



Light curve analysis of a new W UMa system GSC 3581-1856



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HIGHLIGHTS

- The first photometric BVRI observations of the short-period W UMa-type binary, GSC 3581-1856 have been presented.
- The orbital and physical parameters of the system were obtained by using PHOEBE code.
- The GSC 3581-1856 system is a W-type W UMa system with a mass ratio of 1.3362 ± 0.0042 .

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ABSTRACT

New BVRI photometric observations covering seven minima times for the eclipsing binary GSC 3581-1856 were presented. The light curves in BVRI colours were analysed by using PHOEBE code for the system parameters. New minima times were used in revising the light elements. The system is found a W-type contact binary with mass ratio of $q = 1.3362 \pm 0.0042$ and a fill out parameter of $f = 16.89 \pm 3.17\%$. The smaller and less massive component was found hotter component ($T_1 \approx 5590$ K). Lower temperature ($T_2 = 5295$ K) of the mass accreting more massive component is probably due to a disk or envelope around this star. The original temperature of the more massive secondary component would be at least $T_2 \approx 5590$ K. The preliminary absolute dimensions ($M_1 = 0.78 \pm 0.01 M_\odot$, $M_2 = 1.05 \pm 0.01 M_\odot$, $R_1 = 0.92 \pm 0.10 R_\odot$, $R_2 = 1.05 \pm 0.20 R_\odot$, $L_1 = 0.86 \pm 0.20 L_\odot$ and $L_2 = 1.00 \pm 0.20 L_\odot$) indicate a relatively young marginal contact binary for GSC 3581-1856 system. The present luminosity of the less massive but hotter component would be not much different from its main sequence luminosity, and thus its original mass was estimated to be slightly more than one solar mass. This means it could be transferred and/or lost about 30% of its original mass which place the system in relatively young system in contact phase.

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1. Introduction

Binary stars are like astrophysical laboratories (Guinan, 1993). W UMa-type eclipsing binaries are formed by two different late type elongated stars almost or completely touching each other. Studying on W UMa-type binaries contribute to the solution of many physical phenomena such as, shape distortion, mutual heating, mass and heat transfer between the components, mass loss, angular momentum evolution, and final merging process of the component stars.

A new W UMa-type binary GSC 3581-1856 (AC2000 1647164, BWE 2034+4850, RGB J2035+490, R.A. = $20^h35^m51^s.67$, DEC

= $+49^\circ43'9''$) is listed as a new eclipsing binary by Otero et al. (2004). The orbital period of the binary system was found to be 0.2785137 days by Otero et al. (2004). The V magnitude of the system is given about $10^m.97$ by Motch et al. (1997). At present no photometric, spectroscopic study of GSC 3581-1856 is found in the literature.

This study is the second in a series of papers in which we determine the photometric elements of new contact binary systems. The first study was on the new contact binary system GSC 1042–2191 (Bulut et al., 2016). In the present paper we present the first results on the second new contact binary GSC 3581-1856 obtained from the first BVRI light curves.

2. Observations

New CCD observations of GSC 3581-1856 were carried out in three nights, on May 25, on July 01, 05 in 2014, two nights on

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Table 1

The coordinates and V magnitudes of GSC 3581-1856 and two comparison stars.

Star	R.A.(2000)	DEC.(2000)	V (mag)
GSC 3581-1856	20 ^h 35 ^m 57 ^s .1338	+49°00′41″.670	10.931 ± 0.090
C1=TYC 3581 2009	20 ^h 35 ^m 54 ^s .6457	+48°58′43″.317	11.434 ± 0.119
C2=GSC 3581 1943	20 ^h 35 ^m 55 ^s .406	+48°55′28″.84	11.580 ± 0.350

