NETL's Kelly Rose

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Research Highlights . . .

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

Number 250 **December 17, 2007**

Taking the edge off spectrometry

Although it has been called the Cadillac of mass spectrometers, identifying compounds with great precision, Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR-MS) has never quite lived up to all that theory promised. By overhauling the geometry of the cell, Jill Scott, Timothy McJunkin, and David Dahl of the Idaho National Laboratory have found a way to simplify the ion motion to turn the theoretical power of FT-ICR-MS into reality. The innovative design, Scott says, should open the door for accurate isotope ratios and more than double the range of ion masses that can be measured simultaneously. In addition to assisting in the identification of nuclear material, the cell could greatly enhance identification of polymers and pharmaceuticals.

[Rachel Courtland, 208/526-4595, Rachel.Courtland@inl.gov]

DZero physicists find rare four-lepton event

The Tevatron particle collider at DOE"s Fermi National Accelerator Laboratory allows scientists to explore subatomic forces. In the last five years, Tevatron experiments have collected millions of collisions that produced a Z boson. The particle is a carrier of the electroweak force and is a heavy relative of the photon, the carrier of the electromagnetic force.

Sifting through its data, the DZero team now has found a rare incidence in which a collision created two force carriers—probably a Z boson and a photon—that then decayed into a pair of electrons and a pair of muons. This observation sets an upper limit on the rate with which this process can occur. The collaboration is eager to find more four-lepton events, which could reveal information about the Higgs boson or anomalous electroweak interactions.

[Kurt Riesselmann, 630/840-3351, kurtr@fnal.gov]

Plant defense study may improve biofuel production

Plant scientists at DOE's Brookhaven Lab have uncovered clues that may help them engineer more pest-resistant crops as well as feedstocks easily convertible to biofuels. The scientists followed the uptake of a radioactive form of nitrogen (13N) into plant amino acids before and after exposure to jasmonate — a plant "defense" hormone produced, for example, when insects start chewing on a leaf. Jasmonate resulted in increased production of certain amino acids linked with changes that render the plant more difficult to digest. Understanding these changes may assist scientists trying to design hardier crops or varieties with fibers that break down easily for more cost-effective biofuel production.

[Karen McNulty Walsh, 631/344-8350, kmcnulty@bnl.gov]

New T-ray source could help security, cancer detection

A group of researchers at DOE's Argonne National Laboratory, led by physicist Ulrich Welp, has developed a new, compact source of terahertz radiation, or T-rays. This new device could be used to create T-ray scanners that could detect dangerous or contraband materials at airports or new imaging devices for skin and breast cancers. T-rays also present an additional advantage over their more energetic cousins, X-rays: because they lack sufficient energy to ionize atoms, T-rays are perfectly safe for human exposure. T-rays can penetrate leather, fabric, cardboard, and paper but do not pass through water or metal.

[Jared Sagoff, 630/252-5549, jsagoff@anl.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).

DNA repair: A maternal mechanism

Once again, here is something to blame on moms: research published in a recent issue of the *Proceedings of the National Academies of Sciences* shows that maternal DNA-repair capability is responsible for repairing DNA damage in the fertilizing sperm and embryos with improperly repaired DNA die early in development or are born with defective chromosomes.

The research in mice, in which specific DNA-repair genes were missing, was conducted at DOE's Lawrence Livermore National Laboratory by biomedical scientists Francesco Marchetti and Andrew Wyrobek, now researchers at Lawrence Berkeley National Laboratory. Marchetti said he was surprised by the degree to which the effect occurred. In the most extreme case in mice of the *scid* line, which are missing an important DNA repair enzyme, developing zygotes (fertilized eggs) possessed twice as many chromosomal aberrations.

Marchetti and colleagues hypothesized that when developing sperm are exposed to a mutating agent, damaged DNA in the fertilizing sperm is converted into chromosomal aberrations in embryos unless the anomalies are repaired soon after fertilization. They tested their hunch by exposing the male mice to ionizing radiation, which tends to break double-stranded DNA, seven days before the mice were mated.

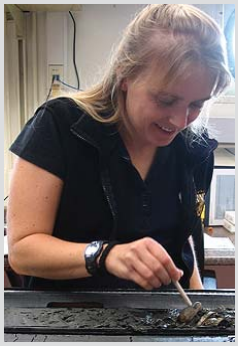
Eggs provide essentially all the cellular machinery for the developing zygote, since mature sperm consist of little more than a packet of chromosomal material. This machinery includes DNA repair enzymes, which spot and fix errors such as breaks in the strand of genetic material.

Previously, the maternal mechanism responsible for preventing aberrations in the fertilizing sperm had not been pinpointed, Wyrobek said. In the mouse, the maternal DNA repair enzymes function in the fertilized egg until it has reached a two-cell stage and the zygote's gene activity takes over, creating its own array of cellular functions. This transition occurs at a slightly later stage in humans.

While some variation derived from mutation may confer traits that enhance adaptation of the offspring, in most cases a new mutation is associated with pregnancy loss, developmental defects, infant mortality, infertility and genetic diseases in the offspring. Mutations may be transmitted by either parent. The types attributed to a mix-up in the original DNA sequence, possibly caused by faulty repair, are more frequently traced to the father's sperm.

Submitted by DOE's Lawrence Livermore National Laboratory

World-Traveling Geologist Outstanding Professional Employee



Kelly Rose of NETL's Office of Research and Development examines sediment cores from the Indian Ocean aboard the drillship Joides Resolution.

It's been a whirlwind 17 months for geologist and sedimentologist Kelly Rose, who specializes in methane hydrates research at the National Energy Technology Laboratory (NETL). Since August 2006, she has been on expeditions in India, the Alaska North Slope, China, the Gulf of Mexico, and Korea, where she provided geologic expertise for a series of major natural gas hydrate field projects. In addition, this past May, Rose received a Silver Award for Outstanding Professional Employee from the Federal Executive Board (FEB). The honor is part of FEB's Excellence in Government Awards Program, which recognizes federal employees whose service exemplifies strong personal and professional commitment.

Rose joined NETL in 2003 and works for the Earth & Mineral Sciences Division, where she oversees projects within the Methane Hydrates and Natural Gas program and the Oil Exploration and Production program.

Prior to joining the Lab, Rose served as a natural gas resource assessment geoscientist for NETL's site support research group; she also worked three years as an operations, development, and exploration geologist performing geologic evaluations and prospect generations for Marathon Oil. Recently, Rose has been focusing on natural gas hydrates, which have enormous potential as a future energy resource. Her studies of the nature of gas hydrate-bearing sediments enable Rose to determine the relationships between lithology, sedimentary structure, and other geological features on gas hydrate occurrence.

The upcoming year promises to be just as busy and fulfilling for Rose.

She has been invited to India to attend a follow-up conference for the joint U.S. Geological Survey-Indian Government Field Expedition. She will also participate in a DOE-sponsored expedition in the Gulf of Mexico. Wherever she travels, Rose will use her shared knowledge and research to contribute to NETL's goal of environmental health and energy independence.

Submitted by DOE's National Energy Technology Laboratory