

NSTX-U Weekly Report (December 11, 2015)

NSTX-U is in the commissioning phase for the FY16 campaign.

Axel Winter from the ITER Control, Data Access, and Communication (CODAC) group visited PPPL for the week of November 30, 2015. He met with the PPPL IT/CODAC groups to discuss NSTX-U and ITER goals, EPICS usage and implementation, diagnostic systems, cyber issues, and real-time data frameworks. NSTX-U team-members provided information on NSTX-U plans for advanced scenarios, active feedback control, disruption detection, and TRANSP applications. The NSTX-U digital coil protection system framework and potential applicability to ITER was also discussed. Joshua Stillerman from MIT also visited PPPL on December 2-4, 2015 to discuss MDSplus issues and future applications with NSTX-U researchers, CODAC personnel, and A. Winter. On Thursday, December 3, 2015, A. Winter gave a seminar entitled "Tools and implementation strategy for real-time control at ITER". (J. Menard and K. Erickson)

An article, "Applications of advanced kinetic collisional radiative modeling and Bremsstrahlung emission to quantitative impurity analysis on the National Spherical Torus Experiment," by J. M. Muñoz Burgos (Johns Hopkins University) in *Physics of Plasmas*, 22, 122301 (2015). The article is available on <http://scitation.aip.org/content/aip/journal/pop/22/12/10.1063/1.4936953>. Quantification of plasma impurities derived from charge-exchange emission spectroscopy will become important when high-Z metallic tiles are introduced into the lower divertor. This kind of measurements will become important when analyzing transport of metallic impurities during high plasma rotation regimes. A Transmission Grating-based Imaging Spectrometer (TGIS) designed and built by the Johns Hopkins University plasma spectroscopy group will operate on NSTX-U to measure impurity lines on the XUV/VUV regions from charge-exchange emission. Combined with advanced beam into plasma charge-exchange collisional radiative modeling, impurity densities will be estimated from TGIS measurements. (J. M. Muñoz Burgos)

A paper on '*Sorption of atmospheric gases by bulk lithium metal*' by C.A. Hart (University of Maryland), C.H. Skinner, A.M. Capece (PPPL), B.E. Koel (Princeton University) has been published on-line in the *Journal of Nuclear Materials* 468 (2016) 26-30, <http://www.sciencedirect.com/science/article/pii/S0022311515303147>. The paper reports on bulk chemical and morphological changes of lithium samples on exposure to ambient and dry synthetic air. For ambient air, the initial mass gain of a 1cm² surface was several mg/h declining to less than 1 mg/h after an hour and decreasing by an order of magnitude after 24 h. A 9 mg sample achieved a final mass gain corresponding to complete conversion to Li₂CO₃ after 5 days. Exposure to dry air resulted in a 30 times lower initial rate of mass gain. The results illustrate that the oxidation of bulk lithium proceeds much more slowly than oxidation of the top few monolayers due to the transition to diffusion-dominated transport for thick films and also the importance of morphological changes (surface cracking) and water vapor in facilitating the reaction. The results have implications for the chemical state of lithium plasma facing surfaces and for safe handling of lithium coated components. (C.H. Skinner, PPPL)

The journal version of the talk "Simplifying the ST and AT Concepts," by R. Raman (University of Washington), T.R. Jarboe (University of Washington), J.E. Menard (PPPL), et al., presented at the FESAC Strategic Planning Meeting, Gaithersburg, MD July 8-10, 2014, has been published on-line by the *Journal of Fusion Energy* <http://link.springer.com/article/10.1007/s10894-015-0040-3>. It describes new tools that would allow ST and AT based devices to operate at close to

their projected performance levels. These are: (1) Advanced fueling based on Compact Toroid Injection for precise core fueling for density profile control and toroidal momentum injection, (2) Electron Bernstein Wave system to provide off-axis current drive capability, and (3) Solenoid-free plasma start-up capability to eliminate the central solenoid, and provide greater flexibility in the device aspect ratio optimization. (R. Raman)

