Introduction

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On behalf of the staff of the Photon Factory we are pleased to present you Photon Factory Activity Report 2005. I was appointed as the Director of the Photon Factory in April 2006, but, as the custom goes, am writing this introduction to the Photon Factory Activity Report for the fiscal year 2005 and would like to address the challenges we face and the strategies we wish to pursue. This report covers the scientific and technological activities for the period between April 2005 and March 2006. The scientific highlights discussed in this report show the depth and diversity of research fields which have used the PF and PF-AR beamlines. The user program covers atomic and molecular physics, electronic states in condensed matter, structural sciences, materials sciences, radiation biology, and structural biology, to name but a few. The number of users registered for radiation safety surpasses 2,500, and annual visits for experiments 23,000 persons·days. Every year, circa 500 papers are published based on research carried out at the PF and the PF-AR.

Perspective

Synchrotron radiation (SR) research in Japan is facing fundamental challenges. On one hand, there are a large number of new and third-generation synchrotron facilities either operational or being constructed around the world. On the other hand, the successful initiation of the RIKEN X-ray Free Electron Laser (XFEL) project along with the corresponding projects overseas, Linac Coherent Light Source (LCLS) in Stanford and European XFEL, are changing the landscape of the X-ray light sources. Well-matured synchrotron facilities, such as the Photon Factory, are all in demand but will have to stay abreast with these new developments. Synchrotron-radiation-based science community has grown dramatically but at the same time the accountability and justification of large facilities are becoming important. We are fully aware of these changes in the SR sciences and are making efforts to propose and initiate a future project, an Energy Recovery Linac (ERL), while keeping the operation and further upgrading of the existing two rings. In April 2006, KEK formed an inter-departmental office for the development of ERL and later signed bilateral agreements with the Japan Atomic Energy Association and the Institute for the Solid State Physics of the University of Tokyo. The ERL office started on the design of a trial machine on KEK campus.

Upgrades of the PF and the PF-AR

The two upgrade projects at the Photon Factory in recent years have been concentrated on the two rings. In 2001 the upgrade of the PF-AR started with the strenuous efforts to improve the life time and the stored current, followed by construction of two new in-vacuum tapered undulator beamlines AR-NW2A and AR-NW12A. Following the success of AR-NW12A, which is an in-vacuum undulator MAD beamline for macromolecular crystallography completed in 2003, we have added another in-vacuum undulator beamline AR-NW14A for time-resolved studies, operational since autumn 2005 and a bending magnet beamline PF-AR NW10A for X-ray absorption spectroscopy (XAS) applications in 2005. As for the PF, the program to refurbish the PF lattice has resulted in the creation of four new short-straight sections, B28-B1, B2-B3, B14-B15 and B16-B17 which increased the number of straight sections from 7 up to 11 as well as elongation of the existing straight sections. Having completed them, we are now trying to build new beamlines to take advantage of the straight sections. A short-gap undulator beamline BL-17A came into operation at the PF in October 2005 with the scientific target being research in structural biology: micro-crystal structure analysis and structure determination using soft X-rays. In the area of industrial applications, we introduced a new scheme in November 2005 which enables access to the PF-AR for proprietary work. In May 2006, a new consortium for industrial applications in structural biology was formed with 9 leading companies in pharmaceutical and food industry.

PF External Review and International Science Advisory Committee

Immediately before the current PF management started, we had an international review committee on 13-15 March 2006, which reviewed our activities and directions proposed by the incoming PF management. The final report has been published on the web (http://pfwww.kek.jp/hyoka05/presen/index.html), but here I would like to discuss it briefly. The committee has commended the successful user programs and the stable operation of the two rings. One particularly pleasing comment is "The PF 2.5 GeV ring is indeed a modern 3rd generation synchrotron radiation accelerator and is competitive in many aspects with other state-of-the-art third generation sources

