Weekly HIGHLIGHTS

PPPL PRINCETON PLASMA PHYSICS LABORATORY
U.S. DEPARTMENT OF ENERGY

The PPPL Highlights for the week ending July 4, 2020, are as follows:

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

Recovery (J. Galayda):

Management — The project submitted requests for approval for a number of NSTX-U personnel to return to work. The request includes both manual and non-manual workers.

Coils — The first coil fabricated by Sigmaphi in France safely arrived in good shape and is in the coil shop undergoing dimensional inspections. In France, coil fabrication continued and PF1A#1 was packaged for shipment to PPPL. In addition, the curing period for the vacuum pressure impregnation (VPI) began for PF1A#2. PF1B#2 winding was completed and prepared for VPI. PF1C#1 VPI was completed, the coil taken out of the mold, and preparations for testing continued. PF1C#2 brazing of the coil flags was completed and preparations for VPI began. In addition, the order for spare coils was processed and Sigmaphi took the first steps in preparation to wind spare coils.

Center Stack Casing (CSC) — Machining continued in Camden, New Jersey, on the center stack casing. The machining of the CSC will resume on two shifts and weekends next week at the Holtec facility in Camden. This phase of machining will continue through mid-July, when the CSC will be shipped to Turtle Creek to attach the collar pieces on each end. The CSC will then be returned back to Camden in late July for more machining.

Machine Core Structure (MCS) — Many fabrication activities continued at the three facilities currently making sling parts. Precision Boring in Michigan shipped PF1B sling component parts to PPPL, with the upper parts to follow in mid-July. In addition, fabrication continued of the PF1A and PF1B capture and common flanges and PF1C capping flanges for the sling supports. In South Carolina, Carolina Fabricators first articles and production of PF1A sling parts continued. Also, G. J. Oliver began radiograph inspection and machining the welded parts of the PF1C supports. The preload parts are at Magnaplate being coated. Additional procurement activities to award contracts for the remaining MCS components neared completion.

Bakeout System PLC Final Design Review — A final design review (FDR) was held June 30 to ensure all requirements were sufficiently met for the design and completion of the bakeout system programmable logic controller (PLC) upgrade. A preliminary design review (PDR) was performed on May 10, 2018, to address the upgraded design of the bakeout system PLC as illustrated by DVVR chits.

Research (S. Kaye):

A Zoom meeting among the ST40 multi-institutional collaboration team and ST40 physicists was held on June 26. The ST40 group gave updates on the status of the device and on targets for resuming operations. S. Doskoczynski (PPPL) also reported on the progress with implementing the Physics Viewer tool on the PPPL system.

Two physics presentations were made by ST40 collaborators. M. Podesta (PPPL) reported on his preliminary assessment of possible TAE modes on ST40, using as a basis for the calculations a projected 2.5 T, 2 MA, 1 MW NBI discharge. It was found that TAE/RSAE modes may be driven unstable for the specific "ST40-like" scenario that was analyzed. The spectrum of these modes indicated n=5-8, f=300-700kHz, which is useful for designing magnetic pickup coils to measure the mode. However, additional target scenarios are needed for a more comprehensive assessment. R. Raman (U. Washington) reported on his assessment of a possible future implementation of transient coaxial helicity injection on ST40. An initial assessment with vacuum field calculations and the hardware layout suggests that much of the ST40 hardware components may be compatible with CHI start-up. Additional components and hardware modifications would be necessary for this implementation, and this assessment will continue with more detailed physics and engineering calculations in conjunction with the ST40 team.

U.S. ITER FABRICATION (H. NEILSON)

Low Field Side Reflectometer — LFSR (A. Zolfaghari):

The LFSR team developed a plan for resolving the chits that were raised at the final design review of the in-vessel antenna assembly, held the preceding week. Planning for manufacturing development, addressing critical fabrication and inspection processes, moved forward under the leadership of S. Shirey.

ITER & TOKAMAKS (R. NAZIKIAN)

Six invited talks were selected for the upcoming AAPPS-DPP meeting (Nov. 2020): A. Teplukhina on energetic particle transport in JET afterglow experiments, P. Bonofiglo on measurement and modeling of fast ion loss in JET using the PPPL Faraday cup detector, W. Choi on understanding lower-hybrid synergy for scenario optimization in EAST, F. Poli on integrated modeling and control in the ITER era, N. Logan on n=2 error field correction in DIII-D, and Q. Hu on how to access robust ELM suppression in DIII-D and KSTAR.

