7 Summary of Experimental Stations

About 70 experimental stations are operated at the PF Storage Ring and the PF-AR, as shown in Figs. 1 and 2. Two thirds of the stations are dedicated to research using hard X-rays, with the remaining one third used for studies in the VUV and soft X-ray energy regions. Tables 1 and 2 summarize the areas of the research carried out at experimental stations at the PF storage ring and PF-AR. The specifications in terms of optics and performance of each experimental station differ according to experimental requirements and methodology. Tables 3 and 4 list the details of the optics of the hard X-ray stations and the soft X-ray / VUV stations. The principal performance parameters, including energy range, energy resolution, beam-spot size, and photon flux at the sample position are shown.

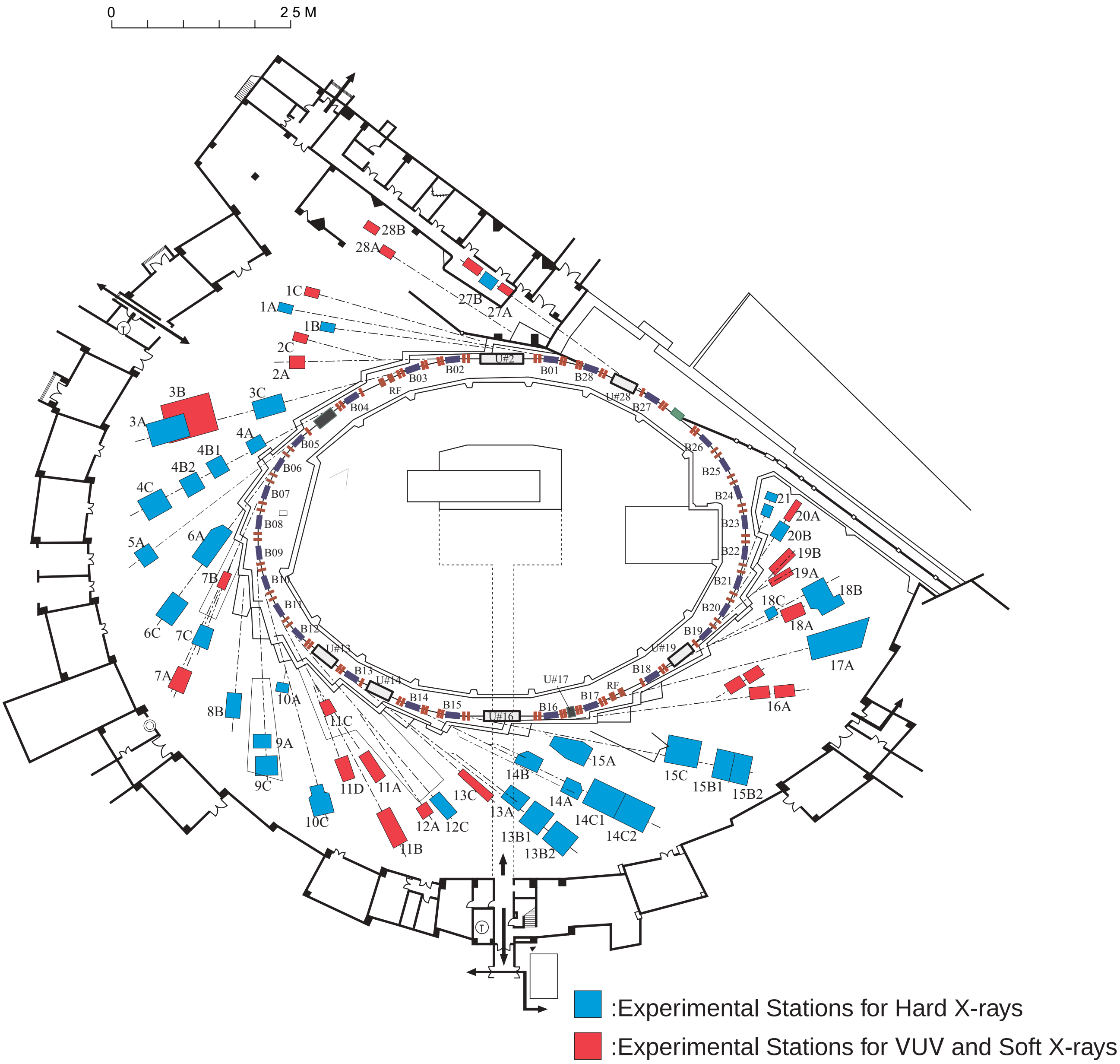

Figure 1
Plan view of the PF experimental hall, showing hard X-ray experimental stations (blue), and VUV and soft X-ray experimental stations (red).

