'Well on way' to 100 trillion

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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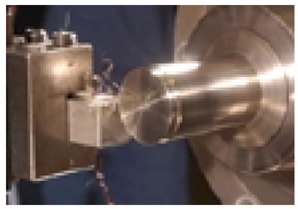
Research Highlights . . .

BAM continues amazing development



A material that rivals industrial diamond in hardness continues to amaze the researchers at DOE's Ames Laboratory who developed it and attract interest from a variety of industrial sectors. Metallurgist Bruce Cook and fellow researchers Alan Russell and Joel Harringa expected the alloy of boron, aluminum, and magnesium (nicknamed "BAM") to perform well as a cutting tool, but were surprised to find out that the material cuts without getting hot. Even when the cutting edge is spinning off red-hot ribbons of lathe-turned stainless steel (somewhere around 700° C), the tool stays cool enough to touch with a bare fingertip.

[Kerry Gibson, 515/294-1405, kgibson@ameslab.gov]

Nu's from underground

At 5:26 p.m., on Friday, July 27, half a mile underground in a former Minnesota iron mine, the MINOS collaboration successfully erected the first plane of steel for their detector. It's the first plane of 486 steel octagons that the long-baseline neutrino experiment, based at DOE's Fermi National Laboratory, will install. The experiment's goal is to detect the mass of the neutrino, using a beam created by the NuMI (Neutrinos at the Main Injector) Project at Fermilab. Late last month, NuMI/MINOS also unveiled a new website (http://www-numi.fnal.gov:8875/), useful for keeping up with all the latest nu's.

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Physicists produce "doubly strange nuclei"

Strange science leaps ahead at Brookhaven Lab, where physicists have produced significant numbers of "doubly strange nuclei"—nuclei containing two strange quarks. The experiment, designed and buit in Japan, was done at the Lab's Alternating Gradient Synchrotron, source of the world's most intense proton beam. Protons colliding with tungsten produce negatively charged kaons, which, when aimed at beryllium, occasionally produce nuclei containing a proton, a neutron, and two lambda particles. These nuclei will help scientists explore the forces between nuclear particles, particularly within strange matter, and may contribute to a better understanding of neutron stars, which are thought to contain large quantities of strange quarks.

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X-rays etch semiconductor patterns

Argonne scientists are using X-rays from the Advanced Photon Source (APS) to cut tiny patterns in semiconductor material. Researchers use a focused X-ray beam to etch the semiconductor surfaces in selected areas to produce patterns. This etching technique could have applications in devices from cell phones to radar to microwave detectors. Using X-rays allows the process to be performed at room temperature and atmospheric pressure. In addition, by tuning the X-ray energy, researchers can select atoms of one type to ionize, etching on one material while an adjacent, different material stays unchanged. Funding for the research comes from DOE's Office of Basic Energy Sciences.

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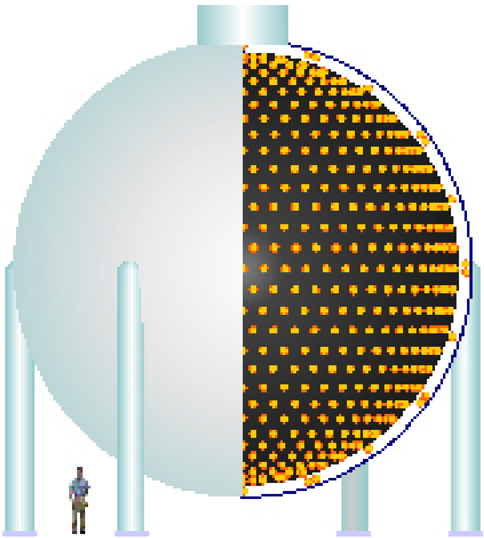
DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***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).

In the tank with MiniBooNE

Last month, the MiniBooNE collaboration at DOE's Fermilab (www.fnal.gov) reached a major milestone with the installation of the last of more than a thousand photmultiplier tubes that collaborators hope will help them make neutrino history.



Project scientists have outfitted a 40-foot spherical tank with 1,520 PMTs, special light-sensitive devices shaped like large deformed light bulbs. The photosensors cover the inside of the sphere, pointing to the center of the tank, which experimenters will fill with 250,000 gallons of mineral oil. That's where they expect the action to be: flashes of light that occur as neutrinos collide with oil molecules. The PMTs will pick up the flashes, serving as the collaborators' "eyes" inside the tank.

MiniBooNE will recycle most of its PMTs from Los Alamos National Laboratory. Physicists used them in the Liquid Scintillator Neutrino Detector, which recorded neutrino events from 1993 to 1998.

In 1995, the LSND collaboration stunned the particle physics community when it reported a few incidences in which the antiparticle of a neutrino had presumably transformed into a different type of antineutrino. However, the results were subject to doubt because of the small number of events and the need for confirmation by another experiment.

The MiniBooNE collaboration has scheduled oil delivery for October, when more than 30 tank trucks will come to Fermilab. Los Alamos physicist Bill Louis, cospokesperson of the collaboration, expects the detector to be operational by December 2001. According to Louis, the first neutrino beam, created by Fermilab's accelerators, will traverse the detector in the spring. The beam will cause a neutrino collision inside the tank about every twenty seconds.

The MiniBooNE collaboration has about 50 physicists from 14 universities and laboratories. Confirming the LSND result would indicate the existence of an additional kind of neutrino beyond the three known flavors, requiring physicists to rewrite a large part of the theoretical framework called the Standard Model.

Submitted by DOE's Fermilab

'WELL ON WAY' TO 100 TRILLION

Dr. David Nowak

Some folks can park their computer on their lap, or tuck it into a briefcase—but not Dr. David Nowak. At DOE's Lawrence Livermore National Laboratory, his computer entails 8200 IBM processors (an advanced version of the one that beat Russian chess champion Garry Kasparov) and nearly 50 miles of high-speed data cables. Fortunately that's not his *only* computer. His *other one* has nearly 6000 processors and fills more than a basketball court.

What they lack in portability, the two machines more than compensate for in speed. Nowak is Livermore Program Leader for the National Nuclear Security Administration's Accelerated Strategic Computer Initiative. In July his computers ranked first and fourth among the world's fastest according to TOP500. They compute at 12.3 and 3.9 trillion operations per second respectively.

For six years, Dr. Nowak has led Livermore's efforts to introduce 3D, high fidelity physics simulation to the Stockpile Stewardship Program. He is also a founding member of ASCI, NNSA's ten-year effort to reach 100-trillion calculations per second by 2005.

That speed is needed to help scientists maintain the nuclear stockpile's safety and reliability by simulating—in three dimensions—the aging and operation of nuclear weapons in a world without nuclear testing.

Accurate computer simulation is essential to retain confidence, as stewardship of the world's most complex arsenal transitions to a new generation of scientists and engineers that has neither designed nor tested a nuclear weapon.

"We're well on our way in our race to reach 100-trillion calculations per second by 2005. And the future challenge we face is just as steep as the one we've conquered. But given the resources, I'm confident we can do it," Nowak said.

Submitted by DOE's Lawrence Livermore National Laboratory