Peculiar Versus Normal Phenomena in A-Type and Related Stars
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DO Bp STARS HAVE "FLARES"?(*

BALÁZS VETŐ
Gothard Astrophysical Observatory of Eötvös University
Szent Imre Herceg út 112, H-9707 Szombathely, Hungary

ABSTRACT UBV(RI)c photoelectric observations of four variable magnetic Bp stars (HD 21699, HD 177003, HD 184927 and HD 217833) were carried out between 1989 and 1992. Random fluctuation of $0^m.1$ range was detected in the U colour band in the case of HD 177003 and HD 184927. The U light curve of HD 21699 shows $0^m.02$ peaks superposed on the periodic light variation which definitely exceeds the typical error of the observations. It is not likely that atmospheric extinction or observational error would cause the phenomena described. On the other hand there are no physical processes known which lead to such changes of the U band continuum radiation in Bp stars.

INTRODUCTION

In the last three years five colour photometric observations of high accuracy on four magnetic Bp stars were obtained to get information about the origin of their photometric variation, by the analysis of the colour indices variation. These investigations are still in process, but it seems to be worth to show several unexpected and interesting features of the observed light curves.

Two intermediate helium (HD 177003 and HD 184927) and two helium weak (HD 21699 and HD 217833) magnetic stars were chosen for the program. Three of the four stars are known low-amplitude ($A \leq 0^m.1$) photometric variables. HD 21699 has a well determined period of 2.49246 days (Percy, 1985). Magnetic and spectroscopic variations are also detected by Brown *et al.* (1985). The periodic light and spectrum variation of the other frequently observed star HD 184927 is discussed by Bond and Levato (1976), Levato and Malaroda (1979) and Vető *et al.* (1980). Barker *et al.* (1982) measured magnetic variation with the same period too. The latest and most accurate period of 9.52793 days was found by Bolton (1990) on the basis of spectroscopic data. HD 217833 has the greatest photometric amplitude with a period of 5.36 days (Vető *et al.*, 1980).

(* Based on observations collected at the Konkoly Observatory

Its magnetic variation is known from Glagolevsky and Chunakova (1985). The fourth star HD 177003 is a suspected UV variable on the basis of ANS observations, the probably period values of 0.66 or 2.1 days are given by Schöneich and Zelwanowa (1984). Only weak magnetic field was found on this star (Glagolevsky *et al.*, 1986), so it might not be a typical example of magnetic Bp stars.

OBSERVATIONS AND RESULTS

The observations were carried out between 1989 and 1992 with the 1-m RCC telescope, equipped a cooled, photon counting UBV(RI)$_c$ photometer at the Piszkéstető Mountain Station of the Konkoly Observatory. Dead time correction and mean atmospheric extinction were taken into account in the course of the reduction process. The standard deviation of the observations was the highest in the U band, it was about $0^m.005$.

HD 21699

The UBV(RI)$_c$ observations of HD 21699 and the comparison stars (HD21551 and HD 21641) are phased according to the period given by Percy (1985), HJD(maximum light)= $2446001.659 + 2.49246N$ in Fig.1. The new observations confirm the photometric variation established by earlier authors the period is in an exact agreement with that given by Percy (1985). The variation occurs in phase in all colours the amplitude is $0^m.05$ in the U band and decreases with the wavelength. An interesting feature was detected on the nights of 28/29 Dec 1989 and 5/6 and 7/8 Jan 1990. The star was $0^m.02$-$0^m.03$ brighter than expected in the U colour band but it was normal in the other colours. A similar effect was detected on 22/23 Feb 1992.

