

## **NSTX Weekly Report (May 14, 2004)**

FY 2004 weeks of operation planned: - 18 weeks, Completed: - 11.6 weeks

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

- On Friday May 14, Michael Bell presented a seminar entitled "Toroidal Magnetic Plasma Confinement at the Limit: Recent Results from the National Spherical Torus Experiment" at the Plasma Science and Fusion Center, MIT, Cambridge. (M. Bell)
- The NSTX Physics meeting will be held on Monday, May 17, beginning at 1:30 P.M. in LSB B-318. Randy Wilson and Ben LeBlanc will provide summaries of the recent HHFW heating and current drive experiments. (C.K. Phillips)

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

Two experiments were run and completed, and a third experiment was started this week. An experiment was performed to study the effect of morning boronization and between shots boronization. While the former technique was found to have some benefit, the latter technique did not lead to the desired recycling conditions. An HHFW experiment was performed to monitor the edge coupling of RF with the plasma for different antenna phasing and plasma species. Important components of this XP were measurements of both the edge ion heating and edge fluctuation levels. rEFIT control, with the new vertical stability algorithm implemented, was used for this XP. Finally, a third XP to study the effect of fueling location on H-mode access was begun.

- An XP to evaluate morning and between shot boronization techniques was completed. The XP focused on making the present good machine conditions better. 5 short boronizations, ranging in duration from 1 minute to 17 minutes followed by varying durations of HeGDC, were performed. The work focused on determining the optimum balance between the duration of boronization, the required HeGDC for desorbing the codeposited deuterium, and the subsequent fiducial performance. It was found difficult to desorb the codeposited D2 sufficiently after between shot boronization to achieve the desired recycling conditions within the preferred duty cycle; hence it was concluded that morning boronization will be more efficient for improving and maintaining stable operating conditions. During this work, a high performance Lower Single Null (LSN) with coil PF1B, achieved the highest stored energy (300 kJ,  $\tau_E \sim 45\text{-}50$  msec ( $\sim 1.7 \times \text{ITER97L}$ ),) for a 2 NBI discharge, and in work immediately following this XP, the resulting conditions yielded several Double Null (DN), 2 and 3 NBI discharges, which achieved the highest stored energy to date for DN discharges (H. Kugel).
- An XP to study the coupling of HHFW to the edge plasma, and to measure the possible associated parametric decay instability and edge ion heating was completed. Scans using 7 m-1 and 14 m-1 were performed in Helium and Deuterium plasmas. The first part of the HHFW pulse was modulated, and MPTs laser times marched through the pulse in order to measure the local electron heating efficiency. The latter part of the RF pulse was steady to make the edge ion heating measurements. The Helium discharges showed good electron response to the HHFW heating, with 14 m-1 heating the electrons over a wider range of radius than at 7 m-1. Simultaneous data from the RF probe and Edge Rotation Diagnostic were taken, and the edge heating results showed more efficient coupling to the electrons (i.e., less edge ion heating) for 7 m-1. Deuterium discharges exhibited more MHD than did Helium discharges, making it more difficult to obtain the edge heating data. rEFIT control was used throughout the day, and good vertical control of  $kappa=2$  plasmas at  $l_i=1.5$  was achieved; vertical control for this combination of parameters in the past was elusive. (J. R. Wilson, T. Biewer, D. Gates)

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

NSTX plasma operations resumed on Wednesday afternoon this past week after completing a scheduled one week maintenance period, followed by an unscheduled two and half day break to repair a water leak in the PF1A upper bus connection. An extended plasma operation was conducted on Thursday. An experiment on between-shot boronization (XP-429) was completed, demonstrating some effectiveness of this new capability. Some time was spent evaluating new gas system control profiles as part of the H-mode gas fueling experiment (XP-409) before moving on to the HHFW edge coupling experiment (XP-441).

By the end of this past run week, NSTX had completed 11.5 weeks of plasma operations and high power testing thus far this year. Access to the NSTX test cell will be restricted during plasma operations this week. Test cell access will be available from 5:00PM to 10:00PM each evening, except for Tuesday, May 18th, when plasma operations will be extended to 7:00PM. The next maintenance period is scheduled for June 5th - 17th. (A. von Halle)

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

#### **Physic Operations (D. Mueller)**

Major changes to the plasma control system (PCS) were commissioned:

- The 192 data channel upgrade that includes data for the HHFW coupling is now running without problems.

- The transition from the simple shape control phase to the rt-EFIT isoflux phase was modified to ramp control from one algorithm to the next rather than making an abrupt change. This was installed, tested and used successfully. It helps to avoid sharp changes in the control when the expected values in the 2 phases differ greatly.
- The rt-EFIT isoflux control was modified to provide the ability to use analog voltage loop difference between upper and lower flux loops as a derivative term in the vertical position control. This was successful and, at least for the high li plasmas used during HHFW experiments, allowed control of plasmas with higher kappa than was possible with rt-EFIT isoflux control prior to the modification. ( $li \sim 1.5$ ,  $kappa \sim 2$ ) In a nice demonstration of the control afforded by rt-EFIT isoflux control, kappa was scanned from shot-to-shot over the range of 1.6 to 2.1 while the outer gap control was held the same from shot-to-shot.

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

- XP-429, "Evaluate Daily and Between Shot Boronization" was completed.
- Lithium Pellet Injector (LPI) magazine rotation, rotary feedthrough, step motor, shaft encoder, and associated software were tested, and successfully operated. Past difficulties representing magazine positioning with the encoder were resolved. (Engineering Dept. Personnel)
- A partial mockup of the Supersonic Gas Injector (SGI) was installed on the test chamber in preparation for testing. Coil leads for the onboard rear edge magnetic sensors were welded and insulated, and parts for the sensor shielding were acquired. Design work for the front graphite shroud progressed using a mockup for small embedded front edge magnetic sensors. (SGI Team)
- Fast Probe parts from the recent maintenance work were shipped to UCSD. Fast Probe spare parts ordered by UCSD were received. (L. Chousal, R. Hernandez, UCSD)

#### Diagnostic Operations (R. Kaita)

- In an attempt to reduce the noise problem on various NSTX diagnostics, the diagnostic ground was reconfigured for a shorter run to a more local ground point. Signals on various systems, including magnetics and ultrasoft X-ray arrays, indicated either no difference or a slight change for the worse. The ground was then reconnected to the TFTR ground pit.