Assessment of non-axisymmetric effects in the SAS divertor at DIII-D

H. Frerichs[1], O. Schmitz[1], B. Covele[2], Y. Feng[3], H. Y. Guo[2], D. Hill[2]

[1]University of Wisconsin – Madison, Madison, WI
[2]General Atomics, San Diego, CA
[3]Max-Planck-Institut für Plasmaphysik, Euratom Association, Garching/Greifswald, Germany

The Small Angle Slot (SAS) divertor is explored at DIII-D for improving access to cold, dissipative/detached divertor conditions. The narrow width of the slot divertor coupled with a small magnetic field line-to-target angle facilitates the buildup of neutral density, and thereby increasing radiative and neutrals-related (atomcs and molecules) losses in the divertor [H.Y.Guo et al., Nucl. Fusion 57 (2017) 044001]. Small changes in the strike point location can be expected to have a large impact on divertor conditions. Non-axisymmetric perturbations to the magnetic field configuration (either intentionally by external coils for the control of ELMs, or unintentionally due to coil misalignments) may cause the strike point to move along the divertor target plate or even leave the divertor slot at some locations. The latter extreme case essentially introduces an opening in the divertor slot from where recycled neutrals can easily escape, and thus degrades the performance of the slot divertor. In the present contribution we approximate such a strike point dislocation by a finite gap in the divertor slot. Three dimensional edge plasma and neutral gas simulations for this case are performed with the EMC3-EIRENE code and compared to a reference case without gap. Initial simulations, starting with moderate density attached conditions, show that such a gap can result in a toroidally localized decrease of plasma density at the strike point with an increase of electron temperature by up to 70%, even causing higher density detached-divertor plasmas to locally re-attach. Conversely, the impact of such toroidally-localized divertor perturbations on the absolute value and, in particular, the toroidal symmetry of midplane separatrix conditions, is small. These effects will be explored by further simulations for increasing upstream density.

Acknowledgement: This work has been funded by the U.S. Department of Energy under Early Career Award grant DE-SC0013911.