A.1: Beam lifetime improvement in Indus-2

The regular beam operation of Indus-2 at beam energy 2.5 GeV and stored beam current 100 mA for beam line users was started in the month of May 2012. To replenish energy loss due to the emission of synchrotron radiation at beam energy 2.5 GeV, all four RF cavities were energised. With the reduction in residual gas pressure in the ring, RF voltage and phase optimisation, beam lifetime ~12 hours was achieved in July 2012. With the same parameters like applied RF cavities voltage, transverse betatron tune, synchrotron tune and closed orbit, a beam lifetime more than ~15 hours has been achieved in November 2012 mainly due to the reduction in vacuum pressure in the storage ring. A comparison in stored beam current decay and instantaneous beam lifetime in the month of July and November 2012 are shown in the Fig. A.1.1.

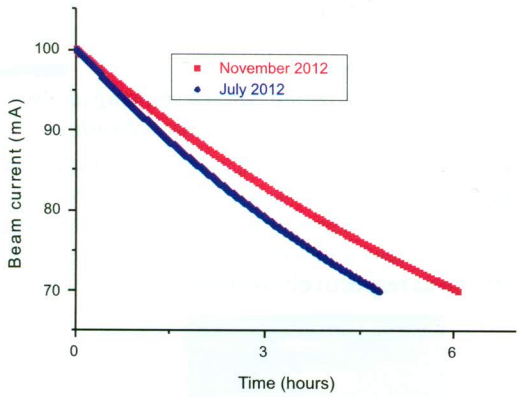

Fig. A.1.1: Comparison of beam current decay

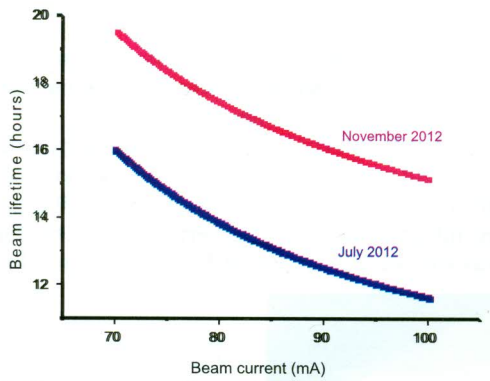

Fig. A.1.2: Comparison of beam lifetime

The instantaneous beam lifetime in electron storage ring is given as [-I(t)/(dI/dt)], where I(t) is the stored beam current and dI/dt is the decay rate. In absence of beam instabilities, beam lifetime is governed by quantum lifetime due to emission of synchrotron radiation, vacuum lifetime due to beam-gas interaction and Touschek lifetime due to electron-electron scattering within a bunch.

Quantum lifetime of electron beam in longitudinal plane was estimated and found to be significantly large for the applied total RF cavities peak voltage ~1275 kV. In the month from July to November 2012, the applied RF cavity voltage was ~1275 kV, so the Touschek lifetime which is decided by RF acceptance is the same. The estimated RF acceptance and quantum lifetime of beam with applied RF cavity voltage is shown in the Fig. A.1.2.

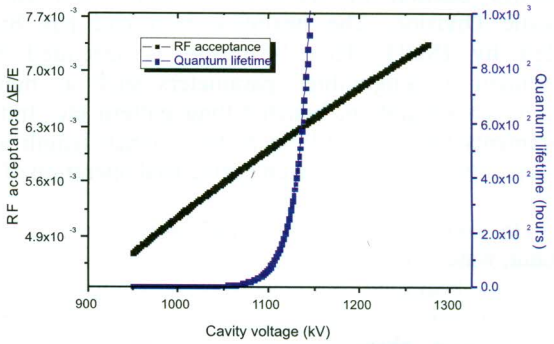

Fig. A.1.2: RF acceptance and quantum lifetime with different RF cavity voltage

Residual gas pressure in Indus-2 was monitored at 25 working Bayard Alpert Gauges (BAGs) in the ring. From the measured pressure, average pressure during beam current decay was estimated. The average pressure in July and November 2012, during beam current decay is shown in the Fig. A.1.3.

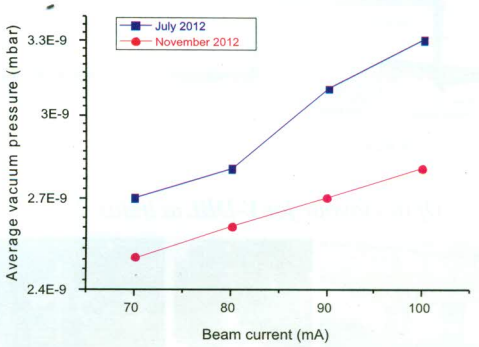

Fig. A.1.3: Average residual gas pressure during beam current decay

During all these measurements, orbit parameters of Indus-2 ring like transverse betatron tune, synchrotron tune and closed orbit were kept same. As from Figure 2, the quantum lifetime for applied RF cavity voltage is sufficiently large so it does not contribute to the beam lifetime. The RF cavity voltage applied in these experiments are the same, thus there is no change in the Touschek beam lifetime. As seen from the Fig. A.1.3, there is reduction in the average residual gas pressure, which is responsible for the improvement in beam lifetime.

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