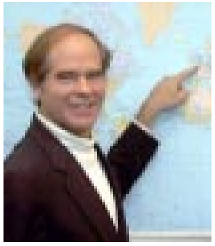

On the Road... with PPPL's Robert Budny Page 2.

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Argonne biochips may help halt tuberculosis epidemic

A new biochip technology developed by Russian and American scientists may help stem the global resurgence of tuberculosis. The technology, developed by DOE's Argonne National Laboratory and the Russian Academy of Sciences' Engelhardt Institute of Molecular Biology, is expected to help health organizations deal with the new variety of drug-resistant strains of the disease. With 3 million deaths each year, tuberculosis kills more youth and adults than any other infectious disease. The biggest problem associated with the new tuberculosis epidemic is that several different bacterial strains can cause the disease, and each is resistant to different drugs. Finding which strain is affecting a patient, and knowing which antibiotic is best equipped to combat that strain, is key to controlling the disease. Researchers will use the biochip to identify the strain, providing that key information.

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Fermilab will become computing hub for CMS detector at CERN

DOE's Fermilab will become a regional center for storing and distributing data to the U.S. collaboration of 35 institutions in 19 states on the Compact Muon Solenoid detector of the Large Hadron Collider at CERN, the European particle physics laboratory in Geneva, Switzerland. The project has received approval and initial funding from DOE and the National Science Foundation. Fermilab, the host laboratory for the U.S. collaboration building subassemblies of the CMS detector, would also become the collaboration's host laboratory for software, analysis and computing support.

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In the long run

A new fuel in development promises to increase the time nuclear reactors can run between shutdowns while discouraging the proliferation of nuclear weapons. Researchers from DOE's Idaho National Engineering and Environmental Laboratory and the Massachusetts Institute of Technology plan to add thorium dioxide to the uranium dioxide that powers commercial reactors. As the uranium-235 in the new fuel undergoes fission, some of the thorium will be transmuted into uranium-233, which will also fission to keep the chain reaction going. The new fuel should make nuclear power plants more efficient and help them compete with fossil fuel-powered plants. It should also generate a smaller amount and a poorer grade plutonium than all-uranium fuel.

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RHIC achieves top environmental standard

The new Relativistic Heavy Ion Collider (RHIC) at DOE's Brookhaven National Laboratory is the first facility in the Office of Science to be registered to the International Standardization Organization (ISO) 14001 Environmental Management System. This internationally recognized standard provides a framework for defining and preventing potential environmental impacts, and for monitoring, communicating, and constantly improving performance. RHIC will produce particle collisions expected to allow researchers laboratory study of states of matter that existed just after the Big Bang. Environmental groups had concerns about possible impacts of RHIC operations. Achieving the ISO 14001 standard, which incorporates community outreach and environmental controls, monitoring and reviews, demonstrates BNL's total commitment to environmental security.

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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).

Fermilab hosts multilab effort for LHC magnets

DOE's Fermilab is the host for a multilaboratory U.S. commitment in delivering superconducting magnets and components to the Large Hadron Collider at CERN, the European particle physics laboratory in Geneva, Switzerland.

Fermilab's Jim Strait is project manager for the three-lab U.S. collaboration producing LHC magnets. Strait is coordinating the Fermilab efforts with those at Lawrence Berkeley National Lab and Brookhaven National Lab. Berkeley Lab is building cryogenic components to connect the Fermilab-built magnets with the CERN cryogenic system, and particle absorbers that protect LHC from the heat energy generated by its own luminosity. LHC will produce about 1,000 times the number of collisions per second as the Tevatron. Brookhaven is building beam separation dipole magnets for the interaction regions and the radiofrequency straight section. With its premier capability for the production testing of cables, Brookhaven is testing all superconducting cables for all LHC magnets.