Table 1 Complete list of experimental stations at the PF Storage Ring.

Experimental Station		Person in Charge
BL-1		
A**	Crystal structure analysis beamline	A. Nakao
B*	X-ray powder diffraction under extreme condition	A. Nakao
C***	VUV and soft X-ray photoelectron spectroscopy	K. Ono
BL-2	(Undulator)	
A	Soft X-ray spectroscopy	Y. Kitajima
C	Soft X-ray spectroscopy	J. Adachi
BL-3	(A: Short Gap Undulator)	
A	X-ray diffraction and scattering station for materials science	H. Nakao (Feb. 2009 ~)
B	VUV and soft X-ray spectroscopy	A. Yagishita
C	Characterization of X-ray optical elements/White X-ray maganetic diffraction	K. Hirano
BL-4		
A	Trace element analysis, X-ray microprobe	A. Iida
B1	Micro-crystal and Micro-area structure analysis	A. Nakao
B2	Powder diffraction	A. Nakao
C	X-ray diffraction and scattering	H. Nakao (Feb. 2009 ~)
BL-5	(Multipole Wiggler)	
A	Macromolecular crystallography	Y. Yamada
BL-6		
A	Macromolecular crystallography	N. Igarashi
C	X-ray diffraction and scattering	H. Kawata
BL-7		
A	[RCS] Soft X-ray spectroscopy	K. Iwata [RCS], K. Amemiya
B	[RCS] Surface photochemical reaction and angle-resolved photoelectron spectroscopy	K. Iwata [RCS], K. Amemiya
C	X-ray spectroscopy and diffraction	H. Sugiyama
BL-8		
B****	X-ray powder diffraction under extreme conditon	A. Nakao
BL-9		
A	XAFS	Y. Inada
C	X-ray versatile station	M. Nomura
BL-10		
A	X-ray diffraction/scattering	A. Nakao
C	Small-angle X-ray scattering of solution sample	T. Mori
BL-11		
A	Soft X-ray spectroscopy	Y. Kitajima
B	Surface EXAFS, soft X-ray spectroscopy	Y. Kitajima
C	VUV spectroscopy (solid state)	K. Ono
D	VUV and soft X-ray photoelectron spectroscopy for solid	K. Ito
BL-12		
A	Characterization of VUV-SX optical elements, soft X-ray spectroscopy	A. Yagishita
C	XAFS	M. Nomura

Experimental Station		Person in Charge
BL-13	(Multipole Wiggler/Undulator)	
A***	Laser-heating high-pressure and high-temperature X-ray diffraction (DAC)	T. Kikegawa
B1***	Surface-sensitive XAFS, X-ray diffraction	T. Kikegawa
B2***	High-pressure and high-temperature X-ray diffraction	T. Kikegawa
C***	Soft X-ray photoemission spectroscopy and XAFS	K. Mase
BL-14	(Vertical Wiggler)	
A	Crystal structure analysis and detector development	S. Kishimoto
B	High-precision X-ray optics	K. Hirano
C1	Medical applications and X-ray experimens for general purpose	K. Hyodo
C2	High-pressure and high-temperature X-ray diffraction (MAX-III)	T. Kikegawa
BL-15		
A	Small-angle X-ray scattering of muscle and alloys	T. Mori
B1	White X-ray topography and X-ray experiments for general purpose	H. Sugiyama
B2	Surface and interface X-ray diffraction	H. Sugiyama
C	High-resolution X-ray diffraction	K. Hirano
BL-16	(Variable Polarization Undulator)	
A	Soft X-ray spectroscopies with circular and linear polarization	K. Amemiya
BL-17	(Short Gap Undulator)	
A	Macromolecular crystallogarphy	N. Igarashi
BL-18		
A	[ISSP] Angle-resolved photoelectron spectroscopy of surfaces and interfaces	I. Matsuda [ISSP], A. Yagishita
B	General purpose (X-ray)	A. Iida
C	High pressure X-ray powder diffraction (DAC)	T. Kikegawa
BL-19	(Revolver Undulator)	
A	[ISSP] Spin-resolved photoelectron spectroscopy (Mott detector)	I. Matsuda [ISSP], A. Yagishita
B	[ISSP] Soft X-ray emission spectroscopy	I. Matsuda [ISSP], A. Yagishita
BL-20		
A	VUV spectroscopy	K. Ito
B	[ANBF] White and monochromatic beam general-purpose X-ray station	G. Foran [ANBF], H. Kawata
BL-21	[Light Source Division]Beam position monitoring	K. Haga [Light Source]
BL-27	(Beamline for experiments using radioisotopes)	
A	Radiation biology, soft X-ray photoelectron spectroscopy	K. Kobayashi
B	Radiation biology, XAFS, X-ray diffuse scattering	N. Usami
BL-28	(Elliptical / Helical Undulator)	
A	High-resolution VUV-SX beamline for angle-resolved photoemission	K. Ono
B	High-resolution VUV-SX spectroscopy	K. Ono

