Berhalter	Technology Specialist	Management and Administration
Sarita	Finn	Technology Specialist	Management and Administration
Dustin	Szelong	Technology Specialist	Management and Administration
Lindsay	Grooms	UBA Associate Director	Management and Administration
Sarah	Childers	UBA Business Associate	Management and Administration
Stacy	Slavichak	Water Resources Manager	Management and Administration
David	Hahn	Web Application Developer	Management and Administration
Duncan	Proctor	Web Designer/Programmer	Management and Administration

Magnet Science & Technology

First Name	Last Name	Position Title	Department
Doris	Geohagan	Accounting Specialist	Magnet Science & Technology
Rebekah	Sweat	Assistant Professor	Magnet Science & Technology
Rongmei	Niu	Associate In Research	Magnet Science & Technology
Nathaniel	Garceau	Graduate Research Assistant	Magnet Science & Technology
Mikai	Hulse	Graduate Research Assistant	Magnet Science & Technology
Toshiaki	Kanai	Graduate Research Assistant	Magnet Science & Technology
Sarajeen	Saima	Graduate Research Assistant	Magnet Science & Technology
Hamid	Sanavandi	Graduate Research Assistant	Magnet Science & Technology
Nissi	Supriya	Graduate Research Assistant	Magnet Science & Technology
Sisi	Wang	Graduate Research Assistant	Magnet Science & Technology
Atousa	Mehrani	Graphic Artist	Magnet Science & Technology
Jiang	Li	Microscopist	Magnet Science & Technology
Matthew	Lundblad	Microscopist	Magnet Science & Technology
Omar	Taleb	Microscopist	Magnet Science & Technology
Shiran	Bao	Postdoctoral Associate	Magnet Science & Technology
Yuan	Tang	Postdoctoral Associate	Magnet Science & Technology
Peng	Xu	Postdoctoral Associate	Magnet Science & Technology
Hui	Yu	Postdoctoral Associate	Magnet Science & Technology

First Name	Last Name	Position Title	Department
Wei	Guo	Professor	Magnet Science & Technology
James	Maddox	Program Associate	Magnet Science & Technology
Kyle	Buchholz	Research Assistant	Magnet Science & Technology
Salem	Fa	Research Assistant	Magnet Science & Technology
Kikelomo	Ijagbemi	Research Assistant	Magnet Science & Technology
William	Markiewicz	Research Assistant	Magnet Science & Technology
Carl	Windham	Research Assistant	Magnet Science & Technology
Todd	Adkins	Research Engineer	Magnet Science & Technology
Scott	Bole	Research Engineer	Magnet Science & Technology
Kurtis	Cantrell	Research Engineer	Magnet Science & Technology
Justin	Deterding	Research Engineer	Magnet Science & Technology
Scott	Gundlach	Research Engineer	Magnet Science & Technology
Brent	Jarvis	Research Engineer	Magnet Science & Technology
Dylan	Kolb-Bond	Research Engineer	Magnet Science & Technology
Jeremy	Levitan	Research Engineer	Magnet Science & Technology
Emsley	Marks	Research Engineer	Magnet Science & Technology
George	Miller	Research Engineer	Magnet Science & Technology
James	O'Reilly	Research Engineer	Magnet Science & Technology
Christopher	Ray	Research Engineer	Magnet Science & Technology
Donald	Richardson	Research Engineer	Magnet Science & Technology
Robert	Stanton	Research Engineer	Magnet Science & Technology
Adam	Voran	Research Engineer	Magnet Science & Technology
James	White	Research Engineer	Magnet Science & Technology
Bertram	Green	Research Faculty I	Magnet Science & Technology
Hongyu	Bai	Research Faculty II	Magnet Science & Technology
Iain	Dixon	Research Faculty III	Magnet Science & Technology
Andrey	Gavrilin	Research Faculty III	Magnet Science & Technology
Ke	Han	Research Faculty III	Magnet Science & Technology
Jun	Lu	Research Faculty III	Magnet Science & Technology
Jack	Toth	Research Faculty III	Magnet Science & Technology
Yan	Xin	Research Faculty III	Magnet Science & Technology
Robert	Goddard	Scientific Research Specialist	Magnet Science & Technology
Vince	Toplosky	Scientific Research Specialist	Magnet Science & Technology
William	Marshall	Sr. Research Associate	Magnet Science & Technology
Thomas	Painter	Sr. Research Associate	Magnet Science & Technology
Robert	Walsh	Sr. Research Associate	Magnet Science & Technology
Sheryl	Zavion	Sr. Research Associate	Magnet Science & Technology
Erick	Arroyo	Technical Research Designer	Magnet Science & Technology
Randy	Helms	Technical Research/Designer	Magnet Science & Technology
Joseph	Lucia	Technical/Research Designer	Magnet Science & Technology

First Name	Last Name	Position Title	Department
Steven	Van	Visiting Research Faculty	Magnet Science & Technology
Yang	Zhang	Visiting Research Faculty III	Magnet Science & Technology
Greg	Erickson	Visiting Scientist/Researcher	Magnet Science & Technology
Al	Zeller	Visiting Scientist/Researcher	Magnet Science & Technology

Los Alamos National Laboratory

First Name	Last Name	Position Title	Department
Amanda	Valdez	Administrative Assistant	LANL
Jeff	Martin	Controls Specialist	LANL
Dave	Sattler	Designer	LANL
Jing	Li	Director Postdoc Fellow	LANL
Andrea	Schmidt	Graduate Research Assistant	LANL
Josiah	Srock	Operations Technician	LANL
Junho	Choi	Postdoctoral Associate	LANL
Mateusz	Goryca	Postdoctoral Associate	LANL
Daniel	Jackson	Postdoctoral Associate	LANL
Satya	Kushwaha	Postdoctoral Associate	LANL
You	Lai	Postdoctoral Associate	LANL
Minseong	Lee	Postdoctoral Associate	LANL
Johanna	Palmstrom	Postdoctoral Associate	LANL
Kirk	Post	Postdoctoral Associate	LANL
Rico	Schoenemann	Postdoctoral Associate	LANL
Dan	Sun	Postdoctoral Associate	LANL
Katherine	Schreiber	Postdoctoral Researcher	LANL
Julie	Gallegos	Program Administrator	LANL
Billy	Vigil	Research & Development Technologist	LANL
Serena	Birnbaum	Research Assistant	LANL
Ashish	Bhardwaj	Research Faculty I	LANL
Mun	Keat	Research Faculty II	LANL
Laurel	Winter	Research Faculty II	LANL
Fedor	Balakirev	Research Faculty III	LANL
Scott	Crooker	Research Faculty III	LANL
Neil	Harrison	Research Faculty III	LANL
Mark	Hinrichs	Research Faculty III	LANL
Marcelo	Jaime	Research Faculty III	LANL
Boris	Maiorov	Research Faculty III	LANL
Ross	McDonald	Research Faculty III	LANL
Doan	Nguyen	Research Faculty III	LANL
Dwight	Rickel	Research Faculty III	LANL
John	Singleton	Research Faculty III	LANL

First Name	Last Name	Position Title	Department
Vivien	Zapf	Research Faculty III	LANL
Jason	Lucero	Research Technician	LANL
Darrell	Roybal	Research Technician	LANL
Hazuki	Teshima	Research Technician	LANL
Marcos	Vigil	Research Technician	LANL
Michael	Gordon	Research Technologist	LANL
James	Michel	Research Technologist	LANL
Scott	Betts	Technician	LANL
Thomas	Kline	Technologist	LANL
Christopher	Cordova	Undergraduate Student	LANL

University of Florida

First Name	Last Name	Position Title	Department
Shane	Chatfield	3 T Tech	UF
Rebecca	Butcher	Assistant Professor	UF
Yousong	Ding	Assistant Professor	UF
Matthew	Eddy	Assistant Professor	UF
Marcelo	Febo	Assistant Professor	UF
Sean	Forbes	Assistant Professor	UF
Dominique	Laroche	Assistant Professor	UF
Leslie	Murray	Assistant Professor	UF
John	Forder	Associate Professor	UF
James	Hamlin	Associate Professor	UF
Chalermchai	Khemtong	Associate Professor	UF
Matthew	Merritt	Associate Professor	UF
Tammy	Nicholson	Certified Radiology Technology Manager	UF
James	Collins	Core Research Facility Manager	UF
Anil	Mehta	Core Research Facility Manager	UF
Jens	Rosenberg	Core Research Facility Manager	UF
Joshua	Slade	Engineering Technician	UF
Alexander	Donald	Graduate Research Assistant	UF
Judith	Steadman	MRI Technologist	UF
Christi	Swiers	MRI Technologist	UF
Denise	Mesa	NHMFL Administrative Assistant	UF
Cynthia	Sager	Office Manager	UF
Andrew	Woods	Postdoctoral Associate	UF
Alexander	Angerhofer	Professor	UF
Amlan	Biswas	Professor	UF
Stephen	Blackband	Professor	UF
Clifford	Bowers	Professor	UF

First Name	Last Name	Position Title	Department
George	Christou	Professor	UF
Gail	Fanucci	Professor	UF
Jeffrey	Fitzsimmons	Professor	UF
Stephen	Hagen	Professor	UF
Arthur	Hebard	Professor	UF
Selman	Hershfield	Professor	UF
Peter	Hirschfeld	Professor	UF
Gary	Ihas	Professor	UF
Kevin	Ingersent	Professor	UF
Pradeep	Kumar	Professor	UF
Song	Lai	Professor	UF
Yoonseok	Lee	Professor	UF
Hendrik	Luesch	Professor	UF
Thomas	Mareci	Professor	UF
Dmitrii	Maslov	Professor	UF
Khandker	Muttalib	Professor	UF
Hai	Ping	Professor	UF
Andrew	Rinzler	Professor	UF
Christopher	Stanton	Professor	UF
Gregory	Stewart	Professor	UF
Neil	Sullivan	Professor	UF
Yasumasa	Takano	Professor	UF
Daniel	Talham	Professor	UF
David	Tanner	Professor	UF
David	Vaillancourt	Professor	UF
Krista	Vandenborne	Professor	UF
Sergey	Vasenkov	Professor	UF
Glenn	Walter	Professor	UF
Perihan	Brown	Research Administrator II	UF
Amy	Howe	Research Coordinator II	UF
Chao	Huan	Research Faculty I	UF
Lucia	Steinke	Research Faculty II	UF
Naoto	Masuhara	Research Faculty III	UF
Huadong	Zeng	Research Faculty III	UF
Kelly	Jenkins	RF Coil Engineer	UF
Malathy	Elumalai	RF Engineer	UF
James	Rocca	Senior Chemist & NMR Applications Specialist	UF

Geochemistry

Geochemistry

First Name	Last Name	Position Title	Department
Burt	Wolff	Assistant In Research	Geochemistry
Alyssa	Atwood	Assistant Professor	Geochemistry
Jeremy	Owens	Assistant Professor	Geochemistry
Robert	Spencer	Assistant Professor	Geochemistry
Michael	Stukel	Assistant Professor	Geochemistry
Seth	Young	Assistant Professor	Geochemistry
Nur	Ahmed	Graduate Research Assistant	Geochemistry
Lindsi	Allman	Graduate Research Assistant	Geochemistry
Megan	Behnke	Graduate Research Assistant	Geochemistry
Samantha	Bosman	Graduate Research Assistant	Geochemistry
Gary	Fowler	Graduate Research Assistant	Geochemistry
Christian	Gfatter	Graduate Research Assistant	Geochemistry
Daniel	Govert	Graduate Research Assistant	Geochemistry
Chance	Hannold	Graduate Research Assistant	Geochemistry
Amy	Holt	Graduate Research Assistant	Geochemistry
Johanna	Imhoff	Graduate Research Assistant	Geochemistry
Shakura	Jahan	Graduate Research Assistant	Geochemistry
Adam	Karl	Graduate Research Assistant	Geochemistry
Nevin	Kozik	Graduate Research Assistant	Geochemistry
Martin	Kurek	Graduate Research Assistant	Geochemistry
Siqi	Li	Graduate Research Assistant	Geochemistry
Mary	Lupo	Graduate Research Assistant	Geochemistry
Sean	Newby	Graduate Research Assistant	Geochemistry
Luis	Rodriguez	Graduate Research Assistant	Geochemistry
Jasmin	Schoenzart	Graduate Research Assistant	Geochemistry
Srishti	Sharma	Graduate Research Assistant	Geochemistry
Daniel	Sheikh	Graduate Research Assistant	Geochemistry
Steffanie	Sillitoe-Kukas	Graduate Research Assistant	Geochemistry
Fajun	Sun	Graduate Research Assistant	Geochemistry
Yahyia	Talebi	Graduate Research Assistant	Geochemistry
Yin	Zhang	Graduate Research Assistant	Geochemistry
Kristie	Dick	Laboratory Assistant / Technician	Geochemistry
Xinming	Chen	Postdoctoral Associate	Geochemistry
Anne	Kellerman	Postdoctoral Associate	Geochemistry
Qing-Feng	Mei	Postdoctoral Associate	Geochemistry
Derrick	Vaughn	Postdoctoral Associate	Geochemistry
Dominic	Woelki	Postdoctoral Associate	Geochemistry
Shuying	Yang	Postdoctoral Associate	Geochemistry
Jeff	Chanton	Professor	Geochemistry

First Name	Last Name	Position Title	Department
Munir	Humayun	Professor	Geochemistry
William	Landing	Professor	Geochemistry
Leroy	Odom	Professor	Geochemistry
Vincent	Salters	Professor	Geochemistry
Yang	Wang	Professor	Geochemistry
Philip	Froelich	Research Faculty III	Geochemistry
Afi	Sachi-Kocher	Scientific Research Specialist	Geochemistry
Gary	White	Scientific Research Specialist	Geochemistry
Theodore	Zateslo	Senior Engineer	Geochemistry
Lauren	Hearn	Undergraduate Research Assistant	Geochemistry
John	Kerigan	Undergraduate Research Assistant	Geochemistry
Jane	Wadhams	Undergraduate Student	Geochemistry
Peter	Morton	Visiting Assistant In	Geochemistry

Appendix 2 – User Facility Statistics

Seven user facilities — AMRIS (NMR-MRI@UF), DC Field, EMR, High B/T, ICR, NMR-MRI @FSU, and Pulsed Field — each with exceptional instrumentation and highly qualified staff scientists and staff, comprise the magnet lab's user program. In this appendix, each facility presents detailed information about its user demographics, operations statistics and requests for magnet time. A user is an individual or a member of a research group that is allocated magnet time. The user does not have to be "on site" for the experiment. A researcher who sends samples for analysis; a scientist who uses new lab technologies to conduct experiments remotely; or a PI who sends students to the magnet lab, are all considered users. All user numbers reflect distinct individuals, i.e. if a user has multiple proposals (different scientific thrusts) or is allocated magnet time more than once during the year, he/she is counted only once. All user data in the user facility statistics is as of February 4, 2021.

1. AMRIS Facility

Table 1a. Users by Demographic – NSF-Funded

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**36**	4	24	8	27	3	0	6
Senior Personnel, non-U.S.	**2**	1	1	0	2	0	0	0
Postdocs, U.S.	**10**	1	7	2	6	3	0	1
Postdocs, non-U.S.	**2**	0	1	1	2	0	0	0
Students, U.S.	**31**	1	18	12	16	7	0	8
Students, non-U.S.	**0**	0	0	0	0	0	0	0
Technician, U.S.	**7**	0	5	2	2	4	0	1
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**88**	**7**	**56**	**25**	**55**	**17**	**0**	**16**

Table 1b. Users by Demographic – Non-NHMFL-Funded

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**96**	7	57	32	48	20	0	28
Senior Personnel, non-U.S.	**1**	0	1	0	0	1	0	0
Postdocs, U.S.	**48**	6	25	17	20	12	0	16
Postdocs, non-U.S.	**0**	0	0	0	0	0	0	0
Students, U.S.	**93**	9	47	37	30	32	0	31
Students, non-U.S.	**0**	0	0	0	0	0	0	0
Technician, U.S.	**47**	6	19	22	10	17	0	20

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**285**	**28**	**149**	**108**	**108**	**82**	**0**	**95**

Table 1c. Users by Demographic – Summary

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
NSF-FUNDED	88	7	56	25	55	17	0	16
NON-NHMFL-FUNDED	285	28	149	108	108	82	0	95
TOTAL	**373**	**35**	**205**	**133**	**163**	**99**	**0**	**111**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 2a. Users by Participation – NSF-Funded

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**36**	20	3	2	11
Senior Personnel, non-U.S.	**2**	0	0	0	2
Postdocs, U.S.	**10**	10	0	0	0
Postdocs, non-U.S.	**2**	0	0	0	2
Students, U.S.	**31**	25	2	0	4
Students, non-U.S.	**0**	0	0	0	0
Technician, U.S.	**7**	7	0	0	0
Technician, non-U.S.	**0**	0	0	0	0
TOTAL	**88**	**62**	**5**	**2**	**19**

Table 2b. Users by Participation – Non-NHMFL-Funded

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**96**	64	0	0	32
Senior Personnel, non-U.S.	**1**	0	0	0	1
Postdocs, U.S.	**48**	42	1	0	5
Postdocs, non-U.S.	**0**	0	0	0	0
Students, U.S.	**93**	86	0	1	6
Students, non-U.S.	**0**	0	0	0	0
Technician, U.S.	**47**	45	0	0	2
Technician, non-U.S.	**0**	0	0	0	0
TOTAL	**285**	**237**	**1**	**1**	**46**

Table 2c. Users by Participation - Summary

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
NSF-FUNDED	88	62	5	2	19

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
NON-NHMFL-FUNDED	285	237	1	1	46
TOTAL	**373**	**299**	**6**	**3**	**65**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3a. Users by Organization – NSF-Funded

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**36**	17	6	13	0	36	0
Senior Personnel, non-U.S.	**2**	2	0	0	0	2	0
Postdocs, U.S.	**10**	2	7	1	0	10	0
Postdocs, non-U.S.	**2**	2	0	0	0	2	0
Students, U.S.	**31**	12	19	0	0	31	0
Students, non-U.S.	**0**	0	0	0	0	0	0
Technician, U.S.	**7**	0	0	7	0	7	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
TOTAL	**88**	**35**	**32**	**21**	**0**	**88**	**0**

Table 3b. Users by Organization – Non-NHMFL-Funded

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**96**	43	38	15	2	92	2
Senior Personnel, non-U.S.	**1**	1	0	0	0	1	0
Postdocs, U.S.	**48**	22	24	2	0	48	0
Postdocs, non-U.S.	**0**	0	0	0	0	0	0
Students, U.S.	**93**	35	58	0	1	92	0
Students, non-U.S.	**0**	0	0	0	0	0	0
Technician, U.S.	**47**	20	20	7	0	47	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
TOTAL	**285**	**121**	**140**	**24**	**3**	**280**	**2**

Table 3c. Users by Organization - Summary

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
NSF-FUNDED	**88**	35	32	21	0	88	0
NON-NHMFL-FUNDED	**285**	121	140	24	3	280	2
TOTAL	**373**	**156**	**172**	**45**	**3**	**368**	**2**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e. on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e. researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4a. Users by Discipline – NSF-Funded

	Users[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
Senior Personnel, U.S.	**36**	0	6	7	0	23
Senior Personnel, non-U.S.	**2**	0	0	0	0	2
Postdocs, U.S.	**10**	0	1	0	1	8
Postdocs, non-U.S.	**2**	1	1	0	0	0
Students, U.S.	**31**	0	12	8	1	10
Students, non-U.S.	**0**	0	0	0	0	0
Technician, U.S.	**7**	0	0	3	4	0
Technician, non-U.S.	**0**	0	0	0	0	0
TOTAL	**88**	**1**	**20**	**18**	**6**	**43**

Table 4b. Users by Discipline – Non-NHMFL-Funded

	Users[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
Senior Personnel, U.S.	**96**	0	5	8	4	79
Senior Personnel, non-U.S.	**1**	0	0	0	0	1
Postdocs, U.S.	**48**	0	4	4	2	38
Postdocs, non-U.S.	**0**	0	0	0	0	0
Students, U.S.	**93**	1	10	12	11	59
Students, non-U.S.	**0**	0	0	0	0	0
Technician, U.S.	**47**	0	0	3	11	33
Technician, non-U.S.	**0**	0	0	0	0	0
TOTAL	**285**	**1**	**19**	**27**	**28**	**210**

Table 4c. Users by Discipline - Summary

	Users[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
NSF-FUNDED	**88**	1	20	18	6	43
NON-NHMFL-FUNDED	**285**	1	19	27	28	210
TOTAL	**373**	**2**	**39**	**45**	**34**	**253**

[1] Users using multiple facilities are counted in each facility listed.

Table 5 Subscription Rate – Summary

	Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experiments With Usage	Experiments With Usage Percentage	Experi-ments Declined	Experi-ments Declined Percentage	Experi-ments Reviewed	Experiments Subscription Percentage
NSF-FUNDED	10	21	31	100 %	0	0 %	31	100%
NON-NHMFL-FUNDED	65	71	127	93.4 %	9	6.6 %	136	107.1 %
TOTAL	**75**	**92**	**158**		**9**		**167**	

Table 6a. Research Proposals [1] Profile (Demographics) with Magnet Time – Summary

	Total Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
NSF-FUNDED	31	3	23	5	7	21	0	3
NON-NHMFL-FUNDED	99	10	60	29	25	51	0	23
TOTAL	**130**	**13**	**83**	**34**	**32**	**72**	**0**	**26**

[1] A “proposal” may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.
Note: The table refers to proposal disciplines.

Table 6b. Research Proposals [1] Profile (Discipline) with Magnet Time – Summary

	Total Proposals[1]	CMP	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochem, Biophys.
NSF-FUNDED	**31**	0	4	5	0	22
NON-NHMFL-FUNDED	**99**	0	0	0	0	99
TOTAL	**130**	**0**	**4**	**5**	**0**	**121**

[1] A “proposal” may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.
Note: The table refers to proposal disciplines.

Find the list of user proposals in Appendix V and on our website

Table 7a. Operations by Magnet System Group – NSF-Funded

	Total Days Used	% of Total Days Used	500 MHz NMR	600 MHz NMR Cryo probe	600 MHz NMR Warm Bore	600 MHz NMR	600 MHz Wide Bore	750 MHz Wide	800 MHz, 63 mm	800 MHz NMR Cryo-probe	4.7 T/33 MRI	11 T/40 MRI
NHMFL-Affiliated	**191.9**	14.6 %	0	20.2	0	0	71.3	0	40.8	59.2	0.5	0
Local	**13.4**	1 %	0	0	0	8.9	1.5	0	0	3	0	0
University, U.S.	**349.7**	26.6 %	0	12.7	122.2	27.3	28.3	70.3	37.5	44	0	7.3
University, non-U.S.	**59.7**	4.5 %	0	9.7	1.0	26.7	1.0	0	4.7	15.7	0	1.0
Government Lab, U.S.	**0**	0 %	0	0	0	0	0	0	0	0	0	0
Government Lab, non-U.S.	**0**	0 %	0	0	0	0	0	0	0	0	0	0
Industry, U.S.	**0**	0 %	0	0	0	0	0	0	0	0	0	0
Industry, non-U.S.	**0**	0 %	0	0	0	0	0	0	0	0	0	0
Test/Calibration/ Maintenance	**701.3**	53.3 %	89	100.5	50.8	81.1	26.8	41.7	72.1	38.2	103.5	97.7
Method Development	**0**	0 %	0	0	0	0	0	0	0	0	0	0
Analytical Chemistry	**0**	0 %	0	0	0	0	0	0	0	0	0	0
Setup	**0**	0 %	0	0	0	0	0	0	0	0	0	0
Repair	**0**	0 %	0	0	0	0	0	0	0	0	0	0
TOTAL	**1,316**		**89**	**143**	**174**	**144**	**129**	**112**	**155**	**160**	**104**	**106**

Table 7b. Operations by Magnet System Group – Non-NHMFL-Funded

	Total Days Used	% of Total Days Used	500 MHz NMR	600 MHz NMR Cryo-probe	600 MHz NMR Warm Bore	600 MHz NMR	600 MHz Wide Bore	750 MHz Wide Bore	800 MHz, 63 mm	800 MHz NMR Cryo-probe	3T Sie-mens	3T Phil-lips	4.7T /33	11T /40
NHMFL-Affiliated	**326.2**	27.1 %	62	0.5	11	0	27.5	102.3	26	18.3	22.6	1	4	51
Local	**157.8**	13.1 %	0	23.1	0	6.2	0	26.5	8.0	0	45.5	10.1	5	33.5
University, U.S.	**652.3**	54.1 %	0	101.4	45	116.8	22.5	34.2	0	93.7	122.8	68.5	12	35.5
University, non-U.S.	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
Government Lab, U.S.	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
Government Lab, non-U.S.	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
Industry, U.S.	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
Industry, non-U.S.	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
Test/ Calibration/ Maintenance	**69.6**	5.8 %	0	0	0	0	0	0	0	0	20.2	49.5	0	0
Method Development	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
Analytical Chemistry	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
Setup	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
Repair	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**1,206**		**62**	**125**	**56**	**123**	**50**	**163**	**34**	**112**	**211**	**129**	**21**	**120**

Table 7c. Operations by Magnet Systems - Summary

	Total Days Used	500 MHz NMR	600 MHz NMR Cryo-probe	600 MHz NMR Warm Bore	600 MHz NMR	600 MHz Wide Bore	750 MHz Wide Bore	800 MHz, 63 mm	800 MHz NMR Cryo-probe	3T Sie-mens	3T Phil-lips	4.7T /33	11T /40
NSF-FUNDED	**1,316**	89	143	174	144	129	112	155	160	0	0	104	106
NON-NHMFL-FUNDED	**1,206**	62	125	56	123	50	163	34	112	211	129	21	120
TOTAL	**2,522**	**151**	**268**	**230**	**267**	**179**	**275**	**189**	**272**	**211**	**129**	**125**	**226**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 8a. Operations by Discipline – NSF-Funded

	Total Days Used[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
NHMFL-Affiliated	**191.9**	0	0	0	0	191.9
Local	**13.4**	0	10.4	0	0	3
University, U.S.	**349.7**	0	48.7	148.8	0	152.2
University, non-U.S.	**59.7**	0	0	0	0	59.7
Government Lab, U.S.	**0**	0	0	0	0	0
Government Lab, non-U.S.	**0**	0	0	0	0	0
Industry, U.S.	**0**	0	0	0	0	0

	Total Days Used[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
Industry, non-U.S.	**0**	0	0	0	0	0
Test/ Calibration/ Maintenance	**701.3**	0	0	0	346.4	354.9
Method Development	**0**	0	0	0	0	0
Analytical Chemistry	**0**	0	0	0	0	0
Setup	**0**	0	0	0	0	0
Repair	**0**	0	0	0	0	0
TOTAL	**1,316**	**0**	**59.1**	**148.8**	**346.4**	**761.7**

Table 8b. Operations by Discipline – Non-NHMFL-Funded

	Total Days Used[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
NHMFL-Affiliated	**326.2**	0	0	0.1	0	326.1
Local	**157.8**	0	0	0	0	157.8
University, U.S.	**652.3**	0	27	49.8	0	575.5
University, non-U.S.	**0**	0	0	0	0	0
Government Lab, U.S.	**0**	0	0	0	0	0
Government Lab, non-U.S.	**0**	0	0	0	0	0
Industry, U.S.	**0**	0	0	0	0	0
Industry, non-U.S.	**0**	0	0	0	0	0
Test/ Calibration/ Maintenance	**69.6**	0	0	0	0	69.6
Method Development	**0**	0	0	0	0	0
Analytical Chemistry	**0**	0	0	0	0	0
Setup	**0**	0	0	0	0	0
Repair	**0**	0	0	0	0	0
TOTAL	**1,206**	**0**	**27**	**50**	**0**	**1,129**

Table 8c. Operations by Discipline - Summary

	Total Days Used[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
NSF-FUNDED	**1,316**	0	59.1	148.8	346.4	761.7
NON-NHMFL-FUNDED	**1,206**	0	27	50	0	1,129
TOTAL	**2,522**	**0**	**86.1**	**198.8**	**346.4**	**1,890.7**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 9a. New PIs[1] and New Users – NSF-Funded

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**27**	7	7	20	36	3	3	33
Senior Personnel, non-U.S.	**2**	0	0	2	2	0	0	2
Postdocs, U.S.	**0**	0	0	0	10	2	2	8

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Postdocs, non-U.S.	**1**	0	0	1	2	0	0	2
Students, U.S.	**1**	0	0	1	31	4	4	27
Students, non-U.S.	**0**	0	0	0	0	0	0	0
Technician, U.S.	**0**	0	0	0	7	0	0	7
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**31**	**7**	**7**	**24**	**88**	**9**	**9**	**79**

Table 9b. New PIs[1] and New Users – Non-NHMFL-Funded

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**64**	12	14	50	96	0	1	95
Senior Personnel, non-U.S.	**0**	0	0	0	1	0	0	1
Postdocs, U.S.	**9**	0	0	9	48	5	5	43
Postdocs, non-U.S.	**0**	0	0	0	0	0	0	0
Students, U.S.	**1**	0	1	0	93	14	18	75
Students, non-U.S.	**0**	0	0	0	0	0	0	0
Technician, U.S.	**0**	0	0	0	47	1	2	45
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**74**	**12**	**15**	**59**	**285**	**20**	**26**	**259**

Table 9c. New PIs[1] and New Users - Summary

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
NSF-FUNDED	**31**	7	7	24	88	9	9	79
NON-NHMFL-FUNDED	**74**	12	15	59	285	20	26	259
TOTAL	**105**	**19**	**22**	**83**	**373**	**29**	**35**	**338**

[1] PIs who received magnet time for the first time.

Table 10a. New [1] User PIs – NSF-Funded

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Johnny Figueroa	Loma Linda University	P19197	Received 2020	Yes
Michael Harris	University of Florida	P19469	Received 2020	Yes
Jonathan Judy	University of Florida	P19466	Received 2020	Yes
Peder Larson	University of California - San Francisco	P17846	Received 2020	Yes
Mario Rivera	Louisiana State University	P19426	Received 2020	Yes
Jeffrey Rudolf	University of Florida	P19437	Received 2020	Yes
Carsten Sievers	Georgia Institute of Technology	P19432	Received 2020	Yes

Table 10b. New [1] User PIs – Non-NHMFL-Funded

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Matthew Eddy	University of Florida	P19523	Received 2020	No
Hugo Guerrero-Cazares	Mayo Clinic, Jacksonville	P19417	Received 2020	Yes

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Robert Huigens	University of Florida	P19489	Received 2020	No
Daniel Isom	University of Miami	P19558	Received 2020	Yes
Eric Krause	University of Florida	P19560	Received 2020	Yes
Andrew Maurer	University of Florida	P19449	Received 2020	No
Giuseppe Morelli	University of Florida	P19481	Received 2020	Yes
Brian Odegaard	University of Florida	P19304	Received 2020	Yes
Jeffrey Rudolf	University of Florida	P19436	Received 2020	Yes
Terence Ryan	University of Florida	P19454	Received 2020	Yes
Dietmar Siemann	University of Florida	P19526	Received 2020	Yes
Maurice Swanson	University of Florida	P19281	Received 2020	Yes
Shahabeddin Vahdat	University of Florida	P19296	Received 2020	Yes
Christopher Wendler	University of Florida	P19347	Received 2020	Yes
Lakiesha Williams	University of Florida	P19527	Received 2020	Yes

[1] PIs who received magnet time for the first time.

2. DC Field Facility

Table 1. Users by Demographic

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**141**	6	117	18	108	21	0	12
Senior Personnel, non-U.S.	**43**	5	30	8	31	6	0	6
Postdocs, U.S.	**50**	3	39	8	39	8	0	3
Postdocs, non-U.S.	**11**	1	6	4	4	2	0	5
Students, U.S.	**122**	4	95	23	83	26	0	13
Students, non-U.S.	**28**	2	20	6	21	3	0	4
Technician, U.S.	**7**	0	6	1	4	2	0	1
Technician, non-U.S.	**2**	0	1	1	2	0	0	0
TOTAL	**404**	**21**	**314**	**69**	**292**	**68**	**0**	**44**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 2. Users by Participation

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**141**	72	0	16	53
Senior Personnel, non-U.S.	**43**	12	0	9	22
Postdocs, U.S.	**50**	24	0	2	24
Postdocs, non-U.S.	**11**	5	0	0	6
Students, U.S.	**122**	67	0	6	49
Students, non-U.S.	**28**	14	0	1	13
Technician, U.S.	**7**	7	0	0	0
Technician, non-U.S.	**2**	1	0	0	1
TOTAL	**404**	**202**	**0**	**34**	**168**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3. Users by Organization

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**141**	82	8	51	15	125	1
Senior Personnel, non-U.S.	**43**	43	0	0	9	33	1
Postdocs, U.S.	**50**	39	3	8	5	45	0
Postdocs, non-U.S.	**11**	11	0	0	2	9	0
Students, U.S.	**122**	99	14	9	7	115	0
Students, non-U.S.	**28**	28	0	0	1	27	0
Technician, U.S.	**7**	0	0	7	0	7	0
Technician, non-U.S.	**2**	2	0	0	0	2	0

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
TOTAL	**404**	**304**	**25**	**75**	**39**	**363**	**2**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e. on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e. researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4. Users by Discipline

	Users[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
Senior Personnel, U.S.	**141**	90	18	11	12	10
Senior Personnel, non-U.S.	**43**	28	7	2	4	2
Postdocs, U.S.	**50**	41	1	1	1	6
Postdocs, non-U.S.	**11**	9	1	0	1	0
Students, U.S.	**122**	95	13	7	3	4
Students, non-U.S.	**28**	22	3	1	2	0
Technician, U.S.	**7**	0	0	0	6	1
Technician, non-U.S.	**2**	1	0	1	0	0
TOTAL	**404**	**286**	**43**	**23**	**29**	**23**

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. Subscription Rate (Experiments)

Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experiments With Usage	Experiments With Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experiments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
289	34	146	45.2 %	177	54.8 %	323	2.2	221.2 %

Table 5b. Subscription Rate (Magnet Days)

Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maint.	Total Days Used	Days Subscription Rate	Days Subscription Percentage
2,253	779.8	7	209.3	25	1,021.1	2.2	221.3 %

Table 6a. Research Proposals [1] Profile (Demographics) with Magnet Time

TOTAL Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
108	5	96	7	22	82	0	4

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.

Note: The table refers to proposal disciplines.

Table 6b. Research Proposals [1] Profile (Discipline) with Magnet Time

TOTAL Proposals[1]	Condensed Matter Physics	Chemistry, Geo-chemistry	Engineering	Magnets, Materials	Biology, Biochem, Biophys.
108	77	11	0	15	5

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.

Note: The table refers to proposal disciplines.

Find the list of user proposals in Appendix V and on our website

Table 7. Operations by Magnet System Group

	Total Days Used	% of Total Days Used	45T	Resistive	SCH	Super-conducting
NHMFL-Affiliated	**209.3**	20.5 %	5	75.3	12	117
Local	**7**	0.7 %	0	0	0	7
University, U.S.	**502.8**	49.2 %	29	118.8	17	338
University, non-U.S.	**174.1**	17.1 %	4	53.1	15	102
Government Lab, U.S.	**26.9**	2.6 %	9	7.9	0	10
Government Lab, non-U.S.	**76**	7.4 %	5	0	0	71
Industry, U.S.	**0**	0 %	0	0	0	0
Industry, non-U.S.	**0**	0 %	0	0	0	0
Test/Calibration/Maintenance	**16**	1.6 %	0	0	0	16
Method Development	**9**	0.9 %	0	0	0	9
Analytical Chemistry	**0**	0 %	0	0	0	0
Setup	**0**	0 %	0	0	0	0
Repair	**0**	0 %	0	0	0	0
TOTAL	**1,021.1**		**52**	**255.1**	**44**	**670**

[1] Each 20 MW resistive magnet requires two power supplies to run, the 45 T hybrid magnet requires three power supplies and the 36 T Series Connected Hybrid requires one power supply. Thus there can be four resistive magnets + three superconducting magnets operating or the 45 T hybrid, series connected hybrid, two resistive magnets and three superconducting magnets. User Units are defined as magnet days. Users of water-cooled resistive or hybrid magnets can typically expect to receive enough energy for 7 hours a day of magnet usage so a magnet day is defined as 7 hours. Superconducting magnets are scheduled typically 24 hours a day. There is an annual four week shutdown in fall of powered DC resistive and hybrid magnets for infrastructure maintenance and a two week shutdown period for the university mandated holiday break.

Table 8. Operations by Discipline

	Total Days Used[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
NHMFL-Affiliated	**209.3**	172	0	0	32.4	5
Local	**7**	0	7	0	0	0
University, U.S.	**502.8**	378	76	0	39.7	9
University, non-U.S.	**174.1**	119.7	31	0	23.5	0
Government Lab, U.S.	**26.9**	26.9	0	0	0	0
Government Lab, non-U.S.	**76**	76	0	0	0	0
Industry, U.S.	**0**	0	0	0	0	0
Industry, non-U.S.	**0**	0	0	0	0	0
Test/Calibration/Maintenance	**16**	16	0	0	0	0
Method Development	**9**	9	0	0	0	0
Analytical Chemistry	**0**	0	0	0	0	0
Setup	**0**	0	0	0	0	0
Repair	**0**	0	0	0	0	0
TOTAL	**1,021.1**	**797.6**	**114**	**0**	**95.5**	**14**

[1] Each 20 MW resistive magnet requires two power supplies to run, the 45 T hybrid magnet requires three power supplies and the 36 T Series Connected Hybrid requires one power supply. Thus there can be four resistive magnets + three superconducting magnets operating or the 45 T hybrid, series connected hybrid, two resistive magnets and three superconducting magnets. User Units are defined as magnet days. Users of water-cooled resistive or hybrid magnets can typically expect to receive enough energy for 7 hours a day of magnet usage so a magnet day is defined as 7 hours. Superconducting magnets are scheduled typically 24 hours a day. There is an annual four week shutdown in fall of powered DC resistive and hybrid magnets for infrastructure maintenance and a two week shutdown period for the university mandated holiday break.

Table 9. New PIs[1] and New Users

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**69**	10	15	54	141	4	6	135
Senior Personnel, non-U.S.	**25**	3	5	20	43	4	5	38
Postdocs, U.S.	**0**	0	0	0	50	4	6	44
Postdocs, non-U.S.	**0**	0	0	0	11	2	2	9
Students, U.S.	**0**	0	0	0	122	23	30	92
Students, non-U.S.	**0**	0	0	0	28	8	9	19
Technician, U.S.	**0**	0	0	0	7	1	2	5
Technician, non-U.S.	**0**	0	0	0	2	0	0	2
TOTAL	**94**	**13**	**20**	**74**	**404**	**46**	**60**	**344**

[1] PIs who received magnet time for the first time.

Table 10. New [1] User PIs

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Shalinee Chikara	National High Magnetic Field Laboratory	P19144	Received 2020	No
Irinel Chiorescu	National High Magnetic Field Laboratory	P19218	Received 2020	No
Enrique Colacio	University of Granada	P17454	Received 2020	No
Tim Cross	National High Magnetic Field Laboratory	P17493	Received 2020	No
Mikel Holcomb	West Virginia University	P19291	Received 2020	Yes
Hua-Fen Hsu	National Cheng Kung University	P19128	Received 2020	Yes
Lin Jiao	National High Magnetic Field Laboratory	P19480	Received 2020	Yes
Xueqian Kong	Zhejiang University	P19235	Received 2020	No
Henry La Pierre	Georgia Institute of Technology	P19236	Received 2020	Yes
Bing Lv	University of Texas, Dallas	P19227	Received 2020	Yes
Vlad Pribiag	University of Minnesota, Twin Cities	P19258	Received 2020	Yes
Jeffrey Rinehart	University of California, San Diego	P19253	Received 2020	Yes
Efrain Rodriguez	University of Maryland, College Park	P18006	Received 2020	Yes
Aaron Rossini	Iowa State University	P17500	Received 2020	No
Keshav Shrestha	Texas A&M University	P19467	Received 2020	Yes
Benjamin Stein	Los Alamos National Laboratory	P19152	Received 2020	No
Mas Subramanian	Oregon State University	P19361	Received 2020	Yes
Akiyasu Yamamoto	Tokyo University of Agriculture and Technology	P19232	Received 2020	Yes
Matthew Yankowitz	University of Washington	P19146	Received 2020	Yes
Qi Zhang	Nanjing University	P19349	Received 2020	Yes

[1] PIs who received magnet time for the first time.

3. EMR Facility

Table 1. Users by Demographic

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**51**	2	41	8	40	5	0	6
Senior Personnel, non-U.S.	**15**	1	12	2	7	7	0	1
Postdocs, U.S.	**8**	0	7	1	7	1	0	0
Postdocs, non-U.S.	**4**	0	3	1	1	2	0	1
Students, U.S.	**30**	1	20	9	17	7	0	6
Students, non-U.S.	**4**	0	2	2	2	1	0	1
Technician, U.S.	**0**	0	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**112**	**4**	**85**	**23**	**74**	**23**	**0**	**15**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 2. Users by Participation

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**51**	30	0	7	14
Senior Personnel, non-U.S.	**15**	0	0	4	11
Postdocs, U.S.	**8**	6	0	1	1
Postdocs, non-U.S.	**4**	2	0	0	2
Students, U.S.	**30**	17	0	3	10
Students, non-U.S.	**4**	2	0	0	2
Technician, U.S.	**0**	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0
TOTAL	**112**	**57**	**0**	**15**	**40**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3. Users by Organization

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**51**	23	6	22	5	46	0
Senior Personnel, non-U.S.	**15**	15	0	0	1	14	0
Postdocs, U.S.	**8**	3	3	2	2	6	0
Postdocs, non-U.S.	**4**	3	0	1	1	3	0
Students, U.S.	**30**	17	9	4	0	30	0
Students, non-U.S.	**4**	4	0	0	0	4	0
Technician, U.S.	**0**	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
TOTAL	**112**	**65**	**18**	**29**	**9**	**103**	**0**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e. on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e. researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4. Users by Discipline

	Users[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
Senior Personnel, U.S.	**51**	12	28	2	0	9
Senior Personnel, non-U.S.	**15**	1	13	0	1	0
Postdocs, U.S.	**8**	4	3	0	1	0
Postdocs, non-U.S.	**4**	0	3	0	1	0
Students, U.S.	**30**	6	22	0	2	0
Students, non-U.S.	**4**	1	3	0	0	0
Technician, U.S.	**0**	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0
TOTAL	**112**	**24**	**72**	**2**	**5**	**9**

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. Subscription Rate (Experiments)

Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experi-ments With Usage	Experiments With Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experiments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
93	15	99	91.7 %	9	8.3 %	108	1.1	109.1 %

Table 5b. Subscription Rate (Magnet Days)

Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maint.	Total Days Used	Days Subscription Rate	Days Subscription Percentage
960	486.5	7	78.5	56	704	1.4	1.4 %

Table 6a. Research Proposals [1] Profile (Demographics) with Magnet Time

TOTAL Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
45	4	38	3	6	38	0	1

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.

Note: The table refers to proposal disciplines.

Table 6b. Research Proposals [1] Profile (Discipline) with Magnet Time

TOTAL Proposals[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochem, Biophys.
45	7	24	1	6	7

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.

Note: The table refers to proposal disciplines.

Find the list of user proposals in Appendix V and on our website

Table 7. Operations by Magnet System

	Total Days Used	Percentage of Total Days Used	12.5T Superconducting Magnet, Pulsed EPR	17T Superconducting Magnet	Bruker	HiPER
NHMFL-Affiliated	**78.5**	11.2 %	22	19.5	3	34
Local	**7**	1 %	0	5	1	1
University, U.S.	**373.5**	53.1 %	78	98.5	108	89
University, non-U.S.	**106**	15.1 %	19	43	11	33
Government Lab, U.S.	**2**	0.3 %	0	2	0	0
Government Lab, non-U.S.	**5**	0.7 %	5	0	0	0
Industry, U.S.	**0**	0 %	0	0	0	0
Industry, non-U.S.	**0**	0 %	0	0	0	0
Test/Calibration/ Maintenance	**56**	8 %	0	2	30	24
Method Development	**76**	10.8 %	0	0	19	57
Analytical Chemistry	**0**	0 %	0	0	0	0
Setup	**0**	0 %	0	0	0	0
Repair	**0**	0 %	0	0	0	0
TOTAL	**704**		**124**	**170**	**172**	**238**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 8. Operations by Discipline

	Total Days Used[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
NHMFL-Affiliated	**78.5**	19	22	0	11.5	26
Local	**7**	0	7	0	0	0
University, U.S.	**373.5**	43	228	7	1.5	94
University, non-U.S.	**106**	24	43	0	39	0
Government Lab, U.S.	**2**	2	0	0	0	0
Government Lab, non-U.S.	**5**	0	5	0	0	0
Industry, U.S.	**0**	0	0	0	0	0
Industry, non-U.S.	**0**	0	0	0	0	0
Test/Calibration/ Maintenance	**56**	0	0	0	20	36
Method Development	**76**	0	0	0	39	37
Analytical Chemistry	**0**	0	0	0	0	0
Setup	**0**	0	0	0	0	0
Repair	**0**	0	0	0	0	0
TOTAL	**704**	**88**	**305**	**7**	**111**	**193**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 9. New PIs[1] and New Users

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**29**	4	5	24	51	4	8	43
Senior Personnel, non-U.S.	**9**	3	3	6	15	3	3	12

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Postdocs, U.S.	**1**	0	0	1	8	2	3	5
Postdocs, non-U.S.	**1**	0	0	1	4	1	1	3
Students, U.S.	**0**	0	0	0	30	8	15	15
Students, non-U.S.	**0**	0	0	0	4	1	2	2
Technician, U.S.	**0**	0	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**40**	**7**	**8**	**32**	**112**	**19**	**32**	**80**

[1] PIs who received magnet time for the first time.

Table 10. New [1] User PIs

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Igor Fritsky	Taras Shevchenko National University of Kyiv	P19517	Received 2020	Yes
Marta Hatzell	Georgia Institute of Technology	P19459	Received 2020	Yes
Kirill Kovnir	Iowa State University	P19330	Received 2020	Yes
Henry La Pierre	Georgia Institute of Technology	P19275	Received 2020	Yes
Michal Leskes	Weizmann Institute of Science	P19484	Received 2020	Yes
Mas Subramanian	Oregon State University	P19361	Received 2020	Yes
Rudi van Eldik	University of Erlangen-Nuremberg, Germany	P19314	Received 2020	Yes
Sungsool Wi	National High Magnetic Field Laboratory	P18056	Received 2020	No

[1] PIs who received magnet time for the first time.

4. High B/T Facility

Table 1. Users by Demographic

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**3**	0	2	1	2	0	0	1
Senior Personnel, non-U.S.	**1**	0	1	0	1	0	0	0
Postdocs, U.S.	**3**	0	1	2	1	1	0	1
Postdocs, non-U.S.	**0**	0	0	0	0	0	0	0
Students, U.S.	**3**	0	3	0	2	0	0	1
Students, non-U.S.	**0**	0	0	0	0	0	0	0
Technician, U.S.	**0**	0	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**10**	**0**	**7**	**3**	**6**	**1**	**0**	**3**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 2. Users by Participation

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**3**	2	0	0	1
Senior Personnel, non-U.S.	**1**	1	0	0	0
Postdocs, U.S.	**3**	3	0	0	0
Postdocs, non-U.S.	**0**	0	0	0	0
Students, U.S.	**3**	3	0	0	0
Students, non-U.S.	**0**	0	0	0	0
Technician, U.S.	**0**	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0
TOTAL	**10**	**9**	**0**	**0**	**1**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3. Users by Organization

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**3**	1	0	2	0	3	0
Senior Personnel, non-U.S.	**1**	1	0	0	0	1	0
Postdocs, U.S.	**3**	1	0	2	0	3	0
Postdocs, non-U.S.	**0**	0	0	0	0	0	0
Students, U.S.	**3**	0	3	0	0	3	0
Students, non-U.S.	**0**	0	0	0	0	0	0
Technician, U.S.	**0**	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
TOTAL	**10**	**3**	**3**	**4**	**0**	**10**	**0**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e. on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e. researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4. Users by Discipline

	Users[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
Senior Personnel, U.S.	**3**	2	0	0	0	1
Senior Personnel, non-U.S.	**1**	1	0	0	0	0
Postdocs, U.S.	**3**	2	0	0	0	1
Postdocs, non-U.S.	**0**	0	0	0	0	0
Students, U.S.	**3**	3	0	0	0	0
Students, non-U.S.	**0**	0	0	0	0	0
Technician, U.S.	**0**	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0
TOTAL	**10**	**8**	**0**	**0**	**0**	**2**

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. Subscription Rate (Experiments)

Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experiments With Usage	Experiments With Usage Percentage	Experi-ments Declined	Experiments Declined Percentage	Experi-ments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
8	2	2	20 %	8	80 %	10	5	500 %

Table 5b. Subscription Rate (Magnet Days)

Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maint.	Total Days Used	Days Subscription Rate	Days Subscription Percentage
640	170	0	0	0	170	3.8	376.5 %

Table 6a. Research Proposals [1] Profile (Demographics) with Magnet Time

TOTAL Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
2	0	2	0	0	2	0	0

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.

Note: The table refers to proposal disciplines.

Table 6b. Research Proposals [1] Profile (Discipline) with Magnet Time

TOTAL Proposals[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochem, Biophys.
2	2	0	0	0	0

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.

[3] The number of proposals satisfying the following condition: The PI is a female.

Note: The table refers to proposal disciplines.

Find the list of user proposals in Appendix V and on our website

Table 7. Operations by Magnet System

	Total Days Used	Percentage of Total Days Used	Bay 2 (UF Microkelvin Lab) 0.02mK, 8T	Bay 3 (UF Microkelvin Lab) 0.3mK, 16T	Williamson Hall (UF Physics) 40mK, 10T (fast cycling)
NHMFL-Affiliated	**0**	0 %	0	0	0
Local	**0**	0 %	0	0	0
University, U.S.	**85**	50 %	85	0	0
University, non-U.S.	**85**	50 %	0	85	0
Government Lab, U.S.	**0**	0 %	0	0	0
Government Lab, non-U.S.	**0**	0 %	0	0	0
Industry, U.S.	**0**	0 %	0	0	0
Industry, non-U.S.	**0**	0 %	0	0	0
Test/Calibration/ Maintenance	**0**	0 %	0	0	0
Method Development	**0**	0 %	0	0	0
Analytical Chemistry	**0**	0 %	0	0	0
Setup	**0**	0 %	0	0	0
Repair	**0**	0 %	0	0	0
TOTAL	**170**		**85**	**85**	**0**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 8. Operations by Discipline

	Total Days Used[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
NHMFL-Affiliated	**0**	0	0	0	0	0
Local	**0**	0	0	0	0	0
University, U.S.	**85**	85	0	0	0	0
University, non-U.S.	**85**	85	0	0	0	0
Government Lab, U.S.	**0**	0	0	0	0	0
Government Lab, non-U.S.	**0**	0	0	0	0	0
Industry, U.S.	**0**	0	0	0	0	0
Industry, non-U.S.	**0**	0	0	0	0	0
Test/Calibration/ Maintenance	**0**	0	0	0	0	0
Method Development	**0**	0	0	0	0	0
Analytical Chemistry	**0**	0	0	0	0	0
Setup	**0**	0	0	0	0	0
Repair	**0**	0	0	0	0	0
TOTAL	**170**	**170**	**0**	**0**	**0**	**0**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 9. New PIs[1] and New Users

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**0**	0	0	0	3	0	0	3
Senior Personnel, non-U.S.	**1**	0	0	1	1	0	0	1
Postdocs, U.S.	**1**	0	0	1	3	0	0	3
Postdocs, non-U.S.	**0**	0	0	0	0	0	0	0
Students, U.S.	**0**	0	0	0	3	0	0	3
Students, non-U.S.	**0**	0	0	0	0	0	0	0
Technician, U.S.	**0**	0	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**2**	**0**	**0**	**2**	**10**	**0**	**0**	**10**

[1] PIs who received magnet time for the first time.

