



**The PPPL Highlights for the week ending June 9, 2018, are as follows:**

**NSTX-U RECOVERY AND RESEARCH (J. MENARD)**

*Recovery:*

A vendor has completed fabrication of a prototype inner poloidal field coil. The coil has been shipped and delivered to PPPL; dimensional inspection has been performed at PPPL and electrical testing will follow. The PPPL prototype coil has completed the vacuum pressure impregnation (VPI) process and is currently being removed from the VPI mold.

A final design review for CAMAC Replacement (Phase 3) was held on June 6, and a conceptual design review for passive plates and helium line repair was held on June 8.

After successful replacement of instrumentation thermocouple wells with welded caps in the neutral beam liquid helium refrigerator cold box, the cold box was evacuated and successfully reached low base pressure. These and other tests confirm the compressor skid is once again operational after compressor rebuilds and full maintenance last year.

*Research:*

R. Maingi presented a plenary talk titled, "Recent Progress on NSTX-U and Future Collaboration Opportunities," at the 9th US-PRC Magnetic Fusion Collaboration Workshop in Xi'an, China, June 5-7. There was substantial interest on the science mission of NSTX-U, the current status of the recovery project, and future collaborations when NSTX-U resumes operations. Maingi also presented an invited talk titled, "Results from the US-PRC collaboration on PMI in EAST," in which he presented results from the entire US-PRC PMI collaboration. Good progress has been made, particularly on flowing liquid lithium technology and science, and the results will inform future NSTX-U liquid metal PFC plans. H. Neilson, R. Nazikian, and F. Poli also attended the meeting, and discussed various possible collaborations with ASIPP on EAST and CFETR design.

An article titled, "Blob-hole correlation model for edge turbulence and comparisons with NSTX gas puff imaging data," by J. R. Myra, S. J. Zweben and D. A. Russell has just been published in *Plasma Physics and Controlled Fusion*. "Holes" are negative-going density perturbations left behind when positive-going "blobs" are formed in the edge plasma. Recent 2-D cross-correlation analysis of NSTX GPI data showed consistent negative regions that are now qualitatively explained by a new blob-hole model. In addition to improving understanding of edge and scrape-off layer turbulence in general, inward hole propagation may be of interest to understand possible turbulence spreading from the separatrix region into the pedestal and inward transport of impurities.



## **U.S. ITER FABRICATION (H. NEILSON)**

The Low Field Side Reflectometer (LFSR) design team has completed a list of deliverables for the ITER LFSR preliminary design review according to U.S. ITER procedures and the Procurement Agreement (PA) for the LFSR system. This was a major open issue from the LFSR design readiness review held at PPPL during the week of May 21. In addition, assembly and component drawing lists for the in-vessel part of the diagnostic system were developed.

The pneumatic valves that will control the gate valves on the ITER secondary confinement barriers were identified and introduced in the ITER's ENOVIA CAD system. The LFSR locally operated maintenance valves were likewise identified and entered. Input was provided to the ITER organization (IO) on the occupational safety as well as nuclear safety considerations, taking into account in the operation logic of these valves, for inclusion into the LFSR interface sheet with ITER safety system.

## **ITER & TOKAMAKS (R. Nazikian)**

### **DIII-D (B. Grierson)**

*Research:*

A new article in *Physics of Plasmas* by A. Ashourvan, B. Grierson, D. Battaglia, S. Haskey, and T. Stoltzfus-Dueck titled, "Validation of the kinetic-turbulent-neoclassical theory for edge intrinsic rotation in DIII-D," was published online here: <https://doi.org/10.1063/1.5018326>. This new article, based on an APS-DPP invited talk by Ashourvan, describes the testing of a recent kinetic model of edge main-ion (deuterium) intrinsic toroidal velocity from neoclassical orbits in an inhomogeneous turbulent field [T. Stoltzfus-Dueck, *Phys. Rev. Lett.* 108, 065002 (2012)]. Using this model, the velocity prediction was tested on the DIII-D tokamak for a database of L-mode and H-mode plasmas with nominally low neutral beam torque. Good agreement is obtained between the measurements and predictions. In the case of balanced high-NBI power, TRANSP and NUBEAM were needed to determine the finite absorbed torque, which was compensated for by generalizing the model beyond torque-free conditions.

