

Appendix A

Summary of Experimental Stations (May 31, 2005)

Table A.1. Public beamlines.

	Name of Beamline	X-rays at Sample			Photon Flux [photon/s]	Beam Size [mm]	Areas of Research
		Energy Range [keV]	Energy Resolution $\Delta E/E$	Energy Resolution $\Delta E/E$			
Public Beamlines							
BL01B1	XAFS	3.8 ~ 117	$3 \times 10^{-5} \sim 2 \times 10^{-4}$	$10^8 \sim 10^{11}$	$10(H) \times 0.2(V)$	<ul style="list-style-type: none"> XAFS in wide energy region (3.8 to 113 keV) XAFS of dilute systems and thin films 	
BL02B1	Single Crystal Structure Analysis	5 ~ 100	10^{-4}	10^{10}	$3(H) \times 0.1(V)$	<ul style="list-style-type: none"> Single crystal structure analysis in X-ray wide energy range Precise X-ray diffraction analysis of the lattice or charge modulation originated from the phase transition at low temperatures 	
BL02B2	Powder Diffraction	12 ~ 35	Si(111) : $\sim 2 \times 10^{-4}$	$\sim 10^{11}$	$3(H) \times 0.5(V)$	<ul style="list-style-type: none"> Accurate structure analysis of crystalline materials using powder diffraction data Structural aspects of phase transition Ab initio structure determination by powder diffraction Rietveld refinements 	
BL04B1	High Pressure and High Temperature Research	20 ~ 150	White radiation	-	$0.05(H) \times 0.05(V) \sim 10(H) \times 10(V)$	<ul style="list-style-type: none"> Determination of phase relation, Equation of state of mantle, Viscosity of melts, Kinetics of mineral transformation, Rheology of mantle minerals, Structure of melts and glasses at high pressures 	
BL04B2	High Energy X-ray Diffraction	Si(111) : 37.8 Si(220) : 61.7	10^{-3}	2×10^{10} (37.8 keV, Flat) 7×10^{11} (37.8 keV, Bent) 3×10^9 (61.7 keV, Flat) 9×10^{10} (61.7 keV, Bent)	$0.22(H)$ (37.8 keV) $0.38(H)$ (61.7 keV)	<ul style="list-style-type: none"> 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	Si(620) : 175 ~ 210 Si(777) : 270 ~ 300	$\sim 10^{-3}$	3×10^{12} (175 keV) 5×10^{10} (275 keV)	$1(H) \times 3(V)$	<ul style="list-style-type: none"> Magnetic Compton scattering High-resolution Compton scattering High-energy Bragg scattering High-energy fluorescent X-ray analysis 	
BL09XU	Nuclear Resonant Scattering	Si(400) : 90 ~ 120	$< 1 \times 10^{-3}$	1×10^{13} (115 keV)	$1(H) \times 2(V)$	<ul style="list-style-type: none"> Lattice dynamics by using nuclear inelastic scattering Time domain Mössbauer spectroscopy, especially under the extreme conditions Coherent X-ray optics using nuclear resonant scattering Nuclear excitation by electron transition (NEET) Surface structures and residual strain analysis 	
BL10XU	High Pressure Research	9 ~ 80	10^{-4}	1.4×10^{13} (14.4 keV)	$2(H) \times 1(V)$	<ul style="list-style-type: none"> Structure analysis and phase transitions under ultra high pressure (DAC experiment) Earth and planetary science 	
BL13XU	Surface and Interface Structures	5.5 ~ 18.9	10^{-4}	$\sim 1 \times 10^{13}$ $10^{13} \sim 10^{14}$	$2(H) \times 1.5(V)$ (@EH1)	<ul style="list-style-type: none"> Atomic-scale structure analysis of a crystal surface, an ultra-thin film and a nanostructure Surface structure analysis under thin-film growth Analysis of nanostructures grown at a vacuum/solid, liquid/solid, and solid/solid 	
BL19B2	Engineering Science Research	5 ~ 100	10^{-4}	10^9	$5(H) \times 2(V)$ (@EH1&2) $10(H) \times 10(V)$ (@EH3)	<ul style="list-style-type: none"> XAFS in wide energy region Residual stress measurement, Structural analysis of thin film, Surface, Interface Powder diffraction X-ray imaging 	

