Edge Radial Electric Field Structure on Alcator C-Mod

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The edge CXRS system on Alcator C-Mod is capable of measuring B^{+5} temperature, density, and both toroidal and poloidal velocity in the pedestal region with 3mm radial resolution and 5ms temporal resolution. This enables the calculation of the radial electric field, E_r, via the force balance equation. Alcator C-Mod provides a unique measurement of this parameter, due to the lack of any external sources of momentum input, which would act as a fixed parameter in the force balance equation. In L-mode, the radial electric field is positive, small (a few kV/m) and has very little shear. In H-mode, the radial electric field is positive in the core, but forms a large negative "well" (-100 to -250 kV/m) approximately half a centimeter in width, the center of which is located one centimeter inside of the LCFS. The maximum of the negative shear of this well corresponds to the slope of the ion density gradient and the region of strongest shear in the poloidal velocity profile, which forms a sharp peak in the electron diamagnetic direction. The E_r well has a very strong gradient, on the order of 20-50MV/m^2, which leads to an **E**x**B** shearing rate on the order of 10MHz. Qualitatively, the structure of the radial electric field observed on C-Mod is very similar to that observed on most other devices. However, the depth of the E_r well on C-Mod is unprecedented as is the relative magnitude of the poloidal velocity contribution to the E_r well. Poloidal velocities of up to 40km/s have been observed transiently after an LH transition and velocities of up to 25 km/s are observed to persist throughout the duration of H-modes. These velocities lead to electric field contributions equivalent to if not greater than the contribution from the pressure gradient term. Additionally, significant evolution of all terms that contribute to E_r is observed during ELM-free H-modes, and the evolution of E_r itself during ELM-free operation suggests the depth of the E_r well may track with plasma stored energy or temperature pedestal heights.