Non-linear coupling between magnetic reconnection and MHD-scale Kelvin-Helmholtz instability: 2D-PIC simulations

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We have performed two-dimensional full particle (PIC) simulations to investigate the non-linear coupling between magnetic reconnection (RX) and the MHD-scale Kelvin-Helmholtz instability (KHI). The results from two-fluid simulations including electron inertial effects have revealed that when the magnetic field components along the k-vector of the KHI are anti-parallel across the velocity boundary layer (anti-parallel case), RX is induced by the flow of KHI at the non-linear stage. The non-linear coupling between RX and KHI can lead to the plasma mixing across the velocity boundary layer. Such plasma mixing may explain how the Earth's tail low-latitude boundary layer (LLBL) is formed. In the two-fluid system, however, since the motion of each particle is neglected the mixing process cannot be accurately understood. The kinetic effects may also deliver additional dynamics to the coupling between RX and KHI. Thus, in this study we use full particle PIC simulations of MHD-scale KHI for the anti-parallel case. This is the first study of the non-linear coupling between RX and MHD-scale KHI using kinetic particle simulations. In our presentation, we will show the plasma mixing and acceleration processes due to the non-linear coupling between reconnection and KHI, and discuss the necessity of large-scale simulations for understanding the large-scale development of MHD-scale KHI.