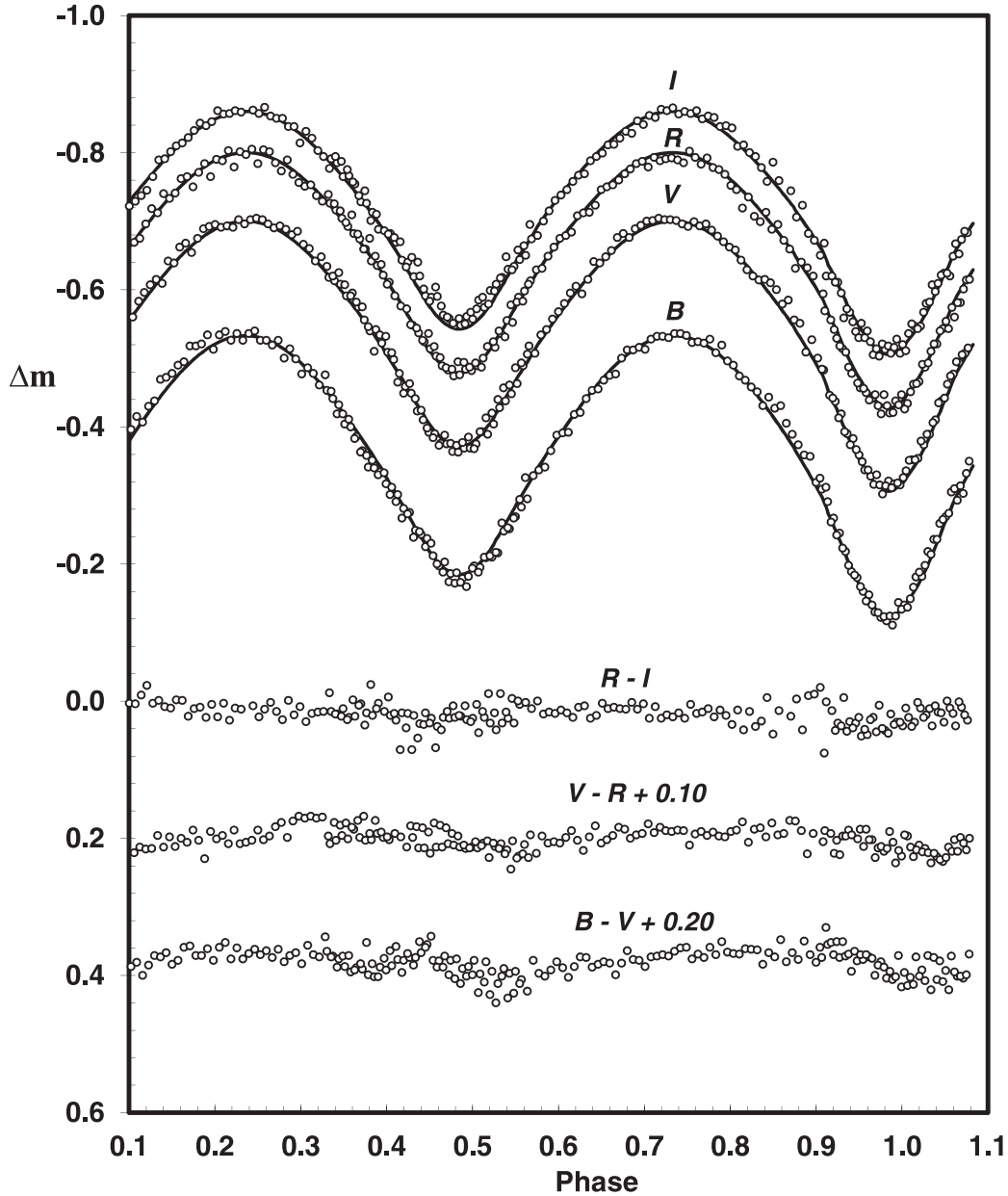


Fig. 1. The light and colour curves of GSC 3581-1856. Points represented the individual observations. Solid lines are the theoretical light curves based on the parameters in Table 4.

September 17, and 18 in 2015 using the 0.4-m Schmidt-Cassegrain telescope at the Çanakkale Onsekiz Mart University Observatory (Turkey). The Apogee ALTA U47 CCD camera and a set of standard Johnson - Cousins - Bessel multicolour filter system were used during the observations. The CCD images have plate scale of 0.65' per pixel and the observed field of view is 12'' × 12''. In order to take into account pixel-to-pixel variations on each frame, several bias, dark and flat frames were taken each night. The data related to the variable, comparison, and check stars are given in Table 1. A total of 820 observational points were obtained

in four filters (208 in B, 207 in V, 202 in R, and 203 in I). A sample page of the differential observations as the magnitude differences between the variable star and the comparison is listed in Table 2 (full list can be provided upon request from the authors). The magnitudes were measured by using C-MUNIPACK software (<http://integral.sci.muni.cz/cmuniack>) in standard fashion, including trimming, bias subtraction, dark frame and flat field correction and performing aperture photometry. The estimated uncertainties for a single observation were of the order of 0^m.01 in each colour.

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