DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Argonne biologist Carol Giometti (right)

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Research Highlights . . .

From top quarks to the blues

The 1995 discovery of the top quark and singer Marian Anderson's 1947 rendition of *Nobody Knows the Trouble I've Seen* may seem unrelated. But through an interagency agreement with the Library of Congress, the same technology used to study subatomic particles is helping to restore and preserve the sounds of yesteryear. "We developed a way to image the grooves in a recording that is similar to measuring tracks in a particle detector," says Carl Haber, a senior scientist in DOE's Lawrence Berkeley National Laboratory's Physics Division who developed the technology along with Vitaliy Fadeyev. Their work could ultimately enable the Library of Congress to digitize the thousands of blues, classical, Dixie, jazz, and spoken word recordings in its archives preserving the nation's musical history and making it accessible to a wide audience.

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INEEL helps Air Force lasso the wind

DOE's Idaho National Engineering and Environmental Laboratory is helping install, test and integrate two new 900-kilowatt wind turbines into the power grid at a U.S. Air Force base that tracks NASA's down-range space launches from Ascension Island. These turbines, which supplement four existing small wind turbines, increase the renewable energy electric capacity to 2.7 megawatts, and further reduce air emissions and dependence on diesel generators. The turbines will save an additional 650,000 gallons of diesel fuel per year and will help power the island's desalination plant, providing 25 million gallons of fresh drinking water each year with "green" wind energy.

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Making connections with magnetic field reconnection

Scientists at DOE's Los Alamos National Laboratory have proposed a new theory to explain the movement of vast energy fields in giant radio galaxies. They theorize that magnetic field reconnection may be responsible for the acceleration of relativistic electrons within large intergalactic volumes. The theory could be the basis for a whole new understanding of the ways in which cosmic rays—and their signature radio waves—propagate and travel through intergalactic space. A deeper understanding of the magnetic field reconnection mechanism could also have important applications here on Earth, such as the creation of a magnetic confinement system for fusion energy reactors.

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CDF moves to the front with top quark data

The CDF collaboration at DOE's Fermilab has submitted the first paper on top quark physics from data collected during Run II of the Tevatron. The measurement, of two leptons with large transverse momenta signaling the decay of the two W bosons produced in the decay of top and anti-top quark pairs, establishes a foundation for detailed comparisons of the properties of these events to the Standard Model as Run II continues. Scientists believe the unusually large mass of the top quark causes it to play a special role in our universe, and top dilepton events are particularly interesting to study with the higher statistics of Run II.

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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).

Center to advance development of metal hydride materials for onboard hydrogen storage

Work toward a new class of materials capable of storing hydrogen safely and economically on board a vehicle took a step forward last month with the creation of the Metal Hydride virtual Center of Excellence (MHvCE). The center, led by DOE's Sandia National Laboratories and involving four other national laboratories, eight universities, and three companies, will advance the study of reversible metal hydride materials, regarded as a promising technology for the development of lightweight, safe onboard hydrogen storage.

The center was one of three virtual Centers of Excellence announced last month by Secretary of Energy Spencer Abraham to support President Bush's Hydrogen Fuel Initiative. Other centers are led by Los Alamos National Laboratory and the National Renewable Energy Laboratory.

Each center will take a different approach toward addressing the major technical barrier to onboard hydrogen storage: storing enough hydrogen to enable more than a 300-mile driving range without impacting cargo or passenger space. Storage is widely considered one of the most important hurdles for the commercial success of hydrogen as a clean fuel for use in vehicles because of weight, volume, and cost constraints.

Sandia will manage $30 million in reversible metal hydrides research over the next five years. Hydrides are metallic alloys that can absorb and then release hydrogen. Sandia researchers have developed a new class of hydrides called complex metal hydrides, which operate at pressures and temperatures that are close to ambient conditions.

"Our approach will be to focus on achieving or exceeding the DOE's hydrogen storage targets through novel materials development, supported by our strengths in fundamental and applied materials science," said Jim Wang, manager of Sandia's analytical materials science department.

Reversible metal hydrides have long been a strength of Sandia's materials research efforts. Just recently, Sandia researchers improved the operating conditions of lithium imides for hydrogen storage by partial substitution of lithium with magnesium. This new class of materials absorbs hydrogen reversibly in two steps, providing a total theoretical capacity of 10.8 weight percent. Current test results demonstrated 4.7 weight percent reversible hydrogen storage at about 30 atmospheric pressure and 200 ºC from the first step reaction alone. A patent application has been filed on the synthesis of the materials.

Wang said the team is exploring further improvements on lithium amide/imide or other similar materials for hydrogen storage capacity and operation conditions toward the DOE FreedomCAR goals.

The center will bring together scientists and institutions with strong capabilities in several research areas.

Submitted by DOE's Sandia National Laboratories

'Abundant expression' boosts protein research

When Leslie Woo needed to learn a new technique to complete her research for her doctorate in biochemistry and molecular biology at the University of Chicago, her advisor knew where to go – DOE's Argonne National Laboratory.

Argonne biologist Carol Giometti (right) works with a student.

Karen Frank, assistant professor of pathology and Woo's dissertation advisor, called Carol Giometti, biologist at Argonne who is expert in two-dimensional gel electrophoresis, a technique that provides measurements on hundreds of proteins – "abundant protein expression," in scientific parlance.

The technique, also called 2DE, is technically challenging and expensive to accomplish, and the tools needed are not often found on university campuses. But Argonne was one of the pioneers in the technique, which was developed nearly 30 years ago at the University of Colorado, and optimized at Argonne.

The technique is a method of separating substances and analyzing molecular structure based on the rate of their movement in a colloidal suspension under the influence of an electric field. The analysis is detailed by the "expression" of the protein – how it manifests itself or its effects within an organism.

Two processes together – the University of Chicago's new mass spectroscopy facility and Argonne's electrophoresis – can be combined to produce large amounts of information on a range of proteins, helping with "protein mapping" – determining how all the complex organic compounds in any living creature link together to provide the structure and functioning of all cells.

The combined research is expected to lead to the biological discoveries necessary to fundamentally alter the future of medical care and human health.

Submitted by DOE's Argonne National Laboratory