New Observations of V530 Andromedae: a Critical Contact Binary?

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Abstract We follow up on single coverage UBVR$_c$I$_c$ light curves taken in 2011 and analyses. Our present BVR$_c$I$_c$ light curves with ample coverage were taken October and November 2013 and January 2014 with the Dark Sky Observatory 0.81-meter reflector of Appalachian State University. They reveal the early-type V530 And as a totally eclipsing shallow or critical contact solar-type binary rather than semidetached near-contact one. In our extended period study, over a 14.25-year interval, we find a continuously decreasing period. This fits the scenario of magnetic braking for solar-type binaries. The temperatures of the primary and secondary components are estimated at 6750 and 6030 K. The component temperature difference is large for a contact binary. The fill-out, however, is a mere 5% so it is near critical contact. The mass ratio, M_2/M_1, was found to be 0.386. Two star spots, probably magnetic in origin, were determined. We suspect that the binary has recently achieved physical contact for the first time.

1. Introduction

This paper represents follow-up observations on single coverage UBVR$_c$I$_c$ light curves (Samec *et al.* 2013) and analyses, adding needed orbital period coverage to ascertain a period change in the system.

2. History and observations

V530 And was discovered by Khruslov (2008). It was designated as EB with a 12.6–13.3 R-magnitude range (MinII = 13.0). Its ephemeris was given as

$$\text{JD Hel Min I} = 2451479.632\ \text{d} + 0.57723 \bullet \text{E}. \quad (1)$$

It appeared in Hoffman *et al.* (2009) with period P = 0.57721 and mean ROTSE unfiltered magnitude = 12.769. An amplitude of 0.633 magnitude was given. The variable was found to be in the Fourier region where β Lyrae types are expected. V530 And is also known as 2MASS J01274106+3351552, NSVS 6447718, TYC 2300-116-1, and GSC 2300 0116. Its position is R.A. (2000) = 01^h 27^m 41.050^s, Dec. (2000) = +33° 51' 55.47" (ICRS). V530 And appeared in the 80th Name-List of Variable Stars (Kazarovets *et al.* 2011). It was designated as EB type. Our earlier, somewhat sparse observations were taken 27 and 29 September 2011. This earlier solution gave a near contact, semidetached configuration with a fill-out of 99 and 100% (Samec *et al.* 2013). But the coverage was scant and only two precision minima and some times of low light were used in the period determination. A follow-up was needed to complete the initial study and to make a more definitive determination of its configuration.

Consequently, we (RGS, DBC, JDC, TS) undertook additional BVR$_c$I$_c$ observations in 2013 on October 1, 2, 9, November 4, 5, and January 4, 2014, at Dark Sky Observatory's 0.81-meter reflector in Philips Gap, North Carolina, with the (–40° C) 2KX2K Apogee Alta CCD. The same check and comp stars were used from the earlier paper. The precision of the R$_c$ and I$_c$ curves were less than 1% while the B and V curves had nightly values of less than this value, but nightly variations took the overall curves to 2% in V and 3% in B. We believe this was due to magnetic activity on the binary since we normally attain mmag precision on stars of this magnitude. Figure 1a and b show B,V typical nightly curves on 1 October 2013 and

4 January 2014. Our complete observations are given in Table 1, in delta magnitudes, ΔB, ΔV, ΔR_c, and ΔI_c in the sense of variable minus comparison star (V–C).

3. Period study

The previous eclipse timings were (Samec *et al.* 2013) HJD Min I = 2455832.74595 (±0.0004) d, and HJD Min II = 2455830.72806 (±0.00045) d. In addition, four more timings were added with our present observations, HJD Min I = 2456566.84275 (± 0.00007), 2456601.76665 (±0.00046), 2456598.8820 (± 0.0005), and HJD Min II= 2456600.6111 (± 0.0002). These produced enough minima to calculate a linear ephemeris, improving on the last estimate:

$$\text{JD Hel Min I} = 2456566.8487 + 0.5771241 \cdot E. \quad (2)$$
$$\pm 0.0012 \quad \pm 0.0000016$$

While producing this updated ephemeris we discovered a way to extend our O–C orbital diagram. NSVS data from 1999–2000 on this binary (Wozniak *et al.* 2004) were phased into a light curve with the current period. The curves were then shifted so that the eclipses were easily seen and worked with. The eclipses were fit with parabolas and the HJD data within 0.005 phase of the primary and secondary eclipses were used as times of minimum light in our O–C analysis. These were weighted at only 0.1 of a regular eclipse timing, while precision timings were weighted 1.0. The complete set of timings revealed that the period has been decreasing over the past 9,000 orbits! This method could be used with any set of nearly complete light curves (which include the minima) even if the observations are taken with only a few sets of observations per night (as most surveys) so no normal minima determinations could be done. This also improves on the conventional "times of low light" method. The following quadratic ephemeris resulted.

$$\text{JD Hel Min I} = 2456566.8496 + 0.5771072 \cdot E - 0.0000000140 \cdot E^2 \quad (3)$$
$$\pm 0.0012 \pm 0.0000019 \quad \pm 0.0000000002$$

The plotted residuals overlaid by the quadratic term of Equation 3 are given in Figure 2. The times of minimum light and the linear residuals are given as Table 2.

4. Light curves

The light curves were phased using Equation 2. These are given as Figures 3a and 3b. A table of light curve characteristics are given in Table 3. The primary amplitudes of this EB system averaged 0.7–0.6 magnitude in the primary from B to I, respectively, and ~0.4 magnitude in the secondary eclipse. The O'Connell effect (difference of magnitudes Max I and Max II, O'Connell 1951) was small, but consistently positive at 0.3–1.4%. These values were mostly within the errors. Thus, we expect the binary is undergoing some magnetic activity. The secondary eclipse showed a time of constant light of 41.5 minutes. This means that the eclipses are total and that the more massive, larger star is the hotter component. This is to be expected in normal stellar evolution.

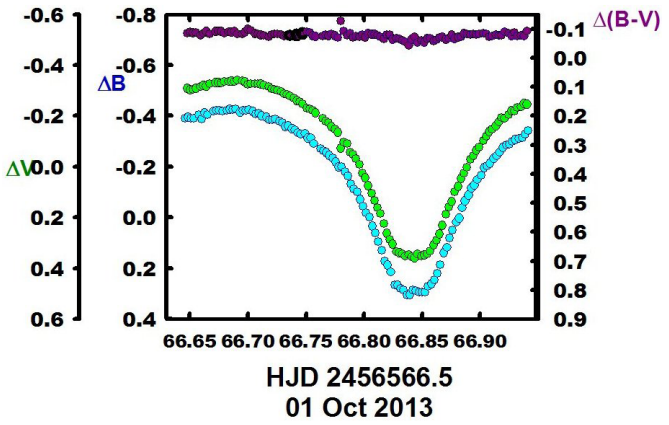

Figure 1a. B, V delta magnitudes from sample observations and color curves on October 1, 2013.

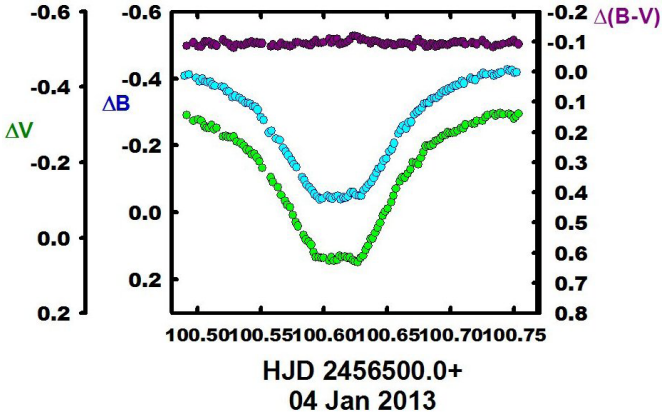

Figure 1b. B, V delta magnitudes and color curves on May 11, 2012.

