

Magnetopause motions during substorms

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In this paper we study the motion of the magnetopause during the substorm by using the GEOTAIL data. We present an event near $X=-5R_E$ observed on Feb. 21, 1997. In this event, GEOTAIL observed the inward motion of the magnetopause after the substorm expansion onset, followed by its return to the pre-substorm position near the end of the substorm. This is the same feature as was observed in a previously studied mid-tail event. In order to find if this feature is common, we also perform a statistical analysis using the GEOTAIL data.

Past studies have shown that the tail magnetosphere tends to inflate during the substorm growth phase and recover toward the quiet-time shape after the expansion onset. The purpose of this paper is to examine the magnetopause motion during the substorm by using the GEOTAIL observations. The orbit of GEOTAIL is set so that it is often close and parallel to the average magnetopause shape in the wide X range, enabling us to monitor the motion of the magnetopause unaffected by the motion of the satellite itself. In addition, in contrast to the satellites used in the past studies, GEOTAIL mainly observes the low-latitude magnetopause, also because of its orbit design.

Last year we studied an event in which GEOTAIL skimmed the mid-tail magnetopause during a series of substorms. For all substorms in the event, GEOTAIL exited from the tail to the magnetosheath after the expansion onset, and then returned to the tail near the end of the recovery phase. This suggests that the tail shrank after the onset, presumably as a result of the near-Earth neutral line formation, and then recovered toward a quiet-time

shape. This does not necessarily contradict with the result of the past studies, but the inward motion of the tail magnetopause after the onset may need to be regarded as a dynamic tail shrinkage rather than a recovery of the inflated tail.

As an example closer to the Earth, we present in this paper an event observed by GEOTAIL near $X=-5R_E$ on Feb. 21, 1997. GEOTAIL also exited from the magnetosphere to the sheath after the substorm expansion onset and then returned to the magnetosphere near the end of the substorm. However, in this event, the interplanetary magnetic field turned southward near the expansion onset time, thus there is a possibility that the flux erosion from the magnetopause caused the above-stated magnetopause motion. The two possibilities are examined in detail to clarify which was actually effective for this event. We also perform a statistical analysis of the GEOTAIL data to obtain a general picture of the magnetopause motion during the substorm.