

NSTX Weekly Report (October 29, 2010)

FY 2011 NSTX plasma operations started on October 4, 2010

Planned Run Weeks: TBD

Run Weeks Completed: 4.21 run weeks and 839 plasma shots

Two papers regarding NSTX research are included as Highlighted Plasma Physics Papers for the 2010 APS-DPP (American Physical Society – Division of Plasma Physics) Meeting. They are “Getting to Know the Sun Advances Fusion Research” by Roger Raman (University of Washington) and “Taming Thermonuclear Plasma with a Snowflake” by Vlad Soukhanovskii (LLNL). <http://www.aps.org/units/dpp/meetings/vpr/2010/highlighted.cfm>,

Run Coordination (E. Fredrickson, S. Sabbagh - Columbia University)

On October 21, D. Clayton (JHU) started and completed XP1073 "Edge impurity transport measurements with the newly installed Multi-Energy Soft X-ray (MESXR) diagnostic". X-ray emission from short (5 ms) neon gas puffs was used to track impurity particle transport. The emission was measured with MESXR diagnostic which provides a radially-resolved toroidal view of the plasma edge. Puff size was optimized to maximize signal while minimizing impact on the plasma. A toroidal field scan, q scan, and time-of-puff scan were completed, including reference shots (no neon puff) at each step. D. Battaglia (ORNL) then conducted L-H threshold scaling with triangularity, XP1029. The power threshold was found to increase as the triangularity increased for discharges with matched density. This observation was consistent over a range of plasma densities

On October 22, J. Boedo (UCSD) started the experiments with XP1072 to study the evolution of ELMs and SOL edge turbulence with the plunging probe as the lithium deposited before the start of experiments became passivated. D. Battaglia (ORNL) then ran XP1030 to study ELM suppression using off-midplane error field coils. The H-mode plasma target was developed with the magnetic axis 40cm below the midplane. The discharge was ELM-free with 2MW of NBI heating. A 50ms pulse of 4MW NBI heating produced regular type-I ELMs. This XP could be continued with a longer period of 4MW heating once the shine through and prompt orbit losses of the off-axis beams are evaluated.

On October 25, S. Gerhardt's XP1071 was conducted which aimed to produce high kappa, high bootstrap fraction plasmas with a slightly higher aspect ratio, in support of NSTX-U. These plasmas reached a normalized beta of 5 at an aspect ratio $A \approx 1.7$ and elongation $kappa \approx 2.6$. A. Diallo then conducted XP1074 on the pedestal/ELM structure vs. triangularity. Target plasmas with stationary X-point heights at different triangularities were made.

On October 26, in XP1058, E. Kolemen used PF4 in reversed polarity to make stable plasmas with higher squareness to complement previous experiments with reduced squareness. Plasmas at least as stable as those with increased squareness were made. Squareness was pushed to current limit of PF5. In the afternoon, XP1022 “RWM State Space Control in NSTX” by Y.S. Park, Columbia University, et al. was run to make a first assessment of altering gains for the controller. Target plasmas that exhibited unstable RWMs with no feedback control (and no alteration of plasma rotation by $n = 3$ magnetic braking) were stabilized with the controller turned on. Gains were changed primarily for the first two plasma states in the controller, with

some gain variation of the higher order states. Some gain settings yielded significantly reduced RWM growth and mode rotation. Several shots with the highest gain settings pushed the switching power amplifiers to maximum current. Low frequency feedback oscillations were generated at the highest gain settings.

On October 27, V. Soukhanovskii (LLNL) attempted to run XP-1002 “Use of supersonic gas injector (SGI) into the divertor to control impurity influxes” but plasma conditions without use of between shots lithium evaporation were not suitable for this experiment. S. Kubota’s (UCLA) XP1039 then attempted to extend ohmic H-mode transition studies to somewhat higher densities. Ohmic H-modes were made, but at higher density the plasmas stayed in L-mode. D. Battaglia (ORNL) then revisited XP1029 to study the H-mode transition power threshold scaling with beam heating power for different triangularity. Better threshold data at high triangularity, lower field, suggests that the triangularity scaling is more simply represented by a scaling with toroidal field magnitude at the X-point. The power scans for A. Diallo’s XP1074 were then completed for the target plasmas developed on Monday.

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

NSTX plasma operations for FY11 continued this past week after replacing the Bay K lithium evaporator (LITER) with a freshly loaded unit over the weekend, and experiments were performed utilizing lithium evaporation, neutral beam heating, and Resistive Wall Mode (RWM) feedback via the Switching Power Amplifier (SPA) driven error field coils. At mid-week we went into overnight periods of lithium evaporation to provide the in-vessel lithium inventory to characterize the pumping capability and effect on plasma performance of the heated Liquid Lithium Divertor (LLD).

The FY11 NSTX outage begins this coming week with the completion of magnetic calibration test shots, a neon glow to calibrate the CHERS diagnostic, and partial vents of the vessel in argon and nitrogen for a calibration of the MPTS diagnostic.

Access to the NSTX test cell will be restricted this coming week during MPTS diagnostic calibrations.

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

- Liquid Lithium Divertor (LLD)
 - The LLD Air Heating System was approved for operation.
 - During plasma operations on October 28 and 29, the LLD Air Heating System was used to heat the LLD to a requested plate temperature of 240°C in support of XP1000.
- Lithium Evaporators (LITER)
 - The LITER-K2 was installed and supported the last week of plasma operations. This included two 6 hour long evaporations at 20 mg/min from midnight to 6am preceding each of 2 days of LLD experiments

- Molybdenum Inner Divertor Tiles
 - Work was initiated to review the modifications made previously to the existing graphite tiles to accommodate as-built conditions in the vessel, and to use this information to inform the design of the integrated graphite tile - molybdenum plates now in progress.

Diagnostic Operations (R. Kaita)

- Diagnostic calibrations are continuing as the present operational period is approaching its end. A set of “magnetic field only” calibration shots was completed for magnetic diagnostics this week.
- J. Boedo of the University of California at San Diego (UCSD) recently completed a two-week visit to PPPL. During this time, he led an experimental proposal on the effects of lithium coatings on plasma-facing surfaces on transport in the edge and scrapeoff layer of NSTX plasmas. A key diagnostic in this study was the UCSD fast reciprocating Langmuir probe, which he operated.
- B. Heim of Purdue University visited PPPL during the past week. He went over implementation details with NSTX personnel for the Materials Analysis Particle Probe (MAPP). These discussions were able to resolve outstanding design review “chits,” and a final design review is planned for December.