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MWC 560: DETECTION OF A PERIODIC COMPONENT IN THE LIGHT CURVE

According to Michalitsianos et al. (1991), the unique object MWC 560 belongs to a new, previously unknown class of binary systems in a critical stage of interacting binary evolution. It consists of an M giant, a compact star and an accretion disk. The photometric variability of the object was studied by several authors. We have collected all the photometry of the object from the literature (Luthardt 1991, Tomov et al., 1990) and from our own observations. The photographic observations by Luthardt (1991) are the main bulk of the data. They were transformed into stellar magnitudes adding the shift correction $9^{m}_{.}44$ which was obtained by comparing our data with Luthardt's observations.

The combined light curve in the B band is shown in Figure 1 (points). One can see that besides of large scattering there are some peaks of brightness and general tendency to light increasing with time.

The time intervals between peaks force us to suspect a 2000-day periodicity. The data for each night have been averaged to obtain the mean points. The general trend was fitted with a third order polinomial and subtracted from the mean data. Applying the standard Deeming period search procedure to the detrended mean curve reveals three peaks corresponding to 1930, 4570 and 11410 days respectively. The most prominent

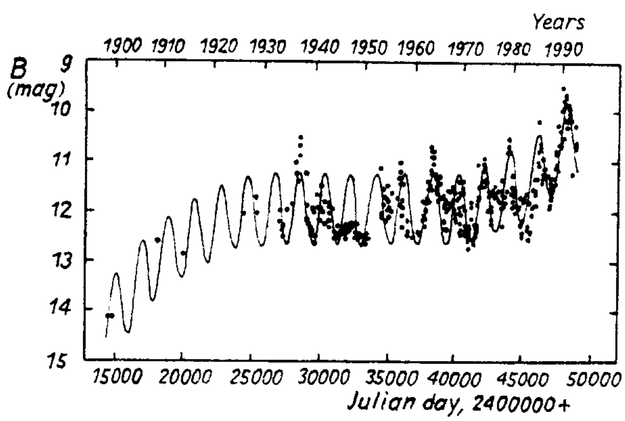

Figure 1. The combined light curve of MWC 560 (points). The solid line is a fit by sinusoidal modulation with amplitude $0^{m}_{.}72$ and ephemeris: JD(Min) =2437455 +1930×E.

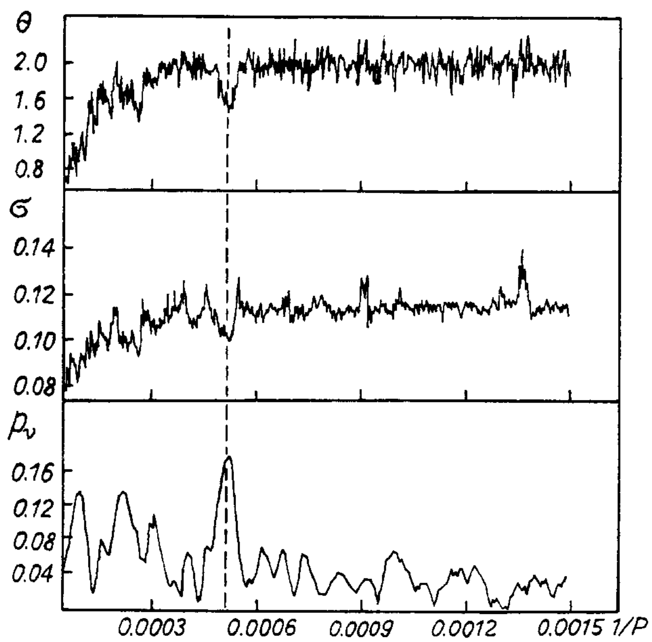

Figure 2. Periodograms of MWC 560 obtained with three different methods. The upper panel is a parameter Θ by Lafler and Kinman. The middle panel is a dispersion parameter by Jurkewich and the lower panel is a Deeming power spectrum (amplitude/2).

peak is that of 1930 days. The length of longest period, 11410 days, is only three times shorter than the whole time interval covered with observations. The nature of the middle (4570 day) period is unclear. But the scattering of points in the phase curve obtained with this period is too large in phases 0.0 and 0.5, and the period is assumed not to be real.

