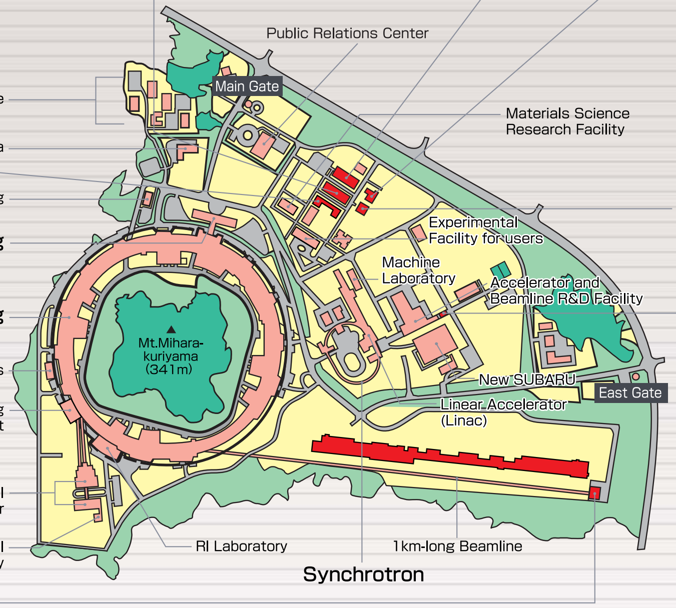
Facilities in RIKEN SPring-8 Center

Highthroughput Factory

Synchrotron Radiation Physics Facility

Structural Biology Facility

Structural Biology Experimental Facility



Research Coordination Facility

EUV-Laser Experimental Facility

1km-long Beamline Facility

XFEL Construction Sight

Institutes and Offices in RIKEN

Harima Institute (SPring-8)

May, 2009

U K	
	● RIKEN Facility Office at RAL
U S A	
	● RIKEN BNL Research Center
	● RIKEN-MIT Brain Science Research Center
Korea	
	● Hanyang University-RIKEN Cooperative Research Laboratory
Singapore	
	● RIKEN Singapore Representative Office
China	
	● RIKEN China Office

Sendai Facility

Kobe Institute

Nagoya Facility

Head Quarter & Wako Institute

Yokohama Institute

Tsukuba Institute

RIKEN SPring-8 Center

1-1-1, Kouto, Sayo, Hyogo, 679-5148, JAPAN

Tel: +81-791-58-0808 Fax: +81-791-58-0800 URL http://www.harima.riken.jp/

2009.10

RIKEN SPring-8 Center

OUTLINE

Message

Ryoji NOYORI
President of RIKEN

Nobuo FUJISHIMA
Director,
RIKEN Harima Institute

Tetsuya ISHIKAWA
Director,
RIKEN SPring-8 Center

Message A group of photon science pioneers

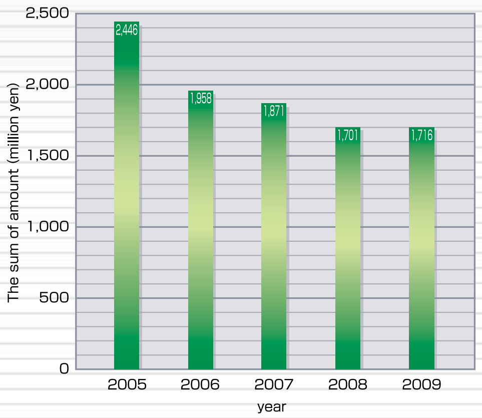
The RIKEN Harima Institute was established in October 1997. A feature of Harima Institute is SPring-8, the largest synchrotron radiation (SR) facility in the world. In October 2005, the RIKEN SPring-8 Center (RSC) was established at Harima Institute to encourage frontier research programs in the wide variety of science fields using SR. The RSC is operating seven beamlines for its own researches at SPring-8.

The RSC has a unique ability to deliver new research achievements through the development of research infrastructures and techniques -something- unattainable at other institutes. The RSC consists of groups of pioneers in photon science. It is creating new types of light sources, developing novel scientific fields using the lights, and identifying potential new applications. Being a part of a key SR facility in the Asia-Oceania region, the RSC is active in cooperative research and exchanges.

