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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Best photos of Neptune, Titan

The best Earth-based images ever of Neptune and of Saturn's largest moon, Titan, were reported by researchers from DOE's Lawrence Livermore Lab, University of California at Berkeley, UCLA and Keck Observatory in Hawaii. The infrared images were captured on Keck-II telescope using a new form of adaptive optics to compensate for Earth's atmospheric turbulence. The unprecedentedly clear images reveal giant storms on Neptune and possible hydrocarbon lakes on Titan. The work, announced to the American Astronomical Society in Atlanta, was supported by DOE, NASA and NSF. Photos are at www.llnl.gov/PAO/photos/Neptunecap.html.

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'Green' chemical industry

New "green chemistry" technology that substitutes benign carbon dioxide for noxious industrial solvents holds great promise for the $368 billion per year U.S. chemical industry. The chemical industry plays a vital role in the nation's economy, representing 10 percent of all manufacturing and employing more than 1 million Americans. It uses about 3.8 million tons of solvents per year, most of which are potentially hazardous to health, safety and the environment. Solvents are necessary as media for chemical reactions, chemical separations and cleaning. A new approach utilizes newly developed chemicals, called surfactants, to disperse insoluble substances in carbon dioxide. It is being pioneered by DOE's Oak Ridge National Laboratory, the University of North Carolina, Pacific Northwest National Laboratory and the University of Texas.

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'Roadmap' to guide U.S. photovoltaics industry

Americans want solar electricity. The U.S. photovoltaics industry wants them to have it. Solar cell manufacturers and suppliers see photovoltaics (PV) producing at least 15 percent of the additional electrical power the United States will need in 2020. But how will the industry bring down costs, overcome market barriers, increase production and accelerate research and development? The recently released Report of the PV Industry Roadmap Workshop provides a guide. The report outlines goals and strategies for industry and its R&D partners through 2020. The National Center for Photovoltaics, which includes researchers from DOE's National Renewable Energy Laboratory and Sandia National Laboratories, coordinated the roadmapping effort.

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Sharper images of the universe

A new kind of charge-coupled device developed by electrical engineer Steve Holland at DOE's Lawrence Berkeley National Laboratory, inspired by detectors built for high-energy physics, is being tested at California's Lick Observatory by astronomers searching for planets around distant stars. Meanwhile, an 8-million-pixel version of the new CCD is being fabricated for the Keck Telescope in Hawaii. Unlike conventional fragile astronomical CCDs, which must be thinned to less than the width of a human hair and cost tens of thousands of dollars, the new high-resistivity, voltage-biased, pure silicon chip is thick, rugged, and far more sensitive in the red and infrared regions of the spectrum.

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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).

DOE satellite developed by Sandia, Los Alamos

Preparations are under way for the planned Feb. 8 launch of DOE's Multispectral Thermal Imager (MTI) research satellite developed at Sandia and Los Alamos national labs in New Mexico.

The unique imager satellite includes a sophisticated telescope that collects day and night ground images in 15 spectral bands ranging from the visible to long-wave infrared. Designed and built by Sandia and calibrated in a special facility at Los Alamos, the satellite has the ability to "see" reflected and thermally radiated electromagnetic waves that are not visible to the human eye, and performs at a level currently achievable only in a laboratory setting.

The project's three-year mission objectives are to advance the state-of-the-art in multispectral and thermal imaging, image processing and associated technologies, and to better understand the utility of these technologies. Researchers at Sandia, Los Alamos and other DOE facilities will compare satellite images to "ground truth data" simultaneously collected from volunteer US sites that have been instrumented by DOE's Savannah River Technology Center.

Because the technology is expected to have a broad range of national defense and civilian applications ranging from treaty monitoring to mapping of chemical spills, waste heat pollution in lakes and rivers, vegetation health and volcanic activity, DOE has established an MTI Users Group, comprising more than 100 researchers from 50 national defense and civilian agencies. These researchers will conduct similar experiments using MTI images of instrumented ground sites.

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The satellite also carries a High-energy X-ray Spectrometer (HXRS) sponsored by the National Oceanic and Atmospheric Administration (NOAA) and developed by Space Devices, Ltd. of the Czech Republic. This instrument will collect data needed to better understand a rare species of solar flare known to be associated with high-energy particle storms that can endanger astronauts and damage space equipment.

The satellite is to be launched by the US Air Force Space and Missile Test and Evaluation Directorate from Vandenberg AFB, Calif. It will be inserted into polar orbit aboard an Orbital Sciences Corporation Taurus rocket.

The satellite's development was funded by DOE's Office of Nonproliferation and National Security, and the launch is funded by the Department of Defense's Air Force Space Test Program.

Submitted by DOE's Sandia National Laboratories

Every picture tells a story

For Andrzej Joachimiak, every picture tells a story in Argonne's Structural Biology Center.

Ever since Watson and Crick made a stick and ball model of DNA and the secret of biological inheritance unfolded before their eyes, 3-D models have been the key to understanding biological activity.

This image of the protein cyanese permits biologists to understand how it works. The enzyme may be important for technologies that use biological species to clean the environment.

Now, scientists at DOE's Argonne National Laboratory are setting speed records in collecting data for those 3-D models. For example, in just 23 minutes, they obtained data needed to fully construct a 3-D image of a portion of a molecular structure involved in protein folding. Previously, such an experiment would have taken 24 to 36 hours.

The work is being done at the Structural Biology Center, part of the Office of Basic Energy Sciences-funded Advanced Photon Source.

"Because we can work so quickly, we can actually test the crystal, learn its diffraction properties and optimize the experiment before collecting the data needed for determining 3-D images," said Joachimiak, who leads the team of scientists at SBC.

So what's the rush? Biologists can now work fast enough to investigate smaller, fragile crystals before the X-rays break them down. Scientists can also study smaller crystals and much larger proteins and protein complexes.

"But most important," said Joachimiak, "we can apply the most advanced methods of structure determination because we can readily change the energy of the X-rays and quickly get several complementary data sets from the same crystal. This approach greatly simplifies the structural analysis."

"Our product is precise, high-resolution 3-D structure," he said. "In about a year, more than 1,200 data sets were produced and more than 100 structures have been solved." Compare that with the slightly more than 7,500 structures identified over the past 50 years.

Submitted by DOE's Argonne National Laboratory