EXPECTED AND OBSERVED PROFILES OF CO AND CS IN COMETARY SPECTRA

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Abstract. The synthetic profile for the ($A^1\pi$–$X^1\Sigma^+$) bands of CO is shown to compare well with the observed profile for comet West. The calculated profile for the (0, 0) band of CS is also in reasonable agreement with the observed profile in comet Bradfield (1979*l*).

1. Introduction

Rocket observations of comet West showed the presence of strong bands of ($A^1\pi$–$X^1\Sigma^+$) of CO around 1500 Å and CS around 2575 Å (Feldman and Brune, 1976; Smith *et al.*, 1980). The molecule CS has also been seen in other comets (Jackson *et al.*, 1978, 1980, 1982). The observed relative intensities of various bands for these two molecules are shown to be consistent with the expected intensities based on the resonance fluorescence process (Krishna Swamy, 1979, 1981). Here, we would like to calculate the synthetic profiles for CO and CS bands and compare them with the available observations.

2. Calculations

The population distribution in various rotational levels for a given band has been obtained from the solution of the statistical equilibrium equations based on the resonance fluorescence process. For details, one may refer to Krishna Swamy (1979, 1981) and Krishna Swamy and O'Dell (1977, 1979). The Höln–London factors are taken from Schadee (1964). From a knowledge of the population distribution in different rotational levels and combining it with the vibrational populations derived earlier, the rotational profile can easily be calculated (Arpigny, 1966).

3. Results

3.1. CO

We would like to calculate the synthetic profile for the wavelength range of about 1400 to 1650 Å for comparing with the observations on comet West obtained at a resolution of 15 Å (Feldman and Brune, 1976). Since the observed profile is a superposition of various bands, we have taken into account 16 bands whose wavelengths lie in the above spectral region. This covers roughly $v'' = 0$ to 2 and $v' = 0$ to 5. In each of the vibrational states, 60 rotational levels have been included. The wavelengths of various rotational lines have

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been calculated from the energy values of Kurucz (1976). The doppler shifted fluxes corresponding to the time of observation has been obtained from the Atlas of Kjeldseth Moe *et al.* (1976). The expected profile is compared with the observed profile in Figure 1.

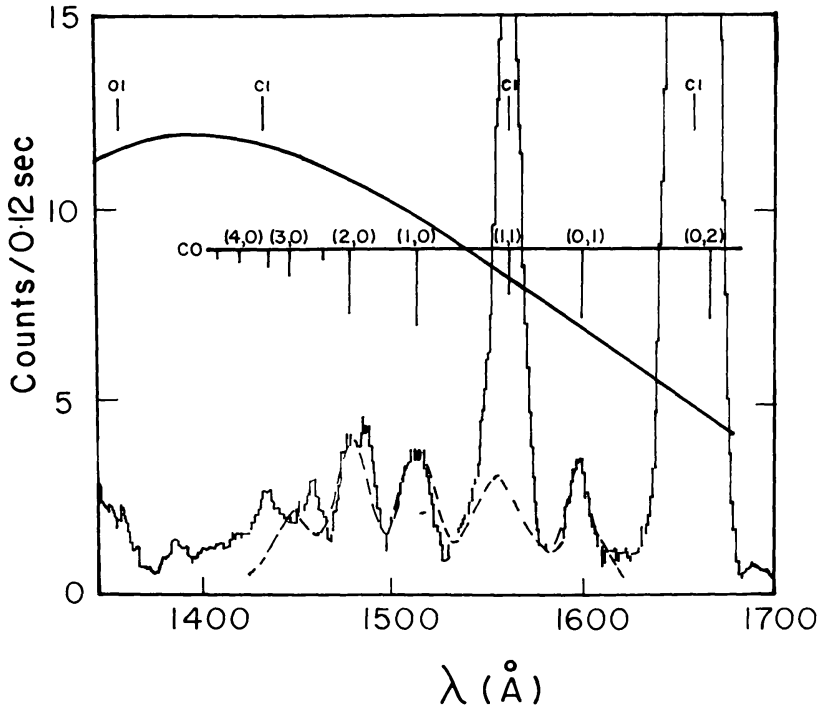

Fig. 1. Comparison between calculated and observed profiles of $(A-X)$ bands of CO. Solid curve and dashed curve refer to HWHM ~ 7.5 and 5.0, respectively.

3.1. CS

Jackson *et al.* (1980, 1982) have obtained high resolution scans of the (0, 0) band of CS on comet Bradfield using the International Ultraviolet Explorer. In the calculation of the synthetic profile, we have considered 30 rotational levels in each of the vibrational states. The wavelength of the transitions are taken from Barrow *et al.* (1960). The Doppler shifted wavelength corresponding to the comet Bradfield observations has been taken into account in interpolating the solar fluxes from the atlas of Tousey *et al.* (1974). The resulting profile is compared with those of observations in Figure 2.

3. Conclusions

The expected profile based on the resonance fluorescence process, of the $(A-X)$ bands of CO and the (0, 0) rotational band of CS, are shown to be in reasonable agreement with the observed profiles.

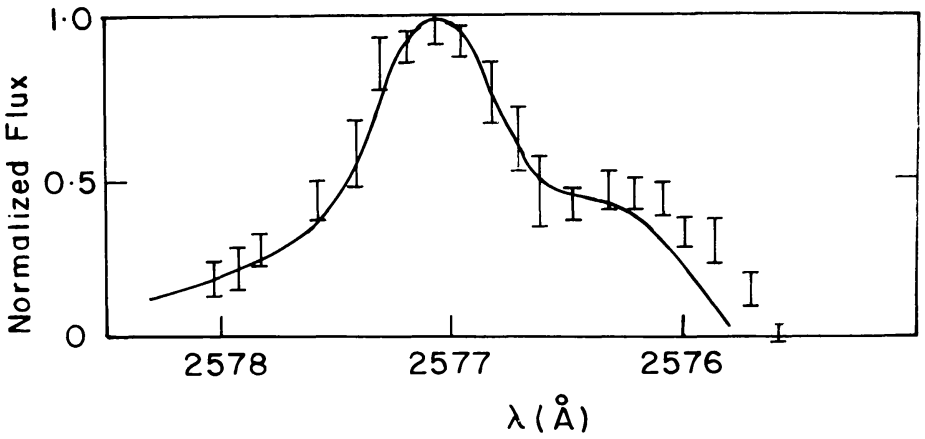

Fig. 2. Comparison between observed and theoretical (solid line) profile for HWHM of 0.1.

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