



The PPPL Highlights for the week ending August 19, 2017, are as follows:

NSTX-U RECOVERY PROJECT (R. HAWRYLUK)

The Subcontract Proposal Evaluation Board (SPEB) for Inner PF Coil prototype procurement convened its 4th meeting and is now moving on to issuing its recommendation memo.

Committee and Chair selections for the September 6-8 Cost and Schedule Review are complete.

The Design Review Summary document for the recent Conceptual Design Review was completed, including disposition of the 103 chits that were submitted.

Agreement has been reached on the content of an NSTX-U Fabrication Oversight Plan that will be used at the outset of all significant NSTX-U fabrication activities to establish plans for surveillance at fabrication facilities, covering cases of in-house PPPL fabrication as well as external subcontractors.

Additional metrology of the NSTX-U vacuum vessel and of the PF5/4/3 coil sets has been completed. These measurements are designed to improve the as-built coil models that are used to assess the error fields that they produce. For example, new measurements of the vertical positioning of the various PF coils facilitate the assessment of any tilting of the coils with respect to the machine axis. Additionally, measurements of the upper and lower nozzles of the outer vacuum vessel as well as the alignment of the machine axis with respect to gravity will be used to inform the machine reassembly process.

NSTX-U RESEARCH (J. MENARD)

The paper “The role of rectified currents in far-field RF sheaths and in SOL losses of HHFW power on NSTX” by R.J. Perkins, et al. has been published online in *Nuclear Materials and Energy* [<http://dx.doi.org/10.1016/j.nme.2017.04.013>]. Radio-frequency rectification has been proposed as the mechanism responsible for converting high-harmonic fast-wave (HHFW) power in the NSTX into a heat flux to the divertor. In this paper, the importance of current rectification is identified as opposed to voltage rectification in analysis of NSTX divertor operation during HHFW heating. When rectified currents are accounted for in first-principle models for the heat flux to the tiles, a larger enhancement of the heat flux is predicted due to rectification than would have been attained assuming voltage rectification alone. This work is important for minimizing SOL losses of HHFW power in NSTX-U but may also have implications for near-field studies of ICRF antennae.

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U.S. ITER FABRICATION (H. NEILSON)

Steady State Electrical Network (J. Dellas)

DC Distribution: The approved release for shipment (RFS) document for four DC battery chargers/rectifiers was issued.

Diagnostics (R. Feder)

Toroidal Interferometer Polarimeter (TIP): A single-channel prototype of the ITER TIP diagnostic has been operating on the DIII-D tokamak at General Atomics (GA), a partner with PPPL in the TIP design project. On ITER, the TIP system will be used to simultaneously measure plasma density and current density profiles with a single, multi-channel instrument. A series of tests using the prototype to probe DIII-D plasmas was conducted from May through August of this year. This system replicated the most relevant features of the ITER design, and demonstrated that the design can successfully meet ITER measurement requirements in a real tokamak environment. GA's Dr. Mike Van Zeeland is drafting the report documenting the results of this key R&D activity.

Motional Stark Effect (MSE): A SULI summer student, Dan Alexander, supported the ITER mirror cleaning R&D task for MSE. He worked on the analysis of the spectroscopy data to identify spectral lines associated with the coating and substrate of the mirror. In the L-wing mirror cleaning lab this week, Nova Photonics was able to remove an aluminum coating (which is a proxy for ITER Beryllium mirror coatings) of about 70 nanometers in thickness.

ADVANCED PROJECTS (H. NEILSON)

Stellarators (D. Gates)

PPPL physicist N. Pablant arrived in Greifswald, Germany, to begin a two-year assignment with the Wendelstein 7-X stellarator program including full participation in the OP1.2 experimental campaign, which will feature for the first time an installed island divertor and completed first wall. Pablant will operate both the U.S. X-ray imaging crystal spectrometer (XICS) and Germany's high-resolution X-ray imaging spectrometer (HR-XIS) to obtain profile measurements of ion and electron temperature, plasma flow, radial electric field, and impurity transport. He will also play a leading role in the planning of the experimental campaign and the development and execution of experiments to explore the physics of core neoclassical heat transport and impurity confinement.

