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ECLIPSING VARIABLE GSC 2084.0777 = ROTSE1 J174103.55+273429.1

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The wealth of data gathered by the ROTSE1 CCD Survey (Akerlof et al., 2000) has resulted in the discovery of a large number of previously unknown variable stars, many of which are eclipsing binaries. In a continuing cooperative effort, the variability of GSC 2084.0777 = ROTSE1 J174103.55+273429.1 has been studied by a team of AAVSO members. All sky photometry was performed in order to determine the color indices for the variable and comparison stars. We used CCD and photographic observations to accurately determine the light elements of the system. In this note we discuss our methods of observation and present an ephemeris and light curve.

From his private observatory Lubcke observed the system with a 0.28-m Schmidt-Cassegrain telescope equipped with a ST9E CCD. On 12 nights, from JD2451775 to JD2452120. A total of 362 observations were made, yielding four primary and two secondary times of minimum. Nelson observed GSC2084.0777 from the observatory of the Prince George Astronomical Society using a 0.60-m Cassegrain telescope and a ST6 CCD camera. From these unfiltered observations three times of primary minimum and four times of secondary minimum were extracted.

Henden used the USNO Flagstaff Station 1.0-m. telescope equipped with a SITe/Tektronix 1024 × 1024 CCD to observe the field in the standard Johnson-Cousins BVR_cI_c passbands on five photometric nights, using Landoldt standards to calibrate the field. Astrometry is based on USNO-A 2.0 and has errors less than 100mas internal error. With magnitude and color errors shown in parenthesis to the last decimal place, the variable, comparison and check stars were standardized as follows:

Star	GSC	RA (J2000)	DEC	V	$B-V$	$V-R_c$	R_c-I_c
var [1]	2084.0777	17:41:03.354	+27:34:34.77	11.887(2)	0.617(1)	0.361(2)	0.338(2)
var [2]	2084.0777	17:41:03.354	+27:34:34.77	12.374(3)	0.630(3)	0.366(4)	0.350(5)
comp	2084.1119	17:41:29.097	+27:37:06.70	12.594(2)	0.476(18)	0.283(11)	0.293(12)
check	2084.1154	17:41:31.324	+27:31:39.99	12.472(24)	0.766(15)	0.410(12)	0.366(11)

1 = maximum light, 2 = primary minimum.

More complete photometric information about all stars within 5 arcmin of the variable can be found in 5228-t2.txt. In addition, Henden recorded a time of primary minimum in V which appears in Table 1.

Guilbault visited the Harvard College Observatory and estimated the brightness of GSC 2084.0777 on 165 blue- sensitive photographic plates from the AC, Damon and RH Patrol Series. From these observations 24 times of minimum light were gathered. The times of minimum light from all sources are collected in Table 1.

