BVR_cI_c Study of the Short Period Solar Type, Near Contact Binary, NSVS 10083189

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Abstract The first precision BVR_cI_c light curves of NSVS 10083189 were taken on eight nights in 2015 at Dark Sky Observatory in North Carolina with the 0.81-m reflector of Appalachian State University and on one night on the SARA 1-m reflector at Kitt Peak National Observatory in remote mode. It is an ~F8V eclipsing binary with a short period of 0.4542238 (2) d. Seven times of minimum light were calculated. In addition, seven observations at minima were determined from archived NSVS Data. A statistically significant negative quadratic ephemeris was calculated. A light curve analysis with the Wilson-Devinney program led to a semidetached-near contact configuration (larger component filling its critical lobe and the secondary just under filing). This may indicate that NSVS 10083189 is near the end of its Detached to Contact Binary Channel. Our synthetic light curve solution gave a mass ratio of 0.58, with component temperatures of 6250 and 4573 K. A 15° radius cool spot with a T-factor of 0.85 was determined on the primary star. Thus, magnetic braking may be its main process acting in the orbital evolution. The fill-out of the secondary star has apparently reached ~99%.

1. Introduction

In this study, we continue our analysis of solar-type binaries in transition. Such transitions include the detached-to-contact binary channel and the contact-to-single star channel. The critical nature of these studies was recently highlighted by the phenomena of Red Novae, a violent event which appears to be the final coalescence a contact binary into fast rotating, blue straggler-like single star. The recovery of archived observations of a contact binary with high fill-out at the site of the red nova V1309 Sco (Tylenda *et al.* 2011; Tylenda and Kamiński 2016) has underlined the need for study of the characterization and continued patrol of such binaries in transition.

The detached-to-contact binary channel (Jiang *et al.* 2014) may be accomplished by several means, including evolutionary expansion of the components through ordinary core nuclear processes, interaction with a third component, or magnetic braking. Exponentially decaying orbital periods are easiest to explain by the magnetic braking process. In this paper, we find NSV 10083189 is a main sequence binary with its smoothly changing light curve and a large amplitude difference, possibly indicating that it is very near contact but still unattached. This binary appears to fall into the probable category of being near the end of the detached-to-contact binary channel. This makes the binary's observation and analysis important in the understanding of contact binary formation. Its study also fits our program of binaries in transition. We have undertaken a complete photometric investigation of this binary and present the results in this paper.

2. History and observations

NSVS 1083189 is listed in the All Sky Automated Survey (ASAS; Pojmański 2002). Light curve data are given at the SkyDOT NSVS website (Los Alamos Natl. Lab. 2017). The binary is in the constellation of Cancer. ASAS-3 categorizes it as a semi-detached eclipsing binary (ESD) type. VSX gives a V = 13.07 (0.72) magnitude and an ephemeris of

$$HJD = 2452623.12\ d + 0.454224 \times E \quad (1)$$

NSVS data from the SkyDOT catalog, object 10083189 (Los Alamos Natl. Lab. 2017), are plotted with Equation (1) and are given as Figure 1. This system was observed as a part of our student/professional collaborative studies of near-contact binaries at Emmanuel College using data taken from DSO and SARA observations. The observations were taken by Dr. Ron Samec, Dr. Daniel Caton, Danny Faulkner, and Robert Hill. Reduction and analyses were done by Dr. Samec and Amber Olsen.

Our 2012 light curves were taken with the Dark Sky Observatory 0.81-meter reflector at Philips Gap, North Carolina, on 21, 22, 23 February, 07, 08, 16 March, and 02 and 06 May 2013 with a thermoelectrically cooled (–40° C) 2KX2K Apogee Alta by D. Caton and R. Samec, and remotely, with the SARA

Table 1. Information on the stars used in this study.

Star	Name	R.A. (2000) h m s	Dec. (2000) ° ′ ″	V	J–K
V	NSVS 10083189 GSC 1388 0132 ASAS 080441+2124.3 UCAC3 3UC223-096945 UCAC4 558-044873	08 04 41.300	+21 24 20.06	13.15[1]	0.32[1]
C	3UC223-096984	08 05 00.1835	+21 24 29.370	14.25[2]	0.30[2]
K (Check)	3UC223-096989	08 04 17.8266	+21 21 34.359	14.36[2]	0.28[2]

[1] *2MASS (Skrutskie et al. 2006).* [2] *UCAC3 (Zacharias et al. 2012a).*

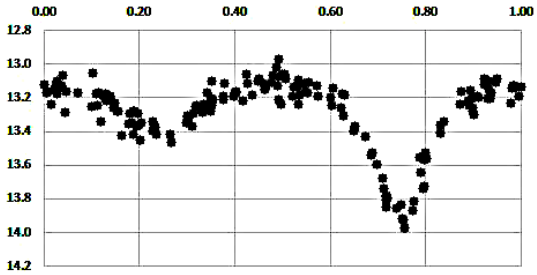

Figure 1. NSVS light curves phased with Equation 1.

North 0.91-meter reflector at KPNO, on 17 March 2015 by R. Samec with the ARC 2KX2K camera cooled to –110° C and both with standard BVR$_c$I$_c$ filters. Individual observations include 527 in B, 536 in V, 540 in R$_c$, and 544 in I$_c$. The probable error of a single observation was 7 mmag in B, 9 mmag in V and R$_c$, and 10 mmag in I$_c$. The nightly C–K values stayed constant throughout the observing interval within a precision of 1%. Exposure times varied from 100–200s in B, 40–60s in V, and 30–40s in R$_c$ and I$_c$. Nightly images were calibrated with twenty-five bias frames, at least five flat frames in each filter, and ten 300-second dark frames.

3. Stellar identifications and finding chart

The coordinates and magnitudes of the variable star, comparison star, and check star are given in Table 1.

The finding chart, given here for future observers, is shown as Figure 2. Figures 3a and 3b show sample observations of B, V, and B–V color curves on the night of 7 and 17 March 2015. Our observations are given in Table 2, in delta magnitudes, *ΔB, ΔV, ΔR$_c$* and *ΔI$_c$,* in the sense of variable minus comparison star.

4. Period study

Seven times of minimum light were calculated, five primary and two secondary eclipses, from our present observations in the form of Heliocentric Julian Day (HJD):

HJD I = 2457067.7545 ± 0.0003
2457088.64907 ± 0.00001
2457089.5571 ± 0.0001
2457098.6416 ± 0.0004
2457113.63117 ± 0.0002

HJD II = 2457066.6187 ± 0.0011
2457067.5233 ± 0.0017.

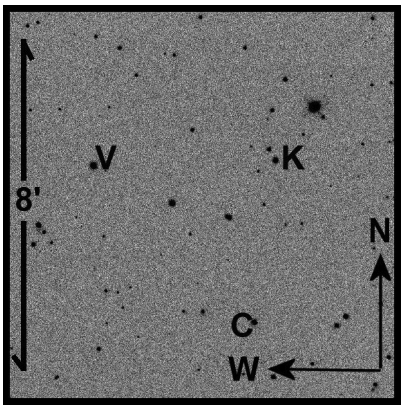

Figure 2. Finding chart of NSVS 10083189 (V), Comparison (C), and Check Stars (K).

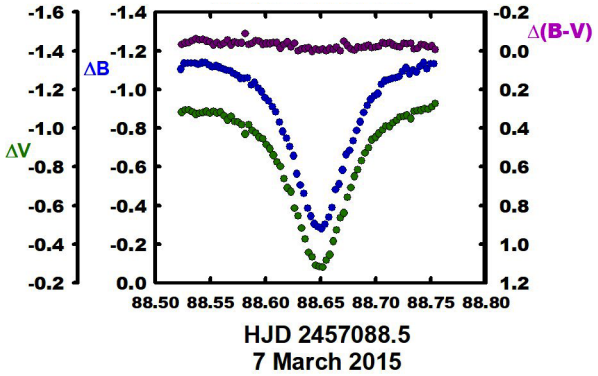

Figure 3 a. B,V and B-V color curves of NSVS 10083189 on the night of 7 March, 2015.

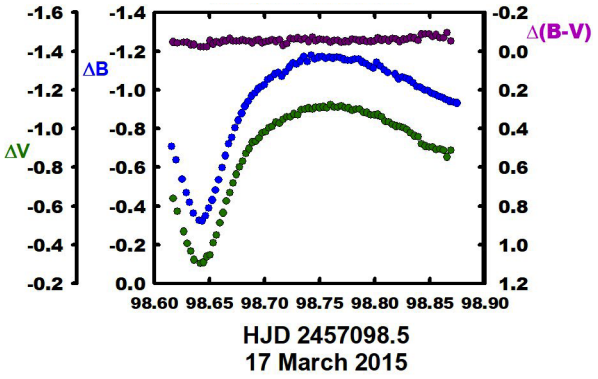

Figure 3 a, b. B,V and B-V color curves of NSVS 10083189 on the night of 17 March, 2015.

In addition, seven more times of low light (points chosen within ± 0.01 of phases 0.0 and 0.5) were taken from an earlier light curve phased from data (ASAS J080441+2124.3) from the all All Sky Automated Survey (Figure 1) were used to obtain these timings. Two additional minima are given by Diethelm (2011, 2012).

A linear ephemeris and quadratic ephemerides were determined from these data, respectively:

$$\text{HJD Min I} = 2457089.5588 + 0.45422383\,\text{d} \quad (2)$$
$$\pm 0.0023 \quad \pm 0.00000034 \times E$$

$$\text{HJD Min I} = 2457089.55665\,\text{d} + 0.45421797 \times E - 0.000000000486 \times E^2 \quad (3)$$
$$\pm 0.00080 \quad \pm 0.00000085 \quad \pm 0.000000000070$$

This period study covers a 15.4-year interval and shows a period that is apparently decreasing (at about the 7-sigma level). A plot of the residuals for Equation 2 is given as Figure 4. Also, a plot of the quadratic term overlying the linear residuals of Equation 3 is shown in Figure 5. O–C residuals, both linear and quadratic calculations, are given in Table 3. The quadratic ephemeris yields a $\dot{P} = -7.816 \times 10^{-7}$ d/yr, or a mass exchange rate of

$$\frac{dM}{dt} = \frac{\dot{P} M_1 M_2}{3P (M_1 - M_2)} = \frac{-9.98 \times 10^{-7} M_\odot}{d.} \quad (4)$$

in a conservative mass scenario.

