Preface

The Synchrotron Radiation Laboratory (SRL) of the Institute for Solid State Physics (ISSP) has been cooperating with the Synchrotron Radiation Research Organization of the University of Tokyo to operate the BL07LSU soft X-ray beamline and its experimental end stations at SPring-8 since 2006. The beamline has a 27-m-long polarization-controlled undulator and monochromator covering the photon energy range from 250 eV to 2 keV, with an average photon flux of 10^{12} photons/s. Since 2009, the SRL staff has been playing an essential role in promoting the ISSP's joint research program for domestic and international users of the BL07LSU. The three end stations—ambient pressure X-ray photoemission spectroscopy, three dimensional nanoESCA, and the high-resolution soft X-ray emission spectroscopy stations—have excellent ability to operate under high pressure (~20 mbar), high spatial resolution (~70 nm), and high energy resolution ($E/\Delta E \approx 10{,}000$), respectively. During FY2021, as the COVID-19 pandemic persisted, we conducted joint research experiments while applying infection control measures in accordance with the SPring-8 facility policy. All of the experiments were carried out as scheduled, except for those involving the international user groups, who could not come to Japan. We thus conducted the experiments on their behalf via remote connection.

To utilize the characteristics of BL07LSU, new challenges were undertaken, including the first observation of rotational X-ray magnetic linear dichroism (XMLD), which is a soft X-ray magneto-optical measurement during rotation of the angle of the linearly polarized beam and the X-ray magneto-optical Kerr effect when utilizing polarization switching. A soft X-ray XAFS imaging experiment has been launched using a 50 nm focused beam produced by a Walter-type soft X-ray focusing mirror system. This experiment serves as both research and development for the next-generation synchrotron radiation facility in Sendai and a way to take advantage of the characteristics of BL07LSU. A high-resolution soft X-ray charge-coupled device detector has been introduced for soft X-ray emission spectroscopy to obtain a resolution of $E/\Delta E > 10000$. The ambient-pressure photoemission spectroscopy system has also been improved to increase the measurement pressure to 100 Torr. All of these improvements were made as part of research and development for the upcoming synchrotron radiation facility. We have also expanded our activities to include the time-resolved soft X-ray magneto-optical effect and nonlinear spectroscopy experiments using a focused beam of several hundred nanometers at the X-ray free electron laser facility SACLA.

The SRL will terminate the joint research program at SPring-8 in the first half of 2022 and transfer most of the instruments to the new facility. In addition, SRL will continue to develop a novel soft X-ray imaging system that can most effectively make use of the new light source.

In addition to the cutting-edge activities using synchrotron radiation and SACLA, the SRL has promoted the scientific use of laser-based high-harmonic generation in the vacuum ultraviolet and soft X-ray regions at the Kashiwa campus. Since 2015, the SRL has operated a joint research program of the high-resolution laser spin- and angle-resolved photoelectron

spectroscopy (SARPES) system, which is designed to provide high-energy (1.7 meV) and -angular resolutions with high-efficiency spin detectors for various types of solids, such as spin-orbit coupled materials and ferromagnetic materials.

Our goal is to provide users with a platform that uses both synchrotron radiation and high-harmonic laser generation through strong collaboration with other LASOR group members.

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Yoshihisa Harada

Director of SRL-ISSP