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BVR_CI_C PHOTOMETRY OF THE ECCENTRIC ECLIPSING BINARY HD 350731

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The star HD 350731 = GSC 1624-0493 at position $\alpha_{2000} = 19^h53^m45\overset{s}{.}26$, $\delta_{2000} = +20°30'33\overset{''}{.}2$ (UCAC2; Zacharias et al., 2004a), was found to be an eccentric eclipsing binary by Otero et al. (2004). It is an early type binary: Nesterov et al. (1995) give a spectral type B9, the AGK3 catalogue (Heckmann, 1975) lists A0.

CCD observations of the object were done on 7 nights in 2007 at SETEC Observatory (30-cm SCT, V only) and on 16 nights in 2008 at Zagori Observatory (30-cm LX200, BVR_cI_c). The images were reduced with AIP4Win (Berry & Burnell, 2000). HD 350730, with a similar spectral type of A0 (Heckmann, 1975), was used as comparison star. Its magnitude $V = 10.04$ and colour $B - V = 0.073$ were taken from the Tycho catalogue (ESA, 1997), the $R = 9.980$ value from NOMAD (Zacharias et al., 2004b) and the $I_c =$ 9.974 magnitude from TASS (Richmond, 2007). The data are available in the electronic edition of IBVS (5860-t3.txt – 5860-t7.txt).

The times of minima derived from our data are listed in Table 1. The following ephemeris was calculated using data from ASAS (Pojmanski, 2002), NSVS (Wozniak et al., 2004), and the minima from Zejda et al. (2006), Brát et al. (2007) and Table 1.

$$HJD\ Min\ I = 2454651.4603(14) + 1.635135(3)E \quad (1)$$

$$HJD\ Min\ II = 2454650.7235(20) + 1.635135(3)E \quad (2)$$

A phase plot of the data is given in Fig. 1. Note that Otero et al. (2004) reversed the primary and secondary eclipses. There is indeed only a small difference in the depth of the two eclipses, suggesting that both stars have a similar temperature. This is also supported by the $B - V$, $V - R_C$ and $V - I_C$ colour curves plotted in Fig. 2, showing only small variation.

The Phoebe program (Prša & Zwitter, 2005) was used to determine the orbital parameters of HD 350731. Calculations were done for a detached system. As is usual when radial velocity curves are absent, it is very difficult to obtain a precise value for the mass ratio q. Values in the range of 0.7 to 1.1 all give very good fits. We further took linear limb darkening coefficients from van Hamme (1993) and assumed periastron-synchronized rotation, albedo and gravity brightening values equal to 1 and a primary temperature of

Table 1: List of minima of HD 350731. $O-C$ values are derived from Eqs. 1 and 2.

Epoch HJD-2400000	Min	Uncertainty [days]	$O-C$ [days]	Observer	Filter
54299.9065	I	0.0002	0.0002	CWR	V
54340.7838	I	0.0002	-0.0009	CWR	V
54345.6896	I	0.0001	-0.0005	CWR	V
54628.5684	I	0.0002	0.0000	SK	BVR_CI_C
54642.5482	II	0.0002	0.0004	SK	BVR_CI_C
54651.4605	I	0.0004	0.0002	SK	BVR_CI_C
54665.4390	II	0.0002	-0.0007	SK	BVR_CI_C

