Beamline Scientific Staff Research Program

Paul Zschack, NSLS-II

19 September 2017

Photon Science Division Mission & Strategy

- Photon Science Division operates state-of-the-art beamlines for a broad, scientifically diverse user community
- Photon Science Division staff lead new beamline development efforts (with user community), develop new experimental instruments & methods, collaborate with users, and produce high impact science using NSLS-II and other facilities
- Photon Science Division staff perform R&D for new developments in x-ray synchrotron science

We recruit excellent scientific and technical staff to address these objectives and prioritize support consistent with our strategic plan. We strive to 1) increase the number of NSLS-II users; 2) increase high impact science productivity; and 3) exploit the unique capabilities of the NSLS-II source by building and operating world-leading experimental facilities.

Outline

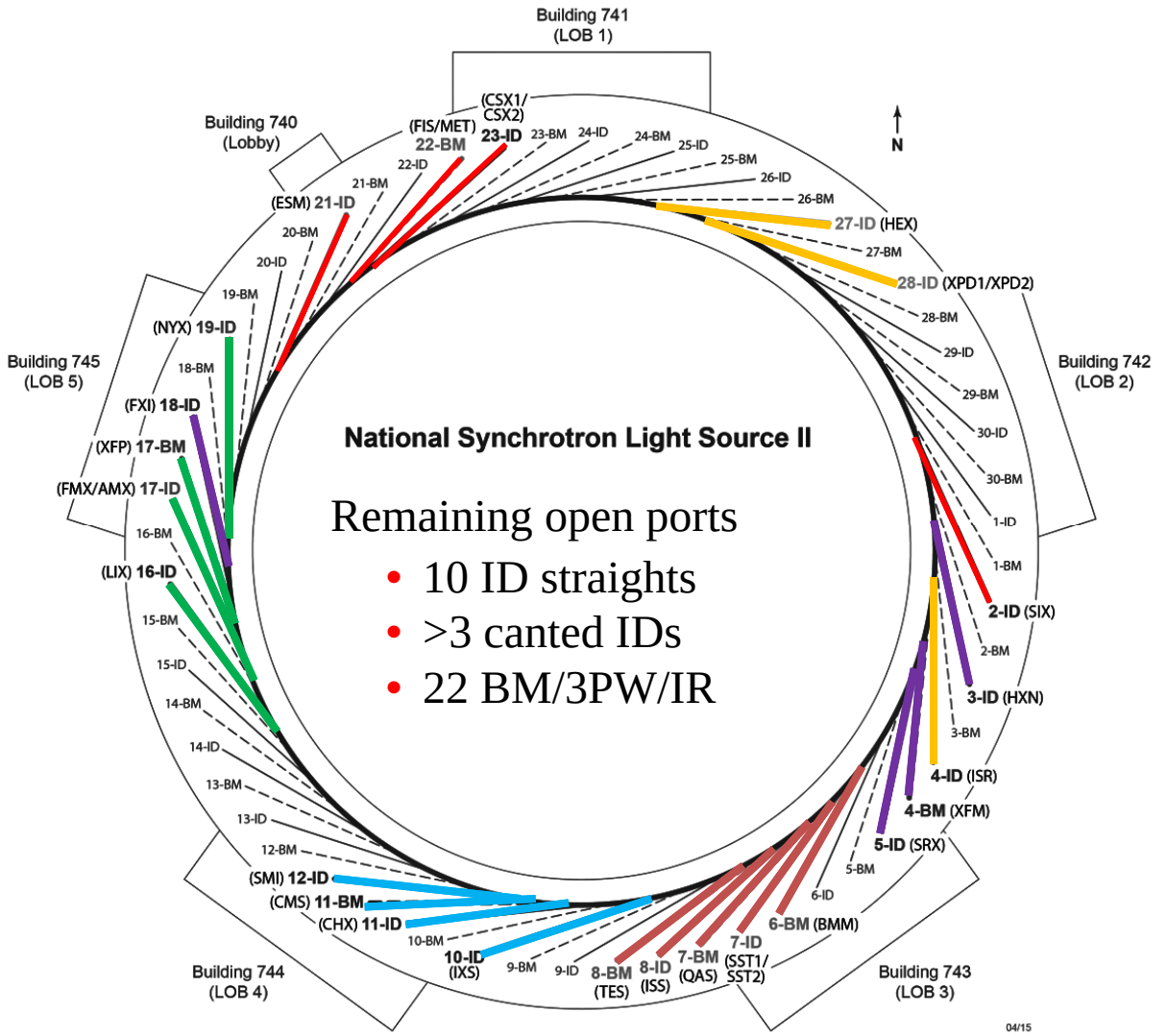
- Beamline Programs
- PSD Staff Science Highlights
- Operating Beamline Work Breakdown Structure
- Other Operations Support for R&D Activities
- BNL LDRD Program
- Other-funded R&D Activities
- Summary

Beamline R&D activities are critically important for staff career development and for assuring that NSLS-II beamlines remain highly productive

Scientific Staff Review Policy

- Normal promotion progression is Assistant Scientist (S1) to Associate Scientist (S2) to Scientist (S3) to Scientist with Continuing Appointment (S4) to Tenure (S4) and/or to Senior Scientist (S5).
- NSLS-II scientific staff are evaluated in any combination of the following areas:
  - a clearly defined scientific program
  - the ability to support facility mission
  - skill in developing and operating NSLS-II facilities
- NSLS-II scientific staff are evaluated against the NSLS-II mission, with assessments in areas such as:
  - Proven record of successful user support on a beamline;
  - Ability to perform original outstanding scientific research, proven by publications in refereed journals, invited talks at recognized conferences, successful guidance of a team of co-workers;
  - Scientific breadth and the demonstrated ability to develop new programs and initiate novel activities;
  - Distinction and leadership within the internal & external scientific community;
  - A high degree of skill and competence in supporting user science;
  - Excellence in developing and operating the NSLS-II experimental and accelerator facilities;
  - Technical/instrumentation excellence

