Roles of plasma instabilities and particle kinetic effects in collisionless driven reconnection

Ritoku Horiuchi
National Institute for Fusion Science, Toki 509-5292, Japan

Roles of anomalous resistivity and particle kinetic effect in collisionless reconnection have been investigated by using two-dimensional and three-dimensional particle simulations for an open system in which plasma inflow and outflow exist through the boundary. From two-dimensional simulation it is found that there are two causes of violation of frozen-in constraint. One is the anomalous resistivity generated by drift-kink instability (DKI), and the other is the pressure tensor term originating from complex particle motion (meandering motion) around a neutral sheet. In driven case two-scale structure of current layer is generated due to meandering orbit effect. The Hall term effect is suppressed due to the gyroviscous cancellation in two-fluid MHD region, and thus the violation of ion frozen-in condition becomes significant inside the ion meandering region (see Fig. 1).

The relationship between anomalous resistivity due to DKI and pressure tensor term has been clarified from three-dimensional simulation. Anomalous resistivity generated by DKI is the main cause of violation of electron frozen-in constraint, while pressure tensor term (meandering orbit effect) sustains reconnection electric field in the ion diffusion region.

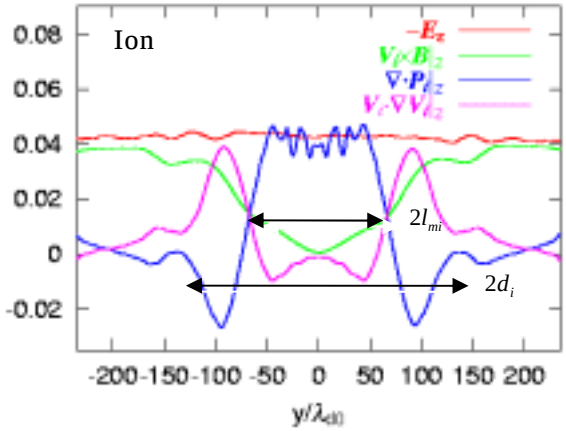

Fig. 1 Spatial profiles of non-ideal terms of ion fluid.