Parameters of 20 newly detected eclipsing binaries from the *Kepler* database

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Abstract. The paper presents a sample of newly detected eclipsing binaries from the public *Kepler* data. Orbits and fundamental parameters of 20 unknown eclipsing binaries were determined by modelling of their photometric data. Most of them are well-detached, high-eccentric binaries. We established that the target KID8552719 satisfied all widespread criteria for a planetary candidate. Fitting its light curve we obtained radius R_p=0.9 R_{Nept}, distance to the host star a=42.58 R$\odot$=0.198 AU and equilibrium temperature T_p=489 K. These values imply a Neptune-size object out of the habitable zone of the host star.

Key words: data analysis; eclipsing binaries; star fundamental parameters; planetary systems-stars: individual KID1995732, KID2307206, KID3102000, KID3428468, KID3851949, KID4247023, KID4659255, KID6182849, KID6233483, KID6312534, KID6525209, KID6933781, KID6947666, KID7021177, KID7132542, KID7620844, KID7866921, KID8044608, KID8491745, KID8552719

Introduction

The *Kepler* Mission of NASA is specifically designed (Borucki et al. 2010; Koch et al. 2010; Batalha et al. 2010; Caldwell et al. 2010; Gilliland et al. 2010) to survey a portion of our region of the Milky Way galaxy to discover Earth-size planets in/near the habitable zone. The second research area of the *Kepler* mission is asteroseismology. Moreover some certain objects are observed by ordering of so called "guest-observers".

It was found that one-meter class Schmidt telescope with FoV of 105 square degrees would fulfill the goal of the *Kepler* mission. This photometer is equipped by 95-megapixel focal plane composed of 42 science CCDs and four fine guidance sensor CCDs. The CCDs are read out every 6.54 s and then summed into 29.4 min Long Cadence bins. In addition, up to 512 targets can be observed in Short Cadence mode, at a 59-sec sampling. The observed band spans 423-893 nm, i.e. the *Kepler* magnitudes (Kp) are usually within 0.1 of an R magnitude. The dynamic range is from Kp=7 to Kp=17.

Preliminary counting stars brighter than V=14 from the USNO star catalog, the Cygnus region has been chosen as the richest area. The Kepler Input Catalog (KIC) of the stars of the observed field (containing 13.2 million targets) was made preliminary. The photometer sees roughly half million targets. But because it is telemetry-limited, not every pixel is read out and stored. Only around 190000 pre-selected stars of interest are observed. The selection criteria were determined according to the primary goal of the mission (Batalha et al. 2010).

Kepler mission was launched in March 2009. The observations are organized into three-month intervals called quarters defined by the roll maneuvers the spacecraft executes about its boresight to keep the solar arrays pointed toward the Sun (Haas et al. 2010). The data packages are processed and analysed by a Science Pipeline.

2321 planet candidates have already been detected until June 2012, 61 of them are confirmed (Koch et al. 2010, Borucki et al. 2010, Dunham et al. 2010, Latham et al. 2010, etc.).

Another very important achievement of the *Kepler* mission is the discovery of great numbers of variable stars which light curves are with unprecedented precision. Many eclipsing binaries were discovered and classified automatically on this rich data base.

Prsa et al. (2011, Paper I) cataloged 1879 eclipsing and ellipsoidal binary systems identified in the first Kepler data release (Borucki et al. 2010). Slawson et al. (2011, Paper II) provide an updated catalog augmented with the second *Kepler* data release which increases the baseline nearly to 125 days. As a result 386 new systems have been added while 100 systems have been removed from the previous catalog. With these changes, the total number of identified eclipsing binary systems in the *Kepler* field-of-view has increased to 2165, that is 1.4 % of the Kepler target stars.

The detection of the EBs presented in the foregoing catalogs is based primarily on the initial pipeline calibrated light curves. Prsa et al. (2011) used automated approach to identify plausible EBs, which entails morphological classification of each light curve's power spectrum. Blomme (2011) proposed improvement of the method for automate classification.

Answering to the appeal to use the available resources of the *Kepler* database for additional research we tried to search for additional eclipsing binaries using the public data from *Kepler* sets Q0, Q1 and Q2. This paper presents the procedure and results from this work.

1 Our searching method

Our searching for eclipsing binaries began in 2011 on the basis of the public data of quarters Q0-Q2 of the *Kepler* mission. Initially we used the data from the web-based NASA Exoplanet Archive http://exoplanetarchive.ipac.caltech .edu/ applications/ETSS/Kepler/ index.html. Further we used also the access to these data via ftp://130.167.252.39/pub/kepler/lightcurves/. It should be noted that we considered only the long cadence data because the short cadence ones were with bigger scatter.

The photometric data for each quarter and each KID are calibrated for bias (dark level) and converted to fluxes. They are available in two forms: "RAW" and "CORR".

The light curves for all observed stars (processed on a quarterly basis at NASA Ames Research Center) are placed in the archive. Users of *Kepler* data might work with both versions of the light curves. Particularly, everyone may use de-trended data or make de-trending himself.

During 2011 the web-based NASA Exoplanet Archive contained not only stellar parameters (magnitudes, temperatures, etc.) but also statistical parameters of their light curves: "Light curve chi-squared", "Points in light curve beyond 5 σ" and "Fraction of points in light curve beyond 5 σ". We used the values of these statistical parameters to search for eclipsing binaries and managed to pick around thousand EB candidates. Unfortunately, the web-based NASA Exoplanet Archive does not contain yet the foregoing statistical parameters and the considered method for selection of EB candidates is not applicable.

The next step was visual examination of our EB candidates. It revealed that most of them are false positives and only around hundred are true EB.

Besides the foregoing approach we made visual inspection of all light curves of one third of the Kepler data (until folder 0040 from the downloaded ftp data).

As a result of these two ways of detection we found many candidates that were out of the published catalogs of *Kepler* eclipsing binaries (Prsa' catalog version 2.0).

