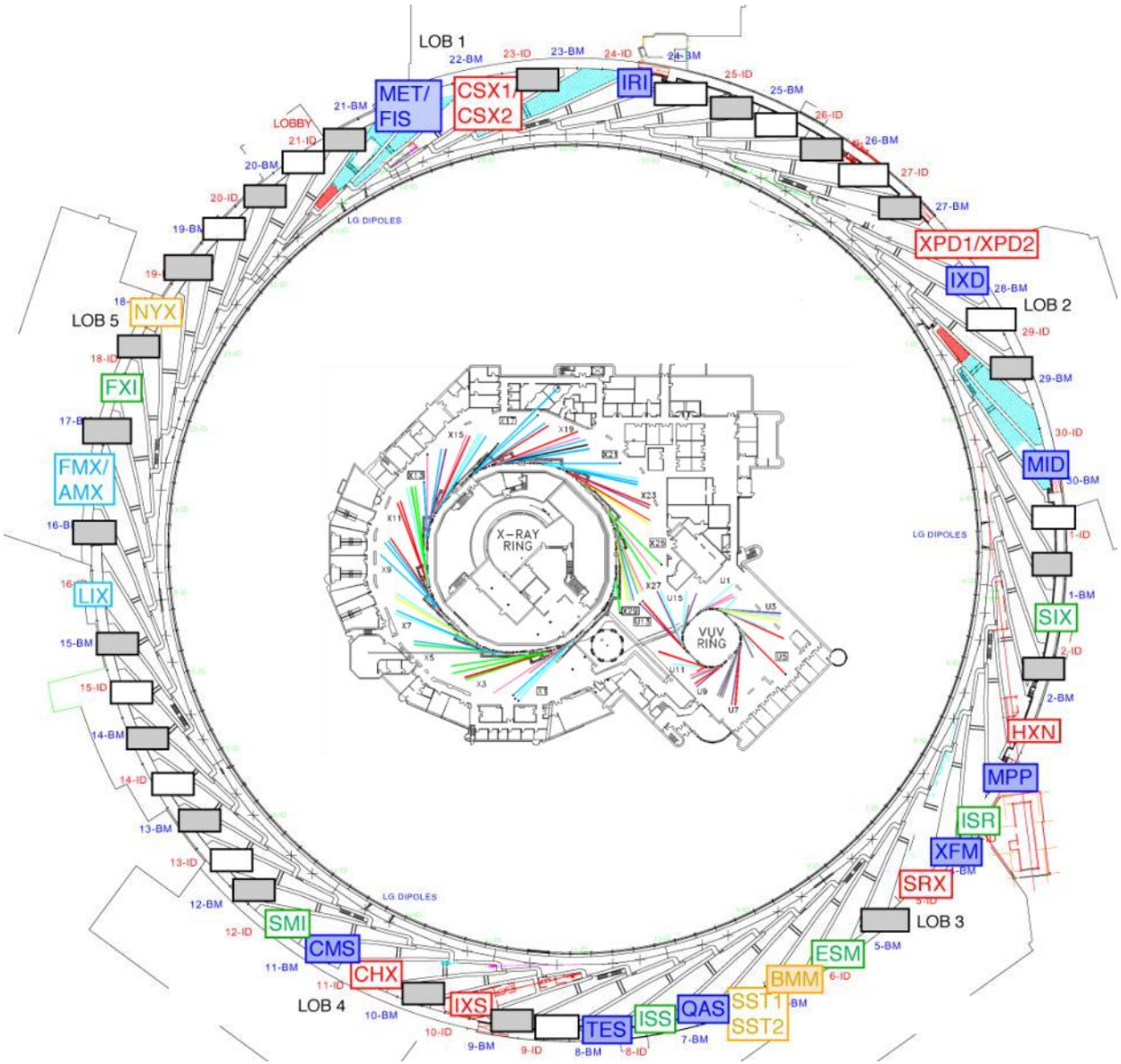
NSLS User Transition Planning Forum

2012 NSLS/CFN Joint Users Meeting

May 21, 2012
1:30 to 5:30 PM
Hamilton Seminar Room
Chemistry Building - 555

<u>Committee:</u>
Jen Bohon
Dan Fischer
Annie Heroux
Erik Johnson
Tony Lanzirotti
Ryan Tappero

Contributions from many others!



U.S. DEPARTMENT OF ENERGY

…. on the way to the forum

recollection of some events leading up to today ….

- 2011 NSLS/CFN user meeting
  - Discuss coordination with other facilities w/Peter Lee
- 2011 August BESAC meeting
  - Met w/DOE and other facility leadership
  - Formed working group (Banda, Erik, Denny, Piero)
- UEC Town meetings Aug & Nov 2011, Feb 2012
  - Outlined anticipated changes in capacity and capability
  - UEC proposed NSLS User Transition Planning Forum
- DOE Review of NSLS-II Pre-Operations Budget

Forum Outline

- Introduction — Erik Johnson
- DOE Perspective on Transition — Peter Lee
- Transition background — Erik Johnson
- DOE Facility User Info — Tony Lanzirotti
- NSLS-II Early Science Operations — Qun Shen

Break

- Panel Discussion with …
  - ★ Denny Mills — APS
  - ★ Zahid Hussain — ALS
  - ★ Piero Pianetta — SSRL
- Moderated Discussion — All Participants

