Title: Comparison of Martian magnetic pileup boundary with ion composition boundary observed by MAVEN

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Abstract:

Since Mars does not possess an intrinsic global magnetic field, the Martian upper atmosphere directly interacts with the solar wind. This interaction forms plasma boundaries between the solar wind and the Martian upper atmosphere. Previous in-situ spacecraft observed two plasma boundaries: “the ion composition boundary” (ICB) and “the magnetic pileup boundary” (MPB). ICB separates the region where the solar wind protons are dominant from where the planetary heavy ions are dominant. MPB is caused by pile up of the draping IMF in front of the Martian upper atmosphere. Mars Global Surveyor (MGS) observed MPB, a boundary between the magnetosheath and the Martian magnetic pileup region by its magnetometer and electron reflectometer. ICB was also observed by the ion mass analyzer of Phobos 2 and Mars Express (MEX). Due to the lack of continuous simultaneous observations of the magnetic field and ion composition, however, relations between MPB and ICB are far from understood. In this study, we investigate relative locations and characteristics of MPB and ICB, and their dependence on solar wind parameters, utilizing a full package of plasma instruments onboard Mars Atmosphere and Volatile EvolutioN (MAVEN).

We conducted a statistical analysis of the ion, electron, and magnetic field data obtained by MAVEN from November 2014 to March 2015 in order to investigate relations between MPB and ICB. We identified MPB from the electron and magnetic field data by inspection based on criteria of Trotignon et al. [2006]. We calculated the density ratio between the planetary heavy ions and the solar wind protons to investigate the ion composition around MPB. Results show that there is a north-south asymmetry in locations of MPB and ICB. Observations also indicate that the relative location of MPB and ICB has deference between dayside and nightside. Moreover, the southern crustal magnetic fields seem to play a role of the north-south asymmetry in locations of MPB and ICB. However, dependences of MPB and ICB on the solar wind dynamic pressure, density, and velocity are not clear. The solar wind induced magnetic field direction also has no clear effects on ICB and MPB locations.