TOYAMA *Pioneering New Horizons in Science*

TOYAMA's Monozukuri Center Opened in April 2015.

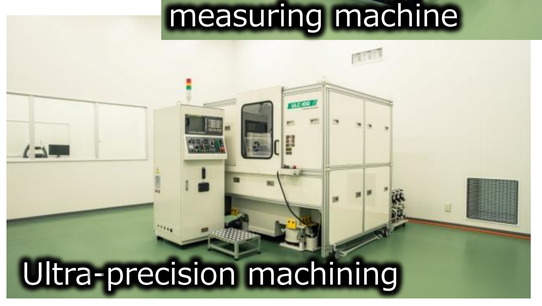
TOYAMA's new factory, *Monozukuri* Center, has a total floor area of 12,400 m², including 1,900 m² of machining & workshop areas, 2,400 m² of assembly & test areas and 800 m² of clean room space.

Monozukuri **is a term which is used to describe Japanese manufacturing processes. It is difficult to translate into English, literally "*mono*" is the thing that is made and "*zukuri*" is the act of making. "*Monozukuri*", however, has a deeper meaning beyond the literal which describes the craftsmanship involved in making objects with skill, artistry and continuous improvement. It might be defined as "The art, science and craft of making things".**

Assembly and Test Area

- Vacuum baking and system test
- Assembling

Temperature Control Room



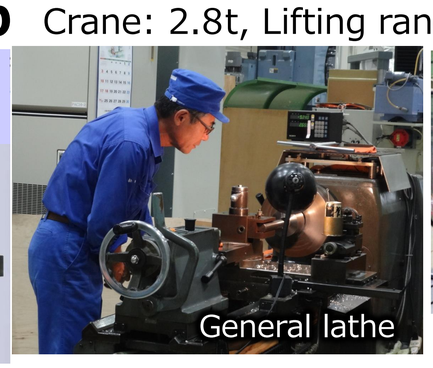
- 3D coordinate measuring machine
- Ultra-precision machining and measuring systems
- 3D optical profiler
- Laser interferometer
- Auto collimator *etc.*

Observatory Room

40 cm Cassegrain reflecting telescope

Machine Shop

Crane: 2.8t, Lifting range: 6m

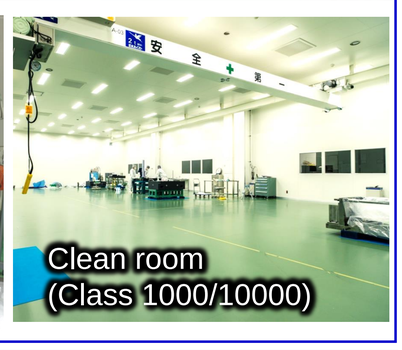


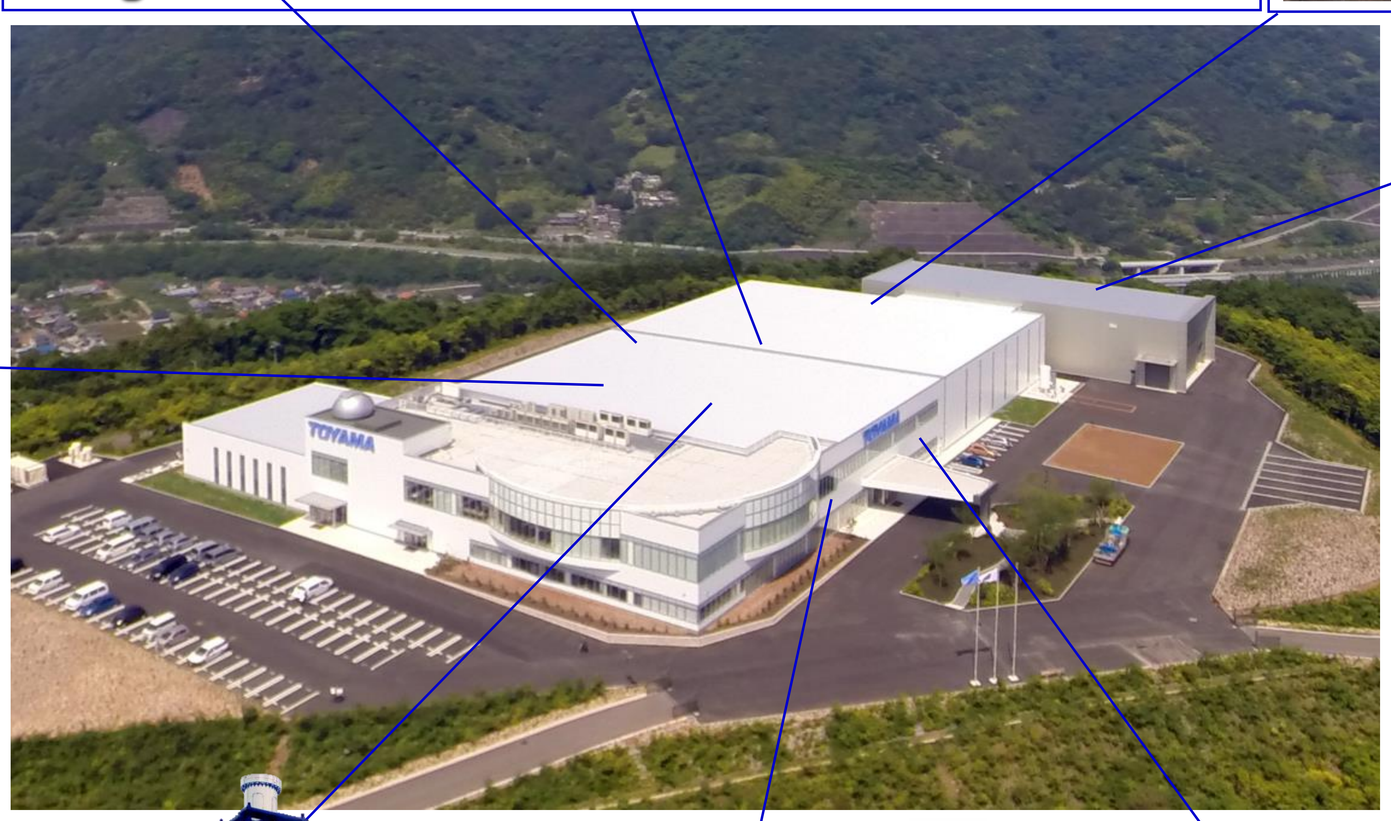
- 6 general lathes
- 8 general milling machines
- 6 machining centers
- 2 Horizontal NC Mchines
- Multitasking machine *etc.*

New!

- Vertical CNC lathe
- Wire electric discharge machine

Assembly, Weld and Test Area

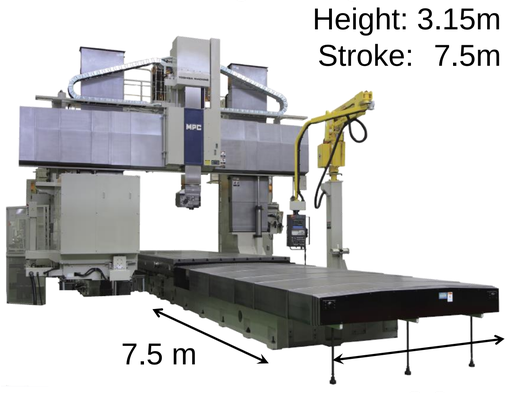




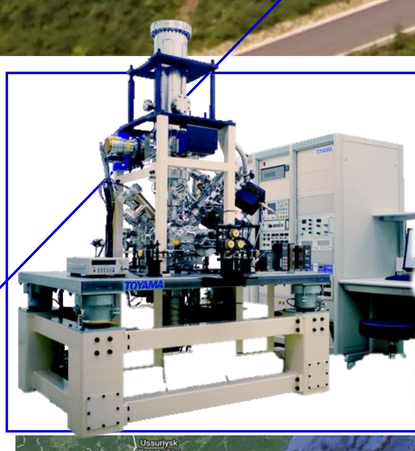
Large Machine Shop

Crane: 5t, Lifting range: 6m

Large milling machine
Height: 3.15m
Stroke: 7.5m



R&D Lab



FILMER
(FIB-TOF-SIMS: Focused Ion Beam Time-Of-Flight Secondary Ion Mass Spectrometer)

LICA-MS
(Laser Ionization Compact Analyzer Mass Spectrometer)

