

**Inter-University Research Institute Corporation
High Energy Accelerator Research Organization (KEK)
Photon Factory Hybrid Light Source
(PF-HLS)**

KEK is promoting PF-HLS project, the next light source

The High Energy Accelerator Research Organization (KEK) designs and installs accelerators for specific purposes and conducts research in a wide range of fields such as particle physics, nuclear physics, materials science and life science, together with university researchers. For more than 40 years since the first beam of 1982, KEK's synchrotron radiation facility, the Photon Factory, has achieved remarkable research results, including its contribution to the structure determination of the ribosome, the subject of the Nobel Prize in Chemistry. It has also created innovative technologies such as the in-vacuum undulator, which has spread to synchrotron radiation facilities all over the world. KEK has decided to move forward with plans for the Photon Factory Hybrid Light Source (PF-HLS), a synchrotron radiation multi-beam facility, as an essential research infrastructure for the purpose of Japan's leadership in materials and life sciences for the next 100 years. This facility is a challenging one that integrates all the capabilities of synchrotron radiation. We would like to realize this dream of researchers to elucidate the origin of the functions of materials and life, and to contribute to the realization of a sustainable society. We would be grateful for your support.



Masanori Yamauchi
Director General of KEK

Mission of PF-HLS

Through research and development, we will supply new technologies and human resources to lead the world's synchrotron radiation science, and continue the Photon Factory's mission of promoting diverse application research on materials and life.

Configuration of PF-HLS

The facility is a hybrid light source with a 2.5 GeV/5.0 GeV energy-selective storage ring and a superconducting linac.

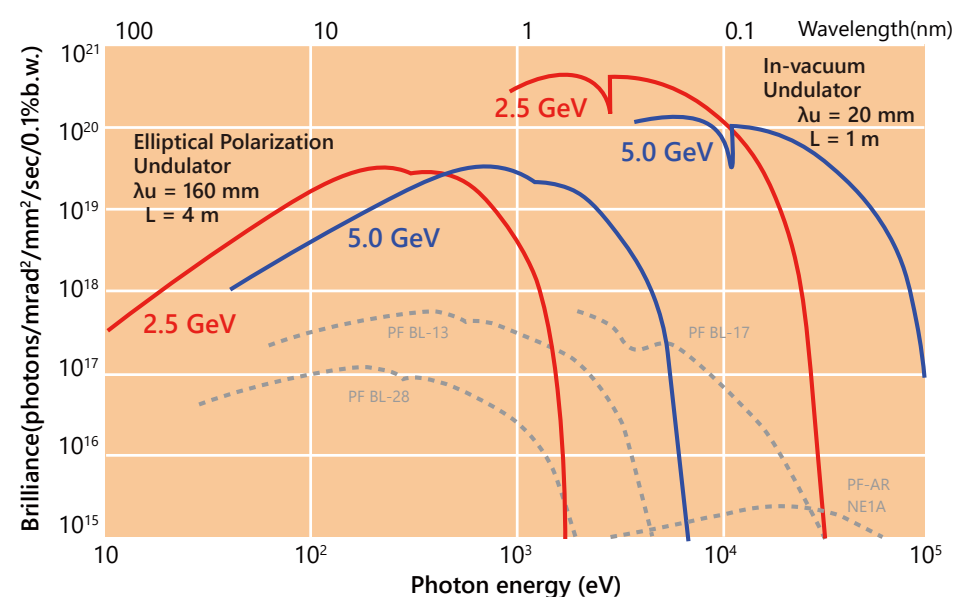
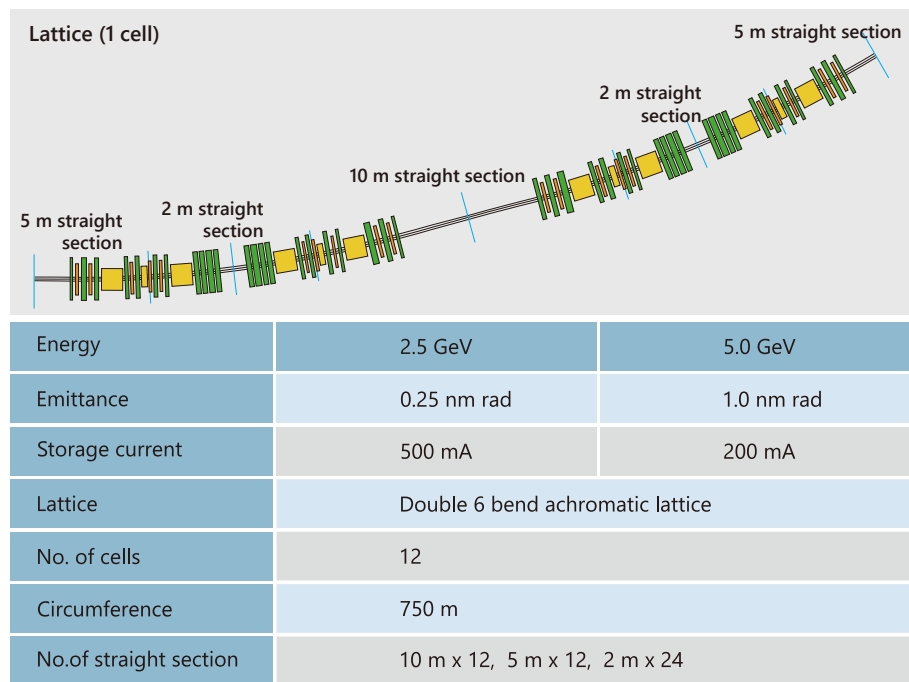
Features of PF-HLS