Table 1. Times of minimum, GSC 2084.0777

HJD 2400000 +	Type	Error +/−	Cycle	$O-C$ (d)	Phase	Observer	Source
25369.845	I	-	−66420	−0.006	0.986	Guilbault	pg
28012.605	I	-	−59777	−0.021	0.947	Guilbault	pg
28716.761	I	-	−58007	−0.022	0.945	Guilbault	pg
29816.642	II	-	−55242	+0.062	0.656	Guilbault	pg
42219.718	II	-	−24065	+0.035	0.587	Guilbault	pg
42325.513	II	-	−23780	+0.008	0.518	Guilbault	pg
42574.753	I	-	−23173	+0.008	0.019	Guilbault	pg
42684.517	I	-	−22897	−0.029	0.925	Guilbault	pg
42844.897	I	-	−22494	+0.026	0.065	Guilbault	pg
44369.735	I	-	−18658	−0.013	0.967	Guilbault	pg
44425.642	II	-	−18541	−0.001	0.497	Guilbault	pg
44465.648	I	-	−18420	+0.023	0.058	Guilbault	pg
44732.762	II	-	−17749	−0.005	0.488	Guilbault	pg
44782.680	I	-	−17623	−0.014	0.964	Guilbault	pg
44836.609	II	-	−17487	+0.009	0.523	Guilbault	pg
45053.830	II	-	−16941	−0.016	0.523	Guilbault	pg
45260.491	I	-	−16422	+0.005	0.011	Guilbault	pg
45823.795	I	-	−15006	+0.017	0.958	Guilbault	pg
46146.862	I	-	−14194	+0.013	0.034	Guilbault	pg
46562.780	II	-	−13149	+0.002	0.504	Guilbault	pg
46652.684	II	-	−12923	−0.004	0.491	Guilbault	pg
47243.875	II	-	−11436	+0.014	0.535	Guilbault	pg
47294.801	II	-	−11308	+0.018	0.545	Guilbault	pg
47628.755	I	-	−10469	−0.005	0.987	Guilbault	pg
51781.6929	I	0.0001	−30	+0.000	0.999	Lubcke	CCD unfiltered
51784.6766	II	0.0001	−23	+0.000	0.499	Lubcke	CCD unfiltered
51792.6334	II	0.0001	−3	+0.000	0.499	Lubcke	CCD unfiltered
51793.6282	I	0.0001	0	+0.000	0.000	Lubcke	CCD unfiltered
51803.5742	I	0.0004	+25	+0.000	0.001	Lubcke	CCD unfiltered
51809.7395	II	0.0006	+40	−0.001	0.498	Nelson	CCD unfiltered
52000.8971	I	0.0001	+521	−0.000	0.000	Nelson	CCD unfiltered
52020.7876	I	0.0002	+571	−0.001	0.998	Nelson	CCD unfiltered
52038.8897	II	0.0001	+617	+0.001	0.500	Nelson	CCD unfiltered
52047.8403	I	0.0001	+639	+0.000	0.999	Nelson	CCD unfiltered
52054.8020	II	0.0001	+656	+0.000	0.498	Nelson	CCD unfiltered
52073.8980	II	0.0003	+704	+0.000	0.499	Nelson	CCD unfiltered
52110.6974	I	0.0000	+797	+0.000	0.999	Henden	CCD V-filter
52120.6434	I	0.0001	+822	+0.000	0.000	Lubcke	CCD V-filter

The CCD times of minimum were determined using the computer program AVE (Barbera, 2000) based on the Kwee–Van Woerden (1956) method. These photometric times

of primary minima were fitted into a least squares solution to yield the preliminary light elements $\mathrm{HJD}_I = 2451793.6282(0) + 0^{\mathrm{d}}.39782832(10) \times E$. The archival minima gathered at Harvard have enabled us to more accurately refine the period of GSC 2084.0777. In most cases the photographic exposures were of 60 minutes duration and the time of mid-exposure is the date the variable was estimated to be at minimum light. The earliest primary minima have been excluded from our solution. The Harvard primary minima from 2442574 to 2447628 were assigned a weight of 1 and the CCD primary minima a weight of 10. Our analysis determined the following ephemeris:

$$\begin{array}{c} \text{Min. I} = \text{HJD } 2451793.6280 + 0^{\mathrm{d}}.39782863 \times E. \\ \pm 0.0006 \pm 0.00000010 \end{array}$$

The unfiltered CCD observations by Lubcke were folded using the elements above and the phased light curve is shown in Figure 1, and these data are available electronically as 5228-t3.txt through the *IBVS* Web site. The magnitudes shown are differential magnitudes with respect to the comparison star GSC 2084.1119.

