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AC Boo CHANGES ITS PERIOD BUT NOT ITS LIGHT CURVE

From season to season significant variations are seen in the light curves of many short period eclipsing binary systems, especially the W-type W Ursae Majoris stars. These stars also experience period changes, which may or may not be associated with the light curve activity. In order not to smear out variations occuring on a time scale of days, it is necessary to obtain complete light curves in the shortest possible time. The W-type W UMa star AC Boo was reported by Schieven et al. (1983) to have experienced a period change at some time between 1982 and 1973. At that time only a lower limit could be found for the new period, so to obtain another time of minimum and also to check on light curve variations, I observed the system in the spring of 1984.

The data were taken with the 50 cm. reflector of the Climenhaga Observatory of the University of Victoria on 1984 April 25/26 and 26/27. A refrigerated EMI 6256SA photomultiplier tube and filters closely matching the Johnson UBV system were used. The sky was observed nearly simultaneously with each star and smoothed with a three point average (Bevington, 1969). The observations of the variable star were bracketed by observations of the comparison star SAO 45287, whose constant brightness was checked twice nightly with observations of SAO 45274. The mean check star minus comparison star magnitude was 0.622±.013 in V, -0.004±.024 in (U-B), and 0.021±.020 in (B-V). The quoted errors are standard deviations about the mean and are consistent with those expected from photon statistics. Mean extinction and transformation coefficients were used to correct the differential magnitudes to the Johnson system. The data have been deposited in the I.A.U. Archives of Unpublished Observations of Variable Stars, File No. 146 (Breger 1985).

The differential UBV magnitudes are plotted in the figures with the heliocentric phase calculated from the ephemeris of Mancuso et al. (1977). The circles identify data observed on Julian date 2445816 and the x's identify Julian Date 2445817. Between the first night and the second the secondary minimum became shallower in V by 0.04 magnitudes and redder in (B-V) by 0.06 and in (U-B) by 0.04. This variation in secondary minimum may represent a substantial change in temperature or obscuration. These new light curves can be compared with light curves from 1962-63 (Binnendijk 1963), 1972-73 (Mancuso et al. 1977), and 1982 (Schieven et al. 1983). Variations are seen in the depth of secondary minimum in both 1982 and 1972-73. The 1962-63 light curve shows similar variations in size and shape in the primary minimum. The distortions previously observed in the ascending branch of the first maximum seem to be stronger now than those seen in 1962-63, 1972-73, or 1982. Differential UBV measures of the comparison stars used by Binnendijk, Schieven and Mancuso could determine if there was a systematic brightening after the period change, as was seen in CG Cyg (Robb 1984). Unfortunately, as noted above, night to night variations are about 0.04 magnitudes in V, 0.02 in B, and 0.06 in U and there is no evidence for yearly variations significantly larger than this.