Engineering Room

Capacity: Over 100 seats

Main Entrance and Mt. Fuji

Vacuum Furnace Area

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TOYAMA

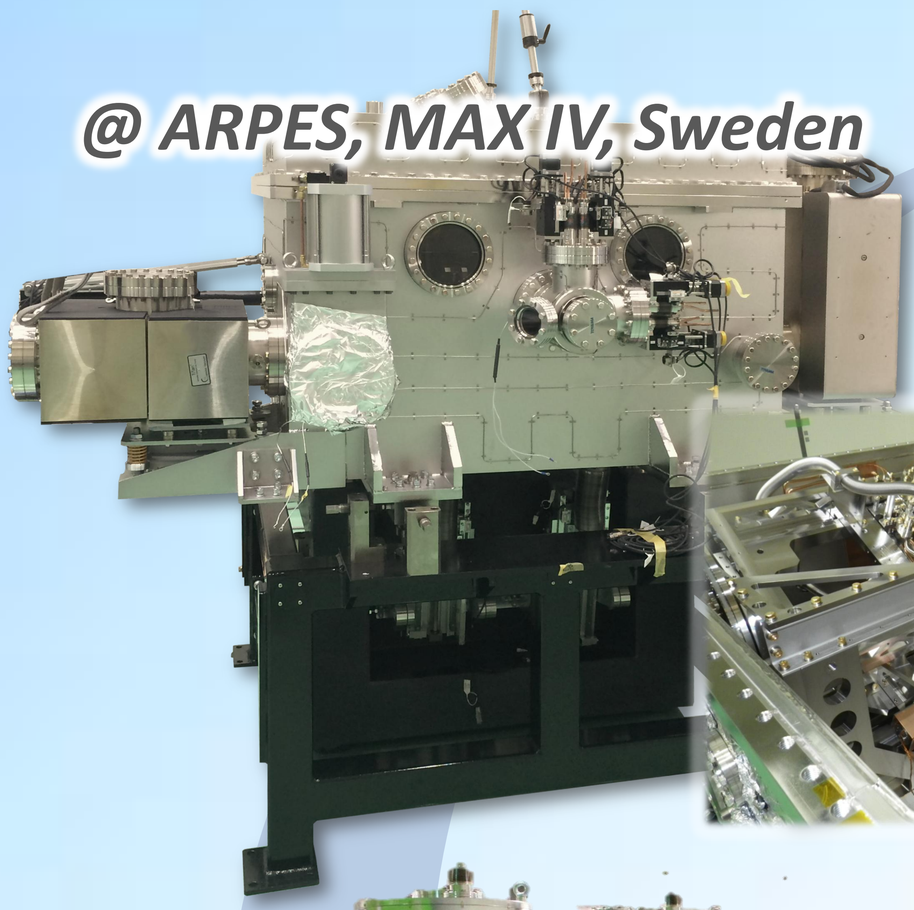
Pioneering New Horizons in Science

High Resolution Soft X-ray Monochromator

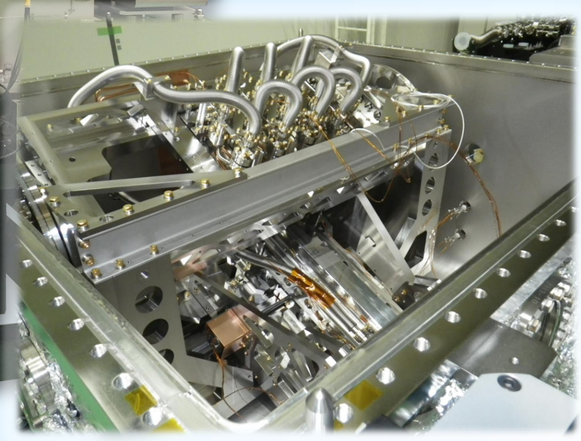
Variable Line Spacing Plane Grating Monochromator (VLS-PGM)

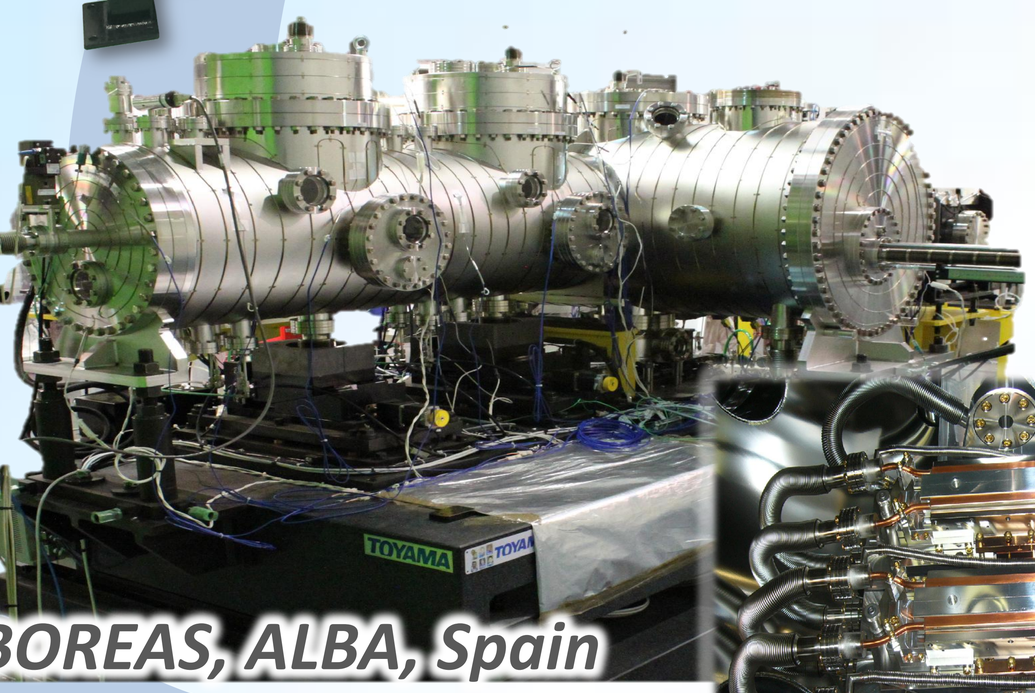
More than 20 VLSPGMs have been designed, manufactured and commissioned on many state-of-the-art beamline facilities around the world.

