

ON THE ULTRAVIOLET PHOTOMETRIC VARIABILITY  
OF THE HELIUM-WEAK B STARS (FROM ANS DATA)

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**ABSTRACT:** Photometric observations in the ultraviolet region obtained by the ANS satellite enabled us: to confirm with a slight improvement the rotational period of HD 22470 (UV lightcurves of HD 22470 compared with  $u$  and magnetic curves are shown in Fig. 1); to confirm the variability with very small amplitudes for HD 74196, a member of the open cluster IC 2391 (Fig. 2); to compare the amplitude-wavelength relations of some other He-weak stars with known periods (HD 35298, HD 142884, HD 144334, HD 175362, and HD 109026). A preliminary rotational period for the star HD 109026 using the 11 ANS observations was found to be about 1.5 days.

Up to now the ultraviolet lightcurves have been published only for one of the helium peculiar stars, HD 125823 (MOLNAR, 1974). We have investigated known helium-weak B stars for which three or more (up to 11) measurements are available from Astronomical Netherlands Satellite (ANS) observations. The observations were carried out during October 1974 - April 1976 with the ultraviolet photometer in five bands with central wavelengths and bandwidths (in Å): 1550(150), 1800(150), 2200(200), 2500(150), 3300(100). For the instrumental characteristics and data reduction methods see WESSELIUS et al.(1982).

We have no place here to discuss all investigated stars in detail. We present only two stars: He-weak star with large amplitude of variation, HD 22470, and HD 74196 for which the ANS observations seem to confirm the variability with very small amplitudes.

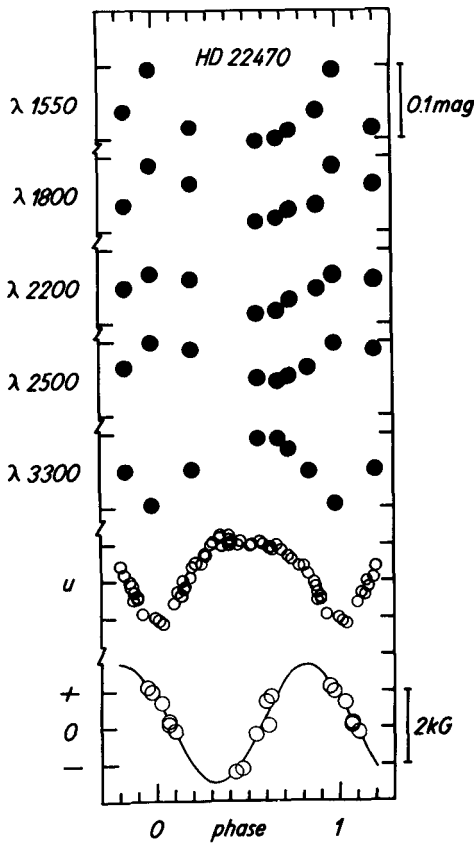


Fig. 1  
 Ultraviolet lightcurves  
 (ANS data) for HD 22470,  
 plotted with the new  
 ephemeris  
 HJD (near *uvby* min.) =  
 $2443456.5389 + 1.92895$  days  
 (see text). Error bars are  
 smaller than the size of the  
 circles. Magnetic field and *u*  
 curves are plotted for  
 comparison.

HD 22470 = HR 1100 = EG Eri, He-weak, subclass Si

This star was found to be light variable (1.93 days) by RENSON and MANFROID (1981) and magnetic field variable by BORRA et al. (1983). Two periods (0.6785 days and 1.935 days) fit the set of 12 magnetic field observations almost equally well. A quantitative analysis of the EG Eri lightcurves shape in the Strömgren system is given by MATHYS and MANFROID (1984). The used measurements are nearly uniformly distributed over the period improved to 1.9387 days. All lightcurves are in phase. The maximum is broad and probably consists of two maxima merged together. The amplitudes are about 0.06 mag. in *y*, *b* and *v* bands and at least 0.10 mag. in *u*. Six UV ANS observations of HD 22470 are available (4 between JD 2442448.788 and ...450.008, and two at JD 2442634.292 and ...4.496). They permit to confirm and slightly improve the period given by MATHYS and MANFROID (1984). Using as zero point the real observation near the light minimum (the measurements were kindly placed at our disposal by Dr. Mathys) we thus

adopt for HD 22470 the ephemeris:

$$\text{HJD}(\text{near } \underline{uvby} \text{ min.}) = 2443456.5389 + 1.92895 \text{ days} \cdot E$$

