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Spectroscopy of Mars and Venus aurora: a remote sensing tool for similarities and differences

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Aurora has been detected on a few occasions on the Venus nightside with the Pioneer Venus UltraViolet Spectrometer (PVO-UVS). The main characteristics are the presence of the OI 130 and 136 nm emissions, a lack of discrete structure (diffuse aurora) and correlation with interplanetary shocks. Ground-based observations in the visible have shown that the [OI] green line at 557.7 nm is also observed following periods of the solar wind intensification. Although no concurrent measurement of auroral particle precipitation has been made, numerical simulations of the UV emissions have indicated that precipitation of soft auroral electrons (15-20 eV) and low energy fluxes is a likely candidate.

A discrete aurora was first observed in the middle ultraviolet on the Martian nightside limb from the Mars Express orbiter in a region of strong crustal field in the southern hemisphere. Prominent emissions included the CO Cameron bands and the CO_2^+ UV doublet. Limb observations have been made from Mars Express and MAVEN during the last 10 years. Recently, global auroral images have been collected with the UltraViolet Spectrometer (EMUS) on board the Emirates Mars Mission (EMM). These observations reveal a wide variety of auroral morphologies including discrete, diffuse, proton and sinuous aurora, each one bearing the signature of the interaction between the solar wind, the induced (or crustal) magnetic field and the atmosphere.

In this presentation, we compare the characteristics of the Venus and Mars diffuse aurora observed by Pioneer Venus and MAVEN respectively. We focus on the determination of the charged particles characteristics (mean energy, flux, energy distribution) based on the brightness and intensity ratio of spectral emissions. Following recent laboratory measurement of the efficiency of the Cameron bands excitation by electron impact, we re-examine the dependence of the Cameron/CO_2^+ UVD intensity ratio on the auroral electron energy. Similarly, the different shapes of the electron excitation cross sections of the OI emissions at 130 and 136 nm induces an intensity ratio that depends on the energy of the precipitation. This dependence can be used to map the mean electron energy, based on FUV spectral observations with the EMUS. Finally, we discuss the expected brightness of the Mars visible aurora and set an upper limit on the intensity of the OI green line based on attempts to detect it with the UVIS spectrometer on board the Trace Gas Orbiter. We show that global observations with the M-AC visible camera on board the M-MATISSE orbiters will generate considerable progress in our understanding of the morphology,

time variations and energetics of the Martian aurora.