VUV RING

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Figure 1 shows the breakdown of the VUV Ring operating statistics for the Fiscal Year 1997. The monthly breakdown of most significant operational performance statistics are presented in Figures 2 through 6. The operational statistics continue to show improvement above the record year of FY 1996. The fraction of the time during the year resulting in unscheduled downtime was only 1.5%. The probability that beam was not available when it was scheduled for operations was only 2.38%. However the total beam time actually delivered to the users was 6 hours greater than was scheduled, or 100.1% of scheduled. This resulted from the early return from maintenance and a reduction in accelerator study hours actually used. The accelerator performance continued to improve with higher injection rates and longer beam lifetimes. Injections are now routinely done in less than 3 minutes with the average approaching 2 minutes. The beam lifetime had been lower due to higher vacuum resulting from the two openings of the ring during the year and due to vacuum leaks. However, from August through the end of the year the lifetime has exceeded the pre-shutdown values by about 8%. This was achieved despite the new gas load introduced by the new U12IR mirror being inserted into the ring vacuum chamber and a leak in the front-ends of two beam ports. To help reduce the impact of these new gas loads, a new beam scrubbing shift (vacuum chamber conditioning shift) was introduced during the owl shift (0:00 to 08:00) of the two day study period that occurs once a month. This shift helps desorb the gas that was introduced by these new sources more rapidly than would occur during normal operations and helps reduce the base pressure of the ring.

The major improvement to the VUV Ring during this fiscal year occurred during the winter shutdown when another large aperture beam port was installed for the U2IR beamline. The ceramic gap just after this beam chamber had started to leak during the fall 1996 and was also replaced during the winter shutdown of the ring. Despite the increased work load from the ceramic gap replacement, the effective planning of the Mechanical Group allowed the ring to be brought on four days early and scrubbing of the vacuum with beam to take place during the three day holiday weekend. This allowed operations to begin on schedule but with longer beam lifetime resulting from the reduced vacuum pressure. During the spring, a front-end valve started leaking in the half of the ring opened during the winter shutdown. This valve was replaced during the May shutdown requiring the same half of the vacuum chamber to be vented again. Recovery to pre-shutdown values of the beam lifetime required about the same integrated current as the winter shutdown, but since this vacuum work had not been anticipated, much of the beam scrubbing had to be done during operations.

Other improvements in the ring resulted from changes in the damping of higher order mode of the main RF cavity and other changes in this RF control system. Testing began on the implementation of a fast RF feedback system on the main RF system. This system should suppress the noise introduced by that RF system on the beam and it appeared to work quite well when operated by itself. However, when the bunch lengthening RF system was also working the beam showed increased fluctuations and will require more work to allow these two systems to work together. Other improvements were in the diagnostics of the electron and photon beams. New extended dynamic range Beam Position Monitor (BPM) receivers were installed on all of the ring's pickups. This will allow measurements of the beam position down to lower values of current. This of little concern for normal operating currents but will help better understand the electron beam model for the ring by allowing measurements at low beam current. A new fast turn-to-turn BPM measurement system was prototyped and the full system should be operational in FY 1998. This BPM will allow modeling of the non-linear properties of the electron beam. Other diagnostic improvements that are planned will help understand the fast beam fluctuations and how to reduce their impact on the users.

The long awaited improvement in the VUV radiation shielding did not take place during FY 1997, as it was originally planned. This was due to the difficulty in finding suppliers of the heavy concrete shielding blocks.

However, this supply difficulty has been overcome and the shielding is planned to be installed around half of the ring during the winter 1997-1998 shutdown. Once the improvement in the radiation levels in that half of the ring is measured the remainder of the shielding will be scheduled for a future shutdown. When the radiation shielding has been installed new studies of the Top-Off Method of Injection (TOMI) will be performed, in order to demonstrate that TOMI offers the users the ultimate improvement in beam stability over long time periods both from the source and the optics points of view. TOMI will also eliminate the age old conflict between longer beam lifetime and higher brightness of the photon beam. To insure that the frequent injection pulses are not seen by the users, new shorter pulse kickers will be installed in FY 1998 to allow the injected beam to be added to the stored beam with minimum disturbance to the stored beam.

During the next fiscal year studies will be carried out to increase the operating beam energy of the VUV Ring. This will continue the improvement in beam lifetime that has dominated the past improvements. In addition, studies are being carried out to develop methods of providing for real-time variation of the undulator gaps in the ring. Although this is common place on the high energy rings, the lower energy of the VUV Ring makes the impact of these gap changes more significant for the other users. The initial studies to control the orbit and betatron tunes proved insufficient and addition correction of horizontal-vertical coupling effects also will have to be compensated. ■

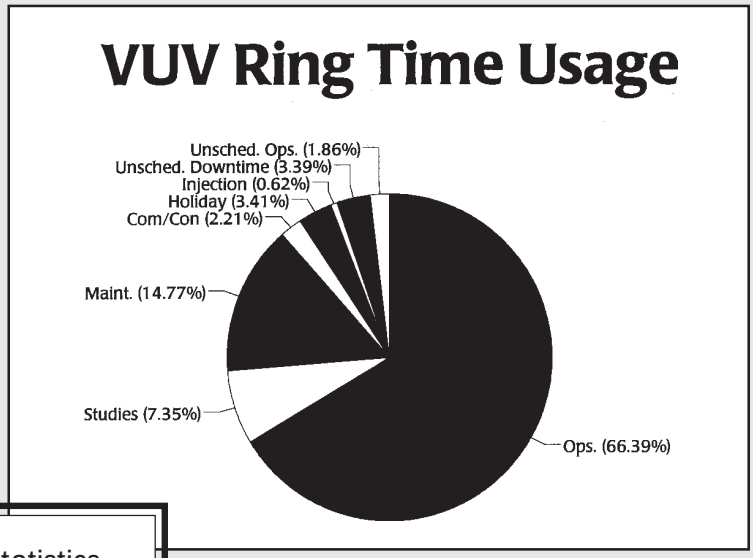

Figure 1: The breakdown of the VUV Ring usage based on total time (not scheduled time) for FY 1998.

