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MAVEN Remote Sensing and *In Situ* Observations of Discrete Aurora on Mars

Nicholas Schneider (1), Sonal Jain (1), Justin Deighan (1), Shaosui Xu (2), David Brain (1), David Mitchell (2), Robert Lillis (2)
(1) LASP, U. Colorado, Boulder (2) SSL, U. California, Berkeley, (nick.schneider@lasp.colorado.edu)

Abstract

Mars has no global magnetic field, but it still exhibits aurora associated with the remanent magnetism from Mars' primordial field locked into the crust. MAVEN recently achieved a goal of simultaneously observing ultraviolet emissions from the atmosphere at the same time it measured the charged particles causing the emission. This localized type of aurora is referred to as *discrete aurora*, distinct from other more widespread auroral phenomenal also seen at Mars.

1. Introduction

Discrete aurora events were detected in regions of strong crustal magnetic fields by the SPICAM instrument on the European Space Agency's Mars Express orbiter [1,2,3]. The emission appeared in patches ~tens of km across at altitudes ~130 km. Further analysis revealed a total of 20 instances of auroral patches during 10 years of intermittent SPICAM observations [4]. Auroral excitation was attributed to the precipitation of electrons, typically ~100 eV - 1 keV, most likely accelerated locally by parallel electric fields [3], analogous to Earth's discrete aurora occurring at the polar ovals. The occurrences mapped to locations within the crustal magnetic field regions where the probability of open field lines was high [4], and occurred when disturbances were underway in Mars' charged particle environment [5].

MAVEN's Imaging UltraViolet Spectrograph (IUVS, [6]) detected discrete aurora under comparable conditions, and has obtained the first images of the phenomenon (Figure 1, [7]). The relatively small number of detections of discrete aurora is a combination of the rarity of favorable instrument pointing and the intermittent nature of the phenomenon.

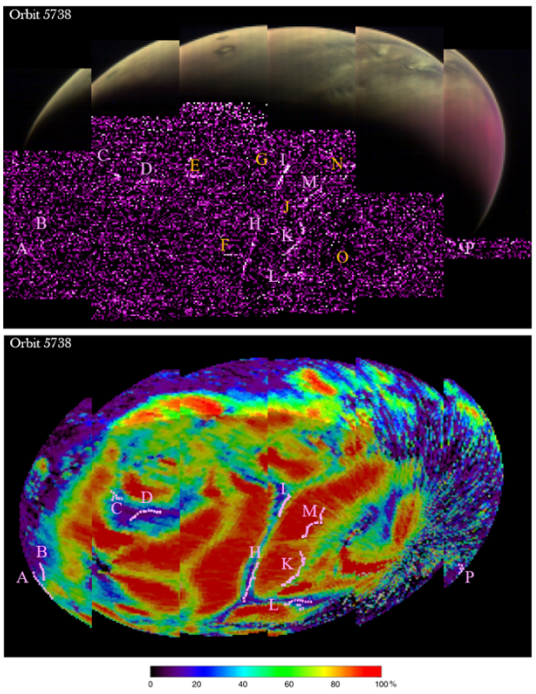

Figure 1: Ultraviolet image of Mars from during the September 2017 space weather event. (top) The upper portion of the data image shows the daylit side with middle UV colors mapped up to visible colors. The lower portion of the data image shows the nightside imaged at high gain. Letters identify the locations of wisps and patches of emission analyzed in detail. (bottom) The specific pixels in wisps and patches with confirmed auroral spectra are shown in purple with their identifying letter. The pixels are overplotted on Mars' crustal magnetic field topology [5] mapped into the observation coordinate system at the moment of each exposure. Red indicates a high probability of closed magnetic field lines, and the dark blue color indicates a high probability of open field lines. Figure reproduced from [7].

2. Contemporaneous *in situ* and Remote Sensing observations in February/March 2019

The observations in Figure 1 occurred during the space weather event of September 2017, when remote sensing observations were obtained at the apoapse of MAVEN's orbit, so *in situ* observations were not sampling the same precipitating particle distributions responsible for causing the emission. In February and March 2019, MAVEN's periapse occurred within the region of crustal magnetic fields where remote sensing in limb scan mode could detect nearby auroral emissions while the particles-and-fields instruments measured accelerated electrons at distances of tens to hundreds of km from the emitting regions. We will present a comparison of the locations and timing of remote sensing and in situ detections. See also the related abstract by Xu *et al.*, this conference, which analyses the accelerated electron distributions during these occurrences in detail.

References

[1] J.-L. Bertaux *et al.*, Nature 435, 790–794 (2005). doi: 10.1038/nature03603.

[2] F. Leblanc *et al.*, J. Geophys. Res. 111, A09313 (2006). doi: 10.1029/ 2006JA011763.

[3] F. Leblanc *et al.*, J. Geophys. Res. 113, A08311 (2008). doi: 10.1029/2008JA013033.

[4] J.-C. Gérard *et al.*, J. Geophys. Res. 120, 6749–6765 (2015). doi: 10.1002/ 2015JA021150.

[5] McClintock, W. E., *et al.* (2015), SSR, 195(1-4), 75-124.

[6] Schneider, N. M., *et al.* (2018). Geophys. Res. Lett., 45, 7391–7398. https://doi.org/10.1029/ 2018GL077772.

[7] Brain, D. A*., et al*., (2007). J. Geophys. Res., 112, A09201. https://doi.org/10.1029/2007JA012435.

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