RCS Research Center for Spectrochemistry, the University of Tokyo
ISSP Institute for Solid State Physics, the University of Tokyo
ANBF Australian National Beamline Facility

* shutdown at the summer of 2008.
** shutdown at the end of 2008.
*** shutdown at the end of FY2008.
**** set up at the FY2008..

Table 2 List of experimental stations at the PF-AR.

Experimental Station	Person in Charge
AR-NE1 (Multipole Wiggler) A*** Laser-heating high pressure X-ray diffraction and nuclear resonant scattering (DAC)	T. Kikegawa
AR-NE3 (Undulator) A*** Macromolecular crystallography	Y. Yamada
AR-NE5 C High pressure and high temperature X-ray diffraction (MAX-80)	T. Kikegawa
AR-NW2 (Undulator) A XAFS/Dispersive XAFS /Time-resolved-X-ray diffraction	Y. Inada
AR-NW10 A XAFS	M. Nomura
AR-NW12 (Undulator) A Macromolecular crystallography	N. Matsugaki
AR-NW14 (Undulator) A Time-resolved X-ray diffraction, scattering and absorption	S. Koshihara [ERATO], S. Adachi

ERATO Exploratory Research for Advanced Technology, Japan Science and Technology Agency

*** set up at the FY2008.

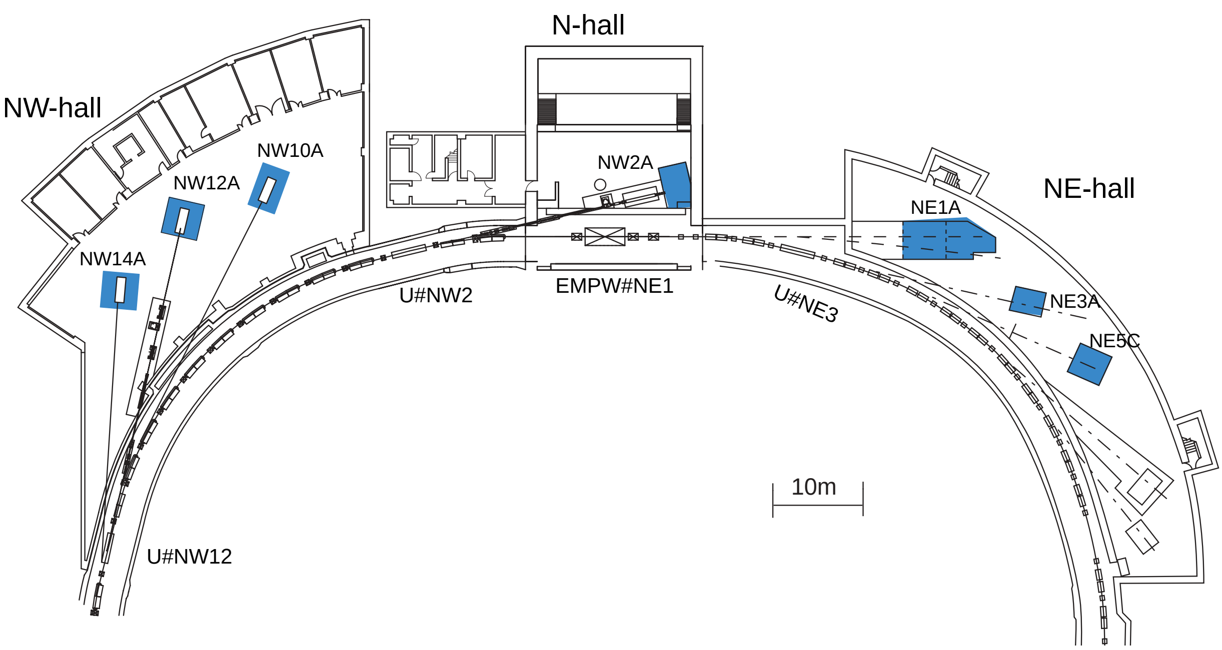

Figure 2
Plan view of beamlines in the PF-AR north-east, north, and north-west experimental halls.

