



The PPPL Highlights for the week ending April 25, 2020, are as follows:

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

Recovery (J. Galayda):

Coils — Sigmaphi has remobilized its workforce and is preparing to restart coil fabrication. The firm’s target date for full operation is May 4. The project’s Princeton Technical Representative is in regular contact with Sigmaphi’s engineers. Sigmaphi personnel are preparing procedures for the next manufacturing steps, and these procedures will be reviewed and approved by PPPL prior to resumption of production. Sigmaphi’s engineers continue work on deliverables for the manufacturing readiness review. This review is required prior to starting the vacuum pressure impregnation (VPI) of PF1A and PF1B and also to resume winding. PPPL has contracted with a French engineer who will provide oversight in concert with PPPL’s QA representative, who has been with the project since last October. Both will be present at the site next week. NSTX-U personnel at PPPL continue to meet weekly with Sigmaphi engineering leads via videoconference.

Center Stack Casing (CSC) — Machining is nearing completion on the inner-diameter (ID) bore of the angled parts of the center stack casing (CSC) at the ORT/Holtec facility in Camden, New Jersey. In parallel, the diverter flange mockup is in process at the Turtle Creek facility near Pittsburgh. The mockup will establish procedures to minimize potential distortion caused by the welding activities.

Machine Core Structure (MCS) — Fabrication activities for machine core components are being performed at several different facilities around the US. PF1A sling parts, preload and stacking pins, PF1C capping flanges, and PF1A/B common and capture flanges are being fabricated in Michigan. In addition, the PF1C support “cans” are being fabricated in New Jersey. Fabrication of PF1A sling parts has also started in South Carolina. Other procurement activities for hardware and other components are also moving through approvals and contracting.

Personnel Safety System (PSS) Breaker Refurbishment — A successful kickoff meeting for the refurbishment of the PSS breakers was held on April 22 with representatives from PPPL and ABB, Inc.

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Research (S. Kaye):

A new paper, “MHD-blob correlations in NSTX,” by S. Zweben, E. Fredrickson, J. Myra, M. Podesta, and F. Scotti has been accepted for publication in *Physics of Plasmas*. This paper describes the cross-correlations between edge fluctuations as seen in the gas puff imaging (GPI) diagnostic and -----low-frequency coherent magnetic fluctuations (“MHD”) in H-mode plasmas in NSTX.

The main result was that large blobs in the scrape-off layer were significantly correlated with MHD activity in the 3-6 kilohertz range in 21 of the 223 shots examined. The structure and motion of the MHD is compared with that of the correlated blobs, and some possible theoretical mechanisms for the MHD-blob correlation are discussed. This paper has been chosen as a featured article by *Physics of Plasmas*.

U.S. ITER FABRICATION (H. NEILSON)

With work resuming this year on several diagnostic systems, a key task is to re-engage the Laboratory’s partners in the design work. Several university and industry groups were involved for several years in developing the designs through conceptual design reviews and well beyond, until the work was suspended in 2017 in order to focus on first-plasma scope. These groups possess most of the corporate knowledge about the designs so re-establishing subcontracts with them is a high priority for the ITER diagnostics team this year. Subcontract procurement packages for the Toroidal Interferometer Polarimeter (TIP) and Electron Cyclotron Emission (ECE) diagnostics have been prepared and are ready to issue to PPPL Procurement. These two diagnostics will be installed in Equatorial Port 9, integration of which is also a PPPL responsibility, and are planned to be operational starting from ITER’s Pre-Fusion Plasma Operation Phase #1 (PFPO1).

The Low Field Side Reflectometer (LFSR) team continues its preparations for a June final design review (FDR) of the in-vessel antenna assembly. The near-term focus is a U.S. ITER readiness review, scheduled for May 5-6. This week, the team posted a “read-ahead” package of documents and drawings that are being prepared as deliverables and input to the FDR. The antenna assembly is due to be installed in Equatorial Port 11, a first-plasma port.

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ITER & TOKAMAKS (R. NAZIKIAN)

DIII-D (B. Grierson):

Research:

The paper titled, “Nonlinear modeling of the scaling law for the $m/n = 3/2$ error field penetration threshold,” by Q. Hu, et al. (N. Logan, J.-K. Park, C. Paz-Soldan, R. Nazikian, and Q. Yu) has been accepted for publication by *Nuclear Fusion*. The scaling of EF penetration threshold is modeled by using nonlinear MHD code TM1 for both single-fluid and two-fluid simulations. The scaling from single-fluid simulations is similar to the analytical EF scaling, while the scaling law from two-fluid simulations shows significant difference depending on plasma parameters. This work highlights the importance of both electron temperature and two-fluid effects in EF scaling. The predicted EF threshold is lower in ITER than DIII-D, indicating the lower EF tolerance in ITER.

ADVANCED PROJECTS (D. GATES)

Stellarators (D. Gates):

The first-ever virtual Coordinated Working Group Meeting (CWGM) was held via Zoom on April 22. The CWGM is a group of international stellarator researchers that meets bi-annually either in Europe, Japan, or the United States and is organized under the auspices of the International Energy Agency’s (IEA) Stellarator/Heliotron Technical Coordination Program. Typically, these are multi-day in-person meetings with 30-45 attendees. Due to COVID-19 travel restrictions, the in-person meeting, which was to be held in Kyoto, Japan, was delayed at least until September. Because of the widely disparate time zones it was decided to have several one-hour meetings with reports from each of the topical leaders in the CWGM. The first topical leader was Y. Suzuki who discussed equilibrium reconstruction results and tools on several different stellarators. The meeting was very successful with 115 attendees. D. Gates is on the organizing committee of the CWGM.

THEORY (S. HUDSON)

M. Cole, T. Moritaka, R. Hager, J. Dominski, S. Ku and C. S. Chang published a paper entitled, “Nonlinear global gyrokinetic delta-f turbulence simulations in a quasi-axisymmetric stellarator,” online here: <https://doi.org/10.1063/1.5140232> The paper shows first-of-a-kind global stellarator turbulence simulations with the XGC gyrokinetic code, using the optimized geometry of PPPL’s quasi-axisymmetric QUASAR design.

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A paper titled, “RF current condensation in the presence of turbulent enhanced transport,” by E. Rodríguez, A. Reiman, and N. Fisch, has been published in *Physics of Plasmas*. Sharp temperature gradients in a magnetically confined plasma can lead to turbulent motion of the plasma. This turbulence in turn enhances the transport of heat across magnetic field lines. The enhanced transport impacts the temperature differential that can be sustained in magnetic islands between the island centre and its periphery. This research shows that by limiting this temperature differential, the enhanced transport can have a profound influence on the extent to which the RF current condensation effect stabilizes the island growth.

DIRECTOR’S OFFICE (S. COWLEY)

Laboratory leadership has been communicating ongoing updates to staff regarding the COVID-19 virus and PPPL.

Preparations continue for upcoming budget planning meetings including the May 4 NSTX-U and May 7 PPPL institutional presentations to Fusion Energy Sciences (FES).

S. Cowley participated in the National Laboratory Directors Council (NLDC) Horizon Scanning Workshop virtually on April 22. The meeting discussed the future and posture of DOE National Laboratories.

This report is also available on the following web site:

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