Particle Exhaust During RMP ELM Suppression on DIII-D with an Open and Closed Divertor*

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A common feature in many edge stochastic experiments is a reduction of plasma density (“pumpout”). During the application of resonant magnetic perturbations (RMPs) in most DIII-D plasmas, pumpout precedes the suppression of ELMs. The magnitude of the pumpout of electrons has a ~30% variation for discharges with similar applied RMP field strength and q_{95}. This large variation in pumpout magnitude motivated a more detailed study of plasma sources and sinks during RMP experiments on DIII-D. Recent analysis using a global particle balance and measurements of the D_α poloidal distribution show that the wall inventory can be strongly affected by changing the average triangularity ($\langle\delta\rangle$) of the plasma (primarily due to changes in δ_{low}). Lower single null (LSN) discharges with similar plasma characteristics (e.g. n_e and electron collisionality) with different $\langle\delta\rangle$ were realized in DIII-D with a significant modification to the lower divertor baffling structure during a vessel upgrade in 2005. In particular, the analysis shows that at $\langle\delta\rangle \sim 0.3$ the integrated plasma efflux during the RMP is greater than the total number of particles removed by the cryopump system, indicating active wall pumping. Conversely, at $\langle\delta\rangle \sim 0.5$ in a scaled ITER-like shape, the plasma efflux during the RMP is balanced by the cryopump exhaust, i.e., no wall pumping is inferred. Additionally, the D_α intensity in the $\langle\delta\rangle \sim 0.5$ discharges increased by ~50%–100% when compared to $\langle\delta\rangle = 0.3$ discharges. The observations at $\langle\delta\rangle \sim 0.5$ imply an increase in the scrape-off layer neutral density. This overall result is significant, because it demonstrates density pumpout and ELM suppression without significant wall pumping, a feature that is essential in long-pulse reactors with saturated walls.

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