NSLS-II Beamline Portfolio



Soft X-Ray Scattering & Spectroscopy

23-ID-1: Coherent Soft X-ray Scat (2015)
23-ID-2:Coherent Soft X-ray Spectr & Pol (2015/2016)
21-ID: Photoemission-Microscopy Facility (2017)
2-ID: Soft Inelastic X-ray Scattering (2017)
22-BM: Magneto, Ellipso, High Pressure IR (2018)

Complex Scattering

10-ID: Inelastic X-ray Scattering (2015)
11-ID: Coherent Hard X-ray Scattering (2015)
11-BM: Complex Materials Scattering (2016)
12-ID: Soft Matter Interfaces (2017)

Diffraction & In Situ Scattering

28-ID-1: X-ray Powder Diffraction (2015)
28-ID-2: X-ray Powder Diffraction (2017)
4-ID: In-Situ & Resonant X-Ray Studies (2017)
27-ID: High Energy X-ray Diffraction (2022)

Hard X-Ray Spectroscopy

8-ID: Inner Shell Spectroscopy (2017)
7-BM: Quick X-ray Absorption and Scattering (2016)
8-BM: Tender X-ray Absorption Spectroscopy (2017)
7-ID-1: Spectroscopy Soft and Tender (2017)
7-ID-2: Spectroscopy Soft and Tender (2017)
6-BM: Beamline for Mater. Measurements (2017)

Imaging & Microscopy

3-ID: Hard X-ray Nanoprobe (2015)
5-ID: Sub-micron Res X-ray Spec (2015)
4-BM: X-ray Fluorescence Microscopy (2017)
18-ID: Full-field X-ray Imaging (2018)

Structural Biology

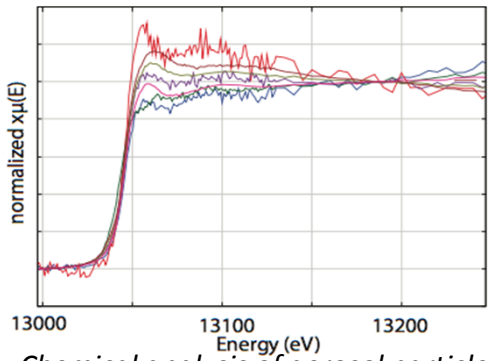
17-ID-1: Frontier Macromolecular Cryst (2016)
17-ID-2: Flexible Access Macromolecular Cryst (2016)
16-ID: X-ray Scattering for Biology (2016)
17-BM: X-ray Footprinting (2016)
19-ID: Microdiffraction Beamline (2017)

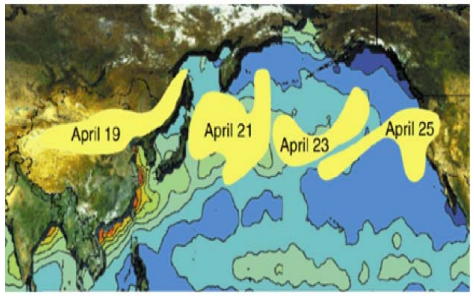
Imaging and Microscopy Program

- Science emphasis on spatially heterogeneous systems benefiting from imaging with multiple contrast mechanisms (absorption, fluorescence, phase, and diffraction) at multiple length scales from nm to μm to mm

- Wide range of scientific disciplines take advantage of imaging and microscopy beamlines for 2D, 3D, time-dependent, in situ, operando, and chemical-sensitive measurements of morphology, structure, and chemical variation in these systems

HXN	**Hard X-ray Nanoprobe**
FXI	**Full-field X-ray Imaging**
SRX	**Submicron Resolution X-ray spectroscopy**
XFM	**X-ray Fluorescence Microprobe**





Chemical analysis of aerosol particles in human health (R. Moffet, U Pacific; M. Schoonen, BNL)

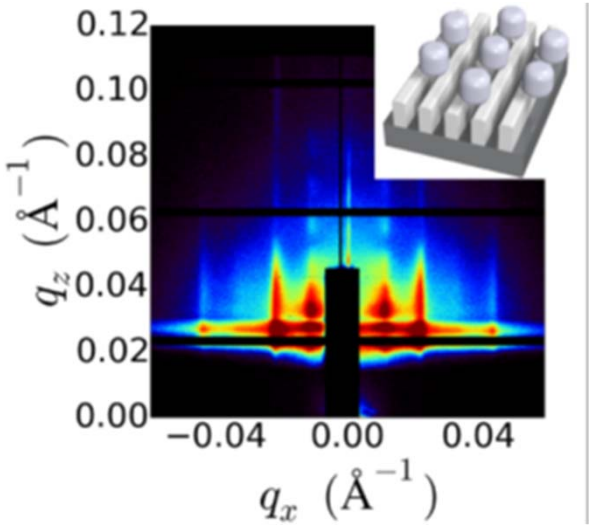
Complex Scattering Program

- Emphasis on structure and dynamics of soft/bio/hard-material architectures with enhanced or emergent properties that drive transformative technologies

- Relationship between function, structure and equilibrium and non-equilibrium dynamics in hierarchically ordered and engineered nanomaterials

- Advanced processing approaches to develop soft/bio/hybrid materials (films & fibers) for energy, advanced manufacturing & filtration applications

IXS	**Inelastic X-ray Scattering**
CHX	**Coherent Hard X-ray scattering**
SMI	**Soft Matter Interfaces**
CMS	**Complex Materials Scattering**