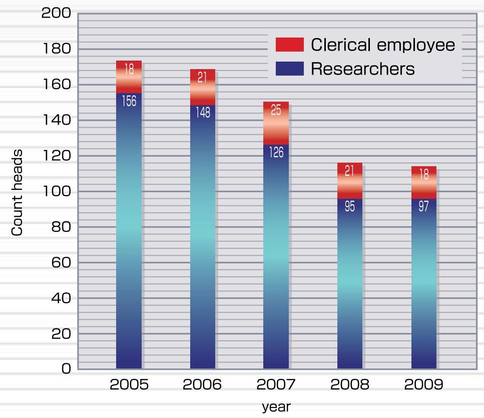
Currently, RIKEN and JASRI (the Japan Synchrotron Radiation Research Institute) are jointly constructing an XFEL (X-ray Free Electron Laser) facility for the generation of coherent X-ray beam which is unavailable at the moment. Scheduled for completion in FY 2010, the XFEL will be open to public use as SPring-8.

Putting XFEL alongside 3rd generation SR in one site opens up unique possibilities to use two sources synergistically, and will make the Harima Institute a world-leading center of excellence for photon science.

Budget of RSC (for 5 fiscal years)



Personnel



History Being a pioneer of global photon science to date and in the future

1980's

Oct. 1988
RIKEN and JAERI (the Japan Atomic Energy Research Institute) formed the joint project team for constructing SPring-8 (Super Photon ring-8GeV)

1990's

Nov. 1991
The construction of SPring-8 began
Oct. 1994
The law regarding the promotion of public use of the Synchrotron Radiation Facility went into effect and JASRI was designated for its dedication
Oct. 1997
SPring-8 started its operation for public use, and RIKEN established the Harima Institute at the site of SPring-8
May 1999
Synchrotron Radiation Research Network was launched

2000's

Oct. 2003
RIKEN was reborn as "Independent Administrative Institution"
Sep. 2005
JAERI withdrew from the SPring-8 management
Oct. 2005
RIKEN SPring-8 Center was launched
Mar. 2006
RIKEN XFEL Project Head Office was launched
Apr. 2006
RIKEN and JASRI established SPring-8 Joint Project for XFEL
July 2006
The law regarding the promotion of public use of the Synchrotron Radiation Facility was amended to also promote public use of other large advanced research facilities.
May 2008
XFEL prototype accelerator opened to the Public

ABOUT

What is SPring-8 ?

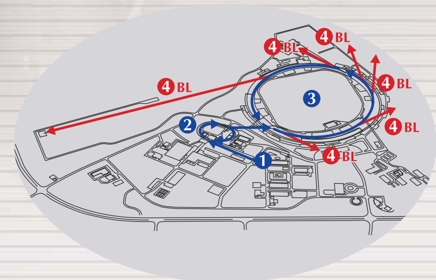
Enabler of your innovative life

SPring-8, the world's largest synchrotron radiation (SR) facility, could be described as a "super microscope". SPring-8 provides the most powerful SR currently available in the world. This ultra-brilliant SR offers researchers exciting opportunities for advanced research in materials science, spectroscopic analysis, earth science, life science, environmental science, forensic science, industrial applications and various other research fields. Many commodities in our daily life have been developed or improved by SPring-8.

※The management, operation, maintenance, support for users of SPring-8 are entrusted to JASRI.

How does SPring-8 generate the light?

The Pathway of Electrons



1. Electrons are generated by an electron gun.
2. Electrons are accelerated and injected into the storage ring.
3. Stored electron beam emits SR.
4. Experiments are performed at beamlines.

RIKEN Beamlines

There are RIKEN Beamlines in SPring-8. RSC have technical advantages for designing, developing and upgrading beamlines itself adapt to various research subject. RSC takes the lead in developing the new photon science by cutting-edge technology.

