

Table II. Beam parameters of SPring-8 storage ring

Energy [GeV]	8
Number of buckets	2436
Tunes (ν_x / ν_y)	40.15 / 18.35
Current [mA]:	
single bunch	12
multi-bunch	100
Bunch length (σ) [psec]	13
Horizontal emittance [nm-rad]	3.4 *
Vertical emittance [pm-rad]	6.8 *
Coupling [%]	0.2
RF Voltage [MV]	16
Momentum acceptance [%]	± 3 (= ± 240 MeV)
Beam size [μm]: (σ_x / σ_y)* [μm]	
Long ID section	294 / 10
ID section	301 / 6
BM section	107 / 13
Beam divergence [μrad]: (σ_x' / σ_y')* [μrad]	
Long ID section	13 / 0.7
ID section	12 / 1.1
BM section	56 / 0.6
Operational chromaticities: (ξ_x / ξ_y)	+2 / +2 **
Lifetime [hr]:	
100 mA (multi-bunch)	~ 200
1 mA (single bunch)	~ 20
Horizontal dispersion [m]:	
Long ID section	0.103
ID section	0.107
BM section	0.032
Fast orbit stability (0.1 – 200 Hz)[μm]:	
horizontal (rms)	~ 4
vertical (rms)	~ 1

* Assuming 0.2% coupling for "Low Emittance Optics"
** With bunch-by-bunch feedback

Table I. Filling patterns

	bunch current	life time
Multi-bunch (160 bunch-train \times 12)	0.05 mA	~ 200 hr
203 bunches	0.5 mA	25 ~ 30 hr
4 bunch-train \times 84	0.3 mA	35 ~ 50 hr
11 bunch-train \times 29	0.3 mA	35 ~ 50 hr
1/7 - filling + 5 single bunches	3.0 mA (single)	18 ~ 25 hr
1/14 - filling + 12 single bunches	1.6 mA (single)	18 ~ 25 hr
2/29 - filling + 26 single bunches	1.4 mA (single)	18 ~ 25 hr
4/58 - filling + 53 single bunches	1.0 mA (single)	18 ~ 25 hr

Beamlines

The electron storage ring of the SPring-8 accelerator complex can potentially accommodate sixty-two beamlines (34 insertion devices, 4 long undulators, 23 bending magnets and 1 infrared). Currently, 49 beamlines are operational, reaching 75% of its full capacity as shown in the beamline map (Fig. 3) and list of beamlines (Table III). The beamlines are categorized into the following four groups:

- (1) public beamlines,
- (2) contract beamlines,
- (3) RIKEN beamlines, and
- (4) accelerator beam diagnostic beamlines.