S. Haskey has been selected to give an invited talk at the EU Transport Task Force meeting contrasting the evolution of the impurity and main-ion rotation, temperature and density across the L-H transition. The research reveals that the main-ion (deuterium) temperature is lower than the fully stripped carbon temperature near the plasma separatrix, and that there are large differences in the toroidal rotation of the main-ions and impurities. The C+6 toroidal rotation often develops a non-monotonic notch feature



that is not present in the main-ion rotation, which instead, depending on plasma parameters, can show a flat or peaked rotation near the separatrix. The peaked-edge rotation can have values up to 100km/s for low collisionality QH modes.

#### *Operations:*

A. Nagy will move from his present role of lead engineer to the position of deputy project manager with a specific role of construction manager for the CCOANB project. In this new role, Nagy will be working with the entire project staff to proactively identify and mitigate problems and streamline the workflow, while maintaining quality and safety.

#### **W7-X (R. Maingi)**

This week, R. Lunsford visited General Atomics to work with D. Mauzey to bench-test the W7-X powder injector. The injector uses non-magnetic components to launch powder horizontally up to ~50 centimeters using a paddle wheel, which is driven by a piezo motor. Calibrations for feed rate and granule size are now underway. This compact unit will fit into an envelope 120 millimeters in diameter and 150 millimeters long on W7-X. The unit has worked better than expected, and should ship to W7-X by the end of July for installation in September.

#### **KSTAR (R, Maingi)**

The Impurity Powder Dropper preparation was boosted this week by E. Gilson visiting DIII-D this week helping E. Wolfe (a PPPL student intern) and Nagy complete assembly and testing of the new KSTAR dropper. This unit was used on DIII-D and will be loaned to KSTAR for powder drop experiments. The unit was cleaned, modified slightly to address a powder leak point, and reassembled. It has passed the evacuation test reaching a base pressure of  $9E-7$  Torr after a bake out. This is the third dropper successfully produced and fourth installation on a fusion device.

#### **ADVANCED PROJECTS (H. NEILSON)**

##### **Stellarators (D. Gates):**

PPPL physicists S. Lazerson and N. Pablant participated in a diagnostic dress rehearsal for long-pulse plasma operation to begin later this summer. During these so-called trigger tests, all diagnostics recorded data and control systems signaled actuators over periods of 10 to 600 seconds. The tests were designed to identify bugs in the integrated data acquisition systems. Although no plasmas were generated, signals from over 45 diagnostic systems were recorded to central data acquisitions systems. Pablant oversaw the X-ray imaging crystal spectrometer system, which performed well within desired

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parameters and demonstrated capabilities that will allow it to record plasmas in excess of 100 seconds in duration in the coming campaign. As part of his duties as the scenario and integration task force leader, Lazerson oversaw the control room and addressed prioritization of diagnostic operation. In addition, Lazerson assessed the computational resource needs of diagnosticians while attempting to address concerns raised by diagnosticians. After two days of testing, all diagnostics appear ready to begin recording data.

## **COMMUNICATIONS (L. BERNARD)**

The Office of Communications posted three press releases to the PPPL website. The first notes that the 23rd International Conference on Plasma-Surface Interactions in Controlled Fusion Devices begins on June 17 and continues for six days. More than 400 scientists from around the world will convene at Princeton University to discuss the state of research on how plasma-material interactions can be managed to optimize fusion reactions. The second press release explains how PPPL recently won two awards from the EPA for its 97 percent recycling rate and for its composting program, and has won a third award from the Green Electronics Council for its green electronics purchasing program. The third press release explains how PPPL physicists C.S. Chang, S.-H. Ku, and R. Hager were involved in new research producing a new model of how magnetic islands interact with surrounding plasma and lead to disruptions. This story was featured on the U.S. DOE Office of Science website. All three stories were also posted on the *Newswise* and *EurekAlert!* press release distribution services.

On June 8, the Office of Communications hosted a meeting and Laboratory tour for the Princeton Campus Communicators Network, an organization of all the professional communicators throughout Princeton University. Tours were led by C. Gentile, N. Allen, and M. Cropper.

In May, the Office of Communications hosted 13 tours with a total of 504 visitors. Tour guides and lecturers for the month included A. Dominguez, J-K Park, R. Camp, A. Brereton, D. Kim, D. Battaglia, R. Camp, B. Kraus, W. Guttenfelder, E. Gilson, M-G Yu, A. Brereton and K. Lamb.

## **DIRECTOR'S OFFICE (R. HAWRYLUK)**

On June 6, Princeton University's H. Stone presented a colloquium entitled, "A Fascination with Fluid Mechanics."

PPPL hosted the first tri-party Contractor Assurance System (CAS) Workshop June 5-6. Workshop participants included leadership from laboratory, site office, and parent



organizations from PPPL, FermiLab, Argonne, and Lawrence Berkeley National Laboratory.

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