LIGHT CURVE VARIATIONS IN ER VULPECULAE

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Abstract. Photoelectric observations of the peculiar eclipsing variable ER Vul were obtained in blue and yellow light, in the 1981 and 1982 observing seasons. The light curves suffer to change in short time-intervals. The wave-like distortion superimposed on the light curves is clearly seen, but sometimes there is no indication about its existence. The migration period has been estimated roughly about eight months. Moreover, small-amplitude light fluctuations in the light curves are noticeable. These variations seem to be occur randomly. When the IUE and optical observations are taken into consideration together it is strongly suggested that both of the components in the system ER Vul are too active.

1. Introduction

The star ER Vul was found to be double-lined spectroscopic binary in 1946 at David Dunlap Observatory by Northcott and Bakos (1956). Using the spectrograms taken from 1949 to 1951, the radial velocities have been obtained and solved for the parameters of the orbit. Due to the spectral types of the components G0V and G5V and shortness of the period it was suspected of being eclipsing binary by Bakos. This, in fact, has been found to be true; the photoelectric observations of Bakos in 1955 indicated light changes by over a tenth of a magnitude. Later, the star was observed more extensively in yellow and blue light by Northcott and Bakos (1967). They have analyzed the light curves and thus, preliminary photometric orbital elements of the system have been derived. Slightly different orbital elements and masses have been derived by Abrami and Cester (1963). Bond (1970) and Eggen (1978) noted the existence of CaII H and K emission lines in the spectrum of this close binary system. In 1976 the system ER Vul has been included by Hall in the list of short-period group of the RS CVn-type binaries.

Two-colour photoelectric observations of this peculiar binary have been obtained in 1978 by Al-Naimiy (1978). He analyzed the light curves by means of Kopal's method of the Fourier analysis of the light changes and derived absolute elements and effective temperatures of the two components (Al-Naimiy, 1981).

The light curves obtained by Abrami and Cester, Northcott and Bakos, and Al-Naimiy were too different from each other. The primary minimum of the light curve obtained by Abrami and Cester was deeper by four hundredths of a magnitude while it was seemed as a secondary minimum in the light curves of Northcott and Bakos. The second difference between these two light curves was at the second quarter. This part of the light curve appears to be flattened and asymmetric in the case of Northcott and Bakos. Moreover, the distortions just after the secondary eclipse and just before the primary one are clearly seen in their light curves. Similar distortions exist in Al-Naimiy's light curves. The asymmetric maxima have been tried to explain by Northcott and Bakos.
as a result of the presence of a gaseous cloud of variable brightness situated at the inner Lagrangian point and extending to one side. However, no spectroscopic evidence was found for the presence of this cloud. Therefore, the spot hypothesis has been suggested by Al-Naimiy for explaining the distortions. The spotted star should be the primary, the hotter component according to him. Both, Northcott and Bakos and Al-Naimiy suggested further observations of the system over a long period in order to explain the unusual and interesting features of the light curve.

Since 1978, some long period RS CVn binaries have been observing at the Ege University Observatory. In 1981, the short period RS CVn binaries ER Vul, UV Psc, SV Cam have been added to the observing program. In this paper the light curves of the peculiar system ER Vul, obtained in 1981 and 1982, are presented and their variations are discussed.

2. Observations

The photometric observations, used to construct the light curves of ER Vul, were made on six nights in 1981 and on three nights in 1982. The 48 cm Cassegrain telescope of the Ege University Observatory with an uncooled EMI 9781A photomultiplier was used. The observations were made in blue and yellow light with B and V filter which are approximately in the standard $UBV$ system. Two stars in the neighbourhood of the variable were used as comparison and check stars, HD 200270 (BD + 27°3946) and HD 200425 (BD + 27°4442), respectively. The same stars were also used by the previous investigators. The differential magnitudes in two colours were taken as variable minus comparison. The atmospheric extinction coefficients were computed using the light changes of comparison star and all differential observations were corrected. The following light elements given by İbanoğlu et al. (1985) were used in computing the phases of the individual observations:

$$\text{Min. I = J.D. Hel. 2440182.2621 + 0^d69809409E}.$$ 

The differential observations were plotted against the orbital phases and are shown in Figures 1(a), 1(b), and 2.

3. Light Curve Variations

The light curves of ER Vul undergo variations in short time-intervals. This situation is clearly seen in the light curves obtained by Al-Naimiy (1981). Therefore, we planned to observe and obtain the light curves of the system in a time-interval as short as possible. The observations obtained between 8 and 16 July in 1981 are shown in Figure 1(a). A glance at the light curves clearly shows that the light curves are asymmetrical in shape. The brightness of the system reaches its maximum value at about 0.7. Then, a steady decline appears until phase 0.9. At the left side branch of the primary eclipse the external tangency is no longer discriminated. The brightness begins to increase after primary eclipse up to phase 0.08. Thereafter, the brightness seems to be constant for about 0.04