The PPPL Highlights for the week ending November 4, 2016 are as follows:

**U.S. ITER FABRICATION (C. NEUMEYER):**

**Steady State Electric Network (SSEN):**

Power Transformers; The French customs approval process is complete for the shipping of the Group 1 and 2 transformers from the Schneider Electric factory near Istanbul, Turkey. Ship date is forecasted for November 11.

Reactive Power Compensators; The FAT for the first lot (out of four lots in total) of RPC units was completed on October 19 – 22 in Pringy, France. Only minor punch list items were identified. The FAT for the second lot has been scheduled for November 16 – 18.

**Diagnostics:**

Diagnostic RGA (DRGA); With respect to EP-11 DRGA the XRCS RO has agreed to incorporate the DRGA blanking flange and its analysis into the XRCS design for First Plasma. This will be documented in a new version of the Interface Sheet. With respect to the LP-12 DRGA the Vacuum Vessel RO agreed in principal to include lower port analysis of blanking flange on lower extension to the vacuum vessel needed for 1st plasma. A schedule for providing 1st plasma hardware (blanking flanges) was created showing that a procurement effort starting in 2022 would be able to deliver flanges to meet ITER need dates.

Equatorial Port 9 Engineering; Following discussions at ITER, the EP09 integration team outlined US possibilities for Task Agreement sharing of development of critical interfaces in the Interspace and Port Cell equatorial zones. Design activities for ISS, PCS, Port Cell lintel and Rails may be advanced by IO collaboration and a TA agreement.

**NSTX-U (M. ONO):**

NSTX-U physicists attended the Annual APS Division of Plasma Physics Meeting in San Jose, California, October 31-November 4. NSTX(-U) physicists gave four Invited talks: “A plasma rotation control scheme for NSTX and NSTX-U” by I. Goumiri (PU), “Plasmoids formation in a laboratory and large-volume flux closure during simulations of Coaxial Helicity Injection in NSTX-U” by F. Ebrahimi (PPPL/PU), “Impact of physics and technology innovations on compact tokamak fusion pilot plants” by J. Menard (PPPL) and “Resistive Wall Mode Stability Forecasting in NSTX and NSTX-U” by J. Berkery (Columbia University). In addition, NSTX(-
U) gave 12 contributed oral and over 50 poster presentations. NSTX-U physicists also participated in ancillary meetings, including those of the Edge Coordinating Committee, United States TTF Steering and Executive Committees, Fusion Facilities Coordinating Committee and the TRANSP User's Group.

The paper “Initial operation of the NSTX-U Real-Time Velocity diagnostic” by M. Podestà and R. E. Bell of PPPL has been published online in Plasma Physics and Controlled Fusion (http://dx.doi.org/10.1088/0741-3335/58/12/125016). The paper describes initial results obtained by the RTV system from NSTX-U plasmas during the FY-16 experimental campaign. The RTV system has been designed to supply plasma velocity - and, possibly, ion temperature - data in real time to the NSTX-U Plasma Control System (PCS), as required for the implementation of toroidal rotation control. Measurements are available from four radii at a maximum sampling frequency of 5 kHz. Post-discharge analysis of RTV data provides information on ion temperature, toroidal velocity and density of carbon impurities that complements results obtained with the CHERS system. Examples of physics studies enabled by RTV measurements from initial operations of NSTX-U, including the effects of sawteeth and MHD instabilities on the dynamics of toroidal rotation, are also discussed in the paper.

Preparations for the removal of the NSTX-U center-stack continued this past week with the completion of work outside the vessel. Work has resumed inside the vessel with re-positioning of in-vessel tiles. Activities are currently on track to lift out the center-stack during the week Nov.14th. The Phase I forensic testing of the PF1aU coil segments has been completed, and a presentation of test data has been made. A report is being generated, and will include recommendations for additional actions.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

Two talks were presented at the ITER session of the APS meeting in San Jose related to recent results from the PPPL collaboration on DIII-D. The first was a talk by Wolfgang Suttrop on RMP ELM suppression in ASDEX-Upgrade based on a joint experiment between AUG and DIII-D led by W. Suttrop (IPP), R. Nazikian (PPPL) and A. Kirk (UKAEA). The work demonstrates that ELM suppression is possible in a metal wall machine with RMP level and plasma conditions similar to those for ELM suppression in carbon machines. The second was a talk by L. Cui (PPPL) on evidence that confinement recovery can occur in plasmas with RMP levels near the threshold for ELM suppression. This work demonstrates that confinement degradation associated with density pump out can be compensated by a spontaneous improvement in ion thermal confinement. Understanding the relationship between density pump out and ion thermal confinement improvement is a priority for future research.

