Weekly HIGHLIGHTS

PPPL PRINCETON PLASMA PHYSICS LABORATORY

U.S. DEPARTMENT OF ENERGY

The PPPL Highlights for the week ending September 30, 2016 are as follows:

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

Steady State Electric Network (SSEN):

Uninterruptible Power Supply (UPS) and DC Distribution Contracts and Arrangement for Battery Banks and LV Distribution & Sub-Distribution Panels: The contract for the DC distribution was signed, but last-minute complications prevented signature of the UPS contract before the end of the fiscal year, which in turn prevented signature of the Arrangement document.

Power Transformers: Progress is being made on planning, logistics and shipping documents related to shipment of Group 1 and 2 transformers (that comprise shipping lots one and two) from the Schneider Electric factory near Istanbul, Turkey. Shipments will finally begin mid-October.

NSTX-U (M. ONO):

The NSTX-U run assessment was held on September 28. This meeting featured two overview presentations followed by opportunities for the NSTX-U team (both PPPL and collaborator) to make comments on the key areas of: communications and program direction, collaborator support, and run staffing and equipment needs. A comprehensive set of notes was collected, and are available via a link on the NSTX-U home page. These notes will be distilled into concrete suggestions for the NSTX-U management.

Yuri Petrov, from ComPXCo, visited PPPL from September 26 to September 30 to work with Francesca Poli and CPPG on the extension of GENRAY+CQL3D in TRANSP for analysis of NSTX-U plasmas with HHFW and NBI. The TRANSP executables have been updated to allow the Fokker-Planck calculations in the case of HHFW only and the complete loop has been successfully tested standalone on one time slice. The HHFW only case will be fully implemented in TRANSP following this test.

NSTX-U in-vessel diagnostic calibrations were performed this past week, and will continue through the first week of October. A review of the procedures and work packages for the dissection and analysis of the failed PF1aU coil was held, and the cutting fixture/test stand is being prepared. Preparations are underway for the mid-October removal of the NB #1 & #2 calorimeters for maintenance.

ITER & TOKAMAKS (R. HAWRYLUK):

ITER and Tokamaks Department (R. Hawryluk)

DIII-D (R. Nazikian)

S. Haskey and B. Grierson have been investigating the possibility of using measurements from the edge main-ion CER system to determine a mid-plane cold neutral density profile across the pedestal and into the SOL. Collisional excitation of the cold neutrals by beam neutrals creates a cold line feature in the D-alpha spectrum. This spectral feature can be isolated using active-passive time-slice subtraction, yielding a cold neutral density profile. The cold line feature has successfully been extracted from the D-alpha spectrum. The next step is to convert the intensity into a density using the beam attenuation and atomic cross sections.

S. Haskey published an article "Measurement of deuterium density profiles in the H-mode steep gradient region using charge exchange recombination spectroscopy on DIII-D" in Review of Scientific Instruments. The publication describes an iterative forward modeling technique used to correct the edge main-ion CER measurements for cross section distortions and finite line of sight effects using the FIDASIM code. This allows deuterium density to be calculated directly from the measured thermal deuterium emission intensity.

A paper titled "Avoidance of Tearing Mode Locking with Electro-Magnetic Torque Introduced by Feedback-based Mode Rotation Control in DIII-D and RFX-mod" by M. Okabayashi, et al., has been accepted for publication in Nuclear Fusion. The paper outlines the experimental results on the entrainment of large amplitude NTMs by 3D fields and shows that the method is effective in preventing the onset of locked modes, providing additional time to mitigate disruption onset.

A. Nagy is leading the DIII-D team on the fabrication and commissioning of the super supply patch panel. A milestone was reached this week with the completion of the panel wiring. The jumper cables are now ready for fabrication.

Nagy is leading the project team for the new off axis beam (NB210) to be installed in the long torus opening in FY18. A successful second review of the heat load calculations for the absolute collimator and drift duct was held this week.

Dave Miller and Bob Ellis continued maintenance of the ECH launchers at DIII-D. They replaced three damaged waveguides and numerous thermistors.

