STATUS OF SESAME

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Abstract

An update of the status of SESAME* is presented. SESAME is a third generation light source facility, with an e-beam energy of 2.5 GeV, located in Allan, Jordan. The emittance is 26 nm.rad and 12 straights are available for insertion devices. The injector consists of a 22.5 MeV microtron and 800 MeV booster synchrotron, with a repetition rate of 1 Hz. The conceptual design of the accelerator complex has been frozen, and the engineering design is well advanced. The Phase I scientific program for SESAME has also been finalized, and it foresees 6 beam lines, including 2 IR ports. The construction of the SESAME building is in progress, and the beneficial occupancy is expected by the spring of 2007. The completion of the accelerators complex construction is scheduled for 2010.

INTRODUCTION

The technical evolution of SESAME is described in [1, 2]. The Building that will house SESAME is under construction with funds and site provided by Jordan (see Fig. 1), under the supervision of R. Al Sarraf, from Al-Balqa University. Its completion, including a 6.0 MVA dedicated Electrical Power Station, is scheduled by the first half of 2007.

Figure 1: A panoramic view of SESAME building during construction (May 2006).

Fig. 2 shows the layout of the accelerator complex and beamlines in the experimental hall. The injector complex (800 MeV booster synchrotron and 22.5 MeV Microtron) is the one already used in Bessy I [3], with new power supplies and vacuum pumps. The 2.5 GeV Main Storage Ring is completely new.

*Synchrotron-light for Experimental Science and Applications in the Middle East is a cooperative venture by the scientists and governments of the region with founding members Bahrain, Egypt, Israel, Jordan, Pakistan, Palestine Authority, and Turkey. Iran is in the process of finalizing its formal membership.

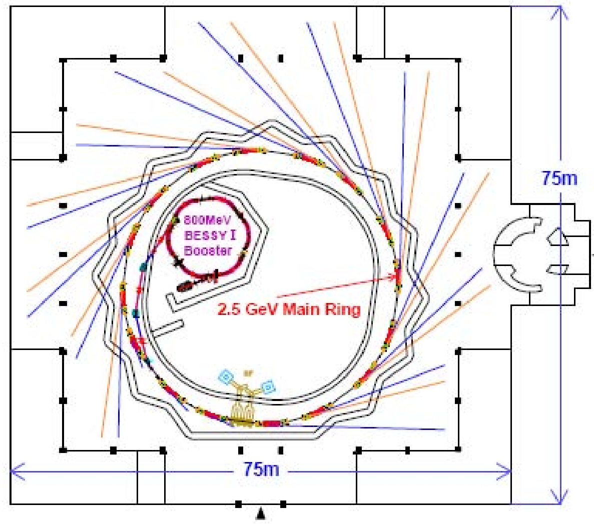

Figure 2: SESAME layout in the experimental hall.

THE MAIN STORAGE RING

The main storage ring parameters are given in Table 1. The storage ring is composed of 8 super periods with 16

Table 1: SESAME design parameters

Energy (GeV)	2.5
Circumference (m)	133.12
N. of Periods	8
Dipole field (T)	1.455
Dipole field index	11
Q_x - Q_z	7.23 – 6.19
Mom. Compaction	0.00829
N. Emitt.(nm.rad)	26.0
U_0 (keV/turn)	589.7
τ_ε, τ_x, τ_z (ms)	2.80, 2.28, 3.77
RF freq. (MHz)	499.564
Harmonic Number	222
Peak Voltage(MV)	2.4
Synch. Freq. (kHz)	37.18
σ_L (cm)	1.15
Current (mA)	400
N. of bunches	200
1/e Lifetime(hrs)	16.9

dipoles and 16 straight sections of alternate length of 4.44m and 2.38m respectively. 4 straights (2 Long and 2 Short) are allocated for Injection, RF cavities, beam diagnostic etc. Each dipole chamber is equipped with a port, to collect the synchrotron light, centered at 6.5^{O}. We will summarize in the following the main features of the Optics and of the main subsystems.

The Optics

For SESAME a Double Bend Achromat (DBA) lattice has been adopted with vertical focusing gradient inside the dipoles and dispersion distribution in the straights. The bare lattice has only 2 families of quadrupoles and 2 of sextupoles. The optical functions for a full period are shown in Fig. 3, while the dynamic aperture [4] is shown in Fig. 4.

