PRINCETON PLASMA PHYSICS LABORATORY
WEEKLY highlights

PPPL
U.S. DEPARTMENT OF ENERGY

The PPPL Highlights for the week ending July 18, 2014, are as follows:

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

Approval was received from the Princeton DOE Site Office to proceed with the award of the contract for "Design and Fabrication of the ITER Upper Port Visible/Infrared Wide Angle Viewing System".

A "kickoff meeting" has been scheduled for August 5-6 in Austin, Texas, to discuss the early R&D technical direction, project performance reporting, progress on the quality plan, invoicing and project schedules for "Physics and Engineering Design Support for the ITER Electron Cyclotron Emission (ECE) Diagnostic Front-End and X-Mode Radiometer."

A final review was completed of presentations for the Final Design Review of the Divertor RGA Sampling Tube. This review will be held July 29-30 in Cadarache, France. Documents associated with this review are being processed through the PPPL and USIPO approval cycles prior to upload to IDM.

NSTX (M. ONO):

Professor Yasushi Ono with his student Keii Gi of University of Tokyo, Japan, visited PPPL during the week of July 14 to discuss the NSTX-U collaboration with his group and also to discuss the student exchange program between University of Tokyo and Princeton University. Gi will be spending two months at NSTX-U/PPPL to conduct research on his PhD thesis work on a conceptual design study of superconducting spherical tokamak power plant.

Preparations for plasma operations in the NSTX-U configuration also continued with the ongoing weld repairs of the Motor Generator Rotor. All planned weld repair areas have now been addressed. Visual weld inspections are being performed by the weld contractor's QC, PPPL QC and the PPPL Weld Engineer, and will be followed by magnetic particle testing next week.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

A 2013 APS invited paper by D. Battaglia et al., has been just been published in Physics of Plasmas. This work describes the first application of XGC0 to assess the contribution of

neoclassical particle transport to the profiles of deuterium and carbon in the QH-mode pedestal on DIII-D. This work demonstrates that the pedestal Er profile is consistent with that required to maintain ambipolarity in the edge.

N. Greenough completed a design review while at DIII-D on the magnet current monitor required for protecting the gyrotrons. These monitors ensure the safe shutdown of gyrotrons if they operate outside the normal range of currents for their internal magnets. The FDR was a success and plans are in place to deliver the final set of monitors by the end of this fiscal year.

B. Ellis and J. Hosea visited DIII-D to inspect and assess the damage to an ECH launcher as a result of back reflection from the over-dense plasma. The assessment is ongoing.

The pole shield RFQ has been sent to potential bidders and responses are expected in the next week. This follows the successful design review of the pole shields where it was verified that molybdenum inserts could effectively handle the power loads expected with increased neutral beam power.

C-Mod (S. Scott/ S. Zweben):

On July 15 experiment for MP742 was conducted to investigate the current and hard X-ray profile during lower hybrid current drive as a function of current and launched lower hybrid n-parallel. After delays to troubleshoot the DNB we successfully measured the current profile at 0.4, 0.8 and 1.0MA using MSE. The global measure of current drive efficiency confirmed the trend observed in databases of an increased efficiency at higher current. Obtaining data at high current was difficult due to the small outer gaps required. Launched n-parallel scans were conducted at high (0.8MA) and low current (0.4MA) with n-parallels in from 1.6 - 2.5. The change in loop voltage, non-thermal ECE and hard X-rays indicate the current drive efficiency is insensitive to the launched n-parallel in this range. Future work will concentrate on using the MSE data to perform magnetic reconstructions and comparing the profiles to ray-tracing and possibly full-wave simulations. This work was carried out for Mumgaard's thesis and upcoming APS invited talk on LHCD.

