NSTX-U Weekly Report (June 23, 2017)

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

NSTX-U Recovery Project (R. Hawryluk)

Pat Hoffman, the Acting Under Secretary for the DOE Office of Science, and the Assistant Secretary for the DOE office of Electricity and Energy Reliability visited PPPL on Tuesday and toured the NSTX-U Facility.

Recommissioning of the coil winding facility continued this week with the completion and approval of drawings for the prototype PF1A coil VPI molds and the installation of the new soft-walled clean room. PPPL staff were on-site at Everson Tesla to witness conductor cleaning and priming.

In vessel preparations have been made for spatial measurements of the passive plates and outboard divertor. Metrology and stands have been set up and procedures prepared.

Also this week, a lab infrastructure project to replace the aging 13.8kV cabling that provides primary power to NSTX-U was successfully completed.

NSTX-U Research (J. Menard)

NSTX-U researchers contributed to the FESAC TEC PMI sub-panel meeting with an oral presentation titled, "Slowly flowing and high temperature liquid metals as plasma-facing materials". The contribution detailed the potential advantages associated with liquid metal plasma-facing components especially the use of Li as a radiating impurity, even up to very high densities such as in the Li Vapor Box Divertor. M. Jaworski, R. Goldston, and M. Ono co-authored the contribution. M. Jaworski presented at the meeting held in Chicago, IL. R. Majeski presented a talk "Mitigation of scrape-off layer power flow with lithium plasma-facing surfaces" and E. Kolemen presented "Fast Flowing Liquid Metal Technology for Fusion Reactor Divertor." The meeting was organized and chaired by R. Maingi.

The paper “Effect of 3-D magnetic perturbations on divertor conditions and detachment in tokamak and stellarator” by J-W. Ahn, et al. has been published in Plasma Physics and Controlled Fusion (https://doi.org/10.1088/1361-6587/aa73ea). This paper is a part of PPCF’s Special Issue Reviewing Divertor Plasma Detachment in Magnetic Fusion Devices. Recent data from two divertor tokamaks (NSTX and DIII-D) and a stellarator (LHD) have been presented, which include both experimental and simulation results for each device. Data from literature search for several other tokamaks and stellarators have been also compared. It is found that the effect of 3-D fields on the ratio of perpendicular to parallel transport is crucial to determine if the transition to detachment is facilitated or hampered by 3-D fields. Limiter tokamaks (TEXTOR and Tore Supra) and stellarators (LHD and W7-AS) can achieve enhanced perpendicular transport by 3-D fields and this leads to early detachment, i.e. transition at lower density, However, parallel transport is still dominant in divertor tokamaks (NSTX and DIII-D) even with 3-D fields and detachment facilitation is not observed. An EMC3-Eirene simulation for ITER H-mode plasmas shows the possibly important role of plasma response in the determination of perpendicular momentum loss that could lead to early detachment induced by 3-D fields.

The paper "Computation of Alfvén Eigenmode stability and saturation through a reduced fast ion transport model in the TRANSP tokamak transport code" by M. Podestà et al. has been published online in Plasma Physics and Controlled Fusion (https://doi.org/10.1088/1361-6587/aa7977). The paper reports on recent work to explore the use of the fast ion "kick model" in TRANSP for predictive runs. A neutral beam heated NSTX discharge is used as reference to illustrate the potential of the model. Predictive capabilities for computing stability and saturation amplitude of Alfvénic instabilities are first assessed, based on given thermal plasma profiles only. Predictions are then compared to experimental results, and the interpretive capabilities of the model further discussed. The paper shows that the reduced "kick" model captures the main properties of the instabilities and associated effects on the fast ion population. Additional information from the actual experiment enables further tuning of the model's parameters to achieve a close match with measurements.

Walter Guttenfelder and Yang Ren visited General Atomics the week of May 19-23 to prepare for two transport related DIII-D/NSTX-U campaign experiments scheduled to run in July. Draft shot plans were reviewed by the BPP-Transport group. Yang Ren also worked with Dr. Yilun Zhu of UC-Davis on the ECEI diagnostic, particularly on how to improve noise shielding.

C. Myers traveled to DIII-D for the week of June 19 to lead a National Campaign experiment titled, "Impact of resonant versus non-resonant 3D fields on n=2 locking." PPPL co-authors on the experiment include N. Logan, J.-K. Park, N. Ferraro, S. Gerhardt, and J. Menard. The experiment is designed to expand the physics understanding of locked mode onset in the presence of applied n=2 fields. Over the course of the full run day (June 21), 35 successful plasmas were acquired on 38 attempts. Key parameter scans included the resonant spectral content of the applied n=2 fields as well as the toroidal field and the plasma density. One major product of the experiments is a series of five-point toroidal field scans in both ohmic and L-mode plasmas. These results will be used to inform the $n > 1$ error field correction strategy for ITER.