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Photometric investigation of contact binaries near the short period limit – 1SWASPJ161335.80-284722.2.

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Abstract. A new period distribution of W UMa type (EW) contact binaries indicates that the short-period limit for EWs is around 0.2 days. Close binary stars with orbital periods near to this limit are an important source to understand the formation and evolution of contact binaries. Recently, some close binary stars with orbital periods in the range of 0.2 to 0.23 days were monitored and their light curves were analyzed using the W-D method. We present here one example of such studies – an analysis of 1SWASPJ161335.80-284722.2, its photometric solutions and period changes.

Key words: contact binary – photometry

1. Introduction

W UMa type contact binaries consist of two cool components and they share a common convective envelope. Both components are late evolutive main-sequence stars, spectral types usually F to K. They have nearly the same effective temperature, although their masses are usually quite different. The exhibited light curves are continuous and have a small difference between the eclipse depths of the two minima, and the depths usually change a little with wavelength variation. Binnendijk (1970) described two subtypes of W UMa systems. The two categories evolve in a similar way but under different circumstances. The details of evolution in contact relation between A- and W-type were discussed several times, e.g. Gazeas & Stepien (2008). However, the complex solution is still missing.

Rucinski (1992) found that the period distribution of main sequence contact binaries shows a sharp cut-off at about 0.22 days. During the last two decades several systems with shorter period have been unveiled. A recent study by Qian et al. (2017) indicates that the short-period limit for EWs is around 0.20 days.

We analyse the period distribution in the VSX database (2018) and in several surveys ASAS[1], CRTS[2], KEPLER[3] and OGLE BLG[4]. The result, displayed in Figure 1, is influenced by a different selection effect, however the most numerous surveys show similar results, which confirmed the 0.20 d value.

The study of short-period close binaries ($P \leq 0.22$ d) is still important. It is crucial to understand the evolution of low mass stars and to investigate the cause of the period cut-off.

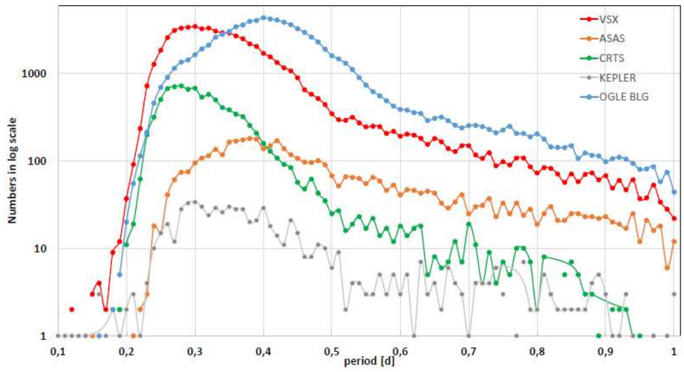

Figure 1. Numbers of EWs contact binaries in the VSX and selected surveys.

2. 1SWASPJ161335.80-284722.2

J161335 is a W-subtype of a late-type W UMa close binary with a very short orbital period. Its variability was reported first by Norton et al. (2011), who presented light curves and periods of 53 candidates for short period eclipsing binaries identified by SuperWASP. Lohr et al. (2012) revised the orbital period as 19852.817 s (= 0.22977796 d) and pointed out that the orbital period is decreasing as $\dot{P}/P$=-3.210^{-6} yr^{-1}.

CCD photometric observations of the system J161335 were obtained in 2015-2016, using the 2.4-m Thai National Telescope and 1-m telescope at the South African Astronomical Observatory. Analysing these data we obtained six sets of photometric parameters using the W-D program. Some deviations between the 2015 and 2016 results may be caused by the uncertain activity of a dark spot. The photometric solutions obtained in 2016 were averaged as the final results. It suggests that J161335 is a W-type contact binary with a fill-out factor nearly = 18.9 %. The less massive component holds an approximately 200 K higher temperature than the more massive one. By considering the spectral type of

[1] http://www.astrouw.edu.pl/asas/
[2] http://nesssi.cacr.caltech.edu/DataRelease/
[3] https://keplerscience.arc.nasa.gov/
[4] http://ogle.astrouw.edu.pl/

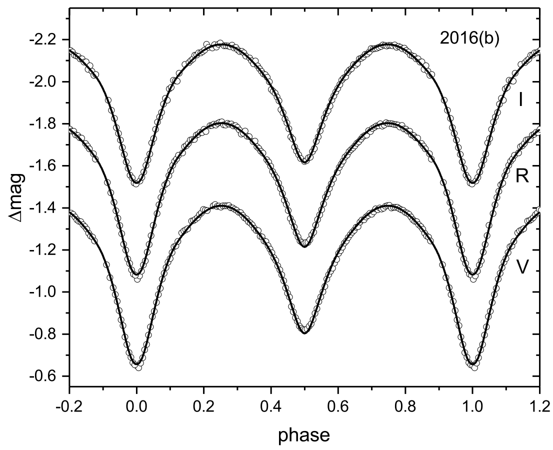

Figure 2. A fit of our observations made in 2016 to the theoretical light curves calculated by using the W-D code. The phases of those observations were calculated with the following linear ephemeris, Min I = HJD 2457117.42272 + 0.229778 × E. (Eq. 1).

the more massive component K7, its mass can be estimated as $M_2 = 0.61 M_\odot$. The derived average mass ratio $q = 1.10$ reveals that the mass of the other component is $M_1 = 0.55 M_\odot$. The detailed parameters will be published soon.

Furthermore, the analysis of an O-C diagram shows not only a decreasing period, but also small amplitude cyclic variations ($P_3 = 4.65$ years) caused very probably by a third, low-mass ($M_3 \sin i = 0.138(7) M_\odot$), very cool stellar companion.

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