

## NSTX Weekly Report (Mar. 26, 2010)

### **FY 2010 NSTX plasma operations**

**Planned: Total - 15 run weeks (Base - 14 run weeks, ARRA - 1 run week)**

**Completed: 0 run week and 0 plasma shot**

Jiansheng Hu, head of the boundary physics / wall conditioning effort on the EAST and HT-7 devices at ASIPP in Hefei, China, visited NSTX on March 15-26, 2010 to discuss wall conditioning collaboration possibilities. Hu participated in loading a Lithium Powder Dropper with 25g of paraffin-coated lithium powder, and a successful operation test of dropping it into a diagnostic apparatus. (H. Kugel)

The paper "Progress in understanding error-field physics in NSTX spherical torus plasmas" by J.E. Menard, et al. has been published in Nuclear Fusion. This paper summarizes a multi-year research effort on NSTX to identify, model, and compensate  $n=1$  intrinsic error fields, perform systematic  $n=1$  lock-mode scaling experiments and analysis for STs and ITER, and to develop real-time error-field correction algorithms utilizing combinations of models for the intrinsic error field and active feedback control of  $n=1$  resonant field amplification (RFA). The paper also describes identification and correction of  $n=3$  non-resonant error fields and systematic plasma performance improvements resulting from a combination of  $n=1$  and  $n=3$  error field correction. Finally, the paper describes comparisons between the measured  $n=1$  RWM instability threshold resulting from  $n=3$  error fields and predictions from the MARS-F code. The measured and simulated results indicate that the plasma stability is very sensitive to the rotation near the plasma edge, in particular for  $q$  surfaces with  $q > 3$  in the outer 10-20% of the minor radius. The paper is downloadable from: <http://stacks.iop.org/0029-5515/50/045008> (J. Menard)

The paper "Modification of divertor heat and particle flux profiles with applied 3-D fields in NSTX H-mode plasmas" by J-W. Ahn (ORNL) et al., was accepted for publication in Nuclear Fusion. This paper presents recent experimental results of the effect of both intrinsic and applied 3-D field on the divertor profiles. Comparison with a vacuum field line tracing calculation showed good agreement for the characteristics of the split strike point structure. (J-W. Ahn)

The paper "Implications of NSTX Lithium Results for Magnetic Fusion Research," by M. Ono et al., was accepted for publication in Fusion Engineering and Design. This paper possible implications and applications of the NSTX lithium results on the magnetic fusion research were suggested which include electron and global energy confinement improvements, MHD stability enhancement at high beta, ELM control, H-mode power threshold reduction, improvements in radio frequency heating and non-inductive plasma start-up performance, innovative divertor solutions and improved operational efficiency. (M. Ono)

R. Maingi presented a seminar at the Fusion Energy Division in Oak Ridge National Laboratory on 3/19/10: "The Enhanced Pedestal H-mode: Characteristics and Long Pulse Prospects." The focus was on a class of discharges with increased pedestal  $T_e$ ,  $T_i$  and enhanced energy confinement ( $H_{98y2}$  up to 1.7) for several energy confinement times, near zero loop voltage, and high non-inductive fraction at  $I_p=0.9$  MA. This discharge scenario appears occasionally after large natural or RMP-triggered ELMs. (R. Maingi, ORNL)

Todd Evans of General Atomics gave a talk at a recent NSTX Physics Meeting on "Edge magnetic field line studies for a proposed set of internal coils on NSTX". Vacuum field modeling results were shown for two rows of coils, positioned in front of the upper and lower primary passive plate stabilizers, with  $n = 3$  and  $n = 6$  perturbation fields. It was shown that the proposed NSTX RMP coils produce an edge stochastic layer width, where the Chirikov island overlap parameter exceeds unity, which exceed the DIII-D  $n = 3$  I-coil edge stochastic layer width by at least 20% when configured for  $n = 6$  RMP operations. It was also shown that this broad  $n = 6$  edge stochastic layer can be maintained over a large range in  $q_{95}$  (i.e., 5.3 to 12.8) by varying the toroidal phase of the currents in the upper and lower coils over an angle of 30 degrees (i.e., between odd and even parity) as  $q_{95}$  is changed. In addition, results were shown for cases in which  $n = 3$  RMPs from the equatorial plane EF/RWM coils were combined with  $n = 6$  perturbation fields from the upper and lower front surface primary passive plate coils to maintain a wide edge stochastic layer over a large range in  $q_{95}$ . Additional optimization studies are underway based on Chirikov parameter and edge field line loss calculations as a function of the aspect ratio and tilt angle of the proposed coils. (R. La Haye, General Atomics)

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

NSTX is preparing to return to experimental operations with the successful completion of integrated system power testing and magnetic diagnostic calibrations this past week. Both lithium evaporation (LITER) probes were used to deposit ~ 15 grams of lithium in the vessel, and an experimental machine proposal (XMP) to evaluate machine conditions is in progress, successfully achieving reproducible ohmic discharges at 450kA. All three neutral beam three ion sources have been conditioned to 90keV for 3/4 second pulse lengths, and the twelve HHFW antennas vacuum conditioned to over 20kV.

Access to the NSTX test cell will be restricted during plasma operations this coming week. Access will be available after 5PM each evening.

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

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

- Liquid Lithium Divertor (LLD)
  - the LLD was loaded with about 1.1g of lithium.
  - LLD plates were operated in the heated and unheated modes in support of XMP-064.
- LLD Diagnostics
  - F. Scotti reported on first images from the 2 new Phantom LLD fast cameras, downward viewing from Bay J and Bay E top. The images taken with the LLD plates at room temperature exhibited a large difference in visible reflectivity between the plates that were warm (220°C) and a plate at room temperature at the time of the lithium deposition.
- Lithium Evaporators (LITERs)
  - LITER units F1 and K1 were used to deposit 16.3g of lithium on the lower divertor region in support of XMP-064.
  - The assembly and off-line testing of LITER units F2 and K2 was completed.

### Diagnostic Operations (R. Kaita)

- Diagnostic preparations continued for plasma operations. Window transmission measurements were performed for the multipoint Thomson scattering system. Calibration shots were completed for magnetic sensors, and new integrators were installed for them.