Characterization of extrasolar planetary transiting candidates II

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Abstract. We present a second paper of fully characterization of a sample of stars whose low-depth transits were discovered by the OGLE-III campaign in order to select the most promising candidates for spectroscopic confirmation, following the same analysis done in Gallardo et al. (2005). We present new optical and near-IR photometry, deriving physical parameters like effective temperature ($T_{\text{eff}}$), distance ($d$), the stellar radii ($R_\star$) and the companion radii ($R_c$). We selected eight M (2800 K $\leq T_{\text{eff}} \leq 3850$ K) or K (3850 K $\leq T_{\text{eff}} \leq 5150$ K) spectral type stellar objects as potential candidates to host exoplanets, even though, considering the radii of their companions, only stars OGLE-TR-61, OGLE-TR-74, OGLE-TR-123 and OGLE-TR-173 are the most promising M-type transit candidates to host planets. Confirmation of the planetary nature of any of these objects will yield another transiting extrasolar planet orbiting a M-type star, or even more interesting, the first extrasolar planets orbiting a late M-type dwarf of effective temperature about 2900 K.

Key words. stars: planetary systems - eclipsing - planets and satellites: general - techniques: photometry - Galaxy: structure

1. Introduction

The first transiting extrasolar planet was announced in 2000, when Charbonneau et al. (2000) and Henry et al. (2000) confirmed, via radial velocity measurements, the planetary nature of the transit light curve of HD 209458b. As of February 2010, there are approximately 69 extrasolar planets that transit their parent stars. Many of these planetary companions have been discovered by different photometric extra-solar planets surveys such as OGLE (Optical Gravitational Lensing Experiment), STARE (STellar Astrophysics & Research on Exoplanets), WASP (Wide Angle Search for Planets) and very recently by the COROT space telescope (CONvection, ROTation & planetary Transits, launched at the end of 2006), which claimed out the discovered of the first telluric planet (Léger et al. 2009). In despite of the success of these projects, one of the major problems identifying transiting planets is that photometry alone does not allow to unambiguously distinguish between extrasolar planets and other astrophysical low-luminosity objects like very late M-type stars, brown dwarfs or grazing binaries, as all these objects have similar characteristics (e.g., Dreizler et al. 2002, 2007; Gallardo et al. 2005; Silva & Cruz 2006). It is evident that transit surveys may monitor orders of magnitude more stars in a comparatively shorter observing time than radial velocity surveys, and hence they have the ability to discover many interesting exoplanet candidates, but non-planetary events must be filtered out. Once the classification is made, precise spectroscopic observations enable us to measure all the important parameters such as radii and masses.

Several works present efficient ways to select the most promising planetary candidates from transit surveys. For instance, Dreizler et al. (2002, 2007) made a selection using low dispersion spectroscopy; Drake (2003) used gravity darkening dependence of the light curve. Besides, Alonso et al. (2004) presented different configurations that can produce signals resembling those produced by transiting planets, listing several strategies to recognize these false alarms. They suggested that multicolor photometry is an useful tool to recognize, for example, eclipsing binaries. Near-IR photometry can be also used to discard giant stars and stars with IR excess as well as the possibility to filter out larger companions observing host stars ellipsoidal variability (e.g., Sirko & Paczynski 2003). Gallardo et al. (2005) developed a method based on the well-calibrated surface brightness relation along with the correlation between mass and luminosity for Main-Sequence stars. This allows not only the classification of the most promising candidates, but also the measurement of the effective temperature and radius for the parent star.

As already mentioned, the OGLE project (Udalski 2002, 2003, 2004) has been an efficient photometric survey for discovering transiting extrasolar planets, proving that the photometric technique of detection of exoplanets can be successfully

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applied. During the years 2003 and 2005, the “planetary and low-luminosity companion” catalogues were published by the OGLE team. In these campaigns, several fields of the Galactic disk were monitored in search for low-depth transits, and 113 objects were discovered with transit depths shallower than 0.08 magnitudes in the $I$ band.