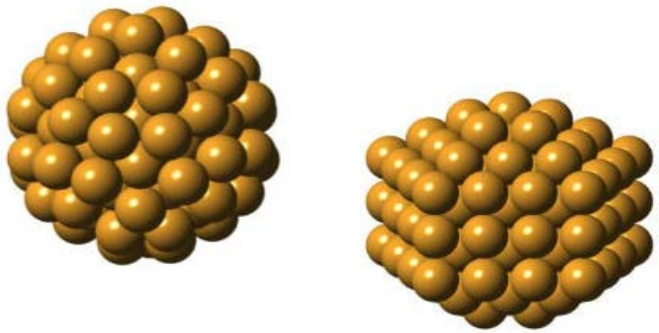


A. Rahman *et al*. Nature Comm. (2016)

In-situ Scattering & Diffraction Program

- In-situ, real time Diffraction & Scattering for structural characterization of both crystalline materials and materials with limited LRO in complex environments
  - Functional Interfaces & surfaces, 3D structures, and thin film growth and processing
- Scientific emphasis in materials engineering, chemistry, earth and environmental science, physics, materials in complex environments, synthesis and reaction processes
- Materials studies including batteries (BNL Battery Solution Center), fuel cells, catalysts, multiferroics, nanocomposites, photovoltaics, strongly correlated electron materials (electronic order)

XPD	**X-ray Powder Diffraction**
PDF	**Pair Distribution Function measurements**
ISR	**Integrated in-Situ and Resonant hard x-ray studies**

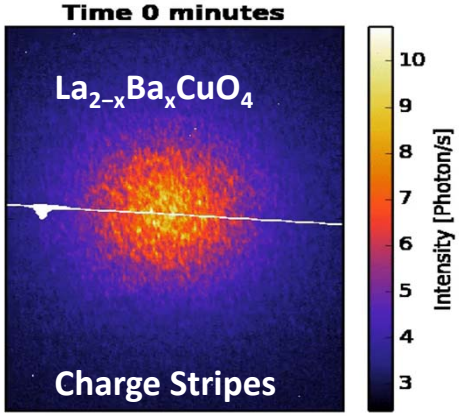


K. M. Jensen and P. Juhas, M. A. Tofanelli, C. L. Heinecke, G. Vaughan, C. J. Ackerson, and S. J. Billinge, *Nature Communications*, **7** 11859 (2016).

Soft X-ray Scattering & Spectroscopy

- Emphasis includes Scattering, Spectroscopy and Imaging for Quantum Materials and Catalysis & Energy Research, including:
  - Understanding and controlling the physics of quantum materials and their behavior on the nanoscale, electronic properties and texture, and exploiting quantum materials in useful devices.
  - The study of energy relevant catalysis in their operating conditions using real catalyst materials in realistic pressures such as near ambient pressure.
  - Studies of complex oxides exhibiting competing phases and emergent phenomena (e.g. multi-ferroics, topological insulators, high-Tc and conventional superconductors)
  - The structure and behavior of materials under conditions of extreme pressures and temperatures.

SIX	**Soft Inelastic X-ray scattering**
CSX-1	**Coherent Soft X-ray scattering**
CSX-2	**Soft X-ray Spectroscopy & polarization**
ESM	**Electron Spectro-Microscopy**
FIS/MET	**Frontier synchrotron Infrared Spectroscopy**

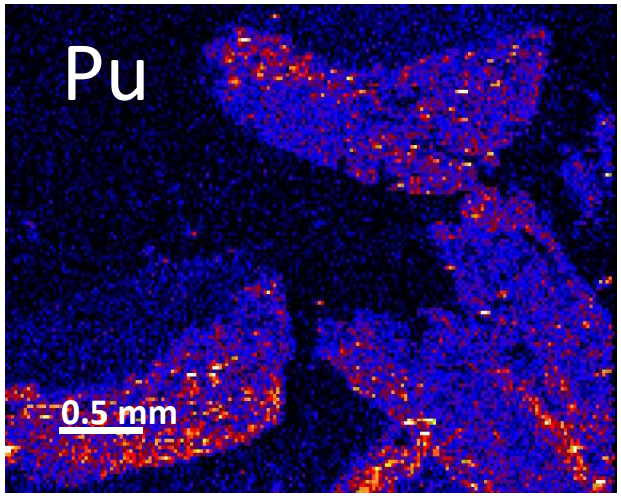


Hard X-Ray Spectroscopy Program

- Emphasis on structural and chemical surface reactions including:
  - Heterogeneous and electro-catalysis for selective oxidation of light hydrocarbon activation, Ammonia synthesis, and catalysis combined with separation (rational design of “smart” nanoporous membranes)
  - Materials growth, device fabrication and device physics such as film growth on specific substrates and device structures (ALD)
  - Environmental sciences to probe chemistry, local/global transport, and bioavailability of nutrients or contaminants in soil and sediments

ISS	**Inner Shell Spectroscopy**
TES	**Tender Energy x-ray absorption Spectroscopy**
QAS	**Quick x-ray Absorption and Scattering**
SST-1,2	**Spectroscopy Soft and Tender – in partnership with NIST**
BMM	**Materials Measurement – in partnership with NIST**

