

Table I. Beam parameters of SPring-8 storage ring.

Energy [GeV]	8
Number of buckets	2436
Tunes ( $\nu_x / \nu_y$ )	40.15 / 18.35
Current [mA]:	
single bunch	10
multi bunch	~100
Bunch length ( $\sigma$ ) [psec]	13
Horizontal emittance [nm·rad]	3.4 *
Vertical emittance [pm·rad]	6.8 *
Coupling [%]	0.2
RF Voltage [MV]	16
Momentum acceptance [%]	$\pm 2.5$ (= $\pm 200$ MeV)
Beam size [ $\mu\text{m}$ ]: ( $\sigma_x / \sigma_y$ ) [ $\mu\text{m}$ ]	
Long ID section	294 / 10
ID section	301 / 6
BM section	107 / 13
Beam divergence [ $\mu\text{rad}$ ]: ( $\sigma_{x'} / \sigma_{y'}$ ) [ $\mu\text{rad}$ ]	
Long ID section	13 / 0.7
ID section	12 / 1.1
BM section	56 / 0.6
Operational chromaticities: ( $\xi_x / \xi_y$ )	+2 / +2 **
Lifetime [hr]:	
100 mA (multi bunch)	~ 200
1 mA (single bunch)	~ 15
Horizontal dispersion [m]:	
Long ID section	0.103
ID section	0.107
BM section	0.032
Fast orbit stability (0.1 – 200 Hz)[ $\mu\text{m}$ ]:	
horizontal (rms)	~ 4
vertical (rms)	~ 1

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

## BEAMLINES

The electron storage ring of the SPring-8 accelerator complex can potentially accommodate 62 beamlines (34 insertion devices, 4 long undulators, 23 bending magnets and 1 infrared). Occupying about 75% of its full capacity, there are 48 beamlines currently in operation as shown in Beamline map (Fig. 2) and List of beamlines (Table II).

These beamlines are primarily categorized into following four groups;

- (1) Public Beamlines,
- (2) Contract Beamlines,
- (3) RIKEN Beamlines, and
- (4) Accelerator Beam Diagnosis beamlines.

Constructed by JAERI<sup>1</sup> and RIKEN with governmental grants, Public Beamlines have been operated for public use. Now there are 25 public beamlines in operation; 22 X-ray beamlines, two soft X-ray beamlines and one infrared beamline. Among them, three beamlines had been specifically used for R&D. According to the recommendation made by R&D Beamline Review Committee, however, all the R&D beamlines have changed their status to general use since the period of 2005A, although one of them (BL46XU) is still kept for R&D programs as an interim measure.

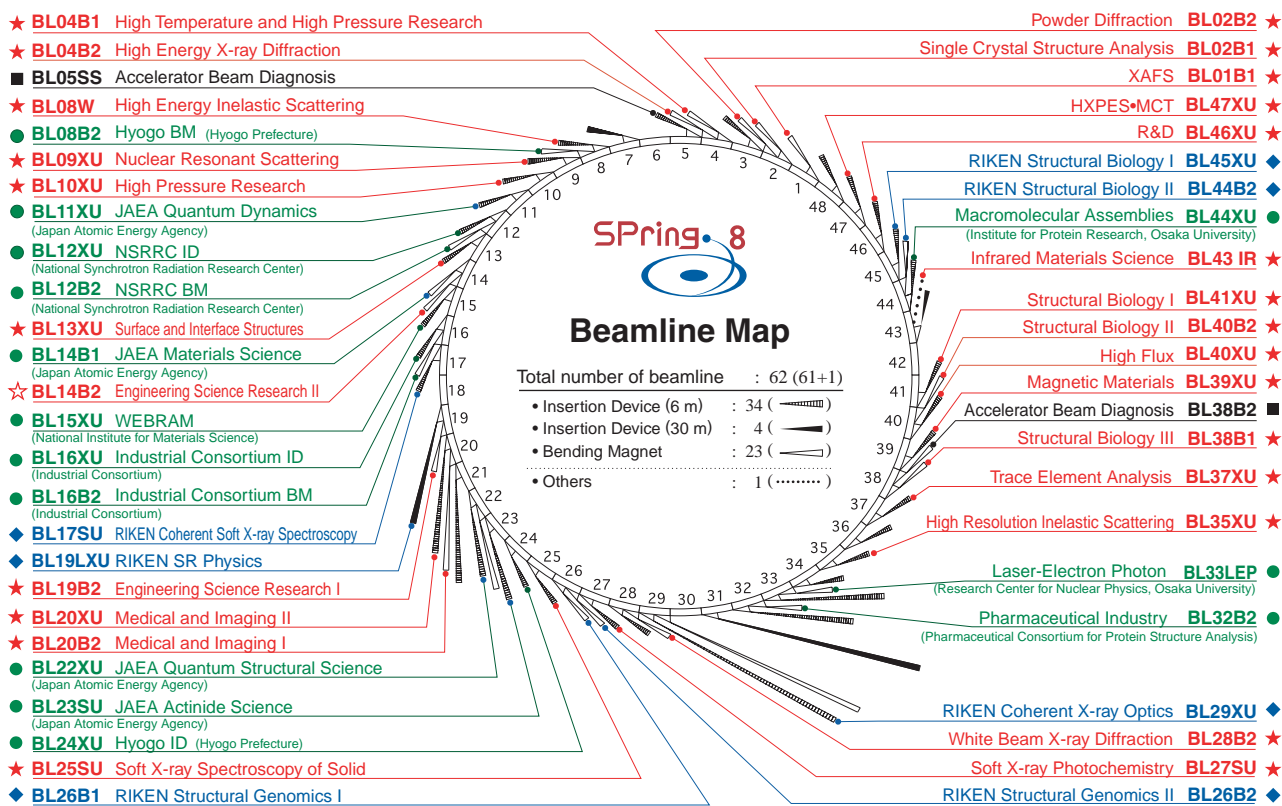
The contract beamlines are installed, owned,

