SPring-8

I. Introduction

SPring-8 was stably operated throughout FY2020 with the total operation time of the accelerator complex and the total user beam time of 5284.6 h and 4309.0 h, respectively, and a total downtime of 7.4 h. SPring-8 had to complete all its operations by the middle of February 2021. (Because of the rapid spread of COVID-19, user operations at SPring-8/SACLA had been suspended from 11th April to 15th June 2020.)

Concerning the contract beamlines, there were two interim reviews conducted for Hyogo BM (BL08B2, Hyogo Prefecture) and Hyogo ID (BL24XU, Hyogo Prefecture), and the project was authorized to continue. Upon the expiration of their contract terms, reviews were also conducted for Laser-Electron Photon (BL31LEP, Research Center for Nuclear Physics, Osaka University), and RISING II BL28XU, Kyoto University), and their proposals for the next term were approved. On the other hand, Laser-Electron Photon (BL33LEP, Research Center for Nuclear Physics, Osaka University) was recommended to be terminated.

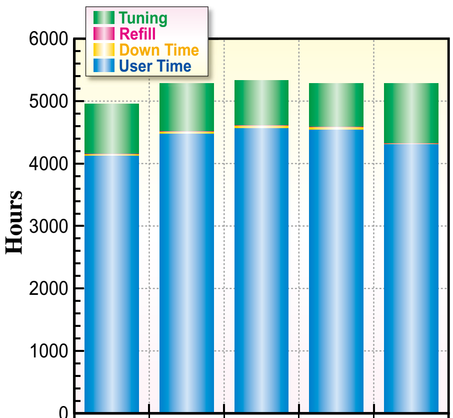
At present, the number of SPring-8 users is as high as 13,000, all of whom are members of the SPring-8 User Community (SPRUC).

It is important for SPring-8 to jointly organize scientific events with SPRUC, such as the SPring-8 Symposium, to facilitate dialogue between users and the facility staff. In 2020, the SPring-8 Symposium was held online on September 18 owing to COVID-19, with a participant number of 391. SPring-8 also facilitates communication between users and industry. The Joint Conference on Industrial Applications of SPring-8 was held in Hyogo Prefecture on September 3–4, 2020, with 232 participants (126 online participants). As part of its continuous effort towards fostering human resources in synchrotron sciences, SPring-8 organized the 20th SPring-8 Summer School with 32 students of graduate schools nationwide, in cooperation with University of Hyogo, Kwansei Gakuin University, the University of Tokyo, Okayama University, Osaka University, Japan Atomic Energy Agency, National Institutes for Quantum and Radiological Science and Technology, and RIKEN. Furthermore, SPring-8 and SPRUC organized the 4th SPring-8 Autumn School with 47 participants, which included university students and corporate researchers.

II. Machine Operation

In FY2020, the SPring-8 operation of beam injection from the SACLA linac to the storage ring was started. The total operation time of the entire SPring-8 accelerator complex was 5284.6 h. The operation time of the storage ring was 5274.8 h, 81.7% of which (4309.0 h) was devoted to SR experiments. Most of the user time was taken up by beam accumulation and topping-up by beam injection from the SACLA linac. There was no serious machine trouble in the storage ring that might have led to interruptions of user time for more than two hours. The total downtime caused by failures amounted to 7.4 h, which accounted for 0.17% of the total user time. The considerably shorter downtime than in previous years has led to an excellent storage ring availability of 99.7%. The availability this year was calculated by excluding, from the planned user time, a certain period when normal user operation was not available owing to the COVID-19 state of emergency. For 99.4% of the user time in FY2020, the stored beam current was maintained at 100 mA by the top-up operation wherein the stored beam was filled up on demand at any time. Extreme stability of better than 0.1% in the light source intensity was achieved by the top-up operation. The operation statistics of SPring-8 for the last five fiscal years are shown in Fig. 1.

The large variety of operation modes for the SR experiments is one of the characteristics of SPring-8. The operation modes are classified into two types: the several-bunch and hybrid-filling modes. The several-bunch mode consists of equally spaced bunches or trains of bunches, for example, 203 bunches or 29 trains of 11 bunches. The hybrid-filling mode is composed of a long train of bunches and isolated single bunches. The operation modes of SPring-8 are listed in Table 1 with the share of each operation mode in FY2020. In the operation with beam injection from the SACLA linac, the spurious bunch sweeping system in the SACLA linac and the bunch cleaning system in the storage ring are activated to maintain a sufficient isolated bunch purity. Table 2 shows the beam parameters of the storage ring.



	FY2016	FY2017	FY2018	FY2019	FY2020
Accelerator Operation Time	4951.7	5281.6	5329.8	5285.7	5284.6
Storage Ring Operation Time	4941.1	5270.4	5316.7	5271.2	5274.8
Tuning & Study (Acc. & BL)	803.1	769.6	721.8	701.7	964.6
Refill	3.4	4.6	5.3	5.6	3.6
Down Time	23.1	28.7	43.1	40.5	7.4
Mean Time Between Failures	229.2	194.7	168.9	206.3	718.2
Achieved User Time	4125.5	4478.7	4559.6	4537.9	4309.0
Planned User Time	4152.0	4512.0	4608.0	4584.0	4464.0
Availability (%)	99.4	99.3	98.9	99.0	99.7

Fig. 1. Operation statistics for last five fiscal years.

Table 1. Operation modes in FY2020

	Single bunch current (mA)	Share of operation time (%)
203 bunches		32.6
4 bunch-train × 84		14.0
11 bunch-train × 29		14.6
1/7-filling + 5 single bunches	3	20.8
2/29-filling + 26 single bunches	1.4	5.1
1/14-filling + 12 single bunches	1.6	0
4/58-filling + 53 single bunches	1.0	0
11/29-filling + 1 single bunch	5	12.9

Table 2. Beam parameters of SPring-8 storage ring

Energy [GeV]	8
Number of buckets	2436
Tunes (ν_x / ν_y) 41.14 / 19.34	
Current [mA]:	
single bunch	12
multi bunch	100
Bunch length (σ) [psec]	13
Horizontal emittance [nm·rad]	2.4*
Vertical emittance [pm·rad]	4.8*
Coupling [%]	0.2
RF Voltage [MV]	14.4** ~ 16
Momentum acceptance [%]	3.2 (~256 MeV)
Beam size (σ_x / σ_y)* [μm]	
Long ID section	333 / 7
ID section	316 / 5
BM1 section	94 / 12
BM2 section	100 / 12
Beam divergence (σ_x' / σ_y')* [μrad]	
Long ID section	8 / 0.7
ID section	9 / 1.0
BM1 section	58 / 0.5
BM2 section	68 / 0.5
Operational chromaticities (ξ_x / ξ_y)	+2 / +2***
Lifetime [hr]:	
100 mA (multi bunch)	~250
1 mA (single bunch)	~30
Horizontal dispersion [m]:	
Long ID section	0.153
ID section	0.146
BM1 section	0.039
BM2 section	0.059
Fast orbit stability (0.1 – 200 Hz) [μm]:	
horizontal (rms)	~4
vertical (rms)	~1

