太陽風侵入イベント時におけるマグネトシース-火星電離圏境界層の特徴の研究

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Characteristics of boundary layer between the magnetosheath and Martian ionosphere during solar wind penetration events

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Deceleration of the solar wind due to the mass loading by planetary heavy ions forms the magnetic pile-up region around unmagnetized planets such as Mars and Venus. The Martian magnetic pile-up region diverts shocked solar wind plasma around the planet at altitudes typically in excess of 800 km [e.g., Vignes et al., 2000]. Mars Global Surveyor (MGS) measurements have shown, on one hand, that shocked solar wind (magnetosheath) electron occasionally penetrates into much lower altitudes (400km) [e.g., Brain et al., 2005; Crider et al., 2005]. Our previous statistical study of these solar wind penetration events using MGS magnetic field and electron observations revealed that both solar wind dynamic pressure (Psw) and the orientation of the interplanetary magnetic field (IMF) control the occurrence of the events. However, MGS could not observe the solar wind regions due to its orbital design.

In this study, we focused on the simultaneous observation of the penetration events by MGS and Mars Express (MEX). MEX possess the ion mass analyzer (IMA) and electron spectrometer (ELS), which are parts of plasma packages of Analyser of Space Plasma and EneRgetic Atoms (ASPERA-3). A part of its one orbit, MEX observed the solar wind region, since the orbit of MEX is elliptical orbit. We can thus obtain the solar wind density and velocity.Among the simultaneous observation data by MEX and MGS, we identified 26 simultaneous events of the solar wind penetration. The solar wind penetration event on January 20, 2005 is observed during the high Psw periods, while the event on February 20, 2005 is during the low Psw periods. From these two typical events, we investigated characteristics of the boundary layers between the magnetosheath and the ionosphere. We found that the electron flux shows a gradual decrease in the boundary in the high Psw event. On the one hand, intermittent appearance of both the magnetosheath plasma and the ionosphere plasma in the boundary is during the low Psw event. The signature of the boundary layer resembles with the K-H instability signature seen in LLBL (low-latitude boundary layer) in the Earth's magnetotail [e.g., Hasegawa et al., 2006]. We also report the results of statistical analysis of 26 simultaneous observation events.