in its energy class in the world, especially serving a large base of X-ray users." At the same time, however, the committee has made a number of critical but constructive comments. Most importantly, they recommended that the incoming PF management is urged to move swiftly to devise a well-conceived and reviewed strategic plan that consolidates the number of beamlines down to 30-40, focusing on 5-10 carefully selected areas of excellence. We will prepare a full reply in due course, but I will describe some important new directions. They have also suggested that the PF should invest more in the vacuum ultra violet and soft X-ray (VUV-SX) fields, following the decision by the University of Tokyo not to pursue the proposal of constructing a third-generation VUV-SX SR facility. The university subsequently decided to form Synchrotron Radiation Research Organization with the emphasis on electronic properties and life sciences. We as well as SPring-8 signed bilateral memoranda of understanding with the University of Tokyo to cooperate on the plan. The PF external review also encourages us to form a regular and sustained international science advisory committee (ISAC). We are in the process of organizing a first ISAC towards the end of this fiscal year and will hold it regularly combined with several subcommittees specialized in specific science fields.

Reorganization of Beamlines

As mentioned above, the international review committee has made strong recommendation to reduce the number of stations from the current 69 down to 30-40. This is an extremely difficult task because any of the stations which might be considered for decommissioning has its own history and user community. We have started to prepare a strategic plan to strengthen the areas which the PF can do well, both in terms of applications but also of preparation for the future. Here, the best use of straight sections has certainly higher priority, and in particular we consider it desirable to reinvigorate the VUV-SX areas. But at the same time, we need to consider innovative (ingenious) schemes to maximize the output with the limited resources. We consider a system of Participating Research Teams, PRTs, or Collaborative Access Teams, CATs, may give part of the solution. The PF has several PRT stations which are run by external users. We will classify PRT beamlines into several categories with different degrees of responsibilities. We will then define terms of reference for each category between the facility and the user groups including the responsibility of hardware maintenance and refurbishment, user operation and external evaluation.

Reorganization of Groups

We also feel very strongly the need for reorganizing or reestablishing the group structure in preparation for the beamline refurbishment and consolidation. The shortage of the staff positions is a major concern; the average number of beamline staff per station is ~0.7, far below the international standard of 3 to 4. There are cases where a junior beamline staff is in charge of several stations and has to liaise with the user community alone. Very often, the human resources have to be thinly spread to cover the wide area of sciences with the result that some of the stations could not have been kept abreast with those in other more recent facilities and therefore in need of renovation. Unfortunately, under the current financial outlook, we cannot expect a massive increase of staff or operation budget, and therefore have to find innovative routes to keep the level of resources and expand them wherever possible. Applying for external funding is an obvious choice but the level of funding needed for beamline construction is not within easy reach of competitive grants in many research fields. A possible way forward is to team up with strong external research groups. There are successful examples in this direction in the PF: an ERATO project led by Prof. Koshihara of Tokyo Institute of Technology, Protein 3000, JST-Sentan (Frontier Technology Development Program) and SHIMPRO (Frontier in Materials Design, Synthesis and Measurements), which either has contributed to construction of beamlines or to development of instruments. It would be extremely difficult if there is only one beamline staff in one research area to do this, but having groups with critical masses will certainly facilitate collaboration with user groups.

PF User Organization and User Groups

A strategic plan for consolidation of beamlines, group reorganization, and preparation for the next light source will have significant impacts on user operation of the PF and PF-AR. We therefore believe it will be essential to proceed in collaboration with the SR user community. Currently there are 21 User Groups (UG) formed in a variety of contexts, some spontaneously and others in consultation with the PF. Many UGs are linked to particular experimental stations. The 21 UGs cover a wide range of research activities. We have started systematic discussions with the PF User Organization at various levels and also individual UGs. The discussions have started from general issues on relations between the User Organization and the facility, schemes to provide open forum for discussions, and individual scientific cases of beamline construction and consolidation.

We will intensify these activities to form a strategic plan for the next 5 years and I would like to ask you all to participate in the discussions to improve the facility and prepare for the future ahead.

Director
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