SESAME STATUS

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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 late 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 (Nov. 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.

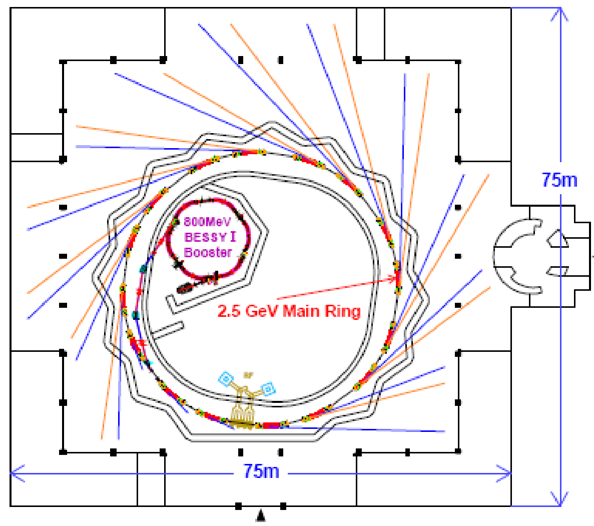

Figure 2: SESAME layout in the experimental hall.

THE MAIN STORAGE RING

The main storage ring parameters are given in Tab. 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

*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, Cyprus and Turkey. Iran is in the process of finalizing its formal membership.

dipoles and 16 straights 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.

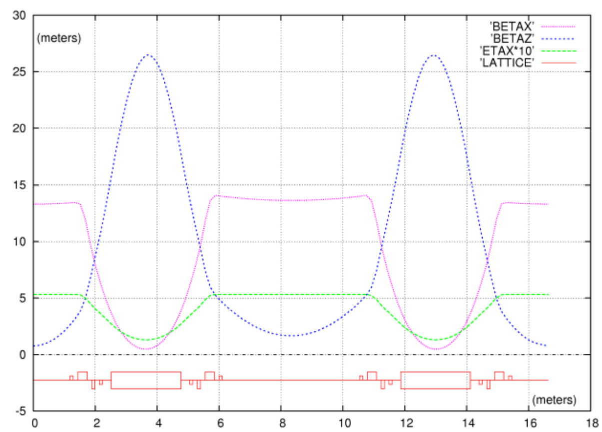

Figure 3: SESAME full period optical functions.

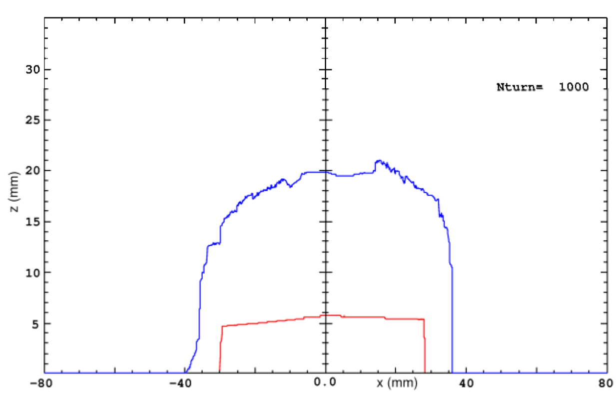

Figure 4: On momentum dynamic aperture (blue) and vacuum chamber limited one (red) in the middle of the Long straight section, taking in account the effect of all the high order multipoles in the magnets.

Injection Scheme

The injection scheme is based on using a four-kicker bump with 3 μsec pulse length. The thin septum exit is located in the centre of a long straight section [5], see Fig.4. The kicker strengths for 20 mm bump are given in Tab. 2, taking into consideration the effect of sextupole magnets. Many solutions have been found to achieve an injection efficiency of 100% taking into account some safety margin, i.e. the energy spread is three times larger and the emittance is 9 times larger than the nominal value at 800 MeV [5]. Fig 6 is an example of injecting into the storage ring with an angle.

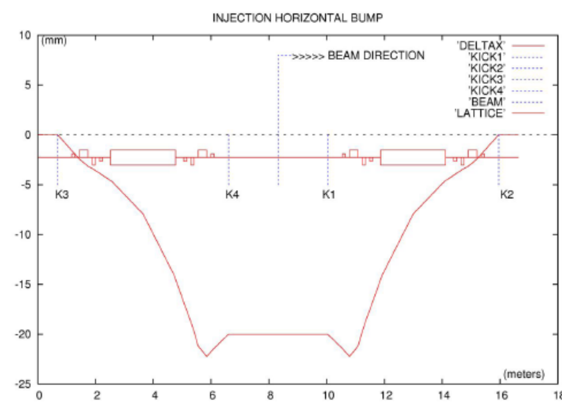

Figure 5: Layout of SESAME kickers and septum magnets.

