NSTX Weekly Report (Aug. 14, 2009)

FY 2009 NSTX plasma operations
Planned: Total - 16 run weeks (Base - 11 run weeks, ARRA - 5 run weeks)
Completed: Total - 16.5 run weeks with 2,679 plasma shots
(Base - 10.95 run weeks with 1,705 plasma shots
ARRA - 5.55 run weeks with 974 plasma shots)

• The NSTX ARRA Five Run Week Milestone was successfully completed on August 10, 2009.

• Yong-Seok Hwang (Professor, Seoul National University, Korea) visited NSTX for research collaboration discussions on tokamak start-up, the FIReTIP interferometry and polarimetry diagnostic, and fusion engineering.

• Benoit LeBlanc of PPPL gave a presentation entitled "Safe Operation of the MPTS Laser System" during the 5th Annual Advanced Laser Safety Officer Workshop at the University of Pennsylvania, Philadelphia, PA, on August 4-6, 2009. (R. Kaita)

• Nobuhiro Nishino (Professor, Hiroshima University, Japan) completed a five- week visit to PPPL. He worked on the SWIFT diagnostic for plasma flow measurements in NSTX discharges. (R. Kaita)

Run Coordination (R. Raman , University of Washington, Deputy: E. Fredrickson)

NSTX Plasma Experimental Highlights for August 6 - 12, 2009**:** The toroidal field (TF) polarity was reversed for the first time on NSTX. In this reversed TF configuration, L-H threshold studies were conducted as well as the Scrape-off-Layer (SOL) profiles, divertor heat fluxes and access to a radiative divertor configuration in low and high triangularity discharges were studied.

On August 6 and 7 and for part of August 10, XP955 "Basic operation with reversed TF" – D. Mueller – was run. These first experiments in NSTX with reversed TF, successfully produced a variety of plasmas. Salient features include: 1) With reversed TF, H-mode access was easier in upper single null (USN) discharges than in lower single null discharges (LSN), the opposite was the case in the normal TF direction. 2) The stability of the discharge seemed to be very sensitive to either the time the H-mode began or to whether the plasma was in USN or LSN at the time the H-Mode began. 3) In reversed TF, USN discharges in general performed better with less MHD activity than LSN discharges despite the relatively short time conditioning the upper divertor compared to the lower divertor and despite the Li coating being primarily on the lower divertor. 4) The Resistive Wall Mode (RWM) coils were used to correct error fields (EFs) and prevent mode locking. As expected the optimal n=3 correction which mainly corrects non-axisymmetric fields from Poloidal Field Coil #5 (PF5) was unchanged compared to normal TF direction. Six discharges were taken in a scan of the n=3 applied field amplitude and phase in reversed TF. It was found that the optimal EF correction, inferred as the applied field which maximized the plasmas total angular momentum, was in the vicinity of -130 A for Ip=800kA, which is consistent with previously determined corrections. Operationally, this indicates that the previously determined n=3 EFC scheme can be used during the reversed TF. From the physics side, it further confirms the finding that the n=3 EF is due to non-circularity in the PF-5 coil, not

the TF coil (S. Gerhardt). 5) The optimal n=1 phase correction which has a component due to the Ohmic heating coil interaction with the TF coil was shifted by about 50° compared to the normal TF direction. An n = 1 feedback phase scan was run under reversed TF operation to determine optimum settings for the RWM control system. Seven shots were taken with the feedback phase varied. The shots bounded the non-feedback case in pulse length, with the cases in which the mode was suppressed (negative feedback) being a factor of two longer than shots in which the mode was driven (positive feedback). The extremes were reproduced and a new optimal feedback phase of ~ 220° was found (S. Sabbagh).

During the afternoon of August 10 and on August 11 and 12, Parts 2 and 3 of XP956, "L-H threshold and edge transport and turbulence in NSTX reversed B_t discharges" – S. Kaye – were run. In Part 3, a study of reversed B_t effects on SOL and divertor transport in high triangularity discharges was undertaken. Reversing the toroidal field leads to different directions of ExB and diamagnetic drifts in the SOL, and results in modifications to particle and heat flux asymmetries in the divertor. NBI power scans between 1 and 5 MW were successfully completed in lower single null H-mode discharges with the ion B x gradB drift up at high triangularity (delta=0.8-0.85). Discharges in general were much shorter than with forward B_t, suffering from many large global MHD events. Several discharges were run with divertor gas injection, with an aim to establish a threshold of outer strike point partial detachment at reversed B_t, to compare with forward B_t experiments. Data was taken with all divertor diagnostics and it is being analyzed. One immediate observation was that the inner divertor was always attached (as compared with it being nearly always detached with forward B_t).

In part 2 of XP956, the L-H threshold (Low-mode to High-mode transition threshold) was studied in both upper and lower single null plasmas. In each configuration the power threshold was studied both without Li evaporation and with 200 mg lithium (Li) deposited between pulses. With no Lithium, the L-H power thresholds were comparable at approximately 3 MW of injected power. With Li evaporation, the power threshold in both configurations was significantly reduced. In the LSN configuration (unfavorable grad B drift direction), the L-H transition occurred at powers in the range of 1.2 MW. In USN (the favorable drift direction), the power threshold was approximately 50% lower. That Li deposition in the lower divertor affects the threshold power even for USN operation suggests that even this local deposition influences profiles in the edge region of the plasma that can affect the threshold.

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

NSTX plasma operations continued this past week with extended run days on Tuesday and Thursday, and with the use of the freshly refilled Lithium Evaporator (LITER) probes, the lithium powder shaker, High Harmonic Fast Wave (HHFW) and neutral beam heating, the RWM error field coils, and the PF Absorber Coils in conjunction with Coaxial Helicity Injection (CHI) operations, all with the machine configured for reversed TF operation. Time was again taken this week to repeat a Motional Stark Effect (MSE) diagnostic calibration for the reversed TF operation. The FY09 NSTX run came to a successful conclusion at the end of this week, and a round of diagnostic calibrations has started with a neon glow to support the Charge Exchange Recombination Spectroscopy (CHERS) calibration on Friday evening, a calibration of the ion gauges and residual gas analyzer (RGA) on Saturday, and machine field operation for a magnetic diagnostics calibration this Monday. Rayleigh and Raman Scattering calibrations of the Multi-Pulse Thomson Scattering (MPTS) diagnostic will be performed on Wednesday through Friday

of this coming week.

The NSTX Test cell will be in restricted access during diagnostic calibrations for the majority of this coming week. Test cell access is expected to be available on Tuesday.

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

• Liquid Lithium Divertor (LLD)
- Parts assemblies started. Some part corrections were identified.
- A 3-day, 600°C, vacuum bakeout of all the newly received plate heaters was completed.
- Preparation of a work station for applying a lithium edge barrier was completed.

• Lithium Evaporator (LITER 2009)
- Both units of the LITER system were reloaded to support operations during the last week of the run.

• Tungsten Dust Dropper
- A tungsten-dust dropper was installed to support planned ITER relevant experiments.

Diagnostic Upgrade (B. Stratton)

Commissioning of the new three-vew divertor bolometer diagnostic was completed during the week of July 13. Two control electronics chassis that had been repaired by the bolometer vendor were re-installed on NSTX during the previous week. All of the amplifiers now communicate with the main control unit and data can be recorded from each amplifier. A balanced-bridge circuit is the electronic configuration that is used for the active reference detector pairs and proper operation requires that the detector-pairs be balanced and the signal nulled before data can be taken. The system is now taking data routinely and inversion software to perform tomographic reconstruction of the emission is being developed. (S. Paul)