FY 1998 Ring Performance Statistics

Ave. fill Current: 830 mA
Ave. Charge Rate: 251 mA/min
Ave. Lifetime at 500 mA: 283 min
Total user integrated current:
3033 A-Hrs (126 A-days)
Total hours of operation: 5978 hours
Average operating current: 507 mA

VUV Ring Performance FY 1998

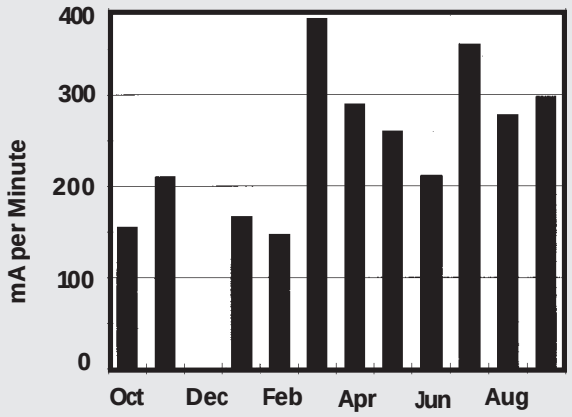

Figure 2: The VUV Ring injection charge rate average over all fills in each month.

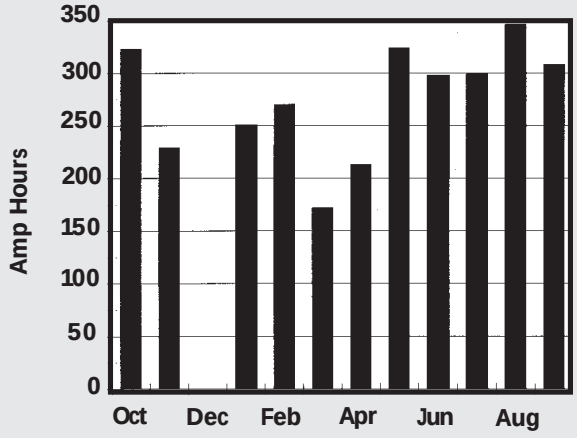

Figure 3: The total integrated current for the VUV Ring accumulated each month.

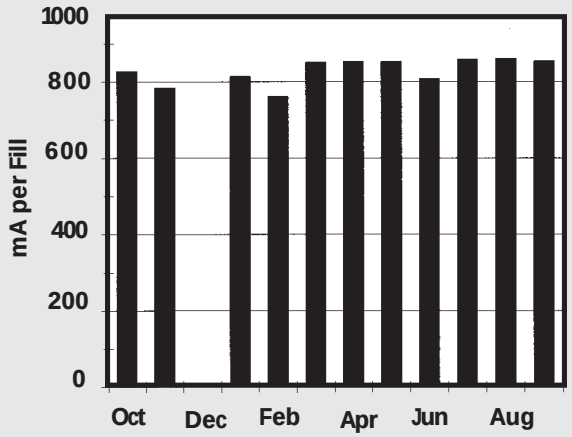

Figure 4: The injection current averaged over all fills in a month for the VUV Ring.

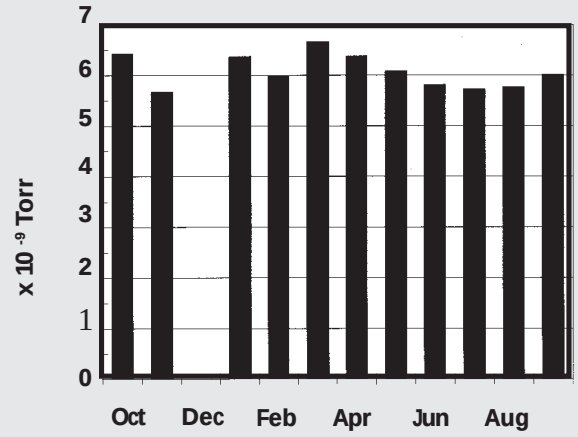

Figure 5: The VUV Ring vacuum pressure at 500 mA beam current averaged over each month.

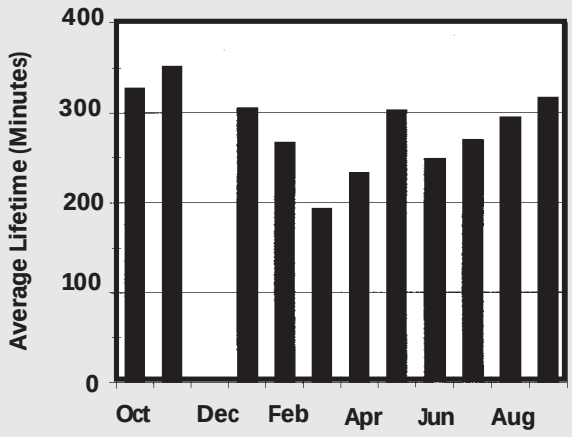

Figure 6: The VUV Ring exponential beam lifetime at 500 mA beam current (seven bunch operation only) averaged over each month.