CORRELATIONS BETWEEN BCD PARAMETERS OF THE CONTINUOUS SPECTRUM AND THE BALMER DECREMENT OF Be STARS.

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I . INTRODUCTION

One of the greatest difficulties in interpreting the continuous spectrum of Be stars is to separate the effects of interstellar reddening from the effects due to the presence of the envelope. This difficulty has been avoided in the two types of correlations considered here. In the first one, parameters not affected by interstellar reddening are used (the Balmer jump and the Balmer decrement). In the second one, the parameters used can be affected by the interstellar extinction but comparisons are made only between values which correspond to the same (but variable) Be star, at different epochs, with different amounts of emission.

II CORRELATION BETWEEN THE BALMER JUMP AND THE BALMER DECREMENT.

It has been shown (Divan, 1979) that Be/shell stars sometimes show two Balmer discontinuities : a longwavelength one, D_o, as in ordinary B stars of luminosity class V, IV or III, and a shortwavelength one, d, occuring very near the theoretical Balmer limit, as in supergiant stars. This second discontinuity can be either in emission or in absorption. For a given star, it can vary and even completely disappear, but these changes never affect the longwavelength discontinuity which remains constant. The longwavelength discontinuity D_o is due to the underlying star ; the shortwavelength discontinuity, d, corresponds to a low density plasma and is due to the variable envelope. The resulting discontinuity D is equal to $D_o + d$, and varies like d. Figure 1 shows the correlation between d (in dex) and the Balmer decrement for 12 different stars. Difficulties due to the variability of the stars are avoided here because d and the Balmer decrement (taken from Briot, 1971 and 1981) have been measured almost simultaneously. A small wavelength overlap between the two discontinuities D_o and d renders the measurement of d somewhat difficult, except when D_o is known accurately from observations done at a phase without, or almost without emission. This was the case for all the stars in Fig. 1 except υ Cyg, φ Per and HD 194335. For these three stars, d is a lower limit and can be in error by a few times 0.01dex. For 9 of the 10 stars having the second Balmer jump in emission ($d<0$), the correlation seems quite good, the smallest Balmer decrements corresponding to the

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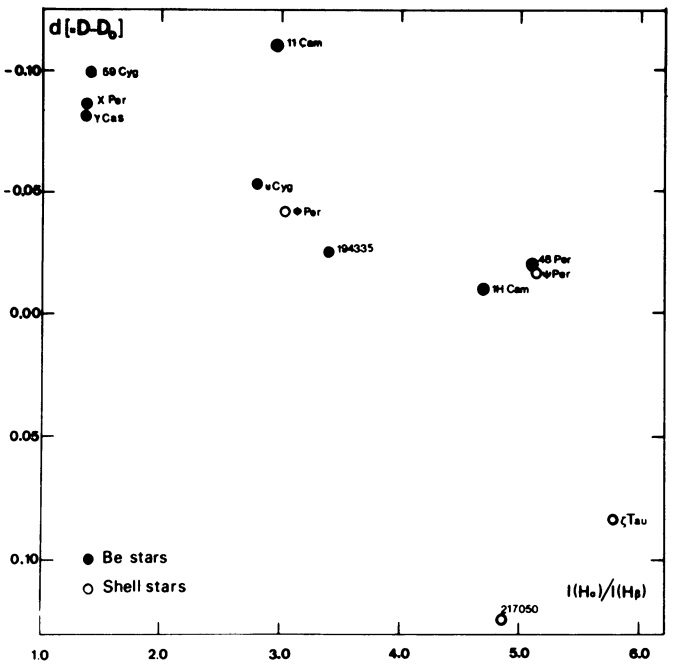

Fig. 1.

