SLAC's Lance Simms

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DOE Pulse

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Research Highlights . . .

Explanation for relaxors' sensitivity

A team including Brookhaven Lab researchers has found an explanation for the extreme sensitivity to voltage or mechanical pressure of a special class of materials called relaxors. Relaxors' ultra-sensitive "piezoelectric" response — the ability to deform in response to an electric field, or to have an electric current induced by a deforming physical force — could be very useful in a wide range of devices that convert between mechanical and electrical energy (e.g., loudspeakers, sonar, and hard drives). Measurements of sound waves propagating through the material revealed that an intrinsic instability related to nanosized polarized regions apparently helps to facilitate the high response.

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Roadrunner mimics brain mechanisms underlying sight

Less than a week after Los Alamos National Laboratory's Roadrunner supercomputer began operating at world-record petaflop/s data-processing speeds, researchers at the DOE lab are already using the computer to mimic extremely complex neurological processes. Los Alamos and IBM researchers used a computational code dubbed "PetaVision" to model the human visual system. Researchers used PetaVision to model more than a billion visual neurons surpassing the scale of 1 quadrillion computations a second (a petaflop/s). The achievement throws open the door to eventually achieving human-like cognitive performance in electronic computers. This in turn could lead to important insights and revolutionary technological applications.

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New water heater nears market

DOE's Oak Ridge National Laboratory and General Electric have collaborated to finalize, test and market the first product from a major brand to meet DOE's new Energy Star criteria for electric heat pump water heaters. The GE Hybrid Water Heater is affordable and designed to be 50 percent more energy efficient than a standard 50-gallon electric water heater, which should help reduce carbon emissions associated with standard electric storage water heaters in the average home. The new models can easily replace an existing water heater. The installed cost will be about $400 more than a conventional 50-gallon water heater. Testing and analysis will be conducted in ORNL's Building Technologies Research and Integration Center and at field sites.

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Transmission line security reaches new level

DOE's Idaho National Laboratory researchers developed a multisensor monitor that mounts directly on high-voltage transmission lines to detect, characterize and communicate terrorist activity, human tampering and threatening conditions around electric transmission support towers.This type of on-scene, real-time information has the potential to thwart costly and disruptive terrorist, vandalism or weather events, and help utilities maximize power transmission efficiency and performance. Using wireless communications to monitor and relay real-time threat information from tower to tower, these advanced sensors can detect tampering from sources such as unbolt–ing tower support structures, the use of cutting torches and saws, shooting of conductors and insulators and explosive blast events.

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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).

The next generation of superconducting magnets

Particle physicists across the world are eagerly awaiting the startup of the Large Hadron Collider at the European laboratory CERN. More than 1,200 U.S. scientists work on what will be the world's highest-energy particle accelerator and its six experiments. Protons traveling the 27-kilometer-long LHC accelerator ring in opposite directions will collide and unveil new particles and forces. Scientists expect to find clues on the origin of mass, look for dark matter particles and search for extra dimensions.

The larger the number of collisions produced by the LHC—its luminosity—the better is the chance to make revolutionary discoveries. The luminosity depends on the number of protons that make up the two proton beams as well as the performance of the magnets that focus the two beams into tiny interaction regions to make the beams collide.

To achieve higher luminosity, LHC scientists plan to build improved sets of focusing magnets, which will squeeze the proton beams even harder before they enter the LHC interaction regions. This increases the chance that protons entering from one side will hit protons entering from the other side.

Collaborating with their colleagues at CERN, members of the U.S. LHC Accelerator Research Program (LARP) already work on the design and prototyping of new focusing magnets for the LHC complex. Physicists from four U.S. laboratories, BNL, FNAL, LBNL and SLAC, are members of the LARP program. The Department of Energy's Office of High-Energy Physics funds the program.

The current sets of LHC focusing magnets, which produce a field of about 7-8 Tesla at the coils, are based on superconducting wire made of niobium-titanium (NbTi), which is also the material that U.S. scientists used to build the Tevatron collider at Fermilab. The next generation of LHC magnets will contain superconducting wires made of niobium-tin (Nb3Sn). Cooled to temperatures less than minus 450 degrees Fahrenheit, the material produces a stronger magnetic field than its predecessor, but it is brittle and difficult to turn into magnet coils.

"This difficulty has motivated us to give high priority to the quality control of the manufacturing process, the performance of the superconducting wire and coils and the quality of the optics in the final magnets," said Giorgio Apollinari, head of the Fermilab Technical Division.

Fermilab has produced 16 almost identical, 1-meter-long Nb3Sn dipole and 29 quadrupole coils in collaboration with LBNL, making incremental improvements to the material and manufacturing technology. This set represents the most complete study of magnetic effects of Nb3Sn magnets.

Submitted by DOE's Fermi National Accelerator Laboratory

Observing the universe from earth and from space

Lance Simms discusses telescopes at a SLAC lecture last autumn.

On July 20, 1969, the world heard Neil Armstrong say, "That's one small step for man; one giant leap for mankind," as he and fellow astronaut Buzz Aldrin took the first human steps on the moon. Research Assistant Lance Simms at DOE's Stanford Linear Accelerator Center was not yet born at the time, but the words echoed just as clearly when he experienced this epic moment in human history at an IMAX theater as a youngster.

"When I saw him get out of the lunar module and speak his famous words, I got goose bumps all over," Simms said.

At the tender age of seven, then, Simms determined he would become an astronaut—a dream he is now one step closer to fulfilling. He recently submitted an application to NASA, seeking to become part of its next class of space explorers; he is now waiting to hear if he has made the administration's cut.

Permanently grounded until he hears back, Simms currently satisfies his explorer's spirit through the eyepiece of a telescope. A little over three years have passed since Simms first came to SLAC as a graduate student, and in that time Simms has begun to dream of helping to build a telescope on the moon. Such an instrument would give astronomers the best of both the ground and space observatories; being built on solid ground would support the large structure of the telescope, and, he explains, existing in a place without an atmosphere would eliminate the inconvenience astronomers face during poor weather as well as the image degradation caused by atmospheric turbulence.

"I'd really love to be a part of the team that raises the money to build this telescope," Simms says, "and to even help build it as an astronaut."

Submitted by DOE's Stanford Linear Accelerator Center