Tearing instability inside a 2D current sheet with a normal magnetic field

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Magnetic reconnection converts the magnetic field energy into thermal and kinetic energies of the plasma. This process usually happens at extremely fast speed and is therefore believed to be a fundamental mechanism to explain various explosive phenomena such as coronal mass ejections and planetary magnetospheric storms. How magnetic reconnection is triggered from the large magnetohydrodynamic (MHD) scales remains an open question, with some theoretical and numerical studies showing the tearing instability to be involved. Observations in the Earth's magnetotail and near the magnetopause show that a finite normal magnetic field is usually present inside the reconnecting current sheet. Besides, such a normal field may also exist in the solar corona. However, how this normal magnetic field modifies the tearing instability is not thoroughly studied. Here we discuss the linear tearing instability inside a two-dimensional current sheet with a normal component of magnetic field where the magnetic tension force is balanced by ion flows parallel and anti-parallel to the magnetic field. We solve the dispersion relation of the tearing mode with wave vector parallel to the reconnecting magnetic field. Our results confirm that the finite normal magnetic field stabilizes the tearing mode and makes the mode oscillatory instead of purely growing.