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RZ CAS: 8 YEARS MONITORING

Summary: about 600 visual estimates of eclipsing binary RZ Cas show the validity of ephemeris(3). Furthermore accidental presence of flat minimums have been observed confirming hypothesis that the hotter star probably has a disk of matter in rapid evolution around its surface.

Introduction

RZ Cas is an EA-type eclipsing binary especially known for the large light variation: between 6.18 and 7.72 magnitudes for primary minimum and between 6.18 and 6.26 magnitudes for the secondary one. In literature I found 3 ephemerides, which indicate different and slowly decreasing light variation periods:

$$\begin{aligned} \text{Min.I} &= 39025.3025 + 1.1952499 * E && (1) && (1) \\ \text{Min.I} &= 39673.1302 + 1.19524892 * E && (2) && (2) \\ \text{Min.I} &= 43200.3063 + 1.195247 * E && (3) && (3) \end{aligned}$$

Concerning the period, photoelectric observations carried out by american astronomers put in evidence that this one is slowly variable in time⁽⁴⁾. Since several years, GEOS members are observing the RZ Cas's eclipses for detecting or not the existence of a flat minimum and its duration, which could reveal a total eclipse. Visual observations carried out by Martignoni⁽⁵⁾ indicated the existence of light constant minima of about 20-25 minutes, while photoelectric observations by Dumont and following by Galli and Aluigi⁽⁷⁾ specified that observation of flat minimum is accidental and its duration, when observed, is about 9 minutes. A first attempt for explaining this phenomenon refers to a disk of matter with variable thickness around the system's hotter star. So, a rapid disk expansion or compression could explain that the flat minimum is not always visible and has non-constant duration⁽⁶⁾.

Results and discussion

Between 1988 and 1995 I carried out about 600 visual estimates of RZ Cas using chart GEOS C15. 10 observed heliocentric times of minima are presented below, calculated by S.O.P.⁽⁸⁾ program forcing symmetry of light curve. Furthermore, I report relative O-C values calculated according to the preceding 3 ephemerides, and at last, duration of total eclipse in minutes, when observed, or the range of time in which I didn't observe any substantial light change:

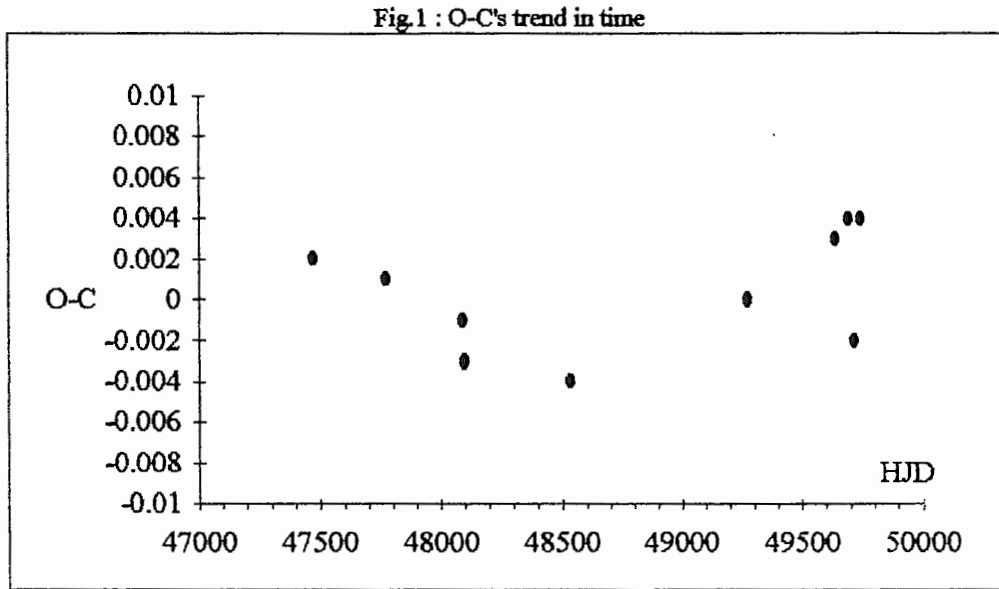
Tab.1 : RZ Cas minima in 1988/1995

DATE	U.T.	HJD	O-C(1)	O-C(2)	O-C(3)	d(min)
7 Nov 88	19.51	47473.327	- 0.002	0.002	0.013	17
3 Sep 89	19.59	47773.333	- 0.003	0.001	0.012	-
19 Jul 90	23.05	48092.462	- 0.006	- 0.001	0.010	14
25 Jul 90	22.29	48098.437	- 0.007	- 0.003	0.008	-
2 Oct 91	19.28	48532.311	- 0.009	- 0.004	0.008	12
12 Oct 93	20.51	49273.369	- 0.006	0.000	0.013	10
14 Oct 94	19.32	49640.314	- 0.003	0.003	0.017	-
2 Dec 94	19.41	49689.320	- 0.002	0.004	0.018	12
26 Dec 94	17.15	49713.219	- 0.008	- 0.002	0.012	-
20 Jan 95	19.48	49738.325	- 0.002	0.004	0.018	12

