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LIGHT CURVE CHANGES IN ECLIPSING BINARIES

L. PATKÓS
Konkoly Observatory of the Hungarian Academy of Sciences, H-1525 Budapest XII, Box 67, Hungary
E–mail patkos@ogyalla.konkoly.hu

Abstract. The eclipsing binary SV Cam has been monitored at Konkoly Observatory since 1973. This binary system showed both period and light curve changes. Main reason of the light curve changes were dark spots on the surface of the primary component, causing migrating distortion waves. A peculiar brightening was also observed. Another kind of light curve variations were optical flares.

1. INTRODUCTION

The close binary system SV Cam ($m_v = 8.40 - 9.11\ mag$, $p\ :\ 0.59^d$, $sp\ :\ G2 - 3V + K4 - 5V$) belongs to the short period group of RS CVn variables (Hall 1976). It was found to be variable by Guthnick (1929). The period and the type of light variation were determined by Detre (Dunst 1933). Asymmetry in the light curve was first established by Wood (1946). Van Woerden (1957) found irregular light-curve changes and small random period fluctuations. First spectroscopic data were published by Hiltner (1953) and by Hill et al. (1975).

2. PERIOD CHANGES

Observed long-term variations in the O-C curve interpreted Sommer (1956) as a 57.5 year light-time effect caused by the presence of a third body in the system. As this period was incompatible with van Woerden's (1957) observations, Frieboes-Conde and Herczeg (1973) tried to fit the O-C data with another sine-wave with a period of 72.8 years. To fit further observations Hilditch et al. (1979) also used a third body revolving around the eclipsing pair with a period of 64.1 years but in an eccentric orbit.

3. SPECTROSCOPY

Spectroscopic data from Rainger et al. (1991) show a systemic radial velocity of $\gamma = -11.2 \pm 5.5 kms^{-1}$ for SV Cam. They also reanalysed former observations from Lucy and Sweeney (1971), from which $\gamma = -16.2 \pm 8.8 kms^{-1}$ was derived. This difference in γ of $5.0 \pm 1.3 kms^{-1}$ gives some hint at the presence of a third body in the system. (The expected orbital motion about a third body with an orbital period of 65-75 years would have a semiamplitude of about 2 kms^{-1} and hence difficult to measure). They also determined the mass function of the system.

4. PHOTOMETRY

Different photometric studies (e.g. Milano 1981, Patkós 1982a, Milano et al. 1983, Cellino et al. 1985 and others) showed extensive light curve and period changes in the system SV Cam. As generally expected for RS CVn type stars, these light curve changes are interpreted as caused by magnetic activity and large spots on the stellar surface. Detailed study of the dark spots on the surface of the primary component causing the distortion wave has been made by Zeilik et al. (1988). They also determined the system parameters as well as Sarma et al. (1989). These determinations of the system parameters were based mainly on the intensive photometric monitoring of SV Cam which has been carried out at Konkoly Observatory in U, B, and V since 1973. Part of these observations (1973-1980) was published (Patkós 1982a). The monitoring of SV Cam has been continued since then with the same intensity. Further observations will be published later. Main results of the first published part are :

I. There exist a "distortion wave" in the system.

II. The wave migrates towards increasing orbital phase, but its speed seems to be not constant.

III. All the observed light curves with the migrating distortion wave are below an upper envelope curve (except the cases IV and VI). There exist an observed light curve (J.D. 2442404-405) which seems to be nearly identical with this upper envelope curve (Patkós 1982a).

IV. The peculiar brightness increase observed between J.D. 2442460-523 (Patkós 1982b) was interpreted as the appearance of a temporarily existing bright spot near the equator of the primary star (Hempelmann and Patkós 1991).

V. The existence of other (but smaller) bright spots was demonstrated at J.D. 2441978, 981 and 982 (Patkós 1982e). Then within a week three independent primary minima were observed. In each case there was a step at the bottom of primary minimum. This phenomenon can be explained by the eclipse of a white spot on the surface of the primary component. The brightness of this spot was not enough to observe it in full light, but in the case of transit eclipse even small brightness differences on the surface of the eclipsed component could be established. Because of the differential rotation the spot was moving and so on the light curves observed two weeks earlier and one month later (and on other light curves of SV Cam) no step at the bottom of primary minima is present. Note that in this case not only the brightness difference between spot and surroundings but also the size of the spot had to be small in contrast to spot models derived by us and by others.

VI. Another case for the light curve growing over the envelope curve was observed at J.D. 2445582 when flare events at around phase 0.61 and at the bottom of primary minimum occurred (Patkós 1981). They were significant in all three colours (U,B,V).

VII. Optical flare events seem to be very rare in RS CVn systems. (Another very alike event was reported by Zeilik et al. (1983) at XY UMa). A previous (but smaller) optical flare in the system SV Cam was also reported by Patkós (1989) but dislike the

J.D. 2445582 event that flare wasn't significant in the B and V light curves. It could be observed only in U.

As conclusion of the first part of the monitoring of SV Cam we find that the best light curve to determine the system parameters is the one observed at J.D. 2442404-405 because this is the most symmetrical one in the 1973-1980 period and spottedness is assumed to be minimal in the system at that time too (Patkós 1982a, p : 42).

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