- High-brilliance synchrotron radiation over a wide wavelength range is available due to the 2.5 GeV/5.0 GeV energy-selective storage ring. **New!**
- SR beams* from the storage ring and SP beams* from the linac are both available. **New!** *Storage (SR), Single Pass (SP)
- The deepening, fusion, and creation of research fields and methods will be promoted.
- PF-HLS will accept over 5,000 users per year, a 50~100% increase over the existing facility.
- PF-HLS will both increase annual operating hours by 10% and reduce power consumption by 25~35%, compared to the existing facility.

Performance of the storage ring

(Tentative parameters as of Sep. 2023)

The plan includes the early construction of a uniquely designed storage ring with a straight section for insertion devices (undulators, wigglers, etc.) and the flexibility of operation necessary for their utilization.

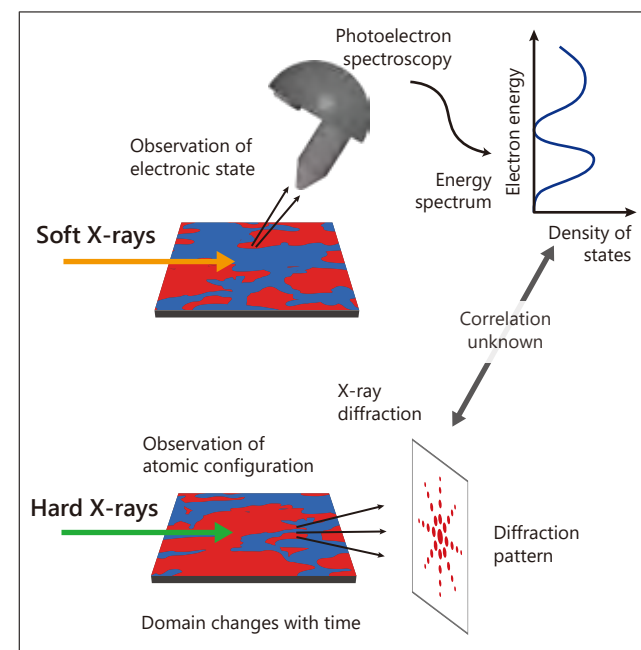


Synchrotron radiation multi beam reveals materials and life

Physical phenomena such as superconductivity and ferromagnetism, chemical reactions in catalysis and batteries, and diverse and complex life processes ... All of these are heterogeneous in time and space. The multi beam experiment will pioneer new methods to elucidate the origins of these functions.

