

J.P. Hill, Director, NSLS-II UEC Town Hall, March 1st 2017







Outline

Accelerator Performance

- Outstanding reliability
- Increasing current

User Program

- Growing rapidly, driven by beamline construction
- Emphasis on new users.
- Data and computing

• Early Science

- High spatial resolution
- High coherence
- Next steps
 - Developing designs for next 6 beamlines
- Summary





National context for NSLS-II





NSLS-II Accelerator Update

- Accelerator is performing well, delivering 275 mA top-off in routine operations
- FY17-to-date reliability performance = 96.4%
- Operations plan in 2017 is to reach 300 mA top-off with > 95% reliability:
 - 2/16/17: 250 mA → 275 mA
 - 4/17: 275 mA → 300 mA





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Accelerator Performance



FY17 Goals: Reliability > 95%, Operating current 300 mA.



BEAMLINE CONSTRUCTION





Beamlines Operations Update

<u>General User Operations</u> CSX-1, CSX-2, XPD, HXN, SRX, IXS, CHX, LIX, AMX, FMX, ISS

Science Commissioning XFP, TES, CMS

Technical Commissioning ESM, ISR, SMI, NYX, SIX

<u>Completion in FY17</u> BMM, SST-1, SST-2, QAS, XFM

Completion in FY18

PDF, FXI, FIS, MET

19 beamlines in operations or commissioning



GISAXS pattern from 2D ordered monolayer of nanoparticles selfassembled at a liquid-air interface [*I. Herman group, Columbia U.*]

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SIX KPP achieved, February 25, 2017



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NSLS-II IRR Schedule - 2017

- October 18: SMI (12-ID) Photon Delivery System (PDS)- Complete
- October 18: SIX (2-ID) Frontend and Insertion Device Complete
- November 3: SMI PPS/EPS verification of completion Complete
- November 8 9: NYX (19-ID) FE/ID and PDS Complete
- November 8 9: SIX PDS (preliminary review) Complete
- January 18, 2017: SIX PDS (Complete Follow-up required)
- February 15, 2017: SIX PDS Follow-up Review Complete
- June 2017: BMM (6-BM) FE/ID and PDS
- August 2017: XFM (4-BM) FE/ID and PDS
- August 2017: QAS (7-BM) FE/ID and PDS
- September 2017: FXI (18-ID) FE/ID and PDS
- October 2017: SST 1 and 2 (7-ID-1, 7-ID-2) FE/ID and PDS
- May 2018: PDF (28-ID-1) FE/ID and PDS



NSLS-II Beamline Buildout Update

Port: Instrument	FY	2014			2015			2016			2017			2018			2019			2020			2021			2022		
	Cycle	13-3	14-1	14-2	14-3	15-1	15-2	15-3	16-1	16-2	16-3	17-1	17-2	17-3	18-1	18-2	18-3	19-1	19-2	19-3	20-1	20-2	20-3	21-1	21-2	21-3	22-1	22-2
23-ID-1: Coherent Soft X-ray Scattering					•																							
23-ID-2:Coherent Soft X-ray Spectroscopy					•																							
10-ID: Inelastic X-ray Scattering					•																							
11-ID: Coherent Hard X-ray Scattering					•																							
28-ID-2: X-ray Powder Diffraction					•																							
3-ID: Hard X-ray Nanoprobe					•																							
5-ID: Sub-micron Res X-ray Spec					•																							
16-ID: X-ray Scattering for Biology								•																				
8-ID: Inner Shell Spectroscopy									•																			
17-ID-1: Frontier Macromolecular Crystallogrpahy									•																			
17-ID-2: Flexible Access Macromolecular Crystallogr.									•																			
21-ID: Photoemission-Microscopy Facility										•																		
11-BM: Complex Materials Scattering										•																		
4-ID: In-Situ & Resonant X-Ray Studies										•																		
8-BM: Tender X-ray Absorption Spectroscopy										•																		
17-BM: X-ray Footprinting										•																		
12-ID: Soft Matter Interfaces											•																	
19-ID: Microdiffraction Beamline											•																	
2-ID: Soft Inelastic X-ray Scattering												•																
6-BM: Beamline for Materials Measurements													•															
7-BM: Quick X-ray Absorption and Scattering													•															
4-BM: X-ray Fluorescence Microscopy													•															
7-ID-1: Spectroscopy Soft and Tender 1														•														
7-ID-2: Spectroscopy Soft and Tender 2														•														
28-ID-1: Pair Distribution Function Diffraction														•														
18-ID: Full-field X-ray Imaging														•														
22-BM-1: Frontier Synchrotron Infrared Spectroscopy																•												
22-BM-2: Magneto, Ellipsometry & Time-resolved IR																•												
Development		28	28	28	21	21	21	15	17	12	10	9	6	2	2													
First light - In Service		-	-	-	7			1	3	5	2	1	3	4		2												
Technical Commissioning						7	3		1	3	4	2	2	3	4													
Science Commissioning							4	3	2	2	4	4	1	2	5	4	4											
General User Operation								4	5	6	8	12	16	17	17	22	24	28	28	28	28	28	28	28	28	28	28	28

