

ERUPTION ACTIVITY OF A NEW ECLIPSING BINARY TYC 5112-252-1

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Abstract: We report on eruption activity of TYC 5112-252-1. This eclipsing binary was discovered only recently and no eruption has been reported in the literature so far. Eruption activity of this star was discovered at night June 21/22 2017 during observation of nearby star V0413 Ser. The light curve of the observed flare is typical for eruptive stars. The variability was subsequently confirmed by additional observations.

1 Introduction

TYC 5112-252-1 (=ASAS J183449-0043.1=UCAC4 447-079250, J2000 RA=18^h34^m49.459^s, DEC= -00°43′09.76″; Serpens, $V=10.33$ mag, $B-V=1.14$ mag) is known to the VSX database (Watson et al. 2006) as a variable star of EA type with the period of 0.976936 days but without the zero epoch. The star is of K5III spectral type (Watson et al. 2006).

TYC 5112-252-1 is known as an X-ray source from the ROSAT (Voges et al. 1999) observations (1RXS J 183450,3-004310), which could indicate an active object. Kirana & Stepien (2013) cross-matched 307 X-ray sources from ROSAT with optical sources from the ASAS survey, one of them being TYC 5112-252-1. Its variability was discovered in data from the ASAS (Pojmanski 1997, 2004).

2 Observation and basic data analysis

The star was observed at Observatory Mladá Boleslav (hereafter OMB), Observatory Valašské Meziříčí (OVM), Observatory Liberec (OL), Czech Republic and Los Leones (FRAM) in Argentina. Telescopes and instruments that we used are listed in Table 1. The star was monitored in clear (C) and Johnsons-Cousins BVR filters during 33 nights between June 21 and October 1, 2017 (altogether 9 780 frames, 139 hours of observing time, see Table 1).

Differential aperture photometry, as well as dark frame and flat field corrections, were performed using C-MuniPack package (Motl, 2009) which is based on DAOPHOT (Stetson, 1987). Characteristics of comparison stars are in Table 2 and are shown in Fig. 1 (field of view of OVM).

During our observations, we observed 6 primary minima (4 OVM, 1 OMB, 1 FRAM). The one from June 30, 2017, was taken as the zero epoch for phase curves. Using the web tool at Variable stars and Exoplanet section webpage we estimated the zero epoch as HJD=2457935.5152±0.0005 (Brát et al. 2012). From the light curves in various filters, the

minimum depth was estimated as 0.23 mag (B), 0.19 mag (V), 0.19 mag (R), and 0.19 mag (C). However, these values are only approximate estimates, because the light curve around minima is not symmetric and, in addition, changes in time (likely due to star spots). Folded light curves in all filters can be seen in Figures 2.

Table 1: Telescopes, instrumentes and filters used. SC means Schmidt-Cassegrain, RL Refractor, N Newtonian.

SC 280/1765 (OVM)	30x30	MII G2-4000	B	60
RL 102/500 (OBM)	144x108	ATIK 320E mono	C	60
RL 55-200/135 (OBM)	210x150	ATIK 320E mono	C	60
SC 280/1765 (FRAM)	24x16	MII G2-1600	V, R	60
N 200/860 (OL)	70x47	M2-G2-1600	V, R	60

Table 2: Comparison stars (values from Zacharias et al. 2013). Coordinates are in J2000.

Star	ID (UCAC4)	RA (hh:mm:ss)	DEC ($^{\circ}$ ' ")	B (mag)	V (mag)
OVM					
Comp	447-079272	18:35:26.65	-00:36:23.68	12.57	11.66
Check	447-079254	18:34:55.86	-00:36:35.40	10.61	10.04
OMB					
Comp	449-081207	18:34:47.94	-00:21:43.57	11.21	10.1
Check	449-081095	18:32:55.43	-00:19:49.07	10.17	9.38
FRAM, OL					
Comp	447-079254	18:34:55.86	-00:36:35.41	10.61	10.04
Check	447-079247	18:34:46.89	-00:46:49.77	14.32	12.87

