INTEGRATED *IN-SITU* AND RESONANT X-RAY STUDIES (ISR)

BROOKHAVEN NATIONAL LABORATORY

NATIONAL SYNCHROTRON LIGHT SOURCE II

SCIENTIFIC SCOPE

ISR is a tender and hard x-ray scattering beamline that enables the *in-situ* study of materials in a flexible range of environment chambers. Specialized optics provide polarization control and microfocusing with a ~1 m working distance. A 6-circle diffractometer and base diffractometers that accommodate user-supplied UHV chambers or magnets enable fundamental research in materials synthesis and processing, structure-property relationships in complex materials, and materials response to external stimuli such as high magnetic field.

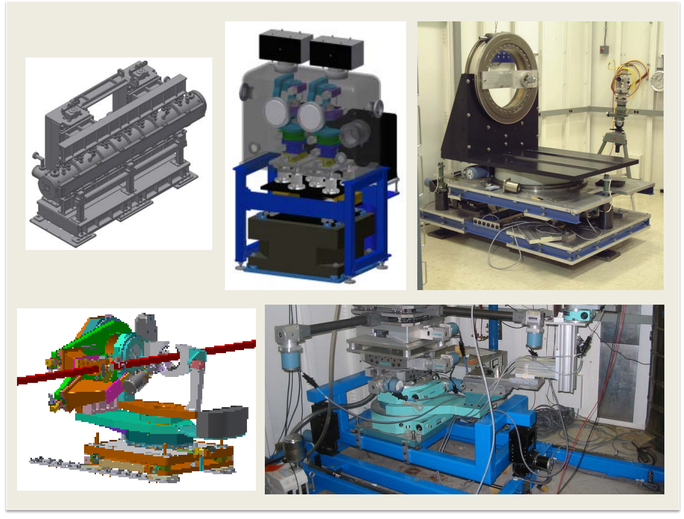
BEAMLINE CHARACTERISTICS

TECHNIQUES:

- Real-time GISAXS and GID
- CTR, XRR, and XRIM
- RXS, polarized XRD, and XMCD

ENDSTATION DETAILS:

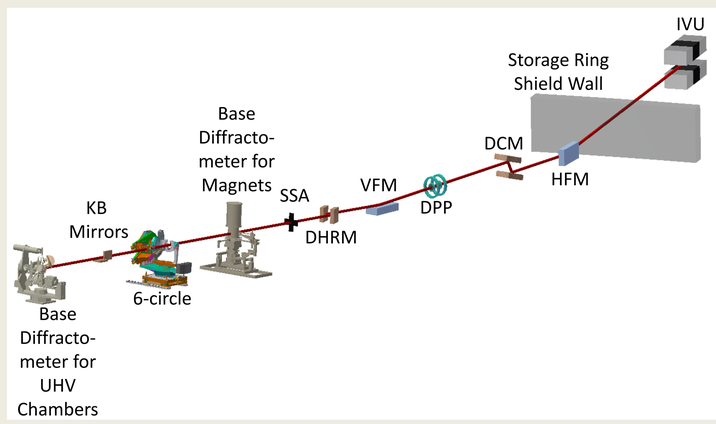
- Base diffractometer for magnets
- Base diffractometer for UHV chambers
- 6-circle diffractometer



Clockwise from top left, IVU-23 model, DPP model, *in-situ* base diffractometer, magnet base diffractometer, and 6-circle model.

ISR at NSLS-II:

- Will enable the study of fundamental processes during materials growth and processing using *in-situ* scattering techniques.
- Will enable direct method mapping of epitaxial heterostructures using CTR studies with on-the-fly scanning and an area detector.
- Will enable the characterization of multipolar order using effective "azimuthal" scans with full polarization control and analysis.



Schematic layout of the ISR beamline.

Overview

PORT: 4-ID

SOURCE: undulator (IVU-23)

ENERGY RANGE: 2.4 – 23 keV

ENERGY RESOLUTION: $\Delta E/E \approx 10^{-4}$

SPATIAL RESOLUTION: 1 μm

CONSTRUCTION PROJECT: NEXT

BEAMLINE STATUS: Construction

AVAILABLE TO USERS: Winter 2017

Beamline Team

STAFF

Christie Nelson: lead beamline scientist

Kenneth Evans-Lutterodt: beamline scientist

Michael Lucas: mechanical engineer

Cynthia Longo: designer

Zhijian Yin: controls engineer

ADVISORS

Joel Brock (Cornell University)

Randall Headrick (University of Vermont)

Jean Jordan-Sweet (IBM)

Valery Kiryukhin (Rutgers University)