operated and maintained by university, companies, and other organizations for exclusive use by contractors. Currently there are 14 contract beamlines in operation, including JAEA beamlines<sup>2</sup>. 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. National Synchrotron Radiation Research Center of Taiwan (NSRRC) was the first foreign organization that constructed contract beamlines at SPring-8, i.e., BL12B2 and BL12XU.

There are seven RIKEN beamlines for their exclusive use to promote RIKEN's own research

activities, although 20% of beamtime is reserved for public use. RIKEN BL19LXU is the only beamline instrumented with a long undulator, realizing the highest brilliance. BL26B1 and BL26B2 are the beamlines used for high throughput protein crystallography, closely related with 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.

Dedicated to studying the characteristics of the electron beam accumulated in the storage ring, the accelerator beam diagnosis beamlines are currently under the exclusive use of JASRI accelerator group.



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 Undulator  
 SS: Straight Section

★ : Public Beamlines  
 ● : Contract Beamlines  
 ◆ : RIKEN Beamlines  
 ■ : Accelerator beam diagnostic  
 ☆ : Under Construction

WEBRAM: Wide Energy range Beamline for Research in Advanced Materials  
 NSRRC: National Synchrotron Radiation Research Center

Fig. 2. Beamline map.

<sup>1</sup> Japan Atomic Energy Research Institute (JAERI) was transformed into an independent administrative institution now called Japan Atomic Energy Agency (JAEA) October 1, 2005.

<sup>2</sup> Due to the withdrawal of JAERI from the SPring-8 management October 1, 2005, JAEA beamlines, previously called JAERI beamlines, are now categorized into contract beamlines.

Table II. List of beamlines

(April, 2006)

