PHOTOELECTRIC OBSERVATIONS OF SELECTED SYMBIOTIC STARS

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Abstract

UBV-lightcurves of 5 Symbiotic stars are presented. Period determination using the photometric observations has been done. The calculated periods are compared with other published values.

Introduction

Symbiotic stars are commonly accepted as binary systems consisting of a late (M-) giant and a hot compact object like a white dwarf or subdwarf. Because of the mass loss of the giant both components are surrounded by a common nebulous envelope. Interactions between the components leed to physical processes like mass transfer, accretion onto the hot component, nova-like eruptions, photo-ionization and radiative transfer within gaseous nebulae.

For studying these processes photometric and spectroscopic observations over a long time scale and over the whole spectrum have to be done.

To construct a model for a special symbiotic star, knowledge of the exact orbital elements is necessary. For period determination one mostly chooses one of these two possibilities:

- using radial velocities from spectroscopic observations
- lightcurve analyses

There is however a problem to each:

1. Bright emission lines are mostly generated inside the common envelope between the components. These lines are not fixed on the surface of one star and are therefore unsuitable for period determination. Unsymmetrical line profiles complicate the determination of the line center. Absorption lines of the late component are qualified, but in some cases they are very weak. Some objects show no or insignificant radial velocities because of low inclination.

2. Variability in brightness is the result of superimposed processes. Typical eclipses are mostly rare. Most of the lightcurves show semiregular changes. Period determination is difficult.

Divergent values published by several authors are the result of those difficulties.

Photoelectric lightcurves of selected objects

A number of Symbiotic stars have been observed photoelectrically at UBV with the Sonneberg 60 cm-reflector-II. On the basis of these observations period determination has been done using the method of LAFLER and KINMAN. The calculated periods were compared with values published by other authors (see table 1).

period (1): recent calculations
period (2): calculations of GARCIA and KENYON (1987), basing on radial velocities
period (3): periods published by other authors

Table 1:

Star	p (1)	p (2)	p (3)	author (3)
EG And	466.8 + 5	492 + 4	481.7 + 2	SKOPAL et al. (1988)
UV Aur	396 + 4	388 + 5	395.2	ZAKAROV (1951)
TX CVn	292 + 5	199 + 1	--	
CI Cyg	856 +10	812 +10	855.25	IIJIMA (1983)
AG Dra	554 + 5	530 + 5	554 + 5	MEINUNGER (1979)

The following figures show the UBV-lightcurves since J.D. 244 6000 and the phase diagrams corresponding to the calculated period values.

The magnitudes are the differences

m (symbiotic) - m (comparison star)

Remarks:

EG And (fig 1):

The variations in U are larger than in B and V.
From the U-observations a period of 466.8 days has been calculated. The differences between this and periods published by other authors are not very large.
Further observations are necessary to get the exact value.

