

NSTX-U Weekly Report (April 5, 2013)

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

The paper "Disruptions, disruptivity, and safer operating windows in the high-beta spherical torus NSTX", by S.P. Gerhardt (PPPL) et al., was published in Nuclear Fusion (S.P. Gerhardt *et al* 2013 *Nucl. Fusion* **53** 043020). This paper describes disruption rate and disruptivity statistics for NSTX operations, and describes the operating conditions that minimized the disruptivity. This paper is the journal article associated with the 2012 IAEA Fusion Energy Conference. (S. Gerhardt)

A paper, "Reduced-order model based feedback control of the modified Hasegawa-Wakatani model" by Imene R. Goumiri (Princeton University) et al., has been published in Physics of Plasmas Vol. 20, 042501 (2013). The focus of this work is the development of model-based feedback control that stabilizes an unstable equilibrium for the Modified Hasegawa-Wakatani (MHW) equations, a classic model in plasma turbulence. First, a balanced truncation (a model reduction technique that has proven successful in flow control design problems) is applied to obtain a low dimensional model of the linearized MHW equation. Then, a model-based feedback controller is designed for the reduced order model using linear quadratic regulators. Finally, a linear quadratic Gaussian controller which is more resistant to disturbances is deduced. The controller is applied on the non-reduced, nonlinear MHW equations to stabilize the equilibrium and suppress the transition to drift-wave induced turbulence. (I. R. Goumiri)

Modeling Non-axisymmetric Control Coils in NSTX-U (Todd Evans and Wen Wu, General Atomics). A series of 36 NSTX-U equilibrium files were successfully tested for compatibility with GA's TRIP3D, TRIP3DGPU, PROBE_G and SURFMN codes. These files are being used to assess the spectral properties of various configurations of the proposed NSTX-U non-axisymmetric control coil (NCC) system using the SURFMN code and to carry out field line trajectory simulations with the TRIP3D and TRIP3DGPU over a range of pressure (beta) variations. The NSTX-U NCC models in the TRIP3D, TRIP3DGPU, PROBE_G and SURFMN codes have been compared to the coordinates of the NCC vertices used in the VALEN code and preliminary tests of these coil models have been run using the SURFMN code. The near term goal is to assess several partial NCC options being proposed in the NSTX-U five year plan. These options consist of 1 off-axis upper 1x12 in-vessel coil located either in from the primary of the secondary passive stabilizer plate along with several 2x6 coil options proposed at an NCC design meeting held at PPPL on January 22, 2013. (R. La Haye, General Atomics)

Jon Menard (PPPL) attended the Research Council UK Fusion Advisory Board (FAB) meeting on April 4, 2013 held at the York Plasma Institute at the University of York, UK to provide the FAB a report on the outcome of the last MAST PAC meeting. He also participated in a tour of the research facilities at the York Plasma Institute which was hosted by the director of the institute, Prof. Howard Wilson. (J. Menard)

R. Kaita (PPPL) gave a seminar entitled "Plasma-Facing Component Research on the National Spherical Torus Experiment-Upgrade - Addressing the Challenge of First Wall Materials for Magnetic Confinement Fusion" at the Department of Physics and Astronomy at Johns Hopkins University. It included a review of NSTX experience with lithium as a coating on carbon plasma-facing components (PFCs), and as a layer on a molybdenum (high-Z) substrate on the

Liquid Lithium Divertor (LLD). Plans were also presented for a phased implementation of high-Z PFCs on NSTX-U, and the development of a flowing liquid lithium divertor module. (R. Kaita)

There are two featured articles related to NSTX-U in the latest issue of eNews, the monthly newsletter of the US Burning Plasma Organization posted on the USBPO website at, <http://burningplasma.org/enews.html> which also provides links to higher-resolution versions.

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

NSTX Upgrade construction activities continued with the epoxy impregnation of the second inner TF quadrant. The mold will now be disassembled for inspections and electrical insulation testing. Tritium decontamination of the top of neutral beam #2 has been completed, and the recommissioning of the calorimeter for that beam-line is nearing completion.

Preparations of plasma operations in the NSTX-U configuration also continued with a successful review of the conceptual design for the new Stand Alone Digitizer (SAD) modules for the real time plasma control system.

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