論文内容の要旨

論文題目　Signatures of the cold plasma sheet in the near-Earth magnetotail
（地球磁気圏近尾部の冷たいプラズマシートの性質）

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The cold plasma sheet formation under northward interplanetary magnetic field (IMF) has been an important issue of the magnetospheric physics. In order to obtain clues to understanding the cold plasma sheet formation under northward IMF, we perform following studies basing upon spacecraft observations.

In Chapter 2 and 3, we study the temperature anisotropies of electrons and two-component protons observed by the Geotail spacecraft. The two-component protons result from mixing of the cold component from the solar wind and the hot component of the magnetospheric origin, and may be the most eloquent evidence for the transport process across the magnetopause. The cold component occasionally has a strong anisotropy in the dusk flank, and the sense of the anisotropy depends on the observed locations: the parallel temperature is enhanced in the tail flank while the perpendicular temperature is enhanced on the dayside. The hot component is nearly isotropic in the tail while the perpendicular temperature is enhanced on the dayside. The parallel anisotropy of electrons is stronger than that of the cold proton component, which is attributed to selective heating of electrons. We further find that strengths of the parallel anisotropies in the tail flank depend on the latitudinal angle of the IMF; strong parallel anisotropies occur under strongly northward IMF. We discuss that the Kelvin-Helmholtz vortices developed under strongly northward IMF and resultant magnetic reconnection therein may lead to the strong parallel anisotropies observed in the tail flank.

In Chapter 4, we perform a case study of a duskside Kelvin-Helmholtz (KH) vortices event on 24 March 1995. We have found that the parallel anisotropy of electrons starts

to be enhanced on the magnetosheath side of a current layer in the KH vortical structure, and low-energy bidirectional electron beams or flat-topped shape of the electron distribution functions in the direction along the local magnetic field are apparent on the magnetosphere side of the current layer. The protons consisted of two separate (cold and hot) components in the magnetosphere-like region inside the KH vortical structure, where the cold proton component have a strong parallel anisotropy and it consisted of bidirectional beams in the region near the boundary. We discuss that the bidirectionality of electrons and the cold proton component implies magnetic reconnection inside the KH vortical structure. In addition, we suggest selective heating of electrons inside the vortical structure. Comparing temperatures in the magnetosphere-like region inside the vortical structure with those in the cold plasma sheet, we show that further heating is taking place in the cold plasma sheet or on the way from the vortices to the cold plasma sheet.

In Chapter 5, we deal with the cold plasma sheet found in the midnight region. Through the effort to obtain clues toward understanding of transport of cold plasma in the near-Earth magnetotail under northward IMF, we find that two-component protons are observed in the midnight plasma sheet under northward IMF. Since the two-component protons are frequently observed on the duskside during northward IMF intervals but hardly on the dawnside, those found in the midnight plasma sheet are thought to come from the dusk flank. The cold proton component in the midnight region occasionally has parallel anisotropy, which resembles that in the tail flank on the duskside. The flows in the plasma sheet with two-component protons were quite stagnant or slightly going dawnward, which supports the idea that the observed two-component protons in the midnight region are of duskside origin. Because the two-component protons in the midnight plasma sheet emerge under strongly northward IMF with the latitudinal angle larger than 45 degrees, and because the lag from the strongly northward IMF to the emergence can be as short as a few h, we suggest that prompt plasma transport from duskside to midnight region occurs under strongly northward IMF. In addition, we also suggest that gradual cooling of hot protons under northward IMF is a global phenomenon in the near-Earth magnetotail.