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The Role of Drifts and Radiating Species in Detached Divertor Operation at DIII-D

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A comprehensive experimental campaign at DIII-D has advanced understanding and modeling of the effects of drifts and radiating species in diverted plasma up to ITER-relevant collisionality. Unique diagnostic capabilities are employed to show directly that plasma drifts lead to in/out asymmetries as well as shifts in radial parameter profiles throughout the divertor legs, and are a critical factor for predicting detachment onset, and particle and heat fluxes for a detached divertor. These results are reproduced by first-of-its-kind boundary modeling of H-mode discharges with a full physics description of drifts using UEDGE in both toroidal field directions, confirming that the interplay of radial and poloidal $E \times B$ drifts are primarily responsible for target asymmetries and localization of high density/low temperature plasma in the scrape-off layer. SOLPS modeling of L-mode Helium discharges with negligible carbon emission suggests that molecules and atomic contributions may play a role in explaining a consistent shortfall in divertor radiation observed in boundary modeling of multiple tokamaks. These and future planned studies of detachment provide valuable physics insight informing the implementation of high-Z plasma facing components at key locations poloidally in DIII-D in 2016.

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