Effect of non-axisymmetric magnetic fields on divertor profiles in NSTX H-mode plasmas

J-W. Ahn[1], J.M. Canik[1], R. Maingi[1], T.K. Gray[1], B. LeBlanc[2], A.G. McLean[1], H.W. Kugel[2], A.L. Roquemore[2], and V.A. Soukhanovskii[3]

[1]*Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA*
[2]*Princeton Plasma Physics Laboratory, Princeton, NJ 08543, USA*
[3]*Lawrence Livermore National Laboratory, Livermore, CA 94551, USA*

The application of 3-D magnetic perturbations by the use of six midplane coils located close to the outer vacuum vessel is used to trigger ELMs to flush impurities out of National Spherical Torus Experiment (NSTX) H-mode plasmas [1]. Heat and particle (D_α) flux profiles at the divertor target plates are found to be significantly affected by the applied 3-D fields in NSTX. We report the effect of 3-D fields on the divertor plasma profiles, both between and during the ELMs, in NSTX with heavy lithium wall conditioning. The imposed 3-D fields produce multiple, radially-separated strike points, which are reflected as striations in the heat flux and D_α data at the divertor plate surface. In some (but not all) NSTX discharges, a modest level of strike point (SP) splitting in both the heat and particle flux profiles is observed [2] even before the application of 3-D fields, presumably due to the intrinsic error fields ('intrinsic' SP splitting). This intrinsic SP splitting is augmented by the externally applied 3-D fields to generate higher local peaks and valleys in the profiles. The modified heat and particle flux profiles have been compared with vacuum field line tracing of the resulting magnetic topology, with good, semi-quantitative agreement on the location and spacing of the observed striations. The inclusion of plasma response inside the separatrix with the IPEC code [3] did not substantially alter the predicted footprints at the divertor targets. Note that with coil currents above a critical value (~0.75kA), the 3-D field application causes ELMs to occur [1]. The measured divertor heat and particle flux profiles for these ELMs show that the locations of local peaks due to the split strike points before the ELM remain unchanged, even during the ELMs. Characteristics of the heat and particle deposition with various parameter scans such as power, q_{95}, and collisionality will be presented. This work was supported by the US Department of Energy, contract DE-AC05-00OR22725, DE-AC02-09CH11466, and DE-AC52-07NA27344.

[1] J. Canik, *et al*, *Phys. Rev. Letts.* **104** (2010) 045001
[2] J-W. Ahn, *et al*, submitted to Nucl. Fusion (2009)
[3] J.-K. Park, *et al*, *Phys. Plasmas* **14** (2007) 052110