JLab's Gwyn Williams

Page 2

Research Highlights . . .

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

Number 174 January 3, 2005

INEEL researchers achieve hydrogen milestone

Researchers at the Idaho National Engineering and Environmental Laboratory and Ceramatec, Inc. of Salt Lake City are reporting a significant achievement in the production of hydrogen from water using high-temperature electrolysis. Instead of conventional electrolysis, which uses only electric current to separate hydrogen from water, high-temperature electrolysis enhances the efficiency of the process by adding substantial external heat – such as high-temperature steam from an advanced nuclear reactor system. This development is viewed as a crucial first step toward large-scale production of hydrogen from water, rather than fossil fuels. Added benefits include the avoidance of both greenhouse gas emissions and fossil fuel consumption.

[Teri Ehresman, 208/526-7785; ehr@inel.gov]

Predicting the devastation of hurricanes

After predicting the devastating effects of 2004 hurricanes with uncanny accuracy, scientists at Los Alamos National Laboratory are using computer models to helping the DOE's Office of Energy Assurance, the Federal Emergency Management Agency (FEMA) and other organizations plan for future disasters. Modeling electric power lost and restoration across storm-damaged areas, the models have been able to provide detailed information to planners on the exact infrastructure impacts even before the hurricanes made landfall. For those in the paths of hurricane devastation, the Los Alamos infrastructure models meant their lights and gas were returned to service hours or even days earlier than normal.

[Nancy Ambrosiano, 505/667-0471; nwa@lanl.gov]

DZero continues search for a possible light Higgs

Scientists of the DZero experiment at the Department of Energy's Fermilab have submitted results of the first Run II search for a light Higgs, hypothesized at 115 GeV/c**2. In this search, DZero looks for events where the W boson decays to leptons and the Higgs boson decays to a b-quark, anti b-quark pair. The real data unfortunately shows no evidence that this is the scenario. But this non-observation allows DZero to set new limits on the critical W-Higgs production rate, which can set limits on theoretical ideas outside the standard model. And it holds out some hope that the Tevatron might produce evidence of a light Higgs.

[Mike Perricone, 630/840-5678; mikep@fnal.gov]

ORNL's LandScan helps tsunami relief

LandScan image of Sri Lanka shows population densities along hard-hit east coast.

Relief agencies working to assist victims of the December 26 tsunamis in the Indian Ocean are using a demographic database developed at DOE's Oak Ridge National Laboratory. LandScan is a global population database that shows geographical distribution of population at one-kilometer resolution. Using population distribution maps, relief workers can easily and quickly determine the locations of potential tsunami victims who would otherwise be cut off from communication. Before the December 26 disaster, LandScan data was used to plan aid and recovery efforts after the 2003 earthquake that destroyed Bam, Iran.

[Bill Cabage, 865/574-4399; cabagewh@ornl.gov]

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 promise of terahertz

Terahertz (THz) light may provide stunning breakthroughs in areas as diverse as national security, medical imaging and communications technology. But it's largely been ignored until recently, because there wasn't a terahertz light source bright enough for these applications. Now the Free-Electron Laser (FEL) at DOE's Jefferson Lab (JLab) is producing 100 Watts of THz light for scientific studies -- nearly 100,000 times brighter than THz light produced anywhere else.

Gwyn Williams holding an accelerator component inside JLab's FEL

Terahertz light is a little-studied realm of the electromagnetic spectrum between microwave and infrared light. Also known as t-rays, terahertz light has a wavelength between 3 millimeters and .003 millimeters; and though just about everything in the universe emits them, humans can neither see nor feel these ubiquitous t-rays.

FEL Basic Research Program Manager Gwyn Williams says scientists are excited about t-rays because they can penetrate many forms of matter and are non-ionizing (don't harm living tissue at modest powers). That means they may provide medical images that are better and safer than x-rays, such as a scanner that can instantly diagnose skin cancer. They could also be used for non-invasive airport screening, spotting weapons concealed in clothing.

Built with JLab's expertise in SRF technology, the FEL is the world's most powerful tunable laser. As electrons used to create the laser beam are steered from the linear accelerator around a curve to a wiggler where the laser beam is produced, the electrons give off t-rays. These t-rays can then be routed into a lab for research. "Every time there's an electron beam, we get terahertz," Williams says. The project is funded by the U.S. Army Night Vision and Electronic Sensors Directorate.

Terahertz research can also extend JLab's mission of studying the structure of matter. For instance, Williams says t-rays can cause individual proteins to vibrate at specific frequencies, revealing structure. "It's also fundamental physics. But instead of looking at the atomic nucleus, we're looking at how materials work at the atomic level."

Submitted by DOE's Jefferson Lab

New material may be key to quality, low-cost housinge

Argonne researcher Arun Wagh sprays Grancrete.

The United Nations estimates there are almost a billion poor people in the world, most of whom live without adequate shelter and basic services. But scientists at DOE's Argonne National Laboratory and Casa Grande LLC have developed a tough new ceramic material that may be the key to providing high-quality, low-cost housing throughout developing nations.

The ceramic is called Grancrete, which, when sprayed onto a rudimentary frame, dries to form lightweight but durable walls and roofing. The resulting house is a major upgrade to the fragile structures in which millions of the world's poorest currently live.

Co-developer Arun Wagh, an Argonne materials scientist, hopes to see Grancrete used throughout his native India and the world to produce housing for the poor. Born in the Indian state of Karnataka, Wagh grew up in a neighborhood where even to this day the homes have walls and ceilings made from knitted mats of palm leaves and the floors are made of dried cow dung.

"These homes are regularly subjected to hundreds of inches of monsoon rains and cyclone winds, and therefore often have to be repaired or even entirely rebuilt," says Wagh. "Obviously such conditions can have a great impact on the health, well-being, and longevity of the children and adults living there." The Grancrete spray-on cement now offers hundreds of millions of people such as these the opportunity to have adequate housing and live longer, healthier lives.

Grancrete is based on an Argonne-developed material called Ceramicrete, which was developed in 1996 to encase nuclear waste. Grancrete is stronger than concrete, is fire resistant and can withstand both tropical and sub-freezing temperatures, keeping dwellings in arid regions cool, and those in frigid regions warm.

Grancrete is made from an environmentally friendly mix of sand or sandy soil, ash and binding material made from biodegradable elements found in fertilizer.

Submitted by DOE's Argonne National Laboratory