REQUEST FOR PHOTOMETRY OF ALGOLS

J. R. W. Heintze
Sterrekundig Institute
Princetonplein 5, Postbus 80 000
NL-3508 Ta Utrecht, Netherlands

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Abstract

Photoelectric observations are requested for U Cep, U CrB, and u Her.

1. Introduction

The main purpose of this short paper is to encourage persons who have access to a telescope equipped with a photometer to observe primary minima of selected Algol-type eclipsing binaries, namely, U Cephei, U Coronae Borealis, and u Herculis. See Table 1 for data.

Table 1. Three Algol-type Binaries

Star	*U CrB*	*U Cep*	*u Her*
RA(2000)	15^h18^m	01^h02^m	17^h17^m
Dec(2000)	$+31^o39'$	$+81^o53'$	$+33^o06'$
Spectrum	B6V+F8III-IV	B7V+G8III-IV	B2IV+B8III(a)
P(days)	3.452250(c)	2.493060(b)	2.051025(b)
Epoch	1980.9-1987.5(c)	1986.9-1988.1(b)	1988.2-1992.3(b)
V(mag)	7.6-8.8	7.0-9.1	4.8-5.4(a)

(a) Batten et al. (1989), (b) this paper, (c) Van Gent (1989)

Considerable work has already been done on these stars at Utrecht in the Utrecht Photometric System (UPS) (Heintze 1989). However, these binaries deserve much more observational attention, and useful work can be done in other systems. Detailed information can be provided by the author to interested persons on request.

2. Properties of the Binaries

2.1. U CrB

The period, P, of U CrB has been observed since 1870; it is not constant but varies in a quasi-periodic way with a period, P_3, of about 78 years. The subscript 3 indicates that the variation is probably caused by a third body in the system. Apsidal motion is a possibility, but Van Gent (1982) has shown that it is very unlikely for this star. Other possible causes of period changes are mass transfer from one component to another and mass loss from the system to interstellar space.

In the case of U CrB, it is likely that the changes are mainly caused by a third body, and period jumps due to impulsive mass transfer superposed on them.

To check this idea, it is of interest to obtain reliable period determinations in the next 50-60 years, for if there is a third body, the period should reach a maximum around the year 2015 and a minimum around 2048.

The primary minima are very suitable for these period determinations because they are nicely symmetric. There is a short flat portion in the light curve at minimum. The depths of minima vary with time, and three different depths have been found so far. See Figure 1. Heintze (1990) has suggested that transient disks can be formed around the small, hot component from matter ejected by the large, cool component. If this happens from time to time, the depth of the primary minimum will depend on the amount of matter in such a disk.

2.2. U Cep

The light curve of this star is similar to that of U CrB, although the slopes of the descending branch of the primary minima can differ markedly from cycle to cycle, as shown in Figure 2a. Periods may be determined by shifting the ascending branches onto each other and assuming that the observed time interval is an integer times the current value of period. See Figure 2b.

Figure 3 shows that it is likely that the period of U Cep has been decreasing since 1969. This is interesting because from the time of its discovery as an eclipsing binary in 1880 the period has always been increasing. The decrease needs to be followed and confirmed. Possibly the changes can be explained by a third body, as in U CrB, but here $P_3 > 110$ years. There is evidence that, in U Cep as in U CrB, abrupt period jumps are superimposed on longer-term variations.

2.3. u Her

Long series of measurements are needed to determine a reliable period for this star, and these long series obscure period changes. See Figure 4. The best way to determine the period is by the method indicated in Figure 2b, but the descending and ascending branches of the light curve do not repeat well from cycle to cycle, so large numbers of points are needed. Figure 4 indicates that the period has probably been decreasing since 1900.

