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NEW ELEMENTS FOR 80 ECLIPSING BINARIES IV.

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The ASAS-3 (Pojmanski, 2002) and Hipparcos (Perryman et al., 1997) databases have been used as in the previous lists (Otero, 2003) to find new elements for 80 eclipsing binaries. Starting with this paper, the NSVS (Northern Sky Variability Survey) database (Wozniak et al., 2004) has also been used. The NSVS observations were collected by the ROTSE-1 experiment using a robotic system of four unfiltered telephoto lenses equipped with CCD cameras. The spectral response ranges from 450 to 1000 nm covering from mid-B to mid-I Johnson-Cousins photometric passbands. Magnitudes were calibrated against 500-1000 Tycho stars per frame. NSVS data have been combined with ASAS-3 and Hipparcos data to improve the period determinations and a systematic offset of all the ROTSE-1 magnitudes to the V magnitude of the stars has been applied. No amplitude difference has been found in any case so the ranges given are V-band magnitudes. For stars more northern than $+28^\circ$ declination, when neither ASAS nor Hipparcos magnitudes were available, observations from the TASS (Droege, 2003) database have been used in combination with NSVS data. In these cases, extreme care was taken in order to avoid error dates or problems that can arise from the use of this experimental dataset (Droege, 2004). Light curves were cleaned of the dubious observations therein that showed clear deviation from the mean magnitude in the folded light curves, prior to deriving the final elements. Saturated data in ASAS-3 and flagged observations in the Hipparcos Epoch Photometry and the NSVS dataset were also discarded. Hipparcos observations have been transformed to V using a table by the author published electronically in IBVS No. 5482 (Otero, 2003b). The candidate stars were selected from the Hipparcos Variability Annex and the NSV catalogue (Kukarkin and Kholopov, 1982) and its supplement (NSVS) (Kazarovets et al., 1998). Stars classified as eclipsing binaries and those showing mean Hp magnitudes close to the maximum Hp values in the Hipparcos Variability Annex were identified and their ASAS-3 and/or NSVS data subsequently obtained. Stars classified as possible eclipsing systems (of all types) and those with a spectral type between O and G that had no given classification within the NSV catalogues were also checked. The method of bisected chords was used to determine times of minima. The accuracy depends on the quantity and quality of the observations. Elements were found with AVE (Barberá, 1999) and a Microsoft Excel period search utility kindly provided by Patrick Wils (Wils, 2003). Table 1 shows the list of variables. The first column gives the variable star designation according to the GCVS. The following columns give another identifier;

the brightness range of the variable, with the magnitude of secondary eclipse between brackets; the epoch of minimum light derived from the complete dataset; the period; the variability class and the spectral type with a note to the spectral type source.

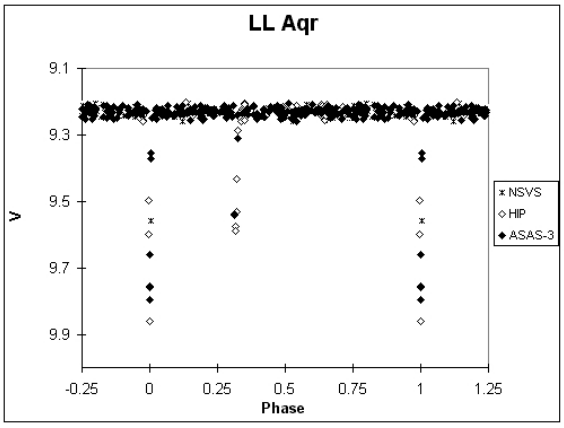

Figure 1. Light curve of LL Aqr showing ASAS-3, Hipparcos and NSVS observations.

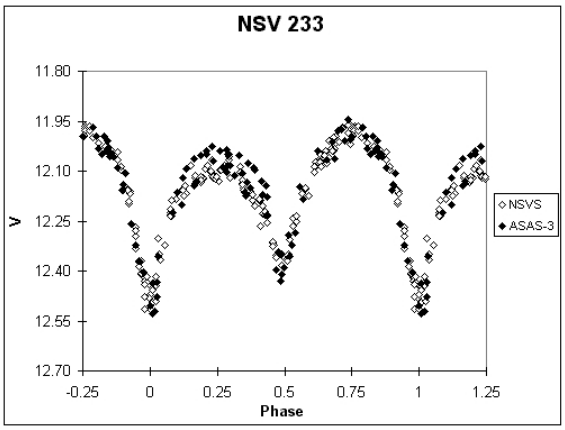

Figure 2. Light curve of NSV 00233 showing ASAS-3 and NSVS observations.

