INELASTIC X-RAY SCATTERING (IXS)

BROOKHAVEN NATIONAL LABORATORY

NATIONAL SYNCHROTRON LIGHT SOURCE II

SCIENTIFIC SCOPE

Inelastic X-ray Scattering (IXS) is an undulator beamline at sector 10-ID providing world-leading IXS capability with ~1 meV resolution at 9.1 keV, sharp (nearly Gaussian) resolution function and excellent momentum resolution (0.1 nm^{-1}). The key instrument at IXS is a novel spectrometer with analyzer optics based on a highly-dispersive back-reflection optical system on a 5m scattering arm that covers a wide range of momentum transfer, enabling studies of low-energy excitations from materials with nanoscale heterogeneities and disorders.

BEAMLINE CHARACTERISTICS

TECHNIQUES:

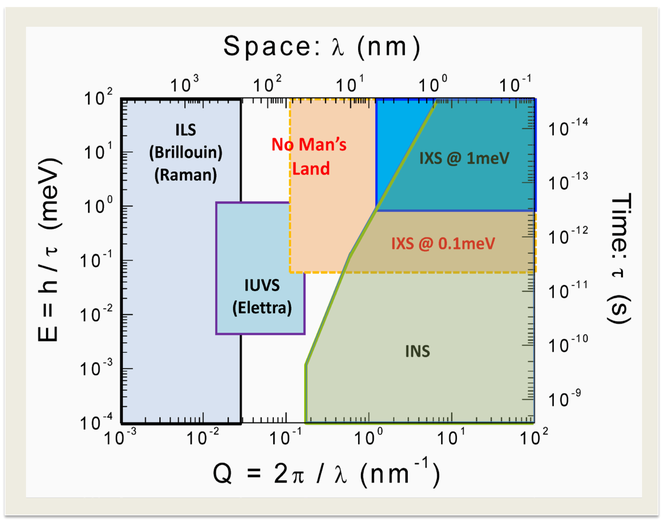
- Ultrahigh resolution inelastic x-ray scattering

ENDSTATION DETAILS:

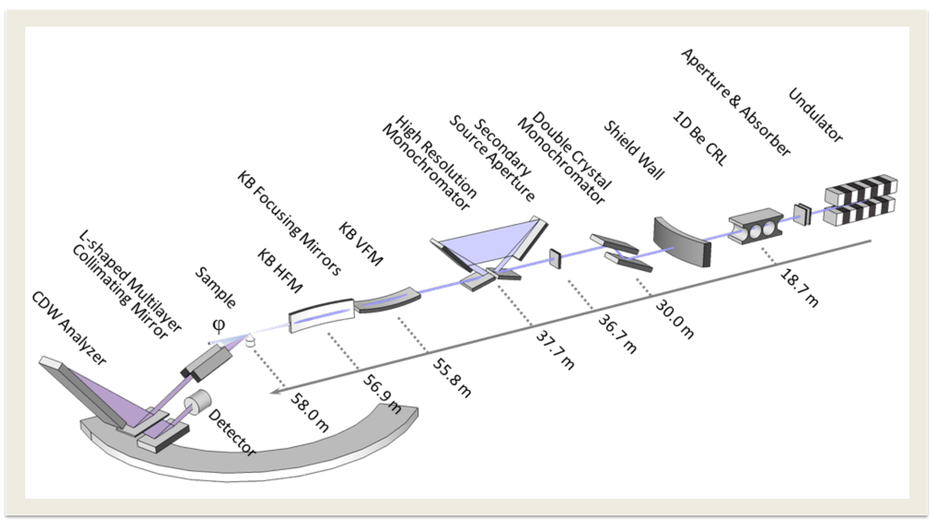
- Novel IXS spectrometer with highly-dispersive back-reflection analyzer optics.
- High-pressure low-temperature cryostat with online Ruby system for in-situ experiments.
- Humidity and temperature controlled sample chamber for biological materials.

IXS at NSLS-II:

- Will enable ultrahigh resolution studies of mesoscopic dynamics at sub-picosecond time in a broad range of material systems with nanoscale heterogeneities and disorders.
- The combination of low operating energy and excellent beam size provides unique research strength on low-Z materials and high-pressure systems.



