Operations

VUV Ring Report

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The VUV ring operating statistics for the fiscal year 2001 are presented in Figure 1. A breakdown of the most significant operational performance statistics is presented in Figures 2 through 6. The VUV Ring operational reliability, 97.2%, shows a small decrease from last year. However, the total users beam time provided exceeded the scheduled time by almost 4%. The major cause of the unscheduled downtime was a leak in a ceramic gap for the injection bump magnet. This gap was scheduled to be replaced during the winter 2000-01 shutdown, but due to a problem with the replacement gap, it was not done. This made the period from January 2001 until the May 2001 shutdown very difficult, since this leak would open up frequently. Most of the operations during this time was at the injection energy and lower beam current, in order to keep the power on this gap as low as possible and allow for some operations. The gap was replaced during the May shutdown, with a repaired gap. However, the thermal analysis of this gap showed that most of the stresses come from synchrotron power hitting the uncooled stainless steel surface of the transition taper. The replacement gap had a water cooled channel attached to it and subsequent temperature measurements show that this metal is staying below 55°C at the highest beam energy and current. A new spare gap will be fabricated, with a water cooling channel built-in, along with other improvements

Despite these problems VUV ring has continued to run quite well, with a record total hours of operation almost 69% of the year. Lifetime continues to be about 17% lower that the peak values obtained in 1997, but this hasn't caused any problem for the users. Injection rates have decreased slightly due to linear accelerator klystron problems, but injections still have been less than 3 minutes on average and the rate has been improving during the last quarter of FY'01.

The Mechanical Group has continued the improvement program: of replacing the older GP front-end vacuum valves with newer VAT valves and replacing the polyflow hoses on the water and pressurized air systems with copper pipe. For those water hoses that cannot be replaced, the maintenance program they have implemented has made water leaks essentially a thing of the past. The Electrical Group has designed and is implementing an improved front-end interlock system, based on the use of Programmable Logic Controllers. The prototype has been installed and has been working on the U16 beam line since the May shutdown. This system will replace the older (difficult to maintain) systems on the remaining beam lines as time and manpower permits. The Digital Orbit Feedback system has been operating well for almost a year now and the older analog system will be removed to free up rack space, as time permits.

The RF Group has been planning to replace the vacuum tube amplifier of the 4^{th} Harmonic RF system with a more modern solid state amplifier. This should improve the maintenance of this system, since the replacement parts for the older system are hard to find. Due to problems with the manufacturer of the new system, it was not delivered in time for the May shutdown and it is presently scheduled for installation during the winter 2001-02 shutdown of the ring.

