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HIPPARCOS ECLIPSING BINARIES SHOWING APSIDAL MOTION II.

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Combination of the publicly available Hipparcos data (Perryman et al., 1997) from 1989-1993 with ASAS-3 (Pojmanski, 2002) and NSVS data (Wozniak et al., 2004) allows the detection of apsidal motion in ten eclipsing binaries discovered by the satellite. Table 1 lists the main parameters of the stars. The first column gives the variable star designation. The following columns show the HIP identifier, the V band range (with the secondary eclipse magnitude between brackets), the epoch and period of the primary and secondary eclipse respectively, the variable and spectral types and the source for spectral type following the numbering first adopted in Otero (2003).

Table 1.

Star	HIP identif	V magnitude	Epoch I	Period I	Epoch II	Period II	Type	Sp
KL CMa	HIP 031017	6.73−6.96(6.92:)	8170.261	1.762250	8171.228	1.762168	EA	B8V (4)
LT CMa	HIP 034080	7.43−7.59(7.57:)	8388.537	1.759535	8389.445	1.759503	EA	B5III (4)
MN TrA	HIP 078231	8.49−9.15 (8.99)	8006.360	2.379818	8007.426	2.379833	EA	B9V (1)
NSV 24512	HIP 091113	7.95−8.09 (8.09)	9038.828	2.259775	9039.972	2.259735	EA	B3V (45)
V0397 Pup	HIP 038167	5.94−6.11 (6.03)	8799.646	3.004449	8801.672	3.004390	EA	B9V (3)
V0399 Pup	HIP 038186	9.33−9.57:(9.47)	7889.738	3.91023	7891.862	3.91003	EA	B1Vnn (8)
V0493 Car	HIP 048832	8.87−9.22 (9.13)	7945.724	3.22943	7947.768	3.22937	EA	B9IV (1)
V0529 Car	HIP 054026	8.10−8.48 (8.36)	8157.209	4.74461	8159.970	4.74449	EA	B8V (1)
V0821 Cas	HIP 118223	8.22−8.66 (8.46)	7964.209	1.769754	7965.031	1.769720	EA	A0 (24)
V1081 Sco	HIP 085569	6.98−7.11 (7.05)	7920.528	2.513741	7921.858	2.513664	EA	O9.5V (24)

Sources of spectral type: (1) Houk and Cowley, 1975. (3) Houk, 1982. (4) Houk and Smith-Moore, 1988. (8) Kennedy, 1983. (24) Ochsenbein, 1980. (45) Skiff, 2003.

Notes on individual stars:

KL CMa = Visual binary (HJ 3864), B= 11.0 mag. Sep. $21''.6$ (Worley et al., 1997). The Hipparcos Catalogue gives a period of 1.7622 d. It is the one with the largest apsidal motion.
LT CMa = The Hipparcos Catalogue gives a period of 1.75955 d.
MN TrA = The Hipparcos Catalogue gives a period of 2.37983 d. This is the only case where the $O - C$ values for min II have grown positive.
NSV 24512 = HD 171491. Primary eclipse might be the secondary. Visual binary. A= $8^m.8$; B= $8^m.9$ Hp. Sep $0''.275$ (Perryman et al., 1997)
V0397 Pup = The Hipparcos Catalogue gives a period of 3.00455 d. Few times of minima in ASAS correspond to the time period November 2003 - October 2004 when the camera

focus and exposure time was changed allowing bright stars not to be saturated.
V0399 Pup = The Hipparcos Catalogue gives a period of 3.9102 d
V0493 Car = The Hipparcos Catalogue gives a period of 3.2294 d
V0529 Car = The Hipparcos Catalogue gives a period of 4.7445 d
V0821 Cas = The Hipparcos Catalogue gives a period of 1.76975 d

Hipparcos observations have been transformed to V using a table by the author (Otero, 2003b). The observation regime for both surveys, specially ASAS, implies that times of minima are often based on a single datapoint so they are approximate. Only single observations closer than 0.05 magnitudes to the mideclipse magnitude and closer than 0.05 days to the phase 0 of the folded lightcurve have been used as times of minima to get a sigma in the order of 0.03 days or less depending on the quality and quantity of the observations. On the other hand, the epochs have been determined applying the method of bisected chords on the whole datasets and are very accurate due to the long time span of the observations (1989-2005). Wrong observations (random datapoints deviating >0.05 mag. from the mean folded lightcurve) were discarded before any analysis was made.