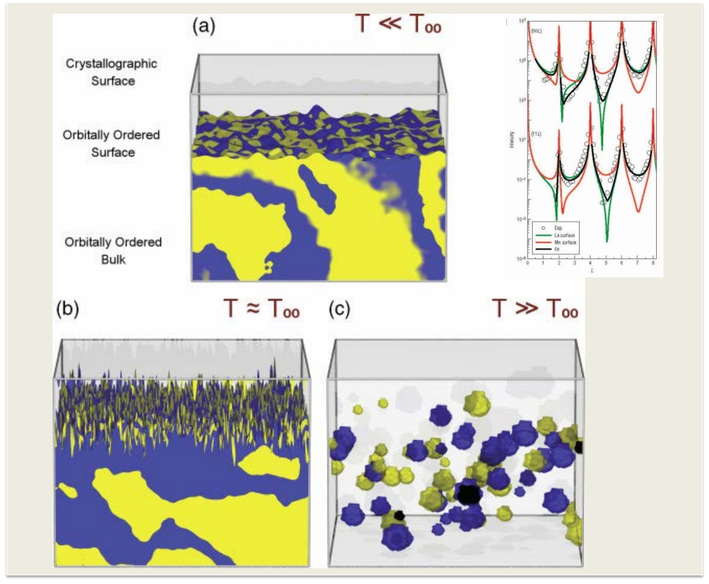
Jonathan Lang (APS, ANL)

Karl Ludwig (Boston University)

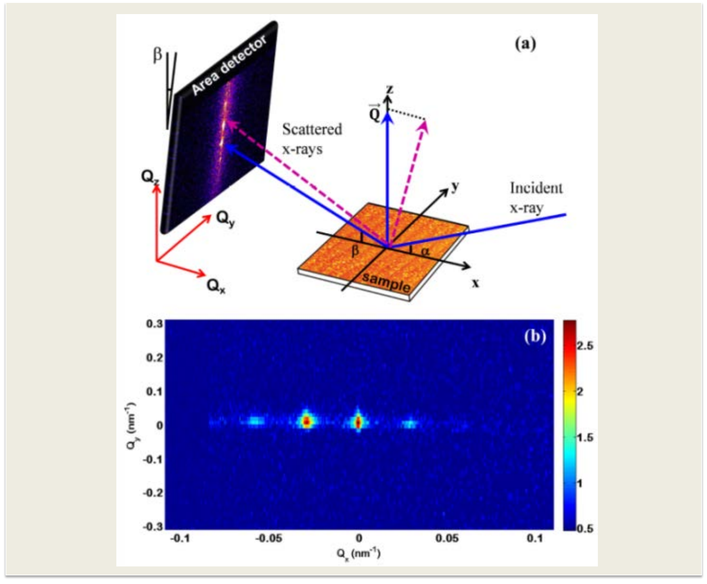
Paul Lyman (University of Wisconsin)

Jörg Strempfer (PETRA III, DESY)

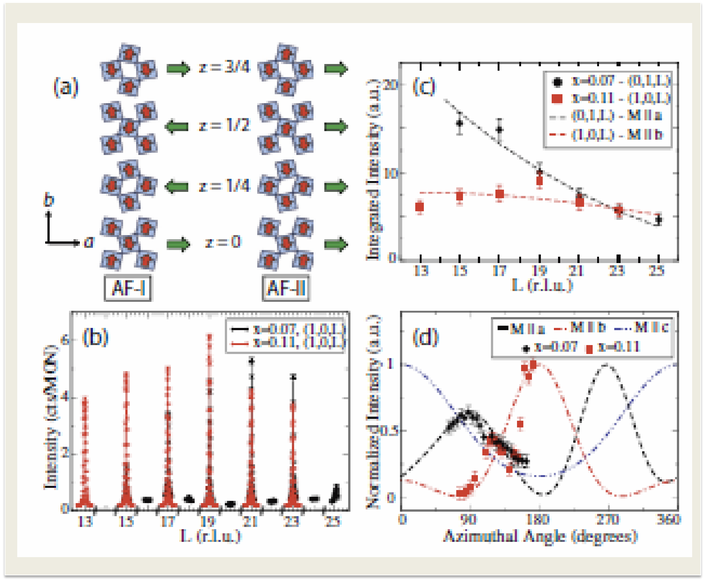
SCIENTIFIC APPLICATIONS



Functional surfaces and interfaces: surface orbital order in $La_{0.5}Sr_{1.5}MnO_4$, Wakabayashi *et al.*, Nature Materials **6**, 972 (2007) and Wilkins *et al.*, PRB **84**, 165103 (2011).



Surface and thin-film growth processes: growth modes of $BiFeO_3$ during PLD and sputter deposition, Chinta *et al.*, APL **101**, 201602 (2012) and PRL **112**, 075503 (2014).



Strongly correlated electron systems: doping-induced change in the magnetic order of the spin-orbital Mott insulator $Sr_2Ir_{1-x}Rh_xO_4$, Clancy *et al.*, PRB **89**, 054409 (2014).