



The PPPL Highlights for the week ending September 26, 2014, are as follows:

U.S. ITER FABRICATION (D. JOHNSON):

Installation plans for components located in the port interspace, port cell, and gallery are being created at the ITER Organization. These diagnostic transmission components, such as microwave transmission lines, fiber optics, and laser relays, must coexist with HVAC, cooling water and cable trays. Hence, diagnostic component installations must be phased properly with these other systems, and diagnostic components may be "trapped" when everything else is installed. With this in mind, installation and maintenance in this crowded environment must be considered in the design of these diagnostic transmission systems.

The US has proposed a simplification in the vacuum and tritium boundary for the Core Imaging X-ray Spectrometer, and discussed this concept with representatives of the IO vacuum and diagnostic groups. Follow-up discussions at the ITER site are planned by PPPL engineers during a visit to attend the system integration review, the week of November 24, for equatorial port plug 17, which houses this diagnostic.

IO and USIPO negotiations on the last two diagnostic procurement arrangements, covering the Motional Stark Effect and Core Imaging X-Ray diagnostics and Equatorial Port 3, have concluded. The associated documents are now under review by DOE.

NSTX (M. ONO):

Keii Gi of University of Tokyo completed his two-month visit to NSTX-U/PPPL. During his stay, as a part of his Ph.D. thesis work, he refined his conceptual study of superconducting spherical tokamak power plant incorporating the NSTX database. He utilized the NSTX H-mode plasma parameters and profiles for a higher bootstrap current fraction equilibrium for the ST reactor which is stable against MHD (kink/ballooning) modes. A plasma ramp-up equilibrium calculation shows a possibility of non-inductive ramp-up scenario with two NBIs with different beam energies. For future collaboration, a time-dependent ramp-up simulation will be performed in collaboration with NSTX-U/PPPL researchers.

Preparations for plasma operations in the NSTX-U configuration also continued. The Neutral Beam (NBPC) and Field Coil (FCPC) power conversion power supplies are being prepared for power testing. Good progress continues on the Power Supply Real Time Control (PSRTC) software specification. The fabrication of ex-vessel MPTS diagnostic equipment such as the Collection Optics Box and the Flight Tube Assembly continues in several PPPL shops.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

The Lithium Granular Injector was received at DIII-D last week and was assembled this week for testing. The device is currently being pumped down in preparation for bench testing with lithium pellets next week. A PPPL team of engineers and physicists will be present for testing the week of September 29. The testing will cover the operation of the granule impeller, fast camera, lighting system, and pellet dropper. The LGI is scheduled to be installed on the DIII-D vessel at the 285R0 port in October.

C-Mod (R. Hawryluk):

F. Poli visited the PSFC to discuss modeling of lower hybrid current drive in C-Mod using the new GenRay/CQL3D package in TRANSP. Discussions with the Alcator C-Mod and PPPL LH/MSE teams identified a candidate shot in which the launched LH spectrum changed in time. It was decided to augment standard simulations, in which TRANSP adjusts the assumed Z_{eff} in time to match measured loop voltage and total plasma current with additional simulations in which the Z_{eff} is held constant at its Ohmic value, while the total plasma current is allowed to float. The latter approach provides more meaningful experiment/model comparisons of the synthetic diagnostics for hard x-ray emission and non-thermal ECE emission.

This week there was a discussion via conference call on the status of and plans for numerical simulations of recent edge turbulence experiments in C-Mod using the 3-D two fluid Lausanne GBS code. This call was between M. Podestà and S. Zweben of PPPL, J. Terry and B. LaBombard of MIT, and Federico Halpern and Paolo Ricci of Lausanne. Two near-circular plasmas from June 19 were chosen for these new simulations, both at 4.0 T but with different $q(a)$ and density. New GBS simulations will be run at NERSC using a recent allocation of two million hours for this project. Synthetic diagnostics for the code results will be compared with the experimental mirror Langmuir probe and GPI edge fluctuation data for these shots. Earlier in September, F. Halpern presented the first results of such comparisons at the Varenna fusion theory meeting, and has submitted the results to PPCF.

International (R. Hawryluk):

D. Mueller participated in vertical control experiments at KSTAR from September 12-19. The use of loop voltage signals in the plasma control system proved superior to the existing measurement of dz/dt , was commissioned and is now in routine use on KSTAR. The use of a high-pass filter in the vertical control system to avoid contention between control by the internal coil and the more powerful, but slower, superconducting coils was tested. Technical difficulties prevented fully commissioning the filters.

Similarly, EAST has used voltage loop signals as the source of dz/dt and has routinely used a high-pass filter to eliminate the contention between its internal coil and the superconducting coils.

A joint EAST-NSTX paper was submitted to the IAEA FES conference: "The role of lithium conditioning in achieving high performance, long pulse H-mode discharges in the NSTX and EAST devices." Experiments in which lithium conditioning reduced recycling and eliminated ELMs in EAST and NSTX were documented in this paper. These results were achieved despite very different lithium delivery methods, i.e. with real-time injection during discharges in EAST, and with inter-shot evaporation in NSTX. The EAST discharges were ELM-free for more than 20 sec, with controlled density and radiated power, improving the prospects for use of lithium for future long pulse devices.

