First Results Examining the Compatibility of RMP ELM Suppression With the Radiating Divertor in DIII-D*

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Recent experiments on DIII-D have focused on whether ELM suppression by resonant magnetic perturbations (RMP) is compatible with a "radiating divertor" approach to heat flux reduction. The current work brings together two activities previously conducted separately, namely: (a) finding the conditions leading to optimal radiating divertor operation [1] and (b) applying the RMP I-coil approach to obtain edge localized mode (ELM)-free H-mode operation [2]. The former can be effective in managing *steady-state* power loading at the divertor targets; the latter is an attractive option for avoiding damage to divertor structures from the *transient* power loading of ELMs. For the single-null plasmas used in the present study, $H98(y,2)$ = 0.9–1.3, β_N = 1.8–2.3, and the direction of the ion $Bx\nabla B$ drift is *toward* the X-point. Argon (Ar) impurities were injected directly into the divertor, while deuterium (D_2) gas was injected from a location upstream of the divertor.

Analysis indicates that there is little difference in how fast the injected argon accumulated in the main plasma between standard ELMing H-mode plasmas and RMP ELM-suppressed H-mode plasmas with a comparable D_2 gas puff rate (Γ_{D2}). Core Ar buildup decreased with increasing Γ_{D2} in both cases. However, when additional D_2 gas puffing was applied following RMP activation, the electron pressure gradient at the plasma edge increased and, if Γ_{D2} was sufficiently high, ELMing activity returned. We note that increases in the RMP at values large enough to suppress ELMs had no perceptible effect on the rate at which Ar accumulated in the core. When Γ_{D2} was constant, Ar accumulation in the core had a near-linear dependence on the argon injection rate, behavior similar to that previously observed for standard ELMing discharges operating under the same conditions [1].

In addition to suppressing ELMs, we found that the RMP has other benefits, such as lowering plasma edge temperature while maintaining the same plasma density, or actively controlling plasma density while maintaining the electron temperature profile unchanged. Suppressing ELMs via RMP have proven to be much more challenging when the ion $Bx\nabla B$ drift was directed *away from* the X-point. We present detailed transport and edge stability analyses of these radiating divertor plasmas, as well as results from the 2010 experimental campaign presently underway.

[1] T.W. Petrie, et al., *Nucl. Fusion* **49** (2009) 065013.
[2] T.E. Evans, et al., *Phys. Plasmas* **13** (2006) 056121.

*Work supported by the US Department of Energy under DE-FC02-04ER54698, DE-AC52-07NA27344, DE-FG02-07ER54917, and DE-AC04-94AL85000.