MAVEN 観測に基づく太陽風電場と地殻磁場が火星からの重イオン流出に与える影響の統計的研究

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Effect of the crustal magnetic fields and solar wind electric fields on heavy ion outflows from Mars observed by MAVEN

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Geological studies have suggested that Mars had a warm climate and liquid water on surface about 4 billion years ago. Now, Mars has a cold surface temperature and little water on surface. Escape of greenhouse gases such as CO_2 to space is considered as the plausible reason to cause the drastic climate change. On one hand, mechanisms enabling the large amount of the CO_2 loss are far from understood. The planetary ion escape through interaction between the solar wind and the Martian upper atmosphere is one of the candidate mechanisms to achieve the atmospheric escape. Mars doesn't have global intrinsic magnetic field, but it has local crustal magnetic fields. Effects of this crustal magnetic fields on the atmospheric escape are far from understood. To understand atmospheric loss from Mars, MAVEN (Mars Atmosphere and Volatile EvolutioN) has observed the ion escape from Mars as well as space environment around Mars since November 2014. In our previous study, we investigated detailed characteristics of a dense cold ion outflow event observed in the Martian induced magnetotail based on the MAVEN observations. We suggested that the combination of the mini-magnetosphere and the downward-E hemisphere facilitates the cold ion escape from low altitude Martian ionosphere.

In this study, we report on a statistical analysis of heavy ion outflows from Mars to investigate influence of the crustal magnetic fields and the direction of solar wind electric field on the ion outflows by using the data of MAVEN. STATIC (Supra-Thermal And Thermal Ion Composition), SWIA (Solar Wind Ion Analyzer) and MAG (Magnetometer) data from November 2014 to March 2017 were used for the statistical study. We focused on the heavy ion outflows in the wake region. At first, we selected the orbits in which solar wind was stable. The stability condition of solar wind was determined by the direction of the interplanetary magnetic field (IMF). We only include the wake observations in the statistical study, if difference between IMF directions observed just before and immediately after the wake observation is less than 30 degrees. Next, we divided observed data by the location of the strongest local crustal magnetic field around east longitude of 180 degrees into 4 local time groups: noon, dawn, dusk, and night. The results show that number densities of heavy ions observed in the southern hemisphere in the MSE coordinates tend to be higher than those observed in the northern hemisphere, while there are no clear difference in number fluxes between the two hemispheres. We will also report on dependence of heavy ion outflows on other solar wind parameters.