

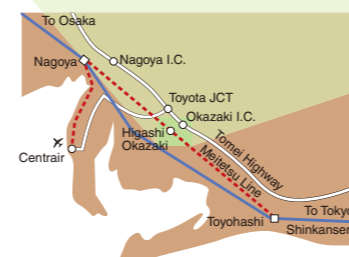
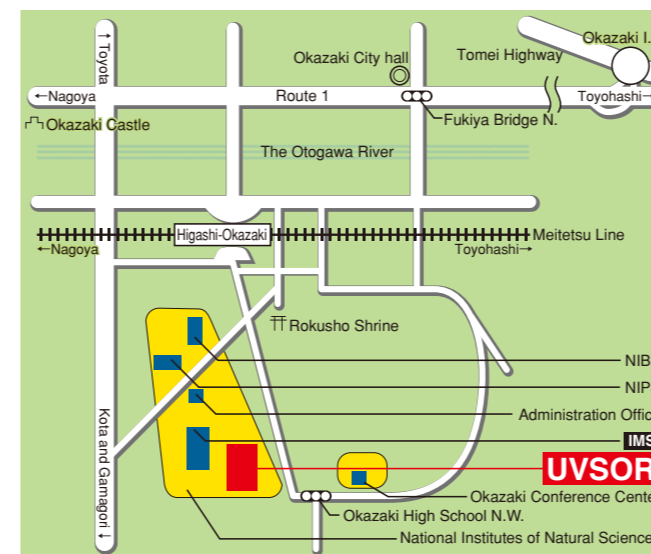


National Institutes of Natural Sciences
Institute for Molecular Science
UVSOR Synchrotron

Beamlines and Stations on UVSOR-III

	U: Undulator Line	A,B: Bending Line
BL1U	Circular Polarized UV Free Electron Laser (FEL) [800-199 nm, ~1W] UV Coherent High-Harmonic Generation from Laser (HHG)	
BL1B	Terahertz Spectroscopy with Coherent Synchrotron Radiation (THz-CSR) [Martin-Puplett FT-FIR 0.5 - 30 meV]	
BL2A	Soft X-ray Absorption Spectroscopy (XAS) [Double Crystal 585 - 4000 eV]	
BL2B	Photoelectron Spectroscopy dedicated to Organic Solids (Molecular PES) [18-m Spherical Grating 23 - 205 eV]	
BL3U	in situ/operando Soft X-ray Absorption Spectroscopy (Molecular XAS) [Varied-line-spacing Plane Grating 60 - 800 eV]	
BL3B	Vacuum Ultraviolet Spectroscopy (VUV) [2.5-m Off-plane Eagle-type Normal Incidence 1.7-31 eV]	
BL4U	Soft X-ray Spectro-microscopy (STXM) [Varied-line-spacing Plane Grating 130 - 770 eV]	
BL4B	Soft X-ray Absorption Spectroscopy (XAS, XMCD) [Varied-line-spacing Plane Grating 25 - 1000 eV]	
BL5U	High-Resolution Spin-, Space- and Angle-Resolved Photoemission (HR spin- and μ -ARPES) [Spherical Grating 20 - 200 eV]	
BL5B	VUV/Soft X-ray Spectrometer dedicated to Calibration of Optical Elements and Detectors [Plane Grating 6 - 600 eV]	
BL6U	Molecular Angle-Resolved Photoemission Spectroscopy (Molecular ARPES) [Varied-line-spacing Plane Grating 30 - 500 eV]	
BL6B	Infrared and Terahertz Spectroscopy (IR/FIR/THz) [Michelson FT-IR 4 meV - 2.5 eV]	
BL7U	High-Resolution Angle-Resolved Photoemission Spectroscopy (HR ARPES) [10-m Normal Incidence 6 - 40 eV]	
BL7B	Vacuum Ultraviolet Spectroscopy (VUV) [3-m Normal Incidence 1.2 - 25 eV]	
BL8B	Angle-Resolved Photoemission Spectroscopy dedicated to Organic Solids (Molecular ARPES) [Plane Grating 1.9-150 eV]	
e-beams	Electron Injector/Storage Ring/Laser Compton g-rays	

