PRINCETON PLASMA PHYSICS LABORATORY
WEEKLY highlights

PPPL
U.S. DEPARTMENT OF ENERGY

The PPPL Highlights for the week ending July 31, 2015, are as follows:

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian)

D. Eldon, E. Kolemen and M. Okabayashi participated in an experiment on ECCD control of a slowly rotating 2/1 NTM. The slow rotation was accomplished by use a rotating magnetic perturbations, with mode entrainment at 70 Hz. The effect of modulated co- and counter-ECCD were documented for island O point and the X-point locations.

M. Vorenkamp worked with W. Brown to complete the wiring for the programmable logic controllers in the new neutral beam control system, NBLCS5.

Vorenkamp also worked with A. Bortolon to design a second version of the photodiode based granule drop counter. The design is complete and ready to be machined by the DIII-D time machine shop. Vorenkamp also worked with Will Brown to design a magnetic shield to house the new impeller motor. It will be machined the week of August 10.

International (R. Hawryluk):

E. Kolemen went to EAST to install and test advanced divertor control system. The code has been successfully implemented in the EAST PCS and tested in plasma discharges for functionality. Using the control for regulation of quasi snowflake divertor at EAST discharges is under development.

R. Perkins and G. Taylor visited ASIPP in Hefei, China, July 9-16 to collaborate during commissioning of the ion cyclotron resonance heating (ICRH) system into EAST plasmas. During their visit they met with members of EAST ICRH, diagnostics and operations research staff, and submitted two draft EAST experimental proposals entitled “Interactions of fast waves with the scrape off layer plasma” and “Partition of ICRH power absorption as a function of T_e/T_i”. They also discussed development of test shots that would support running these experiments on EAST later this year.

W. Solomon, L. Cui, with A. Garofalo, M. Lanctot, Al Hyatt (GA) and Chris Holcomb (LLNL) traveled to EAST to participate in the first experiments aimed at extending DIII-D's high poloidal beta scenario to long pulse on EAST. A new tool to control the loop voltage level was successfully tested in these experiments and was found to be able to drive the plasma loop voltage to zero. However, in many cases the plasma current could not be sustained for long

pulse. Various techniques utilized at DIII-D to broaden the current profile were implemented in EAST for the first time, including early heating and early H-mode transitions. L. Cui also began learning how to prepare EAST data for analysis with TRANSP and will perform analysis of the current drive and transport in the recent experiments.

NSTX-U

NSTX-U is in the Upgrade Project outage in FY 2015

The International Spherical Torus Workshop (ISTW-2015) will be held on main campus of Princeton University - November 3-6. The deadline for abstract submission is August 14. Visit: http://istw-2015.pppl.gov/abstract-submission to submit your abstract and visit http://istw-2015.pppl.gov/ for other details.

Dr. Zixi Liu (ASIPP) arrived for a one-year stay at PPPL, following a one-year stint at GA. Dr. Liu will focus on H-mode pedestal physics during his assignment, with some emphasis on BOUT++ calculations of the NSTX and NSTX-U boundary plasmas. In addition, Dr. Liu has an interest in L-H transition physics, and the effects of Li on both the power threshold and pedestal dynamics.

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. The outer leg TF Rogowski coil was installed. Pneumatic actuators were installed on the Divert or Tangential Imaging diagnostic. Measurements of mirror and target travel as a function of actuator position were completed.

A successful final design review for the Fusion Products diagnostic was held on July 31.

The following NSTX-U XPs (eXperimental Proposals) were approved by run coordination:
XP1505 Boronization Optimization by C.Skinner
XP1507 Maximizing the non-inductive current fraction in NSTX-U H-modes by S. Gerhardt
XP1512 Characterization of the Pedestal Structure as function Ip, BT, and Pnbi by A. Diallo
XP1529 Controlled introduction of Lithium into NSTX-U by R. Maingi

The following XMPs (eXperimental Machine Proposals) were approved:
XMP-104: MHD Spectroscopy Checkout by Jack Berkery

Preparations for NSTX-U Power Testing continued this week with Test cell scrubs and the replacement of bus-work in the power cable termination structure (PCTS). Coil system pre-operational testing has been completed and documented, and impulse testing of the OH coil was successfully completed. A new run copy of OP-NSTX-02 the NSTXU Startup Procedure is in force and recording the completion of the preparation activities.

ADVANCED PROJECTS (H. NEILSON):

S. Lazerson presented a talk entitled "Error field studies using flux surface mapping in W7-X" at the IPP Wendelstein seminar in Greifswald, Germany. In this talk, Lazerson presented a method which allows the measurement of the n=1 field error in W7-X using a low field iota=1/2 surface configuration. Such a configuration meets early operational phase engineering requirements, allowing measurements to be performed before first plasma operation. In this configuration, the trim coils are used to perturb the vacuum configuration allowing an island to open up. The n=1 trim coil waveform is then rotated in a fashion similar to a compass scan used on tokamaks. The intrinsic error field can then be backed out from the measurement of island rotation using the flux surface mapping diagnostics. This method is useful as it does not require a direct measurement of the n=1 error field, can isolate the error field coming from planar coil misalignment, and may allow assessment of the n=2 component of the error field as well. Conducting such an experiment in vacuum also removes any plasma response ambiguity, a capability unique to stellarators. Lazerson has been participating in the first flux surface mapping campaign at W7-X as part of an 11-month assignment.

