

PREFACE

We are pleased to announce the release of SPRING-8/SACLA Research Frontiers 2024, now available exclusively online. This marks the first issue not published in print.

JASRI's mission is to support users and ensure transparent and fair selection of experimental proposals as the user promotion organization for SPRING-8 and SACLA, registered with the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT). Another key mission of JASRI is to manage SPRING-8 and SACLA, which are owned by RIKEN. In this role, JASRI works closely with RIKEN to operate and manage both facilities, located on the same campus. The synergy between these world-class facilities continues to drive groundbreaking scientific achievements.



In 2024, SPRING-8 welcomed over 15,000 users who carried out more than 2,000 experiments. Currently, SPRING-8 users publish over 1,100 research papers each year, while SACLA users publish approximately 100 research papers annually.

Notably, several SPRING-8 and SACLA users were awarded prestigious prizes in 2024 for their achievements in science and technology. Among them, Professor Isao Tanaka (Kyoto University) was awarded the Medal with Purple Ribbon in the fall of 2024 for his contributions to new theory and technological innovation in the pioneering research field of "Quantum Materials Design." Professor Toru Wakihara (University of Tokyo) received the Ceramic Society of Japan Academic Award for his contributions to the application of ceramic processing to zeolite science through PDF analysis at SPRING-8. Professor Hitoki Yoneda (The University of Electro-Communications) received the Photonics and Quantum Electronics Achievement Award from the Japan Society of Applied Physics (JSAP) for his contributions to the realization of the shortest wavelength (0.15 nm) X-ray atomic laser.

This volume also includes two comprehensive review articles. The first, by Professor Hiroshi Sawa (Nagoya Industrial Science Research Institute), introduces his group's ultra-precise valence electron density analysis. They successfully extracted only valence electron density (VED) within a crystal using their developed core-differential Fourier synthesis (CDFS) method. The second review, by Dr. Takeshi Morikawa (Toyota Central R&D Labs.), describes his group's recent advances in artificial photosynthesis using solid-state semiconductors and molecular metal complexes. The team performed angle-resolved HAXPES and *operando* XAS at SPRING-8, as well as femtosecond time-resolved X-ray absorption near-edge structure (TR-XANES) at SACLA, to investigate and improve the structure and function of the artificial photosynthetic systems.

The main part of this volume features research highlights from users of SPRING-8 and SACLA, presenting the essence of their results across various fields such as Life Science, Physical Science, Chemical Science, Earth & Planetary Science, and Industrial Applications. Additionally, the second part contains principal activity reports on SPRING-8/SACLA facilities, provided in the Accelerators & Beamlines Frontiers and Facility Status sections.

I am very grateful to the many authors and experts who contributed their papers to this volume. Special thanks are due to Dr. Toyohiko Kinoshita, Ms. Marcia Obuti-Daté and the members of the editorial board for their continuous efforts.

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