The PPPL Highlights for the week ending August 7, 2015, are as follows:

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

The Upper Port Wide Angle Viewing Visible and Infrared Camera System design is developing rapidly through the work of General Atomics and TNO. Neutronics analysis of the in-vacuum front-end endoscope has not been done for three years since the CDR. The PPPL Upper Port Engineering team reviewed a new SolidWorks ATTLA analysis model this week in preparation for analysis starting August 17. The most important item on the to-do list is to determine the nuclear heating and DPA on the UPP WAVs molybdenum "Bullnose" mirrors. The thermal-hydraulic design of the bullnose is dependent on accurately understanding the distribution of nuclear heating in the mirror and mounts.

**NSTX (M. ONO):**


Robert Barchfeld recently received a DOE Office of Science Graduate Student Research (SCGSR) Program award. He is a graduate student at the University of California at Davis and will be conducting research with the high-k turbulence diagnostic on NSTX-U.

Professors David Ennis and Stuart Loch from Auburn University (Auburn, AL) visited this week. They presented a seminar entitled "An overview of possible Auburn University support for NSTX Upgrade spectroscopy and diagnostics”. They were briefed on LLNL spectroscopy plans for molybdenum and tungsten erosion and edge transport measurements in NSTX-U. Plans were discussed for new high-Z impurity erosion diagnostic developments that could be supported by state-of-the-art atomic structure and rate calculations for neutral, singly and doubly ionized molybdenum and tungsten atoms that are planned at Auburn. Spectroscopic benchmarking of the new atomic calculations will be performed at Auburn University using the Compact Toroidal Hybrid (CTH) experiment. They also met with several NSTX-U staff and discussed new atomic physics calculation and ADAS developments, as well as the experimental details of measurements in CTH device at Auburn University in support of NSTX-U high-Z erosion measurements.

Felipe Bedoya, a doctoral student from the University of Illinois at Urbana-Champaign (UIUC),
completed his two-month visit to PPPL this week. He was able to work with PPPL engineers and designers to finalize the electrical wiring drawings and installation procedure for the Materials Analysis and Particle Probe (MAPP). He successfully installed the control programs for the MAPP diagnostics on a new control computer, and tested remote communication between the NSTX-U Control Room and the NSTX-U Test Cell. The MAPP represents a joint UIUC-PPPL effort, and Bedoya plans to return to PPPL when NSTX-U experiments involving MAPP begin later in the year.

JW Ahn (ORNL) visited ITER Organization to attend a meeting for ITER ELM control coil requirements, held on July 23 – 24. He gave a talk on the effect of 3D fields on steady state and transient divertor heat flux deposition and participated in the discussion and report writing. A total of four US participants, out of 21 as a whole, joined the meeting and actively contributed to the meeting. The outcome of the meeting was summarized and presented to the ITER management at the end of the meeting. Various aspects of ELM control physics requirements were discussed and it was agreed that flexibility in n, spectrum, and the rotation capability of perturbation fields are necessary to optimize ELM control performance with minimum adverse effects.

LLNL Laser Blowoff (LBO) trace impurity injector beam path was determined from laser enclosure in NSTX-U South High Bay to the injection port on Bay J of vacuum vessel. Heater testing for liquid lithium loading system (LIFTER or Lithium Filler for LiTER) was completed. A system was designed to introduce argon ("Argon Dump System") to mitigate effects of exposure of liquid lithium to air from simultaneous structural failure of LITER and loss of large vacuum window. Lithium Granular Injector (LGI) Control System Final Design Review was successfully completed and components for remote control ordered. Gas Injection System calibrations with calibrations of plenum pressure sensors and plenum volumes were started.

The Multi-Pulse Thomson Scattering (MPTS) detection hardware was restarted. The two cameras that view the laser controller screens have been put back in service. Significant progress has been made toward the use of IDL-base software to analyze the videos from the laser path optics IDS cameras. Real-time operation was tested while the Nd:YAG beams were terminated into a light trap located inside the laser optics enclosure on the test-cell south wall.

Components for the Divertor SPRED flight tube have been fabricated. The LLNL UV spectrometers [XEUS, LoWEUS, and Mona Lisa] are installed on their stand at Bay "E" and aligned. Important dimensions for the vacuum manifold and flight tube have been measured. The mounting bracket for the Bay "G" infrared camera is complete. A successful peer review of the Outer TF Rogowski coil was held. Pneumatic actuators were installed on the Divert or Tangential Imaging diagnostic. A successful final design review for the Fusion Products diagnostic was held on July 31.

NSTX-U power testing began this week after a comprehensive review by the NSTX-U Activity Certification Committee (ACC) and approval by the PPPL ES&H Executive Safety Board. Integrated system coil testing began after performing a full set of coil electrical insulation tests (Hi-Pots) from the field coil power conversion building. Current has been applied to all seven of the field coils required for the CD-4 plasma, and Digital Coil Protection System trip verifications are in progress. Magnetic diagnostics calibrations were performed in parallel with coil test shots yesterday, and proper operation of the Rogowski coils has been confirmed. EFIT field data has
also been successfully recorded. The Ip Calculator is on-line and ready to support CD-4 operations. After-hours periods of vessel Glow Discharge Cleaning (GDC) have been performed. Remote control capability of vessel shutters is being commissioned, and we are now capable of performing between-shot GDC.

