

## DETECTION OF A $\delta$ SCUTI-TYPE PULSATING COMPONENT IN THE DETACHED ECLIPSING BINARY SYSTEM TU CMa

MKRTICHIAN, D.E.

National Astronomical Research Institute of Thailand, 260 Moo 4, T. Donkaew, A. Maerim, Chiangmai, 50180 Thailand. e-mail: davidmkrt@gmail.com

### Abstract

We report the detection of 30.5 min low-amplitude ( $A=0.003$  mag)  $\delta$  Scuti-type pulsations in an A5V-A7V type component of the detached eclipsing binary system TU CMa.

TU CMa is a 1.127803854-day (Haans et al. 2015) detached eclipsing binary system with A5V-A7V primary and F8V-G0V secondary components (Garces et al. 2017). It was included in our program to search for pulsating components that have the primary component lying inside the instability strip and hence can be potentially pulsating.

Visual inspection of the SWASP data of TU CMa taken from their archive<sup>1</sup> revealed about 0.02-day short-period, low-amplitude light variations. For the safe detection of possible pulsations, we selected the best quality nights for TU CMa from the SWASP data, namely HJD 2454105, 2454131, 2454132, 2454133, 2454134, 2454135, 2454433, 2454434, 2454436, 2454456, 2454462 and 2454485. The pulsation variations were searched for in the out-of-eclipse parts of the light curves after removal of slow orbital variations using low order polynomial fits. For the period search, we used the PERIOD04 software (Lenz & Breger, 2005) based on a Discrete Fourier Transform (DFT) analysis.

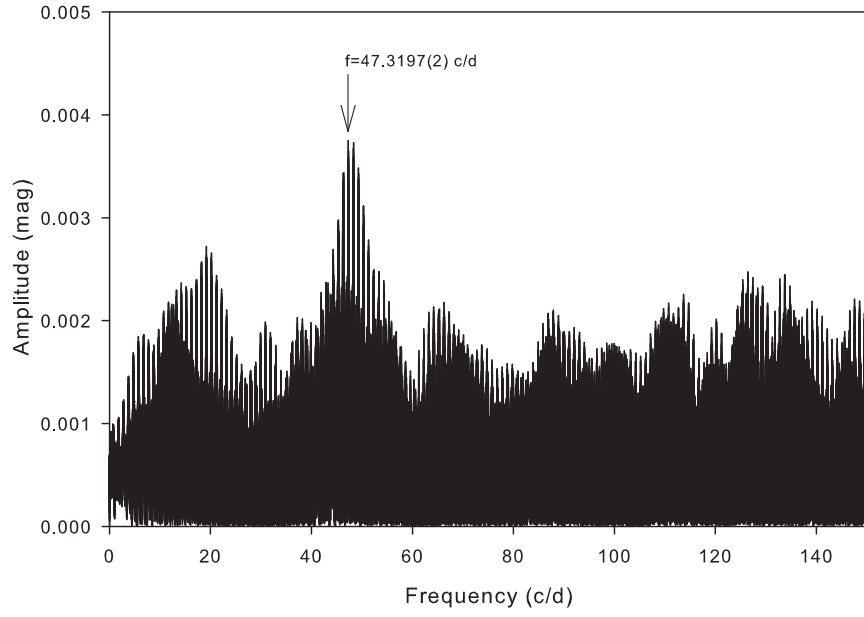
The DFT amplitude-frequency spectrum of the TU CMa residual data is shown in Figure 1. We detected a clear signal at  $47.3197 \pm 0.0002$  c/d ( $P = 30.5$  min) with an amplitude of 0.0038 mag. The phased light curve binned into 20-phase intervals is shown in Figure 2.

Using the mass  $M=1.761 \pm 0.012 M_{\odot}$  and the radius  $R=1.553 \pm 0.002 R_{\odot}$  for the primary component from Garces et al. (2017) we calculated the mean density of the pulsating component as  $\rho/\rho_{\odot}=0.4702$ . The calculated pulsation constant for the discovered 30.5 min ( $P = 0.021$  day) pulsation mode,  $Q = P\sqrt{\rho_{*}/\rho_{\odot}} = 0.014$ , corresponds to a fourth or fifth overtone low degree ( $\ell = 0 - 3$ ) mode.

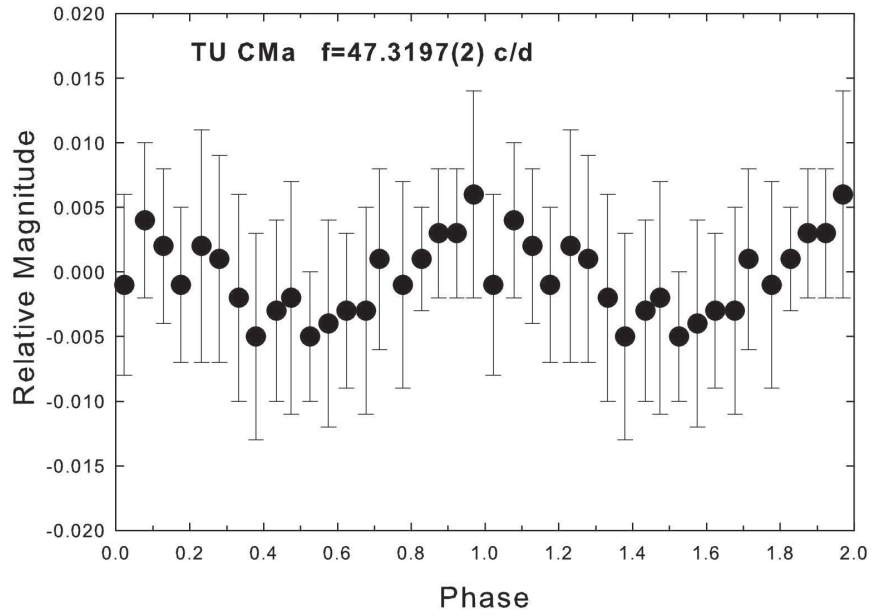
**Conclusion:** We report the detection of a 30.5 min low amplitude ( $A=0.003$  mag)  $\delta$  Scuti-type pulsation in an A5V-A7V type component of the detached eclipsing binary system TU CMa. The calculated pulsation constant corresponds to pulsations in the 4-5th overtone low-degree mode (Fitch, 1981). The parameters of the binary system and

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<sup>1</sup><https://wasp.cerit-sc.cz>



**Figure 1.** The DFT amplitude spectrum of the primary A5V-A7V component. The dominant peak is at  $47.3197 \pm 0.0002$  c/d.



**Figure 2.** The phase-binned pulsation light variations of TU CMa. The phase of the maximum light corresponds to HJD 2454107.9776.

components of TU CMa are accurately determined and are good input parameters for theoretical pulsational modelling. This binary system can be a good target for further more accurate and detailed photometric observations of pulsations in order to detect a low-amplitude pulsation spectrum, for the eclipse mode identification of the dominant mode and for comparison with theoretical pulsation models.

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#### References:

- Butters, O. W., et al., 2010, *A&A*, **520**, L10 DOI  
Fitch, W. S., 1981, *ApJ*, **249**, 218 DOI  
Garcés, J. L., Mennickent, R. E., & Zharikov, S., 2017, *PASP* **129**, 044203 DOI  
Haans, G. K., et al., 2015, *PKAS*, 30, 205 DOI  
Lenz, P., Breger M., 2005, *Communications in Asteroseismology*, **146**, 53 DOI  
Paunzen, E., Kuba, M., West, R.G., Zejda, M., 2014, *IBVS*, **6090**