Serb. Astron. J. № 195 (2017), 41 - 46 UDC 521.8 : 524.3
DOI: https://doi.org/10.2298/SAJ1795041K Original scientific paper

OBSERVATIONS AND MODELING OF THE TRANSITING EXOPLANETS XO-2B, HAT-P-18B, AND WASP-80B

Diana P. Kjurkchieva[1], **Velimir A. Popov**[1,2] **and Nikola I. Petrov**[3]

[1]*Department of Physics, Shumen University, 115 Universitetska, 9700 Shumen, Bulgaria*
E–mail: *d.kyurkchieva@shu-bg.net*

[2]*IRIDA Observatory, Rozhen NAO, Bulgaria*
E–mail: *velimir.popov@shu.bg*

[3]*Institute of Astronomy and NAO, Bulgarian Academy of Sciences, Tsarigradsko shossee 72, 1784 Sofia, Bulgaria*
E–mail: *nip.sob@gmail.com*

(Received: August 4, 2017; Accepted: September 15, 2017)

SUMMARY: We present photometric observations and transit solutions of the exoplanets XO-2b, HAT-P-18b and WASP 80b. Our solution of the XO-2b transit gave system parameters whose values are close to those of the previous studies. The solutions of the new transits of HAT-P-18b and WASP 80b differ from the previous ones by bigger stellar and planet radii. We obtained new values of the target initial epochs corresponding to slightly different periods. Our investigation reaffirmed that small telescopes can be used successfully for the study of exoplanets orbiting stars brighter than 13 mag.

Key words. planetary systems – Techniques: photometric – Stars: individual: XO-2b, HAT-P-18b, WASP 80b

1. INTRODUCTION

It may be argued that a 2-m telescope from the middle of the 20th century is equivalent to a 30-40 cm telescope of the new millenium due to the new generation of light detectors. Today the small telescopes have an invaluable role in the discovery of transiting extrasolar planet candidates by ground-based wide-field surveys: HAT (Bakos et al. 2004), SuperWASP (Pollacco et al. 2006), TrES (O'Donovan et al. 2006), XO (McCullough et al. 2005), Qatar Exoplanet Survey (Alsubai et al. 2013), KELT (Pepper et al. 2007), OGLE (Udalski et al. 2002), etc. This possibility is also due to the fact that according calculations, about 100 stars monitored photometrically with a 2% or better precision over 2 months could yield 1-2 transiting exoplanets. Although the majority of them (at least 95 %) turned out false positives the number of extrasolar planet candidates gradually increased: around 100 exoplanets from HATNet; near 150 from WASP; 5 from XO telescope; 5 from Qatar; 10 from KELT, 8 from OGLE, etc.

Transiting extrasolar planets (TEPs) provide a unique opportunity to determine physical properties (mass, radius, and average density) of planetary bodies outside the solar system (Charbonneau et al. 2009). It was found that the gas giant planets more massive than 0.4 $M_{\rm J}$, where $M_{\rm J}$ is Jupiter's mass, exhibit a wide range of radii: from 0.885 $R_{\rm J}$ for CoRoT-

13b (Cabrera et al. 2010) to 1.79 R_J for WASP-12b (Hebb et al. 2009). The TEPs with masses similar to Saturn ($0.15M_J < M < 0.4M_J$) have variety of densities: from 0.3 g cm^{-3} to 1.6 g cm^{-3} (Hartman et al. 2011).

Many of the hot, giant planets turned out larger than predicted by standard cooling theory of irradiated, gas giant planets. Several hypotheses have been proposed to explain the radius anomaly: tides (Bodenheimer et al. 2001), tides with atmospheric circulation (Guillot and Showman 2002); enhanced opacities (Burrows et al. 2007). Accurate determination of the radii based on photometric data are required to explain the problems of the bloated exoplanets (Fortney et al. 2007).

Follow-up observations of the exoplanets are necessary also to study their ephemerides and thus to search for transit timing variations (TTV) as well as to improve their parameters. This was the main goal of our observations and study of the exoplanets XO-2b, HAT-P-18b and WASP 80b.

Table 1. Discovery information.

