

NSTX-U Weekly Report (October 24, 2014)

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

S.A. Sabbagh and Young-Seok Park of Columbia University attended the IAEA Fusion Energy Conference in St. Petersburg, Russian Federation, held from 13-18 October 2014. S.A. Sabbagh gave two talks, three poster presentations, and aided in a fourth, representing PPPL. The first-authored talk was titled “Physical Characteristics of Neoclassical Toroidal Viscosity in Tokamaks for Rotation Control and the Evaluation of Plasma Response”, and contained both NSTX and KSTAR data. The other presentations included “Overview of recent physics results from NSTX” by S. Kaye, et al., “Progress toward commissioning and plasma operation in NSTX-U” by M. Ono, et al., and supported Laila El-Guebaly of University of Wisconsin who presented “Configuration Studies for an ST-Based Fusion Nuclear Science Facility” by J.E. Menard, et al. Y.S. Park gave the presentation “Plasma Rotation Alteration by Non-axisymmetric Magnetic Fields, Resistive MHD Stability Analysis, and High Normalized Beta Plasmas Exceeding the Ideal Stability Limit in KSTAR”, which included the recent achievement of reaching normalized beta of 4 transiently in KSTAR. (S.A. Sabbagh)

A year-long effort on quantification of 3D plasma response modeling in tokamaks, which has been targeted jointly among DIII-D, NSTX-U, C-Mod team in 2014, has been successfully completed with a comprehensive JRT14 report submitted to the Office of Fusion Energy Sciences. J.-K. Park, A. Reiman, S. Lazerson, Z. Wang, K. Kim (PPPL), S. Sabbagh, J. Berkery (CU) performed various 3D code benchmark and applications to NSTX, NSTX-U and DIII-D, and led the studies of 3D kinetic effects, NTV (neoclassical toroidal viscosity) transport, including NTV optimization for NCC (non-axisymmetric control coils). J. Canik, J.-W. Ahn, J. Lore (ORNL) led the studies of heat flux splitting and detachment by 3D fields, and L. Delgado-Apraicio actively worked with C-Mod team and led layer physics experiments. The key NSTX-U group contributions are as follows. A range of 3D MHD codes, including linear to non-linear, ideal to two-fluids or hybrid-kinetic codes were tested and compared against various experimental data, as well as against each other complementing an ongoing theoretical initiative for the code benchmark. In many circumstances ideal MHD provided a good representation of 3D plasma response, but it was also found that (1) kinetic effects are important in high-beta (2) non-linear effects are significant in the edge of plasma, (3) non-linear and non-ideal effects may be associated with ELM suppression. Error field correction based on dominant single-mode picture from ideal MHD was again largely successful for lower n applications, but relatively not for higher n as non-resonant NTV braking can be substantial in other subdominant modes. The effects on transport by 3D fields were also actively studied. Various NTV codes were compared against each other and also experiments successfully, but internal 3D field structure or non-ideal response including drift-kinetic effects may be needed to account for modification of the mode structure by NTV effects. Ideal MHD modeling was also successful mostly for heat flux splitting and for divertor detachment when properly combined with realistic 3D transport modeling. Finally the island opening physics has been well explored by changing momentum injection by RF and observing locking and unlocking of islands. (J.-K. Park)

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

NSTX Upgrade activities continued with the installation of the centerstack casing over the top of the TF/OH centerstack (see photo below). The PF1A Upper Coil has been installed on the centerstack, and all prep work on the NSTX-U pedestal and umbrella for the installation of the centerstack in the vessel has been completed. Lift and fit-up of the centerstack in the NSTX-U vessel is in progress.

The Digital Coil Protection System (DCPS) and the Power Supply Real Time Control (PSRTC) development efforts are working towards a mid November start of Field Coil Power Conversion System dummy load testing. Dry runs of integrated hardware and software DCPS pre-operational testing continues to make good progress. A modification to the Hardware User Interface to streamline testing has been completed. A new fiberoptic cable has been installed through the C-D Site tunnel to provide the needed DCPS data link between the FCPC Junction Area and the Control Room FCC. Final details in the PSRTC software specification are being worked out. Preparation of procedures and systems for the implementation of the new PSRTC system is in progress. A portable PC is being set up to confirm firing angle controls at individual at individual rectifier firing generators at FCPC.

Preparations for plasma operations in the NSTX-U configuration also continued. The Multi-pulse Thompson Scattering diagnostic (MPTS) Collection Optics Box has been set in place, and preparations are underway to complete alignments in early November. The RF transmission line re-installation is in progress, and the NSTX-U neutron detectors are being tested and then installed in their permanent locations in the test cell. A dynamic calibration of the neutron detectors will be performed in early November utilizing a neutron source run on a spatially calibrated track temporarily installed in the vacuum vessel.

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

New Center-Stack Installed In NSTX-U! (October 24, 2014)

