

NSTX Weekly Report (March 7, 2008)

FY 2008 NSTX plasma operations

Planned: 15 weeks

Completed: 2.76 weeks (through March 5, 2008)

Mitsutaka Isobe, from the LHD group at NIFS, Japan, visited NSTX between February 24 and March 7. During his visit, he exposed some neutron detection emulsions in a prototype neutron profile diagnostic for NSTX. The emulsions were provided by and will be analyzed by Nagoya University's Fundamental Particle Physics Laboratory. (D. Darrow)

Hisamichi Funaba from the National Institute for Fusion Science (NIFS) Nagoya, Japan, visited NSTX as part of the US-Japan collaboration. The purpose of the visit at this time was two-fold: (1) calculation of impurity lines with the collisional radiative -model using the CHIANTI database, and (2) comparison of impurity profiles in LHD and NSTX. On LHD, an impurity hole phenomenon is observed by CHERS in high ion temperature discharges, and also in studies of the VUV spectroscopy of iron. The analysis of pertinent NSTX data, and additional future experiments were discussed. (H. Kugel)

Run Coordination (M. Bell, R. Raman)

Six experiments were conducted in the week February 28 to March 5, 2008.

On Thursday 2/28, an experiment XP-609 "Dependence of ELMs on magnetic balance" [R. Maingi] was completed successfully. The ELM characteristics at two different triangularities were measured as functions of the separation at the midplane between the magnetic surfaces connected to the upper and lower divertor X-points. This completes the NSTX part of a joint experiment endorsed by the ITPA. Hendrik Meyer (UKAEA: MAST) and Jerry Hughes (MIT: C-mod) participated on-site.

On Friday 2/29, two experiments were conducted. An ITPA-endorsed experiment, XP-721 "Comparison of Small ELM regimes on C-Mod, MAST, and NSTX" [R. Maingi, H. Meyer, A. Hubbard], to measure the operational window of small ELMs was completed successfully. The window for small, Type V ELMs was mapped out at lower edge q than in the past to match C-Mod and MAST data. Hendrik Meyer (UKAEA: MAST) and Amanda Hubbard (MIT: C-mod) and Jerry Hughes (MIT: C-mod) participated on-site. A companion experiment on the small ELM regime was then executed on Alcator C-Mod (at a latter date) to measure the shape window for access to the small ELM regime in Alcator C-Mod. This experiment was led jointly by J. Hughes (MIT), R. Maingi (ORNL), and H. Meyer (UKAEA).

In the afternoon, an experiment XP-809 "ELM Destabilization by Resonant Magnetic Perturbations" [J. Canik] was completed, successfully demonstrating that ELMs can be destabilized by the external midplane coils in NSTX. Large ELMs were clearly observed when the non-axisymmetric coils were turned on in otherwise ELM-free periods of small-ELM discharges. A coil current threshold was found. This experiment will help identify the physics of the instability responsible for large ELMs. John Canik (ORNL) travelled to PPPL to lead this experiment.

On Monday 3/3, we began XP-818 "ELM mitigation with midplane coils using different Resonant Magnetic Perturbations" [S. Sabbagh] using the $n=1$ and $n=3$ applied error-field components then

available. After some time spent getting a suitable ELMing condition, good shots were obtained in which the ELM frequency was significantly reduced during the EFC-coil pulse.

After changing the EFC-coils to their even-parity connections overnight, we started XP-805 "Investigation of intrinsic $n=2$ error fields and RWM critical rotation" [Gerhardt] on Tuesday 3/4. The applied $n=2$ field phase was varied for two different current levels in the EFC-coils, to detect an asymmetric response to the error field. The H-mode timing was somewhat irreproducible, leading to variations in the early MHD and the "MHD-free" window was quite short. However, the data collected will provide a preliminary assessment of the error field effects.

Vacuum conditioning of the HHFW antenna was conducted on Tuesday evening. All sources reached an RF voltage of ~ 22.5 kV at the feed cubes and the RF pulses were lengthened to 500 ms. Conditioning stopped when loading was affected by outgassing. Then on Wednesday 3/5 we again ran MP-26 "HHFW coupling to 6MW" [J. Hosea]. The coupled RF power was raised to ~ 2.75 MW in helium. Some arcs which occurred at high power appeared to be due to particles entering antenna and not to exceeding the voltage limit for the antenna. Significant electron heating was observed for both the 180 and -90 degree antenna phases. In deuterium plasmas, the coupled RF power reached ~ 2 MW and did not appear to be restricted by the antenna voltage limit.

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

NSTX Plasma operations continued this week with extensive use of the machine's error field coils and neutral beam heating for experiments on ELM mitigation, comparison of ELM regimes on C-MOD, MAST, and NSTX, and on investigations into resistive wall modes. Present and participating in these experiments were John Canik of ORNL, Amanda Hubbard of C-MOD, and Heindrick Meyer of MAST. Also this week, the HHFW systems were conditioned to >20 kV into a vacuum in the evening, and successfully coupled ~ 3 MW into helium plasmas, using both heating and current drive antenna phasings. Pre-operational testing of the CHI capacitor banks and fast voltage measuring system was performed this week, and lithium evaporation experiments on the test stand continued.

The NSTX test Cell will be in restricted access this week during plasma operations to 5PM each evening.

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

Liquid Lithium Divertor (LLD):

- R. Kaita visited SNL to inspect the NSTX LLD development facilities, and to coordinate near term tasks and planning for the LLD Final Design Review in April. (R. Kaita)
- H. Harjes of SNL held a teleconference with J. Timberlake to discuss LTX lithium control information applicable to LLD development, and a teleconference with H. Schneider to discuss LITER control and interfacing concepts applicable to the LLD as part of preparations for the FDR.

- A teleconference was held with R. Nygren, SNL project manager for the LLD, and NSTX design team members R. Ellis III, R. Kaita, and H. Kugel to discuss recent progress and to coordinate tasks for the FDR.

- Experiments started in the Lithium Test Facility to test the evaporation of lithium on to a candidate LLD surface sample. The sample consisted of a 12 cm diameter, 1 cm thick stainless steel disk coated on one side with 0.1 mm of flame-sprayed molybdenum having a porosity of 50%, and was heated to 200°C. The sample was mounted at 21.5° to the horizontal to mimic the slope of the LLD outer divertor location. The LITER Bay F evaporator operating at 650°C deposited lithium at a rate of about 50 mg/min on the lower edge of the molybdenum surface. Prior to the start of evaporations, a shutter was positioned to shadow the upper region of the sample from direct lithium deposition. This was done to determine if lithium would wet the sample surface and diffuse upward against gravity due to surface tension forces. Preliminary observations from work in progress indicate that sufficient lithium was evaporated to fill the porosity of the lower region of the sample, and that lithium had diffused upwards over two-thirds of the unexposed sample surface.

LITER FY08:

- Limit switch installation has been in progress on the LITER Bay K bellows motion drive in preparation for installation during the next Maintenance Week.
- Work on special lithium loading tools to allow LITER lithium loading in the NTC continued.