LNLS Status Report

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Abstract

The Brazilian synchrotron light source consists of a 1.15 GeV electron storage ring with a 100 MeV injector. Most of their components have already been developed in-house and production has been started. The increase of injection energy is being considered via a booster, for full energy, or by recirculating the beam in the LINAC (200 MeV)[1]. An update of the production and characterization of these components is presented.

1. Introduction

The synchrotron radiation facility being constructed in LNLS comprises a 100 MeV injector LINAC and a 1.15 GeV electron storage ring housed in a 4300 m^2 building (Fig. 1).

Using independent quadrupole power supplies for the zero-dispersion straight sections allows the matching to different insertion devices, including those with small gap. It will be also possible to operate with very low momentum compaction factors[2] with three-fold symmetry obtained by splitting the supplies to the sextupoles and quadrupoles families of the dispersive straights. The principal parameters of five modes of operation are shown in Table I.

Most of the necessary prototypes had been developed and characterized by the end of 1992 when production started. The majority of the components are being made in-house. Construction of the necessary buildings started in January/94.

2. Magnets and Power Supplies

All laminated magnets are laser cut from 1.5 mm thick low carbon steel sheets and assembled without welding by using tie rods[3]. Thus far all twelve dipoles, twelve vertical correctors and eighteen horizontal correctors have been cut and

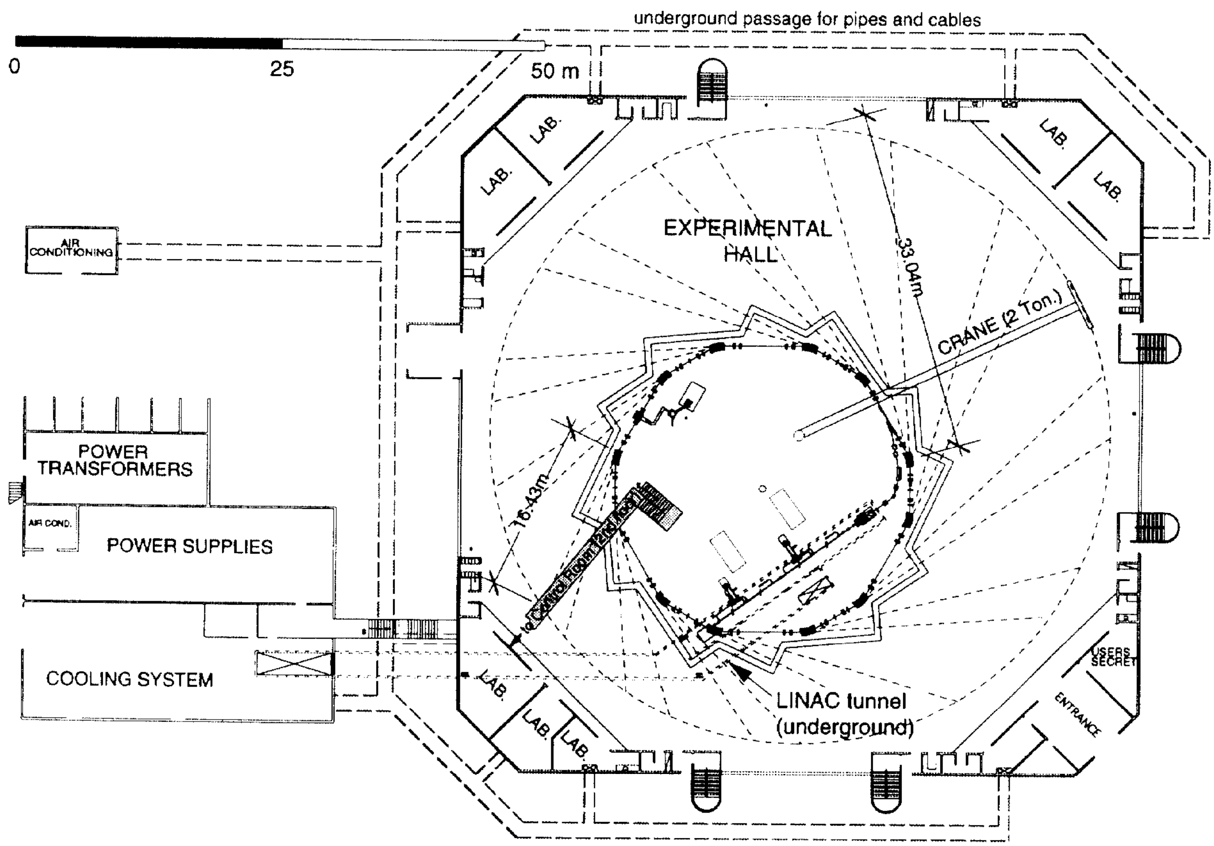

Figure 1: Main Building with the storage ring and experimental hall, on the ground floor, and underground LINAC.

assembled. The dipoles showed 0.02 mm standard deviation of the gap (58 mm). The final version of the quadrupoles presented good harmonic contamination (Fig. 2) and has been approved for production. All quadrupoles have trim coils which can be used in the future as additional correctors. The 24 quadrupoles of the insertion devices straights have built-in sextupoles to compensate for the geometric aberration introduced by the chromatic sextupoles.

