

PRINCETON PLASMA PHYSICS LABORATORY

WEEKLY highlights



The PPPL Highlights for the week ending October 17, 2014, are as follows:

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

In a meeting with a representative of the Vacuum Group at the ITER Organization, PPPL presented measurements of outgassing from cleaned, cylindrical boron carbide pellets. These pellets (5 mm dia. x 10 mm long) are being considered for use inside vented chambers, within the diagnostic shield modules, providing light-weight radiation shielding. From a vacuum standpoint, the outgassing appears adequately low. Neutronics analysis is underway at PPPL to determine if the shielding efficiency is adequate.

A Project Change Request (PCR) was submitted to the USIPO to reflect updated cost and schedule, considering re-estimates of the PPPL scope and the resource-loaded schedules submitted by the design support team led by General Atomics with participation from UCLA.

NSTX (M. ONO):

Bilel Rais from Consorzio RFX, Italy has concluded a four-week visit to NSTX in which he collaborated with C. Skinner (PPPL) and Professor Bruce E. Koel of Princeton University on the surface analysis of boronized and lithiated samples exposed to RFX-mod plasma discharges. Rais made a presentation at PPPL on October 14 entitled 'Surface analyses of graphite samples exposed to wall conditioning in RFX-mod'. The results are relevant to the upcoming NSTX-U plasma startup with boron and lithium conditioning.

Preparations for plasma operations in the NSTX-U configuration also continued. The internal inspection of D-MG-1 stator heat exchanger #1 was performed after chemical flushing and found to be satisfactory. The chemical flushing of the remaining five D-MG-1 stator heat exchangers is now in progress. The final design of the Stand Alone Digitizers (SAD2) was successfully reviewed on October 16, and installations may now proceed. A pre-job briefing for the installation of the Multi-pulse Thompson Scattering diagnostic (MPTS) Collection Optics Box has been held, and that work is starting. An NSTX-U Activity Certification Committee (ACC) review of the NB operations preparation was held this past week.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

The LGI team successfully bench tested and calibrated 900-micron diameter spheres at 50m/s and 70 granules per second into an aluminum foil target. This completes the calibrations of all the granule sizes including 300, 500 and 700 micron spheres at 50 and 80 m/s. Work is ongoing to prepare the vessel interface for installation of the LGI the week of October 20.

R. Maingi and M. Jaworski traveled to ORNL and UT-Knoxville, Tennessee to discuss lithium and liquid metal collaborations with both institutions. Maingi presented an informal talk at ORNL, "Bifurcation to Expanded H-mode Pedestal Width and Height with Lithium Aerosol Injection in DIII-D".

International (R. Hawryluk):

K. Kim and J.-K. Park visited KSTAR to lead magnetic braking experiments using $n=2$ non-resonant magnetic perturbation. Highly non-resonant $n=2$ magnetic perturbation of even parity (0 phasing), which has been rarely used for 3D experiment in KSTAR, was utilized to investigate toroidal rotation damping in the various q profiles. The magnetic braking profile was scanned with q_{95} modulated by toroidal magnetic field and plasma current, and strong toroidal rotation damping in the whole tokamak volume was achieved at $q_{95}\sim 5$, which is consistent to 3D equilibrium calculation by IPEC and NTV torque prediction by POCA. Compared to an observation of edge magnetic braking by $n=2$ odd parity (90 phasing) at high q_{95} in 2013 campaign, this experiment indicates that the $n=2$ field in KSTAR can provide a tool to control toroidal rotation and rotation shear globally or locally depending on the phasing of 3D field coils. Contingency experiment proposal to produce reference discharges for NTV analysis and to further test magnetic braking at lower q_{95} using the same $n=2$ field has been accepted. Additional experiments are scheduled in November.

ADVANCED PROJECTS (D. GATES):

Lazerson has recently installed the STELLOPT code on the Hydra cluster at Rechenzentrum Garching Max-Planck-Gesellschaft. Installation of this code on the cluster will allow PPPL and IPP researchers to conduct large-scale optimizations focusing on turbulent transport. This includes running parallel linear GENE to calculate both ITG and TEM turbulence levels. The code is now undergoing consistency checks along with trial optimizations using the turbulent proxies.

On October 10, D. Gates presented colloquium entitled "Origins of Tokamak Density Limit Scalings" at Columbia University in New York City. He presented information from recent publications on the subject and gave a brief summary of ongoing work.

