# DEMAND

## Dimensional Extreme Magnetic Neutron Diffractometer

High Flux Isotope Reactor

BEAMLINE

# HB-3A

The Dimensional Extreme Magnetic Neutron Diffractometer (DEMAND) has two modes of operation. Four-circle mode with the χ circle goniometer can operate with a closed-cycle-refrigerator (4–800 K) that allows a pressure cell (0-10 GPa), or a permanent magnet (0-0.9 T), and electric field. Two-axis mode allows extreme sample equipment cryomagnet (0-6 T), $^3$He and dilution refrigerators (0.05-300 K). Both modes can have an unpolarized and polarized neutron beam that can be switched by automated elevator device. The current detector has three Anger camera modules stacking vertically to cover 16° (hori) x 48°(vert). The detector sits on the 2Θ rotation arm to cover the scattering angle range of 3°<2Θ <155°. 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 incidentwavelengths 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.

## SPECIFICATIONS

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| Beam spectrum | Thermal |
| Monochro-mator | Double focusing silicon |
| Monochro-mator angle | 47.5° |
| Incident wavelengths | 1.005 Å (331), 1.546 Å (220), 2.541 Å (111) |
| Four-circle mode | Huber, full χ circle, with 4 – 800 K CCR 2Θ < 155° |
| Two-axis mode | -181°< omega < 181° Out-of-scat-tering plane coverage -8° < γ < 40° 2Θ<155° |
| 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<br>$^3$He Polarizer |

21-G02333/jdh Dec 2021

## APPLICATIONS

The HB-3A DEMAND 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.


**For more information, contact**

Huibo Cao, caoh@ornl.gov, 865.686.2608
Bryan Chakoumakos, chakoumakobc@ornl.gov, 865.621.0227
Yan Wu, wuy1@ornl.gov, 865.341.0563

neutrons.ornl.gov/demand



OAK RIDGE National Laboratory

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