@ ARPES, MAX IV, Sweden



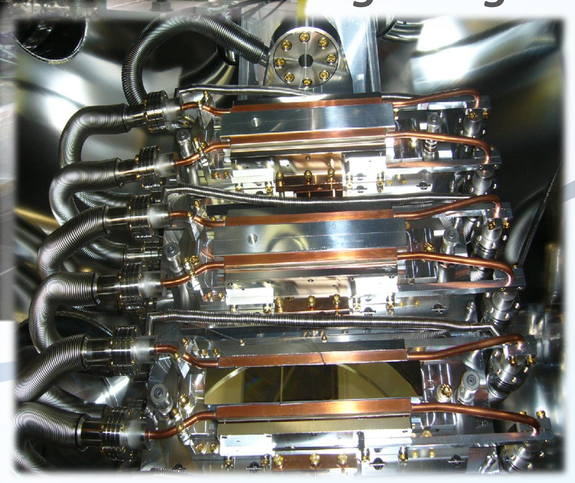
VLSPGM with cooling





@ BOREAS, ALBA, Spain

3 interchangeable gratings

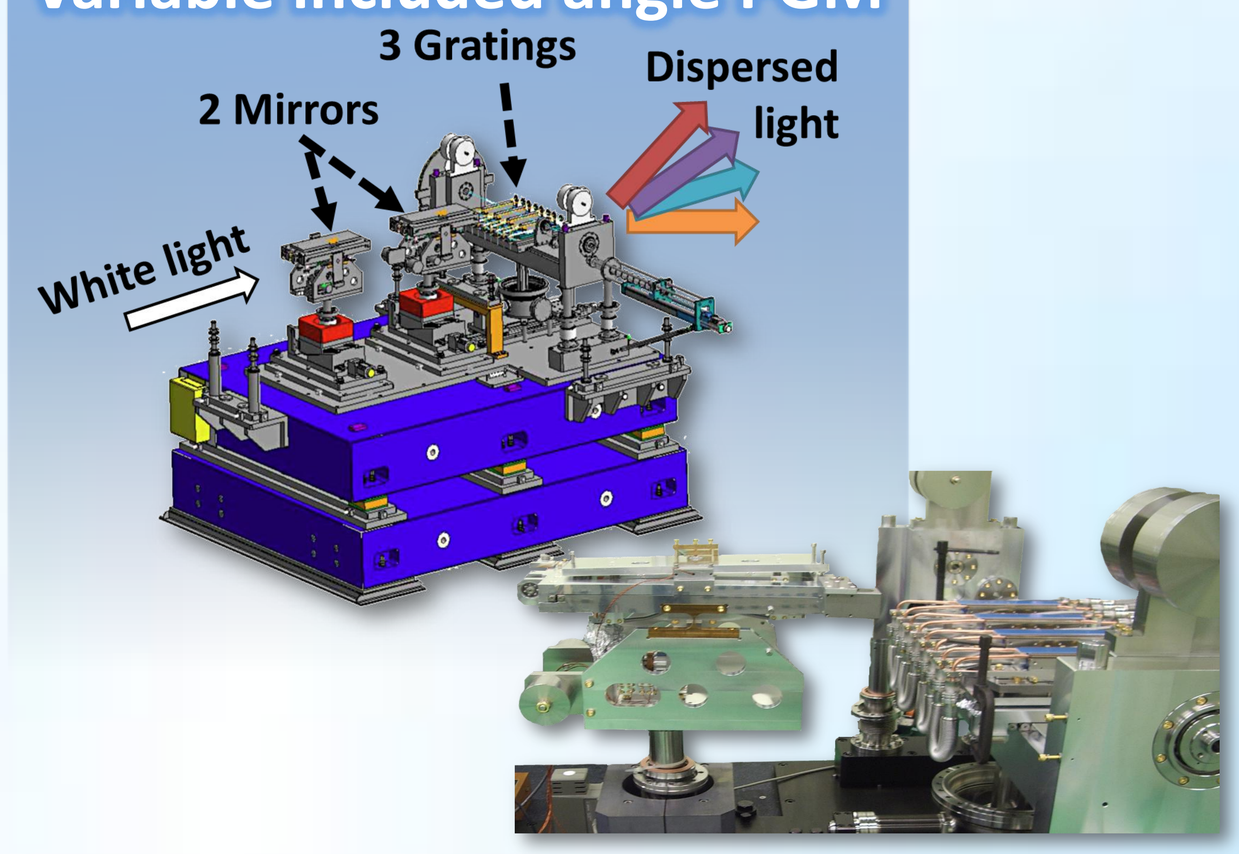


@ VERITAS, MAX IV, Sweden

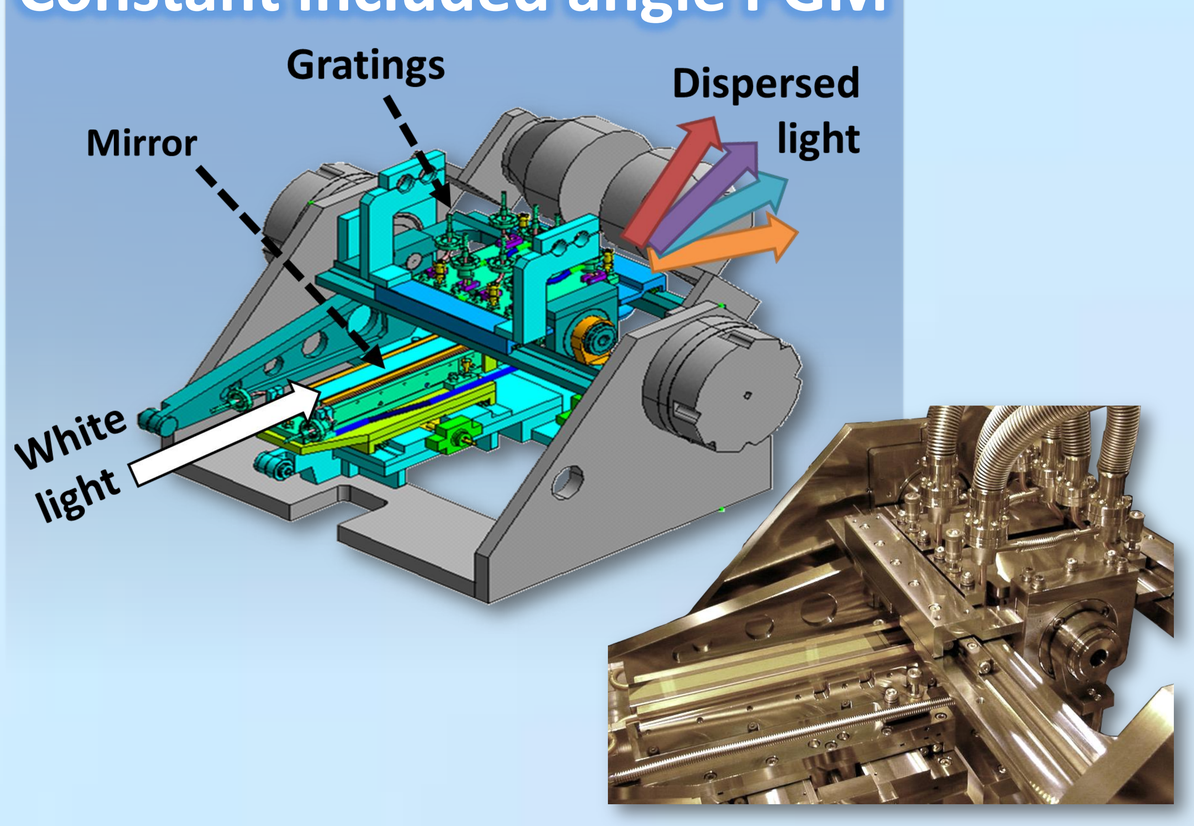
VLSPGM with cooling

SSSJ Industry Technology Award from the Surface Science Society of Japan (SSSJ) in November, 2014.

Variable included angle PGM



Constant included angle PGM



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TOYAMA

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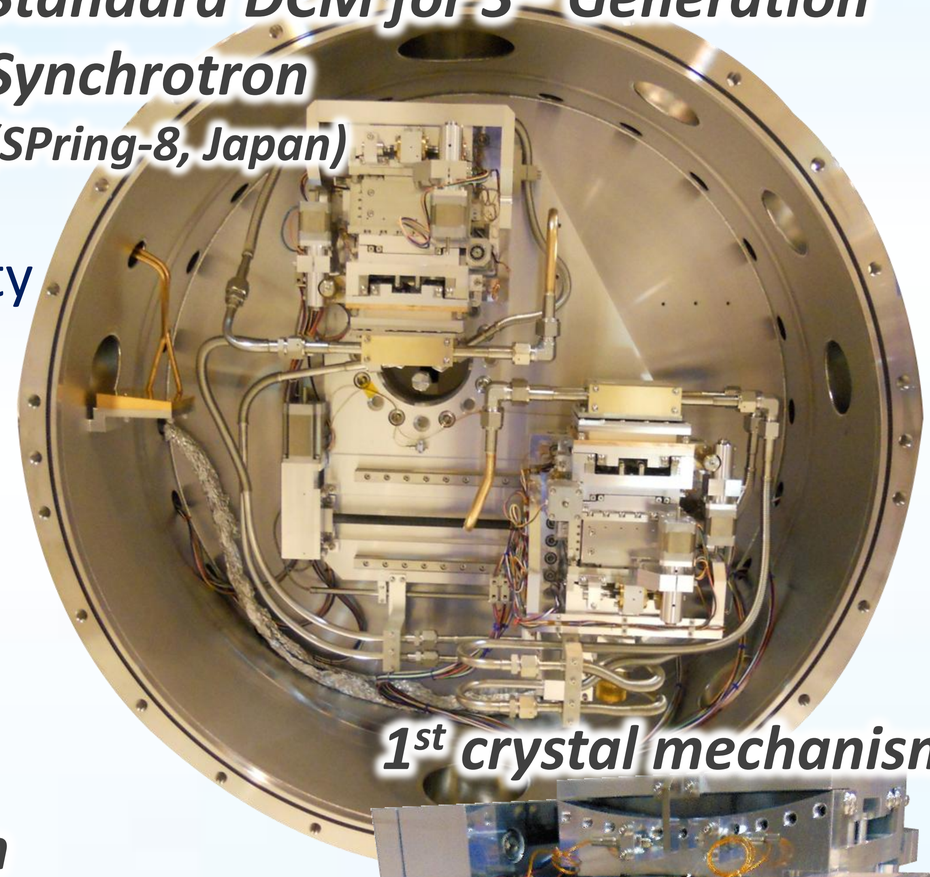
Hard X-ray Double Crystal Monochromator (DCM)

High stability, excellent resolution and compact are key aspects of our monochromator. The standard DCM can achieve less than 20 arc second parallelism between two crystals through the full scan range of Bragg angle from 3° to 32°. A further development of fast scanning using a DC servomotor is available for QEXAFS measurement.

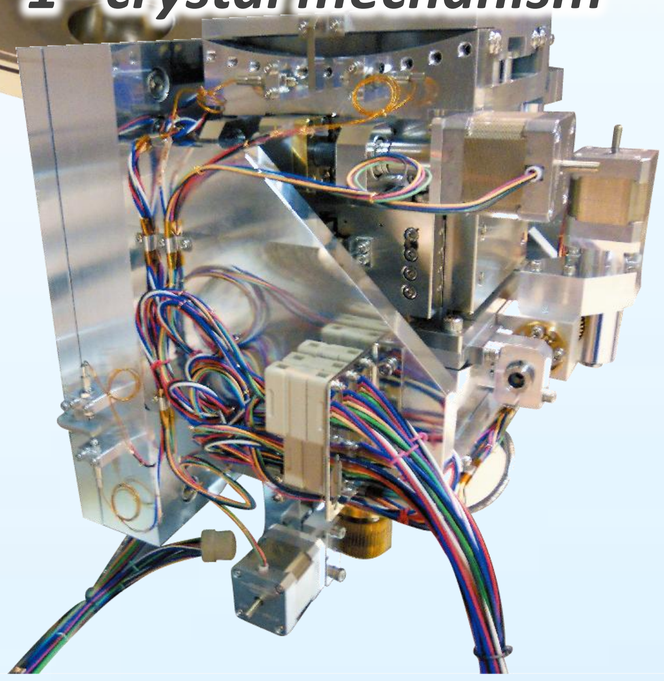
Features for standard DCM:

- Compact UHV design
- Granite mount to minimize low-frequency vibration
- Crystal cage mounted on rigid drive shaft for high stability
- Typical size of crystal 90(L) x 50(W) x 35 (H) mm
- Water and/or LN2 cooling system
- Advanced temperature software for wide range pseudo-channel cut operation
- EXAFS mode scanning speed 0.2 deg/sec available