In this work, which is the continuation of the work published by Gallardo et al. (2005), we present new optical and near-IR photometry and measure the properties of a sample of 27 stars with observed transits (from the 113 just mentioned), constraining astrophysical parameters of both stellar and companion objects. We use the method developed by Gallardo et al. (2005) and we focus our analysis on the G, K and M-type parent stars. We select the most interesting stellar objects to host extrasolar planets from their light curves. We complemented these with observations (5 images per star) carried out with the SoFi instrument on the New Technology Telescope (NTT) for our observations. The SoFi instrument is equipped with a HAWAII HgCdTe detector of 1024 x 1024 pixels equipped with a HAWAII HgCdTe detector of 1024 × 1024 pixels, characterized by a 5.4 e⁻/ADU gain, a readout noise of 2.1 ADU, and a dark current of less than 0.1 e⁻ s⁻¹. We observed in the Large Field mode, giving a 4.9 × 4.9 arcmin² field. All measurements were made through the $J$, $H$ and $K_s$-band filters.

Using a backup program, additional observations of some OGLE planetary transit candidates (taken from those previously observed in the near-IR bands) were carry out with the SMARTS 1.0 m telescope at the Cerro Tololo International Observatory (CTIO) in the $V$ and $I$ optical bands. We included in this sub-sample one target already observed in Gallardo et al. (2005): OGLE-TR-111 (a confirmed planet) and 5 eclipsing binary systems observed and analyzed by Pont et al. (2005): OGLE-TR-72, OGLE-TR-78, OGLE-TR-105, OGLE-TR-106 and OGLE-TR-123, in order to compare their results with our conclusions (see discussion in §5). The camera was the Y4KCam with STA 4064×4064 CCD with 15-micron pixels mounted in an LN₂ dewar, with a field of view 20×20 arcmin² square, giving a scale of 0.289-arcsec/pixel. The data were obtained during two nights on 2009, March 14-15. The fields were monitored both in the $V$ and $I$ band filters with 300 and 180 seconds exposure time for each image respectively.

The paper is organized as follows: in §2, we present our observations followed by data reduction in §3. In §4, we briefly discuss the method we used to determine both stellar and companions physical parameters, and the inferred properties are presented in §5. The conclusions given in §6, close the paper.

2. Observations

In April and May 2005, we carried out several observations of OGLE extrasolar planetary transit candidates of its campaigns during the years 2003 and 2005. We observed every target for 2 or 3 hours (about 100 images for a single star). A total of 14 stars were observed for planetary transits in their light curves. We complemented these with observations (5 images per star) of other OGLE stars to obtain near-IR photometry, and made a near-IR photometric catalogue for the OGLE candidates. We used the SoFi IR camera at the ESO New Technology Telescope (NTT) for our observations. The SoFi instrument is equipped with a HAWAII HgCdTe detector of 1024 × 1024 pixels, characterized by a 5.4 e⁻/ADU gain, a readout noise of 2.1 ADU, and a dark current of less than 0.1 e⁻ s⁻¹. We observed in the Large Field mode, giving a 4.9 × 4.9 arcmin² field. All measurements were made through the $J$, $H$ and $K_s$-band filters.

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3. Data reduction

3.1. Near-IR photometry

The reductions were made using IRAF task. First, a cross-talk correction was applied, taking into account the detectors sensitivity difference between the upper and the lower half. Then the sky subtraction was applied. The whole data set was acquired using “dither” mode (regular offset for a specific number of images). These contiguous sky images were used to generate local sky background close in time for each of the offset images. Then, the appropriately scaled skies were subtracted from the images. Finally, we applied flat-field corrections to all images and aligned them. For the flat-fields we used the correction images provided by the NTT SciOps team and the alignment was done with 1intran and imshift task.

The calibration of the near-IR photometry was made using 2MASS, with common stars between our fields and stars listed in 2MASS Point Sources Catalog. In this calibration we obtained zero point of 0.1 mag for the $K_s$-band photometry. Some stars used for the calibrations were checked against the Deep Near-Infrared Survey (DENIS) sources.

The average errors for the candidates are less than 0.1 mag. for the used near-IR filters. Finally, some candidates were not included in the analysis because they were classified as corrupted data.

3.2. Optical photometry

The reductions of the $V$ and $I$ band data were made using the IRAF phot task. We have picked an aperture size of 6 pixels and a dannulus of 2 pixels for subtracting the sky background. The transformation to the standard system was performed on the base of observations of three Landoldt’s (1992) fields using the Bouger linear relation by fitting the instrumental magnitudes for different airmass observations. The target stars have 14.50 ≤ $V$ ≤ 18.69 mag and 13.79 ≤ $I$ ≤ 16.72 mag with errors that should not exceed 0.05 and 0.07 mag, respectively.

