Consecutive Eclipses of Z Chamaeleontis in Outburst

Martin Nicholson
3 Grovelands, Daventry, Northamptonshire NN11 4DH, England

Received November 4, 2008; revised November 24, 2008; accepted November 25, 2008

Abstract Observations of two consecutive eclipses of the dwarf nova Z Chamaeleontis are presented. The results obtained confirm that neither the linear, quadratic, nor sinusoidal ephemeris presented in the astronomical literature appear to model accurately the observed period changes.

1. Introduction

Z Chamaeleontis is a dwarf nova of the SU Ursae Majoris subtype. This type of variable star consists of a close binary pair made up of white dwarf primary star with a surrounding accretion disk and a K-M dwarf or sub-giant secondary star that has filled its inner Roche lobe. Matter transfer takes place through the inner Lagrangian point of the secondary star to this accretion disk. The "hot spot" is where the material reaches the disk and it is the interactions within this disk that give rise to the observed outbursts. In the specific case of Z Cha, the white dwarf, the accretion disk, and the hot spot are eclipsed every 107 minutes by the red dwarf secondary star (Wood *et al.* 1986).

2. Observations

Z Cha was observed with a 0.25-meter telescope and a SBIG ST-10XM CCD camera situated at the Riverland Dingo Observatory in Moorook, South Australia. The *f*/6 focal ratio gave a scale of 0.93 arc second per pixel and a field of view of 34 × 22.9 arc minutes. An exposure time of 30 seconds was used with a *V*-band filter. The signal-to-noise ratio at minimum light was 150. Subsequent image processing was carried out using the software package MAXIM DL version 3.22 (Diffraction Limited 2004). Information about the comparison and check stars can be found in Table 1.

3. Light curves

Z Cha was in outburst when the two observing runs took place. Figure 1 shows the *V* magnitude versus time for the first observing run on the night of February 18, 2008. Figure 2 shows the *V* magnitude versus time for the second run on the same night. In both cases the time of minimum light was calculated using the software package PERANSO (Vanmunster 2007) and the results are presented in Table 2.

As the bright spot rotates into view it results in a "hump" in the light curve prior to the onset of the eclipse. The rapid flickering, characteristic of dwarf novae, can best be seen in the second light curve after the end of the eclipse.

4. Results and analysis

At different times the ephemeris for Z Cha has been represented by a linear (Kreiner 2004), quadratic (Cook and Warner 1981), and a sinusoidal (Baptista *et al.* 2002) equation. The O–C results using the different equations from the three sources are presented in Table 3.

Baptista *et al.* present compelling evidence for the rejection of the quadratic ephemeris and that a linear plus sinusoidal ephemeris is preferable to a purely linear one. However, the analysis contains the caveat that the observed variation is "not sinusoidal or, most probably, is not strictly periodic."

The results obtained in 2008 support these contentions. The O–C value for the quadratic ephemeris, at over 24 minutes, is far outside any possible error in the timings taken. At under five minutes the O–C value for the sinusoidal ephemeris is the smallest of the three but is still outside the range of experimental error.

References

Baptista, R., Jablonski, F., Oliveira, E., Vrielmann, S., Woudt, P. A., and Catalán, M. S. 2002, *Mon. Not. Roy. Astron. Soc.*, **335**, 75.

Cook, M. C., and Warner, B. 1981, *Mon. Not. Roy. Astron. Soc.*, **196**, 55.

Kreiner, J. M. 2004, *Acta Astron.*, **54**, 207.

Diffraction Limited 2004, MAXIM DL image processing software, http://www.cyanogen.com

Vanmunster, T. 2007, PERANSO period analysis software, http://www.peranso.com

Wood, J., Horne, K., Berriman, G., Wade, R., O'Donoghue, D., and Warner, B. 1986, *Mon. Not. Roy. Astron. Soc.*, **219**, 629.

Table 1. Z Cha comparison and check stars.

Designation	*R.A. (2000)*	*Dec. (2000)*	*V mag. (AAVSO)**
Comp GSC 9394–1549	$08^h\ 09^m\ 06.8^s$	–76° 32' 14.8"	12.59
Check GSC 9394–2743	$08^h\ 09^m\ 13.9^s$	–76° 33' 38.3"	12.78

**The V magnitudes were obtained from the AAVSO chart for Z Chamaeleontis.*

Table 2. Z Cha time of minimum light.

Run number	*Minimum light (JD)*	*Error (JD) ±*	*Minimum light (HJD)*
1	2454515.128110	0.000169	2454515.128112
2	2454515.202871	0.000126	2454515.202875

Table 3. Z Cha O–C values for the two imaging runs.

Source	*Equation type*	*O–C run #1*	*O–C run #2*	*Cycle number*
Kreiner	Linear	–0.00426 day	–0.00400 day	27048 and 27049
Cook	Quadratic	–0.01724 day	–0.01698 day	191283 and 191284
Baptista	Sinusoidal	–0.00333 day	–0.00307 day	191283 and 191284

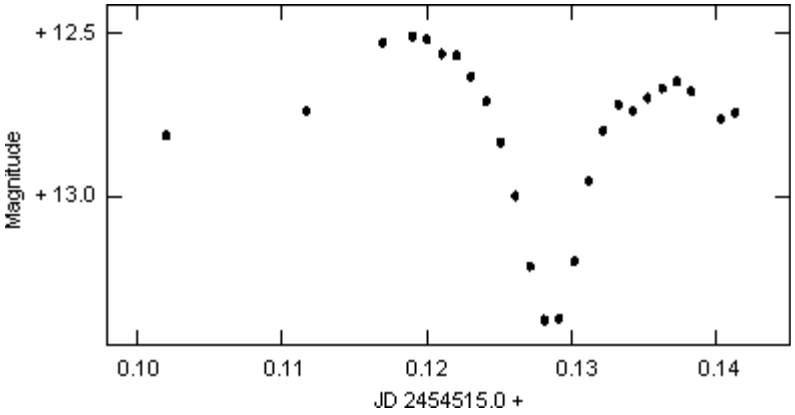

Figure 1. *V* magnitude versus time for the first observing run of Z Cha.

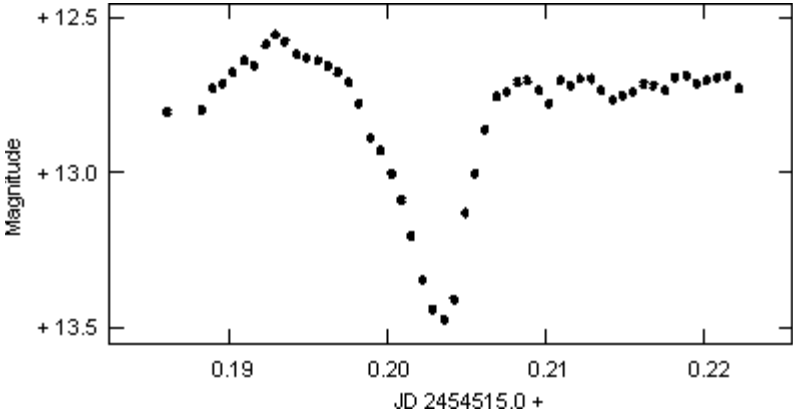

Figure 2. *V* magnitude versus time for the second observing run of Z Cha.