NSLS Update

Chi-Chang Kao

Joint NSLS-CFN Users' Meeting, May 20, 2008

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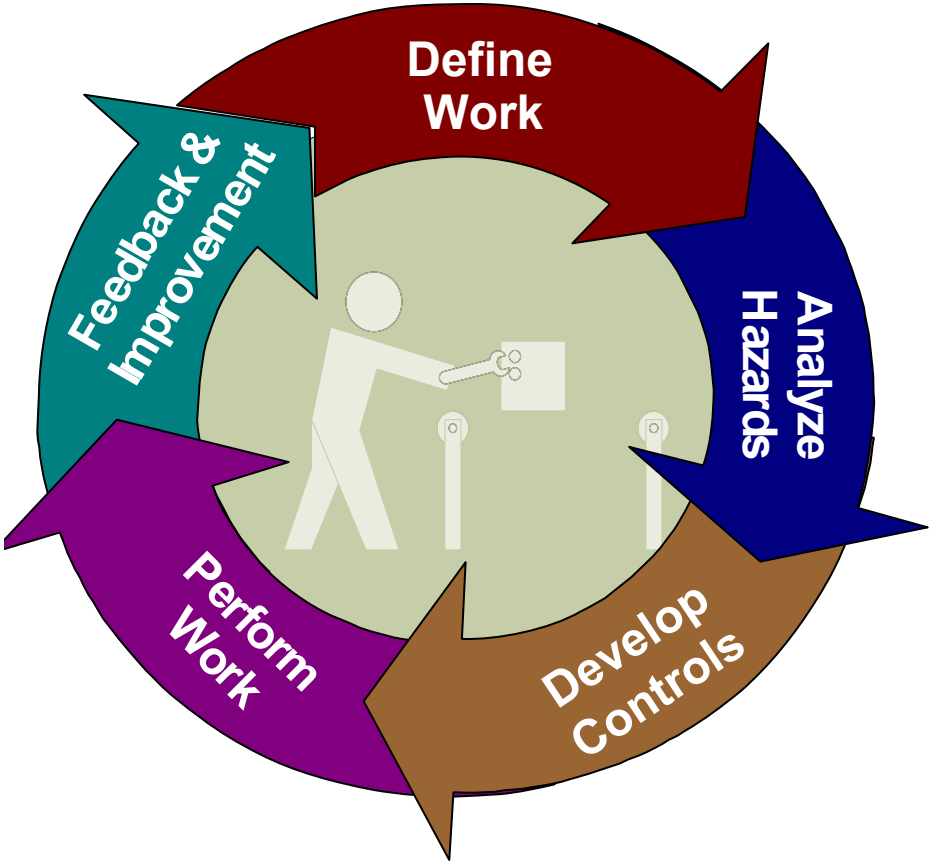
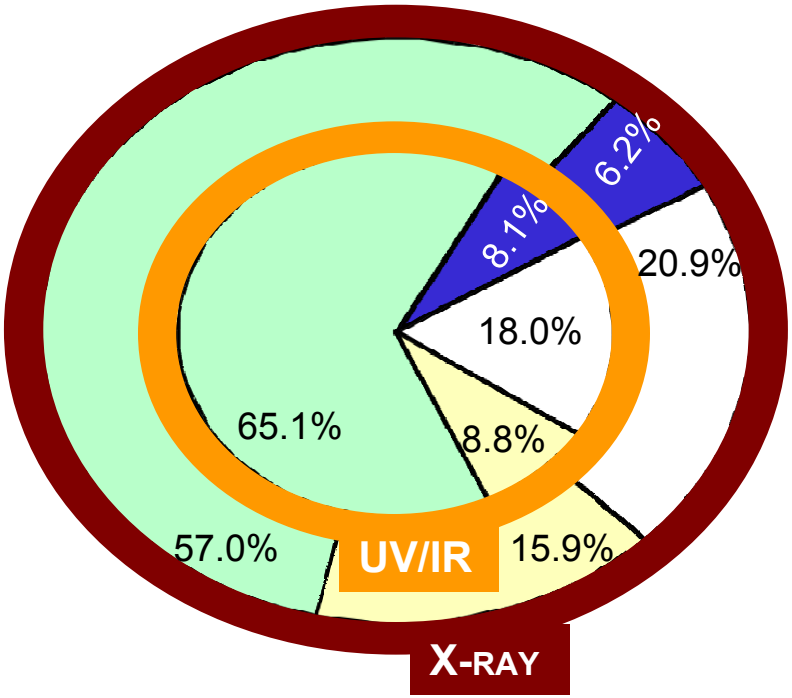
Safety Update



- NSLS did very well in the recent integrated safety management review
- Participate in laboratory wide human performance initiative
- Elec. Equip. Inspection is on track
- Nanomaterials handling

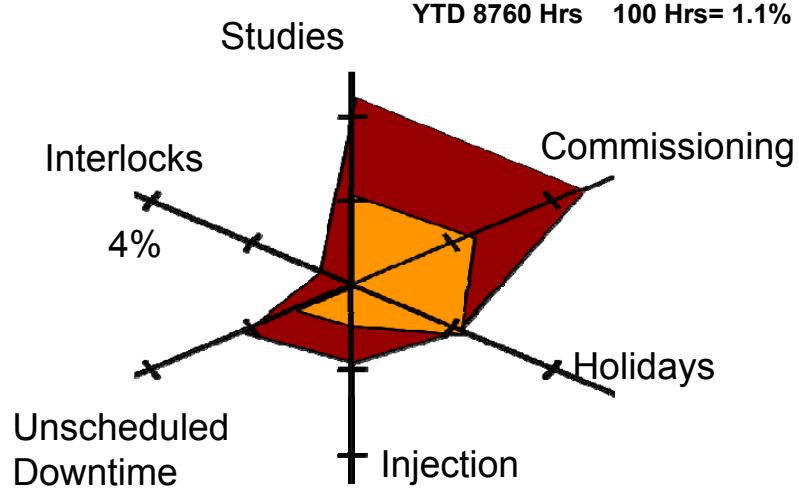
Facility and Beamline Operation

FY 2007 Machine Operation – High Reliability



Other Activities	UV/IR	X-ray
Studies	2.2%	4.5%
Com/Con	2.4%	4.6%
Holiday	2.2%	2.1%
Injection	0.9%	1.8%
Unscheduled Downtime	1.1%	2.2%
Interlock	0.0%	0.7%

YTD 8760 Hrs 100 Hrs= 1.1%



Activity /Hours	UV/IR	X-ray
Operations	5703.6	4989.7
Unscheduled Operations	707.8	539.9
Maintenance	1578.7	1833.7
Other	770.0	1396.7

User Metrics	UV/IR	X-ray
Reliability	98.2%	96.2%
Availability	110.4%	106.6%

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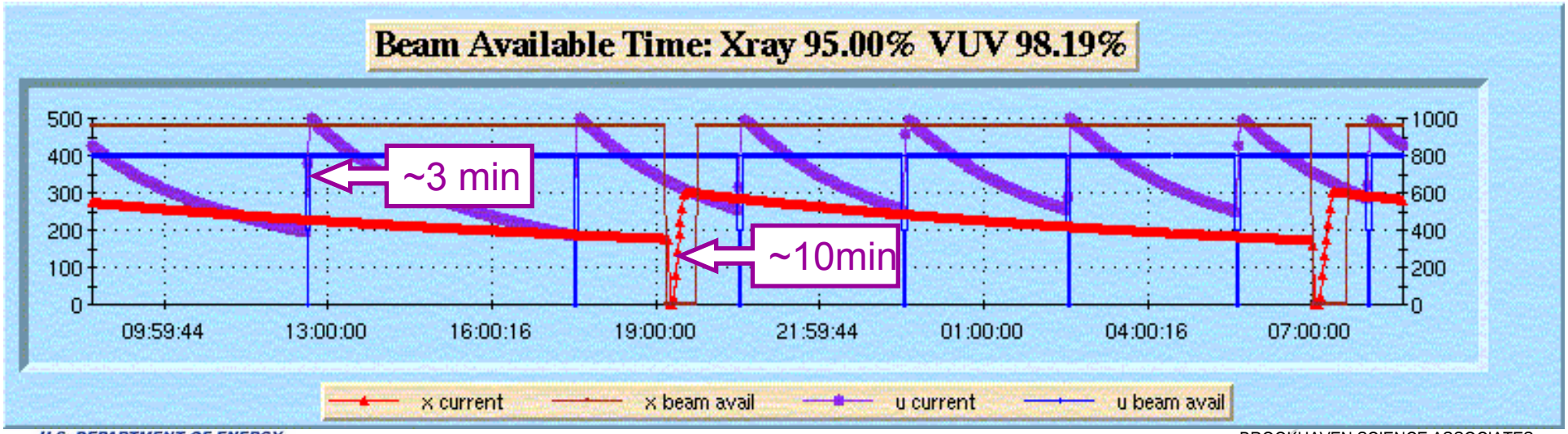
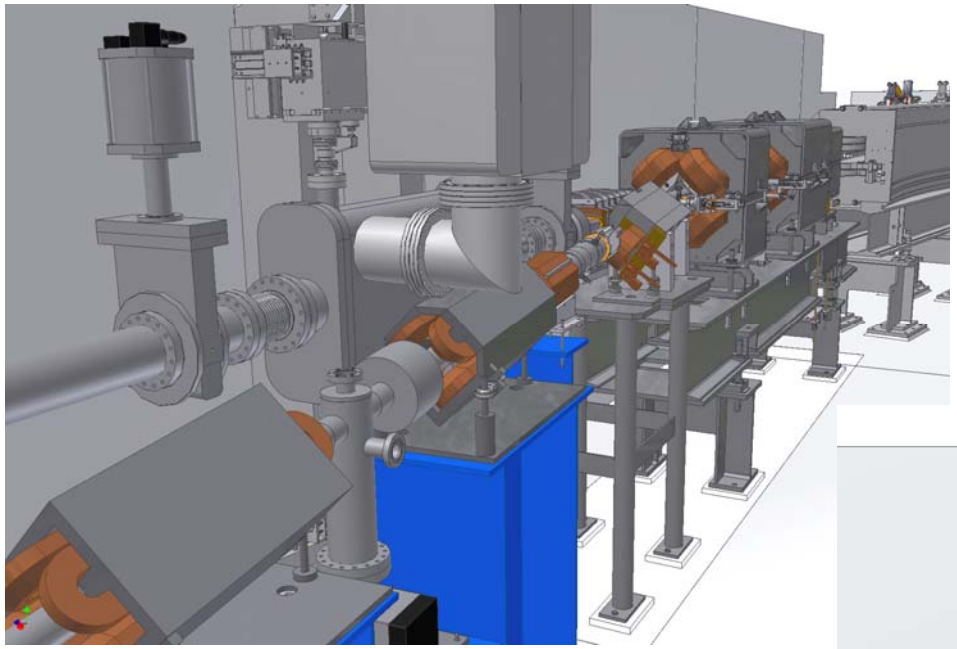
Injection System Improvements

