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Research Highlights . . .

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Powerful computers advance fusion research

Scientists at DOE's Princeton Plasma Physics Laboratory (PPPL) have used the SGI/Cray T3E supercomputer at DOE's National Energy Research Scientific Computing Center (NERSC), Lawrence Berkeley National Laboratory, to create new three-dimensional nonlinear particle simulations of plasma turbulence. Magnetic fields are used to confine a hot ionized gas or plasma for the controlled production of fusion energy. However, turbulence can spoil the efficiency of this approach by causing accelerated loss of particles and energy from the plasma and by preventing transitions to enhanced confinement regimes discovered in recent experiments. In recent work [*Science* (281), 1835 (1998)], PPPL researchers have performed calculations that are providing valuable new physics insights and correlate well with key trends observed in experiments.

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Sandia developing architectural, infrastructure surety

The bombings of the U.S. embassies in Nairobi and Dar es Salaam, and U.S. attacks on terrorist targets in Afghanistan and Sudan are just the latest in disasters raising the public awareness of the importance of architectural and infrastructure integrity. The Architectural Surety (SM) program at DOE's Sandia National Laboratories has been studying events like those—as well as hurricanes, earthquakes, blizzards, and others—with the goal of building stronger buildings that protect the people inhabiting them and remain standing and useable longer. The program uses Sandia risk management methodologies and technical capabilities to examine vulnerabilities and identify changes in architectural design, building codes, or construction standards that would improve their performance in natural disasters, terrorist attacks, or other out-of-the-ordinary situations.

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Improving efficiency at naval utility plants

Engineers at DOE's Pacific Northwest National Laboratory have increased the efficiency of utility plants run by the U.S. Navy Public Works Center in San Diego by installing automated monitoring and control systems at four plants. The center estimates the upgrades will save about $800,000 a year. Upgrades include computer systems that monitor boilers, chillers, gas turbines, electric generators and pumps. The computers monitor and record system performance and keep logs of events and malfunctions to assist operators in troubleshooting and maintaining optimal performance.

[Staci West, 509/372-6313, staci.west@pnl.gov]

It's the MicroCAT's meow for mice

Biologists studying genetic mutations and diseases will soon have a new ultra-high-resolution imaging tool to examine soft tissue and skeletal detail of mice and other laboratory animals—without killing them. The MicroCAT system, developed by researchers at DOE's Oak Ridge National Laboratory, generates three-dimensional images with 10 times the resolution of conventional imaging systems. With MicroCAT, researchers no longer will have to rely on visible genetic markers and physical examinations to discover the presence of mutations. And, because they don't have to dissect the mice, researchers will be able to study the development of a mutation over several weeks or months.

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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).

Several labs together make 'collaboratory'

A virtual electronic laboratory is helping to create long-distance scientific collaborations involving some of the nation's most powerful microscopes and leading researchers at laboratories across the country.

The Materials MicroCharacterization Collaboratory, or MMC, is a prototype of a next generation research facility that transcends geographic, disciplinary and organizational boundaries. The MMC is funded by the Department of Energy's DOE2000 project. DOE-supported scientists are developing innovative solutions to meet the scientific and technical issues DOE faces on the eve of a new millennium.

The collaboratory brings together major materials characterization expertise, instruments and technology at Argonne, Ernest Orlando Lawrence Berkeley and Oak Ridge National Laboratories; the University of Illinois; the National Institute of Standards and Technology through a national computer network. Several U.S. and multinational companies are also part of the consortium.

"It's not just running a microscope over the Internet," said Argonne scientist Nestor Zaluzec, who has played a major role in the development of the MMC. "We're merging the technology and expertise at each lab and allowing scientists to interact unencumbered by the limits of time and distance."

Collectively the instrumentation in these centers represents an investment in state-of-the-art technology of more than $50 million, a research staff that has more than 1000 man-years of expertise in materials research and characterization, and an annual total user base of well over 300 scientists, students and industrial researchers.

The MMC industrial partners include EMiSPEC Systems Inc., Gatan Inc., Graham Technology Solutions, Hitachi Instruments Inc., Japan Electron Optics Laboratories-USA, Philips Electronic Instruments, R.J. Lee Group and Sun MicroSystems.

While the collaboratory usually brings together industry or federally funded projects and scientists over the Internet, the tools developed in the MMC can also be applied to academia both in research and development and in distance learning applications.

Secretary of Energy Bill Richardson sees a demonstration of "telepresence microscopy" at the Argonne Information Center with Harold Myron, Argonne's director of education programs, and Esther Young of Chicago's John F. Kennedy High School.

MMC research scientists are using the collaboratory to help teach students from middle school through graduate school. Secretary of Energy Bill Richardson participated in a demonstration that showcased the MMC's educational capabilities during a visit to Argonne in September. The Secretary, along with a group of high school students, used the collaboratory to remotely operate Argonne's electron microscope. Another group of students participated from their classroom.

The collaboratory allows students and teachers to talk directly with scientists and to use state-of-the-art equipment that would not be available to them otherwise. "This can help bring the excitement of science back into the classroom by using hands-on participation," Zaluzec said.

Submitted by DOE's Argonne National Laboratory

Datz' career has opened a dynamic world

Sheldon Datz' Davisson-Germer prize, which he received from the American Physical Society earlier this year, celebrates his lifelong research into atomic interactions with ions, electrons and photons. It's one more accolade in a long and accomplished career in physics at DOE's Oak Ridge National Laboratory.

It's a career that's done much to reveal to the world the secrets of atomic and molecular physics.

Datz was one of the first to explore, in the early 1950s, molecular-beam techniques for studying chemical reactions. That research laid important groundwork for the field of chemical dynamics.

"The science of chemistry can be divided into structure and dynamics," Datz says. "This applies to all branches of science. Dynamics is the science of change. How did something get that way? What changed?"

In a career like Datz', what you discover over the years may seem arcane at first glance, but it adds up. Sometimes it adds up to billion-dollar industries.

"I'm working on a paper called 'Connections.' I want to show where things that have been done over the years have led, like the James Burke series does. For example, we began studying particle-solid interactions years ago with a view to finding out what happens to fission products as they recoil in fuel elements.

"One can follow this line of research directly to the billion-dollar ion implantation industry."

Datz worries that any trend toward research that is too focused on particular results will close off important avenues to discovery.

"I was a student at Columbia University when the laser was invented there. They were seeking means for doing more precise atomic spectroscopy.

"No one said to go out and invent a laser so that we can scan bar codes in the supermarket checkout lines."

Submitted by DOE's Oak Ridge National Laboratory