Further we checked if some of these candidates were known variables (to the middle of May 2012). For this aim we used:

(i) Lists of Planetary Candidates, False Positives and Eclipsing Binaries from the site http://archive.stsci.edu/kepler/results.html;

(ii) The AAVSO database of variable stars (International Variable Star Index);

(iii) Databases SIMBAD and ADS.

Several candidates turned out known variables and were removed from our sample. Thus we made the first version of our list of EB candidates.

In this paper we present part of the newly detected eclipsing stars satisfying the additional condition to have at least 3 eclipses from different type.

During the visual inspection of the light curves of the *Kepler* database we established that they need additional preliminary "manual" treatment before detailed analysis because the maximum fluxes as well as the light amplitudes for many stars differ from one quarter (even subset) to another. Moreover, the "CORR" data are not always properly de-trended. That is why we decided to use the RAW data of our targets and to make own normalization and de-trending of the data. For this aim the data from each subset were reproduced by spline function and normalized separately.

At the beginning of 2012 when the quarters Q3-Q6 became free-accessed we used the new data for more precise determination of the ephemeres of our targets.

Finally we examined about possible mis-classification of our targets as a result of contamination of nearby known binary with the same period. This effect is due to the high star density near the galactic plane and to the fact that the *Kepler* pixels project onto 4 arcsec on the sky. Thus, for instance, we found that the unknown variable star KID3098197 (detected by us) and the known EB star KID3098194 (Paper I) at distance 4 arcsec have the same period and type of variability (Fig. 1). It is difficult to say which of these stars is the true variable because the contamination depends on the relative magnitude of the stars in question and their separation on the sky. As a result of the examination for contamination effect (into area with radius 60 arcsec around our candidates) several candidates as KID3098197 were excluded from our list.

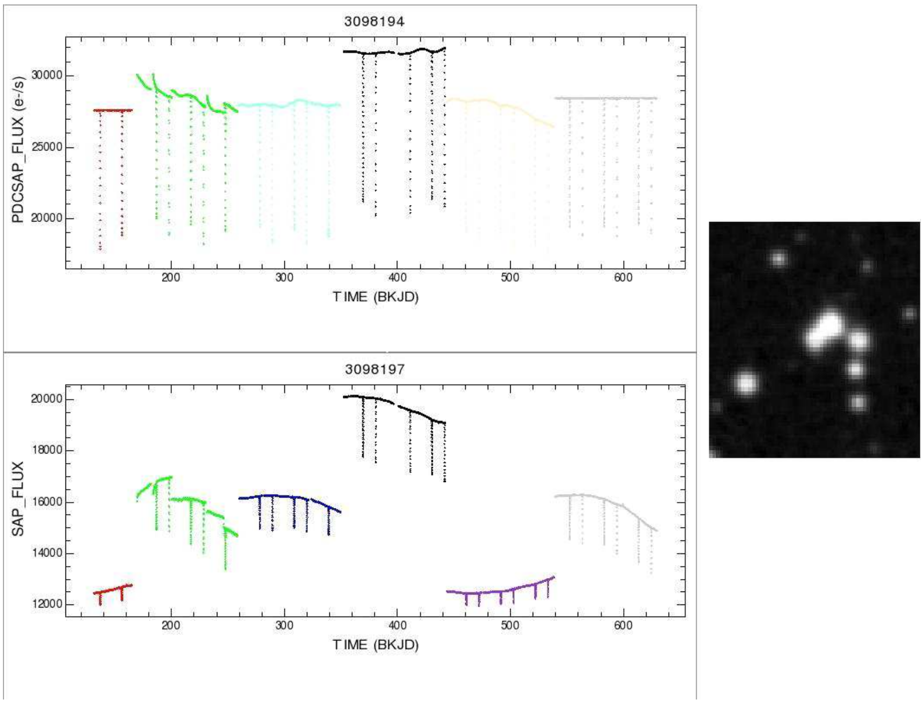

Fig. 1. Illustration of contamination effect by the stars KID3098194 and KID3098197

2 Light curve modeling

As a result of our searching method we found around 150 newly detected EB from the *Kepler* database Q0-Q2. This paper presents 20 of them (Sample 1) which periods and light curves are well determined and allow detailed analysis. Table 1 presents information for their coordinates and ephemeres while Figure 2 shows the fields around them with sizes 1 arcmin.

Figures 3-6 exhibit the parts of the phased light curves around the eclipses (the longer out-of-eclipse parts are almost flat).

Table 2 summarizes the parameters of the eclipses (phase of the secondary eclipse φ_2, durations d_i and amplitudes A_i of the two minima) as well as the orbit parameters e and ω determined by our modelling.

The qualitative analysis of the light curves led to the following notes:

(1) The secondary eclipses of KID3102000 and KID6947666 are around 10 times shallower than their primary minima.

(2) The flat bottoms of the secondary eclipses of KID3851949, KID6182849, KID6233483, KID6525209, KID7866921, KID8491745 imply occultations.

