NSLS-II Update

J.P. Hill, Director, NSLS-II

SAC meeting September 19th 2017

Outline

- **Safety Update**
- **Accelerator Performance**
  - Outstanding reliability
  - Increasing current
- **User Program**
  - Growing rapidly, driven by beamline construction
- **Early Science**
  - High spatial resolution
  - High energy resolution
- **Next steps**
  - Budgets and FY18 goals
- **Charge Questions**
- **Summary**

NSLS-II Safety Statistics

- FY17 Hours Worked: 629,294 hours (As of 8/31/17)
- FY17 Recordable Cases: 5 Rate: 1.59
- FY17 Days Away Restricted or Transferred Cases: 2 Rate: 0.64
- FY17 First Aid Cases: 3
- Last Recordable/DART Injury: 7.14.2017/5.15.2017

Trend

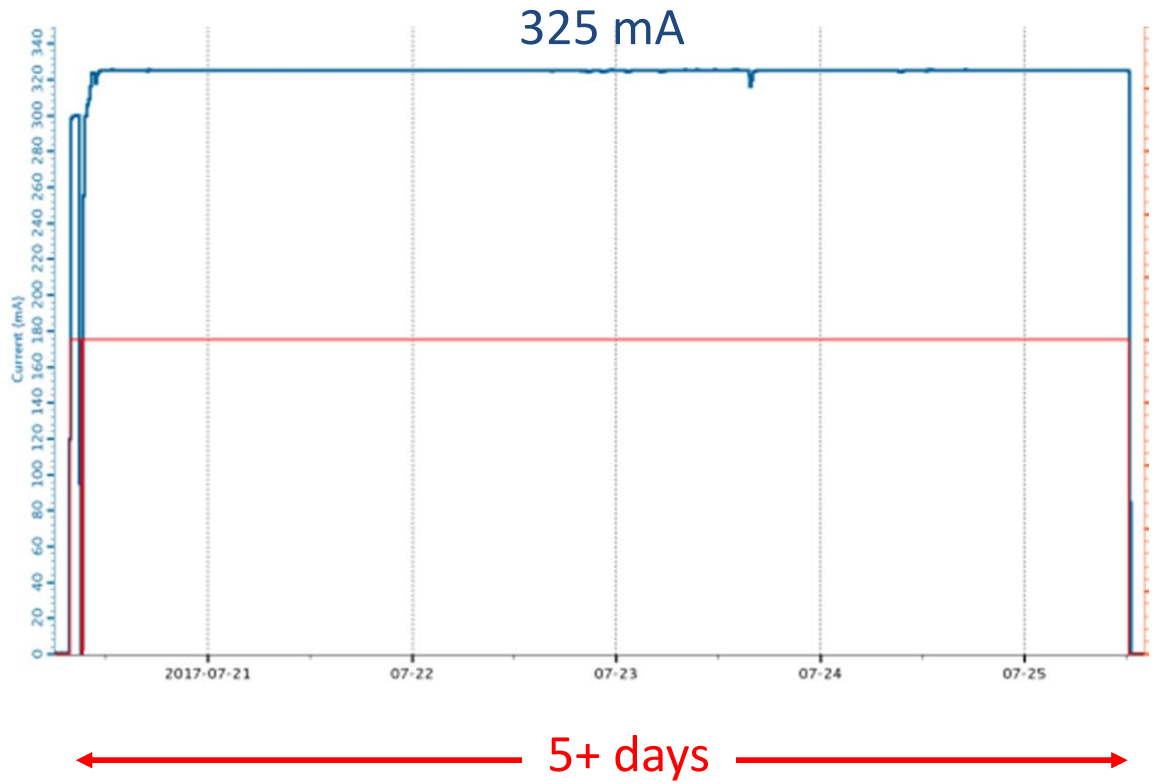
- FY16 : 3 (0 Reportable, 3 non-R injuries)
- FY17: 9 (8 Reportable, 1 non-R injury)

Worrying increase in injuries and events:

- Most common injuries this year are over-exertion.
- All injuries are investigated and communicated with staff
- ESH engaging with groups to discuss injuries to identify possible causes
- Staff distractions due to work load and budget uncertainties are possible contributing causes
- Actions taken: increased messaging against distraction: All-hands, newsletters, group meetings

