

## NSTX-U Weekly Report (February 19, 2016)

### **FY 2016 NSTX plasma operations**

**Operation Targets: Total - TBD**

**Completed: 3.14 run week and 314 plasma shots**

An article on optimization work for the NSTX-U non-axisymmetric control coils (NCC) has been highlight recently in a IOP LabTalk article, <http://iopscience.iop.org/0741-3335/labtalk-article/63548>. The work focused on coupling stellarator optimization tools (STELLOPT) to the ideal perturbed equilibrium code (IPEC) and the neoclassical toroidal viscosity code (PENT). The resulting code (IPECOPT) was applied to NSTX-U equilibria, exploring the possibility of core vs edge rotation control with 3D fields. The planned NCC set was evaluated and found capable to drive both core and edge torques through independent field perturbations. This work was a collaboration between researchers at PPPL (S. Lazerson, J-K. Park, N. Logan) and Columbia University (A. Boozer). (S. Lazerson)

Douglas Ogata, a graduate student of Prof. David Newman of Univ. Alaska, finished a 3 month visit to NSTX-U as part of the the Department of Energy (DOE) Office of Science Graduate Student Research (SCGSR) Program. His project was "Characterizing edge transport with gas puff imaging", working primarily with Stewart Zweben (PPPL). He analyzed GPI data from 2010 and derived an estimate for the local spatial spreading of plasma blobs, showing that this was consistent with a diffusion process at  $\sim 1$  m<sup>2</sup>/sec. This will be part of his Ph.D. thesis, and will be written up for publication. (S. Zweben)

Rob La Haye of General Atomics DIII-D traveled to the Princeton Plasma Physics Laboratory for the second week of February to initiate the tearing stability experimental collaboration on NSTX-U. High beta discharges from the first startup run in H-mode showed the characteristic signature of a neoclassical tearing mode in that the  $n=1$  Mirnov amplitude decreased linearly as the square of betap goes down. Two XPs were written with the first (XP1544 "Make contact with NSTX for  $n=1$  tearing stability") distributed for comments and to tentatively be run in the early Spring of this year. (R. La Haye)

On Feb. 11, 2016 Walter Guttenfelder (PPPL) presented a talk at the UCLA Dept. of Physics & Astronomy titled "Progress, challenges and plans in transport research in NSTX-U upgrade" as part of the NSTX-U Outreach Seminar series. During the visit, collaborative discussions were held with Prof. Jenko's group on NSTX-U simulation opportunities using the GENE code, and with the UCLA diagnostic group on NSTX-U data analysis. (W. Guttenfelder)

### **Run Coordination (J. Menard, S. Gerhard)**

On Monday, 2/15/2016, 6 shots were taken towards XMP-137 (Increase  $I_p$  and Elongation in L- and H-Mode). The start of flattop was moved earlier and the evolution of heating, elongation and fueling in the rampup to 800 kA were adjusted to make progress toward diverting during periods of lower internal inductance.

On Tuesday, 2/16/2016, and Thursday, 2/18/2016, a combined eight shots were taken towards XP-1506 (Low-beta, low-density locked mode studies). All but one of the eight shots were dedicated to developing long ( $\sim 1$  sec), low-density, 600 kA, ohmic discharges using a 20 kA

ohmic pre-charge. This effort was successful in producing a good target for the planned  $n=1$  compass scan. As such,  $n=1$  fields were applied during the final discharge on 2/18/2016, and good evidence of field penetration was observed. These experiments will be continued in the following weeks.

On Friday, 2/19/2016, 25 shots were completed towards XMP-115 (ISOFLUX Commissioning). These shots were successful to implement control of the inner wall limited algorithm in isoflux control and achieved a stable plasma elongation of  $\kappa \sim 1.8$  at  $l_i \sim 1.2$  by tuning the vertical control gains. This represents an improvement in  $\kappa$  of about 0.1 at high  $l_i$ . Also the first shots using the double null ISOFLUX algorithm were made successfully, but gains must be tuned before this algorithm is ready for generic experiments. Overall it was a very successful day qualifying the control system.

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

NSTX-U plasma operations continued this past week with experiments to further investigate the use of ISOFLUX and rtEFIT control via the Plasma Control System and the outer PF coils. Progress was also made on experiments on H-mode access and on optimizing plasma current/elongation at the higher available Neutral Beam power. We have been able to tune systems for some of our longest L-mode plasma shots. Four of the six neutral beam ion sources are currently operational. The ion source in the NB1A position has a vacuum leak and will be replaced with a fresh spare next week. The autotransformer in the NB2B power system will be replaced with a spare unit during the next maintenance period. Also this week, work continued on the development of tools and procedures for the recovery of in-vessel debris from the BES shutter covers. MAPP samples were successfully obtained and are being analyzed. The final design of the power systems for the Massive Gas Injector system was successfully reviewed. A vacuum vessel boronization will be performed on Sunday.

The NSTX-U Test Cell will be in restricted access this coming week during plasma operations. Access will be available in the evenings for approved work.