Magnetostriction in $AlFe_2B_2$ at 25 T measured by X-ray diffraction

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The recent coupling of an X-ray diffractometer with the world-unique 25T Florida Split Helix Magnet enabled instrumentation developers to study the magnetostriction of polycrystalline $AlFe_2B_2$, a ferromagnetic compound with a ferromagnetic transition temperature of 280K and potential applications in magnetocaloric devices.

$AlFe_2B_2$ exhibits anisotropic magnetostriction in an applied DC magnetic field up to 25T. The unit cell parameter c increases, while both the a- and b-axis decrease with increasing magnetic field. The magnetostriction effects are largest at temperatures in the vicinity of the ferromagnetic transition temperature.

A Landau theory model including quartic terms gives qualitatively good agreement with the observed behavior of $AlFe_2B_2$ in high magnetic fields. While not all tensor components of the magnetoelastic tensor can be determined from powder diffraction measurements, this magnet system has been instrumental in assessing the magnetostriction in $AlFe_2B_2$.

This diffractometer enables direct probing of structural properties in high magnetic fields and will transition into the user program in 2022. Initial experiments have been enabled by external groups working closely with the in-house team that developed the diffractometer.

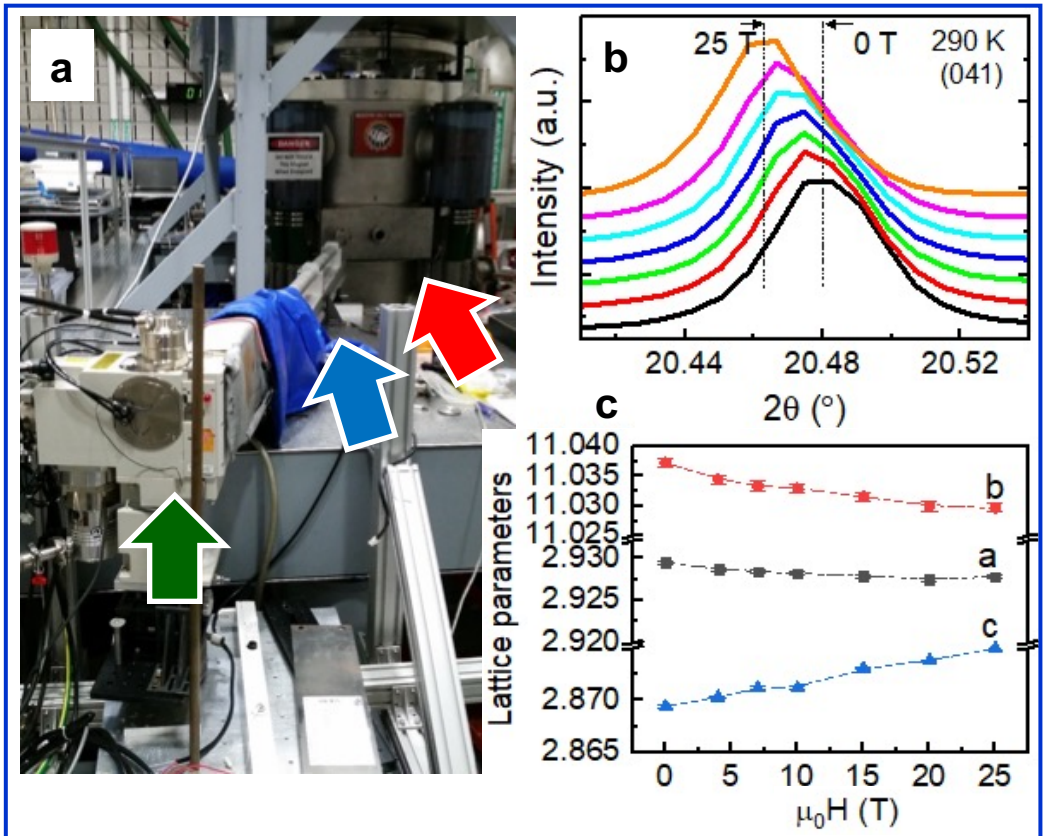

Figure: (a) X-ray source (green arrow) with evacuated X-ray beam tunnel (blue arrow) leading to the two-meter-tall 25T Florida Split Helix Magnet (red arrow). The fringe magnetic field at the X-ray source is ~20 gauss and is compensated to ensure proper functioning of the source. **(b)** Shift of the (041) peak with magnetic field at T=290 K. **(c)** Unit cell parameter changes with magnetic field at T= 290 K.

Facility used: 25T Florida Split Magnet in the DC field facility

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