Table 10. New [1] User PIs - none

5. ICR Facility

Table 1. Users by Demographic

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**106**	8	71	27	57	26	0	23
Senior Personnel, non-U.S.	**27**	3	12	12	13	2	0	12
Postdocs, U.S.	**23**	1	15	7	9	9	0	5
Postdocs, non-U.S.	**6**	0	5	1	1	4	0	1
Students, U.S.	**56**	5	43	8	24	26	0	6
Students, non-U.S.	**7**	1	3	3	3	2	0	2
Technician, U.S.	**6**	1	0	5	0	1	0	5
Technician, non-U.S.	**20**	0	2	18	2	1	0	17
TOTAL	**251**	**19**	**151**	**81**	**109**	**71**	**0**	**71**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 2. Users by Participation

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**106**	16	0	18	72
Senior Personnel, non-U.S.	**27**	2	0	3	22
Postdocs, U.S.	**23**	3	0	1	19
Postdocs, non-U.S.	**6**	0	0	1	5
Students, U.S.	**56**	22	0	5	29
Students, non-U.S.	**7**	0	0	0	7
Technician, U.S.	**6**	0	0	1	5
Technician, non-U.S.	**20**	0	0	0	20
TOTAL	**251**	**43**	**0**	**29**	**179**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3. Users by Organization

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**106**	93	3	10	18	79	9
Senior Personnel, non-U.S.	**27**	27	0	0	11	13	3
Postdocs, U.S.	**23**	20	1	2	3	20	0
Postdocs, non-U.S.	**6**	6	0	0	3	3	0
Students, U.S.	**56**	37	11	8	1	54	1
Students, non-U.S.	**7**	7	0	0	0	7	0
Technician, U.S.	**6**	6	0	0	0	4	2

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Technician, non-U.S.	**20**	20	0	0	2	16	2
TOTAL	**251**	**216**	**15**	**20**	**38**	**196**	**17**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e. on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e. researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4. Users by Discipline

	Users[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
Senior Personnel, U.S.	**106**	0	65	21	1	19
Senior Personnel, non-U.S.	**27**	0	15	0	0	12
Postdocs, U.S.	**23**	0	12	5	0	6
Postdocs, non-U.S.	**6**	0	4	0	0	2
Students, U.S.	**56**	0	37	12	1	6
Students, non-U.S.	**7**	0	4	0	0	3
Technician, U.S.	**6**	0	1	0	0	5
Technician, non-U.S.	**20**	0	2	5	0	13
TOTAL	**251**	**0**	**140**	**43**	**2**	**66**

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. Subscription Rate (Experiments)

Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experiments With Usage	Experiments With Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experi-ments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
104	14	92	78 %	26	22 %	118	1.3	128.3 %

Table 5b. Subscription Rate (Magnet Days)

Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Method Development	Total Days Used	Days Subscription Rate	Days Subscription Percentage
1,474	241	36.7	86.4	17.5	612	2.4	240.8 %

Table 6a. Research Proposals [1] Profile (Demographics) with Magnet Time

Total Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
67	4	50	13	13	46	0	8

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.

Note: The table refers to proposal disciplines.

Table 6b. Research Proposals [1] Profile (Discipline) with Magnet Time

Total Proposals[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochem, Biophys.
67	0	49	3	2	13

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.
Note: The table refers to proposal disciplines.

Find the list of user proposals in Appendix V and on our website

Table 7. Operations by Magnet System

	Total Days Used	Percentage of Total Days Used	9.4T, 155 mm bore FT-ICR MS	9.4T, 220 mm bore FT-ICR MS	14.5T Hybrid LTQ/ FT-ICR MS	21T Hybrid LTQ/FT-ICR MS
NHMFL-Affiliated	**86.4**	14.1 %	0	38.8	1.3	46.3
Local	**36.7**	6 %	0	31.5	0	5.2
University, U.S.	**145.9**	23.8 %	0	61	0	84.9
University, non-U.S.	**32.5**	5.3 %	0	0	0	32.5
Government Lab, U.S.	**16.1**	2.6 %	0	8	0	8.1
Government Lab, non-U.S.	**8.9**	1.5 %	0	7	0	1.9
Industry, U.S.	**5**	0.8 %	0	5	0	0
Industry, non-U.S.	**32.7**	5.3 %	0	25.2	2.5	5
Test/Calibration/ Maintenance	**17.5**	2.9 %	0	1.5	15	1.0
Method Development	**0**	0 %	0	0	0	0
Analytical Chemistry	**230.4**	37.6 %	0	5	153.3	72.2
Setup	**0**	0 %	0	0	0	0
Repair	**0**	0 %	0	0	0	0
TOTAL	**612**		**0**	**183**	**172**	**257**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 8. Operations by Discipline

	Total Days Used[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
NHMFL-Affiliated	**86.4**	0	84.4	0	2.0	0
Local	**36.7**	0	36.7	0	0	0
University, U.S.	**145.9**	0	89.7	3.9	6.0	46.3
University, non-U.S.	**32.5**	0	2.7	0	0	29.8
Government Lab, U.S.	**16.1**	0	13.7	2.0	0	0.3
Government Lab, non-U.S.	**8.9**	0	8.9	0	0	0
Industry, U.S.	**5.0**	0	5.0	0	0	0
Industry, non-U.S.	**32.7**	0	32.7	0	0	0
Test/Calibration/ Maintenance	**17.5**	0	17.5	0	0	0
Method Development	**0**	0	0	0	0	0
Analytical Chemistry	**230.4**	0	230.4	0	0	0
Setup	**0**	0	0	0	0	0
Repair	**0**	0	0	0	0	0
TOTAL	**612**	**0**	**521.6**	**5.9**	**8**	**76.5**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 9. New PIs[1] and New Users

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**45**	10	10	35	106	21	21	85
Senior Personnel, non-U.S.	**6**	1	1	5	27	17	17	10
Postdocs, U.S.	**1**	1	1	0	23	8	8	15
Postdocs, non-U.S.	**2**	1	1	1	6	1	1	5
Students, U.S.	**0**	0	0	0	56	22	22	34
Students, non-U.S.	**0**	0	0	0	7	3	3	4
Technician, U.S.	**0**	0	0	0	6	4	4	2
Technician, non-U.S.	**1**	1	1	0	20	10	10	10
TOTAL	**55**	**14**	**14**	**41**	**251**	**86**	**86**	**165**

[1] PIs who received magnet time for the first time.

Table 10. New [1] User PIs

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Kenneth Carroll	New Mexico State University	P19321	Received 2020	Yes
Núria Catalán	U.S. Geological Survey (USGS)	P19309	Received 2020	Yes
David Harper	University of Tennessee, Knoxville	P19320	Received 2020	Yes
Jon Hawkings	Florida State University	P19475	Received 2020	Yes
Leslie Hicks	University of North Carolina at Chapel Hill	P19430	Received 2020	Yes
Samantha Joye	University of Georgia	P19460	Received 2020	Yes
Xiaolin Li	Xiamen University	P19493	Received 2020	Yes
Jason Masoner	U.S. Geological Survey	P19279	Received 2020	Yes
Colleen McMahan	U.S. Department of Agriculture	P19457	Received 2020	Yes
Karina Meredith	Australia's Nuclear Science and Technology Organization	P19277	Received 2020	Yes
Amin Mirkouei	University of Idaho	P19334	Received 2020	Yes
Calvin Mukarakate	National Renewable Energy Laboratory	P19502	Received 2020	Yes
Raghab Ray	The University of Tokyo, Atmosphere and Ocean Research Institute	P19448	Received 2020	Yes
Estrella Rogel	Chevron ETC	P19359	Received 2020	Yes

[1] PIs who received magnet time for the first time.

6. NMR Facility

Table 1. Users by Demographic

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**84**	4	68	12	65	11	0	8
Senior Personnel, non-U.S.	**39**	3	20	16	21	7	0	11
Postdocs, U.S.	**24**	2	14	8	9	8	0	7
Postdocs, non-U.S.	**5**	0	2	3	0	2	0	3
Students, U.S.	**63**	3	42	18	33	18	0	12
Students, non-U.S.	**15**	2	5	8	5	3	0	7
Technician, U.S.	**3**	0	3	0	2	1	0	0
Technician, non-U.S.	**1**	0	0	1	0	0	0	1
TOTAL	**234**	**14**	**154**	**66**	**135**	**50**	**0**	**49**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 2. Users by Participation

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**84**	33	4	11	36
Senior Personnel, non-U.S.	**39**	5	1	5	28
Postdocs, U.S.	**24**	13	2	2	7
Postdocs, non-U.S.	**5**	1	0	2	2
Students, U.S.	**63**	39	3	11	10
Students, non-U.S.	**15**	3	0	4	8
Technician, U.S.	**3**	3	0	0	0
Technician, non-U.S.	**1**	0	0	0	1
TOTAL	**234**	**97**	**10**	**35**	**92**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3. Users by Organization

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**84**	53	8	23	2	79	3
Senior Personnel, non-U.S.	**39**	39	0	0	4	34	1
Postdocs, U.S.	**24**	13	7	4	3	20	1
Postdocs, non-U.S.	**5**	5	0	0	2	3	0
Students, U.S.	**63**	34	18	11	0	63	0
Students, non-U.S.	**15**	15	0	0	1	14	0
Technician, U.S.	**3**	0	0	3	0	3	0
Technician, non-U.S.	**1**	1	0	0	1	0	0

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
TOTAL	**234**	**160**	**33**	**41**	**13**	**216**	**5**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e. on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e. researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4. Users by Discipline

	Users[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
Senior Personnel, U.S.	**84**	3	37	10	1	33
Senior Personnel, non-U.S.	**39**	0	25	3	2	9
Postdocs, U.S.	**24**	3	4	0	2	15
Postdocs, non-U.S.	**5**	0	4	0	0	1
Students, U.S.	**63**	2	30	11	1	19
Students, non-U.S.	**15**	0	6	5	0	4
Technician, U.S.	**3**	0	0	1	1	1
Technician, non-U.S.	**1**	0	1	0	0	0
TOTAL	**234**	**8**	**107**	**30**	**7**	**82**

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. Subscription Rate (Experiments)

Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experiments With Usage	Experiments With Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experi-ments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
430	15	411	92.4 %	34	7.6 %	445	1.1	108.3 %

Table 5b. Subscription Rate (Magnet Days)

Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maint.	TOTAL Days Used	Days Subscription Rate	Days Subscription Percentage
2,770	1,485	77	1,060	139	2,761	1.0	100.3%

Table 6a. Research Proposals [1] Profile (Demographics) with Magnet Time

Total Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
76	4	60	12	15	57	0	4

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.
Note: The table refers to proposal disciplines.

Table 6b. Research Proposals [1] Profile (Discipline) with Magnet Time

Total Proposals[1]	Condensed Matter Physics	Chemistry, Geochemis-try	Engineering	Magnets, Materials	Biology, Biochem, Biophys.
76	2	21	6	6	41

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.
Note: The table refers to proposal disciplines.

Find the list of user proposals in **Appendix V** and on our website

Table 7. Operations by Magnet System

Usage Type	Total Days Used	% of Total Days Used	900 MHz 105 mm bore 21.1T	830 MHz 31 mm bore 19.6T	800 MHz 63 mm bore (MB) 18.8T #1	800 MHz 63 mm bore (MB) 18.8T #2	800 MHz 54 mm bore (NB) 18.8T	600 MHz 89 mm bore 14T #1	600 MHz 89 mm bore 14T #2	600 MHz 89 mm bore MAS DNP	600 MHz 52 mm bore 14T	500 MHz 89 mm bore 11.7T	500 MHz 89 mm bore 11.7T (Engineering School)	Cell 14 36T 40 mm SCH
NHMFL-Affiliated	**1,060**	38.4 %	156	36	148	213	110	193	139	10	1	44	0	10
Local	**77**	2.8 %	4	0	2	0	16	7	0	2	0	46	0	0
University, U.S.	**1,034.5**	37.5 %	8	229	146	47	217	68	101	27.5	0	174	0	17
University, non-U.S.	**361.5**	13.1 %	10	82	39	37	0	7	69	76.5	15	11	0	15
Government Lab, U.S.	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
Government Lab, non-U.S.	**10**	0.4 %	0	2	0	0	0	8	0	0	0	0	0	0
Industry, U.S.	**79**	2.9 %	79	0	0	0	0	0	0	0	0	0	0	0
Industry, non-U.S.	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
Test/Calibration/Maintenance	**127**	4.6 %	2	0	0	0	2	0	0	123	0	0	0	0
Method Development	**10**	0.4 %	0	0	0	0	0	0	0	10	0	0	0	0
Analytical Chemistry	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
Setup	**2**	0.1 %	0	0	2	0	0	0	0	0	0	0	0	0
Repair	**0**	0 %	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**2,761**		**259**	**349**	**337**	**297**	**345**	**283**	**309**	**249**	**16**	**275**	**0**	**42**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 8. Operations by Discipline

	Total Days Used[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
NHMFL-Affiliated	**1,060**	18	322	5	61	654
Local	**77**	0	48	24	0	5
University, U.S.	**1,034.5**	0	479	5	17	533.5
University, non-U.S.	**361.5**	0	144	5.5	40	172
Government Lab, U.S.	**0**	0	0	0	0	0
Government Lab, non-U.S.	**10**	0	10	0	0	0
Industry, U.S.	**79**	0	0	0	0	79
Industry, non-U.S.	**0**	0	0	0	0	0
Test/Calibration/ Maintenance	**127**	0	0	0	12	115
Method Development	**10**	0	10	0	0	0
Analytical Chemistry	**0**	0	0	0	0	0
Setup	**2**	0	0	0	2.0	0
Repair	**0**	0	0	0	0	0
TOTAL	**2,761**	**18**	**1,013**	**39.5**	**132**	**1,558.5**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 9. New PIs[1] and New Users

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**44**	3	5	39	84	8	10	74
Senior Personnel, non-U.S.	**16**	4	4	12	39	10	10	29
Postdocs, U.S.	**0**	0	0	0	24	4	6	18
Postdocs, non-U.S.	**0**	0	0	0	5	4	4	1
Students, U.S.	**1**	0	0	1	63	11	17	46
Students, non-U.S.	**0**	0	0	0	15	5	6	9
Technician, U.S.	**1**	0	0	1	3	0	0	3
Technician, non-U.S.	**0**	0	0	0	1	0	0	1
TOTAL	**62**	**7**	**9**	**53**	**234**	**42**	**53**	**181**

[1] PIs who received magnet time for the first time.

Table 10. New [1] User PIs

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Rivera de la Rosa	Autonomous University of Nuevo León	P19479	Received 2020	Yes
David Fenning	University of California, San Diego	P19478	Received 2020	Yes
Sami Jannin	École normale supérieure de Lyon	P19284	Received 2020	Yes
Isabelle Marcotte	University of Quebec at Montreal	P19442	Received 2020	Yes
Ildefonso Marin-Montesinos	Universidade de Aveiro	P19491	Received 2020	Yes
Joseph Noel	Salk Institute for Biological Studies	P19225	Received 2020	Yes
Geoffrey Strouse	National High Magnetic Field Laboratory	P19372	Received 2020	No
Pingchuan Sun	Nankai University	P19331	Received 2020	Yes
Adam Veige	University of Florida	P19170	Received 2020	No

[1] PIs who received magnet time for the first time.

7. Pulsed Field Facility

Table 1. Users by Demographic

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**44**	2	40	2	32	10	0	2
Senior Personnel, non-U.S.	**10**	1	5	4	8	0	0	2
Postdocs, U.S.	**24**	0	21	3	16	7	0	1
Postdocs, non-U.S.	**3**	0	3	0	2	1	0	0
Students, U.S.	**24**	1	21	2	16	7	0	1
Students, non-U.S.	**5**	0	5	0	5	0	0	0
Technician, U.S.	**0**	0	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**110**	**4**	**95**	**11**	**79**	**25**	**0**	**6**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 2. Users by Participation

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**44**	23	0	2	19
Senior Personnel, non-U.S.	**10**	1	0	0	9
Postdocs, U.S.	**24**	19	0	1	4
Postdocs, non-U.S.	**3**	0	0	1	2
Students, U.S.	**24**	10	0	2	12
Students, non-U.S.	**5**	3	0	1	1
Technician, U.S.	**0**	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0
TOTAL	**110**	**56**	**0**	**7**	**47**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3. Users by Organization

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**44**	22	6	16	20	24	0
Senior Personnel, non-U.S.	**10**	10	0	0	3	7	0
Postdocs, U.S.	**24**	8	6	10	19	5	0
Postdocs, non-U.S.	**3**	3	0	0	1	2	0
Students, U.S.	**24**	23	1	0	8	16	0
Students, non-U.S.	**5**	5	0	0	0	5	0
Technician, U.S.	**0**	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
TOTAL	**110**	**71**	**13**	**26**	**51**	**59**	**0**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e. on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e. researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4. Users by Discipline

	Users[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
Senior Personnel, U.S.	**44**	40	1	0	0	3
Senior Personnel, non-U.S.	**10**	10	0	0	0	0
Postdocs, U.S.	**24**	22	0	0	2	0
Postdocs, non-U.S.	**3**	3	0	0	0	0
Students, U.S.	**24**	21	2	0	1	0
Students, non-U.S.	**5**	5	0	0	0	0
Technician, U.S.	**0**	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0
TOTAL	**110**	**101**	**3**	**0**	**3**	**3**

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. Subscription Rate (Experiments)

Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experiments With Usage	Experiments With Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experi-ments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
76	16	41	44.6 %	51	55.4 %	92	2.2	224.4 %

Table 5b. Subscription Rate (Magnet Days)

Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maint.	TOTAL Days Used	Days Subscription Rate	Days Subscription Percentage
786	181	36	88	0	305	2.6	257.7 %

Table 6a. Research Proposals [1] Profile (Demographics) with Magnet Time

Total Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
29	1	25	3	9	19	0	1

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.
Note: The table refers to proposal disciplines.

Table 6b. Research Proposals [1] Profile (Discipline) with Magnet Time

Total Proposals[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochem, Biophys.
29	26	1	0	2	0

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.
Note: The table refers to proposal disciplines.

Find the list of user proposals in **Appendix V** and on our website

Table 7. Operations by Magnet System Group

	Total Days Used	Percentage of Total Days Used	100T	Duplex	Short Pulse	Single Turn
NHMFL-Affiliated	**88**	28.9 %	0	0	88	0
Local	**36**	11.8 %	0	10	26	0
University, U.S.	**93**	30.5 %	0	20	73	0
University, non-U.S.	**30**	9.8 %	0	0	30	0
Government Lab, U.S.	**53**	17.4 %	0	0	53	0
Government Lab, non-U.S.	**5**	1.6 %	0	0	5	0
Industry, U.S.	**0**	0 %	0	0	0	0
Industry, non-U.S.	**0**	0 %	0	0	0	0
Test/Calibration/ Maintenance	**0**	0 %	0	0	0	0
Method Development	**0**	0 %	0	0	0	0
Analytical Chemistry	**0**	0 %	0	0	0	0
Setup	**0**	0 %	0	0	0	0
Repair	**0**	0 %	0	0	0	0
TOTAL	**305**		**0**	**30**	**275**	**0**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 8. Operations by Discipline

	Total Days Used[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
NHMFL-Affiliated	**88**	73	0	0	15	0
Local	**36**	36	0	0	0	0
University, U.S.	**93**	85	8	0	0	0
University, non-U.S.	**30**	30	0	0	0	0
Government Lab, U.S.	**53**	53	0	0	0	0
Government Lab, non-U.S.	**5**	5	0	0	0	0
Industry, U.S.	**0**	0	0	0	0	0
Industry, non-U.S.	**0**	0	0	0	0	0
Test/Calibration/ Maintenance	**0**	0	0	0	0	0
Method Development	**0**	0	0	0	0	0
Analytical Chemistry	**0**	0	0	0	0	0
Setup	**0**	0	0	0	0	0
Repair	**0**	0	0	0	0	0
TOTAL	**305**	**282**	**8**	**0**	**15**	**0**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 9. New PIs[1] and New Users

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**19**	1	1	18	44	0	4	40
Senior Personnel, non-U.S.	**2**	0	0	2	10	0	0	10
Postdocs, U.S.	**3**	1	1	2	24	1	1	23
Postdocs, non-U.S.	**0**	0	0	0	3	0	0	3
Students, U.S.	**1**	0	0	1	24	3	4	20
Students, non-U.S.	**1**	1	1	0	5	1	1	4
Technician, U.S.	**0**	0	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**26**	**3**	**3**	**23**	**110**	**5**	**10**	**100**

[1] PIs who received magnet time for the first time.

Table 10. New [1] User PIs

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Taehwan Jang	Pohang University of Science and Technology	P19407	Received 2020	Yes
Rico Schoenemann	Los Alamos National Laboratory	P19194	Received 2020	Yes
Laurel Winter	National High Magnetic Field Laboratory	P18062	Received 2020	Yes

[1] PIs who received magnet time for the first time.

Appendix 3 – User Facilities Overview

All user data in the user facility overview appendix is as of February 4, 2021.

Table 1a. Users by Demographic of All Facilities

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**561**	33	420	108	379	96	0	86
Senior Personnel, non-U.S.	**138**	14	82	42	83	23	0	32
Postdocs, U.S.	**190**	13	129	48	107	49	0	34
Postdocs, non-U.S.	**31**	1	20	10	10	11	0	10
Students, U.S.	**422**	24	289	109	221	123	0	78
Students, non-U.S.	**59**	5	35	19	36	9	0	14
Technician, U.S.	**70**	7	33	30	18	25	0	27
Technician, non-U.S.	**23**	0	3	20	4	1	0	18
TOTAL	**1,494**	**97**	**1,011**	**386**	**858**	**337**	**0**	**299**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 1b. Users by Demographic by Facilities

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
AMRIS – NSF-Funded	**88**	7	56	25	55	17	0	16
AMRIS – Non-NHMFL-Funded	**285**	28	149	108	108	82	0	95
DC Field	**404**	21	314	69	292	68	0	44
EMR	**112**	4	85	23	74	23	0	15
High B/T	**10**	0	7	3	6	1	0	3
ICR	**251**	19	151	81	109	71	0	71
NMR	**234**	14	154	66	135	50	0	49
Pulsed Field	**110**	4	95	11	79	25	0	6
TOTAL	**1,494**	**97**	**1,011**	**386**	**858**	**337**	**0**	**299**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 2a. Users by Participation of All Facilities

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**561**	260	7	56	238
Senior Personnel, non-U.S.	**138**	21	1	21	95

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Postdocs, U.S.	**190**	120	3	7	60
Postdocs, non-U.S.	**31**	8	0	4	19
Students, U.S.	**422**	269	5	28	120
Students, non-U.S.	**59**	22	0	6	31
Technician, U.S.	**70**	62	0	1	7
Technician, non-U.S.	**23**	1	0	0	22
TOTAL	**1,494**	**763**	**16**	**123**	**592**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 2b. Users by Participation by Facilities

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
AMRIS – NSF-Funded	**88**	62	5	2	19
AMRIS – Non-NHMFL-Funded	**285**	237	1	1	46
DC Field	**404**	202	0	34	168
EMR	**112**	57	0	15	40
High B/T	**10**	9	0	0	1
ICR	**251**	43	0	29	179
NMR	**234**	97	10	35	92
Pulsed Field	**110**	56	0	7	47
TOTAL	**1,494**	**763**	**16**	**123**	**592**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3a. Users by Organization of All Facilities

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**561**	334	75	152	62	484	15
Senior Personnel, non-U.S.	**138**	138	0	0	28	105	5
Postdocs, U.S.	**190**	108	51	31	32	157	1
Postdocs, non-U.S.	**31**	30	0	1	9	22	0
Students, U.S.	**422**	257	133	32	17	404	1
Students, non-U.S.	**59**	59	0	0	2	57	0
Technician, U.S.	**70**	26	20	24	0	68	2
Technician, non-U.S.	**23**	23	0	0	3	18	2

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
TOTAL	**1,494**	**975**	**279**	**240**	**153**	**1,315**	**26**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e. on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e. researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The total of university, industry, and national lab users will equal the total number of users.

Table 3b. Users by Organization by Facilities

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
AMRIS – NSF-Funded	**88**	35	32	21	0	88	0
AMRIS – Non-NHMFL-Funded	**285**	121	140	24	3	280	2
DC Field	**404**	304	25	75	39	363	2
EMR	**112**	65	18	29	9	103	0
High B/T	**10**	3	3	4	0	10	0
ICR	**251**	216	15	20	38	196	17
NMR	**234**	160	33	41	13	216	5
Pulsed Field	**110**	71	13	26	51	59	0
TOTAL	**1,494**	**975**	**279**	**240**	**153**	**1,315**	**26**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e. on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e. researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The total of university, industry, and national lab users will equal the total number of users.

Table 4a. Users by Discipline of All Facilities

	Users[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
Senior Personnel, U.S.	**561**	147	160	59	18	177
Senior Personnel, non-U.S.	**138**	40	60	5	7	26
Postdocs, U.S.	**190**	72	25	10	9	74
Postdocs, non-U.S.	**31**	13	13	0	2	3
Students, U.S.	**422**	128	126	50	20	98
Students, non-U.S.	**59**	28	16	6	2	7
Technician, U.S.	**70**	0	1	7	22	40
Technician, non-U.S.	**23**	1	3	6	0	13
TOTAL	**1,494**	**429**	**404**	**143**	**80**	**438**

[1] Users using multiple facilities are counted in each facility listed.

Table 4b. Users by Discipline by Facilities

	Users[1]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
AMRIS – NSF-Funded	**88**	1	20	18	6	43
AMRIS – Non-NHMFL-Funded	**285**	1	19	27	28	210
DC Field	**404**	286	43	23	29	23
EMR	**112**	24	72	2	5	9
High B/T	**10**	8	0	0	0	2
ICR	**251**	0	140	43	2	66
NMR	**234**	8	107	30	7	82
Pulsed Field	**110**	101	3	0	3	3
TOTAL	**1,494**	**429**	**404**	**143**	**80**	**438**

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. Subscription Rate (Experiments) by Facilities

	Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experiments With Usage	Experiments With Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experiments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
AMRIS – NSF-Funded	10	21	31	100 %	0	0 %	31	1	100 %
AMRIS – Non-NHMFL-Funded	65	71	127	93.4 %	9	6.6 %	136	1.1	107.1 %
DC Field	290	34	146	45.1 %	178	54.9 %	324	2.2	221.9 %
EMR	94	14	99	91.7 %	9	8.3 %	108	1.1	109.1 %
High B/T	8	2	2	20 %	8	80 %	10	5	500 %
ICR	104	14	92	78 %	26	22 %	118	1.3	128.3 %
NMR	417	28	411	92.4 %	34	7.6 %	445	1.1	108.3 %
Pulsed Field	76	16	41	44.6 %	51	55.4 %	92	2.2	224.4 %
TOTAL	**1,064**	**200**	**949**		**315**		**1,264**		

Table 5b. Subscription Rate (Magnet Days) by Facilities

	Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maint.	Total Days Used	Days Sub-scription Rate	Days Sub-scription Percentage
AMRIS – NSF-Funded	1,316	409.3	13.4	191.9	701.3	**1,316**	1	100 %
AMRIS – Non-NHMFL-Funded	1,206	652.3	157.8	326.2	69.6	**1,206**	1	100 %
DC Field	2,260	779.8	7	209.3	25	**1,021.1**	2.2	221.3 %
EMR	967	486.5	7	78.5	132	**704**	1.4	137.4 %
High B/T	640	170	0	0	0	**170**	3.8	376.5 %
ICR	1,474	241	36.7	86.4	247.9	**612**	2.4	240.8 %
NMR	2,688	1,485	77	1,060	139	**2,761**	1	97.4 %
Pulsed Field	786	181	36	88	0	**305**	2.6	257.7 %
TOTAL	**11,337**	**4,404.9**	**334.9**	**2,040.4**	**1,314.9**	**8,095.1**		

Table 6. Research Proposals [1] Profile with Magnet Time by Facilities

	Total Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochem, Biophys.
AMRIS – NSF-Funded	**31**	3	23	5	7	21	0	3	0	4	5	0	22
AMRIS – Non-NHMFL-Funded	**99**	10	60	29	25	51	0	23	0	0	0	0	99
DC Field	**108**	5	96	7	22	82	0	4	77	11	0	15	5
EMR	**45**	4	38	3	6	38	0	1	7	24	1	6	7
High B/T	**2**	0	2	0	0	2	0	0	2	0	0	0	0
ICR	**67**	4	50	13	13	46	0	8	0	49	3	2	13
NMR	**76**	4	60	12	15	57	0	4	2	21	6	6	41
Pulsed Field	**29**	1	25	3	9	19	0	1	26	1	0	2	0
TOTAL	**457**	**31**	**354**	**72**	**97**	**316**	**0**	**44**	**114**	**110**	**15**	**31**	**187**

1 A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
2 The number of proposals satisfying the following condition: The PI is a minority.
3 The number of proposals satisfying the following condition: The PI is a female.
Note: The table refers to proposal disciplines.

Find the list of user proposals in Appendix V and on our website

Table 7. Operations by User Type by Facilities

	Total Days Used	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Test/Calibr./ Maint., Method Dev., Analy. Chem., Setup, Repair
AMRIS – NSF-Funded[1]	**1,316**	409.3	13.4	191.9	701.3
AMRIS – Non-NHMFL-Funded[1]	**1,206**	652.3	157.8	326.2	69.6
DC Field[2]	**1,021.1**	779.8	7	209.3	25
EMR[3]	**704**	486.5	7	78.5	132
High B/T[4]	**170**	170	0	0	0
ICR[5]	**612**	241	36.7	86.4	247.9
NMR[6]	**2,761**	1,485	77	1,060	139
Pulsed Field[7]	**305**	181	36	88	0
TOTAL	**8,095.1**	**4,404.9**	**334.9**	**2,040.4**	**1,314.9**

[1] User Units are defined as magnet days; time utilized is recorded to the nearest 15 minutes. Magnet day definitions for AMRIS instruments: Verticals (500, 600s, & 750 MHz), 1 magnet day = 24 hours. Horizontals (4.7 and 11.1 T), 1 magnet day = 8 hours. This accounts for the difficulty in running animal or human studies overnight. Magnet days were calculated by adding the total number of real used for each instrument and dividing by 24 (vertical) or 8 (horizontal). Note: Due to the nature of the 4.7 T and 11 T studies, almost all studies with external users were collaborative with UF investigators.
[2] Each 20 MW resistive magnet requires two power supplies to run, the 45 T hybrid magnet requires three power supplies and the 36 T Series Connected Hybrid requires one power supply. Thus there can be four resistive magnets + three superconducting magnets operating or the 45 T hybrid, series connected hybrid, two resistive magnets and three superconducting magnets. User Units are defined as magnet days. Users of water-cooled resistive or hybrid magnets can typically expect to receive enough energy for 7 hours a day of magnet usage so a magnet day is defined as 7 hours. Superconducting magnets are scheduled typically 24 hours a day. There is an annual four week shutdown in fall of powered DC resistive and hybrid magnets for infrastructure maintenance and a two week shutdown period for the university mandated holiday break.
[3, 4, 5, 6] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.
[7] User Units are defined as magnet days. Magnets are scheduled typically 12 hours a day.
[8] Days to external users at facility => all U.S. University, U.S. Govt. Lab., U.S. Industry, Non-U.S. excluding NHMFL Affiliated, Local, Test, Calibration, Set-up, Maintenance, Inst. Dev.
[9] Days to NHMFL-Affiliated (in-house) research => NHMFL-Affiliated only
[10] Days to instrument development and maintenance (combined) => test, calibration, set-up, maintenance, inst. Dev.
[11] Days to local => local only

Table 8. Operations by Discipline of All Facilities

	Total Days Used	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
NHMFL-Affiliated	**2,040.4**	282	428.4	5.1	121.9	1,203
Local	**334.9**	36	109.1	24	0	165.8
University, U.S.	**3,236.6**	591	956.3	214.5	64.2	1,410.5
University, non-U.S.	**848.8**	258.7	220.7	5.5	102.5	261.5
Government Lab, U.S.	**97.9**	81.9	13.7	2	0	0.3
Government Lab, non-U.S.	**104.9**	81	23.9	0	0	0
Industry, U.S.	**84**	0	5	0	0	79
Industry, non-U.S.	**32.7**	0	32.7	0	0	0
Test/Calibration/ Maintenance	**987.5**	16	17.5	0	378.4	575.6
Method Development	**95**	9	10	0	39	37
Analytical Chemistry	**230.4**	0	230.4	0	0	0
Setup	**2**	0	0	0	2	0
Repair	**0**	0	0	0	0	0
TOTAL	**8,095.1**	**1,355.6**	**2,047.7**	**251.2**	**707.9**	**3,732.7**

Table 8b. Operations by Discipline of All Facilities

	Total Days Used	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics
AMRIS – NSF-Funded[1]	**1,316**	0	59.1	148.8	346.4	761.7
AMRIS – Non-NHMFL-Funded[1]	**1,206**	0	27	50	0	1,129
DC Field[2]	**1,021.1**	797.6	114	0	95.5	14
EMR[3]	**704**	88	305	7	111	193
High B/T[4]	**170**	170	0	0	0	0
ICR[5]	**612**	0	521.6	5.9	8	76.5
NMR[6]	**2,761**	18	1,013	39.5	132	1,558.5
Pulsed Field[7]	**305**	282	8	0	15	0
Total	**8,095.1**	**1,355.6**	**2,047.7**	**251.2**	**707.9**	**3,732.7**

Table 9a. New PIs[1] and New Users of All Facilities

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**297**	47	57	240	561	40	53	508
Senior Personnel, non-U.S.	**61**	11	13	48	138	34	35	103
Postdocs, U.S.	**15**	2	2	13	190	26	31	159
Postdocs, non-U.S.	**4**	1	1	3	31	8	8	23
Students, U.S.	**4**	0	1	3	422	85	110	312
Students, non-U.S.	**1**	1	1	0	59	18	21	38
Technician, U.S.	**1**	0	0	1	70	6	8	62

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Technician, non-U.S.	**1**	1	1	0	23	10	10	13
TOTAL	**384**	**63**	**76**	**308**	**1,494**	**227**	**276**	**1,218**

[1] PIs who received magnet time for the first time.

Table 9b. New PIs[1] and New Users by Facilities

	PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
AMRIS – NSF-Funded	**31**	7	7	24	88	9	9	79
AMRIS – Non-NHMFL-Funded	**74**	12	15	59	285	20	26	259
DC Field	**94**	13	20	74	404	46	60	344
EMR	**40**	7	8	32	112	19	32	80
High B/T	**2**	0	0	2	10	0	0	10
ICR	**55**	14	14	41	251	86	86	165
NMR	**62**	7	9	53	234	42	53	181
Pulsed Field	**26**	3	3	23	110	5	10	100
TOTAL	**384**	**63**	**76**	**308**	**1,494**	**227**	**276**	**1,218**

[1] PIs who received magnet time for the first time.

Table 10a. Funding Source of Users' Research-Day Allotted (Counts) by Facilities

	Total Days Used	NSF[1]	NIH	DOE	DOD[2]	VSP	FFI	UF MBI	EPA	Inter-na-tional	Na-tional	In-dustry[3]	Other
AMRIS – NSF-Funded	**1,316**	1,040	125	0	0	0	0	0	0	3	148	0	0
AMRIS – Non-NHMFL-Funded	**1,206**	92	702	0	3	0	0	15	0	0	322	27	4
DC Field	**1,021**	441	14	188	37	15	0	0	0	212	113	0	0
EMR	**704**	541	39	39	9	0	0	0	0	55	22	0	0
High B/T	**170**	85	0	0	0	0	0	0	0	85	0	0	0
ICR	**612**	439	11	17	24	0	2	0	0	51	34	31	0
NMR	**2,761**	1,274	879	0	0	0	0	0	1	397	151	63	0
Pulsed Field	**305**	110	0	118	4	0	0	0	0	25	49	0	0
TOTAL	**8,095**	**4,021**	**1,770**	**362**	**77**	**15**	**2**	**15**	**1**	**828**	**839**	**121**	**4**

[1] Includes NSF, UCGP, and 'No other support'.
[2] Includes NASA, US Army, US Navy, and US Air force.
[3] Includes US Industry and Non-US Industry.

Table 10b. Funding Source of Users' Research-Day Allotted (Percentage) by Facilities

	NSF[1]	NIH	DOE	DOD[2]	VSP	FFI	UF MBI	EPA	Inter-na-tional	Na-tional	Indus-try[3]	Other
AMRIS – NSF-Funded	79 %	10 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	11 %	0 %	0 %
AMRIS – Non-NHMFL-Funded	8 %	58 %	0 %	0 %	0 %	0 %	1 %	0 %	0 %	27 %	2 %	0 %
DC Field	43 %	1 %	18 %	4 %	1 %	0 %	0 %	0 %	21 %	11 %	0 %	0 %
EMR	77 %	6 %	6 %	1 %	0 %	0 %	0 %	0 %	8 %	3 %	0 %	0 %
High B/T	50 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	50 %	0 %	0 %	0 %

	NSF[1]	NIH	DOE	DOD[2]	VSP	FFI	UF MBI	EPA	Inter-na-tional	Na-tional	Indus-try[3]	Other
ICR	72 %	2 %	3 %	0 %	0 %	0 %	0 %	0 %	8 %	6 %	5 %	0 %
NMR	46 %	32 %	0 %	0 %	0 %	0 %	0 %	0 %	14 %	5 %	2 %	0 %
Pulsed Field	36 %	0 %	39 %	1 %	0 %	0 %	0 %	0 %	8 %	16 %	0 %	0 %

[1] Includes NSF, UCGP, and 'No other support'.
[2] Includes NASA, US Army, US Navy, and US Air force.
[3] Includes US Industry and Non-US Industry.

Appendix 4 – Geographic Distribution

AMRIS - National Users

Facility	First Name	Last Name	Organization	State	Country
AMRIS	Jose	Abisambra	University of Florida	FL	USA
AMRIS	Qutell	Adderley	Fisk University	TN	USA
AMRIS	Mavis	Agbandje-McKenna	University of Florida	FL	USA
AMRIS	Maisha	Akbar	University of Florida	FL	USA
AMRIS	Meryl	Alappattu	University of Florida	FL	USA
AMRIS	Jane	Aldrich	University of Florida	FL	USA
AMRIS	Manish	Amin	University of Florida	FL	USA
AMRIS	Kara	Anazia	University of Florida	FL	USA
AMRIS	Anastasios	Angelopoulos	University of Cincinnati	OH	USA
AMRIS	Tetsuo	Ashizawa	University of Florida	FL	USA
AMRIS	Guita	Banan	University of Florida	FL	USA
AMRIS	Amineh	Baniani	University of Florida	FL	USA
AMRIS	Alison	Barnard	University of Florida	FL	USA
AMRIS	Ana	Barran-Berdon	University of Florida	FL	USA
AMRIS	Elisabeth	Barton	University of Florida	FL	USA
AMRIS	Abhinandan	Batra	University of Florida	FL	USA
AMRIS	Samuel	Berens	University of Florida	FL	USA
AMRIS	Avni	Bhatt	University of Florida	FL	USA
AMRIS	Steve	Blackband	University of Florida	FL	USA
AMRIS	Jeff	Boissoneault	University of Florida	FL	USA
AMRIS	Emanuel	Boutzoukas	University of Florida	FL	USA
AMRIS	Clifford	Bowers	University of Florida	FL	USA
AMRIS	Dawn	Bowers	University of Florida	FL	USA
AMRIS	Jeanine	Brady	University of Florida	FL	USA
AMRIS	Fernando	Bril	University of Florida	FL	USA
AMRIS	Albert	Brotgandel	University of Florida	FL	USA
AMRIS	Madison	Bryan	University of Florida	FL	USA

Facility	First Name	Last Name	Organization	State	Country
AMRIS	Michael	Bubb	University of Florida	FL	USA
AMRIS	A.	Buchanan	University of Florida	FL	USA
AMRIS	Roxana	Burciu	University of Florida	FL	USA
AMRIS	Matthew	Burg	University of Florida	FL	USA
AMRIS	Sara	Burke	University of Florida	FL	USA
AMRIS	Matthew	Burns	University of Florida	FL	USA
AMRIS	Rebecca	Butcher	University of Florida	FL	USA
AMRIS	Barry	Byrne	University of Florida	FL	USA
AMRIS	Weijing	Cai	University of Florida	FL	USA
AMRIS	Eduardo	Candelario-Jalil	University of Florida	FL	USA
AMRIS	Josue	Cardoso	University of Florida	FL	USA
AMRIS	Mario	Chang Reyes	University of Florida	FL	USA
AMRIS	Shane	Chatfield	University of Florida	FL	USA
AMRIS	Munish	Chauhan	Arizona State University	AZ	USA
AMRIS	Qiyin	Chen	University of Florida	FL	USA
AMRIS	Cho-Lun	Chiang	University of Florida	FL	USA
AMRIS	Andreina	Chinea	University of Florida	FL	USA
AMRIS	Stephen	Chrzanowski	University of Florida	FL	USA
AMRIS	Winston	Chu	University of Florida	FL	USA
AMRIS	Jae Woo	Chung	University of Florida	FL	USA
AMRIS	David	Clark	Malcom Randall VA Medical Center	FL	USA
AMRIS	Virginia	Clark	University of Florida	FL	USA
AMRIS	Asia	Cobb	University of Florida	FL	USA
AMRIS	Ron	Cohen	University of Florida	FL	USA
AMRIS	Taylor	Col	University of Florida	FL	USA
AMRIS	Jeremy	Coleman	University of Florida	FL	USA
AMRIS	James H.P.	Collins	University of Florida	FL	USA
AMRIS	Luis	Colon-Perez	University of California, Irvine	CA	USA
AMRIS	Stephen	Coombes	University of Florida	FL	USA
AMRIS	Manuela	Corti	University of Florida	FL	USA

Facility	First Name	Last Name	Organization	State	Country
AMRIS	Tina	Cousins	University of Florida	FL	USA
AMRIS	Yenisel	Cruz-Almeida	University of Florida	FL	USA
AMRIS	Kenneth	Cusi	University of Florida	FL	USA
AMRIS	Abdul Rouf	Dar	University of Florida	FL	USA
AMRIS	Kristin	Dayton	University of Florida	FL	USA
AMRIS	Liselotte	de Wit	University of Florida	FL	USA
AMRIS	Brittany	DeFeis	University of Florida	FL	USA
AMRIS	Phuong	Deleyrolle	University of Florida	FL	USA
AMRIS	Jesse	DeSimone	University of Texas, Southwestern	TX	USA
AMRIS	Yousong	Ding	University of Florida	FL	USA
AMRIS	Jon	Dobson	University of Florida	FL	USA
AMRIS	Joe	Dragone	University of Florida	FL	USA
AMRIS	Kyle	Dyson	University of Florida	FL	USA
AMRIS	Natalie	Ebner	University of Florida	FL	USA
AMRIS	Matthew	Eddy	University of Florida	FL	USA
AMRIS	Michelle	Ehrenberger	University of Florida	FL	USA
AMRIS	Malathy	Elumalai	University of Florida	FL	USA
AMRIS	Alec	Esper	University of Florida	FL	USA
AMRIS	Darin	Falk	University of Florida	FL	USA
AMRIS	Lei	Fan	University of Florida	FL	USA
AMRIS	Marcelo	Febo	University of Florida	FL	USA
AMRIS	Likui	Feng	University of Florida	FL	USA
AMRIS	Guillaume	Ferre	University of Florida	FL	USA
AMRIS	Daniel	Ferris	University of Florida	FL	USA
AMRIS	Tyler	Fettrow	University of Florida	FL	USA
AMRIS	Johnny	Figueroa	Loma Linda University	CA	USA
AMRIS	Matthew	Fillingim	University of Florida	FL	USA
AMRIS	Roger	Fillingim	University of Florida	FL	USA
AMRIS	Roberto	Firpi-Morell	University of Florida	FL	USA
AMRIS	Jeremy	Flint	University of Florida	FL	USA

Facility	First Name	Last Name	Organization	State	Country
AMRIS	Briana	Foerman	University of Florida	FL	USA
AMRIS	Leo	Fontenot	Louisiana State University	LA	USA
AMRIS	Megan	Forbes	University of Florida	FL	USA
AMRIS	Sean	Forbes	University of Florida	FL	USA
AMRIS	Evan	Forman	University of Florida	FL	USA
AMRIS	Anthony	Giacalone	University of Florida	FL	USA
AMRIS	Drew	Gillett	University of Florida	FL	USA
AMRIS	Michael	Goertzen	University of Florida	FL	USA
AMRIS	Hector	Gonzalez	University of Florida	FL	USA
AMRIS	Niloofar	Gopal Pour	University of Florida	FL	USA
AMRIS	Adam	Grippin	University of Florida	FL	USA
AMRIS	Anthony	Gruber	University of Florida	FL	USA
AMRIS	Matteo	Grudny	University of Florida	FL	USA
AMRIS	Hugo	Guerrero-Cazares	Mayo Clinic, Jacksonville	FL	USA
AMRIS	Danielle	Guess	University of Florida	FL	USA
AMRIS	Kimberly	Guice	University of Florida	FL	USA
AMRIS	Joseph	Gullett	University of Florida	FL	USA
AMRIS	Hala	Hachem	University of Florida	FL	USA
AMRIS	Matthew	Hamm	University of Florida	FL	USA
AMRIS	Moriah	Hanson	University of Florida	FL	USA
AMRIS	Michael	Harris	University of Florida	FL	USA
AMRIS	Abigail	Hatcher	University of Florida	FL	USA
AMRIS	Linda	Hayward	University of Florida	FL	USA
AMRIS	Sara	Heshmati	University of Florida	FL	USA
AMRIS	Matthew	Hey	University of Florida	FL	USA
AMRIS	Febrian	Hillman	Texas A&M University	TX	USA
AMRIS	Josh	Holbrook	University of Florida	FL	USA
AMRIS	Chongyang	Huang	university of florida	FL	USA
AMRIS	Haiqing	Huang	University of Florida	FL	USA
AMRIS	Robert	Huigens	University of Florida	FL	USA

Facility	First Name	Last Name	Organization	State	Country
AMRIS	Kathleen	Hupfeld	University of Florida	FL	USA
AMRIS	Bryant	Hutchins	University of Florida	FL	USA
AMRIS	Bryan	Ibarra	University of Florida	FL	USA
AMRIS	Aprinda	Indahlastari	University of Florida	FL	USA
AMRIS	Daniel	Isom	University of Miami	FL	USA
AMRIS	Noelle	Jacobsen	University of Florida	FL	USA
AMRIS	Belita	James	University of Florida	FL	USA
AMRIS	Kelly	Jenkins	University of Florida	FL	USA
AMRIS	Hae-Kwon	Jeong	Texas A&M University	TX	USA
AMRIS	Guangde	Jiang	University of Florida	FL	USA
AMRIS	Keyanni	Johnson	University of Florida	FL	USA
AMRIS	Rachel	Jones	University of Florida	FL	USA
AMRIS	Jonathan	Judy	University of Florida	FL	USA
AMRIS	Catherine	Kaczorowski	Jackson Laboratory	ME	USA
AMRIS	Fatma	Kaplan	Kaplan Schiller Research, LLC	FL	USA
AMRIS	Aditya	Kasinadhuni	University of Florida	FL	USA
AMRIS	Mary	Kasper	University of Florida	FL	USA
AMRIS	Sushain	Kaul	University of Florida	FL	USA
AMRIS	Andreas	Keil	University of Florida	FL	USA
AMRIS	Wiliam R.	Kem	University of Florida	FL	USA
AMRIS	Ram	Khattri	University of Florida	FL	USA
AMRIS	Gee	Kim	University of Florida	FL	USA
AMRIS	Jessica	Kraft	University of Florida	FL	USA
AMRIS	Eric	Krause	University of Florida	FL	USA
AMRIS	Lee	Kugelmann	University of Florida	FL	USA
AMRIS	Magdoom Mohamed	Kulam Najmudeen	University of Florida	FL	USA
AMRIS	Damon	Lamb	University of Florida	FL	USA
AMRIS	Peder	Larson	University of California, San Francisco	CA	USA
AMRIS	Brittany	Lee	Stanford University	CA	USA

Facility	First Name	Last Name	Organization	State	Country
AMRIS	Eli	Levit	University of Florida	FL	USA
AMRIS	Mark	Lewis	University of Florida	FL	USA
AMRIS	Hong	Li	Florida State University	FL	USA
AMRIS	Zining	Li	University of Florida	FL	USA
AMRIS	Denise	Limdimas	University of Florida	FL	USA
AMRIS	Dake	LIU	University of Florida	FL	USA
AMRIS	Ryan	Lively	Georgia Institute of Technology	GA	USA
AMRIS	Joanna	Long	University of Florida	FL	USA
AMRIS	Christopher	Lopez	University of Florida	FL	USA
AMRIS	Donovan	Lott	University of Florida	FL	USA
AMRIS	Hendrik	Luesch	University of Florida	FL	USA
AMRIS	Paige	Lysne	University of Florida	FL	USA
AMRIS	Rohit	Mahar	University of Florida	FL	USA
AMRIS	Wendi	Malphurs	University of Florida	FL	USA
AMRIS	Paul	Mangal	University of Florida	FL	USA
AMRIS	Thomas	Mareci	University of Florida	FL	USA
AMRIS	Kelsey	Marr	University of Florida	FL	USA
AMRIS	James	Matthews	University of Florida	FL	USA
AMRIS	Andrew	Maurer	University of Florida	FL	USA
AMRIS	Susanna	McConn	University of Florida	FL	USA
AMRIS	Johanna	McCracken	University of Florida	FL	USA
AMRIS	Nikolaus	McFarland	University of Florida	FL	USA
AMRIS	Marc	McLeod	University of Florida	FL	USA
AMRIS	Caitlin	McNally	University of Florida	FL	USA
AMRIS	Andrew	Medford	Georgia Institute of Technology	GA	USA
AMRIS	Borna	Mehrad	University of Florida	FL	USA
AMRIS	Marlin	Mejia	University of Florida	FL	USA
AMRIS	David	Mendez	University of Florida	FL	USA
AMRIS	Matthew	Merritt	University of Florida	FL	USA
AMRIS	Zhihui	Miao	University of Florida	FL	USA