Table 3 Specifications of X-ray beamline optics.

Branch Beamline	Horizontal Acceptance (mrad)	Type of Monochromator	Mirror	Photon Energy (keV)	Beam Size (H×V) (mm)	Photon Flux at Sample Position (/s)	Energy Resolution $(\Delta E/E)\times10^{-4}$	Reference
BL-1A*		Flat Double Crystal Si(111)	Bent Cylinder	5 ~ 20	0.7×0.3	4×10^{11}(8.3 keV, 400 mA)	~ 5	
BL-1B*	2	Flat Double Crystal Si(111)	Bent Cylinder	6 ~ 21	0.7×0.5	$8\times10^{10}/4mm^2$ (8.3 keV, 300 mA)	~ 5	1
BL-3A	1	Flat Double Crystal Si(111)	Bent Cylinder	4 ~ 14	0.7×0.2	6×10^{12}	~ 5	
BL-3C	1.75	Double Crystal Si(111)	None	4 ~ 20 or white	20×6(mono) 0.1×0.1(white			
BL-4A	6	Double Crystal Sagittal Focusing	Vertical Focusing Mirror	4 ~ 20	50×4 4×1		~ 2	5
BL-4B1	4.5	Double Crystal Si(111)	None	4 ~ 35	50×5		~ 2	6
BL-4B2	4.5	Double Crystal Si(111)	Bent Cylinder	6 ~ 20	13×2		~2	7, 8
BL-4C	2	Flat Double Crystal Si(111)	Bent Cylinder	5 ~ 19	0.7×0.5		~5	9, 10
BL-5A	0.5	Micro-Channel Double Crystal Si(111)	Bent Plane Si Rh-Coated Bent Cylinder Si Rh-Coated	6.5 ~ 17	1.2×0.4	3×10^{11} (0.2×0.2 mm^2)	~2	
BL-6A	1.2	Bent Si(111) (α = 7.5°)	Bent Plane ULE	9.5 ~ 13.5	0.5×0.25 (12.7keV)	1×10^{10} (12.7keV, 450mA, 0.2×0.2 mm^2)	~10	11
BL-6C	2	Flat Double Crystal Si(111)	Bent Cylinder	5 ~ 12 (~25 non-Focus)	1.2×1.2			
BL-7C	4	Double Crystal Si(111) Sagittal Focusing	Double Mirror Fused Quartz Focusing	4 ~ 20 (4 ~ 13)	5×1	$1\times10^{10}/6mm^2$ (8 keV, 300 mA) (1×10^{11} when focused)	~ 2	12 - 14
BL-8B**	1.80	Flat Double Crystal Si(111)	Bent Cylinder	5 ~ 19	0.75×0.45	2.2×10^{11} (12.4keV, 400mA)	~ 5	

