POWDER

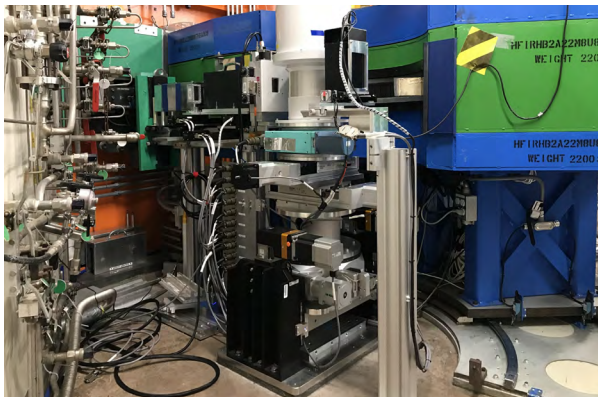
Neutron Powder Diffractometer

High Flux Isotope Reactor

BEAMLINE

HB-2A

The HB-2A Neutron Powder Diffractometer has a Debye-Scherrer geometry. The detector bank has 44 ^{3}He tubes, each with 12′ Soller collimators. Data is collected by stepping the detector to both fill in the 2.7° gaps between detectors and achieve coverage in the range 2-155°. A germanium wafer-stack monochromator is vertically focusing and provides one of three principal wavelengths, depending on which reflection is in the diffracting condition: Ge (113) 2.41 Å, Ge (115) 1.54 Å, and Ge (117) 1.12 Å. The takeoff angle from the monochromator is fixed at 90°, and the minimum peak full width at half maximum (FWHM) is 0.2°. The resolution can be controlled with the premonochromator collimation (α_1), which is open, 60′ effective, and via three choices of presample collimation (α_2 = 16, 21, or 31′). The instrument can operate in polarized mode with the use of a polarizing supermirror V-cavity optimized for the 2.41 Å wave.



SPECIFICATIONS

Beam spectrum	Thermal
Monochromator	Vertically focusing Ge (hhl)
Monochromator angle	$2\Theta_m = 90°$
Wavelengths	λ = 1.54 Å 2.41 Å 1.12 Å
Sample angles	$0° < \omega < 360°$
Scattering angle	$2° < 2\Theta < 155°$
Collimations (FWHM)	Premonochromator (α_1): open (60′ effective) Monochromator–Sample (α_2): 16′, 21′, or 31′ Sample–detector (α_3): 12′
Detector bank	44 ^{3}He detectors
Beam size	50 x 25 mm^2 at sample position
Resolution	2.24 x 10^{-3} Δd/d

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APPLICATIONS

The HB-2A Neutron Powder Diffractometer excels at magnetic structural studies of powdered samples, particularly as a function of intensive conditions of temperature, field, pressure, etc. The primary science performed on HB-2A is the investigation of quantum magnetism. This includes studies of long-range ordered phase transitions and complex magnetic ordering as well as studies of short-range spin correlations. The latter is possible with both reciprocal space techniques and real space mPDF analysis. Analysis of the local susceptibility tensor is achieved with polarized neutron diffraction. Other technologically important materials amenable to study include catalysts, ionic conductors, superconductors, alloys, intermetallic compounds, ceramics, cements, colossal magnetoresistance perovskites, magnets, minerals, waste forms, H-storage materials, thermoelectrics, zeolites, and pharmaceuticals. Powder diffraction data collected on this instrument are ideally suited for the Rietveld method with a well-characterized profile, isotropic background and simple absorption correction when necessary. The constant wavelength neutron beam makes HB-2A well suited to various interchangeable sample environments with minimal calibration required. A full range of ancillary sample environments can be used, including cryofurnaces (4–700 K), furnaces (to 1800 K), cryostats (to 0.06 K), and cryomagnets (to 8 T). These include a variety of sample changer options that can allow multiple samples to be loaded, even down to 0.3 K.

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