NSTX Weekly Report (July 17, 2009)

FY 2009 NSTX plasma operations
Planned: Base - 11 run weeks, ARRA - 5 run weeks
Completed: Base - 10.95 run weeks with 1,705 plasma shots
ARRA - 1.18 run weeks with 188 plasma shots

• The ARRA funded run week operation has started on July 7, 2009. The first ARRA run week milestone was completed on July 14, 2009.

• Stefan Gerhardt received the Presidential Early Career Award which honored twelve young scientists and engineers from U.S. Department of Energy (DOE) national laboratories. Gerhardt was cited for his innovative and seminal work by enabling the systematic diagnosis for interpretation of key stability characteristics of a broad range of magnetically-confined toroidal plasmas and for his outstanding contributions to improving understanding of fundamental plasma physics in laboratory plasmas.

• Stan Kaye attended the ITPA Coordinating Committee meeting in Cadarache, France on July 15-16, 2009 in his role as Chair of the Transport and Confinement Topical Group. The purpose of the meeting was for the ITPA Topical Group leaders to present their annual reports to the CC. The presentations primarily addressed how the TGs addressed the ITER high priority items, what issues arose that impeded more rapid progress and how the ITPA and ITER IO could work towards overcoming obstacles. (S. Kaye)

Run Coordination (R. Raman , University of Washington, Deputy: E. Fredrickson)

NSTX Plasma Experimental Highlights for July 9 - 15, 2009**:** Three new systems were commissioned. The twin Lithium (Li) - dropper system was successfully tested on July 9. Two new poloidal field coils located above the upper divertor plates were commissioned on July 21. A new software capability that allows the time duration of the neutral beam pulses to be feedback modulated based on a pre-specified plasma beta was partially tested.

On the morning of July 9, XP913 "Li dropper – D. Mansfield" was run for an hour to test the Li dropper system. Both lithium droppers were commissioned on Thurs 9/16/09 during a total of four discharges. Each dropper was used successfully at a flux level of 60 - 75 mg/s. In addition, the dual dropper system was used successfully at a total of about 150 mg/s. The NSTX plasma was observed to be remarkably tolerant of these levels of lithium injection.

On the afternoon of July 9 and the morning of July 10, XP908 "Dependence of momentum and particle pinch on collisionality – W. Solomon (General Atomics)" was run and completed. Key data was obtained to address the two primary goals of the experiment. n=3 non-resonant magnetic perturbations were applied to the plasma to investigate the roles of diffusive versus non-diffusive momentum transport, with the specific goal of characterizing the dependence of momentum pinch on collisionality (an ITPA joint experiment, TC-15). The collisionality was varied by scanning (Bt, Ip) at constant q, while adjusting power to attempt to keep beta and rho* as near as possible constant. For the particle transport, gas pulses from the supersonic gas injector were injected and the response to the electron density was measured with MPTS. No detectable change outside the noise was detected. On the other hand, impurity transport

measurements using Neon puffs and the Soft X-Ray system appear to have obtained suitable data for resolving the particle pinch. Collisionality variation of approximately a factor of two was obtained for both data sets.

On the afternoon of July 10, XP948 “Optimization of long-pulse high beta_T discharges – S. Gerhardt” was started. A very high elongation reference shot was repeated at Ip=900 kA and Bt=0.45 T. The field and current were then modified to Ip=1000 kA and Bt=0.4 T, and a number of steps were taken to optimize the discharge, including changes to the fueling and shape evolution. A discharge was achieved with duration greater than a second, and which achieved a toroidal beta of 30%. Analysis of this discharge indicates further optimization steps, to be tested in future experiments.

On the morning of July 13, the absorber poloidal field coils were commissioned. These are two small poloidal field coils located above the upper divertor plates in NSTX. This is a new hardware capability that allows the poloidal field pattern in the region of the upper divertor plates to be controlled so as to reduce the intensity of spurious arcs during CHI experiments.

On July 13 and the morning of July 14, XMP26 “Bring High Harmonic Fast Wave (HHFW) online and condition the antenna – J. Hosea” was run. An HHFW conditioning campaign into 2 MW deuterium NBI fueled H-mode plasmas, with lithium injection, was conducted on July 13. -90 degree current drive phasing was used throughout the day. 2.4 MW was coupled into a 1 MA plasma for 80 ms but the RF pulse was terminated by source trips, and large ELMs were observed after the initial RF pulse. The plasma current was then lowered to 700 kA and RF power was gradually increased throughout the rest of the day. Eventually 2.3 MW was coupled for 200 ms, 3.3 MW was coupled for 100 ms and 4 MW was coupled for 30 ms. Increases in stored energy and central electron temperature were measured during the RF pulses. On July 14, -90, -150 and +90 degree phasing was coupled into discharges with plasma currents between 700 and 900 kA. About 2 MW was coupled with -90 and -150 degree phasing, and over 1 MW was coupled with +90 degree phasing. An outer gap scan was performed with -150 degree phasing.

On the afternoon of July 14, XP946 “HHFW heating and Current Drive in Deuterium H- Mode Plasmas – P. Ryan” was partially run. 2 MW of RF power with -90 degree phasing was coupled into 700 and 900 kA plasmas. No HHFW baseline plasmas were also run at the same plasma currents. MSE data was acquired during the HHFW and no HHFW plasmas.

On the morning of July 15, five shots were taken for XMP63, "Commissioning of PCS (Plasma Control System) NBI Control for Beta Feedback – S. Gerhardt". This new software capability for NSTX compares a requested evolution of beta_N to the value calculated in rtEFIT (real time plasma reconstruction code), and adjusts the neutral beam modulation frequency to minimize the difference between the two. Cases were obtained where the PCS successfully ramped down the input power is response to beta_N exceeding the request. However, the gains need to be further optimized.

On the afternoon of July 15th, XP919 "Development and characterization of an intermediate triangularity discharge with lithium PFC (Plasma Facing Component) coatings – J. Kallman" was run and completed. Feedback control for both the outer and inner strike points was demonstrated in support of the LLD (Liquid Lithium Divertor) configuration planned for FY10.

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

NSTX plasma operations continued this past week with extended run days on Tuesday and

Thursday, and with the use of HHFW and neutral beam heating, the lithium evaporator (LITER) probes, the UCSD fast probe, and the new high speed IR camera in support of experiments. Plasma operation to support the commissioning of new Plasma Control System (PCS) controls on neutral beam injection for beta feedback was also successfully performed, and integrated system testing for operation of the PF Absorber (CHI absorber field-nulling) coils via the Switching Power Amplifier (SPA) supplies was completed.

The NSTX Test cell will be in restricted access this coming week during plasma operations, with extended run days (to 7PM) planned for Tuesday and Thursday. Test cell access will be available each evening at the end of the run day.

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

• Liquid Lithium Divertor (LLD)
- A teleconference was held with SNL, PPPL, and the coating vendor to discuss LLD progress and planning.
- The molybdenum coating of several plates has been completed. Delivery of all 6 plates is scheduled for 7/22/09.
- Tests of nickel plating on copper to inhibit liquid lithium flow were started.
- Thermal response testing of the LLD Bias Tile and the Langmuir Probe Array diagnostics were completed. (M. Viola)

• Lithium Evaporator (LITER-09_
- Preparation of lithium material for reloading the LITER system started.