A.1: Operational improvements in Indus-2

Synchrotron radiation source Indus-2 is regularly being operated with 100 mA beam current at 2 GeV beam energy in round the clock mode. The exercise of orbit correction was pursued further to reduce closed orbit distortion (COD). It is necessary to correct the COD, when a large number of beamlines are to be simultaneously operated. In order to improve the sensitivities of beam position indicators (BPIs), old cables connecting the BPIs to their respective instrument racks were replaced with low-loss cables. With this, 51 BPIs are now available for COD measurements. Using these BPIs and steering magnets well distributed all over the circumference, orbit correction trials were made.

The BPIs and steering magnets available in one unit cell of Indus-2 for COD correction are shown in Fig. A.1.1. It has seven BPIs, six horizontal steering magnets and five vertical steering magnets. With 8 numbers of such unit cells in Indus-2, there are 48 horizontal steering magnets, 40 vertical steering magnets and 56 BPIs distributed all over the ring. Out of 56 BPIs, 51 of them were used in orbit correction trials as the remaining five are not yet fully operational. During the horizontal COD correction, RF frequency was also optimized.

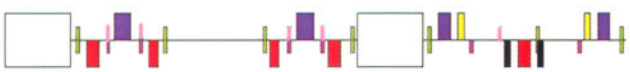

Fig.A.1.1: One unit cell of Indus-2 : empty rectangles - dipoles; blue-focussing quadrupoles; red- defocussing quadrupoles; yellow-focussing sextupoles; black-defocussing sextupoles; green- BPIs ; magenta- horizontal steering magnets and pink- vertical steering magnets.

An interactive global COD correction software has been developed in MATLAB. It requires the beam position data and response matrix of the Indus-2 for calculations of required optimal steering magnet strengths for COD correction. It generates the Indus-2 response matrix in horizontal and vertical planes. A singular value decomposition method has been used for the COD correction. Using this software, the rms COD in horizontal plane was brought down from 4.6 mm to 1.1 mm at injection energy (550 MeV) and from 4.5 mm to 0.9 mm at 2 GeV. Similarly, in vertical plane, the rms COD was reduced from 1.7 mm to 0.5 mm at injection energy and from 2.8 mm to 0.5 mm at 2 GeV. For this, 48 horizontal and 40 vertical steering magnets were used. The beam position data obtained from 51 BPIs were considered. The horizontal COD was further reduced to 0.9 mm at the injection energy and 0.6 mm at 2 GeV beam energy on reducing the RF frequency by 5 kHz. The horizontal COD before and after correction at the BPI locations at 2 GeV is shown in Fig. A.1.2. In vertical plane, the COD before and after correction are shown in Fig. A.1.3. With this corrected orbit, photon beam was provided to BL-7(X-ray lithography), BL-8(EXAFS), BL-11(EDXRD), BL-12(ADXRD), BL-14(XPES) and BL-16 (XRF- microprobe) beamlines.

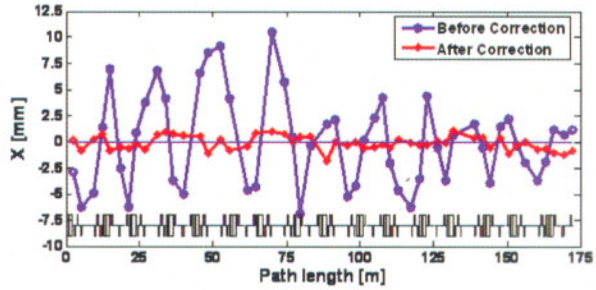

Fig.A.1.2: The horizontal COD before and after correction at 2 GeV.

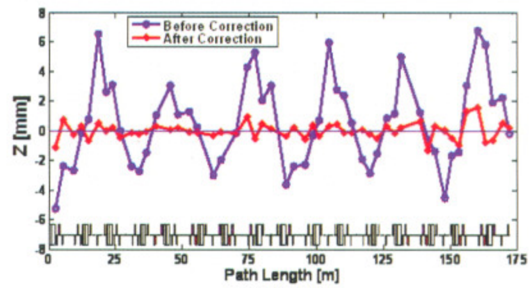

Fig. A.1.3: The vertical COD before and after correction at 2 GeV.

With COD correction and some improvement in the vacuum, the beam lifetime at 2 GeV, 100 mA has improved to 14 hours.

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A.2: Study of soft x-ray optical response of Indium Phosphide using Indus-1 Reflectivity Beamline

The response of a given material to an incident electromagnetic wave in extreme ultraviolet (EUV)/soft x-ray region is described by the energy dependent refractive index $n=1-\delta+i\beta$, where δ (dispersion) and β (absorption) are known as optical constants. Knowledge of these two parameters is essential to predict the response of medium to an electromagnetic wave as well as interpretation of experimental results. Various techniques can be used to determine the δ and β, such as transmission, photoemission and angle dependent reflection etc.

Angle dependent reflectivity technique provides information of optical constants. This method has an