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Contributed paper

Present status of NSLS-II design and construction

S. SHARMA†, A. BROADBENT, L. DOOM, M. FALLIER,
H. C. HSEUH, B. KOSCIUK, V. RAVINDRANATH,
T. SHAFTAN, A. SITNIKOV AND J. SKARITKA

NSLS-II, BNL, Upton, NY 11973-5000, USA

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National Synchrotron Light Source (NSLS-II) is a new 3 GeV, 500 mA, high-brightness synchrotron light source facility being built at the Brookhaven National Laboratory. Approved for construction in January 2009, the NSLS-II project is expected to be completed in June 2014. In this paper we discuss the present status of the mechanical design and construction of some major components of this facility, namely (i) conventional facilities, (ii) injector complex (iii) storage ring, (iv) RF system and (v) beamlines.

1. Conventional facilities

The conventional construction of the NSLS-II (figure 1) is progressing on schedule or slightly ahead. The building foundations and Storage Ring (SR) tunnels are nearly complete followed by structural steel construction that is 70 % complete. The booster tunnel floor is about 30 % complete while placing of the experimental floor concrete is just getting underway. Underground utilities consisting of water, electrical, chilled water, steam and sanitary systems outside the ring building are in place and are now being extended into the inner courtyard. The completion of all conventional construction is anticipated in the spring of 2012.

2. Injector complex

The NSLS-II injector will be able to fill the storage ring from 0 to 500 mA in about 3 min and support the top-off mode in which 7.5 nC of charge would be injected once every minute to multiple bunches. A contract for the linac, consisting of a 100 keV thermionic gun, a 500 MHz/3 GHz bunching system, along with accelerating structures powered by 3 GHz klystrons, was awarded to Research Instruments GmbH in April 2010. Another contract for a 3 GeV booster with 1 Hz repetition rate (with 2 Hz option) was awarded to the Budker Institute of Nuclear Physics (BINP) in May 2010. Transport line magnets, supports, vacuum and diagnostics equipment are being specified and will be procured in 2010 – 2011. The SR injector straight with its DC and pulsed septa and four kickers is present in a preliminary design phase.

† Email address for correspondence: sharma@bnl.gov



FIGURE 1. NSLS-II construction site – June 2010.

3. Storage ring

3.1. Magnets and supports

The SR lattice consists of 60 dipoles, 300 quadrupoles, 270 sextupoles, 180 slow (iron-core) correctors and 90 fast (coils-only) correctors. In fall of 2009, five different contracts for magnet production were awarded to Institute of High Energy Physics (Beijing, China) (IHEP), Everson-Tesla, Danfysik, BINP and Buckley Systems. In May 2010, the first first-article magnet, a sextupole (figure 2a), was received and is currently under test and evaluation. After an evaluation of additional first articles of different types of magnets, full magnet production will start in fall of 2010 with final deliveries expected by the end of 2011. The magnets are supported on girders (figure 2b) designed for high vibrational and thermal stability (Ravindranath *et al.* 2010) Two first-article girders, delivered in May 2010, are undergoing evaluation. All 150 girders are expected to be delivered by August 2011.

3.2. Vacuum chambers

The detailed design of all aluminum vacuum chambers is complete. Extrusion, machining and welding of the chambers are underway with over 20 of the total

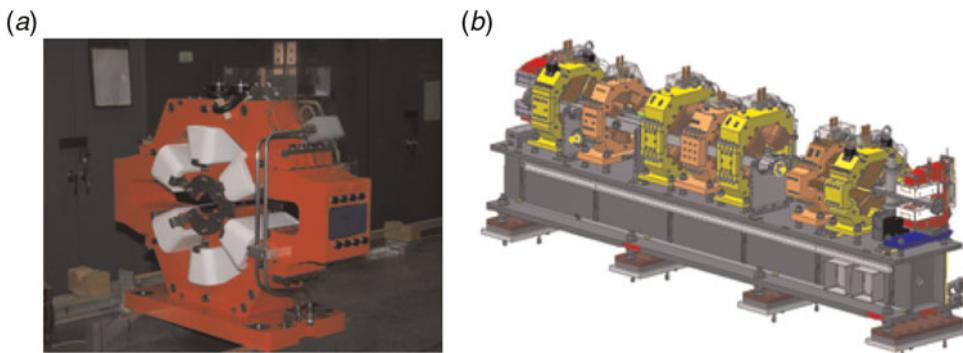


FIGURE 2. SR lattice magnets: (a) first-article sextupole and (b) magnets on a girder.