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

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

B. Grierson and S. Haskey succeeded in acquiring the first measurements in the H-mode pedestal from the recently upgraded edge main-ion CER diagnostic. Pedestals with the steep pressure gradient region aligned in the middle of the diagnostic channel array are being processed for measurements of the deuterium ion temperature, density and toroidal velocity. The measurements are also being simulated with the FIDAsim diagnostic simulator. Initial indications are that the deuterium profiles are well resolved with sharp spatial features, particularly in the density pedestal. Near the plasma boundary, clear and large differences in the toroidal velocity between deuterium and carbon have been observed, with deuterium being more positive in the co-current direction. Discharges have been acquired in L-mode, H-mode and matched plasma conditions with both directions of the toroidal field. A new workflow established in OMFIT is enabling rapid processing of the main-ion CER data for comparison to neoclassical velocity calculations with NCLASS and NEO.

R. M. Churchill is working with CS Chang to apply the fully kinetic code XGCa to explore the impact of kinetic effects on scrape-off layer (SOL) physics in DIII-D H-mode plasmas. XGCa is a total-f, gyrokinetic code which self-consistently calculates the axisymmetric electrostatic potential and plasma dynamics, and includes modules for neutral Monte Carlo transport. Benchmarking XGCa results with those from a fluid code (SOLPS) are planned for the sheath-limited, high-recycling, and detached SOL regimes. The goal of this work is to address a number of discrepancies observed between experiment and leading SOL fluid codes (e.g. SOLPS), including underestimating outer target temperatures, radial electric field in the SOL, parallel ion SOL flows at the low field side, and impurity radiation. Many of these discrepancies may be linked to the fluid treatment that assumes high collisionality and could be resolved by including kinetic effects in SOL simulations. A production run using XGCa of DIII-D H-mode plasmas with a sheath-limited SOL has been completed and is being analyzed.

M. Vorenkamp worked with A. Bortolon to assess the existing Matlab analysis tools used to track granules with a fast-framing camera. Vorenkamp has begun working on the code to adapt it to the photodiode sensor in preparation for experiments in FY16.

**ADVANCED PROJECTS (H. NEILSON):**

Installation of all main components of the Wendelstein 7-X (W7-X) x-ray imaging crystal spectrometer (XICS), including all vacuum hardware, is now complete. The XICS of PPPL and Max Planck Institute for Plasma Physics (IPP) researchers pumped down the system for the first time, remarkably reaching a pressure of 3x10^-3 mBar within about an hour. This is in line with our experience on Japan’s Large Helical Device (LHD) for a fully vacuum tight system, and
the achieved pressure is already better than required for diagnostic operation. In addition, the team performed a full test of the detector system including data acquisition as configured for a typical shot with external triggering. All electrical and water feedthroughs are connected, leak tight, and fully operational. This verifies that all feedthroughs and the important cabling are installed correctly. With the exception of minor remaining interface tasks for IPP, the U.S. XICS equipment is ready for operation in the first W7-X campaign, scheduled for this Fall.

**THEORY (A. BHATTACHARJEE):**

The paper "Ion temperature effects on magnetotail Alfven wave propagation and electron energization" by P. Damiano, J. Johnson and C. Chaston was published in the Journal of Geophysical Research, Space Physics, 120, doi:10.1002/2015JA021074 (http://onlinelibrary.wiley.com/doi/10.1002/2015JA021074/full). The abstract reads "A new 2-D self-consistent hybrid gyrofluid-kinetic electron model in dipolar coordinates is presented and used to simulate dispersive-scale Alfvén wave pulse propagation from the equator to the ionosphere along an L = 10 magnetic field line. The model is an extension of the hybrid MHD-kinetic electron model that incorporates ion Larmor radius corrections via the kinetic fluid model of Cheng and Johnson (1999). It is found that consideration of a realistic ion to electron temperature ratio decreases the propagation time of the wave from the plasma sheet to the ionosphere by several seconds relative to the cold ion limit (which also implies shorter timing for a substorm onset signal) and leads to significant dispersion of wave energy perpendicular to the ambient magnetic field. Additionally, ion temperature effects reduce the parallel current and electron energization all along the field line for the same magnitude perpendicular electric field perturbation."

As part of the ongoing OFES planning process for frontiers in plasma physics, several PPPL theory department members participated in an on-line town hall meeting focused on theory and computation: I. Dodin presented on modernizing and advancing the understanding of plasma waves: field-theoretical paradigm; J. Burby discussed structure-preserving continuum gyrokinetic modeling for improved data locality; H. Qin gave a short talk on structure-preserving geometric algorithms for plasma physics; T. Stoltzfus-Dueck discussed opportunities for fundamental studies of plasma turbulence.

**DIRECTOR’S OFFICE (C. AUSTIN):**

A. Cohen, A. vonHalle, R. Camp and J. DeLooper visited Brookhaven National Laboratory on August 4-5 to see how several accelerator experiments implement the conduct of operations order. Information was exchanged and minutes will be issued. Although the terms are different, the methodologies for operations are very similar.

**PUBLICATIONS:**

Damiano, P.; Johnson, J.; and Chaston, C., "Ion Temperature Effects On Magnetotail Alfven Wave Propagation And Electron Energization," Journal of Geophysical Research, Space Physics,
120, doi:10.1002/2015JA021074

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