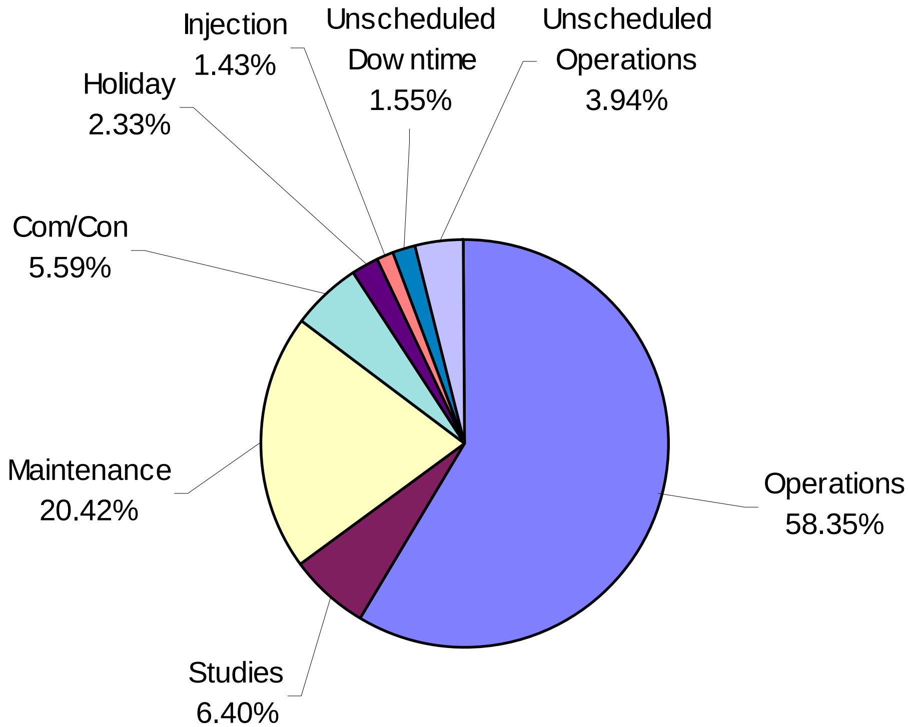

Figure 1: The breakdown of the VUV Ring usage based on total time (not scheduled time)

FY 2001 Ring Performance Statistics

Ave. fill Current: 786 mA
Ave. Charge Rate: 87 mA/min
Ave. Lifetime at 500 mA: 272 min
Total user integrated current:
3122 A-Hrs (136 A-days)
Total hours of operation: 5457 hours
Average operating current: 786 mA

VUV Ring Performance

2001

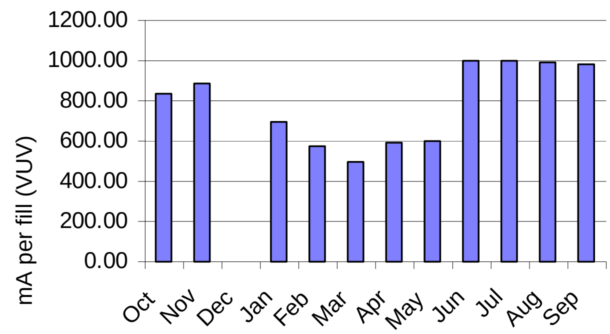

Figure 4: The injection current averaged over all fills in a month for the VUV Ring.

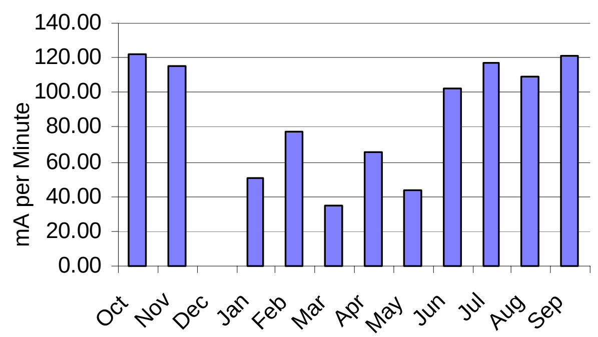

Figure 2: The VUV Ring Injection charge rate average over all fills in each month.

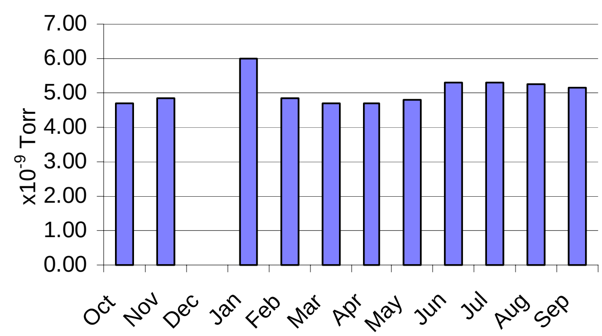

Figure 5: The VUV Ring vacuum pressure at 500 mA beam current averaged over each month.

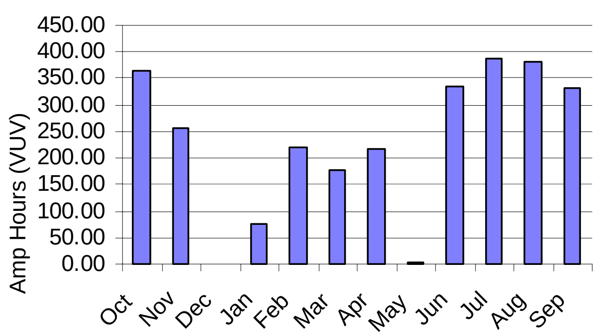

Figure 3: The total integrated current for the VUV Ring accumulated each month.

