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The variability, morphology and outflow of martian ionospheric plasma

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Abstract

ASPERA-3 measurements from Mars Express demonstrate that Martian ionospheric plasma escapes in a comet-like fashion [1]. Low-energy (cold) ionospheric plasma is swept from the dayside, expanding into the nightside/tail of Mars (Fig. 1). The primary energization processes brings ionospheric plasma to just above escape velocity (5 - 20 km/s). In analogy with the polar wind of the Earth, ionospheric plasma is expected to become energized by waves and electric fields generated by solar wind energy and momentum transfer processes. The escape of low-energy ionospheric plasma, streaming along the external sheath flow, suggest a "viscous-like" coupling between the sheath plasma and the expanding ionospheric plasma. The ionospheric ion outflow is very structured, fan-like and modulated in the ULF frequency range. The ionospheric densities measured vary correspondingly with time, altitude, latitude and local time (Figure 2). A similar variability of solar wind ions is found in the Martian magnetosheath. This implies that magnetosheath wave activity is involved, transferring energy and momentum to ionospheric ions. We demonstrate that the wave activity modulating ions and electrons, reaches down to the MEX pericenter (≈300 km), suggesting that heating/energization of ionospheric plasma extends deep into the ionosphere.

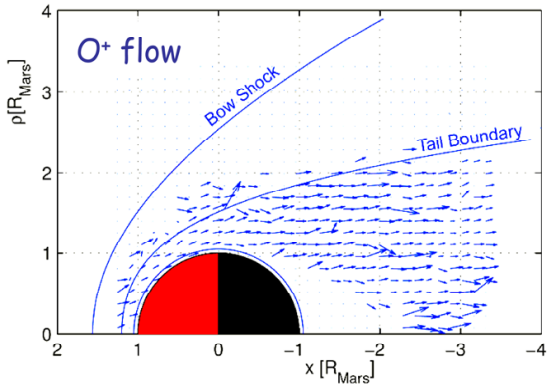

Figure 1: Flow velocity diagram in a cylindrical coordinate system displaying the low-energy (cold) ionospheric ion escape from Mars.

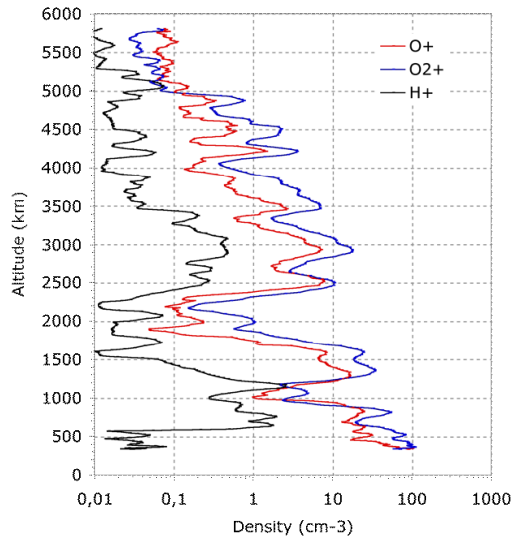

Figure 2: O^+, O_2^+, and H^+ densities versus altitude illustrating the strong ULF wave activity modulating ions down to pericenter (≈300 km).

References

[1] Lundin, et al. (2008), *Geophys. Res. Lett*, doi:10.1029/2008GL034811.