Fermilab's G. P. Yeh

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DOE Pulse

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Research Highlights . . .

INL makes hydrogen for record 1,000 hours

Researchers at DOE's Idaho National Laboratory used a high-temperature electrolysis stack to produce hydrogen for 1,000 hours. It was the longest and largest experiment on processes for the production of hydrogen using nuclear energy. The stack produced 177 normal liters of hydrogen each hour. In a 24-hour period, it can produce hydrogen equal to half of one person's average daily gasoline usage. The milestone will increase the likelihood of nuclear energy producing hydrogen on a large scale. Someday, hydrogen is hoped to replace gasoline as fuel for vehicles, but today hydrogen is widely used in refining crude oil and making fertilizer.

[Teri Ehresman, 208-526-7785, Teri.Ehresman@inl.gov]

Scientists propose device to view the dance of electrons

Scientists at DOE's Los Alamos National Laboratory have modeled the dynamics of a device that could be used to view the motion of electrons much like a strobe light is used to capture the stop-action motion of dancers on a dance floor. Based on existing femtosecond (quadrillionths of a second) devices that use ultrashort laser pulses to capture the motion of atoms in molecules, the proposed attosecond pump-probe device would use extreme ultraviolet pulses to capture the motion of electrons in atoms on an attosecond time scale of one billionth of a billionth of a second.

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Nanotube networks in no time

Researchers at DOE's National Center for Electron Microscopy at Lawrence Berkeley National Laboratory and the University of Kiel have found a new way to form complex networks of nanotubes on the surface of vanadium selenide, a layered crystal. Copper atoms infiltrate the crystal for several minutes in high vacuum. Then hexagonal networks of tubes, intricately branched and connected, form in less than a second. The copper initiates a phase change in the topmost layers, which expand and glide over the underlying layers. A network of prismatic folds results, having the cross section of a pitched roof four nanometers high.

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Successful experiments amaze scientists but shock plutonium

JASPER's flawless record has researchers agog. JASPER (stands for Joint Actinide Shock Physics Experimental Research) is a nearly 100-foot, two-stage gas gun at DOE's Lawrence Livermore National Laboratory that can fire small projectiles at velocities of up to eight kilometers (five miles) per second-nearly18,000 miles per hour-or more than 24 times the speed of sound. Since March 2001, JASPER has fired 48 experiments. This prolific record is further enhanced because all were successful-including 15 in calendar year 2004. The total includes 17 plutonium shots and 31 experiments involving surrogate materials. Built for $20 million inside existing facilities at NTS, annually the gun can fire up to 24 experiments and costs about $6 million, with an expected ten-year lifetime. In the absence of full-scale nuclear testing, JASPER helps assess the properties of nuclear weapon materials to verify that aging weapons can perform as designed.

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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).

Bucksbaum propels new PULSE center

If only airplanes traveled as quickly as the ultrafast laser pulses Phil Bucksbaum uses, he would have no trouble commuting between the Stanford Linear Accelerator Center in Menlo Park and the University of Michigan in Ann Arbor. Bucksbaum is the director of PULSE, the new ultrafast science center at SLAC and Stanford. This academic year he concurrently holds the new job and is finishing his teaching duties at University of Michigan, where he has been a professor of physics since 1990.

Phil Bucksbaum

PULSE is a partnership between Stanford and the DOE to provide a central home and world leadership in ultrafast and short wavelength science and technology. Ultrafast science examines the fast movements and transformations of atoms, molecules and materials that take place in mere femtoseconds (quadrillionths of a second). The center's researchers will develop groundbreaking experiments and exceptional machine capabilities for an incredible new tool for ultrafast x-ray science-the Linac Coherent Light Source (LCLS)-currently under construction at SLAC.

PULSE's research programs include atomic-molecular-optical physics, time-resolved x-ray scattering, ultrafast magnetic effects, single molecule imaging, ultrafast chemistry, ultrafast electron beam physics.

“We're having wonderful new results in these areas,” he said.

Bucksbaum's own research involves quantum control. In his new lab in the Varian physics building at Stanford he is building an ultrafast laser that emits 5.2 femtosecond pulses of optical light-“about as good as it gets,” he notes. Using precise control over the energy and timing of the laser field, researchers will rip an electron off an atom in larger molecule and then send the electron careening back into the molecule to get an image of chemical changes as they take place in the molecule.

“It will be control of quantum mechanics at a real virtuoso level, and will help us in developing the imaging we want to do with LCLS,” he said.

Submitted by DOE's Stanford Linear Accelerator Center

G.P. Yeh helps to realize Okinawa Physics Institute

From the event display that enabled researchers to see the very first collisions at the CDF detector, to the earliest top quark data, to Fermilab's leadership in large scale computing using Linux, G.P. Yeh has made many contributions during his twenty years at DOE's Fermilab. Lately he has been working on a project of a different scope.

When Japan's Minister of Science and Technology Policy, Koji Omi, announced in 2001 a plan to create the Okinawa Institute of Science and Technology (OIST), the Minister appointed Yeh as a Special Advisor for the project. Yeh had already been bringing graduate students from Okinawa to do research at Fermilab. "The main goal of OIST is to establish one of the best graduate universities in the world," Yeh says. "This project has incredible, strong support from the leaders of Japan, the scientific community worldwide, and every one of the 1.3 million people of Okinawa." Fourteen Nobel Laureates, including Jerome Friedman of MIT and Leon Lederman of Fermilab, have been supporting the project as well.

Among many other milestones, G.P. Yeh recently celebrated his 20th anniversary at Fermilab.

Since then, the Japanese government has annually increased the project's budget, and in 2003, the Okinawa government donated 700 acres of land. Organizers published the master plan for the school in January 2006, and construction is scheduled to begin this spring. The university plans to have 300 professors, 500 graduate students, and 900 postdoctoral researchers. "They say on Okinawa, 'This is a once in a hundred years chance for us. Please succeed,'" Yeh says.

Yeh joined Fermilab in March 1985 and recalls that his first task was to write an event display enabling CDF researchers to view the collisions made by the Tevatron's proton and antiproton beams. He served as a member of the International Organizing Committee for worldwide studies for the International Linear Collider from 1998 to 2003 and remains active in many international scientific organizations. Yeh declares: "Why do I say Fermilab is paradise? Here we have scientists and students from 200 universities, from about 40 countries. It's so nice every day in the cafeteria, hallways, anywhere—you can talk to people from all different backgrounds."

Submitted by DOE's Fermi National Accelerator Laboratory