Introduction

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During the fiscal year 2009, April 2009 to March 2010, the Photon Factory has continued its Ring and Beamline Refurbishment Program of the two synchrotron rings, the 2.5 GeV PF and 6.5 GeV PF-AR. The top-up operation at 450 mA has been a major improvement of the 2.5 GeV PF-ring while significant efforts have gone into the beamline development of several insertion device beamlines. The commissioning and first year operation of BL-16A, a soft-X-ray beamline with fast switching of two opposing circular and/or linear polarizations, and the constructions of BL-13A, another insertion device soft X-ray spectroscopy beamline for functional organic materials, and a low-energy SAD protein crystallography beamline BL-1A (see below) have progressed smoothly. During FY2009, BL-16A has already started to produce science outputs using the first Apple-II type undulator, installed in spring 2008. While X-ray magnetic circular and linear dichroism (XMCD/XMLD) experiments are the major applications of the beamline, 3D nano ESCA and resonant soft X-ray scattering experiments were also successfully performed on this beamline.

As explained in the last year's PF Activity Report, the Condensed Matter Research Center (CMRC) was inaugurated in April 2009. The Center has defined its four core areas of research, strongly correlated electron systems, materials under extreme conditions, soft condensed matter and biomolecules, and surface, interface & catalysis, and recruited young researchers and established strong collaboration links with neighboring institutes. It has played a major role in organizing the second IMSS Symposium, Frontiers in Surface and Interface Sciences, on November 17 & 18 in Tsukuba, which was attended by 137 scientists who discussed recent research on surface and interface of thin layers and artificial super lattices, etc. using synchrotron, neutron and muon beams.

Structural biology area has also been extremely productive with a number of research papers published in highly influential journals. One of the highlights is the influenza virus RNA polymerase structure solved by Prof. S.-Y. Park of Yokohama City University, which has paved the way for development of strain-independent anti-influenza virus drugs. Another example is from a national project of the MEXT, Targeted Protein Research Program (TPRP); Prof. M. Tanokura's group in the University of Tokyo determined the structure of abscisic acid receptor, a plant dehydration stress response receptor. This work was featured in the Science journal as one of the most influential discoveries of 2009. After the completion in April 2009, the Astaellas Pharma Beamline AR-NE3A has gone into full operation allowing fully automated continuous data collection from close to 300 crystals without human intervention. The low energy SAD beamline BL-1A construction also proceeded smoothly as part of the TPRP "Analysis Core" in collaboration with SPring-8/RIKEN, Hokkaido University, Osaka University, and Kyoto University.

A Light Source Subcommittee of the PF International Science Advisory Committee was held on February 25 & 26, 2010. This subcommittee was chaired by Dr. Efim Gluskin, a member of the PF-ISAC and reviewed the light source developments and operation of the PF and PF-AR rings. The Subcommittee critically reviewed the merger between the KEK Accelerator Laboratory and the PF Light Source Division in April 2009. They concluded that the merger has had very positive effects on the development of the future light source projects. In particular they commended the progress of the Compact Eergy Recovery Linac (cERL) project and strongly recommended acceleration of the 5 GeV class ERL project. On the other hand, they encouraged us to assess the feasibility of the KEK-X project, a plan to use part of the KEK-B ring for synchrotron radiation in conjunction with its upgrade. One important characteristic of storage ring facilities is mean time between failures (MTBF). Upon request of the PF-ISAC Light Source Subcommittee MTBF figures were calculated and it turned out that both PF and PF-AR rings have had remarkable MTBF figures: 170 to 230 hours for PF and 60 to 110 hours for PF-AR between 2006 and 2009, as compared to 60 to 150 hours at the third generation SR facilities.

