SLAC's Les Cottrell

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

A 'greener,' cleaner two-stroke engine

Researchers at DOE's Idaho National Engineering and Environmental Laboratory have developed an idea to reduce exhaust emissions from two-stroke engines that are used in chain saws, gas-powered lawn trimmers and hand-held power tools. The patented invention is a small separator that will remove unburned oil and gas from the two-cycle engine exhaust without compromising engine performance. The separator will take the exhaust which contains some of the fuel and oil and spin it at a high rate, thereby centrifugally separating the fuel from the lighter gaseous combustion products. Researchers feel they can realize a significant emission reduction, and at a per-unit cost of under $400.

[Steve Zollinger, 208/526-9590; gaz@inel.gov]

Secrets of drug resistance revealed

In the race to stay one step ahead of drug-resistant bacteria, scientists from DOE's Lawrence Berkeley National Laboratory and the University of California at Berkeley obtained high-resolution images of a protein complex found in bacteria that repels a wide range of antibiotics. The images offer new insight into how bacteria survive attacks from different antibiotics, a growing health problem called multidrug resistance. As the team learned, these robust defenses are rooted in the protein complex's remarkable ability to capture and pump out a spectrum of structurally diverse compounds. The research may inform the development of antibiotics that either evade or inhibit these pumps, allowing drugs to slip inside bacteria cells and kill them.

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Optimizing turbine designs

A mere 25 degrees can make a big difference in the operating efficiency of a turbine engine, and researchers at DOE's Oak Ridge National Laboratory are helping Rolls Royce to demonstrate a technique called phosphor thermography. The technique could be used in the future to optimize turbine designs. Using special optics, a laser and phosphor powder, researchers can make extremely accurate measurements at temperatures up to 1,706 degrees Celsius. The ORNL method, which is patented and has received an R&D 100 Award, uses fiber optics and pulses from a small ultraviolet laser to excite the phosphor. Light detectors measure the time it takes the fluorescence to decay, giving researchers an extremely accurate measure of temperature.

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Breast fluid a better option for detecting cancer

A new method of extracting and analyzing fluid from a woman's breast may provide a more accurate, less expensive and noninvasive way to determine a patient's risk for breast cancer or to diagnose the disease in its early stages. Scientists at DOE's Pacific Northwest National Laboratory and UCLA report they have discovered six times more proteins than previously identified in this fluid, called nipple aspirate fluid, or NAF. The presence of such proteins suggests that NAF could be a resource for biomarkers, or biological indicators, of breast cancer, which is expected to claim the lives of approximately 40,000 American women this year.

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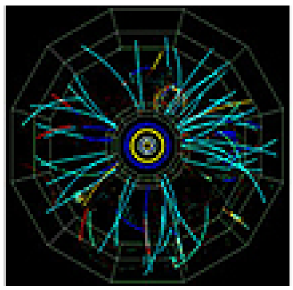
DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions.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

Cookin' up quark soup at RHIC

A standing-room-only crowd attended a special colloquium at DOE's Brookhaven National Laboratory on June 18 to hear the latest results from the Relativistic Heavy Ion Collider (RHIC). The findings strengthen the scientists' confidence that RHIC's collisions of gold ions have created unusual conditions and that they are on the right path to discover a form of matter called the quark-gluon plasma, believed to have existed in the first microseconds after the birth of the universe.

"These results are profoundly important," said Raymond L. Orbach, Director of DOE's Office of Science, in a statement issued prior to the colloquium. "They go to a fundamental question in science: How did the universe look at the beginning of time? People have always been fascinated by the question of how our world began."



End view of particles emerging from a deuteron-gold collision at RHIC.

More than 1,000 scientists—including physicists from Ames, Argonne, Brookhaven, Lawrence Berkeley, Lawrence Livermore, Los Alamos, and Oak Ridge national labs—have collaborated on these experiments. While the scientists are not yet ready to declare the discovery of quark-gluon plasma—a claim that must await corroborating experiments, now under way at RHIC—the excitement in the room was palpable. Special guests included John Marburger, director of the Office of Science & Technology Policy and Science Adviser to the President; Peter Rosen, associate director for High Energy & Nuclear Physics, DOE's Office of Science; and Dennis Kovar, director of DOE's Division of Nuclear Physics within High Energy & Nuclear Physics—who all offered their congratulations to the scientific team. "It's clear that a new fundamental phenomenon has been discovered here," said Rosen.

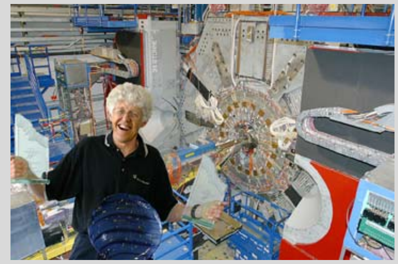
The latest RHIC findings come from experiments in which a beam of heavy gold nuclei collides head-on with a beam of deuterons. These deuteron-gold experiments, along with proton-proton collisions, serve as a basis for comparison with collisions of two gold beams at RHIC. When two gold nuclei collide head-on, the temperatures reached are so extreme that the individual protons and neutrons inside the merged gold nuclei are expected to melt, releasing the quarks and gluons normally confined within them to form a tiny sample of particle "soup" called quark-gluon plasma. In contrast, the small deuteron passes through the large gold nucleus like a bullet, without heating or compressing it very much.

In the deuteron-gold and proton-proton experiments, back-to-back jets of ordinary particles were seen to emerge, but in head-on collisions of gold nuclei, one of the two jets was missing. One possible explanation of the missing jets is that one of the two quarks traveling through this new environment would interact strongly and lose a substantial amount of its energy, so its jet would get stuck, or "quenched," in the "soup."

If further research proves that RHIC has re-created quark-gluon plasma, the physics story has just begun. By studying the behavior of free quarks and gluons in the plasma, RHIC scientists hope to learn more about the strong nuclear force—the force that holds quarks together in the atomic nuclei all around—and in—us.

Submitted by Brookhaven National Laboratory

High speeds are good for Guinness



Les Cottrell with internet speed awards in front of the BaBar detector at SLAC.

Particle physicists want their cake and they want to eat it—they want data from their experiments and they want it shipped to them quickly. Modern high-energy physics experiments are international collaborations that produce vast quantities of computer data. To work effectively, collaborators at institutes and laboratories all over the world need access to the data quickly, making high-speed data transfer a foundation of modern physics research. Les Cottrell and his group at DOE's Stanford Linear Accelerator Center are at the leading edge of research on boosting data transfer speeds.

Cottrell's group has now been awarded two certified data transfer speed records by the Internet2 consortium. In November 2002 the team, working with Caltech and the National Institute for Nuclear Physics and High Energy Physics (NIKHEF) in Amsterdam, transferred un-compressed data at 923 megabits per second for 58 seconds from Sunnyvale to Amsterdam— a distance of almost 6,800 miles. This transfer speed is more than 3500 times as fast as a typical home Internet broadband connection. Not content with this, the team doubled the speed in February 2003. This time, collaborating with Caltech, Los Alamos National Laboratory, and CERN, they transferred data at a rate of 2.3 gigabits/sec from Sunnyvale California to CERN in Geneva Switzerland. This achievement won them the second Internet 2 record, as well as CENIC's "Biggest, Fastest in the West Award." and a mention in the Guinness Book of World Records. This experiment—the breakthroughs made by Les Cottrell and his colleagues—are immediately useful to other data intensive sciences, human genome companies, world weather predictions, seismology, aeronautics, medicine, and shareware.

Submitted by DOE's Stanford Linear Accelerator Center