LONGTERM AAVSO OBSERVATIONS OF THE SYMBIOTIC SYSTEM CH CYGNI

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Abstract

The 10-day means of AAVSO observations from 1948 to 1992 have been analyzed for the symbiotic star CH Cygni, using the Horne-Baliunas period searching technique. The data have been divided into 4 segments corresponding to quiescent or outburst phases of the system. Several periods (738±, 338±, 155±, 101± days) are detected in each segment. In addition, periodicity of 17-years is detected in the Fourier transform of the entire data set. The results of this study are compared with those obtained by other researchers using different data sets and or period-analysis techniques.

1. Introduction

CH Cygni is a symbiotic system - the brightest of its class - consisting of an M giant (semiregular) and an active hot companion, possibly a white dwarf. It was discovered by Graff (1924a, b) and initially classified as a semiregular variable due to its M6-M7 spectrum, 90- to 100-day period, and about one-magnitude amplitude. CH Cygni was identified as a symbiotic system by Deutsch (1964), who noticed the composite nature of its spectra: a hot blue continuum and emission lines of H, HeI, [FeII], and CaII combined with a late type spectrum.

It has undergone several outbursts in the past several decades, preceded by long intervals of inactivity, as can be seen in AAVSO light curves from 1948 to 1992 (Figure 1). The most prominent outburst was between 1977 and 1986.

The light variability has been studied by several authors (Graff and Yamamoto 1924; Gaposchkin 1952; Luud *et al.* 1977; Muciek and Mikolajewski 1989; Mikolajewski *et al.* 1990 and the references therein), using various data sets. Period search studies show quasiperiodic fluctuations ranging from several minutes (flickering activity) to several thousand days.

Yamashita and Maehara (1979) determined spectroscopically the binary period of 15.7 years. This period has been attributed to eclipses (Mikolajewski *et al.* 1987, 1988), when the M giant occults the hot active companion, an accreting magnetic white dwarf. Recently, Hinkle *et al.* (1993), analyzing their 13 year time-series (1979-1992) IR spectra, reported CH Cygni to be a (non-eclipsing) triple system, consisting of a symbiotic M giant, and a hot companion, and an additional main sequence star. They detected a short period of 756 days and attributed it to the orbital motion of the symbiotic pair, and a longer period of 14.5 years, which they attributed to the orbital motion of the third star around the symbiotic pair.

2. Observations and Analysis

Long term AAVSO visual data provide a rich resource for studying CH Cygni light variability. For this study we use 10-day means of AAVSO observations from 1948 to 1992. We divided the data set into the following four time intervals (Figure 2): 1) 1948 - 1960; 2) 1960 - 1975; 3) 1975 - 1986; 4) 1986 - 1992.

The intervals we use are different from previous studies, particularly that of Muciek and Mikolajewski (1989), who included in their study the AAVSO data up to 1978. We believe that our selection of intervals represent the changes of the behavior more clearly.

We performed Fourier transforms of the data in each of the intervals mentioned above, using the Horne and Baliunas (1986) technique. This technique is particularly suitable for period analysis of unevenly-sampled time series. We checked aliases by taking out each period and running the Fourier transform again.

Our analysis detected the presence of several periods and/or quasi-periods. Table 1 lists those detected from each interval.

Table 1. Periods (days) detected in the AAVSO data on CH Cygni.

Interval	*P1*	*P2*	*P3*	*P4*	*P5*
1948-1960	101	154	425	765	
1960-1975	100	155	385	719	
1975-1986					1930?
1986-1992	101		338	738	

In addition, we performed Fourier transform of the entire data set from 1948 to 1992. Our analysis shows a 17-year periodicity.

3. Conclusion

The periods of 100 days, 155 days, and about one year may be due to the pulsations of the M giant. The periods of about 2 years and 17 years may reflect the orbital motion of the components of the system. Further multi-wavelength monitoring is necessary to determine the nature and cause(s) of CH Cygni light variability.

