Statistical analysis on the plasma dynamics of vortices at the magnetopause

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The plasma mixing and transport are recognized as one of important processes in the astroplasma as well as in the space plasma physics. From the viewpoint of plasma supply to the earth's magnetosphere, the entry processes of solar wind plasma have long been studied. It has been shown statistically that during periods of northward IMF the plasma sheet is cold and dense, especially there are temperature minima and density maxima along the dawn and dusk flanks [Terasawa et al., 1997;Wing and Newell., 2002]. It is believed that the one of plasma mixing processes is the Kelvin-Helmholtz instability which develops by being the velocity shear between the flow of the magnetosphere and the flow of the magnetosheath region[Sckopke et al., 1981]. However, how plasma is transported while passing such a mixing process is not yet clarified.

This study is based on the rotation angle of flow velocity classified into four kinds of the waveform. Statistically we can obtain the occurrence frequency of vortices, although intrinsically the magnetopause is oscillatory. We found that the vortices are more often observed during the northward IMF than during the southward IMF. Moreover we found that the width of region where the vortices are observed is thicker in the dawn side than in the dusk side.

In order to examine the possibility of turbulent transport of plasmas suggested in simulation research [Matsumoto and Hoshino 2004], we built a model geometrically for the simplest structure of vortex and investigated the travelling directions of vortex. In the case of the prolonged northward IMF, it is found that the density ratio between magnetosphere side and magnetosheath side influences the travelling directions of vortex, and namely promotes the plasma transport. It may be that the pressure gradient acts effectively the vortex invasion toward magnetosphere.