NSTX-U Weekly Report (July 21, 2017)

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

NSTX-U Recovery Project (R. Hawryluk)

The new Pulse Beam Laser System (PBLS) from the University of Wisconsin has been installed in the Multi-Pulse Thompson Scattering (MPTS) Laser Room, and will be ready for an initial round of pre-operational testing by UW and PPPL this coming week. This is in support of Ahmed Diallo's Early Career Award.

The fabrication of a test stand capable of mounting any one of the three inner PF coil configurations (PF1A, B, or C) for power testing has been completed and is ready for final inspection.

The new OH Coil Preheater Central Instrumentation and Control Timing Hardware procurement has been completed.

NSTX-U Research (J. Menard)

C. Myers presented an invited talk titled, "A multi-machine scaling of halo current rotation," at the Theory & Simulation of Disruptions Workshop held at PPPL on July 17-19. This work represents the culmination of a multi-year, multi-machine study of rotating halo currents conducted under the auspices of the ITPA MHD, Disruptions, and Control Topical Group. The conclusion of the study is that halo currents generated during unmitigated disruptions in ITER have the potential to rotate long enough at frequencies that resonate with the ITER vessel to dynamically amplify the halo current forces on the machine. These results, which further motivate both the ITER disruption mitigation system (DMS) and additional studies of halo current rotation, have been submitted to Nuclear Fusion for publication.

R. Kaita gave a seminar entitled "Synergies in Liquid Metal Technology Development for Divertor Applications" in the Department of Nuclear, Plasma, and Radiological Engineering at the University of Illinois at Urbana-Champaign on July 18. The talk explained how experiments with a fully-toroidal Liquid Lithium Limiter on CDX-U led to the discovery of convection in liquid lithium by thermoelectric MHD, which is the principle behind the Liquid Metal Infused Trench (LiMIT) approach developed at the University of Illinois for handling high divertor heat loads. More recently, the technology used in the NSTX-U lithium evaporators is being incorporated into a prototype for testing the "vapor box" concept, where lithium vapor is enclosed at a sufficiently high density to extract momentum and energy from divertor plasmas. The goal of the presentation was thus to show how research in liquid metals to addressed specific engineering problems uncovered new and unexpected phenomena, and broadened the options for their implementation in future divertors.

F. Bedoya successfully defended his doctoral thesis entitled "Plasma Facing Components Conditioning Techniques and their Correlation with Plasma Performance in the National Spherical Torus Experiment Upgrade (NSTX-U)" on July 18 at the University of Illinois at Urbana-Champaign. Bedoya used the Materials Analysis Particle Probe (MAPP) to expose samples during boronization for wall conditioning and subsequent plasma operations on NSTX-

U. He studied the samples without exposure to air in an analysis chamber connected to the vacuum vessel, and obtained the first direct evidence for oxygen retention on a boronized PFC during an experimental campaign. The unique analysis capability MAPP provided also enabled Bedoya to show the relationship between boron oxide formation and the bombardment of deuterium from NSTX-U plasmas.

E. Scott successfully defended his doctoral thesis entitled “Interferometry and Vibration Compensation on the National Spherical Torus Experiment – Upgrade” on July 18 at the University of California at Davis. The Far-infrared Tangential Interferometer/Polarimeter (FIReTIP) system is a laser-based plasma diagnostic for line-integrated plasma density measurements, and Scott was responsible for its reinstallation in a new configuration after removal for the construction of NSTX-U. Mechanical vibrations are a concern for interferometers, and Scott explored active noise cancellation for use with FIReTIP. He successfully completed impulse tests on the NSTX-U vacuum vessel that demonstrated the accuracy and feasibility of the Kalman filtering approach, and provided a proof of principle of this novel technique.

Graduate student Yusuke Iida from the University of Tokyo completed his six-week visit to NSTX-U/PPPL as part of the Princeton University-University of Tokyo Exchange Program. In addition to basic plasma studies, Yusuke also learned how to run beam tracing and 2-D full-wave (FWR2D) codes for studying microwave beam propagation and scattering in toroidal plasmas. Target magnetic equilibria from the University of Tokyo’s TST-2 device were also used. These tools will assist Yusuke in his graduate research, which will involve installing and operating a microwave imaging reflectometer on the TST-2 device for density fluctuation measurements. Shige Kubota (UCLA) and Gerrit Kramer (PPPL) were the PPPL advisors. (S. Kubota)

Gary Taylor is visiting the QUEST spherical tokamak at Kyushu University from July 18 to July 28 to collaborate on the first current drive experiments with the newly installed 28 GHz gyrotron. The first week of his visit was spent conditioning the gyrotron into a dummy load. 28 GHz power was coupled into the QUEST plasma for the first time on July 25. 170 kW was coupled for up to 300 ms and 150 kW was coupled for up to 500 ms. Good progress was made on July 25 with up to 40 kA of electron cyclotron current drive generated with a 500 ms, 150 kW heating pulse by the end of the day. These experiments will continue through July 28.