

Report of the Photon Factory International Science Advisory Committee (ISAC)

April 3-4, 2007

Introduction, ISAC Process and Report Organization

The Photon Factory International Science Advisory Committee (ISAC) was chartered by the Institute of Materials Structure Science (IMSS) of the High Energy Accelerator Research Organization with providing ongoing advice on the operations and strategic planning for the Photon Factory (PF). The ISAC follows upon the external independent review of the PF carried out in March, 2006 by a Committee of 10 members. The ISAC meeting on April 3-4, 2007 was the first meeting of the ISAC whose membership of 10 includes a number of scientists who participated in the earlier review.

ISAC was provided written information, including copies of many of the presentations, in advance of ISAC meeting that was held in Tsukuba, Japan at the Photon Factory on April 3-4, 2007. ISAC heard a series of technical and scientific presentations. Opportunities were provided to hear comments from staff scientists. Following questions and discussion, ISAC met in closed session and formulated its observations, conclusions and recommendations. ISAC reached unanimous agreement on the material presented in the closeout to the management of the IMSS and PF held on Wednesday morning, April 4.

This written report briefly summarizes ISAC's findings and recommendations. Following are more details and elaboration of the topics in the same order that they were presented in the verbal closeout with IMSS and PF management. The Appendix contains *i)* a list of the ISAC members of the Review Committee and *ii)* the Agenda of the ISAC meeting.

1. Perspective of ISAC Since the March, 2006 Meeting

ISAC now acknowledges and strongly supports the management's strategy of developing hard x-ray beam lines on the AR and expanding the undulator-based SX beam lines on PF. This strategy takes advantage of the unique short-bunch capabilities of the AR for innovative x-ray science in the short time domain and the expansion capacity for undulators on PF and AR.

ISAC recognizes that the prioritization of SX at PF is addressing the concerns that it raised earlier about the SX community and its access to cutting edge resources. PF is encouraged to continue to make this role a more visible part of its overall mission and identity. At minimum, this global strategy of continuing to push the forefront with hard x-ray science (especially in support of the University community) and in parallel developing further the SX capabilities to fill a real need in Japan should be considered and discussed by the Japanese synchrotron science user community.

ISAC supports the efforts that have begun since the March, 2006 meeting towards prioritization, consolidation and reduction in the number of operational stations on PF and AR. More effort in this direction is strongly needed and encouraged by ISAC. This should be done with the involvement of the planned ISAC subcommittees and this effort should be kicked off soon in order to provide effective advice in decision making.

2. Photon Science at KEK, Budget, and PF Reorganization

ISAC recognizes the strategic importance of photon science playing a larger role in the

future of KEK. ISAC strongly encourages that KEK management recognize the opportunities for synergy in key areas like accelerator science and its important role in fostering next generation storage ring light source development in Japan (and indeed worldwide). We would like to compare the situation at KEK with that at Cornell, DESY and SLAC, recognizing that KEK also has J-PARC as a major long term investment.

ISAC sees the declining budget situation as very threatening to the long-term healthy development of the Laboratory and one that will have to be managed. Utilizing committees like ISAC and input from the user community and other advisory bodies is a key to sound strategic planning and future success. Industrial involvement is a promising area where technology transfer is an important factor and this could offer additional sources of complementary funding. ISAC also strongly encourages continuing to develop other competitively awarded sources of funding.

ISAC welcomes the initiative to coordinate photon science activities in Japan through bodies like the "roundtable" and JSSRR and strongly encourages it to continue and indeed become even more active. ISAC would like to see PF and KEK plan to host, over the course of the next year or two, a national conference dedicated to planning future x-ray user facilities in Japan.

ISAC welcomes the new group structure at PF and in particular congratulates the management on achieving such a complex task in only one year. Going further, we suggest augmenting the senior management in ways that help the PF director deal with a large and diverse portfolio and range of issues. Comparable light source facilities elsewhere have associate and/or assistant directors to help lead administrative, technical and scientific efforts.

3. Strategic (Action) Plan for Beam Lines

ISAC strongly supports the engagement of external investment in the form of new beam lines and instrumentation. In particular, ISAC supports the Pharma beam line development and recognizes that this will bring additional excellent science and provide resources for developing new instruments at PF.

Management is strongly encouraged to continue to actively develop additional investment through the competitively awarded grants process, including expanding the center concept beyond structural biology and structural materials science.

ISAC recognizes the significant effort in prioritization and reorganization of the beam line program. A good start has been made in this regard within a relatively short time and ISAC strongly supports continued evaluation of the existing stations on the basis of the criteria presented to ISAC. However, the chosen metrics need to be adjusted by area of science and in comparison with international standards. SAC applauds the steps the PF management has taken in coordinating beam line developments/upgrades at PF with other SR facilities in Japan.

In the process of reorganizing beam lines, it is important to find means to minimize the disruption that will be caused to the users.