System	XO 2	HAT-P-18	WASP 80
Star			
T_s, K	5200	4803	4020
R_s, R$\odot$	0.97	0.75	0.571
M_s, M$\odot$	0.98	0.77	0.57
orbit			
P, days	2.615857	5.508023	3.0678504
a, AU	0.0369	0.0559	0.0346
planet			
R_p, R$_J$	0.98	0.995	0.952
M_p, M$_J$	0.57	0.197	0.554
ρ, g cm^{-3}	(0.741)	0.25	0.554
T_{eq}, K	(1300)	852	800
references	Burke et al. (2007)	Hartman et al. (2011)	Triaud et al. (2013)

2. TARGETS

We have chosen to observe known hot giant exoplanets orbiting bright stars with transit depths above 10 mmag, appropriate for the precision of our equipment. Table 1 presents the discovery information about the targets: (i) host star - temperature T_s, radius R_s and mass M_s; (ii) orbit - period P and radius a; (iii) planet - radius R_p, mass M_p, density ρ and equilibrium temperature T_eq (a theoretical temperature that a planet would have if it were a black body being heated only by its parent star, i.e. without considering atmospheric effects).

XO-2b

XO-2 is a nearby solar-type K0V star with high metallicity ([Fe/H] = 0.45). The XO-2b planet (Table 1, the values in brackets are from Torres et al. 2008) was discovered by Burke et al. (2007) and classified as a normal hot Jupiter (Charbonneau et al. 2007).

Fernandez et al. (2009) found that its period differs from the previously published value. But the study of the transit times of Kundurthy et al. (2013) shows no evidence for transit timing variations (TTVs).

The radial velocity measurements of Desidera et al. (2014) and multi-band light curves (Damasso et al. 2015) indicated that XO-2 is a wide stellar binary system with almost twin components, XO-2N and XO-2S, and both they have planets (Zellem et al. (2015).

HAT-P-18b

This low-density planet with mass comparable to that of Saturn (Table 1) was discovered by Hartman et al. (2011). It is assumed as a hydrogen-helium gas giant planet without a heavy element core, similar to HAT-P-12b and WASP-21b. However, unlike HAT-P-12b and WASP-21b, HAT-P-18b orbits a star with super-solar metallicity ([Fe/H] = 0.1).

By joint modelling of the radial velocity and photometric data, Esposito et al. (2014) concluded that HAT-P-18b is one of few planets known to transit a star with $T_\mathrm{eff} \leq 6250$ K on a retrograde orbit. Seeliger et al. (2013) and Baluev et al. (2015) did not find transit timing variations.

WASP 80b

This planet of a hot Jupiter type (Table 1) was discovered by Triaud et al. (2013). It transits M dwarf WASP-80 and produces one of the deepest transits. The host star shows a strong chromospheric activity (Mancini et al. 2014). Fukui et al. (2014) did not find a TTV signal. WASP-80b turned out to be one of the coolest gas giants resembling a T dwarf (Triaud et al. 2015). The known planets with similar or lower temperatures are of the Neptune-type, orbiting M-dwarfs. Thus, WASP-80b is assumed to fall within the gap between small warm Neptunes and more massive and large hot Jupiters.

3. OBSERVATIONS AND DATA REDUCTION

Our CCD photometric observations were carried out at Rozhen Observatory with the 30-cm Ritchey Chretien Astrograph (located into the *IRIDA South* dome) using CCD camera ATIK 4000M (2048 × 2048 pixels, 7.4 μm/pixel, field of view 35 x 35 arcmin). Information for our observations (dates, exposures, precision) is presented in Table 2.

Table 2. Log of our photometric observations.

Target	Date	Filter	Exposure [sec]	Error [mag]
XO-2b	2015 Dec 21	r'	30	0.003
HAT-P-18b	2013 Apr 17	V	60	0.005
WASP 80b	2015 Jul 7	i'	60	0.004

Twilight flat fields were obtained for each filter, dark and bias frames were also taken throughout the run. The frames were combined respectively into a single master bias, dark and flat frames. The standard procedure was used for reduction of photometric data (de-biasing, dark frame subtraction and flat-fielding) by software AIP4WIN2.0 (Berry and Burnell 2006).

