NUMERICAL ANALYSIS OF ORBITAL PERIOD VARIATIONS AND A MECHANISM FOR CHANGES IN THE LIGHT CURVE OF VW CEP

L. Xuefu and L. Chengzhong
Beijing Normal University, People's Republic of China

NEW INTERPRETATION OF THE KWEE EFFECT

The WUMa contact binary VW Cep has a period of 0.2783 days, spectral type G5+K1 and mass 1.1+0.4 $M_\odot$. Our three-colour photoelectric measurements made in Sept. and Oct. 1964 confirmed the existence of the Kwee effect in this system. We believe that if the Kwee effect is to be explained in terms of moving gas streams the influence of magnetic fields must be considered. It is assumed that there is a deep convection zone on the primary accompanied by a dipole magnetic field. This field is distorted by the moving gas streams to form a ring-like configuration with an enhanced field strength close to the inner Lagrangian point, L_1 (see figure 1), where large groups of spots form. We suppose the magnetic field in the spots to be 5000G and the general field to be ∿10-20 G. The cycle of magnetic activity can be calculated using the theory of magnetic flux oscillation. The period, $T = 4\pi^{3/2}(\rho Hd/B_pB_t)$ we calculate as 747 days, close to the observed period of 718 days. Hot gas streams from the secondary could gradually develop into a shock and form a heat flare or local emission region on the primary. Such flare activity would also be seen on the light curve but would not affect the basic period. In short the Kwee effect is the result of spot activity and a local emission region on the primary. Figure 1

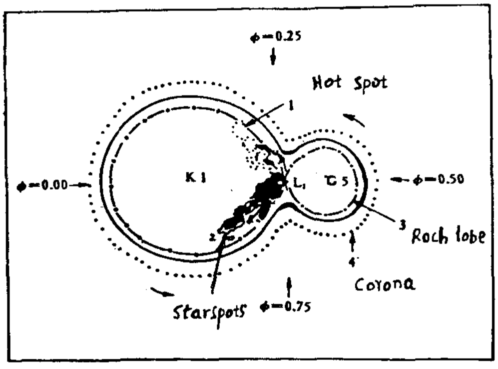

Figure 1. A model of VW Cep.

P. B. Byrne and M. Rodonò (eds.), Activity in Red-Dwarf Stars, 485–486.

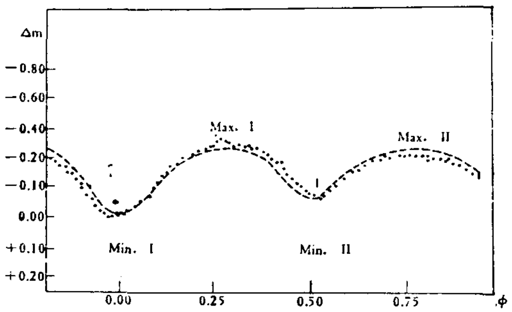

Figure 2. Light curve of VW Cep distorted by additional or missing light due to hot spots or starspots respectively.

shows the model and Figure 2 shows the Kwee effect on the light curve. Note that the light curve has two maxima at phases 0.25 and 0.75 respectively.

NUMERICAL ANALYSIS OF THE ORBITAL PERIOD CHANGES.

The change in the orbital period (O-C) referred to the minimum at phase zero in Figure 2 is given by JD(hel)2424658.758-0.2783199E based on data from 1926 to 1977. The resulting (O-C) curve is given in Figure 3. Let (O-C)=f(E). f(E) oscillates about a mean relation $f(E)=0.047-2.029\times10^{-6}E$. A Fourier method was applied to the oscillations of the form.

$$f(E)=a+bE+\sum_{k=1}^{m} A_k \sin(kwE+\phi_k)$$

where $w=2\pi/T$. Altogether 35 solutions for A_k, ϕ_k and T_k were obtained. We believe that the variation of the orbital period is not caused by a third body alone. There are also effects due to gas streams, tidal action, stellar wind, mass loss, etc.

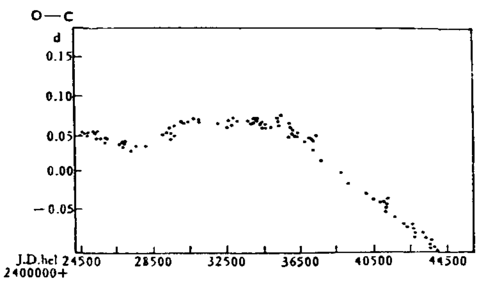

Figure 3. Period changes in VW Cep (1926-1977).

https://doi.org/10.1017/S0252921100096548 Published online by Cambridge University Press