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Numerical Simulation of Flapping Oscillations in the Magnetotail of the Earth

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Abstract

Many spacecraft measurements (e.g. Cluster) have been detecting flapping oscillations in the magnetotail current sheet of the Earth. They observed wave like structures propagating from the center to the flanks perpendicular to the magnetic field lines. One possible explanation for the flapping oscillations has been suggested by Erkaev et al. (2009). They found that the gradients of the x- and z-components of the magnetic field may cause an instability, which is called "double gradient instability". Simplified analytical studies showed this approach to be in good agreement with observations (comparable plasma velocity and frequency).
Here we present a numerical study of the "double gradient instability" in two dimensions using ideal magnetohydrodynamic simulations. The problem is solved with the TVD Lax-Friedrichs algorithm. We investigate the kink-mode of the instability and compare the analytical estimations with the numerical results.