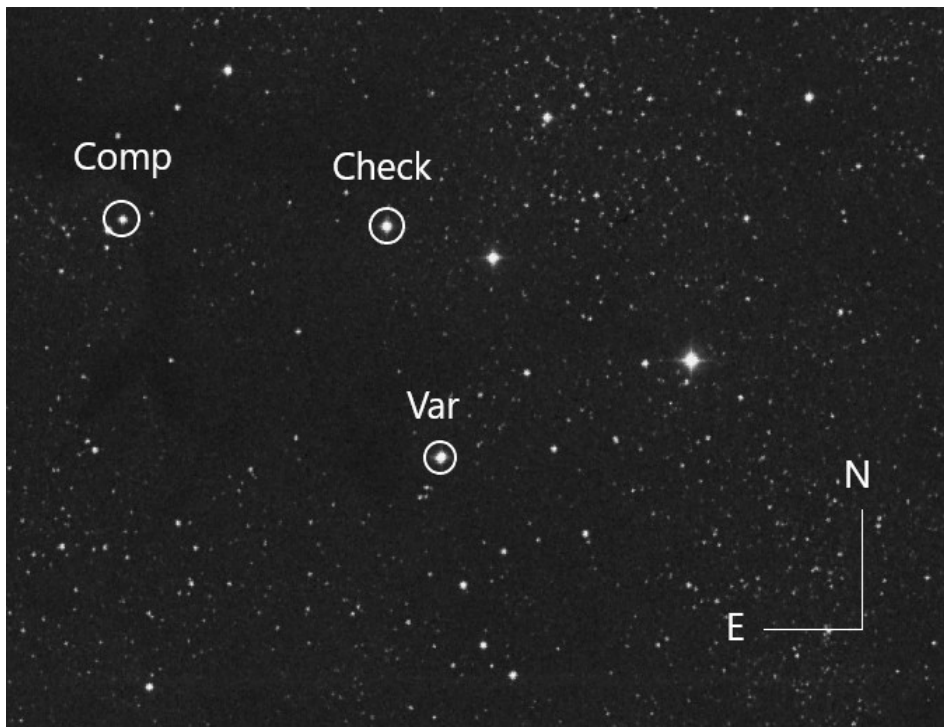


Figure 1: Star field TYC 5112-252-1 OVM with identification of stars.

