A Simulation Study of Energy Transport on Kelvin-Helmholtz Instability in MHD Plasmas

Shu-Hua Lai and Ling-Hsiao Lyu
Institute of Space Science
National Central University, Taiwan, R.O.C

Abstract

Kelvin-Helmholtz (K-H) instability on a tangential discontinuity (TD) with a finite thickness is studied by means of the two-dimensional Magnetohydrodynamic (MHD) simulation. It is found that the nonlinear evolution of the K-H instability depends on the fast-mode Mach number of the surface wave obtained in the plasma rest frame. When the fast-mode Mach numbers on both sides of the TD are less than 1, the surface waves will be amplified by the K-H instability and grow into vortex structures or kink-type surface waves. When the fast- mode Mach number on either side of the surface wave is greater than 1, the surface disturbances associated with the K-H instability can generate nonlinear fast-mode plane waves on that side of the TD. Energy transport on the K-H instability is addressed in this study. The fast-mode wave plays an important role in transporting the wave energy converted from the shear flow energy away from the transition layer. The direction of the energy flux is compared with the direction of the fast-mode group velocity in the high-Mach-number K-H instability. Results of the energy transport indicate that most of the energy transfer process takes place near the transition layer for the low-Mach-number K-H instability. For the high-Mach-number K-H instability, a huge amount of the energy is transported away from the transition layer with the expanding of the nonlinear fast-mode plane waves.