

SAC Close-Out Presentation

NSLS-II: March 29, 2019

Opening Remarks

- SAC is impressed by progress achieved in the last 6 months
- SAC congratulates Staff and Management on the “heroic” efforts put in to make the NSLS-II an instant success
- SAC congratulates management for reaching CD-0 for NEXT-II on a very short hand notice
- Big challenges remain in the areas of controls and data management
- Operation budget is a constant/recurring concern with the pressure to construct and bring more beamlines online

Accelerator Update

Accelerator (general)

- SAC is very pleased that the AD has addressed all the issues raised in the last report.
- The SAC again 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.
- Challenges to high reliability operation include: 1) insufficient sub-system maturity; 2) insufficient staffing in some areas; and 3) low component redundancy and incomplete set of spares. The Accelerator Division is working on mitigating each of these challenges.
- Regarding staffing, the reduction of staff in the transition to operations and in the presence of retirements has led to an effort to cross-train staff, make new hires to replace retirees and to maintain existing staff with doing work for others. This effort is having some success but there is a remaining concern that the division remains understaffed to maintain a high level of accelerator reliability over the long term and to carry out new developments.

Accelerator (general) – cont.

- Regarding efforts to maintain and improve accelerator performance and reliability, several development projects have been launched related to accelerator sub-systems and facilities based on assessment of their history of impact on accelerator reliability. These systems include SC RF, cryogenics, components that are overheating due to beam current, PLC interlock problems, magnet water issues, etc.
- In addition to the above, an “Accelerator Vulnerabilities Mitigation Plan” has been created involving a ~33 M\$ investment in large sub-systems over 5 years. These investments have been prioritized, beginning with a spare RF cryo-module and cryo-plant, critical spares, the third harmonic cavity (THC) system, spare electron gun and power supplies. The SAC agrees with these prioritized investments in general, but questions whether the ~12 M\$ investment in a 4th RF cavity system to support increasing operating beam current from 400 mA to 500 mA is worth it.

Accelerator (general) – cont.

- The team continues to study high current operation approaching 500 mA. 475 mA has been reached with reduced lifetime and increased heating observed in many components, but the replacement of ~60 RF springs around has been successful in mitigating RF heating impact.
- The Accelerator group is pursuing a limited R&D program, including lattice upgrades, 3HC studies, machine learning applications for accelerator control, an investigation of UEM development, and lattice studies for eRHIC. Replacing the NSLS-II accelerator lattice with an aggressive (and very preliminary) “complex bend” lattice could reduce emittance from ~2200 pm to ~30 pm.
- The Accelerator group is taking on Work for Others, including accelerator and beamline design tasks for the APS-U, power supply and accelerator system for ALS-U, engineering consultation with LCLS-II, and contributions to eRHIC design and accelerator physics. These activities augment funding for staff and help keep the staff engaged in interesting and challenging design activities.

Accelerator (general) – cont.

Recommendations:

1. Given the benefit of the 3HC system in reducing RF heating of accelerator components, increasing lifetime at low transverse beam coupling (i.e. to reach 8 pm or less vertical emittance), and the possible mitigation of single bunch instabilities, the SAC strongly suggests that an effort be made to implement this system in parallel with the procurement of critical spares if funding permits.
2. The SAC recommends that the plan to proceed to 500-mA with the ~12-M\$ procurement of a 4th RF system in the next 5 years be deferred until other critical and priority investments have been made.

Accelerator charge questions

1. Is the prioritized, resource-loaded schedule for mitigating our vulnerabilities appropriate and achievable?

The schedule and costs shown for the main vulnerability mitigation plan, based on NSLS-II experience with implementing similar systems, appear to be realistic. The schedule for the 3HC implementation may be less certain, depending on the actual scope of work (e.g. does a cryo-vessel need to be designed). The schedules shown must be carefully managed if they are to be realized.

2. Given funding realities, have we made the right choices in regard to performance vs reliability trade-offs?

The SAC agrees in general with the choices that have been made, but we reiterate here that the investment in a fourth RF system (~12 M\$) in the next few years, which would enable reliable operation at 500 mA, should be reconsidered, adopting 400 mA as the standard operating current.

Beamline Operations

Beamline program

- SAC was pleased to see productive science activities emerging across many beamlines
- SAC recognizes management efforts to improve communication and encourages continued efforts along these lines
- The decision to increase the canting angle between CSX and IOS undulators is a reasonable decision that should end discussion of a difficult problem.
- Working to enhance detector speed (for XPCS) will help alleviate the impact of the half/full length decision

Beamline program, cont.

