Carolyn Larabell's microscopy images have graced the covers of numerous science publications. ***See page 2.***

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Physics—Shortest Half-Life on the Block

Physicists' discovery of the shortest-lived proton emitter ever at ORNL is just a preview of what's to come from the recently revamped Holifield Radioactive Ion Beam Facility. Researchers from ORNL, Oak Ridge Institute for Science and Education and collaborators have identified the 33rd isotope of thulium, a silvery rare-earth element used today as an X-ray source. The newly identified isotope, thulium-145, exists only a few millionths of a second in its normal state and then emits a proton to form erbium-144, another rare-earth element. Thulium-145 was produced by bombarding a molybdenum-92 target with a beam of stable nickel-58 ions. The measured half-life of 3.5 microseconds for the ground state of thulium-145 makes it the shortest-lived proton emitter known.

[Ron Walli, 423/576-0226, wallira@ornl.gov]

Spinach Enzymes Neutralize Explosives

Spinach may have given Popeye brute strength, but enzymes found inside the green leaves soon may be used to neutralize dangerous explosives. Researchers at DOE's Pacific Northwest National Laboratory have discovered that nitroreductase enzymes found in spinach and other natural compounds can eat, digest and transform explosives such as TNT. The biotechnology process reduces dangerous explosives to low toxicity byproducts that can be used by industry or reduced further to harmless products such as carbon dioxide and water. The digestion process addresses a need of the U.S. military to eliminate tons of explosives stockpiled around the country.

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That Blasted Boom Box!

Researchers at DOE's Los Alamos National Laboratory have teamed up with the New Mexico State Police and Foster-Miller Inc. to create an inexpensive, versatile, portable container that can capture shrapnel from a pipe bomb and redirect the blast away from personnel and property. The "Frag Bag" is a small, lightweight box that a person can carry into confined areas, much more versatile than the heavy blast-containment devices that often must be moved by vehicles. Since the bag captures all shrapnel, investigators can recover and analyze bomb fragments, which contain vital clues about the bomb maker or the origin of the materials. The Frag Bag is commercially available.

[Kathy DeLucas, 505/667-1455, duke@lanl.gov]

"Green" Buildings in National Parks to Save Millions of Dollars

An ambitious program to bring energy efficiency to several of the country's most popular national parks will save taxpayers millions of dollars and highlight the benefits of low-energy, passive solar building designs. DOE's National Renewable Energy Laboratory is helping the National Park Service design and build energy efficient facilities in Zion, Yosemite and Grand Canyon national parks. Among the first will be the Visitor Transit Center at Zion National Park in Utah. The new center will be 70 percent more energy efficient than a conventional building and save $350,000 in energy costs. More information at http://www.nrel.gov/hot-stuff/press/21zionr.html

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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*** is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

DOE Labs On Call When Chemical Accidents Occur

When there's a major accident anywhere in the United States and it involves chemicals, chances are good that several DOE laboratories will be called upon to help investigate and prevent similar accidents.

John Sorensen, a member of ORNL's Energy Division, heads a newly created Emergency Management Preparedness Program (EMPP), which takes advantage of resources and people at ORNL, the lead laboratory, and DOE's Pacific Northwest and Argonne national laboratories. It's Sorensen's job to assemble a team of experts to study the accident and provide information to help prevent future ones.

"It's our job to serve as part of a team to interview witnesses, take pictures, gather information and reconstruct what happened," Sorensen said. "Then we can help figure out what we can do to prevent similar accidents from occurring."

The EMPP supports the Chemical Safety and Hazard Investigation Board, which is modeled after the National Transportation Safety Board (NTSB). The NTSB is an independent federal agency that investigates accidents and works with the transportation industry to investigate and report on accidents. Like the NTSB, the chemical safety board can make recommendations to improve the safety of, in its case, operations involved in the production, transportation, industrial handling, use and disposal of chemicals.

With 72,000 manmade chemical compounds in use today, and accidents involving chemicals increasing every year, Congress and private industry endorse the creation of the chemical safety board.

"They recognize the value and importance of increased safety and the importance of an independent investigation," Sorensen said. "Our goal, of course, is to decrease the number of accidents, reduce deaths and injuries and minimize any harm to the environment."

The EMPP has experts in natural hazards, biological and chemical warfare agents, nuclear accidents, hazardous materials, terrorism and environmental risks. "These are all areas for which there has been increased interest and awareness on a national level," Sorensen said.

The Chemical Safety and Hazard Investigation Board sees the EMPP as a way to be more responsive and benefit from the latest technologies.

"The chemical safety board turned to the Department of Energy laboratory system for assistance because of its unique and diverse capabilities," Sorensen said. "The board recognized that DOE has developed one of the best accident investigation procedures in the country."

Each accident is like a scientific puzzle that requires the latest technologies in science and engineering, and that's where the DOE labs shine.

Submitted by DOE's Oak Ridge National Laboratory

For Carolyn Larabell, Image Is Everything

Inside the world of living cells, form almost always follows function. As a result, scientific knowledge of cell biology starts with imaging. In 1990, Carolyn Larabell, a native of Michigan—following an academic trail that took her from Arizona State University, to Stanford and finally the University of California at Davis—came to the DOE's Lawrence Berkeley National Laboratory as a cell biologist with training in electron microscopy. Highly energetic electrons can provide images of unmatched resolution, down to one-tenth of a nanometer, but are poor penetrators that can only be used on dehydrated samples that have been sectioned off into tissue-thin slices and placed inside a vacuum.

At Berkeley Lab, looking for a way to image an entire cell in its natural "wet" environment, Larabell became an expert in confocal microscopy, a technique in which thousands of pin-points of laser light are collected and assembled into highly-focused images. As a confocal microscopist, Larabell produced a number of dazzling pictures that graced the covers of leading cell biology magazines. Still, she was not happy with the technique's relatively low spatial resolution of about 200 nanometers.

She found her solution at the Advanced Light Source, a synchrotron radiation facility that provides laserlike beams of low-energy X-rays, ideal for biological imaging. The key was finding a technique whereby critical proteins inside cells could be labeled so that X-rays could be used to identify them.

Larabell's training in both electron and confocal microscopy plus her willingness to be "flexible" in her sample protocols paid off. She and her collaborators are now peering inside whole wet cells and producing images at resolutions of 40 to 50 nanometers.

"We have demonstrated a practical technique that gives cell biologists a whole new way of looking at their samples," Larabell says. "I think X-ray microscopy will help answer a lot of questions no other imaging technique can."

Submitted by DOE's Lawrence Berkeley National Laboratory