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LIGHT CURVE ANALYSIS OF CW CEPHEI

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ABSTRACT

The *UBV* observations of the close binary system CW Cephei were made from August 1983 to December 1984 during 25 nights using the 61cm Boller and Chivens reflector at the Sobaeksan Astronomy Observatory. The new *UBV* light curves were analyzed with the recent Wilson-Devinney binary model. Our photometric solution for CW Cep were well consistent with those of Clausen & Giménez (1991). Using our photometric solution and Popper & Hill (1991) spectroscopic one, each absolute masses and radii of components for CW Cep were derived as 13.63 $M_\odot$ and 5.83 $R_\odot$ for the primay, and 12.18 $M_\odot$ and 5.14 $R_\odot$ for the secondary, respectively.

Key Words : Stellar Astronomy - Binary Systems - CW Cep

I. INTRODUCTION

Since the discoveries of CW Cep as a spectroscopic binary by Petrie in 1947 and of its eclipsing nature by Gaposchkin (1949), this interesting star has been studied by many investigators. CW Cep (HD 218066, P=2^d.7191, Sp=B0.6V+B0.7V, M_v=7.7) belongs to a member of young III Cep OB association (Blaauw *et al.* 1959) and shows apsidal motion (Nha 1975) with the relatively short period of about 45 years (Giménez *et al.* 1987, Clausen & Giménez 1991). The photoelectric observations of CW Cep have been made and analyzed by Abrami & Cester (1960), Nha (1975), Söderhjelm (1976), and recently by Giménez *et al.* (1990). Meanwhile Popper (1974) made spectroscopic observations which were rediscussed by Popper & Hill (1991).

In recent years, these light curves were re-analyzed with modern synthesis techniques for light curve analysis; Cester *et al.* (1978) with WINK model, Clausen & Giménez (1991) with a modified EBOP model, and Terrell (1991) with the Wilson-Devinney (hereafter, WD) code. Although their solutions greatly improved the previous pictures on CW Cep system, there are still some disagreements among the published parameters of this system, especially relative radii of the components. In this paper, our new *UBV* light curves of CW Cep were analyzed with the 1993 version of WD program (Wilson & Devinney 1971, Wilson 1993).

II. OBSERVATION

The *UBV* observations of CW Cep were made from August 1983 to December 1984 during 25 nights using the 61cm reflector at the Sobaeksan Astronomy Observatory. The photometer was equipped with a refrigerated 1P21 photomultiplier and an *UBV* Johnson photometric system. The comparison and check stars uesd were HD218342 and HD217919, respectively. The details of the observations were well described by Han (1984). A total of 1,789 observations in three colors were secured. Among them 1,422 observations observed on 20 nights from August 1983 to November 1983, were already presented by Han (1984), but not analyzed. The rest were unpublished.

III. ANALYSIS

The *UBV* light curves secured from our observations were well defined in all phases and made a total of 108 normal points, as shown in Figure 1. The normal *UBV* light curves were analyzed with the 1993 version of WD code. Some parameters, according to theoretical basis, were fixed as $T_1 = 28300K$, $g_1 = 0.42$, $g_2 = 0.43$, $A_1 = A_2 = 1.0$, $x_1 = x_2 = 0.32$ for U, 0.385 for B, 0.330 for V, respectively. Adjusted parameters were intialized from Terrell (1991) and Clausen & Giménez (1991) as the values of $q(0.938)$, $i(82.5)$, $\Omega_1(5.0100)$, $\Omega_2(6.2460)$, $T_2(27,700)$, and $L_1(7.2005(U), 7.1402(B), 7.1163(V))$. The mode 2 of the WD code for detached system is used. Table I listed our final solution. The theoretical and normalized light curves were drawn for each color in Figure 1.

IV. CONCLUSION

Our results were in good agreement with those of Clausen & Giménez (1991) rather than those of Terrell (1991). Combined our photometric solution with the spectroscopic ones of Popper & Hill (1991), absolute dimensions of CW Cep were derived as 13.63 $M_\odot$ and 5.83 $R_\odot$ for the primary, and 12.18 $M_\odot$ and 5.14 $R_\odot$ for the secondary, respectively. We had some difficulties in inter-comparisons of system paramers of CW Cep derived by different authors mainly bacause different models and different assumptions were used and made for their solutions. Söderhjelm (1976) used all the light curves of CW Cep published at that time. However, his solution failed to represent the light curves of Abrami & Cester (1960) satisfactorily. Terrell (1991) again analyzed Abrami & Cester's light curves with the

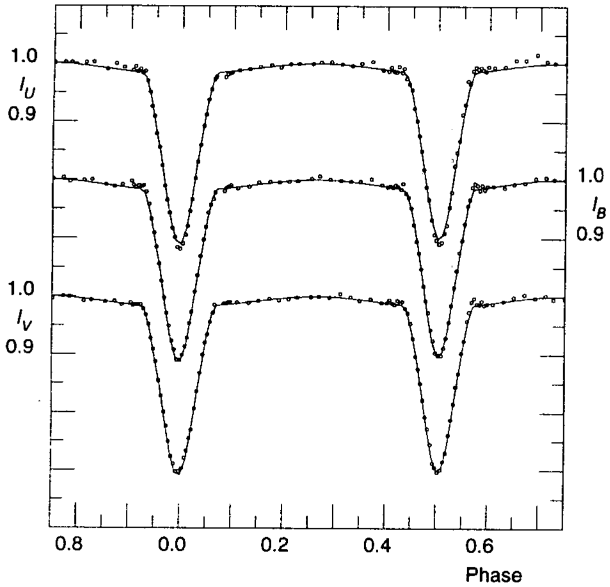

Fig. 1.— The theoretical and normalized *UBV* light curves of CW Cep.

WD model, but his solution were quite different from those of ours and Clausen & Giménez (1991). It seems that such results are mainly due to the differences of observations made by Abrami & Cester, and those of ours and Clausen & Giménez. It is necessary to analyze all the light curves of CW Cep published so far with only one binary model. Detailed analysis of our observations with the study of its apsidal motion for CW Cep will be published elsewhere.

Table 1. Photometric solution of CW Cep

A. Parameters dependent on wavelengths			
Parameters	U	B	V
l_1	0.5731(6)	0.5762(7)	0.5749(6)
l_2	0.4198	0.4188	0.4201
$x_1^* = x_2^*$	0.320	0.385	0.330
B. Parameters independent on wavelengths			
e	0.0290	Ω_1	5.1928(43)
ω	290.75	Ω_2	5.5412(50)
q	0.939(1)	r_1	0.2351(2)(pole)
i	81.37(2)		0.2448(3)(point)
$F_1^* = F_2^*$	1.000		0.2382(3)(side)
g_1^*	0.420		0.2427(3)(back)
g_2^*	0.430	r_2	0.2085(2)(pole)
T_1^*	28,300		0.21485(3)(point)
T_2	27,400(260)		0.2105(2)(side)
$A_1^* = A_2^*$	1.0		0.2134(3)(back)

* Fixed Parameters

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