Outline of SPring-8 Public Beamlines under Construction (from the SPring-8 www site*)

*)SPring-8 Homepage address : http://www.spring8.or.jp/

JAERI-RIKEN SPring-8 Project Team Experimental Group

SPring-8 Beamline

- **Public Beamline**
  - BL01B1 XAFS — partial operation in Oct. 1997
  - BL02B1 Crystal Structure Analysis — full operation in Oct. 1997
  - BL04B1 High Temperature Research — partial operation in Oct. 1997
  - BL08W High Energy Inelastic Scattering
  - BL09XU Nuclear Resonant Scattering — partial operation in Oct. 1997
  - BL10XU Extremely Dense State
  - BL25SU Soft X-ray Spectroscopy of Solid
  - BL27SU Soft X-ray Photochemistry
  - BL39XU Physicochemical Analysis — partial operation in Oct. 1997
  - BL41XU Bio-Crystallography — partial operation in Oct. 1997

- **Beamline for the Research and Development**
  - BL47XU R&D 1 — full operation in Oct. 1997

- **JAERI Beamline**
- **RIKEN Beamline**

- **Location of Beamlines**

- **Technical Information of Beamline**
  - Insertion Device

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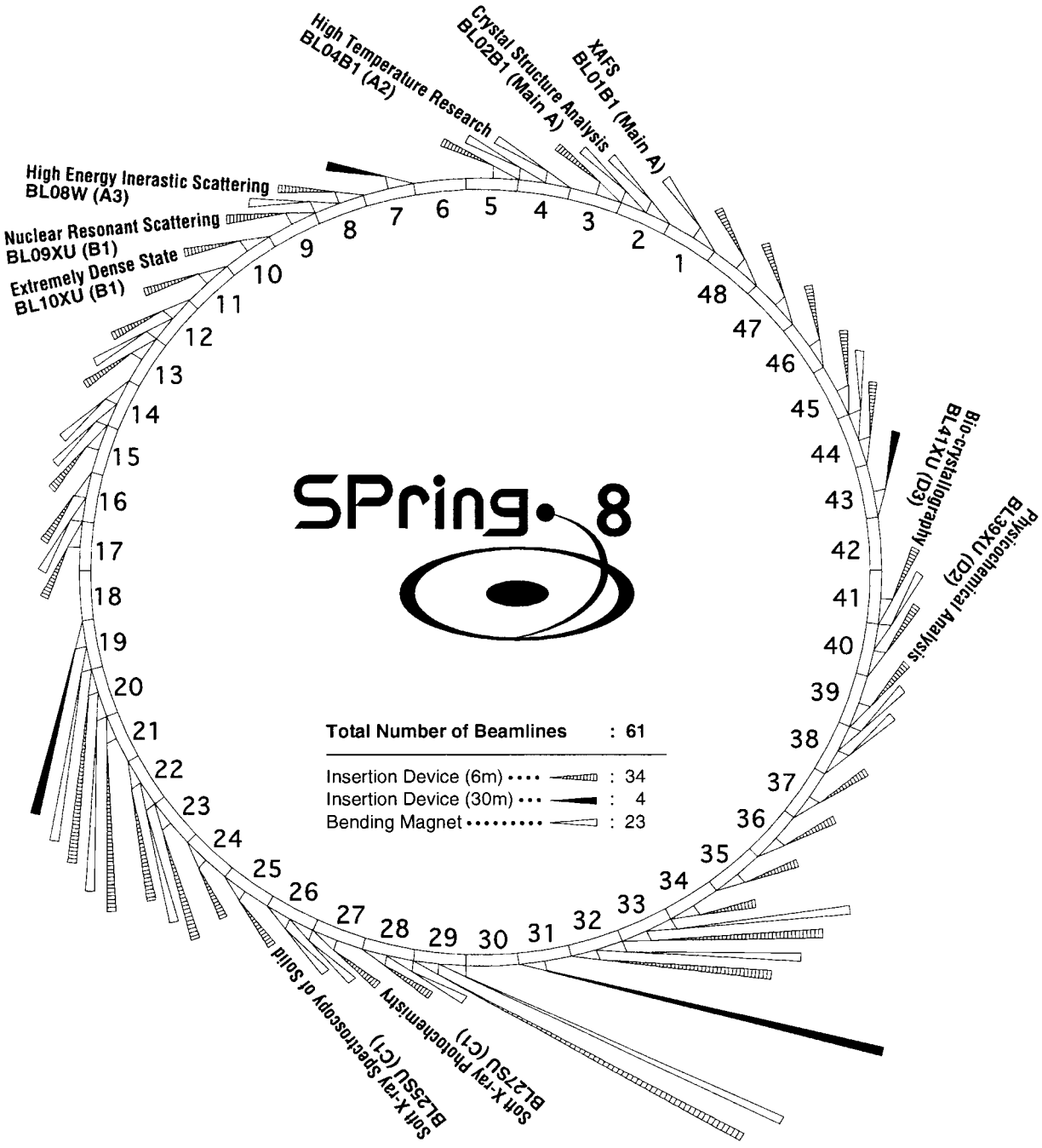
Last modified : Oct 16,1996

