In-situ Observations of Ionospheric Instabilities in the Ion Demagnetization Region

S. A. Thaller(1), L. Andersson* (1), M. Pilinski (1), D. Andrews(2) and C. M. Fowler(3)
(1) University of Colorado, Boulder, CO, USA, e-mail: Scott.Thaller@lasp.colorado.edu; laila.andersson@lasp.colorado.edu; Marcin.Pilinski@lasp.colorado.edu
(2) Swedish Institute of Space Physics, Uppsala, Sweden; e-mail: david.andrews@irfu.se
(3) University of California, Berkeley, CA, USA; e-mail: cmfowler@berkeley.edu

Satellites at Mars with sufficiently low periapsis can collect data from ionospheric regions with different plasma magnetizations; e.g., both electrons and ions are magnetized, only ions are demagnetized, or both ions and electrons are demagnetized. The in-situ observations of these regions allow for investigation of instabilities and heat layers that occur in the Martian ionosphere. In this presentation, we discuss observations where electrons and ions are both demagnetized and then where ions only are demagnetized. At the sub-solar point, frictionally heated electrons are observed where the electrons become demagnetized; this region is located in the Earth-equivalent D-region [1]. For the ion demagnetized region, we investigate whether the two-stream instability changing between the nonlinear and linear phase can be identified in the data (example in Figure 1). As has been identified previously at Mars, the two-stream instability is commonly observed where the magnetic field is horizontal [2]. The event shown here in Figure 1 is at the terminator where strong winds (>120 m/s) are observed blowing from the sunlit region into darkness [3]. The observations used in this presentation are made by the following instruments onboard the MAVEN satellite: the Neutral and Ion Mass Spectrometer (NGIMS), the two electrostatic analyzers, e.g., the Solar Wind electron analyzer (SWEA) and Solar Wind Ion Analyzer (SWIA); the Langmuir probe of the Langmuir Probe and Waves (LPW) instrument, and the Magnetometer (MAG). That instabilities that can arise will be demonstrated in data from topside sounders.

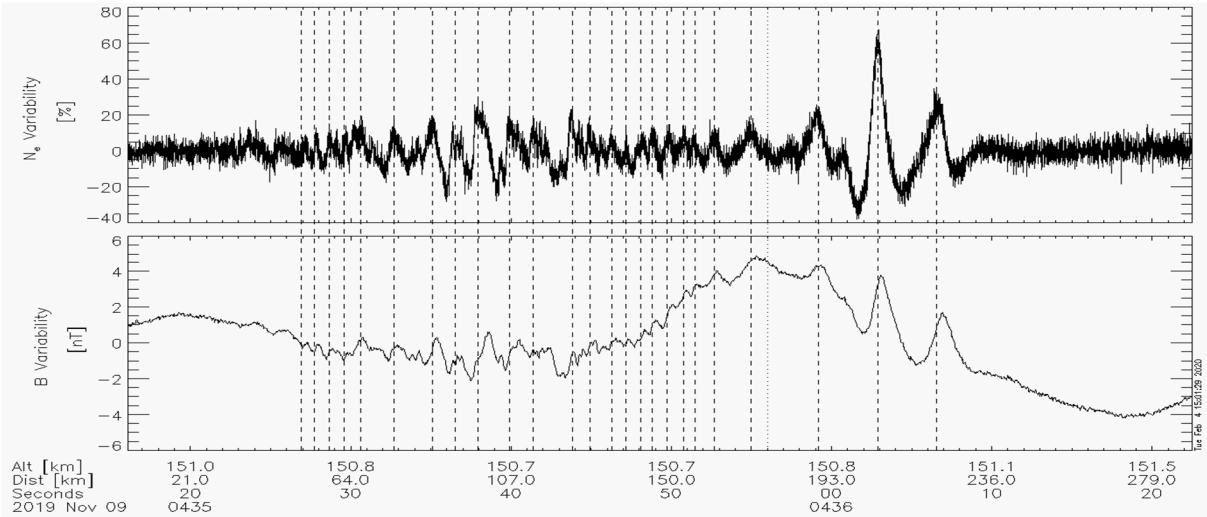

Figure 1. Example of density fluctuations (top panel) with 3-18 km horizontal scale sizes in the region where ions are demagnetized (altitude of ~150 km) with a magnetic field signature (bottom panel) observed by the MAVEN spacecraft on 9 November 2019.

References

[1] Brower, L., J. P. Thayer, and J.-P. St.-Maurice (2009), Frictionally heated electrons in the high-latitude D region, J. Geophys. Res.,114, A12302, doi:10.1029/2009JA014421.
[2] Fowler, C. M., Andersson, L., Shaver, S. R., Thayer, J. P., Huba, J. P., et al. (2017). MAVEN observations of ionospheric irregularities at Mars. Geophysical Research Letters, 44, 10,845–10,854 https://doi.org/10.1002/2017GL075189.
[3] Benna, M. et al., *Science* 13 Dec 2019: Vol. 366, Issue 6471, pp. 1363-1366 DOI: 10.1126/science.aax1553