Brookhaven's Sergei Maslov

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Small hybrid solar and wind energy systems offer alternatives

Researchers with the National Renewable Energy Laboratory's PV (photovoltaics) International Program currently are testing and collecting data on hybrid power systems, including a small hybrid solar and wind energy system, to show how they can power remote households and villages as effectively as solar, wind, diesel or battery power alone. These systems are an increasingly economic alternative because solar and wind technologies are modular and the seasonal variations of solar and wind resources often are complementary. As part of project, the PV International Program is providing live data and project details on its Web site at International Systems Testing.

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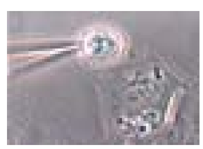
'Nanobiosensor' probes living cells



The nanoprobe can penetrate and be safely removed from a living cell.

Researchers at DOE's Oak Ridge National Laboratory have developed a "nanobiosensor" that allows scientists to physically probe inside a living cell without destroying it. As scientists adopt a systems approach to studying biomolecular processes, the nanobiosensor—a tiny fiber-optic probe with a tip1,000 times smaller than a human hair—provides a valuable tool for intracellular studies that have applications ranging from medicine to national security to energy production. The new technology has already provided researchers with the first observation of programmed cell death in a single live cell.

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NETL 'hyper' unit goes active

A new 250-kilowatt test unit at DOE's National Energy Technology Laboratory helps engineers reach a near-zero emissions approach to electricity production by giving them a better understanding of how a fuel cell/gas turbine hybrid system operates. The hybrid technology is highly efficient, and the Hybrid Performance Project (Hyper) will further boost efficiency and lower emissions. By simulating a fuel cell/ turbine system, Hyper allows organizations to test their emissions-control strategies, validate models and see how a fuel cell, integrated with a turbine, functions. Specifically, it charts changes in load, pressure or air flow, analyzing data on a millisecond basis. University and industrial researchers are lining up to start testing on the one-of-a kind facility.

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Study reveals new details about cloud formations

A team of scientists, including DOE's Lawrence Livermore National Lab computer scientist David Stevens, has determined a close tie exists between distant sources of pollution, and their effect on the formation of clouds that influence global climate. Their study, reported in the April 30 edition of the journal *Science*, focused on tropical anvil cirrus clouds, which respond strongly to increasing sea surface temperatures. The clouds' ice crystals were found to form in the mid-troposphere, 6-10 km above the earth, higher than previously thought. The results also show that polluted aerosol concentrations in this area of the atmosphere may affect cirrus cloud radiative properties, evolution and lifetime.

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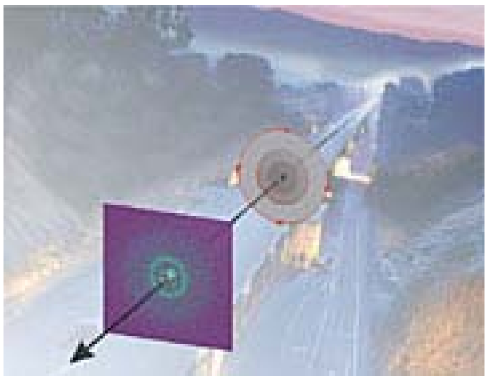
DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***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).

Physicists post a lower speed limit for magnetic switching

The speed of magnetic recording–a crucial factor in a computer's power and multimedia capabilities–depends on how fast one can switch a magnet's poles. A team led by Hans Christof Siegmann and Joachim St hr of DOE's Stanford Synchrotron Radiation Laboratory (SSRL) found that the ultimate speed of magnetic switching is at least 1,000 times slower than previously expected. SSRL is part of the Stanford Linear Accelerator Center (SLAC), a DOE facility operated by Stanford University.



Magnetic Recording

The experiment exploited the unique capabilities of SLAC's 2-mile-long linear accelerator (linac). "This is a wonderful illustration of the value of very different disciplines working together: scientists from a synchrotron light source using a high energy physics linear accelerator to do an experiment on magnetism," says Raymond L. Orbach, director of the DOE Office of Science.

In a computer hard drive, a writing head hovers over a rapidly spinning disk. An electric current running in the head creates a magnetic field, which records data by turning tiny areas of the disk's surface into microscopic magnets. The disk is coated with a special, grainy material that allows only two, opposite directions of the magnetization, representing the 0 or 1 of a basic unit of data, or bit.

The beam of electrons produced by the linac played the role of the electric current in a hard drive's writing head, producing some of the world's strongest and fastest magnetic pulses. The researchers shot electrons through samples of magnetic recording material, and found that the material responded inefficiently, a behavior that was only expected at much higher speeds.

In principle, the experiment puts a limit at 100 times the speed of the fastest hard drive currently available, says collaboration member Dieter Weller of Seagate Technology, the world's largest manufacturer of hard drives. But long before those speeds are reached, other physical constraints will get in the way, Weller says. In particular, higher speeds require smaller magnetic grains, but their size cannot go below the size of atoms.

SLAC's new Linac Coherent Light Source (LCLS), scheduled to start operating in 2008, will produce laser-like X-ray pulses lasting just one femtosecond (one billionth of a billionth of a second), enabling researchers to understand magnetization by taking snapshots of the process. "We will take images observing not only what has happened," says SSRL's St hr. "We will be able to see those processes while they happen."

Submitted by DOE's Stanford Linear Accelerator Center

Brookhaven Lab scientist gets complicated

Sergei Maslov

Brookhaven National Laboratory's Sergei Maslov is complex–at least, his research is. Maslov works in a new area of theoretical physics that studies large numbers of interacting objects, or "complex systems."

This field, known as Complexity Studies, involves observing and predicting the behavior of all sorts of systems, such as grains of sand, people, or biological molecules.

His recent work at DOE's Brookhaven Lab focuses on the statistics of networks, a field with broad applications, including the millions of computers that make up the Internet. He also studies systems in molecular biology, such as protein networks.

Maslov has been involved in this research since graduate school, and refers to his field as "fascinating." He attempts to decipher the most complex processes that make up our natural world–one of the most fundamental endeavors in science, he says.

For his contributions to this field, Maslov recently received a 2002 Presidential Early Career Award for Scientists and Engineers–the highest honor bestowed by the U.S. government on outstanding scientists and engineers at the outset of their careers in science and technology.

He accepted the award at a May 4 ceremony at the White House. Maslov is one of 57 researchers to receive the award this year. The recipients were also honored at a separate ceremony the same day at DOE headquarters, hosted by Secretary of Energy Spencer Abraham.

"It was a very pleasant and totally unexpected surprise for me to learn that I am among the winners of this award," Maslov said. "It makes me especially happy that it was awarded to me for my contributions to the physics of complex systems. This field is finally starting to get the recognition it deserves."

Submitted by DOE's Brookhaven National Laboratory