DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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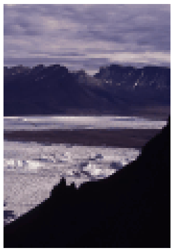

DOE's Argonne National Laboratory e-mails from the Arctic.

See page 2.

Research Highlights . . .

Senate OKs Bill to Create School Security Center at Sandia

The U.S. Senate has unanimously approved the Safe Schools Security Act proposed by Sen. Jeff Bingaman, D-N.M., which is based on a demonstration project by Sandia to cut the crime and violence level at Belen (N.M.) High School. The bill calls for establishment of a School Security Technology Center at DOE's Sandia National Laboratories, staffed by experts who would examine the needs of individual schools and custom-design security packages. Since the beginning of the Belen pilot program, which cost about $72,000, Belen High has experienced, among other things, 75 percent fewer fights on campus, 95 percent fewer false alarms, and a 90-percent drop in incidents of vandalism and theft. More details at http://www.sandia.gov/media/schlsec.htm.

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NREL Researcher is Top World Physicist

Dr. Alex Zunger, Institute Research Fellow at DOE's National Renewable Energy Laboratory, has been ranked as one of the top physicists in the world by the Institute of Scientific Information. The standing is based on the number of times his research has been cited by fellow scientists. Of the 517,111 physicists ranked in the ISI study, Zunger was the 39th most-cited physicist worldwide, and the seventh most-cited theoretical physicist. His published research was cited about 8,000 times by fellow physicists over a 15-year period. You can find more at http://www.nrel.gov/

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Synchrotron X-rays Shine On Environmental Tasks

Scientists at the Synchrotron Division at DOE's Stanford Linear Accelerator Center are concerned about a wide variety of environmental problems from remediation of toxic sites to accumulation of selenium in agricultural soils. Synchrotron X-rays provide the means to characterize trace quantities of metals found in the natural environment (such as water or soils) and may be hazardous (like uranium and plutonium). Research is currently being done on Hanford waste tank speciation; vitrification of high-level waste; and phytoremediation of metal contaminants in waters and soils. An understanding of the fundamental chemistry of such materials will help guide strategies for clean up and long term waste management, issues of paramount importance to the Department of Energy.

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Deadly Kidney Disease Gene Found

Scientists from DOE's Lawrence Livermore National Laboratory have teamed with international collaborators to pinpoint a gene responsible for causing a deadly kidney disease. Congenital nephrotic syndrome is a progressive disease that causes massive amounts of proteins to be excreted from the body and usually causes death by age 2. The only life-saving alternative is a kidney transplant. Although the disease is most prevalent in Finland, the discovery may have relevance far beyond Scandinavia. Scientists believe the mutated protein may be a key to how the human kidney filtration process works and thus shed light on other kidney ailments.

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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*** is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

Sandia, Lawrence Livermore and Los Alamos March Toward Fusion

Researchers at Sandia National Laboratories' Z machine—a massive accelerator meant for weapon research and to produce conditions required for nuclear fusion—have increased its X-ray power output by nearly 10 times in the past two years, while achieving other-worldly temperatures and astonishing energy levels.

One of the most recent advances resulted in a world-record X-ray power output of about 290 trillion watts—for billionths of a second, about 80 times the entire world's production of electricity. That shattered Sandia's previous world record—210 trillion watts—reported last summer.

Almost in the same research breath, Z achieved 1.8 million degrees Kelvin in its spool-of-thread-sized target.

And working closely with Sandia's "Z scientists" all the while have been colleagues from both Los Alamos and Lawrence Livermore national laboratories. The three labs often are called the Department of Energy's "national security" labs.

Z's power and temperature advances clearly demonstrate a key programmatic goal of DOE's national security labs—to make major contributions to the department's science-based approach to stockpile stewardship, which must use giant computing and laboratory experiments to provide the basis to sustain the nation's nuclear stockpile without above- or below-ground tests.

The Lawrence Livermore group performed some of the experiments leading up to attainment of Z's 1.8 million temperature—one of four key performance goals, which fall into the general categories of power, energy, and weapons and fusion temperatures. Los Alamos team members have been providing complex two-dimensional computer simulation support for Z's suite of experiments, which are moving ever closer to fusion conditions.

A recently proposed, bigger machine called X-1, built along the lines of Z, is expected to achieve high-yield fusion. High-yield means that considerably more energy is released by a nuclear reaction than was used to ignite it. There action, the same type as occurs in our sun, could eventually be used to produce virtually limitless electrical power.

Although Z relies upon simple wall-current electricity to charge giant capacitor banks, there can be no dispute that Z is one of the most complex machines in the world. When the accelerator fires, powerful electrical pulses are delivered by 36 transmission cables protected by insulation techniques developed over the past 30 years. Highly synchronized laser-triggered switches allow the stored energy to be discharged simultaneously through the 36 cables, each as big around as a horse and 30 feet long, arranged like spokes of a wheel and insulated by water. The enormous electrical pulse of 50 trillion watts strikes a complex target about the size of a spool of thread. (The machine is named Z because the current passing directly into the target travels vertically—a direction conventionally labeled 'z' by mathematicians and physicists to distinguish it from the x and y directions, both horizontal.)

The target consists of a metal can containing several hundred nearly invisible tungsten wires, each much smaller in diameter than a human hair. The metal can, called a hohlraum, functions like an oven, confining radiation energy released when the wires first explode and then subsequently collapse on themselves. Several variations of this assembly are responsible for increasing the temperature and power of Z.

For more about Sandia's Z machine and related research along with downloadable art see: http://www.sandia.gov/media/z290.htm and http://www.sandia.gov/media/Z.htm.

Submitted by Sandia National Laboratories

Argonne Chemist Shares the Arctic with Students via E-mail

Last July, students and teachers from around the world were the first to have the chance to communicate with a scientific expedition to the Arctic.

Chemist Ken Anderson of DOE's Argonne National Laboratory was one of six researchers who traveled to Axel Helbert Island in the far northern Canadian Arctic. The research site is located between the magnetic north pole and the geographic north pole.

Anderson maintained contact with Argonne via satellite link. He was able to transfer data and images collected from the research site and send and receive e-mail.

Anderson said no one has ever attempted communicating with portable equipment from a location so far north.

"The satellite is located one degree above the horizon," he said. "Just a little further north, and you're out of satellite range."

Using e-mail was originally intended only for transmitting data, but Anderson's wife suggested that family members in his native Australia would enjoy receiving e-mail from the Arctic.

"From that, I got the idea to involve students," Anderson said. "Going on the expedition was too good an opportunity to pass up, and too good not to share."

The expedition collected fossilized plants from the remains of a forest that grew at the site 45 million years ago.

Anderson's research focuses on how plant matter—leaves, bark, wood and resin—is converted into coal. The trip provided a unique opportunity to collect samples of individual plant tissues that were preserved before they could decompose and mix with others.

Researchers also studied the site's geology and sediment to learn why these fossils are so well preserved.

"There had to be something there at the time that was preserving things as they fell," Anderson said.

The expedition was funded by the Carnegie Mellon Foundation. Anderson's research is funded through DOE's Office of Basic Energy Science, Division of Chemical Sciences.

Submitted by Argonne National Laboratory