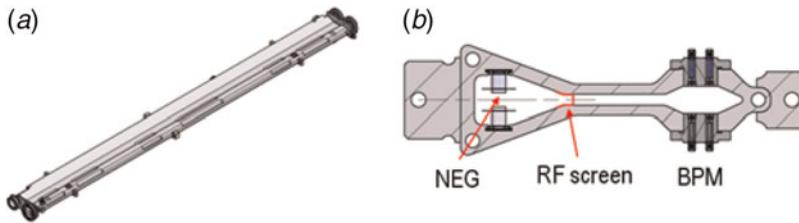


FIGURE 3. (a) A typical SR chamber and (b) a typical SR chamber with NEG strips, RF screen and BPM.

150-cell chambers already completed. Some production units, assembled with Non-Evaporable Getter (pump) (NEG) strips, RF screen and Beam Position Monitor (BPM) buttons (figure 3), are ready for integration with magnets and girders. Prototype absorbers and bellows have also been fabricated for testing and evaluation.

3.3. Frontends

Initial designs, FE analyses and prototypes of most of the frontend components (figure 4) have been completed. The X-ray intercepting components are designed to be made from Glidcop. Thermally stable Invar stands and stages have been designed for supporting X-ray Beam Position Monitors (XBPMs) and adjustable slits to meet the ± 200 nm stability and ± 1 μ m positioning specifications. A new simplified safety shutter with external lead shielding was developed and tested. All frontend components for the six project beamlines will be procured in 2011.

4. RF system

The baseline RF system consists of a two 500 MHz CESR-II cavities and one 1500 MHz harmonic Superconducting (SC) resonator at 4.2 K and a cryoplant with a heat load of 816 W. The layouts of the Superconducting Radio Frequency (SCRF) cavities and the cryoplant are shown in figure 5(a) and 5(b) respectively. The SCRF cavities, presently under design validation, will be contracted out in the fall of 2010 with the delivery expected in mid 2012. The basic design, layout and P&ID of the cryoplant have been completed (Sitnikov *et al.* 2010). A contract with detailed specifications is expected to be awarded in late 2010.

5. Beamlines

The six project beamlines (presented in several posters/papers of these proceedings) cover in-elastic X-ray scattering (IXS), hard X-ray nanoprobe (HXN), coherent

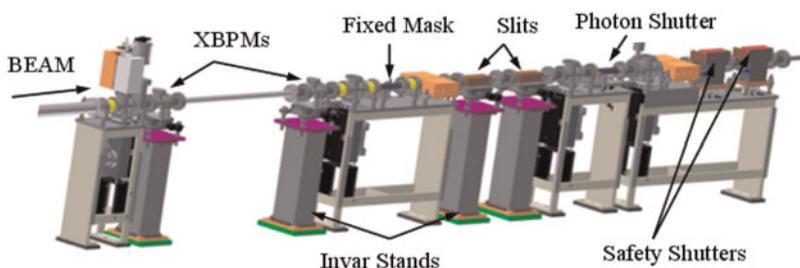


FIGURE 4. Layout of a typical frontend.

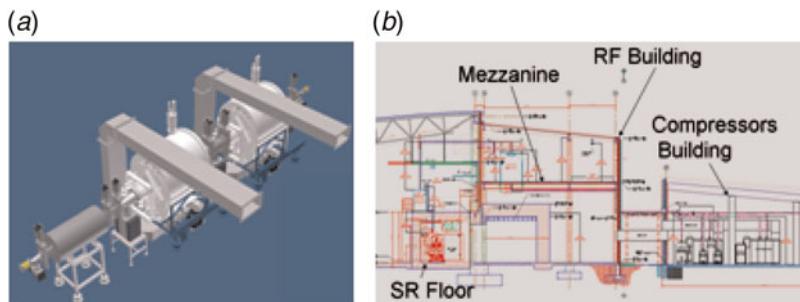


FIGURE 5. RF system layout (a) SCRF cavities and resonator and (b) helium cryoplant.

hard X-ray (CHX), coherent soft X-ray (CSX), sub-micron resolution X-ray spectroscopy (SRX) and X-ray powder diffraction (XPD). These beamlines are now about to go through the preliminary design review milestone, having already completed the conceptual design review in November 2009. First contracts will be placed in early 2011. First light for the beamlines is projected in June 2014.

6. Conclusion

The NSLS-II project is moving forward on schedule with many major components of the project already in the final design and construction phase. An early completion of the project is expected in mid-2014. Support for this work at NSLS-II, Brookhaven National Laboratory, was provided by the U.S. DOE, under Contract No. DE-AC02-98CH10886.

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