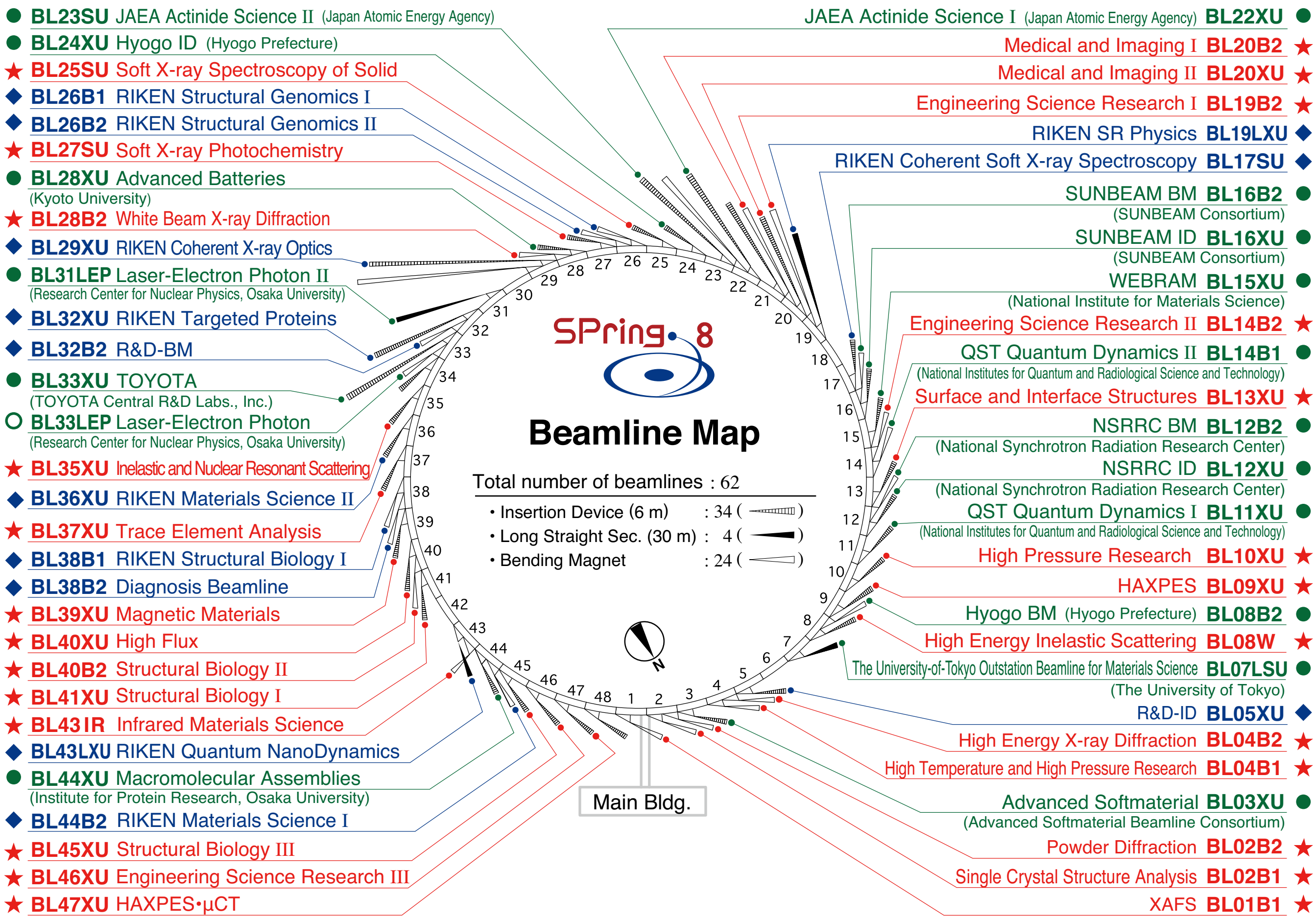
* Assuming 0.2% coupling
** Power saving mode
*** With bunch-by-bunch feedback

III. Beamlines

The SPring-8 storage ring can accommodate up to 62 beamlines: 34 insertion devices, 4 long undulators, and 24 bending magnets. At present, 57 beamlines are in operation, covering a wide variety of research fields involving synchrotron radiation science and technology. The beamlines are classified into the following three types.

(1) Public Beamlines (26 beamlines operating),
(2) Contract Beamlines (17 beamlines operating), and
(3) RIKEN Beamlines (13 beamlines operating).

There are now 26 public beamlines in full operation. The beamlines that have been proposed and constructed by external organizations, such as universities, research institutes, private companies and consortiums, are called contract beamlines and are used exclusively by the contractors for their own research purposes. At present, 17 contract beamlines are in operation. The beamlines constructed by RIKEN or transferred to RIKEN, except for public beamlines, are called RIKEN beamlines and are mainly used for RIKEN's own research activities, with partial availability for public use. RIKEN is now operating 13 beamlines. To illustrate the beamline portfolio of SPring-8, a beamline map is shown in Fig. 2 together with the beamline classification. The research fields of each beamline are presented in Table 3.



BL: Beamline
B1, B2: Bending Magnets
XU: X-ray Undulator
SU: Soft X-ray Undulator
W: Wiggler

IR: Infrared Radiation
LEP: Laser-Electron Photon
LXU: Long-length X-ray Undulator
LSU: Long-length Soft X-ray Undulator

★ : Public Beamlines
● : Contract Beamlines
◆ : RIKEN Beamlines

○ : Under removal work

WEBRAM: Wide Energy Range Beamline for Research in Advanced Materials
NSRRC: National Synchrotron Radiation Research Center, Taiwan
RISING: Research & Development Initiative for Scientific Innovation of New Generation Batteries

Fig. 2. Beamline map.

