Introduction

Youichi Murakami

We are pleased to present Photon Factory Activity Report 2011. This report covers the research activities carried out at the Photon Factory (PF) facility in fiscal 2011 (April 2011 – March 2012). I was appointed Director of the Photon Factory in April 2012, and as is the custom, it is my pleasure to write this introduction of the report. First of all, on behalf of the staff of the PF I would like to express our deepest appreciation to the staff of both domestic and overseas synchrotron facilities, who supported us and offered our users beamtime after the Great East Japan Earthquake on March 11th, 2011. In particular, SPring-8 kindly assisted us by setting aside their beamtime for more than 100 PF users' experiments. Other domestic and overseas facilities also thoughtfully accepted PF users. In the end, 122 experiments were carried out in domestic facilities and 10 experiments in overseas facilities. The PF facility has been restored to its former state very quickly; the electron beam was accumulated in the PF and PF-AR rings on May and then test runs were carried out at both the PF and PF-AR for 6 weeks. During the summer shutdown, repairs to the PF, PF-AR rings and their beamlines were carried out and the user program was resumed in October. Although we are still in the process of recovering from the disaster, the user program began to run smoothly in 2012. Once again, we sincerely thank everyone who sent us letters and emails of consolation and support.

In fiscal 2011 we organized two PF symposiums, one in July and the other in March, because the 28th PF symposium in March 2011 had to be postponed because of the earthquake. At the PF symposium in July, the situation of reconstruction after the disaster and the recovery plans were reported, and the role of our research institute amid the difficult situation was discussed with many PF users. About 380 users got together to discuss the restoration after the disaster and how to continue their ongoing studies. One of the scientific topics in this symposium was the mineralogical characteristics of Itokawa particles recovered by the spacecraft Hayabusa; the fine particles were analyzed by diffraction and fluorescence measured at beamline 3A of the PF.

The Photon Factory (PF) started operation in 1982 as the first dedicated facility for synchrotron radiation in Japan, handling photons from VUV to X-rays. The inter-university research program also started in the same year. Thus, 2011 was the 30th anniversary of the PF. To mark the occasion, a ceremony was held at the PF symposium in March 2012. Professor Kora, who was the first director of the PF, talked about the background of the formation of the PF and interesting anecdotes from the early days. Everyone was impressed by the dedication of the PF staff and users for synchrotron radiation at the beginning of the PF project. Next, Professor Sasaki, who was the second director of the PF, delivered a lecture on the first work of insertion devices in Japan. He explained the importance of close collaboration between users and accelerator staff for the progress of synchrotron science. Finally Professor Hodgson, who was the first chairperson of the PF Scientific Advisory Committee, gave a lecture titled "The Photon Factory – Building on a Rich History for a Bright Future of Innovation and Discovery" in which he talked about the long collaboration between SSRL and PF.

The High Energy Accelerator Research Organization (KEK) has promoted the Energy Recovery Linac (ERL) project over the past decade. The ERL is the future X-ray light source designed based on state-of-the-art superconducting linear accelerator technology, which has been developed at KEK over many years. The high repetition rate, short pulse, high spatial coherence and high brightness of the ERL will enable the filming of ultrafast atomic-scale movies and determination of the structure of heterogeneous systems on the nano-scale. KEK is planning to construct the ERL in the latter part of this decade, and expects it to enter operation in the early 2020s. In addition, it is proposed that an X-ray free-electron laser oscillator (XFEL-O) with full coherence will be feasible by taking advantage of the unprecedented quality of the electron beam of the ERL. Construction of the XFEL-O is planned for the second phase of the ERL project. The conceptual design report (CDR) of the ERL was published in collaboration with many people from universities and national laboratories. The CDR includes enabling methodologies by the ERL, many science cases, and accelerator technology related to the ERL. The superb beam quality of the ERL will open up a new era of X-ray science by extending the capabilities of existing synchrotron X-ray sciences, and will also provide an opportunity for a paradigm shift from static homogeneous systems to dynamic heterogeneous systems to many users.

