Preliminary survey of application of the radiating divertor approach to innovative tokamak divertor concepts

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Abstract. Recent DIII-D experiments evaluated the effectiveness of three innovative tokamak divertor concepts in reducing divertor heat flux under radiating divertor conditions. These concepts are: (1) high performance magnetically unbalanced double-null divertor (DND) plasmas, (2) high performance double-null "snowflake" (SF-DN) plasmas, and (3) single-null H-mode plasmas with different isolation from their divertor targets. Large reductions in both divertor heat flux and electron temperature were observed in both standard DND and SF-DN high performance discharges under comparable neon/deuterium-based radiating divertor conditions, while at the same time maintaining favorable high performance metrics, e.g., $\beta_N \cong 3.0$ and $H_{98(Y,2)} \cong 1.4$. The high performance metrics for SF-DN plasmas were comparable to those of the magnetically unbalanced DND plasmas, although impurity accumulation in the former was typically higher, e.g., ≥20%. The peak heat flux $\left(q_{\perp,P}\right)$ was significantly reduced by extending the parallel connection length $\left(L_{\|-XPT}\right)$ in the scrape-off layer between the X-point and divertor targets, both under radiating- and non-radiating divertor conditions. Extending $\left(L_{\|-XPT}\right)$ was also shown to facilitate access to lower core density as well as lower neon accumulation in the core. In general, all three concepts are attractive, achieving reduced divertor heat flux while preserving good H-mode confinement.