NSTX Weekly Report (Aug. 12, 2005)

FY2005 Planned Operations: 17 weeks
Completed: 14.92 weeks producing 1747 plasmas

NSTX Department, Project, Program (M. Ono, M. Peng, E. Synakowski)

• There will be an NSTX Physics Meeting on Monday, 8/15 at 1:30 pm in LSB318. The agenda will be: 1) Recycling Measurements Following Repeated Lithium Pellet Injection – XP515 – H. Kugel (20 min), 2)**1-2** Vugraph updates of recent XPs; a. XP529 – Maingi, b. Xp513 – Peng, c. XP507,510 – Menard, d. XP521 – Kessel, e. XP 501,524,512 – Zhu/Sontag, f. XP533 – Mueller, g. XP511 – Takase (The presentation material is available on the NSTX web). (S. Kaye)

Run Coordination (J. Menard, S. Sabbagh)

The fourteenth week of operation was completed successfully with eight experimental proposals.

XP507 Error field correction in LSN long-pulse discharges
A particular 800kA LSN discharge scenario with small ELMs and steady beta-N = 5-5.5 was studied. These discharges reproducibly disrupt following the formation of a slowly growing near-edge locked magnetic island. n=1 external fields of varying direction and amplitude were applied during the discharge flat-top to try to heal the island and increase the near-edge rotation. For a particular range of amplitudes and phase angles the discharge pulse length was extended by 150-200ms and the plasma rotation at the nominal locking radius was found to increase. Other amplitudes and phases were observed to induce disruption at or before the time the discharge would otherwise disrupt in the absence of externally applied n=1 field.

XP510 PF-only startup with outboard field-null and HHFW
HHFW preionization power, TF, PF3, and PF5 scans were performed to try to increase the maximum plasma current achievable with ramping PFs and an outboard field null. Doubling the HHFW power was found to increase the plasma current by approximately 40-50%, 3kG operation was found to perform as good or better than 4.5kG operation, and reductions of the PF3 current after breakdown increased the plasma current. Reducing the PF5 current shortly after breakdown appeared to increase the plasma duration. Unfortunately, HHFW noise-induced faults of a real-time data-acquisition module in the test cell limited the usable HHFW power to 300kW out of 800kW possible. Plasma currents of approximately 15-20kA were reproduced with roughly 1/2 the HHFW power used last year.

XP511 Merging Start-up

Solenoidless plasma start-up using merging of two plasmas was attempted for the first time on NSTX. In this scenario two ST plasmas are formed at X-points at the top and bottom ends of the vacuum vessel near the divertor plates. The two plasmas subsequently merge to form a single plasma on the midplane. Plasma was formed by a combination of ECH, RF (HHFW), and induction by PF coils. A streak of light that follows the magnetic field line from the X-point region and moves towards the midplane was observed by the divertor fast camera. However, a conclusive evidence of plasma current formation was not observed.

XP512 NSTX/DIII-D RWM Similarity
NSTX discharges with a DIII-D similar poloidal cross-section were reproduced to examine variations in RWM physics with aspect ratio. External fields with n=1 helicity were applied and resonant field amplification was observed and again found to increase with increasing beta above the no-wall limit.

XP513 NSTX/MAST Identity Experiments on iITB Formation and Evolution
The goal was to document plasma properties regarding ion Internal Transport Barrier (iITB) formation and evolution in long-pulse high beta-poloidal H-mode plasmas in NSTX, in parameter ranges that enable identity comparison with similar plasmas on MAST. The plasma operating scenario from Integrated Scenario Development that produced plasma pulse length up to 1.5 s was utilized to create long-pulse H-mode plasmas with substantial flattop duration (250ms - 400ms) without significant n=1 MHD activity. Neutral beam injection power was varied from 6.8MW to 3.2MW, and energy from 100kV to 65kV to document plasma characteristics to develop the physics of interest. Thomson, CHERS, NPA, Mirnov, and MSE data were obtained for all discharges of interest.