Dynamic domains covered by the IXS versus other inelastic scattering probes

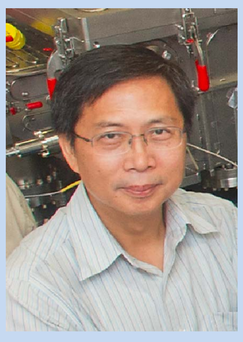


Schematic layout of the IXS beamline and endstation optical system

Overview

PORT: 10-ID
SOURCE: undulator (IVU22-3m)
OPERATING ENERGY : 9.13 keV
ENERGY RESOLUTION: ΔE ~1 meV
MOMENTUM (Q) RANGE: 0.1 – 40 nm^{-1}
MOMENTUM RESOLUTION: 0.1 nm^{-1}
BEAM SIZE: 5 μm (V) x 7 μm (H)
BEAMLINE STATUS: Open to users
BEAMLINE PHONE: 631.344.1610
BEAMLINE WEBSITE: www.bnl.gov/nsls2/beamline/10-ID

Beamline Staff



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Apply for Beam Time

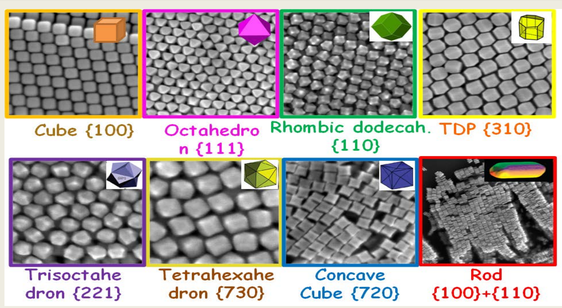
Beamlines at NSLS-II are available to all scientific researchers through a peer-review proposal process. For more information, see the NSLS-II Users' Guide at:

www.bnl.gov/ps/userguide/

SCIENTIFIC APPLICATIONS

- Anomalies in thermal and elastic properties in liquids and glasses
- Dynamics of soft matter, colloids and biological materials
- Phonons in crystalline and polycrystalline materials
- Vibrational dynamics of surfaces and interfaces and systems under extreme pressure

Programmable Nanoparticle Assemblies

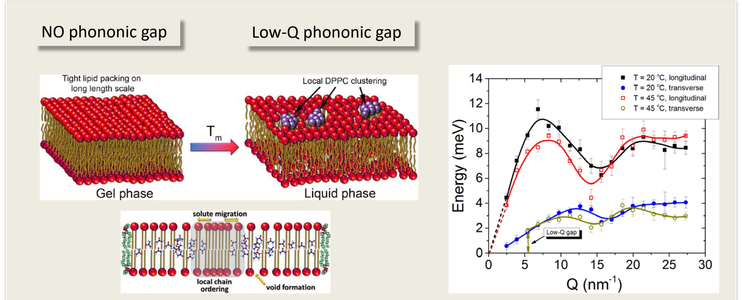


(Gang et al, Phys. Rev. Lett., 2011)

Addressing challenges in mesoscale science:

- Inter-particle phonons: insight on tunable strength of particle linkage
- Intra-particle phonons: effects on particle shape and size
- Phonon damping and viscosity

Dynamics in Lipid Membranes

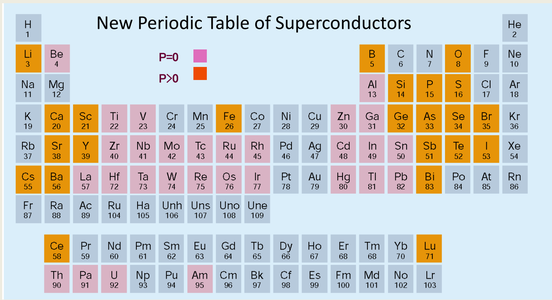


(Zhernenkov et al, Nat. Comm. 7, 11575, 2016)

Key biological processes to be studied:

- Lipid and protein diffusion and transport
- Protein-protein, protein-lipid interaction
- Nanoscale dynamics in lipid domains (rafts)

Light Elements under High Pressure



(Ashcroft., Nature 2002)

Understanding novel phase transitions:

- Intra- and intermolecular vibrations probe the state of bonding and changes under extreme pressure and temperature.
- Direct access to dispersion, a critical test of theories, including superconductivities.