

**The PPPL Highlights for the week ending June 2, 2017 are as follows:**

**U.S. ITER FABRICATION (H. NEILSON):**

**Steady State Electrical Network (J. Dellas):**

Reactive power compensator Lots 3 and 4 were delivered to the ITER off-site warehouse in Port Saint Louis du Rhones on May 29. The preliminary inspection report was satisfactory.

Assembly work on the uninterruptible power supply (UPS) and DC distribution network is on schedule. Assembly is complete for both 600 kVA UPS systems (101 & 102) and the DC Distribution. Assembly is underway on one of the 900 KVA UPS systems (103).

**Diagnostics (R. Feder):**

Several papers were prepared by the PPPL ITER Diagnostics team for presentation at the 27th IEEE Symposium on Fusion Engineering, held June 4-8 in Shanghai, China. The group is represented at the conference by Team Leader R. Feder and Analysis Leader Y. Zhai. Team members K. Lukazik and P. Serai are attending to manage conference registration and logistics. H. Neilson organized the symposium.

Toroidal Interferometer/Polarimeter (TIP): A new strategy for remote handling the thermocouple attachment to the TIP cooled mirrors was developed and modeled. This strategy will be presented to a peer group in the near future. The TIP team was asked by the IO to assess the impact of additional windows in the laser beam relay system that transports the beams from the diagnostic hall to the port plug. These windows would provide a "passive" rather than an "active" approach to tritium and beryllium confinement. The baseline "active" approach relies on isolation valves.

**NSTX-U RESEARCH (J. MENARD):**

R. Majeski, L. Delgado-Y. Zhai, and E. Kolemen made presentations at the FESAC TEC panel in Rockville MD. Majeski presented "Recycling reduction for control of anomalous transport", Zhai presented "High Temperature Superconductors for next step fusion magnets", Delgado-Aparicio presented "Burning-plasma diagnostics: photon and particle detector development needs", and Kolemen presented "Real-time Stability Analysis and Control for Disruption Free Operations." R. Maingi chaired the panel, and J. Menard was a panelist.

Walter Guttenfelder visited General Atomics the week of May 22-26 to prepare for the NSTX-U/DIII-D collaborative campaign experiment, “Validate electromagnetic effects on transport in high performance plasmas,” and to discuss potential longer range DIII-D engagement during the NSTX-U outage.

Members of the University of Washington and PPPL CHI team traveled to the QUEST spherical torus facility, Kyushu University, Japan, from May 22 to June 2 to conduct transient CHI experiments on QUEST (R. Raman and B.A. Nelson, University of Washington and M. Ono, PPPL). The first week was spent improving the voltage monitoring system on the capacitor bank, re-testing the CHI capacitor bank and improving two fast CHI gas injection systems by using smaller gas injection plenums and increasing the operating pressure from 0.4 to 0.8 MPa.

A new fast mid-plane camera system was also commissioned during CHI plasma discharges. This was followed by quickly re-establishing discharges conducted during the December 2016 campaign. During the second week, significant progress was made in four areas: First, the CHI produced toroidal current was increased from 29kA (achieved in December 2016) to 48kA. Second, the current multiplication ratio was increased from 0.75 to over 1.5. Third, during the design phase of the new biased electrode system for QUEST, it was thought that this configuration might be more prone to absorber arcs. During this run, improved camera measurements of the lower divertor region identified the occurrence of absorber arcs. However, through proper programming of the poloidal field coils and optimized gas injection conditions these arcs could be readily controlled. Fourth, the absorber arc control allowed us to initiate a new discharge configuration in a narrower injector flux footprint configuration, with the use of higher vertical fields, to conduct useful scans of the vertical field, the applied CHI voltage, and the impact of operating with a single gas valve. During these two weeks of CHI experiments, the CHI engineering systems operated with 100% reliability with no issues. Members of the QUEST Team, including a number of students and researchers from various Universities in Japan participated and provided dedicated support during the productive second CHI campaign. (R. Raman)

