

CCD Photometric Observations of Primary Minima of the Eclipsing Binary System RZ Cas

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Abstract

Photometric observations of the eclipsing binary system RZ Cas were carried out using a CCD camera system attached to a 60-cm reflector. Our interest is focused on the shape of the light curve near the bottom of the primary minimum, as well as the period change. Light curves of two primary eclipses have been obtained. The eclipse observed on November 21, 1992 seemed to be partial, while another one observed on December 8 seemed to be total. We also confirmed a period change.

Key words: CCD Photometry; Eclipsing binaries: RZ Cas; Variable Stars

1. Introduction

RZ Cas (HD17138) is a favorite object for observers of eclipsing binaries because of its brightness ($m_v = 6.18 - 7.72$) and its relatively short period ($P = 1.195$ day). It has been known a typical Algol-type semi-detached system. It has also shown irregular period changes. Many photometric observations have been made concerning the timing of primary minima. There are some reports on the period changes (e.g., Herczeg and Frieboes-Conde 1974, Hall et al. 1976, Nowak and Piotrowski 1982, and Hegedüs et al. 1992). A semi-detached and partial occultation model has been accepted for this system (e.g., Chambliss 1976). But some observations detected primary minima with a flat bottom showing the total eclipse (e.g., Arganbright et al. 1988, Hegedüs 1989, and Nakamura et al. 1991a, b).

In this paper we present results of photometric observations of primary minima. Our interests are (1) Shape of the light curve during the eclipse, and (2) the time of the eclipse center and the period change.

2. Observations

Observations were carried out with the 60-cm reflector of Nishi-Harima Astronomical Observatory on November 21 and December 8, 1992. A CCD camera system is attached to it at the f/12 Cassegrain focus. The V-band filter used in the observations approximates the standard Johnson V system.

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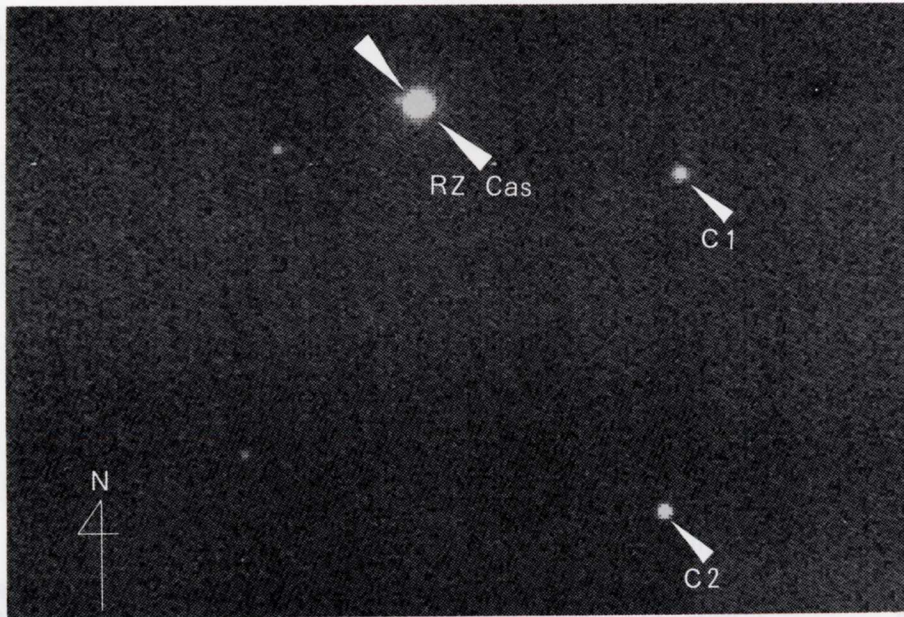


Fig. 1. Finding chart (a CCD image) of RZ Cas. The comparison star is C1 and the check star is C2. Note a faint companion star near RZ Cas. The field of view is $4' \times 6'$.

The CCD chip yields a field of view of 6×4 arc minutes. Two stars contained simultaneously in the same field with RZ Cas were chosen as the comparison stars (C1 and C2; See figure 1). Positions and V magnitudes of the comparison stars are taken from the Guide Star Catalog (table 1). C2 is an IRAS point source designated as 02441+6922, which has an O-rich envelope and varies its light with 26 % likelihood (IPAC 1986). Then we used only C1 as the comparison star.

