



The PPPL Highlights for the week ending August 8, 2014, are as follows:

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

PPPL representatives met with University of Texas contractors in a kickoff meeting for design support for the ITER ECE diagnostic. Meetings were held at the Austin, Texas campus and at the Center for Electromechanics, since the work is divided between these locations. Part of the University of Texas team, experts from MIT and University of Maryland participated remotely.

The design team for the ITER RGA met to discuss the effort needed to resolve chits from the recent FDR for the divertor sampling tube and to plan for the FDR of the remainder of the RGA system, tentatively scheduled for the summer of 2016.

Possible FY15 and FY16 milestones were selected from a list developed by PPPL CAMs for diagnostics.

NSTX (M. ONO):

Preparations for plasma operations in the NSTX-U configuration also continued with the ongoing reassembly of the Motor Generator after the successful completion of the rotor weld repairs. Pre-operational testing of Neutral Beam (NBPC) and Field Coil (FCPC) power conversion systems continues. Testing of output codes/links for the Plasma Control System is in progress.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

E. Kolemen participated in experiments aimed at achieving high β_n in high li plasmas using a combination of methods including the preemptive control of 2/1 tearing modes using ECCD with real time q-surface following. Real time MSE-EFITS are used to identify the $q=2$ surface and real time ray tracing with Thomson density and temperature profiles is used to calculate the mirror steer angles. Effective control of the 2/1 mode was demonstrated.

B. Grierson has produced the first main ion CER measurements from the recently installed prototype four-channel system on DIII-D. The brightness of the measured D-alpha emission varies rapidly across the array, in proportion to the plasma density, indicating that high-

resolution main ion CER measurements can be obtained in the pedestal. The validation of the method for main ion measurements in the pedestal region opens up new opportunities to study pedestal dynamics, such as isotope effect, edge intrinsic rotation and momentum transport. Forward modeling is in progress to develop a more quantitative interpretation of these measurements.

Interface design work on the Lithium Granule Injector is in progress. The LGI stand and mechanical connections have been designed, enabling three-axis alignment to the vessel port. An LGI assembly/training week at the end of August is planned, then shipment of the device to DIII-D for final calibration with lithium.

C-Mod (R. Perkins):

R. Perkins participated in ICRH experiments at C-Mod. The experiment consisted of comparisons between the field-aligned and toroidally-aligned antennas after boronization and is part of an ongoing campaign to understand the source and penetration of impurities during ICRH operation. In particular, data from numerous lines-of-sight on a visible-range spectrometer (Chromex) are being analyzed to locate molybdenum sources. Experiments on this topic will resume in two weeks.

ADVANCED PROJECTS (D. GATES):

In its collaboration with the Wendelstein 7-X (W7-X) project at Germany's Max Planck Institute for Plasma Physics (IPP), PPPL is a partner in constructing a pair of high-heat flux components, the "TDU Scraper Element," to study plasma control and divertor issues. Since installation is expected to be challenging due to the crowded conditions inside the W7-X vacuum vessel, the project is considering a mockup exercise to develop and test installation procedures in a separate facility that approximates the W7-X environment as closely as possible. The goal of such an activity would be to rehearse all critical installation operations in advance in order to reduce the risk of schedule delays during actual installation. This week H. Neilson, currently on assignment at the project site in Greifswald, Germany, accompanied IPP staff on a visit to an IPP satellite facility in nearby Lubmin, Germany to inspect a prototype vacuum vessel sector that is housed there. The team determined that the sector could be used for installation mockup if fitted with simulated components made of wood or plastic to accurately represent the real environment. Neilson reported on the team's assessment at this week's scraper element project meeting.

S. Lazerson presented a poster entitled "PPPL contributions to the W7-X experimental program" at the Workshop on Exploratory Topics in Plasma and Fusion Research (EPR) and US-Japan Compact Torus (CT) Workshop held August 5-8 in Madison, Wisconsin. This presentation highlighted PPPL's hardware and intellectual contributions to the W7-X program. Topics of the poster included use of the PPPL design trim coils for error field correction, participation in the field line mapping experiments, installation of the XICS system, 3D equilibrium reconstruction with STELLOPT, magnetic diagnostic sensitivity studies for W7-X, and divertor control scenarios. Additionally, S. Lazerson's recent collaborations with the CNT group at Columbia University were highlighted in an invited talk by Professor Francesco Volpe, wherein VMEC equilibria of the CNT device were presented.

