ANOMALOUS UV-EXTINCTION AND THE EFFECTIVE TEMPERATURE OF V348 SGR

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Our idea of the evolutionary state of the hot R CrB-star V348 Sgr is seriously restricted by our ignorance of its effective temperature. A direct determination from photospheric lines is very difficult, owing to contamination by emission lines. Using Johnson photometry, Houziaux (1968) estimated a spectral type of B0 or B1. This result was, however, based on the assumption that V348 Sgr behaves photometrically as a main sequence star. V348 Sgr appears, however, to be an extreme helium star since hydrogen absorption lines are completely absent (Houziaux, 1968). This conclusion has been strengthened by a study of Heber et al. (1984) in which IUE-spectra (low resolution) of V348 Sgr are compared with those of well-known extreme helium stars. From the similarity between these spectra, it was concluded that V348 Sgr must be a helium supergiant with an effective temperature of about 16000 K, though its (dereddened) spectral flux distribution differs in a peculiar way from that of HD 124448 which has about the same temperature. It should, however, be noted that the dereddening was performed by eliminating the $\lambda = 2200$ Å dip with Seaton's law for the interstellar reddening. Obviously, the latter is not applicable when describing the extinction towards V348 Sgr.

Owing to the importance of a reliable temperature determination of this unique object, we decided to further examine the extinction problem. We assumed that the extinction to V348 Sgr is composed of two parts, namely a normal interstellar contribution which can be described by Seaton's parametrization, and a circumstellar contribution with different absorption properties in the UV. As a first preliminary choice for the latter, we selected an absorption law belonging to amorphous carbon grains (carbon "smoke") of $r = 0.01$ μm as measured by Stephens (1980). Figure 1 illustrates the extinction caused by these amorphous carbon grains as compared to the normal extinction law. In the optical region both are alike, but in the UV they differ considerably. The amorphous grains give more extinction in the near UV, but less for $\lambda < 2500$ Å. The peaked absorption occurs at $\lambda \approx 2500$ Å, contrary to the normal law of extinction which peaks at $\lambda \approx 2200$ Å. In this respect, it should be noted that Greenstein (1981) found the first evidence of circumstellar matter containing amorphous carbon when he

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studied the UV-spectrum of the central star of A 30. Also, Hecht et al. (1984) noted a peculiar extinction in UV-spectra of R CrB-stars and suggested glassy or amorphous carbon grains as being responsible.

For the interstellar extinction, we used the value found by Heber et al. (1984), E(B-V) = 0.45, which is necessary to remove the 2200 Å dip in the IUE-spectrograms. The additional contribution of the circumstellar carbon grains that is necessary to flatten the whole UV-spectrum was estimated by trial and error to E(B-V) = 0.15. The result is displayed in Figure 2 where the old fit of Heber et al. (1984) is also shown. With our choice of circumstellar extinction, the observations are now reasonably well matched by a helium model atmosphere (unblanketed) of 20000 K from the UV to the red spectral region. The fit, though, is not perfect since it appears that we somewhat overcorrected at $\lambda \approx 2500$ Å. The fit suggests a weaker bump for the carbon smoke extinction than that given by Stephen's (1980) measurements. Of course, we cannot expect to get final results with only one of different possible extinction curves for amorphous carbon grains (cf. Stephens, 1980). In the future we shall have to model the circumstellar extinction using better exposed UV-spectrograms of V348 Sgr.

We can, however, quite safely conclude that circumstellar extinction by amorphous carbon grains is important in interpreting UV-spectrograms of V348 Sgr, and its consideration leads to a substantially higher effective temperature of about 20000 K (cf. Fig. 2). The total reddening amounts to E(B-V) = 0.6, thus being close to the value of E(B-V) = 0.6 .. 0.7 which one gets by comparing Johnson photometry with theoretical colours of helium model atmospheres (Heber and Schönberner, 1981). Finally, we would like to emphasize that this reddening is only valid along the line of sight to the star. In fact, Dahari and Osterbrock (1984) determined a reddening up to E(B-V) ≈ 1.5 from emission lines. Since these lines originate in the shell, this large reddening must not be in contradiction to our result. Instead, it points to an inhomogeneous dust distribution around the star.

