Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PEM09-03 Room:211 Time:April 28 09:30-09:45

Geotail observation of magnetic reconnection

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The spacecraft Geotail was launched on July 24, 1992. The main objective of the Geotail mission is to explore magnetic reconnection with in situ observations, and the Geotail mission has revealed various physical processes of magnetic reconnection. The ion-electron decoupling region where electron outflow speed differs from ion outflow speed is formed in the magnetic reconnection site. Ion and electron dynamics in the ion-electron decoupling region is derived with magnetic field and plasma observations by the spacecraft Geotail in near-Earth magnetotail magnetic reconnection. The ion-electron decoupling region has a spatial extent of approximately 11 ion inertial length along the GSM x direction, and the dawn-dusk current sheet with main current carriers of electrons exists over this region. An intense electron current layer with a spatial extent of 0.5?1 ion inertial length occupies in its center around the X line. High-speed electron outflow jets are formed just outside the central intense electron current layer. They are decelerated and become non-jet outflows with speed slightly higher than ion outflow speed. Electrons have flattop distribution functions indicating heating and acceleration in both the outflow jets and the non-jet outflows; however, heating and acceleration are weak in the central intense current layer. Inflowing ions enter the central intense electron current layer, and these ions are accelerated up to 10 keV inside the electron outflow jet regions. Ion acceleration beyond 10 keV and thermalization operate mostly in the non-jet electron outflow regions. Electrons show thermal distributions without any heating/acceleration signatures immediately beyond the edge of the ion-electron decoupling region, while higher-energy ions pervade even beyond the edge and hot MHD plasma flows are produced.

Keywords: magnetic reconnection, space plasma, substorm, magnetotail