



The PPPL Highlights for the week ending May 11, 2019, are as follows:

NSTX-U RECOVERY (R. HAWRYLUK) AND RESEARCH (S. KAYE)

Research (S. Kaye):

S. Jardin gave a presentation at the May 6 research meeting about a new perspective on sawtooth destabilization. The premise of the work was based on the observation that the sawtooth crash times are much shorter on devices like TFTR with high electron temperature than would be predicted by a resistive reconnection time relevant to the Kadomtsev model.

On May 7, S. Kaye participated remotely in a U.K. Fusion Advisory Board meeting. The purpose of the Engineering and Physical Sciences Research Council (EPSRC), the U.K.'s main agency for funding research in engineering and the physical sciences, is to advise on the role of and plans for U.K. fusion science and engineering.

On May 8, a video conference was held between real-time control experts from NSTX-U (F. Hoffman, C. Freeman, D. Boyer, and D. Battaglia) and from MAST Upgrade (K. Cave-Ayland, G. Fisher, J. Harrison) to discuss hardware and software details of implementing a real-time control system on MAST Upgrade, which would be initially used for plasma detachment control to mitigate high levels of plasma exhaust.

U.S. ITER FABRICATION (H. NEILSON)

In a peer review of the Low Field Side Reflectometer (LFSR) cooling design this week, engineers M. Duco and W. Wang reported progress in optimizing the system of water cooling channels in the front-end antenna unit. The assembly, which consists of six microwave antennas installed in a massive support block, faces the plasma directly and is subject to large volumetric heat loads from fusion neutrons as well as surface heating from plasma-emitted photons and particles. To prevent overheating, the design incorporates a network of channels drilled into the block and antenna material, including series and parallel paths, through which water will flow to remove the heat in real time. The report by Duco and Wang explained the evolution of the design since the Nov. 2018 preliminary design review, and the detailed thermal-fluid analysis and fabricability considerations which have guided the work. A solution for ensuring adequate flow and heat transport throughout the support block, and good progress on the antennas, were shown. A few suggestions for remaining work were provided by the LFSR team.

Weekly

HIGHLIGHTS



ITER & TOKAMAKS (R. NAZIKIAN)

DIII-D (B. Grierson).

Research:

W. Guttenfelder visited MIT/PSFC on May 2 and 3 to present a seminar titled, “Testing predictions of electron-scale ETG pedestal turbulence in DIII-D ELMy H-modes,” and to speak with MIT and CFS colleagues about the DPP community planning process.

B. Grierson attended the Advancing Fusion with Machine Learning Workshop co-sponsored by the DOE’s Office of Fusion Energy Sciences and the Office of Advanced Scientific Computing Research (ASCR) in Gaithersburg, Maryland. Grierson was invited to participate on the data panel, one of many panels charged with identifying priority opportunities and identify areas where application of machine learning / artificial intelligence (ML/AI) techniques and data science more broadly can have a transformative impact on FES mission.

International PMI (R. Maingi):

A. Bortolon, A. Diallo, F. Laggner, R. Lunsford, and T. Gray (ORNL) visited IPP to execute two planned experiments on the ASDEX-Upgrade tokamak, leveraging the PPPL Impurity Powder Dropper (IPD). The first experiment, proposed and led by Lunsford, studied the effectiveness of real-time wall conditioning through boron powder injection through execution of RMP ELM-suppression plasmas, which are particularly sensitive to good wall conditions. The second experiment, proposed and led by Bortolon, focused on the effect of boron nitride injection on the pedestal structure and global confinement, aiming to collect a data set of plasma conditions to compare and contrast with previous experiments with nitrogen gas injection. Both experiments were successfully completed with a total of 12 useful discharges in which IPD was used to reliably deliver boron and boron nitride at different rates, displaying performance close to nominal.

