The PPPL Highlights for the week ending June 3, 2016 are as follows:

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

Instructions have been received from the U.S. ITER project office concerning the re-baselining exercise in response to the DOE report on U.S. Participation in the ITER project. The need for readiness for an October Baseline Review has been indicated.

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

Uninterruptible Power Supply (UPS) system and DC Distribution: The UPS Request for Proposal (RFP) package has been approved so both packages will be issued early next week.

Power Transformers: The Lot 3 transformers were received at the ITER site on May 24, achieving an important ITER Council milestone well ahead of schedule. Target date to begin shipping the Lot 1 and Lot 2 oil-filled units (eight @ 35MVA and four @ 7MVA) is June 29.

6.6kV Switchgear: Forecast shipping date for the 48 cubicles in Lot 2 from the Schneider Electric factory in Manisa, Turkey is June 17. Fabrication of the remaining 110 cubicles in Lot 3 and 4 are nearing completion and the FAT will commence on June 17.

**Diagnostics:**

Administrative: Additional telephone interviews were conducted to fill open positions for an Optical/Mechanical Engineer, a Nuclear/Mechanical Engineer, and a Project Engineer. Three promising candidates were down-selected and will be invited to visit PPPL for face-to-face interviews and to make a presentation concerning a prior engineering achievement.

Core Imaging X-Ray Spectrometer (CIXS): The first stage of magnetic field tests on the head of our X-ray detector was completed. Initial results show that the detector head survived the field with few issues, though the data taken while the field was active has not yet been analyzed. Data taken in between shots to check the working order of the detector head showed no issues from the field. Final portions of the tests will start on Thursday afternoon.

Electron Cyclotron Emission (ECE): Piezo motor actuator test preparation is underway, with creation of the detailed test protocol and modification of existing oven for bake-out and operational testing. Work is continuing on the alternative push rod design of the shutter mirror actuation, which is currently incorporated into ECE DSM. Layout and attachment of the waveguides is designed in coordination with TIP design team, and EPP09 port integrator.
Equatorial Port 9 Integration (EPP9): TIP meetings with General Atomics and IO were held which identified and clarified numerous integration questions for the Interspace, Port Cell, and Gallery regions of EP09. Coordination efforts of TIP with the adjacent ECE diagnostic (INDA) have begun in order to plan maintenance access and to consider common support structures.

Toroidal Interferometer and Polarimeter (TIP): The PPPL/GA/PSI development team met with representatives of the IO diagnostic group to discuss various building interface issues. These included minor interferences of the laser relay enclosure tubes with other features at the ceiling level in the diagnostic hall. Also discussed were details of the shielding labyrinth at the gallery/diagnostic hall penetration, and the tube support structures anchored to embedded plates in the gallery.

NSTX-U (M. ONO):

A FY 2016 NSTX-U plasma operations update: The department has completed 8.95 run weeks and 940 plasma shots. The total operation target is 18 run weeks.

Many NSTX-U team members participated in the International Plasma-Surface Interactions Conference in Roma, Italy, May 30-June 3. M. Jaworski (PPPL) presented a review talk “Liquid Metals as PFCs: Progress and Prospects.” M. Reinke (ORNL) presented an invited talk, “Expanding the role of impurity spectroscopy for investigating the physics of high-Z dissipative divertors.” J-W. Ahn (ORNL) presented a contributed oral, “Effect of pedestal stability regime on the behavior of ELM heat flux footprints in NSTX and DIII-D.” In addition, F. Bedoya (UI-UC), A. Fil (PU), R. Goldston (PPPL), T. Gray (ORNL), E. Kolomen (PU), P. Krsic (SUNY), R. Lunsford (PPPL), R. Maingi (PPPL), J. Nichols (PPPL), R. Perkins (PPPL), F. Scotti (LLNL), C. Skinner (PPPL), V. Soukhanovskii (LLNL), D. Stotler (PPPL), and B. Wirth (UT-Knoxville) had poster presentations. Princeton University was chosen as the site for the next PSI meeting, tentatively scheduled for June 14-18, 2018. PPPL is the host institution, R. Maingi is the Local Organizing Committee Chair, and E. Kolomen is the Princeton University liaison. The hydrogen isotopes in fusion devices meeting (a satellite meeting to PSI), will be hosted by Professor B. Wirth at UT-Knoxville, either just preceding or just following the PSI meeting.

Dr. Roddy Vann from the University of York in the United Kingdom visited PPPL on June 2 and 3. Dr. Vann leads the team that developed the Synthetic Aperture Microwave Imaging (SAMI) diagnostic, which was previously installed on MAST in the U.K. and is now installed and operating on NSTX-U. The SAMI diagnostic can image mode-converted electron Bernstein wave emission and perform 2-D Doppler backscattering. Both techniques allow the measurement of the radial profile of the field pitch, and hence the current density, in the plasma edge. The diagnostic can also measure edge flows and turbulence characteristics. During his visit Dr. Vann presented a talk entitled “Measuring edge pitch angle using 2-D microwave Doppler backscattering on MAST and NSTX-U” and met with several members of the NSTX-U research staff. G. Taylor (PPPL) was his host.

