

## **NSTX-U Weekly Report (April 28, 2017)**

**FY 2017 status: NSTX-U is in a maintenance and repair outage.**

### **NSTX-U Research (J. Menard)**

The paper "Stabilizing effects of enhanced resistivity due to lithium-conditioning on low-n edge localized modes in NSTX" by D. Banerjee, P. Zhu and R. Maingi was published in Phys. Plasmas **24** (2017) 054501. The abstract reads "The stabilizing effects of enhanced edge resistivity on edge-localized instabilities in high confinement discharges due to lithium-conditioning in the National Spherical Torus Experiment are identified for the first time. Linear stability analysis of the experimentally constrained equilibrium suggests that the change in the equilibrium plasma density and pressure profiles alone due to lithium-conditioning may be insufficient for a complete suppression of low toroidal mode number peeling-ballooning modes. The enhanced resistivity due to the increased effective electric charge number  $Z_{\text{eff}}$  after lithium-conditioning provides additional stabilization of the edge localized modes. Notably, this stabilizing effect by enhanced edge resistivity becomes evident only in two-fluid magnetohydrodynamic simulations." The paper is downloadable from:

<http://scitation.aip.org/content/aip/journal/pop/24/5/10.1063/1.4981931>

From April 3-14, Ian Waters, an NSTX-U University collaborator from UW-Madison (group O. Schmitz), traveled to the Culham Centre for Fusion Energy to participate in the MAST-U research forum. Proposals on neutral fueling and exhaust and its optimization by means of 3-D fields were presented and well received. The trip also included work with CCFE collaborators on 3D modeling of Scrape Off Layer flows in MAST in preparation for the upcoming Sherwood Fusion Theory Conference and an oral contribution at the conference of the European Physics Society this year.

Mario Podesta, Devon Battaglia, Walter Guttenfelder, Vinicius Duarte, Filippo Scotti and Francesca Poli traveled to attend the US/EU TTF workshop in Williamsburg, VA, on April 25-28. Plenary talks were given by the NSTX-U team in three plenary sessions. Battaglia gave one in the Pedestal structure and dynamics session, entitled "Bifurcation to Enhanced Pedestal H-mode on NSTX-U. Duarte gave one in the session Transport induced by Energetic particle instabilities entitled "quasilinear relaxation formalism for energetic particle interaction with Alfvénic modes". Shawn Tang (UCLA) gave also a plenary talk in this session, entitled "Parametric investigation of compressional and global Alfvén eigenmode instability and effect on thermal confinement in NSTX-U". Poli gave one in the session Transport predictions for experimental planning and real control systems entitled "the role of integrated modeling in the development of more robust control algorithms (for NTMs)". Scotti (LLNL) gave a presentation in the Working group Pedestal and scrape-off layer entitled "Scrape-off layer and near-separatrix intermittent filaments in the NSTX and NSTX-U divertor". In addition, five posters were presented on NSTX-U simulations and experiments. Guttenfelder reported on "Transport and turbulence validation using NSTX and NSTX-U L-mode", S. Zweben on "2-D turbulence cross-correlation functions in the edge of NSTX", Podesta' on "fast ion transport by counter-propagating TAEs destabilized by off-axis co-NBI". Tariq Rafiq (Lehigh University) presented simulations of "Unstable Microtearing Modes in High Collisionality NSTX Discharge" and Juan Ruiz Ruiz (MIT) reported on the development of "A Synthetic Diagnostic for Studying Electron Scale Turbulence at NSTX and NSTX-U". Podesta chaired the Energetic Particle plenary session and Working group, and Podesta and Poli participated in the Executive Committee meeting.

The paper "A review of radiative detachment studies in tokamak advanced magnetic divertor configurations" by V. A. Soukhanovskii has been published in the Plasma Physics and Controlled Fusion journal Special Issue dedicated to reviewing divertor plasma detachment in magnetic fusion devices in Plasma Phys. Control. Fusion **59** (2017) 064005 [<https://doi.org/10.1088/1361-6587/aa6959>]. The present vision for a plasma-material interface in the tokamak is an axisymmetric poloidal magnetic X-point

divertor. Four tasks are accomplished by the standard poloidal X-point divertor: plasma power exhaust; particle control (D/ T and He pumping); reduction of impurity production (source); and impurity screening by the divertor scrape-off layer. A low-temperature, low heat flux divertor operating regime called radiative detachment is viewed as the main option that addresses these tasks for present and future tokamaks. Advanced magnetic divertor configuration has the capability to modify divertor parallel and cross-field transport, radiative and dissipative losses, and detachment front stability. Advanced magnetic divertor configurations are divided into four categories based on their salient qualitative features: (1) multiple standard X-point divertors; (2) divertors with higher order nulls; (3) divertors with multiple X-points; and (4) long poloidal leg divertors (and also with multiple X-points). The paper reviews experiments and modeling in the area of radiative detachment in the advanced magnetic divertor configurations.

### **NSTX-U Recovery Project (R. Hawryluk)**

A meeting was held to discuss issues related to the NSTX-U radiation field and its impact on electronics. George Ascione presented a summary of radiation effects on electronics. Scott Doskoczynski presented the results of a survey of electronics racks in the NSTX-U Test Cell. The next step in this work is to quantify the radiation field expected at full NSTX-U performance, and to begin discussions with the US ITER I&C team at ORNL that is addressing similar issues but at much higher levels that will exist at ITER.

The PF1AU Coil Failure Root Cause Analysis team of Les Hill, Frank Malinowski, Irving Zatz, and experts from the firm of McCallum-Turner have completed their planned first round of interviews with members of the NSTX-U Project Team, and are now conducting secondary interviews in parallel with analyzing data and developing timelines. The team is working towards a final report in mid-May.

Removal, inspection and silver plating of the TF, OH and CHI bus under the machine is in progress has started, and the installation and alignment of the FIRETIPS diagnostic wave guides is nearing completion.

Recommissioning of the coil winding facility also continued with the trial wrapping of sections of copper conductor to go out for testing by Clinton Instruments Co. Grit blasting of the first spool of inner PF coil conductor was completed this week by the vendor.

Work continues in the Neutral Beam Clean Room on the assembly of a second spare ion source (An ion source has successfully passed all pre-operational testing, and has been declared our first spare source for the next run period.)

The new Pulse Burst Laser System Stand has been moved into the Multi-pulse Thomson Scattering (MPTS) diagnostic room, and is being configured for University of Wisconsin and PPPL testing.

Scott Davis, the DOE Accelerator Safety Program Manager, visited PPPL this week and provided helpful advice on the PPPL implementation of the Accelerator Safety Order, DoE O 420.2C.