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RAPID SPECTROSCOPIC AND PHOTOMETRIC VARIATIONS IN o Cas

o Cas (HD 4180, HR 193, BD + 47°183, SAO 36620, MWC 8) is a bright Be star (m_v=4.5, B5IIIe).

The photometric variability of o Cas was first reported by Haupt and Schroll (1974). The comparison of their own measurements and values given by other authors (apparently absolute photometry) revealed 0.15 mag in V, while the variations in both B-V and U-B were negligible.

The infrared photometry and spectroscopy of o Cas was discussed by Elias et al. (1978). Their results showed the long-term variability in the infrared and possible correlation with the variations in the Balmer emission lines.

The long-term variability of the hydrogen lines has been studied for long time (see Peton, 1972 for references). This type of variability was further documented by Slettebak and Reynolds (1978), Elias et al. (1978), Hubert-Delplace and Hubert (1979), Barker (1979, 1984) and by Andrillat and Fehrenbach (1982).

o Cas is included in the photometric campaign on Be stars proposed by Harmanec et al. (1982). It has been observed with the 0.65m telescope of the Hvar Observatory since 1982. The photometric behaviour of the star is illustrated in Figure 1. The photometric variability is well pronounced and rapid (at least in certain periods).

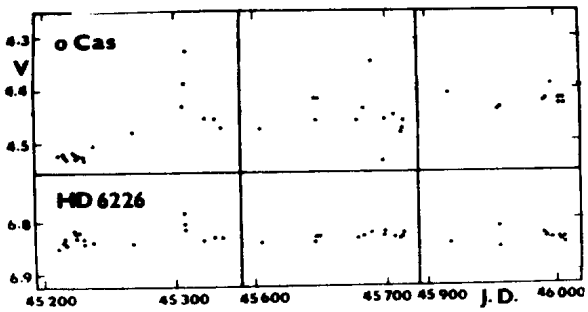

Figure 1

The V magnitudes of o Cas and HD 6226 (check star) measured differentially against comparison star HR 189 (V = 5.68) versus J.D.

The results of the photometric monitoring prompted spetroscopic observations of the star. Three spectra were secured on two consecutive nights with the coudé spectrograph of the 2m RCC telescope at Rožen National Astronomical Observatory, Bulgaria. We used IIa 0 emulsion. The reciprocal dispersion was about 9A/mm. In Figure 2, we show two normalized intensity profiles of Hβ. The date of the exposure is given in the left part of the figure.

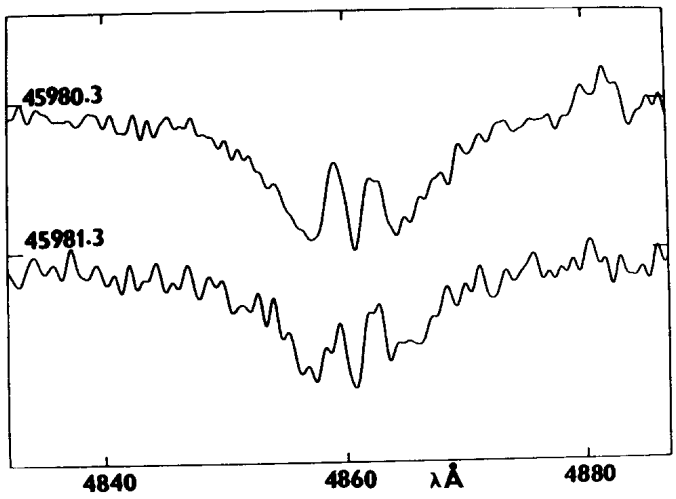

Figure 2

Hβ profiles of o Cas taken on two consecutive nights.

It is readily seen that the inversion of the emission line ratio occured in the Hβ profile of o Cas within 24 hours.

Due to the scheduling problems we were not able to arrange for simultaneous spectroscopic and photometric observations. Therefore, it is not clear whether there is a correlation between V/R variation and photometric behaviour of the star.

We have found two hints at possible rapid variability of o Cas in the literature. Gomez and Abt(1982) reported possible change in the profile of HeI 5876 A in 3 days and Slettebak and Reynolds (1978) quote the paper by Butler (1975) where he allegedly found variations with a time scale of the order of 1 day in Hα narrow-band photometry. But it seems that this evidence is not very strong since the values are given in the graphical form and o Cas is not mentioned in the text (while other stars are).

The V/R change is one of the most conspicuous type of change in the spectrum

of Be stars. The largest survey of the V/R variability so far has been presented by Copeland and Heard (1963). This study is concerned with slow cyclic V/R variations because it is based on spectra of 60 Be stars which were observed about once a year over a 24-year interval.

Since 1970 a great deal of evidence have been accumulated for the existence of V/R variability (including the inversion of the emission line ratio) over much shorter time-interval.

Dachs et al. (1981) observed 36 bright southern Be stars and disclosed rapid V/R variations visible in the Balmer emission line profiles of four stars. Other cases of rapid variability of V/R ratio were described by Baade (1984).