SPring-8 Location of Beamlines (Clickable Map)



BL01B1 —XAFS—

Location : BL-01 Bending Magnet #1 BL.

Person in Charge : Tomoya URUGA (e-mail:urugat@spring8.or.jp)

Subgroup : Broad Energy Band XAFS

Source Characteristics :

Device	Bending Magnet, E_c=28.9keV
Total power	220W (I=100mA)
Power density	1.5kW/mrad^2 (I=100mA)
Source size at 2% coupling	S_x=0.182mm, S_y=0.058mm, S_y,=0.065mrad

Optics :

Distance from source	Optical Element	Function
32.7m	first mirror	collimation, higher harmonics elimination
35.7m	adjustable inclined double crystal monochromator	monochromatization, sagital focusing
42.3m	second mirror	meridional focusing, higher harmonics elimination

X-ray at Sample :

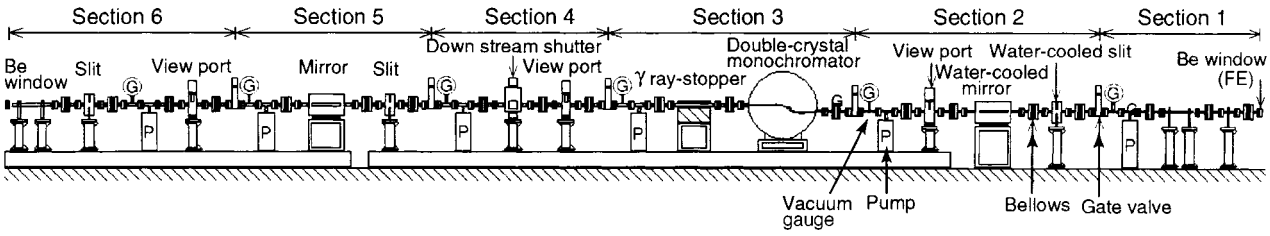
Energy range: 3.5-90keV

Energy resolution: DE/E=10^{-4}

Photon flux: 10^{9}-10^{11}ph/s

BM1 (02B1) : Crystal Structure Analysis

BM3 (01B1) : XAFS



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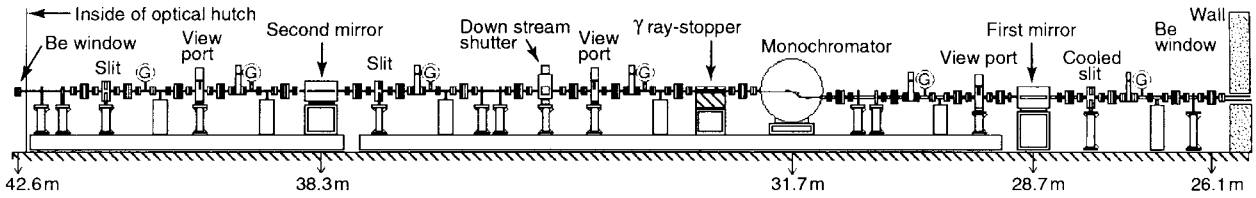
Last modified: May 1, 1996

BL02B1 — Crystal Structure Analysis —

Location : BL-02 Bending Magnet #1 BL.
Scientist in Charge : Yukio NODA (e-mail:ynoda@science.s.chiba-u.ac.jp)
In-house Staff : Hiroyuki KONISHI (e-mail:konishi@sp8sun.spring8.or.jp)