(3) The light curve of the most targets exhibits different duration of the two eclipse minima and/or the secondary minimum is shifted from phase 0.5 (Table 2). These are sure evidences of eccentric orbits (Table 2). The selection

Table 1. Coordinates and ephemeres of the targets from Sample 1

KID	RA[2000]	DEC[2000]	BJD0	Period
1995732	19h 04m 51.84s	37d 25m 30.86s	2455049.45692971	77.363032
2307206	19h 29m 30.28s	37d 39m 26.86s	2455086.53717057	204.030667
3102000	19h 09m 23.87s	38d 17m 09.74s	2454997.25556938	57.059216
3428468	19h 06m 53.61s	38d 35m 44.38s	2455032.44996961	114.908636
3851949	19h 27m 36.80s	38d 55m 33.10s	2454976.78185172	54.776991
4247023	19h 07m 23.64s	39d 18m 17.78s	2455061.78039575	47.189567
4659255	19h 32m 11.61s	39d 43m 31.26s	2455067.15120620	198.014033
6182849	18h 52m 17.77s	41d 32m 27.17s	2454967.70080728	6.399107
6233483	19h 56m 12.01s	41d 32m 14.82s	2454976.85610603	15.873552
6312534	19h 55m 32.15s	41d 39m 43.49s	2454965.94158660	3.015550
6525209	19h 30m 53.13s	41d 54m 17.71s	2455017.42871952	75.131944
6933781	19h 06m 47.36s	42d 27m 04.18s	2455062.75755611	130.419512
6947666	19h 26m 01.46s	42d 26m 53.20s	2455071.15247452	56.687032
7021177	19h 10m 32.89s	42d 31m 50.95s	2455017.49723690	18.645334
7132542	19h 43m 32.45s	42d 37m 18.77s	2455067.74039272	66.360950
7620844	19h 42m 26.49s	43d 15m 37.51s	2455070.18823707	58.621582
7866921	18h 39m 25.46s	43d 40m 04.44s	2455107.26924060	91.500871
8044608	19h 47m 36.97s	43d 49m 26.00s	2455067.64037980	106.175893
8491745	19h 22m 02.79s	44d 33m 21.67s	2455059.64770915	111.320439
8552719	19h 15m 53.20s	44d 37m 28.31s	2455009.27199064	88.407500

Table 2. Parameters of the eclipses and the orbit of the targets

KID	φ_2	d_1 days	d_2 days	A_1 mag	A_2 mag	e	ω
1995732	0.4165	0.4951	0.5415	0.1430	0.1040	0.14252	157.08
2307206	0.5071	0.7141	0.4897	0.7600	0.3410	0.17664	273.55
3102000	0.0790	0.3081	0.2970	0.0950	0.0045	0.73492	181.77
3428468	0.0787	0.3103	0.1724	0.3100	0.1800	0.77405	207.65
3851949	0.6425	1.5007	1.0187	0.0080	0.0020	0.29014	319.65
4247023	0.2891	0.4719	0.3303	0.6570	0.4920	0.37693	151.88
4659255	0.4599	0.4040	0.3723	0.1900	0.0450	0.07572	213.66
6182849	0.5000	0.2240	0.2150	0.5240	0.1388	0.01178	269.91
6233483	0.4813	0.3492	0.3175	0.0132	0.0047	0.05569	238.72
6312534	0.5000	0.1206	0.1206	0.0203	0.0087	0.00115	15.42
6525209	0.2176	0.8565	0.3757	0.1480	0.0399	0.58949	224.72
6933781	0.8044	0.1826	0.3391	0.0033	0.0014	0.56295	32.14
6947666	0.1260	0.2834	0.2834	0.0628	0.0019	0.63304	175.39
7021177	0.5543	0.1604	0.5482	0.7088	0.3385	0.57877	83.09
7132542	0.2632	0.8361	0.7831	0.6767	0.6277	0.38159	182.84
7620844	0.5416	0.3517	0.2579	0.3500	0.0892	0.18617	290.21
7866921	0.3814	0.7869	0.6497	0.0760	0.0430	0.22484	214.15
8044608	0.8510	0.4247	0.3716	0.2019	0.0283	0.58766	356.54
8491745	0.5973	0.9574	0.9462	0.0712	0.0158	0.15338	0.33
8552719	0.5000	0.7073	0.7073	0.0020	0.0000	0.00000	180.00

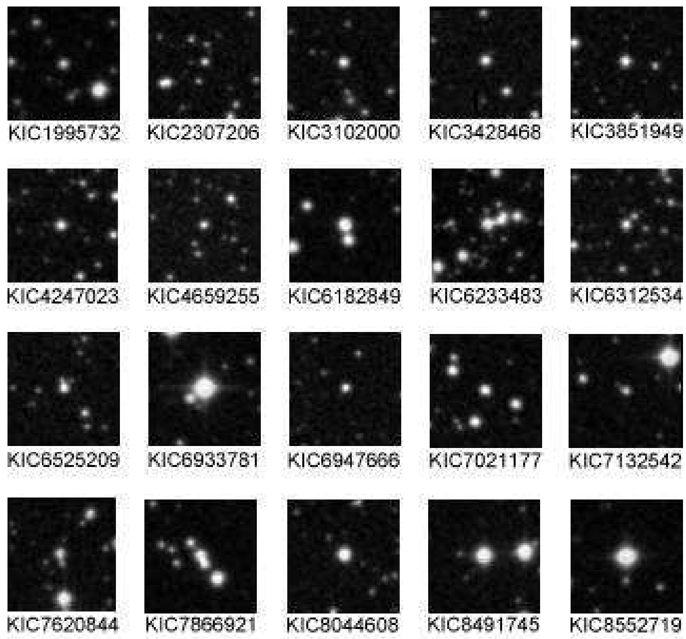

Fig. 2. Fields around the targets (at the centers) with size 1 arcmin

effect could explain partially such a result because the eccentric systems can be identified more surely. Another reason for the relative big number eccentric orbits is the relative large orbital periods of the targets from our Sample 1. It is known that eccentric orbits are not too infrequent among well-separated systems of long periods.

The quantitative analysis of the targets was made by modeling of their light curves using the software *PHOEBE* (Prsa & Zwitter 2005), the values of the mean temperatures T_m from the Kepler Input Catalog (Batalha et al. 2010) and the limb-darkening coefficients derived by Sing (2009) especially for the *Kepler* wide, nonstandard response function and avoiding the major deficiency present at the limbs of the 1D stellar models.

It is known that the modeling of eccentric binaries requires much time and sometimes is very difficult without any guessed input values of the fitted parameters. That is why we calculated preliminary values of the eccentricity e and periastron angle ω by the analytical formulae of Kopal (1959). Their using as input parameters shortened considerably the modeling time. Another trick in this direction was the averaging a large number of data points out of the eclipses into phase bins.

