97 Eclipsing Quadruple Star Candidates Discovered in TESS Full Frame Images

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ABSTRACT

We present a catalog of 97 uniformly-vetted candidates for quadruple star systems. The candidates were identified in *TESS* Full Frame Image data from Sectors 1 through 42 through a combination of machine learning techniques and visual examination, with major contributions from a dedicated group of citizen scientists. All targets exhibit two sets of eclipses with two different periods, both of which pass photocenter tests confirming that the eclipses are on-target. This catalog outlines the statistical properties of the sample, nearly doubles the number of known multiply-eclipsing quadruple systems, and provides the basis for detailed future studies of individual systems. Several important discoveries have already resulted from this effort, including the first sextuply-eclipsing sextuple stellar system and the first transiting circumbinary planet detected from one sector of *TESS* data.

Keywords: Eclipsing Binary Stars — Astronomy data analysis — Multiple star systems — Machine learning — High-performance computing

1. INTRODUCTION

Corresponding author: Veselin B. Kostov veselin.b.kostov@nasa.gov Half of Sun-like stars are members of binary systems (Raghavan et al. 2010) and about one in ten of these are triples and quadruples (Tokovinin 2018). The higherorder multiplicity fraction increases with stellar mass, to the point where massive single stars are an exception

rather than the norm (e.g. Moe & Di Stefano 2017). Multiple stellar systems are important tracers of stellar formation, can experience rich interactions such as Lidov-Kozai oscillations (Lidov 1962; Kozai 1962) or dynamical instability, and provide pathways for important stages of stellar evolution such as short-period binaries, common-envelope events, Type Ia Supernovae, black hole mergers (e.g. Pejcha et al. 2013; Fang et al. 2018; Hamers et al. 2021; Fragione & Kocsis 2019; Liu & Lai 2019). For example, the mass ratios between the individual components of a quadruple system, the period ratios between the constituent binary systems and the mutual inclination provide important insight into whether the system formed through a 'top-down' scenario via core or disk fragmentation, or 'bottom-up' aggregation via gravitational capture (e.g. Mathieu 1994; Pineda et al. 2015; Tobin et al. 2016; Tokovinin 2021; Whitworth 2001). In addition, the evolution of a compact quadruple stellar system can include a combination of single-star evolution, interactions between the two stars in the constituent binary systems, as well as dynamical interactions between the two binary systems. Detection and characterization of eclipsing binary stars in quadruple stellar systems provide an excellent opportunity to explore these processes (e.g. Borkovits et al. 2016; Rappaport et al. 2016, 2017; Tokovinin 2021).

To study multiple stellar systems, we have been performing a search for eclipsing binary stars (EBs) utilizing the long-cadence TESS lightcurves (Kruse et al. in prep). The lightcurves were created using the eleanor pipeline (Feinstein et al. 2019), which uses the Full-Frame Image TESS data to extract photometry on a target-by-target basis. A natural by-product of this search is the identification of 97 candidates for quadruple stellar systems based on the presence of (at least) two sets of eclipses following two distinct periods and/or measured eclipse-timing variations (ETVs). These eclipses indicate quadruple candidates with a 2+2hierarchical configuration. As part of this effort, we have already discovered the first sextuply-eclipsing sextuple system (TIC 168789840, Powell et al. 2021), a compact and coplanar quadruply-eclipsing quadruple system (TIC 454140642, Kostov et al. 2021a), and a transiting circumbinary planet (TIC 172900988, Kostov et al. 2021b).

Multiply-eclipsing stellar quadruples are highly valuable as they provide precise measurements of orbital periods, relative stellar sizes, temperatures, and orbital inclinations – yet are quite rare as they require fortuitous alignment with the observer. At the time of writing there are about 150 *candidates* for such systems, many of which could be false positives caused by two unrelated binaries, and only a handful of *confirmed* systems (e.g. Zasche et al. 2019). Thus the catalog of uniformly-vetted quadruple candidates presented here nearly doubles their numbers.

We note that the targets listed in this catalog are quadruple candidates that each originate from a single TESS source, i.e. the two component EBs are unresolved in TESS data. The reason is that for the purposes of this work our interests are in close quadruple systems that can exhibit dynamically-interesting interactions on a human timescale (months to years). Thus we deliberately exclude quadruple candidates that originate from two resolved sources in TESS data (either within the same pixel or separated by multiple pixels) yet have parallaxes and proper motions that may be consistent within their mutual uncertainties. For example, two EBs that are located on two different point sources separated on the sky by half a TESS pixel (~ 10 arcsec) and are both at a distance of 200 pc have a skyprojected separation of 2,000 AU; if the two EBs are separated by 2 *TESS* pixels and the distance is 500 pc, the sky-projected separation is 20,000 AU. If such EBs have the same proper motion they may indeed represent genuine, wide quadruple systems. However, even if there are significant dynamical interactions in such systems, the very long timescales are beyond the interest and scope of this work.

The organization of this paper is as follows: Section 2 provides an overview of detection methods, Section 3 outlines the vetting process, and Section 4 describes the ephemerides determination. We present the catalog and discuss the results in Section 5, and draw our conclusions in Section 6.

2. DETECTION METHODS

A collaboration between NASA Goddard Space Flight Center (GSFC) Astrophysics Science Division, the MIT Kavli Institute, and seven experienced citizen scientists has arisen in order to fully exploit the *TESS* Full-Frame Images (FFIs) in search of interesting lightcurves. Though many different types of stellar systems as well as planets have been discovered in this pursuit, the aforementioned collaboration has specialized in the identification of triple and quadruple star systems. To rule out false positives due to nearby field stars or systematic effects, we evaluate the pixel-by-pixel lightcurve of the target as well as the motion of center-of-light during each set of detected eclipses, also taking into account the stellar size and contamination ratio according to the TIC, as well as the astrometric noise measured by Gaia.

Following initial visual identification and inspection of the lightcurve for known artefacts, each candidate

quadruple system must undergo further analysis to ensure that the eclipse signals are originating from the indicated source. Of the candidate quadruple systems identified through visual analysis, only about 5-10 percent pass photocenter vetting¹. The remainder are dismissed as being caused by contamination of the lightcurve by two eclipsing binaries (EBs) that are either physically unrelated or too widely separated on the sky (as discussed above). We note that some of these contaminated sources may actually be wide physical quadruples as per the measured parallaxes and proper motions from Gaia. Each system presented in this catalog has undergone and passed photocenter vetting, indicating, at the very least, the source of each of the independent periods of eclipses is visually inseparable. We assess that a substantial majority of the systems presented here will be further confirmed as being gravitationally-bound hierarchical quadruple systems.

Prior to this collaboration, each organization pursued these candidates through different means. The NASA GSFC group pursued machine learning methods to find eclipses, then visually examined the lightcurves containing high-confidence eclipses. The machine learning method is described in Powell et al. (2021). Briefly, we use a convolutional neural network (CNN) adapted from the ResNet (He et al. 2015) structure to accept onedimensional lightcurves as input. The CNN was trained to find the feature of the eclipse in the lightcurves, using over 40,000 training examples and a binary cross entropy loss function. After constructing all the FFI lightcurves from Sectors 1-40 for targets brighter than 15th magnitude (~ 115 million), we used the neural network to perform inference and positively identify those lightcurves containing eclipses. Altogether, about 450,000 EB candidates were identified (Kruse et al. in prep). Finally, we conducted a visual inspection of those lightcurves identified by the neural network. Given that the final step of our process was visual inspection, a collaboration with the VSG was natural. Since the start of our collaboration, we have continued the process of constructing the FFI lightcurves for every newly released sector of TESS data, inference through the neural network, then a final visual survey by the VSG.

The MIT Visual Survey Group (VSG, Kristiansen et al. submitted) visually examined outputs of the MIT Quick Look Pipeline (QLP, Huang et al. 2020). The VSG discoveries were all made using standard personal computers with Linux, Macintosh, or Windows operating systems. The visual surveyors made use of the LcTools software system (Schmitt et al. 2019; Schmitt & Vanderburg 2021) – an interactive set of tools designed for lightcurve analysis – and custom software written in Python, C, or JavaScript. The most common method of detection required scanning through millions of public domain lightcurves using LcTools. Where necessary, the data were detrended and filtered for additional qualification to remove systematic noise and glitches when possible. LcTools was often used to also check eclipse depth and periodicity using a built-in BLS (Box-fitting Least Squares) or the built-in QuickFind method to further qualify the candidate lightcurves. The candidates were then visually inspected for dips from possible multiple eclipsing binaries. An example of this process is shown in Figure 1, highlighting the preliminary analysis of quadruple candidate TIC 285681367.

We note that trained visual inspection for specific features (like additional eclipses superimposed on an otherwise regular pattern) using tools specifically-designed for the task can be quite fast and efficient. The three main reasons are that (i) LcViewer is extremely fast with close to zero lag time between light curve presentations, and presents the lightcurves in a consistent, uniform, and homogeneous format; (ii) the seasoned visual surveyor is experienced in knowing what an object of interest looks like as well as whether it is a known pattern or not; and (iii) human perception is exceptionally good at recognizing a change in a known pattern or the emergence of a new pattern. For example, showing a trained surveyor 99 consecutive images of trees planted at regular intervals (like eclipses) is unlikely to trigger a reaction if asked to identify a new pattern. While the types of trees and the intervals change between images, the size, shape and color pattern of the images remains the same so that, in essence, the trees (eclipses) practically become the background. If, however, the hundredth image contains a tiger hiding behind a new set of trees planted at a regular interval, the surveyor will raise a red flag in the matter of seconds.

From our experience with Kepler, K2 and TESS data, members of our team can inspect a particular lightcurve in about five to ten seconds, and potentially much faster. Thus assuming a typical 'cruising speed' of 10 sec per lightcurve, ten dedicated visual surveyors can inspect 1 million light curves in two years spending less than 25 minutes a day. For context, over the last 10 years VSG members have visually surveyed more than 15 million light curves from Kepler, K2 and TESS (Kristiansen et al. submitted). In comparison, the subsequent vetting process (described below) is orders of magnitude slower.

¹ A catalog of quadruple false positives is beyond the scope of this work but we plan to present such a catalog in the future

3. VETTING METHODS

Due to the large pixel size of the TESS photometer $(\approx 20 \text{ arcsec})$, false positives due to nearby field stars are a common occurrence. To account for this, we evaluate the motion of the measured center-of-light during each set of eclipses detected in the lightcurve of each target. We also take into account the presence of nearby field stars and their respective magnitude differences with the target star, contamination ratio according to the TESS Input Catalog (TIC) where available, as well as information from the Gaia EDR3 catalog. In addition, we pursue follow-up photometry observations for a subset of targets as part of the TESS Follow-up Observing Program (TFOP), as well as dedicated spectroscopy on the 1.5m telescope at the F. L. Whipple Observatory in Arizona with the Tillinghast Reflector Echelle Spectrograph (TRES; Szentgyorgyi & Furesz 2007; Furesz 2008).

The vast majority of our quadruple candidates were unknown as EBs prior to their detection with TESS. As a result, they were not on the list of TESS targets observed at 2-min cadence and no data validation reports were available. Thus we used a center-of-light analysis based on the photocenter module of the DAVE vetting pipeline (Kostov et al. 2019) to evaluate the source of the detected EBs. Briefly, we investigate the center-oflight motion for each eclipse of each EB for each sector of available data by fitting to the difference image (outof-eclipse image minus in-eclipse image) a Point-Spread Function (PSF) and a Pixel-Response Function (PRF), and measuring the corresponding photocenter. When the eclipses of two EBs are too close to each other in time, so that there is little to no out-of-eclipse section of the lightcurve available for photocenter measurement, we exclude said eclipses from the analysis. To evaluate whether there is a significant motion during the detected eclipses, we compare the measured average difference image photocenter to the pixel position of the target as provided in the corresponding FITS header. We note that comparing the photocenter measured from the average difference image to the photocenter measured from the average out-of-eclipse image, as used for the analysis of Kepler and K2 data, is not optimal for TESS. The reason for this difference is that the *TESS* aperture is much larger and often contains multiple field stars that are as bright as the target itself (or even brighter). As a result, these field stars "pull" the measured out-of-eclipse photocenters away from the position of the target star, effectively preventing a meaningful comparison between the difference image and the out-of-eclipse image. While this was a known issue for K2 data (e.g. Kostov et al. 2019), it is much more prevalent for TESS data.

