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Feasibility study of the Mars ionospheric imaging

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The planetary atmospheric escape to the outer space is a universal phenomenon for planets, and the escape flux will determin the atmospheric evolution of each planet. Mars of the non-magnetization planet has dry and tenuos atmosphere, and it is severe environment for the survival of living matter. The observations of the recent Mars Express (MEX) spacecraft have shown that the molecular ion, whose outflow flux is very small conventionally, is escaped in large quantities. In addition, it is pointed out that there is possibility for low energy ions less than a few eV to be escaped. The quantity of escape rate of the atmosphere is one of indispensable values for the study of atmospheric evolution, but it is a physical amount to have the big error. It is caused by the fact that the physical mechanism to cause the escape of the molecular ions and low energy ions is not understood. Many physical mechanisms to the atmosphere escape derived by the solar wind and the solar radiation are suggested, including ionospheric ion outflow, ion pickup, sputtering, Jeans escape, and the outflow caused by the photochemical reaction.

We study possibility of the imaging observation instruments to obtain the two-dimensional structure that has not yet been performed for identification of these scatter mechanism until now. In particular, it is one of aims to catch the two dimensional structure of the ionopause where ionospheric ions escape. A fact that emission intensity of the outflow is very low and the albedo of the main body of Mars is very strong as a stray light, is a reason for the very difficult observation. However, because this observation method is thought as an instrument bringing a breakthrough for study on atmospheric evolution, and because it is predicted that it is an essential technique to future planetary probe, we started the research and development of the basic technology. In this paper an optics design of Mars ionosphere observation equipment is argued for example, and it is hoped that it is a beginning of the universal technique to detect the faint emission around the bright light source.

Keywords: Mars ionosphere, Imaging observation, Atmospheric escape, Atmospheric evolution