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Wave activity around the X-line observed in the near Earth magnetotail

I. Shinohara (1), H Kojima (2), T Nagai (3), and M Fujimoto (1)

(1) Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, (2) Research Institute for Sustainable Humanosphere, Kyoto University, (3) Department of Earth and Planetary Sciences, Tokyo Institute of Technology

We have examined plasma wave activity observed in the near Earth magnetotail reconnection event reported in Nagai et al., JGR (2011). Geotail encountered a reconnection site on May 15, 2003 where the enhanced cross-tail electron current layer was detected in association with the simultaneous plasma flow and magnetic field reversals. This event is thought to be the closest approach of Geotail to the X-line ever before. The intense plasma wave activity in wide frequency range is observed in the electron-ion decoupling region around the X-line. In particular, both the electrostatic and electromagnetic waves in the lower-hybrid frequency range are observed, and those are expected as a result of the lower-hybrid drift instability in a thin current sheet. However, the most surprising result is that the wave intensity right in the center of the electron current layer, that is a possible X-line, is much weaker than that in its surrounding region. The observed wave power at the X-line cannot explain the anomalous resistivity sufficient to the energy dissipation for fast magnetic reconnection. The Geotail observation suggests that the magnetic diffusion region of the near Earth magnetotail reconnection site is mainly controlled by the physics of the collisionless reconnection process, rather than the anomalous resistivity due to turbulence. We also have tested the consistency of the observed spatial structure with the collisionless reconnection model, and found that the estimated reconnection electric field and electron flow distribution in the electron-ion decoupling region agree with the theoretical model. These results support the collisionless reconnection model that can be seen in results of recent full kinetic numerical simulations.