SAC Close-Out Presentation

NSLS-II: September 21, 2018

Opening Remarks

- SAC is impressed by the many achievements during the last 6 months
- SAC congratulates Staff and Management on the smooth running of the facility and the increase in users and publications
- Impressive rapid recovery from two major failures involved many staff

Accelerator

Accelerator (general)

- The SAC congratulates the Accelerator Division for continuing to achieve highly reliable high quality operation of the NSLS-II accelerator and for setting goals for better performance going forward. The machine operates with 400 mA now and is scheduled for 500-mA operation in FY20.
- The accelerator team's dedication in responding to machine problems (e.g. HXN IVU, booster dipole supply, etc.) and the approach for analyzing and mitigating them is commendable.
- The team faces 4 main challenges for securing highly reliable operations: system immaturity, threat of insufficient staff, insufficient spares, insufficient RF redundancy. Subsystems of concern include the SC RF and cryoplant system, pulsed magnets and pulsers, linac klystrons and the DI water system. The team has launched programs to address each of these challenges and concerns. In particular a strategic assessment of vulnerabilities has been carried out and an estimated 25 M$ would be needed to fully address them. This includes eventual procurement of costly redundant systems: 4th RF, booster and ring dipole power supplies and electron gun.

Accelerator (general) – cont.

- Regarding the reduction in staffing, the Accelerator Division is endeavoring to cross-train support staff, assign controls tasks to accelerator physicists and ensure that essential skills are retained. The SAC approves of the effort to engage support staff from other BNL Directorates where appropriate (e.g. cryogenic and DI utility support from RHIC) which can improve the overall efficiency of staffing at BNL.
- There are many computer control tasks that could be of interest to accelerator physicists, including those already ongoing: diagnostics and related data analysis, feedback systems, beam-based optimization algorithms, etc. So much the better if accelerator physicists learn how to provide general control system support in the process. Machine learning is an emerging area of interest at some other accelerator labs: this technology might be employed to improve accelerator performance for the NSLS-II.
- Studies of operating with <10 pm vertical emittance are ongoing. More users are becoming interested in this mode in spite of the reduction in lifetime. A 3rd harmonic bunch lengthening cavity will improve lifetime in the future.

Accelerator (general) – cont.

- 45 accelerator development projects over the next 3 years. These include a 3rd harmonic cavity, improved BPM processors and ideas for a future lattice conversion. A novel concept using superconducting "complex bend" modules is being studied and funding for a low-energy test of this concept at the ATF has been funded. These development projects are exciting and important for engaging and maintaining a high level of accelerator skills at the NSLS-II and motivating the staff.

Accelerator charge questions

1. Are we on the right track in regard to the heating issues seen at high stored current, in terms of diagnosing the causes and mitigating the effects in order to be ready for 500 mA operations in FY20?

   - Several components experiencing over-heating due to high beam current have been identified and have been upgraded to mitigate the problem. Still, it seems that the ring remains vulnerable to these problems. A technical review of the 500-mA program held in July addressed several issues besides heating, including collective effects issues. The reviewers urged caution in immediately proceeding with the 3rd harmonic bunch lengthening cavity, which promises to mitigate heating and lifetime issues at 500 mA, until more studies are done.
   - **Recommendation:** Make a decision on pursuing the 3rd harmonic cavity implementation and decide whether to do so before going to 500-mA operations.

Accelerator charge questions – cont.

2. Do we have a good handle on the causes of operations downtime and do we have an appropriate program to address the issues?

- The Accelerator Division is doing an excellent job of tracking and analyzing the causes of accelerator downtime. A 25-M$ reliability program for addressing issues, including procuring system spares (<5 M$) and costly redundant components has been proposed. There could be some concern about obtaining spares for the Russian-built booster. It is not clear to the SAC is the elements of the reliability program have been prioritized or placed on a resource-loaded schedule.
- **Recommendation:** Develop a prioritized resource loaded schedule for the reliability program, including the 3rd harmonic cavity. Prioritize accelerator items with respect to requests from other divisions

Beamline Controls

Beamline controls

- Is the controls program on a path to success?
  - Visible progress in some areas: PoC definitions, town-hall meetings, prioritization meetings
  - Variable commitment levels by PoC; calling for some management training and continued attention from the Control Group head
  - PoC flow chart provides good guidelines but does not show that it is PoC's job to follow projects to completion
  - TRAC system is becoming better used but needs further clearing up of mixed usage (avoid "to-do list" usage)
  - Outsourcing to Central IT is commended, and regarded as positive by BL and Controls teams

