

GENERATION OF THE SUBSTORM-FAC BY SLOW MODE DISTURBANCES IN THE NEAR EARTH PLASMA SHEET

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The magnetospheric substorm is the fundamental but unsolved problem in the solar-terrestrial physics. In our previous studies, by using the GOTAL/MGF, LEP, and EPIC data, we have presented the fundamental structure of convection in the near-earth magnetotail and suggested a scenario for the behavior of near-earth plasma sheet during substorms. Observational facts obtained from these studies are summarized as follows: (1) The stress balance is primarily achieved by $-\text{grad } P$ and $\mathbf{J} \times \mathbf{B}$. This basic condition remains unchanged even in the magnetotail disturbances. (2) The diamagnetic property pertains to variation of all time scales. (3) In relatively near-earth magnetotail, $-\text{grad } P$ is intensified for a few tens of minutes prior to the onset of magnetotail disturbances. The enhancement subsides in accordance with the development of disturbances. As for the interval of substorms, (i) during the growth phase, plasma pressure is intensified in the near-earth plasma sheet and additional earthward pressure gradient is superimposed to the background gradient. The plasma pressure peak is formed in the region less than the radial distance of $8 R_E$. (ii) After the onset, enhanced pressure gradient is reduced in accordance with the development of slow mode disturbances. Consequentially, the plasma stress and the Maxwell stress are reduced in the near-earth tail where they have been intensified during the growth phase.

From these observational facts, it is suggested that the slow mode is the primary process as the non-Alfvénic (non-convective) motion in the earth's magnetotail. The role of slow mode motion is to resolve the pressure gradient and magnetic tension along the background magnetic field. The slow mode disturbance is crucial for the redistribution of plasma fluid along the magnetic field and the reconfiguration of magnetic field.

The excitation of the substorm-FAC must be explained by the energy and stress balance consistent with the above facts. In this paper, we refine the data analysis and examined in detail some substorm events. We will show the obtained results and propose its implication for the excitation of substorm-FAC.

energy and momentum balance, slow mode, FACs

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