The PPPL Highlights for the week ending July 18, 2020, are as follows:

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

Recovery (J. Galayda):

**Coils** — PF1B Lower, the first coil fabricated by Sigmaphi, was in place at PPPL as preparations for low-power electrical testing were conducted. In France, coil fabrication continued while final paperwork was reviewed for coil PF1C#1, which will be shipped along with coil PF1A#1 to PPPL early next week. In addition, PF1A#2 dimensional checks were satisfactorily completed, and low-power testing started. PF1B#2 winding was completed and the coil was prepared for vacuum pressure impregnation (VPI). PF1C#2 VPI continued as the coil cured. In addition, the order for spare coils was processed and the Red Book is with DOE for approval before the order is placed.

**Center Stack Casing (CSC)** — Machining continues in Camden, New Jersey, on the center stack casing. The CSC machining is being done in two shifts and on weekends at the Holtec facility in Camden. The spiral groove for the heat transfer tube was completed on both ends and the ID of each end was in the final machine phase. This phase of machining will continue through July 24, when the CSC will be shipped to Turtle Creek so the collar pieces on each end can be attached. The CSC will then be returned back to Camden in early August for more machining.

**Machine Core Structure (MCS)** — Many fabrication activities continued at the three facilities currently making sling parts. Precision Boring in Michigan has shipped a portion of PF1B Lower sling component parts to PPPL. The shipment was received at PPPL this week. The remainder of the PF1B Lower parts were shipped later this week, and the Upper parts will follow toward the end of July. In addition, fabrication of the PF1A and PF1B capture and common flanges and PF1C capping flanges for the sling supports continued this week. In South Carolina, Carolina Fabricators first articles and production of PF1A sling parts continued. G. J. Oliver finished radiographic inspection and resumed final machining of the welded parts of the PF1C supports. The preload parts at Magnaplate were coated and will ship early next week to PPPL. Additional procurement activities to award contracts for the remaining MCS components neared completion this week.

**Personnel Safety System (PSS)** — Two pre-bid conferences, including site walkdowns, were conducted on July 16 and 17 for the personnel safety system (PSS) conduit installation subcontract.
Research (S. Kaye):

Various discussions were held with Tokamak Energy (TE) this past week on the ST40 collaboration. The first, held on July 14, included ST40 researchers V. Shevchenko, S. McNamara, and ST-40 graduate student P. van de Glessen. NSTX-U researcher N. Bertelli gave an overview of the ray-tracing GENRAY code and how to run it for EC frequency regime in ST-F1/ST-40 plasmas. The second discussion was held on July 15 and included ST40 researchers S. McNamara, V. Shevchenko, and G. Naylor, and PPPL researchers Y. Ren, A. Diallo, and S. Kaye. The discussion focused on the assessment of a turbulence diagnostic that would be implemented on ST40 for the start of Programme 4 (~start of CY23). The schedule for the next steps of this design will be developed after TE revisits any schedule shifts due to Covid and after PPPL assesses the amount of engineering support needed locally and from TE to support a preliminary design. A final decision on implementing this diagnostic will not be made prior to gyro-kinetic physics studies, based on ST40 experimental results, of the likely micro-instabilities operative in these plasmas.

M. Poulos started remote work on his postdoctoral work at PPPL on June 29. He recently received a Ph.D. from the UCLA Physics Department, and he will be working on the RF modeling under the US RF SciDAC project.

U.S. ITER FABRICATION (H. Neilson)

Motional Stark Effect — MSE (A. Cohen):

The MSE team reported further progress in their assessment of first-mirror deformations due to heating. Engineer B. Linn reported analysis results in which deformations were characterized by small changes in the major axis of the mirror, rotation about that axis, and an expansion perpendicular to the major axis. A simple analysis by PPPL Senior Scientist D. Johnson, assuming a spherical mirror, highlighted the necessity of decomposing the deformations into components in this way, rather than relying on peak values to judge the impact on optical properties. The next steps in the analysis were agreed upon. The aim is to assess whether active cooling of the mirror is necessary to limit the temperature increase of the mirrors, and impacts on optical performance, under heat loading during burning plasma operation.

Electron Cyclotron Emission — ECE (G. Paraiso):

The ECE team reported progress in its update of the in-vessel component layout within its shield module. Impacts of repositioning one of the mirrors and the in-situ calibration sources, needed to resolve clashes with the structure, were described. In addition, design modifications being considered for certain components were described, with
feedback from Central Team and ITER-India regarding impacts to interfacing systems, being requested.

**Upper Wide Angle Viewing — UWAV (M. Smith):**

The UWAVS team is working with Central Team counterparts to support documentation of system requirements and to reach agreement on the document deliverable package for UWAV design. These are foundational for defining the scope of work involved in completing preliminary and final design reviews for the system.