Branch Beamline	Horizontal Acceptance (mrad)	Type of Monochromator	Mirror	Photon Energy (keV)	Beam Size (H×V) (mm)	Photon Flux at Sample Position (/s)	Energy Resolution ($\Delta E/E$)×10^{-4}	Reference
BL-9A	3	Double Crystal Si (111)	Collimating and Focusing Bent Conical Mirrors (Rh-Coated) Double Flat Mirror (Rh/Ni-Coated)	2.2 ~ 15	1×0.3	4×10^{11}(9 keV, 300 mA)	2	15, 16
BL-9C	3.5	Double Crystal Si(111)	Bent Cylinder Rh-Coated Si	4 ~ 23 or white	1×1	5×10^{10}(9 keV, 300 mA)	~ 2	
BL-10A	1	Si(111), Si(311) Quartz(100), PG(002) Curved Si(111) (α~ 4°, 8°)	Plane Pt coated Fuzed Quartz	5 ~ 25	10×3		10 ~ 5	17
BL-10C	4	Double Crystal Si(111)	Bent Cylinder	4 ~ 10	1.2×0.2	~10^{11}/1.5mm^2 (8 keV, 400 mA)	2	
BL-12C	2	Double Crystal Si(111) Si(311)	Bent Cylinder	6 ~ 23	0.65×0.4	5×10^{10}/1mm^2 (8 keV, 300mA) w.Si(111)	~ 2	18
BL-13A*	1	Double Crystal Si(111), Ge(111)	Cylinder Pt-coat Fused Quartz	30	0.045×0.032	5×10^{10}/1mm^2	~ 2	19
BL-13B1* B2*	4	Double Crystal Si(111), Si(220) Sagittal Focusing	Bent Plane Fused Quartz	4 ~ 30	4×1		~ 2	20
BL-14A	1.28 (Vertical)	Double Crystal Si (111) Si (311) Si (553)	Bent Cylinder Rh-coated Fused Quartz	5.1 ~ 19.1 9.9 ~ 35.6 22.7 ~ 84.5	2×1 at focus 5×38		2	21
BL-14B	2.2 (Vertical)	Double Crystal Si(111),	None	10 ~ 57	5×14		2	
BL-14C1 C2	1.96 (Vertical)	Double Crystal Si(111), Si(220)	None	5 ~ 100 or white	6×70		2	22, 23
BL-15A	2	Bent Crystal Ge(111) (α = 8.0°)	Bent Plane, Fused Quartz Pt-coated	8.0 (fixed)	0.5×0.25	9×10^{10}/mm^2 (8.0 keV, 350 mA)	~ 10	24
BL-15B1 B2	2	Double Crystal Si (111)	Bent Cylinder	5 ~ 20 or white	0.6×0.4	10^{11}/1mm^2 (8.0keV, 350mA)	~ 2	
BL-15C	2	Double Crystal Si (111)	None	4 ~ 30	60×6			

Branch Beamline	Horizontal Acceptance (mrad)	Type of Monochromator	Mirror	Photon Energy (keV)	Beam Size (H×V) (mm)	Photon Flux at Sample Position (/s)	Energy Resolution ($\Delta E/E$)×10^{-4}	Reference
BL-17A	0.1 ~ 0.2	Double Crystal Si(111) Liquid N_2 cooling	Bent Plane Si Rh-Coated Bent Plane Si Rh-Coated	6 ~ 9 11 ~ 13	0.25×0.04	10^{10} (12.4 keV, 450mA, 0.02×0.02mm^2)	~2	26, 27
BL-18B	2	Double Crystal Si(111)	Plane and Bent Cylinder	6 ~ 30			~2	
BL-18C	1	Double Crystal Si(111)	Cylinder Fused Quartz, Pt-coated	6 ~ 25	0.07×0.04		~2	
BL-20B [ANBF]	2	Channel Cut Si(111) Channel Cut Si(311) Sagittal Focusing Si(111) Double Crystal	None	4.5 ~ 21 10 ~ 36 4.5 ~ 25	25×2 25×1.5 0.6×1		~ 2 ~ 1 ~ 2	28
BL-27B	4	Double Crystal Si(111)	None	4 ~ 20	100×6		~ 2	29
AR-NE1A**	0.28	Micro-Channel Double Crystal Si(111), High-resolution Channel Cut Si(4,2,2,)&(12,2,2)	Bent Plane W/C Mutilayer Coated Si	6 ~ 50	0.1×0.1	6×10^{11} (14.4keV)	~ 2	
AR-NE3A**	H:0.2 V:0.1	Double Crystal Si(111) Liquid N_2 Cooling	Pre-Mirror Bent Flat Si Rh-Coated Post-Mirror Bent Cylinder Fused Quartz Rh-Coated	6.5 ~ 17	0.8×0.2	8×10^{11} (0.2×0.2mm^2)	~ 2	
AR-NE5C	3	Double Crystal Si(111)	None	30 ~ 100 or white	60×5		5	30
AR-NW2A	H:1.0 V:0.2	Double Crystal Si(111) Liquid N_2 Cooling	Bent Cylinder Si Rh-Coated Bent Flat Si Rh-Coated	5 ~ 25	0.6×0.2 ~10×0.06	6×10^{12}	~2	31-33
AR-NW10A	1.2	Si(311)	Pt-Coated Bent Cylinder	8 ~ 42	2.2×0.5	1×10^{10}	~1	34