NSLS User Transition - Background

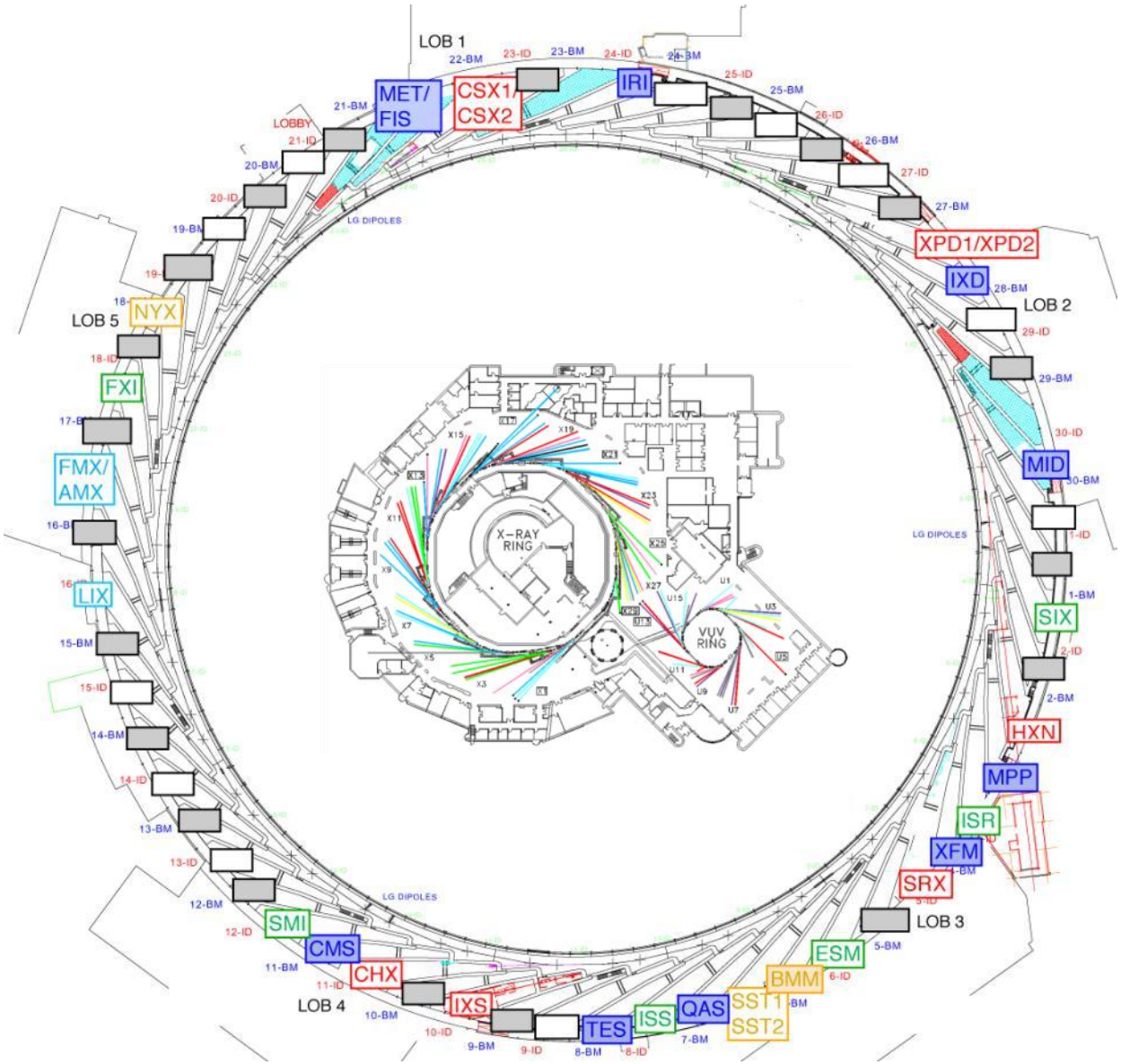
Erik D. Johnson

Brookhaven National Laboratory

Deputy for Programs
Photon Sciences Directorate

NSLS User Transition Planning Forum

May 21, 2012



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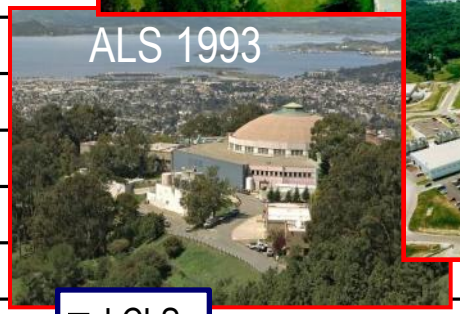
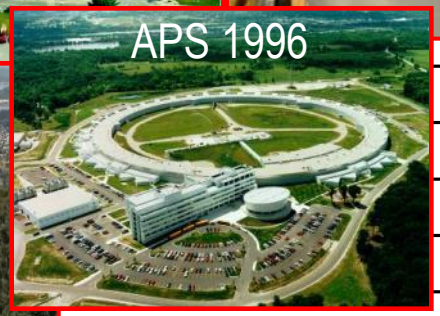
DOE - BES Light Sources

Harriet Kung, BESAC March 17 2011





User Transition

- Impacts on users, facilities, and science
  - Loss of capabilities and capacity until NSLS-II is fully built out
  - Displacement of substantial fraction of user community
- Mitigation Options
  - Build out NSLS-II
  - Identify and communicate to users similar capabilities at ALS, APS, SSRL
  - Adjust capacities at ALS, APS, SSRL

Capability Assessment - August 2011

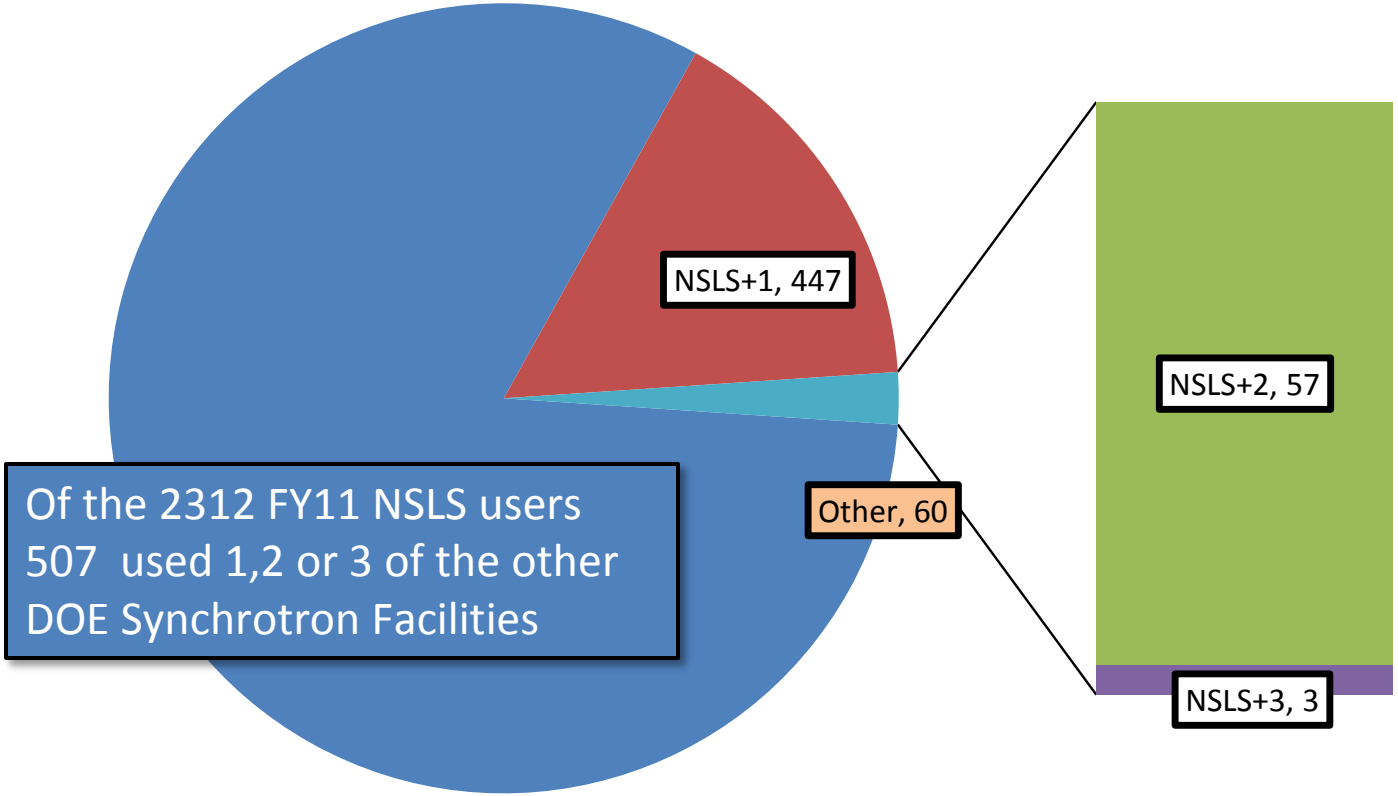
- Met with DOE SUF and Synchrotron Facility leadership 1 August 2011
- Reviewed assessment of scientific capability changes anticipated with shutdown of NSLS and ramp up of NSLS-II
- Established working group with other facilities -
  - BNL- NSLS/NSLS-II Erik Johnson
  - LBNL- ALS Michael Banda
  - ANL- APS Denny Mills
  - SLAC - SSRL Piero Pianetta

