

NSTX Weekly Report (Aug. 19, 2005)

FY2005 Planned Operations: 17 weeks

Completed: 16.12 weeks producing 1892 plasmas

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

- Jessica Baumgaertel (University of Washington), working with Martha Redi this summer, has written a Summer Undergraduate Laboratory Intern Paper which will appear as a PPPL Report: "Gyrokinetic Stability Studies of the Microtearing Mode in the National Spherical Torus Experiment H-mode" by J. A. Baumgaertel, et al.

- There will be an NSTX Physics Meeting on Monday, 8/22 at 1:30 pm in LSB318. The agenda will be: 1) CHI Results – R. Raman (20 min), 2) **1-2** Vugraph updates of recent XPs; a. XP529– Maingi, b. 505 – Maingi, c. XP533 – Mueller, d. XP511 – Menard (for Takase) (S. Kaye)

Run Coordination (J. Menard, S. Sabbagh)

The fifteenth week of operation was completed successfully with six experimental proposals.

XP505 "LH threshold vs. magnetic balance"

Comparing the H-mode power threshold, P_{thr} , in different magnetic configurations, but otherwise similar shape parameters, the lowest P_{thr} was found in DN ($drsep \sim 0$ mm) with injected beam power of $PNBI = 0.6$ MW. In LSN ($drsep = -20$ mm) H-mode was achieved with $PNBI = 1.1$ MW. This supports the results previously observed on MAST and ASDEX Upgrade as well as the initial results from NSTX in 2004, except that in 2004 no H-mode could be achieved in LSN in this particular shape. A reduction of P_{thr} in DN by about a factor of 2 is in quantitative agreement with the observations on MAST. For the first time in NSTX and indeed in STs H-mode was achieved in USN ($drsep = 20$ mm) with $PNBI = 4.0$ MW. With HHFW heating qualitatively similar results were achieved in DN and LSN. Here, P_{thr} seemed to increase with increasing $|drsep|$, when going to LSN. Finally, Ohmic H-mode was readily achieved in both LSN and for the first time in DN on NSTX, when the X-point height and triangularity was reduced and the elongation increased. Hendrik Meyer (Culham/UKAEA) and Ted Biewer (C-MOD/MIT) led the NBI and HHFW portions (respectively) of the experiment.

XP511 "Merging Start-up"

Solenoidless plasma start-up using merging of two plasmas was attempted for the second time on NSTX. A new scenario which does not use the PF1A coils was tested. This scenario created X-points at a larger major radius than the scenarioused on Aug. 12. The available poloidal flux was 0.09Wb, three times

larger than the previous scenario. Plasma was formed by a combination of ECH, RF (HHFW), and induction by outboard PF coils (PF2 and PF4). Visible light images indicated evolution of the field null region as designed, but a measurable plasma current was not observed. In this scenario, ionization by the HHFW antenna does not provide plasma in the field null region. Comparison of this result with the TST-2 result and XP510 suggests strongly that a more powerful ionization source (several hundred kW) in the field null region is necessary. Yuichi Takase and Yasushi Ono (Tokyo University) led the experiment.

XP526 "ELM type vs. boundary shape"

The aim of XP526 was to study the effect of triangularity and elongation on both ELM behavior and confinement. This was to be attempted by varying each parameter while holding other parameters fixed. Technical problems affected the run day, and only the very initial part of the triangularity scan was accomplished. There were a few interesting results along the way, however, including a long pulse double null plasma lasting over 1 sec (with the 1 MA current level steady for 0.8 s), and discharges that had characteristics of the VH-mode.

XP529 "H-mode Pedestal Structure vs. Aspect Ratio"

The desired target shape for the experiment was developed/recovered using this year's modified/upgraded version of rt-EFIT. Enhanced radiation apparently arising from density accumulation made comparisons of the pedestal parameters with those of previous run days difficult, and more shots are needed to complete the experiment. Andrew Kirk (Culham/UKAEA) participated in the experiment remotely from Culham.

XP533 "CHI into Ohmic discharge"

PF2L was used in the normal current direction to quickly obtain the desired LSN shape for this experiment. Lower dome gas injection pressure and CHI cap bank voltage were scanned to maximize the driven plasma current. The largest increase in measured plasma current was achieved with NB heating present in the discharge, and the plasma current was transiently increased from 500kA to 600kA.