Table 3. List of beamlines

BL #	Beamline Name	(Public Use) or (First Beam)	Areas of Research and Available Techniques
★ Public Beamlines			as of April 2021
BL01B1	XAFS	(Oct. 1997)	XAFS in wide energy region (3.8 to 113 keV). XAFS of dilute systems and thin films. Quick XAFS with a time resolution of seconds to tens of seconds.
BL02B1	Single Crystal Structure Analysis	(Oct. 1997)	Charge density study and crystal structure analysis from single crystal X-ray diffraction. (X-ray energy range: 8 – 115 keV)
BL02B2	Powder Diffraction	(Sept. 1999)	Crystal structure study by Rietveld method, and *in situ* powder diffraction experiment under various conditions. (X-ray energy range: 12 – 37 keV)
BL04B1	High Temperature and High Pressure Research	(Oct. 1997)	High temperature and high pressure research with the multi-anvil press by powder X-ray diffraction, radiography and ultrasonic measurement.
BL04B2	High Energy X-ray Diffraction	(Sept. 1999)	Pair distribution function analysis for glass, liquid, and amorphous materials. High-energy X-ray total scattering. Containerless levitation.
BL08W	High Energy Inelastic Scattering	(Oct. 1997)	Magnetic Compton scattering. High-resolution Compton scattering. High-energy Bragg scattering. High-energy fluorescent X-ray analysis.
BL09XU	HAXPES	(Oct. 1997)	Hard X-ray photoelectron spectroscopy (HAXPES). Electronic state analysis with tunable energy (resonant HAXPES) and high energy resolution. Depth analysis of angle resolved HAXPES with wide acceptance lens.
BL10XU	High Pressure Research	(Oct. 1997)	Structure analysis and phase transitions under ultrahigh pressure (DAC experiment). Earth and planetary science.
BL13XU	Surface and Interface Structures	(Sept. 2001)	Atomic-scale structural analysis of surfaces and interfaces of crystalline materials, ultrathin films, and nanostructures. Surface X-ray diffraction (SXRD). Microbeam diffraction.
BL14B2	Engineering Science Research II	(Sept. 2007)	X-ray Imaging. XAFS in wide energy region (3.8 to 72 keV). XAFS of dilute systems and thin films.
BL19B2	Engineering Science Research I	(Nov. 2001)	Residual stress measurement. Structural analysis of thin film, surface, interface. Powder diffraction. X-ray topography. Ultrasmall angle X-ray scattering.
BL20XU	Medical and Imaging II	(Sept. 2001)	Microimaging. Micro-/nano-tomography, phase-contrast microtomography, X-ray diffraction tomography (XRD-CT), hard X-ray microbeam/scanning microscopy, imaging microscopy, coherent X-ray optics, and other experiments on X-ray optics and developments of optical elements. Refraction-enhanced imaging. Ultrasmall angle scattering.
BL20B2	Medical and Imaging I	(Sept. 1999)	Microimaging: microtomography, phase-contrast microtomography with grating interferometer for biological specimen and other kinds of specimen. Evaluation and development of various kinds of optical elements for novel imaging techniques. Large field X-ray topography.
BL25SU	Soft X-ray Spectroscopy of Solid	(Apr. 1998)	Study of electronic state of solids by soft X-ray photoemission spectroscopy (PES) including angle-resolved PES (ARPES). Atomic arrangement analysis of surfaces by photoelectron diffraction (PED) technique using two-dimensional photoemission analyzer. Magnetic state analysis by magnetic circular dichroism (MCD) of soft X-ray absorption and its element-specific magnetization curve measurements.
BL27SU	Soft X-ray Photochemistry	(May 1998)	Ambient atmospheric pressure soft X-ray photoabsorption spectroscopy. Chemical state analysis of light elements in dilute samples (NEXAFS). Elemental and chemical mapping using micro soft X-ray beam. Soft-X-ray emission spectroscopy.
BL28B2	White Beam X-ray Diffraction	(Sept. 1999)	White X-ray diffraction and topography. Time-resolved energy-dispersive XAFS (DXAFS) for studies of chemical and/or physical reaction process. Biomedical imaging and radiation biology studies. High energy X-ray microtomography.
BL35XU	Inelastic and Nuclear Resonant Scattering	(Sept. 2001)	Phonons in solids and atomic dynamics in disordered materials by inelastic X-ray scattering. Atomic and molecular dynamics by nuclear resonant inelastic scattering and quasi-elastic scattering. Synchrotron-radiation-based Mössbauer spectroscopy. Nuclear excitation.
BL37XU	Trace Element Analysis	(Nov. 2002)	X-ray spectrochemical analysis using micro/nano beam: Scanning X-ray microspectroscopy. X-ray spectroscopic imaging: Projection type spectroscopic tomography and imaging type spectroscopic tomography. Ultra trace element analysis. High energy X-ray fluorescence analysis.
BL39XU	Magnetic Materials	(Oct. 1997)	X-ray magnetic circular dichroism (XMCD) spectroscopy and element-specific magnetometry under multiple-extreme conditions. XMCD/XAS using a 100 nm focused X-ray beam. X-ray emission spectroscopy.
BL40XU	High Flux	(Apr. 2000)	Time-resolved diffraction and scattering experiments. Microbeam X-ray diffraction and scattering experiments. X-ray photon correlation spectroscopy. Fluorescence analysis. Quick XAFS. Submicrometer-scale single crystal structure analysis with high flux and zone plate focused X-ray beam. Single shot imaging with X-ray choppers. Laser pump-X-ray probe experiment.
BL40B2	Structural Biology II	(Sept. 1999)	Noncrystalline small and wide angle X-ray scattering.
BL41XU	Structural Biology I	(Oct. 1997)	Structural biology. Macromolecular crystallography. Microcrystallography. High resolution data collection.
BL43IR	Infrared Materials Science	(Apr. 2000)	Infrared microspectroscopy.
BL45XU	Structural Biology III	(Apr. 2019)	Structural biology. Macromolecular crystallography. Automation & High throughput data collection. Microcrystallography.
BL46XU	Engineering Science Research III	(Nov. 2000)	Structural characterization of thin films by X-ray diffraction and X-ray reflectivity measurement. Residual stress measurement. Time resolved X-ray diffraction measurement. Hard X-ray Photoemission Spectroscopy. X-ray Imaging.
BL47XU	HAXPES · μCT	(Oct. 1997)	Hard X-ray photoelectron spectroscopy (HAXPES). Depth analysis of angle resolved HAXPES with wide acceptance lens. Projection type microtomography. Imaging type microtomography. Hard X-ray microbeam/scanning microscopy.