R. Tappero, P. Northrup, M. Maloubier & B. Powell

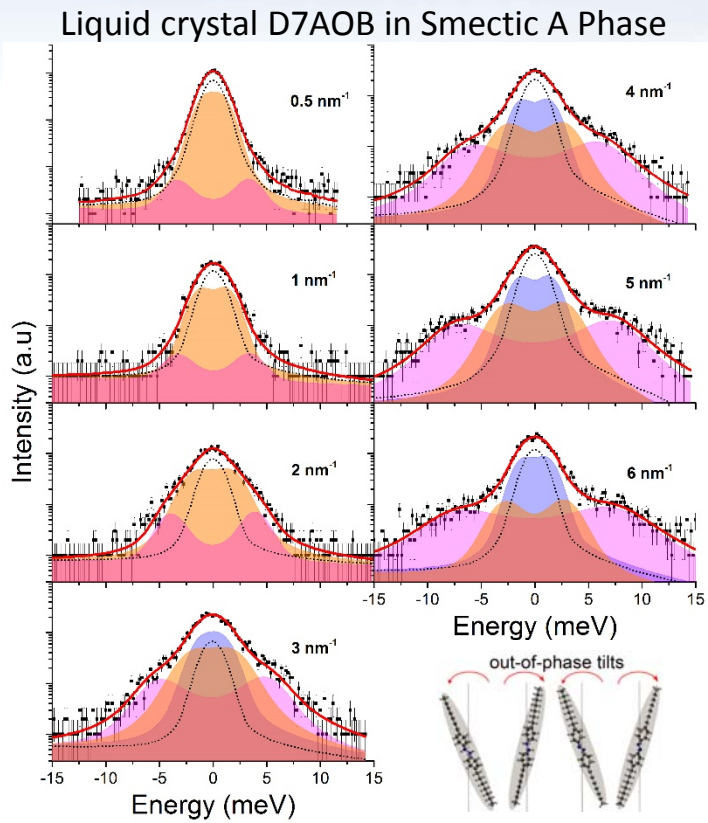


Structural Biology Program

- Emphasis on the atomic structure, function and dynamics of molecules of importance in fundamental function of all biological systems.
- Structural biology, using micro-diffraction, anomalous dispersion, automatic data collection and structure interpretation, time resolved measurements.
- Dynamics and imaging, using ptychography and scattering-based imaging for bio-materials, proteins in solution, and dynamics through X-ray foot printing (XFP beamline)

AMX	**Automated Macromolecular X-ray crystallography**
FMX	**Frontier Macromolecular X-ray crystallography**
LIX	**Life science X-ray scattering**
XFP	**X-ray Footprinting – in partnership with Case Western Reserve University**
NYX	**New York structural biology – in partnership with New York Structural Biology**

New Way to Control Molecular Vibrations that Transmit Heat



IXS spectra of a liquid crystal D7AOB in the layered smectic A phase (T=48°C), showing two acoustic (purple and orange) and one optical (pink) vibrational modes. The latter mode is linked to the out-of-phase tilt motion of the molecules (bottom right).

D. Bolmatov, M. Zhernenkov, L. Sharpnack, D. Agra-Kooijman, S. Kumar, A. Suvorov, R. Pindak, Y. Cai, & A. Cunsolo, Nano Letters 17, 3870–3876 (2017).

Scientific Achievement

Using inelastic x-ray scattering three distinct terahertz vibrations, which are common in solid matter, were detected moving through the layers of the Smectic A liquid crystal phase and were linked to the nanoscale structure of the material.

Significance and Impact

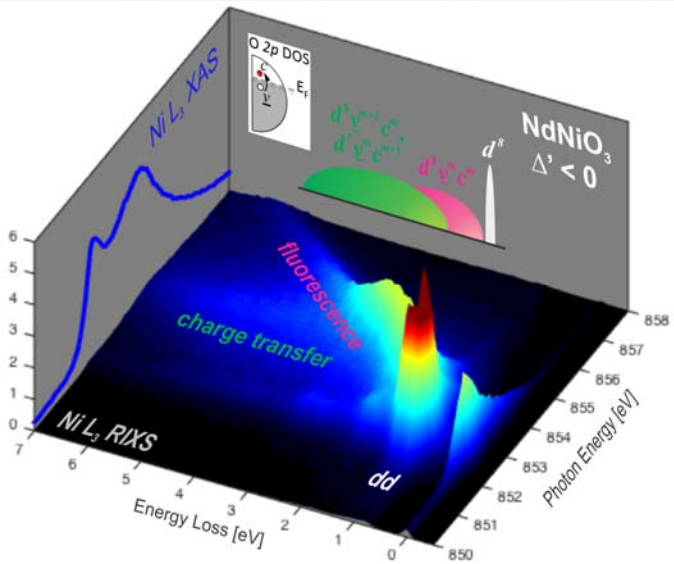
Understanding the dynamic molecular features in soft materials such as liquid crystals could offer a new pathway to control the vibrations, and hence the flow of heat, sound or other forms of energy coupled with those vibrations.

Research Details

- Studies showed that modulating the amount of structural disorder using different phases of a liquid crystalline material can create a variety of terahertz vibrational effects.
- Studies used beamline 10-ID (IXS) at NSLS-II, which features an unprecedented energy resolution of 2 meV with sharp instrumental resolution at 9 KeV, providing a unique capability for studies of complex materials with nanoscale inhomogeneities.

Work was performed at Brookhaven National Laboratory

Revealing new properties of Ni-based functional materials



3D map of RIXS plane (bottom), measured across the at the Ni L_3 absorption edge (XAS on the left). The finding of fluorescence excitations in the RIXS plane down to low energy loss (magenta) supports the presence of delocalized electronic states across the Fermi level, with a dominant oxygen character (right).

V. Bisogni, S. Catalano, R. J. Green, M. Gibert, R. Scherwitzl, Y. Huang, V. N. Strocov, P. Zubko, S. Balandeh, J.-M. Triscone, G. Sawatzky and T. Schmitt; **Nat. Comm. 13017** (2016).