★under construction

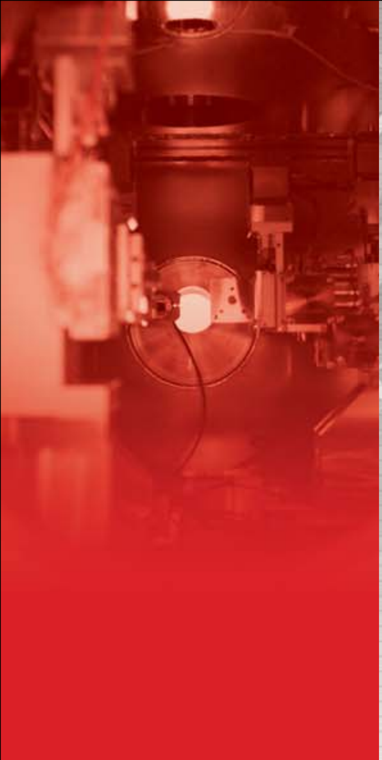
	No.	Name of the Beamline	Main area & subject of research
1	BL17SU	RIKEN Coherent Soft X-ray Spectroscopy	High-intensity soft X-ray spectroscopy, surface science
2	BL19LXU	RIKEN SR Physics	Science of high-intensity X-ray
3·4	BL26B1&2	RIKEN Structural Genomics I & II	high throughput analysis of protein Micro-crystallography
5	BL29XU	RIKEN Coherent X-ray Optics I	Coherent X-ray optics
6	BL44B2	RIKEN Materials Science	Macromolecular crystallography
7	BL45XU	RIKEN Structural Biology I	X-ray small-angle scattering and diffraction, non-crystalline biological materials
8★	BL32XU	RIKEN Targeted Proteins	Protein micro-crystallography
9★	BL43LXU	RIKEN Quantum Nano Dynamics	Atomic and Electronic Dynamics using Inelastic X-Ray Scattering

What is the RSC ?

COE (Center of Excellence) in high-energy photon science

The RSC was established in October, 2005 at RIKEN Harima Institute. The mission of RSC is to pursue cutting-edge research and development in high-energy photon science using SPring-8, XFEL and any relevant future light sources.
The RSC consists of three strategic divisions as follows.
1) to produce concepts leading to newer light sources
2) to develop science accessible only with these light sources
3) to expand the newer science and technology for wider application

The members of the RSC (April, 2009.)



RSC

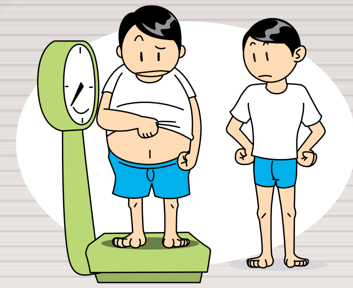
Research Highlights of the RSC

Various research activities are going on at RSC. These highlights represent a part of the published works from the RSC.

Future treatments for metabolic syndrome

An acetyl-CoA carboxylase (ACC) in fatty-acid biosynthesis pathway can cause metabolic syndrome. A pharmaceutical control of the enzymatic ACC activation by biotin protein ligase (BPL) is one possible approach to treatments for metabolic disorders. To facilitate drug development, the complex crystal structure between ACC catalytic domain and BPL was clarified. Difficulties in obtaining good crystals were overcome using the multiple mutant method.

Journal of Biological Chemistry (23 May 2008)



Circularly polarized x-rays probe crystal chirality

X-rays are normally much less sensitive to the "handedness" of an enantiomer.

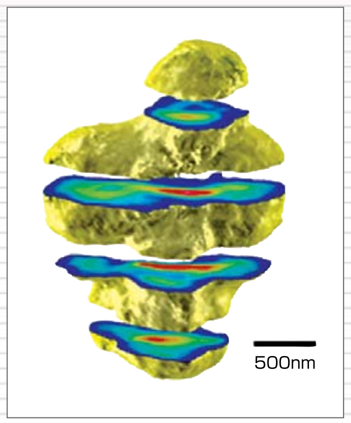
Enantiomers in many proteins, sugars and pharmaceuticals crystallize into two forms that are mirror images of each other like our right and left hands. X-rays, which are normally useful in determining the structure of materials and biomolecules, are much less sensitive to the "handedness" of an enantiomer. We have shown that right and left circularly polarised (RCP and LCP) X- rays at the resonant energy can distinguish "left" from "right" low-quartz, whose crystal structures are mirror images of each other.

Physical Review Letters (11 April 2008)

See into the cellular world

RSC scientists observed three-dimensional structure of an unstained human chromosome by using coherent X-ray diffraction. The observed images reveal an internal axial structure with high electron-density, which other microscopic methods have been unable to visualize under unstained conditions. The result experimentally demonstrates the high imaging ability of coherent X-ray diffraction for unstained biological specimens, which is transparent to X-rays, opening novel and strong means of exploring cellular structures. This image made the cover of the PRL.