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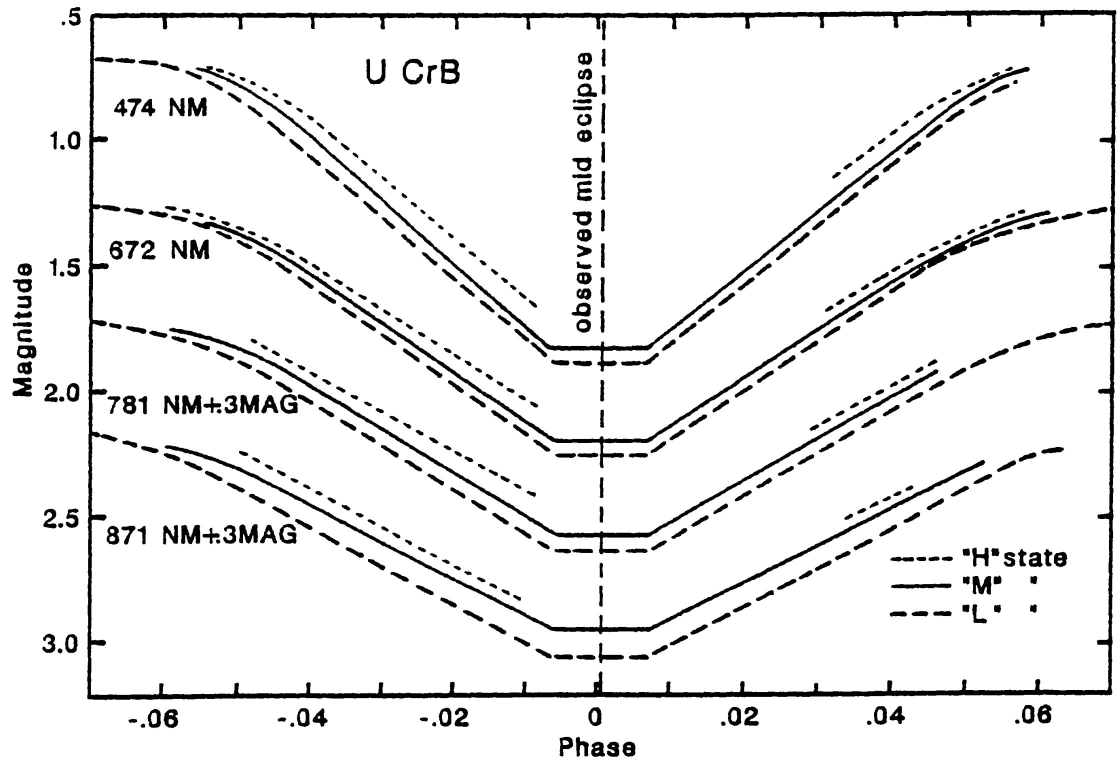

Figure 1. The three different depths of the primary minima of U CrB as observed at wavelengths of 474, 672, 781, and 871 nm (1 nm = 10 Angstroms). The depths are designated H, M, and L states. During 10 years of observations, the flat part of the H state has not yet been seen.