Beamline controls

- Has there been an improvement in the execution of the responsibilities of the Controls Program in the last six months?
  - Addressing urgent issues seems to work much better now
  - Non-urgent fixes, even if small tasks, still take too much time
  - Frustration continues in many areas, but too early to see an impact
- Are the extant issues (technical and organizational) understood?
  - Improved understanding of the problems and willingness to address; prioritized effort by controls program together with people from other parts of the organization, this is highly commended

Beamline controls

- Is there a clear plan to address these issues going forward?
  - Action plan to address specific recommendations by SAC and CS review – plan needs to be focused and prioritized
  - No overall assessment of the actual work that needs to be done for beamlines has been presented yet, and is probably difficult to produce before organizational improvements start to bear fruit
- Is that plan executable on a reasonable timeframe with the current resources?
  - SAC can not assess this based on the information provided

Controls - recommendations

- Retention and filling open position need focused and coordinated efforts; help needed from HR, BL programs, NSLS-II management in mission critical areas
- Slow hiring procedures need to be addressed for competitive hiring
- Lay out clear pathways to prioritize work in the Controls Program, for IT, beamline controls, accelerator controls; currently too many models
- Some beamline groups discovered value in the town hall meetings and use them actively; we strongly encourage other groups to follow
- Beamline groups need to realize that development of controls, DAQ and analysis chains can never been seen merely as a service but rather as active collaboration, needs active involvement from all levels of management

Early mini-reviews of BMM, NYX, SIX

Beamline program

- Beamline programs make impressive overall progress with soon 28 beamlines in operation, SAC congratulates to this continuing rapid progress
- Large and complex program; activities that rely on central controls, technicians and engineering need clear prioritization for those efforts
- Equipment failures occur on both new and legacy equipment; there is close attention as to understand origins; needs continuing attention

BMM (Beamline for Materials Measurement)

- Materials characterization with a small focused beam and high flux
  - Well suited to XANES, EXAFS, and XRD of thin films and other materials, including reactive materials such as catalysts
  - Future on-line analysis capability for in-operando catalysis experiments
- Highly experienced NIST personnel involved at every stage including start-up and operation
- First light July 2017
- GU program underway with 9 proposals, experiments in late 2018
  - 50% of beamtime for GU
  - Excellent Wiki accessible to users
- Positive trajectory, on time development, highly encouraging results

Structural Biology: Overall

- Congratulations to the team for securing BER funds for the operation of the CryoEM facility created with New York State funds; impressive progress in the LOM and external building construction.
- AMX/FMX suite continues to evolve cutting-edge MX (e.g. R&D 100 Award Finalist) and to move to smooth operation. The remote data collection capability is used by a growing number; robotics needs further attention to improve robustness and bring to mature operation.
- Expediting Rapid Access proposals: PRP review and PASS system are problematic. (At other facilities, RA proposals are not externally reviewed.)
- LIX beamline has state-of-the-art SAXS capabilities including sample delivery and data analysis (SVD for background subtraction), but needs to be more proactive to expand the user base.
- X-ray imaging beamline (XFM-4BM) has started to produce impressive results, e.g. element-specific imaging of leaves.

Structural Biology: NYX

- NYX commissioning continues under a new scheme (D. Schneider as Lead Beamline Scientist)
- High energy resolution almost achieved: $\Delta E/E$ is now 6.7×10^{-5} (target $\Delta E/E$ 6×10^{-5}).
- SAC recommends limiting efforts on microfocusing and instead concentrate on streamlining user experiments.
- ADSC detector: maintenance issue even with spare modules; long-term integration to the LS beamline suite is desirable, with sensitivity to NYX goals.
- Long-term future of the beamline needs careful discussion among all stakeholders, perhaps by redefining the scope.

