Melinda Hamilton cleans up concrete with little critters. Page 2

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

"This brilliant example of quality research by DOE-supported scientists represents an important advance in our understanding of the universe. It is impressive payback, in terms of advancing human knowledge and developing promising new technologies, for this country's investment in basic science research."

Energy Secretary Bill Richardson, commenting on the Supernova Cosmology Project.

AAAS names Supernova project breakthrough of year

Science magazine has named the Supernova Cosmology Project at DOE's Lawrence Berkeley National Laboratory as a co-winner of the "Breakthrough of the Year for 1998" for determining that the universe is expanding at an accelerating rate. This observation implies the existence of a mysterious, self-repelling property of space first proposed by Albert Einstein, which he called the cosmological constant. The Supernova Cosmology Project is an international collaboration headed by Saul Perlmutter of Berkeley Lab's Physics Division. Validation of the results was enabled in part by supercomputing calculations at DOE's National Energy Research Scientific Computing Center at Berkeley.

[Paul Preuss, 510/486-6249, paul_preuss@lbl.gov]

Cooperative R&D in Middle East

A DOE multi-lab research program is working toward cooperative water resource development in one of the world's tensest regions, the Middle East. DOE labs include Lawrence Livermore, Los Alamos, National Renewable Energy, Sandia and Oak Ridge, and the countries are Israel, Jordan, and the Palestinian Authority. The effort includes acquifier modeling, solar desalination, and re-use of wastewater. Scientists from the various labs and countries met recently at Livermore. "We are showing that cooperation is possible," says chemist Jeff Richardson, Livermore arms control group leader. "And we believe that we can improve water resources in that arid region."

[Jeff Garberson, 925/423-3125 , jbg@llnl.gov]

Collaboration keeps fish from fouling river

Farming fish can be a messy business. Fish feces and uneaten chow add nutrients downstream, contributing to algae blooms in rivers. Ernest Brannon of the University of Idaho and Robert Cherry of DOE's Idaho National Engineering and Environmental Laboratory have developed methods to make fish farming more efficient and environmentally sound. Adjusting levels of nutrients in fish chow reduced the amount of nitrogen and phosphorous dissolved in a farm's outflow by 40 percent. They experimented with tank structures, food binders, and vacuuming methods to catch more feces before they dissolved, and they calculated optimum food levels based on the oxygen levels in a pond.

[Laura Helmuth 208/526-0063, helmll@inel.gov]

Holidays are a busy time for Fermilab's new Main Injector

The new Main Injector was a home away from home during the holidays at DOE's Fermilab, where commissioning test-run activities for the $230 million accelerator moved to a full-time schedule on December 12 and continued through the shutdown for the rest of the Lab between the Christmas and New Year holidays. The two-mile accelerator ring had to pass all its safety requirements before accelerating a proton beam to its full design potential of 150 GeV (billion electron volts). The eight-year project has been completed on time and under budget, and will report the full commissioning results to DOE by the end of February, 1999.

[Mike Perricone, 630/840-5678, mikep@fnal.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).

New system monitors Chornobyl nuclear fuel debris

Remains of the nuclear fuel that was severely damaged in 1986 at Chornobyl Unit 4 still lie in large masses within the shelter built after the accident. In the form of dust, chunks, and solidified lava, the fuel has the potential to initiate uncontrolled fission reactions when exposed to water that accumulates inside the shelter. Occasionally, high neutron readings detected by monitoring equipment used in the shelter for more than a decade suggest that may be the case.

Chornobyl nuclear power plant

A close-up view of the Chornobyl shelter

To confirm whether the high neutron readings are caused by increasing fission reactions in the fuel debris, the result of faulty detection equipment, or other detection anomalies in the monitoring equipment, U.S. experts designed and built a new neutron monitoring system for the shelter. The system was recently installed by Ukrainian technicians and underwent a series of operational tests by a team of scientists from DOE's Pacific Northwest National Laboratory performing work for DOE's Office of International Nuclear Safety and Cooperation.

"The equipment performed very well during post-installation testing," said Bob Scherpelz, a Pacific Northwest health physicist. "The Ukrainians are comfortable with the new system and expect that it will provide the measurements needed to better understand the nuclear safety conditions in the shelter."

The system is now measuring the gamma and neutron radiation fields in six locations throughout the shelter. It's designed to provide the data necessary to interpret correctly the cause of any future unusual neutron count rates. Possibilities for high neutron count rates detected by the previous system included moisture-damaged equipment cables and shifts in the neutron energy spectrum caused by water. The new system will either verify or rule out these possibilities.

The project is part of a major U.S. effort to improve the safety of Soviet-designed nuclear power plants. Other laboratories involved in international nuclear safety activities are Argonne National Laboratory, Oak Ridge National Laboratory, Lawrence Livermore National Laboratory, Brookhaven National Laboratory, Sandia National Laboratories, and Savannah River Ecology Laboratory.

Submitted by DOE's Pacific Northwest National Laboratory

Bugs provide a concrete solution: Melinda Hamilton

Sometimes it seems like bugs are eating everything—goodies from our picnics, prize-winning taters from our gardens, forgotten leftovers in the back of the fridge—and now scientists are putting those appetites to good use, with bugs that eat the concrete in our buildings.

Melinda Hamilton, a biologist at DOE's Idaho National Engineering and Environmental Laboratory, is leading a team of researchers who are using microbes to remove contaminated layers from concrete surfaces through a natural degradation process.

Hamilton's team coats contaminated concrete surfaces with naturally occurring microbes and slathers them with a tasty broth of sulfur—their favorite nutrient. By controlling the humidity in the room (think Mississippi in August), the microbes have everything they need to go to work. The microbial byproduct—corrosive bug poop—is sulfuric acid. The acid etches the concrete surface, loosening the contaminated layer. Test trials have removed as much as 10 mm in 12 months. Lowering the humidity kills the microbes, then scientists vacuum the dust off the walls, floors, and ceiling and dispose of it.

"I've been working with these little critters for eight years," says Hamilton. She started out studying how soil microbiology affects the stability of buried cement waste forms. Hamilton quickly realized that the microbial degradation problem could be put to good use actually treating contaminated concrete. This technology offers significant improvements in treatment costs and personnel safety over current methods.

British Nuclear Fuels Limited (BNFL) has been working with the INEEL and hopes to apply the technology at nuclear facilities worldwide. The INEEL and BNFL are planning a full scale demonstration at Sellafield in the UK. "I've been to England several times to help get everything set up. It's been fun," says Hamilton.

Submitted by DOE's Idaho National Engineering and Environmental Laboratory