



The PPPL Highlights for the week ending June 15, 2019, are as follows:

## **NSTX-U RECOVERY (R. HAWRYLUK) AND RESEARCH (S. KAYE)**

### **Recovery (R. Hawryluk):**

**TF Bundle** — Fabrication continues on samples for the material testing that will be performed at PPPL. The turn-to-turn samples were subject to two additional cure cycles and the laminates were removed from the mold. The next step is to cut the test samples from the laminates. Preparations have been completed for the second vacuum pressure impregnation (VPI) of the quadrant-quadrant samples. The vendor (CTD) for tensile testing that experienced a setback has revised its sample design and will be switching to a stainless-steel mold to avoid mismatch of coefficient of thermal expansion with the copper samples. The PPPL machine shop has prepared and shipped the copper parts for the samples of the revised design and is completing the machining of the stainless-steel molds. As a back-up for and supplement to the CTD tensile testing, PPPL is conducting in-house sample testing and results thus far have been informative. Modulus and coefficient of thermal expansion (CTE) tests at CTD are complete and preliminary data has been sent to PPPL. Analysis efforts continue to refine the high fidelity and delamination models. The aim is to have the models all working and in alignment using estimated property data so that preliminary findings can be presented at the director's review. Then, once the material test data becomes available, the results will be finalized prior to the Stage 2 review, now scheduled for August 7-8.

**Inner PF Coils** — PPPL awarded a subcontract for fabrication of the inner PF coils to Sigma Phi (France) this week, and both parties have signed the contract. A kickoff meeting is being scheduled for next week and the COG, M. Kalish, is planning a site visit in early August.

**Machine Core Structures** — All global/parent finite element models have been completed and analysts are running load cases on all elements of the machine core structures. In addition, Oak Ridge National Lab (ORNL) is performing load case work to support PPPL. Prototype sling fabrication continues, and lessons learned are being incorporated into instructions for production.

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

S. Kojima, a graduate student from the QUEST group at Kyushu University, completed his three-week visit to PPPL under the US-Japan personnel exchange program. Kojima worked with NSTX-U researchers including L. Delgado-Aparicio, M. Ono, and N. Bertelli on soft X-ray diagnostics, ECH/EBW ray tracing calculations, and the CQL3D code. During

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his visit, he also participated in a soft X-ray experiment at the Madison Symmetric Torus at University of Wisconsin, Madison.

R. Maingi (PPPL), C. Kessel (ORNL), and D. Andruczyk (U. Illinois) visited FES on June 13 to present a strategic framework for a national liquid metal technology program, with the concepts developed potentially being tested on the NSTX-U toroidal confinement device.

**Publications** — A paper titled, “Effect of Wall Boundary on the Scrape-Off Layer Losses of High Harmonic Fast Wave in NSTX and NSTX-U,” by E.-H. Kim, N. Bertelli, M. Ono, E. Valeo, J. C. Hosea, and R. J. Perkins, was published in *Physics of Plasmas*: <https://doi.org/10.1063/1.5091579>. This paper shows that a realistic NSTX scrape-off layer (SOL) boundary can significantly affect high-harmonic fast wave (HHFW) propagation and power losses in the SOL. In SOL boundaries within NSTX, HHFW is easily localized near the antenna and less propagate to the SOL, thus less power is lost to the SOL. The authors also show the lower SOL power losses occur when SOL volume is smaller, the distance between the last closed flux surface and the antenna is shorter, the SOL density is near the critical density where the fast wave cutoff is open, and the plasma is strongly magnetized.

