

PRINCETON PLASMA PHYSICS LABORATORY

**WEEKLY** highlights



**The PPPL Highlights for the week ending April 26, 2013, are as follows:**

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

PPPL issued a Request for Proposals for ITER HV Control & Protection Hardware.

The ITER In-Vessel Coil design team, led by M. Kalish, participated in an "Analysis Review" of this coil system, designed to control edge instabilities and vertical plasma position.

R. Feder submitted a revised report entitled "Survey of Interspace Dose Rates for US ITER Equatorial Port Diagnostics" to the US ITER Project, incorporating comments from independent reviewers at ORNL.

The ITER Organization hosted a "Workshop on Mirror Cleaning". There were two presentations on mirror cleaning from the US (C. Skinner - PPPL, H. Yuh - Nova Photonics). A highlight of the meeting was the presentation of observations of mirror degradation during exposures in the new "JET- with ITER-like wall" configuration. The observed degradation was far less for mirrors at the outer midplane than that previously observed with similar exposures when JET utilized carbon rather than tungsten divertor targets.

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

The text of the NSTX-U 5 year plan for FY2014-18 has been completed by the NSTX-U research team and made available to the 5 year plan review panel. Special thanks to the team for their hard work over the past 1.5 years in putting together the plan. The text is available at the following URL: <http://nstx-u.pppl.gov/five-year-plan/five-year-plan-2014-18>.

Several NSTX-U Team members participated in the ITPA MHD Stability Group meeting, held last week at the Culham Centre for Fusion Energy, UK. S. Sabbagh (Columbia University) gave two presentations, one to summarize recent work conducted under joint experiment MDC-2 on global instability analysis code benchmarking and joint experimental results, and another proposing a new joint experimental activity on global mode disruption prediction and avoidance. D. Gates (PPPL) delivered a presentation on the origin of the tokamak density limit. L. Delgado-Aparicio (PPPL) gave a talk on impurity-induced MHD and the impact of low vs. high-Z plasma facing components. J.K. Park (PPPL) gave a remote presentation on NTV physics theory and analysis.

R. Maingi (PPPL) attended the ITPA Pedestal and Edge Physics Meeting on April 22 in Garching, Germany, and served as Vice-Chair. John Canik (ORNL) presented a talk remotely, "Changes to Edge Microstability When Lithium PFC Coatings are Applied in NSTX." A. Diallo (PPPL) attended and presented a talk "Direct Observations of the Onset of a Coherent Continuous Edge Instability Limiting the Pedestal Gradient Between ELMs", highlighting joint work with Alcator C-Mod. J-W. Ahn (ORNL) presented a talk remotely "Effect of Shaping on ELMs and Observation of a Small ELM Regime at KSTAR", highlighting joint work with KSTAR.

C. Skinner (PPPL) and H. Yuh (Nova Photonics) attended the ITER workshop in First Mirror Surface Recovery on April 23-24 by remote connection. C. Skinner gave two presentations: the first was "Laser Cleaning of Candidate Diagnostic Mirrors for ITER" and reported results from laser cleaning carbon and beryllium coated mirrors and an initial concept for implementation of laser mirror cleaning in ITER. The second presentation was on "First Mirror and Dust Risk" and outlined strategies and recommendations for mitigating the technical and project risk in these areas. H. Yuh gave a presentation on "Low Energy Ion Beam Mirror Cleaning" that described a proposal to apply a 2D array of duoplasmatrons to generate a uniform low energy ion beam for ITER diagnostic mirror cleaning.

Dr. Pratipalsinh Rayjada from the Institute for Plasma Research in Gandhinagar, India, visited PPPL on April 22-25. His expertise is in materials for fusion applications, and he gave a seminar on his work entitled "Erbium Oxide Coating for Hydrogen Barrier: Process Optimization." India has proposed to develop and test a Lead-Lithium cooled Ceramic Breeder (In-LLCB) concept Test Blanket Module (TBM) for ITER. The erbium oxide coating is intended to create a tritium permeation barrier (TPB) to avoid accumulating tritium in the structural material of the TBM. Dr. Rayjada also had numerous discussions with PPPL personnel on lithium as a plasma-facing component.

