



The PPPL Highlights for the week ending October 31, 2020, are as follows:

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

Recovery (J. Galayda):

Bus Supports — Electrical testing of the PF1B power cable was completed, and water test preparations continued. The materials required for fabrication and installation of PF extension and OH coax bus connection were on-site in QC receipt inspection.

Coils — Preparations for machining the six production coils continued at PPPL. The mockups were completed and manipulation lifts were rehearsed. At Sigmaphi, coil PF1C-S (spare) was shipped and was expected at PPPL by the end of the week. PF1B-S (spare) was cured (post-vacuum-pressure impregnation) and demolded. PF1A-S (spare) was prepped and underwent VPI.

Center Stack Casing (CSC) — The finish machining of the CSC in Camden, New Jersey, continued without any issues. PPPL reinstated QA oversight in Camden. At Turtle Creek, the mockup welding continued, along with stud installation prototyping. On-site oversight at Turtle Creek will begin again next week.

IVPS — Piping installation was completed and preparations continued for leak testing.

Machine Core Structure (MCS) — Many fabrication activities continued at the three facilities currently making sling parts. Precision Boring in Michigan curtailed work for a short period of time due to positive COVID cases. The capture and common flanges neared completion. In South Carolina, Carolina Fabricators production of PF1A sling base parts continued. G. J. Oliver delivered the lower PF1C support and receipt inspection was completed. Preparations for welding and leak testing continued. The upper PF1C support was at the vendor for coating. The ceramic break flange was machined, and the outer skirt forging is due by the end of month so fabrication can proceed. The on-site mockup activities were completed, and lessons learned were reviewed and incorporated into assembly procedures. PF1B lower slings welding continued, and PF1A welding fixtures were completed.

Research (S. Kaye):

D. Battaglia has joined MAST-U experiments remotely to assist in the development of the breakdown and ramp-up scenarios. The MAST-U team is using tools and procedures developed by Battaglia to interpret results and optimize the start-up scenarios. MAST-U achieved its first plasma and subsequent discharges with closed magnetic flux surfaces this week.

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J. Yang presented an invited talk at the 2020 AAPPs-DPP meeting titled, “Coupled tearing and internal kink modes and their effect on fast ion transport in NSTX.” The analysis uses time-dependent analysis through the TRANSP code coupled with the kick fast ion transport model. The work shows that a synergetic effect is observed on NSTX for coupled tearing and internal kink modes on fast ion transport.

ITER PROJECTS (H. NEILSON)

Electron Cyclotron Emission — ECE (G. Paraiso):

The ECE team is working with Central Team responsible officers to firmly establish the system requirements, interface sheets, and design deliverables package that will determine the scope of system design work. The team has completed its review of the system requirements document and is currently updating the list of deliverable documents which when completed will document compliance with the requirements.

The revised ECE optics layout has been provided to the Central Team and India DA (INDA) for review. To date, no issues pertaining to the in-vessel optics layout have been identified, but minor discrepancies in the location of waveguide mounting flanges were noted and are being addressed in collaboration with INDA colleagues. With respect to front-end component redesign, integration of the push-rod concept with the DSM is in progress as option #1 for shutter actuation. Alternative options for actuation are also currently being investigated.

Diagnostics Team:

The U.S. has an opportunity to utilize standard designs of electrical vacuum feedthroughs, and in-vacuum connectors and cables developed by the Central Team. A flexible catalog of components, which can be customized to meet the requirements of a particular port or diagnostic, is available. The advantage of this system is that the design work is being completed by the Central Team while the U.S. would incur only a share of the qualification costs, and only the procurement cost of the components within its scope. The team is evaluating the Central Team’s assessment of U.S. component and cable needs.

A diagnostics team meeting on Oct. 30 kicked off the team’s planning activity for its FY-2021 work. Priorities include design and fabrication work toward delivery of first plasma equipment, and design work needed to secure space and interfaces within ITER’s crowded diagnostic port structures.

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ITER & TOKAMAKS (R. NAZIKIAN)

F. Poli has given an invited talk at the AAPPS-DPP e-conference entitled, “Integrated modeling in the ITER era: Taking standard approaches to the next level.”

An impurity powder dropper has completed its assembly process and is now being shipped to WEST for installation. This is the sixth such device over five years that has been sent worldwide to deliver impurities into plasmas. A main focus of the impurity dropper is delivering boron for wall conditioning.

DIII-D (B. Grierson):

B. Grierson led a DIII-D experiment during the hydrogen isotopes campaign for transport model validation at high Te/Ti for ITER PFPO-1. The experiment was designed to vary Te/Ti by changing the plasma density and level of ion-electron coupling, as well as applying auxiliary electron heating near the center of the plasma. Isotope ratio measurements via main-ion charge-exchange spectroscopy and turbulence documentation were collected in high-hydrogen-purity plasmas.

Two presentations were given at the 2020 AAPPS-DPP meeting this week. E.-H. Kim gave an invited talk entitled, “Physics of simultaneous excitation of electrostatic slow-mode and fast helicon waves” showing her recent simulations on helicon and slow waves in DIII-D. By adopting a realistic antenna structure, she showed the slow-mode wave's excitation from the antenna the slow mode propagation characteristics. Q. Hu gave an invited presentation titled, “Role of edge resonant magnetic field penetration in ELM suppression and density pump-out in the DIII-D tokamak.” In this talk, he presented the understanding of magnetic island formation in the pedestal, which causes ELM suppression and determines the access conditions in terms of lower density, higher rotation and specific q95 windows.