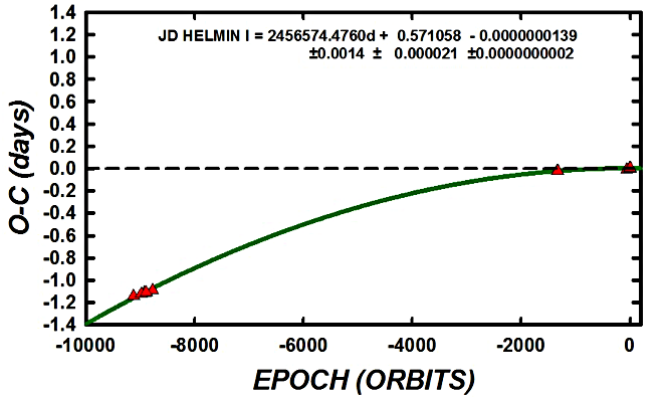

Figure 2. Linear and Quadratic O–C residuals from the period study.

5. Synthetic light curve solution

As before, we used the 2MASS Photometry J–K value of 0.258 to determine the temperature of the binary. From this we found that the primary component was an F4V type, thus we assigned the primary component a surface temperature of ~6750 K in our light curve solution. The system was pre-modeled with BINARY MAKER 3.0 (Bradstreet and Steelman 2002). We used these results as starting values for the Wilson-

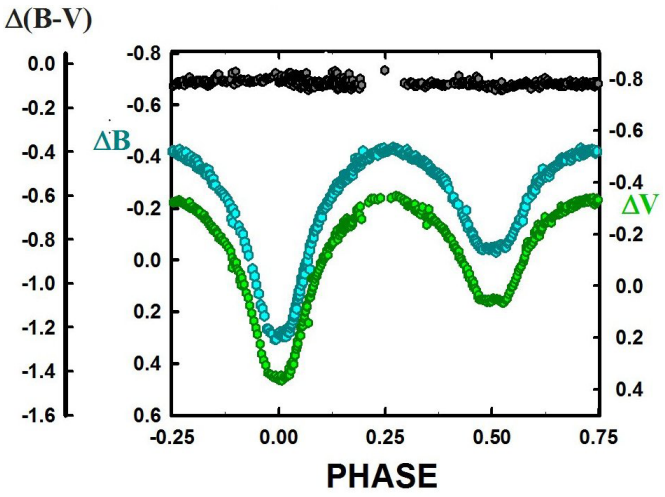

Figure 3a. B, V delta magnitude and color magnitudes vs. phase plots in the sense of V–C.

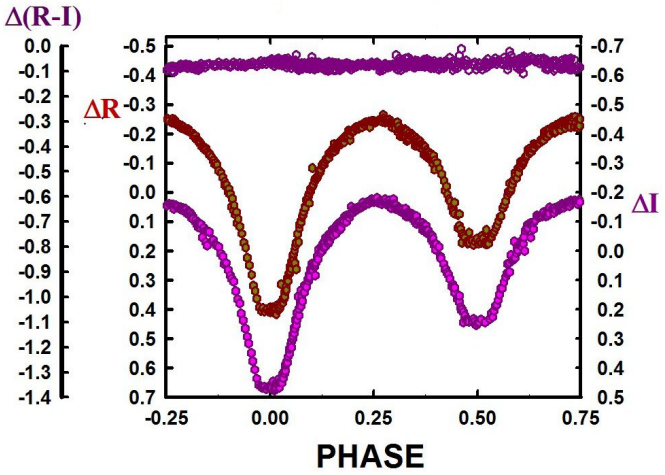

Figure 3b. R_c, I_c delta magnitude and color magnitudes vs. phase plots in the sense of V–C.

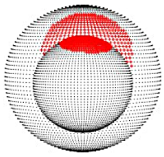

Figure 4a. Roche Lobe surfaces from our BVRI solution, phase 0.00 (the primary eclipse).

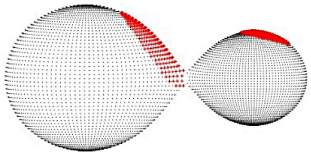

Figure 4b. Roche Lobe surfaces from our BVRI solution, phase 0.25.

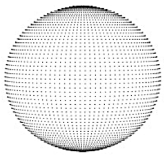

Figure 4c. Roche Lobe surfaces from our BVRI solution, phase 0.50.

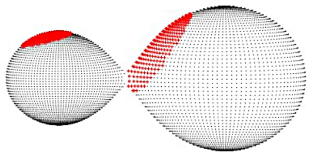

Figure 4d. Roche Lobe surfaces from our BVRI solution, phase 0.75.

Devinney program. A simultaneous four-color synthetic light curve solution was obtained with the Wilson-Devinney program (Wilson and Devinney 1971; Wilson 1990, 1994, 2001, 2004; Van Hamme and Wilson 1998, 2003). We note that one surface spot stayed remarkably stable throughout the iterations and is near the L_1 position of the primary component. Third light

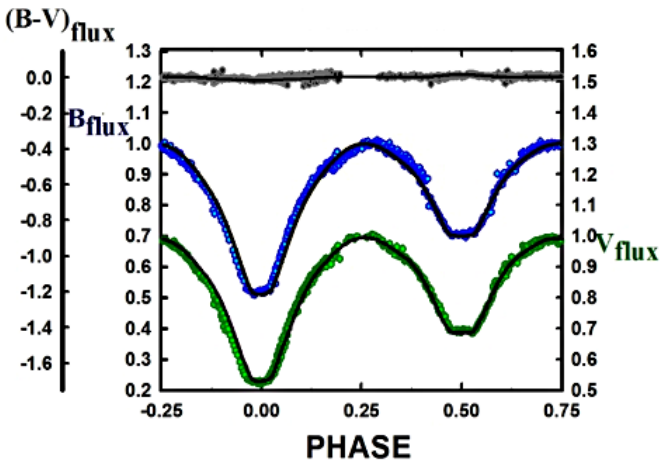

Figure 5a. B, V synthetic light curve solutions overlaying the normalized flux curves.

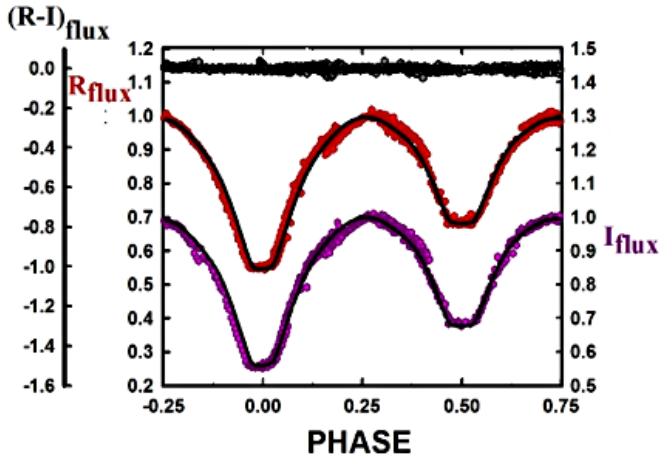

Figure 5b. R_c, I_c synthetic light curve solutions overlaying the normalized flux curves.

was small but still persisted. No q-search was needed since the curves display total eclipses. Mode 4 was used in our initial iterations as before, but the iterations took the solution into contact. We switched to mode 3 and the program proceeded in this configuration with no problems. The solution converged in contact. Since the binary is in contact and undergoes total eclipses, the mass ratio is well determined (Terrell and Wilson 2005). The synthetic light curve solution is given in Table 4. A geometrical representation of the system is given in Figures 4a, b, c, d, so that the reader may visualize the placement of the spots and the relative size of the stars as compared to the orbit. The normalized curves overlain by our light curve solutions are shown as Figures 5a and 5b.

6. Conclusion

Our present curves reveal the early-type V530 And system as a totally eclipsing, marginal contact, magnetically active binary. This is opposed to the semidetached, near-contact configuration that our earlier sparse but complete curves gave. In our new, extended period study over a 14.25 year interval, we find a continuously decreasing period. This fits the scenario

of magnetic braking for solar-type binaries. The temperatures of the primary and secondary components are estimated at 6750 and 6030 K, respectively, which is arguably hot for solar-type binaries. However, our earlier studies show that spots persist into early F-type and even late A-type binaries (Samec 2015). Our third light model gave a fill-out of only 5% (the no-third-light solution gave 4%). The mass ratio, M_2/M_1, was found to be 0.386. Two star spots, probably magnetic in origin, were determined. There is a large temperature difference in components showing that the binary has not yet achieved thermal contact. This suggests that the system has just recently come into contact. It is possible that the binary came into contact in the last two years. However, no "red novae" are on record in this vicinity (Tylenda *et al.* 2011). But with our present curves with their night-to-night variations, we are unable to make such a definite determination. It may also be true that our early observations covering only two observing days may have allowed a better "picture" of the binary without the variability to better constrain the solution. The third light may indicate a third body is present, which may lead us to believe that the period changes may be a part of a sinusoidal variation. Further eclipse timings are needed over the next decade or so to give a firm handle on the orbital period evolution. Also, radial velocity curves are needed to affirm or disaffirm our solution and to obtain absolute (not relative) system parameters. Spectroscopy or standard star photometry will yield a precision temperature of the binary.

