

Magnetic reconnection coupled with the MHD-scale KH Instability: Two-fluid simulations including finite electron inertia effects

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In understanding the role of an MHD-scale Kelvin-Helmholtz Instability (KHI) in collisionless space plasmas, magnetic reconnection within the flow of the instability must not be neglected. Here we have performed two-dimensional two-fluid simulations including finite electron inertial effects to investigate this issue. In the two-fluid system, magnetic reconnection occurs spontaneously because the 'frozen-in' condition can be broken by the electron inertial effects. An MHD-scale velocity shear is set up and evolution of MHD-scale KH mode is followed. We have been focusing on basic models with different initial magnetic configuration, in which density is uniform and only in-plane magnetic field is present. Particularly in this study, the magnetic field is set anti-parallel across the shear layer. In this case, it is observed that the coupling between the flow of the KHI and magnetic reconnection strengthens the flow of the KHI and thus assists the formation of highly rolled-up vortex even when the Alfvén Mach number (MA) of the shear is too weak for the KHI alone to form it. Moreover, such a coupling enables coalescence of vortices to take place, which enhances further the effects of the coupling on large scale dynamics. This result is not observed in a MHD system with anomalous resistivity that is proportional to the magnitude of the current density.