



The PPPL Highlights for the week ending October 7, 2017, are as follows:

NSTX-U (J. Menard)

Recovery

Successful Preliminary Design Reviews (PDRs) for the Low Heat Flux Plasma Facing Components (PFCs) and the vacuum system backing pump have been completed.

Research

R. Maingi presented a talk at the Workshop on High-Fidelity Boundary Plasma Simulation on Leadership Class Computers, held Oct. 4 and 5, 2017 at PPPL: "Cutting Edge boundary simulation calculations and validation opportunities for ITER and NSTX-U."

M. Jaworski visited Sandia National Laboratories on Sept. 28 and delivered a talk titled, "Liquid Metal Technologies and Consequences for Magnetic Fusion Energy and More," at the Z-Machine High-Energy Density Physics Seminar. The seminar described the usefulness of liquid components to create resilient and renewable surfaces in tokamaks.

U.S. ITER FABRICATION (H. NEILSON)

Steady State Electrical Network (J. Dellas)

The final shipment of uninterruptible power supply (UPS) equipment arrived at the ITER off-site warehouse on Oct. 2. Final inspection results, provided by the Central Team, were reported to be satisfactory. Likewise, final inspection results for the DC distribution network were reported as satisfactory.

Diagnostics (R. Feder)

Low-field side reflectometer (LFSR): PPPL CAD designer M. Gomez visited General Atomics (GA) to set up and prepare the PPPL-fabricated self-aligning Gaussian telescope for testing with millimeter waves. Gomez is working with the GA and UCLA team to assemble the telescope and integrate it into the ITER LFSR transmission line test stand, and will also be setting up the vacuum window assembly for testing.

Motional Stark Effect (MSE): Nova Photonics replicated previous Mirror Cleaning experiments with ~70 nanometers of aluminum on stainless steel (SS) masked with aluminum foil and using neon as the sputtering cleaning gas. Aluminum is used as a lab

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proxy for beryllium which will be the actual mirror contaminant on ITER. This time a 0.1 Tesla magnetic field was introduced in the testing apparatus. The application of the magnetic field caused more rapid sputtering cleaning rates. Aluminum and some of the base stainless steel were removed at a more rapid rate than when no field was applied. The reason for the enhanced sputtering rate will be investigated over the next few weeks.

Toroidal Interferometer-Polarimeter (TIP): General Atomics delivered reports documenting their TIP development work. One described the ZEMAX optical design, including an assessment of the wavefront distortion resulting from computed thermal distortion of the retroreflectors, finding that the expected distortion is acceptable. A report on tests of polarization phase shift on custom mirrors at wavelengths of 10.6 microns was also delivered.

ITER & TOKAMAKS (R. Nazikian)

R. Nazikian and R. Maingi presented the I&T year-end report, including completion of two notable outcomes for which the department is responsible, at FES in Germantown on Oct. 3. One notable was on plasma materials interactions in EAST where R. Maingi leads a multi-institutional collaboration. The major accomplishments on EAST were (i) suppression of ELMs using a lithium dropper with control of metallic impurities, (ii) successful testing of a flowing liquid lithium limiter and demonstration of recycling control, and (iii) demonstration of ELM-triggering by lithium granules. The DIII-D notable, led by R. Nazikian, produced the following major accomplishments: (i) suppression of ELMs in ITER-relevant steady-state plasmas with high confinement factor, (ii) validation of theoretical models for the strong amplification of edge magnetic perturbations in the same steady-state plasmas, and (iii) validation of fast-ion transport models developed at PPPL for the excitation of Alfvén waves by beam ions and their effect of particle transport in DIII-D.

DIII-D (B. Grierson)

Research:

K. Erickson visited DIII-D from Sept. 27 to Oct. 6 to deploy several NSTX software and control advances on DIII-D. The NSTX Isoflux Double Null algorithm is now fully ported and running on DIII-D, after passing several days of regression tests. The NSTX rtEFIT post-processing algorithm now serves as the backbone for a new machine-learning framework that will enable multiple AI algorithms to predict disruptions in advance and will be portable to other machines running the same PCS.



EAST Plasma Materials Interactions (R. Maingi)

R. Maingi led a periodic conference call with PPPL/JHU and EAST colleagues. Topics discussed included the EAST schedule, the EAST oral session at the APS and site visits, and the status of lithium delivery technology tools being developed at PPPL for EAST. In addition, the status of joint papers and analysis was discussed.

