Investigation of periodic electron injection observed in Martian crustal magnetic fields with MAVEN and MGS

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Mars has no global intrinsic magnetic field, but it has relatively strong crustal remanent magnetic fields. The solar wind interacts with these localized crustal magnetic fields and with the upper atmosphere of Mars, forming a complex magnetosphere. Provided that electrons get injected impulsively from the adjacent plasma into closed magnetic field lines formed above the strongly magnetized areas, they drift in an energy-dependent manner in the direction perpendicular to the magnetic field while bouncing between the mirror points, producing energy-time dispersion at a fixed observing point on the closed filed line. These energy-time dispersed electron signatures were measured by the Mars Atmosphere and Volatile EvolutioN (MAVEN) mission. It has been reported that the energy-time dispersed electron signatures sometimes occur periodically for multiple times in succession, but the generation mechanism of this periodicity has not been clarified yet. In this study, we investigate characteristics of these periodic electron energy-time dispersion observed in the crustal magnetic fields of Mars using the solar wind electron analyzer (SWEA) and magnetometer (MAG) onboard MAVEN, and the electron reflectometer (ER) and magnetometer (MAG) onboard the Mars Global Surveyor (MGS). First, we conducted a survey of the periodic events from the MAVEN data obtained from September 2014 to September 2020 at altitudes from 200 km to 1000 km. As a result, we identified 211 cases in which electron energy-time dispersion was observed for multiple times in succession. In addition, we analyze the MGS data obtained from March 1999 to November 2006. Although no cases of the periodic electron energy-time dispersion have been reported from the MGS data, we have identified such cases by utilizing the methodology originally developed for the MAVEN data analysis. We will discuss long-term trends of these events based on statistical results derived from a large amount of the MGS data.

Keywords: Mars, Martian crustal magnetic fields, the energy-time dispersed signatures, MAVEN, MGS

