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Advanced Photon Source

Building the Linac Coherent Light Source

Early commissioning for the Linac Coherent Light Source (LCLS), the next-generation, U.S. Department of Energy-funded, free-electron laser x-ray source at the SLAC National Accelerator Laboratory (SLAC), has been nearly as easy as pushing the "Start" button.

On Saturday, December 13, 2008, a single, low-charge bunch of 13.6-GeV electrons was injected into the LCLS undulator system. The LCLS team had tried to predict how many shots of electrons would be required for transmission through the full length of the channel. Based on start-ups of other linear accelerators in years past, predictions of the time required ranged up to as much as three shifts, or 24 hours. The LCLS beam made it in two shots.

The beam traveled 1/4 of the way along the undulator line. Radio-frequency beam-position monitors responded, giving enough information to make a steering correction upstream of the undulators. A second bunch of electrons was injected, and it passed through the entire channel to the beam dump.

Sharing in the jubilation at SLAC were the personnel at Argonne National Laboratory who played a central role in the design and fabrication of critical LCLS technical components. Scientists, engineers, and technicians at the Advanced Photon Source (APS) and other Argonne divisions, together with private industry, worked closely with SLAC to produce the string of 33 undulator insertion devices (IDs) as well as the vacuum chambers, beam diagnostics, and controls systems for the hardware.

Technical parameters for the IDs' precision, stability, and uniformity were more stringent than those for any insertion devices manufactured to date. Another important strategic decision was how to make 100s of meters of devices economically. An innovative technical strategy allowed Argonne to build the devices in partnership with a company that could meet the task without necessarily having prior expertise in highly sophisticated insertion device production.

The 40 extruded aluminum vacuum chambers were also technologically challenging, given the need for a mirror-like surface through the entire interior length of each 3.4-m-long chamber, inside a very small aperture of 5 mm. Yet another challenge involved machining the chambers to be extremely flat and accurate to allow for alignment at very rigid tolerances during installation. The tolerance within the gap of the undulator is plus or minus just 25 μm over the entire length of the undulator.

The final five LCLS vacuum chambers, crated in Argonne building 382 and ready for shipment to SLAC, are shown surrounded by the members of the Argonne team that produced the chambers. APS Director Murray Gibson (right foreground) attended the send-off ceremony.

L. to r.: Joseph Xu, Marion White, Isaac Vasserman, Emil Trakhtenberg, Robert Lill, and Efim Gluskin (all APS) in the Long-Term Test Facility (LCLS undualtor, girder, and component mockup) in the APS experiment hall.

Call for APS General-User Proposals

The Advanced Photon Source is open to experimenters from all scientific disciplines who can benefit from the brightest hard x-ray beams in the Western Hemisphere.
General-user proposals for beam time during Run 2010-1 are due by October 30, 2009.
Information on access to beam time at the APS is at http://www.aps.anl.gov/Users/apply_for_beamtime.html or contact Dr. Dennis Mills, DMM@aps.anl.gov, 630/252-5680.

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