View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by NASA Technical Reports Server

N87-15112

The Ultraviolet Extinction in M-supergiant Circumstellar Envelopes

Richard H. Buss Jr. and Theodore P. Snow Jr.

Using *IUE* archival low-dispersion spectra, we have derived ultraviolet spectral extinctions in the circumstellar envelopes of two M supergiants: HD 60414 and HD 213310. The observed stellar systems belong to a class of widely-separated spectroscopic binaries that are called *VV Cephei* stars. These systems usually contain an early M supergiant and a hot companion B star that lies within the stellar wind of the M star. The ultraviolet radiation of the hot stars has allowed us to obtain ultraviolet spectral extinction curves for two different M supergiant envelopes: M0 Ib (HD 213310) and M2 Iab pe (HD 60414).

We first classified the hot stars with the *IUE* Low-Dispersion Spectral Atlas (Heck *et al.* 1984). By non-quantitative comparison, we found gB3 as the ultraviolet spectral type for HD 213310 and s-B3pe as the ultraviolet spectral type for HD 60414. It is interesting that the hot component of HD 213310 has been classified as a B8 V star (Hoffleit 1982) and that the hot component of HD 60414 has been tentatively classified as a B2 V star (Jasheck 1963). Though the the ultraviolet classification system and the MK system do not directly correspond, the discrepancies between the luminosity types for the same star indicate that the luminosity-sensitive ultraviolet lines better characterize the luminosity class for B stars in *VV Cephei* systems.

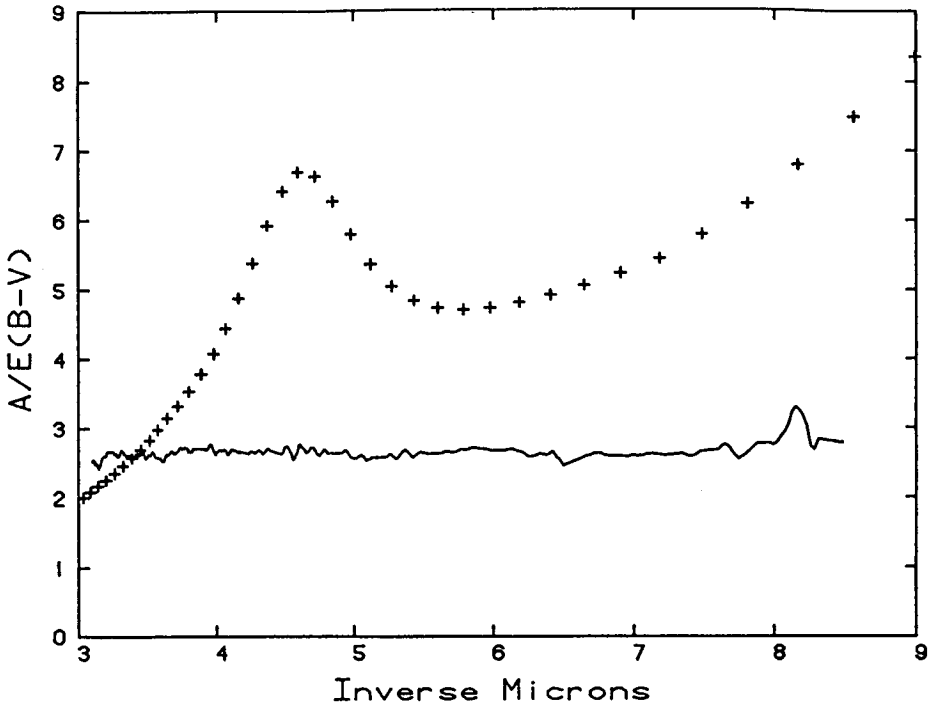
We calculated the total extinction by dividing the reddened fluxes with unreddened comparison fluxes of similar stars (g B2.5 for HD 213310 and a normalized s+B3 for HD 60414) from the reference atlas. After subtracting the interstellar extinctions (Seaton 1979), which we estimated from the E(B - V) reddening of nearby stars [E(ism) ≅ 0.12 toward HD 213310 and E(ism) ≅ 0.22 toward HD 60414], we normalized the resultant circumstellar extinctions (solid lines in the accompanying figures) to the interstellar extinction (crosses in the figures) at about 3.5 inverse microns.

Not only is the 2175 Å extinction bump absent in the circumstellar extinctions but also the far-ultraviolet extinction rise is absent. We interpret the rather flat, ultraviolet extinction curves as signatures of a population of non-carbonaceous, oxygen-rich grains that have diameters larger than the longest observed wavelength. Hence, the similarity of flat extinction in both the α Sco circumstellar envelope (Snow *et al.* 1986) and in these two *VV Cephei* systems, which contain primary and secondary stars that differ from each other's counterparts, indicates that the spectral subtypes of the stars do not greatly influence the composition and sizes of the nascent grains around M supergiants; all of the circumstellar grains appear to be large and non-carbonaceous.

References

Heck, A., Egret, D., Jaschek, M., and Jaschek, C. 1984, *ESA* SP-1052.
Hoffleit, D., and Jaschek, C. 1982, *The Bright Star Catalog* 4th ed., Yale University Observatory.
Jaschek, C. and Jaschek, M. 1963, *P. A. S. P.*, **75**, 509.
Seaton, M. J. 1979, *M. N. R. A. S.*, **187**, 73P.
Snow, T. P., Buss, R. B., Gilra, D. P., and Swings, J. P. 1986, in preparation.

HD 213310



HD 60414