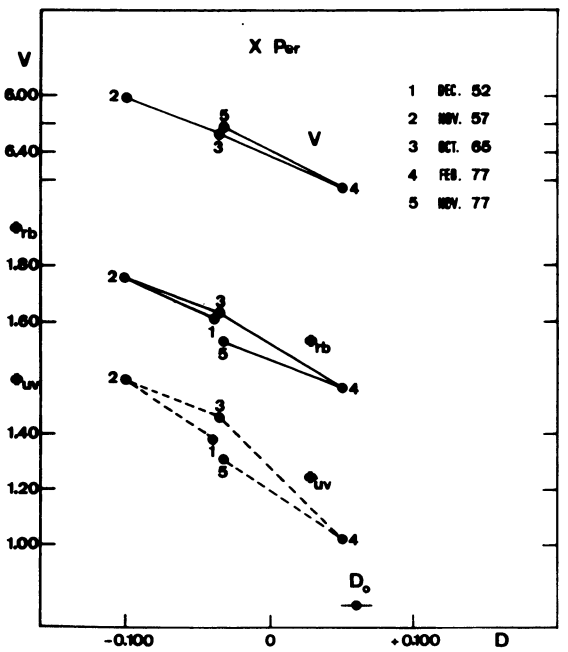

Fig. 2.

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strongest emission in the Balmer continuum ; even stars showing shell phases like φ Per or ψ Per do not deviate. The exception is 11Cam which also behaves differently in the other correlations (see below). This correlation between d and the Balmer decrement is definitely better than the correlations between d and the equivalent width of H_α. Only two stars (ζ Tau and HD217050) have the second Balmer discontinuity in absorption and nothing can be said in this case. However it seems improbable that a correlation should exist between this absorption and the Balmer decrement corresponding to emission lines.

III CORRELATIONS BETWEEN BCD PARAMETERS FOR A VARIABLE Be STAR.

Figure 2 shows the variation of

1- the V magnitude (measured at λ 5500Å on the BCD spectra).

2- the red-blue gradient $\emptyset_{rb}$ corresponding to the wavelength range 6200-4000Å ($\emptyset$ increases when the color temperature decreases).

3- the ultraviolet gradient $\emptyset_{uv}$ corresponding to the wavelength range 3700-3150Å

as a function of D (equal to d + the constant value D_o), for five different states of the spectrum of X Per, observed in Dec. 1952, Nov. 1957, Oct. 1965, Feb.1977 and Nov. 1977. The value of D_o is indicated, with the error bar due to the possible existence of a small emission in the Balmer continuum, not detected in the almost "B normal" phase of Feb. 1977.

The same correlations, with the same slopes, have been obtained for 59 Cyg (6 different phases) and 1HCam (3 different phases). The star γ Cas also seems to behave in the same manner. But for 11 Cam (3 different phases) the slopes are quite different. The sample of stars is too small to allow any conclusion. However the behaviour of X Per seems to be the rule for many of the Be stars for which emission in the Balmer continuum can be present ; they become brighter and redder when the emission increases. This intrinsic reddening explains the B-V colors of Be stars which often seem too red for their MK spectral types and their suspected interstellar reddening. Inversely, the U-B colors of the same stars are too blue ; this is due to the influence of the second Balmer jump in emission on the U magnitude, and Fig.2 shows clearly that the color of the star continuum is redder on both sides of the Balmer jump.

Finally it must be noted that many Be stars have no second Balmer jump, neither in emission nor in absorption, and in this case their colors are normal and correspond to the MK spectral type.

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DISCUSSION

Viotti: It is important to note that if the Balmer discontinuity and the continuum gradients of X Per were close to that of a reddened BO star also there was no excess.

Divan: I am very glad to learn that. It shows that when X Per shows only one Balmer discontinuity (in absorption) as in Feb. 1977, its energy distribution is that of a normal B star, from the IR to 3100 A at least.

Harmanec: Is it not possible, that the different dependence of the V magnitude on the Balmer discontinuity for 11 Cam in comparison to X Per and 59 Cyg is a consequence of an aspect effect -- the observed v sin i is small for 11 Cam and large (and similar) for X Per and 59 Cyg.

Divan: Yes, it is quite possible.

Andrillat: Parmis les étoiles O, il existe une classe spectrale d'étoiles (Oe) qui s'apparentent aux étoiles Be. Avez-vous étudié la discontinuité de Balmer dans les étoiles et l'avez-vous comparée à celles des étoiles Be?

Divan: Very few O stars are really Oe stars in the same sense that B stars are Be stars. I observed only one of them, HD60848. It has a short wavelength Balmer discontinuity in emission. But as we observed it only once we do not know whether it varies.

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