Coordination with other DOE Facilities

- Weekly call with Banda, Denny and Piero
- Discuss options for mitigation of impacts
  - They are charting their own programs into the future
  - They have money and staffing issues too….
- Tiered approach to serving dislocated NSLS users
  - Work to host students finishing thesis research
  - 'Experienced' NSLS users can work on understaffed beamlines
  - New instruments (NSLS-II and other facilities)

User Community Overlap

Part of working with APS/ALS and SSRL to understand the impacts



In common with the 2312 FY 11 NSLS Users

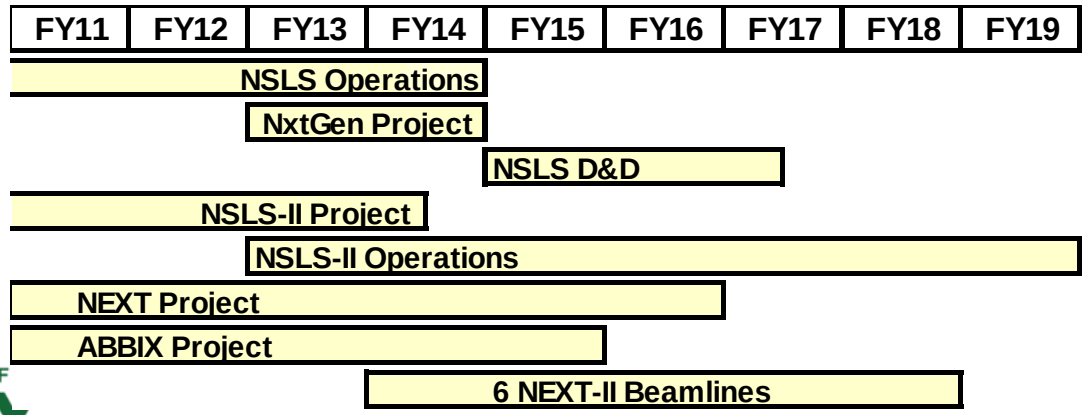
APS – 363 (16% of NSLS)

ALS – 92 (4% of NSLS)

SSRL – 55 (2% of NSLS)

Photon Sciences Portfolio

- The discovery potential of BNL photon sciences is being greatly expanded by constructing NSLS-II and its associated experimental facilities
- This is being achieved by a coordinated portfolio of activities that includes:
  - Operating NSLS
  - Constructing NSLS-II, including 8 ID beamlines (NSLS-II Project)
  - Constructing 6 ID beamlines (NEXT Project)
  - Constructing 3 ID beamlines (ABBIX Project)
  - Constructing 9 BM/3PW/IR beamlines for DOE-BES (NxtGen Project)
  - Overseeing construction of 4 Type II beamlines (NIST, NYSBC)
  - Operations of NSLS-II
  - Decommissioning NSLS
  - Constructing 4-6 ID beamlines (NEXT-II Project)



NSLS Operations – Present State

- DOE Storage Rings Host 8800 ± 350 users over last 5 years
- NSLS hosts 2200 ± 50 (~24% of all users)
  - ~1200 experiments per year
- NSLS Publications
  - ~ 900 per year
  - ~ 150 per year of these are premier publications
- NSLS Resources
  - NSLS has 61 End Stations hosting users (57 independent + sum of fractions)

NSLS User Community Today

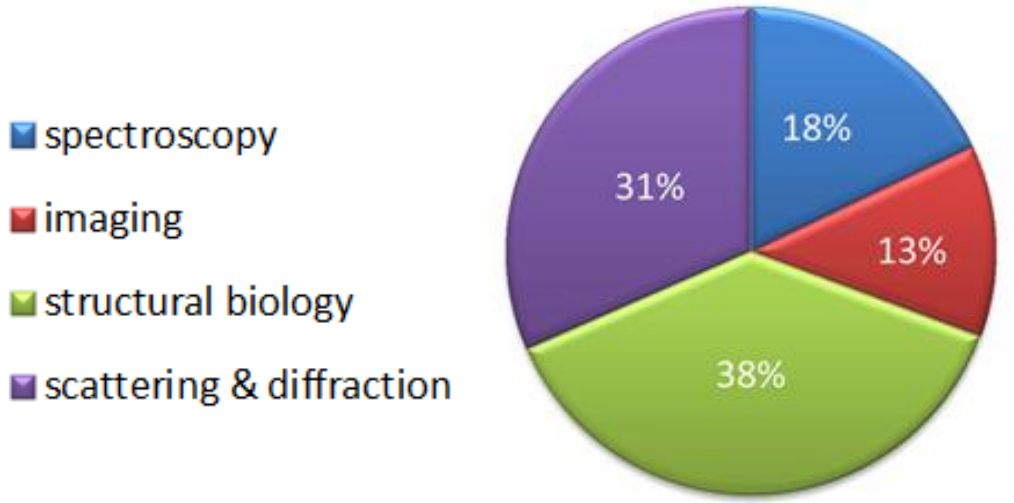
Spectroscopy
- Low-energy spectroscopy (IR, VUV)
- X-ray spectroscopy

Scattering & Diffraction
- Hard X-ray Scattering & Diffraction
- Soft X-ray Scattering

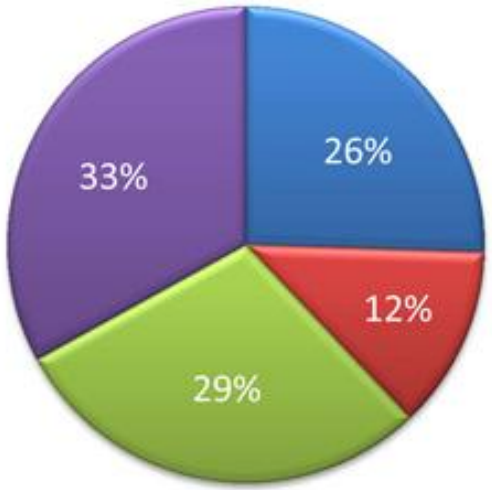
Imaging & Microprobes
- FTIR imaging
- micro-XRF
- micro-CT, TXM
- STXM
- DEI

Structural Biology
- Macromolecular crystallography
- Small/Wide-Angle X-ray Scattering
- X-ray Footprinting