4. Determining the stellar parameters

This is the second paper using the same analysis presented in Gallardo et al. (2005), thus, here we briefly discuss the main equations developed in order to determine physical parameters of the observed objects. Two steps are necessary in order to characterize each star. Using the limb darkened angular diameter of the star ($\theta_{ld}$), we can infer intrinsic magnitudes via the following relations:

$$\log \left( \frac{\theta_{ld}}{\text{mas}} \right) = 0.5 + 0.1(V - K)_0 - 0.2K_o, \quad (1)$$

$$\log \left( \frac{\theta_{ld}}{\text{mas}} \right) = 0.5 + 0.2(I - K)_0 - 0.2K_o, \quad (2)$$

where the index “0” refers to unreddened values and where the rms. dispersions are less than 1% and 3.7% respectively

1 IRAF is distributed by the NOAO, operated by Universities for Research in Astronomy, Inc.

2 See www.ls.eso.org/lasilla/sciops/ntt/sofi/reduction/flat_fielding.html
(Kervella et al. 2004) and the final estimate is the weighted mean of these estimates. Then we can infer the effective temperature through the relation:

$$\log T_{\text{eff}} = 4.2 - [1.2 \log \theta_{\text{obs}} + 0.2 K_0 + 0.6]^{1/2}. \quad (3)$$

Finally, the combination of relations (1), (2) and (3) yields an estimate of $R_*$ by its dependence on the assumed distance as:

$$\left( \frac{R_*}{R_\odot} \right) = 4.4 \times 10^{10} \left( \frac{d}{\text{kpc}} \right) \tan \left( \frac{\theta_{\text{obs}}}{2} \right). \quad (4)$$

The second step comes from the properties of Main-Sequence stars: the strong correlation between luminosity and mass ($L \sim M^4$), and between mass and radius ($M \sim R^3$), hence between effective temperature and radius of the form:

$$\left( \frac{T_{\text{eff}}}{T_{\text{eff}(0)}} \right) \approx \left( \frac{R_*}{R_\odot} \right)^{0.64}, \quad (5)$$

using the standard values of $\alpha = 1/0.8, \beta = 3.6$ and solar effective temperature $T_{\text{eff}(0)} = 5770$ K. In this way, if the distance exists, both estimates agree and the parameters are fully consistent. On the other hand, if there is no distance solution, then either the star is a giant (for which equations (1), (2) and (3) do not apply), or the assumed reddening at that distance is incorrect (necessary to calculate ($1 - K_0$)). At last, the companion radius is derived using the standard relation from Seager & Mallen-Ornelas (2003):

$$\left( \frac{R_c}{R_\odot} \right) = \left( 10^{M/2.5} - 1 \right)^{1/2}, \quad (6)$$

where $\Delta I$ is the depth of the transit in magnitudes in the $I$ band, provided by OGLE.

5. Constrains on the stellar objects and companions

Table I lists the inferred stellar properties. In column (1) we give the name of the target, the derived distance and the effective temperature of the host star in column (2) and (3), respectively. The calculated companion radius and its error are shown in column (4) and (5), respectively. The stellar radius is listed in column (6) and the corresponding error is shown in column (7). The transit depth in the $I$ band is displays in column (8). Finally, column (9) presents the observed orbital period.

As this table shows, there are many M-type stars (Column (3)) in this sample. Analyzing these results, several companions have radii comparable with the known close-in giant transiting extrasolar planets and, even more interesting, some planetary companion candidates are orbiting late M-type stars, as Fig. 1 shows. This figure displays the effective temperature of the host star versus the derived transiting companion’s radius.

