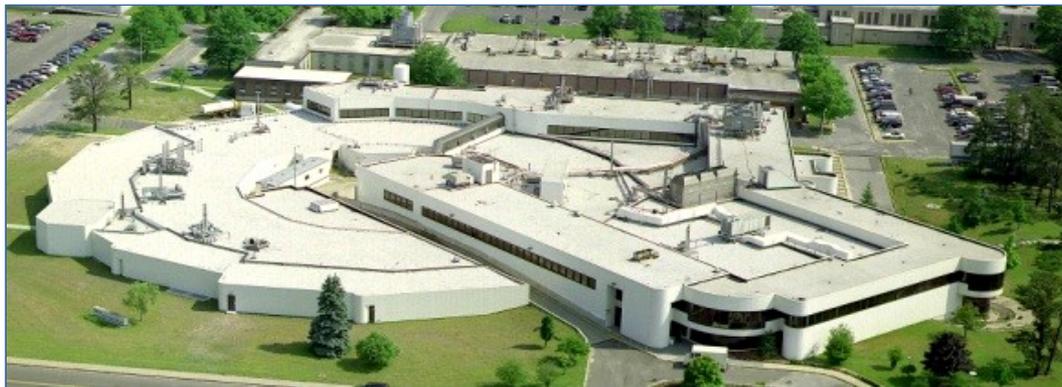


Photon Sciences at BNL



NSLS



NSLS-II

Qun Shen
Director, Photon Division, Photon
Sciences Directorate
NSLS X6A Scientific Advisory
Committee Meeting
July 14, 2016

Major Activities in Photon Sciences Directorate

- NSLS operations



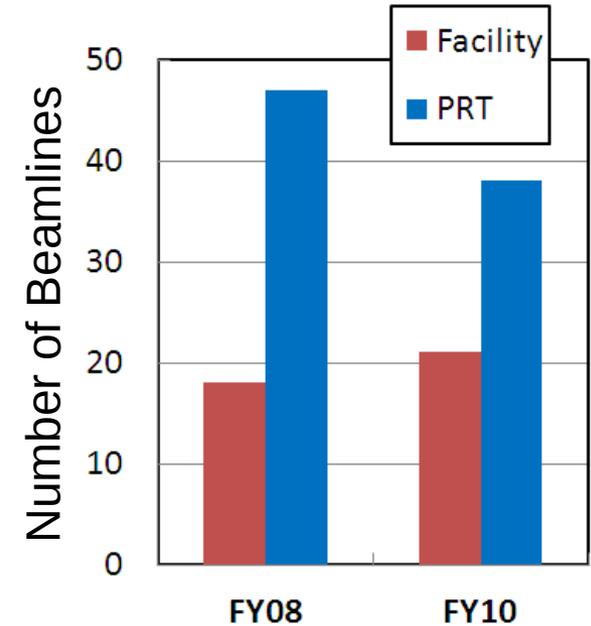
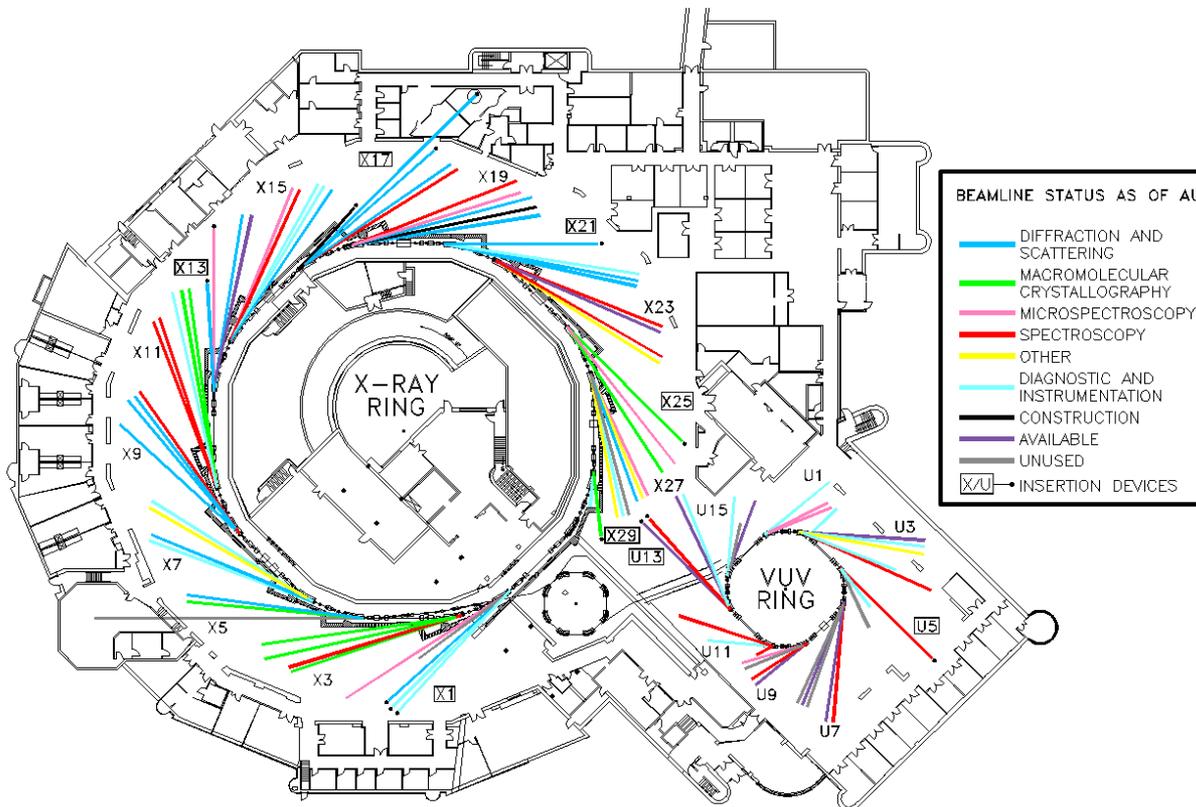
- NSLS-II construction



- Future planning: additional beamlines projects in coming years

NSLS Beamlines

- NSLS operates 59 beamlines on X-ray & VUV rings:
 - 48 X-ray beamlines and 11 UV/IR beamlines
 - 9 other beamlines are being maintained and developed as active Diagnostics & Instrumentation (D&I) beamlines