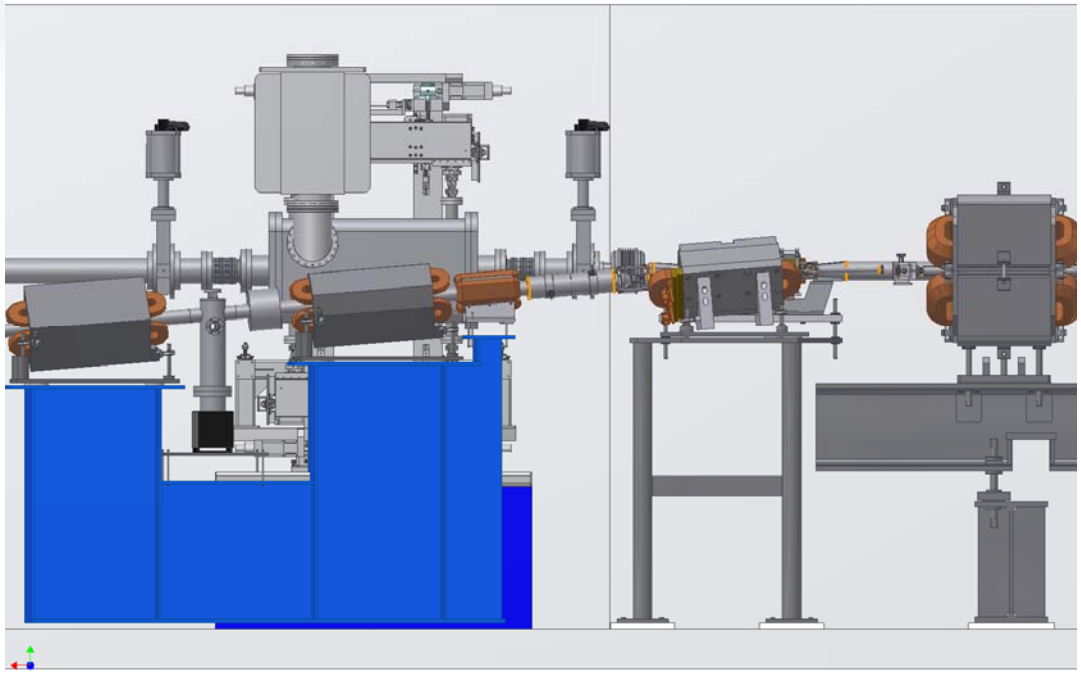
- Motivation: faster injections, reduce radiation to staff/users, faster troubleshooting
- What: new/improved diagnostics (orbit, efficiency, etc) modeling and studies
- Achievements: booster shot-to-shot variations reduced 50%, extraction loss reduced
- Injection rate is great now!



Possible Development of X5 Straight



- New 50 cm MGU or EPU
- Possible installation in 2 yrs
- Cost & schedule being done



- X5 straight section was freed from LEGS. It is crowded with injection hardware, but….

S. Pjerov Artwork

Operating Beamlines (~65 total, 18 Facility)

IR/UV/Soft X-ray Spectroscopy (10)

U1A, [U4A], U4B, U5UA, U7A, U9B, U11, U12A, U12IR, U13UB, X13A

X-ray Spectroscopy (10)

X9B, X10C, X11A, X11B, X15B, X18B, X19A, X23A2, X23B, X24A

Soft Matter/Biophysics Scattering (8)

X6B, X10A, X10B, X19C, X22A, X22B, X27C, X28C

Hard Matter/Strongly Correlated Scattering (7)

X1B, X5A, X17B1, [X18A], X20A, [X20B], X20C, X21, X22C

Powder/Single Crystal/High Pressure/Optics (11)

U2A, U3C, X7A, X7B, X8A, X14A, X16C, X17B2, X17B3, X17C, X24C

Imaging and Microprobe (9)

U2B, U10B, X1A1, X1A2, X2B, X13B, X15A, X26A, X27A

Macromolecular Crystallography (10)

X4A, X4C, X6A, X8C, X9A, X12B, X12C, X25, X26C, X29

X-ray	52
VUV/IR	13
Total	65

18 Facility Beamlines
47 PRT Beamlines

Current Contributing Users

- Beamline suite for studies of materials under extreme conditions – funded by COMPRES, *managed by Stony Brook U. (X17B2), Stony Brook U. & Princeton U. (X17B3, C), Carnegie Inst. Wash. (U2A)* **X17B2, X17B3, X17C, U2A**
- Synchrotron Catalysis Consortium (SCC) for studies of catalytic systems under reaction conditions, PIs are *J. Chen, U. Delaware; A. Frenkel, Yeshiva U.; R. Adzic, BNL-Chem.* **X18A, X18B, X19A**
- Materials growth and processing studied in real-time – MBE growth chamber (*K. Ludwig, Boston U.*) & a PLD growth chamber (*R. Headrick, U. of Vermont*) **X21**
- Real-time analysis of surface growth and reactions using a combined LEEM-PEEM facility. *BNL Center for Functional Nanomaterials (CFN) program.* **U5UA**
- Strain field mapping using energy dispersive x-ray diffraction. PI is *M. Croft, Rutgers U.* **X17B1**
- Charge, spin, & orbital properties of complex oxide interfaces. PIs are *Y. Idzerda & A. Lussier, Montana State U.* **U4B**
- Combined Quick-XAFS/XRD technique for battery research. PIs are *X.-Q. Yang, BNL-Chemistry & D. Qu, U. Mass.-Boston.* **X18B**
- Biological & Soft Nanomaterials, PI is *O. Gang (CFN)* **X6B**
- Protein Crystallography Research Resource (PXRR), PI is *R. Sweet* (BNL-Biology) **X25**
- Center for Environmental & Molecular Sciences (CEMS), PIs are *R. Reeder (SBU) & J. Fitts (BNL-Enviro)* **X27A**
- Geo-Soil-Enviro Consortium for Advanced Radiation Sources (GSE-CARS), PI is T. Lanzirotti (U. Chicago) **X27A**

2008 Tri-annual Beamline Review

January 5, 2008

- Beamline statistics and review timeline sent to beamline spokespersons

February 5, 2008

- Beamline questionnaire due to User Administration Office

February, March 2008

- February 25-26 Powder/Single Crystal Diffraction and High Pressure
- February 26-27 X-Ray Spectroscopy
- February 28-29 X-Ray Scattering & Diffraction
- March 3-4 Macromolecular Crystallography
- March 4-5 Imaging and Microprobes
- March 6-7 IR/UV/Soft X-Ray Spectroscopy

April 2008

- Spring SAC meeting: review results of beamline reviews

Beamline Review Committees

Powder/Single Crystal Diff. & High Pressure	X-Ray Spectroscopy	X-Ray Scattering & Diffraction
James Kaduk	Simon Bare	Joel Brock
Robert von Dreele (ANL)*	T.-K. Sham (Univ Western Ontario)*	George Srajer (APS)*
Yan Gao (General Electric)	Bruce Bunker (Notre Dame)	Wim de Jeu (Univ Mass)
Peter Lee (ANL)	Graham George (Univ Saskatchewan)	Jeffrey Kortright (LBNL)
Angus Wilkinson (Georgia Tech)	Steve Heald (ANL)	Detlef Smilgies (CHESS)
Macromolecular Crystallography	**Imaging and Microprobes**	**IR/UV/Soft X-Ray Spectroscopy**
Mario Amzel	Bill Thomlinson	Ed Kramer
Quan Hao (CHESS)*	Piero Pianetta (SLAC)*	Tai C. Chiang (Univ Illinois)*
Aneel Aggarwal (Mount Sinai)	K. Kaznatcheev (Univ Saskatchewan)	John Freeland (APS)
Ashley Deacon (SLAC)	Barry Lai (ANL)	Eli Rotenberg (ALS)
	Satish Myneni (Princeton Univ)	Barrett Wells (Univ Conn)