To check the reliability of the peaks we also used the Lafler-Kinman's and Jurkewich's methods. They confirmed the existence of the 1930-day peak and indicated the presence of the double period (Fig.2). Only traces of two low frequency peaks are seen in the periodograms. The phase curve obtained with double wave period, 3860 days, also shows large scattering and its shape is unlike to any phase curve for known binaries.

So, we accept the 1930−day period as real.

The phase curve obtained with the 1930−day period is shown in Figure 3. Large points with error bars denote the mean data in 0.04 phase bins.

In Figure 1 we represent the fit of the original data with the polinomial and sinusoidal modulation with amplitude of $0\overset{m}{.}72$ calculated with the following ephemeris:
JD_{min}=2437455 +1930 ×E (solid line).

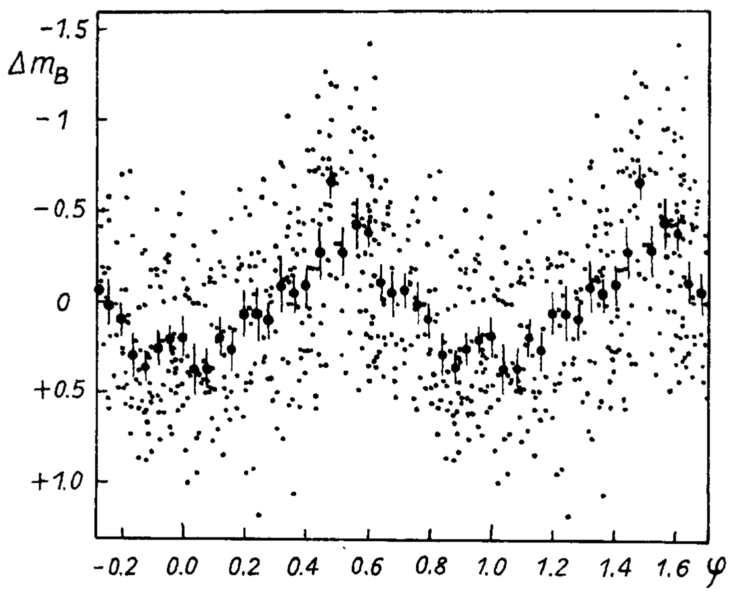

Figure 3. The light curve folded with the 1930 day period. Large points with error bars denote the mean data in $0\overset{p}{.}04$ bins.

One can see that the fitting is good enough for the time with extensive sets of observations and worse for the time where the observations are scarce. There are some time intervals when the expected light maximum was not observed (JD 2430250−32750), or the light minimum was not reached too. Besides, there are many time intervals in the minima and maxima when the observed brightness exceeds the value expected from the only periodic component. It seems there are irregular light variations due to nonstationary processes in the object which may be responsible for high dispersion of the phase curve.

What is the nature of the periodicity? There are several possibilities: orbital motion, accretion disk precession, the M giant pulsation and periodic outbursts. The period is much longer than any pulsation period known for Mira-type stars and comparable with the 1360-day period which was found for symbiotic binary star BX Mon (Whitelock and Catchpole 1983). MWC 560 is known to be a binary star containing an M giant, which suggest a long orbital period.

If the orbital plane is markedly tilted to the line of sight then the periodicity may be caused by reflection effect on the hemisphere of the M giant due to action of short wave radiation and winds from the hot star. A good explanation of such type periodicity is proposed by Kurochkin (As. Ap. Trans., 1992, in the press) for symbiotic variables. He supposes that the hot star is moving on an elliptical orbit, so both the accretion rate and the disk brightness increase in the periastron passage. This mechanism may cause the orbital periodicity at all the possible orbit inclinations.

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