

NSTX Weekly Report (January 30, 2004)

FY 2004 weeks of operation planned: - 18 weeks, Completed: - 1.1 weeks

Draft Featured Highlights:

NSTX completed a successful first full week of plasma operations. The rEFIT and isoflux control algorithms in collaboration with General Atomics were used to control both double null and single null plasmas. A double null plasma was controlled for ~150ms flat-top at an elongation of 1.9 with an internal inductance of 1.2, which is a record value for the product of $l_i \kappa$ for NSTX. Up to 5.3MW of neutral beam power was injected to create plasma stored energies up to 120kJ during double null operations. Electron temperatures of up to 1.2 keV were measured, as were Ti profiles, with Ti approximately twice Te. An ohmic experiment scoping out edge plasma characteristics, using the Edge Rotation Diagnostic, was completed. Significant progress was made on commissioning new diagnostics, including first light from MSE (Motional Stark Effect) current profile diagnostic system. Boronization was carried over the weekend in anticipation of full neutral beam operation next week.

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

- A paper entitled "New Benchmarks from Tokamak Experiments for Theoretical Calculations of the Dielectronic Satellite Spectra of Helium-like Ions" by M. Bitter, M. F. Gu, L. A. Vainshtein, P. Beiersdorfer, G. Bertschinger, O. Marchuk, R. Bell, B. LeBlanc, K. W. Hill, D. Johnson, and L. Roquemore, was published in Phys. Rev. Lett. **91**, 265001 (2003). The analysis of the argon spectra that were obtained from previous NSTX experimental campaigns revealed an inconsistency in the theoretical predictions for the $n=2$ and $n=3$ dielectronic satellites in the widely used atomic modeling code of Vainshtein and Safronova. This inconsistency was removed in new atomic modeling calculations by M. F. Gu. These improved calculations are in agreement with the observed spectral data and the derived electron temperature values are also in good agreement with the central electron temperature values measured by Thomson scattering. The results from NSTX are also of interest for the interpretation of astrophysical spectra. They have been published in reference. (M. Bitter)

Run Coordination (S. Kaye)

The first full week of plasma operations was focused on plasma development through optimization of gains in the plasma control system. The vertical control work was finished, and radial position control optimization was started. Three days were devoted to real-time EFIT work in which the Double Null configuration development was completed, and is at the stage where it can be used for control during physics experiments. Remaining to do is rEFIT development for LSN configurations. Neutral beams were injected into plasmas towards the end of the week, with powers up to 4.5 to 5 MW. Electron temperatures of up to 1.2 keV were measured, as were Ti profiles, with Ti approximately twice Te. An ohmic experiment scoping out edge plasma characteristics, using the Edge Rotation Diagnostic, was completed. Significant progress was made on commissioning diagnostics, including the new CHERs, first light with MSE, MPTs, FIRETIP, reflectometry, bolometry and other spectroscopic diagnostics. Boronization will take place over the weekend in anticipation of full neutral beam operation next week.

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

- NSTX operations continued this past week with experiments to implement rEFIT control for double null and lower single null plasmas. Neutral beam injection was used in these experiments after completing interlock tests and qualifying the beams into vacuum vessel armor. The beams injected into plasmas at over 4.5MW with the three ion sources operating at 90, 80, and 70kV. All six RF sources were used to vacuum condition the HHFW antennas this week. Vacuum vessel boronization using TMB will be performed over the weekend in preparation for high Beta experiments scheduled for this coming week.

In the coming week, the test cell will be in restricted access during 1st shift, with test cell access available from approximately 5:00PM to 10:00PM each evening. A maintenance week is scheduled for February 9th - 13th. (A. von Halle)

Research Operations (M. Bell)

Physics Operations (D. Mueller)

- John Ferron visited NSTX to help develop rEFIT/isoflux control for NSTX plasma operations and to help train NSTX operators in the use of the new control scheme. Dr. Ferron is the inventor of the rEFIT/isoflux control concept and the main architect of the Plasma Control System (PCS) which is used on NSTX.

The rEFIT and isoflux control algorithms were used to control both double null and single null plasmas on Wednesday through Friday. A double null plasma was controlled for ~150ms flat-top at an elongation of 1.9 with an internal inductance of 1.2, which is a record value for the product of $l_i \kappa$. Up to 5.3MW of neutral beam power was injected to create plasma stored

energies up to 120kJ during double null operations. The single null plasmas had limited flat-top due to poor machine conditions, but the control algorithm appeared to function properly.

Several software issues were addressed during the run by programmers from both General Atomics and PPPL (T. Gibney, D. Mastrovito, R. Johnson). The main new software capability was the ability to restore plasma boundary shapes from archived rtEFIT runs for use in new shots which use rtEFIT/isoflux. This is an important new ability that will greatly facilitate the creation of new discharge control scenarios. (D. Gates)

Boundary Physics Operations (H. Kugel)

- A successful Peer Review was held for the Supersonic Gas Injector and Edge Magnetic Sensor probe system.
- A special pressure transducer was received and is being installed on the test stand for nozzle characterization measurements of the CDX-U / NSTX prototype Supersonic Gas Injector (SGI). (V.Soukhanovskii, LLNL)
- The installation of the support fixtures for connecting the Lithium Pellet Injector (LPI) to the vessel was completed.

Diagnostic Operations (R. Kaita)

- The plasma TV system is ready to capture images at different visible wavelengths. The optical communication fibers needed to control a new filter wheel for the camera were connected, and its remote operation was successfully tested.
- The installation for shielded camera mount and stand for the fast tangential soft X-ray camera has been completed.

RF Operations (J. R. Wilson)

This week the rf engineering group commissioned the newly installed high power tetrode in transmitter 4 for the High Harmonic Fast Wave heating and current drive system. The tube (which has been in storage for 3 years) was found to be in excellent shape and the source came up in power in less than an hour of rf operation on Monday. After this the remainder of the week was devoted to vacuum conditioning of the antennas and shakedown of the data signals and remote control operation. By Friday the antennas had been conditioned to greater than 20kV for 1 second pulses. After some work the various rf signals are operational and the remote control function was successfully tested.