Fermilab's Debbie Harris

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Research Highlights . . .

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Examining bacteria, one cell at a time

Researchers at DOE's Argonne National Laboratory have found a new way to study individual living bacteria cells and analyze their chemistry. The scientists used high-energy X-ray fluorescence measurements to determine differences between free-floating, or planktonic, and surface-adhered, or biofilm, cells of bacteria exposed to hexavalent chromium, a heavy-metal contaminant and carcinogen. The biofilm cells were more tolerant of the contaminant, while it damaged or killed the planktonic cells. In addition to determining the chemical differences between the cells, the work pioneers a revolutionary new technique, setting the stage for studies defining mineral-metal-microbe interactions in contaminated environments. No previously available techniques had the spatial resolution needed to analyze individual bacterial cells noninvasively and nondestructively.

[Donna Jones Pelkie, 630/252-5501, djpelkie@anl.gov]

Linking descriptions of the proton

The ubiquitous proton takes on a different persona depending on how its snapshot is taken. When probed with particle accelerators using high energies, the proton appears as a sum of quarks loosely bound by gluons; at very low energies, the proton appears as a rigid object. Thus, physicists use different theories to describe proton structure probed at different energies. Now, new data from DOE's Jefferson Lab link these descriptions. Physicists formed a quantity called the "Bjorken sum" by combining data on the spin structure of protons and neutrons. This quantity can help describe proton structure in all energy regimes.

[Kandice Carter, 757/269-7263, kcarter@jlab.org]

Better bond coat performance

Using fundamental information from an initial study of the high-temperature phase equilibria in the Ni-Al-Pt system, researchers at DOE's Ames Laboratory and Iowa State University developed novel bond coat (BC) alloy compositions for advanced thermal barrier coating (TBC) systems that result in remarkable performance improvements. Their technology defines a composition range of Ni-Al-Pt-based alloys that deliver unprecedented oxidation resistance and phase stability compared to existing BC compositions based on the ß-NiAl system. Demonstrating up to a 20-fold performance improvement over existing technologies, their invention may significantly increase the durability and reliability of TBCs used on turbine engine components and help engine designers increase the operating temperature and efficiency of the engines.

[Saren Johnston, 515/294-3474, sarenj@ameslab.gov]

Floating mount takes plasma screens on the road

Manufacturers typically recommend against mounting large plasma screen displays in environments where shock and vibration occur—like in moving vehicles. Researchers at DOE's Savannah River National Laboratory, however, needed to use a 42-inch plasma display screen in a mobile surveillance laboratory, so SRNL engineers created a unique floating mount that enables the use of such display screens within mobile vehicles. The patented SRNL Plasma Screen Floating Mount's lightweight frame allows the plasma display to "float," which eliminates vibration and dampens shock from external impacts, such as pot holes or rough terrain.

[Angeline French, 803/725-2854, Angeline.French@srs.gov]

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).

Quantum Diaries: The physicists' blog

What is it like to be a physicist in 2005? A new Web site helps to answer that question by cataloging the daily lives of over 25 physicists around the globe.

Quantum Diaries celebrates the World Year of Physics by recording the experiences, thoughts, impressions, triumphs and disappointments of these men and women in their 'blogs', which is short for weblogs, or web-based logs.

The diarists hail from universities and laboratories in the Americas, Asia and Europe and write in English, Japanese, French, Chinese, Russian, Italian, Dutch and German, among other languages. DOE Laboratories participating in this effort include Brookhaven National Laboratory, Fermilab, Stanford Linear Accelerator Center and the Lawrence Berkeley National Laboratory.

The response so far has been stunning. *Quantum Diaries* was launched on January 13 and garnered over 45,000 pageviews by the end of the month. Some of the physicists' weblogs are getting nearly 1,000 pageviews per day.

"The '*Quantum Diaries*' web site will be a marvelous contribution to the global celebration of the World Year of Physics," said Dr. Raymond L. Orbach, director of the U.S. Department of Energy's Office of Science. '*Quantum Diaries*' promises to help the public understand how scientists think, behave, and accomplish their goals. Diaries from real physicists, doing real physics, will show that being a physicist is much more complex, frustrating and yet rewarding, than most people think. Most of all, the fruits of scientific discovery, and the intellectual contribution these discoveries make to our lives, will become visible. We shall all be able to share in the delights that drive these men and women to devote their lives to science."

The *Quantum Diaries* Web site was developed and is jointly maintained by the InterAction collaboration, whose members represent the world's particle physics laboratories in Europe, North America and Asia, with funding provided by the science funding agencies of many nations.

Submitted by DOE's Stanford Linear Accelerator Center

Fermilab's Harris observes neutrinos, family with equal fervor

Debbie Harris believes physicists need to share their enthusiasms with the public.

When the MINOS experiment sends its first neutrinos from DOE's Fermilab to the Soudan Underground Laboratory in Minnesota this month, Debbie Harris will have the inside scoop.

Harris is describing her experiences throughout 2005 for Quantum Diaries, a collection of on-line journals by more than two dozen young physicists from around the globe celebrating the World Year of Physics. The mother of two children, Isaac (7) and Sonia (4), Harris likened the experiment to child development in her entry for Jan. 22, 2005: "So if the beamline was 'born' on December 3 when we sent the first protons through the entire beamline, then the baby took it first steps today when we put a target in the way of those protons, and finally produced a neutrino beam. We are still not ready to start the official 'run,' but we want to test what we already have in place to make a neutrino beam, and a few things need to be finished before we can run at the high intensity we ultimately have to achieve."

MINOS (Main Injector Neutrino Oscillation Search) will send neutrinos through the earth (no tunnel needed) from the lab to a 6,000-ton steel-and-scintillator detector, a half-mile underground in the former Soudan iron mine. The 450-mile trip will take 2.5 milliseconds. Neutrinos carry no charge. They rarely interact with other forms of matter, yet they are so abundant that billions pass through us at any given moment. Of the trillions that the experiment will send to Soudan each year, only about 1500 will leave traces in the detector. Scientists will determine whether the neutrinos have changed from one kind to another ("oscillation"), and Harris will document the progress.

"I think it's important that physicists try to share their enthusiasm with the public," she says, "since it is the public whose taxes go to fund the research. I have to confess to another motive, too—that is to show that 'mothers of young children' can be physicists, and that they aren't somehow terrible or uninvolved mothers (or terrible or uninvolved physicists) because of their work."

Submitted by DOE's Fermilab