From the archived records of Bob Nelson on the AAVSO website (Nelson 2016), a very early timing is listed, HJD = 2440273.8663. With this data point added to our study, a simple quadratic fit does not fit two recent timings very well (residuals 0.009 and 0.0065 d) for precision timings. The quadratic term including the new timing becomes $-1.10(8) \times 10^{-10}$. However, a cubic fit or a large amplitude sinusoidal ephemeris (with a 158.8-year period and an a sin(i) = 14.2 AU, $M_\odot$ sin(i) ≈ 0.11) does fit quite well. The cubic fit with its slightly smaller RMSE is shown in Figure 6. Both the quadratic and the cubic terms of this fit are negative. Further timings are needed to determine the orbital evolution of this binary.

Presently, there are not enough timings are available to distinguish between the cubic and quadratic fits.

5. Light curve characteristics

The phased B,V and R_c,I_c light curves folded using Equation (2) of NSVS 10083189, delta mag vs. phase, are shown in Figures 7a, and 7b, respectively. Light curve characteristics are tabulated by quadratures (averaged magnitudes about Phase 0.0, 0.25, 0.50, and 0.75) in Table 4. As noted in the table, averaged data about phase 0.0 (primary eclipse) are denoted as "Min I", phase 0.5 (secondary eclipse) as "Min II", phase 0.25 as "Max I", and phase 0.250.75 as "Max II". The curves are of good photometric precision, averaging 0.98% in B and 1.2% in V, 1.1% in R_c, and 1.3% in I_c. The amplitudes of the light curves vary from 0.86 to 0.74 magnitude in B to I_c. The O'Connell effect (|Max II–Max I|), a classic indicator of spot activity, averages several times the noise level, 0.02–0.04 magnitude. The differences in minima are large, 0.5–0.6 magnitude, indicating a noncontact binary, since thermal contact

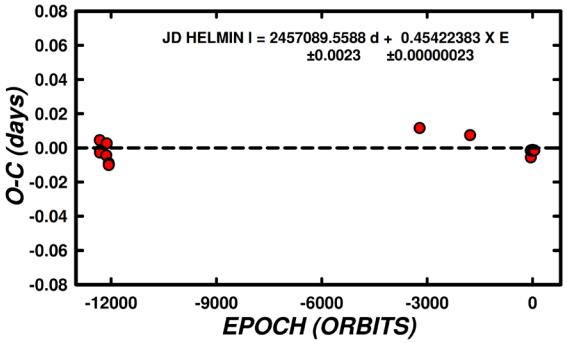

Figure 4. A plot of the linear residuals calculated from Equation 2.

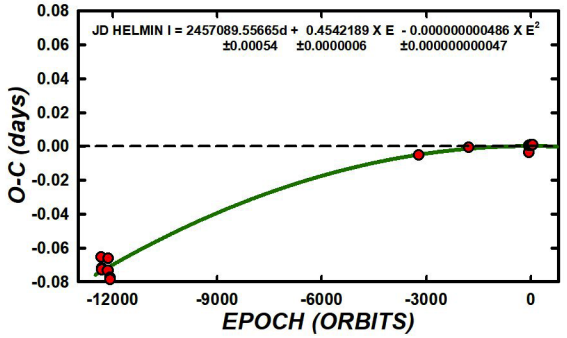

Figure 5. A plot of the quadratic term overlying the linear residuals of Equation 3.

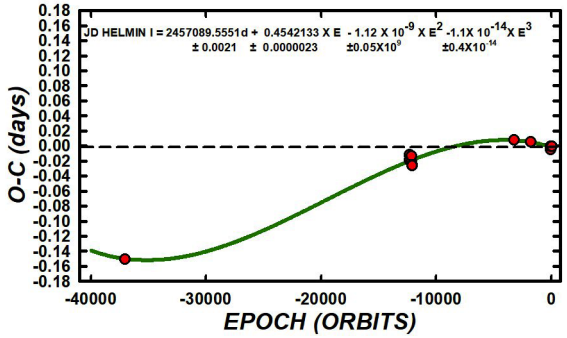

Figure 6. A cubic fit of the residuals shown in Figure 3 including the earliest minima.

is not attained (which means the depths of eclipse should be more similar). Some interesting trends are noted. The $(R–I)_c$ color curves dip at phase 0.0, which is characteristic of a contact binary, however, the rising color curves' rise at phase 0.5 may indicate that the secondary component is under-filling its Roche Lobe. Despite these apparent signs, synthetic light curve modeling is needed to disclose the characteristics of the binary.

6. Temperature and light curve solution

The 2MASS, J–K = 0.32 for the binary. This corresponds to an ~F8V eclipsing binary which yields a temperature of 6250 K. Fast rotating binary stars of this type are noted for having convective atmospheres, so spots are expected.

The B, V, R_c, and I_c curves were pre-modeled with BINARY MAKER 3.0 (Bradstreet and Steelman 2002) and program fits were determined in all filter bands. The result of the best fit was that of a shallow contact binary (fill-out 1%). The parameters were then averaged and input into a four-color simultaneous light curve calculation using the Wilson-Devinney Program (WD;

Wilson and Devinney 1971; Wilson 1990; Wilson 1994; Van Hamme and Wilson 1998). Convective parameters, g = 0.32, A = 0.5 were used. The initial iterations were computed in contact mode (Mode 3). After about ten iterations the potentials went slightly under contact and persisted in that state. We then switched to Mode 2, which has no constraints on the Roche Lobe configuration. The primary component then iterated into fill-outs of 0–1% with the secondary component under-filling (<0.0%). This also persisted. This indicates that the binary was in a semidetached mode computed in Mode 4 (primary filling its critical lobe and the secondary component under-filling its Roche Lobe). The computation converged in that configuration.

The eclipses were not total, so a number of solutions were generated with fixed mass ratios (q). The sum of square residuals was tabulated with each q-value. Solutions were obtained with q-values from 0.38 to 0.8, where the minimization clearly occurred between 0.5 and 0.6. Allowing the q value to adjust along with the other iterated values from our best solution, the residuals minimized at q ~ 0.58. The residual vs. mass ratio plot is given as Figure 8. A single spot was iterated along with the other parameters. A cool spot resulted. In running the WD program, when the absolute values of all of the corrections became less than their associated uncertainties, i.e. convergence was achieved, which is the solution. A geometrical (Roche-lobe) representation of the system is given in Figures 9a, b, c, d at light curve quadratures so that the reader may see the placement of the spot and the relative size of the stars as compared to the orbit. As seen, the system is semi-detached and very near contact, within 0.1% potential-wise. The normalized curves overlain by our light curve solutions are shown as Figures 10a and 10b. The light curve solution parameters are given in Table 5.

7. Discussion

Due to its temperature, configuration, and evolution, NSVS 10083189 is a *precontact* W UMa binary (i.e., a W UMa progenitor) in a V1010 Oph (primary, more massive component is filling its critical Roche Lobe and the secondary is underfilling) configuration (Samec *et al.* 2016). This binary system can result when a binary is coming into contact for the first time. Considering this and its decreasing (and perhaps accelerating decreasing) orbital period, it is near the end of the detached to contact channel (Jiang *et al.* 2014, here after, JHL). JHL found that the ratio of the birth rate of the progenitors of contact binaries to that of contact binaries is greater than about 1.2. This suggests that for the detached-binary channel, the progenitors are sufficient in number to produce the observed contact binaries. NSVS 10083189 is evidently an example of this process taking place. Its spectral type indicates a surface temperature of 6250 K for the primary component. The secondary component has a temperature of ~4570 K (K4V), which means that it is near the values expected for single main sequence stars. The mass ratio is 0.6, with an amplitude of 0.9–0.7 magnitude in B to I, respectively. The fill-out of the secondary component is 99% by potential, which means it is very near critical contact. The inclination is 79°, which allows only 3% of the light of the system to be contributed by the secondary component at phase 0.5.

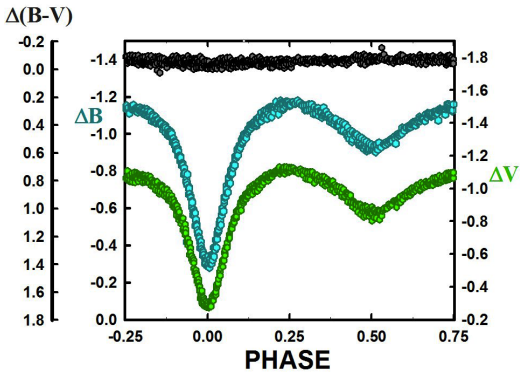

Figure 7a. B,V Δ mag. of NSVS 10083189 phased with Equation 2.

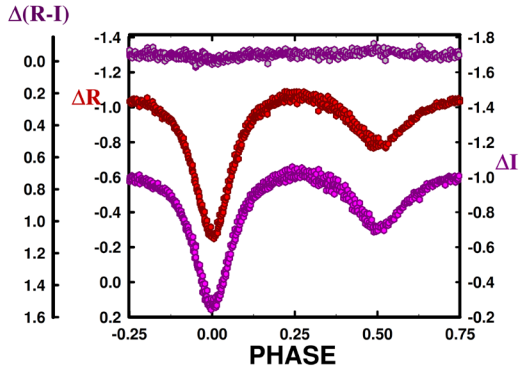

Figure 7b. R,I Δ mag. of NSVS 10083189 phased with Equation 2.

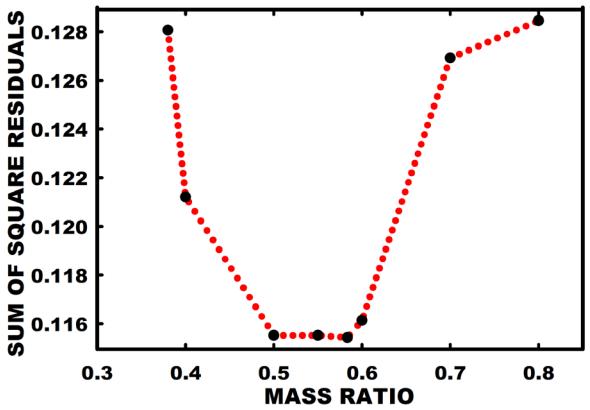

Figure 8. Q-search: plot of mass ratios verses the sum of square residual for each solution.

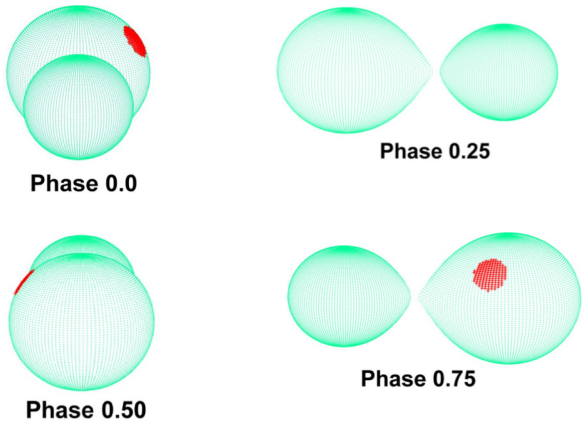

Figure 9. Geometrical representation of the surface of the binary at phases, 0.0, 0.25, 0,50, and 0.75 for NSVS 10083189.