4. ERL Project

ISAC continues to strongly support the ERL development in that it offers a route to next generation performance that compliments SPring-8, XFELs and other Japanese light sources. Further, it can strongly engage the KEK accelerator competence and position KEK to be at the forefront of future light sources. Given the importance of the ERL development to the future of PF and indeed more broadly KEK, ISAC spent considerable time on this topic and hence this section of the report is somewhat more detailed.

ISAC heard presentations on the ERL project and felt that these showed considerable progress made during the past year in identifying issues involved in designing an ERL light source and in establishing salient features of an ERL that will enable new types of scientific investigations. This progress is seen as considerable in light of the fact that relatively little direct funding has been targeted for these efforts. ISAC summarizes some notable successes and challenges to the project and make recommendations for the coming year.

Over the course of this year ERL project teams have been formed and upwards of 20 KEK staff and 30 more from other labs meet on a monthly basis to discuss design, performance and testing. Efforts to build collaborations have succeeded, with MOUs established with JAEA, ISSP (Tokyo) and CLASSE (Cornell). A short list of accelerator developments needed to prove ERL technology, and used that to justify the plan to build an “ERL Test Facility” was presented to ISAC. A timeline was shown for realizing both the test facility and a “5 GeV” machine, but both seemed quite aggressive.

ISAC heard of the plans regarding the ERL Test Facility and efforts to develop key components: the electron gun, injector linac, and main linac (including results on developments on DC photocathode gun (JAEA) and SC cavities (KEK)). ISAC took positive note of the synergies with other ongoing projects and this pointed to local technologies that could be incorporated. The ERL Test Facility was discussed and the beam dynamics issues to be tested identified. A new site has been found for the Test Facility, in the Proton Synchrotron East Experimental Hall, which affords much more space than the cold neutron building shown last year and this was viewed very positively by ISAC. Little was said about converting or upgrading the Test Facility into a useable VUV/SX light source although the 2006 Review found this aspect of the project compelling. ISAC supports the new site since the larger building allows such a vision to develop.

ISAC recommendations for action regarding the ERL project:

Develop a compelling science case for ERL facilities. ISAC recommends using the new group structure introduced at PF to organize an effort, based on various scientific fields and disciplines, to identify forefront scientific applications that will need the fully coherent, high repetition rate, ultrafast pulses of light from ERL light sources. One should not underestimate how difficult it can be to get scientists to think many years into the future to identify measurements they cannot achieve with existing 3rd generation or upcoming linac-based FEL sources. ISAC suggests that one strategy would be to couple one

scientist at PF with one scientist outside PF to co-organize each a series of topical workshops. The scientific staff at PF should be fully engaged in formulating this future vision so they are positively motivated by the prospects. This effort should proactively engage the user community and relevant organizations and scientific societies.

Identify and fund a “core accelerator technologies” program at KEK to accelerate ERL development. PF should identify “core accelerator technologies” that will be needed for the ERL and work closely with KEK to build a cohesive, central R&D effort in these areas. PF should offer to KEK to partner in these efforts. This R&D effort should coordinate with accelerator efforts at other laboratories throughout Japan where appropriate. Adequate levels of support will be needed. PF should play a central role in pursuing external funding options and use its compelling science case to propel the cause.

Planning and Strategy. PF should develop a realistic, multi-phase project time line based on milestones and incremental successes for the ERL project. This should undergo rigorous technical, scientific and schedule review. ISAC believes that ERL project must build on such a strategy in order to convince the Japanese scientific and larger community that: 1) the facility goals will be achievable and based on accelerator technologies that will be proven by PF/KEK scientists, 2) the science will be compelling and advance Japanese society as a whole, 3) that KEK is one of only a few laboratories that can combine accelerator and x-ray skills and experience to succeed in this project, and 4) that PF will continue, in the interim years, to be a vital and growing piece of the SR community in concert with SPring-8 and other synchrotron radiation sources in Japan.

ISAC believes that PF should rename the “test facility” as a light source, calling the R&D project “phase 1” and pursue a plan “phase II” project that will see it to evolve beyond R&D into a cutting edge facility for scientific applications in the VUV/SX region. The original vision of PF - to provide two ERL machines spanning the VUV/SX and hard x-ray energy spectrum - should be discussed with KEK and the broader user community. ISAC suggests that it should become the “official” KEK vision for the future of photon sciences on the Tsukuba campus and could be viewed as one of the strategies for keeping KEK a competitive equal to other renowned accelerator laboratories in the world who have embraced photon sciences as both a key customer of accelerator technology and a driver for advances in the field.

It is very important to identify and name a “champion” for the ERL project. This should be a lead scientist who shares project management status with other KEK project managers. ISAC also encourages PF to seek international partners within the Asia-Pacific region for participating in R&D, developing and financing and utilizing the large ERL project. ISAC views this strategy as a very important opportunity to provide leadership in next generation source development in a region with growing strength in photon science applications.