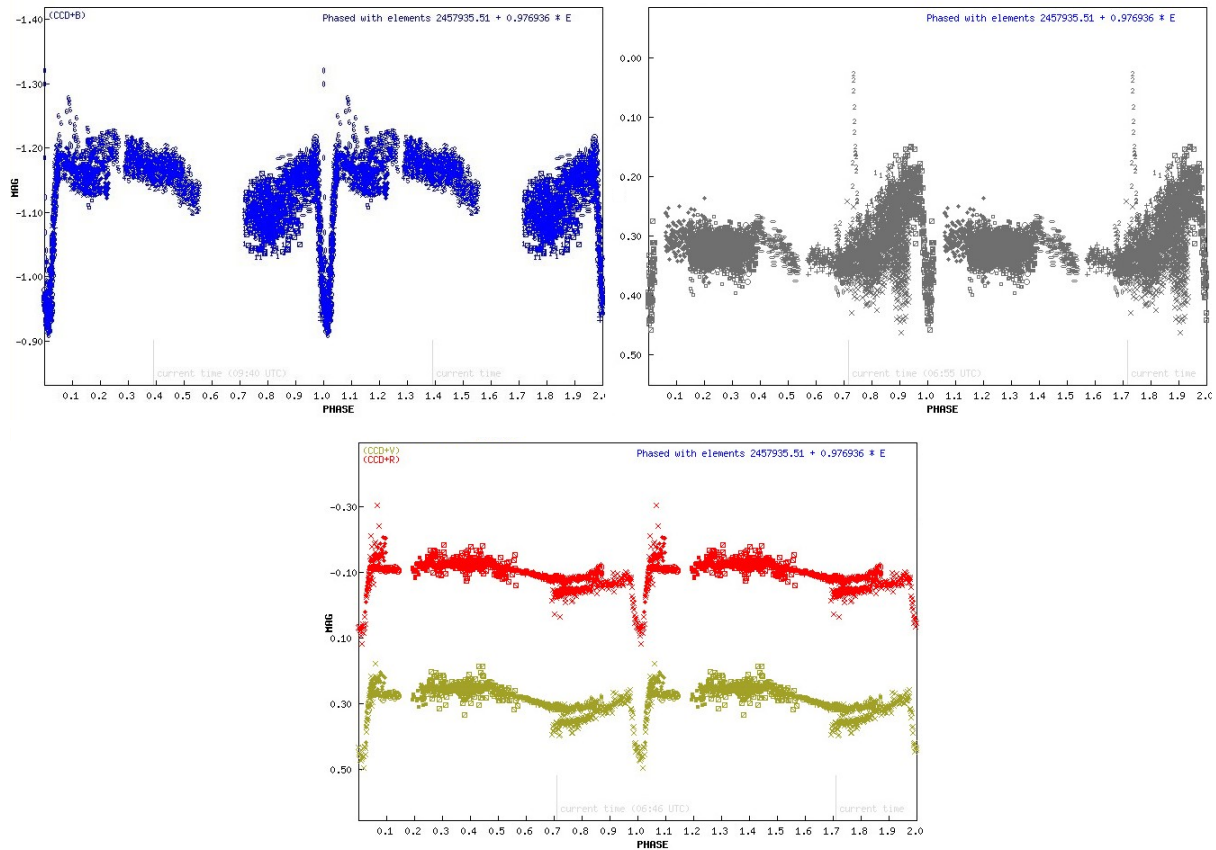


Figure 2: Data in Johnson *B* filter (OVM, top left panel), *C* filter (OMB, top right-hand panel) and FRAM (*V* and *R* filters, the bottom panel) phased with the VSX period of 0.976936 d and zero epoch determined by us ($JD_{\text{hel}}=2\ 457\ 935.5152$).

3 Stellar eruptions

The eruption from the discovery night is shown in Fig. 3. The shape indicates a typical eruption due to magnetic field reconnection. The impulse phase lasted 7 minutes and gradual phase 1 hour and 24 minutes. This case is, therefore, long-lasting type of brightening, which is not common. For example, from all eruptions observed in GJ 3236, only 17 % is of this type (Šmelcer 2018, priv. comm).

Center of the brightening can be estimated as $JD_{\text{hel}} = 2\ 457\ 926.4489(7)$. Because the evolution of eruption is very fast and integration time is about 1 minute, time of maximum brightness is estimated from the highest observed point. The lowest limit for uncertainty estimation is therefore 1 minute (0.0007 d) for all given times.

Another eruption was observed from OVM on 15 August 2017 (Fig. 4). Maximal brightness was at $JD_{\text{hel}} = 2\ 457\ 981.42748$ (see Fig. 4). The eruption lasted 17 minutes and its amplitude was about 0.35 mag in *B*. This eruption appeared during the primary minimum.