*Chair

Beamline Performance Vetting and Improvement

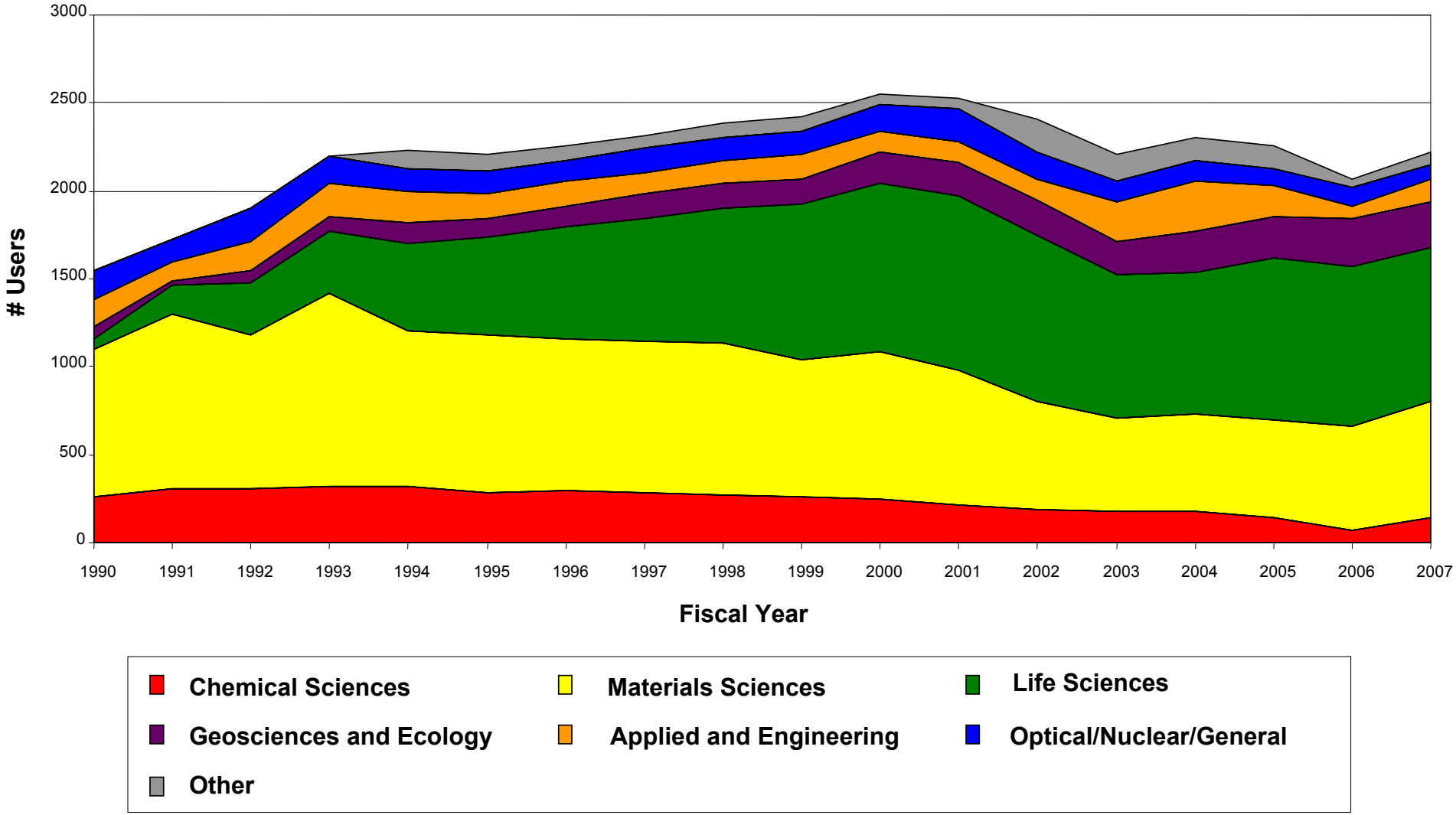
Project goals:

- Measure flux, beam size, energy resolution at relevant energies at all beamlines
- Perform ray tracing simulations of NSLS beamlines for comparison with measured performance values
- Work with facility beamline staff and PRT staff to measure their beamline performance
- Improve the performance of facility and PRT beamines

New hire in Beamline R&D section to implement and carry out this project: J. Dvorak

User Trend, Publication and Budget

NSLS User Trend: ~2200 annually



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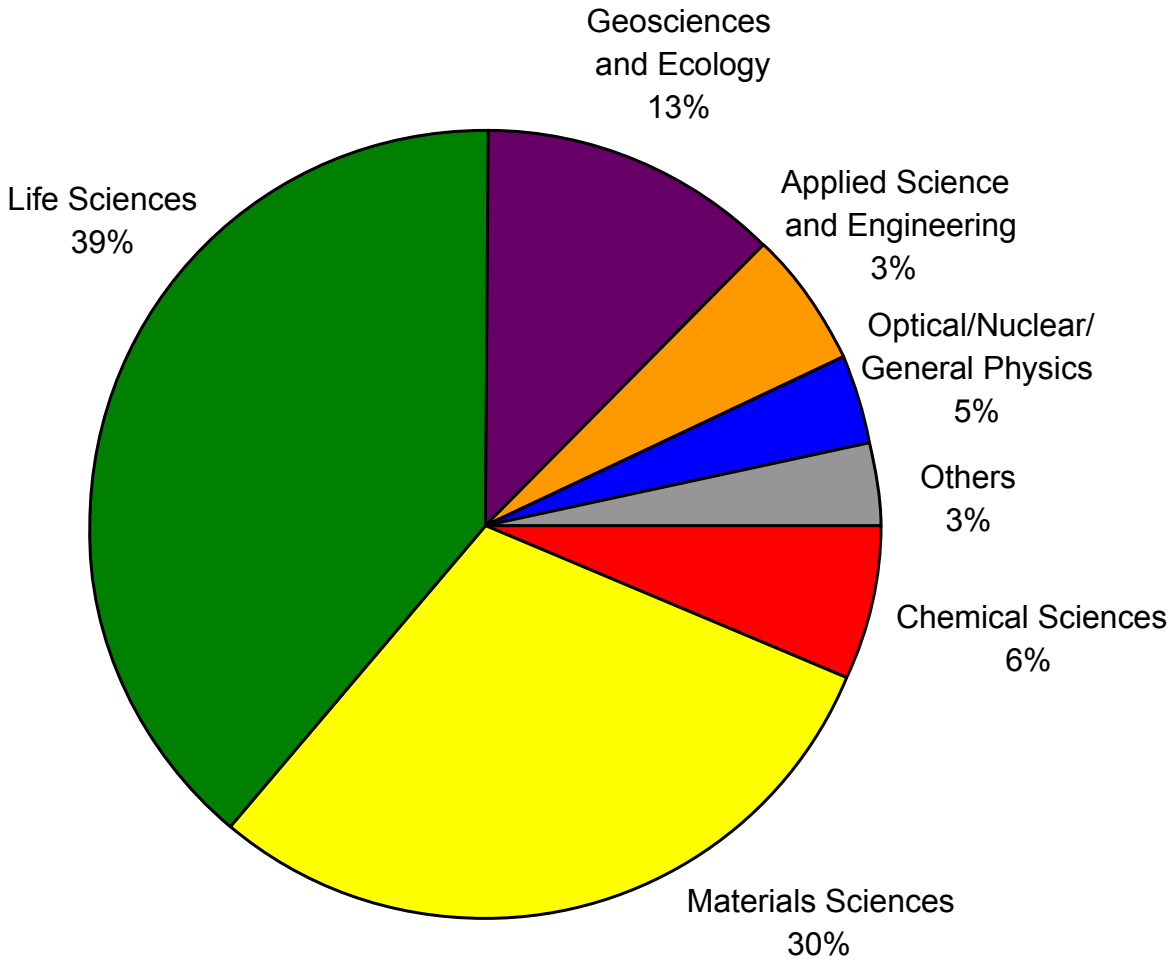
NSLS Users by Field of Research (2007)