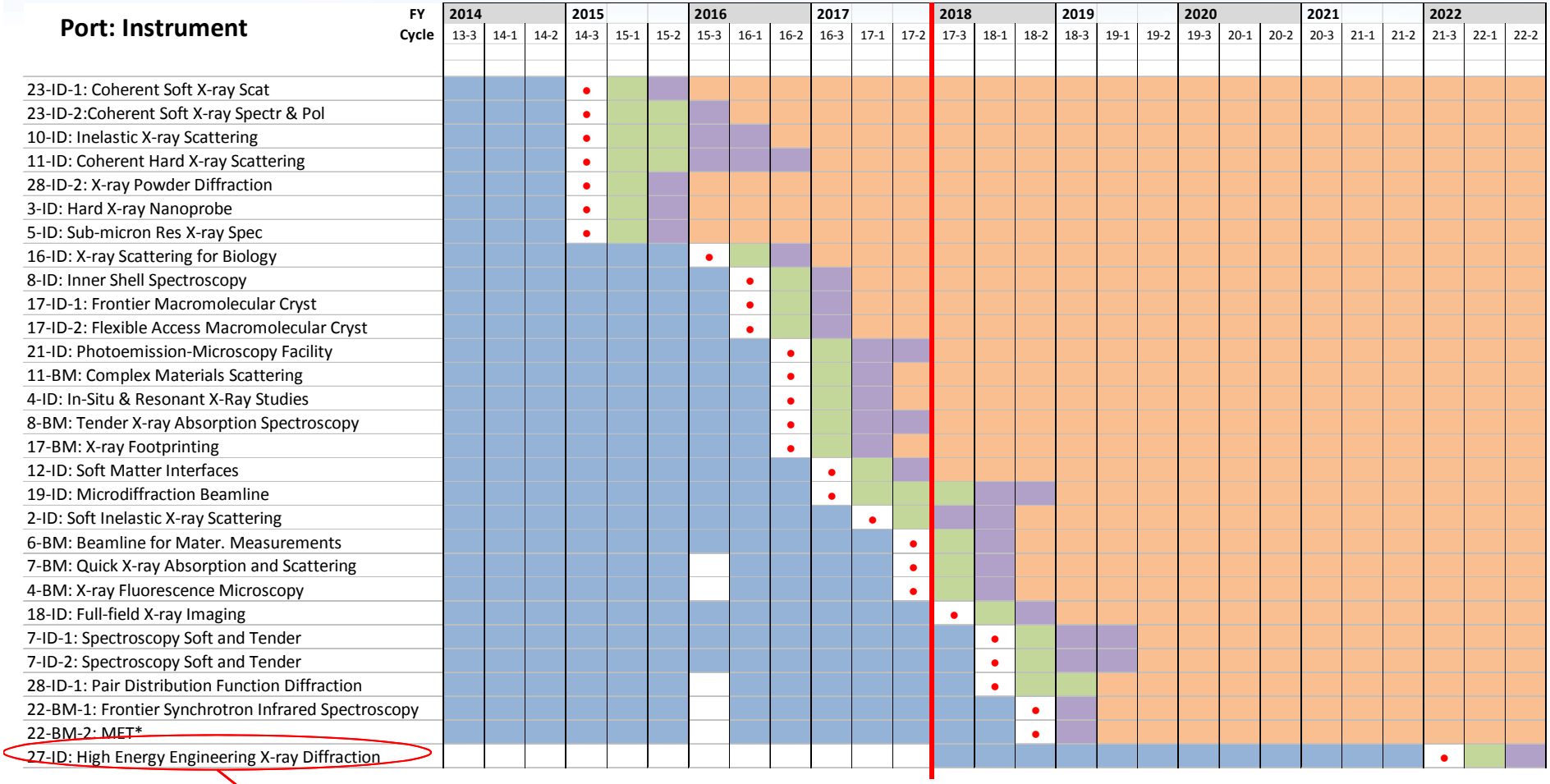
Accelerator Update

- Accelerator is performing well, delivering 325 mA top-off in routine operations
- FY17-to-date reliability performance = 96.7 %
- Plan is to increase to 350 mA on September 28th .
- FY18 Goal is > 95% reliability and 400 mA
- 3rd RF cavity system purchase underway (reliability and current)



(See Timur's talk)

