# Weekly HIGHLIGHTS

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

**The PPPL Highlights for the week ending February 6, 2021, are as follows:**

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

**Recovery (J. Galayda):**

**NSTX-U Baseline Update Director's Review** — A baseline update director's review was held on Feb. 3 and chaired by K. Robinson. The review focused primarily on the proposed cost and schedule estimate for work-to-go. The reviewers concluded that the cost estimates for work-to-go were properly based, but the estimated cost increases associated with COVID-19 may be too low in light of current events and should be re-examined. The committee also recommended that the project stay in contact with projects at other labs to learn of any changes in their experience managing work in the presence of COVD-19.

**Bus Supports** — The water-cooled power cables were repaired at the vendor with an improved closure design and will be returned to PPPL post-testing. The materials required for the PF extension and OH co-ax bus connection were inspected and prepared for fabrication of the supports in conjunction with the work packages.

**Coils** — The prototype B coil was machined on the Haasin preparation for machining the production coils. Other preparations for machining the production coils continued at PPPL.

**Center Stack Casing (CSC)** — The finish machining of the OD of the center stack casing in Camden, New Jersey, was on hold due to a machining error at the Camden facility. An investigation into the root cause was performed by the Holtec QA organization, and a report is expected next week. At Turtle Creek, the materials for the solution to the bellows mockup welding distortion issue with the diverter flange were gathered for assembly. Preparations for a second mockup continued.

**Machine Core Structure (MCS)** — Fabrications continued at Precision Boring in Michigan. The capture flanges were completed and the common flanges were back on the machine for enlargement of several flange holes as depicted in an ECN. Upon completion of this action, all four flanges will be shipped to PPPL. Fixture plates fabrication are to be shipped early next week, and spare PF1B coil components are nearly completed, with holes to be drilled per new drawings. In South Carolina, Carolina Fabricators production of PF1A sling base parts was completed, and shipment was ongoing. G. J. Oliver is continued machining the outer skirt support.

At PPPL, assembly procedures were in the approval process for the PF1B coil assemblies, and PF1A assembly procedures were reviewed. PF1B lower slings welding and base plate drilling was completed, and heat-treating and subsequent post-machining began. Upper PF-1B sling welding began, along with preparations to weld the PF1A slings. Testing of the PF1C lower support is on track to complete next week, followed by the PF1C upper support testing.

**Research (S. Kaye):**

The paper, "Microtearing Instabilities and Electron Thermal Transport in Low and High Collisionality NSTX Discharges" by T. Rafiq, et al. was published this week in *Physics of Plasmas*: https://aip.scitation.org/doi/10.1063/5.0029120. The paper presents application of the microtearing mode (MTM) model developed by Lehigh University collaborators to NSTX plasmas. A number of parametric dependencies for real frequency, growth rate, magnetic fluctuation amplitude and electron thermal transport computed by the model are shown to be consistent with gyrokinetic simulations using the GYRO code. Profile predictions of electron temperature (using TRANSP) are found to agree better with NSTX experiments when incorporating the MTM transport model within the Multi-Mode Model (MMM), although scaling trends with collisionality are not completely recovered.

**ITER PROJECTS (H. NEILSON)**

**Electron Cyclotron Emission — ECE (G. Paraiso):**

In its continuing push to develop a shutter design, the ECE team is studying details of a pneumatic actuator design developed for the RFDA's H-alpha diagnostic. The aim is to identify design modifications that would be required for implementation in ECE should it be selected as our backup actuation solution, as well as for general considerations applicable to actuation mechanism design. Meanwhile the team continues to progress on shutter hinge design details such as bearing type, mounting scheme, and sizing.

The ECE team, working with IO counterparts, continues to make progress toward agreement on the system requirements and deliverables that will define the scope of its design work. Comments on the team's updated deliverables list were received and are being reviewed. In addition, a draft system requirements document was issued by the IO and is currently being reviewed.

**Equatorial Port Integration — EP03/09 (A. Basile):**

The IO Port Integration team has issued a consolidated system requirements document applicable to multiple equatorial ports, including the two U.S. ports. The PPPL team provided comments at a recent meeting, but to date has not identified any problems with the SRD as issued. Also in review is an initial design compliance matrix (DCM) issued by the IO, which will be used to document compliance with system requirements.