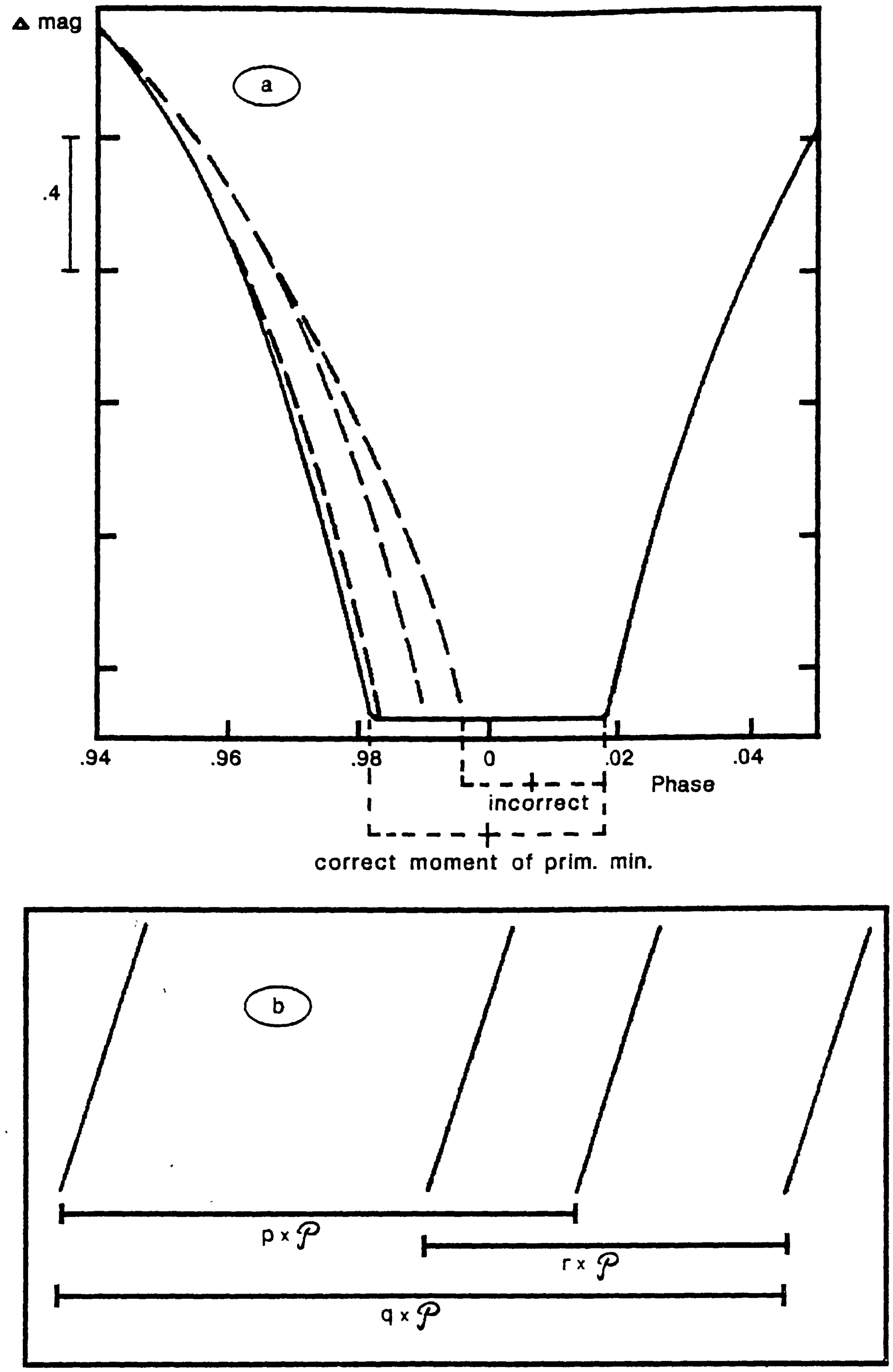

Figure 2. Light curves of U Cep. (a) The upper diagram shows various shapes of primary minimum, in which the steepness of the descending branch varies from cycle to cycle (dashed lines). The solid curve shows the extreme case, when the steepest descending branch occurs. Only in this case can the middle of the flat portion provide a correct time of primary minimum. Most of the time, the descending branches are not as steep as indicated by the solid curve and may not be used to determine the moment of primary minimum. (b) Successive ascending branches are separated by an integer (e.g., p, q, r) times the current period, P.