Green indicates beamlines open to public users.
Orange indicates beamlines dedicated to joint research with in-house memb



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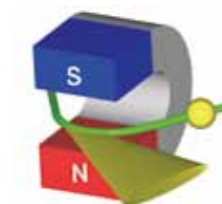
38 Nishigo-Naka, Myodaiji, Okazaki 444-8585, Japan
TEL:+81-564-55-7401 FAX:+81-564-54-7079
<https://www.uvsor.ims.ac.jp/eng/index.html>

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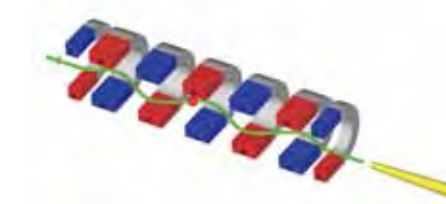
Synchrotron Radiation



Synchrotron radiation is quite bright and has a wide wavelength range including microwave, infrared rays, visible light, ultraviolet and vacuum ultraviolet rays, and soft and hard X-rays. It has highly directional, pulse, and polarization characteristics. It is used as a tool of research for broad fields, such as molecule science, solid science, materials science, life science, and space science.



Synchrotron radiation (SR) is emitted from high energy electrons which are bent by the strong magnetic field of bending magnet. It is called bending radiation.



Semi-monochromatic and semi-coherent SR is emitted from high energy electrons passing through a periodic magnetic field with a small gap. The wavelength and polarization is changeable by controlling the sequence and gap. It is called undulator radiation.

UVSOR-I 1983, UVSOR-II 2003, UVSOR-III since 2012

The original UVSOR Synchrotron was constructed for application of highly focused and bright IR, VUV and soft X-rays to molecular science in 1983 and for its promotion to the world. UVSOR Synchrotron is a rather small (53-m circumference) and low-energy (0.75 GeV) facility. It excels the other facilities in the world in the VUV and lower soft X-ray region. The VUV light and lower soft X-rays interact strongly with materials and can only be handled in vacuum (no materials). It serves as a powerful photon source to research the origin of chemical and physical phenomena, such as chemical reactivity and conductive and magnetic functions. UVSOR Synchrotron was constructed 30 years ago; however, new technologies, such as diffraction limit beam emittance and top up injection, have been strategically introduced by two major upgrade projects from UVSOR-I to UVSOR-III. The performance is still on the highest level in the world, as a small and low-energy synchrotron light source.



UVSOR Users

★Academic and Public Users

UVSOR Synchrotron belongs to the Institute for Molecular Science (IMS), which is dedicated to academic researches as one of the inter-university national research institutes. IMS is open to the world. Academic use of UVSOR Synchrotron is free of charge. Travel and local expenses for the registered users (even from abroad) are fully or partly covered by IMS.

