Accelerator Beam Diagnostic Line

BL38B2 Accelerator Beam Diagnosis

The accelerator diagnostics beamline I (BL38B2) has a bending magnet light source, and wide band spectral availability including visible/UV light, and soft and hard X-rays has been achieved. The visible synchrotron light is used for diagnostics of longitudinal properties of the source electron beam, such as bunch length and single bunch impurity. Bunch length is measured by a streak camera, and single bunch impurity is measured by a gated photon counting method. For diagnostics of transverse emittance of the electron beam, a single Fresnel zone plate and an X-ray zooming tube are used to image the X-ray synchrotron radiation from a dipole magnet source. Monochromatic X-ray is selected by a double crystal monochromator. Synchrotron radiation experiments on accelerator components such as photon absorbers, and study of production of γ-ray photons by Laser backward Compton scattering with energies of the order of 10 MeV are also in progress.

Area of research

Accelerator beam diagnostics
R&D of accelerator components
Production of MeV γ-ray photons

Keywords

Scientific field

Emittance, Bunch impurity, Bunch length, Backward Compton scattering

Equipment

Monochromator, Zone plate, X-ray zooming tube, Photon counting, Streak camera, Laser

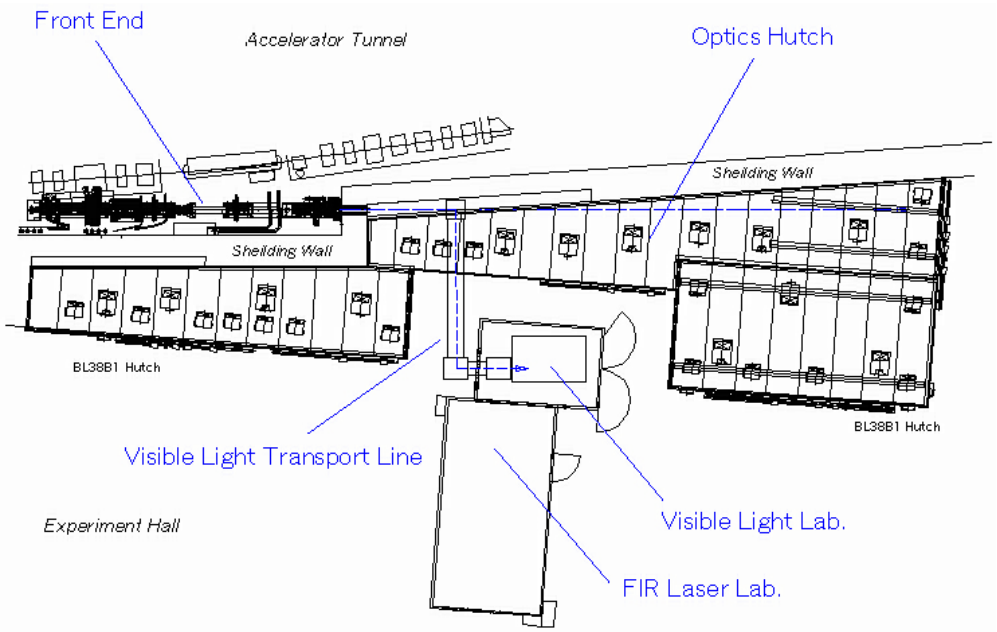
Source and optics

Light source

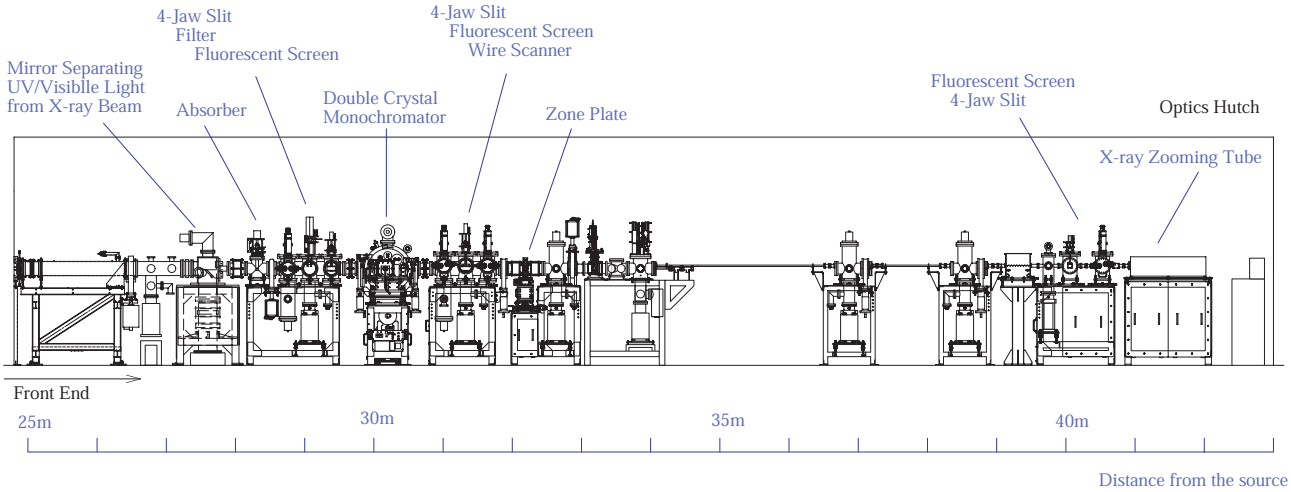
Type	Bending magnet
Critical energy	28.9 keV
Horizontal beam divergence	3.6 mrad

Optics

Mirror separating UV/ Visible light
Double crystal monochromator
Fresnel zone plate