The fitting parameters of our procedure and their values derived as a result of the light curve solutions are shown in Table 3 which columns are: mean temperature T_m; the ratio of the temperatures of the components T_2/T_1; orbital inclination i; photometric mass ratio q; relative radii r_1 and r_2; third

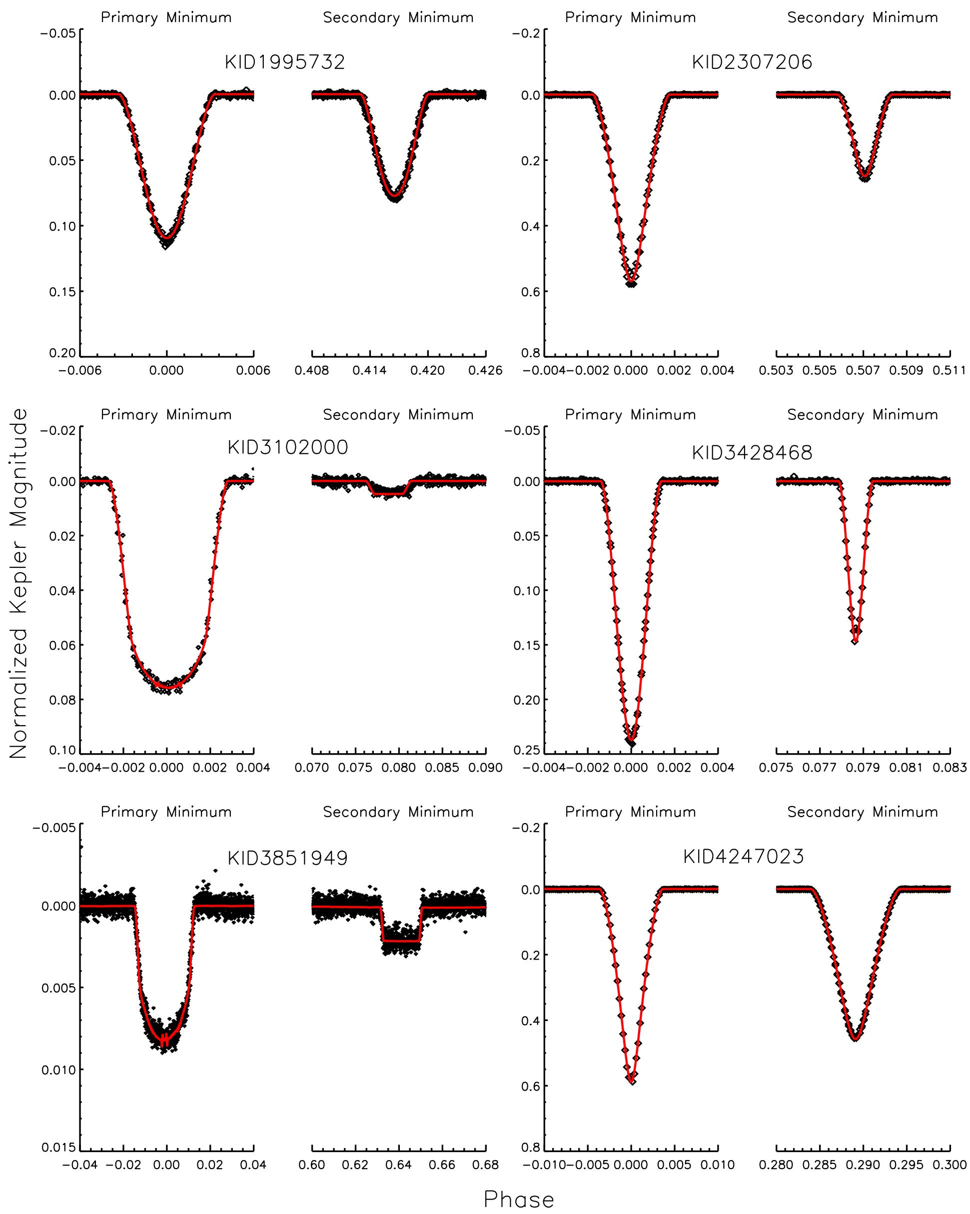

Fig. 3. Eclipses of KID1995732, KID2307206, KID3102000, KID3428468, KID3851949, KID4247023 and their fits