Branch Beamline	Horizontal Acceptance (mrad)	Type of Monochromator	Mirror	Photon Energy (keV)	Beam Size (H×V) (mm)	Photon Flux at Sample Position (/s)	Energy Resolution ($\Delta E/E$)×10^{-4}	Reference
AR-NW12A	H:0.3 V:0.1	Double Crystal Si(111) Liquid N_2 cooling	Pre-Mirror Bent Flat Si Rh-Coated Post-Mirror Bent Cylinder Si Rh-Coated	6.5-17	1.3×0.3	2×10^{11} (0.2×0.2 mm^2)	~2	
AR-NW14A [ERATO]	H:0.3 V:0.1	Double Crystal Si(111) Liquid N_2 Cooling	Bent Cylinder Rh-Coated Bent Flat Rh-Coated	4.9 ~ 25	0.45×0.25	5×10^{12}	~2	35

ERATO Exploratory Research for Advanced Technology, Japan Science and Technology Agency
ANBF Australian National Beamline Facility

* shutdown during FY2008.
** set up at the FY2008.

REFERENCES

[1] A. Fujiwara *et al.*, *J. Appl. Cryst.*, **33** (2000) 1241.
[2] S. Sasaki *et al.*, *Rev. Sci. Instrum.*, **63** (1992) 1047.
[3] K. Kawasaki *et al.*, *Rev. Sci. Instrum.*, **63** (1992) 1023.
[4] T. Mori and S. Sasaki, *Rev. Sci. Instrum.*, **66** (1995) 2171.
[5] A. Iida *et al.*, *Rev. Sci. Instrum.*, **66** (1995) 1373.
[6] K. Ohsumi *et al.*, *Rev. Sci. Instrum.*, **66** (1995) 1448.
[7] Powder Diffraction User Group, *KEK Report,* **94-11** (1995).
[8] H. Toraya, H. Hibino and K. Ohsumi, *J. Synchrotron Rad.*, **3** (1996) 75.
[9] H. Iwasaki *et al.*, *Rev. Sci. Instrum.*, **60** (1989) 2406.
[10] *Photon Factory Activity Report* 1995, **#13** (1996) E-1.
[11] N. Sakabe et al., *Rev. Sci. Instrum.*, **66** (1995) 1276.
[12] M. Nomura and A.Koyama, *KEK Internal,* **93-1** (1993).
[13] M. Nomura et al., *KEK Report,* **91-1** (1991).
[14] M. Nomura and A. Koyama, in *"X-ray Absorption Fine Structure"*, ed. by S. S. Hasnain, Ellis Horwood, Chichester, 1991, p.667.
[15] M. Nomura and A. Koyama, *J. Synchrotron Rad.*, **6** (1999) 182.
[16] M. Nomura and A. Koyama, *Nucl. Insrtum. Meth.*, **A467-468** (2001) 733.
[17] S. Sasaki, *Rev. Sci. Instrum.*, **60** (1989) 2417.
[18] M. Nomura and A. Koyama, *KEK Report,* **95-15** (1996).
[19] *Photon Factory Activity Report* 2000, **#18** (2001) A. 72
[20] *Photon Factory Activity Report* 1994**, #12** (1995) C-6.
[21] Y. Satow and Y. Iitaka, *Rev. Sci. Instrum.*, **60** (1989) 2390.
[22] *Photon Factory Activity Report* 1999, **#17** (2000) A 92.
[23] *Photon Factory Activity Report* 1999, **#17** (2000) A 103.
[24] Y. Amemiya *et al.*, *Nucl. Instrum. Meth.*, **208** (1983) 471.
[25] *Photon Factory Activity Report* 1994, **#12** (1995) E-3.
[26] N. Igarashi et al., *AIP Conf. Proc.,* **879** (2007) 812.
[27] N. Igarashi et al., *J. Synshrotron Rad.,* **15** (2008) 292.
[28] R.F. Garret *et al.*, *Rev. Sci. Instrum.*, **66** (1995) 1351.
[29] H. Konishi *et al.*, *Nucl. Insrtum. Meth.*, **A372** (1996) 322.
[30] T. Kikegawa *et al.*, *Rev. Sci. Instrum.*, **66** (1995) 1335.
[31] T. Mori *et al.*, *AIP Conf. Proc.,* **705** (2004) 255.
[32] H. Kawata *et al.*, *AIP Conf. Proc.,* **705** (2004) 663.
[33] Y. Inada et al. *AIP Conf. Proc.,* **879** (2007) 1230.
[34] M. Nomura et al., *AIP Conf. Proc.,* **882** (2007) 896.
[35] S. Nozawa et al., *J. Synchrotron Rad.,* **14** (2007) 313.

