COHERENT SOFT X-RAY SCATTERING (CSX-1)

BROOKHAVEN NATIONAL LABORATORY

NATIONAL SYNCHROTRON LIGHT SOURCE II

SCIENTIFIC SCOPE

The Coherent Soft X-ray Scattering beamline (CSX-1) is a canted undulator beamline at sector 23-ID providing coherent soft x-ray scattering and imaging with world-leading high-coherent flux and detectors for probing correlated electronic textures and dynamics. Endstation instrumentation allows experiments using X-ray Photon Correlation Spectroscopy (XPCS), scanning diffraction microscopy, and coherent diffraction imaging.

BEAMLINE CHARACTERISTICS

TECHNIQUES:

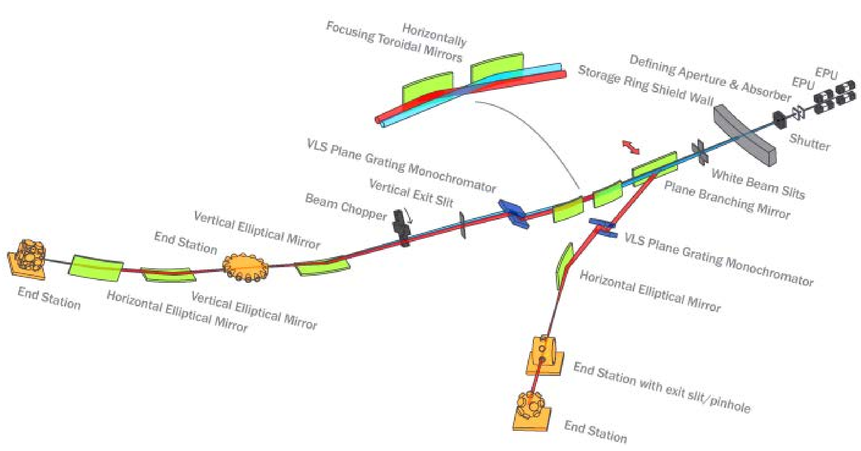
- Resonant Soft X-ray Scattering
- X-ray Photon Correlation Spectroscopy (XPCS)
- Scanning Diffraction Microscopy
- Coherent Diffraction Imaging (CDI)

ENDSTATION DETAILS:

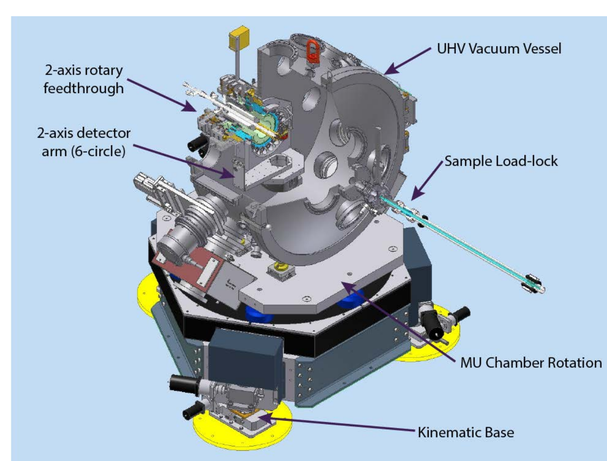
- 6-circle in-vacuum diffractometer
- 100 Hz FastCCD Detector
- Zone Plate imaging with nano positioning stages for OSA and ZP

CSX-1 at NSLS-II:

- Enables measurements of electronic textures with a resolution better than 50 nm.
- Enables measurements of electronic dynamics with a time resolution better than 15ms.
- Resonant scattering experiments with a flexible in-vacuum endstation with capabilities for surface soft x-ray scattering.



The CSX beamlines (CSX-1 and CSX-2) are served by two identical EPU49 sources and can be run simultaneously.



The 6-Circle In-vacuum endstation installed at CSX-1

Overview

PORT: 23-ID-1

SOURCE: undulator (EPU49)

ENERGY RANGE: 270 eV – 2 keV

ENERGY RESOLUTION: $\Delta E/E = 5 \times 10^{-3}$

SPATIAL RESOLUTION: 10 um (XPCS), 50 nm (zone plate)

