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THE ENERGY DISTRIBUTION OF 630 SOURCES FROM THE VALINHOS 2 μm SURVEY

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RESUMO: Foram observadas nas bandas JHKLM, com o telescópio de 1-m do ESO, 630 fontes infravermelhas detetadas pelo "survey" de Valinhos em 2 μm. Os objetos foram identificados com fontes do catálogo de fontes pontuais do satélite IRAS. Com base no estudo estatístico das distribuições de energia no infravermelho, propomos uma classificação para os objetos observados.

ABSTRACT: 630 sources detected by the Valinhos 2 μm survey were observed in the JHKLM bands with the ESO 1-m telescope. The objects were also identified with entries of the IRAS point source catalogue. Based on a statistical investigation of their infrared energy distribution, we propose a classification of the sources.

Key words: INFRARED-SOURCES

I. INTRODUCTION

We present a statistical study of the infrared energy distribution of 630 sources first detected by the Valinhos 2 μm survey (Epchtein et al. 1985, paper I). Our sample comprises the 338 sources listed in paper I, and 292 newly observed sources. The JHKLM photometric observations were made with the 1-m ESO telescope at La Silla; identification of the sources with the IRAS point source catalogue provided the far-infrared part of the energy distributions. We discuss the interesting features of the colour diagrams that can be obtained by combination of the different bands, and we propose some criteria to classify the sources.

II. RESULTS

The average characteristics of the source can be summarized as follows: 1) The near-infrared energy distribution of the stars is not very different from a blackbody, as can be seen for instance in the (K-M) × (K-L) diagram (Figure 1). 2) Strong deviations from blackbody distribution appears when near and far-infrared colours are mixed, as for instance in the (L-12 μm) × (K-L) diagram (Figure 2).

However in *almost all cases* the *sum of two blackbodies*, one corresponding to the circumstellar dust shell, the other to the photosphere, provides a good fit of the whole energy distribution. We show in Figures 3 and 4 two examples of such fits.

The (L-12 μm) × (K-L) diagram appears to be the most useful to classify the sources as follows: 1) *class "a" sources*: they are the group of points around (K-L) $\sim$ 0.2, (L-12 μm) $\sim$ 0.5. These are stars (photospheres) without envelopes. 2) *class "b" sources*: they correspond to the second concentration of objects in the interval 0.2 < K-L < 0.7, and 0.8 < L-12 μm < 2.0, and comprises 45% of the objects. These are stars with relatively thin envelopes. Note the gap between "a" and "b" objects. The stars which have envelopes are cooler than the stars without envelopes. 3) *Class "c" and "d" sources*: the remaining objects seem to separated in two branches. The upper branch (class "d") contains relatively hot stars (T > 2000 K) with large dust shells. The object Hen 1379 (Figure 4) is an extreme case of "d" objects. The lower branch (class "c") contains cool stars with cool envelopes. The relative size of the envelopes, measured in stellar