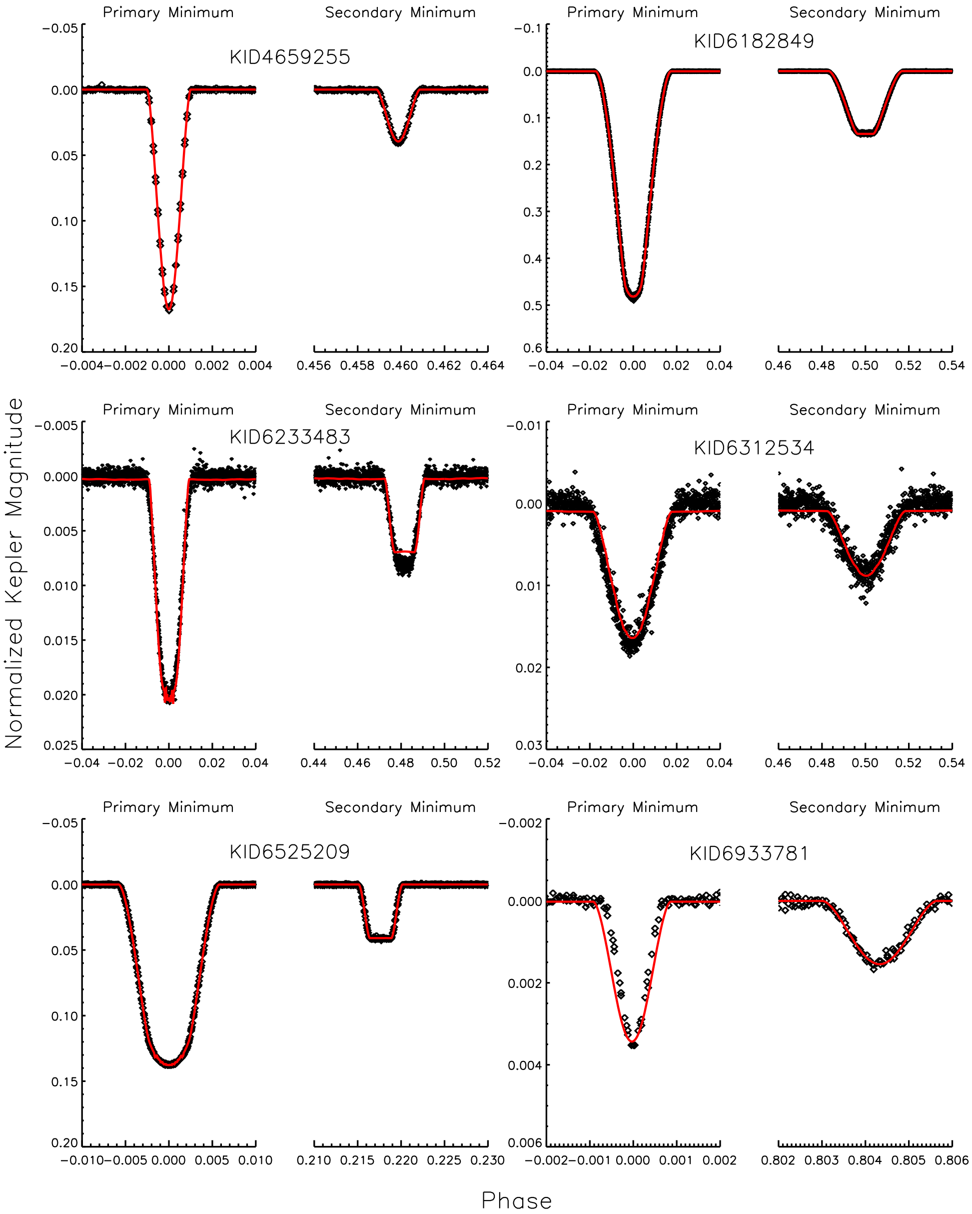

Fig. 4. Eclipses of KID4659255, KID6182849, KID6233483, KID6312534, KID6525209, KID6933781 and their fits

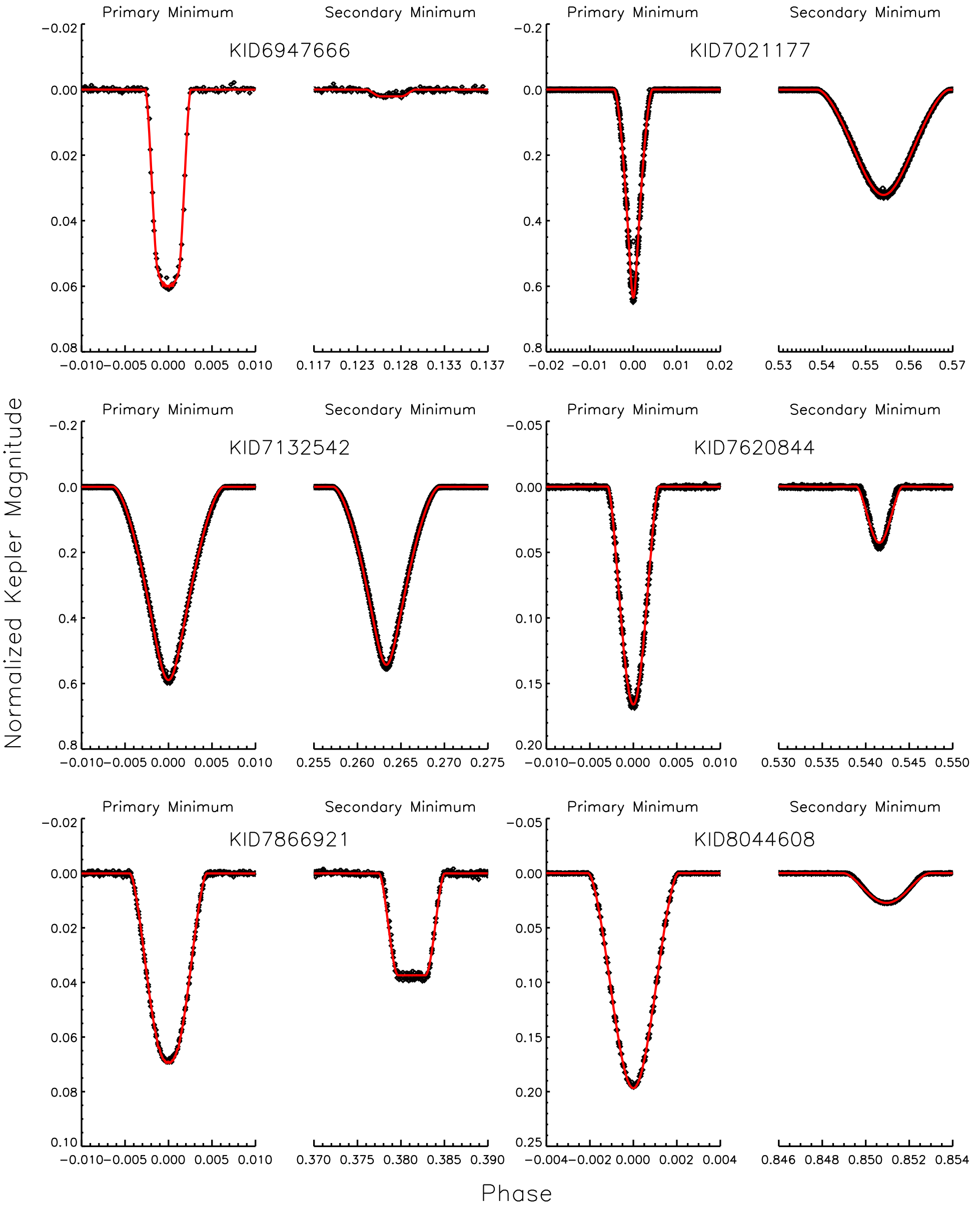

Fig. 5. Eclipses of KID6947666, KID7021177, KID7132542, KID7620844, KID7866921, KID8044608 and their fits