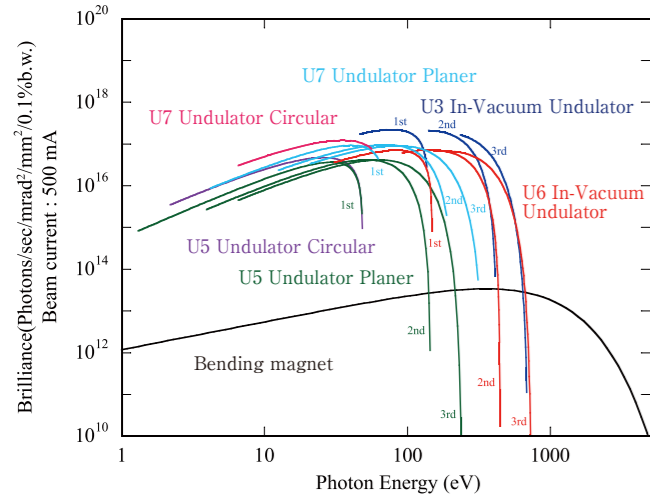
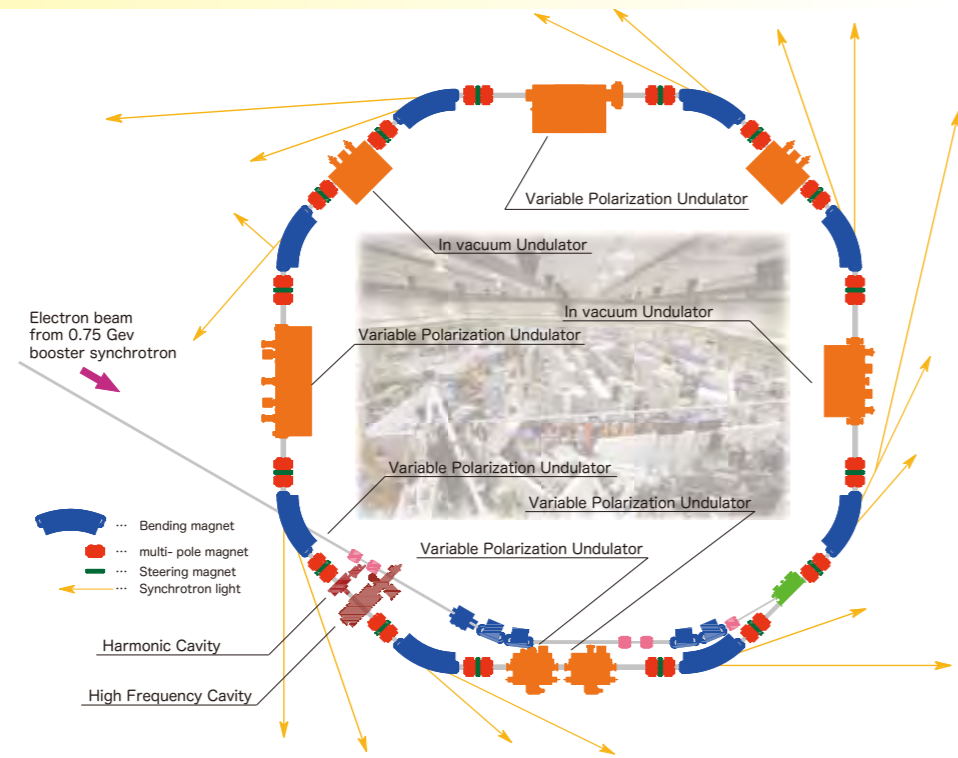
★Private Users : charged

★Please check UVSOR for details.

UVSOR Search

Accelerators of UVSOR-III

The UVSOR-III is composed of three accelerators: a 15MeV linear accelerator for electron injection, a booster synchrotron of about 8.5 m in diameter for accelerating the electron beam up to 0.75 GeV and a 0.75 GeV electron storage ring of about 17 m in diameter and 53 m in circumference. Synchrotron light is produced from 8 pairs of bending magnets and 6 units of undulators.



Electron Storage Ring

UVSOR can generate THz wave to 4keV soft X-rays from 8 bending magnets and VUV and <1keV soft X-rays from 6 units of undulators. The synchrotron light is guided to each unique experimental equipment. Each beamline consists of a monochromator to choose the wavelength or photon energy and a focusing mirror to collimate and focus the light.



Undulator

An undulator is a device with periodic magnetic structures. When the electrons pass through the undulator, they are forced into a snake-like path. The device is inserted into the straight section between the bending magnets. 6 units of undulators have already been installed in the UVSOR-III storage ring.



Injector

The injector consists of a linear accelerator to generate electron beams and a booster synchrotron to accelerate electron beams. As the beam current of the storage ring decreases, the electrons are injected immediately to keep the current almost constant. This is called top-up injection.

