



The colours of the Mars night sky: when aurora and nightglow illuminate the atmosphere

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The first detection of aurora in the Mars night sky was made in 2005 with the SPICAM ultraviolet spectrometer on board Mars Express. It revealed the presence of emissions from CO, CO_2^+ and O, concentrated in regions of strong open magnetic field lines in the southern hemisphere. Further ultraviolet observations with the IUVS instrument on board MAVEN and EMUS on the Emirates Mars missions measured the N_2 Vegard-Kaplan bands, the OI 130.4 and 135.6 nm and the CI 156.1 and 165.7 nm emissions.

All space-borne instruments so far were only able to observe in the ultraviolet. Yet, laboratory simulations of the aurora at low CO_2 pressure have shown the presence of the CO_2^+ Fox-Duffendack-Barker (FDB) emission between 300 and 500 nm with 7% of the intensity in the blue. The oxygen green and red lines were not observed. More recently, the green line at 557.7 nm has been unambiguously measured from the Martian surface with the Supercam spectrometer covering the 535-853 nm range and the Mastcam-Z imaging camera on the Perseverance rover during Solar Energetic Particle Events. It is mainly excited by collisions of energetic electrons with ambient CO_2 . ESA's M-MATISSE mission will carry the Mars Aurora and dust Camera (M-AC) equipped with a green line (557.7 nm) and a FDB channel (367.0-393.2 nm).

In contrast, the Martian ultraviolet nightglow is characterised by the presence of the nitric oxide δ and ϵ bands between 180 and 300 nm discovered with Mars Express-SPICAM. It is caused by radiative recombination of O and N atoms created on the day side. Additional emissions in the near infrared and visible ranges result from three-body recombination of O atoms in the winter polar regions. The visible contribution corresponds to the O_2 $c^1\Sigma_u^- - X^3\Sigma_g^-$ Herzberg II band system extending from 300 to 600 nm. It is expected to be bright enough to be observable with the naked eye in the winter polar regions from Mars orbit and from the surface.

In this presentation, we will combine observed spectral measurements with Monte Carlo modelling of the excitation rates to define the colours and the visibility of the nightside emissions.