Industrial Users 7%

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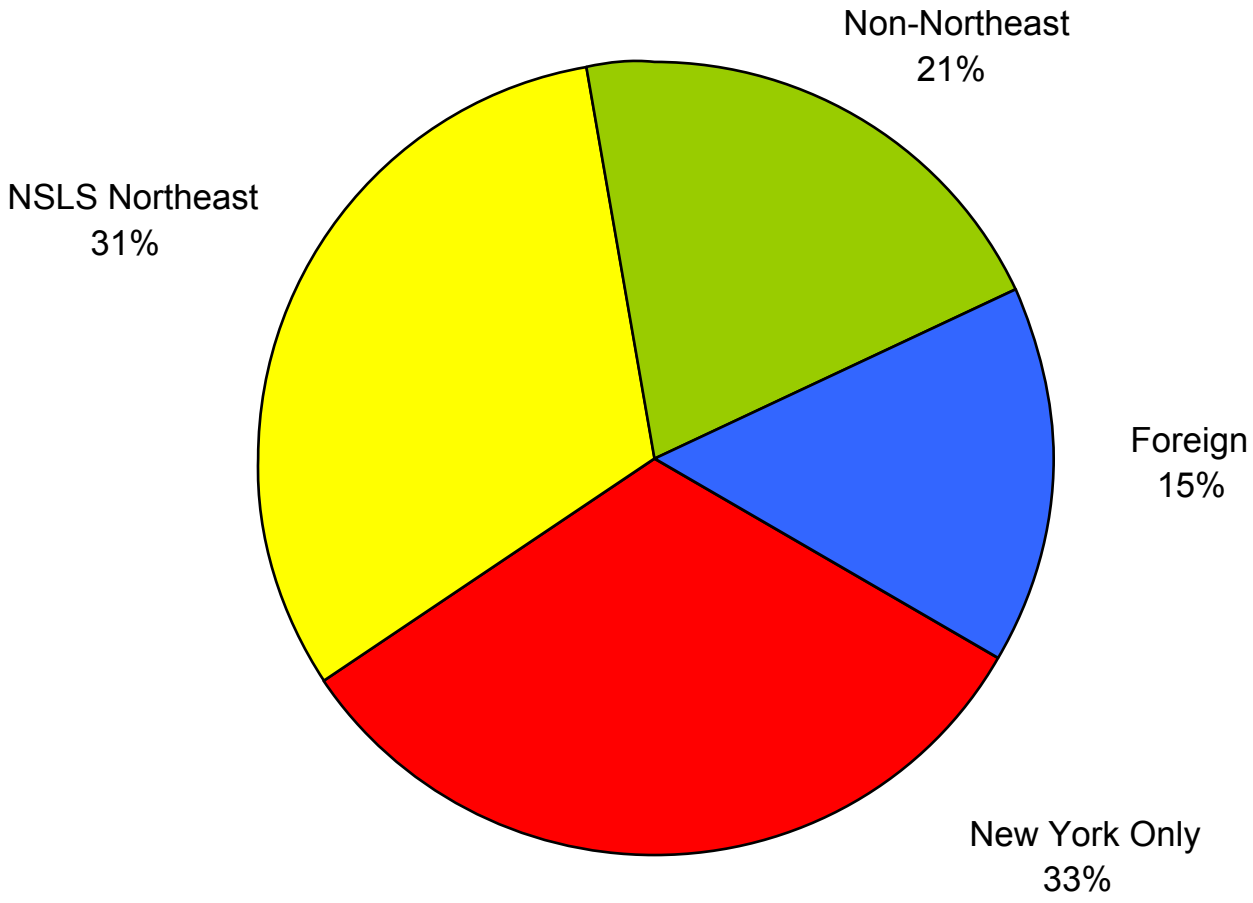
NSLS Geographical User Distribution (2007)



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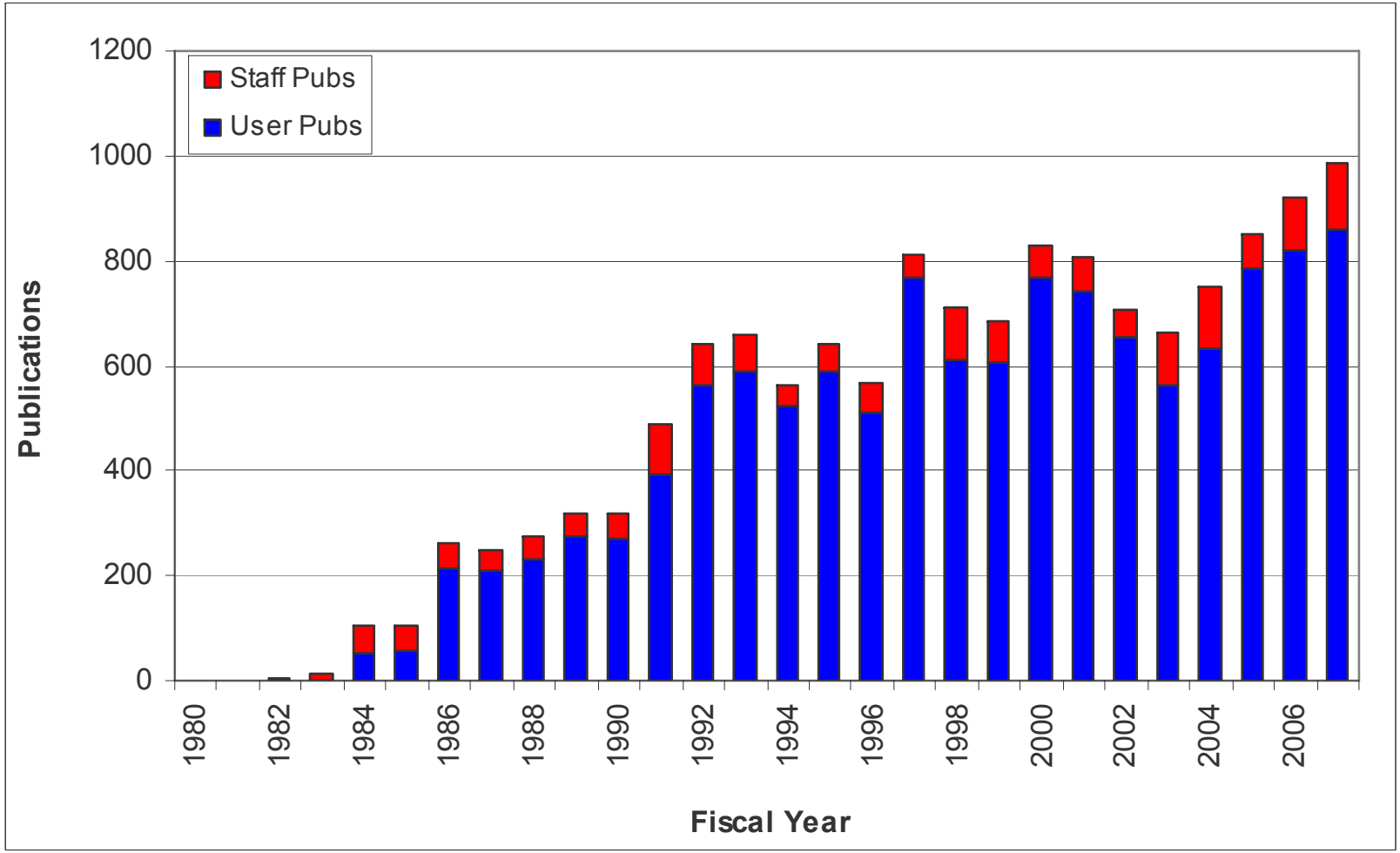
NSLS Publications



- Premier* publications represent (Impact factor > 6) ~25% of total pubs
- Staff publications represent ~10% of total NSLS publications

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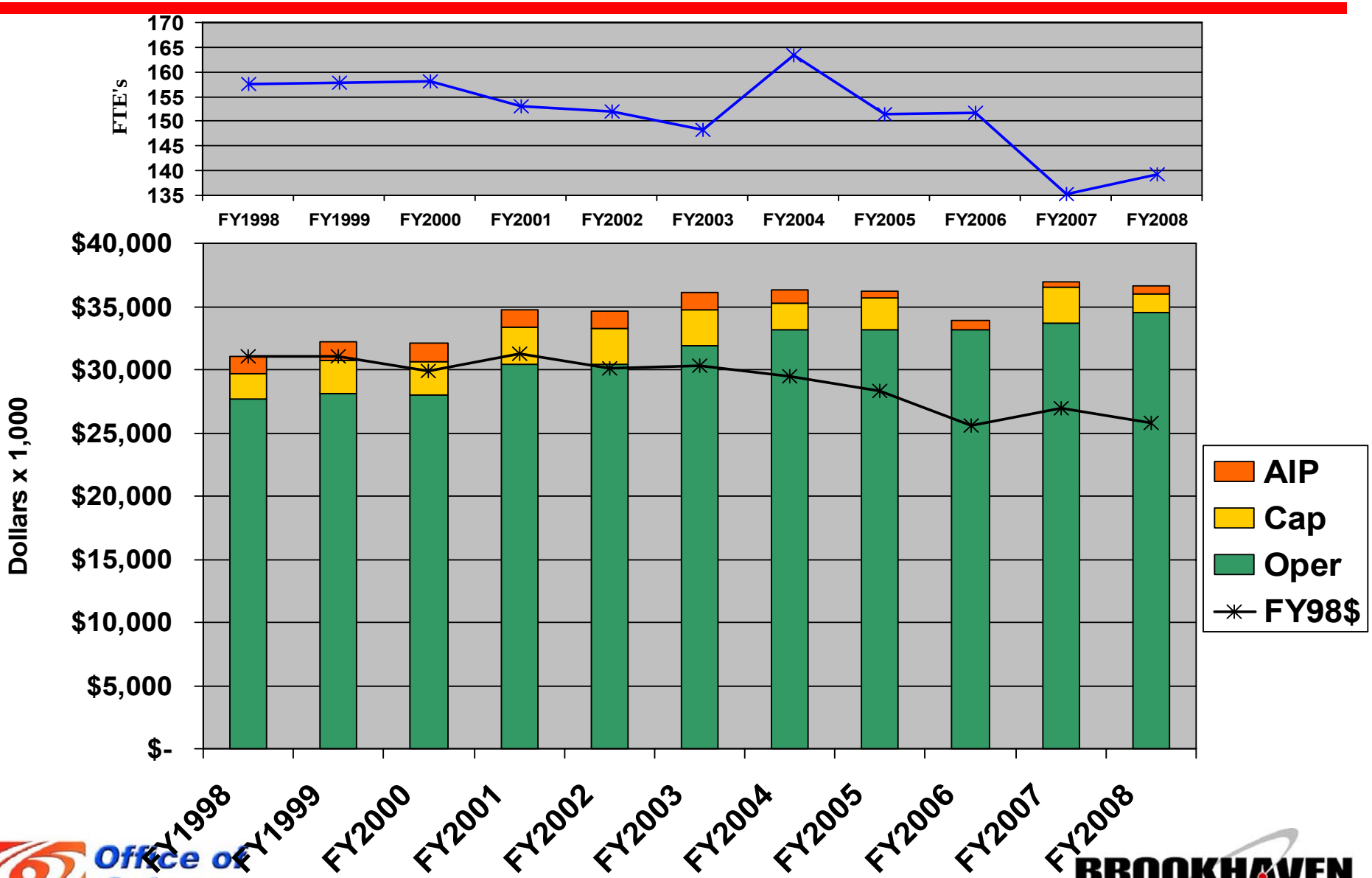
High Impact Publications

