

PRINCETON PLASMA PHYSICS LABORATORY

**WEEKLY** highlights



**The PPPL Highlights for the week ending July 13, 2012, are as follows:**

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

A kickoff meeting was held with URS Energy and Construction, Inc. to discuss the work plan on a new contract to develop the purchasing specs for the ITER Steady State Electric Network components. A limited start of work has been authorized to set up project control, reporting, and invoicing schemes which link with PPPL's requirements. However, no work will be authorized on the start of production of purchasing specs, etc., until the Procurement Arrangement between the ITER Organization and the USIPO is signed.

**NSTX (M. ONO):**

**NSTX-U is in the Upgrade Project outage in FY 2012**

The papers "Transient CHI Plasma Start-up in NSTX and CHI Program Plans on NSTX-U", by R. Raman (U. Washington), D. Mueller (PPPL), S.C. Jardin (PPPL), et al. and "Massive Gas Injection Plans for Disruption Mitigation Studies in NSTX-U" by R. Raman, D.P. Stotler (PPPL), T. Abrams (PPPL), et al., were published in a special issue of the journal IEEJ Transactions on Fundamentals and Materials, Vol. 132 (2012) No. 7, dedicated to the International ST Workshop. These papers briefly summarize experimental and computational results from NSTX CHI experiments and program plans for CHI and MGI experiments on the upgrade to NSTX, which is now under construction.

Jon Menard (PPPL), Gary Taylor (PPPL), and Rajesh Maingi (ORNL) attended the 10th US-PRC Magnetic Fusion Workshop, held at UCSD from July 10-12. Menard presented a talk "Overview of PPPL and NSTX-U collaboration interests, plans, and results on EAST", and Maingi presented a talk "The steps by which lithium wall coatings lead to ELM avoidance in NSTX". There were many fruitful discussions on new collaboration prospects between US and Chinese scientists.

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

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

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

Ben Tobias and Michio Okabayashi presented papers titled "ECE Imaging of the H-mode Pedestal" and "Off-axis-Fishbone-mode Excitation of ELM and RWM in High Beta<sub>N</sub> Regime", respectively, at the 39th EPS meeting in Stockholm Sweden.

### **Alcator C-Mod (R. Ellis):**

Luis F. Delgado-Aparicio gave a contributed talk the EPS meeting in Stockholm-Sweden, and was invited to give a seminar at the EPFL-CRPP in Lausanne, Switzerland. The topic of these two presentations was on the research of the formation and stability of impurity 'snakes' in tokamak plasmas. These new results have been summarized in a paper that Luis F. and our collaborators from Alcator C-Mod have recently submitted to Physical Review Letters.

### **International (J.R. Wilson):**

Robert Budny presented an EPS paper: "Transport in JET H-mode plasmas with beam and ion cyclotron heating".

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

The Wendelstein 7-X (W7-X) collaboration made progress on both engineering and physics fronts this week. The manufacturer Everson Tesla, Inc. shipped the second of five trim coils to the Max Planck Institute for Plasma Physics (IPP), the project site in Greifswald, Germany. The coil is expected to arrive on August 7. The third coil is being prepared for resin impregnation at Everson's Nazareth, PA, facility. PPPL stellarator physics head David Gates began a two-week visit to IPP for discussions with the scientific staff regarding the next phase of the U.S. collaboration on W7-X, which will center on the transition to physics research. Accordingly, potential U.S. involvement in W7-X diagnostics, for example x-ray imaging crystal spectrometry, is one of the discussion topics. While at IPP, Gates also participated as reviewer in a preliminary design review of the W7-X "scraper element," a high heat-flux component for which Oak Ridge National Laboratory is playing a major design role as part of the U.S. collaboration.

