BNL's Panayotis (Peter) Thanos

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Research Highlights . . .

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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System drastically cuts down botulinum toxin detection time

Researchers at DOE's Pacific Northwest National Laboratory have developed a method for detecting the presence of one of the world's most lethal substances, *botulinum neurotoxin*, which causes botulism, in as little as five minutes. The Lab's successful Biodetection Enabling Analyte Delivery System, or BEADS, combined with optical detection includes two critical features. First, BEADS isolates the toxin from environmental samples using antibodies to purify and concentrate the toxin to enable accurate and sensitive detection. Next, a second antibody, called a reporter antibody, labeled with a fluorescent dye or a fluorescent quantum dot binds to a different region on the toxin. The fluorescence of the quantum dot is measured on the bead and can quantify the concentration of the toxin.

[Greg Koller, 509/372-4864, greg.koller@pnl.gov]

PPPL provides small plasma lab to Goshen College

A small plasma lab soon will be on its way from the U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL) to Indiana to serve as a teaching tool for undergraduate students at Goshen College. The lab uses helium and neon plasmas and consists of two glass plasma-filled tubes. It is designed to teach students some plasma physics and give them experience with vacuum systems, basic electrical measurements, optical measurements and spectroscopy, plasma diagnostic techniques, and data analysis. It also will allow for creativity and the design of new experiments. The equipment is expected to be operational at Goshen in time for the January 2006 semester.R

[Anthony DeMeo, 609/243-2755, ademeo@pppl.gov]

New beam lines handle SPEAR3 thrust

Three beam lines on the SPEAR3 accelerator at the Stanford Linear Accelerator Center are undergoing major upgrades during the machine's scheduled downtime that started August 1 and ends November 28. When complete, the beam lines will be ready to handle the fivefold increase in beam power—to 500 milliamps (mA)—that SPEAR3 began generating on June 20. The beam lines will shine light for macromolecular crystallography, biological x-ray absorption spectroscopy and hard x-ray materials science applications. SSRL currently has 11 beam lines. A typical beam line carries the synchrotron x-rays created by magnets on the SPEAR3 storage ring some 30 to 35 meters to experimental stations where the research is done.

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Tiny devices eliminate blood drawing for medical tests

Two tiny devices recently developed at DOE's Sandia National Laboratories could mean the elimination of blood drawing by diabetes patients to test glucose levels or by medical personnel to determine if someone is having a heart attack. The two arrays of micron-sized needles operate similarly by penetrating painlessly into the skin. The needles can measure molecules inside the body, eliminating the need to withdraw blood from a patient. One device is ElectroNeedles, micron-sized electrodes capable of measuring molecules such as glucose that can donate or accept electrons. The other is µPosts, micron-sized posts that have the potential of painlessly measuring proteins and other macromolecules, released during a heart attack.

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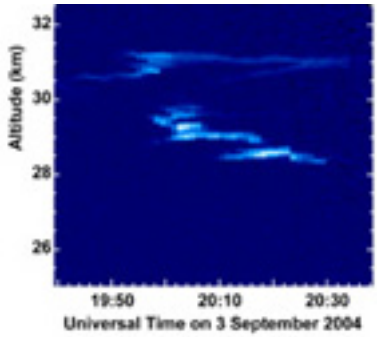
DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***DOE Pulse*** (www.ornl.gov/news/pulse/) is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

Meteoroid 'smoke' may influence weather, study finds

Space-based infrared sensors of the U.S. Department of Defense detected the object 75 kilometers high, descending rapidly off the coast of Antarctica.

DOE visible-light sensors, built by DOE's Sandia National Laboratories, noticed the intruder when it became a fireball. They identified it as an asteroid — not a missile — 56 kilometers above Earth. Five infrasound stations, to detect nuclear explosions anywhere in the world, registered acoustic waves (analyzed at the DOE's Los Alamos National Laboratory), confirming the speeding asteroid.



This image of a dust cloud from an asteroid plunging into Earth's atmosphere shows some of its unusual properties. The cloud sits vertically with thin wispy layers separated by a few kilometers. It lasted about an hour.

The debris cloud formed by the disintegrating space rock was imaged by NASA's multi-spectral polar orbiting sensor.

This array of multi-agency sensors worked together to provide basic facts: the time of entry, speed, and size — one of the largest meteoroids to enter Earth's atmosphere in a decade.

But, there was one last sighting: scientists using ground-based lidar detected an irregular cloud of material in the upper stratosphere over Antarctica. These were the first direct measurements of meteoritic "smoke."

Scientists have paid little attention to meteoroid dust, assuming it did not affect Earth's environment, says Andrew Klekociuk, a scientist at the Australian Antarctic Division. New observations suggest that this micron-sized dust could play a more important climate role, according to Klekociuk and other researchers, including Sandia's Dick Spalding, in an Aug. 25 paper published in the journal Nature.

The asteroid deposited 1,000 metric tons in the stratosphere in seconds, according to data from Sandia sensors, whose primary function is to detect nuclear explosions. The sensor evolution to include meteor fireball observations came when Sandia's Spalding recognized that ground-based data processing might be modified to record the relatively slower flashes of asteroids and meteoroids.

This ability to distinguish a nuclear explosion from an asteroid fireball with equavalent energy provides an additional safety margin for decision makers responding to nuclear threats.

Submitted by DOE's Sandia National Laboratories

Turning off alcohol abuse

Panayotis (Peter) Thanos

"Stopping alcohol abuse will never be as easy as turning on or off a 'switch,'" says Panayotis (Peter) Thanos, a neuroscientist at the U.S. Department of Energy's (DOE's) Brookhaven National Laboratory. "But understanding the brain's reward circuits and finding ways to modulate them could play a role in developing successful treatments."

Through brain-imaging and behavioral studies in animals, Thanos and his colleagues have demonstrated that a variety of brain receptors play a role in excessive drinking — including those for dopamine, one of the brain's primary reward chemicals, and those that trigger the reinforcing properties of marijuana.

Adding more receptors via "gene therapy" or blocking their ability to send pleasure/reward signals can drastically affect drinking behavior, Thanos' studies have shown.

"When you see a rat that chooses to drink 80 to 90 percent of its daily fluid as alcohol, and then three days later it's down to 20 percent, that's a dramatic drop in alcohol intake."

Thanos traces his interest in brain chemistry and behavior to an undergraduate class at Queen's University in Canada. He volunteered to work with his professor in the lab and got hooked — on research. After completing his Ph.D. at Eastern Virginia Medical School, he went to Stony Brook University and collaborated with scientists at Brookhaven's Center for Translational Neuroimaging, joining the Lab as a neuroscientist in 1999.

Thanos extends the research opportunity he had as a student to three or four undergraduate students each semester — and sometimes more in the summer. "Even if students have had no prior research experience," he says, "they can produce great work."

With many of these students going on to medical school, graduate school, dental and veterinary schools, it's clear that Thanos' ability to spot and spark that motivation pays off for the students as well as their mentor.

Submitted by DOE's Brookhaven National Laboratory