A BRIGHT SPOT AND A SERENDIPITOUS STELLAR FLARE ON THE CONTACT-BINARY VW Cep.

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INTRODUCTION

Almost twenty years ago a large flare event was observed on the prototype contact binary W UMa by Kuhi (1964). Similar events have been reported on 44 i Boo (Eggen 1948) and U Peg (Huruhata 1952). In this paper we present photoelectric observations at three wavelengths of a flare on VW Cep. This is the first event of this kind to be reported for this star. VW Cep is a triple system. The main contributor to the visual flux is the eclipsing binary, consisting of a K1 primary and a G6 secondary (Kopal 1978), classified to be in contact. The orbital period is 6^h41^m. Seven per cent of the total flux in the visual filter is due to the third component, a late K type dwarf at a distance of 12 AU from the eclipsing system (Hershey 1975).

OBSERVATIONS

The photoelectric observations were made with the 50 cm Ritchey-Chrétien telescope at Skibotn Astrophysical Observatory using a chopping photometer which alternates between star and sky background at a frequency of 5 Hz. Data were taken through three filters approximating the UBV system at a time resolution of about two minutes per filter. A comparison star was measured at regular intervals.

The observations were made on the night 27-28 December 1978 UT, and photometric conditions prevailed for ten hours. Whereas the primary eclipse is perfectly symmetrical, the light curves reveal that the secondary eclipse is asymmetrical. Relative to mid-eclipse at phase 0.5, each point on the descending branch (0.25<phase<0.5) has a systematically higher flux than the corresponding points on the rising branch. In fact, the excess flux prevails until phase 0.52. The observations cover two succesive secondary eclipses. The excess flux is detected from about phase 0.25 in both cycles. Figure 1 shows portions of the light curves, corrected for the effects of eclipses. The excess flux is present in all filters, but has diminished in amplitude by 0.02 mag from the first

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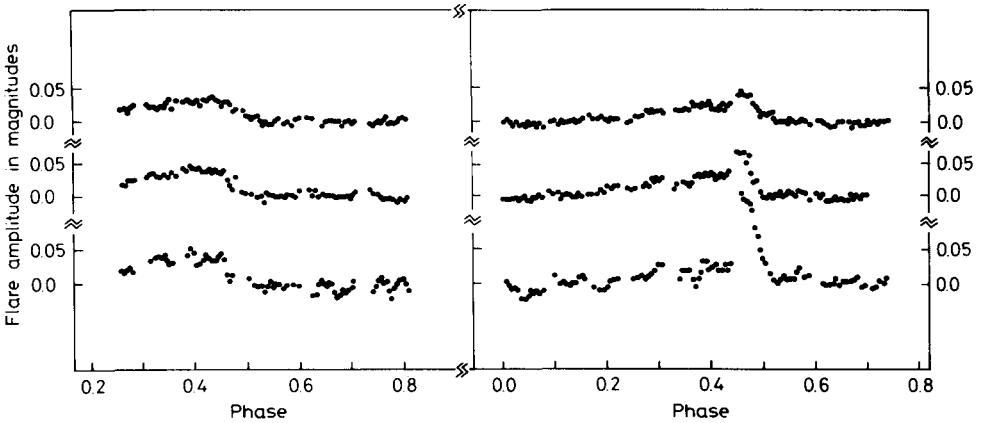

Fig. 1. Two succesive cycles on VW Cep displaying excess flux and a flare.

cycle to the second. During the later part of the excess plateau in the second cycle a flare event occurred. Correcting for the shape of the plateau we obtain the light curve of the flare itself, as shown in Fig. 2. The flare decays to one half of the peak value in 13 minutes, and the total duration is less than 35 minutes. We have no time resolved observation of the rise phase, and can only set an upper limit of 5 minutes to this parameter. Adopting Johnson's(1966) calibration of the UBV system, the peak fluxes of the flare is $7 \cdot 10^{30}$ erg/s(U), $6 \cdot 10^{30}$ erg/s(B), and $5 \cdot 10^{30}$ erg/s(V). Integrating numerically under the light curves we obtain for the total energy during the flare $4 \cdot 10^{33}$ erg(U), $6 \cdot 10^{33}$ erg(B), and $4 \cdot 10^{33}$ erg(V).

DISCUSSION

Because of the perfect symmetry of the primary eclipses and the consistency obtained in the results of the light curve analyses of each of the three filters, we assume here that the phase interval from about 0.5 to 1.25 represents the unperturbed system. Thus the interpretation of the asymmetry of the secondary eclipses is that the excess flux on the descending branch is due to a bright spot. This spot rotates into view near phase 0.25 when the two stars of the binary have their largest separation as seen by the observer. If the stars rotate in synchronism with the orbital revolution, the spot is near the disk meridian at phase 0.5 and is being eclipsed. Consequently the spot is situated on the larger star in the system. The observed close relationship in time between the spot and the flare is indicative of a close physical relationship. We suspect that the flare occurred on the leading edge of the spot and that it was actually eclipsed during the decay phase. The flare light curve has no slow tail and falls of rather abruptly. As the active region is facing the other component, it is possible that the activity observed is related to mass transfer phenomena rather than solar-like flare activity.

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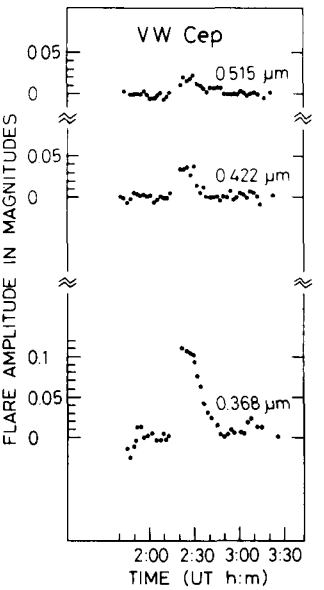

Fig. 2. A flare on VW Cep at three wavelentghs.

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