DOE-Defined Premiere Journals (Calendar Year)	2007	2006	2005
Cell	10	13	6
Journal of American Chemical Society	17	20	20
Nature	13	9	16
Physical Review Letters	14	17	18
Science	14	11	8
Total Premier Journals:	**68**	**70**	**68**

NSLS Funding and Staffing Trend



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Budget Impact

- Slow down addition of staff, affecting succession planning in Accelerator Operation and Experimental Systems Division and Facility Beamline support
- Slow down major beamline upgrade projects
- Reduce operating budget
- Reduce operating hours in FY08 for the first time in NSLS history

Strategy

- Prioritize, ask tough questions and make difficult choices
- Leverage limited NSLS resources as much as possible
- Increase communication with staff and users
- Creative solutions

Major Scientific Program Highlights and New Initiatives

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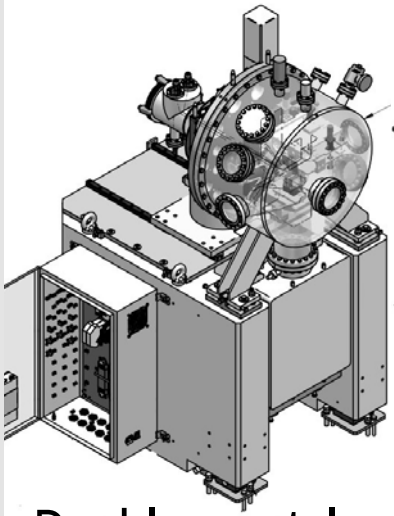
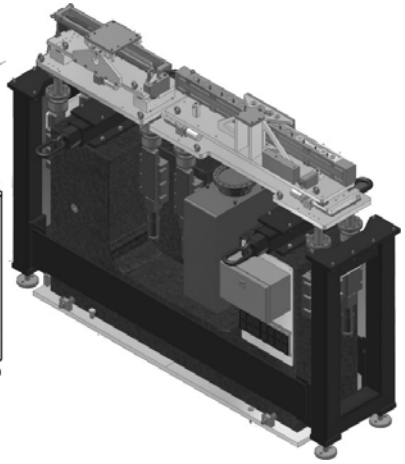
X9 Undulator BL- Small Angle X-Ray Scattering

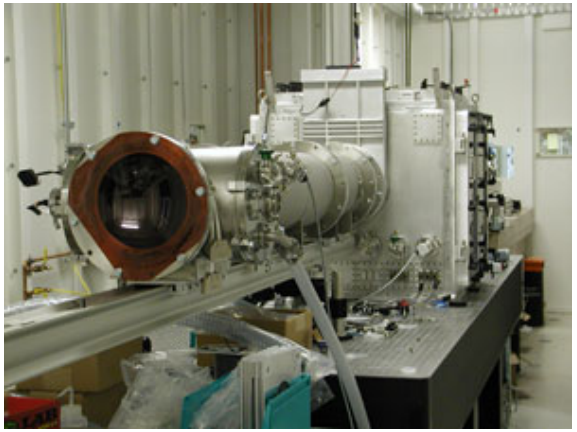
New NSLS beamline: X9
Capabilities: SAXS, including micro-focusing optics and detectors optimized for GISAXS and time-resolved SAXS
Significance: state-of-the-art SAXS capability
Institutions: NSLS, CFN (endstation funding)
Schedule:
- End of 2007: Endstation equipment installed
- May 2008: Delivery of monochromator and bimorph KB mirror systems
- By end of FY2008: Undulator, front end, and remainder of beamline to be installed



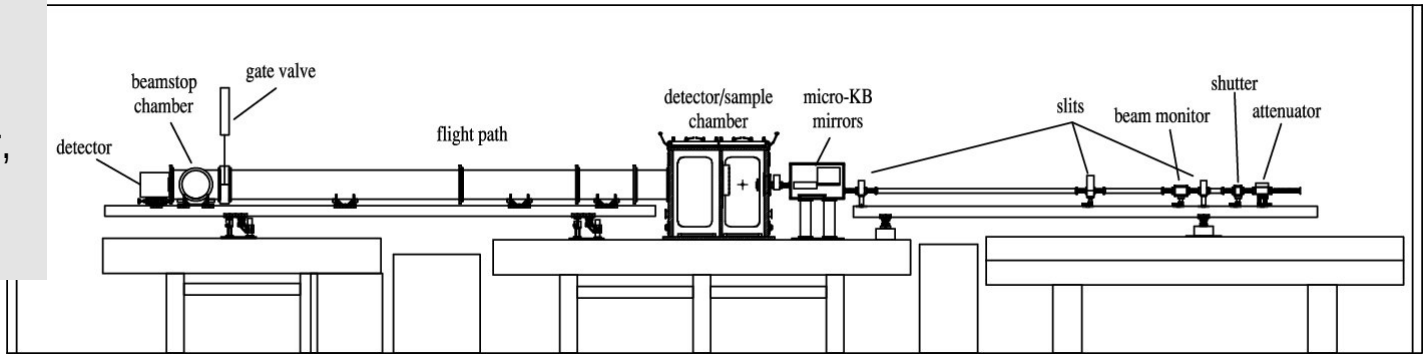
Double-crystal monochromator



Primary K-B mirrors

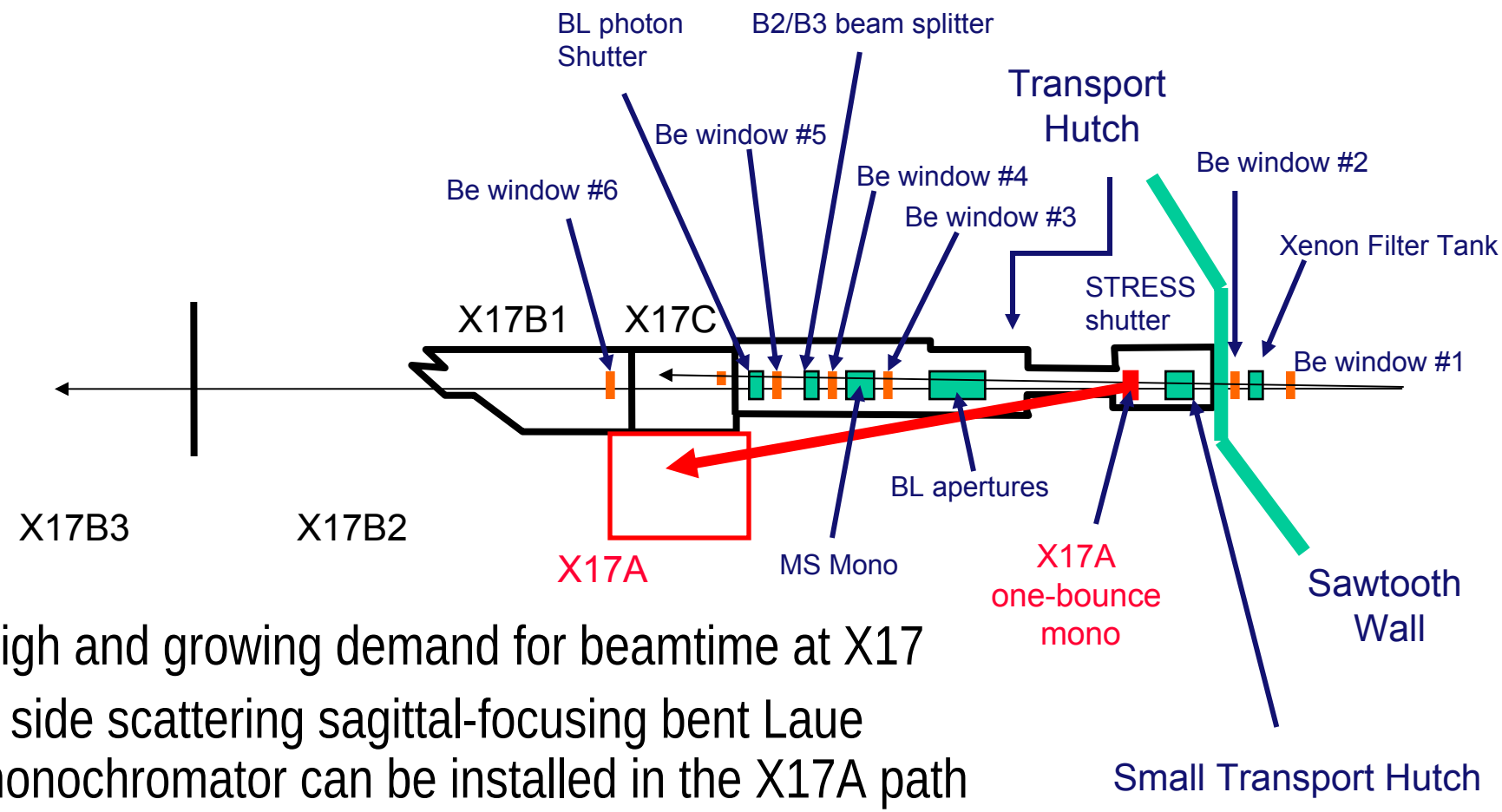


Experimental hutch



X9 hutch layout

X17A –High Energy Materials Science



- High and growing demand for beamtime at X17
- A side scattering sagittal-focusing bent Laue monochromator can be installed in the X17A path
- Ideal instrument for high energy X-ray scattering

