

NSTX Weekly Report (June 24, 2005)

FY2005 Planned Operations: 17 weeks

Completed: 9.35 weeks producing 1037 plasmas

FEATURES Highlight: (Submitted to the PPPL Weekly Highlights)

Record discharge pulse-lengths of 1.5s have been achieved on NSTX. This pulse length, which represents about 30 times the energy confinement time and 5 times the current relaxation timescale, was produced in H-mode discharges heated by neutral beam injection. The corresponding plasma parameters are toroidal beta 17%, poloidal beta 1.5, and normalized beta 6.0. An estimated 70% of the total plasma current of 750 kA was driven non-inductively; the bootstrap current fraction was about 60%. A saturated $n=1$ MHD mode persisted for the last 0.5s of the discharge when the minimum in the q -profile became close to 1. The density rose to near the Greenwald density but relaxed to about 70% of that value during the saturated $n=1$ mode phase.

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

- There will be an NSTX Physics Meeting on Monday, 6/27 at 1:30 pm in LSB318. There will be two short talks I) Luis Delgado-Aparicio from Johns Hopkins: "The tangential 3-color "optical" soft x-ray array for fast electron temperature and transport measurements" II) Kazuya Nakayama from College of Engineering, Chubu University, Japan: "Development of a new two color interferometer using short wavelength FIR lasers for plasma diagnostics." (S. Kaye)

Run Coordination (J. Menard, S. Sabbagh)

The ninth week of operation was completed successfully with four experimental proposals and two machine proposals conducted.

XMP-32: "rtEFIT shape control": Double-null high-kappa, high-delta plasmas at 1MA were created and controlled under rtEFIT/isoflux control which had 700ms pulse length using 2 NBI sources. Discrepancies were noted between the rtEFIT and regular EFIT boundaries. Initial investigations indicate a possible cause of the boundary discrepancy in differences between the real time data and that used by between-shots EFIT analysis. The origin of the differences is under investigation.

XMP-33: MSE calibration: MSE gas-filled torus calibration was completed at 0.45 and 0.3 T following recent filter tuning. Beam voltage scans were also performed to determine the allowable range of source voltages. All went well and analysis of data is underway.

XP-520: "Divertor detachment in NBI-heated plasmas": D₂ and neon injection were used to obtain detachment of the outer divertor leg in 3-4 MW NBI-heated L- and H-mode plasmas. Clear signs of outer-leg detachment were obtained in 4 MW H-mode plasmas with D₂ injection from the private flux region (PFR). Peak heat flux at the outer divertor target was reduced four-fold from about 2 MW/m² to 0.5 MW/m². During D₂ injection from the PFR, spectroscopic diagnostics indicated the onset of volume recombination in the outer leg, where D-gamma/D-alpha ratio increased two-fold and approached the value measured in the detached inner divertor. Midplane gas injectors alone with D₂ fueling rate up to 110 Torr l / s failed to produce SOL conditions necessary for outer divertor leg detachment. Charles Lasnier (LLNL @ DIII-D) participated in the first phase of the experiment.

XP-524: In "Active control of rotation damping in RWM plasmas", the braking effect of applied field using the RWM/EF coils was tested. The non-resonant plasma rotation damping by n=3 applied field in a controlled way was demonstrated. The RWM rotation alteration by applied field will be further examined in future run days. Vacuum calibration data for the RWM/EF internal sensors was also obtained.

XP-527: "HHFW power deposition": HHFW coupling efficiency and power deposition profiles were measured as a function of plasma current, antenna-plasma gap, and antenna phasing in He plasmas. High time-resolution EFIT reconstructions were used to measure the incremental confinement time of the RF heated plasmas, and density fluctuation measurements at the plasma edge also indicated evidence of parametric decay under some conditions and consistent with previous observations using Langmuir probes. John Wilgen and Phil Ryan from ORNL participated in the experiments.

XP -531: "Transient CHI Startup": Further pre-ionization test were conducted with less gas injection and with the ECH power increased to 14kW. This improved breakdown conditions at the lower injected pressures. Transient CHI experiments at the 1kV capacitor bank voltage were improved to provide better equilibrium control. We routinely produced 100kA discharges, with one discharge getting to about 150kA. The current multiplication was consistently very high (above 60). Many shots were used for Thomson scattering measurements. The electron temperature profiles were similar to those seen in HIT-II transient CHI shots (15 to above 40 eV with good profile). The plasma fully filled the vessel and produced a harmless absorber arc that lasted for a few milliseconds. The Nova Photonics fast camera at 68,000 frames/second recorded images of the discharge evolution. The equilibrium codes EFIT and LRDFIT, both with vessel current calculations, were used to adjust the PF coils. Brian Nelson from the University of Washington was at NSTX to participate in these experiments.

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

NSTX operations continued this past week with further progress made on rtEFIT development (XMP-32), and a completion of an MSE calibration at both 0.45 and 0.3 Tesla TF (XMP-33). Progress was also made in an experiment on divertor detachment (XP-520) and, after a so-called "mini vacuum vessel boronization", the SPA power supply was placed back in service to continue an experiment on rotation damping in RWM (XP-524). The week concluded with additional work on the transient CHI experiment (XP-521). During the evenings this past week, fit-ups of mounting brackets for the new movable glow discharge cleaning probe to be installed at bay K were completed.

The NSTX test cell will be open for maintenance this coming week, with plans to continue installations associated with the new high K scattering diagnostic and the new moveable glow discharge cleaning probe, and to complete installations of the lithium pellet injector and the Johns-Hopkins Li telescope (bay J bottom) and multicolor X-ray array (bay G mid-plane). Machine areas scrubs will begin on Friday, July 1st, and plasma operations will resume on Tuesday, July 5th. (A. von Halle)

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

- The first attempt to test the Joint CDX-U/NSTX Resistive Lithium Evaporator was successful. Approximately 1000 Angstroms of lithium was evaporated in about 3 minutes on to a simulated CDX-U Center Stack target. (D. Mansfield)
- The welding of supports to the upper umbrella structure at Bay-K for the Moveable GDC probe was completed. (G. Labik)
- LPI reassembly and leak check was completed, and the system is ready for reinstallation.
- A brief morning Boronization (#44) was performed.
- XP 520 "Divertor regimes and outer target detachment in NBI-heated plasmas" to investigate means to reduce heat flux on the outer divertor target, and to determine conditions for outer divertor leg detachment was completed. (V. A. Soukhanovskii, LLNL)