Neoclassical tearing Modes in the presence of sheared flows

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The influence of equilibrium shear flows on the evolution of neoclassical tearing modes is an important issue for future long pulse experiments on tokamaks and for reactor grade machines like ITER. Sheared flows can be generated in a tokamak plasma due to a variety of reasons, such as due to neutral beam injection, ion cyclotron heating and self-consistent drift turbulence. A number of past studies have examined the effect of flows on classical tearing modes, particularly in the linear regime and for simplified geometries. There have also been a few nonlinear studies of the classical tearing mode but the problem is quite complex, particularly in realistic toroidal geometries, and is an important area of present and future study for major numerical initiatives such as NIMROD. A detailed understanding of the evolution of NTMs in the presence of flows is still lacking. In this paper we study certain aspects of this problem through numerical solutions of a set of generalized reduced MHD equations that includes viscous force effects based on neoclassical closures. Our principal findings are that in general differential flow has a strong stabilizing influence leading to lower saturated island widths for the classical tearing mode and reduced growth rates for the neoclassical modes. Velocity shear on the other hand is seen to make a destabilizing contribution. We delineate the contributions of various linear and nonlinear terms in the model equations towards this evolution process and also compare our results with some of the present experimental findings

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