Electron dynamics around the X line observed by the Cluster multi-satellite observations

Yoshihiro Asano[1]; Rumi Nakamura[2]; Masaki Fujimoto[3]; Iku Shinohara[4]; Andrei Runov[5]; Wolfgang Baumjohann[6]; Taku Takada[7]; Klaus Torkar[5]; Christopher J. Owen[8]; Andrew Fazakerley[9]; Berndt Klecker[10]; Andre Balogh[11]; Henri Reme[12]

[1] IWF; [2] IWF,OEAW; [3] DEPS, TITECH; [4] JAXA/ISAS; [5] IWF, OeAW; [6] IWF,OEAW
; [7] IWF, OEAW; [8] MSSL, Univ. Coll. London; [9] MSSL, UCL; [10] Max-Planck-Institut; [11] Imperial College; [12] CESR

Magnetic reconnection plays an important role in the conversion from magnetic energy to thermal and kinetic energy in the magnetotail. Plasma particles supplied from the lobe (inflow region) are accelerated and thermalized, then ejected into the plasma sheet (outflow region).

Through more than a decade of recent satellite observations by Geotail, WIND and other satellites, we obtained plenty of kinetic features associated with magnetic reconnection: ion dynamics have been mostly revealed and there has been large progress of theoretical and numerical analyses. Electron observations also gave us some interesting features, such as inflow beams associated with the Hall current system around the X line, however, several processes which cause atypical distributions, different from the simple Maxwellian, are not yet clear. In order to reveal the spatial and temporal evolution of such electron distributions and discuss mechanisms, we examined electron data obtained from PEACE instrument on board the four Cluster satellites. During the magnetotail orbits (between July and October) from 2001 to 2003 with different spatial separation among the satellites, we picked up several substorm events with fast ion flow observations and with highly thermalized flat-top electron distributions, and examined the characteristics of electron distributions.

In the vicinity of the X line we found accelerated inward beams into X lines up to 5 keV, which is distinctively higher than the inward beams observed in the plasma sheet-lobe boundary associated with the Hall current system

(0.5 - 1.0 keV), and similar energy as the edge of the background flat-top distributions. They are associated with high-energy ion outflows, yet quadrupole-like By is not always clearly observed. We also discuss the spatial distribution of electron distribution functions among the satellites.