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

Kentaro Hara (Texas A&M University, PPPL), I. Barth (PPPL, Racah Institute of Physics), Erez Kaminski (Birmingham-Southern College), I. Dodin (PPPL), and N. Fisch (PPPL) published a paper titled “Kinetic simulations of ladder climbing by electron plasma waves” [Phys. Rev. E 95, 053212 (2017)]. The paper explores parametric manipulation of the plasma wave spectrum. Specifically, the energy of plasma waves can be moved up and down the spectrum using chirped modulations of plasma parameters, which can be driven by external fields. Depending on whether the wave spectrum is discrete (bounded plasma) or continuous (boundless plasma), this phenomenon is called ladder climbing (LC) or autoresonant acceleration of plasmons. It was first proposed by Barth *et al.* [Phys. Rev. Lett. 115, 075001 (2015)] based on a linear fluid model. In this paper, LC of electron plasma waves is investigated using fully nonlinear Vlasov-Poisson simulations of collisionless bounded plasma. It is shown that, in agreement with the basic theory, plasmons survive substantial transformations of the spectrum and are destroyed only when their wave numbers become large enough to trigger Landau damping. Since nonlinear effects decrease the damping rate, LC is even more efficient when practiced on structures like quasiperiodic Bernstein-Greene-Kruskal (BGK) waves rather than on Langmuir waves per se.

M. Churchill attended the IAEA Technical Meeting on Fusion Data Processing, Validation, and Analysis. He presented a talk entitled "Finding structure in large datasets of particle distribution functions using unsupervised machine learning."

## **ENGINEERING & INFRASTRUCTURE (V. RICCARDO):**

Innovation Group: Support neutron survey of the NSTX-U Test Cell using a recently procured (D-T) neutron generator. The purpose of this work was to better characterize the NTC (n) shielding configuration.

High temperature superconductors: A white paper titled "High Temperature Superconducting Magnets for Next Step Fusion Reactors" has been submitted to the FESAC TEC (Transformative Enabling Capabilities) sub-panel for the first TEC community input meeting in Rockville, Maryland this week.

Hoisting and Rigging: The rigging practical refresher training was completed for 36 people. After review the locations for the mobile crane servicing the CMG roof work has been modified. The anticipated crane to support the LSB annex roof air-handling unit is under review. To date 53 lift data sheets to support the IOI have been reviewed.

Project Management Office: The Work Planning System Upgrade project continues to gather, define, and assess requirements. New items were requested and added to the list. A project execution plan template has been developed; the template has been applied to the FLiT project to assess the efficacy of its use and to support FLiT. The drafted PEP is in review. The PMO supported the reassessment of the laboratory QA plan with regard to graded approach. Two design reviews were chaired. A poster was prepared and reviewed to present at the SOFE conference next week regarding the PMO Work Planning System and its implementation. The annual COG RLM update training was deemed complete; several action items hinging upon it were closed.

Heating Systems support: Progress continues on D site trailer clean-out and dispositioning of hardware; trailers are approximately two thirds complete. RF trailers on C site have been evaluated and inventoried and will now undergo clean out also. A shield block wall was installed in the TFTR Test Cell NW labyrinth to secure the area and mitigate streaming. The RF building removals continue in RF 323A to expedite the removal of the cap bank.

Tc-99m: A meeting was held at PPPL with Dr. Oye, MD, regarding PPPL's patented technology for the production of medical isotope Tc-99m. A statement of work is now being developed for the optimization of the PPPL production process, leading to the construction of a prototype system. Dr. Oye, MD, a heart surgeon, represents a group of private investors.

Tritium: A tritium system Femto-Tech monitor was surveyed and released from the Tritium Area and re-purposed for use in the new D-Site real time stack monitoring system. This activity supports preparatory work required for the Tritium Stabilization and Removal task(s) planned for this summer.

Work continues for preparations in support of the Tritium Stabilization / Removal Task. Good progress has been made for installing a new D-Site Real Time stack monitoring system. This system is a requirement before stabilization and removal work can commence in the Tritium Area. Work has begun on the removal of tritium systems related files from the Engineering Building (open floor space).

CAD Group: Electrical backlog of ECN spread sheet formulated; identified groupings for priority assignments. M. Donohue "facility" responded with priorities. Working on prioritizing Mechanical backlog of ECNs. GA Calorimeter drawings have been released. Supporting development of lift plans. USDA Diagnostic CAD group had a successful meeting with IO in France. Featuring design model status and highlighting the Da-Draft of arrangements for LFS, 09 Equatorial, DRGA and Upper Visible-IR. New coolant manifold was completed for EP 09 neutronics analysis. Port 01 MSE line of site was imported from vendor and uploaded to Catia/Enovia.

**DIRECTOR'S OFFICE (S. ZELICK):**

On May 31, C. Komanoff of the Carbon Tax Center presented a colloquium titled, "Role of carbon taxing in decarbonizing the world's energy system."

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