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TYPE OF SILICATE FEATURE IN OXYGEN RICH STELLAR ENVELOPES

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The 10 μm silicate feature is seen in several types of astronomical sources. Laboratory measurements of emissivities of silicate grains of different types show variation in the absolute value and in wavelength dependence. In many astronomical studies, one has used the emissivity function derived from the Trapezium emission feature (Gillett et al., 1975). Here, we describe a statistical study of a large sample of objects about the applicability of this commonly used function (hereafter TR).For comparison, we also use another emissivity function derived for lunar silicate (LS) sample 14321 (Knacke and Thomson, 1973) which has a maximum at 10.2 μm instead of at 9.7 μm as for TR. For the present study we use the IRAS Low Resolution Spectra sources classified as 7n, having a silicate absorption feature without any atomic line emission. Most of these sources are likely to be oxygen rich stellar envelopes or hotspots in molecular clouds. Of the 66 sources listed, we selected 61 having a higher flux density in the 25 μm band than in the 12 μm band. We further restricted our study to 59 sources with S/N > 5 at about 8 μm.

For the present study, we assumed the central source to emit a Planckian spectrum characterised by a temperature T and an absorbing envelope with an emissivity dependence of type TR or LS. Values of T and τ, the absorption optical depth were obtained by minimising χ^2 between the observed and fitted spectra in the 7-13 μm range. Values of reduced χ^2 were obtained by taking the noise listed in the LRS Catalog as standard deviation. The τ values obtained correspond to 9.7μm for TR and 10.2 μm for LS.

A summary of the results is given in Table 1. Defining $R = \chi^2(TR)/\chi^2(LS)$, we give the distribution of log R for different ranges of $\chi^2(TR)$ and $\tau(TR)$. Taking all the sources, it is seen that 36% are better fitted by TR shape (log R < -0.2), 24% are better fitted by LS (log R > 0.2) and the rest 40% equally well by both. If we consider only those with $\chi^2 < 10$, the corresponding percentages are 49(TR), 13(LS) and 38 (both). The fraction of sources for which TR is not a good representation is $\sim$ 0.2. In Fig. 1, we show two sources illustrating the difference in fits when TR(LS) is much better than LS(TR).

REFERENCES

Gillett, F.C., Forrest, W.J., Merrill, K.M., Capps, R.W., and Soifer, B.T.: 1975, Ap. J., 200, 609.

Knacke, R.F. and Thomson, R.K.: 1973, PASP, 85, 341

Table 1: Statistics of fits

	χ^2(TR) $\leq$ 10		χ^2(TR) $\geq$ 10	
	$\tau \leq 2$	$\tau \geq 2$	$\tau \leq 2$	$\tau \geq 2$
log R < -0.2	15	3	3	0
0.2 > log R > -0.2	10	4	8	2
log R > 0.2	4	1	6	3

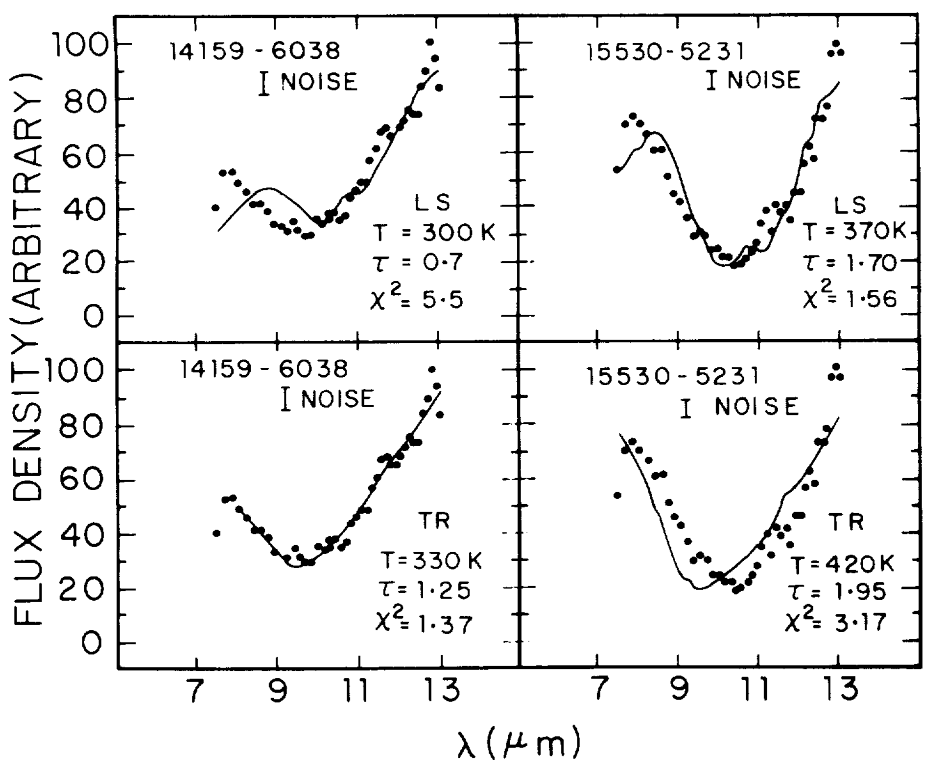

Figure 1. The observed 7-13 μm spectra (filled circles) and the best fits (continuous lines). Emissivity functions used are: TR, Trapezium; LS, lunar silicate.