## **THEORY:**

A few Theory Department members attended the 39th European Physical Society Conference on Plasma Physics & International Congress on Plasma Physics held in Stockholm, Sweden, July 2-6. Jay Johnson presented an invited talk in the basic, space, and astrophysical plasmas sessions entitled "The Effect of Heavy Ions on Magnetopause Transport", Seung-Hoe Ku gave an invited talk, entitled "Intrinsic Rotation in Flux-driven Global ITG Turbulence Simulations," Nat Fisch presented a poster titled "Very High Laser Intensities via Resonant Raman Compression" and the poster "Possibility of Type-I ELMy H-mode Operation in ITER Hydrogen Phase" was prepared by A. Polevoi, N. N. Gorelenkov, S.Yu.Medvedev, S. Konovalov et.al. on a possible study

important physics questions on TAE driven quasilinear diffusion, NTM and peeling-ballooning limits. The work is a result of the continuing collaboration of PPPL, ITER organization, Keldysh and Kurchatov institutes in Russia. In it a special case of a hydrogen plasma was considered with low B field which is stable or close to being stable with the respect of the modes addressed.

Jay Johnson also visited the International Space Science Institute in Bern, Germany, July 9- 12, Jay led a team meeting on plasma entry and transport.

On July 10, Dr. Bruce Scott gave a special theory seminar entitled "Symmetry of Momentum Conservation in Gyrokinetics." A brief overview of the gyrokinetic field theory was given and the specific role of the time-dependent polarization current was discussed. It was shown that the contributions in the zonal toroidal momentum transport equation due to higher-order field components in the Hamiltonian can be put into the same symmetric structure as the lowest-order piece. Hence arguments about symmetry and cancellation should be applied equally to all orders, not just the lowest. Measurements of the PDF of these terms in computations were given.

On July 12, Dr. Kimin Kim gave a theory seminar entitled "Delta-f Monte-Carlo Calculation of NTV in Perturbed Tokamaks and Demonstration of Bounce Harmonic Resonance." A new delta-f particle code (POCA) was discussed capable of addressing the nonambipolar transport associated with non-axisymmetric magnetic perturbations. The code is using a modified pitch-angle collision operator, preserving momentum conservation. Basic features of POCA were introduced with benchmarking tests in axisymmetry. Neoclassical toroidal viscosity (NTV) torques were calculated and compared with a combined and  $1/n$  theory, indicating essential physics of NTV transport such as the dependence on the perturbed magnetic field and strong resonance. The first numerical demonstration of bounce harmonic resonance was given. Also discussed was the observation of a new type of bounce orbit, modified by the bounce harmonic resonance, which prevents phase mixing of bounce orbit thus enhancing the NTV. Finally, a preparation for experimental application of POCA was addressed.

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

The M3D-C1 group met with Sherry Li and others in the NERSC/LBNL Linear Solvers group to discuss development of an improved linear solver for the preconditioning phase of M3D-C1 at high processor count (10,000p - 40,000p) as is planned for production runs in 2013. The SuperLU\_Dist and MUMPS based block Jacobi preconditioners start to deviate from ideal weak scaling in this range of processors. The M3D-C1 formulation approximately decomposes the velocity field into the 3 MHD wave components by way of the Helmholtz decomposition of the velocity vector and the application of annihilation operators on the momentum equation. Our plan is to take advantage of this partial separation in PDSLIn, which is an iterative solver based on SuperLU\_Dist, to quickly form concurrent approximate factorizations corresponding to each wave type on each toroidal plane and then iteratively refine the solution to take into account the wave-wave coupling. We agreed to start working evaluating this technique as applied to test matrices of this size in the coming weeks.

## **PLASMA SCIENCE AND TECHNOLOGY (P. EFTHIMION):**

### **Laboratory Plasma Astrophysics**

H. Ji gave a lecture at East-Asian School and Workshop on Laboratory, Space and Astrophysical Plasmas which was held in Jeju Island, South Korea from June 25-June 29. This meeting is the second one after the first such a school and meeting held in Beijing, China last year on the same subjects: to promote plasma astrophysics in Asian Countries including China, South Korea and Japan. The subjects of this school and workshop include turbulence, reconnection, dynamo and momentum transport. The lecture gave by H. Ji was entitled "Magnetic Reconnection: An Introduction" which lasted for 1.5 hours and substantial discussions took place following the lecture. Possible collaborations were discussed among many participants including students and young researchers. The next year's plan is to hold it in Japan during the summer.

