

NSTX-U Weekly Report (August 9, 2013)

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

A paper on "Properties of Alfvén eigenmodes in the TAE range on the National Spherical Torus Experiment-Upgrade" by M. Podestà (PPPL) et al. has been published online in Physics of Plasmas **20**, 0825012 (2013), (http://pop.aip.org/resource/1/phpaen/v20/i8/p082502_s1). The paper reports on predictions of modes in the TAE range of frequency for NSTX-U scenarios with different NB injection geometry. In particular, the stability of *AEs as the new NB sources are used is investigated. Analysis is performed through the ideal MHD code NOVA-K. Results show that, for the scenarios considered in this work, modifications of the Alfvén continuum result in a frequency up-shift and a broadening of the radial mode structure. The latter effect may have consequences for fast ion transport by TAEs in NSTX-U. Stability calculations through NOVA-K including finite plasma rotation indicate that TAEs are potentially unstable for the more tangential NBI scenarios, with ion Landau damping representing the dominant damping mechanism. (M. Podestà)

The article "Electron temperature profile reconstructions from multi-energy SXR measurements using neural networks" by D.J. Clayton (NSTec/JHU) et al. was published in Plasma Phys. Control. Fusion **55**, 095015 (Sept. 2013). The article describes the implementation of neural networks to reconstruct electron temperature profiles from multi-energy soft-x-ray (ME-SXR) arrays and other plasma diagnostics with fast time resolution. By training a neural network to match fast (>10 kHz) x-ray data with Te profiles from the 60 Hz Thomson scattering system, the ME-SXR diagnostic can be used to produce Te profiles with high time resolution. In particular, a new ME-SXR system will be used in conjunction with impurity injection to measure cold pulse propagation in NSTX-U plasmas for direct, perturbative heat transport measurements. Synthetic ME-SXR data were used to optimize performance of the neural networks and study the impact of including data from various diagnostics in the networks. Initial tests on data from previous ME-SXR diagnostics on NSTX have proven successful. (D. J. Clayton)

Jon Menard (PPPL), Steve Sabbagh (Columbia University), and Stan Kaye (PPPL) attended the US-Korea conference on Science, Technology, and Entrepreneurship (UKC 2013) held in Secaucus, NJ on August 7-8 on behalf of NSTX/PPPL. S. Sabbagh gave a presentation entitled "[Initial KSTAR Stability and Rotation Alteration Results for High Normalized Beta Plasmas Near or Exceeding the Ideal MHD No-wall Stability Limit](#)", J. Menard gave a presentation entitled, "Research Plans and Collaboration Opportunities on NSTX-U", and Stan Kaye gave a presentation entitled " TRANSP Capabilities ". (J. Menard)

On July 26th, Steve Sabbagh gave a presentation at the DIII-D Science Meeting titled "Resistive wall modes in high β_N , high q_{min} (DIII-D) target plasmas, and use of target in kinetic RWM experiment". The talk examined the dynamics of RWMs in these low li plasmas in DIII-D with comparison to results from NSTX. The frequency and reproducibility of these modes in these plasmas makes them a good candidate for use in a proposed joint DIII-D/NSTX experiment investigating RWM stabilization physics. (S.A. Sabbagh)

Roger Raman (U-Washington) visited General Atomics during July 31 to August 2, to participate in Massive Gas Injection experiments conducted on DIII-D. On August 1, an experiment was

conducted (by Eric Hollmann, UCSD) in which a massive gas injection pulse was first injected from the bottom and then from the top (in separate experiments) into a plasma discharge that was forced to undergo a downward moving VDE. The conditions were then reversed to cause the plasma to move upward. The goals were to study the effect of gas injection from different locations on the impact on halo currents and wall heat loading. On August 2, gas was injected from two MGI systems (that were separated in time) and was located at different toroidal locations to assess variations to the toroidal asymmetries in the radiated power (Nicolas Commaux, ORNL). Both these experiments relied on Neon injection and were highly successful in achieving their goals. An observation was that the DIII-D plasmas were highly reliable in being able to reproduce the reference discharge after the MGI pulse. A second observation was the reliability of the neutral beam system following the MGI pulse. Support and help from Nick Eidietis, John Wesley (General Atomics) and the DIII-D Disruption Mitigation group is much appreciated. The DIII-D experience will assist NSTX-U in planning its own first MGI experiments during FY15 (R. Raman).

Prof. Wonho Choe of Korea Advanced Institute of Science and Technology (KAIST) visited NSTX-U/PPPL the week of August 5, 2013. He discussed x-rays diagnostics and related analysis codes with the NSTX-U/PPPL researchers. Future collaboration between NSTX-U and his group was also discussed. He also met with the PPPL hall thruster researchers. Prof. Choe gave a seminar entitled "Soft X-ray/VUV imaging diagnostics and impurity transport analysis on KSTAR." (M. Ono, PPPL)

Felipe Bedoya, a Purdue University graduate student, completed a two-month visit to PPPL last week. His activities focused on the installation and operation of the NSTX-U Materials Analysis and Particle Probe Upgrade (MAPP-U) on the Lithium Tokamak Experiment (LTX). This collaborative effort involved researchers from Purdue University, led by Prof. Jean-Paul Allain (now at the University of Illinois at Urbana-Champaign), and PPPL. In situ analysis of samples exposed to LTX plasmas was performed using X-ray photoelectron spectroscopy (XPS). No difference in the XPS spectra was observed after exposure to plasmas in LTX either before or after its plasma-facing components (PFCs) were conditioned with lithium. This was not unexpected, since the LTX plasma currents and densities were still low. Argon glow discharge cleaning (GDC) was then performed to remove impurities on the LTX PFC surfaces. There were clear changes in the XPS spectra after the samples were exposure to the argon GDC, including a significant reduction in the carbon peak and signatures for iron that were not observed before. These measurements are the first of their kind in a tokamak, and provide a practical demonstration of MAPP-U for in situ analysis of the effects of plasmas on PFC surfaces. (R. Kaita, PPPL)

The first of several Python (a linux OS-based scripting language that can be used for data manipulation and analysis) training courses was attended by close to 25 physicists on 8/6/13. The training course covered the basics of Python variable and list operations, including floating point and character data types. Follow-up training on numpy, Python graphics and interfaces to MDS+ will be offered in several weeks. Development of expertise in Python is desired due to license pricing issues with commercially offered data manipulation products. (S. Kaye, PPPL)

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

NSTX Upgrade construction activities continued with the completion of the sanding of the TF

inner quadrants, and the start of the work associated with fitting up the 4 inner TF quadrants in the full mold for the upcoming VPI. In the test cell, the welding of the in-vessel J-K stiffeners and the S-flip diagnostic reinforcements continued, and electricians have begun preparations to restore the area from construction to normal power.

Preparations of non-upgrade equipment for plasma operations in the NSTX-U configuration also continued with the completion of the fabrication and testing of the 34 new firing generators for the field coil power conversion (FCPC) system rectifiers. Activities in the electronics shop have now shifted to the fabrication of the prototype stand alone digitizer for use by NSTX diagnostics.

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