# The Advanced Photon Source
## The Dynamic Compression Sector at the APS

New knowledge, including atomistic level understanding regarding the performance of materials under extreme dynamic loading conditions is a field of interest to many researchers, but is of central importance to the U.S. Department of Energy (DOE) National Nuclear Security Administration (NNSA). Consequently, the DOE/NNSA is sponsoring a partnership between Washington State University (WSU) and the Argonne National Laboratory Advanced Photon Source (APS) to develop a first-of-a-kind user facility dedicated to dynamic compression science at the APS.


At the DCS sector on the APS experiment hall floor are, left to right, Kevin D'Amico, DCS Project Manager; Yogendra Gupta, WSU Regents Professor of Physics and Institute of Shock Physics Director; and Timothy Graber, WSU Research Professor and DCS Manager.

Dynamic compression experiments are both unique and versatile in their ability to produce and examine a broad range of extreme thermomechanical conditions (very large compressions, high temperatures, and large deformations) on very short time scales (picoseconds to microseconds) in a controllable manner. Advances in x-ray capabilities, such as the APS synchrotron, enable the generation of bright, high-energy, tunable x-rays to probe dynamic compression phenomena in real time, and with unprecedented temporal and spatial resolution. The result is time-resolved, atomistic-scale investigations of condensed matter phenomena as they occur.

The Dynamic Compression Sector (DCS) now under construction at the DOE Office of Science's (DOE-SC's) APS, will be a dedicated experimental facility designed to enable a mechanistic understanding of matter under extreme dynamic loading conditions. It will integrate state-of-the-art dynamic compression platforms and drivers with the APS x-ray source to permit time-resolved, multiscale measurements in single-event experiments.

The DCS facility, which is scheduled to start commissioning experiments in 2014 with full operations to commence in 2015, is the culmination of a NNSA-supported initiative begun several years ago by Professor Yogendra M. Gupta of Washington State University. WSU is partnering with the APS and collaborating with the DOE/NNSA National Laboratories (Los Alamos, Lawrence Livermore, and Sandia), Department of Defense laboratories, and academic institutions in developing and constructing the DCS infrastructure and instrumentation at Sector 35 on the APS experiment hall floor.

Scientific investigations at the DCS will examine time-dependent changes under dynamic compression pulses with peak stresses of ~5 GPa to well over 200 GPa, and time durations of ~5 ns to microseconds. This first-of-a-kind capability will focus on time-resolved, *in situ* diffraction and imaging measurements, simultaneous continuum measurements, and non-single-event experiments to complement dynamic compression.

The DCS beamline will have a nominal energy range from 10-35 keV—with a higher energy possible—and monochromatic-, pink-, and white-beam capability. Focused beam properties will range between ~20 μm x 20 μm to ~100 μm x 100 μm for probing a broad range of materials.

Novel instrumentation at the DCS includes a revolver undulator (being developed as part of the DOE-SC APS Upgrade Project), which allows higher x-ray brightness over a broader energy range than from a planar undulator with a single magnetic period, and single-stage and two-stage light-gas launchers coupled to unique motion systems designed to optimally link to the beamline.

The DCS capabilities will address long-standing scientific challenges with the potential for unprecedented scientific payoff in the areas of structural changes, deformation and fracture, and chemical reactions. In addition, the DCS will provide hands-on training for the next generation of scientists in this exciting field.

For additional information regarding the DCS, visit www.dcs-aps.wsu.edu.

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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 2014-1 are due by Friday, November 1, 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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