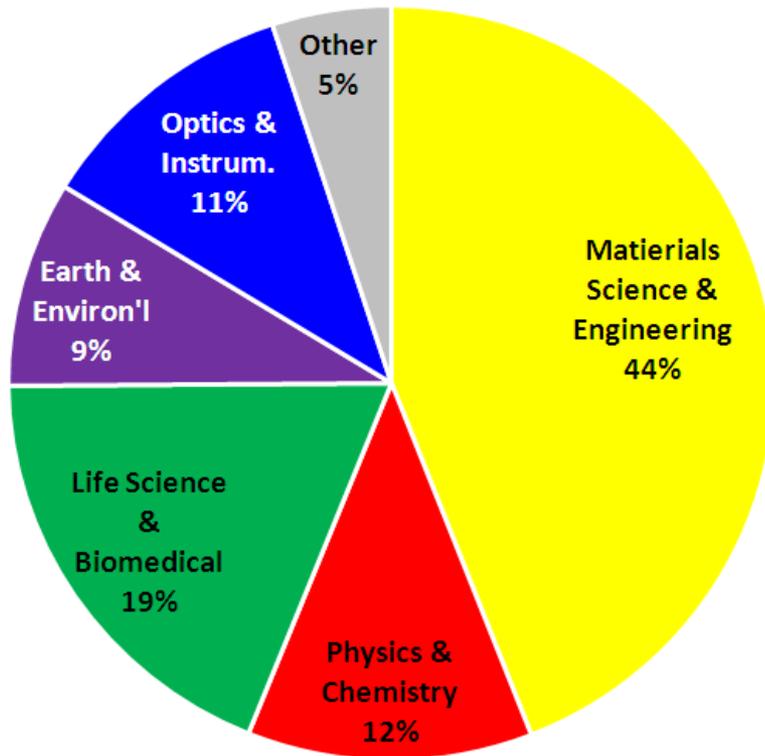
Facility: 21

PRT: 38

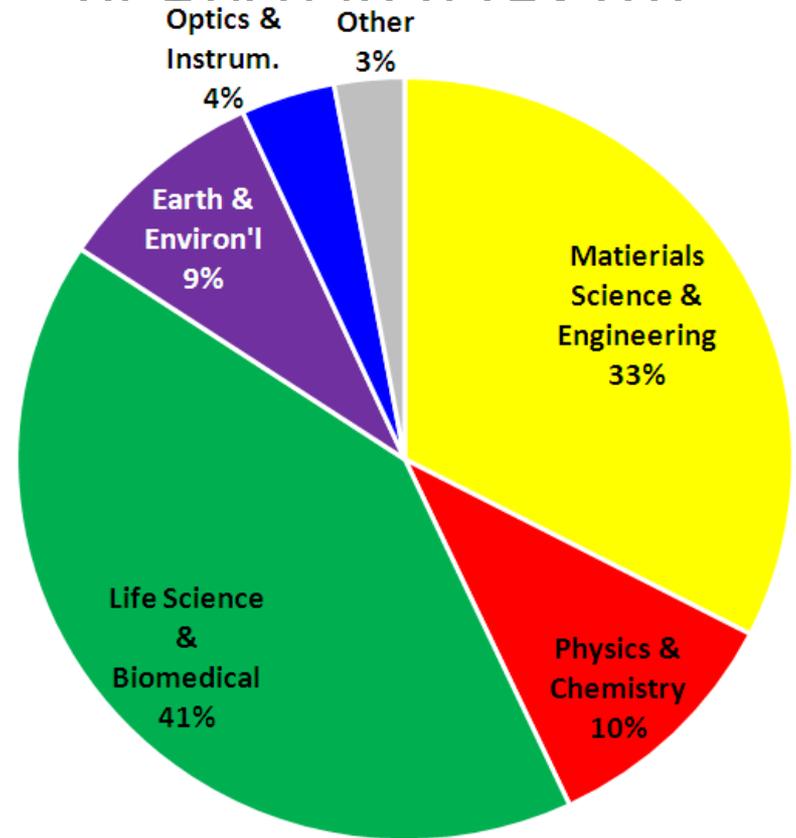
Total: 59

NSLS Beam Time Usage

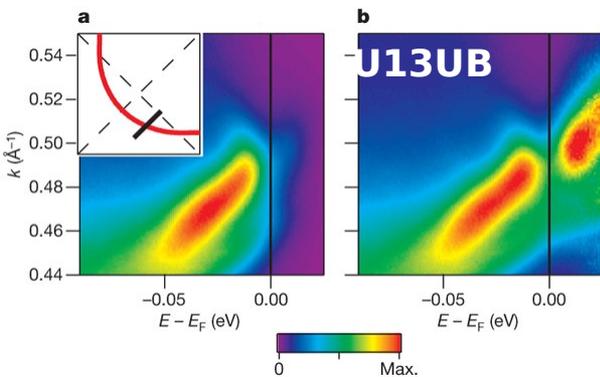
Allocated Beam Time by Field of Research (FY10)
(Ave. beam time /opr.-BL ~ 5400 hrs.)



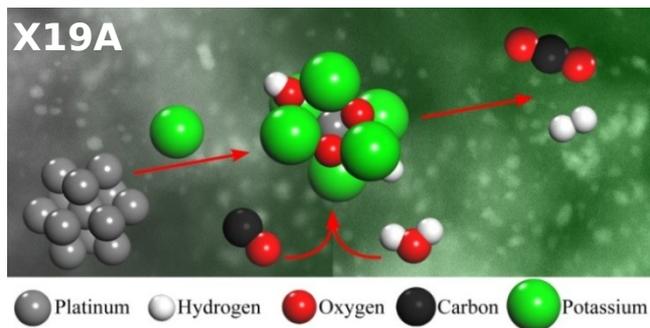
Number of User Experiments by Field of Research (FY10)



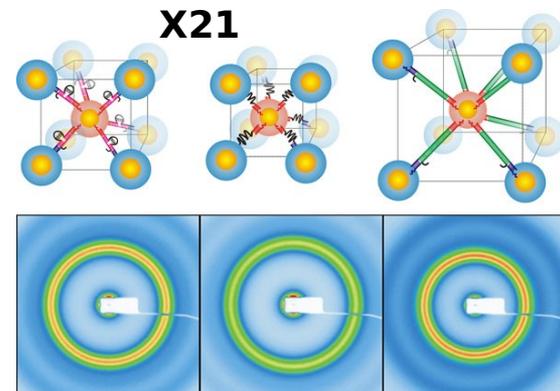
High-Impact Science at NSLS



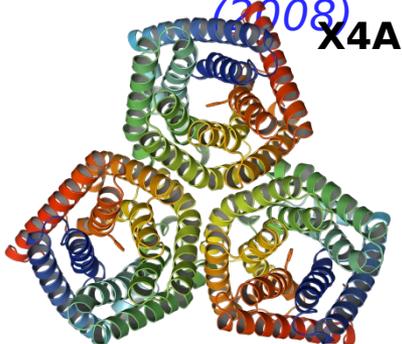
Electron pair formation precedes high- T_c superconductivity. *Nature* (2008)



