NSTX Weekly Report (Aug. 06, 2004)

For FY2004 Joule milestone: 18 weeks; programmatic goal: 20 weeks.
Completed: 21.1 weeks producing 2460 plasmas.

Run Coordination (S. Kaye, J. Menard)

During this last week of operation for FY04, a priority was given to completing the experiments on solenoid-free star-up. One day of high beta experiment was also carried out taking advantage of better plasma control and shaping capabilities. The highlights are:

- The NSTX supersonic gas injector (SGI) was commissioned. It performed deuterium injections into the vacuum vessel for calibration purposes, and into the plasmas, at a rate of 20 Torr l / s. This rate is comparable to the rate of the center stack gas injector which is routinely used for plasma fueling. At this rate, the SGI delivers approximately 0.5 Torr l in a 50 ms pulse. This amount is small compared to the plasma inventory. The SGI injected 20-50 ms gas pulses during the current ramp-down phase of "high performance high beta" discharges. Images of highly collimated plumes obtained by the fast CDX-U camera confirmed that the gas jet operates in a supersonic regime. The SGI injected deuterium during current flat-top in one NBI heated discharge. The rise of line-integrated density was observed. Fueling efficiency calculations are in progress. The CHERS system observed spectroscopic signs of very localized cooling of the plasma. In one discharge, the SGI injected a 50 ms deuterium pulse during an ELMy H-mode phase, and the injection did not cause an H-L transition. (V. Soukhanovski, LLNL)
- Coaxial Helicity Injection experiments continued on Monday. Experiments focused on using the low injector flux, low gas pressure discharges in order to increase the CHI produced plasma electron temperature. A correlation between gas pressure and electron temperature was found. The lowest gas pressure discharges had the highest electron temperatures (of 10 to 15 eV) measured so far in these CHI discharges, indicating a need for further reducing the gas pressure needed to initiate CHI discharges. The lower gas pressure discharges also had increased incidence for absorber arcs indicating a need for improving field nulling conditions in the absorber. Professor M. Nagata from the University of Hyogo in Japan and Professor B.A. Nelson from the University of Washington were on site at NSTX to participate in these experiments. Professor T.R. Jarboe participated remotely. (R. Raman, B. Nelson, the University of Washington).
- Additional divertor magnetics signals aided in the development of high beta discharges. These magnetics helped in developing the plasma shape and controlling the plasma in order to achieve plasma currents

close to 1.4 MA (or I_p/I_{TF} = 1.08, a record value for NSTX.) Beta values of at least in the high 30% range were obtained. Further analysis is required to determine the precise beta value. (D. Gates).

- Several dedicated shots were run in order to diagnose ELMS with a pair of cameras (N. Nishino, Hiroshima University).
- Work continued on increasing the plasma current in the solenoid-free inductive startup scenario using the PF3 and PF5 coils. Plasma currents of up to 20kA were created by progressively reducing the applied vertical field during plasma current ramp. The PF3 programming was also optimized to keep the plasma vertically centered during this phase. The highest current equilibrium was obtained when > 500kW of HHFW power was sustained during the initiation phase, suggesting that increased preionization power could be a critical element in further optimizing the plasma. Thomson scattering data was obtained for these discharges and measured peak densities of 1-1.5x10^12 /cc and Te = 20-30eV consistent with C-III spectroscopic Ti measurements of 30-40eV. The PF-only start-up scenario with PF 4 was also performed. A pressure scan was performed including injection of supersonic gas injector. A good correlation between the predicted field null location and the bright plasma region was obtained however there was no observable plasma current. C-III spectroscopic and Thomson scattering showed lower temperatures of Te < 10 eV and Ti < 15eV, underscoring the importance of the field null quality and the need for a pre-ionization source such as ECH to directly heat electrons. (J. Menard, M. Ono)

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

NSTX plasma operations continued this past week, continuing to develop plasma breakdown scenarios using the new CHI transient start-up capacitor bank (XP-406). CHI operations was expanded to include neutral beam heating, and plasma currents to 150kA were achieved in CHI-initiated discharges. PF-only plasma start up experiments (XP-443, XP-448) were also performed this week, as well as a return to the hi-beta experiment (XP-421). The Supersonic Gas Injector/ Edge Sensor Probe was commissioned and supported experimental operations this week.

The NSTX FY04 plasma operation was concluded on Thursday, After the conclusion of the Thursday run, the CHERS diagnsotic calibration was performed and the MPTS calibration was performed on Friday.

During the FY06, NSTX had completed 21.1 run weeks this year, producing 2460 plasmas with 2702 attempts. (A. von Halle)

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

The NSTX Supersonic Gas Injector (SGI) / Edge Magnetic Sensor probe was successfully commissioned. The SGI injected deuterium pulses in the ramp-down and flat-top plasma phases during the high beta, ELMy H-mode and PF-only startup experiments. Highly collimated plumes were observed by fast cameras, and an electron density increase as a result of the SGI injections was measured. The Edge Magnetic Sensors were used extensively in support of experiments on PF-Only Startup. (V. Soukhanovskii, LLNL)