# NSTX-U Weekly Report (June 28, 2013)

## NSTX-U is in the Upgrade Project outage in FY 2013

The paper "Plasma facing surface composition during NSTX Li experiments" by C.H. Skinner (PPPL) et al., R. Sullenberger, B.E. Koel, M.A. Jaworski, and H.W. Kugel has been published in the Journal of Nuclear Materials (vol. 438 (2013) pp.S647-S650). It reports laboratory studies of the chemical composition of lithium surfaces exposed to typical residual gases found in tokamaks. Solid lithium and a molybdenum alloy (TZM) coated with lithium were examined using X-ray photoelectron spectroscopy, temperature programmed desorption, and Auger electron spectroscopy both in ultrahigh vacuum conditions and after exposure to trace gases. Lithium surfaces near room temperature were oxidized after exposure to 1–2 Langmuirs of oxygen or water vapor. Lithiated PFC surfaces in tokamaks will be oxidized in about 100 s depending on the tokamak vacuum conditions. (C. Skinner)

The paper "Study of non-axisymmetric divertor footprints using 2-D IR and visible cameras and a 3-D heat conduction solver in NSTX" by J-W. Ahn (ORNL), et al., has been published in the Journal of Nuclear Materials (vol. 438 pp. S317-S320). It presents data for toroidally non-axisymmetric divertor profiles during the 3-D field application and for ELMs with simultaneous observation by a new wide angle visible camera and a high speed IR camera. This confirmed the validity of vacuum field line tracing on the prediction of split strike point pattern by n=3 fields. A newly implemented 3-D heat conduction code was also used to obtain 2-D divertor heat flux, which allowed for defining the degree of asymmetry ($e_{DA}$) to quantify the asymmetric heat deposition on the divertor surface. $e_{DA}$ is found to have a strong positive dependence on peak heat flux for all cases of investigation. (J-W Ahn)

The paper "Overview of Innovative PMI Research on NSTX-U and Associated PMI Facilities at PPPL" by M. Ono (PPPL) et al., has been published in the Transaction of Fusion Science and Technology (vol. 63 pp.21-28, 2013). It describes an overview of the NSTX-U PMI research that is focused on developing innovative divertor heat flux solutions for future devices. With ~ 15 MW of auxiliary heating power, NSTX-U will be able to test the PMI physics with the peak projected divertor plasma facing component (PFC) heat loads of up to 40-60 MW/m$^2$. The snow-flake configuration can produce exceptionally high divertor flux expansion of up to ~ 50. Another area of active PMI investigation is the effect of divertor lithium coating (both in solid and liquid phases). The overall NSTX lithium PFC coating results suggest exciting opportunities for future magnetic confinement research. To support the NSTX-U PMI research, a comprehensive set of PMI diagnostic tools are being implemented. To support the NSTX-U/PPPL PMI research, there are also a number of associated PMI facilities implemented at PPPL/Princeton University including the Liquid Lithium R&D facility, Lithium Tokamak Experiment, and Laboratories for Materials Characterization and Surface Chemistry. (M. Ono)

C.S. Chang (PPPL) made a presentation at the 6/17/2013 NSTX-U Physics Meeting on the capabilities and applications of the XGC1 that his group has been developing. The XGC suit of code capabilities span the range from non-turbulent neoclassical transport (XGC0), to turbulent regimes in simple, circular geometries (XGC-p) and in general geometries (XGC1). In the more general incarnation, the code can `handle both X-point geometry, transport along open field lines, and impurities. The codes use a simplified Monte-Carlo neutrals code ("Baby DEGAS2")

or the full DEGAS2. The full electromagnetic effects will be fully implemented within ~1 year, although this implementation can be accelerated if necessary (which for NSTX it is, owing to the importance of microtearing modes). Proper treatment of neutrals have been shown to be important in the resulting charge-exchange cooling near the edge and on their effect on the ExB shearing rate, which modifies the turbulence. One validation issue that needs to be studied is the effect of Finite Larmor Radius near the plasma edge in the low toroidal field NSTX plasmas, and whether these FLR effects impact the gyrokinetic ordering in this region. Possible high leverage studies for NSTX/NSTX-U using XGC1 include studying the dynamics of the L-H transition, assessing the role of Electron Temperature Gradient modes, especially near the edge, turbulence spreading in the central core that affects the electron transport there, impurity transport and the formation of internal transport barriers. Results from first gyrokinetic simulations of H-mode blobs were shown, with the blob dynamics shown to be associated with turbulent as well as neoclassical processes. (S. Kaye, PPPL)

**Engineering Operations (A. von Halle, C. Neumeyer)**

NSTX Upgrade construction activities continued with the ongoing preparation of all four quadrants for the full inner TF coil mold and subsequent winding of the OH Coil. The mold for the combined four inner TF quadrants is being prepared to be shipped to PPPL, and is expected to be on site sometime next week. Preparations also continued for the vessel cut at bays F-G for the new MPTS diagnostic port. Final metrology was completed and the template tacked in the vessel for the actual cut next week.

Preparations for plasma operations in the NSTX-U configuration continued with the ongoing fabrication and power testing of the new firing generators for the field coil power conversion (FCPC) system rectifiers. Testing has been completed on more than half of all the planned firing generators, and test results for all units have been identical giving us confidence that we can rely on bench testing for the remaining units. Power testing will continue to confirm Firing Generator operation with both the old and new fault detectors, and current balancing on multiple rectifiers. Autotransformer and transformer rectifier maintenance continues in the Neutral Beam yard.

Access to the NSTX test cell will be available only through previous arrangement with the Upgrade Work Control Center.