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Hotter at night: electron structure and dynamics on the nightside of Mars

Robert Lillis (1), Jean-Yves Chaufray (2), David Pawlowski (3), David Mitchell (1), Mehdi Benna (4), Meredith Elrod (4), Christopher Fowler (1), Laila Andersson (5), Shaosui Xu (1)

1 Space Sciences Laboratory, University of California Berkeley

2 LATMOS, Paris

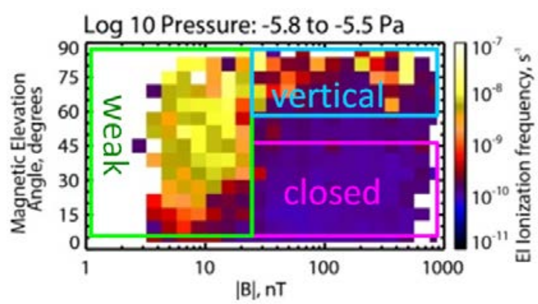
3 Eastern Michigan University

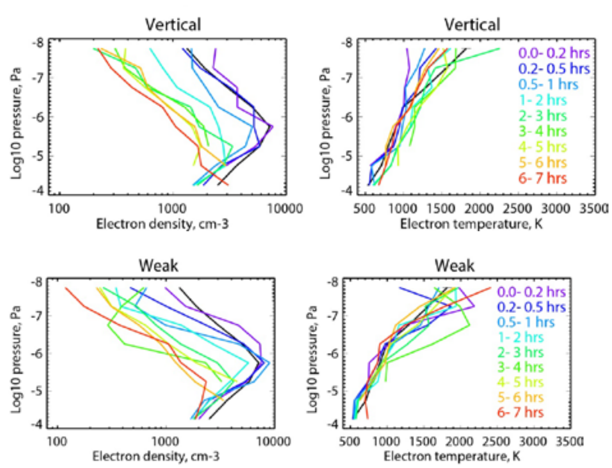
4 NASA Goddard Space Flight Center

5 Laboratory for Atmospheric and Space Physics, University of Colorado Boulder (rlillis@berkeley.edu)

The nightside ionosphere of Mars is known to be highly variable, with densities varying substantially with ion species, solar zenith angle, solar wind conditions and geographic location. The MAVEN mission has been the first to systematically sample the density, temperature and composition of the nightside ionosphere. For the first time we can use measurements of suprathermal electron fluxes, thermal electron densities and temperatures, and neutral and ion densities between 120 and 300 km on the nightside of Mars, to study the complex system of ionization, heating, cooling, magnetic exclusion/mirroring, and diffusion, that govern electron densities and temperatures as the ionosphere rotates from day into night.

For all magnetic topologies (open and closed), to zeroth order, a) electron densities fall rapidly with time in darkness as previously photo-produced electrons recombine with ions, while at the same time, b) electron temperatures increase by ~20-30% until 2-3 hours past sunset as the colder electrons within the Boltzmann distribution recombine faster due to their higher collision cross-sections. However beyond this, behavior is dependent on topology. Where crustal magnetic fields are open (i.e. where suprathermal magnetosheath electrons have access to the atmosphere) average densities fall less rapidly and electron temperatures fall back to their terminator levels due to increased ionization from the precipitation of suprathermal magnetosheath electrons. In contrast, where magnetic fields are closed, no new ionization can occur. In these regions, densities fall more rapidly and temperatures continue to rise as slower electrons continue to recombine. This behavior is shown in the figure below. We can reproduce some of this behavior with simple one dimensional time-dependent electron velocity distribution models that include electron sources, sinks, heating, and cooling, but additional fidelity will be provided by including plasma flow velocities from global circulation models.





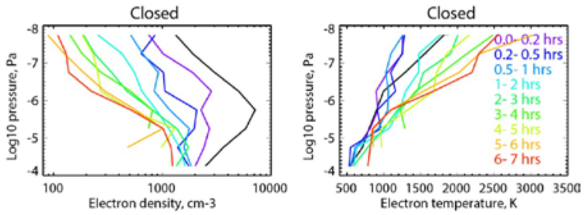


Figure 1: (top panel) three Mars nightside magnetic topologies overlaid on average electron impact ionization frequency as a function of magnetic field and elevation angle. (Lower panels) thermal electron densities and temperatures as a function of neutral pressure and time since dusk (colors) are plotted for these topologies.

1. Equations

Below, you will find examples of two equations. You should use an equation editor of your word-processing program in order to include your equation(s). The equation number should be placed at the right side of the column and all equations should be consecutively numbered.

$$a^2 + b^2 = c^2 \qquad (1)$$

$$E = m \cdot c^2 \qquad (2)$$

2. Summary and Conclusions

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Acknowledgements

The Acknowledgements section should not be numbered. Here, you may include all persons or institutions which you would like to thank. We recommend that the abstract is carefully compiled and thoroughly checked, in particular with regard to the list of authors, **before** submission.

References

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[3] Author, F.: Third example of a cited conference paper, The Great Science Conference, 1–7 February 2001, Sciencetown, Sciencecountry, 2001.