Electron Inertia Effects On an MHD-Scale Kelvin-Helmholtz Vortex

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We study the electron inertia effects on an MHD-scale Kelvin-Helmholtz(KH) vortex. The KH vortex has been considered to play an important roll in the plasma mixing at Low Latitude Boundary Layer(LLBL). An LLBL like situation, that is, an MHD/ion scale velocity shear with density gradient, is set up and the evolution of a MHD-scale KH-mode followed. The magnetic field is assumed to be perpendicular to the flow and the simulation plane.

In an MHD system, the highly rolled up vortex is generated and remains rather stable. Then, we study the same MHD-scale dynamics by using the two fluid equations including ion/electron inertia effects. A rolled-up MHD-scale vortex tends to generate smaller scale structures, that is, it produces the part in which the MHD system breaks down. Therefore, it is necessary to use the equations including electron effects. Indeed, when the electron inertia effects are considered, we observe the decay of MHD-scale vortex induced by the smaller vortices which grow within the highly rolling-up parent vortex. The sizes of smaller vortices are about quarter of the parent's. Through a detailed study on the decaying process of an MHD-scale vortex, it is revealed that the coupling between the electron inertia effects and the MHD-scale dynamics makes the process possible. Moreover, by understanding the process, the parameter range where the decay process occurs is revealed.

We will present a detailed analyses that reveals the nature of these surprising results.