

## **Report of the RIKEN SPring-8 Center Advisory Council 2019**

### **General statement**

RSAC greatly appreciates the organization and management of the review. The written materials, the travel arrangements, and the accomodations were all excellent. The presentations were well-prepared, clear, and complete.

RSAC recognizes the world class status of the SPring-8/SACLA complex. In particular, RSAC appreciates the thoughtful response to the 2016 RSAC recommendations and the specific steps taken by RSC and JASRI to address these recommendations. An example that highlights this response is the joint review of RSC and JASRI, affording RSAC the opportunity to understand the SPring-8/SACLA facilities as a whole.

The new directions in the areas of cryo-EM, NMR, laser science, and forensic science highlight the dynamic leadership of SPring-8 and SACLA. The continuous progress in the technical areas, detector development for example, is very impressive.

The collaborative development of SLiT-J is a significant step towards a unified approach to SR in Japan.

The RSAC has several specific comments/recommendations.

- RSAC again takes note that large research infrastructures, like SPring-8/SACLA do not fit into the ‘RIKEN single investigator model’. There is an ongoing need to address the operation and management of such facilities in Japan, especially in light of the approval of SLiT-J and its construction start. RSAC suggests investigating existing large facility management systems worldwide, for example the HGF in Germany and the DoE in the US.
- The extraordinary operational performance of SPring-8 relies on a foundation of *all* of the infrastructure being reliable. By all we mean not only the storage ring and FEL components but also the conventional facilities, power, water, buildings, and so on. These systems are sufficiently complex and subtle that a single entity must take ‘ownership’ of the facility and management of the facility must be located on-site. Only with the responsibility for all aspects of the facility being managed by a single entity that considers itself to be ‘part of the team,’ can the world-leading SPring- 8/SACLA performance be maintained. RSAC strongly suggests creating a management structure consistent with this scenario.
- RSAC encourages RSC/JASRI to work toward eliminating the requirement for ‘radiation worker’

- status for users. This is especially important for users from institutions and industries that do not have radiation worker training.
- The new efforts toward a more unified management approach to the SPring-8 should focus not only on efficiency but also career development for young staff whether from RSC or JASRI.

## **Comments on the specified issues**

### **Terms of Reference for RSAC**

***Comments and/or recommendations regarding the management and operation of the SPring-8/SACLA facilities.***

The view of RSAC regarding management of the SPring-8/SACLA facilities is best described in the MEXT Quinquennial Assessment of SPring-8/SACLA recommendation “...that the roles and responsibilities for public, RIKEN, and contract beamlines should be redefined in a more coordinated manner in order to address broad, critical requirements from society.”

The separation into public, RIKEN, and contract beamlines has both positive and negative features. The SPring-8 system enables general user access, RIKEN user access, and industrial access. This is a very positive approach. The funding and management for the public and RIKEN beamlines is separate highlighting the challenge of maintaining the quality of the contract beamlines. The present approach can naturally lead to aging infrastructure and a lack of renewal of beamline hardware. Therefore, RSAC recommends a review and evaluation of the contract beamline system.

The RSAC appreciates the unique opportunity that the SPring-8-II upgrade affords JASRI and RIKEN to investigate possibilities to streamline governance of the facility. The upgrade also affords the opportunity to review the facility as a whole and identify inefficiencies that can be eliminated freeing up resources for the development and maintenance of the beamline portfolio.

RSAC encourages the development of a regular beamline review system that looks at all the beamlines, RIKEN, public, and contract, one by one, every ten years. This corresponds to 6 beamlines per year that could be grouped according to research area and/or technique. These reviews can provide critical input into technical choices for investment and upgrade of the beamlines. These reviews can also serve as a mechanism to ensure that the contract beamlines remain well-funded, maintained, and utilized.

The use of SCSS as the third SACLA beamline has been very successful. RSAC endorses its continued use as part of the SACLA portfolio. Two aspects of beamline 1 that should be considered are (1) increasing the electron beam energy thereby extending the photon energy and perhaps reaching the carbon K edge at 0.284 keV), and (2) consider implementing HGHG. FERMI at Elettra has been highly successful and world leading in many aspects as a result of their standard HGHG mode of operation. The SPring-8 site has all the necessary expertise, accelerator physics, undulator technology, and laser science to implement HGHG quickly on beamline 1.

***Comments and/or recommendations regarding the accelerator/beamline upgrade for the SPring-8-II project (including scrap & build),***

RSAC takes note of the world leading reliability of SPring-8. The present approach to the SPring-8-II accelerator is designed to maintain this position. We note here that reliable conventional facilities and system infrastructure (power supplies, for example, but also building and site maintenance, ) are critical for reliable operations of the accelerator complex.

The ‘pause in SPring-8-II’ for the construction of SLiT-J affords the opportunity to follow the ESRF upgrade before finalizing the approach for the SPring-8- II design. External advice on the ring design can be helpful in making a final decision for the approach. We note that a green field design at HEPS (China) aims to achieve 34 pm-rad at 6 GeV, 200 mA and a circumference of 1360 m.

RSAC takes note of the world leading optics and detector developments ongoing at SPring-8 and encourages designers to incorporate these novel capabilities into their beamline designs. RSAC appreciates the presentations of the beamline portfolio and the approach to the decisions about the portfolio that takes unique advantage of the performance gains from SPring-8-II.

RSAC strongly supports the immediate implementation of the ‘scrap and build ‘approach to producing world leading beamline capabilities in advance of the completion of the SPring-8-II storage ring upgrade. RSAC endorses the development of the portfolio with a balance between workhorse (high throughput), advanced (science), and novel (technology/methods) beamlines.

