Weekly HIGHLIGHTS

PPPL PRINCETON PLASMA PHYSICS LABORATORY
U.S. DEPARTMENT OF ENERGY

The PPPL Highlights for the week ending January 5, 2019, are as follows:

NSTX-U RECOVERY AND RESEARCH (J. MENARD)

Recovery:

Inner PF Coils — A peer review was held on Jan. 4 to review minor modifications to the water fittings of the inner PF1 coils. The review was held to confirm the final design details of these changes and readiness for PF1 coil procurement. The peer review was successful, pending resolution of chits.

The PF1A conductors have been grit-blasted and primed and are being boxed for shipment. PPPL staff will remain on site at ICAS Tratos through the duration of the grit-blasting and priming of the PF1B and PF1C conductors, and a contract QA individual will be on site for the remaining spare conductors.

U.S. ITER FABRICATION (H. NEILSON)

United States Patent No. 10,162,138 was awarded to Princeton University on Dec. 25, 2018, for the invention of "a self-aligning mirror device for transmission line offset correction" by a PPPL team including M. Gomez and A. Zolfaghari of the ITER diagnostics group. The invention, which automatically adjusts mirrors to couple microwave radiation between two offset or non-collinear waveguides, is incorporated into the design of the ITER Low Field Side Reflectometer (LFSR) as a "Gaussian telescope" (GT) to accommodate displacements of up to 3 centimeters in the waveguides that extend from and move with the vacuum vessel under thermal deflections. The GT maintains transmission of the microwave beam between the in-vessel and ex-vessel waveguides, using a pair of spherical mirrors to maintain focus and beam quality. A prototype was fabricated by PPPL and its performance successfully demonstrated in tests performed in collaboration with LFSR design partner General Atomics.

A final report on the first phase of mirror cleaning studies for the Motional Stark Effect (MSE) diagnostic was received from subcontractor Nova Photonics. Mirrors can become coated with sputtered first-wall materials such as beryllium or tungsten during ITER plasma operation, potentially degrading MSE system performance. The Nova team has investigated an option for in-situ cleaning of the mirrors, using a local radiofrequency (rf) wave driven discharge to remove surface impurities by sputtering. Stainless steel test samples were pre-coated with thin films of aluminum (as a proxy for beryllium) and tungsten, then moved to a test chamber where they were exposed to rf-heated discharges, typically in neon, for a period of time. Tests were carried out over a range of conditions, including both the presence and absence of an applied magnetic field. A

suite of diagnostics was used to monitor the plasma during operation, to measure impurity film thickness and removal rate, and to characterize the surface composition and reflectivity. It was found that both aluminum and tungsten are readily removed from the substrate using neon as the working gas. Stainless steel substrate material was also removed, an issue which will have to be addressed in future studies with a molybdenum or rhodium substrate, as these materials are more difficult to sputter than stainless steel. Applying a magnetic field increased the sputtering rate for all working species, however, an asymmetry was observed in the uniformity of the material removal.

THEORY (S. HUDSON)

On Dec. 20, D. Schaffer was award a grant through NASA's HTIDS (Heliophysics Technology and Instrument Development for Science) program for a proposal titled, “Understanding Electron and Ion Heating by Collisionless Shocks in Laboratory and Space Plasmas.” The goals of the research are aimed at understanding particle heating across high-Alfvén-Mach-number collisionless shocks using high-powered laser experiments, numerical simulations, and spacecraft observations. The three-year award starts in FY 2019. W. Fox from PPPL and L.-J. Chen from UMD/GSFC are co-investigators. On Dec. 10, H. Qin presented a Hamiltonian Colloquium at the Mathematical Sciences Research Institute (MSRI). The title of the presentation was, “Parity-time symmetry entails pseudo-Hermiticity regardless of diagonalizability.” After the presentation, Qin talked with the members of MSRI about related topics, including the proof of the Riemann hypothesis and quantum measurement.

This report is also available on the following web site:

http://www.pppl.gov/publication-type/weekly-highlights