7. Acknowledgements

We wish to thank Dr. Caton for joining our research team of observers and we appreciate him scheduling us in for regular observations at Dark Sky Observatory on his 32- and 18-inch research grade instruments.

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Table 1. V530 And Observations ΔB, ΔV, ΔRc, and ΔIc, variable minus comparison star.

Δ*B*	*HJD 2456500+*	Δ*B*	*HJD 2456500+*	Δ*B*	*HJD 2456500+*	Δ*B*	*HJD 2456500+*	Δ*B*	*HJD 2456500+*
–0.389	66.6460	–0.350	67.9021	–0.306	100.5477	0.096	101.5074	–0.413	161.6834
–0.326	100.6829	–0.375	100.5193	–0.426	100.7446	–0.431	161.6619	–0.070	66.7969
–0.381	75.0359	–0.392	100.7086	–0.415	161.6404	–0.270	66.7627	–0.112	74.9715
–0.327	100.6810	–0.378	161.6190	–0.386	66.7236	0.195	74.9448	–0.039	100.6130
–0.305	161.5976	–0.424	66.6868	0.050	67.9472	–0.096	100.5846	–0.396	101.5847
–0.394	66.6486	–0.327	67.9043	–0.284	100.5501	0.084	101.5096	–0.410	161.6851
–0.087	66.8901	–0.373	100.5212	–0.423	100.7465	–0.436	161.6636	–0.044	66.7994
–0.306	161.5959	–0.385	100.7105	–0.406	161.6421	–0.262	66.7652	–0.123	74.9734
–0.340	100.6848	–0.386	161.6207	–0.378	66.7272	0.176	74.9468	–0.044	100.6153
–0.326	161.5992	–0.427	66.6893	0.162	67.9495	–0.081	100.5865	–0.366	101.5870
–0.389	66.6510	–0.306	67.9066	–0.275	100.5523	0.055	101.5119	–0.397	161.6867
–0.116	66.8926	–0.361	100.5232	–0.424	100.7484	–0.429	161.6653	–0.018	66.8019
–0.421	75.0379	–0.400	100.7157	–0.428	161.6438	–0.255	66.7677	–0.128	74.9754
–0.342	100.6867	–0.389	161.6223	–0.372	66.7297	0.155	74.9487	–0.043	100.6172
–0.326	161.6009	–0.414	66.6935	0.286	74.9233	–0.075	100.5885	–0.136	101.6145
–0.390	66.6535	–0.292	67.9088	–0.238	100.5566	0.016	101.5151	–0.399	161.6884
–0.127	66.8951	–0.361	100.5251	–0.416	100.7503	–0.423	161.6669	0.035	66.8073
–0.408	100.4902	–0.397	100.7175	–0.422	161.6454	–0.244	66.7702	–0.148	74.9773
–0.341	100.6887	–0.384	161.6240	–0.357	66.7322	0.122	74.9507	–0.047	100.6191
–0.332	161.6025	–0.421	66.6960	0.278	74.9252	–0.067	100.5904	–0.192	101.7304
–0.403	66.6577	–0.257	67.9122	–0.244	100.5585	0.036	101.5184	–0.400	161.6900
–0.399	67.8793	–0.344	100.5277	–0.418	100.7522	–0.431	161.6685	0.062	66.8098
–0.412	100.4935	–0.396	100.7195	–0.429	161.6471	–0.234	66.7734	–0.165	74.9793
–0.348	100.6906	–0.392	161.6256	–0.360	66.7347	0.108	74.9526	–0.059	100.6214
–0.340	161.6042	–0.421	66.6985	0.290	74.9272	–0.055	100.5923	–0.124	101.7327
–0.386	66.6602	–0.245	67.9145	–0.220	100.5623	–0.310	101.5626	–0.390	161.6917
–0.390	67.8826	–0.347	100.5300	0.278	101.4882	–0.426	161.6702	0.095	66.8123
–0.401	100.4994	–0.410	100.7239	–0.417	161.6487	–0.218	66.7759	–0.178	74.9812
–0.357	100.6925	–0.393	161.6273	–0.349	66.7382	0.070	74.9548	–0.059	100.6233
–0.337	161.6058	–0.423	66.7010	0.283	74.9291	–0.048	100.5947	–0.110	101.7368
–0.411	66.6627	–0.229	67.9167	–0.215	100.5650	–0.313	101.5651	–0.402	161.6933
–0.390	67.8849	–0.341	100.5335	0.280	101.4911	–0.423	161.6719	0.130	66.8156
–0.390	100.5020	–0.415	100.7258	–0.432	161.6504	–0.198	66.7784	–0.195	74.9832
–0.362	100.6944	–0.401	161.6289	–0.345	66.7407	0.042	74.9567	–0.052	100.6252
–0.346	161.6075	–0.417	66.7044	0.273	74.9311	–0.040	100.5966	–0.099	101.7390
–0.405	66.6652	–0.190	67.9189	–0.192	100.5680	–0.324	101.5673	–0.390	161.6950
–0.382	67.8871	–0.335	100.5356	0.252	101.4933	–0.423	161.6735	0.173	66.8181
–0.398	100.5043	–0.412	100.7277	–0.419	161.6520	–0.199	66.7808	–0.205	74.9851
–0.361	100.6963	–0.391	161.6306	–0.333	66.7432	0.021	74.9587	–0.049	100.6277
–0.346	161.6091	–0.406	66.7069	0.276	74.9331	–0.041	100.5985	–0.069	101.7426
–0.418	66.6706	–0.161	67.9327	–0.182	100.5699	–0.333	101.5696	–0.390	161.6966
–0.368	67.8893	–0.326	100.5381	0.233	101.4957	–0.411	161.6752	0.188	66.8206
–0.391	100.5062	–0.414	100.7323	–0.423	161.6537	–0.180	66.7838	–0.206	74.9871
–0.368	100.6982	–0.399	161.6322	–0.328	66.7457	0.007	74.9606	–0.050	100.6296
–0.359	161.6108	–0.409	66.7094	0.266	74.9350	–0.049	100.6028	–0.023	101.7449
–0.422	66.6731	–0.145	67.9349	–0.170	100.5718	–0.288	101.5719	–0.384	161.6983
–0.352	67.8924	–0.327	100.5400	0.211	101.4980	–0.412	161.6768	0.216	66.8231
–0.388	100.5082	–0.407	100.7342	–0.421	161.6553	–0.162	66.7863	–0.225	74.9890
–0.369	100.7003	–0.412	161.6339	–0.331	66.7493	–0.022	74.9637	–0.067	100.6315
–0.362	161.6124	–0.400	66.7119	0.264	74.9370	–0.044	100.6047	–0.048	101.7495
–0.421	66.6756	–0.120	67.9371	–0.156	100.5745	–0.282	101.5746	–0.384	161.6999
–0.354	67.8946	–0.324	100.5419	0.189	101.5004	–0.418	161.6785	0.266	66.8264
–0.391	100.5101	–0.412	100.7361	–0.425	161.6570	–0.131	66.7888	–0.227	74.9910
–0.377	100.7022	–0.407	161.6355	–0.312	66.7518	–0.055	74.9656	–0.074	100.6335
–0.370	161.6141	–0.394	66.7161	0.254	74.9390	–0.042	100.6066	–0.044	101.7587
–0.419	66.6781	–0.110	67.9394	–0.144	100.5764	–0.329	101.5768	–0.375	161.7016
–0.349	67.8969	–0.316	100.5439	0.152	101.5026	–0.414	161.6801	0.268	66.8289
–0.381	100.5121	–0.415	100.7380	–0.428	161.6586	–0.111	66.7913	–0.243	74.9929
–0.379	100.7041	–0.413	161.6371	–0.314	66.7543	–0.069	74.9676	–0.084	100.6354
–0.365	161.6157	–0.385	66.7186	0.248	74.9409	–0.047	100.6092	–0.050	101.7682
–0.421	66.6818	–0.063	67.9427	–0.135	100.5783	–0.393	101.5799	–0.377	161.7032
–0.354	67.8991	–0.316	100.5458	0.136	101.5048	–0.427	161.6818	0.280	66.8314
–0.378	100.5140	–0.418	100.7399	–0.430	161.6603	–0.100	66.7944	–0.249	74.9948
–0.382	100.7067	–0.410	161.6388	–0.290	66.7568	–0.084	74.9695	–0.090	100.6373
–0.375	161.6174	–0.385	66.7211	0.223	74.9429	–0.049	100.6111	–0.031	101.7705
–0.425	66.6843	–0.016	67.9450	–0.105	100.5827	–0.385	101.5822	–0.383	161.7049

Table continued on following pages

Table 1. V530 And Observations ΔB, ΔV, ΔRc, and ΔIc, variable minus comparison star, cont.