Beamline Buildout Update



- $3M for HEX has arrived. HEX is formally underway

Beamline Operations Update

General User Operations

CSX-1, CSX-2, XPD, HXN, SRX, IXS, CHX, LIX, AMX, FMX, ISS, XFP, CMS, ISR

Science Commissioning

TES, SMI, ESM

Technical Commissioning

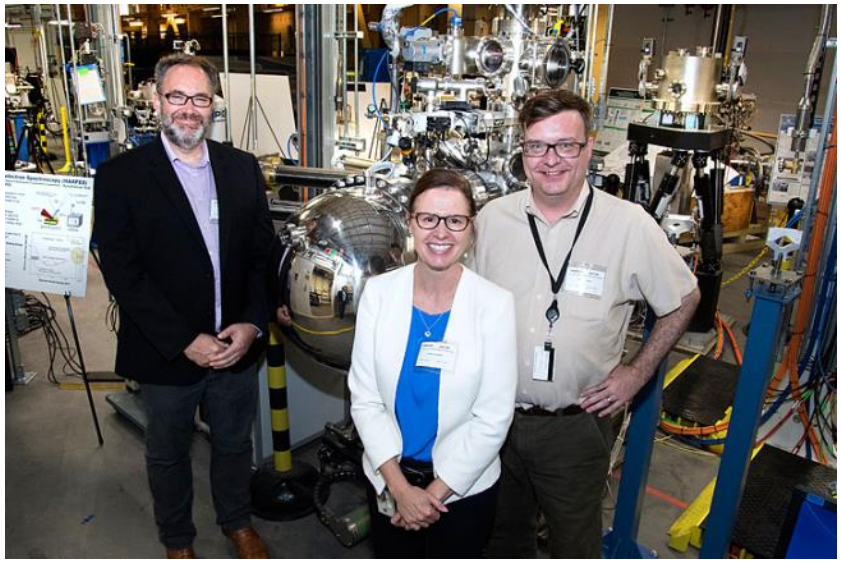
BMM, NYX, SIX, *QAS, XFM*

Completion* in FY18

FXI, PDF, FIS, MET, SST-1, SST-2

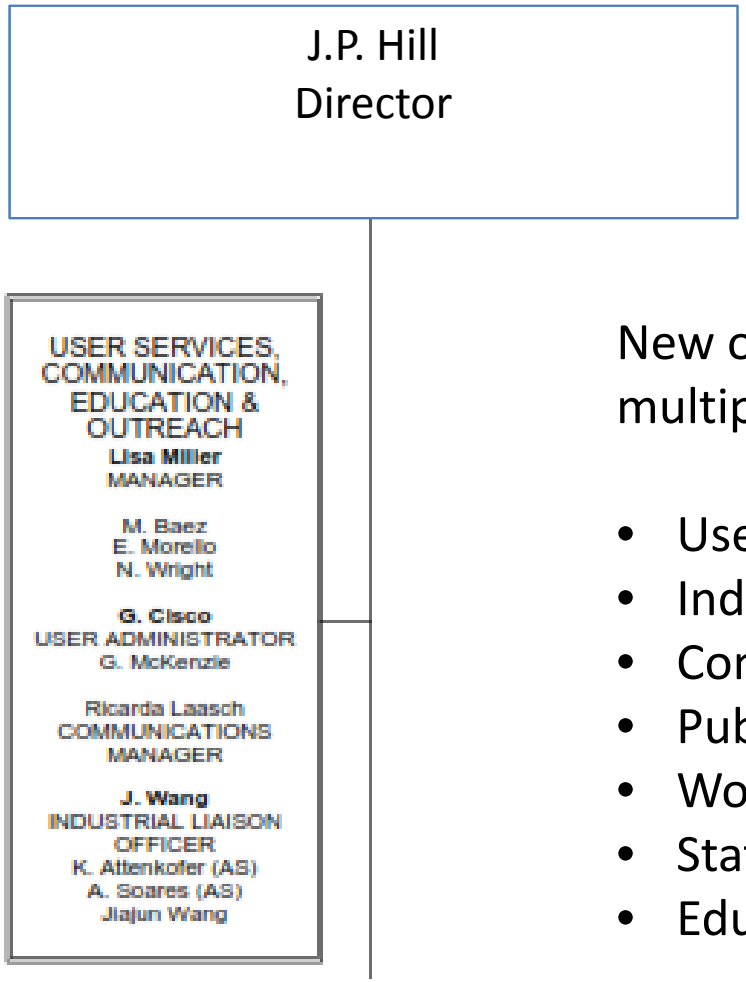
22 beamlines operating/commissioning
– 14 beamlines in GU ops, 3 in SC
28 beamlines operating by end FY18

* Completion defined as having completed IRR
Green: BES funded beamline



Visit to NSLS-II by Laurie Locascio, Director, Materials Measurements Laboratory at NIST, Aug 24 , 2017