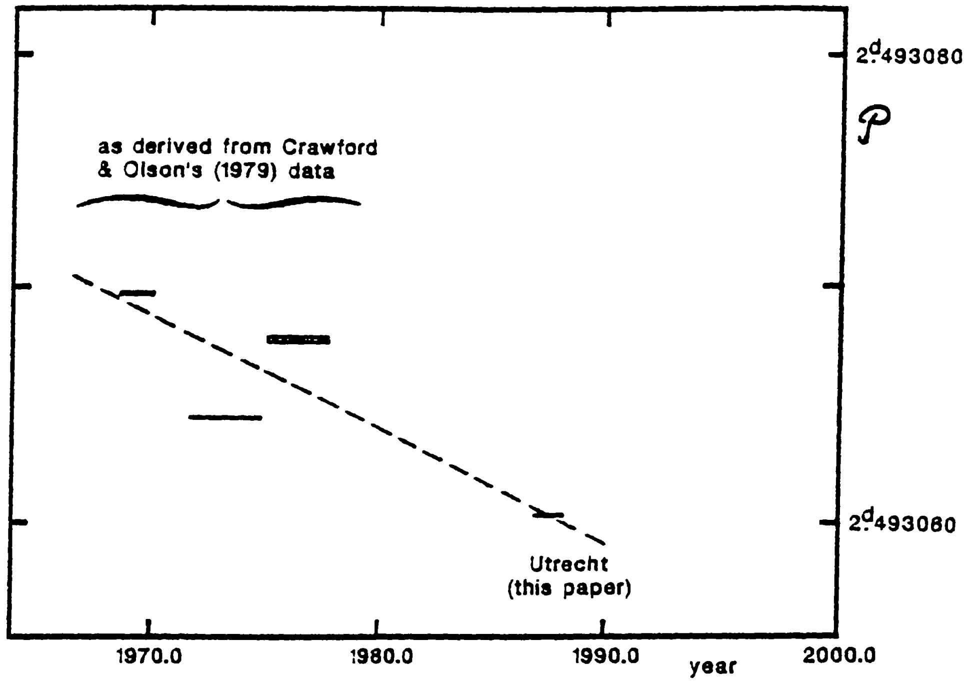

Figure 3. Recent period determinations for U Cep.

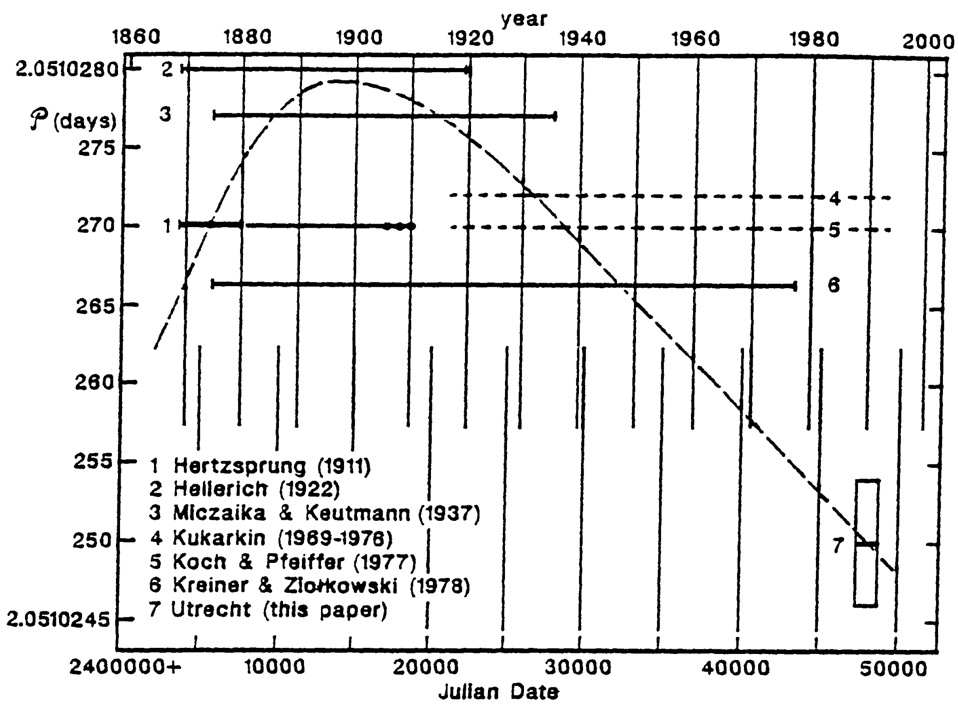

Figure 4. Results of period determinations of u Her. The first parts of No. 1 and 2 consist of 4,148 visual measurements by J.F.J. Schmidt from 1869 to 1897 (inclusive). [From 1844 on Schmidt (1989) had been observing u Her occasionally.] Hertzsprung (1911a) reduced Schmidt's results in a correct way and checked them later (Hertzsprung 1911b) with three photographic determinations of moments of primary minimum. No.'s 3, 6, and 7 are observational results also. No.'s 4 and 5 are compilations of several observational results.