Jeff Coderre's work offers hope to brain cancer patients, page 2

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Tracking a legacy of waste in Siberia

Scientists from DOE's Pacific Northwest National Laboratory are investigating the way radioactive waste travels in the groundwater of Russia's West Siberian Basin. The waste was generated by nuclear weapons material production. Pacific Northwest will model movements of radioactive contaminants, and estimate their future path and where they pose the greatest threat. The models will help improve understanding of how radioactive wastes react with underground rocks as they are transported by groundwater. Research includes the areas around Mayak, Tomsk and Krasnoyarsk.

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World's smallest combination lock

The "worlds smallest combination lock," a minuscule mechanical device developed by researchers at DOE's Sandia National Laboratories, promises to build a virtually impenetrable computer firewall that even the best hacker can't beat. The Recodable Locking Device, which uses microelectro-mechanical system (MEMS) technology so small that it takes a microscope to see it, is a series of tiny notched gears that move to the unlocked position only when the right code is entered. It's the first known mechanical hardware designed to keep unwanted guests from breaking codes and illegally entering computer and other secure systems. For more details see http://www.sandia.gov/media/hacker.htm.

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Environment: Technology yields answer

Better farming practices and fertilizers rather than increased atmospheric CO2 are responsible for the remarkable increases in crop yields, according to a paper by Jeff Amthor of DOE's Oak Ridge National Laboratory. Amthor notes that average yield of most crops in many countries has increased significantly during the past 100 years. Up to 90 percent of that increase is the result of factors that include nitrogen fertilization, selection of genotypes with increased harvest index and disease resistance and mechanization of planting. If technology continues to increase aver-age yields at recent rates, near-future increases in carbon dioxide will have only small impacts on yield in comparison to technology.

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It works! First proton beam accelerated in Fermilab's Main Injector

Eight years and $230 million dollars after the project began, scientists at DOE's Fermilab accelerated beam for the first time in the Laboratory's new Main Injector. Champagne corks popped on Sunday evening, November 17, when monitor screens showed the unmistakable trajectory of a beam of protons accelerated to 120 GeV. "This means everything was put together right, and it works," said Project Manager Steve Holmes. "Not only that, we're completing the Main Injector on time and under budget." The new Main Injector will greatly increase the scientific capability of Fermilab's Tevatron, the world's highest-energy particle accelerator.

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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).

Labs model climate in heart of tornado alley

Kansas. Rolling prairies, wildflowers, farm fields. Thunderstorms, lightning, tornadoes. It is here that Mother Nature lets loose with a variety of weather phenomena and extremes like no other place on Earth.

That's why researchers from around the world have come to the heart of the Midwest to study climate conditions. Their goal is to improve weather and climate models and to understand climate change. To do this they have turned 55,000 square miles across the Southern Great Plains of Kansas and Oklahoma into one big meteorological "laboratory."

As part of the U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) program, scientists from Argonne National Laboratory are operating observational equipment placed among the plains' agricultural fields and grasslands. This observational facility is called a Cloud and Radiation Testbed (CART) site.

The Southern Great Plains site is the largest of three primary field "laboratories" in the ARM program and was the first to begin operations—opening in 1992. A second CART site, the Tropical Western Pacific, operated by Los Alamos National Laboratory on Manus Island, Papua, New Guinea, began operations in the fall of 1996, and a third CART site, the North Slope of Alaska, operated by Sandia National Laboratories, began limited operations in the fall of 1997 According to Argonne meteorologist Doug Sisterson, who manages the Southern Great Plains site for the ARM program, the sites are located in strategic parts of the world where the most significant climatological and weather processes can be found.

The Southern Great Plains was the first field measurement site in part because, in the course of a year, the area plays host to nearly every kind of cloud system. It has both cold, dry winter weather and hot, muggy summer weather, providing climate models with the widest range of conditions possible at one location.

"It's no accident this area is the heart of tornado alley," says Sisterson. "Extreme differences in air masses produce a large range of meteorological conditions, making the Southern Great Plains one of the most attractive places in the world to do climate research."

The heart of the Southern Great Plains site is the heavily instrumented Central Facility located on 160 acres of Oklahoma cattle pasture and wheat field southeast. Many of the 240 instruments at the Southern Great Plains site are the only one of their kind or the first of their kind.

Researchers are using the meteorological and solar radiation data collected at the CART sites to improve General Circulation Models (GCMs). These are the computer programs used by meteorologists to make climate change forecasts. Current GCMs leave much uncertainty in forecasting.

By improving GCMs, researchers in the ARM program hope to improve long-range forecasts of weather patterns in the next 50 years. As a result, they hope to answer important questions about climate change, including how much of it is caused by humans and how much is just the random behavior of Mother Nature at work.

Research at ARM/CART sites is a collaborative effort. Participants in the ARM program come from more than 40 organizations, including national laboratories, universities, private and federal agencies and foreign institutions.

Submitted by DOE's Argonne National Laboratory

FIGHTING CANCER FROM WITHIN

These days are busy ones for Jeff Coderre. But when you're offering one of the few rays of hope for people facing life-threatening brain tumors, that's what happens.

First, there's the clinical trial he runs at DOE's Brookhaven National Laboratory. Since 1994, patients have traveled from around the nation to receive the experimental enhanced-radiation treatment called boron neutron capture therapy, or BNCT. All have had deadly glioblastoma multiforme, an insidious brain tumor that kills within a year. Most have lived just as long after the single-session BNCT treatment as they would have after weeks of conventional radiation and chemotherapy, with virtually no side effects and a far better quality of life. The results are encouraging and hopes are high, but Coderre isn't calling it a cure - yet. There's still work to be done.

Just recently, he and his team began a new phase of the trial, expanding the admission criteria and increasing the radiation dose.

BNCT works from within cancer cells, killing them with a one-two punch. First, the patient is given an intravenous dose of BPA, a drug co-developed by Coderre using skills he learned at Yale while working toward his Ph.D. in chemistry. BPA carries the element boron to tumor cells, while largely avoiding normal cells.

Then, the patient receives a carefully aimed dose of neutron radiation from BNL's small medical research reactor. When a neutron hits a boron atom in a tumor cell, the atom "captures" its energy, releasing radiation that kills the cell from within.

Even as the trial progresses, Coderre has the future in mind. He's working to make BNCT better, through studies of new boron compounds and better neutron beams. In theory, BNCT could attack not only brain tumors, but virtually any cancer. And Jeff Coderre will help lead the charge to make that happen.

Submitted by DOE's Brookhaven National Laboratory