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Electron Density Profiles in the Martian Ionosphere from MAVEN Observations (MY 32–36)

The Martian ionosphere controls solar–atmosphere interactions and is central to atmospheric escape. From MAVEN electron density observations over Martian Years (MY) 32–36, we describe ionospheric structure at altitudes of 150–500 km. Inbound and outbound orbital pass data were averaged in 10-day bins to enhance robustness. The resulting profiles systematically show a sharp ionospheric peak at 150–200 km (10^3–10^4 cm^{-3}) with precipitously decreasing densities above 300 km. Every-day comparisons show stability of the lower ionosphere, whereas variability with higher altitudes indicates solar zenith angle dependence and solar forcing. Consistency between inbound and outbound passes verifies dataset reliability. Preliminary interannual comparisons show lower electron densities by MY 36, as expected with decreasing solar activity, and clearly indicate solar cycle influence.

The Martian ionosphere controls solar–atmosphere interactions and is at the center of atmospheric escape. From electron density measurements from MAVEN between Martian Years (MY) 32–36, we describe ionospheric structure from 150–500 km altitude. Inbound and outbound orbital pass data were averaged on 10-day periods to enhance robustness. The resulting profiles uniformly show a prominent ionospheric peak at approximately 150–200 km (10^3–10^4 cm^{-3}), with densities dropping steeply above 300 km. Day-to-day comparisons exhibit stability of the lower ionosphere and variability at higher altitudes reflecting solar zenith angle dependence and solar forcing. The agreement between inbound and outbound passes validates the quality of the dataset. The results set limits for models of the Martian ionosphere and improve our understanding of how the Sun interacts with the atmosphere without a global magnetic field.

The study provides solid ionospheric electron density profiles for Martian Years 32–36, offering important insights into the planet's upper atmosphere. It illustrates a dual control mechanism, where photochemistry dominates processes below 200 km, while solar forcing plays a stronger role above 300 km. The results also briefly indicate a dependence of ionospheric density on the solar cycle. Additionally, the findings highlight certain limitations for ionospheric models while supplying valuable information about atmospheric escape. Beyond Mars itself, this work contributes to comparative planetology by examining ionospheric dynamics in the context of an unmagnetized planet.

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