Users by Technique

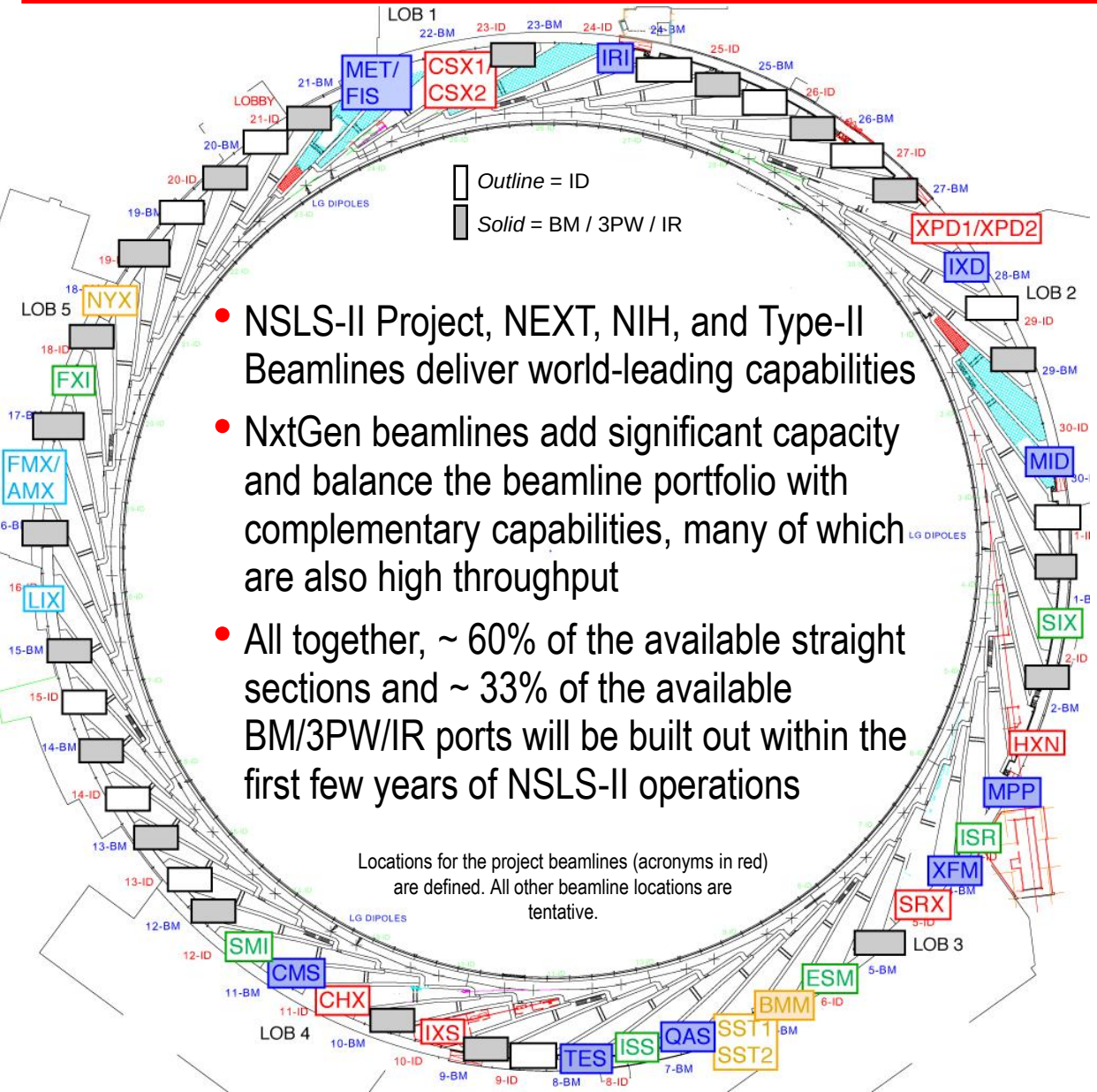


Publications by Technique



FY10

NSLS-II Beamline Portfolio



- NSLS-II Project, NEXT, NIH, and Type-II Beamlines deliver world-leading capabilities
- NxtGen beamlines add significant capacity and balance the beamline portfolio with complementary capabilities, many of which are also high throughput
- All together, ~ 60% of the available straight sections and ~ 33% of the available BM/3PW/IR ports will be built out within the first few years of NSLS-II operations

8 NSLS-II Project Beamlines

Inelastic X-ray Scattering (IXS)
Hard X-ray Nanoprobe (HXN)
Coherent Hard X-ray Scattering (CHX)
Coherent Soft X-ray Scat & Pol (CSX1, CSX2)
Sub-micron Res X-ray Spec (SRX)
X-ray Powder Diffraction (XPD1, XPD2)

6 NEXT MIE Beamlines

Photoemission-Microscopy Facility (ESM)
Full-field X-ray Imaging (FXI)
In-Situ & Resonant X-Ray Studies (ISR)
Inner Shell Spectroscopy (ISS)
Soft Inelastic X-ray Scattering (SIX)
Soft Matter Interfaces (SMI)

3 ABBIX Beamlines

Frontier Macromolecular Cryst (FMX)
Flexible Access Macromolecular Cryst (AMX)
X-ray Scattering for Biology (LIX)

4 Type-II Beamlines

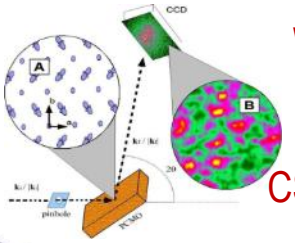
Spectroscopy Soft and Tender (SST1, SST2)
Beamline for Mater. Measurements (BMM)
Microdiffraction Beamline (NYX)

9 NxtGen Beamlines

Complex Materials Scattering (CMS)
Magneto, Ellipso, High Pressure IR (MET/FIS)
Metrology & Instrum Development (MID)
Full-Field Infrared Spectroscopic Imaging (IRI)
In-situ X-ray Diffraction Studies (IXD)
Materials Physics & Processing (MPP)
Quick X-ray Absorption Spectroscopy (QAS)
Tender X-ray Absorption Spectroscopy (TES)
X-ray Fluorescence Microscopy (XFM)