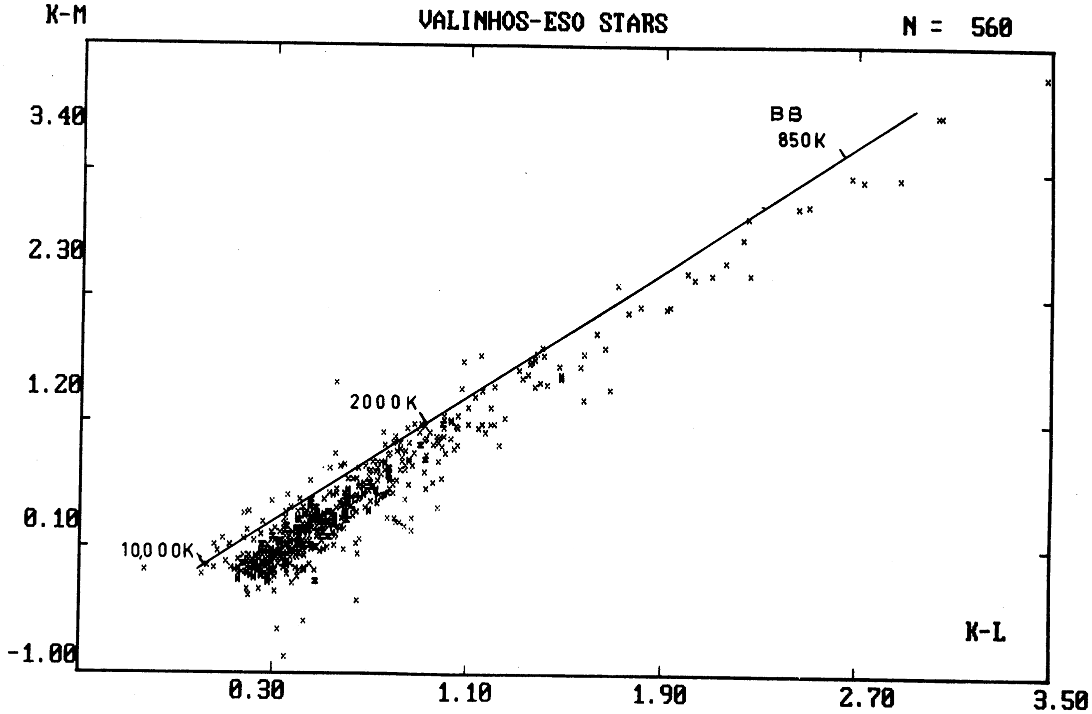

Fig. 1. The (K-M) × (K-L) colour diagram of 560 sources. The blackbody line is indicated.

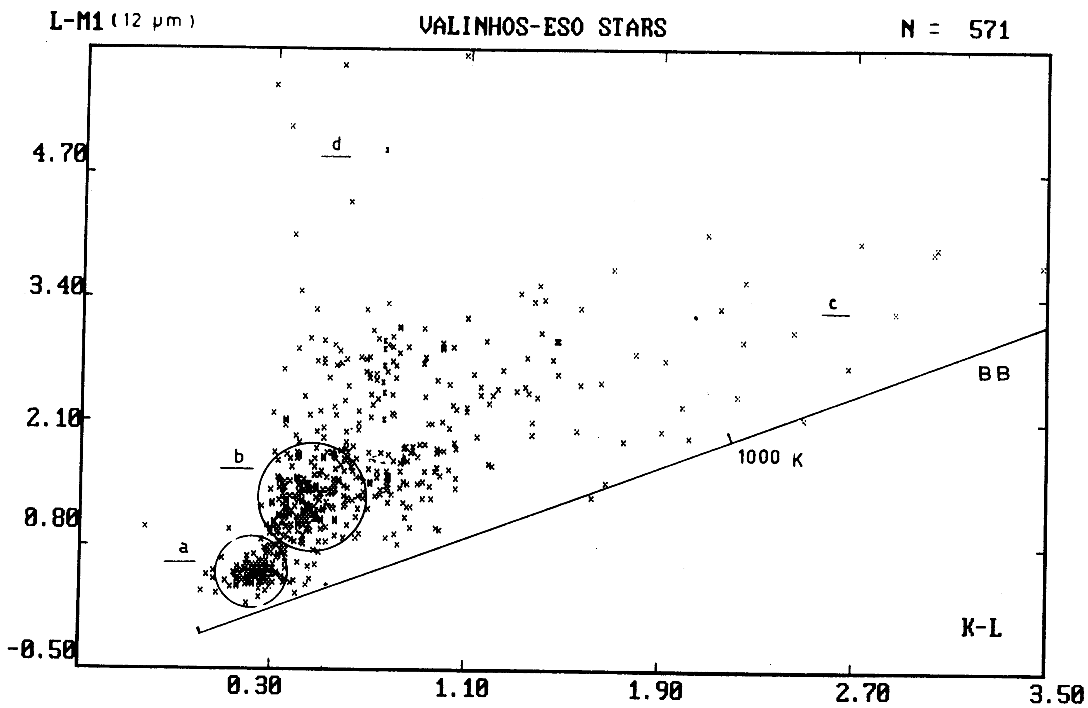

Fig. 2. The (L-12 μm) × (K-L) colour diagram of 571 sources. The circles enclose the sources of class "a" and class "b" (see text).

