PHOTOMETRIC OBSERVATIONS OF THE BINARY SYSTEM V350 LACERTAE

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Abstract. Differential $UBV$ observations of the small amplitude (0.12 mag in $V$) single-lined active binary V350 Lac are presented. It was observed that the light minima occur in conjunction time. A shift of the light curve (0.05 in orbital phase) towards lower phases could be due to a small error in the light elements. The primary minimum is about 0.04 mag deeper than the secondary. It was shown that different depths of two light minima are not produced by the reflection effect but due primarily to gravity darkening on the tidally elongated and synchronously rotating visible component. An O’Connel effect observed as the brighter primary maximum could be an indication of starspot activity or gas streaming between the components.

1. Introduction

V350 Lac (HR 8575 = HD 213389) is a single-lined spectroscopic binary with 17.755 days orbit (Northcott, 1947). Hossack (1954) found during his application of an oscillographic microphotometer to the spectral classification of late-type stars that V350 Lac has very peculiar spectra showing too strong hydrogen lines, appropriate to spectral class G9. The metallic ratios gave K2 III spectral type (Hossack, 1954). Herbst (1973) reported the photometric variability of this strong Ca II emission binary. The photometric period was found half the orbital one suggesting ellipsoidal variability. The light minimum at J.D. 2441119.6 was found to occur during descending branch of the radial velocity curve. A nine-days photometry only in $V$ by Percy and Welch (1982) looks consistent with Herbst’s (1973) observations. The CaII emission fluxes from the system were found typical for an active chromosphere giant such as 87 Gem or λ And by Linsky et al. (1979) and Bopp (1984). The more recent photometry by Strassmeier et al. (1989) are also consistent with Herbst’s ellipsoidal hypothesis. Strassmeier et al. (1989) was found by a Fourier analysis of their observations (in three colours) that a total range of variability of 0.07 mag in $V$ due to ellipticity effect. The reflection effect gave an amplitude in $V$ of 0.011 mag.

We observed V350 Lac in two seasons in 1981 and 1982. We present the new observations in Section 2. The photometric period will be studied in the next section, and the final section is devoted to a discussion on the system.

2. $UBV$ Observations and Light Variation

New $UBV$ observations on 56 nights in 1981 and on 28 nights in 1982 were obtained by using an EMI 6256 S photomultiplier attached to the 30 cm Maksutov telescope of the Ankara University Observatory. Table I contains data on variable, comparison...
TABLE I

Data on the variable, comparison (C1), and check (C2) stars

<table>
<thead>
<tr>
<th>Stars</th>
<th>HD No.</th>
<th>( \alpha_{1950} )</th>
<th>( \delta_{1950} )</th>
<th>( m )</th>
<th>Sp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>213389</td>
<td>22h29'0</td>
<td>49°13.0</td>
<td>7.5</td>
<td>K2 III</td>
</tr>
<tr>
<td>C1</td>
<td>213776</td>
<td>22h26'.9</td>
<td>48°38.5</td>
<td>8.1</td>
<td>F5</td>
</tr>
<tr>
<td>C2</td>
<td>213176</td>
<td>22h22'.7</td>
<td>48°43.1</td>
<td>9.1</td>
<td>K2</td>
</tr>
</tbody>
</table>

(C1), and check (C2) stars. The comparison star is the same as used by Percy and Welch (1982).

The individual differential magnitude determinations in the sense of variable minus comparison, with a number made on each night ranging from 2 to 4, were corrected for differential atmospheric extinction, but was found unnecessary to transform them to the standard system. Corrected 133 differential magnitudes in each passband (100 in 1981 and 33 in 1982) were listed in Table II. The comparison star was found sensibly constant during the observations. The mean magnitudes of comparison relative to check star are 0.18 ± 0.02 in V, 1.13 ± 0.03 in B, and 2.48 ± 0.08 in U passbands. Light variation of V350 Lac was found ~0.12 mag in V, ~0.18 mag in B, and ~0.20 mag in U. The \((B - V)\) and \((U - B)\) colours of the system did not change significantly during the observations. The mean \((B - V)\) and \((U - B)\) colours together with the standard deviations of all measures from the means are 0.802 ± 0.024, 0.978 ± 0.034 in 1981 and 0.791 ± 0.020, 0.993 ± 0.042 in 1982, respectively. Individual differential magnitudes between J.D. 2444 860 and J.D. 2444 920 are plotted in Figure 1 against Julian date. Although there are large gaps between the observation, a free-hand curve drawn among them in this figure indicates a periodic light variation. All observations listed in Table II were plotted against orbital phase in Figure 2. The orbital phases were calculated by use of the light elements given by Strassmeier et al. (1989), as

\[ T_{\text{conj.}} = \text{Hel. J.D. } 2446604.26 + 17.755E. \]

It is important to note in Figure 2 that (i) contrary to Herbst's (1973) light curve, the primary maximum is about 0.01 mag brighter than the secondary, (ii) the primary minimum is about 0.04 mag deeper than the secondary. (iii) The light curve is shifted about 0.05 in orbital phase towards lower phases. The shift of the light curve towards lower phases could be due to a small error in the light elements given by Strassmeier et al. (1989). Thus the light elements need to be improved by furthermore accurate observations. We have also formed a light curve by use of the photometric period of \( \sim 8.8 \) days (see next section) instead of the orbital period, in phase calculation. We saw, however, that the scatter of observations is much larger in this case.

We next fit a truncated Fourier series of the form

\[ l = A_0 + A_1 \cos \theta + A_2 \cos 2\theta + B_1 \sin \theta, \]

to the light curves with orbital period in V and B colours. The mean differential