

## NSTX Weekly Report (June 10, 2005)

FY2005 Planned Operations: 17 weeks  
Completed: 6.91 weeks producing 702 plasmas

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

We will hold a short Physics Meeting this Monday, 6/13 at 1:30 pm in LSB318. Fred Levinton will give an update on the MSE measurements, and Jon Menard will give a brief overview of our run schedule (past, present and future) and needs. (S. Kaye)

### **Run Coordination (J. Menard, S. Sabbagh)**

The seventh week of operations was completed successfully with five experimental proposals conducted.

#### XP501 - MHD Spectroscopy of Wall-stabilized High Beta Plasmas

The effect on plasma characteristics, especially toroidal rotation, when applying DC  $n=1$  and 3, AC  $n=1$  traveling waves, and AC  $n=3$  standing waves was examined. The applied fields were detected by the internal RWM sensors, and the plasma response to varying applied field frequency was examined (MHD spectroscopy). Frequency was varied over the range -100 to 100 Hz. The RWM was generated at relatively high field vs. last year (0.45T). Based on initial RWM sensor calibrations, mode dynamics included the appearance of a rotating  $n=1$  RWM at 15 – 25 Hz when an  $n=3$  standing wave field was applied to reduce the plasma toroidal rotation.

#### XP503 - Locked modes and error fields

The ohmic target plasma development for this experiment was completed, and reproducible density and  $q$  evolution was achieved at line-average densities  $< 7 \times 10^{12} \text{ cm}^{-3}$ . Externally applied  $n=1$  error fields were applied during a time interval when  $1 < q_{\text{min}} < 2$  in the  $I_p$  flat-top. The fields were applied in 6 different directions with ramping amplitude, and clear asymmetries in the locking threshold as a function of field direction were observed. In one particular direction, the compensated external locked mode signal was reduced to effectively zero. The magnitude and direction of the required nulling field is being compared to expectations based on physical and magnetic measurements of static error fields from the poloidal field coils.

#### XP506 - Physics of Ohmically Heated H-mode plasmas

The main goals were (continuing the run of May 4, 2005), to further document the edge and core turbulence using the correlation spectrometer and GPI diagnostics, and further to compare  $T_i$  profiles of these shots obtained from the NPA and CHERS diagnostics. Due to machine problems earlier in the day only 3 shots were possible in the remaining time and none of these resulted in an H-

mode. The reduced access to H-mode is probably due to being many shots away from the hot boronization that was done at the beginning of the run.

#### XP524 - Active control of rotation damping in RWM plasmas

The goal is to use the RWM/EF coils to control plasma toroidal rotation, and RWM growth and rotation, allowing a broader study of the physics of plasma rotation damping due to an applied resonant field and the RWM. The experiment was barely begun and only executed three discharges. However, in a shot with sweeping  $n=1$  rotating applied field frequency from 25Hz to 100Hz in the direction of plasma flow, the typically observed  $n=1$  rotating MHD that locks at the end of the shot and ceases the plasma was absent, and both the plasma beta and the toroidal rotation increased before the pulse termination. The reproducibility of this interesting result will be examined in future run days.

#### XP531 - Transient CHI Startup

The goal of this experiment is the observation of toroidal current persistence after the injector current is reduced to zero. Very productive experiments on Transient CHI startup were initiated. First, a new crowbar system that rapidly quenches left over energy from the CHI cap bank was successfully tested. Then, using the recently commissioned, ECH/Lower divertor pre-ionization system, a gas pressure scan and capacitor bank voltage scan were conducted to initiate discharges at the lowest yet gas pressures (1.7 Torr.L) for CHI initiation in NSTX. Using the lower divertor coils for flux footprint shaping and the upper coils for vertical stability control, using a 25mF capacitor bank charged to 970Volts several 100kA discharges were produced. Many of these had current multiplication factors of 60 and approached current multiplication factors of 170 towards the end of the discharge, i.e. very close to the conditions necessary for the observation of toroidal current persistence after the injector current is reduced to zero. Prof. Brian Nelson (U-Wash.) visited NSTX on June 10 to participate in these CHI experiments.

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

NSTX operations continued this past week, with progress made on several experiments and the completion of integrated system testing to extend the overall NSTX pulse time window to 2.75 seconds for a TF flat-top of 1.4 seconds. The external error field coils, powered by the Switching Power Amplifier (SPA) system, were used extensively this week to support XMP-503 "Error-field and locked-mode physics studies using RWM/EF coils", XP-501 "RWM spectroscopy", and XP-524 "Active control of rotation damping in RWM plasmas". Some initial work was done on XP-506 "OH H-modes". At the end of the week, the machine was configured for Coaxial Helicity Injection (CHI) operations to complete the commissioning of the CHI Capacitor bank (XMP-39), and to begin work on XP-531 "Transient CHI Startup ". NSTX will be reconfigured for ohmic operations over the weekend, and a vacuum vessel boronization will be performed.

Plasma operations will resume on Monday morning and there will be no access to the NSTX test cell during the 1st shift. Run days will be extended to 7PM on Monday 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.

Paul Sichta has assumed managerial responsibility for the NSTX Central Instrumentation and Control Systems upon the retirement of Gary Oliaro. Many thanks to Gary for a job well done. (A. von Halle)

### **Research Operations (M. Bell)**

#### Boundary Physics Operations (H. Kugel)

- XP-505, "Physics of Ohmically Heated H-Mode Plasmas" was continued. (C. Bush, ORNL)
- The LPI was removed from the vessel for maintenance.
- A trial fit-up of internal parts for the Moveable GDC probe was successful and qualified the assembly for final welding.
- A glass slide with a NSTX dust sample was retrieved from the vessel divertor region. Particle analysis showed a 2.06 micron count median diameter. Using an assumed density of 1.6 gram/cm<sup>3</sup>, the mass of the dust was calculated to be 2.8 microgram/cm<sup>2</sup>, in good agreement with the weight of 2 +/- 1 microgram/cm<sup>2</sup> measured with a Micro Analytical Balance (courtesy of Dr. Anton Darhuber, Princeton University). (C. H. Skinner)

#### Physics Operations (D. Mueller)

A successful week of operations was had. The locked mode coil calibration with the RWM coils was done. The RWM coils were used to study the effect of both DC and AC  $n=3$  and  $n=1$  perturbations on the plasma. A frequency scan was completed. A day of Coaxial helicity injection was used to study break-down conditions. The toroidal wrapping number (toroidal current/injector current) was around 60 in many discharges.

#### Diagnostic Operations (R. Kaita)

- A peer review was held on Wednesday, June 8, to discuss new diagnostics proposed by collaborators from the Johns Hopkins University. They are a "telescope" for viewing the core plasma emission along the trajectory of a lithium pellet, and an "optical" X-ray array, so called because it uses fiber optics

to couple the scintillator to the detectors. These two systems should be ready for installation during the upcoming maintenance week, pending resolution of minor mounting hardware issues.