ΔB	HJD 2456500+	ΔB	HJD 2456500+	ΔB	HJD 2456500+	ΔB	HJD 2456500+	ΔB	HJD 2456500+
0.286	66.8339	–0.294	75.0046	–0.206	100.6555	–0.321	101.8379	–0.295	161.7331
–0.263	74.9968	–0.155	100.6471	–0.316	101.8261	–0.322	161.7265	0.019	66.8796
–0.104	100.6393	–0.237	101.8115	–0.336	161.7199	0.140	66.8689	–0.367	75.0301
0.066	101.7765	–0.357	161.7132	0.262	66.8582	–0.354	75.0223	–0.304	100.6751
–0.371	161.7066	0.295	66.8476	–0.330	75.0143	–0.268	100.6669	–0.295	161.5910
0.307	66.8370	–0.312	75.0065	–0.235	100.6586	–0.324	101.8422	–0.287	161.7348
–0.276	74.9987	–0.160	100.6490	–0.243	101.8285	–0.312	161.7282	0.004	66.8821
–0.118	100.6412	–0.313	101.8155	–0.332	161.7215	0.119	66.8715	–0.361	75.0320
–0.014	101.7788	–0.345	161.7149	0.247	66.8607	–0.353	75.0242	–0.312	100.6772
–0.365	161.7083	0.294	66.8501	–0.329	75.0163	–0.270	100.6688	–0.294	161.5926
0.305	66.8395	–0.296	75.0085	–0.245	100.6605	–0.015	101.8462	–0.293	161.7365
–0.281	75.0007	–0.181	100.6517	–0.239	101.8307	–0.314	161.7298	–0.037	66.8846
–0.130	100.6431	–0.273	101.8195	–0.331	161.7232	0.081	66.8739	–0.395	75.0340
–0.151	101.8068	–0.342	161.7166	0.220	66.8632	–0.358	75.0262	–0.325	100.6791
–0.372	161.7099	0.295	66.8526	–0.326	75.0182	–0.292	100.6713	–0.309	161.5943
0.286	66.8420	–0.311	75.0104	–0.258	100.6624	–0.269	161.5877	–0.179	161.7381
–0.296	75.0026	–0.189	100.6536	–0.352	101.8339	–0.300	161.7315	–0.065	66.8871
–0.136	100.6451	–0.302	101.8238	–0.335	161.7248	0.051	66.8764		
–0.210	101.8093	–0.335	161.7182	0.186	66.8657	–0.358	75.0281		
–0.362	161.7116	0.271	66.8551	–0.334	75.0203	–0.300	100.6732		
0.289	66.8445	–0.330	75.0124	–0.251	100.6650	–0.279	161.5893		

ΔV	HJD 2456500+	ΔV	HJD 2456500+	ΔV	HJD 2456500+	ΔV	HJD 2456500+	ΔV	HJD 2456500+
–0.308	66.6478	–0.042	66.8943	–0.124	74.9885	–0.058	100.6465	–0.111	101.6199
0.159	66.8732	–0.015	74.9729	0.048	100.6309	–0.401	101.5905	–0.259	66.7424
0.153	74.9562	0.052	100.6142	–0.262	101.5689	–0.306	66.7203	–0.336	67.8407
0.052	100.5959	–0.125	101.5410	–0.333	66.6977	–0.245	66.9404	–0.232	75.0217
0.115	101.5112	–0.330	66.6749	–0.193	66.9186	–0.197	75.0060	–0.169	100.6662
–0.302	66.6503	–0.063	66.8968	–0.119	74.9904	–0.069	100.6484	–0.205	101.6224
0.138	66.8757	–0.039	74.9748	0.033	100.6328	–0.361	101.5952	–0.255	66.7449
0.127	74.9581	0.051	100.6166	–0.257	101.5712	–0.303	66.7228	–0.332	67.8620
0.054	100.5978	–0.153	101.5442	–0.324	66.7002	–0.315	67.8232	–0.247	75.0237
0.076	101.5134	–0.329	66.6773	–0.190	66.9211	–0.204	75.0079	–0.181	100.6681
–0.304	66.6528	–0.076	66.8993	–0.146	74.9924	–0.076	100.6503	–0.339	101.6281
0.099	66.8782	–0.052	74.9768	0.022	100.6348	–0.323	101.5982	–0.246	66.7474
0.096	74.9601	0.054	100.6185	–0.240	101.5761	–0.301	66.7253	–0.328	67.8645
0.054	100.5997	–0.164	101.5485	–0.326	66.7027	–0.318	67.8254	–0.260	75.0256
0.143	101.5167	–0.335	66.6798	–0.203	66.9244	–0.204	75.0099	–0.200	100.6700
–0.308	66.6553	–0.101	66.9027	–0.155	74.9943	–0.093	100.6529	–0.372	101.6310
0.079	66.8813	–0.062	74.9787	0.004	100.6367	–0.337	101.6023	–0.229	66.7510
0.081	74.9620	0.053	100.6204	–0.261	101.5784	–0.295	66.7289	–0.324	67.8670
0.062	100.6040	–0.198	101.5523	–0.326	66.7061	–0.330	67.8276	–0.264	75.0276
–0.029	101.5207	–0.335	66.6835	–0.220	66.9269	–0.217	75.0118	–0.198	100.6726
–0.315	66.6594	–0.118	66.9053	–0.172	74.9962	–0.111	100.6548	–0.348	101.6350
0.047	66.8838	–0.077	74.9807	0.002	100.6386	–0.337	101.6059	–0.226	66.7535
0.044	74.9651	0.060	100.6227	–0.293	101.5815	–0.287	66.7314	–0.316	67.8695
0.053	100.6059	–0.216	101.5559	–0.326	66.7086	–0.324	67.8299	–0.268	75.0295
–0.027	101.5236	–0.336	66.6860	–0.218	66.9294	–0.221	75.0138	–0.194	100.6745
–0.319	66.6619	–0.137	66.9077	–0.168	74.9982	–0.130	100.6567	–0.346	101.6384
0.027	66.8863	–0.088	74.9826	–0.012	100.6405	–0.334	101.6101	–0.222	66.7560
0.042	74.9670	0.064	100.6246	–0.288	101.5837	–0.283	66.7339	–0.311	67.8736
0.061	100.6078	–0.223	101.5595	–0.325	66.7111	–0.325	67.8332	–0.274	75.0315
–0.038	101.5276	–0.335	66.6885	–0.233	66.9319	–0.226	75.0157	–0.211	100.6764
–0.316	66.6644	–0.147	66.9102	–0.196	75.0001	–0.148	100.6598	–0.339	101.6417
0.004	66.8888	–0.106	74.9846	–0.026	100.6424	–0.341	101.6138	–0.211	66.7585
0.018	74.9690	0.065	100.6265	–0.308	101.5863	–0.278	66.7364	–0.325	67.8761
0.060	100.6104	–0.248	101.5641	–0.321	66.7136	–0.336	67.8357	–0.275	75.0334
–0.089	101.5324	–0.340	66.6910	–0.236	66.9354	–0.232	75.0177	–0.226	100.6784
–0.327	66.6669	–0.160	66.9137	–0.187	75.0021	–0.160	100.6617	–0.335	101.6455
–0.028	66.8919	–0.111	74.9865	–0.039	100.6443	–0.243	101.6170	–0.190	66.7644
0.002	74.9709	0.054	100.6290	–0.259	101.5885	–0.269	66.7399	–0.314	67.8785
0.048	100.6123	–0.248	101.5666	–0.315	66.7178	–0.327	67.8382	–0.325	100.4919
–0.111	101.5368	–0.337	66.6953	–0.248	66.9379	–0.234	75.0196	–0.242	100.6803
–0.330	66.6724	–0.176	66.9162	–0.180	75.0040	–0.159	100.6636	–0.327	101.6504

Table continued on following pages

Table 1. V530 And Observations ΔB, ΔV, ΔRc, and ΔIc, variable minus comparison star, cont.

