

## **NSTX-U Weekly Report (June 30, 2017)**

**FY 2017 status: NSTX-U is in a maintenance and repair outage.**

### **NSTX-U Research (J. Menard)**

A team of physicists and engineers from PPPL (C. Ciummo, A. Jariwala, M. Jaworski), ORNL (T. Gray, M. Reinke, D. Youchison) and General Atomics (C. Murphy, B. Fischler) visited the Applied Research Laboratory (ARL) at Penn State University on June 26th. Discussions were held regarding use of their 240 kW electron beam coating facility PVD-1 to test the material properties of various grades of graphite being considered for new PFC tiles in NSTX-U. Testing of prototype divertor targets for NSTX-U seems possible on the timeline desired by the NSTX-U recovery project assuming additional instrumentation and personnel is provided by PPPL/ORNL. Future collaborations at ARL utilizing their facilities for diagnostic development and testing also seemed possible and discussions are ongoing.

In support of a NSTX-U National Campaign experiment on DIII-D led by D. Boyer, a new algorithm has been designed and implemented in the DIII-D PCS that uses the new variable beam voltage and perveance capabilities of the neutral beam injectors. The algorithm determines the optimal combination of voltage, perveance, and duty cycle for each of the beams to achieve requested total torque or power waveforms, taking into account transmission and neutralization losses, drift-duct losses, re-ionization losses, and beam overlap losses. Fast adjustments in perveance and duty cycle are used to compensate for the slow response of beam voltage to requested changes, which arises due to bending magnet power supply limitations. The power and torque control capabilities are also used for feedback control of the stored energy and rotation (from a selected channel of the real-time CER system), enabling feedback control of these quantities without perturbative beam modulations (modulations can still be used for feedback control if desired). A constrained optimization scheme is used to determine the voltage, perveance and duty cycle requests to account for the limits on the range of voltage and perveance changes allowed for reliable beam operation. Experimental testing of the new algorithm is scheduled for July 13.

Vlad Soukhanovskii (LLNL) visited General Atomics the week of June 19-23 to participate in the NSTX-U experimental campaign on DIII-D. He led the experiment “Divertor detachment studies in highly-shaped NSTX/NSTX-U-like plasmas” aimed at the comparison of divertor detachment between NSTX and DIII-D. This work is in support of the Joint Research Target (JRT) 2017. An NSTX-like high-triangularity double null shape with strong bias toward the lower divertor (and ion grad B drift toward the lower divertor), and with high divertor poloidal flux expansion was developed. Preliminary results obtained in the first half-day of the experiment indicated that the deuterium gas puff location used to detach the divertor had less influence on DIII-D than on NSTX.

### **NSTX-U Recovery Project (R. Hawryluk)**

Recommissioning of the coil winding facility continued with the completion of the new soft-walled clean room. PPPL staff were on site at at Everson Tesla to witness conductor cleaning and priming. A pre-proposal teleconference for the Inner PF coil prototype RFQ was held on Thursday 6/29.

Good progress was made on the work packages installing cabling and fiber-optics for the instrumentation needed for PF Inner Coil power testing.

In vessel, set-up and pre-tests of metrology for spatial measurements of the passive plates and outboard divertor were completed. Actual measurements will be made upon arrival of the new calibration standard.

A new calibration probe is being installed on the vessel to complete Multi-Pulse Thompson Scattering (MPTS) diagnostic calibrations prior to the removal of port covers to replace vacuum seals.

Also this week, on-site vacuum technology and ANSYS training courses were held for NSTX-U staff.

R. Hawryluk attended the EPS meeting in Belfast and chaired a meeting of the Nuclear Fusion Board of Editors.