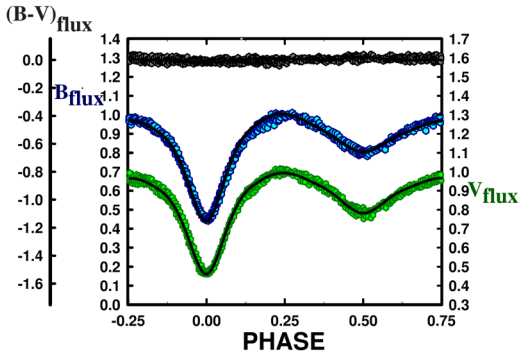

Figure 10a. B,V Normalized Fluxes overlaid by our solution of NSVS 10083189.

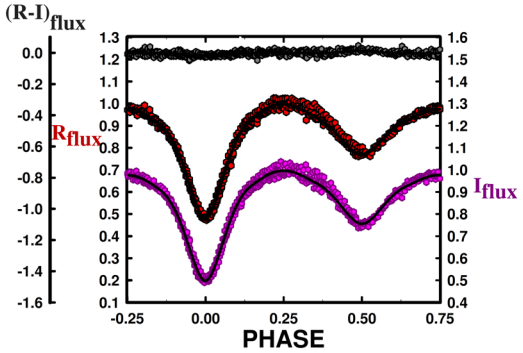

Figure 10b. R_c,I_c Normalized Fluxes overlaid by our solution of NSVS 10083189.

The primary component has an iterated cool spot region of ~15° with a mean T-factor of ~0.86 (T~5360 K). This spot fits the small observed asymmetries in the light curves.

8. Conclusions

The period study of this apparent pre-contact W UMa binary has a ~15-year time duration. The period is found to be decreasing at about the 7 sigma level. This calculated decrease is not unusual for a solar type binary undergoing magnetic braking. The presence of a cool magnetic spot supports this scenario. If this is the case, the system should soon become a contact (W UMa) binary and eventually coalesce over time as it loses angular momentum (AML) due to ionized winds moving radially outward on stiff magnetic field lines rotating with the binary (out to the Alfvén radius). We note that AML due to gravitational radiation also plays a role at this stage. One would expect, eventually, that the binary will coalesce into a rather normal, fast rotating, single A5V type field star after a red novae coalescence event (Tylenda and Kamiński 2016). FK Comae Berenices stars are believed to be a result of such a coalescence event. Finally, radial velocity curves are needed to obtain absolute (not relative) system parameters.

9. Acknowledgements

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Table 2. CW Scl observations ΔB, ΔV, ΔR, and ΔI, variable minus comparison star (Epoch 2400000+).

Δ*B*	*HJD* 2457000+	Δ*B*	*HJD* 2457000+	Δ*B*	*HJD* 2457000+	Δ*B*	*HJD* 2457000+	Δ*B*	*HJD* 2457000+
–1.129	66.5259	–0.933	67.5262	–1.125	88.5485	–0.884	89.5159	–1.079	89.7288
–1.127	66.5290	–0.932	67.5302	–1.116	88.5517	–0.872	89.5191	–1.072	89.7320
–1.129	66.5322	–0.942	67.5334	–1.121	88.5549	–0.830	89.5223	–1.044	89.7352
–1.107	66.5382	–0.937	67.5366	–1.114	88.5581	–0.788	89.5255	–1.047	89.7383
–1.109	66.5414	–1.128	67.6606	–1.105	88.5613	–0.725	89.5286	–1.021	89.7415
–1.099	66.5447	–1.120	67.6638	–1.099	88.5645	–0.676	89.5318	–1.018	89.7447
–1.088	66.5493	–1.125	67.6670	–1.096	88.5677	–0.606	89.5350	–1.004	89.7479
–1.106	66.5525	–1.122	67.6714	–1.083	88.5708	–0.565	89.5382	–0.984	89.7510
–1.093	66.5557	–1.103	67.6746	–1.072	88.5741	–0.508	89.5413	–0.999	89.7542
–1.067	66.5601	–1.104	67.6778	–1.058	88.5773	–0.446	89.5445	–0.971	89.7574
–1.063	66.5633	–1.091	67.6823	–1.056	88.5804	–0.396	89.5477	–0.990	89.7606
–1.052	66.5665	–1.074	67.6855	–1.060	88.5836	–0.299	89.5540	–0.958	89.7637
–1.048	66.5726	–1.065	67.6887	–1.023	88.5868	–0.294	89.5572	–0.954	89.7669
–1.017	66.5759	–1.044	67.6954	–1.034	88.5900	–0.300	89.5604	–0.941	89.7701
–1.028	66.5791	–1.025	67.6986	–1.007	88.5932	–0.339	89.5636	–0.940	89.7733
–0.993	66.5844	–1.016	67.7018	–0.988	88.5964	–0.376	89.5667	–0.948	89.7765
–0.973	66.5876	–0.976	67.7062	–0.956	88.5996	–0.433	89.5699	–0.912	89.7796
–0.958	66.5908	–0.952	67.7094	–0.939	88.6028	–0.500	89.5731	–0.920	89.7828
–0.986	66.5952	–0.920	67.7126	–0.911	88.6060	–0.563	89.5763	–0.921	89.7860
–0.957	66.5984	–0.816	67.7215	–0.883	88.6092	–0.630	89.5795	–0.915	89.7891
–0.938	66.6016	–0.762	67.7248	–0.830	88.6124	–0.684	89.5826	–0.916	89.7923
–0.931	66.6065	–0.712	67.7280	–0.782	88.6156	–0.733	89.5858	–0.952	97.5158
–0.931	66.6097	–0.631	67.7326	–0.747	88.6188	–0.785	89.5890	–0.928	97.5188
–0.916	66.6129	–0.577	67.7358	–0.705	88.6220	–0.818	89.5922	–0.946	97.5218
–0.914	66.6205	–0.504	67.7391	–0.656	88.6252	–0.871	89.5953	–0.942	97.5247
–0.902	66.6237	–0.419	67.7437	–0.563	88.6283	–0.885	89.5985	–0.951	97.5279
–0.956	66.6388	–0.370	67.7469	–0.506	88.6315	–0.934	89.6017	–0.968	97.5311
–0.961	66.6421	–0.331	67.7501	–0.463	88.6348	–0.957	89.6049	–0.961	97.5343
–0.968	66.6453	–0.323	67.7573	–0.386	88.6380	–0.996	89.6081	–0.975	97.5375
–0.985	66.6495	–0.347	67.7606	–0.344	88.6412	–1.007	89.6112	–0.985	97.5407
–0.994	66.6527	–0.388	67.7638	–0.304	88.6443	–1.030	89.6144	–0.995	97.5439
–0.993	66.6559	–0.474	67.7683	–0.289	88.6475	–1.034	89.6176	–1.012	97.5471
–1.002	66.6600	–0.533	67.7715	–0.281	88.6507	–1.048	89.6208	–1.024	97.5503
–1.028	66.6633	–0.600	67.7747	–0.302	88.6539	–1.044	89.6240	–1.036	97.5535
–1.034	66.6665	–0.777	67.7854	–0.339	88.6571	–1.082	89.6271	–1.042	97.5567
–1.038	66.6705	–0.820	67.7886	–0.388	88.6603	–1.113	89.6303	–1.052	97.5599
–1.054	66.6737	–0.868	67.7918	–0.483	88.6635	–1.088	89.6335	–1.057	97.5631
–1.061	66.6769	–0.934	67.7976	–0.510	88.6667	–1.102	89.6367	–1.047	97.5663
–1.062	66.6811	–0.967	67.8008	–0.583	88.6699	–1.107	89.6399	–1.071	97.5695
–1.079	66.6843	–0.998	67.8040	–0.663	88.6731	–1.144	89.6430	–1.069	97.5728
–1.079	66.6875	–1.027	67.8098	–0.685	88.6762	–1.128	89.6462	–1.078	97.5760
–1.088	66.6945	–1.048	67.8130	–0.734	88.6794	–1.142	89.6494	–1.069	97.5791
–1.100	66.6977	–1.059	67.8162	–0.787	88.6826	–1.136	89.6526	–1.092	97.5823
–1.095	66.7010	–1.066	67.8222	–0.832	88.6858	–1.160	89.6557	–1.106	97.5855
–1.101	66.7059	–1.090	67.8254	–0.879	88.6890	–1.169	89.6589	–1.103	97.5887
–1.112	66.7091	–1.115	67.8287	–0.916	88.6922	–1.139	89.6621	–1.109	97.5919
–1.134	66.7124	–1.124	67.8320	–0.948	88.6954	–1.173	89.6652	–1.123	97.5951
–1.129	66.7196	–1.125	67.8352	–0.966	88.6986	–1.170	89.6684	–1.127	97.5983
–1.159	66.7228	–1.137	67.8384	–0.978	88.7018	–1.157	89.6716	–1.127	97.6015
–1.134	66.7258	–1.143	67.8416	–1.025	88.7049	–1.171	89.6748	–1.128	97.6047
–1.123	66.7298	–1.134	67.8448	–1.044	88.7081	–1.162	89.6780	–1.134	97.6079
–1.150	66.7331	–1.153	67.8480	–1.049	88.7113	–1.180	89.6811	–1.140	97.6111
–1.142	66.7363	–1.150	67.8513	–1.056	88.7145	–1.167	89.6843	–1.150	97.6143
–1.139	66.7406	–1.153	67.8545	–1.059	88.7177	–1.152	89.6875	–1.128	97.6174
–1.132	66.7438	–1.167	67.8577	–1.067	88.7209	–1.150	89.6907	–1.152	97.6207
–1.123	66.7470	–1.153	67.8610	–1.093	88.7241	–1.136	89.6938	–1.135	97.6270
–1.127	66.7513	–1.172	67.8642	–1.111	88.7273	–1.150	89.6970	–1.146	97.6302
–1.134	66.7545	–1.151	67.8674	–1.081	88.7305	–1.134	89.7002	–1.138	97.6334
–1.128	66.7577	–1.104	88.5229	–1.097	88.7337	–1.129	89.7034	–1.134	97.6366
–1.132	66.7618	–1.134	88.5261	–1.091	88.7369	–1.120	89.7066	–1.127	97.6398
–1.069	66.7683	–1.136	88.5293	–1.118	88.7401	–1.138	89.7097	–1.122	97.6430
–0.947	67.5092	–1.135	88.5325	–1.137	88.7433	–1.121	89.7129	–1.109	97.6462
–0.934	67.5124	–1.136	88.5357	–1.106	88.7464	–1.099	89.7161	–1.112	97.6494
–0.921	67.5156	–1.129	88.5389	–1.133	88.7496	–1.112	89.7193	–1.096	97.6526
–0.909	67.5198	–1.137	88.5421	–1.132	88.7528	–1.102	89.7225	–1.090	97.6558
–0.918	67.5230	–1.140	88.5453	–0.930	89.5127	–1.087	89.7256	–1.075	97.6590

Table continued on following pages

Table 2. CW Scl observations ΔB, ΔV, ΔR, and ΔI, variable minus comparison star (Epoch 2400000+), cont.