XP534 "Study of perturbative electron transport using pellet injection"

Li pellet injection was optimized for peripheral Te perturbations in high Te L-mode and high ne H-mode discharges. The initial results are quite promising. In H-mode a fast (~1 ms) and deep (up to the axis) crash of the Te profile is observed when the pellet reaches the pedestal, with only little density perturbation. In L-mode the pellet reaches $r/a \sim 0.6$ and quenches the current, several ms after the penetration. However, in the few ms before the quench, almost no perturbation of the Te sensitive USXR profile is seen inside the $q=1$ radius, suggesting a strong electron transport barrier.

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

NSTX operations continued this past week, making progress on several experiments. Similarities to DIII-D and MAST were investigated in double null divertor plasmas in XP-529 "Dependence of the H-mode Pedestal Structure on Aspect Ratio", and beams and HHFW were used in different plasma shapes to investigate H-mode power thresholds in XP-505 "L-H Power Threshold". The Lithium Pellet Injector fired lithium and carbon pellets into H-mode plasmas in XP-534 "Investigation of perturbative electron transport vs. magnetic shear using pellet injection", and work was begun on obtaining scans of plasma triangularity and elongation for XP-526 "Dependence of ELMs and Confinement on Shape". Further investigations on plasma initiations were also performed in XP-533 "CHI added to induction" and in XP-511 "Merging startup". During the evenings, work continued on the commissioning of the new Moveable Glow Discharge Cleaning Probe, successfully operating the probe through a range of power levels and gas pressures.

Plasma operations will continue on Monday morning and there will be no access to the NSTX test cell during the 1st shift this week. The run day will be extended to 7PM on Tuesday and Thursday this week, and the test cell will be in controlled access each evening from the end of run day until 10PM. A machine area scrub will be performed from 10-11PM each evening in preparation for the following day's run. The next NSTX maintenance week is scheduled for the last in August. (A. von Halle)

Research Operations (M. Bell)

Diagnostic Operations (R. Kaita)

- The electronics for the Johns Hopkins University three-color "optical" SXR array have been installed, and data have begun to be obtained. Initial results include clear measurements of sawtooth oscillations along multiple sightlines with good signal-to-noise ratios.
- A fast visible camera borrowed from CDX-U was installed beneath NSTX to check the motion of the toroidal field flag joints during machine pulses. Initial measurements suggest small but measurable movement during test shots. To determine if this motion is radial, the installation of an additional CDX-U fast visible camera is planned.

Diagnostic Upgrades (D. Johnson)

- Construction activities for the High-k Scattering diagnostic wrapped up last week after a steady 2 year engineering and fabrication effort. The capability to inject, steer and collect the scattered millimeter wave signal was made possible after considerable changes to the port covers at Bay-K and H and modifications to the Neutral Beam Armor at machine mid-plane. Inside of Bay-H 4 new

cooled and instrumented neutral beam baffles were installed as well as a steering launch mirror. Inside Bay-K a large steering spherical collection mirror directs the scattered signal out through 5 quartz vacuum windows. In all there are 17 mirrors, 2 in vacuum and 15 outside of Bay-H and K. 120 feet of corrugated wave guide was routed and aligned with the external mirrors. Underneath Bay-K a support structure for the collection wave guide and UC-Davis detection electronics was constructed in very tight quarters. There were several issues with parts of the installation including the obstruction of the 5th (of 5) collection channel at Bay-K. This and other improvements such as shutters for the Bay-K windows, in-vessel beam dumps and automation of the steering mirrors will be considered for future work. (R. Feder)

Boundary Physics Operations (H. Kugel)

- The Integrated Systems Test Procedure (ISTP) for the MGP using forced-air cooling of the mounting flange was successfully completed. The probe body temperature rise is greatly reduced and now is in an acceptable range $< 250^{\circ}\text{C}$. The MGP will be ready for operational pending installations in progress for a more permanent temperature monitoring and flexible cooling air line.
- The Ocean Optics spectrometer on loan from DIII-D (N. Brooks) for the NSTX / LLNL / DIII-D collaboration has been automatically tracking NSTX shot numbers and sending data to the MDS Plus tree. The present configuration uses the DIII-D shortpass filter. The obtained Balmer spectra (up to $n=12$) in the inner divertor are well correlated with other observations of inner divertor detachment. (V. Soukhanovskii, LLNL)