CURRENT STATUS OF THE LSB PROJECT

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Abstract
A summary of the current status of the LSB project is given..

1 INTRODUCTION

The LSB project (Laboratori del Sincrotró de Barcelona) [1] has the responsibility for the design and eventual construction of a Spanish synchrotron radiation light source.

Following a survey of user requirements in 1995 [1], the following priorities emerged:

- The spectrum of the synchrotron light must extend to X-Rays of intermediate energy [up to 20 keV].
- The source dimensions must be as small as possible in both the vertical and horizontal planes.
- The accelerator should run with a long lifetime (at least 24 hours) and be free of beam instabilities.
- The design should be conservative enough to guarantee that the specifications are achieved, but susceptible to future upgrades.
- The straight sections should be as long as possible.

With these considerations, as well as cost, in mind, the design [2,3] has converged to the following parameters:

- Energy 2.5 GeV.
- Bending field 1 T.
- 12 Cells.
- TBA structure with gradient in the bending magnets.
- Injection at nominal energy.

This design will offer a critical energy of 4.2 keV and an emittance under 10 nm-rad.

2 THE LATTICE

Figure 1 shows the layout of one of the 12 cells of the machine. Some notable features are:

- Achromatic cell.
- 2 families of sextupoles used for chromaticity correction. A third family, normally set to zero strength, is provided to compensate for possible non-linear effects.
- 2 families of quadrupoles are used to select the working point.

The working point (14.3, 8.2) has been chosen to provide a good dynamic aperture, a relatively low emittance (ε_x~8.5 nm-rad) and the potential for good coupling control.

Figures 2 and 3 show the optical functions and the dynamic aperture respectively.

8 BPMs and correctors are used per cell. Some of the correctors are integrated in the sextupoles. Simulations carried out with various codes (e.g. MAD, Tracy2, Racetrack) including a realistic set of errors show a good that a good stability of the beam (maximum closed orbit distortions of the order of 0.15 mm) and a coupling of the order of 2-3% can be achieved.

Table 1 lists the most important parameters of the machine.

Table 1: Parameters of the machine.

Lattice type	TBA	
Energy	2.5	[GeV]
Number of Cells	12	
Cell Length	20.987	[m]
Circumference	251.844	[m]
Current	250	[mA]
Length of ID sections	7.31666	[m]
Emittance	8.48	[nm]
Coupling	5%	
Horizontal Emittance	8.08	[nm]
Vertical Emittance	0.40	[nm]
Energy Spread	$8.61*10^{-4}$	
Energy Lost per Turn	0.42	[MeV]
τ_x	6.67	[ms]
τ_y	10.03	[ms]
τ_ε	6.71	[ms]
α_p	$1.9*10^{-3}$	
Q_x	14.30	
Q_y	8.20	
ξ_x	-24.6	
ξ_y	-24.6	
ε_c	4.20	[keV]

† On behalf of the LSB design team.

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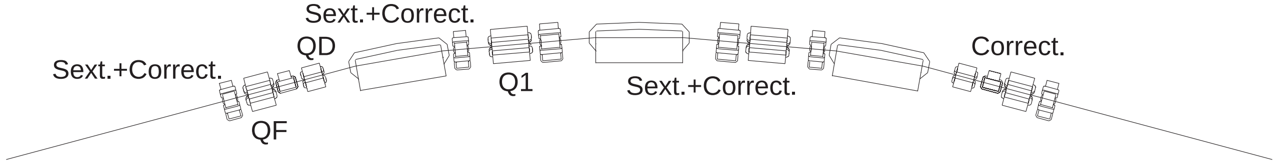

Figure 1: Layout of the cell.

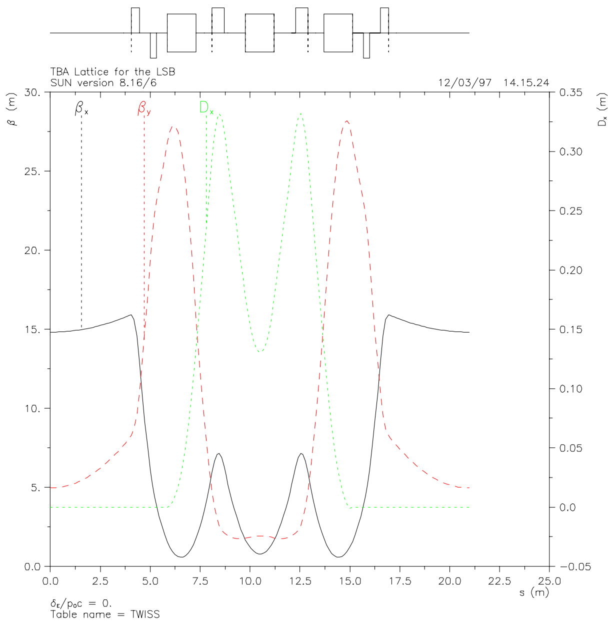

Figure 2: Optical Functions.