Δ*B*	*HJD 2457000+*	Δ*B*	*HJD 2457000+*	Δ*B*	*HJD 2457000+*	Δ*B*	*HJD 2457000+*	Δ*B*	*HJD 2457000+*
–1.061	97.6622	–1.081	98.7090	–1.012	98.8413	–0.870	113.6695	–1.134	117.6072
–1.053	97.6686	–1.090	98.7123	–1.000	98.8447	–0.924	113.6727	–1.110	117.6102
–1.035	97.6718	–1.070	98.7156	–0.995	98.8479	–0.926	113.6759	–1.149	117.6131
–1.007	97.6749	–1.092	98.7189	–0.983	98.8512	–0.981	113.6791	–1.155	117.6161
–0.999	97.6782	–1.117	98.7223	–0.977	98.8545	–0.983	113.6823	–1.128	117.6190
–0.996	97.6814	–1.140	98.7256	–0.967	98.8579	–1.004	113.6855	–1.137	117.6220
–0.965	97.6846	–1.133	98.7289	–0.959	98.8612	–1.027	113.6887	–1.141	117.6249
–0.957	97.6878	–1.147	98.7322	–0.949	98.8644	–1.051	113.6919	–1.121	117.6279
–0.914	97.6910	–1.172	98.7355	–0.942	98.8678	–1.054	113.6951	–1.134	117.6308
–0.880	97.6942	–1.145	98.7388	–0.937	98.8711	–1.054	113.6983	–1.105	117.6337
–0.843	97.6973	–1.178	98.7421	–0.932	98.8744	–1.088	113.7015	–1.106	117.6367
–0.792	97.7005	–1.159	98.7454	–1.046	113.5735	–1.080	113.7047	–1.119	117.6396
–0.707	98.6157	–1.167	98.7487	–0.995	113.5767	–0.948	117.5247	–1.093	117.6426
–0.639	98.6196	–1.173	98.7520	–1.011	113.5799	–0.999	117.5276	–1.074	117.6455
–0.538	98.6251	–1.162	98.7553	–0.975	113.5831	–1.005	117.5306	–1.077	117.6485
–0.469	98.6287	–1.170	98.7587	–0.915	113.5863	–1.033	117.5335	–1.057	117.6514
–0.420	98.6319	–1.164	98.7620	–0.918	113.5895	–1.018	117.5365	–1.054	117.6544
–0.362	98.6351	–1.168	98.7653	–0.877	113.5927	–1.031	117.5394	–1.040	117.6573
–0.325	98.6405	–1.165	98.7686	–0.828	113.5959	–1.031	117.5424	–1.016	117.6602
–0.324	98.6435	–1.157	98.7719	–0.790	113.5991	–1.037	117.5453	–0.992	117.6632
–0.349	98.6465	–1.153	98.7752	–0.782	113.6023	–1.062	117.5482	–0.986	117.6661
–0.388	98.6494	–1.153	98.7785	–0.676	113.6055	–1.058	117.5512	–1.001	117.6690
–0.430	98.6524	–1.159	98.7818	–0.623	113.6087	–1.072	117.5541	–0.957	117.6720
–0.482	98.6554	–1.159	98.7851	–0.581	113.6119	–1.091	117.5571	–0.938	117.6749
–0.535	98.6583	–1.144	98.7884	–0.513	113.6151	–1.087	117.5600	–0.906	117.6779
–0.599	98.6613	–1.135	98.7917	–0.469	113.6183	–1.080	117.5630	–0.854	117.6808
–0.659	98.6643	–1.122	98.7950	–0.392	113.6215	–1.103	117.5659	–0.840	117.6838
–0.720	98.6672	–1.114	98.7984	–0.334	113.6279	–1.111	117.5689	–0.792	117.6867
–0.755	98.6702	–1.113	98.7984	–0.339	113.6311	–1.110	117.5718	–0.739	117.6897
–0.803	98.6732	–1.142	98.8017	–0.308	113.6343	–1.111	117.5748	–0.674	117.6926
–0.878	98.6791	–1.122	98.8050	–0.321	113.6375	–1.118	117.5777	–0.662	117.6955
–0.915	98.6821	–1.102	98.8083	–0.375	113.6407	–1.110	117.5807	–0.593	117.6985
–0.939	98.6850	–1.089	98.8116	–0.465	113.6439	–1.073	117.5836	–0.574	117.7014
–0.968	98.6880	–1.081	98.8182	–0.520	113.6471	–1.129	117.5866	–0.481	117.7043
–0.983	98.6909	–1.058	98.8215	–0.582	113.6503	–1.129	117.5895	–0.438	117.7073
–1.004	98.6939	–1.066	98.8248	–0.643	113.6535	–1.134	117.5925	–0.380	117.7102
–1.016	98.6969	–1.059	98.8281	–0.701	113.6567	–1.143	117.5954	–0.349	117.7132
–1.025	98.6999	–1.051	98.8314	–0.764	113.6599	–1.158	117.5984		
–1.052	98.7028	–1.035	98.8347	–0.807	113.6631	–1.140	117.6013		
–1.063	98.7058	–1.015	98.8380	–0.835	113.6663	–1.159	117.6043		

Δ*V*	*HJD 2457000+*	Δ*v*	*HJD 2457000+*	Δ*V*	*HJD 2457000+*	Δ*V*	*HJD 2457000+*	Δ*V*	*HJD 2457000+*
–1.060	66.5269	–1.060	66.6108	–1.060	66.6886	–1.060	67.5178	–0.752	67.7237
–1.060	66.5301	–1.060	66.6140	–1.060	66.6956	–1.060	67.5219	–0.693	67.7269
–1.060	66.5333	–1.060	66.6184	–1.060	66.6988	–1.060	67.5251	–0.636	67.7301
–1.060	66.5393	–1.060	66.6216	–1.060	66.7020	–1.060	67.5283	–0.561	67.7348
–1.060	66.5425	–1.060	66.6248	–1.060	66.7070	–1.060	67.5323	–0.502	67.7380
–1.060	66.5457	–1.060	66.6290	–1.060	66.7102	–1.060	67.5355	–0.445	67.7412
–1.060	66.5503	–1.060	66.6320	–1.060	66.7134	–1.060	67.5387	–0.377	67.7459
–1.060	66.5536	–1.060	66.6350	–1.060	66.7206	–1.060	67.6627	–0.320	67.7491
–1.060	66.5568	–1.060	66.6399	–1.060	66.7238	–1.060	67.6660	–0.310	67.7523
–1.060	66.5612	–1.060	66.6431	–1.060	66.7268	–1.060	67.6692	–0.320	67.7595
–1.060	66.5644	–1.060	66.6463	–1.060	66.7309	–1.060	67.6736	–0.354	67.7627
–1.060	66.5676	–1.060	66.6505	–1.060	66.7341	–1.060	67.6768	–0.396	67.7659
–1.060	66.5737	–1.060	66.6538	–1.060	66.7373	–1.060	67.6800	–0.491	67.7704
–1.060	66.5769	–1.060	66.6570	–1.060	66.7416	–1.060	67.6844	–0.533	67.7737
–1.060	66.5801	–1.060	66.6611	–1.060	66.7449	–1.060	67.6876	–0.610	67.7769
–1.060	66.5854	–1.060	66.6643	–1.060	66.7481	–1.060	67.6908	–0.783	67.7875
–1.060	66.5887	–1.060	66.6675	–1.060	66.7523	–1.060	67.6975	–0.820	67.7908
–1.060	66.5919	–1.060	66.6715	–1.060	66.7555	–1.060	67.7007	–0.862	67.7940
–1.060	66.5962	–1.060	66.6748	–1.060	66.7588	–1.060	67.7039	–0.916	67.7998
–1.060	66.5995	–1.060	66.6780	–1.060	66.7629	–1.060	67.7083	–0.944	67.8030
–1.060	66.6027	–1.060	66.6821	–1.060	67.5114	–0.894	67.7115	–0.966	67.8062
–1.060	66.6075	–1.060	66.6854	–1.060	67.5146	–0.857	67.7148	–1.007	67.8120

Table continued on following pages

Table 2. CW Scl observations ΔB, ΔV, ΔR, and ΔI, variable minus comparison star (Epoch 2400000+), cont.

