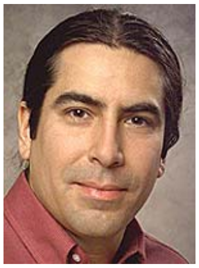

Brookhaven's Louis Peña

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Face-changing dust

Dry dust reacts with air pollutants to form a new species of dust—dewy particles whose sunlight-reflecting and cloud-altering properties are unaccounted for in atmospheric models, say scientists at DOE's Pacific Northwest National Laboratory and collaborators from the University of Iowa and the Weizmann Institute of Science. The team collected 2,000 micron-sized dust specks from a mountaintop in Israel for a recent analysis at the PNNL-based W.R. Wiley Environmental Molecular Sciences Laboratory. The dust had blown in from the northern shores of Egypt, Sinai and southern Israel and had mingled with air containing pollutants that originated from Cairo. These new particles absorb and retain water, causing them to scatter and absorb sunlight, hence presenting climate modelers with a new wild card on the fate of the sun's energy.

[Bill Cannon, 509/375-3732, cannon@pnl.gov]

Soda-straw-like tubes can solve widespread sensing problems

Sending weak beams of light through inexpensive glass tubes that resemble soda straws, Sandia National Laboratories researcher Jonathan Weiss —dubbed by some the "light wizard"— can inexpensively solve problems ranging from the migration of waste through a landfill to detecting when an automobile battery soon will be too weak to start a car. Similar sensors also could tell oil field operators when to stop pumping oil from their tanks before the pumps pick up water that accompanies oil from the ground. Measuring battery deterioration will become increasingly important as more hybrid electric/gas vehicles, with their high reliance on batteries, take to the highways, he says.

[Howard Kercheval, 505/844-7842, hckerch@sandia.gov]

High speed pictures of atoms, molecules

Researchers at the Stanford Synchrotron Radiation Laboratory and the German laboratory BESSY have crafted a technique to take x-ray images that reveal tiny variations and lightning-quick changes in materials a thousand times smaller than the thickness of a strand of hair. The technique—lensless x-ray holography—will be valuable for researchers working with the world's first x-ray free electron laser, the Linac Coherent Light Source, slated to begin experiments in 2009 at DOE's Stanford Linear Accelerator Center.

"We have demonstrated the first direct imaging technique that will work with LCLS, opening the door for taking pictures of ultra-fast changes in the collective behavior of ensembles of atoms and molecules," said SSRL physicist Jan Lüning.

[Neil Calder, 650/926-8707, Neil.Calder@slac.Stanford.edu]

Genes hold key to skull growth disorder

Abnormalities of the face and skull rank among the most common birth defects in humans. Researchers at DOE's Oak Ridge National Laboratory are taking a systems biology approach to the problem, investigating a series of eight mutant mouse strains that could serve as animal models for deciphering the complex molecular interactions underlying skull development. Mutations in the gene that codes for a novel cell-signaling protein affected skull and spine growth in mice. The strains could serve as models for craniosynostosis, a condition where a child's skull bones grow very fast and fuse prematurely, preventing further brain growth and requiring major skull reconstruction.

[Carolyn Krause, 865/574-7183, krausech@ornl.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).

Sandia, General Motors focus on hydrogen storage

General Motors and DOE's Sandia National Laboratories have launched a partnership to design and test an advanced method for storing hydrogen based on metal hydrides.

Metal hydrides—formed when metal alloys are combined with hydrogen—can absorb and store hydrogen within their structures, then, when subjected to heat, release their hydrogen. In a fuel cell system, the hydrogen can then be combined with oxygen to produce electricity.

Sandia and GM have embarked on a four-year, $10 million program to develop and test tanks that store hydrogen in a complex hydride—sodium aluminum hydride, or sodium alanate. The goal is to develop a pre-prototype solid-state hydrogen storage tank that would store more hydrogen onboard a fuel cell vehicle than current conventional hydrogen storage methods. Researchers also hope to create a tank design that could be adaptable to any type of solid-state hydrogen storage.

Researchers at both GM and Sandia say the program is part of a concerted effort to find a way to store enough hydrogen onboard a fuel cell vehicle to equal the driving range obtained from a tank of gasoline, which will be key to customer acceptance of fuel cell vehicles.

The current leading methods of storage are liquid and compressed gas. To date, however, neither of these technologies has been able to provide the needed range and running time for fuel cell vehicles.

"We are designing a hydrogen storage system with challenging thermal management requirements and limits on volume and weight," says Chris Moen, manager of Engineering and Science Technologies at Sandia's California lab. "Our staff researchers are excited to apply their unique, science-based design and analysis capabilities to engineer a viable solution."

"We know a lot of research still needs to be done, both on the types of hydrides we use, as well as the tanks we store them in," says Jim Spearot, director of GM's Advanced Hydrogen Storage Program. "We think our work on projects like this with Sandia will get us another step closer to our goal."

In the first of the project's two phases, researchers will study and analyze engineering designs for a sodium alanate storage tank using thermal and mechanical modeling, develop controls systems for hydrogen transfer and storage, and develop designs for external heat management. GM and Sandia scientists will also be testing various shapes—from cylindrical to semi-conformable—to see which are the most promising.

In the second phase, researchers will subject promising tank designs to rigorous safety testing and ultimately fabricate pre-prototype sodium alanate hydrogen storage tanks based on knowledge gained from the program's first phase.

Submitted by DOE's Sandia National Laboratories

Cells awash in synthetic growth factors may aid healing

Louis Peña

Louis Peña, a scientist in the Medical Department at DOE's Brookhaven Lab, has developed a chemical design strategy to generate synthetic analogs of natural growth factors to see how they might help protect cells from radiation damage or foster tissue regrowth following injury.

Starting with a high-school job washing dishes in a lab at the University of Southern California School of Medicine, Peña became interested in biomedical research, returning to the same lab each summer while studying evolutionary biology at Harvard. He went on to earn a Ph.D. in anatomy and cell biology from UCLA. After holding research positions at Cold Spring Harbor Laboratory and Memorial Sloan Kettering Cancer Center, he joined Brookhaven's staff in 1999.

Throughout, his interest has been in how cells "talk" to one another and how growth factors mediate that communication, sometimes telling cells to regenerate tissue, other times telling them to die. His understanding of how growth factors mediate cell growth may lead to ways to protect cells from radiation damage—or, alternatively, make tumor cells more vulnerable to radiation, allowing therapeutic doses to kill cancer cells more effectively while sparing healthy tissue.

In soon-to-be-published work, Peña and colleagues developed a synthetic analog of fibroblast growth factor that protects mice from radiation exposure. The more stable analog may be useful to persons facing accidental exposure to occupational, military, or even terrorism-related radiological events.

In another recent development, Peña worked with industry partners to synthesize a biologically active analog of a naturally occurring growth factor that appears to synergistically enhance the effects of another growth factor used in bone healing. The ability to use much lower doses of growth factors could be a boon to manufacturers of orthopedic implants because there is concern over the high doses currently required.

"An agent that decreases the amount of growth factor needed—or one that can recruit the body's own growth factors to be more effective—could have a substantial clinical benefit," Peña said.

Submitted by DOE's Brookhaven National Laboratory