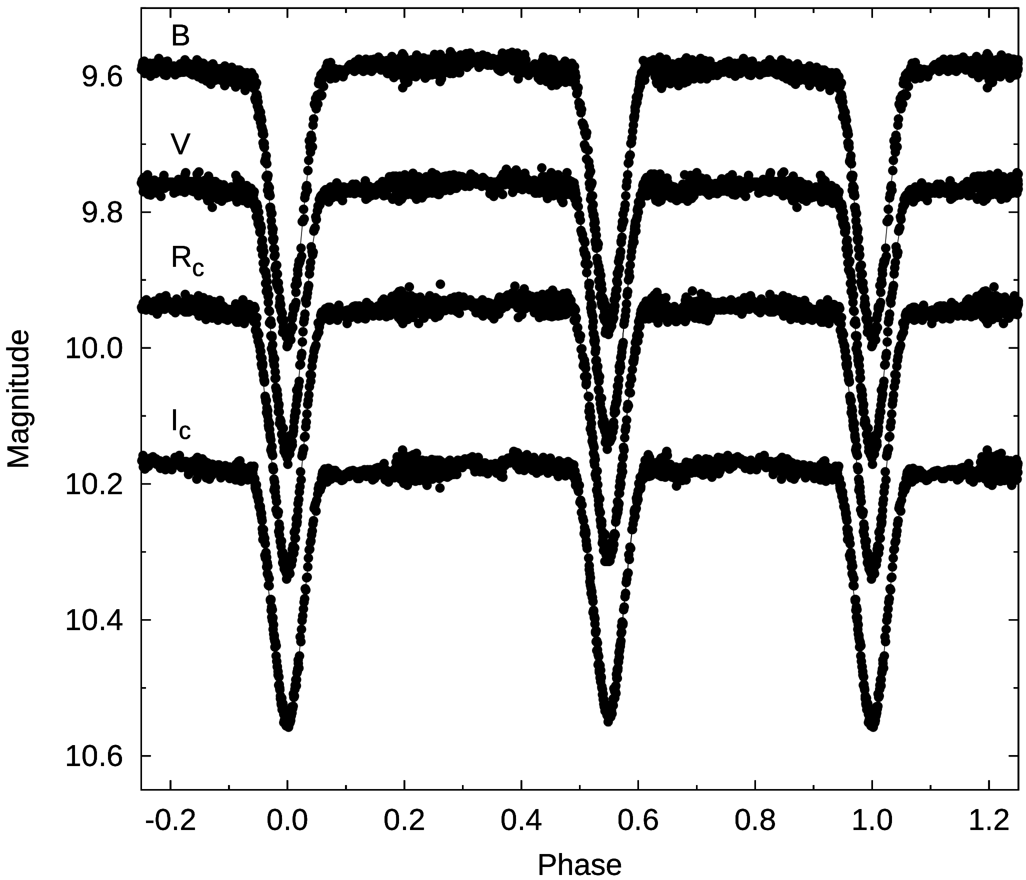

Figure 1. Phase plot of the HD 350731 data. The V, R_C and I_C data have been shifted in magnitude by resp. 0.25, 0.50 and 0.75 mag. for clarity.

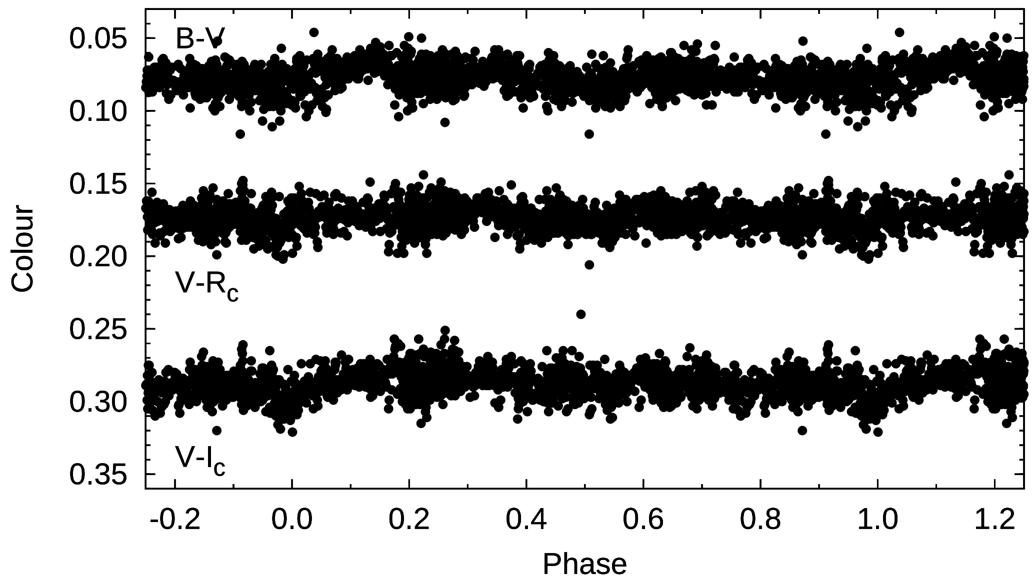

Figure 2. Phase plot of the $B-V$, $V-R_C$ and $V-I_C$ colours of HD 350731. The latter two colours have been shifted for clarity by 0.1 and 0.2 mag. respectively.

Table 2: Calculated system parameters for HD 350731.

q	0.9	$\pm$	0.2
i	82.3°	$\pm$	0.4°
e	0.078	$\pm$	0.001
ω	348°	$\pm$	3°
Ω_1/Ω_2	1.14	$\pm$	0.08
$T_1 - T_2$	320K	$\pm$	60K

$T_1 = 10500$K, based on the spectral type (Cox, 2000). Uncertainties on the calculated parameters were then derived by varying q in the range given above. The results obtained are presented in Table 2.

HD 350731 shows some scatter outside of eclipse, but no periodicity was found. Mainly because of the fairly short period of this eccentric eclipsing binary, apsidal motion will be dominated by general relativistic effects. With an estimate of 3 $M_\odot$ for the mass of a main sequence primary (Cox, 2000), general relativity predicts an apsidal motion of $28 \pm 6°$ per century (Gimenez, 1985), while classical effects are only responsible for less than one tenth of that amount (Claret & Gimenez, 1993). Because the argument of periastron ω is close to the ascending node, variations in the phase of the secondary minimum will however be almost negligible in the near future.

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