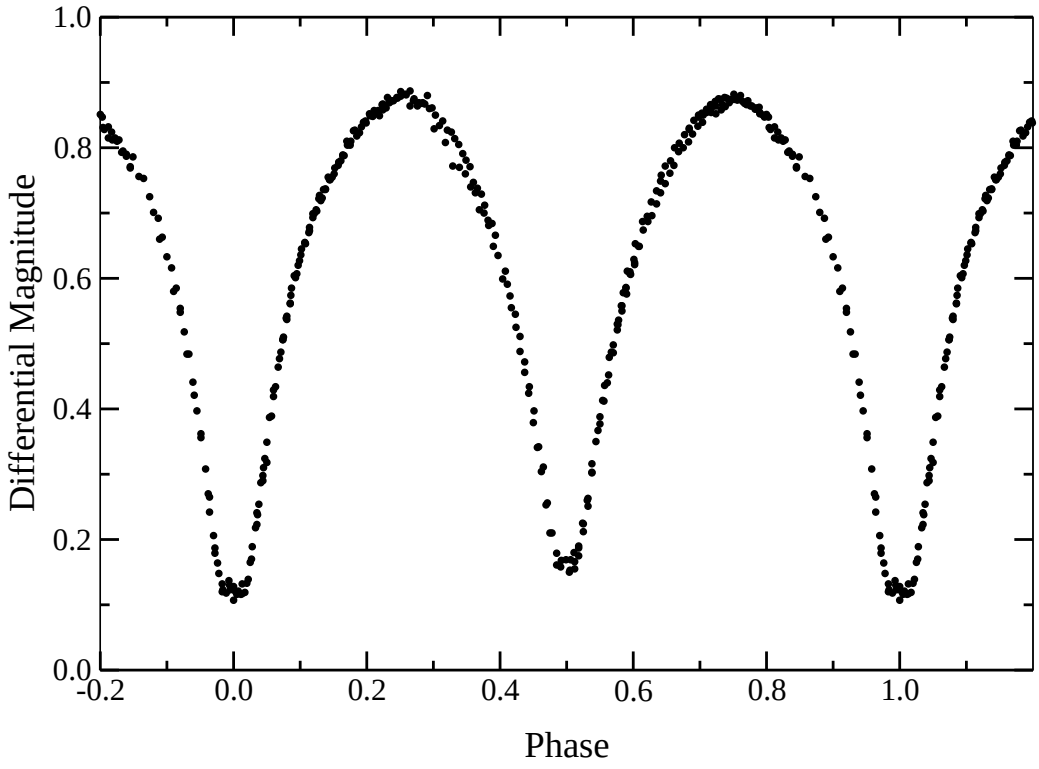

Figure 1. Differential phased light curve, GSC 2084.0777- unfiltered CCD - Lubcke.

The CCD light curve shows that the star is a W Ursae Majoris type (EW) eclipsing variable that is characterized by continuous light changes, with the primary and secondary minima being almost equal in depth.

The phase diagram of the folded Harvard photographic data is shown in Figure 2. These observations are available as 5228-t4.txt. Estimates were made by eye, and a sequence of steps was used to determine changes in brightness with respect to comparison stars GSC2084.0693 and GSC2084.1154.

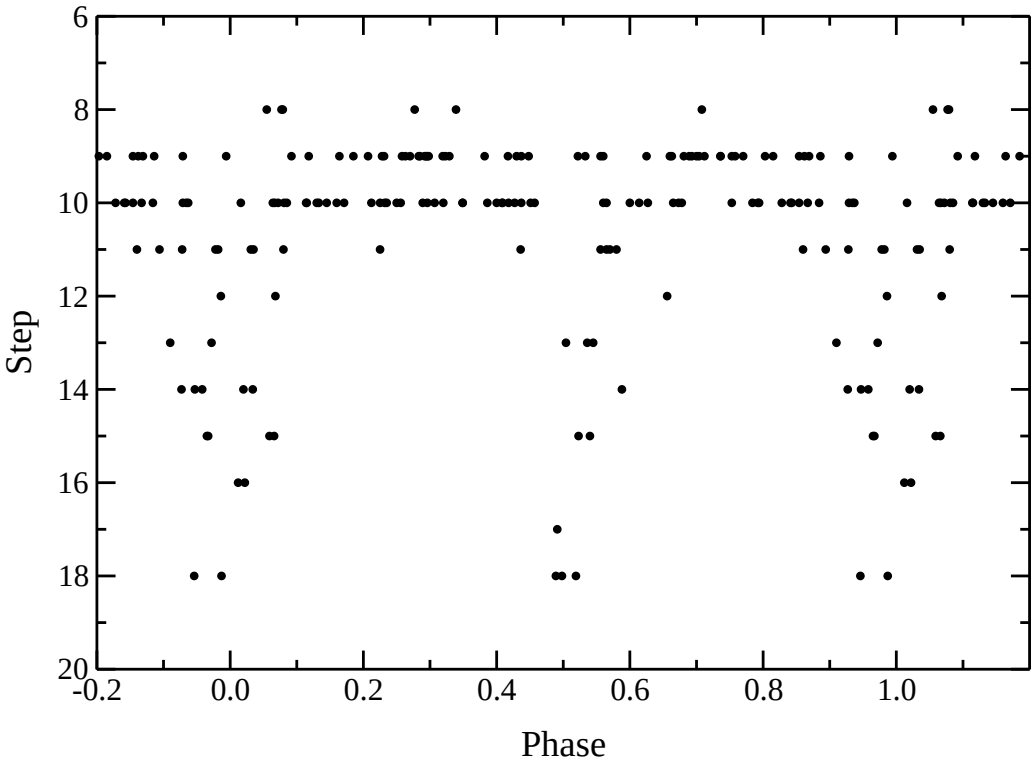

Figure 2. Phased Harvard light curve, GSC 2084.0777.

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