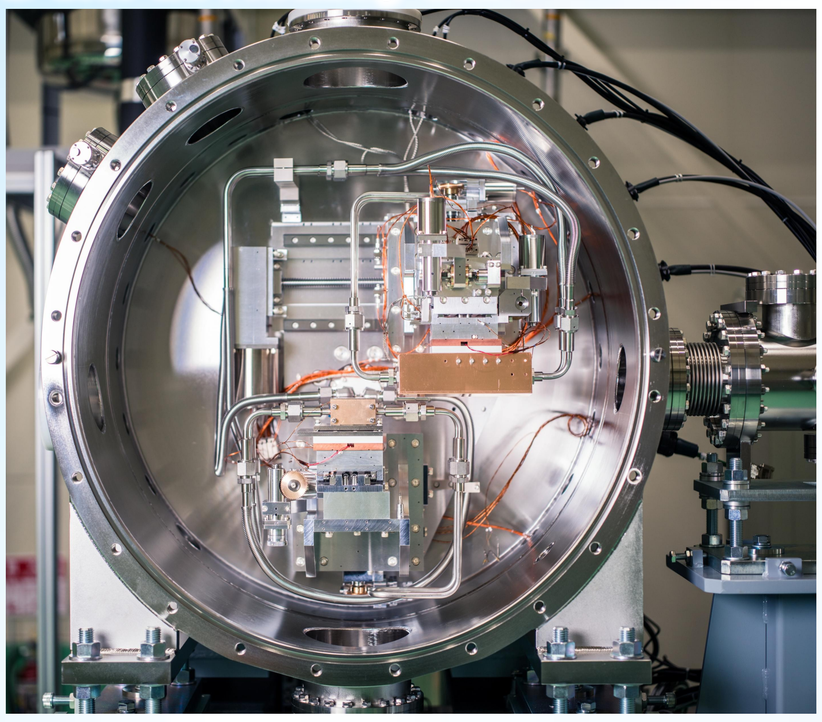
Standard DCM for 3rd Generation Synchrotron
(SPring-8, Japan)



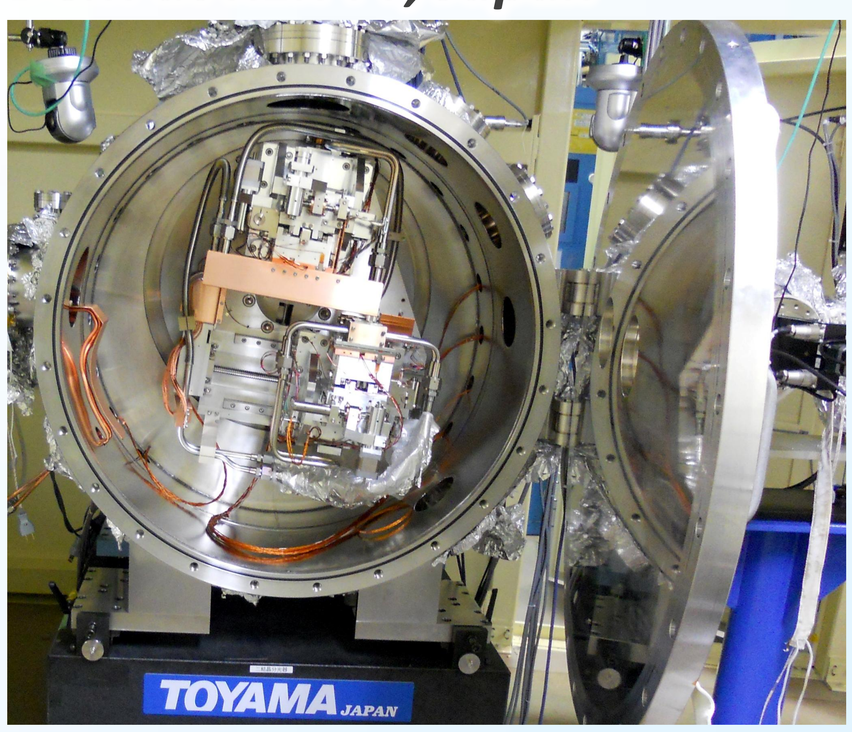
1st crystal mechanism



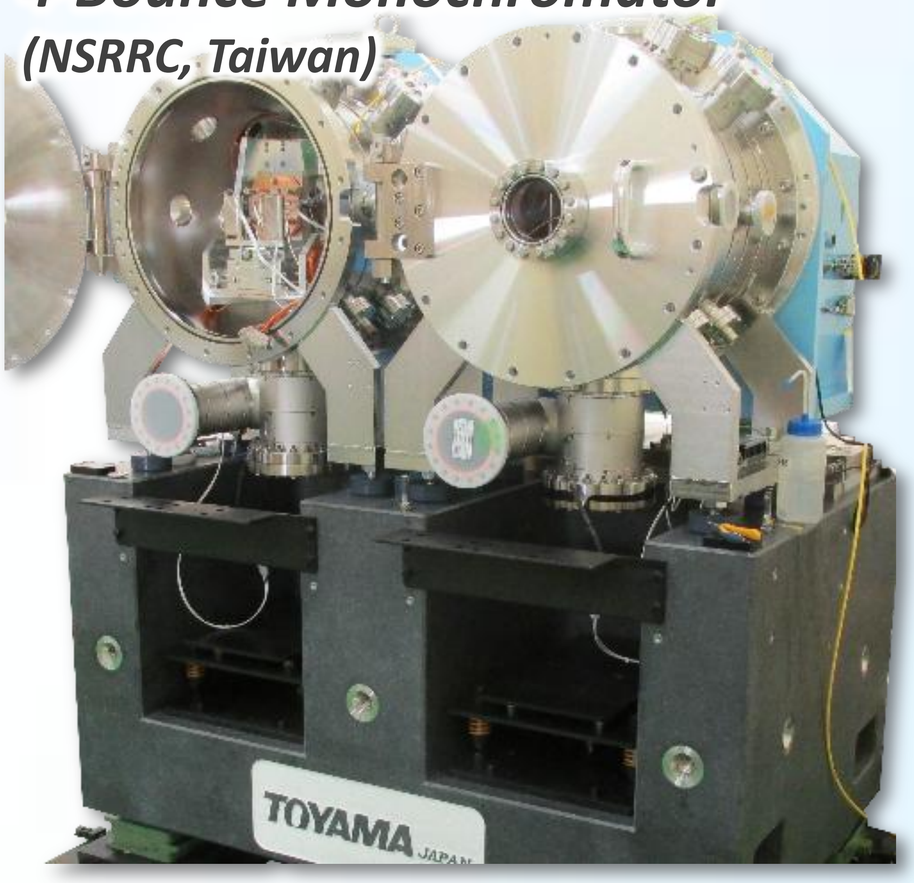
DCM at NSLSII, USA



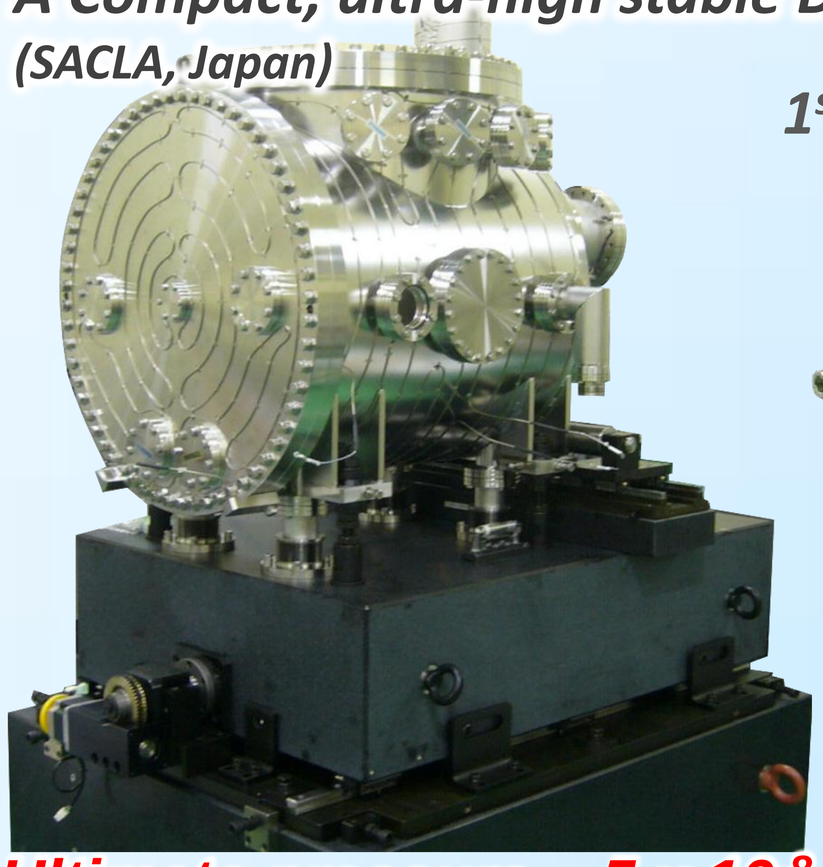
DCM at KEK-PF, Japan



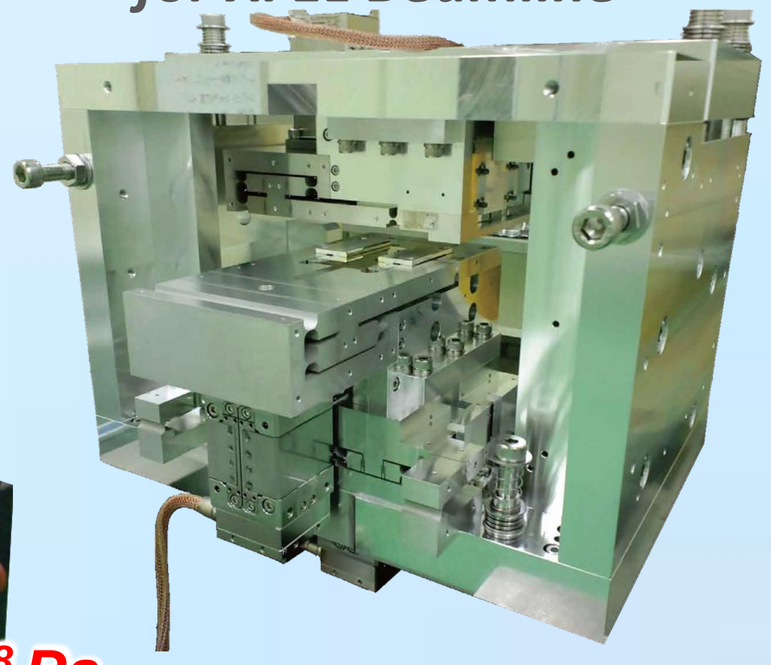
4-Bounce Monochromator
(NSRRC, Taiwan)



A Compact, ultra-high stable DCM for XFEL
(SACLA, Japan)



1st and 2nd crystal mechanism for XFEL Beamline



Ultimate pressure ~ 5 x 10^{-8} Pa

Please contact us for more details or special requests.

