



Fig. 1. Operation statistics for most recent five fiscal years.

Table 1. Operation modes in FY2017

	Single bunch current (mA)	Share of operation time (%)
203 bunches		18.1
4 bunch-train × 84		7.4
11 bunch-train × 29		20.7
1/7-filling + 5 single bunches	3	8.0
2/29-filling + 26 single bunches	1.4	3.2
1/14-filling + 12 single bunches	1.6	14.4
4/58-filling + 53 single bunches	1	6.4
11/29-filling + 1 single bunch	5	21.8

Table 2. Beam parameters of SPRING-8 storage ring

Energy [GeV]	8
Number of buckets	2436
Tunes ( $\nu_x / \nu_y$ )	41.14 / 19.34
Current [mA]:	
single bunch	12
multi bunch	100
Bunch length ( $\sigma$ ) [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 ( $\sigma_x / \sigma_y$ )* [ $\mu\text{m}$ ]	
Long ID section	333 / 7
ID section	316 / 5
BM1 section	94 / 12
BM2 section	100 / 12
Beam divergence ( $\sigma'_x / \sigma'_y$ )* [ $\mu\text{rad}$ ]	
Long ID section	8 / 0.7
ID section	9 / 1.0
BM1 section	58 / 0.5
BM2 section	68 / 0.5
Operational chromaticities ( $\xi_x / \xi_y$ )	+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) [ $\mu\text{m}$ ]	
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 (19 beamlines operating)
- (3) RIKEN Beamlines (12 beamlines operating)

There are now 26 public beamlines in full operation. The beamlines that are proposed and constructed by external organizations, such as universities, research institutes, private companies and consortiums, are called contract beamlines and are exclusively used by the contractors for their own research purposes. At present, 19 contract beamlines are in operation. The beamlines constructed by 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 12 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.



Fig. 2. Beamline map.

