Report of the RIKEN SPring-8 Center Advisory Council 2011

The RSAC2011 committee is requested to provide advice specifically on the following topics:

1. A review of improvements to the management systems of the RSC (especially its organizational structure and administrative systems) after RSAC2009, which aimed to make the RSC a world-leading Photon Science Research Complex,
2. An evaluation of the research programs and the collaborative activities inside and outside RIKEN that are currently being conducted or are planned for the RSC (from the viewpoints of both scientific and social/societal impacts), and
3. An assessment of the roles that the RSC is expected to take in the research complex with the SPring-8 and SACLA facilities at the Harima site.

President Noyori's suggested topics for deliberation by the Advisory Councils for RIKEN's Centers and Institutes

1. Does the Center/Institute have achievements of major scientific significance and/or social impact?
2. Does the Center/Institute have a functioning Plan-Do-Check-Action (PDCA) cycle? In particular, are the mechanisms for reorganizing, improving or closing laboratories working effectively?
3. Are the personnel management practices (hiring and employment conditions) of the Center/Institute appropriate to its world-class standing? Are the quality and the diversity of researchers being maintained at a sufficient high level?
4. Evaluate the Center/Institute's collaborative activities within and outside RIKEN, as well as its efforts to promote international collaboration.

General statement

The RIKEN SPring-8 Center (RSC) has been playing many important roles in the frontiers of science and technology from the materials to the life science fields by providing state-of-the-art experimental facilities utilizing brilliant light sources as well as by promoting its own research activities. The reorganization of the RSC to a more mission-oriented structure with three divisions in response to the 1st RSAC 2006 recommendations has been successful in delivering the completed XFEL, SACLA, that has produced the first one Ångstrom FEL beam in a remarkably short time. The three divisions of the RSC: Innovative Light Sources Division, responsible for the technical development of advanced SR sources including XFEL; Photon Science Research Division, carrying out cutting edge research in life, materials and physical sciences at SPring-8; and Advanced Photon Technology Division, developing technologies to make best use of SPring-8 and XFEL for users including industrial sectors, have been actively fulfilling their assigned responsibilities. The ongoing achievements in research and development using state of the art synchrotron radiation (SPring-8) by the groups in each of the three divisions have proved the RSC to be one of the best institutes in the world with impressive progress and exciting potential as described at the RSAC 2011. It is crucial to maintain and further improve the quality and the level of R&D for the RSC to continue to be a leading figure in the world scientific community and to contribute to the future developments of industrial and medical science and technology. The task of the RSC to contribute to the benefit of human society is a formidable challenge. However now that the XFEL facility construction is complete with the early commissioning success the goal to make the Spring-8 campus one of the world-leading centers for photon science requires an organizational structure that will enable this. The development of this structure is the focus of the RSAC 2011 recommendations.

1. **Evaluation system for SPring-8 as a whole should be made jointly with JASRI in addition to the evaluation of RSC.**
2. **The photon science research as a whole needs to develop a near and long term perspective incorporating the unique capabilities of SACLA.**

Improvements to the management systems of the RSC (especially its organizational structure and administrative systems) after RSAC2009, which aimed to make the RSC a world-leading Photon Science Research Complex

The development of the RSC has evolved over time, in some sense in a reactive mode, as there have been changes in funding, participating institutions and demands and needs on the Harima site. There are numerous successes, perhaps none more impressive than the initial startup of the SACLA x-ray free electron laser. The structure of the RSC and in particular the cooperation within the divisions, in particular the innovative light sources division was critical to the success. Looking forward, with the goal of making the SPring-8 campus one of the leading photon science institutes in the world a new approach to the structure of the Harima Institute is proposed by RSAC 2011. The RSAC 2011 notes that often organizations are 'designed' to accommodate the people that are part of an organization rather than creating a structure that meets the needs and then looking at staffing the structure. The RSC indeed has outstanding staff and the latter approach is recommended as one looks to the future on the SPring-8 campus within the Harima Institute.

The RSAC 2011 therefore recommends restructuring the RSC into two centers, one the RIKEN Photon Science Center made up of a bio-sciences research division and a materials sciences research division. The bio-science division would include what was the bio-science division in the present RSC structure as well as the protein crystallography research group that is presently part of the advanced photon technology division. The materials science research division would include the same groups that are presently in the division in the RSC.

The second center that the RSAC 2011 proposes is the RIKEN Photon Technology Center which would include the innovative light sources division, the advanced photon technology division, the XFEL research and development division and the RIKEN RSC-RIGAKU Collaboration Center. One can envision developing also a division for laser science and technology as lasers will play an ever more important role in photon science.

