$O_2(c^1\Sigma_u^- – b^1\Sigma_g^+)$ BAND EMISSION IN THE TERRESTRIAL NIGHTGLOW

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Understanding of the spectroscopy of molecular oxygen has benefited from many investigations of the absorption and emission spectra from planetary atmospheres, a number of which we have described previously at this symposium. In the process of line-by-line assignment of "sky spectra" recorded by astronomers using the Keck I and II telescopes, we have discovered a new O_2 band system in the 380-450 nm region of the Earth's nightglow spectrum.

Sharp isolated lines are assigned to the single Q-branch of $O_2(c^1\Sigma_u^-, v'=5\text{-}11)$ radiating to $O_2(b^1\Sigma_g^+, v''=0\text{-}2)$, with intensities that follow the $J'(J'+1)(2J'+1)\exp[-B'J'(J'+1)/kT]$ formula for rotational coupling with $^1\Pi$ states suggested by Wilkinson and Mulliken [1] for the corresponding a′-X transition in N_2. Assignment of lines up to $J'=32$ allows for improvement of centrifugal distortion constants for the O_2(c) state [2,3], while the measured positions of the low J lines agree with those calculated from known term energies [2-4].

The individual lines in the 9-1 c-b band are as intense as any lines in the Herzberg I (A-X) or Chamberlain (A′-a) bands at wavelengths longer than 365 nm. Surprisingly, Herzberg II (c-X) band emissions are much weaker than expected from previous studies of the terrestrial [5,6] and venusian nightglows [7,8].

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