Table 4 Specifications of VUV and soft X-ray beamline optics.

Beamline	Acceptance H × V (mrad) or Undulator Parameters	Type of Monochromator	Groove Density (ℓ/mm)	Energy Range (eV)	Beam Size H × V (mm)	Resolving Power (E/ΔE) Photon Flux (photons/s)	Reference
BL-1C*	5 × 3	Varied-Line-Space Plane Grating	300 600 1200	20 ~ 60 40 ~ 120 80 ~ 240	1 × 1	1000 ~ 10000 10^{11} ~ 10^{9}	1
BL-2A Undulator	K = 0.5 ~ 2.2 λ_u = 6 cm	Double Crystal InSb (111), Si (111)	____	1740 ~ 5000	< 1ϕ	2000, 8000 10^{11}	2 - 5
BL-2C Undulator	K = 0.55 ~ 2.2 λ_u = 6 cm	Varied-Line-Space Plane Grating	1000 2200	250 ~ 1400	0.9 × 0.1	5000 ~ 10000 10^{11} ~ 10^{10}	6 - 8
BL-3B	10 × 2	Grazing Incidence R = 24 m α+β = 165°	200 600 1800	10 ~ 280	< 2ϕ	200 ~ 3000 10^{12} ~ 10^{9}	9, 10
BL-7A [RCS]	6 × 1	Varied-Line-Space Plane Grating	300 650	50 ~ 1300	2.5 × 0.5	1000 ~ 9000 10^{12} ~ 10^{9}	11
BL-7B [RCS]	6 × 4	1m Seya-Namioka	1200 2400	5 ~ 50	1 × 1	1000	12
BL-11A	5 × 1	Varied-Line-Space Plane Grating	300 800 1200	70 ~ 1900	2 × 1	500 ~ 5000 10^{12} ~ 10^{9}	13 - 16
BL-11B	4 × 0.6	Double Crystal InSb (111), Ge (111)	____	1760 ~ 3910	5 × 2	2000 10^{10}	4, 17, 18
BL-11C	4.8 × 3	1m Seya-Namioka	1200	4 ~ 35	~1ϕ	1000	19
BL-11D	4 × 2	Grazing Incidence Varied Deviation-angle On-Blaze Mount R_1 = 52.5 m R_3 = 22.5 m	2400	60 ~ 245 200 ~ 900	1 × 0.1	2000 10^{11}	20
BL-12A	2.2 × 0.34	Grazing Incidence R = 2 m α = 88°	1200	30 ~ 1000	2 × 3	1000 10^{9}	21
BL-13C* Undulator	K = 0.3 ~ 4.2 λ_u = 18 cm	Grazing Incidence R = 50 m α+β = 173.2°	350 750	70 ~ 500 150 ~ 1000	5 × 1	1000 ~ 6000 10^{12} ~ 10^{10}	22, 23
BL-16A Undulator	K_{max} = 2.37 (Circular Polarization) K_{max} = 3.12 (Horizontal Linear Polarization) K_{max} = 1.98 (Vertical Linear Polarization) K_{max} = 1.73 (45-deg Linear Polarization) λ_u = 5.6 cm	Variable-included-angle varied-line-spacing plane grating	500 1000	250 ~ 1500	~0.2 × 0.1	4000 ~ 8000 10^{12} ~ 10^{11}	31
BL-18A (ISSP)	2 × 2	Grazing Incidence R = 3 m α+β = 160° R = 6.65 m α+β = 167.5°	300 600 1200	15 ~ 150	< 1ϕ	1000~2000 10^{11} ~10^{9}	24

