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CCD PHOTOMETRY OF V1147 Cyg

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Recently Chinarova (1997) published a photographic lightcurve of the eclipsing binary star V1147 Cyg=HBV 426 based on measurements of 144 photographic plates. The lightcurve was generated assuming a period of 1.097382 days found from photographic minima.

Table 1. Observing Journal (HJD − 2450000)

HJD Start	HJD End	Site	HJD Start	HJD End	Site
631.687	631.861	USAFA	702.724	702.784	USAFA
632.675	632.758	USAFA	722.556	722.639	ASU
634.741	634.894	USAFA	724.571	724.786	USAFA
635.666	635.793	USAFA	726.631	726.632	ASU
636.677	636.757	USAFA	731.556	731.718	USAFA
638.648	638.933	USAFA	735.507	753.510	ASU
639.849	639.935	USAFA	737.518	737.690	ASU
640.650	640.787	USAFA	742.503	742.635	ASU
641.726	641.925	USAFA	758.648	758.751	USAFA
642.670	642.883	USAFA	760.479	760.670	ASU
643.705	643.884	USAFA	798.478	798.580	ASU
644.655	644.745	USAFA	798.530	798.600	USAFA
697.906	697.686	USAFA			

During the period of UT 1997 July 2-15 and on several isolated nights thereafter we recorded 272 and 278 images of this star through V and R filters respectively using the 0.61 m telescope at the US Air Force Academy (USAFA) and a liquid nitrogen cooled 512x512 Photometrics CCD. 110 and 9 additional CCD images were taken through V and R filters respectively using the 0.8 m telescope at Appalachian State University (ASU) and a thermoelectrically cooled 1024x1024 Photometrics CCD. All images were flat fielded and then magnitudes were extracted using IRAF software. Additionally, the ASU observations were transformed to USAFA instrumental magnitudes using coefficients derived from stars within the field. Table 1 lists the observing circumstances for all observations.

Our goals included verifying the period, studying the nature of the primary eclipse, and looking for a secondary minimum which was not apparent in Chinarova's lightcurve. We studied five stars in the 3!7 × 3!7 field as candidates for comparison stars. Figure 1 is a finder chart made from one of our images that identifies V1147 Cyg and the comparison stars. After examining all images, stars 2, 3 and 4 where chosen as comparison stars due to the stability of their magnitude differences in all seeing conditions. The standard deviations in the R filter differences in magnitude for these stars on 180 USAFA images was about 0.015. All three of these stars are about 13th magnitude and the differential magnitude between V1147 Cyg and the combined light of these stars was calculated for each image.

Figure 1. Finder chart for V1147 Cyg (3!7 × 3!7). North is up and East is to the left

Primary minima were observed on UT 1997 July 7, 1997 September 6 and 1997 November 6 of depth 0.75 ± 0.01 in R and 0.77 ± 0.03 in V. The primary eclipse (first to fourth contacts) lasts 7.0 ± 0.3 hours. The observations also revealed secondary minima, observed on UT 1997 October 16 and UT 1997 December 16, of depth 0.59 ± 0.01 in R and 0.57 ± 0.02 in V. Although the secondary eclipse was never observed from minima to either first or fourth contact, when compared to the primary eclipse, the duration of the secondary eclipse (first to fourth contact) appears to be about 1.69 ± 0.05 times the duration of the primary eclipse, and thus lasts 11.8 ± 0.6 hours. The heliocentric Julian date of minima, uncertainty in each minima, and type of minima for these timings are shown in Table 2. Combining these observations reveal the most likely period to be 15.25141

