南向き惑星間空間磁場に対する近地球低緯度マントル領域のプラズマ対流

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Plasma convection in the near-Earth low-latitude mantle for southward IMF

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The plasma mantle is a magnetospheric boundary layer which the magnetosheath plasma flows into and where stronger field of the magnetospheric lobe is balanced by decreasing density. In this region the plasma density, bulk speed, and the magnetic field are therefore intermediate between those of the magnetosheath and the tail lobe. The plasma mantle having these properties was first found poleward of the cusp, i.e., at the near-Earth high-latitude magnetosphere, and later identified in the distant tail with ISEE3 and early Geotail observations.

These distant tail observations also have shown that the distant plasma mantle can occur even near the equatorial plane in association with the twisting of the magnetotail. This twisting is believed to be smaller in shorter distances from the Earth, which appears to fit in a picture that the near-Earth mantle exists in the high-latitude magnetosphere. This may expect that it is the mantle plasma originating from the high-latitude, i.e., having velocities toward the neutral sheet that Geotail at near-Earth low-latitude orbits can identify.

We report the Geotail observations of the near-Earth plasma mantle, and show that the convection of the low-latitude mantle plasma for southward IMF is rather poleward as opposed to the above expectation. First, we examined the Geotail data obtained near the magnetopause crossing at X = 5 - -15 RE, and searched for the plasma mantle using appropriate criteria based on the LEP and MGF data. For the identified mantle intervals, we then examined the WIND solar wind data, and selected the mantle events that correspond to southward IMF, considering the solar wind transit time from WIND to Geotail.

The identification location of these mantle events is naturally in the low-latitude, within |Zgsm|= 10 RE, due to the Geotail orbits. The plasma velocity perpendicular to the magnetic field has clear poleward and inward components in addition to the tailward component. The magnitude of the poleward component is 30 to 80 km/s, which is usually dominant. Their low-latitude location and poleward convection show that the magnetosheath plasma flows into the mantle from some place near the equatorial plane or even in the opposite hemisphere, and that the mantle plasma convection in the GSM Y-Z plane is roughly aligned to the magnetopause. The location of the mantle events clearly has By-dependence, that is, the mantle identified in the northern dusk corresponds to negative IMF By, and the northern dawn mantle is for positive By. This tendency is true when the By-component is relatively small, i.e., close to purely southward IMF. Considering plasma and magnetic field signatures for the non-mantle magnetopause crossing, detailed convection patterns in the near-Earth low-latitude mantle will be presented, and the magnetosheath plasma entry into the magnetosphere will be discussed.