Based on our experience, the resolution limit of the photocenter analysis depends on multiple factors, which typically vary not only on a target-by-target but also on a sector-by-sector basis. Specifically, the limiting factors are the (i) magnitude difference between the target and nearby field stars; (ii) overall contamination ratio; (iii) out-of-eclipse lightcurve variability; (iv) number and depth of clean, un-blended eclipses; (v) quality of the difference images used to measure the photocenters; and (vi) the peculiarities of the systematic effects. For a typical pair of sources, measuring a photocenter separation of $\sim 5 - 10$ arcsec ($\sim 0.25 - 0.5$ pixels) is relatively easy, whereas a separation of ~ 1 arcsec (~ 0.05 pixels) is highly challenging.

We note that for some targets the TIC and/or Gaia EDR3 catalogs show that there is indeed a field star within ~ 1 arcsec of the target, and the photocenter measurements may not be sufficiently precise to pinpoint the true source of the eclipses. In these cases, we evaluate whether the eclipses can be produced by a field star using the eclipse depth (d_e) and the magnitude difference in the *TESS* bandpass (Δ T) between the field star and the target star, Δ T = -2.5 log₁₀(2d_e) mag. For example, for a field star to produce 10%-deep eclipses as contamination in the target's *TESS* lightcurve, Δ T has to be smaller than about 1.75 mag.

An example of a quadruple candidate (TIC 285681367) passing these vetting tests is shown in Figure 2. The target was observed in Sectors 18, 24 and 25, and produced two sets of eclipses with periods of $\mathrm{P_{A}}$ = 2.3660 days, and $\mathrm{P_{B}}$ = 3.9703 days, each showing primary and secondary eclipses. The FFI lightcurve of the target for Sector 25 is shown in the upper panel of the figure. The lower left and middle panels of the figure show the average difference images for each set of primary eclipses; the red symbols represent the measured photocenters and the black star represents the catalog position of the target. Our photocenter analysis shows that the target is the source of both sets of eclipses. We note that the aperture eleanor used for TIC 285681367 in Sector 25 (dashed contour in lower left and middle panels) does not include the target itself. This is a relatively rare (and sector-dependent) occurrence, and indicates that the eclipses are actually deeper than what we see in the **eleanor** lightcurve.

Throughout this work, we used **eleanor**'s default $aperture_mode = `normal'$ option which, by design, already tests various aperture sizes depending on the target's magnitude and contamination ratio. Further adjusting the photometric aperture in order to extract a custom lightcurve would require modifying the source code itself. This is beyond the scope of our work and

would likely require working closely with the creators of **eleanor**. However, the aperture only affects the measured eclipse depths. It does not affect our photocenter analysis at all because we uses our own codes and all available pixels as directly provided by TESS (typically a 13x13 pixels cutout, see lower left panel in Figure 2).

The lower right panel of Figure 2 represents a Skyview image of the target's *TESS* aperture (with the same size as the difference images, 13×13 pixels) showing all stars down to G = 21 mag. This is a crowded field – the target is blended with TIC 627730721 (separation ≈ 2.7 arcsec, $\Delta T \approx 7.3$ mag) and there are two more field stars inside the central pixel for Sector 25 – TIC 627730803 (separation ≈ 5.1 arcsec, $\Delta T \approx 7.3$ mag) and TIC 627730804 (separation ≈ 6.5 arcsec, $\Delta T \approx 8.6$ mag). However, none of these field stars is bright enough to produce the detected eclipses.

3.1. Pixel-by-pixel analysis

Once a multi-stellar candidate is identified, we utilize the interactive feature in Lightkurve (Lightkurve Collaboration et al. 2018) to inspect the target pixel file as an initial test prior to the photocenter analysis discussed above. As a standard, we compute a 15×15 pixel cutout which normally encompasses both EBs in question. The size of the cutout is based on a compromise between reliability and efficiency. In terms of reliability, our experience shows that this pixel mask allows consistent identification of the location of both EBs, regardless of their brightness. In terms of efficiency, the computational time is negligible compared to the time needed to adjust the aperture in an attempt to find the perfect match for each target. We also note that a contaminating star does not need to be exceptionally bright - only bright enough compared to the target star itself (see Section 3 for details).

In most cases, we experience one of the following scenarios: (i) The two EBs are sufficiently separated on the sky with at least one EB being off-target; or (ii) the positions of the two EBs are in adjacent pixels (as inferred with Lightkurve) yet different apertures show that the corresponding eclipse depths scale differently as a function of the aperture size. This indicates that the EBs originate from two resolved targets, which may or may not be a wide quadruple system. These two scenarios can be further evaluated by comparing parallax and proper motion values which we find via the Swarthmore Finding Chart through ExoFOP-TESS. Examples of these scenarios are shown in Fig. 3 and 4.

We note that there can be more than two unrelated stars in a target's *TESS* aperture (i.e., with different Gaia distances and/or proper motions), coming from clearly distinct pixels of the aperture. For example, there are four unrelated EBs in the *TESS* aperture of quadruple false positive TIC 28553336. Finally, sometimes two or more stars are located very close to each other within the same pixel. In cases like this, pinpointing the source of each EB needs further analysis as discussed above.

3.2. Types of False Positives

All candidate quadruples listed in this catalog have passed the photocenter vetting process described above. Those that did not pass the process fall into several categories, described below for completeness.

In general, we encountered the following five false positive scenarios:

- Target EB + Field EB: This represents a scenario where the photocenter analysis shows that one of the detected EBs is the target itself and the other is a nearby field star whose signal bleeds into the target's aperture (see Fig. 5).
- Field EB (star 1) + Field EB (star 1): A scenario where the photocenter analysis shows that both EBs originate from a nearby quadruple candidate which bleeds into the aperture of the target star (see Fig. 6). We note that here the off-target quadruple is a genuine candidate, but the target itself is considered in this work to be a false positive.
- Field EB (star 1) + Field EB (star 2): A scenario where the photocenter analysis shows that two EBs from two field stars bleed into the target's aperture (see Fig. 7). Star 1 and star 2 may or may not be in a wide quadruple system.
- Target triple star: A scenario where a triplyeclipsing triple star produces a single pair of tertiary eclipses that mimic a second highly-eccentric eclipsing binary with a period longer than the duration of the observations; the photocenter analysis shows that tertiary eclipses originate from the target. If there are more pairs of these eclipses in additional sectors of data, the target can be immediately marked as a triply-eclipsing triple star as the pairs of tertiary eclipses will (usually) vary in shape and order between consecutive conjunctions (see Fig. 8)
- **Potential false positive:** A case where one or more field stars nearly overlap with the target and are bright enough to produce a second set of eclipses in the target's lightcurve. The angular separation

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between the target and the field stars (sub-arcsec separation) is too small for reliable photocenter measurements, and is likely beyond the capabilities of dedicated follow-up as well (see Fig. 9). The contaminating field star may or may not form a physical quadruple with the target.

For completeness, we perform a preliminary comparison between each set of ephemerides for each quadruple candidate presented here to those of a sample of 31,154 EB candidates (unvetted) from the GSFC EB Catalog (Kruse et al. in prep).

Restricting the ephemerides match to 10^{-3} fractional difference in orbital period and 10^{-3} in orbital phase, 3 of the quadruple candidates show close matches with targets from the GSFC TESS EB cat-These are (i) TIC 63459761 alog (see Table 2). vs TIC 63459765/63459804/63459811, which is due to contamination as the coordinates are very close; (ii) TIC 283940788 (ra = 8.85, dec = 62.90) vs TIC 285609529/285609535 (ra = 296.25/296.25, dec = 26.14/26.14; and (iii) TIC 370440624 (ra = 143.23, dec = -68.68) vs TIC 451982722/451982756 (ra = 296.58/296.58, dec = 27.06/27.06). Assuming no crosstalk between distant TESS pixels, (ii) and (iii) are due to coincidence as the corresponding sky coordinates are quite different. While a comprehensive cross-match is beyond the scope of this work, it could be performed once the GSFC FFI EB Catalog is released and fully vetted (Kruse et al. in prep).

4. EPHEMERIS DETERMINATION

To determine the ephemerides of the two EBs for each quadruple candidate in this catalog, we perform the following steps. First, we run a preliminary Box-Least Square (BLS, Kovács et al. 2002) analysis of the lightcurve of each target for each available sector. Where needed, we clean the lightcurve by removing sections with partially- or fully-blended eclipses, as well as sections exhibiting known systematic effects. Additionally, for targets exhibiting prominent out-of-eclipse modulations we detrend the lightcurve by masking out the eclipses, applying a Savitsky-Golay filter to remove the variability, and adding the eclipses back in. For completeness, we include in our catalog relevant comments for any targets exhibiting prominent lightcurve variability due to either potential ellipsoidal modulations or general variability (e.g., TIC 271186951, TIC 357810643, TIC 367448265). Next, we extract small sections of the lightcurve centered on each eclipse for each binary, with a typical length of 2-3 eclipse durations as measured by BLS. Finally, using these sections we measure the eclipse times, depths and durations using four different functions – a trapezoid, a Gaussian, a generalized Gaussian of the form

$$F(t) = A - Be^{-\left(\frac{|t-t_{o}|}{\omega}\right)^{\beta}} + C(t-t_{o})$$
(1)

and a generalized hyperbolic secant of the form

$$F(t) = A - \frac{2B}{e^{-(\frac{|t-t_o|}{\omega})^{\beta}} + e^{(\frac{|t-t_o|}{\omega})^{\beta}}} + C(t-t_o)$$
(2)

where A, B, C, t_o , ω , and β are free parameters. For $\beta = 2$, Eqn. 1 becomes a standard Gaussian except for an additional factor of 2 in the denominator of the exponential (which can be absorbed into ω). We note that (i) β can take non-integer values; and (ii) the C(t - t_o) term in Equations 1 and 2 helps minimize the effects of in-eclipse lightcurve variability by accounting for a residual linear trend.

Because eclipse depths can vary between sectors (due to genuine changes caused by dynamical interactions or simply because of systematics), we fit each eclipse individually and then adopt the measurements from the corresponding function which provides the smallest chisquare. An example is shown in Fig. 10 for the case of TIC 392229331. Here, although the four functions look similar to the eye, the generalized Gaussian provides the best fit: the chi-square ratios between the generalized Gaussian function and the Gaussian, generalized hyperbolic secant, and trapezoid are $\approx 0.77, 0.84, 0.95$, respectively.

The differences between the Gaussian and the generalized Gaussian and secant functions – and the benefit of using the latter two – become more pronounced the flatter/sharper the eclipse bottom is. This is highlighted in Fig. 11 for the primary eclipses of binary B of TIC 285681367 (see also Fig. 2). Here, the eclipse shape clearly deviates from a Gaussian but is well-represented by the generalized Gaussian and secant functions (as well as the trapezoid function).

This approach allows us to keep track of potential eclipse-time variations that might indicate dynamical interactions between the two EBs. Indeed, several systems exhibit such variations as discussed below.