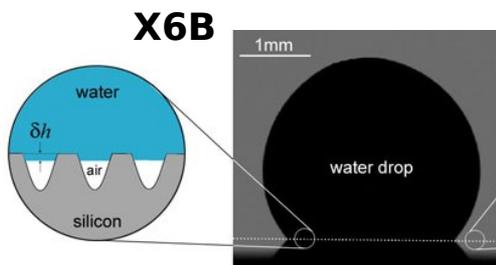
Alkali-ion promoted Pt-SiO₂ to produce H₂ at low temperature. *Science* (2010)



Switching nanoparticle superlattices with DNA. *Nature Nanotech.* (2010)



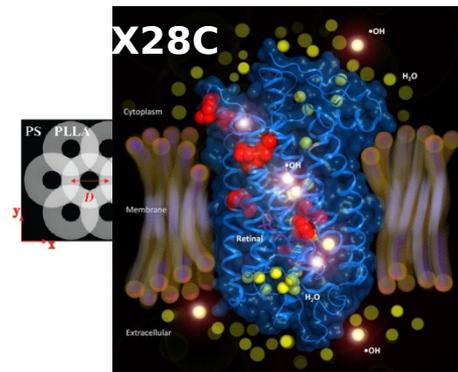
Anion channel control of stomatal closure in leaves. *Nature* (2010)



Nano-bubbles ~10 nm in water droplet on nanostructured Si surface. *Nano Lett.* (2010)

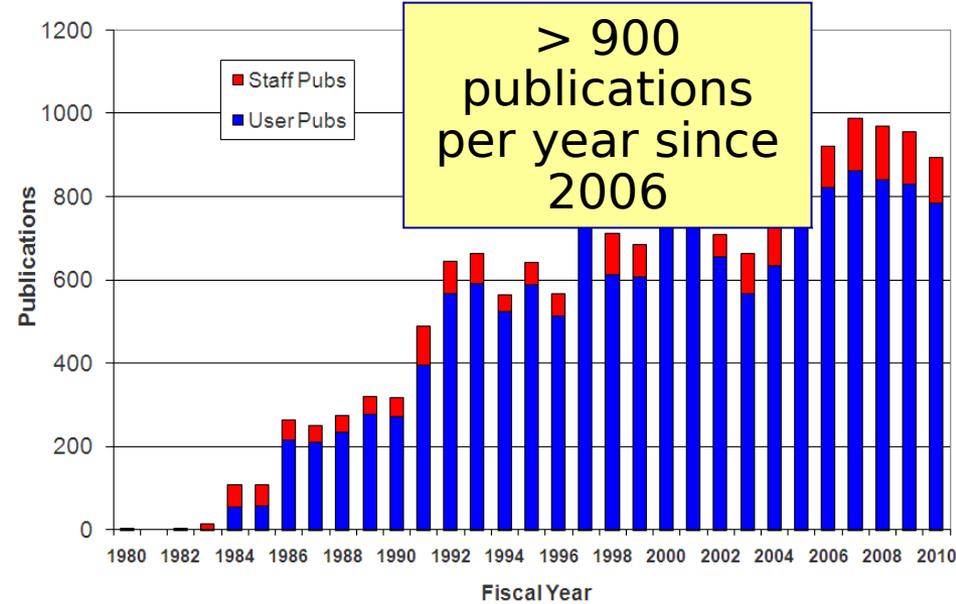
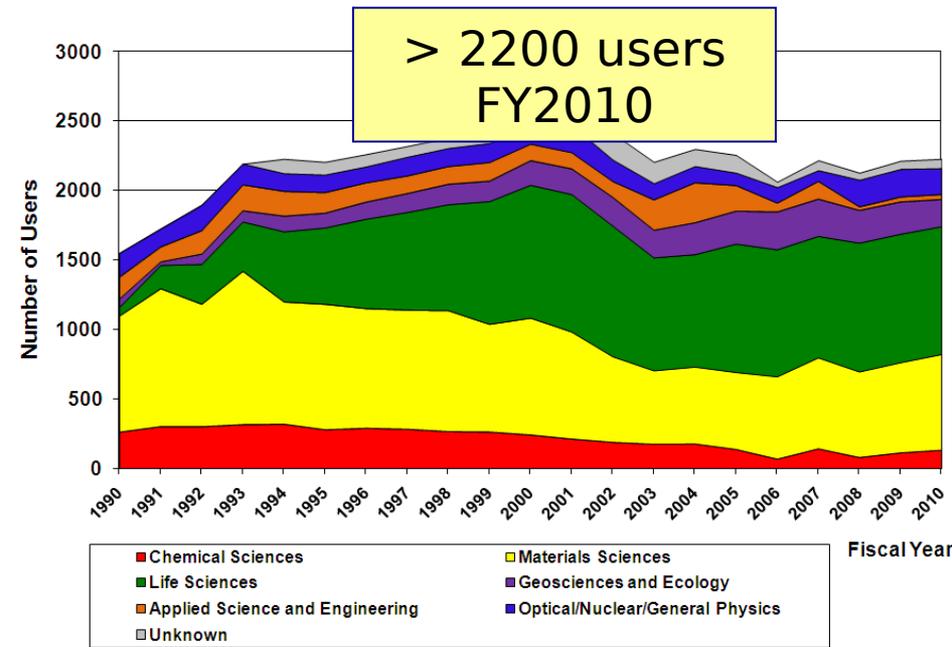
X27C

New phase of block copolymers with a twist. *JACS* (2009)



Probing water molecules deep inside proteins. *PNAS* (2009)

