PPPL physicists essential to new campaign on world's most powerful stellarator

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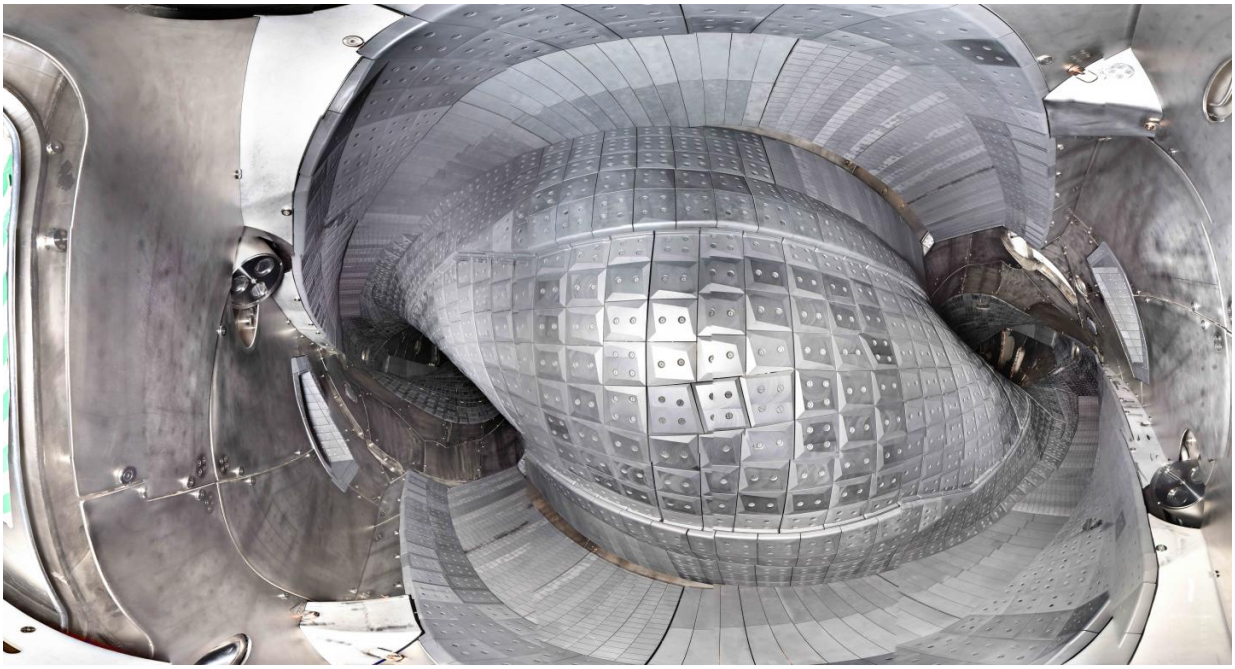

This is a fish-eye view of interior of W7-X showing graphite tiles that cover magnetic coils. Credit: Max Planck Institute of Plasma Physics

Physicists from the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) are providing critical expertise for the first full campaign of the world's largest and most powerful stellarator, a magnetic confinement fusion experiment, the Wendelstein 7-X (W7-X) in Germany. The fusion facility resumes operating on

August 28, 2017, and will investigate the suitability of its optimized magnetic fields to create steady state plasmas and to serve as a model for a future power plant for the production of a "star in a jar," a virtually limitless source of safe and clean energy for generating electricity.

The W7-X started up in December, 2015, and concluded its initial run in March, 2016. The facility has since been upgraded to prepare for the high-power campaign that is set to begin.

Deeply involved in the new 15-week run are PPPL physicists Sam Lazerson and Novimir Pablant, who are spending two years at the Max Planck Institute of Plasma Physics in Greifswald, Germany. Lazerson, who previously mapped the W7-X magnetic fields with barn-door sized magnetic coils built by PPPL, heads a task force that will plan and run a series of experiments on the stellarator. Pablant, who designed an x-ray crystal spectrometer to record the behavior of W7-X plasma, will operate the diagnostic together with a German spectrometer and will contribute to planning and executing research.

First run in designed configuration

"This will be the first run of the machine in its designed configuration," said David Gates, who heads the stellarator physics division at PPPL and oversees the laboratory's role as lead U.S. collaborator in the W7-X project. The new run will test a device called an "island divertor" for exhausting thermal energy and impurities. The campaign will also increase the heating power of the stellarator to eight megawatts to enable operation at a higher beta—the ratio of plasma pressure to the magnetic field pressure, a key factor for plasma confinement.

Such progress marks steps toward lengthening the confinement time of the hot, charged plasma gas that fuels fusion reactions within the optimized machine. "The goal is to increase plasma confinement

compared with traditional stellarators," said Gates.

Going forward, Max Planck engineers plan to install a U.S.-built "scraper element" on the W7-X after completion of the initial 15-week campaign. The following phase will study the ability of the unit, originally designed at Oak Ridge National Laboratory and completed at PPPL, to intercept heat flowing toward the divertor and improve its performance. Plans call next for installation of a water-cooled divertor in 2019 to further increase the allowable pulse length of the stellarator.

PPPL, on Princeton University's Forrestal Campus in Plainsboro, N.J., is devoted to creating new knowledge about the physics of plasmas—ultra-hot, charged gases—and to developing practical solutions for the creation of fusion energy. The Laboratory is managed by the University for the U.S. Department of Energy's Office of Science, which is the largest single supporter of basic research in the physical sciences in the United States, and is working to address some of the most pressing challenges of our time. For more information, please visit science.energy.gov.

Provided by Princeton Plasma Physics Laboratory