Sudden Period Change and Dimming of the Eclipsing Binary V752 Centauri

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Abstract Video photometry was used to determine a time of minimum light of V752 Centauri at heliocentric JD 2457051.1458 ± 0.0002. The observed time was late by nearly two hours relative to the ephemeris in the *General Catalouge of Variable Stars* (GCVS). Analysis of this and other timings indicates that the orbital period of V752 Cen increased abruptly by 7.49×10^{-6} days in 2004 after remaining constant for at least the previous 34 years. Simultaneously, the star became fainter by 0.07 magnitude in the V band during primary eclipse, as indicated by an analysis of ASAS data. Dimming of 0.02 to 0.03 magnitude occurred at other phases in the light curve, too. By 2008 the star had returned to its normal brightness. The dimming and the period change may both have been the consequence of material escaping from one of the stars. The deepening of the primary eclipse is also consistent with a color change.

1. Introduction

V752 Centauri is a W UMa-type eclipsing binary star. The V magnitude range is 9.1 to 9.66 and the spectral type is F8V according to the AAVSO International Variable Star Index (VSX; Watson *et al.* 2014). The ephemeris for primary minima according to the *General Catalogue of Variable Stars* (GCVS; Kholopov *et al.* 1985) is given in Equation 1.

$$\text{JD hel} = 2444243.6916 + 0.37022484 \times \text{N} \qquad (1)$$

where N is the number of cycles. Times of minimum of V752 Cen determined prior to the year 2000 are in good agreement with this ephemeris. A secondary eclipse of V752 Cen was recorded with video equipment in 2015 by one of the authors (HP). The method of recording and analyzing video photometry will be described in a separate article. The time of minimum was determined to be at heliocentric JD 2457051.1458 ± 0.0002. This value was late by about 1.9 hours relative to the GCVS ephemeris, which alerted us that a period change had probably occurred.

2. Period study

There are many times of minimum of V752 Cen listed in the AAVSO O–C database (Nelson 2014) from 1970 through 1995 and three additional times between 2009 and 2012. In order to fill the 14-year gap from 1995 until 2009 we analyzed ASAS photometry (Pojmański 1997). The new times of minimum and O–C residuals derived from ASAS data are listed in Table 1. We found that the O–C was changing rapidly during this interval and so we separated the data into 3 groups spanning 1,000 days each.

The orbital period of V752 Cen increased abruptly by 7.49×10^{-6} days around cycle 24,000 of the GCVS ephemeris (year 2004), as shown in Figure 1. This is a large change for a star whose period had been constant since at least 1970. The updated ephemeris given in Equation 2 is based on the most recent time of primary minimum and the best fitting period after 2004.

Table 1. V752 Cen times of minimum and residuals to the GCVS ephemeris derived from ASAS photometry.

*Interval**	*Phase*	*JD (hel.)*	*Cycle*	*O–C*
1	Primary	2452546.3492	22428	–0.0047
1	Secondary	2452546.5368	22428.5	–0.0022
2	Primary	2453524.1272	25070	+0.0095
2	Secondary	2453524.3073	25070.5	+0.0045
3	Primary	2454531.1528	27790	+0.0236
3	Secondary	2454531.3398	27790.5	+0.0255

**Intervals: No. 1, JD 2452000.0–2453000.0; No. 2, JD 2453000.0–2454000.0; No. 3, JD 2454000.0–2455000.0.*

The O–C residuals to Equation 2 for the times of minimum recorded after the period changes are shown in Figure 2.

$$\text{JD hel} = 2456108.344 + 0.37023233 \times \text{N} \qquad (2)$$

3. Light curve anomaly

Light curves of V752 Cen for the three intervals of ASAS data are plotted in Figure 3. The rightward shift of the times of minimum with interval number is very evident. Also notice the overall brightness decrease associated with interval 2, which corresponds to the epoch of the period change. Table 2 lists the V magnitude by phase and by ASAS interval. The average V magnitude at primary eclipse during intervals 1 and 3 was 9.66, which is in perfect agreement with the VSX value. However, during interval 2 (which coincides with the epoch of the period change) the primary eclipse was 0.07 magnitude fainter than the VSX value.

The dimming during primary eclipse suggests that the secondary star was fainter at the same time that the period change occurred. Brightness decreases are also evident at other phases during interval 2 but they range from just 0.02 to 0.03 magnitude. The dimming and the period change may both have been the consequence of material escaping from one of the stars, as often happens in close binary systems. D. Terrell

Table 2. V752 Cen maximum and minimum brightness during the three ASAS intervals.