Fermilab's Jim Kerby is the project manager for the Fermilab group developing and building 18 high-gradient quadrupole magnets comprising what is called the inner triplets, which provide the final focusing of the particle beam at the interaction points. Fermilab is also responsible for building the cryostats ("thermos bottles" supporting and insulating the magnet cold masses) and for assembling all the inner triplet quadrupole systems, with an additional 18 cold masses from Japan's KEK Laboratory, and corrector elements from CERN.

Together with the magnets from Japan, the focusing magnets being built at Fermilab have the responsibility of producing the smallest possible beam "spot," or cross-sectional area, at the interaction points. Analogous to a series of three optical lenses, the triplets use two focusing elements bracketing a defocusing element. Quadrupole magnets focus a beam in one plane (horizontally, for example) but defocus in the other plane (vertically, in this example). The three elements are structured to produce a net focusing effect in both planes.

The first Fermilab component ready for shipment to CERN is one of the four sections of a 30-meter-long heat exchanger. Delivery is a critical step: this test unit will verify an inner triplet system design change proposed by the Fermilab group, which added flexibility in the design of the magnet components being built at Fermilab, KEK and CERN.

The heat exchanger design change is one example of the many intangible Fermilab "deliverables" to CERN. Among them: the tooling expertise of the Fermilab Technical Division's Fabrications Group; testing experience of the Magnet Test Facility; beam physics design support; and the engineering skill to assemble all the inner triplet components-quadrupole magnets from KEK and Fermilab, correctors and instrumentation from CERN-into cryostats from Fermilab, and make sure they work.

"We have to tell CERN, 'Here's a magnetic field this strong, this pure, at this position,'" Kerby says. "That's what they need to make the accelerator. The hardware around it is what's needed to make that magnetic field. CERN trusts us to deliver the goods, and we will."

Submitted by DOE's Fermi National Accelerator Laboratory

On the Road...with PPPL's Robert Budny

When European and Asian scientists analyze data from experiments on tokamak fusion machines, they often call upon American collaborators for assistance.

One of these collaborators is Robert Budny, a physicist at DOE's Princeton Plasma Physics Laboratory (PPPL). Budny is currently analyzing data from the Joint European Torus (JET) in England.

"JET is a very interesting opportunity for us because it is one of the largest fusion experiments in the world and the researchers there have done an extensive deuterium-tritium (D-T) campaign. The Tokamak Fusion Test Reactor, which operated at PPPL from 1982 to 1997, is the only other fusion machine to do experiments using D-T as the fuel, so there is a natural affinity between TFTR and JET," says Budny, adding that another similarity between JET and TFTR is both produce high-temperature plasmas. Plasmas are hot, ionized gases.

Budny, who has collaborated on tokamak research around the globe, shares his special expertise in code analysis that he has culled from years of experience on TFTR. "I model tokamak plasmas to understand what makes them tick. I use a computer code that inputs many different measurements, and calculates various quantities that we cannot measure. This allows us to check the consistency of the data, for instance to see if quantities that physics tells us must be conserved actually are. If not, this tells us that there may be a problem with the data, so the measuring system needs to be checked. Also, the results from the code are used as a bridge between the experimental data and theories," he explains.

For the past two years, Budny has made six trips to England annually, spending three weeks at a stretch there. "I go to JET, talk to people, get data, and bring it back to PPPL, where I run the analysis. When I get the results, I send them back to England for use in publications and further analysis," he says.

Budny has also spent considerable time in France analyzing data from the Tore-Supra tokamak, as well as in Japan working with researchers on the JT-60U fusion machine, and with scientists at the TEXTOR tokamak in Jülich, Germany. In addition, while at PPPL he has worked with various foreign visitors. "I set up operations for a Chinese researcher to do simulations of the0 HL-2A tokamak in China," says Budny, who eventually co-authored a paper with the visitor.

Budny is one of several collaborators from PPPL. DOE funds the collaborative efforts.

Submitted by DOE's Princeton Plasma Physics Laboratory