Last week, installation of the XICS and HR-XIS diagnostics was completed in preparation for the OP1.2 campaign. Pablant and IPP colleagues have collaborated to combine these two systems and the associated analysis suite into a powerful integrated

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diagnostic system. New upgrades expand the system from a single channel viewing Ar16+ emission, to a three-channel system capable of simultaneously measuring emissions from Ar16+, Ar17+, Fe24+ and one additional selectable impurity ion. The upgrade involved installation of two additional Pilatus 3 x-ray detectors, and an additional eight spherically bent crystals for Bragg reflection and focusing of X-rays. This upgrade will improve the quality of all XICS measurements, particularly in the hot core of the machine, and enable a comprehensive impurity transport program.

THEORY (A. BHATTACHARJEE)

A theory seminar titled “Simulation of resonant wave-particle interaction in tokamaks” was presented by M. Li, Institute of Fusion Sciences (IFS), The University of Texas. The abstract and presentation is available on the Theory Department website:
<http://theory.pppl.gov/news/seminars.php?scid=1&n=research-seminars>

F. Ebrahimi (PPPL) visited General Atomics, August 10-11, and presented a talk at the DIII-D Friday Science meeting, entitled, "Coherent current-carrying filaments during nonlinear reconnecting ELMs and VDEs."

An official demonstration was held of fast, large data transfer and real-time analysis between the KSTAR tokamak at the National Fusion Research Institute (NFRI) in Daejeon, Korea, and PPPL in Princeton. This demo, held through an online web meeting and displayed in the KSTAR control room, was attended by NFRI management and scientists, as well U.S. researchers and collaborators. Large file transfer was demonstrated using the MDTM FTP tool (W. Wu, Fermi National Lab), transferring 40 gigabytes of data from NFRI servers to PPPL file systems in 2 minutes. Streaming large data transfer, with near real-time movie creation and analysis of the KSTAR Electron Cyclotron Emission imaging (ECEi) data, was performed using the I/O framework ADIOS (S. Klasky, J. Choi, Oak Ridge National Lab), and comparisons made at PPPL with simulation results from the XGC1 code (C.S. Chang, S. Ku, M. Churchill, PPPL). These demonstrations were made possible utilizing an optimized network configuration at PPPL, which achieved over 8.8 gigabytes per second (88 percent utilization) in throughput tests from NFRI to PPPL (M. Churchill, P. Henderson, S. Kampel, T. Carroll, K. Silber, K. Czarnecki, and the PPPL Information Technology department). This demonstration showed the feasibility of PPPL researchers connecting and participating with the KSTAR experiment remotely in near real-time, and the ability to utilize remote compute resources for large-scale data analysis of KSTAR data. It also provides a framework looking forward to remote international participation with the ITER experiment.



ENGINEERING (V. RICCARDO)

Power Systems

The final reimbursements from the recyclers to complete the S1/S2 15-kilovolt cable replacement project has been received. This multi-year, \$1M-plus project was completed one week ahead of schedule and about \$36K under budget. The full contingency budget of \$155.4K has been returned to the General Plant Project (GPP) pool.

CODAC and Electronics

This week Chris Freeman and Greg Tchilinguirian met with Scientific, a defense and aerospace contractor, that specializes in analyzing the radiation effects on electronics. Considerable information was gathered and a plan to address these issues is being formulated. A new MDSplus server was built and deployed for the Lithium Tokamak Experiment (LTX). This server houses their existing data and provides additional capacity to support the upgraded machine LTX-b with a new MDSplus data architecture currently under development. On the OH Pre-Heater Project, central I&C installation of a timing unit and networking in the D-Site pumproom was completed by Paul Sichta. Software for controlling the timer was completed and EPICS software for integrating the Water PLC was started. Greg completed the CI&C NSTX-U Recovery work risks table in preparation for the upcoming cost and schedule review scheduled for early September.

PUBLIC OUTREACH (A. ZWICKER)

On Wednesday, August 16, PPPL held its Annual Summer Student Poster Session. Approximately 35 undergraduate and high school students presented posters on the projects they have been working on throughout their summer internship. PPPL staff were in attendance and visited posters as students presented to them. State Sen. Linda Greenstein, Assemblyman Andrew Zwicker, Assemblywoman Nancy Pinkin and a representative from Assemblyman Erik Peterson's office attended and presented special resolutions to the students in their legislative districts.

DIRECTOR'S OFFICE (S. ZELICK)

On August 14, James Van Dam, Associate Director (Acting) for the DOE Office of Fusion Energy Sciences, visited PPPL. Dr. Van Dam met with senior laboratory management and the Princeton Site Office, and was also provided with a tour of the Laboratory.

On August 16, S. Zelick and T. Brog participated in the National Laboratory Chief Operating Officers meeting at DOE headquarters in Washington, DC.

This report is also available on the following web site:

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