*Interval**	*Phase*	*Mag.*	*Phase*	*Mag.*	*Phase*	*Mag.*	*Phase*	*Mag.*
1	Pri	9.67	~0.25	9.15	Sec	9.67	~0.75	9.14
2	—	9.73	—	9.16	—	9.69	—	9.19
3	—	9.65	—	9.13	—	9.66	—	9.18
2−(1+3)/2	—	+0.070	—	+0.020	—	+0.025	—	+0.030

**Intervals: No. 1, JD 2452000.0–2453000.0; No. 2, JD 2453000.0–2454000.0; No. 3, JD 2454000.0–2455000.0.*

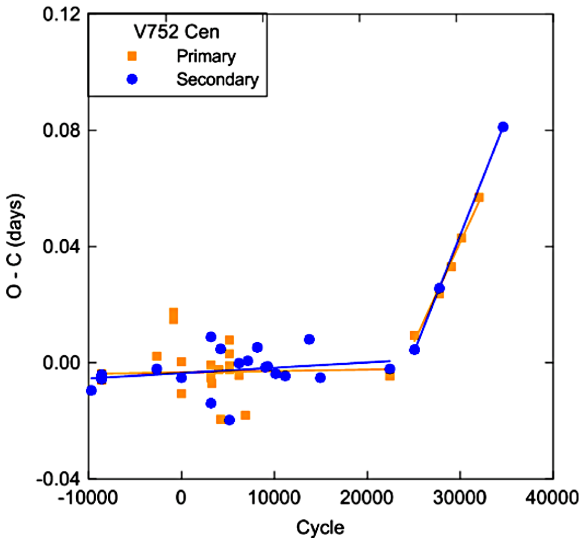

Figure 1. V752 Cen times of minimum according to the GCVS ephemeris in Equation 1 began running late after cycle 24,000, which was in year 2004.

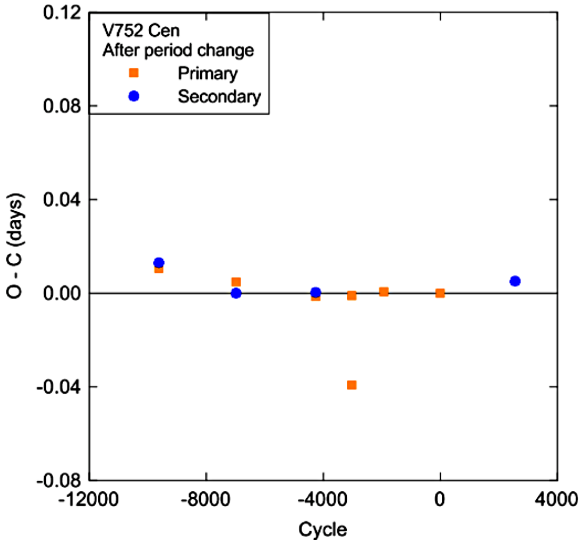

Figure 2. O–C values for the times of minimum of V752 Cen after the period change based on the updated ephemeris in Equation 2. The time of secondary minimum recorded by video and reported in this study is plotted at the far right.

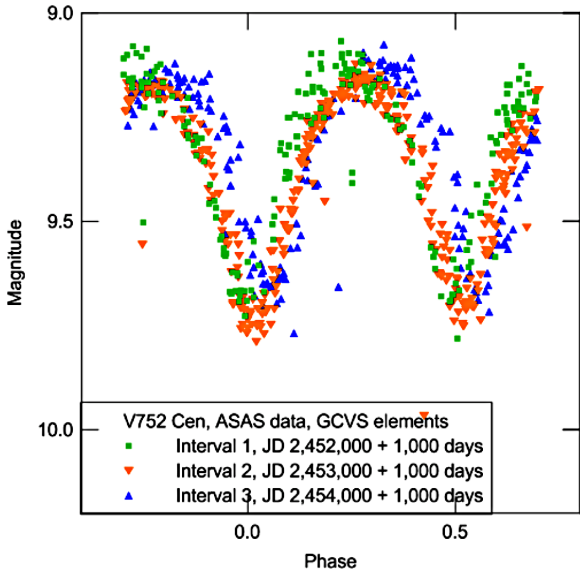

Figure 3. V-band light curve of V752 Cen compiled from three time intervals of ASAS data. The horizontal shifting with interval is due to the period increase. Notice, too, that the primary minimum was significantly fainter during interval 2.

(private communication) has noted that the deepening of the primary eclipse is also consistent with a color change.

4. Summary and conclusion

V752 Cen underwent a large orbital period increase in 2004 after a span of at least 34 years when it had not changed perceptibly. At that same time the brightness during primary eclipse dimmed by 0.07 magnitude as compared with data taken a few years before and after. Recording more times of minimum as well as full light curve photometry for this star is highly desirable. Furthermore, analysis of archival photometry for other close binaries might reveal additional light curve anomalies that have occurred simultaneously with period changes.

5. Acknowledgements

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