Research Objectives	Study of structural aspects by fixed energy X-ray beam ・Precise structural analysis of new synthesized materials ・Observation of an extremely weak diffraction intensity reflectioing very small structural change.
Light Source	Bending Magnet

Abstract



The beamline called Crystal Structure Analysis is assigned to four subgroups, that is, Structural Phase transition, Highly Precise Molecular Crystallography, Diffuse Scattering and High-Resolution Powder groups. These groups handle materials to study structural aspects by fixed energy X-ray beam commonly. However, there are divergences in techniques such as crystal size, variation of atmospheres of samples, requirements of resolution function for the diffraction experiments and so on. The structural phase transition group became the group leader of this project to organize and converge the requirement for the system settled on the beamline.

The main concept of this beamline is to construct the machine as the general purpose for the diffraction experiments to include all of necessary demands of these four groups. They proposed the high flux and high energy beamline by using the radiation generated from a bending magnet in order.

1. to observe various weak diffraction such as diffuse scattering or superlattice diffraction utilizing the high flux radiation,
2. to collect a lot of diffraction data for precise structural analysis by utilizing high energy radiation and expanding the observable reciprocal lattice volume.

The experimental station is designing by the collaboration of four groups. The central part of the station is the seven-axes diffractometer. It is very similar with the conventional six-axes diffractometer commonly used at many beamlines of synchrotron radiation facilities, and one extra two-theta axis is added. The purpose of the extra axis is to be specialized for the conventional structure analysis to give the high speed motor function. Off-center type chi-cradle is planned to put a cryostat, a furnace, a vacuum chamber and a spindle for powder sample on the phi-circle. Many other optional tools is be planning, for instance, a high precision solar slit, Imaging plate system for photographic method.

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Last modified: May 8, 1996

SPring-8 BL04B1 — High Temperature Research —

Location : BL-04 Bending Magnet #1 BL.
Scientist in Charge : Kazuhiko TSUJI (e-mail:tsuji@phys.keio.ac.jp)
In-house Staff : Wataru UTSUMI (e-mail:utsumi@spring8.or.jp

Scientific Applications	X-ray diffraction for expanded fluids, liquids, and liquid alloys, XAFS, Small-angle x-ray scattering, Anomalous x-ray scattering (AXS) for multi-componet system.
Light Source	Bending Magnet, 10-150keV
Beam characteristics at sample	1. Energy range 10-150keV 2. Energy resolution 5(eV), white 3. Beam Size 1 × 1 mm^2 4. Beam Divergence vertical < 0.05 mrad, horizontal < 0.5mrad 5. Photon flux 10^{10} photons/sec/mm^2/0.1%b.w. 6. Beam Stability 0.1 (mm) 7. Others white x-ray and moochomatized x-ray

Abstract

The experimental hutches for the high temperature research will be built at the BL04B1 bending magnet beamline. This beamline has no monochrometer and white x-rays will be supplied for the experiment. Two scientific subgroups, high pressure mineral physics group and high temperature group, are planning to carry out their experiment in the two experimental stations tandemly built on this beamline.

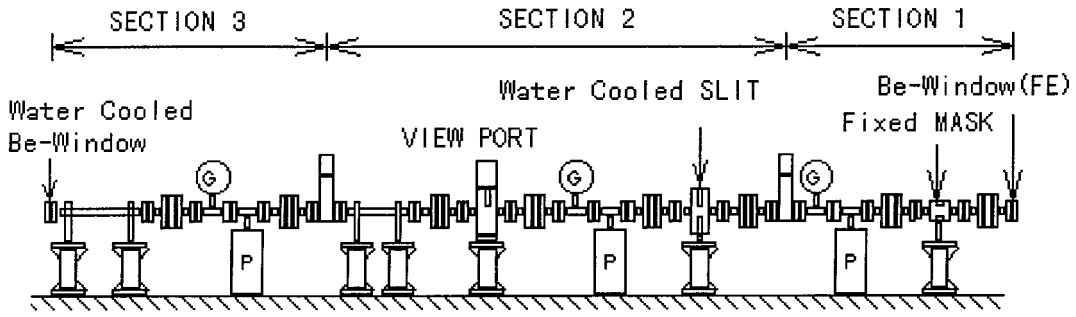

Fig.1 Schematic view of transport channel of BL04B1

High Pressure Mineral Physics

Research Subjects

- Structure of the Earth's Mantle and Core
- Magma and Molten Metal in the Earth's Interior
- In situ Observation of Diamond Synthesis

