NSTX-U Weekly Report (July 5, 2013)

NSTX-U is in the Upgrade Project outage in FY 2013

Stefan Gerhardt (PPPL) submitted to DOE the third quarter report for the 2013 Joint Research Target (JRT) on Friday, June 28th. This JRT is designed to examine high-performance, stationary regimes without large ELMs. The report described various experiments on DIII-D designed to study I-mode or different aspects of QH-mode. The report also described ongoing analysis of previously collected C-Mod and NSTX data. (S. Gerhardt)

The paper "Comparison of Gas Puff Imaging Data in NSTX with DEGAS 2 Simulations" by B. Cao (Chinese Academy of Science, China), D. P. Stotler (PPPL), et al., was published in Fusion Science and Technology **64**, 29 (2013). It describes a validation test of the DEGAS 2 Monte Carlo neutral transport code using deuterium light emission data obtained with the Gas Puff Imaging (GPI) diagnostic on NSTX. The radial widths and peak locations of the simulated and measured light emission profiles agree to within the estimated uncertainties, similar to previous validation efforts. An important new aspect of this validation is a comparison of the absolute magnitude of the light emission. The experimental result for a particular shot is 1/89 +/- 34% photons per atom, while the DEGAS 2 simulation yields 1/75 +/- 18% photons per atom, again agreeing to within the estimated uncertainties. This result provides confidence that similar techniques can be used to interpret passive light emission in NSTX. (D. Stotler)

Michael Jaworski (PPPL) delivered an invited presentation, "Liquid metal plasma-facing component research on the NSTX" at the 40th European Physical Society Conference on Plasma Physics in Espoo, Finland. Three critical issues which face liquid-metal plasma-facing component development were described: liquid-metal stability, mass-transport and inventory control, and the development of integrated scenarios. In this talk results of the Liquid Lithium Divertor experiments conducted in NSTX during the FY2010 run campaign which demonstrate stable operation of a liquid metal target in the NSTX divertor. The research also indicates that vacuum residual gases rapidly contaminate lithium surfaces in the NSTX and motivate development of flowing systems for future experiments in the NSTX-U. The talk also described design studies conducted with Laboratory Directed Research and Development funding aimed at developing a self-consistent divertor target appropriate to a power reactor. In these studies that focus on state-of-the-art cooling technologies, it was found that surface temperatures above 700C are likely to be found when the surface is subjected to typical divertor heat-loads expected for next-step devices. This result motivates research on continuously vapor-shielded divertor targets on the NSTX-U and the impact of such a regime on mass-transport and core performance. (M. Jaworski)

Steve Jardin (PPPL) made a presentation at the 6/24/2013 NSTX-U Physics Meeting entitled "The nonlinear M3D-C1 code with application to the disruptive beta limit in NSTX". The motivation for developing this code was to assess the non-linear and fully 3D aspects leading to both hard and soft disruptive scenarios. M3D-C1 has high accuracy, flexible geometry that can handle a separatrix, it can run long-time simulations, encompassing both transport and stability time scales. It can be run in 2D nonlinear or 3D linear or nonlinear modes. It uses an unstructured mesh with high resolution near the plasma edge (developed by collaborators at RPI), and uses a unique implicit PDE solver that enables large time steps and quick convergence (e.g., 10s to 100s iterations). The code is inherently numerically stable even if the toroidal mode

number of the mode being studied is the same order as the number of toroidal elements being used (i.e., underresolved). The code was used to examine pressure driven modes in NSTX with q0>=1 in OH and NBI heated plasmas. In the OH case, with relatively low and decreasing beta, the 3D mode effect was found to be important for redistributing Te by comparing to 2D simulations. 3D asymmetries are found to develop during the initial phase of the calculation, but the plasma becomes more axisymmetric in time, most likely due to fast parallel transport. With NBI heating to keep beta constant near the beta limit, the surfaces remain distorted with toroidal asymmetries, but the plasma retains confinement, suggesting a mechanism for a soft (non-disruptive) beta limit. As q0 decreases towards 1, the simulations show a thermal collapse, indicating more violent behavior that might reflect a hard (disruptive) limit. (S. Kaye, PPPL)

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

NSTX Upgrade construction activities continued with the arrival of the full inner TF mold, and the ongoing preparation of all four inner quadrants for taping and subsequent assembly into that mold. In-vessel MPTS site lines have been verified, and the vessel cut at Bay F-G for that diagnostic has been made.

Preparations of non-upgrade equipment for plasma operations in the NSTX-U configuration also continued with the refurbishment and maintenance of the transformers and fast vacuum interrupters for the neutral beam power system.

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