During the year we held many conferences on the ERL to examine the feasibility of various technical aspects of the accelerator such as the electron gun, superconducting cavity for the injector and main linac. The ERL Science Workshop II was held at KEK on April 2011 to discuss many scientific issues and to enable the ERL to help create a sustainable society. The first ERL symposium was convened in July to discuss the relationship between synchrotron science and society. The key theme of the symposium was “a step toward realizing a sustainable society”. The second ERL symposium was held in March 2012, at which Professor Negishi, Nobel laureate for Chemistry in 2010, gave a lecture on d-Block transition metals, which have great importance for our lives today. In October 2011 the international workshop ERL2011 was held at KEK as one of the Advanced Beam Dynamics Workshops of the 50th International Committee for Future Accelerators (ICFA) to promote international collaboration on high-energy accelerators and study the related problems.

The IMSS Symposium 2011 was held in December at Tsukuba International Congress Center. The Institute of Materials Structure Science (IMSS) is studying material and life sciences through the comprehensive use of multi-probes such as synchrotron radiation, neutrons, muons, and slow positrons. Every year, we organize the IMSS symposium focusing on cutting-edge quantum beam science, and this year’s symposium examined the prospects for quantum beam facilities and its sciences. The first half of the symposium was dedicated to ERL sciences: Professor Gruner presented science at the hard X-ray diffraction limit as a summary of the XDL2011 workshop and Professor Chen talked about solar energy research using X-ray transient absorption spectroscopy. In the second half of the symposium, presentations were made on recent studies on strongly correlated electron systems, focusing on electronic degrees of freedom (charge, spin, and orbital), electron correlation at surfaces and interfaces, organic electronic devices, and order and disorder in soft matter and bio-matter. These topics are being studied at the Condensed Matter Research Center (CMRC) of the IMSS, and CMRC researchers sparked vigorous discussion on the topics.

The 6th PF Science Advisory Committee (PF-SAC) meeting was held in October 2011 and discussed the following: 1) Earthquake recovery and refurbishment processes, 2) Relation between PF operation and KEK-B upgrade, 3) The second phase of the plan to refurbish the PF, 4) The two subcommittees: Condensed Matter and Materials Chemistry, 5) Transformation from PF-Kondankai to PF User Association, 6) The 3-GeV ERL, and so on. The SAC appreciated the management and staff of KEK and the PF for their efforts in recovering from the disaster and supporting our refurbishment plan, and made useful suggestions for the above issues. In particular, the SAC strongly endorsed KEK’s strategy of designing, building and operating the 3-GeV ERL as a future next-generation light source serving the broad scientific community and appreciates the rationale behind the decision to change the energy from 5 GeV to 3 GeV. As part of the PF-SAC activities, a subcommittee meeting on time-resolved science was held in February 2012. This was the first meeting of the subcommittee, which greatly evaluated and appreciated the scientific activities of PF-AR NW14A and provided important suggestions. The committee also strongly supports the scope and strategy of the beamline.

Finally, I would like to mention the PF User Organization, “PF-Kondankai”. The PF-Kondankai has a long history and has worked in cooperation with the PF. PF-Kondankai members are all power users of the PF and have worked together to achieve scientific results in a variety of academic disciplines and industrial fields. However, the percentage of PF-Kondankai members among all PF users was only 20%. The PF-SAC suggested that the PF-Kondankai should raise this proportion to become more effective in assisting the PF and its future projects. The PF-Kondankai extensively discussed its transformation to the PF User Association (PF-UA) in which all PF users become members automatically in order to represent the entire PF user community. This transformation took place in April 2012. The SAC welcomed the proposal for a major change of the users’ organization and fully supported a more independent user association with the broad membership of all PF Users. The SAC commended the PF management for this change which will make the PF user organization more in line with similar organizations at many international and domestic facilities.

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