BL #	Beamline Name	(Public Use) or (First Beam)	Areas of Research and Available Techniques
	● Contract Beamlines		as of April 2021
BL03XU	**Advanced Softmaterial** (Advanced Softmaterial Beamline Consortium)	(Nov. 2009)	Structural characterization of softmaterials using small- and wide-angle X-ray scattering. Grazing-incidence small- and wide-angle X-ray scattering for thin films.
BL07LSU	**The University-of-Tokyo Outstation Beamline for Materials Science** (The University of Tokyo)	(Oct. 2009)	Ambient pressure photoemission spectroscopy, nano-beam photoemission spectroscopy, high-resolution soft X-ray emission spectroscopy, and any methods requiring the highly brilliant soft X-ray beam.
BL08B2	**Hyogo BM** (Hyogo Prefecture)	(Jun. 2005)	XAFS in a wide energy region. Small angle X-ray scattering. X-ray topography. Imaging. X-ray diffraction for multipurpose.
BL11XU	**QST Quantum Dynamics I** (National Institutes for Quantum & Radiological Science & Technology)	(Oct. 1998)	Nuclear resonant scattering. Surface and interface structure with MBE. Resonant inelastic X-ray scattering. X-ray emission spectroscopy.
BL12B2	**NSRRC BM** (National Synchrotron Rad. Res. Center)	(Oct. 2000)	X-ray absorption spectroscopy. Powder X-ray diffraction. High resolution X-ray scattering. Protein crystallography.
BL12XU	**NSRRC ID** (National Synchrotron Rad. Res. Center)	(Dec. 2001)	Non-resonant or resonant inelastic X-ray scattering. Hard X-ray photoemission spectroscopy.
BL14B1	**QST Quantum Dynamics II** (National Institutes for Quantum & Radiological Science & Technology)	(Dec. 1997)	Materials science at high pressure. XAFS. Time-resolved energy-dispersive XAFS (DXAFS).
BL15XU	**WEBRAM** (National Institute for Materials Science)	(Jan. 2000)	Under preparations
BL16B2	**SUNBEAM BM** (SUNBEAM Consortium)	(Oct. 1998)	Characterization of secondary battery related materials, semiconductors, fuel cells, catalysts, and several industrial materials with using X-ray absorption fine structure measurements, X-ray diffraction (including X-ray reflectivity technique), X-ray topography and computed tomography/laminography.
BL16XU	**SUNBEAM ID** (SUNBEAM Consortium)	(Oct. 1998)	Characterization of secondary battery related materials, semiconductors, fuel cells, catalysts, and structural materials using X-ray diffraction, X-ray microbeam based evaluation techniques (including X-ray magnetic circular dichroism), hard X-ray photoelectron spectroscopy and fluorescence X-ray analysis.
BL22XU	**JAEA Actinide Science I** (Japan Atomic Energy Agency)	(May 2002)	HAXPES. XAFS. Residual stress/strain distribution analysis. Materials science under high-pressure. Coherent X-ray diffraction. Surface X-ray diffraction. High-energy X-ray diffraction.
BL23SU	**JAEA Actinide Science II** (Japan Atomic Energy Agency)	(Feb. 1998)	Surface chemistry with supersonic molecular beam. Photoelectron spectroscopy. Magnetic circular dichroism. STXM.
BL24XU	**Hyogo ID** (Hyogo Prefecture)	(May. 1998)	Microbeam small- and wide-angle X-ray scattering for local structure analysis. Scanning and imaging microscope, micro-tomography, coherent diffraction. Microbeam X-ray diffraction and bright field X-ray topography for electronic device materials. Near-ambient pressure hard X-ray photoelectron spectroscopy.
BL28XU	**Advanced Batteries** (Kyoto University)	(Apr. 2012)	Characterization of rechargeable battery reactions and battery related materials by resonance X-ray diffraction, X-ray absorption spectroscopy (XAS), X-ray diffraction spectroscopy (XDS), and hard X-ray photoemission spectroscopy (HAXPES).
BL31LEP	**Laser-Electron Photon II** (RCNP, Osaka University)	(Oct. 2013)	Production of high intensity GeV photon beam by laser-backward Compton scattering. Hadron physics via photonucleon and photonuclear reactions. Test and calibration of detectors with GeV gamma-ray and converted electrons/positrons.
BL33LEP	**Laser-Electron Photon** (RCNP, Osaka University)	(Jun. 1999)	Under removal work
BL33XU	**TOYOTA** (TOYOTA Central R&D Labs., Inc.)	(Apr. 2009)	Time-resolved XAFS. 3DXRD. Characterization of industrial materials and devices (e.g. catalysts, lightweight bodies, secondary batteries, fuel cells, and power modules).
BL44XU	**Macromolecular Assemblies** (IPR, Osaka University)	(May 1999)	Crystal structure analysis of biological macromolecular assemblies (e.g., membrane protein complexes, protein complexes, protein-nucleic acid complexes, and viruses).
	◆ RIKEN Beamlines		as of April 2021
BL05XU	**R&D-ID**	(Mar. 2004)	Structural and dynamical research using small and wide angle scattering, R&D of SR instruments.
BL17SU	**RIKEN Coherent Soft X-ray Spectroscopy**	(Sept. 2003)	High resolution photoemission spectroscopy. Soft X-ray emission spectroscopy. Soft X-ray diffraction spectroscopy. Soft X-ray microspectroscopy.
BL19LXU	**RIKEN SR Physics**	(Oct. 2000)	SR science with highly brilliant X-ray beam.
BL26B1	**RIKEN Structural Genomics I**	(Apr. 2002)	Structural biology research based on single crystal X-ray diffraction.
BL26B2	**RIKEN Structural Genomics II**	(Apr. 2002)	Structural biology research based on single crystal X-ray diffraction.
BL29XU	**RIKEN Coherent X-ray Optics**	(Dec. 1998)	X-ray optics, especially coherent X-ray optics.
BL32XU	**RIKEN Targeted Proteins**	(Oct. 2009)	Protein microcrystallography.
BL32B2	**R&D-BM**	(May 2002)	X-ray computed tomography, X-ray diffraction, X-ray absorption fine structure, R&D of SR instruments.
BL36XU	**RIKEN Materials Science II**	(Jan. 2013)	Time resolved XAFS and X-ray diffraction, 2D/3D scanning XAFS imaging, 3D computed tomography/laminography XAFS imaging, X-ray emission spectroscopy, ambient pressure hard X-ray photoelectron spectroscopy, pink beam experiment.
BL38B1	**RIKEN Structural Biology I**	(Oct. 2000)	Structure study of non-crystalline biological materials using small-angle scattering and diffraction techniques.
BL38B2	**Diagnosis Beamline**	(Sept. 1999)	Accelerator beam diagnostics.
BL43LXU	**RIKEN Quantum NanoDynamics**	(Oct. 2011)	High resolution inelastic X-ray scattering for investigating atomic and electronic dynamics.
BL44B2	**RIKEN Materials Science I**	(Feb. 1998)	Structural materials science research using powder X-ray diffraction.

IV. User Program and Statistics

SPring-8 calls for public use proposals twice a year, in principle. However, proposals were not called for 2020B because of the COVID-19 pandemic. The submitted proposals are reviewed by the SPring-8 Proposal Review Committee (SPring-8 PRC). Since 1997, SPring-8 has accepted a variety of proposals. For the promotion of research on industrial applications at SPring-8, the Industrial Application Division was established in 2005, with consultation support for industrial users being provided by the division's coordinators. Currently, Industrial Application Proposals account for approximately 16%–18% of the total number of proposals conducted at the public beamlines. There always exist those companies and research institutes that find it difficult to retain specialized staff and to accommodate the need for quick access to SPring-8. To appropriately respond to this circumstance, the SPring-8 Measurement Service has been established. In this framework of service, JASRI staff members perform measurements on behalf of users. It is up to the users whether to come to SPring-8 and be present during the measurements or to simply send their samples to SPring-8. As far as the formalization of the proposal system is concerned, applications for this service are treated as proprietary, and, therefore, are subject to the conditions applied to proprietary beamtime and the user beamtime fee for Time-Designated Proposals (calculated in two-hour increments), as mentioned in the previous section. Currently, the Industrial Application Division of JASRI is carrying out XAFS measurements on behalf of users at BL14B2. Since 2009B, the purview of the SPring-8 Measurement Service has been expanded by including Mail-in Protein Crystallography Data Collection at BL38B1 and Powder X-ray Diffraction at BL19B2. In addition, the Feasibility Study Proposal for Industrial Application was introduced in 2018A. The Feasibility Study Proposal for Industrial Application is designed to provide a simple procedure for beamtime application to SPring-8 for users who are interested in the use of SPring-8 or considering an application to SPring-8. Feasibility Study Proposals for Industrial Applications are considered a form of proprietary proposals and are subject to the proprietary beamtime fee and user fee applicable to “Proprietary Time-Designated Proposals.” All three Engineering Science Research Beamlines (BL14B2, BL19B2 and BL46XU) as well as measurement techniques at these beamlines are available to this proposal. The staff of the Industrial Application Division of the Japan Synchrotron Radiation Research Institute (JASRI) will perform measurements at SPring-8 on behalf of users, in common with Measurement Services. Therefore, users can choose whether to come to SPring-8 and be present during the measurements or to simply send their samples to SPring-8. Protein Crystallography Automatic Data Collection was introduced in 2019B; users need only to send samples to SPring-8 to obtain data (no visit required).