5. THE CATALOG

5.1. Contents of the Catalog

The catalog presents the TIC ID, periods, eclipse times, depths, durations, secondary phases of the potential quadruple systems detected in the GSFC FFI lightcurves (Powell et al. in prep, Kruse et al. in prep), as well as additional comments including important features, issues, caveats, etc. The results are summarized in Table 1. For completeness, the table also provides the estimated composite effective temperature and the TESS magnitude from the TESS Input Catalog, as well as the Gaia EDR3 distance and identifier; for convenience, we label the targets as e.g. TGV-1 for "TESS/Goddard/VSG quadruple candidate-1".

The sky coordinates of the 97 quadruple candidates are shown in Figure 12. Compared to the quadruple candidates listed in Zasche et al. (2019), our targets are uniformly-spread in declination (see their Figure 12 vs upper right panel of Figure 12 here). The apparent lack of targets in some parts of the sky (e.g. southern targets with RA greater than about 250°) is likely due to the incompleteness of our catalog – there are many more potential quadruple candidates in our database awaiting vetting and analysis.

A powerful tool to infer the potential presence of unresolved companion(s) in a given stellar system is measurements of astrometric noise in excess of that expected from the target's parallax and proper mo-The Gaia EDR3 Catalog (Gaia Collaboration tion. et al. 2021) provides such measurements in terms of an astrometric excess noise above a single star model, i.e. astrometric_excess_noise (AEN), with a corresponding significance astrometric_excess_noise_sig (AENS), as well as an indicator for the astrometric goodness-of-fit in terms of a renormalized unit weight error (RUWE). The method has been demonstrated for known spectroscopic binaries, used to measure binarity fraction across the HR diagram, detect hierarchical triples, and X-ray binary stars (e.g. Belokurov et al. (2020); Penovre et al. (2020); Stassun & Torres (2021); Gandhi et al. (2022), and references therein). Figure 12 shows Gaia's EDR3 AEN, AENS, and RUWE for those targets in our catalog with measured AEN (91 out of 97). Of these 93, the AEN is greater than 1/5/10 mas for 32/7/6 targets, and can reach up to 93 mas (for TIC 168789840). Most of the targets (90) have AENS greater than 5 and 56 targets have AENS > 100; more than half of the targets (59 out of 91) have RUWE greater than 1.5 (the value above which the astrometry is likely affected by wide companions) and 20 targets have RUWE greater than 10. Altogether, these indicate potentially significant orbital motion between the two unresolved components for a large number of the quadruple candidates presented in this catalog.

5.2. Period Distributions

Recent analysis of quadruple systems consisting of two eclipsing binaries in a 2+2 hierarchical configuration shows strong peaks near period ratios of 1/1 and 3/2, a smaller peak near 5/2, and no significant peak near 2/1 (Zasche et al. 2019). The systems representing the 1/1 peak are close to resonance but not exactly in resonance, and only about a quarter of the systems representing the 3/2 peak are close to an exact period ratio. With the caveat that some of the studied systems may not be genuine quadruples, and also assuming co-planar orbits, it has been suggested that period ratios of 2/1and 3/2 could be due to resonant capture and should be common (Tremaine 2020). However, a period ratio near or at 1/1 is expected to be rare as the corresponding resonance capture is inefficient (Breiter & Vokrouhlický 2018; Tremaine 2020). This makes makes the origin of the 1/1 peak in the Zasche et al. (2019) sample puzzling.

Our catalog of uniformly-vetted quadruple candidates presents a new opportunity to study period distributions. These are shown in Fig. 13 for the 97 candidates that pass our vetting tests measurements. As a comparison to Figure 13 of Zasche et al. (2019), 72 of the 97 systems have period ratios P_B/P_A smaller than 4. The distribution of these 72 systems is shown as a histogram in the upper right panel of Fig. 13 presented here, using the same number of bins as Zasche et al. (2019) (26). Of these 72 systems, 24(7) have period ratios of 1:1, 5:4, 4:3, 3:2, 5:3, 2:1, 5:2, and 3:1 to within 4%(1%), respectively; the value of 4% was chosen as twice the difference between the 5:4 and 4:3 period ratios.

To evaluate the significance of the measured period ratios, we computed the matches to rational numbers 1:1, 5:4, 4:3, 3:2, 5:3, 2:1, 5:2, and 3:1 to within 8%, 4%, 2%, and 1% for a simulated distribution of period ratios as follows. First, we selected P_A periods measured randomly according to a $dp/dP_A\propto \hat{P}_A^{-1}$ probability distribution covering the range of 0.3 to 16 days (in line with the 72 systems outlined above). Next, for any given P_A we selected P_B randomly according to $dp/dP_B \propto P_B^{-4/3}$ such that P_B ranges from P_A to 25 days; we experimented with various empirical power-law indices and found that the value of 4/3 yielded approximately the observed fraction of systems with $P_B/P_A(<4)$ vs with $P_B/P_A(>4)$. This was done 72 times to make a complete simulation of one TESS dataset. For each simulated period ratio we checked whether this ratio was within a certain percentage of a rational number. We then stored the number of matches within the set of 72 ratios. Finally, the entire process was repeated 10^5 times and distributions of matches to rational numbers were computed. The mean numbers of expected matches vs those found in the data, as a function of the percentage match requirement, are listed in Table 3.

Overall, these simulations show that the numbers of accidental matches with rational numbers agrees to within the statistical uncertainties with the observed numbers for each of the four percentage match requirements. From this, we conclude that there is no evidence in our data set for an enhancement of period ratios in quadruples at the rational number values. In turn, this indicates that either (i) we have insufficient statistics to conclude that there is an enhancement at rational number period ratios, or (ii) if Nature prefers special period ratios they are not sufficiently close to rational numbers for us to measure them.

Finally, once the quadruple orbital period and eccentricity are known, a dynamical stability study on these systems would provide further proof that they are not just coincident but gravitationally bound.

5.3. Secondary Eclipses, Eclipse Depth and Duration Distributions

The phase difference between primary and secondary eclipses directly constrains $e\cos(\omega)$. As the eclipse times can be measured reasonably well from the data, even at relatively low SNR, $e\cos(\omega)$ can be readily estimated. The other component of the orbital eccentricity, $e\sin(\omega)$, is constrained by the difference between the primary and secondary eclipses durations (e.g. Prsa et al. 2011). The eclipse durations are more difficult to measure compared to the eclipse times and thus $e\sin(\omega)$ is less-well constrained. With this in mind, the distributions of the measured $e\cos(\omega)$ and $e\sin(\omega)$ for the quadruple candidates presented in this catalog are shown in Figure 14. Both distributions are strongly clustered around 0.0, suggesting a tendency for circular orbits. Given the relatively short orbital periods (< 15 - 25 days, see Fig. 13), this is not unexpected. The measured duration ratios between the primary and secondary eclipses are smaller than 1.5 with the exception of TIC 1337279468, binary C, where it is ≈ 4 .

We note that the individual eclipse depths reported in Table 1 are guaranteed to be different from the true depths due to the mandatory "contamination" produced by the contribution of the other binary to the total light of each A+B system. However, the ratio between the primary and secondary eclipse depths – an indicator of the relative brightness of the two stars in each binary, as well as of the orbital eccentricity – are less affected by said contamination. The measured eclipse depth ratios are presented in Figure 14, showing no clear preference towards a specific value.

5.4. Discussion

A uniformly-vetted catalog of eclipsing quadruple systems provides the opportunity to examine in further detail both individual systems of particular interest, as well as study broader questions relevant to their formation and evolution.

5.4.1. Individual Systems

Below we list several potentially interesting systems detected as part of this work.

- TIC 168789840: TIC 168789840 (TGV-96) is a confirmed (2+2)+2 hierarchical sextuple system consisting of an inner quadruple composed of two EBs and an outer EB (Powell et al. 2021). The two EBs of the quadruple have orbital periods of $P_A = 1.31$ days and $P_B = 1.57$ days, and a mutual orbital period of about 4 years. The third EB has an orbital period of P_C = 8.22 days. The outer orbit of the sextuple has a period of about 2,000 years. The six stars have very similar masses (1.23-1.3 M_{\odot} for the primaries, 0.56–0.66 M_{\odot} for the secondaries), sizes (1.46–1.69 R_{\odot} for the primaries, 0.52–0.62 R_{\odot} for the secondaries), and effective temperatures (T_{eff} = 6350–6400 K for the primaries, T_{eff} = 3923–4290 K for the secondaries).
- TIC 454140642: TIC 454140642 (TGV-89) is a confirmed 2+2 hierarchical quadruple system composed of two EBs that exhibit strong dynamical interactions and eclipse timing variations (Kostov et al. 2021a). The two EBs have orbital periods of $P_A = 10.3928$ days and $P_B = 13.6239$ days, and a mutual orbital period of about 432 days. The entire system is practically co-planar, with mutual inclinations smaller than 0.5 degrees. The four stars have very similar masses (1.11-1.2 M_{\odot}), sizes (1.1–1.26 R_{\odot}), and effective temperatures ($T_{eff} =$ 6188–6434 K).
- TIC 52856877: TIC 52856877 (TGV-6) is a candidate 2+2 hierarchical quadruple system composed of two EBs with orbital periods of $P_A = 5.1868$ days and $P_{\rm B} = 18.5864$ days. For simplicity, throughout this manuscript we label the periods of the two EBs as sorted in ascending order. The target was observed in Sectors 18 and 24; the TESS lightcurve of the system is shown in 15. The system exhibits strong eclipse timing variations, as seen from Figure 15. Gaia EDR3 shows AEN =0.31 mas with an AESN of 150.57, and RUWE = 2.19. Altogether, these considerations indicate kinematic motions between the two EBs and suggest that the system is gravitationally-bound. The analysis of the system, including follow-up observations, is in progress.
- **TIC 45160946:** TIC 45160946 (TGV-5) is a candidate 2+2 hierarchical quadruple system composed of two EBs with orbital periods of $P_A = 3.5163$

days and $P_B = 7.8462$ days. The target was observed in Sectors 9, 35 and 36; the *TESS* lightcurve for the latter two is shown in Fig. 16. As in the case for TIC 52856877, TIC 45160946 also exhibits strong eclipse timing variations (see Fig. 16). Gaia EDR3 shows AEN = 3.6 mas, with an AESN of 13472, and RUWE = 26.33. This indicates kinematic motions between the two EBs and suggests that the system is gravitationally-bound with a relatively short outer orbital period. A detailed analysis of the system is in progress.

• TIC 256158466: TIC 256158466 (TGV-37) is a candidate 2+2 hierarchical quadruple system composed of two EBs with orbital periods of $P_A =$ 5.7745 days and $P_{\rm B} = 7.4544$ days, with nearlyidentical primary and secondary eclipses for P_A (depths of 131 parts-per-thousand (ppt) and 128 ppt, respectively). The target was observed in Sectors 12, 13 and 39; the TESS lightcurve for the latter is shown in Fig. 17. Our analysis shows potential sinusoidal variations for the times of the P_A eclipses, although the variations only appear if we use relatively narrow sections of the lightcurve centered on the corresponding eclipses. If we use somewhat wider sections of the eclipses, the variations disappear in the scatter, as demonstrated in Figure 17. Thus we label this target as showing potential ETVs.

> We also note that there is a nearby field star, TIC 1508756606, with a separation of 5.65 arcsec, coordinates of RA = 17:47:35.21 and Dec = -79:22:40.94, and magnitude difference $\Delta T \approx 4.8$ mag. Our analysis rules out TIC 1508756606 as a source of either P_A or PB. The coordinates of TIC 1508756606, along with Gaia's parallax $(1.26 \pm 0.32 \text{ arcsec vs } 1.4 \pm 0.02 \text{ arcsec}$ for TIC 256158466) and proper motion (pmRA $= 0.54 \pm 0.3 \text{ mas/yr}, \text{ pmDec} = -29.57 \pm 0.36$ $mas/yr vs pmRA = -0.92 \pm 0.02 mas/yr, pmDec$ $= -29.18 \pm 0.02 \text{ mas/yr}$ for TIC 256158466), suggest that it might in fact form a co-moving quintuple system with TIC 256158466. Gaia's EDR3 AEN for both targets is zero, and the corresponding RUWE is about 0.96.

