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],

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

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 will also be explored.

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[2] W. W. Lee, Phys. Plasmas 23, 070705 (2016).

[3] J. C. Hildesheim, E. Delabie, H. Meyer et al., Phys. Rev. Lett. 116, 065002 (2016).

[4] A. Diallo, J. Canik, T. Goerler et al., Nucl. Fusion 53, 1 (2013).

[5] C. Theiler, R, M. Churchill, B. Lipschultz et al., Nucl. Fusion 54, 083017 (2014).