SPring-8 has been consistently providing ~4,500 h of user beamtime per year. Since the start of its operation in 1997, SPring-8 has succeeded in providing users with

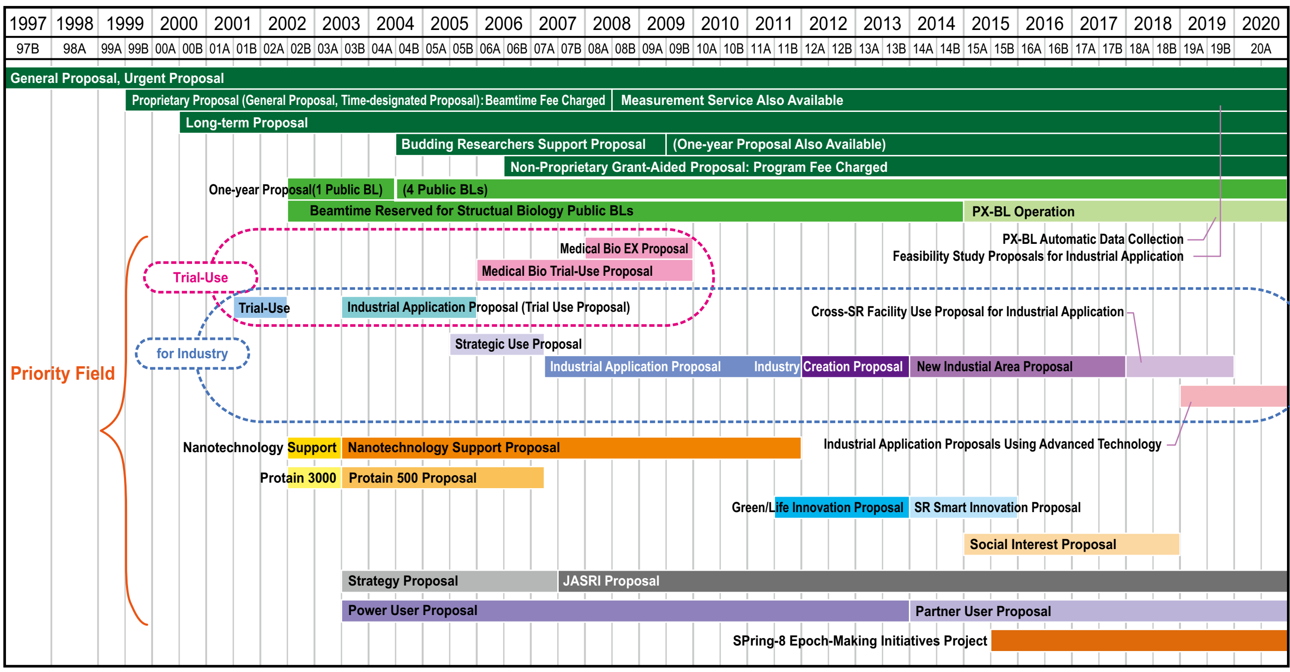


Fig. 3. Categories of proposals for the public beamlines.

a total beamtime of 91,859 h. The beamtime available to users, the number of experiments conducted, and the number of user visits at the public and contract beamlines are summarized in Fig. 3. Part of the proposals are for proprietary use, for which refereed reports are not required. Figures 4 to 13 show the information on user programs.

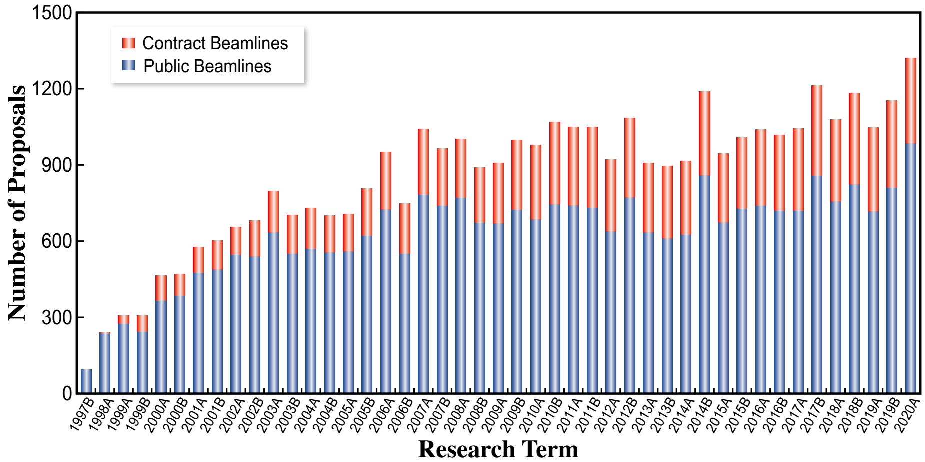


Fig. 4. Numbers of conducted experiments.

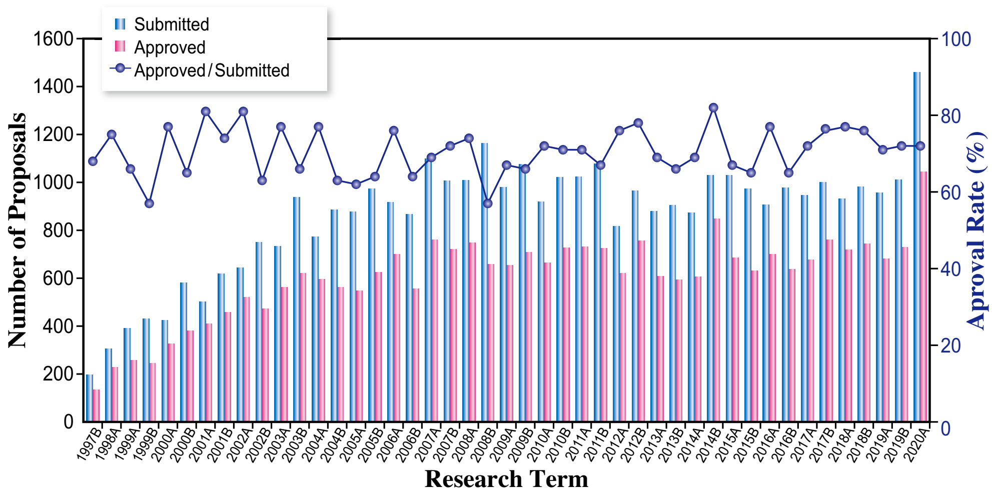


Fig. 5. Numbers of submitted proposals and approved proposals by research term (public beamlines).

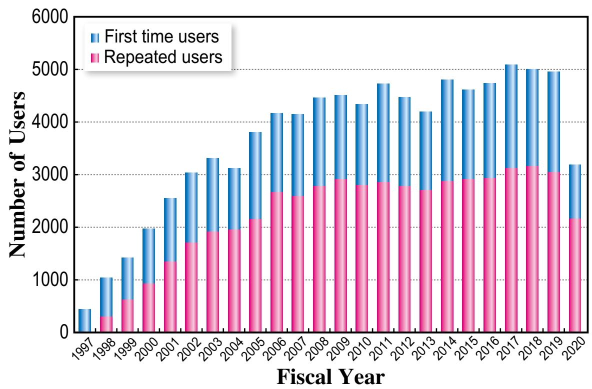


Fig. 6. Numbers of users by fiscal year.

