A PHOTOELECTRIC LIGHT CURVE OF AH CEPHEI

PATRICK HARTIGAN
RICHARD P. BINZEL
Physics and Astronomy Dept.
Macalaster College
St. Paul, MN 55105

Abstract

This B3-type eclipsing binary has a β Lyrae-type light curve of small amplitude. Between August 3 and November 24, 1978, 133 photoelectric observations of AH Cephei were obtained. A time of minimum derived from the mean light curve, JD_{min} (hel.) = 2442779.813 ± 0.011 day, indicates the period may still be increasing.

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1. Introduction

The eclipsing binary AH Cephei has a β Lyrae-type light curve of small amplitude. The period has been investigated in detail most recently by Guarnieri et al. (1975). Their study indicated that AH Cephei underwent a period increase around 1942. We obtained photoelectric observations in order to verify the new ephemeris of Guarnieri et al.

2. Data

We observed AH Cephei photoelectrically 133 times on 38 different nights from August 3 through November 24, 1978. The equipment used was described in a previous paper by Hartigan (1980). The comparison star used was HD 215371 (SAO 020214). From measurements of standard stars we determined its apparent visual magnitude to be magnitude 6.79 ± 0.02 on the UBV system. The V magnitude measurements of AH Cephei were determined differentially with respect to the comparison star from

$$V = V_{comp} + \Delta v, \qquad (1)$$

where Δv is the instrumental differential magnitude. Atmospheric extinction was ignored in these measurements since the two stars are separated by only 35 minutes of arc. The spectral types of the variable and comparison star are listed in the SAO Catalog as B3 and B2, respectively. This close spectral match and a low transformation coefficient for our system allowed us to also ignore color transformations in our V magnitude measurements.

The 133 individual observations are listed in Table I and plotted in Figure 1. All Julian Dates are heliocentric. Phases were computed with the ephemeris

$$JD_{min}\ (hel.) = 2434989.404 + 1^d.774759\ E \qquad (2)$$

of Guarnieri et al. We see that the eclipses appear to be partial and have amplitudes of approximately 0.26 and 0.24 magnitude in V. The eclipses were too shallow to be detected visually by the authors.

3. Analysis

Since the primary eclipse was not covered adequately on any

single night, the tracing paper method was used on the mean light curve. The primary eclipse was found to occur at phase 0.016 ± 0.006. A similar analysis of the secondary minimum showed that (within a comparable uncertainty) it occurs 0.5 phase after the primary. A minimum at phase 0.016 corresponds to an O-C residual of 0.028 ± 0.011 day. Choosing a date near the middle of the observing interval that is consistent with this O-C value, we obtain a time of primary minimum equivalent to 2443779.813 ± 0.011 day.

For their period study, Guarnieri et al. collected all the available times of minimum for AH Cephei and weighted the observations appropriately. Their O-C diagram is reproduced in Figure 2, with our time of minimum plotted at E = 4953. For -11000 < E < -3000 Guarnieri et al. used the ephemeris

$$JD_{min}\ (hel.) = 2434989.404 \pm 1^{d}.774736\ E. \qquad (3)$$

For epochs after E = -3000, they used the ephemeris in equation (2). Since our O-C is positive, it is probable that the period has again increased slightly. If the period is increasing continuously with time, then the points in Figure 2 should be fitted by a parabola. The value of the orbital eccentricity obtained by Huffer and Eggen (1947), e = 0.03, is too small for the observed nonlinearity in Figure 2 to be explained by apsidal motion. Future minimum timings will be needed to determine the true nature of the period variations in AH Cephei.

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REFERENCES

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TABLE I

Individual V Magnitudes for AH Cephei

J.D.(Hel.) 2,443,000+	Phase	V	J.D.(Hel.) 2,443,000+	Phase	V
724.770	.0015	7.105	775.672	.6821	6.852
724.788	.0116	7.119	775.711	.7041	6.850
725.710	.5311	7.085	775.743	.7221	6.829
725.720	.5367	7.060	775.772	.7385	6.839
725.772	.5660	7.018	776.667	.2428	6.836
725.783	.5722	6.984	776.732	.2794	6.850
725.842	.6055	6.900	776.765	.2980	6.849
725.857	.6139	6.904	782.651	.6144	6.872
726.763	.1244	6.921	782.759	.6753	6.862
728.683	.2062	6.836	789.711	.5930	6.896
728.695	.2129	6.841	793.670	.8236	6.851
728.740	.2383	6.845	793.765	.8772	6.897
728.754	.2462	6.842	794.603	.3493	6.877
728.798	.2710	6.852	794.634	.3668	6.874
729.668	.7612	6.832	794.701	.4046	6.876
729.680	.7679	6.831	794.775	.4463	6.937
729.730	.7961	6.810	794.794	.4570	6.971
729.737	.8000	6.833	794.812	.4671	7.005
729.804	.8378	6.866	794.848	.4874	7.043
729.812	.8423	6.866	801.692	.3437	6.839
729.843	.8598	6.863	801.724	.3617	6.877
730.698	.3415	6.898	804.695	.0357	7.068
730.737	.3635	6.844	804.722	.0509	7.036
730.793	.3950	6.886	804.744	.0633	6.996
730.855	.4300	6.894	804.771	.0785	6.953
731.711	.9122	6.888	804.798	.0938	6.917
733.650	.0047	7.075	809.660	.8333	6.854
733.689	.0267	7.089	809.730	.8727	6.876
733.697	.0312	7.085	811.612	.9332	6.901
734.650	.5682	6.957	811.633	.9450	6.930
734.662	.5749	6.946	811.655	.9574	6.989
734.687	.5890	6.927	811.673	.9675	7.014
734.767	.6341	6.867	811.714	.9906	7.070
734.816	.6617	6.806	811.742	.0064	7.099
740.618	.9308	6.898	812.657	.5220	7.083
740.648	.9477	6.943	812.676	.5327	7.088
740.680	.9657	6.991	812.689	.5400	7.051
740.706	.9803	7.055	813.616	.0623	7.055
740.716	.9860	7.047	813.721	.1215	6.882
740.756	.0085	7.090	813.748	.1367	6.862
741.601	.4846	7.024	814.530	.5773	6.918
741.612	.4908	7.036	814.555	.5914	6.951
741.655	.5150	7.082	816.671	.7837	6.874
741.680	.5291	7.115	816.696	.7978	6.857
741.721	.5522	7.035	819.678	.4780	7.078
749.711	.0546	7.040	819.702	.4916	7.057
749.746	.0744	6.963	819.725	.5045	7.088
749.796	.1025	6.895	819.741	.5135	7.092
749.842	.1285	6.909	820.641	.0206	7.114
750.761	.6463	6.850	820.664	.0336	7.066
752.726	.7534	6.846	820.687	.0466	7.072
754.620	.8206	6.862	820.705	.0567	7.022
754.654	.8397	6.876	820.730	.0708	6.994
754.688	.8589	6.873	820.747	.0804	6.964
754.767	.9034	6.905	820.756	.0854	6.934
755.613	.3801	6.872	820.776	.0967	6.920
755.681	.4184	6.870	828.734	.5802	6.949
755.709	.4341	6.875	828.740	.5836	6.942
756.611	.9424	6.939	828.748	.5881	6.930
756.676	.9790	7.063	831.595	.1923	6.862
756.707	.9965	7.128	831.626	.2097	6.866
773.699	.5705	6.964	831.674	.2368	6.868
773.774	.6127	6.874	831.712	.2582	6.847
774.724	.1480	6.892	831.716	.2605	6.838
774.765	.1711	6.888	837.732	.6503	6.867
774.817	.2004	6.857	837.765	.6689	6.871
774.860	.2246	6.841			

