The PPPL Highlights for the week ending June 27, 2014, are as follows:

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

Princeton DOE Site Office approval was obtained for contract award for "Physics and Engineering Design Support for ITER Electron Cyclotron Emission (ECE) Diagnostic Front-End and X-Mode Radiometer."

A Readiness Review was successful in preparation for the Final Design Review of the Divertor Residual Gas Analyser Sampling Tube.

The Quality Plan for Physics and Engineering Design Support and Diagnostic Hall Instrumentation Development for ITER Low-Field-Side Reflectometry (LFSR) Diagnostic System was submitted by General Atomics and entered into the US ITER iDocs system.

NSTX (M. ONO):

Several members of the NSTX-U research team participated in the European Physical Society (EPS) meeting held June 23-27 in Berlin, Germany at the Berlin Conference Center (BCC). A. Bortolon (UT Knoxville/PPPL) gave an invited talk "Mitigation of Alfvénic activity by 3D magnetic perturbations on NSTX" and NSTX-U researcher V. Soukhanovskii (LLNL) gave an oral presentation "Radiative snowflake divertor studies in DIII-D". Posters on NSTX science or on research performed by NSTX-U research team members were also presented including: "Stochastic heating of thermal ions by compressional Alfvén eigenmodes in NSTX" by H. Smith (MPPC), "Physics of forced magnetic reconnection in coaxial helicity injection experiments in NSTX" by F. Ebrahimi (Princeton University), "Kinetic resistive wall mode stability evaluation and physics insight application in NSTX" by J. Berkery (Columbia University), "Understanding ion cyclotron harmonic fast wave heating losses in the scrape off layer of tokamak plasmas" by N. Bertelli (PPPL), "Investigations of pedestal turbulence and ELM bursts in NSTX H-mode plasmas" by D.R. Smith (University of Wisconsin), "Rotation and kinetic effects on ideal and resistive-wall modes in NSTX" by J. Menard (PPPL), "Predictions of Vrf on a Langmuir probe under the RF heating spiral on the divertor floor on NSTX-U" by J. Hosea (PPPL), "Pedestal evolution and scaling with plasma current on MAST" by A. Diallo (PPPL), "Locked-mode avoidance and recovery with ICRH and LHCD in Alcator C-Mod" by L. Delgado-Aparicio (PPPL), "Suppression of TAE and GAE with HHFW heating" by E. Fredrickson (PPPL), "Characteristics of Fluctuation-induced Plasma Flows and Implications to Experimental Observations" by W. Wang (PPPL), and "Fast Time Response Electromagnetic Disruption Mitigation System" by R. Raman (University of Washington).

S. Sabbagh (Columbia University) visited General Atomics last week to run MP2014-22-07 “Testing kinetic RWM stability theory at marginal stability in high beta, tearing mode stabilized plasmas”. The experiment successfully produced high betaN (up to 4 transiently), high qmin > 2 plasmas to study RWM stability and mode dynamics over a wide range of toroidal rotation profiles, and with variations in betaN and qmin. RWM activity was not observed when n = 1 tearing modes were present. However, when NTMs were stabilized or actively controlled by pre-emptive ECCD aimed at the q = 3 surface, large betaN collapses (up to 80% drop in Wtot) and full current-quench disruptions were produced at various stability parameters, correlated with RWM activity and indicating that the marginal stability point was reached. High time resolution (1 ms) CER data was specifically set to capture the detailed evolution of the toroidal rotation profile approaching significant fast betaN collapses and leading up to full current-quench disruptions. Early (unaimed) ECRF with current drive phasing vs. heating phasing lead to greater central q shear reversal and lower rho_qmin making NTMs less stable. The lithium dropper was used to attempt creation of ELM-free periods and to change collisionality in the high normalized beta plasmas created in MP2014-22-07. Lithium rates of 40mg/s and 80mg/s were tolerated by the target plasma with no H-L back-transition. When n = 1 NTMs were stable, modest changes to pedestal T, collisionality, and ELM frequency were found. With a strong n = 1 NTM present, the mode amplitude was halved during the period when lithium was dispensed at the 80mg/s rate. These experiments provide a unique data set for understanding the somewhat complex kinetic RWM marginal stability boundary (e.g. non-monotonic dependence on plasma rotation speed), and provide a greater understanding of the significant beta-limiting / disruption producing events in high betaN plasmas when NTMs are stabilized.

Installation of the HHFW antenna, with compliant sections added to the center conductors of the RF feedthroughs, was completed. The compliant center conductor sections decouple the increased mechanical forces on the antenna straps from the electrical feedthroughs. Electrical and mechanical analyses were used to develop the design of the compliant conductors, and they were tested on an antenna mockup in the RF test stand.

Preparations of non-upgrade equipment for plasma operations in the NSTX-U configuration also continued with the completion of the spectrometer-based tFIDA and CHERS diagnostic calibrations. Neutral Beam and Field Coil Power Conversion (FCPC) Subsystems are being made ready for power testing with the exercise of pre-operational test procedures. Weld repairs of the D-MG#1 rotor are now about 30% complete, and measured distortion at eight locations on the rotor are all well within specified levels.

