NSTX Weekly Report (March 24, 2006)

FY2006 weeks of research operations
Planned: 11 weeks
Completed: 3.16 weeks

Naoki Tamura of National Institute for Fusion Science, Japan, visited NSTX to collaborate on the study for the impurity transport using TESPEL (Tracer Encapsulated Solid Pellet) provided by NIFS and a new type spectrometer from Johns Hopkins University. Satoshi Ohdachi of NIFS visited NSTX to collaborate on the data analysis using an eigenfunction decomposition technique on the fast tangential soft x-ray camera on NSTX.

Stanley Kaye attended the MAST Research Forum, which was held at St. John's College, Oxford, U.K. on 3/22-23/06. He presented a talk entitled NSTX Research Results and Plans for 2006. The MAST Research Forum is similar in scope to the NSTX Research Forum, with presentation of the previous year's results and plans for the upcoming run. The results and plans were presented for each Task Group by the Task Group leaders.

There will be an NSTX Physics Meeting today, Monday, 3/27 at 1:30 pm in **LSB252** (note change of room). The agenda is: **XP Updates (5 min each):** Rotation braking – S. Sabbagh, Error Fields – J. Menard, **Physics Talk:** Summary of MAST Research Forum – S. Kaye. (S. Kaye)

Run Coordination (R. Raman, S. Sabbagh)

Three machine proposals (XMPs) and two physics experiments (XPs) were run. All three machine proposals successfully demonstrated system capability. Considerable progress was made with the two experiments that were conducted.

XMP44: High-k system commissioning - D. Smith, H. Park (March 20, 21): The proposed tests for the high-k scattering system were completed: 1) Outboard launching positions were explored including investigation of the k-matching conditions. 2) Inboard launching positions were explored for the first time and examined scannable range of the system near the core. The capabilities and limitations of the present system were identified and it is now being prepared to support physics experiments.

XMP045: RWM system commissioning – A. Sontag (March 21): Dedicated shots with the active RWM coils in the circuit were performed allowing significant progress towards successful active control experiments. The PCS was used to control the SPA currents in response to the measured n=1 poloidal perturbation during long-pulse, high beta (beta_N ~ 5.4) 1 MA discharges. The toroidal phase angle of the applied correcting field was varied in four 90 degree steps. This test showed that the target discharge could be extended in time or induced to disrupt earlier, depending on the phase of the applied field. DC n=3 perturbations were applied simultaneously with the n=1 feedback control currents. Most of the required commissioning for this system were completed.

XP614: Comparison of error field correction techniques at high betaN – J. Menard (March 22, 23): A new algorithm for predictive error field correction was implemented in the first part of this experiment. The algorithm uses the product of the OH and TF coil currents to apply a corrective field, and discharges with edge locking activity were extended as much as 200ms so far. The correction multiplier was scanned and rotation damping was minimized for the nominal multiplier obtained from the TFxOH interaction model. Applying the correction before the OH zero crossing also resulted in higher earlier rotation relative to cases with non-optimal multiplier.

XP618: Optimize error field correction vs. rotation – R. LaHaye, T. Strait (March 23, 24): Discharges had applied n=1 rotating magnetic field of either 7 or 12 Hz for from 2 to 6 periods at two different current amplitudes each. In a few shots the 7 Hz AC field was added on top of the DC field error correction as determined in XP-614. No plasma vacuum shots were obtained for both the 7 and 12 Hz cases so as to be able to correct direct pickup and wall eddy fields from magnetic diagnostics. The data was obtained for modulation of the plasma rotation; this will require substantial smoothing and filtering to remove the variations from ELMs and plasma shape control oscillation (~16 Hz in some shots). As the drag on the plasma rotation depends on the phase difference of the rotating and static n=1 fields, the analysis will focus on "backing out" the effective phase and amplitude of the error field for comparison to empirical shot-by-shot correction.