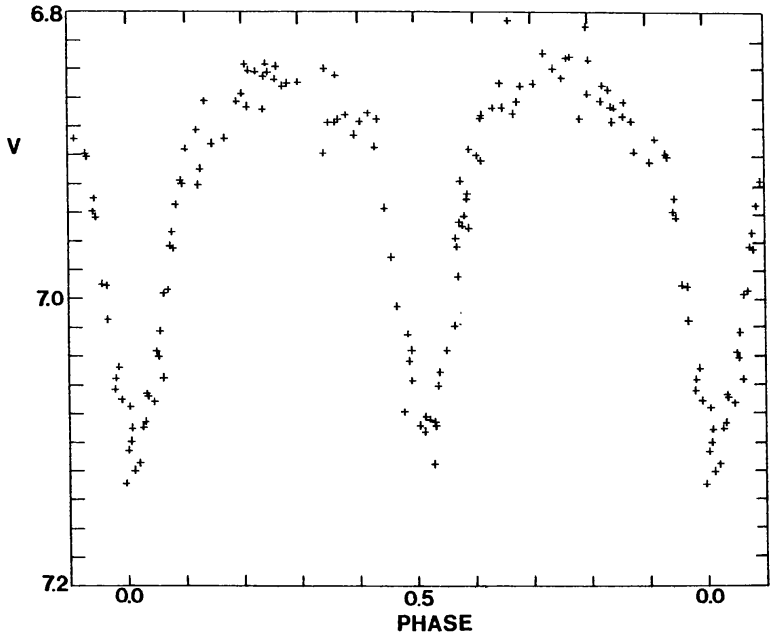

Figure 1. Photoelectric Observations of AH Cephei. Visual Magnitude vs. Phase. Phases Calculated with the Ephemeris in Equation (2).

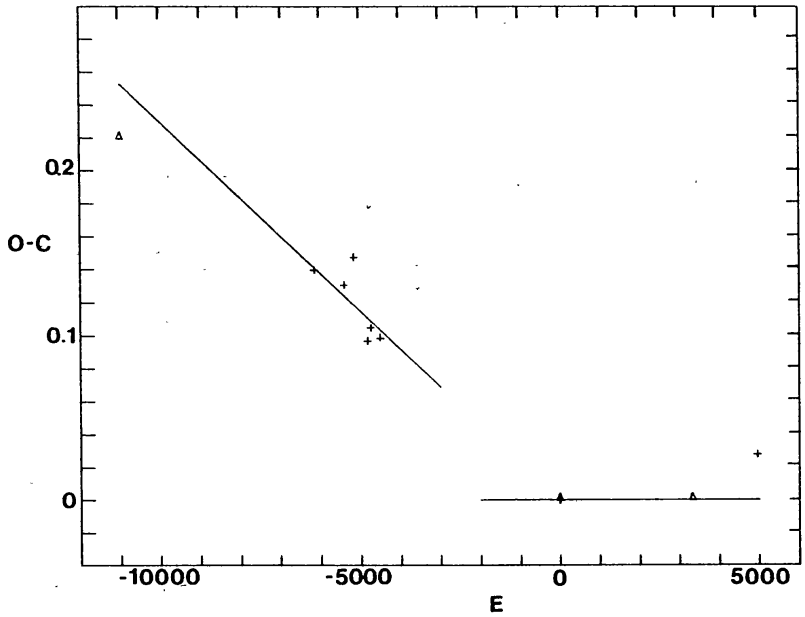

Figure 2. O-C Residuals based on the Ephemeris in Equation (2). Residuals in Days vs. Number of Elapsed Cycles. Crosses (+) are Primary Minima; Triangles (Δ) are Secondary Minima.