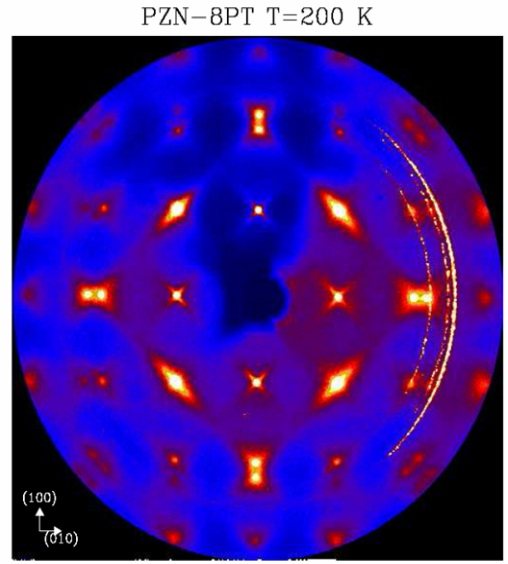
Possible Scientific Programs at X17A

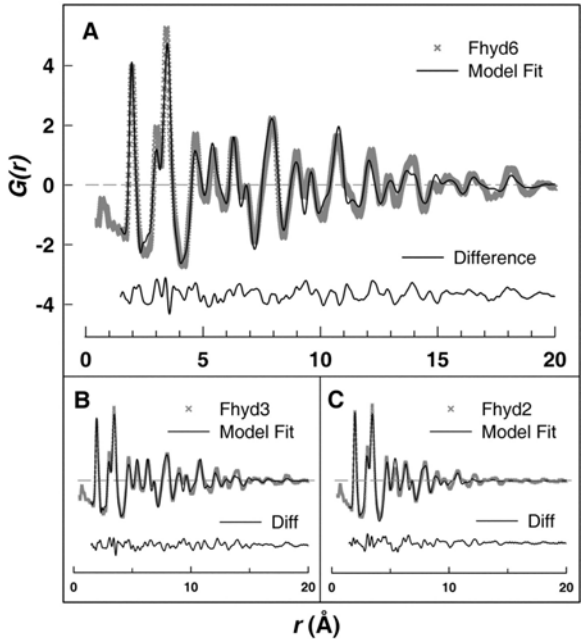
X-ray total scattering

Atomic structure of disordered, nanocrystalline and amorphous compounds
Domain size and microstructure

at variable p,T,magnetic or electric field

Michel et al. Chem Matter. (2007), Science (2007)

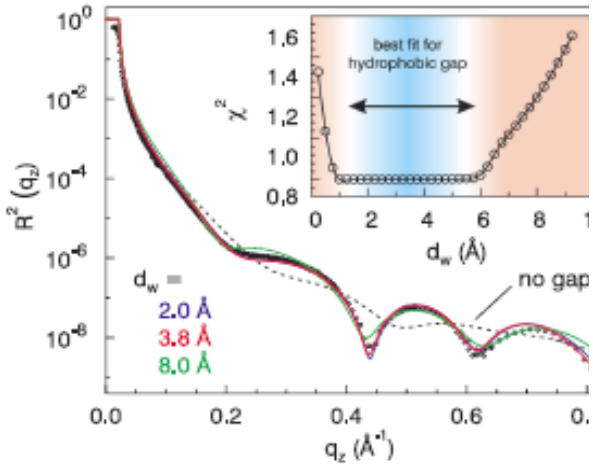


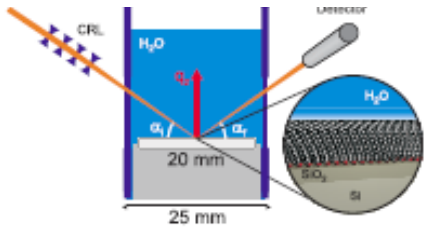


Diffuse scattering

Superconductors
Ferroelectrics
Piezoelectrics

Diffuse scattering in PZN-PT crystal. (Xu, Zhong, et. al., Phys. Rev. B. (2004) 174109





Scattering at Interfaces

High-resolution in situ x-ray study of the hydrophobic gap at the water–octadecyl-trichlorosilane interface (Metzger et al PNAS 2006 18401)

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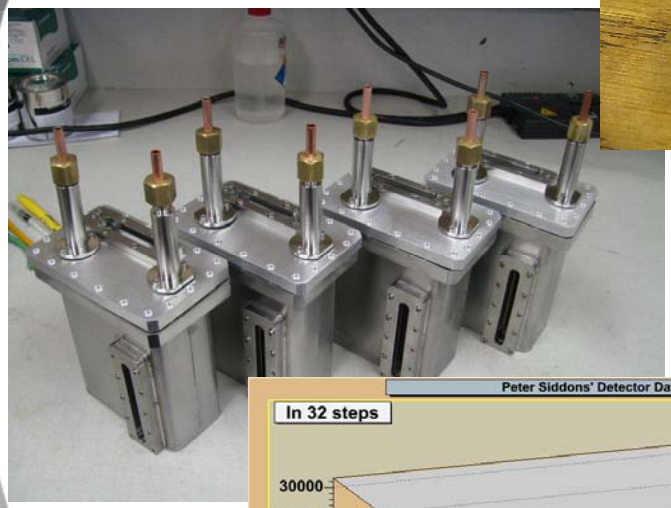
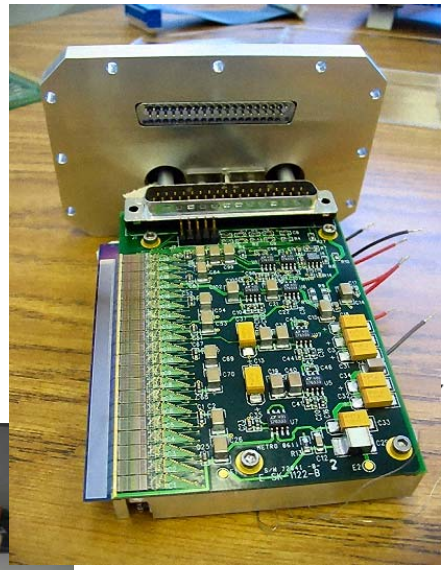
NSLS Detector Development Program

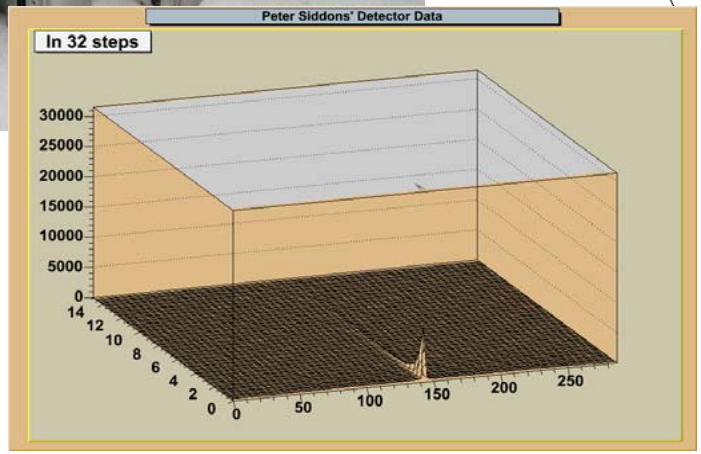
Provide 1D detectors to NSLS and other SR facilities