XMP47: Assessment of TESPEL Penetration in NSTX – D. Stutman, K. Tritz (March 21, 24): A new type of pellet developed at LHD, TESPEL, or Tracer Embedded Solid Pellet, was tested on NSTX within the JHU/NIFS/NSTX collaboration. The pellets were provided NIFS and consisted of thin, small diameter (few hundred microns) shells of deuterated polystyrene filled with LiH tracer. The amount of Li tracer in TESPEL is much smaller than in conventional pellets (a few times 10^18 atoms). The purpose of the XMP performed was to estimate the penetration of the TESPEL in NSTX L-mode and H-mode discharges, as well as to assess its effects on the plasma. In high temperature L-modes having improved electron transport, the pellets penetrated several cm inside the L-mode plasma. The density perturbation associated with the pellet was small, of the order of several percent. In high power (6MW NBI) and density H-modes the pellet breaks before reaching the separatrix. In contrast, in a lower power (4 MW) H-mode the pellet perturbation appeared to be limited to the edge region, possibly indicating a significant change in the perturbed electron transport with heat flux. Finally, at even lower beam power (2 MW), the pellet was found to have a large impact on the discharge, penetrating relatively deep into the plasma and quickly quenching the current. Adequate data was collected to optimize the TESPEL pellet size and injection velocity.

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

The NSTX FY'06 run continued this past week with the completion of XMP-44 "High-k Scattering Commissioning", measuring signals in both the inboard and outboard launch configurations. Progress was also made on XMP-45 "RWM/EFC system commissioning", where error field feedback loops were successfully closed to the switching power amplifiers, and on XMP-47 "Assessment of TESPEL pellet penetration", using the lithium pellet injector to inject lithium-doped deuterated-polystyrene pellets. After a vacuum vessel boronization, the new RWM/EFC system

capability was used in support of XP-618 "Optimize error field correction vs. rotation" and XP-614 "Comparison of error field correction techniques at high beta-N". In the off hours, work continued on the commissioning of the new lithium evaporator (LITER), and the remote control of the new EBW antennas was successfully tested.

NSTX plasma operations are scheduled for this coming week with the lithium evaporator installation expected toward the latter part of the week. A maintenance week is scheduled for April 3rd through the 7th. (A. von Halle)

Research Operations (M. Bell)

Diagnostic Operation (R. Kaita)

• Progress was made on the commissioning of the "High-k Scattering" turbulence diagnostic. From microwave data obtained during dedicated plasma shots, the alignment of the system in the "inboard launch" configuration was completed.

• The implementation of the remote control capability for the electron Bernstein wave antenna has been successfully completed.

• The diagnostic shutters at Bay B were repaired by clearing foreign material in the control valves that entered them from their air lines.

Boundary Physics Operations (H. Kugel)

• The LITER-1 Cartridge-B fabrication was completed, and it was assembled on the probe. Thermal testing without lithium was initiated and completed. The probe was then loaded with 27.5 g of lithium and testing with lithium was successfully completed.

• Boronization-52 applied 5 gms of deuterated trimethylboron (TMB) and this was followed by HeGDC to remove the co-deposited deuterium. (W. Blanchard)

• The LPI was used to support XMP-047 for the NIFS/NSTX collaboration (Dr. N. Tamura, NIFS) on the application of the TESPEL (Tracer-Encapsulated Solid Pellet) technique to experiments in NBI heated L- and H-mode plasmas.

Physics Analysis (S. Kaye)

Conversion of the package of DIII-D H-mode pedestal analysis codes to work with NSTX data and installation of the codes at PPPL has been completed. The codes include tools for ELM timing analysis, profile analysis with the ability to average data in a particular phase of the ELM period over many ELMs, and kinetic EFIT analysis. The profile tool writes results to MDS+ which are then read by the kinetic EFIT tool to set the pressure profile in EFIT. The pedestal current density in the kinetic EFIT tool is determined by finding the best multiplier, CBOOT, of the pedestal bootstrap plus Ohmic current based on minimization of the magnetics chi squared. The Sauter expression for the bootstrap current is used including a formulation of the trapped particle fraction based on work of Lin-Lu, and the pedestal Ohmic current is set by either the measured loop

voltage or by an estimate of the loop voltage determined by subtracting the total bootstrap current from the plasma current. The codes are controlled through entries in tables on a relational database server. The RDB tables can be modified through a GUI interface. The EFIT analysis uses distributed processing to increase efficiency. Some plotting tools are also provided. The package also includes general purpose data analysis tools written in the Python language. All software used is free and open source. Future work would involve including rotational effects in the kinetic EFIT. (Tom Asborne, General Atomics)