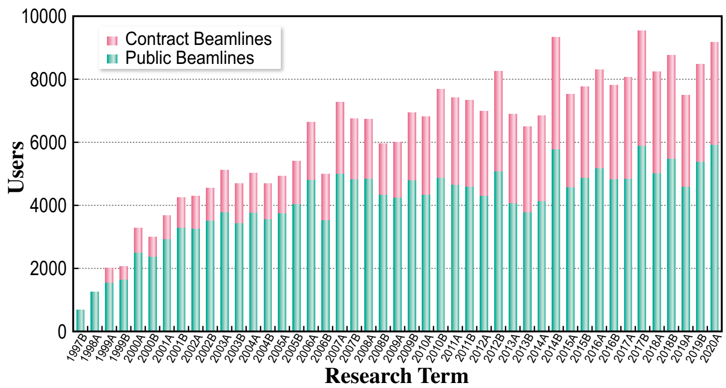


Fig. 7. Numbers of users visits by research term.

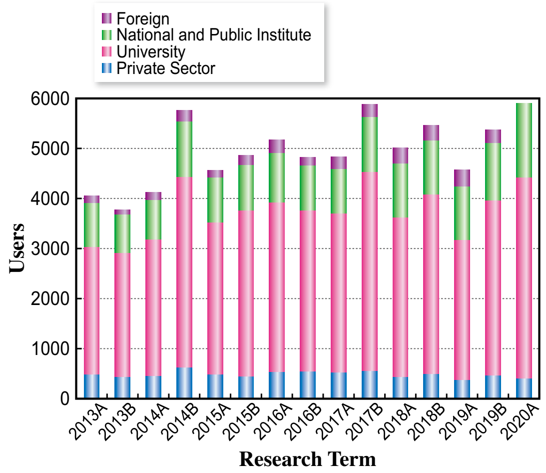


Fig. 8. Numbers of users by affiliation categories (public beamlines).

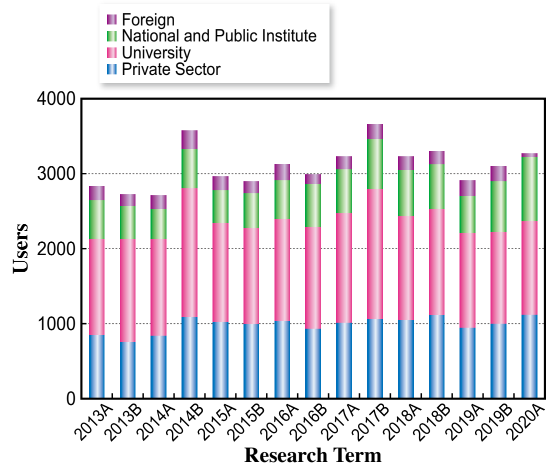


Fig. 9. Numbers of users by affiliation categories (contract beamlines).

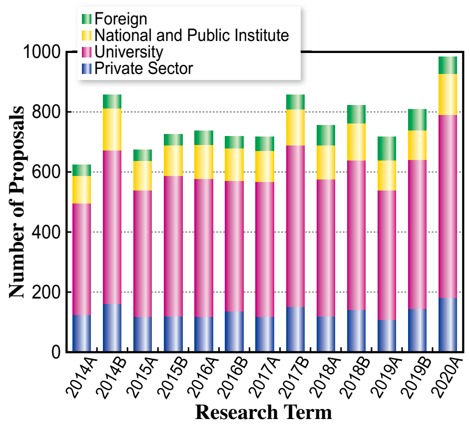


Fig. 10. Numbers of conducted proposals by affiliation (public beamlines).

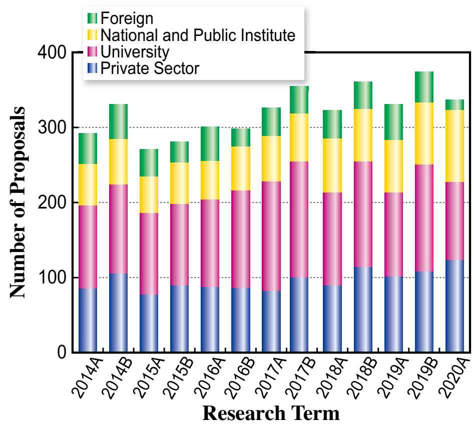


Fig. 11. Numbers of conducted proposals by affiliation categories (contract beamlines).

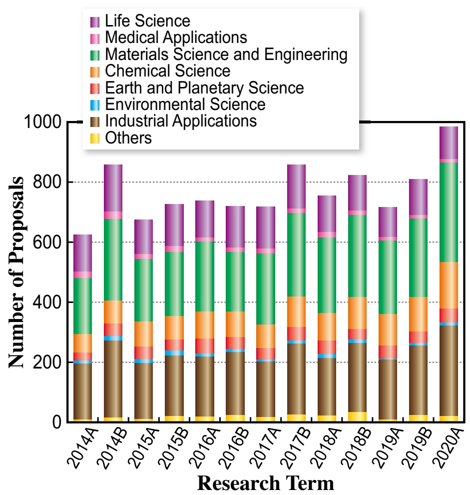


Fig. 12. Numbers of conducted proposals by research area (public beamlines).

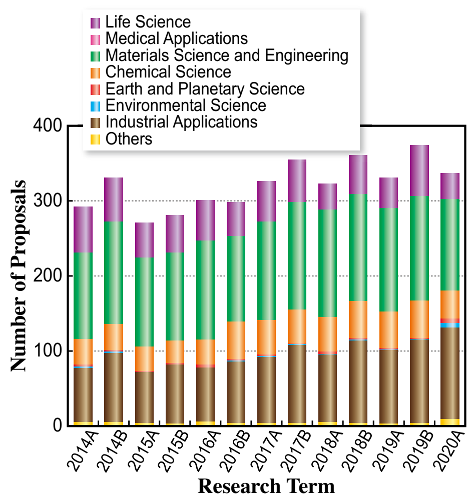


Fig. 13. Numbers of conducted proposals by research area (contract beamlines).

V. Research Outcome

As of March 2021, the total number of registered refereed papers from SPring-8 was 18,398. Figure14 shows the annual statistics of refereed papers.

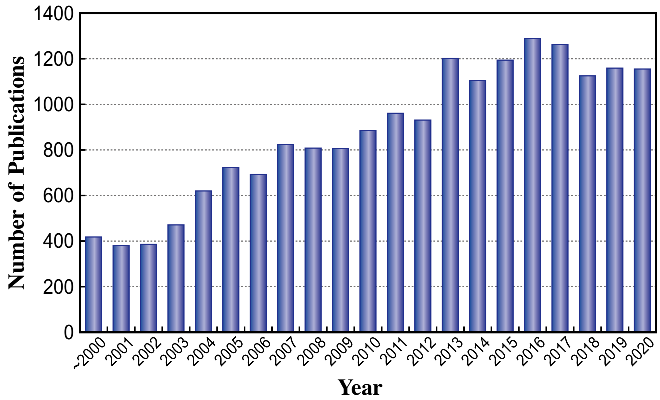


Fig. 14. Number of refereed publications.

