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Spectrophotometry of RZ Cas

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Abstract. Spectrum scans of the eclipsing binary star RZ Cas at different phases in the wavelength range $\lambda\lambda$ 3300 – 7600 Å taken through Hilger and Watts monochromator equipped with 104-cm telescope of Uttar Pradesh State Observatory, Naini Tal, have been presented and discussed.

1. Introduction

RZ Cas (HD 17138) is an eclipsing binary system. The system is bright enough ($m_v = 6^m.18$ at maximum light), so many photometric observations, mostly by rather small telescopes, have been made, which mainly concerns the timing of primary minima of the system. Recently, RZ Cas has been reported to have a flat bottom near the centre of the primary minimum light and in some cases this behaviour was not observed (viz. Hegedus 1989; Nakamura *et al.* 1991).

We had selected RZ Cas for spectrophotometry in 1982 because no spectrophotometric observations of the system had ever been published and not till now. The purpose of this paper is to present our spectrophotometric observations and to discuss what we have been able to understand about the system.

2. Observations and reductions

The spectrophotometric observations of RZ Cas were taken in the wavelength range $\lambda\lambda$ 3300 – 7600 Å on 10/11 November 1983, with the 104-cm telescope of Uttar Pradesh State Observatory, Naini Tal. The Hilger and Watts spectrum scanner was used at the Cassegrain focus (f/13) for obtaining the spectral scans. An exit slit of 50Å width was used. The standard d.c. technique was used for detecting and recording the signal. A total of 8 scans (2 scans outside the eclipse phases, 4 during the partial primary eclipse and 2 at the primary minimum light) have been taken. We have also observed the 6 photometric standard stars listed in Table 1, as comparison stars.

Table 1. A list of stars observed for comparison

HR	HD	Spectral type	m_v
437	9270	G8	3.62
1829	36079	G5	2.85
2693	54609	F8	4.84
3043	63660	G0	5.33
46271	2382	K0	5.83
69267	3249	K4	3.53

Alongwith these, the spectrophotometric standard star α Lyr was observed many times during the same night for deriving the extinction coefficients and converting the observations into standard monochromatic magnitudes. The absolute calibrations of α Lyr, given by Taylor (1984) was adopted. The standard deviation of the observations does not exceed $\pm 0^m.03$ in the whole wavelength region. The observed standard monochromatic magnitudes of RZ Cas at phases $0^P.90$ and $0^P.00$ against wavelengths are given, respectively, in figures 1 and 2. The phases have been computed with the ephemeris :

$$M\,(E)\,J.D.\,(Hel) = 2444634 + 1^d.1952473E \qquad (1)$$

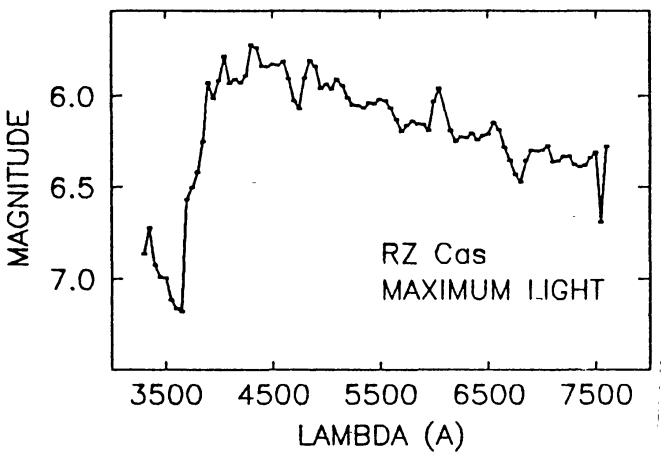

Figure 1. Observed flux of RZ Cas at 0P.90

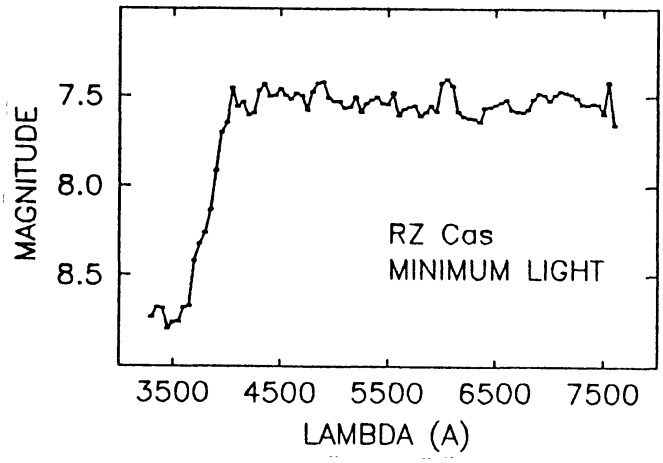

Figure 2. Observed flux of RZ Cas at $0^P.00$

In order to study the systemic components, we have corrected all the observations of the continuum of the secondary star in RZ Cas, as observed at $0^P.00$, for reddening by taking the value of E(B-V) = $0^m.15$ (Chambliss 1976). The reddening at the visual magnitude (A_v) was determined by adopting the mean value of total to selective extinction R = 3.25 (Moffat & Schmidt - Kaler 1976). The reddening corrections at different wavelengths were worked out by using the value of A_v and extrapolated reddening law by Lucke (1980).

3. Result and discussion

The spectral scans of RZ Cas observed during the $0^P.00$ represents the spectrum of secondary component of the system. This spectrum scan enables us to classify the secondary star of RZ Cas by matching its flux distribution to those of late-type giant stars and also to derive the effective temperature by matching the continuum energy distribution with that obtained from model atmosphere.

In order to determine the spectral type of the secondary star in RZ Cas, we have compared its observed de-reddened normalized monochromatic fluxes with the observed de-reddened normalized monochromatic fluxes of some photometric standard late type giant stars as listed in Table 1. It is found that flux distribution of the continuum of photometric standard star is matched with HR 2693 (F8) in the wavelength range $\lambda\lambda$ 3800 – 7600 Å.

The spectrum of the primary star of the eclipsing binary system RZ Cas may be constructed from the intensity tracings, by subtracting the intensity of the spectral scan of the secondary star as observed outside the eclipse. In order to get the continuum flux distribution of the primary star the observed magnitude of both the spectra (Figures 1 and 2), at interval of 5 nm, were converted into fluxes with the aid of the equation (Hayes *et al.* 1975) :

$$m_\lambda = -2.5 \log F_\lambda + 21^m.17 \quad (2)$$

where m_λ and F_λ are, respectively, the monochromatic magnitude and flux at wavelength λ.

As in practice, further in all our calculations, we need normalized monochromatic magnitudes, therefore, the extracted monochromatic fluxes of the primary star were converted into normalized magnitudes with the help of the equation :

$$nm_\lambda = -2.5 \log F_\lambda / F_{550}, \quad (3)$$

where nm_λ is the normalized magnitude at wavelength λ and F_{550} is the monochromatic flux at wavelength λ = 550 nm. In this way, the continuum flux distribution curve obtained for the primary star of RZ Cas is matched with Kurcz model atmosphere having T_{eff} = 10000 K and log g = 4.0.

References

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