Preparations for plasma operations in the NSTX-U configuration also continued with the start of power testing of the new firing generators for the field coil power conversion (FCPC) system rectifiers. Six of the planned thirty four firing generators have now been delivered to FCPC.

## **ITER & TOKAMAKS (R. WILSON):**

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

The lithium granule injector developed at PPPL and installed on DIII-D as part of a DIII-D/NSTX-U collaboration was commissioned at DIII-D, led by Gary Jackson. Granules were dropped into ohmic and H-mode discharges. The timing and amount were varied to confirm controllability and assess effects on the plasma. The lithium was observed on a tangential visible camera with a lithium-1 filter, the MDS spectrometer, SPRED, and CER spectroscopy. There were no adverse effects observed in the plasma and signs of modest recycling reduction.

D. Battaglia presented a talk at the US-EU Joint Turbulence Task Force Workshop titled: "Interpretive full-f edge transport calculations for DIII-D." This talk summarized recent work with XGC0 showing that particle, energy and momentum transport through the steep gradient region of the H-mode pedestal is very close to neoclassical following the L-H transition. In

addition, the drift-kinetic simulation quantitatively matches a number of experimental observations that are not captured in fluid models, such as large intrinsic ion parallel flows near the separatrix, poloidal asymmetries in plasma profiles, ion temperature anisotropy at low collisionality, and large impurity ion temperatures in the SOL.

A paper titled "Collisionality Scaling of Main-ion Toroidal and Poloidal Rotation in Low Torque DIII-D Plasmas" by Brian Grierson et al., has been accepted for publication in Nuclear Fusion.

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

H. Neilson and C. Gentile attended the Office of Science review of the U.S. ITER project as reviewers. The review, which was held April 23-24 at Oak Ridge National Laboratory, focused on progress against the U.S. ITER project plans for FY13 and FY14.

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

Two PPPL Theory graduate students were selected for the 2013 Sherwood Theory Poster Award this week in Santa Fe, NM. The awards, which carry a \$500 stipend, went to J. Parker for his poster on "Zonal Flow as Pattern Formation: Merging Jets and the ultimate Jet Length Scale" and to Brendan Lyons for his poster on "A New Drift-kinetic Equation Solver for Coupled Neoclassical-magnetohydrodynamic Simulations in Axisymmetric Systems".

Dr. Dennis from the Australian National University, who is visiting PPPL and has been working with S. Hudson, presented a seminar on "A Minimally Constrained Model of Self-organized Helical States in Reversed-field-pinches". He presented a two-volume model for finding the helical states when energy is minimized against five assumed constraints (magnetic helicities and fluxes) on the two volumes. The SPEC equilibrium code is used to find these helical states by taking the constraints from the VMEC code. The talk stimulated many interesting questions regarding the number the constraints, the location of the domain of the first volume and helicity. This simplified equilibrium model has reproduced the experimental single helical states of RFX.

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

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

Construction: The upper cable tray has been installed on NSTX. Welding of the lower umbrella stiffeners continues. The two modified passive plates were completed in the shops and have been through vacuum prep. Their re-installation has been placed on hold by engineering while design requirements are being reviewed. PF5 supports on the vessel are being drilled and tapped for heli-coils.

CS Upgrade: The third quadrant is in the oven and it being readied for the VPI epoxy injection early next week. Two conductors for quadrant four were insulation wrapped this week. The Centerstack Casing is being vacuum leak tested. It is currently pumping down with the pressure at 10<sup>-5</sup> Torr. The OH Winding station and spool station fabrication continued throughout the

week in RESA. Everson has repaired the mold leak, closed it back up and performed the first VPI. The resin is currently undergoing the oven cycle and is expected to be completed over the weekend. The Bus Runs design has progressed well through the week. A well detailed design for the CHI and TF Bus Runs was completed. The OH Bus Runs is being designed now. A peer review is scheduled for Wednesday next week.