VI. Budget and Personnel

When SPring-8 started operation in 1997, it was jointly managed by RIKEN, JAERI (now JAEA), and JASRI. However, JAERI withdrew from the management of SPring-8 on September 30, 2005. SPring-8 is currently administered by RIKEN and JASRI collaboratively.

The total budget for the operation of SPring-8 in FY2020 was about 9.1 billion yen. As of October 2020, the total number of RIKEN and JASRI staff members is 446. Figure 15 shows the annual budget allocated to the operation, maintenance, and promotion of SPring-8. Figure 16 shows the manpower of RIKEN and JASRI.

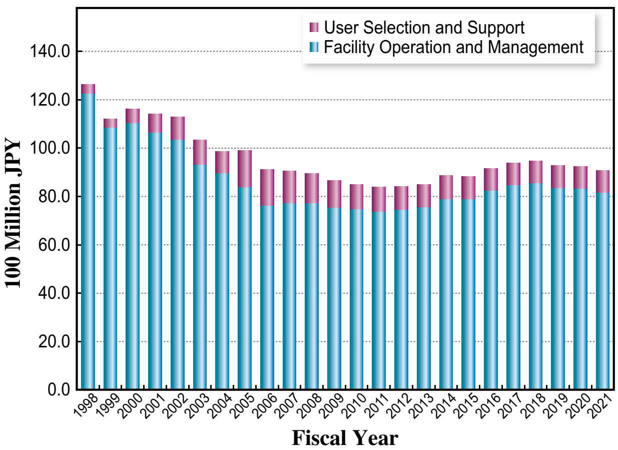


Fig. 15. SPring-8 budget.

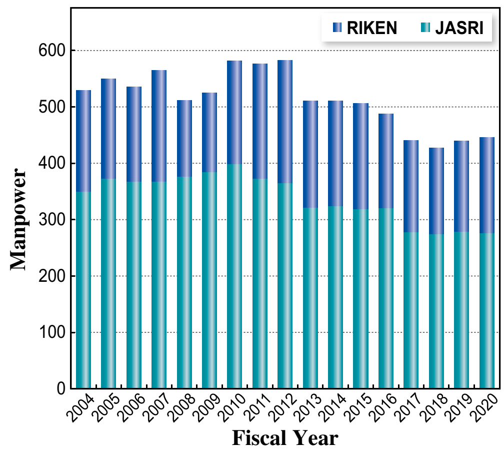


Fig. 16. Personnel at SPring-8: JASRI and RIKEN.

VII. Research Complex

The facilities of SPring-8, SACLA, and NewSUBARU form the Center of Excellence (COE) at the SPring-8 campus where JASRI, public beamline users, the contractors of contract beamlines, RIKEN, and the University of Hyogo work in close cooperation, forming a research complex where each member has their own role in delivering high-quality results to the field of synchrotron radiation science and technology. The organizational charts of RIKEN and JASRI, which are at the center of this research complex, are shown in Fig. 17 and Fig. 18, respectively.

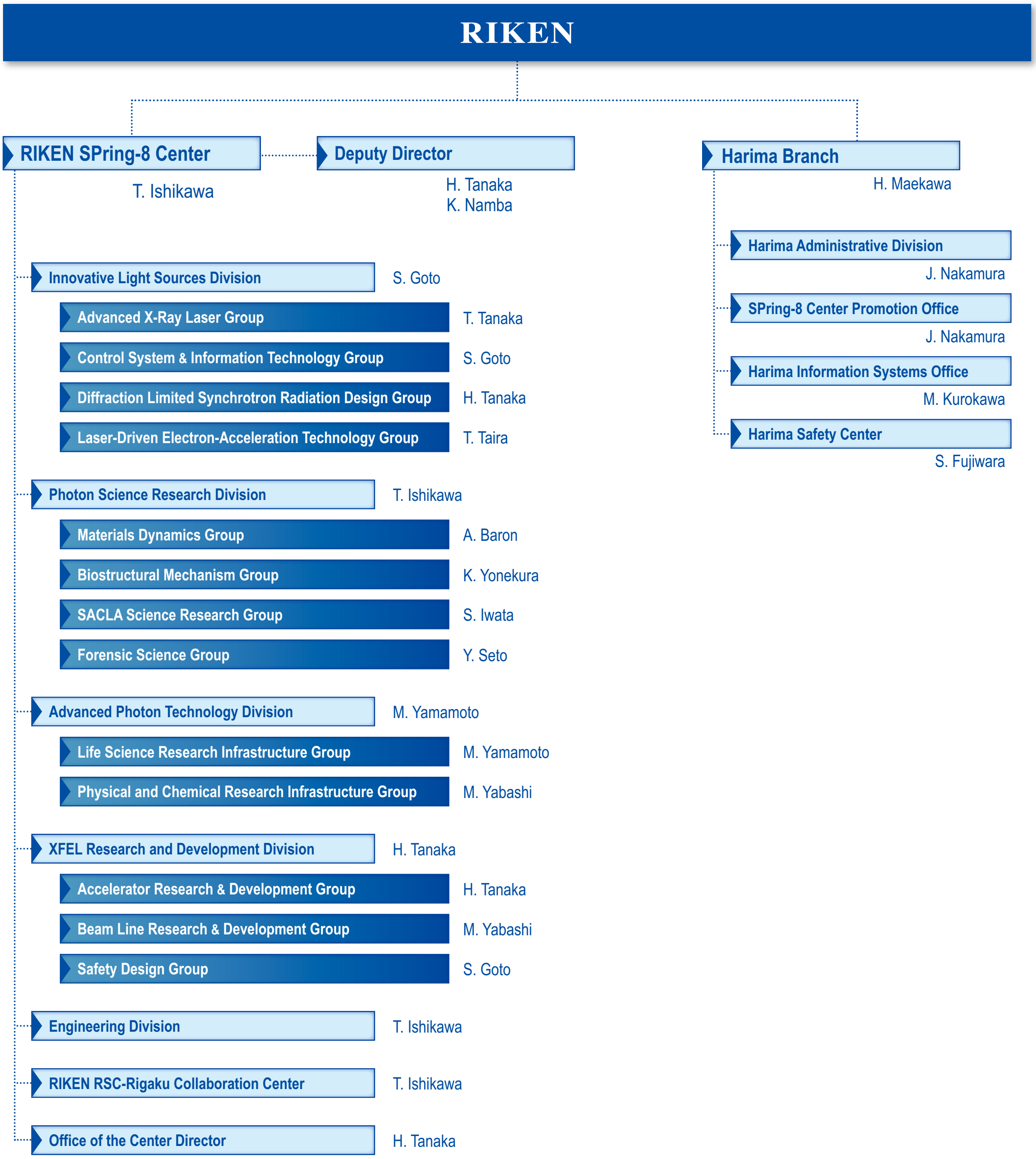


Fig. 17. RIKEN Harima Campus chart as of April 2021.