R. Hawryluk also visited DIII-D and met with the on-site research staff to discuss recent progress.

C-Mod (S. Scott)

The C-Mod Motional Stark Effect (MSE) diagnostic with wavelength-interpolation of the partially-polarized background light successfully measured the pitch angle in a plasma for

MP787, “Improving stability of non-inductive discharges.” Large changes in the pitch angle profile, well outside measurement error, were observed during simultaneous LHCD and a downward plasma current ramp. Initial indications are that the time variation of the measured pitch angle profile is qualitatively in agreement with the expected behavior. Analysis is ongoing.

International: (R. Maingi)

R. Maingi (PPPL) and K. Tritz (JHU) visited ASIPP September 21-27, to discuss details of the newly funded international collaboration on PMI, and to continue EAST data analysis. Most of the new work will focus within the wall conditioning group, led by J.S. Hu, and the PFC group, led by G.N. Luo, both of ASIPP. Additional discussions on L-H transition work took place with G.S. Xu, and overall strategy was discussed with B.N. Wan.

ADVANCED PROJECTS (H. NEILSON):

The Wendelstein 7-X divertor scraper project is in its final stages. Due to delays encountered in the final processing step, cleaning and bakeout of the graphite tiles, the equipment was not shipped to the Greifswald, Germany project site in September as had been planned. The tiles, which had been shipped to a commercial bakeout supplier, were returned to PPPL after it was determined that the supplier would not be able to establish the required processing conditions due to equipment issues. A procedure proposed by PPPL for re-cleaning the tiles and bakeout by a new supplier was approved by Max Planck Institute for Plasma Physics (IPP) collaborators. It is currently forecast that all remaining equipment, including the tiles, will be shipped to IPP in October.

Also in the Wendelstein 7-X divertor scraper project, IPP reported that a high heat flux test of a sample tile was successfully completed this week. The tile was subjected to fourteen 2-second beam pulses with power density of 8 MW/m^2. There was no visible damage, but post-test deformation measurements are in progress and analysis of measurement data is planned. The sample tile and fixture were designed and fabricated by PPPL for this test, which was performed to confirm the basic soundness of the tile thermal design.

THEORY (A. BHATTACHARJEE):

Professor A. Bhattacharjee gave a presentation to the Office of Fusion Energy Sciences (FES) describing the ongoing research of the Theory Department During FY 2015-16. This presentation described the progress the department is making towards achievement of the five-year plan, and included a description of recent changes in Departmental Organization, the role of various Centers led by Theory Staff, an identification of the “Flagship Codes” being developed, and the status of the NSTX-U Theory Partnership. Recent research highlights in the areas of “Turbulence and Transport”, “Macroscopic Equilibrium and Stability”, “Energetic Particles”, “Basic Plasma Science”, “High-Performance Computing and the Exascale Computing” were presented.

Matthew Kunz has an article in press in the Journal of Plasma Physics titled “Linear Vlasov theory of a magnetised, thermally stratified atmosphere”, with the authors Rui Xu and Matthew

W. Kunz. The abstract reads: “The stability of a collisionless, magnetised plasma to local convective disturbances is examined, with a focus on kinetic and finite-Larmor-radius effects. Specific application is made to the outskirts of galaxy clusters, which contain hot and tenuous plasma whose temperature increases in the direction of gravity. At long wavelengths (the “drift-kinetic” limit), we obtain the kinetic version of the magnetothermal instability (MTI) and its Alfvénic counterpart (Alfvénic MTI), which were previously discovered and analyzed using a magneto-fluid (i.e. Braginskii) description. At sub-ion-Larmor scales, we discover an over-stability driven by the electron temperature gradient of kinetic-Alfvén drift waves -- the electron MTI (eMTI) -- whose growth rate is even larger than the standard MTI. At intermediate scales, we find that ion finite-Larmor-radius effects tend to stabilize the plasma. We discuss the physical interpretation of these instabilities in detail, and compare them both with previous work on magnetised convection in a collisional plasma and with temperature-gradient-driven drift-wave instabilities well-known to the magnetic-confinement-fusion community. The implications of having both fluid and kinetic scales simultaneously driven unstable by the same temperature gradient are briefly discussed.”

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