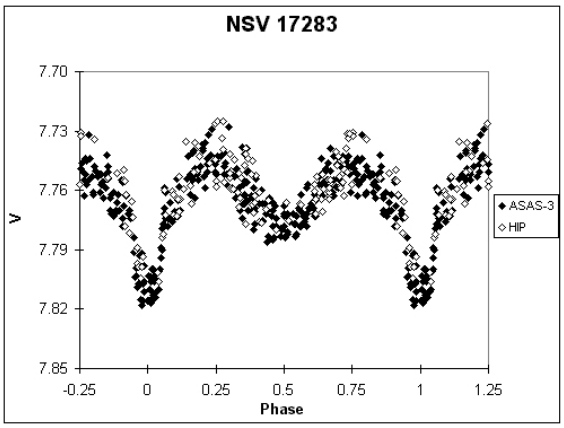

Figure 3. Light curve of NSV 17283 showing ASAS-3 and Hipparcos observations.

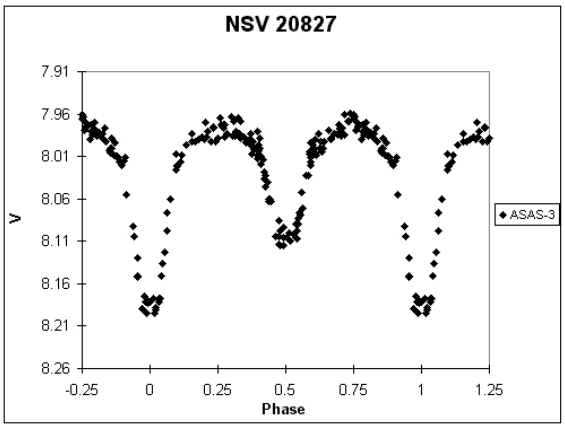

Figure 4. Light curve of NSV 20827 showing ASAS-3 observations.

Acknowledgements: The author wants to thank John Greaves and Patrick Wils for their collaboration and suggestions. This research has made use of the SIMBAD and VizieR databases operated at the Centre de Donnes Astronomiques (Strasbourg) in France and the data from the Northern Sky Variability Survey created jointly by the Los Alamos National Laboratory and University of Michigan. The NSVS was funded by US Department of Energy, the National Aeronautics and Space Administration and the National Science Foundation.

Table 1. New elements for 80 eclipsing binary stars.