H. Ji attended the 2012 ASTRONUM meeting which was held in Big Island, Hawaii, from June 25-June 29. This is the latest one of a major meeting series of Numerical Simulations in Astrophysics, covering a wide range of topics from numerical methods, to astrophysics, even cosmology. Plasma astrophysics is a major part of this meeting series, including heliophysics. H. Ji gave a keynote talk titled "Laboratory Studies of Magnetic Reconnection", possible collaborations between laboratory experiments and numerical simulations followed the talk, and a few specific ideas were discussed.

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

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

NBI Upgrade: Work continues in NBPC, NTC, TTC, and the Technical Shops. HP support continues to keep pace with beam activities in the TTC. Re-evaluation of the Bay JK cap and port extension will be required to assess welds. Management held the monthly status meeting with active jobs reporting steady progress. Concerns for inefficiencies due to parts delays and summer vacations were noted.

NBI Armor: Machining resumed on the backing plates to accommodate as built manifolds.

NBI Relocation: Development of the Installation procedure for the Beamline relocation into the NTC continues. Development of a procedure for the Beamline alignment has started. The lift beam for the BL has been moved to the TTC for trial fit. The trail lift and leg rearrangement is scheduled for next week.

NBI Refurbishment: Progress continues on Calorimeter water lines and reassembly in the TTC. Ion Dump helicoil installation was delayed awaiting the last few parts. 90 inch flange feedthrough fabrication and leakchecking proceeded this week.

NBI Power & Services: A bidder conference is being held for penetration subcontractors to evaluate the job. Work continues on the liquid Nitrogen supply line and fabrication of Helium parts.

NBI Controls: LCC controls and wiring modifications continue on the NBPC 138 level. Mod/Reg chassis modifications continued in the Mod/Reg shop.

NBI Duct and TVPS: The Bay JK weldment and port extension need reinspection for weld quality. Ultrasonic testing is planned. An NCR is being written because some rework is probable. Flange fabrications continue. VV temporary support structure installation is complete. Metrology was performed on the cap to prepare to make the JK cut.

NSTXU Coil winding is now in production mode. The first seven bars have their coolant tubes installed and were delivered to the winding area. Three of the seven have been wound with insulation while the last three are waiting to be deburred and cleaned for winding.

The first 12 Outer TF structure weldments have been received and were given an incoming inspection. Several non-conformances were identified including mislocated holes and non-conforming welds. The vendor has been notified of the issues and a teleconference was held to determine the condition of the remaining 12 pieces still at the supplier and to discuss the nonconformances. The rework options are being discussed internally and a disposition will be provided to the vendor on Monday. As a precaution the other weldments supplied by this supplier are being inspected to determine if similar deficiencies may be present. A NDE vendor is being brought in to inspect those parts ultrasonically to verify the integrity of those welds prior to approving them for payment.

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

The Project Status Review Board meeting was held this week to review highlighted jobs.

Changes were made to the production Work Planning online system to account for personnel changes.

Comments resolution on ENG-016 Preventive Maintenance is in progress but no major concerns were noted. Development of SOW ENG-006 continues to meet requirements for resolutions of Skid Steer JONs.

COG/RLM training development for ENG-016 Preventative Maintenance, for the updated SOW procedure ENG-006, and for Davis Bacon considerations has started

Several draft documents were reviewed for Project Management content and impact.

#### **Facilities (M. Viola):**

Roof rework: The roofing continues on the LSB. The metal edging has arrived and is being installed. The focus is now on the Commons patio, which has been demolished and is being cleared of the rubble. There is a new system that will be installed that involves several layers with a very nice decorative paving block as the top layer. However, the waterproof layer applied during this installation involves a highly noxious hot substance similar to rubber. We are looking at performing this work on the weekend but the odor may linger.

Steam Trap Program: The Facilities Division initiated a steam trap maintenance program in FY12. The first phase was completed during the heating season and consisted of a complete survey of the entire steam trap system in C and D sites. The second phase is underway consisting of replacing defective traps. The third phase will entail re-tagging the entire system and schedule preventive maintenance. The steam trap program is aimed at improving system reliability, reduce steam losses, and greatly improve facility efficiency. This program will translate in improved heating system cost-efficiency at PPPL.

