

## Advances in measurement and modeling of the H-mode pedestal on Alcator C-Mod\*

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Edge transport barriers (ETBs) forming pedestals are crucial in determining H-mode plasma confinement. ETB studies on Alcator C-Mod have improved understanding in several areas, including pedestal scalings, edge stability, and radial transport of both plasma and neutrals. Results depend on the H-mode type, two examples of which are typically observed on C-Mod: ELM-free and enhanced D-alpha (EDA). Pedestal profiles from edge Thomson scattering show clear trends with plasma operational parameters, particularly in EDA operation. Notably, a ballooning-like  $I_p^2$  dependence is seen in  $\text{grad-}p_e$ , despite calculated stability to ideal ballooning modes. A similar scaling is seen in near scrape-off-layer probe data for both L- and H-mode discharges, possibly due to electromagnetic fluid drift turbulence setting transport at the pedestal foot. Neutral density diagnosis at the ETB has allowed examination of fueling by atomic  $D^0$  in typical H-modes, and has yielded profiles of an effective diffusivity well in the ETB, the depth of which varies between ELM-free and EDA operation. This experimental work is supplemented with a 1D semi-analytic model for neutral transport in the edge, in order to understand how changes in source  $D^0$  impact the  $n_e$  pedestal. By coupling a fluid analysis to a kinetic computation of neutral distribution functions, the thermal equilibration between ions and neutrals is considered. Rapid equilibration at typical C-Mod densities can explain the invariance of  $n_e$  pedestal width and gradient with source rate, a result that contrasts with those of lower-density tokamaks. Incorporating neutral kinetics may resolve these apparently contradictory results, as well as dimensionless comparisons between C-Mod and larger tokamaks such as DIII-D and JET.

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