- There remains concern among NSLS-II beamline staff concerning working situation and professional development pathways.
- It might be helpful to work with other facilities to understand best practices in these areas.
- SAC was pleased to hear that BNL is working on plans to update corrosive promotion policies that discriminate against facility staff. We look forward to hearing about real progress in our next meeting.

Comments on *Beamline Guidelines for Users*

- The draft policy on “Beamline Guidelines for Users” is a good step forward in defining a host of issues for staff and users.
- The title is confusing and the document is long enough that users will not easily read and absorb all of it. A bulletized executive summary, suitable for presentation, would help.
- Safety in general deserves a particular place as a bullet.
- We understand similar policies have been or are being written by other BES light sources, and it would be good to communicate and compare these.
- After garnering final input from staff and the UEC, there needs to be a concerted process for communicating this to users – probably with some regularity.

Structural Biology: progress and strategy

- AMX/FMX suite maturing with automated data collection, more (%50) remote access, resulting in doubling of user base. Important collaboration with Diamond and DAMA on data management. SAC wants to hear more science results next time (in addition to the planned beamline reviews)
- LIX beamline has also grown its use base by factor of 2, with better user interface for data acquisition. Strongly encourages speedy implementation of on-site data analysis for feedback during user beamtime. Looking forward to hearing the progress and science outputs next meeting.
- XFP: commends the team on securing funds and recent GPCR results by an external group. Encourage closer integration with the rest of SB activities.

Structural Biology: NYX

- Science commissioning has progressed well and now preparing for GUP
- Energy gradient of 1 eV across the 2nd mono crystal has been resolved: support from NSLS-II.#
- Beam focusing has been improved to ~twice the target size. SAC consider it's good enough for now to move ahead with other aspects of the beamline development and operation, esp. streamlining user experiments.
- ADSC detector maintenance is an issue: plan is to apply for funding for Eiger 9M detector to NIH HEI S10, next year
- SAC recognizes acute need of crystallography expert help from NSLS-II during May-July 2019 being discussed with the SB group, in addition to 1/3 FTE on control. SAC strongly supports the NSLS-II contribution.
- Short term solution: additional capabilities on BLUEICE (raster scan, helical scan) to be implemented with help from SSRL

Structural Biology: strategy

- Well thought-out and forward looking structural biology strategy. Excellent progress on many fronts.
- CryoEM challenge: recommend acceleration of recruitment of experts to run the facility. Watch out for timing of building completion and Krios delivery.
- CryoET will become much more important and requires different expertise.
- Tomato plant metal uptake work: excellent example of multi-modal multi scale bioimaging using HXN and SRX, and APS GSECARS. Can be even more impactful if connected to molecular scale work on receptors responsible for metal oxid particles uptake.
- Optical and super-resolution optical microscopy could bring a wider molecular cell user base if properly integrated with X-ray and EM/ET capabilities.
- Encourage machine learning projects to reach critical mass with special attention to integration of multi-modal imaging/structural analyses.
- Congratulations to R. Tappero (XFM-4BM for securing BER bioimaging funding. Good example of coordinated efforts of staff development to bring junior members to the forefront with more exposure to BER user community.

CHX: Coherent Hard X-Ray Beamline, 11-ID

- CHX got off to a very slow start due to
 - Lingering effects of premature transition from commissioning to user operations
 - Challenges from staffing levels much below original plans
 - Hurdles created by facility IT/networking/data access management
- Impressive strides have been made in the past 12-24 months
 - Now arguably the world's premier beamline for XPCS
 - Promising science portfolio being established also attracting user groups new to XPCS
 - Successful instrument developments by beamline staff and in-house science initiatives supported by grants
- Issues remain that threaten productivity and impact going forward
 - Insufficient staffing level
 - Hurdles created by facility IT/networking/data access management
 - Correlation analysis on the fly barely possible and only due to workarounds (e.g. local data storage) initiated by beamline staff.

CHX: Coherent Hard X-Ray Beamline, cont.

