

Observation of auroral brightenings and fast plasma flows produced by magnetic reconnection in the magnetotail

*Kawashima Takahiro¹, Akimasa Ieda¹, Miura Tsubasa¹

1. Institute for Space-Earth Environmental Research

Substorm is explosive release of energy that is stored in the magnetotail and is manifested by explosive auroral brightenings. According to the reconnection model of substorm, the stored magnetic energy is converted to the plasma energy by the magnetic reconnection at about 20 Re down the tail. This magnetic reconnection creates a pair of earthward and tailward fast plasma flows. The earthward plasma flows are supposed to hit the inner magnetosphere at 10 Re down the tail, leading to explosive auroral brightenings (i.e., substorm onset). Thus, fast plasma flows are expected at 10 Re and beyond at the times of substorm onsets. To demonstrate this expectation, in this study we investigated fast flow produced by magnetic reconnection, using multi-satellite observations of the tail and ground all-sky images. Thus, we investigated this reconnection event with fast tailward flow.

At 06-07 UT February 27, 2009, each of THEMIS satellites were located near midnight 21 Re (THEMIS-1), 18 Re (THEMIS-2) and 11 Re (THEMIS-3, 4, 5) down the tail. Satellite foot-points were located near Gillam (magnetic latitude: 66.0 degree) in Canada. An auroral brightening started at 0636:00 UT (23.5 MLT) with ray structure. At this time, THEMIS-1 observed tailward fast flow at 21 Re. In addition, THEMIS-3, 4 observed earthward fast flow at 11 Re. In contrast, THEMIS-2 did not observe fast flow. Since the plasma beta was decreasing at this time, THEMIS-2 moved toward the tail lobe. These THEMIS 2 observations suggest that no fast flow was observed at 18 Re because the plasma sheet was thinning.

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