ΔV	HJD 2457000+	ΔV	HJD 2457000+	ΔV	HJD 2457000+	ΔV	HJD 2457000+	ΔV	HJD 2457000+
–1.016	67.8152	–0.750	88.6805	–1.089	89.6473	–1.030	97.5770	–0.984	98.7008
–1.024	67.8184	–0.785	88.6837	–1.096	89.6504	–1.041	97.5802	–1.003	98.7038
–1.044	67.8244	–0.832	88.6869	–1.103	89.6536	–1.035	97.5834	–1.010	98.7067
–1.053	67.8276	–0.871	88.6901	–1.092	89.6568	–1.045	97.5866	–1.034	98.7101
–1.064	67.8308	–0.897	88.6932	–1.110	89.6599	–1.061	97.5898	–1.026	98.7134
–1.080	67.8341	–0.939	88.6964	–1.090	89.6631	–1.066	97.5930	–1.047	98.7167
–1.086	67.8373	–0.952	88.6996	–1.104	89.6663	–1.063	97.5962	–1.061	98.7200
–1.095	67.8405	–0.972	88.7028	–1.099	89.6695	–1.079	97.5994	–1.059	98.7233
–1.096	67.8438	–0.990	88.7060	–1.125	89.6727	–1.070	97.6026	–1.075	98.7266
–1.105	67.8470	–1.011	88.7092	–1.107	89.6758	–1.079	97.6057	–1.071	98.7299
–1.113	67.8502	–1.009	88.7124	–1.112	89.6790	–1.091	97.6089	–1.097	98.7332
–1.129	67.8534	–1.027	88.7156	–1.093	89.6822	–1.081	97.6121	–1.099	98.7366
–1.122	67.8566	–1.040	88.7188	–1.102	89.6854	–1.090	97.6153	–1.105	98.7399
–1.131	67.8598	–1.058	88.7220	–1.085	89.6885	–1.097	97.6185	–1.101	98.7432
–1.130	67.8631	–1.060	88.7252	–1.105	89.6917	–1.108	97.6217	–1.109	98.7465
–1.126	67.8663	–1.065	88.7284	–1.102	89.6949	–1.081	97.6249	–1.108	98.7498
–1.127	67.8695	–1.049	88.7316	–1.086	89.6981	–1.090	97.6281	–1.112	98.7531
–1.082	88.5239	–1.086	88.7347	–1.083	89.7013	–1.098	97.6313	–1.106	98.7564
–1.094	88.5271	–1.089	88.7379	–1.074	89.7044	–1.093	97.6345	–1.124	98.7597
–1.094	88.5303	–1.092	88.7411	–1.062	89.7076	–1.079	97.6377	–1.110	98.7630
–1.083	88.5335	–1.099	88.7443	–1.068	89.7108	–1.080	97.6409	–1.111	98.7663
–1.072	88.5367	–1.096	88.7475	–1.048	89.7140	–1.079	97.6441	–1.117	98.7696
–1.077	88.5399	–1.109	88.7507	–1.060	89.7171	–1.062	97.6472	–1.106	98.7729
–1.080	88.5431	–1.126	88.7539	–1.038	89.7203	–1.078	97.6504	–1.105	98.7762
–1.085	88.5463	–0.867	89.5138	–1.041	89.7235	–1.071	97.6536	–1.093	98.7795
–1.076	88.5495	–0.835	89.5170	–1.040	89.7267	–1.038	97.6568	–1.101	98.7828
–1.087	88.5527	–0.812	89.5202	–1.044	89.7299	–1.039	97.6600	–1.101	98.7861
–1.077	88.5559	–0.762	89.5233	–1.021	89.7330	–1.040	97.6632	–1.084	98.7895
–1.082	88.5591	–0.729	89.5265	–0.987	89.7362	–1.021	97.6664	–1.082	98.7928
–1.064	88.5623	–0.671	89.5297	–0.985	89.7394	–1.008	97.6696	–1.069	98.7961
–1.042	88.5655	–0.612	89.5329	–0.977	89.7426	–0.997	97.6728	–1.071	98.7994
–1.061	88.5687	–0.563	89.5360	–0.955	89.7458	–0.995	97.6760	–1.068	98.8027
–1.034	88.5719	–0.497	89.5392	–0.966	89.7489	–0.975	97.6792	–1.071	98.7994
–1.030	88.5751	–0.440	89.5424	–0.948	89.7521	–0.936	97.6824	–1.072	98.8027
–1.017	88.5783	–0.376	89.5456	–0.919	89.7553	–0.934	97.6856	–1.059	98.8060
–0.969	88.5815	–0.331	89.5487	–0.912	89.7584	–0.899	97.6888	–1.037	98.8093
–1.017	88.5847	–0.309	89.5519	–0.902	89.7616	–0.875	97.6920	–1.034	98.8126
–0.987	88.5879	–0.278	89.5551	–0.892	89.7648	–0.821	97.6952	–1.020	98.8159
–0.973	88.5911	–0.274	89.5583	–0.893	89.7680	–0.819	97.6984	–1.012	98.8193
–0.952	88.5943	–0.290	89.5614	–0.860	89.7711	–0.782	97.7016	–1.010	98.8226
–0.944	88.5975	–0.319	89.5646	–0.852	89.7743	–0.638	98.6170	–1.004	98.8259
–0.914	88.6007	–0.352	89.5678	–0.868	89.7775	–0.573	98.6209	–0.994	98.8292
–0.893	88.6038	–0.415	89.5710	–0.862	89.7807	–0.468	98.6264	–0.976	98.8325
–0.859	88.6070	–0.493	89.5742	–0.850	89.7839	–0.407	98.6298	–0.962	98.8358
–0.825	88.6102	–0.557	89.5773	–0.855	89.7870	–0.367	98.6330	–0.958	98.8391
–0.801	88.6134	–0.601	89.5805	–0.858	89.7902	–0.322	98.6360	–0.922	98.8424
–0.739	88.6166	–0.657	89.5837	–0.856	89.7934	–0.303	98.6415	–0.909	98.8457
–0.690	88.6198	–0.710	89.5869	–0.854	97.5169	–0.309	98.6444	–0.904	98.8490
–0.670	88.6230	–0.760	89.5900	–0.862	97.5198	–0.339	98.6474	–0.905	98.8523
–0.587	88.6262	–0.798	89.5932	–0.880	97.5228	–0.348	98.6504	–0.891	98.8556
–0.546	88.6294	–0.822	89.5964	–0.882	97.5258	–0.409	98.6533	–0.895	98.8589
–0.483	88.6326	–0.861	89.5996	–0.902	97.5290	–0.450	98.6563	–0.887	98.8622
–0.427	88.6358	–0.895	89.6028	–0.902	97.5322	–0.513	98.6593	–0.853	98.8655
–0.357	88.6390	–0.912	89.6059	–0.923	97.5354	–0.564	98.6622	–0.888	98.8688
–0.334	88.6422	–0.950	89.6091	–0.926	97.5386	–0.626	98.6652	–0.867	98.8721
–0.291	88.6454	–0.952	89.6123	–0.932	97.5418	–0.668	98.6682	–0.944	113.5745
–0.284	88.6486	–0.977	89.6155	–0.948	97.5450	–0.719	98.6711	–0.933	113.5778
–0.280	88.6518	–0.999	89.6186	–0.959	97.5482	–0.763	98.6741	–0.932	113.5810
–0.316	88.6550	–0.999	89.6218	–0.959	97.5514	–0.802	98.6770	–0.887	113.5842
–0.345	88.6582	–1.023	89.6250	–0.979	97.5546	–0.831	98.6800	–0.863	113.5874
–0.415	88.6614	–1.021	89.6282	–0.990	97.5578	–0.870	98.6830	–0.822	113.5906
–0.472	88.6645	–1.036	89.6314	–1.003	97.5610	–0.896	98.6860	–0.787	113.5938
–0.535	88.6677	–1.038	89.6346	–1.002	97.5642	–0.929	98.6889	–0.755	113.5970
–0.561	88.6709	–1.060	89.6377	–1.017	97.5674	–0.935	98.6919	–0.726	113.6002
–0.643	88.6741	–1.066	89.6409	–1.023	97.5706	–0.951	98.6948	–0.655	113.6034
–0.693	88.6773	–1.073	89.6441	–1.036	97.5738	–0.976	98.6978	–0.607	113.6066

Table continued on following pages

Table 2. CW Scl observations ΔB, ΔV, ΔR, and ΔI, variable minus comparison star (Epoch 2400000+), cont.

ΔV	HJD 2457000+	ΔV	HJD 2457000+	ΔV	HJD 2457000+	ΔV	HJD 2457000+	ΔV	HJD 2457000+
–0.556	113.6098	–0.861	113.6738	–0.987	117.5522	–1.050	117.6112	–0.897	117.6701
–0.489	113.6130	–0.868	113.6770	–0.998	117.5551	–1.056	117.6141	–0.889	117.6730
–0.434	113.6162	–0.927	113.6802	–0.989	117.5581	–1.060	117.6171	–0.836	117.6759
–0.399	113.6194	–0.935	113.6834	–1.011	117.5610	–1.062	117.6200	–0.812	117.6789
–0.308	113.6226	–0.955	113.6866	–1.009	117.5640	–1.043	117.6230	–0.819	117.6818
–0.301	113.6258	–0.985	113.6898	–1.015	117.5669	–1.057	117.6259	–0.748	117.6848
–0.277	113.6290	–0.965	113.6929	–1.025	117.5699	–1.039	117.6289	–0.718	117.6877
–0.276	113.6322	–0.983	113.6961	–1.026	117.5728	–1.040	117.6318	–0.679	117.6906
–0.281	113.6354	–0.986	113.6993	–1.022	117.5758	–1.040	117.6347	–0.598	117.6936
–0.317	113.6386	–1.001	113.7025	–1.039	117.5787	–1.036	117.6377	–0.569	117.6965
–0.370	113.6418	–1.022	113.7057	–1.034	117.5817	–1.019	117.6406	–0.513	117.6995
–0.423	113.6450	–0.886	117.5257	–1.045	117.5846	–1.017	117.6436	–0.469	117.7024
–0.468	113.6482	–0.917	117.5286	–1.048	117.5876	–0.991	117.6465	–0.418	117.7053
–0.523	113.6514	–0.915	117.5315	–1.048	117.5905	–0.984	117.6495	–0.329	117.7083
–0.592	113.6546	–0.932	117.5345	–1.051	117.5935	–0.982	117.6524	–0.296	117.7112
–0.640	113.6578	–0.952	117.5375	–1.054	117.5964	–0.973	117.6553	–0.284	117.7142
–0.698	113.6610	–0.952	117.5404	–1.056	117.5994	–0.959	117.6583		
–0.754	113.6642	–0.970	117.5434	–1.067	117.6023	–0.949	117.6612		
–0.794	113.6674	–0.974	117.5463	–1.063	117.6053	–0.930	117.6642		
–0.829	113.6706	–0.977	117.5492	–1.060	117.6082	–0.923	117.6671		