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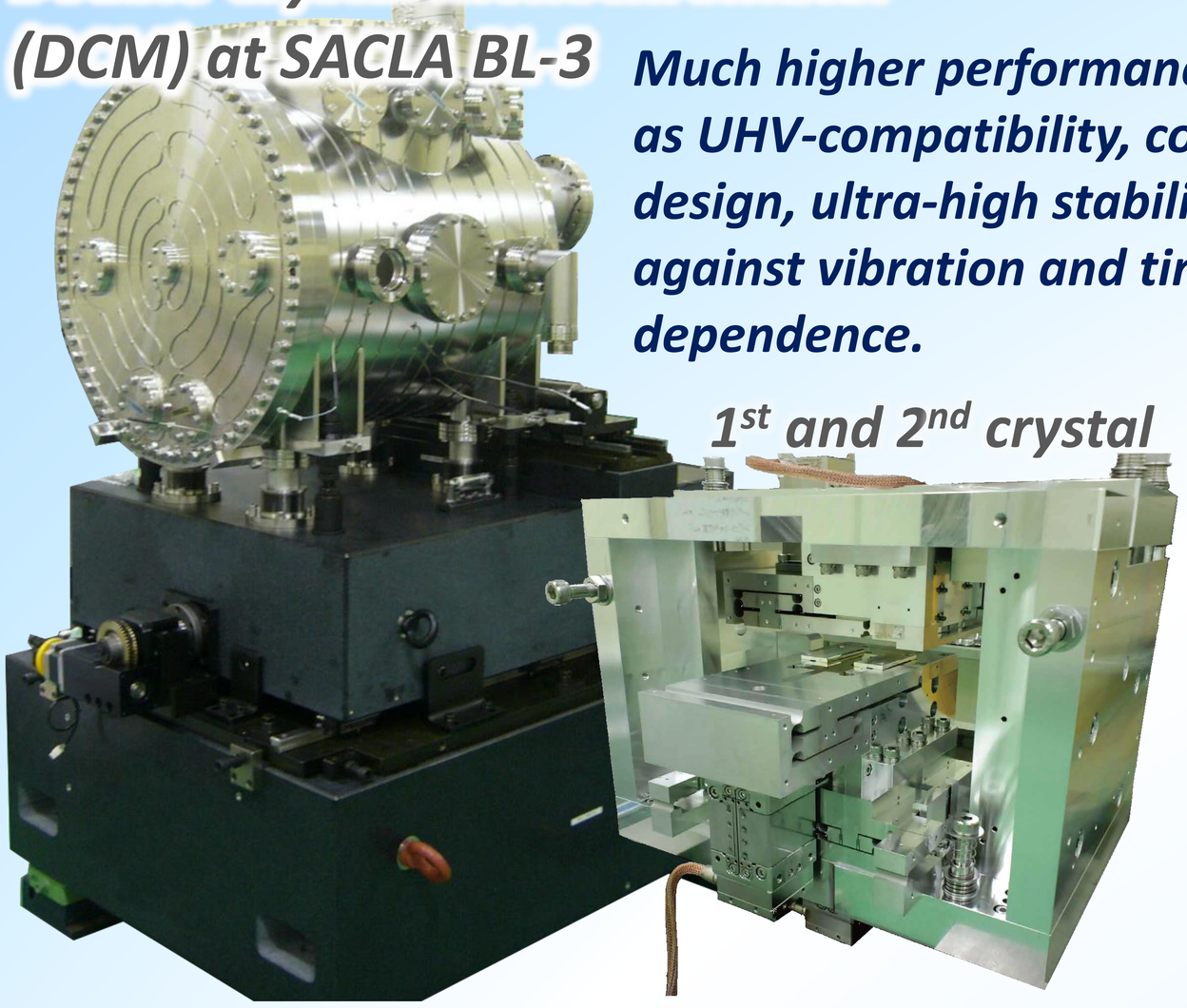
XFEL Beamline Components

Toyama worked with the SACLA (XFEL facility in Japan) project team to develop various beamline components for XFEL, which have been installed in the accelerator and undulator sections of SACLA as well as in the experimental beamline.

Double Crystal Monochromator (DCM) at SACLA BL-3

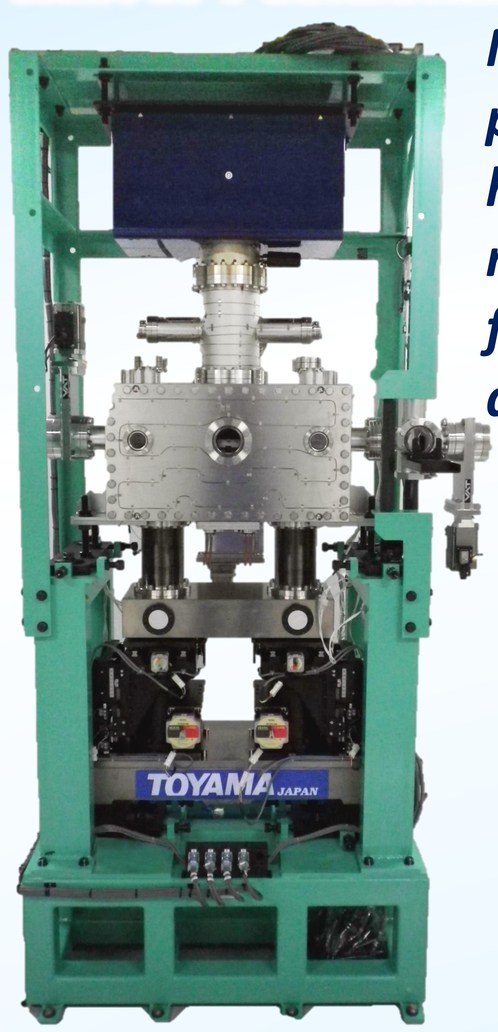
Much higher performance such as UHV-compatibility, compact design, ultra-high stability against vibration and time-dependence.



1st and 2nd crystal

Mirror Positioning System

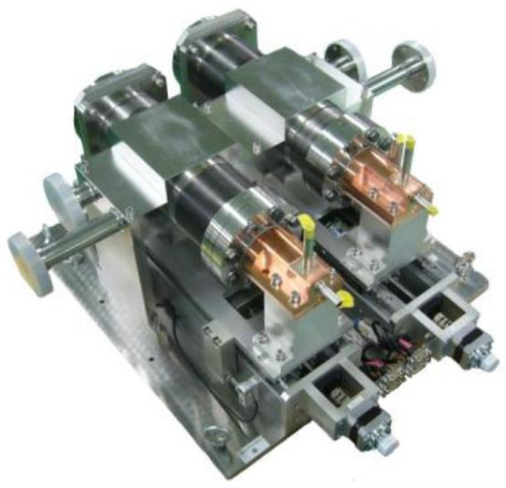
Much more precise positioning and higher stability to realize very sharp focus and excellent alignment for XFEL.



SACLA, Japan

Energy Slit for Chicanes

The slit system acts to cut off the halo element of the electron beam and to remove dark current on the accelerator tubes.



CT-type Beam Current Monitor

A core monitor with four terminal outputs to measure current value of accelerating electron beam.

RF Cavity Beam Position Monitor

<0.2 μm position resolution and 25 fs temporal resolution of the beam arrival time has been measured.

Beam Profile Monitor

For measuring the transverse beam profile. It can measure very small beam sizes down to ~100μm.

Please contact us for more details or special requests.

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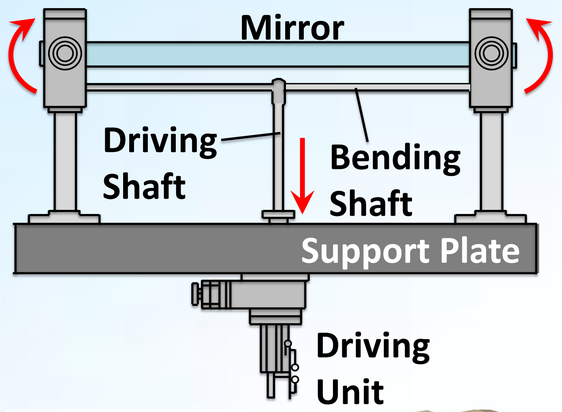
Beamline Components – Mirror Systems

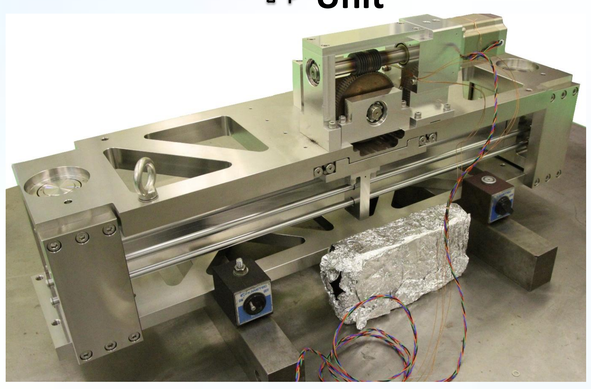
Toyama's mirror systems are all individually customized to suit the requirements of the beamline. Every new system design will be modelled and subjected to finite element analysis in order to optimize stability and minimize unwanted vibration. Thermal modelling can also be used to optimize the cooling arrangement, if required.