Little is known about the character of the rapid variability of V/R ratio. Regular behaviour of the V/R was reported by Peters (1972) during the periodic two-component shell phase in the Be star HR 2142. Baade (1982) was able to prove that in the Be star 28 CMa the V/R follows strictly the 1.365-day period. There are other reports of the possible short-period variations of V/R ratio (LQ And - Baade et al. 1984, EM Cep - Harmanec, 1984) but these conclusions need further confirmation.

The changes of V/R ratio in the spectrum of o Cas pointed out in this communication are very similar to those described in the above mentioned papers.

We tried to look for possible correlation between the V/R variation and radial-velocity changes.

First, we analyzed the data by Abt and Levy (1978). The harmonic analysis of their values disclosed a number of shorter periods which lead to comparable orbital solutions. We have not included old available RV of o Cas (Lick and Victoria Observatories) due to the fact that these measurements were made on classical Abbé comparators, while Abt and Levy (1978) used the whole line profile for determination of the position. Unfortunately it was not possible to analyze the data by Elias et al.(1978) either due to the fact that they publish rounded dates only. But it seems that even this material supports the possibility of much shorter period of radial-velocity variation (nearly full range of radial velocity during 54 days).

We measured all 3 spectra for radial velocity (the method was similar to that described by Abt and Levy, 1978). These velocities were combined with data by Abt and Levy (1978) and by Elias et al. (1978) and orbital solution for the fixed original value of period (1033^d) was computed. The appropriate velocity curve is shown in Figure 3a. In Figure 3b we present the radial-ve-

Figure 3 a

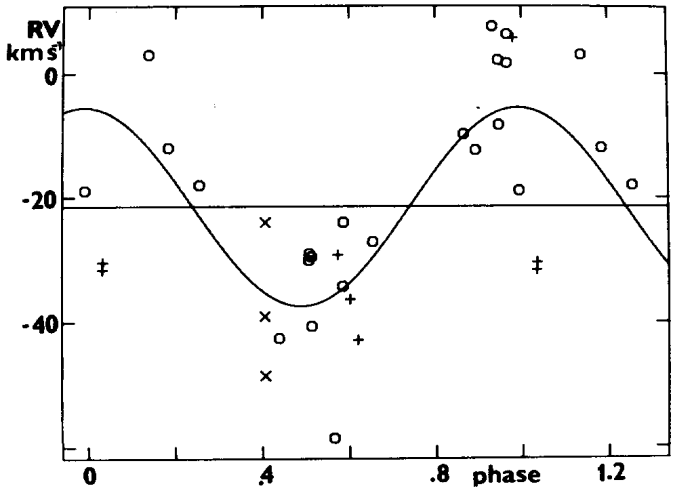

Figure 3 b

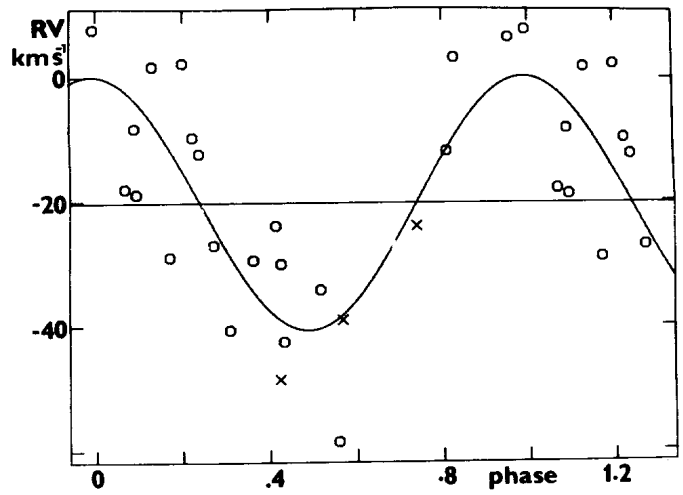

Figure 3

Computed velocity curves (solid lines) and individual measured velocities (O-Abt and Levy, 1978; X- this paper, + Elias et al. 1978) for o Cas; a) represents the solution for the fixed period 1033^d
b) the same for the period 1.1679^d (data by Elias et al. 1978 not used).

locity curve corresponding the orbital solution based on our measurements and data by Abt and Levy (1978). The value of the period is 1.1679^{d}. Clearly, the correlation between V/R ratio and radial velocity cannot be ruled out.

It seems that the number of Be stars showing rapid V/R variability might be much higher than is known now. The main reason is that most of the observational material is severely undersampled in time (see Dachs et al., 1981 or Barker, 1979).

We would like to use this note as challenge to people i terested in rapid variations of Be stars to concentrate on V/R ratio. One shc ld collect the observational material needed for answering the following questi ns:

1) What is the typical time scale of the rapid V/R variation?
2) What is the fraction of the Be stars showing periodic short-term V/R variation?
3) Are there Be stars which display only long-term V/R variation?
4) Are there any correlations between light, radial-velocity changes and V/R variations?

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