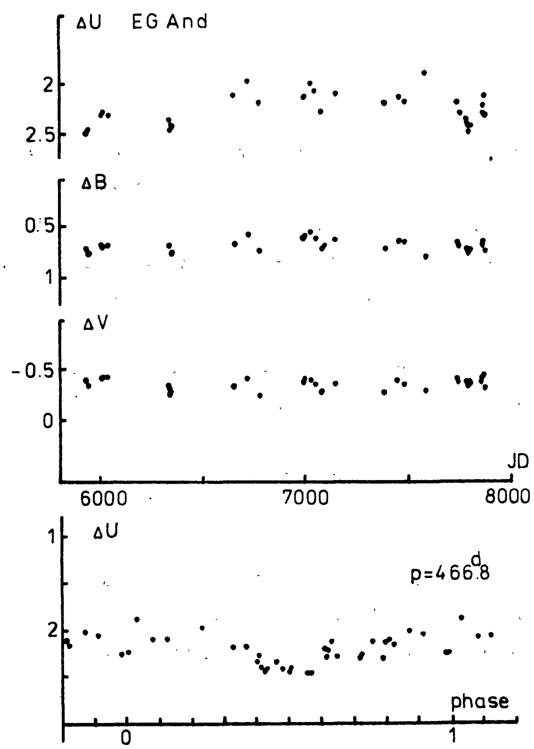

fig. 1

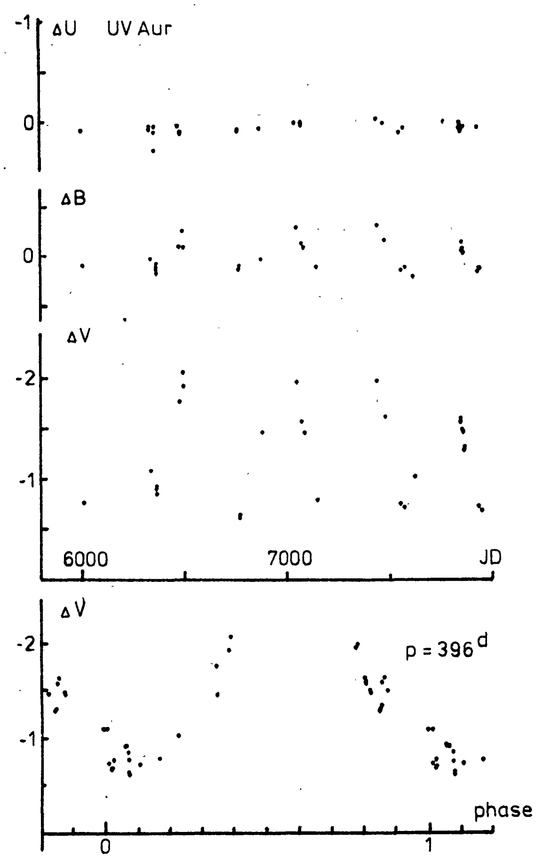

fig. 2

UV Aur (fig. 2):

The star shows periodical variations in B and V. The amplitude in V is about 1.5 mag, but in B only about 0.6 mag. In U we observe only very small irregular variations which do not correlate to B and V. The calculated period of 396 days corresponds to the value published by ZAKAROV (1951). The large amplitude in V and almost complete absence of variations in U leed to the assumption that we observe rather the pulsating Mira component than the orbital motion of the system.

