Argonne NATIONAL LABORATORY
www.anl.gov

Advanced Photon Source
Bldg. 401/Rm A4115
Argonne National Laboratory
9700 S. Cass Ave.
Argonne, IL 60439 USA
apsinfo@aps.anl.gov ◦ www.aps.anl.gov

The Advanced Photon Source

An R&D 100 for the Hard X-ray Quad Collimator

The Hard X-ray Mini-beam Quad Collimator, an innovative x-ray technology that enhances science's ability to study large biological proteins won an R&D 100 award, regarded as the "Oscars of invention," for the U.S. Department of Energy's (DOE's) Argonne National Laboratory.

The awards recognize the top scientific and technological innovations of the past year as judged by a team of independent experts for R&D Magazine. Argonne scientists have won 108 R&D 100 awards since they were first introduced in 1964.

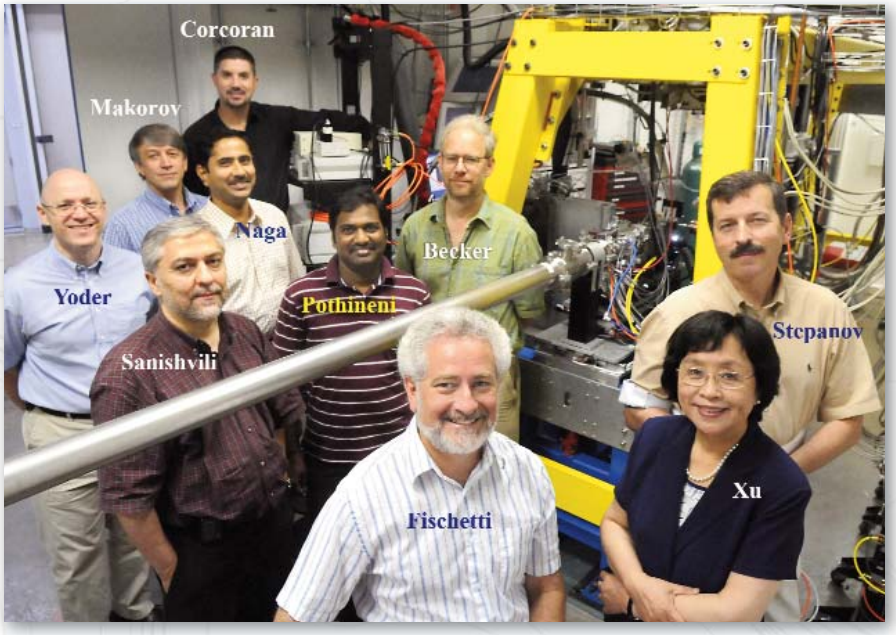
"I want to congratulate all of this year's winners on their awards and to thank them for their work," Energy Secretary Steven Chu said. "The large number of winners from the Department of Energy's national labs every year is a clear sign that our labs are doing some of the most innovative research in the world. This work benefits us all by enhancing America's competitiveness, ensuring our security, providing new energy solutions and expanding the frontiers of our knowledge. Our national labs are truly national treasures, and it is wonderful to see their work recognized once again."

The advent of high-quality, third-generation x-ray sources, such as the DOE's Advanced Photon Source (APS) at Argonne, has provided new advantages to protein crystallographers. One such benefit is the use of mini x-ray beams, which can be created in two ways: by using optical elements to reduce the focus size of the incident x-ray beam or by using collimating devices to sample portions of a focused beam.

The Hard X-ray Mini-beam Quad Collimator developed by researchers from the Argonne BioSciences Division, the General Medicine and Cancer Institutes Collaborative Access Team at Sector 23 of the APS, and the University of Michigan narrows the APS x-ray beam to a user selectable "minibeam" of 5, 10, or 20 micrometers in order to facilitate the study of extremely small protein crystals or to locate the best part of a heterogenous crystal. It also allows the process of selecting the correct collimator aperture size for a given protein crystal size to be automated.

The collimator consists of three essential components: a unibody quad collimator, a magnetically indexed kinematic mount, and a precision motion system. The system provides micrometer-sized beams of various sizes to a sample. It is compact, durable, and economical, and its motions are reproducible and precise at the submicrometer level. It can be placed on x-ray beamlines such as those at the APS or other x-ray sources.

Funding came from the National Institute of Health's National Institute of General Medical Sciences and National Cancer Institute.



The Argonne group named on the R&D 100 Award for the hard x-ray quad collimator, photographed at the GM/CA-CAT beamline at the APS: Robert Fischetti, Shenglan Xu, Nagarajan Venugopalan, Derek Yoder, Ruslan Sanishvili, Michael Becker, Sergey Stepanov, Oleg Makarov, Sudhir Pothineni, Steve Corcoran. Not pictured: Craig Ogata, Mark Hilgart and (from the University of Michigan): Janet Smith.

The Hard X-ray Mini-beam Quad Collimator was jointly developed by a team from Argonne and the Life Sciences Institute of University of Michigan. The principal developers from Argonne are Robert Fischetti, senior physicist; Shenglan Xu, principal beamline engineer; Nagarajan Venugopalan, protein crystallographer; Derek W. Yoder, beamline specialist; Ruslan Sanishvili, protein crystallographer; Michael Becker, protein crystallographer; Craig Ogata, protein crystallographer; Sergey Stepanov, controls group leader; Oleg Makarov, principal control systems developer; Mark Hilgart, software developer senior; Sudhir Pothineni, software developer senior; and Steve Corcoran, engineering specialist. The principal developer from the University of Michigan is Janet L. Smith, director of the Life Sciences Institute.

See: R.F. Fischetti, S. Xu, D.W. Yoder, M. Becker, V. Nagarajan, R. Sanishvili, M.C. Hilgart, S. Stepanov, O. Makarov, J.L. Smith, "Mini-beam collimator enables microcrystallography experiments on standard beamlines," J. Synchrotron Rad. 16 (2), 217-225 (2009). DOI: 10.1107/S0909049508040612

Contact: rfischetti@anl.gov

Call for APS General-User Proposals

The Advanced Photon Source is open to experimenters who can benefit from the brightest hard x-ray beams in the Western Hemisphere.
General-user proposals for beam time during Run 2011-1 are due by Friday, October 29, 2010.
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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