リコネクション率に伴って変化するX-line近傍の電場構造に関する研究

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

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We have inspected how the electric field structure around an X-line varies according to reconnection rate. Reconnection rate is controlled not by electron physics in the vicinity of the X-line but by the macroscopic circumstances surrounding the X-line. In a very simple simulation of collisionless 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 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. Reconnection electric field at the outer edge of the electron diffusion region (EDR) reflects the MHD condition at an electron frame. The time evolution of the normal magnetic field at the edge of the inner EDR is closely related to the temporal behavior of reconnection rate. Comparing between the developing phase and the decaying phase of reconnection, we find that reconnection rate is affected by the reconnection electric field at the edge of the outer EDR though the gradient of the reconnection electric field at the edge of the inner EDR. This perspective is also applicable to complex cases including X-line's retreating and plasmoid ejection.