NBI Upgrade: The BL2 pressure plate fixture was mounted behind the source platform. Water manifold installation underneath the source platform continued. The second HVE relocation is in progress. The third HVE was moved into position for disassembly. Fabrication and leakchecking of LHe cryo line continues in the NB shop. LHe cryogenics line installation, welding, and leakchecking on the TFTR Test Cell South and East wall continues. Fabrication continues on the NB/TVPS duct components in the Tech Shop. Procurement activity for the water system piping subcontract continues. Work continued on the SOW and drawings for the power supply cable and tray subcontract requisition package. Tray support brackets were analyzed. The NBI Armor leakchecking was performed in the NBI Shop and one quadrant will require rework on a section of manifold tubing. VV reinforcement fabrication was evaluated for a make versus buy decision.

### **Office of Project Management:**

The COG/RLM online training for 2013 is in progress. Preparation and collection of requirements and scoping continues for Work Planning System 7.0 upgrade. A draft requirements document is nearing completion. Several concerns regarding WP page format were found and investigation by IT is in progress.

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

Engineering Services: A contractor walk through was held with four contractors to view the ESU Building work. Reviewed cost estimates for C site MG Building conversion to the Machine shop and Laboratory Building conversion to Offices as well as the first draft of the BLCC Life Cycle Cost analysis for the Project. This part requires some more inputs. We have begun the process of pulling the documentation together and putting in a package in order to wind down on this effort while we await more information on status of funding. Two boilers have been placed in shutdown mode for the summer. Steam will be shut down on May 17.

Fire Protection: A contract is being issued by procurement on the contract for the five year visual inspection of fire sprinklers systems. This was an action item from the Fire Protection Audit.

Telecommunications: The Telecommunications Office, Princeton University's Public Safety Department and Quality Communications (the Lab's radio vendor) installed and programmed new radio equipment, which will enable PPPL's Site Protection dispatcher to communicate directly with Princeton University's Public Safety primary dispatch center. During the monthly audit of the Verizon phone bill for the Laboratory's backup phone lines, the Telecommunications Office noticed that Verizon was charging for an extra feature not necessary for this particular service. The Telecommunications Office requested that Verizon remove this feature which will save the Lab \$25 per month.

Material Services: There was a meeting with representatives from the Baker Tilly, LLC (the Laboratory's external accounting firm) on April 24 to review government personal property

items that were selected from purchase orders. This was part of the Accounting Systems cost allowability audit. Several individuals within the Laboratory are currently using the new "Online Property Pass System". Minor issues have been reported and will be addressed prior to initial roll-out to entire Laboratory staff.

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

The Travel Office responded to a DOE data call requesting PPPL's conference attendance through the end of CY 2013.

R. Templon chaired a purchasing system peer review team at Washington River Protection Solutions (WRPS) in Richland, Washington. WRPS is responsible for tank cleanup and preparation for long term storage of radioactive wastes from plutonium processing.

#### **ENVIRONMENT, SAFETY, HEALTH & SECURITY (J. LEVINE):**

Emergency Services Engine 66 responded to Princeton for two mutual aid assignments.

SPD received the final report, "PPPL Physical Protection System Risk Assessment," from the DOE Office of Health, Safety and Security. This report summarizes the results of a DOE Office of Science led effort to conduct a physical protection system assessment of PPPL. The assessment was held in November 2012.

SPD issued two all staff e-mail messages regarding Campus Road closures and Saturday work in the LSB Lobby.

The Princeton University Department of Public Safety (DPS) provided radio equipment and antenna for improved interoperability communications between DPS and PPPL ESU. This equipment was installed and tested by the PPPL Telecommunications Office. The equipment will enable the Emergency Services Communication Center dispatcher to communicate directly with the DPS dispatcher.

