Geophysical Research Abstracts
Vol. 14, EGU2012-3557, 2012
EGU General Assembly 2012

Electric field structure inside the secondary island in reconnection diffusion region

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Secondary islands have recently been intensively studied because of its essential role in energy dissipation during reconnection. It is generally formed due to tearing instability in a stretched current sheet with or without guide field. In this presentation we study the electric field structure inside the secondary island in diffusion region by large scale two-and-half dimensional Particle-In-Cell (PIC) simulation. Intense in-plane electric fields, which point toward the center of island, are formed inside the secondary island. The magnitudes of in-plane electric field Ex and Ez inside the island are much larger than those outside the island in diffusion region. Their maximum magnitudes are about 3 times the B0VA, where B0 is the asymptotic magnetic field strength and VA is the Alfvén speed based on B0 and initial current sheet density. Our results could explain the intense electric field ($\sim$100mV/m) inside the secondary island observed in the Earth magnetosphere. Ex inside the secondary island is primarily balanced by the Hall term (j$\times$B)/ne, while Ez is balanced by a combination of (j$\times$B)/ne, -(vi$\times$B) and divergence of electron pressure tensor with (j$\times$B)/ne term dominates. This large Hall electric field is due to the large out-of-plane current density jy inside the island, which is mainly carried by accelerated electrons forming strong bulk flow in the –y direction. Ey shows bipolar structure across the island, with negative Ey corresponding to negative Bz and vice versa. It is balanced by (j$\times$B)/ne and convective electric field. There are significant parallel electric fields, forming quadrupolar structure, inside the island with largest amplitude about 0.3B0VA.