

# NSTX Weekly Report (February 27, 2004)

FY 2004 weeks of operation planned: - 18 weeks, Completed: - 4.5 weeks

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

· Osamu Mitarai (Professor, Kyushu Tokai University, Japan) arrived on Monday February 23 for a three week visit to collaborate with J. Menard, C. Kessel and the NSTX researchers on the *study of the current drive by the vertical field and heating power in the plasma current flat phase in NSTX*.

· The NSTX Physics meeting will be held today, March 1, 2004, in B318 at 1:30 P.M. There will be three brief presentations on progress with the experimental run:

Ben LeBlanc will discuss the status of the window coatings

Dave Gates will summarize the results obtained thus far for XP 421 (High  $\beta$  T)

Steve Sabbagh will summarize the results obtained thus far for XP 414 (High  $\beta$  N)

## Run Coordination (S. Kaye, J. Menard)

· An overview: Several high performance experiments were run during this week. Achieving high beta-t through high elongation and thus high normalized current in DND plasmas was attempted. While currents up to 1.3 MA were achieved, an NSTX record, no further progress in achieving high-beta-t was made, with beta-t values of up to 34% attained. High-beta-pol (high beta-norm) in LSN plasmas was revisited as well, and good data was obtained for the starting point of 800 kA, ramping down to 600 and 500 kA. However, rotating and locked modes were encountered when the starting point of 1 MA was attempted, making it difficult to establish a good discharge at this condition. An experiment to scan through the NPA spectrum was started, and the vertical scan was completed satisfactorily with enough data to attempt comparisons to model calculations. Finally, higher elongation in LSN plasmas using PF1b was attempted in order to maximize pulse lengths. Long duration plasmas, lasting beyond 600 msec, were achieved at elongations of 2. This plasma had stored energy in excess of 200 kJ, with beta-t of 18% at 4.5 kG. Attempts to use PF1b were unsuccessful possibly due to mutual coupling among coil currents causing more current in the coil than was allowed. (S. Kaye)

· An experiment (XP432) to develop longer-pulse lower single null discharges with enhanced shaping was started. An 800kA discharge with duration just below 0.7s, peak beta of 18%, and normalized beta of 5.8 was obtained using 4.4MW of NBI heating at elevated beam voltage. Small changes to this shape designed to increase the elongation resulted in repeated partial collapses in stored energy - suggesting small changes in plasma shape might have a significant impact on MHD stability. This sensitivity will be further investigated in future run days. PF1B was also used for the first time in a non-CHI discharge. A high-triangularity LSN boundary shape was produced during the current ramp-up using this coil. Inductive coupling to the OH solenoid will be compensated for in the plasma control system in future experiments to allow usage of the PF1B coil throughout the discharge. (J. Menard)

· Experiments were run to investigate the Troyon scaling at high normalized current. High normalized current was to be achieved by raising the plasma elongation. Initially, high triangularity plasmas similar to those run during 2002 were run and were found to reach similar values of toroidal beta (35 - 37%, depending on the method of calculation, compared to 34-35% in 2002). The second part of the XP was to develop a high kappa shape using rEFIT and isoflux control. Higher current,  $I_p = 1.3$ MA, and elongation,  $\kappa = 2.3$ , were obtained, but issues with vacuum vessel eddy current control were identified that prevented access to H-mode and thereby prevented achieving high beta. Actions are underway to improve the shape control during these aggressive current ramp scenarios. (D. Gates)

· Xp414 was run on 2/25/04 and made progress in moving toward the equilibrium limit in NSTX. Poloidal beta value of 1.8 (epsilon beta poloidal = 1.3) was reached at an  $I_p$  value of 0.5 MA (Stored energy 137 kJ). Several discharges were created with beta\_normal ~ 6.5, and the NSTX operational space in ( $I_p$ , beta\_normal) was expanded. Plasma core rotation was high, yielding good data for equilibrium reconstructions with rotation. (S. Sabbagh, Columbia University)

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

· NSTX operations continued this week, with experiments on producing high-beta toroidal at high normalized current by increasing the plasma elongation (XP421), and further investigations into high beta normal (XP414). Fast-ion distribution during neutral beam injection was measured with the Neutral Particle Analyzer (XP417) and experiments were started to produce long pulse high beta plasmas (XP432). Control cabling and the gas line electrical break for the new Lithium Pellet Injector were installed during the evening shifts this week, and pressure testing of the gas delivery system was completed. The shot cycle this week was slowed by necessity for beam conditioning into the armor in light of the calorimeter problem.

Focus will shift to HHFW experiments this coming week, and the neutral beam will be warmed up to repair the guide bearing on the calorimeter mechanism. During this week, the test cell will be in restricted access during 1st shift, with test cell access available from approximately 5:00PM to 10:00PM each evening. The next maintenance week is scheduled for March 8th - 12th. (A. von Halle)

### **Quality Assurance (J. Malsbury)**

QC performed weld inspections for the LPI instrumentation.

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

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

- The fast RGA data acquisition time has been extended to  $t = 45s$  by reordering the sequence of events before the helium glow. This will enable a correlation to be made between out-gassing of hydrocarbon radicals after the discharge, and deposition recorded by the deposition monitor. (C. Skinner, R. Gernhardt)
- The Lithium Pellet Injector (LPI) cable terminations in the NTC were completed. The high pressure gas lines were pressure tested successfully. The LPI unit passed a leak test, was evacuated, and its bake-out system was operated to 100°C.
- Candidate parts were located for use with the Supersonic Gas Injector/Edge Magnetic Probe system, and preparations started for performing flow measurements. The Magnetic Sensor coils were prepared for welding of the field leads.

#### Diagnostic Upgrades (D. Johnson)

- First light was seen by the ultra-fast tangential x-ray pinhole camera in the initial debugging phase, satisfying a February diagnostic milestone to install this system.

#### Diagnostic Operations (R. Kaita)

- The lead shield for the solid state neutral particle analyzer has been installed, and the diagnostic is undergoing tests during plasma operations.
- The reinstallation of the UCLA reflectometer system has been completed. Further cable installation is required for additional fluctuation measurement capabilities at fixed frequency.