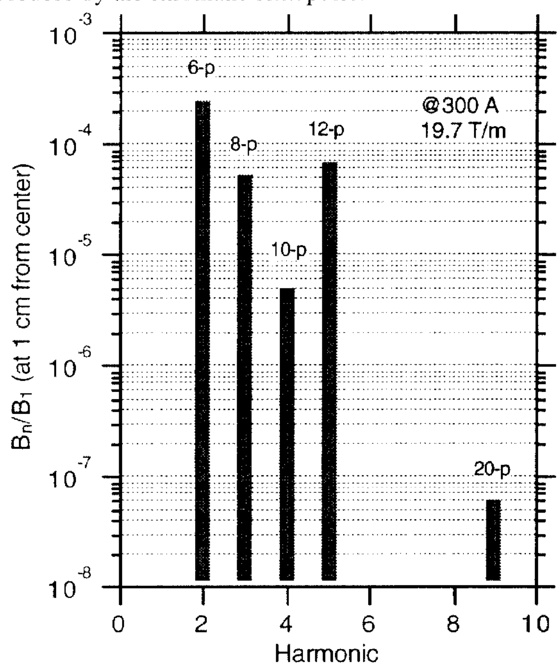

Figure 2: Storage ring quadrupoles harmonic contents.

The power supply for the twelve dipoles was tested with half load and full current (300 A) showing the same performance of the prototype[4]: repeatability and ripple smaller than 50 ppm from 30 A to 300 A. Fourteen 250 A quadrupoles power supplies, following the same topology, are also being fabricated in-house. All power supplies for correctors, including those for the transport line, have been tested.

3. STORAGE RING RF SYSTEM

Tests of the 476 MHz transmitter, using a UHF standard klystron and a water load, have been performed up to the maximum power of 60 kW.

The cavity under development, based on the SLAC PEP II B factory design, has one cell and 'extraction' wave guides for damping high order modes. An aluminum prototype has been characterized at low power and the copper version was vacuum-brazed recently[5].

4. VACUUM SYSTEM

TIG welded stainless steel 316L is used for the bending magnet vacuum chambers. Each chamber has two synchrotron light ports (4°/60 mrad and 15°/75 mrad), two NEG strip pumps, one ion clearing electrode (CERMET coated alumina) and a water cooled copper absorber (Fig. 3). Although the twelve chambers have reached a pressure of 2.10^{-10}mbar it may be necessary to rebuild these chambers to eliminate the NEG strips since it has been shown that they produce magnetic dust which may be a problem in applications with variable magnetic fields[6].

26 pumping stations, each with a 230 l/s ion pump, a 1600 l/s Ti sublimation pump and hot cathode gauge, have been built.

