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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Blood stains lead to bar codes

Information found in a blood sample one-fiftieth the size of a single drop can identify abducted infants and possibly apprehend a murderer. Scientists at DOE's Idaho National Engineering and Environmental Laboratory in collaboration with Miragen, Inc., are helping to refine a blood test which reveals individual-specific antibodies present in a person's blood. Like a fingerprint, these antibodies can identify a person and final test results resemble a bar code. The test is currently being used in some hospitals for infant identification, but researchers are working to make the test sensitive enough to be used at crime scenes and have the results admissible in court.

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Fusion experiment gets new lease on life

DOE's Lawrence Livermore National Laboratory dedicated the Sustained Spheromak Physics Experiment recently, giving a new lease on life to a magnetic fusion concept pioneered at Los Alamos. A reinterpretation of old Los Alamos fusion research results found them more promising than originally believed. Potential advantages include simplicity of design and economy of size. The spheromak generates magnetic fields by internal dynamo motion caused by turbulence in the plasma, the hot ionized gas that serves as the reactor fuel. The objective of the SSPX will be to better understand and, ultimately, control the physics of magnetic fusion.

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From cells to whales: Universal scaling laws in biology

Working with other New Mexico biologists, Geoffrey West, a theoretical physicist at DOE's Los Alamos National Laboratory, has proposed a theory to explain the universal scaling laws of biology. The theory predicts such things as the structural and functional properties of vertebrate cardiovascular and respiratory systems, plant vascular systems, insect tracheal tubes, and other transport systems based on three unifying principles: the branching pattern is space filling and fractal-like, the final branch of the network must be proportionately the same size, and the energy required to distribute resources is minimized. These scaling laws seem to work at both the cellular and multicellular levels and may apply to entities from river systems to large corporations.

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Role for x-ray crystallography in genome projects

Researchers at the DOE's Lawrence Berkeley National Laboratory used beams of x-rays at the Advanced Light Source to demonstrate that protein crystallography can play a vital role in helping scientists find out what a specific gene does. By determining the three-dimensional crystal structure of a protein whose function was unknown, the Berkeley Lab researchers led by Sung-Ho Kim were able to predict the protein's function and from there identify its role in the cell. This is the first demonstration that x-ray-based protein crystallography can be used in structural genomic investigations.

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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).

Berkeley, Livermore address inertial fusion challenges

Fossil fuels are headed for extinction. Projected timetables for when this will happen vary, but the ultimate exhaustion of fossil fuel supplies is a certainty. Alternative energy sources must be found. Arguably, the most promising alternative is fusion, the energy source that lights up the sun and every other star.

And two U.S. Department of Energy laboratories are combining forces to solve the technological challenges that might bring this stellar energy down to earth.

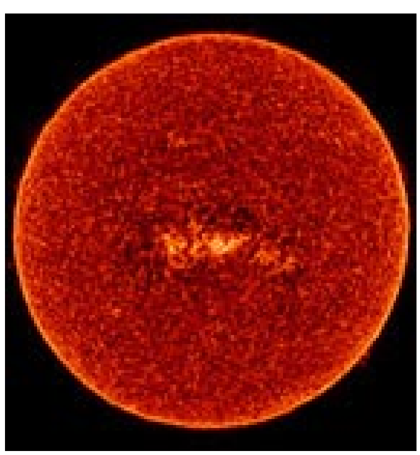
Fusion takes place when lighter atomic nuclei are combined to form heavier nuclei. It is a reaction that releases roughly one million times the energy released by the burning of oil. A fusion power plant would use the nuclei of the two hydrogen isotopes—deuterium, which can be directly extracted from water, and tritium, which is produced by adding neutrons to lithium atoms. Enough fusion water to supply a year's worth of electrical power to a metropolitan city could be delivered in a pickup truck.

Unlike the burning of oil or other fossil fuels, a fusion reaction does not contribute to global warming. Unlike nuclear fission, fusion cannot sustain an uncontrolled chain reaction and does not produce high-level radioactive by-products that must be carefully stored for thousands of years.

One approach to harnessing fusion as a power source is a technique called inertial fusion energy. In an IFE reactor, pea-sized capsules of fusion fuel are heated so quickly and uniformly, they burn while confined by their own inertia. IFE fuel capsules can be heated either with a beam of laser light or with a beam of heavy ions (positively charged atoms with more than three protons).

To determine whether or not a beam of heavy ions could be used to cost-effectively heat an IFE target, researchers at Lawrence Berkeley and Lawrence Livermore National Laboratories have agreed to collaborate as a Heavy-Ion Fusion Virtual National Laboratory. They are proposing to design and construct a unique particle accelerator—of a type known as an induction linac—that will address all of the critical heavy ion IFE technological issues. This proposal is being called the "Integrated Research Experiment."

Submitted by Lawrence Berkeley National Laboratory



Fusion, the reaction that ignites the sun, would be a clean, safe, and virtually inexhaustible source of energy.

Pipeline Leads to ASCI and Livermore Supercomputer

David Cooper, associate director for Computations at DOE's Lawrence Livermore National Laboratory, joined DOE Assistant Secretary Vic Reis and Deputy Assistant Secretary Gil Weigand recently to kick off a program aimed at increasing the number of university students in computer science, engineering and other academic disciplines related to DOE's Accelerated Strategic Computer Initiative. The program benefits the two participating universities—Northern Arizona University and the University of Utah—as well as the Livermore Lab, DOE and the nation's security.

The 10-year, billion-dollar ASCI program should deliver 100-trillion calculations-per-second computing capabilities by the year 2004. Highly skilled people who can operate the hardware and develop software and peripherals are an essential component.

"To be truly successful, ASCI must develop the hardware, software, infrastructure and people to produce 100-trillion-operations-per-second computer simulations by 2004," explained Cooper. "This pilot project addresses that last vital element: people. By working with universities like Northern Arizona University, we can introduce students at the undergraduate level to the ASCI program and facilities. By serving as interns or spending summers working at the DOE Labs, these students will become familiar with large scale simulations.

"Hopefully, some of them will choose their career to assist us in programming and administering these very complicated systems."

Dubbed the "ASCI Pipeline Project," the goal is to build on the existing strengths of Northern Arizona U.'s College of Engineering and Technology to support the Multicultural Engineering Program. That program focuses on Native Americans, minority students and women. The Multicultural Engineering Program also works to increase the number of qualified Northern Arizona students who complete graduate education.

The program will provide opportunities for students to learn about a number of career paths and increase student awareness of ASCI opportunities at DOE labs. For further information call David Schwoegler, 925/422-6900, schwoegler1@llnl.gov.

Submitted by DOE's Lawrence Livermore National Laboratory