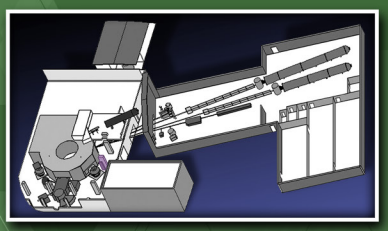
High Flux Isotope Reactor

Instrument

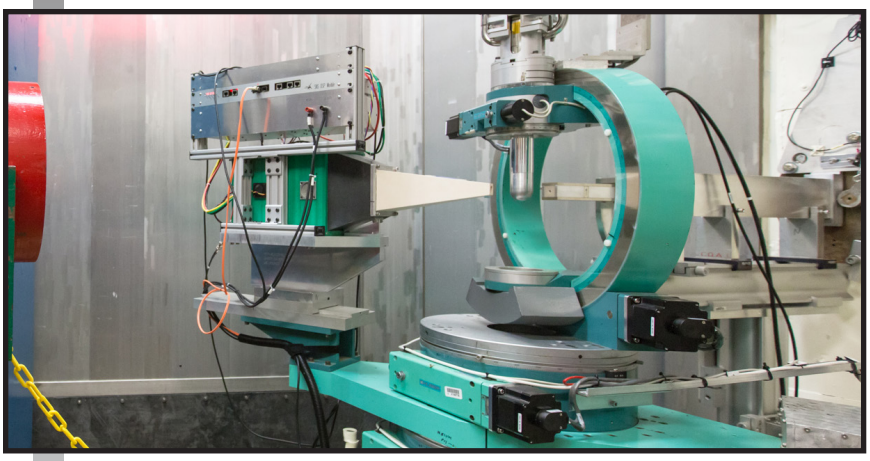
Beam Line

HB-3A



Four-Circle Diffractometer

The Four-Circle Diffractometer (FCD) goniometer has a full χ circle with a 4–800 K closed-cycle helium refrigerator. The detector is a scintillator-based 2D Anger camera. The upper 2Θ limit is 160°. A multilayer-[110]-wafer silicon monochromator with the reflection from HHL planes ensures sharp diffraction peaks in specified ranges of detector angles by control of the horizontal radius of curvature. Any HHL planes can be set in Bragg position, but only the (331), (220) with (440), and (111) with (333) reflections are of practical interest. For the fixed monochromator angle of 47.5°, these reflections provide principal incident wavelengths of 1.005 Å, 1.546 Å, and 2.541 Å, respectively. A PC-based LabView system provides user-friendly diffractometer control and data acquisition. The beam size is 6.3 mm in diameter, and the minimum measured crystal size is 0.02 mm^3. The maximum crystal dimension is usually limited to 5 mm. The flux on the sample can be up to 2.2×10^7 $n/cm^2/s$. The horizontal bending of the monochromator can be changed to optimize the Q-resolution or flux depending upon the needs of the measurement. The longer wavelength of 2.541 Å has ~5% λ/3 contamination and is mainly used for polarized neutron diffraction. The 1.546 Å-wavelength has the highest flux, but with ~1.4% λ/2 contamination (a PG filter is available to reduce the contamination to 10^{-4}), is mainly used for determining magnetic structures. The 1.005 Å wavelength is monochromatic and is good for precisely determining both nuclear and magnetic structures, although the flux is 8 times lower than the highest flux at 1.546 Å.



Applications

The HB-3A FCD has the mission to explore nuclear and magnetic structures as a function of temperature, pressure, magnetic field, and electric field. The instrument is particularly suitable for studying phase transitions and accompanying structure changes, as well as measuring order parameters and exploring the phase diagram. It also is suitable for a wide range of small-unit-cell crystallography studies including superlattice structures and atomic anharmonicity. Users have researched problems in physics, materials science, chemistry, and mineralogy. Recent topics can be found in the publication and science highlight pages.

Specifications

Beam spectrum	Thermal
Monochromator	Double focusing silicon
Monochromator angle	47.5°
Incident wavelengths	1.005 Å (331), 1.546 Å (220), 2.541 Å (111)
Goniometer	Huber, full χ circle, with 4 – 800 K CCR
Scattering angles	-27° < 2θ < 160°
Detector	2D Anger camera
Crystal size requirement	>0.1 mm^3, maximum crystal dimension 5 mm
Flux at sample	2.2×10^7 $n/cm^2/s$
Polarized neutron diffraction	Polarizer: S-bender super mirror Polarization ratio: 95%

Status: Available to users

For more information, contact

Instrument Scientist: Huibo Cao, caoh@ornl.gov, 865.686.2608
Instrument Scientist: Bryan Chakoumakos, chakoumakobc@ornl.gov, 865.574.5235

neutrons.ornl.gov/hb3a

OAK RIDGE National Laboratory

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