

NSTX-U Weekly Report (May 27, 2016)

FY 2016 NSTX plasma operations

Operation Targets: Total – 18 run weeks

Completed: 8.95 run weeks and 940 plasma shots

A paper "Evaluation of thermal helium beam and line-ratio fast diagnostic on the National Spherical Torus Experiment-Upgrade" by J. M. Munoz Burgos (Johns Hopkins University) et al. was published in *Physics of Plasmas* **23** 053302 (2016), available on line at <http://scitation.aip.org/content/aip/journal/pop/23/5/10.1063/1.4948554>. Synthetic evaluation of a helium line-ratio diagnostic based on a gas-puff system for characterization of the SOL, and Edge regions of NSTX-U plasmas has been accomplished for the THB diagnostic currently in operation on RFX-mod. It has been proposed to install this diagnostic on NSTX-U. The purpose of the synthetic analysis is to evaluate the application of this diagnostic for high temporal resolution (~4us) measurements of electron temperatures and densities. This diagnostic makes use of the 667.8, 706.5, and 728.1 nm lines of helium, and it is concluded that the expected signal level of the THB system on NSTX-U should exceed the detection limit, thus making this diagnostic a viable option for high temporal resolution characterization of SOL and edge plasmas. (J. M. Munoz Burgos)

A paper "Parallel electron force balance and the L-H transition" by T. Stoltzfus-Dueck (PPPL), *PoP* **23** 054505 (2016) was published on line at <http://scitation.aip.org/content/aip/journal/pop/23/5/10.1063/1.4951015>. In one popular model for the L-H transition, the energy in turbulent fluctuations is directly depleted via Reynolds-stress-induced energy transfer to the zonal flows. Experimental attempts to validate this model have used energy balance between zonal flows and nonzonal (turbulent) ExB velocities, concluding that the mechanism was viable. However, in a recently accepted article, Tim Stoltzfus-Dueck demonstrated that parallel electron force balance couples the nonzonal velocities with the free energy carried by the electron density fluctuations, replenishing the turbulent ExB energy until the sum of the two turbulent free energies is exhausted. Since that sum is typically two orders of magnitude larger than the energy in turbulent ExB flows alone, the Reynolds-stress-induced energy-transfer mechanism is likely to be much too weak to explain the rapid turbulence suppression at the L-H transition. (T. Stoltzfus-Dueck)

N. Bertelli, J. Hosea and G. Taylor of PPPL participated in the US-Japan RF Physics Workshop held in Toyama, Japan May 18 – 20, 2016. This allowed them to gain knowledge of recent developments in ICRF, EC, EBW, and LH research in Japan and the US. This helps to inform planning of fast wave experiments on NSTX-U and guide the development and design of the 28 GHz EC/EBW heating system on NSTX-U to support non-inductive plasma start-up. It provides them with valuable access to Japanese RF researchers currently working on ICRF, EBW, EC, and LH heating and current drive. There were 21 presentations at the workshop covering the topics of EC/EBW, IC/LH, HHFW, Helicon and theory/modeling. Many contacts were made – especially with the Japanese coordinator of the meeting Prof. Shin Kubo of NIFS. G. Taylor and J. Hosea were chairmen of two sessions of the workshop and G. Taylor presented the summary of all presentations at the end of the workshop. There was in depth coverage of the presented research. This gave all of the participants a very good overview of much of the RF research that is on-going in Japan and the US. Also, this workshop serves to foster valuable collaborations between the two research programs in many RF areas. (J. Hosea)

Walter Guttenfelder (PPPL) gave a talk to the Cranbury Presbyterian Senior Breakfast club on May 26 titled "Containing a star on earth: PPPL and the promise of fusion energy". The talk provided an introduction to plasmas, nuclear fusion, and research being done at PPPL with a focus on the NSTX-U project. (W. Guttenfelder)

C. Myers (PPPL) was interviewed by Gizmodo on Friday, May 20, following the NSTX-U dedication ceremony. An article incorporating the interview was published by Gizmodo on Friday, May 27. The story can be viewed here: <http://gizmodo.com/the-real-problem-with-fusion-energy-1777994830>. (C. Myers)

Experimental Plasma Operations (S. Gerhardt, R. Kaita)

The Granule Injector has now been interlocked to the NSTX-U TVPS and its TIV has been exercised. In addition the Granule Injector preoperative test procedure has been successfully completed and the system is now fully commissioned. It has been initially loaded with 300 and 500 micron carbon spheres and 500 micron boron carbide granules and is ready to support operations when NSTX-U operations recommence. (R. Lunsford, PPPL)

Engineering Operations (A. von Halle, P. Titus)

NSTX-U is in a maintenance period to address a deformation discovered on a connecting flag on a PF1A coil lead, and to continue several previously scheduled test cell installations. The deformation of the PF1A coil flag was due to insufficient restraint of the water cooled flex bus in the combined field forces of that area. All coil leads/flex bus have since been evaluated, and it's been determined that additional bracing for the PF1A upper and lower water cooled flex bus is required. Similar bracing will be implemented for the PF1B and PF1C coil circuits before those systems are brought into service. PF1A bracing schemes have been fit up, and analysis is in progress. In parallel with this work, time was taken to condition all six of the neutral beam ion sources which have reached a total combined neutral power of ~ 9MW. New protective relaying has been implemented on RF power supplies, and plans are being made for off-hours HHFW antenna conditioning. Also this week, pre-operational testing of the new Lithium Granule Injector (LGI) was completed, and both lithium evaporator probes (LITERS) have been installed on NSTX-U, baked, and have been manually cycled into the vacuum vessel to set limit switches and perform other pre-op testing. Commissioning of the new Massive Gas Injector (MGI) is in progress, and software for MGI triggering has been implemented and tested in the Plasma Control System (PCS).

Access to the NSTX-U Test cell will be available for approved work during this upcoming maintenance week.