S. Zweben visited Jim Terry at MIT last week for discussions of edge turbulence experiments and GPI diagnostic analysis. There was also a conference call between S. Prager, Jim Terry, and Brian LaBombard with Jim Myra and David Russell of Lodestar Inc, to discuss work Lodestar will be doing to compare the a SOLT simulation of C-Mod edge turbulence with GPI and mirror probe data. This analysis will focus on the poloidal motion of turbulence seen in the simulations vs. the experiments, and a detailed comparison of turbulence quantities in the edge and SOL.

International (W. Solomon):

E. Kolemen and colleagues from ASIPP agreed on the deployment of the snowflake control algorithms developed for DIII-D on EAST. The DIII-D PCS code will be transferred to EAST and he will give a seminar about the recent control developments. W. Solomon was involved in developing a near-term plan for achieving fully non-inductive operation on EAST with reduced parameters during their current commissioning phase. These experiments are anticipated to be conducted when reliable plasma and heating system operation is achieved. Data analysis tools were adapted from DIII-D in preparation for future experiments.

ADVANCED PROJECTS (H. NEILSON):

The Final Design Review (FDR) for the W7-X X-ray Imaging Crystal Spectrometer (XICS) diagnostic has been scheduled for July 29. The review committee for the FDR will be comprised of individuals from both PPPL and IPP.

As part of its collaboration with the Wendelstein 7-X (W7-X) project at Germany's Max Planck Institute for Plasma Physics, PPPL and ORNL are partners in constructing a pair of high-heat flux components, the "TDU Scraper Element," to study plasma control and divertor issues. Since these components will be used during early phases of the program, before the implementation of active cooling, the peak and average power handling will be limited by radiative heat transfer to the surrounding thermal mass. PPPL's Han Zhang presented a 3D finite element model of the scraper element, adjacent components, and vacuum vessel, together with radiative links among all the various elements. The model will be used to analyze the thermal response to an applied heat load onto the scraper element during a pulse. This work will follow up on 1D modeling which has been used to support the design development, in order to confirm the design and document the operating envelope of the scraper element in preparation for a preliminary design review.

H. Neilson arrived in Greifswald, Germany to begin an extended work assignment at the Max Planck Institute for Plasma Physics. During his nine-month stay, Neilson will support the transition from construction to research operations of the Wendelstein 7-X (W7-X) stellarator project. The main objectives are to: 1) ensure effective integration of U.S. contributions into the W7-X program; 2) develop protocols to assist long-term U.S. research visitors, especially students and post-doc, in all aspects of such visits to work on W7-X; and 3) support the W7-X Head of Operations in bringing the W7-X facility into operation, emphasizing physics-engineering integration issues.

THEORY (A. BHATTACHARJEE):

A. Bhattacharjee hosted the Theory and Simulation of Disruptions Workshop at PPPL July 9-11. The objective of this Workshop was to bring together experts (theorists, experimentalists, and engineers) on the subject of disruptions in tokamaks. Understanding, predicting, and mitigating disruptions is one of the principal challenges confronting ITER. The emphasis of this Workshop was on the theory and simulations of disruptions in tokamaks, informed by and in coordination with experimental campaigns on the world's principal tokamaks. The Theory Department members that presented talks were: J. Breslau on "Calculation of Disruption Halo Currents and Forces With the M3D Code" and L. Zakharov on "Tokamak Magnetohydrodynamics (TMHD) as a Model for Macroscopic Plasma Dynamics in Tokamaks". Two long-term visitors to the Theory Department at PPPL gave talks: H. Cai on "Simulations of Resistive MHD Instabilities in the Presence of Runway Current" and X. Li on "Simulations of vertical disruptions with VDE code: Hiro and Evans currents". Also, two members of the Department of Astrophysical Sciences who are affiliated with the Theory Department at PPPL also attended the Workshop: F. Ebrahimi and D. Brennan, who presented a talk titled "Control of resistive wall modes in a cylindrical tokamak with plasma rotation and complex gain."

