PPPL researchers' paths combine for fusion advances

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Argonne-West completes reactor milestone

DOE's Argonne National Laboratory–West has verified that the liquid metal sodium coolant from Experimental Breeder Reactor-II has been completely drained from the reactor vessel, reaching a major milestone in demonstrating safe shut-down of a sodium cooled nuclear reactor. EBR-II was turned off in September 1994, and completing the sodium drain makes it technically impossible to re-start the reactor in the future. The sodium coolant is being treated, and the resulting sodium hydroxide will be disposed of in a standard low-level radioactive waste disposal site. Argonne and the Idaho National Engineering and Environmental Laboratory are the lead laboratories for DOE's nuclear reactor research program.

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Biosensor chips for cancer risk assessment

Novel biosensor chip technology from DOE's Ames Laboratory offers a direct readout method for identifying DNA adducts in urine—adducts that may have been produced by such cancer-causing pollutants as cigarette smoke and power plant emissions. Formation of DNA-carcinogen adducts is the primary step in chemical carcinogenesis. The new technology makes it possible to bind specific adducts to the biosensor chips that contain monoclonal antibodies immobilized on gold surfaces. Laser-induced fluorescence, both at room temperature and at low temperature (4 degrees Kelvin, or minus 452 F), then reveals the type and concentration of DNA adducts present in a sample—vital information for cancer risk-assessment.

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Reducing fuel-oil costs

The price of home heating oil has skyrocketed this winter, but Brookhaven researchers are working to help keep costs down. One technology they have developed is the fan-atomized burner, which fires fuel at low input rates to match the smaller heating loads of well-insulated homes. It offers improved fuel- and air-mixing for better performance, and its features translate to about a five to ten percent improvement in efficiency over conventional burners. The new burner also reduces nitrogen-oxide emissions by as much as 30 percent. Heatwise, Inc., of Ridge, New York, has begun to commercialize the burner.

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State-of-the-art silicon boosts DZero detector

One of the smallest sub-assemblies in the revamped 5,000-ton DZero detector at DOE's Fermilab crams 800,000 electronic channels into a volume you can wrap your arms around. With 10 to 20 times the resolution of other detector materials, this new silicon-based component will bring physicists an unprecedented up-close and personal look at particle collisions when Collider Run II of the Tevatron begins operation in March 2001. The dramatic increase in resolution will allow DZero physicists to identify and track articles with relatively short lifetimes, particularly bottom and charm quarks. Identifying these heavy quarks is crucial to new discoveries in Run II.

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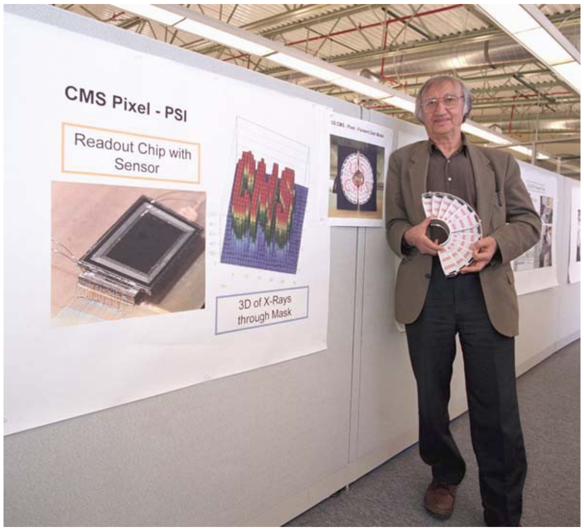
DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***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).

A copper colossus for CERN's new collider

Jim Freeman doesn't need hyperbole when describing the stature of the Hadron Calorimeter for the Compact Muon Solenoid. The facts alone place this detector subassembly in rare company.



Jim Freeman

"The CMS HCAL barrel and endcap will weigh about 1600 tons when completed, and most of that is copper. It will be the heaviest copper alloy structure ever built," said Freeman, technical coordinator for the HCAL construction at DOE's Fermilab.

Fermilab is in charge of building this major component for the Large Hadron Collider at CERN, the European particle physics laboratory in Geneva, Switzerland. Alongside its own all-out campaign to begin Run II of the Tevatron in March, and construction of neutrino experiments NuMI and MiniBooNE, Fermilab is also managing an effort for both LHC accelerator and detector components extending throughout virtually every lab production facility. CMS alone could consume the resources of some institutions.

"This is a $167 million project. So far we've committed about $80 million, meaning we're just about half done," said Dan Green, project manager for the US/CMS collaboration , which includes nearly 400 scientists from 37 institutions across the country. Lawrence Livermore National Laboratory and Los Alamos National Laboratory are collaboration members, along with Fermilab and 34 universities. The full international CMS collaboration numbers 1,800 scientists from 144 institutions worldwide.

The CMS detector will have 15,000,000 individual detector channels, all prepared to detector and record particle collisions that may lead to new discoveries, including the Higgs mechanism which may offer the key to the origin of mass in all the other fundamental particles in the Standard Model. The LHC will have proton-proton beam crossings about 40 million times each second, with about 20 collisions in each crossing-a total of some 800 million collisions each second.

Submitted by DOE's Fermi National Accelerator Laboratory

PPPL RESEARCHERS' PATHS COMBINE FOR FUSION ADVANCES

From spectroscopy to novel measurements of plasma dynamics, the paths of Edmund Synakowski and Ronald Bell have intersected often during the past two decades.

Bell (left) and Synakowski

Bell and Synakowski, physicists at DOE's Princeton Plasma Physics Laboratory, were recently honored for experimental results obtained on the Laboratory's Tokamak Fusion Test Reactor four years ago—results that are currently being reproduced and confirmed elsewhere. The researchers developed novel measurements of the dynamics of hot ionized gases, or plasmas, which will someday fuel fusion power plants.

The work suggests that generating plasma flows in a fusion reactor might increase the reactor efficiency, thus reducing its cost and size. In November, the two received Princeton University's Kaul Foundation Prize for Excellence in Plasma Physics and Technology Development.

Bell and Synakowski, presently involved in research on the National Spherical Torus Experiment sited at PPPL, met in 1979 at Johns Hopkins University. While a sophomore, Synakowski took a work-study job with the University's plasma spectroscopy group, and soon changed his focus from astrophysics to plasma physics.

"Ron was working on his Ph.D. and involved in spectroscopy," recounts Synakowski. "I built some of the control system electronics for a first-of-a-kind spectrometer that Ron designed and built."

The two eventually worked on TFTR together. "Ron likes to say his strengths complement mine. I have some background in atomic physics that we drew on to interpret flow measurements on TFTR. Ron is extremely creative in any system he builds, whether it is hardware or software. We worked well in pulling together atomic physics and implementing complex programs to analyze data. Interactions like this are typical of much of the work we've done together. Because of this, it was doubly rewarding receiving the Kaul Prize together," Synakowski said.

Submitted by DOE's Princeton Plasma Physics Laboratory