• TIC 141733685: The lightcurve of TIC 141733685 (TGV-95) exhibits three EBs. The target was observed in Sectors 8, 9, 35 and 36. Two of the EBs have orbital periods of $P_A = 5.29$ days and $P_B = 7.37$ days. We note that the former is seen in eleanor data only in Sectors 35 and 36, where it is unclear whether the period is 5.29 days or half of

that. To account for this, we extract the target's lightcurve using the FITSH pipeline (Pál 2012) which shows the primary and secondary eclipses of P_A in all 4 sectors of data. The third EB shows three eclipses but it is unclear from TESS data whether its period, PC, is ~ 21.8 days or ~ 43.6 days. This is because one of three eclipses coincides with a momentum dump in S35 and is blended with a P_A eclipse, and another (in Sector 36) is blended with a P_A primary and a P_B secondary. The eleanor and FITSH lightcurves for Sectors 35 and 36 are shown in Fig. 18. Analysis of archival ASAS-SN data for TIC 141733685 shows a clear periodicity at $P_{\rm C} = 43.63$ days with primary and secondary eclipses, and a slight eccentricity. We note that TIC 141733685 contaminates the TESS eleanor lightcurve of TIC 141733683 and TIC 141733701.

Closer inspection of the field around TIC 141733685 shows that there is a nearby field star, TIC 141733688, with a separation of 4.53 arcsec, coordinates of RA = 08:39:24.8 and Dec = -47:21:39.85, and magnitude difference $\Delta T \approx 3.15$ mag (see Fig. 19). This field star is not bright enough to produce the P_B or P_C eclipses as the needed $\Delta T < 0.9$ mag and $\Delta T < 2.06$ mag, respectively. TIC 141733688 is bright enough to produce the P_A eclipses (needed $\Delta T < 4.05$ mag). Another field star, TIC 141733701, has a separation of 12.6 arcsec, magnitude difference of ($\Delta T \approx 2.03$ mag), and is nominally bright enough to produce all three sets of eclipses.

As seen from Figure 20, our photocenter analysis clearly rules out the nearby TIC 141733701 as a potential source of the detected eclipses, and shows that all three EBs originate from the position of TIC 141733685. However, the measurement is not precise enough to distinguish between TIC 141733685 and TIC 141733688 for P_A as the eclipses are very shallow and the separation very small. Thus the source of P_A can be either TIC 141733685 or TIC 141733688. With that said, the P_A photocenters for TIC 141733685 "pull" away from TIC 141733688 (first row of panels, Fig. 20) indicating that the latter is not a likely source. Overall, these considerations suggest that there are two possibilities for the structure of the system: (i) quadruple (PB+PC) on TIC 141733685, P_A on TIC 141733688; or (ii) sextuple (PA+PB+PC) on TIC 141733685. Furthermore, the measured ETVs for both P_A and P_B imply non-linear effects (more prominent for PB, see Fig. 21) which strengthens the sextuple interpretation.

Gaia EDR3 measurements show AEN = 0.085mas, with an AENS of 9.19, and RUWE = 0.95for TIC 141733685. The target's parallax is within one sigma of that for TIC 141733688, 0.55 ± 0.01 mas for the former vs 0.58 ± 0.03 mas for the latter. The corresponding proper motions are comparable, 7.25 mas vs 7.45 mas, respectively, although the proper motions in declination are nominally different at a greater than 3 sigma level: (pmRA $= -6.12 \pm 0.03 \text{ mas/yr}, \text{ pmDec} = 3.89 \pm 0.04$ mas/yr) vs (pmRA = $-6.08 \pm 0.02 mas/yr$, pmDec $= 4.3 \pm 0.02$ mas/yr). Thus TIC 141733685 and TIC 141733688 might be a co-moving system, in which case possibility (ii) above would represent a septuple at a projected separation of $\sim 8,000$ AU. Given the magnitude and early spectral type of both sources, the prospect of spectroscopic followup might be poor.

Finally, we note that the coordinates of TIC 141733685 (RA = 08:39:25.2, Dec = -47:21:38.36) also coincide with those of the open Galactic cluster [KPS2012] MWSC 1523 (RA = 08:39:27, Dec = -47:21.4, Monteiro et al. 2020, MNRAS, 499, 1874). The proper motion of two are, however, different: (pmRA = -6.08 ± 0.01 mas/yr, pmDec = 4.29 ± 0.01 mas/yr) for TIC 141733685 vs (average pmRA = -4.12 ± 0.77 mas/yr, pmDec = 8.37 ± 0.77 mas/yr) for MWSC 1523.

• TIC 1337279468: The lightcurve of TIC 1337279468 (TGV-97) exhibits three EBs with orbital periods $P_A = 4.45$ days, $P_B = 5.94$ days, and $P_C = 10.57$ days. The target was observed in Sectors 12 and 39. The *TESS* lightcurve for the latter is shown in Fig. 22. We note that the TIC lists a source at a separation of 0.59 arcsec (TIC 246039685) and another at a separation of 4.84 arcsec (TIC 246039695). Neither is present in the Gaia EDR3 data.

There are three nearby field (TIC stars 1337279457. TIC 1337279471, and TIC 1337279458,) with separations of $\sim 4-6$ arcsec and magnitude differences $\Delta T \sim 5.5 - 6$ mag (see Fig. 23). None of these is bright enough to produce the eclipses seen in the lightcurve as the shallowest primary eclipses (PB, depth ~ 25 partsper-thousand, ppt) require a magnitude difference of $\Delta T < 3.2$ mag. Our photocenter analysis indicates that all three sets of eclipses are on-target (Fig. 22) and, accordingly, we consider the system

to be a likely sextuple. At the time of writing, there is insufficient data to evaluate its hierarchy and structure.

Gaia EDR3 shows AEN = 2.43 mas, with an AENS of 5891, and RUWE = 12.82 for TIC 1337279468. The target's proper motion is within $\sim 1\sigma$ of those for TIC 1337279471, and the two might be potential co-moving septuple. However, the proper motions are small and the parallax accuracy is relatively low (the EDR3 parallax for TIC 1337279471 is 0.4 ± 0.5 mas) so it is currently unclear whether this is the case.

Finally, we note that there is another EB in the 13×13 *TESS* pixels surrounding TIC 1337279468 – TIC 246039698 – separated by about 4 pixels. The ephemeris of TIC 246039698 is unrelated to any of the three EBs of TIC 1337279468.

• TIC 438226195: TIC 438226195 (TGV-85) produced a single extra transit-like event in Sector 6 near time t = 1488.8598 (see Fig. 24). Our analvsis indicates that the feature is on-target and, as we suspected this to be a candidate for a circumbinary planet, we added the target for 2-min cadence observations with *TESS* through the DDT program (#27). It was observed again in Sector 33 and indeed produced another clear extra transit-like event, strengthening the CBP hypothesis. However, closer inspection of the Sector 33 lightcurve showed that the first secondary eclipse of the main EB, about 11.7 days before the clear extra event, is deeper than the rest—the trademark signature of a blend between two events. This indicated that the extra events are due to a second, on-target, EB making this a quadruple candidate.

5.4.2. Cross-match with archival data

The results presented here can be further used to compare the measured ephemerides from TESS, especially for targets with multi-sector observations, to available archival photometric data from e.g. ASAS-SN (Shappee et al. 2014; Kochanek et al. 2017), Digital Access to a Sky Century @ Harvard (DASCH, Grindlay et al. 2012), Hungarian-made Automated Telescope Network (HATNet, Bakos et al. 2004), Kilodegree Extremely Little Telescope (KELT, Pepper et al. 2007), Kepler/K2 (Borucki et al. 2010), Northern Sky Variability Survey (NSVS, Woźniak et al. 2004), Optical Gravitational Lensing Experiment (OGLE, Udalski et al. 1992), Wide Angle Search for Planets (WASP, Pollacco et al. 2006). Such a comparison could also allow testing for potential apsidal motion which, if large enough to be readily detected, would strengthen the case for a genuine quadruple system.

As an example of this approach, we show on Fig. 25 the DASCH data of TIC 172900988. This is an eclipsing binary system hosting a transiting circumbinary planet (Kostov et al. 2021b) and exhibiting clear apsidal motion. While the cadence of the DASCH observations is low and there are very few in-eclipse datapoints, the phase change of the secondary eclipse relative to the primary is clearly seen in the phase-folded DASCH data, and the two eclipses follow slightly different periods. However, checking the archival data for the bulk of our 97 targets is beyond the scope of this paper.

Another potential comparison can be with spectroscopic archives. For example, Kounkel et al. (2021) examined the APOGEE DR16 and D17 for double-lined spectroscopic binaries. They detected several SB2 with corresponding eclipses in *TESS* data – demonstrating the cross-match potential – and uncovered 813 SB3 and 19 SB4 systems. One of the targets in our catalog, TIC 219469945, is listed as an SB3 system in the Kounkel et al. (2021) database. None is listed as SB4.

Finally, the targets in our catalog can be compared to astrometric binary stars detected by Gaia, especially those with significant astrometric excess noise (e.g. Belokurov et al. 2020, Peynore et al. 2021).

5.4.3. Different datasets, different lightcurves

During our visual examination of **eleanor** and QLP lightcurves we have noticed that sometimes there are distinct differences between the two datasets. As another potential source of false positives, it is important to keep track of such differences and investigate their source.

An example is shown in Fig. 26 for the case of TIC 13120007 where there are clear eclipses in QLP data but no discernible features in **eleanor** data. Note that the Sector 15 eclipses in QLP data have notably different depths before and after the data gap, which is a potential indicator for a false positive. The photocenter vetting analysis discussed above cannot be applied to **eleanor** data as there are no eclipses. However, in cases like this we use the pixel-by-pixel **eleanor** data to vet the target. Here, the data show that the target is not the source of the signal and the EB is in fact off-target, about 2 pixels away.

Another example is shown in Fig. 27 for the case of TIC 63708251. Here, the **eleanor** lightcurve shows one set of eclipses whereas QLP shows two sets of eclipses. As in the case of TIC 13120007, we cannot perform photocenter analysis of the **eleanor** data for the shallow

eclipses. However, as seen from Fig. 27, the pixel-bypixel eleanor data show that only the deeper eclipses seen in both datasets are on-target whereas the second EB seen in QLP data is off-target, about 5 pixels away. Interestingly, there is a third EB in the target's 13×13 pixels *TESS* aperture, near the upper right corner.

5.4.4. Quadruple stars from TESS

Our group has visually inspected millions of *TESS* lightcurves produced by several different pipelines. These include (i) ≈ 2.2 million eleanor lightcurves (Powell et al. in prep) for Sectors 1-40; (ii) all *TESS* CTL (Stassun et al. 2019) SC lightcurves for Sectors 1-42; (iii) QLP lightcurves for Sectors 2-4, 9, 13-27, 35 (Huang et al. 2020); (iv) (Oelkers & Stassun 2018) lightcurves for Sectors 1-5; (v) CDIPS FFI lightcurves for Sectors 6-13 (Bouma et al. 2020); (vi) PATHOS Sector 4-14 lightcurves (Nardiello et al. 2019). Altogether, the different lightcurve sets include targets as faint as T = 15 mag and thus represent a significant portion of all available *TESS* data.

Using these lightcurves, at the time of submission we have detected 2311 candidates for multiple stellar systems (triple and higher-order). Of these, 1319 ($\sim 57\%$) have been already vetted such that (i) 10% passed all vetting tests; (ii) 9% passed preliminary vetting tests, including the analysis of the pixel-by-pixel data; and (iii) 81% were ruled out as false positives. The catalog of 97 quadruple candidates presented here represents all such fully-vetted systems except the handful that need further analysis. 905 candidates ($\sim 39\%$) still need to be vetted, and the nature of 87 candidates (4%) is currently unclear. Overall, the detection, vetting and analysis of our candidates is a continuous process, and we plan to present the results in a series of papers.

