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Effects of guide field on quick magnetic reconnection triggering

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Effects of guide field on quick magnetic reconnection triggering (QMRT) in an ion-scale current sheet with the aid of the lower-hybrid drift instability (LHDI) activity have been investigated by two-dimensional (2-D) full-particle simulations. Firstly, tau = omega_pe/Omega_e = 1 (omega_pe: the electron plasma frequency, Omega_e: the electron cyclotron frequency) and the ion-to-electron mass ratio of M = 400 are set. When B0y = 0 (B0y: the guide field), the current concentration at the center of the current sheet is attained in reaction to the LHDI activity for D = 0.5 ~0.75 (D: the initial half thickness of the current sheet normalized by the ion inertial length), and its time scale is as quick as the LHDI time scale (Type-I). At the current sheet center the meandering-accelerated electrons are produced by the inductive electric field due to the LHDI activity. At D = 1, the electron temperature anisotropy Te,perp/Te,para = 1.5 is produced as quick as the LHDI time scale. In this case the bifurcated current layer structure is formed at the flank of the current sheet center (Type-II). When B0y = 0.25, the D = 0.5 case shows the Type-I current sheet structure and the electrons at the center are accelerated with the beam-like distribution. In contrast, at D = 0.75 with B0y = 0.25, the bifurcated current layer is formed at the flank of the current sheet, however no remarkable growth of the electron temperature anisotropy is attained in the LHDI time scale (Type-S). This case is too thick to be subject to QMRT. When setting the stronger guide field of B0y = 0.75, the D = 0.5 case has been found to be Type-S. Recovery of Type-I in B0y = 0.75 is found at D = 0.35.

Next, tau has been set to tau = 4 in order to see tau dependence on QMRT. When B0y = 0, D = 0.5 shows the Type-I aspects, whereas D = 0.75 shows the Type-II aspects. This implies that the transition from Type-I to Type-II shifts to smaller D. Meanwhile, two cases of D = 0.5 with B0y = 0.25 and D/ = 0.35 with B0y = 0.75 show the aspects of Type-S. This implies that the transition from Type-I to Type-S also shifts to smaller D. We have concluded that the guide field gives the larger impact on QMRT by increasing tau.

Lastly, one more simulation has been performed by setting D = 0.5, tau = 4 and B0y = 0 with the physically real mass ratio in order to see the tau effect on QMRT in the real mass situation. The detailed results will be discussed in the meeting.