

Theoretical modeling of the diffuse aurora in Martian atmosphere

Jethwa Masoom^{1*} & S. A. Haider¹

¹Planetary Sciences Division, Physical Research Laboratory, Ahmedabad, India.

[*masoom@prl.res.in](mailto:masoom@prl.res.in)

Abstract: Aurorae are observed on various solar system bodies. It helps us to understand the complex relationship between an atmosphere and solar wind plasma around it. These aurorae can be either discrete, or diffuse (emission due to solar energetic particles) in nature. Martian Aurorae has come to known since 2004 with the help of observations from ultraviolet spectrometers [1]. In the Martian atmosphere, Carbon dioxide is major species, is ionized by various mechanism. These incorporates direct processes such as ionization by solar photon, galactic cosmic rays and solar wind electron. During nighttime, excess energy deposited by the energetic electrons into the atmosphere ionizes Carbon dioxide. This leads formation of auroral emission and produce CO₂⁺ Ultraviolet Doublet (UVD) emission in ultraviolet. During December, 2014, the Mars Atmosphere and Volatile Evolution (MAVEN) recorded a significant enhancement in the energetic electron fluxes [2]. We present the modeling of CO₂pUVD to look into the significant reduction in the ionization peak due to the electron impact ionization. We have used hybrid model and four-dimensional yield spectrum approach based on Monte Carlo simulation to calculate the ionization rate and limb intensity of diffuse aurora due to precipitation of solar energetic particle and proton-hydrogen (H⁺-H) fluxes in the nighttime ionosphere of Mars. The model results are compared with the observed intensity of CO₂pUVD emission [3]. The data from Solar energetic Particle Package and Imaging Ultraviolet Spectrograph has been utilized in the study.

References: [1] Bertaux, J. L. et al. (2005) *Nature*, 435(7043), 790. [2] Schneider, N. M. et al. (2015) *Science*, 350(6261). [3] S. A. Haider and Masoom J. (2019) *JGR*, 124, 9566-9576