Modifications to H-mode pedestal structure via particle control and topology variation on Alcator C-Mod

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Edge profile structure is characterized in H-modes on the Alcator C-Mod tokamak, with the objective being a physics-based understanding of factors setting the pedestal height and width. Because large Type I edge-localized modes (ELMs) are rare on C-Mod, H-mode pedestal studies typically concentrate on steady H-modes either in the enhanced D-alpha (EDA) regime or, at higher power levels, operating with small grassy ELMs. Transient ELM-free H-modes with low particle transport are also considered in the study of profile structure. Across this range of operation, pedestal width shows little systematic variation, while the pedestal height is strongly linked to total plasma current I_P. In particular, the height of the H-mode density pedestal $n_{\rm ped}$ appears to be regulated by plasma transport such that $n_{\rm ped} \sim 0.3\ n_G$, where n_G is the Greenwald density limit. In addition, plasma transport governs the edge pressure profile such that, across a wide spectrum of operational parameters, the poloidal beta gradient ($\propto \nabla p / I_P^2$) is a decreasing function of collisionality.[1] These correlations among density, pressure and current have been further explored, using both active particle pumping and variations of magnetic topology. Active pumping significantly reduces edge collisionality and increases both pedestal pressure gradient and global H-mode confinement. This effect comes about via only a modest reduction to $n_{\rm ped}$, accompanied by a boost in pedestal temperature. Magnetic topology is found to have a substantial effect on pedestal density, in both pumped and unpumped discharges. For single null discharges with the same engineering parameters, $n_{\rm ped}$ is lowered by ~20% when ion ∇B drift is directed away from the active x-point, independent of field direction. The density pedestal in nearly double null discharges is a sensitive function of the proximity of the equilibrium to magnetic balance, such that slight variations in topology about double null gave the potential to regulate H-mode density and collisionality. Details of pedestal structure (*e.g.* widths, gradients) in these configurations will be presented.

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[1] J.W. Hughes *et al.* Nucl. Fusion **47** 1057 (2007).