THEORY (A. BHATTACHARJEE):

A joint meeting of the Theory Plasma-Material Interaction working group and NSTX Boundary Physics and Materials & Plasma Facing Components Topical Science Groups was held on October 10. The meeting was focused on the prospects for developing a consistent simulation of the plasma-material interface. The discussion was led by D. Stotler.

An IAEA poster, "A Cross-Benchmarking and Validation Initiative for Tokamak 3D Equilibrium Calculations", by A. Reiman, T. Evans, N. Ferraro, J. King, S. Lazerson, J.K. Park, A. Turnbull, A. Cerfon, M. Lanctot, E. Lazarus, Y. Liu, G. McFadden, D. Monticello, R. Nazikian, E.J. Strait and Y. Suzuki, was presented for Allan Reiman at the IAEA meeting by T. Evans from GA.

The Theory Department Research & Review Seminar entitled "Numerical optimization of tokamak and stellarator equilibrium" was given by S. Lazerson. Abstract reads "Numerical optimization is a technique by which input parameters for a given numerical model may be determined, which in turn results in a specific set of calculated properties. The STELLOPT code is one such numerical optimizer, which has been used in the design of the NCSX stellarator. Recently, the algorithms and framework of the STELLOPT code have been extended to encompass the IPEC plasma model. The resulting code IPECOPT has been used to explore the effect of 3D fields on neoclassical toroidal viscosity in the NSTX and DIII-D device. In this talk, the numerical optimization algorithms will be discussed along with various examples of optimization, including optimization as equilibrium reconstruction, and turbulent transport optimization."

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

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

Construction: High spots on the centerstack casing inner diameter have been ground off and a gauge has been used to verify that the clear diameter is sufficient. New shields have been fabricated and welded on the PF1A lower coil and the same is now being done for the upper PF1A. The outer layer of microtherm insulation has been removed so the inner layer can be adjusted/repared. The outer layer will then be done. The installation of the casing and the PF1A upper will occur in the next week and they will be followed by the installation of the centerstack into NSTX. The PF1C upper can fabrication was completed in the Tech Shop and it has passed leak check. Re-installation of the RF transmission lines at the machine has been started and the re-installation of the MPTS Collection Optics Box is just starting. The vacuum system cable terminations are nearing completion.

CS Upgrade: Removal of the CS casing from the TF/OH Assembly revealed some damage to the Microtherm thermal insulation and Rogowski electrical insulation. The damage was caused by the tight fit between the two assemblies. Clearance was increased by grinding and smoothing the inside diameter of the centerstack casing forgings and modifying the PF1A cover. The Microtherm damage is being repaired now and another attempt at assembly will be made on Monday. Started cleanup of the TF Lead Extensions to remove weld overhang. ECN issued for CHI Buss to capture the changes resulting from the field fit up of the CHI busswork. The OH bus connection to the TF Bundle was trial fit and is now being insulated. PF1C can cover installation

was completed and inspected. The PF1C has been assembled to the ceramic break and is being leak checked.

NBI Upgrade: Platform support column location and installation has started. Services work continues on vacuum piping. HVE cleaning and inspections were completed and HVE closures are in progress. Switchyard, surge room, and mod/reg work was completed in anticipation of Accel reactivation. Bending magnet tests were completed. Controls work continues with installation of cable tray, cabling, and gallery rack wiring and additional trays are needed in the gallery. Cryogenics maintenance and repairs in preparation for operations continues. N door shield wall drawings are in progress. Management presented the NBI upgrade to the ACC including a walkdown of the NBI system and review of the preoperational test procedures required to startup and operate NSTX-U NBI.

Digital Coil Protection System: DCPS system work included fixes in software and I/O to allow software PTP testing to continue and preoperational test procedures resumed.

BUSINESS OPERATIONS (K. FISCHER):

PPPL submitted the following two proposals to the National Science Foundation (NSF) Geospace Environment Modeling (GEM) solicitation:

E.-H. Kim submitted "Electromagnetic Ion Cyclotron Propagation and Dissipation in the Inner Magnetosphere and Ionosphere." The total budget request for the three-year period of performance is \$274,300.

P. Damiano submitted "GEM: Coupling Fast Flows and Electron Energization in the Magnetotail." The total budget request for the three-year period of performance is \$405,100.

DIRECTOR'S OFFICE (C. AUSTIN):

On October 15, Professor Joseph Minervini from the Massachusetts Institute of Technology presented a colloquium entitled, "Large Scale Superconducting Magnets for Variety of Applications".

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