The O-C(1) values, negative, show that period is shorter than 1.1952499 days, while O-C(3) values show that this one is greater than 1.195247 days. The ephemeris that seems to be in accordance with observations is the (2), which shows a mean difference of:

$$O-C(2)_{\text{mean}} = 0.000 \pm 0.003 \text{ day}$$

O-C(2) values are reported below in fig. 1 versus heliocentric julian days:



We can see that O-C values seems to have a curvilinear trend, which could confirm the slow variation of the RZ Cas period, but points are still too few for proposing a regular trend of O-Cs and period.

The flat minimum

As we see in Tab.1, only 6 out of 10 observed minima have a constant light close to middle eclipse. Flat minima seem to be casual rather than regular. Duration of total eclipses are also fluctuating in time:

$$\text{Duration of totality} = 13 \pm 2 \text{ minutes}$$

this value is between those ones found by Martignoni and by Dumont, Galli, Aluigi. This fact confirm the oddity of one of the most known variable stars. 4 RZ Cas's light curves are presented below, which show how light curve varies at the minimum:

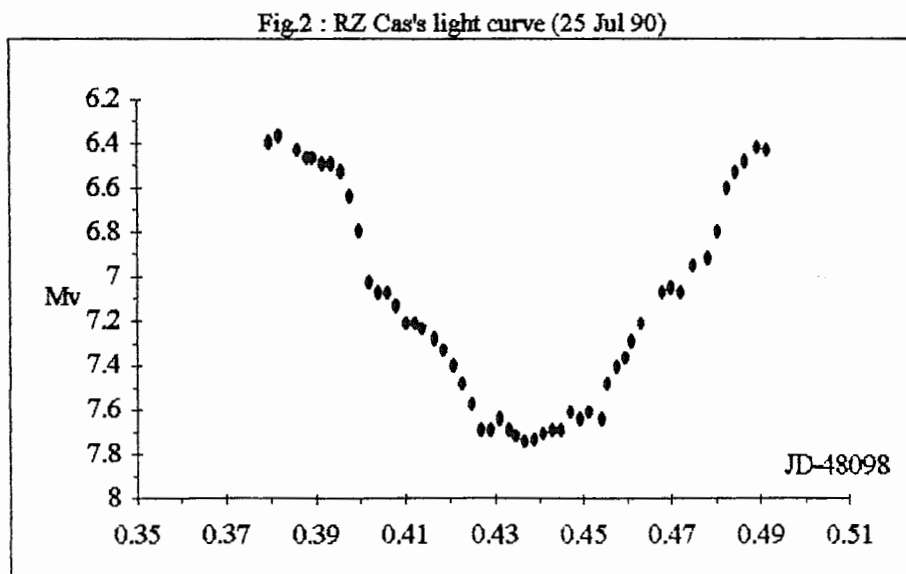


Fig.3 : RZ Cas's light curve (12 Oct 93)

