A.2: Design and development of X-ray diagnostic beamline at Indus-2 and initial measurement results

Beamline BL-24 at 10° port of bending magnet (DP-10) of Indus-2 storage ring has been designed, developed and installed as X-ray diagnostic beamline (X-DBL) by BDS/ACBDD, RRCAT. The beamline (BL) front-end has been installed by ISUD, RRCAT. This beamline is intended for measurement of transverse beam parameters such as size, emittance, position etc. Initial measurements for beam size, beam emittance and beam stability have been taken during trial operation of X-DBL.

In X-DBL, standard front-end components include collimator, water cooled shutter, gate valves, fast shutter, safety shutter, delay line chamber, Beryllium window etc. Other specific beamline components are wire beam profile monitor (WBPM), pinhole array and staggered pair blade monitor (SPM) assembly, metal filter assembly, phosphor screen assembly, imaging optics and detectors. The schematic layout of X-DBL and some photographs of installed beamline components are shown in Fig. A.2.1 and Fig. A.2.2.

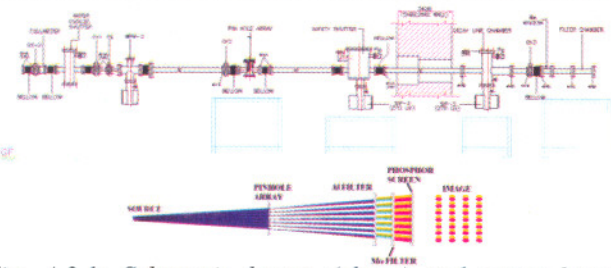

Fig. A.2.1: Schematic layout (above) and optics layout (below) for X-DBL at Indus-2.

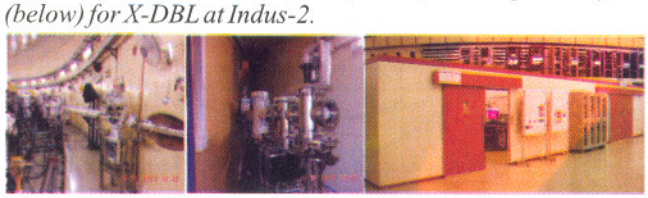

Fig. A.2.2: Some photographs of installed components at X-DBL; beamline portion inside Indus-2 tunnel (left), beamline portion inside radiation shielded hutch (middle) and beamline hutch in the experimental hall (right).

X-DBL is primarily based on pinhole array imaging. A Tungsten pinhole array with 17 (H) X 21 (V) pinholes of 20 μm diameter each is designed for imaging of Indus-2 electron beam. It is placed at 8 m from the source point, and its imaging is carried out at a phosphor screen (P-43 Gd_2O_2S: Tb, 360-680 nm, peak at 545 nm) with magnification factor of 1.222. Wire-BPM system with Tungsten wire (100 μm diameter) is developed to find the position and profile of synchrotron radiation before the pinhole array. Energy selection of synchrotron light is carried out using metal filter assembly. In this assembly metal filters (Al and Mo) of different thickness (6.5 μm - 50 μm) are remotely controlled to provide nine set of filter combinations for energy selection. Phosphor screen converts x-ray to visible light for measurements with a CCD camera having remote controlled zoom optics.

For integration of all beamline components and their respective operations a LabView based graphical user interface (GUI) has been developed. It continuously monitors pressure and temperature parameters of various beamline components and displays online position of wire BPM and SPM. Pinhole array images on P-43 phosphor screen are captured and processed online for measurments of beam position, beam size and beam emittance at a rate of 1 Hz. Measured results are also displayed online on the GUI as shown in Fig. A.2.3.

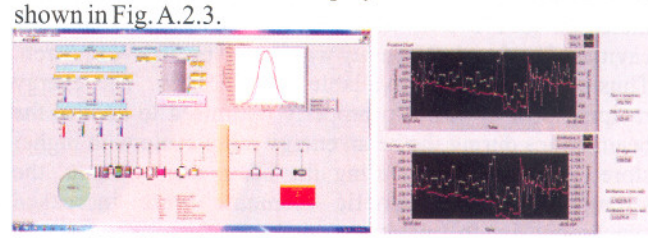

Fig. A.2.3: Snapshot of GUIs developed for beamline control (left), and for online measurement of beam parameters at X-DBL (right).

Photograph of pinhole array image captured in X-DBL and measured intensity profile across marked column is shown in Fig. A.2.4. Typical measured beam size (RMS) is 460 μm horizontal and 150 μm vertical, and correspondingly typical measured emittance is 190 nm rad horizontal and 3.5 nm rad vertical at 61 mA beam current (vertical dispersion assumed to be zero). Measurment plots for five hours data at 1 Hz are shown in Fig. A.2.5.

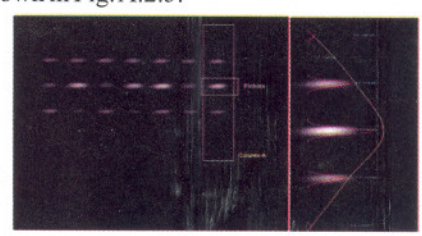

Fig. A.2.4 : Photograph of pinhole array image captured in X-DBL and measured intensity profile across column-A in the pinhole array image.

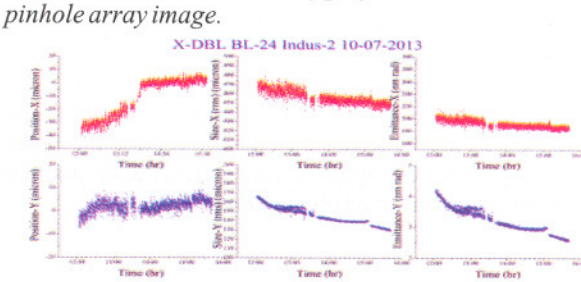

Fig.A.2.5: Typical plots for measured data of beam position, beam size and beam emittance for five hours at a rate of 1Hz.

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