Facility	First Name	Last Name	Organization	State	Country
AMRIS	Ann	Mislovic	University of Florida	FL	USA
AMRIS	Duane	Mitchell	University of Florida	FL	USA
AMRIS	Sahba	Mobini	University of Florida	FL	USA
AMRIS	Adam	Monsalve	University of Florida	FL	USA
AMRIS	Giuseppe	Morelli	University of Florida	FL	USA
AMRIS	Lauren	Morelli	University of Florida	FL	USA
AMRIS	Rebecca	Morgan	University of Florida	FL	USA
AMRIS	Zahra	Moslemi	University of Florida	FL	USA
AMRIS	Emma	Mulry	University of Florida	FL	USA
AMRIS	Maeve	Murphy	University of Florida	FL	USA
AMRIS	Sean	Najmi	Georgia Institute of Technology	GA	USA
AMRIS	John	Neubert	University of Florida	FL	USA
AMRIS	Tammy	Nicholson	University of Florida	FL	USA
AMRIS	Nicole	Nissim	University of Florida	FL	USA
AMRIS	Sara	Nixon	University of Florida	FL	USA
AMRIS	Samantha	Norman	University of Florida	FL	USA
AMRIS	Emily	Norton	Mayo Clinic, Jacksonville	FL	USA
AMRIS	Rebecca	O'Connell	University of Florida	FL	USA
AMRIS	Brian	Odegaard	University of Florida	FL	USA
AMRIS	Walter	O'Dell	University of Florida	FL	USA
AMRIS	Edward	Ofori	University of Florida	FL	USA
AMRIS	Marite	Ojeda	University of Florida	FL	USA
AMRIS	Michael	Okun	University of Florida	FL	USA
AMRIS	Caitlin	Orsini	University of Florida	FL	USA
AMRIS	Andrew	O'Shea	University of Florida	FL	USA
AMRIS	Deirdre	O'Shea	University of Florida	FL	USA
AMRIS	Andrew	Palmer	Florida Institute of Technology	FL	USA
AMRIS	Chris	Pampo	University of Florida	FL	USA
AMRIS	Valerie	Paul	Smithsonian Institution	FL	USA
AMRIS	Qingqing (Emily)	Peng	University of Florida	FL	USA

Facility	First Name	Last Name	Organization	State	Country
AMRIS	Wenbo	Peng	University of Florida	FL	USA
AMRIS	Leronne	Perera	University of Florida	FL	USA
AMRIS	Nathan	Petro	University of Florida	FL	USA
AMRIS	Benjamin	Philmus	Oregon State University	OR	USA
AMRIS	Marjory	Pompilus	University of Florida	FL	USA
AMRIS	Eric	Porges	University of Florida	FL	USA
AMRIS	Ryan	Poulsen	University of Florida	FL	USA
AMRIS	Danielle	Poulton	University of Florida	FL	USA
AMRIS	Cathy	Powers	University of Florida	FL	USA
AMRIS	Robert	Prather	University of Florida	FL	USA
AMRIS	Catherine	Price	University of Florida	FL	USA
AMRIS	Wonn	Pyon	University of Florida	FL	USA
AMRIS	Mukundan	Ragavan	University of Florida	FL	USA
AMRIS	Maryam	Rahman	University of Florida	FL	USA
AMRIS	Sakthivel	Ravi	University of Florida	FL	USA
AMRIS	Arka Prabha	Ray	University of Florida	FL	USA
AMRIS	Alyssa	Ray	University of Florida	FL	USA
AMRIS	Julian	Rey	University of Florida	FL	USA
AMRIS	Matthew	Reyna	University of Florida	FL	USA
AMRIS	Roxanne	Rezaei	University of Florida	FL	USA
AMRIS	Lori	Rice	University of Florida	FL	USA
AMRIS	Sutton	Richmond	University of Florida	FL	USA
AMRIS	Samuel	Riehl	University of Florida	FL	USA
AMRIS	Mario	Rivera	Louisiana State University	LA	USA
AMRIS	Gwladys	Riviere	University of Florida	FL	USA
AMRIS	Elizabeth	Roberts	University of Florida	FL	USA
AMRIS	Kimberly	Robertson	University of Florida	FL	USA
AMRIS	Michael	Robinson	University of Florida	FL	USA
AMRIS	James	Rocca	University of Florida	FL	USA
AMRIS	Alexandra	Roder	University of Arizona	AZ	USA

Facility	First Name	Last Name	Organization	State	Country
AMRIS	Jens	Rosenberg	NHMFL	FL	USA
AMRIS	Pratik	Roy	University of Florida	FL	USA
AMRIS	Jeffrey	Rudolf	University of Florida	FL	USA
AMRIS	Anna	Rushin	University of Florida	FL	USA
AMRIS	Terence	Ryan	University of Florida	FL	USA
AMRIS	Rosalind	Sadleir	Arizona State University	AZ	USA
AMRIS	Stephanie	Salabarria	University of Florida	FL	USA
AMRIS	Addison	Sans	University of Florida	FL	USA
AMRIS	Malisa	Sarntinoranont	University of Florida	FL	USA
AMRIS	Elias	Sayour	University of Florida	FL	USA
AMRIS	Michael	Schär	Johns Hopkins University	MD	USA
AMRIS	Christine	Schmidt	University of Florida	FL	USA
AMRIS	Rachael	Seidler	University of Florida	FL	USA
AMRIS	Medina	Serdarevic	University of Florida	FL	USA
AMRIS	Barry	Setlow	University of Florida	FL	USA
AMRIS	Valay	Shah	University of Florida	FL	USA
AMRIS	Bryanna	Sharot	University of Florida	FL	USA
AMRIS	Qingyao	Shou	University of Florida	FL	USA
AMRIS	Priyank	Shukla	University of Florida	FL	USA
AMRIS	Kimberly	Sibille	University of Florida	FL	USA
AMRIS	Dietmar	Siemann	University of Florida	FL	USA
AMRIS	Carsten	Sievers	Georgia Institute of Technology	GA	USA
AMRIS	Prashant	Singh	University of Florida	FL	USA
AMRIS	Shruti	Siva Kumar	University of Florida	FL	USA
AMRIS	Joshua	Slade	University of Florida	FL	USA
AMRIS	Amanda	Slater	University of Florida	FL	USA
AMRIS	Glenn	Smith	University of Florida	FL	USA
AMRIS	Jasmine	Smith	University of Florida	FL	USA
AMRIS	Jessie	Somerville	University of Florida	FL	USA
AMRIS	Judith	Steadman	University of Florida	FL	USA

Facility	First Name	Last Name	Organization	State	Country
AMRIS	Bethany	Stennett	University of Florida	FL	USA
AMRIS	S. Patricia	Stock	University of Arizona	AZ	USA
AMRIS	Amanda	Studnicki	University of Florida	FL	USA
AMRIS	Brent	Sumerlin	University of Florida	FL	USA
AMRIS	Maurice	Swanson	University of Florida	FL	USA
AMRIS	Lee	Sweeney	University of Florida	FL	USA
AMRIS	Christi	Swiers	University of Florida	FL	USA
AMRIS	Daniel R.	Talham	University of Florida	FL	USA
AMRIS	Mai	Tanaka	University of Florida	FL	USA
AMRIS	Srinivasarao	Tenneti	University of Florida	FL	USA
AMRIS	Ellen	Terry	University of Florida	FL	USA
AMRIS	Naveen	Thakur	University of Florida	FL	USA
AMRIS	Nagheme	Thomas	University of Florida	FL	USA
AMRIS	Grace	Thompson	University of Florida	FL	USA
AMRIS	Adrian	Todd	University of Florida	FL	USA
AMRIS	Zhaohui	Tong	University of Florida	FL	USA
AMRIS	Yvette	Trahan	University of Florida	FL	USA
AMRIS	David	Tran	University of Florida	FL	USA
AMRIS	Nhi	Tran	University of Florida	FL	USA
AMRIS	Tram-Ahn	Tran	University of Florida	FL	USA
AMRIS	Monica	Tschosik	University of Florida	FL	USA
AMRIS	Shahabeddin	Vahdat	University of Florida	FL	USA
AMRIS	David	Vaillancourt	University of Florida	FL	USA
AMRIS	K.	Vandenborne	University of Florida	FL	USA
AMRIS	Sergey	Vasenkov	University of Florida	FL	USA
AMRIS	Adam	Veige	University of Florida	FL	USA
AMRIS	Ravneet	Vohra	University of Florida	FL	USA
AMRIS	Aparna	Wagle Shukla	University of Florida	FL	USA
AMRIS	Zachary	Wakefield	University of Florida	FL	USA
AMRIS	Glenn	Walter	University of Florida	FL	USA

Facility	First Name	Last Name	Organization	State	Country
AMRIS	Kevin	Wang	University of Florida	FL	USA
AMRIS	Yuting	Wang	University of Florida	FL	USA
AMRIS	Zheng	Wang	University of Florida	FL	USA
AMRIS	Eric	Weber	University of Florida	FL	USA
AMRIS	Steven	Weisberg	University of Florida	FL	USA
AMRIS	Thomas	Weldeghiorghis	Louisiana State University	LA	USA
AMRIS	Christopher	Wendler	University of Florida	FL	USA
AMRIS	Keith	White	University of Florida	FL	USA
AMRIS	Tyler	Wildes	University of Florida	FL	USA
AMRIS	Bradley	Wilkes	University of Florida	FL	USA
AMRIS	Rebecca	Willcocks	University of Florida	FL	USA
AMRIS	Lakiesha	Williams	University of Florida	FL	USA
AMRIS	John	Williamson	University of Florida	FL	USA
AMRIS	Adam	Woods	University of Florida	FL	USA
AMRIS	Brandon	Wummer	University of Florida	FL	USA
AMRIS	Benjamin	Wylie	Texas Tech University	TX	USA
AMRIS	Baofu	Xu	University of Florida	FL	USA
AMRIS	Hongfen	Yang	University of Florida	FL	USA
AMRIS	Zhihui	Yang	University of Florida	FL	USA
AMRIS	Muhammad	Yusufali	Malcom Randall VA Medical Center	FL	USA
AMRIS	Zareen	Zaidi	University of Florida	FL	USA
AMRIS	Huadong	Zeng	University of Florida	FL	USA
AMRIS	Fengli	Zhang	NHMFL	FL	USA
AMRIS	Peilan	Zhang	University of Florida	FL	USA
AMRIS	Yi	Zhang	University of Florida	FL	USA
AMRIS	Xinxing	Zhang	University of Florida	FL	USA
AMRIS	Erkang	Zhou	Georgia Institute of Technology	GA	USA
AMRIS	Tian	Zhu	University of Florida	FL	USA
AMRIS	Eric	Ziegler	Florida Institute of Technology	FL	USA
AMRIS	Abigail	Zulich	University of Florida	FL	USA

Facility	First Name	Last Name	Organization	State	Country
AMRIS	Ran	Zuo	University of Florida	FL	USA

DC Field - National Users

Facility	First Name	Last Name	Organization	State	Country
DC Field	Dmytro	Abraimov	NHMFL	FL	USA
DC Field	Muhtar	Ahart	University of Illinois at Chicago	IL	USA
DC Field	Mashael	Altaiary	University of California, Riverside	CA	USA
DC Field	Laurel	Anderson	Harvard University	MA	USA
DC Field	Stephen	Armstrong	Caltech	CA	USA
DC Field	Neil	Ashcroft	Cornell University	NY	USA
DC Field	Can	Aygen	Northwestern University	IL	USA
DC Field	Hongwoo	Baek	NHMFL	FL	USA
DC Field	Rabindranath	Bag	Duke University	NC	USA
DC Field	Paul	Baity	NHMFL	FL	USA
DC Field	Shreyas	Balachandran	Florida State University	FL	USA
DC Field	Kirk	Baldwin	Princeton University	NJ	USA
DC Field	Luis	Balicas	NHMFL	FL	USA
DC Field	Alimamy	Bangura	NHMFL	FL	USA
DC Field	Dimitri	Basov	University of California, San Diego	CA	USA
DC Field	Ryan	Baumbach	NHMFL	FL	USA
DC Field	Christianne	Beekman	NHMFL	FL	USA
DC Field	Maximilian	Bernbeck	University of California, San Diego	CA	USA
DC Field	John	Berry	University of Wisconsin, Madison	WI	USA
DC Field	Tushar	Bhowmick	University of Utah	UT	USA
DC Field	Greg	Boebinger	NHMFL	FL	USA
DC Field	Scott	Bole	NHMFL	FL	USA
DC Field	Alexandria	Bone	University of Tennessee, Knoxville	TN	USA
DC Field	Stanimir	Bonev	Lawrence Livermore National Laboratory	CA	USA
DC Field	Ernesto	Bosque	NHMFL	FL	USA
DC Field	William	Brey	NHMFL	FL	USA
DC Field	Nicholas	Butch	National Institute of Standards and Technology	MD	USA
DC Field	Gang	Cao	University of Colorado, Boulder	CO	USA

Facility	First Name	Last Name	Organization	State	Country
DC Field	Robert	Chang	Northwestern University	IL	USA
DC Field	Ramakanta	Chapai	Louisiana State University	LA	USA
DC Field	Shouvik	Chatterjee	University of California Santa Barbara	CA	USA
DC Field	Joseph	Checkelsky	Massachusetts Institute of Technology	MA	USA
DC Field	Kuizhi	Chen	NHMFL	FL	USA
DC Field	Kuan-Wen	Chen	University of Michigan	MI	USA
DC Field	Lu	Chen	University of Michigan	MI	USA
DC Field	Po-Hsiu	Chien	Florida State University	FL	USA
DC Field	Shalinee	Chikara	NHMFL	FL	USA
DC Field	Irinel	Chiorescu	NHMFL	FL	USA
DC Field	Eun Sang	Choi	NHMFL	FL	USA
DC Field	Jiun-Haw	Chu	University of Washington	WA	USA
DC Field	Josiah	Cochran	NHMFL	FL	USA
DC Field	Emilio	Codecido	Ohio State University	OH	USA
DC Field	William	Coniglio	NHMFL	FL	USA
DC Field	Carolina	Corvalan Moya	Los Alamos National Laboratory	NM	USA
DC Field	Tim	Cross	NHMFL	FL	USA
DC Field	Pengcheng	Dai	University of Tennessee, Knoxville	TN	USA
DC Field	Bryon	Dalton	NHMFL	FL	USA
DC Field	Kristiaan	De Greve	Harvard University	MA	USA
DC Field	Shanti	Deemyad	University of Utah	UT	USA
DC Field	Connor	Dempsey	University of California, Santa Barbara	CA	USA
DC Field	Hao	Deng	Princeton University	NJ	USA
DC Field	Aravind	Devarakonda	Massachusetts Institute of Technology	MA	USA
DC Field	Timothy	Diethrich	University of Maryland, College Park	MD	USA
DC Field	Xiaxin	Ding	Idaho National Laboratory	ID	USA
DC Field	Sachith	Dissanayake	Duke University	NC	USA

Facility	First Name	Last Name	Organization	State	Country
DC Field	Charuni	Dissanayake	University of Central Florida	FL	USA
DC Field	Rick	Dorn	Iowa State University	IA	USA
DC Field	Sabri	Elatresh	Cornell University	NY	USA
DC Field	Rebecca	Engelke	Harvard University	MA	USA
DC Field	Matthew	Ennis	Duke University	NC	USA
DC Field	Cristian	Escobar	NHMFL	FL	USA
DC Field	Zaiyao	Fei	University of Washington	WA	USA
DC Field	Rafael	Fernandes	University of Minnesota, Twin Cities	MN	USA
DC Field	Adam	Fiedler	Marquette University	WI	USA
DC Field	Aikaterini	Flessa Savvidou	NHMFL	FL	USA
DC Field	Ashleigh	Francis	NHMFL	FL	USA
DC Field	Giovanni	Franco-Rivera	NHMFL	FL	USA
DC Field	Riqiang	Fu	NHMFL	FL	USA
DC Field	Hailong	Fu	Pennsylvania State University	PA	USA
DC Field	XIaojun	Fu	University of Minnesota, Twin Cities	MI	USA
DC Field	Jorge	Galeano Cabral	Florida State University	FL	USA
DC Field	Eduard	Galstyan	University of Houston	TX	USA
DC Field	Zhehong	Gan	NHMFL	FL	USA
DC Field	Xueshi	Gao	Ohio State University	OH	USA
DC Field	Ryan	Gelly	Harvard University	MA	USA
DC Field	Stephanie	Gnewuch	University of Maryland, College Park	MD	USA
DC Field	Krzysztof	Gofryk	Idaho National Laboratory	ID	USA
DC Field	Thaige	Gompa	Georgia Institute of Technology	GA	USA
DC Field	Tata	Gopinath	University of Minnesota, Twin Cities	MN	USA
DC Field	Larry	Gordon	NHMFL	FL	USA
DC Field	Aranya	Goswami	University of California, Santa Barbara	CA	USA
DC Field	David	Graf	NHMFL	FL	USA
DC Field	Matthew	Grayson	Northwestern University	IL	USA
DC Field	Elizabeth	Green	NHMFL	FL	USA

Facility	First Name	Last Name	Organization	State	Country
DC Field	Samuel	Greer	Los Alamos National Laboratory	NM	USA
DC Field	Audrey	Grockowiak	NHMFL	FL	USA
DC Field	Onder	Gul	Harvard University	MA	USA
DC Field	Danial	Haei Najafabadi	Harvard University	MA	USA
DC Field	Seungyong	Hahn	NHMFL	FL	USA
DC Field	Alex	Hamill	University of Minnesota, Twin Cities	MN	USA
DC Field	Minyong	Han	Massachusetts Institute of Technology	MA	USA
DC Field	Xingyue	Han	University of Pennsylvania	PA	USA
DC Field	Adam	Hand	University of Tennessee, Knoxville	TN	USA
DC Field	Scott	Hannahs	NHMFL	FL	USA
DC Field	Zeyu	Hao	Harvard University	MA	USA
DC Field	Sara	Haravifard	Duke University	NC	USA
DC Field	Minhao	He	University of Washington, Seattle	WA	USA
DC Field	Brett	Heischmidt	University of Minnesota, Twin Cities	MN	USA
DC Field	Eric	Hellstrom	NHMFL	FL	USA
DC Field	Russell	Hemley	University of Illinois at Chicago	IL	USA
DC Field	Michael	Hicks	NHMFL	FL	USA
DC Field	Stephen	Hill	NHMFL	FL	USA
DC Field	Pei-Chun	Ho	California State University, Fresno	CA	USA
DC Field	Roald	Hoffmann	Cornell University	NY	USA
DC Field	Mikel	Holcomb	West Virginia University	WV	USA
DC Field	Md Shafayat	Hossain	Princeton University	NJ	USA
DC Field	Xinbo	Hu	NHMFL	FL	USA
DC Field	Katie	Huang	Harvard University	MA	USA
DC Field	Ke	Huang	Pennsylvania State University	PA	USA
DC Field	Qing	Huang	University of Tennessee, Knoxville	TN	USA
DC Field	Ivan	Hung	NHMFL	FL	USA
DC Field	Hadass	Inbar	University of California, Santa Barbara	CA	USA

Facility	First Name	Last Name	Organization	State	Country
DC Field	Hisashi	Inoue	Massachusetts Institute of Technology	MA	USA
DC Field	Marcelo	Jaime	NHMFL	NM	USA
DC Field	Jan	Jaroszynski	NHMFL	FL	USA
DC Field	Luis	Jauregui	Harvard University	MA	USA
DC Field	Zhigang	Jiang	Georgia Institute of Technology	GA	USA
DC Field	Yuxuan	Jiang	NHMFL	FL	USA
DC Field	Qianni	Jiang	University of Washington	WA	USA
DC Field	Lin	Jiao	NHMFL	FL	USA
DC Field	Rongying	Jin	Louisiana State University	LA	USA
DC Field	Andrew	Joe	Harvard University	MA	USA
DC Field	Kaifei	Kang	Cornell University	NY	USA
DC Field	Soumen	Kar	University of Houston	TX	USA
DC Field	Eliana	Karr	Florida State University	FL	USA
DC Field	Brian	Kettell	University of Tennessee Space Institute	TN	USA
DC Field	Philip	Kim	Harvard University	MA	USA
DC Field	Sangsoo	Kim	NHMFL	FL	USA
DC Field	Brendan	King	University of Minnesota, Twin Cities	MN	USA
DC Field	Mason	Klemm	Rice University	TX	USA
DC Field	Mehdi	Kochat	University of Houston	TX	USA
DC Field	Alexey	Kovalev	NHMFL	FL	USA
DC Field	Jurek	Krzystek	NHMFL	FL	USA
DC Field	Takashi	Kurumaji	Massachusetts Institute of Technology	MA	USA
DC Field	John	Kynoch	NHMFL	FL	USA
DC Field	Henry	La Pierre	Georgia Institute of Technology	GA	USA
DC Field	David	Larbalestier	NHMFL	FL	USA
DC Field	Erik	Larsen	University of Minnesota, Twin Cities	MN	USA
DC Field	Chun Ning (Jeanie)	Lau	Ohio State University	OH	USA
DC Field	Ian	Leahy	University of Colorado, Boulder	CO	USA

Facility	First Name	Last Name	Organization	State	Country
DC Field	Patrick	Lee	Massachusetts Institute of Technology	MA	USA
DC Field	Seng Huat	Lee	Pennsylvania State University	PA	USA
DC Field	Minhyea	Lee	University of Colorado, Boulder	CO	USA
DC Field	Jia	Li	Brown University	RI	USA
DC Field	Xiang	Li	California Institute of Technology	CA	USA
DC Field	Tingxin	Li	Cornell University	NY	USA
DC Field	Lu	Li	University of Michigan	MA	USA
DC Field	Ilya	Litvak	NHMFL	FL	USA
DC Field	Xiaoxue	Liu	Brown University	RI	USA
DC Field	Xiaomeng	Liu	Harvard University	MA	USA
DC Field	Erfu	Liu	University of California, Riverside	CA	USA
DC Field	I-LIn	Liu	University of Maryland, College Park	MD	USA
DC Field	Zhaoyu	Liu	University of Washington	WA	USA
DC Field	Hongcheng	Lu	Duke University	NC	USA
DC Field	Zhengguang	Lu	NHMFL	FL	USA
DC Field	Chun Hung	Lui	University of California, Riverside	CA	USA
DC Field	Bing	Lv	University of Texas, Dallas	TX	USA
DC Field	Meng	Ma	Princeton University	NJ	USA
DC Field	Kin Fai	Mak	Pennsylvania State University	PA	USA
DC Field	Paul	Malinowski	University of Washington	WA	USA
DC Field	David	Mandrus	University of Tennessee, Knoxville	TN	USA
DC Field	Michael	Manfra	Nokia Bell Labs	NJ	USA
DC Field	Efstratios	Manousakis	Florida State University	FL	USA
DC Field	Jamie	Manson	Eastern Washington University	WA	USA
DC Field	Zhiqiang	Mao	Pennsylvania State University	PA	USA
DC Field	Brian	Maple	University of California, San Diego	CA	USA
DC Field	Jonathan	Marbey	NHMFL	FL	USA
DC Field	Ross	McDonald	NHMFL	NM	USA

Facility	First Name	Last Name	Organization	State	Country
DC Field	Tony	McFadden	University of California, Santa Barbara	CA	USA
DC Field	Stephen	McGill	NHMFL	FL	USA
DC Field	Tyrel	McQueen	Johns Hopkins University	MD	USA
DC Field	Dmitri	Mihaliov	University of Michigan	MI	USA
DC Field	Lujin	Min	Pennsylvania State University	PA	USA
DC Field	Kimberly	Modic	NHMFL	NM	USA
DC Field	Seongphill	Moon	NHMFL	FL	USA
DC Field	Emilia	Morosan	Rice University	TX	USA
DC Field	Duncan	Moseley	University of Tennessee, Knoxville	TN	USA
DC Field	Navid	Mottaghi	West Virginia University	WV	USA
DC Field	Shirin	Mozaffari	NHMFL	FL	USA
DC Field	Riffat	Munir	University of Central Florida	FL	USA
DC Field	Tim	Murphy	NHMFL	FL	USA
DC Field	Janice	Musfeldt	University of Tennessee, Knoxville	TN	USA
DC Field	Joshua	Mutch	University of Washington	WA	USA
DC Field	Stephen	Nagler	Oak Ridge National Laboratory	TN	USA
DC Field	Yasuyuki	Nakajima	University of Central Florida	FL	USA
DC Field	Sarah	Nelson	University of Minnesota, Twin Cities	MN	USA
DC Field	Martin	Nikolo	Saint Louis University	MO	USA
DC Field	Wei	Ning	Pennsylvania State University	PA	USA
DC Field	Kyle	Noordhoek	University of Tennessee, Knoxville	TN	USA
DC Field	Robert	Nowell	NHMFL	FL	USA
DC Field	Jong Mok	Ok	Oak Ridge National Laboratory	TN	USA
DC Field	Olatunde	Oladehin	Florida State University	FL	USA
DC Field	Andrew	Ozarowski	NHMFL	FL	USA
DC Field	Mykhaylo	Ozerov	NHMFL	FL	USA
DC Field	Chris	Palmstrom	University of California, Santa Barbara	CA	USA
DC Field	Joon Young	Park	Harvard University	MA	USA
DC Field	Ju-Hyun	Park	NHMFL	FL	USA

Facility	First Name	Last Name	Organization	State	Country
DC Field	Nawaraj	Paudel	Florida State University	FL	USA
DC Field	Joana	Paulino	NHMFL	FL	USA
DC Field	Loren	Pfeiffer	Princeton University	NJ	USA
DC Field	Joel	Piotrowski	NHMFL	FL	USA
DC Field	Kateryna	Pistunova	Stanford University	CA	USA
DC Field	Christopher	Pocs	University of Colorado, Boulder	CO	USA
DC Field	Bal	Pokharel	NHMFL	FL	USA
DC Field	Dragana	Popovic	NHMFL	FL	USA
DC Field	Andy	Powell	NHMFL	FL	USA
DC Field	Vlad	Pribiag	University of Minnesota, Twin Cities	MN	USA
DC Field	Huajun	Qin	Florida State University	FL	USA
DC Field	Ayyalusamy	Ramamoorthy	University of Michigan	MI	USA
DC Field	Arun	Ramanathan	Georgia Institute of Technology	GA	USA
DC Field	Brad	Ramshaw	Cornell University	NY	USA
DC Field	Sheng	Ran	Washington University in St. Louis	MO	USA
DC Field	Thirupathi	Ravula	University of Michigan	MI	USA
DC Field	Dan	Read	University of California, Santa Barbara	CA	USA
DC Field	Arneil	Reyes	NHMFL	FL	USA
DC Field	Natalie	Rice	Georgia Institute of Technology	GA	USA
DC Field	Jeffrey	Rinehart	University of California, San Diego	CA	USA
DC Field	Jacob	Rochester	Ohio State University	OH	USA
DC Field	Efrain	Rodriguez	University of Maryland, College Park	MD	USA
DC Field	Yuval	Ronen	Harvard University	MA	USA
DC Field	Tom	Rosenbaum	University of Chicago	IL	USA
DC Field	Aaron	Rossini	Iowa State University	IA	USA
DC Field	Shanta	Saha	University of Maryland, College Park	MD	USA
DC Field	Jeffrey	Schiano	Pennsylvania State University	PA	USA
DC Field	Giovanni	Scuri	Harvard University	MA	USA

Facility	First Name	Last Name	Organization	State	Country
DC Field	Venkat	Selvamanickam	University of Houston	TX	USA
DC Field	Dmitry	Semenov	NHMFL	FL	USA
DC Field	Sabyasachi	Sen	University of California, Davis	CA	USA
DC Field	Jie	Shan	Pennsylvania State University	PA	USA
DC Field	Yinming	Shao	Columbia University	NY	USA
DC Field	Qing	Shao	Northwestern University	IL	USA
DC Field	Shivani	Sharma	NHMFL	FL	USA
DC Field	Mansour	Shayegan	Princeton University	NJ	USA
DC Field	Dmitry	Shcherbakov	Ohio State University	OH	USA
DC Field	Arkady	Shehter	NHMFL	FL	USA
DC Field	Zhenzhong	Shi	Duke University	NC	USA
DC Field	Sufei	Shi	Rensselaer Polytechnic Institute	NY	USA
DC Field	Yiseul	Shin	Florida State University	FL	USA
DC Field	Keshav	Shrestha	Texas A&M University	TX	USA
DC Field	K A M Hasan	Siddiquee	University of Central Florida	FL	USA
DC Field	Peter	Siegfried	University of Colorado, Boulder	CO	USA
DC Field	Theo	Siegrist	NHMFL	FL	USA
DC Field	Daniel	Silevitch	University of Chicago	IL	USA
DC Field	Siddharth Kumar	Singh	Princeton University	NJ	USA
DC Field	John	Singleton	NHMFL	NM	USA
DC Field	Dmitry	Smirnov	NHMFL	FL	USA
DC Field	Julia	Smith	NHMFL	FL	USA
DC Field	Egon	Sohn	Cornell University	NY	USA
DC Field	Maddury	Somayazulu	Argonne National Laboratory	IL	USA
DC Field	Tiancheng	Song	University of Washington	WA	USA
DC Field	Lily	Stanley	NHMFL	FL	USA
DC Field	Benjamin	Stein	Los Alamos National Laboratory	NM	USA
DC Field	William	Steinhardt	Duke University	NC	USA
DC Field	Sebastian	Stoian	University of Idaho	ID	USA
DC Field	Mas	Subramanian	Oregon State University	OR	USA

Facility	First Name	Last Name	Organization	State	Country
DC Field	Mike	Sumption	Ohio State University	OH	USA
DC Field	Jiho	Sung	Harvard University	MA	USA
DC Field	Andrey	Sushko	Harvard University	MA	USA
DC Field	Alexey	Suslov	NHMFL	FL	USA
DC Field	Takehito	Suzuki	Massachusetts Institute of Technology	MA	USA
DC Field	Fazel	Tafti	Boston College	MA	USA
DC Field	Chiara	Tarantini	NHMFL	FL	USA
DC Field	Joshua	Taylor	Florida State University	FL	USA
DC Field	Joshua	Telser	Roosevelt University	IL	USA
DC Field	Jasminka	Terzic	NHMFL	FL	USA
DC Field	Pranav	Thekke Madathil	Princeton University	NJ	USA
DC Field	Christie	Thompson	Florida State University	FL	USA
DC Field	Haidong	Tian	Ohio State University	OH	USA
DC Field	Pagnareach	Tin	University of Tennessee, Knoxville	TN	USA
DC Field	Colin	Tinsman	University of Michigan	MI	USA
DC Field	Jacob	Tosado	University of Maryland, College Park	MD	USA
DC Field	Jack	Toth	NHMFL	FL	USA
DC Field	Stan	Tozer	NHMFL	FL	USA
DC Field	Ahmad Ikhwan	Us Saleheen	Louisiana State University	LA	USA
DC Field	Jeremiah	van Baren	University of California, Riverside	CA	USA
DC Field	Gianluigi	Veglia	University of Minnesota, Twin Cities	MN	USA
DC Field	Kevin	Villegas Rosales	Princeton University	NJ	USA
DC Field	Joshua	Wakefield	Massachusetts Institute of Technology	MA	USA
DC Field	Zhi	Wang	Brown University	RI	USA
DC Field	Yuxin	Wang	Florida State University	FL	USA
DC Field	Ke	Wang	Harvard University	MA	USA
DC Field	Xiaoling	Wang	University of California, Santa Barbara	CA	USA
DC Field	Songlin	Wang	University of Minnesota, Twin Cities	MN	USA

Facility	First Name	Last Name	Organization	State	Country
DC Field	Kaya	Wei	NHMFL	FL	USA
DC Field	Dagmar	Weickert	NHMFL	NM	USA
DC Field	Thomas	Werkmeister	Harvard University	MA	USA
DC Field	Ken	West	Princeton University	NJ	USA
DC Field	Chelsea	Widener	University of Tennessee, Knoxville	TN	USA
DC Field	Matthew	Wilson	University of California, Riverside	CA	USA
DC Field	Marshall	Wood	NHMFL	FL	USA
DC Field	Liang	Wu	University of Pennsylvania	PA	USA
DC Field	Yiqing	Xia	University of California, Davis	CA	USA
DC Field	Ziji	Xiang	University of Michigan	MI	USA
DC Field	Chengkun	Xing	University of Tennessee, Knoxville	TN	USA
DC Field	Xingchen	Xu	Fermi National Accelerator Laboratory	IL	USA
DC Field	Xiaodong	Xu	University of Washington	WA	USA
DC Field	Ziling	Xue	University of Tennessee, Knoxville	TN	USA
DC Field	Lalit	Yadav	Duke University	NC	USA
DC Field	Hung-Yu	Yang	Boston College	MA	USA
DC Field	Jiawei	Yang	University of California, Riverside	CA	USA
DC Field	Matthew	Yankowitz	University of Washington	WA	USA
DC Field	Linda	Ye	Massachusetts Institute of Technology	MA	USA
DC Field	Hyobin	Yoo	Harvard University	MA	USA
DC Field	Vivien	Zapf	NHMFL	NM	USA
DC Field	Jonathan	Zauberman	Harvard University	MA	USA
DC Field	Biwen	Zhang	Florida State University	FL	USA
DC Field	Rongfu	Zhang	NHMFL	FL	USA
DC Field	Han	Zhang	University of Tennessee	TN	USA
DC Field	Qi	Zhang	University of Washington	WA	USA
DC Field	Tianhao	Zhao	Georgia Institute of Technology	GA	USA
DC Field	WenKai	Zheng	NHMFL	FL	USA
DC Field	Xilin	Zhou	Harvard University	MA	USA

Facility	First Name	Last Name	Organization	State	Country
DC Field	You	Zhou	Harvard University	MA	USA
DC Field	Haidong	Zhou	University of Tennessee, Knoxville	TN	USA
DC Field	Jiacheng	Zhu	Cornell University	NY	USA
DC Field	Junbo	Zhu	Massachusetts Institute of Technology	MA	USA
DC Field	Jun	Zhu	Pennsylvania State University	PA	USA
DC Field	Yanglin	Zhu	Tulane University	LA	USA
DC Field	Weidi	Zhu	University of California, Davis	CA	USA
DC Field	Michael	Zudov	University of Minnesota, Twin Cities	MN	USA

EMR - National Users

Facility	First Name	Last Name	Organization	State	Country
EMR	Adewale	Akinfaderin	Florida State University	FL	USA
EMR	Thomas	Albrecht-Schmitt	Florida State University	FL	USA
EMR	Adam	Altenhof	Florida State University	FL	USA
EMR	John	Berry	University of Wisconsin, Madison	WI	USA
EMR	Christoph	Boehme	University of Utah	UT	USA
EMR	Alexandria	Bone	University of Tennessee, Knoxville	TN	USA
EMR	Clifford	Bowers	University of Florida	FL	USA
EMR	ChristiAnna	Brantley	University of Florida	FL	USA
EMR	Nhat Nguyen	Bui	NHMFL	FL	USA
EMR	Shalinee	Chikara	NHMFL	FL	USA
EMR	George	Christou	University of Florida	FL	USA
EMR	Carl	Conti	Florida State University	FL	USA
EMR	Naresh	Dalal	NHMFL	FL	USA
EMR	Enrique	del Barco	University of Central Florida	FL	USA
EMR	Linda	Doerrer	Boston University	MA	USA
EMR	Thierry	Dubroca	NHMFL	FL	USA
EMR	Jessica	Elinburg	Boston University	MA	USA
EMR	Alec	Esper	University of Florida	FL	USA
EMR	Adam	Fiedler	Marquette University	WI	USA
EMR	Lucio	Frydman	NHMFL	FL	USA
EMR	Riqiang	Fu	NHMFL	FL	USA
EMR	Miguel	Gakiya	Florida State University	FL	USA
EMR	Eranga	Gamage	Iowa State University	IA	USA
EMR	Zhehong	Gan	NHMFL	FL	USA
EMR	Tuhin	Ghosh	University of Florida	FL	USA
EMR	Thaige	Gompa	Georgia Institute of Technology	GA	USA
EMR	Samuel	Greer	Los Alamos National Laboratory	NM	USA
EMR	Brittany	Grimm	Florida State University	FL	USA
EMR	Adam	Hand	University of Tennessee, Knoxville	TN	USA

Facility	First Name	Last Name	Organization	State	Country
EMR	Marta	Hatzell	Georgia Institute of Technology	GA	USA
EMR	Stephen	Hill	NHMFL	FL	USA
EMR	Ivan	Hung	NHMFL	FL	USA
EMR	Cassidy	Jackson	Colorado State University	CO	USA
EMR	Brian	Kettell	University of Tennessee Space Institute	TN	USA
EMR	Gyan	Khatri	University of Central Florida	FL	USA
EMR	Kirill	Kovnir	Iowa State University	IA	USA
EMR	Stosh	Kozimor	Los Alamos National Laboratory	NM	USA
EMR	Jurek	Krzystek	NHMFL	FL	USA
EMR	Krishnendu	Kundu	NHMFL	FL	USA
EMR	Jason	Kuszynski	Florida State University	FL	USA
EMR	Jaesuk	Kwon	University of Central Florida	FL	USA
EMR	Henry	La Pierre	Georgia Institute of Technology	GA	USA
EMR	Trevor	Latendresse	Texas A&M University	TX	USA
EMR	David	Lederman	University of California, Santa Cruz	CA	USA
EMR	Russell	Maier	National Institute of Standards and Technology	MD	USA
EMR	Hans	Malissa	University of Utah	UT	USA
EMR	Jamie	Manson	Eastern Washington University	WA	USA
EMR	Jonathan	Marbey	NHMFL	FL	USA
EMR	Frederic	Mentink	NHMFL	FL	USA
EMR	Zhihui	Miao	University of Florida	FL	USA
EMR	Clay	Mings	University of Tennessee, Knoxville	TN	USA
EMR	Ian	Moseley	Colorado State University	CO	USA
EMR	Duncan	Moseley	University of Tennessee, Knoxville	TN	USA
EMR	Michael	Nippe	Texas A&M University	TX	USA
EMR	Andrew	Ozarowski	NHMFL	FL	USA
EMR	Mykhaylo	Ozerov	NHMFL	FL	USA
EMR	Jianjun	Pan	University of South Florida	FL	USA
EMR	Nathan	Peek	Florida State University	FL	USA

Facility	First Name	Last Name	Organization	State	Country
EMR	Sanath Kumar	Rama Krishna	Florida State University	FL	USA
EMR	Arun	Ramanathan	Georgia Institute of Technology	GA	USA
EMR	Ellis	Reinherz	Dana-Farber Cancer Institute	MA	USA
EMR	Natalie	Rice	Georgia Institute of Technology	GA	USA
EMR	Robert	Schurko	Florida State University	FL	USA
EMR	Susannah	Scott	University of California, Santa Barbara	CA	USA
EMR	Michael	Shatruk	NHMFL	FL	USA
EMR	Srinivasa Rao	Singamaneni	University of Texas, El Paso	TX	USA
EMR	John	Singleton	NHMFL	NM	USA
EMR	Likai	Song	NHMFL	FL	USA
EMR	Murari	Soundararajan	NHMFL	FL	USA
EMR	Benjamin	Stein	Los Alamos National Laboratory	NM	USA
EMR	Albert	Stiegman	Florida State University	FL	USA
EMR	Geoffrey	Strouse	NHMFL	FL	USA
EMR	Mas	Subramanian	Oregon State University	OR	USA
EMR	Brent	Sumerlin	University of Florida	FL	USA
EMR	Joshua	Telser	Roosevelt University	IL	USA
EMR	Pagnareach	Tin	University of Tennessee, Knoxville	TN	USA
EMR	Aaron	Tondreau	Los Alamos National Laboratory	NM	USA
EMR	Priyanka	Vaidya	University of Central Florida	FL	USA
EMR	Johan	van Tol	NHMFL	FL	USA
EMR	Adam	Veige	University of Florida	FL	USA
EMR	Sungsool	Wi	NHMFL	FL	USA
EMR	Chelsea	Widener	University of Tennessee, Knoxville	TN	USA
EMR	Ziling	Xue	University of Tennessee, Knoxville	TN	USA
EMR	Fengyuan	Yang	Ohio State University	OH	USA
EMR	Joseph	Zadrozny	Colorado State University	CO	USA
EMR	Vivien	Zapf	NHMFL	NM	USA
EMR	Jianyuan	Zhang	Rutgers University	NJ	USA
EMR	Tommy	Zhao	University of Florida	FL	USA

Facility	First Name	Last Name	Organization	State	Country
EMR	Mary Ellen	Zvanut	University of Alabama, Birmingham	AL	USA

High B/T - National Users

Facility	First Name	Last Name	Organization	State	Country
High B/T	Johnny	Adams	University of Florida	FL	USA
High B/T	Donald	Candela	University of Massachusetts	MA	USA
High B/T	Keegan	Gunther	University of Florida	FL	USA
High B/T	Chao	Huan	University of Florida	FL	USA
High B/T	Yoonseok	Lee	University of Florida	FL	USA
High B/T	Marc	Lewkowitz	University of Florida	FL	USA
High B/T	Lucia	Steinke	University of Florida	FL	USA
High B/T	Neil	Sullivan	University of Florida	FL	USA
High B/T	Andrew	Woods	University of Florida	FL	USA

ICR- National Users

Facility	First Name	Last Name	Organization	State	Country
ICR	Jeramie	Adams	University of Wyoming	WY	USA
ICR	Archana	Agarwal	University of Utah	UT	USA
ICR	Lissa	Anderson	NHMFL	FL	USA
ICR	William	Bahureksa	Colorado State University	CO	USA
ICR	Megan	Behnke	Florida State University	FL	USA
ICR	Barbara	Bekins	U.S. Geological Survey	CA	USA
ICR	Greg	Blakney	NHMFL	FL	USA
ICR	Jens	Blotevogel	Colorado State University	CO	USA
ICR	Thomas	Borch	Colorado State University	CO	USA
ICR	Brian	Bothner	Montana State University	MT	USA
ICR	Catherine	Brewer	New Mexico State University	NM	USA
ICR	David	Butcher	NHMFL	FL	USA
ICR	Kenneth	Carroll	New Mexico State University	NM	USA
ICR	Renato	Castelao	University of Georgia	GA	USA
ICR	Núria	Catalán	U.S. Geological Survey	CO	USA
ICR	Jose	Cerrato	University of New Mexico	NM	USA
ICR	Martha	Chacon	NHMFL	FL	USA
ICR	Romy	Chakraborty	Lawrence Berkeley National Laboratory	CA	USA
ICR	Huan	Chen	NHMFL	FL	USA
ICR	Feng	Cheng	Worcester Polytechnic Institute	MA	USA
ICR	Nicole	Coffey	University of Delaware	DE	USA
ICR	Katrina	Counihan	Alaska SeaLife Center	AK	USA
ICR	Isabelle	Cozzarelli	U.S. Geological Survey	VA	USA
ICR	Than	Dam	Univesity of Wyoming	WY	USA
ICR	Juliana	D'Andrilli	Louisiana Universities Marine Consortium	LA	USA
ICR	Cameron	Davis	NHMFL	FL	USA
ICR	Caroline	DeHart	Northwestern University	IL	USA
ICR	Mostafa	Dehghanizadeh	New Mexico State University	NM	USA

Facility	First Name	Last Name	Organization	State	Country
ICR	Benjamin	DesSoye	Northwestern University	IL	USA
ICR	Ermias	Dheressa	National Renewable Energy Laboratory	CO	USA
ICR	Greg	Dooley	Colorado State University	CO	USA
ICR	Elizabeth	Duselis	University of Virginia	VA	USA
ICR	Nimisha	Edayilam	Clemson University (Clemson)	SC	USA
ICR	Ekanayaka	Ellepola	New Mexico Tech	NM	USA
ICR	Jason	Fellman	University of Alaska Southeast	AK	USA
ICR	Sarah	Fischer	University of Colorado, Boulder	CO	USA
ICR	William	Fitt	University of Georgia	GA	USA
ICR	Daniela	Fraga Alvarez	Worcester Polytechnic Institute	MA	USA
ICR	Danielle	Freeman	Woods Hole Oceanographic Institution	MA	USA
ICR	Joseph	Frye	NHMFL	FL	USA
ICR	Claudia	Galvan	New Mexico State University	NM	USA
ICR	Valier	Galy	Woods Hole Oceanographic Institution	MA	USA
ICR	Valerie	Garcia-Negron	University of Tennessee, Knoxville	TN	USA
ICR	Rana	Ghannam	University of New Orleans	LA	USA
ICR	Taylor	Glattke	Florida State University	FL	USA
ICR	Sophia	Gomez	Florida State University	FL	USA
ICR	Sergio	Granados-Focil	Clark University	MA	USA
ICR	David	Griffith	Willamette University	OR	USA
ICR	Sara	Gushgari-Doyle	Lawrence Berkeley National Laboratory	CA	USA
ICR	Andrea	Hanson	Colorado State University	CO	USA
ICR	David	Harper	University of Tennessee, Knoxville	TN	USA
ICR	Maxwell	Harsha	University of New Orleans	LA	USA
ICR	Jon	Hawkings	Florida State University	FL	USA
ICR	Lidong	He	NHMFL	FL	USA
ICR	Deja	Hebert	University of New Orleans	LA	USA
ICR	Chris	Hendrickson	NHMFL	FL	USA

Facility	First Name	Last Name	Organization	State	Country
ICR	David	Herold	University of California, San Diego	CA	USA
ICR	Leslie	Hicks	University of North Carolina at Chapel Hill	NC	USA
ICR	Daisuke	Higo	Thermo Fisher Scientific	VA	USA
ICR	William	Hockaday	Baylor University	TX	USA
ICR	F. Omar	Holguin	New Mexico State University	NM	USA
ICR	Amy	Holt	Florida State University	FL	USA
ICR	Eran	Hood	University of Alaska Southeast	AK	USA
ICR	Brian	Hopkinson	University of Georgia	GA	USA
ICR	Aixin	Hou	Louisiana State University	LA	USA
ICR	Zhen	Hu	University of Wyoming	WY	USA
ICR	Katherine	Humpal	University of New Orleans	LA	USA
ICR	Donald	Hunt	University of Virginia	VA	USA
ICR	Carolyn	Hutchinson	Iowa State University	IA	USA
ICR	Kristiina	Iisa	National Renewable Energy Laboratory	CO	USA
ICR	Jackie	Jarvis	New Mexico State University	NM	USA
ICR	Wenbin	Jiang	New Mexico State University	NM	USA
ICR	Alexander	Johs	Oak Ridge National Laboratory	TN	USA
ICR	Samantha	Joye	University of Georgia	GA	USA
ICR	David	Keffer	University of Tennessee, Knoxville	TN	USA
ICR	Neil	Kelleher	Northwestern University	IL	USA
ICR	Anne	Kellerman	Florida State University	FL	USA
ICR	Eugene	Kelly	Colorado State University	CO	USA
ICR	Naima	Khan	New Mexico State University	NM	USA
ICR	Dana	Kolpin	U.S. Geological Survey	IA	USA
ICR	John	Kominoski	Florida International University	FL	USA
ICR	Logan	Krajewski	NHMFL	FL	USA
ICR	Elizabeth	Kujawinski	Woods Hole Oceanographic Institution	MA	USA
ICR	Martin	Kurek	Florida State University	FL	USA

Facility	First Name	Last Name	Organization	State	Country
ICR	Iurii	Kurerov	University of New Orleans	LA	USA
ICR	Boris	Lau	University of Massachusetts	MA	USA
ICR	Maria	Letourneau	University of Georgia	GA	USA
ICR	Liang	Li	Florida Department of Environmental Protection	FL	USA
ICR	Wenbo	Li	Florida State University	FL	USA
ICR	Runwei	Li	FSU-FAMU College of Engineering	FL	USA
ICR	Yuan	Lin	Florida State University	FL	USA
ICR	Qianxin	Lin	Louisiana State University	LA	USA
ICR	Peilu	Liu	Florida State University	FL	USA
ICR	Omics	LLC	Omics, LLC	FL	USA
ICR	Merritt	Logan	Colorado State University	CO	USA
ICR	Jonathan	Long	Advanced Magnet Lab, Inc.	LA	USA
ICR	Joseph	Loo	University of California, Los Angeles	CA	USA
ICR	Christian	Lopes	Florida International University	FL	USA
ICR	Francisco	Lopez Linares	Chevron, Richmond	CA	USA
ICR	Lu	Lu	University of Colorado, Boulder	CO	USA
ICR	Thomas	Manning	Valdosta State University	GA	USA
ICR	Hairuo	Mao	University of Wyoming	WY	USA
ICR	Zachary	Marinelli	University of Georgia	GA	USA
ICR	Alan	Marshall	NHMFL	FL	USA
ICR	Rachel	Martineac	University of Georgia	GA	USA
ICR	Jason	Masoner	U.S. Geological Survey	OK	USA
ICR	Amy	McKenna	NHMFL	FL	USA
ICR	Colleen	McMahan	U.S. Department of Agriculture	CA	USA
ICR	Patricia	Medeiros	University of Georgia	GA	USA
ICR	Rafael	Melani	Northwestern university	IL	USA
ICR	Amin	Mirkouei	University of Idaho	ID	USA
ICR	John	Moses	CF Technologies, Inc.	MA	USA
ICR	Remi	Moulian	NHMFL	FL	USA

Facility	First Name	Last Name	Organization	State	Country
ICR	Calvin	Mukarakate	National Renewable Energy Laboratory	CO	USA
ICR	Robert	Nelson	Woods Hole Oceanographic Institution	MA	USA
ICR	Taylor F	Nelson	Woods Hole Oceanographic Institution	MA	USA
ICR	Christopher	Nevitt	University of Louisville	KY	USA
ICR	Sydney	Niles	NHMFL	FL	USA
ICR	Mark	Nimlos	National Renewable Energy Laboratory	CO	USA
ICR	Rachel	Ogorzalek Loo	University of California, Los Angeles	CA	USA
ICR	Chris	Osburn	North Carolina State University	NC	USA
ICR	Cesar	Ovalles	Chevron Energy Tech. Comp.	CA	USA
ICR	Alex	Paulsen	Mainstream Engineering Corp	FL	USA
ICR	Jesse	Peach	Montana State University	MT	USA
ICR	Nasim	Pica	Colorado State University	CO	USA
ICR	Dante	Placido	U.S. Department of Agriculture	CA	USA
ICR	David	Podgorski	University of New Orleans	LA	USA
ICR	Zeljka	Popovic	Florida State University	FL	USA
ICR	Brett	Poulin	U.S. Geological Survey	CO	USA
ICR	Jonathan	Putman	NHMFL	FL	USA
ICR	Chris	Reddy	Woods Hole Oceanographic Institution	MA	USA
ICR	Zachary	Redman	University of Alaska, Anchorage	AK	USA
ICR	Zhiyong	Ren	University of Colorado, Boulder	CO	USA
ICR	Charles	Rhoades	U.S. Department of Agriculture	CO	USA
ICR	Orlando	Rios	Oak Ridge National Laboratory	TN	USA
ICR	Alan	Rockwood	University of Utah	UT	USA
ICR	Ryan	Rodgers	NHMFL	FL	USA
ICR	Estrella	Rogel	Chevron ETC	CA	USA
ICR	Jennifer	Rogers	Florida State University	FL	USA
ICR	Carla	Roma	Worcester Polytechnic Institute	MA	USA

Facility	First Name	Last Name	Organization	State	Country
ICR	Fernando	Rosario-Ortiz	University of Colorado, Boulder	CO	USA
ICR	Holly	Roth	Colorado State University	CO	USA
ICR	Steven	Rowland	National Renewable Energy Laboratory	CO	USA
ICR	Gayan	Rubasinghege	New Mexico Tech	NM	USA
ICR	Christine	Schaner Tooley	SUNY Buffalo	NY	USA
ICR	Kendhl	Seabright	University of Tennessee, Knoxville	TN	USA
ICR	Jeffrey	Shabanowitz	University of Virginia	VA	USA
ICR	Sergei	Shalygin	New Mexico State University	NM	USA
ICR	Hamidreza	Sharifan	Colorado State University	CO	USA
ICR	Kavita	Sharma	Idaho State University	ID	USA
ICR	Ryan	Sibert	University of Georgia	GA	USA
ICR	Donald	Smith	NHMFL	FL	USA
ICR	Ashley	Smyth	University of Florida	FL	USA
ICR	Amanda	Smythers	University of North Carolina at Chapel Hill	NC	USA
ICR	Robert	Spencer	Florida State University	FL	USA
ICR	Kristina	Srzentic	Northwestern University	IL	USA
ICR	Ethan	Struhs	University of Idaho	ID	USA
ICR	Aron	Stubbins	Northeastern University	MA	USA
ICR	Jessica	Sweeney	CF Technologies, Inc.	MA	USA
ICR	Youneng	Tang	Florida State University	FL	USA
ICR	Nishanth	Tharayil	Clemson University	SC	USA
ICR	Paul	Thomas	Northwestern University	IL	USA
ICR	Michael	Timko	Worcester Polytechnic Institute	MA	USA
ICR	Patrick	Tomco	University of Alaska Anchorage	AK	USA
ICR	Geoffrey	Tompsett	Worcester Polytechnic Institute	MA	USA
ICR	Richard	Vachet	University of Massachusetts Amherst	MA	USA
ICR	Dave	Valentine	University of California, Santa Barbara	CA	USA
ICR	Carmen	Velasco	University of New Mexico	NM	USA

