

NSTX-U Weekly Report (June 7, 2013)

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

The paper, “Non-inductive plasma start-up on NSTX and projections to NSTX-U using transient CHI” by R Raman (U. Washington), et al., has now been published on-line [Nuclear Fusion **53** (2013) 073017]. The paper summarizes transient CHI experimental results from NSTX, describes the CHI hardware enhancements to NSTX-U; which allows for much higher current generation potential in NSTX-U, and presents initial simulations of a full non-inductive start-up and non-inductive current ramp-up scenario for NSTX-U. (R. Raman)

An article “Edge sheared flows and the dynamics of blob-filaments” by J. R. Myra (Lodestar Research) et al. has been published online in Nucl. Fusion **53** (2013) 073013, available at <http://stacks.iop.org/0029-5515/53/073013>. 2D time-resolved images from the NSTX gas puff imaging diagnostic and data from a synthetic diagnostic in numerical SOLT code simulations were analyzed using a new blob tracking algorithm (<http://nstx.pppl.gov/nstx/Software/Applications/BlobTracking.html>). Simulations reproduced many qualitative and quantitative features of the experimentally observed blob tracks. Mechanisms related to blob motion, SOL currents and radial inhomogeneity were shown to be sufficient to explain the presence or absence of mean and oscillating zonal sheared flows in selected shots in NSTX and Alcator C-Mod. The paper is based on Jim Myra’s 2012 IAEA presentation and invited talk at the 2012 APS-DPP meeting. (J. Myra)

Dr. Kimin Kim (PPPL) made a presentation at the 6/3/13 NSTX-U Monday Physics Meeting entitled “Application of POCA for NTV analysis and field line tracing in the non-axisymmetric magnetic perturbations”. POCA is a delta-f guiding center tracking code that has been developed to calculate neoclassical transport, including the neoclassical toroidal viscosity (NTV) in the presence of non-axisymmetric magnetic fields in tokamak plasmas. Non-axisymmetric fields are typically applied for, for instance, ELM pacing/suppression, or occur naturally from large 3D structures such as Test Blanket Modules (TBM). NTV is an important area of research as it can change the plasma rotation, impacting the stability of the plasma on both macro- and micro-scales. While previous analytic theory has captured the essence of NTV, the previous theory is missing the effects resulting from distorted particle orbits and rotational (e.g., bounce harmonic (BH)) resonances that can enhance the neoclassical radial transport. The enhanced neoclassical effects are computed by POCA after inputting the perturbed magnetic field spectrum as computed by the IPEC code, which includes the plasma response to the vacuum perturbation. The importance of the BH resonance was indeed reflected by a peak in the NTV computed at the location of the ExB precession frequency. Benchmarking against NSTX and DIII-D NTV results are just starting. NTV profiles have been calculated for the present and proposed 3D coil sets for NSTX-U, with the results indicating that a wide range of NTV profiles, and thus flexibility in controlling rotation profiles, may be expected. Finally, the field line tracing capability of the POCA/IPEC code combination provides a unique capability that incorporates all possible field components, multiple toroidal modes and plasma response to calculate field line connection length and particle loss fraction. This capability is being benchmarked against NSTX and DIII-D measurements and images of plasma lobes, divertor footprints and heat fluxes. Development will continue on all applications of the new code as benchmarking results become available. (S. Kaye, PPPL)

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

NSTX Upgrade construction activities continued with the alignment of the inner TF conductors in the mold for the fourth and last TF inner quadrant, and the sealing of that mold in preparation for the vacuum impregnation with epoxy scheduled for next week. In the test cell, studs are being attached to the vessel for the installation of thermocouples and flux loops, and mounts for the in-vessel neutral beam armor are being welded in place. Work continues on the commissioning of the second neutral beam (NB2) on NSTX with the installation of beam-line magnetic shielding and water manifolds. Contractors are on site installing new cooling lines to accommodate that second beam-line.

Preparations for plasma operations in the NSTX-U configuration also continued with the fabrication of new diagnostic port covers, the recommissioning of the three autotransformer and transformer rectifier sets that will provide the primary power for the NB2 ion sources, and the power testing of the new firing generators for the field coil power conversion (FCPC) system rectifiers.

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