The theory seminar on July 17 was presented by Jennifer Schober from Institute of Theoretical Astrophysics, Heidelberg University (Germany), entitled "Turbulent Magnetic Field Amplification in Young Galaxies". The abstract of the talk is "Magnetic fields play an important role in present-day galaxies, in particular by influencing the star formation process. In models of young galaxies magnetic fields are usually not considered as they are assumed not to be dynamical important at high redshifts. In the presence of turbulence, however, the small-scale or turbulent dynamo can amplify weak magnetic seed fields by randomly stretching, twisting and folding the field lines. The details of this process depend on the nature of turbulence, i.e. on the hydrodynamic and magnetic Reynolds numbers, and on the compressibility of the gas. With a model of a typical young galaxy, where turbulence is generated by accretion and supernova explosions, we determine the growth rate of the small-scale dynamo. We follow the exponential growth of the magnetic field on the viscous scale and also the subsequent transport of the magnetic energy to larger scales in the non-linear dynamo phase. Depending on the parameters of our model we find that equipartition of magnetic and kinetic energy, i.e. a field strength of roughly 10^(-5) G, is reached within 4 to 270 Myr. Thus, we expect that the turbulent dynamo can generate strong unordered fields already in very young galaxies."

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

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

Construction: Work on the centerstack casing continued this week with the completion of the re-machining of pockets for the PF coils, trial fit-ups of tiles and centerstack gas injection tubing, and lifting the casing to a vertical position for the installation of the PF1B lower coil the week of July 21. Installation of supports for the coil cooling water hoses and installation and termination of cables for the vacuum and gas injection systems continues. Work continues on the upper ceramic break and PF1C assembly so it can be trial fit on the vessel is a few days. Fabrication and wrapping of coil bus continues in the Tech Shop and the C-site test cell, and trial fit-up of the CHI bus has been started under the machine.

CS Upgrade: The OH Coil was hipot tested to 13kv on the morning of July 18. The leakage current was 12 micro-amps. The Aquapour removal process will begin the afternoon of July 18 and continue through the weekend. Materials were received for the fabrication of a welding mandrel for the PF1C cover. Fabrication of the mandrel also started this week. The first PCHERS passive plate was cleared for shipment and is expected to arrive at the Lead Extensions with the first batch shipping August 12 and the last parts shipping September 2.

NBI Upgrade: The TVPS fore line installation and exhaust installation continues. The TVPS turbopump table installation is in progress and other TVPS installation work continues including some water piping modifications and instrumentation. The TVPS cabling is also in progress. The Armor manifold installation continues. Service installations continue on BL2 including dry nitrogen and airlines. 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. Some rework of f/o terminations is required before power testing can start. Additional NB installation procedures are in development and review. A successful Peer Review was held to add a shield wall at the NTC North door in the gallery.

Digital Coil Protection System: The DCPS Code Peer Review is in progress; an additional day was added to the schedule to complete the code review. DCPS PTP testing continued in force including tests of overcurrents. A requested change was made to the Autotester. The AT interface panel was used for PTP functional tests in FCC. Progress continues on the RCIM interface. It's use was also attempted during PTP testing and troubleshooting continues. Progress continues on hardware layout, drawings, orders, and fabrication of digital and analog boards. The lemo cable testing continues. The component installation and bench testing continues.

OFFICE OF COMMUNICATIONS (K. MACPHERSON):

On July 16, at 1 p.m., PPPL hosted its first on-site "Live" Google Hangout featuring A. Dominguez and the Remote Glow Discharge Experiment (RGDX).

DIRECTOR'S OFFICE (C. AUSTIN):

On July 14-17, A. Cohen travelled to Argonne National Laboratory in Lemont, Illinois to participate in an annual DOE project management workshop.

On July 17, S. Prager, M. Dikeakos, M. Zarnstorff and J. DeLooper hosted a visit with Mr. Daniel Poneman, Deputy Secretary for the Department of Energy. Mr. Poneman met with PPPL and Princeton Site Office management, addressed PPPL staff at an all hands meeting, and toured the Laboratory.

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