Facility	First Name	Last Name	Organization	State	Country
ICR	Radisav	Vidic	University of Pittsburgh	PA	USA
ICR	Jana	Voriskova	Lawrence Berkeley National Laboratory	CA	USA
ICR	Sasha	Wagner	University of Georgia	GA	USA
ICR	Anna	Walsh	Woods Hole Oceanographic Institution	MA	USA
ICR	Huan	Wang	University of Colorado, Boulder	CO	USA
ICR	Collin	Ward	Woods Hole Oceanographic Institution	MA	USA
ICR	Chad	Weisbrod	NHMFL	FL	USA
ICR	Helen	White	Haverford College	PA	USA
ICR	Kimberly	Wickland	U.S. Geological Survey	CO	USA
ICR	Mike	Wilkins	Colorado State University	CO	USA
ICR	Nolan	Wilson	National Renewable Energy Laboratory	CO	USA
ICR	Andrew	Wozniak	University of Delaware	DE	USA
ICR	Xiaoqin	Wu	Lawrence Berkeley National Laboratory	CA	USA
ICR	Mengxue	Xia	Clemson University	SC	USA
ICR	Pei	Xu	New Mexico State University	NM	USA
ICR	Robert	Young	Colorado State University	CO	USA
ICR	Lu	Yu	University of Tennessee, Knoxville	TN	USA
ICR	Zhiming	Zhang	NHMFL	FL	USA
ICR	Jianchao	Zhang	University of Wyoming	WY	USA
ICR	Ruihan	Zhang	Worcester Polytechnic Institute	MA	USA
ICR	Mengqiang	Zhu	University of Wyoming	WY	USA
ICR	Phoebe	Zito	University of New Orleans	LA	USA
ICR	Yi	Zuo	Chevron, San Ramon	CA	USA

NMR - National Users

Facility	First Name	Last Name	Organization	State	Country
NMR	Christer	Aakeroy	Kansas State University	KS	USA
NMR	Nastaren	Abad	Florida State University	FL	USA
NMR	Maryam	Abdolrahmani	Oklahoma State University	OK	USA
NMR	Waseem	Afzaal	Florida State University	FL	USA
NMR	Adewale	Akinfaderin	Florida State University	FL	USA
NMR	Omar	Al-Danoon	Oklahoma State University	OK	USA
NMR	Hannah	Alderson	Florida State University	FL	USA
NMR	Adam	Altenhof	Florida State University	FL	USA
NMR	Dan	Au	University of Colorado, Denver	CO	USA
NMR	Frederick	Bagdasarian	Florida State University	FL	USA
NMR	Jasleen	Bindra	National Institute of Standards and Technology	MD	USA
NMR	Ashley	Blue	NHMFL	FL	USA
NMR	Cesario	Borlongan	University of South Florida	FL	USA
NMR	Clifford	Bowers	University of Florida	FL	USA
NMR	William	Brey	NHMFL	FL	USA
NMR	Nhat Nguyen	Bui	NHMFL	FL	USA
NMR	Bruce	Bunnell	Tulane University	LA	USA
NMR	Thach	Can	Salk Institute for Biological Studies	CA	USA
NMR	Silvia	Centeno	The Metropolitan Museum of Art	NY	USA
NMR	Arnab	Chakraborty	Louisiana State University	LA	USA
NMR	Kevin	Chalek	University of California, Riverside	CA	USA
NMR	Bharat	Chaudhary	Oklahoma State University	OK	USA
NMR	Banghao	CHen	Florida State University	FL	USA
NMR	Kuizhi	Chen	NHMFL	FL	USA
NMR	Bo	Chen	University of Central Florida	FL	USA
NMR	Po-Hsiu	Chien	Florida State University	FL	USA
NMR	Carl	Conti	Florida State University	FL	USA
NMR	Whitney	Costello	University of Texas, Southwestern	TX	USA
NMR	Myriam	Cotten	College of William and Mary	VA	USA

Facility	First Name	Last Name	Organization	State	Country
NMR	Tim	Cross	NHMFL	FL	USA
NMR	Salik	Dahal	Oklahoma State University	OK	USA
NMR	Naresh	Dalal	NHMFL	FL	USA
NMR	Anvesh Kumar Reddy	Dasari	East Carolina University	NC	USA
NMR	Mark	Davis	California Institute of Technology	CA	USA
NMR	Valeria	Di Tullio	The Metropolitan Museum of Art	NY	USA
NMR	Malitha	Dickwella Widanage	Louisiana State University	LA	USA
NMR	Rick	Dorn	Iowa State University	IA	USA
NMR	Justin	Douglas	University of Kansas	KS	USA
NMR	Zach	Dowdell	Florida State University	FL	USA
NMR	Zachary	Dowdell	Florida State University	FL	USA
NMR	Thierry	Dubroca	NHMFL	FL	USA
NMR	Cecil	Dybowski	University of Delaware	DE	USA
NMR	Elan	Eisenmesser	University of Colorado, Denver	CO	USA
NMR	Cristian	Escobar	NHMFL	FL	USA
NMR	Alec	Esper	University of Florida	FL	USA
NMR	Xuyong	Feng	Florida State University	FL	USA
NMR	David	Fenning	University of California, San Diego	CA	USA
NMR	Emily	Foley	University of California, Santa Barbara	CA	USA
NMR	Kendra	Frederick	University of Texas, Southwestern	TX	USA
NMR	Lucio	Frydman	NHMFL	FL	USA
NMR	Riqiang	Fu	NHMFL	FL	USA
NMR	Zhehong	Gan	NHMFL	FL	USA
NMR	Lina	Gao	Florida State University	FL	USA
NMR	Yuan	Gao	Georgia Institute of Technology	GA	USA
NMR	Carlos	Garcia	Clemson University	SC	USA
NMR	Tata	Gopinath	University of Minnesota, Twin Cities	MN	USA
NMR	Petr	Gor'kov	NHMFL	FL	USA
NMR	Samuel	Grant	NHMFL	FL	USA

Facility	First Name	Last Name	Organization	State	Country
NMR	Robert	Griffin	Massachusetts Institute of Technology	MA	USA
NMR	Cong	Guo	NHMFL	FL	USA
NMR	Sossina	Haile	Northwestern University	IL	USA
NMR	James	Harper	Brigham Young University	UT	USA
NMR	Michael	Harrington	Huntington Medical Research Institutes	CA	USA
NMR	Shannon	Helsper	NHMFL	FL	USA
NMR	Stephen	Hill	NHMFL	FL	USA
NMR	Samuel	Holder	Florida State University	FL	USA
NMR	Sean	Holmes	Florida State University	FL	USA
NMR	Sarah	Horstmeier	Oklahoma State University	OK	USA
NMR	Yan-Yan	Hu	Florida State University	FL	USA
NMR	Danting	Huang	Florida State University	FL	USA
NMR	Ivan	Hung	NHMFL	FL	USA
NMR	Sonjong	Hwang	California Institute of Technology	CA	USA
NMR	Robbie	Iuliucci	Washington and Jefferson College	PA	USA
NMR	Taylor	Johnston	Florida State University	FL	USA
NMR	Mercouri	Kanatzidis	Northwestern University	IL	USA
NMR	Jessica	Kelz	University of California, Irvine	CA	USA
NMR	Alex	Kirui	Louisiana State University	LA	USA
NMR	Jason	Kitchen	NHMFL	FL	USA
NMR	Jaka	Kragelj	University of Texas, Southwestern	TX	USA
NMR	Krishnendu	Kundu	NHMFL	FL	USA
NMR	Jason	Kuszynski	Florida State University	FL	USA
NMR	Erik	Larsen	University of Minnesota, Twin Cities	MN	USA
NMR	Kwang Hun	Lim	East Carolina University	NC	USA
NMR	Jin	Liming	Florida State University	FL	USA
NMR	Ilya	Litvak	NHMFL	FL	USA
NMR	Haoyu	Liu	Florida State University	FL	USA
NMR	Joanna	Long	University of Florida	FL	USA

Facility	First Name	Last Name	Organization	State	Country
NMR	Teng	Ma	Florida State University	FL	USA
NMR	Benito	Marinas	University of Illinois at Urbana-Champaign	IL	USA
NMR	Tobin	Marks	Northwestern University	IL	USA
NMR	Steven	McKnight	University of Texas, Southwestern	TX	USA
NMR	Frederic	Mentink	NHMFL	FL	USA
NMR	Kilsia	Mercedes	University of Colorado, Denver	CO	USA
NMR	Matthew	Merritt	University of Florida	FL	USA
NMR	Yimin	Miao	Florida State University	FL	USA
NMR	Zhihui	Miao	University of Florida	FL	USA
NMR	Hadi	Mohamma-digoushki	Florida State University	FL	USA
NMR	Smita	Mohanty	Oklahoma State University	OK	USA
NMR	Daniel	Mosiman	University of Illinois at Urbana-Champaign	IL	USA
NMR	Leonard	Mueller	University of California, Riverside	CA	USA
NMR	Dylan	Murray	University of California Davis	CA	USA
NMR	Lakshmi Bhai	N Vidyadharan	Ohio State University	OH	USA
NMR	Karthik	Nagapudi	Genentech Inc.	CA	USA
NMR	Sarah	Nelson	University of Minnesota, Twin Cities	MN	USA
NMR	Bradley	Nilsson	University of Rochester	NY	USA
NMR	Joseph	Noel	Salk Institute for Biological Studies	CA	USA
NMR	Lauren	O'Donnell	Hunter College of CUNY	NY	USA
NMR	Dmitry	Ostrovsky	University of Alaska, Anchorage	AK	USA
NMR	Anant	Paravastu	Georgia Institute of Technology	GA	USA
NMR	Sawankumar	Patel	Florida State University	FL	USA
NMR	Joana	Paulino	NHMFL	FL	USA
NMR	Austin	Peach	Florida State University	FL	USA
NMR	Linda	Petzold	University of California, Santa Barbara	CA	USA
NMR	Kenneth	Poeppelmeier	Northwestern University	IL	USA
NMR	Huajun	Qin	Florida State University	FL	USA

Facility	First Name	Last Name	Organization	State	Country
NMR	Elena	Quigley	University of Rochester	NY	USA
NMR	Sanath Kumar	Rama Krishna	Florida State University	FL	USA
NMR	Ayyalusamy	Ramamoorthy	University of Michigan	MI	USA
NMR	Thirupathi	Ravula	University of Michigan	MI	USA
NMR	Jens	Rosenberg	NHMFL	FL	USA
NMR	Terrone	Rosenberry	Mayo Clinic, Jacksonville	FL	USA
NMR	Aaron	Rossini	Iowa State University	IA	USA
NMR	Varun	Sakhrani	University of California, Riverside	CA	USA
NMR	Edward	Saliba	Massachusetts Institute of Technology	MA	USA
NMR	Victor	Schepkin	NHMFL	FL	USA
NMR	Jeffrey	Schiano	Pennsylvania State University	PA	USA
NMR	Joseph	Schlenoff	Florida State University	FL	USA
NMR	Robert	Schurko	Florida State University	FL	USA
NMR	Sabyasachi	Sen	University of California, Davis	CA	USA
NMR	Yiseul	Shin	Florida State University	FL	USA
NMR	Ansgar	Siemer	University of Southern California	CA	USA
NMR	Robert	Silvers	Florida State University	FL	USA
NMR	Likai	Song	NHMFL	FL	USA
NMR	Murari	Soundararajan	NHMFL	FL	USA
NMR	Geoffrey	Strouse	NHMFL	FL	USA
NMR	Brent	Sumerlin	University of Florida	FL	USA
NMR	Hillary	Sutton	University of California, Davis	CA	USA
NMR	Jennifer	Swift	Georgetown University	DC	USA
NMR	Vasily	Sysoev	University of Texas, Southwestern	TX	USA
NMR	Kan	Tagami	University of California, San Diego	CA	USA
NMR	Joshua	Taylor	Florida State University	FL	USA
NMR	Suzanne	Thomas	Salk Institute for Biological Studies	CA	USA
NMR	Fang	Tian	Pennsylvania State University	PA	USA
NMR	Johan	van Tol	NHMFL	FL	USA
NMR	Gianluigi	Veglia	University of Minnesota, Twin Cities	MN	USA

Facility	First Name	Last Name	Organization	State	Country
NMR	Adam	Veige	University of Florida	FL	USA
NMR	Amrit	Venkatesh	Iowa State University	IA	USA
NMR	Cameron	Vojvodin	Florida State University	FL	USA
NMR	Liliya	Vugmeyster	University of Colorado, Denver	CO	USA
NMR	Pengbo	Wang	Florida State University	FL	USA
NMR	Tuo	Wang	Louisiana State University	LA	USA
NMR	Xiaoling	Wang	University of California, Santa Barbara	CA	USA
NMR	Songlin	Wang	University of Minnesota, Twin Cities	MN	USA
NMR	Taylor	Watts	Georgetown University	WA	USA
NMR	Jens	Watzlawik	Mayo Clinic, Jacksonville	FL	USA
NMR	Jeffery	White	Oklahoma State University	OK	USA
NMR	Tanya	Whitmer	Ohio State University	OH	USA
NMR	Sungsool	Wi	NHMFL	FL	USA
NMR	Yuuki	Wittmer	University of California, Davis	CA	USA
NMR	Qiong	Wu	University of Texas, Southwestern	TX	USA
NMR	Yiqing	Xia	University of California, Davis	CA	USA
NMR	Yiling	Xiao	University of Texas, Southwestern	TX	USA
NMR	Xuegang	Yuan	Florida State University	FL	USA
NMR	Bing	Yuan	University of California, Davis	CA	USA
NMR	Rongfu	Zhang	NHMFL	FL	USA
NMR	Xiangwu	Zhang	North Carolina State University	NC	USA
NMR	Jim	Zheng	Florida Agricultural and Mechanical University	FL	USA
NMR	Jin	Zheng	Florida State University	FL	USA
NMR	Huan-Xiang	Zhou	University of Illinois at Chicago	IL	USA
NMR	Weidi	Zhu	University of California, Davis	CA	USA
NMR	Nicholas	Zumbulyadis	Independent Scholar and Consultant	NY	USA

PFF - National Users

Facility	First Name	Last Name	Organization	State	Country
PFF	James	Analytis	University of California, Berkeley	CA	USA
PFF	Fedor	Balakirev	NHMFL	NM	USA
PFF	Luis	Balicas	NHMFL	FL	USA
PFF	Alimamy	Bangura	NHMFL	FL	USA
PFF	Eric	Bauer	Los Alamos National Laboratory	NM	USA
PFF	Ryan	Baumbach	NHMFL	FL	USA
PFF	Jonathan	Betts	NHMFL	NM	USA
PFF	Avery	Blockmon	University of Tennessee, Knoxville	TN	USA
PFF	Greg	Boebinger	NHMFL	FL	USA
PFF	Paul	Canfield	Ames Laboratory	IA	USA
PFF	Gang	Cao	University of Colorado, Boulder	CO	USA
PFF	Mun	Chan	NHMFL	NM	USA
PFF	Joseph	Checkelsky	Massachusetts Institute of Technology	MA	USA
PFF	Kuan-Wen	Chen	University of Michigan	MI	USA
PFF	Lu	Chen	University of Michigan	MI	USA
PFF	Sang Wook	Cheong	Rutgers University, New Brunswick	NJ	USA
PFF	Amanda	Clune	University of Tennessee, Knoxville	TN	USA
PFF	Carolina	Corvalan Moya	Los Alamos National Laboratory	NM	USA
PFF	Scott	Crooker	NHMFL	NM	USA
PFF	Aravind	Devarakonda	Massachusetts Institute of Technology	MA	USA
PFF	Xiaxin	Ding	Idaho National Laboratory	ID	USA
PFF	Priscila	Ferrari Silveira Rosa	Los Alamos National Laboratory	NM	USA
PFF	Zachary	Fisk	University of California, Irvine	CA	USA
PFF	Krzysztof	Gofryk	Idaho National Laboratory	ID	USA
PFF	Laura	Greene	NHMFL	FL	USA
PFF	Binghao	Guo	University of California, Santa Barbara	CA	USA
PFF	Minyong	Han	Massachusetts Institute of Technology	MA	USA

Facility	First Name	Last Name	Organization	State	Country
PFF	Neil	Harrison	NHMFL	NM	USA
PFF	Pei-Chun	Ho	California State University, Fresno	CA	USA
PFF	Kendall	Hughey	University of Tennessee, Knoxville	TN	USA
PFF	Daniel	Jackson	NHMFL	NM	USA
PFF	Marcelo	Jaime	NHMFL	NM	USA
PFF	Na Hyun	Jo	Ames Laboratory	IA	USA
PFF	David	Kealhofer	University of California, Santa Barbara	CA	USA
PFF	Takashi	Kurumaji	Massachusetts Institute of Technology	MA	USA
PFF	Satya	Kushwaha	Los Alamos National Laboratory	NM	USA
PFF	Brinda	Kuthanazhi	Ames Laboratory	IA	USA
PFF	You	Lai	NHMFL	NM	USA
PFF	Ian	Leahy	University of Colorado, Boulder	CO	USA
PFF	Minseong	Lee	Los Alamos National Laboratory	NM	USA
PFF	Minhyea	Lee	University of Colorado, Boulder	CO	USA
PFF	Jing	Li	Los Alamos National Laboratory	NM	USA
PFF	Lu	Li	University of Michigan	MA	USA
PFF	Nikola	Maksimovic	University of California, Berkeley	CA	USA
PFF	David	Mandrus	University of Tennessee, Knoxville	TN	USA
PFF	Jamie	Manson	Eastern Washington University	WA	USA
PFF	Zhiqiang	Mao	Pennsylvania State University	PA	USA
PFF	Brian	Maple	University of California, San Diego	CA	USA
PFF	Ross	McDonald	NHMFL	NM	USA
PFF	Robert	McQueeney	Ames Laboratory	IA	USA
PFF	Lujin	Min	Pennsylvania State University	PA	USA
PFF	Kimberly	Modic	NHMFL	NM	USA
PFF	Shirin	Mozaffari	NHMFL	FL	USA
PFF	Janice	Musfeldt	University of Tennessee, Knoxville	TN	USA
PFF	Stephen	Nagler	Oak Ridge National Laboratory	TN	USA
PFF	Wanyi	Nie	Los Alamos National Laboratory	NM	USA

Facility	First Name	Last Name	Organization	State	Country
PFF	Wei	Ning	Pennsylvania State University	PA	USA
PFF	Magdalena	Owczarek	Los Alamos National Laboratory	NM	USA
PFF	Johanna	Palmstrom	Los Alamos National Laboratory	NM	USA
PFF	Christopher	Pocs	University of Colorado, Boulder	CO	USA
PFF	Narayan	Poudel	Idaho National Laboratory	ID	USA
PFF	Brad	Ramshaw	Cornell University	NY	USA
PFF	Myron	Salamon	University of Texas, Dallas	IL	USA
PFF	Rico	Schoenemann	Los Alamos National Laboratory	NM	USA
PFF	Katherine	Schreiber	NHMFL	NM	USA
PFF	Timo	Schumann	University of California, Santa Barbara	CA	USA
PFF	Arkady	Shehter	NHMFL	FL	USA
PFF	Peter	Siegfried	University of Colorado, Boulder	CO	USA
PFF	John	Singleton	NHMFL	NM	USA
PFF	Susanne	Stemmer	University of California, Santa Barbara	CA	USA
PFF	Andreas	Stier	NHMFL	NM	USA
PFF	Dan	Sun	Los Alamos National Laboratory	NM	USA
PFF	Takehito	Suzuki	Massachusetts Institute of Technology	MA	USA
PFF	Yasu	Takano	University of Florida	FL	USA
PFF	Colin	Tinsman	University of Michigan	MI	USA
PFF	Paul	Tobash	NHMFL	NM	USA
PFF	Hsinhan	Tsai	Los Alamos National Laboratory	NM	USA
PFF	Joshua	Wakefield	Massachusetts Institute of Technology	MA	USA
PFF	Mark	Wartenbe	Los Alamos National Laboratory	NM	USA
PFF	Dagmar	Weickert	NHMFL	NM	USA
PFF	Nathan	Wilson	University of Washington	WA	USA
PFF	Laurel	Winter	NHMFL	NM	USA
PFF	Ziji	Xiang	University of Michigan	MI	USA
PFF	Xiaodong	Xu	University of Washington	WA	USA

Facility	First Name	Last Name	Organization	State	Country
PFF	Dmitry	Yarotski	Los Alamos National Laboratory	NM	USA
PFF	Linda	Ye	Massachusetts Institute of Technology	MA	USA
PFF	Vivien	Zapf	NHMFL	NM	USA
PFF	Dechen	Zhang	University of Michigan	MI	USA
PFF	Guoxin	Zheng	University of Michigan	MI	USA
PFF	Haidong	Zhou	University of Tennessee, Knoxville	TN	USA
PFF	Junbo	Zhu	Massachusetts Institute of Technology	MA	USA
PFF	Yanglin	Zhu	Tulane University	LA	USA

AMRIS - International Users

AMRIS - International Users

Facility	First Name	Last Name	Organization Name	Country
AMRIS	Celine	Baligand	Leiden University Medical Center	Netherland
AMRIS	Pascal	Bernatchez	University of British Columbia	Canada
AMRIS	Christian	Chmelik	Leipzig University	Germany
AMRIS	John	Jones	Center for Neurosciences and Cell Biology	Portugal
AMRIS	Ahmad	Mostafa	Al-Azhar University	Egypt

DC Field - International Users

Facility	First Name	Last Name	Organization Name	Country
DC Field	Jordan	Baglo	University of Sherbrooke	Canada
DC Field	Somak	Basistha	Tata Institute of Fundamental Research	India
DC Field	Alina	Bienko	University of Wroclaw	Poland
DC Field	Joan	Cano	University of Valencia	Spain
DC Field	David	Cardwell	University of Cambridge	UK
DC Field	Kwang Yong	Choi	Chung Ang University	South Korea
DC Field	Joonyoung	Choi	Kyungpook National University	South Korea
DC Field	Min Hyuk	Choi	Pohang University of Science and Technology	South Korea
DC Field	Matthew	Coak	University of Warwick	UK
DC Field	Enrique	Colacio	University of Granada	Spain
DC Field	Amalia	Coldea	University of Oxford	UK
DC Field	Sam	Curley	University of Warwick	UK
DC Field	Yoram	Dagan	Tel-Aviv University	Israel
DC Field	Tony	Dennis	University of Cambridge	UK
DC Field	Nicolas	Doiron-Leyraud	University of Sherbrooke	Canada
DC Field	Irina	Drichko	Ioffe Physical-Technical Institute of the Russian Academy of Sciences	Russia
DC Field	Feng	Du	Zhejiang University	China
DC Field	John	Durrell	University of Cambridge	UK
DC Field	Surajit	Dutta	Tata Institute of Fund. Research	India
DC Field	Paul	Goddard	University of Warwick	UK
DC Field	Kathrin	Gotze	University of Warwick	UK
DC Field	Adrien	Gourgout	University of Sherbrooke	Canada
DC Field	Gaël	Grissonnanche	University of Sherbrooke	Canada
DC Field	Hanxi	Guan	Zhejiang University	China
DC Field	Toni	Helm	Max Planck Institute for Chemical Physics of Solids, Dresden	Germany
DC Field	Hishiro	Hirose	National Institute for Materials Science	Japan

Facility	First Name	Last Name	Organization Name	Country
DC Field	Hua-Fen	Hsu	National Cheng Kung University	Taiwan
DC Field	Yining	Huang	University of Western Ontario	Canada
DC Field	Dmytry	Inosov	Technische Universität Dresden	Germany
DC Field	Ho Seong	Jeon	Pohang University of Science and Technology	South Korea
DC Field	John	Jesudasan	Tata Institute of Fundamental Research	India
DC Field	YounJung	Jo	Kyungpook National University	South Korea
DC Field	Miguel	Julve	University of Valencia	Spain
DC Field	Woun	Kang	Ewha Womans University	South Korea
DC Field	Bernhard	Keimer	Max Planck Institute for Solid State Research, Stuttgart	Germany
DC Field	Naoki	Kikugawa	National Institute for Materials Science	Japan
DC Field	Hoil	Kim	Pohang University of Science and Technology	South Korea
DC Field	Jun Sung	Kim	Pohang University of Science and Technology	South Korea
DC Field	Xueqian	Kong	Zhejiang University	China
DC Field	Etienne	Lefrançois	University of Sherbrooke	Canada
DC Field	Jiangxiazi	Lin	Hong Kong University of Science and Technology	China
DC Field	Joosep	Link	National Institute of Chemical Physics and Biophysics	Estonia
DC Field	Francesc	Lloret	University of Valencia	Spain
DC Field	Fernando	Machado	Federal University of Pernambuco	Brazil
DC Field	Vinicius	Martins	University of Western Ontario	Canada
DC Field	Devendra	Namburi	University of Cambridge	UK
DC Field	Shimpei	Ono	Central Research Institute of Electric Power Industry	Japan
DC Field	Mattia	Ortino	Technical University of Wien	Austria
DC Field	Je-Geun	Park	Seoul National University	South Korea
DC Field	Silke	Paschen	Vienna University of Technology	Austria
DC Field	Matthew	Pearce	University of Warwick	UK

Facility	First Name	Last Name	Organization Name	Country
DC Field	Pavlo	Portnichenko	Technische Universität Dresden	Germany
DC Field	Helene	Raffy	University of Paris-Sud	France
DC Field	Danilo	Ratkovski	Federal University of Pernambuco	Brazil
DC Field	Pratap	Raychaudhuri	Tata Institute of Fund. Research	India
DC Field	Andreas	Rydh	Stockholm University	Sweden
DC Field	Shay	Sandik	Tel-Aviv University	Israel
DC Field	Takao	Sasagawa	Tokyo Institute of Technology	Japan
DC Field	Bin	Shen	Zhejiang University	China
DC Field	Natalya Yu	Shitsevalova	Institute for Problems of Material Sciences	Ukraine
DC Field	Itai	Silber	Tel-Aviv University	Israel
DC Field	Michael	Smidman	Zhejiang University	China
DC Field	Ivan	Smirnov	Ioffe Physical-Technical Institute of the Russian Academy of Sciences	Russia
DC Field	Chaoyu	Song	Fudan University	China
DC Field	Jan	Srpcic	University of Cambridge	UK
DC Field	Raivo	Stern	National Institute of Chemical Physics and Biophysics	Estonia
DC Field	Louis	Taillefer	University of Sherbrooke	Canada
DC Field	Hidekazu	Tanaka	Tokyo Institute of Technology	Japan
DC Field	Taichi	Terashima	National Institute for Materials Science	Japan
DC Field	Shinnosuke	Tokuta	Tokyo University of Agriculture and Technology	Japan
DC Field	Alexander	Tsirlin	National Institute of Chemical Physics and Biophysics	Estonia
DC Field	Julia	Vallejo	University of Valencia	Spain
DC Field	Marta	Viciano-Chumillas	University of Valencia	Spain
DC Field	An	Wang	Zhejiang University	China
DC Field	Robert	Williams	University of Warwick	UK
DC Field	Gang	Wu	Queen's University at Kingston	Canada
DC Field	Akiyasu	Yamamoto	Tokyo University of Agriculture and Technology	Japan

DC Field - International Users

Facility	First Name	Last Name	Organization Name	Country
DC Field	Hugen	Yan	Fudan University	China
DC Field	Yunkun	Yang	Fudan University	China
DC Field	Huiqiu	Yuan	Zhejiang University	China
DC Field	Zachary	Zajicek	University of Oxford	UK
DC Field	Qi	Zhang	Nanjing University	China
DC Field	Minhao	Zhao	Fudan University	China
DC Field	Sergei	Zvyagin	Helmholtz-Zentrum Dresden-Rossendorf	Germany

EMR - International Users

Facility	First Name	Last Name	Organization Name	Country
EMR	Alina	Bienko	University of Wroclaw	Poland
EMR	Christian	Buch	University of Copenhagen	Denmark
EMR	Enrique	Colacio	University of Granada	Spain
EMR	Sam	Curley	University of Warwick	UK
EMR	Markus	Enders	Heidelberg University	Germany
EMR	Igor	Fritsky	Taras Shevchenko National University of Kyiv	Ukraine
EMR	Paul	Goddard	University of Warwick	UK
EMR	Vibe	Jakobsen	University College Dublin	Ireland
EMR	Zofia	Janas	University of Wroclaw	Poland
EMR	Daniel	Jardón Álvarez	Weizmann Institute of Science	Israel
EMR	Julia	Jezierska	University of Wroclaw	Poland
EMR	Kinga	Kaniewska	Gdansk University of Technology	Poland
EMR	Anna	Katafias	N Copernicus University Torun	Poland
EMR	Anna	Kozakiewicz	Nicolaus Copernicus University in Torun	Poland
EMR	Irina	Kuehne	University College Dublin	Ireland
EMR	Michal	Leskes	Weizmann Institute of Science	Israel
EMR	Daphné	Lubert-Perquel	Imperial College London	UK
EMR	Grace	Morgan	University College Dublin	Ireland
EMR	Dmytro	Nesterov	Technical University of Lisbon	Portugal
EMR	Stergios	Piligkos	University of Copenhagen	Denmark
EMR	Snorri	Sigurdsson	University of Iceland	Iceland
EMR	Rudi	van Eldik	University of Erlangen-Nuremberg, Germany	Germany
EMR	Grzegorz	Wrzeszcz	Nicolaus Copernicus University in Torun	Poland

High B/T - International Users

Facility	First Name	Last Name	Organization Name	Country
High B/T	Ryuji	Nomura	Tokyo Institute of Technology	Japan

ICR - International Users

Facility	First Name	Last Name	Organization Name	Country
ICR	Nelson	Acevedo	Université de pau et des Pays de l'Adour	France
ICR	Nelson	Acevedo	University of Pau and Pays de l'Adour	France
ICR	Carlos	Afonso	Normandy University	France
ICR	Martin	Andersen	University of New South Wales	Australia
ICR	Andy	Baker	University of New South Wales	Australia
ICR	Tom	Battin	Ecole Polytechnique Federale de Lausanne	Switzerland
ICR	Robert	Beynon	University of Liverpool	UK
ICR	Brice	Bouyssiere	University of Pau and Pays de l'Adour	France
ICR	Philip	Brownridge	University of Liverpool	UK
ICR	Clément	Brügger	UNSW Sydney	Australia
ICR	Casey	Bryce	University of Tuebingen	Germany
ICR	Herve	Carrier	University of Pau and Pays de l'Adour	France
ICR	Jimmy	Castillo	Central University of Venezuela	Venezuela
ICR	Rohana	Chandrajith	University of Peradeniya	Sri Lanka
ICR	Jean-Luc	Daridon	University of Pau and Pays de l'Adour	France
ICR	Pierre	Giusti	Total	France
ICR	Didia Coelho	Graca	Hôpitaux Universitaires de Genève	Switzerland
ICR	Bertrand	Guenet	French National Center for Scientific Research	France
ICR	Huang	Hanxue	UNSW Sydney	Australia
ICR	Victoria	Harman	University of Liverpool	UK
ICR	Hitoshi	Hasegawa	Ehime University	Japan
ICR	John	Headley	Environment and Climate Change Canada	Canada
ICR	Nicole	Heshka	Natural Resources Canada	Canada
ICR	Jun	Ishizaki	Ehime University	Japan

Facility	First Name	Last Name	Organization Name	Country
ICR	Peng	Jiang	Xiamen University	China
ICR	Andreas	Kappler	Eberhard Karls University of Tübingen	Germany
ICR	Jorge	León-Muñoz	Universidad Católica de la Santísima Concepción Facultad de Ciencias	Chile
ICR	Pierre	Lescuyer	Universitaires de Gene`ve	Switzerland
ICR	Xiaolin	Li	Xiamen University	China
ICR	Caroline	Mangote	Total	France
ICR	Christopher	Marjo	University of New South Wales	Australia
ICR	Matthew	Marshall	University of Bristol	UK
ICR	Liza	McDonough	University of New South Wales	Australia
ICR	Aurora	Mejia	University of Pau and Pays de l'Adour	France
ICR	Karina	Meredith	Australia's Nuclear Science and Technology Organisation	Australia
ICR	Toshihiro	Miyajima	The University of Tokyo, Atmosphere and Ocean Research Institute	Japan
ICR	Sandra	Mounicou	University of Pau and Pays de l'Adour	France
ICR	Anika	Neumann	University of Rostock	Germany
ICR	Denis	O'Carroll	University of New South Wales	Australia
ICR	Phetdala	Oudone	University of New South Wales	Australia
ICR	Ada	Pastor	Aarhus University	Denmark
ICR	Monique Sézanne	Patzner	University Tuebingen	Germany
ICR	Kerry	Peru	Environment and Climate Change Canada	Canada
ICR	Vincent	Piscitelli	Central University of Venezuela	Peru
ICR	Sadia	Radji	University of Pau and Pays de l'Adour	France
ICR	Raghab	Ray	University of Tokyo, Atmosphere and Ocean Research Institute	Japan
ICR	Helen	Rutlidge	University of New South Wales	Australia
ICR	Keisuke	Shima	Shimadzu Corporation	Japan

Facility	First Name	Last Name	Organization Name	Country
ICR	Junpei	Suzuki	Ehime University	Japan
ICR	Ayako	Takemori	Ehime University	Japan
ICR	Nobuaki	Takemori	Ehime University	Japan
ICR	Bryce	Van Dam	Helmholtz-Zentrum Geesthacht	Germany
ICR	Ian	Vander Meulen	Environment and Climate Change Canada	Canada
ICR	Jemma	Wadham	University of Bristol	UK
ICR	Masakatsu	Yamashita	Ehime University	Japan
ICR	Mary	Zeller	Leibniz Institute for Baltic Sea Research Warnemünde	Germany
ICR	Xuepei	Zhang	Karolinska Institutet	Sweden
ICR	Ralf	Zimmermann	University of Rostock	Germany
ICR	Roman	Zubarev	Karolinska Institute	Sweden

NMR - International Users

Facility	First Name	Last Name	Organization Name	Country
NMR	Alexandre	Arnold	University of Quebec at Montreal	Canada
NMR	Ana Rita	Bastos	Universidade de Aveiro	Portugal
NMR	Diana	Bernin	Chalmers University of Technology	Sweden
NMR	Henrik	Bildsoe	Aarhus University	Denmark
NMR	Christian	Bonhomme	Pierre and Marie Curie University	France
NMR	Michael	Brorson	Haldor Topsoe	Denmark
NMR	David	Bryce	University of Ottawa	Canada
NMR	Shuhui	Cai	Xiamen University	China
NMR	Quentin	Chappuis	École normale supérieure de Lyon	France
NMR	Huixin	Chen	Chinese Academy of Sciences	China
NMR	Chia-Hsin	Chen	French National Center for Scientific Research	France
NMR	Zhong	Chen	Xiamen University	China
NMR	Elisabete	Coelho	Universidade de Aveiro	Portugal
NMR	Manuel A.	Coimbra	Universidade de Aveiro	Portugal
NMR	Rivera	de la Rosa	Autonomous University of Nuevo León	Mexico
NMR	Gael	De Paepe	The French Alternative Energies and Atomic Energy Commission	France
NMR	Ulrich	Fekl	University of Toronto (Mississauga)	Canada
NMR	Tomislav	Friscic	McGill University	Canada
NMR	Christel	Gervais	Sorbonne University	France
NMR	Ieva	Goldberga	French National Center for Scientific Research	France
NMR	Eric	Gottwald	Karlsruhe Institute of Technology	Germany
NMR	Hanxi	Guan	Zhejiang University	China
NMR	James	Hook	University of New South Wales	Australia
NMR	Yining	Huang	University of Western Ontario	Canada
NMR	Yuqing	Huang	Xiamen University	China
NMR	Igor	Huskic	McGill University	Canada
NMR	Jin Pyo	Hwang	Dankook University	South Korea

Facility	First Name	Last Name	Organization Name	Country
NMR	Hans	Jakobsen	Aarhus University	Denmark
NMR	Sami	Jannin	École normale supérieure de Lyon	France
NMR	Michael	Jaroszewicz	University of Windsor	Canada
NMR	Woo Young	Kim	Dankook University	South Korea
NMR	Xueqian	Kong	Zhejiang University	China
NMR	Adam	Lange	Leibniz-Forschungsinstitut für Molekulare Pharmakologie, Berlin	Germany
NMR	Danielle	Laurencin	University of Montpellier	France
NMR	Chang Hyun	Lee	Dankook University	South Korea
NMR	Józef	Lewandowski	University of Warwick	UK
NMR	Luís	Mafra	Universidade de Aveiro	Portugal
NMR	Isabelle	Marcotte	University of Quebec at Montreal	Canada
NMR	Ildefonso	Marin-Montesinos	Universidade de Aveiro	Portugal
NMR	Vinicius	Martins	University of Western Ontario	Canada
NMR	Francisco José	Morales-Leal	Autonomous University of Nuevo León	Mexico
NMR	Chang Hoon	Oh	Dankook University	South Korea
NMR	Sarah	Overall	Swiss Federal Institute of Technology in Zurich	Switzerland
NMR	In Kee	Park	Dankook University	South Korea
NMR	Alexandre	Poulhazan	University of Quebec at Montreal	Canada
NMR	Ernest	Prack	University of Toronto (Mississauga)	Canada
NMR	Se Youn	Pyo	Dankook University	South Korea
NMR	Jan	Rainey	Dalhousie University	Canada
NMR	Luke	Reynolds	University of British Columbia	Canada
NMR	Mariana	Sardo	Universidade de Aveiro	Portugal
NMR	Lothar	Schad	Heidelberg University	Germany
NMR	Snorri	Sigurdsson	University of Iceland	Iceland
NMR	Jeffrey	Simmons	Dalhousie University	Canada
NMR	Neeraj	Sinha	Centre of Bio-Medical Research	India
NMR	Carolina	Solis Maldonado	Veracruzan University	Mexico

Facility	First Name	Last Name	Organization Name	Country
NMR	Anamika	Sulekha	Dalhousie University	Canada
NMR	Pingchuan	Sun	Nankai University	China
NMR	Chunhua	Tan	Xiamen University	China
NMR	Daniel	Topgaard	University of Lund	Sweden
NMR	Fenfen	Wang	Nankai University	China
NMR	Dror	Warschawski	French National Center for Scientific Research	France
NMR	Gang	Wu	Queen's University at Kingston	Canada
NMR	Guiming	Zhong	Chinese Academy of Sciences	China

PFF - International Users

Facility	First Name	Last Name	Organization Name	Country
PFF	Yuen Chung	Chan	Chinese University of Hong Kong	Hong Kong
PFF	Sam	Curley	University of Warwick	UK
PFF	Mijkhail	Eremets	Max Planck Institute for Chemistry, Mainz	Germany
PFF	Paul	Goddard	University of Warwick	UK
PFF	Swee	Goh	Chinese University of Hong Kong	Hong Kong
PFF	Mateusz	Goryca	University of Warsaw	Poland
PFF	Kathrin	Gotze	University of Warwick	UK
PFF	Shusaku	Imajo	University of Tokyo	Japan
PFF	Taehwan	Jang	Pohang University of Science and Technology	South Korea
PFF	Kwing To	Lai	Chinese University of Hong Kong	Hong Kong
PFF	Xavier	Marie	National Institute for Applied Sciences, Toulouse	France
PFF	Yuji	Matsuda	Kyoto University	Japan
PFF	Joonbum	Park	Helmholtz-Zentrum Dresden-Rossendorf	Germany
PFF	Andres	Saul	Aix-Marseille University	France
PFF	Hidekazu	Tanaka	Tokyo Institute of Technology	Japan
PFF	Bernhard	Urbaszek	National Institute for Applied Sciences, Toulouse	France
PFF	Jianyu	Xie	Chinese University of Hong Kong	Hong Kong
PFF	Wei	Zhang	Chinese University of Hong Kong	Hong Kong

Appendix 5 – User Proposals

1. AMRIS Facility

Participants (Name, Role, Org., Dept.)	Funding Sources (Funding Agency, Division, Award #)	Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Yousong Ding (S), PI, University of Florida, Medicinal Chemistry Guangde Jiang (G), C, University of Florida, Medicinal Chemistry Peilan Zhang (G), C, University of Florida, Medicinal Chemistry Yi Zhang (G), C, University of Florida, Medicinal Chemistry Ran Zuo (P), C, University of Florida, Medicinal Chemistry	University of Florida, startup package, US College and University Air Force, Office of Scientific Research, Other US Federal Agency	P16310	Discovery of bioactive microbial metabolites via synthetic biology approaches	Biology, Biochemistry, Biophysics	1	1.5
Robert Huigens (G), PI, University of Florida, Medicinal Chemistry Hongfen Yang (G), C, University of Florida, college of pharmacy medicinal chemistry	University of Florida, College of Pharmacy startup, US College and University	P17386	Development of Halogenated Phenazine Prodrugs and Antibiotic Conjugates as Antibacterial Therapeutics	Chemistry	1	3
Anastasios Angelopoulos (S), PI, University of Cincinnati, Department of Chemical and Environmental Engineering Samuel Berens (G), C, University of Florida, Chemical Engineering Taylor Col (G), C, Vasenkov Lab, Chemical Engineering Sergey Vasenkov (S), C, University of Florida, Chemical Engineering	NSF, CBET - Chemical, Bioengineering, Environmental, and Transport Systems, CBET18 36551 NSF, CBET - Chemical, Bioengineering, Environmental, and Transport Systems, CBET18 36556	P17443	Diffusion-mediated exchange of small organic molecules between different types of local environments in perfluorosulfonic acid (PSA) membranes by high field PFG NMR	Engineering	1	52.33
Ryan Lively (S), PI, Georgia Institute of Technology, School of Chemical & Biomolecular Engineering, Amineh Baniani (G), C, University of Florida, Chemical Engineering Christian Chmelik (P), C, Leipzig University, Physics Lei Fan (G), C, University of Florida, Chemical Engineering Evan Forman (G), C, University of Florida, Chemical Engineering Sergey Vasenkov (S), C, University of Florida, Chemical Engineering Fengli Zhang (S), C, National High Magnetic Field Laboratory, CIMAR Erkang Zhou (G), C, Georgia Institute of Technology, School of Chemical & Biomolecular Engineering,	NSF, CBET - Chemical, Bioengineering, Environmental, and Transport Systems, CBET15 10411 NSF, CBET - Chemical, Bioengineering, Environmental, and Transport Systems, CBET15 10442	P17444	The role of the framework flexibility in gas transport inside zeolitic imidazolate frameworks by pulsed field gradient NMR	Engineering	1	41
Joanna Long (S), PI, University of Florida, Biochemistry & Molecular Biology James H.P. Collins (P), C, University of Florida, Biochemistry & Molecular Biology Malathy Elumalai (T), C, University of Florida, AMRIS, McKnight Brain Institute Anil Mehta (O), C, University of Florida, AMRIS James Rocca (S), C, University of Florida, AMRIS Affiliated Faculty & Staff Joshua Slade (T), C, University of Florida, AMRIS	No other support NIH, NIGMS - National Institute of General Medical Sciences, GM122 698	P17539	New equipment/upgrades/troubleshooting on verticals (formerly P09507)	Biology, Biochemistry, Biophysics	1	218.75
Joanna Long (S), PI, University of Florida, Biochemistry & Molecular Biology Malathy Elumalai (T), C, University of Florida, AMRIS, McKnight Brain Institute Kelly Jenkins (T), C, University of Florida, AMRIS Affiliated Faculty & Staff Joshua Slade (T), C, University of Florida, AMRIS Huadong Zeng (S), C, University of Florida, AMRIS Affiliated Faculty & Staff	No other support	P17540	New equipment/upgrades/troubleshooting on horizontals (formerly P09509)	Biology, Biochemistry, Biophysics	1	49.5

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Joanna Long (S)	PI		University of Florida	Biochemistry & Molecular Biology	No other support			P17541	Routine maintenance of existing equipment (formerly P09510)	Biology, Biochemistry, Biophysics	1	346.42
Shane Chatfield (T)	C		University of Florida	AMRIS, McKnight Brain Institute								
James H.P. Collins (P)	C		University of Florida	Biochemistry & Molecular Biology								
Malathy Elumalai (T)	C		University of Florida	AMRIS, McKnight Brain Institute								
Kelly Jenkins (T)	C		University of Florida	AMRIS Affiliated Faculty & Staff								
Thomas Mareci (S)	C		University of Florida	Biochemistry and Molecular Biology								
Anil Mehta (O)	C		University of Florida	AMRIS								
Tammy Nicholson (T)	C		University of Florida	AMRIS Affiliated Faculty & Staff								
James Rocca (S)	C		University of Florida	AMRIS Affiliated Faculty & Staff								
Jens Rosenberg (S)	C		National High Magnetic Field Laboratory	NMR								
Joshua Slade (T)	C		University of Florida	AMRIS								
Judith Steadman (T)	C		University of Florida	AMRIS								
Christi Swiers (T)	C		University of Florida	AMRIS								
Huadong Zeng (S)	C		University of Florida	AMRIS Affiliated Faculty & Staff								
Joanna Long (S)	PI		University of Florida	Biochemistry & Molecular Biology	No other support			P17542	New user training (formerly P09511)	Biology, Biochemistry, Biophysics	1	53
Guita Banan (G)	C		University of Florida	Biology								
James H.P. Collins (P)	C		University of Florida	Biochemistry & Molecular Biology								
Malathy Elumalai (T)	C		University of Florida	AMRIS, McKnight Brain Institute								
Thomas Mareci (S)	C		University of Florida	Biochemistry and Molecular Biology								
Anil Mehta (O)	C		University of Florida	AMRIS								
James Rocca (S)	C		University of Florida	AMRIS Affiliated Faculty & Staff								
Joshua Slade (T)	C		University of Florida	AMRIS								
Huadong Zeng (S)	C		University of Florida	AMRIS Affiliated Faculty & Staff								
Ahmad Mostafa (P)	PI		Al-Azhar University	Pharmacognosy	Egyptian government	Other		P17558	Study on Chemical Constituents, and anticancer activities of certain natural products isolated from plants or marine drugs	Biology, Biochemistry, Biophysics	1	3
Hendrik Luesch (S)	C		University of Florida	College of Pharmacy								
James Rocca (S)	C		University of Florida	AMRIS Affiliated Faculty & Staff								
Benjamin Philmus (S)	PI		Oregon State University	College of Pharmacy	No other support			P17583	Understanding the chemical diversity, and biosynthesis triazine-containing secondary metabolites	Chemistry	1	3.5
Joanna Long (S)	PI		University of Florida	Biochemistry & Molecular Biology	University of Florida matching support	US College and University		P17621	[Independently-funded Research Proposal]	Biology, Biochemistry, Biophysics	1	66.67
James H.P. Collins (P)	C		University of Florida	Biochemistry & Molecular Biology								
Chongyang Huang (P)	C		university of florida	Biochem/Molecular Biology								
Jeanine Brady (S)	PI		University of Florida	Oral Biology	NIH	NIDCR - National Institute of Dental and Craniofacial Research	DE021789	P17623	Structural studies of adhesion protein P1 of Streptococcus mutans, its quaternary structure, and its formation of amyloid fibrils	Biology, Biochemistry, Biophysics	1	15.67
Mavis Agbandje-McKenna (S)	C		University of Florida	Biochemistry and Molecular Biology								
Ana Barran-Berdon (P)	C		University of Florida	Oral Biology								
Matthew Burg (G)	C		University of Florida	Chemistry								
Joanna Long (S)	C		University of Florida	Biochemistry & Molecular Biology								
Leronne Perera (G)	C		University of Florida	Oral Biology								
Gwladys Riviere (P)	C		University of Florida	Biochemistry and molecular biology								
John Jones (S)	PI		Center for Neurosciences and Cell Biology	Metabolic Control Lab	No other support			P17827	High-sensitivity 13C NMR isotopomer analysis of triglyceride fatty acid enrichment from [U-13C]fructose	Biology, Biochemistry, Biophysics	1	37.5
Ram Khattri (P)	C		University of Florida	Biochemistry and molecular biology/medicine								
Rohit Mahar (P)	C		University of Florida	Biochemistry and molecular biology								
Marc McLeod (G)	C		University of Florida College of Medicine	Biochemistry and Molecular Biology								
Matthew Merritt (S)	C		University of Florida	Biochemistry and Molecular Biology								
Mukundan Ragavan (P)	C		University of Florida	Department of Biochemistry and Molecular Biology								
Peder Larson (S)	PI	*	University of California - San Francisco	Radiology and Biomedical Imaging	No other support			P17846	ML-LARSON-001: Hyperpolarized 13C Metabolism Studies for Preclinical Detection of Hypertrophic Cardiomyopathy	Biology, Biochemistry, Biophysics	1	27.33
Matthew Merritt (S)	C		University of Florida	Biochemistry and Molecular Biology								
Mukundan Ragavan (P)	C		University of Florida	Department of Biochemistry and Molecular Biology								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Daniel R. Talham (S)	PI		University of Florida	Chemistry	No other support			P17951	Polymer coated lanthanide nanoparticles as PARACEST MRI contrast agents	Chemistry	1	36.67
Pratik Roy (G)	C		University of Florida	Chemistry								
Luis Colon-Perez (S)	PI		University of California, Irvine	Neurobiology and Behavior	No other support			P18050	Characterization of brain structure at multiple scales in a rodent model early life stress	Biology, Biochemistry, Biophysics	1	16.5
Pascal Bernatchez (S)	PI		University of British Columbia	Anesthesiology, Pharmacology, & Therapeutics	No other support			P18061	Imaging tissue heterogeneity in a new model of chronic muscle damage with fibrofatty infiltration and wasting.	Biology, Biochemistry, Biophysics	1	19.17
Elisabeth Barton (S)	C		University of Florida	Applied Physiology and Kinesiology								
Abhinandan Batra (G)	C		University of Florida	Physical therapy								
Ram Khattri (P)	C		University of Florida	Biochemistry and molecular biology/medicine								
Glenn Walter (S)	C		University of Florida	Physiology and Functional Genomics								
Huadong Zeng (S)	C		University of Florida	AMRIS Affiliated Faculty & Staff								
Hae-Kwon Jeong (S)	PI		Texas A&M University	Chemical Engineering, Materials Science and Engi	NSF	CMMI - Civil, Mechanical & Manufacturing Innovation	CMMI1 561347	P18084	Microscopic gas diffusion in hybrid zeolitic-imidazolate frameworks (ZIFs) by high field diffusion NMR	Engineering	1	6
Samuel Berens (G)	C		University of Florida	Chemical Engineering								
Febrian Hillman (G)	C		Texas A&M University	Chemical Engineering								
Sergey Vasenkov (S)	C		University of Florida	Chemical Engineering								
Matthew Eddy (S)	PI		University of Florida	Chemistry	University of Florida (start-up funds)	US College and University		P19106	ML-EDDY-001: Allosteric Regulation of Human Signaling Complexes	Biology, Biochemistry, Biophysics	1	76.83
Kara Anazia (G)	C		University of Florida	Chemistry department								
Niloofar Gopal Pour (G)	C		University of Florida	Chemistry								
Emma Mulry (G)	C		University of Florida	Chemistry								
Arka Prabha Ray (G)	C		University of Florida	Chemistry								
Naveen Thakur (G)	C		University of Florida	Chemistry								
Andrew Palmer (S)	PI		Florida Institute of Technology	Department of Biomedical and Chemical Engineering and Sciences	No other support			P19156	Regulating Bacterial Virulence through Quorum Sensing Modulation	Biology, Biochemistry, Biophysics	1	18
Anil Mehta (O)	C		University of Florida	AMRIS								
Eric Ziegler (G)	C		Florida Institute of Technology	Biological and Chemical Engineering and Sciences								
Benjamin Wylie (S)	PI		Texas Tech University Department of Chemistry and Biochemistry	Chemistry and Biochemistry	No other support		DMR16 44779	P19164	Determining the dynamic structure of lipid-membrane protein complexes via solid-state NMR	Biology, Biochemistry, Biophysics	1	37.5
Anil Mehta (O)	C		University of Florida	AMRIS								
Adam Veige (S)	PI		University of Florida	Chemistry	NSF	CHE - Chemistry	CHE180 8234	P19170	Quantification of End Groups in Cyclic vs. Linear Polyacetylenes by Carbon-13 Magic Angle Spinning Nuclear Magnetic Resonance Spectroscopy	Biology, Biochemistry, Biophysics	1	7.33
Clifford Bowers (S)	C		University of Florida	Chemistry								
Alec Esper (G)	C		University of Florida	Chemistry								
Zhihui Miao (G)	C		University of Florida	Department of Chemistry								
Brent Sumerlin (S)	C		University of Florida	Chemistry								
Johnny Figueroa (S)	PI	*	Loma Linda University	Center for Health Disparities and Molecular Medicine	No other support			P19197	Microstructural Correlates Of Adolescent Adversity	Biology, Biochemistry, Biophysics	1	7.33
Marcelo Febo (S)	C		University of Florida	Psychiatry								
Marjory Pompilus (G)	C		University of Florida	Psychiatry								
Matthew Eddy (S)	PI		University of Florida	Chemistry	No other support			P19419	ML-EDDY-002: Small molecule fragment screening with GPCRs in natural membranes by HRMAS NMR	Biology, Biochemistry, Biophysics	1	46.92
James H.P. Collins (P)	C		University of Florida	Biochemistry & Molecular Biology								
Guillaume FERRE (P)	C		University of Florida	Chemistry								
Niloofar Gopal Pour (G)	C		University of Florida	Chemistry								
Hala Hachem (G)	C		University of Florida	Chemistry								
Emma Mulry (G)	C		University of Florida	Chemistry								
Arka Prabha Ray (G)	C		University of Florida	Chemistry								
Mario Rivera (S)	PI	*	Louisiana State University	Chemistry	No other support			P19426	Probing the impact of iron limitation on the metabolome of P. aeruginosa	Biology, Biochemistry, Biophysics	1	19.5
Leo Fontenot (G)	C		Louisiana State University	Chemistry								
Anil Mehta (O)	C		University of Florida	AMRIS								
Thomas Weldeghiorghis (S)	C		Louisiana State University	Chemistry								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Carsten Sievers (S)	PI	*	Georgia Institute of Technology	School of Chemical & Biomolecular Engineering	No other support			P19432	Diffusion of a model sugar through Lewis acidic metal oxides in various solvents	Engineering	1	8.5
James H.P. Collins (P)	C		University of Florida	Biochemistry & Molecular Biology								
Andrew Medford (S)	C		Georgia Institute of Technology	Chemical Engineering								
Sean Najmi (G)	C		Georgia Institute of Technology	Chemical Engineering								
Ryan Lively (S)	PI		Georgia Institute of Technology	School of Chemical & Biomolecular Engineering,	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1836735	P19434	Quantification of liquid diffusion in MOF-based hybrid membranes by high field diffusion NMR	Engineering	1	49.5
Amineh Baniani (G)	C		University of Florida	Chemical Engineering								
Sergey Vasenkov (S)	C		University of Florida	Chemical Engineering								
Jeffrey Rudolf (S)	PI	*	University of Florida	Chemistry	No other support			P19437	Bacterial terpenoids and their biosynthesis	Biology, Biochemistry, Biophysics	1	8.92
Baofu Xu (P)	C		University of Florida	Chemistry								
Jonathan Judy (S)	PI	*	University of Florida	Soil and Water Sciences	No other support			P19466	Evaluating the Nature of Phosphorus Entering, Within and Leaving Everglades Stormwater Treatment Areas (STAs)	Chemistry	1	1.5
A. Buchanan (G)	C		University of Florida	Ag - Soil and Water Science								
Michael Harris (S)	PI	*	University of Florida	Chemistry	No other support			P19469	ML-HARRIS-001: Analysis of RNA induced protein folding during ribonucleoprotein assembly	Biology, Biochemistry, Biophysics	1	3
Matthew Eddy (S)	C		University of Florida	Chemistry								
Joanna Long (S)	PI		University of Florida	Biochemistry & Molecular Biology	No other support			P19543	Maintenance: Routine maintenance of existing equipment (formerly P09510 and P17541)	Biology, Biochemistry, Biophysics	1	33.67
James H.P. Collins (P)	C		University of Florida	Biochemistry & Molecular Biology								
Thomas Mareci (S)	C		University of Florida	Biochemistry and Molecular Biology								
Anil Mehta (O)	C		University of Florida	AMRIS								
James Rocca (S)	C		University of Florida	AMRIS Affiliated Faculty & Staff								
Jens Rosenberg (S)	C		National High Magnetic Field Laboratory	NMR								
Huadong Zeng (S)	C		University of Florida	AMRIS Affiliated Faculty & Staff								
									Total Proposals: 31		Experiments: 31	Days: 1,316.00

