

PRINCETON PLASMA PHYSICS LABORATORY

WEEKLY **highlights**



**The PPPL Highlights for the week ending October 26, 2012, are as follows:**

### **NSTX (M. ONO):**

NSTX-U is in the Upgrade Project outage in FY 2013

A new paper "Edge Turbulence Velocity Changes with Lithium Coating in NSTX" by Bin Cao (a visiting student from ASIPP, China), et al., has been published by Plasma Phys. Control. Fusion 54, 112001 (2012): <http://stacks.iop.org/0741-3335/54/112001>. In this paper the gas puff imaging diagnostic on NSTX was used to measure changes in edge turbulence velocity during a controlled scan of lithium coating. With increased lithium there was a small increase in poloidal turbulence velocity and decrease in poloidal velocity fluctuations. The possible effect of charge exchange damping by neutrals was evaluated for this scan.

Several NSTX researchers attended the ITPA Topical Group meeting held last week (following the IAEA FEC meeting), which was a joint meeting of the majority of the ITPA topical groups. S. Sabbagh (Columbia University) gave a presentation for joint experiment MDC-2 on resistive wall mode physics, which included several new NSTX analysis results. S. Gerhardt (PPPL) gave a remote presentation titled "Halo current asymmetry dynamics and disruption detection in NSTX". Dr. Joe Snipes (ITER Organization) gave a summary presentation for the ITER Integrated Plasma Control Working Group, which included contributions from several NSTX scientists.

R. Goldston (PPPL) participated in the Divertor and Scrape-Off layer ITPA meeting in San Diego after the IAEA meeting. As a member of the ITER Science and Technology Advisory Committee, he is paying particular attention to the issues associated with the choice for the material to be used in the first ITER divertor target, tungsten or graphite. In addition he made a presentation on the issues associated with extrapolating the recent SOL width measurements, and his heuristic drift-based theory, to ITER. He found that contrary to some arguments, the required upstream pressure is not particularly high, either in a sheath limited or a conduction-limited regime. The latter requires, however, substantial radiation or spreading of the heat flux directed at the divertor plate. In addition the pressure gradient, as measured by the MHD alpha parameter, is no higher in the projection to ITER than in the highest  $n/n_{GW}$  JET data points. This led to the speculation that the upper density limit in the H-mode may be governed by MHD stability of the SOL, even if drifts govern the SOL width at lower density.

M. Ono and T. Brown of PPPL participated in the IAEA DEMO Programme Workshop at UCLA, California from October 15–18. The meeting covered the three main topics; Fusion power extraction and tritium fuel cycle, plasma power exhaust and impurity control, and

magnetic configuration and operating scenario for a next-step fusion nuclear facility. T. Brown gave a talk entitled “Studies of ST-FNSF Mission and Performance Dependence on Device Size” on behalf of J. Menard. M. Ono gave a poster presentation entitled “Prospect of DEMO-relevant Radiative Liquid Lithium Divertor”.

The Transport and Confinement ITPA meeting was held October 15-17, after the end of the IAEA meeting. Attending for NSTX-U were S. Kaye, W. Guttenfelder and Y. Ren of PPPL. Major topics of discussion for the meeting included the limit cycle oscillations associated with L-H transitions, transport and other results of the JET ILW experiments for assessing the ITER plan of having a W divertor on Day 1, profile stiffness, impurity transport and summaries of joint experiments and activities. There were also breakout sessions for small group discussions. W. Guttenfelder gave a presentation on his TC-15 work on determining modes that cause momentum transport in NSTX, and S. Kaye gave a summary of the BES observations on NSTX. This summary was based on D. Smith's IAEA presentation. S. Kaye, W. Guttenfelder and Y. Ren discussed collaborative work on MAST with M. Valovic, A. Field and C. Roach, as well as the disposition of TC-12, in a breakout session. The MAST folks welcomed the ideas for momentum and particle transport experiments by the NSTX-U group.

R. Maingi (ORNL) and A. Diallo (PPPL) attended the pedestal and edge physics ITPA group meeting in San Diego, California, from October 15-17. Diallo presented a talk, "Characterization of Pedestal Fluctuations During the ELM Cycle on NSTX". Diallo also presented preliminary analysis on the same subject on Alcator C-Mod.