Third Asian Science Camp was held from 2 to 8 August, 2009 in Epochal Tsukuba. Nine distinguished scientists including seven Nobel laureates were invited as lecturers. Prof. M. Koshiba is the president of the organizing committee along with other Nobel laureates. KEK including the PF staff and users have played major roles in the organization of this school. The Camp was attended

by highly motivated 182 students selected from Asian countries who studied intensively on specific themes with the lecturers and assisting staff during the week. Their Majesties the Emperor and Empress of Japan visited the Science Camp on the last day and viewed the 40 posters prepared by the students, and later attended the reception in the evening. I had an honor of explaining the posters to Their Majesties but had only an hour to preview them since the students finished the preparation only an hour so before their arrival, which made me painfully nervous. The process went smoothly mostly except on one occasion. It was left with me to choose which posters to explain and I prepared myself by picking posters mostly on materials and life sciences before their visit. Halfway through the procession Their Majesties noticed a poster on neutrino experiments and asked Prof. Koshiba who was accompanying us. I thought that I was saved because I expected that Prof. Koshiba would take this opportunity to tell them about his neutrino research. However, he waved to my direction suggesting that I should explain. This made me to explain neutrino science to Their Majesties in front of Prof. Koshiba! During the reception, Their Majesties stayed much longer than expected to talk to the young students from Asia.

The 27th PF symposium was held on March 9 & 10, 2010. This is an annual users meeting of the PF. We have been trying to reinvigorate this as a science forum for PF users to exchange recent results and new ideas using the PF. In the past several years the numbers of attendants have increased steadily and several hundred posters are presented and discussed. This year, Prof. Ada Yonath of Weizmann Institute, Israel, one of the three scientists who received Nobel Prize in Chemistry in 2009 for their research on the ribosome structures, and Prof. Herman Winick of SLAC gave special lectures which drew a very large audience and three rows of attendants had to stay standing in the back of the auditorium during the lectures. Thanks to their special lectures, PF Symposium this year drew a record high attendance, in total 405 participants and 290 poster presentations. Prof. Yonath described her lifelong research on ribosome structural analysis with many anecdotes and messages to young scientists and students. In 1987, she submitted one of the first three beamtime proposals to use the newly constructed Weissenberg Camera by Prof. Noriyoshi Sakabe for large unit cell protein crystals. She brought with her a cryogenic apparatus to freeze protein crystals to mitigate severe radiation damage. This was a pioneering development which paved the way for establishing the cryofreezing technique which is now used by every protein crystallographer around the globe. Since 1987 she used the PF beamline for about 10 years, which also benefited the Photon Factory enormously in learning her expertise of cryofreezing and the feedback to Prof. Sakabe's team to improve the beamlines. After her lecture at the PF Symposium, a Honorary Supreme Professorship was awarded to her from Prof. Atsuto Suzuki, Director General of KEK. During her visit, Prof. Yonath kindly accepted an interview by me with support from the TPRP office. The interview was published in the October 2010 issue of Chemistry Today (in Japanese). The interview lasted nearly two hours covering many topics ranging from her childhood, student days, and the path to ribosome research.

As mentioned above, owing to the merger between the KEK Accelerator Laboratory and the PF Light Source Division in April 2009, the cERL project has gained further momentum with an accelerated timeline of energy recovery at 35 MeV by the end of March 2013. East Counter hall with the vast floor space and adjoining three-story lab spaces has been renovated for the construction of the cERL. The energy of the cERL will be increased later by implementing a double loop scheme and additional super conducting RF cavities in the subsequent years. Based on the experience gained with the installation and initial energy recovery operation of the cERL, we will accelerate the preparation of the detailed design of a large ERL facility. During FY2009, the ERL project has also expanded its scope with the addition of X-ray FEL oscillator (XFEL-O) proposed by Prof. Kwang-Je Kim of APS, Argonne as its critical component. Using a high quality electron beam accelerated by superconducting cavities XFEL-O is expected to produce X-ray beams with peak brightness rivaling SASE XFEL and unprecedented average brightness at 1 MHz and 1 meV bandwidth. In collaboration with Dr. K.-J. Kim, we are developing a scheme of integrating the XFEL-O with the X-ray ERL. Two workshops were held in KEK to discuss the project with emphasis on science case, one on 5 GeV class ERL on July 9-11, 2009, and the other on XFEL-O on Dec. 21, 2009. The science case will be further developed in the following years along with the machine design.

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