

## **NSTX Weekly Report (June 20, 2008)**

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

**Planned: 15 run weeks**

**Completed: 13.05 run weeks, 1987 plasmas (through June 18, 2008)**

• NSTX research was described in an invited talk and four contributed posters at the 35th European Physical Society (EPS) Conference on Plasma Physics in Crete, Greece, from June 9 through 13, 2008. The presentations covered lithium plasma-facing components (PFCs), coaxial helicity injection, supersonic gas fueling, MHD instabilities, and active plasma equilibrium with control resonant magnetic perturbation (RMP) coils. There was particular interest in the first and last topics, since lithium was now being used on variety of magnetic confinement devices, and RMP coils are planned for ITER. The MHD poster was also timely, since L. Chen of the University of California at Irvine was recognized at the conference with the EPS Hannes Alfvén Prize for his lifetime work on Alfvén wave physics. The titles and first authors of the NSTX-related papers are as follows:

"The response of tokamak plasmas to 3D magnetic field perturbations" by J. Menard, (invited talk);

"Toroidal Alfvén Eigenmode Avalanches in NSTX" by E. Fredrickson;

"Improvement in Plasma Performance with Lithium Coatings in NSTX" by R. Kaita;

"Coaxial Helicity Injection plasma start-up coupled to inductively driven sustainment on the National Spherical Torus Experiment" by D. Mueller; and

"H-mode fueling optimization with supersonic deuterium jet in the National Spherical Torus Experiment NSTX" by V. Soukhanovskii, (LLNL)  
(R. Kaita)

• There will be an NSTX Physics Meeting on Monday, 6/23 at 1:30 PM in LSB318.

We will have XP updates from the following:

6/16 XP-833 "Halo Current Dependencies" [Gerhardt]

6/16 XP-826 "X-point limiter" [Bell]

6/17 XP-836 "High elongation plasmas" [Gates]

6/17 XMP-56 "SWIFT diagnostic commissioning" [Paul]

6/18 XP-812 "Impact of rotation on energy and impurity confinement" [Kaye,]

6/18 XP-813 "Momentum transport using n=3 braking" [Kaye for Solomon]

(S. Kaye)

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

On Monday 6/16, the experiment "Halo Current Dependencies" [XP-833, S. Gerhardt] was completed. Deliberate Vertical Displacement Events (VDEs) were forced in deuterium plasmas, both with and without NBI. Halo currents up to 130kA were measured. No strong dependence of the halo currents on injected power was found. For the last hour on Monday afternoon we continued development for the experiment "X-point limiter" [XP-826, M. Bell].

On Tuesday 6/17 we continued "High elongation plasmas" [XP-836, D. Gates] for most of the day. The experiment used both lithium evaporation, and combined EF correction and RFA feedback. The primary highlight was production of a plasma which reached poloidal beta 1.5 and normalized beta  $\sim 6\%$  at an elongation of  $\sim 2.7$ . The pulse lasted for  $\sim 1.4$ s and had a

peak electron temperature  $\sim 1\text{keV}$ . This was the first time a plasma at very high elongation has been created near the wall-stabilized limit. In the last two hours of the extended run day, we performed the NSTX Machine Proposal "SWIFT diagnostic commissioning" [XMP-56, S. Paul], making use of a 14-bit monochrome camera on loan. The camera frame-rate was varied from 250 to 2000 fps and recorded 100 - 400 frames per shot. The camera was found to be sensitive to magnetic field and a maximum tolerable toroidal field current of 40kA was established. In discharges taken at 36kA ( $B_T = 0.3\text{T}$ ) in helium with 4MW of NBI, adequate light was obtained at the camera for time resolution as short as 0.5ms.

On Wednesday 6/18, the experiment "Impact of rotation on energy and impurity confinement" [XP-812, S. Kaye] was completed. Braking of the NBI-induced rotation with an applied  $n=3$  error field was employed to determine the effect on energy confinement. The  $n=3$  braking currents were varied from -600A to 800A, resulting in rotation rates that varied from 70km/s to 25km/s at  $R=1.35\text{m}$ . The stored energy showed very little variation with rotation. Local analysis will be done to determine what effect, if any, the rotation and rotational shear has on local transport coefficients. At the end of the day we switched to the experiment "Momentum transport using  $n=3$  braking" [XP-813, Solomon]. This experiment was completed the next day and its results will be reported next week.

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

NSTX plasma operations resumed this past week after a maintenance week during which the two lithium evaporator (LITER) probes were filled with about 55 grams each of lithium, and the neutral beam ion sources reconditioned to full power after the calorimeter bellows replacement. The neutral beams and the LITER probes were both used extensively in support of NSTX experiments this past week. High Harmonic Fast Wave (HHFW) heating was brought into the mix late in the week after an evening of HHFW antenna conditioning. Also this week, the lithium powder injector was installed on NSTX, and is now under vacuum but still isolated from machine vacuum.

There will be no access to the NSTX test cell during plasma operations this coming week, and plasma operations will be extended to 7PM on Tuesday and Thursday. Access to the test cell will be available from the end of the run day to 10PM each evening.

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

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

- Two new fast visible cameras were obtained for NSTX/ cameras. The first is a 10-bit color camera for overall imaging of plasmas and in-vessel components at up to 1,000 frames per second. The second is a 14-bit monochrome camera for imaging turbulence, dust transport, and other transient phenomena at up to 190,000 frames per second.
- Work on the remote control system for the mirrors on the high-k turbulence diagnostic will conclude this run period with motor testing using a computer in the NSTX Test Cell. Full implementation is planned for the outage this summer.

## Boundary Physics Operations (H. Kugel)

- Lithium Evaporator (LITER) - The LITER system was used this week to support XP-836 (High kappa), XMP-56 (SWIFT), XP-812 Rotation and confinement ), XP-813(Momentum transport), XP-820( Core momentum transport), XP-829 (Shear & transport), XP-821 (High-kappa HHFW), and machine condition
- Liquid Lithium Divertor (LLD) - Checking of drawings for new divertor tiles that interface with the LLD is ~80% complete. A manufacturing scheme that involves machining the LLD plate in a flat configuration, then bending it to its conical shape, has been discussed with potential vendors and received a positive response. Work has progressed on the design of diagnostic tiles, with input from scientists at UIUC and Culham. (R. Ellis,III)
- Lithium Powder Dropper - Mechanical installation on the vessel was completed and the unit is under vacuum. The engineering of the control software is in progress. (D. Mansfield, L. Roquemore)