Three-dimensional Hall-MHD simulations of localized magnetic reconnection

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We have performed 3D Hall-MHD simulations to investigate Hall effects on magnetic reconnection localized in the current direction. Past 3D hybrid simulations implied that the reconnection region localized in the current direction could broaden towards the current direction due to the current disruption induced at the downstream region of the localized reconnection region [Nakamura and Fujimoto, 1998]. They, however, were not able to reproduce such the broadening of the reconnection region since the spatial scale of their simulations was too small and also they did not treat the current dependent resisitivity. In this study, we can successfully reproduce the broadening process of the reconnection region using large-scale 3D Hall-MHD simulations with the current dependent resistivity. Furthermore, we newly found that the reconnection region can move towards the anti-current direction when the initial current sheet is sustained by the electron current. These results strongly imply that not only the motion of the X-line in the magnetic field (X_GSM) direction but also that in the current (Y_GSM) direction should not be neglected in considering actual 3D situations. In this presentation, we will show the detailed results of 3D simulations and discuss how important the motion of the X-line in the current direction is in Earth's magnetotail situations.