ITER & TOKAMAKS (R. HAWRYLUK):

C. Gentile, J. Levine, C. Skinner and K. Rule participated in a conference call with the ITER Organization Safety Division. The following talks were given transferring experience from the D-T experiments on TFTR to the ITER Organization: C. Gentile " Tritium Handling and Management in MFE, What We Learned from TFTR." C. Skinner ""TFTR experience tritium retention and tritiated dust." J. Levine "Preparation of the safety documentation, environmental approval and the ORR process for DT operations." K. Rule "Summary of the D&D engineering operations".

R. Hawryluk and C. Neumeyer had meetings with the USIPO regarding how the experience with ITER costs can impact the algorithms used in power plant studies.

DIII-D (R. Nazikian)

R. Nazikian was session leader, working with C. Paz-Soldan and the DIII-D team, on a DIII-D experiment aimed at measuring the 3D plasma response to Resonant Magnetic Perturbations. An n=2 rotating RMP was used to measure the profile response to the applied field. In addition the upper row of I-coils was rotated relative to the lower row to assess the coupling of the applied field to the edge kink mode. Valuable imaging, profile and magnetics data was obtained on the plasma response. New windows of ELM suppression were opened at high q95, and new information obtained on the relation between coil phasing and density pumpout.

B. Grierson attended the EPS conference in Berlin, Germany and presented results on impurity confinement in the QH-mode regime. In this work, it was demonstrated that particle transport by the EHO was as efficient or even more efficient at removing impurities from the core compared to type I ELMs. The ratio of energy confinement to impurity particle confinement time peaks at low rotation in QH-mode, which is beneficial for extrapolation to reactor regimes.

A successful review was held on the Neutral Beam Local Control System upgrade that incorporates the Fast Analog controls with the slow digital controls. The review covered the CDR for the Fast Analog and a PDR for the slow digital control. An FDR will be held in August.

A. Nagy was chief operator for two sessions this week. D. Battaglia served as physics operator for one session and W. Solomon as beam operator for another.

International (R. Hawryluk)

D. Mansfield and L. Roquemore completed the assembly and testing of the lithium granule injector (LGI) for EAST. The system is ready for installation.

D. Mueller is at EAST participating in experiments, which resulted in the resumption of plasma operation.

ADVANCED PROJECTS (H. NEILSON):

C. Kessel and H. Neilson participated in the Fusion Energy Systems Studies FNSF project meeting June 25-26, held in Idaho Falls, Idaho. During the two-day meeting, members of the national study team discussed mission requirements for a fusion nuclear science facility (FNSF) and associated R&D program requirements. Kessel summarized the progress in the project and gave presentations on systems operating point analysis, blanket backup strategies, DEMO requirements, and structural steel and irradiation testing. Other topics covered include magnet assessments by Y. Zhai (PPPL); tritium pre-FNSF R&D by P. Humrickhouse (INL); liquid metal breeder pre-FNSF R&D by N. Morley (UCLA); the exclusion of water from the fusion core and the use of helium cooling by M. Tillack (UCSD); neutronics analysis in FNSF by L. El-Guebaly (U. of Wisconsin); damage limits and maintenance schemes by L. Waganer; disruption, divertor and first wall analysis by J. Blanchard (U. Wisconsin); and magnetic divertor configuration

issues by T. Rognlien (LLNL). Using accumulated exposure of critical in-vessel systems to fusion neutrons as a metric, the team has defined a reference time-phased program for FNSF and DEMO. The FNSF program is designed to support the development, under integrated testing conditions, of fusion blankets needed for DEMO. Programs and facilities preceding the FNSF, needed to bring blankets, tritium systems, divertors, and other systems to a level of readiness for testing in an FNSF environment were discussed. Progress is being made on defining the FNSF program, the testing approaches on the device, and pre and parallel needs for offline facilities R&D in support of the FNSF.

S. Lazerson and N. Pablant attended the EPS Plasma Physics Conference in Berlin, Germany, both presenting work performed in the framework of the U.S. collaboration with Wendelstein 7-X (W7-X). Lazerson presented a poster entitled "Error field and magnetic diagnostic modeling for W7-X," describing a possible new set of magnetic diagnostics for improved current and pressure profile reconstruction, along with error field measurement techniques for W7-X Modeling of the diagnostics signals suggests a helical stripe of probes located in the bean shaped cross section. Simulations of field line tracing experiments on W7-X indicate the possibility to detect error fields using non-resonant deformations of the flux surfaces. This is important as it can be performed in any magnetic scenario as opposed to the proposed iota=1 on axis scenario. Pablant presented "Measurement of core plasma temperature and rotation on W7-X made available by the x-ray imaging crystal spectrometer (XICS)." The XICS diagnostic will contribute to the study of ion and electron thermal transport and the evolution of the radial electric field by providing high resolution temperature and rotation measurements under many plasma conditions, including electron cyclotron heated plasmas. It is expected that the diagnostic will be available for the first experimental campaign, making an important set of measurements for the first W7-X plasmas. This diagnostic will also work in concert with the HR-XCS diagnostic to provide an excellent diagnostic set for core impurity transport on W7-X.