E. Fredrickson, Nikolai Gorelenkov and Guoyong Fu of PPPL presented papers at the Meeting of the ITPA Energetic Particle Topical Group held in San Diego from October 15-17. New experimental and theoretical results were presented on fast ion driven instabilities, fast ion redistribution and benchmarking of codes for modeling the experimental results. E. Fredrickson reported on “An update on further benchmarking of NOVA/ORBIT against NSTX TAE data and losses” and Nikolai Gorelenkov presented a report on “Validation of Quasilinear Models for Fast Ion Relaxation due to Alfvén Eigenmodes for Burning Plasmas”. Ultimately these codes will be used to predict the stability of ITER to fast ion driven instabilities and their affect on fast ion confinement. These predictions will help guide ITER towards more efficient operational regimes. The meeting ended with discussions on what tasks could be considered closed, what remained to be done on unfinished tasks and the choice of new tasks.

NSTX Upgrade construction activities continued this week and are highlighted in the Engineering section below.

Preparations of non-upgrade equipment for plasma operations in the NSTX-U configuration also continued with the ongoing testing of the prototype fault detector in conjunction with the new firing generator in a field coil power conversion rectifier. All fault detector faults have been cleared, and power supply permissives (control power only) have been established. Section currents are being simulated to generate trips.

Access to the NSTX test cell will be available only through previous arrangement with the Upgrade Work Control Center.

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

The Wendelstein 7-X team at the Max Planck Institute for Plasma Physics (IPP) reported that the first of the U.S.-supplied trim coils was installed on the device on October 24. The team encountered no difficulties in placing the coil in its proper position within its tightly constrained space allocation. On the same day, the third and fourth coils arrived at IPP, four weeks after leaving the facility of the U.S. supplier, Everson Tesla, Inc. Said W7-X Director Thomas Klinger, "This is a great accomplishment. I gratefully acknowledge the dedicated work of all our US colleagues that made possible the timely delivery and high quality of the coils."

Wendelstein 7-X engineers Konrad Risse and Victor Bykov visited PPPL this week to participate in the completion of several Trim Coil project tasks and to review the status of coil manufacture. During their visit a final review of the trim coil structural analysis report was conducted. Mike Mardenfeld and Peter Titus responded to IPP comments on the final draft, and reached agreement with the IPP visitors on disposition. In discussions with PPPL quality assurance specialist Frank Malinowski, final agreement was reached on the content and organization of the documentation package that accompanies each coil. During a visit to Everson Tesla's facility in Nazareth, PA, the team inspected the tooling preparations and initial manufacturing steps for the fifth and final coil, which has a unique geometry. Finally Dr. Bykov presented a seminar, "Structural analysis for the W7-X stellarator," to the PPPL staff.

A paper by S. A. Lazerson, *et al.*, "The Virtual Casing Principle for 3D Toroidal Systems," was accepted for publication in Plasma Physics and Controlled Fusion Research. The article deals with a method, the "virtual casing principle," in which the vacuum magnetic fields outside the plasma are calculated by performing a surface integral of an equivalent surface current over the entire plasma surface. The capability to calculate the magnetic field due to a toroidally confined magnetic fusion equilibria is of manifest relevance to equilibrium reconstruction and stellarator divertor design. The virtual casing method is advantageous because of its computational efficiency compared to a volume integration. The article presents a full derivation of the method along with a discussion regarding its proper application.

## **FUSION SIMULATION PROGRAM (W. TANG):**

B. Tang visited Beijing, China on October 17- 26, and participated in activities which included: chairing the session on Numerical Simulations of High Energy Density Phenomena on October 18 and presenting an invited plenary talk on "Extreme Scale Computational Challenges in Fusion Energy Sciences" at the International Conference on High Energy Density Plasmas (ICHEDP 2012); presenting an invited seminar on "Scientific & Computational Challenges of the Fusion Simulation Program (FSP)" to the Physics Department at Peking University and also meeting with Prof. Jiangang Li, Director of the Institute of Plasma Physics, Chinese Academy of Sciences, to discuss mutually beneficial collaboration opportunities on October 22; and participating as Co-chairman and invited plenary speaker on "Computational Challenges at the Extreme Scale in Fusion Energy Sciences" at the International Exascale Software CoDesign Workshop on October 23-25.

## **THEORY (A. BHATTACHARJEE):**

H. Mynick attended the IAEA Fusion Energy Conference in San Diego, CA and presented a paper, "Turbulent Optimization in Stellarators & Tokamaks via Shaping".

A. Hakim contributed to several sections of the report "Multiphysics Simulations: Challenges and Opportunities", which is the outcome of a multidisciplinary workshop organized by David Keyes, Lois McInnes, and Carol Woodward. The report, to appear in the International Journal of High Performance Computing, is available at <http://www.ipd.anl.gov/anlpubs/2012/01/72183.pdf>.