Table 2 shows times of minima and residuals for all the stars based on the primary eclipse period to make the phase shift of the secondary eclipse evident.

Table 2.

Star	HJD+2440000	$O-C$	Min	Source*
KL CMa	8171.256	0.028	II	H
	8304.198	0.006	I	H
	8532.505	0.016	II	H
	8652.310	−0.012	II	H
	8661.146	0.013	II	H
	8698.920	−0.016	I	H
	8747.506	0.022	II	H
	12197.796	−0.173	II	A
	12235.747	−0.025	I	A
	12924.839	0.028	I	A
	12997.823	−0.208	II	A
	13043.628	−0.221	II	A
	13256.857	−0.225	II	A
	13294.885	0.001	I	A
	13399.597	−0.227	II	A
	13414.705	−0.012	I	A
	13436.603	−0.228	II	A
LT CMa	8323.409	−0.025	I	H
	8389.416	−0.029	II	H
	8402.644	0.031	I	H
	8590.861	−0.023	I	H
	11980.586	−0.070	II	A
	12250.740	0.024	I	A
	12623.723	−0.015	I	A
	12645.688	−0.072	II	A
	12727.562	0.012	I	A
	13018.677	−0.105	II	A
	13115.503	−0.053	II	A
	13251.900	0.008	I	A
	13362.719	−0.023	I	A
	13444.538	−0.051	II	A
	13466.550	−0.005	I	A

*H = Hipparcos; A = ASAS-3; N = NSVS

Table 2. (cont.)

Star	HJD+2440000	$O-C$	Min	Source*
MN TrA	8006.362	0.002	I	H
	8566.687	0.004	II	H
	8568.021	0.024	I	H
	8680.933	0.019	II	H
	11950.811	0.027	II	A
	12437.605	0.024	I	A
	12790.893	0.033	II	A
	12826.585	0.028	II	A
	12839.748	−0.022	I	A
	13059.824	0.044	II	A
	13391.866	−0.022	I	A
	13454.849	0.020	II	A
NSV 24512	8168.808	−0.007	I	H
	9038.822	−0.006	I	H
	11996.852	−0.021	I	A
	12030.811	0.041	I	A
	12701.902	−0.021	I	A
	12736.870	−0.094	II	A
	12804.694	−0.063	II	A
	13092.868	0.004	I	A
	13127.811	−0.094	II	A
	13290.521	−0.088	II	A
	13298.522	0.018	I	A
	13492.864	0.019	I	A
V0397 Pup	7979.456	0.008	I	H
	8655.450	0.015	I	H
	8697.493	−0.004	I	H
	8801.699	0.027	II	H
	12971.749	−0.098	II	A
	12974.781	−0.071	II	A
	12980.773	−0.088	II	A
V0399 Pup	7891.838	−0.024	II	H
	8116.550	0.019	I	H
	8153.949	0.102	II	H
	8550.550	−0.017	I	H
	8976.765	−0.017	I	H
	11948.581	0.024	I	A
	12239.767	−0.271	II	A
	12720.718	−0.278	II	A
	12724.630	−0.276	II	A
	12730.616	0.013	I	A
	12884.896	−0.330	II	A
	13469.625	−0.011	I	A
	13520.473	0.004	I	A
V0493 Car	7947.738	−0.030	II	H
	7971.541	−0.018	I	H
	8067.253	−0.004	II	H
	8210.531	−0.006	I	H
	8288.026	−0.018	I	H
	8629.140	−0.038	II	H
	8992.019	−0.040	I	H
	11903.721	−0.099	II	A
	11958.656	−0.064	II	A

*H = Hipparcos; A = ASAS-3; N = NSVS

Table 2. (cont.)

