Particle Transport Measurements on DIII-D using Perturbative Techniques*

E.J. Doyle[1], L. Zeng[1], T.L. Rhodes[1], T.E. Evans[2], S. Mordijck[3], R.A Moyer[4], L. Schmitz[1], G.R. McKee[5], Z. Yan[5] and W.A. Peebles[1]

[1]University of California, Los Angeles, California USA
[2]General Atomics, P.O. Box 85608, San Diego, California 92186-5608 USA
[3]The College of William and Mary, Williamsburg, Virginia USA
[4]University of California-San Diego, La Jolla, California USA
[5]University of Wisconsin, Madison, Wisconsin USA

As part of a DIII-D program to improve measurements and understanding of multi-channel transport and model-experiment comparisons, particle transport measurements have been initiated and data obtained under a wide variety of operating conditions, including: L-mode, ELMing and ELM-free H-mode, QH-mode, and L- and H-mode plasmas with resonant magnetic perturbations (RMPs). Particle diffusivities (D) and pinch velocities (V) are determined from high resolution profile reflectometry data using perturbative techniques (e.g. modulated gas puffing), employing a simple analytic model [1]. Results show a considerable variation in D and V with operating regime, e.g. D is in general higher in L-mode than in H-mode, while V is more negative in H-mode than L-mode. Using these techniques we have obtained the first direct measurements to confirm that D increases and the inward pinch V is reduced during n=3 RMP application, in both L- and H-mode plasmas. These changes in particle transport are associated with the reduction in operating density commonly observed with n=3 RMP application in H-mode plasmas [2]. In the RMP plasmas, the increase in D and decrease in V is consistent an increase in density fluctuation levels in the vicinity of radial location $\rho \sim 0.6$-0.9, along with a decrease in **ExB** shearing levels, while calculations using the linear TGLF code indicate a change in the mode type and growth rate, potentially providing insight into the transport change. In separate experiments using L-mode and Ohmic plasmas, the magnitudes of both D and V are observed to increase with plasma collisionality, similar to previous measurements of momentum pinch velocity and diffusivity [3]. SOLPS5 modeling is also underway to investigate the contribution of neutral fueling to the observed transport changes.

[1] H. Hakenaga, et al., Plasma Phys. Control Fusion **40**, 183 (1998)
[2] T.E. Evans, et al., Nucl. Fusion **48**, 024002 (2008)
[3] W.M. Solomon et al., Phys. Plasmas **17**, 056108 (2010)

*This work supported in part by the U.S. Department of Energy under DE-FG02-08ER54984, DE-FC02-04ER54698, DE-FG02-07ER54917, DE-FG02-05ER54809, DE-FG02-89ER53296 and DE-FG02-08ER54999.