Physical Review Letters (9 January 2009)



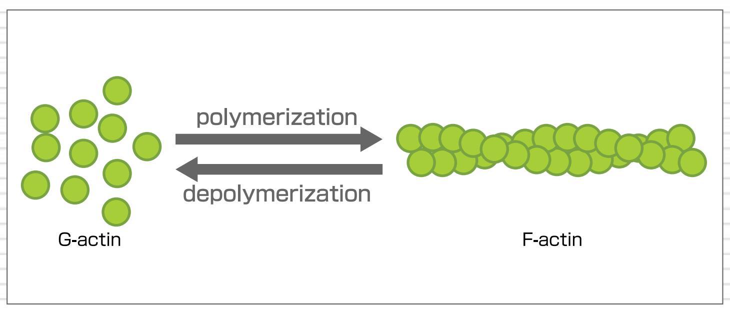
Axial image of a human chromosome

Structural analysis of F-actin by the X-ray fiber diffraction

The nature of transition form monomer to polymer

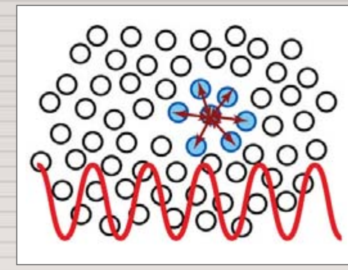
Actin is found in many eukaryotic cells and it has two states, momonetic G-actin and polymeric F-actin. The transition from G- to F-actin drives a broad range of cellular functions. G-actin structure was solved in 1990, but F-actin structure remains vague for a long time. We determined the higher resolution structure of F-actin by the x-ray fiber diffraction. A structural characteristic of the G- to F-actin transition is flattening of actin molecule.

Nature (22 January 2009)



The transition of G- to F-actin occurs by polymerization and depolymerization of actin. The transition drives important cellular functions such as cell motility.

Atomic-Scale Shear Motion in a Simple Liquid



Schematic showing cage-like atomic motion of an atom in the liquid and the x-ray wave-field.

The recent first observation of transverse atomic motion in a simple liquid will further understanding of the liquid state. While long expected, observation of this fundamental feature was only possible using a special x-ray spectrometer with extremely good resolution ($\Delta E/E<10^{-7}$). Atomic motions are intimately connected with liquid behavior, so this result, and work building on it, will improve our understanding of this very common and fundamental state of matter.

Physical Review Letters (13 March 2009)

The secret of water: Clear water has inhomogeneous micro structure

The RSC scientists revealed that the existence of inhomogeneous micro structure in pure liquid water by using SPring-8. Temperature dependent changes of microstructures named "ice-like" and "distorted" were also studied. These new findings are interesting and important for understanding of water in cell, aqueous chemical reaction, function of water as solvent etc.

Proceedings of the National Academy of Sciences (10 August 2009)

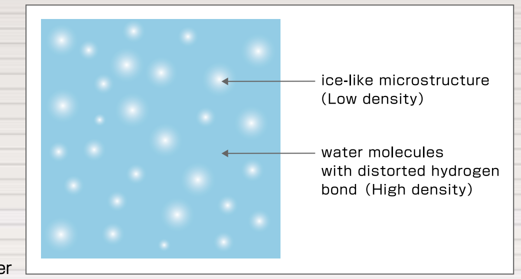
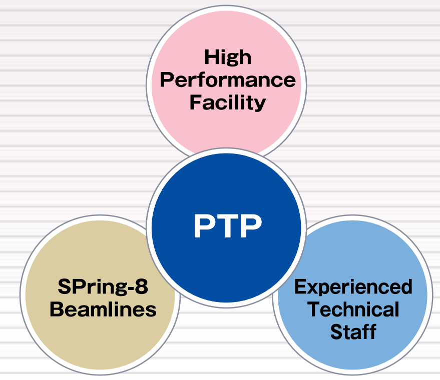


Image of instantaneous microstructure in liquid water

Protein Tectonics Platform

SPring-8, the biggest synchrotron radiation facility in the world, is a powerful tool for the structural study of proteins. Many proteins are difficult to be stored for a long term due to their structural instability.

In the SPring-8 Center, these delicate proteins can be analyzed smoothly within the campus by utilizing a high-throughput structure analysis pipeline which covers all aspects of protein crystallography composed of sample preparation, beamline experiment, and structure determination. This platform will contribute to various studies in such as life science.