NSLS User and Publications



DOE Triennial Review of NSLS, Dec. 14-16, 2010

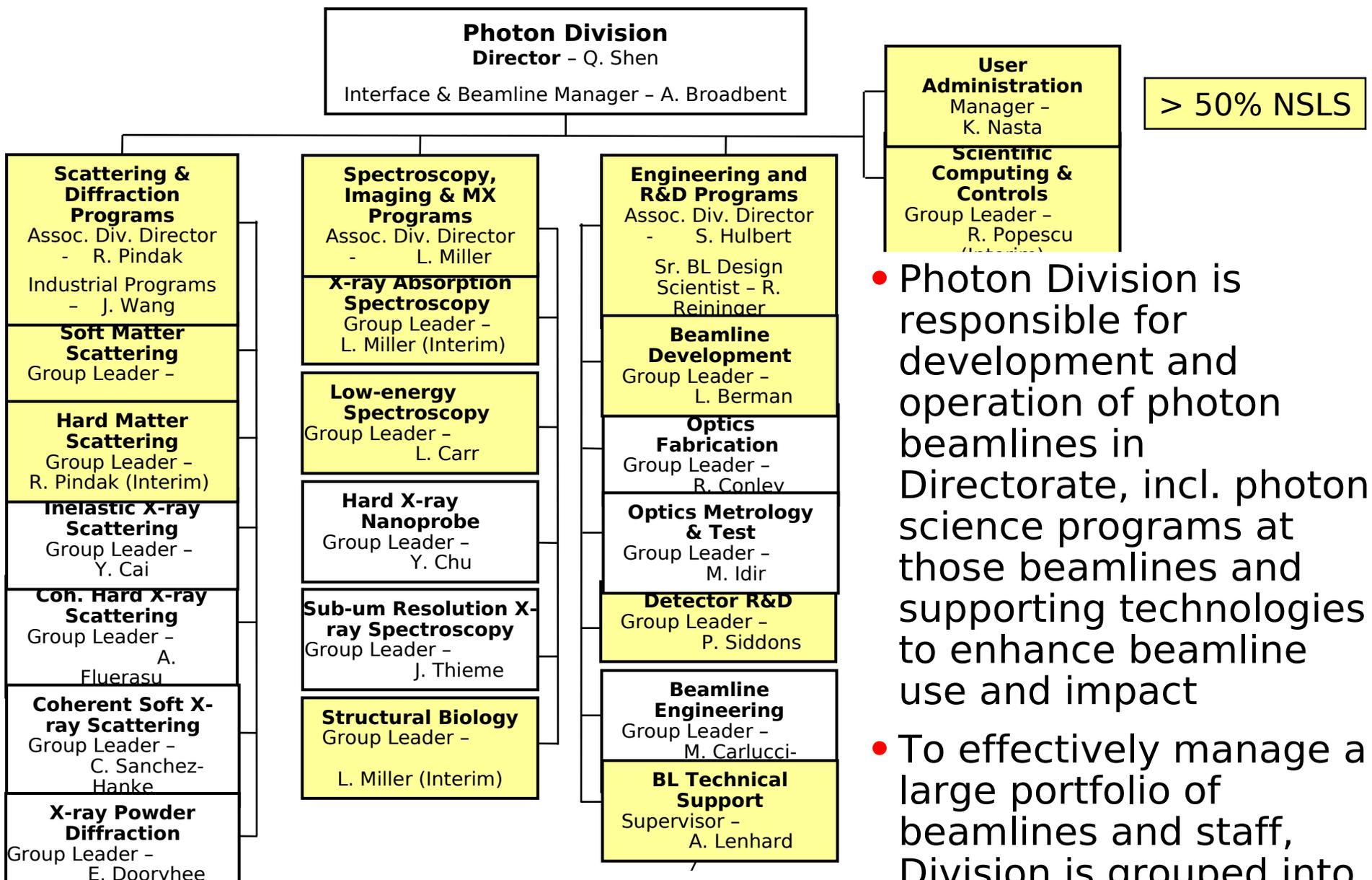
- Very impressed with outstanding science, high performance, and high productivity
- Very impressed with dedications of hard-working staff & high-quality user community
- Acknowledged excitement in the community and also considerable work ahead of us in transitioning to NSLS-II, including engagement of existing staff and user communities, and finalizing access policies



U.S. DEPARTMENT OF ENERGY

BROOKHAVEN
NATIONAL LABORATORY
BROOKHAVEN SCIENCE
ASSOCIATES

Photon Division Organization & Responsibilities



NSLS-II Construction Progress



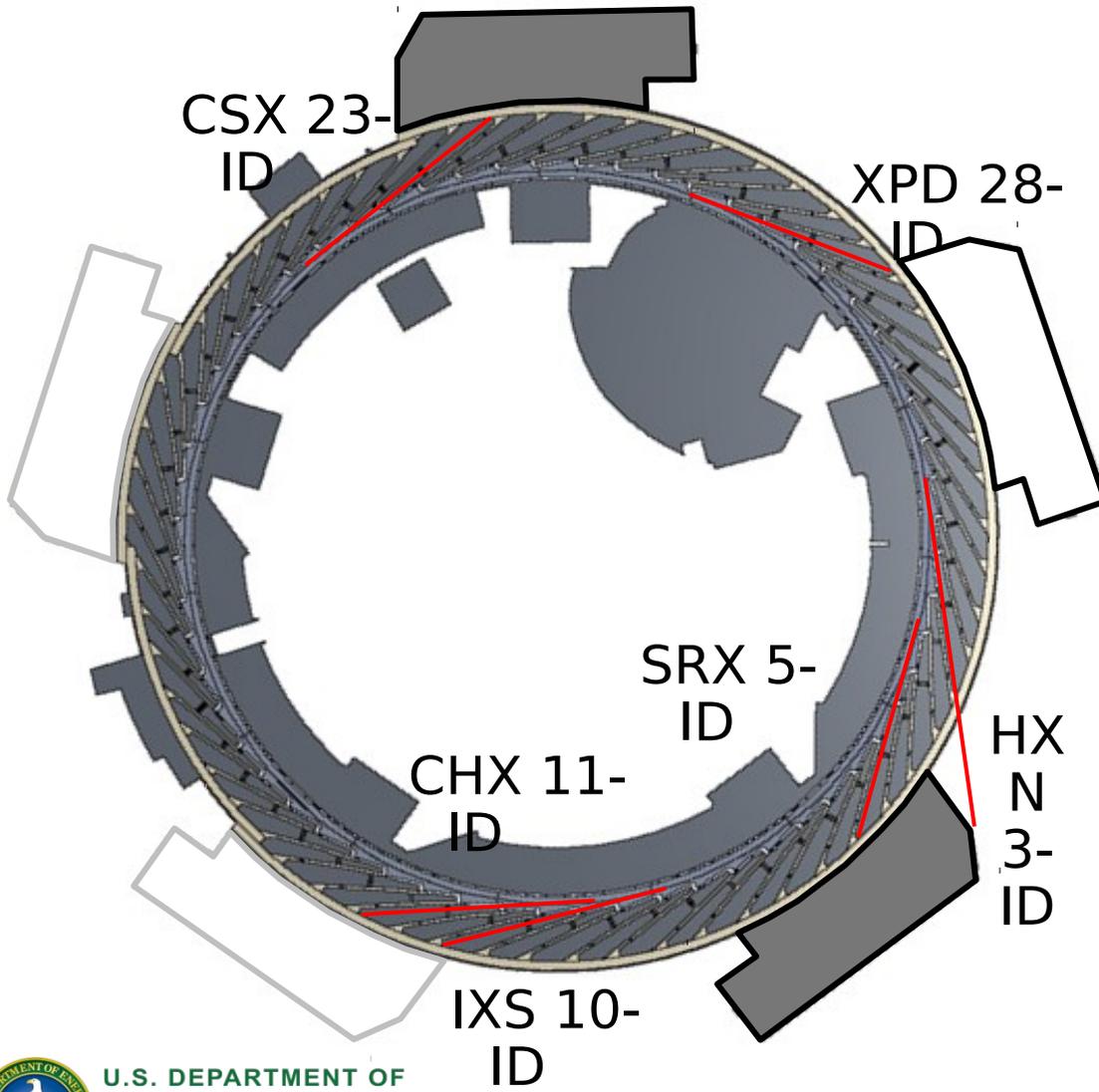
[://www.bnl.gov/nsls2/webcam](http://www.bnl.gov/nsls2/webcam) December 2, 2010