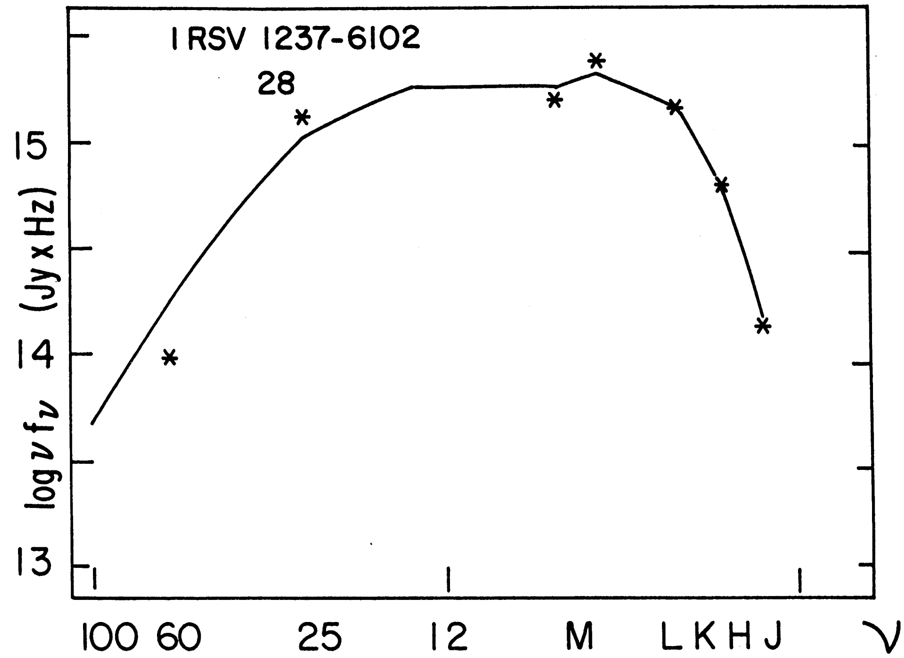

Fig. 3. The energy distribution of the source IRSV 1237-6102, fitted by the sum of two blackbody curves (T_1= 1100 K and T_2 = 250 K).

