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Pulsations in Cool Eclipsing Binary System V699 Cyg

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Abstract

Aims. We aimed to perform the analysis of the long-term variability and precession of the orbital inclination of the eclipsing binary system V699 Cyg for the first time.
Methods. We obtained the long-term photometric observation series of the eclipsing binary system V699 Cyg at High-altitude Maidanak Astronomical Observatory in Uzbekistan and performed the deep analysis of the light curves of V699 Cyg.
Results. We found that the system changed of orbital inclination. And the same time within eclipse the object periodically changes brightness with a small amplitude ($\sim 0.037 mag$). Based on analysis of the all light curves available, we found that V699 Cyg also exhibit the periodic pulsating oscillations.

1 Introduction

The binary stars are crucial for our knowledge about the universe. Especially, eclipsing binaries provide us a unique insight to the basic physical parameters of the stars, stellar clusters, interstellar medium and galaxies. They are excellent distance indicators (Zasche, 2008). Eclipsing binaries with pulsating components are important objects to understand stellar structure and evolution. Investigating the frequencies of oscillations, known as asteroseismology, helps us to identify the physical processes behind the pulsating nature and so the stellar interiors. On the other hand, modeling the light and radial velocity curves of a eclipsing binary can precisely determine the physical parameters of the components. This enables one to definitively identify the pulsation modes and compare the results with theoretical models in detail. The study of pulsating stars in eclipsing binaries offers new and strict constraints for stellar theories, helps people to understand the influences of tidal forces and mass transfer among the interacting binaries.

Recent space missions such as CoRoT (Baglin *et al.*, 2006), Kepler/K2 (Borucki *et al.*, 2010) and TESS (Ricker *et al.*, 2015) have dramatically improved our understanding of various phenomena of the stellar variability with a large number of newly detected eclipsing binary systems with pulsating components.

The eclipsing binary V699 Cyg ($V_{max} = 11.^m61$) $\alpha_{2000.0} = 20^h17^m00.^s33$, $\delta_{2000.0} = +39^\circ08'19.57''$ with period $P = 0.15152d$) was discovered to be a variable by (Whitney, 1952). However photoelectric measurements of (Azimov & Zakirov, 1991) resulted in an amplitude of $\Delta m_B = 0.1$ mag and they were found that the primary minimum's amplitude decreased. They were suggest to interpreted that the massive hot primary filled its Roche lobe. The secondary is small cool star surrounded by the thick disc. The disc around the system is close to the previous one. (Lippky & Marx, 1991) was analyzed light curves of the V699 Cyg were token by Whitney, Romano and Azimov & Zakirov. The analysis of the light curves an eclipsing binary Lippky (1994) made conclusions, the binary system changed i orbital inclination.

2 Observation & Data Reduction

New photometric observations of V699 Cyg were carried out with the Carl Zeiss-600 (Southern) telescope in August, September and October 2019 at Maidanak Astronomical Observatory (MAO) of the Ulugh Beg Astronomical Institute of the Uzbekistan Academy of Science (Ehgamberdiev, 2018). The optical system of the telescope is Cassegrain, the focal length is 7200 mm. The FLI-New 1024×1024 CCD camera was used as the receiver. The readout noise and gain of the CCD are 8.73 ADUs and 1.24e-, the effective field of view is 6.3×6.3 arcmin, and the pixel scale is 0.372 arcsec per pixel. Image acquisition was done with MaxIm DL. The filter system was a standard Johnson-Cousins multi-color R_c photometric system. Based on the extinction coefficients and transformation equations provided by (Artamonov *et al.*, 2010) we converted the instrumental magnitudes into the standard system.

We are get total light curve of the V699 Cyg and analyzed measured orbital period. To our investigation of the light curve showed that, an orbital period of the V699 Cyg equal to $P = 0.310304d$. And in light curve have a micro pulsation Fig. 1. The our results confirmed of the TESS data analysis. The results an our analysis of the light curve of the V699 Cyg taken by TESS (Ricker *et al.*, 2015) showed that one of the maximum's have a micro pulsation Fig.2.

3 Discussion & Conclusion

We collected all available photometric data since its discovery, and the light curves were analyzed with a special focus on the evolution of system's orbital inclination. An analysis of the TESS data has shown a periodic pulsating oscillation in the V699 Cyg light curves too. These mean that V699 Cyg could be a candidate for pulsating eclipsing binary system. Based on a thorough analysis of the photometric behavior

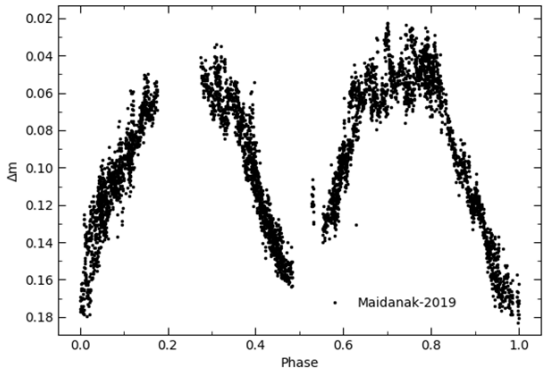

Figure 1: R-band light curve of V699 Cyg observed on August in 2019 in the Maidanak.

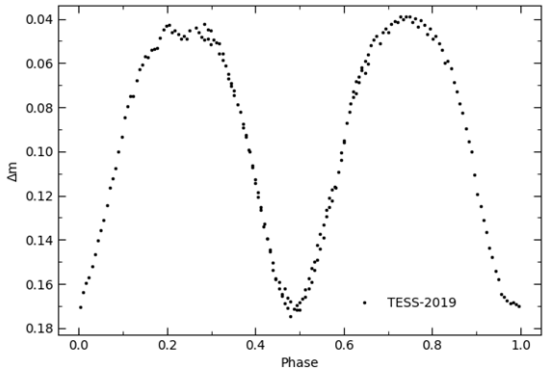

Figure 2: TESS Sector 9 phase-folded light curves for V699 Cyg

Table 1: Coordinates of the Overcontact Binary V699 Cyg, the Comparison Star (C), and the Check Star (CH).

Stars	$\alpha_{2000.0}$	$\delta_{2000.0}$	R_{mag}
V699 Cyg	$20^h17^m00.33^s$	$+39°08'19.57''$	11.03
TYC 3151-600-1	$20^h16^m56.56^s$	$+38°57'17.09''$	10.95
TYC 3151-480-1	$20^h17^m13.95^s$	$+39°06'18.42''$	10.23

of the eclipsing binary system V699 Cyg, it can be argued with a high degree of probability that, along with the features of an eclipsing binary system, V699 Cyg demonstrates also a pulsating activity, discovering of which is important both for understanding the physical processes occurring in the stellar system, and inside these stars.

Acknowledgments

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