PPPL researcher flies like a bird.

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Research Highlights . . .

Ames Lab facility goes to extremes

Researchers at DOE's Ames Laboratory are learning more about the behavior of unusual materials thanks to a new extreme environments facility. Associate scientist Robert Modler is using a dilution cryostat, high pressure cell and superconducting solenoid to simultaneously create the extreme conditions of very low temperature, high pressure and high magnetic field in one instrument. "Many researchers use one or two of these parameters to investigate materials, but only a few combine all three in one facility," says Modler. "I would guess there are probably only five comparable facilities in the world."

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

No more Tata non grata

Physicist Naba Mondal, of India's Tata Institute of Fundamental Research, is shown joining DZero colleague and physicist Tom Diehl of DOE's Fermilab in commissioning activities for the detector's central muon "cosmic cap" scintillation counters. For 18 months, Tata scientists, who built the scintillation counters, were unable to install and test their half-million dollar instrumentation system at Fermilab because of diplomatic sanctions levied against Indian scientific institutions in the wake of India's 1998 nuclear weapons tests. In December, 1999, the U.S. Department of Commerce removed Tata Institute from the list of banned scientific institutions.

[Mike Perricone, 630/840-5678, mikep@fnal.gov]

Cleaning up harbor sediments

Brookhaven scientists are using the New York/New Jersey Harbor as a real-world laboratory for studies on sediment decontamination. Dredged sediments in this area are widely contaminated with metals and organic pollutants, limiting options for their disposal. So Brookhaven is researching ways to treat the sediments. The project ranges from basic research on contaminant chemistry and transport, to actual testing and large-scale implementation of sediment processing. The ultimate goal is not only to remove the contaminants, but also to turn the leftover material into useful products like manufactured soil or construction-grade cement. The findings could help clean up harbors everywhere.

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

"Welding" may increase superconductor uses

A new welding technique for high-temperature superconductors, developed at DOE's Argonne National Laboratory, is adding to the range of practical applications for these materials, which conduct electricity without resistance. Superconductors hold great potential for transmitting electricity, but most ideas require large components. Researchers have been unable to grow large superconducting structures that carry current uniformly, and previous metholds to join smaller sections interrupt electrical flow. Now, however, materials scientists at Argonne have developed a way to weld components of superconducting materials with strong bonds that preserve uniform electrical flow across the joint, using a special melting process.

[Rich Greb, 630/252-5565, rgreb@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).

Groundbreaking in extreme conditions

Not snow, no, nor rain, nor heat, nor night keeps them from accomplishing their appointed courses with all speed," wrote the Greek historian Herodotus in his *History*, in the fifth century B.C. He was writing of the Persians (not New York City letter carriers, who adapted his words some 25 centuries later), but his description applies equally to those unstoppable subatomic particles, the neutrinos—and to the groundbreaking held on their behalf at DOE's Fermi National Accelerator Laboratory on May 31.

Lightning flashed, thunder rolled and wind drove the rain in horizontal sheets across the Fermilab site. Nevertheless, groundbreakers for the $30 million NuMI construction project that will send a beam of neutrinos from Fermilab's Main Injector accelerator to a detector in northern Minnesota wielded their gold-toned shovels undaunted. And undampened. While the prairie thunderstorm raged outside, turning the planned site of the groundbreaking into a lagoon, representatives from Fermilab, DOE, the NuMI project, the MINOS collaboration, and the S.A. Healy Company turned over the requisite spadefuls of soil in a planter in the atrium of Fermilab's Wilson Hall.

"There are just as many neutrinos in here as there are out there," observed Fermilab Director Mike Witherell. "And it's drier in here."

The digging marked the start of construction for a new particle beamline that will act like a fire hose, directing a high-intensity stream of nearly pure muon neutrinos from the Fermilab Main Injector toward two detectors, "near" and "far," both capable of detecting and counting all three flavors of neutrinos. In the far detector, in a cavern-turned-laboratory in a former iron mine a half-mile below ground, some 150 scientific collaborators, including physicists from Fermilab, Argonne National Laboratory, Lawrence Livermore National Laboratory and Brookhaven National Laboratory as well as 27 universities and laboratories in five countries, will analyze particle interactions in the detector to determine whether any of the muon neutrinos that left Fermilab have turned to tau neutrinos during their split-second trip to Minnesota. If such "oscillations" show up in the MINOS data, experimenters will know that some of the muon neutrinos that started out at Fermilab must have oscillated and hence must have mass.

The implications of massive neutrinos for our understanding of the fundamental structure of matter and the nature of the universe would be profound.

Profound as well were the deep cracks of thunder punctuating the remarks of speakers at the groundbreaking ceremony. "That's Mother Nature," said MINOS spokesman and Stanford physics professor Stan Wojcicki, as lightning flashed in the background, "reminding us that she is an *ex officio* member of every physics collaboration."

Submitted by DOE's Fermilab

Dave Cylinder develops bird-like aircraft

David Cylinder holds the Samara prototype.

The next time a small bird perches on a ledge outside your office window, beware; it could be a surveillance device.

David Cylinder, a researcher at the DOE's Princeton Plasma Physics Laboratory, is creating innovative, bird-like airframes for micro aircraft vehicles, which could carry sensors for intelligence gathering and radar jamming. Cylinder's creation is part of his work with the U.S. Naval Research Laboratory to develop autonomous vehicle systems for use in various military applications.

The aircraft would range from bug-size to bird-size, weigh in at under a pound, and have wingspans of less than a foot. The Navy and Marines would ultimately use the aircraft to carry electronic, acoustical, magnetic, nuclear, chemical, motion, and other types of micro-sensors and secure transmitters. For surveillance purposes, the vehicles could resemble an insect or a bird.

Cylinder designed one model, Samara, which looks like two winged seeds that counter rotate. The name hails from the samara seed—such as that of a maple tree—which has a wing like a single-bladed rotor.

His inspiration for the Samara model? Hummingbirds.

"I thought about the Samara design while I was in the backyard watching a hummingbird. When they hover, they flap their wings like reversing propellers because without a rotary joint, the wings cannot go all the way around like a helicopter. The Samara's wings rotate slightly off kilter, so that they can go all the way around. One wing just passes over the top of the other," he noted.

Cylinder, who has a lifelong passion for birds and model planes, observed, "Nature has the perfect flying system - birds. They have every piece of apparatus to survive and still can fly thousands of miles without refueling. We are nowhere near duplicating this…but maybe we can learn to design better small aircraft from the birds."

Submitted by DOE's Princeton Plasma Physics Laboratory