4. Acknowledgements

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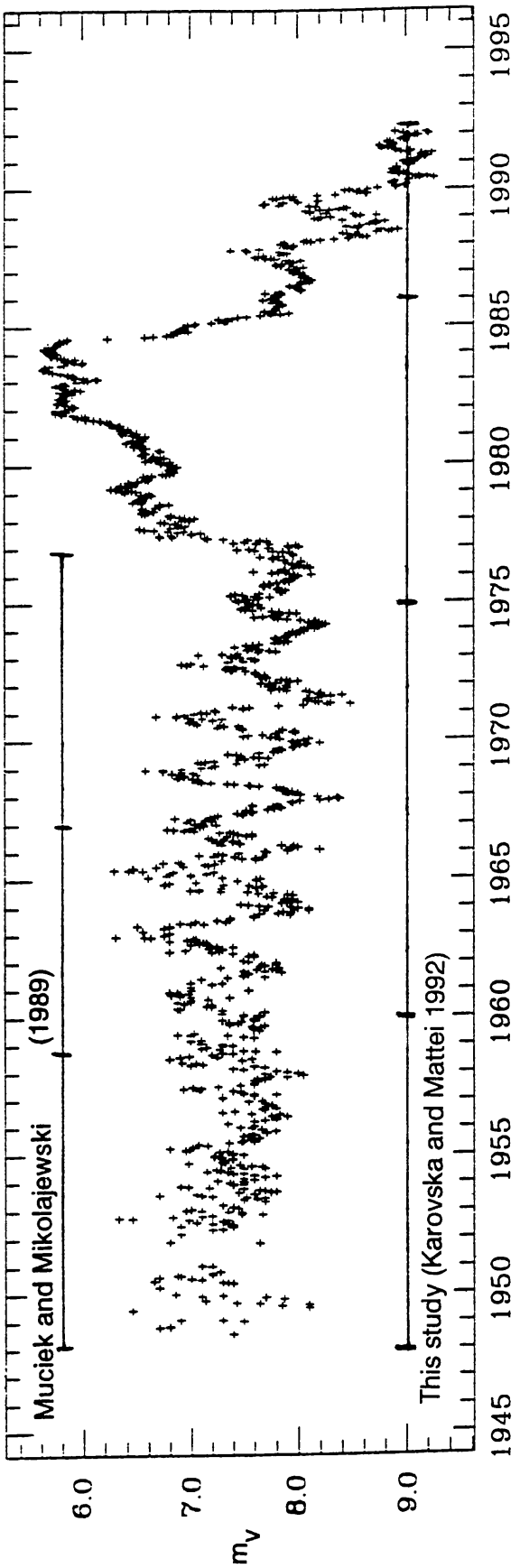

Figure 1. AAVSO light curve (10-day means of observations) of CH Cygni from 1948 to 1992. The time intervals used for this study are marked, along with those used by Muciek and Mikolajewski (1989).