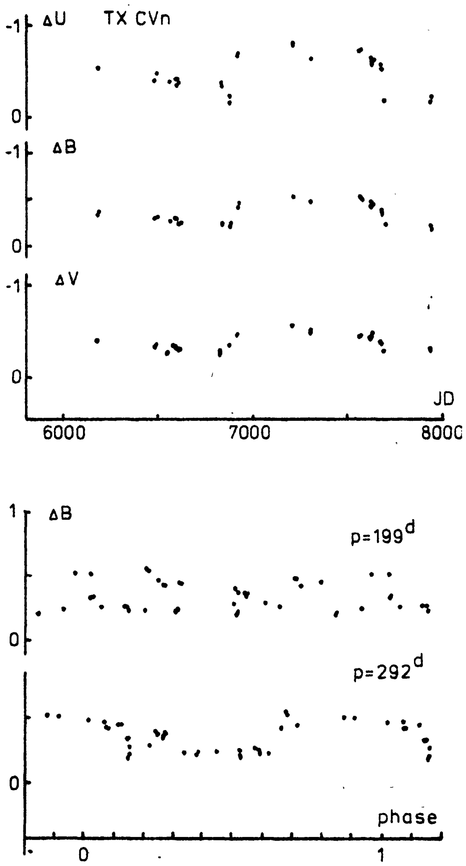

fig. 3

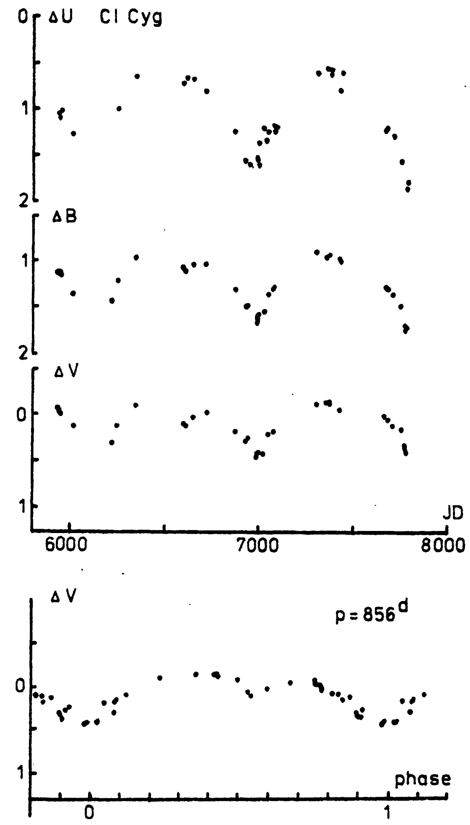

fig. 4

TX CVn (fig. 3):

The amplitudes in B and V are about 0.5 mag, in U about 0.8 mag. Period determination led to a period of 292 days. The value of 199 days by GARCIA and KENOYN could not be confirmed by the periodogram (See also the phase diagrams). The variations in brightness might possibly not be caused by the orbital motion. The shape of the reduced lightcurve is complicated and cannot be explained by a simple eclipsing model.

CI Cyg (fig. 4):

This star shows strong periodicity in all three colours. The period of 855.25 days calculated by ALLER (1954) could be confirmed.

AG Dra (fig. 5):

Since 1982, AG Dra has shown three outbursts. The amplitude increases toward the shorter wavelengths. MEINUNGER (1979) found out a period of 554 days in U before the great outburst in 1981/82. He assumed that the variation in U is caused by the orbital motion of a hot spot in the binary system. These elements calculated by MEINUNGER did not change after the outbursts. This confirms the assumption.

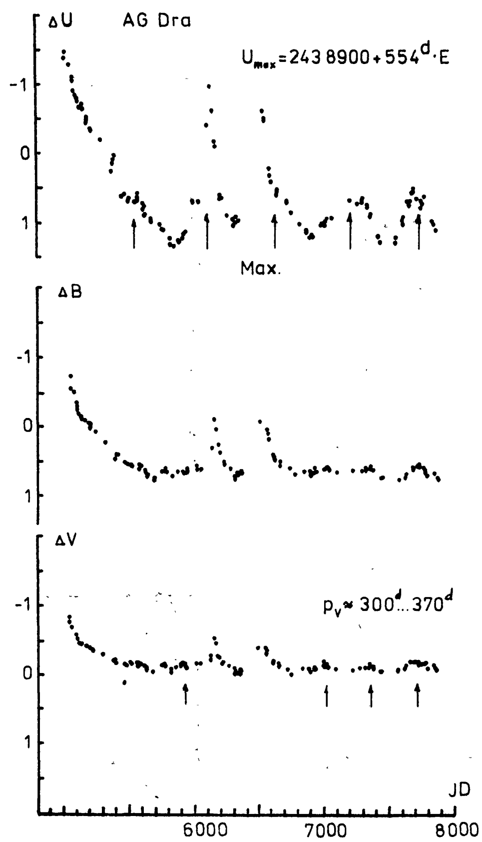

fig. 5

Contrary to the U-observations the B- and V-lightcurve show semiregular variations of small amplitude with a mean period of about 300 .. 400 days. Up to now there has been no explanation for this phenomenon.

Conclusions

For most of the objects there is a distance of the period values to those calculated by GARCIA and KENYON. In some cases the photometric periods differ from the spectroscopic periods because the variations in brightness are not or not only caused by the orbital motion. The smaller differences may be explained by using different time intervals and different numbers of observations.

Period determination in Symbiotic stars is complicated on account of the large orbital periods and the complex interacting processes occuring between the components of the system.

Great numbers of observations during a long time interval are necessary.

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