Work was performed at the Swiss Light Source.

Scientific Achievement

Resonant inelastic x-ray scattering (RIXS) revealed that electrons from oxygen atoms in Ni-compounds such as $NdNiO_3$ are responsible for their metal-to-insulator transition properties.

Significance and Impact

Revealing the electronic structure of $NdNiO_3$ shows that it is a candidate for an exciting new transistor material.

Research Details

- $NdNiO_3$ is either a metal or an insulator, depending on its temperature. This characteristic makes the material a potential candidate for transistors.
- Several theories tried to explain how the transition from metal to insulator happens, without final consensus.
- High resolution RIXS experiment provides unambiguous information on the electronic structure of $NdNiO_3$: this finding represents a solid base for modeling the material, allowing the development of a coherent picture in the direction of its functional engineering.

Nanoscale Structure of the Oil-Water Interface

Scientific Achievement

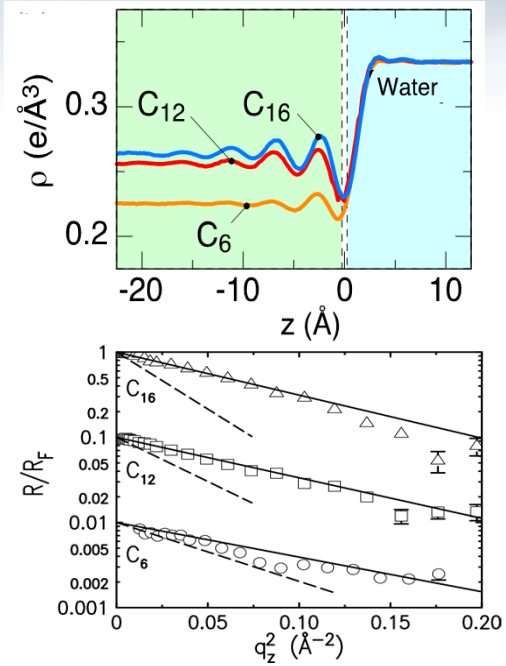
X-ray reflectivity (XR) and molecular dynamics (MD) simulations provide new insight into the nanoscale structure of liquid alkane-water interfaces.

Significance and Impact

Understanding alkane-water interfaces, the simplest hydrophobic-hydrophilic interfaces, is of fundamental importance to basic science and Energy-Water Nexus.

Research Details

- XR alone reveals good agreement with a sharp density profile, broadened by thermal capillary waves, independent of alkane chain length.
- XR and MD together show that the interfacial depletion layer is no more than 0.5 Å thick, significantly (3-8 times) smaller than obtained previously for methyl-terminated self-assembled monolayer-water interfaces.
- MD suggests that the relative insensitivity of the interfacial width to alkane chain length arises from the chain's propensity to lie parallel to the interface.

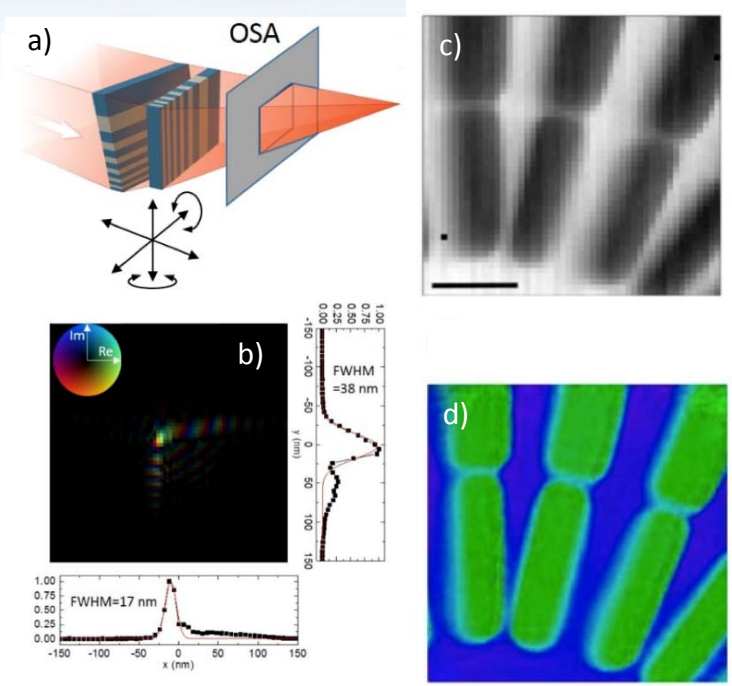


(top) Molecular Dynamics (MD) and (bottom) Fresnel-normalized reflectivity R/R_F for three alkane/water interfaces: pure capillary-wave theory (CWT) and MD with CWT are nearly indistinguishable(solid lines). Previous measurements (dashed lines are their best fits) show vastly different behavior [Mitrinovic et al. PRL 85, 582 (2000)].

M. Fukuto, B. M. Ocko, D. J. Bonthuis, R. R. Netz, H.-G. Steinrück, D. Pontoni, I. Kuzmenko, J. Haddad, M. Deutsch, *Physical Review Letters* 107, 256102 (2016)

Work was performed at Brookhaven National Laboratory, Argonne National Laboratory, and European Synchrotron Radiation Facility.

Sub-20 nm X-Ray Imaging with Bonded Multilayer Laue Lenses



(a) schematic view of the cross-bonded MLLs. (b) A 17×38 nm² point focus was obtained at the common focal plane. (c) STXM image and (d) ptychography reconstruction of the star test pattern. The scale bar is 250 nm.