Exposures were taken with integration times of 4 seconds. The dark counts subtraction and flat-fielding were done in a usual way for an individual CCD frame. Synthetic aperture photometries were performed using the APPHOT package in IRAF¹.

Table 1. Positions and V magnitudes of comparison stars

ID	R.A. (2000.0)	DEC (2000.0)	V mag.
C1	02:48:38.41	+69:37:30.2	11.1
C2	02:48:41.71	+69:35:31.7	10.7

3. Results

Light changes on November 21 and December 8, 1992 are shown in figure 2a and 2b, respectively. Relative magnitudes of RZ Cas and the check star C2 with respect to the comparison star C1 are shown. The rms scatter in the C2 - C1 magnitudes are about 0.03 mag on both nights.

¹IRAF is distributed by the National Optical Astronomy Observatories, U.S.A.

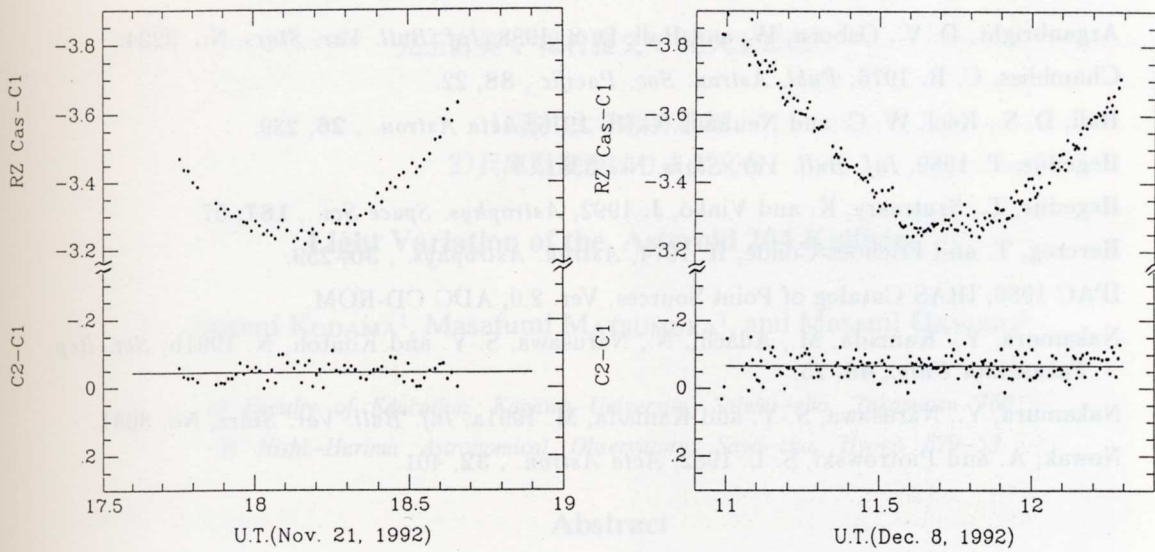


Fig. 2. Light curves of primary minima. (a) Light curve on November 21 1992. (b) Light curve on December 8, 1992. Relative magnitudes of RZ Cas and the check star C2 with respect to the comparison star C1 are plotted against U. T.

Although the light curve on November 21 is suggestive of the partial eclipse, that obtained on December 8 clearly have a flat bottom showing the total eclipse, which lasted about 14 minutes. Light curves on both nights have asymmetric shapes probably showing the effect of gas stream.

Previous papers have not commented on the visible companion of RZ Cas. However, we can see a faint companion on all CCD images on both nights (figure 1). It is about 6 arcsec east of RZ Cas and is enclosed in the aperture of measurements. Because its estimated *V* magnitude is about 13 to 14 mag, we safely assume that its influence on the light curve is negligible.

We determined the central time of primary minima on November 21 and December 8, 1992 as follows;

November 21	HJD 2448948.2591
December 8	HJD 2448964.9927

Nakamura et al. (1991a) derived an ephemeris of the primary minimum as follows;

$$Min.I HJD = 2448174.9307 + 1.1952402E$$

The central time of primary minima on November 21 and December 8 are 11.5 minutes and 11.8 minutes delayed after the predictions, respectively. Consequently, we suggest that the period change has occurred after observations by Nakamura et al. (1991a).

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