Star	HJD+2440000	$O-C$	Min	Source*
	12198.869	−0.014	I	A
	12255.764	−0.064	II	A
	12552.864	−0.071	II	A
	12647.766	−0.008	I	A
	12649.750	−0.068	II	A
	12854.469	0.011	I	A
	12946.819	−0.107	II	A
	12957.832	0.033	I	A
	13382.792	−0.107	II	A
	13450.638	−0.079	II	A
	13474.513	0.005	I	A
V0529 Car	8159.997	0.027	II	H
	8261.618	0.028	I	H
	9015.943	−0.040	I	H
	11938.694	0.031	I	A
	12752.655	−0.097	II	A
	12754.752	0.016	I	A
	12809.545	−0.143	II	A
	13008.784	−0.177	II	A
	13167.536	0.019	I	A
	13385.781	0.012	I	A
	13454.799	−0.156	II	A
	13480.686	0.025	I	A
V0821 Cas	8224.368	0.005	I	H
	8357.091	−0.003	I	H
	8363.224	−0.002	II	H
	8561.413	−0.025	II	H
	8777.324	−0.024	II	H
	9040.219	0.000	I	H
	11417.694	−0.127	II	N
	11450.603	−0.021	I	N
	11479.637	−0.125	II	N
V1081 Sco	8184.452	−0.019	I	H
	8838.078	0.035	I	H
	11963.858	−0.096	II	A
	12432.681	−0.012	I	A
	12466.594	−0.108	II	A
	13504.728	−0.149	II	A

*H = Hipparcos; A = ASAS-3; N = NSVS

Acknowledgements: This research has made use of the SIMBAD and VizieR databases operated at the Centre de Données Astronomiques (Strasbourg) in France.

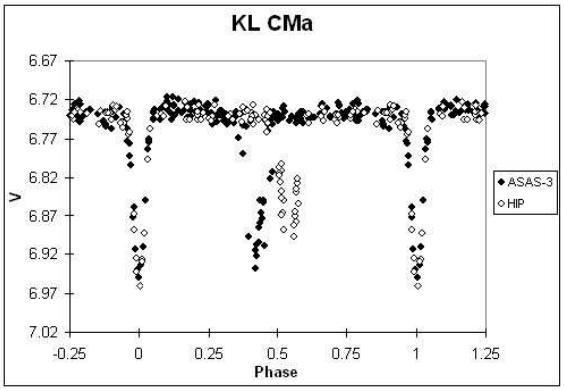

Figure 1. Light curve of KL CMa showing Hipparcos and ASAS-3 observations.

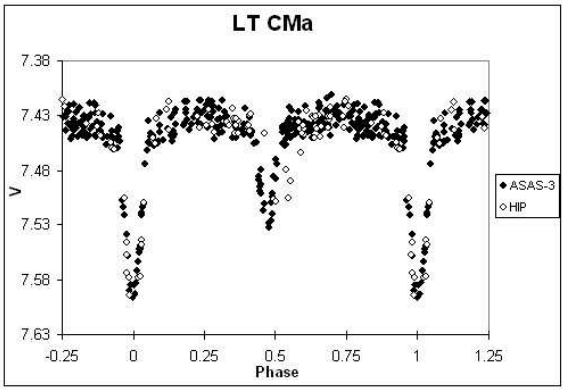

Figure 2. Light curve of LT CMa showing Hipparcos and ASAS-3 observations.

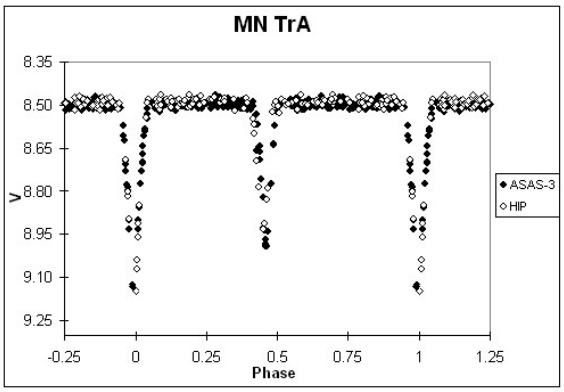

Figure 3. Light curve of MN TrA showing Hipparcos and ASAS-3 observations.

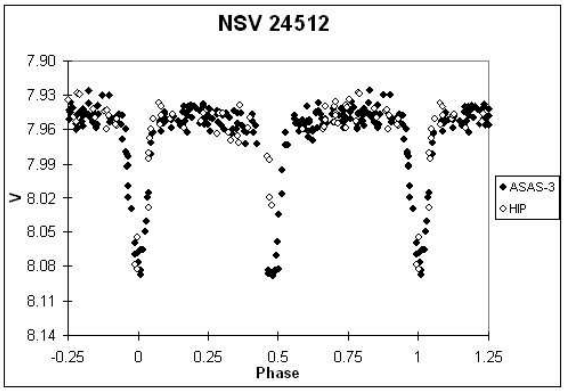

Figure 4. Light curve of NSV 24512 showing Hipparcos and ASAS-3 observations.