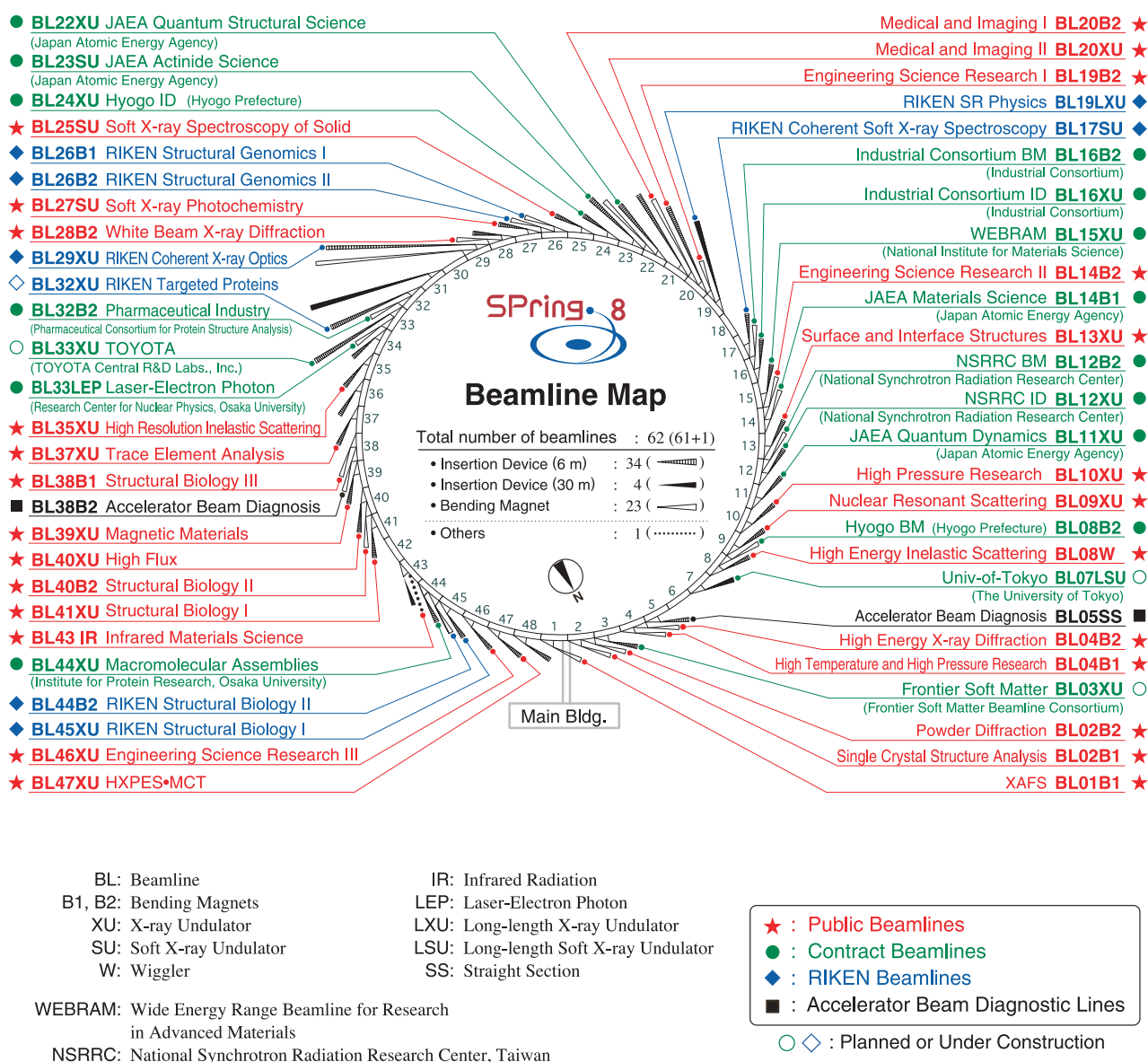
The portfolio of SPring-8 beamlines is significantly increasing its variation. A new public beamline called "Engineering Science Research II (BL14B2)" became in operation since last autumn in order to appropriately respond to those users coming from industrial domain for XAFS experiments. In addition, there have been four contact beamlines approved, which are "LEPS2

(BL31IS)," "Univ-of-Tokyo (BL07LSU)," "TOYOTA (BL33XU)," and "Frontier Soft Matter (BL03XU). Furthermore, RIKEN has decided to construct a new beamline called "RIKEN Targeted Proteins (BL32XU)." At the time of writing this report, there are 26 public beamlines in operation: 11 BM beamlines, 14 ID beamlines (12 hard X-ray beamlines and 2 soft X-ray beamlines), and one infrared beamline. As for contract beamlines, 14 beamlines are operational and three beamlines are under construction. Among the eight RIKEN beamlines, seven of them are operational and the last one under construction. There are two accelerator diagnostic lines, both in operation. In order to effectively and efficiently promote the priority industrial application proposals started in April 2007, "R&D Beamline (BL46XU)" has become specialized in industrial applications, and its name was changed to "Engineering Science Research III" from 2007B.

The contract beamlines are installed, owned, operated and maintained by universities, companies, and other organizations for exclusive use by

contractors. Currently, there are 14 contract beamlines in operation and three new contract beamlines are scheduled for construction as mentioned above. The experimental stations of BL22XU and BL23SU are located at JAEA's RI Laboratory and are dedicated to research utilizing radioactive isotopes and actinide materials. The National Synchrotron Radiation Research Center of Taiwan (NSRRC) was the first foreign organization to construct contract beamlines at SPring-8, i.e., BL12B2 and BL12XU.

There are 7 RIKEN beamlines for their exclusive use to promote RIKEN's research activities, although 20% of the beamtime is reserved for public use. RIKEN BL19LXU is the only beamline equipped with a long undulator, realizing the highest degree of brilliance. BL26B1 and BL26B2 are the beamlines used for high-throughput protein crystallography, a method used in the human genome project. BL29XU has two experimental stations, one located in the experimental hall and the other at the end of the 1 km beamline.



HXPES•MCT: Hard X-ray Photoelectron Spectroscopy, Micro-Tomography

Fig. 3. Beamline map.