Δ*V*	*HJD 2456500+*	Δ*V*	*HJD 2456500+*	Δ*V*	*HJD 2456500+*	Δ*V*	*HJD 2456500+*	Δ*V*	*HJD 2456500+*
–0.178	66.7669	–0.253	67.9006	–0.243	100.5369	–0.326	100.7374	–0.232	101.8300
–0.308	67.8808	–0.291	100.5152	–0.302	100.7169	0.019	101.7803	0.344	66.8544
–0.309	100.4971	–0.278	100.6976	–0.023	101.7383	0.344	66.8331	0.327	74.9404
–0.243	100.6822	–0.191	101.7055	0.162	66.8116	0.362	74.9247	–0.041	100.5776
–0.314	101.6541	–0.048	66.7906	–0.109	67.9342	–0.159	100.5579	0.301	101.4926
–0.172	66.7694	–0.237	67.9036	–0.233	100.5393	–0.330	100.7393	–0.220	101.8322
–0.299	67.8842	–0.268	100.5206	–0.302	100.7188	–0.103	101.8083	0.332	66.8569
–0.313	100.5006	–0.277	100.6995	–0.013	101.7406	0.352	66.8356	0.306	74.9423
–0.244	100.6842	–0.181	101.7103	0.186	66.8141	0.363	74.9266	–0.030	100.5795
–0.315	101.6608	–0.031	66.7930	–0.093	67.9365	–0.147	100.5598	0.294	101.4949
–0.157	66.7719	–0.234	67.9059	–0.231	100.5412	–0.327	100.7412	–0.267	101.8366
–0.297	67.8864	–0.269	100.5225	–0.309	100.7207	–0.150	101.8108	0.309	66.8599
–0.310	100.5033	–0.277	100.7015	0.018	101.7442	0.347	66.8387	0.303	74.9443
–0.248	100.6861	–0.162	101.7136	0.225	66.8173	0.365	74.9286	–0.007	100.5840
–0.276	101.6681	–0.007	66.7962	–0.080	67.9387	–0.134	100.5635	0.267	101.4973
–0.147	66.7751	–0.215	67.9081	–0.221	100.5431	–0.329	100.7458	–0.249	101.8406
–0.290	67.8886	–0.266	100.5245	–0.310	100.7252	–0.170	101.8131	0.290	66.8624
–0.295	100.5056	–0.280	100.7034	0.034	101.7464	0.355	66.8412	0.267	74.9462
–0.257	100.6880	–0.144	101.7169	0.263	66.8198	0.353	74.9305	0.006	100.5859
–0.304	101.6713	0.027	66.7987	–0.065	67.9409	–0.112	100.5662	0.243	101.4995
–0.134	66.7776	–0.212	67.9103	–0.223	100.5452	–0.324	100.7477	–0.245	101.8449
–0.285	67.8909	–0.266	100.5264	–0.319	100.7271	–0.173	101.8182	0.266	66.8649
–0.290	100.5075	–0.283	100.7053	0.052	101.7557	0.360	66.8437	0.244	74.9482
–0.259	100.6900	–0.134	101.7202	0.287	66.8223	0.354	74.9325	0.010	100.5878
–0.236	101.6763	0.045	66.8012	–0.022	67.9443	–0.097	100.5693	0.213	101.5019
–0.072	66.7801	–0.201	67.9138	–0.212	100.5471	–0.316	100.7496	0.362	161.6298
–0.268	67.8939	–0.267	100.5290	–0.324	100.7290	–0.206	101.8222	0.232	66.8674
–0.290	100.5094	–0.290	100.7080	0.082	101.7698	0.345	66.8462	0.223	74.9501
–0.263	100.6919	–0.107	101.7235	0.306	66.8248	0.348	74.9345	0.019	100.5898
–0.297	101.6796	0.076	66.8036	–0.003	67.9465	–0.086	100.5712	0.194	101.5041
–0.096	66.7826	–0.186	67.9160	–0.201	100.5490	–0.322	100.7515	0.363	161.6735
–0.274	67.8962	–0.254	100.5313	–0.329	100.7336	–0.218	101.8254	0.189	66.8707
–0.297	100.5113	–0.289	100.7098	0.030	101.7720	0.353	66.8494	0.190	74.9521
–0.269	100.6937	–0.065	101.7320	0.335	66.8281	0.339	74.9364	0.039	100.5917
–0.252	101.6829	0.105	66.8066	0.034	67.9488	–0.081	100.5731	0.160	101.5064
–0.090	66.7856	–0.185	67.9182	–0.185	100.5513	–0.328	100.7534	0.365	161.7171
–0.261	67.8984	–0.250	100.5347	–0.323	100.7355	–0.238	101.8276	0.159	66.8732
–0.287	100.5133	–0.299	100.7117	0.092	101.7781	0.348	66.8519	0.192	74.9540
–0.271	100.6957	–0.047	101.7342	0.340	66.8306	0.345	74.9384	0.052	100.5936
–0.208	101.7023	0.134	66.8091	0.053	67.9510	–0.060	100.5757	0.139	101.5089
–0.057	66.7880	–0.175	67.9205	–0.189	100.5535	0.319	101.4898	0.353	161.7607

ΔR_c	*HJD 2456500+*	ΔR_c	*HJD 2456500+*	ΔR_c	*HJD 2456500+*	ΔR_c	*HJD 2456500+*	ΔR_c	*HJD 2456500+*
–0.208	66.6472	–0.193	67.890	–0.192	100.511	–0.222	100.725	–0.209	161.6217
–0.214	67.880	–0.192	100.503	–0.199	100.711	–0.188	161.6151	–0.252	66.6972
–0.224	100.491	–0.178	100.703	–0.178	161.6085	–0.247	66.6854	–0.038	67.934
–0.167	100.695	–0.160	161.602	–0.243	66.6743	–0.128	67.913	–0.150	100.534
–0.139	161.595	–0.227	66.6613	–0.158	67.903	–0.172	100.524	–0.237	100.737
–0.211	66.6497	–0.194	67.893	–0.176	100.513	–0.213	100.727	–0.207	161.6233
–0.209	67.884	–0.194	100.505	–0.207	100.717	–0.192	161.6167	–0.251	66.6997
–0.218	100.497	–0.193	100.705	–0.177	161.6101	–0.254	66.6879	–0.022	67.936
–0.170	100.697	–0.162	161.6035	–0.243	66.6768	–0.122	67.916	–0.131	100.537
–0.142	161.597	–0.230	66.6638	–0.149	67.905	–0.160	100.526	–0.225	100.739
–0.215	66.6522	–0.180	67.896	–0.178	100.515	–0.231	100.729	–0.211	161.6250
–0.206	67.886	–0.193	100.507	–0.204	100.718	–0.204	161.6184	–0.246	66.7022
–0.207	100.500	–0.190	100.708	–0.188	161.6118	–0.260	66.6904	–0.003	67.938
–0.180	100.699	–0.172	161.6052	–0.244	66.6793	–0.110	67.918	–0.132	100.539
–0.143	161.599	–0.230	66.6663	–0.144	67.908	–0.158	100.529	–0.224	100.741
–0.215	66.6547	–0.175	67.898	–0.191	100.520	–0.221	100.733	–0.222	161.6266
–0.202	67.888	–0.196	100.509	–0.209	100.720	–0.197	161.6200	–0.240	66.7056
–0.207	100.500	–0.199	100.710	–0.190	161.6134	–0.250	66.6947	0.005	67.940
–0.181	100.701	–0.165	161.6068	–0.250	66.6829	–0.097	67.920	–0.122	100.541
–0.152	161.600	–0.242	66.6718	–0.139	67.910	–0.157	100.531	–0.226	100.745
–0.224	66.6588	–0.167	67.900	–0.183	100.522	–0.233	100.735	–0.223	161.6283

Table continued on following pages

Table 1. V530 And Observations ΔB, ΔV, ΔRc, and ΔIc, variable minus comparison star, cont.

