# NSTX Weekly Report (July 16, 2004)

For FY2004 Joule milestone: 18 weeks; programmatic goal: 20 weeks. Completed: 18.3 weeks producing 2099 plasmas.

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

• DOE-OFES NSTX Quarterly Review teleconference was held on July 16, 2004. The review material can be viewed on the NSTX web site, ttp://nstx.pppl.gov/DragNDrop/Quarterly_reports/.

• Wonho Choe from Korea Advanced Institute of Science & Technology, Korea arrived on July 8, 2004. His student Jayhyun Kim also arrived on July 12, 2004. They will be working on the PF Coil only inductive plasma start up on NSTX.

• At the NSTX Physics meeting on Monday, July 19, some of the team members who attended the recent EPS meeting will provide brief overviews of highlights from the conference. The meeting will be held in LSB B-318 starting at 1:30 pm, and will be available as usual for remote participation, as indicated below. (C. K. Phillips)

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

During this week of 3 kG operation, experiments were performed using RF and NBI. Key new technical features this week included the MSE diagnostic for current profile measurement and the EF/RWM active control coil.

- The HHFW Current Drive experiment was run again in order to document changes in the plasma current profile induced by the HHFW with the newly commissioned MSE diagnostic. Some discharges with electron temperatures near 1 keV, a necessary condition for driving current, were obtained. However, many discharges had the electron temperature below 1 keV due likely to the MHD activities. (P. Ryan, ORNL)
- An edge turbulence experiments was continued from earlier in the run, making use of the reciprocating probe and GPI diagnostics. Discharges were run in DN with a plasma current of 640 kA in order to match the field pitch with the GPI view. By the end of the day, 5 L-mode shots were obtained, but the discharge did not transition into H-mode most likely due to wall loading and MHD activity. (J. Boedo, UCSD)
- A good starting point was established for further studies of divertor regimes and detachment in NSTX. It was confirmed that the outer divertor does not detach under normal plasma conditions of NSTX (LFS gas injection rate up to 120 Torr-l/ s, central el. density up to 5.5 x 10^19 m^-3,

total input power 3.1 MW). A future experiment will study the inner and outer divertor regimes corresponding to other regions of NSTX operational space. (V. Soukhanovski, LLNL)

- An ion Internal Transport Barrier (iITB) in co-NBI H-mode plasmas was carried out in order to document the iITB behavior as the NBI momentum input was varied over a wide range by systematic changes in power, sources and energy. Initial examination of the data obtained indicates that a ~10-cm zone (~10-20 ion gyroradius) of steep Ti gradient (~10 keV/m) consistently evolves to about 10 cm inside of the outer plasma edge. A strong nonlinear dependence of plasma rotation and rotation shear was observed, when MHD activity was moderate and the plasma rotation tended to saturate as the input NBI momentum is varied over a factor of about 2.5. Co-session leader Anthony Field of MAST team participated remotely from Culham via video and data link. (M. Peng, ORNL)
- The two new external EF/RWM coils were used to study the interaction between applied static error fields and locked modes which occur during the Ip ramp in NSTX plasmas at BT = 3kG. The error field magnitude, polarity, and plasma density were varied to determine the locking threshold as a function of applied error field. The density threshold for locking showed a clear dependence on the polarity of the applied error field. At a fixed coil current magnitude of roughly 1kA, the threshold density was found to be at least a factor of 2 lower for the optimal polarity relative to the opposite polarity. These results imply that some source of residual error field is present during the Ip ramp phase of NSTX discharges. With compensation of this error field, a low density regime with ne-bar = 1.4x10^13/cc and high central Te = 1.7keV was obtained using 2 NBI sources and H-mode during the Ip ramp in PF1B LSN plasmas at 3kG. (J. Menard)
- "Resistive wall mode physics using the initial global mode stabilization coil" commenced last week. The initial global mode stabilization coil pair was used to generate both preprogrammed DC and AC field perturbations in plasmas with varying beta-N, both above and below the n=1 no-wall beta limit. The greater control using the coil allowed the generation of the resistive wall mode during a period free of n=1 rotating mode activity. Mode stability was found to be sensitive to the applied error field current. In both polarities of the applied current, a difference of 300 amps was enough to change plasma conditions to destabilize the mode. MHD spectroscopy was attempted on the rotationally stabilized high beta plasma. Resonant field amplification is now being examined for both pulsed and modulated applied currents. Only two values of frequency were used during modulation, so additional data is needed to complete the MHD spectroscopy scan. (S. Sabbagh, Columbia University)

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

NSTX plasma operations continued this past week, beginning with an experiment on HHFW current drive with MSE (XP-403), where some good RF heating was obtained in low-density deuterium discharges. The UCSD fast reciprocating probe was used to measure edge turbulence (XP-437), and an experiment on divertor detachment (XP-438) was partially completed. Data wa obtained over several different NB conditions in a momentum scan (XP-435) and high beta poloidal plasmas with CHERS and MSE were documented in XP-414. The ISTP to operate the first two RWM coils to 4.5kA was completed and the system was subsequently used over its full range of operation in support of XP-432, measuring the effects of imposed error fields on mode rotation and locking, and XP-455, on error field amplification and RWM growth.

Over the weekend, a snubber circuit was added across the inner and outer vacuum vessel sections in preparation for upcoming CHI operations, and one of the two NSTX turbo-molecular pumps was replaced. Also, additional capability to monitor TF joint performance was added.

NSTX will be operating extended shifts until 7:00pm on Tuesday, Wednesday, and Thursday this week. The NTC will be open after the run until 10:00pm each evening. (A. von Halle)

## Research Operations (M. Bell)

Physics Operations (D. Mueller)

The PCS was modified to permit the control of current in the newly installed RWM coil pair. The power supply used was one of the standard rectifiers and no additional impedance was added to the circuit. The implementation was successful; the coil pair was used to vary the stray field and to investigate resistive wall mode physics.

Diagnostic Upgrades (D. Johnson)

Four channels of MSE were operational on Friday providing pitch-angle data at 0.3 T toroidal field. Although further calibration work is needed, preliminary measurements were roughly in agreement with predictions of EFIT.

## Physics Analysis (C. K. Phillips, S. Kaye)

Cynthia Phillips traveled to MIT on July 12 -14 to work with Paul Bonoli and John Wright on TORIC modeling of HHFW heating and current drive experiments in NSTX. They successfully tested an updated version of TORIC using data from recent HHFW experiments on NSTX. This latest version of the code features a more accurate model for the HHFW regime than previous versions. It also has been parallelized to provide higher resolution simulations than was possible on serial processor machines. Procedures for utilizng EFIT

equilibria and experimental density and temperature profiles in TORIC simulations were developed and successfully implemented. The TORIC package will soon be installed on the PPPL Petrel Cluster. (C.K. Phillips)