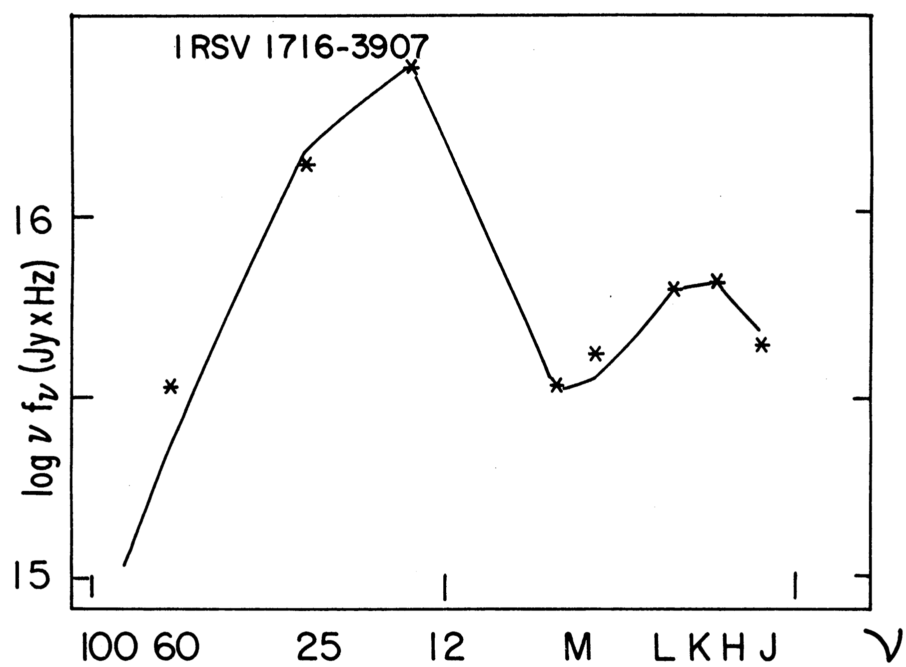

Fig. 4. The energy distribution of the source IRSV 1716-3907 (Hen 1379), fitted by the sum of two blackbody curves (T_1 = 2000 K and T_2 = 270 K).

radii, are smaller than those of "d" objects.

In the (12 µm-25 µm) × (K-L) diagram, the cool (large K-L) objects separate into two branches (Figure 5). The lower branch lies along the blackbody line and contains all the known carbon stars of the sample, as revealed by their optical identifications or from their IRAS LRS spectra. The upper branch contains oxygen-rich variables.

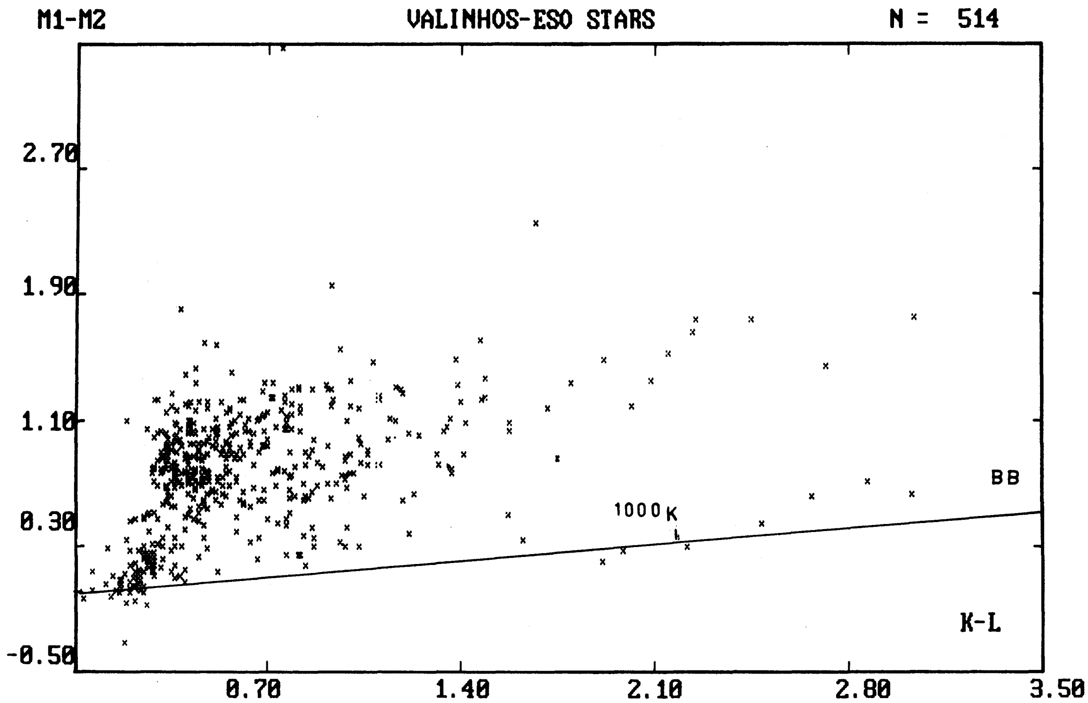

Fig. 5. The (12 µm-25 µm) × (K-L) colour diagram of 514 sources. The blackbody line is indicated.

III. CONCLUSIONS

The combined IRAS and far-infrared colours are very efficient indicators of the nature of the infrared sources. In the two-blackbody model which fits almost all the cases (K-L) gives the temperature of the star, (12 µm-25 µm) is mostly related to the temperature of the dust shell, and (L-12 µm) is mostly related to the ratio of the two components.

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