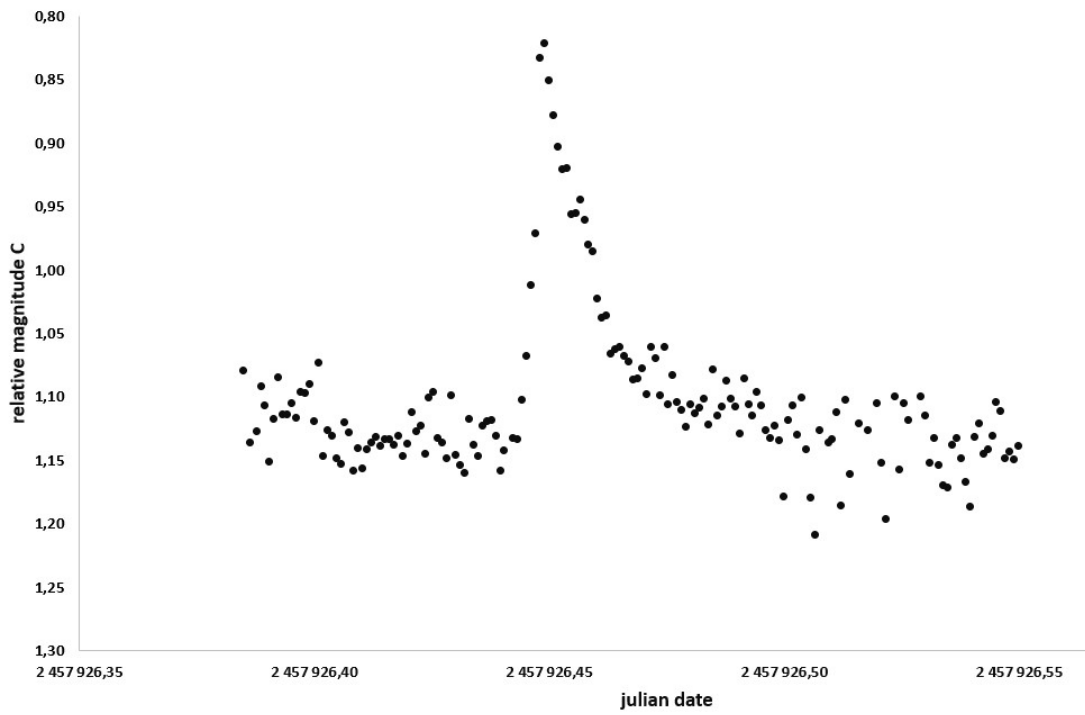


Figure 3: Light curve from June 21, 2017 observed at OMB.

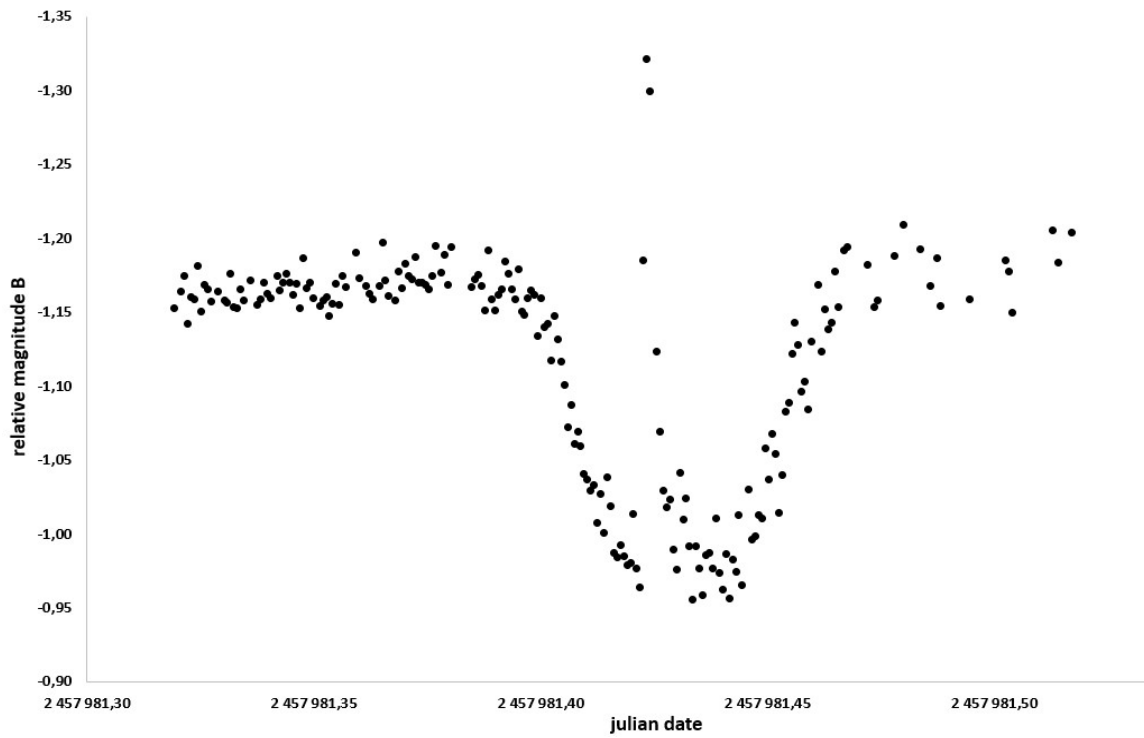


Figure 4: The second detected flare from 15 August, 2017 detected at OVM.

4 Conclusions

We observed TYC 5112-252-1 between June and October 2017 in a scope of eruptive binary stars survey. During this interval, we detected two eruptions. Altogether we observed this star for 33 nights (139 hours). The minimal frequency of eruptions can be estimated as 0.0144 eruptions/hour (2 eruptions during 139 hours).

From the similarity with the eruptions observed in GJ 3236 and NSVS 01031772 (Smelcer et al. 2016, 2017) it seems that also in case of TYC 5112-252-1 we observed supereruptions at cool star. The star is being monitored also in the observing season 2018.

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