2017 International Sherwood Fusion Theory Conference, Annapolis, MD

Finite Larmor Radius Effects at the Tokamak Edge and the Associated MHD Equilibria

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We will present a novel mechanism for producing the equilibrium potential well near the edge of a tokamak [1]. Briefly, because of the difference in gyroradii between electrons and ions, an equilibrium electrostatic potential is generated in the presence of spatial inhomogeneity of the background plasma due to [2],

$$\frac{n_i|_{particle}}{n_i} = 1 + \frac{1}{2}\rho_i^2 \frac{1}{p_i}\nabla_\perp^2 p_i,$$

which, in turn, produces a well associated with the radial electric field, E_r, as observed at the edge of many tokamak experiments. We will show that this theoretically predicted E_r field, which can be regarded as producing a long radial wave length zonal flow, actually agrees well with recent measurements on JET [3], NSTX [4], and C-MOD [5]. The relationship between the equilibrium pressure balance due to the Finite Larmor Radius effects used in the study [1, 2],

$$\mathbf{J}_\perp \approx \frac{c}{B}\hat{\mathbf{b}} \times (\nabla p_i)\left[1 - \frac{1}{4}\rho_i^2 \frac{\nabla_\perp^2 p_i}{p_i}\right],$$

and the associated MHD equilibria based on the SPEC code [6] will also be explored.

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