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BVRI OBSERVATIONS OF AN ECLIPSE OF RZ Cas

JEFFREY HILL, WAYNE OSBORN

Physics Department, Central Michigan Univ., Mt. Pleasant, MI 48858, U.S.A.
e-mail: osborn@dune.phy.cmich.edu

The Algol-type eclipsing binary RZ Cas is an interesting system that has both x-ray (McCluskey and Kondo 1984) and radio (Drake *et al.* 1986) emission. The variable is bright (V_{max} = 6.2) with a relatively short period ($1\overset{d}{.}195$) and deep primary eclipse (ΔV =$1\overset{m}{.}5$) and therefore has often been observed photometrically. Nevertheless, the system is still not well understood. Particularly puzzling is the change in shape of light curve at primary minimum. It is accepted that the eclipses are partial (Hegedüs *et al.* 1991, Maxted *et al.* 1994, Narusawa *et al.* 1994), but some primary minima exhibit a flat-bottom light curve characteristic of a total eclipse. Recently published examples can be found in Arganbright *et al.* (1988), Hegedüs (1989), Nakamura *et al.* (1991), and Narusawa *et al.* (1994).

Continued minimum timings and photometric monitoring at a variety of wavelengths are needed to determine the cause of the light curve variations. This note presents BVRI observations of a recent primary eclipse. The data were obtained with the 40-cm Cassegrain reflector of the Brooks Astronomical Observatory at Central Michigan University employing a Photometrics Star-1 CCD camera and standard Johnson-Cousins BVRI filters. Details concerning our CCD system, observing techniques, and data reduction methods have been given by Miller and Osborn (1996).

Observations began with clear skies about one hour before the predicted time of minimum on 1996 December 12. Sets of exposures with the four filters were made, alternating between the comparison star HD 15784 = BD+67°224 and RZ Cas. Occasional observations were made of HD 16769 = BD+67°215 as a check star. Clouds appeared shortly after the eclipse minimum and affected the measures until the monitoring ended some 40 minutes later. The exposure times for each filter were kept constant throughout the observations.

Instrumental magnitudes were obtained by aperture photometry of the individual CCD frames. Bias and flat field corrections were applied and then the star brightness measured using a circular aperture of 15" radius and a sky annulus with radii of 19" and 29". The derived values were used to form differential magnitudes with respect to the comparison star. The results are given Table 1, where the time is the fractional heliocentric Julian date after 2450425.0 and colons indicate observations in the presence of clouds. Some measures obviously degraded by clouds have been discarded. The measures of the check star indicate that the magnitudes have mean errors of about 0.02 in B, 0.015 in V and less than 0.010 in R and I.

Table 1: Differential magnitudes relative to HD 15784.
The integer part of the J.D. is 2450 425

Star	Time	ΔB	Time	ΔV	Time	ΔR	Time	ΔI
RZ Cas	.....	.....	.5564	0.271	.5584	0.433	.5592	0.534
	.5649	0.263	.5654	0.469	.5666	0.611	.5669	0.677
	.....	.....	.....	.....	.5704	0.703	.5707	0.763
	.5740	0.512	.5745	0.687	.5751	0.813	.5763	0.858
	.5793	0.659	.5799	0.844	.5802	0.937	.5805	0.950
	.5808	0.726	.5813	0.888	.5818	0.973	.5821	0.981
	.5862	0.864	.5867	1.024	.5872	1.080	.5875	1.076
	.5879	0.913	.5884	1.057	.5889	1.113	.5894	1.096
	.5921	0.969	.5927	1.103	.5933	1.172	.5936	1.148
	.5940	1.008	.5948	1.139	.5955	1.192	.5958	1.162
	.5964	1.044	.5970	1.175	.5975	1.226	.5977	1.188
	.6003	1.082	.6007	1.185	.6013	1.236	.6018	1.185
	.6021	1.075	.6026	1.188	.6032	1.211	.6037	1.168
	.6041	1.055	.6046	1.173	.6050	1.196	.6053	1.153
	.6100	1.013	.6106	1.094	.6112	1.093	.6114	1.117
	.6117	0.966	.6122	1.038	.6126	1.14:	.6129	1.11:
	.6179	cloud	.6184	cloud	.6188	cloud	.6192	0.92:
	.6195	0.82:	.6201	0.86:	.6204	cloud	.6209	cloud
	.6248	0.60:	.6255	0.75:	.6260	0.95:	.6264	cloud
	.6267	cloud	.6272	0.71:	.6277	0.77:	.6279	0.79:
	.6307	0.39:	.6312	0.59:	.6315	0.72:	.6319	cloud
	.6345	0.33:	.6350	0.51:	.6353	0.59:	.6357	0.65:
HD 16769	.5845	−.905	.5850	−.633	.5854	−.501	.5857	−.320
	.6082	−.936	.6086	−.651	.6091	−.509	.6095	−.337
	.6233	−.95:	.6238	−.66:	.6241	−.51:	.6244	−.32:

The resulting light curves are shown in Figure 1. While clouds affected the latter observations, it is clear that this eclipse does not show a flat bottom. Other recent eclipses also do not show the flat-bottom effect (Davis 1996). Our light curves also show some evidence for the "light instabilities" that have been noted by others (e.g. Olson 1982a, 1982b, Hegedüs 1989, Davis 1996). The average from applying the method of bisecting chords to the four individual light curves yields the following time of minimum:

$$\mathrm{JD}_{Helio} = 2450425.6004 \pm 0.0002.$$

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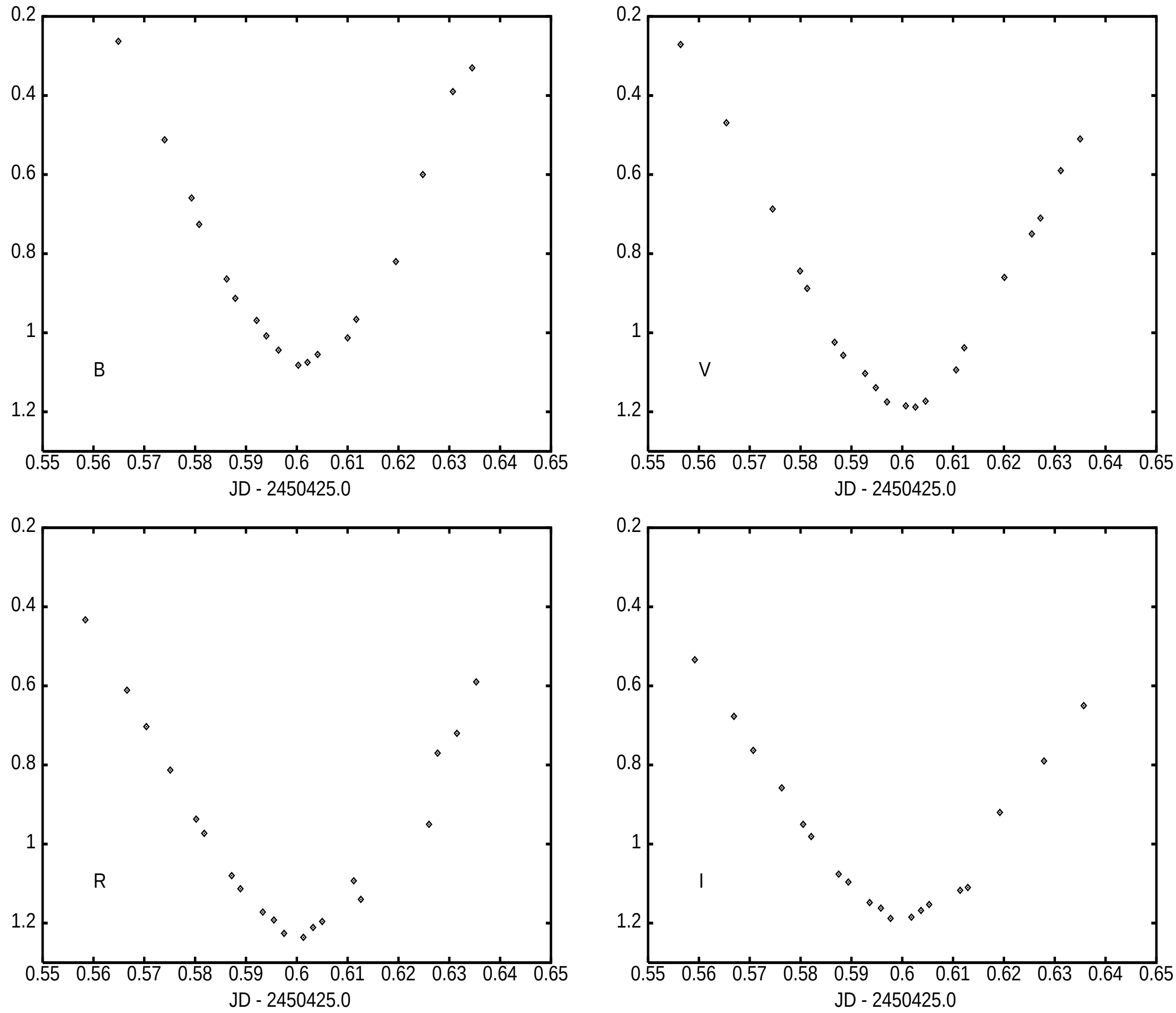

Figure 1. The differential light curves in BVRI (y-axis in mag)

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