The light variability of the targets was estimated with respect to nearby comparison (constant) stars in the observed field of each target. A check star served to determine the observational accuracy and to check the constancy of comparison stars. The ensemble photometry calculates the difference between the instrumental magnitude of the target and a comparison magnitude obtained from the mean of the intensities of the chosen comparison stars. The use of numerous comparison stars increases considerably the statistical accuracy of the comparison magnitude (Gilliland and Brown 1988, Honeycutt 1992).

We performed the ensemble aperture photometry with the software VPHOT. We used the aperture of 5 arcsec (5 pixels = 2 FWHM) and checked that there is no nearby stars affecting the signal. Table 3 presents the coordinates of the comparison and check stars from the catalogue UCAC4 (Zacharias et al. 2013) and their magnitudes in the corresponding band from the catalogue APASS DR9 (Henden et al. 2016).

The original data are available at *http://www.irida-observatory.org/Observations/Exoplanets-volume15.zip*. We carried out de-trending and phasing by the period from Table 1. The newly-observed transits are shown in Figs. 1–3.

4. MODELS OF THE OBSERVED TRANSITS

Our observations were modelled using the method of Kjurkchieva et al. (2013) by the code *TAC maker 1.1.0* (Kjurkchieva et al. 2014). It assumes circular orbits.

We fixed the stellar temperature and target period P to values from Table 1. Although *TAC maker 1.1.0* allows to vary the planet temperature $T_{\rm p}$, we fixed it to the value of $T_{\rm eq}$ because the transit solutions are very insensitive to this parameter. We varied the initial epoch T_0 (based on the UTC timescale as all data), relative stellar radius $r_{\rm s} = R_{\rm s}/a$, relative planet radius $r_{\rm p} = R_{\rm p}/a$ (a is orbital axis), orbital inclination i, and the stellar limb-darkening coefficients u_i.

We carried out the fitting procedure taking into account the following considerations: (i) the transit depth depends on inclination and mainly on the relative planet radius; (ii) the transit width (in phase units) depends on the relative stellar radii; (iii) the shape of transit depends mainly on the stellar limb-darkening coefficient (small value leads to a transit with flat bottom and steep ingress and egress, big value to a round-shaped transit.) Initially, each parameter was varied separately and, after reaching a satisfactory fit, all the parameters were varied simultaneously by fine grids to search for minimum of χ^2.

We established a high sensibility of the solution to the limb-darkening coefficients that gave us a ground to propose to use exoplanet transits for investigation of stellar limb-darkening effect for different star types.

Table 3. Coordinates and magnitudes of the targets (Var), check (Chk) and comparison (C) stars.

Label	Star ID	RA	Dec	Filter	Mag
Var	XO-2	07 48 07	+50 13 33	r’	10.887
Chk	UCAC4 702-047101	07 47 45.18	+50 14 57.38	r’	12.122
C1	UCAC4 702-047109	07 47 57.04	+50 21 16.53	r’	11.640
C2	UCAC4 702-047117	07 48 12.33	+50 17 54.10	r’	11.273
C3	UCAC4 702-047081	07 47 14.70	+50 16 04.73	r’	11.070
C4	UCAC4 702-047096	07 47 35.72	+50 14 28.46	r’	12.572
C5	UCAC4 702-047114	07 48 07.43	+50 13 00.75	r’	10.846
C6	UCAC4 701-048892	07 47 33.08	+50 09 15.02	r’	12.681
C7	UCAC4 701-048895	07 47 36.86	+50 08 22.09	r’	12.033
Var	HAT-P-18	17 05 23.15	+33 00 45.0	V	12.655
Chk	UCAC4 616-055004	17 04 54.54	+33 01 17.64	V	13.105
C1	UCAC4 615-055415	17 04 31.15	+32 56 14.33	V	13.861
C2	UCAC4 615-055424	17 04 41.92	+32 55 33.23	V	14.231
C3	UCAC4 615-055443	17 05 03.06	+32 57 29.95	V	13.019
C4	UCAC4 616-054970	17 04 10.35	+33 03 00.64	V	12.774
C5	UCAC4 615-055445	17 05 05.33	+32 58 16.71	V	13.863
Var	WASP 80	20 12 40.18	-02 08 39.15	i’	10.763
Chk	UCAC4 440-112701	20 12 22.85	-02 03 01.50	i’	11.137
C1	UCAC4 440-112791	20 12 48.08	-02 10 58.05	i’	12.156
C2	UCAC4 440-112875	20 13 06.95	-02 06 46.78	i’	10.178
C3	UCAC4 440-112898	20 13 14.55	-02 04 00.13	i’	11.540
C4	UCAC4 439-111166	20 12 55.77	-02 20 19.64	i’	11.294

