



**The PPPL Highlights for the week ending November 18, 2017, are as follows:**

### **NSTX-U (J. MENARD)**

#### **Recovery Planning:**

For the Plasma Facing Components (PFCs), a Preliminary Design Review (PDR) was held on Nov. 15 to address the high-heat-flux PFCs.

For the new poloidal field coils, the vacuum pressure impregnation (VPI) for the straight copper log bundle began in the PPPL winding shop on Nov. 13. The bundle was impregnated with CTD-425 resin on Nov. 15. Fabrication of the winding form mounting beam has progressed ahead of schedule. The mounting beam is needed to start winding PPPL's prototype poloidal field coil.

#### **Research:**

On Nov. 14, N. Gorelenkov (PPPL) gave an NSTX-U/I&T Physics meeting talk on his work on developing a reduced code to determine the effect of Alfvén eigenmodes on energetic particles, work which is within the SciDAC center on energetic particles. The effect of Alfvén eigenmodes on fast ions is evaluated using the quasi-linear approach generalized for this problem recently (V.N. Duarte, PhD thesis, 2017). The generalization involves the resonance line broadened interaction with the diffusion coefficients prescribed by quasi-linear theory to find the evolution of the velocity distribution function. Initial applications of the new model to DIII-D plasmas with elevated q-profiles leads to good agreement between measured and calculated neutrons and fast ion profiles.

### **ITER & TOKAMAKS (R. NAZIKIAN)**

R. Maingi presented the annual update on activities and proposals for the ITPA Pedestal and Edge Physics (PEP) topical group at the ITPA Coordinating Committee at the ITER Organization HQ, Nov. 7-9 in Cadarache, France. He also served as a member on the ITPA Coordinating Committee, representing NSTX-U, and presented the annual collection of international exchanges between the U.S. and other countries on behalf of John Mandrekas at the IEA-CTP meeting.



### **DIII-D (B. Grierson)**

#### *Operations:*

The NB calorimeter plates (4) produced by PPPL have been delivered to DIII-D. This calorimeter set will be installed during the new NB210 Co/counter off-axis conversion scheduled to begin in May 2018. This calorimeter plate design uses gun-drilled coolant passages to eliminate systemic thermal expansion tube cracking that plagued the original design after 25 years of operation. This design also doubled the number of thermocouples for better beam thermal topography analysis and provides an internally serviceable cooling tube interface. Three of the four DIII-D NBs do not have water-cooled calorimeters due to coolant tube leaks, which require overnight passive cooling to cycle back to room temperature. This new design will set the future refurbishment path.

### **EAST Plasma Materials Interactions: (R. Maingi)**

R. Maingi visited ASDEX-Upgrade to conduct analysis of the Oct. 2017 experiments and make plans for possible shots in the Nov. campaign. In addition, the outline of near-term actions preparing for the 2018 campaign was agreed upon.

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

Low-Field-Side Reflectometer (LFSR): PPPL physicist G. Kramer and designer M. Gomez visited General Atomics (GA) to take part in and direct the microwave testing of the self-aligning Gaussian telescope and vacuum window prototypes that were fabricated by PPPL. The testing is performed on the ITER LFSR transmission line test assembly at GA. Kramer and Gomez are assisted by subcontractor staff from UCLA and GA. Testing will determine how well the Gaussian telescope self-aligns and directs millimeter waves to the output waveguide to compensate for motion associated with thermal growth of the ITER vacuum vessel. The testing with the vacuum window prototype will determine the angles, separation and thickness of glass pieces in the LFSR ITER vacuum double window.

U.S. ITER Diagnostics Head R. Feder attended the Equatorial Ports 11 and 12 Preliminary Design Reviews at the ITER Organization (IO) headquarters in Cadarache, France. These reviews were milestone events for the IO PBS.55 diagnostics team as the first port plugs to hold formal preliminary design reviews. Ports 11 and 12 are on accelerated design cycles because these ports will be installed for ITER's first plasma. There are two US ITER diagnostic systems in Equatorial Port 11: the Low-Field-Side Reflectometer (LFSR) and the Diagnostic RGA (DRGA). There were many technical challenges and solutions discussed. Also highlighted were the challenges and resulting



teamwork and common management of integrating a system with components provided by every ITER domestic agency and the IO.

**Toroidal Interferometer-Polarimeter (TIP):** Spawr Industries finished polishing the three surfaces that form the molybdenum prototype retroreflector for TIP. The assembly and alignment process has begun; we expect delivery of the retroreflector and the final test report in early Dec.

**Steady State Electrical Network (SSEN):** Work continues to complete the final documentation and closeout of the SSEN Procurement Arrangement. The final credit request of 2.16 kilo-ITER units of account for direct-current distribution has been prepared.