SPD staff participated in a Pre-Bid Conference walk-thru of the Emergency Services Building for the Exterior Wall Upgrade project.

ESH&S staff participated in a DOE review of evaluation of our corrective actions for the electrical shock incident that occurred in the ESAT Robicon Power supplies after Hurricane Irene in August 2011.

#### **OFFICE OF COMMUNICATIONS: (K. MACPHERSON):**

C. Cane and J. Greenwald attended a Research SPIN meeting at the School of Engineering on the Princeton main campus on April 24 where the updating of local Wikipedia sites was discussed.

J. DeVoe and N. Ananos produced the PPPL Weekly, including stories on P. Heitzenroeder winning the 2013 Fusion Technology Award and a system to verify nuclear warheads, CFO Ed Winkler's retirement, Green Machine award winners and Earth Day photos.

J. DeVoe worked with videographer K. Coughlin to film at the NCSX/NSTX-U production site and at the NSTX-U site, where they were hosted by Erik Perry.

PPPL's Communiversity table was organized by J. DeVoe, with assistance from P. Hampton. The event occurred on April 18. T.J. Levis and others from facilities set up the tables, poster and ITER model and J. DeLooper set up science demonstrations. PPPL'ers gave science demonstrations, spoke to hundreds of visitors about PPPL and handed out give-aways and leaflets about PPPL and the upcoming Open House. Volunteers for Communiversity were: A. Cohen; J. DeLooper; J. DeVoe; H. Carnevale N. Desai; J. Greenwald; H. Neilson; D. Johnson; R. Hawlryuk; S. Jardin; S. Lazerson; K. MacPherson; M. Mardenfeld; D. Ortiz; and A. Zwicker.

J. Greenwald's piece about a PPPL-Princeton nuclear warhead verification project was published on the PPPL and Princeton homepages and was picked up by at least eight other websites.

K. MacPherson assisted Sara Bojo, a Princeton University journalism student, for an interview with H. Neilson on NCSX. She also assisted editors from International Innovation magazine for a story on S. Prager and PPPL. She worked with the Princeton University Office of Communications to produce an informational poster about PPPL for Communiversity.

E. Starkman composed/provided photos for the Weekly and slideshow.

J. DeVoe organized the following tours:

Twelve students and professors from Valley Forge Military College visited on April 25 and were hosted by J. DeVoe. The group visited the NSTX Control room and annex and the NCSX/NSTX-U production site.

### **BEST PRACTICES & EXTERNAL AFFAIRS (J. DELOOPER):**

The following PPPL Report were posted to the web:

Properties of Alfvén Eigenmodes in the TAE range on the National Spherical Torus Experiment-Upgrade PPPL-4868

Authors: M. Podesta, N.N. Gorelenkov, R.B. White, E.D. Fredrickson, S.. Gerhardt and G.J. Kramer

Submitted to: Physics of Plasmas (April 2013)

Calculation of Neoclassical Toroidal Viscosity with a Particle Simulation in the Tokamak Magnetic Breaking Experiments PPPL-4869

Authors: Kimin Kim, et. al.

Submitted to: Nuclear Fusion (January 2013)

Geometrical Optics of Dense Aerosols PPPL-4870

Authors: Michael J. Hay, Ernest J. Valeo and Nathaniel J. Fisch  
Submitted to: Physical Review Letters (April 2013)

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

On April 23 M. Zarnstorff attended the IPO Lehman Review held at Oak Ridge, TN.

On April 24, Professor Brad Marston, Brown University, presented a colloquium entitled "Environmental Condensed Matter Physics".

April 24-25, the Princeton University Advisory Committee Meeting was held.

On April 26, S. Prager met with the University Board of Directors to discuss the preliminary reports presented by the Advisory Committee Chairs.

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