The number of false positives we have encountered is more than an order of magnitude larger than the number of fully-vetted quadruple candidates presented here. Thus while completeness analysis is beyond the scope of this work, given the large number of targets inspected and assuming many of the additional candidates turn out to be real, *TESS* has the potential to increase the number of known eclipsing quadruple systems by more than a factor of two.

6. SUMMARY

We have presented a catalog of 97 eclipsing quadruple star candidates detected in *TESS* Full Frame Images. The target stars have been identified through visual inspection and exhibit two sets of eclipses with two distinct periods, each with primary and, in most cases, secondary eclipses. All targets have been uniformly-vetted and passed a series of tests, including pixel-by-pixel and photocenter motion analysis. We outlined the procedures for determining orbital periods, eclipse depths and durations, and discussed the statistical properties of the sample.

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Facilities: Gaia, MAST, TESS, WASP, ASAS-SN, NCCS, FRAM, PEST, CHIRON, TRES, SOAR, LCOGT

Software: Astrocut (Brasseur et al. 2019), AstroImageJ (Collins et al. 2017), Astropy (Astropy Collaboration et al. 2013, 2018), Eleanor (Feinstein et al. 2019), IPython (Pérez & Granger 2007), Keras (Chollet et al. 2015), LcTools (Schmitt et al. 2019; Schmitt & Vanderburg 2021), Lightcurvefactory (Borkovits et al. 2013; Rappaport et al. 2017; Borkovits et al. 2018), Lightkurve (Lightkurve Collaboration et al. 2018), Matplotlib (Hunter 2007), Mpi4py (Dalcin et al. 2008), NumPy (Harris et al. 2020), Pandas (McKinney 2010), PHOEBE (Prsa et al. 2011), Scikit-learn (Pedregosa et al. 2011), SciPy (Virtanen et al. 2020), Tensorflow (Abadi et al. 2015), Tess-point (Burke et al. 2020) wotan (Hippke et al. 2019)

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	RA	Dec	Binary	Period	T_0	$Phase_s$	Dep_p	Dep_s	Dur_p	Dur_{s}
-	degrees	degrees	-	d	BJD-2457000	-	ppt	ppt	hr	hr
9493888	69.510209	55.731524	А	2.098992	1816.2345	0.4999	146	117	2.9	2.7
			В	2.706156	1818.6919	0.5018	96	90	3.7	2.2
Additional	information: Л	GV-1, Gaia	EDR3 27'	71425916607	52128, Tmag: 1	1.98, Teff	: 5112 ł	K, Dist:	374.29 p	с
Comments .	A: –									
Comments 1	B: –									
25818450	352.743444	53.069150	А	10.132402	1769.9109	0.6396	12	9	—	-
			В	17.101657	1765.8009	-	80	-	-	-
				92486494566	143744, Tmag:	11.14, Tel	ff: 7172	K, Dist	: 838.61	\mathbf{pc}
Comments .	A: depth differ	rence between	n sectors							
Comments 2	B: depth differ	rence between	n sectors							
27543409	122.702004	13.567217	А	2.122862	1493.1001	0.4964	50	15	—	-
			В	4.013356	1494.513	—	75	_	_	-
Additional	information: 7	TGV-3, Gaia	EDR3 653	36200845928	24960, Tmag: 1	3.22, Teff	: 6421 I	K, Dist:	1878.88	\mathbf{pc}
Comments .	A: –									
Comments 2	B: SNR too lo	w for seconda	ary measu	rements						
31928452	53.969191	-66.936899	А	2.8823	1337.9129	0.5014	30	25	2.1	1.6
			В	7.829944	1326.0719	0.5584	89	72	3.2	3.4
Additional	information: Л	GV-4, Gaia	EDR3 46'	70910529358	997888, Tmag:	13.28, Tef	ff: – K,	Dist: 57	'4.18 pc	
Comments .	A: Ellipsoidal	variations; p	otential de	epth differen	ces between sec	tors				
Comments 2	B: potential de	epth differend	ces betwee	en sectors						
45160946	147.614561	-36.191917	А	3.516299	1544.8002	0.4989	35	20	2.9	2.2
			В	7.846200	1550.438	0.4954	125	75	5.9	6.8
Additional	information: Л	FGV-5, Gaia								6.8
			EDR3 543	34831348413	276160, Tmag:	13.21, Tel	ff: – K,	Dist: 44		6.8
	A: Prominent		EDR3 543 act 2+2 q	34831348413 Juadruple sys		13.21, Tel	ff: – K,	Dist: 44		6.8
Comments .	A: Prominent Nearly-blen	ETVs; comp nded with TI	EDR3 543 act 2+2 q C 8729192	34831348413 uadruple sys 203;	276160, Tmag:	13.21, Tel ator for T	ff: – K, IC 4516	Dist: 44 60944;		6.8
Comments .	A: Prominent Nearly-blen A: Prominent	ETVs; comp nded with TI	EDR3 543 act 2+2 q C 8729192 act 2+2 q	34831348413 uadruple sys 203; uadruple sys	276160, Tmag: stem; Contamina	13.21, Tel ator for T	ff: – K, IC 4516	Dist: 44 60944;		6.8
Comments .	A: Prominent Nearly-blen A: Prominent	ETVs; comp nded with TI ETVs; comp	EDR3 543 act 2+2 q C 8729192 act 2+2 q	34831348413 uadruple sys 203; uadruple sys	276160, Tmag: stem; Contamina	13.21, Tel ator for T	ff: – K, IC 4516	Dist: 44 60944;		6.8
Comments . Comments .	A: Prominent Nearly-blen A: Prominent Nearly-blen	ETVs; comp aded with TI ETVs; comp aded with TI	EDR3 543 act 2+2 q C 8729192 act 2+2 q C 8729192	34831348413 uadruple sys 203; uadruple sys 203;	276160, Tmag: stem; Contamina stem; Contamina	13.21, Tel ator for T ator for T	ff: – K, TC 4516 TC 4516	Dist: 44 60944; 60944;	6.90 pc	5.5
Comments . Comments . 52856877	A: Prominent Nearly-blen A: Prominent <u>Nearly-blen</u> 17.334288	ETVs; comp aded with TI ETVs; comp aded with TI 61.041245	EDR3 54: act 2+2 q C 8729192 act 2+2 q C 8729192 A B	34831348413 uadruple sys 203; uadruple sys 203; 5.186818 18.586410	276160, Tmag: stem; Contamina stem; Contamina 1791.059 1812.5146	13.21, Tel ator for T ator for T 0.5001 0.3736	$\begin{array}{c} \text{ff:} -\text{K}, \\ \text{TC} \ 4516 \\ \text{TC} \ 4516 \\ \hline \\ \hline 220 \\ 200 \end{array}$	Dist: 44 50944; 50944; 90 55	6.90 pc 5.5 9.4	5.5
Comments . Comments . 52856877 Additional :	A: Prominent Nearly-blen A: Prominent Nearly-blen 17.334288 information: T	ETVs; comp aded with TI ETVs; comp aded with TI 61.041245	EDR3 54: act 2+2 q C 8729192 act 2+2 q C 8729192 A B	34831348413 uadruple sys 203; uadruple sys 203; 5.186818 18.586410	276160, Tmag: stem; Contamina stem; Contamina 1791.059	13.21, Tel ator for T ator for T 0.5001 0.3736	$\begin{array}{c} \text{ff:} -\text{K}, \\ \text{TC} \ 4516 \\ \text{TC} \ 4516 \\ \hline \\ \hline 220 \\ 200 \end{array}$	Dist: 44 50944; 50944; 90 55	6.90 pc 5.5 9.4	5.5 7.6
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Comments . Comments . 52856877 Additional : Comments . 63459761 Additional : Comments .	A: Prominent Nearly-blen A: Prominent <u>Nearly-blen</u> 17.334288 information: T A: – B: Prominent 308.525065 information: T A: heavily-blen B: Potential E	ETVs; comp nded with TI ETVs; comp nded with TI 61.041245 TGV-6, Gaia ETVs 41.135869 TGV-7, Gaia nded eclipses TVs; heavily	EDR3 54: act 2+2 q C 8729192 act 2+2 q C 8729192 A B EDR3 52: A EDR3 200 ; ephemer -blended 6 3459765 A	34831348413 uadruple sys 203; uadruple sys 203; 5.186818 18.586410 24501341139 4.244072 4.362293 67766791544 is might be seclipses; eph- 1.483742	276160, Tmag: stem; Contamina stem; Contamina 1791.059 1812.5146 50336, Tmag: 1 1715.1118 1683.8128 561920, Tmag: slightly off emeris might be 1493.5234	13.21, Ter ator for T ator for T 0.5001 0.3736 0.62, Teff 0.4846 0.6822 10.93, Ter	$\begin{array}{c} \text{ff:} & -\text{ K,} \\ \text{IC } 4516 \\ \text{IC } 4516 \\ \hline 220 \\ 200 \\ \text{: } 8886 \text{ I} \\ \hline 15 \\ 70 \\ \text{ff: } 3960 \\ \text{off;} \\ \hline 11 \end{array}$	Dist: 44 50944; 50944; 90 55 \$, Dist: 10 45	6.90 pc 5.5 9.4 847.17 p 7.0 6.7	5.5 7.6 9.2 8.9
Comments . Comments . 52856877 Additional : Comments . 63459761 Additional : Comments . Comments . 73296637	A: Prominent Nearly-blen A: Prominent <u>Nearly-blen</u> 17.334288 information: T A: – B: Prominent 308.525065 information: T A: heavily-blen B: Potential E False positi 121.017527	ETVs; comp aded with TI ETVs; comp aded with TI 61.041245 CGV-6, Gaia ETVs 41.135869 CGV-7, Gaia aded eclipses TVs; heavily ive for TIC 6 -3.380218	EDR3 54: act 2+2 q C 8729192 act 2+2 q C 8729192 A B EDR3 52: A B EDR3 200 ; ephemer -blended o 3459765 A B	34831348413 uadruple sys 203; uadruple sys 203; 5.186818 18.586410 24501341139 4.244072 4.362293 67766791544 is might be seclipses; ephe 1.483742 1.844061	276160, Tmag: stem; Contamina stem; Contamina 1791.059 1812.5146 50336, Tmag: 1 1715.1118 1683.8128 561920, Tmag: slightly off emeris might be 1493.5234 1494.0154	13.21, Ter ator for T ator for T 0.5001 0.3736 0.62, Teff 0.4846 0.6822 10.93, Ter slightly c - -	$\begin{array}{r} \text{ff:} & -\text{ K,} \\ \text{IC } 4516 \\ \hline \\ \text{IC } 4516 \\ \hline \\ 220 \\ 200 \\ \text{: } 8886 \\ \text{I} \\ \hline \\ 15 \\ 70 \\ \text{ff: } 3960 \\ \hline \\ \text{off;} \\ \hline \\ 11 \\ 27 \end{array}$	Dist: 44 50944; 50944; 90 55 5, Dist: 10 45 K, Dist - _	6.90 pc 5.5 9.4 847.17 p 7.0 6.7 : 2005.35 - -	5.5 7.6 c 9.2 8.6 pc
Comments Comments 52856877 Additional Comments Comments Comments Comments Comments T3296637 Additional Comments Comm	A: Prominent Nearly-blen A: Prominent Nearly-blen 17.334288 information: T A: – B: Prominent 308.525065 information: T A: heavily-blen B: Potential E False positi 121.017527 information: T	ETVs; comp inded with TI ETVs; comp inded with TI 61.041245 CGV-6, Gaia ETVs 41.135869 CGV-7, Gaia inded eclipses TVs; heavily ive for TIC 6 -3.380218 CGV-8, Gaia	EDR3 54: act 2+2 q C 8729192 act 2+2 q C 8729192 A B EDR3 52: A B EDR3 200 ; ephemer -blended o 3459765 A B EDR3 300	34831348413 uadruple sys 203; uadruple sys 203; 5.186818 18.586410 24501341139 4.244072 4.362293 67766791544 is might be s eclipses; ephe 1.483742 1.844061 69066742193	276160, Tmag: stem; Contamina stem; Contamina 1791.059 1812.5146 50336, Tmag: 1 1715.1118 1683.8128 561920, Tmag: slightly off emeris might be 1493.5234 1494.0154 077760, Tmag:	13.21, Ter ator for T 0.5001 0.3736 0.62, Teff 0.4846 0.6822 10.93, Ter - slightly c	$\begin{array}{r} \text{ff:} & -\text{ K,} \\ \text{IC } 4516 \\ \hline \\ \text{IC } 4516 \\ \hline \\ 220 \\ 200 \\ \text{: } 8886 \\ \text{I} \\ \hline \\ 15 \\ 70 \\ \text{ff: } 3960 \\ \hline \\ \text{off;} \\ \hline \\ 11 \\ 27 \end{array}$	Dist: 44 50944; 50944; 90 55 5, Dist: 10 45 K, Dist - _	6.90 pc 5.5 9.4 847.17 p 7.0 6.7 : 2005.35 - -	5.5 7.6 c 9.2 8.6 pc
Comments - Comments - 52856877 Additional = Comments - Comments - Comments - Comments - 73296637 Additional = Comments -	A: Prominent Nearly-blen A: Prominent Nearly-blen 17.334288 information: T A: – B: Prominent 308.525065 information: T A: heavily-blen B: Potential E False positi 121.017527 information: T A: Potential E	ETVs; comp ided with TI ETVs; comp ided with TI 61.041245 CGV-6, Gaia ETVs 41.135869 CGV-7, Gaia ided eclipses TVs; heavily ive for TIC 6 -3.380218 CGV-8, Gaia CGV-8, Gaia	EDR3 54: act 2+2 q C 8729192 act 2+2 q C 8729192 A B EDR3 52: A B EDR3 200 ; ephemer -blended o 3459765 A B EDR3 300	34831348413 uadruple sys 203; uadruple sys 203; 5.186818 18.586410 24501341139 4.244072 4.362293 67766791544 is might be s eclipses; ephe 1.483742 1.844061 69066742193	276160, Tmag: stem; Contamina stem; Contamina 1791.059 1812.5146 50336, Tmag: 1 1715.1118 1683.8128 561920, Tmag: slightly off emeris might be 1493.5234 1494.0154	13.21, Ter ator for T 0.5001 0.3736 0.62, Teff 0.4846 0.6822 10.93, Ter - slightly c	$\begin{array}{r} \text{ff:} & -\text{ K,} \\ \text{IC } 4516 \\ \hline \\ \text{IC } 4516 \\ \hline \\ 220 \\ 200 \\ \text{: } 8886 \\ \text{I} \\ \hline \\ 15 \\ 70 \\ \text{ff: } 3960 \\ \hline \\ \text{off;} \\ \hline \\ 11 \\ 27 \end{array}$	Dist: 44 50944; 50944; 90 55 5, Dist: 10 45 K, Dist - _	6.90 pc 5.5 9.4 847.17 p 7.0 6.7 : 2005.35 - -	5.5 7.6 c 9.2 8.9 p pc
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$$\label{eq:test} \begin{split} \text{TGV-N} &= \text{TESS}/\text{Goddard}/\text{VSG} \text{ quadruple candidate -N, } \text{Phase}_s = \text{Secondary phase}, \ \text{Dep}_n = \text{Depth of eclipse } n, \\ \text{Dur}_n &= \text{Duration of eclipse } n, \ \text{Teff} = \text{Composite effective temperature, } \text{ppt} = \text{parts-per-thousand} \end{split}$$