A. Lumsdaine and D. McGinnis from Oak Ridge National Laboratory visited PPPL this week to discuss various aspects of the TDU Scraper Element design and fabrication for Wendelstein 7-X. The visit included a meeting with an outside vendor who presented his company's core competencies. Ideas on fabrication techniques and approaches were discussed with the vendor. Additional meetings were held regarding handling of fabrication drawings, scheduling issues, and engineering analysis for the scraper element.

THEORY (A. BHATTACHARJEE):

Members of the PPPL Theory Department's Space Plasma Group attended the Geospace Environment Modeling (GEM) Summer Workshop at Portsmouth, Virginia on June16-20. Dr. P. Damiano presented a poster entitled "2D Gyrofluid-kinetic electron simulations of dispersive scale Alfven waves in a dipole geometry" Dr. E.-H. Kim gave two oral talks entitled "Global Modeling of EMIC waves in Earth's Inner magnetosphere" and "Inferring magnetopsheric heavy ion density using EMIC waves". She also presented a poster entitled "Global Modeling of EMIC waves in Earth's Inner magnetosphere: Generation and Application of linearly Polarized EMIC waves". Dr. J. Johnson gave a talk on "Role of kinetic Alfven waves on plasma heating and transport into the plasma sheet and Dr. P. Porazik presented a poster entitled "Modeling of Low Frequency Anisotropic Instabilities."

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

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

Construction: Calibrations of tFIDA and CHERS occurred this week. RF antenna in-vessel work has been completed. Centerstack casing work has started in the south high bay. Cable terminations for the vacuum and gas injection systems continued. The electrical installation for the IR camera is underway. The new buswork is being insulated in the C-site test cell. The RWM coils passed megger and hi-pot testing. Installation of the MPTS optics box continues. Fabrication of parts for the MPTS flight tube supports has been completed. Bakeout tubing and insulation is being completed on the NB2 duct.

CS Upgrade: The OH Coil completed the cure cycle and is in the cool down cycle. It is scheduled for removal from the oven on June 30. Covers for the PF1A coil have been welded in place, and the last PF1 coil was received at PPPL from Everson. Kapton and wet wrap insulation of the CHI Bus bars continued this week with Powers Electric taking over the work and will continue the week of June 30. Hollis shipped the OTF finger supports this week. The fasteners for the OTF connections were also shipped this week. The water system flow control valves arrived, but are the wrong size from what was ordered. Procurement is investigating a solution.

NBI Upgrade: Decon and survey of equipment out of the TTC was completed this week. The vacuum system roughing line and HVE SF6 line fabrication and installation has been completed and leakchecked. Scaffold between BL2 and the VV will be removed in preparation for TVPS installation, which is imminent. TVPS Fore line installation has started. BL2 Pneumatic manifold installations are complete. NB armor manifold drawings were completed; parts are in fabrication. An MPC for the IP and installation are imminent. Reactivation and installation of FVI fast switch circuits continued in preparation of powering the NBPS high voltage. Mod/Reg preparations continue. LCC low voltage power supply installation and reactivation is in progress. 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 continues in NTC. OMA hardware installations were completed on BL2 source platform. Additional NB installation procedures are in development and review.

Digital Coil Protection System: Study and comparisons of the NSTX-U Design Point Spread Sheet and DCPS parameter tree content has been undertaken with refined algorithm calculation additions to the spreadsheet completed. Methods for checking have been outlined and will be pursued. A review and development of a System Design Description including reliability, failure modes, and administrative control continued. The review of open chits is in progress. A DCPS Code Peer Review has been scheduled next month.

ENVIRONMENT, SAFETY, HEALTH & SECURITY (J. LEVINE):

PPPL received a new ten-year technology export license from the U.S. Department of Commerce for technical assistance to ITER on diagnositc and heating neutral beam systems. This license replaces the previous license, which was scheduled to expire in September 2014.

OFFICE OF COMMUNICATIONS (K. MACPHERSON):

More than two-dozen media worldwide reported J. Greenwald's news release about a zero-knowledge protocol for nuclear warhead verification that is under development in the Laboratory. The news release cited the project and the publication of a paper about it in the June 26 issue of Nature magazine.

DIRECTOR'S OFFICE (C. AUSTIN):

S. Prager and M. Zarnstorff participated in the EPS Conference on Plasma Physics, Berlin Germany from June 23-27.

On June 25, Dr. Renee Hlozek of Princeton University presented a colloquium entitled, "Small-scale CMB Cosmology: ACT, Planck and Beyond".

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