Effect of Two-Fluid Equilibrium Flow on Tearing Linear Stability

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Tearing modes have been studied extensively in the literature and much attention has been devoted to two-fluid effects (i.e. on the effect of distinguishing ion and electron dynamics) on their behavior. With special reference to tokamaks, the modifications introduced by equilibrium flows are also of interest. In this work, we introduce a novel element in our analysis of the linear tearing mode problem by considering a two-fluid equilibrium model including macroscopic flow and in particular poloidal rotation. In the two-fluid equilibrium model ions and electrons are frozen into different surfaces: a flow surface for ions and (same as in MHD) the magnetic surface for (massless) electrons. As a result, in toroidal systems plasma poloidal flow is not aligned with magnetic surfaces and a θ-dependent component of the velocity $v_\psi \sim \sin\theta$ normal to the magnetic surfaces is present. [1] Using a classical slab model [2] we highlight the differences introduced to the standard tearing mode problem by the presence of a finite v_ψ. In particular, it is found that a single-mode analysis is not possible, even if all the effects of toroidicity other than v_ψ are neglected. Moreover, a finite v_ψ introduces a higher-order derivative for the perturbed velocity than in the textbook description of the problem. We report on our progress in building a solution for the slab model problem including a sinusoidal component of the equilibrium velocity normal to the magnetic surfaces.

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