

## **NSTX Weekly Report (April 4, 2008)**

### **FY 2008 NSTX plasma operations**

**Planned: 15 weeks**

**Completed: 5.84 weeks (through April 2, 2008)**

A report was submitted to the ITER project detailing the results of a recent vertical stability experiment run on NSTX. The experiment measured the maximum controllable vertical displacement by turning off the vertical control, allowing the plasma to drift and turning the control back on. The results showed NSTX has a maximum controllable vertical displacement of 10% of the minor radius near the control boundary. It was also found that displacements varied if they were upwards versus downwards, a feature attributed to asymmetries in the NSTX vacuum vessel. These results will be used to help ITER decide whether or not to modify its vertical control to make it more robust. The ITER poloidal field system as currently envisioned would only support a 2% maximum controllable vertical displacement. (D. Gates)

A report was submitted to the ITER project on the recent resonant magnetic perturbation (RMP) experiments performed on NSTX with various applied n-spectra using the mid-plane RMP coils. When RMP fields were applied on NSTX, ELM suppression was not observed, but instead ELMs were destabilized and/or increased in fractional energy loss. The H-mode threshold power is observed to increase and inter-ELM recovery time increases. These results apparently re-affirm the need for spectral flexibility - i.e. a combination of midplane and off-midplane coils in ITER to minimize edge flow-damping while also providing ergodizing fields in the pedestal. NSTX experiments do not exhibit density pump-out directly attributable to RMP fields. This could be because of lack of particle pump in divertor, and/or shielding of RMP fields by rotation in the plasma edge. These results highlight the continued need for additional efforts to understand the required pumping, and the expected rotation and flow-damping from RMP in ITER. (J. Menard)

There will be an NSTX Physics Meeting on Monday, 4/7 at 1:30 PM in LSB318. We will have some summaries of XPs from last week and the week before by:

E. Mazzucato – High-k scattering (XP821)

D. Stutman – Power scaling of electron transport (XP822)

R. Maqueda – Edge characterization (XP816)

V. Soukhanovskii – Detached divertor (XP814)

S. Sabbagh – ELM suppression (XP818)

E. Fredrickson – Fast ion transport (XP819)

The talks will be found in

[http://nstx.pppl.gov/DragNDrop/NSTX\\_Meetings/Monday\\_Physics\\_Meetings/2008/4-7-08/](http://nstx.pppl.gov/DragNDrop/NSTX_Meetings/Monday_Physics_Meetings/2008/4-7-08/) (S. Kaye)

### **Run Coordination (M. Bell, R. Raman)**

Five experiments were conducted in the week March 27 - April 2, 2008.

On Thursday March 27, XP-816 "Edge characterization in highly shaped plasmas" was run. Edge and divertor data, including measurements of turbulence and blobs in the outer midplane, were collected for H-mode plasmas with 2, 4 and 6 MW NBI heating.

On Friday March 28 we performed XP-823 "Robustness of improved error field suppression in long-pulse discharges" [Menard]. Combinations of pre-programmed  $n=3$  error field correction (EFC) and  $n=1$  feedback suppression of RFA/RWM were tested at three plasma currents. At  $I_p = 900\text{kA}$ , the response of the plasma rotation to applied  $n=3$  field depended on the timing of the H-mode transition, suggesting that the  $q$  profile and/or beta play a role. At lower current  $I_p = 750\text{kA}$  and with early H-mode, the rotation near the plasma edge clearly depended on the sign and amplitude of the applied  $n=3$  field, confirming the presence of the intrinsic  $n=3$  EF found previously at  $900\text{kA}$ . At  $I_p=1.1\text{MA}$ , plasma flat-top durations matching the longest previously achieved were obtained using a combination of  $n=3$  EFC and  $n=1$  feedback.

