Weekly HIGHLIGHTS

PPPL PRINCETON PLASMA PHYSICS LABORATORY

U.S. DEPARTMENT OF ENERGY

The PPPL Highlights for the week ending July 28, 2018, are as follows:

NSTX-U RECOVERY AND RESEARCH (J. MENARD)

Recovery:

NSTX-U Passive Plates - A preliminary design review (PDR) for the passive plate and helium bakeout line repair was held on July 26 and was deemed successful by the review committee, pending resolution of outstanding chits. Completion of this PDR completes the 3rd Notable Outcome for FY2018 for NSTX-U: "For the NSTX-U recovery project, complete a preliminary design review (PDR) for the passive plates and helium bake-out line supports by July 31, 2018."

Magnets - The Tesla Engineering (UK) coil vacuum pressure impregnation (VPI) fill is tentatively scheduled for next week. The Sigma Phi coil was successfully packaged, the documentation package is almost approved, and PPPL has been addressing customs issues. ICAS Tratos is exploring different ways to apply primer to the coil conductor using legacy PF1a and PF1c conductor shipped from PPPL.

Plasma Facing Components (PFCs) - The analysis on five models for outboard diverter (OBD) rows 3-5 Poloidal Charge Exchange Recombination Spectroscopy (PCHERs) tiles has been completed. All first round OBD345 analysis will be considered complete once the PCHERs integrated analysis is finished. The design for OBD row 1 and 2 is 95% complete. Additional information from diagnostics is required to finalize the design. The in-board diverter horizontal (IBDH) tile design is 90% percent complete and also needs information from diagnostics to finalize the design. The IBDH tile is undergoing final analysis with support from Oak Ridge National Laboratory (ORNL). The interfaces between OBD12 and the IBDH are fully resolved.

The T-bar in the Inboard Diverter Vertical (IBDV) Low heat flux final design has been adjusted to mitigate over-constraining the design. ORNL is moving forward with its analysis, and the wireways and 3D printed models for test fit-up are being finalized. Thermal ratcheting analysis is complete for the Center Stack Angled (CSA) floating tiles and the Center Stack, First Wall (CSFW). The CSFW also completed halo forces, eddy moments, tile tension, and structural analyses. The date for the PFC FDR is presently scheduled for the last week of September.

Polar Region - Preparations continue for the Polar Region PDR scheduled for August 2. The team is in contact with the bellows vendor to address fatigue assessment concerns.

NTC Shielding - The requirements document was completed for the radiation monitor annunciation upgrade and test cell shielding.

Systems Engineering - Revised System Requirements Documents were posted for both the Plasma Facing Components and for the Vacuum Vessel and Internal Hardware scope.

Research:

N. Bertelli attended the 2018 Scientific Discovery through Advanced Computing (SciDAC-4) Principal Investigator Meeting sponsored by the U.S. Department of Energy, Office of Advanced Scientific Computing Research in Rockville, MD, July 23-24. Two posters and an overview talk were presented by the Center for Simulation of Fusion Relevant RF Actuators (RF-SciDAC) project team.

M. Ono (PPPL) visited the Plasma Research Center at the University of Tsukuba, Japan, on July 23. He met with Prof. T. Imai and T. Kariya on the 28/35 GHz gyrotron development and the recent high power test results. He also met with Profs. Y. Nakashima and M. Sakamoto to discuss the recent diverter test facility experimental results and the facility upgrade plan.

U.S. ITER FABRICATION (H. NEILSON)

The Low-Field-Side Reflectometer (LFSR) design team continued its work of completing input data package deliverables in preparation for a preliminary design review (PDR) later this year. This week, several deliverable documents were uploaded to the U.S. ITER document management system, iDocs. They include: 1) Memorandum Regarding Penetrations Through Safety Barriers; 2) Reliability, Availability, Maintainability, and Inspectability (RAMI) Analysis; 3) System-Integrated Logistics Plan; and 4) Status Report on Deviation Requests. Preparation of these reports was led by PPPL engineer J. Gonzalez Teodoro.

