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NEW ECLIPSE TIMING OF AS CAMELOPARDALIS FROM THE IUE SATELLITE

As Cam (HD 35311) is an 8th magnitude eclipsing binary consisting of a pair of ~B9V stars moving in an eccentric orbit (e = 0.17) with a period of 3.43 days. Like the eccentric eclipsing binary DI Her (see Guinan and Maloney 1985), AS Cam is an important test case for studying relativistic apsidal motion, because the expected relativistic apsidal motion is comparable to that expected from classical effects. Accurate determinations of the orbital and stellar properties of the system have been made by Hilditch (1972) and Khaliullin and Kozyreva (1983). Furthermore, from a study of eclipse timings Khaliullin and Kozyreva found its observed apsidal motion to be $\dot{\omega}$obs = 16.0 ± 1.3 deg/100 yrs, which is about one-third the expected combined classical and relativistic apsidal motion of $\dot{\omega}$theo = $\dot{\omega}$CL(= 35.7 deg/100 yr.) +$\dot{\omega}$GR(= 7.9 deg/100yr) = 43.6 deg/100 yr. Recently, Maloney et al. (1986) investigated the apsidal motion of AS Cam from eclipse timings dating back to 1899, determined from the Harvard College Observatory plate collection as well as from photoelectrically determined timings up to 1982. Least aquares solutions of these eclipse timings yield and apsidal motion of $\dot{\omega}$obs = 13.6 ± 1.5 deg/100 yrs, which is in good accord with the previous study. Thus, AS Cam joins DI Her in having an observed apsidal motion significantly less than that predicted by theory. At present, the conflict between the observed and the theoretical apsidal motion of AS Cam and DI Her remains unresolved.

On November 23, 1986 and December 06, 1986 AS Cam was observed in the ultraviolet (λλ 1150-3200) with the International Ultraviolet Explorer (IUE) satellite. A comprehensive description of the IUE satellite and its scientific instrumentation is given by Boggess et al. (1978). The chief aim of this study is to uncover evidence in the ultraviolet such as the presence of a third member of the system, circumbinary gas, and/or strong stellar winds that might explain the system's observed small apsidal motion.
In the course of obtaining ultraviolet spectra of the system during primary minimum on 06 December 1986, the Fine Error Sensor (FES) was used as a photo-

meter to measure the changes in the system's brightness at visible wavelengths as the eclipse progressed.

The FES is an unfiltered image dissector tube with an S-20 photocathode which has a broad wavelength response from about 4000A to 7000A with a broad maximum sensitivity centered near 5000A. The incident photons to the FES are reflected from the satellite's 45 cm, f/15 Cassegrain telescopic system. The FES is normally used to provide an image of the star field or in a track mode. In the track mode of operation the FES gives a count rate which is proportional to the brighrness of the object. The brightness of the star is obtained by averaging the count rate from multiple scans of the image dissector with an effective integration time of about 2.5 seconds. The source plus background is actually measured, but for bright stars ($m_v \leq +10$ mag), the contribution of the background is insignificant. FES measures of a nearby comparison star (HD 34463; V=+8.51; B-V=+0.17) were made near the beginning and end of the 8 hour observing shift to monitor the sensitivity of the detector. These measurements indicated that the sensitivity of the FES remained nearly constant (to within 1.5 percent) over the ∿7 hour observing interval. The camparison and variable stars were observed at the same reference position of the FES detector and measurements consisted of sampling the star's count rate for about 10 seconds. The FES counts of the variable star were reduced differentially with respect to the comparison star and the times were converted to heliocentric Julian Day Number. The differential FES magnitudes were transformed to Δ V (v-c) using the photometric calibration of the FES made recently by Imhoff and Wasatonic (1986). Because the comparison and variable stars are well matched in color and brightness, the conversion to V-magnitudes should be relatively accurate. The differential V-magnitudes obtained with the FES are given in Table I.

Table I
Observations of AS Cam Made with the FES

J.D. Hel. 2446771.0+	Δ V(v-c) (mag)	J.D. Hel., 2446771.0+	Δ V(v-c) (mag)
0.2554	+0.143	0.3827	+0.683
0.2567	0.153	0.3835	0.695
0.2581	0.153	0.3849	0.683
0.2590	0.162	0.3962	0.679
0.3037	0.320	0.3973	0.675
0.3045	0.313	0.3982	0.669
0.3249	0.438	0.4396	0.421
0.3255	0.450	0.4405	0.421
0.3265	0.452	0.4677	0.276
0.3681	0.688	0.4684	0.276
0.3688	0.686	0.4958	0.154
0.3706	0.670	0.4970	0.163
0.3724	0.683	0.4981	+0.163
0.3739	+0.688		

The observations defining the primary eclipse are plotted against heliocentric Julian Date in Figure 1.

