NSTX-U Weekly Report (November 25, 2015)

NSTX-U is in the commissioning phase for the FY16 campaign.

The paper "Design description for a Coaxial Helicity Injection plasma start-up system for a ST-FNSF," by R. Raman (University of Washington), T. Brown (PPPL), L.A. El-Guebaly University of Wisconsin), et al., was published in Fusion Science and Technology **68**, 674 (2015). The paper describes two possible configurations for CHI implementation in a fusion reactor. In the first concept referred to as "NSTX-like", the entire blanket structure is insulated from the vessel using insulating supports. In the second configuration referred to as "DIII-D - like", a toroidal insulated electrode is placed on top of the blanket structure to shield the insulator from neutrons, allowing more than six years of full power operations before insulator replacement. The second concept is planned to undergo a test on the QUEST ST in Japan (R. Raman).

Two doctoral students from the United Kingdom, Jakob Brunner (Durham University) and Dave Thomas (University of York), visited PPPL November 10-25 to install an innovative Synthetic Aperture Microwave Imaging (SAMI) diagnostic on NSTX-U. The SAMI diagnostic can both measure plasma emission over a broad frequency range (10--34.5 GHz) and can actively probe the plasma edge to study Doppler Back Scattering (DBS). SAMI measured the magnetic pitch angle in the edge for the first time using DBS on MAST. This is possible with simultaneous 2D DBS because the maximum backscattered power is perpendicular to the turbulence and turbulence is elongated along the magnetic field. SAMI has also studied the effect of NBI and the L--H transition on turbulent velocity, and turbulence suppression in the edge during H−mode plasmas in MAST. The diagnostic has been significantly upgraded for operation on NSTX-U. Jakob and Dave made presentations on SAMI technology and physics results at an NSTX-U seminar on November 24, 2015. (G. Taylor, PPPL)

Michael Fox, a graduate student from the University of Oxford, working at CCFE on the BES diagnostics on MAST, visited PPPL from Nov. 23 through 25. Michael gave a seminar on Nov. 25 entitled "Extracting physical quantities from BES data". The talk focused on a method to extract the underlying physical properties of turbulence from measurements, thereby facilitating quantitative comparisons between theory and experiment. Beam Emission Spectroscopy (BES) diagnostics record fluctuating intensity time series, which are related to the density field in the plasma through Point-Spread Functions (PSFs). Assuming a suitable form for the correlation function of the underlying turbulence, analytical expressions are derived that relate the correlation parameters of the intensity field: the radial and poloidal correlation lengths and wavenumbers, the correlation time and the fluctuation amplitude, to the equivalent correlation properties of the density field. In many cases, the modification caused by the PSFs is substantial enough to change conclusions about physics. The method is tested by applying PSFs to the "real" density field, generated by non-linear gyrokinetic simulations of MAST, to create synthetic turbulence data, from which the method successfully recovers the correlation function of the "real" density field. This method is applied to BES data from MAST to determine the scaling of the 2D structure of the ion-scale turbulence with equilibrium parameters, including the ExB flow shear. A correlation between the poloidal correlation length and the ExB shearing rate was found, with higher correlation lengths and eddy tilting the stronger the shearing. The shearing rate is probably below the threshold required for actual shearing of the eddies and resulting suppression of turbulence. (S. Kaye, PPPL)

Experimental Research Operations (S. Gerhardt, R. Kaita)

The Preoperational Test Procedure (PTP) for the deuterated Trimethyl Borane (dTMB) system was successfully completed. The initial wall conditioning technique in preparation for NSTX-U plasma operations uses dTMB, and the system is ready for its application. (D. Cai, PPPL)

The MPTS laser delivery optics was tweaked up on Wednesday night. A previously seen "seasonal" displacement was observed and corrected. This motion is consistent with a breathing in of the test wall during the colder season of the year; previous laser operation had been in August. A mirror which is attached to the test-cell east wall was adjusted. A set of laser burns and camera videos was obtained to document the alignment. (B. LeBlanc, PPPL)

Engineering Operations (A. von Halle, P. Titus)

Field Coil power testing on individual coils per the Integrated System Test Procedure continued this past week in preparation for combined field test shots scheduled for this coming week. Pre-operational testing of the new deuterated trimethylboron (dTMB) injection system was successfully completed, and that system is now ready to support plasma operations. Also this week, the Multiples Thomson Scattering (MPTS) Laser alignments were re-confirmed, and the new Synthetic Aperture Microwave Imaging (SAMI) diagnostic was installed on the NSTX-U vessel.

The NSTX-U Test Cell will be in restricted access this coming week for field coil testing. Access will be available on the 2nd shifts for approved work.