Comparison of resonant magnetic perturbation induced particle transport changes in H-mode (DIII-D) and L-mode (MAST)

S Mordijck[1], R A Moyer[2], A Kirk[3], P Tamain[4], D Temple[3], G R McKee[5] and E Nardon[4]

[1] The College of William and Mary, McGlothlin-Street Hall, Williamsburg, Virginia 23187, USA

[2] University of California-San Diego, 9500 Gilman Dr., La Jolla, California 92093, USA

[3] EURATOM/CCFE Fusion Association, Culham Science Centre, Abingdon, OX14 3DB, UK

[4] CEA, Cadarache, 13108 St Paule lez Durance Cedex, France

[5] University of Wisconsin-Madison, Madison, Wisconsin 53706

E-mail: mordijck@cs.wm.edu

Abstract. Recent experiments show the impact of Resonant Magnetic Perturbations on the density [O Schmitz *et al* Plasma Phys. Control. Fusion **50** 124029 (2008); T E Evans *et al* Nucl. Fusion **48** 024002 (2008); A Kirk *et al* Nucl. Fusion **50** 024002 (2008); Y Liang *et al* Phys. Rev. Lett. **98** 265004 (2007)], leading to a so-called density pump-out. Previous comparisons between DIII-D and TEXTOR have focussed on the similarities of the deformation of the separatrix and the creation of striations at the intersection of the main chamber wall [O Schmitz *et al* Plasma Phys. Control Fusion **50** 124029 (2008); O Schmitz *et al* Phys. Rev. Lett. **103** 165005 (2009)]. In this paper, we compare the difference in magnitude of the experimentally observed density pump-out in L-mode with H-mode in two diverted tokamaks: MAST and DIII-D. In order to address the differences in magnetic field from the coils, plasma shape and q_{95} between the two devices, we compute a weighted magnetic diffusion coefficient with a vacuum field line tracing code. This allows us to compare the changes in density pump-out with the weighted magnetic diffusion coefficient, using a simple particle diffusion model. We find that the density pump-out is vastly different in the two devices, suggesting different particle transport mechanisms. Since one main difference in transport characterics between L- and H-mode is turbulence, we compare turbulent particle characteristics. We find that in L-mode (MAST) the fluctuations and $E \times B$ shear increase at the plasma edge, whereas in H-mode (DIII-D) the fluctuations decrease at the plasma edge. Deeper inside the core, the $E \times B$ shear remains similar in L-mode (MAST), whereas a large decrease that quickly saturates with RMP strength is observed in H-mode (DIII-D). These results suggest that the RMP induced particle transport at the plasma edge in L-mode (MAST) is the result from increases in turbulent particle

transport, whereas the results in H-mode (DIII-D) suggest a decrease in turbulent particle transport.

PACS numbers: 52.25.Fi Transport properties, 52.35.Ra Plasma Turbulence, 52.55 Tokamaks, spherical tokamaks

Submitted to: *Plasma Phys. Control. Fusion*