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H-mode pedestal and threshold studies over an expanded operating space on Alcator C-Mod[1]

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Understanding of the transition to, and pedestal structure in, the H-mode regime is both critically important for extrapolation to burning plasmas, and incomplete. H-mode studies on Alcator C-Mod exploit state-of-the-art high resolution edge diagnostics. Past studies have focused primarily on operating regimes with B_T ~5.4 T, using D(H) heating, and with ion $B \times \nabla B$drift towards the closed divertor, favorable for H-mode. These show pedestal widths to be very narrow, typically 3-5 mm, and fairly constant, with gradients scaling primarily with I_p. The quiescent Enhanced D-Alpha H-mode regime is most typical. Experiments in recent campaigns, using varied ICRF frequencies and heating scenarios, have greatly expanded the parameter space, with B_T varied from 2.6-8 T. At 8 T, L-H thresholds in edge T as well as power are much increased. Pedestals are accordingly also hot, with T_{ped} up to 0.8 keV, while widths remain narrow. Likely as a result of the decreased collisionality, these H-modes are typically ELM-free. Similarly, when I and B are reversed, producing drifts away from the divertor, threshold powers, temperatures and gradients are again much higher, particularly at low n. Grad T gradually increases to H-mode-like values (~100 keV/m), with decreasing thermal conductivity before the transition in particle confinement. Past experiments varying topology with fixed drift direction have shown a connection of thresholds to SOL flows and core toroidal rotation [1]; the new results confirm and extend this picture with improved measurements. Extended experimental pedestal scalings will be presented and compared with models which consider both neutral penetration and plasma transport [2]. [1] B. LaBombard et al, Phys. Plasmas **12**, 056111, 2005. [2] J.W. Hughes et al, Phys. Plasmas **13**, 056103, 2006.

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