The PPPL team is currently using analysis data for the mature EP12 design for scoping of component layouts within the EP09 and EP03 port plugs. The extent to which EP12 can serve as a proxy for EP09 is a major question since despite their broad similarity, the two have important differences. The port integration and tenant teams are working to address an expressed need to specify the geometry of the apertures in the diagnostic first wall based on the diagnostics sight lines.

*Research:*

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

R. Maingi hosted a bi-weekly liquid metal plasma-facing component development meeting E. Kolemen (PPPL/PU) presented plans and upgrade prospects for the Liquid Metal eXperiment (LMX). The group discussed priorities for near term experiments and upgrades in this meeting and a follow-on meeting later in the week.

**ADVANCED PROJECTS (D. GATES)**

**Stellarators (D. Gates):**

Development of the PPPL virtual engineering analysis workflow processes continues in the DOE Advanced Research Projects Agency-Energy (ARPA-E) permanent magnet (PM) stellarator program. Ansys Minerva Analysis Tool Architecture production and staging setup are complete and workflow process implementation of system analysis tasks are underway. A PPPL virtual engineering framework configuration-controlled material database setup has begun. Automation of the structural layout through the process is being undertaken.

**THEORY (S. HUDSON)**

D. Schaeffer, A. Bott, and W. Fox co-organized the first Workshop on Charged Particle Radiography in High-Energy-Density Laboratory Plasmas, hosted virtually by the Princeton Center for Theoretical Science from Jan. 25-28: https://pcts.princeton.edu/programs/current/workshop-on-charged-particle-

radiography-in-high-energy-density-laboratory-plasmas/138. The workshop aimed to provide a platform to widely disseminate recent improvements in quantitative analysis, as well as stimulate discussion between experiment and theory. The workshop consisted of a series of reviews, invited talks, and moderated discussions, and was attended by over 150 people.

S. Ethier gave two lectures at the Princeton University Research Computing Bootcamp, Winter 2021. This two-week virtual event organized by the Princeton Institute for Computational Science and Engineering (PICSciE) introduced some foundational topics, tools, and techniques that underpin modern computational research. Ethier gave a presentation titled, "What Every Computational Researcher Should Know About Computer Architecture," as well as an afternoon training session titled, "Parallel Programming: Intro to MPI." The workshop was open to all students and researchers at Princeton University and PPPL. More information can be found at https://princetonuniversity.github.io/PUbootcamp_winter2021/.

**COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)**

**Communications (L. Bernard):**

A. Zwicker and L. Bernard participated remotely in the U.S. Department of Energy Office of Science (SC) Lab Communicators and Program Directors Mini-Summit on Feb. 4. The meeting helped align priorities of the SC programs with communications efforts at the Labs.

L. Bernard participated remotely in the DOE Public Affairs and National Lab Communicators All Hands meeting on Feb. 3.

The Office of Communications posted two press releases to the PPPL website. The first reports that multi-institutional researchers led by C.S. Chang have been granted millions of supercomputer node-hours to investigate issues crucial to the success of ITER, the international tokamak under construction in France to demonstrate the feasibility of fusion power. The two-year award from the DOE's Innovative and Novel Computational Impact on Theory and Experiment (INCITE), selected in competition with science and engineering research from around the world, enables the team to extend its previous INCITE work into areas of critical interest for next-step fusion facilities.

The second reports that M. Ono and R. Raman have created a plan using liquid lithium to keep the full force of extreme heat from hitting a tokamak's divertor and enable the tokamaks to keep running.

Both stories have also been posted to the *Newswise* and *EurekAlert* press release distribution services.

**DIRECTOR'S OFFICE (S. COWLEY)**

S. Cowley provided a welcome message at the NSTX-U Baseline Director's Review update on Feb. 3.

S. Cowley participated virtually in the Feb. 4 bi-weekly National Laboratory Director's Council (NLDC) coordination meeting.

J. Menard participated in the German Max Planck Institute for Plasma Physics (IPP) Advisory Board (Fachbeirat) meeting held virtually Feb. 1-4.

J. Menard participated in the biweekly National Virtual Biotechnology Laboratory (NVBL) working group call held Feb. 5.

Professor P. Martin from the University of Padova presented a virtual colloquium entitled "Science Basis and Present Status of the new Divertor Tokamak Test facility" on Feb. 3.

**This report is also available on the following web site:**

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