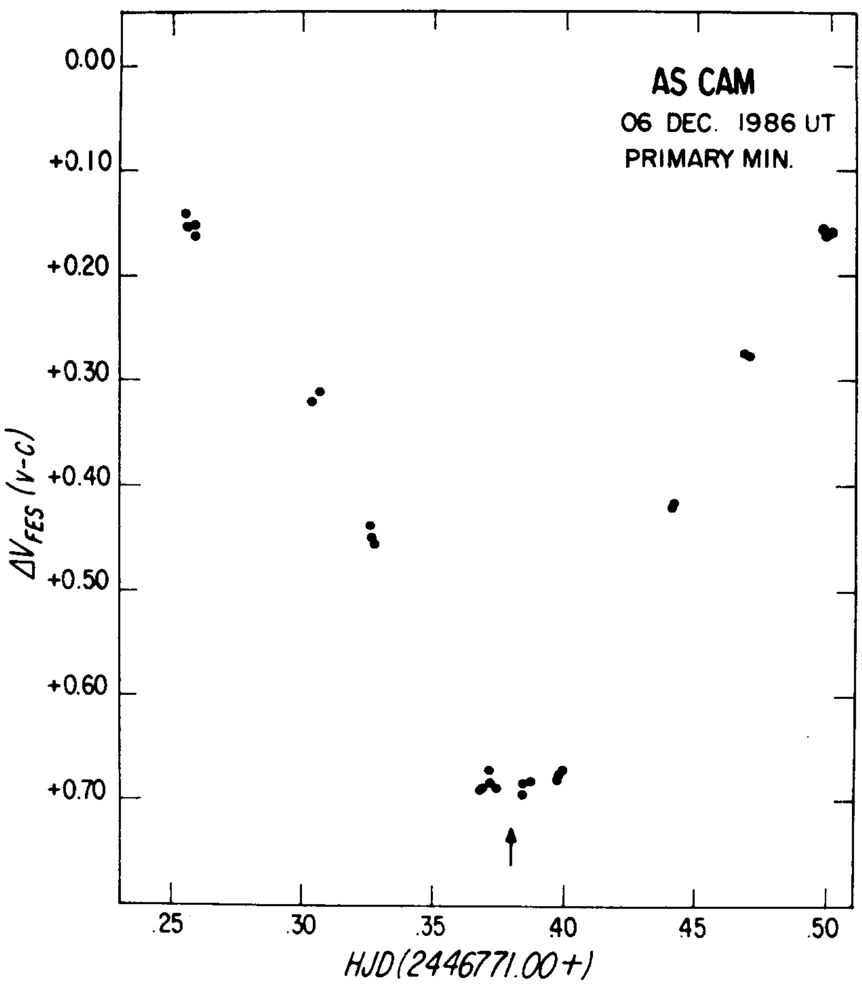

Figure 1

The V-magnitude at the bottom of the minimum is V(FES) = +9.200 which is in excellent agreement with the value of V(MinI) = +9.203 found previously by Khaliullin and Kozyreva (1983). A determination of the time of mid-eclipse was made by reflecting the ingress and egress portions of the light curve until a best fit was obtained. This was accomplished on a video terminal with an IBM-PC. The time of primary eclipse is:

$$T(minI) = HJD\ 2446771.3810 \pm 0.0012d.$$

and the (O-C) = -0.010d was computed using the ephemeris of Khaliullin and Kozyreva. Additional eclipse timings of AS Cam are being attempted from the ground with standard photoelectric photometry. It is important to secure additional timings of primary and secondary minima to determine more precisely the apsidal motion rate of the system.

We wish to thank the IUE staff at Goddard Space Flight Center for help in the acquisition of these data. The IUE telescope operator, Peter E. Summers, did an efficient and careful job in obtaining the observations. This study was supported by NASA under grants GSF 86-110 and 83-283 whose aupport we gratefully acknowledge.

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