NSLS-II Key Project Milestones

Aug 2005	CD-0 , Approve Mission Need	(Complete)
Jul 2007	CD-1 , Approve Alternative Selection and Cost Range	
	(Complete)	
Jan 2008	CD-2 , Approve Performance Baseline	(Complete)
Jan 2009	CD-3 , Approve Start of Construction	(Complete)
Feb 2009	Contract Award for Ring Building	(Complete)
Aug 2009	Contract Award for Storage Ring Magnets	(Complete)
May 2010	Contract Award for Booster System	(Complete)
Feb 2011	1 st Pentant Ring Building Beneficial Occupancy; Begin Accelerator Installation	
Feb 2012	Beneficial Occupancy of Experimental Floor	
Oct 2013	Start Accelerator Commissioning	
Mar 2014	Projected Early Completion; Ring Available to Beamlines	
Jun 2014	Early Project Completion; Ring Available to Beamlines	
Jun 2015	CD-4 , Approving Start of Operations	

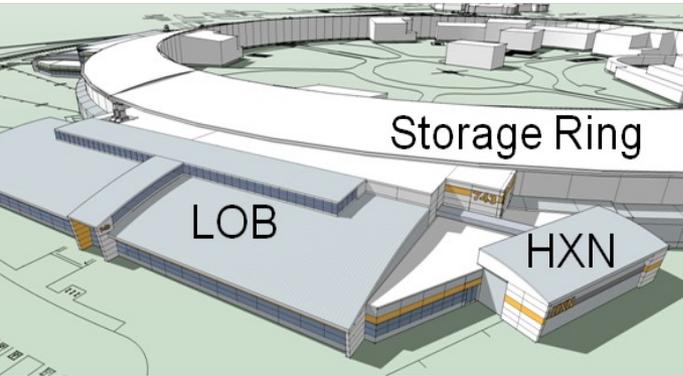
- Sufficient carry-over funds (due to ARRA) from prior year at the beginning of FY11
- Under Continuing Resolution, expect no major impact in

Six Beamlines in Construction Project



- Inelastic X-ray Scattering (IXS)
- Hard X-ray Nanoprobe (HXN)
- Coherent Hard X-ray Scattering (CHX)
- Coherent Soft X-ray Scattering & Polarization (CSX)
- Sub-micron Resolution X-ray Spectroscopy
- *Beamline locations finalized for the six project beamlines*
- *Preliminary designs completed*
- *Procurement of long-lead-time components approved*

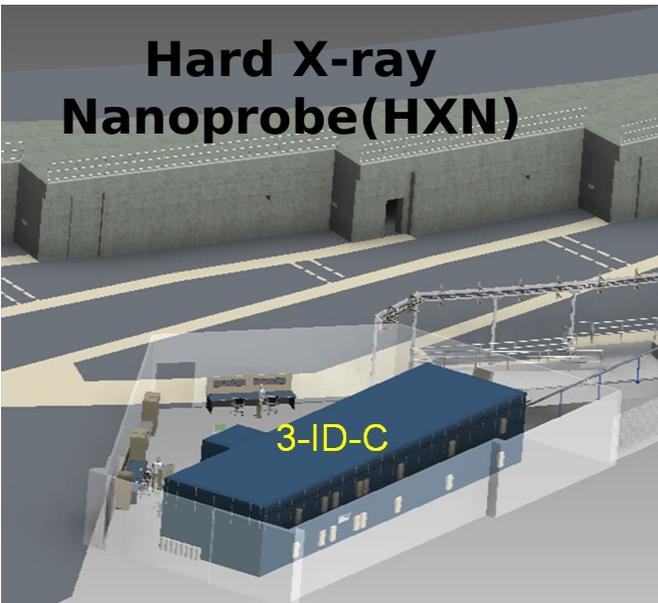
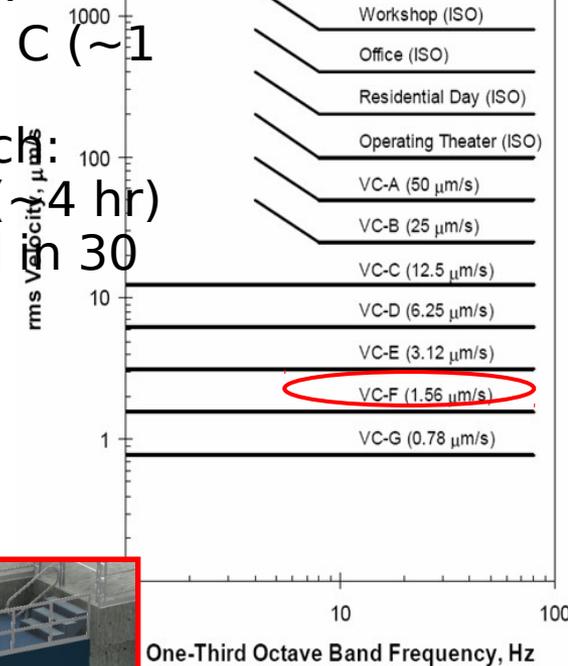
Beamline Design Progress - Hard X-ray Nanoprobe



Satellite Bldg. Stabability Specifications:

- Vibration: VC-F minimum; goal to achieve VC-G
- Temperature Inside hutch: ± 0.1 C (long term), ± 0.05 C (~ 1 hr)
- Temperature Outside hutch: ± 1.0 C (long term), ± 0.5 C (~ 4 hr)
- Equilibrium temp reached in 30 minutes

