*SLAC's John Galayda*

*Page 2*


# DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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# Research Highlights . . .

## PASER: A novel acceleration scheme

Scientists from the Technion-Israel Institute of Technology have used the Accelerator Test Facility at DOE's Brookhaven Lab to demonstrate, for the first time, the feasibility of particle acceleration by stimulated emission of radiation (PASER), a kind of particle analog of the laser process. In a laser, photons traveling through an active medium stimulate excited atoms, which release energy in the form of additional photons. In the PASER experiment, the active medium surrenders its energy directly to the electrons. The technology may provide a new tool for the field of nanoscience because the "cool" electrons produced will enable more precise x-ray probes of ultra-small structures.

***[Karen McNulty Walsh, 631/344-8350, kmcnulty@bnl.gov]***

## Better X-ray and nuclear images

A grid as little as three millimeters tall could save lives by helping X-rays and radiotracers provide clearer diagnostic images of the human body. These X-ray anti-scatter grids and nuclear collimators, developed by scientists at DOE's Argonne and Creatv MicroTech, Inc., are superior to existing anti-scatter grids because they work in two dimensions, and reduce scatter to less than 1 percent. X-rays travel through matter to produce images used in medicine. However, when a beam of X-rays hits the target, the X-rays are scattered, clouding the image, which can lead to medical misdiagnoses. Anti-scatter grids reduce this X-ray scattering, but those currently on the market are one-dimensional, and only reduce scattering to 10 percent.

***[Catherine Foster, 630/252-5580, cfoster@anl.gov]***

## Enormous changes at three trillion times a second

The CDF collaboration at DOE's Fermi National Accelerator Laboratory announced that it has met the exacting standard to claim discovery of astonishingly rapid transitions of the B_s meson between matter and antimatter: 3 trillion oscillations per second. The B_s meson is a short-lived particle consisting of a bottom quark and a strange antiquark. The discovery is immediately significant for reinforcing the validity of the Standard Model, which governs physicists' understanding of the fundamental particles and forces; and for narrowing down the possible forms of supersymmetry, the theory proposing that each known particle has its own more massive "super" partner particle.

***[Mike Perricone, 630/840-5678, mikep@fnal.gov]***

## New tool for nano vision

Ames Laboratory researchers have a new $1.8 million scanning transmission electron microscope to give them an unprecedented view of materials at the nanoscale. The new STEM has a probe of 0.18 nm with more than a factor of 100 times more brightness over the previous equipment. This will allow for very precise measurements of chemical changes over a few nanometers. The new machine also has computerized alignment and focusing, which dramatically reduce set-up time boasts features that allow energy-filtered imaging, low-dose imaging, Lorentz imaging, holographic imaging, Z-contrast imaging and 3-D imaging. The STEM was funded by DOE's Office of Basic Energy Sciences.

***[Kerry Gibson, 515/294-1405, kgibson@ameslab.gov]***

*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).

# Collaboration moves forward on Advanced Fuel Cycle Facility

A team of engineers from national laboratories, universities and industry is moving forward on conceptual design work for the Advanced Fuel Cycle Facility, a vital component to establishing an acceptable nuclear fuels recycling program under the Global Nuclear Energy Partnership (GNEP).

When completed around 2014, the AFCF will essentially be a versatile nuclear fuels research campus - the world's premier proving ground for tomorrow's advanced nuclear fuel cycle technology.

"This project will provide a place to continue to advance technology in nuclear fuel for at least 50 years," said engineer Wayne Ridgway of DOE's Idaho National Laboratory.

Ridgway is managing a national project team of engineers from Idaho National Laboratory, Argonne National Laboratory, Brookhaven National Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, Sandia National Laboratory, SRS Technologies, Washington Group International and various universities.

The AFCF team is charged with designing a flexible, integrated testing and demonstration facility. Running at a fraction of the capacity of a full-scale commercial plant, it will help researchers prove that new nuclear fuel recycling processes, such as pyroprocessing, can work on a commercial scale.

To support the anticipated demand of the commercial nuclear industry for demonstration of integrated fuel cycle processes, the facility will be equipped to carry out engineering scale demonstrations in a number of fuels-related areas, including separating the components of spent nuclear fuels, advanced aqueous separations, advanced pyrochemical separations, fabricating transmutation fuels, advanced waste forms and advanced safeguards.

Advanced fuels for Global Nuclear Energy Partnership nuclear reactors will also be designed and tested there.

The long-term goal of the DOE-owned facility will be to bring the U.S. back up to speed in nuclear fuel cycle technology.

"We're revitalizing our expertise in this country," Ridgway said. "We're basically reviving core competency in nuclear technologies and we need a place to do that. You can build up universities all you want but until the students have a place to demonstrate the science and technology, their progress is limited."

The actual site for the facility is pending on the results of an environmental impact statement being prepared for several potential locations.

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

## John Galayda: From turtles to electrons

***John Galayda***

John Galayda knows long-term commitment. Just ask his pet turtle, Opie, who's 20. Fortunately, for the Linac Coherent Light Source (LCLS) project at DOE's Stanford Linear Accelerator Center, Galayda also knows physics.

"I was a Sputnik kid," said Galayda, who became a Fellow of the American Physical Society in 1996. "When I was growing up I never considered any other career besides science."

Galayda's abiding fascination with science at the dawn of the space age has led him to the forefront of 21st Century physics, as director of the LCLS project, now under construction at SLAC.

Galayda's qualifications as LCLS project director stem from an entire career building particle accelerators. While working as a physicist for Brookhaven National Laboratory's National Synchrotron Light Source, Galayda had a hand in all aspects of accelerator construction, from magnet and RF cavity design to electron beam control systems. In 1989, Galayda and his team received an R&D100 award for their innovative system for stabilizing the electron beam within Brookhaven's storage ring.

After 13 years at Brookhaven, Galayda moved to the Advanced Photon Source at Argonne National Laboratory. In 1996, his organization transformed the APS injector into Argonne's free electron laser, which operated in visible to ultraviolet wavelengths.

Now, Galayda brings the lessons learned at Brookhaven and Argonne to the LCLS project. LCLS will be an even more powerful free electron laser, using the final 1/3 of SLAC's existing linear accelerator to produce ultra-fast pulses of X-rays a billion times brighter than any other source on earth.

As a man who claims to have "found out the hard way" that turtles are not allowed aboard airplanes, Galayda understands creative problem solving. This, in fact, is what he rates as his favorite aspect of managing physics projects such as the LCLS.

"It's one thing to think about designing accelerators," said Galayda, "but it's a whole other thing to make one happen. I have to be aware of all the different ingredients—I'm never bored. It's a fascinating challenge."

The LCLS project is a collaboration among DOE laboratories including SLAC, Argonne, Brookhaven, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and the University of California Los Angeles.

***Submitted by DOE's Stanford Linear Accelerator Center***