Boiler and Chilled Water Operations: The boiler controls have been calibrated and rebuilt and will be reinstalled July 17. Boiler cleaning begins this week and the state inspection is planned for August. The gas regulators have been rebuilt and may also be installed in a week or so. The chillers are now running in automatic and have been functioning really well keeping up with our recent heat wave.

Cafeteria: We have reevaluated our use of compostable utensils. For one month's cost of compostable utensils, we can purchase a full set of stainless flatware. Chef Keith advises that this would be a desirable change from his point of view as well. We are also looking into the cost benefit of compostable vs. biodegradable paper products for other items.

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

The Accounting Division submitted PPPL's third quarter FY2012 Financial Statement Analysis and Footnote Disclosure information to the DOE Chicago Office.

The Accounting Division submitted the quarterly Accounts Receivable Report to DOE. This is a report of accounts receivable due to PPPL from the public including employees, non-Federal work-for-others, intra-university sponsors, and other miscellaneous parties.

The Accounting Division submitted the required information to DOE to comply with the testing phase of OMB Circular A-123 (SOX) reporting requirements. PPPL's evaluation included testing the design and operating effectiveness of each control for the processes identified by DOE. Based on the results of this evaluation, PPPL can provide reasonable assurance that internal controls over financial reporting are operating effectively. This exercise supports the representations and assurances provided in support of the Federal Manager's Financial Integrity Act reporting requirements.

Marie Iseicz attended the annual meeting of the DOE Laboratory Budget Officers in Boston. The purpose of the meeting is to bring together the Budget Officers of all DOE national laboratories to discuss current and emerging issues, to share best practices, and to exchange lessons learned.

PPPL provided information regarding non-Federal WFOs and CRADAs in response to the Technology Transfer Data Call issued by the DOE Technology Transfer Coordinator.

PPPL submitted to the DOE its "interim" approval package for qualifying conferences in accordance with the guidance published by Daniel B. Poneman on July 6.

Procurement Division representatives participated in the monthly teleconference of the Procurement Evaluation and Reengineering Team (PERT). Rod Templon reported on the activities of the subcommittee revising the PERT's Procurement System Independent Peer Review Handbook. Other agenda topics included other subcommittee reports, results of the recently completed peer review at Ames Laboratory, and staffing of review teams for FY 2013.

The Procurement Division has set up a Labor Law bulletin board in the lobby entrance off the Lower "N" parking lot. This board is devoted exclusively to the display of posters and materials related to federal laws and regulations governing subcontract work on the PPPL site, including the Davis Bacon Act (DBA) and the Service Contract Act (SCA). Three-ring binders have been installed adjacent to the board. These binders contain copies of the current wage determinations for all DBA and SCA procurements currently underway at PPPL. The announcements and binder contents will be updated as work is completed and new subcontracts are initiated. Comments or questions about the display materials should be directed to Debbie Parente (email: [dparente@pppl.gov](mailto:dparente@pppl.gov); ext. 2428).

Natalya Gnyp participated in a management development training course presented by the Princeton University Human Resources Office. The course, entitled "Leveraging Diversity: Challenges and Opportunities," The course is designed to equip participants to deal effectively with today's increasingly diverse work force.

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

Keith Rule hosted collaborators from Carnegie Mellon University, Penn State, Rutgers, and Bayer Materials Science in support of our efforts to perform energy efficiency projects at PPPL for the DOE Energy Efficient Building Hub (EEB Hub).

The Environmental Services Division received approval from DOE-PSO for disposal of low-level radioactive waste at the Energy Solutions facility in Clive Utah.

ESU Engine 66 responded to Princeton, Princeton Township and B-Site for one mutual aid assignment each. ESU Ambulance 166 responded to Plainsboro for two mutual aid assignments.

ESU Officers Ashley White and Ani Malool attended a Basic Security Officer Training Program sponsored by NJCUPSA at Rutgers University. This 40-hour course covered essential training that includes security procedures, first aid, CPR & AED use, defensive driving, incident command and fire safety/response.