During the visit, two physicists from the group gave presentations. Bortolon presented, “Low-Z impurity powder injection on DIII-D for wall conditioning and divertor power exhaust,” providing an overview of the IPD research conducted at DIII-D. Laggner presented, “A scalable real-time framework for Thomson scattering analysis at NSTX-U,” illustrating the solutions to the technical challenges of acquisition and data processing of a real-time Thomson scattering.

THEORY (S. HUDSON)

On April 29, W. W. Lee gave a seminar at the University of California at Irvine's department of physics and astronomy entitled, "Force-Free State for Tokamak/Stellarator Plasmas." Lee first reviewed the calculations on the radial electric field at the H-mode pedestal based on gyrokinetics in comparison with the actual magnetic fusion experimental measurements. He then discussed the new pressure balance due to the $E \times B$ current, which was induced by the resulting radial electric field, and its impact on the gyrokinetic MHD equations [W. W. Lee and R. B. White, Phys. Plasmas <26>, 040701 (2019)] as well as their relationship to the famous Woltjer/Taylor force-free state.

I. Dodin recently gave two invited talks at the University of Oxford. One of them, "Quantum-like modeling of drift-wave turbulence: recent updates," was presented at a Plasma Theory Group seminar on May 2. The other talk, "Structure from turbulence," was given as a Theoretical Physics Colloquium on May 3.

M. Churchill attended the Advancing Fusion with Machine Learning Workshop, a joint FES/ASCR workshop to identify areas where the application of machine learning / artificial intelligence (ML/AI) techniques and data science more broadly can have a transformative impact on FES mission areas.

R. Hager and A. Hakim attended the 2019 US-EU TTF Meeting held in Austin, Texas, March 18-21. Hager gave an invited talk entitled, "Understanding the RMP-Driven Density and Heat Transport in Tokamak Edge Plasma from Gyrokinetic-MHD Coupled Study." Hakim gave an invited talk titled, "Continuum electromagnetic gyrokinetic simulations of edge turbulence: algorithms and applications."

Hakim also attended the MGK-SciDAC meeting March 21 and 22 in Madison, Wisconsin. He gave a talk titled, "Progress in edge turbulence simulations with Gkeyll."

A. Scheinberg attended the Auror ESP workshop which featured talks about the planned hardware and software for the Aurora supercomputer at Argonne National Laboratory, and early user experiences. By attending this meeting, Aaron gained a lot of (currently non-public) information on how best to prepare XGC to run on Aurora with maximum performance.



SITE PROTECTION (D. CHRISTIE)

The new “Upcoming Events” section of the Site Protection Division (SPD) website provides information on upcoming activities like EMS Week, May 19-25:

<https://pppl-intranet.princeton.edu/resources/site-protection-division/upcoming-events>

SPD and the Emergency Services Unit (ESU) provided support for the 2019 DOE 3rd Annual 1 Mile Walk/Run with motivational posters, EMS Bike Patrol and Safety Support, and active participation in the race.

ESU completed confined space refresher training in preparation for upcoming confined space entries at the lab. ESU is scheduled to complete NFPA 1410 drills for emergency scene operations.

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

Communications (L. Bernard):

J. Jackson Devoe contributed a story to the Princeton University website about a Princeton Writes symposium titled, “Connect: Harnessing the Power of Words,” held on May 2 -3. The Princeton Writes program, established in 2013, offers writing seminars, tutorials and other support for students and staff members looking to strengthen their practical communication skills.

DIRECTOR’S OFFICE (S. COWLEY)

On May 7 and 8, M. Zarnstorff, J. Menard, and M. Safabakhsh attended the DOE InnovationXLab Advanced Manufacturing Summit at Oak Ridge National Laboratory.

On May 8, MIT’s J. Buongiorno presented a colloquium titled, “The Future of Nuclear Energy in a Carbon-Constrained World — Findings from a New MIT Study.”

On May 8 and 9, J. Menard and S. Kampel participated in the NP/ESnet Requirements Review in Gaithersburg, MD.

On May 10, a colloquium was presented by M. Kramer of Ames Laboratory titled, “Material Design and Synthesis for the 21st Century.”

This report is also available on the following web site:

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