

**APS-U
MAJOR UPGRADE PROPOSAL FOR SECTOR 3-ID**

NUCLEAR RESONANT AND INELASTIC X-RAY SCATTERING PROGRAM

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ABSTRACT

We propose to upgrade the “nuclear resonant and inelastic x-ray scattering” beamline at the APS 3-ID. This is the only dedicated beamline for nuclear resonant scattering in the country. It was operational in 1997 and it has not been upgraded since then. The proposed innovations will open research possibilities in catalytic cycle of enzymes like hydrogenase (1) and nitrogenase (2), charge transfer proteins (3), and oxygen reduction reaction catalysts (4,5). Iron vibrations could discern the catalytic activity, where diffraction and other spectroscopic methods may fail (6). Newer applications like microscopic determination of isotope fractionation in minerals (7,8), real time charge/discharge in Li or Na-ion batteries (9) and similar energy storage systems will be possible. New capabilities for low temperature – high pressure studies in lanthanides (10,11) will illuminate the interplay between magnetism and superconductivity. High-pressure studies beyond 1 Mbar will quantify seismic properties of minerals in the Earth’s deep mantle and core (12-14). The questions we address are the central issues of current debate regarding carbon capture, energy storage, new energy materials like magnetocalorics (15), clathrates (16,17), and nanomaterials (18).