



JLAB's Visiting Fellow, Alex Dzeirba

Page 2



Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Imaging in a FLASH

Using the soft X-ray laser at Deutsches Elektronen-Synchrotron in Hamburg, researchers have for the first time captured a high-resolution image of a nano-scale object before the single, 25-femtosecond laser pulse destroyed the sample. The international collaboration was led by Janos Hajdu of DOE's [Stanford Linear Accelerator Center](#) and Uppsala University and Henry Chapman of the DOE's [Lawrence Livermore National Laboratory](#). Successfully demonstrating this technique on a nano-scale object using soft x-rays opens the door for scientists to apply the technique to study atomic-scale objects using hard x-rays. The results are published in the November 12 online edition and the December print edition of *Nature Physics*.

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Biofuel cells without bio cells

Researchers at DOE's [Pacific Northwest National Laboratory](#) have observed a first: direct electricity-shuttling from proteins—removed from the outer membrane of the metal-altering soil bacterium *Shewanella oneidensis*—to a mineral, hematite. The feat is the bacterial equivalent of removing lungs and coaxing the disembodied tissue to breathe. Iron in the hematite acts as an "acceptor," a dumping point for thousands of trillions of electrons per square centimeter shuttled by the protein, called OmcA. The seal made by an OmcA coating a hematite-electrode effectively acts in place of a membrane necessary in the design of whole-organism biofuel cells. Eliminating the membrane could aid the design of bioreactors to power small electronic devices.

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SRNL to build hydrogen power system

DOE's [Savannah River National Laboratory](#) has teamed with the Center for Hydrogen Research to build and test a prototype system to demonstrate how hydrogen fuel cells can be effectively used to provide an [emergency backup power system](#) for hospitals and other critical facilities.

The partners will combine SRNL's unique hydrogen storage technology with a fuel cell capable of generating electricity from hydrogen fuel and an electrolyzer to produce hydrogen. These combined elements will make up a regenerative fuel cell system that will provide a rugged, compact, quick-response, reliable emergency power supply for occasions when grid power is temporarily cut off. The resulting prototype will serve as a model for future larger scale systems.

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Red Storm No. 1 in scalability

A \$15 million upgrade to [Red Storm](#), a Cray-built supercomputer at DOE's [Sandia National Laboratories](#), has increased its peak speed from 41.5 to 124.4 teraflops in a computing terrain in which a single teraflop was a big deal only six years ago. Bill Camp, director of Sandia's Computation, Computers, Information, and Math Center, says, "The Cray XT3 supercomputer now dominating the highest end of computing worldwide is based upon Sandia's Red Storm. Scientists love it because they can do bigger science more quickly on it than any other computer in existence, except for molecular dynamics studies on BlueGene/L ([Lawrence Livermore National Lab's](#) supercomputer). Otherwise, it's the best thing since night baseball."

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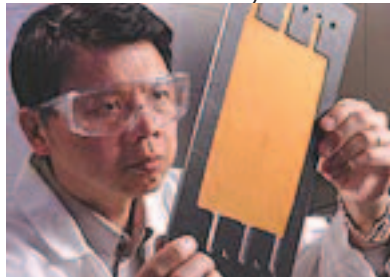
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Argonne and partners help biorefineries compete with oil refineries

Argonne National Laboratory researchers are partnering with industry and other national laboratories to develop biorefineries that compete economically with oil refineries.

"Making ethanol is already half as cheap as making gasoline," explained Seth Snyder, a biochemical engineer in Argonne's Energy Systems Division. "Researchers at Argonne and around the nation are investigating ways to create new bioproducts that can compete with petrochemicals on cost and performance."

Argonne is one of five DOE laboratories working to replace 30 percent of today's motor fuel with alternative biofuels by 2030. Called the National



Argonne's Yupo Lin inspects the resin wafer in a gasket before loading it into the bioreactor.

Bioenergy Center, the team includes Idaho, Oak Ridge and Pacific Northwest national laboratories and the National Renewable Energy Laboratory.

"Researchers and industry see developing alternative processes to replace the country's reliance on foreign oil as filling

a national need," Snyder said. "It is not just the price of gas we are concerned about, but the overall costs of petroleum products. As oil prices rise, so do all petroleum-based products, including paint, plastic and carpets."

Argonne is working with Archer Daniels Midland Company to optimize a separative bioreactor that converts sugar from corn into chemicals. This research is supported jointly by DOE's Office of the Biomass Program and ADM.

The Argonne-ADM effort currently focuses on demonstrating the fermentation of gluconic acid on a commercial scale. "Gluconic acid is one of many bioproducts from biomass," Snyder said. "We have to work through the processes one by one to build up an inventory to compete with petrochemical processing."

In a related project, Argonne is partnering with BP Chemicals to produce acetic acid by fermentation of biomass. The U.S. currently uses about 5 billion pounds per year of acetic acid, to make everything from plastics used in water bottles to paints. In research supported by DOE's Industrial Technologies Program and BP, Argonne is developing technology to produce acetic acid from a kind of biogas. The current technology requires expensive natural gas.

Submitted by DOE's Argonne National Laboratory

LISTENING TO THE MUSIC OF EXOTICS

As a professor of physics at Indiana University, Alex Dzierba's name graces over 100 articles in the scientific literature; but his most unusual achievement may be a contribution to music.

In a 2004 distinguished faculty lecture at Indiana University, Dzierba discussed his work on the GlueX project at DOE's Jefferson Lab. GlueX is an experiment to probe the strong force by producing exotic mesons, particles built of two quarks held together by an excited "flux tube" of gluons.

Don Freund, a music professor at Indiana, was so impressed by Dzierba's talk that he composed a piece of music on the subject, "Exotic Particles and the Confinement of Quarks - A Subatomic Fantasy for Wind Ensemble." The piece was performed by music school students at the university in February 2005. "I'm one of the few physicists in the world with music written for his experiment," Dzierba says.

Dzierba landed at Jefferson Lab through a collaboration on two experiments at DOE's Fermilab. "One was an early bubble chamber experiment to look at the interaction of high-energy protons, and the other was similar but used an electronic version of the bubble chamber, which was an early precursor of our current GlueX work," Dzierba explains. "Since we will need the 12 GeV Upgrade [for GlueX], my position at [Jefferson Lab] now is to work with the Director and his staff on that project."

Dzierba, his 16-year-old son, and his wife of 20 years, Linda, have recently taken up SCUBA diving as a family. "[It's] a wonderful enhancement to our existing hobby of photography," Dzierba says.

Pictures from his last trip line the walls of his Jefferson Lab office. When he's not working or snapping pictures of fish in the Caribbean, Dzierba also enjoys woodworking on a 16-acre farm his family shares with several horses.



Alex Dzierba, Jefferson Lab visiting fellow

Submitted by DOE's Jefferson National Laboratory