Table 3. List of beamlines

BL #	Beamline Name	(Public Use or First Beam)	Areas of Research and Available Techniques
<b>★ Public Beamlines</b>			
BL01B1	<b>XAFS</b>	(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	<b>Single Crystal Structure Analysis</b>	(Oct. 1997)	Charge density study and crystal structure analysis from accurate single crystal X-ray diffraction. (X-ray energy range: 8 – 115 keV)
BL02B2	<b>Powder Diffraction</b>	(Sept. 1999)	Charge density study and phase identification of crystalline materials from accurate powder diffraction measurements. (X-ray energy range: 12.4 – 35 keV)
BL04B1	<b>High Temperature and High Pressure Research</b>	(Oct. 1997)	High temperature and high pressure research with the multi-anvil press by powder X-ray diffraction, radiography and ultrasonic measurement.
BL04B2	<b>High Energy X-ray Diffraction</b>	(Sept. 1999)	Pair distribution function analysis for glass, liquid, and amorphous materials. High-energy X-ray total scattering. Containerless levitation.
BL08W	<b>High Energy Inelastic Scattering</b>	(Oct. 1997)	Magnetic Compton scattering. High-resolution Compton scattering. High-energy Bragg scattering. High-energy fluorescent X-ray analysis.
BL09XU	<b>Nuclear Resonant Scattering</b>	(Oct. 1997)	Lattice dynamics using nuclear inelastic scattering. Mössbauer spectroscopy, especially for the surface/interface study and under the extreme conditions. Hard X-ray photoelectron spectroscopy (HAXPES). Depth analysis of HAXPES with high flux and energy resolution.
BL10XU	<b>High Pressure Research</b>	(Oct. 1997)	Structure analysis and phase transitions under ultra high pressure (DAC experiment). Earth and planetary science.
BL13XU	<b>Surface and Interface Structures</b>	(Sept. 2001)	Atomic-scale structural analysis of surfaces and interfaces of crystalline materials, ultra-thin films, and nanostructures. Surface X-ray diffraction (SXRD). Microbeam diffraction.
BL14B2	<b>Engineering Science Research II</b>	(Sept. 2007)	X-ray Imaging. XAFS in wide energy region (3.8 to 72 keV). XAFS of dilute systems and thin films.
BL19B2	<b>Engineering Science Research I</b>	(Nov. 2001)	Residual stress measurement. Structural analysis of thin film, surface, interface. Powder diffraction. X-ray imaging, X-ray topography. Ultra-small angle X-ray scattering.
BL20XU	<b>Medical and Imaging II</b>	(Sept. 2001)	Microimaging. Micro-/nano-tomography, phase-contrast microtomography, X-ray diffraction tomography (XRD-CT), hard X-ray microbeam/scanning microscopy, imaging microscopy, microtomography, phase-contrast microtomography X-ray diffraction tomography (XRD-CT), X-ray holography, coherent X-ray optics, and other experiments on X-ray optics and developments of optical elements. Refraction-enhanced imaging, phase-contrast CT. Ultra-small angle scattering.
BL20B2	<b>Medical and Imaging I</b>	(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	<b>Soft X-ray Spectroscopy of Solid</b>	(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. Chemical and magnetic imaging by soft X-ray scanning microscopy and photoelectron emission microscopy (PEEM).
BL27SU	<b>Soft X-ray Photochemistry</b>	(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 for solids.
BL28B2	<b>White Beam X-ray Diffraction</b>	(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	<b>High Resolution Inelastic Scattering</b>	(Sept. 2001)	Materials dynamics on ~meV energy scales using inelastic X-ray scattering (IXS).
BL37XU	<b>Trace Element Analysis</b>	(Nov. 2002)	X-ray microbeam spectrochemical analysis. Ultra trace element analysis. High energy X-ray fluorescence analysis.
BL38B1	<b>Structural Biology III</b>	(Oct. 2000)	Structural biology. Macromolecular crystallography. Automatic data collection.
BL39XU	<b>Magnetic Materials</b>	(Oct. 1997)	X-ray magnetic circular dichroism (XMCD) spectroscopy and element-specific magnetometry under multiple-extreme conditions. XMCD/XAS using a 100 nm focussed X-ray beam. X-ray emission spectroscopy. Resonant X-ray magnetic scattering.
BL40XU	<b>High Flux</b>	(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	<b>Structural Biology II</b>	(Sept. 1999)	Noncrystalline small and wide angle X-ray scattering.
BL41XU	<b>Structural Biology I</b>	(Oct. 1997)	Structural biology. Macromolecular crystallography. Microcrystallography. High resolution data collection.
BL43IR	<b>Infrared Materials Science</b>	(Apr. 2000)	Infrared microspectroscopy.
BL46XU	<b>Engineering Science Research III</b>	(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.
BL47XU	<b>HAXPES · μCT</b>	(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
<b>◆ Contract Beamlines</b>			
BL03XU	<b>Advanced Softmaterial</b> (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. X-ray diffraction and reflectivity measurements for softmaterials.
BL07LSU	<b>The University-of-Tokyo Outstation Beamline for Materials Science</b> (The University of Tokyo)	(Oct. 2009)	Time-resolved soft X-ray spectroscopy, nano-beam photoemission spectroscopy, ultra high-resolution soft X-ray emission spectroscopy, and any methods requiring the highly brilliant soft X-ray beam.