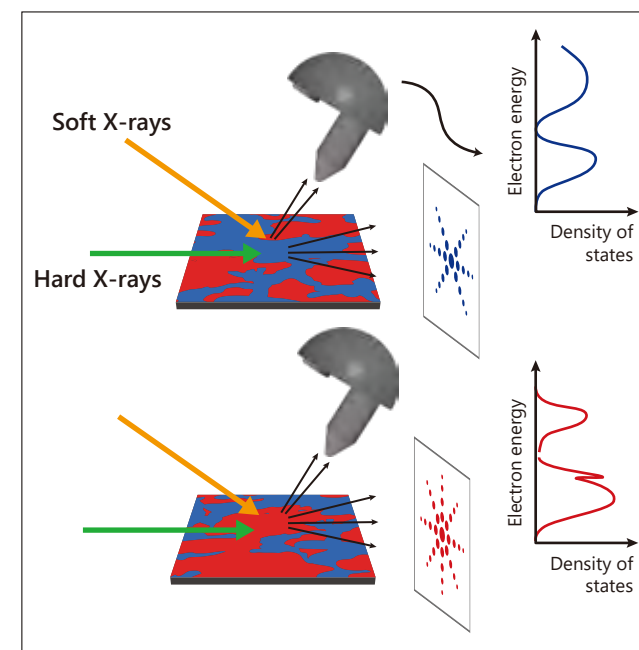
① SR single beam experiment

A wide wavelength range is available on a single beamline. This expands the targets and methods and promotes the **deepening** of wide fields and methods.



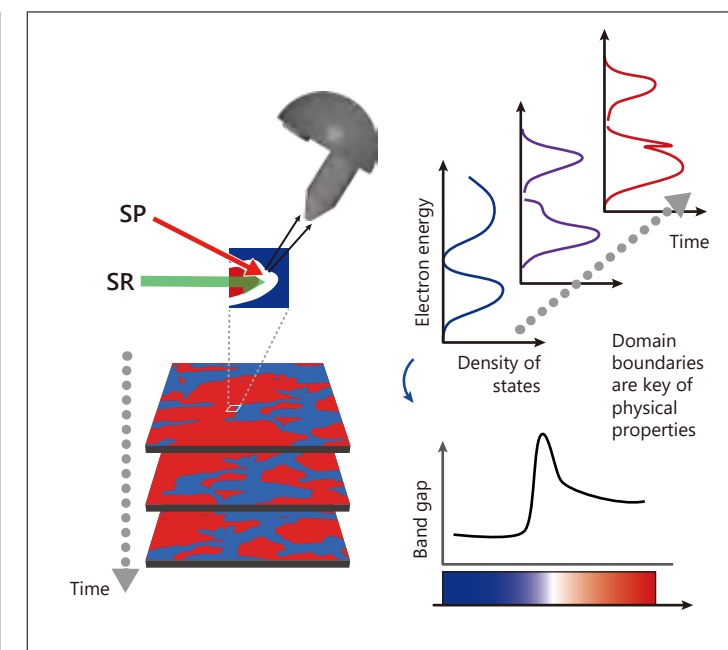
② SR + SR multi beam experiment

The electronic state and atomic configuration can be obtained simultaneously, providing a correlation between function and structure. Collaboration promotes the **fusion** of fields and methods.