Table III. List of beamlines

(September, 2007)

BL #	Beamline Name	(Public Use)	Areas of Research
★ Public Beamlines			
BL01B1	XAFS	(Oct. 1997)	XAFS in wide energy region (3.8 to 113 keV). XAFS of dilute systems and thin films.
BL02B1	Single Crystal Structure Analysis	(Oct. 1997)	Structure physics using single crystal analysis. Precise structure analysis of photo-excited state.
BL02B2	Powder Diffraction	(Sept. 1999)	Accurate structure analysis of crystalline materials using powder diffraction data by Rietveld refinements and MEM (maximum entropy method).
BL04B1	High Temperature and High Pressure Research	(Oct. 1997)	Mineral physics at high temperature and high pressure. Energy-dispersive X-ray diffraction and X-ray radiography using the large-volume press.
BL04B2	High Energy X-ray Diffraction	(Sept. 1999)	Structural analysis of glass, liquid, and amorphous materials. X-ray diffraction under ultra high-pressure. Precise single crystal structure analysis
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	Nuclear Resonant Scattering	(Oct. 1997)	Time domain Mössbauer spectroscopy. Lattice dynamics study using nuclear resonant scattering.
BL10XU	High Pressure Research	(Oct. 1997)	Structure physics and earth science under ultra high pressure using DAC.
BL13XU	Surface and Interface Structures	(Sept. 2001)	Atomic-scale structure analysis of an ultra-thin film, nanostructure and surface, using in-air measurements (room temperature to 500 °C) and in-vacuum measurements (20 to 1300 K).
BL14B2	Engineering Science Research II	(Sept. 2007)	Medium-length hard X-ray bending magnet beamline designed for engineering science researches. X-ray absorption spectroscopy.
BL19B2	Engineering Science Research I	(Nov. 2001)	Industrial application using XAFS in wide energy region, residual stress measurement, structural analysis of thin film, surface and interface, powder diffraction, and X-ray imaging.
BL20XU	Medical and Imaging II	(Sept. 2001)	Medical application: Microangiography, refraction-enhanced imaging. / Microimaging: Scanning microscopy, imaging microscopy, microtomography, X-ray holography and X-ray optics. / Ultra-small angle scattering.
BL20B2	Medical and Imaging I	(Sept. 1999)	Medical application: Microradiography, micro-tomography and refraction-enhanced imaging. / Microimaging: R&D of optical elements for novel imaging techniques.
BL25SU	Soft X-ray Spectroscopy of Solid	(Apr. 1998)	High resolution photoemission spectroscopy. Photoelectron diffraction and holography. Magnetic circular dichroism (MCD). Photoelectron emission microscope (PEEM).
BL27SU	Soft X-ray Photochemistry	(May 1998)	Industrial research of functional material. Atomic and molecular spectroscopy by high resolution electron spectroscopy. Surface analysis and solid state physics.
BL28B2	White Beam X-ray Diffraction	(Sept. 1999)	White X-ray diffraction. Time-resolved energy-dispersive XAFS (DXAFS) .
BL35XU	High Resolution Inelastic Scattering	(Sept. 2001)	Material dynamics on ~ meV energy scales using inelastic X-ray scattering (IXS) and nuclear resonant scattering (NRS).
BL37XU	Trace Element Analysis	(Nov. 2002)	X-ray microbeam spectrochemical analysis. Ultra trace element analysis. High energy X-ray fluorescence analysis.
BL38B1	Structural Biology III	(Oct. 2000)	XAFS. R&D of optics and detector. Macromolecular crystallography.
BL39XU	Magnetic Materials	(Oct. 1997)	X-ray magnetic circular dichroism (XMCD) spectroscopy. Element-specific magnetometry. X-ray emission spectroscopy and its magnetic circular dichroism. Resonant or non-resonant magnetic scattering.
BL40XU	High Flux	(Apr. 2000)	Time-resolved diffraction and scattering experiments. X-ray speckle. X-ray fluorescence trace analysis.
BL40B2	Structural Biology II	(Sept. 1999)	Macromolecular crystallography. Small angle X-ray (solution) scattering.
BL41XU	Structural Biology I	(Oct. 1997)	Biological macromolecular crystallography.
BL43IR	Infrared Materials Science	(Apr. 2000)	Infrared microspectroscopy. Magneto-optical spectroscopy. Infrared surface science. Absorption and reflection spectroscopy. Time-resolved experiments with pulsed laser and SR (pump and probe).
BL46XU	R&D	(Nov. 2000)	Insertion devices R&D. Resonant and non-resonant magnetic scattering structural analysis.
BL47XU	HXPES •MCT	(Oct. 1997)	R&D of microtomography and microbeam technique. High energy photoemission spectroscopy.

