Observation of MHD-induced Current Redistribution in NSTX*

J. Menard[1], M. Bell[1], R. Bell[1], D. Gates[1], S. Kaye[1], B. LeBlanc[1], F. Levinton[2], R. Maingi[3], S. Medley[1], D. Stutman[4], S. Sabbagh[5], K. Tritz[4], H. Yuh[2], and the NSTX research team.

[1] *Princeton Plasma Physics Laboratory, Princeton, NJ, USA*
[2] *Nova Photonics, Princeton, NJ, USA*
[3] *Oak Ridge National Laboratory, UT-Battelle, Oak Ridge, TN, USA*
[4] *Johns Hopkins University, Baltimore, MD, USA*
[5] *Columbia University, New York, NY, USA*

A novel Motional Stark Effect diagnostic capable of operation at low magnetic field strength ≥ 0.3 Tesla [1] has been utilized to constrain magnetic reconstructions of the parallel current density profile of a spherical torus plasma for the first time. When no large-scale MHD instabilities are present in the plasma, the reconstructed current profile is found to compare favorably with TRANSP calculations of neutral beam injection current drive combined with neoclassical conductivity and bootstrap current models applicable to low-aspect-ratio [2]. However, in recent NSTX record pulse-length discharges with a sustained high fraction of non-inductive current drive (60-70%) aided by operation at high elongation [3], a current profile anomaly is observed during saturated kink/tearing mode activity. Significant redistribution or loss of core fast ions (anomalous fast ion diffusivity) can account for both a deficit in neutron production and reduced central current density, while resistive tearing and reconnection at the q=2 surface may be responsible for generating dynamo co-current drive at larger minor radius. Comparison of the reconstructed current profiles to those predicted indicates that the saturation of the core MHD mode is apparently an important element in sustaining the central safety factor at or above unity for several current redistribution times, and may represent a low-aspect-ratio analog to the "hybrid" scenario [4] currently being pursued to produce sustained high performance discharges in ITER. These results may also be relevant to a co-NBI-driven Component Test Facility [5]. Characteristics of the MHD modes active in these discharges and the techniques used to model their impact on the current profile will be discussed. *This work is supported by USDOE.

[1] F.M. Levinton, et al., in preparation.

[2] O. Sauter, C. Angioni ,Y. R. Lin-Liu, Phys. Plasmas **9**, 5140 (2002)

[3] D.A. Gates et al., Nucl. Fusion **46** (2006) S22-S28.

[4] M.R. Wade et al., Nucl. Fusion **45** (2005) 407-416

[5] Y.-K.M. Peng et al., Plasma Phys. Controlled Fusion **47** (2005) B263-B283.