	Name of Beamline		X-rays at Sample			Areas of Research		
	Energy Range [keV]	Energy Resolution $\Delta E/E$	Photon Flux [photon/s]	Beam Size [mm]				
	7.62 ~ 113	$\sim 10^{-4}$	$10^{13}/\text{mm}^2$ (@EH1)	1.2(H) \times 0.7(V) (@EH1) 6(H) \times 2.5(V) (@EH2)				
BL20XU	Medical and Imaging II				<ul style="list-style-type: none"> • Micro-imaging : Scanning microscopy, Imaging microscopy, Micro-tomography, X-ray holography and other experiments on X-ray optics and developments of optical elements • Medical application : Micro-angiography, Refraction-enhanced imaging, Radiation therapy 			
BL20B2	Medical and Imaging I	Si (311) : 8.4 ~ 71.9 Si (111) : 4.4 ~ 37.7 Si (511) : 13.0 ~ 113.3	$\sim 10^{-4}$	$10^8 \sim 10^9$ (@Exp. Hall) 10^7 (@Biomedical Imaging Center)	75(H) \times 3(V) (Si (311), @Exp. Hall) 300(H) \times 20(V) (Si (311), @Biomedical Imaging Center)	<ul style="list-style-type: none"> • The medical research mainly involves micro-radiography, micro-tomography and refraction-contrast imaging on biological specimens and small animals. • Imaging techniques involve the evaluation and development of various kinds of optical elements for novel imaging techniques. 		
BL25SU	Soft X-ray Spectroscopy of Solid	0.22 ~ 2	$E/\Delta E > 10^4$	$> 10^{11}$	0.4 diam.	<ul style="list-style-type: none"> • High resolution photoemission • Photoelectron diffraction and holography • Magnetic circular dichroism in the core absorption (MCD) • Photoelectron emission microscope (PEEM) 		
BL27SU	Soft X-ray Photochemistry	0.2 ~ 2.8	A and B branches : $E/\Delta E > 10^4$ $\sim 10^2$ C branches : $E/\Delta E > 10^4$	$> 10^{15}$ $> 10^{11}$	4(H) \times 2(V) 0.5(H) \times 0.2(V)	<i>Industrial research --- B branch</i> <ul style="list-style-type: none"> • Growth of thin film of functional material • Micro fabrication by functional material etching <i>Atomic and molecular spectroscopy --- C branch (C1, C2 station)</i> <ul style="list-style-type: none"> • Search of novel photochemical processes • High resolution atomic and molecular electron spectroscopy • Complete determination of electronic decay channel • Dissociation dynamics of inner-shell excited molecules • Site-specific dissociation processes of isolated molecules <i>Surface analysis and solid state physics --- C branch (C3 station)</i> <ul style="list-style-type: none"> • Search of electronic and chemical structures of solids and nano layers • Elucidation of electronic state of molecule on surface 		
BL28B2	White Beam X-ray Diffraction	> 5	White radiation	-	30(H) \times 10(V)	<ul style="list-style-type: none"> • White X-ray diffraction • Time-resolved energy-dispersive XAFS (DXAFS) for studies of chemical and/or physical reaction process. 		
BL35XU	High Resolution Inelastic Scattering	8 ~ 50 (fundamental to 5th)	Optics Dependent	Optics Dependent		<ul style="list-style-type: none"> • Dynamics of materials including phonons, Glass transitions, Liquid dynamics, Diffusion, etc. • Methods of investigation include inelastic X-ray scattering (IXS) and nuclear resonant scattering (NRS). 		
BL37XU	Trace Element Analysis	A branch : 5 ~ 37 B branch : Si (111) : 75.5	2×10^{-4}	A branch : $10^{12} \sim 10^{13}$ B branch : $10^{10} \sim 10^{12}$	A branch : 2(H) \times 0.7(V) B branch : 3(H) \times 0.5(V)	<ul style="list-style-type: none"> • X-ray microbeam spectrochemical analysis • Ultra trace element analysis • High energy X-ray fluorescence analysis 		

