Gyrofluid investigation of finite β_e effects on collisionless reconnection

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Magnetic reconnection and magnetic island formation are ubiquitous phenomena in magnetically confined plasmas. These processes cause a modification of the topology of the magnetic field which is accompanied by a transformation of magnetic energy into kinetic energy and heat. The classic instability that leads to a reconnected configuration is well known as tearing instability. These modes are considered a potential threat to the proper functioning of plasma combustion experiments since they are often responsible for degrading the plasma confinement in tokamak devices.

In this work, the linear and nonlinear evolution of the tearing instability in a collisionless plasma with a strong guide field is analyzed based on a two-field Hamiltonian gyrofluid model. This model is a gyrofluid extension of previous studies based on the $\beta_e \rightarrow 0$ limit (Porcelli F., Borgogno D., Califano F., Grasso D., Ottaviani M., Pegoraro F., Plasma Phys. Control. Fusion (2002)), where β_e is the ratio between the electron pressure and the magnetic pressure. The finite β_e value, which can be relevant for collisionless plasmas, involves a magnetic perturbation along the guide field direction and electron finite Larmor radius effects. Gyrofluid models provide an effective tool, complementary to kinetic models, for studying such contributions. In this study, magnetic reconnection can be driven by electron inertia and by finite Larmor radius effects. The growth rate of the tearing instability is evaluated considering a fixed mass ratio, m_e/m_i=0.01.

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