The ORPS (Occurrence Reporting and Processing System) Quarterly Performance Analysis Report for CY 2011 Second Quarter was submitted to DOE/PSO and PPPL senior management.

The surface water permit limit for chlorine produced oxidants (CPO) was exceeded at the basin outfall, resulting in submission of an ORPS Report (SC--PSO-PPPL-PPPL-2012-0003).

SPD and Capital Health Emergency Medical Services have renewed and finalized a three-year Automated External Defibrillator Agreement. The Agreement allows SPD to offer Automated

External Defibrillator (AED) services under the guidance of the sponsor (Capital Health). ESU Officer John Mazukewicz is SPD's AED Coordinator.

The US flag was lowered to half-staff on July 13. New Jersey Governor Christie ordered the flag to be flown at half-staff in recognition of the life and in mourning of the passing of Millville Police Department Patrolman Christopher Reeves who died in the line of duty on July 8.

A Management Safety Walkthrough of the C-Site Lab Building, second floor was held on July 12.

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

Andrew Zwicker attended a meeting hosted by the DOE Office of Workforce Development for Teachers and Students in Gaithersburg, MD. The agenda included a review of the SULI/CCI/VSP programs and preparation for a reverse site visit review of the national lab education programs.

The following PPPL Reports were posted to the web:

Plot/SurfW: Plotting Utility for EDGE2D Output PPPL-4773

Authors: W.M. Davis and J.D. Strachan

Submitted to: TBD

Varying the Pre-discharge Lithium Wall Coatings to Alter the Characteristics of the ELM-free H-mode Pedestal in NSTX PPPL-4774

Authors: D.P. Boyle, J.M. Canik, R. Maing, P.B. Snyder, T.H. Osborne, and the NSTX Team

Submitted to: Journal of Nuclear Materials/Elsevier

Numerical Calculation of Neoclassical Distribution Functions and Current Profiles in Low Collisionality, Axisymmetric Plasmas PPPL-4775

Authors: B.C. Lyons, S.C. Jardin, and J.J. Ramos

Submitted to: Physics of Plasmas (May 2012)

Plasma-based Accelerator with Magnetic Compression PPPL-4776

Authors: Paul F. Schmit and Nathaniel J. Fisch

Submitted to: Physical Review Letters (June 2012)

Stochastic Orbit Loss of Neutral Beam Ions From NSTX Due to Toroidal Alfvén Eigenmode Avalanches PPPL-4777

Authors: D.S. Darrow, N. Crocker, E.D. Fredrickson, N.N. Gorelenkov, M. Gorelenkova, S. Kubota, S.S. Medley, M. Podestà, L Shi, and R.B. White

Submitted to: Nuclear Fusion (July 2012)

Full Toroidal Imaging of Non-axisymmetric Plasma Material Interaction in the National Spherical Torus eXperiment PPPL-4778

Authors: Filippo Scotti, A.L. Roquemore, and V. A. Soukhanovskii

Submitted to: Review of Scientific Instruments (April 2012) Submitted to: High Temperature Plasma Diagnostic Conference, Monterey, California (May 6-10, 2012)

Fast-ion Energy Loss During TAE Avalanches in the National Spherical Torus Experiment  
PPPL-4779

Authors: E.D. Fredrickson, N.A. Crocker, D.S. Darrow, N.N. Gorelenkov, G.J. Kramer, S. Kubota, M. Podesta, R.B. White, A. Bortolon, S.P. Gerhardt, R.E. Bell, A. Diallo, B. LeBlanc, F.M. Levinton, H. Yuh

Submitted to: Nuclear Fusion (June 2012)

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

On July 10, Stewart Prager chaired a meeting of the Laboratory's Budget and Human Resources Committee.

July 11-12, Adam Cohen attended the Brookhaven's Operations meeting in Long Island, New York.

On July 12, the quarterly Laboratory Management Review (LMR) meeting was held.

This report is also available on the following web site:  
<http://www.pppl.gov/polWeeklyHightsExternal.cfm>