X. Huang, W. Xu, E. Nazaretski, N. Bouet, J. Zhou, Y. Chu, H. Yan, Optics Express, **2017**, 25(8), 8698-8704.

Work was performed at Brookhaven National Laboratory

Scientific Achievement

A common focal plane was achieved from a pair of bonded multilayer Laue lenses (MLLs) at 9.3 keV and used for scanning probe X-ray imaging.

Significance and Impact

A bonded MLL pair significantly simplifies the optical setup and alignment complexity, thus greatly extending its applications in both scanning and full-field X-ray microscopies.

Research Details

- High quality MLLs with 53 µm and 43 µm apertures and 4 nm outmost zone width were used for bonding.
- Ultrahigh orthogonal accuracy down to 0.03 degree was achieved with a developed optical alignment system.
- A 17×38 nm² point focus was obtained from the bonded MLL pair, which was used at NSLS-II Beamline 3-ID (HXN) to generate a scanning transmission X-ray microscopy (STXM) image with 50×50 nm² spatial resolution.
- The image resolution was further enhanced to 13×13 nm² by applying ptychography reconstruction.

PSD Beamline Operations Work Breakdown Structure

- Beamline Management & other activities (15 – 30%)
- User Support (50 – 60%)
- Beamline Development & Research (15 – 20%)
- Maintenance & Improvements (5 – 10%)

Beamline Management & Other Activities

- ***Conference attendance***
- Tours, outreach
- Budgeting
- Supervision
- BNL & NSLS-II committee participation
- Meetings at other facilities (PRP, SAC, UEC…)
- ***DOE workshop attendance***
- DOE reviews
- ***NSF / other agency meetings & reviews***
- NSLS-II regular, periodic group/division meetings
- BNL & NSLS-II training
- Reviewing proposals & procedures

User Support

- BL user safety orientation
- Instructing users on use of beamlines
- Beamline alignment & tuning
- Endstation configuration
- Assist in sample setup & alignment
- Review & address safety issues
- Remote monitoring & troubleshooting
- ***Participate in collaborative research***
- ***Develop experiment procedures***
- ***Consultation on measurements***
- ***Discussion of preliminary results***
- End of run discussions
- Data transfer and analysis
- ***Post experiment data analysis***
- ***Discuss proposals w/users***
- ***Prepare manuscripts***

Beamline development & research

- ***Experiment proposal development***
- ***Experiment planning & preparations***
- ***Experiment execution***
- ***Data analysis***
- ***Manuscript preparation & editing***
- ***Development of new protocols***
- ***Software (scanning) development***
- ***Development & implementation of new methods***
- ***Planning, development, implementation of sample environments***

Maintenance & Improvements

- Planning and coordinating maintenance & servicing
- Beamline calibrations & benchmarking
- ***Installation & integration of new instruments***
- Safety walkthroughs, housekeeping
- Beamline component testing & servicing
- ***Beamline upgrade planning & implementations***

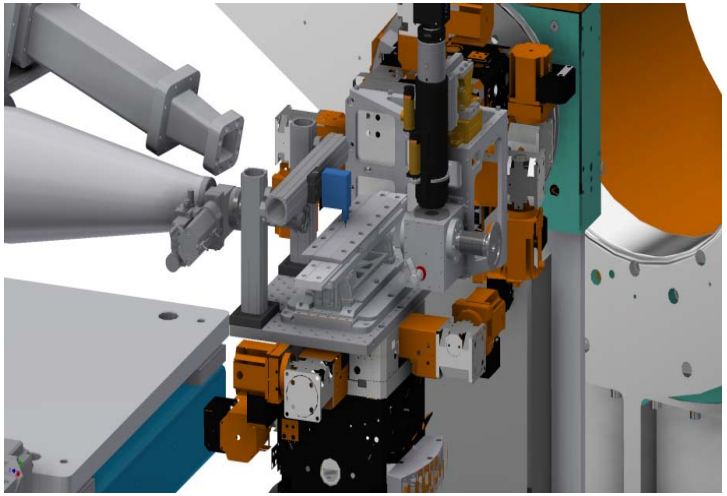
Operations Support for R&D Activities

- Staff research support - $10K each beamline scientist
- Travel support - $5K each beamline scientist; typically 2 annual conferences (0.5-1 International)
- Beamline Program support ($20-30K each program)
- Facility-supported Research, Development, & Improvement Program
  - Director's program for cost-shared Post-docs (3 FTEs)
  - New program for student support (10 students at $20K each)
  - Beginning in FY2018, program for Special Projects
- Support for Metrology, Optics & Detector R&D

- Budgeted $385K for beamline staff research in FY2017
- Budgeted $221K for beamline staff travel in FY2017
- Budgeted $170K for beamline program support in FY2017

Beamline Scientific Staff Use of Research Support

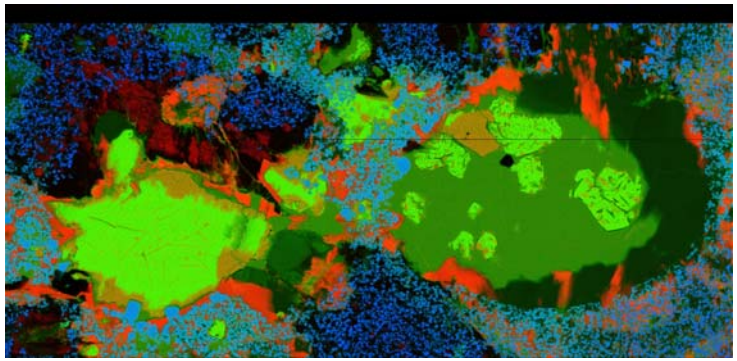
- Travel to other facilities for experiments
- Support for collaborators
- Sample fabrication & procurements
- New equipment purchases
- Instrumentation development
- Pooled resources for internal collaborations
- Feasibility experiments to support proposals