ΔR_c	HJD 2457000+	ΔR_c	HJD 2457000+	ΔR_c	HJD 2457000+	ΔR_c	HJD 2457000+	ΔR_c	HJD 2457000+
–1.035	66.5245	–0.978	66.6860	–0.857	67.7077	–1.045	68.7726	–0.745	88.6141
–1.041	66.5275	–0.985	66.6930	–0.833	67.7109	–1.036	68.7759	–0.685	88.6173
–1.023	66.5307	–1.006	66.6962	–0.795	67.7141	–1.020	68.7791	–0.643	88.6205
–1.023	66.5367	–1.026	66.6995	–0.694	67.7231	–1.041	68.7827	–0.579	88.6237
–1.012	66.5399	–1.009	66.7076	–0.647	67.7263	–1.040	68.7859	–0.546	88.6269
–1.018	66.5431	–1.008	66.7109	–0.608	67.7295	–1.067	68.7891	–0.485	88.6301
–1.003	66.5477	–1.044	66.7181	–0.517	67.7341	–1.040	68.7942	–0.422	88.6333
–0.984	66.5510	–1.048	66.7213	–0.459	67.7373	–1.029	68.8012	–0.390	88.6365
–0.984	66.5542	–1.041	66.7244	–0.409	67.7406	–0.979	68.8083	–0.327	88.6397
–0.982	66.5586	–1.045	66.7283	–0.333	67.7452	–1.019	68.8132	–0.276	88.6429
–0.951	66.5618	–1.031	66.7315	–0.291	67.7484	–0.997	68.8187	–0.265	88.6460
–0.963	66.5650	–1.020	66.7348	–0.277	67.7516	–0.988	68.8229	–0.275	88.6492
–0.941	66.5711	–1.031	66.7391	–0.274	67.7588	–0.994	68.8276	–0.263	88.6524
–0.918	66.5744	–1.019	66.7423	–0.309	67.7620	–0.979	68.8325	–0.280	88.6556
–0.919	66.5776	–1.004	66.7455	–0.344	67.7653	–0.966	68.8347	–0.332	88.6588
–0.902	66.5828	–1.038	66.7498	–0.429	67.7698	–1.031	88.5246	–0.387	88.6620
–0.874	66.5861	–1.027	66.7530	–0.483	67.7730	–1.029	88.5278	–0.447	88.6652
–0.863	66.5893	–1.054	66.7562	–0.543	67.7762	–1.030	88.5310	–0.486	88.6684
–0.854	66.5937	–1.026	66.7603	–0.706	67.7869	–1.045	88.5342	–0.552	88.6716
–0.837	66.5969	–1.032	66.7636	–0.705	67.7901	–1.039	88.5374	–0.605	88.6748
–0.812	66.6050	–0.969	66.7668	–0.782	67.7933	–1.047	88.5406	–0.650	88.6779
–0.782	66.6082	–0.815	67.5107	–0.842	67.7991	–1.030	88.5438	–0.696	88.6811
–0.777	66.6114	–0.790	67.5139	–0.872	67.8023	–1.021	88.5470	–0.741	88.6843
–0.773	66.6158	–0.772	67.5171	–0.899	67.8055	–1.026	88.5502	–0.770	88.6875
–0.793	66.6190	–0.767	67.5213	–0.932	67.8113	–1.019	88.5534	–0.834	88.6907
–0.782	66.6222	–0.786	67.5245	–0.941	67.8145	–1.019	88.5566	–0.857	88.6939
–0.779	66.6266	–0.777	67.5277	–0.955	67.8177	–1.003	88.5598	–0.877	88.6971
–0.790	66.6296	–0.795	67.5317	–0.980	67.8237	–0.998	88.5662	–0.899	88.7003
–0.820	66.6373	–0.781	67.5349	–0.987	67.8269	–0.972	88.5694	–0.915	88.7035
–0.822	66.6406	–0.768	67.5381	–1.006	67.8302	–0.976	88.5726	–0.940	88.7066
–0.859	66.6438	–1.015	67.6621	–1.005	67.8335	–0.963	88.5758	–0.957	88.7098
–0.852	66.6480	–1.003	67.6653	–1.023	67.8367	–0.957	88.5790	–0.968	88.7130
–0.874	66.6512	–1.010	67.6685	–1.013	67.8399	–0.959	88.5822	–0.965	88.7162
–0.884	66.6544	–0.998	67.6729	–1.025	67.8431	–0.953	88.5853	–0.966	88.7194
–0.892	66.6585	–0.982	67.6761	–1.034	67.8463	–0.921	88.5885	–0.973	88.7226
–0.901	66.6618	–0.982	67.6793	–1.039	67.8495	–0.924	88.5917	–1.006	88.7258
–0.914	66.6650	–0.972	67.6838	–1.029	67.8528	–0.904	88.5949	–1.008	88.7290
–0.938	66.6690	–0.966	67.6870	–1.048	67.8560	–0.883	88.5981	–1.015	88.7322
–0.938	66.6722	–0.942	67.6902	–1.053	67.8592	–0.856	88.6013	–1.016	88.7354
–0.965	66.6754	–0.930	67.6969	–1.058	67.8625	–0.839	88.6045	–1.021	88.7386
–0.984	66.6796	–0.906	67.7001	–1.045	67.8657	–0.816	88.6077	–1.029	88.7418
–0.975	66.6828	–0.889	67.7033	–1.061	67.8689	–0.776	88.6109	–1.038	88.7450

Table continued on following pages

Table 2. CW Scl observations ΔB, ΔV, ΔR, and ΔI, variable minus comparison star (Epoch 2400000+), cont.

ΔR_c	*HJD 2457000+*	ΔR_c	*HJD 2457000+*	ΔR_c	*HJD 2457000+*	ΔR_c	*HJD 2457000+*	ΔR_c	*HJD 2457000+*
–1.048	88.7481	–0.994	89.7178	–0.974	97.6575	–1.062	98.7902	–0.961	113.7063
–1.056	88.7513	–1.006	89.7210	–0.980	97.6607	–1.050	98.7935	–0.883	117.5262
–1.045	88.7544	–0.993	89.7242	–0.935	97.6639	–1.048	98.7968	–0.886	117.5292
–0.812	89.5145	–0.976	89.7273	–0.938	97.6671	–1.062	98.8001	–0.907	117.5321
–0.778	89.5176	–0.967	89.7305	–0.943	97.6703	–1.045	98.8034	–0.905	117.5351
–0.748	89.5208	–0.962	89.7337	–0.940	97.6735	–1.035	98.8068	–0.923	117.5380
–0.707	89.5240	–0.969	89.7369	–0.929	97.6767	–1.025	98.8101	–0.935	117.5410
–0.677	89.5272	–0.933	89.7401	–0.903	97.6799	–1.005	98.8134	–0.933	117.5439
–0.627	89.5303	–0.927	89.7432	–0.876	97.6831	–1.006	98.8167	–0.952	117.5469
–0.565	89.5335	–0.900	89.7464	–0.851	97.6863	–0.989	98.8200	–0.968	117.5498
–0.526	89.5367	–0.881	89.7496	–0.827	97.6895	–0.981	98.8233	–0.974	117.5528
–0.450	89.5399	–0.888	89.7527	–0.796	97.6927	–0.960	98.8266	–0.976	117.5557
–0.413	89.5430	–0.873	89.7559	–0.784	97.6959	–0.964	98.8299	–0.979	117.5587
–0.363	89.5462	–0.850	89.7591	–0.725	97.6991	–0.937	98.8332	–0.982	117.5616
–0.304	89.5494	–0.837	89.7623	–0.670	98.6140	–0.918	98.8365	–0.992	117.5646
–0.269	89.5526	–0.821	89.7654	–0.584	98.6179	–0.905	98.8398	–1.000	117.5675
–0.264	89.5557	–0.823	89.7686	–0.490	98.6234	–0.888	98.8431	–1.012	117.5705
–0.269	89.5589	–0.813	89.7718	–0.442	98.6273	–0.884	98.8464	–1.009	117.5734
–0.320	89.5653	–0.792	89.7750	–0.402	98.6306	–0.879	98.8497	–1.004	117.5764
–0.355	89.5685	–0.798	89.7782	–0.352	98.6338	–0.853	98.8530	–1.029	117.5793
–0.408	89.5716	–0.796	89.7813	–0.315	98.6392	–0.849	98.8563	–1.028	117.5823
–0.468	89.5748	–0.781	89.7845	–0.343	98.6481	–0.839	98.8596	–1.019	117.5852
–0.525	89.5780	–0.775	97.5175	–0.385	98.6511	–0.822	98.8629	–1.021	117.5882
–0.582	89.5812	–0.791	97.5204	–0.417	98.6541	–0.823	98.8662	–1.041	117.5911
–0.634	89.5843	–0.823	97.5234	–0.478	98.6570	–0.824	98.8695	–1.033	117.5941
–0.679	89.5875	–0.830	97.5264	–0.528	98.6600	–0.923	113.5752	–1.026	117.5970
–0.717	89.5907	–0.834	97.5296	–0.578	98.6630	–0.881	113.5784	–1.040	117.6000
–0.762	89.5939	–0.849	97.5328	–0.637	98.6659	–0.880	113.5816	–1.050	117.6029
–0.785	89.5970	–0.855	97.5360	–0.670	98.6689	–0.856	113.5848	–1.036	117.6059
–0.845	89.6002	–0.874	97.5393	–0.728	98.6719	–0.829	113.5880	–1.045	117.6088
–0.854	89.6034	–0.885	97.5424	–0.771	98.6748	–0.823	113.5912	–1.042	117.6118
–0.888	89.6066	–0.902	97.5456	–0.795	98.6778	–0.758	113.5944	–1.046	117.6147
–0.894	89.6098	–0.907	97.5488	–0.838	98.6808	–0.726	113.5976	–1.021	117.6177
–0.918	89.6129	–0.937	97.5520	–0.855	98.6837	–0.677	113.6008	–1.040	117.6206
–0.941	89.6161	–0.931	97.5552	–0.897	98.6867	–0.635	113.6040	–1.020	117.6236
–0.948	89.6193	–0.945	97.5584	–0.911	98.6896	–0.587	113.6072	–1.028	117.6265
–0.954	89.6225	–0.967	97.5616	–0.935	98.6926	–0.514	113.6104	–1.022	117.6294
–0.965	89.6257	–0.965	97.5648	–0.950	98.6956	–0.461	113.6136	–1.008	117.6324
–0.982	89.6288	–0.973	97.5681	–0.972	98.6986	–0.415	113.6168	–1.016	117.6353
–0.985	89.6320	–0.974	97.5713	–0.980	98.7015	–0.352	113.6200	–1.013	117.6383
–1.001	89.6352	–0.990	97.5745	–0.997	98.7045	–0.322	113.6232	–0.999	117.6412
–1.011	89.6384	–0.993	97.5777	–1.001	98.7075	–0.297	113.6264	–0.974	117.6442
–1.012	89.6415	–0.989	97.5808	–1.005	98.7108	–0.259	113.6296	–0.988	117.6471
–1.027	89.6447	–0.998	97.5840	–1.020	98.7141	–0.249	113.6329	–0.958	117.6501
–1.028	89.6479	–1.004	97.5872	–1.025	98.7174	–0.283	113.6360	–0.961	117.6530
–1.038	89.6511	–1.007	97.5904	–1.031	98.7207	–0.333	113.6393	–0.942	117.6559
–1.054	89.6543	–1.017	97.5936	–1.052	98.7240	–0.378	113.6424	–0.934	117.6589
–1.049	89.6574	–1.021	97.5968	–1.045	98.7273	–0.399	113.6456	–0.932	117.6618
–1.036	89.6606	–1.014	97.6000	–1.056	98.7307	–0.486	113.6488	–0.913	117.6647
–1.030	89.6638	–1.018	97.6032	–1.069	98.7340	–0.519	113.6520	–0.876	117.6677
–1.045	89.6670	–1.025	97.6064	–1.065	98.7373	–0.590	113.6552	–0.863	117.6706
–1.061	89.6701	–1.033	97.6096	–1.089	98.7406	–0.638	113.6584	–0.852	117.6736
–1.055	89.6733	–1.047	97.6128	–1.089	98.7439	–0.673	113.6616	–0.833	117.6765
–1.063	89.6765	–1.037	97.6160	–1.083	98.7472	–0.708	113.6648	–0.794	117.6795
–1.072	89.6797	–1.033	97.6192	–1.084	98.7505	–0.756	113.6681	–0.749	117.6824
–1.053	89.6828	–1.028	97.6224	–1.087	98.7538	–0.818	113.6712	–0.727	117.6854
–1.055	89.6860	–1.034	97.6255	–1.088	98.7571	–0.827	113.6744	–0.684	117.6883
–1.051	89.6892	–1.029	97.6287	–1.087	98.7604	–0.858	113.6776	–0.631	117.6912
–1.054	89.6924	–1.031	97.6319	–1.074	98.7637	–0.883	113.6808	–0.580	117.6942
–1.038	89.6955	–1.029	97.6351	–1.088	98.7670	–0.895	113.6840	–0.531	117.6971
–1.040	89.6987	–1.017	97.6383	–1.080	98.7703	–0.940	113.6872	–0.515	117.7001
–1.039	89.7019	–1.009	97.6415	–1.073	98.7737	–0.965	113.6904	–0.435	117.7030
–1.032	89.7051	–1.016	97.6447	–1.066	98.7770	–0.944	113.6936	–0.404	117.7059
–1.002	89.7083	–1.008	97.6479	–1.073	98.7803	–0.947	113.6968	–0.336	117.7089
–1.005	89.7114	–0.995	97.6511	–1.073	98.7835	–0.981	113.7000	–0.303	117.7118
–1.011	89.7146	–0.996	97.6543	–1.059	98.7869	–0.986	113.7032	–0.283	117.7147