User Services, Communications, Education and Outreach (USCEO) Office

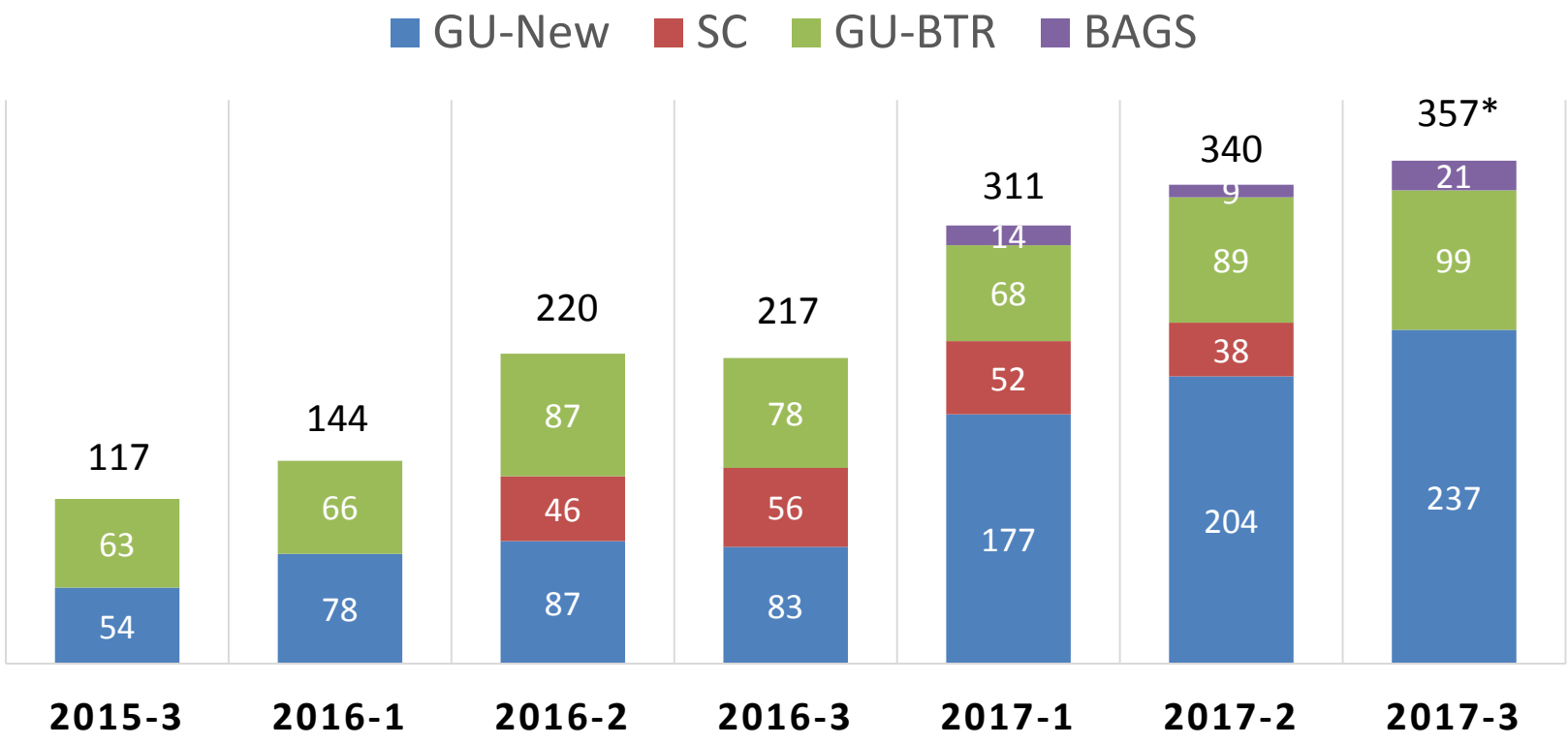


New office led by Lisa Miller draws multiple functions into a single office:

- User Administration
- Industrial program
- Communications
- Publications
- Workshops and meetings
- Statistics and reporting
- Education and Outreach

(see Lisa's talk)

Beam Time Proposals



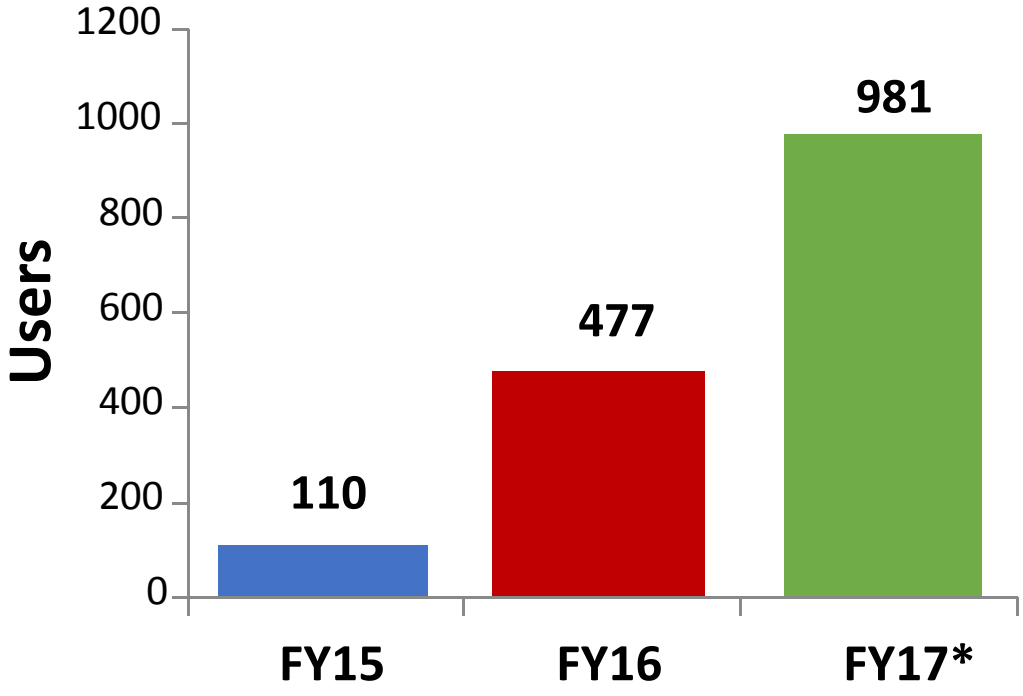
BTR: Beam Time Request (against existing proposal)
GU = General User
SC = Science Commissioning
BAGs = Block Allocation Groups

