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14:45-15:00

Statistical properties of solar energetic electron penetration into the Martian upper atmosphere observed by MAVEN

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The diffuse aurora observation at Mars in the region where the crustal magnetic field is absent, indicates penetration of the high-energy electrons of ~100 keV down to the altitudes around 70 km along the draped IMF around the planet [Schneider et al., 2015; 2018]. However, how the draped magnetic field configuration around Mars controls the SEP (solar energetic particle) electron penetration to the atmosphere is far from understood. Moreover, global simulations of the solar-wind-Mars interaction have shown that the existence of the crustal magnetic fields primarily in the southern hemisphere results in the complexed magnetic structure around entire Mars [e.g., Luhmann et al., 2015].
In this study, we investigated SEP events observed by MAVEN from December 2014 to October 2017 in order to investigate effects of the magnetic field structure in the ionosphere, including both the crustal magnetic fields and penetrating draped IMF, on SEP pitch angle distributions and energy dependent loss into the atmosphere. The pitch angle (PA) distributions of the high-energy (30-210 keV) electrons observed in the Martian ionosphere are analyzed in details. In order to achieve a good coverage in the 2-D (PA-energy) phase space, data obtained during a SEP event is accumulated and binned. Using the elevation angle of the local magnetic field, we also sorted the data so as to investigate the SEP electron loss below the MAVEN periapsis (~150 km altitude). The obtained PA distributions in the ionosphere are compared with the distributions of the source electrons in the magnetosheath. For some of the strong SEP events, one-to-one correspondence of the SEP distributions to the strength and dip angle of the local magnetic field was investigated.
The results show that the field-aligned component is pronounced for the penetrating electrons and it does not significantly depend on the initial PA distributions in the magnetosheath. The highest energy of the SEP electrons lost into the Martian atmosphere depends on the magnetic field configuration draped around the planet. The SEP electron penetration depleted in the region of the strong crustal magnetic field. Its loss into the atmosphere tend to be pronounced in the nightside, suggesting the deeper penetration of draped magnetic fields in the nightside than dayside. We will also report on the energy dependent penetration seen in some SEP events and discuss role of the magnetic field to determine the precipitation flux of SEP electrons into the Martian atmosphere.
References:
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