Egemen Kolemen (Princeton University) and Luis F. Delgado-Aparicio (PPPL) have won the 2015 Torkil Jensen Award (TJA) for DIII-D experimental run time in 2016. The experiments will aim at studying the stabilization of radiatively induced tearing modes (RiTMs) using off-axis ERCH heating and its connection with the density limit. (L.F. Delgado-Aparicio)

Luis F. Delgado-Aparicio (PPPL) visited the TJII and TCV facilities in Spain and Switzerland. In Madrid he ran an experiment with Spanish scientists at the TJII stellarator in CIEMAT. The experiment consisted in introducing low-, medium- to high-Z impurities (e.g. C, Fe and W) in a stellarator configuration with magnetic islands. Differences were observed between impurities and their accumulation around and inside the magnetic islands. Data analysis is under way and a summary of the experiment will be submitted to the 2016 IAEA Fusion Energy Conference in Kyoto-Japan. Luis also visited colleagues from the TCV tokamak at the Swiss Plasma Center (SPC) at the École Polytechnique Fédérale de Lausanne and exchanged ideas about data analysis and the effect of impurities in $(m/n)=(2/1)$ magnetic islands. The analysis is being conducted in neon-seeded plasmas near the density limit, which helps motivate future ECRH stabilization experiments in the TCV Tokamak. Similar experiments will be also conducted at DIII-D and NSTX-U (using off-axis ECRH and NBI) as part of Luis's Early Career Research award (DOE – 2015). (L.F. Delgado-Aparicio)

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

A Final Design Review (FDR) for the mechanical installation of the Far Infrared Tangential Interferometer/Polarimeter (FIRETIP) was conducted. Participants included PPPL personnel and collaborators from the University of California at Davis (UCD). E. Scott (UCD) gave an overview of the FIRETIP diagnostic, and I. Zatz (PPPL) reviewed the details of the installation. Four chits were generated concerning vibration isolation of the laser and receiver/mixer tables, ensuring adequate space for cylinders supplying the laser working gas, and completion of the documentation and drawings for the electrical installation. It was also recommended that a calculation be made of the power radiated from the plasma to the in-vessel laser retroreflector, to see what might happen to its surface. The review committee deemed the review successful, and recommended proceeding with the installation pending resolution of the chits. (W. Blanchard, R. Kaita, PPPL)

A design review was also held for the first phase of the high-Z upgrade to the NSTX-U plasma-facing components (PFCs). M. Jaworski (PPPL) reviewed the Systems Requirements Document (SRD) for the TZM (titanium, zirconium, molybdenum) tiles. K. Tresemer (PPPL) reviewed the design and analysis of the TZM tiles and configuration in the vacuum vessel, where the new tiles will replace the row of graphite tiles at a single radial location on the outboard divertor. Several chits were generated during the review concerning additional analysis, tolerances, installation considerations, thermocouple and calorimeter implementation, and documentation requirements. The review committee deemed the review to be sufficient for a Preliminary Design

Review (PDR), with a Final Design Review (FDR) to be conducted pending resolution of the chits. The review committee also recommended that a separate peer review be held for special non-TZM test tiles that are also under consideration for the PFC upgrade task. (W. Blanchard, R. Kaita)

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

Calibrations of the Motor Generator cycloconverter and liquid rheostat control systems continued this week in response to cycloconverter control trips during synchronization. A design is being prepared to implement full Liquid Rheostat control of Motor Generator Set #2 to support NSTX-U plasma operations in parallel with work on the MG#1 cycloconverter. Field Coil power testing on individual coils per the Integrated System Test Procedure did continue this past week on individual PF coils and on a Switching Power Amplifier (SPA) driven Resistive Wall Mode (RWM) coil. Neutral beam power supply and ion source conditioning also continued, and allowed for neutron detection and accounting system tests. A successful Coaxial Helicity Injection (CHI) system dummy load test shot was performed this week utilizing its controls in synch with the NSTX-U clock. Commissioning of the (Lithium Evaporator) LITER empty/fill station continues.

The NSTX-U Test Cell will be in restricted access this coming week for field coil testing. Access will be available on the 2nd shifts for approved work.