BL #	Beamline Name	(Public Use)	Areas of Research
<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.
BL02B1	<b>Single Crystal Structure Analysis</b>	(Oct. 1997)	Structure physics using single crystal analysis. Precise structure analysis of photo-excited state.
BL02B2	<b>Powder Diffraction</b>	(Sep. 1999)	Accurate structure analysis of crystalline materials using powder diffraction data by Rietveld refinements and MEM (maximum entropy method).
BL04B1	<b>High Temperature and High Pressure Research</b>	(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	<b>High Energy X-ray Diffraction</b>	(Sep. 1999)	Structural analysis of glass, liquid, and amorphous materials. X-ray diffraction under ultra high-pressure. Precise single crystal structure analysis
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)	Time domain Mössbauer spectroscopy. Lattice dynamics study using nuclear resonant scattering.
BL10XU	<b>High Pressure Research</b>	(Oct. 1997)	Structure physics and earth science under ultra high pressure using DAC.
BL13XU	<b>Surface and Interface Structures</b>	(Sep. 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).
BL19B2	<b>Engineering Science Research</b>	(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	<b>Medical and Imaging II</b>	(Sep. 2001)	Medical application: Microangiography, refraction-enhanced imaging. / Micro-imaging: Scanning microscopy, imaging microscopy, microtomography, X-ray holography and X-ray optics. / Ultra-small angle scattering.
BL20B2	<b>Medical and Imaging I</b>	(Sep. 1999)	Medical application: Micro-radiography, micro-tomography and refraction-enhanced imaging. / Micro-imaging: R&D of optical elements for novel imaging techniques.
BL25SU	<b>Soft X-ray Spectroscopy of Solid</b>	(Apr. 1998)	High resolution photoemission spectroscopy. Photoelectron diffraction and holography. Magnetic circular dichroism (MCD). Photoelectron emission microscope (PEEM).
BL27SU	<b>Soft X-ray Photochemistry</b>	(May 1998)	Industrial research of functional material. Atomic and molecular spectroscopy by high resolution electron spectroscopy. Surface analysis and solid state physics.
BL28B2	<b>White Beam X-ray Diffraction</b>	(Sep. 1999)	White X-ray diffraction. Time-resolved energy-dispersive XAFS (DXAFS) .
BL35XU	<b>High Resolution Inelastic Scattering</b>	(Sep. 2001)	Material dynamics on ~ meV energy scales using inelastic X-ray scattering (IXS) and nuclear resonant scattering (NRS).
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)	XAFS. R&D of optics and detector. Macromolecular crystallography.
BL39XU	<b>Magnetic Materials</b>	(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	<b>High Flux</b>	(Apr. 2000)	Time-resolved diffraction and scattering experiments. X-ray speckle. X-ray fluorescence trace analysis.
BL40B2	<b>Structural Biology II</b>	(Sep. 1999)	Macromolecular crystallography. Small angle X-ray (solution) scattering.
BL41XU	<b>Structural Biology I</b>	(Oct. 1997)	Biological macromolecular crystallography.
BL43IR	<b>Infrared Materials Science</b>	(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	<b>R&amp;D</b>	(Nov. 2000)	Insertion devices R&D. Resonant and non-resonant magnetic scattering structural analysis.
BL47XU	<b>HXPES • MCT</b>	(Oct. 1997)	R&D of microtomography and microbeam technique. High energy photoemission spectroscopy.

BL #	Beamline Name (First Beam)	Areas of Research
<b>● Contract Beamlines</b>		
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 nano-composite materials. X-ray topography. Imaging. Powder diffraction with a high angular resolution.
BL12XU	<b>NSRRC ID</b> (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	<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.
BL15XU	<b>WEBRAM</b> (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	<b>Industrial Consortium ID</b> (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	<b>Industrial Consortium BM</b> (Industrial Consortium) (Oct. 1998)	Characterization of industrial materials, such as metal and oxide films, semiconductor crystals by XAFS, topography and other methods.
BL24XU	<b>Hyogo ID</b> (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.
BL32B2	<b>Pharmaceutical Industry</b> (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	<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.
BL44XU	<b>Macromolecular Assemblies</b> (IPR, Osaka University) (May 1999)	Crystal structure analysis of biological macromolecular assemblies (e.g. membrane complexes, protein complexes, protein-nucleic acid complexes, and viruses).
<b>◆ RIKEN Beamlines</b>		
BL17SU	<b>RIKEN Coherent Soft X-ray Spectroscopy</b> (Sep. 2003)	Spectroscopy of multiply charged ions. Angle-resolved photoemission spectroscopy (ARPES). Soft X-ray emission spectroscopy.
BL19LXU	<b>RIKEN SR Physics</b> (Oct. 2000)	Any research field requiring the highly brilliant X-ray beam.
BL26B1/B2	<b>RIKEN Structural Genomics I &amp; II</b> (Apr. 2002)	Structural genomics 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.
BL44B2	<b>RIKEN Structural Biology II</b> (Feb. 1998)	Macromolecular crystallography.
BL45XU	<b>RIKEN Structural Biology I</b> (Jul. 1997)	Macromolecular crystallography. Time-resolved structures of non-crystalline biological materials using small-angle scattering and diffraction technique.
<b>■ Accelerator Beam Diagnosis</b>		
BL05SS	<b>Accelerator Beam Diagnosis</b> (Mar. 2004)	Accelerator beam diagnostics. R&D of accelerator components.
BL38B2	<b>Accelerator Beam Diagnosis</b> (Sep. 1999)	Accelerator beam diagnostics. R&D of accelerator components. Production of MeV $\gamma$ -ray photons.