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HIPPARCOS ECLIPSING BINARIES SHOWING APSIDAL MOTION

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Combination of the publicly available Hipparcos data (Perryman et al., 1997) from 1989-1993 and ASAS-3 data (Pojmanski, 2002) from 2001 to the present allows the detection of apsidal motion in three 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 V band range (with the secondary eclipse magnitude between brackets), the period of the primary and secondary eclipse respectively, and the variability and spectral types.

Table 1.

Star	V magnitude	Period I	Period II	Type	Sp
V366 Pup	8.07 –8.59 (8.47)	2.4840254	2.483898	EA	B9V*
PT Vel	7.02 –7.70:(7.37:)	1.8020075	1.802035	EA	A0V**
V466 Car	7.27 –7.55 (7.46)	3.455800	3.455887	EA	B8/9V*

*Houk & Cowley, 1975.

*Houk, 1978.

Hipparcos observations have been transformed to V using a table by the author (Otero, 2001). The method of bisected chords was used to determine times of minima. The accuracy depends on the quantity and quality of the observations. Wrong observations (random data points deviating >0.05 mag. from the mean folded light curve) were discarded before any analysis was made.

Table 2 show 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.

Individual stars

1) V366 Puppis = NSV 3555 = HIP 35607 = HD 57897 is a known visual binary system (WDS07209-4831 AB), with an 8.4 mag. primary and a 9.6 secondary $7''$ away according to the WDS (Worley et al., 1997). It was first suspected as a variable star (BV 438) back in 1964 (Strohmeier et al., 1964a). Its period could not be solved in the Hipparcos Catalogue. The primary is the eclipsing binary with the following light elements:

$$\text{Min I} = \text{HJD}2447860.351(\pm 0.001) + 2.4840254(\pm 0.0000020) \times E$$

$$\text{Min II} = \text{HJD}2447861.900(\pm 0.100) + 2.4838980(\pm 0.0000050) \times E$$

Table 2.

Star	HJD+2400000(σ)	$O - C$	Min	Source*
V366 Pup	47861.900(0.100)	0.000	II	H
	48635.365(0.010)	-0.002	I	H
	51905.708(0.030)	-0.185	II	A
	52033.514(0.010)	0.000	I	A
	52234.714(0.010)	-0.006	I	A
	52787.502(0.050)	-0.220	II	A
PT Vel	48294.360(0.020)	0.000	II	H
	52425.479(0.020)	-0.017	I	A
	52651.704(0.020)	0.090	II	A
	52789.521(0.020)	0.019	I	A
	52922.862(0.010)	0.012	I	A
	V466 Car	48316.908(0.020)	0.017	I
48779.943(0.020)		-0.025	I	H
49047.376(0.020)		-0.002	II	H
51931.658(0.010)		0.000	I	A
51967.612(0.020)		0.083	II	A
52539.853(0.020)		-0.025	I	A
52940.765(0.020)		0.014	I	A

*H = Hipparcos; A = ASAS-3

Eclipse durations are very different, the secondary during 0.29 and the primary 0.11 days. The light curve can be seen in Figure 1a. The apsidal motion is fast and comparable to that of GL Carinae (Giménez & Clausen, 1986) which shows a 25 years-period. If we use the primary eclipse period as a reference, V366 Pup eclipse shifted from phase 0.63 in 1989 to phase 0.54 in 2003. Figure 1b shows this effect clearly.

