The PPPL Highlights for the week ending October 14, 2017, are as follows:

NSTX-U (J. Menard)

Recovery Planning

In the area of magnet development, the following activities were completed. The straight test bundle was prepared and is ready to be brought into the VPI oven. The fabrication of tooling for the PPPL PF1A prototype coil was completed and fabricated components have passed dimensional inspection. A kickoff meeting was held with an external coil vendor selected to fabricate a prototype inner PF coil.

Research

D. Battaglia led a meeting of the Advanced Scenarios and Control Topical Science Group (ASC-TSG) to plan activities for the FY2018 NSTX-U Research Milestone R(18-2): “Develop simulation framework for spherical tokamak breakdown and current ramp-up.”

U.S. ITER FABRICATION (H. Neilson)

Steady State Electrical Network (J. Dellas)

Transfer of ownership documentation for the DC distribution and uninterruptible power supply (UPS) equipment was approved by the ITER Organization following satisfactory final inspection results for those items.

Diagnostics (R. Feder)

Low-field-side reflectometer (LFSR): PPPL CAD designer M. Gomez visited General Atomics (GA) to set up and prepare the self-aligning Gaussian telescope (built at PPPL) for testing with millimeter waves. With the assistance of UCLA and GA engineers and scientists, Gomez assembled the Gaussian telescope and associated hardware and integrated it with the ITER low-field-side reflectometer (LFSR) transmission line test assembly. He mechanically tested the Gaussian telescope and aligned the telescope for testing. He also set up the vacuum double window mockup and the 2D beam scanner on the test stand.
ITER & TOKAMAKS (R. Nazikian)

ASDEX-U (R. Maingi)

A. Bortolon, R. Lunsford, and R. Maingi visited ASDEX-Upgrade to complete the installation of the impurity powder dropper, started two weeks earlier by A. Nagy and A. Bortolon. The primary IPP contacts were V. Rohde, E. Wolfrum, A. Herrmann, A. Kallenbach, and R. McDermott. A highlight on the dropper commissioning can be found in the Engineering and Infrastructure section below. In the discharges with BN, there is clear evidence of both nitrogen and boron entering the plasma. At sufficient injection rates, the radiated power more than doubled and confinement increased modestly, similar to N2 gas puffing. With pure boron injection, the radiated power increased by up to 50% for the drop rates used, with no obvious effect on confinement. This first set of experiments was regarded as highly successful, and follow-on experiments are being evaluated.

C-MOD (R. Nazikian)

As part of the C-MOD collaboration on X-ray impurity measurements, L. F. Delgado-Aparicio visited the X-ray group at the Institute of Plasma Physics (IPP) Chinese Academy Of Sciences (CAS) in Hefei, China to work on the use of xenon as an option for ion temperature and flow velocity measurements on EAST. Luis presented three talks titled, 1) “Xenon option for ion temperature and flow velocity measurements aimed at ITER and CFETR, 2) “Novel multi-energy soft X-ray (ME-SXR) cameras for magnetically confined fusion plasmas,” and 3) “Impurities in the core of a magnetically confined fusion (MCF) plasmas: Transport, MHD, the density limit and diagnostic challenges.”

His main activity was to work on an ITPA task to assess the use of xenon as a working gas for present and future X-ray crystal spectrometer systems. The potential benefit of xenon is that it can be use for both core (r/a<0.5) and mid-radius (0.5<r/a<0.9) measurements of ion temperature and flow in ITER. The reason to undertake an experiment with xenon in current tokamaks is to check whether its emission lines are usable in high-tellurium plasmas.

DIII-D (B. Grierson)

Research:

L. Delgado-Aparicio visited General Atomics to present a Physics Validation Review on a multi-energy soft X-ray imaging diagnostic. The enhanced low-energy sensitivity of the
novel Pilatus3 camera will allow the measurement of emission from medium- to high-Z impurities (e.g. from Si, Ar and Ca to Mo and W). The talk was very well received and Luis will move swiftly towards a Conceptual Design Review (CDR) before the end of the calendar year, with the goal of installing an instrument in DIII-D during the long torus opening.

D. Battaglia visited DIII-D to work with S. Haskey and B. Grierson on continued XGC0 modeling of DIII-D discharges with the goal of assessing the importance of kinetic neoclassical effects on pedestal transport in H-mode plasmas. The interpretive modeling calculations are being iterated to match new measurements of deuterium ion properties using the edge main ion charge exchange recombination spectroscopy system on DIII-D. With help from O. Meneghini and S. Smith, progress was made on improving OMFIT capabilities for NSTX.

F. Laggner visited DIII-D from Oct. 2 to Oct. 13 to test a new density feedback controller in the plasma control system (PCS). He also met with the research team to develop plans for experiments he will coordinate in the FY 2018 campaign and gave a presentation to the Core Edge Integration Taskforce, led by B. Grierson. The new density feedback controller uses deuterium gas fueling to increase the density, when the density is below the target value, and 3D magnetic perturbations when the density is above the requested target density. The controller was successfully operated and the gains were varied to determine their optimal values. Florian also implemented and tested a vertical oscillation controller in the PCS system for additional experiments.

