Variation of electric field structure around an X-line associated with variation in reconnection rate

Kenya Shimizu[1]; Masaki Fujimoto[2]; Iku Shinohara[3]
[1] Earth and Planetary Science, Tokyo Univ.; [2] ISAS, JAXA; [3] ISAS/JAXA

We have inspected how the electric field structure around an X-line varies according to reconnection rate. In a very simple simulation of magnetic reconnection, where reconnection is initiated in a thin current sheet with anti-parallel magnetic field bounded by a periodic boundary, reconnection rate explosively increases, hits a peak, slowly declines, and then reconnection terminates. We will show that spatial structure of out-of-plane electric field (reconnection electric field) and temporal variation of the current-sheet-normal component of magnetic field according to the phase of reconnection. When reconnection rate hits a peak, the normal magnetic field is rapidly ejected from inner electron diffusion region, causing a downward convex profile of the electric field. This feature is also seen when overshoot of reconnection rate due to a plasmoid ejection occurs. On the other hand, when reconnection is about to terminate, the gradient of the electric field caused by increasing normal magnetic field becomes attached at the edge of the electron diffusion region, causing a barrier to set-up of electron outflow from the diffusion region. An analysis from the same perspective allows us a better understanding of how a retreating X-line, which is an X-line that retreats from a wall against which one of the jets from the X-line is ejected, can maintain high reconnection rate during its retreat motion.