

HRVUV Beamline, Indus-1 SRS

A High Resolution Vacuum Ultraviolet (HRVUV) beamline has been set up at Indus-1 for photoabsorption studies of atoms and molecules in the wavelength region of 1050-3000 Å (3.5-11.8 eV). The beamline consists of three major components: a pre-focusing optical system, a gas phase absorption setup and a 6.65 m vacuum ultraviolet spectrometer in off-plane Eagle mount. The performance of the beamline has been evaluated by recording VUV absorption spectra of Xenon, Oxygen and Sulphur dioxide using synchrotron radiation from Indus-1. The resolution achieved is ~ 0.1 Å with a 1200 ln/mm grating. The beamline has been commissioned and is in operation since June 2010.

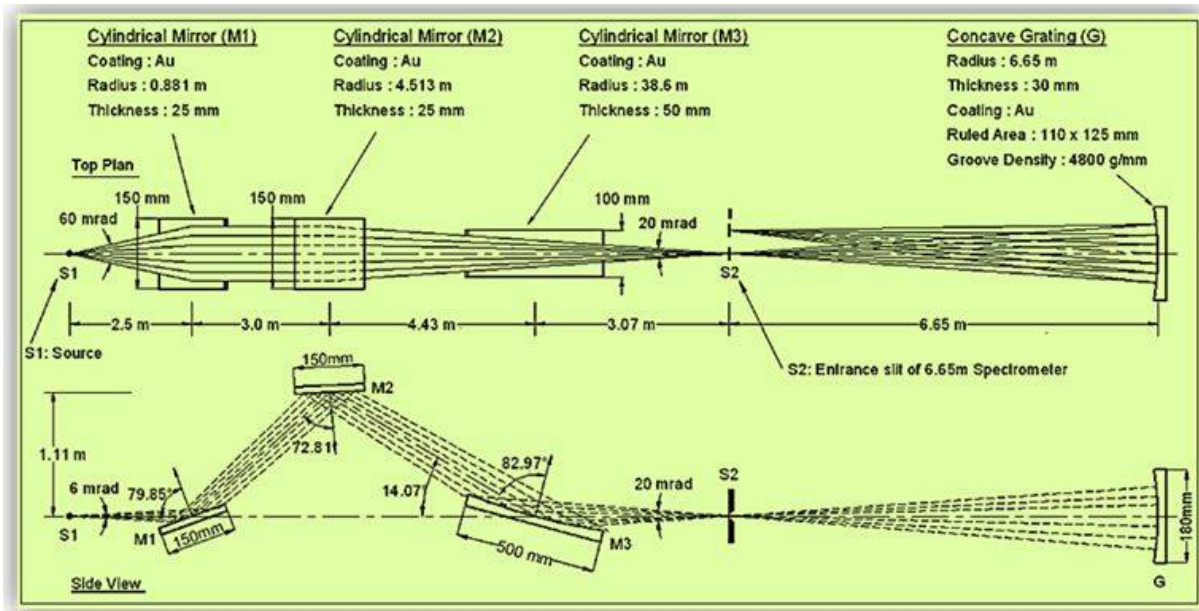


Fig. 1: Schematic Optical layout of HRVUV beamline

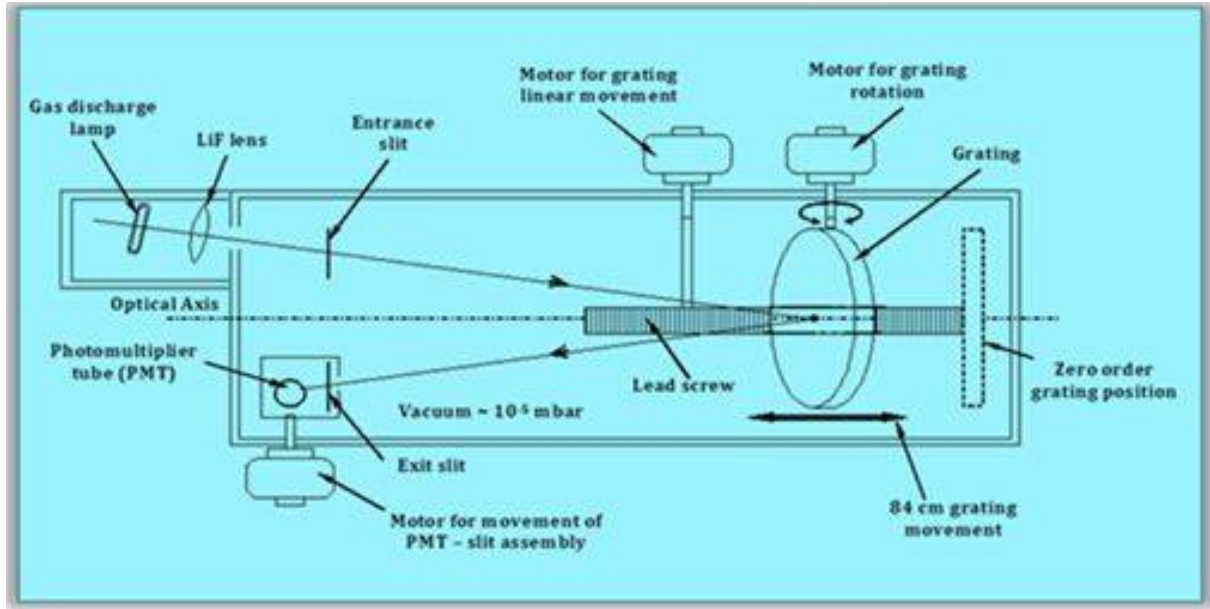


Fig. 2: Schematic of 6.65m off-plane Eagle mount spectrometer

- Range: 1050-3000 Å
- Resolution: 0.1 Å (1200gr/mm)
- Resolving Power: 15000
- Photon flux: 10^8 - 10^9 ph/s

The optical layout of the beamline is illustrated in Fig.1. The choice of the pre-dispersing optical system is such that it maximizes the throughput in the VUV region and effectively matches the source aperture to the spectrometer aperture within constraints imposed by the source, space availability and cost. The vertical and horizontal acceptance angles of the beamline are 6 and 60 mrad respectively. The designed acceptance angles of the spectrometer for the entrance beam are 20 mrad \times 20 mrad. It is therefore necessary to expand the SR beam by a factor \sim 3.3 in the vertical direction and compress by a factor 3 in the horizontal direction to ensure full illumination of the grating aperture. This is achieved by the focusing system consisting of three concave cylindrical mirrors (M1, M2 and M3) as shown in Fig.2. The parameters of these mirrors are given in Table-1.

