NSTX-U Weekly Report (November 7, 2014)

NSTX-U is in the Upgrade Project outage in FY 2014

The review paper "Enhanced confinement scenarios without large edge localized modes in tokamaks: control, performance, and extrapolability issues for ITER" by R. Maingi (PPPL) et al., was published in Nucl. Fusion 54 (2014) 114016. It can be downloaded at http://stacks.iop.org/0029-5515/54/114016. The abstract describes well the scope: "Large ELMs typically accompany good H-mode confinement in fusion devices, but can present problems for plasma facing components because of high transient heat loads. Here the range of techniques for ELM control deployed in fusion devices is reviewed. Two strategies in the ITER baseline design are emphasized: rapid ELM triggering and peak heat flux control via pellet injection, and the use of magnetic perturbations to suppress or mitigate ELMs. While both of these techniques are moderately well developed, with reasonable physical bases for projecting to ITER, differing observations between multiple devices are also discussed to highlight the needed community R&D. In addition, recent progress in ELM-free regimes, namely quiescent H-mode, I-mode, and enhanced pedestal H-mode is reviewed, and open questions for extrapolability are discussed. Finally progress and outstanding issues in alternate ELM control techniques are reviewed: supersonic molecular beam injection, edge electron cyclotron heating, lower hybrid heating and/or current drive, controlled periodic jogs of the vertical centroid position, ELM pace-making via periodic magnetic perturbations, ELM elimination with lithium wall conditioning, and naturally occurring small ELM regimes." (R. Maingi)

Jack Berkery and Steve Sabbagh of Columbia University attended the 19th MHD Stability Control Workshop hosted by Auburn University, delivering the presentations “Kinetic resistive wall mode stability evaluation and physics insight application in NSTX” and “Physical Characteristics of Neoclassical Toroidal Viscosity in Tokamaks for Rotation Control and the Evaluation of Plasma Response”, respectively, which showed results and analysis from NSTX, DIII-D, and KSTAR. (S.A. Sabbagh)

NSTX researchers participated in and contributed significant analysis to a DIII-D National Fusion Science Campaign experiment "Controlling H-mode particle transport with ECH", the results of which were presented as orals at both recent IAEA-FEC and APS-DPP meetings. The experiments were led by D. Ernst (MIT) and co-led by K. Burrell (DIII-D), W. Guttenfelder (NSTX) and T. Rhodes (UCLA). The APS presentation was featured as a press release for the annual DPP 2014 conference titled "Using radio waves to control density in fusion plasmas" http://www.aps.org/units/dpp/meetings/vpr/2014/upload/ernst.pdf. (W. Guttenfelder, PPPL)

Physics Analysis (S. Kaye)

A concerted effort was undertaken to develop a means to run TRANSP automatically between NSTX-U discharges. This process is called BEAST (BEtween and Among Shots Transp). Code modifications along with detailed timing runs to optimize namelist parameters were undertaken as part of this process. A 1.1 sec NSTX H-mode discharge was used as the basis for this study. The timing tests, which were done on 32 dedicated processors, indicated, as expected, that most of the modification and optimization necessary was in the NUBEAM (fast ion) calculation. Namelist parameters controlling the beam time step, number of beam particles, goosing parameter and fast ion distribution output were tested. With proper optimization, still preserving

acceptable output statistics, the 1.1 sec H-mode discharge calculation wall clock time was reduced to 5.5 min. Estimating approximately 1 to 2 min of overhead in run setup and post-processing, this would enable a run to finish within 8 min of the plasma discharge, within the between shot time of 10-20 min. Additional run profiling will be done in an attempt to further optimize the time, and a new 32 cpu cluster will be implemented dedicated to tBEAST calculations.

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

NSTX Upgrade activities continued with the installation of the upper and lower row one tiles (see photo below) after the final spatial adjustments of the centerstack were completed. The Vacuum Prep Lab is preparing the last items to go on the vessel to complete the vacuum boundary for pumpdown.

The Digital Coil Protection System (DCPS) and the Power Supply Real Time Control (PSRTC) development efforts are working towards the start of Field Coil Power Conversion System dummy load testing. The DCPS Interconnection Subsystem test procedure to verify both auto tester and real world configurations has been approved and a final run copy will be performed (several dry runs have already been completed). The PSRTC software specification has been approved, and pre-operational test procedures are being developed. PSRTC software development continues. Work on the portable firing angle recorder for PSRTC to FCPC Firing Generator testing is in progress.

Preparations of non-upgrade equipment for plasma operations in the NSTX-U configuration also continued. RF transmission line re-installation/testing continues, and the NSTX-U neutron detectors were installed in their permanent locations in the test cell. A dynamic end-to-end calibration of the neutron detectors with a known source was performed this week using a temporary track system installed in the vessel (see photo below). Preparations are underway for the in-vessel alignments of the Multi-pulse Thompson Scattering diagnostic (MPTS) which is scheduled to occur next week, immediately following the neutron detector calibrations.

Access to the NSTX test cell will be available only through previous arrangement with the Upgrade Work Control Center.

Row 1 Tiles Installed In NSTX-U (Nov. 3, 2014)