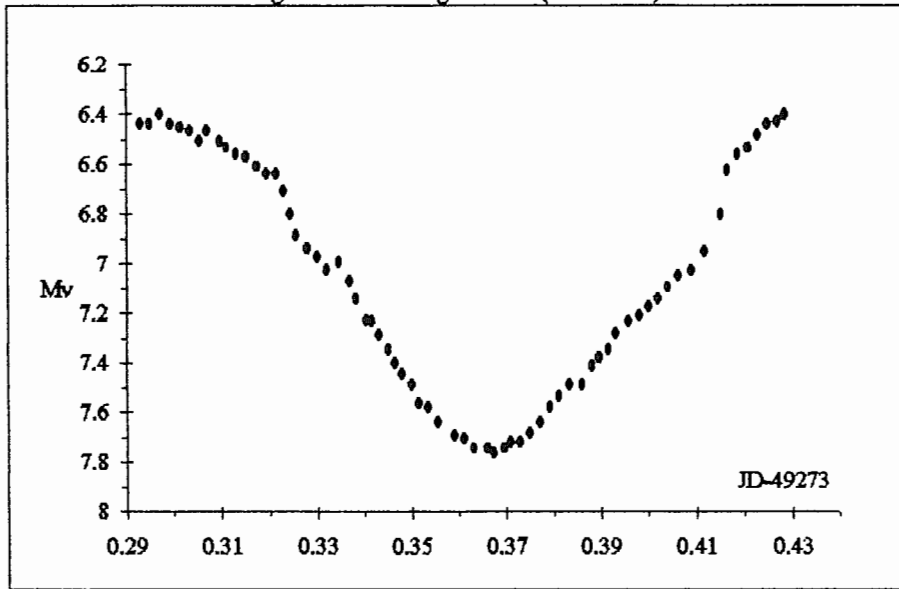


Fig.4 : RZ Cas's light curve (14 Oct 94)

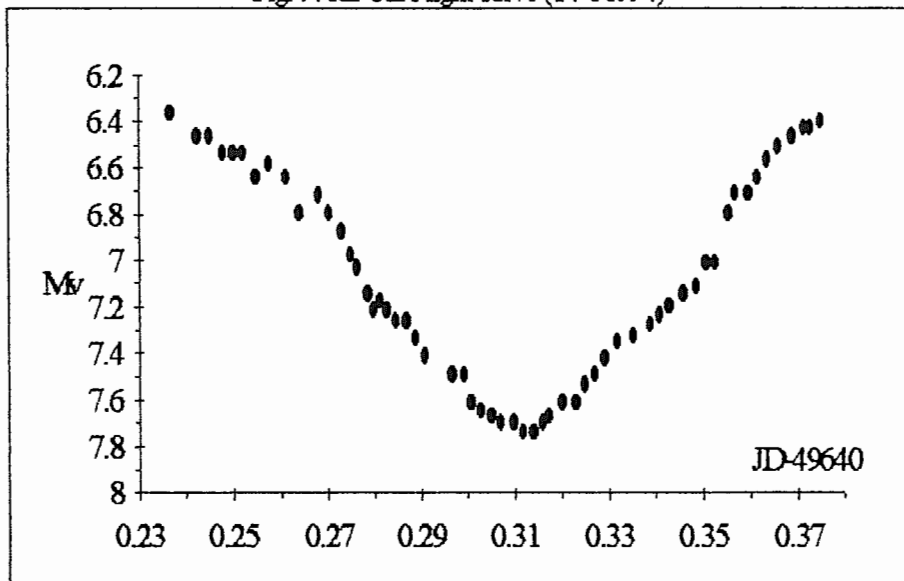
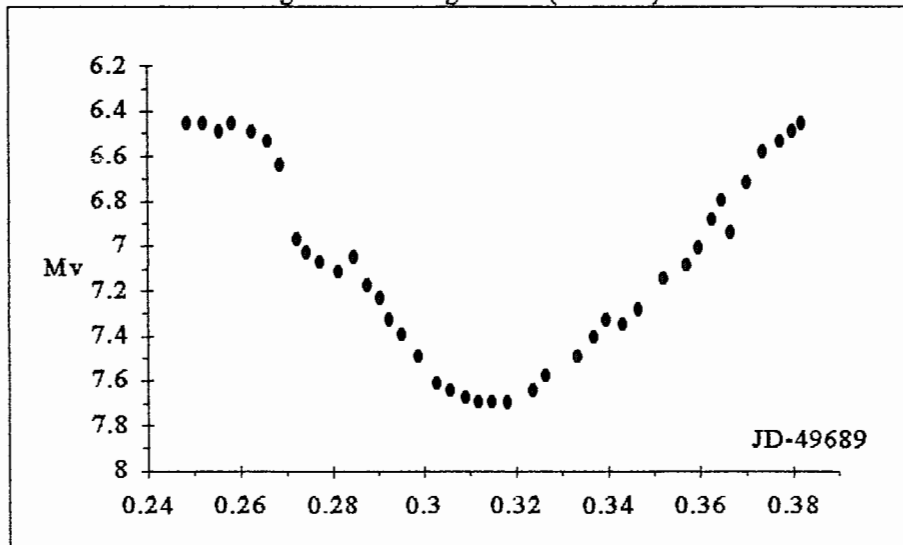


Fig.5 : RZ Cas's light curve (2 Dec 94)