International PMI and Liquid Metal PFC Concept Development (R. Maingi & A. Diallo):

E. Gilson, A. Bortolon, A. Diallo, and R. Maingi led two remote impurity powder dropper (IPD) experiments on KSTAR to further characterize the effects of boron nitride powder injection into ELMy H-modes. Local participants at PPPL led the sessions safely and effectively from the newly renovated B-205 Remote Collaboration Room. NFRI collaborators H. Lee and W. Jeong coordinated the IPD and KSTAR operation from the KSTAR Control Room. In the first series of experiments, the neutral beam heating power was increased to 4.5 MW, beyond what had been used in previous KSTAR IPD experiments. In the second series of experiments, the plasma configuration was

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changed to upper single null for the first time in KSTAR IPD experiments. The data are being analyzed to look for the effects of boron nitride powder injection on wall conditions, pedestal structure and radiative heat exhaust.

International JET/EU (M. Podestà, F. Poli):

P. Bonfiglio and A. Teplukhina presented their research on the JET collaboration in two invited talks at the AAPPS-DPP e-conference. The talk by Bonfiglio was entitled, "Measurements and modeling of fast ion losses in JET deuterium plasmas in preparation for DT" and the talk by Teplukhina was entitled, "Features of energetic particle transport in the after-glow phase of JET plasma discharges."

International EAST (F. Poli):

W. Choi has presented his research on the EAST Long Pulse collaboration in an invited talk at the AAPPS-DPP e-conference entitled, "Explore and expand regimes of synergy with two frequencies of lower hybrid waves."

ADVANCED PROJECTS (D. GATES)

Stellarators (D. Gates):

A verification/validation of the XICSRT ray-tracing code has been completed through a comparison with SHADOW3. The XICSRT ray-tracing code, developed by N. Pablant, is a new photon-based X-ray and optical ray-tracing code written in Python. XICSRT offers several advanced features, in particular the ability to accurately model complex crystal optic shapes using mesh-grids. This capability has recently been used to design a new spectrometer for an EXAFS experiment at the National Ignition Facility (NIF) based on a concept by M. Bitter. Before finalization of the spectrometer design, a detailed validation of the code was performed through comparison to SHADOW3, which is a mature X-ray ray-tracing code widely used in the synchrotron field. The comparative exercise utilizing a realistic spectrometer geometry showed near-perfect agreement in the X-ray intersections at the detector (agreement within better than 50 nanometers). With this validation XICSRT can be considered ready to be used in the finalized design of spectroscopic instruments. XICSRT is currently under review for release under an open-source license and will be available for public use in the coming months.



THEORY (S. HUDSON)

V. Duarte gave an invited talk on Oct. 27 at the 4th Asia Pacific Conference on Plasma Physics titled, "First-principles formulation of resonance broadened quasilinear theory near an instability threshold."

N. Gorelenkov gave a talk at the energetic particle ITPA meeting on Oct. 15. The title of the talk was, "Self-consistent fast ion relaxation in the presence of Alfvénic mode amplitude oscillations in Resonance Broadened Quasi-Linear (RBQ) model."

D. Schaeffer presented the inaugural early career invited lecturer seminar titled "Bringing Cosmic Shock Waves Down to Earth: Laboratory Studies of Laser-Driven, High-Mach-Number Collisionless Shocks," on Oct. 21, hosted by the Michigan Institute for Plasma Science and Engineering (MIPSE). The intent of the invited lecture is "to honor an early career investigator of high accomplishment." A copy and recording of the talk can be found here: https://mipse.umich.edu/seminars_2021.php

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

Communications (L. Bernard):

The Office of Communications posted two press releases to the PPPL website. The first noted that PPPL hosted a virtual Industry Day on Oct. 27 to inform business owners about a new research building and other planned large construction projects as PPPL expands its mission to become a multipurpose national laboratory. The second reported that PPPL researchers have gained a better understanding of a promising method for improving the confinement of superhot fusion plasma using magnetic fields. Both stories were also posted to the Newswise press release distribution service.

DIRECTOR'S OFFICE (S. COWLEY)

C. Ferguson hosted the Facility for Laboratory Reconnection Experiments (FLARE) project baseline review on Oct. 27 and 28 in preparation for the proposed project re-baseline and funding request. S. Cowley and J. Menard also participated in the review.

The Director's Office participated in the PPPL Industry Day event on Oct. 27. S. Cowley provided a welcome; C. Ferguson provided a PPPL operational overview and future of the Lab update; and J. Menard described upcoming research opportunities at PPPL.

S. Hsu, program director of ARPA-E at the U.S. Department of Energy, presented a virtual colloquium on Oct. 28 titled, "Fusion Energy Programs at ARPA-E."



S. Cowley hosted a PPPL strategic planning retreat for Laboratory leadership on Oct. 29. Some of the goals of the retreat were ensuring an understanding of PPPL strategic priorities and Laboratory agenda deliverables during FY 2021, as well as how to manage risks to enable successful strategic delivery.

S. Cowley participated as a panelist in the Princeton University Andlinger Center Annual Meeting on Oct. 30. The meeting was titled, "Securing a Sustainable Energy Transition."

S. Cowley participated in the bi-weekly virtual National Laboratory Director's Council (NLDC) coordination meeting on Oct. 30.

This report is also available on the following web site:

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