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ADVANCED PROJECTS (H. NEILSON)

Stellarators (D. Gates):

S. Lazerson conducted experiments on the Wendelstein 7-X experiment in order to document the fueling capabilities of the main gas valve system, pellet injector, and helium beam system. The experiments examined differences among piezoelectric valves located in each of the five modules of the device. Additionally, the experiments examined the effect of gas pressure on both valve actuation and fueling performance. Combined with these experiments were tests of the pellet injection system and demonstration of density control with the helium beam system. The process also identified a standard gas-valve test for actuating valves and verifying performance before plasma operation.

THEORY (A. BHATTACHARJEE)

W. Tang and S. Ethier represented PPPL at the DOE CSGF Annual Program Review held in Arlington, Virginia. The U.S. Department of Energy Computational Science Graduate Fellowship (http://www.krellinst.org/csgf/) program provides outstanding benefits and opportunities to students pursuing doctoral degrees in fields of study that use high-performance computing to solve complex science and engineering problems. As part of the program, CSGF fellows are required to complete a practicum project in one of the many DOE labs, giving them practical work experiences while strengthening collaborative ties between the national academic community and DOE laboratories. The annual conference gives the students an opportunity to meet with the laboratory representatives to discuss their practicum. A poster session held by the DOE labs also gives them an overview of the science and activities taking place at the laboratories.

A Theory seminar titled, “Understanding coronal structures on the Sun” was presented by H. Peter, from the Max Planck Institute for Solar System Research in Göttingen, Germany. The abstract and a copy of the presentation are available here: https://theory.pppl.gov/news/seminars.php?scid=1&n=research-seminars

C. Liu published a paper in *Nuclear Fusion* titled, “The effects of kinetic instabilities on the electron cyclotron emission from runaway electrons.” In this paper, a new synthetic diagnostic model for electron-cyclotron-emission from runaway electrons is introduced, and is applied to study quiescent runaway electrons discharges in the DIII-D tokamak.

The results show clearly that the significant increase of ECE signals observed in experiments is not only because of the avalanche growth of runaway electron population, but also due to the excitation of kinetic instability of runaway electrons. This work can be further extended to study the ECE signals in tokamak disruptions, which can be important to understand the properties of runaway electrons in this case.

A. Reiman gave a talk on work done in collaboration with N. Fisch, https://arxiv.org/abs/1806.09260, at the 6th Annual Workshop on the Theory and Simulation of Disruptions at PPPL. The talk described an RF current condensation effect in magnetic islands, previously overlooked, that can facilitate island stabilization. The effect arises from the sensitivity of the power deposition and current drive by electron cyclotron and lower hybrid waves to perturbations of the temperature. The resulting concentration of the RF-driven current near the center of the island improves the efficiency of the RF current stabilization effect, and reduces its sensitivity to precise alignment of the ray trajectories with the center of the island. In particular, the effect will allow the RF stabilization of larger islands in the ITER tokamak than would otherwise be possible. Analyses of disruptions on the JET tokamak have found that neoclassical tearing modes (NTMs) have been the single most common cause of disruptions, and the effect can aid in reducing the frequency of such disruptions.

J. Dominski *et al.* published a paper titled, "A tight-coupling scheme sharing minimum information across a spatial interface between gyrokinetic turbulence codes," *Phys. Plasmas* **25**, 072308 (2018). The abstract and a link to the paper are given on the Theory website here:
https://theory.pppl.gov/news/seminars.php?scid=4&n=publications

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

COMMUNICATIONS (L. BERNARD)

The Office of Communications posted one press release to the PPPL website. It focused on PPPL physicist S. Jardin leading a team of scientists that won 40 million core hours of supercomputer time to simulate plasma disruptions that can halt fusion reactions and damage fusion facilities. The PPPL team will apply its findings to ITER; the results could help ITER operators mitigate the large-scale disruptions the facility will face. The story was also posted to the *Newswise* and *EurekAlert!* press release distribution services.

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DIRECTOR'S OFFICE (S. COWLEY)

July 26-27, M. Zarnstorff attended a National Lab Chief Research Officer (NLCRO) meeting in Washington, DC.

This report is also available on the following web site:
http://www.pppl.gov/publication-type/weekly-highlights