

## NSTX-U Weekly Report (April 11, 2014)

### **NSTX-U is in the Upgrade Project outage in FY 2014**

The paper "A reduced fast ion transport model for the tokamak transport code TRANSP" by M. Podestà (PPPL) et al. has been published online in Plasma Phys. Control. Fusion **56** 055003 (2014) (<http://iopscience.iop.org/0741-3335/56/5/055003/article>). The paper describes the implementation of a fast ion transport model consistent with the basic mechanisms of resonant mode-particle interaction. The model is formulated in terms of a "probability distribution function" for the particle's steps in phase space, which is consistent with the Monte Carlo approach used in TRANSP. The proposed model is based on the analysis of fast ion response to TAE modes through the ORBIT code, but it can be generalized to higher frequency modes (e.g. Compressional and Global Alfvén Eigenmodes) and to other numerical codes or theories. Preliminary verification of the new model against the guiding center code ORBIT has been successfully performed, along with initial tests with a stand-alone version of the NUBEAM module. The implementation of the model in the NUBEAM module of TRANSP is under way. It will be followed by extensive verification and validation work to assess the potential of the new model as well as its limitations. (M. Podestà)

The article "Theory comparison and numerical benchmarking on neoclassical toroidal viscosity torque" by Z.R. Wang (PPPL), J-K. Park (PPPL) et al is published on Phys. Plasmas, 21, 042502 (2014). This paper systematically compares the three semi-analytic approaches of neoclassical toroidal viscosity (NTV) theory: combined NTV approach, drift kinetic energy approach and connected NTV approach. The successful cross-benchmarking among the three corresponding codes: IPEC-PENT and MARS-K/Q show agreement and correlation among the three approaches. The importance of bounce harmonic response is also indicated by IPEC-PENT and MARS-K. (Z.R. Wang)

Z. R. Wang (PPPL) visited DIII-D from March 27th to April 4th, 2014 to work with Dr. M. Lanctot of DIII-D for the collaborative work of studying the drift-kinetic effect on 3D plasma response in DIII-D high beta  $n=1$  resonant field amplification (RFA) experiments. This work provides a possible resolution for the long-standing RFA issue that plasma response solved by Fluid MHD disagrees with the experimental measurements near/above no-wall beta limit. Z. Wang also gave a talk entitled "Study of Drift Kinetic Effect on Linear 3D Plasma Response in Tokamak Plasmas" in DIII-D Friday Science Meeting on March 28th, 2014. The work of comparing the three semi-analytic neoclassical toroidal viscosity theories and performing the successful cross-benchmarking among the corresponding codes: IPEC-PENT and MARS-K/Q is introduced. The results of applying MARS-K to reproduce the observed magnetic response in DIII-D  $n=1$  resonant field amplification experiments by including drift-kinetic effects is also presented. (Z.R. Wang)

Filippo Scotti, a new LLNL postdoc researcher working on NSTX-U at PPPL, visited DIII-D this week. He gave a presentation at the Boundary/PMI Center, entitled "Characterization of intrinsic impurity transport and divertor sources in NSTX discharges with lithium wall conditioning". During his visit, he implemented an automated camera acquisition software package for the LLNL Divertor flow camera. In addition, possible collaborations were discussed, including diagnostics for radiative divertor control and a two color visible camera system, both of which are being developed for NSTX-U. (V. Soukhanovskii, LLNL)

S. Kaye and W. Guttenfelder of PPPL attended the Transport and Confinement ITPA meeting held at the PSFC, MIT on April 9-11, 2014. Various topics were covered at the meeting, including Transport Diagnostics for ITER, Transport Modeling, Rotation, 3D effects, I-mode, Profile Stiffness, L-mode shortfall, and Fueling and Particle transport. S. Kaye gave two talks, one entitled "RMP effect on the L-H threshold power and on edge transport" in the 3D session, and the other entitled "Reduced model prediction of Te profiles in microtearing-dominated NSTX plasmas" in the Thermal Transport session. (S. Kaye)

Steve Sabbagh (Columbia University) attended the 2014 IAEA Fusion Energy Conference International Committee Meeting along with Drs. Steve Eckstrand (DOE), Martin Greenwald (MIT), Vincent Chan (GA), and Pravesh Patel (LLNL) as US representatives on the international committee. The committee finalized the scientific program of the conference, including defining sessions, session chairs, and aligning summary speakers. A total of 651 paper submissions were considered. (S. Sabbagh)

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

NSTX Upgrade activities continued with the ongoing work to wind the new OH coil on the inner TF bundle. The brazing to transition the OH conductor to the fourth and final winding layer of that coil is in progress. The new PF1B coil is nearing completion with the installation of flux loops and the welding of the coil case. In-vessel, the installation of new Langmuir probes continues, and the connection of passive plate cabling is in progress. The ion source platform pressure plates have been installed on Neutral beam #2 (NB2), and the assembly of the ion source trunk lines has started. Welding of NB2 vacuum and cooling water piping continues.

Phase 1 testing of the new Digital Coil Protection System (DCPS) software continued this week utilizing the DCPS internal Auto-tester. The Hardware and I/O layout and design continues.

Preparations of non-upgrade equipment for plasma operations in the NSTX-U configuration also continued with the preparations of the Field Coil Power Conversion (FCPC) system for upcoming power testing. Maintenance of the bus-work/cabling in the Power Cable Termination Structure (PCTS) has been completed, and the FCPC deionized cooling water pump is being sent to a local shop to be rebuilt. Maintenance of the neutral beam power supplies also continued.

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