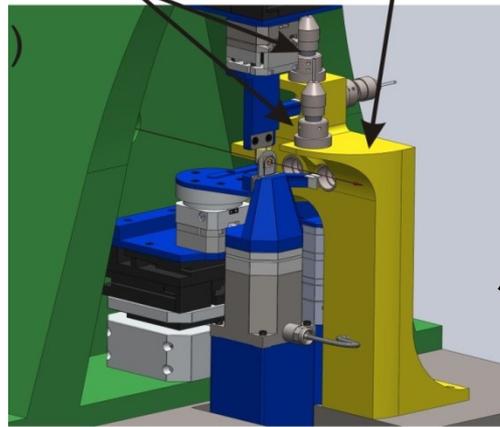
NIST Vibration Criterion



HXN Endstation with MLL-based Microscope

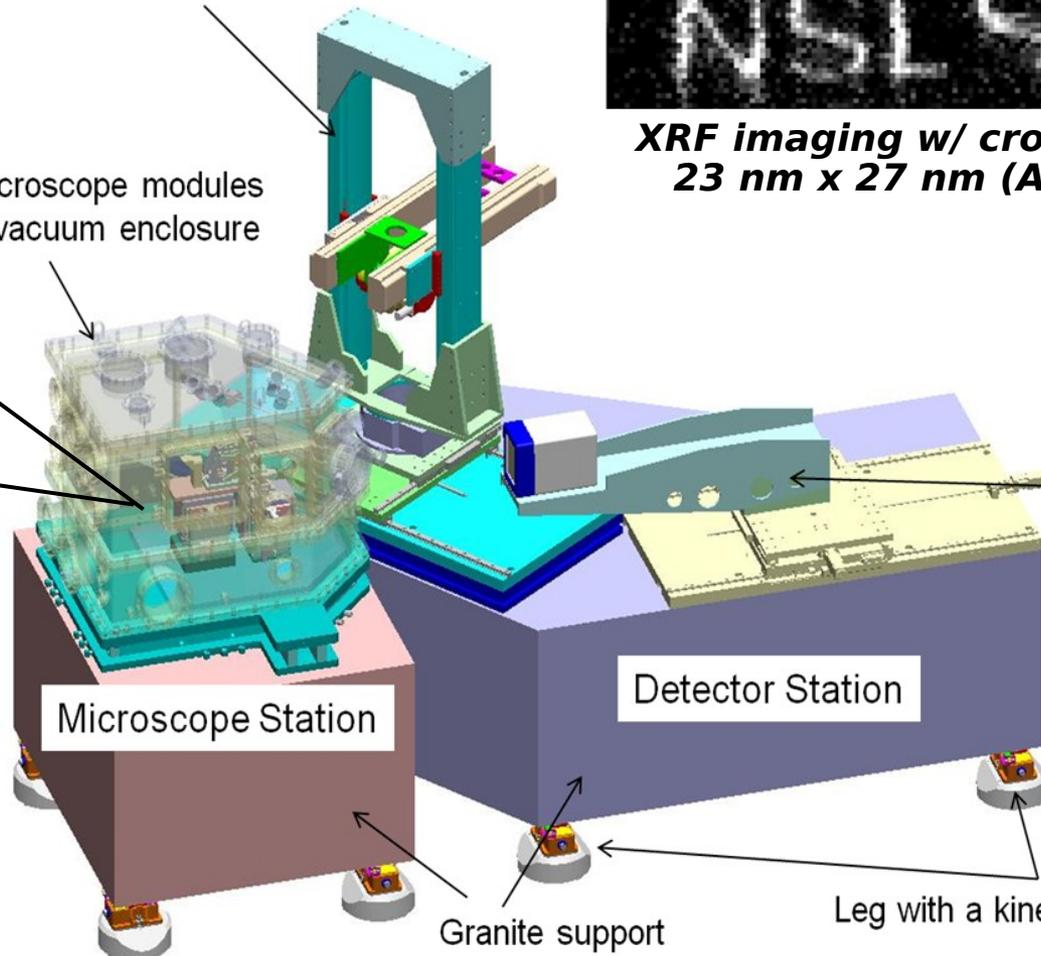
- Conceptual design of HXN microscope completed; Preliminary
- It includes innovative design features based on compact nanopositioning system

Interferometers Reference frame



MLL mount with compact laser interferometer system

Microscope modules & vacuum enclosure



*XRF imaging w/ crossed-MLLs:
23 nm x 27 nm (APS 26-ID)*

In-line detector track

Development in collaboration w/ APS/CNM

Granite support

Leg with a kinematic mount

Beamline Transition Planning and Results

- Beamline program transition plan developed in FY2010 through an open call and rigorous scientific merit review process for new beamline development at NSLS-II, resulting in 34 approved new beamlines
- Taskforce (Chaired by Steve Hulbert) established in September 2010 to conduct preliminary cost and scope analysis for all approved new beamlines:
 - Scope definition, for both initial and mature phases; Cost estimates of hardware and labor
 - Taking into account of reusable existing equipment (incl. those own by PRTs and users, in which cases negotiations are still needed)
 - Estimated time to move the existing equipment from NSLS ranges from 1 day to 8 wks → No significant impact on NSLS beamline operations from transferring equipment
 - Preliminary cost estimates are used for communications with funding sources
- Current funding opportunities:

Transition of NSLS Beamline Programs to NSLS-II

	NSLS	NSLS-II
• Soft X-ray Scattering	U4B, X1B	CSX, SSS, SIX
• Hard X-ray Scattering	X6B, X9, X10A, X21, X22B, X22C, X27C	IXS, HIX, LIX, ABS, CHX, SMI, CMS, ISR
• Hard X-ray Diffraction	X7B, X10B, X13B, X14A, X16C, X17C, X17B1/B2/B3, X20A, X20C	MPP, XPD, IXD, 4DE, TEC, MXD
• Macromole. Crystallogr.	X3A, X4A, X4C, X6A, X12B, X12C, X25, X26C, X29A, X28C	FMX, AMX, SM3, NYX, XFP
• Low Energy Spectroscopy	U11, U12IR, U13UB, U2A, U5UA	ESM, MET, FIS
• Soft X-ray Spectroscopy	U12A, U7A, X24A	SSS, SST
• Hard X-ray Spectroscopy	X3B, X10C, X11A, X11B, X15B, X18A, X18B, X19A, X23A2	ISS, QAS, TES, BMM, XAS
• Imaging	U10B, U2B, X1A1, X2B, X15A, X19C, X26A, X27A	AIM, IRI, HXN, FXI, SRX, SRX-2, XFM, CDI
• Metrology	U3C, X8A, X24C, X27B	OFT, MID

- 41 approved beamlines for NSLS-II, if all built, will accommodate all critical programs at 59 existing operating beamlines at NSLS, with enhancements in many areas

- Approved beamlines posted at <http://www.bnl.gov/nsls2/beamlines/2010BeamlineProposal-Approved.asp>

Beamline Development Prospects

Projected Early 					CD- 			
FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17

6 NSLS-II Project Beamlines

6

4 NIH Beamlines

10

6 NEXT Beamlines

16

3 Type II Beamlines

19

up to 14 NxtGen Beamlines

up to 33

Funding assured or reasonably certain for 19 beamlines by FY15

Under discussion with DOE for up to 14 more

Near-term

Preliminary

Early

NEXT Schedule

Finish

to

CD-1

1 BER Beamline

CD-4

6 BER MIE Beamlines

& CD-3A

CD-3

7 NEXT II Beamlines

This is an ambitious plan, but achievable if necessary funding is provided

- Pre-conceptual designs already well advanced in most cases
- Substantial schedule benefit from experience gained with project beamlines
- Several scientist/engineer candidates already identified among existing and/or new staff
- However, no FY11 funding yet to date for either NEXT, NIH, or NxtGen

