SLOW VARIABILITY AND CIRCUMSTELLAR SHELLS OF RED VARIABLE STARS

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Infrared photometry shows that while all RV Tauri stars have circumstellar dust shells, the RVb stars with slow cyclic variations in mean light as well as the 30-100 day variations common to all RV stars have more hot dust close to the star (Lloyd Evans 1985). Many M giant stars which are variables of semiregular type also show long-period variations in the mean light (O'Connell 1933; Payne-Gaposchkin 1954), with a roughly constant ratio between the two periods. Payne-Gaposchkin (1954) found $P_2/P_1 \sim 9.4$ for red variables of type M and $P_2/P_1 \sim 19.4$ for stars of type F-K, most of which are RV Tauri stars. Re-analysis using the more extensive data available now indicates $P_2/P_1 \sim 10$ for the M giants and $P_2/P_1 \sim 15$ for the RV Tauri stars. The nature of the long-period variability is unknown (Wood 1975).

K - [12] and [12] - [25] have values close to 0.65 and 0.10, respectively, throughout the spectral range M0-6 for stars with visual light amplitude $\Delta m < 0.3$ mag. These colours become redder rapidly as a function of amplitude when Δm exceeds 0.3 mag. Part at least of the increase in colour must result from the contribution of a circumstellar shell, as the IRAS Low Resolution Spectra show that silicate emission becomes common among the stars with larger K - [12] and [12] - [25]. Variability of small amplitude evidently promotes the formation of a dust shell just as occurs for the large amplitude Mira variables (Whitelock, Feast & Pottasch 1986; Jones, Ney & Stein 1981). The stars with variable mean light have redder colours than average at a given amplitude, especially in the case of [12] - [25].

The distribution of the infrared spectral types of SR variables as a function of visual light amplitude has been studied using the classification system described by Beichman et al. (1985) for the IRAS Low Resolution Spectra. Stars with $P_1 > 150$ days were excluded to eliminate luminous stars which tend to have stronger silicate emission. The doubly periodic stars have a higher proportion of silicate emission spectra in four of the five amplitude subdivisions and show silicate emission more frequently than SRb, SRa or even Mira variables.

It is concluded that the occurrence of a long period variation in the mean light is conducive to the formation of circumstellar dust shells in semiregular variable stars of spectral type M, as it is in the case of the RV Tauri stars.

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