

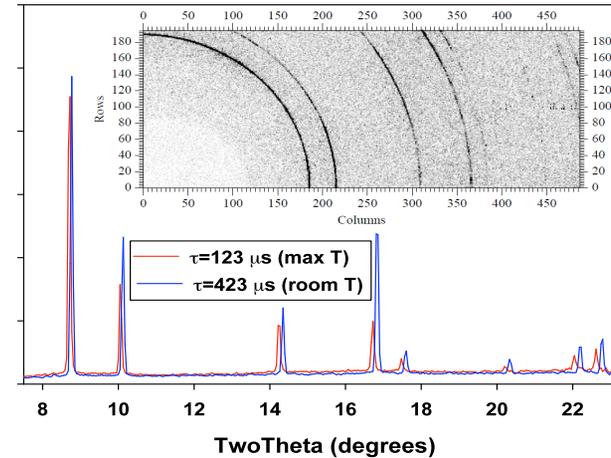
Time-resolved X-ray diffraction and spectroscopy under extreme conditions (TEC)

TEC at NSLS-II

- Will enable time-domain capabilities (femto to milli seconds) for combined x-ray and pulsed laser diagnostics under extreme conditions of pressure (static & dynamic), temperature (0.001 eV to 1 eV), and magnetic field (dc fields to 35 T and pulsed to 50 T) to study ultrafast physical, chemical, and transport phenomena
- Will enable high spatial resolution to study *in-situ* dynamic processes and transport properties at submicron scale
- Tightly focused, brilliant beams will make TEC the world's leading beamline for extreme conditions research

Examples of Science Areas & Impact

- **MATERIALS SCIENCE:** Material response to extremes, synthesis of new materials with unique properties (nano, superconducting, superhard) in nonequilibrium conditions
- **CHEMISTRY:** Energetic materials under detonation conditions, bonding character changes under extreme conditions
- **GEO- & PLANETARY SCIENCES:** Origin, evolution, and interior structure of planets through *in-situ* direct study of transport and melting phenomena, equations of state (including fluids), fluid-fluid transitions, electronic and spin transitions, change in redox and valence states, chemical reactivity, mineral interfaces
- **ENVIRONMENTAL SCIENCE:** Carbon Sequestration



Time-domain laser heating x-ray diffraction experiments in platinum at 40 GPa (APS, GSECARS). Blue line – the pattern measured (with 1 μ s time resolution) at the delay time well outside the laser pulse duration. Red solid line- the pattern collected at the delay time corresponding to the largest thermal expansion and hence the largest bulk sample temperature (3000 K). The inset shows the diffraction image corresponding to the pattern measured from the hot sample (red curve). A. Goncharov et al., *Rev. Sci. Instrum.*, in press (2010).

Beamline Capabilities:

TECHNIQUES: micro-XRD and SAXS, XAS, XFS, XES, x-ray Raman

SOURCE: high beta undulator

ENERGY RANGE / TIME RESOLUTION: 5-20 keV (up to 40 keV) / down to 10 ps, 1 μ s typical

SPATIAL RESOLUTION: 0.2 – 5 μ m