

NSTX-U Weekly Report (April 22, 2016)

FY 2016 NSTX plasma operations

Operation Targets: Total – 18 run weeks

Completed: 7.23 run weeks and 748 plasma shots

The paper "Phase space effects on fast ion distribution function modeling in tokamaks" by M. Podestà et al. has been published online in Physics of Plasmas. Electronic link: <http://scitation.aip.org/content/aip/journal/pop/23/5/10.1063/1.4946027>). The paper discusses the modeling of energetic particle dynamics in tokamaks when EP transport departs from "classical". Examples include transport by plasma instabilities. New approaches based on physics-based reduced models are being developed to address those issues in a simplified way, while retaining a more correct treatment of resonant wave-particle interactions. The kick model implemented in the tokamak transport code TRANSP is an example of such reduced models. It includes modifications of the EP distribution by instabilities in real and velocity space, retaining correlations between transport in energy and space typical of resonant EP transport. The relevance of EP phase space modifications by instabilities is first discussed in terms of predicted fast ion distribution. Results are compared with those from a simple, ad-hoc diffusive model. It is then shown that the phase-space resolved model can also provide additional insight into important issues such as internal consistency of the simulations and mode stability through the analysis of the power exchanged between energetic particles and the instabilities. (M. Podesta, PPPL)

A paper "Observation of quasi-coherent edge fluctuations in Ohmic plasmas on National Spherical Torus Experiment" by S. Banerjee (Institute of Plasma Research, India), A. Diallo (PPPL), and S.J. Zweben (PPPL) was published in Phys. Plasmas 23, 044502 (2016) (<http://scitation.aip.org/content/aip/journal/pop/23/4/10.1063/1.4946871>). This paper describes the recent work on the quasi coherent edge density mode observed in Ohmic plasmas in NSTX using the gas puff imaging diagnostic (GPI). This mode is located predominantly just inside the separatrix, with a maximum fluctuation amplitude significantly higher than that of the broadband turbulence in the same frequency range. The quasicohherent mode has a poloidal wavelength ~ 16 cm and a poloidal phase velocity of about 4.9 ± 0.3 km s⁻¹ in the electron diamagnetic direction, which are similar to the characteristics expected from a linear drift-wave like mode in the edge. This is the first observation of a quasi-coherent edge mode in an Ohmic diverted tokamak, and so may be useful for validating tokamak edge turbulence codes. (A. Diallo)

D. Brunner, A. Kuang, B. Labombard, and R. Mumgaard from MIT visited PPPL on April 19, 2016. Installation details for the advanced scanning mirror Langmuir probe (MLP) were discussed. They included the feasibility of mounting both the MLP and a Langmuir probe for high harmonic fast wave (HHFW) studies on a new port cover with behind the HHFW antenna array. Port possibilities where divertor multispectral imaging could use existing optical fiber bundles were also identified. (R. Kaita, PPPL)

R. Kaita (PPPL) gave a seminar entitled "Measurement Challenges in Fusion Research: Plasma Diagnostics on the National Spherical Torus Experiment-Upgrade" at the Johns Hopkins University Applied Physics Laboratory (JHU-APL) in Laurel, Maryland on April 20, 2016. The talk included diagnostics covering detection energies from eV in the edge plasma to MeV for fusion products, and the utility of tokamak plasmas for calibrating spectrometers used on

spacecraft. These topics were of interest to researchers at the JHU-APL because their work on spacecraft instrumentation. (R. Kaita)

On Friday, April 22nd, Steve Sabbagh (Columbia University) presented the talk “Initial results from NSTX-U and the Disruption Prediction, Avoidance, and Mitigation Working Group” at the DIII-D Science Meeting. The presentation covered NSTX-U results from the first seven weeks of NSTX-U operation, initial analysis using the Disruption Event Characterization and Forecasting (DECAF) code on NSTX and NSTX-U data, and the present status of the disruption mitigation system presently being installed on NSTX-U. (S.A. Sabbagh)

Experimental Research Operations (S. Gerherdt, R. Kaita)

The reinstallation of the UCLA 16-channel reflectometer system continued this week. Waveguide runs, microwave source/receiver boxes, and power supplies were successfully installed. Lab testing of the sources/mixers, digitizer, and data acquisition software were successfully completed prior to this installation. This work was performed by UCLA engineer Roman Lantsov (on travel to NSTX-U) and Shige Kubota (UCLA). Completion of this work awaits installation of cable runs and an additional isolation transformer. (T. Rhodes, UCLA)

Ahmed Diallo and Ben LeBlanc of PPPL travelled to Physical Science Laboratory in Madison to continue the integration of the pulse burst laser system under Diallo’s early career research proposal. Progress has been made in terms of testing the response of NSTX-U Thomson detection system to double-hump pulses. In addition, the system has been tested for 30 Hz operations for 5 seconds with success. The slow burst (1 kHz rep rate) was achieved. The fast burst (10 kHz rep rate) is still under development. Once the fast burst is achieved, the beam will be propagated to the amplifier stage in the upcoming weeks. (A. Diallo)

Installation of the Lithium Granule Injector (LGI) was completed with a successful leak check. Installation of the variable angle flange for SPRED was completed. Installation of lower Massive Gas Injection (MGI) valve continues. (R. Ellis)

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

NSTX-U is in a maintenance period, which includes the warm-up and regeneration of the neutral beam LHe cryoplant. The cryoplant is currently at room temperature, and the process gas has been purified. The higher than expected levels of impurities indicate a leak, and the cold box shell has been lowered to investigate. Maintenance on the Motor Generator set has been completed, and the set is ready to support full power operations. Installation activities in support of the UCLA Reflectometer, MSE-LIF, the Massive Gas Injector, a variable angle flange for the SPRED diagnostic, the Bay H Top Camera, and the fast Voltage measuring system needed for CHI operations continued this week. All six of the RF sources are being prepared for operation and conditioning of the HHFW antennas.

The NSTX-U Test cell will remain open for approved work into the coming week pending the conclusion of the neutral beam LHe cryoplant work. Plasma operations will not resume until the neutral beams are ready, but power operations may resume this week on machine coil tests or HHFW conditioning.

After it was determined that the LHe Refrigerator Cold Box had a Helium leak into its vacuum, several tests were performed to ascertain the extent and location. It was determined that the Helium leak required entry into the Cold Box so the shell was lowered. Leak checking identified one large leak in a thermocouple well. This well is not longer used in favor of more modern measurements already in place so it was removed and capped. Similar well was also removed and capped as a precaution. Another small leak was found and also capped. After leak checking was successful, the shell was raised into place and the Cold Box pumped down to rough vacuum. Once the Cold box pumpdown is complete, Helium process startup will continue to support NBI operations. (T. Stevenson, PPPL)