Bending systems

Standard Double Bender Mirror System

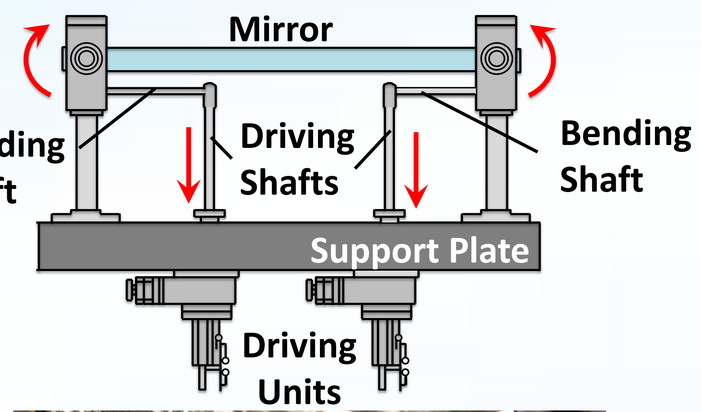
Single Bender (for cylindrical mirror)

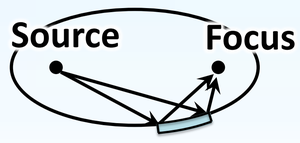


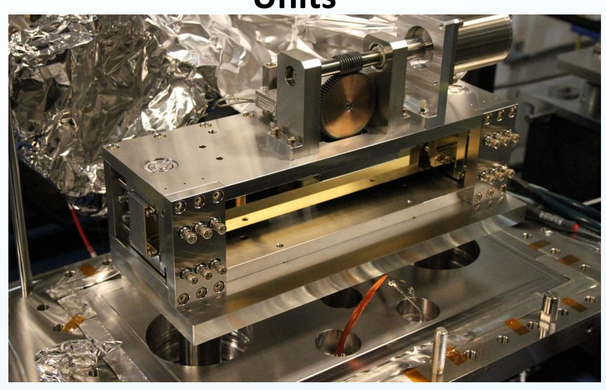


Cylindrical bending system with single actuator bender design.

Double Bender (for ellipsoidal mirror)







UHV single mirror bender for CSX Beamline at NSLS II, USA

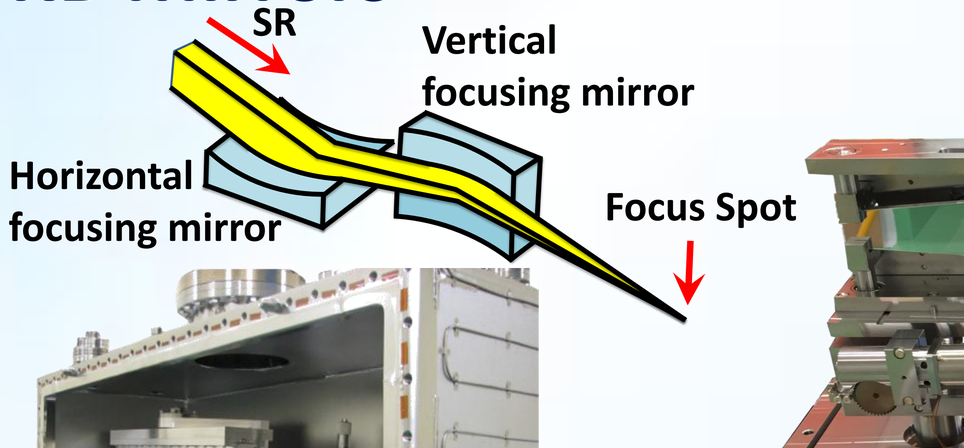
KB Mirrors

Standard KB Mirror System

KB bending mirror system for ISR Beamline at NSLS II, USA

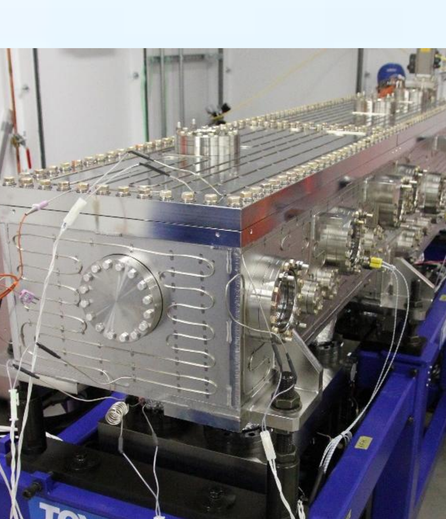
KB mirror system for IXS Beamline at NSLS II, USA

Mirrors with Cooling systems



Liquid nitrogen-cooled mirror system for BL43LXU at SPring-8, Japan

Indirect water cooling system (on the side surface of the mirror)



Flexible water cooling circuits for VESPERS at CLS, Canada

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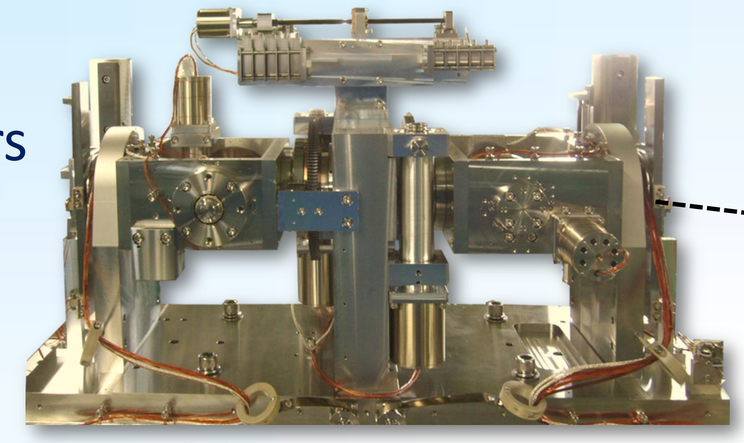
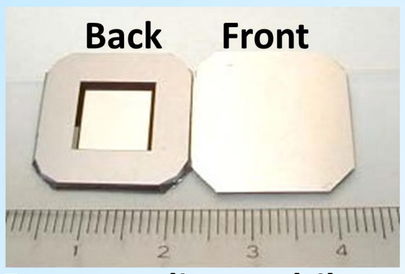
Beamline Components – End stations

Toyama constructs both standard and bespoke soft x-ray end stations. Standard designs include ellipsometrys for polarization analysis of soft x-rays, reflectometers, diffractometers and x-ray scanner systems for x-ray lithography.

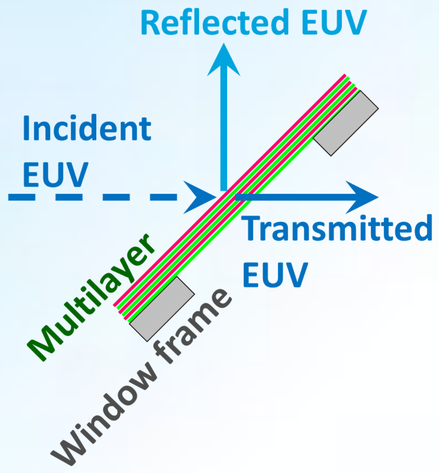
High precision 5-axis EUV Polarimeter

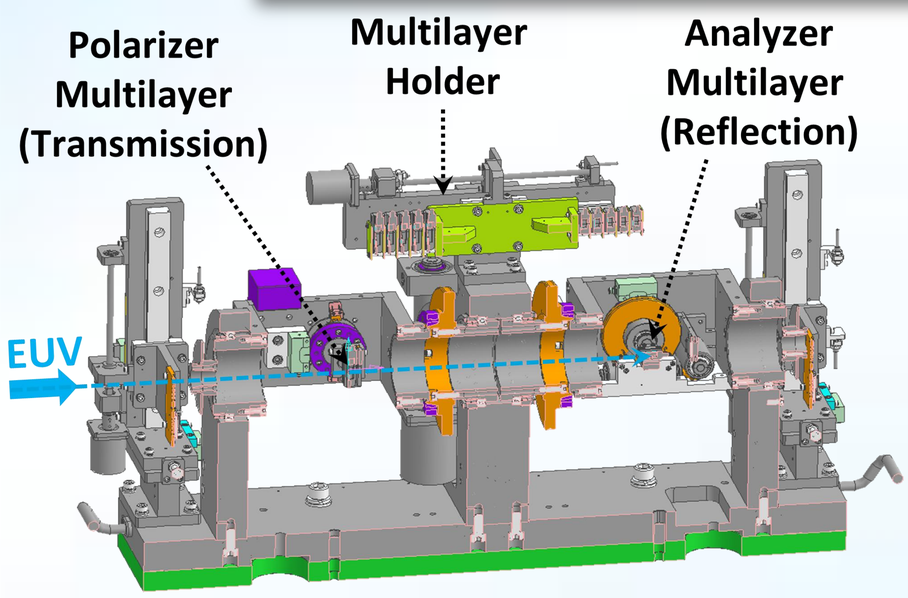
- Wide energy range (100 – 1200 eV).
- Up to 5 sets of trans. and reflect. multilayers can be mounted on the multilayer holder.
- Supported on a hexapod to simplify the alignment.
- Ease of transportation.

