Title:

The Study of Martian Plasma Boundaries Based on Spacecraft Observations

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Abstract:

Direct interaction between the solar wind and the Martian upper atmosphere forms a characteristic region, called the induced magnetosphere between the magnetosheath and the ionosphere. Since the solar wind deceleration due to increasing mass loading by heavy ions plays an important role in the induced magnetosphere formation, the ion composition is also expected to change around the induced magnetosphere boundary (IMB). Here we report on the relations of the IMB, the ion composition boundary (ICB), and the pressure balance boundary based on a statistical analysis of about 8-months of simultaneous ion, electron, and magnetic field observations by Mars Atmosphere and Volatile EvolutioN (MAVEN). We chose the period when MAVEN observed the solar wind directly near its apoapsis to investigate their dependence on solar wind parameters. Results show that IMBs almost coincide with ICBs on the dayside and locations of all three boundaries are affected by the solar wind dynamic pressure. A remarkable feature is that all boundaries tend to locate at higher altitudes in the southern hemisphere than in the northern hemisphere on the nightside. This clear geographical asymmetry is permanently seen regardless of locations of the strong crustal magnetic fields in the southern hemisphere, while the boundary locations become higher when the crustal fields locate around the noon local time. On the nightside, IMBs usually locate at higher altitude than ICBs, except for the periods when IMF B_y is positive and the strong crustal fields locate on the dayside, suggesting enhanced cold ion outflows from the dayside mini-magnetosphere under this specific condition.