The PPPL Highlights for the week ending July 28, 2017, are as follows:

**NSTX-U RECOVERY PROJECT (R. HAWRYLUK)**

The Pulse Burst Laser System (PBLs) has been installed in the Multi-Pulse Thomson Scattering (MPTS) Laser Room, and is ready for power supply testing with Andrew Laundrie (Project leader at Physical Science Laboratory of the University of Wisconsin. This is in support of A. Diallo’s Early Career Award.

The fabrication of a test stand capable of mounting any one of the three inner PF coil configurations (PF1A, B, or C) for power testing has been completed and is ready for final inspection.

The new OH Coil Preheater Central Instrumentation and Control Timing Hardware procurement has been completed.

**NSTX-U RESEARCH (J. MENARD)**

C. Myers presented an invited talk, "A multi-machine scaling of halo current rotation," at the Theory & Simulation of Disruptions Workshop held at PPPL on July 17-19. This work represents the culmination of a multi-year, multi-machine study of rotating halo currents conducted under the auspices of the ITER International Tokamak Physics Activity Magnetohydrodynamics, Disruptions, and Control Topical Group. The conclusion of the study is that halo currents generated during unmitigated disruptions in ITER have the potential to rotate long enough at frequencies that resonate with the ITER vessel to dynamically amplify the halo current forces on the machine. These results, which further motivate both the ITER disruption mitigation system (DMS) and additional studies of halo current rotation, have been submitted to Nuclear Fusion for publication.

R. Kaita gave a seminar, “Synergies in Liquid Metal Technology Development for Divertor Applications,” in the Department of Nuclear, Plasma, and Radiological Engineering at the University of Illinois at Urbana-Champaign (U. of I.) on July 18. The talk explained how experiments with a fully-toroidal Liquid Lithium Limiter on CDX-U led to the discovery of convection in liquid lithium by thermoelectric MHD, which is the principle behind the Liquid Metal Infused Trench (LiMIT) approach developed at the U. of I. for handling high divertor heat loads. More recently, the technology used in the NSTX-U lithium evaporators is being incorporated into a prototype for testing the “vapor box” concept, where lithium vapor is enclosed at a sufficiently high density to extract momentum and energy from divertor plasmas. The goal of the presentation was thus to show how research in liquid metals to addressed specific engineering problems.
uncovered new and unexpected phenomena, and broadened the options for their implementation in future divertors.

F. Bedoya successfully defended his doctoral thesis entitled, “Plasma Facing Components Conditioning Techniques and their Correlation with Plasma Performance in the National Spherical Torus Experiment Upgrade (NSTX-U),” on July 18 at the University of Illinois at Urbana-Champaign. Bedoya used the Materials Analysis Particle Probe (MAPP) to expose samples during boronization for wall conditioning and subsequent plasma operations on NSTX-U. He studied the samples without exposure to air in an analysis chamber connected to the vacuum vessel, and obtained the first direct evidence for oxygen retention on a boronized plasma facing component during an experimental campaign. The unique analysis capability MAPP provided also enabled Bedoya to show the relationship between boron oxide formation and the bombardment of deuterium from NSTX-U plasmas.

E. Scott successfully defended his doctoral thesis entitled, “Interferometry and Vibration Compensation on the National Spherical Torus Experiment – Upgrade,” on July 18 at the University of California at Davis. The Far-infrared Tangential Interferometer/Polarimeter (FIReTIP) system is a laser-based plasma diagnostic for line-integrated plasma density measurements, and Scott was responsible for its reinstallation in a new configuration after removal for the construction of NSTX-U. Mechanical vibrations are a concern for interferometers, and Scott explored active noise cancellation for use with FIReTIP. He successfully completed impulse tests on the NSTX-U vacuum vessel that demonstrated the accuracy and feasibility of the Kalman filtering approach, and provided a proof of principle of this novel technique.

U.S. ITER FABRICATION (H. Neilson)

Steady State Electrical Network (J. Dellas)

Uninterruptible power supply (UPS): The supplier has successfully verified a solution – cabinet cooling modifications – for an overheating problem that surfaced during internal testing. The supplier and the Laboratory are currently negotiating a revised shipment schedule. Plans are in place for PPPL to attend the final acceptance test and verify all punch list modifications for the 900 kVA UPS systems in early August.

Diagnostics (R. Feder)

Toroidal Interferometer Polarimeter (TIP): PPPL and Spawr Industries are developing an innovative corner cube reflector which will return the reflected infrared laser beam along the incident path. PPPL reviewed and approved drawings of a molybdenum prototype reflector, fabrication of which will now proceed.
Motional Stark Effect (MSE) mirror cleaning R&D: A new mirror holder, with a stainless steel coupon, has been operated in argon and neon successfully. Data have been obtained with various RF powers, fill pressures, and magnetic fields. No effects due to magnetic fields were seen except a decrease in the self-bias voltage on the mirror. Analysis of data for an aluminum coated coupon tested in neon for 2 hours is in progress.