Experimental Stations on UVSOR-III



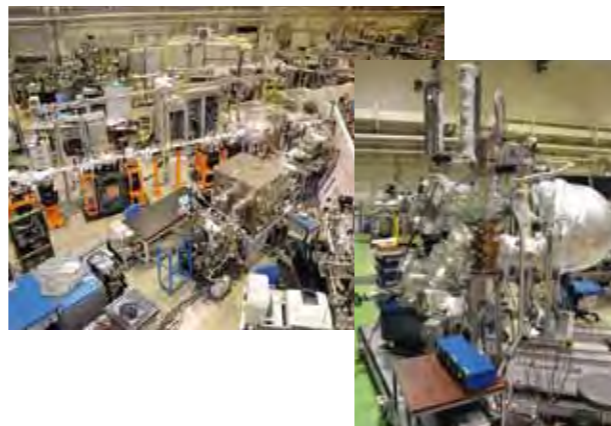
[BL4U] Scanning Transmission X-ray Microscope (STXM)

The STXM focuses X-rays onto a sample as ~30 nm spot size and measures the intensity of the transmitted X-rays. Then, by changing the energy of the X-rays, 2-dimensional chemical state mapping with high spatial resolution can be obtained. The samples in atmospheric or wet condition can be also observed.



[BL4B] High Magnetic Field, Low Temperature Soft X-ray Magnetic Circular Dichroism (XMCD)

Element specific magnetization in magnetic materials is observed at a magnetic field up to ±7 T and a temperature down to 5 K. Magnetic thin films prepared in a connected sample preparation chamber can be investigated under an ultrahigh vacuum condition as they are without exposing to air.



[BL5U] High-Resolution Spin-, Space-, and Angle-Resolved Photoemission Spectroscopy (HR spin- and μ-ARPES)

Information of electrons in solid which causes interesting physical properties is directly obtained by analyzing space dependence of spin, angle, and energy of electrons emitted from bulk solid and solid surface by illuminating micro-focused VUV light.



[BL3U] in-situ/operando Soft X-ray Absorption Spectroscopy of Liquid in Transmission Mode (XAS)

This apparatus is used for in-situ/operando observation of liquids, catalytic reactions, and electrochemical reactions. The local structures around target atoms in liquid, such as hydration structures, reaction intermediates, and electrode surfaces, are investigated by T-mode soft X-ray absorption.



[BL6U] Molecular High-Resolution Angle-Resolved Photoelectron Spectrometer (HR ARPES)

When a molecule is irradiated by linearly polarized monochromatic soft X-ray photons, a photoelectron is emitted due to the photoelectric effect. In order to measure the angular distributions of the photoelectrons, a new apparatus which is rotatable around the photon beam axis has been developed.



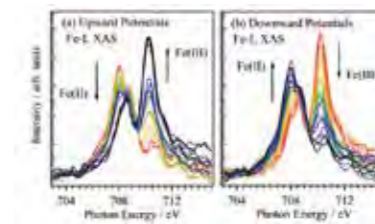
[BL7U] High-Resolution Angle-Resolved Photoemission Spectroscopy (HR ARPES)

High energy- and momentum-resolution ARPES is available using low energy photons (6 -40 eV). Measurements with extremely low energy photons (< 10 eV) provide bulk electronic structure of solids.

Research Outputs from UVSOR-III

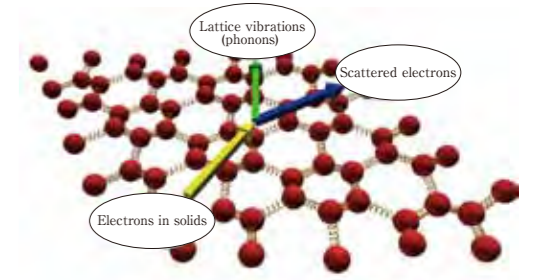
[BL3U] In-situ Observation of Electrochemical Reaction by Soft X-ray Absorption Spectroscopy

We have developed an in-situ observation system of soft X-ray absorption spectroscopy (XAS) to study local structures of electrolytes in electrochemical reaction by using a liquid flow cell with built-in electrodes, in which the thickness of the liquid layer is controllable between 20 nm and 2000 nm. We have measured Fe L-edge XAS of aqueous iron sulfate solution, and revealed the kinetics of the oxidation process from Fe(II) to Fe(III) ions by increasing the electrode potential and that of the reduction process from Fe(III) to Fe(II) ions by decreasing the potential. Reference: M. Nagasaka et al., J. Phys. Chem. C 117, 16343 (2013).