3D Printing Platform installed on CHX

Metrology, Optics & Detector R&D Priorities

Priorities set by importance to NSLS-II beamlines and resulting high impact science productivity



MAIA installed at SRX: image shows Rb-Fe-Cr in natural rock from Siberia. 7M-pixel image with pixel size 1μmx1μm measured in 3 hrs

- Nano-positioning developments
- Optical Metrology (characterization)
- Detector R&D
- Simulations
- MLL developments toward sub-5nm probe
- Kinoform R&D*
- At-wavelength metrology*
- Ion beam figuring of mirrors*

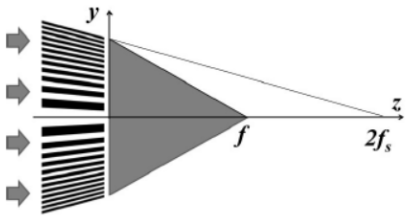
* Externally supported activities

Photon Science Division R&D

MLL fabrication

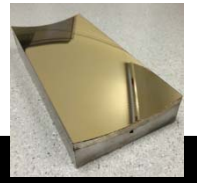
Advances in wedged MLL growth to produce smaller focus with increased efficiency.

Fabricated 25 μm thick wedged MLL with ~10nm zone placement error (designed for 15keV, f~2.5mm and focus size targeted of 8nm). Wedged MLL have been measured at APS – preliminary estimate 35% efficient. Fabricated wedged MLL with new materials (VSi_2/Si)

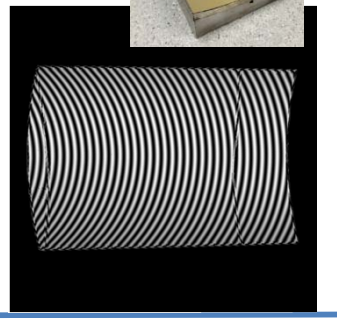


Phase Measuring Deflectometry for Mirror Metrology

Method eliminates the slope-height ambiguity in mirror figure measurement



Fringe patterns reflected by a mirror from an LCD display are captured by a camera, which will be used as feature points for an optimization with a mirror surface model to minimize their discrepancy in ray tracing



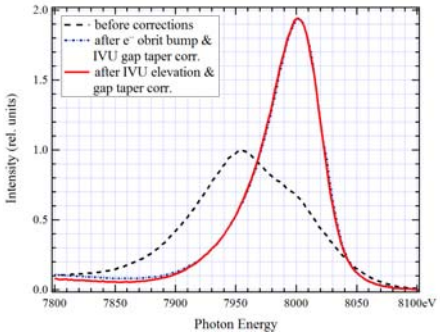
Detector developments

The VIPIC (*Vertically Integrated Photon Imaging Chip)* under development with a full-scale (i.e. 1 megapixel) version planned.

Detector optimized for XPCS experiments is essential for accessing micro-second time regimes and is ideally suited for a high-coherence X-ray scattering beamline, CHX.

Simulations

SRW simulations used to optimize beamline and undulator performance



Spectral performance of NSLS-II IVUs was improved through use of a Spectrum-Based Alignment procedure. The "underperforming" IVUs were identified by comparison of their measured spectra with SRW simulations (making use of magnetic measurements data).

Brookhaven's LDRD Program

The purpose of the Laboratory Directed Research and Development (LDRD) Program is to promote the conduct of highly innovative and exploratory research that supports the mission of the Laboratory including strategic initiatives for the growth of the Laboratory.

General principles that guide the LDRD Program:

- Fund highly innovative and exploratory research that can be of high risk.
- Expect high payoff such as funding prospects, breakthrough science and broadening of the Laboratory's mission.
- Set a fraction of the funds for strategic areas.
- Give some preference to emerging scientists consistent with the quality of their proposals.
- Encourage collaborations across Directorates and Departments/Divisions.

Active Photon Science Division LDRD FY17

Project Title	Principal Investigator	FY17 Budget
Inelastic X-Ray Scattering Determination of the Inter- and IntraParticle Dynamics of Nanoparticle Superlattices: Key to the Development of THz Phononic Crystals	Cunsolo,Alessandro	$52,570
Searching and Sorting Haystacks	McSweeney,Sean	$133,639
In-Situ Microscopy Investigation of Complex Manganese Oxides for Energy Storage	Chu,Yong	$97,702
Serial Micro Crystallography at Full Flux	Fuchs, Martin	$155,980
3D Ptychography Imaging without Rotation Using Highly Convergent X-ray Beam	Huang,Xiaojing	$197,351
Development of Compact, High Efficiency Nanofocusing Optics for Hard X-Ray Nano-Imaging	Nazaretski, Evgeny	$94,536
Diffractíon-Límíted and Wavefront Preserving Reflective Optìcs Development	Idir, Mourad	$189,000
Enabling Sustainable Ammonia Synthesis through Ambient and High Pressure Synchrotron Techniques	Rodriguez, Jose/Stavitski, E.	(on hold)
Total		$920,778

Photon Science Division LDRD Proposals FY18

A direct-detection electron imaging detector for cryo-EM instruments - Peter Siddons

Operando Studies of 3D Printing with Nanostructured Inks - Lutz Wiegart

Fabrication, Structure and Function of Ultrathin Reverse Osmosis Films - Ben Ocko

Characterizing atomic scale ordering in self-assembly nanocrystal superlattice by Bragg ptychography - Hanfei Yan

Sub-nanometer metrology for x-ray wavefront preserving mirrors - Lei Huang

Separating the roles of various degrees of freedom in quantum materials at SIX using polarization analysis - Ignace Jarrige

