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Dipolarization front structure as viewed from three-dimensional PIC simulations

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Dipolarization fronts (DFs) are brief and sharp jumps of the magnetic field component normal to the tail, accompanied by the fast plasma flows. Two-dimensional Particle-in-Cell simulations reproduce many important features (B_z component jump, density peak/wake at/behind the front). However, such critical signatures like enhanced wave activity at the front, or strong normal (E_x) electric field are excluded in the two dimensions. We performed 3D Particle-in-Cell simulations of magnetic reconnection starting from a conventional Harris current sheet. At the earlier stages the evolution is comparable to that of 2D. Later times show the growth of the LHDI or interchange mode at the front, which creates the well-visible density 'fingers' and produces strong variations in the E_x field. We conclude that going beyond the usual two-dimensional description is necessary to explain the kinetic physics of the dipolarization fronts.