Star Name		Magnitude range	Epoch	Period	Type	Spectral type
Variable	Other ID	(V)	(HJD2440000+)	(days)		
AC Pyx *	HIP 041811	7.78 – 8.06 (8.03)	8503.246	7.66793	EA	A0/A1IV (4)
DP Cet *	HIP 010099	6.79 – 6.99 (6.9:)	8686.729	2.36817	EA	A2 (24)
DV Boo *	HIP 070287	7.53 – 7.76 (7.69)	8045.254	3.78264	EA	F1Vm (8)
GZ Dra *	HIP 089243	9.46 – 9.78 (9.6:)	8745.844	2.253355	EA	F0 (24)
GZ UMa	HIP 052892	10.48–11.02(10.98)	11556.830	6.5420	EA	G0 (28)
IL Lib *	HIP 074127	7.56 – 7.84(7.81:)	8443.842	5.76937	EA	F0V (5)
IV Lib *	HIP 076480	8.35 – 8.95 (8.55)	11932.900	6.8617	EA/GS	K1III+(F) (4)
IW CMa	HIP 030583	6.88 – 7.02 (6.99)	8799.850	6.23584	EA	A0V (3)
KV CMa *	HIP 032856	7.16 – 7.40(7.40:)	8353.430	68.3842	EA	B3n (44)
LL Aqr *	HIP 111454	9.23 – 9.86 (9.59)	8762.552	20.1784	EA	G1V (5)
LQ Mus *	HIP 062801	9.04 – 9.66:(9.65)	12712.719	7.50640	EA	F5V (1)
MP Del *	HIP 100981	7.56 – 7.87 (7.81:)	8246.300	21.3387	EA	A3mA8-F3 (27)
NSV 00233*	GSC 0013 0919	11.97–12.52(12.41)	11384.436	4.09242	EB	
NSV 00726	GSC 2317 0163	11.90– 12.5:(12.05)	11437.733	0.88198	EB:	
NSV 01403	GSC 4327 0280	12.30– 14.4 (12.47)	11401.892	1.40856	EA	
NSV 02470	GSC 0714 0391	11.95– 13.32 (12.3)	12896.886	5.5416	EA	
NSV 03443	GSC 9380 1419	12.45– 14.6 (12.65)	11935.585	4.5521	EA	
NSV 03728	GSC 0790 0482	11.32–11.95(11.83:)	12971.806	2.14948	EA	
NSV 04638	GSC 4631 1042	10.57– 10.95(10.85)	11278.439	0.690046	EB	F4(14)
NSV 05040	GSC 3827 0163	12.68– 13.4 (13.4:)	11306.810	3.02405	EA	
NSV 05914	GSC 6110 0930	12.76– 14.7(13.05:)	12086.498	1.78878	EA	
NSV 06157*	HIP 064716	8.77 – 8.98 (8.87)	11955.858	13.4197	EA	B1/2V (1)
NSV 06968	GSC 7830 0775	12.15– 14.2:(12.32)	12441.566	5.4193	EA	
NSV 07178*	HD 139337	9.20 – 9.56 (9.51)	12062.557	3.2300	EA	B9IV (1)
NSV 07400*	HD 143511	8.33 – 8.88 (8.85)	12104.552	5.5354	EA	A0IV/V (1)
NSV 07746	GSC 7348 1787	12.88– 14.2:(13.07)	12924.412	2.918	EA	
NSV 08499	GSC 4568 0313	11.09– 12.00(11.70)	11274.913	0.32540	EW	
NSV 10982*	GSC 5699 2009	9.69 – 9.96 (9.93)	12879.618	4.95232	EA/KE	B1:V:pe (36)
NSV 11243*	HD 172666	10.05–10.55:(10.27)	12104.605	6.4478	EA	A9IV (2)
NSV 11781*	HD 178755	8.60 – 9.05 (8.88:)	12474.633	11.7902	EA	B9V (3)
NSV 12326	GSC 8778 1496	12.76– 13.74(12.9:)	12069.712	0.844598	EA	
NSV 12870*	GSC 2679 2844	10.97– 11.27 (11.2)	11354.500	32.34	EB/GS:	
NSV 13121	GSC 0522 0799	12.25–12.45(12.93:)	12832.775	0.646147	EA	
NSV 13625*		13.4 – 14.1 (13.6)	11282.392	1.31477	EB	
NSV 15234*	HIP 004974	8.78 – 9.0: (8.92:)	12559.740	14.7104	EA	F5/6V (3)
NSV 15375*	HIP 008156	8.44 – 8.54(8.51:)	8648.639	1.69261	EA	F0 (24)
NSV 15730	HIP 017094	9.73 – 10.03(10.0:)	8678.948	3.76674	EA	A4IV (8)
NSV 16199*	HIP 022979	9.07 – 9.20(9.18:)	8181.925	1.528311	EA	A0 (24)
NSV 16296*	HIP 025174	7.08 – 7.14 (7.12)	8188.925	2.22878	EA	B9.5V (5)
NSV 17236*	HIP 033303	8.21 – 8.41 (8.41)	12232.752	0.372457	EW	F6/8+G6/8 (5)
NSV 17283*	HIP 033844	7.73 – 7.82 (7.78)	12942.804	3.37443	EB	A2V (3)
NSV 17436	HIP 035624	8.74 – 8.92 (8.78)	8536.929	1.04776	EA	A2 (24)
NSV 17456*	HIP 035859	7.98 – 8.11 (8.02)	7912.729	2.198515	EA	B9III (3)
NSV 17552	HIP 037455	8.12 – 8.33(8.30:)	8196.000	31.4204	EA	B9.5/A0IV (5)
NSV 17578*	HD 062589	8.11 – 8.35 (8.33)	12540.855	6.3177	EA	B3IVk (45)
NSV 17647*	HIP 038581	8.13 – 8.22 (8.20)	8588.418	7.72461	EA	A0V (5)
NSV 17723*	HIP 039390	9.04 – 9.16 (9.10)	7913.248	1.425902	EA	A0V (3)
NSV 18104*	HD 077207	9.37 – 9.48 (9.47)	12714.620	11.4248	EA	B0IVnp (17)
NSV 18480*	HIP 052362	9.04 – 9.22 (9.22)	8970.460	1.46857	EA	F2V (2)
NSV 18546*	HIP 053209	9.27 – 9.50(9.50:)	8058.296	5.50762	EA	G5IV (42)
NSV 18553*	HIP 053357	9.47 – 9.63 (9.60)	8603.597	2.354858	EA	A7III (24)
NSV 18786*	HIP 056249	7.88 – 7.96 (7.95)	8502.854	5.48793	EA	B9.5V (1)
NSV 19698*	HIP 063245	9.78 – 10.03(9.99:)	8557.320	7.1520	EA	A3 (24)
NSV 19703	GSC 8994 2160	10.44– 10.67(10.65)	11985.818	11.0385	EA	B3-B5 (46)
NSV 19773*	HIP 065380	9.42 – 9.59 (9.50)	8331.778	0.795629	EA	A1V (24)

