Contrib. Astron. Obs. Skalnaté Pleso **49**, 349 – 351, (2019)

Analysis of exoplanetary system WASP-118

P. Gajdoš[1], M. Vaňko[2], Š. Parimucha[1] and M. Fedurco[1]

[1] *Institute of Physics, Faculty of Science, Pavol Jozef Šafárik University, Košice, Slovakia*

[2] *Astronomical Institute of the Slovak Academy of Sciences 059 60 Tatranská Lomnica, The Slovak Republic*

Received: October 17, 2018; Accepted: January 28, 2019

Abstract. We present a new study of a recently discovered exoplanetary system WASP-118. The system consists of an F-type star and a close-in giant planet (an inflated hot Jupiter). Using Kepler-K2 observations, we re-determined the orbital and physical parameters of the system. Our results are in good agreement with the values published in the literature. The precise times of all transits were determined, however, no significant transit timing variations were detected. Our analysis of an upper mass limit allows us to include additional Earth-mass planet(s) near to mean-motion resonance(s).

Key words: planetary systems - eclipses - methods: numerical - planets and satellites: individual: WASP-118 b

1. Introduction

The parent star of hot Jupiter WASP-118 b, discovered in 2016 and confirmed by Hay et al. (2016), is a 2.38 Gyr-old F6-type star with a radius of 1.696 $R_\odot$ and a mass of 1.320 $M_\odot$. The 2^{nd} Gaia Data Release gives a distance of 380.5 pc (Gaia Collaboration et al., 2018). Močnik et al. (2017) found γ Dor pulsations in the light curve (LC) of WASP-118 with a period of 1.9 day and a semi-amplitude of $\sim$ 200 ppm.

WASP-118 was observed during Campaign 8 of the Kepler K2 mission (from 3 Jan to 23 Mar 2016). We used de-trended short-cadence data (PDCSAP_FLUX), sampled every 58.8 seconds. During the observation period 19 transits were observed.

2. Light curve and TTV analysis

For our light curve (LC) analysis, we used the same approach as in our paper Gajdoš et al. (2017):

1. We extracted parts of the LC around detected transits.
2. We aligned and stacked all 19 LCs together to obtained the template of transit.

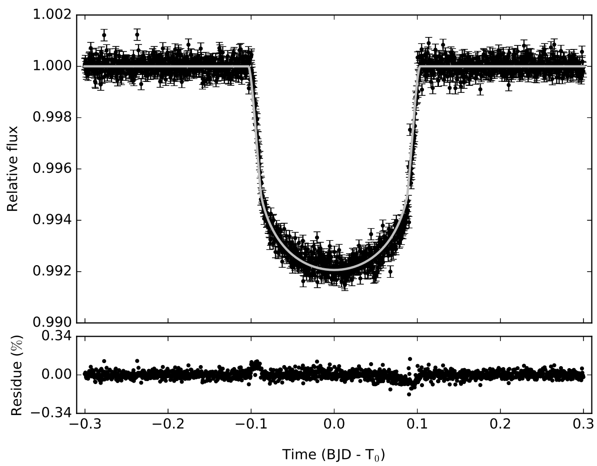

Figure 1. Template of transit WASP-118 b.

3. We used our software implementation of the Mandel & Agol (2002) model and MCMC simulation for the determination of transit parameters and to obtain template of transit.

4. For each of 19 individual transits, the time of the transit was determined using template from step 3. We constructed an O-C diagram.

Table 1. Parameters of exoplanet WASP-118 b.

Parameter	Hay et al. (2016)	Močnik et al. (2017)	This paper
T_0 [HJD]*	6787.81423(62)	6787.81256(2) **	6787.81249(68)
P [d]	4.0460435(44)	4.0460407(26)	4.0460654(43)
a [au]	0.05453(48)	0.05450(49)	0.05356(99)
r_{p} [$R_\oplus$]	16.141(404)	15.630(150)	14.940(268)
i [°]	88.70(90)	88.24(14)	89.86(18)
χ^2	116249.01	19040.62	17746.10

* in HJD - 2450000; ** original value 7423.04483 shifted to the same epoch

We did not observe any significant periodic variations on the O-C diagram. The periodic TTV signal with an amplitude greater than 100 s over the observing period seems to be unlikely.

We put upper constraint on the mass of a potential perturbing planet in the system with refined assumptions: maximal variance in the O-C diagram (100 s) as the amplitude of possible TTV and the orbits of both planets are circular and coplanar.

We used MERCURY6 code (Chambers, 1999) to produce 20000 synthetic O-C diagrams for different configurations of the mass and orbital period of a hypothetical planet.

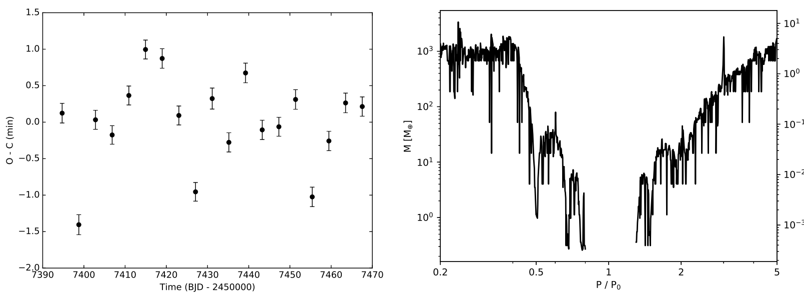

Figure 2. The O-C diagram for transit timing of WASP-118 b, plotted according to the new linear ephemeris (*left*). The upper-mass limit of a hypothetical additional planet in the WASP-118 system (*right*).

3. Discussion and conclusion

We redetermined the basic parameters of exoplanet WASP-118 b. We also determined the accurate times of all transits of this planet to analyse possible TTVs. We concluded that our values of the planetary parameter are, in general, consistent with previously published papers.

The obtained O-C diagram showed no significant periodic variation. We put upper limit of the mass of a potential planet in the system which could generate the TTV signal. We observed that in this system there could exist also the earth-mass planet near to the mean-motion resonance. To better specify the mass limit of a potential perturbing planet, the high-quality photometric observations of transits during a long observing period are needed. Radial velocity measurements would also be helpful.

Acknowledgements. This paper was supported by the grant of the Slovak Research and Development Agency with number APVV-15-0458. M.V. would like to thank the project VEGA 2/0031/18. The research of P.G. was supported by the VVGS-PF-2017-724 internal grant of the Faculty of Science, P. J. Šafárik University in Košice.

References

Chambers, J. E. 1999, MNRAS, 304, 793

Gaia Collaboration, Brown, A. G. A., Vallenari, A., et al. 2018, A&A, 616, A1

Gajdoš, P., Parimucha, Š., Hambálek, Ľ., & Vaňko, M. 2017, MNRAS, 469, 2907

Hay, K. L., Collier-Cameron, A., Doyle, A. P., et al. 2016, MNRAS, 463, 3276

Mandel, K., & Agol, E. 2002, ApJL, 580, L171

Močnik, T., Hellier, C., Anderson, D. R., Clark, B. J. M., & Southworth, J. 2017, MNRAS, 469, 1622