XP521 Ip Rampup with HHFW
The experiment was intended to continue efforts to sustain or drive up the plasma current with HHFW heating and/or CD from a low Te and low Ip plasma. Plasma currents of 300 and 250 kA were examined, phasing of 14 m-1 heating, HHFW powers up to 3.5 MW. Entry into H-mode was obtained at 300 and 250 kA, although this frequently caused RF trips. CS gas injection was used to improve control of H-mode access. At 300 kA, when the RF recovered after a trip, the plasma tended to stay in low-mode, but at 250 kA it re-entered H-mode each time the RF recovered after a trip. The electron temperatures were as high as 2.5 keV, and strong temperature pedestals and density ears were produced. At 250 kA, the plasma oscillated back and forth between betap value of 0.5 and 1.8 at least four times as the plasma entered H-mode, the RF tripped, the RF recovered, and the plasma re-entered H-mode. Each time the plasma entered H-mode the loop voltage went negative, and the OH coil current went flat or reversed.

XP524 Active control of rotation damping in RWM plasmas
n=3 DC fields generated by the RWM control coil were used to control plasma rotation, reducing it to drive the resistive wall mode unstable. In these plasmas, an n=1 AC traveling wave field was superposed to determine the plasma response. Frequencies in the range 25 Hz - 67 Hz were applied. Plasma response to the applied field (RFA) with increasing normalized beta was observed. Small changes in the applied field led to a controlled plasma response, allowing precise RWM stability control right up to the marginal stability point. The experiment demonstrated the controlled production of low rotation targets for RWM active feedback control and gives confidence that computer controlled application of the n=1 field (active feedback) may allow cancellation of the RWM field perturbation.

XP 533 CHI into Ohmic Discharge
Ohmic lower single null plasmas with inner and outer strike points connected to the inner and outer divertor plates (respectively) were used as target discharges for applying voltage between the inner and outer vessel using the CHI capacitor bank. The capacitor bank voltage and lower dome gas injection pressure were scanned, and for the best discharges, the injected current lowered the toroidal loop voltage as much as a factor of 2 when the injector current was positive. The density increase associated with the current injection appears to significantly decrease the plasma current and increase the loop voltage after the injector current terminates. The electrical noise introduced into the magnetics and other diagnostics was significantly reduced relative to previous CHI into Ohmic attempts with the TRANSREX power supply.

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

NSTX operations resumed this past week after the maintenance period, making progress on XP-513 "iITB Identity Investigation" and using the HHFW systems in XP-510 "Solenoid-free inductive start-up with an outboard field-null", driving plasma currents up to about 17kA. Higher HHFW power levels were also used in support of progress on XP-521 "HHFW rampup". The resistive wall mode error field coils were used in several experiments, successfully suppressing a locked mode and extending a current flattop in XP-507 "Early divertor and H-mode development for long pulse in LSN", applying radial field perturbations for XP-524 "Rotation damping in RWM", and for continued progress on XP-512 "NSTX - DIII-D RWM Similarity Experiment". The CHI power system was used in XP-533 "CHI added to induction", and the PF4 coil was re-commissioned and placed in service to be used in concert with PF2 for XP-511 "Merging startup". Commissioning of the new Moveable Glow Discharge Cleaning Probe continued on the evening shift, studying the characteristics and effects of the glow discharge at various pressures. The lithium Pellet Injector has been loaded with about 200 assorted pellets of lithium, boron and carbon in preparation for an experimental machine proposal scheduled for next week.

Plasma operations will continue on Monday morning and there will be no access to the NSTX test cell during the 1st shift this week. The run day will be extended to 7PM on Tuesday and Thursday this week, and the test cell will be in controlled access each evening from the end of run day until 10PM. A machine area scrub will be performed from 10-11PM each evening in preparation for the following day's run. The next NSTX maintenance week is scheduled for the last in August. (A. von Halle)

Research Operations (M. Bell)

Diagnostic Operations (R. Kaita)

• The Johns Hopkins University three-color "optical" X-ray array was installed on NSTX and opened to vacuum. Installation of the electronics is expected to be completed this weekend.

• The vessel dust collector that was removed during the last maintenance week has been reinstalled.

• The solid state neutral particle analyzer that was also worked on during the past maintenance period has been reinstalled, and work is continuing on signal noise mitigation.

• The wiring has been corrected in the connectors for the poloidal field coil flux loops used in coaxial helicity injection experiments. The cabling was also completed between these connectors and the electronics racks containing the digitizers for the flux loop signals.

Boundary Physics Operations (H. Kugel)

• The commissioning of the MGP continued. The characteristics and effects of the glow discharge were studied at different pressures. Significant heating of the movable anode was observed at low gas pressure.

• The LPI was loaded with Li, B, and C pellets of various masses in preparation for supporting planned JHU transport experiments (D. Stutman).