

NSTX Weekly Report (May 12, 2006)

FY2006 weeks of research operations

Planned: 11 weeks

Completed: 7.78 weeks

Three invited talks and twenty-one contributed presentations related to NSTX research were given at the 16th Annual Conference on High-Temperature Plasma Diagnostics that was held on 7 to 11 May 2006 in Williamsburg, VA. Nine institutions were represented in these presentations. The invited papers were "Investigation of electron gyroscale fluctuations on NSTX with a millimeter-wave scattering system" by D. Smith, Ph. D. Thesis, Princeton University, "Fast Te measurements via 'Optical' soft x-ray detectors on NSTX" by L. Delgado-Aparicio, Ph. D. Thesis, Johns Hopkins University, and "Development of LIF-MSE" by J. Foley, Nova Photonics.

The paper "Observation of Plasma Toroidal Momentum Dissipation by Neoclassical Toroidal Viscosity" by W. Zhu, S.A. Sabbagh, R.E. Bell, et al., has been accepted for publication in Physical Review Letters. The paper quantitatively compares the most recent theory of neoclassical toroidal viscosity including trapped particle effects to dedicated plasma rotation damping experiments on NSTX, finding good agreement. The result shows that this non-resonant mechanism can be much stronger than past publications have shown. Clearly applicable to tokamaks, the analysis may shed light on more general issues of momentum balance, including application to astrophysical plasmas. The work was performed as a part of Wubiao Zhu's Ph.D thesis research under the supervision of S.A. Sabbagh of Columbia University.

Results of the first resistive wall mode similarity experiment between NSTX and DIII-D appear in the paper "Cross-machine comparison of resonant field amplification and resistive wall mode stabilization by plasma rotation", by H. Reimerdes, T.C. Hender, S.A. Sabbagh, et al., recently published in Physics of Plasmas. The paper includes data from DIII-D, JET, and NSTX. Among the results shown is the dependence of the RWM critical rotation frequency (normalized to the Alfvén frequency) on aspect ratio, apparent in the comparison of DIII-D and NSTX results.

There will be an NSTX Physics Meeting at 1:30 pm on May 15, 2006 in LSB318. At this meeting, Roger Raman will summarize the discussions and emerging priorities from last week's Mid-Run Assessment. (S. Kaye)

Run Coordination (R. Raman, S. Sabbagh)

XP601 Effect of Evaporated Lithium PFC Coatings on Density Control – (May 4-5) H. Kugel: The goal was to observe the effects of deposited lithium in a reference NBI-heated, divertor discharge fueled using a combination of Low Field Side gas puffing and the Supersonic Gas Injector (SGI). First, 6 ohmic helium discharges were run to remove adsorbed fuel gas from the walls. The LITER-1 evaporator was then used to deposit lithium on the plasma facing surfaces. During this evaporation, the Quartz Deposition Monitor in the lower divertor at Bay H registered about 48 nm of lithium deposition, which

is consistent with the estimated total of 380 mg of lithium evaporated based on the temperature and time history of the evaporator. The first reference discharge following the lithium deposition exhibited almost a 30% decrease in density relative to the reference discharge before lithium and the electron temperature reached 2 keV for 2 MW NBI. However, on the next reference discharge, the density reverted to its pre-lithium level. The OVIII emission measured by the XEUS extreme UV spectrometer was the same for the pre- and first post-lithium reference discharges, but, over the following three reference shots, the oxygen emission decreased to below detectable levels.

On the second day, reference discharges run before and after a sequence of 6 ohmic helium discharges were compared. After the helium shots, the reference discharge exhibited about a 14% decrease in density due to pumping of the fuel gas by the conditioned walls. A lithium evaporation was then attempted but the snout heater failed, terminating the experiment.

XP615 Active Stabilization of the Resistive Wall Mode at Low Aspect Ratio – S. Sabbagh (May 5): Immediately following the Li experiment, the remaining time was used to produce six shots for XP615. The desired target plasma could not be reproduced, even though the CS (Center Stack) gas puffing was significantly increased, and between-shots glow time was reduced. Two plasma discharges came close to the desired target conditions, and a new $n = 3$ braking waveform was set up lengthen the time of the low rotation target plasma.

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

The NSTX test cell remained open this past week for system maintenance and for the continued development of the new lithium evaporator (LITER). The LITER cartridge B, used in support of experiments last week, was removed from the NSTX vessel for evaluation and will possibly be replaced by cartridge C, currently in operation on a test chamber. NSTX control system maintenance was also scheduled for this week with system back-ups, the installation of new software to diagnose ongoing problems with the real-time data acquisition system, upgrades to the amplifiers for the Langmuir probe system, and upgrades to the digitizers used for the real-time outer vacuum vessel diagnostic data acquisition system. Routine testing of the NSTX site fire protection systems was also performed this week.

The PPPL Safety Forum will be held on Monday, May 15th. Plasma operations will resume on Tuesday this week, and the test cell will be locked-up until 5 PM each day. Access to the test cell will be available from 5PM to 9PM each evening.

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

- LITER-1 was powered in support of XP601 but developed a discontinuity in the output duct (snout) heater. It was then removed from the vessel and moved to a C-site for disassembly and inspection. The initial analysis indicated the appearance of a melted break in one of the two snout heater cables as it entered the encapsulated heater tube. Cartridge replacement options are under investigation.

- After the first day of the recent XP601, the Bay F Lower Divertor Quartz Deposition Monitor (QDM) in the field of view of LITER exhibited a 10 ohm continuity across an insulator to Category-4 ground, possibly due to a conducting lithium film. During the Maintenance Week, the resistance of this continuity increased slowly to greater than 1 megaohm, possibly due to the reaction of lithium with residual gas components, the system was able to pass a vessel Hi-Potting test. (C.H. Skinner)

Plasma Diagnostic Operations (R. Kaita)

- Improvements to diagnostics during the past week included the successful replacement of commercial digitizer system with a locally developed version for real-time data acquisition, and the completion of upgrading the tile-mounted Langmuir probe array for 50 V operation.