A.1: Full energy operation of Indus-2

Indus-2 is a 2.5 GeV storage ring, which generates synchrotron radiation of critical wavelength ~2 Å from the bending magnets. The lattice is designed to produce a low emittance circulating beam, which in turn enhances the brightness of the radiated photon beam. The lattice of Indus-2 consists of 8 cells. Each cell consists of two dipole magnets to bend the beam on the desired orbit, and nine quadrupoles, distributed in five families for controlling the beam sizes. Four sextupoles are placed in each cell for correcting the chromatic aberration. There are 291 radio-frequency (RF) buckets, which can be filled with the electrons.

The main objective during the year 2008 was to operate Indus-2 at 2.5 GeV, the maximum rated energy of its operation. Trials to achieve this goal commenced soon after the AERB gave its clearance for Indus-2 operation at 2.5GeV and 50mA beam current. All magnet power-supplies were tested for the currents required for Indus-2 operation at 2.5GeV. The RF system was fully tested for accelerating voltages exceeding 1.2 MV and for operation at higher power levels. For ramping beam energy, the currents of magnets were increased. The actual process is rather complex because of the requirement that the optics of the accelerator has to remain unchanged during acceleration to avoid beam loss. To satisfy this requirement, a detailed study of the transfer function, which include the non-linear behaviour of the dipole magnet was carried out. Using this transfer function in the ramp software, the beam was successfully ramped up to 2.5 GeV. This was achieved by synchronously ramping the currents of all 29 power supplies driving the dipole, quadrupole, and sextupole magnets. Besides this, a higher cavity gap voltage of nearly 1.2 MV was applied with proper optimized phases. This voltage was provided by the four RF cavities installed in the ring. Adhering to the AERB guidelines, Indus-2 operation at 2.5 GeV is restricted to 50 mA beam current. Fig. A.1.1 shows a typical beam operation at 2.5 GeV.

An improvement in the beam lifetime of Indus-2 has been observed during the last one year. This improvement is mainly attributed to the improvement in the vacuum conditions resulting from the synchrotron radiation (SR) stimulated gas desorption of the vacuum chamber, as well as, further optimization of the RF parameters. In the beginning of year 2008, the beam lifetime at 2 GeV, 15mA stored beam current was 130 minutes. Towards the end of the year, the lifetime improved to 660 minutes for the same energy and current. In the month of June 2008, when 2.5 GeV operation was started, the beam lifetime for 15 mA stored current was 140 minutes and this increased to 360 minutes towards the end of the year.

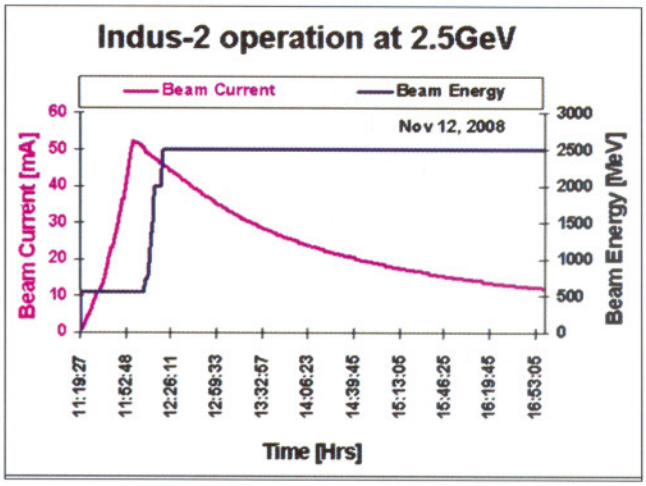

Fig. A.1.1: Electrons are injected and accumulated at 550 MeV energy and are then accelerated to 2.5 GeV for storage

For time resolved experiments, single bunch mode operation is needed. To operate the accelerator in the single bunch mode, a detailed algorithm was evolved, integrated in the timing system hardware, and also tested successfully during the ring operation at the injection energy. In the single bunch operation, 8 mA per bunch beam current was accumulated. The ring is normally operated in the multiple bunch filling mode.

So far, in the limited trials, 135 mA beam current has been accumulated at the injection energy. In a normal run, the beam current is accumulated as per the user requirements and then the beam energy is ramped to the required higher values.

In order to provide the photon beam at the proper location at the user end, an angular deflection of the electron beam orbit is generated in the vertical plane, using four steering magnets based on the feedback from the users. Currently, three photon beam lines (BL-8, 11 and 12) are in operation. After application of the angular deflection, the photon beam reaches the correct positions at experimental stations of these beam lines .

Presently, the ring is operated in two shifts and beam is provided to the users at 2 and 2.5 GeV as per their requirements.

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