Table 1. New elements for 80 eclipsing binary stars.

Star Name		Magnitude range	Epoch	Period	Type	Spectral type
Variable	Other ID	(V)	(HJD2440000+)	(days)		
NSV 20174*	HIP 072178	8.66 – 8.75 (8.75)	8347.805	7.06114	EA/DM	F3/F5V (2)
NSV 20433*	HIP 077972	8.67 – 9.06 (8.82)	13170.910	29.6924	EA	F5 (24)
NSV 20782	HIP 082378	7.96 – 8.07 (8.01)	8704.307	4.49244	EA	O9.5IV (39)
NSV 20827*	HD 152333	7.96 – 8.19 (8.11)	12439.649	2.15767	EA/KE	09.5IV (47)
NSV 20894*	HIP 083583	8.87 – 9.03(9.02:)	8005.710	29.3467	EA	B9IV/V (3)
NSV 20913*	HIP 083634	8.26 – 8.43 (8.36)	12787.824	10.8743	EA	A5 (33)
NSV 22984*	HIP 086058	9.04 – 9.15 (9.15)	8604.780	3.10886	EA	A0 (24)
NSV 24620*	HIP 092754	9.68 – 9.96(9.96:)	8017.991	1.21125	EA	G3V (2)
NSV 25862*	HIP 109743	9.09 – 9.25 (9.17)	11450.602	6.00911	EA	B8 (24)
NSV 25928*	HIP 111590	9.84 – 10.04(10.02:)	8305.198	6.15727	EA	B9V (8)
PQ Vel *	HIP 044612	7.63 – 7.81(7.75:)	8256.740	22.2632	EA	A2/3III(m) (2)
PS Ser *	HIP 077045	8.08 – 8.37(8.16:)	8596.364	15.8861	EA/RS	F8+F8 (37)
QR Hya *	HIP 053487	8.39 – 8.70(8.45:)	8948.181	2.502939	EA	G1V (3)
QT Peg	HIP 112058	7.43 – 7.75 (7.46)	8645.097	3.5937	EA	A1V (27)
QY Vel *	HIP 048185	8.13 – 8.30 (8.19)	8753.850	46.390	EA/GS	G5III (2)
V0339 Gem	HIP 035428	8.86 – 9.37 (8.89)	8361.280	2.88032	EA	A3m (32)
V0365 Pup*	HIP 035447	7.82 – 8.60(8.06:)	8202.637	30.0338	EA/DM	A0V (3)
V0392 And*	HIP 116685	9.07 – 9.41 (9.41)	8035.107	4.046275	EA	A2 (24)
V0394 Vul	HIP 097500	8.70 – 8.98 (8.83)	8248.702	3.080315	EA	A3 (24)
V0454 Cep*	HIP 113065	9.04 – 9.30 (9.13)	8313.100	5.58450	EA	B1V (43)
V0467 Car*	HIP 040838	8.02 – 8.45 (8.09)	8692.080	7.04615	EA	B9IV (1)
V0775 Cas*	HIP 008693	9.73 – 10.26(10.07)	8766.027	5.39017	EA	B8V (38)
V0912 Her*	HIP 081967	8.59 – 8.73 (8.72)	8002.955	3.40985	EA	G5 (24)
V1044 Sco*	HIP 078708	8.60 – 9.07 (8.92)	13064.836	0.914833	EA	K0V (4)
V1126 Tau*	HIP 017040	10.37 – 10.54(10.53:)	8527.515	3.38751	EA	F8 (28)

Sources of spectral type: (1) Houk and Cowley, 1975. (2) Houk, 1978. (3) Houk, 1982. (4) Houk and Smith-Moore, 1988. (5) Houk and Swift, 1999. (8) Kennedy, 1983. (14) Kholopov et al., 2003. (17) Buscombe, 1998. (24) Ochsenbein, 1980. (27) Grenier et al., 1999. (28) Kharchenko, 2001. (32) Bartaya, 1987. (33) Cannon and Pickering, 1993. (36) Jaschek et al., 1964. (37) Batten et al., 1989. (38) Boulon and Fehrenbach, 1958. (39) Schild et al., 1969. (42) Glebocki et al., 2000. (43) Hardorp et al., 1959-1965. (44) Rubin et al., 1962. (45) Skiff, 2003. (46) Sundman et al., 1974. (47) Jaschek, 1978.