ITER & TOKAMAKS (R. NAZIKIAN)

R. Maingi (PPPL) visited EAST, along with K. Tritz (JHU), T. Gray (ORNL), and K. Woller (MIT) to conduct dedicated experiments for the US-PRC PMI collaboration on EAST. Discharges were conducted with the Li powder dropper to suppress ELMs in both low and high power discharges, including comparison discharges with forward and reversed grad-B drift direction. In addition the Li granule injector was used to try to trigger ELMs in high heating power discharges with low natural ELM frequency. Finally analysis of past experiments and preparation of papers was continued.

DIII-D

On-axis neutral beam design work continued on the water manifold assembly connection of the carriage and routing of the water headers. In addition, substantial progress was made on the design and implementation for the four chamber powder dropper, with one unit for DIII-D and other for collaborative work on ASDEX-Upgrade.

ADVANCED PROJECTS (H. NEILSON)

Department program leaders C. Kessel and D. Gates participated in the U.S. Magnetic Fusion Research Strategic Directions Workshop, held July 25-28 in Madison, Wisconsin. Both made presentations representing national activities that they lead.

stellarators (D. Gates)

D. Gates presented “An Invigorated U.S. Domestic Quasi-symmetric Stellarator Program,” one of three presentations coordinated by the National Stellarator Coordinating Committee, which Gates co-chairs. Together the stellarator presentations identified the leadership opportunities available through an expanded stellarator research program as well as the opportunities to fill a critical gap in world fusion research by advancing the quasi-symmetric stellarator concept. Gates’ presentation put forward a plan for a domestic initiative to incorporate and test concept advances in new experimental facilities.

System studies (C. Kessel)
C. Kessel presented “The Fusion Nuclear Science Facility, the Break-In to the Fusion Nuclear and Ultra-Long Pulse Plasma Regime,” making the case for a critical step to bridge large gaps in pulse length and fusion neutron exposures between ITER and an eventual DEMO. In addition Kessel and department head H. Neilson co-authored a presentation by Virtual Laboratory for Technology Director P. Ferguson, “U.S. Opportunities in Fusion Nuclear Science and Technology,” which identified leadership opportunities available to the U.S. with a growing fusion nuclear science component of the program.

ENGINEERING & INFRASTRUCTURE (V. RICCARDO)

C. Neumeyer attended an IEEE Nuclear Plasma Sciences Society (IEEE/NPSS) Administrative Committee meeting on which he serves as Chair of the Fusion Technology Committee, the group that runs the biennial Symposium on Fusion Engineering (SOFE) meeting. The next SOFE meeting will be held in Jacksonville, Florida, in June 2019.

CODAC initiated property transfer of CAMAC equipment from LLNL to PPPL. These 11 fiber optic transceiver modules are critical to our Data and Control I/O infrastructure, are no longer in production and we have no spares on hand.

The CODAC team resolved NSTX-U Recovery Issue ICS8-3, successfully completing a Central Instrumentation and Control corrective action. We have provided UPS power to the NSTX-U Control Room rack that houses critical CAMAC equipment. Gretchen Zimmer worked with Kevin Lamb to perform end to end testing of the new Phase II HP Stack monitoring system. With the new integrated Lab View software system they were able to open/close all nine valves via computer control. This milestone was achieved despite the fact that a rebuild of the system was required due to a hard drive failure Wednesday morning.

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

COMMUNICATIONS (L. BERNARD)

Communications posted a story on the website by J. Greenwald on the research of D. Stotler on the first basic-physics attempt to study the impact of recycled atoms on plasma turbulence. Communications also distributed the press release to Newswise and EurekAlert!, two media distribution services.

PUBLIC OUTREACH (A. ZWICKER)
A Dominguez led a two-day workshop in plasma physics for undergraduate students who are typically underrepresented in plasma science and fusion energy. The seven undergraduates were recruited nationally and heard lectures in plasma physics, toured PPPL and the Princeton University physics department, performed experiments in plasma physics, and learned about opportunities like the SULI undergraduate internship program. The workshop was funded by the DOE Office of Workforce Development for Teachers and Students.

DIRECTOR’S OFFICE (S. ZELICK)

July 24-28 - M. Zarnstorff attended the National Academies of Science (NAS) Workshop in Madison, Wisconsin. The NAS workshop focused on the importance of burning plasmas in the future of U.S. fusion energy development, along with consideration of the scientific and engineering challenges and opportunities on the path toward fusion energy, and possible scenarios to achieve that goal.

July 26-27 - T. Brog attended the National Laboratory Director’s Council summer retreat meeting at DOE headquarters, in Washington, D.C. The National Laboratory Directors’ Council (NLDC) advances the effectiveness of the Department of Energy (DOE) National Laboratory Complex in meeting the collective National missions and provides an interface to DOE organizations on issues and concerns of common interest, both strategic and operational. The Council also functions as a forum for information exchange, consensus building, and coordination of matters that affect the NLDC members.

This report is also available on the following web site:

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