

## BL12B2 NSRRC BM

The BL12B2 beamline is part of the Taiwan X-ray facilities at SPring-8. It is designed to provide atomic-resolution structural probing environment for biostructure and materials researches. Combining various configurations of the beamline optical components, the users can operate the beamline in either white mode, or monochromatic mode with X-ray energies from 5 to 70 keV and an energy resolution  $\Delta E/E \sim 10^{-4}$ . Four experimental stations are attached to the beamline, including X-ray Absorption Spectroscopy (XAS), powder X-ray diffraction (PX), X-ray scattering (XRS) and protein crystallography (PX).

### Area of research

X-ray absorption spectroscopy  
Powder X-ray diffraction  
High resolution X-ray scattering  
Protein crystallography

### Keywords

#### Scientific field

Nano structures, Quantum dots and quantum wells, High pressure EXAFS, Charge density wave, Protein crystallography

#### Equipment

Curved image-plate diffractometer, 6-C Huber diffractometer

### Source and optics

The beamline optical design follows mostly the generic SPring-8 BM beamlines design (Fig.1). The beamline optics consists of three major components: (1) a dual-strip (Rh + Si) collimating mirror (CM) for beam collimation, higher harmonic suppression and thermal load reduction, (2) the standard SPring-8 adjustable-inclined double crystal monochromator (DCM) for photon energy selection in the energy range 5 keV to 70 keV, (3) a toroidal Rh-coated to focus focusing mirror (FM) focusing beam at PX sample

position. The beam spot is measurement  $250 \mu\text{m} \times 250 \mu\text{m}$ , at PX sample position, with  $2 \times 10^{11}$  photons/sec/Si (111) at 12.4 keV.

The beamline can be operated in one of the three operational modes (Fig.2):

- (1) white beam mode
- (2) monochromatic beam in high energy range ( $25 < E < 70$  keV) with high energy resolution ( $\Delta E/E \sim 10^{-4}$ )
- (3) monochromatic beam in medium energy range ( $5 < E < 25$  keV) with high energy resolution ( $\Delta E/E \sim 10^{-4}$ )

