

## On the Pressure Balance between the Plasma Sheet and the Lobe in the distant magnetotail

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We have statistically studied Pressure Balance between the plasma sheet and the lobe in the distant magnetotail using data obtained by GEOTAIL.

First of all, we selected events where the spacecraft transverses from the lobe (neutral sheet) to the neutral sheet (lobe), and then got 232 events.

Based on the statistical analysis of the observed data, we have found that plasma sheet is not always balanced with the lobe.

Studying in detail, we have found that Pressure Balance breaks in the events where the spacecraft observed near the reconnection region. This result indicates that there certainly exists two (or three) dimensional structure in the distant magnetotail. In such cases there must be the acceleration of the plasma in X direction to be balanced with the gradient of the total pressure.

Distant magnetotail has been explored with the data obtained mainly by the two space craft, ISEE-3 and GEOTAIL. From many studies, we now know its average feature. There exist one dimensional anti parallel magnetic structure in the high latitude region (Lobe) separated by the Plasma Sheet which is filled with hot plasma. In a such region, Plasma Sheet may exist in a steady state because many observations show a property of the Plasma Sheet.

To be stable, Plasma Sheet must exist under some force balances. We derived the force balance on the Plasma Sheet in the distant magnetotail from the MHD equations and found that Pressure Balance between the Lobe and the Plasma Sheet must be established.

We have statistically studied this Pressure Balance in the distant magnetotail ( $X_{GSM} < -75$ ) with the data obtained by GEOTAIL. First of all, we collected the events where the spacecraft transverses from the Lobe (Neutral Sheet) to the Neutral Sheet (Lobe) and then got 232 events. With these events we checked the Pressure Balance and then found that Plasma Sheet is not always balanced with the Lobe.

Before we conclude that the Plasma Sheet is not stationary stable in the distant magnetotail, we studied in detail the events where the Pressure Balance breaks. As a result, we have found that Pressure Balance breaks in some special events which have the following characteristics.

- 1, Reversals of fast flow ( $|V_x| > 300\text{km/s}$ ) in the plasma sheet are observed.
- 2, Plasmoids are observed before the events within 2 hours.
- 3, Slow-mode shock boundaries are observed before and/or after the events within 2 hours.
- 4, Higher temperature and more tenuous density plasma sheet is observed.

It seems that the events with these characteristics indicate that the spacecraft observed near the reconnection region. So, as a one of conclusions, we have confirmed that there certainly exists a two (or three) dimensional structure which can be explained by the reconnection model in the distant magnetotail.

Then we have studied the two dimensional effects to be balanced with the gradient of the total pressure. From the order estimation result, the acceleration of the plasma in X direction must exist to be balanced with the gradient of the total pressure. This result also supports the reconnection model where the plasma is accelerated by the magnetic tension.