



NREL's Tony Markel



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Research Highlights . . .

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).

Precise top measurement means Higgs looming larger in Fermilab estimations

The mass of the **top quark**—about equivalent to that of a gold nucleus—reflects some of the crucial aspects of the **Standard Model of particle physics**, and is correlated with the mass of the still-unobserved **Higgs particle and mechanism** that give mass its origins. Scientists at the **DZero experiment** of DOE's **Fermilab**, using approaches made possible by more powerful computing available for data analysis, have reduced the statistical uncertainty in the measurement of top quark mass corresponding to a factor of 2.4 increase in the size of the data sample. This measurement is as accurate as all previous measurements combined, and suggests a Higgs mass a bit larger than previously thought.

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Novel closure system under development

The prototype of the system that will close waste packages of spent nuclear fuel for placement in **Yucca Mountain** in Nevada, the site being studied for the federal repository, is being designed, built and tested at DOE's **Idaho National Engineering and Environmental Laboratory**. Based on its proven performance in remote fuel handling activities, the INEEL was selected for this work. The Waste Package Closure System installs three lids on waste containers, welds them shut, inspects the welds and then tests for leaks. INEEL engineers are integrating off-the-shelf equipment, developing new or modifying existing equipment where required, and making the entire process remotely operated.

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Another magnet, and another world record

Only two years after building the world's most powerful dipole electromagnet, a team at DOE's **Lawrence Berkeley National Laboratory** has upstaged itself with an even stronger magnet, a **16-tesla design** that paves the way for upgrades to existing and under-construction accelerators like Fermilab's Tevatron and CERN's Large Hadron Collider. The magnet, which in October generated a field more than 300,000 times stronger than the Earth's magnetic field, cements Berkeley Lab's place as the leader in high-field superconducting magnets. Dubbed HD-1, it owes its performance to a niobium tin alloy that offers unprecedented field strengths but requires innovative fabrication and analysis techniques.

[Dan Krotz, 510/486-4019, dakrotz@lbl.gov]

Economical superconductors could reduce cost of MRI machines

Scientists at DOE's **Los Alamos National Laboratory** have developed a way to manufacture a low-cost superconducting material that should lead to cheaper magnetic resonance imaging (MRI) machines. The material is made of magnesium diboride treated with hot isostatic pressing and prepared as wires roughly 80 feet long and one-sixteenth of an inch thick and then wrapped into a coil. With the new conductor, the cost of wire used in MRI magnets could be reduced to less than one third current cost because miles of wire are wound into the coils of a typical MRI machine.

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Berkeley Lab works With NASA to use wheat to get to Mars

An astronaut aboard a spacecraft bound for Mars reaches into a container and grabs a handful of wheat straw: she's holding the key to a sustainable mission, waste that can be converted into fertilizer for the plants she eats and nitrogen for the air she breathes.

"To get to Mars, we need to develop a fully regenerative life-support system," says Ted Chang of DOE's [Lawrence Berkeley National Laboratory](#), who led a research team from the Lab's [Environmental Energy Technologies Division](#) and [NASA Ames Research Center](#).



With Berkeley Lab's Ted Chang, NASA is developing ways to use a nutrient solution and artificial sunlight to grow wheat, then recycle the waste. (Photo NASA)

A round trip to Mars will take three years, so the crew will have to grow food along the way. With food comes waste. The right incineration techniques can recover carbon dioxide, water, and minerals as well as pollutants like oxides of nitrogen and sulfur. Locked in these pollutants are nutrients that can help grow the next batch of plants, including fertilizers like ammonia, nitrates, and sulfates. Food to waste to nutrients, then back to food—a textbook sustainable system.

Stripping nutrients from pollutants uses routine technology on Earth, says Chang, but in space "you can't use expendable materials, gravity-dependent processes, or dangerous gases. So we focused on material that is available and can be continuously regenerated."

He didn't have to look far. Growing wheat, astronauts will have a steady supply of straw. Converting the straw to activated carbon, using a system developed by Chang and his collaborators, facilitates a cyclical flow of food, waste, and nutrients. A six-person crew eating 1.5 kilograms of wheat per day would yield over 200 kilograms of wheat-straw-derived activated carbon each year—enough to supply their needs.

"Waste has nutrients that shouldn't be thrown away, and in fact could help sustain a mission for its entire duration," says Chang. "Our method could allow astronauts to reuse valuable resources."

Submitted by DOE's [Lawrence Berkeley National Laboratory](#)

VEHICLE SYSTEMS ANALYSIS TEAM REACHES NEW HEIGHTS



Tony Markel

Tony Markel has contributed to almost every aspect of the development of ADVISOR, a trademarked hybrid electric vehicle simulation tool developed by researchers at DOE's [National Renewable](#)

[Energy Laboratory](#). He admits that he probably knows more about the inner workings of ADVISOR than anyone at the Lab and has personally been in the guts of nearly every file ADVISOR has to offer.

"I've focused on ADVISOR for several years, contributing to model development, validations, vehicle benchmarking and the application of the tool," Markel said.

Markel is a senior engineer with the Lab's Center for Transportation Technologies and Systems and the new Vehicle Systems Analysis Task Leader. The Vehicle Systems Analysis team provides analysis support to DOE's FreedomCAR program and has been instrumental in the success of ADVISOR. Recently, AVL Powertrain Engineering, Inc. obtained a license from NREL to commercialize ADVISOR.

ADVISOR can be used to simulate and analyze conventional, advanced, light and heavy vehicles, including hybrid electric and fuel cell vehicles. It predicts the effect of changes in vehicle components (such as motors, batteries, catalytic converters, climate control systems, and alternative fuels) and other modifications that might affect fuel economy, performance or emissions.

Markel began working on ADVISOR in 1998 when it first was released to the public and has seen it change and grow through the years.

"The biggest change I've seen is the program's range of capabilities," Markel said. "It's like a tree. ADVISOR has grown and branched out, depending on what our users have needed."

Submitted by DOE's [National Renewable Energy Laboratory](#)