KSTAR RF Collaboration (J. Hosea)

J. Hosea and B. Ellis visited KSTAR Sept. 20-21 to complete delivery of an ECH launcher prototype. Ellis presented a seminar on the technical advances made in the new launcher design compared with the previous generation launcher. The current launcher uses additive manufacturing to produce optimally shaped cooling passages. Two features of the water channels are the shape and the ability to form them without cutting through from the outside of the mirror. For the latter, additive manufacturing is essential. For the former, it is significantly more cost-effective to use additive manufacturing, which yields a more reliable component.

THEORY (A. Bhattacharjee)

A paper entitled "Evolution of the magnetorotational instability on initially tangled magnetic fields," by P. Bhat, F. Ebrahimi, E. G. Blackman, and K. Subramanian was published in [Mon Not. R. Astron. Soc. 472, 2569 \(2017\)](#).

A paper titled, "Metriplectic integrators for the Landau collision operator," by E. Hirvijoki was published in *Physics of Plasmas* <http://aip.scitation.org/doi/full/10.1063/1.4998610>.

E. Hirvijoki presented an invited talk titled, "Metriplectic dynamics -- a framework for plasma kinetic theory and numerics," on Oct. 3 at Courant Institute of Mathematical Sciences, New York University. <http://math.nyu.edu/dynamic/calendars/seminars/magneto-fluid-dynamics-seminar/1467/>

On Oct 1, the Dept. of Energy completed its 40-milestone list over the last 40 years. Nat Fisch's 1978 paper made it into this list. See <https://science.energy.gov/about/history/doe-science-at-40/>.

S. Hudson and A. Reiman attended the International Stellarator Heliotron Workshop (ISHW) held in Kyoto Japan. Dr. Hudson presented a poster titled "Three-dimensional magnetohydrodynamic equilibria with continuous magnetic fields," and Dr. Reiman presented a poster titled "Effect of Stellarator Symmetry on Pfirsch-Schlüter Currents in and near Magnetic Islands, and near Island Divertors." Dr. Hudson was also a co-author



on the oral presentations given by C. Zhu of the Univ. Sci. Tech. China titled “Hessian Matrix Used for Stellarator Coil Design and Error Fields Prediction,” and J. Loizu of IPP-Greifswald titled “Ideal and Relaxed equilibrium beta-limits in classical stellarators.”

ADVANCED PROJECTS (H. NEILSON)

Stellarators (D. Gates)

In its collaboration with the Wendelstein 7-X (W7-X) stellarator project in Germany, the Laboratory is developing an effective model for collaboration on overseas facilities that combine remote and on-site participation by U.S. scientists. In September, improved capabilities for remote access to W7-X data archives and other online resources were made available to all of the U.S. partners in the collaboration. This achievement was the result of an initiative that started in 2016 with a survey to ascertain user requirements for remote collaboration, followed by a working meeting with Max Planck Institute for Plasma Physics CODAC staff to develop a project plan. The improved capabilities include: 1) convenient access to data archives, including MDSPlus, from anywhere in the world, via virtual private network (VPN) authentication, 2) improvements in speed and connection stability, 3) access to the W7-X overhead data monitor, electronic logbook, and other tools, and 4) convenient communication between off-site and on-site colleagues using Zoom. The Laboratory will continue to serve as a point of contact for U.S. collaborators to provide assistance and respond to problems.

ENGINEERING & INFRASTRUCTURE (V. RICCARDO)

A colloquium was presented by Phoenix Nuclear Labs (PNL) on Oct. 4 in the MBG Auditorium titled "High Yield Neutron Generators for Industrial Applications." Breakout meetings with PNL on high-output D-D and D-T neutron generators took place the following day.

AC Power is supporting the IOI project and there are currently two Saturday shutdowns scheduled for October. On Saturday, Oct. 21, IOI contractor Sal Electric will perform electrical tie-in work on Substation #9. On Saturday, Oct. 28, Sal Electric will perform electrical tie-in work on Substation #6. AC Power will provide Whiting-Turner with appropriate LOTO procedures and written switching orders for these planned shutdown events. Further, as part of its ongoing IOI support, AC Power will provide project oversight while this shutdown work is being accomplished.



COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

COMMUNICATIONS (L. BERNARD)

The Office of Communications posted a press release to the PPPL website describing how PPPL physicist B. Grierson and General Atomics physicist O. Meneghini coupled the TRANSP simulation code to the OMFIT workflow manager, allowing beginners to use TRANSP more easily and with a more intuitive interface. The story was also posted on the *Newswise* and *EurekAlert!* press release distribution services.

DIRECTOR'S OFFICE (R. HAWRYLUK)

On Oct. 4, E. Sengbusch from Phoenix Nuclear Labs presented a colloquium entitled "High-Yield Neutron Generators for Industrial Applications."

This report is also available on the following web site:

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