ΔR_c	*HJD 2456500+*	ΔR_c	*HJD 2456500+*	ΔR_c	*HJD 2456500+*	ΔR_c	*HJD 2456500+*	ΔR_c	*HJD 2456500+*
–0.239	66.7081	0.361	74.942	0.167	100.614	–0.083	101.712	–0.176	161.7159
0.049	67.944	0.114	100.586	–0.180	101.588	–0.214	161.6943	0.401	66.8538
–0.122	100.543	0.241	101.511	–0.244	161.6729	0.318	66.8193	–0.176	75.021
–0.237	100.747	–0.245	161.6514	–0.012	66.7850	–0.094	74.996	–0.086	100.670
–0.220	161.6299	–0.159	66.7468	0.064	74.971	0.083	100.642	–0.013	101.813
–0.241	66.7105	0.341	74.944	0.172	100.616	–0.063	101.716	–0.176	161.7176
0.061	67.946	0.124	100.587	–0.224	101.616	–0.216	161.6960	0.392	66.8563
–0.114	100.545	0.262	101.513	–0.249	161.6745	0.337	66.8218	–0.175	75.023
–0.225	100.749	–0.244	161.6530	0.005	66.7875	–0.100	74.998	–0.090	100.672
–0.219	161.6316	–0.156	66.7505	0.049	74.972	0.080	100.644	–0.067	101.817
–0.238	66.7130	0.322	74.946	0.157	100.618	–0.040	101.719	–0.166	161.7192
0.075	67.948	0.142	100.589	–0.265	101.634	–0.214	161.6976	0.372	66.8594
–0.114	100.547	0.169	101.516	–0.242	161.6762	0.362	66.8243	–0.183	75.025
–0.222	100.751	–0.239	161.6547	0.021	66.7900	–0.104	75.000	–0.098	100.674
–0.228	161.6332	–0.151	66.7529	0.024	74.974	0.053	100.646	–0.082	101.821
–0.230	66.7173	0.292	74.948	0.172	100.620	–0.022	101.722	–0.164	161.7209
0.105	67.951	0.147	100.591	–0.239	101.637	–0.210	161.6993	0.363	66.8619
–0.101	100.549	0.004	101.520	–0.237	161.6779	0.392	66.8276	–0.173	75.027
–0.229	100.753	–0.241	161.6563	0.043	66.7925	–0.111	75.002	–0.110	100.676
–0.223	161.6349	–0.139	66.7554	0.026	74.976	0.043	100.648	–0.106	101.825
–0.228	66.7197	0.279	74.950	0.177	100.622	0.057	101.732	–0.159	161.7225
0.392	74.924	0.154	100.593	–0.242	101.641	–0.197	161.7010	0.337	66.8644
–0.078	100.551	0.036	101.531	–0.237	161.6795	0.405	66.8300	–0.194	75.029
0.397	101.489	–0.246	161.6580	0.066	66.7956	–0.116	75.004	–0.124	100.678
–0.223	161.6365	–0.133	66.7579	0.003	74.978	0.030	100.650	–0.108	101.827
–0.223	66.7222	0.253	74.952	0.177	100.624	0.034	101.734	–0.157	161.7242
0.404	74.926	0.170	100.596	–0.242	101.644	–0.204	161.7026	0.300	66.8669
–0.007	100.566	–0.084	101.535	–0.235	161.6812	0.394	66.8325	–0.189	75.031
0.313	101.492	–0.248	161.6597	0.091	66.7981	–0.133	75.006	–0.129	100.680
–0.235	161.6382	–0.111	66.7639	–0.012	74.980	0.010	100.653	–0.105	101.830
–0.218	66.7247	0.239	74.954	0.175	100.626	0.077	101.738	–0.144	161.7259
0.393	74.928	0.174	100.597	–0.209	101.664	–0.194	161.7043	0.270	66.8701
0.007	100.569	–0.140	101.564	–0.238	161.6828	0.406	66.8350	–0.212	75.033
0.376	101.494	–0.249	161.6613	0.116	66.8006	–0.137	75.008	–0.142	100.682
–0.232	161.6398	–0.102	66.7663	–0.018	74.982	–0.001	100.655	–0.119	101.832
–0.216	66.7284	0.215	74.956	0.155	100.629	0.073	101.740	–0.139	161.7275
0.397	74.930	0.171	100.599	–0.202	101.667	–0.199	161.7059	0.236	66.8726
0.022	100.571	–0.142	101.566	–0.234	161.6844	0.399	66.8382	–0.208	75.035
0.356	101.497	–0.248	161.6629	0.140	66.8031	–0.136	75.009	–0.134	100.684
–0.240	161.6414	–0.095	66.7688	–0.027	74.984	–0.006	100.656	–0.148	101.836
–0.206	66.7309	0.197	74.958	0.152	100.631	0.172	101.744	–0.137	161.7292
0.394	74.932	0.165	100.604	–0.186	101.670	–0.193	161.7076	0.210	66.8751
0.029	100.573	–0.150	101.568	–0.241	161.6861	0.407	66.8406	–0.224	100.491
0.333	101.499	–0.242	161.6646	0.171	66.8060	–0.149	75.011	–0.140	100.686
–0.241	161.6431	–0.075	66.7713	–0.048	74.986	–0.028	100.659	–0.153	101.840
–0.204	66.7334	0.171	74.960	0.140	100.632	0.137	101.754	–0.130	161.7309
0.384	74.934	0.178	100.606	–0.161	101.678	–0.190	161.7093	0.184	66.8776
0.049	100.575	–0.161	101.571	–0.226	161.6878	0.408	66.8431	–0.218	100.497
0.303	101.501	–0.254	161.6663	0.188	66.8085	–0.167	75.013	–0.150	100.688
–0.241	161.6448	–0.067	66.7745	–0.048	74.988	–0.042	100.661	–0.167	101.844
–0.197	66.7359	0.141	74.962	0.133	100.634	0.149	101.772	–0.112	161.7325
0.391	74.936	0.168	100.607	–0.132	101.701	–0.183	161.7109	–0.220	67.873
0.064	100.577	–0.132	101.578	–0.214	161.6894	0.400	66.8456	–0.189	75.031
0.276	101.504	–0.248	161.6679	0.223	66.8110	–0.156	75.015	–0.154	100.690
–0.242	161.6464	–0.051	66.7770	–0.053	74.990	–0.056	100.663	–0.112	161.587
–0.183	66.7394	0.108	74.965	0.121	100.636	0.128	101.778	–0.117	161.7342
0.384	74.938	0.158	100.610	–0.127	101.704	–0.183	161.7126	–0.223	67.876
0.072	100.579	–0.194	101.583	–0.215	161.6910	0.396	66.8488	–0.212	75.033
0.260	101.506	–0.247	161.6696	0.249	66.8135	–0.163	75.017	–0.164	100.692
–0.243	161.6481	–0.026	66.7795	–0.068	74.992	–0.050	100.666	–0.118	161.590
–0.179	66.7419	0.097	74.967	0.111	100.638	–0.003	101.808	–0.115	161.7358
0.377	74.940	0.175	100.612	–0.102	101.709	–0.176	161.7142	–0.217	67.878
0.120	100.584	–0.203	101.586	–0.212	161.6927	0.415	66.8513	–0.208	75.035
0.232	101.508	–0.248	161.6712	0.281	66.8168	–0.165	75.019	–0.164	100.693
–0.244	161.6497	–0.027	66.7820	–0.070	74.994	–0.068	100.668	–0.136	161.594
–0.171	66.7443	0.083	74.969	0.097	100.640	–0.032	101.810	–0.110	161.7375

Table continued on following pages

Table 1. V530 And Observations ΔB, ΔV, ΔRc, and ΔIc, variable minus comparison star, cont.

