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Toward Effective Heat Flux Reduction Combining Resonant Magnetic Perturbations with a Radiating Divertor in DIII-D*

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Core-edge integration seeks to match acceptable boundary conditions with attractive core scenarios for fusion energy. Such overlap becomes particularly important when mitigating the high levels of divertor power loading anticipated in future generation tokamaks, both from *transient* heat pulses at the divertor target due to ELMs and from the *between-ELM* heating component at the divertor targets. Our experiments have shown that significant reductions to both the transient and non-transient components can be obtained by applying resonant magnetic perturbations (I-coil with n=3, 60^o phasing in even parity) to ELMing H-mode plasmas under puff-and-pump radiating divertor conditions, such as those described in [1]. While complete ELM-suppression for these RMP radiating divertor plasmas was only accessible over a limited range in pedestal density and collisionality, significant ELM *mitigation* with heat flux reduction was demonstrated over a much wider range. When radiating divertor H-mode discharges with applied RMP are compared with corresponding ELMing H-mode plasma at the same pedestal density, the former are shown to have (1) lower average electron temperature at the midplane separatrix (~2x), implying lower average electron temperature at the divertor target, (2) lower *time-averaged* peak heat flux at the divertor target (~2x), and (3) lower *transient* peak heat flux from ELMs (~ 1.5x). In addition, these radiating divertor discharges still maintain good H-mode energy confinement properties, e.g., $H_{98(y,2)}$ = 0.9 – 1.0. The dynamics of these results can be explained in terms of simple 1-D modeling of the scrape-off layer and divertor, supplemented by results from the 2-D UEDGE fluid transport code. Our studies identify the most promising scenarios that can produce significant heat flux reduction while still preserving standard (or advanced) fusion performance.

[1] Wade, M. R. *et*. *al*. Nucl. Fusion **38** (1998) 1939.

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