SPS2019_Abstract

We carried out ground-based telescope observations of Martian ionospheric O_2^+ emission to obtain global distribution of Martian O_2^+ ionosphere and its variation for understanding Martian atmospheric escape process. After verifying the analysis method, the result suggests that the O_2^+ first negative bands (1NG) (1, 0) emissions are successfully detected, and calculated O_2^+ emission intensity and column density.

Mars has tenuous atmosphere compared with the Earth. One possible model for Martian tenuous atmosphere is caused by atmospheric escape to space for a long time. In recent years, ion composition and densities in the Martian ionosphere are revealed by Mars probes. In the Martian ionosphere, main ion is O_2^+. Moreover O_2^+ recombines with an electron, and as a result neutral atomic oxygens are generated, and neutral atomic oxygen can be escaped from Martian gravity. This process is important in Martian atmosphere escape, and escape quantity of neutral atomic oxygen is indirectly estimated by plasma temperature and density from in-situ observations. It is essential to combine in-situ plasma data with global remote sensing for understanding Martian atmospheric escape, such as solar wind impact.

We carried out Martian ionosphere O_2^+ emission observation using Tohoku University T60 telescope with Vispec (Visual imager and Spectrograph with Coronagraphy) from September 10 to 19, 2018. This is the first attempt to detect Martian O_2^+ emission with a ground-based telescope. We focused O_2^+ 1NG (1, 0) bands emission with a peak wavelength of about 561 nm. Vispec slit (width 2”×length 90”) was located near Martian dayside limb parallel to the Martian rotation axis, and exposure time of one frame was 2 minutes. Total exposure time in observation period was 450 minutes. First analysis process (subtraction dark, revision by flat-field, wavelength and space) was conducted on each frame. Next, sunlight spectrum was subtracted using disk center to obtain O_2^+ 1NG (1, 0) bands emission spectrum. Finally, we compared observed O_2^+ spectrum with O_2^+ 1NG (1, 0) model spectrum given by Henriksen and Veseth [1987]. Focusing on only short period wavelength variations, we performed high-pass filter analysis on the both of observed and model spectrum. After that, we calculated the correlation coefficient between observed spectrum and model spectrum, and found that the coefficient maximum is 0.40 with no wavelength lag between two spectra. Data points, i.e., wavelength range, using correlation coefficient analysis were selected so that model O_2^+ emission is intense and the contamination of solar fraunhofer absorption line is negligible. We estimated O_2^+ 1NG (1, 0) emission intensity with a least-square method to be 691 +/- 171 $\times 10^3$ Rayleighs, and the column density to be 4.4 +/- 1.1 $\times 10^{13}$ /cm^2. The estimated column density was greater than that of simulation. In this presentation, we compare O_2^+ emission observation spectrum with model spectrum, and give the estimation of O_2^+ emission intensity and column density in detail.