Japan Synchrotron Radiation Research Institute (JASRI)

President : Y. Amemiya
Managing Exec. Directors : R. Tanaka, M. Abe, A. Yamaguchi

Research Sector

- Deputy Director — Y. Sakurai, O. Sakata
- Center for Synchrotron Radiation Research — R. Tanaka
  - Spectroscopy Division — Y. Tamenori
    - Spectroscopic Imaging Team — N. Kawamura
    - Advanced Spectroscopy Team — Y. Tamenori
  - Diffraction and Scattering Division — S. Kimura
    - Powder Diffraction and Total Scattering Team — K. Sugimoto
    - Multi-purpose Diffraction and Scattering Team — Y. Imai
  - Scattering and Imaging Division — O. Sakata
    - Time-resolved Scattering Team — H. Sekiguchi
    - Microscopic and Dynamic Imaging Team — O. Sakata
  - Protein Crystal Analysis Division — T. Kumasaka
    - Macromolecular Crystallography Team — T. Kumasaka
    - Experimental Instrumentation Team — K. Hasegawa
  - Industrial Application and Partnership Division — A. Yamaguchi
    - Structure Analysis Team — T. Koganezawa
    - Materials Characterization Team — T. Honma
  - Industrial Platform Development Division — M. Yabashi
    - Instrumentation Development Team — M. Yabashi
  - Spectroscopy Division — A. Baron
  - Engineering Support Group — Y. Sakurai
    - Engineering Support Team — T. Oguchi
- XFEL Utilization Division — M. Yabashi
  - Advanced Light Source and Optics Research Group — K. Tono
    - Optical Instrumentation Team — T. Yabuuchi
    - Experimental Instrumentation Team — K. Tono
  - Advanced Measurement and Analysis Group — T. Hatsui
    - Measurement System Development Team — T. Hatsui
    - Data Analysis Team — Y. Joti
- Light Source Division — S. Goto
  - Beam Dynamics and Monitor Group — S. Takano
    - Beam Dynamics Team — K. Soutome
    - Beam Monitor Team — M. Masaki
  - Accelerator Machine Group — T. Watanabe
    - Magnet Team — K. Fukami
    - RF Team — T. Inagaki
    - Vacuum Team — K. Tamura
  - Insertion Device and Front End Group — T. Tanaka
    - Insertion Device Team — T. Tanaka
    - Front End Team — S. Takahashi
  - Optics and Transport Channel Group — H. Ohashi
    - Optics Team — H. Yamazaki
    - Transport Channel Team — Y. Senba
  - Technical Development Group — K. Takeshita
    - Technical Development Team — K. Takeshita
    - Radiation Shielding Team — N. Nariyama
  - Control Group — S. Goto
    - Machine Control Team — M. Yamaga
    - Advanced Application Team — T. Sugimoto
    - Interlock Team — C. Saji
- Information-technology Promotion Division — C. Saji
  - Information-technology Promotion Group — C. Saji
    - Data Handling Team — C. Saji
    - Information System Team — M. Kodera

Administration Sector

- User Administration Division — T. Kinoshita
- General Administration Division — K. Yagi
- Planning Office — T. Ohata

Safety

- Safety Office — Y. Ohishi

Fig. 18. JASRI chart as of April 2021.

VIII. SPring-8 Users Community (SPRUC)

Prof. A. Kimura
Hiroshima University
SPRUC Chairman FY2020

The SPring-8 Users Community (SPRUC) is a user society that consists of all users of SPring-8/SACLA. In addition to individuals, representative organizations comprising 26 institutes (principal universities, national/international research institutes, industries, beamline consortiums) participate in SPRUC to discuss further promotion of the utilization of SPring-8 from strategic and perspective viewpoints. Prof. Akio Kimura, Hiroshima University, has been serving as the president of SPRUC since FY2020.

As one of the key activities of SPRUC, the SPring-8 Symposium is held annually at the site of one of the representing organizations jointly with RIKEN and JASRI. SPring-8 Symposium 2020 had been scheduled to be held on September 18 and 19 at the International Congress Center EPOCAL TSUKUBA. However, owing to the COVID-19 pandemic, the plan was forced to be changed. SPring-8 Symposium 2020 with the theme "Use of SPring-8 in the Post-CORONA era" was held on September 18 with a hybrid style of on-site and online presentations. As indicated by the theme, the major issue of the symposium was to discuss how to promote remote experiments and automation of experimental processes. Demands and supplies concerning future perspectives, including Digital Transformation technology information transportation, were shared between users and facility. The ceremony to present the SPRUC 2020 Young Scientist Award, which was conferred on Dr. Taito Osaka, RIKEN, and Dr. Longjian Xie, University of Bayreuth, was also held. The decision on how to hold SPring-8 Symposium 2021, jointly hosted by SPRUC, RIKEN, JASRI, is to be made on the basis of the status of the COVID-19 pandemic.

SPRUC cohosted the third beamline upgrade workshop on March 5–6 with RIKEN and JASRI. The workshop was planned to enrich the information exchange between members of SPRUC and the facility. The workshop was also held as a hybrid style of on-site and online presentations. The workshop focused mainly on mutual consensus about the beamline reorganization of the hard X-ray photoemission, non-resonant inelastic X-ray scattering and nuclear resonant scattering experiments. The facility presented the latest situation of their reorganization, future prospect and related problems, and the members discussed demands and suggestions for beamline upgrades.

SPRUC2020 Young Scientist Award
Dr. T. Osaka, Dr. L. Xie, and Prof. A. Kimura

The fifth-term SPRUC research groups were voluntarily organized in each research field, and the research groups actively conducted research meetings. Each SPRUC research group has been collecting ideas and needs for beamline reorganization and innovative experimental techniques toward SPring-8 II, and has presented opinions and demands obtained through discussion in each field.

SPRUC supported the "SPring-8 Summer School" for the enhancement of user's research competency, and also hosted the "SPring-8 Autumn School" with JASRI for acquiring new users and human resources development. For the Autumn School, the SPRUC research groups contributed to planning of lectures. Although the number of participants was greatly reduced compared with previous years and the Autumn School was postponed to December owing to the COVID-19 pandemic, both schools were successfully held.

Finally, SPRUC continues to consider, as part of the SPring-8 utilization committee, how the Science Promotion Board, which was established with the purpose of making practical plans to realize cutting-edge science at SPring-8, should be actuated to promote the creation of new multidisciplinary research fields.

IX. Outreach Activities

To reach out to new users in unexplored fields of application, SPring-8 holds various serialized seminars named "Workshop on Advanced Techniques and Applications at SPring-8". This year, most of the workshops are being held as video conferences because of COVID-19. Here are some representatives.

- 54th: Automatic and Remote Measurement in the Protein Beamlines at SPring-8
  November 27, 2020 • Video conference

- 56th: Research for Advanced Devices
  March 3, 2021 • Video conference

- 59th: Current Status and Future Prospects of Protein Structural Biology Research at SPring-8
  March 23, 2021 • Video conference

Also taking advantage of video conferencing, we have been holding a "Seminar on Advanced Techniques and Applications at SPring-8" every Tuesday evening since January 2021. The participants of these seminars number over 500 in total for the first 9 seminars.