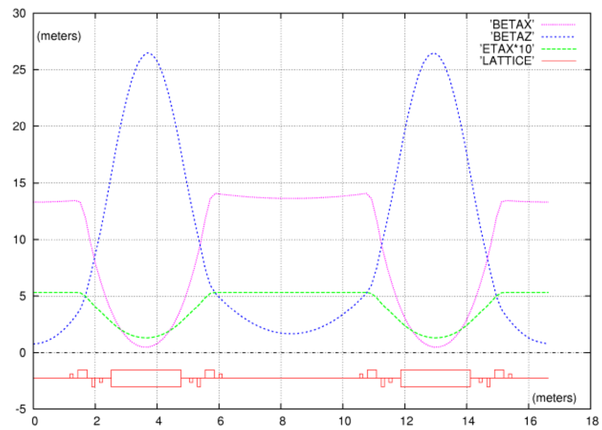

Figure 3: SESAME full period optical functions.

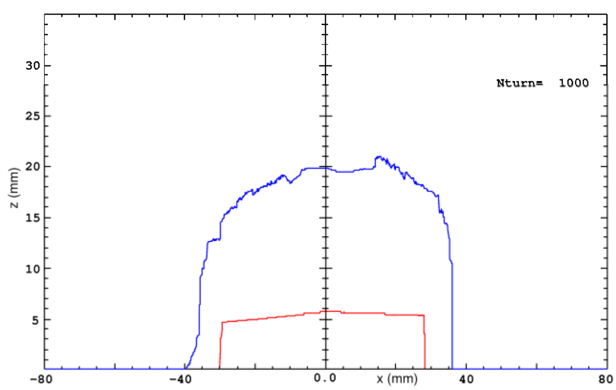

Figure 4: On-momentum dynamic aperture (blue) and vacuum chamber limited one (red) in the middle of the Long straight section, taking in account the effect of all the high order multipoles in the magnets.

The lattice is quite flexible to compensate locally the optical perturbation of ID. The matched optical functions are plotted in Fig. 4 for a 2.1 Tesla 3m long wiggler (2 additional q-pole power supplies are used in this case). The only questionable point is the non zero dispersion in the straights: an ID will produce an increase in the emittance. Anyway, with the SESAME parameters, if the magnetic field of the ID does not exceed a value of 2÷2.5 Tesla, such increase is negligible: for the above mentioned wiggler the emittance goes up from 26.0 nm to 26.44 nm.

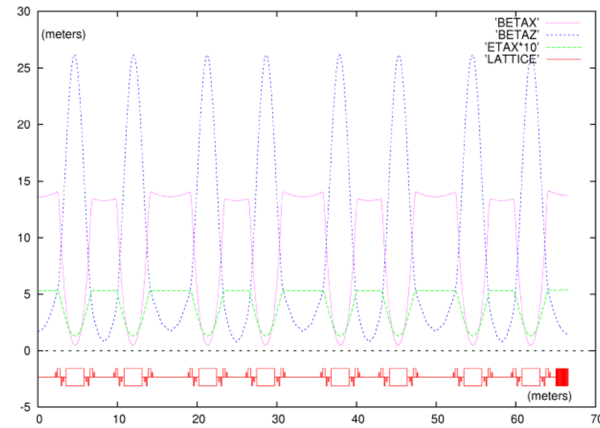

Figure 5: Half ring optical functions after matching: the wiggler (1/2) is the last element of the lattice.

Finally we plot in Fig. 6 the minimum stay clear vertical aperture reduction that the SESAME lattice can tolerate for ID with a gap smaller than the 30 mm value adopted for the entire vacuum chamber.

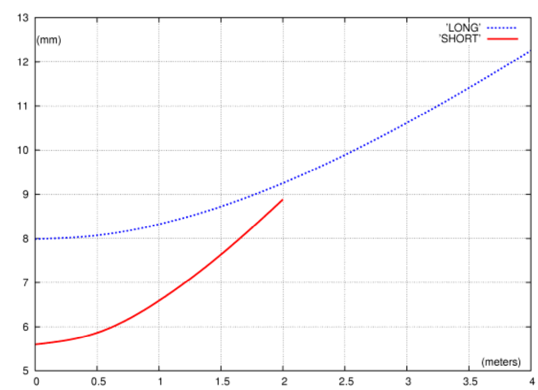

Figure 6: Long and Short straights minimum vertical full stay-clear aperture vs. ID length.

The RF System

It was initially decided for SESAME to adopt a RF system similar to the ANKA one and based on Elettra type cavities [5, 6]. We are presently investigating the possibility to use RF power amplifiers based on 80 kW cw IOT transmitters. We are also following with attention the evolution in the performance of the newly developed EU HOM [7] damped cavity, in relation to the suppression of longitudinal and transverse multibunch instabilities driven by HOM's of the RF cavities.

