

NSTX Weekly Report (June 9, 2006)

FY2006 weeks of research operations

Planned: 11 weeks

Completed: 11.29 weeks

Akira Ejiri from the University of Tokyo visited NSTX under the US-Japan collaboration agreement to participate in reflectometry experiments with UCLA and the NSTX Team. The specific goal of his visit was the measurement of density oscillations induced by HHFW using millimeter-wave reflectometry. During his stay he participated in experiments to evaluate the level of RF pickup in the new diagnostic, and also presented results from similar experiments on TST-2. (S. Kubota, UCLA)

There will be an NSTX Physics meeting on Monday, June 12 at 1:30 pm in LSB18. The agenda is: **XP Summaries:** E. Fredrickson – TAE impact on fast ion transport, D. Gates – DND H-mode, H. Park – High-k H-mode results, D. Smith – High-k L-mode results, H. Kugel – Li deposition. **Physics Presentation:** Dr. Richard Frazin, Electrical and Computer Engineering, Univ. of Ill. Title: 3D, 4D, and 5D Tomography of Plasma in the Solar Corona. (S. Kaye)

Run Coordination (R. Raman, S. Sabbagh)

Good progress was made during this busy week during which seven experiments were conducted.

XP602: Long-pulse development in lower-single-null (June 1) – J. Menard: This was a continuation of experiments conducted on March 10. Two 700kA LSN discharge scenarios were used in attempts to reduce the plasma surface voltage and maximize the non-inductive current fraction. A delayed H-mode target was developed at 5.2kG which achieved 0.1V surface voltage, sustained for 0.5s. The sustained poloidal beta was approximately 25% higher than the best comparable discharge from 2005. Very early H-mode discharges at lower li exhibited beta-p increases of only 15%. Both scenarios utilized the error field control algorithm developed in XP-614. All profile data needed for non-inductive current fraction analysis was obtained.

XP612: Perturbed electron transport with heat flux, collisionality and current in NSTX (June 1) – D. Stutman: This was a continuation of experiments conducted on May 3. The aim was to produce larger Te perturbation than achieved with 0.5 mg Li pellets, using 0.5 mg vitreous C pellets or 3 mg Li pellets. It was found that, in contrast with last year's H-modes, the 0.5 mg C pellets did not produce substantial Te perturbation, although they penetrated deep into the plasma. Nevertheless, the data will be useful for particle transport measurements, indicating a long particle confinement time. The 3 mg Li pellets on the other hand, ablated at the plasma periphery producing the larger Te perturbations desired. A small change in the plasma shape and position was however also induced by the large Li pellet. The last part of XP 612, a density scan with pellet injection in L-mode, has not yet been executed.

XP613: Z-scaling of impurity transport in beam heated NSTX H-mode discharges (June 2) – L. F. Delgado-Aparicio: The purpose was to produce a small impurity perturbation at the edge of an NSTX H-mode and observe its propagation throughout the plasma radial mid-plane in order to infer the Z-scaling properties of the impurity transport coefficients. Two impurities were to be injected into the

plasma: Carbon ($Z=6$) and Neon ($Z=10$), both in gas forms (CD_4 and Ne) and the former also by using vitreous carbon pellet injection (with the help of the LPI). The use of the PCS controlled valve (PZV3) in Bay J (upper midplane, injector 3) where the neon gas was connected, worked reliably on all occasions when it was needed (1.5 – 2.0 Torr l/s for 50 ms). We injected gas-puffs at three different times during the H-mode as well as during an ion gyro radius scan at fixed q (Bt/I_p) for fields of 4, 4.5 and 5.5 kG. Scans with deuterated methane and carbon pellet injection will be conducted during a future run.

XP608: Neutral beam driven current evolution (June 5) – E. Fredrickson: A toroidal field scan was conducted including points at 4.0 kG, 4.5 kG, 5.0 kG and 5.5 kG. Additionally, small density scans were conducted at 4.5 kG and 5.5 kG. With sources B & C at 67 kV and 60 kV, respectively, no MHD-quiescent conditions were found. A quiescent period was found by using only source C. The current profile evolution was documented by moving source A on time from 0.3 to 0.25 and then 0.21s. Source A voltage didn't settle as quickly as on previous days, so usable MSE data was available 25 to 30 ms after source A start time.

