PROGRESS OF ALBA

Dieter Einfeld, for the ALBA design team, CELLS-ALBA, Bellaterra, Spain.

Abstract

ALBA is a third generation light source under construction near Barcelona, Spain. ALBA consists of a 3 GeV storage ring, a 100 MeV LINAC and a full energy booster. The LINAC has been installed and conditioned. The installation of the booster will start in December 2008 and the Storage Ring in spring 2009. The commissioning of the machine is expected to take place in sprint 2010. All components of the accelerators as well the transfer lines are under production or have already been finished.

LINAC

ALBA Linac is a turn key system provided by THALES Communications. The Linac has already been installed at CELLS. It was pre-assembled at THALES in three different girders and then shipped to CELLS.

The RF structures (Buncher, 1st and 2nd accelerating sections) are now being conditioned with a repetition rate of 1 Hz and a pulse length of 4.5 μs by means of two klystrons amplifiers (TH2100) that can provide up to 35 MW of maximum peak power. The nominal power that must be reached is around 20 MW. After that the nominal repetition rate of 3 Hz will be applied.

As soon as the RF structures stand the nominal input power the Linac commissioning will start, first in multi bunch mode and later on in single bunch mode. More details can be found in these proceedings [1].

Figure 1: Status of the LINAC

STORAGE RING

Magnets

The production of magnets is coming to an end. Around 50% of all SR magnets have been delivered to ALBA and have been magnetically validated.

Bending Combined Magnets

Up to now Danfysik has produced 20 combined magnets, 12 of them have already been magnetically validated at CELLS. The rms field integral reproducibility is $1.5\cdot10^{-3}$ at nominal current. The rms gradient integral reproducibility is $1.7\cdot10^{-3}$ at nominal current.

Quadrupoles

First statistical results concerning 22 quadrupoles 260 mm long and 12 quadrupoles 500 mm long are given in Table 1. The rms gradient identity between quadrupoles is of the order of $1.2\cdot10^{-3}$ at 150 A.

The B6 component has been minimised by optimising the chamfer during the pre-series measurements.

Table 1: Integrated multipolar components normalised to the main component (An=an/b2, Bn=bn/b2) in units of 10^{-4} at 25 mm

Harmonics	Q260		Q500	
	Mean Value	rms value	Mean Value	rms value
A3	+0.14	2.8	+1.48	2.0
B3	+0.50	3.3	-0.55	2.5
B4	-0.07	2.7	-0.86	2.7
B6	-0.87	1.4	-1.03	0.6
B10	-1.87	2.3	-1.97	0.5
B14	-0.56	0.6	-0.7	0.2

Sextupoles

Up to now 80 sextupoles (40 short (S150) and 40 long (S220)) had their magnetic measurements performed and have been validated by ALBA. First statistical results are given below in Table 2. The rms sextupolar strength reproducibility from magnet to magnets is $1.2\cdot10^{-3}$ at maximum strength.

The corrector coils are mounted on the sextupoles. The strength of correction has been measured at different currents and shown to be linear. All magnets should be deliver before winter 2008.

Table 2: Integrated multipolar component normalised to the main component (Bn=bn/b3) in units of 10^{-4} at 25 mm

Harmonics	S150		S220	
	Mean Value	rms value	Mean Value	rms value
B4	-3.00	3.0	-1.25	3.0
B5	-0.82	1.9	-1.27	1.8
B7	+0.25	0.4	+0.19	0.6
B9	-4.43	0.3	-3.84	0.4
B15	+2.43	0.2	+2.24	0.2

Power converters

All the SR power supplies are digitally regulated. A pre-series first delivery consisting of 4 quadrupoles PS and 2 sextupole PS have been delivered and undergone extensive testing at ALBA to demonstrate the fulfilment of the specifications. The power supplies exceed the expectations. All series power supplies are scheduled for delivery in autumn of 2008.

Vacuum System

Several components of the vacuum system are under manufacturing: the storage ring vacuum chambers are under production by FMB-Berlin together with the crotch absorbers and 6 aluminum vacuum chambers which will be coated at SAES Getter with non-evaporable getter (NEG) material. An assembly test of one complete cell of the storage ring was performed successfully: the chambers were assembled, baked out inside 14m long oven and vacuum tested.

The bellows and the chambers for the IDs, Diagnostics and injection straight are under prototyping with CECOM-Rome.

The delivery for almost all the vacuum chambers and bellows of the injection system is already accomplished; the chambers of the LTB are already installed inside the linac bunker, the vacuum performance of these chambers is within the specifications.

The standard vacuum components (ion pumps, and controllers, NEG pumps, valves…etc) have been already ordered and several deliveries were sent to CELLS.

Figure 2: one complete cell assembled and ready for transport to the bakeout oven

RF System

The RF system of ALBA is based in a new designed IOT amplifier feed with a Pulse Step Modulator HVPS [2]. The first system was delivered last year and it is installed in the ALBA RF lab, where it has been fully tested, complying with specifications. In the same RF lab, the first of the RF cavities has been tested and conditioned [3].

Two LLRF prototypes has been developed in-house, one Analogue for the Booster [4] and another Digital for the Storage Ring [5].

The waveguide system includes two new developments, a waveguide transition to coaxial transiton (Watrax) to feed the cavity; and a Cavity Combiner, to combine the power of two IOTs into one cavity.

All components are now in the production phase and will ready to be installed at the end of this year 2008.

