NSTX Weekly Report (March 2, 2012)

NSTX is in the Upgrade Project outage in FY 2012

Michael Bell, the head of the NSTX Research Operations Division, and Henry Kugel, the head of the NSTX Boundary Physics Operations, have retired from PPPL as of March 1, 2012. Accordingly, Masa Ono will serve as the acting head of the NSTX Research Operations Division and Robert Kaita will be the acting head of the NSTX Boundary Physics Operations. We thank Michael and Henry for their dedication and leadership for the NSTX Research Operations Division management. (M. Ono / J. Menard)

The paper "Modification of the electron energy distribution function during lithium experiments on the National Spherical Torus Experiment" by M. Jaworski (PPPL) et al.,has been published in Fusion Eng. Des. (2012), doi:10.1016/j.fusengdes.2011.07.013. It is available online at: http://www.sciencedirect.com/science/article/pii/S0920379611006302. The paper describes a non-local probe interpretation method which is applied to the NSTX divertor probes for the first time. Non-Maxwellian distributions are found in the analysis. During LLD experiments, a rise in the hot electron population fraction is found in a sequence simultaneously showing decreased fueling efficiency during plate heating by plasma bombardment. Changes in the distribution function could arise due to changes in recycling or impurity production and this possibility is discussed in the paper. (M. Jaworski)

Ramona Valenzuela Perez, a Ph.D student from the Florida International University, visited PPPL during the past week. She developed an array of charged particle detectors for measuring fusion products on NSTX for her doctoral research. The performance of her diagnostic was checked with various radiation sources at the laboratory. (R. Kaita)

Daniel Andruczyk, a postdoctoral research fellow from the University of Illinois at Urbana-Champaign, arrived at PPPL this week. He will be collaborating on research related to lithium plasma-facing components. Andruczyk plans to stay at the laboratory until December of this year. (R. Kaita)

Joon-Wook Ahn (ORNL) and Rajesh Maingi (ORNL) visited ASDEX-Upgrade to discuss collaborations on 3-D field effects. Ahn presented a seminar detailing the effect of 3-D fields on detachment in NSTX, while Maingi presented a seminar describing the characteristics of small ELM regimes in NSTX, and possible similarities to ELM mitigation scenarios with 3-D fields in ASDEX-Upgrade. Collaborative experiments on ASDEX-Upgrade were also discussed. (R. Maingi)

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

NSTX Upgrade construction activities continued this week with the ongoing welding of additional support for the upper and lower vacuum vessel support ribs. The lower 10 bays have been cleared of bus-work and equipment, and that welding is nearing completion. Scaffolding has been installed on the top of the machine, and welding at the 1st of the top 10 bays has been completed. In-vessel, graphite tiles are being installed in place of the Liquid lithium Divertor (LLD). Removal of HVAC ductwork in the TFTR Test Cell (TTC) over the doorway to the NSTX Test Cell (NTC) began this week in preparation for the eventual moving of the second

neutral beam-line into the NTC. Good progress continues to be made on the fabrication of the neutral beam cryogenic lines, and internal beam-line assemblies. Also this week, the installation of new field coil power cabling between the NTC and the test cell basement was completed, and end-to-end resistance measurements and electrical insulation tests (HiPots) successfully performed.

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

General Atomics - NSTX collaboration quarterly report summary (R. La Haye, GA):

Studies of NSTX control have focused on understanding discrepancies between calculated and experimentally derived vertical displacement growth rates. The growth rate of a VDE can be predicted by the plasma response codes rzrig and gspert (part of the GA TokSys computational environment for control design and analysis). For DIII-D these predictions have been in very good agreement with observed growth rates after triggered VDE's for a range of growth rates. However, for VDE's in NSTX the same codes predict values that are 3 times smaller than observed. One of the reasons for the observed discrepancy, and possibly the most significant, can be that the models make incorrect assumptions about how the current and pressure profiles are affected when the applied flux changes. When the gspert prediction is corrected for details of the profile behavior, there is good agreement found with the efits. The gspert model is usually calculated with the assumption that li, betap, ip are unaltered by perturbations of the applied flux (with specific recipes for the details of the profiles). Any changes of these quantities are regarded as external influences. If a model is developed that correctly includes the detailed response of the current and pressure profiles to changes in the applied flux then the prediction would follow without the addition of any "external influences" and the growth rate should therefore be correctly predicted. (A. Welander and M. Walker, General Atomics).

Three basic algorithms are essential for modeling magnetic footprints: 1. a fixed-point finder 2. a manifold and field line integrator and 3. a high-resolution target plate field line starting point generator. While the TRIP3D-MAFOT code has C++ versions of these algorithms, at GA it only runs on the DIII-D Linux Star Cluster under Open MPI as a development and testing platform. Here, the TRIP3D-MAFOT code was used to generate a preliminary set of NSTX footprints using a DN plasma equilibrium in which an n=3 RWM/EFCC field from the mid-plane non-axisymmetric NSTX coil was applied. Since two independent x-points are present in this simulation, a hetroclinic rather than a homoclinic tangle is observed. An initial set of footprints was generated for this case using TRIP3D-MAFOT but the resolution was too poor to determine the internal field line structure accurately enough for the NSTX footprint studies. Since the homoclinic lobes have a much finer spatial structure in NSTX than in DIII-D, a significant increase in the internal resolution of the footprints is needed. The TRIP3DGPU code is much better suited for calculating these high-resolution footprints since it is expected to be at least a factor of 3 faster than the TRIP3D-MAFOT code when running on the DIII-D Linux Star Cluster. (T. Evans and W. Wu, General Atomics).

A collaborative paper entitled "*Independent Control of the Particle Transport Channel as the Critical Ingredient for Avoidance of Deleterious Edge Instabilities in Tokamaks*" is in preparation for submission to Nature. (Tom Osborne, General Atomics).