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The Reference Optics for SESAME Storage Ring

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The Reference Optics for SESAME Storage Ring

Introduction and History

Two optics "Optics 1" with working point (7.23, 5.19) and "Optics 2" with working point (7.23, 6.19) had been optimized for SESAME Storage Ring [1]. The destruction noticed in the chamber-limited dynamic aperture of Optics 1 [2], which was caused by a 5^{th} order resonance, has been cured by changing the tunes to (7.21, 5.185) [2] or to (7.28, 5.19) keeping almost the same linear optics.

The Storage Ring circumference then has been increased by 8 cm to become 133.2 m instead of 133.12 m. This increment was needed to make the Ring Circumference an integer number of the 500 MHz RF periods.

The fact that "Optics 2" had smaller beam stay-clear vertical aperture [1] (which enables to accommodate longer Insertion Devices in the straight sections) made us adopt Optics 2 for SESAME Storage Ring. On the other hand Optics 2 has appreciably larger β_z in the bending magnets which makes the closed orbit more sensitive to the magnetic misalignments [3] than in Optics 1. This makes Optics 1 more convenient for the Storage Ring commissioning mainly for the first beam turns in the Storage Ring where the closed orbit is not corrected yet.

1 Two Optics for SESAME Storage Ring

According to the arguments mentioned above, one can use the two optics for SESAME operation. Optics 1, which is shown in Fig.1.a, can be used in the commissioning period and as long as no Insertion Devices are installed yet whereas Optics 2, which is shown in Fig.1.b, can be more convenient when the Insertion Devices are installed.

May be it is worth to mention that switching from optics to another is done easily by changing the settings of the quadrupoles and sextupoles.

