

The PPPL Highlights for the week ending November 11, 2016 are as follows:

U.S. ITER FABRICATION (C. NEUMEYER):

Steady State Electric Network (SSEN):

The Group 1 and 2 transformers (that comprise shipping lots #1 and #2) have been loaded onto transport vehicles and are presently in transit to the ITER site from the Schneider Electric factory near Istanbul, Turkey.

Diagnostics and Port Plug Engineering; Toroidal Interferometer and Polarimeter (TIP)
In preparation for the single channel TIP prototype interferometer/polarimeter on DIII-D, workers are duplicating the water cooling strategy planned for ITER. In this strategy, all of the high dissipation sources are water-cooled, to minimize HVAC loads. This approach is new, and system stability will be evaluated and compared to the previous laboratory prototype.

NSTX-U (M. ONO):

An article “Theory based scaling of edge turbulence and implications for the scrape-off layer width” by J. R. Myra (Lodestar), D. A. Russell (Lodestar), and S. J. Zweben (PPPL) has just been published in *Physics of Plasmas* 23, 112502 (2016). Length scales, time scales and dimensionless parameters between Ohmic, L and H modes using the NSTX edge turbulence GPI database were compared with theoretical estimates. Dimensionless parameters characterizing the drift-interchange turbulence were obtained and employed to assess the importance of turbulence in setting the scrape-off layer heat flux width and its scaling, in comparison to the total modeled cross-field transport. The analysis suggests that turbulence was not negligible in determining the heat flux width in NSTX, at least for discharges with high plasma current, where the heat flux width is smallest.

R. Kaita (PPPL) gave a talk entitled “Suppressed gross erosion of high-temperature lithium via rapid deuterium implantation” at the 2016 Japan-U.S. Workshop on Heat Removal and Plasma Material Interactions for Fusion, Fusion High Power Density Components and Systems and IEA Workshop on Solid Surface Plasma Facing Components at University of California at Berkeley on November 7. It included studies of the erosion of lithium coatings on TZM molybdenum plasma-facing components, performed by T. Abrams and M. Jaworski of PPPL and collaborators from the Dutch Institute For Fundamental Energy Research on the Magnum-PSI linear plasma device. Projections based on their results for lifetimes of lithium coatings in the NSTX-U divertor were also presented.

ITER & TOKAMAKS (R. HAWRYLUK):

N. N. Gorelenkov published a review paper in a special collection on energetic particles in a New Journal of Physics and is titled “Energetic particle-driven compressional Alfvén eigenmodes and prospects for ion cyclotron emission studies in fusion plasmas”. The abstract of the paper says that as a fundamental plasma oscillation the compressional Alfvén waves (CAWs) are interesting for plasma scientists both academically and in applications for fusion plasmas. They are believed to be responsible for the ion cyclotron emission (ICE) observed in many tokamaks. The theory of CAW and ICE was significantly advanced at the end of twentieth century in particular motivated by first DT experiments on TFTR and subsequent JET DT experimental studies. More recently, ICE theory was advanced by ST (or spherical torus) experiments with the detailed theoretical and experimental studies of the properties of each instability signal. There the instability responsible for ICE signals previously indistinguishable in high aspect ratio tokamaks became the subjects of experimental studies. The prospects of ICE theory development and its applications for fusion alpha particle diagnostics in future burning plasma experiments such as the ITER are discussed.

DIII-D (R. Nazikian)

N. Logan has used the Generalized Perturbed Equilibrium Code (GPEC) to calculate the evolution of the MHD stability, 3D plasma response and neoclassical toroidal viscosity for a high q DIII-D scenario with plasma pressure near the macroscopic MHD stability limit. The results show a clear kinetic stabilization of the plasma as the pressure increases above the no-wall limit, where the ideal models predict instability. This kinetic stabilization allows the calculation of finite plasma response and NTV torque above this limit. This analysis made extensive use of the new implementation of GPEC in the OMFIT integrated modeling framework for preparing the inputs, running the models, and visualizing the outputs.

B. Tobias and G. Kramer attend the US-Japan workshop on millimeter wave technology and fusion plasma diagnostics, which was held this year at UC Davis. A large number of topics were discussed ranging from improved mm and sub-mm wave length sources, digital beam forming phased array antenna systems for MIR systems, miniaturized receiver arrays for various microwave imaging techniques, and experimental results which were obtained by applying recent microwave techniques. Ben Tobias presented results on ECE-Imaging on DIII-D and Kramer reported results on 3D full wave simulations for the ITER low-field side antenna-plasma coupling.

In-vessel spatial and absolute intensity calibration has been completed for the DIII-D charge-exchange recombination (CER) spectroscopy systems (impurity and main-ion) for the FY17 run campaign. B. Grierson, S. Haskey and A. Ashourvan together with the DIII-D CER team participated in both in-vessel calibration and ex-vessel spectrometer operation and calibration.

The first Neutral Beam Local Control System (LCS8) has been integrated into the beam power supplies and tested. The system will be ready for the next operating period, expected to commence in December.

D. Mauzey, PPPL technician/machinist, is about 50% complete in his fabrication of a neutral beam calorimeter cooling plate assembly.

The Impurity Granular Injection dropper development continues. A new dropper concept was developed. The granules are loaded into a tall entrance tube. Gravity is used to keep the granules edge to edge without creating spaces between them. Testing will commence next week.