Evaluation of the research programs and the collaborative activities inside and outside RIKEN that are currently being conducted or are planned for the RSC (from the viewpoints of both scientific and social/societal impacts)

Materials Science

Overview

The material science overview was presented as part of the Photon Science Research Division activities by Dr. Takata. The materials science research efforts are well coordinated within the division and have created programs that more than meet the expectations of the material science community worldwide for science programs utilizing one of the most powerful 3rd generation

synchrotron light source. The research is at the cutting edge of materials science spanning the development advanced photon science methods with the concept of electronic quantum order – spin order, spatial order, and excitation order, leading to the development of unique programs. With the SACLA FEL operation for users coming on line in the near future the committee expects continued development of activities that will remain amongst the world leading efforts in the use of x-rays to study materials relevant to the science and technology demands of the future.

Dr. Baron has demonstrated exceptional skill and expertise in the development of world leading tools for high resolution inelastic x-ray scattering and utilizing these tools for world class research. The committee expects these efforts to culminate in experiments that elucidate fundamental phenomena from the study of electronic excitations leading to publications in the high profile journals such as PRL, Science and Nature

Lastly, SACLA opens a new horizon for the materials science group led by Dr. Takata. In order to capitalize on this rare opportunity, the committee suggests that the group, as a whole, set specific scientific milestones in for short-term projects as well as on a long-term scale.

Research Output

The science topics are well focused on the following:

1. SR Smart Crystallography
2. X-ray Pinpoint Structural Measurement,
3. Nano-Structural Dynamics,
4. Ultra High Resolution SX Spectroscopy,
5. SR Magnetic Structural Materials Science.

These areas span the range from basic science to application and are well aligned with the goals Prof. Noyori has set for RIKEN. Each topic is well organized with clearly defined targets and they are pursued by both the RIKEN staff as well as through collaboration with prominent researchers in the relevant field. These collaborators come from industry, academia and laboratories as appropriate. It is very important to highlight that the techniques developed by RIKEN staff have been transferred to the SPring-8 public beamlines. In particular the committee continues to be impressed by the promotion of the Industry-Academy Project.

RECOMMENDATIONS

The breadth of applications for x-ray photon-based research in materials science is extremely wide. Recognizing the success and strengths of the RSC materials research efforts the committee recommends the addition of another senior researcher with the imminent start of the SACLA FEL research program in order to maintain the RSC leading role in materials research.
The committee also reminds the RSC that they must actively pursue the development of young scientists.

Bio-science

The biological research, which is carried out in more than 10 research groups/teams, is multi-facetted and addresses many important biological problems. However the quality of the research is variable. The committee recognizes that biological research is very labor intensive, and it appears that not all the teams are above the critical mass to be internationally competitive. This

was already discussed in the last RSAC and continues to be a concern of the committee. In the course of the highlighted areas presented the committee was pleased to hear of the integration of EM into the photon sciences activities. This is scientifically valuable research.

The committee notes that the vast majority of the efforts of the Advanced Photon Technology Division are directed towards the biological sciences. Specifically:

1. The Research infrastructure group is internationally leading in the development of beamlines for macromolecular crystallography and should be congratulated with the successful completion of the microfocus beamline
2. The Protein Crystallography Research group fulfills an important mission by continuing and further developing the activities of the Protein 3000 program.

RECOMMENDATIONS

The committee repeats and emphasizes its recommendations from RSAC2009, which remain valid.

1. RSC should appointment a Life Sciences coordinator to fully realize the potential to become a leading center for biological research.
2. Engagement of young scientists. The same goal as for the materials sciences.

In the new Harima Center structure proposed by RSAC 2011 we recommend recruiting the director of the Biological Science Division in the RIKEN Photon Science Center. This individual will naturally be the 'coordinator' recommended in 2009.

An assessment of the roles that the RSC is expected to take in the research complex with the SPring-8 and SACLA facilities at the Harima site.

There are several aspects of the role of RSC. Combined they represent the research leadership at the HARIMA site and naturally point to the development of sources, methods and world leading science. This is a difficult challenge and RSC has laid out an aggressive plan for the future focused on the development of the next generation steady state light source in Harima, perhaps the 'ultimate storage ring'. This development will require a combination of accelerator physics, x-ray optics and methods and crucially the science that drives these developments. RSC is positioned to do this by maintaining forefront research using both SPring-8 and SACLA. The committee expects that RSC will play a leading role in future accelerator based photon sources in Japan. The committee realizes that the development of SPring-8 II is very important to keep the leading position of SR research at the Harima site. In order to meet the proposed 2019 completion date for SPring-8 II the committee recommends that the discussion of the conceptual design of SPring-8 II with the user community begin in the very near future. The committee appreciates that the roadmap for the upgrade of the advanced SR sources, SPring-8 and SACLA, is an excellent first step for the SR community in Japan. To accomplish this roadmap the committee strongly suggests that discussions begin that include all projects proposed across Japan. This will lead to a roadmap that represents a consensus view and can be brought to both the Japanese government as well as the science communities that compete with the SR community for budget.