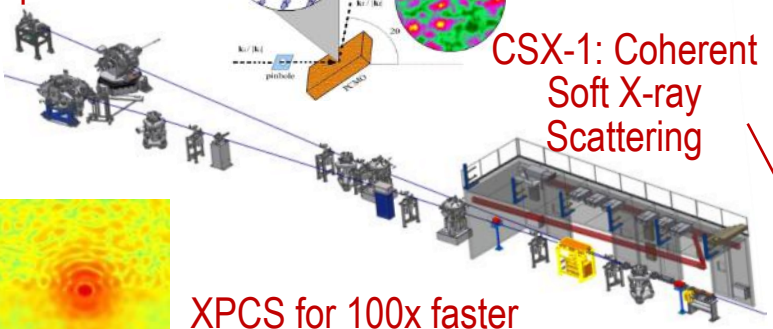
Eight NSLS-II Project Beamlines

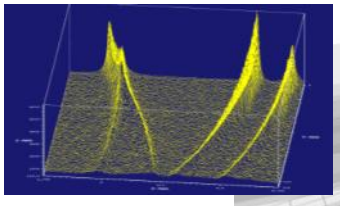
CSX-2: Fast switching polarization



World-leading coherent flux

CSX-1: Coherent Soft X-ray Scattering



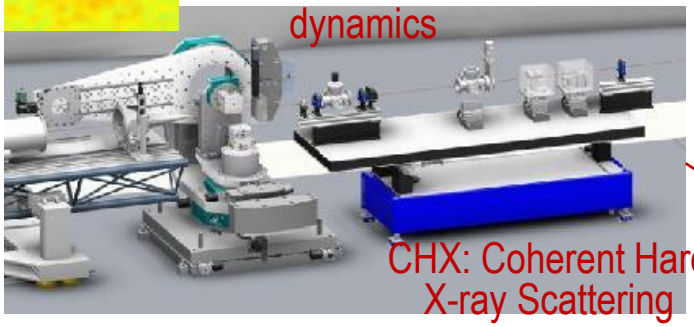


Time-resolved In-situ extreme conditions

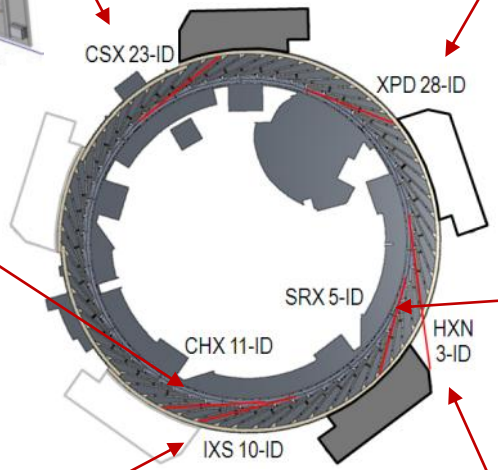
XPD-1: X-ray Powder Diffraction

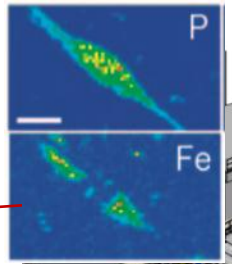
XPD-2: PDF studies

XPCS for 100x faster dynamics

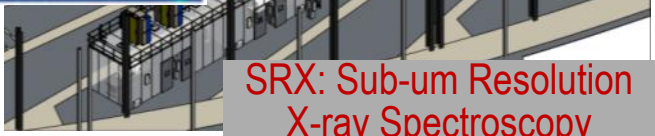


CHX: Coherent Hard X-ray Scattering



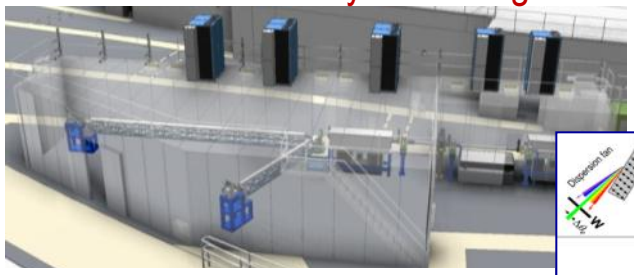


World-leading flux in sub-um spot

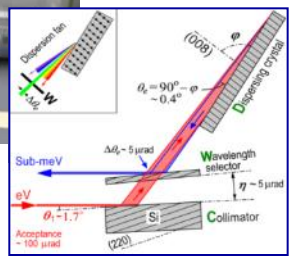


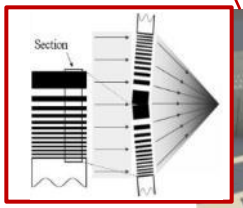
SRX: Sub-um Resolution X-ray Spectroscopy

IXS: Inelastic X-ray Scattering

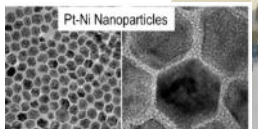


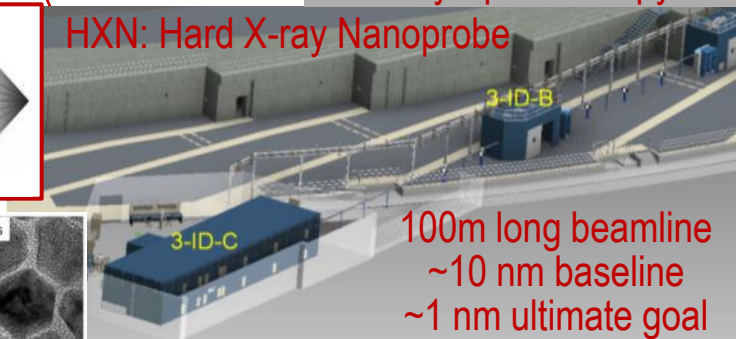
~1 meV baseline
~0.1 meV ultimate goal





HXN: Hard X-ray Nanoprobe





100m long beamline
~10 nm baseline
~1 nm ultimate goal

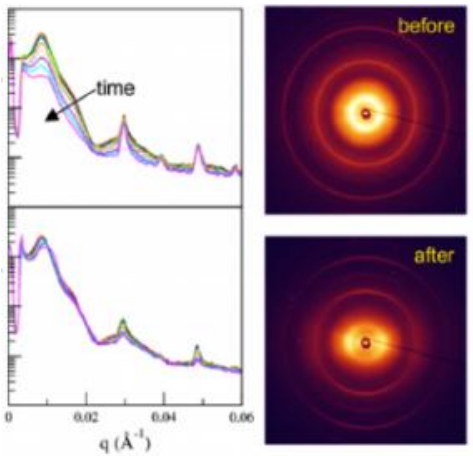
NxtGen Beamlines by WBS

- Establish additional beamline capacity at NSLS-II by extensive re-use and recycling of existing NSLS Beamline equipment (whole beamlines or components along with new equipment where necessary)

WBS	Beamline
6.02	Complex Materials Scattering (CMS)
6.03	Magneto, Ellipsometric and high-Pressure IR spectroscopy (MET/FIS)
6.04	Metrology and Instrumentation Development (MID)
6.05	Full-Field Infrared Spectroscopic Imaging (IRI)
6.06	In situ X-ray Diffraction studies of structural and chemical transformations (IXD)
6.07	Materials Physics and Processing Beamline (MPP)
6.08	Quick x-ray Absorption Spectroscopy (QAS)
6.09	Tender X-ray Absorption Spectroscopy (TES)
6.10	X-ray Fluorescence Microscopy (XFM)

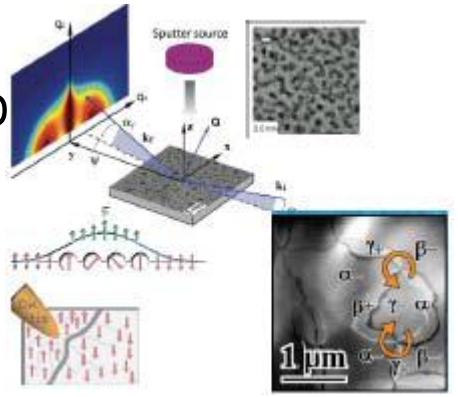
ABBIX Project

- Advanced Beamlines for Biological Investigations with X-rays (ABBIX)
- NIH funded $45M project to build 3 beamlines to support the needs of the life sciences community at NSLS-II
  - **AMX** – Highly Automated Macromolecular Crystallography
  - **FMX** – Frontier Macromolecular Crystallography
  - **LIX** – High Brilliance X-ray Scattering for Life Sciences
- Successful “CD-1” Review held on Jan 17-18
- ABBIX staff and Beamline Advisory Teams (BATs) in place
- “CD-2” Review scheduled for June 26-27
- Operations to begin 1QFY16