Facilities

- 1500 ton Large Volume Press with 6-8 Multi-Anvil Type High Pressure System
  40 GPa, 2500 C

- Vertical and Horizontal Goniometer

The aim of the high pressure mineral physics group is to reveal the origin, evolution and present state of the internal structure of the Earth and other planets. For this purpose, various properties of planetary materials, such as iron, silicates, hydrogen and helium, will be investigated under high pressures and high temperatures. In particular, in situ x-ray diffraction experiment under high pressure and high temperature will be mainly carried out using the polychromatic x-rays from a bending magnet. The extreme pressure and temperature conditions corresponding to those of planetary interiors can be obtained with a multi-anvil type high pressure apparatus, which will be installed on this beamline. This high pressure apparatus has a 1500 ton ram-force uniaxial press with a cubic anvil type guide block, and is operated in the two-stage mode (so called 6-8 system) to reach the desired P-T conditions. This system has a capability of generating pressures up to 40 GPa and a temperature of 3000 K using a solid pressure medium. For the x-ray experiments, two single-axis goniometers (vertical and horizontal directions) are equipped by the high pressure press. The Ge solid state detector is used for the energy dispersive x-ray diffraction experiments.

High Temperature

Research Subjects

- Structural Studies for Expanded Fluid Metals and Semiconductors
- Partial Structures in Multi-Component System
  - o Anomalous X-ray Scattering
  - o XAFS
- Structural Studies at Extremely High Temperatures

Facilities

- High Pressure Gas Vessel
  Helium 2000 kg/cm^2, 1650 C
- Horizontal Goniometer
- Protection Wall

The high temperature group is planning to investigate the structural properties of disordered materials under high temperatures. One of the biggest topics is the structural studies of expanded fluid metals and semiconductors. When liquid metals are heated and pressure is applied to prevent boiling, significant density decreases can be achieved. When temperature is elevated at low pressure, a first-order phase transition from liquid to gas occurs accompanied with increasing pressure, and disappears at the critical point. At the pressure higher than this critical pressure, the volume of expanded fluid can be changed continuously in a wide range by heating. The structure of these expanded fluids, such as Hg and Se, will be investigated in a wide density range by the x-ray diffraction measurements and the small-angle x-ray scattering. In the experimental station, a high pressure gas vessel and an energy dispersive x-ray diffractometer will be installed. This high pressure vessel permits x-ray diffraction measurements at high temperature and pressure up to 1650 C and 2000 kg/cm^2. Since helium high pressure gas is used as pressure medium, all these facilities will be placed in small rooms surrounded by the protection wall built inside the hutch.

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Last modified: July 30, 1996

SPring-8 BL08W —High Energy Inelastic Scattering —

Location : BL-08 Insertion Device BL.

Person in Charge : Hitoshi YAMAOKA (e-mail:yamaoka@spring8.or.jp)

Subgroups : High Energy Inelastic Scattering

Scientific Applications : Magnetic Compton Scattering
High-resolution Compton Scattering
High-energy Bragg Scattering

Source Characteristics :

Device	Elliptic multipole wiggler
l_u	12cm
N	37
Critical energy	42.6keV at K_y=11.2
Total Power	17.9kW at K_y=11.2
Peak Power density	160kW/mrad^2 at K_y=11.2
On-aixs degree of circular polarization	0.76 at 300keV, K_y=11.2, K_x=0.6

Station A : (for Magnetic Compton Scattering)

Optics : Asymmetric Johanson monochromator, Si(771)
X-ray energy: 300keV
Energy resolution: DE/E = $5x10^{-3}$
X-ray beam size at sample : 3mm(H)x1mm(W)
X-ray flux at sample: $5x10^{12}$ph/s at 300keV

Station B : (for High-resolution Compton Scattering)

Optics : Doubly bent monochromator, Si(400)
X-ray energy : 100-150keV
Energy resolution: DE/E<$1x10^{-3}$
X-ray beam size at sample : 0.5mm(H)x0.5mm(W)
X-ray flux at sample : $3.3x10^{13}$ph/s at 100keV

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Last modified: May 1, 1996

SPring-8 BL09XU — Nuclear Resonant Scattering —

Location : BL-09 Insertion Device BL.

