

NSTX Weekly Report (April 21, 2006)

FY2006 weeks of research operations

Planned: 11 weeks

Completed: 5.17 weeks

Run Coordination (R. Raman, S. Sabbagh)

Five experiments were run, which produced new and important results for NSTX. 1MA-discharges at high elongation were produced for a record 1.15s. Significant progress was made in demonstrating active feedback of the resistive wall mode in NSTX. The supersonic gas injector was used to reduce the amount of gas injected by the center stack gas injector while initiating H-modes. Data for optimizing non-solenoidal current ramp-up using NBI was generated. Discharges were developed for a future assessment of the ELM character and confinement as the plasma elongation is varied.

XP526: Dependence of ELM severity and confinement on boundary shape – S. Kaye (April 17):

Some of the planned scan in elongation was completed. Initial target shapes were developed to be used in a future scan to obtain a more complete database.

XP603: Long pulse double null development – D. Gates (April 18): Plasma elongation was increased to a steady-state value of ~ 2.45 . This resulted in a record pulse length of 1.15s at a flattop current of 1MA. Attempts were made to produce an earlier H-mode transition in these discharges, without substantial effect. Error field correction was also applied for the first time to long pulse discharges. Further optimization will be required for error field correction to be a useful tool.

XP626: Plasma fueling with supersonic gas jet – V. Soukhanovskii (April 18): Part 2 of this experiment which aims at H-mode access with low field side Supersonic Gas Jet (SGJ) fueling was investigated in 1.0 MA, 6 MW NBI, double-null, 1 s-long pulses. It was demonstrated that H-mode plasmas of comparable density, confinement and performance could be obtained with the SGJ fueling while significantly reducing the fueling from the high field side (HFS) gas injector used in most NSTX H-mode plasma scenarios. The HFS plenum pressure was reduced by a factor of up to 9 without affecting H-mode access characteristics. The density approached the Greenwald limit. Interestingly, almost all SGJ-fueled discharges had Type III small-amplitude ELMs not seen in the reference HFS-fueled discharge. These results suggest the possibility of density control and eventually density feedback with the SGJ in high-performance H-mode plasmas.

XP627: Non-inductive current ramp-up - C. Kessel (April 19): Part B of this experiment examined NBI into low current plasmas as a method for non-solenoidal plasma current rampup. The effect of the NBI was examined at plasma currents from 0.4 to 0.6 MA. As expected the ions from NB source C were not well confined at the lowest current. The lowest surface voltage was 0.1 V, although more typically across these discharges it was about 0.2 V. The density regularly exceeded the Greenwald limit by about 50% due to the low plasma currents and strong NB fueling. Analysis of the NB characteristics with TRANSP will be undertaken to understand the trade-offs of NB confinement vs plasma current, bootstrap and NBCD, and other effects. The diminishing returns of NBI for non-solenoidal current rampup were becoming evident at 400 kA, although the easy transitions to H-mode were encouraging.

XP615: Active Stabilization of the Resistive Wall Mode at Low Aspect Ratio – S. Sabbagh (April 19): Experiments from March 28 were continued producing 11 plasma discharges during the afternoon run. Significant progress was made in demonstrating active feedback of the resistive wall mode in NSTX. Plasma rotation was slowed with non-resonant magnetic braking, generating RWMs in a controlled fashion. The feedback system gain was scanned with clear impact on the plasma and feedback loop. This scan complements the phase scan performed during the prior experimental run day of XP615.

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

NSTX plasma operations continued this week, making progress on experiments to enhance machine capability and to gather new experimental data. XP-526 "Dependence of ELM Severity and Confinement on Boundary Shape" was run for a day before performing a vacuum vessel boronization. Good long-pulse plasma performance was seen in XP-603 "Long-pulse Double Null Discharges" and in XP-626 "Plasma Refuelling with the SGI". XP-627 "Non-solenoidal I_p rampup" was completed, and good progress was made on XP-615 "Active Stabilization of the Resistive Wall Mode at Low Aspect Ratio". Time was spent running shots for XMP-46 "Scanning the divertor X-points" and in conditioning the HHFW system to higher operating levels in XMP-26. During the last phase of this conditioning, the toroidal field was increased to 0.5T for the first time during plasma operation.

Plasma operations will continue this coming week, and the test cell will be locked-up until 5 PM each day. Access to the test cell will be available from 5PM to 9PM each evening. The next NSTX maintenance week is scheduled for May 8-12.

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

Analysis continues of data from the operation last week of the LITER-1 lithium evaporator on NSTX. Although a reduction of hydrogen recycling was not apparent after lithium evaporation, there was a significant reduction in the ratio of the oxygen to carbon line emission. A heat of fusion measurement after the experiments revealed that less lithium was evaporated than expected. A second evaporator has been loaded with lithium and mounted on the laboratory vacuum chamber which has been instrumented with fixed and movable quartz crystal monitors to measure the deposition rate and spatial distribution as a function of the evaporator temperature. The spatial distribution was measured at an evaporator temperature of 450°C. Measurements at higher temperatures are in progress.

Boronization-53 was performed on April 17 using approximately 5 g of deuterated trimethyl boron.

Diagnostic Operations (R. Kaita)

The diagnostics continue to function well in support of the experimental program, except for the following problems.

- 1) The reason for the failure several of the current-measuring resistors in the amplifiers for the tile-mounted Langmuir probe system is being investigated. The resistors have been replaced, and all of the amplifiers are functional again.

2) One of the computers for the electron Bernstein wave diagnostic has failed and is being replaced. Part of the system can still be operated with the second computer.

3) The visible camera with the one-dimensional self-scanning array that was intended for edge density measurements has a data readout problem. It is being sent to the manufacturer for repairs, and should be returned to NSTX in two or three weeks.

RF Operations (J. Hosea)

Machine proposal XMP-26 was performed on April 20 to condition the HHFW launcher and raise the power coupled to the plasma. For the heating phasing, producing $k_{\parallel} \approx 14\text{m}^{-1}$, the coupled power was raised to 2.3MW. It was encouraging that for the current-drive phasing, producing $k_{\parallel} \approx 7\text{m}^{-1}$, over 2MW of power was also coupled.