	Name of Beamline	X-rays at Sample				Areas of Research			
		Energy Range	Energy Resolution	Photon Flux	Beam Size				
		[keV]	$\Delta E/E$	[photon/s]	[mm]				
BL39XU	Magnetic Materials	5 ~ 37	2×10^{-4}	4×10^{13}	$2(H) \times 0.7(V)$	<ul style="list-style-type: none"> • X-ray magnetic circular dichroism (MCD) spectroscopy • Element-specific magnetometry • X-ray emission spectroscopy and its magnetic circular dichroism • Resonant or non-resonant magnetic scattering 			
BL40XU	High Flux	8 ~ 17	0.017	10^{15} (12.4 keV)	$0.25(H) \times 0.04(V)$ (with mirror)	<ul style="list-style-type: none"> • Time-resolved diffraction and scattering experiments • X-ray speckle • X-ray fluorescence trace analysis 			
BL40B2	Structural Biology II	7 ~ 17	10^{-4}	$\sim 10^{11}$ (12 keV)	$0.25(H) \times 0.15(V)$	<ul style="list-style-type: none"> • Macromolecular crystallography, Small angle X-ray (solution) scattering 			
BL41XU	Structural Biology I	6 ~ 38	$< 2 \times 10^{-4}$	10^{13}	$0.1(H) \times 0.1(V)$	<ul style="list-style-type: none"> • Macromolecular crystallography 			
BL43IR	Infrared Materials Science	Wave num. $100 \sim 20000$ cm^{-1}	0.0063 cm^{-1}	-	-	<ul style="list-style-type: none"> • Infrared microspectroscopy • Magneto-optical spectroscopy • Infrared surface science • Absorption and reflection spectroscopy • Time-resolved experiments with pulsed laser and SR (pump and probe) 			

Table A.2. Public R&D beamlines.

	Name of Beamline	X-rays at Sample				Areas of Research	
		Energy Range [keV]	Energy Resolution $\Delta E/E$	Photon Flux [photon/s]	Beam Size [mm]		
Public R&D Beamlines							
BL38B1	R&D (3)	6 ~ 17	$\sim 10^{-4}$	$\sim 10^{11}$ (12 keV)	$0.3(\text{H}) \times 0.2(\text{V})$ (12 keV)	<ul style="list-style-type: none"> • XAFS, R&D of optics and detector • Monochromatic data collection for routine macromolecular crystallography 	
BL46XU	R&D (2)	12 ~ 25 (fundamental)	10^{-4}	4.6×10^{12}	$< 1(\text{H}) \times 1(\text{V})$	<ul style="list-style-type: none"> • Insertion devices R&D • Resonant and non-resonant magnetic scattering structural analysis 	
BL47XU	R&D (1)	6 ~ 18 (fundamental) 18 ~ 54 (3rd)	$\sim 2 \times 10^{-4}$	2×10^{14} (18 keV)	$2(\text{H}) \times 0.3(\text{V})$ (18 keV, 40 m from source)	<ul style="list-style-type: none"> • R&D • Microtomography • Microbeam 	

Table A.3. JAERI beamlines.

	Name of Beamline	X-rays at Sample		Photon Flux [photon/s]	Beam Size [mm]	Areas of Research
		Energy Range [keV]	Energy Resolution $\Delta E/E$			
JAERI Beamlines						
BL11XU	JAERI Materials Science II	6 ~ 70	10^{-4}	1.2×10^{13} (14.4 keV)	$1.8(H) \times 0.5(V)$ (@EH1)	<ul style="list-style-type: none"> • Nuclear Resonant Scattering • Surface and interface structure with MBE • Inelastic scattering • XAFS
BL14B1	JAERI Materials Science I	4 ~ 110 (monochromatic)	Si (111) : 10^{-4} Si (311) : 3×10^{-5} Si (511) : 7×10^{-6}	$10^7 \sim 10^{13}$ /mrad	$1(H) \times 1(V)$	<ul style="list-style-type: none"> • Materials science at high pressure • Structure physics
		4 ~ 150 (white)	-	$10^9 \sim 10^{10}$ /mm		
BL22XU	JAERI Actinide Science II	3 ~ 70	10^{-4}	$10^{13} \sim 10^{14}$	$0.05(V) \times 0.05(H)$ (@EH1) $0.3(H) \times$ $1(V)$ (@EH3)	<ul style="list-style-type: none"> • Materials science at high pressure • Resonant X-ray scattering (activity at RI laboratory)
BL23SU	JAERI Actinide Science I	0.3 ~ 1.5 (circular polarization)	10^{-4}	10^{11}	$0.5(H) \times 0.5(V)$	<ul style="list-style-type: none"> • Surface chemistry with high speed molecular beam • Biophysical spectroscopy • Photoelectron spectroscopy (activity at RI laboratory) • MCD (activity at RI facility)

Table A.4. RIKEN beamlines.