TIC ID	RA	Dec	Binary	Period	T_0	$Phase_s$	Dep_p	Dep_s	Dur_p	Dur_s
-	degrees	degrees	-	d	BJD-2457000	-	ppt	ppt	hr	hr
			В	0.986341	1520.8984	0.5067	81	26	2.5	2.0
Additional i	information: T	GV-9, Gaia	EDR3 54	23787166437	660032, Tmag:	12.40, Te	ff: -K,	Dist: 78	30.64 pc	
Comments A	A: heavily-ble	nded eclipses								
Comments I	B: heavily-bler	nded eclipses								
78568780	102.848953	-22.167204	А	2.88838	1468.5374	0.4935	57	20	3.9	3.7
			В	23.903000	1500.8335	—	37	_	_	_
Additional i	information: T	GV-10, Gaia	EDR3 2	92587964501	7239552, Tmag:	11.05, T	eff: 719	9 K, Dis	t: 2777.2	22 pc
Comments A	A: –									
Comments I	B: Period migl	ht be an integ	ger of the	listed value						
79140936	103.846452	-22.623862	А	3.54389	1468.3795	0.3969	23	7	3.7	3.4
			В	30.913745	1479.6195	0.6070	400	325	11.5	13.0
Additional i	information: T	GV-11, Gaia	EDR3 2	92278228639	9030912, Tmag:	10.90, T	eff: 902	2 K, Dis	t: 1084.7	70 pc
Comments A		,			, 0	,		,		-
Comments 1	B: –									
80914862	106.116464	-20.563763	А	1.967319	1492.6062	_	95	_	_	_
			В	18.666628	1495.0672	_	158	_	_	_
Additional i	information: T	GV-12, Gaia	EDR3 2		2142336, Tmag:	12.20, T		6 K. Dis	t: 2443.3	33 pc
Comments A		,			, 0	,		,		1
		ht be half of t	the listed	value						
Comments	D: Ferioù imei									
				2.417501	1522.0949	_	15	_	_	_
82818966	124.931906	-47.096644	А	2.417501 4.930024	1522.0949 1521.5166	-0.3652	$\frac{15}{25}$	- 10	2.7	2.5
82818966	124.931906	-47.096644	A B	4.930024	1521.5166	– 0.3652 13.63 T	25	- 10 1 K Dis	- 2.7 t: 1533 2	– 2.5 25 nc
82818966 Additional i	124.931906 information: T	-47.096644 TGV-13, Gaia	A B EDR3 5	4.930024 51663803718	1521.5166 4056960, Tmag:	13.63, T	25	-		
82818966 Additional i Comments A	124.931906 information: T A: False positi	-47.096644 TGV-13, Gaia	A B EDR3 5	4.930024 51663803718	1521.5166	13.63, T	25	-		
82818966 Additional i Comments I	124.931906 information: T A: False positi B: –	-47.096644 CGV-13, Gaia ve for 828189	A B EDR3 5 75; low S	4.930024 51663803718 NR; epheme	1521.5166 4056960, Tmag: ris might be slig	13.63, T ghtly off	25 leff: 823	1 K, Dis	t: 1533.2	25 pc
82818966 Additional i Comments A	124.931906 information: T A: False positi	-47.096644 TGV-13, Gaia	A B EDR3 54 75; low S A	4.930024 51663803718 NR; epheme 2.557052	1521.5166 4056960, Tmag: ris might be slig 1684.2273	13.63, T ghtly off 0.5008	25 leff: 823 53	1 K, Dis 32	t: 1533.2	25 pc 4.6
82818966 Additional i Comments 1 Comments 1 89278612	124.931906 information: T A: False positi B: – 301.219498	-47.096644 CGV-13, Gaia ve for 828189 32.643051	A B EDR3 5 75; low S A B	4.930024 51663803718 NR; epheme 2.557052 3.641763	1521.5166 4056960, Tmag: pris might be slig 1684.2273 1685.1175	13.63, T ghtly off 0.5008 0.4547	25 leff: 823 53 111	1 K, Dis 32 60	t: 1533.2 4.5 5.8	25 pc 4.6 5.9
82818966 Additional i Comments 2 Comments 1 89278612 Additional i	124.931906 information: T A: False positi B: – 301.219498 information: T	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia	A B EDR3 5 75; low S A B	4.930024 51663803718 NR; epheme 2.557052 3.641763	1521.5166 4056960, Tmag: ris might be slig 1684.2273	13.63, T ghtly off 0.5008 0.4547	25 leff: 823 53 111	1 K, Dis 32 60	t: 1533.2 4.5 5.8	25 pc 4.6 5.9
82818966 Additional i Comments 1 89278612 Additional i Comments 4	124.931906 information: T A: False positi B: – 301.219498 information: T A: Potential E	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia	A B EDR3 5 75; low S A B	4.930024 51663803718 NR; epheme 2.557052 3.641763	1521.5166 4056960, Tmag: pris might be slig 1684.2273 1685.1175	13.63, T ghtly off 0.5008 0.4547	25 leff: 823 53 111	1 K, Dis 32 60	t: 1533.2 4.5 5.8	25 pc 4.6 5.9
82818966 Additional i Comments 1 89278612 Additional i Comments 1 Comments 1	124.931906 information: T A: False positi B: – 301.219498 information: T A: Potential E B: –	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs	A B EDR3 55 75; low S A B EDR3 20	4.930024 51663803718 NR; epheme 2.557052 3.641763 05512525970	1521.5166 4056960, Tmag: bris might be slig 1684.2273 1685.1175 7080832, Tmag:	13.63, T ghtly off 0.5008 0.4547 10.88, T	25 beff: 823 53 111 beff: 874	1 K, Dis 32 60 0 K, Dis	t: 1533.2 4.5 5.8 t: 20073	25 pc 4.6 5.9 .90 pc
82818966 Additional i Comments 1 89278612 Additional i Comments 4	124.931906 information: T A: False positi B: – 301.219498 information: T A: Potential E	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia	A B EDR3 5 75; low S A B EDR3 2 A	4.930024 51663803718 NR; epheme 2.557052 3.641763 05512525970 2.36543	1521.5166 4056960, Tmag: pris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123	13.63, T ghtly off 0.5008 0.4547	25 heff: 823 53 111 heff: 874 150	1 K, Dis 32 60	t: 1533.2 4.5 5.8	25 pc 4.6 5.9
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255	124.931906 information: T A: False positi B: – 301.219498 information: T A: Potential E B: – 136.380566	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331	A B EDR3 55 75; low S A B EDR3 20 A B	4.930024 51663803718 NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586	1521.5166 4056960, Tmag: ris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123 1518.7943	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 -	25 eeff: 823 53 111 eeff: 874 150 40	1 K, Dis 32 60 0 K, Dis 120 –	t: 1533.2 4.5 5.8 t: 20073 2.5 -	25 pc 4.6 5.9 .90 pc 2.5 –
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255 Additional i	124.931906 information: T A: False positi B: – 301.219498 information: T A: Potential E B: – 136.380566 information: T	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331	A B EDR3 55 75; low S A B EDR3 20 A B	4.930024 51663803718 NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586	1521.5166 4056960, Tmag: pris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 -	25 eeff: 823 53 111 eeff: 874 150 40	1 K, Dis 32 60 0 K, Dis 120 –	t: 1533.2 4.5 5.8 t: 20073 2.5 -	25 pc 4.6 5.9 .90 pc 2.5 –
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255 Additional i Comments 4	124.931906 information: T A: False positi B: – 301.219498 information: T A: Potential E B: – 136.380566 information: T A: –	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331	A B EDR3 55 75; low S A B EDR3 20 A B	4.930024 51663803718 NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586	1521.5166 4056960, Tmag: ris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123 1518.7943	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 -	25 eeff: 823 53 111 eeff: 874 150 40	1 K, Dis 32 60 0 K, Dis 120 –	t: 1533.2 4.5 5.8 t: 20073 2.5 -	25 pc 4.6 5.9 .90 pc 2.5 –
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255 Additional i Comments 2 Comments 1	124.931906 information: T A: False positi B: – 301.219498 information: T A: Potential E B: – 136.380566 information: T A: – B: –	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331 CGV-15, Gaia	A B EDR3 55 75; low S A B EDR3 20 A B EDR3 5	4.930024 51663803718 NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586 74332606745	1521.5166 4056960, Tmag: pris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123 1518.7943 7954944, Tmag:	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 - 13.39, T	25 beff: 823 53 111 beff: 874 150 40 beff: 431	1 K, Dis 32 60 0 K, Dis 120 6 K, Dis	t: 1533.2 4.5 5.8 t: 20073 2.5 - t: 391.73	25 pc 4.6 5.9 .90 pc 2.5 - 3 pc
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255 Additional i Comments 4	124.931906 information: T A: False positi B: – 301.219498 information: T A: Potential E B: – 136.380566 information: T A: –	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331	A B EDR3 54 75; low S A B EDR3 24 A B EDR3 57 A	4.930024 51663803718 5NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586 74332606745 1.533535	1521.5166 4056960, Tmag: bris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123 1518.7943 7954944, Tmag: 1494.5954	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 - 13.39, T 0.5009	25 eff: 823 53 111 eff: 874 40 eff: 431 150 40 15	1 K, Dis 32 60 0 K, Dis 120 - 6 K, Dis 5	t: 1533.2 4.5 5.8 t: 20073 2.5 - t: 391.73 4.0	25 pc 4.6 5.9 .90 pc 2.5 - 3 pc 4.0
