DOE Pulse
Science and Technology Highlights from the DOE National Laboratories
Number 31 June 1, 1999

Ames Lab's David Halstead cooks up a supercomputer, page 2.

Research Highlights . . .

A mining pollution solution

Scientists at DOE's Los Alamos National Laboratory have developed a technology capable of removing toxic metal contaminants from acidic mine runoff. The technology, known as Polymer Filtration, uses patented water-soluble, ion-binding polymers to remove contaminants like lead from acid mine drainage, while allowing for recovery of valuable metals like silver, copper and zinc. These metals are typically lost in conventional remediation processes. The technology provides a potential remedy for environmental problems arising from the thousands of abandoned mine sites in the United States that pose hazards to local aquifers.

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Armor through atomization

The DOE's Idaho National Engineering and Environmental Laboratory is working to make armored vehicles of the future lighter and more maneuverable. Using an atomization process and optimizing the composition, researchers are creating composite steel alloy powders that exhibit extreme hardness, without requiring additional heat treatment. In the atomization process, the cooling rate is controlled to maintain the composite properties of the alloy within nano-scale crystals. Researchers plan to use the powders to create thinner armor that also has superior ballistic performance. The spray atomization process facilitates the creation of complex shapes, a major advantage over current armoring methods, and can facilitate one-step production of armor coatings.

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Permanent magnet accelerator technology saves energy

Permanent magnets require no power or cooling water to operate—like the magnets that stick to your refrigerator door. They have played a significant and award-winning role in the seven-year, $259-million Main Injector Project, recently completed on time and within budget at the DOE's Fermilab. The Federal Interagency Energy Policy Committee and the Department of Energy presented a Federal Energy and Water Management Award to Fermilab. And physicists Bill Foster and Gerry Jackson were named Fellows of the American Physical Society for their work in designing the new Antiproton Recycler Ring, the world's largest use of permanent magnets.

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Trees grow faster in CO_2-rich 21st century atmosphere

Trees bathed in atmospheric carbon dioxide at levels expected by the year 2050 grew 25 percent faster, according to results from a facility built by DOE's Brookhaven National Laboratory in a North Carolina forest. But the increased growth is not likely to continue, nor to compensate for the effects of CO2 emissions. The report, based on research at the Forest-Atmosphere Carbon Transfer and Storage (FACTS-1) facility, was published by scientists from the University of Illinois, Duke University, Brookhaven and others. FACTS-1 is one of several such Brookhaven facilities around the world used by scientists to evaluate the effects of global change on plants and ecosystems.

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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).

Raiders of the Lost Tunnel

Picture a scientist from DOE's Stanford Linear Accelerator Center. His name is Lowell Klaisner but he could be a brother of Indiana Jones. Bullwhip over the shoulder, hat at a jaunty angle, flaming torch held high, he peers into the abyss. "Eureka!" shouts California Klaisner. "I've found the lost tunnel!"

Lowell Klaisner coming up three flights of stairs from the depths of his newly-discovered tunnel at SLAC.

Or words to that effect. Klaisner has in fact found a tunnel at SLAC that appears to have been hidden for 30 years. Even 30-year veteran physicist Greg Loew didn't know about it, and Greg knows everything. "Well, almost everything," says Loew modestly. Another veteran, Leo Giannini, didn't know about it, and he's been at SLAC 23 years. Finally, Klaisner tracked down colleagues Roger Miller and Bill Herrmannsfeldt. Bill had designed an injector for this tunnel during SLAC's early years in the 1960's. He went as far as the detailed design of the bending magnets before the idea was dropped for lack of funds.

The adventure of the lost tunnel started when Klaisner was named Project Engineer for the new Linac Coherent Light Source (LCSL), an X-ray free electron laser that will use the last one-third of SLAC's two-mile long accelerator. Klaisner's idea was to dig a trench alongside the accelerator for the off-axis injector. In order to find out what he might encounter if he started trenching, he looked up accelerator blueprints from 1966, and there it was!

Historians are amazed at the wisdom of the founding fathers of the Constitution. After all, that document has lasted for 200 years. Engineers feel the same way about the Linac designers. "The original Linac designers wisely put in off-axis injector tunnels at the one-third and two-thirds points along the linac. Of course, they probably didn't have the LCLS in mind, but it was still a smart move," says Klaisner.

The importance of this discovery is operational, according to Klaisner. "We need to do R&D on the injector for the LCLS and this tunnel allows us to work while the linac is in use." The injector needs to be able to create and transport a low emittance beam for the LCLS.

Once Klaisner found the entryway, co-workers Burl Skaggs and Frank Brenkus lifted the creaky door while Klaisner peered down 30 feet. "It's amazingly clean," says Klaisner, "no snakes or bats, just a few cobwebs." Safety expert Bill Myers arranged to rig the hatch open, turn on the ventilation fan and find the original hand rails.

The next step was to assess its radiation level, and Jim Allan, from SLAC's Health Physics Department, was called in. "It tested clean," says Allan, "so we went exploring and found that 15 feet of shielding was working really well."

"The drawing calls this tunnel the Future Off Access Injector," says Klaisner. "The future is now."

Submitted by DOE's Stanford Linear Accelerator Center

Recipe for a Supercomputer

As a theoretical chemist, David Halstead quickly discovered that supercomputers were a necessity—not an option.

"You want to make your simulation effective and interesting," says Halstead, an associate scientist in the Scalable Computing Lab at DOE's Ames Laboratory. "You need a big machine. That's where my interest started."

Halstead's abilities are a perfect fit at the SCL, where he and his colleagues search for effective, affordable approaches to parallel computing. They have written a Web-based "cookbook" that explains how to network personal computers to create parallel-computing "clusters." The ingredients—PCs and network switches—can be found on the shelves of most computer stores.

"This really is the way to go if you want to build a low-cost machine," Halstead says, adding that the operating system is free and that DOE develops free message-passing libraries for these systems.

PC clusters fill a valuable niche in today's scientific world. Researchers can use the smaller systems to develop the complex code that will enable them to run simulations in a parallel-computing environment. The code can then be moved onto larger, more powerful machines.

"We give people a way to learn how to do power programming without having to apply for computer time on huge machines before they really need the horsepower," Halstead says.

The SCL examines ways to enhance communication between machines in the clusters, as well as finding methods for developing code that is both portable and scalable. "The lifetime of a computer is maybe two or three years, but the lifetime of scientific code can be decades," he says.

The SCL manages clusters ranging in size from eight to 128 CPUs that are used by researchers from Ames Laboratory and Iowa State University for chemistry, physics, engineering, mathematics and molecular biology problems. "We get a good sanity check from a real-world audience," Halstead notes.

Submitted by DOE's Ames Laboratory