NEXT Beamlines

Announced Feb. 8, 2011:

Acronym Title

SMI Soft Matter Interfaces

ESM Photoelectron Spectro-Microscopy for Fundamental Studies of Physics and Chemistry of Materials

SIX Soft Inelastic X-ray Scattering

ISS Inner Shell Spectroscopy

ISR Integrated In-Situ and Resonant X-Ray Studies

FXI Full-field X-ray Imaging from Microns to Nanometers

Photon Sciences User Access Modes

- Current user access modes at NSLS i
 - General users (GU)
 - Participating research teams (PRT)
 - Contributing users (CU)
 - Methods & instrumentation development to
 - Proprietary users
- Photon Sciences User Access Policy:
 - Ensure open & fair access to Photon Sciences facilities by broad scientific community
 - Sustain the highest standards of scientific and technical excellence
 - Responsive and adaptable to varying user needs and funding realities
- Plans well underway to evolve User Access Policy (UAP) to NSLS-II:
 - First draft of new UAP developed and posted at [http://www.bnl.gov/nsls2/docs/PDF /UserAccessPolicy.pdf](http://www.bnl.gov/nsls2/docs/PDF/UserAccessPolicy.pdf))



Transition of Beamline Science Consortia

- Preliminary discussions began with existing Science Consortia / PRTs for continued involvement at NSLS-II

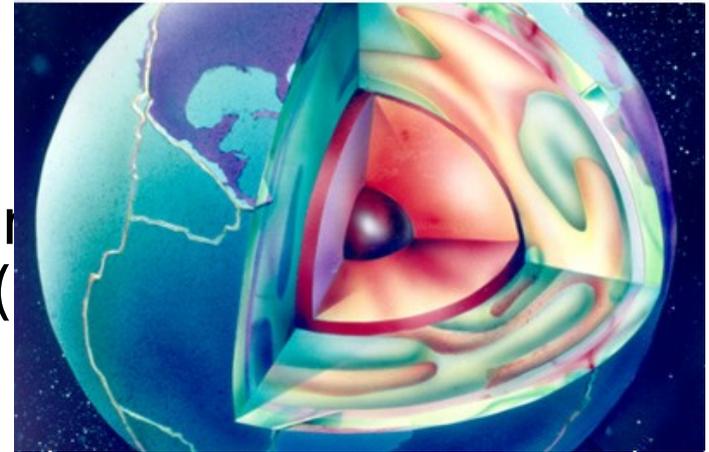
- Four possible pathways:

- Evolving consortia into Beamline Advisory Teams (BATs)

- Continuing as Partner Users

- Evolving into long-term access General Users

- Continuing as cross-cutting Science Consortia (e.g. HP-Sync at APS) to promote specific science conducted across all beamlines at facility, which may play an important role in a Science Village