Table 1: Parameters of Mirrors

Cylindrical mirror	Dimensions in mm	Radius of curvature	Focal length f	Angle of incidence (θ)	Reflective Coating
M1	150 \times 150 \times 25	0.881 m	2.7 m	79.85°	Gold
M2	150 \times 150 \times 25	4.513 m	7.6 m	72.81°	Gold
M3	100 \times 500 \times 50	38.6 m	3.07 m	82.97°	Gold

A schematic diagram of the optical arrangement of the spectrometer is shown in Fig.2. The spectrometer is based on off-plane Eagle mounting utilizing a concave spherical grating of radius of curvature 6.65 m. The parameters of the two gratings used in the spectrometer are given in Table-2. For selecting a particular wavelength, the grating is rotated about the horizontal axis passing through its pole and parallel to the entrance and exit slits. It is then translated along the axis of the spectrometer in order to focus the dispersed wavelength on the Rowland circle. The spectrum is scanned by moving the exit slit and photomultiplier (PMT) assembly vertically along the focal plane. The linear and rotational motion of the grating and the linear motion of PMT are controlled by a 3-axis stepper motor controller and driver system. We use sodium salicylate coated quartz window mounted at the exit slit of the spectrometer to convert the VUV radiation into visible radiation, which is then detected by a PMT.

Table 2: Parameters of Gratings

Ruling	4800 ln/mm	1200 ln/mm
Coating	Gold	Al + MgF ₂
Diameter of blank	180 mm	210 mm
Ruled area	125 mm × 110 mm	125 mm × 110 mm
Blaze angle	13° 52'	5°10'
Blaze wavelength	1000 Å	1500 Å
Linear dispersion	0.3 Å/mm	1.24 Å/mm
Wavelength coverage	500-2000 Å	1150-6000 Å
PMT Scanning Range	50 Å	200 Å

