

NSTX Weekly Report (September 17, 2010)

FY 2010 NSTX plasma operations

Planned: Total - 15 run weeks (Base - 14 run weeks, ARRA - 1 run week)

Total completed – 13.80 run weeks and 2616 plasma shots

Completed: Base – 12.79 run weeks and 2445 plasma shots

Completed: ARRA -1.01run week and 171 plasma shots

The following sixteen NSTX papers have been accepted for publication in Rev. Sci. Instrum: “Measurement of Poloidal Velocity on the National Spherical Torus Experiment (Invited)” by R. Bell, “Concept of a Charged Fusion Product Diagnostic for NSTX” by W. Boeglin (Florida International University), “Results from the FIRETIP Electronics Upgrade on NSTX” by W. C. Tsai (UCD), “The NSTX Beam Emission Spectroscopy Diagnostic System: Capabilities and Research Plan” by N. Schoenbeck (U. Wisconsin), “Low-noise, High-Speed Detector Development for Optical Turbulence Fluctuation Measurements for NSTX” by D. Smith (U. Wisconsin), “Spectroscopic Diagnostics for Liquid Lithium Divertor Studies on the National Spherical Torus Experiment” by V. Soukhanovskii (LLNL), “A Ka-Band Direct-Conversion Correlation Reflectometer for NSTX” by S. Kubota (UCLA), “Biasing, Acquisition, and Interpretation of a Dense Langmuir Probe Array in NSTX” by M. Jaworski, “High-Density Langmuir Probe Array for NSTX Scrape-Off Layer Measurements under Lithiated Divertor Conditions” by J. Kallman, “First Real-Time Detection of Surface Dust in a Tokamak” by C. Skinner, “Tungsten Transport in the NSTX Plasma” by J. Clementson (LLNL), “A Two-Color Adaptor for High Speed Infrared Imaging of the NSTX Divertor” by A. McLean (ORNL), “Simulations and Inversion Techniques for 2D Soft X-Ray Imaging Systems” by D. Battaglia (ORNL), “Prototype High Resolution Multi-Energy Soft X-Ray Array for NSTX” by K. Tritz (Johns Hopkins), “Transmission Grating Based EUV Imaging Spectrometer for Impurity and Electron Temperature Measurements” by D. Kumar (Johns Hopkins), and “Modeling the Polarization Properties of Propagating Electromagnetic Waves in NSTX” by J. Zhang (UCLA). (B. Stratton)

Bilel Rais, a graduate student from [Université de Provence Aix-Marseille, France](#), completed a 6 month visit to PPPL this week to do a master’s research project on dust detection in tokamaks. He performed calibrations of the electrostatic dust detector with carbon and lithium particles for a variety of configurations including the one used on NSTX. He also developed and tested a helium puffing system to remove residual dust from the detector. The system was able to completely remove dust from the detector and cover mesh using two helium puffs in a four nozzle manifold. The system geometry and amount of gas used were optimized for use on NSTX. The calibration results have been the subject of a RSI paper and PPPL report and a second RSI paper and PPPL report on the helium puffer will be submitted for publication. (C. Skinner)

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

On September 9 – 10, we continued with CHI experiments “Flux saving and improved coupling to OH “ (Raman, Mueller, Nelson, Jarboe, XP1034). Up to seven capacitors (5 mF each) were used to generate 330kA of initial current without absorber arcs showing that the absorber coils are effective in suppressing the arcs. The experiments on Friday were done without fresh lithium deposition which is very effective in enhancing plasma performance, and reducing the

low-Z impurities to permit inductive ramp-up. Nevertheless in the early discharges on September 10, 1MA currents were generated using less than the full value of flux from the single swing of the central solenoid. The discharges exhibited very low internal inductance early from the start of the discharge.

On September 13, the machine was configured back to the normal plasma operations with John Canik's XP1025 on ELM pacing with a synergistic combination of vertical jogs and applied error fields. In the half day of operations, results were obtained that demonstrated proof-of-principle. A further half day will be scheduled for this XP.

On September 14, we started Yang Ren's XP1037 to study the scaling of high-k turbulence. A scan of toroidal field at constant q_{95} was completed, although constant density could not be maintained over this range of plasma current.

On September 15, we completed Richard Buttery's XP1032 to study the error field threshold for triggering tearing modes in H-mode plasmas. Experiments were executed to measure the scaling of error field thresholds in H modes with toroidal field. This is a challenging task in NSTX time evolving plasmas, as issues such density, beta and q profile variation potentially influence thresholds. Nevertheless good data were obtained at three key values covering the operating range, with enough repeat-variation shots taken (via changes of beam power, waveform timing and gas puff) to enable the other effects to be understood and compensated. This should provide a good basis for extrapolating error field thresholds for standard ELMy H modes to future devices like the ST CTF, and confirming underlying physics relevant to ITER - complementing related joint experiments on DIII-D. Also to note, this was the first experiment on NSTX to make use of the new real time betaN control as a background control tool. Despite the wide range in toroidal fields and plasma currents, the feedback controller was able to hit close to the target value in all cases through modulation of sources B and C - with virtually no operator involvement. This saved valuable shots that would have been needed to re-optimize beam waveforms to hit desired betaN values. It also validates the technique as a potentially useful tool for experiments in general where a prescribed beta is desirable and modulation of beams is acceptable. Also, preliminary results from the soft X ray camera show very nice imaging of the rotating 2/1 mode and its inversion point - this is a potentially powerful diagnostic in constraining q profile measurements and seeing small variations thereof, and possibly backing out island sizes. Following this experiment we started an XP to study the effect of rotational shear on confinement, now with the new BES turbulence diagnostic. The experiment will be continued Thursday.

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

NSTX plasma operations continued on extended shifts this past week after re-configuring the vacuum vessel, coil and power systems for ohmic operations. The Bay K lithium evaporator (LITER) was replaced with a freshly refilled probe over the weekend before starting a week of experiments utilizing lithium evaporation, neutral beam heating, and Resistive Wall Mode (RWM) feedback via the Switching Power Amplifier (SPA) driven error field coils. Also this week, a contract was awarded to the preferred contractor to complete the electrical installations needed to commission the 2nd SPA upgrade planned for the upcoming outage.

Access to the NSTX test cell will be restricted during plasma operations this coming week.

Access is expected to be available each evening.

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

- Liquid Lithium Divertor (LLD)
 - Fabrication of parts for the gas manifold for air heating of the LLD plates was started.
 - Drafting was started for the installation of a high capacity air compressor to support air heating of 4 LLD plates.
- Lithium Evaporators (LITER)
 - LITER-K2 and -F1 units were removed from the vessel.
 - The reloaded LITER-K1 unit was installed on the vessel.
 - Preparations started for possible maintenance on the Bay-F lithium shutter system.
- Molybdenum Inner Divertor Tiles
 - Drafting for a prototype molybdenum plate - graphite tile unit was completed
 - A Work Request was submitted for fabrication of a prototype molybdenum plate-graphite tile unit.