This period differs from that obtained by MATHYS and MANFROID(1984) only by  $1 \cdot \Delta f$  (see table 2 in their paper). Ultraviolet lightcurves for HD 22470, compared with  $\underline{u}$  and magnetic curves (MATHYS and MANFROID, 1984; BORRA et al., 1983), are shown in Fig.1. This star is variable in  $\underline{y}$ ,  $\underline{b}$ ,  $\underline{v}$  (not shown in Fig.1),  $\underline{u}$  and  $\lambda 3300$  in phase. Maximum amplitude is in  $\underline{u}$  and  $\lambda 3300$ . The amplitude at  $\lambda 1550$  is comparable to that at  $\underline{u}$  and  $\lambda 3300$ , but is in antiphase!

The UV lightcurves in the phase range near the positive magnetic extremum is sufficiently well represented by observations. Unfortunately only one observation falls near the negative magnetic extremum, preventing the more detailed interpretation.

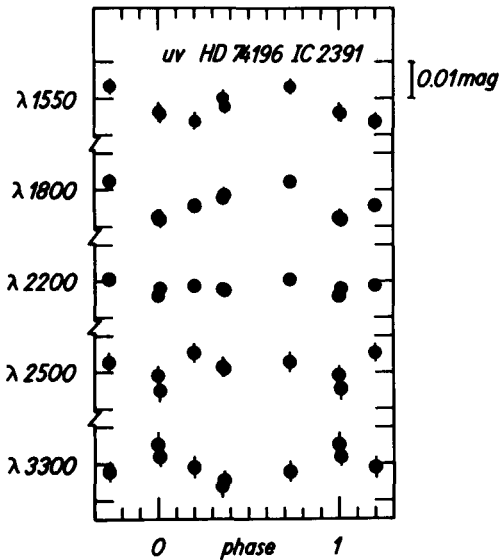


Fig.2  
Ultraviolet lightcurves  
(ANS data) for HD 74196,  
plotted with the period  
0.3880 days (JAKATE, 1979).

HD 74196 = HR 3448, He-weak, member of IC2391

This star was found by JAKATE(1979) to be light variable with a period of only 0.3880 days and a small amplitude of 0.01 mag. in Strömgren  $\underline{b}$ .

Six UV ANS observations in the time interval of 2.254 days are available for HD 74196. The ANS observations plotted in Fig.2 using the ephemeris:

$$\text{JD}(\text{max } \lambda 3300) = 2442390.195 + 0.3880 \text{ days} \cdot E$$

suggest that the star is really variable. The amplitudes in  $\lambda 3300$  and  $\lambda 1800$  bands are about 0.01 mag. The star varies at  $\lambda 1800$  and  $\lambda 1550$  in antiphase to the  $\lambda 3300$  band.

Is HD 74196 indeed the He-weak star with the shortest known period? The high value of  $V \cdot \sin i = 235$  km/s (UESUGI and FUKUDA, 1982) indicates a rapid rotation. Let us remember here that HD 74196 is a member of the open cluster IC 2391 and a spectroscopic binary (BUSCOMBE, 1965). Might it be that this star is also magnetic?

### Conclusions

On the basis of the ultraviolet photometric ANS data we found that for the He-weak stars HD 22470 (Pleiades Group), HD 35298 (Ori OB1), HD 74196 (IC 2391, SB), HD 142884 (Sco-Cen, nonmagnetic, Si subclass), HD 144334 (Sco-Cen) and HD 175362 (Sco-Cen):

- 1) The variations in the  $\lambda 1550$  band is in antiphase to those in the  $\lambda 3300$  band and in the visible spectral region. This property agrees with the data for the stars HD 28843 (field), HD 125823 (= aCen, Sco-Cen), and HD 175362, obtained for regions around  $\lambda 2740$  and  $\lambda 1550$  using TD-1 scans (SCHÖNEICH et al., 1983).
- 2) The amplitudes of the variations in the shortest ( $\lambda 1550$ ) and in the longest ( $\lambda 3300$ ) wavelengths bands are comparable to those in the visible light (u colour). This property of the He-weak stars is quite different from that of Ap stars, where the amplitudes at short UV wavelengths are in general considerably larger than in the visible.

If the period of the star HD 109026 (about 1.5 days, obtained from 11 ANS observations by SCHÖNEICH, 1984) will be confirmed, this star would be an example of the He-weak stars, which vary in all spectral ANS bands in phase.

### References

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Discussion appears after the following paper.