ΔI_c	*HJD 2456500+*	ΔI_c	*HJD 2456500+*	ΔI_c	*HJD 2456500+*	ΔI_c	*HJD 2456500+*	ΔI_c	*HJD 2456500+*
–0.133	66.647	–0.059	66.9344	–0.072	100.5340	0.134	101.5192	–0.156	161.6824
0.087	66.8983	–0.144	100.5026	–0.172	100.7509	–0.170	161.6609	0.164	66.798
–0.094	75.0188	–0.147	100.7181	–0.157	161.6395	–0.037	66.763	0.420	74.9415
–0.098	100.6893	–0.120	161.6180	–0.145	66.724	–0.080	67.8997	0.242	100.6033
–0.073	161.5966	–0.170	66.687	–0.156	67.8660	0.094	100.5724	–0.158	101.6435
–0.120	66.649	–0.077	66.9369	–0.079	100.5362	0.092	101.5305	–0.157	161.6841
0.064	66.9017	–0.136	100.5049	–0.175	100.7527	–0.169	161.6626	0.178	66.800
–0.091	75.0209	–0.141	100.7200	–0.159	161.6411	–0.025	66.766	0.412	74.9434
–0.104	100.6912	–0.127	161.6197	–0.128	66.728	–0.048	67.9027	0.232	100.6052
–0.073	161.5982	–0.167	66.690	–0.151	67.8685	0.121	100.5750	–0.177	101.6484
–0.121	66.652	–0.073	66.9394	–0.069	100.5387	0.083	101.5394	–0.147	161.6857
0.052	66.9042	–0.133	100.5068	0.454	101.4889	–0.160	161.6642	0.214	66.803
–0.094	75.0228	–0.149	100.7245	–0.162	161.6427	–0.020	66.768	0.390	74.9453
–0.122	100.6931	–0.129	161.6213	–0.133	66.730	–0.031	67.9072	0.240	100.6071
–0.080	161.5999	–0.161	66.694	–0.149	67.8725	0.123	100.5769	–0.147	101.6521
–0.128	66.654	–0.080	66.9419	–0.073	100.5406	–0.071	101.5632	–0.144	161.6874
0.040	66.9067	–0.132	100.5087	0.430	101.4939	–0.171	161.6659	0.237	66.806
–0.102	75.0248	–0.153	100.7264	–0.169	161.6444	–0.014	66.771	0.379	74.9473
–0.117	100.6950	–0.131	161.6230	–0.124	66.733	–0.019	67.9094	0.253	100.6097
–0.088	161.6015	–0.168	66.697	–0.147	67.8750	0.142	100.5788	–0.136	101.6588
–0.144	66.658	–0.143	67.8223	–0.067	100.5424	–0.069	101.5657	–0.148	161.6890
0.028	66.9092	–0.145	100.5106	0.419	101.4963	–0.173	161.6675	0.265	66.808
–0.096	75.0267	–0.162	100.7283	–0.164	161.6460	0.008	66.774	0.361	74.9493
–0.117	100.6969	–0.132	161.6246	–0.117	66.735	0.460	74.9238	0.246	100.6116
–0.094	161.6032	–0.156	66.699	–0.137	67.8775	0.164	100.5833	–0.136	101.6628
–0.130	66.661	–0.148	67.8245	–0.059	100.5445	–0.083	101.5680	–0.143	161.6907
0.007	66.9126	–0.127	100.5126	0.385	101.4986	–0.177	161.6692	0.292	66.811
–0.119	75.0287	–0.160	100.7329	–0.170	161.6477	0.018	66.777	0.334	74.9512
–0.121	100.6988	–0.141	161.6263	–0.106	66.739	0.457	74.9258	0.243	100.6135
–0.090	161.6048	–0.162	66.702	–0.142	67.8799	0.173	100.5852	–0.119	101.6660
–0.140	66.663	–0.150	67.8267	–0.039	100.5464	–0.082	101.5703	–0.142	161.6923
–0.001	66.9151	–0.132	100.5145	0.363	101.5010	–0.167	161.6709	0.315	66.813
–0.101	75.0306	–0.163	100.7348	–0.178	161.6494	0.043	66.779	0.309	74.9532
–0.119	100.7008	–0.141	161.6279	–0.099	66.741	0.446	74.9277	0.233	100.6159
–0.087	161.6065	–0.159	66.705	–0.135	67.8833	0.193	100.5871	–0.120	101.6693
–0.151	66.666	–0.149	67.8290	–0.034	100.5483	–0.096	101.5725	–0.131	161.6940
–0.013	66.9176	–0.126	100.5199	0.347	101.5032	–0.161	161.6725	0.348	66.816
–0.114	75.0345	–0.165	100.7367	–0.172	161.6510	0.040	66.782	0.284	74.9553
–0.128	100.7027	–0.142	161.6296	–0.093	66.744	0.469	74.9297	0.243	100.6220
–0.103	161.6081	–0.159	66.708	–0.132	67.8855	0.200	100.5891	–0.057	101.7003
–0.155	66.671	–0.157	67.8321	–0.022	100.5507	–0.118	101.5805	–0.137	161.6956
–0.016	66.9201	–0.119	100.5218	0.320	101.5055	–0.173	161.6742	0.376	66.819
–0.153	75.0365	–0.168	100.7386	–0.168	161.6527	0.065	66.785	0.263	74.9573
–0.122	100.7046	–0.149	161.6312	–0.092	66.746	0.452	74.9317	0.231	100.6283
–0.099	161.6098	–0.156	66.710	–0.115	67.8877	0.209	100.5910	–0.043	101.7035
–0.157	66.674	–0.160	67.8346	–0.006	100.5528	–0.112	101.5828	–0.129	161.6973
–0.026	66.9234	–0.118	100.5238	0.300	101.5080	–0.163	161.6758	0.405	66.821
–0.141	75.0384	–0.173	100.7405	–0.169	161.6543	0.084	66.787	0.234	74.9592
–0.139	100.7073	–0.152	161.6329	–0.080	66.750	0.454	74.9336	0.212	100.6302
–0.106	161.6114	–0.151	66.713	–0.109	67.8900	0.221	100.5929	–0.023	101.7083
–0.160	66.676	–0.154	67.8371	0.018	100.5591	–0.125	101.5854	–0.131	161.6989
–0.040	66.9258	–0.093	100.5257	0.280	101.5102	–0.161	161.6775	0.435	66.824
–0.147	100.4910	–0.172	100.7452	–0.173	161.6560	0.095	66.790	0.210	74.9612
–0.134	100.7092	–0.149	161.6345	–0.069	66.753	0.438	74.9356	0.226	100.6321
–0.119	161.6131	–0.144	66.717	–0.101	67.8930	0.235	100.5952	–0.015	101.7116
–0.165	66.679	–0.164	67.8396	0.063	100.5655	–0.171	101.6330	–0.134	161.7006
–0.054	66.9283	–0.100	100.5283	0.253	101.5125	–0.165	161.6791	0.457	66.827
–0.144	100.4965	–0.172	100.7471	–0.181	161.6576	0.104	66.792	0.198	74.9642
–0.150	100.7111	–0.152	161.6362	–0.069	66.755	0.448	74.9375	0.205	100.6341
–0.121	161.6147	–0.143	66.719	–0.091	67.8952	0.236	100.5971	0.025	101.7148
–0.162	66.683	–0.155	67.8610	0.074	100.5686	–0.163	101.6364	–0.125	161.7022
–0.053	66.9308	–0.094	100.5306	0.155	101.5158	–0.161	161.6808	0.461	66.830
–0.143	100.4999	–0.170	100.7490	–0.165	161.6593	0.136	66.795	0.179	74.9662
–0.139	100.7162	–0.165	161.6378	–0.065	66.757	0.446	74.9395	0.188	100.6360
–0.119	161.6164	–0.142	66.722	–0.082	67.8975	0.241	100.5990	0.043	101.7182
–0.163	66.685	–0.144	67.8635	0.081	100.5705	–0.159	101.6397	–0.124	161.7039

Table continued on next page

Table 1. V530 And Observations ΔB, ΔV, ΔRc, and ΔIc, variable minus comparison star, cont.