BL08B2	<b>Hyogo BM</b> (Hyogo Prefecture)	(Jun. 2005)	XAFS in a wide energy region. Small angle X-ray scattering for structural analyses of polymer and nanocomposite materials. X-ray topography. Imaging. Powder diffraction with a high angular-resolution.
BL11XU	<b>QST Quantum Dynamics I</b> (National Institutes for Quantum & Radiological Science & Technology)	(Oct. 1998)	Synchrotron radiation Mössbauer spectroscopy. XAFS. Resonant inelastic X-ray scattering spectroscopy. <i>In situ</i> X-ray diffraction during molecular-beam epitaxial growth.
BL12B2	<b>NSRRC BM</b> (National Synchrotron Rad. Res. Center)	(Oct. 2000)	X-ray absorption spectroscopy. Powder X-ray diffraction. High resolution X-ray scattering. Protein crystallography.
BL12XU	<b>NSRRC ID</b> (National Synchrotron Rad. Res. Center)	(Dec. 2001)	Non-resonant or resonant inelastic X-ray scattering. Hard X-ray photoemission spectroscopy.
BL14B1	<b>QST Quantum Dynamics II</b> (National Institutes for Quantum & Radiological Science & Technology)	(Dec. 1997)	Materials science under high-temperature and high-pressure, Energy-dispersive XAFS. X-ray diffraction for surface structure analyses.
BL15XU	<b>WEBRAM</b> (National Institute for Materials Science)	(Jan. 2000)	Hard X-ray photoelectron spectroscopy. High-precision X-ray powder diffraction.
BL16B2	<b>SUNBEAM BM</b> (SUNBEAM Consortium)	(Oct. 1998)	Characterization of secondary battery related materials, semiconductors, fuel cells, catalysts, and several industrial materials using X-ray absorption fine structure measurements, X-ray diffraction (including X-ray reflectivity technique) and X-ray topography.
BL16XU	<b>SUNBEAM ID</b> (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 photoemission spectroscopy and fluorescence X-ray analysis.
BL22XU	<b>JAEA Actinide Science I</b> (Japan Atomic Energy Agency)	(May 2002)	Materials science under high-pressure. Resonant X-ray scattering. Speckle scattering. Residual stress/strain distribution analysis.
BL23SU	<b>JAEA Actinide Science II</b> (Japan Atomic Energy Agency)	(Feb. 1998)	Surface chemistry with supersonic molecular beam. Biophysical spectroscopy. Photoelectron spectroscopy. Magnetic circular dichroism.
BL24XU	<b>Hyogo ID</b> (Hyogo Prefecture)	(May. 1998)	Surface/interface analysis for industry by fluorescent X-ray analysis, strain measurements and grazing incidence X-ray diffraction. Microbeam formation studies for material and life sciences. Scanning and imaging microscope. Micro-tomography. Micro-XAFS. Microbeam small- and wide-angle X-ray scattering for local structure analysis. Bright field X-ray topography. Near-ambient pressure hard X-ray photoelectron spectroscopy. 2016 Bright-field X-ray topography under multiple-beam diffraction condition.
BL28XU	<b>RISING II</b> (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	<b>Laser-Electron Photon II</b> (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	<b>Laser-Electron Photon</b> (RCNP, Osaka University)	(Jun. 1999)	Meson photoproduction from nucleon and nucleus. Photoexcitation of hyperons, nucleon resonances, and other exotic states. Photonuclear reactions. Beam diagnoses. Test and calibration of detectors with GeV photon beam.
BL33XU	<b>TOYOTA</b> (TOYOTA Central R&D Labs., Inc.)	(Apr. 2009)	Time-resolved XAFS. Characterization of industrial materials, such as catalysts, secondary batteries, fuel cells.
BL36XU	<b>Catalytic Reaction Dynamics for Fuel Cells</b> (The University of Electro-Communications)	(Jan.2013)	Real time analysis of catalytic reaction dynamics for fuel cells: time resolved XAFS and X-ray diffraction, 2D scanning microscopic XAFS, 3D computed tomography/laminography XAFS, ambient pressure hard X-ray photoelectron spectroscopy.
BL44XU	<b>Macromolecular Assemblies</b> (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).
<b>◆ RIKEN Beamlines</b>			
BL05XU	<b>RIKEN Diagnosis Beamline I</b>	(Mar. 2004)	Accelerator beam diagnostics. R&D of accelerator components.
BL17SU	<b>RIKEN Coherent Soft X-ray Spectroscopy</b>	(Sept. 2003)	High resolution photoemission spectroscopy. Soft X-ray emission spectroscopy. Soft X-ray diffraction spectroscopy. Soft X-ray microspectroscopy.
BL19LXU	<b>RIKEN SR Physics</b>	(Oct. 2000)	SR science with highly brilliant X-ray beam.
BL26B1	<b>RIKEN Structural Genomics I</b>	(Apr. 2002)	Structural biology research based on single crystal X-ray diffraction.
BL26B2	<b>RIKEN Structural Genomics II</b>	(Apr. 2002)	Structural biology research based on single crystal X-ray diffraction.
BL29XU	<b>RIKEN Coherent X-ray Optics</b>	(Dec. 1998)	X-ray optics, especially coherent X-ray optics.
BL32XU	<b>RIKEN Targeted Proteins</b>	(Oct. 2009)	Protein microcrystallography.
BL38B2	<b>RIKEN Diagnosis Beamline II</b>	(Sept. 1999)	Accelerator beam diagnostics.
BL43LXU	<b>RIKEN Quantum NanoDynamics</b>	(Oct. 2011)	High resolution inelastic X-ray scattering for investigating atomic and electronic dynamics.
BL44B2	<b>RIKEN Materials Science</b>	(Feb. 1998)	Structural materials science research using powder X-ray diffraction.
BL45XU	<b>RIKEN Structural Biology I</b>	(Jul. 1997)	Time-resolved and static structures of non-crystalline biological materials using small-angle scattering and diffraction techniques.