Monday March 31 was devoted to the experiment XP-817 "Flux savings from inductive drive of a transient CHI-started plasma" [Raman]. A successful transition was achieved from a CHI produced discharge to inductive rampup by the central solenoid. The electron temperature in the coupled discharges increased in time and exhibited a hollow profile even during the current ramp-up. This feature apparently results from the CHI startup which produces edge current, resulting in a plasma with a hotter edge.

On Tuesday April 1, we performed the machine proposal MP-26 "HHFW coupling" [Hosea] concentrating on coupling to deuterium L-mode plasmas. Over 2MW was coupled in both heating and current drive phasings. Combined  $n = 3$  error field correction and  $n = 1$  active feedback were used successfully to delay or eliminate slowly rotating MHD activity which occurred during these discharges.

The experiment XP-821 "High-k turbulent fluctuations in HHFW heated plasmas" [Mazzucato] was attempted on Wednesday April 2 with the goal to compare the high-k fluctuations in helium and deuterium plasmas. The experiment started with an attempt to reproduce the helium plasmas studied last year in XP-735. However, similar electron temperature profiles were not obtained reliably, although steep electron temperature gradients were observed in some shots.

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

NSTX plasma operations continued this past week with the machine configured for one day of Coaxial Helicity Injection (CHI) operations and then for fully ohmic operations for a set of experiments utilizing High Harmonic Fast Wave (HHFW) heating and current drive. During the CHI experiment, NSTX successfully achieved for the first time an inductively driven ramp-up of the plasma current after initiating the discharge by CHI. The HHFW systems successfully coupled up to 3 MW in heating and current drive phasings in experiments also utilizing neutral beam injection and the machine's error field coils. Also this week, the new LITER probe installed at bay K was opened to machine vacuum for the first time in order to begin alignment checks and pre-operational testing.

NSTX Test Cell access will be restricted during plasma operations this coming week. Test Cell access is expected to be available from 5PM to 10PM each evening.

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

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

#### **Liquid Lithium Divertor (LLD):**

- The following LLD Abstracts were submitted to the 25th Symposium on Fusion Technology, 15-19 Sept., 2008, Rostock, Germany.
  - "Physics Design Requirements for the National Spherical Torus Experiment Liquid Lithium Divertor," Henry Kugel<sup>1</sup>, et al;
  - "Thermal Control of the Liquid Lithium Divertor for NSTX," Richard E. Nygren<sup>1</sup>, et al;
- The Final Design Review (FDR) for the LLD will be Tuesday, April 22, 2008 at 9:30am in B-318. A partial list of work tasks in progress for the FDR are:
  - Approved drawings of the LLD and parts list.
  - Thermal analysis demonstrating adequacy of the design with porous molybdenum and thin stainless steel on copper.
  - Price and delivery of ITER adopted Hot Isostatic Pressure bonding (HIP).
  - Price and delivery of plasma spraying.
  - Electrical elementary of control rack and interfacing.
  - Price and delivery of thermocouples and heaters.
  - Price and delivery of components for heater control and thermocouple monitoring.
  - Resource-loaded price and assembly schedule.
  - Responses to chits from CDR.
- Lithium Evaporator (LITER) FY08
  - Preparations were completed for the installation of LITER-Bay F on NSTX.
  - A preliminary test of the LITER-Bay K alignment found an interference in the vessel near the end of travel close to the operating point. Preparations are progress to provide suitable TV camera views to facilitate realignment.
  - Planning for XP826 on "LITER Characterization and ELM Mitigation" was presented at a BP-TSG meeting.
- Lithium Powder
  - Work started on the final testing and assembly of the hardware for installation on NSTX during the next maintenance period. The laboratory software for off-line testing has been completed.
  - Planning for XP827 on "Lithium Powder Characterization" was presented at a BP-TSG meeting.

### **Diagnostic Operations (R. Kaita)**

- All of the hardware for remotely controlling the mirrors for the high-k microwave scattering system has been received, and installation has begun. The software for moving the stepper motors is being checked on the computer that has been designated for this system.