D. Gates gave a talk at Fusion for Energy (F4E, Europe's Domestic Agency for ITER) headquarters in Barcelona, Spain entitled "The Tokamak Density Limit: a Thermoresistive Disruption Mechanism" on July 28. In the talk, Gates presented a simple model of the tokamak density limit based on a radiation driven island dynamic model that quantitatively reproduces the Greenwald limit with plausible assumptions for the impurity densities. The work is a collaborative effort with R. White, D. Brennan, L. Delgado-Aparicio, and Q. Teng.

This week, the Laboratory accomplished one of its FY-15 Notable Outcomes with the final delivery of components for the Wendelstein 7-X (W7-X) x-ray imaging crystal spectrometer (XICS) to the project site in Greifswald, Germany. PPPL's N. Pablant reported from the project site that the equipment arrived in good condition and preparations by the Max Planck Institute for Plasma Physics (IPP) team were progressing well. Installation work continued this week. The XICS that will be used to measure plasma temperature and velocity profiles with high resolution on the W7-X stellarator, which is scheduled to begin plasma operation this Fall.

THEORY (A. BHATTACHARJEE):

Recent global modeling of ULF waves at Mercury's magnetosphere has been published in Geophys. Res. Lett: E.-H. Kim, J. R. Johnson, E. Valeo, and C. K. Phillips (2015), Global modeling of ULF waves at Mercury, Geophys. Res. Lett., 42, 5147–5154

On July 30, Kirit Makwana (U Chicago) presented a theory seminar on current sheets and particle energization in Alfvenic plasma turbulence: Turbulence is observed in a wide variety of laboratory, space, and astrophysical plasmas. Turbulence is driven by injecting energy at large scales through stirring or instabilities. This energy cascades forward to smaller scales by nonlinear interactions, described by magnetohydrodynamics (MHD) at scales larger than the ion gyroradius. At smaller scales, the fluid description of MHD breaks down and individual particle motion becomes important. This is also where kinetic damping comes into play and can dissipate the turbulent energy into heat. We investigate this entire process by simulating the cascade of

strongly interacting Alfven waves using MHD and particle-in-cell (PIC) simulations. We find that both formulations agree very well at large scales in their energy dynamics and energy spectra. We estimate that collisionless damping mechanisms in the PIC simulations can account for the dissipation of the observed nonlinear energy cascade. Spontaneous turbulent current sheets are formed in both simulations. A statistical analysis of the current sheet morphology, characterizing their length scales, is performed. The longest dimension of current sheets scales with the driving length of turbulence. PIC simulations reveal that their thickness is limited to the skin-depth, which MHD is not able to capture. Anisotropic heating of particles is observed, and at low beta we obtain a significant non-thermal component to the particle energy distribution function. We are trying to understand the particle energization mechanism behind this.

COMPUTATIONAL PLASMA PHYSICS GROUP (S. JARDIN):

S. Ethier represented PPPL at the DOE Laboratory Poster Session of the CSGF Annual Program Review held in Arlington, Virginia. The Department of Energy Computational Science Graduate Fellowship (DOE CSGF, http://www.krellinst.org/csgf/) program provides outstanding benefits and opportunities to students pursuing doctoral degrees in fields of study that use high performance computing to solve complex science and engineering problems. As part of the program, CSGF fellows are required to complete a practicum project in one of the many DOE labs, giving them practical work experiences while strengthening collaborative ties between the national academic community and DOE laboratories.

BUSINESS OPERATIONS (K. FISCHER):

Budget Office:

First year funding was received from NASA in the amount of $134,200 for the research proposal titled “Laboratory Study of Magnetohydrodynamic and Hydrodynamic Instabilities in Rotating Flows Relevant to Astrophysical Disks”. The Principle Investigator for this effort is H. Ji.

First year funding was received from NASA in the amount of $189,650 for the research proposal titled “Multi-Fluid Studies of Chromospheric Reconnection in a Partially Ionized Laboratory Plasma”. The Principle Investigator for this effort is H. Ji.

BEST PRACTICES & EXTERNAL AFFAIRS (J. DELOOPER):

Best Practices (J. Graham):

J. Graham gave a presentation on PPPL's requirements management process at the Requirements Managers’ Contractor Consortium held at NREL on July 22-23. Contractors from several DOE Lab's shared best practices and lessons learned, and were able to benchmark their processes.

PUBLICATIONS:

Kim, E.-H.; Johnson, J.R.; Valeo, E.; and Phillips, C.K., "Recent Global Modeling of ULF Waves at Mercury's Magnetosphere," Geophysical Research Letters, 42, 5147–5154.

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