International Exchange

SPring-8 plays an active role in training young scientists from Asia-Oceania region through summer school named "Cheiron School※". The school includes lectures on SR science technologies, synchrotron operation and industrial applications.

※Cheiron is one of the immortal Greek gods who was known for providing the right knowledge and skills to the appropriate mortal.

Science Outreach Activity

The RSC is also active in science outreach activity. It provides opportunities to feel the state-of-the-art science to local.

http://www.spring8.or.jp/ja/support/contact/site_tour/

Organization

President, RIKEN
Ryoji NOYORI (D.Eng.)

Director, RIKEN Harima Institute
Nobuo FUJISHIMA

- Deputy Director
  Mitsuharu KIDA
- Harima Research Promotion Division
- Harima Safety Center

Director, RIKEN SPring-8 Center
Tetsuya ISHIKAWA (D.Eng.)

- Deputy Director
  Yoshitsugu SHIRO (D.Eng.)
- Senior Advisor
  Tetsutarou IIZUKA (D.Sci.)
- RIKEN SPring-8 Center Advisory Council

XFEL Project Head office

Innovative Light Sources Division

Innovative Light Sources Division is responsible for the technical development of advanced synchrotron radiation (SR) sources (including XFEL) and the upgrade of existing light sources at SPring-8.

- Coherent X-Ray Optics Laboratory
  Tetsuya ISHIKAWA (D.Eng.)
- Advanced Electron Beam Physics Laboratory
  Tsumoru SHINTAKE (D.Eng.)


Boys, be ambitious !
Chief Scientist
Tetsuya ISHIKAWA


It's my mission.
Chief Scientist
Tsumoru SHINTAKE

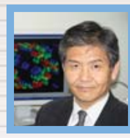
Photon Science Research Division

Photon Science Research Division is responsible for promoting sciences made possible with innovative light sources. The division is carrying out cutting edge research in vast fields of life, materials and physical sciences at SPring-8 and is seeking to open new interdisciplinary scientific fields by developing innovative analytical tools.

- Structural Biophysics Laboratory
  Masashi MIYANO (D.Sci.)
- Biometal Science Laboratory
  Yoshitsugu SHIRO (D.Eng.)
- Structural Materials Science Laboratory
  Masaki TAKATA (D.Sci.)
- Materials Dynamics Laboratory
  Alfred Q. R. BARON (Ph.D.)
- Biostructural Mechanism Laboratory
  Koji YONEKURA (Ph.D.)
- Structural Physiology Research Group
  Atsuo MIYAZAWA (D.Sci.)
  - Bio-multisome Research Team
    Atsuo MIYAZAWA (D.Sci.)
  - Three-dimensional Microscopy Research Team
    Teruhisa HIRAI (Ph.D.)
  - Molecular Signaling Research Team
    Atsuko YAMASHITA (Ph.D.)
  - X-ray Structural Analysis Research Team
    Toshirou ODA (Ph.D.)
- SR System Biology Research Group
  Seiki KURAMITSU (D.Sci.)
  - Functomics Integration Research Team
    Seiki KURAMITSU (D.Sci.)
  - Functomics Biology Ⅰ Research Team
    Akeo SHINKAI (D.Agr.)
  - Functomics Biology Ⅱ Research Team
    Seiki KURAMITSU (D.Sci.)
- Quantum Order Research Group
  Masaki TAKATA (D.Sci.)
  - Spin Order Research Team
    Takahisa ARIMA (Ph.D.)
  - Spatial Order Research Team
    Susumu KITAGAWA (D.Eng.)
  - Excitation Order Research Team
    Shik SHIN (D.Sci.)
- Song Initiative Research Unit
  Changyong Song (Ph.D.)


Think first, and see it as is.
Chief Scientist
Masashi MIYANO


Imagination and Creation.
Chief Scientist
Yoshitsugu SHIRO


Have a can-do spirit !
Chief Scientist
Masaki TAKATA


OK, Lets do it!
Associate Chief Scientist
Alfred Q. R. BARON


Challenge !
Associate Chief Scientist
Koji YONEKURA


Science should be fun.
Group Director
Atsuo MIYAZAWA

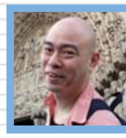

Enjoy excitement.
Team Leader
Teruhisa HIRAI


God is in the details.
Team Leader
Atsuko YAMASHITA


Invitation to imagination.
Team Leader
Toshirou ODA


Treasure every encounter, for it will never recur.
Group Director
Seiki KURAMITSU