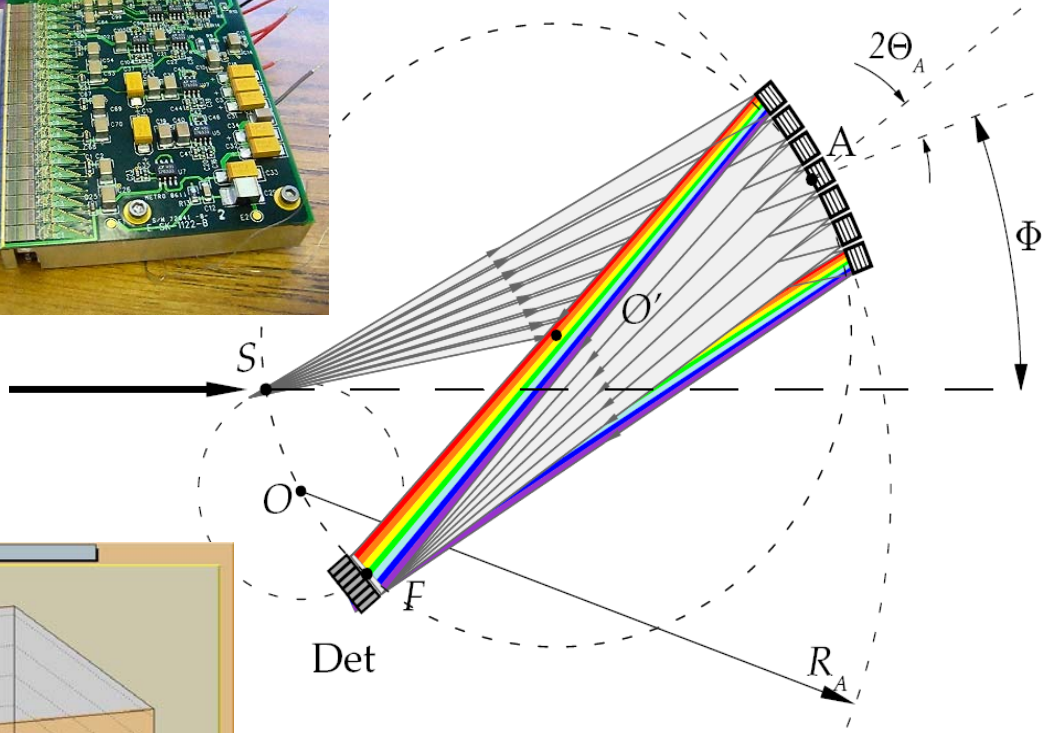
NSLS & Brazilian

APS and Taiwan









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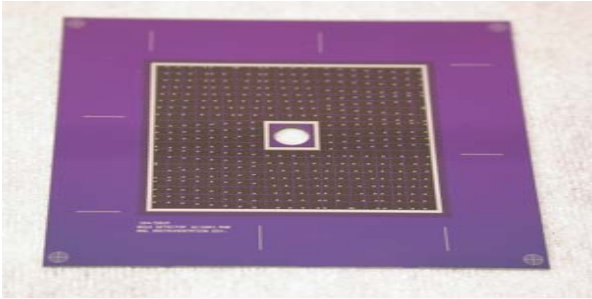
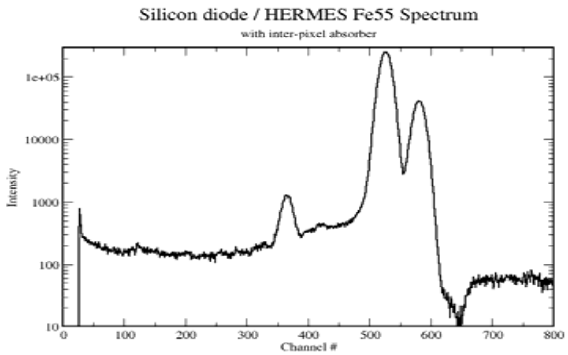
2D Spectroscopy and Microprobe Detector

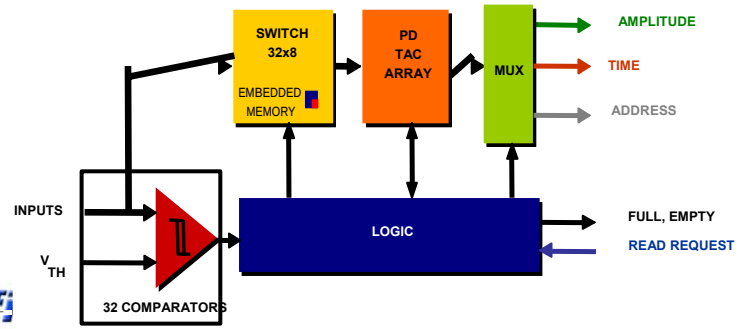


BNL / CSIRO Australia collaboration

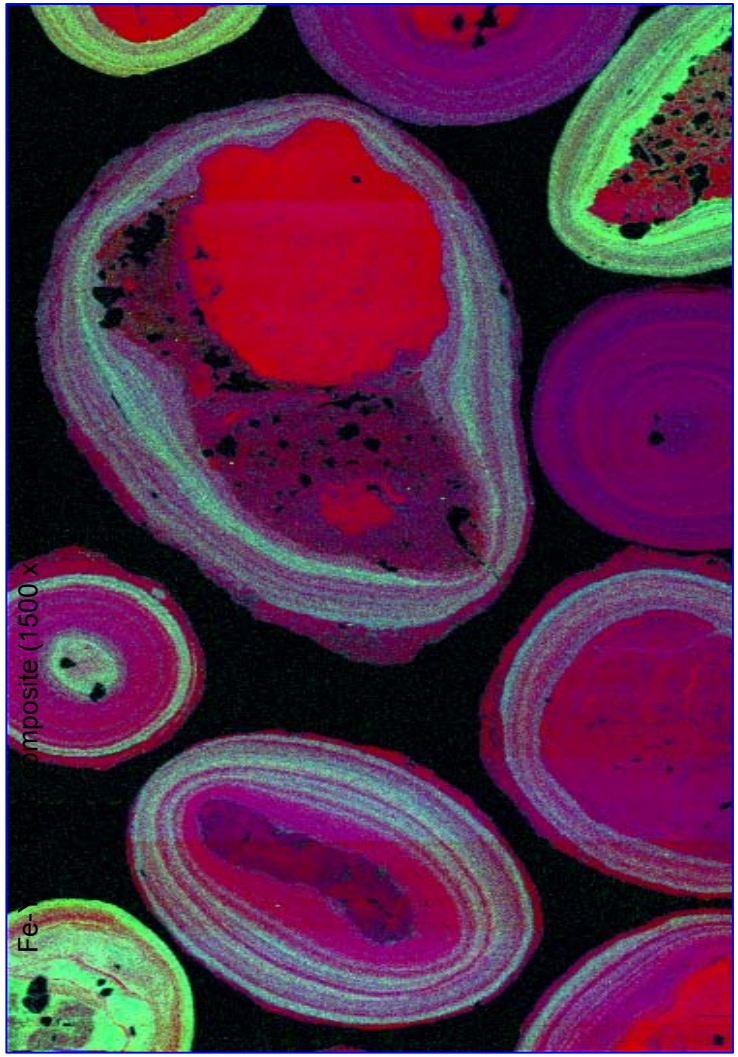


- BNL: 384-element array development
- CSIRO: Fast FPGA-based analysis

Real-time quantitative SXRF imaging



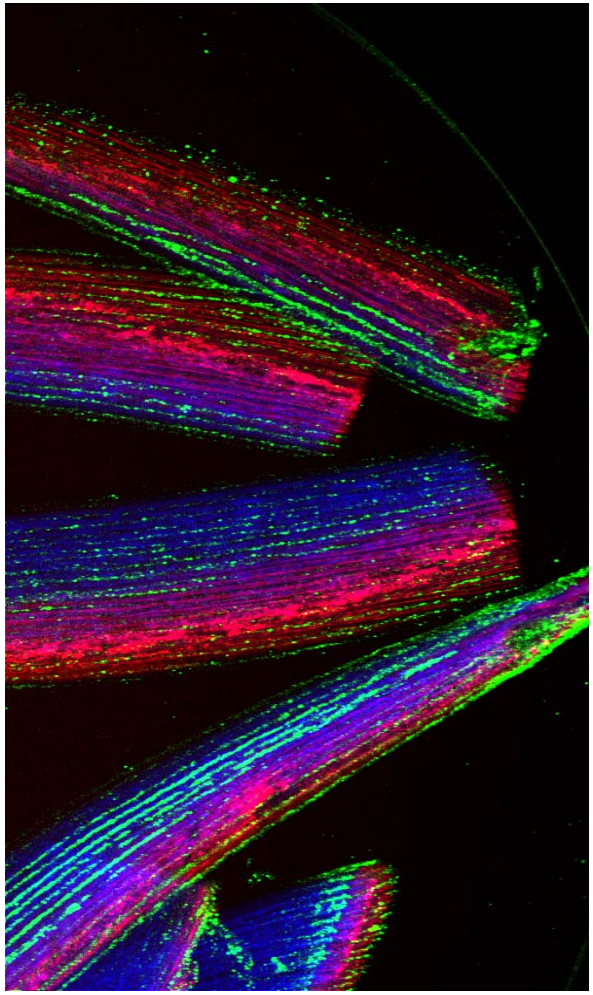
Rapid XRF Elemental Mapping
(BNL/CSIRO collaboration)



-1200 x 2267 (9 x 17 mm^2)

-5.7 hours (7.5 ms dwell)

-7.5 x 7.5 μm^2 pixels



Synchrotron Catalysis Consortium Renewed

Synchrotron Catalysis Consortium (SCC) has played a key role in

- Providing training and enhanced infrastructure for catalysis and energy research
- 40 groups of researchers have benefited from SCC over the last few years
- Coordinating new research opportunities. For example, 2 out of 13 new programs funded by BES Hydrogen production, storage and end use research call are based at NSLS. In addition, several other groups are part of the SCC
- Upgrading X18A to provide new capabilities to catalysis researchers

Historical Black Colleges and Universities Workshop

Office of Educational Programs and NSLS

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Scientific Strategic Planning Workshops

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Goals of Planning Workshops

- Identify the key scientific drivers for the coming years
- Identify the capabilities required by the community at the NSLS in the short term and NSLS-II in the long term
- Identify R&D opportunities

→ Provide input for the strategic plans at the NSLS and NSLS-II

Deliverable of the Workshops

A white paper that includes:

