The Martian Induced Magnetosphere Boundary from the Proton and Alpha particle observation

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Abstract

The Martian ionospheric plasma directly interact with the solar wind due to the lack of the strong intrinsic magnetic field. The recent observations by Mars Express (MEX) revealed that there are three plasma boundaries in the interaction region; the bow shock, the induced magnetic boundary (IMB), and the photoelectron boundary [Lundin et al., 2004]. The IMB is defined as the envelope of the induced magnetosphere which means that the IMB is the stopping boundary for the solar wind. On the other hand, Mars Global Surveyor defined another boundary called the magnetic pileup boundary (MPB). The characteristics of the IMB are not yet well known, especially the relationship between the MPB and the IMB is still an open question.

We searched 300 orbits, (Jun.7-Jul.4 2004 and Jan.17-Mar.13 2005), and identified 132 IMB crossings. Because the IMB have large thickness, we used two definitions of the IMBs; Top of the IMB (IMB_T) and Bottom of the IMB (IMB_B). The IMB_T is the point where the solar wind ions begin to decrease. The IMB_B is the position where the solar wind proton or alpha particles disappear. We obtained the average locations and the distributions of the IMBs by plotting those boundary crossings on three-dimensional maps to investigate the difference and similarity between the IMB and the MPB.

We also investigated the dependence of the IMB positions for different solar wind species. By the identification of the IMBs for the proton and alpha particle independently, and found that the observed alpha boundaries are occasionally higher than the proton boundaries. This tendency conflicts with Mars-solar wind interaction theories considering gyromotion. In those theories, the proton boundary should be higher than the alpha boundary because the Larmor radius of the protons is smaller than that of alpha particles. We would discuss possible physical processes that explain the tendency of the IMB locations for different species.