The Canadian Light Source: STATUS REPORT UPDATE

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Abstract

The Canadian Light Source, CLS, is presently in the final phases of construction and commissioning of subsystems has begun. The CLS comprises four main systems: a 250 MeV LINAC, a 2.9GeV full energy booster, a 2.9 GeV storage ring and a number of beam lines serving interests ranging from infrared light to hard X-rays. Commissioning of the injection system up to and including the booster ring is expected to be complete in September 2002. The storage ring has compact lattice consisting of 12 double bend "achromats" sectors, incorporating twelve 5.2 m straights. Three straights will be used for injection, RF, diagnostics, and remaining nine for insertion devices (IDs). The initial set of beamlines will include two IR (bend magnet) and five ID sources supplying light to seven beamlines and up to ten experimental end stations. Construction and commissioning of the storage ring and initial phase of beamlines is scheduled to be complete by the end of 2003.

Keywords: Canadian Light Source, linac, booster, storage ring, insertion devices, beamlines

1. Linear Accelerator

The injection system is composed of the 250 MeV linear accelerator (linac), linac to Booster Transfer Line (LTB), and a 2.9 GeV full energy booster. The linac has been in operation for over 30 years as part of the former Saskatchewan Accelerator Laboratory. The 2856 MHz linac produces pulse trains of up to 136 ns in duration, corresponding to 68 buckets, at 500 MHz, in the booster and storage ring. The energy spread of the electron beam from the linac will be compressed [1] to about ±0.15%. This energy spread eases the beam transport [2] to the booster and increases the booster injection efficiency.

2. Booster Ring

The booster [3] accelerates the electrons from 250 MeV to the full energy of the storage ring, 2.9 GeV. The beam extracted from the booster is expected to have an average current of 20 mA over the duration of the pulse train. The booster repetition rate is 1 Hz. Pulse trains from the booster will be stacked in the storage ring, tail to tail over (3×68=)204 buckets, and up to an average circulating current of 500 mA.

This system was designed and built by Danfysik in Denmark as part of a design build contract. Danfysik used a concept design developed by CLS [3] and completed the detailed design and fabrication. With this contract CLS was responsible for the installation and Danfysik was responsible for supervision of the installation. The intent was to have a system that could be fabricated offsite and integrated at the CLS. This on-site integration to CLS systems required close coordination between the CLS staff and Danfysik staff.

The first parts to arrive on site were the girder pedestals that were to be installed within the tunnel. CLS staff installed the girders within ±3mm of the required ideal location. As part of the off-site fabrication, the magnets were mounted and aligned on the girders and the vacuum chambers installed. These aligned pre-assembled girders were then shipped to the CLS for installation. Installation and final alignment of the girders and cavities went extremely well. Survey checks of the magnets showed that they had not shifted during shipment, and alignment was easily achieved. Power supplies were tested at Danfysik prior to shipment to ensure functionality. Once at CLS, these power supplies and cables were quickly installed.

CLS procured and installed all vacuum pumps and gauges so that standard equipment could be used throughout the facility. Once the main girders were in place the water systems were installed.

Two radio frequency (RF) cavities were shipped to CLS for installation within the ring at the same time as the girders. Integration of the RF system required more time than was originally expected due to the complexity of the system and coordination between all contractors. However, the RF system was ready for commissioning tests in June, 2002.

The first injection into the booster took place in June. This was quickly followed by stored beam at the injection energy. In August a circulating current of 7.5 mA was ramped to 2.9 GeV. Shortly after this, the 2.9 GeV was successfully extracted from the booster. Details of the beam parameters will be measured in September 2002, when booster commissioning is expected to be completed.

3. Storage Ring

The storage ring (SR) has a circumference of 170.9 m, and incorporates twelve 5.2 m straights. The basic machine parameters are provided in Table 1.

Table 1: CLS Storage Ring Machine Parameters

Circumference	170.88 m
Periodicity	12
Tunes: ν_x, ν_y	10.22, 3.26
Momentum compaction	0.0038
Straights	
Length	5.2 m
β_x , β_y.,η_x (functions at center)	8.5, 4.6, 0.15 m
RF frequency	500 MHz
Harmonic number	285
Energy acceptance	1.54%
Dipole field	1.354 T
Horizontal emittance	18.1 nm-rad
Energy spread	0.111%