***Comments and/or recommendations regarding the role of SPring-8 in synchrotron radiation facilities in Japan and around the world.***

RSAC notes that SPring-8 is the leading high energy x-ray storage ring facility in Japan and one of five worldwide (ESRF, APS, PETRA III, CHESS and SPring-8).

RSAC takes note that, with the completion of SPring-8-II, the hard x-ray capabilities in Japan will remain competitive with the very best worldwide efforts (ESRF EBS and APS-U) presently under construction.

RSAC encourages RSC/JASRI to utilize their world leading positions in detector development and x-ray optics to create several truly world leading beamlines as part of the portfolio. In the development process, engagement of the scientific community in Japan and worldwide is essential to create world leading scientific programs. This is clear from the successes of inelastic scattering (SPring-8) and non-linear x-ray science (SACLAA).

RSAC recommends that the strong collaboration with the SLiT-J accelerator design and construction should be extended to beamline design, optics development and detectors not only for SLiT-J but broadly across all SR facilities in Japan as well as worldwide.

RSAC notes that the detector developments can also impact electron microscopy and the HTS developments for NMR can be applied to other disciplines. These opportunities should not be missed.

RSAC notes that the world leading development in optics by Osaka University led to commercialization with JTEC and similar commercialization efforts may be possible for detectors as well. This has the potential to broadly impact the x-ray community in the same way as JTEC mirrors have.

RSAC greatly appreciates the inclusion of both cryo-EM and NMR into the RSC driven by structural biology. These capabilities are not restricted to structural biology but will impact science more broadly. Of particular note are the technical developments that are world leading – driving toward 1.5 GHz NMR and the highest resolution cryoEM. In collaboration with JEOL the development of the cold field emission gun will lead to a next generation microscopes.

***Comments and/or recommendations regarding the progress of SPring-8/SACLAA toward their mission to set the direction for the future of science.***

RSAC notes that it is not sufficient to just have the best tools, one needs to apply these tools to cutting

edge scientific challenges as well as the needs of society. The measure of success is that research results obtained on the SPring-8 campus provides critical information to address these challenges that one cannot get anywhere else.

### **Terms of Reference for Center Advisory Councils**

President Dr. Hiroshi Matsumoto has asked the Center Advisory Councils to answer specific questions in his terms of reference (TOR). What follows are the RSAC comments and recommendations.

#### ***Comments***

TOR 1. The SPring-8 campus hosts two world class accelerator based light sources: The storage ring, SPring-8 and the free electron laser, SACLAA. Both are among the best in the world. Of particular note is SACLAA the world's first 'compact' free electron laser incorporating many novel features. The user base for both facilities although Japan centric attracts the best researchers from around the world. The science accomplishments span from basic to applied research and of note is the industrial use component of SPring-8. The research results have and almost certainly will continue to address important problems that directly impact society from energy to the environment and health. The strategic goals presented to the RSAC 2019 are consistent with the present fourth mid to long term plan.

TOR 2.

(Strength)

- Operate SPring-8/SACLAA as Advanced Solution Providing Facilities including now cryoEM and NMR
- Experience of SPring-8/SACLAA construction and commissioning
- High capabilities of equipment development supported by Japanese industry
- Distance from Tokyo, Small Noize

(Weakness)

- Location; Far from big cities, Difficulties in recruiting
- Unnecessary role sharing among the managing stakeholders (RSC and JASRI)
- Inefficiency of the subcontractors and ourselves
- Wako management system is optimized for single investigator research

(Opportunity)

- Grand-Design and redefinition of the SR facilities in Japan
- Sophistication of the science by the construction of the 3 GeV SR facility
- Exploitation of the new users and development of the new scheme of industrial collaboration by the upgrading

(Threat)

- Dwindling human resource supply with the decreasing university courses
- Recruiting Technical Supporting Staff
- Misunderstandings in large-scale facility management (support which caused the historical degradation of INS-SOR and PF)

The SWOT analysis that was presented addresses concisely the position that the accelerator based light sources on the Harima campus sit on the world scene. It addresses accelerator development, beamline development and the user base.

TOR 3. The RSC plays a leading role as a result of the breadth of applications of accelerator based x-ray sources as a ‘Science and Technology Hub’. The HUB is intrinsic in large x-ray facilities such as SPring-8 and SACLA. On any given day one finds international investigators side by side with Japanese researchers from all disciplines that benefit from results of x-ray experiments. By their nature, in particular for hard x-ray free electron lasers, large accelerator based x-ray sources are international. This is clear from the diverse user base of SACLA and SPring-8.

TOR 4. See attached.

***Recommendations***

1. All other facilities of comparable size and breadth have regular beamline reviews that evaluate

technical status, scientific productivity by users and staff. These reviews guide investments to keep the beamlines competitive and productive. RSAC recommends establishing reviews at SPring-8 in preparation for SPring-8-II. These reviews will inform the prioritization of investments between now and the completion of the upgrade. These reviews should cover all the beamlines whether under the responsibility of RIKEN or JASRI.

2. The overall portfolio of beamlines at SPring-8 should be evaluated in light of the developments at SLiT-J and the existing facilities at PF and PF-AR at KEK to guide choices for SPring-8-II.
3. Some peer facilities have management structures where the scientific disciplines that benefit most from their beamline capabilities are highlighted in order to optimally invest resources to maximize scientific impact. This approach for the RSC in collaboration with JASRI is strongly encouraged.