ΔI_c	*HJD 2456500+*	ΔI_c	*HJD 2456500+*	ΔI_c	*HJD 2456500+*	ΔI_c	*HJD 2456500+*	ΔI_c	*HJD 2456500+*
0.467	66.832	0.467	66.845	0.450	66.859	0.330	66.872	0.188	66.885
0.154	74.9681	0.080	74.9779	0.040	74.9876	–0.031	74.9993	–0.063	75.0090
0.184	100.6379	0.106	100.6477	0.032	100.6591	–0.022	100.6693	–0.078	100.6797
0.061	101.7215	0.201	101.7433	0.013	101.8122	–0.025	101.8291	–0.042	161.5867
–0.120	161.7056	–0.100	161.7139	–0.086	161.7222	–0.056	161.7305	–0.024	161.7387
0.465	66.835	0.475	66.848	0.435	66.861	0.290	66.875	0.171	66.888
0.141	74.9701	0.062	74.9798	0.018	74.9895	–0.045	75.0012	–0.072	75.0110
0.168	100.6398	0.089	100.6496	0.027	100.6610	–0.032	100.6719	–0.079	100.6816
0.113	101.7311	0.243	101.7455	–0.034	101.8166	–0.001	101.8313	–0.042	161.5883
–0.119	161.7072	–0.100	161.7155	–0.076	161.7238	–0.055	161.7321	–0.133	161.7387
0.471	66.838	0.464	66.851	0.408	66.864	0.265	66.877	0.141	66.891
0.117	74.9720	0.044	74.9818	–0.005	74.9915	–0.045	75.0032	–0.076	75.0129
0.148	100.6417	0.077	100.6523	0.023	100.6629	–0.039	100.6738	–0.093	100.6835
0.125	101.7333	0.234	101.7521	–0.015	101.8206	–0.089	101.8350	–0.057	161.5900
–0.107	161.7089	–0.098	161.7172	–0.087	161.7255	–0.052	161.7338	0.122	66.893
0.465	66.840	0.455	66.853	0.381	66.866	0.235	66.880	–0.075	75.0149
0.115	74.9740	0.048	74.9837	–0.014	74.9954	–0.036	75.0051	–0.095	100.6854
0.127	100.6436	0.074	100.6542	0.007	100.6655	–0.048	100.6757	–0.059	161.5916
0.163	101.7374	0.043	101.8074	–0.023	101.8244	–0.046	101.8390	0.103	66.896
–0.100	161.7105	–0.089	161.7188	–0.061	161.7272	–0.043	161.7355	–0.090	75.0168
0.466	66.843	0.466	66.856	0.350	66.870	0.220	66.883	–0.095	100.6873
0.098	74.9759	0.045	74.9857	–0.023	74.9973	–0.035	75.0071	–0.049	161.5933
0.128	100.6457	0.040	100.6561	–0.002	100.6674	–0.071	100.6778		
0.153	101.7397	0.071	101.8099	–0.014	101.8267	–0.075	101.8433		
–0.120	161.7122	–0.097	161.7205	–0.071	161.7288	–0.024	161.7371		

Table 2. V530 And times of minimum light and linear residuals.

No.	*Epochs JD 2400000+*	*Cycles*	*Initial Residuals*	*Linear Residuals**	*Quadratic Residuals*	*Weight*	*Notes*
1	51454.308	–8857.0	–0.0086	—	–0.0048	0.1	Fits to NSVS 6447718 Data
2	51335.399	–9063.0	–0.0083	—	0.0219	0.1	Fits to NSVS 6447718 Data
3	51454.309	–8857.0	–0.0075	—	–0.0037	0.1	Fits to NSVS 6447718 Data
4	51453.159	–8859.0	–0.0036	—	0.0005	0.1	Fits to NSVS 6447718 Data
5	51535.126	–8717.0	–0.0024	—	–0.0159	0.1	Fits to NSVS 6447718 Data
6	51414.193	–8926.5	–0.0064	—	0.0062	0.1	Fits to NSVS 6447718 Data
7	51467.300	–8834.5	–0.0045	—	–0.0035	0.1	Fits to NSVS 6447718 Data
8	51467.301	–8834.5	–0.0035	—	–0.0025	0.1	Fits to NSVS 6447718 Data
9	55830.7281	–1275.5	0.1422	0.0011	0.0016	1.0	Samec *et al.* 2012
10	55832.7460	–1272.0	0.1398	–0.0009	–0.0006	1.0	Samec *et al.* 2012
11	56566.8428	0.0	0.0000	–0.0059	–0.0068	1.0	Present Observations
12	56598.8820	55.5	0.0030	0.0030	0.0030	1.0	Present Observations
13	56600.6111	58.5	0.0004	0.0007	0.0008	1.0	Present Observations
14	56601.7667	60.5	0.0015	0.0020	0.0022	1.0	Present Observations

**The Linear Ephemeris is calculated from CCD determinations only.*

Table 3. V530 And light curve characteristics.

Filter	*Phase*	*Magnitude Min. I*	*Phase*	*Magnitude Max. I*
	0.00		0.25	
B		0.288 ± 0.005		–0.424 ± 0.008
V		0.356 ± 0.007		–0.343 ± 0.005
R		0.399 ± 0.008		–0.245 ± 0.007
I		0.466 ± 0.005		–0.170 ± 0.006
Filter	*Phase*	*Magnitude Min. II*	*Phase*	*Magnitude Max. II*
	0.50		0.75	
B		–0.045 ± 0.007		–0.420 ± 0.006
V		0.055 ± 0.005		–0.330 ± 0.006
R		0.167 ± 0.010		–0.240 ± 0.011
I		0.241 ± 0.007		–0.167 ± 0.007

Filter	*Min. I – Max. I*	*Max. II – Max. I*	*Min. I – Min. II*
B	0.712 ± 0.012	0.005 ± 0.013	0.332 ± 0.012
V	0.699 ± 0.012	0.014 ± 0.011	0.301 ± 0.012
R	0.645 ± 0.015	0.005 ± 0.017	0.233 ± 0.018
I	0.636 ± 0.010	0.003 ± 0.012	0.224 ± 0.012

Table 4. V530 And light curve solution.

Parameters	*Values*
$\lambda_B, \lambda_V, \lambda_R, \lambda_I$ (nm)	440, 550, 640, 790
$x_{bol1,2}$, $y_{bol1,2}$	0.638, 0.638, 0.248, 0.248
$x_{1I,2I}$, $y_{1I,2I}$	0.539, 0.539, 0.281, 0.281
$x_{1R,2R}$, $y_{1R,2R}$	0.624, 0.624, 0.291, 0.291
$x_{1V,2V}$, $y_{1V,2V}$	0.698, 0.698, 0.282, 0.282
$x_{1B,2B}$, $y_{1B,2B}$	0.796, 0.796, 0.255, 0.255
g_1 , g_2	0.32
A_1 , A_2	0.5
Inclination (°)	86.7±0.2
T_1, T_2 (K)	6750, 6030±30
Ω	2.637±0.004
$q(m_2 / m_1)$	0.386±0.004
Fill–outs: $F_1 = F_2$ (%)	5±1
$L_1 / (L_1 + L_2 + L_3)_I$	0.767±0.008
$L_1 / (L_1 + L_2 + L_3)_R$	0.779±0.009
$L_1 / (L_1 + L_2 + L_3)_V$	0.792±0.010
$L_1 / (L_1 + L_2 + L_3)_B$	0.816±0.012
$L_3 / (L_1 + L_2 + L_3)_I$	0.0026± 0.0004
$L_3 / (L_1 + L_2 + L_3)_R$	0.0045±0.0004
$L_3 / (L_1 + L_2 + L_3)_V$	0.0016±0.0004
$L_3 / (L_1 + L_2 + L_3)_B$	0.0072±0.0004
JD_o (days)	2456566.8434±0.0001
Period (days)	0.577233±0.000002
r_1, r_2 (pole)	0.438±0.001, 0.282±0.002
r_1, r_2 (side)	0.468±0.001, 0.294±0.003
r_1, r_2 (back)	0.495±0.002, 0.328±0.005
Spot Parameters	
Spot 1 On STAR 1	*Cool Spot*
Colatitude (°)	57.2±0.3
Longitude (°)	5.3±0.1
Spot radius (°)	36.7±0.1
Spot T-factor	0.844±0.001
Spot 2 On STAR 1	*Hot Spot*
Colatitude (°)	16.7±0.3
Longitude (°)	193±1
Spot radius (°)	31.9±0.1
Spot T-factor	1.397±0.002