Effect of island overlap on ELM suppression by resonant magnetic perturbations in DIII-D

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Abstract. Recent DIII-D [J.L. Luxon, *et al.,* Nucl. Fusion **43**, 1813 (2003)] experiments show a correlation between the extent of overlap of magnetic islands induced in the edge plasma by perturbation coils and complete suppression of Type-I edge localized modes (ELMs) in plasmas with ITER-like electron pedestal collisionality $\nu_e^* \sim 0.1$, flux surface shape and low edge safety factor ($q_{95} \approx 3.6$). With fixed amplitude $n = 3$ resonant magnetic perturbation (RMP), ELM suppression is obtained only in a finite window in the edge safety factor (q_{95}) consistent with maximizing the resonant component of the applied helical field. ELM suppression is obtained over an increasing range of q_{95} by either increasing the $n = 3$ RMP strength, or by adding $n = 1$ perturbations to "fill in" gaps between islands across the edge plasma. The suppression of Type-I ELMs correlates with a minimum width of the edge region having magnetic islands with Chirikov parameter >1.0, based on vacuum calculations of RMP mode components excluding the plasma response or rotational shielding. The fraction of vacuum magnetic field lines that are lost from the plasma, with connection length to the divertor targets comparable to an electron-ion collisional mean free path, increases throughout the island overlap region in the ELM suppressed case compared with the ELMing case.