Schematic view of beamline



X-rays at sample

Energy range:

White radiation

4.0 ~ 14.2 keV (Monochromatic radiation)

Energy resolution:

$\Delta E/E \sim 10^{-4}$ (Monochromatic radiation)

Photon flux:

$10^{10} \sim 10^{12}$ ph/s (Monochromatic radiation)

Experimental stations

Optics hutch

The double crystal monochromator covers the energy range of 4 to 14 keV by Silicon 111 reflection. When white X-ray radiation is used, the monochromator crystals and their mechanisms can be removed off the photon beam axis in the monochromator vacuum chamber. The X-ray transport channel as well as the front end has no Be windows, which obstructs soft X-ray and visible/UV light and potentially could distort wavefront of synchrotron radiation. Therefore, all the components of the X-ray transport channel are in vacuum chambers under UHV pressure.

To measure precisely the small vertical size of the storage ring electron beam, X-ray imaging observation of the electron beam is in progress. The synchrotron radiation from a dipole magnet source is imaged by a single Fresnel zone plate after passing through the monochromator. The magnification factor of the zone plate is about 0.3, and an X-ray zooming tube is used as a detector to compensate for demagnification.

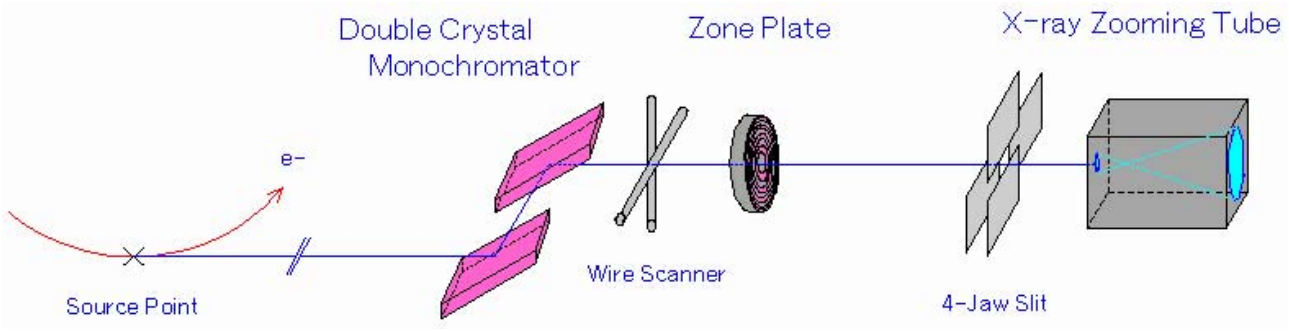
The X-ray transport channel has been designed so that it can be used not only for beam diagnostics but also for synchrotron radiation experiments on accelerator components. For example, study of effects of synchrotron radiation to cooling water in vacuum chamber components such as photon absorbers is in progress.