2. DC Field Facility

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Dmitry Smirnov (S)	PI	National High Magnetic Field Laboratory	Instrumentation & Operations	No other support			P09593	Testing new probes and techniques for high-field optical magnetospectroscopy	Magnets, Materials	1	7
Yuxuan Jiang (P)	C	National High Magnetic Field Laboratory	CMS								
Zhengguang Lu (G)	C	National High Magnetic Field Laboratory	Physics								
Seongphill Moon (G)	C	National High Magnetic Field Laboratory	Physics								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Dmitry Semenov (T)	C	National High Magnetic Field Laboratory	DC Field								
Dmytro Abraimov (S)	PI	National High Magnetic Field Laboratory	The Applied Superconductivity Center	NSF	DMR - Division of Materials Research	DMR1644779	P13640	Angular dependence of Jc for modern ReBCO Coated Conductors at high magnetic fields	Magnets, Materials	1	4.73
Griffin Bradford (O)	C	National High Magnetic Field Laboratory	Applied Superconductivity Center								
Ashleigh Francis (T)	C	National High Magnetic Field Laboratory	ASC								
Jan Jaroszynski (S)	C	National High Magnetic Field Laboratory	CMS								
David Larbalestier (S)	C	National High Magnetic Field Laboratory	ASC								
Tim Murphy (S)	PI	National High Magnetic Field Laboratory	Operations	No other support			P14838	Testing of Resistive and Hybrid magnets and power supplies in the DC Field Facility	Magnets, Materials	1	-0.05
Scott Bole (S)	C	National High Magnetic Field Laboratory	MS&T								
William Brey (S)	C	National High Magnetic Field Laboratory	NMR								
Bryon Dalton (S)	C	National High Magnetic Field Laboratory	Instrumentation								
Larry Gordon (T)	C	National High Magnetic Field Laboratory	Instrumentation								
Scott Hannahs (S)	C	National High Magnetic Field Laboratory	Instrumentation								
Ilya Litvak (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Ju-Hyun Park (S)	C	National High Magnetic Field Laboratory	Instrumentation & Operations, User Support								
Julia Smith (S)	C	National High Magnetic Field Laboratory	DC Field								
Jack Toth (S)	C	National High Magnetic Field Laboratory	MS&T								
Haidong Zhou (S)	PI	University of Tennessee, Knoxville	Physics and Astronomy	NSF	DMR - Division of Materials Research	DMR1350002	P14982	Studies on low temperature physical properties of new quantum spin liquid and spin-orbital liquid candidates	Condensed Matter Physics	1	7
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department								
Qing Huang (G)	C	University of Tennessee, Knoxville	Physics								
Kyle Noordhoek (U)	C	University of Tennessee, Knoxville	Physics and Astronomy								
Chengkun Xing (G)	C	University of Tennessee, Knoxville	Physics								
Han Zhang (P)	C	University of Tennessee	Physics								
Chun Ning (Jeanie) Lau (S)	PI	Ohio State University	Department of Physics and Astronomy	DOE	OC - BES	SC0020187	P16071	Symmetry-broken Quantum Hall States and Phase Diagrams in 2D Materials	Condensed Matter Physics	2	13.17
Emilio Codecido (G)	C	Ohio State University	Physics								
Xueshi Gao (G)	C	Ohio State University	Physics								
Dmitry Shcherbakov (G)	C	Ohio State University	Physics								
Dmitry Smirnov (S)	C	NHMFL	Instrumentation & Operations								
Haidong Tian (G)	C	Ohio State University	Physics								
Jiawei Yang (G)	C	University of California, Riverside	Physics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Zhigang Jiang (S)	PI	Georgia Institute of Technology	School of Physics	DOE	Office of Science - BES – Basic Energy Sciences	DE-FG02-07ER46451	P16079	Magneto-infrared Spectroscopy Study of Emerging Topological Materials with Layered Structures	Condensed Matter Physics	2	17
Yuxuan Jiang (P)	C	NHMFL	CMS								
Dmitry Smirnov (S)	C	National High Magnetic Field Laboratory	Instrumentation & Operations								
Tianhao Zhao (G)	C	Georgia Institute of Technology	School of Physics								
Irina Drichko (S)	PI	Ioffe Physical-Technical Institute of the Russian Academy of Sciences	Physics of Semiconductors and Dielectrics	Russian Academy of Sciences	Other	Program 'Physics and technology of nanostructures, nanoelectronics and diagnostics' of the Presidium of RAS	P16087	High-frequency magnetotransport in high-mobility n-AlGaAs/GaAs/AlGaAs heterostructures with wide quantum well near the filling factor with even denominators, ½ and others: Acoustic studies	Condensed Matter Physics	1	21
Loren Pfeiffer (S)	C	Princeton University	Electrical Engineering								
Ivan Smirnov (S)	C	Ioffe Physical-Technical Institute of the Russian Academy of Sciences	Physics of Semiconductors and Dielectrics								
Alexey Suslov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Ken West (S)	C	Princeton University	Princeton Institute for the Science and Technology of Materials								
Dmitry Smirnov (S)	PI	National High Magnetic Field Laboratory	Instrumentation & Operations	DOE	Office of Science - BES – Basic Energy Sciences	DE- FG02-07ER46451	P16234	Electrical and magnetic field control of optical processes in mono- and few-layer transition metal dichalcogenides	Condensed Matter Physics	1	1.29
Yuxuan Jiang (P)	C	National High Magnetic Field Laboratory	CMS								
Zhigang Jiang (S)	C	Georgia Institute of Technology	School of Physics								
Zhengguang Lu (G)	C	NHMFL	Physics								
Taichi Terashima (S)	PI	National Institute for Materials Science	Quantum Transport Properties Group	NIMS	Non US Government Lab		P16248	Fermi surface studies of iron-based superconductors and other exotic materials	Condensed Matter Physics	1	5
David Graf (S)	C	NHMFL	DC Field CMS								
Hishiro Hirose (P)	C	National Institute for Materials Science	Nano-quantum Transport Group								
Naoki Kikugawa (S)	C	National Institute for Materials Science	Superconducting Properties Unit								
Philip Kim (S)	PI	Harvard University	Department of Physics	DOE	OS - BES	DOE DE-SC0012260	P16250	Unconventional quantum Hall effect in 2D material Heterostructures	Condensed Matter Physics	1	7
Laurel Anderson (G)	C	Harvard University	Physics								
Kristiaan De Greve (P)	C	Harvard University	Physics								
Rebecca Engelke (G)	C	Harvard University	Physics								
Ryan Gelly (G)	C	Harvard University	Physics								
Onder Gul (P)	C	Harvard University	Department of Physics								
Danial Haei Najafabadi (U)	C	Harvard University	Applied Physics								
Zeyu Hao (G)	C	Harvard University	Physics								
Katie Huang (G)	C	Harvard University	Physics								
Luis Jauregui (P)	C	Harvard University	College of Science								
Andrew Joe (G)	C	Harvard University	Physics								
Jia Li (S)	C	Brown University	Department of Physics								
Xiaomeng Liu (G)	C	Harvard University	Physics								
Zhengguang Lu (G)	C	NHMFL	Physics								
Joon Young Park (P)	C	Harvard University	Physics								
Kateryna Pistunova (G)	C	Stanford University	Physics								
Yuval Ronen (P)	C	Harvard University	Physics								
Giovanni Scuri (G)	C	Harvard University	Physics								
Jiho Sung (P)	C	Harvard university	Physics								
Andrey Sushko (G)	C	Harvard University	Physics								
Thomas Werkmeister (G)	C	Harvard University	Applied Physics								
Hyobin Yoo (P)	C	Harvard University	Physics								
Jonathan Zauberman (G)	C	Harvard University	Physics								
Xilin Zhou (U)	C	Harvard University	Physics								
You Zhou (P)	C	Harvard University	Department of Physics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Joseph Checkelsky (S)	PI	Massachusetts Institute of Technology	Physics	NSF	DMR - Division of Materials Research	DMR1554891	P16258	High Field Studies of Magnetic Weyl Semimetals	Condensed Matter Physics	2	13.94
Aravind Devarakonda (G)	C	Massachusetts Institute of Technology	Physics	MIT	Other						
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Minyong Han (G)	C	Massachusetts Institute of Technology	Physics								
Hisashi Inoue (P)	C	Massachusetts Institute of Technology	Physics								
Takashi Kurumaji (P)	C	Massachusetts Institute of Technology	Physics								
Takehito Suzuki (P)	C	Massachusetts Institute of Technology	Department of Physics								
Joshua Wakefield (G)	C	Massachusetts Institute of Technology	Physics								
Linda Ye (G)	C	Massachusetts Institute of Technology	Physics								
Junbo Zhu (G)	C	Massachusetts Institute of Technology	Physics								
Fernando Machado (S)	PI	Federal University of Pernambuco	Physics	CNPq	Other		P16271	Thermal Conductivity Of Yig At High-Applied Magnetic Fields And Low Temperatures	Condensed Matter Physics	1	5.47
Luis Balicas (S)	C	National High Magnetic Field Laboratory	Condensed Matter Experiment								
Alimamy Bangura (S)	C	National High Magnetic Field Laboratory	CMS								
Danilo Ratkovski (G)	C	Federal University of Pernambuco	Departamento de Fisica								
Mike Sumption (S)	PI	Ohio State University	CSMM, MSE	DOE	Office of Science - HEP – High Energy Physics	DE-SC0013849	P16278	High Field Transport Properties in ternary and Binary APC type Nb3Sn Conductors	Magnets, Materials	1	5.8
Mattia Ortino (G)	C	Technical University of Wien	Low Temperature and Superconductivity Group	DOE	Office of Science - HEP – High Energy Physics	DE-SC0017755					
Jacob Rochester (G)	C	Ohio State University	Materials Science								
Xingchen Xu (S)	C	Fermi National Accelerator Laboratory	Magnet System								
David Graf (S)	PI	National High Magnetic Field Laboratory	DC Field CMS	No other support			P16282	Study of the Electronic Structures of Doped Dirac Metals and Topological Insulators	Condensed Matter Physics	1	4
Ryan Baumbach (S)	C	National High Magnetic Field Laboratory	CMS								
Theo Siegrist (S)	C	National High Magnetic Field Laboratory	Chemical and Biomedical Engineering								
Kaya Wei (P)	C	National High Magnetic Field Laboratory	CMS								
Louis Taillefer (S)	PI	University of Sherbrooke	Physics	CFI, NSERC, Canada Research Chair	Other		P16283	Transport studies of the pseudogap critical point of cuprates	Condensed Matter Physics	1	4.07
Jordan Baglo (P)	C	University of Sherbrooke	Department of Physics								
Nicolas Doiron-Leyraud (S)	C	University of Sherbrooke	Physics								
Adrien Gourgout (P)	C	University of Sherbrooke	Physics								
Gaël Grissonnanche (G)	C	University of Sherbrooke	Physics								
Etienne Lefrançois (G)	C	University of Sherbrooke	Physics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Mansour Shayegan (S)	PI	Princeton University	Department of Electrical Engineering	NSF	DMR	DMR1157490	P16287	Probing Exotic Phases of Interacting Electrons in Low-dimensional Systems	Condensed Matter Physics	1	19
Hao Deng (G)	C	Princeton University	Electrical Engineering								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Md Shafayat Hossain (P)	C	Princeton University	Physics								
Meng Ma (G)	C	Princeton University	Electrical Engineering								
Siddharth Kumar Singh (G)	C	Princeton University	Electrical Engineering								
Pranav Thekke Madathil (G)	C	Princeton University	Electrical Engineering								
Kevin Villegas Rosales (G)	C	Princeton University	Electrical Engineer								
Shanti Deemyad (S)	PI	University of Utah	Physics and Astronomy	DOE	Office of Science - EFRC - Energy Frontier Research Centers	DE-SC0020340	P17344	Fermi Surface of Lithium Isotopes	Condensed Matter Physics	1	4.3
Neil Ashcroft (S)	C	Cornell University	Physics								
Tushar Bhowmick (G)	C	University of Utah (UT)	Physics and Astronomy								
Stanimir Bonev (S)	C	Lawrence Livermore National Laboratory	Physics Division								
William Coniglio (S)	C	National High Magnetic Field Laboratory	A1								
Sabri Elatresh (P)	C	Cornell University	chemistry								
Audrey Grockowiak (S)	C	National High Magnetic Field Laboratory	DC Field/CMS								
Roald Hoffmann (S)	C	Cornell University	Dept. of Chemistry and Chemical Biology								
Stan Tozer (S)	C	National High Magnetic Field Laboratory	Physics								
Sergei Zvyagin (S)	PI	Helmholtz-Zentrum Dresden-Rossendorf	EPR	Deutsche Forschungs-gemeinschaft	Non US Foundation	ZV 6/2-2	P17345	Spin dynamics and magnetic properties of spin systems with competing magnetic interactions	Condensed Matter Physics	1	7
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Hidekazu Tanaka (S)	C	Tokyo Institute of Technology	Physics								
Christianne Beekman (S)	PI	National High Magnetic Field Laboratory	Physics	NSF	CAREER - Faculty Early Career Development Program	1847887	P17363	Frustrated magnetism in vanadium oxides	Condensed Matter Physics	1	7
Sangsoo Kim (G)	C	Florida State University	Physics								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Christie Thompson (G)	C	Florida State University	Materials Science and Engineering								
Biwen Zhang (G)	C	Florida State University	Physics								
Mykhaylo Ozerov (S)	PI	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS	No other support			P17373	FTIR magneto-spectroscopy in the NHMFL DC facility: new developments, tests and optimization of experimental protocols	Magnets, Materials	1	3.61
Dmitry Semenov (T)	C	National High Magnetic Field Laboratory	DC Field								
Dmitry Smirnov (S)	C	National High Magnetic Field Laboratory	Instrumentation & Operations								
Sara Haravifard (S)	PI	Duke University	Department of Physics	NSF	DMR - Division of Materials Research	DMR1828348	P17377	New Plateaus in the Doped Spin Dimer System SrCu(2-x)Mgx(BO3)2 at High Fields	Condensed Matter Physics	1	7
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department	Duke University	US College and University	William M Fairbank Chair in Physics					
Sachith Dissanayake (P)	C	Duke University	Physics								
Zhenzhong Shi (P)	C	Duke University	Department of Physics								
Joan Cano (S)	PI	University of Valencia	Instituto de Ciencia Molecular	No other support			P17379	Building quantum gates and quantum computer by assembling mononuclear single-molecule magnets based on Co(II) and other 3d transition metal ions. In pursuit of new physics in spintronics	Chemistry	1	7
Miguel Julve (S)	C	University of Valencia	Inorganic Chemistry								
Jurek Krzystek (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Francesc Lloret (S)	C	University of Valencia	Institut de Ciència Molecular (ICMOL).								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Julia Vallejo (G)	C	University of Valencia	Chemistry								
Marta Viciano-Chumillas (P)	C	University of Valencia	Instituto de Ciencia Molecular								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Gianluigi Veglia (S)	PI		University of Minnesota, Twin Cities	BMBB	NIH	NIGMS - National Institute of General Medical Sciences	GM064742	P17438	NMR Structural Analysis of Sarcoplasmic Reticulum Proteins in Membranes	Biology, Biochemistry, Biophysics	1	5
Riqiang Fu (S)	C		National High Magnetic Field Laboratory	NMR								
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								
Tata Gopinath (P)	C		University of Minnesota, Twin Cities	Biochemistry								
Erik Larsen (G)	C		University of Minnesota, Twin Cities	Chemistry								
Sarah Nelson (G)	C		University of Minnesota, Twin Cities	Biochemistry, Molecular Biology, and Biophysics								
Joana Paulino (P)	C		National High Magnetic Field Laboratory	CIMAR								
Songlin Wang (P)	C		University of Minnesota, Twin Cities	Biochemistry, Molecular Biology, and Biophysics								
Xiaoling Wang (P)	C		University of California, Santa Barbara (UC Santa Barbara, UCSB)	Physics								
Rongfu Zhang (P)	C		National High Magnetic Field Laboratory	NHMFL								
Enrique Colacio (S)	PI	*	University of Granada	Inorganic Chemistry	No other support			P17454	High-frequency and -field EPR of 2D Co(II) SMMs with different hexacoordinated Co(II) ions.	Chemistry	1	7
Jurek Krzystek (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Lu Li (S)	PI		University of Michigan	Physics	NSF	DMR - Division of Materials Research	DMR1707620	P17469	Spin-orbit-coupled Correlated Metals	Condensed Matter Physics	2	9
Kuan-Wen Chen (P)	C		University of Michigan	Physics								
Lu Chen (G)	C		University of Michigan	Physics								
William Coniglio (S)	C		National High Magnetic Field Laboratory	A1								
Bernhard Keimer (S)	C		Max Planck Institute for Solid State Research, Stuttgart	Solid State Spectroscopy								
David Mandrus (S)	C		University of Tennessee, Knoxville	Materials Science and Engineering								
Dmitri Mihaliov (G)	C		University of Michigan	Applied Physics								
John Singleton (S)	C		National High Magnetic Field Laboratory	Physics								
Colin Tinsman (G)	C		University of Michigan	Physics								
Ziji Xiang (P)	C		University of Michigan	Physics								
Jun Zhu (S)	PI		Pennsylvania State University	Physics	NSF	DMR - Division of Materials Research	DMR1506212	P17473	Probing quasi-particle charge and statistics in the quantum Hall and fractional quantum Hall regimes of bilayer graphene	Condensed Matter Physics	1	7
Hailong Fu (P)	C		Pennsylvania State University	Physics								
Ke Huang (G)	C		Pennsylvania State University	Physics								
Dragana Popovic (S)	PI		NHMFL	Condensed Matter Science / Experimental	No other support			P17479	Transport Studies of Magnetic-Field-Tuned Phase Transitions in Cuprates	Condensed Matter Physics	4	35.65
Paul Baity (G)	C		NHMFL	Physics	NSF	DMR - Division of Materials Research	DMR1707785					
Emilia Morosan (S)	C		Rice University	Physics and Astronomy								
Shimpei Ono (S)	C		Central Research Institute of Electric Power Industry	Materials Science Research Laboratory								
Bal Pokharel (G)	C		NHMFL	Physics								
Helene Raffy (S)	C		University of Paris-Sud	Laboratoire de Physique des Solides								
Pratap Raychaudhuri (S)	C		Tata Institute of Fund. Research	Condensed Matter Physics and Materials Science								
Takao Sasagawa (S)	C		Tokyo Institute of Technology	Materials and Structures Laboratory								
Zhenzhong Shi (P)	C		Duke University	Department of Physics								
Lily Stanley (G)	C		NHMFL	Physics and CMS, NHMFL								
Jasminka Terzic (P)	C		NHMFL	CMS								
Yuxin Wang (G)	C		Florida State University	CMS								

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Ayyalusamy Ramamoorthy (S)	PI		University of Michigan	Chemistry & Biophysics	NIH	NIGMS - National Institute of General Medical Sciences	GM084018	P17486	Solid-State NMR Experiments on Magnetically-Aligned Polymer Macro-Nanodiscs	Biology, Biochemistry, Biophysics	1	4
Riqiang Fu (S)	C		National High Magnetic Field Laboratory	NMR								
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								
Thirupathi Ravula (P)	C		University of Michigan	Chemistry								
Tim Cross (S)	PI	*	National High Magnetic Field Laboratory	NHMFL/Chemistry & Biochemistry	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI119178	P17493	Mycobacterium tuberculosis Divisome: Insights on protein structure and protein-protein interaction of important drug targets	Biology, Biochemistry, Biophysics	1	5
Cristian Escobar (P)	C		National High Magnetic Field Laboratory	IMB								
Joana Paulino (P)	C		National High Magnetic Field Laboratory	CIMAR								
Huajun Qin (T)	C		Florida State University	Chemistry & Biochemistry								
Yiseul Shin (G)	C		Florida State University	Chemistry								
Joshua Taylor (U)	C		Florida State University	Chemistry & Biochemistry								
Rongfu Zhang (P)	C		National High Magnetic Field Laboratory	NHMFL								
Aaron Rossini (S)	PI	*	Iowa State University	Chemistry	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1916809	P17500	Enhancing the Resolution of 1H Solid-State NMR Spectra With Fast MAS and High Magnetic Fields	Chemistry	1	4
Kuizhi Chen (P)	C		National High Magnetic Field Laboratory	NMR								
Rick Dorn (G)	C		Iowa State University	Chemistry								
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C		National High Magnetic Field Laboratory	CIMAR/NMR								
Yining Huang (S)	PI		University of Western Ontario	Chemistry	NSERC	Other Non US Federal Agency		P17504	O-17 solid-state NMR of metal-organic frameworks	Chemistry	1	5
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C		National High Magnetic Field Laboratory	CIMAR/NMR								
Vinicius Martins (G)	C		University of Western Ontario	Chemistry								
Jun Sung Kim (S)	PI		Pohang University of Science and Technology	Physics	National Research Foundation of Korea	Non US Foundation		P17521	Exotic topological transport induced by spin/pseudospin texture at high magnetic fields	Condensed Matter Physics	1	5.46
Joonyoung Choi (G)	C		Kyungpook National University	Physics								
Min Hyuk Choi (G)	C		Pohang University of Science and Technology	Physics								
Ho Seong Jeon (G)	C		Pohang University of Science and Technology	Physics								
YounJung Jo (S)	C		Kyungpook National University	Physics								
Woun Kang (S)	C		Ewha Womans University	Department of Physics								
Hoil Kim (G)	C		Pohang University of Science and Technology	Physics								
Jong Mok Ok (G)	C		Oak Ridge National Laboratory	Physics								

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Julia Smith (S)	PI	National High Magnetic Field Laboratory	DC Field	No other support			P17594	Enhancement of the Infrastructure & Instrumentation of the DC Field Facility	Magnets, Materials	4	3.35
Alimamy Bangura (S)	C	National High Magnetic Field Laboratory	CMS	NSF	DMR - Division of Materials Research	DMR1644779					
William Brey (S)	C	National High Magnetic Field Laboratory	NMR								
William Coniglio (S)	C	National High Magnetic Field Laboratory	A1								
Kevin Gamble (O)	C	National High Magnetic Field Laboratory	Facilities								
Scott Hannahs (S)	C	National High Magnetic Field Laboratory	Instrumentation								
Michael Hicks (T)	C	National High Magnetic Field Laboratory	Instrumentation & Operations								
Tra Hunter (O)	C	National High Magnetic Field Laboratory	Facilities								
John Kynoch (S)	C	National High Magnetic Field Laboratory	Facilities								
Ilya Litvak (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Tim Murphy (S)	C	National High Magnetic Field Laboratory	Operations								
Joel Piotrowski (T)	C	National High Magnetic Field Laboratory	Instrumentation & Operations								
Andy Powell (S)	C	National High Magnetic Field Laboratory	Operations								
Eric Stiers (O)	C	National High Magnetic Field Laboratory	DC Field								
Sujana Sri Venkat Uppalapati (O)	C	National High Magnetic Field Laboratory	DC Field Facility								
Marshall Wood (S)	C	National High Magnetic Field Laboratory	Facilities								
Zhehong Gan (S)	PI	National High Magnetic Field Laboratory	NHMFL	No other support			P17597	Development of 1.5 GHz NMR using 36T Series-Connected-Hybrid (SCH) Magnet	Magnets, Materials	1	5
William Brey (S)	C	National High Magnetic Field Laboratory	NMR								
Kuizhi Chen (P)	C	National High Magnetic Field Laboratory	NMR								
Po-Hsiu Chien (G)	C	Florida State University	Chemistry and Biochemistry								
Tim Cross (S)	C	National High Magnetic Field Laboratory	NHMFL/Chemistry & Biochemistry								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Ilya Litvak (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Joana Paulino (P)	C	National High Magnetic Field Laboratory	CIMAR								
Jeffrey Schiano (S)	C	Pennsylvania State University	Electrical Engineering								
Alina Bienko (S)	PI	University of Wroclaw	Faculty of Chemistry	Wroclaw University, Poland	Non US College and University		P17642	Search for New Single-Molecule Magnets: High-Field EPR Studies on High-Spin Complexes of d-Electron Metals – Co(II), Ni(II), Re(IV)	Chemistry	2	10
Andrew Ozarowski (S)	C	National High Magnetic Field Laboratory	EMR								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Sebastian Stoian (S)	C	University of Idaho	Chemistry								
Chiara Tarantini (S)	PI	National High Magnetic Field Laboratory	Applied Superconductivity Center	DOE	Office of Science - HEP – High Energy Physics	DE-SC0012083	P17643	Characterization of state-of-the-art and experimental Nb3Sn wires	Condensed Matter Physics	2	10.75
Shreyas Balachandran (P)	C	Florida State University	Applied Superconductivity Center	CERN	Other						
Jan Jaroszynski (S)	C	National High Magnetic Field Laboratory	CMS								
Nawaraj Paudel (G)	C	Florida State University	Physics								

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Yasuyuki Nakajima (S)	PI	University of Central Florida	Physics	University of Central Florida	US College and University		P17651	Magnetic and thermal properties in topological phases of matter	Condensed Matter Physics	1	5.46
Charuni Dissanayake (G)	C	University of Central Florida	Physics								
Riffat Munir (G)	C	University of Central Florida	Physics								
K A M Hasan Siddiquee (G)	C	University of Central Florida	Physics								
Chun Hung Lui (S)	PI	University of California, Riverside	Physics	University of California, Riverside	US College and University		P17665	Probing the high-order few-body states in two-dimensional materials by magneto-optical spectroscopy	Condensed Matter Physics	1	6
Mashael Altaiary (G)	C	UC, Riverside	Physics and Astronomy								
Erfu Liu (P)	C	UC, Riverside a, Riverside	Astronomy & Physics								
Zhengguang Lu (G)	C	NHMFL	Physics								
Dmitry Smirnov (S)	C	NHMFL	Instrumentation & Operations								
Jeremiah van Baren (G)	C	University of California, Riverside	Physics								
Matthew Wilson (G)	C	University of California, Riverside	Physics and Astronomy								
Kin Fai Mak (S)	PI	Pennsylvania State University	Physics	DOD	ONR - Office of Naval Research	N00014-18-1-2368	P17668	Investigating van der Waals superconducting heterostructures in the high-field, paramagnetic limit	Condensed Matter Physics	3	13.8
Kaifei Kang (G)	C	Cornell University	Applied and engineering physics								
Tingxin Li (P)	C	Cornell University	AEP								
Jie Shan (S)	C	Pennsylvania State University	Physics								
Dmitry Smirnov (S)	C	NHMFL	Instrumentation & Operations								
Egon Sohn (G)	C	Cornell University	Applied Engineering and Physics								
Jiacheng Zhu (G)	C	Cornell University	Applied and Engineering Physics								
Huiqiu Yuan (S)	PI	Zhejiang University	Physics Department	NSFC	Non US Foundation	No. U1632275	P17765	Evolution of the electronic structure in novel quantum critical systems	Condensed Matter Physics	1	4
Feng Du (G)	C	Zhejiang University	Physics								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Bin Shen (G)	C	Zhejiang University	Physics								
Michael Smidman (P)	C	Zhejiang University	Center for Correlated Matter /Physics								
An Wang (G)	C	Zhejiang University	Physics								
Ziling Xue (S)	PI	University of Tennessee, Knoxville	Chemistry	NSF	CHE - Chemistry	CHE1900296	P17767	Investigating Molecular Magnetism by Magneto-Far-IR Spectroscopy	Chemistry	3	21
Alexandria Bone (G)	C	University of Tennessee, Knoxville	Chemistry								
Adam Hand (G)	C	University of Tennessee, Knoxville	Chemistry								
Brian Kettell (G)	C	University of Tennessee Space Institute	Chemistry								
Duncan Moseley (G)	C	University of Tennessee, Knoxville	Chemistry								
Mykhaylo Ozerov (S)	C	NHMFL	Condensed Matter Science, DC Field CMS								
Dmitry Smirnov (S)	C	NHMFL	Instrumentation & Operations								
Pagnareach Tin (G)	C	University of Tennessee, Knoxville	Chemistry								
Chelsea Widener (G)	C	University of Tennessee, Knoxville	Chemistry								
Minhyea Lee (S)	PI	University of Colorado, Boulder	Physics	University of Colorado Boulder	US College and University		P17772	Probing novel magnetism in spin-orbit coupled systems	Condensed Matter Physics	1	7
Gang Cao (S)	C	University of Colorado, Boulder	Department of Physics.								
Kwang Yong Choi (S)	C	Chung Ang University	Department of Physics								
Ian Leahy (G)	C	University of Colorado, Boulder	Physics								
Tyrel McQueen (S)	C	Johns Hopkins University	Chemistry and Physics and Astronomy								
Christopher Pocs (G)	C	University of Colorado, Boulder	Physics								
Peter Siegfried (G)	C	University of Colorado, Boulder	Physics								

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Eun Sang Choi (S)	PI	National High Magnetic Field Laboratory	Physics Department	No other support			P17780	Magnetothermal conductivity studies on breathing pyrochlore magnets	Condensed Matter Physics	1	6
Hongwoo Baek (S)	C	National High Magnetic Field Laboratory	DC field								
Rabindranath Bag (P)	C	Duke University	Physics								
Sachith Dissanayake (P)	C	Duke University	Physics								
Matthew Ennis (G)	C	Duke University	Physics								
Sara Haravifard (S)	C	Duke University	Department of Physics								
Hongcheng Lu (P)	C	Duke University	Physics								
Zhenzhong Shi (P)	C	Duke University	Department of Physics								
William Steinhardt (G)	C	Duke University	Physics								
Lalit Yadav (G)	C	Duke University	Physics								
Sabyasachi Sen (S)	PI	University of California, Davis	Chemical Engineering and Materials Science	NSF	DMR - Division of Materials Research	DMR1855176	P17811	Investigation of the atomistic basis of structural relaxation and viscous flow in supercooled chalcogenide liquids by high field dynamical NMR spectroscopy	Condensed Matter Physics	1	4
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Yiqing Xia (G)	C	University of California, Davis	Materials Science								
Weidi Zhu (G)	C	University of California, Davis	Materials Science & Engineering								
Xiaodong Xu (S)	PI	University of Washington	Physics	DOE	Office of Science - BES – Basic Energy Sciences	DE-SC0019443	P17854	pressure tuning magnetic properties of van der Waals magnets	Condensed Matter Physics	1	23.76
Jiun-Haw Chu (S)	C	University of Washington	Physics								
Zaiyao Fei (P)	C	University of Washington	Physics								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Tiancheng Song (G)	C	University of Washington	Physics								
Matthew Yankowitz (S)	C	University of Washington	Physics								
Qi Zhang (P)	C	University of Washington (UW)	Physics and Astronomy								
Hugen Yan (S)	PI	Fudan University	Physics	Fudan University	Non US College and University		P17878	Magneto-optical Spectroscopy of topological semimetals in the quantum limit	Condensed Matter Physics	1	8
Chaoyu Song (G)	C	Fudan University	Physics								
Yunkun Yang (G)	C	Fudan University	Dept. of Physics								
Minhao Zhao (G)	C	Fudan University	Physics								
Yoram Dagan (S)	PI	Tel-Aviv University	School of Physics and Astronomy	Tel Aviv University	Non US Foundation	382/17	P17882	TaS2 exotic phases of Quantum Spin Liquid and P-wave superconductivity	Condensed Matter Physics	1	5.93
Shay Sandik (U)	C	Tel-Aviv University	Physics								
Itai Silber (G)	C	Tel-Aviv University	Physics								
Christianne Beekman (S)	PI	National High Magnetic Field Laboratory	Physics	NSF	CAREER - Faculty	1847887	P17889	The effect of strain and confinement on spin ice physics in pyrochlore titanate thin films.	Condensed Matter Physics	1	7
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Sangsoo Kim (G)	C	Florida State University	Physics								
Ryan Baumbach (S)	PI	National High Magnetic Field Laboratory	CMS	NSF	DMR - Division of Materials Research	DMR1644779	P17894	Investigation of dual nature f-electron intermetallics using high magnetic fields	Condensed Matter Physics	1	2.74
Jorge Galeano Cabral (G)	C	Florida State University	College of Engineering								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Eliana Karr (U)	C	Florida State University	MagLab								
Olatunde Oladehin (G)	C	Florida State University	Physics								
Kaya Wei (P)	C	NHMFL	CMS								
John Durrell (S)	PI	University of Cambridge	Engineering Department	EPSRC	Non US Council		P17896	High Field Trapping in Reinforced Bulk Superconductors	Magnets, Materials	1	4.06
David Cardwell (S)	C	University of Cambridge	Engineering Department								
Tony Dennis (T)	C	University of Cambridge	Engineering								
Eric Hellstrom (S)	C	NHMFL	Applied Superconductivity Center								
Jan Jaroszynski (S)	C	NHMFL	CMS								
Devendra Namburi (P)	C	University of Cambridge	Engineering								
Jan Srpcic (G)	C	University of Cambridge	Engineering								

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Seungyong Hahn (S)	PI	National High Magnetic Field Laboratory	Applied Superconductivity Center, Mechanical Engineering	NSF	DMR - Division of Materials Research	DMR1644779	P17900	No-Insulation Type High Temperature Superconductor Winding Techniques for All-Superconducting >30-T DC User Magnets	Magnets, Materials	1	3.61
Dmytro Abraimov (S)	C	National High Magnetic Field Laboratory	The Applied Superconductivity Center								
Griffin Bradford (O)	C	National High Magnetic Field Laboratory	Applied Superconductivity Center								
Xinbo Hu (G)	C	National High Magnetic Field Laboratory	ASC								
Jan Jaroszynski (S)	C	National High Magnetic Field Laboratory	CMS								
Kwanglok Kim (O)	C	National High Magnetic Field Laboratory	Applied Superconductivity Center								
Kwangmin Kim (O)	C	National High Magnetic Field Laboratory	Applied Superconductivity Center								
Krzysztof Gofryk (S)	PI	Idaho National Laboratory	Fuel Performance & Design	DOE	Office of Science - ECRP - Early Career Research Program	K.Gofryk's early career award	P17910	High Field Static & Dynamic Crystal Lattice Studies of Piezomagnetic UO2 and related compounds	Condensed Matter Physics	1	3.94
Carolina Corvalan Moya (S)	C	Los Alamos National Laboratory	MPA-MAG								
Xiaxin Ding (P)	C	Idaho National Laboratory	NST								
Marcelo Jaime (S)	C	National High Magnetic Field Laboratory	Physics								
alexey kovalev (S)	C	National High Magnetic Field Laboratory	CMS								
Shivani Sharma (P)	C	National High Magnetic Field Laboratory	CMS								
Theo Siegrist (S)	C	National High Magnetic Field Laboratory	Chemical and Biomedical Engineering								
Julia Smith (S)	C	National High Magnetic Field Laboratory	DC Field								
Alexey Suslov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Venkat Selvamanickam (S)	PI	University of Houston	Mechanical Engineering	DOE	Office of Science - HEP – High Energy Physics	DE-SC0015983	P17917	Critical current characterization of Symmetric Tape Round (STAR) REBa2Cu3Ox wires at 4 K and very high magnetic fields	Magnets, Materials	1	5.91
Eduard Galstyan (S)	C	University of Houston	Texas Center for Superconductivity								
Soumen Kar (S)	C	University of Houston	Mechanical Engineering								
Mehdi Kochat (G)	C	University of Houston	Mechanical engineering								
Liang Wu (S)	PI	University of Pennsylvania	Physics and Astronomy	VSP			P17918	Identify a possible quantum spin liquid phase in RuCl3 above 7 Tesla	Condensed Matter Physics	3	14.7
Xingyue Han (G)	C	University of Pennsylvania	Physics and Astronomy								
Yuxuan Jiang (P)	C	NHMFL	CMS								
David Mandrus (S)	C	University of Tennessee, Knoxville	Materials Science and Engineering								
Stephen McGill (S)	C	NHMFL	Condensed Matter Science								
Stephen Nagler (S)	C	Oak Ridge National Laboratory									
Mykhaylo Ozerov (S)	C	NHMFL	Condensed Matter Science, DC Field CMS								
Gang Wu (S)	PI	Queen's University at Kingston	Chemistry	NSERC of Canada	Non US Council		P17926	Probing the hydrogen nuclear wavefunction in OHO low-barrier hydrogen bonds by 1H-17O double resonance NMR	Chemistry	1	5
Zhehong Gan (S)	C	NHMFL	NHMFL								
Ivan Hung (S)	C	NHMFL	CIMAR/NMR								
Nicholas Butch (S)	PI	National Institute of Standards and Technology	NIST Center for Neutron Research	NIST	US Government Lab		P17928	Physical properties of spin triplet superconductor UTe2 in high magnetic field	Condensed Matter Physics	2	9
David Graf (S)	C	NHMFL	DC Field CMS								
I-LIn Liu (G)	C	University of Maryland, College Park	Chemical Physics								
Sheng Ran (S)	C	Washington University in St. Louis	Physics								
Shanta Saha (P)	C	University of Maryland, College Park	Physics								

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Fazel Tafti (S)	PI	Boston College	Physics	NSF	DMR - Division of Materials Research	DMR1708929	P17991	Revealing the Weyl-Kondo physics in a new semimetal	Condensed Matter Physics	1	3
Luis Balicas (S)	C	National High Magnetic Field Laboratory	Condensed Matter Experiment								
Hung-Yu Yang (G)	C	Boston College	Physics								
Paul Goddard (S)	PI	University of Warwick	Department of Physics	European Research Council Consolidator Grant	Non US Council	681260	P17992	Molecule-based quantum magnets in applied pressures	Condensed Matter Physics	1	5.56
Matthew Coak (P)	C	University of Warwick	Department of Physics								
Sam Curley (G)	C	University of Warwick	Physics and Astronomy								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Jamie Manson (S)	C	Eastern Washington University	Chemistry and Biochemistry								
Robert Williams (P)	C	University of Warwick	Dept of Physics								
Matthew Grayson (S)	PI	Northwestern University	Electrical Engineering & Computer Science	NSF	DMR - Division of Materials Research	DMR1729016	P17998	Weak localization as tunneling signature in In2O3/MoO3 polymorphic superlattice	Condensed Matter Physics	1	7
Can Aygen (G)	C	Northwestern University	Electrical and Computer Engineering								
Robert Chang (S)	C	Northwestern University	Materials Science and Engineering								
Qing Shao (G)	C	Northwestern University	Electrical Engineering and Computer Science								
Martin Nikolo (S)	PI	Saint Louis University	Physics	Saint Louis University	US College and University		P18000	Low-temperature, angle-dependent magnetic properties of Ce3Pd20Si6, Ce3Pd20Ge6, and CeB6 crystals	Condensed Matter Physics	3	21
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department								
Dmytry Inosov (S)	C	Technische Universität Dresden	Physics								
Silke Paschen (S)	C	Vienna University of Technology	Physics								
Pavlo Portnichenko (P)	C	Technische Universität Dresden	Physics								
Natalya Yu Shitsevalova (S)	C	Institute for Problems of Material Sciences	Materials Science								
Efrain Rodriguez (S)	PI *	University of Maryland, College Park	Chemistry and Biochemistry	DOE	Office of Science - BES – Basic Energy Sciences	DESC0016434	P18006	Spin Flop Evolution in LiFe_x Mn_{1-x} PO_4	Condensed Matter Physics	1	5.28
Timothy Diethrich (G)	C	University of Maryland, College Park	Chemistry & Biochemistry								
Stephanie Gnewuch (G)	C	University of Maryland, College Park	Chemistry and Biochemistry								
Jacob Tosado (P)	C	University of Maryland, College Park	Chemistry & Biochemistry								
Chris Palmstrom (S)	PI	University of California, Santa Barbara	ECE-Material Science	DOE	MSE - Materials Science and Engineering	DE-SC0014388	P18013	Revealing topological properties of Heusler compounds via magneto-transport under high magnetic field.	Condensed Matter Physics	1	4
Shouvik Chatterjee (P)	C	University of California Santa Barbara	Electrical & Computer Engineering								
Connor Dempsey (G)	C	University of California, Santa Barbara	ECE								
Aranya Goswami (G)	C	University of California, Santa Barbara	ECE								
Hadass Inbar (G)	C	University of California, Santa Barbara	Materials								
Tony McFadden (G)	C	University of California, Santa Barbara	ECE								
Dan Read (S)	C	University of California, Santa Barbara	Materials								
Jia Li (S)	PI	Brown University	Department of Physics	Brown University	US College and University	Li lab start up grant	P18016	Studying correlated electron states in two-dimensional material in high magnetic field with microwave techniques	Condensed Matter Physics	1	7
Jiangxiazi Lin (G)	C	Hong Kong University of Science and Technology	Center for Quantum materials								
Xiaoxue Liu (P)	C	Brown University	Physics department								
Zhi Wang (G)	C	Brown University	Physics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Seng Huat Lee (S)	PI	Pennsylvania State University	Physics	NSF	MIP - Materials Innovation Platform	DMR1539916	P18018	Seeking for Weyl State in Intrinsic Antiferromagnetic Topological Insulator MnBi2Te4 under High Magnetic Fields	Condensed Matter Physics	1	8.62
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Zhiqiang Mao (S)	C	Pennsylvania State University	Department of Physics								
Lujin Min (G)	C	Pennsylvania State University	Department of Physics								
Wei Ning (P)	C	Pennsylvania State University	Department of Physics								
Paul Goddard (S)	PI	University of Warwick	Department of Physics	European Research Council Consolidator Grant	Other	681260	P18021	Phase diagram and quantum criticality of MOs4Sb12 skutterudites under pressure	Condensed Matter Physics	2	20.02
Kathrin Gotze (P)	C	University of Warwick	Department of Physics, Superconductivity and Magnetism group	European Research Council Consolidator Grant	Non US Council	681260					
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Audrey Grockowiak (S)	C	National High Magnetic Field Laboratory	DC Field/CMS								
Pei-Chun Ho (S)	C	California State University, Fresno	Physics								
Brian Maple (S)	C	University of California, San Diego	Inst for Pure & Applied Physical Sciences								
Matthew Pearce (G)	C	University of Warwick	Physics								
John Singleton (S)	C	National High Magnetic Field Laboratory	Physics								
Stan Tozer (S)	C	NHMFL	Physics								
Adam Fiedler (S)	PI	Marquette University	Chemistry	No other support		CHE1900562	P18030	Probing the Magnetic Anisotropy of Co(II) Complexes Featuring Radical Ligands	Chemistry	2	12
John Berry (S)	C	University of Wisconsin, Madison	Department of Chemistry	NSF	CHE - Chemistry	CHE1900562					
Jurek Krzystek (S)	C	NHMFL	Condensed Matter Science								
Mykhaylo Ozerov (S)	C	NHMFL	Condensed Matter Science, DC Field CMS								
Joshua Telser (S)	C	Roosevelt University	Biological, Physical and Health Sciences								
Jiun-Haw Chu (S)	PI	University of Washington	Physics	DOD	US Air Force	FA9550-17-1-0217	P18033	Hc2 of a strained iron-based superconductor	Condensed Matter Physics	1	4.91
Shalinee Chikara (S)	C	NHMFL	CMS, DC Field Facility	Gordon and Betty Moore Foundation	US Foundation	GBMF6759					
Qianni Jiang (G)	C	University of Washington	Physics								
Zhaoyu Liu (P)	C	University of Washington	Department of Physics								
Paul Malinowski (G)	C	University of Washington	Physics								
Joshua Mutch (G)	C	University of Washington	Physics								
Arkady Shehter (S)	C	NHMFL	NHMFL, DC Field Facility								
Pratap Raychaudhuri (S)	PI	Tata Institute of Fund. Research	Condensed Matter Physics and Materials Science	NSF	DMR - Division of Materials Research	DMR1707785	P19110	Exploring quantum vortex liquid phases in very weakly pinned superconducting a-MoGe thin films at low temperatures and high magnetic fields	Condensed Matter Physics	2	21
Somak Basistha (G)	C	Tata Institute of Fundamental Research	Department of Condensed Matter Physics and Materials Science								
Surajit Dutta (G)	C	Tata Institute of Fund. Research	Condensed Matter Physics and Materials Science								
John Jesudasan (T)	C	Tata Institute of Fundamental Research	Dept. Of Condensed Matter Physics and Material Science								
Bal Pokharel (G)	C	NHMFL	Physics								
Dragana Popovic (S)	C	NHMFL	Condensed Matter Science / Experimental								
Jasminka Terzic (P)	C	NHMFL	CMS								
Yuxin Wang (G)	C	Florida State University	CMS								

