NEWSLINE

Published for the employees of Lawrence Livermore National Laboratory August 31, 2007 Vol. 32, No. 27

Stellar science NIF laboratory

– page 4

What's INSIDE

TRANSITIONING TO DECISION TIME PAGE 2

CARBON NANOTUBES FOR BIOENGINEERING PAGE 5

FY08 SALARY PROCESS KICKS OFF PAGE 8

SCIENCE NEWS

NIF experiments may answer cosmic questions

By Charles Osolin
NIF

What happens inside an exploding supernova? What is dark energy? How were the heavy elements formed? What happens to the materials in the core of a giant planet?

These are just a few of the cutting-edge questions that scientists at the Laboratory and researchers from around the world are hoping to begin to answer when basic science experiments begin as early as 2010 at the National Ignition Facility (NIF).

As the world's largest and highest-energy laser, NIF will be uniquely capable of producing temperatures, pressures and densities in its target chamber that are similar to those in the cores of stars, supernovae and giant planets, as well as inside exploding nuclear weapons. Scientists hope the data they can obtain from NIF experiments will provide new insights into how the universe operates at both the smallest and the largest scales.

To learn more about NIF's promise, about 70 scientists from the United States and Europe gathered at the Martinelli Center on Greenville Road this week for a NIF nuclear astrophysics workshop, the first in a series of "Science Use of NIF" workshops that will help lay the groundwork for NIF's evolution into a premier international center for experimental science early in the next decade.

"We have every intention of turning NIF into an international user facility," NIF Science Director Richard Boyd told the group. "Our intent is to encourage world-class physics and world-class scientists to do research at NIF."

In his welcoming remarks, NIF Associate Director Ed Moses challenged the scientists to find ways to use NIF for "really revolutionary" research, the kind that wins major scientific prizes. "NIF is not only the path to national security through stockpile stewardship, to energy security through fusion energy, but it's also the path to great science that may changes the nature of our understanding of the cosmos," Moses said. "We are on the verge of making the visions of yesterday our reality."

Along with discussions about how to prepare proposals for NIF shot time and descriptions of the diagnostic equipment currently being installed in the facility, the workshop delved into such topics as "Pair Creation and Annihilation in the Vicinity of Black Holes," "Astrophysical Reaction Rate Calculations" and "Measuring Astrophysical S-factors in Hot and Dense Plasmas." After the presentations, breakout sessions were held to brainstorm experimental topics and discuss new diagnostic devices that may be required for the experiments.

Bruce Remington, group leader in the NIF high energy density (HED) program, said many topics of interest to astrophysicists, such as stellar envelope opacities, protostellar jet dynamics and molecular cloud radiation dynamics, are "uniquely accessible in HED facilities like NIF." He noted that a recent National Research Council report listing a series of questions that are fundamental to understanding how the universe works helped to mobilize LLNL scientists to use NIF to look for answers.

"There's clearly a place for us to participate in this style of big-question physics, high-impact science, chemistry and materials science," Remington said. "We have a dual responsibility to benefit society as scientists addressing basic science questions, along with and complementary to our programmatic work at the national labs."

NIF is currently on track for completion in 2009, with the first attempts at achieving ignition scheduled for 2010. While it will be a couple of years before NIF is ready to issue a general call for research proposals, three research teams already have been formed and received seed grants from the Laboratory to design experiments and targets for NIF shots. The groups will study the response of materials to enormous pressures such as those found in the interiors of Jupiter and Saturn; the kinds of turbulent hydrodynamic processes that affect the evolution of supernovae; and the laser-plasma instabilities that occur when lasers interact with large-scale plasmas. LLNL scientists will serve as liaisons between the groups and NIF to help work through fielding their experiments and interpreting the results.

JACQUELINE MCBRIDE/NEWSLINE

National Ignition Facility Science Director Richard Boyd (left) discusses astrophysics research on NIF with (left to right) Peter Thompson of the United Kingdom's Atomic Weapons Establishment, Michael Paul of Hebrew University in Jerusalem and Karl Van Bibber of LLNL's Physics and Advanced Technologies Directorate during this week's nuclear astrophysics workshop at the Martinelli Center on Greenville Road.

NASA

ON THE COVER: The Crab Nebula is now known to be a supernova remnant, an expanding cloud of debris from the death explosion of a massive star. Composed of 24 exposures taken in October 1999, January 2000, and December 2000, this Hubble Space Telescope mosaic spans about 12 light years. Colors in the intricate filaments trace the light emitted from atoms of hydrogen, oxygen and sulfur in the debris cloud. One of the most exotic objects known to modern astronomers, the pulsar is a neutron star, the spinning remnant of the collapsed stellar core. The Crab Nebula lies about 6,500 light-years away in the constellation Taurus.