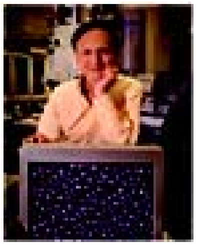

BNL's Yimei Zhu

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Leave for Mars without fuel to return?

Engineers at DOE's Pacific Northwest National Laboratory are making traveling to Mars more feasible and less costly thanks to microchannel process technology. Engineers are developing a lightweight, micro chemical processing plant about the size of a desktop personal computer. The processor would convert carbon dioxide from the Martian atmosphere into the propellant and oxygen needed for the return trip. Considering the cost of putting items into orbit can be as much as $20,000 per pound, packing fuel from earth for a return trip is incredibly expensive. The ability to produce fuel while on Mars would be much more efficient, economical and practical.

[Geoff Harvey, 509/372-6083, geoffrey.Harvey@pnl.gov]

New control schemes tested on CART

By capturing more energy and reducing overall wear and tear, researchers at the National Renewable Energy Laboratory's National Wind Technology Center hope to eventually lower the cost of modern wind turbines. Because wind turbines are designed to capture the highest amount of energy from the wind, engineers must devise new ways of keeping the turbines from wearing out quickly. This requires advanced control systems. Tests on the Control Advanced Research Turbine began last year after two years of substantial modifications to the control system. Engineers think these modifications will lead to better performance and reduce the cost of wind energy.

[Sarah Holmes Barba, 303/275-3023, sarah_barba@nrel.gov]

Cancer treatment packs punch to tumor

Doctors will soon have a new treatment for incurable brain tumors and other therapy-resistant cancers. Developed by Isotron, of Alpharetta, Ga., and DOE's Oak Ridge National Laboratory, the new treatment enables physicians to deliver a highly concentrated dose of californium-252 neutrons to the site of a tumor instead of having to treat the tumor with conventional gamma rays. This therapy has proved particularly useful against cancers that are resistant to photon and gamma treatments, which do not kill cancer cells as effectively as do the californium-252 neutrons. Cancers most resistant to the conventional treatments include brain tumors, melanoma, sarcoma, certain types of prostate cancer, locally advanced breast cancer, cervical cancer and cancer of the head, neck and mouth.

[Ron Walli, 865/576-0226, wallira@ornl.gov]

Method provides in situ spectra of synthetic methane hydrate

The Methane Hydrate Research Team at DOE's National Energy Technology Laboratory is investigating the physical properties of methane hydrates, including their use as a storage medium for natural gas. The team has developed a method of obtaining Raman spectra of bulk, laboratory-prepared hydrate samples under the conditions of their synthesis. This unusual capability allows collection of vibrational spectroscopic data on samples unperturbed by changes in pressure and temperature, allowing new insights into hydrate structure, composition, and stability. This technique will be used to further provide important information about the hydrate, such as the presence of other cage types and the fraction of cages containing methane.

[David Anna, 412/386-4646, anna@netl.doe.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).

SLAC scientists help set data transfer speed record

Transmit 6.7 Gigabytes of data—the data equivalent of 2 feature-length DVD-quality movies—across 6,800 miles in less than a minute? Can do.

DOE's Stanford Linear Accelerator Center (SLAC) is part of an international relay team that was recently awarded a certified data transfer speed record by the Internet2 consortium. The team transferred un-compressed data at 923 megabits per second for 58 seconds from Sunnyvale to Amsterdam -a distance of almost 6,800 miles, or about 1/4th of the way around the world. This transfer speed is more than 3500 times as fast as a typical home Internet broadband connection.

This new world record is an example of particle physics scientists and laboratories working collaboratively with industry to drive forward the possibilities, and realities, of worldwide high-speed data transfer. It also underlines the tradition of groundbreaking work in the manipulation and transfer of enormous datasets that is a necessary concomitant of doing particle physics.

While advanced work like this will often have as yet unimagined applications, known practical applications of such capabilities include, as Les Cottrell, assistant director of the SLAC Computer Services noted, "...doctors at multiple sites sharing and discussing a patient's cardio-angiographs to diagnose and plan treatment, or disaster recovery experts sharing information across the globe in near real-time to develop recovery and relief plans." Intended to deliver much more than merely a faster Web or email, these new technologies will enable completely new applications such as digital libraries, virtual laboratories, and distance-independent learning..

The record setting team consisted of staff from the Stanford Linear Accelerator Center (SLAC), the National Institute for Nuclear Physics and High Energy Physics (NIKHEF) in Amsterdam, the California Institute of Technology (Caltech), and the Faculty of Science of the Universiteit van Amsterdam. The success took place over the advanced networking capabilities of TeraGrid, StarLight, SURFnet, NetherLight, Cisco and Level 3 Communications.

Submitted by DOE's Stanford Linear Accelerator Center

Brookhaven's Zhu advances TEM tech

The transmission electron microscope (TEM) has so far provided mostly qualitative images about the microstructure, defects and arrangement of atoms in a sample. But Yimei Zhu, a senior scientist in the Materials Science Department at DOE's Brookhaven National Laboratory, has advanced the TEM to provide new insights into the electronic and magnetic structure and behavior of functional materials, such as superconductors and magnetic materials.

Yimei Zhu

Unlike optical and x-ray microscopes, which use light to magnify objects, an electron microscope projects high-energy electrons toward a sample of solid matter. The electrons that penetrate the sample are transmitted through it to reveal its inner structure.

By looking at how the waves created by the electrons interfere with each other after they cross the sample, Zhu and his collaborators developed techniques that provide very rich information not only on the misalignment of atoms at the level of a billionth of a meter with an accuracy of a trillionth of a meter, but also on the detailed distribution of electron clouds and magnetic spin in materials.

Examples of Zhu's team's recent achievements with Brookhaven's advanced TEM include revealing distribution and symmetry of valence electrons of a newly discovered superconductor, which, below certain temperatures, conduct electricity with no energy loss; and magnetization and interaction of tiny patterned magnetic arrays, which have potential applications for recording media technology.

Acknowledging Zhu's accomplishments and potential, DOE's Office of Science expanded his research program and awarded Brookhaven funding for a new microscope. "I am pleased and honored that our research has been recognized by DOE," says Zhu. "Looking at atoms, electrons and spins is so fascinating that I want to share the excitement with both scientists and nonscientists."

Submitted by DOE's Brookhaven National Laboratory