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Characterizing the Martian Ionospheric M2 layer using MAVEN / ROSE

Mars'atmosphere consists of mostly Carbon dioxide (˜95%). The dayside of the ionosphere is formed primarily due to photoionization of CO2 by the Extreme Ultraviolet (EUV) radiation from the Sun. The electron density structure of Martian ionosphere is similar to E and F1 layers of Earth's ionosphere. The altitude where maximum electron density formed by photoionization is known as the peak altitude is found to be near ˜ 130 Km. This layer is termed as M2 layer. To study this layer, we use the instrument Radio Occultation Science Experiment (ROSE) on board the Mars Atmosphere and Volatile EvolutioN (MAVEN). A total of 1400 electron density profiles were obtained between July 2016 and February 2025. Peak altitudes and densities were extracted by Chapman fitting the profiles. Nearly 600 profiles were found have a good fit and results were obtained from them. The solar irradiance is measured by the instrument EUV Monitor on-board MAVEN. The EUV irradiance of 30.5 nm is chosen as it ionizes CO2 the most.

The observation reveal that peak altitude and densities vary with different parameters such as SZA, Local time, Seasons, Solar irradiance. Peak altitudes ranging from 120 –170 Km is found to be inversely related to peak densities ranging from 2 x 104 to 2 x 105 cm-3. The observation is also separated into Martian Year (MY), and positive correlation is found for most Martian years except MY 34 where a negative correlation is found for electron density and irradiance. This could be due to other parameters like Dust storms affecting the M2 layer. Studying the M2 layer is crucial since it is the most dominant layer in the ionosphere containing the most electron density.

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