Visible light laboratory

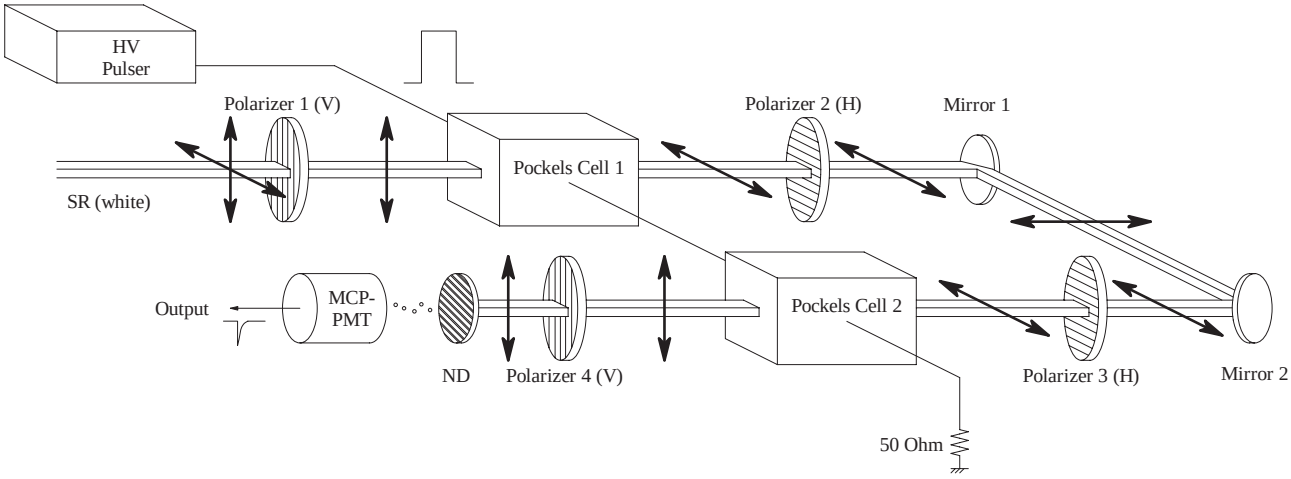
The visible and UV synchrotron light is separated from the X-ray photon beam by an in-vacuum mirror installed in the optics hutch and is transported in the bent shielded pipe to the visible light laboratory on the experiment hall. The visible light is used for diagnostics of longitudinal properties of the storage ring beam, such as bunch length and single bunch impurity. Bunch length is measured by a streak camera. Single bunch impurity is measured by a gated photon counting method that utilizes fast Pockels cells for switching light pulses. To improve the extinction ratio or isolation of the light shutter, the optical system uses two Pockels cells arranged in tandem.

FIR laser laboratory

Study of production of γ-ray photons with energies of the order of 10 MeV is in progress, which utilizes backward Compton scattering of far infrared (FIR) laser photons injected to the storage ring.



Optical system of the beam profile monitor based on a zone plate



Gated photon counting system for bunch impurity measurement

Contact information

Shiro TAKANO
SPring-8/JASRI
1-1-1 Kouto, Mikazuki, Hyogo 679-5198
Phone : +81-(0)791-58-0851
Fax : +81-(0)791-58-0850
e-mail : takano@spring8.or.jp