Swift progress on NSLS-II booster

October 2 2012, by Laura Mgrdichian

Booster installation has been the work of many here at Brookhaven and at Budker.

The electrons that will generate intense, focused beams of x-rays at NSLS-II are accelerated to their target energy before they enter the large main ring. That crucial job falls on a complex of equipment known as the injector, consisting of a linear accelerator, booster ring, transport lines, and storage ring injection straight section.

The booster is a joint venture between the NSLS-II injector group and the Budker Institute of Nuclear Physics (BINP), one of the NSLS-II vendors. BINP has a solid relationship with Brookhaven Lab and has played a significant role in NSLS-II development, coming up with the final design of the booster – the details regarding its magnets, power supplies, diagnostics, and other systems – and manufacturing most of the components.

The testing and installation activities have also spanned both organizations; in fact, several BINP staff have been staying on site to assist in readying design drawings, vacuum systems, power supplies, cabling, booster controls, pulsed magnets, etc. Booster commissioning, which may begin in early spring, will also involve both NSLS-II and BINP staff.

Injector installation coordinator Bill Wahl discussed the injector's swift progress over the last several months. Shipments from BINP and another vendor, Danfysik, started arriving at the Lab in January with a delivery of magnet girders and other equipment. BINP's final shipments came in August.

"Thanks to support provided by numerous NSLS-II team members, we are right on track for meeting our installation and commissioning objectives for the injector," said Wahl.

"Our injector group works very closely with other groups, such as the controls, diagnostics, radiofrequency, power supply, vacuum, etc. After the installation we'll do the integration test and commissioning together with these other groups and BINP," added Guimei Wang, a physicist in the injector group and one of the few women on technical staff.

Once components arrive on site, they are inspected and tested, including checks on the electrical components, vacuum quality, and magnet cooling systems. As of late August, most of the booster's magnet girders had been installed, with the last few currently undergoing testing. Those will be installed in the middle of this month, completing the booster girder installation.

At that point, tables for the transport lines – built at Brookhaven to connect the linac to the booster and the booster to the main ring – will be put in. By November, all of the components that go on the tables should be installed.

"The directorate is now entering a very exciting time where, by spring of 2013, we will be in a position to circulate beam in the booster to energy levels as high as 3 GeV," said Wahl. "This is a significant milestone that I am very happy to be part of."

Until then, the team is making improvements to organization and safety systems for booster commissioning. This is a consequence of lessons learned from initial linac commissioning, when, during a test, more radiation than expected was released into a controlled and secured area in the booster tunnel.

The booster sits inside the NSLS-II storage ring in its own tunnel, separated from the storage ring by a concrete wall and covered by a berm. Out of view is the linac vault, which resides adjacent to the ring building under a thick berm of earth as well.

Like the main ring, the booster ring consists of a specific arrangement of magnets, called a lattice. But the magnets are different, stemming from the rings' different jobs: The booster accelerates the electrons to their target energy of 3 giga-electron volts (GeV) while the storage ring keeps them at that energy. The booster magnets can simultaneously produce a dipole field, a quadrupole field, and a sextupole field, allowing the magnets to bend and focus the beam at the same time. The main reason for combined function is compactness and cost efficiency.

Wang designed and further optimized the transport lines to connect to the booster lattice. She also extensively studied the beam dynamics to ensure beam quality despite certain problems in the machine, such magnet field and alignment errors, and is currently in charge of the injector high-level application development. Along with BINP, she is developing user operations panel applications and beam measurement applications for booster commissioning, which will greatly improve the machine's operation efficiency.

Other NSLS-II staff members deeply involved in injector development are Timur Shaftan, who is in charge of injector development; Raymond Fliller, who has participated extensively in testing, design and commissioning; and Jim Rose, the radiofrequency (RF) group leader. As noted by Wang earlier, other NSLS-II groups are also making significant contributions.

Provided by Brookhaven National Laboratory