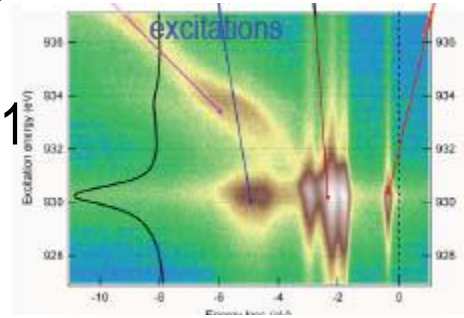


NSLS-II Experimental Tools (NEXT) Project

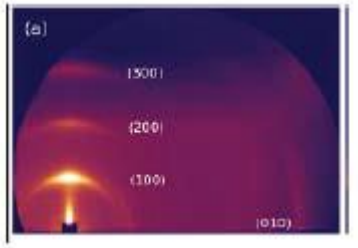
- DOE-BES funded $90M MIE project 5-6 beamlines, ready for commissioning with X-ray beam, to expand BES beamline portfolio
- Scientific programs complementary to NSLS-II Project beamlines
- Leveraged by extensive auxiliary supporting infrastructure developed by NSLS-II Project

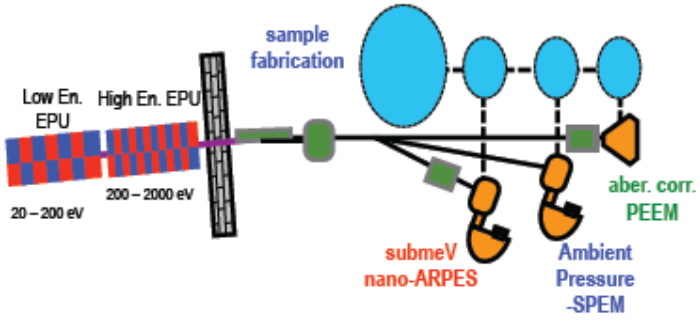


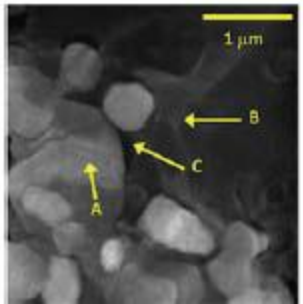
ESM -- Electron Spectro-Microscopy
ISS -- Inner Shell Spectroscopy
SIX -- Soft Inelastic X-ray Scattering
FXI -- Full-field X-ray Imaging
ISR -- Integrated In-Situ & Resonant X-Ray Studies
SMI -- Soft Matter Interfaces

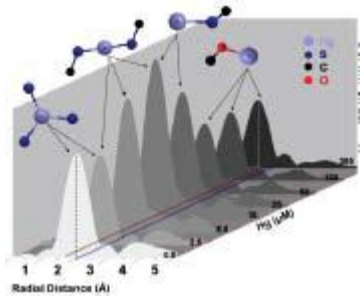


- Successful CD-1 review Sep, 2011 led to CD-1 approval Dec, 2011
- NEXT staff and Beamline Advisory Teams (BATs) in place
- CD-2 review scheduled for Sep 11-13, 2012
- Operations to begin 1QFY17









BROOKHAVEN NATIONAL LABORATORY
BROOKHAVEN SCIENCE ASSOCIATES

NSLS to NSLS-II Beamline Transitions

		FY12	FY13	FY14	FY15	FY16	FY17
Hard X-ray Diffraction	Powder Diffraction	X7B, X10B, X14A, X16C			IXD		
				XPD-1			
	Diffraction - Extreme Cond.	X17B2 / B3 / C					
				XPD-1			
	Rapid Acquisition PDF	X17A					
				XPD-2			
	Microbeam Diffraction	X13B					
				CHX			
	Energy Dispersive	X17B1					
Hard X-ray Scattering	SAXS / WAXS / GISAXS / Liq	X6B, X9, X10A, X22B, X27C			CMS		
							SMI
	Resonant / In-Situ	X20A, X20C, X21, X22C			MPP		
							ISR
	Inelastic				IXS		
	XPCS / CDI				CHX		
Soft X-ray Scattering	Scattering / XMCD	U4B, X1A2, X1B, X13A					
				CSX-2			
	Coherent Scattering			CSX-1			
	Inelastic						SIX
Spectroscopy	Hard X-ray	X3A, X3B, X10C, X11A, X11B, X18A, X18B, X23A2			QAS		
						BMM	
							ISS
	Tender X-ray	X15B, X19A			TES		
						SST-1	
	Soft / UV	U7A, U5UA, U12A, U13B, X1A1, X24A				SST-2	
							ESM
	IR	U2A, U4IR, U12IR			MET / FIS		
Imaging	Hard X-ray Nanoprobe				HXN, SRX		
	Hard X-ray Microprobe	X26A, X27A			XFM		
	Hard X-ray Nano CT	X8C					FXI
	Hard X-ray Micro CT, DEI	X2B, X15A					
	Instrum, Top, Det Char	X19C, X27B			MID		
	Tender X-ray				TES		
						SST-1	
	CDI				CHX		
	Soft / UV Full-field	U5UA				SST-2	
							ESM
	IR Microprobe, Full-field	U2B, U10B			IRI		
Structural Biology	Protein Crystallography	X3A, X4A, X4C, X6A, X12B, X12C, X25, X26C, X29				FMX, AMX	
						NYX	
	Solution Scattering					LIX	
	X-ray Footprinting	X28C					

Key
NSLS
NSLS-II Project
NxtGen
NEXT
TYPE II
ABBIX

- Clear transition path to NSLS-II for almost every NSLS capability & program
- In some cases, there is continuous coverage but for a few there is a gap of one or two years
- Many new capabilities that don't exist at NSLS and will spawn new programs and user communities
- NxtGen beamlines are critical for providing continuity and capacity
- All beamlines at NSLS-II are expected to be in high demand
- Achieving this scenario is sensitive to available funding

DOE Synchrotron Beamlines

Experimental techniques at Light-Source Beamlines
http://science.energy.gov/~/media/bes/pdf/Synchrotron_Techniques.pdf

- Divides techniques into 3 broad categories
- 12 basic techniques

SPECTROSCOPY	SCATTERING	IMAGING
01 Low-Energy spectroscopy	05 Hard X-ray diffraction	09 Hard X-ray Imaging
02 Soft X-ray spectroscopy	06 Macromolecular X'tal	10 Soft X-ray Imaging
03 Hard X-ray spectroscopy	07 Hard X-ray scattering	11 Infrared Imaging
04 Optics/Calibration/Metrology	08 Soft X-ray scattering	12 Lithography

Worked with peers across the complex -

- Compiled list of DOE facility beamlines with techniques available at NSLS or NSLS-II
- Goal – see what is available where through the transition