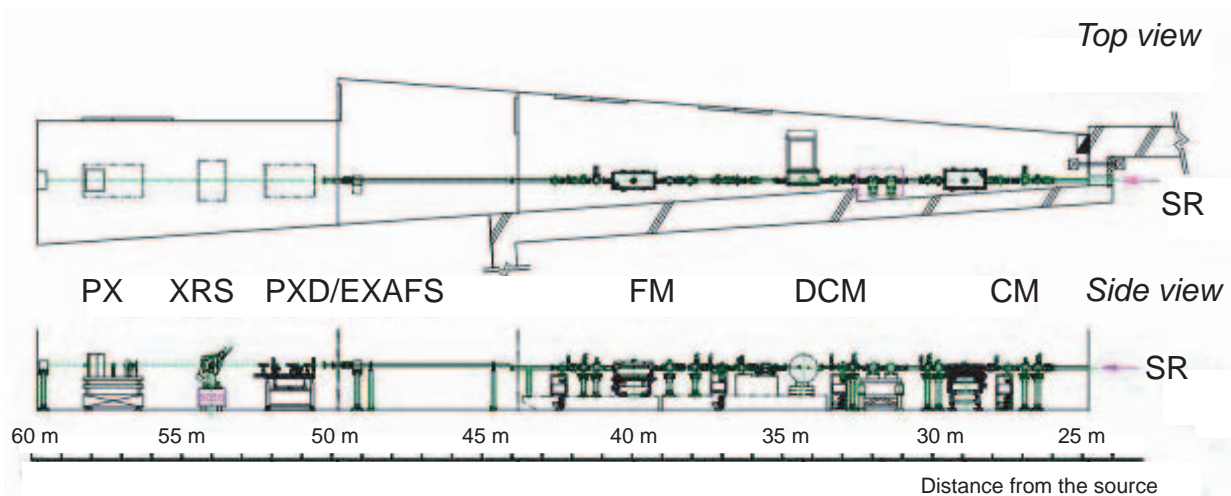


Fig.1. BL12B2 beamline layout

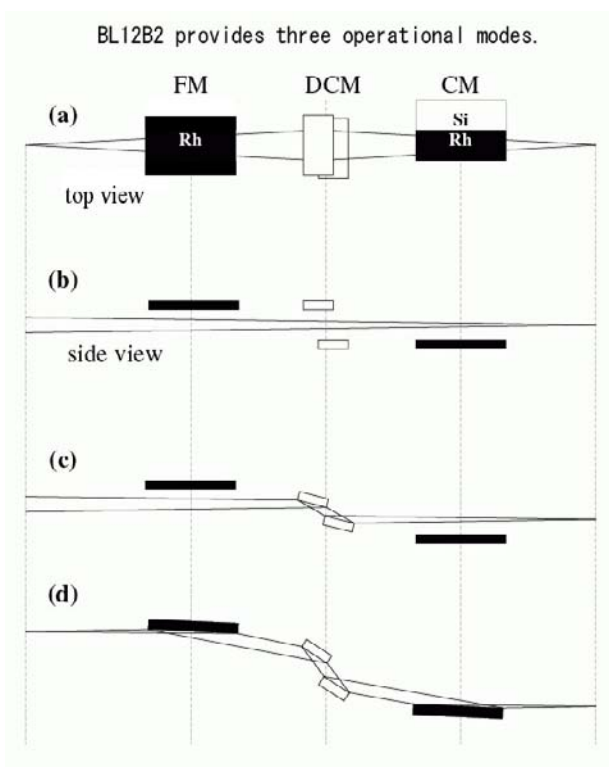


Fig.2. Three BL12B2 operational modes

- (a) top view of BL12B2
- (b) side views for white mode (5 ~ 90 keV)
- (c) high energy mono-mode (25 < E < 70 keV)
- (d) medium energy mono-mode (5 < E < 25 keV)

### X-rays at sample

White beam

Energy range 5 ~ 90 keV

Monochromatic beam

Energy range 5 ~ 70 keV

Energy resolution  $\Delta E/E = 10^{-4}$

Photon flux  $10^{10} \sim 10^{12}$  ph/sec

Beam size  $0.25$  (v)  $\times$   $0.25$  (H)  $\text{mm}^2$  at PX

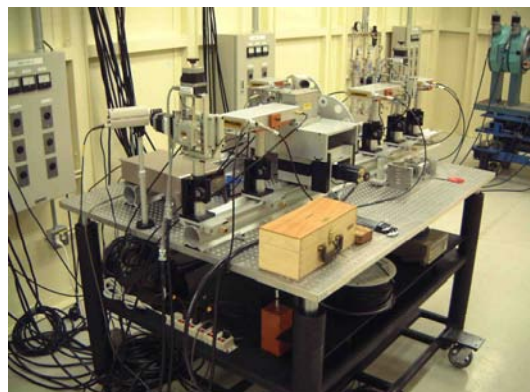
### Experimental stations

There are four experimental stations attached to the beamline, namely, the X-ray absorption spectroscopy (XAS), the powder X-ray diffraction (PX), the X-ray scattering (XRS) and the protein crystallography (PX). The constructions of the stations were in sequence completed in February 2001 (for XAS, PXD and XRS) and in September 2002 ( for PX ). Figure shows the end stations at BL12B2

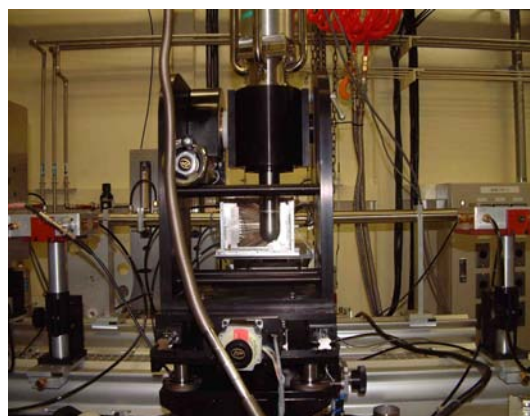
### X-ray absorption spectroscopy (XAS)

The XAS end station provides transmission type as well as fluorescence type measurements. It is equipped with ionization chambers, Ge (Li) solid state detector and Lytle detector.

Equipping with a cryostat, the user can perform low temperature EXAFS down to 7 K. Experiments carried out at the station include, high  $T_C$  superconductors, bimetallic nano-particles in micro emulsion and in mesoporous molecular sieves, nano-particles under high pressure phase transition, dilute environmental metallic contamination, etc.