5. PF ISAC – Processes and Recommendations

It is the experience of ISAC members with a number of other advisory bodies that a 2-year term appointment for advisors is too short for continuity and providing effective advice. Three or 2x2 terms are more effective and PF management is encouraged to take this into consideration. Membership should rotate on a staggered basis and in the first cycle this

can be phased in.

ISAC strongly supports the formation of the proposed review subcommittees and expresses its willingness to fully engage in this process. Scheduling should be such that the reviews are completed in a timely manner prior to the following ISAC meeting but need not be immediately preceding it. However, timely action is needed if at least some of these committees are to be formed to provide input before the next ISAC meeting.

ISAC feels that a meeting only once per year is very inadequate given the range of issues, decisions and opportunities facing PF and KEK. ISAC should meet at minimum as a full body twice per year. To help with practical considerations, we request that PF consider picking two months per year as targets for ISAC meetings, say April and October. Subcommittee meetings would interleave.

ISAC membership – ISAC recommends the addition of a strong accelerator scientist with an international perspective and reputation. Another area of future need is the area of time domain science and an additional member might be considered in this area. ISAC would be pleased to put forward names that might be considered by PF management.

6. Other Conclusions and Comments

ISAC observes that there are several areas where science leadership at PF needs further development (e.g. the PF Director also acting as head of the “Electronic Properties” Group). It is important in future strategic planning to pay close attention to these issues, appoint excellent people and delegate responsibilities to them.

While ISAC did not have time to fully consider the “XYZ” projects strategy, we find it very innovative and look forward to hearing more at a future meeting.

ISAC encourages PF to proceed with the development of the top-up mode of operation of the PF storage ring and implement it as expediently as possible.

ISAC appreciates the first look at the mission statement for the facility and the groups and looks forward to discussing it in more detail at the next meeting.

ISAC would like to applaud the PF senior management for its strong leadership and vision during this past year and looks forward to hearing additional progress at its upcoming Fall meeting.

ISAC thanks the PF staff for their excellent science and technical presentations and openness in discussion. Also we thank the administrative staff for their outstanding organizational and logistical support.

**Appendix – Contained in the Appendix to this ISAC
Committee Report are the following:**

1. List of ISAC members

2. Agenda of the ISAC Meeting – April 3-4, 2007

1. List of the Members of the PF ISAC Committee

Ernest Fontes – Cornell High Energy Synchrotron Source

Hidetoshi Fukuyama – Tokyo University of Science

Keith Hodgson – Stanford University, Chairperson of Committee

Hiromichi Kamitsubo – Riken Wako Institute

Ingolf Lindau – Stanford University

Gerhard Materlik – Diamond Light Source (absent for 4/3-4/07 meeting)

Kunio Miki – Kyoto University

Toshiaki Ohta – Ritsumeikan University

Volker Saile – University of Karlsruhe

Hiroyoshi Suematsu – Riken Harima Institute

2. Agenda of the 1st ISAC Committee Meeting

First PF ISAC Meeting

Date: April 3 – 4, 2007

Place: Room 244, Building No.4, KEK

PROGRAM

Tuesday April 3, 2007

- 9:00-9:10 Introduction and charge to the committee (O. Shimomura & K.O. Hodgson)
- 9:10-9:30 Photon Factory update (S. Wakatsuki)
- 9:30-11:10 Response to the PF External Review held in March 2006 (S. Wakatsuki)
Report on the preparation process of the strategic plan (S. Wakatsuki)
The new group structure (S. Wakatsuki)
New schemes for communication with user community and the PF Users
Organization (S. Wakatsuki)
Organization of ISAC subcommittees and the next ISAC sometime later in
FY2007 (S. Wakatsuki)
- 11:10-11:30 Coffee break
- 11:30-12:30 BL strategy and the new beam lines (PF-BL17A, BL3A, BL16A, PF-AR NW14A,
NW10A, a pharma BL) and consolidation of BLs (M. Nomura)
- 12:30-13:30 Lunch
- 13:30-15:00 Science topics
100-picosecond resolved X-ray studies at the beam line NW14A (S. Adachi PF)
Symmetry breaking and interatomic resonant Auger decay in molecular
inner-shell photoionization (A. Yagishita PF)
Structural study of orbital-ordered magnetite thin film (H. Wakabayashi PF)
Structural basis for knock-in-lock dynamics of RNA polymerization (O. Nureki,
Tokyo Inst. Tech.)
- 15:00-15:20 Coffee break
- 15:20-16:20 Present status of ERL project at KEK (H. Kawata)
Present status of ERL project –Light Source- (T. Kasuga)
- 16:20-17:00 Discussion with PF directorate (closed session)
- 17:00-18:00 Executive session (closed session)

Wednesday April 4, 2007

09:00-10:00 Executive session (closed session)

10:00-10:30 Summary discussion