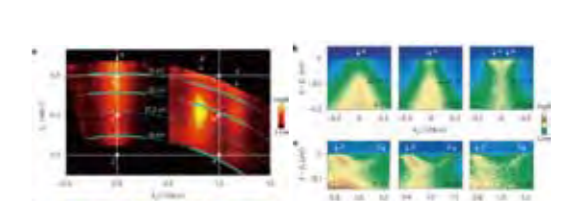
[BL7U] Direct Observation of Electron-Phonon Scattering in Graphite

Electrons are scattered by the thermal vibrations of the lattice, i.e. phonons, resulting in an electric resistance. The microscopic features of the electron-phonon scattering have not been clear so far. In this study, we performed the angle-resolved photoemission spectroscopy of graphite, which is used in pencil lead, with the low photon energy. For the first time, we have succeeded to directly observe the electrons after the scattering process by the phonons.



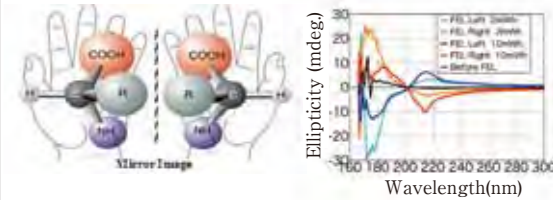
[BL7U] Novel Electronic Structure in Newly Discovered Fe-based Superconductors

Iron-based high-temperature superconductors, have attracted much attention because, until then, the magnetic nature of iron has been considered to disturb the superconductivity. From the angle-resolved photoemission spectroscopy for the iron-based superconductors A₀Fe₂Se₂ (A = K, Cs), we found that their superconducting mechanism can be described in terms of the conventional BCS theory despite the transition temperature is rather high. These results indicate a possibility to increase the transition temperature beyond the framework of BCS theory, leading to exciting applications such as a lossless power transmission.



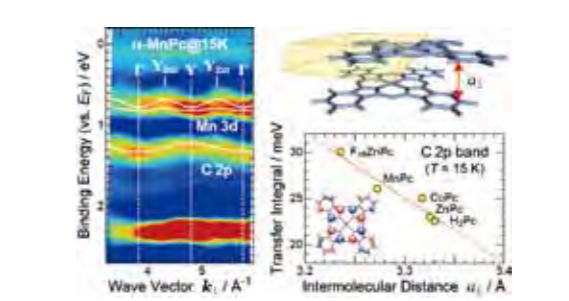
[BL3B] Origin of Chiral Asymmetry of Biomaterials

Amino acids have enantiomers, which have same chemical composition but different three-dimensional structure, such as of right hand and left hand. They are referred to L- and D-forms. Mysteriously, most of the amino acids contained in the natural biological materials on the earth have the L-form. If the origin of the biological material were in the space, this asymmetry might have been caused by irradiation of circularly polarized light in space. Using the polarization variable undulator and free electron laser, the experimental verification has been carried out.



[BL6U] Site Specific Intermolecular Interaction on Organic Crystals

Charge transport in organic solids is an important fundamental process in organic electronics such as organic light-emitting diodes and organic photovoltaic cells, and is dominated by the weak intermolecular interaction. We have systematically studied the valence band structure of crystalline films of various metal phthalocyanine molecules. It was found that the charge transport mechanism in organic crystals is dominated by the site-specific interplay between the local and non-local electron-phonon couplings.



[BL6U] Dissociation Dynamics of Core Excited Molecules

A molecule consists of more than two atoms held together by chemical bonds. We can classify the electrons in the molecules into two categories: valence and core electrons. While the valence electrons participate in the formation of the chemical bonds, the core electrons are localized to particular atoms and not involved in any chemical bonding. The core electron excitation and subsequent Auger decay often result in multiple bond-breaking, which is hardly seen in the valence excitation. We develop new experimental techniques to explore the decay dynamics in core-excited or core-ionized molecules.