(See Lisa's talk)

** rapid access not yet included*

Facility Users by Fiscal Year

*(*as of September 11, 2017)*



FY16:

- unique users: **477**
- 80% were first-time users

FY17*

- unique users: **981**
- 69% were first-time users

Publications using NSLS-II photons:

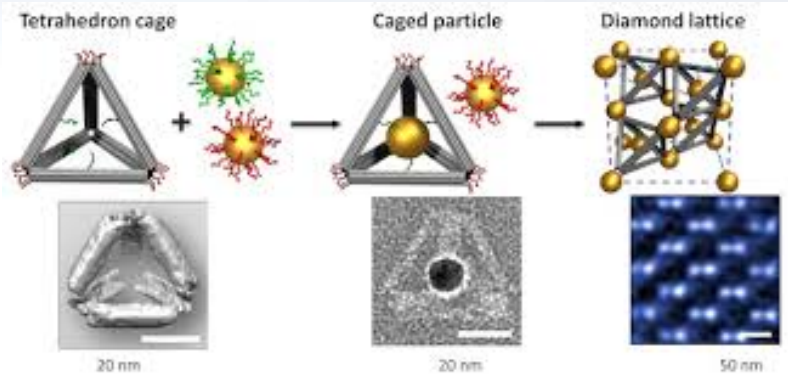
- 81 pubs
- 15 DOE high impact
- 49 included staff

(See Lisa's talk)

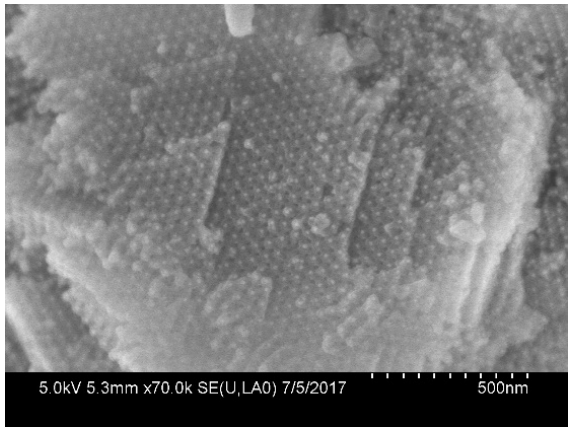
Sub-10 nm Imaging

Oleg Gang *et al.* at CFN have perfected DNA driven self assembly of Au nanoparticles in crystalline arrays

These have many potential applications in functional devices

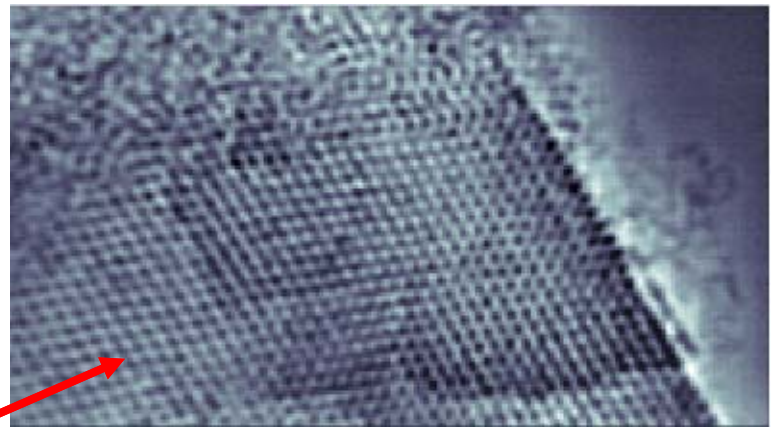


At NSLS-II we have the intensity and resolution to characterize these arrays with x-rays:



Electrons - TEM

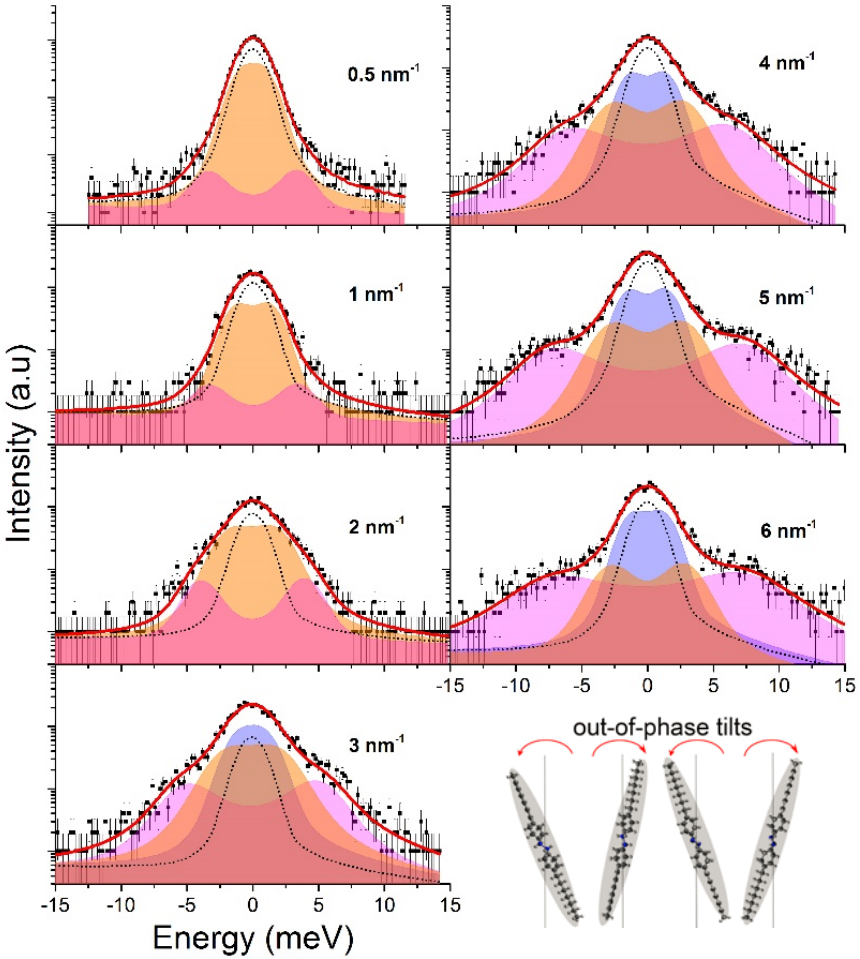
15 nm NP



X-rays - HXN

Fluctuations in Liquid Crystals

Liquid crystal D7AOB in Smectic A Phase



D. Bolmatov, et al. , Nano Letters 17, 3870−3876 (2017).

Scientific Achievement

Using inelastic x-ray scattering three distinct modes were detected moving through the layers of the Smectic A liquid crystal phase.

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.

Next steps: FY18 Goals

1) Operate the accelerator and deliver 4750 hours for user operations at > 95% reliability. Achieve 400 mA. Continue 3rd RF cavity.
2) Grow user program and carry out impactful science demonstrating capabilities of NSLS-II
3) Continue beamline development. Specifically
   a. Complete FXI, PDF, FIS, MET, SST-1 and SST-2
   b. Continue the HEX beamline in partnership with NYS
   c. Continue development of the CDI beamline and ARI R&D
   d. To the extent possible advance designs of one or more of SMF, INF, QIX, PLS to appropriate level to seek additional funding.
4) Improve Diversity and Inclusion at NSLS-II. Improve safety performance

NSLS-II is developing a world-leading Bragg CDI beamline from operations funds

Science Case:

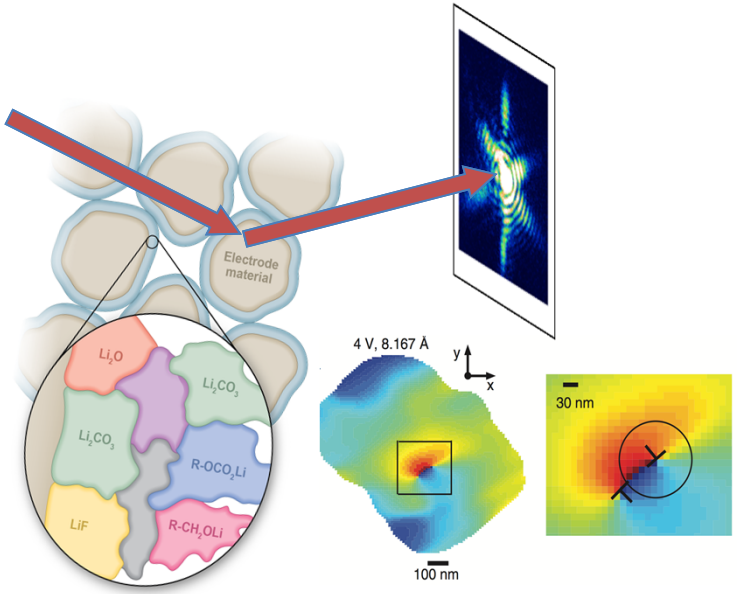
- Imaging defects, dislocations, and strain in single grains of heterogeneous materials
- Capable of imaging in-situ/operando under realistic conditions (e.g. charge & discharge)

Technical Scope:

- High coherent flux in 6 – 15 keV, with µm sized beam and ptychography capability

Immediate scope of work

- Given science case, determine the technical case for a remote endstation
- Develop cost, scope and schedule to "CD-2" level



Science Example: imaging Li battery electrode to see how it changes following Li insertion and de-insertion

Lead Beamline Scientist hired (Garth Williams)

Budget

- FY17 came in: $111.8 M (+1.6% on FY16)
- Director's budget review May 2017
  - Validated FY18 $118.2 M, with recommendation to increase future investment fraction
- DOE triennial review June 2017
  - Facility benchmarking occurring now
- FY18 budget remains uncertain:
  - President's budget $102.9 M (-9.2%)
  - House, Senate: $111.8 M
  - CR through December 2017. Awaiting DOE guidance.

FY 18 budget: Flat funding scenario

	FY18
New Funds	111.8
Unobligated carryover from previous FY	16.6
Total	**128.4**
Accelerator Operations	35.0
Experimental Operations	46.1
BL Development	4.5
Facilities	17.9
ESH	5.2
Unobligated carryforward into next FY (ops)	14.0
Special projects	5.7
3rd RF cavity	3.8
New projects	1.3
3 FTE postdocs, 10 students@$20k	0.6
Total	**128.4**

This budget accomplishes our FY18 goals for operations, but has limited investment and beamline development is tightly constrained

New Partnerships and Funding Opportunities

We are exploring a number of new partnerships. Each in the early stages:

1. Yale – plant biology, Chemistry, CS, Geophysics and cryoEM
2. CSHL – bio imaging, novel nanoarchitectures
3. EMSL – aerosols, “micro-bio”, chemical/biostructure imaging
4. IBM – materials research needs for next generation computing, e.g strain fields in FETs
5. DTRA/Edgewood Chemical Biological Center – chemical and bio protection

Potential new funding opportunities:

1. DOE-BES: Possible for multiple beamlines, eg. SMF, ARI and QIX
2. NSF: Expecting call for mid-scale instrumentation ARI and INF. Would partner with local universities. Also MRI call for STXM
3. DOE-NE, NNSA: Possible sponsors for MRE. Would partner with INL
4. Advanced Manufacturing Initiative: PLS. Would partner with NIST
5. BER/NIH: Potential for FED and/or imaging beamlines
6. Moore Foundation: Preliminary conversations

CryoEM @ NSLS-II

Project Director: **Sean McSweeney**, Project Manager: Erik Johnson

- $15 M from New York State to purchase 2 microscopes and shell of building.
- BNL support for lab fit out.
- Goal: Operations begin end of CY2018. Funded with partner model and subscriptions
- Proposal submitted to NIH for 3 additional microscopes and operations costs