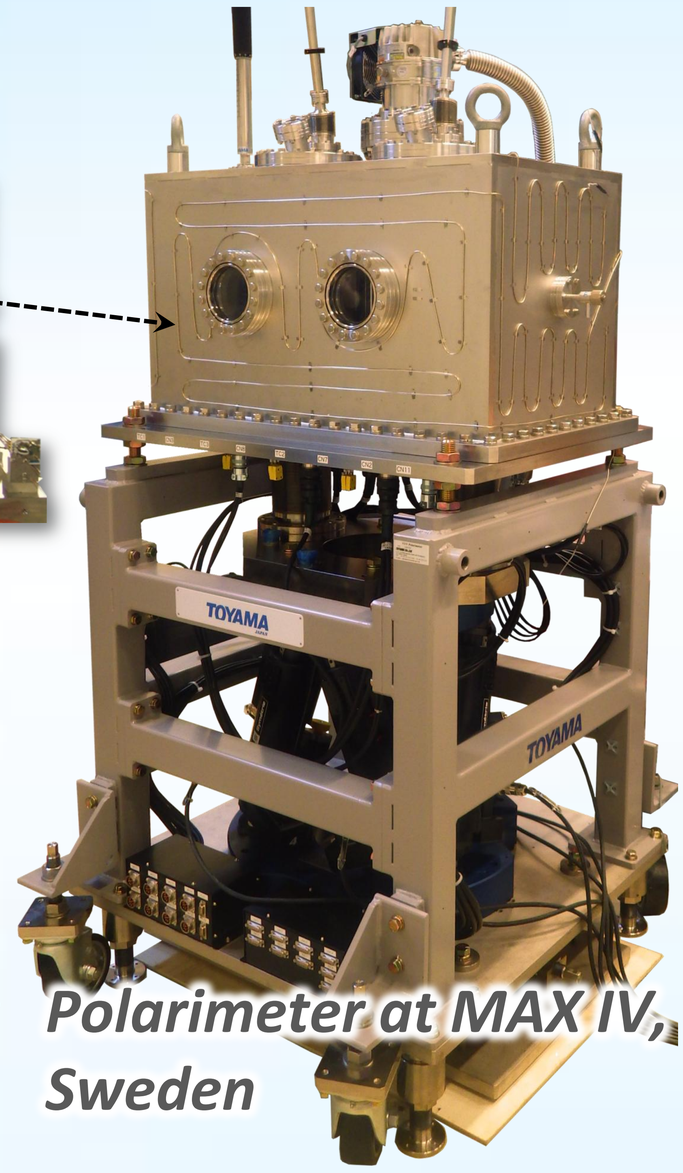




Free-standing multilayer window size : 10 X 10 mm







Polarimeter at MAX IV, Sweden

Soft x-ray Diffractometer

- World performance.
- 2 main rotation circles, theta for the sample and 2 theta for the detector with full range of motion.
- ± 20 mm travel range ⊥ the diffraction plane, ± 5 mm across the plane.
- Polarization analyzer.
- Available of liquid helium cryostat.

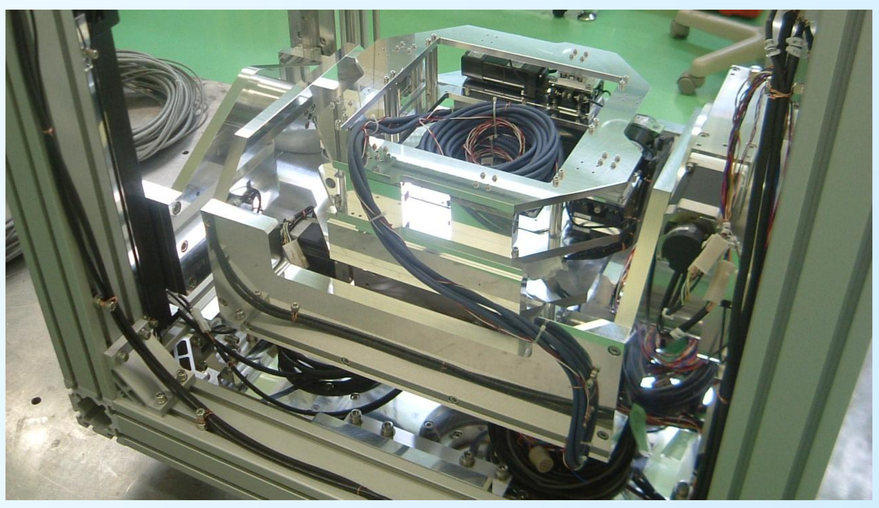
RASOR at Diamond, UK

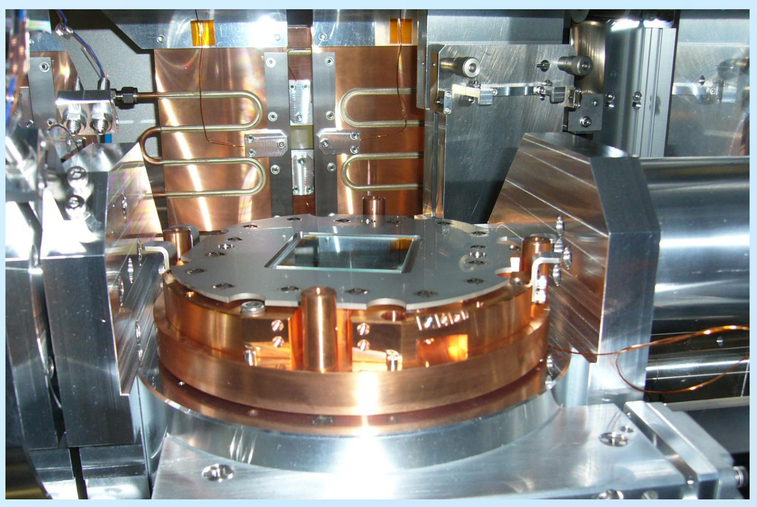
TACoDE at TPS, Taiwan

X-ray scanner for X-ray Lithography

X-ray scanner for BL7 at Indus2, India

To create complex 3D high aspect ratio microstructures, with inclined and conical sidewalls, using the tilt and rotation of the mask and substrate relative to x-ray beam.





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TOYAMA *Pioneering New Horizons in Science*

Cryogenic mirror for a-high-heat-load X-ray beamline at SPring-8

T. Mochizuki[a], K. Akiyama[a], N. Ohtani[a], N. Kamachi[a], K. Endo[a], A. Q.R. Baron[b,c], D. Ishikawa[b,c], H. Uchiyama[b,c], Y. Senba[c], H. Yamazaki[c], T. Takeuchi[c], H. Ohashi[c], and S. Goto[c]

