

Number density distribution of hot oxygen in the Martian exosphere

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Mars has no significant intrinsic magnetic field, hence the planet has no developed magnetosphere, which indicates that the escape mechanism of the Martian atmosphere differs from that of Earth. Escape of neutrals is potentially important for the evolution of Martian environment. Non-thermal mechanisms by which O can escape from the Martian atmosphere have been identified, but it is far from complete quantification.

McElroy et al. [1972] suggested that hot oxygen atoms are likely to be present around Mars. After his suggestion, a number of theoretical and quantitative calculations of nonthermal oxygen escape rates have been reported. However, all of them were restricted to the case where the ionospheric parameters were assumed to be under the steady state condition. We have investigated number density distribution of oxygen atoms by combining a time-dependent ionosphere model, in which the two-stream model and Monte Carlo model have been coupled with MHD model to simultaneously calculate the variations of the hot oxygen fluxes and the ionospheric parameters.

The solar wind which directly interacts with the Martian ionosphere is quite variable. Time variation of the solar wind parameters is expected to result in a dynamic response of the ionosphere. For example, an enhancement of the solar wind dynamic pressure causes a downward displacement of the ionopause altitude. In such a case, molecular oxygen ions in the upper ionosphere are pushed to lower altitudes, leading to a temporal enhancement of the dissociative recombination rate around the ionopause. In this paper, we present the result of the calculations for the time variation of the nonthermal escape of oxygen and the exospheric oxygen number density during the ionopause displacement.