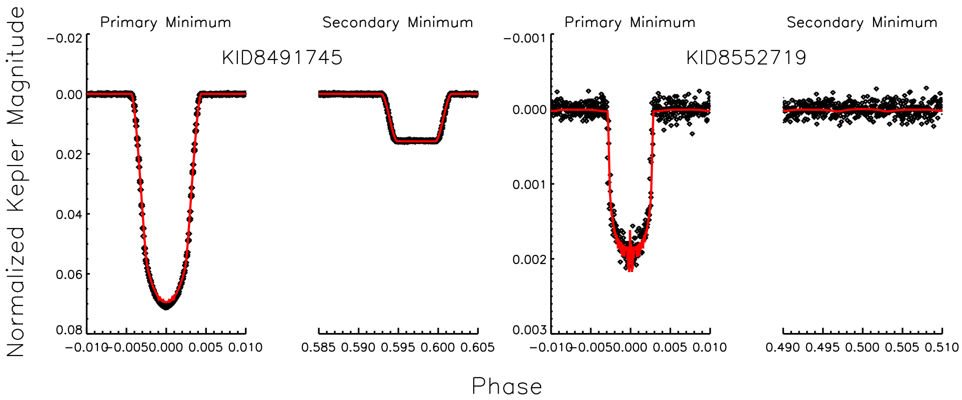

Fig. 6. Eclipses of KID8491745, KID8552719 and their fits

light L3. The values of the rest fitting parameters (initial epoch BJD0, period P; eccentricity e and periastron angle ω) are given in Tables 1-2. The fits of the minima of some targets are not perfect and may be considered as preliminary ones. The next public data will be used for improving of these models.

3 Analysis and comments on the results

The analysis of the obtained parameters led to several important conclusions.

(1) Almost all orbital inclinations, excluding the shortest-period target KID6312534, are near 90^0 that is normal for long-period eclipsing binaries.

(2) The relative stellar radii are less than 0.07 that means that the systems are well-detached.

(3) The temperatures of stellar components are in the range 3500-6000 K. The primaries are the hotter components. The temperatures of the secondaries are lower than those of the primaries with less 1500 K. The only exclusion is the target KID8552719 which secondary' temperature is of planetary' order.

(4) The values of the photometric mass ratio q are in the range 0.20-1.83. It shoult be noted that the q values are precisely determined only for the targets with total eclipses.

(5) Although the presence of eccentric systems in our sample was expected (Table 2) it was surprising to find 7 of the 20 targets to have e >0.5 (the biggest value is e=0.77). It should be noted that the final values of the eccentricity and periastron angle differ from the preliminary ones by only several %.

For comparison, the examination of 124 eclipsing systems with eccentric orbits in the Bulut & Demircan (2007)' catalog (compiled from Hipparcos catalog, the atlas of Kraimer Kim & Nha (2001) and the ninth catalog of

Table 3. Fundamental parameters of the binaries from Sample 1

KID	T_m	T_2/T_1	i	q	r_1	r_2	L3
1995732	5163	0.959	89.1715	0.450	0.01902	0.00689	0.1264
2307206	5342	0.897	89.8847	0.787	0.00536	0.00514	0.0037
3102000	5718	0.683	89.9889	0.218	0.02003	0.00472	0.0000
3428468	4279	0.860	89.3941	1.830	0.00597	0.00506	0.0000
3851949	4981	0.840	88.8893	0.102	0.07074	0.00549	0.0000
4247023	5424	0.987	89.6098	1.003	0.01492	0.01459	0.0000
4659255	5153	0.784	89.6561	0.992	0.00425	0.00444	0.0000
6182849	5893	0.816	89.2096	1.254	0.06713	0.04041	0.0003
6233483	5942	0.808	86.8016	1.000	0.06943	0.00991	0.0000
6312534	4897	0.894	77.3068	0.300	0.01480	0.09830	0.1307
6525209	5207	0.851	89.5055	0.450	0.02113	0.00690	0.0000
6933781	5502	1.045	89.6300	1.000	0.00362	0.00579	0.9850
6947666	5777	0.629	88.8576	0.080	0.02041	0.00456	0.0000
7021177	5684	0.985	89.2692	1.000	0.02896	0.02442	0.0000
7132542	5389	0.989	89.5995	1.260	0.01929	0.02335	0.0000
7620844	5056	0.741	89.1450	1.000	0.01070	0.01265	0.0000
7866921	5019	0.904	89.0497	0.202	0.02444	0.00629	0.0000
8044608	5788	0.718	89.1088	0.350	0.01207	0.00666	0.0000
8491745	4839	0.837	89.4061	0.236	0.02405	0.00564	0.0000
8552719	5114	0.196	89.4149	0.038	0.02009	0.00080	0.0000

spectroscopic binary orbits of Pourbaix et al. 2004) exhibits that 22 of them have e >0.3 and only 2 binaries are with e >0.5.

The examination of the Eclipsing Binary with Eccentric Orbits Catalog (Bulut & Demircan 2007) revealed that 22 targets have $e > 0.3$ and only 2 of them are with $e > 0.5$. In fact, this catalog containing information for 124 systems with eccentric orbits, at present is the largest catalogue of eccentric binaries compiled from the literature including three large sources Hipparcos catalogue, the atlas of Kreiner, Kim & Nha (2001) and the ninth catalogue of spectroscopic binary orbits (Pourbaix et al. 2004).