THEORY (A. BHATTACHARJEE):

J. Squire and A. Bhattacharjee have published a paper in PRL on a new nonmodal analysis of the magnetorotational instability (MRI), which is widely believed to play an important role in controlling angular momentum transport in rotating astrophysical objects such as accretion disks (PRL 113, 025006, 2014). Their findings are quite different from standard eigenmode analyses, illustrating that shearing wave energy can grow at a universal growth rate for any choice of azimuthal and vertical wavelengths in the disc. They thus demonstrate that fast linear growth is possible at all wavelengths, suggesting that nonmodal linear physics could play an important role in MRI turbulence. The methodology used in the paper is potentially useful in the study of instabilities in rotating fusion plasmas.

A. Bhattacharjee and G. Hammett were invited to attend and give talks at the conference "From the MRI to the Sun" in honor of the 60th Birthday of Steven Balbus, Savilian Professor at the University of Oxford at Chamonix, France, July 14-18.

W. Fox traveled to the University of Rochester Laboratory for Laser Energetics (LLE) to participate in experiments on the OMEGA EP facility. He collaborated with Gennady Fiksel and other colleagues at the LLE in experiments pertaining to the dynamics of magnetic reconnection in colliding high-energy-density plasmas. The goal of the experiments was to study secondary instabilities of current sheets and their consequences during magnetic reconnection varying the magnitude of an externally imposed magnetic field. The experiments involved collisions of plumes of magnetized and unmagnetized plasma and observations with proton radiography and optical probing diagnostics. A. Bhattacharjee and W. Deng collaborated on developing theory and simulations for the experiments.

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

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

Construction: The PF1B lower coil has been installed in the centerstack casing and will be welded to the casing by August 11. The casing will then be stood up so the upper PF1B can be installed. Installation of tiles on the centerstack casing should be able to start in about ten days. The TF bus is being installed in the tower in the NTC and CHI bus is being trial fit under the machine and the lower connections are being welded to the vessel. Installation of mid-plane and upper diagnostics continues. Fiber runs for the vacuum, RGA, and gas injection systems have been put into place. Fit-ups of TF flex and other bus inside the umbrella will start in a few days.

NBI Upgrade: Ion Source relocation started this week and the first source was installed in position BL2A. The magnetic shielding for the source enclosure was installed. Preparations are underway for relocation of the next two sources scheduled for the week of August 11. TVPS fore line, exhaust line, and TVPS installation continues. The BL Platform designs were evaluated for fabrication and installation. The NB controls fabrication and installation cabling work on rack connections, cable runs, and BL wiring continued in NTC and gallery. Telemetry fiber optics end-to-end testing and rework continues in NTC and new tooling for polishing terminations is being evaluated. The PTP-NB-212 decel power supply reactivation and dummy load tests were

completed on BL2 (N4) AB&C. In parallel with power testing, the LCCs are receiving attention in support of PTP-NB-212 testing. Additional NB installation procedures are in development and review. The NBI cryogenics effort has started to pump down cryogenic lines for upcoming operations. Management held the monthly status meeting with active jobs reporting status and plans.

Digital Coil Protection System: DCPS PTP testing and compilation of testing documentation has reached a completion point in FCC. The PTP will be revisited after the move the Junction Area and after hardware installation. The Junction Area racks have been addressed to create space for the incoming DCPS computer and hardware. After some investigation of a watchdog timer issue with concurrent support, the DCPS computer and autotester panel will be moved to the Junction Area. Progress continues on hardware interface layout, drawings, orders, and fabrication of digital and analog boards and chassis bus. Component installation and bench testing continues. Water PLC testing continues in parallel with water system operations in support of FCPC rectifier testing. Evaluation of the DCPS chit log continues.

PUBLICATIONS:

Squire, J.; and Bhattacharjee, A., "Nonmodal Growth of the Magnetorotational Instability," Physical Review Letters, 113, 025006, 2014

Progress In Understanding The Enhanced Petestal H-mode In NSTX, PPPL-5031

Authors: Stefan Gerhardt, et. al.

Submitted to: Nuclear Fusion (January 2014)

Magnetic Diagnostics For Equilibrium Reconstruction And Realtime Plasma Control In NSTX-Upgrade, PPPL-5032

Authors: Stefan Gerhardt, et. al.