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255 Additional i Comments 1 97356407	124.931906 information: T A: False positi B: - 301.219498 information: T A: Potential E B: - 136.380566 information: T A: - B: - 106.502031	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331 CGV-15, Gaia -30.655710	A B EDR3 55 75; low S A EDR3 20 A B EDR3 5 A B	4.930024 51663803718 NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586 74332606745 1.533535 8.098533	1521.5166 4056960, Tmag: bris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123 1518.7943 7954944, Tmag: 1494.5954 1493.0889	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 - 13.39, T 0.5009 0.6567	25 eff: 823 53 111 eff: 874 150 40 eff: 431 15 140	1 K, Dis 32 60 0 K, Dis 120 - 6 K, Dis 5 20	t: 1533.2 4.5 5.8 t: 20073 2.5 - t: 391.73 4.0 7.7	25 pc 4.6 5.9 .90 pc 2.5 - 3 pc
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255 Additional i Comments 1 97356407 Additional i	124.931906 information: T A: False positi B: - 301.219498 information: T A: Potential E B: - 136.380566 information: T A: - B: - 106.502031 information: T	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331 CGV-15, Gaia -30.655710 CGV-16, Gaia	A B EDR3 55 75; low S A B EDR3 20 A B EDR3 57 A B EDR3 50	4.930024 51663803718 5NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586 74332606745 1.533535 8.098533 60468603497	1521.5166 4056960, Tmag: bris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123 1518.7943 7954944, Tmag: 1494.5954 1493.0889 6764928, Tmag:	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 - 13.39, T 0.5009 0.6567 6.46, Te	25 eff: 823 53 111 eff: 874 150 40 eff: 431 15 140 ff: - K,	1 K, Dis 32 60 0 K, Dis 120 - 6 K, Dis 5 20 Dist: 30	t: 1533.2 4.5 5.8 t: 20073 2.5 - t: 391.73 4.0 7.7	25 pc 4.6 5.9 .90 pc 2.5 - 3 pc 4.0
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255 Additional i Comments 1 97356407 Additional i Comments 4	124.931906 information: T A: False positi B: - 301.219498 information: T A: Potential E B: - 136.380566 information: T A: - B: - 106.502031 information: T A: Coherent I	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331 CGV-15, Gaia -30.655710 CGV-16, Gaia	A B EDR3 55 75; low S A B EDR3 20 A B EDR3 57 A B EDR3 50	4.930024 51663803718 5NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586 74332606745 1.533535 8.098533 60468603497	1521.5166 4056960, Tmag: bris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123 1518.7943 7954944, Tmag: 1494.5954 1493.0889	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 - 13.39, T 0.5009 0.6567 6.46, Te	25 eff: 823 53 111 eff: 874 150 40 eff: 431 15 140 ff: - K,	1 K, Dis 32 60 0 K, Dis 120 - 6 K, Dis 5 20 Dist: 30	t: 1533.2 4.5 5.8 t: 20073 2.5 - t: 391.73 4.0 7.7	25 pc 4.6 5.9 .90 pc 2.5 - 3 pc 4.0
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255 Additional i Comments 1 97356407 Additional i Comments 2 Comments 1	124.931906 information: T A: False positi B: - 301.219498 information: T A: Potential E B: - 136.380566 information: T A: - B: - 106.502031 information: T A: Coherent li B: -	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331 CGV-15, Gaia -30.655710 CGV-16, Gaia ghtcurve mod	A B EDR3 54 75; low S A B EDR3 24 A B EDR3 5 A B EDR3 5 A B EDR3 5	4.930024 51663803718 5NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586 74332606745 1.533535 8.098533 60468603497 (likely spots)	1521.5166 4056960, Tmag: ris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123 1518.7943 7954944, Tmag: 1494.5954 1493.0889 6764928, Tmag:) with a period	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 - 13.39, T 0.5009 0.6567 6.46, Te of about	25 eff: 823 53 111 eff: 874 150 40 eff: 431 15 140 ff: - K, 1.2 days	1 K, Dis 32 60 0 K, Dis 120 - 6 K, Dis 5 20 Dist: 30	t: 1533.2 4.5 5.8 t: 20073 2.5 - t: 391.73 4.0 7.7	25 pc 4.6 5.9 .90 pc 2.5 - 3 pc 4.0
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255 Additional i Comments 1 97356407 Additional i Comments 4	124.931906 information: T A: False positi B: - 301.219498 information: T A: Potential E B: - 136.380566 information: T A: - B: - 106.502031 information: T A: Coherent I	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331 CGV-15, Gaia -30.655710 CGV-16, Gaia	A B EDR3 54 75; low S A B EDR3 20 A B EDR3 5 A B EDR3 5 A lulations A	4.930024 51663803718 5NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586 74332606745 1.533535 8.098533 60468603497 (likely spots) 1.730707	1521.5166 4056960, Tmag: bris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123 1518.7943 7954944, Tmag: 1494.5954 1493.0889 6764928, Tmag:) with a period of 1685.852	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 - 13.39, T 0.5009 0.6567 6.46, Te	25 eff: 823 53 111 eff: 874 150 40 eff: 431 15 140 ff: - K, 1.2 days 35	1 K, Dis 32 60 0 K, Dis 120 - 6 K, Dis 5 20 Dist: 30	t: 1533.2 4.5 5.8 t: 20073 2.5 - t: 391.73 4.0 7.7	25 pc 4.6 5.9 .90 pc 2.5 - 3 pc 4.0
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255 Additional i Comments 1 97356407 Additional i Comments 1 97356407 Additional i Comments 1 123098844	124.931906 information: T A: False positi B: - 301.219498 information: T A: Potential E B: - 136.380566 information: T A: - B: - 106.502031 information: T A: Coherent li B: - 279.572843	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331 CGV-15, Gaia -30.655710 CGV-16, Gaia ghtcurve mod 44.698600	A B EDR3 54 V75; low S A B EDR3 20 A B EDR3 50 A B EDR3 50 A B EDR3 50 A B	4.930024 51663803718 5NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586 74332606745 1.533535 8.098533 60468603497 (likely spots) 1.730707 11.210254	1521.5166 4056960, Tmag: bris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123 1518.7943 7954944, Tmag: 1494.5954 1493.0889 6764928, Tmag:) with a period 1685.852 1685.345	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 - 13.39, T 0.5009 0.6567 6.46, Te of about	25 eff: 823 53 111 eff: 874 150 40 eff: 431 15 140 eff: - K, 1.2 days 35 83	1 K, Dis 32 60 0 K, Dis 120 - 6 K, Dis 5 20 Dist: 30 - -	t: 1533.2 4.5 5.8 t: 20073 2.5 - t: 391.73 4.0 7.7 00.37 pc - - -	25 pc 4.6 5.9 .90 pc 2.5 3 pc 4.0 7.7 - _
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255 Additional i Comments 1 97356407 Additional i Comments 1 97356407 Additional i Comments 1 123098844 Additional i	124.931906 information: T A: False positi B: $-$ 301.219498 information: T A: Potential E B: $-$ 136.380566 information: T A: $-$ B: $-$ 106.502031 information: T A: Coherent li B: $-$ 279.572843 information: T	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331 CGV-15, Gaia -30.655710 CGV-16, Gaia ghtcurve moo 44.698600 CGV-17, Gaia	A B EDR3 54 V75; low S A B EDR3 20 A B EDR3 50 A B EDR3 50 A B EDR3 50 A B	4.930024 51663803718 5NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586 74332606745 1.533535 8.098533 60468603497 (likely spots) 1.730707 11.210254	1521.5166 4056960, Tmag: bris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123 1518.7943 7954944, Tmag: 1494.5954 1493.0889 6764928, Tmag:) with a period of 1685.852	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 - 13.39, T 0.5009 0.6567 6.46, Te of about	25 eff: 823 53 111 eff: 874 150 40 eff: 431 15 140 eff: - K, 1.2 days 35 83	1 K, Dis 32 60 0 K, Dis 120 - 6 K, Dis 5 20 Dist: 30 - -	t: 1533.2 4.5 5.8 t: 20073 2.5 - t: 391.73 4.0 7.7 00.37 pc - - -	25 pc 4.6 5.9 .90 pc 2.5 3 pc 4.0 7.7 - _
82818966 Additional i Comments 1 89278612 Additional i Comments 1 95928255 Additional i Comments 1 97356407 Additional i Comments 1 97356407 Additional i Comments 1 123098844 Additional i	124.931906 information: T A: False positi B: $-$ 301.219498 information: T A: Potential E B: $-$ 136.380566 information: T A: $-$ B: $-$ 106.502031 information: T A: Coherent li B: $-$ 279.572843 information: T A: Ellipsoidal	-47.096644 CGV-13, Gaia ve for 828189 32.643051 CGV-14, Gaia TVs -10.058331 CGV-15, Gaia -30.655710 CGV-16, Gaia ghtcurve moo 44.698600 CGV-17, Gaia	A B EDR3 54 V75; low S A B EDR3 20 A B EDR3 50 A B EDR3 50 A B EDR3 50 A B	4.930024 51663803718 5NR; epheme 2.557052 3.641763 05512525970 2.36543 4.426586 74332606745 1.533535 8.098533 60468603497 (likely spots) 1.730707 11.210254	1521.5166 4056960, Tmag: bris might be slig 1684.2273 1685.1175 7080832, Tmag: 1518.123 1518.7943 7954944, Tmag: 1494.5954 1493.0889 6764928, Tmag:) with a period 1685.852 1685.345	13.63, T ghtly off 0.5008 0.4547 10.88, T 0.5003 - 13.39, T 0.5009 0.6567 6.46, Te of about	25 eff: 823 53 111 eff: 874 150 40 eff: 431 15 140 eff: - K, 1.2 days 35 83	1 K, Dis 32 60 0 K, Dis 120 - 6 K, Dis 5 20 Dist: 30 - -	t: 1533.2 4.5 5.8 t: 20073 2.5 - t: 391.73 4.0 7.7 00.37 pc - - -	25 pc 4.6 5.9 .90 pc 2.5 3 pc 4.0 7.7 - _