The cabling for remotely controlling the insertion of the Lithium Evaporators (LITERs) and the Materials Analysis and Particle Probe (MAPP) into the NSTX-U vacuum vessel has been installed. The cable terminations are nearly complete, and testing can begin during the coming
week. LITER use requires the Argon Purge System (APS) to be enabled. The elements of the Torus Vacuum Pumping System (TVPS) that control the APS have been tested, and the system is now operational.

The major components of the Far-infrared Tangential Interferometer/Polarimeter (FIRETIP) system were received at PPPL from the University of California at Davis. They included the lasers, detectors, and optics for steering the beam into the NSTX-U vacuum vessel. Installation of the electrical utilities for the FIRETIP laser enclosure (“cage”) outside the NSTX-U Test Cell is almost complete, and the laser power supply and chiller have been moved there.

The new Langmuir probe electronics chassis installations have been completed. The new Langmuir probe arrays for the upper and lower NSTX-U outboard divertors are now instrumented.

NSTX-U is in a maintenance period to address a deformation discovered on a connecting flag on a PF1A coil lead, and to continue several previously scheduled test cell installations. A design is being prepared to provide additional bracing for the PF1A upper and lower water-cooled flex bus. Dye penetrant tests indicate no cracking in the deformed flag, and bracing schemes have been fit up. Analysis in progress and a final design review is being scheduled for this coming Thursday. In parallel with this work time was taken to condition the neutral beam ion sources, concentrating on the three NB#1 sources which are now conditioning at ~90kV. Dummy load testing of all six HHFW RF sources continued.

**ITER & TOKAMAKS (R. HAWRYLUK):**

**DIII-D (R. Nazikian):**

Upgraded charge-exchange spectroscopy measurements at DIII-D have now enabled direct measurements of the main-ion (deuterium) toroidal rotation near the plasma boundary. This new main-ion CER capability has already revealed a large difference (greater than a factor of two) between the commonly measured carbon rotation and the toroidal rotation of the main-ions, where the main-ion toroidal velocity is enhanced in the co-current direction. Presentations at the 2016 HTPD conference will display the new diagnostic. Future research will focus on using this new capability for studying intrinsic rotation generation and momentum transport.

M. Churchill and D. Eldon are attending the PSI meeting and giving presentations on their DIII-D boundary plasma work. M. Churchill is presenting kinetic simulations of the SOL using the XGCa code for a sheath limited discharge. The simulations have successfully predicted strong parallel flows of the order observed in experiment, with the next step aimed at benchmarking with the SOLPS fluid code. D. Eldon is presenting a poster on the integration of the SOLPS code into the OMFIT workflow that allows rapid execution of SOLPS runs. He is also presenting results on heat flux simulations in DIII-D using SOLPS to assess the effects of increased heating power on DIII-D.
C-Mod (S. Scott):

A tokamak-independent analysis suite has been developed to process data from Motional Stark Effect (MSE) diagnostics and will be presented at the 2016 HTPD conference by S. Scott and R. T. Mumgaard. The software supports multi-spectral line-polarization MSE diagnostics, which simultaneously measure emission at the MSE $\sigma$ and $\pi$ lines as well as at two “background” wavelengths that are displaced from the MSE spectrum by a few nanometers. This analysis accurately estimates the amplitude of partially-polarized background light at the $\sigma$ and $\pi$ wavelengths even in situations where the background light changes rapidly in time and space. The software suite is modular, parallelized, and portable to other facilities.

THEORY (A. BHATTACHARJEE):

On June 3, W. Fox (PPPL) presented a theory seminar on the experimental study of the role of electron pressure in fast magnetic reconnection with a guide field. The abstract reads “Magnetic reconnection, the change of magnetic topology in the presence of plasma, is observed in space, laboratory, and enables the explosive energy release by plasma instabilities, as in solar flares or magnetospheric substorms, and the change in topology allows the rapid heat transport associated with sawtooth relaxation and self-organization in RFPs. In numerous environments, especially in toroidal confinement devices, reconnection proceeds in the presence of a net guide field. We report detailed laboratory observations in MRX of the structure of reconnection current sheets with a guide field regime in a two-fluid plasma regime (ion gyro-radius comparable to the current sheet width). We observe experimentally for the first time the quadrupolar electron pressure variation in the ion-diffusion region, an analogue of the quadrupolar “Hall” magnetic fields in anti-parallel reconnection. The quadrupolar pressure perturbation was originally predicted by extended MHD simulation as essential to balancing the large parallel reconnection electric fields over the ion-scale current-sheet. We observe that electron density variations dominate temperature variations and may provide a new diagnostic of reconnection with finite guide field for fusion experiments and spacecraft missions. We discuss consequences for force balance in the reconnection layer and implications for fast reconnection in fusion devices.”

DIRECTOR’S OFFICE (C. AUSTIN):

On June 1, Professor John Higgins, Princeton University, presented a colloquium entitled, “Extending the Ice Core Record of Atmospheric Composition and the Global Carbon and Oxygen Cycles Beyond 1 Million Years.”

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