Workers install the Stirling engine on dish/Stirling system at NREL. See page 2.

Research Highlights . . .

DOE Pulse

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New Laser's "First Light" Shatters Record

Researchers at DOE's Jefferson Lab delivered 155 watts of light from their Free Electron Laser (FEL) on June17. This light is 150,000 times more powerful than a supermarket scanner—fifteen times the power of existing FELs. Jefferson Lab pioneered superconducting technology for accelerating electrons to high energy in efficient, cost-effective accelerators. This technology offers two cost advantages for FELs: the laser can stay on 100% of the time and 99% of the energy not converted to light can be recycled. The FEL could potentially produce light at a cost useful for industrial processing and it provides a unique tool for basic research in materials. [http://www.JLab.org/FEL/firstlight.html]

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Sandia Detector Determines If Food Not Fit to Eat

If frozen food thawed on the cross-country truck transporting it, was then refrozen and you bought it, how would you know the food wasn't fit to eat? Perhaps by the color change in a very inexpensive thaw indicator placed in the package. The indicator, originated at and patented by DOE's Sandia National Laboratories and the byproduct of a solar research project, changes color when its temperature rises above 32°F, the point above which harmful bacteria multiply, and the color doesn't change back if the temperature then drops below freezing. For details see http://www.sandia.gov/media/food.htm.

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Zed Zero Hits New Highs

DOE's Stanford Linear Accelerator Center is celebrating as collaborators in the SLD/SLC group logged 350,000 Z0 events in its 12-month experimental run, which is more than the number of events for the 1992, 1993, 1994-95, and 1996 runs combined. In the last full day of logging data, over 5300 Z0's were recorded in 24 hours. This output has delighted experimenters who are analyzing the information for presentation at summer conferences. The Z0 data provide the world's most precise measurements in several areas which deal with the basic forces of nature: electromagnetism and the weak force.

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Princeton Physicists Study Solar Phenomena

Researchers at DOE's Princeton Plasma Physics Laboratory are studying magnetic reconnection—the topological breaking and reconnection of magnetic field lines in plasmas, or hot ionized gases. Magnetic reconnection has relevance not only to fusion energy research, but also to solar physics, astrophysics, and magnetospheric physics. It may play a key role in heating the plasma in the solar corona. Researchers hope to explain why the sun's corona (2 million degrees Celsius) gets so much hotter than the sun's surface (6,000 degrees Celsius). Princeton's magnetic reconnection experiments could aid in the interpretation of photographs of solar flares and arcades taken by the Yohkoh satellite, a joint effort of the United States and Japan.

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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*** is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

Solar Energy System Offers Solutions

An eye-catching 50-foot diameter solar collector—shaped like a concave dish with sixteen 10.5-foot diameter mirrors—is up and running at DOE's National Renewable Energy Laboratory (NREL).

The dish/Stirling system uses mirrors to focus sunlight into a concentrated beam. The beam strikes a thermal receiver that absorbs the heat to run a Stirling engine. The engine then drives a generator to produce electricity.

The prototype concentrator, developed by Science Applications International Corp. (SAIC), incorporates new cost-saving features such as an increased reflective area, an improved control system that provides autonomous operation and a Stirling engine with 42 percent thermal efficiency.

The engine, produced by Stirling Thermal Motors Inc., can be powered by natural gas or other fuels during the night or in cloudy weather. The project is funded by a subcontract SAIC has with Sandia National Laboratories and is managed by SunLab, a DOE research organization that combines the expertise of NREL and Sandia. The system at NREL is the first of at least five systems that will be installed throughout the country during the next year. A system was recently installed on the grounds of the Pentagon to demonstrate its environmental benefits and generating efficiency.

Laboratory research in support of SAIC's efforts will focus on optical characterization and alignment of the dish/Stirling system, accelerated testing of optical materials, wind load characterization and emissions measurements.

"The goal for the next year is to begin building a reliability record for the systems," Mark Mehos, senior mechanical engineer in NREL's Research Program Management Office, said. "This should yield statistically meaningful data on their reliability, which is critical before they will be accepted in the marketplace."

Past dish/Stirling systems have demonstrated impressive 30 percent solar to electric conversion efficiencies. Their greatest potential is in developing countries and remote, sunny areas around the world because they can be used on or off the grid, reducing the need for costly electric power infrastructure investments. Individual systems range in size from 10 kW to 50 kW and can be used independently or linked to increase generating capacity.

Submitted by DOE's National Renewable Energy Laboratory

Medical Physicist Seeks Better Cancer Therapy

Christine Hartmann Siantar can recall all too vividly her days in an oncology clinic in Wisconsin. As a medical physicist working in radiation therapy for cancer patients, she saw too many deaths.

"It was very stressful," she said. "In graduate school, we were trained to use science to solve problems. I thought that there must be ways to apply physics to make radiation therapy more effective."

In 1993 Hartmann-Siantar got her chance. She joined DOE's Lawrence Livermore National Laboratory to help a research team apply tools used for nuclear weapons work to radiation therapy. Now, she is the principal investigator of PEREGRINE, a revolutionary new radiation transport modeling system that promises higher cure rates in cancer patients.

Until now, radiation therapists have been forced to calculate the passage of radiation through the human body as though it consisted entirely of water, without full consideration for differences between bones, body cavities or even a metal prosthesis.

Yet precision in radiation therapy is critical. The margin of error between failing to cure a tumor and damaging, perhaps killing, healthy tissue can be very small. PEREGRINE provides the most accurate dose calculations so doctors can plan safe, effective radiation therapy.

The success of the PEREGRINE project arises from an integrated team of physicists, electrical engineers, computer scientists and collaborators from leading medical institutions in the United States. Together, they have created the fastest and most accurate transport algorithms, used the best atomic data bases and built a highly efficient computer platform from commercial hardware to provide a solution to one of the most persistent problems in providing better care for cancer patients.

Christine thinks PEREGRINE could be available to hospitals in 1999. "This is the most exciting thing I could ever work on—taking technology developed for our national security and using it to save lives," she says.

Submitted by DOE's Lawrence Livermore National Laboratory