The space physics group at PPPL hosted a NASA LWS team meeting on "Integrating Kinetic Effects in Global Models" at PPPL on October 22-23. The group discussed collaborative projects considering comparative studies of reconnection in global systems using MHD, Hall-MHD, and fully kinetic models. The team also considered how to model wave-particle interactions that control temperature anisotropies in the solar wind and planetary magnetospheres.

## **COMPUTATIONAL PLASMA PHYSICS GROUP (S. JARDIN):**

At the request of TRANSP user David Pace and Ron Waltz of General Atomics, X. Yuan and M. Gorelenkov have implemented a new model for fast ion diffusion due to background turbulence into TRANSP. The model makes use of the micro instabilities calculated by TLGF on each flux surface. An auxiliary program DEP then computes the expected diffusion coefficient for fast particles on this surface as a function of particle velocity and pitch angle. This information is transmitted to the neutral beam package NUBEAM where a diffusion operator is applied to each particle depending on its location and velocity coordinates. This capability will be used in David Pace's upcoming APS invited talk to assess the role of background turbulence on the beam-driven current profiles in DIII-D.

## **ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):**

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

Leak checking of the new Bay J-K cap (NB2 vessel nozzle) was successfully completed. One vessel leg mount is being modified to make room for a TF clevis block.

TF Conductors: Nine TF conductors have been installed into the Quadrant mold in the winding area. The end indexing plates were trial fit and some minor modifications were made to improve the fitup. Five additional conductors were received from Major Tool this week.

Coil Support Structures: Installation of the umbrella legs continued this week in the Test Cell. The PF 4/5 support structures and the first piece for the OTF weldment were shipped and received at PPPL. They are currently in receiving inspection.

NBI Upgrade: Work continues in the NTC, TTC, NBPC, and Technical Shops. HP support continues to support activities in both the NTC and TTC. TTC removals continue as equipment is cleaned, surveyed, and moved to storage.

NBI Armor: Armor installation plans have been formulated for Construction. Fit-up of backing plates in the vacuum vessel prior to final structural welds has been scheduled in approximately two weeks.

NBI Relocation: Alignment of the BL to the beam midplane height and aiming trajectories paused after shim assessment. Shim plates and insulator plate thicknesses have been fabricated. Alignment will resume with location and height adjustments.

NBI Refurbishment: 90 inch flange water feedthrough brazing continues in the TTC. Effort continued on the calorimeter reassembly. The ion dump reassembly continues. Clearing other equipment in the TTC continues also.

NBI Services: Fabrication of cryo lines continues in the NB shop. TTC installation work will be slated to begin after relocation of beamline components

NBI Power: Preparation of the requisition package for the cable and tray installation subcontract is in progress.

**NBI Controls: Work continued on LCC modifications.**

NBI Duct and TVPS: The large circular bellows has been received. Fabrication continues on duct flanges and spool pieces. A requisition was placed to order turbomolecular pumps. The Bay JK cap passed leak check and returned to the shop for final flange machining and weld preparation. The drawing update for the JK as-built condition is in progress. The lift fixture was evaluated and changes are underway to improve the design for additional failure modes and effects.

**Office of Project Management (T. Stevenson):**

Development of the Work Planning online system revision 6.0 continues. On page format changes are in progress.

ENG-006 Statements for Work and Specification procedure was finalized and sent for approvals. This procedure received a full process review and revision for skid steer JONs.

Development of the System Engineer training per procedure ENG-016 on Preventive Maintenance continues. A brief online training package similar to the COG/RLM training module is in development.

An in-house EVMS surveillance self-assessment required by the PMSD has been planned and scheduled in November. Primary focus will be on the NSTX Upgrade capital project.

## **Facilities and Site Services (M. Viola):**

Ana Pinto and Charlie Kircher have begun entering FIMS data for PPPL into the Federal information management system.

Material Services Highlights: Fleet Services exchanged one of ESU's trucks that used gasoline with a new pick-up that uses E-85 fuel.

The C-site (OA) Scrap yard was cleaned generating over 26 tons of scrap metal that was transported to PPPL's scrap contractor for recycling.

Fire Protection: A Laboratory wide fire protection review is being scheduled and will involve outside personnel. R. Camp provided some info on ACAMS to Site Protection in preparation for DOE review next week. Drawing mark-ups for print room card reader installation is complete. We requested prices from Siemens to provide a duct detector for the new Carpenter Shop HVAC and program it into the fire alarm panel. We also received an estimate from Master Fire for installation. For Halon Discharge Follow Up, R. Camp contacted duPont and requested video to be used in training for people who occupy Halon protected areas.

