ACADEMIC

Emerging Technologies

Doubling up a photon source

A small group of government officials dedicated three new synchrotron beamlines at Argonne (Ill.) National Laboratory's (ANL's) Advanced Photon Source (APS) this past June. By itself this was not groundbreaking news, seeing that the APS currently operates 46 instrumented beamlines occupying 30 "straight sections" or sectors of the ring. The exciting part of the event was the announcement of the *type* of new beamlines that were being dedicated.

Developers: NIH and DOE researchers at Argonne's Advanced Photon Source

What's new: Beam management technology that enables doubling of the number of experimental beamlines in an x-ray synchrotron.

How it works: An insertion device creates two 1-mrad-separated beams while traversing a magnetically manipulated chicane.

Applications: Structural biology

Web site: www.aps.anl.gov

Termed the GM/CA (beamlines sponsored by the National Institute of General Medical Sciences and the National Cancer Institute, both branches of the National Institutes of Health, Rockville, Md.), the new designs allow increased automation, additional experimental stations, and finer x-ray beams. They also are the first implementation of a novel APS technology that splits one x-ray beam into two beams, each one with the same brightness as the original.

High-brightness x-ray sources are increasing in demand among materials scientists, physicists, biologists, and chemists. Structural biology by itself accounts for about half of all current synchrotron usage. Researchers who want to use the APS (the brightest x-ray source in North America) often have to wait months for a time slot to open up. The ability to create two beamlines in the space normally used for just one could effectively double the capacity of the APS for much less than the original $800+ million it cost to build the APS more than 10 years ago.

Creating two from one

The APS contains 34 straight sections in which 2.4-m long insertion devices are placed to tap into the APS's main rotating hard x-ray beam source. The design of the two insertion device beamlines is based on the APS's unique dual-canted undulator geometry. In this design, two independent, hard x-ray, insertion devices are placed collinearly in one straight section.

To create the doubling effect, a 0.4-m undulator section of each insertion device is replaced with a 1-mrad chicane with three small electromagnets. While the beam separation created at this location is only 1-mrad apart in the horizontal plane, at 30 m down the beamline, the separation has expanded to about 30 mm (500 mm at 70 m), which is large enough to be further separated with conventional optics, thus creating two identical beamlines in the physical space where only one beamline is now. The similarity of the two beamlines also allows standardization of experimental component design and know-how transfer during commissioning.

Several studies have already been conducted on the first of the new beamlines. In one study, researchers obtained a detailed structure of the bacteria-infecting HK97 virus, which is normally difficult to image. Access to one GM/CA beamline begins later this year, with all three available by 2007.

Color-dependent sensing

Scott Sanders, a mechanical engineering assistant professor at the Univ. of Wisconsin-Madison, has developed a laser system that rapidly delivers a pulsed rainbow of colors. The laser builds on the supercontinuum generation phenomenon, which converts single-color lasers into a multicolored beam using a special kind of optical fiber. By directing the laser through a 20-km optical fiber, Sanders created a "color-dependent speed limit."

>>More info: www.wisc.edu

Virtual neurorehabilitation

A research team led by Margaret McLaughlin and Thomas McNeill at the Univ. of Southern Calif., Los Angeles, is creating an assortment of haptics devices for stroke patients. The mutual touch task is designed for hand-reaching and grasping exercises. This tool uses a cyber grasp exoskeleton, which fits over an instrumented data glove that measures the position and orientation of the hand in 3-D.

The pincher is for two-fingertip contact with virtual objects. Telerehabilitation is a web-based interface, allowing both the therapist and the patient to log in to a private site, where patient recovery goals can be set.

>>More info: http://viterbi.usc.edu

Microcapsules made easy

Chemical engineers led by Michael Wong at Rice Univ., Houston, Texas, have developed an environmentally friendly approach for making microcapsules. Involving self-assembly at room temperature, under normal pressure, in water, and at mild pH, the process allows small silica particles to spontaneously form when nanoparticle building blocks are mixed with polymer and salt. Since the method takes place in water, any chemical suspended in the water gets trapped inside the sphere.

>>More info: www.rice.edu