

NSTX Weekly Report (April 16, 2004)

FY 2004 weeks of operation planned: - 18 weeks, Completed: - 8.6 weeks

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

- Danilo Pacella from Frascati, Italy arrived on April 14, 2004. Bob Kaita is his host. Dr. Pacella gave a seminar titled "Energy resolved fast 2-D X-ray imaging for MFE plasmas."
- The NSTX Physics Meeting will be held on Monday, April 19, 2004 at 1:30 P.M, in B318. Steve Sabbagh will review the results on RWM's from XP 407. This meeting will be available for remote participation. (C. K. Phillips)

Run Coordination (S. Kaye, J. Menard)

- This has been an exceptionally productive run week. The horizontal NPA scan in L-mode plasmas was performed, completing XP417 which was begun before the mini-outage. After a full boronization Monday night, XP402 continued, with long pulse, Double Null Diverted discharges achieving up to 300 kJ stored energies with global confinement times in excess of 2.2 times the L-mode scaling. XP407 was run and completed, exploring the stability boundaries of RWMs. The plasmas run for this XP benefited from the development in XP402, and achieved beta toroidal values of up to 38% and Alfvén Mach numbers of approximately 0.5. In these discharges, long periods (150 msec) of approximately zero loop voltage were observed. Excellent data was taken to study the association of the collapse of plasma rotation with the onset of low-n locked modes, perhaps indicative of RWMs. XP419 was performed to study the effect of fueling location on L-H transitions. This experiment confirmed that center stack midplane gas fueling leads to a lower LH power threshold than low field side fueling at comparable density. Preliminary measurements showed that the edge radial electric field profiles measured by the edge rotation diagnostic were comparable just before the L-H transition, despite the difference in fueling location. XP401 studied the confinement scaling of H-mode plasmas in long pulse, discharges. A current range from 0.6 to 1.2 MA was accessed, and the stored energy of the H-mode plasmas scaled nearly linearly with plasma current. The power degradation at 0.8 MA was less than $P \sim 0.5$. Type III ELMs were observed for the first time during this experiment. Finally HHFW conditioning resulted in power levels up to 4 MW, with several HHFW-only H-modes being observed. (S. Kaye)
- XP 402, Long pulse high current plasmas at high triangularity was run for 4 hours on Tuesday following the boronization on Monday night. During this brief run, the longest 1MA discharge to date on NSTX was produced. This discharge had normalized beta > 6.0 and toroidal beta > 20% for ~230ms. The current flattop time was ~450ms or 9 energy confinement times. There were several shots produced with similar parameters. The loop voltage averaged over the high beta phase was 190mV, with beta-p ~ 1.1, with the stored energy ~300kJ. These were the baseline shots for the later part of the XP, which is aimed at extending the high triangularity double null scenarios to higher plasma elongation and at increasing the toroidal beta in long pulse scenarios. The maximum toroidal beta achieved was 26% and the maximum normalized beta was 6.3. The shots were limited by (probably neoclassical) tearing modes which locked, causing a loss of confinement. (D. Gates)
- An experiment confirmed that center stack mid-plane gas fueling leads to a lower LH power threshold than low field side fueling at comparable density. However, preliminary measurements showed that the edge radial electric field profiles measured by the edge rotation diagnostic were comparable just before the L-H transition, despite the difference in fueling location. Type III ELMs were observed for the first time in NSTX during the H-Mode confinement scaling (XP-401) experiment. The frequency of these ELMs decreased with increasing edge/loss power, and a magnetic precursor was observed before each event. These ELMs and others were observed clearly on the divertor fast framing visible camera from Hiroshima University, Japan. (R. Maingi – ORNL)
- The first experiment of the year to examine the resistive wall mode stability boundary was performed on 4/13/04. Following our previous observation that mode stabilization (critical rotation frequency) depends on q, the experiment altered q by slowly ramping the toroidal field to alter the stability boundary. This technique also altered the pressure peaking factor, which is another key parameter for plasma stability. By varying these parameters, several different plasma terminations were observed. Greatly expanded diagnosis of the modes was made, which included 51 channel CHERS rotation measurements and the new RWM sensor array. As the plasma was moved slowly toward the unstable boundary, mode with low, finite frequency ~ 370Hz ~ $O(1/\tau_{wall})$ appeared and locked. Full diagnosis of these modes is underway. Internal RWM sensor data is being analyzed for n > 1 RWM activity. Also of note in these experiments were the very high toroidal rotation normalized to the Alfvén speed attained = 0.48 and high toroidal beta = 38% reached, both representing record values for the device. A normalized beta value of 6.7 was also reached, which is a new high at constant plasma current. (S. Sabbagh, Columbia University)

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

- NSTX plasma operations continued this past week with improved machine conditions after a vacuum vessel boronization.

Experiments in long-pulse double null plasmas (XP-402) and investigations into resistive wall modes (XP-407) were completed along with H-mode comparisons at inner and outer gas feeds (XP-419) and H-Mode confinement scaling (XP-401). RF filters have been installed in the real-time digitizers for the magnetic diagnostics referenced to class 3 (center-column) and class 4 (outer vacuum vessel) systems and are being evaluated during high power HHFW conditioning shots. The UCSD fast reciprocating probe was fully operational and collecting data this week.

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, April 22nd, when plasma operations will be extended to 9:00PM. The next maintenance week is scheduled for May 3rd-7th. (A. von Halle)

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

- NSTX TMB Boronization-24 was performed.
- The upgraded UCSD Fast Probe performed well during H-mode transition measurements and interesting edge data was obtained. (J. Boedo)
- The Joint CDX-U/NSTX Supersonic Gas Injector (SGI) team reviewed the NSTX SGI final design, and approved the completed fabrication drawings. Parts were submitted for welding. (T. Provost)
- The Joint CDX-U/NSTX Lithium Resistive Evaporator (LRE) team met to inventory the available parts, and approved the plan for assembly of the test stand. (R. Majeski)
- An upgraded rotary motion feedthrough was received for the Lithium Pellet Injector (LPI) and integration is in progress. (G. Gettelfinger)
- Meetings were held to facilitate the development a realistic 3D NSTX model for neutral gas transport calculations with DEGAS 2. (D. Stotler)