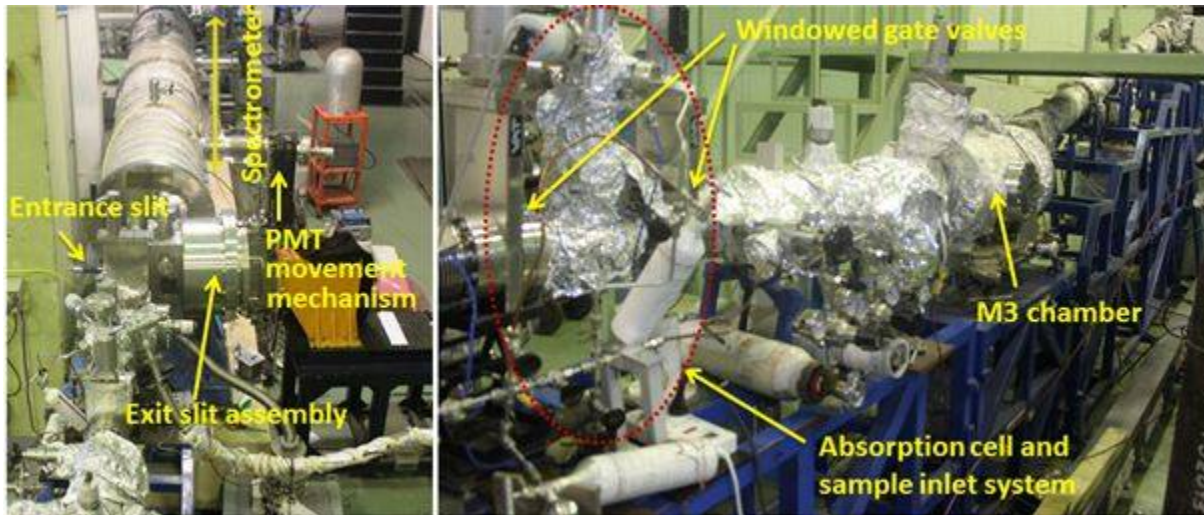


Fig. 3: Photograph of HRVUV beamline showing 6.65 spectrometer, fore-optics and absorption cell

Facilities at Experimental Station

1. Gas Phase Absorption Cell

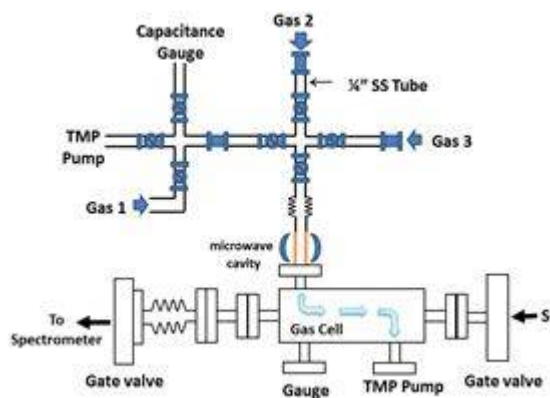


Fig. 4: Schematic of photoabsorption setup

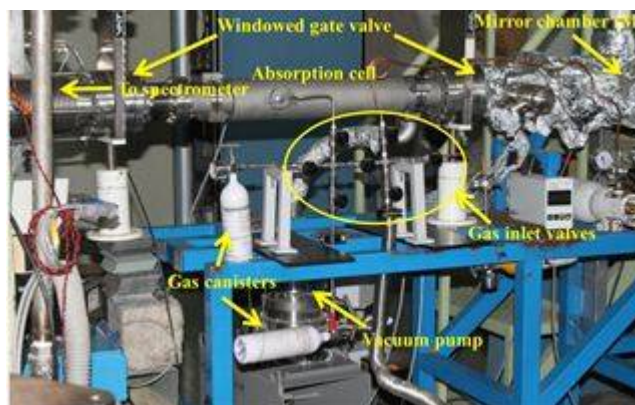
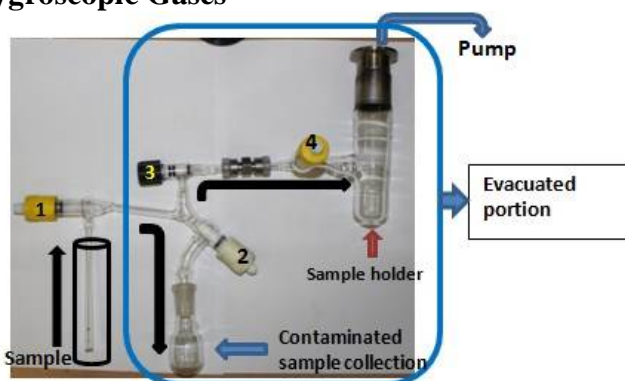
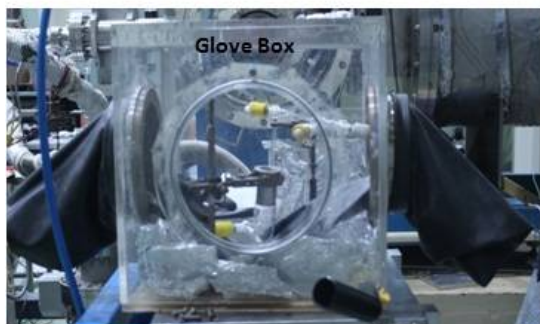


Fig. 5: Gas phase absorption cell

2. Sample Handling System for Toxic/Hygroscopic Gases



3. Absorption Cell for recording VUV spectrum of solid samples in vapor phase

