Penn State's Karl Mueller

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

New form of matter-antimatter transformation observed

For the first time, scientists of the BaBar experiment at the DOE's Stanford Linear Accelerator Center (SLAC) have observed the transition of the neutral D-meson into its antimatter particle. This observation will now be used as a test of the Standard Model, the current theory that best describes all the universe's luminous matter and its associated forces. "It's too soon to know if the Standard Model is capable of fully accounting for this effect, or if new physics is required to explain the observation," said BaBar Spokesman Hassan Jawahery, a physics professor at the University of Maryland. "But in the coming weeks and months we are likely to see an abundance of new theoretical work to interpret what we've observed." Learn more…

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Thirstier trees on horizon

Increased levels of ozone associated with the release of greenhouse gases are causing vegetation to use more water and may intensify the effects of global warming on ecological systems, according to findings published in New Phytologist. Researchers from DOE's Oak Ridge National Laboratory and the University of Tennessee conducted studies of trees in the mountains of East Tennessee and found that current levels of ozone amplified the effects of climate stresses on large tree growth, transfer of water from soil to the atmosphere and rates of stream flow from forested watersheds. The mechanism for these effects, which has been implicated by several studies, is reduced capacity of the plants to regulate water loss through stomata, the breathing pores in leaves.

[Ron Walli, 865-576-0226, wallira@ornl.gov]

New sensor detects gaseous chemical weapon surrogates in 45 seconds

Using lasers and tuning forks, scientists at DOE's Pacific Northwest National Laboratory have developed a chemical weapon agent sensing technique that promises to meet or exceed current and emerging defense and homeland security chemical detection requirements. The technique, called Quartz Laser Photo-Acoustic Sensing, or "QPAS," is now ready for prototyping and field testing. It is an extremely sensitive and selective chemical detection technique that can be miniaturized and is practical to operate in field environments. PNNL has demonstrated QPAS's ability to detect gaseous nerve agent surrogates. The instrument is based on Laser Photo-Acoustic Sensing and infrared Quantum Cascade Lasers.

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Mine slime reveals lode of genetic info

Researchers from DOE's Oak Ridge National Laboratory and the University of California Berkeley have discovered that Leptosprillium group II bacteria in battery-acid-like mine runoff are exchanging large blocks of genes. While scientists have seen extensive gene transfer in bacteria, this is the first observation of exchange of huge genomic blocks in a natural microbial community. The pink slime is proving to be a treasure for researchers in their quest to learn more about how bacterial communities exist in nature, leading to a greater understanding of genetic diversity in related organisms.

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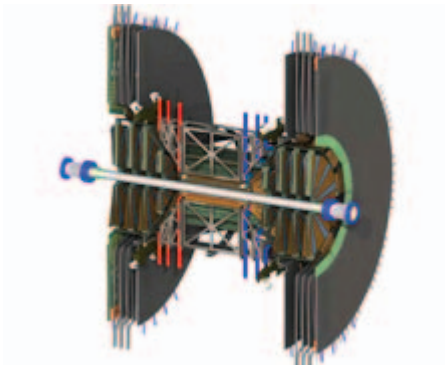
DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions.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

Los Alamos/Brookhaven collaboration lands funds to start detector construction

Physicists at DOE's Los Alamos National Laboratory working for six years on the design and development of a new forward silicon vertex detector upgrade (FVTX) for the Pioneering High-Energy Nuclear Interaction Experiment (PHENIX) experiment at Brookhaven National Laboratory's Relativistic Heavy Ion Collider (RHIC) recently learned that the $5M upgrade for a construction start is in next year's budget.



The FVTX detector is designed to detect particles from heavy ion and proton-proton collisions and determine the direction from which they arrive. The detector will house roughly 6500 square centimeters of silicon strip detectors, comprising 1.1 million strips and 8640 custom integrated circuits.

Addressing the fundamental question of where the proton gets its spin, the FVTX detector upgrade will open the door to new physics studies of the so-called "perfect liquid", a new state of matter recently discovered at RHIC. FVTX is designed specifically to detect and identify heavy quarks, charm and beauty. As heavy quarks traverse the device's liquid medium, they can be used to probe the detailed characteristics of this new state of matter.

The FVTX detector work is actually part of an even larger collaborative effort between Los Alamos physicists and their colleagues from the University of New Mexico and New Mexico State University, who are leading the spin physics effort at RHIC using the LANL-built muon spectrometers. The spin team's simulation efforts have determined that the FVTX detector will be able to provide improved polarization measurements for heavy quark production over what can be obtained with the existing PHENIX detectors.

As the only polarized proton-proton collider facility in the world, Brookhaven's RHIC is the flagship accelerator facility of DOE's Office of Science - Office of Nuclear Physics. The detector project is supported by the Medium Energy Program and the Heavy Ion Program in DOE's Office of Nuclear Physics.

Submitted by DOE's Los Alamos National Laboratory

Penn State's Mueller: 'Cyber' scientist

Karl Mueller

It's not surprising that one of Dr. Karl Mueller's favorite science fiction authors is William Gibson, who coined the term "cyberspace" and writes about the influence of technology on humans. Mueller, associate professor of chemistry at Penn State University, is using technology to do some influencing of his own.

Mueller, a physical chemist, is known for developing and applying solid-state nuclear magnetic resonance, or NMR, to attack problems in materials and environmental sciences. Since1999, his work for DOE has increased understanding about the reactions and transport of elements like strontium in Cold War legacy waste. He and his collaborators are making significant contributions to a nationwide cyberkinetics database, co-funded by DOE and the National Science Foundation. The work addresses some of the nation's most challenging problems in remediation, element cycling and pollution control.

One of Mueller's most powerful tools is the 900 megahertz NMR system at DOE's Environmental Molecular Sciences Laboratory, a BER national scientific user facility at Pacific Northwest National Laboratory. Since 2002, Mueller and his graduate students have been using the system to investigate chemical reactions at the atomic level.

For cyberspace fan Mueller, there's an added bonus: He and his students can operate the NMR from their desktop computers at Penn State. First, they ship the material samples to EMSL, where researchers place them in the NMR magnet and tune the probe. Then Mueller's team logs onto a secure Internet connection to operate the equipment and collect data.

The capabilities of the NMR and EMSL research staff are unparalled nationwide, according to Mueller.

"Some of the data we can get in three days at EMSL would have taken more than two years to acquire with the equipment at Penn State," he said.

In cyberspace and on the ground, Mueller's work is helping reduce the nation's environmental risks.

Submitted by DOE's Pacific Northwest National Laboratory