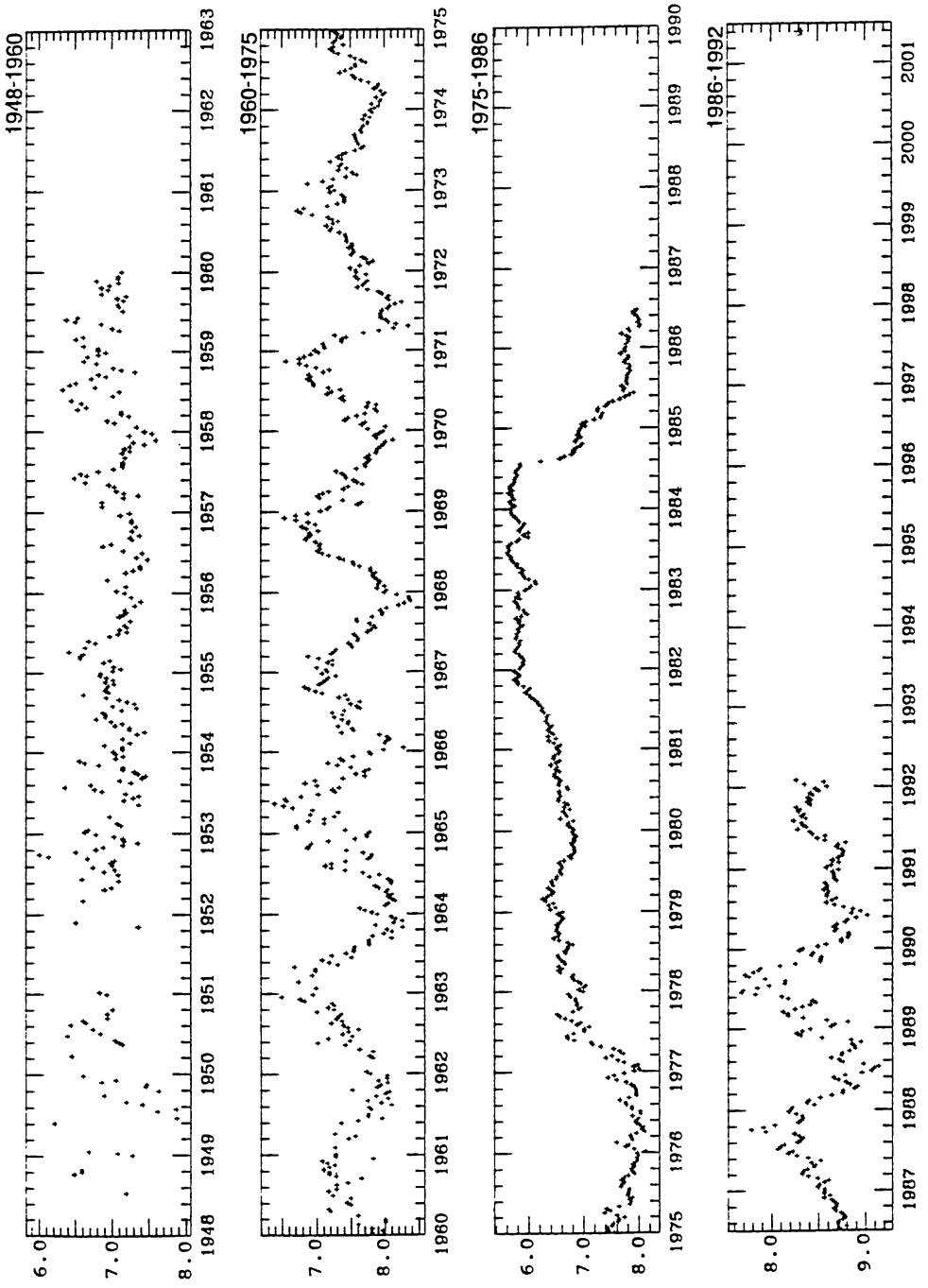

Figure 2. AAVSO light curves (10-day means of observations) of the four time intervals used in the analysis in this study.

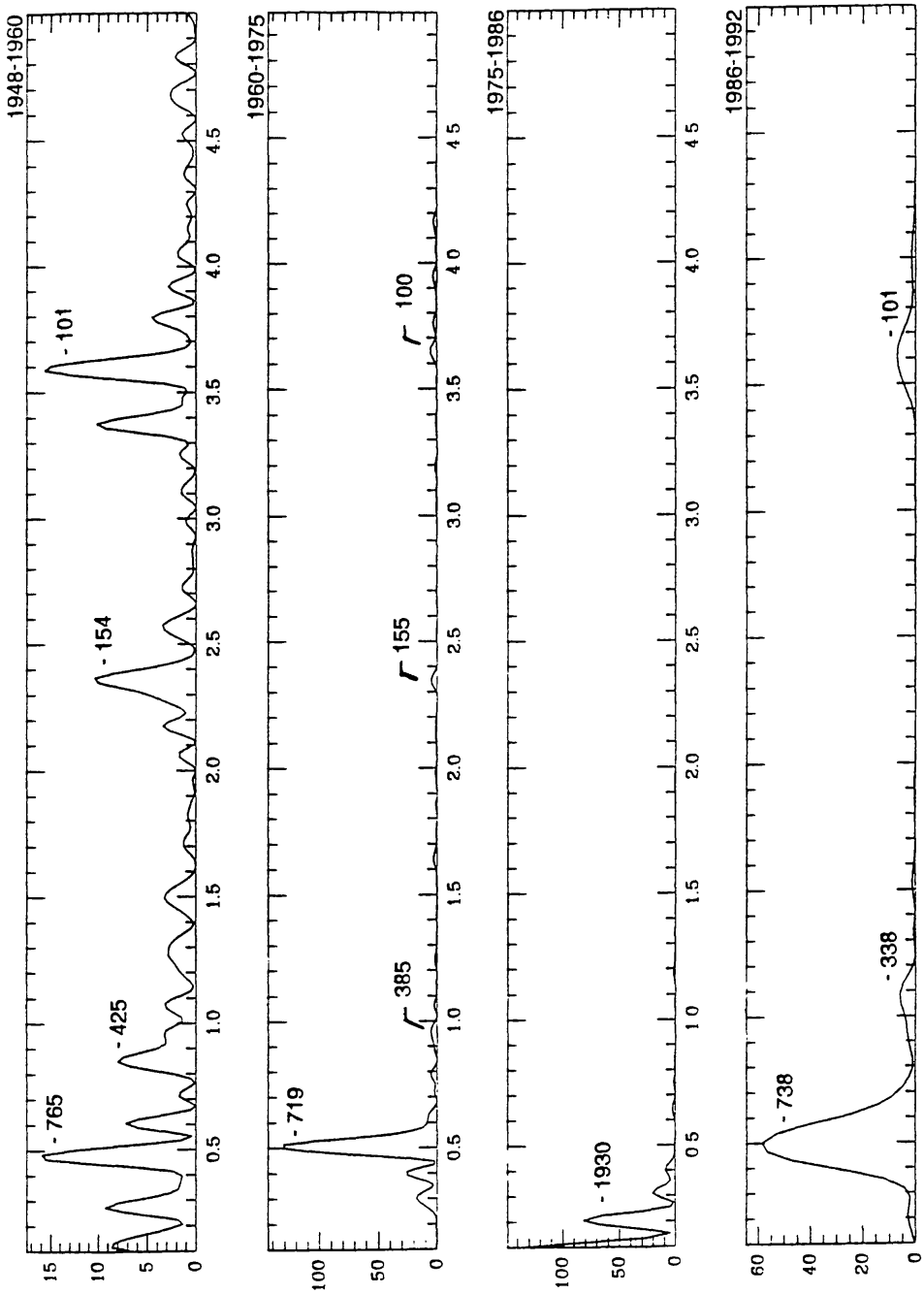

Figure 3. Fourier Transforms of 10-day means of observations of CH Cygni for each of the indicated time intervals - normalized to accommodate the highest peak.