Fusion scientists gear up to learn how to harness plasma energy

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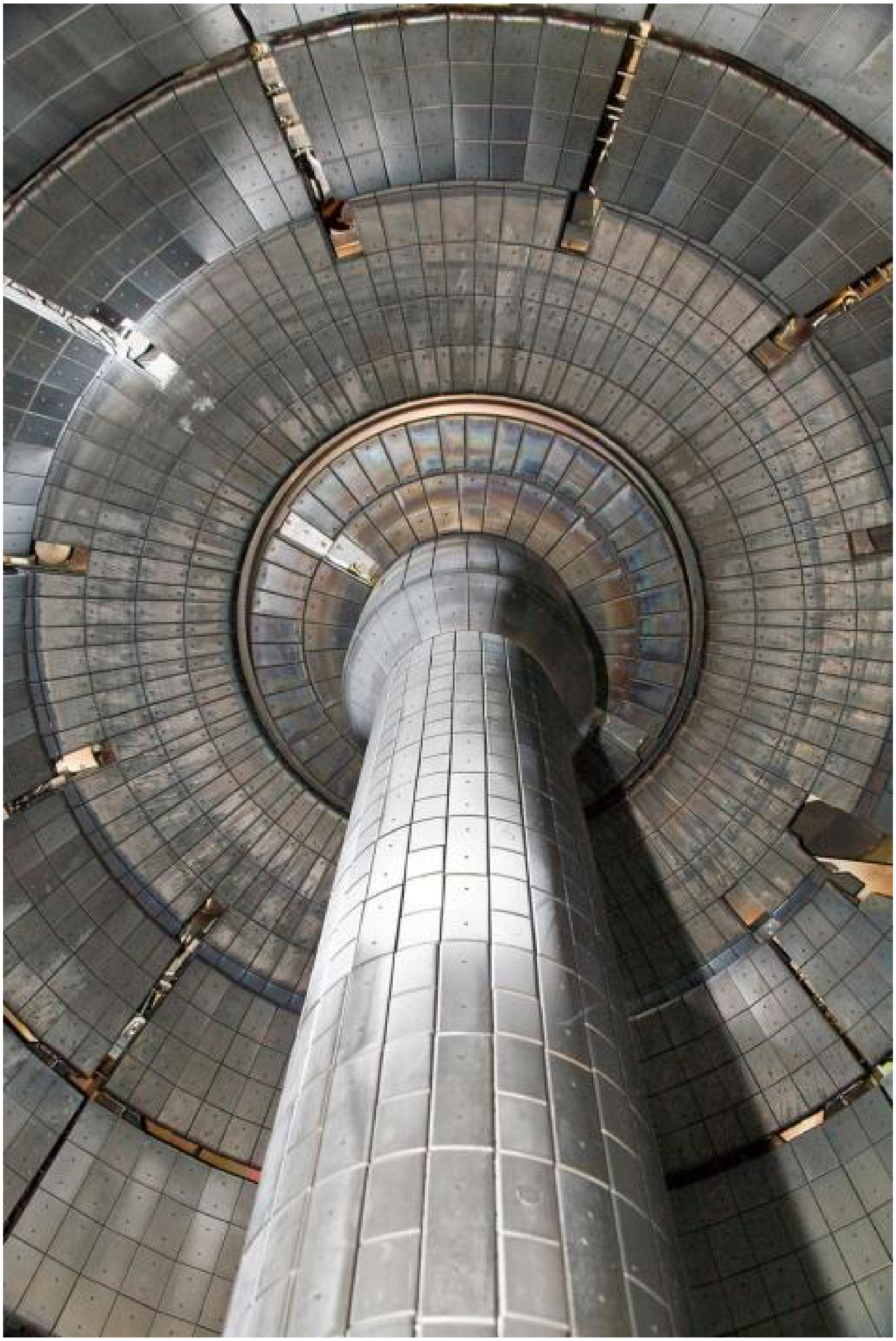

(PhysOrg.com) -- Researchers working on an advanced experimental fusion machine are readying experiments that will investigate a host of scientific puzzles, including how heat escapes as hot magnetized plasma, and what materials are best for handling intense plasma powers.

Scientists conducting research on the National Spherical Torus Experiment (NSTX) at the U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL) have mapped out a list of experiments to start in July and run for eight months. The experimental machine is designed to deepen understanding of how plasmas can be mined for energy.

A major topic of investigation by scientists for the coming round of experiments will be the issue of transport – how plasma energy and particles escape the machine. Of particular interest is transport near the plasma edge where the temperature can reach several million degrees Centigrade within a few centimeters. The plasma edge region is very important, since it has a strong influence on the temperature in the even hotter plasma core. The edge is also the region where the plasma must be cooled to lower temperature so it doesn't damage the walls that confine the experiment.

"We have made a lot of progress already on the machine," said Jonathan Menard, a principal research physicist and program director for NSTX at the laboratory. "And these experiments will push us further in understanding these mechanisms more fully."

Menard made the remarks at the close of the four-day NSTX Research Forum, held March 15 to 18 at PPPL, where 55 team members from 17 institutions gathered to focus on experimental research plans and priorities.

Masayuki Ono, a principal research physicist who heads the NSTX department at PPPL, characterized the resulting plan as "highly thoughtful and exciting." "The planning process," he added, "is particularly important this year." He noted that the coming run will represent the research team's last opportunity to conduct experiments for several years on the device before machine operation is paused to enable a major device upgrade between 2012 and 2014.

Among several other topics, researchers also will focus on the potential of lithium to blanket the hot ionized gas produced in fusion reactions. A major question in magnetic fusion is how to make the plasma and its surrounding walls work well together. For example, if the plasma is too hot when it touches the wall, it can damage it in ways that are difficult to control. One possible solution is to make the wall a liquid, and lithium is special because it liquefies at relatively low temperature, and it does not easily enter hot plasma. Further, lithium has the special property of absorbing particles that hit it so that much less cold gas enters the plasma. As a result, the edge temperature can be increased, turbulence is reduced, and the whole plasma stays hotter –three important characteristics for the creation of fusion energy. Experimenters are actively preparing to cover the floor of the machine with molybdenum tiles that will then be coated with lithium. "We are trying to get more aggressive with this approach of improving the walls that surround the plasma," Menard said.

Experiments on the NSTX, the largest of the lab's experiments, began in 1999. The plasmas in NSTX are, like most fusion experiments, confined using magnetic fields and walls designed to withstand the heat from plasmas with temperatures that exceed 100 million degrees Centigrade. Unlike other machines which confine plasmas in a doughnut-like shape, the plasmas in NSTX are spherical in shape with a hole through the center.

PPPL, in Plainsboro, N.J., is devoted both to creating new knowledge about the physics of plasmas – ultrahot, charged gases – and to developing practical solutions for the creation of fusion energy. Through the process of fusion, which is constantly occurring in the sun and other stars, energy is created when the nuclei of two lightweight atoms, such as those of hydrogen, combine in plasma at very high temperatures. When this happens, a burst of energy is released, which could theoretically be used to generate electricity.

Provided by Princeton Plasma Physics Laboratory

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