We have made the following selection steps to find the most promising candidates to host exoplanets. First, we made a spectral type and effective temperature analysis, using Table I and Fig. 2 where we plot the $V - I$ and $I$ absolute values for the 27 stars in filled squares, along with the locus of the Main-Sequence stars, showed in solid line. Thus, we have selected the following M-type star candidates: OGLE-TR-61, OGLE-TR-74, OGLE-TR-123, OGLE-TR-143, OGLE-TR-161, OGLE-TR-167, OGLE-TR-172 and OGLE-TR-173. Considering the obtained companion radii, in consistency with the median radii of exoplanets found by transits, only the candidates OGLE-TR-61, OGLE-TR-74, OGLE-TR-123, OGLE-TR-167 and OGLE-TR-173 are the most promising stars to host extrasolar planets, and deserve further spectroscopic observations. Very recently, Pietrukowicz et al. (2010) conclude that the shape of the transit OGLE-TR-167 rules out its planetary nature based on VIMOS+VLT photometry. Pont et al. (2005) presented an spectroscopic follow-up of OGLE-TR-123, but they claimed that more data is needed to confirm the planetary nature of the mentioned object. Their tentative result indicates that OGLE-TR-123 may be orbited by a brown dwarf or low-mass star near the hydrogen-burning limit, making OGLE-TR-123 an extremely interesting candidate. The possible sub-stellar companion of the other four stellar objects (i.e., OGLE-TR-61, OGLE-TR-74, OGLE-TR-123 and OGLE-TR-173) orbit M-type stars. These are very interesting in their own right, because they appear to have small size stellar companions like HD-149026b (Sato et al. 2005), HAT-P-3b (Torres et al. 2007) or OGLE-TR-111b (Minniti et al. 2007), with radius ranging from ~ 0.5 $R_{\text{Jup}}$ to 1.0 $R_{\text{Jup}}$. Moreover we show the reliability of the method proposed by Gallardo et al. (2005), by confirming OGLE-TR-111 (Minniti et al. 2007) as an exoplanet host star that has effective temperature and companion radius in total consistency with our estimations.

It is important to notice that some K-type stars that have companion radius well measured, should also be considered as good transit candidates. These are OGLE-TR-71, OGLE-TR-72, OGLE-TR-158 and OGLE-TR-164. One of these candidates, OGLE-TR-72 was however discarded following Pont et al. (2005), who classified it as M eclipsing binary system.

Finally, using the same method described above, we select OGLE-TR-60, OGLE-TR-155, OGLE-TR-160, OGLE-TR-162 and OGLE-TR-163 as also good transit candidates to host exoplanets, belonging to earlier F or G spectral type Main-Sequence stars.

On the other hand, we discard all of the rest for the following reasons; OGLE-TR-75 presents substantial inconsistencies in the magnitude for estimating accurate stellar properties; OGLE-TR-70, OGLE-TR-156 and OGLE-TR-159 are in disagreement when comparing effective temperature inferred and spectral type classification; OGLE-TR-78, OGLE-TR-105, OGLE-TR-106, OGLE-TR-142 and OGLE-TR-146 are either giants since the method based on the well-calibrated surface brightness relation along with the correlation between mass and luminosity for Main-Sequence stars, does not give acceptable solutions, or their distances have been estimated with errors that are far too high. It is important to note that candidates OGLE-TR-78, OGLE-TR-105 and OGLE-TR-106, were classified by Pont et al. (2005) as M, G and M binary systems, respectively, making our selection criteria result of these candidates a robust conclusion. Finally, candidates OGLE-TR-143, OGLE-TR-161 and OGLE-TR-172 have low-mass companions whose radii are far too small to be good transit candidates following our selection criteria.
Fig. 1. Radius for the companions versus effective temperature of the host star for 27 observed OGLE objects. Error of $T_{\text{eff}}$ is of $\pm 600$ [K]. Filled squares indicate the promising candidates around M-type stars while the rest of the sample is indicated with filled triangles.

Fig. 2. Absolute color-magnitude diagram. Filled black circles denote the most promising M-type candidates. The filled black squares denote also promising candidates around F- and/or G-type stars. On the other hand, discarded candidates are represented by grey filled squares. Error bars are mainly due to distance uncertainties. The Main-Sequence stars loci have been plotted in solid black line.

6. Conclusions

We present the second paper, as a continuation of the results presented in Gallardo et al. (2005), analyzing optical and near-IR photometry for candidate OGLE transits. We carry out a self-consistent characterization of systems identified by the OGLE collaboration. By combining near-IR and optical observations, we obtained the stellar parameters such as effective temperature, distance, mass and radii of 27 transiting candidates using the method presented in Gallardo et al. (2005). This method provides accurate determination of the aforementioned astrophysical properties, allowing us to further refine the radii of the companions and make an efficient selection of possible extrasolar planets.

