Topic: OV

Overview of First Results from NSTX-U and Analysis Highlights from NSTX

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The National Spherical Torus Experiment (NSTX) has undergone a major upgrade, and NSTX Upgrade (NSTX-U) is now the most capable Spherical Torus/Tokamak (ST) in the world program. NSTX-U mission elements include: exploring unique ST parameter regimes to advance predictive capability for ITER and beyond, developing solutions for the plasma-material interface challenge, and advancing the ST as a possible Fusion Nuclear Science Facility or Pilot Plant. NSTX-U has two major new tools including a new central magnet and new 2nd more tangential neutral beam injector (NBI). Plasma control commissioning and scenario development has proceeded rapidly on NSTX-U. Diverted plasmas with I_P = 0.8MA, B_T = 0.6T, and τ_{pulse} ~ 1s are obtained routinely, and sustained H-mode plasmas have been accessed with 2.5MW of NBI heating power. Peak parameters achieved during the first run-month of NSTX-U plasma operation include: NBI power ~4MW, I_P = 1MA, stored energy ~ 200kJ, β_N ~ 4, κ ~ 2.2, $\tau_{E,tot}$ > 50ms, τ_{pulse} ~ 1.7s, and a 50% increase in pulse-length from n=1 error field correction. Expected results from the first run campaign include assessments of: core and pedestal confinement at lower ν^* via 60% higher field and current than NSTX, fast-ion confinement and current drive from the new 2nd NBI, and stability and control of high κ and high β_N plasmas. Extensive analysis of NSTX results continued including novel analysis of: edge turbulence data during the L-to-H-mode transition, heat flux footprint narrowing with increasing amplitude of edge-localized modes, and gyrokinetic modeling of core turbulence from dissipative trapped electron mode and electron temperature gradient modes. Further, a unified kinetic resistive wall mode physics model has been developed, and Massive Gas Injection valves similar to proposed ITER valves will be tested on NSTX-U. Lastly, a new method for determining the saturation level for Alfvén Eigenmodes has been developed, and SOL power losses for RF heating modeled and interpreted with the AORSA code. Results from the first research campaign of NSTX-U will be presented, initial comparisons between NSTX-U and NSTX results described, and NSTX analysis highlights presented.

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