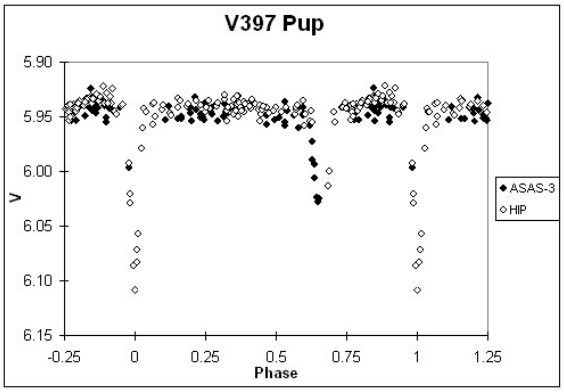

Figure 5. Light curve of V397 Pup showing Hipparcos and ASAS-3 observations.

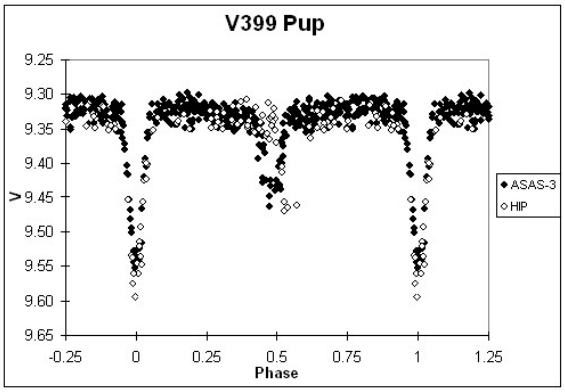

Figure 6. Light curve of V0399 Pup showing Hipparcos and ASAS-3 observations.

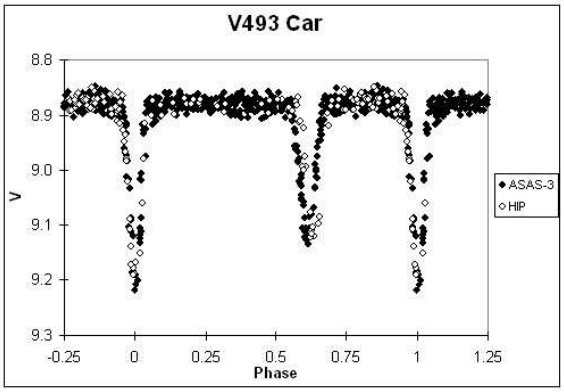

Figure 7. Light curve of V493 Car showing Hipparcos and ASAS-3 observations.

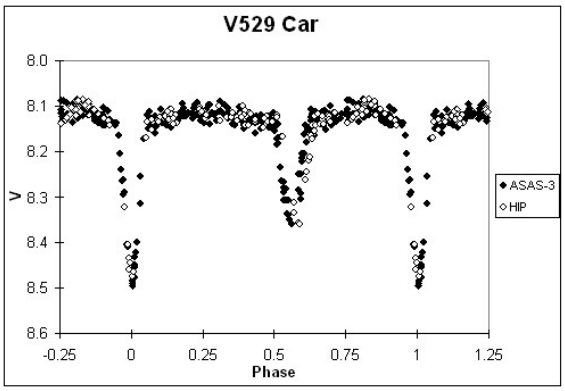

Figure 8. Light curve of V529 Car showing Hipparcos and ASAS-3 observations.

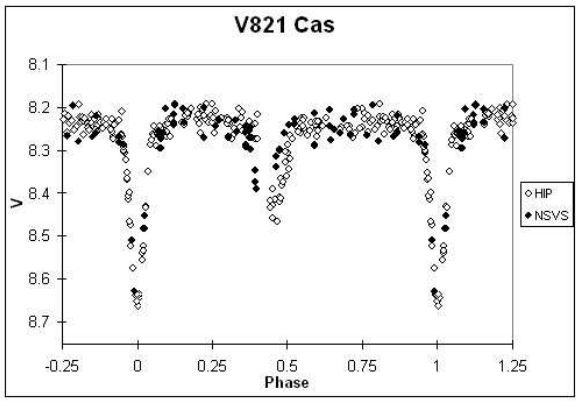

Figure 9. Light curve of V821 Cas showing Hipparcos and NSVS observations.

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