Table continued on following pages

Table 2. CW Scl observations ΔB, ΔV, ΔR, and ΔI, variable minus comparison star (Epoch 2400000+), cont.

ΔI_c	*HJD 2457000+*	ΔI_c	*HJD 2457000+*	ΔI_c	*HJD 2457000+*	ΔI_c	*HJD 2457000+*	ΔI_c	*HJD 2457000+*
–0.988	66.5250	–0.715	67.5166	–1.002	68.7896	–0.880	88.7040	–0.992	89.6707
–0.978	66.5280	–0.715	67.5208	–0.995	68.7954	–0.885	88.7072	–1.006	89.6738
–0.964	66.5312	–0.720	67.5240	–0.992	68.8024	–0.895	88.7104	–1.011	89.6770
–0.952	66.5372	–0.695	67.5272	–0.976	68.8089	–0.938	88.7136	–1.022	89.6802
–0.959	66.5404	–0.728	67.5312	–0.970	68.8139	–0.923	88.7168	–1.008	89.6834
–0.965	66.5437	–0.710	67.5343	–0.924	68.8193	–0.927	88.7200	–1.004	89.6865
–0.965	66.5483	–0.728	67.5375	–0.984	68.8236	–0.946	88.7232	–1.016	89.6897
–0.926	66.5515	–0.968	67.6616	–0.957	68.8283	–0.963	88.7263	–1.009	89.6929
–0.919	66.5547	–0.957	67.6648	–0.953	68.8331	–0.954	88.7295	–0.977	89.6961
–0.904	66.5591	–0.948	67.6680	–0.949	68.8353	–0.965	88.7327	–0.977	89.6992
–0.930	66.5623	–0.951	67.6724	–1.000	88.5251	–0.976	88.7359	–0.981	89.7024
–0.928	66.5656	–0.942	67.6756	–0.972	88.5283	–0.980	88.7391	–0.971	89.7056
–0.880	66.5717	–0.934	67.6788	–1.003	88.5315	–0.977	88.7423	–0.975	89.7088
–0.891	66.5749	–0.919	67.6832	–0.976	88.5347	–0.984	88.7455	–0.962	89.7120
–0.870	66.5781	–0.915	67.6864	–1.008	88.5379	–0.972	88.7487	–0.963	89.7151
–0.815	66.5834	–0.922	67.6896	–0.991	88.5411	–1.013	88.7519	–0.951	89.7183
–0.807	66.5866	–0.891	67.6963	–1.004	88.5443	–0.981	88.7549	–0.953	89.7215
–0.803	66.5899	–0.872	67.6995	–0.989	88.5475	–0.775	89.5150	–0.959	89.7247
–0.786	66.5942	–0.865	67.7027	–0.981	88.5507	–0.757	89.5181	–0.955	89.7279
–0.766	66.5974	–0.824	67.7072	–0.982	88.5539	–0.719	89.5213	–0.932	89.7310
–0.762	66.6007	–0.797	67.7104	–0.992	88.5571	–0.683	89.5245	–0.915	89.7342
–0.728	66.6055	–0.769	67.7136	–0.984	88.5603	–0.635	89.5277	–0.896	89.7374
–0.729	66.6087	–0.656	67.7225	–0.980	88.5635	–0.593	89.5309	–0.874	89.7406
–0.710	66.6120	–0.630	67.7257	–0.957	88.5667	–0.541	89.5340	–0.878	89.7438
–0.690	66.6163	–0.578	67.7289	–0.940	88.5699	–0.500	89.5372	–0.859	89.7469
–0.712	66.6228	–0.493	67.7336	–0.959	88.5731	–0.457	89.5404	–0.841	89.7501
–0.696	66.6271	–0.463	67.7368	–0.938	88.5763	–0.387	89.5436	–0.848	89.7533
–0.743	66.6301	–0.404	67.7400	–0.925	88.5795	–0.347	89.5467	–0.807	89.7564
–0.725	66.6330	–0.323	67.7447	–0.926	88.5827	–0.301	89.5499	–0.791	89.7596
–0.752	66.6379	–0.271	67.7479	–0.926	88.5859	–0.271	89.5531	–0.787	89.7628
–0.759	66.6411	–0.254	67.7511	–0.884	88.5891	–0.272	89.5563	–0.773	89.7660
–0.800	66.6443	–0.271	67.7583	–0.882	88.5922	–0.258	89.5594	–0.749	89.7691
–0.817	66.6485	–0.299	67.7615	–0.859	88.5955	–0.289	89.5626	–0.740	89.7723
–0.825	66.6517	–0.324	67.7647	–0.835	88.5986	–0.325	89.5658	–0.742	89.7755
–0.844	66.6549	–0.391	67.7693	–0.814	88.6018	–0.348	89.5690	–0.687	89.7787
–0.854	66.6591	–0.432	67.7725	–0.794	88.6050	–0.418	89.5722	–0.716	89.7818
–0.864	66.6623	–0.507	67.7757	–0.762	88.6082	–0.472	89.5753	–0.717	89.7850
–0.872	66.6655	–0.669	67.7863	–0.733	88.6114	–0.533	89.5785	–0.730	89.7882
–0.882	66.6695	–0.702	67.7896	–0.691	88.6146	–0.560	89.5817	–0.722	89.7914
–0.907	66.6727	–0.747	67.7928	–0.663	88.6178	–0.616	89.5849	–0.729	89.7945
–0.872	66.6760	–0.810	67.7986	–0.615	88.6210	–0.656	89.5880	–0.727	97.5179
–0.910	66.6801	–0.833	67.8018	–0.570	88.6242	–0.699	89.5912	–0.739	97.5209
–0.936	66.6833	–0.823	67.8050	–0.506	88.6274	–0.729	89.5944	–0.762	97.5238
–0.931	66.6866	–0.883	67.8108	–0.470	88.6306	–0.782	89.5976	–0.759	97.5270
–0.969	66.6935	–0.911	67.8140	–0.409	88.6338	–0.811	89.6008	–0.785	97.5302
–0.960	66.6968	–0.916	67.8172	–0.365	88.6370	–0.825	89.6039	–0.785	97.5334
–0.963	66.7000	–0.936	67.8232	–0.318	88.6402	–0.854	89.6071	–0.808	97.5366
–0.978	66.7049	–0.933	67.8264	–0.273	88.6434	–0.869	89.6103	–0.826	97.5398
–0.983	66.7082	–0.933	67.8296	–0.243	88.6466	–0.878	89.6135	–0.854	97.5430
–0.956	66.7114	–0.952	67.8329	–0.274	88.6498	–0.912	89.6166	–0.857	97.5462
–0.975	66.7186	–0.963	67.8361	–0.256	88.6529	–0.901	89.6198	–0.855	97.5494
–0.989	66.7218	–0.967	67.8393	–0.305	88.6561	–0.916	89.6230	–0.876	97.5526
–0.988	66.7249	–0.988	67.8426	–0.325	88.6593	–0.946	89.6262	–0.901	97.5558
–0.983	66.7289	–0.966	67.8458	–0.381	88.6625	–0.931	89.6294	–0.913	97.5590
–0.987	66.7321	–0.991	67.8490	–0.447	88.6657	–0.958	89.6325	–0.920	97.5622
–0.988	66.7353	–0.986	67.8522	–0.481	88.6689	–0.941	89.6357	–0.918	97.5654
–0.969	66.7396	–0.996	67.8554	–0.536	88.6721	–0.986	89.6389	–0.940	97.5686
–0.972	66.7428	–1.010	67.8587	–0.598	88.6753	–0.971	89.6421	–0.945	97.5718
–0.963	66.7460	–1.000	67.8619	–0.632	88.6785	–0.990	89.6453	–0.948	97.5750
–0.987	66.7503	–0.999	67.8651	–0.689	88.6817	–0.980	89.6484	–0.965	97.5782
–0.966	66.7535	–1.001	67.8683	–0.702	88.6849	–0.987	89.6516	–0.947	97.5814
–0.966	66.7567	–1.008	68.7732	–0.748	88.6880	–1.000	89.6548	–0.965	97.5846
–0.953	66.7609	–0.992	68.7764	–0.772	88.6912	–0.993	89.6579	–0.979	97.5878
–0.934	66.7641	–1.006	68.7796	–0.814	88.6944	–0.988	89.6611	–0.974	97.5910
–0.734	67.5102	–0.998	68.7832	–0.834	88.6976	–1.013	89.6643	–0.976	97.5942
–0.724	67.5134	–1.010	68.7864	–0.841	88.7008	–0.996	89.6675	–0.988	97.5974

Table continued on following pages

Table 2. CW Scl observations ΔB, ΔV, ΔR, and ΔI, variable minus comparison star (Epoch 2400000+), cont.