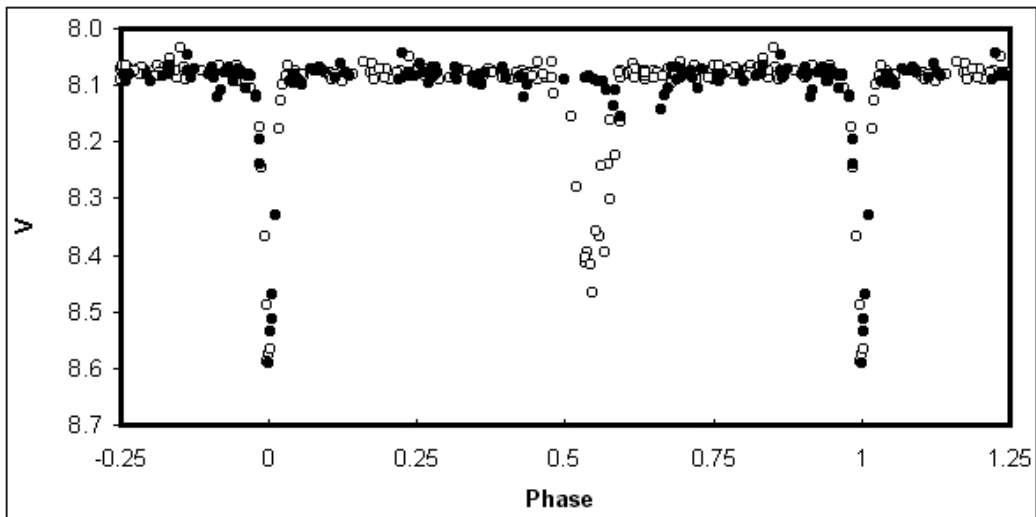


Figure 1. Light curve of V366 Pup showing Hipparcos (filled circles) and ASAS-3 observations (open circles).

2) PT Velorum = NSV 4409 = HIP 45079 = HD 79154 was first suspected of variability in 1964 and named BV 469 (Strohmeier et al., 1964b). Its eclipsing nature was discovered by Hipparcos which solved a period of 1.80201 days. Comparison with ASAS-3 data also

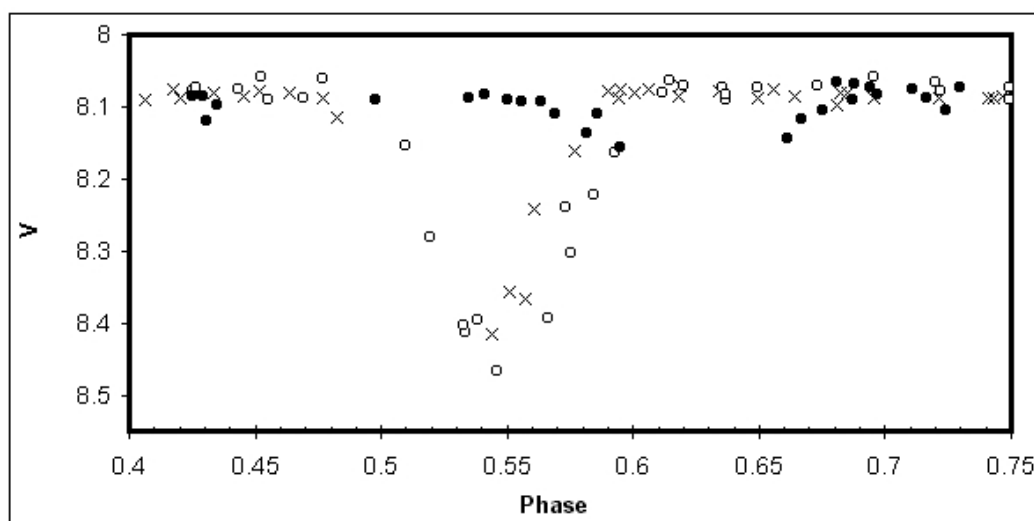


Figure 2. Phase shift in the secondary eclipse of V366 Pup. Filled circles are Hipparcos observations. Open circles and crosses are 2000-2001 and 2002-2003 data from ASAS-3 respectively.

revealed apsidal motion.

$$\text{Min I} = \text{HJD}2448293.493(\pm 0.001) + 1.8020075(\pm 0.0000010) \times E$$

$$\text{Min II} = \text{HJD}2448294.360(\pm 0.020) + 1.8020350(\pm 0.0000010) \times E$$

Primary eclipse lasts 0.23 days and secondary 0.17 days. The latter shifted from phase 0.48 to 0.53. Both eclipses lack observations at the instant of minimum light so more observations are needed to confirm the amplitude and nature of the eclipses.

