MULTI-POINT OBSERVATIONS OF MAGNETOTAIL RECONNECTION

R. Nakamura[1]

[1] *Space Research Institute, Austrian Academy of Sciences*

Magnetic reconnection is one of the key processes in space plasmas. It converts magnetic field energy into particle energy and enables to mix plasmas from different origins. In the Earth's magnetotail, magnetic flux transported from the dayside causes increased magnetic stress and forms a thin current sheet leading to magnetotail reconnection. It can affect the large-scale dynamics of the Earth's magnetotail such as during substorms and storms. Important consequence of the reconnection is also the narrow fast plasma jets (known as bursty bulk flows), which provide the major contribution to energy and mass transport in the magnetotail. This paper is a review of the current understanding of the magnetotail reconnection obtained from Cluster multi-point measurements. Being a constellation of four identical spacecraft, Cluster allows discrimination of spatial and temporal variations in magnetic field and plasma parameters at its tetrahedron scale. Thus it is ideal to study the structure and dynamics of plasma and fields relevant to reconnection, which is a highly dynamic system. Depending on the spatial scales of the Cluster tetrahedron different characteristics of the tail reconnection have been obtained. Observations from a relatively large-scale tetrahedron (2000-4000 km) obtained simultaneous measurements in different plasma regions, to monitor simultaneously the inflow signatures and acceleration processes closer to the neutral sheet and its development. We highlight four point measurements at the smallest scales (200 km) that obtained characteristics of the ion-scale thin current sheet. These detailed studies found 3-D temporal/local events during a longer lasting thin current sheet interval showing X-line signatures (reversal from tailward flows with negative Bz to Earthward flows with positive Bz) on average. Characteristics of the Hall-current in the ion diffusion region and a 3D nature of the localized magnetic structures in the reconnection region without guide field and with guide field are discussed. Possible acceleration/scattering sites of the electrons, which are expected to carry currents in the ion diffusion region, are identified around the X-line and close to the flux lope structure within the thin current sheet near the reconnection site. These observations suggest that in order to understand reconnection it is essential to examine these transient small-scale signatures in a larger context of thin current sheet development.