Demonstration of particle exhaust control during ELM suppression by resonant magnetic perturbations in DIII-D

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Abstract. A reduction of plasma electron density ("pump-out") during the application of resonant magnetic perturbations (RMPs) on DIII-D precedes the suppression of edge localized modes (ELMs) in discharges with low (≤0.2) electron pedestal collisionalities. The magnitude of the density drop near the plasma pedestal can be up to 30% and as low as ~2% for discharges with similar applied RMP, and thus motivates further study to determine the cause of the variation. Based on an analysis of the global particle balance and measurements of the D_α poloidal distribution, it is shown that the wall inventory can be strongly affected by changing the average triangularity ($\langle\delta\rangle$) of the discharge. Specifically, particle balance in $\langle\delta\rangle = 0.3$ discharges shows that the density pump-out was substantially higher than the increase of particle exhaust to the cryo-pumps, i.e. wall pumping was apparently required. On the other hand, particle balance in $\langle\delta\rangle = 0.5$ discharges shows that the density pump-out was offset by an increase of exhaust to the cryo-pumps, i.e. wall pumping was not required. Correspondingly, the D_α intensity increased by ~50%–100% at $\langle\delta\rangle = 0.5$ when compared to $\langle\delta\rangle = 0.3$ discharges. Both of these observations imply a possible increase in the neutral particles in the scrape-off layer. More significantly, this new result demonstrates density pump-out and ELM suppression without significant wall pumping, which is a concern for long-pulse reactors with saturated walls.

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