Telecommunications: As a preventive maintenance action plan, Altura, our phone system vendor, is replacing Gateway 1 in the phone system. Gateway 1 supports approximately 168 analog phone users. Prior to the system firmware upgrade, station cards on Gateway 1 had the most problems.

The telecommunications office supported various temporary office moves due to office renovations in DOE and HP departments by relocating phones, faxes and wiring.

In an effort to reduce costs, the telecommunications office is soliciting quotes from various radio vendors for the purchase of portable and mobile radios requested by Laboratory staff. The telecommunications office will purchase this same equipment from the least expensive vendor. The telecommunications office now does most of the programming for the Lab's UHF portable radios, which saves the Lab money on vendor programming costs.

The bad audio panel from the radio console located in the Command Center will be replaced. The panel was damaged by liquid that spilled on the equipment. The panel is part of a 'backup' system for the Command Center's radio operations. The replacement panel will be funded by the Site Protection Division, who is the user of this equipment.

## **BUSINESS OPERATIONS (E. WINKLER):**

The Travel Office is processing the travel arrangements for PPPL participants to attend the Annual Meeting of the APS Division of Plasma Physics that will be held in Providence, Rhode Island from October 29 – November 2.

S. Prager and T. Bleach met with Tracey Robertson, Director, Sponsored Research Accounting from the Princeton University Office of Finance & Treasury, and members of her staff to discuss

the upcoming Princeton A-133 Audit. This is an annual audit of expenditures charged to federal grants and contracts to ensure federal compliance and internal controls are in place.

PPPL's maintenance cost data was provided to DOE for inclusion in the Office of Science Quarterly Maintenance Report for the fourth quarter of FY2012.

A Work for Others Agreement was executed with Corning Incorporated for the project titled "Radiological Analysis on Glass". The Principal Investigator is G. Ascione. The budget for this effort is \$17,000.

A. White participated in the Small Business Program Managers' conference call hosted by OSDDBU Deputy Director John Hale. One major agenda item was a discussion of three-year commodity forecast data provided by some of the participating laboratories, including PPPL.

PPPL is participating in planning for a new consortium buying initiative for automobile rental services. This effort is being coordinated by the NNSA's Supply Chain Management Center (SCMC). SCMC is operated by Honeywell at the NNSA's Kansas City Plant. The objective of the initiative is to leverage the DOE contractor community's aggregate buying power to establish more favorable, agency-wide rental car rates.

The Procurement Division entered the Laboratory's FY 2012 small business plan performance data into the eSRS reporting system. All FY 2012 small business subcontracting goals were met or exceeded.

The Procurement Division reported the Laboratory's fourth quarter and total FY 2012 cost savings results to DOE. As of September 30, PPPL reported total annual cost savings of approximately \$2.7 Million. These results were derived by the application of standardized metrics adopted by the DOE Contractor Supply Chain Council. Cost savings are reported as part of the Procurement system balanced score card (BSC) metric.

#### **INFORMATION TECHNOLOGY (S. BAUMGARTNER):**

A quote for manufacturing GA integrator boards was obtained. This will be reviewed with GA engineering.

Work continues on the NSTX-U Plasma Control System. Software is being modified to conform with the GA-recommended PCS framework; this vastly reduces the amount of PPPL-written code. On the hardware side, the focus is on getting the new Curtiss-Wright SL240 boards to perform FPDP I/O.

Microsoft SQL2000 databases used for NSTX need to be ported to a currently-supported version of Microsoft SQL (2005 or 2008). The first step is to discover client codes and assess the magnitude of the upgrade work.

Business Computing released a new enhancement to Great Plains supporting payroll, procurement, and material control.

We received and are evaluating two responses to the Cyber Security SharePoint Dashboard RFP.

**DIRECTOR'S OFFICE (B. SOBEL):**

On October 23, Professor Kripa K. Varanasi of the Massachusetts Institute of Technology, presented a colloquium entitled "Nanoengineered Surfaces in Energy and Water".

On October 23, Dick Oberman, Democratic Chief of Staff for the House Science, Space and Technology Committee visited the Laboratory. S. Prager presented an overview of the Laboratory and Mr. Oberman was given a tour of the facility.

On October 24, M. Zarnstorff attended a meeting of the Chief Research Officers in Washington, DC.

This report is also available on the following web site:

<http://www-local.pppl.gov/director/highlights/2012-highlights.htm>