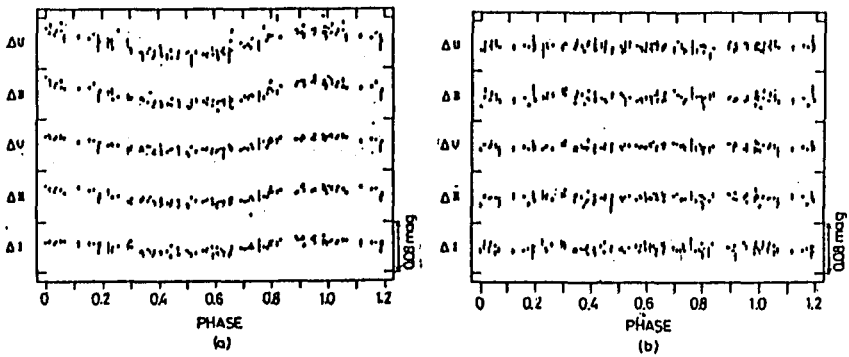

Fig. 1. UBV(RI)$_c$ observation of HD 21699. The magnitude differences V-C1 (a) and C2-C1 (b) are phased according to the period of 2.49246 days.

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HD 177003

The star was observed with the comparison stars HD178207 and HD 176707 where the second one might be variable. In the U colour band variation of about $0^m.1$ range was detected. This variation might be periodic with 0.724 days too, but a strong random component is also present. In the BV(RI)$_c$ colours there are no detectable variations. Only the V-C1 magnitude differences are plotted in Fig. 2.

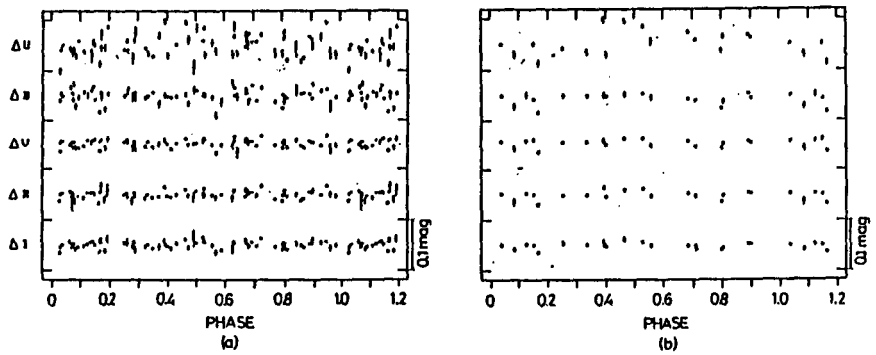

Fig. 2. UBV(RI)$_c$ observations of HD 177003. The magnitude differences V-C1 are phased according to the most probably period of 0.724 days. All observations (a), and observations on the nights from Aug 22 to Sep 8 1991 (b).

HD 184927

The known periodic variationof the star was detected in the V(RI)$_c$ colours only with an amplitude of $0^m.02$. In the U and B bands a random

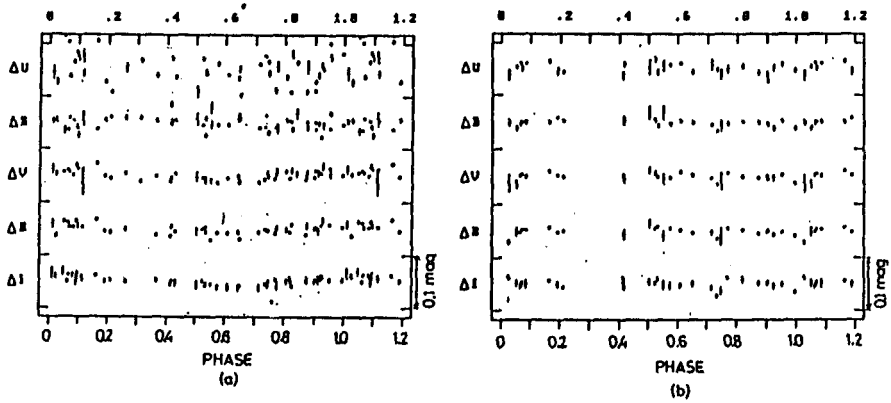

Fig. 3. UBV(RI)$_c$ observation of HD 184927. The magnitude differences V-C1 (a) and C2-C1 (b) are phased according to the 9.52793 days period.