	Name of Beamline	X-rays at Sample			Areas of Research		
		Energy Range [keV]	Energy Resolution $\Delta E/E$	Photon Flux [photon/s]	Beam Size [mm]		
RIKEN Beamlines							
BL17SU	RIKEN Coherent Soft X-ray Spectroscopy	0.1 ~ 3.1 (designed)	$E/\Delta E > 10^4$	10^{11}	0.2 (H) \times 0.01 (V)	<p><i>Spectroscopic study on multiply charged ions --- A1a station</i></p> <ul style="list-style-type: none"> Photoabsorption study on multiply charged ions Fundamental research for X-ray astronomy using synchrotron radiation <p><i>High resolution photoemission spectroscopy --- A2 station</i></p> <ul style="list-style-type: none"> Angle-resolved photoemission (ARPES) study using soft X-rays to observe 'bulk' band structure In situ ARPES measurement on strongly-correlated transition-metal oxide thin films fabricated by laser MBE method <p><i>Soft X-ray emission spectroscopy for solid and biological samples --- A3 station</i></p> <ul style="list-style-type: none"> Soft X-ray emission study on transition metal compounds to study electronic correlations in solids Study of the electronic structure of biological samples by soft X-ray emission spectroscopy 	
BL19LXU	RIKEN SR Physics	7.2 ~ 18 (fundamental) 22 ~ 54 (3rd)	10^{-4}	2×10^{14}	1(H) \times 0.5(V)	<ul style="list-style-type: none"> This beamline is open for any research field requiring the highly brilliant X-ray beam 	
BL26BI&B2	RIKEN Structural Genomics I & II	6 ~ 17	$\sim 10^{-4}$	$\sim 10^{11}$ (12 keV)	0.3(H) \times 0.2(V) (12 keV)	<ul style="list-style-type: none"> Structural genomics research based on single crystal X-ray diffraction 	
BL29XU	RIKEN Coherent X-ray Optics	4.4 ~ 37.8	$\sim 1.3 \times 10^{-4}$	6×10^{13} (10keV)	0.72(H) \times 1.3(V) (@EH1) 10(H) \times 30(V) (@EH2)	<ul style="list-style-type: none"> X-ray optics, especially coherent X-ray optics 	
BL44B2	RIKEN Structural Biology II	6 ~ 30	$\sim 10^{-4}$	4×10^{10} (12 keV, monochromatic) 10^{15} (7 ~ 30 keV, white)	0.2(H) \times 0.2(V)	<ul style="list-style-type: none"> Laue macromolecular crystallog 	
BL45XU	RIKEN Structural Biology I	13.8 (@SAXS station) 7.8 ~ 13.8 (@crystallography station)	10^{-4} (@S St.) $< 10^{-4}$ (@P St.)	$\sim 10^{12}$ (@S St.) $\sim 2 \times 10^{11}$ (@P St.)	0.8(H) \times 0.4(V) (@S St.) 0.15(H) \times 0.15(V) (@P St.)	<ul style="list-style-type: none"> Time-resolved structures of non-crystalline biological materials such as protein, nucleic acid solutions, membrane, muscle, and micelle system under various conditions, are studied by using small-angle scattering and diffraction technique. 	

Table A.5. Contract beamlines.