**THEORY (A. Bhattacharjee)**


**ADVANCED PROJECTS (H. NEILSON)**

H. Neilson visited the Naka Fusion Institute, a unit of Japan’s National Institutes of Quantum and Radiological Science and Technology (QST) and site of the JT60-SA tokamak project. The device is under construction on the site of the former JT-60 and JT-60U tokamaks and will reuse much of the infrastructure, including its 40 MW neutral beam injection (NBI) system. As a joint project between Japan and Europe under the Broader Approach agreement, JT-60SA components are being manufactured by both parties. A tour of the site showed that manufacture of the large superconducting poloidal field coils, manufactured on site by Japanese industry, has been completed and the lower coils already installed. Twelve of the eighteen superconducting toroidal field (TF) coils, manufactured in Europe, have been delivered and installed. It is forecast that the final TF
coil will be installed and the vessel closed next April. The tour also included visits to Naka’s negative-ion NBI and remote handling R&D projects for ITER. Neilson presented a seminar focusing on the U.S. contributions as a partner in Germany’s Wendelstein 7-X stellarator project, as well as recent advances in stellarator design optimization under PPPL leadership. In addition, opportunities for PPPL collaboration in JT-60SA were discussed.

**Stellarators (D. Gates)**

D. Gates, S. Lazerson, and H. Neilson attended the 2017 International Stellarator and Heliotron Workshop (ISHW) in Kyoto, Japan the week of Oct. 3. Lazerson presented an invited talk, “Error fields in stellarators,” highlighting his work on Wendelstein 7-X (W7-X) in the first operating campaign and examining initial results from the current campaign. This work featured the flux surface measurement system and U.S. supplied trim coil system. The purpose of the activity is to null out the edge resonant components of the error field to minimize the heat flux imbalance in the ten divertor sections on W7-X, a crucial activity for the long pulse mission of W7-X. Gates presented a poster entitled, “A multi-institutional stellarator optimization study,” describing the results from a recently launched initiative to consider possible future stellarator designs. The areas for optimization considered so far include coil simplification, turbulent transport optimization, and divertor plate design. Another part of the optimization activities is the generation of a database of optimized equilibria that will be used to study the dependence of coil complexity on plasma shaping. Neilson presented a poster summarizing the U.S. collaboration on W7-X, which now spans many institutions and a broad range of activities covering the topics of equilibrium, error fields, transport and turbulence, fueling studies, and edge and divertor physics. A significant activity during the current campaign will be the installation of the U.S. provided “scraper element.” Preparations for the upcoming OP2.0 campaign, which is scheduled to begin two years after the end of the current run, were also described.

**ENGINEERING & INFRASTRUCTURE (V. RICCARDO)**

The PPPL Dropper team has successfully commissioned and injected into plasma both boron nitride and pure boron powder into AUG. After about 1.5 weeks of AUG installation work by A. Bolland (AUG tech), A. Bortolon, R. Lunsford, R. Maingi, and A. Nagy, the dropper was commissioned and opened to the AUG vessel. This work is the culmination of 8 months of effort to perfect the dropper functionality, calibrate, and fabricate the unit. The design team was led by PPPL engineer A. Nagy. The team includes D. Mauzey (fabrication and overall design) and E. Wolfe (fabrication and subsystem design). The dropper has four independent reservoirs and can drop any powder by remote command. It has a powder flow meter for measurement of the amount dropped. The next dropper is being built for EAST, with expected delivery in December.
SITE PROTECTION (F. WHITE)

The Site Protection Division and members of the Emergency Services Unit (ESU) conducted the 2017 Emergency Exercise After-Action Meeting in which members of the Emergency Management Review Committee, ORPS Facility Managers, Department of Energy, PPPL Management and University Medical Center of Princeton at Plainsboro defined future opportunities of improvement for the PPPL Emergency Operations Systems.

Members of ESU hosted the 2017 Fire Prevention Week demonstrations here at PPPL. Live activities included fire extinguisher and fire hose demonstrations and basic information concerning work and home fire prevention tips. Daily informational messages were distributed to the PPPL staff to address various topics concerning fire safety.

Members of PPPL ESU provided Emergency Medical Services (EMS) support to Eden Autism Services for the 2017 Eden Autism 5K Run and Fun Walk.

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

COMMUNICATIONS (L. BERNARD)

The Office of Communications posted a press release to the PPPL website describing how Lab scientists led by S. Zweben have built a large database of detailed measurements of the two-dimensional structure of edge plasma turbulence made visible by a diagnostic technique known as gas puff imaging. The story was also posted on the Newswise and EurekAlert! press release distribution services.

DIRECTOR’S OFFICE (R. HAWRYLUK)

On Oct. 11, T. Carter from the University of California-Los Angeles presented a colloquium entitled "Overview of the Basic Plasma Science Facility."

This report is also available on the following web site:

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