Techniques at DOE Synchrotrons

- Spectroscopy
- Scattering
- Diffraction

Number	Technique	Contact	Coordinator	FY12	FY14	FY16
01-01	Infrared	Carr	Lisa Miller	4.5	5	4
01-02	Photoemission	Vescovo	Lisa Miller	7.8	7.8	5.3
02-01	Soft X-ray Spectroscopy	Dvorak	Lisa Miller	8.85	8.85	7.6
02-02	Tender XAS	Northrup	Lisa Miller	1.5	2.5	2
03-01	EXAFS	Ravel	Lisa Miller	17.55	18.25	12.25
04-01	Metrology	Kiester	Lisa Miller	9.65	9.95	4.7
05-01	X-Ray Powder Diffraction	Dooryhee	Ron Pindak	14.2	14.2	10
05-02	Extreme Conditions	Ehm	Ron Pindak	7	7.2	5.8
05-03	Energy Dispersive	Zhong	Ron Pindak	0.4	0.4	0.1
05-04	Micro-Beam Diffraction	Evans-Lutterodt	Ron Pindak	3.25	3.4	3.15
06-01	Macromolecular Crystallography	Heroux	Lisa Miller	39	39	34
06-02	X-ray footprinting	Bohon	Lisa Miller	1	1	0
07-01	SAXS/WAXS/GISAXS/Liq Surface	DiMasi	Ron Pindak	14	14	10.5
07-02	Resonant & High Magnetic-Field Scattering	Nelson	Ron Pindak	2.75	2.75	2.75
07-03	General Diffraction	Ludwig	Ron Pindak	9.6	9.6	6.8
07-04	In-Situ Scattering	Ludwig	Ron Pindak	5.7	5.7	4.65
07-05	XPCS	Fluerasu	Ron Pindak	2	2	2.5
07-06	Solution, BioSAXS	Yang	Ron Pindak	2.35	2.35	2.65
07-07	Hard IXS	Cai	Ron Pindak	4.4	4.4	6.7
08-01	Soft X-ray Scattering	Sanchez-Hanke	Ron Pindak	5.75	5.75	6.3
08-02	Pump/Probe	Arena	Ron Pindak	5.65	5.85	5.7
08-03	Soft IXS	Jarrige	Ron Pindak	1.2	1.2	0.7
09-01	HX Microprobe	Lanzirotti	Lisa Miller	7.6	7.8	9.8
09-02	TXM	Lee	Lisa Miller	1.9	2.1	1.1
09-03	Topography	Dudley	Lisa Miller	1	1.25	0.25
09-04	micro-CT	Lee	Lisa Miller	2.75	1.85	1.85
09-05	Coherent Diffraction Imaging	Lima	Lisa Miller	1.975	2.475	2.475
10-01	Soft X-ray Microprobe	Thieme	Lisa Miller	4.5	4.6	4.6
				187.8	191.2	158.2

Note *– Shown with NSLS running through FY14*

Transition of Spectroscopy Programs

	NSLS	Total Users/Yr	Pubs (3yrs)	Ave. Sub. Ratio	NSLS-II FY14	FY15	FY16	FY17
Hard X-ray	X3A, X3B, X10C, X11A, X11B, X18A, X18B, X23A2	282	336	1.51		QAS	BMM	**ISS**
Tender X-ray	X15B, X19A	119	117	2.68		TES		
Soft / UV	U7A, U5UA, U12A, U13B, X1A1*, X24A	106	126	2.22			SST	**ESM**
IR	U2A, U4IR, U12IR	44	56	1.25		MET/FIS		

*new NSLS program

- NxtGen beamlines start in FY15 => this impacts a community of over 500 NSLS users
- The soft x-ray community will see photons in FY16
- The UV photoemission program will come online in FY17

bold: ID beamlines
red: NxtGen beamlines
blue: Type-II beamlines

Beamline Overview
Scattering and Diffraction Program

TECHNIQUES	NSLS (FY12)	NSLS-II (FY17)		
		Project (FY14)	NxtGen (FY15)	NEXT (FY17)
Hard X-ray Diffraction				
Powder Diffraction	X7B, X10B, **X14A**, X16C	XPD-1	IXD	
Diffraction -Extreme Cond	**X17B2,B3, X17C**	XPD-1		
Rapid Acquisition PDF	**X17A**	XPD-2		
Microbeam Diffraction	**X13B**	CHX		
Energy Dispersive	**X17B1**			
Hard X-ray Scattering				
SAXS/WAXS/GISAXS/Liq	**X6B**, **X9**, X10A, X22B, X27C		CMS	SMI
Resonant/In-Situ	X20A, X20C, **X21**, X22C		MPP	ISR
Inelastic		IXS		
XPCS/CDI		CHX		
Soft X-ray Scattering				
Scattering/XMCD	**U4B**, X1A2, X1B, **X13A**	CSX-2		
Coherent Scattering		CSX-1		
Inelastic				SIX
BEAMLINE TOTALS		6	3	3

- Research programs, largely in the physical sciences, currently use the technique capabilities of 23 NSLS scattering & diffraction beamlines.
- NSLS-II will have 12 scattering & diffraction beamlines that, as early as FY15, will provide almost all of these technique capabilities as well as offer exciting new capabilities

Transition of Imaging Programs

	NSLS	Total Users/Yr	Pubs (3yrs)	Ave. Sub. Ratio	NSLS-II FY14	NSLS-II FY15	NSLS-II FY16	NSLS-II FY17
Hard X-ray, nanoprobe					**HXN, SRX**			
Hard X-ray, microprobe	X26A, X27A	99	88	2.00		XFM		
Hard X-ray, nano CT	X8C*							**FXI**
Hard X-ray, micro CT	X2B	12	10	1.53				
Coherent Diffraction Imaging								
Soft / UV, full-field	U5UA	20	22	1.84				**ESM**
Soft / UV, nanoprobe	X1A1**	21	66	1.23				
IR (microprobe, full-field)	U2B, U10B	56	89	1.71		IRI		