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Rongying Jin (S)	PI		Louisiana State University	Department of Physics and Astronomy	DOE	EPSCoR - Established Program to Stimulate Competitive Research	DE-SC0012432	P19126	Investigating quantum oscillations in TaSe3 and PtTe2 under high magnetic field	Condensed Matter Physics	1	5.37
Ramakanta Chapai (G)	C		Louisiana State University	Physics and Astronomy								
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Ahmad Ikhwan Us Saleheen (P)	C		Louisiana State University	Physics and Astronomy								
Michael Zudov (S)	PI		University of Minnesota, Twin Cities	School of Physics and Astronomy	DOE	Office of Science - BES – Basic Energy Sciences	46640-SC0002567	P19127	Broken-symmetry states in high Landau levels of GaAs/AlGaAs quantum wells	Condensed Matter Physics	1	7
Kirk Baldwin (S)	C		Princeton University	Electrical Engineering								
XIaojun Fu (G)	C		University of Minnesota, Twin Cities	Physics								
Brendan King (G)	C		University of Minnesota, Twin Cities	Physics								
Michael Manfra (S)	C		Nokia Bell Labs	Semiconductor Physics Research								
Loren Pfeiffer (S)	C		Princeton University	Electrical Engineering								
Ken West (S)	C		Princeton University	Princeton Institute for the Science and Technology of Materials								
Hua-Fen Hsu (S)	PI	*	National Cheng Kung University	Chemistry	No other support			P19128	Magnetic Studies of Bis(thiolatophosphineoxide)cobalt(II) Complexes in Pseudo Tetrahedral Geometry by Advanced Magnetic Resonance Techniques	Chemistry	1	7
Jurek Krzystek (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Haidong Zhou (S)	PI		University of Tennessee, Knoxville	Physics and Astronomy	DOE	Office of Science - BES – Basic Energy Sciences	DE-SC0020254	P19130	Manipulating the strong quantum spin fluctuations in new triangular lattice antiferromagnets with spin-1/2	Condensed Matter Physics	3	21
Eun Sang Choi (S)	C		National High Magnetic Field Laboratory	Physics Department	NSF	DMR - Division of Materials Research	DMR1350002					
Qing Huang (G)	C		University of Tennessee, Knoxville	Physics								
Kyle Noordhoek (U)	C		University of Tennessee, Knoxville	Physics and Astronomy								
Chengkun Xing (G)	C		University of Tennessee, Knoxville	Physics								
Han Zhang (P)	C		University of Tennessee	Physics								
Tom Rosenbaum (S)	PI		University of Chicago	Physics	NSF	DMR - Division of Materials Research	DMR1606858	P19132	Investigation of Pressure Tuned Quantum Phase Transition from Spinon to Electronic Fermi Surface	Condensed Matter Physics	1	7
Stephen Armstrong (G)	C		Caltech	Applied Physics and Materials Science								
Joseph Checkelsky (S)	C		Massachusetts Institute of Technology	Physics								
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Patrick Lee (S)	C		Massachusetts Institute of Technology	Physics Department								
Xiang Li (P)	C		California Institute of Technology	Physics								
Daniel Silevitch (S)	C		University of Chicago	Physics, Math, and Astronomy								
Linda Ye (G)	C		Massachusetts Institute of Technology	Physics								
Shalinee Chikara (S)	PI	*	National High Magnetic Field Laboratory	CMS, DC Field Facility	No other support			P19144	Multiferroic/magnetoelectric behavior by magnetic-field-induced spin-statetransitions in molecular complexes	Condensed Matter Physics	2	12.14
Janice Musfeldt (S)	C		University of Tennessee, Knoxville	Department of Chemistry								
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Vivien Zapf (S)	C		National High Magnetic Field Laboratory	Physics								

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Matthew Yankowitz (S)	PI	*	University of Washington	Physics	DOE	Office of Science - EFRC - Energy Frontier Research Centers	DE-SC0019443	P19146	Correlations and topology in twisted van der Waals heterostructures	Condensed Matter Physics	2	24
Zaiyao Fei (P)	C		University of Washington	Physics	NSF	MRSEC - Materials Research Science and Engineering Centers	1719797					
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Minhao He (G)	C		University of Washington, Seattle	Physics								
Tiancheng Song (G)	C		University of Washington	Physics								
Xiaodong Xu (S)	C		University of Washington	Physics								
Benjamin Stein (S)	PI	*	Los Alamos National Laboratory	C-PCS: PHYSICAL CHEM & APPLIED SPECTROSCOPY	No other support			P19152	Far-IR Studies of Lanthanide-Based Molecular Materials	Biology, Biochemistry, Biophysics	1	7
Samuel Greer (P)	C		Los Alamos National Laboratory	C-PCS: PHYSICAL CHEM & APPLIED SPECTROSCOPY								
Stephen Hill (S)	C		NHMFL	EMR								
Jonathan Marbey (G)	C		NHMFL	EMR								
Eun Sang Choi (S)	PI		NHMFL	Physics Department	No other support			P19217	Magnetometry instrumentation: calibration and background measurements	Condensed Matter Physics	2	14
Irinel Chiorescu (S)	PI	*	National High Magnetic Field Laboratory	CMT/E	NSF	DMR - Division of Materials Research	DMR1644779	P19218	Instrument Development: use of niobium thin films for spin sensitive devices	Condensed Matter Physics	1	6
Josiah Cochran (G)	C		National High Magnetic Field Laboratory	CMS								
Giovanni Franco-Rivera (U)	C		National High Magnetic Field Laboratory	Physics								
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Dimitri Basov (S)	PI		University of California, San Diego	Department of Physics	DOD	Other	W911NF1710543	P19221	Magneto-infrared study of novel quantum materials	Condensed Matter Physics	2	14
Zhiqiang Mao (S)	C		Pennsylvania State University	Department of Physics	DOE	Office of Science - BES – Basic Energy Sciences	DE-SC0019443					
Seongphill Moon (G)	C		National High Magnetic Field Laboratory	Physics								
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Yinming Shao (G)	C		Columbia University	Physics								
Dmitry Smirnov (S)	C		National High Magnetic Field Laboratory	Instrumentation & Operations								
Yanglin Zhu (G)	C		Tulane University	Department of Physics and Engineering Physics								
Bing Lv (S)	PI	*	University of Texas, Dallas	Physics	DOD	US Air Force	FA9550-15-1-0236	P19227	Clarifying the nature of the superconducting pairing symmetry in ß-Bi2Pd	Condensed Matter Physics	1	14
Luis Balicas (S)	C		NHMFL	Condensed Matter Experiment								
Eun Sang Choi (S)	C		NHMFL	Physics Department								
Danilo Ratkovski (G)	C		Federal University of Pernambuco	Departamento de Fisica								
Kaya Wei (P)	C		NHMFL	CMS								
Akiyasu Yamamoto (S)	PI	*	Tokyo University of Agriculture and Technology	Dept. of Applied Physics	DOE	Office of Science - HEP – High Energy Physics	DE-SC0018750	P19232	Exploring high field transport performance of Ba122 phase iron-based superconductors by lattice defect engineering	Magnets, Materials	1	4.39
Chiara Tarantini (S)	C		NHMFL	Applied Superconductivity Center	JST	Non US Foundation	JPMJCR18J4					
Shinnosuke Tokuta (G)	C		Tokyo University of Agriculture and Technology	Dept. of Applied Physics	JSPS	Non US Foundation	JP18H01699					
Xueqian Kong (S)	PI	*	Zhejiang University	Chemistry	Zhejiang University	Non US College and University		P19235	Ultrahigh Field NMR Study of the Formation and Decomposition Mechanisms of MOFs	Magnets, Materials	1	5
Zhehong Gan (S)	C		NHMFL	NHMFL								
Hanxi Guan (G)	C		Zhejiang University	Chemistry								

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Henry La Pierre (S)	PI	*	Georgia Institute of Technology	School of Chemistry and Biochemistry	Arnold and Mabel Beckman Foundation	US Foundation		P19236	Magnetic Properties Characterization of Kagome Lattice Compounds, (CH3NH3)2MM'3F12 (M = Na+, K+ and NH4+, M' = V3+ and Ti3+)	Chemistry	3	28
Ryan Baumbach (S)	C		NHMFL	CMS								
Arun Ramanathan (G)	C		Georgia Institute of Technology	Chemistry								
Luis Balicas (S)	PI		NHMFL	Condensed Matter Experiment	DOE	Office of Science - BES – Basic Energy Sciences	DE-SC0002613	P19238	Unconventional Topological Fermions in Rh silicides and germanides	Condensed Matter Physics	1	5.68
Ryan Baumbach (S)	C		NHMFL	CMS								
Aikaterini Flessa Savvidou (G)	C		NHMFL	Condensed Matter								
Shirin Mozaffari (P)	C		NHMFL	Condensed Matter Sciences								
WenKai Zheng (G)	C		NHMFL	Condensed Matter Sciences								
Raivo Stern (S)	PI		National Institute of Chemical Physics and Biophysics	Chemical Physics	ETAg/ERC	Non US Ministry	PRG4 (ENIQMA)	P19240	(H,T)-phase diagram of the frustrated spin-1/2 chain system in beta-TeVO4	Condensed Matter Physics	1	26
Elizabeth Green (S)	C		NHMFL	Condensed Matter Science								
Marcelo Jaime (S)	C		NHMFL	Physics								
Joosep Link (U)	C		National Institute of Chemical Physics and Biophysics	Physics								
Arneil Reyes (S)	C		NHMFL	Condensed Matter Science								
Alexander Tsirlin (S)	C		National Institute of Chemical Physics and Biophysics	Chemical physics								
Dagmar Weickert (S)	C		NHMFL	MPA-Mag								
Pengcheng Dai (S)	PI		University of Tennessee, Knoxville	Physics	NSF	DMR - Division of Materials Research	DMR1700081	P19244	Investigation into Orbital Pairing Mechanism of Superconducting Electrons in Ni doped BaFe2As2	Condensed Matter Physics	1	20.57
Mason Klemm (G)	C		Rice University	Physics								
Jeffrey Rinehart (S)	PI	*	University of California, San Diego	Chemistry and Biochemistry	NSF	DMR - Division of Materials Research	DMR1904937	P19253	Magnetospectroscopic study of the modulation of single-ion anisotropy by dipolar and orbital-mediated exchange in anisotropic lanthanide molecular magnetic clusters	Magnets, Materials	2	14
Maximilian Bernbeck (G)	C		University of California, San Diego	Chemistry and Biochemistry								
Vlad Pribiag (S)	PI	*	University of Minnesota, Twin Cities	Physics	NSF	MRSEC - Materials Research Science and Engineering Centers	DMR-1420013	P19258	Anisotropic superconducting properties of few-layer NbSe2	Condensed Matter Physics	1	7
Rafael Fernandes (S)	C		University of Minnesota, Twin Cities	School of Physics and Astronomy								
Alex Hamill (G)	C		University of Minnesota, Twin Cities	Physics								
Brett Heischmidt (G)	C		University of Minnesota, Twin Cities	Physics								
Ke Wang (P)	C		Harvard University	Physics								
Woun Kang (S)	PI		Ewha Womans University	Department of Physics	National Research Foundation of Korea	Non US Foundation	2018R1D1A1B0705008 7	P19259	Study of low-dimensional materials under very high pressure	Condensed Matter Physics	1	5.38
Eun Sang Choi (S)	C		NHMFL	Physics Department								
Joonyoung Choi (G)	C		Kyungpook National University	Physics								
Min Hyuk Choi (G)	C		Pohang University of Science and Technology	Physics								
Ho Seong Jeon (G)	C		Pohang University of Science and Technology	Physics								
YounJung Jo (S)	C		Kyungpook National University	Physics								
Hoil Kim (G)	C		Pohang University of Science and Technology	Physics								
Jun Sung Kim (S)	C		Pohang University of Science and Technology	Physics								

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Amalia Coldea (S)	PI	University of Oxford	Clarendon Laboratory	CFAS (Oxford Centre for Applied Superconductivity)	Other		P19260	Exploring electronic and quantum phenomena in iron-based superconductors under extreme conditions	Condensed Matter Physics	1	4.93
David Graf (S)	C	NHMFL	DC Field CMS								
Zachary Zajicek (G)	C	University of Oxford	Physics								
Alimamy Bangura (S)	PI	National High Magnetic Field Laboratory	CMS	NSF	DMR - Division of Materials Research	DMR1157490	P19273	Development of high field calorimetry probe	Condensed Matter Physics	1	12.37
Greg Boebinger (S)	C	National High Magnetic Field Laboratory	Directors Office								
Ross McDonald (S)	C	National High Magnetic Field Laboratory	Physics								
Kimberly Modic (G)	C	National High Magnetic Field Laboratory	PFF								
Brad Ramshaw (S)	C	Cornell University	Laboratory of Atomic and Solid State Physics								
Andreas Rydh (S)	C	Stockholm University	Department of Physics								
Arkady Shehter (S)	C	National High Magnetic Field Laboratory	NHMFL, DC Field Facility								
Henry La Pierre (S)	PI *	Georgia Institute of Technology	School of Chemistry and Biochemistry	DOE	Office of Science - BES – Basic Energy Sciences	DE-SC0019385	P19275	Study of Zero Field Splitting in Molecular Tb4+ Complexes by High Field EPR	Biology, Biochemistry, Biophysics	1	7
Ryan Baumbach (S)	C	NHMFL	CMS								
Thaige Gompa (G)	C	Georgia Institute of Technology	School of Chemistry and Biochemistry								
Samuel Greer (P)	C	Los Alamos National Laboratory	C-PCS: PHYSICAL CHEM & APPLIED SPECTROSCOPY								
Arun Ramanathan (G)	C	Georgia Institute of Technology	Chemistry								
Natalie Rice (G)	C	Georgia Institute of Technology	School of Chemistry and Biochemistry								
Joshua Telser (S)	C	Roosevelt University	Biological, Physical and Health Sciences								
YounJung Jo (S)	PI	Kyungpook National University	Physics	2018K2A9A1 A06069211	Non US Foundation		P19278	Magnetic anisotropy in van der Waals antiferromagnets	Condensed Matter Physics	1	14
Joonyoung Choi (G)	C	Kyungpook National University	Physics								
Je-Geun Park (S)	C	Seoul National University	Department of Physics & Astronomy								
Mikel Holcomb (S)	PI *	West Virginia University	Physics & Astronomy	DOE	Office of Science - BES – Basic Energy Sciences	DE-SC0016176	P19291	Dynamic studies of inhomogeneous magnetic thin films of La0.7Sr0.3MnO3 by ac susceptibility measurements to understand the strength of interparticle interactions embedded in the magnetic dead layers	Condensed Matter Physics	2	14
Ryan Baumbach (S)	C	NHMFL	CMS	NSF	DMR - Division of Materials Research	DMR1608656					
Navid Mottaghi (G)	C	West Virginia University	Physics and Astronomy								
Qi Zhang (S)	PI *	Nanjing University	Physics and Astronomy	Nanjing University	Non US College and University	New Faculty Startup Funds	P19349	Terahertz magnons, phonons and magnetic phase transitions in 2D honeycomb antiferromagnets	Condensed Matter Physics	2	15.86
Jiun-Haw Chu (S)	C	University of Washington	Physics								
Mykhaylo Ozerov (S)	C	NHMFL	Condensed Matter Science, DC Field CMS								
Xiaodong Xu (S)	C	University of Washington	Physics								
Pengcheng Dai (S)	PI	University of Tennessee, Knoxville	Physics	NSF	DMR - Division of Materials Research	DMR1700081	P19360	Investigation into Orbital Pairing Mechanism of Superconducting Electrons in Ni doped BaFe2As2	Condensed Matter Physics	1	4.9
Luis Balicas (S)	C	NHMFL	Condensed Matter Experiment								
Mas Subramanian (S)	PI *	Oregon State University	Chemistry	NSF	DMR - Division of Materials Research	DMR1508527	P19361	Frequency- and field-domain magnetic resonance investigation of novel materials based on Mn4+-doped sillenites.	Magnets, Materials	1	7
Jurek Krzystek (S)	C	NHMFL	Condensed Matter Science								
Mykhaylo Ozerov (S)	C	NHMFL	Condensed Matter Science, DC Field CMS								
Joshua Telser (S)	C	Roosevelt University	Biological, Physical and Health Sciences								

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Stan Tozer (S)	PI		NHMFL	Physics	DOE	Other	DE-AC02-06CH11357	P19362	Search for and an Understanding of Room Temperature Superconductivity	Condensed Matter Physics	1	12.37
Muhtar Ahart (S)	C		University of Illinois at Chicago	Physics								
William Coniglio (S)	C		NHMFL	A1								
Audrey Grockowiak (S)	C		NHMFL	DC Field/CMS								
Toni Helm (P)	C		Max Planck Institute for Chemical Physics of Solids, Dresden	Physics of Quantum materials								
Russell Hemley (S)	C		University of Illinois at Chicago	Physics								
Maddury Somayazulu (S)	C		Argonne National Laboratory	Advanced Photon Source HPCAT sector 16								
Henry La Pierre (S)	PI	*	Georgia Institute of Technology	School of Chemistry and Biochemistry	Beckman Young	Other		P19365	Heat capacity measurement of (CH3NH3)2NaV3F12	Chemistry	1	7
Fazel Tafti (S)	PI		Boston College	Physics	NSF	DMR - Division of Materials Research	DMR1708929	P19384	Hydrodynamic Electron Flow in NbGe2	Condensed Matter Physics	1	5.56
Luis Balicas (S)	C		National High Magnetic Field Laboratory	Condensed Matter Experiment								
Shirin Mozaffari (P)	C		National High Magnetic Field Laboratory	Condensed Matter Sciences								
Hung-Yu Yang (G)	C		Boston College	Physics								
Shalinee Chikara (S)	PI	*	National High Magnetic Field Laboratory	CMS, DC Field Facility	No other support			P19402	Strange frustration and quantum liquid behavior in an insulating trimer Ba4Ir3O10	Condensed Matter Physics	2	28
Gang Cao (S)	C		University of Colorado, Boulder	Department of Physics.	NSF	DMR - Division of Materials Research	DMR1644779					
Eun Sang Choi (S)	C		National High Magnetic Field Laboratory	Physics Department								
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Dmitry Smirnov (S)	PI		National High Magnetic Field Laboratory	Instrumentation & Operations	DOE	Office of Science - BES – Basic Energy Sciences	DE-FG02-07ER46451	P19412	Electrical and magnetic field control of optical processes in atomicallythin layers and van der Waals heterostructures	Condensed Matter Physics	1	7
Zhigang Jiang (S)	C		Georgia Institute of Technology	School of Physics								
Chun Ning (Jeanie) Lau (S)	C		Ohio State University	Department of Physics and Astronomy								
Zhengguang Lu (G)	C		National High Magnetic Field Laboratory	Physics								
Sufei Shi (S)	C		Rensselaer Polytechnic Institute	Chemical and Biological Engineering								
Luis Balicas (S)	PI		National High Magnetic Field Laboratory	Condensed Matter Experiment	DOE	Office of Science - BES – Basic Energy Sciences	DE-SC0002613	P19425	Proper magnetization measurements in the Dirac type-II semimetallic candidate NiTe2	Condensed Matter Physics	1	7
Efstratios Manousakis (S)	C		Florida State University	Physics								
Theo Siegrist (S)	C		National High Magnetic Field Laboratory	Chemical and Biomedical Engineering								
Kaya Wei (P)	C		National High Magnetic Field Laboratory	CMS								
WenKai Zheng (G)	C		National High Magnetic Field Laboratory	Condensed Matter Sciences								
Irina Drichko (S)	PI		Ioffe Physical-Technical Institute of the Russian Academy of Sciences	Physics of Semiconductors and Dielectrics	Russian Foundation for Basic Research	Non US Foundation	19-02-00124	P19427	Magnetotransport Properties of High-Mobility p-AlGaAs/GaAs/AlGaAs Structures: Acoustic Studies.	Condensed Matter Physics	1	17
Loren Pfeiffer (S)	C		Princeton University	Electrical Engineering								
Ivan Smirnov (S)	C		Ioffe Physical-Technical Institute of the Russian Academy of Sciences	Physics of Semiconductors and Dielectrics								
Alexey Suslov (S)	C		NHMFL	Condensed Matter Science								
Ken West (S)	C		Princeton University	Princeton Institute for the Science and Technology of Materials								
Sara Haravifard (S)	PI		Duke University	Department of Physics	NSF	DMR - Division of Materials Research	DMR1828348	P19445	High Pressure Studies of Frustrated Magnets	Condensed Matter Physics	1	4.64
David Graf (S)	C		NHMFL	DC Field CMS								
Zhenzhong Shi (P)	C		Duke University	Department of Physics								

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Jan Jaroszynski (S)	PI		National High Magnetic Field Laboratory	CMS	UCGP		P19446	Torque acting on REBCO coated conductors in external magnetic field	Magnets, Materials	2	7.1
Ernesto Bosque (S)	C		National High Magnetic Field Laboratory	ASC/MST							
Griffin Bradford (O)	C		National High Magnetic Field Laboratory	Applied Superconductivity Center							
Ashleigh Francis (T)	C		National High Magnetic Field Laboratory	ASC							
Keshav Shrestha (S)	PI	*	Texas A&M University	Chemistry and Physics	West Texas A&M University	US College and University	P19467	Search of Topological Phases of Materials	Condensed Matter Physics	1	7
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS							
Bal Pokharel (G)	C		National High Magnetic Field Laboratory	Physics							
Dragana Popovic (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science / Experimental							
Lin Jiao (S)	PI	*	National High Magnetic Field Laboratory	CMS	No other support		P19480	High Magnetic Field Probe Design and Technique Development	Condensed Matter Physics	2	16
Alimamy Bangura (S)	C		National High Magnetic Field Laboratory	CMS							
Robert Nowell (T)	C		National High Magnetic Field Laboratory	DC User Support							
								Total Proposals: 108		Experiments: 146	Days: 1,021.1

3. EMR Facility

Participants (Name, Role, Org., Dept.)	Funding Sources (Funding Agency, Division, Award #)	Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Ellis Reinherz (S), PI, Dana-Farber Cancer Institute, Medicine	No other support	P16241	EPR analysis of HIV-1 MPER segment for optimized vaccine design	Biology, Biochemistry, Biophysics	1	9
Enrique del Barco (S), PI, University of Central Florida, Physics Gyan Khatri (G), C, University of Central Florida, Physics Jaesuk Kwon (P), C, University of Central Florida, Physics David Lederman (S), C, University of California, Santa Cruz, Physics Priyanka Vaidya (G), C, University of Central Florida, Physics Department Johan van Tol (S), C, National High Magnetic Field Laboratory, EMR Fengyuan Yang (S), C, Ohio State University, Physics	No other support DOD, US Air Force, FA9550-19-1-0307	P16298	Spintronics with Antiferromagnetic Insulators	Condensed Matter Physics	2	21
Johan van Tol (S), PI, National High Magnetic Field Laboratory, EMR Thierry Dubroca (S), C, National High Magnetic Field Laboratory, EMR Mary Ellen Zvanut (S), C, University of Alabama, Birmingham, Physics	No other support	P16303	Field dependence of Electron Spin Relaxation	Condensed Matter Physics	3	19
Andrew Ozarowski (S), PI, National High Magnetic Field Laboratory, EMR	No other support	P17321	Calibration And Maintenance Of The 15/17 T EPR Instrument Instruments	Magnets, Materials	1	2
Markus Enders (S), PI, Heidelberg University, Chemistry Jurek Krzystek (S), C, National High Magnetic Field Laboratory, Condensed Matter Science Joshua Telser (S), C, Roosevelt University, Biological, Physical and Health Sciences	No other support	P17384	Unpaired electron spin properties of light d-block metal compounds	Chemistry	2	9
Likai Song (S), PI, NHMFL, EMR Krishnendu Kundu (P), C, NHMFL, EMR Jonathan Marbey (G), C, NHMFL, EMR	No other support	P17449	Developing Multifrequencey EPR Methods for Biological Applications	Biology, Biochemistry, Biophysics	7	80
Enrique Colacio (S), PI, University of Granada, Inorganic Chemistry Jurek Krzystek (S), C, NHMFL, Condensed Matter Science Mykhaylo Ozerov (S), C, NHMFL, Condensed Matter Science, DC Field CMS	No other support	P17454	High-frequency and -field EPR of 2D Co(II) SMMs with different hexacoordinated Co(II) ions.	Chemistry	2	8
Russell Maier (P), PI, National Institute of Standards and Technology, Materials Measurement Laboratory Andrew Ozarowski (S), C, NHMFL, EMR	National Institute of Standards and Technology (NIST), US Government Lab	P17488	High Frequency EPR Characterization of Mn and Fe-Related Point Defects in the Perovskite Structure	Condensed Matter Physics	1	2
Zofia Janas (S), PI, University of Wroclaw, Faculty of Chemistry Julia Jezierska (S), C, University of Wroclaw, Chemistry Andrew Ozarowski (S), C, National High Magnetic Field Laboratory, EMR	No other support Wroclaw University, Poland, Other Wroclaw University, Poland, Non US College and University	P17629	High-Field EPR Studies on V(IV) and V(III) Complexes of Schiff Bases and Diaminebis(aryloxides)	Chemistry	3	8
Alina Bienko (S), PI, University of Wroclaw, Faculty of Chemistry Andrew Ozarowski (S), C, National High Magnetic Field Laboratory, EMR	Wroclaw University, Non US College and University	P17642	Search for New Single-Molecule Magnets: High-Field EPR Studies on High-Spin Complexes of d-Electron Metals – Co(II), Ni(II), Re(IV)	Chemistry	1	8
Ziling Xue (S), PI, University of Tennessee, Knoxville, Chemistry Alexandria Bone (G), C, University of Tennessee, Knoxville, Chemistry Adam Hand (G), C, University of Tennessee, Knoxville, Chemistry Brian Kettell (G), C, University of Tennessee Space Institute, Chemistry Jurek Krzystek (S), C, National High Magnetic Field Laboratory, Condensed Matter Science Clay Mings (G), C, University of Tennessee, Knoxville, Chemistry Duncan Moseley (G), C, University of Tennessee, Knoxville, Chemistry Likai Song (S), C, National High Magnetic Field Laboratory, EMR Pagnareach Tin (G), C, University of Tennessee, Knoxville, Chemistry Chelsea Widener (G), C, University of Tennessee, Knoxville, Chemistry	No other support	P17697	Investigating Molecular Magnetism by Magneto-Raman Spectroscopy	Chemistry	4	18

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Srinivasa Rao Singamaneni (S)	PI	University of Texas, El Paso	Physics	No other support			P17698	Controlling Spin States in Honeycomb Two-Dimensional Layered Solids using Coherent Light	Condensed Matter Physics	3	12
Johan van Tol (S)	C	National High Magnetic Field Laboratory	EMR	The University of Texas at El Paso	US College and University						
Joseph Zadrozny (S)	PI	Colorado State University	Chemistry	NSF	CHE - Chemistry	CHE1836537	P17730	Molecular Control of Spin Relaxation and EPR Linewidth in Transition Metal Complexes	Chemistry	2	9
Cassidy Jackson (G)	C	Colorado State University	Chemistry	Colorado State University	US College and University						
Ian Moseley (G)	C	Colorado State University	Chemistry								
Johan van Tol (S)	C	National High Magnetic Field Laboratory	EMR								
Lucio Frydman (S)	PI	National High Magnetic Field Laboratory	NMR	No other support			P17754	Three-Spins Solution State DNP	Biology, Biochemistry, Biophysics	2	19
Adewale Akinfaderin (G)	C	Florida State University	Physics	NSF	CHE - Chemistry	CHE1808660					
Thierry Dubroca (S)	C	National High Magnetic Field Laboratory	EMR								
Stephen Hill (S)	C	National High Magnetic Field Laboratory	EMR								
Krishnendu Kundu (P)	C	National High Magnetic Field Laboratory	EMR								
Murari Soundararajan (P)	C	NHMFL	CIMAR, NMR								
Johan van Tol (S)	C	NHMFL	EMR								
Sungsool Wi (S)	C	NHMFL	NMR								
Michael Nippe (S)	PI	Texas A&M University	Chemistry	NSF	CHE - Chemistry	CHE1753014	P17842	Exploring Magnetic Coupling and Spin Relaxation in Ln-[1]metallocenophane Compounds using High-Field and Pulsed EPR spectroscopy	Chemistry	1	2
Stephen Hill (S)	C	NHMFL	EMR								
Trevor Latendresse (G)	C	Texas A&M University	Chemistry								
Jonathan Marbey (G)	C	NHMFL	EMR								
Benjamin Stein (S)	PI	Los Alamos National Laboratory	C-PCS: PHYSICAL CHEM & APPLIED SPECTROSCOPY	No other support			P17990	Applications of Advanced Electron Paramagnetic Resonance Techniques to Actinide-Based Molecular Systems	Chemistry	1	1
Thomas Albrecht-Schmitt (S)	C	Florida State University	Chemistry and Biochemistry								
Samuel Greer (P)	C	Los Alamos National Laboratory	C-PCS: PHYSICAL CHEM & APPLIED SPECTROSCOPY								
Stephen Hill (S)	C	NHMFL	EMR								
Stosh Kozimor (S)	C	Los Alamos National Laboratory	C-IIAC: INORGANIC ISOTOPE & ACTINIDE CHEM								
Aaron Tondreau (S)	C	Los Alamos National Laboratory	C-IIAC: INORGANIC ISOTOPE & ACTINIDE CHEM								
Adam Fiedler (S)	PI	Marquette University	Chemistry	No other support			P18030	Probing the Magnetic Anisotropy of Co(II) Complexes Featuring Radical Ligands	Chemistry	3	8.5
John Berry (S)	C	University of Wisconsin, Madison	Department of Chemistry								
Kinga Kaniewska (G)	C	Gdansk University of Technology	Department of Inorganic Chemistry								
Jurek Krzystek (S)	C	NHMFL	Condensed Matter Science								
Andrew Ozarowski (S)	C	NHMFL	EMR								
Mykhaylo Ozerov (S)	C	NHMFL	Condensed Matter Science, DC Field CMS								
Joshua Telser (S)	C	Roosevelt University	Biological, Physical and Health Sciences								
Jianyuan Zhang (S)	PI	Rutgers University	Chemistry and Chemical Biology	No other support			P18049	A Route to Molecular Quantum Technologies Using Endohedral Metallofullerenes	Chemistry	7	90
Stephen Hill (S)	C	NHMFL	EMR								
Krishnendu Kundu (P)	C	NHMFL	EMR								
Jonathan Marbey (G)	C	NHMFL	EMR								
Sungsool Wi (S)	PI *	NHMFL	NMR	NSF	CHE - Chemistry	CHE1808660	P18056	Solution State Overhauser DNP at 14 T	Chemistry	1	10
Thierry Dubroca (S)	C	NHMFL	EMR								
Christoph Boehme (S)	PI	University of Utah	Department of Physics and Astronomy	DOE	Office of Science - BES – Basic Energy Sciences	DE-SC0000909	P18076	Investigation of weak spin-orbit coupling in organic semiconductor diodes with high-field electrically detected magnetic resonance	Condensed Matter Physics	1	10
Hans Malissa (P)	C	University of Utah	Department of Physics and Astronomy								
Johan van Tol (S)	C	NHMFL	EMR								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Naresh Dalal (S)	PI		NHMFL	Chemistry	NSF	CHE - Chemistry	CHE1464955	P18094	Study of molecular dynamics on metal organic framework [(CH3)2NH2]Mg(HCOO)3] using solid state NMR spectroscopy	Chemistry	1	2
Riqiang Fu (S)	C		NHMFL	NMR								
Sanath Kumar Rama Krishna (G)	C		Florida State University	Condensed Matter Physics								
Jamie Manson (S)	PI		Eastern Washington University	Chemistry and Biochemistry	No other support			P19143	Determining phase diagrams in bespoke S = 1 Ni(II) quantum magnets	Condensed Matter Physics	2	14.5
Sam Curley (G)	C		University of Warwick	Physics and Astronomy	NSF	DMR - Division of Materials Research	DMR1703003					
Paul Goddard (S)	C		University of Warwick	Department of Physics								
Andrew Ozarowski (S)	C		NHMFL	EMR								
Adam Veige (S)	PI		University of Florida	Chemistry	NSF	CHE - Chemistry	CHE1808234	P19170	Quantification of End Groups in Cyclic vs. Linear Polyacetylenes by Carbon-13 Magic Angle Spinning Nuclear Magnetic Resonance Spectroscopy	Biology, Biochemistry, Biophysics	1	9
Clifford Bowers (S)	C		University of Florida	Chemistry								
Alec Esper (G)	C		University of Florida	Chemistry								
Frederic Mentink (S)	C		National High Magnetic Field Laboratory	NMR Division								
Zhihui Miao (G)	C		University of Florida	Department of Chemistry								
Brent Sumerlin (S)	C		University of Florida	Chemistry								
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								
Tommy Zhao (G)	C		University of Florida	Chemistry								
Dmytro Nesterov (P)	PI		Technical University of Lisbon	Chemistry Department	FCT - Fundação para a Ciência e Tecnologia (Portugal)	Non US Foundation		P19177	Magnetic Properties and EPR spectroscopy of Tetranuclear Copper Complexes	Chemistry	1	2
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR								
George Christou (S)	PI		University of Florida	Chemistry	No other support			P19185	High-Field EPR Studies of Exchange Coupling Within Single-Molecule Magnet Oligomers	Chemistry	7	45.5
ChristiAnna Brantley (G)	C		University of Florida	Chemistry	DOE	Office of Science - EFRC - Energy Frontier Research Centers	DE-SC0019330					
Tuhin Ghosh (P)	C		University of Florida	Department of Chemistry								
Stephen Hill (S)	C		National High Magnetic Field Laboratory	EMR								
Daphné Lubert-Perquel (P)	C		Imperial College London	Physics								
Johan van Tol (S)	C		NHMFL	EMR								
Johan van Tol (S)	PI		National High Magnetic Field Laboratory	EMR	No other support			P19207	Testing and Maintenance	Condensed Matter Physics	1	2
Frederic Mentink (S)	PI		National High Magnetic Field Laboratory	NMR Division	No other support			P19241	Improving biradicals for MAS-DNP at high field: a combined approach of Spin-Dynamics theory, DFT and high-field EPR	Chemistry	2	9
Krishnendu Kundu (P)	C		National High Magnetic Field Laboratory	EMR								
Snorri Sigurdsson (S)	C		University of Iceland	Chemistry								
Henry La Pierre (S)	PI	*	Georgia Institute of Technology	School of Chemistry and Biochemistry	DOE	Office of Science - BES – Basic Energy Sciences	DE-SC0019385	P19275	Study of Zero Field Splitting in Molecular Tb4+ Complexes by High Field EPR	Biology, Biochemistry, Biophysics	4	14
Thaige Gompa (G)	C		Georgia Institute of Technology	School of Chemistry and Biochemistry	Arnold and Mabel Beckman Foundation	US Foundation						
Samuel Greer (P)	C		Los Alamos National Laboratory	C-PCS: PHYSICAL CHEM & APPLIED SPECTROSCOPY								
Arun Ramanathan (G)	C		Georgia Institute of Technology	Chemistry								
Natalie Rice (G)	C		Georgia Institute of Technology	School of Chemistry and Biochemistry								
Joshua Telser (S)	C		Roosevelt University	Biological, Physical and Health Sciences								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Likai Song (S)	PI		National High Magnetic Field Laboratory	EMR	No other support			P19282	Instrument Development and Maintenance of the HiPER Spectrometer	Magnets, Materials	2	61
Krishnendu Kundu (P)	C		National High Magnetic Field Laboratory	EMR								
Jonathan Marbey (G)	C		National High Magnetic Field Laboratory	EMR								
Linda Doerrer (S)	PI		Boston University	Chemistry Department	NSF	CHE - Chemistry	CHE1800313	P19306	A Unique {Mn6} Cluster with Axial Symmetry as a Single-Molecule Magnet Candidate	Chemistry	1	10
Jessica Elinburg (G)	C		Boston University	Chemistry								
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR								
Rudi van Eldik (S)	PI	*	University of Erlangen-Nuremberg, Germany	Department of Chemistry and Pharmacy	National Science Center (NCN) Poland	Other	2019/03/X/ST4/01317	P19314	Characterization of the first mixed-valence Ru(II)/Ru(III) ion-pair complex	Chemistry	1	4
Anna Katafias (S)	C		N Copernicus University Torun	Faculty of Chemistry								
Anna Kozakiewicz (S)	C		Nicolaus Copernicus University in Torun	Faculty of Chemistry								
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR								
Grzegorz Wrzeszcz (S)	C		Nicolaus Copernicus University in Torun	Department of Inorganic and Coordination Chemistry, Faculty of Chemistry								
Stergios Piligkos (S)	PI		University of Copenhagen	Department of Chemistry	No other support			P19318	Pulsed EPR of Yb(trensal) based quantum gates	Magnets, Materials	8	63
Christian Buch (G)	C		University of Copenhagen	Chemistry	Villum Foundation	Non US Foundation						
Stephen Hill (S)	C		NHMFL	EMR								
Krishnendu Kundu (P)	C		NHMFL	EMR								
Jonathan Marbey (G)	C		NHMFL	EMR								
Likai Song (S)	C		NHMFL	EMR								
Johan van Tol (S)	C		NHMFL	EMR								
Kirill Kovnir (S)	PI	*	Iowa State University	Chemistry	No other support			P19330	EPR investigation of Cr2Se2 dimer	Chemistry	3	8.5
Eranga Gamage (G)	C		Iowa State University	Chemistry	Iowa State University	US College and University						
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR								
Jianjun Pan (S)	PI		University of South Florida	Physics	NIH	NIGMS - National Institute of General Medical Sciences	GM117531	P19341	Interactions of the Helix 0 of Endophilin with Lipid Membranes Defined by Multi-Frequency EPR	Biology, Biochemistry, Biophysics	2	29
Albert Stiegman (S)	PI		Florida State University	Chemistry	DOE	Office of Science - BES – Basic Energy Sciences	DE-FG-02-03ER15467	P19345	Characterization of the active sites in the Phillip's ethylene polymerization catalyst with EPR spectroscopy	Chemistry	2	6
Jurek Krzystek (S)	C		NHMFL	Condensed Matter Science								
Nathan Peek (G)	C		Florida State University (FSU)	Chemistry and Biochemistry								
Susannah Scott (S)	C		University of California, Santa Barbara	Chemical Engineering								
Ellis Reinherz (S)	PI		Dana-Farber Cancer Institute	Medicine	No other support			P19358	EPR analysis of HIV-1 MPER segment for optimized vaccine design	Biology, Biochemistry, Biophysics	4	47
					NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI126901					
Mas Subramanian (S)	PI	*	Oregon State University	Chemistry	NSF	DMR - Division of Materials Research	DMR1508527	P19361	Frequency- and field-domain magnetic resonance investigation of novel materials based on Mn4+-doped sillenites.	Magnets, Materials	1	1.5
Jurek Krzystek (S)	C		NHMFL	Condensed Matter Science								
Mykhaylo Ozerov (S)	C		NHMFL	Condensed Matter Science, DC Field CMS								
Joshua Telser (S)	C		Roosevelt University	Biological, Physical and Health Sciences								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Geoffrey Strouse (S)	PI		NHMFL	Chemistry	NSF	DMR - Division of Materials Research	DMR1905757	P19372	Multinuclear solid-state NMR investigation of plasmonic and photoluminescent nanocrystals	Chemistry	1	1
Adam Altenhof (G)	C		Florida State University	Chemistry and Biochemistry								
Nhat Nguyen Bui (P)	C		NHMFL	CMS								
Carl Conti (G)	C		Florida State University	Chemistry & Biochemistry								
Zhehong Gan (S)	C		NHMFL	NHMFL								
Ivan Hung (S)	C		NHMFL	CIMAR/NMR								
Jason Kuszynski (G)	C		Florida State University	Chemistry								
Frederic Mentink (S)	C		NHMFL	NMR Division								
Robert Schurko (S)	C		Florida State University	Chemistry								
Likai Song (S)	C		NHMFL	EMR								
Grace Morgan (S)	PI		University College Dublin	School of Chemistry and Chemical Biology	No other support			P19428	Multiferroic behavior at spin-state transitions – beyond Mn(taa)	Chemistry	1	5
Shalinee Chikara (S)	C		National High Magnetic Field Laboratory	CMS, DC Field Facility								
Brittany Grimm (G)	C		Florida State University	Physics								
Stephen Hill (S)	C		National High Magnetic Field Laboratory	EMR								
Vibe Jakobsen (G)	C		University College Dublin	School of Chemistry								
Irina Kuehne (P)	C		University College Dublin	School of Chemistry								
John Singleton (S)	C		National High Magnetic Field Laboratory	Physics								
Vivien Zapf (S)	C		NHMFL	Physics								
Marta Hatzell (S)	PI	*	Georgia Institute of Technology	George W. Woodruff School of Mechanical Engineering	NSF	ECS - Environment al Chemical Sciences	ECS1846611	P19459	Investigating Oxygen Vacancies of Various Metal Doped Titania for Direct Air Nitrogen Photofixation	Engineering	1	7
Michael Shatruk (S)	PI		National High Magnetic Field Laboratory	Department of Chemistry	No other support			P19472	EPR Investigation of Lantanide Complexes as Potential Hosts for Clock Transitions and Molecular Qubits	Magnets, Materials	1	3
Miguel Gakiya (G)	C		Florida State University	Chemistry and Biochemistry								
Stephen Hill (S)	C		National High Magnetic Field Laboratory	EMR								
Daphné Lubert-Perquel (P)	C		Imperial College London	Physics								
Michal Leskes (S)	PI	*	Weizmann Institute of Science	Materials and Interfaces	European Research Council	Non US Council	803024	P19484	Determining spin relaxation properties of metal phosphates with varying Mn(II) content at high field	Chemistry	1	5
Daniel Jardón Álvarez (P)	C		Weizmann Institute of Science	Materials and Interfaces								
Enrique Colacio (S)	PI		University of Granada	Inorganic Chemistry	No other support			P19485	High-frequency and -field EPR and FIRMS of prismatic trigonal Co(II) and pentagonal bipyramidal Dy(III) SIMs complexes	Chemistry	1	2
Jurek Krzystek (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Andrew Ozarowski (S)	PI		National High Magnetic Field Laboratory	EMR	No other support			P19505	CALIBRATION AND MAINTENANCE OF THE 15/17 T EPR INSTRUMENT	Magnets, Materials	1	2.5
Igor Fritsky (S)	PI	*	Taras Shevchenko National University of Kyiv	Chemistry	Taras Shevchenko University, Kiev, Ukraine	Non US College and University		P19517	HF-EPR study of stable water-soluble manganese(IV) hexahydrazide clathrochelate complexes with unusual electronic structure	Chemistry	1	5
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR								
									Total Proposals: 45		Experiments: 99	Days: 704

4. High B/T Facility

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)		Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Ryuji Nomura (S)	PI	Tokyo Institute of Technology	Physics	Japanese Society for Promotion of Sciences (JSPS)	Non US Foundation	P16308	Investigating Spin Degrees of Freedom of Surface Andreev Bound States of Non-unitary Superfluid Helium Three in High Magnetic Fields	Condensed Matter Physics	1	85
Keegan Gunther (G)	C	University of Florida	Physics							
Yoonseok Lee (S)	C	University of Florida	Department of Physics							
Lucia Steinke (P)	C	University of Florida (UF)	High B/T Facility							
Andrew Woods (P)	C	University of Florida	Physics							
Chao Huan (P)	PI	University of Florida	Physics	UCGP		P17606	Studies of Novel Phases of 3He in Extreme Conditions	Condensed Matter Physics	1	85
Johnny Adams (G)	C	University of Florida	Physics							
Donald Candela (S)	C	University of Massachusetts	Physics							
Marc Lewkowitz (G)	C	University of Florida	Physics							
Neil Sullivan (S)	C	University of Florida	Physics							
							Total Proposals: 2		Experiments: 2	Days: 170

5. ICR Facility

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Andy Baker (S)	PI	University of New South Wales	School of Biological, Earth and Environmental Sciences	Australia Research Council	Other	DP160101379	P16162	Groundwater organic matter: carbon source or sink?	Chemistry	1	1
Martin Andersen (T)	C	University of New South Wales	School of Civil and Environmental Engineering	Australian Government Research Training Program and Australian Nuclear Science Technology Organization (ANSTO)	Other						
Megan Behnke (G)	C	Florida State University	Earth, Ocean and Atmospheric Science	Centre for Accelerator Science at ANSTO, the Australia National Collaborative Research Infrastructure Strategy (NCRIS)	Other						
Clément Brügger (T)	C	UNSW Sydney	Connected Waters Initiative Research Centre	NSW Department of Primary Industries Office of Water for bore infrastructure at Anna Bay and the National Centre for Ground water Research and Training (NCGRT)	Other						
Huang Hanxue (T)	C	UNSW Sydney	School of Civil and Environmental Engineering								
Christopher Marjo (T)	C	University of New South Wales	School of Biological, Earth and Environmental Sciences								
Liza McDonough (G)	C	University of New South Wales	School of Biological, Earth and Environmental Sciences								
Karina Meredith (T)	C	Australia's Nuclear Science and Technology organization	Australia's Nuclear Science and Technology organization								
Denis O'Carroll (T)	C	University of New South Wales	School of Civil and Environmental Engineering								
Phetdala Oudone (G)	C	University of New South Wales	School of Biological, Earth and Environmental Sciences								
Helen Rutlidge (T)	C	University of New South Wales	School of Civil and Environmental Engineering								
Robert Spencer (S)	C	Florida State University	Earth, Ocean & Atmospheric Science								
Donald Hunt (S)	PI	University of Virginia	Chemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM037537	P16320	Hemoglobin Characterization by FT-ICR MS	Biology, Biochemistry, Biophysics	1	2
Lissa Anderson (S)	C	NHMFL	ICR								
Elizabeth Duselis (G)	C	University of Virginia	Chemistry								
David Herold (S)	C	University of California, San Diego	Pathology								
Yuan Lin (G)	C	Florida State University	Department of Chemistry and Biochemistry								
Jeffrey Shabanowitz (S)	C	University of Virginia	Chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Zhiyong Ren (S)	PI	University of Colorado, Boulder	Civil Environmental Architectural Engineering	Chevron Energy Company			P17328	Mechanisms of Enhanced of Petroleum Hydrocarbon Degradation by Bioelectro chemical Systems	Chemistry	1	1
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance	NSF	CAREER - Faculty Early Career Development Program	1453906					
Logan Krajewski (G)	C	National High Magnetic Field Laboratory	Chemistry and Biochemistry	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1512705					
Lu Lu (P)	C	University of Colorado, Boulder	Civil, Environmental, and Architectural Engineering	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1510682					
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1704921					
Fernando Rosario-Ortiz (S)	C	University of Colorado, Boulder	Environmental Engineering								
Huan Wang (P)	C	University of Colorado, Boulder	Environmental Engineering								
Yi Zuo (S)	C	Chevron, San Ramon	Environmental Unit								
Neil Kelleher (S)	PI	Northwestern University	Department of Biochemistry, Molecular Biology, and Cell Biology	NIH	NIGMS - National Institute of General Medical Sciences	P41 GM108569	P17465	Characterization of Higher-MW Proteoforms from FACS-Sorted Patient B- and T- Cells	Biology, Biochemistry, Biophysics	1	1
Lissa Anderson (S)	C	National High Magnetic Field Laboratory	ICR								
David Butcher (P)	C	National High Magnetic Field Laboratory	ICR								
Caroline DeHart (P)	C	Northwestern University	Proteomics Center of Excellence								
Benjamin DesSoye (P)	C	Northwestern University	Chemistry								
Rafael Melani (P)	C	Northwestern university	CLP								
Kristina Srzentic (P)	C	Northwestern University	Chemistry								
Paul Thomas (S)	C	Northwestern University	Departments of Chemistry and Molecular Biosciences and the Proteomics Center of Excellence								
Archana Agarwal (S)	PI	University of Utah	Department of Pathology/ARUP Laboratories	No other support			P17485	21 Tesla FT-ICR MS Analysis of Hemoglobinopathy	Biology, Biochemistry, Biophysics	3	25.83
Lissa Anderson (S)	C	NHMFL	ICR								
Didia Coelho Graca (T)	C	Hôpitaux Universitaires de Genève	Division of Laboratory Medicine,								
Lidong He (G)	C	NHMFL	Chemistry								
Chris Hendrickson (S)	C	NHMFL	Ion Cyclotron Resonance Program								
Pierre Lescuyer (T)	C	Universitaires de Gene`ve	Service de Me´decine de laboratoire								
Yuan Lin (G)	C	Florida State University	Department of Chemistry and Biochemistry								
Alan Marshall (S)	C	NHMFL	ICR								
Alan Rockwood (S)	C	University of Utah	School of Medicine and ARUP Laboratories								
Christine Schaner Tooley (S)	PI	SUNY Buffalo	Biochemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM011127	P17590	Quantitative analysis of MYL9 N-terminal post-translational modifications	Biology, Biochemistry, Biophysics	2	8
Lissa Anderson (S)	C	National High Magnetic Field Laboratory	ICR								
Christopher Nevitt (G)	C	University of Louisville	Biochemistry and Molecular Genetics								
Zeljka Popovic (G)	C	Florida State University	Ion Cyclotron Resonance								
Chris Hendrickson (S)	PI	NHMFL	Ion Cyclotron Resonance Program	No other support			P17599	Analytical Method Development for FT-ICR MS	Magnets, Materials	4	267.42
Lissa Anderson (S)	C	NHMFL	ICR								
Greg Blakney (S)	C	NHMFL	ICR								
Martha Chacon (S)	C	NHMFL	Ion Cyclotron Resonance								
Alan Marshall (S)	C	NHMFL	ICR								
Amy McKenna (S)	C	NHMFL	ICR								
Zeljka Popovic (G)	C	Florida State University	Ion Cyclotron Resonance								
Donald Smith (S)	C	NHMFL	ICR								
Chad Weisbrod (S)	C	NHMFL	ICR								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Donald Smith (S)	PI	National High Magnetic Field Laboratory	ICR	No other support			P17604	Complex Mixture Method Development	Chemistry	3	11
Greg Blakney (S)	C	National High Magnetic Field Laboratory	ICR								
Chris Hendrickson (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance Program								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Ryan Rodgers (S)	C	National High Magnetic Field Laboratory	ICR								
Steven Rowland (S)	C	National Renewable Energy Laboratory	National Bioenergy Center								
Chad Weisbrod (S)	C	National High Magnetic Field Laboratory	ICR								
Alan Marshall (S)	PI	National High Magnetic Field Laboratory	ICR	No other support			P17699	Comprehensive Compositional and Structural Comparison of Coal and Petroleum Asphaltenes based on Extrography Fractionation Coupled with Fourier Transform Ion Cyclotron Resonance MS and MS/MS Analysis	Chemistry	1	1.5
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Taylor Glattke (G)	C	Florida State University	ICR								
Sydney Niles (G)	C	National High Magnetic Field Laboratory	Chemistry								
Ryan Rodgers (S)	C	National High Magnetic Field Laboratory	ICR								
Aixin Hou (S)	PI	Louisiana State University	Department of Environmental Sciences	Gulf of Mexico Research Initiaitve	Other US Federal Agency		P17789	A Decade-long Study on Impact, Recovery, and Resilience in Louisiana Salt Marshes: The evolution of oil transformation compounds and plant-soil-microbialresponses to the Deepwater Horizon oil spill	Chemistry	1	2
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Cameron Davis (U)	C	National High Magnetic Field Laboratory	ICR/CIRL								
Qianxin Lin (S)	C	Louisiana State University	Department of Oceanography and Coastal Science								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Omics LLC (S)	PI	Omics, LLC	Omics	FFI			P17792	Omics LLC	Chemistry	1	2
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Ryan Rodgers (S)	C	National High Magnetic Field Laboratory	ICR								
Chris Hendrickson (S)	PI	NHMFL	Ion Cyclotron Resonance Program	No other support			P17794	Training of students on ICR techniques	Biology, Biochemistry, Biophysics	1	2
Lissa Anderson (S)	C	NHMFL	ICR								
David Butcher (P)	C	NHMFL	ICR								
Yuan Lin (G)	C	Florida State University	Department of Chemistry and Biochemistry								
Peilu Liu (G)	C	Florida State University	Chemistry								
Zeljka Popovic (G)	C	Florida State University	Ion Cyclotron Resonance								
Romy Chakraborty (S)	PI	Lawrence Berkeley National Laboratory	Ecology	DOE	Office of Science - BER - Biological & Environmental Research	DE-SC0205112	P17797	Mapping Utilization of Natural Organic Matter to Activity of Indigenous Key Functional Microbesin Oak Ridge FRC Subsurface Sediments	Chemistry	1	0.83
Sara Gushgari-Doyle (P)	C	Lawrence Berkeley National Laboratory	Earth & Environmental Sciences	Lawrence Berkeley National Laboratory	US Government Lab						
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Jana Voriskova (P)	C	Lawrence Berkeley National Laboratory	Ecology Department								
Xiaoqin Wu (S)	C	Lawrence Berkeley National Laboratory	Department of Ecology								
Brian Bothner (S)	PI	Montana State University	Chemistry and Biochemistry	NSF	MCB - Molecular and Cellular Biosciences	MCB1714556	P17821	Describing the Thermoalkaline Environments in Yellowstone National Park: The Effects of pH, Temperature and Location on Organisms and the Dissolved Organic Matter Composition	Chemistry	1	0.5
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR	NSF	MCB - Molecular and Cellular Biosciences	MCB1413534					
Jesse Peach (G)	C	Montana State University	Biochemistry								
David Podgorski (S)	C	University of New Orleans	Department of Chemistry								

