Seran Gibbard studies the cosmos Page 2.

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Fermilab neutrino oscillation experiment gets help from "Teletubbies"

A "value engineering" session produced a time-and-money-saving design change for the MiniBooNE neutrino experiment at DOE's Fermilab: the "Teletubby" electronics room. Veteran Fermilab engineer Tom Pawlak had recently baby-sat with his grandchildren, watching TV's *Teletubbies* romp about on a mound of earth, emerging from a circular underground playroom. Pawlak proposed a circular electronics room under a mound of earth atop the MiniBooNE detector. The scientists would have a huge open space for their electronics, replacing the cramped original design. MiniBooNE will search for neutrino oscillations, seeking to confirm results from an earlier experiment at Los Alamos National Laboratory.

[Judy Jackson, 630/840-5678, jjackson@fnal.gov]

Laser glazing saves rails, environment

The high costs railroad companies pay due to energy losses from friction and friction-induced rail cracking can be greatly reduced by using a process called laser glazing, according to research at DOE's Argonne National Laboratory. When steel rails are laser glazed, trains travel on them with significantly reduced friction. "In addition to railroad rails and wheels, the process can be applied to many other steel surfaces, such as bearings and gears, where reduced friction and wear are important," said Argonne scientist Ron DiMelfi. Railroad companies estimate reducing rail-wheel friction could save $56 million per year in fuel and rail replacement costs.

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New method for making optical photonic crystals

Using a novel ceramic technique, DOE's Ames Laboratory is creating colloidal optical photonic crystals from an inexpensive, non-toxic mixture of polystyrene microspheres and a titania suspension slurry. The colloidal crystals possess a periodic structure resembling a honeycomb and have a photonic bandgap—a range of forbidden frequencies within which a specific electromagnetic wavelength is blocked and light is reflected. Three-dimensional photonic crystals that operate at optical wavelengths have captured the fancy of the research community because of their potential for controlling and manipulating light in applications such as light-emitting diodes, micro-fabricated lasers and optical switches for telecommunications.

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Vigabatrin promises new 'low' for heroin 'highs'

For the first time, a drug has been shown to block heroin-induced "highs" in animals' brains. DOE's Brookhaven National Laboratory scientists reported [*Synapse*, 34, 11 (1999)] that in freely moving animals, the antiepilepsy drug vigabatrin abolishes the "high" effects of not only heroin, but also of alcohol on brain dopamine, and it significantly inhibits the "high" of methamphetamine. These data extend Brookhaven's earlier findings on vigabatrin's blocking cocaine and nicotine "highs" in animals. Brookhaven and Boston University also showed that vigabatrin blocks heroin self-administration in laboratory animals. Brookhaven research now focuses on vigabatrin's potential as an alternative to methadone for heroin addiction.

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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).

Waste not, want not

In the early 1900s, when petroleum was first used in the Unites States as an energy feedstock, its single refined product was kerosene. Today it is the feedstock for everything from gasoline to jet fuel to asphalt to a variety of chemical products.

Similarly, biomass in the early 1900s was used exclusively for heat. It is now also used for electricity, ethanol from corn and charcoal. Thanks to research at DOE's National Renewable Energy Laboratory, Pacific Northwest National Laboratory and industry partners, there are exciting new uses for biomass.

New technology converts almost any biomass feedstock, such as this dried paper sludge, to levulinic acid, a chemical building block for many environmentally friendly

The public/private partnership developed the technology to convert wastes such as paper sludge, municipal solid waste, unrecyclable waste paper, waste wood and agricultural residues into levulinic acid, a valuable industrial chemical used to make a range of everyday products, including substitutes for petrochemicals.

"The new biomass conversion process can help reduce the tons of trash clogging the nation's landfills and replace petrochemicals made from imported oil," said NREL's Joe Bozell, the project's technical coordinator. "Commercially produced levulinic acid derivatives could become part of a new chemical industry based on renewable feedstocks."

Biofine, a small company that operates a levulinic acid pilot plant in New York, developed the technology to convert waste to levulinic acid. Work at the national labs focused on converting the acid to useful chemicals. Luc Moens of NREL's Chemistry for Bioenergy Systems Center converted levulinic acid to delta-aminolevulic acid, a biodegradable herbicide. Work at PNNL involved converting levulinic acid to methyltetrahydrofuran, a gasoline additive.

The project combined funding and expertise from NREL, PNNL, Biofine, the New York State Energy Research and Development Authority, Chemical Industry Services, Merichem and Pencor Environmental Ventures. In recognition of their research success, the group received recently the Environmental Protection Agency's Presidential Green Chemistry Challenge Award. Visit the Web site at http://www.nrel.gov/hot-stuff/press/3599award.html for more information.

Submitted by DOE's National Renewable Energy Laboratory

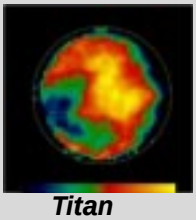
Love of animals became love of planets

As a youth, Seran Gibbard originally wanted to become a veterinarian because she loved animals.

But along way, the Lawrence Livermore National Laboratory researcher changed her mind after watching the PBS *Cosmos* series with Carl Sagan.

"I'd never been particularly interested in astronomy, but when I was in high school and saw the *Cosmos* television series, I found it fascinating," Gibbard recalls.

Now it's Gibbard who is studying the stars and the planets.



Titan

Most recently, she led a team from DOE's Livermore Lab and the University of California campuses at Los Angeles and Berkeley that captured the best images ever taken of Saturn's moon, Titan, using the world's largest telescope, the 10-meter Keck on Mauna Kea, Hawaii.

Those images, with approximately twice the resolution of the Hubble Space Telescope, revealed a complex surface that may be home to icy landforms and frigid hydrocarbon seas.

Results of the team's research appeared in the July issue of the planetary-science journal *Icarus.*

The blurring of the Earth's atmosphere was overcome using "speckle interferometry," a technique whereby hundreds of short, turbulence-freezing snapshots are computer-processed together.

Gibbard teamed with Chris McKay of NASA's Ames Research Center and Eliot Young of the Southwest Research Institute to convert these images into a map of surface features. They removed light scattered in Titan's atmosphere to produce an image uncontaminated by haze.

"These models give the first quantitative map of Titan's surface. The bright region shaped somewhat like a rubber duck seems to be made of a mixture of rock and ice," Gibbard said.

Gibbard, who obtained a BA in physics from Johns Hopkins University and her Ph.D. in planetary science from the University of Arizona, has been a researcher at Livermore's Institute for Geophysics and Planetary Physics for three years.

Submitted by DOE's Lawrence Livermore National Laboratory