

R009-25

A 会場 : 11/25 AM2 (11:05-12:35)

11:35~11:50:00

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Effects of magnetic field structures on Martian diffuse auroras based on MAVEN observations

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Mars lacks a global intrinsic magnetic field, and crustal magnetic fields exist mainly in the southern hemisphere. In such an environment, solar wind magnetic fields drape around Mars and form an induced magnetosphere, which is variable due to the variation of solar wind conditions. The nightside structures of the draped magnetic fields during extreme solar events are especially not well understood, despite the importance of these periods for understanding the ion loss from Mars. During extreme solar events, global diffuse auroras are observed. The Martian diffuse auroras are global ultraviolet emissions including CO₂⁺ ultraviolet doublet (UVD) on the nightside, caused by solar energetic particles (SEPs) consisting of electrons and protons (Schneider et al., 2015; Schneider et al., 2018; Nakamura et al., 2022). The auroral emissions caused by the electrons can vary with nightside magnetic fields around Mars, while those by protons are less affected by the magnetic fields due to the larger Larmor radii than electrons. We investigated the relationship between the Martian diffuse auroral emissions and magnetic fields based on the newly developed Monte Carlo model and the MAVEN observations (Okuyama et al, 2025). Our model study indicates that the more horizontal magnetic fields lead to brighter mean auroral intensities for the higher altitude, where the SEP electron contributions are dominant compared to the SEP protons, with the same incident electron flux in the uniform magnetic field assumption. However, the effects of nightside magnetic fields on the electron-induced Martian diffuse auroras were not confirmed by observations.

We investigated the dependence of diffuse auroral emissions on the nightside magnetic field structure with MAVEN observations. We selected the December 2014 SEP event because the diffuse auroras were observed in the northern hemisphere, where the crustal magnetic field effects are relatively weak, and MAVEN observed upstream solar wind magnetic fields during this event. The observed mean auroral intensities at 90-110 km altitude normalized by the SEP electron flux increased as the angles from the current sheet on the Martian nightside increased. The MHD simulations indicate that the magnetic fields tend to be more horizontal with the larger angles from the current sheet (Xu et al., 2018). Therefore, the observed dependence of mean auroral intensities on the angle from the current sheet might be consistent with our model predictions. Future missions will increase the proper observational conditions, where the solar wind magnetic fields and the precipitated SEP fluxes will be observed at the same time as the auroras, which will help us to analyze more events to validate statistical significance.