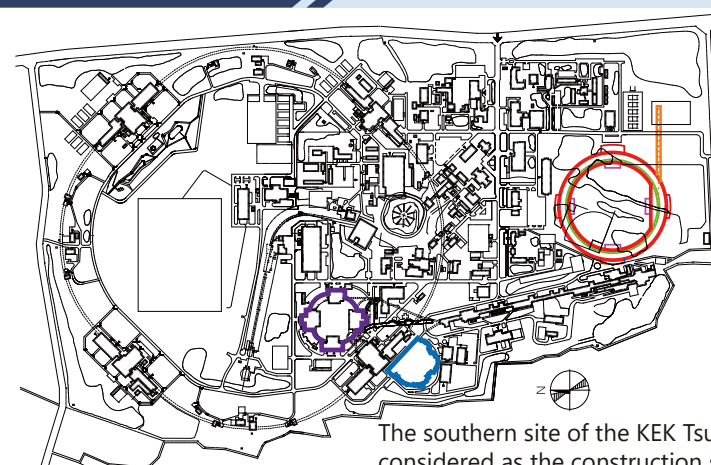


③ SR + SP multi beam experiment

Qualitatively novel methods using the high spatio-temporal resolution of the SP beam, such as domain boundary observation and pump-probe experiments, will facilitate the **creation** of new knowledge.



Construction site



- PF-HLS
- SC linac
 - Storage ring
- Existing facilities
- PF
 - PF-AR

The southern site of the KEK Tsukuba Campus is being considered as the construction site.

Annual plan

FY	1	2	3	4	5	6	7	8	9	10	11	12
Storage ring	Design, development, prototyping		Manufacturing, construction			Commissioning, experiment						
Beamline						Construction and relocation						
SC linac	Design, development, prototyping								Manufacturing, construction		Commissioning, experiment	

First, a storage ring will be constructed, then new beamlines will be built and relocated (the existing facility will be closed), followed by the superconducting linac.

Efforts to realize PF-HLS

R&D at the existing facility

The three academic synchrotron radiation facilities (PF, UVSOR, and HiSOR) have started construction of the R&D beamline, the BL-11, at the Photon Factory, as a joint project. This beamline allows for a highly flexible arrangements, for example, a sample is irradiated with two distinct beams simultaneously. It will serve as a demonstration site for synchrotron radiation multibeam experiments. To make space for the R&D beamline, we are constructing a new soft and tender X-ray beamline, BL-12A, which has the functions of the three closed beamlines, BL-11A, B, and D, and will be ready for use during FY2023. This beamline will be able to irradiate the same sample with over a wide wavelength range of synchrotron radiation.



Survey of the proposed site for the construction of the R&D beamline (August 2023). The removal of the former BL-11A, B, and D has been completed and some of the equipment will be moved to newly constructed BL-12A.

Photon Factory Project Promotion Committee

KEK established the Photon Factory Project Promotion Committee in October 2021. The committee consists of more than 30 members, including experts from outside of KEK, and mainly discusses the promotion of the successor facility of the Photon Factory. This committee is open to anyone who is interested in.

Workshops and Schools

This plan is strongly supported by the PF User Association (PF-UA). In FY2022, PF-UA and the three academic facilities (PF, UVSOR, and HiSOR) jointly held the PF workshop "Construction and Utilization of R&D Beamlines," which was attended by about 250 researchers who proposed and discussed multibeam experiments beyond the framework of their fields and methods. For effective use of multibeam, it is important to be familiar with multiple fields and methods. A school for learning about fields and methods outside of specialty is being planned by PF-UA.

At an academic facility like KEK, students are involved in activities such as an advanced R&D, while giving concrete form to their free ideas and developing highly original research. I believe that the human resources trained in such a process will be the future leaders of science in Japan. Since it started operation in 1982, PF has made significant contributions to the development of science and society through various upgrades. We strongly hope that every efforts and achievements, as well as our enthusiasm will lead to the realization of "PF-HLS" that is both highly advanced and versatile enough to accept a wide range of research fields.



President of PF-UA / The University of Tokyo
Yoshio Takahashi, Professor