We found best fits with the same χ^2 for linear, quadratic, logarithmic and square root limb-darkening laws using appropriate combinations of limb-darkening coefficients. The synthetic curves corresponding to the best fit parameters and linear limb-darkening law are shown in Figs. 1–3 as continuous lines. The obtained main parameters are given in Tables 4–6 together with all previous results.

5. RESULTS

XO-2b

There are a dozen solutions of this target and their parameter values coincide within the errors (Table 4). This result means the absence of transit depth variations (TDV). The geometric parameters have average values: $i = 88.^\circ8$; $r_\mathrm{s} = 0.125$ and $r_\mathrm{p} = 0.0125$. Hence, although the observations indicated that the star XO-2N is variable with an amplitude of 0.003–0.005 mag and a period of around 27–29 days (Kundurthy et al. 2013), this variability does not influence the transit parameters and the corresponding solutions.

Our best fit (Fig. 1) corresponds to $T_\mathrm{p} = T_\mathrm{eq} = 1300$ K (Torres et al. 2008) and to the linear limb-darkening coefficient $u = 0.67 \pm 0.01$.

Our transit solution is almost the same as those of Kundurthy et al. (2013). There is a difference of 63.6 s in T_0 with respect to their observations (Table 4). This is equivalent to a slightly shorter period $P = 2.61585928$ d than the value of 2.61585988 d (Table 5) of Kundurthy et al. (2013).

HAT-P-18

There are several previous solutions of this target and their parameter values coincide within the errors (Table 5). The geometric parameters have average values: $i = 88.^\circ8$; $r_\mathrm{s} = 0.061$ and $r_\mathrm{p} = 0.0083$.

Our transit solution differs from the previous ones by a smaller inclination (by around 1 %), bigger relative stellar radius by around 12 %, and considerably bigger planet radius (by around 26 %). Our best fit (Fig. 2) corresponds to $T_\mathrm{p} = T_\mathrm{eq} = 850$ K and the linear limb-darkening coefficient $u = 0.63 \pm 0.01$.

There is a difference of 226 s (Table 5) between the values of initial epoch T_0 determined by our observations and those of Hartman et al. (2011). This is equivalent to a slightly longer period $P = 5.5080316$ d as compared with their value of 5.508023 d (Table 5).

WASP 80

The values of previous solutions of this target are very close except for the orbital inclination (Table 6). The geometric parameters have average values: $i = 89.^\circ4$; $r_\mathrm{s} = 0.078$ and $r_\mathrm{p} = 0.0134$.

Our relative stellar radius is bigger by around 5 % with respect to the earlier values while our relative planet radius is bigger by around 13 % if compared with the previous ones (Table 6). Our best fit (Fig. 3) corresponds to $T_\mathrm{p} = T_\mathrm{eq} = 825$ K and the linear limb-darkening coefficient $u = 0.65 \pm 0.01$.

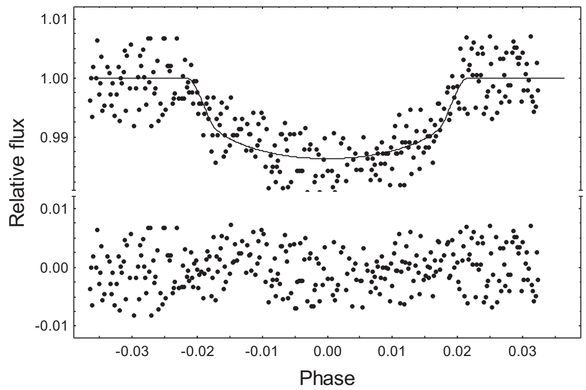

Fig. 1. *Top: the Rozhen transit of XO 2 and the synthetic curve is corresponding to the best solution; bottom: the residuals of the fit.*