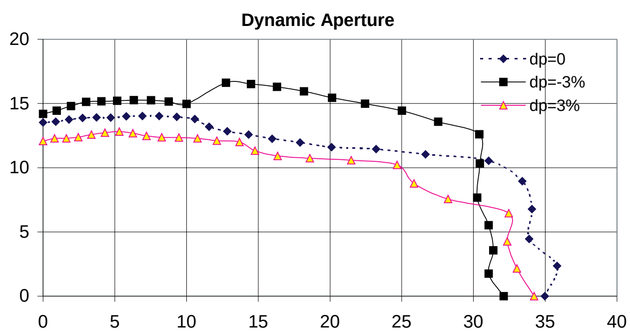

Figure 3: Dynamic aperture.

3 VACUUM SYSTEM AND LIFETIME [4]

Assuming an average vacuum pressure with beam of 10^{-9} mbar, the contributions to the lifetime in the multibunch mode of operation have been calculated to be:

Process	Lifetime [h]
Touschek	55
Bremsstrahlung	96
Coulomb	300
Elastic	6145
Inelastic	213
TOTAL	27

These values fulfil the design goals.

The conceptual design of the vacuum chamber is finished. It consists of two vacuum vessels for the achromat region. The first of these vessels covers from the first bending to the entry of the second, and the second vessel extends from the second to the third bending. A detailed engineering design of the chamber is currently underway.

4 RF SYSTEM [5]

The RF system will be distributed, with 4 cavities placed along the ring, at the ends of some of the straight sections. Bell shaped cavities, operating at a frequency of 500 MHz, with a total voltage of 2.6 MV, and allowing a maximum beam current of 500 mA, will be used. This system offers the potential to increase the energy of the machine to 3 GeV.

5 MAGNETS [6]

The design of quadrupoles, sextupoles and bending magnets is finished. The construction of a prototype bending magnet has started. Delivery is expected in October 97. Simultaneously, a laboratory for the testing of magnetic structures is being commissioned. In addition to the testing of the prototype bending magnet, we anticipate the development of prototype insertion devices.

6 INSERTION DEVICES

Following from the users specifications, we have selected a number of generic insertion devices. Currently, we are considering 2 undulators and 3 multipole wigglers. The parameters defining this insertion devices are given in table 2, whilst figures 4 and 5 show the predicted performance. These insertion devices will cover the know needs of the current user community.

Table 2: Parameters of the Ids.

Name	λ_u [cm]	Poles	Gap [cm]	k	Field [T]
U44	4.4	136	2	2.3	0.57
U73	7.3	82	2	5.7	0.83
W80	8	75	2	8.3	1.11
W120	12	50	2	15.7	1.4
W150	15	40	2	22.4	1.6

The detailed study of the effect of these insertion devices in the machine is being carried out at present. First results shows that the diminution of the dynamic aperture generated by the multipole wigglers can be compensated by restoring the correct phase advance in the corresponding straight section.

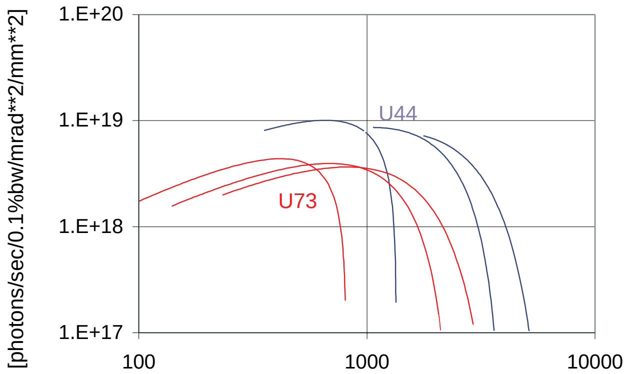

Figure 4: Undulator spectra.

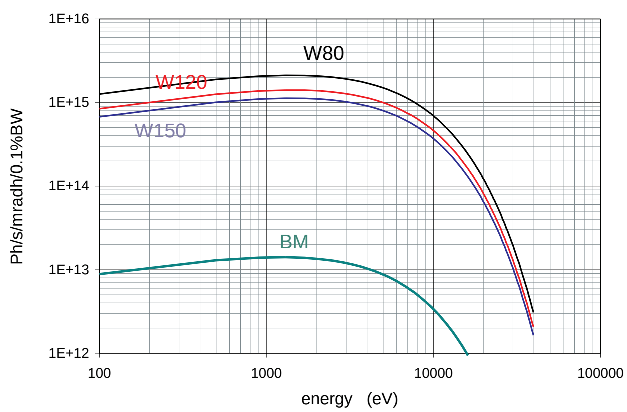

Figure 5: Wiggler and bending spectra.

7 POSSIBLE UPGRADES

The design provides for some possible future upgrades, for example:

- The energy of the machine can be increased up to 3 GeV, increasing the critical energy to 7.3 keV, as both the magnet and the RF systems can support this upgrade with ease.
- Insertion of a third family of quadrupoles in pairs of straight sections will allow further reduction of the vertical size of the beam, thus enabling the use of undulators with smaller gaps. These could provide first harmonic with a higher energy than those currently designed.
- The possibility exist to replace some of the central bending magnets with superconducting magnets, thus providing the potential for experiments in the region of very high energy X-Rays (e.g. 40 keV).

8 CURRENT STATUS

A detailed design report, and a request for full construction funding, will be submitted to the relevant authorities by the end of this year (1997). A decision on how to proceed is expected by early 1998.

ACKNOWLEDGEMENTS

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