



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

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

Recovery (J. Galayda):

The Recovery Project team spent the week finalizing presentations and preparing for the Directors' Review scheduled for April 6-9. This review is a prerequisite to approval for CDE-3B. Since PPPL is still in curtailment, this review will be held via teleconference between the review committee and Recovery Project team members.

PF coil manufacturer Sigmaphi reports a target date of April 15 for return-to-work. Holtec (Camden, New Jersey) has begun machining the Center Stack Casing (CSC).

OBD 345 Tile Modification Peer Review — A successful peer review was held April 2 to review the test and analysis of OBD 345 related to the design modification in order to recommend the right level of torque to apply during tile installation. Previously, the tiles had a T-bar design with no pre-load which, per finite element stress analysis, resulted in local peak stresses that exceeded allowable material design stress.

Research (S. Kaye):

Nothing to report

U.S. ITER FABRICATION (H. NEILSON)

The Laboratory's ITER Diagnostics team is moving forward on several of its diagnostic projects that had been suspended and are now being re-started. Engineering team leads are being assigned and frequent meetings with Technical Responsible Officers (TRO) in the ITER Diagnostics Division are being held to gain an understanding of the current status and near-term issues. The Laboratory's CAD team is re-establishing ownership of the CAD models for U.S. systems. Planning and execution of the work on the U.S. side are moving forward at a rapid pace.

For the Electron Cyclotron Emission (ECE) diagnostic, the PPPL team led by engineer G. Paraiso has reviewed the current CAD model of the diagnostic and its enclosing diagnostic shield module. While a spatial layout of the ECE microwave path has been developed, the structural mounts for the various components have yet to be designed, so the PPPL team will tackle this issue as an immediate design task. The design includes a set of shutters to switch between measurement and calibration modes of operation. The team determined that a satisfactory actuation mechanism has not yet been identified, in common with several other ITER diagnostics that require shutters.



Meetings with Diagnostic Division experts are taking place to learn about the status of shutter developments, in order to inform U.S. planning.

ADVANCED PROJECTS (D. GATES)

Stellarators (D. Gates)

On March 30, F. Nespoli presented a talk titled, “Impurity Powder Injection Experiments in LHD,” during the Magnetic Fusion meeting. The talk reports on the first successful experiments on LHD employing the PPPL-designed-and-built impurity powder dropper. In particular, injection of boron and boron nitride powder led to beneficial wall conditioning effects such as reduction of recycling, observed both on a shot-to-shot basis and in real time during long discharge experiments. Furthermore, powder injection was shown to improve energy confinement for low-density plasmas. The presentation also included a preliminary investigation of the effect of plasma turbulence on dust dynamics, using a simple, recently developed model.

THEORY (S. HUDSON)

The development of the kinetic ion module in the M3D-C1 code has reached a milestone in that it now has begun to produce physical results. The code utilizes GPUs to accelerate the kinetic particle advance. Three linear benchmarks have been conducted including TAE, RSAE, and fishbone modes, and good agreement with 10 other codes has been obtained. Nonlinear benchmarking work is now underway. This work was conducted by C. Liu and J. Brelsau, with consultation with S. Jardin, N. Ferraro, G.-Y. Fu, N. Gorelenkov, the M3D-C1 group, and M. Shephard and the SCOREC group at RPI.

The paper titled, “A new explanation of sawtooth phenomena in tokamaks,” was published this week as a featured article in *Physics of Plasmas*. It was accompanied by an AIP Scilight titled, “3D extended magnetohydrodynamic simulations lead to new sawtooth phenomena theory.” See: <https://doi.org/10.1063/10.0001001>

The Second Quarter FY2020 FES Theory Milestone for “Modeling of Fully 3D Vertical Displacement Event Disruptions,” was successfully completed and a report was submitted to J. Mandrekas at the DOE. The milestone was as follows: “Perform several 2D VDE simulations of ITER using either NIMROD or M3D-C1 with differing ‘halo current’ parameters to determine likely worst-case configurations regarding axisymmetric vessel forces.”



ENGINEERING (V. RICCARDO)

A member of PPPL's engineering department helped organize a DOE Office of Science working group on advanced radio communications for science. This conference, held in Chicago, included representation from all of the major DOE laboratories and encompassed a number of technical areas. Speakers at this three-day event included DOE program managers, the head of ESnet, and C. Fall, director of the Office of Science. Despite looming travel issues, about 100 researchers from the DOE complex attended in person, as well as a significant number of remote participants. G. Tchilinguirian organized and ran the Distributed Instruments technical area and co-chaired the Edge Computing area, both of which had more than 30 participants. The result of this effort will be a report on technical areas to be funded and to set the direction for research initiatives that will serve the DOE mission using advanced wireless technology.

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

Communications (L. Bernard):

The Office of Communications posted two news stories to the PPPL website. The first focuses on a new model developed by S. Jardin and others that explains the sawtooth instability better than past models could. The second reports that C. Dong and others have created the first detailed model of how the solar wind interacts with Mercury's magnetosphere. 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.

On April 3, J. Menard and B. Dorland (University of Maryland) hosted a Computational Science Group (CSG) Virtual Retreat. The goals of the retreat were: 1) reach consensus on hardware requirements and support needs for the next cluster, 2) develop CSG vision statement elements and discuss research scope, and 3) further develop and coordinate PPPL/Princeton University proposals to the Funding Opportunity Announcement for machine learning and artificial intelligence for Fusion Energy Sciences.

This report is also available on the following web site:

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