XP603: Long pulse double null development (June 6) – D. Gates: Plasmas were developed at high toroidal field with high plasma elongation, up to 2.95. This sustained high elongation result, while preliminary, represents a world record. Plasmas with very high shape factors $S = q_{95} I_p / (aB) = 44$ MA/(m*Tesla) were also created. In addition, a plasma with a very low internal inductance of 0.4 was maintained for about one current relaxation time. A current scan was also performed. Analysis of non-inductive current fraction is ongoing.

XP601: Effect of Evaporated Lithium PFC Coatings on Density Control (June 7) – H. Kugel: A measurement of graphite pumping without lithium was performed. The L-mode deuterium DN NBI comparison discharge used for the previous lithium pumping experiment on 5/04/06 was run. Then 6 ohmic Helium Conditioning discharges were run. The first deuterium DN NBI comparison discharge following this conditioning sequence exhibited about a 14% decrease in density at the flat top versus the previous lithium pumping experiment which exhibited about a 29% decrease. This result is comparable to the result of a similar graphite pumping measurement on 5/05/06, using a slightly different comparison discharge, which exhibited about an 18% decrease in density at the flat top compared to the before graphite conditioning discharge. Similarly in both graphite pumping measurements, the graphite pumpout effect stopped after one discharge. These results complete XP601.

XP 629: Comparative study of the scattered spectra between L and H-mode confinement regime on NSTX (June 7) - H. Park: We were able to revisit the same regime that we made the first measurement (119284) of the "bifurcation of wave-number spectra during H-mode phase". Attempt on DN H-mode was not conclusive and we have learned that the scattered signals from DN were significantly different from SN H-mode even though the time evolution of the equilibrium is not so much different near the H-mode transition time. This will be another subject for the future study. Experiment started with the probe beam tangency of 142 cm (outside the edge pedestal) and the probe beam was moved to the tangency of 137cm (inside the edge pedestal of H-mode). Bifurcation was less pronounced as the probe beam was moved toward inside but scattered signal at the highest k was increased. We have succeeded making the outer gap distance smaller (effectively can scan inner part of the pedestal) and observed similar trend. We need more time to sort out the details and have to pull together other fluctuation measurements such as reflectometry, probe, etc. to understand the new phenomena. Also we had two L-mode plasmas to be compared with the H-mode discharges. Overall, the XP operation was quite a success.

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

NSTX plasma operations continued this week after a test heat run of the LITER probe over the weekend, during which a small amount of lithium (~ 10mg) was evaporated into the NSTX vessel. During the run week, XP-608 "Characterize NBI driven current evolution" was completed before performing a vacuum vessel boronization. XP-603 "Long pulse double null development" was then performed, achieving an increase in the non-inductive current fraction at higher TF fields in highly elongated plasmas. At the end of the week, the LITER probe was used for an extended initial lithium evaporation and between-shot depositions in XP-601 "Lithium evaluation". Work also continued this week on XP-629 "Study of the scattered spectra between L and H mode", XP-620 "Shear profile effects on core high-k fluctuations", and XP-625 "Thermal Electron Bernstein Wave Conversion to O-Mode".

Plasma operations will continue this coming week. Access to the test cell will be available from the end of the run day to approximately 9PM each evening. The FY06 run is scheduled to conclude on June 16th.

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

- LITER 1C was inserted into the vessel to its operating position. The oven was heated to about 585°C resulting in an estimated 110 mg of lithium evaporation in the vessel. The heating of surrounding regions was found to be mild. The effect on the vessel partial pressures was similar to that of LITER 1B.
- XP601 was completed by measuring the density pumping effect of conditioned graphite.
- NSTX TMB Boronization-56 (~5g) was performed. (W. Blanchard)

Diagnostic Operations (R. Kaita)

- Most diagnostics continue to be operational. A CCD camera for filtered visible plasma measurements was repaired and returned to NSTX. The only major instrument not functioning is the SPRED vacuum ultraviolet survey spectrometer. There appears to be a problem with the microchannel plate intensifier, which is being investigated. Meanwhile, a Lawrence Livermore Laboratory spectrometer is being used to measure emission from higher charge states, which actually provides more information on impurity behavior closer to the core of the plasma.