- CHX has a very focused mission to optimize XPCS capabilities
 - Leverages a main strength of NSLS-II as a high brightness source
 - Committee endorsed continued primary focus on XPCS but there are growth opportunities
- Data access/management is very problematic
 - Users must be able to transfer raw data to home institutions easily
 - Access to data analysis tools housed by NSLS-II must be made easier and much more reliable
- Short-medium term improvements and future
 - Pink beam XPCS with multilayer mono
 - Develop plans for better focusing for WA-XPCS
 - XPCS with larger beam to be explored; opens up for studies of radiation sensitive samples (bio/soft matter)
 - Further growth of local user community and unique sample environment capabilities is encouraged to better face future challenge from DLSRs in the US and elsewhere

SRX

- The SAC supports the report prepared by the beamline review committee.
- Items to note are:
 - Data quality, beam flux, stability, beamline performance are all very good. XANES and XAFS data are of high quality.
 - Staff research seems appropriate, Committee applauds level of user support.
 - Overheating mono motor still an issue; will be resolved April 2019
 - Fly-scanning is now working, showing progress, scan speed must be improved.
 - The committee encourages focus on improving core capability in XRF, XANES, fly-scanning, undulator, mono, 100-nm resolution (new KBs) over making new capabilities (XRD, tomography, DPC) available to users.

Beamline Development

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

- SAC commends the impressive pace in putting 28 BLs on the floor in about 4 yrs
- The MIE beamlines (CDI, ARI/SMF) received CD-0 in Dec 2018. CDI well on the way towards CD-1. More work is required for ARI concerning focusing schemes etc. Aiming for CD-1 end of 2019 for all projects still seems realistic
- NPB partner projects appear to be in good state (SST1&2 and NYX projects well underway, others in operation)
- HEX is progressing well with NYSERDA. Recent developments include de-scoping from the original 3 stations to 1 station, wiggler issue being addressed, and a new lead scientist hired

Beamline Development, cont.

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

- J-PLS in hutch-B at SMI seems to be addressing a pertinent need for expanding on liquid (surface) scattering possibilities at NSLS-2.
- The INF construction project is possibly supported by NSF (more news soon). SAC recommends mgmt to consider how operation funds for this beamline can be secured in the longer term.
- SAC was impressed by the MRE beamline project and its uniqueness. The independent construction and operation funding by DOE-NE is a real advantage and a benefit to NSLS-2 and the lab. SAC urges management to point out the advantages of implemented the full range of techniques right from the outset to the funders
- Involving staff in the discussions about the next BLs to be constructed and the strategic planning WS in Oct 2019 is endorsed by SAC

Beamline Development, cont.

Does the SAC have any early feedback on MIE beamline concepts?

- SAC endorses the choice of MIE beamlines which nicely complement the existing beamline portfolio
- There is a real question concerning the cost/benefit of canting ARI/SMF. Is this really the optimum solution for two such different projects? SMF would greatly benefit from a designated straight section
 - Nano-RIXS need highest possible coherent flux, as long as zone-plate refocusing is needed.
 - The SAC questions the decision to combine ARI and SMF at a canted undulator. It sees a high risk that ARI, when not on a full length ID, will not perform sufficiently to satisfy even less demanding experiments.
 - With the experience of CXS-1/CXS-2/IOS, the SAC urges NSLS-II to carefully reconsider this.
- The CDI project fits well into the portfolio of beamlines at NSLS-2 but is it unique in view of the upcoming projects at DLSRs?

Controls Program & DAMA report

Beamline controls

- SAC recognizes the high pressure (not least by the SAC) under which the controls program and Richard are operating, and commends the group for working actively on the challenges
- Continued progress in many areas
 - PoC system further improved
 - Restructured teams and responsibilities address concerns about siloing
 - Addressing technical issues, e.g. which system to use for what
 - Hiring processes seem to have improved
 - Communication seems to have improved
- Instability, lack of reliability and performance of controls and related systems still a large concern

Beamline controls

- There appears to be a flaw in the ticket system in that development for a new beamline is treated at the same level as something that is trivial in comparison. Continued progress in many areas
- Some of the ticket items may be very small issues and offer the opportunity for quick victories. Other tickets may be year-long efforts, and a strategy for dealing with these disparate levels of complexity needs to be identified, and relayed to the requestors as well.
- It would be helpful to the SAC to have additional evidence of traceable progress, especially against three or four key criteria as opposed to overall summary statistics which may obscure fundamental issues, or fail to highlight important ones.

