

## **NSTX-U Weekly Report (December 20, 2013)**

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

Filippo Scotti successfully defended his doctoral dissertation entitled "Modifications of Impurity Transport and Divertor Sources by Lithium Wall Conditioning in the National Spherical Torus Experiment" on Thursday, December 19. His advisors were Vsevolod (Vlad) Soukhanovskii of the Lawrence Livermore National Laboratory and Robert Kaita of PPPL. Scotti used data from an extensive set of diagnostics, including visible camera systems he implemented, to study the behavior of impurities in the NSTX divertor region. He observed that lithium evaporated into the lower divertor region resulted in a lower carbon sputtering yield. This effect, however, can be counteracted by weaker impurity retention because of the reduced recycling associated with lithium, and carbon sources that the graphite NSTX walls present. Scotti also conducted an extensive investigation of core impurity transport. He showed that ELM suppression and changes in neo-classical transport can explain the core carbon accumulation in H-mode plasmas with lithium evaporation. While the presence of carbon can also lead to enhanced lithium particle diffusivities, this does not provide a complete explanation for the low core lithium concentrations. Such issues will be the focus of further research in NSTX-U. (R. Kaita)

A paper entitled "Intrinsic rotation generation in NSTX ohmic H-mode plasmas" by J.-K. Park (PPPL) et al., has been published in Nuclear Fusion 53 (2013) 063012. This work reported intrinsic rotation generation observed in NSTX ohmic plasmas, by uniquely utilizing passive views of charge exchange recombination diagnostics (R. E. Bell). Results indicated that intrinsic rotation generation in the edge is well correlated with ion temperature gradient change. This is consistent with a corresponding theory of residual stress by P. H. Diamond and Y. Kosuga, as a quantitative comparison was successfully made between the measured torques with the predicted ones. However, it was discussed that an uncertainty on the order of diamagnetic rotation can exist in many places across measurement and theory in general, which should be further resolved to predict the intrinsic torque and rotation in the next-step devices such as ITER. (J.-K. Park)

A paper "Turbulence-induced diffusion analysis of national Spherical Torus Experiment based on the gyrocenter shift", by K.C. Lee (NFRI, Daejeon, Korea), et al., was published in Journal of the Korean Physical Society, **63**, 2102 (2013). The paper describes a confinement time deterioration proportional to the square of density fluctuation and electron temperature measured in the edge region of the NSTX plasmas. The experimental measurement showed an agreement with the turbulence induced diffusion coefficient based on the gyrocenter shift (GCS) theory. (K.C. Lee)

Dan Boyer, a recent Ph. D. recipient from the LeHigh University Department of Mechanical Engineering and Mechanics, began a 2-year ORISE post-doctoral fellowship at PPPL on Monday December 16th. Boyer's fellowship proposal was entitled "Feedback Control and Optimization of the Current Profile for NSTX-Upgrade". He will be working with David Gates (PPPL) and others on implementing his ideas for current profile control on NSTX-U. (D. Gates)

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

NSTX Upgrade activities continued with the ongoing preparation to wind the new OH coil on the TF inner bundle in the Coil Shop. OH conductor has been pulled through the taping heads

and the coil lead blocks have been brazed and leak checked. The leads are anchored in the lead blocks, and tension is being applied to the conductor. In the NSTX Vessel, all four neutral beam armor quadrants have been installed. Also this week, a Final Design Review of the in-vessel secondary passive plates was successfully held. A subcontract to fabricate the plates is expected to be in place late next month.

Preparations of non-upgrade equipment for plasma operations in the NSTX-U configuration also continued with the ongoing control power testing of the installed new FCPC firing generators. Fiberoptic cabling for the Plasma Control System connections to the the Firing Generators is on site, and the installation procedure is near completion. A Preliminary Design Review of the new Stand Alone Digitizer (SADII) system was successfully held this week.

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

## OH Winding is Starting!