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variation of about $0^m.1$ and $0^m.03$ was obtained, respectively. So it seems that in these colours the random variation suppresses the periodic one if it exists at all. The light curve of HD 184927 and the comparison stars (HD 185224 and HD 185603) phased according to the period given by Bolton (1990), HJD(HeI max.)= 2442564.24 + 9.52793N are given in Fig.3.

HD 217833 Periodic variation was found in this star with an amplitude exceeding $0^m.12$ in the U colour band and decreasing toward longer wavelengths. The variation occurs in phase in all colours. On the basis of the present observations the period of the photometric variation was improved, the new value of the period is 5.393 days. The light curve of HD 217833 and of the comparison stars HD 218151 and HD 216928 are plotted in Fig. 4.

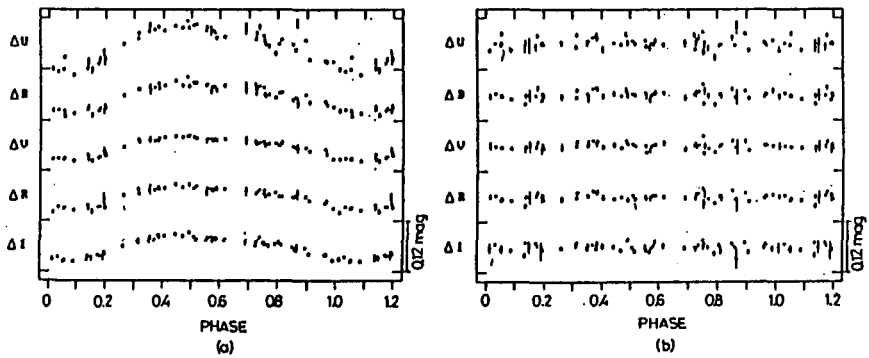

Fig. 4. UBV(RI)$_c$ observation of HD 217833. The magnitude differences V-C1 (a) and C2-C1 (b) are phased according to the new 5.393 days period.

DISCUSSION

Comparing the photometric behaviour of the four stars observed the difference between the intermediate and weak helium stars is evident. The two helium weak stars (HD 21699 and HD 217833) vary periodically in all the five colours, the amplitude of the variation decreases with increasing wavelength. It means that a slight variations of the colour indices are also present.

The two intermediate helium stars show more irregular behaviour specially in the U colour band. In the VRI colours HD 184927 varies with $0^m.02$, and no colour index variation is detected. HD 177003 seems to be constant in the VRI colours.

The possibility that observational errors cause the strange U band behaviour of the two intermediate helium stars cannot be ruled out, but several facts indicate that the observations are correct. Comparing the U magnitude differences of the variable and the comparison with that of

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the check and the comparison stars it is evident that the variations origin from the variable in the case of HD 184927. Atmospheric effect is not probably because of the variable and the comparison stars are very close to each other, the angular distance is less than 40 arc minutes. In the case of HD 177003, though there are problems with the red check star, the scatter of the magnitude differences of the check and comparison stars is significantly less than that of the V-C1 difference. The similarity in the behaviour of HD 184927 and HD 177003 also refer to the reality of this kind of photometric variation. The light curves of HD 184927 observed by Bond and Levato (1976) and Vető *et al.* (1980) show a strong scatter in the U colour band. The peaks detected in the U light curve of HD 21699 confirm Percy's (1985) observations who complained of a large scatter in the U band but explained it by instrumental origin.

Though the observations need further confirmation, they indicate atmospheric activities in magnetic Bp stars if they are correct. A photometric variation appearing in the U colour only, can be caused by the change of the Balmer-jump. This picture seems to agree with the irregular H_α emission detected in intermediate helium stars. Further spectroscopic investigations are necessary to check the behaviour of the H_α emission and the UV continuum radiation.

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