Do one's best to take one's fortune.
Team Leader
Akeo SHINKAI


Man can grow.
Team Leader
Yoshitaka BESSHO


Curiosity did not kill the scientist.
Team Leader
Takahisa ARIMA


Scientific creativity for space.
Team Leader
Susumu KITAGAWA


Let's watch electrons with us.
Team Leader
Shik SHIN


Commitment, dedication and passion
Initiative Research Scientist
Changyong Song

Advanced Photon Technology Division

Advanced Photon Technology Division is responsible for the development of measurement technologies to make the best use of SPring-8 synchrotron radiation and the XFEL. The Division is developing both hardware and software which enhance the usability of innovative light sources, thus providing easier access to outside users, including industrial sectors.

- Research Infrastructure Group
  Masaki YAMAMOTO (D.Sci.)
  - SR Life Science Instrumentation Unit
    Masaki YAMAMOTO (D.Sci.)
  - SR Materials Science Instrumentation Unit
    Yoshihito TANAKA (Dr.Sci.)
- Protein Crystallography Research Group
  Tetsuya ISHIKAWA (D.Eng.)
  Naoki KUNISHIMA (Dr.Sci.)


Do and it will be done.
Group Director
Masaki YAMAMOTO


Yes we can !
Unit Leader
Yoshihito TANAKA

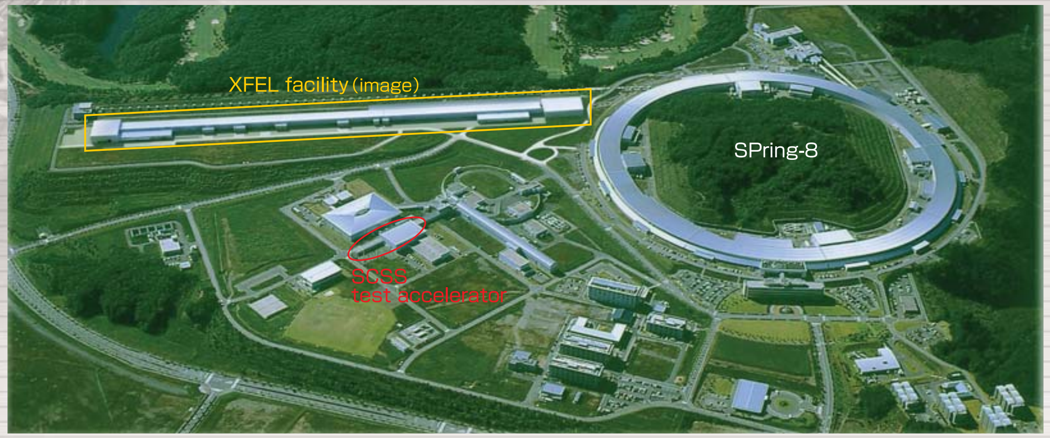

Science is sight of the universe.
Deputy Group Director
Naoki KUNISHIMA

XFEL

XFEL : the "Dream Light"

XFEL heralds the dawn of a new era in Science

RIKEN has set up the SPring-8 Joint Project for XFEL to construct an X-ray free electron laser (XFEL), in collaboration with JASRI. The XFEL will enable major progress in the structural analysis of proteins and the development of new materials, thus leading to the creation of new scientific fields.



The XFEL facility (the area surrounded by yellow lines) is being built next to the SPring-8 Storage Ring.
The red line shows the XFEL prototype called SCSS test accelerator.

Milestones

- **2005** Manufacture of a 250MeV test apparatus begins
- **2006** Success achieved in laser oscillation of 49nm UV rays in the test apparatus
- **2007** XFEL facility construction begins
- **2008** XFEL User Promotion Projects and User Projects open to the Public
- **2009** Finish construction of the building housing the light source and all related equipment

Future Plans

- **2010** Finish construction of experiment/research building
- **2010 ~ 2011** Achieve XFEL laser oscillation; Open facility to shared use

X-ray Free Electron Laser Light

To date, conventional lasers using stimulated emission, and higher harmonics generated by the non-linear process have had difficulty in reaching shorter X-ray wavelength, which are essential to microscopic observation with atomic resolution. One way to go down to X-rays is to use free electron in an accelerator producing coherent X-ray photons as a result of electron-photon interaction in a long undulator.