Person in Charge : Taikan HARAMI (e-mail:taikan@spring8.or.jp)

Subgroups : Nuclear Resonant Scattering
Surface and Interface Structure

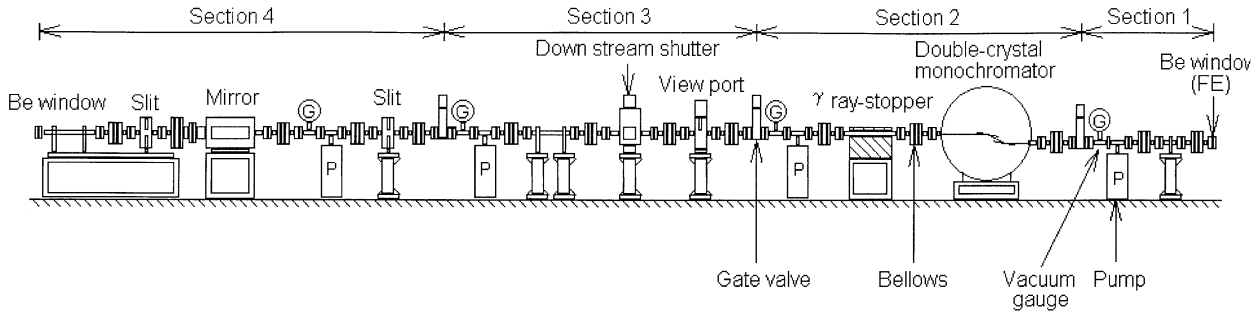
Source Characteristics ：

Device	In-vacuum-type undulator
l_u	3.2cm
N	140
Tunable range	6-80keV
Brilliance	$1.5x10^{19}$ ph/s/mrad^2/mm^2/0.1%b.w. at 14.4keV
Total Power	1.31kW at 14.4keV
Power density	141kW/mrad^2 at 14.4keV
Source size	S_x=0.41mm, S_y=0.035mm, S_x'=0.017mrad, S_y'=0.0039mrad

Optics ：

Distance from source	Optical Element	Description
40m	Rotated-inclined double crystal monochromator	Energy resolution: DE/E~10^{-4}

XU2 (09XU) : Nuclear Resonant Scattering



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Last modified: July 2, 1996

BL10XU — Extremely Dense State —

Location ： BL-10 Insertion Device BL.
Person in Charge ： Kentaro SUZUYA (e-mail:suzuya@sp8sun.spring8.or.jp)
Subgroups ： Structural Properties of Extremely Dense Materials
High Brilliance XAFS

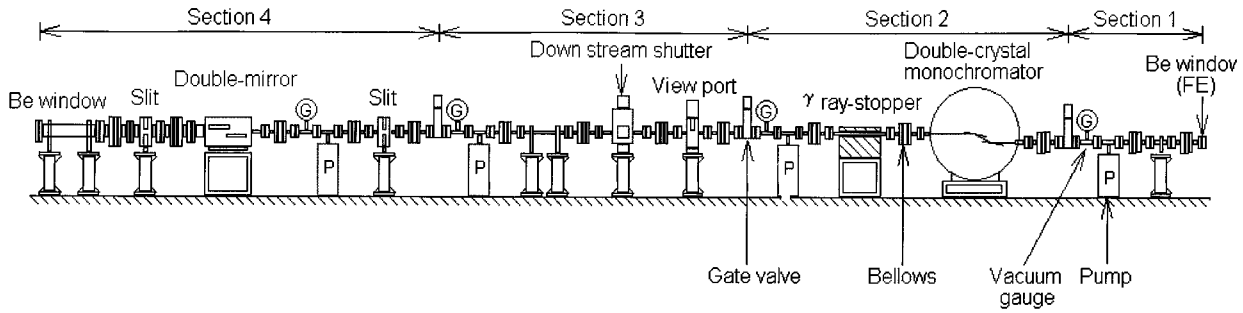
Source Characteristics ：

Device	In-vacuum-type undulator
l_u	3.2cm
N	140
Tunable range	>5keV
Brilliance	$2x10^{19}$ ph/s/mrad^2/mm^2/0.1%b.w. (I=100mA)
Total Power	5kW
Power density	300kW/mrad^2

Optics :