BL #	Beamline Name (First Beam)	Areas of Research
● Contract Beamlines		
BL08B2	Hyogo BM (Hyogo Prefecture) (Jun. 2005)	XAFS in a wide energy region. Small angle X-ray scattering for structural analyses of polymer and nano-composite materials. X-ray topography. Imaging. Powder diffraction with a high angular resolution.
BL24XU	Hyogo ID (Hyogo Prefecture) (May 1998)	Structure analysis of small bio-crystals for industry. Surface/interface analysis for industry by fluorescent X-ray analysis, strain measurements and grazing incidence X-ray diffraction. Microbeam formation studies for materials and life sciences.
BL12XU	NSRRC ID (National Synchrotron Rad. Res. Center) (Dec. 2001)	High resolution non-resonant or resonant inelastic X-ray scattering. High resolution near-edge X-ray Raman scattering. Phase transitions under high-pressure, low and high temperatures. High-resolution X-ray absorption and emission spectroscopy. X-ray physics and optics.
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.
BL15XU	WEBRAM (National Institute for Materials Science) (Jan. 2000)	High resolution X-ray photoemission microscopy. High energy excitation X-ray photoelectron spectroscopy. High resolution X-ray emission spectroscopy. Highly precise X-ray powder diffraction and ultra-small angle scattering.
BL16XU	Industrial Consortium ID (Industrial Consortium) (Oct. 1998)	Characterization of thin films for ULSI and magnetic devices, catalysts, functional materials, and structural materials by X-ray diffraction, fluorescence X-ray analysis, X-ray magnetic circular dichroism, and imaging with X-ray microbeam.
BL16B2	Industrial Consortium BM (Industrial Consortium) (Oct. 1998)	Characterization of industrial materials, such as metal and oxide films, semiconductor crystals by XAFS, topography and other methods.
BL32B2	Pharmaceutical Industry (Pharmaceutical Consortium for Protein Structure Analysis) (Apr. 2002)	Protein structure analysis for structure-based drug design: Design and optimization of new leading compounds based on pharmacodynamic action mechanism elucidated at the molecular level which obtained from a detailed interaction analysis of receptor-drug complexes.
BL33LEP	Laser-Electron Photon (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.
BL44XU	Macromolecular Assemblies (IPR, Osaka University) (May 1999)	Crystal structure analysis of biological macromolecular assemblies (e.g. membrane complexes, protein complexes, protein-nucleic acid complexes, and viruses).
BL11XU	JAEA Quantum Dynamics (Oct. 1998)	Nuclear resonant scattering. Surface and interface structure with MBE. Inelastic scattering. XAFS.
BL14B1	JAEA Materials Science (Dec. 1997)	Materials science at high pressure. Structure physics.
BL22XU	JAEA Quantum Structural Sci. (May 2002)	Materials science at high pressure. Resonant X-ray scattering (activity at RI laboratory).
BL23SU	JAEA Actinide Science (Feb. 1998)	Surface chemistry with supersonic molecular beam. Biophysical spectroscopy. Photoelectron spectroscopy (activity at RI laboratory). Magnetic circular dichroism (activity at RI laboratory).
◆ RIKEN Beamlines		
BL17SU	RIKEN Coherent Soft X-ray Spectroscopy (Sept. 2003)	Spectroscopy of multiply charged ions. Angle-resolved photoemission spectroscopy (ARPES). Soft X-ray emission spectroscopy.
BL19LXU	RIKEN SR Physics (Oct. 2000)	Any research field requiring the highly brilliant X-ray beam.
BL26B1/B2	RIKEN Structural Genomics I & II (Apr. 2002)	Structural genomics research based on single crystal X-ray diffraction.
BL29XU	RIKEN Coherent X-ray Optics (Dec. 1998)	X-ray optics, especially coherent X-ray optics.
BL44B2	RIKEN Structural Biology II (Feb. 1998)	Macromolecular crystallography.
BL45XU	RIKEN Structural Biology I (Jul. 1997)	Macromolecular crystallography. Time-resolved structures of non-crystalline biological materials using small-angle scattering and diffraction technique.
■ Accelerator Beam Diagnosis		
BL05SS	Accelerator Beam Diagnosis (Mar. 2004)	Accelerator beam diagnostics. R&D of accelerator components.
BL38B2	Accelerator Beam Diagnosis (Sept. 1999)	Accelerator beam diagnostics. R&D of accelerator components. Production of MeV γ -ray photons.