Preface

This volume is the third issue of the SPring-8 Research Frontiers and presents the results of the most impressive experiments carried out at the SPring-8 facility from September 1999 to June 2000. This corresponds to the users period of 1999B (from Sep. 29 to Dec. 24, 1999) and 2000A (from Jan. 19 to June 16, 2000). Beam time of 430 shifts (174 shifts in 1999B and 256 shifts in 2000A) were dedicated to more than 770 user experiments. These were performed by over 6000 users via 24 beamlines (17 public, 4 JAERI/RIKEN and 4 contract beamlines).

Reflecting the high performance of the storage ring and development of high performance instrumentation and experimental technology relating to the outstanding physical characteristics of synchrotron radiation, research activities at SPring-8 have increased both in their breadth and significance leading to a number of important findings.

The experiments covered in this report are classified by topic into six groups: Life Science, Diffraction and Scattering, XAFS, Spectroscopy, Instrumentation and Techniques, and Industrial Applications. A total of 753 experiments were pursued resulting from 1054 proposals. These experiments are separated by topic as follows with the number of proposals given in parenthesis: 150 (176) in Life Science, 216 (360) in Diffraction & Scattering, 86 (155) in XAFS, 61 (87) in Spectroscopy, 59 (77) in Instrumentation & Techniques, and 181 (199) in Industrial Applications. The above number does not include experiments pursued mainly by the in-house staff of SPring-8.

Six experiments in the field of Life Science are presented in this volume. An undulator beamline for the structural analysis of macro-molecular assemblies became operational during this period. Furthermore, data collection for MAD phasing is now a nearly routine procedure of all beamlines used in the study of structural biology. Many outstanding results have been obtained through use of these beamlines. In addition to structural analysis, time-resolved X-ray diffraction was studied at the small-angle X-ray scattering station of BL45XU. Additionally, a high-resolution X-ray CT (computer tomography) imaging technique has been developed with potential use in medical applications.

In this volume seven reports are selected from the Diffraction and Scattering group. In addition to the existing beamlines, two new beamlines, BL02B2 and BL04B2, became operational in 1999. It should be emphasized that four out of the seven studies in this group were performed using newly developed beamlines. Reflecting its high performance in hardware as well as the newly developed method of MEM/Rietveld analysis, many outstanding results were produced at BL02B2 in a very short time. Through use of beamline BL04B2 it is possible to obtain an accurate structure factor up to high scattering Q of 35 A^{-1}.

Five experiments are selected from the XAFS group. XAFS analysis has become the standard method of clarifying the relationship between the function and the atomic and/or electronic structure of materials in order to develop more useful materials. Development of the XAFS method continues using a number of specific features of SPring-8, such as high brilliance, polarization and microbeam, and pursuing in situ experiments under extreme conditions.

Spectroscopic studies at SPring-8 cover Compton scattering, magnetic X-ray scattering, magnetic circular dichroism, spectroscopy of atoms and molecules, photoemission spectroscopy of solids, and infrared spectroscopy. Although SPring-8 is the world's most advanced radiation source in the hard X-ray region, it also provides a highly brilliant and very stable soft X-ray beam, and is one of the most powerful tools available in photoemission spectroscopy. Three experiments from the Spectroscopy group are presented in this volume.

Three experiments are presented from the Instrumentation and Techniques group. The development of microbeam optics has been pursued preferentially at SPring-8 and submicron spatial resolutions have been realized by using various types of focusing lenses. A new type of sagittal focusing bender was developed for the standard monochromator of SPring-8 bending magnet beamline.

A new section entitled "Industrial Applications" is added in this issue of SPring-8 Research Frontiers. Industrial application of synchrotron radiation is one of the major aims of the SPring-8 project and the coordinator system has recently been introduced in JASRI to promote the industrial applications in SPring-8. It should be noted that 24% of all the experiments in 1999B and 2000A periods were performed in conjunction with industry.

In 2000, a 27 m-long undulator was installed in the storage ring and the world's most brilliant X-ray was successfully extracted. As the initial ring had no long straight sections for the long undulators, it was converted to the new ring with long magnet-free spaces before installing the long undulator. During the summer shut down time in 2000, the initial lattice structure (phase-I optics) of the storage ring was changed to the new lattice structure (Phase-II optics) that has four long magnet-free straight sections by rearranging the focusing magnets. Remodeling of the lattice structure and beam commissioning was successfully completed in the middle of September. The beam performance achieved by the Phase-II optics is almost nearly identical to that of the phase-I optics. Works performed toward the improvement of the accelerator performance and development of insertion devices and detectors are also presented in this issue along with the status reports of the facility in 2000.

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