RECENT CHANGES OF THE Be STAR HD 58050

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Abstract Emission line variations in 1961-1981 of the B2 star HD58050 are reported. Brightness variations are recalled. An estimation of the veiling effect given by continous emission of the envelope, observed in November 1980 in the Balmer lines, is given.

1. INTRODUCTION

This star is classified B2V by Jaschek et al. (1980), and is often considered as a pole-on star (Kogure, 1970), because of the low value of its projected rotational velocity, vsini = 140 km/s (Uesugi, 1978).

2. PREVIOUS OBSERVATIONS

A strengthening of emission lines was observed from 1933 to 1952. According to Tcheng Mao Lin (1946) emission was seen up to H11 in 1945, according to Burbidge et Burbidge (1953), up to H19 in 1952, emission being single up to Hδ, Hε, then double with a mean peak separation of about 145 km/s.
In "An Atlas of Be Stars", Hubert-Delplace et Hubert (1979), this star exhibited strong H emission lines from 1954 to 1961 . Fe II lines were also in emission during this period. Then H emission lines slightly decreased in intensity ; and on medium dispersion spectrograms the FeII emission lines which were strongest in 1960, decreased also afterwards and disappeared after 1963.

3. SPECTRAL VARIATIONS SINCE 1961

17 spectrograms have been obtained at the 193 and 152 cm telescopes of the Haute Provence Observatory (dispersion 9.67 A/mm and 12.27 A/mm respectively).
From 1961 to 1968 we observe a large decrease of the emission component

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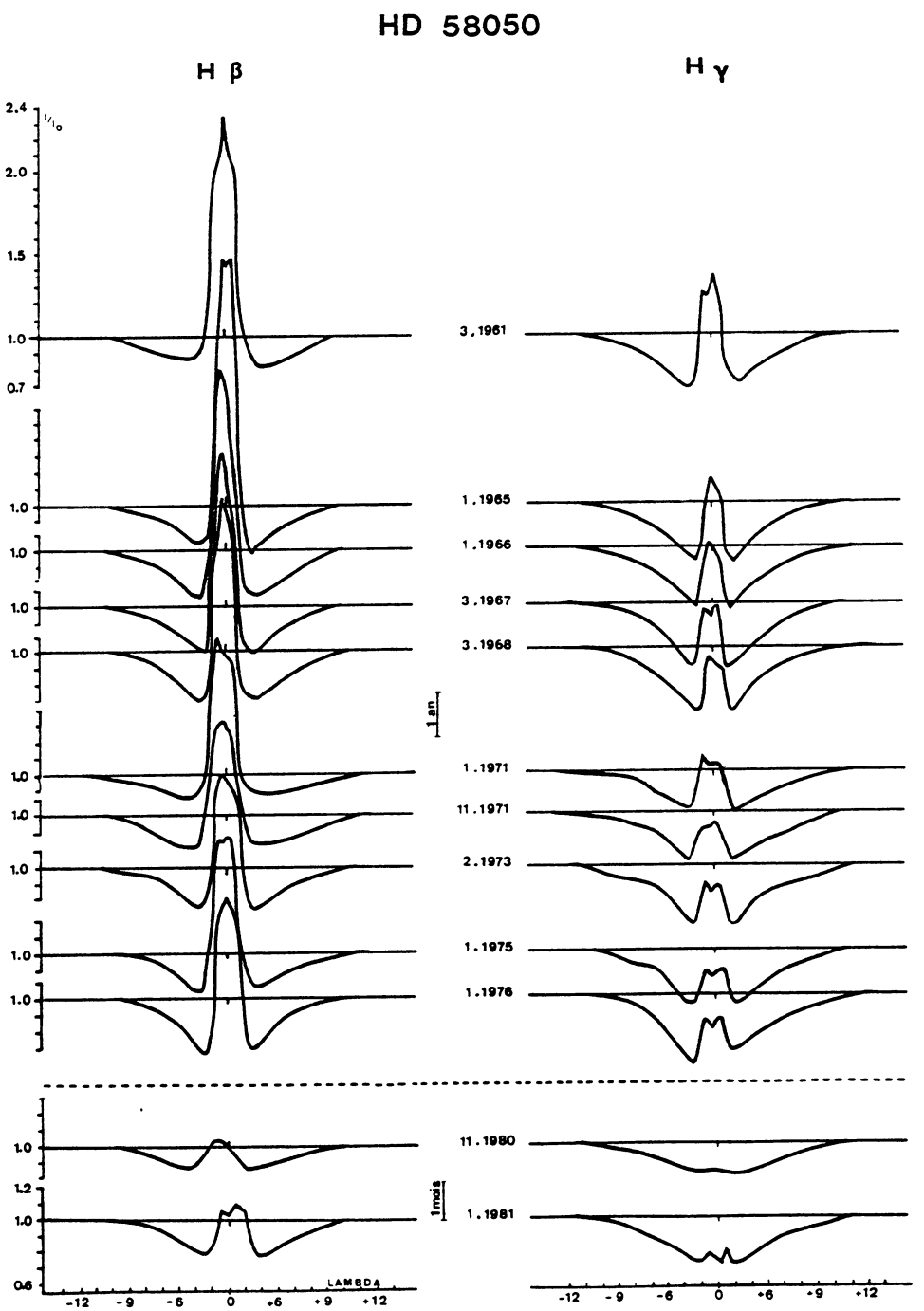

Fig.1. Variations of the Hβ and Hγ line profiles of HD 58050

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superimposed in the photospheric lines, fig 1. The last Balmer term Hn affected by emission is variable (in 1961-1965 n = 19, in 1967-1968 n = 7) . In 1970-1971 emission again increases and is seen up to H 19 but without reaching the intensity of 1961, then strongly decreases (end 1971-1976 n = 9, in 1981 n = 7). Rapid fluctuations of the intensity of the V and R emission components are observed, sometimes is one day as on January 17 and 18, 1981. These fluctuations could be produced by propagation of disturbances in the atmosphere.
In November 21, 1980 a spectrogram reveals a weak diffuse emission on the Hβ line while some traces are also visible in Hγ, Hδ, Hε (emission is blue-shifted on Hδ, Hε), the other H lines being in diffuse absorption. A comparison of the higher Balmer profiles of Nov 21, 1980 with those obtained in Feb 1973 and Jan 1981 shows that the equivalent width and central depth of these lines are always smaller in Nov 1980, (see Table 1) ; the HeI absorption lines are also fainter.