International PMI and FES LM PFC Development Program (R. Maingi):

A periodic meeting of the liquid metal plasma-facing component design program was conducted. D. Andruczyk (UIUC) gave a status report of the UI-UC program, including evaluation of thermocouple data taken with the flowing liquid lithium LIMIT tile insert in EAST in 2020. Measurements of the flow speed as a function of JxB drive would be useful for liquid lithium MHD model validation.

International 3D (J.-K. Park):

A group of KSTAR collaborators at PPPL and Princeton University has received run time on KSTAR. A total of 4 days runtime was allocated to PPPL and PU researchers. The PPPL experiments and session leads are: N. Logan on the scaling of low-n resonant magnetic penetration thresholds, S. Yang on "Optimizing low-n resonant magnetic perturbation for enhanced ELM control" and "Application of localized current drive to prevent error field penetration;" Q. Hu on "Validating the effects of pedestal-foot magnetic islands on density pump-out prior to ELM suppression in KSTAR;" R. Shousha on "Further development of relay feedback MHD spectroscopy;" A. Nelson on "Study of inter-ELM pedestal fluctuations through vertical plasma oscillations;" E. Kolomen on "Adaptive ELM control" and J-K Park on "Navigating field space to validate kinetic 3D responses."

The paper on "Localizing resonant magnetic perturbations for edge-localized mode control in KSTAR" by S. Yang, J.-K. Park, N. Logan, C. Zhu, Q. Hu, Y. Jeon, Y. In, W. Ko, S. Kim, Y. Lee, and Y.-S. Na has been accepted for publication by *Nuclear Fusion*. This paper introduces a novel scheme to isolate RMPs in the plasma edge from the core, based on the projection of resonant coupling to the null space of core RMPs. A notable feature of such an edge-localized RMP found in the KSTAR applications is the importance of suppressing non-axisymmetric field components near the outboard midplane. The scheme is being actively used to optimize and design RMPs for ELM control in KSTAR and future tokamak devices.

ADVANCED PROJECTS (D. GATES)

Stellarators (D. Gates)

On June 29, several abstracts were submitted to APS-DPP: "Geometric concepts for stellarator permanent magnet arrays," by K. Hammond; "Fast particle optimization of a quasi-axisymmetric stellarator equilibrium," by A. LeViness; "First results from boron and boron nitride powder injection in LHD," by F. Nespoli; and "Advances in X-ray imaging crystal spectrometer design and through raytracing," by N. Pablant. C. Zhu submitted two poster abstracts: "Fast convergence methods for calculating the

magnetic field from coils" and "Design of a permanent magnet stellarator." M. Cole submitted an APS-DPP contributed poster abstract entitled, "Global microinstabilities in stellarators with radial electric field."

In addition, three students have submitted abstracts to APS with N. Pablant as co-author: "STRAHL modeling of impurity transport experiments with on- and off-axis heating during the first divertor campaign on Wendelstein 7-X" by P. Traverso; "Simulated validation of the ITER XRCS core using ray-tracing algorithm" by Y. Yakusevitch, and "Investigation of variable radii crystal spectrometers for HEDP applications through X-ray raytracing" by M. Slominski.

N. Lonigro, a summer student, submitted a contributed poster abstract with C. Zhu as co-author, entitled, "3D coil design using splines for simplified maintenance in fusion devices."

OFFICE OF ACADEMIC AFFAIRS (N. FISCH)

L. Gunderson, a graduate student in the Program in Plasma Physics, successfully defended his thesis, "Solar Equilibrium à la Grad-Shafranov," and passed his FPOE on June 22. His thesis advisor was A. Bhattacharjee.

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

Communications (L. Bernard):

The Office of Communications posted one press release to the PPPL website. It focused on research by C. Smiet that revealed a link between magnetic topology and the sawtooth instability. The story was 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 participated in the virtual monthly National Laboratory Chief Operations Officer meeting on June 30.

This report is also available on the following web site:
http://www.pppl.gov/publication-type/weekly-highlights