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The effect of the ion gyro motion to the non-linear growth of the Kelvin-Helmholtz instability

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The Kelvin-Helmholtz instability (KHI) is one of fundamental hydrodynamic instabilities in plasma. The KHI takes place in a velocity shear layer and has been considered to occur at in the low-latitude boundary layer. In the present study, we examine the effect of the ion gyro motion to the nonlinear growth of the KHI via a full-kinetic two-dimensional Vlasov simulation. We perform two simulation runs. In Run A, the direction of the ion gyro motion is opposite to the rotation direction of the KH vortex. In Run B, on the other hand, the directions are same.

It is found that the growth rate of a wave mode at the ion gyro radius in Run B is smaller than in Run A. This is due to the stabilization effect of the ion gyro motion. In Run A, a secondary instability occurs at the outer edge of the KH vortex where the half thickness of the gradient of the ion density and secondary velocity shear is thinner than the ion gyro radius. On the other hand, the secondary instability does not develop in Run B because the half thickness becomes similar spatial scale as the ion gyro radius.

Keywords: Kelvin-Helmholtz instability, Vlasov simulation, space plasma, ion gyro motion