

PROFILE ANALYSIS OF THE (B-X) BANDS OF CO⁺ IN COMET WEST

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Abstract. The calculated profile of ($B^2\Sigma^+ - X^2\Sigma^+$) bands of CO⁺ based on resonance fluorescence process is shown to be in agreement with the observed profile for comet West.

The ultraviolet spectra of comets are rich in molecular emissions. This result came out of the spectra taken on various comets through rockets and satellites (Feldman and Brune, 1976; Smith *et al.*, 1980). The line of interest here are the ($B^2\Sigma^+ - X^2\Sigma^+$) transitions of the molecule CO⁺ which have bands around 2200 Å. The (B-X) bands of CO⁺ were very strong in comet West as was shown in the rocket spectra of Feldman and Brune (1976). Their spectra was taken with a resolution of 22 Å and when the comet was at heliocentric and geocentric distances of 0.39 AU and 0.84 AU, respectively. Here we would like to make a synthetic profile analysis of these observations.

The calculation of the synthetic profile requires a knowledge of the population distribution in various vibrational and rotational levels. The population distribution in various rotational levels has been determined from the solution of the statistical equilibrium equations based on the resonance fluorescence process. Since the observed profile is a superposition of various bands, we have taken this into account in all 18 bands whose wavelengths lie in the observed spectral region. In each of the vibrational levels for the upper and lower states, 30 rotational levels have been taken into account. The vibrational population distribution are taken from the earlier work, which is based on the detailed solution of the statistical equilibrium equation of vibrational levels (Krishna Swamy, 1979). The wavelengths of the various rotational transitions have been calculated using the molecular constants of Rao (1950). The Hönl-London factors are taken from Schadee (1964). The solar fluxes in the wavelength region of interest has been taken from Tousey *et al.* (1974), Kjeldseth Moe *et al.* (1976) and Broadfoot (1972). Doppler shifted fluxes corresponding to the time of observation have been used in the calculations. The calculated profile convolved with the instrumental profile is compared with the observed profile in Figure 1. The curves are normalised to the feature at $\lambda \sim 2300$ Å. As can be seen from Figure 1, the calculated and the observed profiles are in reasonable agreement with each other, therefore supporting the resonance fluorescence process as the excitation mechanism (Arpigny, 1964).

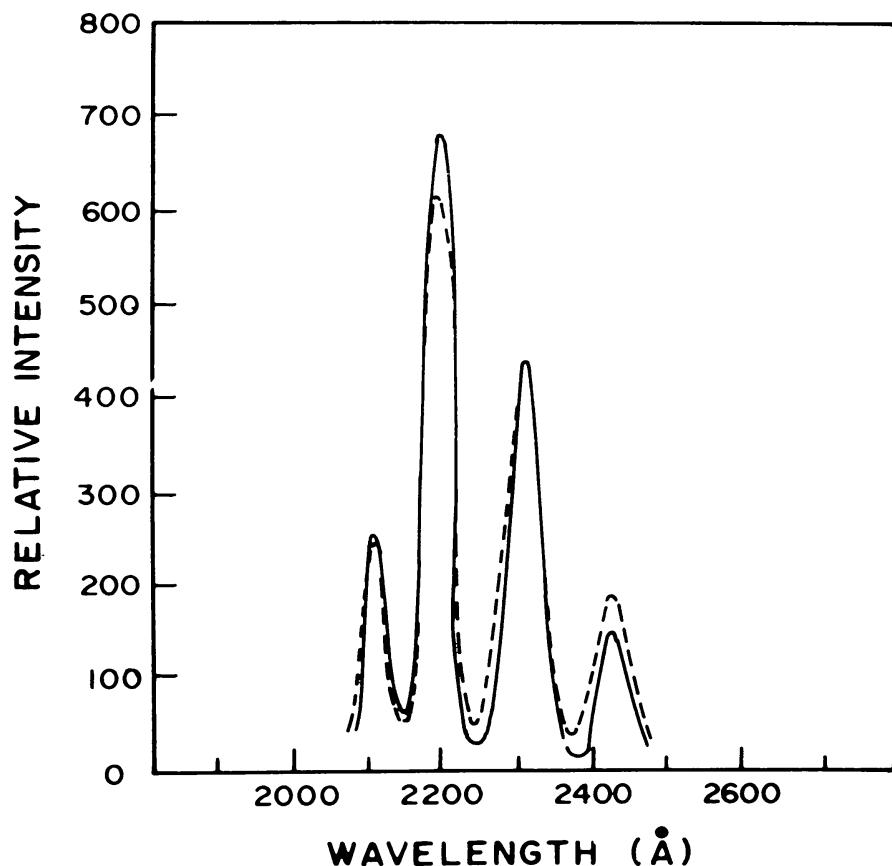


Fig. 1. Comparison of the calculated (solid line; HWHM = 11 Å) and the observed profile for comet West (dashed line) of ($B-X$) bands of CO^+ .

References

Arpigny, C.: 1964, *Ann. d'Ap.* **27**, 406.
 Broadfoot, A. L.: 1972, *Astrophys. J.* **173**, 681.
 Feldman, P. D. and Brune, W. H.: 1976, *Astrophys. J.* **209**, L45.
 Kjeldset Moe, O., Van Hoosier, M. E., Bartoe, J. D. F., and Brueckner, G. E.: 1976, *A Spectral Atlas of the Sun between 1175 and 2100 Å*, NRL Report 8057.
 Krishna Swamy, K. S.: 1979, *Astrophys. J.* **227**, 1082.
 Rao, K. N.: 1950, *Astrophys. J.* **111**, 50.
 Schadee, A.: 1964, *Bull. Astron. Inst. Neth.* **17**, 311.
 Smith, A. M., Stecher, T. P., and Casswell, L.: 1980, *Astrophys. J.* **242**, 402.
 Tousey, R., Milone, E. F., Purcell, J. D., Schneider, W. P., and Tilford, S. G.: 1974, *An Atlas of the Solar Ultraviolet Spectrum between 2226 and 2992 Å*, NRL Report 7788.