The examination of the catalogs from PaperI and PaperII revealed that 1376 are eccentric systems: 7 with $e > 0.6$; 34 with e >0.5; 184 with $e > 0.3$; 799 with $e > 0.1$ (the biggest value is e=0.64).

It should be noted that the most eccentric binary 41 Dra has a period of 1247 d and e=0.97. The last value is determined by radial velocity curve (Tokovinin et al. 2003).

The presented statistics exhibits the relative big frequency of high-eccentric targets in our Sample 1. We attributed this result mainly to the huge duration of uninterrupted observations made by *Kepler*.

(6) Besides the eclipses with orbital period of P_{orb}=3.0156 d the target KID6312534 exhibits a variability with amplitudes around 4.5 times smaller than the depths of the primary eclipses and a period of around P_2=3.005 days which values slightly change from one subset to another. It is reasonable to attribute the second variability to spots and the period P_2 to the stellar rotation. This means that KID6312534 is synchroneous system that is expected from its short orbital period. The small changes of P_2 may due to

the differential rotation of the spotted star. It should be noted that there are several data subsets in which the spot variability lacks at all. This fact may due to some artificial effect.

After the submission of our manuscript we were informed that KID6312534 is a known eclipsing binary which light curve has been investigated by Coughlin et al. (2011). The reason for the discrepancy is that this target is present in the Prsa' catalog version 1.0 but it is missing in the newer version 2.0 that we have checked.

(7) The modeling of KID6933781 was possible only with huge value L3=0.98. This result implies that the modeled light variability does not belong to the observed star but rather to a nearby star which light enters into the aperture around the observed target. The map of KID6933781 (Fig. 3) revealed central bright star and faint star at distance of 10 arcsec or 2.5 pix. Taking into account that the aperture of the *Kepler* photometry is with radius 5-6 pix it is reasonable to suppose that the eclipsing star in this case is the faint star.

(8) Besides the binary period of 18.6 days the system KID7021177 exhibits light changes with a period of P=6.355932 days (Fig. 7) which light curve means possible rotational variability (caused by spots, etc.).

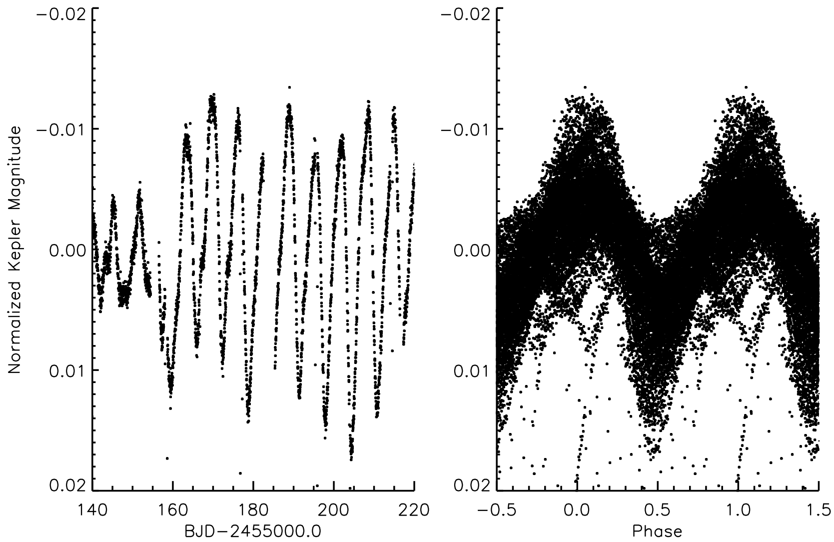

Fig. 7. The additional (rotation) variability of KID7021177 and its folded curve

(9) The depth of the primary eclipse of KID8552719 is only 0.002 mag and there is not any indication of a secondary eclipse (Fig. 6). Hence, this target reveals behavior of an exoplanet candidate. The shape of the light minimum also resembles transit event (not V-shape).

4 The exoplanet candidate KID8552719

The planet detection passes through data validation (DV) and follow-up observations (FOP). DV performs false-positive elimination from diagnostics that can be pulled out of the *Kepler* data itself (Batalha et al. 2010), while the FOP relies on additional observations such as moderate and high-precision spectroscopic radial velocities.

If the light curve solution of exoplanet candidate leads to radius $< 2R_J$ it is assigned as a Kepler Object of Interest (KOI). But only those candidates that pass the DV tests are submitted to the follow-up observers for spectroscopic vetting, confirmation, and characterization. Candidates with a companion radius larger than $2R_J$ are likely associated with late M dwarfs and are not considered as high-priority planetary candidates.

The goal of the DV tests is to eliminate the false positives caused by either grazing or diluted eclipsing binaries.

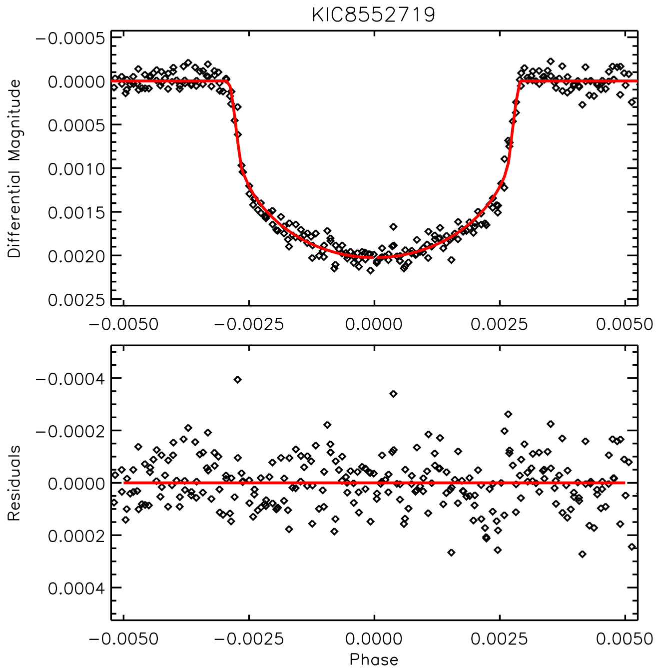

Fig. 8. Model of KID8552719 by our code

We used our own code (Kjurkchieva & Dimitrov, 2012) to model the light curve of KID8552719. For this purpose we retrieved the star parameters from the Kepler Input Catalog: T_s=5114 K (Sp K0 V); R_s=0.822 $R_\odot$; $\lg g_s$=4.56.