Bragg Ptychography Investigation of Self-assembled Gas Bubble Superlattices in Irradiated Materials - Yong Chu

A multi-modal, multi-dimensional challenge: 'Self-assembling' Nano-/Meso-porous Metal for Photo-catalysis and Heterogeneous catalysis - Karen Chen-Wiegart

Electronic dynamics investigation of photo-excited SCES - Claudio Mazzoli

An Autonomous Nanoparticle Synthesis Growbot at BNL - Eric Dooryhee

FY2016 Photon Science Division R&D Proposals

Non-destructive, In-situ Synchrotron-based Analysis of Returned Mars Samples Sealed in Sample Container	NASA	Thieme, Juergen
Multimodal Tomographic Imaging for the NSLS-II		Williams, Garth
Screen to beam: X-ray guided crystal screening and optimization	NIH	Soares, Alexei
Low noise, Sub-micron Electronics Integrated X-ray Detectors	DOE	Rumaiz, Abdul
Development of a novel 3D X--ray microscope for in-situ investigation	DOE	Huang, Xiaojing
Towards Prediction of Materials Synthesis	DOE	Dooryhee, Eric
MRI Consortium: Development of a Highly Flexible Diffraction and Imaging Beamline for X-Ray Characterization of Advanced Energy Materials, Processes and Devices at NSLS-II	NSF	Keister, Jeffrey
Sawtooth and Kinoform Lenses for High Photon Energy study of Materials*	**DOE**	**Evans-Lutterodt, Kenneth**
Fabrication of Maia DAM unit (revised)*	**CSIRO**	**Siddons, David**
Fiber-Optic Based Distributed Atomic Absorption Spectroscopy for Film Growth Monitoring*	**AccuStrata Inc**	**Bouet, Nathalie**
Wavefront Preserving Mirrors*	**DOE**	**Idir, Mourad**

* Indicates funded proposal

FY2017 Photon Science Division R&D Proposals

Battery Reliability Development for NASA Missions	NASA	Attenkofer, Klaus
NIH CryoEM User Facility	NIH	McSweeney, Sean
Detecting Small Structural Differences with XFEL and Synchrotron Serial Crystallography	NIH	Soares, Alexei
Advancing Image Reconstruction Pipelines with Deep Learning Approaches		Malitsky, Nikolay D
An in situ, streaming, data- and compute-intensive platform for experimental data	Kitware Inc	Malitsky, Nikolay D
ZIKA virus structure and function	NYU	Soares, Alexei
Development of a novel X-ray ptychography microscope for 3D in-situ investigation	DOE	Huang, Xiaojing
Development of Software Framework for X-Ray Optics Simulation and Modeling (SBIR Phase 2a)*	**RadiaSoft LLC**	**Tchoubar, Oleg**
Fabrication of Maia Detector Analog Modules*	**CSIRO**	**Siddons, David**
A Modular X-Ray System Based On Silicon Drift Diodes*	**Square One**	**Attenkofer, Klaus**

* Indicates funded proposal

Other Ongoing Division R&D Activities

- SBIRs
  - HERMES-based x-ray strip detector (Sydor Instruments Phase II – Siddons, D.)
  - Advanced Compact X-Ray Spectrometer with High Resolution and Efficiency (INCOM Phase II – Attenkofer, K)
- Direct DOE Support (FWP)
  - Molecular Mechanisms Mediating Environment Sensing and Response - Miller, L
  - New Mesoscale Multi-modal of cellular communication between microbe and plant in the Rhizosphere - McSweeney, S.
  - A proposal to construct a 1 MPixel detector for X-ray Correlation Spectroscopy – Siddons, D.
  - Monolithic Germanium Strip Detectors for High-energy X-ray Applications – Siddons, D.
- Direct NIH Support (P41)
  - Life Science and Biomedical technology Research Resource at NSLS-II-LSBR - McSweeney, S

Research and Development (R&D) program

- R&D directions are largely informed by the NSLS-II Strategic Plan, BNL and Directorate priorities, LDRD opportunities, and BES strategic directions
- Photon Division R&D goals are almost exclusively driven by beamline needs and opportunities
- R&D in metrology, detectors, optics, and nano-positioning are very closely tied to specific beamline needs at NSLS-II. External reviews have helped establish priorities.
- To remain internationally competitive or world-leading requires growth in some R&D areas. Operating budget pressures have permitted stable, ongoing R&D without growth.
- Beamline staff R&D generally extends beamline capabilities, benefitting the general user community. Beamline scientific staff budgeted $10K each for individual research.

Staff morale and career development

Staff morale concerns

- Morale varies among the groups in the Photon Science Division
- Budget uncertainty creates anxiety in some groups
- Beamline groups are excited to commence science programs; some place additional pressure on themselves to quickly serve diverse user communities

Response to concerns & staff development

- Scientific staff encouraged to develop research programs; considerable challenges due to time pressures on x-ray operations
- Staff have opportunities for growth by participating in Supervisor Development Programs, Lab Operations Supervisory Academy, Scientist & Engineer Development Program (delayed start), and Lab Operations Leadership Academy
- Scientific staff encouraged to participate at conferences for their own development and to advertise NSLS-II capabilities

Summary

- Beamline staff R&D is highly valued and is critically important to assure NSLS-II beamlines provide world leading capabilities
- Beamline staff R&D is essential for scientific career development and for staff retention
- There are various avenues available to beamline staff for R&D support, including NSLS-II operations, BNL LDRD, external proposals to gov't agencies, and collaborations
- The mission of NSLS-II to develop and operate a premier user facility results in conflicts where staff R&D is not the highest priority
- Highly constrained budgets further challenge opportunities to support beamline staff R&D