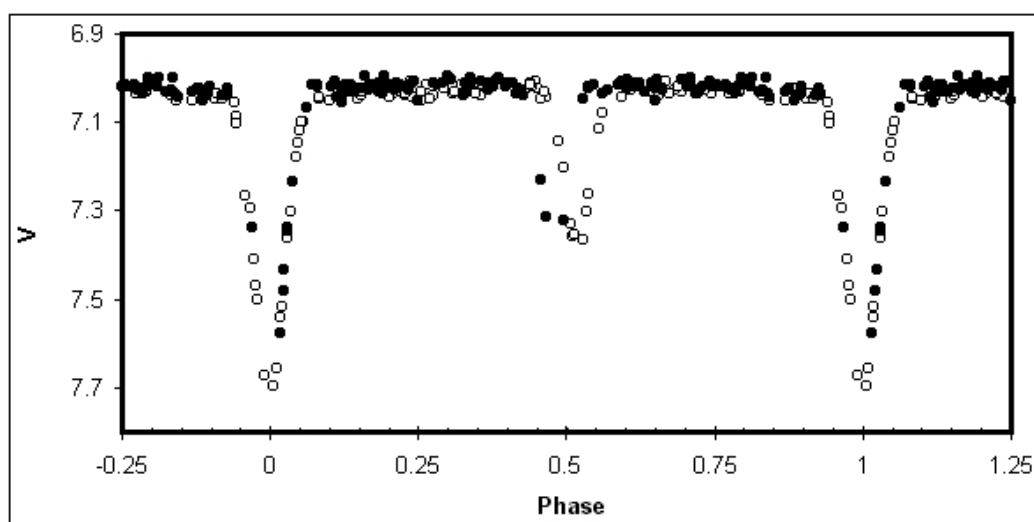


Figure 3. Light curve of PT Vel showing Hipparcos (filled circles) and ASAS-3 observations (open circles).

3) V466 Carinae = NSV 4003 = HIP 40666 = HD 70333 was first discovered to be variable by Strohmeier (1966) who designated it as BV 821. Its period was published in

the Hipparcos Catalogue. ASAS-3 data again show a slight displacement in the secondary eclipse over these ten years. However, this is small if compared with the previous cases and goes from phase 0.38 to 0.41. Light elements:

$$\text{Min I} = \text{HJD}2448036.971(\pm 0.02) + 3.455800(\pm 0.000001) \times E$$

$$\text{Min II} = \text{HJD}2448038.284(\pm 0.05) + 3.455887(\pm 0.000002) \times E$$

Eclipses seem to be total (this needs confirmation) and last 0.35 (primary) and 0.27 (secondary) days.

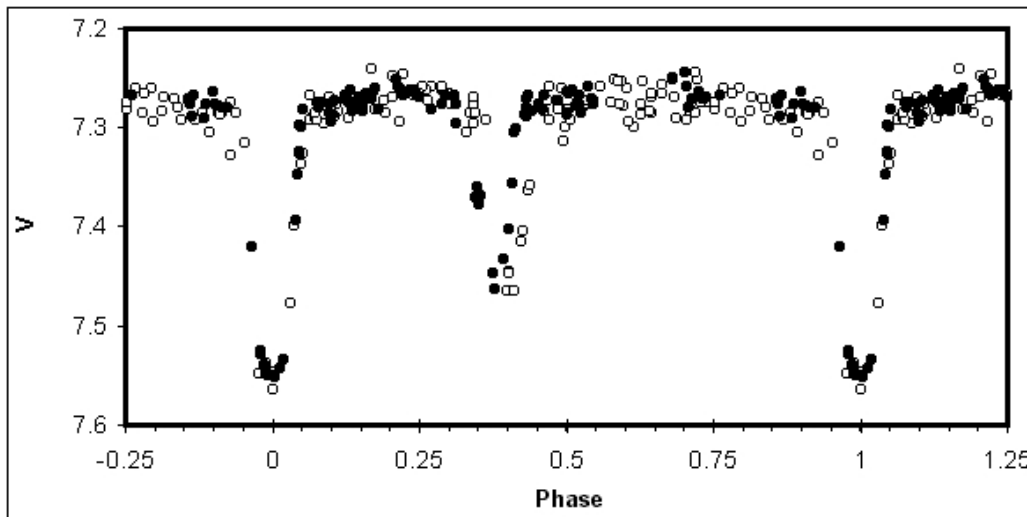


Figure 4. Light curve of V466 Car showing Hipparcos (filled circles) and ASAS-3 observations (open circles).

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