ΔI_c	*HJD 2457000+*	ΔI_c	*HJD 2457000+*	ΔI_c	*HJD 2457000+*	ΔI_c	*HJD 2457000+*	ΔI_c	*HJD 2457000+*
–0.996	97.6005	–0.456	98.6575	–0.998	98.7941	–0.446	113.6494	–1.006	117.5975
–1.005	97.6037	–0.516	98.6604	–1.006	98.7974	–0.511	113.6526	–0.994	117.6004
–1.000	97.6069	–0.558	98.6634	–1.013	98.8007	–0.560	113.6558	–1.008	117.6034
–0.999	97.6101	–0.612	98.6664	–1.010	98.8040	–0.608	113.6590	–1.001	117.6063
–0.993	97.6133	–0.668	98.6693	–0.986	98.8073	–0.644	113.6622	–1.001	117.6093
–0.993	97.6165	–0.703	98.6723	–0.988	98.8106	–0.685	113.6654	–0.991	117.6122
–0.999	97.6197	–0.746	98.6753	–0.983	98.8139	–0.748	113.6686	–1.000	117.6152
–1.007	97.6229	–0.772	98.6782	–0.944	98.8173	–0.796	113.6718	–0.986	117.6181
–0.997	97.6261	–0.805	98.6812	–0.945	98.8205	–0.793	113.6750	–0.987	117.6211
–1.006	97.6293	–0.829	98.6842	–0.953	98.8239	–0.828	113.6782	–0.971	117.6240
–1.013	97.6325	–0.850	98.6871	–0.927	98.8272	–0.859	113.6814	–0.977	117.6270
–0.994	97.6357	–0.867	98.6901	–0.905	98.8305	–0.865	113.6845	–0.953	117.6299
–0.983	97.6389	–0.899	98.6931	–0.896	98.8338	–0.904	113.6877	–0.957	117.6329
–0.979	97.6421	–0.903	98.6960	–0.874	98.8371	–0.901	113.6909	–0.955	117.6358
–0.972	97.6452	–0.925	98.6990	–0.824	98.8404	–0.928	113.6941	–0.948	117.6387
–0.959	97.6484	–0.931	98.7020	–0.853	98.8437	–0.912	113.6973	–0.942	117.6417
–0.968	97.6516	–0.947	98.7050	–0.816	98.8470	–0.934	113.7005	–0.936	117.6446
–0.944	97.6548	–0.949	98.7080	–0.802	98.8503	–0.958	113.7037	–0.928	117.6476
–0.965	97.6580	–0.972	98.7113	–0.792	98.8536	–0.972	113.7068	–0.935	117.6505
–0.926	97.6612	–0.969	98.7147	–0.790	98.8569	–0.827	117.5267	–0.907	117.6535
–0.937	97.6676	–0.988	98.7180	–0.756	98.8602	–0.852	117.5297	–0.921	117.6564
–0.926	97.6708	–0.995	98.7213	–0.870	113.5757	–0.870	117.5326	–0.891	117.6593
–0.914	97.6740	–1.009	98.7246	–0.842	113.5789	–0.875	117.5356	–0.876	117.6623
–0.895	97.6772	–1.014	98.7279	–0.830	113.5821	–0.887	117.5385	–0.872	117.6652
–0.863	97.6804	–1.014	98.7312	–0.788	113.5886	–0.913	117.5415	–0.856	117.6682
–0.856	97.6836	–1.022	98.7346	–0.741	113.5918	–0.897	117.5444	–0.823	117.6711
–0.831	97.6868	–1.029	98.7378	–0.697	113.5950	–0.916	117.5474	–0.790	117.6740
–0.806	97.6900	–1.039	98.7412	–0.673	113.5982	–0.906	117.5503	–0.783	117.6770
–0.761	97.6932	–1.043	98.7445	–0.625	113.6014	–0.929	117.5533	–0.757	117.6799
–0.705	97.6964	–1.043	98.7478	–0.578	113.6046	–0.933	117.5562	–0.733	117.6829
–0.717	97.6996	–1.059	98.7511	–0.611	113.6078	–0.963	117.5591	–0.695	117.6858
–0.658	98.6146	–1.042	98.7544	–0.479	113.6110	–0.949	117.5621	–0.666	117.6888
–0.601	98.6185	–1.048	98.7577	–0.446	113.6142	–0.956	117.5650	–0.626	117.6917
–0.498	98.6240	–1.029	98.7610	–0.343	113.6174	–0.971	117.5680	–0.537	117.6946
–0.436	98.6278	–1.053	98.7643	–0.298	113.6206	–0.971	117.5709	–0.504	117.6976
–0.391	98.6310	–1.040	98.7676	–0.284	113.6238	–0.982	117.5739	–0.475	117.7005
–0.352	98.6342	–1.032	98.7709	–0.261	113.6270	–0.986	117.5768	–0.404	117.7035
–0.306	98.6397	–1.036	98.7742	–0.275	113.6302	–0.986	117.5798	–0.338	117.7064
–0.301	98.6427	–1.030	98.7775	–0.266	113.6334	–0.983	117.5827	–0.305	117.7093
–0.314	98.6456	–1.033	98.7808	–0.267	113.6366	–0.988	117.5857	–0.297	117.7123
–0.327	98.6486	–1.018	98.7841	–0.305	113.6398	–0.991	117.5886	–0.271	117.7152
–0.372	98.6516	–1.044	98.7874	–0.360	113.6430	–1.001	117.5916		
–0.405	98.6545	–1.020	98.7908	–0.418	113.6462	–0.997	117.5946		

Table 3. O–C residuals from NSVS 10083189 period study.

No.	*HJD 2400000+*	*Cycle*	*Linear Residual*	*Quadratic Residual*	*Weight*	*Reference*
1	51492.3901	–12322.5	0.0045	0.0082	0.2	NSVS (Wozniak et al. 2004)
2	51494.4278	–12318.0	–0.0018	0.0019	0.2	NSVS (Wozniak et al. 2004)
3	51494.4268	–12318.0	–0.0028	0.0009	0.2	NSVS (Wozniak et al. 2004)
4	51576.1855	–12138.0	–0.0044	–0.0018	0.2	NSVS (Wozniak et al. 2004)
5	51581.1890	–12127.0	0.0026	0.0051	0.2	NSVS (Wozniak et al. 2004)
6	51608.2037	–12067.5	–0.0090	–0.0069	0.2	NSVS (Wozniak et al. 2004)
7	51608.2026	–12067.5	–0.0100	–0.0079	0.2	NSVS (Wozniak et al. 2004)
8	55629.6950	–3214.0	0.0116	0.0030	1.0	Diethelm 2011
9	56282.8654	–1776.0	0.0074	0.0007	1.0	Diethelm 2013
10	57066.6187	–50.5	–0.0017	0.0001	1.0	Present Observations
11	57067.5233	–48.5	–0.0056	–0.0038	1.0	Present Observations
12	57067.7545	–48.0	–0.0015	0.0003	1.0	Present Observations
13	57088.6491	–2.0	–0.0013	0.0009	1.0	Present Observations
14	57089.5571	0.0	–0.0017	0.0004	1.0	Present Observations
15	57098.6416	20.0	–0.0016	0.0006	1.0	Present Observations
16	57113.6312	53.0	–0.0015	0.0010	1.0	Present Observations

Table 4. NSVS 1083189 light curve characteristics ΔB, ΔV, ΔR_c, and ΔI_c, variable minus comparison star.

Filter	*Phase*	*Magnitude Max. I*	*Phase*	*Magnitude Max. II*
	0.25		0.75	
ΔB		–1.165 ± 0.008		–1.137 ± 0.013
ΔV		–1.113 ± 0.014		–1.071 ± 0.017
ΔR_c		–1.058 ± 0.017		–1.037 ± 0.008
ΔI_c		–1.015 ± 0.023		–0.996 ± 0.010
Filter	*Phase*	*Magnitude Min. II*	*Phase*	*Magnitude Min. I*
	0.50		0.00	
ΔB		–0.926 ± 0.012		–0.307 ± 0.020
ΔV		–0.850 ± 0.019		–0.287 ± 0.014
ΔRc		–0.793 ± 0.018		–0.241 ± 0.092
ΔIc		–0.751 ± 0.014		–0.272 ± 0.019

Filter	*Min. I – Max. I*	*Max. I – Max. II*	*Min. I – Min. II*
ΔB	0.858 ± 0.028	–0.028 ± 0.021	0.619 ± 0.033
ΔV	0.826 ± 0.028	–0.042 ± 0.032	0.564 ± 0.033
ΔRc	0.817 ± 0.109	–0.021 ± 0.025	0.552 ± 0.110
ΔIc	0.743 ± 0.043	–0.019 ± 0.033	0.479 ± 0.034

Filter	*Max. II – Max. I*	*Min. II – Max. I*
ΔB	0.028 ± 0.021	0.239 ± 0.020
ΔV	0.042 ± 0.032	0.263 ± 0.034
ΔRc	0.021 ± 0.025	0.265 ± 0.035
ΔIc	0.019 ± 0.033	0.264 ± 0.038

Table 5. NSVS 1083189 synthetic light curve solution.

Parameters	*Values*
$\lambda_B, \lambda_V, \lambda_R, \lambda_I$ (nm)	440, 550, 640, 790
$x_{bol1,2}$, $y_{bol1,2}$	0.642, 0. 828, 0.242, -0.167
$x_{1Ic,2Ic}$, $y_{1Ic,2Ic}$	0. 569, 0.668, 0. 271, 0.144
$x_{1Rc,2Rc}$, $y_{1Rc,2Rc}$	0.652, 0.754, 0. 278, 0.096
$x_{1V,2V}$, $y_{1V,2V}$	0.725, 0.799, 0. 266, 0.006
$x_{1B,2B}$, $y_{1B,2B}$	0. 815, 0.840, 0.206, -0.155
g_1 , g_2	0.32
A_1 , A_2	0.5
Inclination (°)	78.60 ± 0.04
T_1, T_2 (K)	6250, 4573 ± 2
Ω_1, Ω_2	3.031, 3.054 ± 0.002
q (m_2 / m_1)	0.584 ± 0.001
Fill-outs: $F_1 = F_2$	100%,99.3 ± 0.1%
$L_1 / (L_1 + L_2)_{Ic}$	0.8480 ± 0.0005
$L_1 / (L_1 + L_2)_{Rc}$	0.8732 ± 0.0006
$L_1 / (L_1 + L_2)_V$	0.9027 ± 0.0008
$L_1 / (L_1 + L_2))_B$	0.9385 ± 0.0014
JDo (days)	2457098.642242 ± 0.000054
Period (days)	0.4542195 ± 0.0000015
r_1, r_2 (pole)	0. 40135 ± 0.00076, 0.309 ± 0.002
r_1, r_2 (point)	0.555 ± 0.002, 0.405 ± 0.014
r_1, r_2 (back)	0.4250 ± 0.0009, 0.322 ± 0.003
r_1, r_2 (back)	0.4537 ± 0.008, 0.352 ± 0.004
Spot	
Co-latitude (˚)	58.3 ± 0.4
Longitude (˚)	76 ± 1
Spot Radius	14.7 ± 0.2
Temperature Factor	0.858 ± 0.004