STATUS OF THE ALBA PROJECT

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Abstract

The Storage Ring ALBA is a 3 GeV third generation synchrotron light source under construction in Barcelona (Spain). ALBA is optimized for high photon flux density with a beam emittance of 4.5 nm×rad and a large number of straight sections for Insertion Devices (3 of 8 m, 12 of 4.2 m and 2 of 2.6 m) in a relatively small circumference of 268.8 m. Top-up operation is foreseen from the start. The injector complex will consist of a 100 MeV Linac and a full energy booster with a rather small emittance of 9 nm×rad. The design of the lattice and of the major components of the accelerator complex (Linac and booster, Magnets, RF system, Vacuum system) has been completed and the procurement procedure has started for the large majority of them. The construction of the building started in May 2006 and the commissioning of the storage ring is foreseen for the beginning of 2009. This report gives an overview of the status of the project.

INTRODUCTION

ALBA is the synchrotron facility constructed and operated by CELLS, the Consortium for the Exploitation of the Synchrotron Light Laboratory and is co-financed by the Spanish and the Catalan governments. Since the beginning of 2004, the team for CELLS is being constituted, the final design of the light source has been produced and several call for tenders have been launched. The light source should be operational in 2010, including the operation of seven Beam-lines among which six are based on Insertion Devices (IDs), covering a wide spectral range extending from UV to hard X-rays. Injector

INJECTOR

The injector for ALBA consists of a 100 MeV Linac, a 3 GeV booster synchrotron and the corresponding two transfer lines [1]. The Linac will be provided as a turn-key system by Thales Communications and the manufacturing will be finished in the second half of 2007. The ALBA booster has a circumference of 249.6 m and will be located in the same tunnel as the storage ring. A TME based lattice has been used in order to reduce the emittance up to 9 nm×rad. Figure 1 shows the optical functions for one quarter of the ALBA booster.

STORAGE RING

During 2005, the ALBA storage ring has seen the completion of its design and the start of the ordering of its main components (magnets, RF cavities and vacuum system). The optimization of the lattice has been extensively discussed in previous publications [2]. The storage ring is composed of 4 super-periods and provides 4 long straight sections of 8 meters long (one of them will be used for injection), 14 of 4.2 meters to accommodate most of the Insertion Devices and 8 of 2.6 meters will be mainly used for installing RF cavities and diagnostic components. Table 1 and figure 2 show the main characteristics of the ring and the optical functions within one super-period. We are currently examining more in details the closed orbit correction scheme and the effects of IDs on the beam dynamics. The first results are presented in [3] and [4].

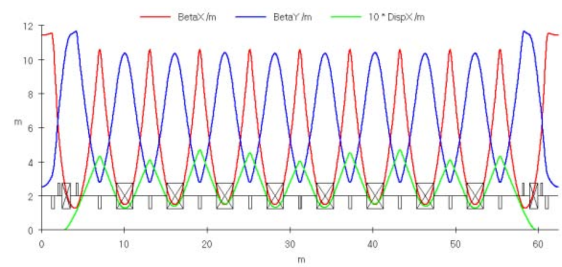

Figure 1: Machine functions along one quarter of the booster.

Table 1: Main parameters of the storage ring

Emittance	4.5 nm×rad
Energy	3 Gev
Circumference	268.8 m
Maximum beam current	400 mA
Betatron tunes (Q_x, Q_y)	(18.18, 8.37)
Natural Chromaticities (C_x, C_y)	(-39, -27)
Beam sizes (σ_x/σ_y)	
Middle of medium straight	132/7 μm
Middle of dipole	49/32 μm

Magnets

The ALBA Storage Ring is composed of 32 combined function magnets, 112 quadrupoles and 120 sextupoles. The combined magnets have a central field of 1.42 T, a gradient of 5.65 T/m and a central gap of 36 mm. The magnetic design of the ALBA Storage Ring magnets has been completed [5] and magnets are under design, at present, at the manufacturers. The magnetic measurements will be performed at the manufacturer for the quadrupoles and sex-

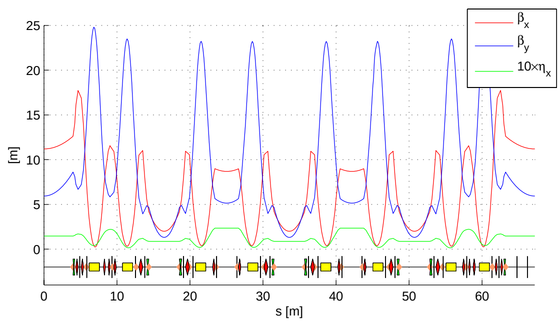

Figure 2: Machine functions along one superperiod of the storage ring.

tupoles using a rotating coil system and at CELLS for the combined function magnets using an existing Hall probe bench.

Vacuum

The storage ring will be divided into 16 vacuum sections by ultra high vacuum (UHV) gate valves. The vacuum chamber will be made of stainless steel with an internal vertical aperture of 28 mm and 72 mm width and will be connected to an antechamber with a slot of 15 mm height at the dipole chambers location and 10 mm elsewhere and 20 mm width [6]. The pumping system will guarantee that a pressure of 10^{-9} mbar will be achieved with beam on the machine. The antechamber will have discrete absorbers which will be distributed after each dipole all around the ring. Their design is similar to that of ANKA/SLS [7]; however, more cooling pin holes (4) have been introduced to the absorbers which are receiving the higher power densities (up 37 W/mm^2). Additionally, FEA have been performed in order to estimate the thermal stress and strain (see figure 3). The results show that this design is safe for the lifetime of the absorbers (up to 10^5 cycles).