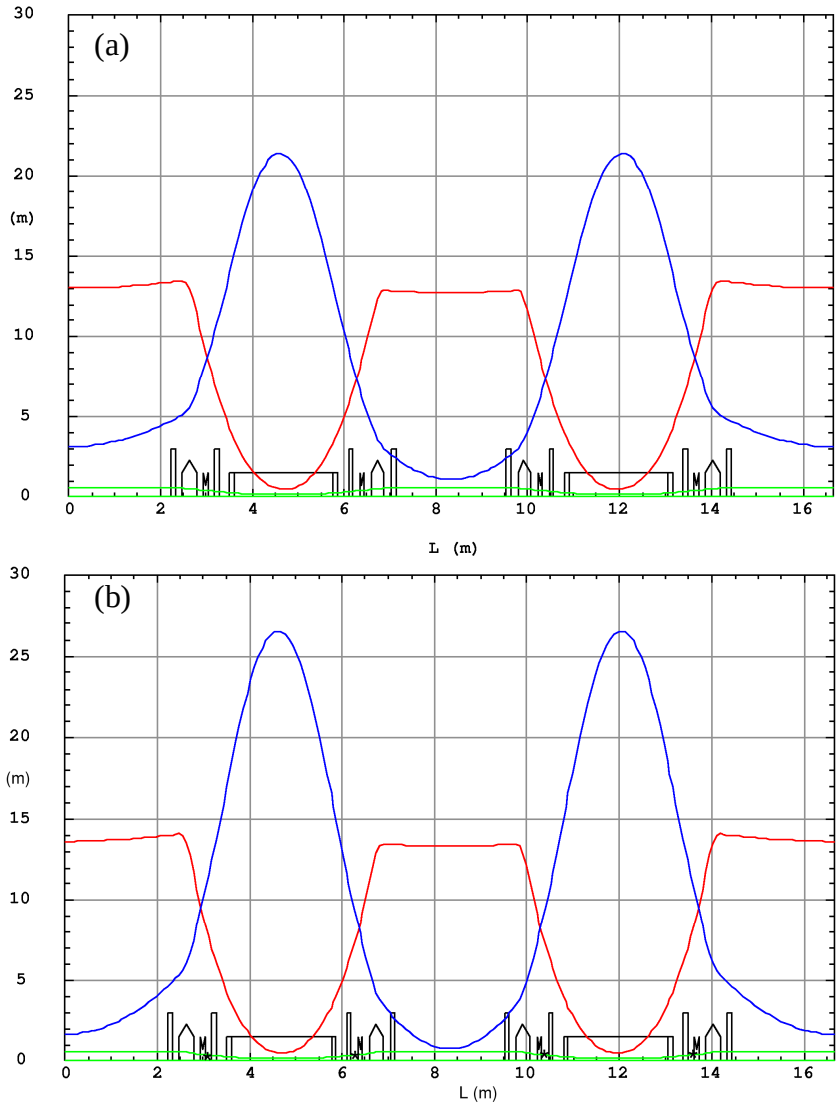

Figure 1: a) Optics 1 and b) Optics 2 for SESAME Storage Ring. The horizontal beta function β_x (red), the vertical one β_z (blue) and the dispersion function D_x (green) are shown.

The main parameters of the two Optics are listed in Table 1.

Parameter	Unit	Optics 1	Optics 2
Energy	GeV	2.5	
Circumference	m	133.2	
Betatron tunes Q_x / Q_z		7.23 / 5.19	7.23 / 6.19
Number of super-periods		8	
Bending Dipole field	T	1.45545	
Field index **n**, gradient (T/m)		11, -2.794	
Natural Chromaticities H / V		-13.63 / -15.06	-15.15 / -20.56
Momentum compaction		0.008331	0.00828
Energy loss / turn	keV	590.2	
Damping times τ_E / τ_x / τ_z	msec	2.74/ 2.31/ 3.76	2.74/ 2.32/ 3.76
RMS energy spread σ_E	%	0.1074	0.1073
Natural emittances ε_x / ε_z	nm.rad	25.6400 / 0.2564	25.74 / 0.2574
Betatron coupling	%	1	
RF Parameters			
Frequency	MHz	499.654097	
Harmonic Number		222	
Peak Voltage	MV	2.4	
RF acceptance ($\boldsymbol{\varepsilon}_{RF}$)	%	1.459	1.463
Synchrotron tune		0.0165	0.0165
Synchrotron frequency ($\boldsymbol{\nu}_s$)	kHz	37.147	37.147
Natural bunch length ($\boldsymbol{\sigma}_L$)	mm	11.46	11.42
Max. current (200 bunch)	mA	400	
Beam Lifetime (@ P = 1nTorr)	hrs	22.3	21.5
Optical Functions [middle of straights and @ dipole port (6.5^0)]			
Horizontal Beta:			
Long straight/ Short straight/ Dipole	m	12.29/ 11.97/ 1.04	13.59/ 13.27/ 1.03
Vertical Beta:			
Long straight/ Short straight/ Dipole	m	3.12/ 1.09/ 20.32	1.65/ 0.77/ 25.12
Horizontal Dispersion:			
Long straight/ Short straight/ Dipole	m	0.521/ 0.521/ 0.154	0.533/ 0.533/ 0.153
Beam Sizes and Angular Divergences			
Horizontal beam size (σ_x):			
Long straight/ Short straight/ Dipole	μm	792.8/ 787.7/ 232.5	825.9/ 820.8/ 232.3
Vertical beam size (σ_z):			
Long straight/ Short straight/ Dipole	μm	28.3/ 16.7/ 72.2	20.8/ 14.2/ 81.0
Horizontal divergence (σ'_x):			
Long straight/ Short straight/ Dipole	μrad	45.68/ 46.28/ 260.20	43.5/ 44.0/ 266.6
Vertical divergence (σ'_z):			
Long straight/ Short straight/ Dipole	μrad	9.06/ 15.33/ 10.07	12.49/ 18.30/ 11.50

Table 1

References

[1] G. Vignola, M. Attal, Tech. Note O-1,"*SESAME Lattice*".

[2] M. Attal, Tech. Note O-4,"*SESAME Dynamic Aperture with High Order Multipoles*".

[3] M. Attal, Tech. Note O-6,"*Closed Orbit Distortion and Correction*".