Ames Lab's Costas Soukoulis

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Cell surface profiling could yield cancer blood test

A chemical profiling technique that has potential for detecting the onset of cancer at the cellular level has been developed by scientists with DOE's Lawrence Berkeley National Laboratory. Led by chemist Carolyn Bertozzi, the Berkeley Lab scientists have reported a technique for rapidly profiling O-linked glycoproteins in living animals. Changes in O-linked protein glycosylation, the attachment of sugars to proteins through an oxygen atom on the protein, are known to correlate with cancers and other diseases, such as inflammations and infections. Until now, however, scientists have lacked a practical means of monitoring such changes in a physiological setting.

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Cyber security training for utility owners

At the recent Process Control and Supervisory Control and Data Acquisition (SCADA) Summit, sponsored by the SANS Research Institute, researchers and scientists from DOE's Idaho National Laboratory provided two-days of comprehensive cyber security and control systems training to more than 300 private utility engineers and equipment manufactures from the United States and 23 foreign countries. The training ranged from introductory security courses, to more advanced hands-on training in SCADA and control systems security.

[Ethan Huffman, 208/526-0660, ethan.huffman@inl.gov]

CDF achieves precision measurement of a subtle matter-antimatter dance

Scientists of the CDF collaboration at DOE's Fermi National Accelerator Laboratory have announced the precision measurement of extremely rapid transitions between matter and antimatter. It has been known for 50 years that very special species of subatomic particles can make spontaneous transitions between matter and antimatter. In this exciting new result, CDF physicists measured the rate of the matter-antimatter transitions for the Bs (pronounced "B sub s") meson, which consists of the heavy bottom quark bound by the strong nuclear interaction to a strange anti-quark. The staggering rate challenges the imagination: three trillion times per second.

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Scientists study dynamics that create and sustain fluid vortices

Scientists at DOE's Los Alamos National Laboratory in New Mexico and Johns Hopkins University in Baltimore have developed a new theory that for the first time quantitatively describes the physical process of how small-scale swirling patterns in fluids, or vortices, can become large-scale, long-lasting circulation patterns, like Jupiter's red spot. Through both computer modeling and laboratory experiments on thin salt-water layers, the scientists were able to observe the physical processes and measure the energy transfer of two-dimensional inverse energy cascades in turbulent fluids. Their findings confirmed theories that the energy transfer by stretching of small-scale vortices sustains the large-scale vortices.

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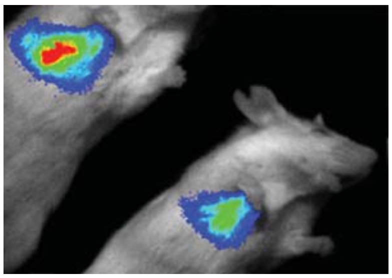
DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions.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

Toward Speeding Wound Healing

Efforts to mitigate patient discomfort during and after medical treatments has focused on making procedures less invasive. For instance, laparoscopic surgery uses specially designed tools to allow much smaller incisions, greatly reducing recovery and healing times. Now technology provided by DOE's Jefferson Lab is helping physicians develop a therapy that may one day cut healing time by helping the body heal wounds faster.



The glowing stem cells inside these sleeping mice (false-color image shows relative brightness) are the first step in developing a new therapy for shortening the amount of time it takes wounds to heal.

Zhenghong Lee is a Case Western Reserve University and Center for Stem Cell and Regenerative Medicine researcher. He and his colleagues are testing whether a therapy using stem cells derived from adults can aid healing. "[Stem cells] have great potential in many things—therapeutic repair, such as bone fracture, cartilage damage, and even some of the heart problems," Lee says.

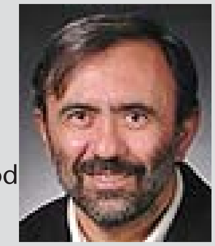
Lee and his colleagues obtained a type of stem cell donated by adult volunteers and categorized as Mesenchymal Stem Cells (MSCs). The researchers modified the MSC by inserting extra genes into the cells' DNA. One of these genes, from the North American firefly, causes the MSC to produce a gentle glow that can be detected by a sensitive camera.

The researchers can see where these cells go thanks to a new optical camera procured and tested by Jefferson Lab's Detector and Imaging Group, headed by Stan Majewski. The group selected a camera based on charged-coupled device (CCD) technology. "They use a solid-state detector called a CCD, which is the same thing you see in digital cameras. The only difference is that these CCDs are actually cooled to a very low temperature," says Carl Zorn, Detector and Imaging Group member. Cooling the camera produces sharper pictures by eliminating the natural electronic noise produced by the CCD itself.

Now the Case team is planning to track whether the MSC will home in on sites of injury in the mouse and lend a hand in wound healing. Lee expects preliminary results sometime this year.

Submitted by DOE's Jefferson Lab

From Dance to Descartes



Costas Soukoulis

Costas Soukoulis enjoys kicking up his heels, especially in traditional Greek dance. By his own admission, he's a good dancer. A close colleague testifies to his skill, declaring, "He's the god of Greek dance!"

So what does all this dancing have to do with the life Soukoulis leads as an Ames Laboratory senior physicist and an Iowa State University distinguished professor of physics? Plenty if you realize the important role dance plays in the lives of Greek people.

It's an expression of human feelings and everyday life. It influences the soul, according to Plato, the ancient Greek philosopher. And for Soukoulis, who grew up with the dance, that influence led to and continues to thrive in his passion for physics, in particular the field of left-handed materials, LHMs, a new subclass of materials he created in collaboration with a top-notch team of international researchers.

These artificial materials, also known as metamaterials, exhibit negative refraction, bending light in the opposite direction to that seen in natural materials. They can be fabricated to have zero reflectance and can focus light without the need for curved surfaces, promising a wide range of potential applications for LHMs, especially within the fields of medical diagnostics and cellular communications.

The superb work of Soukoulis and his colleagues in demonstrating the experimental reality of LHMs and their consistency with the laws of physics was recognized when the research team was awarded the 2005 Descartes Prize for Excellence in Scientific Collaborative Research, the European Union's highest honor in the field of science.

"I feel lucky to be one of the first people working in this completely new field of LHMs—it's a great opportunity to combine basic and applied physics and rewrite some of the laws of electromagnetism," says Soukoulis, who also studies photonic crystals, random media and wave propagation and, of course, continues to dance!

Submitted by DOE's Ames Lab