Dahari and Osterbrock (1984) identified a weak photospheric absorption at 4089 Å as being caused by Si IV. The very existence of Si IV in the photosphere of V348 Sgr would be in variance with our temperature estimate of only 20000 K. However, the Si IV line at 4116 Å is not reported by Dahari and Osterbrock, despite the fact that this line should be comparable in strength to the 4089 Å line. We therefore inspected the old tracings of Houziaux (private communication) and found no evidence of a photospheric absorption at 4116 Å. We concluded that the line at 4089 Å is obviously not due to Si IV, but instead to O II, $\lambda = 4089.3$ Å. The latter line is clearly evident in hotter stars, and a number of other strong O II lines have also been identified in V348 Sgr. Thus, the absorption spectrum of V348 Sgr, as far as is known, also appears to be consistent with an effective temperature of 20000 K.

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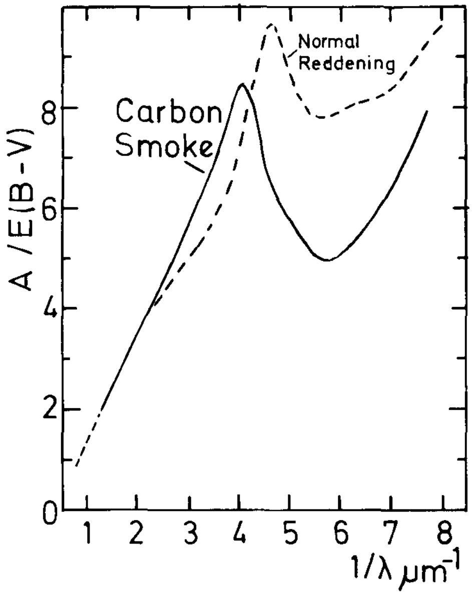

Fig. 1 The reddening law of carbon smoke consisting of amorphous carbon grains with $r = 0.01\ \mu m$ (Stephens, 1980). Figure adapted from Greenstein (1981).

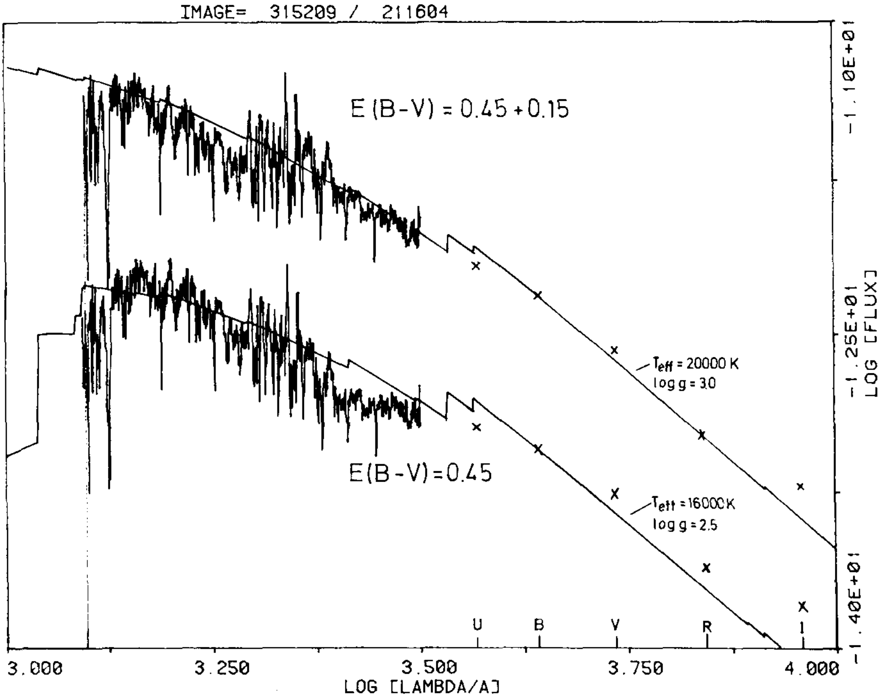

Fig. 2 Fit of dereddened spectra (SWP 15209, LWR 11604) of V348 Sgr with helium-carbon atmospheres for interstellar reddening E(B-V) = 0.45 (bottom), and for the same interstellar reddening plus a circumstellar contribution of E(B-V) = 0.15 with the law as shown in Fig. 1 (top).