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Youneng Tang (S)	PI	Florida State University	Civil and Environmental Engineering	Bill Hinkley Center for Solid and Hazardous Waste Management		UFDSP00011955	P17822	Detection of Organic Compound sin Wastewater and Leachate	Chemistry	1	1
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance	Florida State University	US College and University						
Liang Li (T)	C	Florida Department of Environmental Protection	Environmental								
Runwei Li (G)	C	FSU-FAMU College of Engineering	Civil and Environmental Engineering								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Zhiming Zhang (G)	C	Florida State University	Department of Civil and Environmental Engineering								
Robert Spencer (S)	PI	Florida State University	Earth, Ocean & Atmospheric Science	Patagonia Ice Field Shrinkage Impacts on Coastal and Fjord Ecosystems	Other		P17826	Insights into Organic Matter Sources in Glacier Environments	Chemistry	1	0.5
Jason Fellman (S)	C	University of Alaska Southeast	Environmental Science								
Amy Holt (G)	C	Florida State University	EAOS								
Eran Hood (S)	C	University of Alaska Southeast	Environmental Science								
Anne Kellerman (P)	C	Florida State University	Earth, Ocean and Atmospheric Science								
Wenbo Li (G)	C	Florida State University	Earth, Ocean& Atomospheric Science								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Aron Stubbins (S)	C	Northeastern University	Marine and Environmental Science								
Sasha Wagner (P)	C	University of Georgia	Marine Sciences and Oceanography								
Jens Blotevogel (S)	PI	Colorado State University	Civil & Environmental Engineering	DOD	ER - Environmental Research Program	ER-2718	P17857	Transformation of per- and polyfluoroalkyl substances (PFASs) during bioelectrochemical treatment of aqueous film-forming foam (AFFF)	Engineering	1	2.53
Thomas Borch (S)	C	Colorado State University	Soil and Crop Science								
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Greg Dooley (S)	C	Colorado State University	ERHS								
Andrea Hanson (G)	C	Colorado State University	Civil and Environmental Engineering								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Sydney Niles (G)	C	National High Magnetic Field Laboratory	Chemistry								
Nasim Pica (P)	C	Colorado State University	Environmental engineering								
Hamidreza Sharifan (P)	C	Colorado State University	Civil and Environmental Engineering								
Chad Weisbrod (S)	C	National High Magnetic Field Laboratory	ICR								
Robert Young (S)	C	Colorado State University	Soil & Crop Sciences								
Robert Spencer (S)	PI	Florida State University	Earth, Ocean & Atmospheric Science	No other support			P17943	Changes to Permafrost and Vegetation Dissolved Organic Matter: an insight into the Kolyma River	Chemistry	2	1.67
Valier Galy (S)	C	Woods Hole Oceanographic Institution	Marine Chemistry & Geochemistry								
Anne Kellerman (P)	C	Florida State University	Earth, Ocean and Atmospheric Science								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Jennifer Rogers (U)	C	Florida State University	EOAS								

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Martha Chacon (S)	PI	NHMFL	Ion Cyclotron Resonance	Conseil Régional d'Aquitaine		20071303002PFM	P17944	Comprehensive characterization of asphaltenes by FT-ICR MS and chromatography separations	Chemistry	1	17.25
Nelson Acevedo (G)	C	Université de pau et des Pays de l'Adour	Nouvelle Aquitaine	FEDER		31486/08011464					
Brice Bouyssiere (S)	C	University of Pau and Pays de l'Adour	IPREM	European Network of Fourier-Transform Ion-Cyclotron-Resonance Mass Spectrometry Centers		731077					
Herve Carrier (S)	C	University of Pau and Pays de l'Adour	UPPA	German Research Foundation		INST 264/56					
Jimmy Castillo (S)	C	Central University of Venezuela	Escuela de Quimica	Franco-Venezuelan Project RMR							
Jean-Luc Daridon (S)	C	University of Pau and Pays de l'Adour	IPREM	Laboratoire LabEx SynOrg		ANR-11-LABX-0029					
Pierre Giusti (S)	C	Total	Refining and Chemicals	Région Normandie							
Taylor Glattke (G)	C	Florida State University	ICR								
Caroline Mangote (S)	C	Total	Research & Technology								
Aurora Mejia (S)	C	University of Pau and Pays de l'Adour	UPPA								
Remi Moulian (G)	C	University of Pau and Pays de l'Adour	ICR								
Anika Neumann (G)	C	University of Rostock	Department Life Light & Matter								
Vincent Piscitelli (S)	C	Central University of Venezuela	Escuela de Quim´ica								
Sadia Radji (S)	C	University of Pau and Pays de l'Adour	UPPA								
Ryan Rodgers (S)	C	NHMFL	ICR								
Ralf Zimmermann (S)	C	University of Rostock	Division of Analytical and Technical Chemistry								
Patricia Medeiros (S)	PI	University of Georgia	Marine Sciences	NSF	OCE - Ocean Sciences	OCE1832178	P17972	Dissolved Organic Matter Composition and Transformations in Coastal Systems	Chemistry	2	14.33
Renato Castelao (S)	C	University of Georgia	Marine Sciences	NSF	OCE - Ocean Sciences	OCE1902131					
Martha Chacon (S)	C	NHMFL	Ion Cyclotron Resonance								
Huan Chen (S)	C	NHMFL	Ion Cyclotron Resonance								
William Fitt (S)	C	University of Georgia	Odum School of Ecology								
Brian Hopkinson (S)	C	University of Georgia	Department of Marine Sciences								
Maria Letourneau (G)	C	University of Georgia	Marine Sciences								
Rachel Martineac (G)	C	University of Georgia	Marine Sciences								
Amy McKenna (S)	C	NHMFL	ICR								
Nobuaki Takemori (S)	PI	Ehime University	Proteo-Science Center	Biotechnology and Biological Sciences Research Council	Other	BB/M025756/1	P17980	Development of a novel top-down proteomics workflow using a polyacrylamide gel electrophoresis	Biology, Biochemistry, Biophysics	1	9
Lissa Anderson (S)	C	NHMFL	ICR	Biotechnology and Biological Sciences Research Council	Other	BB/R005311/1					
Robert Beynon (T)	C	University of Liverpool	Centre for Proteome Research	US National Institutes of Health	Other US Federal Agency	R01GM104610					
Philip Brownridge (T)	C	University of Liverpool	Centre for Proteome Research	US National Institutes of Health	Other	R01GM103479					
David Butcher (P)	C	NHMFL	ICR	National Institute of General Medical Sciences, National Institutes of Health	Other US Federal Agency	P41 GM108569					
Victoria Harman (T)	C	University of Liverpool	Centre for Proteome Research	Japan Society for the Promotion of Science	Other	18H04559					
Hitoshi Hasegawa (T)	C	Ehime University	Department of Hematology								
Daisuke Higo (T)	C	Thermo Fisher Scientific									
Jun Ishizaki (T)	C	Ehime University	Department of Hematology, Clinical Immunology and Infectious								
Joseph Loo (T)	C	University of California, Los Angeles	Department of Chemistry and Biochemistry								
Rachel Ogorzalek Loo (T)	C	University of California, Los Angeles	Department of Biological Chemistry								
Keisuke Shima (T)	C	Shimadzu Corporation									
Junpei Suzuki (T)	C	Ehime University	Department of Immunology								
Ayako Takemori (T)	C	Ehime University	Division of Analytical Bio-Medicine								
Masakatsu Yamashita (T)	C	Ehime University	Department of Immunology								

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Mark Nimlos (S)	PI	National Renewable Energy Laboratory	National Bioenergy Center	DOE	EERE - Energy Efficiency and Renewable Energy	DE-EE33392__	P18047	High Resolution Mass Spectral Analysis of Biomass Pyrolysis Residues Used to Prepare Graphite for Lithium Ion Batteries	Chemistry	1	3
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Ermias Dheressa (U)	C	National Renewable Energy Laboratory	5100								
Steven Rowland (S)	C	National Renewable Energy Laboratory	National Bioenergy Center								
Nolan Wilson (S)	C	National Renewable Energy Lab	National Bioscience Center								
Mengqiang Zhu (S)	PI	University of Wyoming	Ecosystem Science and Management	NSF	CAREER - Faculty Early Career Development Program	EAR-1752903	P18048	Oxidation of Dissolved Organic Matter by Manganese Oxides	Chemistry	2	8.5
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance	NSF	DEB - Division of Environmental Biology	DEB2027284					
Than Dam (G)	C	University of Wyoming	Department of Ecosystem Science and Management								
Zhen Hu (G)	C	University of Wyoming	College Of Agriculture And Natural Resources								
Hairuo Mao (P)	C	University of Wyoming	Ecosystem science and management								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Jianchao Zhang (P)	C	University of Wyoming	Ecosystem Science and Management								
Thomas Borch (S)	PI	Colorado State University	Soil and Crop Science	University Tuebingen	Non US College and University		P18055	Investigation into Dissolved Organic Matter in Arctic Soil	Chemistry	1	3
William Bahureksa (G)	C	Colorado State University	Chemistry	German Academic Scholarship Foundation	Other Non US Federal Agency						
Casey Bryce (P)	C	University of Tuebingen	Center for Applied Geoscience								
Andreas Kappler (S)	C	Eberhard Karls University of Tübingen	Center for Applied Geosciences								
Merritt Logan (G)	C	Colorado State University	Chemistry								
Monique Sézanne Patzner (G)	C	University Tuebingen	Geoscience								
Jeramie Adams (S)	PI	University of Wyoming	Transportation Technology	Petroleum			P18097	Investigation of Fractionated and Chemically Modified Interfacial Asphaltenes	Biology, Biochemistry, Biophysics	2	2.83
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Ryan Rodgers (S)	C	National High Magnetic Field Laboratory	ICR								
Collin Ward (S)	PI	Woods Hole Oceanographic Institution	Department of Marine Chemistry and Geochemistry,	No other support			P19124	Chemical characterization of marine plastic partial photochemical oxidation	Chemistry	1	2.53
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Sydney Niles (G)	C	National High Magnetic Field Laboratory	Chemistry								
Ryan Rodgers (S)	C	National High Magnetic Field Laboratory	ICR								
Anna Walsh (G)	C	Woods Hole Oceanographic Institution	Marine Chemistry and Geochemistry								
Chad Weisbrod (S)	C	National High Magnetic Field Laboratory	ICR								
Andrew Wozniak (S)	PI	University of Delaware	School of Marine Science and Policy	University of Delaware	US College and University	Start Up	P19159	Environmental controls on the chemical composition of Delaware Bay’s surface microlayer	Chemistry	1	1
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance	Univ of Delaware	US College and University						
Nicole Coffey (G)	C	University of Delaware	School of Marine Science and Policy								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								

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Roman Zubarev (S)	PI	Karolinska Institute	Division of Molecular Biometry	No other support			P19161	FT-ICR MS analysis of monoisotopic mammalian proteome and antibodies	Biology, Biochemistry, Biophysics	2	20.83
Lissa Anderson (S)	C	National High Magnetic Field Laboratory	ICR	UCGP		227000-520-038653					
Greg Blakney (S)	C	National High Magnetic Field Laboratory	ICR								
David Butcher (P)	C	National High Magnetic Field Laboratory	ICR								
Chris Hendrickson (S)	C	NHMFL	Ion Cyclotron Resonance Program								
Alan Marshall (S)	C	NHMFL	ICR								
Zeljka Popovic (G)	C	Florida State University	Ion Cyclotron Resonance								
Chad Weisbrod (S)	C	NHMFL	ICR								
Xuepei Zhang (P)	C	Karolinska Institutet	Department of Medical Biochemistry & Biophysics (MBB)								
Michael Timko (S)	PI	Worcester Polytechnic Institute	Chemical Engineering	MassCEC			P19162	Comprehensive Mass Spectrometer Analysis of Algae and Food Waste Hydrothermal Liquefaction Products	Chemistry	2	12.33
Feng Cheng (T)	C	Worcester Polytechnic Institute	Chemical Engineering	NSF	CAREER - Faculty Early Career Development Program	155428					
Daniela Fraga Alvarez (G)	C	Worcester Polytechnic Institute	Department of Chemical Engineering	DOE	Other	DE-SC0015784					
Sergio Granados-Focil (S)	C	Clark University	Department of Chemistry	DOE	Other	DE-EE0008513					
Amy McKenna (S)	C	NHMFL	ICR	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1605916					
John Moses (S)	C	CF Technologies, Inc.	Laboratory								
Robert Nelson (S)	C	Woods Hole Oceanographic Institution	Dept Marine Chemistry and Geochemistry								
Sydney Niles (G)	C	NHMFL	Chemistry								
Alex Paulsen (S)	C	Mainstream Engineering Corp	Defense and Space								
Chris Reddy (S)	C	Woods Hole Oceanographic Institution	Geochemistry								
Carla Roma (G)	C	Worcester Polytechnic Institute	Chemical Engineering								
Jessica Sweeney (S)	C	CF Technologies, Inc.	Laboratory								
Geoffrey Tompsett (S)	C	Worcester Polytechnic Institute	Chemical Engineering								
Ruihan Zhang (S)	C	Worcester Polytechnic Institute	Dept. Mechanical Engineering								
Jose Cerrato (S)	PI	University of New Mexico	Civil Engineering	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1652619	P19179	Investigation of the effect of natural organic matter and pH on the precipitation of U (VI)	Engineering	1	1
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance	NSF	Other	HRD1454443					
F. Omar Holguin (S)	C	New Mexico State University	Department of Plant and Environmental Science								
Jackie Jarvis (S)	C	New Mexico State University	Plant and Environmental Sciences								
Carmen Velasco (G)	C	University of New Mexico	Civil Engineering								
Robert Spencer (S)	PI	Florida State University	Earth, Ocean & Atmospheric Science	NASA			P19189	The dark side of DOM: probing obscured and functionalized freshwater DOM signatures	Chemistry	1	2
Taylor Glattke (G)	C	Florida State University	ICR								
Anne Kellerman (P)	C	Florida State University	Earth, Ocean and Atmospheric Science								
Martin Kurek (G)	C	FSU	Earth, Ocean, and Atmospheric Science								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Brett Poulin (S)	C	U.S. Geological Survey	National Research Program								
Jennifer Rogers (U)	C	Florida State University	EOAS								
Gayan Rubasinghege (S)	PI	New Mexico Tech	Chemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM103451	P19192	Fate, Transformation, and Toxicological Impacts of Pharmaceuticals and Personal Care Products	Chemistry	1	1
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance	DOE	Office of Science - BER - Biological & Environmental Research	DE-SC547055_					
Ekanayaka Ellepola (G)	C	New Mexico Tech	Chemistry	Center for Integrated Nanotechnologies	Other US Federal Agency						
Amy McKenna (S)	C	NHMFL	ICR								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Boris Lau (S)	PI	University of Massachusetts	Civil and Environmental Engineering	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1454443	**P19198**	Probing the Effects of Sulfidation on the Reactivity of Natural Organic Matter with Polymer-Capped Silver Nanoparticles by Fourier-Transform Ion Cyclotron Resonance Mass Spectrometry	Biology, Biochemistry, Biophysics	4	10
Martha Chacon (S)	C	NHMFL	Ion Cyclotron Resonance	University of Massachusetts - Internal Research Grant	Other						
Salimar Cordero (O)	C	University of Massachusetts	Civil and Environmental Engineering								
William Hockaday (S)	C	Baylor University	Geosciences								
Richard Vachet (S)	C	University of Massachusetts Amherst	Chemistry								
Nishanth Tharayil (S)	PI	Clemson University	Plant & Environmental Sciences	NSF	DEB - Division of Environmental Biology	DEB1754679	**P19212**	Chemical characterization of dissolved organic matter originating from decomposing leaf and root litter to elucidate their differential ability to influence soil organic matter sequestration	Chemistry	2	7
Huan Chen (S)	C	NHMFL	Ion Cyclotron Resonance								
Nimisha Edayilam (G)	C	Clemson University (Clemson)	Plant and Environmental Science								
Amy McKenna (S)	C	NHMFL	ICR								
Mengxue Xia (P)	C	Clemson University	Plant and Environmental Sciences Department								
David Griffith (S)	PI	Willamette University	Chemistry	No other support			**P19215**	Identification and resolution of isobaric interferences of estrogens in wastewater	Chemistry	1	1
Carolyn Hutchinson (G)	C	Iowa State University	Chemistry								
Amy McKenna (S)	C	NHMFL	ICR								
Zeljka Popovic (G)	C	Florida State University	Ion Cyclotron Resonance								
Chad Weisbrod (S)	C	National High Magnetic Field Laboratory	ICR								
Robert Spencer (S)	PI	Florida State University	Earth, Ocean & Atmospheric Science	NSF	GRFP - Graduate Research Fellowship Program	GRFP1449440	**P19219**	Dissolved organic matter composition and sources in sub-catchments in a Southeast Alaskan forested watershed	Chemistry	1	9
Megan Behnke (G)	C	Florida State University	Earth, Ocean and Atmospheric Science								
Jason Fellman (S)	C	University of Alaska Southeast	Environmental Science								
Sophia Gomez (U)	C	Florida State University	Biogeochemistry								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Ryan Rodgers (S)	PI	National High Magnetic Field Laboratory	ICR	NSF	OCE - Ocean Sciences	1045811	**P19237**	The Role of Sulfur Functionality in the Production of Photogenerated Water-Soluble Compounds from Surrogate and MC252 Crude Oils	Chemistry	1	2
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance	NSF	OCE - Ocean Sciences	1634478					
Elizabeth Kujawinski (S)	C	Woods Hole Oceanographic Institution	NA	NSF	OCE - Ocean Sciences	1756242					
Alan Marshall (S)	C	National High Magnetic Field Laboratory	ICR	NSF	OCE - Ocean Sciences	1756947					
Sydney Niles (G)	C	National High Magnetic Field Laboratory	Chemistry	NSF	OCE - Ocean Sciences	1635562					
Chris Reddy (S)	C	Woods Hole Oceanographic Institution	Geochemistry								
Dave Valentine (S)	C	University of California, Santa Barbara	Department of Geological Sciences								
Helen White (S)	C	Haverford College	Chemistry								
Mary Zeller (P)	PI	Leibniz Institute for Baltic Sea Research Warnemünde	Department of Marine Geology	NSF	DEB - Division of Environmental Biology	DEB1237517	**P19274**	Molecular characterization of Florida Bay DOM	Chemistry	1	0.5
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance	NSF	DEB - Division of Environmental Biology	DEB1832229					
John Kominoski (S)	C	Florida International University	Biological Sciences								
Christian Lopes (G)	C	Florida International University	Biology								

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Amy McKenna (S)	C		NHMFL	ICR								
Chris Osburn (S)	C		North Carolina State University	Marine, Earth, and Atmospheric Sciences								
Ashley Smyth (S)	C		University of Florida	Tropical Research and Education Center								
Bryce Van Dam (P)	C		Helmholtz-Zentrum Geesthacht	Institute for Coastal Science								
Karina Meredith (T)	PI	*	Australia's Nuclear Science and Technology organization	Australia's Nuclear Science and Technology organization	Australian Department of Foreign Affairs and Trade	Other Non US Federal Agency		P19277	Addressing Chronic Kidney Disease of Unknown Aetiology (CKDu) in Sri Lanka	Biology, Biochemistry, Biophysics	1	1.33
Andy Baker (S)	C		University of New South Wales	School of Biological, Earth and Environmental Sciences	Australian Nuclear Science Technology organization	Other						
Megan Behnke (G)	C		Florida State University	EAOS								
Rohana Chandrajith (S)	C		University of Peradeniya	Faculty of Science								
Liza McDonough (G)	C		University of New South Wales	School of Biological, Earth and Environmental Sciences								
Robert Spencer (S)	C		Florida State University	EAOS								
Jason Masoner (S)	PI	*	U.S. Geological Survey	Texas Water Science Center	USGS	US Government Lab		P19279	Determining potential environmental exposure and effects through the irrigation of crops with treated WWTP effluent and applied biosolids (i.e. Chickasha Wastewater Reuse Study)	Engineering	2	2
Huan Chen (S)	C		NHMFL	Ion Cyclotron Resonance	University of New Orleans	US College and University						
Isabelle Cozzarelli (S)	C		U.S. Geological Survey	National Research Program								
Katherine Humpal (G)	C		University of New Orleans	Chemistry								
Dana Kolpin (S)	C		U.S. Geological Survey	Research Hydrologist								
Amy McKenna (S)	C		NHMFL	ICR								
David Podgorski (S)	C		University of New Orleans	Department of Chemistry								
Robert Spencer (S)	PI		Florida State University	Earth, Ocean & Atmospheric Science	NOMIS Foundation	Non US Foundation		P19289	Global perspective on the sources, cycling and composition of dissolved organic matter exported from mountain glaciers	Chemistry	1	3
Tom Battin (S)	C		Ecole Polytechnique Federale de Lausanne	ENAC IEE SBER								
Amy Holt (G)	C		Florida State University	EAOS								
Anne Kellerman (P)	C		Florida State University	EAOS								
Amy McKenna (S)	C		NHMFL	ICR								
Thomas Manning (S)	PI		Valdosta State University	Chemistry	NSF	DUE	DUE1240059	P19292	Bryostatin Analysis	Chemistry	1	2
Taylor Glattke (G)	C		Florida State University	ICR								
Sydney Niles (G)	C		NHMFL	Chemistry								
Pierre Giusti (S)	PI		Total	Research & Technology	Conseil Régional d'Aquitaine		20071303002PFM	P19298	Analysis of Petroleum Products by Gel Permeation Chromatography (GPC) Online with Inductively Coupled Plasma Mass Spectrometry (ICP MS) and with Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS)	Biology, Biochemistry, Biophysics	3	30.67
Nelson Acevedo (S)	C		University of Pau and Pays de l'Adour	IPREM	FEDER		31486/08011464					
Carlos Afonso (S)	C		Normandy University	Chemistry	EU		636829					
Brice Bouyssiere (S)	C		University of Pau and Pays de l'Adour	IPREM	Total university of pau et des pays de	Other						
Herve Carrier (S)	C		University of Pau and Pays de l'Adour	UPPA								
Jimmy Castillo (S)	C		Central University of Venezuela	Escuela de Quimica								
Martha Chacon (S)	C		NHMFL	Ion Cyclotron Resonance								
Jean-Luc Daridon (S)	C		University of Pau and Pays de l'Adour	IPREM								
Pierre Giusti (S)	C		Total	Refining and Chemicals								
Caroline Mangote (S)	C		Total	Research & Technology								
Aurora Mejia (S)	C		University of Pau and Pays de l'Adour	UPPA								
Remi Moulian (G)	C		Unknown	ICR								
Sandra Mounicou (S)	C		University of Pau and Pays de l'Adour	Chimie Analytique								
Vincent Piscitelli (S)	C		Central University of Venezuela	Escuela de Quim´ica								
Jonathan Putman (G)	C		NHMFL	ICR								
Sadia Radji (S)	C		University of Pau and Pays de l'Adour	UPPA								
Ryan Rodgers (S)	C		NHMFL	ICR								
Juliana D'Andrilli (S)	PI		Louisiana Universities Marine Consortium (LUMCON)	Environmental Chemistry	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1804736	P19300	Disentangling the Underlying Chemistry of Absorbance and Fluorescence Spectroscopy: Coupling Multi-detector Size-Exclusion Based Fractionation of Dissolved Organic Matter to Molecular-Level FT-ICR MS Composition Analysis	Chemistry	1	4
Martha Chacon (S)	C		NHMFL	Ion Cyclotron Resonance								
Sarah Fischer (P)	C		University of Colorado, Boulder	Civil, Environmental and Architectural Engineering								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Fernando Rosario-Ortiz (S)	C		University of Colorado, Boulder	Environmental Engineering								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Núria Catalán (S)	PI	*	U.S. Geological Survey (USGS)	Water Mission Area	European Comission	Non US Council	H2020-MSCA-IF2018-839709	P19309	Potential effects of land use change on fjords of Northern Patagonia under climate change scenarios	Chemistry	1	3.28
Anne Kellerman (P)	C		Florida State University	Earth, Ocean and Atmospheric Science								
Jorge León-Muñoz (S)	C		Universidad Católica de la Santísima Concepción Facultad de Ciencias	Environmental Chemistry								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Robert Spencer (S)	C		Florida State University	EAOS								
Núria Catalán (S)	PI	*	U.S. Geological Survey (USGS)	Water Mission Area	European Comission	Non US Council	H2020-MSCA-IF-2018-839709	P19310	CHROME: Linking chemical diversity and reactivity of arctic dissolved organic matter for its integration in Earth system models	Chemistry	1	2.78
Bertrand Guenet (S)	C		French National Center for Scientific Research	Laboratoire des sciences du climat et de l'environnement								
Anne Kellerman (P)	C		Florida State University	Earth, Ocean and Atmospheric Science								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Ada Pastor (P)	C		Aarhus University	Bioscience-Aquatic Biology								
Robert Spencer (S)	C		Florida State University	Earth, Ocean & Atmospheric Science								
Kimberly Wickland (S)	C		U.S. Geological Survey	National Research Program								
David Harper (S)	PI	*	University of Tennessee, Knoxville	Center for Renewable Carbon	USDA - Department of Agriculture		2017 2016-08827	P19320	A Comprehensive Chemical Analysis of Lignin Feedstocks	Magnets, Materials	1	6
Huan Chen (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance	DOE	BETO - Bioenergy Technologies Office	DE-EE0008353					
Valerie Garcia-Negron (G)	C		University of Tennessee, Knoxville	Center for Renewable Carbon								
Alexander Johs (S)	C		Oak Ridge National Laboratory	Environmental Sciences Division								
David Keffer (S)	C		University of Tennessee, Knoxville	Materials Science & Engineering								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Sydney Niles (G)	C		National High Magnetic Field Laboratory	Chemistry								
Orlando Rios (S)	C		Oak Ridge National Laboratory	Materials Science & Technology								
Kendhl Seabright (P)	C		University of Tennessee, Knoxville	Center for Renewable Carbon								
Lu Yu (G)	C		University of Tennessee, Knoxville	Materials Science and Engineering								
Kenneth Carroll (S)	PI	*	New Mexico State University	Plant and Environmental Sciences	New Mexico State University Agricultural Experiment Station	US College and University		P19321	Characterization of Produced Water in the Permian Basin for Potential Beneficial Use	Chemistry	1	2
Jackie Jarvis (S)	C		New Mexico State University	Plant and Environmental Sciences								
Wenbin Jiang (G)	C		New Mexico State University	Civil Engineering								
Naima Khan (S)	C		New Mexico State University	Plant and Environmental Sciences								
Pei Xu (S)	C		New Mexico State University	Civil Engineering								
Patrick Tomco (S)	PI		University of Alaska Anchorage	Chemistry Department	NSF	OIA - Office of Integrative Activities	1929173	P19325	Photo-enhanced toxicity of dispersed and burned crude oil to arctic mussels	Chemistry	1	6.7
Katrina Counihan (S)	C		Alaska SeaLife Center	Research	Department of Homeland Security	Other US Federal Agency						
Rana Ghannam (G)	C		University of New Orleans	Chemistry								
Maxwell Harsha (G)	C		University of New Orleans	Chemistry								
Deja Hebert (G)	C		University of New Orleans	Chemistry								
Katherine Humpal (G)	C		University of New Orleans	Chemistry								
Iurii Kurerov (G)	C		University of New Orleans	Chemistry								
Jonathan Long (G)	C		Advanced Magnet Lab, Inc.	Chemistry								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
David Podgorski (S)	C		University of New Orleans	Department of Chemistry								
Zachary Redman (P)	C		University of Alaska, Anchorage	Chemistry								
Phoebe Zito (S)	C		University of New Orleans	Chemistry								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
John Headley (S) Huan Chen (S) Nicole Heshka (S) Amy McKenna (S) Kerry Peru (T) Ian Vander Meulen (T)	PI C C C C C		Environment and Climate Change Canada National High Magnetic Field Laboratory Natural Resources Canada National High Magnetic Field Laboratory Environment and Climate Change Canada Environment and Climate Change Canada	National Hydrology Research Centre Ion Cyclotron Resonance CanmetENERGY ICR Water Science and Technology Watershed Hydrology and Ecology and Ecology Research Division	Environment Canada	Non US Government Lab		P19328	APPI characterization of naphthenic acids in soft tailing capped treatments and weathering of petroleum spill in a laboratory wave simulator	Chemistry	2	7
Amin Mirkouei (S) Martha Chacon (S) Kavita Sharma (P) Ethan Struhs (G)	PI C C C	*	University of Idaho National High Magnetic Field Laboratory Idaho State University University of Idaho	Mechanical and Biological Engineering Ion Cyclotron Resonance Department of Chemistry Engineering	University of Idaho (EIS Grant)	Other		P19334	Multi-level chemical fractionation scheme to enable in-depth characterization of bio-oil	Chemistry	1	5
Thomas Borch (S) Eugene Kelly (S) Merritt Logan (G) Amy McKenna (S) Sydney Niles (G) Charles Rhoades (S) Holly Roth (G) Mike Wilkins (S)	PI C C C C C C C		Colorado State University Colorado State University Colorado State University National High Magnetic Field Laboratory National High Magnetic Field Laboratory U.S. Department of Agriculture Colorado State University Colorado State University	Soil and Crop Science College of Agricultural Sciences Chemistry ICR Chemistry Rocky Mountain Research Station Chemistry College of Agricultural Sciences	No other support			P19338	Forest fire-impacted soil organic matter chemistry	Chemistry	3	3.08
Estrella Rogel (S) Martha Chacon (S) Francisco Lopez Linares (S) Cesar Ovalles (S) Ryan Rodgers (S)	PI C C C C	*	Chevron ETC National High Magnetic Field Laboratory Chevron, Richmond Chevron Energy Tech. Comp. National High Magnetic Field Laboratory	Products and Analytical Ion Cyclotron Resonance Downstream and Service-Petroleum and Material Characterization Downstream and Services ICR	Chevron Research	Other		P19359	Entangling Petroleum Properties with Molecular Composition: Analysis of Asphaltene Fractions by High-Temperature GC Coupled to ICP MS.	Chemistry	2	5
Chris Reddy (S) Martha Chacon (S) Robert Nelson (S) Sydney Niles (G) Ryan Rodgers (S) Dave Valentine (S)	PI C C C C C		Woods Hole Oceanographic Institution National High Magnetic Field Laboratory Woods Hole Oceanographic Institution National High Magnetic Field Laboratory National High Magnetic Field Laboratory University of California, Santa Barbara	Geochemistry Ion Cyclotron Resonance Dept Marine Chemistry and Geochemistry Chemistry ICR Department of Geological Sciences	No other support			P19420	Brazil Oil Spill - Analysis of Field Samples	Chemistry	1	1.5
Collin Ward (S) Danielle Freeman (G) Amy McKenna (S) Taylor F Nelson (P)	PI C C C		Woods Hole Oceanographic Institution Woods Hole Oceanographic Institution NHMFL Woods Hole Oceanographic Institution	Department of Marine Chemistry and Geochemistry, Marine Chemistry & Geochemistry ICR Marine Chemistry & Geochemistry	NSF Canadian Division of Fisheries and Ocean Sciences: Multi-Partner Research Initiative	OCE - Ocean Sciences Non US Ministry	OCE174530_ 1.06	P19429	Analysis of photochemical incorporation of 18O-labeled dioxygen and water into crude oil using ultra high-resolution mass spectrometry: a novel assessment of reactants and pathways	Chemistry	1	0.5
Leslie Hicks (S) Lissa Anderson (S) Amanda Smythers (G)	PI C C	*	University of North Carolina at Chapel Hill NHMFL University of North Carolina at Chapel Hill	Chemistry ICR Chemistry	NSF NSF	CAREER - Faculty Early Career Development Program MCB - Molecular and Cellular Biosciences	MCB-1552522 MCB1714405	P19430	Leveraging top-down proteomics to assess reversible cysteine oxidation in Chlamydomonas reinhardtii	Biology, Biochemistry, Biophysics	1	4.5

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Robert Spencer (S)	PI		Florida State University	Earth, Ocean & Atmospheric Science	NASA			P19435	Characterizing DOM compositions across a changing arctic	Chemistry	1	19.5
Martin Kurek (G)	C		FSU	Earth, Ocean, and Atmospheric Science								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Sydney Niles (G)	C		National High Magnetic Field Laboratory	Chemistry								
Brett Poulin (S)	C		U.S. Geological Survey	National Research Program								
RAGHAB RAY (P)	PI	*	The University of Tokyo, Atmosphere and Ocean Research Institute	Chemical Oceanography	No other support			P19448	Composition and fate of dissolved organic matter derived from mangroves	Chemistry	1	0.25
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Toshihiro Miyajima (S)	C		The University of Tokyo, Atmosphere and Ocean Research Institute	Atmosphere and Ocean Research Institute								
Robert Spencer (S)	C		Florida State University	Earth, Ocean & Atmospheric Science								
Aron Stubbins (S)	C		Northeastern University	Marine and Environmental Science								
Colleen McMahan (S)	PI	*	U.S. Department of Agriculture	Bioproducts Research Unit/Western Regional Research Center	USDA - Department of Agriculture		2030-24-1410-022D	P19457	Determination of isoprenoid pathway metabolites in bioengineered guayule	Biology, Biochemistry, Biophysics	1	0.33
Catherine Brewer (S)	C		New Mexico State University	Chemical and Materials Engineering	New Mexico State University Agricultural Experiment Station	US College and University						
Mostafa Dehghanizadeh (G)	C		New Mexico State University	Chemical and Materials Engineering								
Claudia Galvan (T)	C		New Mexico State University	Plant and Environmental Science								
F. Omar Holguin (S)	C		New Mexico State University	Department of Plant and Environmental Science								
Jackie Jarvis (S)	C		New Mexico State University	Plant and Environmental Sciences								
Dante Placido (P)	C		U.S. Department of Agriculture	Bioproducts Research Unit/Western Regional Research Center								
Sergei Shalygin (G)	C		New Mexico State University	Plant and Environmental Science								
Samantha Joye (S)	PI	*	University of Georgia	Department of Marine Sciences	NSF	OCE - Ocean Sciences	OCE2023575	P19460	Microbially-mediated oil transformation in contrasting natural environments.	Chemistry	1	1.83
Zachary Marinelli (G)	C		University of Georgia	Marine Sciences								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Ryan Rodgers (S)	C		National High Magnetic Field Laboratory	ICR								
Ryan Sibert (G)	C		University of Georgia	Marine Science Department								
Ryan Rodgers (S)	PI		National High Magnetic Field Laboratory	ICR	No other support			P19464	Understanding of Emulsion Formation from Photo-Oxidized Crude Oils	Chemistry	1	17.33
Joseph Frye (G)	C		National High Magnetic Field Laboratory	CIMAR								
Alan Marshall (S)	C		National High Magnetic Field Laboratory	ICR								
Jon Hawkings (P)	PI	*	Florida State University	Earth, Ocean and Atmospheric Sciences	European Research Council	Non US Council	793962	P19475	Glacial influence on organic matter export in polar watersheds	Chemistry	1	1.83
Anne Kellerman (P)	C		Florida State University	Earth, Ocean and Atmospheric Science								
Matthew Marshall (G)	C		University of Bristol	School of Geographical Sciences								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Robert Spencer (S)	C		Florida State University	Earth, Ocean & Atmospheric Science								
Jemma Wadham (S)	C		University of Bristol	School of Geographical Sciences								
Xiaolin Li (S)	PI	*	Xiamen University	School of Marine and Earth Sciences	NSFC	Other	41676059	P19493	Fate of Diazotroph-derived Nitrogen in the North Pacific Subtropical Gyre: Revealed by the Molecular Characterization of Dissolved Organic Nitrogen	Chemistry	1	0.33
Peng Jiang (G)	C		Xiamen University	State Key Laboratory of Marine Environmental Science								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Robert Spencer (S)	C		Florida State University	Earth, Ocean & Atmospheric Science								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Jens Blotevogel (S)	PI		Colorado State University	Civil & Environmental Engineering	No other support			P19497	Membrane Distillation of Oil & Gas Produced Water	Chemistry	1	0.33
Andrea Hanson (G)	C		Colorado State University	Civil and Environmental Engineering								
Amy McKenna (S)	C		NHMFL	ICR								
Radisav Vidic (S)	C		University of Pittsburgh	Civil & Environmental Engineering								
Robert Young (S)	C		Colorado State University	Soil & Crop Sciences								
Calvin Mukarakate (S)	PI	*	National Renewable Energy Laboratory	National Bioenergy Center	DOE	BETO - Bioenergy Technologies Office	DE-AC36-08-GO28308	P19502	Impacts of Biomass Feed, Catalyst, and Operating Conditions on Molecular Transformations during Catalytic Fast Pyrolysis Oil	Chemistry	1	5
Martha Chacon (S)	C		NHMFL	Ion Cyclotron Resonance								
Kristiina Iisa (S)	C		National Renewable Energy Laboratory	Catalytic Carbon Transformation and Scale-Up Center								
Steven Rowland (S)	C		National Renewable Energy Laboratory	National Bioenergy Center								
David Podgorski (S)	PI		University of New Orleans	Department of Chemistry	Enbridge Energy			P19518	Extraction Selectivity of Polar Compounds in Petroleum Contaminated Groundwater Plumes	Chemistry	1	1
Barbara Bekins (S)	C		U.S. Geological Survey	National Research Program	Shell Global Solutions							
Rana Ghannam (G)	C		University of New Orleans	Chemistry	USGS Toxic Substances Hydrology Program	Other US Federal Agency						
Amy McKenna (S)	C		NHMFL	ICR	Minnesota Pollution Control Agency	Other						
Phoebe Zito (S)	C		University of New Orleans	Chemistry								
Chris Hendrickson (S)	PI		NHMFL	Ion Cyclotron Resonance Program	No other support			P19548	Analytical Method Development for FT-ICR MS	Chemistry	1	14
Lissa Anderson (S)	C		NHMFL	ICR								
Greg Blakney (S)	C		NHMFL	ICR								
Amy McKenna (S)	C		NHMFL	ICR								
Chad Weisbrod (S)	C		NHMFL	ICR								
									Total Proposals: 67		**Experiments: 92**	**Days: 612**

6. NMR Facility

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Anant Paravastu (S)	PI	Georgia Institute of Technology	School of Chemical & Biomolecular Engineering	NIH	Other	1R01AG045703-01A1	P11458	Solid State NMR Structural Characterization of oligomeric ß-Amyloid (1-42) peptide	Biology, Biochemistry, Biophysics	1	2.5
Yuan Gao (G)	C	Georgia Institute of Technology	School of Chemical and Biomolecular Engineering								
Cong Guo (P)	C	NHMFL	physics								
Danting Huang (G)	C	Florida State University	College of Engineering								
Frederic Mentink (S)	C	NHMFL	NMR Division								
Terrone Rosenberry (S)	C	Mayo Clinic, Jacksonville	Neuroscience								
Jens Watzlawik (P)	C	Mayo Clinic, Jacksonville	College of Medicine								
Sungsool Wi (S)	C	NHMFL	NMR								
Huan-Xiang Zhou (S)	C	University of Illinois at Chicago	Physics and Chemistry								
Fang Tian (S)	PI	Pennsylvania State University	Biochemistry and Molecular Biology, Penn State Medical School	NIH	NIGMS - National Institute of General Medical Sciences	GM127730	P16233	Structure Determination of the Transmembrane Domain of Human Amyloid Precursor Protein Binding Receptor LR11 (sorLA) in a Biological Membrane	Biology, Biochemistry, Biophysics	2	12
Riqiang Fu (S)	C	NHMFL	NMR								
Liliya Vugmeyster (S)	PI	University of Colorado, Denver	Chemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM115111	P16309	Dynamics of amyloid-beta fibrils by deuteron NMR	Biology, Biochemistry, Biophysics	1	4
Dan Au (G)	C	University of Colorado, Denver	Bioengineering								
Dmitry Ostrovsky (S)	C	University of Alaska, Anchorage	Mathematics								
Sungsool Wi (S)	PI	NHMFL	NMR	No other support			P16311	Development of the state-of-the-art solid-state NMR methods suitable at ultrahigh magnetic fields and MAS spinning rates	Biology, Biochemistry, Biophysics	6	39
Tim Cross (S)	C	NHMFL	NHMFL/Chemistry & Biochemistry	NSF	DMR - Division of Materials Research	DMR1644779					
Lucio Frydman (S)	C	NHMFL	NMR	Israel Science Foundation	Non US Foundation	965/18					
Kwang Hun Lim (S)	C	East Carolina University	Chemistry								
Yiseul Shin (G)	C	Florida State University	Chemistry								
Ashley Blue (T)	PI	NHMFL	NHMFL	No other support			P16319	NMR System Maintenance	Magnets, Materials	6	121
Kevin Chalek (G)	C	University of California, Riverside	Chemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM122698					
Bo Chen (S)	C	University of Central Florida	Department of Physics								
Banghao CHen (S)	C	Florida State University	Chemistry & Biochemistry								
Justin Douglas (S)	C	University of Kansas	Molecular Structures Group								
Thierry Dubroca (S)	C	NHMFL	EMR								
Emily Foley (G)	C	University of California, Santa Barbara	Materials								
Riqiang Fu (S)	C	NHMFL	NMR								
Zhehong Gan (S)	C	NHMFL	NHMFL								
Ivan Hung (S)	C	NHMFL	CIMAR/NMR								
Jessica Kelz (G)	C	University of California, Irvine	Chemistry								
Jason Kitchen (T)	C	NHMFL	NMR								
Joanna Long (S)	C	University of Florida	Biochemistry & Molecular Biology								
Frederic Mentink (S)	C	NHMFL	NMR Division								
Lakshmi Bhai N Vidyadharan (G)	C	Ohio State University	Department of Chemistry and Biochemistry								
Lauren O'Donnell (P)	C	Hunter College of CUNY	Physics								
Sarah Overall (P)	C	Swiss Federal Institute of Technology in Zurich	Chemistry								
Luke Reynolds (G)	C	University of British Columbia	Physics and Astronomy								
Jens Rosenberg (S)	C	NHMFL	NMR								
Victor Schepkin (S)	C	NHMFL	CIMAR								
Kan Tagami (G)	C	University of California, San Diego	Chemistry								
Tanya Whitmer (S)	C	Ohio State University	CCIC								
Sungsool Wi (S)	C	NHMFL	NMR								
Qiong Wu (S)	C	University of Texas, Southwestern	Biophysics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Benito Marinas (S)	PI	University of Illinois at Urbana-Champaign	Civil and Environmental Engineering	NSF	GRFP - Graduate Research Fellowship Program	GRFP1746047	P17334	Determination of fluoride chemical environment on calcium hydroxyapatite nanoparticles of different crystallinities – distinguishing the dominant mechanism(s) of fluoride removal	Engineering	2	10
Daniel Mosiman (G)	C	University of Illinois at Urbana-Champaign	Civil and Environmental Engineering								
Tuo Wang (S)	PI	Louisiana State University	Chemistry	NSF	OIA - Office of Integrative Activities	1833040	P17348	Structure and Packing of Complex Carbohydrates in Native Plant and Fungal Cell Walls from Solid-State DNP-NMR	Biology, Biochemistry, Biophysics	6	24
Arnab Chakraborty (G)	C	Louisiana State University	Chemistry	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI121149					
Malitha Dickwella Widanage (G)	C	Louisiana State University	chemistry	NSF	CAREER - Faculty Early Career Development Program	1942665					
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL	NSF	MCB - Molecular and Cellular Biosciences	MCB1942665					
Alex Kirui (G)	C	Louisiana State University	Chemistry								
Frederic Mentink (S)	C	NHMFL	NMR Division								
Cecil Dybowski (S)	PI	University of Delaware	Chemistry and Biochemistry	NSF	DMR - Division of Materials Research	DMR1608366	P17354	Assessing the potential of high-field, natural abundance 67Zn solid-state NMR for understanding the reactivity of ZnO-based pigments in paint films	Chemistry	1	6
Silvia Centeno (S)	C	The Metropolitan Museum of Art	Scientifi Research	NSF	DMR - Division of Materials Research	DMR1608594					
Valeria Di Tullio (P)	C	The Metropolitan Museum of Art	Scientific Research								
Nicholas Zumbulyadis (S)	C	Independent Scholar and Consultant	Consultancy								
Myriam Cotten (S)	PI	College of William and Mary	Applied Science	NSF	MCB - Molecular and Cellular Biosciences	MCB1716608	P17425	Investigating Host Defense Mechanisms at Biological Membranes	Biology, Biochemistry, Biophysics	5	57
Riqiang Fu (S)	C	NHMFL	NMR								
Leonard Mueller (S)	PI	University of California, Riverside	Chemistry	NSF	CHE - Chemistry	CHE1710671	P17435	Chemically-Rich Structure and Dynamics in the Active Site of Tryptophan Synthase from 17O Quadrupole Central Transition NMR at 36 T	Biology, Biochemistry, Biophysics	1	7
Varun Sakhrani (G)	C	University of California, Riverside	Chemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM097569					
Chang Hyun Lee (S)	PI	Dankook University	Energy Engineering Department	No other support			P17436	Solid-state NMR characterization of nanodispersed polymeric membrane materials for energy generation and valued chemicals production	Chemistry	2	15
Jin Pyo Hwang (G)	C	Dankook University	Energy Engineering	Korea Institute of Energy Technology Evaluation and Planning (KETEP) and the Ministry of Trade, Industry & Energy (MOTIE)	Non US Foundation	No. 20153010031920					
Woo Young Kim (G)	C	Dankook University	Energy Engineering								
Chang Hoon Oh (G)	C	Dankook University	Energy Engineering								
In Kee Park (G)	C	Dankook University	Energy Engineering								
Se Youn Pyo (G)	C	Dankook University	Energy engineering								
Sungsool Wi (S)	C	NHMFL	NMR								
Gianluigi Veglia (S)	PI	University of Minnesota, Twin Cities	BMBB	NIH	NHLBI - National Heart and Blood Institute	HL144130	P17438	NMR Structural Analysis of Sarcoplasmic Reticulum Proteins in Membranes	Biology, Biochemistry, Biophysics	2	6
Riqiang Fu (S)	C	NHMFL	NMR	NIH	NIGMS - National Institute of General Medical Sciences	GM064742					
Zhehong Gan (S)	C	NHMFL	NHMFL								
Tata Gopinath (P)	C	University of Minnesota, Twin Cities	Biochemistry								
Erik Larsen (G)	C	University of Minnesota, Twin Cities	Chemistry								
Sarah Nelson (G)	C	University of Minnesota, Twin Cities	Biochemistry, Molecular Biology, and Biophysics								
Joana Paulino (P)	C	NHMFL	CIMAR								
Songlin Wang (P)	C	University of Minnesota, Twin Cities	Biochemistry, Molecular Biology, and Biophysics								
Xiaoling Wang (P)	C	University of California, Santa Barbara (UC Santa Barbara, UCSB)	Physics								
Rongfu Zhang (P)	C	NHMFL	NHMFL								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Danielle Laurencin (S)	PI	University of Montpellier	Institut Charles Gerhardt de Montpellier	CNRS	Other		P17464	High resolution solid state NMR studies of biomaterials at 36 T:analysis of calcium and oxygen local environments	Chemistry	2	20
Christian Bonhomme (S)	C	Pierre and Marie Curie University	Laboratoire de Chimie de la Matière Condensée	European Research Council	Non US Council						
Chia-Hsin Chen (P)	C	French National Center for Scientific Research	Institut Charles Gerhardt de Montpellier								
Zhehong Gan (S)	C	NHMFL	NHMFL								
Christel Gervais (S)	C	Sorbonne University	Laboratoire de Chimie de la Matière Condensée								
Ieva Goldberga (P)	C	French National Center for Scientific Research	Institut Charles Gerhardt de Montpellier								
Frederic Mentink (S)	C	NHMFL	NMR Division								
Ayyalusamy Ramamoorthy (S)	PI	University of Michigan	Chemistry & Biophysics	NIH	NIGMS - National Institute of General Medical Sciences	GM084018	P17486	Solid-State NMR Experiments on Magnetically-Aligned Polymer Macro-Nanodiscs	Biology, Biochemistry, Biophysics	2	15
Riqiang Fu (S)	C	NHMFL	NMR								
Zhehong Gan (S)	C	NHMFL	NHMFL								
Thirupathi Ravula (P)	C	University of Michigan	Chemistry								
Tim Cross (S)	PI	NHMFL	NHMFL/Chemistry & Biochemistry	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI119178	P17493	Mycobacterium tuberculosis Divisome: Insights on protein structure and protein-protein interaction of important drug targets	Biology, Biochemistry, Biophysics	40	308
Cristian Escobar (P)	C	NHMFL	IMB	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI101119					
Joana Paulino (P)	C	NHMFL	CIMAR	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI131512					
Huajun Qin (T)	C	Florida State University	Chemistry & Biochemistry								
Yiseul Shin (G)	C	Florida State University	Chemistry								
Joshua Taylor (U)	C	Florida State University	Chemistry & Biochemistry								
Rongfu Zhang (P)	C	NHMFL	NHMFL								
Aaron Rossini (S)	PI	Iowa State University	Chemistry	NSF	CHE - Chemistry	CHE1709972	P17500	Enhancing the Resolution of 1H Solid-State NMR Spectra With Fast MAS and High Magnetic Fields	Chemistry	3	19
Kuizhi Chen (P)	C	NHMFL	NMR	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1916809					
Rick Dorn (G)	C	Iowa State University	Chemistry								
Zhehong Gan (S)	C	NHMFL	NHMFL								
Ivan Hung (S)	C	NHMFL	CIMAR/NMR								
Amrit Venkatesh (G)	C	Iowa State University	Chemistry								
Yining Huang (S)	PI	University of Western Ontario	Chemistry	NSERC of Canada	Other Non US Federal Agency		P17504	O-17 solid-state NMR of metal-organic frameworks	Chemistry	4	24
Zhehong Gan (S)	C	NHMFL	NHMFL	NSERC	Other Non US Federal Agency						
Ivan Hung (S)	C	NHMFL	CIMAR/NMR								
Vinicius Martins (G)	C	University of Western Ontario	Chemistry								
Hadi Mohammadigoushki (S)	PI	Florida State University	Chemical and Biomedical Engineering	NSF	CAREER - Faculty Early Career Development Program	XXX	P17560	Dynamics and structural characterization of living polymers via NMR spectroscopy	Engineering	3	4
Samuel Grant (S)	C	NHMFL	Chemical & Biomedical Engineering	NSF	CAREER - Faculty Early Career Development Program	CBET 1942150					
Samuel Holder (G)	C	Florida State University	Chemical & Biomedical Engineering								
Sungsool Wi (S)	C	NHMFL	NMR								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Zhehong Gan (S)	PI	NHMFL	NHMFL	No other support			P17597	Development of 1.5 GHz NMR using 36T Series-Connected-Hybrid (SCH) Magnet	Magnets, Materials	1	5
William Brey (S)	C	NHMFL	NMR								
Kuizhi Chen (P)	C	NHMFL	NMR								
Po-Hsiu Chien (G)	C	Florida State University	Chemistry and Biochemistry								
Tim Cross (S)	C	NHMFL	NHMFL/Chemistry & Biochemistry								
Ivan Hung (S)	C	NHMFL	CIMAR/NMR								
Ilya Litvak (S)	C	NHMFL	CIMAR/NMR								
Joana Paulino (P)	C	NHMFL	CIMAR								
Jeffrey Schiano (S)	C	Pennsylvania State University	Electrical Engineering								
Tim Cross (S)	PI	National High Magnetic Field Laboratory	NHMFL/Chemistry & Biochemistry	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI119178	P17605	Interactions of Tuberculosis Divisome Membrane Domains ChiZ, CrgA and FtsQ	Biology, Biochemistry, Biophysics	7	110
Samuel Grant (S)	PI	NHMFL	Chemical & Biomedical Engineering	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS102395	P17628	In vivo tracking of cell therapy to treat stroke: Cell migration & 23Na MRI	Biology, Biochemistry, Biophysics	59	115
Frederick Bagdasarian (G)	C	Florida State University	College of Engineering								
Cesario Borlongan (S)	C	University of South Florida	College of Medicine, Neurosurgery								
Bruce Bunnell (S)	C	Tulane University	Pharmacology								
Shannon Helsper (G)	C	NHMFL	NMR								
Teng Ma (S)	C	Florida State University	Chemistry & Biomedical Engineering								
Jens Rosenberg (S)	C	NHMFL	NMR								
Xuegang Yuan (G)	C	Florida State University	Chemical & Biomedical								
Kwang Hun Lim (S)	PI	East Carolina University	Chemistry	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS097490	P17630	Molecular Basis of Distinct Tau Strains and their Prion-like Propagation	Biology, Biochemistry, Biophysics	11	96
Anvesh Kumar Reddy Dasari (G)	C	East Carolina University	Chemistry	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS109749					
Sungsool Wi (S)	C	NHMFL	NMR								
Bo Chen (S)	PI	University of Central Florida	Department of Physics	NSF	MCB - Molecular and Cellular Biosciences	MCB1856055	P17687	Molecular basis of tunable iridescence of cephalopods	Biology, Biochemistry, Biophysics	2	11
Zhehong Gan (S)	C	NHMFL	NHMFL								
Ivan Hung (S)	C	NHMFL	CIMAR/NMR								
Lucio Frydman (S)	PI	NHMFL	NMR	NSF	CHE - Chemistry	CHE1808660	P17754	Three-Spins Solution State DNP	Biology, Biochemistry, Biophysics	1	9
Adewale Akinfaderin (G)	C	Florida State University	Physics								
Thierry Dubroca (S)	C	NHMFL	EMR								
Stephen Hill (S)	C	NHMFL	EMR								
Krishnendu Kundu (P)	C	NHMFL	EMR								
Murari Soundararajan (P)	C	NHMFL	CIMAR, NMR								
Johan van Tol (S)	C	NHMFL	EMR								
Sungsool Wi (S)	C	NHMFL	NMR								
Sabyasachi Sen (S)	PI	University of California, Davis	Chemical Engineering and Materials Science	NSF	DMR - Division of Materials Research	DMR1855176	P17811	Investigation of the atomistic basis of structural relaxation and viscous flow in supercooled chalcogenide liquids by high field dynamical NMR spectroscopy	Condensed Matter Physics	11	134
Zhehong Gan (S)	C	NHMFL	NHMFL								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Yiqing Xia (G)	C	University of California, Davis	Materials Science								
Bing Yuan (G)	C	University of California, Davis	Engineering								
Weidi Zhu (G)	C	University of California, Davis	Materials Science & Engineering								
Smita Mohanty (S)	PI	Oklahoma State University	Chemistry	No other support			P17830	Asparagine-linked N-glycosylation: structure & function studies	Biology, Biochemistry, Biophysics	4	58
Omar Al-Danoon (G)	C	Oklahoma State University	Chemistry								
Bharat Chaudhary (G)	C	Oklahoma State University	Department of Chemistry								
Salik Dahal (G)	C	Oklahoma State University	Chemistry								