Beamline	Acceptance or H × V (mrad) Undulator Parameters	Type of Monochromator	Groove Density (ℓ/mm)	Energy Range (eV)	Beam Size H × V (mm)	Resolving Power (E/ΔE) Photon Flux (photons/s)	Reference
BL-19A Revolver Undulator (ISSP)	K = 1.0 ~ 9.0 λ_u = 16.4 cm K = 0.5 ~ 1.25 λ_u = 5 cm K = 0.5 ~ 2.5 λ_u = 7.2 cm	Grazing Incidence R = 2 m α+β = 160° R = 4 m α+β = 170°	600 1200 600 1200	12 ~ 250	< 0.7ϕ	1000 10^{12}	25, 26
BL-19B Revolver Undulator (ISSP)	K = 1.0 ~ 5.0 λ_u = 10 cm	Varied-Line-Space Plane Grating	800 2400	10 ~ 1200	< 0.5ϕ	400~4000 10^{12} ~10^{11}	26 - 28
BL-20A	28 × 5	3m Normal Incidence	1200 2400	5 ~ 40	2 × 1	300 ~ 30000 10^{12} ~ 10^{8}	29
BL-27A	5 × 0.5	Double Crystal InSb (111)	____	1800 ~ 4000		2000	30
BL-28A/B Helical Undulator	K_x = 0.23 ~ 3 K_y = 0.23 ~ 6 λ_u = 16 cm	Varied-Line-Space Plane Grating	400	30 ~ 300	0.15 × 0.05	30000 10^{12}	31

RCS Research Center for Spectrochemistry, the University of Tokyo
ISSP Institute for Solid State Physics, the University of Tokyo

* shutdown during FY2008.

REFERENCES

[1] K. Ono *et al.*, *Nucl. Instrum. Meth.*, **A467-468** (2001) 573.
[2] H. Maezawa *et al.*, *Nucl. Instrum. Meth.*, **A246** (1986) 310.
[3] Y. Kitajima *et al.*, *Rev. Sci. Instrum.*, **63** (1992) 886.
[4] Y. Kitajima, *J. Elec. Spec. Relat. Phenom.*, **80** (1996) 405.
[5] Y. Kitajima, *J. Synchrotron Rad.*, **6** (1999) 167.
[6] Y. Yan and A. Yagishita, *KEK Report*, **95-9** (1995).
[7] M. Watanabe *et al.*, *Proc. SPIE*, **3150** (1997) 58.
[8] M. Watanabe *et al.*, *Nucl. Instrum. Meth.*, **A467-468** (2001) 512.
[9] A. Yagishita *et al.*, *Nucl. Instrum. Meth.*, **A306** (1991) 578.
[10] S. Masui *et al.*, *Rev. Sci. Instrum.*, **63** (1992) 1330.
[11] K. Amemiya *et al.*, *J. Elec. Spectrosc. Relat. Phenom.*, **124** (2002) 151.
[12] H. Namba *et al.*, *Rev. Sci. Instrum.*, **60** (1989) 1917.
[13] K. Amemiya *et al.*, *J. Synchrotron Rad.*, **3** (1996) 282.
[14] K. Amemiya *et al.*, *Proc. SPIE Proceedings,* **3150** (1997) 171.
[15] Y. Kitajima *et al.*, *J. Syncrotron Rad.*, **5** (1998) 729.
[16] Y. Kitajima *et al.*, *J. Elec. Spectrosc. Relat. Phenom.*, **101-103** (1999) 927.
[17] T. Ohta *et al.*, *Nucl. Instrum. Meth.*, **A246** (1986) 373.
[18] M. Funabashi *et al.*, *Rev. Sci. Instrum.*, **60** (1989) 1983.
[19] *Photon Factory Activity Report* 1982/1983, (1984) V-15.
[20] *Photon Factory Activity Report* 1997, **#15** (1998) A 101.
[21] *Photon Factory Activity Report* 1992, **#10** (1993) I-2.
[22] N. Matsubayashi *et al.*, *Rev. Sci. Instrum.*, **63** (1992) 1363.
[23] H. Shimada *et al.*, *Rev. Sci. Instrum.*, **66** (1995) 1780.
[24] S. Suzuki *et al.*, *Activity Report of SRL-ISSP,* **60** (1989).
[25] A. Kakizaki *et al.*, *Rev. Sci. Instrum.*, **60** (1989) 1893.
[26] A. Kakizaki *et al.*, *Rev. Sci. Instrum.*, **63** (1992) 367.
[27] M. Fujisawa *et al.*, *Nucl. Instrum. Meth.*, **A467-468** (2001) 309.
[28] M. Fujisawa *et al.*, *Nucl. Instrum. Meth.*, **A467-468** (2001) 313.
[29] K. Ito *et al.*, *Rev. Sci. Instrum.*, **66** (1995) 2119.
[30] H. Konishi *et al.*, *Nucl. Instrum. Meth.*, **A372** (1996) 322.
[31] K. Amemiya and T.Ohta, *J. Synchrotron Rad.*, **11** (2004) 171.