Includes only committed work as of 6-Feb-17; Several additional projects are in development



Partner Beamlines in Service

USER PROGRAM





Beam Time Proposals



BTR: Beam Time Request (against existing proposal) GU = General User SC = Science Commissioning BAGs = Block Allocation Groups

U.S. DEPARTMENT OF

ENERGY

Office of

Science

2016-1: Jan-Apr 2016 2016-2: May-Aug 2016 2016-3: Sept-Dec 2016 2017-1: Jan-Apr 2017 2017-2: May-Aug 2017



Subscription Rates



■ 2016-2 ■ 2016-3 ■ 2017-1

proposals submitted / proposals allocated

2016-2: May-Aug 2016 2016-3: Sept-Dec 2016 2017-1: Jan-Apr 2017

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NSLS-II Facility Users by FY (as of February 13, 2017)



SCIENCE HIGHLIGHTS





NSLS-II: Brightest MX beamlines



U.S. DEPARTMENT OF Office of Science

The old brightness problem







The new brightness problem







NSLS-II can change the way structural biology is done



~ 5ms before radiation damage destroys sample = 4 frames





FMX Scientific Commissioning

- Developing raster data collection
- Serial microcrystallography of 1-5 µm size Thaumatin crystals
- "real samples" now being studied.







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Hard X-ray Nanoprobe

Award Winning MLL design

Smallest spot in working x-ray microscope in the world (13 nm x 13 nm)!





E. Nazaretski, Y. S. Chu, et al.





Highest resolution 3D XRF image ever taken. Showing Er tag on surface of E-coli



20 nm voxel, 0.1 sec/pixel dwell

K. Allen (Boston Univ), B. Imperiali (MIT), L. Miller (BNL), whole HXN Team

> National Synchrotron Light Source II



Revealing Dynamics of Polymer Gels

Coherent x-ray scattering studies of dynamics in transient networks of associative polymers which are used in applications such as artificial skin and self-healing gels



- Challenging expt: low signal as samples are *real* and not *dressed* w/ nanoparticles
- Unprecedented coherent flux at CHX produced high quality dynamical information on smaller length scales (q~0.03 Å⁻¹) and shorter time scales (~10 ms) than ever possible before with similar polymer samples

Olsen and Dursch (MIT) with CHX group, unpublished



Budget

- FY17 remains uncertain. CR through April 28th.
- We are currently executing a plan that assumes a full year CR at FY16 levels (\$110 M) and leaves \$14 M carryforward in to FY18.
- No guidance for FY18 yet.
- Demands on DOE-BES budget are high
 - SUF operations
 - Construction: LCLS-II, APS-U, ALS-U, LCLS-II-HE, SNS STS, SNS PU....
 - Core programs research
- Triennial review of NSLS-II June 20-21st



Next steps

Priority is to

- 1) Operate existing beamlines. Grow user program
- 2) Maintain reliable accelerator operations. Reach design performance
- 3) Develop new beamlines:
 - FY15 User community-driven proposal process
 - FY16 Selection of 6 beamlines. Task force developed approximate cost and schedule
 - FY17 Advance designs to appropriate level to seek additional funding. Push development of highest priority beamline, dependent on operating budgets





New Beamlines

1) Hard x-ray imaging

World-leading lensless imaging down to 5nm

2) Soft x-ray imaging-1

Chemical and electronic structure down to 5 nm resolution

3) Soft x-ray imaging-2

State-of-the-art transmission x-ray microscope

4) Chemical reactions

Time-resolved snapshots of chemical reactions in-operando

5) Polymer processing and liquids

Liquid interfaces and thin film processing studied in-situ

6) Infra-red spectroscopic imaging

Nano-IR spectroscopy on heterogeneous solid state systems





These beamlines will provide world-leading capabilities that will significantly enhance NSLS-II. We are working with BES and others to seek additional funds to develop and operate them.



Summary

- Accelerator is performing very well. We will continue to increase the current, consistent with maintaining reliability
- Beamline construction has been very rapid. 19 beamlines currently taking light. 9 more on the way
- User program is growing rapidly, strong demand for beamtime
- Early science is exciting! Publications following
- Next steps
 - Continue strong focus on user program growth
 - Continue to push accelerator performance
 - Work with BES and others to develop funding for additional beamlines