Notes on individual stars:
AC Pyx = Eccentric system. Visual binary. A=$8\overset{m}{.}0$; B=$10\overset{m}{.}0$ Hp. Sep. $1\overset{m}{.}91$ (Perryman et al., 1997).
DP Cet = Slightly eccentric. Wrong period in the HIP catalogue ($3\overset{d}{.}1748$).
DV Boo = Wrong period of $1\overset{d}{.}26086$ in the HIP catalogue.
GZ Dra = Visual binary. A=$9\overset{m}{.}9$; B=$10\overset{m}{.}9$ Hp. Sep. $0\overset{''}{.}43$ (Perryman et al., 1997).
IL Lib = Primary eclipse might be the secondary.
IV Lib = Wrong period in the HIP catalogue ($6\overset{d}{.}3605$). Changing O'Connell effect. Visual binary. B=$11\overset{m}{.}8$. Sep. $4\overset{''}{.}2$ (Dommanget et Nys, 2002).
KV CMa = Eccentric system. Primary eclipse might be the secondary. Period found with help of visual observations by the author.
LL Aqr = Eccentric system.
LQ Mus = Wrong period in the HIP catalogue ($4\overset{d}{.}0070$). Primary eclipse might be the secondary.
MP Del = Eccentric system.
NSV 00233 = Strong and variable O'Connell effect. Max. II V=$12\overset{d}{.}07$.
NSV 06157 = Eccentric system. Not classified as variable in the HIP catalogue although there were 3 secondary eclipses recorded.
NSV 07178 = Eccentric system.
NSV 07400 = Eccentric system.
NSV 10982 = Classified as a GCAS star in the NSV catalogue (Kukarkin and Kholopov, 1982).
NSV 11243 = Slightly eccentric.
NSV 11781 = Eccentric system.
NSV 12870 = Classified as LB in the NSV catalogue (Kukarkin and Kholopov, 1982). Tycho-2 $B-V$=$0\overset{m}{.}82$ (Hog et al., 2000)