Our main conclusions are: (1) The objects: OGLE-TR-70, OGLE-TR-72, OGLE-TR-75, OGLE-TR-78, OGLE-TR-105, OGLE-TR-106, OGLE-TR-142, OGLE-TR-143, OGLE-TR-146, OGLE-TR-156, OGLE-TR-159, OGLE-TR-161, OGLE-TR-167 and OGLE-TR-172 can be excluded from future observations; (2) We select M or K-type star candidates OGLE-TR-61, OGLE-TR-71, OGLE-TR-74, OGLE-TR-123, OGLE-TR-158, OGLE-TR-164 and OGLE-TR-163 as very good transit candidates to host exoplanets; (3) We have also selected OGLE-TR-60, OGLE-TR-155, OGLE-TR-160, OGLE-TR-162 and OGLE-TR-163 as some other possible Main-Sequence stars harboring planets. Dreizler et al. (2007) selected OGLE-TR-138 (not included in our analysis), OGLE-TR-158, OGLE-TR-160 and OGLE-TR-163 as possible stars harboring planets. We agree in the classification for 3 of their 4 best candidates. Moreover, our estimate of the $T_{\text{eff}}$ and $R_c$ are also in agreement with their work. This confirms the reliability of our present selection. Finally, it is important to notice that candidates in group (2) are all M or K spectral type stars potentially one of the first detections of planetary companions orbiting a stellar object with this characteristic. There is only one exoplanet transiting an M-type dwarf known: Gliese 436b (Butler et al. 2004; Gillon et al. 2007). In this way, we mostly select candidates OGLE-TR-61, OGLE-TR-74, OGLE-TR-123 and OGLE-TR-173 as the most promising M-type stars to host extrasolar planets around, and plan to obtain high-resolution follow-up observations to confirm our results by determining the masses accurately and to conclude their nature.

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### Table 1. Physical properties for the 27 observed OGLE objects and their companions.

| Name | \(d\) \([\text{kpc}]\) | \(T_{\text{eff}}\) \([\text{K}]\) | \(R_c\) \([R_{\text{Jup}}]\) | \(\pm R_c\) \([R_{\text{Jup}}]\) | \(R_\star\) \([R_\odot]\) | \(\pm R_\star\) \([R_\odot]\) | \(\Delta I\) \([\text{mag}]\) | \(P\) \([\text{days}]\) |
|------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 60   | 2.35           | 7800           | 1.89           | 0.30           | 1.60           | 0.26           | 0.016          | 2.31           |
| 61   | 0.25           | 3050           | 0.60           | 0.06           | 0.37           | 0.04           | 0.030          | 4.26           |
| 70   | 0.25           | 3050           | 0.80           | 0.08           | 0.36           | 0.04           | 0.053          | 8.04           |
| 71   | 0.80           | 4250           | 0.86           | 0.06           | 0.62           | 0.05           | 0.022          | 4.19           |
| 72   | 0.65           | 3950           | 1.14           | 0.09           | 0.55           | 0.04           | 0.048          | 6.85           |
| 74   | 0.25           | 3150           | 0.63           | 0.06           | 0.39           | 0.04           | 0.030          | 1.58           |
| 75   | 1.55           | 5250           | 1.49           | 0.22           | 0.86           | 0.13           | 0.034          | 2.64           |
| 78   | 2.40           | 7250           | 2.32           | 0.40           | 1.43           | 0.25           | 0.03           | 5.32           |
| 105  | 2.80           | 6800           | 1.95           | 0.54           | 1.29           | 0.36           | 0.026          | 3.06           |
| 106\*| 6.00           | 7060           | 1.90           | 0.10           | –             | –              | 0.022          | 2.54           |
| 111\*| 0.80           | 4650           | 0.92           | 0.06           | 0.71           | 0.05           | 0.019          | 4.02           |
| 123  | 0.50           | 3670           | 0.41           | 0.03           | 0.49           | 0.04           | 0.008          | 1.80           |
| 142\*| 3.80           | 7700           | 2.72           | 0.1            | –              | –              | 0.034          | 3.06           |
| 143  | 0.04           | 2600           | 0.21           | 0.02           | 0.29           | 0.03           | 0.006          | 3.34           |
| 146\*| 5.80           | 7420           | 2.89           | 0.1            | –              | –              | 0.043          | 2.94           |
| 155  | 1.10           | 5080           | 0.68           | 0.06           | 0.82           | 0.08           | 0.008          | 5.27           |
| 156  | 0.25           | 3480           | 0.79           | 0.07           | 0.45           | 0.04           | 0.034          | 3.58           |
| 158  | 0.70           | 4130           | 0.77           | 0.06           | 0.59           | 0.04           | 0.019          | 6.38           |
| 159  | 0.45           | 3540           | 0.85           | 0.08           | 0.47           | 0.04           | 0.038          | 2.12           |
| 160  | 0.50           | 4580           | 0.58           | 0.04           | 0.70           | 0.05           | 0.008          | 4.90           |
| 161  | 0.25           | 3180           | 0.28           | 0.03           | 0.39           | 0.04           | 0.006          | 2.74           |
| 162  | 0.75           | 4860           | 0.75           | 0.05           | 0.76           | 0.05           | 0.011          | 3.75           |
| 163  | 0.65           | 4130           | 1.03           | 0.08           | 0.59           | 0.04           | 0.034          | 0.94           |
| 164  | 0.75           | 4190           | 0.78           | 0.06           | 0.61           | 0.05           | 0.019          | 2.68           |
| 167  | 0.25           | 3230           | 0.56           | 0.05           | 0.40           | 0.04           | 0.022          | 5.26           |
| 172  | 0.20           | 3190           | 0.29           | 0.03           | 0.40           | 0.04           | 0.006          | 1.79           |
| 173  | 0.10           | 2850           | 0.43           | 0.05           | 0.33           | 0.04           | 0.019          | 2.60           |

