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Electron holes at magnetic reconnection separatrices: the role of streaming instabilities.

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Large electrostatic waveforms are the typical features of magnetic reconnection in the Earth's magnetotail observed by Cluster satellites. Kinetic simulations attribute such solitary waves to the generation of streaming instabilities created by the fast reconnection flows. The present contribution is focused on the detailed study of the separatrix instability which develops within the electron flow channel. The Particle-in-Cell simulations are performed with the realistic ratios of electron-to-ion mass and Alfven-to-light velocities, being possible by the use of the implicit moment PIC method [Brackbill, 1982], [Lapenta, 2006]. Electron separatrix jets are of particular interest because of their large spatial extent in the direction parallel to the magnetic field and, on the contrary, small thickness in the perpendicular direction. Bipolar variations of the parallel electric field are usually found there [Cattell, 2005], and represent the nonlinear stage of Buneman or electron two-stream instability characterized by the typical O-shaped profile in the phasespace. The instability is studied by means of the special high resolution Particle-in-Cell simulations with the initial condition at the separatrix taken from large-scale magnetic reconnection simulation [Lapenta, 2010]. Rotating the simulational plane with respect to the magnetic field, various electrostatic and drift modes are recovered. Large scale of the electron holes observed in the simulations is explained by the significant density depletion at the separatrix. Better theoretical understanding of the physics of magnetic reconnection is expected to contribute to a better identification of satellite data during active events in magnetosphere.