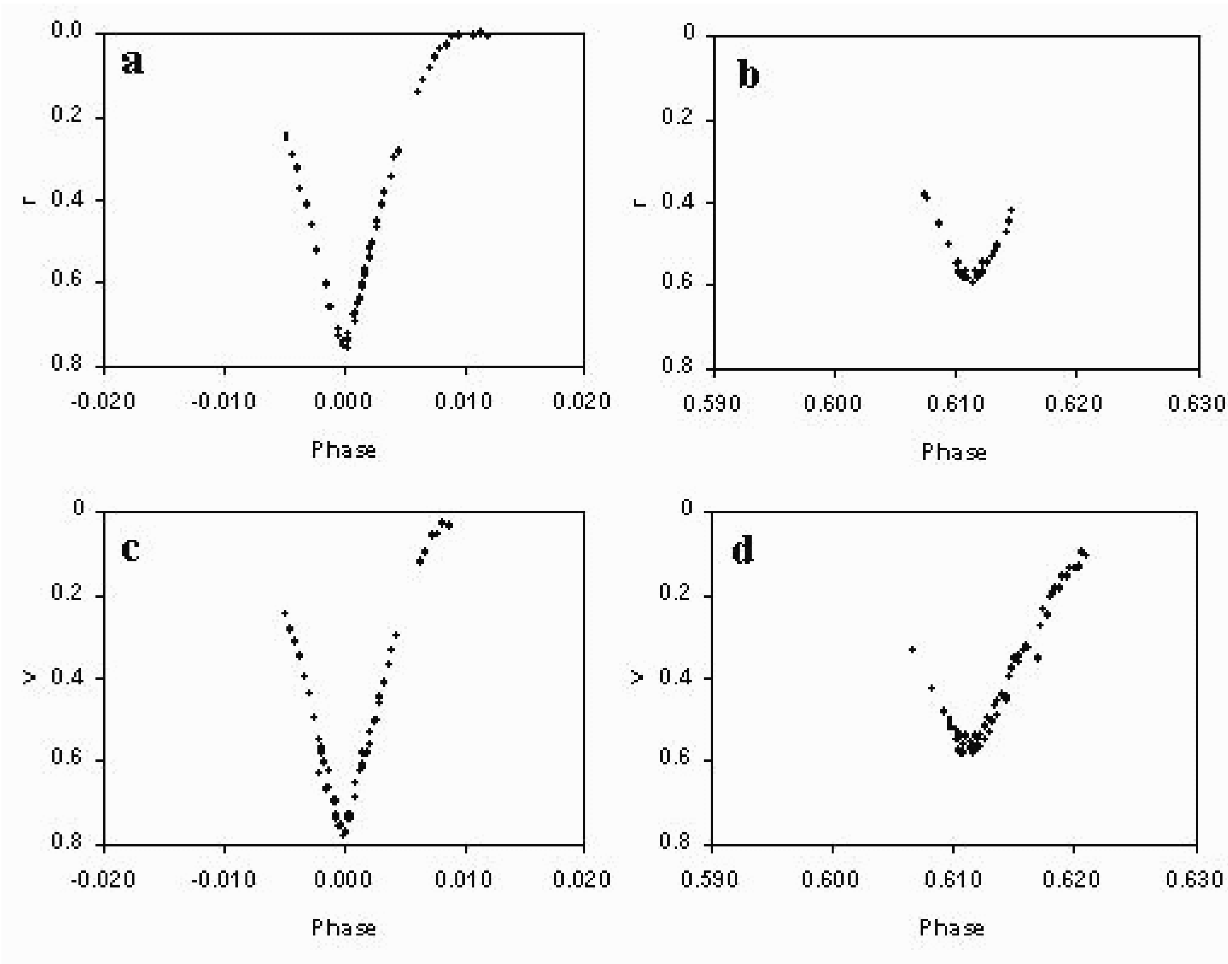

Figure 2. V1147 Cyg lightcurve (instrumental magnitudes): a. primary eclipse in R, b. secondary eclipse in R, c. primary eclipse in V, d. secondary eclipse in V

days, with twice and four times this period also possible. These longer periods (30.50282 days and 61.00564 days), however, can be ruled out by considering visual observations which will be reported elsewhere (Lloyd, in preparation) or by considering Chinarova's "most prominent weakenings". The ephemeris using the three primary minima and two secondary minima presented here is 2450758.7233 (± 0.0004) + 15.25141 (± 0.00011) ×E. The secondary minima occurs at phase 0.6114 (± 0.0003). This, along with the fact that the primary and secondary eclipse durations are different, indicate elliptical orbits for the two stars in V1147 Cyg. With this period we present the primary and secondary minima in instrumental V and R magnitudes in Figure 2, where the out of eclipse magnitude of V1147 Cyg has been normalized to zero and the primary eclipse has been centered at zero phase. The light curve between eclipses is flat to within the measured uncertainty.

Table 2. Times of Minima

Epoch (HJD)	Error	Type	Source
2434119.525	0.10	primary	Wachmann, 1966
2434952.358	0.10	secondary	Wachmann, 1966
2436462.3483	0.10	secondary	Chinarova, 1997
2439741.3395	0.10	secondary	Chinarova, 1997
2441150.3982	0.10	primary	Chinarova, 1997
2441544.3847	????	unknown	Chinarova, 1997
2450636.7119	0.0010	primary	This paper
2450697.7158	0.0014	primary	This paper
2450737.5441	0.0009	secondary	This paper
2450758.7233	0.0004	primary	This paper
2450798.5493	0.0005	secondary	This paper

If we combine our data with Chinarova's "most prominent weakenings" (also shown in Table 2), we find that all but one of the minima occur close to either a primary or secondary eclipse. We have estimated the uncertainty in the photographic data for the time of minima to be the amount of time that an eclipse is dimmer than half its mid-eclipse value. Excluding the one timing that does not have a close fit to the ephemeris and using all instances of primary and secondary eclipses, we obtain an ephemeris of 2450758.7233 (± 0.0004) + 15.25134 (± 0.00003) ×E.

References:

Chinarova, L.L., 1997, *IBVS*, No. 4455
Wachmann, A.A., 1966, *Berged Abh.*, **6**, No. 4