Distance from source	Optical Element	Function
36m	rotated-inclined double crystal monochromator	monochromatization of 5-60keV X-rays
43m	double-flat mirror system (fixed exit double mirrors)	cut off energy: 10-20keV
56m	Bragg Fresnel Lens	

XU3 (10XU) : Extremely Dense State



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Last modified: July 3, 1996

BL25SU — Soft X-ray Spectroscopy of Solid —

Location : BL-25 Insertion Device BL.
Person in Charge : Y. SAITOH (e-mail:ysaitoh@spring8.or.jp)
Subgroups : Soft X-ray Spectroscopy of Solid

Source Characteristics :

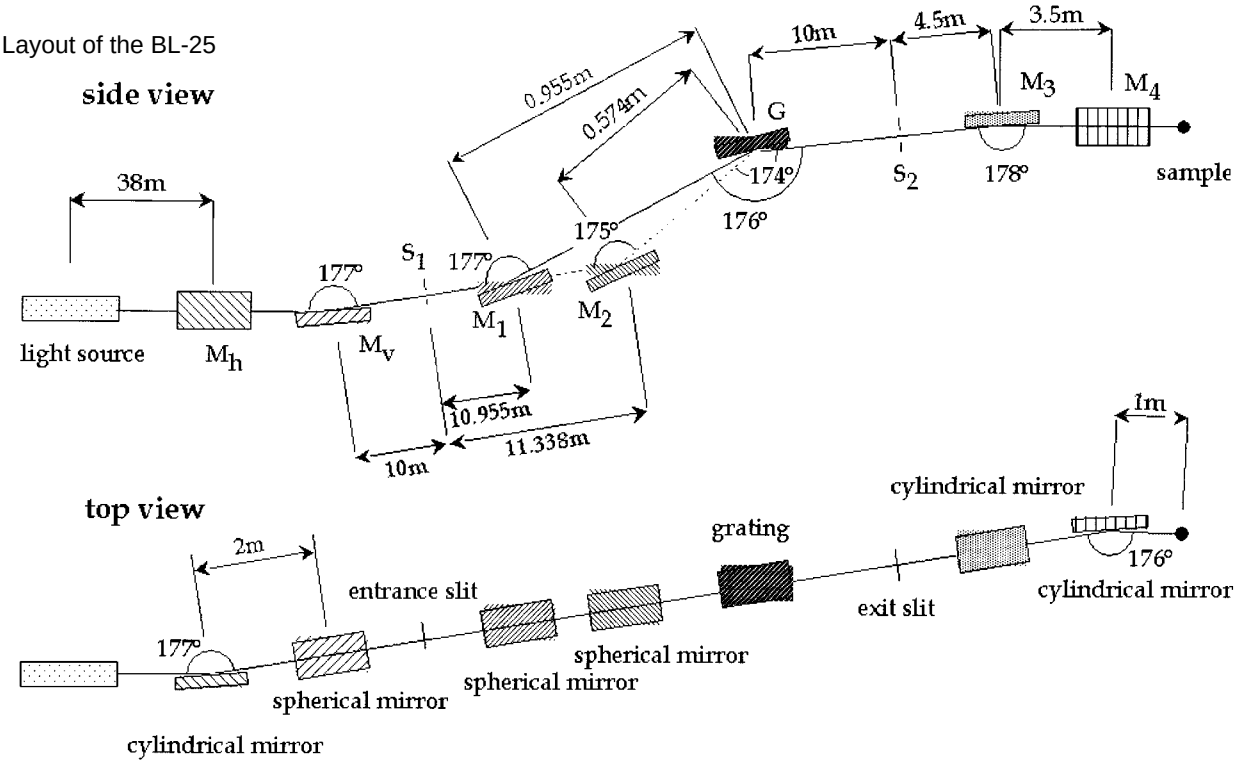
Device	Twin helical undulator Fast helicity modulation
l_u	120mm
N	12
Tunable range	0.5-3keV
Brilliance	6.65×10^{17} ph/s/mrad^2/mm^2/0.1%b.w.
Total Power at 1keV	667.5W
Power density at 1keV	0.862kW/mrad^2
Source size	S_x=0.41mm, S_y=0.035mm, $S_{x'}$=0.033mrad, $S_{y'}$=0.029mrad