Submitted to: Review of Scientific Instruments (June 2014)

Development and Operation of High-throughput Accurate-wavelength Lens-based Spectrometer, PPPL-5033

Authors: Ronald E. Bell

Submitted to: Review of Scientific Instruments (June, 2014) Presented at: High Temperature Plasma Diagnostics Conference, Atlanta, GA (June 1-5, 2014)

Error field and magnetic diagnostic modeling for W7-X, PPPL-5034

Authors: S.A. Lazerson, D.A. Gates, H. Neilson, M. Otte, S. Bozhnikov, T.S. Pedersen, J. Geiger, and J. Lore

Presented at: 41st European Physical Society (EPS) Conference on Plasma Physics, Berlin, June 23-27, 2014.

Published on-line in conference proceedings: <http://ocs.ciemat.es/EPS2014PAP/html/>

Understanding ion cyclotron harmonic fast wave heating losses in the scrape off layer of tokamak plasmas, PPPL-5035

Authors: N. Bertelli, E. F. Jaeger, J. C. Hosea, C. K. Phillips, L. Berry, P. T. Bonoli, S. P.

Gerhardt, D. Green, B. LeBlanc, R. J. Perkins, P. M. Ryan, G. Taylor, E. J. Valeo, J. R. Wilson

and J. C. Wright

Presented at: 41st European Physical Society (EPS) Conference on Plasma Physics, Berlin, June 23-27, 2014.

Published on-line in conference proceedings: <http://ocs.ciemat.es/EPS2014PAP/html/>

Predictions of V_{RF} on a Langmuir Probe under the RF Heating Spiral on the Divertor Floor on NSTX-U, PPPL-5036

Authors: J.C. Hosea, R.J. Perkins, M.A. Jaworski, G.J. Kramer, J-W Ahn, et al.

Presented at: 41st European Physical Society (EPS) Conference on Plasma Physics, Berlin, June 23-27, 2014.

Published on-line in conference proceedings: <http://ocs.ciemat.es/EPS2014PAP/html/>

The ITER 3D Magnetic Diagnostic Response to Applied $n=3$ and $n=4$ RMP's, PPPL-5037

Author: S.A. Lazerson

Submitted to: Plasma Physics and Controlled Fusion

High-resolution Tangential AXUV Arrays for Radiated Power Density Measurements on NSTX-U, PPPL-5038

Authors: L. Delgado-Aparicio, R.E. Bell, I. Faust, K. Tritz, A. Diallo, S.P. Gerhardt, T.A. Kozub, B.P. LeBlanc, and B.C. Stratton

Presented at: the 20th Topical Conference on High Temperature Plasma Diagnostics (HTPD 2014), Atlanta, Georgia, June 1-5, 2014 Submitted to: Review of Scientific Instruments

Dependence of Recycling and Edge Profiles on Lithium Evaporation in High Triangularity, High Performance NSTX H-mode Discharges, PPPL-5039

Authors: R. Maingi, T.H. Osborne, M.G. Bell, R.E. Bell, D.P. Boyle, J.M. Canik, A. DiIalla, R. Kaita, S.M. Kaye, H.W. Kugel, B.P. LeBlanc, S.A. Sabbagh, C.H. Skinner, V.A. Soukhanovskii, and the NSTX team

Presented at: the 21st International Conference on Plasma Surface Interactions in Controlled Fusion Devices (21st PSI), May 26-30, 2014, Kanazawa City, Japan. Submitted to: Journal of Nuclear Materials

Hybrid Molten Salt Reactor (HMSR) System Study, PPPL-5040

Authors: Robert D. Woolley, and Laurence F. Miller

Presented at: the 2014 American Nuclear Society (ANS) Annual Meeting, Reno, Nevada, 15-19 June 2014

Submitted to: ANS Transactions (January 2014)

Enhanced Confinement Scenarios Without Large Edge Localized Modes in Tokamaks: Control, Performance, and Extrapolability Issues for ITER, PPPL-5041

Author: R. Maingi

Presented at: the Fourteenth International Workshop on H-mode Physics and Transport Barriers, 2 - 4 October 2013 Fukuoka, Japan.

Submitted to: Nuclear Fusion

In-situ Measurement of Low-Z Material Coating Thickness on High Z Substrate for Tokamaks, PPPL-5042

Authors: D. Mueller, A.L. Roquemore, M. Jaworski, C.H. Skinner, J. Miller, A. Creely, P.

Raman, and D. Ruzic

Presented at: the 20th Topical Conference on High-Temperature Plasma Diagnostics (HTPD 2014), Atlanta, Georgia, June 1-5, 2014

Submitted to: Review of Scientific Instruments

This report is also available on the following web site:

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