SIX

- Beamline is making overall very slow process, and this is not only related to optics, but also sample environment etc.
- The more mundane elements of the beamline are coming up too slow and this heavily on the overall progress
- Working optics at this beamline will soon be installed. SAC understands that these still not are the design optics, but appreciates the difficulties in sourcing the final gratings
- Delay of the constantly rotating flange should not be limiting
- Science program of the beamline: too early to judge
- SAC congratulates NSLS-II and Valentina Bisogni to 2018 DOE Early Career Award, and recognizes that other staff at this beamline pursues strong scientific activities as well. SAC would like to emphasize the beamline, nevetherless, lose these additional resources by cutting down on facility efforts.

Triennial Beamline Reviews

Triennial Beamline Reviews

- Was the format for the reviews appropriate? For staff? For reviewers? Are there opportunities for improvement?
- Generally the process was very good. Model including SAC member on committee, and holding coincident with SAC, overall worked well
- Timing was unfortunate for staff (coincided with startup)
- Written document from beamlines very well received
- Need more guidance for staff about the content of talks

Beamline Development

Beamline Development

Is the approach being taken to explore new beamline concepts appropriate?

- The process to develop the evolving list of potential new beamline is good. We encourage *inclusive, bi-directional* discussion with the NSLS-II staff leading to the planned workshop at the spring 2019 user meeting . The SAC looks forward to helping with this process of prioritization.

Does the SAC have any early feedback on the concepts identified?

- The six concepts previously prioritized remain of high quality
- The new concepts are interesting and warrant further discussion and prioritization, as noted above.

Beamline Development, cont.

Does the SAC have any feedback on the prioritization of the next round of beamlines?

- Throughout this process, the NSLS-II should consider the evolving landscape at other US and international facilities, particularly for instruments requiring high source brightness.
- In the hard x-ray regime the NSLS-II will be ~100x less bright than facilities now being upgraded or built. This is much less true in the soft and tender x-ray regimes, particularly given accelerator upgrades presently under consideration.
- To remain competitive in two of its most important research areas, quantum materials and chemical transformations, the NSLS-II should re-evaluate its investment in soft and tender x-ray tools. The prioritization of beamlines planned for the new MIE should be revisited.

Staff Interactions

Suggestions from staff discussions

- It would be a real morale builder, if John, Paul and Qun spent at least 1 hour per week walking the floor of NSLS II and spontaneously talk with the staff. It would be useful if Richard did the same.
- Provide feedback to staff on new beamline brainstorming sessions. They need to know that their good ideas have gone somewhere useful.
- Include the physics safety group and ESH early in beamline design stage
- After IRR a clearly defined way forward could be helpful. (IRR has an IRP (plan) which is very useful to guide people through a complex process)
- Address the need for rapid hiring for NSLS II key staff positions (HR issue)
- Address unclear or perhaps inconsistent policy on assisting with visa issues and helping staff address the issues (HR issue)

Staff discussions: Structural Biology group

- Missing Controls staff is biggest problem; emergencies are handled, but other issues take very long. Main position has been unfilled for ~1.5 years; only 1 person qualified for EPS issues.
- Controls town hall meetings work well for those who attend.

Staff discussions: DAMA group

- Controls management understands the problems and is trying to help.
- By far the greatest problem is insufficient staff to bring new beamlines to life and address issues with existing beamlines.
- Relative to the situation with NSLS-I, within the Controls staff there remains a legacy of misunderstanding the magnitude of the computing and controls infrastructure at NSLS-II. In the worst case, this leads to stonewalling when problems are encountered.
- The group has turned a corner: initial work for the project beamlines is done to the extent that data acquisition can occur. Long-planned improvements could now begin if fully staffed.

Beamline program

- SAC understands that management efforts to improve communication have been recognised but have not had the desired impact yet on beamline staff (walk the floor, lunches with John etc.)
- SAC commends all efforts to address scientific staff working situation and development pathways
- Communication still needs improvement
- Beamline staff needs active support / discussions in developing beamline and individual science activities

SAC advice on staff professional development

- The long-term success of the NSLS-II is strongly linked to the professional development of its staff, particularly its scientific staff.
- The staff must be empowered to participate in helping to plan initiatives at NSLS-II and across BNL, on equal footing with staff from across the lab.
- The NSLS-II should develop a document that outlines its goals, policies, and procedures related to staff professional development.
- The facility should work with the BNL management to end the discriminatory and counterproductive policy that does not allow NSLS-II scientific staff to be “tenured”.
- At all times, the NSLS-II should represent and champion the unique and valuable combination of expertise found in NSLS-II scientific staff.