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Naresh Dalal (S)	PI	National High Magnetic Field Laboratory	Chemistry	NSF	CHE - Chemistry	CHE1608364	P17847	Probing Site Symmetry of Al dopants in Doped ZnSe Quanutm Dots Using MAS NMR	Condensed Matter Physics	1	8
Jasleen Bindra (G)	C	National Institute of Standards and Technology	PML								
Sanath Kumar R. Krishna (G)	C	Florida State University	Condensed Matter Physics								
Geoffrey Strouse (S)	C	National High Magnetic Field Laboratory	Chemistry								
Mark Davis (S)	PI	California Institute of Technology	Chemical Engineering	Chevron Corporation		15038035/ 15051812	P17852	Zn-67 NMR Investigation of strong Lewis Acid Sites in Zincosilicates	Chemistry	1	4
Sonjong Hwang (S)	C	California Institute of Technology	Chemistry and Chemical Engineering								
Sungsool Wi (S)	C	National High Magnetic Field Laboratory	NMR								
Zhehong Gan (S)	PI	National High Magnetic Field Laboratory	NHMFL	No other support			P17856	Development of solid-state NMR methods for applications at high-field and the 36 T SCH magnet	Chemistry	13	73
David Bryce (S)	C	University of Ottawa	Department of Chemistry and Biomolecular Sciences								
Kuizhi Chen (P)	C	NHMFL	NMR								
Po-Hsiu Chien (G)	C	Florida State University	Chemistry and Biochemistry								
Tim Cross (S)	C	NHMFL	NHMFL/Chemistry & Biochemistry								
Petr Gor'kov (S)	C	NHMFL	CIMAR								
Robert Griffin (S)	C	Massachusetts Institute of Technology	Chemistry								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Sabyasachi Sen (S)	C	University of California, Davis	Chemical Engineering and Materials Science								
Amrit Venkatesh (G)	C	Iowa State University	Chemistry								
Gang Wu (S)	C	Queen's University at Kingston	Chemistry								
Jeffery White (S)	PI	Oklahoma State University	Chemical Engineering	NSF	CHE - Chemistry	CHE1764116	P17925	Elucidating H+/Al Siting and Chemical Structures in Zeolites by Ultra-High Field NMR	Chemistry	12	76
maryam Abdolrahmani (G)	C	Oklahoma State University	Chemistry								
Kuizhi Chen (P)	C	National High Magnetic Field Laboratory	NMR								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Sarah Horstmeier (G)	C	Oklahoma State University	Chemistry								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Gang Wu (S)	PI	Queen's University at Kingston	Chemistry	NSERC of Canada	Non US Council		P17926	Probing the hydrogen nuclear wavefunction in OHO low-barrier hydrogen bonds by 1H-17O double resonance NMR	Chemistry	3	12
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL	NSERC of Canada	Other Non US Federal Agency						
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Dylan Murray (S)	PI	University of California Davis	Chemistry	No other support			P17941	Molecular Determinants for the Assembly of Low Complexity Protein Domains	Biology, Biochemistry, Biophysics	6	44
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Steven McKnight (S)	C	University of Texas, Southwestern	Medical Center								
Hillary Sutton (G)	C	University of California, Davis	Chemistry								
Vasily Sysoev (P)	C	University of Texas, Southwestern	Biochemistry								
Yuuki Wittmer (G)	C	University of California, Davis	Chemistry								

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Robert Schurko (S)	PI	Florida State University	Chemistry	NSF	CHE - Chemistry	CHE2003854	P17946	Multinuclear Solid-State NMR of Quadrupolar Nuclei in Active Pharmaceutical Ingredients	Biology, Biochemistry, Biophysics	37	217
Christer Aakeroy (S)	C	Kansas State University	Chemistry and Biochemistry	State of Florida	Other						
Adam Altenhof (G)	C	Florida State University	Chemistry and Biochemistry	State of Florida	Other	n/a					
Zach Dowdell (G)	C	Florida State University	Chemistry	NSERC	Other Non US Federal Agency	NSERC RGPIN-2016_06642					
Zachary Dowdell (G)	C	Florida State University	Chemistry	nserc	Non US Council	NSERC RGPIN-2016_06642					
Ulrich Fekl (S)	C	University of Toronto (Mississauga)	Chemistry and Biochemistry	nserc	Non US Council	NSERC RGPIN-2016_006642					
Tomislav Friscic (S)	C	McGill University	Chemistry	NSERC	Non US Council						
Lucio Frydman (S)	C	National High Magnetic Field Laboratory	NMR	NSERC	Non US Council	n/a					
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL	nserc	Non US Council	NSERC RGPN-2016_06642					
James Harper (S)	C	Brigham Young University (BYU)	Chemistry and Biochemistry								
Sean Holmes (P)	C	Florida State University	Chemistry and Biochemistry								
James Hook (S)	C	University of New South Wales	Chemistry								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Igor Huskic (P)	C	McGill University	Chemistry and Biochemistry								
Robbie Iuliucci (S)	C	Washington and Jefferson College	Chemistry								
Michael Jaroszewicz (G)	C	University of Windsor	Chemistry								
Karthik Nagapudi (S)	C	Genentech Inc.	Small Molecule Pharmaceutical Sciences								
Austin Peach (G)	C	Florida State University	Chemistry and Biochemistry								
Ernest Prack (G)	C	University of Toronto (Mississauga)	Chemistry and Biochemistry								
Joseph Schlenoff (S)	C	Florida State University	Chemistry and Biochemistry								
Jennifer Swift (S)	C	Georgetown University	Chemistry								
Cameron Vojvodin (G)	C	Florida State University	Chemistry and Biochemistry								
Taylor Watts (G)	C	Georgetown University	Chemistry								
Bradley Nilsson (S)	PI	University of Rochester	Chemistry	NSF	CHE - Chemistry	CHE1904528	P17957	Structural interrogation of the packing architecture in hydrogel biomaterials: Towards rational design	Biology, Biochemistry, Biophysics	3	11
Elena Quigley (G)	C	University of Rochester	Chemistry								
Kendra Frederick (S)	PI	University of Texas, Southwestern	Biophysics	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS111236	P17968	Protein conformation determined in native cellular environments	Biology, Biochemistry, Biophysics	1	5
Whitney Costello (G)	C	University of Texas, Southwestern	Biophysics	NSF	CAREER - Faculty Early Career Development Program	1751174					
Jaka Kragelj (P)	C	University of Texas, Southwestern	Biophysics								
Frederic Mentink (S)	C	National High Magnetic Field Laboratory	NMR Division								
Yiling Xiao (P)	C	University of Texas, Southwestern	Biophysics								
Diana Bernin (S)	PI	Chalmers University of Technology	Chemistry and Chemical Engineering	No other support			P17969	Resource-efficient wood chips conversion to produce biobased chemicals	Engineering	1	5.5
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Frederic Mentink (S)	C	National High Magnetic Field Laboratory	NMR Division								
Daniel Topgaard (S)	C	University of Lund	Department of Chemistry								

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Sungsool Wi (S)	PI	National High Magnetic Field Laboratory	NMR	NSF	CHE - Chemistry	CHE1808660	P18056	Solution State Overhauser DNP at 14 T	Chemistry	1	10
Shuhui Cai (S) Zhong Chen (S) Riqiang Fu (S) Yuqing Huang (S) Chunhua Tan (G)	PI C C C C	Xiamen University Xiamen University National High Magnetic Field Laboratory Xiamen University Xiamen University	Department of Electronic Science Electronic Science NMR Electronic Science Department of Electronic Science	National Natural Science Foundation of China Xiamen University Chinese Scholarship council National Science Foundation of China	Other Non US College and University Non US Foundation Other		P18057	Development of high-resolution two-dimensional (2D) J-resolved NMR spectroscopy at high fields	Biology, Biochemistry, Biophysics	9	78
Guiming Zhong (S) Huixin Chen (T) Riqiang Fu (S)	PI C C	Chinese Academy of Sciences Chinese Academy of Sciences National High Magnetic Field Laboratory	Xiamen Institute of Rare Earth Materials Xiamen Institute of Rare Earth Materials NMR	Xiamen University Chinese Academy of Sciences National Natural Science Foundation of China	Non US College and University Non US Foundation Non US Foundation		P18086	Probing storage mechanisms of anode materials for potassium ion batteries by employing high-magnetic field MAS NMR spectroscopy	Chemistry	4	10
Joanna Long (S) Thierry Dubroca (S) Petr Gor'kov (S) Frederic Mentink (S)	PI C C C	University of Florida National High Magnetic Field Laboratory National High Magnetic Field Laboratory National High Magnetic Field Laboratory	Biochemistry & Molecular Biology EMR CIMAR NMR Division	NIH	NIGMS - National Institute of General Medical Sciences	GM122698	P18089	MAS-DNP Probe development	Chemistry	1	10
Naresh Dalal (S) Riqiang Fu (S) Sanath Kumar Rama Krishna (G)	PI C C	National High Magnetic Field Laboratory National High Magnetic Field Laboratory Florida State University	Chemistry NMR Condensed Matter Physics	NSF	CHE - Chemistry	CHE1464955	P18094	Study of molecular dynamics on metal organic framework [(CH3)2NH2]Mg(HCOO)3] using solid state NMR spectroscopy	Chemistry	6	52
Neeraj Sinha (S) Sungsool Wi (S)	PI C	Centre of Bio-Medical Research (CBMR) National High Magnetic Field Laboratory	Bio-medical department NMR	Science and Engineering Research Board, Government of India	Non US Foundation	EMR/2015/001758	P18099	Structural and interaction study of collagen protein in native bone and cartilage through dynamic nuclear polarization	Biology, Biochemistry, Biophysics	1	2
Robert Silvers (S) Yimin Miao (P)	PI C	Florida State University Florida State University	Chemistry and Biochemistry Chemistry & Biochemistry	Florida State University	US College and University	STARTUP	P19107	Development of ssNMR methods for structural elucidation of RNAs and RNPs	Biology, Biochemistry, Biophysics	2	3
Ansgar Siemer (S)	PI	University of Southern California	Physiology and Neuroscience	NIH	NIA - National Institute on Aging	AG061865	P19109	High MAS frequency fingerprint spectra of Amyloid-ß fibrils or mammalian origin	Biology, Biochemistry, Biophysics	1	2
Yan-Yan Hu (S) Xuyong Feng (P) Zhehong Gan (S) Ivan Hung (S) Pengbo Wang (G)	PI C C C C	Florida State University Florida State University National High Magnetic Field Laboratory National High Magnetic Field Laboratory Florida State University	Chemistry & Biochemistry Chemistry and Biochemistry NHMFL CIMAR/NMR Chemistry	Solid Power No other support			P19111	Structure-property correlation in Cl-doped tetragonal Na3PS4 (t-Na3PS4)	Chemistry	4	46
Xiangwu Zhang (G) Yan-Yan Hu (S) Jin Zheng (G)	PI C C	North Carolina State University Florida State University Florida State University	Wilson College of Textiles Chemistry & Biochemistry Chemistry & Biochemistry	NSF	DMR - Division of Materials Research	DMR1720139	P19119	Interconnected Double Layers with Ultrafast and Continuous Li+ Conduction from Cathode to Anode for solid-state Li-S batteries	Engineering	3	16

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Michael Harrington (S)	PI		Huntington Medical Research Institutes	Molecular Neurology	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS201072	P19167	Evaluating Brain Dysfunction in Migraine	Biology, Biochemistry, Biophysics	17	79
Nastaren Abad (G)	C		Florida State University	Chemical-Biomedical Engineering	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS010724					
Hannah Alderson (U)	C		Florida State University	Chemical & Biomedical Engineering	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS072497					
Samuel Grant (S)	C		National High Magnetic Field Laboratory	Chemical & Biomedical Engineering								
Samuel Holder (G)	C		Florida State University	Chemical & Biomedical Engineering								
Linda Petzold (S)	C		University of California, Santa Barbara	Computer Science								
Yan-Yan Hu (S)	PI		Florida State University	Chemistry & Biochemistry	NSF	DMR - Division of Materials Research	DMR1808517	P19169	In-situ and Operando MRI studies of All-solid-state Batteries	Chemistry	1	2
Po-Hsiu Chien (G)	C		Florida State University	Chemistry and Biochemistry								
Haoyu Liu (G)	C		Florida State University	Chemistry								
Frederic Mentink (S)	C		National High Magnetic Field Laboratory	NMR Division								
Adam Veige (S)	PI	*	University of Florida	Chemistry	NSF	CHE - Chemistry	CHE1808234	P19170	Quantification of End Groups in Cyclic vs. Linear Polyacetylenes by Carbon-13 Magic Angle Spinning Nuclear Magnetic Resonance Spectroscopy	Biology, Biochemistry, Biophysics	1	7
Clifford Bowers (S)	C		University of Florida	Chemistry								
Alec Esper (G)	C		University of Florida	Chemistry								
Zhihui Miao (G)	C		University of Florida	Department of Chemistry								
Brent Sumerlin (S)	C		University of Florida	Chemistry								
Sossina Haile (S)	PI		Northwestern University	Materials Science and Engineering, and Chemistry	NSF	DMR - Division of Materials Research	DMR1720139	P19180	Multinuclear Solid-state NMR Investigations of Oxyhalides, Oxynitrides and Chalcohalides	Biology, Biochemistry, Biophysics	23	224
Yan-Yan Hu (S)	C		Florida State University	Chemistry & Biochemistry	NSF	DMR - Division of Materials Research	DMR1508404					
Mercouri Kanatzidis (S)	C		Northwestern University	Chemistry								
Haoyu Liu (G)	C		Florida State University	Chemistry								
Tobin Marks (S)	C		Northwestern University	Chemistry								
Sawankumar Patel (G)	C		Florida State University	Chemistry								
Kenneth Poeppelmeier (S)	C		Northwestern University	Chemistry								
Joseph Noel (S)	PI	*	Salk Institute for Biological Studies	Chemical Biology and Proteomics	Harnessing Plants Initiative, The Salk Institute for Biological Studies	Other		P19225	Structural, Quantitative and Genetic Characterization of Plant Biopolymers by Solid-state NMR	Biology, Biochemistry, Biophysics	2	8
Thach Can (P)	C		Salk Institute for Biological Studies	Chemical Biology and Proteomics								
Riqiang Fu (S)	C		National High Magnetic Field Laboratory	NMR								
Suzanne Thomas (P)	C		Salk Institute for Biological Studies	Chemical Biology and Proteomics								
Xueqian Kong (S)	PI		Zhejiang University	Chemistry	Zhejiang university	Non US College and University		P19234	Solid state NMR Investigation of highly conductive solid electrolytes	Biology, Biochemistry, Biophysics	3	10
Waseem Afzaal (G)	C		Florida State University	Chemistry								
Lina Gao (G)	C		Florida State University	Chemistry & Biochemistry								
Yan-Yan Hu (S)	C		Florida State University	Chemistry & Biochemistry								
Xueqian Kong (S)	PI		Zhejiang University	Chemistry	Zhejiang University	Non US College and University		P19235	Ultrahigh Field NMR Study of the Formation and Decomposition Mechanisms of MOFs	Magnets, Materials	5	21
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								
Hanxi Guan (G)	C		Zhejiang University	Chemistry								
Frederic Mentink (S)	PI		National High Magnetic Field Laboratory	NMR Division	NIH	NIGMS - National Institute of General Medical Sciences	GM122698	P19241	Improving biradicals for MAS-DNP at high field: a combined approach of Spin-Dynamics theory, DFT and high-field EPR	Chemistry	2	10
Gael De Paepe (S)	C		The French Alternative Energies and Atomic Energy Commission	Institute for Nanoscience and Cryogenics								
Snorri Sigurdsson (S)	C		University of Iceland	Chemistry								

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Sami Jannin (S)	PI	*	École normale supérieure de Lyon	CRMN	Horozon 2020 (EUROPEAN COMMISSION, Research Executive Agency)	Other Non US Federal Agency	766402	P19284	Study of 1H polarization transfers through the spin diffusion barrier indynamic nuclear polarization using microwave gating	Chemistry	1	4
Quentin Chappuis (G)	C		École normale supérieure de Lyon	High field NMR centre								
Frederic Mentink (S)	C		National High Magnetic Field Laboratory	NMR Division								
Eric Gottwald (S)	PI		Karlsruhe Institute of Technology	Institute for Biological Interfaces (IBG 5)	University of Heidelberg, Germany	Non US College and University		P19285	Cellular Responses from a Three Dimensional Cell Culture in a Microcavity Array-Based MR-Compatible Bioreactor: Application of 23Na Triple-Quantum MRS/MRI Methods	Biology, Biochemistry, Biophysics	2	4
Lothar Schad (S)	C		Heidelberg University	Computer Assisted Clinical Medicine	Heidelberg University	Non US College and University						
Victor Schepkin (S)	C		National High Magnetic Field Laboratory	CIMAR								
Jan Rainey (S)	PI		Dalhousie University	Biochemistry & Molecular Biology	Natural Sciences and Engineering Research Council of Canada	Non US Council	RGPIN/05 907-2017	P19288	Solid-state NMR characterization of spider wrapping and pyriform silks	Biology, Biochemistry, Biophysics	7	26
Tim Cross (S)	C		National High Magnetic Field Laboratory	NHMFL/Chemistry & Biochemistry	Natural Sciences and Engineering Research Council of Canada	Non US Council						
Frederic Mentink (S)	C		National High Magnetic Field Laboratory	NMR Division	Natural Sciences and Engineering Research Council of Canada	Non US Council	RGPAS/50 7805-2017					
Jeffrey Simmons (G)	C		Dalhousie University	Department of Biochemistry & Molecular Biology								
Anamika Sulekha (G)	C		Dalhousie University	Department of Biochemistry & Molecular Biology								
Hans Jakobsen (S)	PI		Aarhus University	Department of Chemistry	UCGP			P19317	33S and 95Mo Solid-State NMR Studies of Single-, Few-, and Multi-Layer MoS2 Materials	Chemistry	3	28
Henrik Bildsoe (S)	C		Aarhus University	Chemistry	Haldor Topsøe A/S							
Michael Brorson (S)	C		Haldor Topsoe	Catalysis	Haldor Topsoe, Lyngby, Denmark							
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL	Aarhus University	Non US College and University						
Ivan Hung (S)	C		NHMFL	CIMAR/NMR								
Jim Zheng (S)	PI		Florida Agricultural and Mechanical University	Department of Electrical Engineering	NSF	Other	520	P19319	Solid State NMR Studies of sodium ion batteries	Engineering	1	4
Zhehong Gan (S)	C		NHMFL	NHMFL								
Hanxi Guan (G)	C		Zhejiang University	Chemistry								
Jin Liming (G)	C		Florida State University	College of Engineering, Dep of electrical and computer engineering								
William Brey (S)	PI		National High Magnetic Field Laboratory	NMR	NIH	NIGMS - National Institute of General Medical Sciences	GM12269 8	P19329	Development of 13C detection NMR experiment for long-range correlation	Biology, Biochemistry, Biophysics	1	1
Taylor Johnston (G)	C		Florida State University	Chemistry								
Matthew Merritt (S)	C		University of Florida	Biochemistry and Molecular Biology								
Pingchuan Sun (S)	PI	*	Nankai University	College of Chemistry	National Natural Science Foundation of China	Other		P19331	Probing the Transesterification Reaction and Topology Freezing Transition Temperature in Vitrimer by VT 17O and 13C Chemical Exchange SSNMR	Chemistry	2	30
Riqiang Fu (S)	C		NHMFL	NMR								
Zhehong Gan (S)	C		NHMFL	NHMFL								
Fenfen Wang (P)	C		Nankai University	College of Chemistry								
Gianluigi Veglia (S)	PI		University of Minnesota, Twin Cities	BMBB	NIH	NIGMS - National Institute of General Medical Sciences	GM50106 4	P19333	solid state nmr (Gopinath Tata)	Biology, Biochemistry, Biophysics	1	6
Tim Cross (S)	C		National High Magnetic Field Laboratory	NHMFL/Chemistry & Biochemistry								
Riqiang Fu (S)	C		National High Magnetic Field Laboratory	NMR								
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								

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Robert Silvers (S)	PI		Florida State University	Chemistry and Biochemistry	No other support			P19340	Structural Study of RNase P	Biology, Biochemistry, Biophysics	1	2
Yimin Miao (P)	C		Florida State University	Chemistry & Biochemistry								
Robert Griffin (S)	PI		Massachusetts Institute of Technology	Chemistry	NIH	NIA - National Insitute on Aging	R01-AG058504	P19370	Structural Studies on the Human Voltage-Dependent Anion-Selective Channel Protein 1 (VDAC1) by Solid-State NMR	Biology, Biochemistry, Biophysics	1	15
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C		National High Magnetic Field Laboratory	CIMAR/NMR								
Edward Saliba (P)	C		Massachusetts Institute of Technology	Francis Bitter Magnet Laboratory								
Robert Silvers (S)	C		Florida State University	Chemistry and Biochemistry								
Geoffrey Strouse (S)	PI	*	National High Magnetic Field Laboratory	Chemistry	NSF	DMR - Division of Materials Research	DMR1905757	P19372	Multinuclear solid-state NMR investigation of plasmonic and photoluminescent nanocrystals	Chemistry	2	7
Adam Altenhof (G)	C		Florida State University	Chemistry and Biochemistry	NSF	DMR - Division of Materials Research	DMR1644779					
Nhat Nguyen Bui (P)	C		National High Magnetic Field Laboratory	CMS	State of Florida	Other	n/a					
Carl Conti (G)	C		Florida State University	Chemistry & Biochemistry								
Zhehong Gan (S)	C		NHMFL	NHMFL								
Ivan Hung (S)	C		NHMFL	CIMAR/NMR								
Jason Kuszynski (G)	C		Florida State University	Chemistry								
Frederic Mentink (S)	C		NHMFL	NMR Division								
Robert Schurko (S)	C		Florida State University	Chemistry								
Likai Song (S)	C		NHMFL	EMR								
Cameron Vojvodin (G)	C		Florida State University	Chemistry and Biochemistry								
Hadi Mohammadigoushki (S)	PI		Florida State University	Chemical and Biomedical Engineering	Florida State University-CRC	Other		P19421	Probing in situ structure of monoclonal antibodies at water-air and water-oil interfaces via high field nuclear magnetic resonance spectroscopy	Engineering	2	16
Sungsool Wi (S)	C		NHMFL	NMR								
Liliya Vugmeyster (S)	PI		University of Colorado, Denver	Chemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM111681	P19439	Variant-specific dynamics of amyloid-beta fibrils by solid-state deuteron NMR.	Biology, Biochemistry, Biophysics	2	5
Dan Au (G)	C		University of Colorado, Denver	Bioengineering								
Dmitry Ostrovsky (S)	C		University of Alaska, Anchorage	Mathematics								
Elan Eisenmesser (S)	PI		University of Colorado, Denver	Biochemistry & Molecular Genetics	NSF	CHE - Chemistry	CHE1807326	P19441	SARS-CoV Nucleocapsid protein dynamics and their role in host protein interactions.	Biology, Biochemistry, Biophysics	6	138
Kilsia Mercedes (G)	C		University of Colorado, Denver	Biochemistry and Molecular Genetics								
Isabelle Marcotte (S)	PI	*	University of Quebec at Montreal	Chemistry	NSF	MCB - Molecular and Cellular Biosciences	MCB1942665	P19442	Chlamydomonas reinhardtii cell-wall and whole cell glycan architecture studied by high-field and DNP Solid-State NMR	Biology, Biochemistry, Biophysics	7	47
Alexandre Arnold (S)	C		University of Quebec at Montreal	Chemistry	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI194266					
Malitha Dickwella Widanage (G)	C		Louisiana State University	chemistry	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI121149					
Ivan Hung (S)	C		NHMFL	CIMAR/NMR								
Alex Kirui (G)	C		Louisiana State University	Chemistry								
Frederic Mentink (S)	C		NHMFL	NMR Division								
Alexandre Poulhazan (G)	C		University of Quebec at Montreal	Chemistry								
Tuo Wang (S)	C		Louisiana State University	Chemistry								
Dror WARSCHAWSKI (S)	C		French National Center for Scientific Research	Chemistry								
Ashley Blue (T)	PI		NHMFL	NHMFL	No other support			P19456	NMR System Maintenance	Magnets, Materials	6	23
Riqiang Fu (S)	C		NHMFL	NMR								
Zhehong Gan (S)	C		NHMFL	NHMFL								
Samuel Grant (S)	C		NHMFL	Chemical & Biomedical Engineering								
Frederic Mentink (S)	C		NHMFL	NMR Division								
Sungsool Wi (S)	C		NHMFL	NMR								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
David Fenning (S)	PI	*	University of California, San Diego	Nanoengineering	NSF	DMR - Division of Materials Research	DMR1720139	P19478	137Ba and 127I NMR of Halide Perovskite Solar Materials FABaxPb1-xI3	Magnets, Materials	3	12
Yan-Yan Hu (S)	C		Florida State University	Chemistry & Biochemistry	NSF	CAREER - Faculty Early Career Development Program	DMR1848371					
Sawankumar Patel (G)	C		Florida State University	Chemistry	NSF	CAREER - Faculty Early Career Development Program	1848371					
Rivera de la Rosa (S)	PI	*	Autonomous University of Nuevo León	Chemical Engineering	EPA		2013206	P19479	The role of phosphorus in the self-pillared pentasil siliceous zeolite catalyst used for the dehydra-decyclization reaction of tetrahydrofuran in producing 1,3-butadiene	Magnets, Materials	2	19
Carolina Solis Maldonado (S)	C		Veracruzan University	Chemical Sciences	Agribusiness Center for Research and Entrepreneurship (ACRE)	Other	2013590					
Carlos Garcia (S)	C		Clemson University	Chemistry	Facultad de Ciencias Qui´micas, Universidad Auto´noma de Nuevo Leo´n (UANL)	Non US College and University	02–084347–PST–14/105					
Francisco José Morales-Leal (S)	C		Autonomous University of Nuevo León	Chemical Sciences	Fondo Sectorial de Investigacio´n para la Educacio´n SEP-CONACYT	Other	A1-S-37606					
Sungsool Wi (S)	C		National High Magnetic Field Laboratory	NMR	Universidad Autonoma de Nuevo Leon (UANL)	Non US College and University	02-084347-PST-14/105					
					Fondo Sectorial de Investigacion para la Education SEP-CONACYT	Non US Foundation	A1-S-37607					
Ildefonso Marin-Montesinos (S)	PI	*	Universidade de Aveiro	Chemistry	Universidade de Aveiro	Non US College and University		P19491	Disclosing brewers spent yeast cell wall polysaccharides: an in deep structural characterization and network assignment	Biology, Biochemistry, Biophysics	1	5
Ana Rita Bastos (G)	C		Universidade de Aveiro	Chemistry								
Elisabete Coelho (S)	C		Universidade de Aveiro	Chemistry								
Manuel A. Coimbra (S)	C		Universidade de Aveiro	Department of Chemistry								
Luís Mafra (S)	C		Universidade de Aveiro	Chemistry								
Frederic Mentink (S)	C		NHMFL	NMR Division								
Mariana Sardo (S)	C		Universidade de Aveiro	Chemistry								
Sungsool Wi (S)	PI		NHMFL	NMR	No other support			P19492	Utilization of 1H-1H correlation schemes for the structural study of perdeuterated/non-perdeuterated 13C and/or 15N-labeled biosolids	Biology, Biochemistry, Biophysics	4	38
Lucio Frydman (S)	C		NHMFL	NMR	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS097490					
Adam Lange (S)	C		Leibniz-Forschungsinstitut für Molekulare Pharmakologie, Berlin	Department of Molecular Biophysics	The European Research Council under the European Union’s Seventh Framework Programme	Non US Council	ERC Grant Agreement 639907					
Józef Lewandowski (S)	C		University of Warwick	Chemistry	The European Research Council under the European Union's Seventh Framework Programe	Non US Foundation	639907					
Kwang Hun Lim (S)	C		East Carolina University	Chemistry								
Yining Huang (S)	PI		University of Western Ontario	Chemistry	NSERC of Canada	Other		P19515	17O and 91Zr solid-state NMR of metal-organic frameworks at 35.2 T	Chemistry	1	11
Zhehong Gan (S)	C		NHMFL	NHMFL								
Ivan Hung (S)	C		NHMFL	CIMAR/NMR								
Vinicius Martins (G)	C		University of Western Ontario	Chemistry								
Tim Cross (S)	PI		NHMFL	NHMFL/Chemistry & Biochemistry	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI119178	P19516	Structural Characterization of SARS-CoV-2 E protein in lipid bilayer with Solid-State NMR	Biology, Biochemistry, Biophysics	6	43
Huajun Qin (T)	C		Florida State University	Chemistry & Biochemistry								
									Total Proposals: 76		Experiments: 411	Days: 2,761

7. Pulsed Field Facility

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Janice Musfeldt (S)	PI	University of Tennessee, Knoxville	Department of Chemistry	NSF	DMR - Division of Materials Research	DMR1707846	P16137	High field spectroscopy of materials	Chemistry	1	8
Avery Blockmon (G)	C	University of Tennessee, Knoxville	Chemistry								
Amanda Clune (G)	C	University of Tennessee, Knoxville	Chemistry								
Kendall Hughey (G)	C	University of Tennessee, Knoxville	Chemistry								
Minseong Lee (P)	C	Los Alamos National Laboratory	MPA-MAG								
Vivien Zapf (S)	C	National High Magnetic Field Laboratory	Physics								
Joseph Checkelsky (S)	PI	Massachusetts Institute of Technology	Physics	NSF	DMR - Division of Materials Research	DMR1554891	P16258	High Field Studies of Magnetic Weyl Semimetals	Condensed Matter Physics	2	25
Aravind Devarakonda (G)	C	Massachusetts Institute of Technology	Physics	MIT	Other						
Minyong Han (G)	C	Massachusetts Institute of Technology	Physics								
Takashi Kurumaji (P)	C	Massachusetts Institute of Technology	Physics								
Takehito Suzuki (P)	C	Massachusetts Institute of Technology	Department of Physics								
Joshua Wakefield (G)	C	Massachusetts Institute of Technology	Physics								
Linda Ye (G)	C	Massachusetts Institute of Technology	Physics								
Junbo Zhu (G)	C	Massachusetts Institute of Technology	Physics								
Zhiqiang Mao (S)	PI	Pennsylvania State University	Department of Physics	DOE	Office of Science - BES – Basic Energy Sciences	DE-SC0019068	P16316	Studies of exotic quantum phenomena near the quantum limit in Dirac semimetals AMnSb2 (A=Sr, Ba and Yb)	Condensed Matter Physics	1	3
Fedor Balakirev (S)	C	National High Magnetic Field Laboratory	PFF								
Marcelo Jaime (S)	C	National High Magnetic Field Laboratory	Physics								
Ross McDonald (S)	C	National High Magnetic Field Laboratory	Physics								
Lujin Min (G)	C	Pennsylvania State University	Department of Physics								
Wei Ning (P)	C	Pennsylvania State University	Department of Physics								
Yanglin Zhu (G)	C	Tulane University	Department of Physics and Engineering Physics								
Lu Li (S)	PI	University of Michigan	Physics	NSF	DMR - Division of Materials Research	DMR1707620	P17467	Interaction-Driven Topological Materials	Condensed Matter Physics	2	25
Kuan-Wen Chen (P)	C	University of Michigan	Physics	DOE	Office of Science - BES – Basic Energy Sciences	DE-SC0020184					
Lu Chen (G)	C	University of Michigan	Physics								
Zachary Fisk (S)	C	University of California, Irvine	Physics and Astronomy								
Yuji Matsuda (S)	C	Kyoto University	Physics								
Colin Tinsman (G)	C	University of Michigan	Physics								
Ziji Xiang (P)	C	University of Michigan	Physics								
Dechen Zhang (G)	C	University of Michigan	Department of Physics								
Guoxin Zheng (G)	C	University of Michigan	Department of Physics								
Haidong Zhou (S)	C	University of Tennessee, Knoxville	Physics and Astronomy								
Eric Bauer (S)	PI	Los Alamos National Laboratory	MST-10	DOE	Office of Science - BES – Basic Energy Sciences	F100 Science of 100 T	P17510	The ground-state of cuprate high-temperature superconductors	Condensed Matter Physics	1	5
Joonbum Park (P)	C	Helmholtz-Zentrum Dresden-Rossendorf (HZDR)	Dresden High Magnetic Field Laboratory								
Katherine Schreiber (P)	C	National High Magnetic Field Laboratory	NHMFL Pulsed Field Facility								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Eric Bauer (S)	PI	Los Alamos National Laboratory	MST-10	No other support			P17522	Electronic properties of putative topological Kondo insulators.	Condensed Matter Physics	1	12
Mun Chan (S)	C	National High Magnetic Field Laboratory	Pulsed field Facility								
Daniel Jackson (P)	C	National High Magnetic Field Laboratory	MPA/MAG								
Mijkhail Eremets (S)	PI	Max Planck Institute for Chemistry, Mainz	Chemistry and Physics at High Pressures Group	Max Planck Society	Non US Foundation		P17644	High field superconducting phase-diagram of sulphur hydride/deuteride	Condensed Matter Physics	1	5
Fedor Balakirev (S)	C	National High Magnetic Field Laboratory	PFF								
Luis Balicas (S)	C	National High Magnetic Field Laboratory	Condensed Matter Experiment								
Laura Greene (S)	C	National High Magnetic Field Laboratory	Management and Administration								
Shirin Mozaffari (P)	C	National High Magnetic Field Laboratory	Condensed Matter Sciences								
Dan Sun (P)	C	Los Alamos National Laboratory	MPA-MAG								
Swee Goh (S)	PI	Chinese University of Hong Kong	Department of Physics	Hong Kong Research Grants Council	Other		P17646	Pressure-driven quantum magneto-transport phenomena in topological semimetals	Condensed Matter Physics	2	20
Fedor Balakirev (S)	C	National High Magnetic Field Laboratory	PFF	Research Grants Council Hong Kong	Non US Council						
Yuen Chung Chan (U)	C	Chinese University of Hong Kong	Physics								
Kwing To Lai (P)	C	Chinese University of Hong Kong	Physics								
Joonbum Park (P)	C	Helmholtz-Zentrum Dresden-Rossendorf (HZDR)	Dresden High Magnetic Field Laboratory								
Dan Sun (P)	C	Los Alamos National Laboratory	MPA-MAG								
Jianyu Xie (G)	C	Chinese University of Hong Kong	Physics								
Wei Zhang (G)	C	Chinese University of Hong Kong	Physics								
Priscila Ferrari Silveira Rosa (P)	PI	Los Alamos National Laboratory	MPA-CMMS	DOE	Office of Science - BES – Basic Energy Sciences	F101	P17682	Pulsed field measurements on topological semi-metals	Condensed Matter Physics	3	19
Eric Bauer (S)	C	Los Alamos National Laboratory	MST-10	DOE	Office of Science - BES – Basic Energy Sciences	Science of 100 tesla					
Mun Chan (S)	C	National High Magnetic Field Laboratory	Pulsed field Facility	DOE		DE-XW					
Neil Harrison (S)	C	National High Magnetic Field Laboratory	Physics								
Satya Kushwaha (P)	C	Los Alamos National Laboratory	MPA-MAG								
Ross McDonald (S)	C	National High Magnetic Field Laboratory	Physics								
Scott Crooker (S)	PI	National High Magnetic Field Laboratory	Nat High Magnetic Field Lab	DOE	LDRD - Laboratory Directed R&D	DE-AA99-99AA99999	P17750	Optical Spectroscopy of Excited Rydberg Excitons (& Determination of Exciton Mass) in Monolayer Semiconductors	Condensed Matter Physics	2	20
Mateusz Goryca (S)	C	University of Warsaw	Institute of Experimental Physics, Solid State Physics	LDRD	Other						
Jing Li (P)	C	Los Alamos National Laboratory	MPA-MAGLAB								
Xavier Marie (S)	C	National Institute for Applied Sciences, Toulouse	Laboratoire de Physique et Chimie des Nano-objets								
Andreas Stier (P)	C	National High Magnetic Field Laboratory	MPA-CMMS								
Bernhard Urbaszek (S)	C	National Institute for Applied Sciences, Toulouse	Laboratoire de Physique et Chimie des Nano-objets								
Nathan Wilson (G)	C	University of Washington	Physics								
Xiaodong Xu (S)	C	University of Washington	Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Neil Harrison (S)	PI		National High Magnetic Field Laboratory	Physics	Los Alamos National Laboratory	US Government Lab		P17768	Electronic Structure and Equation of State of Plutonium	Condensed Matter Physics	2	10
John Singleton (S)	C		National High Magnetic Field Laboratory	Physics	Los Alamos National Laboratory LDRD	US Government Lab						
Paul Tobash (P)	C		National High Magnetic Field Laboratory	MPA-cmms								
Mark Wartenbe (P)	C		Los Alamos National Laboratory	MST-16								
Laurel Winter (S)	C		National High Magnetic Field Laboratory	Physics								
Dagmar Weickert (S)	PI		National High Magnetic Field Laboratory	MPA-Mag	NSF	DMR - Division of Materials Research	DMR1644779	P17769	Exotic ordered ground states in low-dimensional spin systems induced by high magnetic fields	Condensed Matter Physics	1	5
Carolina Corvalan Moya (S)	C		Los Alamos National Laboratory	MPA-MAG								
Myron Salamon (S)	C		University of Texas, Dallas	Physics								
Andres Saul (S)	C		Aix-Marseille University	CINaM/CNRS								
Hidekazu Tanaka (S)	C		Tokyo Institute of Technology	Physics								
Susanne Stemmer (S)	PI		University of California, Santa Barbara	Materials	DOD	ONR - Office of Naval Research	N00014-16-1-2814	P17876	3D Dirac Semimetal Thin Films	Condensed Matter Physics	1	4
Binghao Guo (G)	C		University of California, Santa Barbara	Materials Department								
David Kealhofer (G)	C		University of California, Santa Barbara	Physics								
You Lai (P)	C		National High Magnetic Field Laboratory	Physics								
Ross McDonald (S)	C		NHMFL	Physics								
Timo Schumann (P)	C		University of California, Santa Barbara	Materials Department								
Ryan Baumbach (S)	PI		NHMFL	CMS	DOE	Office of Science - BES – Basic Energy Sciences	DESC0016568	P17894	Investigation of dual nature f-electron intermetallics using high magnetic fields	Condensed Matter Physics	1	5
You Lai (P)	C		NHMFL	Physics								
Minhyea Lee (S)	PI		University of Colorado, Boulder	Physics	University of Colorado Boulder	US College and University		P17906	Investigation on unusual magnetic responses in quantum magnets	Condensed Matter Physics	1	12
Gang Cao (S)	C		University of Colorado, Boulder	Department of Physics.								
Ian Leahy (G)	C		University of Colorado, Boulder	Physics								
Ross McDonald (S)	C		NHMFL	Physics								
Christopher Pocs (G)	C		University of Colorado, Boulder	Physics								
Arkady Shehter (S)	C		NHMFL	NHMFL, DC Field Facility								
Peter Siegfried (G)	C		University of Colorado, Boulder	Physics								
Laurel Winter (S)	PI	*	NHMFL	Physics	No other support			P18062	Testing and development of pulsed field probes	Magnets, Materials	4	18
Daniel Jackson (P)	C		NHMFL	MPA/MAG	DOE	Other	20180025DR					
You Lai (P)	C		NHMFL	Physics	DOE	Office of Science - EFRC - Energy Frontier Research Centers	DE-AC02-07CH1135					
Johanna Palmstrom (P)	C		Los Alamos National Laboratory (LANL)	MPA-MAG	Los Alamos National Laboratory	US Government Lab						
Mark Wartenbe (P)	C		Los Alamos National Laboratory	MST-16	LANL -- LDRD	US Government Lab						
Vivien Zapf (S)	PI		National High Magnetic Field Laboratory	Physics	DOE	Office of Science - BES – Basic Energy Sciences	0	P19135	Magnetic field induced spin liquids and quantum phase transitions in orbital-assisted dimerized quantum magnets.	Condensed Matter Physics	1	5
Sang Wook Cheong (S)	C		Rutgers University, New Brunswick	Physics and Astronomy								
Minseong Lee (P)	C		Los Alamos National Laboratory	MPA-MAG								
Haidong Zhou (S)	C		University of Tennessee, Knoxville	Physics and Astronomy								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Arkady Shehter (S)	PI	National High Magnetic Field Laboratory	NHMFL, DC Field Facility	NSF	DMR - Division of Materials Research	DMR1157490	P19136	Longitudinal and Hall transport in critically doped cuprates at very high magnetic fields. Field-temperature competition as a signature of quantum criticality.	Condensed Matter Physics	1	5
Alimamy Bangura (S)	C	National High Magnetic Field Laboratory	CMS								
Jonathan Betts (S)	C	National High Magnetic Field Laboratory	NHMFL-PFF								
Greg Boebinger (S)	C	National High Magnetic Field Laboratory	Directors Office								
Ross McDonald (S)	C	National High Magnetic Field Laboratory	Physics								
Kimberly Modic (G)	C	National High Magnetic Field Laboratory	PFF								
Brad Ramshaw (S)	C	Cornell University	Laboratory of Atomic and Solid State Physics								
James Analytis (S)	PI	University of California, Berkeley	Physics	DOE	MSE - Materials Science and Engineering	DE-SC0014039	P19137	High-field phase transitions in the Kitaev hyperhoneycomb beta-Li2IrO3	Condensed Matter Physics	1	14
Nikola Maksimovic (G)	C	University of California, Berkeley	Physics								
Kimberly Modic (G)	C	National High Magnetic Field Laboratory	PFF								
Hsinhan Tsai (P)	PI	Los Alamos National Laboratory	MPA-11	No other support			P19141	New 2D perovskites for high temperature multiferroics	Magnets, Materials	2	10
Wanyi Nie (S)	C	Los Alamos National Laboratory	MPA-11								
Magdalena Owczarek (P)	C	Los Alamos National Laboratory	CINT								
Vivien Zapf (S)	C	National High Magnetic Field Laboratory	Physics								
Jamie Manson (S)	PI	Eastern Washington University	Chemistry and Biochemistry	NSF	DMR - Division of Materials Research	DMR1703003	P19143	Determining phase diagrams in bespoke S = 1 Ni(II) quantum magnets	Condensed Matter Physics	1	12
Fedor Balakirev (S)	C	National High Magnetic Field Laboratory	PFF								
Sam Curley (G)	C	University of Warwick	Physics and Astronomy								
Paul Goddard (S)	C	University of Warwick	Department of Physics								
John Singleton (S)	C	NHMFL	Physics								
Dan Sun (P)	C	Los Alamos National Laboratory	MPA-MAG								
Krzysztof Gofryk (S)	PI	Idaho National Laboratory	Fuel Performance & Design	DOE	Office of Science - ECRP - Early Career Research Program	KG's early career award	P19145	Transport and magnetic properties of selected d- and f-electron topological materials in high magnetic fields	Condensed Matter Physics	1	5
Xiaxin Ding (P)	C	Idaho National Laboratory	NST								
Neil Harrison (S)	C	NHMFL	Physics								
Marcelo Jaime (S)	C	NHMFL	Physics								
Narayan Poudel (P)	C	Idaho National Laboratory	Nuclear Materials								
Dagmar Weickert (S)	C	NHMFL	MPA-Mag								
Vivien Zapf (S)	PI	NHMFL	Physics	DOE	LDRD - Laboratory Directed R&D	DE-AA00-00AA00000	P19182	Magnetic field-induced spin liquids and quantum phase transitions in Kitaev materials	Condensed Matter Physics	1	5
Marcelo Jaime (S)	C	NHMFL	Physics								
Minseong Lee (P)	C	Los Alamos National Laboratory	MPA-MAG								
David Mandrus (S)	C	University of Tennessee, Knoxville	Materials Science and Engineering								
Rico Schoenemann (P)	PI *	Los Alamos National Laboratory	MPA-MAG	No other support			P19194	Magnetostriction and thermal expansion measurements in a frustrated spin system.	Condensed Matter Physics	1	5
Shusaku Imajo (S)	C	University of Tokyo	International MegaGauss Science Laboratory								
Marcelo Jaime (S)	C	NHMFL	Physics								
Stephen Nagler (S)	C	Oak Ridge National Laboratory									
Yasu Takano (S)	C	University of Florida	Physics								
Dagmar Weickert (S)	C	NHMFL	MPA-Mag								
Jamie Manson (S)	PI	Eastern Washington University	Chemistry and Biochemistry	NSF	DMR - Division of Materials Research	DMR1703003	P19233	New topologies in Ni(II) quantum magnets with XY anisotropy	Condensed Matter Physics	1	5
Paul Goddard (S)	C	University of Warwick	Department of Physics								
John Singleton (S)	C	National High Magnetic Field Laboratory	Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Na Hyun Jo (G)	PI		Ames Laboratory	Division of Materials Science & Engineering	DOE	Office of Science - EFRC - Energy Frontier Research Centers	DE-AC02-07CH11358	P19250	Investigation of exotic topological states using high magnetic fields	Condensed Matter Physics	2	23
Paul Canfield (S)	C		Ames Laboratory	Physics & Astronomy	DOE	Office of Science - EFRC - Energy Frontier Research Centers	DE-AC02-07CH1135					
Brinda Kuthanazhi (G)	C		Ames Laboratory	Division of Material Sciences and Engineering								
You Lai (P)	C		National High Magnetic Field Laboratory	Physics								
Ross McDonald (S)	C		National High Magnetic Field Laboratory	Physics								
Robert McQueeney (S)	C		Ames Laboratory	physics & astronomy								
Dmitry Yarotski (S)	C		Los Alamos National Laboratory	Center for Integrated Nanotechnologies								
Haidong Zhou (S)	PI		University of Tennessee, Knoxville	Physics and Astronomy	DOE	Office of Science - BES – Basic Energy Sciences	0	P19406	Magnetic field-induced quantum phase transitions in a Kitaev spin liquid candidate.	Condensed Matter Physics	1	5
Minseong Lee (P)	C		Los Alamos National Laboratory	MPA-MAG								
Vivien Zapf (S)	C		National High Magnetic Field Laboratory	Physics								
Taehwan Jang (G)	PI	*	Pohang University of Science and Technology	Physics	DOE	Office of Science - BES – Basic Energy Sciences	0	P19407	Magnetic and Magnetoelectric Measurements on 2D square-lattice antiferromagnet	Condensed Matter Physics	1	10
Minseong Lee (P)	C		Los Alamos National Laboratory	MPA-MAG								
Vivien Zapf (S)	C		National High Magnetic Field Laboratory	Physics								
Pei-Chun Ho (S)	PI		California State University, Fresno	Physics	NSF	DMR - Division of Materials Research	DMR1905636	P19415	Investigation of Valance Transition in Ce1-xRxOs4Sb12 (R = Pr, Nd) and Fermi-Surface Topologies of SmOs4Sb12	Condensed Matter Physics	1	5
Paul Goddard (S)	C		University of Warwick	Department of Physics								
Kathrin Gotze (P)	C		University of Warwick	Department of Physics, Superconductivity and Magnetism group								
Brian Maple (S)	C		University of California, San Diego	Inst for Pure & Applied Physical Sciences								
John Singleton (S)	C		National High Magnetic Field Laboratory	Physics								
									Total Proposals: 29		Experiments: 41	Days: 305

2020

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