NSTX Weekly Report (May 21, 2004)

FY 2004 weeks of operation planned: - 18 weeks, Completed: - 12.8 weeks

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

• **This week Ben Fraenkel , from** Hebrew University, Israel (retired) arrived on Monday, May 17, 2004. Dave Johnson is the host. He will collaborate with Manfred Bitter on the x-ray crystal spectroscopy on NSTX. (J. Savino)

• At the NSTX Phyiscs meeting on Monday, May 24, Stewart Zweben will show ***"Recent movies of edge turbulence in NSTX"***. The meeting will start at 1:30 pm in B-318, and will be available for remote participation (connection information given below.) (C.K. Phillips)

Run Coordination (S. Kaye, J Menard)

Five XPs and two XMPs were run during days, or partial days, this week. An rtEFIT XMP was run to optimize the hand-off time between proportional and rtEFIT control. An XP was run which explored the dependence of H-mode access on fueling location and plasma configuration. RWM experiments continued with studies of mode dissipation and stabilization processes, focusing on the physics of rotation damping. A suite of diagnostics examined edge turbulence and changes during density scans in both L- and H-mode plasmas. An experiment was run which attempted to isolate the discharge parameters that influenced the character and severity of ELMs. Finally, an XP and XMP were run examining non-ohmic solenoidal startup, using inductive flux from the PF coils with assists from HHFW and NBI. Over 10 kA of current were obtained with the HHFW breakdown and PF-only ramp-up.
• Long pulse H-modes were obtained with center stack shoulder fueling in a double-null shifted downward by 0.7cm, and a higher fueling rate was required than in balanced double-null. The density rise was comparable between midplane and shoulder fueling, but the ELMs were more frequent with midplane fueling. The stored energy was higher with shoulder fueling (R. Maingi).
• Dissipation and Inertial Effects on RWM Stability was started on 5/18/04. The experiment aims to examine the relative importance of dissipation and inertial effects on RWM stability. Technical issues significantly delayed the start of the planned parameter scans, but eventually control shots were taken and the initial scan of B0 at constant q was completed, which represents approximately 20% of the planned shot list (A. Sontag, S. Sabbagh).
• The first day of an edge turbulence characterization XP was run, which used a combination of edge turbulence diagnostics (reciprocating probe, FIRETIP, reflectometer, Gas Puff imaging) to study the nature of and changes in edge turbulence. A density scan was performed in LSN L-mode plasmas, with more turbulence and “intermittency” being observed at higher density, and several shots in LSN H-mode plasmas and one shot in a DN L-mode were obtained. In both the LSN and DN L-modes, the reciprocating probe penetrated the flow shear layer in the edge plasma (J. Boedo).
• An experiment was performed to isolate parameters that controlled ELM severity and effect on stored energy. Scans of plasma shape (i.e., elongation/triangularity) and X-point height were performed, and the results indicated that it was shape, and not X-point height, that controlled the ELM severity. At higher elongations (2.3) and lower triangularities, the ELM amplitude and apparent turbulence levels were higher than at lower elongation, resulting in a degradation in stored energy. This change in the character of the ELMs was observed irrespective of lower X-point vertical height. The next phase of this experiment is to examine the dependence of the ELMs on triangularity and/or squareness (S. Kaye).
• An XMP and XP were performed to attempt to initiate the plasma using inductive flux only from the PF coils with an assist from HHFW. The XMP was run with TF fields only in order to optimize gas needed to initiate the plasma with the RF. Breakdown with fill pressures as low as 1x10-5 T were obtained. The XP focused on plasma startup with an outside null created by the PF coils, with the inductive flux coming from ramps of the PF3 and PF5 coils. Plasma currents of over 10 kA were produced with this novel breakdown method. The Thomson scattering diagnostic measured the plasma breaking down on the outside, near the null, and moving to the inside. This motion, occurring over 3 to 4 msec, was also observed on the CHERS background array. Peaked electron pressure profiles indicated the formation of closed flux (J. Menard).

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

NSTX plasma operations continued this past week on extended run days with all technical subsystems operating reliably. Work continued on the development of rt-EFIT control (XMP-32) early in the week before moving to the H-mode gas fueling experiment (XP-409), during which the center stack shoulder gas injector was successfully used to fuel H-

modes. Density and beta scans were performed in support of an experiment on RWM dissipation physics (XP-428), which examined q dependence and dissipation mechanisms during the generation of resistive wall modes. The UCSD fast reciprocating probe was used extensively in support of an experiment measuring edge turbulence (XP-437) in L-mode lower single null and double null plasmas. A vacuum vessel boronization was completed before starting an experiment on the effects of shaping on ELMs (XP-446) and the continuation of the ongoing investigations into using HHFW to initiate the plasma (XMP-30). NSTX finished the week with an experiment on PF-only plasma startup (XP-431). Dummy load testing of the power circuit that will be used to power either the PF4 coil or the RWM coils was completed after hours this past week.

By the end of this past run week, which included extended run days, NSTX had completed 12.8 run weeks this year, producing 1332 plasmas. Access to the NSTX test cell will be restricted during plasma operations this week. Test cell access will be available from 5:00PM to 10:00PM each evening, except for Thursday, May 27th, when plasma operations will be extended to 7:00PM. The next maintenance period is scheduled for June 5th - 17th. (A. von Halle)

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

• A 15 min Morning Boronization was performed. (J. Winston, W. Blanchard)

• Computer testing of Lithium Pellet Injector (LPI) motion drive is in progress. (Engineering Dept. Personnel)

• Off-line testing of a partial mockup of the Supersonic Gas Injector (SGI) started. A prototype for the front graphite shroud was fabricated. (SGI Team)
Physics Analysis (C. K. Phillips, S. Kaye)

Good progress was made toward the goal of developing a physically motivated and mathematically consistent form of magnetic helicity that treats toroidally and simply connected volumes on an equal basis. The physical content of the theory is the topological linkage enunciated by Berger and Field, but generalized to an arbitrary toroidally connected volume. Field matching conditions at the bounding surface S are chosen to preserve physical content and gauge independence. A "strong" boundary condition case, much like prior extensions of Berger and Field, was developed, but it is quite restrictive of gauge choice. A new "weak" boundary condition case has now been developed that does not restrict gauge choice, but it is more complicated. Separation of the magnetic field into closed (does not penetrate S) and open (penetrates S) components yields further interpretability. The next step is to derive the helicity conservation equation in this same new and more general way. The work to date will be presented as a poster next week at the Innovative Confinement Concepts Workshop in Madison, WI. (M. Schaffer, GA)