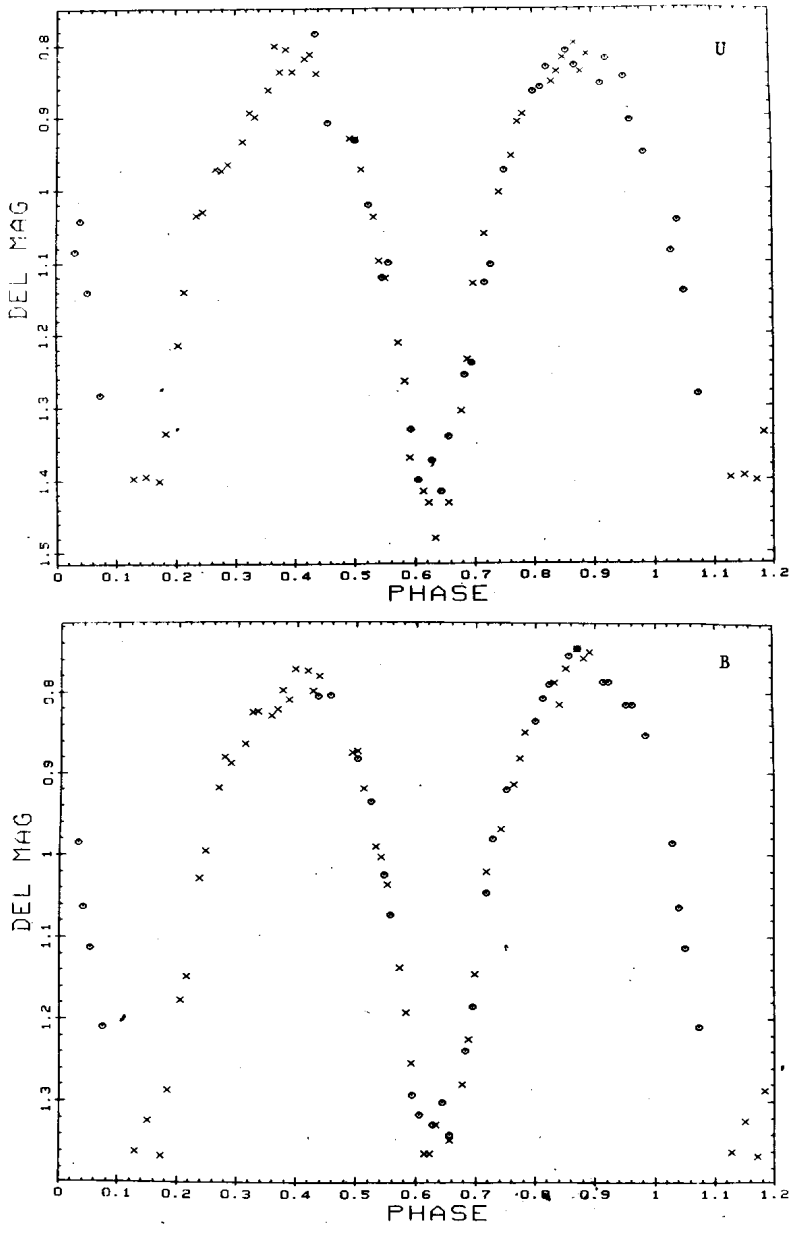

Figure 1a, b.

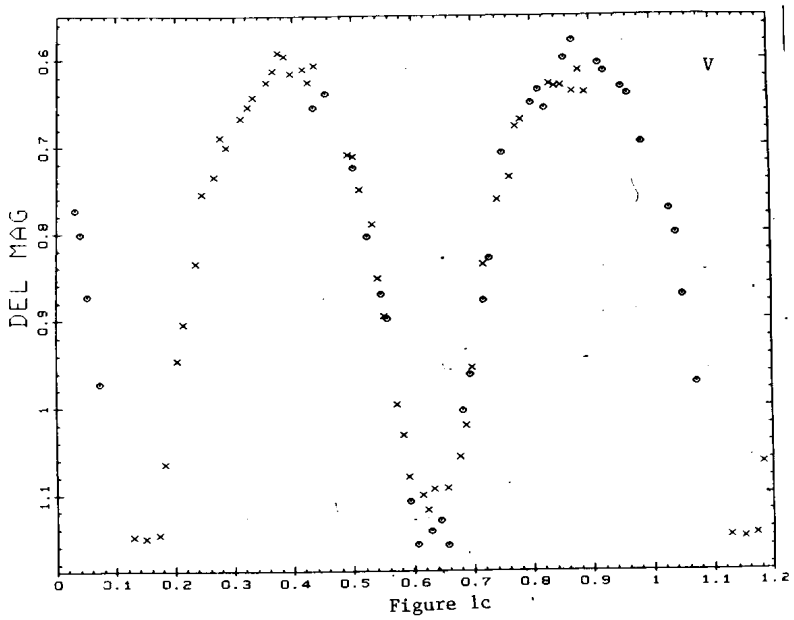

Figure 1c

To find the times of minimum light all data points within one hour of the minimum were used in a computer program based on the method of Kwee and Van Woerden (1956). Observations in each color were treated individually, but since there was no significant difference between the times obtained, they were combined in a mean weighted by the error in each color's determination. The heliocentric times of minimum light were found to be 2445816.8361±.0004 and 2445817.8935±.0003 for the secondary minima. These minima confirm the period change found by Schieven et al. (1983) and a new ephemeris based on their data and my two minima is:

$$\text{J.D. Hel. min. I} = 2445117.7816 \pm 22 + .352435 \pm 2\ E.$$

Assuming the period change was a discrete event, this new period implies that the change took place in 1978. The period became longer by 0.55 second or 1.8E-5 $\Delta P/P$.

A truncated nine-term Fourier series was fitted to all the intensity data shifted to make primary minimum at 0.0 phase and normalized to maximum light equal to 1.0. The coefficients are given in Table I.

Table I.

	V		B		U	
A0	0.832 ±	.002	0.811 ±	.002	0.811 ±	.003
A1	-.003	.003	-.016	.003	-.012	.004
A2	-.187	.003	-.199	.003	-.201	.004
A3	0.000	.003	0.004	.003	0.012	.004
A4	-.046	.003	-.044	.003	-.049	.004
B1	-.007	.003	-.010	.003	-.006	.004
B2	-.005	.003	-.010	.003	-.005	.004
B3	-.008	.003	0.004	.003	-.002	.004
B4	0.000	.003	0.001	.003	0.005	.004

These coefficients are essentially the same as those found by Rucinski (1973) from Binnendijk's 1962 data. A fit to the out of eclipse variations gave coefficients very similar to the ones from 1972-73. Mancuso et al. (1978) solved the 1962-63 and 1972-73 light curves and significantly different solutions would not be expected to result for the 1984 data. This lack of activity in the general shape of the light curve is quite different from that found for 44 i Boo (Robb 1982, Duerbeck 1978).

From these light curves we can see that AC Boo varies in brightness and color over a timescale of days, but the light curve stays essentially the same over the longer term, in spite of a rather large period change. More observations of this very interesting system will be necessary to refine the determination of the new period and to look for light curve variations.

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