火星探査機MAVENの観測に基づいた火星上層大気への降下SEP電子の特性の研究

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Characteristics of penetrating SEP electrons into Martian upper atmosphere observed by MAVEN

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Recent discovery of new diffuse aurora at Mars caused by the SEP (solar energetic particle) electrons [Schneider et al., 2015] sheds a new light on the high-energy particle environment at Mars. In contrast to Earth, Mars posses no global intrinsic magnetic field and the solar wind interacts directly with Martian upper atmosphere. The diffuse aurora observation in the northern hemisphere at Mars, where the crustal field is absent, indicates penetration of the high-energy electrons of ~100 keV down to the altitudes around 70 km along the draped interplanetary magnetic field around the planet. However, to what extent the draped magnetic field configuration around Mars controls the SEP electron penetration to the atmosphere is far from understood.

In this study, we investigate pitch angle distributions of the high-energy (30-210 keV) electrons observed in the Martian ionosphere based on the MAVEN observations during strong SEP events. In order to achieve a good coverage in the 2-D (pitch angle-energy) phase space, data obtained during a SEP event is accumulated and binned. The obtained pitch angle distributions in the ionosphere are compared with the distributions of the source electrons in the solar wind. The results show that the field-aligned electrons are dominant in the ionosphere. While the low-energy (<~100 keV) electrons are more unidirectional, high-energy electrons tend to have bi-directional distributions. We will discuss possible cause of the energy-dependent pitch angle distributions and their relation to the magnetic field configuration around the planet.