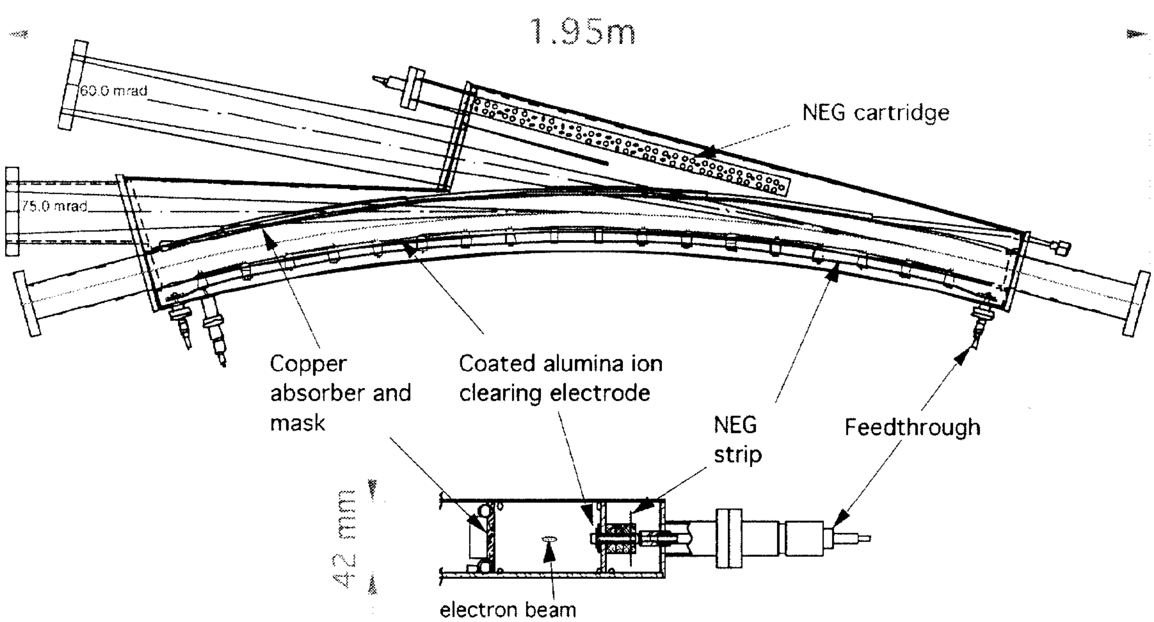

Figure 3: Bending magnet vacuum chamber.

5. SYNCHROTRON LIGHT INSTRUMENTATION

A standard frontend for the light beamlines has been developed and approved. The frontend comprises a gamma-ray shutter, slow and fast valves, synchrotron light mask and shutter and a air delay line.

The first beamline was finished in 1992 and was installed in the Center for Advanced Microstructures and Devices (CAMD) storage ring at Louisiana State University . It consists of a toroidal grating monochromator and detectors for VUV.

X ray monochromators have been developed and tested in the DCI ring (LURE, Orsay)[7]. One of these monochromators is now being installed in a CAMD X ray beamline.

A total of eight beam lines for applications in Material Science are being designed or constructed at LNLS.

6. REFERENCES

[a] Also at Inst. de Física "Gleb Wataghin", Univ. Estadual de Campinas (UNICAMP).

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[1] R.H.Farias *et al.*, "A 200 MeV Recirculating LINAC as an Injector for the LNLS UVX Electron Storage Ring", in these proceedings.

[2] Liu Lin and C.E.T. Gonçalves da Silva, NIM A 329 (1993) 9-15.

[3] A.R.D.Rodrigues et *al.*, Proceedings of the Particle Accelerator Conference, IEEE (1993) 1454-1456.

[4] J.A.Pomilio *et al.*, IEEE Trans. on Nuclear Science, 39 (1992) 1506-1511.

[5] D.Wisnivesky *et al.*, "The RF System for the LNLS Synchrotron Light Source", in these proceedings.

[6] Y. Petroff, personal communication, 1994.

[7] H.C.Tolentino *et al.*, Synchrotron Rad. News 6

	Normal	**Low Emittance**	**High Emittance**	**Low β**	**Quasi-Isochronous**
Energy (GeV)	1.15				
Nominal current (mA)	100				
Circumference (m)	93.212				
Magnetic structure	CG-6-fold				
Revolution frequency (kHz)	3216				
Harmonic number	148				
RF frequency (MHz)	476				
Natural emittance (nm.rad)	70.3	35.2	125.0	70.1	286
Tunes					
Betatron horizontal	5.27	5.72	4.75	5.27	5.26
Betatron vertical	2.17	1.85	1.85	2.17	2.15
Synchrotron (@ 500 kV)	9.194	9.194	9.194	9.194	0.946
Momentum compaction factor	8.3×10^{-3}	8.3×10^{-3}	8.3×10^{-3}	8.3×10^{-3}	8.3×10^{-5}
Natural energy spread (%)	0.059	0.059	0.059	0.059	0.059
Natural bunchlength FWHM (mm)	18.6	18.6	18.6	18.6	1.84
Natural bunchlength FWHM (ps)	62.0	62.0	62.0	62.0	6.1
Natural chromaticity					
Horizontal	-7.8	-17.7	-5.5	-7.9	-10.4
Vertical	-9.5	-9.3	-8.6	-10.0	-11.9
Damping times					
Betatron horizontal (ms)	13.2	13.2	13.2	13.2	12.1
Betatron vertical (ms)	12.6	12.6	12.6	12.6	12.0
Synchrotron (ms)	6.2	6.2	6.2	6.2	6.0
r.m.s. beam size for 10% coupling at insertion middle point					
Horizontal (mm)	0.94	0.95	1.17	0.93	0.30
Vertical (mm)	0.27	0.19	0.37	0.06	0.51

Table I: Main parameters of the storage ring for five different modes of operation.