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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

All tuned up and ready to go

Two venerable nuclear research devices at DOE's Los Alamos National Laboratory, part of a set of four critical assembly machines that formed the nation's last general-purpose, critical-mass laboratory, were decontaminated, disassembled and dispatched to storage at Technical Area 35 in the winter of 2006. Having formed the core of the nation's criticality research ability for 60 years, it was time for the old machines, like treasured classic cars, to go in for an overhaul of their control and safety systems and move on to a new home. Now, with updated safety systems and state-of-the-art, remote-control electronics, "Planet" and "Flat Top" are completing their acceptance testing in preparation for a return to nuclear criticality work. They'll be relocated to new digs at the Nevada Test Site's Device Assembly Facility later this year.

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Asymptotic freedom

The strong force, which binds quarks and gluons inside protons and neutrons, becomes weaker at higher energies. Particle theory predicts that in high-energy collisions the interaction of quarks and gluons becomes so weak that they almost behave as free particles. Physicists call this "asymptotic freedom. Thomas Becher of DOE's Fermi National Accelerator Laboratory and Matthew D. Schwartz of Johns Hopkins University compared experimental data gathered at high energies to their calculations, determining with unprecedented precision the strength of the strong force. Their result agrees with the result that is extrapolated from experimental data at low energies, confirming the correctness of Quantum Chromodynamics, the theory of the strong force, at low and high energies.

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EPRI/INL plan focuses on increase in nuclear energy production

The Electric Power Research Institute and DOE's Idaho National Laboratory have released a joint INL/Nuclear Power Industry Strategic Plan for Light Water Reactor Research and Development. The plan was developed by an industry-lab team and reviewed and approved by the leadership of the INL's Utility Advisory Board and EPRI's Nuclear Power Council. The plan sets forth two strategies that must be employed for nuclear energy to play a substantial role in meeting future U.S. energy needs. The first strategy is to efficiently construct and operate dozens of new nuclear power plants, starting in the next several years. The second is to maximize the contribution from our existing nuclear power fleet by extending the operating licenses.

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How iron gets into the North Pacific

Most oceanographers assume that it's the iron in wind-blown Asian dust that fertilizes infrequent plankton blooms in the North Pacific Ocean, otherwise rich in nutrients but poor in carbon-dioxide-absorbing plankton. But the dust-storm theory is overblown, say Phoebe Lam and James Bishop of DOE's Lawrence Berkeley National Laboratory. Lam, also with the Woods Hole Oceanographic Institution, and Bishop have shown that the key source of iron in the Western North Pacific is not dust but the volcanic continental margins of the Kamchatka Peninsula and the Kuril Islands. The researchers question schemes to offset global warming by fertilizing the oceans with iron.

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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).

Double whammy for breast cancer

DOE's Jefferson Lab and the University of Virginia have redoubled efforts to catch breast cancer in its earliest stages. Researchers are developing and testing a two-headed compact gamma camera system.

Breast cancer strikes more women in the U.S. than any other cancer, killing more than 40,000 women each year. The first line of defense is to spot it early. While mammography is the primary method of breast cancer screening, the Dilon 6800 Gamma Camera has saved women's lives by revealing cancers not seen on mammograms.

Patty Judy shows the two-headed compact gamma camera system being used in clinical trials.

The Dilon system is based on technologies originally developed by Jefferson Lab's Radiation Detector and Medical Imaging Group. It uses breast-specific gamma imaging. In this method, a radiopharmaceutical is injected into the body, where it accumulates in cancer cells. The drug contains a radioactive agent that releases gamma rays, which are imaged by the gamma camera, thus revealing the hidden cancer. The system uses one gamma camera.

Now scientists are testing whether two gamma cameras, each similar to the Dilon 6800's single camera, can spot cancer better than one.

Patty Judy, a graduate student at the University of Virginia, presented the results of early preclinical tests of the two-camera system at the 2007 IEEE Medical Imaging Conference.

"What we wanted to look at was would we get better detection of lesions, especially small lesions, in all regions of the breast with that setup."

With assistance from Dilon, the researchers imaged breast phantoms, plastic and gel mockups of the breast with an embedded radioactive agent to simulate cancer. They found that the system, which combines information from both cameras, imaged the lesions better than each camera alone.

"The resolution is better than any of the individual camera's resolution at any depth. So in most cases, you're going to do better with a multiplied image," Judy concludes.

As for its effectiveness in spotting cancer in patients, initial results of clinical trials confirm the conclusions from the phantom tests.

Submitted by DOE's Jefferson Lab

King settling in as New Ames Laboratory Director

Alex King

For only the fourth time in its 60-plus year history, Ames Laboratory has a new director. Alex King became the director of the Ames Laboratory on Jan. 1, 2008, coming to Ames from Purdue University where he was head of the School of Materials Engineering from 1999 to 2007.

As a materials scientist, King was previously aware of some of the research taking place at Ames Laboratory, but has been pleasantly surprised by what he's found since taking over the helm.

"There is certainly a good dose of 'Midwestern modesty' here, and a lot of the work is undersold, but I am finding exciting research and exceptional scientific quality in every corner of the Lab," King said.

"The more people I talk to, the more great science I find."

King has been especially impressed with the collaborative environment that exists at Ames Laboratory and the relationship with Iowa State University, which holds the Lab's operational contract.

"Ames Laboratory has a great working climate in which novel ideas are conceived in fundamental science, tested in theoretical and modeling studies, formed into actual materials that you can hold in your hand, and then measured with high sophistication to prove the original concept," he said. "You cannot easily find all of those things working together as well as they do at Ames."

King succeeds Tom Barton, who served as Ames Laboratory director for 19 years. Prior to his eight-years at Purdue, King was at the State University of New York at Stony Brook for eight years, serving as Vice Provost for Graduate Studies from 1987 to 1992. He holds a B.Met. in physical metallurgy from the University of Sheffield, England, and a D.Phil. in metallurgy and the science of materials from the University of Oxford.

King is a fellow of the American Society of Materials and the Institute of Materials of the United Kingdom. He was a visiting fellow of the Japan Society for the Promotion of Science in 1996 and a Jefferson Science fellow in the U.S. Department of State from 2005 to 2006.

Submitted by DOE's Ames Laboratory