We calculated the stellar mass M_s=0.94 M⊙ and searched for transit solution for the foregoing input parameters by fitting the ratios R_s/a and R_p/R_s, orbital inclination i, limb-darkening coefficient u, initial epoch T0 and period P. The obtained values are (Fig. 8): i=89^0.53; orbital radius a=42.58 R⊙=0.19757 AU; planet radius R_p=0.0321 R⊙=0.315 R_J=0.9 R_{Nept}. Thus, KID8852719 turned out almost Neptune-sized object and passed the first criterion for exoplanet candidate.

The next criterion (Batalha et al. 2010) required modeling of the odd and even numbered transits independently. A significant difference in the companion radii (10 σ difference) for the odd and even transit implies that this system is likely a diluted EB at twice the orbital period. Our candidate did not reveal considerable difference of the odd and even transits and passed this criterion.

A false positive can be identified by the presence of secondary events at phase 0.5 with depth greater than 2σ. Our examination around phase 0.5 did not reveal such an event. In any case, in order to escape cases similar to KID310200 and KID694766 (see Figs. 3 and 4) with shallow secondary events far away from phase 0.5, we examined the whole light curve of KID8552719 but did not find such a secondary event. Hence, our candidate passed this test as well.

Assuming that the star and companion behave as black bodies we estimated the equilibrium temperature T_{eq} of the secondary component of KID8552719 by the formula (Batalha et al. 2012)

$$T_{eq} = T_s(R_s/2a)^{1/2}[f(1-A_B)]^{1/4} \quad (1)$$

where A_B is a Bond albedo and f is a proxy for atmospheric thermal circulation.

Using the values A_B=0.1 (for highly irradiated planets, Rowe et al. 2006) and f=1 for efficient heat distribution to the nightside of the planet we obtained a rough estimate for the dayside temperature of the secondary T_{eq}=489 K. This value is near to that of dayside Mercury and is suitable for a planet. It should be noted that it is higher than the temperature limit of the habitable zone of the host star.

The next test for false positives is checking of possible shift of the photocenter just at the transit (Batalha et al. 2010). Evidences of a diluted EB, i.e. false positive, are transit-like features in both row and column centroid residuals which are highly correlated with the transit features in the flux time series. In our case there were not any shifts of the photocenter of KID8552719 during the transits.

Another diagnostics to confirm the identity of the transiting (or eclipsing) object is to examine the spatial flux distributions and to find if the out-of-transit photocenter is centered on the target star. For this test one should compare the out-of-transit image with the difference image. If their brightest pixels are different then the event may be a false positive. The last step is to make a time series analysis of the brightest pixels that confirms which is the source of the transit variability.

The planetary candidate KID8552719 passed also all photocenter motion diagnostics (the centroid time series, the difference image, and the pixel flux time series) and it may be included in the next version of the planetary candidate catalog. We estimated that if the planet mass is near that of Neptune (as its radius) then the mass ratio of the system should be around 10000 and the effect on the radial velocity of the host star would be around 1 m/s.

During the final stage of preparation of this manuscript we found a paper of Huang, Bakos and Hartman, that has appeared in astro-ph.EP on May 29 2012 (Paper III). These authors reported new 16 planetary candidates based on searching for in the Q1-Q6 public data. One of them is KID8552719.

Huang, Bakos & Hartman (2012) used the formalism of Mandel & Agol (2002) and fitted the parameters R_p/R_s, the square of the impact parameter $b{=}a\cos i/\ R_s$ and the inverse of half duration $\zeta/R_s = 2/T_{dur}$ that is related to a/R_s and the impact parameter b.

The comparison of our results with those of Paper III revealed that the values of the planetary radius coincide within 1 % while the values of the rest geometric parameters (orbital inclination and semi-major axis) differ by 2 %. We attributed the last differences to the different methods of normalization of the *Kepler* data.

There is not any estimation of the planet temperature in Paper III.

5 Conclusion

Applying own searching method for eclipsing binaries to the public *Kepler* database Q0-Q2 we detected candidates that were out of the published catalogs of the *Kepler* eclipsing stars.

This paper presents the results of our light curve solutions of 20 newly detected eclipsing binaries and the values of their orbital and fundamental parameters. Most of them turned out binaries with high-eccentric orbits. Consequently, they present appropriate targets for study of the apsidal motion and the internal structure of the component stars.

Some of our discoveries have interesting peculiarities. We confirmed the conclusion of Huang, Bakos & Hartman (2012) that KID8552719 satisfied the criteria for a planetary candidate. The estimations of its physical parameters revealed the Neptune-size object out of the habitable zone of the host star.

Hence, the softwares do are indispensable for an automatic processing and analysis of a huge data-sets of the space missions as *Kepler* but the obtained results in this paper revealed that it is worth to examine such data-sets "manually/visually" in order to compensate the omission of some interesting objects and events, available in the database but missed by the software. At first glance this time-consuming work seems boring and requires patience and attention. But it is a true pleasure to see the wonderful light curves of the *Kepler* mission!

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