Diagnostics Status

The Diagnostic system of ALBA will allow a complete characterisation of the electron beam as required by modern synchrotron light sources [6]. It includes Libera Brilliance electronics for the BPMs, fast digital oscilloscopes and electronics, precise timing, and dedicated designed in-vacuum components. Most of the components have been already delivered, some of them are undergoing acceptance tests and the first ones in the LTB has been already installed.

Electronics

The core of the timing system has been received. The Event generators and the 130 Event receivers, with their interface modules for TTL, LVPECL and optical outputs were tested, and some parts are already installed for the LTB transfer line.

The patch-panels for the data acquisition systems (ADCs, DAC, Beam loss monitors, etc) have been deployed and are ready for the installation. A new interlock board has been developed to interface the Liberas with the ALBA interlock system, and the fast interlock module, which is a fast data logger for the RF plants, and the series production has started.

Other developments include a High Voltage splitter, which will split the voltage output from the ion pump controllers to the ion pumps. This circuit measures the current for each branch and handles the interlock for the ion pumps. It includes the software for the automatic calibration of the system.

Control System

Alba uses TANGO as the toolkit for building the control system. 120 Diskless Compact PCI and 16 Industrial PCs will run the device servers. The main equipment protection system is implemented using B&R PLCs with distributed IO inside the tunnel. It consist on about 50 CPU and 100 remote I/O. Beam position monitors are read from Libera boxes controlled from a cPCI IOC.

Ethernet is widely used as a fieldbus. All Power supplies are controlled by Ethernet (with the exception of the correctors of the storage ring which will use a dedicated Link for the fast orbit feedback). Fluorescence screens (E-Giga), oscilloscopes (read through VNC connections), Motor controllers, communication with PLCs, and monitoring of the IOC boxes are connected by Ethernet. More than 2500 ethernet ports are dedicated to the accelerators control system. The network is organized in VLANS, separating PLCs, CCDs, General controls, monitoring and safety.

Insertion Devices

For the first phase of beamlines, six IDs are required. All of them have been outsourced: 2 in-vacuum devices (IVU-21) are being build by ACCEL in Germany, one conventional wiggler (MPW-80) is being build by ADC in USA, and one superconducting wiggler (SC-W31) is being build by BINP in Russia; 2 Apple-II devices are also being build in collaboration with ELETTRA in Italy. All these projects are in production phase and have passed the Final Design Review successfully.

The main characteristics of the devices according to the Final Design Reports are shown in Table 3 below, where'Gap' stands for minimum magnetic gap achievable and 'Field' stands for maximum vertical field in the magnetic axis and 'N' for the number of full-field periods.

Table 3. Magnetic characteristics of 1st phase insertion devices at ALBA

	Period	Field	Gap	N
	(mm)	(T)	(mm)	
IVU-21	21.8	0.797	5.7	92
MPW-80	80.0	1.782	12.5	12.5
EU-62	62.36	0.62	15.5	27
EU-71	71.36	0.70	15.5	22
SC-W31	30.16	2.10	12.6	59.5

Three devices (the two IVU-21 and SC-W31) have the own vacuum chamber, extending 2.5 m from flange to flange. The other three devices (Apple-II and MPW-80) are out vacuum devices and will use a thin Al vacuum chamber with a height of10 mm. All of the devices will be installed in the centre of the medium length straight sections except the wiggler MPW-80, which will be moved within downstream the medium straight section to reduce the distance between the source and the first optical element.

GENERAL FACILITES

The construction of the ALBA building started in June 2006. The civil works are already in their final stage, both at the Main and Technical building. A 2000 m2 warehouse is already in operation since the beginning of the year 2008 for storage of the deliveries from the different companies. Conventional installations (electricity, cooling, HVAC, etc…) are in progress, with the plan to have all works finished by the beginning of 2009. Meanwhile the installation activities are in progress (LINAC and preassembly of racks). Some preliminary tasks related to the mechanical installation of the booster are also in progress (drilling, supports…), whereas the main activities therein (vacuum, magnets,…) will start gradually during the period September-December 2008. The target is to have a short pre-commissioning run for the booster within the first half of 2009, while the storage ring mechanical installation proceeds. The commissioning of the storage ring is foreseen to the beginning of 2010.

Figure 3: Status of the building, June 2008

CONCLUSION

The construction of the ALBA light source is well under way, with a planned commissioning of the machine in 2009 (for LINAC and Booster) and 2010 (for the main storage ring).. More information about accelerator physics presented in this conference can be found in references [1-11].

REFERENCES

[1] A. Falone et alt., "Commissioning of the 100 MeV Preinjector for the ALBA Synchrotron", this proceedings.
[2] P. Sanches et alt, "The ALBA RF Amplifier System Based on Inductive Output Tubes (IOT)", this proceedings.
[3] M. Langlois, "Measurements on the Rf Cavity for the ALBA Storage Ring", this proceedings.
[4] H. Hassanzadegan et alt., "Analogue LLRF for the ALBA Booster", this proceedings.
[5] A. Salom, "Digital LLRF for ALBA Storage Ring", this proceedings.
[6] U.Iriso et alt, "Electron Beam Diagnostics for the ALBA Light Source". Proceedings DIPAC-07.
[7] T. Günzel, "Impedance and Instabilities for the ALBA Storage Ring", this proceedings.
[8] M. Muñoz et alt, "Alternative Optics for the ALBA Lattice", this proceedings.
[9] G. Benedetti et alt. "Linear and Non-linear Optics of the ALBA Booster Synchrotron", this proceedings.
[10] G. Bendetti, "Injection into the ALBA Storage Ring", this proceedings.
[11] J. Campmany, D. Zangrando et alt, "Design of Two Variable Polarization Undulators for the ALBA Project", this proceedings.