Density Peaking And Particle Transport At Low Collisionality On Alcator C-Mod

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Though H-mode core plasmas tend to have very flat density profiles, modest density peaking would be advantageous for fusion performance. Thus robust pinch mechanisms that would allow operation with peaked profiles, in the absence of any internal ionization source, are of considerable interest. Recent experiments on C-Mod, at low collisionality, show just such peaking and are consistent with earlier results from ASDEX-U[1] and JET[2]. The new experiments reported here extend the range of collisionality in C-Mod H-modes downward by a factor of three ($\nu^* \sim 0.07$). Wall fueling is exceptionally shallow, in these plasmas, due to their high absolute density ($> 1.5\text{x}10^{20}/\text{m}^3$) and the lack of neutral beam fueling – ICRF is used for auxiliary heating. Peaking is notable in the region from r/a ~ 0.4-1.0 . Profiles closer to the axis are subject to strong sawtooth oscillations, so reliable estimates of transport in that region are not available. From the steady-state profiles, we can calculate a normalized pinch velocity, $aV/D \sim 1$, in the peaked region, for these low-density discharges. In contrast, the normalized Ware velocity, $aV_W/\chi \sim 0.02$-0.03, suggesting that a strong anomalous pinch is present. While the evidence for density peaking at low density was clear, the data from ASDEX-U and JET could not break the covariance between different density normalizations, namely collisionality, ν^* or ν_{EFF}, and the density normalized to the density limit, n_G. These differ in scaling only by a factor of about $R^{1/4}$ and is significant for ITER since it uniquely runs at very low ν^* and very high n_G. Addition of C-Mod data widens the range in R and breaks this covariance, supporting the hypothesis that collisionality is the controlling parameter.

[1]C. Angioni, et al., PRL **90**, 205003, 2003

[2]H.Weisen, Nucl. Fusion **45**, L1, 2005