Beamline controls

The SAC said last time and still does not see a clear answer:

- Is there a clear plan to address these issues going forward?
 - The action plan to address specific issues **needs to be focused and prioritized**
 - **No overall assessment of the actual work that needs to be done for beamlines has been presented.**
- Is that plan executable on a reasonable timeframe with the current resources?
 - SAC can still not assess this based on the information provided

Controls - recommendations

- SAC sees a risk that perpetuating issues will very soon affect user confidence and staff retention
- Top management needs to help the controls program to
 - Identify most pressing issues (data storage stability, data transfer, user access for data, but also scanning speeds etc.)
 - set out clear high-level priorities for these, based on a strategic decision for the facility (user confidence, high-impact beamlines)
 - Decide how much resources and priorities to be allocated to longer timeline activities such as detector and metrology
 - Develop an actionable, time defined plan to address these
- SAC would like to see a mitigation plan addressed and initial follow up in the next meeting

DAMA report

- Are the data plans for storage and compute appropriate and achievable with current resources?
 - Data infrastructure clearly has problems: GPFS problems/reliability, no sync between beamlines and NSLS-II central storage, no access from outside.
 - this needs a fix before the reputation is tarnished beyond repair
 - a milestone concept for solving these issues should be developed with clear deliverables; estimates on resource needs should be based on that concept
 - Where should the central disk reside? → best solution is SDCC, seems to be the cheapest solution while keeping full control over the data
 - Remote access for analysis is still in the testing phase: no clear path forward is visible yet; required resources are unknown
 - Collaboration with CSI seems to be picking up speed
 - SAC supports the plan to focus on working with SDCC

DAMA report

- Forecast for data generation and on-demand computing is scary
 - Data retention is an issue
 - Seems unlikely that this can be tackled by the facilities on an individual level
 - Good start has been made for collaboration of the light sources within the DoE complex: common data policy is very important item to start with
 - SAC recommends to tackle as many data related issues as possible in collaboration with the other DoE facilities
- Are there opportunities to leverage the work of others that we are not taking advantage of?
 - This is done well so far
- Data confidentiality issue needs to be addressed asap

PASS review & next steps

PASS review

The SAC commends Lisa Miller and colleagues for the insightful work evaluating the PASS system and appreciates the challenge of planning future work on that system or some alternative. The SAC hesitates to make a specific recommendation, believing that NSLS-II personnel, with continuing efforts to improve the system, are on track to making good decisions. Our impression is that the PASS system is functional and valuable and that it can be improved—with substantial ongoing efforts to be required.

Integration of reporting capabilities such as end-of-run reports and publications is an essential goal, and expansion of capabilities for more effective linking with proposal review activities as well as inclusion of extensive reporting capabilities, such as inclusion of appropriate demographic information and data management plans and results are expected to become essential going forward. Inputs from highly skilled software engineers could be helpful.

The SAC judges that an important point is missing from the review:
The proposal system is essential in the data management life cycle. Experimental sessions, meta data catalogs, user login and data management, offline data analysis, etc. are essential and intimately connected with each other, and the future (or continuing) proposal system must take care of this.

Developers need to be co-located and in close collaboration with DAMA.

Close collaboration between the various DOE facilities could be a viable way forward.

Meeting with staff

Takeaways from meeting the Program Managers

- Program managers (beamlines) miss (clear / any) role descriptions, or some budget / scientific / strategic responsibility
- Efforts by to improve career pathways by management (Paul) are being recognized by staff, impact yet to early to judge
- Efforts to solicit input from program managers to science proposals by BNL management (Jim) / others are positively received
- Morale in BL teams partly low, due to CS instabilities / issues beyond control, keeps BL people from engaging in science / funding proposals
- Program managers often feel like just “messengers” between the staff on the floor and upper management without a clear parameter space within which they can take decisions
- Some program managers feel that the effectiveness of communicating with the Photon Science Division Director is not as good as it might be. Too many of the interactions require input from the director.

Takeaways from meeting with User office staff and Comms

- Communication from management to ground level on overall strategy / vision / goals needs further improvement and include all scientific, technical and administrative groups.
- Groups want to know what their role is in the overall picture
- Improve lateral communication to avoid “silo”ing, e.g. make all-hands more participatory/interactive
- John’s newsletter is good and worth archiving available on web/blog
- Support from other BNL functions sometimes seems to stall in policy issues / unclear priority from overall BNL
- Now that TLD are no longer mandatory, encoding the main BNL badges could improve the workload of the user office

Takeaways from meeting with detector & metrology groups

- Communication from management to ground level doesn't always work: e.g. communication of results of internal competition for funding.
- The groups greatly resent the absence of dedicated support from other support groups for projects (controls!)
- A test beamline is severely missed