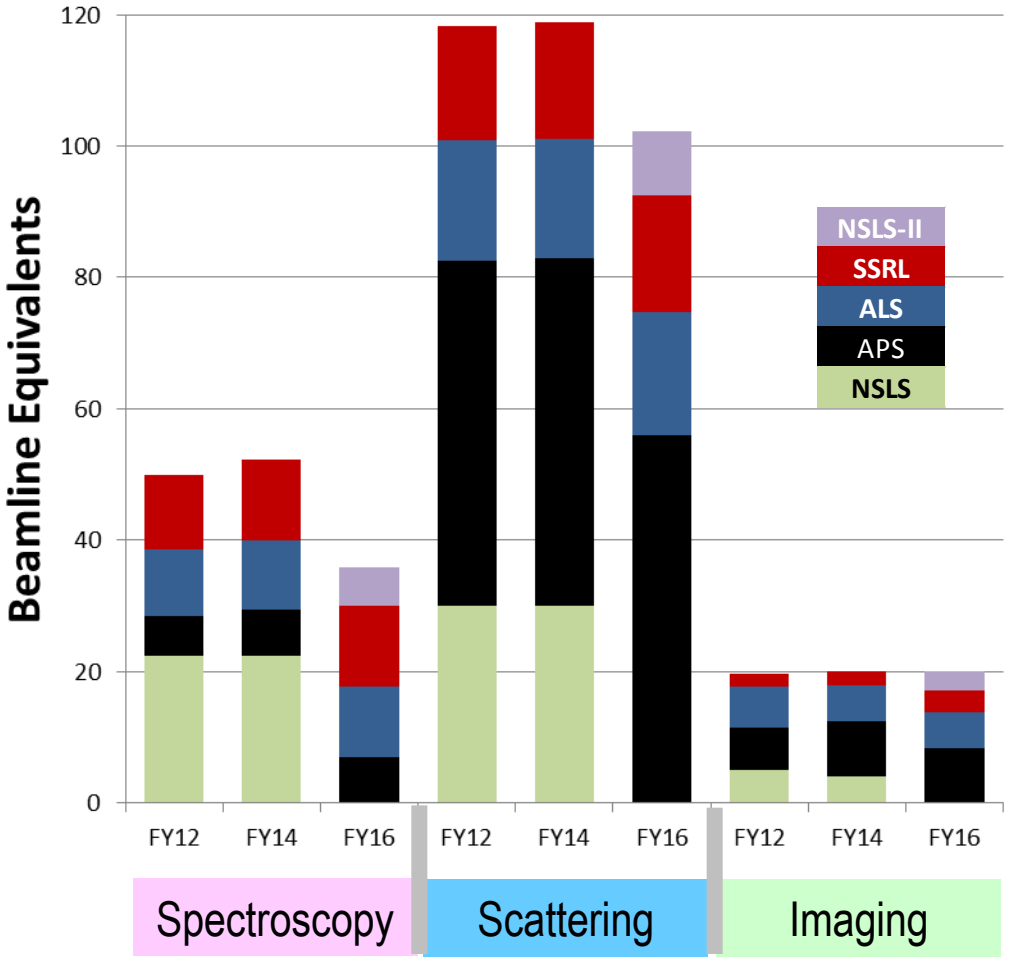
*new NSLS program **discontinued

- High resolution nanoprobes (HXN, SRX) will be available at the start of NSLS-II, quickly followed by the complementary microprobe (XFM).
- Full-field imaging, both hard and soft x-ray, will be available in FY17.
- CDI, STXM, and micro-CT are still missing capabilities in the NSLS-II portfolio (candidates for NEXT-II).

bold = ID beamline
red = NxtGen beamline

BE Distribution – DOE Light Sources

	FY12	FY14	FY16
Spectroscopy	49.9	52.4	35.9
NSLS	22.4	22.4	-
APS	6.1	7.1	7.1
ALS	10.1	10.6	10.6
SSRL	11.3	12.3	12.3
NSLS-II	-	-	5.9
Scattering	118.3	118.8	102.3
NSLS	30.1	30.0	-
APS	52.6	52.9	56.1
ALS	18.2	18.2	18.7
SSRL	17.5	17.8	17.8
NSLS-II	-	-	9.8
Imaging	19.7	20.1	20.1
NSLS	5.0	4.0	-
APS	6.5	8.4	8.4
ALS	6.2	5.5	5.5
SSRL	2.1	2.2	3.2
NSLS-II	-	-	3.0



- All NSLS beamlines will go off-line by the end of FY14
- 17 NSLS-II beamlines are on-line at beginning of FY15 (Project + NxtGen)

Number	Technique	FY12	FY14	FY16	FY14 LS	LS/DOE	FY12	FY14	FY16
01-01	Infrared	4.5	5	4	3	60%	4.5	2	4
01-02	Photoemission	7.8	7.8	5.3	2.5	32%	7.8	5.3	5.3
02-01	Soft X-ray Spectroscopy	8.85	8.85	7.6	2.15	24%	8.85	6.7	7.6
02-02	Tender XAS	1.5	2.5	2	1.5	60%	1.5	1	2
03-01	EXAFS	17.55	18.25	12.25	7	38%	17.55	11.25	12.25
04-01	Metrology	9.65	9.95	4.7	6.25	63%	9.65	3.7	4.7
05-01	X-Ray Powder Diffraction	14.2	14.2	10	5.2	37%	14.2	9	10
05-02	Extreme Conditions	7	7.2	5.8	1.7	24%	7	5.5	5.8
05-03	Energy Dispersive	0.4	0.4	0.1	0.3	75%	0.4	0.1	0.1
05-04	Micro-Beam Diffraction	3.25	3.4	3.15	0.25	7%	3.25	3.15	3.15
06-01	Macromolecular Crystallography	39	39	34	8	21%	39	31	34
06-02	X-ray footprinting	1	1	0	1	100%	1	0	0
07-01	SAXS/WAXS/GISAXS/Liq Surface	14	14	10.5	5	36%	14	9	10.5
07-02	Resonant & High Magnetic-Field Scattering	2.75	2.75	2.75	0.8	29%	2.75	1.95	2.75
07-03	General Diffraction	9.6	9.6	6.8	2.9	30%	9.6	6.7	6.8
07-04	In-Situ Scattering	5.7	5.7	4.65	2.5	44%	5.7	3.2	4.65
07-05	XPCS	2	2	2.5	0		2	2	2.5
07-06	Solution, BioSAXS	2.35	2.35	2.65	0.2	9%	2.35	2.15	2.65
07-07	Hard IXS	4.4	4.4	6.7	0		4.4	4.4	6.7
08-01	Soft X-ray Scattering	5.75	5.75	6.3	1.45	25%	5.75	4.3	6.3
08-02	Pump/Probe	5.65	5.85	5.7	0.15	3%	5.65	5.7	5.7
08-03	Soft IXS	1.2	1.2	0.7	0.5	42%	1.2	0.7	0.7
09-01	HX Microprobe	7.6	7.8	9.8	2	26%	7.6	5.8	9.8
09-02	TXM	1.9	2.1	1.1	1	48%	1.9	1.1	1.1
09-03	Topography	1	1.25	0.25	1	80%	1	0.25	0.25
09-04	micro-CT	2.75	1.85	1.85	0		2.75	1.85	1.85
09-05	Coherent Diffraction Imaging	1.975	2.475	2.475	0		1.975	2.475	2.475
10-01	Soft X-ray Microprobe	4.5	4.6	4.6	0		4.5	4.6	4.6
		187.8	191.2	158.2	**56.35**	**29%**	187.8	134.9	158.2
		Beamline Equivalents, DOE			**NSLS**		**Beamline Equivalents, DOE**		
		Assumes NSLS runs through 14					**If** NSLS Ops stops End of FY13		

Limiting Scenarios

NSLS User Transition Planning Forum

Lots of Planning through the transition period – What about you and your science?

What do you need to know to answer the question:

What will you do to maintain and grow your research through this period of diminished capacity and capability?

Thanks –

- Committee and UEC
  - Especially Jen & Tony
- Banda, Denny & Piero
- Ron Pindak, Lisa Miller
- PS colleagues for their work (and slides!)