Table 1

	date	H_{10}	H_{11}	H_{12}	H_{13}
W_λ (Å)	13.2.73	4.2	3.1	2.2	1.5
W_λ	14.1.81	4.2	3.2	2.2	1.4
W_λ	21.11.80	3.0	2.2	1.4	0.8
ω	14.1.81	0.72	0.70	0.64	0.55
R_λ	13.2.73	0.35	0.32	0.27	0.23
R_λ	14.1.81	0.33	0.31	0.25	0.19
R_λ	21.11.80	0.26	0.24	0.17	0.12
ω	14.1.81	0.76	0.76	0.59	0.57

4. BRIGHTNESS VARIATIONS

The Groupe d'Etude et d'Observations Stellaires (GEOS) has observed this star from the beginning of 1977 to Feb 1981, and found :
a) short time scale brightness variations (period P~ 3 hours, amplitude a ~ 0.15 mag) as in βCMa stars. Variations seem periodic.
b) an increase of brightness in Nov, Dec 1980 of about 0.4 mag.
From 1977 to April 1980, m_v = 6.4 ; in Nov, Dec 1980, m_v = 6.0, and in Jan, Fev 1981, m_v slightly increases.
Furthermore Dr. Divan and Dr Zorec kindly communicated that the Balmer discontinuity was seen in emission in Nov 1980 but not in 1977.
So we conclude that the apparent faintness of the H and HeI absorption lines observed in Nov 1980 could be produced by a "veiling effect" given by continuous emission of the envelope

5. ESTIMATION OF VEILING EFFECT

In presence of an envelope, the central depth R_λ and the equivalent width W_λ of an absorption line are given by :

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$$R_\lambda = \omega R^*_\lambda \qquad W_\lambda = \omega W^*_\lambda \qquad \omega = \frac{e^{-\tau_e}}{Fe/Fc + e^{-\tau_e}}$$

where R^*_λ and W^*_λ are the photospheric central depth and equivalent width,
F_c is the stellar continuum flux at the line,
F_λ the stellar line flux at the wavelength ,
F_e the envelope continuous emission,
τ_e the average optical thickness of the continuum,
ω the veiling factor.

In the approximation $\tau_e = 0$ and $Fe \neq 0$ (true in the case of "pole-on" stars), for an increase of brightness of 0.4 mag at $\lambda \sim 5500$ Å, we find

$Fe/Fc = 0.45$
$R_\lambda \sim 0.7\ R^*_\lambda$
$W_\lambda \sim 0.7\ W^*_\lambda$

From our observations, see Table 1, we find

$\omega = R\lambda/R^*\lambda \sim 0.6 - 0.7$
$\omega = W\lambda/W^*\lambda \sim 0.6 - 0.7$

In this peculiar case, it is difficult to derive the wavelength dependence of the veiling effect, because of the presence of a central emission in the Hβ and Hγ lines, and of the accuracy of our measurements (10-15%) of equivalent widths and central depths.

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DISCUSSION

Sonneborn: I find it misleading to use the term "pole-on" for a star with line broadening which implies a projected rotational velocity of 150 km/sec. I would reserve the term "pole-on" for stars with sin i close to zero. The problems of terminology in this field cannot be emphasized too strongly. I hope there will be more discussions to these problems during this symposium.

Traving: Can one estimate the effect of veiling (which is in the case of this star of the order of 50%) on the structure of the photosphere itself? Such a veiling should change the boundary conditions of the photosphere and hence affect the formation of absorption lines.

Hubert-Delplace: From the paper by Divan and Zorec it seems possible in the case of HD58050 to distinguish two kinds of Balmer discontinuities with the BCD classification in Nov. 1980, the first given by the star itself, the second (at shorter wavelength) by the outer structure. This is probably a means to determine the effect of veiling on the stellar continuum. However the veiling effect on the absorption lines is very difficult to treat and we give here only a rough approach because we have only one spectrogram. It should be necessary to investigate the wavelength dependence of the veiling factor, if for a given line there is a variation of this factor over the line.

Sonneborn: I can answer this question for the point of view of model atmospheres. At Ohio state we have studied model atmospheres with radiation incident from a second star. In this case the atmospheric structure is altered and the effective temperature rised. We have not examined the effect of incident radiation from a circumstellar shell or disk, although this would be possible with our atmospheric code. I would expect to find results similar to the incident stellar radiation case.

Sareyan: I would like to comment on the star HD58050. This star seems to have a reliable 3^h period. When observed spectroscopically it is a Be star. If its short period light variations had been discovered by photoelectric photometry through filters placed on the continuum, it would have been described as a β Cep star. So this is a new member of a growing intersection between Be and β Cep stars. (HD77320, which has a 7^h period, according to Burki et al. would also be in this case, as it is a Be star.) So we don't know really if many Be stars undergo short period variations, and on the other hand, many β Cep stars could show - at least irregularly - emission features. (β Cep stars should be checked periodically for emission, at least at H_α and Be stars investigated systematically for short period light variations.)

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