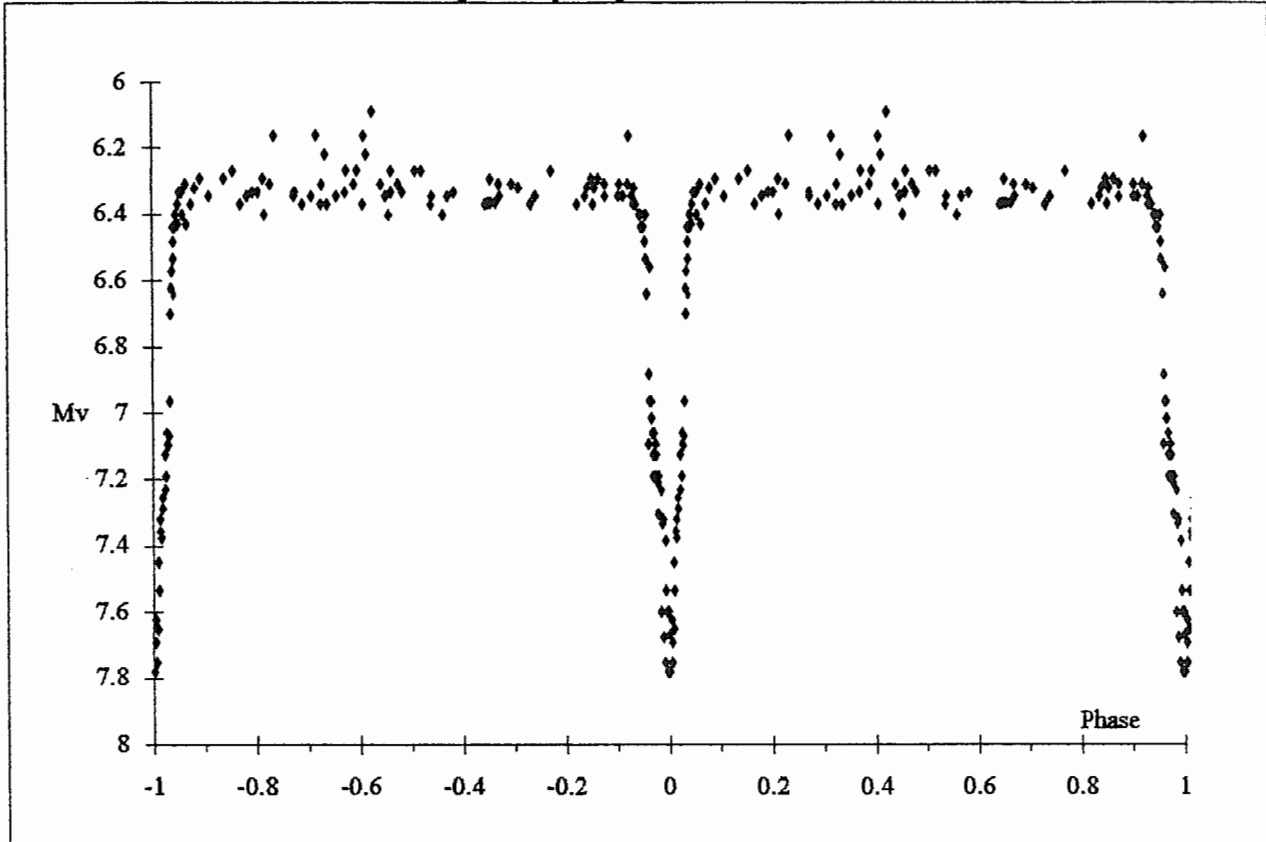


As we see, the difference between a flat minimum and a continuous one can really be observed, even if, objectively, it is more difficult through visual observations.

The light curve

The 163 observations carried out in 1988 let us to plot a *compositage* presented in the next fig.6:

Fig.6 : compositage of RZ Cas in 1988



Conclusions

This work confirms the validity of ephemeris (2) in respect with that (3) of GCVS 85 for RZ Cas. Furthermore we could think that light variation period is varying in time caused by physical reasons. Accidental observations of flat minima, with variable duration, seems to confirm the hypothesis of the presence of a disk of matter around the hotter star in rapid evolution, as suggested Gaspani. However, we need further observations of this variable star to verify if the period and total eclipses have a clearer behaviour.

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References:

- (1) *Rocznik Astronomiczny Obserwatorium Kraskowiego*, 52
- (2) AA.VV. - *Note Circulaire GEOS*, 677
- (3) *General Catalogue of Variable Stars*, 1985
- (4) P.BARUFFETTI - note on *l'Astronomia*, 92
- (5) M.MARTIGNONI - *Note Circulaire GEOS*, 660
- (6) A.GASPANI - *Simposium GEOS, Selvino 1992 (paper contained in NC 686)*
- (7) M.MALUIGI, G.GALLI - *Note Circulaire GEOS*, 695
- (8) A.GASPANI - *Stochastic Optimization Program v.5*, (priv. comm.)