



Ames Lab's
Deborah
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Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

New technique determines interfacial structure

Researchers at DOE's Argonne National Laboratory have taken the guesswork out of interfacial structure determination. The researchers have directly visualized, in three-dimensions, ion site distributions at the mineral-water interface using a technique called X-ray standing wave (XSW) imaging. Their finding demonstrates a new capability for revealing complex reactions. XSW, in contrast to X-ray crystallography, measures both the amplitude and phase information that completely describes the molecular-scale structure of interest. The XSW imaging approach allows scientists to streamline the tedious process of structure determination. With XSW imaging, data acquisition and analysis can be completed in less than 24 hours. Previously, surface structure determination would take weeks or months to complete.

[Donna Jones Pelkie, 630/252-5501;
djpelkie@anl.gov]

"Beefed up" plant-dwelling bacteria boost phytoremediation

Using plants to soak up and degrade environmental pollutants, a strategy known as **phytoremediation**, can be more successful in theory than in practice. The accumulated pollutants or their metabolites sometimes kill the plants or evaporate via the leaves back into the atmosphere. But scientists at DOE's Brookhaven Lab think they've found a way to improve the process: Transfer genes from pollutant-degrading bacteria into bacteria residing in the plants so the resident bacteria can help the plants break down the pollutants. In a recent test study, plants inoculated with the "beefed-up" bacteria survived in toluene-contaminated soil and increased the degradation of the pollutant.

[Karen McNulty Walsh, 631/344-8350;
kmcnulty@bnl.gov]

Zapping polyester for soil resistant clothes

Laser-cut fabric has long been a popular fashion statement, but by aiming light at the surface of fabric, rather than through it, scientists at DOE's Jefferson Lab have found they can make polyester garments soil resistant. Manufacturers currently use chemical treatments to give fabrics soil resistance. But these treatments may yield environmentally unfriendly waste and add significantly to a garment's price. Using a deep UV lamp, College of William and Mary and JLab collaborators have developed a cost-effective method to change polyester's surface chemistry. The treatment doesn't affect fabric's shape, feel or look.

[Kandice Carter, 757/269-7263;
kcarter@jlab.org]

Rites of spring have carbon impact

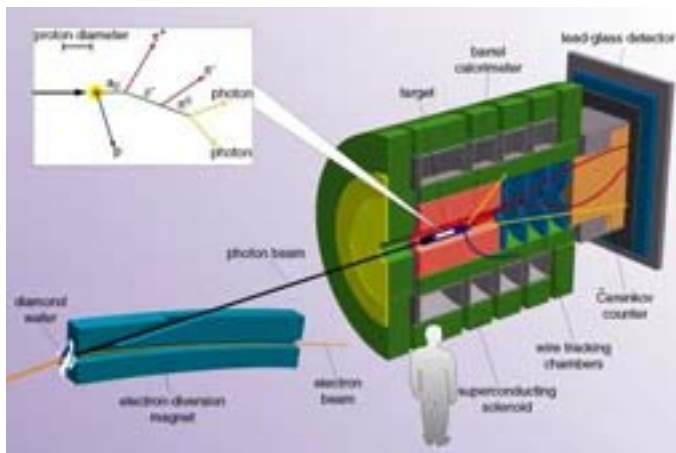
Spring's lush green lawns and hot pink shoes contribute at least in a small way to the world's total carbon picture, say researchers at DOE's Oak Ridge National Laboratory. Indeed, the latest fashions on Fifth Avenue and fertilizers that help homeowners achieve that "barefoot" lawn have their associated carbon dioxide costs. A recent analysis shows that nearly 22,000 manufacturers in the textile and apparel industry emitted about 12 million tons of carbon dioxide in 1998. And fertilizing one acre of lawn at the recommended rate of 137 pounds per acre results in 405 pounds of carbon dioxide-equivalent emissions from the production, transportation and application of the fertilizer.

[Ron Walli; 865/576-0226;
wallira@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).

JLab Experiment to look for the glue

The Hall D Collaboration, also called the Glue Excitations Experiment (**GlueX**) Collaboration, at DOE's **Jefferson Lab** plans to address one of the great mysteries of modern physics, the mechanism that "confines" quarks together. The Collaboration, which includes more than 100 scientists from 29 institutions and seven countries, aims to study the glue that binds all matter together.



The GlueX Detector will allow scientists to study the "glue" that holds quarks (and ultimately all matter) together.

Quarks are basic building blocks of matter. They are usually found in the nucleus of atoms, bound up in groups of three in protons and neutrons. According to the "Standard Model," a fundamental theory of particle physics, the force that binds quarks together—the strong force—is so powerful that no quark can ever be found alone. Until recently, quarks had only been seen in pairs (particles called mesons) and in triplets (particles called baryons: protons and neutrons are baryons). But other quark combinations are theoretically possible.

For instance, recent experiments have shown evidence of a five-quark particle (dubbed the **pentaquark**). GlueX aims to produce exotic or hybrid mesons. These exotic mesons are produced by exciting the strong force "glue" that binds quarks together. Though predicted by theory, many of these exotic mesons have never been seen before, and identifying them and their properties will provide information on the strong force and how it confines quarks.

Hall D collaboration scientists recently received good news about their plans. On April 19, Deputy Secretary of Energy Kyle McSlarrow announced that Critical Decision Zero for JLab's 12 GeV Continuous Electron Beam Accelerator Facility Upgrade has been signed. The proposed Upgrade would double the energy of Jefferson Lab's electron beam to 12 GeV (billion electron volts) and would add a fourth experimental Hall to the Lab—Hall D. This Upgrade would allow Collaboration physicists to proceed with the experiment.

Submitted by DOE's Jefferson Lab

THE ROAD TO LINDAU

For Deborah Zorn, the road to Lindau, Germany, and the 54th International Convention of Nobel Laureates began in childhood. The **Ames Laboratory** graduate student from Lincoln, Neb., says she rarely missed an airing of "Newton's Apple" and almost always took summer science classes in Lincoln's Bright Lights program.



Deborah Zorn

Zorn is one of 25 top, young researchers from the United States who will receive full support from DOE's **Office of Science** to attend the June 27-July 2 Lindau meeting. There, she will interact with Nobel Laureates and network with student participants from around the world.

"Debbie is interested in all aspects of science and is fearless and successful in attacking problems," says Mark Gordon, Zorn's major professor and director of Ames Laboratory's Applied Mathematics and Computational Sciences Program.

Zorn studies theoretical and computational chemistry at Iowa State University. In one DOE research project, she is creating and implementing theoretical and computational models to ease the identification of properties in new materials being developed for catalytic systems.

Another of Zorn's DOE projects uses quantum mechanics and molecular mechanics methods to study the behavior of certain metals on a silicon surface. The work may lead to atomic wires one atom wide for nanotechnology applications.

Zorn credits her father with encouraging her interest in science. "He instilled an interest in science and an appreciation for math in me for which I will always be grateful," she says.

Science is Zorn's passion, but she's also an art enthusiast and an accomplished golfer, and was an NCAA division III All-American and Academic All-American Athlete.

"I like to think of myself as a creative person," says Zorn. "Whether it's science, art or sports, it's all about problem solving. I enjoy taking bigger problems and breaking them down until they are similar to something I've seen before and that I can solve."

Submitted by DOE's Ames National Laboratory