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Blackbody Fits of Semiregular Variables

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Abstract. Semiregular variables of type SRa and SRb are studied by fitting combinations of blackbodies to new near infrared and IRAS data.

In Kerschbaum & Hron (1992) a systematic investigation of the basic properties of type SRa and SRb Semiregular variables (SRVs) was presented. For the O-rich subgroup a new classification scheme into 'blue', 'red' and 'Mira' SRVs was one of the main outcomes. Concerning the physical properties an independent study by Jura & Kleinmann (1992) arrived at similar conclusions, except for the long-period SRVs. New JHKL′M-photometry (Kerschbaum & Hron 1994, Paper II) supports independently the classification into 'red' and 'blue' SRVs.

As a next step, visual information is taken from the GCVS4, near infrared JHKL′M-photometry from Paper II; mid- and far-infrared measurements were extracted from the IRAS-PSC. The resulting energy distributions can be reasonably well fitted for almost all objects by a combination of two blackbody curves. The overall spectra can be roughly described by a 'photospheric' temperature T^*, a 'dust'-temperature T^d and the 'size' of the circumstellar shell relative to the star $r = R^d/R^*$.

The resulting parameters T^*, T^d and r of course need to be related to astrophysically meaningful quantities. T^* can be compared with a $T_{\rm eff}$ derived from the synthetic H–K colours given by Bessell et al. (1989). For T^* above 2100 K only a constant offset of about 400 K is found for our O-rich SRVs. For the parameters related to the circumstellar material, namely T^d and $r = R^d/R^*$ the situation is more complex. A comparison of BB-Fits with the results of dust shell models by Le Bertre (1988) and Le Sidaner & Le Bertre (1993) shows that our T^d and r both correspond to almost the same region of the innermost part of the dust shell.

Fig. 1 shows the blackbody fit parameters for 'red' SRVs and C- and S-SRVs. The different energy distributions show up clearly. All 'blue' objects can be reasonably well approximated by only *one* blackbody whereas the 'red' and the 'Mira' SRVs need *two*. The T^* values, reflecting mainly the effective temperatures for objects with only small mass loss, are typically 300 K higher in the 'blue' than in the 'red' SRV cases. With a few extreme exceptions most of the 'red' T^d values are concentrated around 400 K whereas the 'Mira' like Semiregular variables show a wider distribution between 330 and 570 K. C-rich objects and S-stars differ significantly from the O-SRVs in the fit parameters. Sometimes 'unphysically' low T^* are found — a result of circumstellar reddening in the high mass loss cases. Also lower values of T^d, accompanied by normal T^*

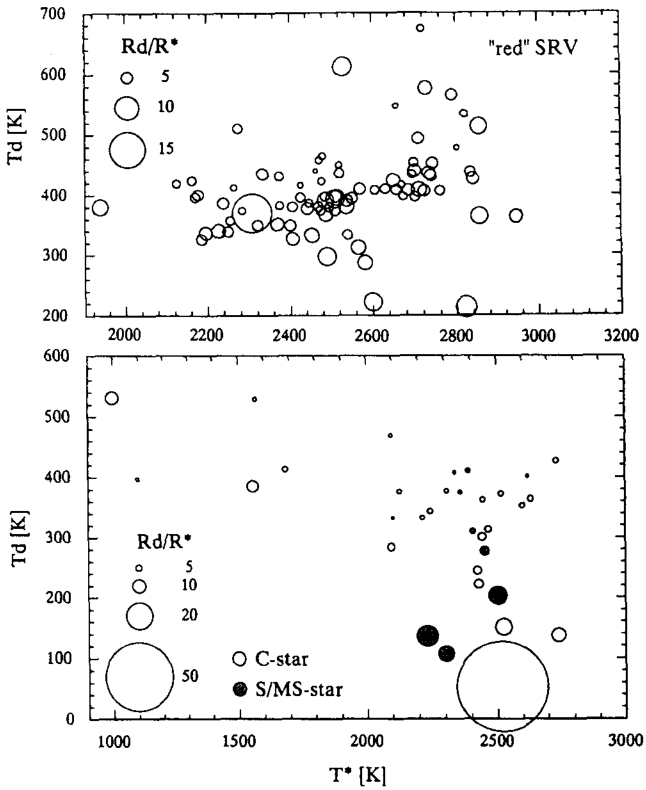

Figure 1. 'Dust'-temperature T^d as a function of 'photospheric' temperature T^* with the relative 'size' of the dust shell R^d/R^* indicated by the diameter of the plot symbols.

and large values of r are common — the most extreme example being TT Cyg with its detached envelope.

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References

Bessell M.S., Brett J.M., Scholz M., Wood P.R. 1989, A&AS 77, 1

Jura M. 1988, ApJS 66, 33

Jura M., Kleinmann S.G. 1992, ApJS 79, 105

Kerschbaum F., Hron J. 1992, A&A 263, 97 (Paper I)

Kerschbaum F., Hron J. 1994, A&AS 106, 397 (Paper II)

Le Bertre T. 1988, A&A 190, 79

Le Sidaner P., Le Bertre T. 1993, A&A 278, 167