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The visible dayglow emission at Venus and Mars; some conclusions from laboratory measurements

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There is very little observational information on the visible dayglows of the CO_2 planets, principally because spacecraft have not been equipped with instrumentation for recording spectra in the visible spectral region. UV dayglows have been measured for Mars by the Mariner spacecraft and by Mars Express, where it is observed that the most important emissions at 180-300 nm are the CO($a^3\Pi$-$X^1\Sigma^+$) Cameron bands, the CO_2^+(*B*-*X*) doublet, and the O(^{1}S - ^{3}P) line at 297.2 nm. The Cameron bands arise from CO_2 photodissociation at wavelengths shorter than 108 nm, and from photoelectron collisions. However, at wavelengths below 100 nm, photodissociation of CO_2 can produce triplet states of CO lying above the $a^3\Pi$ state, which then cascade into that level before finally radiating in the Cameron system. This cascading emission lies in the visible spectral region. Lee and Judge (1973) showed that this indeed takes place at 90-93 nm, and we have investigated the process further with tunable synchrotron radiation at the ALS (Advanced Light Source) in Berkeley. We find that once the energy threshold is exceeded, the higher CO triplets are excited, and thus a fraction of the Cameron band emission is preceded by visible emission, so that the visible Mars/Venus dayglows will include radiation at 500-900 nm, in the CO(*a'*-*a*, *d*-*a*, *e*-*a*) bands. The same will be true for CO_2 photoexcitation in cometary atmospheres.

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