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

**DIII-D (B. Grierson)**

*Research:*

PPPL physicists N. Logan and Q. Hu led a second run day on the DIII-D tokamak, following up on exciting results from last week’s study of MHD and turbulent effects on density pump-in and pump-out under the application of 3D magnetic fields. The additional time was used to form a forward Ip match to the reverse Ip scenario in which 3D fields were found to increase particle confinement. The change of sign in the ratio of ExB to electron diamagnetic precession seemed to reverse this effect, consistent with resonant MHD induced transport models.

**International JET/EU (Podestà, Poli):**

A. Teplukhina discussed the status and plans for PPPL research on scenario development and fast ion studies on JET at a remote JET meeting on July 17. The presentation highlighted recent work by Teplukhina on TRANSP analysis and sensitivity studies based on the available JET data for the so-called “after-glow” phase, which is presently assumed as the target scenario for future alpha-driven Alfvén eigenmode (AE) experiments in the coming JET DT campaign. Work continues to define reference TRANSP runs that can be used for the analysis of AE stability and associated fast ion transport, including projections from DD to DT plasmas.

At the same meeting, V. Kiptily (JET/Culham) presented a summary of fast ion loss measurements including work by P. Bonofiglo (PPPL), who is in charge of the JET Faraday Cups system (KA2) provided by PPPL. Results based on preliminary tests of an upgraded KA2 acquisition with a faster sampling rate (200kHz vs 5kHz for the present system) clearly show the capability of detecting correlations between MHD activities and enhanced fast ion losses. Based on these encouraging results, a full upgrade of the KA2 system to a faster digitization is underway by JET collaborators.
International KSTAR (Podestà):

The paper, “Model predictive control of KSTAR equilibrium parameters enabled by TRANSP,” by M. Boyer et al., has been accepted for publication in Nuclear Fusion. In this work, an algorithm for controlling stored energy, loop voltage, and internal inductance using adjustments to beam injection, target plasma current, and target plasma boundary shaping is developed and simulated in closed loop TRANSP simulations. The algorithm includes real-time constrained actuator optimization enabling active avoidance of engineering and physics limits. For example, simulations demonstrate successful control while adjusting actuator response to maintain elongation below an imposed internal-inductance-dependent limit and avoid triggering vertical displacement events.

Hardware for the real-time toroidal velocity (RTV) system was shipped from PPPL to NFRI (Korea) on July 17. The system, previously used for real-time plasma rotation measurements on NSTX-U in FY-16, will be used to assess requirements for a new real-time rotation diagnostic for the KSTAR tokamak within the ongoing international collaboration on Disruption Mitigation and Avoidance.

THEORY (S. HUDSON)

V. Duarte gave a talk at the FES/PPPL video-conference meeting on July 13 titled, “Recent progress on fast ion transport modeling in tokamaks in preparation for burning plasmas.”

R. Kube presented a talk at the 19th Annual Scientific Computing with Python Conference and published a paper in the conference proceedings. The title of the talk and paper is “Leading Magnetic Fusion Energy Science into the Big and Fast Data Lane:” https://www.youtube.com/watch?v=rih7Hp9nPvM&list=PLYx7XA2nY5GfY4WWJjG5cQZDc7DIUmnn6Z&index=9

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

Communications (L. Bernard):

The Office of Communications posted two press releases to the PPPL website. The first reports that B. Harrison is the Lab’s new equity, diversity, and inclusion business partner. She will develop and oversee PPPL’s diversity and inclusion plan to attract and retain a more diverse workforce. Harrison will be in charge of promoting diversity through learning and development and employee resource groups, and will work with PPPL’s research staff to recruit and maintain more diverse post-doctoral staff as a pipeline to the future workforce.
The second story notes that PPPL’s internship programs have gone virtual with 47 interns from all over the U.S. working on projects remotely and hundreds tuning in to a virtual introductory course in plasma physics and fusion energy. Most of PPPL’s interns are enrolled in the DOE’s Science Undergraduate Laboratory Internship (SULI), but interns also come from DOE’s Community College Internship (CCI) program, as well as PPPL’s Engineering Internship program. SULI and CCI are sponsored by the DOE’s Office of Science’s Office of Workforce Development for Teachers and Scientists (WDTS). Both stories were also posted to the Newswise and EurekAlert press release distribution services.

DIRECTOR’S OFFICE (S. COWLEY):

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

C. Ferguson, J. Menard, and S. Cowley participated virtually in the Princeton Plasma Innovation Center (PPIC) CD-1 Director’s Review July 14-16.

J. Menard participated in the National Laboratory Chief Research Officer (NLCRO) monthly video conference on July 17.

This report is also available on the following web site:

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