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Dynamic Electrical Conductivity In A Bumpy Cylinder Magnetic Field*

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In the banana collisionality regime, the parallel electrical conductivity in a toroidal plasma is affected by interactions between trapped and passing particles. In a fluid moment approach this effect is introduced through the parallel viscous force $B \cdot \nabla \cdot \Pi$. What we seek here, is a functional form for this term for a dynamically varying case. The equilibrium and time dependent cases have been dealt with by various authors [1]-[5] with different approaches and results. We present a discussion of these procedures as well as advances in a new model based on a Chapman-Enskog-like approach [4, 5].

In the spirit of developing an appropiate expression for this parallel viscous force, we consider the simple case of a cylindrical magnetic field with periodic bumps. The viscous force in equilibrium ($\frac{\partial}{\partial t} \to 0$) has already been solved and recovers the known result. For the dynamic problem, an eigenmode expansion procedure already developed [6] has been used. We present a deductive approach within this context based on a large aspect ratio expansion that simplifies the response. High and low frequency limits relative to the collision frequency are being investigated.

The calculation seeks a real space, time-dependent analytical solution, convenient for facilitating use in future numerical computations in codes like NIMROD. A transformation to frequency space makes it possible to compare the results for relaxation rates with those in the literature mentioned above.

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