- The Growth, Expansion, and Transition of NSLS Scientific Programs
- Proposed Suite of Beamlines
- Beamline Specifications and R&D Needs
- Recommended Transition/Construction Sequence
- Facility Infrastructure at NSLS-II
- Synergy with other Communities
- Possible funding mechanisms

Scientific Strategic Planning Workshops

• Life Sciences	Jan. 15-16
• Materials Science and Engineering	Jan. 17-18
• Earth and Environmental Sciences	Jan. 22-23
• Chemical and Energy Sciences	Feb. 1
• Hard Condensed Matter and Materials Physics	Feb. 5-6
• Soft and Biomolecular Materials	Feb. 11-12

- *White papers online http://www.bnl.gov/ls/workshops.asp

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Beamline Transfer Planning

Rationale

- Ensure significant capacity for NSLS-II at the commencement of operation to accommodate the large number of users from NSLS
- NSLS-II large gap dipole (for far-IR), soft bend, three-pole wiggle are world-class sources for many experimental techniques
- Many NSLS beamlines, with proper upgrades funded by DOE and other agencies, will be state-of-the-art for these sources
- Recommended by Lehman review, NSLS-II Experimental Facility Advisory Committee (EFAC) and supported by DOE/BES

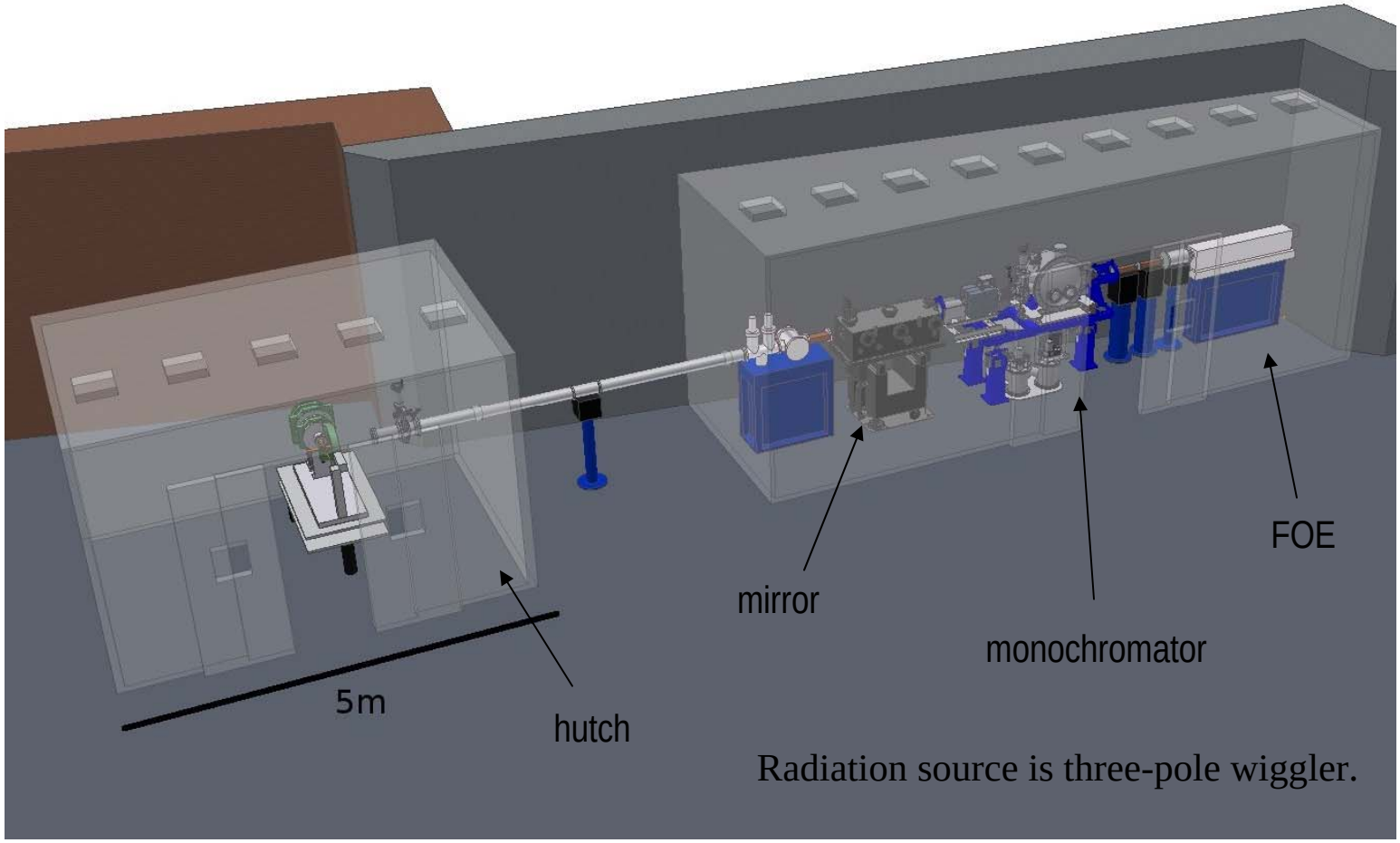
Beamline Transfer Working Group

The group is headed by Steve Hulbert, head of the NSLS exp. system division and includes both NSLS and NSLS-II staff as well as NSLS users

Scope of the working group:

- -Identify the types of beamlines which are most suitable to be transferred
- -Perform detailed analysis of the performance of these beamlines and necessary upgrade for NSLS-II
- -Evaluate the quality of existing NSLS beamline/endstation
- -Perpare detailed cost and schedule for beamline transfer
- -Coordinating major NSLS upgrades

Layout of X25 moved to NSLS-II 3-pole wiggler



Courtesy of Mary Carlucci-Dayton and Scott Coburn

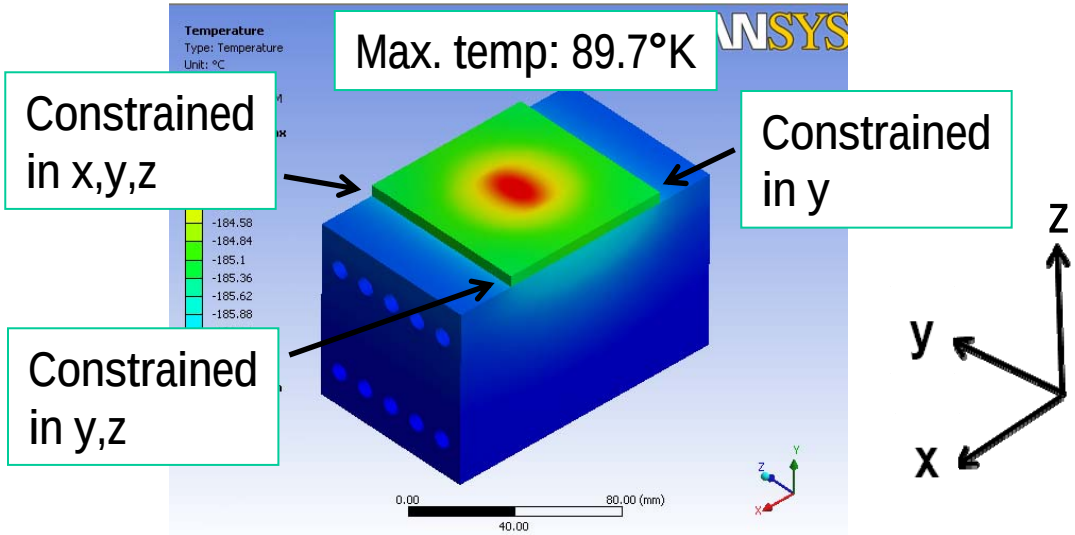
Thermal performance of X25 mono. on NSLS-II 3-pole Wiggler

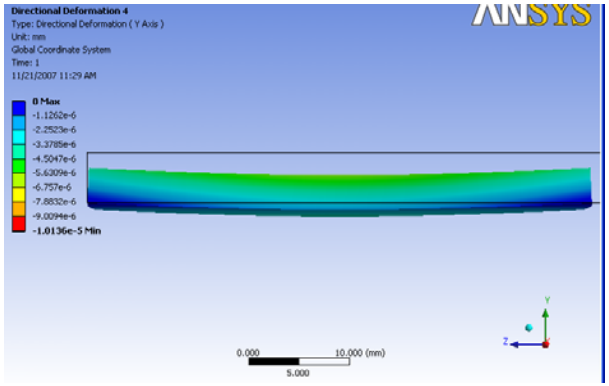
Source: 1mrad horiz. angle, total absorbed power on Si xtal: 67.4W

Peak absorbed power density at 20° grazing angle: 0.12 W/mm^2

Optical layout: mono 30m, mirror 34m, sample 39.1m (from source): sagittal demag. 3.3:1 (mono), tangential demag. 6.6:1 (mirror)

Max. deformation Δz = 4 nm
P-V slope error: 0.35 µrad





Conclusion: existing X25 monochromator cooling is perfectly acceptable for NSLS-II 3PW source.

Office of Science
U.S. DEPARTMENT OF ENERGY

FEA calcs: V. Ravindranath

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Summary

- NSLS continues to be a highly reliable and productive user facility and an exciting place to be.

- We have begun to work with the user community to plan the transition to NSLS-II.

"The mission of the NSLS is to support our users in doing outstanding science in a safe and environmentally friendly manner."