NSV 13625 = Inaccurate position in the GCVS. The star is USNO-A2.0 1275-15145487. UCAC2 (Zacharias et al., 2003) position is $21^h15^m37^s.231$ $+38°02'27''.70$ (2000.0). ROTSE1 magnitudes, no data from TASS.
NSV 15234 = Eccentric system. Visual binary. A=9^m.5; B=9^m.8 Hp. Sep. 0$''$.80 (Perryman et al., 1997).
NSV 15375 = Visual binary. A=9^m.1; B=9^m.8. Sep. 0$''$.2 (Dommanget et Nys, 2002).
NSV 16199 = Visual binary. A=10^m.0; B=9^m.8 Hp. Sep. 0$''$.86 (Perryman et al., 1997).
NSV 16296 = Visual binary. A=7^m.72; B=7^m.98 V (Shatsky et al., 1999). Sep. 4$''$.76 (Perryman et al., 1997)
NSV 17236 = Period given is based only on ASAS-3 data. Possible period change, HIP observations are noisy due to duplicity but only fit at a period of 0^d.372461. Visual binary. A=8^m.6v; B=9^m.84 (Mermilliod et al., 1997). Combined brightness given. Sep. 13$''$.9 (Perryman et al., 1997).
NSV 17283 = Period 1^d.6872 in the HIP catalogue with no variability type.
NSV 17456 = Eccentric system.
NSV 17578 = Eccentric system. Visual binary. A=8^m.6; B=9^m.1 V. Sep. 0$''$.2 (Dommanget et Nys, 2002).
NSV 17647 = ASAS-3 V-magnitudes are 0.05 mag. fainter than Hipparcos V-magnitudes. ASAS mag. were adopted.
NSV 17723 = Visual binary. A=9^m.65; B=10^m.0 Hp. Sep. 8$''$.59 (Perryman et al., 1997).
NSV 18104 = Slightly eccentric.
NSV 18480 = Slightly eccentric system. Primary eclipse might be the secondary.
NSV 18546 = Period might be half the value given. Visual binary. A=9^m.6; B=11^m.9 Hp. Sep 1$''$.12 (Perryman et al., 1997).
NSV 18553 = Koen an Eyer (2002) give a wrong period of 0.5886647 d.
NSV 18786 = Eccentric system.
NSV 19698 = Slightly eccentric.
NSV 19773 = Koen and Eyer (2002) give per = 0.3977978 d.
NSV 20174 = Period might be half the value given. Primary eclipse might be the secondary.
NSV 20433 = Very eccentric system. Total eclipses.
NSV 20827 = Spectroscopic binary with a period of 2^d.1579 in Batten et al., 1989.
NSV 20894 = Period might be half the value given.
NSV 20913 = Eccentric system. Visual binary. A=8^m.6; B=10^m.1 Hp. Sep. 1$''$.44 (Perryman et al., 1997).
NSV 22984 = Primary eclipse might be the secondary.
NSV 24620 = Visual binary. A=9^m.9; B=13^m.3 Hp. Sep. 3$''$.14 (Perryman et al., 1997).
NSV 25862 = Visual binary. A=9^m.2; B=12^m.7 Hp. Sep 0$''$.72 (Perryman et al., 1997).
NSV 25928 = Period might be half the value given.
PQ Vel = Eccentric system. Period 22^d.25 in the HIP catalogue. Very few observations at minimum II.
PS Ser = RS period is 18^d.843 Koen and Eyer (2002) give per= 18^d.769 Known as a spectroscopic binary with a period of 15^d.8880 (Batten et al., 1989) Visual binary. A=8^m.7; B=9^m.3 Hp. Sep. 0$''$.4 (Perryman et al., 1997). B is also a spectroscopic binary. AB-combined light given. The F8+F8 spectrum is for the unresolved A and B stars.
QR Hya = Eccentric system.
QY Vel = Wrong period in the HIP catalogue (9^d.571).
V0365 Pup = Eccentric system. Period 30^d.01 in the HIP catalogue.
V0392 And = Period might be half the value given. Primary eclipse might be the secondary. Visual binary. A=9^m.3; B=11^m.5 Hp. Sep. 2$''$.28 (Perryman et al., 1997). Hipparcos $B-V$ (0^m.14) is wrong. $B-V$ from Tycho-2 is 0^m.42, consistent with TASS V magnitude.
V0454 Cep = Slight apsidal motion. Batten et al. (1989) give a spectroscopic period of 5^d.6556.
V0467 Car = Eccentric system.
V0775 Cas = Eccentric system. Wrong period suggested in the HIP catalogue (2^d.95946).
V0912 Her = Primary eclipse might be the secondary.
V1044 Sco = Visual binary. A=8^m.8; B=11^m.5 Hp. Sep. 10$''$.3 (Perryman et al., 1997). Cutispoto et al. (1999) give spectral type G9V+M0:V+K7:V. According to Woolley et al. (1970), the M0 star is the visual binary.
V1126 Tau = Visual binary. A=10^m.7; B=12^m.5 Hp. Sep. 0$''$.28 (Perryman et al., 1997).

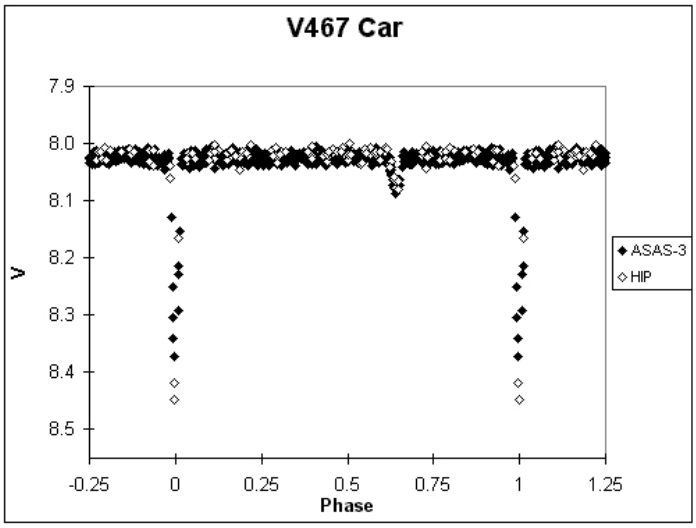

Figure 5. Light curve of V0467 Car showing ASAS-3 and Hipparcos observations.

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Sebastian Otero reported the following error:

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