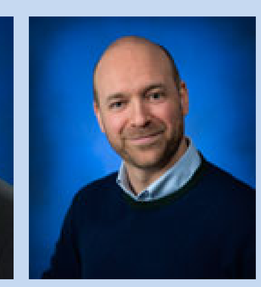
BEAMLINE STATUS: Open to users

BEAMLINE PHONE: 631.344.1623

BEAMLINE WEBSITE: www.bnl.gov/nsls2/beamline/23-ID-1

Beamline Staff

Stuart Wilkins
Lead Beamline Scientist



Claudio Mazzoli
Beamline Scientist

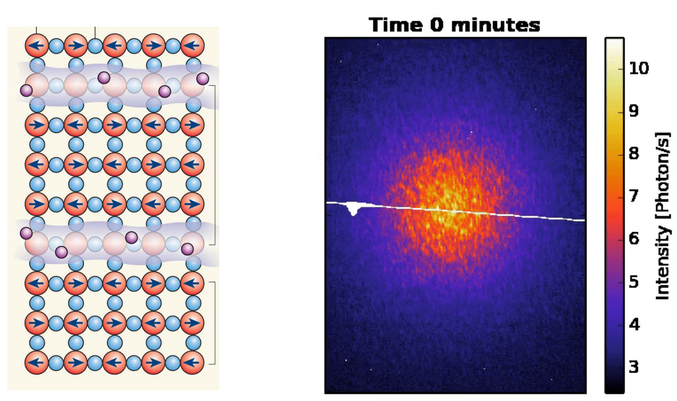
Wen Hu
Beamline Scientist

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

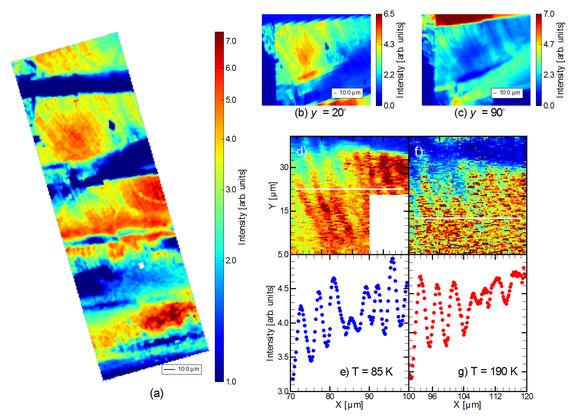


Electronic Textures in Cuprates

Discovered at BNL in the 1995, the charge and spin texture in cuprate – stripes – is now known to lie at the heart of the great mystery that is high temperature superconductivity. When static, these textures prevent superconducting phase coherence, when dynamic they may promote pairing. Key unanswered questions are:

- What is the real space organization of the stripes?
- What is the origin of the pinning of the domain walls?
- Are they correlated with dopant induced defects?
- Are the domains truly static or are they glass-like?

At NSLS-II, coherent soft x-ray scattering will produce *real space* images with nm resolution of charge stripe domains to answer these questions.

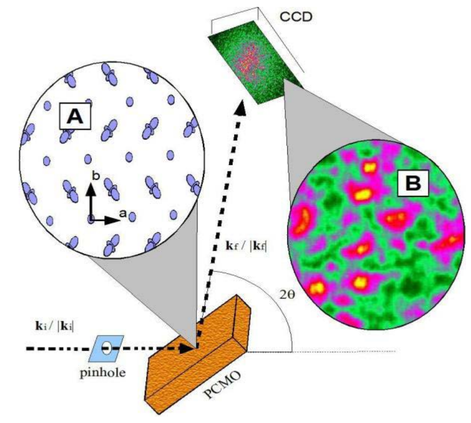


Magnetic Domain Imaging

While ferromagnetic domains are relatively easy to image, antiferromagnetic (AFM) domains remain mysterious due to a lack of techniques which can spatially resolve the antiferromagnetic order parameter with sufficient spatial resolution. The study of these domains is however is vitally important for any device as they define the properties of the device.

Soft x-ray nano-diffraction will allow measurements of the domain patters of this ubiquitous ground state, and be able to address:

- The real space orientation of the AF domains
- Whether the domains are static upon temperature cycling.
- Whether the domains are pinned, and if so what is pinning them.



Dynamics in Correlated Oxides

Dynamics in strongly correlated systems studied with coherent soft x-rays. In these systems the coupling is complicated due to interplay among the charge, the spin and the lattice.

Working in the time domain with coherent soft x-rays allows to study the dynamics in the systems in temperature driven phase transitions. The figure above shows the experimental set- up and data collected under Bragg conditions in a half doped $Pr_{0.5}Ca_{0.5}MnO_3$.

J. J. Turner, *et al*, *New Journal of Physics* 10, 053023 (2008).