\(^a\) Errors on the distance correspond to ± 0.25 kpc on average  
\(^b\) Errors on the effective temperature correspond to ± 600 K  
\(^c\) \(R_{\text{ap}} = 0.103 R_\odot\)  
\(^*\) Presumed giant stars (see discussion in §5)  
\(^**\) Already confirmed planet

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Table 2. Physical properties for the 27 observed OGLE objects and their companions.

| Name  | $a$  | $V$  | $I$  | $J$  | $H$  | $K$  |
|-------|------|------|------|------|------|------|
| OGLE-TR-60 | 0.016 | 15.25 | 14.59 | 14.16 | 14.07 | 13.81 |
| 61    | 0.03  | 18.17 | 16.33 | 14.82 | 14.27 | 13.87 |
| 70    | 0.053 | 17.87 | 16.68 | 15.7  | 14.18 | 13.93 |
| 71    | 0.022 | 17.55 | 16.22 | 15.61 | 15.13 | 14.54 |
| 72    | 0.048 | 17.78 | 16.41 | 15.61 | 15.13 | 14.54 |
| 74    | 0.03  | 17.74 | 15.99 | 14.37 | 13.95 | 13.58 |
| 75    | 0.034 | 16.18 | 16.86 | 15.96 | 14.87 | 14.84 |
| 78    | 0.03  | 16.24 | 15.71 | 14.93 | 14.68 | 14.64 |
| 105   | 0.026 | 16.93 | 15.93 | 15.09 | 14.72 | 14.9  |
| 106   | 0.022 | 17.84 | 16.72 | 15.99 | 16.04 | 16.3  |
| 111   | 0.019 | 16.93 | 15.6  | 14.7  | 14.22 | 14.11 |
| 123   | 0.008 | 18.69 | 15.81 | 14.64 | 14.31 | 14.21 |
| 142   | 0.034 | 16.22 | 15.32 | 15.18 | 14.86 | 14.9  |
| 143   | 0.006 | 16.31 | 13.79 | 12.1  | 11.1  | 10.73 |
| 146   | 0.043 | 17.79 | 16.43 | 15.73 | 15.41 | 16.02 |
| 155   | 0.008 | 16.77 | 15.68 | 14.82 | 14.44 | 14.29 |
| 156   | 0.034 | 16.39 | 15.31 | 13.78 | 13.15 | 12.98 |
| 158   | 0.019 | 17.56 | 16.01 | 14.89 | 14.3  | 14.29 |
| 159   | 0.038 | 17.84 | 16.43 | 15.32 | 14.04 | 14.17 |
| 160   | 0.008 | 15.53 | 14.44 | 13.57 | 13.18 | 13    |
| 161   | 0.006 | 17.59 | 15.80 | 14.5  | 13.76 | 13.55 |
| 162   | 0.011 | 16.17 | 15.00 | 14.09 | 13.81 | 13.67 |
| 163   | 0.034 | 17.16 | 15.90 | 14.99 | 14.4  | 14.14 |
| 164   | 0.019 | 17.66 | 16.23 | 15.07 | 14.54 | 14.51 |
| 167   | 0.022 | 17.85 | 15.71 | 14.41 | 13.68 | 13.41 |
| 172   | 0.006 | 17.49 | 15.41 | 13.93 | 13.18 | 12.99 |
| 173   | 0.019 | 16.96 | 14.93 | 13.31 | 12.52 | 12.34 |