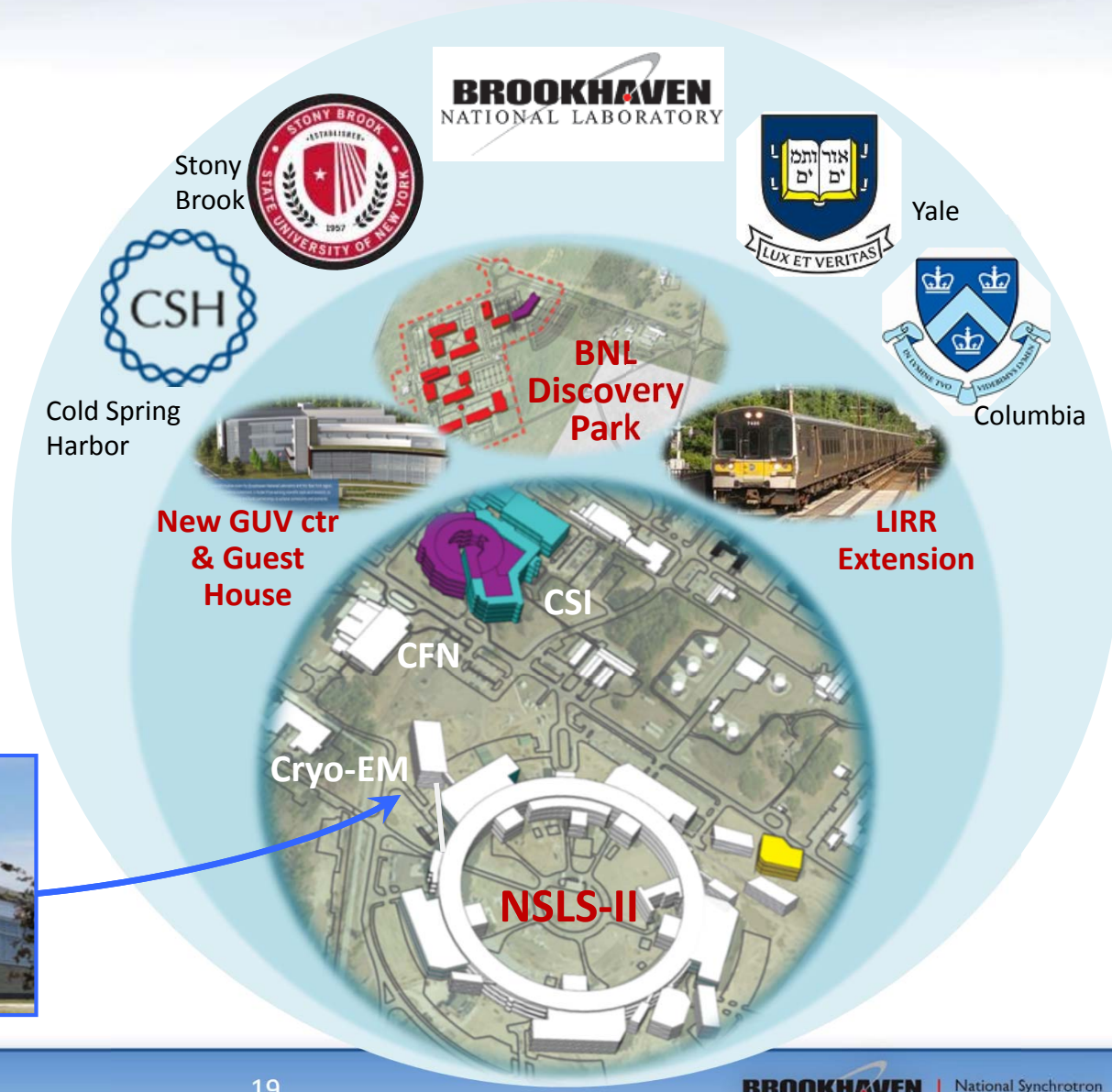
CryoEM @ NSLS-II

Sample prep labs and screening microscopes in 745

Space for 4 Krios microscopes in 748

Vision: NSLS-II in 2027

- Thriving R&D enterprise with NSLS-II at its center
  - Institutes nucleate around NSLS-II and remote endstations
  - Discovery Park with new GUV center and guest house. Government-private partnership drives innovation and start-ups
  - LIRR increases connectivity
  - Strong partnerships with BNL-SBU-CSHL alliance, with Yale and Columbia, …



Issues raised by SAC following March 2017 meeting

1) Description and valuation of in-house scientific research (Zschack)
2) Beam stability issues (Shaftan)
3) CSX interference issues (Wilkins)
4) Beamline value engineering update (not discussed here)
5) Opportunities for additional partnerships and for funding (Hill)
6) Life sciences strategy (Hill)

September 2017 Charge Questions

Accelerator

1) Is the accelerator studies program appropriate to deliver design performance?
2) Are the appropriate steps being taken to mitigate the issues at high currents?
3) Is appropriate attention being paid to possible upgrades?

Operations and beamline development

1) Is the in-house science program appropriately sized and valued?
2) Does the controls program have the right priorities?
3) Does the SAC have advice on how to proceed at CSX?
4) Are the plans outlined to further develop beamlines appropriate?

User program

1) Is the user program making appropriate progress?
2) Is the proposal for the triennial review of the beamlines reasonable?
3) Are the beamlines reviewed this time on track?

Summary

- Accelerator continues to perform very well. On track to reach 400 mA in FY18.
- Beamline construction has been very rapid. 20 beamlines currently taking light. 9 more on the way (8 next year)
- User program is growing rapidly, strong demand for beamtime
- Early science is exciting! Publications following
- Next steps
  - Continue strong focus on user experience
  - Continued focus on accelerator reliability
  - Limited beamline development
  - Work with BES and others to develop funding for additional beamlines
- Big issues – Funding for operations and for future beamline construction