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The Martian diffuse aurora: Monte Carlo simulations and comparison with IUVS-MAVEN observations

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Abstract Text:

A new type of Martian aurora, characterized by an extended spatial distribution, an altitude lower than the discrete aurora and electron precipitation up to 200 keV has been observed following solar activity on several occasions with the IUVS on board the MAVEN spacecraft. We describe the results of Monte Carlo simulations of the production of several ultraviolet and visible auroral emissions for initial electron energies from 0.1 to 200 keV. These include the CO_2^+ ultraviolet doublet (UVD) at 288.3 and 289.6 nm and the Fox–Duffendack–Barker (FDB) bands, CO Cameron and Fourth Positive bands, OI 130.4 and 297.2 nm and CI 156.1 nm and 165.7 nm multiplets. We calculate the nadir and limb intensities of several of these emissions for a unit precipitated energy flux. Our results indicate that electrons in the range 100-200 keV produce maximum CO_2^+ UVD emission near 75 km. We combine SWEA and SEP electron energy spectra measured during diffuse aurora to calculate the volume emission rates and compare with IUVS observations of the emission limb profiles. The strongest predicted emissions are the CO_2^+ FDB, UVD and the CO Cameron bands. The metastable a $^3\Pi$ state which radiates the Cameron bands is deactivated by collisions below ~110 km. As a consequence, we show that the CO_2^+ UVD to the Cameron bands ratio increases at low altitude in the energetic diffuse aurora.

Topic Selection: Mars Upper Atmosphere, Ionosphere, Solar Wind Interactions, and Escape

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