The Advanced Photon Source
Upgrading the ID Beamline at GSECARS

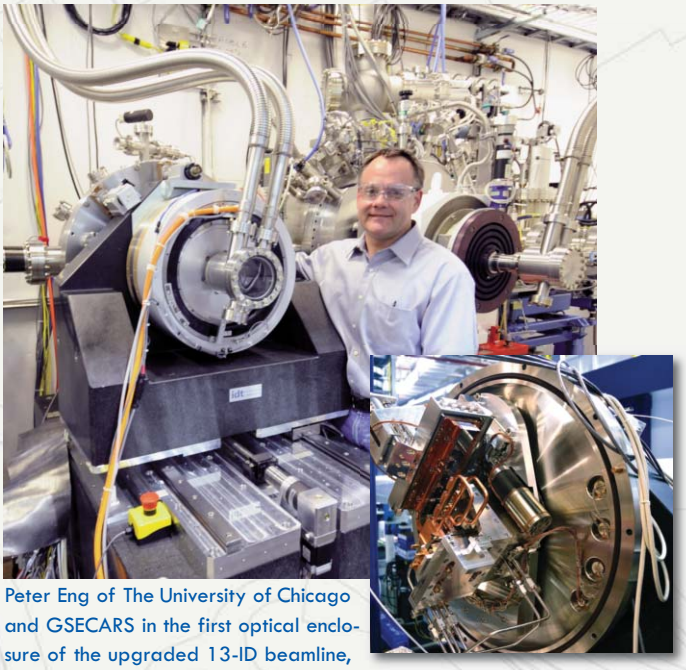
The GeoSoilEnviroCARS (GSECARS) sector at the Advanced Photon Source (APS, Sector 13 has just completed a major upgrade that doubles the amount of undulator beam time available to users. The facility, operated by the University of Chicago Center for Advanced Radiation Sources, provides synchrotron resources that support research on Earth materials and is open to the entire scientific community. Since the beginning of full operations in 1997, more than 3,787 individual scientists have utilized this facility on four end stations, two of which utilized APS Undulator A (UA).

The upgrade, funded jointly by the Department of Energy Basic Energy Sciences Program, the National Science Foundation, and the National Aeronautics and Space Administration, and in part utilizing American Recovery and Reinvestment Act funds provided to the APS, replaces the existing UA with two new undulators in a canted geometry. Each new undulator is better optimized for the end-station requirements and provides new or upgraded x-ray optics for these instruments.

One undulator (3.0-cm period) is optimized for hard x-ray energies (5.6-80 keV) for the surface scattering, multi-anvil press, and laser-heated diamond-anvil-cell instruments that it serves in stations 13-ID-C and 13-ID-D. The monochromator for this branch was upgraded and the existing large Kirkpatrick-Baez (K-B) mirrors were relocated, but most of the end-station instruments remain unchanged. The other undulator (3.6-cm period) serves a new, dedicated x-ray microprobe at 13-ID-E employing K-B mirrors to achieve beams with spatial resolution of 500 nm and providing a tunable energy range from 2.4 keV (sulfur K edge) to 28 keV.

To accommodate the tight spatial constraints of the canted geometry, many optical components were updated so that the two branches could work independently and without interference. Many of the upgraded designs were done in collaboration with Instrument Design Technology Ltd. (IDT) in the U.K. The double-crystal monochromator (DCM) on the in-board branch that serves the 13-ID-C/D end stations was rebuilt to use clamped cryo-cooled Si(111) and Si(311) crystals and to pass white-beam for experiments desiring it, while also allowing the outboard beam to pass by. This DCM was further upgraded to use dual in-vacuum encoders on the rotation axis and a granite base block. Vertical and horizontal K-B mirrors (each 1-m long) downstream of the DCM on this beamline can focus the full monochromatic beam to approximately 30 x 80 μm.

The DCM for the outboard microprobe branch also uses clamped cryo-cooled Si(111) and Si(311) crystals, but incorporates several relatively new design features. It uses a state-of-the-art direct-drive rotary stage with an air-bearing and ferro-fluid seal to provide a frictionless and ultra-smooth rotary drive with no backlash, very high radial stiffness, and low eccentricity and wobble. Two horizontal mirrors just downstream of the DCM are used to further separate this beam from the inboard beam. These mirrors can focus the beam to create a secondary horizontal source (SHS) that illuminates a high-stability precision slit.



Peter Eng of The University of Chicago and GSECARS in the first optical enclosure of the upgraded 13-ID beamline, with two monochromators in a canted geometry. Inset: crystal cage of the new 13-ID-E monochromator.

The microprobe end station includes new micro-focusing K-B mirrors capable of directly focusing the full vertical beam divergence and, in the horizontal, re-images the SHS producing a tunable spot size. This new optics configuration allows efficient optimization of the final focus for either high-flux or ultimate spatial resolution.

Commissioning of the upgraded 13-ID sector has now been fully completed and the beamline will support full user operations in the APS January-April 2013 cycle (run 2013-1) for all three 13-ID end-stations.

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Call for APS General-User Proposals

The Advanced Photon Source is open to experimenters who can benefit from the facility's high-brightness hard x-ray beams.

General-user proposals for beam time during Run 2013-2 are due by Friday, March 8, 2013.

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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