ADVANCED PROJECTS (D. GATES):

Department collaborations are represented in several papers submitted for the Symposium on Fusion Technology, to be held September 29 - October 3 in San Sebastian, Spain, including "Analysis of the Wendelstein 7-X Inertially Cooled Test Divertor Unit Scraper Element," by P. Titus, et al. In addition, PPPL researchers are co-authors on "Design of the Wendelstein 7-X Inertially Cooled Test Divertor Unit Scraper Element," by A. Lumsdaine (ORNL), et al.; on an invited paper, "Experience with the commissioning of the superconducting Stellarator Wendelstein 7-X," by H.-S. Bosch (IPP), et al.; on "Conceptual Design Study of the K-DEMO Magnet System," by K. Kim (NFRI), et al.; on "Pre-conceptual Design Study on K-DEMO Divertor System," by K. Im (NFRI), et al.; and on "Pre-conceptual Design Study on K-DEMO Ceramic Breeder Blanket," by J. Park (NFRI), et al.

H. Neilson attended a meeting of the Fusion Energy Sciences Advisory Committee (FESAC) and participated in discussions regarding the report of the Strategic Planning sub-panel. Neilson is a member of FESAC through June 2016.

THEORY (A. BHATTACHARJEE):

R. Kulsrud presented a seminar on "the revival of the Colliding Beam Tokamak (CBT)." CBT is based on the concept that a very desirable reactor would be one that has no thermal particles and only energetic nuclear active particles. It was first proposed in 1976 and analyzed by solving a Fokker-Planck equation for beam particles numerically. Recent more-detailed calculations were performed in collaboration with E. Valeo. In the zero-dimensional limit it was found that, if neutrals were neglected, values of capital Q up to 4 would be attained (Q is the ratio between the power produced by the fusion reactions and the external power required to sustain them via plasma heating.). Kulsrud and Valeo have repeated this earlier calculation and extended it to a more detailed 3 D calculation, using more sophisticated collision algorithm and including neutrals. The result was that Q's of CBT were somewhat lower than obtained in earlier analysis but still large enough that the CBT can be considered not as an energy producer but as a reactor that could produce large amounts of 14.6 MeV neutrons for materials studies or tritium production.

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

NSTX Upgrade (R. Strykowski, E. Perry, L. Dudek, T. Stevenson):

Construction: The in-vessel floor has come out for the last time this outage and the temporary platform at bays A and L has been removed. The centerstack pedestal has been moved to under the machine and the lower ceramic break and PF1C coil are being installed. All tiles have been installed on the centerstack casing and the row one tiles have been removed as required for installing the centerstack into NSTX. The casing will be moved to the top of the southeast labyrinth in preparation for the delivery of the centerstack to the south high bay during the week of October 6. The Vacuum Prep Lab is working on parts for the gas injection system. The electricians are working on the new category three-quarter ground bus and on installing the RGA rack under NB2. Fabrication of the upper PF1C coil can continues in the Tech Shop.

CS Upgrade: The centerstack was uprighted and the lower PF1A coil has been installed on the centerstack. Magnetic diagnostic coils installation on the OH are approximately 50 percent complete and should be finished early during the week of September 29. The Lower PF1C coil has been installed on the ceramic break. The Upper PF1C thermocouples were installed, and the can has been tacked in position on the coil and welding to the mandrel has begun. All of the outer lead extensions have been completed at Martinez. The last NCR has been dispositioned and approved, and final lot shipment is expected the week of September 29. The busbar for the PF1 coils was shipped out for bending and is due back in two weeks.

NBI Upgrade: Services work continues on turbopump flanges and turbo installation and flange modification has been completed. Platform drawings were completed and parts fabrication has started for the catwalk between source platforms. A SF6 piping ECN has been approved. Power system work focused primarily on fiber optic termination testing, remedial polishing and re-termination if needed, and channel assignment and testing. This work tests the hundreds of fibers that extend from NBPC 138-foot level to the NBPC 100-foot level and to the NTC BL2 HVEs. Some switchyard and Mod/Reg work was completed in anticipation of Accel reactivation. Controls work continues with installation of cabling, the completed installation of brackets and studs on BL2 for cable tray supports, installation of junction boxes, purchase of instrumentation cabling, terminations, and gallery rack wiring. More cable tray will be required in the gallery area and installation is planned. PLC to LCC interconnection wiring has started. Progress continues on developing the north door shield wall statement of work. Cryogenics maintenance and repairs in preparation for operations continues. The PTP procedure development continues. Management attended the monthly IPT.

BUSINESS OPERATIONS (K. FISCHER):

The DOE Office Science approved PPPL's Laboratory Directed Research & Development (LDRD) plan for FY15 at a maximum funding level of \$3.0 million.

PPPL submitted a proposal to NASA titled "Relating shear plasma flow and auroral emission at Saturn." J. Johnson is the Principal Investigator. The total budget proposed for the three-year period of performance is \$410,650.

One year renewal proposals for FY15 funding were submitted to the Office of Fusion Energy Sciences for the following projects: Offsite University Research Support at a requested budget of \$685,000, Princeton Field Reversed Configuration (PFRC-2) at a requested budget of \$395,000 and FRC Theory at a requested budget of \$181,000.

A Field Work Proposal covering the final year funding of \$185,000 for the Center for Magnetic Self-Organization was submitted to DOE.

DIRECTOR'S OFFICE (C. AUSTIN):

September 22-23, the Fusion Energy Sciences Advisory Committee (FESAC) meeting was held in Washington, D.C. H. Neilson, and A. Bhattacharjee participated as FESAC members, while S. Prager, M. Zarnstorff, R. Hawryluk, J. Menard, and H. Ji observed.

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