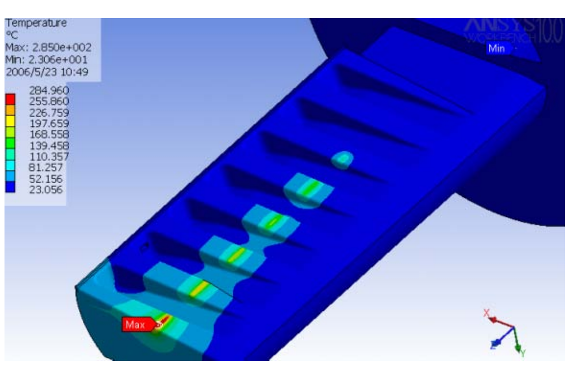

Figure 3: The FEA results for the temperature map for the most critical absorber (type 4), made of Glidcop.

Girders

The criteria for the design of the girder systems are to have a stiff system and to have high eigenfrequencies. In order to compensate for the effects of reverse focusing magnets, these should be mounted on just one girder. Mounting the dipole and its surrounding quadrupoles on the same girder gives a length of 6 m for the ALBA girder. To get eigenfrequencies above 40 Hz with such a girder, 3 pedestals per girder are necessary with overall 6 feet. The first design of one of the girders is shown in figure 4, including the location of the magnets in it. A prototype of the girder is under tendering. The alignment of the magnets on the girders relies on the magnetic measurements. After evaluation of the magnetic measurements, a set of shims will be produced to assure that the electron trajectory is defined by the magnetic axis of the magnets and not by the mechanical axis. The magnets will be then placed on the girders against the precise pins and fixed to the girders. Only the girders will have the possibility to be mechanically aligned inside the tunnel.

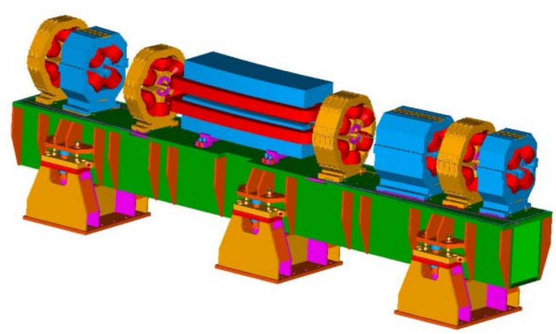

Figure 4: CAD drawing of one of the girder for ALBA.

RF System

The RF system of the ALBA Storage Ring has to provide 3.6 MV of accelerating voltage and 520 kW of beam power. This will be accomplished by six independent RF plants. Each one consisting of one HOM damped cavity, two 80 kW transmitters combined by a Cavity Combiner (CaCo), a transmission line and the Low Level RF [8]. CaCo is a new development which combines the power of two IOTs in a compact and efficient way [9]. The Low Level RF is developed in house and we are building two prototypes, one analogue and another digital [10]. A high power RF laboratory is intended to be completed by spring 2007 in order to test these new developments one year before the final installation.

Diagnostics

The orbit will be measured with 88 BPMs. At least three additional BPMs will be installed in the short straight sections: one for the Fast Feedback system, one for the tune measurement and one for general diagnostics. The design of the BPMs buttons has been optimized for good resolution and low beam power deposition [11]. Two synchrotron radiation monitors will be installed; one will work in the visible range and the other in the XR range, using the pinhole technique [12]. The diagnostics is completed with current transformers for beam current measurements, fluorescent screens for first orbit detection, scrapers for IDs protection, annular electrode for the longitudinal beam spectrum, striplines for tune excitation, kickers for the fast feedback system and pinger magnets for single turn excitation.

Insertion Devices

Seven beam-lines will be built together with the storage ring in the first phase. Six of them are based on IDs which characteristics are given in reference [13]. The magnetic conceptual design has been completed for all phase 1 IDs except for the conventional wiggler which is not yet specified. The in-vacuum and APPLE II devices will be built in collaboration with other laboratories.

SITE AND BUILDING

The design of the building including the technical infrastructure has been finished. Geotechnical studies, including ground vibration measurements, were carried out during the years 2004 and 2005. The execution of the projects has been divided in 13 lots, plus some additional ones for coordination and management. The responsibility and coordination of the construction is in the hands of the CELLS consortium. The tendering for the different lots of the building is under way, with some contracts already awarded, among them the soil movement and the construction of th slab of the critical floor area. The work started in May 2006. Figure 5 shows a view of the future ALBA complex, with the main office building attached to the experimental hall. The technical buildings hosting the infrastructure services are hidden behind the main building, with the help of the natural slope of the terrain.

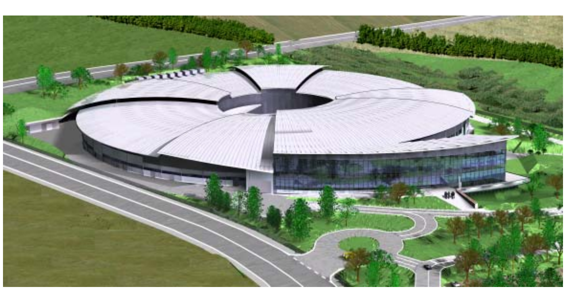

Figure 5: Preview of the ALBA building.

TIME SCHEDULE

The time schedule of the project is the following:

- March 2006: Start of the building construction and site urbanization.
- November 2007: Start of the installation.
- May 2008: Linac commissioned.
- June 2008: Finishing of the building.
- October 2008: booster commissioning.
- February 2009: Storage Ring commissioning.
- June 2009: Insertion Devices commissioning.
- 2010: Light for users.

ACKNOWLEDGMENTS

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