



The PPPL Highlights for the week ending February 29, 2020, are as follows:

## **NSTX-U RECOVERY (J. GALAYDA) AND RESEARCH (S. KAYE)**

### **Recovery (J. Galayda):**

**CSC** — Final weld-out of the assembly continued at the Turtle Creek facility in Pennsylvania. The center stack will be shipped to the Camden facility upon completion of the welds for machining of the outer diameter to meet PPPL required dimensions and tolerances.

**HTT/HTP** — The Heat Transfer Plate (HTP) and Heat Transfer Tubing (HTT) were welded and tested at Hollis Line in New Hampshire. The final weld and leak tests were witnessed by PPPL, QA, and Engineering. The parts are being prepared for shipment to PPPL in early March.

**Coils** — Brazing of the coil flags and installation of the G7 fillers were completed on both the PF1AL coil and PF1BL coil, and preparations for vacuum pressure impregnation (VPI) of the coils continued. In addition, the testing of mandrels for PF1BU and PF1CL was satisfactorily completed, and the winding lines are ready to begin winding these coils. The last mandrel for PF1CU is due to arrive in Paris on March 7.

**Reassembly Preparation** — PPPL technicians continued with preparation of the TFTR test cell for the NSTX-U reassembly staging and pre-assembly areas.

**NTC Shielding** — Installation of the NSTX-U test cell wall shielding was completed on Feb. 26. The subcontractor 3BD installed the labyrinth roof blocks' support brackets and installed the framing for the new door into the test cell. Installation of labyrinth roof blocks will begin, and completion is scheduled for the week of March 2. After that, the lighting and fire protection sprinklers will be installed to complete labyrinth construction. The next step is verification of the shielding with the D-T neutron generator test.

### **Research (S. Kaye):**

The paper titled, "Simulation of Alfvénic avalanche onset in NSTX," by R. White, V. Duarte, et al. has been published in *Physics of Plasmas*. The paper reports guiding-center simulations leading to a range of Alfvén wave amplitude responses and their associated fast ion losses. Experimental conditions in NSTX are identified in connection with benign quasi-steady saturation and explosive avalanche behavior of multiple waves. A threshold in neutral beam power is shown to exist in NSTX

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for the excitation of Alfvénic avalanches via a path for global stochasticity. The paper can be accessed at <https://doi.org/10.1063/1.5136236>

**NSTX-U/ST40 Collaboration** — Access to ST40 Data and their Physics Viewer utility has been established by PPPL's Instrument & Controls group and ST40 staff. An interface created for PPPL researchers, in the form of a new cluster module and an interface server, gives managed access from the computing cluster or desktops and facilitates remote collaboration. The next stage of this effort will be to mirror available test/model data at PPPL to provide an automated, high-speed synchronization mechanism shortly after the data is acquired.

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

This week the last of more than 70 deliverable reports documenting the preliminary design of the ITER Low Field Side Reflectometer (LFSR) was approved by the ITER Organization. The LFSR will measure the density profile in the outer layers of the ITER plasma. The design has been developed by the Laboratory, in partnership with General Atomics, since 2014. The team presented its design solution to an exhaustive set of requirements in a full-system preliminary design review in 2018. Since then, the effort has moved to final design and manufacturing trials for the front end of the system, an in-vessel antenna assembly that will be installed in one of ITER's first plasma ports. Approval of the last preliminary design deliverable clears the way for formal closure of preliminary design and planning for final design reviews.

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

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

#### *Research:*

The paper, "Setting the H-mode pedestal structure: variations of particle source location using gas puff and pellet fueling" by A. Nelson, et al. in collaboration with colleagues from Oak Ridge National Laboratory and General Atomics has been published in *Nuclear Fusion*: <https://doi.org/10.1088/1741-4326/ab5e65>. The paper demonstrates that pellet fueling increasing the height of the pedestal density, while gas fueling both increases the pedestal density and shifts the density pedestal outwards towards the separatrix. Contrasting equivalent fueling rates, the pedestal pressure does not degrade with increased pellet fueling, but the pedestal pressure does degrade with strong gas puffing.



S. Haskey presented a DIII-D Friday Science Meeting talk on an improved neutral beam power calibration that will be applied to the off-axis neutral beam systems at 150 and 210 degrees for recent DIII-D discharges. This power calibration has been derived using TRANSP from the relative variation between the neutron production by on-axis and off-axis injection in MHD-quiescent plasmas. This improved power accounting will be applied to the relevant shots in the next week.

A. Ashourvan visited the Lawrence Livermore National Laboratory and presented a talk titled, "Formation of a High Pressure Staircase Pedestal with Suppressed Edge Localized Modes in the DIII-D Tokamak." In this visit, Ashourvan and X. Xu (LLNL) discussed the divertor heat flux width scaling in the Grassy-ELM regime and planned for future theoretical and experimental collaborations on this topic.

*Operations:*

**International PMI and FES LM PFC Development Program (R. Maingi):**

An impurity powder dropper workshop was held at General Atomics (GA) in San Diego, California, organized by A. Bortolon, R. Maingi, and M. Umansky (LLNL), and hosted by T. Abrams and L. Cerda (GA). This meeting provided a venue for open discussion on new research opportunities offered by this novel tool, which is now implemented and operational on several tokamaks and stellarators. A sequence of experimental talks was given to bring everyone to the same level of knowledge regarding experiment and modeling results and capabilities. In addition, a research forum style series of individual contributions was given to solicit ideas on critical science questions and activities across the complement of facilities. There were 25 onsite and 15 online participants. A workshop report including the tasks needed to assess scalability of powder injection for several applications in reactors is being prepared.

**THEORY (S. HUDSON)**

W. Zhang from the Institute for Fusion Theory and Simulation, Department of Physics, Zhejiang University, Hangzhou, China, has completed his year-long visit to the PPPL Theory Department and returned to China. During his stay, he carried out detailed linear and nonlinear benchmark calculations between the Chinese code CLT and the M3D-C1 code. He successfully performed benchmark calculations for both the resistive kink mode and the tearing mode. He has written up his work, which will soon be submitted for publication.



On Feb. 17 and 18, S. Hudson, Y. Zhou, and C. Liu attended *Structure-Preserving Geometric Discretization of Physical Systems*, a workshop at the Princeton Center for Theoretical Physics. A. Glasser (a fifth-year graduate student at PPPL) presented an invited talk titled “Poincaré Symmetry on a discrete lattice.” The workshop was organized by H. Qin, C. Rowley, N. Fisch, and M. Leok. Presentations describing how numerical methods for solving dynamical systems can be designed that are guaranteed to exactly preserve symmetries and conservation laws of the dynamical systems.

### **COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)**

#### **Communications (L. Bernard):**

The Office of Communications posted three news stories to the PPPL website. The first reports on research led by N. Pablant showing that the W7-X stellarator in Germany has demonstrated a key step in maintaining the device’s plasma heat. The second reports research led by M. Churchill into using artificial intelligence to improve the predictions of disruptions in fusion energy devices. The third notes that Ridge High School and Princeton Charter School won their respective divisions of the New Jersey Regional Science Bowl and will now compete in the National Science Bowl in Washington, D.C. These stories were also posted to the *Newswise* and *EurekaAlert* press release distribution services.

#### **DIRECTOR’S OFFICE (S. COWLEY)**

S. Cowley and M. Zarnstorff participated in Fusion Day on the Hill activities in Washington, D.C., on Feb. 26. Cowley also participated in meetings with the National Academy of Sciences on Feb. 26.

**This report is also available on the following web site:**

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