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

PPPL’s ITER diagnostics team maintained its focus on finalizing the mechanical interfaces between the Low Field Side Reflectometer (LFSR) and port structures, now meeting weekly with the Russian Federation’s port integration team. A key open issue for the port integrator is ensuring the required minimum width corridor for safe access by maintenance workers to equipment near the vacuum vessel closure plate. It was found that parts of the LFSR waveguide system encroach on this space. PPPL design engineer M. Duco, working with the detailed CAD model of the system, has led the effort to find a solution, reconfiguring the LFSR equipment within the limited available space in order to clear the passageway, resulting in steady step-by-step reductions in the encroachment. To date, Duco’s proposals have met with acceptance by the port integration team, and work continues toward full resolution of the issue.

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

### **International PMI (R. Maingi):**

R. Maingi was awarded the membership grade of Fellow of the American Nuclear Society on June 10 at the ANS annual meeting in Minneapolis, Minnesota. The citation reads as follows: “For his pioneering technical contributions and outstanding international leadership to fusion tokamak boundary plasmas, plasma-wall interactions, transport and turbulence, and integrated scenarios development in fusion magnetic confinement devices.”

D. Andruczyk (UIUC), C. Kessel (ORNL), and R. Maingi visited FES in Germantown to discuss a proposal for a focused national liquid-metal plasma-facing component program for future devices, within the technology group. The timeliness for a new liquid metal program was emphasized, given that the Fusion Energy Systems Study for liquid metal PFCs in a Fusion Nuclear Science Facility was just completed.

### **KSTAR Stability (S. Scott):**

The PPPL/NFRI MSE team submitted a mini-proposal to the upcoming KSTAR research forum covering three calibration activities for the two MSE systems implemented at KSTAR. These include an improved beam-into-gas calibration, a “plasma sweep” calibration similar to that used on TFTR by F. Levinton, and an Ohmic density ramp to validate the use of the MSE background polychromator as a Zeff profile diagnostic.

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

### **Public Outreach (A. Zwicker):**

The Science Education Department led the Science Undergraduate Laboratory Internship (SULI) one-week course: Approximately 65 undergraduate students conducting plasma research at PPPL, General Atomics, and other institutions this summer attended 15 talks by scientists from all over the country.

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

The Office of Communications posted two press releases to the PPPL website. The first describes research by W. Guttenfelder into validating computer codes that predict turbulent transport of particles in plasma. The second announces that A. Diallo was named deputy director of the Innovation Network of Fusion Energy, a DOE initiative that facilitates fusion-related collaborations between industry and DOE national laboratories.



The stories were also posted to the *EurekaAlert* and *Newswise* press release distribution services.

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

On June 11, S. Cowley attended a Princeton University/Andlinger Center — ACEE Princeton E-affiliates Partnership Retreat at the Princeton Marriott Forrester.

The director of the KSTAR program, S. Yoon, visited PPPL on June 13 with H. Park (UNIST) to discuss collaboration proposals with the PPPL director and with scientists from PPPL, Columbia University, Oak Ridge National Laboratory, and General Atomics. Yoon gave a seminar on the latest results and future plans of the KSTAR program, indicating a planned upgrade to a tungsten monoblock divertor in 2023 in addition to major enhancements in on/off-axis heating and current drive systems. The visitors discussed ways that US researchers could best contribute to a range of R&D needs on KSTAR including scenario development, real-time control, transient avoidance and mitigation, power handling, and remote data processing. The visitors departed for Washington on June 13 to meet with U.S. DOE FES.

A colloquium was presented on June 13 titled, "Precision plasma-based acceleration towards 10 GeV and new photon or ion sources" by C. Geddes of the BELLA Center at Lawrence Berkeley National Laboratory.

The Stellar Energy Foundation and the Fusion Industry Association hosted a conference on June 13 titled, "Roadmap to the Fusion Energy Economy," which was held at the Flatiron Institute in New York City. S. Cowley was a panel member. The panel also included leaders in technology, finance, government and philanthropy. PPPL meeting participants included: D. McComas, M. Zarnstorff, W. Guttenfelder, N. Fisch, D. Gates, A. Diallo, A. Bhattacharjee, E. Kolemen, and A. Zwicker.

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

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