Optics ：

Distance from source	Optical Element	Function
38m	cylindrical mirror (M_h)	deflection and horizontal focusing
40m	spherical mirror (M_v)	vertical focusing at the entrance slit
50-71.9m	constant deviation monochromator with varied-space plane gratings (S_1-M_1 or M_2-G-S_2)	monochromatization
76.4m, 80.9m	cylindrical mirrors (M_3, M_4)	focusing the beam onto the sample

X-ray at Sample : Energy resolution: E/DE > 10000
Photon flux: > 10^{13}ph/s
Beam size: < 0.1mm

Layout of the BL-25



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Last modified: May 1, 1996

BL27SU —Soft X-ray Photochemistry—

Location ： BL-27 Insertion Device BL.
Person in Charge ： T. Sekiguchi (e-mail:tsekiguc@spring8.or.jp)
Subgroups ： Soft X-ray Photochemistry
Soft X-ray CVD

Scientific Applications :

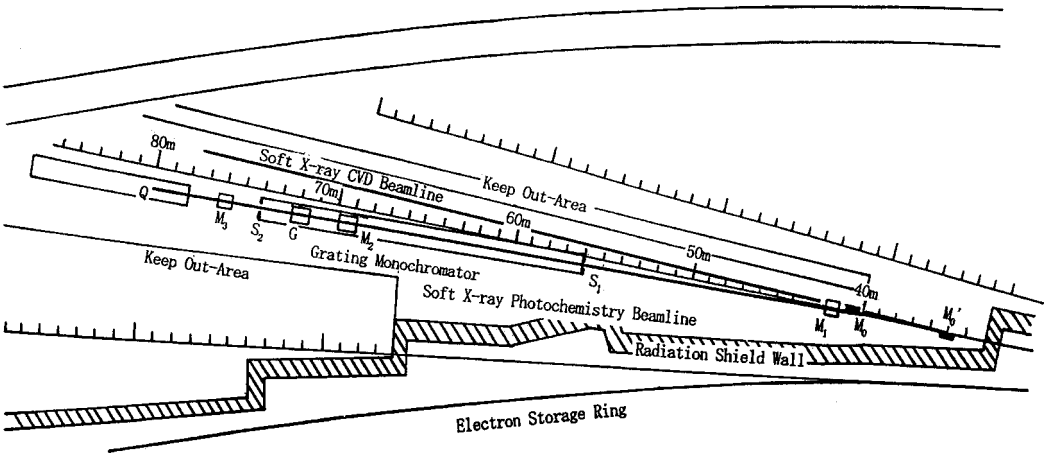
High resolution molecular spectroscopy
Photoionization dynamics by various correlation measurements
Dynamics of inner-shell excited molecules
Production and dynamics of novel core-excited states by SR(UR)-laser double resonance techniques
Site-specific dissociation processes of adsorbed molecules
Growth of thin film of functional material
Micro fabrication by functional material etching
Clarification of the reaction mechanics for deposition and process

Source Characteristics :

Device	Figure-8 undulator
l_u	100mm
N	44
Tunable range	0.5-5keV
Brilliance	$1.1x10^{18}$ ph/s/mrad^2/mm^2/0.1%b.w. at 500eV (I=100mA)
Total Power	2.7kW at 1st harmonic(500eV)
Power density	1.7kW/mrad^2 at 1st harmonic(500eV)

X-ray at Sample :

Energy range: 0.5-2keV
Linearly polarized
Photon flux: 10^{12}ph/s
Beam size: 0.5x0.5mm^2
Resolution: E/DE = 10000
and microbeam capability of several-some tens micrometers diameter in the energy range of 0.5-5keV



$M_{O'}$, M_O : Horizontally deflecting mirror, M_1 : Vertically focusing mirror
Monochromator/ S_1 : Entrance slit, S_2 : Exit slit, M_2 : Focusing mirror, G : Grating
M_3 : refocusing mirror, Q : Sample position

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Last modified: Aug. 6, 1996

BL39XU — Physicochemical Analysis —

Location : BL-39 Insertion Device BL.

