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A study of close binary system EE Cet

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Abstract. Variability of the combined light of close binary EE Cet in the visual/spectroscopic triple system ADS 2163 was discovered by the Hipparcos satellite. New photoelectric BV light curves of EE Cet were obtained at the Rozhen National Astronomical Observatory, Bulgaria. We have combined this photometric with earlier spectroscopic observations to derive the physical parameters of the system. Due to the proximity of the visual companion, the light curves were contaminated by the third light. Spectroscopic observations, which were able to separate EE Cet from its companion, found that spectral type of the system is F8 V (T = 6095K) and mass ratio is $q = \mathcal{M}_2/\mathcal{M}_1 = 0.315$. Our analysis show that EE Cet is a high-overcontact system ($f_{\rm over} \sim 32\%$), with orbital inclination $i \approx 79^\circ$, component masses $\mathcal{M}_1 = 1.37$, $\mathcal{M}_2 = 0.43\ \mathcal{M}_\odot$ and mean radii $\mathcal{R}_1 = 1.35$, $\mathcal{R}_2 = 0.82\ \mathcal{R}_\odot$. Future photometric observations, able to separate EE Cet from its companion, would put even more tight constraints on properties and parameters of this close binary system.

Key words. Binaries: close - Stars: fundamental parameters - Stars: individual: EE Cet

1. Introduction

Variability of the combined light of close binary EE Cet in the visual/spectroscopic triple system ADS 2163 was discovered by the Hipparcos satellite. We have combined new photometric observations (photoelectric BV light curves) obtained at the Rozhen National Astronomical Observatory, Bulgaria during October 7 and 8, 2004, with earlier spectroscopic observations, to derive the physical parameters of the system.

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2. Analysis, Results and Conclusions

The Hipparcos photometric observations of the system show a light curve variation with a period of 0.38 days. In a radial velocity study Rucinski et al. (2002) found that the source of variability is the southern, fainter component (separated from the northern companion, by $5''.6$), which is classified as a W-type W Ursa Majoris (W UMa) eclipsing binary EE Cet (of spectral class F8 V). The mass ratio determined is $q = \mathcal{M}_2/\mathcal{M}_1 = 0.315$.

We have analysed the light curves of EE Cet using the code of Djurašević (1992a,b) modified for overcontact configura-

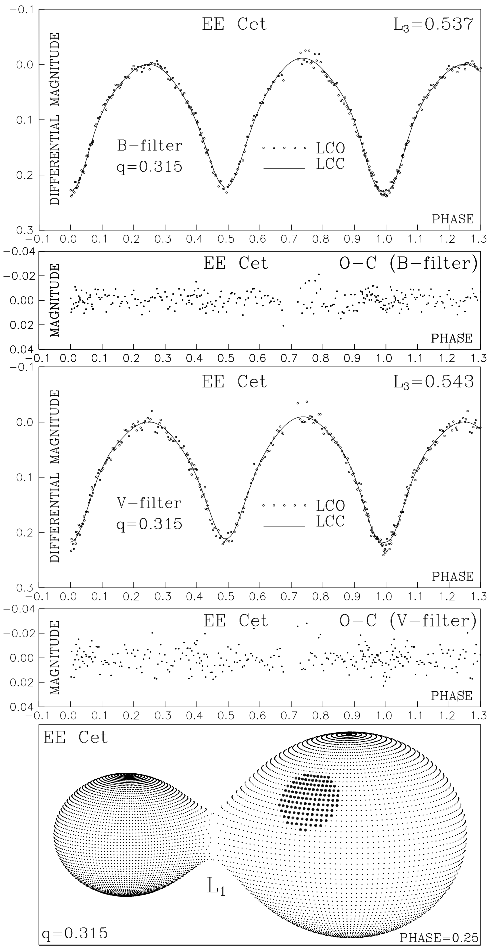

Fig. 1. Observed (LCO) and final synthetic (LCC) light-curves of the EE Cet with final O-C residuals obtained with third light effect $L_3 \sim 0.54$, and the view of the system at orbital phase 0.25.

tion (Djurašević et al. 1998). The results are shown in Table 1 and Fig. 1.

Due to the proximity of the visual companion, the light curves were contaminated by the third light. Future photometric observations, able to separate EE Cet from its companion, would put even more tight constraints on properties and parameters of this close binary system.

Table 1. Results of the simultaneous B and V light curve analysis by applying the Roche model with cool spot area on the primary component.

Quantity	
$q = \mathcal{M}_2/\mathcal{M}_1$	0.315
L_3	0.537 [B], 0.543 [V]
T_1	6095
$\beta_1 = \beta_2$	0.08
$A_1 = A_2$	0.5
$f_1 = f_2$	1.0
$A_s = T_s/T_1$	0.91 ± 0.02
θ_s	16.9 ± 0.6
λ_s	295.7 ± 4.1
φ_s	29.2 ± 6.1
T_2	6305 ± 12
i [°]	78.9 ± 0.2
f_{over} [%]	31.59
L_1/L_{tot}	0.320 [B]; 0.318 [V]
$\mathcal{M}_1$ [$\mathcal{M}_\odot$]	**1.37** ± 0.02
$\mathcal{M}_2$ [$\mathcal{M}_\odot$]	**0.43** ± 0.02
$\mathcal{R}_1$ [$\mathcal{R}_\odot$]	**1.35** ± 0.02
$\mathcal{R}_2$ [$\mathcal{R}_\odot$]	**0.82** ± 0.02
$\log g_1$	**4.32** ± 0.02
$\log g_2$	**4.25** ± 0.02
M^1_{bol}	**3.91** ± 0.02
M^2_{bol}	**4.85** ± 0.03
a_{orb} [$\mathcal{R}_\odot$]	**2.68** ± 0.01

Note: $q = \mathcal{M}_2/\mathcal{M}_1$ - mass ratio, $T_{1,2}$ - temperature of the more-massive primary and less-massive secondary, $\beta_{1,2}$, $A_{1,2}$, $f_{1,2}$ - gravity-darkening exponents, albedos and nonsynchronous rotation coefficients, A_s, θ_s, λ_s and φ_s - spot temperature coefficient, angular dimension, longitude and latitude (in arc degrees), i [°] - orbit inclination, L_3 - third light, f_{over}[%] - degree of overcontact, L_1/L_{tot} ($L_{tot} = L_1 + L_2 + L_3$) - luminosity of the more massive star (including spot), $\mathcal{M}_{1,2}[\mathcal{M}_\odot]$, $\mathcal{R}_{1,2}[\mathcal{R}_\odot]$, - stellar masses and mean radii in solar units, $\log g_{1,2}$ - logarithm (base 10) of the system components effective gravity, $M^{1,2}_{bol}$ - absolute bolometric magnitudes and $a_{orb}[\mathcal{R}_\odot]$ - orbital semi-major axis in units of solar radius.

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