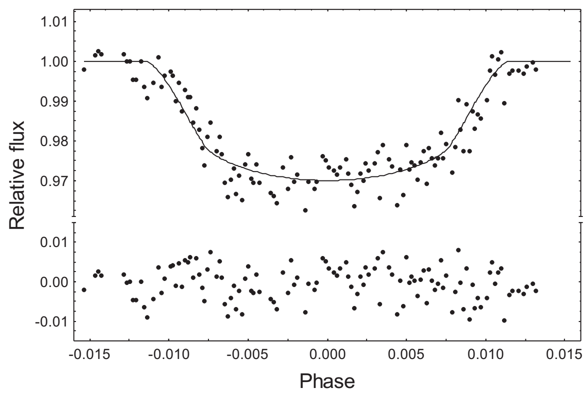

Fig. 2. *The same as in Fig. 1 but for HAT-P-18.*

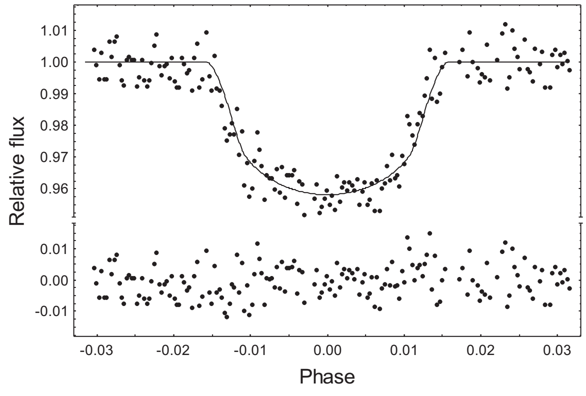

Fig. 3. *The same as in Fig. 1 but for WASP 80.*

Table 4. Parameters of XO-2b (sign * corresponds to fixed values).

Source	T_0 (d)	P (d)	r_s	r_p	i
Burke et al. (2011)	2454147.74902 ± 0.0002	2.615857 ± 0.000005	0.1198 ± 0.0064	0.01241 ± 0.00037	88.9 ± 0.7
Torres et al. (2008)		2.615857*	0.1219 ± 0.0022	0.01267 ± 0.00012	88.9 ± 0.6
Fernandez et al. (2009)	2454466.88467 ± 0.00012	2.615864 ± 0.000016	0.1230 ± 0.0021	0.01289 ± 0.00008	88.9
Southworth (2010)		2.615864 ± 0.000016	0.1237 ± 0.0024	0.01300 ± 0.0005	88.8 ± 1.2
Sing et al. (2011)	2454466.88457 ± 0.00014	2.61586178 ± 0.0000007	0.1277 ± 0.0027	0.01342 ± 0.00012	87.62 ± 0.52
Crouzet et al. (2012)	2454406.71987 ± 0.00016	2.61586178*	0.1252 ± 0.0012	0.01290 ± 0.00005	88.01 ± 0.28
Kundurthy et al. (2013)	2454406.720516 ± 0.000046	2.61585988 ± 0.00000016	0.1230 ± 0.0002	0.01267 ± 0.0045	88.8± 0.6
Baluev et al. (2015)	2455139.16092 ± 0.00013	2.61585779 ± 0.000043			
Zellem et al. (2015)	2455139.16092 ± 0.00013	2.61586178*	0.1252*	0.01315 ± 0.00049	88.01*
Our analysis	2454406.71978 ± 0.00002	2.61585988*	0.1230 ± 0.0010	0.01270 ± 0.00015	89.04±0.22

Table 5. Parameters of HAT-P-18b (sign * corresponds to fixed values).

Source	T_0 (d)	P (d)	r_s	r_p	i
Hartman et al. (2011)	2454715.02174 ±0.00020	5.508023 ± 0.000006	0.0623 ± 0.0028	0.0085 ± 0.0001	88.8 ± 0.3
Esposito et al. (2014)		5.507978 ± 0.000043	0.0597 ± 0.0021	0.00792 ± 0.00037	88.79± 0.25
Seeliger et al. (2015)	2454715.02254 ±0.00039	5.5080291 ± 0.0000042	0.0623± 0.0038	0.00851 ± 0.00011	88.79± 0.21
Our analysis	2454715.02438 ±0.00001	5.508023*	0.0691 ± 0.0001	0.01115 ± 0.00005	88.00 ± 0.05

Table 6. Parameters of WASP 80b (sign * corresponds to fixed values).