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

### **Stellarators (D. Gates)**

N. Pablant led a set of experiments aimed at exploring low-density neoclassical heat and impurity transport in Wendelstein 7-X, providing scans of power and density applicable to many core transport proposals. The first day of this two-day program was dedicated to developing a shot scenario that would allow multiple aspects of core transport to be simultaneously diagnosed. The scenario includes a high-power phase for plasma startup; a stable phase in the plasma for core electron temperature, ion temperature, and density profiles; argon impurity seeding for investigation of impurity recycling and for high quality ion temperature and radial electric field measurements with the X-ray imaging crystal spectrometer (XICS); trace iron injection for impurity transport; and finally a phase with electron cyclotron heating modulation for heat pulse propagation studies. This program has become the default program used at W7-X for core transport investigations, and is expected to be used throughout the current campaign. The second day was dedicated to performing power and density scans in helium plasmas over the accessible operating range. These experiments provided the first systematic data set for exploration of core transport properties in helium plasmas that the entire W7-X team can use for analysis.

On Nov. 10, D. Gates gave a tour to a group of students and professors from the Science, Technology, and Energy Policy group of the Woodrow Wilson School of Public and International Affairs at Princeton University. The group was made up of people of varying backgrounds — from the physical sciences to biological sciences to government policy. They conveyed a keen interest in viability of fusion as a potential long-term energy source and an interest in energy policy issues in general. The tour group was very interactive and asked many directed questions. There was a general agreement that future interactions between the groups would be beneficial.

Weekly

# HIGHLIGHTS



## THEORY (A. BHATTACHARJEE)

C-S. Chang attended the SC17 Conference (SuperComputing 2017), and gave both a keynote talk at a workshop session and a featured talk at the DOE exhibition booth. The title of the presentation is “Facing the Big Data Challenge in the Fusion Code XGC.” The abstract etc. are available on the Theory department website:

<http://theory.pppl.gov/news/seminars.php?scid=3&n=invited-talks>

The paper, “Surface currents associated with external kink modes in tokamak plasmas during a major disruption,” by C.S. Ng and A. Bhattacharjee has been “hand-selected” by the editorial staff of *Physics of Plasmas* for its significance to the journal. A link to the paper is available on the Theory website:

<http://theory.pppl.gov/news/seminars.php?scid=4&n=publications>

Dr. C. Smiet joined the PPPL Theory Department for a two-year extended visit. He will work on reconnection in resistive MHD calculations.

Prof. G. Eyink, from the Department of Applied Mathematics & Statistics in The Johns Hopkins University’s Whiting School of Engineering, visited the Theory Department this week. He discussed some very interesting results on (violation of) flux-freezing in “idea” turbulence. These results directly and concretely illustrate the “ideal violation” of flux-freezing and show how it leads to large-scale reconnection in a turbulent environment with many unusual features.

A new module for simulating radiation from impurities has been implemented in the M3D-C1 extended-MHD code. This module makes use of the KPRAD model for ionization, recombination, bremsstrahlung, and line radiation, and tracks the density of each impurity ionization state separately. This module will allow more accurate simulations of tokamak disruption mitigation with massive gas injection or pellets using M3D-C1. Disruption mitigation is a critical concern for ITER and other reactor-scale tokamaks. This work was done with support from the Center for Tokamak Transients Simulation (CTTS) SciDAC.

## COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

### COMMUNICATIONS (L. BERNARD)

The Office of Communications posted a press release to the PPPL website about the 2017 outstanding research and engineering awards given to physicist B. Grierson and engineer N. Greenough. Grierson received the Kaul Foundation Prize for Excellence in Plasma Physics Research and Technology Development for his groundbreaking measurements of



of the flow of ions in the DIII-D tokamak. Greenough was named “Distinguished Engineering Fellow” for his creation of high-power electrical and electronic engineering solutions to heat and diagnose plasmas with radio frequencies. The story was also posted in the *Newswise* and *EurekAlert!* press release distribution services.

#### **SCIENCE EDUCATION (A. ZWICKER)**

S. Greco spoke on the “Academic Panel” at the NJ Technology Council's inaugural Women in Technology Conference.

S. Greco spoke on a “Women in STEM” panel for the Boys and Girls Club Teen STEM Conference to an audience of 50 underrepresented minority girls, grades 6-11. As a panelist, Greco encouraged the young women to participate in our programs such as the Young Women's Conference and the PPPL High School Internship.

S. Greco presented the science of PPPL with interactive demos to 7th- and 8th-graders at St. Paul's School's STEM Day and promoted our education program

#### **DIRECTOR’S OFFICE (R. HAWRYLUK)**

On Nov. 15, Prof. Xiadong Li, University of Virginia, presented a colloquium entitled, “Nature’s Multiscale Materials Integration Strategies and Additive Manufacturing.”

**This report is also available on the following web site:**

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

**The next issue of *Highlights* will appear on Dec. 4.**