# Experimental Comparison of Recycling and Pumping Changes During Resonant Magnetic Perturbation Experiments at Low and High Collisionality in DIII-D*

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Resonant magnetic perturbations (RMP) have been shown to successfully suppress edge-localized modes (ELMs) in the DIII-D tokamak with a previous comparison of target plate conditions highlighting differences between low and high collisionality operations [1]. In this present work, a detailed comparison of the recycling patterns and global particle balance is presented for the low ($\nu_e^* \sim 0.1$) and high ($\nu_e^* \sim 1$) collisionality cases. In low-$\nu_e^*$ discharges, a 5%-30% reduction in the line integrated and pedestal density is always observed prior to the suppression of the last ELM while the pedestal electron temperature increases modestly and ion temperature increases as much as 50%-70% depending on discharge conditions before the RMP [2]. This behavior contrasts with stochastic transport theory, which predicts a large increase in the thermal transport and a relatively smaller change in the particle transport. Experimental results presented in this paper for various RMP H-mode configurations provide the first quantitative assessment of possible physics mechanisms that may be responsible for this unexpected behavior. In general, the baseline recycling ($D_\alpha$) light is decreased during RMP operation in low-$\nu_e^*$ cases with low triangularity while in high-$\nu_e^*$ cases the recycling baseline remains constant and takes on a periodically modulated bursty behavior. Furthermore in the low-$\nu_e^*$ case, the integrated beam fueling during the RMP exceeds the amount pumped by the cryopump, suggesting either a trapping of the particles in some unsaturated portion of the wall or a local buildup of particle flux or neutrals. During an extended down period from 2005-2006 on DIII-D, the lower divertor pump plenum entrance was modified to enable pumping of high triangularity discharges. ELM suppression has been demonstrated with this modified divertor [3], but contrary to the prior low triangularity discharges, global recycling is seen to increase in the low-$\nu_e^*$ cases. Detailed analysis of the recycling changes and particle balance for these configurations will be presented.

[1] J.G. Watkins, *et al.*, J. Nucl. Mater. **363-365**, 708 (2007).
[2] T.E. Evans, *et al.*, Phys. Plasmas **13**, 056121 (2007).
[3] R.A. Moyer, *et al.*, Proc. of 21st IAEA Conf., Chengdu, China, 2006, http://wwwnaweb.iaea.org/napc/physics/FEC/FEC2006/html/index.htm.

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