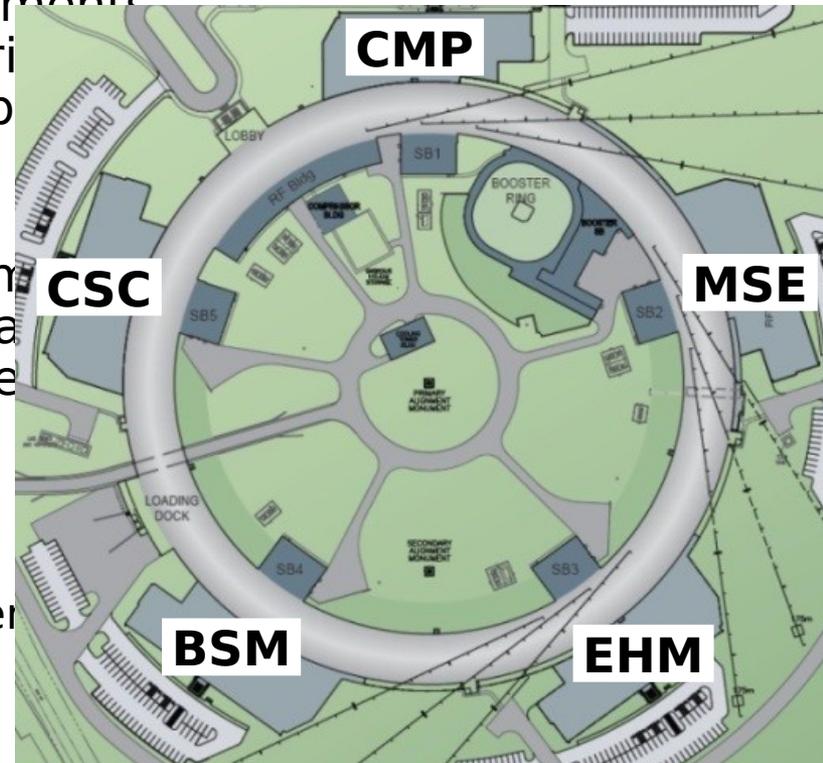


COMPRES: one of several multi-beamline consortia at NSLS



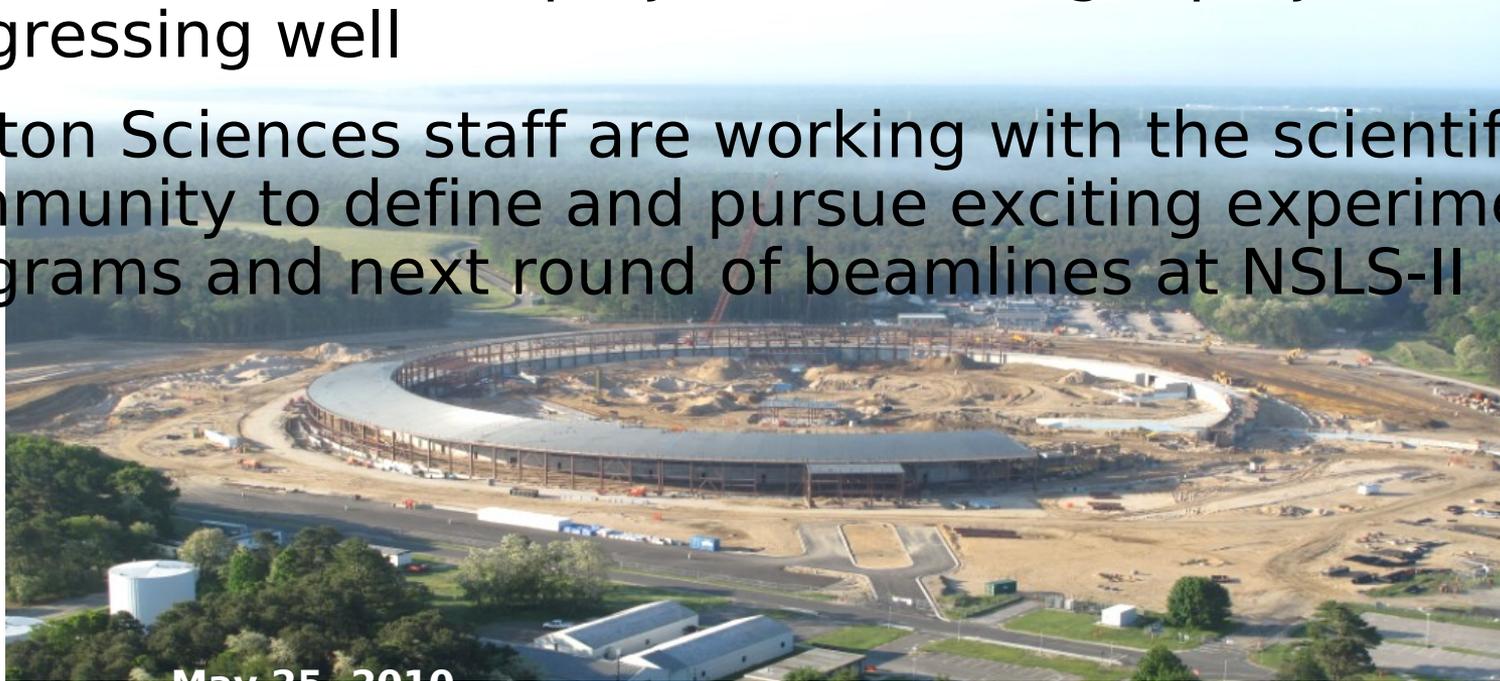
Science Villages

- Science Village concept has been widely advocated by the scientific community. Photon Science Directorate strongly supports this concept and plans to co-locate beamlines likely to be utilized by a specific scientific community, after satisfying physical constraints
- These co-located beamlines, along with nearby Laboratory Office Buildings (LOB), serve as 'hubs' for Science Villages distributed around the ring
- LOB in a Village may house ancillary instruments to provide off-line experimental capabilities
- Staff and users in a Village may share beamlines and instrumentation and serve as primary meeting points with fellow colleagues & co-workers
- Staff and users in a Village may share beamlines and instrumentation and e
- Possible five Science Villages:
 - Condensed matter & materials physics (CMP)
 - Materials science & engineering (MSE)
 - Environmental & heterogeneous materials science (EHM)
 - Biology and soft matter science (BSM)
 - Chemical science and catalysis (CSC)

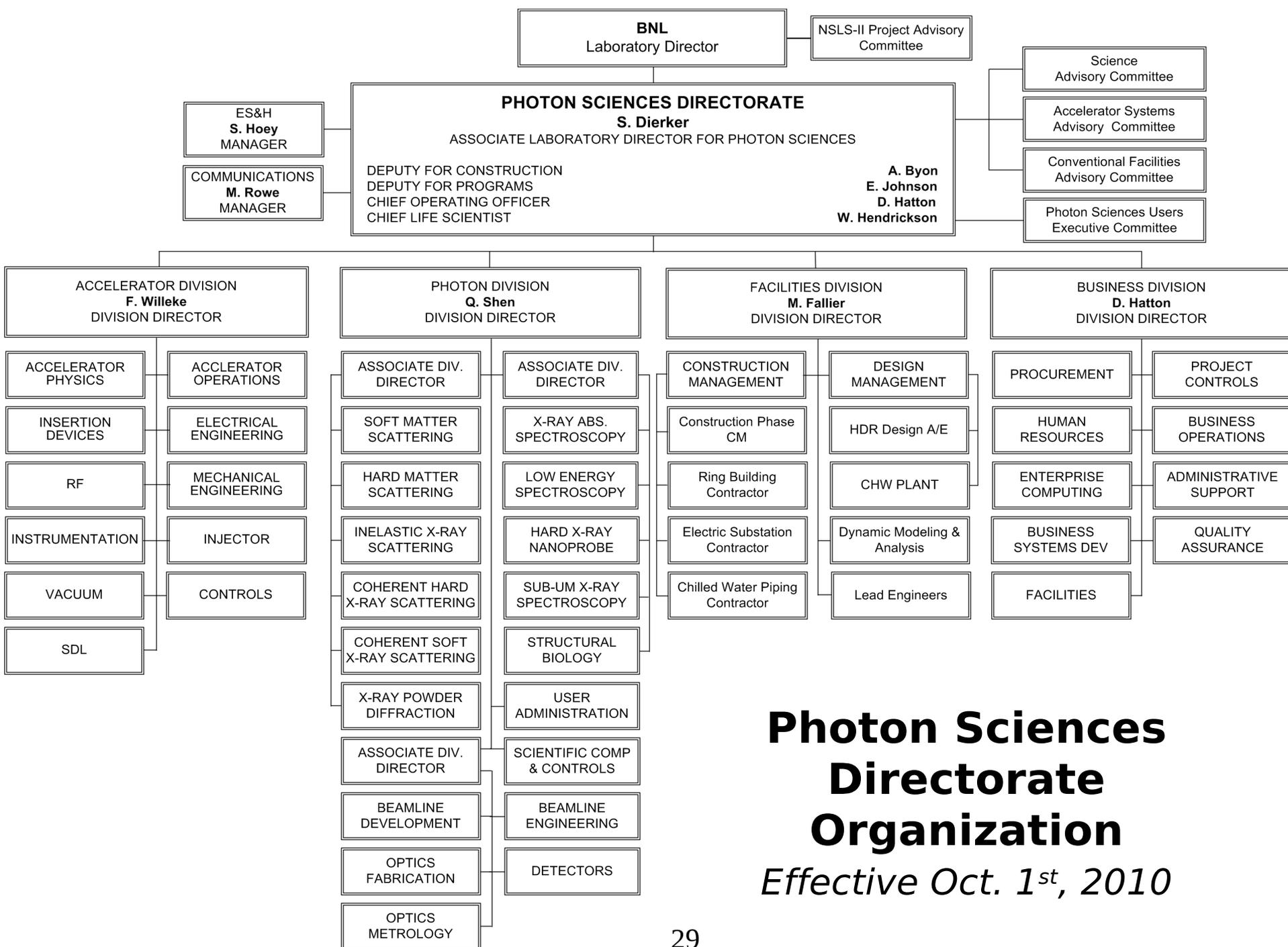


Summary

- NSLS continues to be a thriving and highly productive scientific user facility
- Photon Sciences Directorate reorganization has led to much desired unified staffing in Photon Division – with better efficiency and coordination
- NSLS-II construction project (including 6 project BLs) is progressing well
- Photon Sciences staff are working with the scientific community to define and pursue exciting experimental programs and next round of beamlines at NSLS-II



May 25, 2010



Photon Sciences Directorate Organization

Effective Oct. 1st, 2010