

Light curve analysis of the eclipsing binary system V781 Tau

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Abstract. V781 Tau is one of W UMa eclipsing binary systems whose orbital period is 0.34 days. The 0.7-meter telescope with CCD photometric system in B and V filters was conducted at the Regional Observatory for the Public, Chachoengsao, Thailand during December 2018, UT. The Wilson-Devinney Technique was used for calculating the physical properties of V781 Tau. The results showed the inclination of their orbital is $66.140^\circ \pm 0.14$. The effective temperature of the primary and secondary star is 6,060 and 5,881 K, respectively and the degree of contact is 4.38 %

1. Introduction

V781 Tau is one of W UMa eclipsing binary systems, which R.A. 05h 50m 13.1s and Dec 26^o57'43". The orbital period of V781 Tau is 0.3449098 days [1]. It was discovered by Harris in 1979 [2]. Lu *et al.* studied by using the cross-correlation technique for measured for radial velocities $V_0 = +24.4 \pm 1.3$ kms⁻¹. The estimated distance of V 781 was 70 pc [3]. Liu and Yang found that the period change is $\delta p/p = -5.0 \times 10^{-11}$ and the minimum shrinking velocity is 6.77×10^{-5} cms⁻¹[4]. Zwitter *et al.* using GAIA performance the properties of binary systems. The result showed the spectrum type of V781 was G0 and the period change same to Liu and Yang. Determined V781 Tau is a W-subtype medium contact binary star, which the rate of orbital period change $-6.01(\pm 2.28) \times 10^{-8}$ d/yr [4,5].

In this work, the physical properties of V781 Tau were analyzed from the photometric observed data by Wilson-Devinney Technique to construct the V781 Tau binary star model. There were compared with the result from the past and collected in the binary star database for the future.

2. Observation and data analysis

V781 Tau was observed in the clear night sky on 18 December 2018, UT at the Regional Observatory for the Public, Chachoengsao, Thailand. The 0.7 - meter reflecting telescope and CCD with 30 seconds exposure time each in the blue (*B*) and standard visual (*V*) filters of the *UBV* system were used. The data reduction and the photometry were analyzed by MaxIn DL6 program. The Comparison and the Check stars are TYC 1870-582-1 and BD +26 972, respectively. The observational light curve of V781 Tau from 667 images in *B* and 657 images in *V* wavelength bandwidth is shown in figure 1. The Wilson-Devinney Technique was used to calculate the physical properties values.

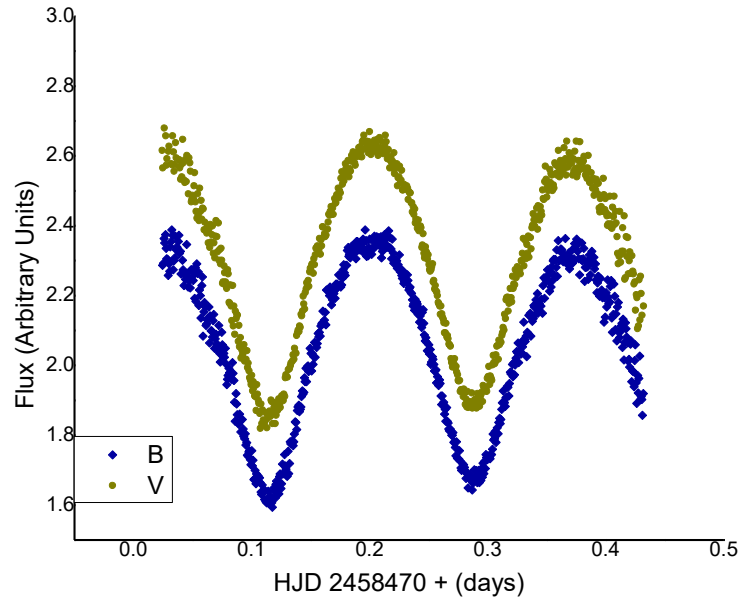


Figure 1. The light curve of V781 Tau.

3. Results and discussion

The synthetic light curve between phase and relative light of V781 Tau in *B* and *V* filters, as shown in figure 2, was constructed from photometric data computation by using Wilson-Devinney software which was developed by Kang Y.W. [6]. The red line shows the calculated data and the dots are observed data. We operated the light curve in mode 1 of the differential correction (DC) in Wilson-Devinney (WD) code [7]. The initial parameters were used from Li K. that publish in 2016 [8]. The best solution of the V781 Tau in this study, as shown in table 1., is the subscripts 1 and 2 refer to the primary (hotter) and the secondary (cooler) components, respectively.