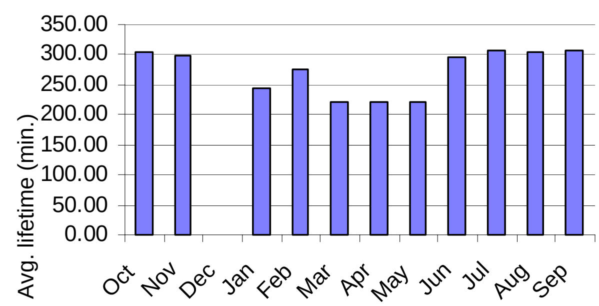

Figure 6: The VUV Ring exponential beam lifetime at 500 mA beam current (seven bunch operation only) averaged over each month.

VUV Storage Ring Parameters
as of November 2001

Normal Operating Energy	0.808 GeV
Peak Operating Current (multibunch ops.)	1.0 amp (1.06 x 10^{12}e-)
Circumference	51.0 meters
Number of Beam Ports on Dipoles	18
Number of Insertion Devices	2
Maximum Length of Insertion Devices	~ 2.25 meters
$\lambda_c(E_c)$	19.9 Å (622 eV)
$B(\rho)$	1.41 Tesla (1.91 meters)
Electron Orbital Period	170.2 nanoseconds
Damping Times	$\tau_x=\tau_y$= 13 msec; τ_ε = 7 msec
Lifetime @ 200 mA with 52 MHz	360 min
(with 211 MHz Bunch Lengthening)	(590 min)
Lattice Structure (Chasman-Green)	Separated Function, Quad, Doublets
Number of Superperiods	4
Magnet Complement	8 Bending (1.5 meters each) 24 Quadrupole (0.3 meters each) 12 Sextupole (0.2 meters each)
Nominal Tunes (ν_x,ν_y)	3.14, 1.26
Momentum Compaction	0.0235
RF Frequency	52.886 MHz
Radiated Power	20.4 kW/amp of Beam
RF Peak Voltage with 52 MHz (with 211 MHz)	80 kV (20kV)
Design RF Power with 52 MHz (with 211 MHz)	50 kW (10 kW)
Synchrotron Tune (ν_s)	0.0018
Natural Energy Spread (σ_e/E)	5.0 x 10^{-4} , I_b< 20 mA
Bunch Length (2σ)	9.7 cm (I_b < 20 mA)
($2L_{rms}$ with 211 MHz Bunch Lengthening)	(36 cm)
Number of RF Buckets	9
Typical Bunch Mode	7
Horizontal Damped Emittance (ε_x)	1.60 nm-rad
Vertical Damped Emittance (ε_y)	≥ 3.5 nm-rad (4nm-rad in normal ops.)*
Power per Horizontal Milliradian (@ 1A)	3.2 Watts

Arc Source Parameters

Betatron Function (β_x, β_y)	1.18 to 2.25 m, 10.26 to 14.21 m
Dispersion Function (η_x, η_x)	0.500 to 0.062 m, 0.743 to 0.093 m
$\alpha_{x,y} = -\beta'_{x,y}/2$	-0.046 to 1.087, 3.18 to -0.96
$\gamma_{x,y} = (1+\alpha_{x,y})/\beta_{x,y}$	0.738 to 0.970 m^{-1}, 1.083 to 0.135 m^{-1}
Source Size (σ_x, σ_y)	536 to 568 µm, >60 to >70 µm (170-200 µm in normal ops.)*
Source Divergence (σ_x, σ_y)	686 to 373 µrad, 19.5 to 6.9 µrad (55-20 µrad in normal ops.)*

Insertion Device Parameters

Betatron Functionµm (β_x, β_y)	11.1 m, 5.84 m
Source Size (σ_x, σ_y)	1240 µm, >45 µm (220 µm in normal ops.)*
Source Divergence (σ_x, σ_y)	112 µrad, >7.7 µrad (22 µrad in normal ops.)*

* ε_y is adjustable