Source	T_0 (d)	P (d)	r_s	r_p	i
Triaud et al. (2013)	2456125.417512 ± 0.000061	3.0678504 ± 0.0000025	0.07699 ± 0.00127	0.01318 ± 0.00004	89.92 ± 0.1
Mancini et al. (2014)	2456125.417405 ± 0.000091	3.06786144 ± 0.00000087	0.07929 ± 0.00046	0.01354 ± 0.00012	88.91 ± 0.16
Fukui et al. (2014)	2456490.492507 ± 0.000091		0.07929*	0.01357 ± 0.00031	88.91*
Our analysis	2456125.419391 ± 0.000010	3.0678504*	0.08220 ± 0.0002	0.01462 ± 0.00020	89.4 ± 0.1

There is a difference of 162 s between the values of the initial epoch T_0 determined by our observations and those of Triaud et al. (2013). This leads to a slightly longer period $P = 3.0678557$ d in comparison with their value of 3.0678504 d (Table 6).

6. ANALYSIS OF THE RESULTS AND CONCLUSION

We presented observations of transiting exoplanets XO-2b, HAT-P-18b, and WASP 80b with a 30 cm telescope. Our solution of XO-2b gave system parameters whose values are within the ranges of the previous solutions. Our solutions for HAT-P-18b and WASP 80b differ from the previous ones by bigger stellar and planet radii. These discrepancies may be attributed mainly to the differences of relative durations and depths of the observed transits. Moreover, we found new values of the initial epochs of HAT-P-18b and WASP 80b which might mean slightly longer periods. This effect may have some contribution to the obtained bigger stellar and planet radii.

The creation of remote controlled telescopes after the middle of the 20th century enlarged the role of small telescopes. The robotized telescopes (as our one) revealed new horizons by saving human and financial resources and by increased efficiency of usage of observation time. This study justified the expectation about the successful observations of exoplanet transits with 30-40 cm telescopes.

Acknowledgements – This work was supported partly by project DN08/20 of Scientific Fundation of the Bulgarian Ministry of Education and Science as well as by project RD 02-102 of Shumen University. This research makes use of the SIMBAD database, VizieR service, and Aladin previewer operated at CDS, Strasbourg, France, and NASA's Astrophysics Data System Abstract Service. The authors are very grateful to anonymous referee for the valuable notes and suggestions.

REFERENCES

Alsubai, K. et al.: 2013, *Acta Astron.*, **63**, 465.
Bakos, G. et al.: 2004, *Publ. Astron. Soc. Pacific*, **116**, 266.
Baluev, R. et al.: 2015, *Mon. Not. R. Astron. Soc.*, **450**, 3101.
Berry, R. and Burnell, J.: 2006, The Handbook of Astronomical Image Processing with AIP4WIN2 software, Willmannn-Bell.Inc.
Bodenheimer, P., Lin, D. and Mardling, R.: 2001, *Astrophys. J.*, **548**, 466.
Burke, C. J. et al.: 2007, *Astrophys. J.*, **671**, 2115.
Burrows, A., Hubeny, I., Budaj, J. and Hubbard, W. B.: 2007, *Astrophys. J.*, **661**, 502.
Cabrera, J. et al.: 2010, *Astron. Astrophys.*, **522**, A110.
Charbonneau, D., Brown, T. M., Burrows, A. and Laughlin, G.: 2007, in "Protostars and Planets V", eds. B. Reipurth, D. Jewitt, K. Keil, Univ. Arizona Press, Tucson, 701.
Charbonneau, D. et al.: 2009, *Nature*, **462**, 891.
Crouzet, N., McCullough, P, Burke, C. and Long, D.: 2012, *Astrophys. J.*, **761**, 7.