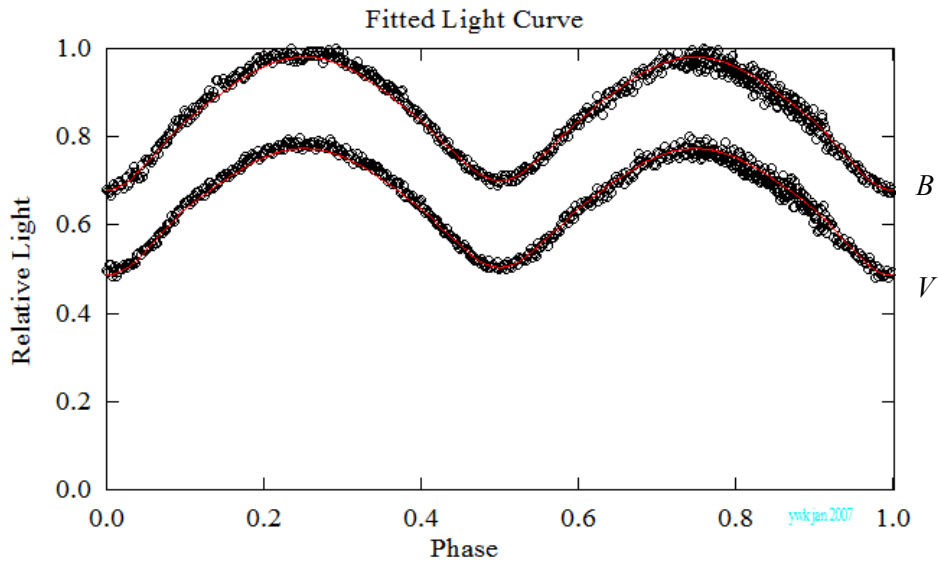
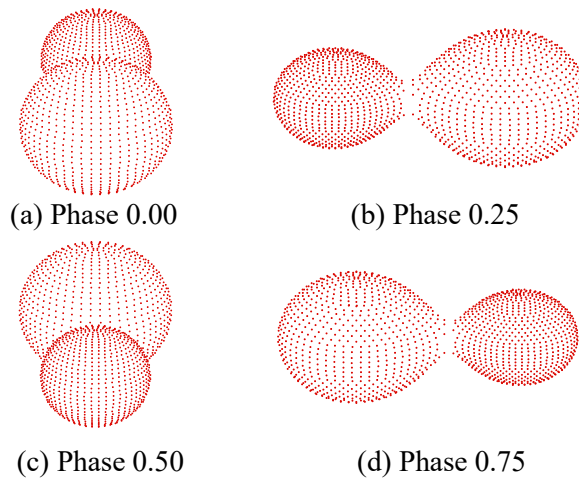


Figure 2. Synthetic light curve of the V781 Tau.

Table 1. Parameters for simulated of the V781 Tau Model.

Parameter	The Best Solution
i	$66.14^0 \pm 0.14$
g_1	0.32
g_2	0.32
$\Omega_1 = \Omega_2$	5.123377 ± 0.011423
Ω_{in}	5.239784
Ω_{out}	2.580423
T_1 (K)	6060 ± 152
T_2 (K)	5881 ± 136
A_1	0.50
A_2	0.50
q	1.991664 ± 0.007192
$L_1/(L_1+L_2)_V$	0.38296 ± 0.03222
$L_1/(L_1+L_2)_R$	0.37744 ± 0.02727
Degree of Contact (%)	4.38

From table 1, The inclination of V781 Tau is $66.14^\circ \pm 0.14$ nearly Cereda *et al.*, J. Yakut *et al.* and Kallrath *et al.*, [2,9,10]. They calculated the value of 68° , 65.9° and 62.3° , respectively. The gravity-darkening coefficients and bolometric albedo coefficients of the two components were fixed at $g_{1,2} = 0.32$ and $A_{1,2} = 0.50$ appropriate for stars with convective envelope [4]. Surface temperature $T_{1,2}$ were 6,060 K and 5,881 K., that corresponding to G0 spectra in Li *et al.*, Kallrath *et al.* and Donato *et al.* The mass ratio (q) approximate to 1.99 mean the mass of the first star less than the secondary star [8,10,11]. There are not significantly different from Yakut *et al.* and Li *et al.* [2,8]. The degree of contact of V781 Tau is 4.38 percent that is smaller than the result from Li *et al.* [8], the value of contact degree of $f = 21.6\%$, might be the effect of mass transfer. The plotted geometric structure models are 0.00, 0.25, 0.50, and 0.75 are shown in figure 3.

**Figure 3.** Geometric structure model of V 781 Tau.

4. Conclusion

The W UMa eclipsing binary system V781 Tau was observed on 18 December 2018, UT at the Regional Observatory for the Public, Chachoengsao, Thailand. The 0.7 - meter reflecting telescope and CCD with the blue (*B*) and standard visual (*V*) filters of the *UBV* system were used. The Wilson-Devinney technique was used for investigated photometric data at the Faculty of Science and Technology, Chiang Mai Rajabhat University, Chiang Mai, and Phetchaburi Rajabhat University, Phetchaburi, Thailand. We found that the inclination of their orbital is $66.14^\circ \pm 0.14$. The effective temperature of the primary and secondary stars is 6,060 and 5,881 K, respectively. The mass ratio is 1.99 and the degree of contact is 4.38 %.

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