Dynamics of Axisymmetric ExB and Poloidal Flows in Tokamaks

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Abstract

As a result of turbulence and finite Larmor radius effects, random radial currents are present in a tokamak plasma, and these drive sheared axisymmetric poloidal flows. We model these currents with a noise source with given statistical properties and calculate the linear kinetic response to this source. Without collisions, there is no long term damping of these flows; when collisions are included, poloidal flows are damped. The mean square potential associated with these flows is given in terms of the linear response function we calculate and a model correlation function for the current source. Without collisions, the mean square $E \times B$ flow increases linearly with time, but with collisions, it reaches a steady state. In the long correlation time limit, the collisionless residual flows are important in determining the mean square $E \times B$ flow.