The transmission type EXAFS stage



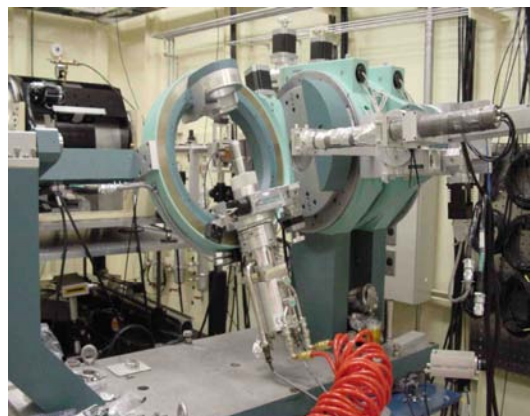
EXAFS stage equipped with Lytle detector and cryostat

### Powder X-ray diffraction (PX)

The powder X-ray diffraction can be carried out at the beamline either using a conventional Huber 6-circle diffractometer or an image plate setup (Mac Science DIPR-420). A pre-curve image plate stage provides two-dimensional PXD measurement with two-theta angle larger than  $110^\circ$ . When equipped with a cryostat, one can conduct low temperature PXD at the station. A charge density study of the Fe-phen spin crossover complex has specifically been carried out to test the performance of setups. A feasibility study of high pressure powder X-ray scattering was also conducted at the pressure around 30 GPa using diamond anvil cell.



Curved image plate stage for PXD



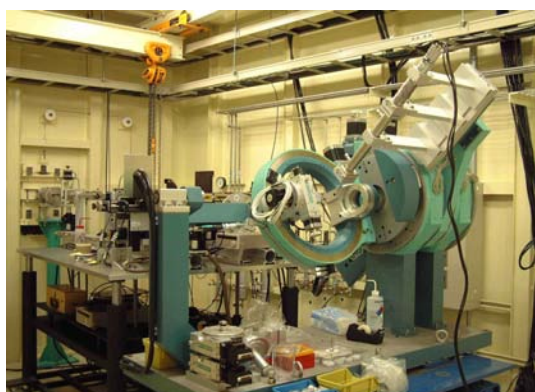
6-C diffractometer equipped with a cryostat for low temperature measurement



Mac Science image plate reader (DIPR 420)

### X-ray scattering (XRS)

The conventional as well as surface X-ray scattering experiments can be done at the beamline at a 6-C Huber diffractometer. Studies, including the magnetic thin films, semiconductor quantum wells, charge density waves, semiconductor quantum dots, confined bimetallic quantum wires, etc., have been carried out at the station recently.



The Huber conventional 6-C diffractometer for XRS

### Protein crystallography (PX)

The protein crystallography end station is a collaborative project between SPring-8 and NSRRC. It is equipped with an ADSC Quantum 4R CCD detector and a high-speed data network system. The station was opened to users since September 2002. A supporting team was formed to provide users on-site experimental support and advises. Information for doing protein crystallography experiments at SP12B can be found by logging up to web page <http://biosrrc.nsrcc.org.tw>.

#### Detecting system

- Gas-filled ionization chambers
- Lytle detector
- Scintillation counters
- Ge solid-state detector
- ADSC Quantum 4R CCD detector
- Image plate
- AMPTEK x-ray detectors for MAD

#### Sample manipulation

- Cryostat (6K) with precise carrier
- Polarization chamber

#### Control

- SPEC on PC Linux for beamline and end station control
- Three SGI dual-CPU Octane2 workstations and one terabytes storage disk array



The ADSC Quantum 4R CCD detector for PX



The SGI-SAN architecture computer system for PX

---

### Contact information

---

**Mau-Tsu Tang** (Beamline spokesperson)

Beamline Division

National Synchrotron Radiation Research Center

101 Hsin-Ann Road, Hsinchu Science-Park

Hsinchu 30077, Taiwan

Phone : +886-(0)3-5780281 ext. 7107

Fax : +886-(0)3-5783892

e-mail : [mautsu@nsrc.org.tw](mailto:mautsu@nsrc.org.tw) and [mautsu@spring8.or.jp](mailto:mautsu@spring8.or.jp)

**Jey-Jau Lee** ( Beamline deputy and local contact )

Taiwan Beamline Office

1-1-1 Kouto, Mikazuki-cho, Sayo-gun, Hyogo 679-5148,

Japan

Phone : +81-(0)791-58-1867

Fax : +81-(0)791-58-1868

e-mail : [jjlee@spring8.or.jp](mailto:jjlee@spring8.or.jp)