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

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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. The relationship between the IMB (defined by ion data) and the MPB (the magnetic pileup boundary, defined by magnetic field data of Mars Global Surveyor) is not clear and is still an open issue.

To study the characteristics of the IMB, we surveyed about 300 orbits, (Jun.7-Jul.4 2004 and Jan.17-Mar.13 2005), and identified 132 IMB crossings.

Because the IMB have finite thickness, we used two definitions of the IMBs; Top of the IMB (IMBT) and Bottom of the IMB (IMBB).

The IMBT is the point where the solar wind ions begin to decrease.

The IMBB is the position where the solar wind proton and 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.

The boundary identification is done for different solar wind species, i.e., protons and alpha particles, respectively. While the Mars-solar wind interaction theories considering gyromotion predicts that the proton boundary should be located at higher altitude than the alpha boundary because the Larmor radius of the protons is smaller than that of alpha particles, observations show opposite: we found that the observed alpha boundaries are occasionally located at higher altitude than the proton boundaries. We discuss possible physical mechanisms that may explain this discrepancy.