# CORRELATIONS FOR INTERSTELLAR MOLECULES AND DIFFUSE BANDS

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## ABSTRACT

Results are presented from a programme of optical spectroscopy and related studies which has the double purpose of investigating the structure of diffuse molecular clouds and of establishing tighter correlations for the unidentified interstellar diffuse bands.

## MOLECULAR STUDIES

There has been a tendency for each study of interstellar molecules to be concentrated on one spectral region, neglecting the advantages of relating different observations along the same line of sight. In University College London, D. McNally has developed ideas of analyzing interstellar cloud structures by combining optical and ultraviolet molecular observations, using IUE and other satellites, and comparing them with microwave observations in the same directions made by R.L. Dickman of Aerospace Corporation, Los Angeles. Whittet et al. (1979a) have discussed in this way the abundances of CN and CO in diffuse interstellar clouds. Results are well correlated and lead to the relative abundance

$$N(CN) \,/\, N(CO) \sim 4.5 \times 10^{-3}.$$

This value is consistent with an extrapolation of theoretical results based on ion-molecule reactions in the gas, and is not consistent with predictions involving grain surface reactions.

## DIFFUSE INTERSTELLAR BANDS

It is important to establish how precise are the correlations of the unidentified diffuse band strengths with each other and with other quantities such as the colour excess E(B-V) and the strength of the ultraviolet λ2200 band, and to scrutinize all cases where anomalies may be present. We have found that several reported anomalies cannot be confirmed, and have formed the opinion that all putative anomalies should be approached with caution.



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From low-resolution observations, the star ρ Leo appeared to have anomalously-strong λ4430; it was frequently cited as an outstanding example of this. However, by high-resolution spectroscopy Blades and Somerville (1977) established that the apparent anomaly is caused by a combination of weak lines in the spectrum of the star itself. Similar results have been found for other stars. This suggests an explanation of the effect in correlation studies of a non-zero λ4430 strength for zero reddening: this has been a puzzle for, whatever the carrier of the band, it is hard to imagine it present where there is no dust. Our work suggests that the λ4430 - E(B-V) correlation line should be lowered, by about 3% in the central intensity $A_c(4430)$, and pass through the origin.

A statistical analysis of the scatter about the mean line in the correlation diagram of Snow et al. (1977) for $A_c(4430)$ with E(B-V) (Somerville, in preparation 1979) indicates that the major part of the scatter is consistent with observational error. There is, however, evidence for some physical departure from a linear relation. This does not in itself prove that the bands are not produced by the grains responsible for the reddening; they could be associated with some property such as impurity content which varies from place to place. The distribution in the sky appears random apart from a tendency in a few regions for stars of weak λ4430 to cluster together, in accord with the well-established result that the diffuse bands are below strength relative to the reddening in certain regions. The statistical analysis predicts that there should be similar numbers of reddened stars where the bands are anomalously strong.

From TD-1 observations, Willis and Wilson (1975) found that the ultraviolet feature λ2200 was anomalously very strong in HD 192163, a Wolf-Rayet star of class WN6. Optical observations (Whittet et al., 1979b) show that interstellar atomic lines and diffuse bands in this star are of normal strength. A quick look at recent observations by Somerville and Whittet suggest that the same conclusion will be reached in a second case, HD 156385, class WC7. If the large anomaly in λ2200 is confirmed, it will thus indicate that the carrier of λ2200 is different from the carriers of all these optical features, and from the dust grains which produce the optical extinction.

## REFERENCES

Blades, J.C., and Somerville, W.B., 1977, Mon. Not. R. Astr. Soc. 181, pp 769-776.
Snow, T.P., York, D.G., and Welty, D.E., 1977. Astr. J. 82, pp 113-128.
Whittet, D.C.B., McNally, D., and Dickman, R., 1979a. "The First Year of IUE" (University College London), in press.
Whittet, D.C.B., Somerville, W.B., McNally, D., and Blades, J.C., 1979b. Mon. Not. R. Astr. Soc. 189, pp. 519-525.
Willis, A.J., and Wilson, R., 1975, Astr. Astrophys. 44, pp 205-207.