Damasso, M. et al.: 2015, *Astron. Astrophys.*, **575**, A111.
Desidera, S. et al.: 2014, *Astron. Astrophys.*, **567**, L6.
Esposito, M. et al.: 2014, *Astron. Astrophys.*, **564**, L13.
Fernandez, J. et al.: 2009, *Astrophys. J.*, **137**, 4911.
Fortney, J., Marley, M. and Barnes, J.: 2007, *Astrophys. J.*, **659**, 1661.
Fukui, A. et al.: 2014, *Astrophys. J.*, **790**, 108.
Gilliland, R. and Brown, T.: 1988, *Publ. Astron. Soc. Pacific*, **100**, 754.
Guillot, T. and Showman, A.: 2002, *Astron. Astrophys.*, **385**, 156.
Hartman, J. et al.: 2011, *Astrophys. J.*, **726**, 52.
Hebb, L. et al.: *Astrophys. J.*, **93**, 1920.
Henden, A.: 2016, *Journal of the American Association of Variable Stars Observers*, **44**, 84.
Honeycutt, R. K.: 1992, *Publ. Astron. Soc. Pacific*, **104**, 435.
Kjurkchieva, D., Dimitrov, D., Vladev, A. and Yotov, V.: 2013, *Mon. Not. R. Astron. Soc.*, **431**, 3654.
Kjurkchieva, D., Dimitrov, D. and Vladev, A.: 2014, *Bulg. Astr. J.*, **21**, 85.
Kundurthy, P. et al.: 2013, *Astrophys. J.*, **770**, 36.
Mancini, L. et al.: 2014, *Astron. Astrophys.*, **562**, A126.
McCullough, P. et al.: 2005, *Publ. Astron. Soc. Pacific*, **117**, 783.
O'Donovan, F., Charbonneau, D. and Hillenbrand, L.: 2006, *American Astronomical Society Meeting*, **209**, 226.02.
Pepper, J. et al.: 2007, *Publ. Astron. Soc. Pacific*, **119**, 923.
Pollacco, D. et al.: 2006, *Publ. Astron. Soc. Pacific*, **118**, 1407.
Seeliger, M. et al.: 2015, *Mon. Not. R. Astron. Soc.*, **451**, 4060.
Sing, D. et al.: 2011, *Astron. Astrophys.*, **527**, A73.
Southworth, J.: 2010, *Mon. Not. R. Astron. Soc.*, **408**, 1689.
Torres, G., Winn, J. and Holman, M.: 2008, *Astrophys. J.*, **677**, 1324.
Triaud, A. et al.: 2013, *Astron. Astrophys.*, **551**, A80.
Triaud, A. et al.: 2015, *Mon. Not. R. Astron. Soc.*, **450**, 2279.
Udalski, A. et al.: 2002, *Acta Astron.*, **52**, 115.
Zacharias, N. et al.: 2013, *Astron. J.*, **145**, 44.
Zellem, R. et al.: 2015, *Astrophys. J.*, **810**, 11.

ПОСМАТРАЊА И МОДЕЛОВАЊЕ ТРАНЗИТА ЕГЗОПЛАНЕТА XO-2B, HAT-P-18B И WASP-80B

Diana P. Kjurkchieva[1], **Velimir A. Popov**[1,2] **and Nikola I. Petrov**[3]

[1]*Department of Physics, Shumen University, 115 Universitetska, 9700 Shumen, Bulgaria*
E–mail: *d.kyurkchieva@shu-bg.net*

[2]*IRIDA Observatory, Rozhen NAO, Bulgaria*
E–mail: *velimir.popov@shu.bg*

[3]*Institute of Astronomy and NAO, Bulgarian Academy of Sciences, Tsarigradsko shossee 72, 1784 Sofia, Bulgaria*
E–mail: *nip.sob@gmail.com*

УДК 521.8 : 524.3
Оригинални научни рад

Представљамо фотометријска посматрања и решења за транзите егзопланета XO-2b, HAT-P-18b и WASP 80b. Наше решење за транзит XO-2b даје параметре система чије вредности су блиске претходним студијама. Решења за нове транзите HAT-P-18b и WASP 80b разликују се од претходних у правцу већих звезданих и планетарних радијуса. За ове објекте смо добили нове вредности иницијалних епоха које одговарају мало различитим периодима. Наше истраживање потврдило је да мали телескопи могу бити успешно коришћени код истраживања егзопланета које орбитирају око звезда сјајнијих од 13. магнитуде.