Abstract Submitted
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Determining the radial electric field in tokamak plasmas[1] J.D. CALLEN, C.C. HEGNA, University of Wisconsin, Madison, WI 53706-1609 — Tokamak plasma transport equations are obtained using a multiple time scale analysis [1]: Alfvenic radial ion force balance, ion collisional poloidal flow relaxation, and then transport equations. Transport time scale toroidal torques that are not equal and opposite on electrons and ions create non-ambipolar particle fluxes. The total toroidal torque balance results from requiring the radial current they induce to vanish. In the plasma core NBI-induced ion torque is balanced by ITG-turbulence-driven Reynolds stress. Setting their sum to zero yields an ion transport root for the radial electric field. In H-mode pedestals other torque processes (c-x, toroidal ion viscous forces, ion direct-loss current etc) are likely dominant, but still yield an ion root. Addition of 3D fields from tearing modes, RMPs etc produce non-ambipolar electron fluxes and push the plasma toward an electron transport root. A procedure is proposed for determining the effects of such non-ambipolar electron fluxes on the radial electric field and other plasma transport changes this produces. In addition, possible changes in poloidal flow that large non-ambipolar fluxes could induce will be discussed.

[1] J.D. Callen, A.J. Cole and C.C. Hegna, Phys. Plasmas 16, 082504 (2009); Erratum 20, 069901 (2013).

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