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Mayling Wong with the Cerenkov Luminosity Counter at Fermilab.

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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).

Buoy voyage

A promising new buoy—designed to validate satellite signals recorded and relayed from space while simultaneously monitoring water quality parameters in coastal, estuarine and inland waters—has been developed by researchers from DOE's Pacific Northwest National Laboratory at its Marine Sciences Laboratory in Sequim, Wash.. The portable, lightweight buoy provides quick-response data gathering for natural resource assessment. During its maiden voyage recently, the buoy—equipped with cell-phone technology and a multi-sensor platform—demonstrated it could communicate with researchers in near real-time and provide customized data. It also showed promise for replacing labor-intensive and expensive shipboard platforms and providing a remote platform for data collection.

[Gayle O'Donahue, 509/375-2561, gayle.odonahue@pnl.gov]

Intelligent nanostructures report on environment

Intelligent nanostructures that report on their environment by changing color from blue to fluorescent red under mechanical, chemical, or thermal stress have been created by researchers at DOE's Sandia National Laboratories and the University of New Mexico. The self-assembling structures—as durable as seashells—could lower costs by reducing the need for expensive manufactured devices. When the environmental disturbance is removed, the structures change back to their original color in some cases, making them potentially reusable. Sandia senior scientist and UNM professor Jeff Brinker says NASA—one of the sponsors of the research—is interested in the material, for possible use in planetary exploration.

[Howard Kercheval, 505/844-7842, hckerch@sandia.gov]

New clues to proton's properties

The proton is the positively charged core of the hydrogen atom, the most abundant element in the universe. But mysteries still remain as to how the proton's building blocks combine to give the particle its electric and magnetic properties. New experiments at DOE's Jefferson Lab in Virginia show for the first time that the distribution of electric charge in the proton is different from the magnetization distribution. This knowledge will help to develop a more sophisticated view of how the proton's building blocks interact with each other, and it helps to rule out some earlier ideas.

[Linda Ware, 757/269-7689, ware@jlab.org]

The enzyme is the message

New studies using X-ray crystallography at DOE's Stanford Linear Accelerator Center reveal the molecular structure of how genes are transcribed into the messenger RNA that directs the ribosome in protein synthesis. The studies conducted at SLAC's Synchrotron Division capture the enzyme in the act of transcribing a fragment of DNA into RNA Polymerase II. The enzyme is at the center of the machinery that controls all cellular activity—from differentiating developing embryo tissues to responding to everyday stresses. The results of the studies are expected to effect the analysis of transcription and transcription mechanisms.

[Eleanor Mitchell, 650/926-8701, elm@slac.stanford.edu]

Liquid lithium experiments underway at PPPL

Among the greatest technological challenges in the creation of a practical fusion power reactor is the development of the material surface that will surround the hot magnetically-confined deuterium-tritium (D-T) plasma fuel. This vacuum chamber wall will be subject to power densities in excess of 25 million watts per square meter from neutrons produced in the D-T fusion reactions, escaping plasma particles, and radiation. Current designs call for a lithium "blanket" to be incorporated into the wall. Fusion neutrons will react with the lithium to produce tritium to be extracted and used as fuel. But the neutrons will also react with the structural materials in the wall itself, producing radioactive isotopes (activation) and possibly causing erosion and loss of structural integrity.

Experiments on the Current Drive Experiment-Upgrade (CDX-U) at DOE's Princeton Plasma Physics Laboratory may yield a revolutionary solution to this problem, and, of equal importance, may lead to improved plasma performance. The work, performed in collaboration with DOE's Oak Ridge National Laboratory, DOE's Sandia National Laboratory and the University of California, San Diego, involves studies of the interactions between plasma and liquid lithium.

Bob Kaita, who is leading the effort with Dick Majeski, noted, "the use of a flowing liquid lithium wall can potentially eliminate erosion, because the wall is continuously renewed. Furthermore, it may result in a substantial reduction of activation because neutrons will no longer react with materials that stay fixed in a solid wall structure." Kaita went on to point out that lithium can withstand the onslaught of 25 million watts of power per square meter, and it may be able to soak up helium, a by-product of D-T fusion reactions that must be removed from the plasma.

Earlier experiments have demonstrated that a conducting wall surrounding the plasma inhibits plasma oscillations and "kinks" that can destroy plasma confinement. Liquid lithium would serve as a conducting wall, and if the lithium flows at rates of 10 to 20 meters per second, its ability to stabilize the plasma may actually improve.

Limiter plates are metal surfaces that protrude from the vacuum vessel wall toward the edge of the plasma. Their job is to prevent the plasma from striking the vacuum chamber wall and sputtering impurities, especially heavy metals, into the plasma. Metal atoms soak up energy and radiate it away, causing the plasma temperature to drop.

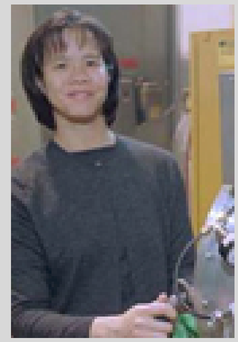
Plasma particles striking the limiter plates are neutralized and return to the plasma where they again become ionized. But this recycling tends to cool the plasma edge, preventing the attainment of beneficial operational modes. A liquid-lithium wall may solve this problem because of its capability for absorbing plasma particles. "For me the most exciting aspect of these experiments is the chance to investigate the behavior of plasmas with a new and different type of boundary. Experience from other experiments all over the world tells us that when we change the wall conditions, we change the plasma contained by the wall," said Dick Majeski.

Submitted by DOE's Princeton Plasma Physics Laboratory

Wong puts together key component for Tevatron Run

Mayling Wong liked to take things apart when she was a child.

"I wasn't so good at putting them back together," she admits, but the challenge led her to a career in mechanical engineering and an important role for the launch of Collider Run II of the Tevatron at DOE's Fermilab.



Mayling Wong

A member of the Engineering and Technical Teams of the lab's Particle Physics Division, Wong was instrumental in the design and construction of the Cerenkov Luminosity Counter, an important component of the upgrades for CDF, one of the two apartment building-sized collider detectors tracking the billions of particle interactions during the experimental run.

Women engineers are still the exception in a male-dominated field, but Wong and her colleagues make exceptional contributions.

"It's always my hope to be accepted for my work and not to be set apart because I am a woman," she says. "I always have technical questions, but so many people here are willing to share their experience and their point of view. Fermilab has a vast wealth of technical knowledge among engineers, machinists, and technicians. I've felt very comfortable in this setting. It' s been great."

Wong's parents had emigrated from China to the suburbs of Chicago, where she was born and raised. Her father was a civil engineer who often helped her with her physics homework. She studied at the University of Illinois, then received a master's in mechanical engineering from Case-Western Reserve University before joining the lab four years ago. She wants other women to experience the rewards she has found in science and technology.

"Young girls start off strong in science, but for some reason they back off in junior high and high school," she says, adding this advice: "If that's what you want to do, then go for it. Go for it one hundred percent."

Submitted by DOE's Fermilab