International Collaborations and ITER:

A Conceptual Design Review was held for the flowing liquid lithium limiter plate that is being prepared for experiments in EAST. The CDR was deemed a success, pending resolution of chits. Professor Jiansheng Hu visited PPPL this week, both to attend this review and to plan details of the liquid lithium limiter collaboration. Professor Hu and R. Maingi also visited MIT (Z. Hartwig and L.A. Kessler) to plan details of the erosion depth marker surface science collaborative studies on EAST, as part of the US-ASIPP PMI collaboration.

JET has reviewed the Quality Assurance documents for the replacement KA2 Faraday cups recently shipped by PPPL. The paperwork has been approved. Installation of the new Faraday cups on the KA2 diagnostic is tentatively scheduled for January 2017.

ADVANCED PROJECTS (H. NEILSON):

In its capacity as U.S. technical coordinator for collaboration in Germany's Wendelstein 7-X (W7-X) stellarator experiment, the Laboratory is working with all seven U.S. partner institutions to update the U.S. W7-X work program for FY17. After a successful first campaign (known as OP1.1), results of which have now been disseminated in numerous conference presentations and papers, the U.S. team is turning its focus to preparations for the OP1.2 campaign, which will start in the summer of 2017. Among the U.S. equipment preparations now in progress are new fluctuation diagnostics (MIT), an expanded filterscope array (ORNL), two instrumented divertor "scrapers" (PPPL), improved capabilities for imaging in-vessel components (LANL), and an upgraded x-ray imaging diagnostic (PPPL). Two U.S. scientists are relocating to the Greifswald, Germany project site as a step toward closer integration with the host team and European collaborators, and a PPPL scientist has been appointed as a co-task force leader, with new responsibilities for helping to plan the OP1.2 experimental program in integrated plasma scenarios. An ORNL scientist is leading the physics preparations for experiments that will utilize the new divertor scrapers to test predictions of power and particle flows in the plasma edge and divertor. U.S. tasks are documented in a series of Task Agreements (TAs) covering all ongoing work. Up-to-date TAs, identifying key U.S. and host personnel and FY-17 goals for each task, are maintained on the U.S. team web site at <http://advprojects.pppl.gov/home/w7-x>.

THEORY (A. BHATTACHARJEE):

M. Parsons and A. Reiman attended the 21st Annual Workshop on MHD Stability Control, which was hosted by General Atomics (GA) Monday through Wednesday, and featured talks on the prediction and forecasting of transient events. About 50 scientists from across the world were in attendance. Dr. Parsons gave a talk on the use of supervised machine learning for the task of

disruption prediction, and how he and his collaborators are using the Disruption Predictor Feature Developer code at PPPL to work toward a machine portable predictor. Dr. Reiman gave a talk on resonant, pressure-driven equilibrium currents in and near magnetic Islands.

I. Kaganovich chaired the session PO7 Low-temperature Plasma Science, Engineering and Technology at last week's American Physical Society (APS) Division of Plasma Physics (DPP) Annual Meeting (<http://meetings.aps.org/Meeting/DPP16/Session/PO7>). Four oral presentations were given in this session by members of the Laboratory for Plasma Nanosynthesis (<http://nano.pppl.gov/index.html>) on physics of arc and carbon and boron nitride nanotube formation and were very well received by the audience. Michael Campanell (currently at LLNL) presented an invited talk entitled "Plasma-Wall Interaction with Strong Electron Emission Revisited", which is based in large part on results of his Ph.D. Thesis at PPPL.

ENVIRONMENT, SAFETY, & HEALTH (J. LEVINE):

Keith Rule attended the American Nuclear Society Winter meeting November 7 -11. He attended the President's special session, which focused on the Grand Challenges for technology advancements for nuclear by 2030. A team of fusion engineers and researchers developed a proposed list of grand challenges specific to fusion. Between now and March 2017 these will be reduced to 3 and then submitted to a committee. In all about 60 challenges are expected which the committee will reduce to 3 for publication and dissemination to government sponsor, academia, foundations, etc. More information can be found at <http://www.ans.org/challenges/> and collaborate.ans.org

BEST PRACTICES & EXTERNAL AFFAIRS (J. DELOOPER):

Science Education (A. Zwicker):

A. Dominguez and A. Brereton represented PPPL at the DOE day event at Clark-Atlanta University on October 20.

Dominguez presented on "Plasma, Fusion and PPPL" at Spelman College on October 20 to a group of undergraduate physics students to promote SULI.

Dominguez participated in the National Society of Black Physicists Conference on October 26 and October 27 at Fermilab. He presented on the work done at the lab and its student opportunities and led round table discussions with students about programs like SULI, CCI and VFP.

Dominguez led a Plasma 101 workshop at the APS-DPP teacher's day event on November 1 at the San Jose APS-DPP meeting.

A. Zwicker, D. Ortiz, S. Greco and A. Dominguez presented posters about the work done at the Science Education department on November 1 at the APS-DPP meeting. 21 PPPL SULI/CCI students presented their work at the November 1 pm poster session at the APS-DPP meeting.

PPPL had a booth at the Plasma Expo in San Jose held on November 3 and November 4. More than 600 local middle and high school students participated in the expo and there was a strong PPPL volunteer showing.

A. Brereton and J. Schwartz represented PPPL at the Princeton Center for Complex Materials' Materials Science Day held at the Princeton Public Library on November 12.

This report is also available on the following web site:

<http://www.pppl.gov/publication-type/weekly-highlights>