The Magnets System

In SESAME there are 16 Dipoles, 32 F-quadrupoles with magnetic length of 30 cm, 32 D-quadrupoles with magnetic length of 10 cm, 32 F-sextupole and 32 D-sextupole with magnetic length of 10 cm. 4 additional coils inside each F(D) sextupole are used as horizontal (vertical) correctors. For quadrupoles and sextupoles a design identical (a part the length) to the one adopted for ANKA has been chosen [8], the max gradient is 19T/m for the quadrupoles and 300 T/m^2 for the sextupoles. The design of the other magnets is described in [9].

The Power Supplies System

In Table 2 is shown the rating of the D.C. Power supplies for the main magnets for 2 options: the first has all the q-pole P.S. connected in series, while the last has independent q-pole P.S. for each straight section. There are, of course intermediate solutions between the two options, depending on the number of ID: the final choice will be made on the basis of the available construction budget.

Table 2: D.C. Power Supplies Rating

	Option 1			Option 2		
	Amp.	Volt	Number	Amp.	Volt	Number.
Dipole	720	480	1	720	480	1
QF	400	240	1	400	15	16
QD	400	160	1	400	10	16
SF	120	120	1	120	120	1
SD	120	120	1	120	120	1

The Vacuum System

The design of the stainless steel vacuum chamber is based on the chamber-antechamber concept, with OFHC crotch absorber and a slot height of 12 mm. The full stay clear aperture in the chamber is 70mm in the horizontal plane and 30 mm in the vertical one. The chamber wall thickness is 3 mm, while the antechamber length in the transverse direction, depending on the position, is up to 25 cm. A 3D view of the Arc Vacuum Chamber is shown in Fig. 7.

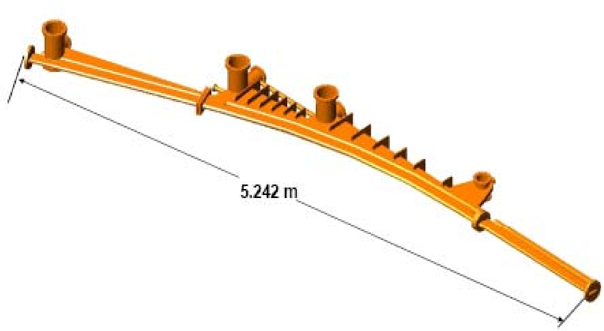

Figure 7: 3D view of the Arc Vacuum Chamber.

The SESAME vacuum system, with a total pumping speed of ~30.000 l/s, is dimensioned to reach after adequate beam conditioning (~100 Ampere-hours of stored beam) an average operating pressure of ~ 1 nTorr with 400 mA of circulating current.

Let us point out that we have adopted the ante-chamber concept in the entire storage ring: this allows, by properly positioning the 8 crotch absorbers of one super period, to intercept ~100% of the emitted synchrotron radiation while reducing the antechamber transverse size to a maximum of ~25 cm. The vacuum layout for one full period is shown in Fig. 8

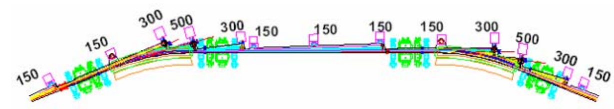

Figure 8: Vacuum Layout for one SESAME period: the numbers indicate the pumping speed in l/s of the vacuum pumps.

The dynamic pressure profile along one period is plotted in Fig. 9: the value of the average pressure is ~ 0.9 ntorr.

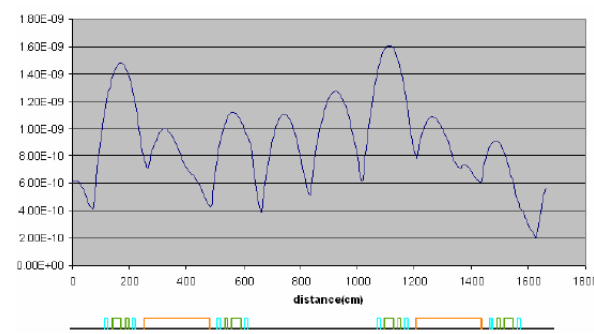

Figure 9: Dynamic pressure profile (mbar) at 400 mA along one full period, after a dose of 100 Ah.

ACKNOWLEDGMENTS

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