Shaun Haskey presented a talk in the DIII-D oral session on the first measurements of main ion temperature and flow in an H-mode plasma. A notable result is that the deuterium temperature at the separatrix on the outboard midplane is much lower than the temperature of the carbon VI. This has profound implications on the main ion temperature in the divertor and hence on the sputtering yield from the divertor based on simplified two-point model estimates using upstream temperatures. The large difference between carbon VI and deuterium upstream temperature
suggests that main ion spectroscopic measurements in the upstream and downstream SOL are essential for divertor plasma studies. In addition W. Wang (PPPL) presented an invited talk on the Reynold's stress induced main ion rotation in the core of DIII-D L-mode plasmas with central ECH. The corresponding experimental paper was presented by B. Grierson in a poster at the APS.

**International Collaborations and ITER (F. Poli):**

Francesca Poli attended the DPP-APS meeting in San Jose, California, where she gave a presentation in the session “research in support of ITER” on NTM control in ITER. The talk focused on the challenges in stabilizing modes at the q=2 rational surfaces, due to the high focalization of the electron cyclotron beam and the fast growth rate of the mode.

**ADVANCED PROJECTS (H. NEILSON):**

The department’s stellarator research was represented in several papers at the 58th Annual Meeting of the APS Division of Plasma Physics, held 31 October to November 4 in San Jose, California. Research in collaboration with the Wendelstein 7-X team was reported in an invited paper by N. Pablant, “Core Radial Electric Field and Transport in Wendelstein 7-X Plasmas,” and in “Characterization of error fields and their impacts on Wendelstein 7-X,” by S. Lazerson et al. A poster presentation by D. Gates, et al., “Recent Advances in Stellarator Optimization,” discussed advances that have opened new opportunities for improved stellarator designs.

As part of the Laboratory's collaboration with the Wendelstein 7-X (W7-X) project at Germany’s Max Planck Institute for Plasma Physics (IPP), a joint project is under way with the aim of significantly improving remote collaboration capabilities for U.S. participants. Some weeks ago it was decided to utilize commercial virtual private network (VPN) authentication tools, basically an adaptation of the solution used by most researchers to access their home institutions’ computer networks from off-site. Recently, network specialists at IPP and PPPL have collaborated in performance testing of network access by this means and have been able to realize significant improvements in data transfer rates over initial test results. Next, user testing will move forward to assess whether capability for access to W7-X data archives and web services has been made adequate, albeit not yet optimal in terms of speed, for researchers’ use.

**THEORY (A. BHATTACHARJEE):**

Many of the Theory Staff attended the American Physical Society (APS) Division of Plasma Physics (DPP) Annual meeting and made many presentations, including the following invited talks: “Laser-Driven Magnetized Collisionless Shocks”, by Derek Schaeffer, Amitava Bhattacharjee & Will Fox; “Extending geometrical optics: A Lagrangian theory for vector waves”, by D.E. Ruiz; and “Plasmoids formation in a laboratory and large-volume flux closure during simulations of Coaxial Helicity Injection in NSTX-U”, by F. Ebrahimi. Various contributed oral presentations were also given: “Kinetic Magnetorotational Turbulence and Dynamo”, by Matthew Kunz, James Stone & Eliot Quataert; “Three-Dimensional Hybrid-Kinetic Simulations of Alfvénic Turbulence in the Solar Wind”, by Lev Arzamasskiy, Matthew Kunz, Ben Chandran & Eliot Quataert; “New developments in algorithms and verification in the


S. Jardin, J. Breslau, N. Ferraro, D. Pfefferle, and I. Krebs attended a meeting of the SciDAC Center for Extended MHD Modeling on October 30.
Fatima Ebrahimi and Nate Ferraro (Treasurer) attend the Sherwood ExCom Meeting. F. Ebrahimi is the local host for the Sherwood fusion theory conference in 2019 and she presented some details on a proposal to host the Sherwood meeting on Princeton University campus.

This report is also available on the following web site:
http://www.pppl.gov/publication-type/weekly-highlights