Table 2: SESAME kicker's strengths in mrad.

Kicker strength	K1	K2	K3	K4
With sextupole	-2.936	-3.190	-3.190	-2.936
w/o sextupole	-2.872	-3.242	-3.242	-2.872

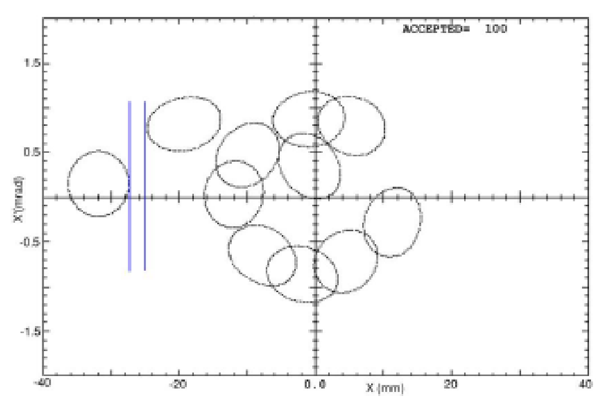

Figure 6: Tracking of 100 particles for 10 turns injected with 0.15 mrad angle.

The RF system

The RF system for the SESAME initial phase is based on four single-cell cavities of ELETTRA type, each one powered with an 80 kW CW IOT amplifier [6, 7, 8]. In Phase II the available RF power will be doubled by combining two 80 kW IOTs for each cavity to increase the stored beam current, the lifetime and to compensate the additional losses due to the insertion devices. The possible RF operating scenarios are listed in Tab. 3.

Table 3: Voltage and power for SESAME RF system.

P_{tot} (per cavity)	V_{RF} [kV] (4 cavities)	$P_{cav.}$ [kW] (each cavity)	P_{beam} [kW] (P_{tot}-P_{cav})	Max. I_{beam} [mA]
80 kW (Phase I)	2400	53	27	183
	2100	40	40	275
	1800	30	50	340
150 kW (PhaseII)	2400	53	97	658

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 [9], 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 [10].

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.

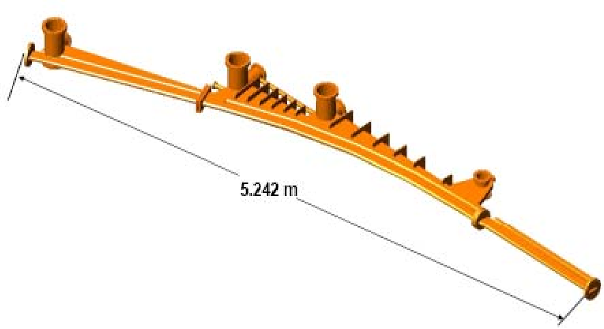

Figure 7: 3D view of the Arc Vacuum Chamber.

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

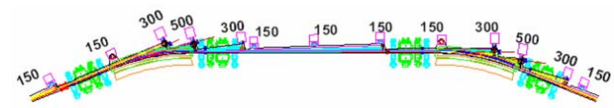

Figure 8: Vacuum Layout for one SESAME period: the numbers indicate the pumping speed in l/s of the vacuum pumps.

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

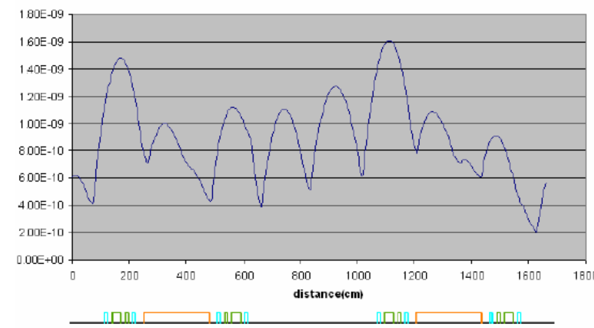

Figure 9: Dynamic pressure profile (mbar) at 400 mA along one full period, after a dose of 100 Ah.

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