Thermodynamics drives Migliori's eclectic career

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Research Highlights . . .

Carbon dioxide puzzle explained

Researchers at DOE's Lawrence Liveremore National Lab have helped explain the puzzle of missing carbon dioxide in the cold Southern Ocean near Antarctica. The Southern Ocean absorbs carbon dioxide from the atmosphere, but measurements find less of this greenhouse gas near the ocean surface than expected. In an article in *Science* magazine, Livermore researchers Ken Caldeira and Phil Duffy explain that ocean currents take the carbon dioxide deep below the surface as they flow north to subtropical regions. Understanding this pattern helps clarify one of the many puzzles that scientists must solve to understand global climate change more completely.

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Lunar impacts linked to life on Earth

Following an idea proposed by physicist Richard Muller of DOE's Lawrence Berkeley National Laboratory, a team of geologists analyzed the history of lunar impact cratering and found a surprising increase over the past 400 million years. This increase may have played a central role in the evolution of life on Earth for it coincides with the "Cambrian explosion," a period in which terrestrial life took off with a dramatic burst in the number and diversity of species. "Just as we stress trees, through pruning, to make them give more fruit, the stress cause by catastrophic impacts may have forced evolution into new directions," said Muller.

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For those whose thoughts have turned to fuel economy

Car and truck buyers concerned about either the environment or the price at the pump can turn to a Web site maintained by DOE's Oak Ridge National Laboratory to find information about the environmental and energy consequences of vehicle choices. Shoppers can check out Environmental Protection Agency gas mileage numbers, compare estimates of greenhouse gas emissions and follow links to other car buyer information sites. DOE is distributing the EPA's estimates of gas mileage for every 2000 model car and light truck, plus recently added data on used cars from 1999 to 1985.

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On the road to lighter vehicles

A composite material developed at DOE's Ames Laboratory may steer automotive companies toward lighter, more fuel-efficient vehicles. The composite consists of cobalt ferrite and small amounts of nickel and silver to hold the material together. A quarter-inch-thick ring of the composite could be used in an electronic torque sensor to regulate the steering power provided to a car's wheels by an electric motor. This would enable automakers to eliminate the heavy, energy-draining hydraulic system currently used in power-steering assists. Estimates indicate that switching to a lighter, energy-efficient electrical system could improve a car's fuel efficiency by five percent.

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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).

ORNL center brings Terra data down to Earth

NASA recently launched *Terra,* the flagship satellite for its Earth Observation System to monitor environmental and climate change on Earth. Researchers at DOE's Oak Ridge National Laboratory, working closely with the space agency and global change researchers, are helping to verify the data that come from the satellite's instruments.

Terra's first images are scheduled to be released in mid-April. All spacecraft subsystems continue to function as expected during the calibration phase with more than seven terabits of data downlinked and captured by the ground system.

ORNL's role is to assist in the validation of information coming from *Terra's* MODIS (or Moderate Resolution Imaging Spectroradiometer) by helping to compare it with actual observations from the ground. In other words, the researchers in the field are going to help confirm what the spacecraft is seeing and how it should be interpreted.

"Sensing climatic and environmental conditions on the ground from a satellite requires a lot of interpretation," says Dick Olson, with ORNL's Distributed Active Archive Center, or DAAC. "We're helping NASA determine how well satellite-derived images relate to the information on the ground."

The DAAC is funded by NASA to assemble, archive, and distribute data on terrestrial ecosystems useful to global change researchers. It will compile data from 24 sites around the globe use that knowledge to help Terra researchers accurately interpret what the MODIS instrument is measuring.

"Another satellite, the Hubble space telescope, gave us tremendous ability to look out in space. *Terra* gives us an ability to look back at the Earth," says Olson. "The science community sees *Terra* as a big jump in its ability to monitor, understand, and predict global environmental conditions and the impact they may have on the environment."

Olson further explains that the ORNL-NASA collaboration could eventually add up to an eye-in-the-sky model for environmental and climate effects.

"The complexity of this project is beyond most I've been associated with," says Olson. "It involves a very large community and large amounts of data. On the other hand, it makes it fun, because it involves an international group of researchers in different fields—ecologists, geographers and computer modelers, for instance—and we know they will use our data."

Submitted by DOE's Oak Ridge National Laboratory

Eclectic physicist's work has unifying theme

Albert Migliori, a staff member at DOE's Los Alamos National Laboratory since 1976, is co-discoverer of acoustic heat engines and has won numerous awards for his work in resonant ultrasound spectroscopy.

However, like many Los Alamos scientists, Migliori has worked on a virtual What's What of cutting-edge physics. He has pursued interests in the Mossbauer effect, design of liquid working fluid heat engines, picosecond optical studies of vibrational localization, ultrasound, microwave and critical state studies of superconductors and Kondo systems, insulators and semi-metals. He is a fellow of LANL and of the American Physical Society, holds 21 patents, and has written more than 100 publications, five book chapters and one book.

Migliori sees the unifying theme of his career as his fascination with thermodynamics.

"Since the age of 17 when I took my first thermodynamics course at Carnegie Mellon University, I have been interested in the effects of thermodynamics on the physical world," he said.

Migliori's work on sound speed measurement led to resonant ultrasound spectroscopy designs for a number of commercial systems for such applications as detecting flaws in auto parts. He gives annual lectures on these techniques at the Physical Acoustics Summer School in California.

Migliori recently applied these techniques to the study of the properties of plutonium, making the first sound speed measures on that metal since 1973. "With resonant ultrasound, we can study plutonium aging in real time, which will allow us to make superb predictions for stockpile stewardship, and possibly reduce the number of weapons in the stockpile," he said.

Migliori currently works at the National High Magnetic Field Laboratory at Los Alamos, a natural extension to his previous work. "The availability of the very highest research magnetic fields in the world give me the opportunity to study many aspects of the thermodynamics of solids."

He is an unabashed cheerleader for the Laboratory. "Los Alamos is an outstanding place to do research," he said. "It's amazing what scientists have been able to accomplish here."

Submitted by DOE's Los Alamos National Laboratory