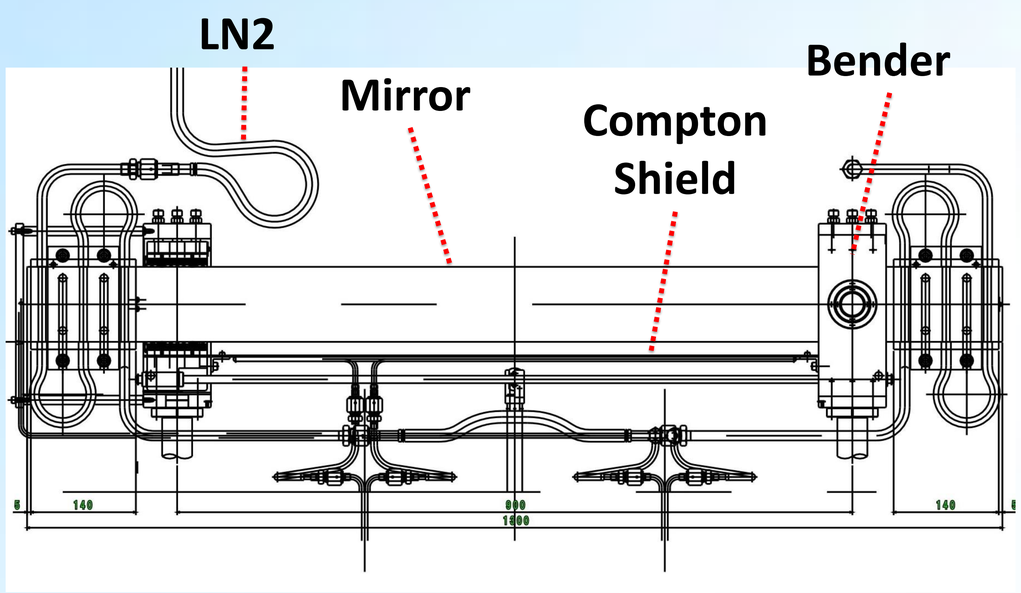
[a]Toyama Co., Ltd.,

[b]Materials Dynamics Laboratory, RIKEN SPring-8 Center,

[c]Japan Synchrotron Radiation **Research Institute, SPring-8/JASRI,**

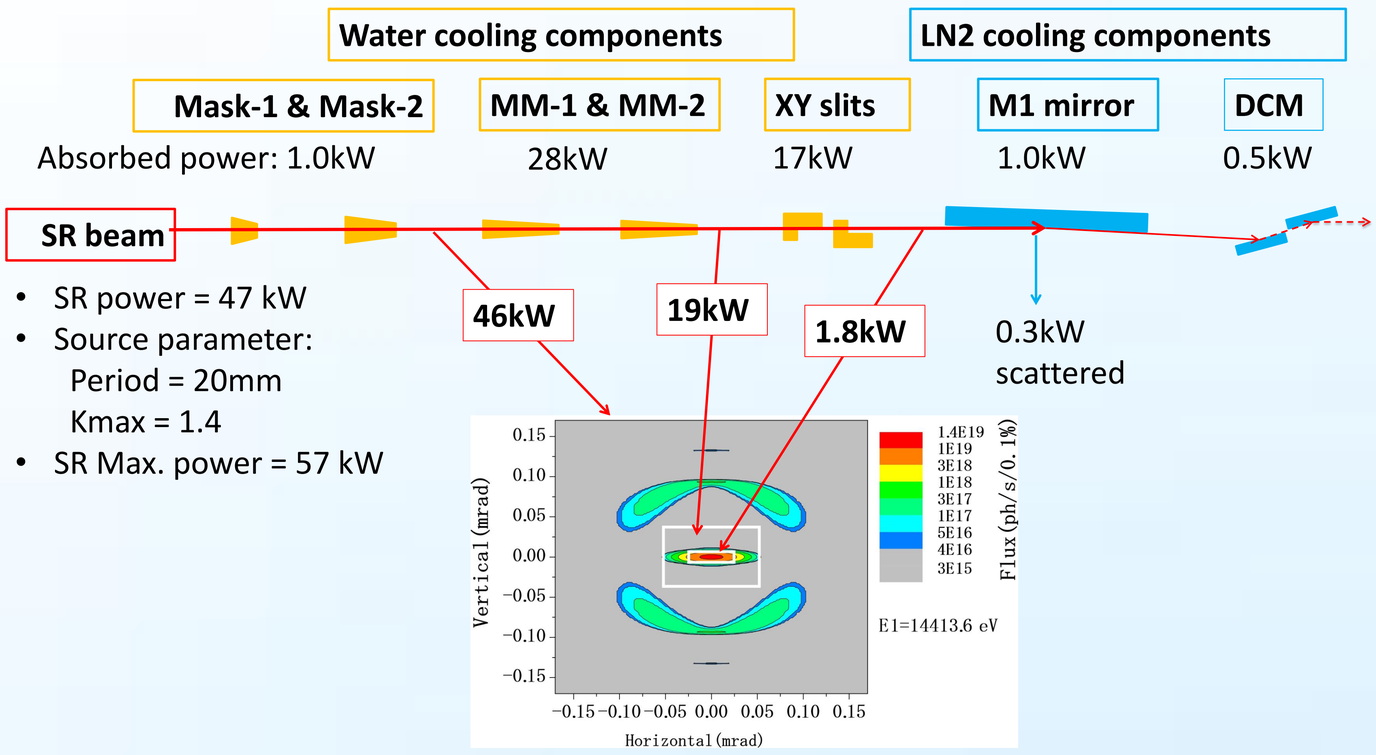
A liquid-nitrogen-cooled (LN) x-ray mirror has been designed and built for the high power loads of a 15 m in-vacuum undulator beamline at SPring-8. It is designed to operate for beam energy of 14 to 25 keV and is vertically deflecting. It was designed as the first mirror to reduce the heat load of the first crystal of DCM. The maximum beam power load to the mirror was estimated to be a max 1.8 kW, and 1 kW absorbed (0.3 kW scattered).

The design of a cryogenic mirror



Heat load management

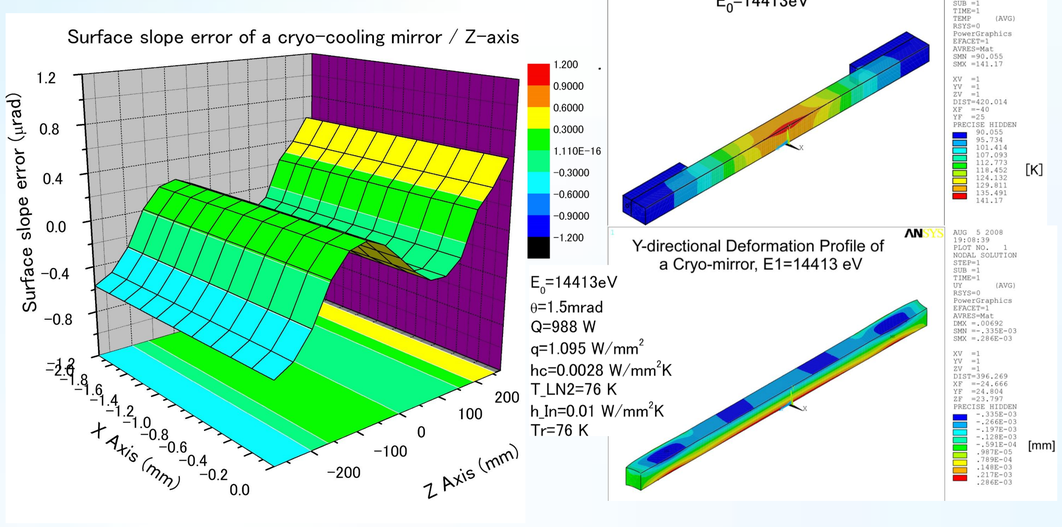
The heat load of the monochromator crystal is reduced to 0.5 kW, which is the design heat load of the standard SPring-8 DCM. The design heat load of 0.5 kW is achieved by aperture defining components and mirror, which are illustrated below.



- SR power = 47 kW
- Source parameter:
  Period = 20mm
  Kmax = 1.4
- SR Max. power = 57 kW

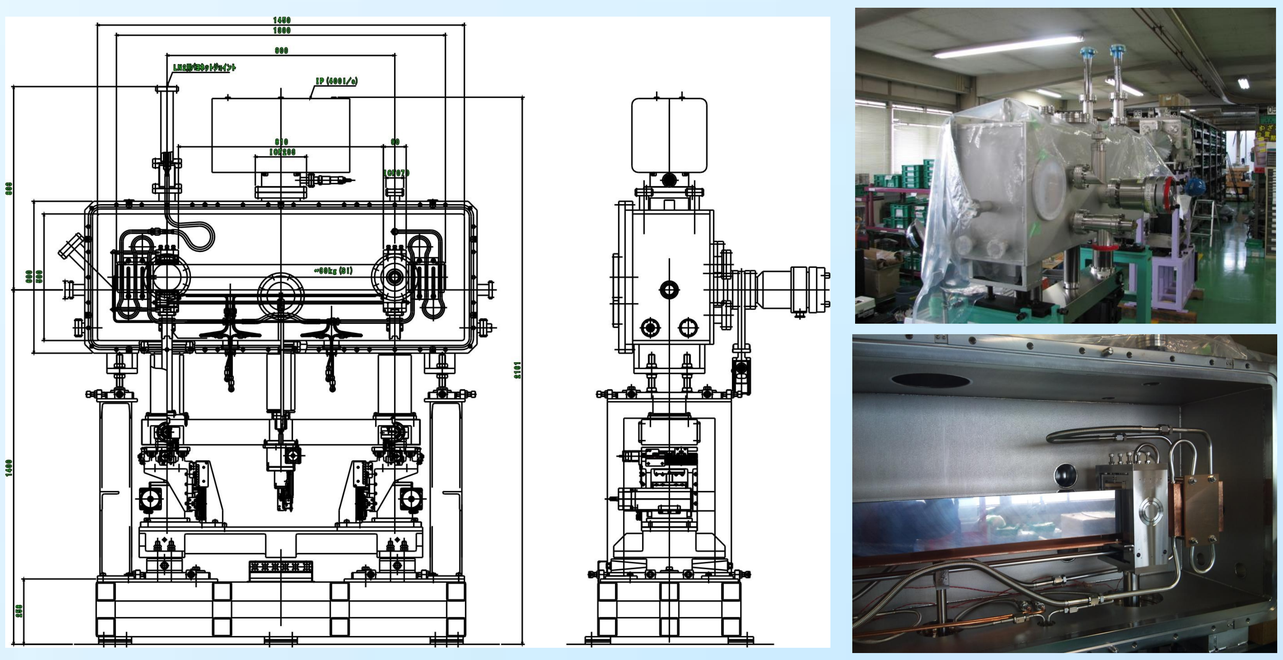
Flux density (ph/s/0.1%)

FEA simulation / half model



Cryogenic mirror at SPring-8 BL43LXU

Toyama has fabricated and installed another two cryogenic mirrors without bender at SPring-8.



The mirror system was installed at SPring-8 BL43LXU (http://user.spring8.or.jp/sp8info/?p=3138) in 2011.

Others

- Mirror foot print: 367 (L) x 2.46 (W) mm
  (@1.5 mrad grazing incidence @ max. power load)
- Absorbed power: 988 W
  (power density: 1.1 W/mm^2).
- Active area: 800 x 20 mm with 1300 mm-length
- This mirror is indirectly cooled by circulating liquid nitrogen and provided with mechanical bender.
- The bender mechanism is used for gravity force compensation mechanism and it is also used to collimate the beam.

Please contact us for more details or special requests.

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