DOE Pulse
Science and Technology Highlights from the DOE National Laboratories
Number 278 January 19, 2009

SRNL's Elmer Wilhite

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# Research Highlights . . .

## LCLS gets first electrons

Last month, a series of electron beams zipped down the full length of the Linac Coherent Light Source at DOE's SLAC National Accelerator Laboratory for the first time. In this exciting round of tests, bunches of electrons traveling very close to the speed of light traveled from the injector, down the final third of SLAC's linac, through several halls and into the electron beam dump. When the LCLS is completely up and running later this year, the electrons will encounter undulators that will cause the beam to emit X-rays. It is these X-rays that researchers will use to discover new states of matter, follow chemical reactions and biological processes as they happen, and image the properties of materials on the nanoscale—to name just a few applications.

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## More chip cores can mean slower supercomputing, simulation shows

The attempt to increase supercomputer speed by increasing the number of processor cores on individual chips unexpectedly worsens performance for many complex applications, simulations at DOE's Sandia National Laboratories have found. The simulations show a significant increase in speed from two to four multicores but an insignificant increase from four to eight. Speed slows beyond eight multicores due to lack of immediate access to individualized memory caches. "The difficulty is contention among modules," says Sandia's James Peery. "The cores are all asking for memory through the same pipe. It's like having one, two, four, or eight people all talking at the same time, then having to wait for the answer to their request. This causes delays."

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## PPPL scientists gain INCITE supercomputing time

Three research projects involving four scientists at DOE's Princeton Plasma Physics Laboratory have been awarded a total of 56 million processor hours on supercomputers at DOE's Argonne National Laboratory and DOE's Oak Ridge National Laboratory. The researchers—Stephane Ethier, Greg Hammett, David Mikkelsen, and William Tang—will be using the time for fusion energy-related research regarding plasma turbulence simulations. Plasma is a hot, gaseous state of matter used as the fuel to produce fusion energy—the power source of the sun and the stars. The projects are among 66 awarded nearly 900 million processor-hours by the DOE's Office of Science.

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## The heat is on

Even with policies that curtail greenhouse gas emissions, temperatures will continue to increase into the next century from greenhouse gases that have built up over time. This is the sober finding from a team of international climate experts, published in the Proceedings of the National Academy of Sciences. "Our assessment shows that while emission reduction policies are important to reduce the probability of large changes, the world must also adapt to reduce the impact of unavoidable residual warming," said Steven Smith, a Pacific Northwest National Laboratory scientist who was one of the study's authors. "These climate research findings can help policymakers who are considering guidelines and practices to reduce and cope with climate change," Smith said.

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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).

# Blue Gene/P takes on a green hue

From Deep Blue, the computer that defeated Garry Kasparov in a 1997 chess match, to the new Blue Gene line of high-performance computers created by IBM, a single color has traditionally been associated with advanced computing.

With the recent opening of the Argonne Leadership Computing Facility at DOE's Argonne National Laboratory, however, high-performance computing has taken on a different hue: green. Several innovative steps designed to maximize the efficiency of Argonne's new Blue Gene/P high-performance computer have saved many taxpayer dollars while reducing the laboratory's environmental footprint.

While similar computing centers at other laboratories and institutions often require several megawatts of electricity—enough to meet the energy demands a small town—the ALCF needs only a little more than a megawatt of power. Because the ALCF can effectively meet the demands of this world-class computer, the laboratory ends up saving taxpayers more than a million dollars a year, said Paul Messina, director of science at the ALCF.

The Blue Gene/P currently runs at a speed of more than 557 teraflops, which means that it can complete more than 557 trillion calculations per second. While several high-performance computing facilities recently established or upgraded at some of Argonne's sister laboratories have surpassed that mark, only one exceeds the efficiency of Argonne's Blue Gene/P. "The Blue Gene/P uses about a third as much electricity as a machine of comparable size built with more conventional parts," Messina said.

While a megawatt of electricity might seem like a lot of power, the massive number of computations that the Blue Gene/P can do puts it in perspective. Energy efficiency of high-performance computers is measured in flops per watt – how many calculations per second the computer can do for every watt of electricity it uses.

According to the November 2008 Green500 ranking of supercomputers, the Blue Gene/P's energy efficiency averages out to more than 350 million calculations a second per watt. By contrast, a common household lightbulb frequently uses between 50 and 100 watts of electricity. Among the top 20 supercomputers in the world, the Blue Gene/P is the second-most energy-efficient.

***Submitted by DOE's Argonne National Laboratory***

# A career in protecting public, environment

**Elmer Wilhite**

Facilities used for disposal of low-level radioactive waste must be able to protect the public and the environment for thousands of years. Demonstrating how well DOE's facilities can be expected to meet that standard is the purpose of Performance Assessments (PAs); developing the practices and requirements to assure that PAs provide credible, science-based documentation has long been the mission of Savannah River National Laboratory's Elmer Wilhite. Wilhite calls on his broad background in environmental chemistry and radiochemistry to understand just what it takes to protect the public and the environment.

Familiar with work at other national laboratories on the impacts from nuclear fallout on radiation exposure to humans through vegetation pathways, he expanded those ideas into a broader framework. As a result, his expertise has been sought out since the 1980s, when he participated in development of DOE's order establishing the first performance requirements for low-level waste disposal. He later chaired the first peer review panel to provide technical review of low-level waste disposal facility PAs. Since that time, he has frequently been called upon to take a leadership role in the development or review of PAs across the DOE complex.

Wilhite's work has pointed the way to approval of appropriate levels of protection for each disposal facility. For example, he showed that the Savannah River Site's "saltstone" waste must be isolated from the environment by concrete vaults, but the Site's lower activity solid waste could safely be disposed in less expensive facilities. He also developed a concept for a separate radiological assessment, which would consider the composite effects of a low-level waste disposal facility as well as other residual radiological source terms that could add to the dose from the facility.

His impact reaches beyond the U.S. borders: As part of his leadership of international efforts in the areas of low-level waste treatment and disposal, he chaired an international advisory working group meeting for the International Atomic Energy Agency to develop a methodology for comparison of health and environmental impacts of various energy production fuel cycles. Perhaps more importantly, Wilhite's impact will continue to be felt in the future as well: In addition to his ongoing work, he serves as a mentor and resource to younger researchers and he trains and guides numerous personnel to manage radioactive waste facilities to ensure protection of the environment and population for years to come.

***Submitted by DOE's Savannah River National Laboratory***