Period and light-curve study of the contact eclipsing binary V523 Cas

Author links open overlay panelMahya Mohammadi [a], Abbas Abedi [a], Nematollah Riazi [b]

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Abstract

CCD photometry of the eclipsing W Uma binary system V523 Cas in U, B, V and R_C filters was carried out during eight nights in 2012. The physical and geometrical parameters of this system are obtained. A possible pulsation period of one of the components is obtained by analyzing the residuals of the ephemeris light curve. Our observations contain 16 times of minimum light. We combined these with all available published times of minimum. By fitting a quadratic curve to the O-C values, a new ephemeris of the system is calculated. By attributing the period change to mass transfer, we find a mass transfer rate of 4×10−12�⊙��. Also, Period (80.58 yr) and the minimum mass (0.3 $M_\odot$) of a possible third body is estimated. In addition, the possible existence of a fourth body with a mass of order 0.15 $M_\odot$ is discussed. These third and fourth bodies could be low-mass main-sequence stars (red dwarfs).

Introduction

V523 Cas was found to be an eclipsing binary of W UMa type by Zola et al. (2010). This system is an overcontact binary with one of the shortest known orbital periods (P = 0.2337d). Photometric studies began four decades ago by Lavrov and Zhukov (1975). They found its photometric mass ratio (Zola et al., 2010). Times of minimum light were published by Haussler (1974) who classified the system as a W UMa type (Bradstreet, 1981). Hrivnak determined average color indices of the system (Lister et al., 2000). Bradstreet (1981) calculated that it is a contact configuration with a 9% filling factor (Jeong et al., 2006). Milone et al. (1984) determined the first mass ratio spectroscopically and found that ���=0.42±0.02. Rucinski et al. (2003) calculated a new spectroscopic mass ratio of ���=0.516±0.007 and classified its spectral type as K4V (Zola, et al., 2010, Milone, et al., 1984, Rucinski, et al., 2003). Period variations of V523 Cas have been studied by numerous authors. Lister et al. (2000), Elias and Koch (2000), Shegbang (2001), Zhang and Zhang (2004), Samec et al. (2004) and Kose et al. (2009) have modeled the times of minima (Lister, et al., 2000, Elias, Koch, 2000, Shegbang, 2001, Zhang, Zhang, 2004, Samec, et al., 2004, Kose, et al., 2009).

Section snippets

Observations and data reduction

The photometric observations of V523 Cas were obtained with the 14-inch Schmidt-Cassegrain Telescope and SBIG ST-7 CCD camera mounted at the Cassegrain focus at the Mojtahedi Observatory of Birjand University (longitude: 59°26'23.8'', latitude: 32°38'29.3''). Data were obtained in the U, B, V and R_C Johnson–Cousins filters. We observed V523 Cas at 8 nights in August and September 2012. The stars Tyc 3257-1068-1 and Tyc 3257-1326-1 were observed as comparison and check, respectively. Table 1

Light curve solution

We analyzed the light curves of V523 Cas using the PHOEBE software (Prsa and Zwitter, 2005), which is based on the Wilson-Devinney program (Wilson, 1979, Wilson, Devinney, 1971). The best fit was obtained for an overcontact binary of W UMa type. We selected a temperature for the primary star based on its observed B-V obtained in Samec et al. (2004) and then adjusted the temperature of the secondary star. We used limb darkening coefficients according to the Van Hamme software (Hamme, 1993). We

Period study

During the 8 nights of observation, 7 primary and 9 secondary eclipses were obtained. Therefore, 16 mean epochs of minimum light were determined from the data. These times of minimum light are given in Table 6, along with standard errors. We have collected all the times of minima that are available in the O-C gateway. In Fig. 4, we present the O-C diagram of the period analysis. The conformity of primary and secondary minimuma, shows that there is no apsidal motion.

A quadratic function fit to

The third component

A sinusoidal variation in the O-C residuals is seen only in systems that have a third body present in the system. Assuming that this is the case, we estimated the orbital period of the third component, using the period-04 software to be about 80.58 years. Then allowing the e, and ω parameters to change, and for any such e, and ω, χ^2 is obtained. The contour curves of the χ^2 in terms of e, and ω are shown in Fi. 5. The best values obtained for K, semi-amplitude of the light-time function, e,

Results and discussions

In order to compare our results with the results of other authors, the solutions by Samec et al. (2004), Zboril and Djurasevic (2006) and Latkovic et al. (2009) are also tabulated in the 3rd, 4th and 5th columns of Table 3, respectively. To obtain absolute parameters, the UBV and R_C light curves were solved simultaneously with the radial velocity curves of Rucinski et al. (2003). These absolute parameters for V523 Cas are obtained and listed together with those of Samec et al. and Latkovic

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