Person in Charge : Shunji GOTO (e-mail:sgoto@spring8.or.jp)
X-ray Magnetic Absorption and Scattering

Subgroups : Spectrochemical Analysis
Medical Application

Source Characteristics :

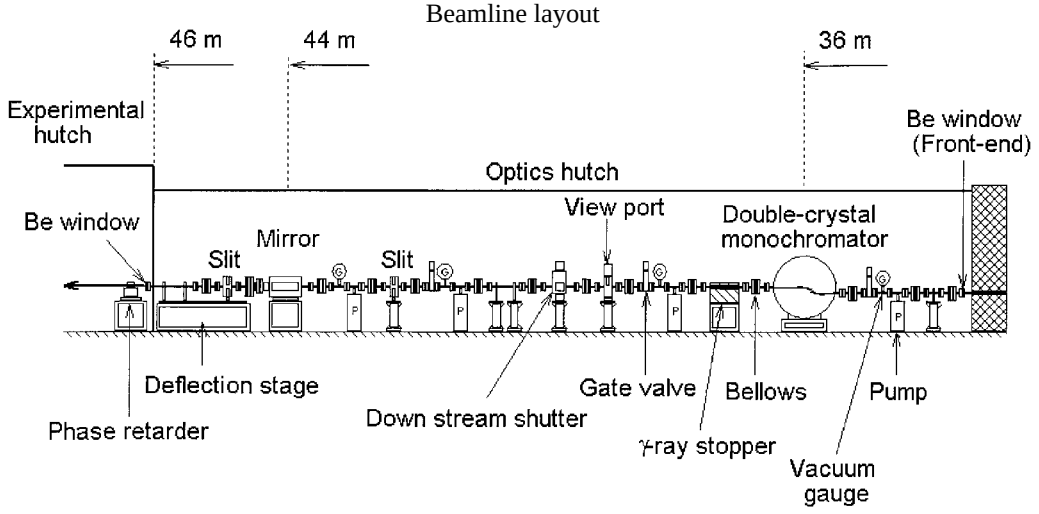
Device	In-vacuum-type undulator
Period length	3.2cm
Peroid number	140
Tunable range	5-70keV (fundamental-5th)
Brilliance	$2x10^{19}$ ph/s/mrad^2/mm^2/0.1%b.w. (I=100mA)
Total power	11kW at 5keV, K=2.3
Power density	470kW/mrad^2

Optics :

Distance from source	Optical Element	Function
36m	rotated-inclined double crystal monochromator	monochromatization, high heat load elimination
44m	platinum coated plane mirror	higher harmonics elimination, horizontal deflection

X-rays at Sample :
Energy range : 5-20keV
Energy resolution : $2x10^{-4}$
Photon flux : 10^{15}ph/s
Beam divergence : < 0.1mrad
Beam size : < 1mm

Beamline layout



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Last modified: May 1, 1996

SPring-8 BL41XU — Bio-Crystallography —

Location : BL41- Insertion Device BL.

Person in Charge : Nobuo KAMIYA (e-mail:nkamiya@postman.riken.go.jp)

Subgroups : Biological Structure
X-ray Structural Biology

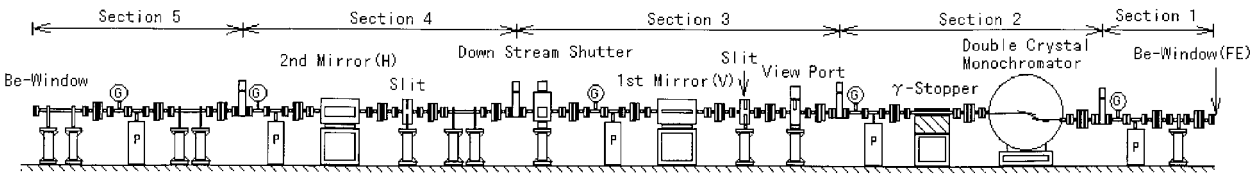
Source Characteristics :

Device	In-vacuum-type undulator
Period length	3.2cm
Peroid number	140
Tunable range	> 9keV
Brilliance	$2x10^{19}$ ph/s/mrad^2/mm^2/0.1%b.w. (I=100mA)
Total power	5kW
Power density	300kW/mrad^2

Optics :

Distance from source	Optical Element	Function
35.9m	rotated-inclined double crystal monochromator	elimination of heat load, monochromatization
39.5m	vertical focusing mirror	3:1 demagnification
44.0m	horizontal focusing mirror	5:1 demagnification

X-ray at sample :
Energy range: 9-38keV
Energy resolution: $2x10^{-4}$ (< 10^{-3} over 20keV)
Photon flux: 10^{14}ph/s
Beam divergence: 0.1 mrad
Beam size: 0.1 mm



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