	Name of Beamline	X-rays at Sample			Areas of Research	
		Energy Range [keV]	Energy Resolution $\Delta E/E$	Photon Flux [photon/s]	Beam Size [mm]	
Contract Beamlines						
BL12XU	NSRRC ID (NSRRC)	1st harmonic : 4.6 ~ 16 3rd harmonics : 13.8 ~ 48 5th harmonics : 23 ~ 75	~ 10 ⁻⁴	Optics Dependent	0.12(H) × 0.075(V)	<ul style="list-style-type: none"> Elementary electronic excitations, quasiparticle behaviors, and electron-correlation effects in correlated electron systems investigated using high resolution non-resonant or resonant inelastic X-ray scattering Local electronic structure of molecular solids of low-Z elements (e.g., biomaterials) investigated by high resolution near-edge X-ray Raman scattering Phase transitions under high-pressure, low and high temperatures Materials science using high-resolution X-ray absorption and emission spectroscopy X-ray physics and optics
BL12B2	NSRRC BM (NSRRC)	5 ~ 70 (monochromatic)	~ 10 ⁻⁴		1(H) × 0.5(V)	<ul style="list-style-type: none"> X-ray absorption spectroscopy Powder X-ray diffraction High resolution X-ray scattering Protein crystallography
BL15XU	WEBRAM (National Institute for Materials Science)	0.5 ~ 60	10 ⁻⁴	> 10 ¹² (5 ~ 20 keV)	~ 0.8 diam.	<i>Highly precise characterization of advanced materials</i> <ul style="list-style-type: none"> High resolution X-ray photoemission microscopy Study and analysis for synthesis process of thin films assisted with X-ray irradiation High energy excitation X-ray photoelectron spectroscopy High resolution X-ray emission spectroscopy Highly precise X-ray powder diffraction study and ultra-small angle scattering
BL16XU	Industrial Consortium ID (Industrial Consortium)	4.5 ~ 40	10 ⁻⁴	> 10 ¹² (normal) ~ 10 ¹⁰ (focusing)	0.88(H) × 0.6(V) 1 μm diam.	<ul style="list-style-type: none"> Characterization of thin films for VLSI and magnetic devices, catalysts, functional materials, and structural materials
BL16B2	Industrial Consortium BM (Industrial Consortium)	4.5 ~ 113	10 ⁻⁴	~ 10 ¹⁰	~ 0.1(H) × 0.1(V) (with mirror) ~ 40(H) × 2(V) (without mirror)	<ul style="list-style-type: none"> Characterization of industrial materials, such as metal and oxide films, semiconductor crystals, etc., by XAFS, topography and other methods
BL24XU	Hyogo (Hyogo Prefecture)	3.5 ~ 60	< 10 ⁻⁴	~ 10 ¹²	< 1(H) × 1(V)	<ul style="list-style-type: none"> Structure analysis of small bio-crystals for industry Surface/interface analysis of metallic materials for industry (fluorescent X-ray analysis and strain measurements) Surface/interface analysis during metal-organic chemical vapor deposition (grazing incidence X-ray diffraction) Microbeam formation studies for materials and life science
BL32B2	Pharmaceutical Industry (Pharmaceutical Consortium for Protein Structure Analysis)	6 ~ 17	~ 10 ⁻⁴	~ 10 ¹¹ (12 keV)	0.3(H) × 0.2(V) (12 keV)	<ul style="list-style-type: none"> Protein structure analysis for structure-based drug design

	Name of Beamline	X-rays at Sample				Areas of Research	
		Energy Range [keV]	Energy Resolution $\Delta E/E$	Photon Flux [photon/s]	Beam Size [mm]		
BL33LEP	Laser-Electron Photon (RCNP, Osaka University)	1.5 ~ 2.4 GeV (tagged photon)	$\Delta E \sim 15$ MeV	8×10^5 (1.5 ~ 2.4 GeV)	7.3 (H) \times 5.7 (V)	<ul style="list-style-type: none"> • Meson photoproduction from nucleon and nucleus • Photoexcitation of hyperons, nucleon resonances, and other exotic states • Photonic nuclear reactions • Beam diagnoses • Test and calibration of detectors with GeV photon beam 	
BL44XU	Macromolecular Assemblies (Institute for Protein Research, Osaka University)	7 ~ 16	2×10^{-4}	10^{13}	1.0(H) \times 0.7(V)	<ul style="list-style-type: none"> • Crystal structure analysis of biological macromolecular assemblies (e.g. membrane protein complexes, protein complexes, protein-nucleic acid complexes, and viruses) 	

Table A.6. Accelerator beamlines.

Name of Beamline	X-rays at Sample		Photon Flux [photon/s]	Beam Size [mm]	Areas of Research
	Energy Range [keV]	Energy Resolution $\Delta E/E$			
Accelerator Beamlines					
BL05SS Accelerator Beam Diagnosis					<ul style="list-style-type: none"> Accelerator beam diagnostics
BL38B2 Accelerator Beam Diagnosis	4.0 ~ 14.2	$\sim 10^{-4}$	$10^{10} \sim 10^{12}$	-	<ul style="list-style-type: none"> Accelerator beam diagnostics R&D of accelerator components Production of MeV γ-ray photons