$$\label{eq:test} \begin{split} \text{TGV-N} &= \text{TESS/Goddard/VSG} \text{ quadruple candidate -N, } \text{Phase}_s = \text{Secondary phase}, \ \text{Dep}_n = \text{Depth of eclipse } n, \\ \text{Dur}_n &= \text{Duration of eclipse } n, \ \text{Teff} = \text{Composite effective temperature, } \text{ppt} = \text{parts-per-thousand} \end{split}$$

	RA	Dec	Binary	Period	Τ ₀	$Phase_s$	Dep_p	Dep_s	Dur_p	Dur
	degrees	degrees	-	d	BJD-2457000	-	ppt	ppt	hr	h
125952257	115.426817	-27.582624	А	2.161915	1492.877	0.6134	140	100	4.8	4.9
			В	2.898585	1494.5706	_	30	-	-	-
Additional is	nformation: T	GV-18, Gaia	EDR3 56	60020593741	7955968, Tmag:	11.36, T	eff: 9578	$8 \mathrm{K}, \mathrm{Dis}$	t: 2851.5	3 pc
Comments A	A: -									
Comments I	3: -									
130276377	119.825676	-28.378980	А	2.757776	1495.0112	0.4833	74	48	4.6	4.7
			В	6.457989	1497.1837	_	40	_	_	-
Additional is	nformation: T	GV-19, Gaia	EDR3 55	59779762468	7631232, Tmag:	11.93, T	eff: 1032	29 K, D	ist: 3549.	38 pc
Comments A	A: Potential E	TVs; "ringing	g" in fold	ed LC						
Comments I	B: Potential E	TVs								
139650665	65.602471	-18.916383	А	2.091887	1439.7823	0.4992	110	31	3.4	3.0
			В	10.631474	1438.907	_	30	_	_	-
Additional is	nformation: T	GV-20, Gaia	EDR3 50)9239336538	1610880, Tmag:	10.74, T	eff: 5515	5 K, Dis	t: 257.83	\mathbf{pc}
Comments A	A: -									
Comments I	B: S32 data lo	w SNR; ephe	meris mig	ht be slight	y off					
139944266	127.035827	-44.334557	А	1.443586	1518.7658	-	10	_	_	-
			В	27.065312	1560.4232	_	45	_	—	-
Additional i	nformation: T	GV-21, Gaia	EDR3 55	52304970179	9164160, Tmag:	10.36, T	eff: – K	Dist: 1	.041.59 p	с
Comments A					, 0				-	
Comments I	3: –									
146810480	160.527028	-42.877977	А	0.544981	1545.7233	_	25	_	_	_
			В	0.734297	1544.2573	_	131	_	_	-
Additional i	nformation: T	GV-22. Gaia			3824768, Tmag:	8.67. Tet		K. Dist	: 368.84	oc
	A: heavily-bler					0.01, 10.		, בוגני		20
	B: heavily-bler		-	-						
161043618	223.425163	52.715848	A	1.350249	1744.7203	0.4995	75	20	4.0	4.0
101010010	220.120100	02.110010	В	1.488497	1739.1594	0.5029	50	20	2.6	1.0
			D				00			2.5
Additional i	nformation. T	'GV-23 Gaia	EDR3 1	59408240760			off· 5860			2.5 3 nc
		,			6370176, Tmag:	11.91, T				
Comments A	A: Ellipsoidal	variations; he	avily-bler	nded eclipses	6370176, Tmag: ; ephemeris mig	11.91, T				
Comments A Comments H	A: Ellipsoidal B: heavily-bler	variations; he nded eclipses;	avily-bler ephemeri	nded eclipses is might be s	6370176, Tmag: ; ephemeris mig slightly off	11.91, Teht be slig	htly off) K, Dis	t: 1822.5	3 pc
Comments A	A: Ellipsoidal	variations; he	avily-bler ephemeri A	nded eclipses is might be s 1.422857	6370176, Tmag: ; ephemeris mig slightly off 1493.1115	11.91, T	htly off 125			
Comments A Comments E 177810207	A: Ellipsoidal B: heavily-bler 106.524515	variations; he nded eclipses; -3.007379	avily-bler ephemer A B	nded eclipses is might be s 1.422857 1.737808	6370176, Tmag: ; ephemeris mig slightly off 1493.1115 1492.9002	11.91, Te ht be slig 0.5001 -	htly off 125 60	90 –	t: 1822.5	3 pc 3.3
Comments A Comments E 177810207 Additional in	A: Ellipsoidal B: heavily-bler 106.524515 nformation: T	variations; he nded eclipses; -3.007379 CGV-24, Gaia	avily-bler ephemer A B	nded eclipses is might be s 1.422857 1.737808	6370176, Tmag: ; ephemeris mig slightly off 1493.1115	11.91, Te ht be slig 0.5001 -	htly off 125 60	90 –	t: 1822.5	3 pc 3.3
Comments A Comments E 177810207 Additional in Comments A	A: Ellipsoidal B: heavily-bler 106.524515 nformation: T A: blended ecli	variations; he aded eclipses; -3.007379 CGV-24, Gaia ipses	avily-bler ephemer A B	nded eclipses is might be s 1.422857 1.737808	6370176, Tmag: ; ephemeris mig slightly off 1493.1115 1492.9002	11.91, Te ht be slig 0.5001 -	htly off 125 60	90 –	t: 1822.5	3 pc 3.3
Comments A Comments I 177810207 Additional in Comments A Comments I	A: Ellipsoidal B: heavily-bler 106.524515 nformation: T A: blended ecli B: blended ecli	variations; he nded eclipses; -3.007379 CGV-24, Gaia ipses ipses	avily-bler ephemeri A B EDR3 3	nded eclipses is might be s 1.422857 1.737808 10798498705	6370176, Tmag: ; ephemeris mig slightly off 1493.1115 1492.9002 3417728, Tmag:	11.91, Te ht be slig 0.5001 - 13.47, Te	htly off 125 60 eff: – K	90 K, Dis 90 - , Dist: 2	t: 1822.5 3.4 - 2485.24 p	3 pc 3.3 - c
Comments A Comments I 177810207 Additional in Comments A Comments I	A: Ellipsoidal B: heavily-bler 106.524515 nformation: T A: blended ecli	variations; he aded eclipses; -3.007379 CGV-24, Gaia ipses	avily-bler ephemeri A B EDR3 3 A	aded eclipses is might be s 1.422857 1.737808 10798498705 3.182144	6370176, Tmag: ; ephemeris mig slightly off 1493.1115 1492.9002 3417728, Tmag: 1438.3095	11.91, Te ht be slig 0.5001 - 13.47, Te 0.5001	htly off 125 60 eff: - K 40	90 K, Dis 90 - , Dist: 2 25	t: 1822.5 3.4 - 2485.24 p 2.2	3 pc 3.3 c 2.6
Comments A Comments E 177810207 Additional in Comments A Comments E 178953404	A: Ellipsoidal B: heavily-bler 106.524515 nformation: T A: blended ecli B: blended ecli 69.096433	variations; he aded eclipses; -3.007379 CGV-24, Gaia ipses ipses -25.587820	avily-bler ephemeri A B EDR3 3 A B	aded eclipses <u>is might be s</u> 1.422857 1.737808 10798498705 3.182144 28.005157	6370176, Tmag: ; ephemeris mig slightly off 1493.1115 1492.9002 3417728, Tmag: 1438.3095 1454.5725	11.91, Te ht be slig 0.5001 - 13.47, Te 0.5001 0.8268	htly off 125 60 eff: - K 40 110	90 - , Dist: 2 25 75	t: 1822.5 3.4 - 2485.24 p 2.2 5.9	3 pc 3.3 c 2.6 3.9
Comments A Comments E 177810207 Additional in Comments A Comments E 178953404 Additional in	A: Ellipsoidal B: heavily-bler 106.524515 nformation: T A: blended ecli B: blended ecli 69.096433 nformation: T	variations; he aded eclipses; -3.007379 CGV-24, Gaia ipses ipses -25.587820	avily-bler ephemeri A B EDR3 3 A B	aded eclipses <u>is might be s</u> 1.422857 1.737808 10798498705 3.182144 28.005157	6370176, Tmag: ; ephemeris mig slightly off 1493.1115 1492.9002 3417728, Tmag: 1438.3095	11.91, Te ht be slig 0.5001 - 13.47, Te 0.5001 0.8268	htly off 125 60 eff: - K 40 110	90 - , Dist: 2 25 75	t: 1822.5 3.4 - 2485.24 p 2.2 5.9	3 pc 3.3 c 2.6 3.9
Comments A Comments E 177810207 Additional in Comments A Comments E 178953404 Additional in Comments A	A: Ellipsoidal B: heavily-bler 106.524515 nformation: T A: blended ecli 69.096433 nformation: T A: -	variations; he nded eclipses; -3.007379 CGV-24, Gaia ipses ipses -25.587820 CGV-25, Gaia	A B EDR3 3 A B EDR3 48	aded eclipses is might be s 1.422857 1.737808 10798498705 3.182144 28.005157 39430232686	6370176, Tmag: ; ephemeris mig slightly off 1493.1115 1492.9002 3417728, Tmag: 1438.3095 1454.5725	11.91, Te ht be slig 0.5001 - 13.47, Te 0.5001 0.8268	htly off 125 60 eff: - K 40 110	90 - , Dist: 2 25 75	t: 1822.5 3.4 - 2485.24 p 2.2 5.9	3 pc 3.3 c 2.6 3.9
Comments A Comments E 177810207 Additional in Comments A Comments E 178953404 Additional in Comments A	A: Ellipsoidal B: heavily-bler 106.524515 nformation: T A: blended ecli B: blended ecli 69.096433 nformation: T	variations; he nded eclipses; -3.007379 CGV-24, Gaia ipses ipses -25.587820 CGV-25, Gaia	A B EDR3 3 A B EDR3 48	aded eclipses is might be s 1.422857 1.737808 10798498705 3.182144 28.005157 39430232686	6370176, Tmag: ; ephemeris mig slightly off 1493.1115 1492.9002 3417728, Tmag: 1438.3095 1454.5725	11.91, Te ht be slig 0.5001 - 13.47, Te 0.5001 0.8268	htly off 125 60 eff: - K 40 110	90 - , Dist: 2 25 75	t: 1822.5 3.4 - 2485.24 p 2.2 5.9	3 pc 3.3 c 2.6 3.9
Comments A Comments E 177810207 Additional in Comments A Comments E 178953404 Additional in Comments A	A: Ellipsoidal B: heavily-bler 106.524515 nformation: T A: blended ecli 69.096433 nformation: T A: -	variations; he nded eclipses; -3.007379 CGV-24, Gaia ipses ipses -25.587820 CGV-25, Gaia	A B EDR3 3 A B EDR3 48	aded eclipses is might be s 1.422857 1.737808 10798498705 3.182144 28.005157 39430232686	6370176, Tmag: ; ephemeris mig slightly off 1493.1115 1492.9002 3417728, Tmag: 1438.3095 1454.5725	11.91, Te ht be slig 0.5001 - 13.47, Te 0.5001 0.8268	htly off 125 60 eff: - K 40 110	90 - , Dist: 2 25 75	t: 1822.5 3.4 - 2485.24 p 2.2 5.9	3 pc 3.3 c 2.6 3.9
Comments A Comments F 177810207 Additional in Comments A Comments F 178953404 Additional in Comments A Comments F	A: Ellipsoidal B: heavily-bler 106.524515 nformation: T A: blended ecli B: blended ecli 69.096433 nformation: T A: - B: Period may	variations; he aded eclipses; -3.007379 CGV-24, Gaia ipses ipses -25.587820 CGV-25, Gaia be an intege	A B EDR3 3 A B EDR3 4 A EDR3 4 A r of the li	aded eclipses is might be s 1.422857 1.737808 10798498705 3.182144 28.005157 39430232686 sted value	6370176, Tmag: ; ephemeris mig slightly off 1493.1115 1492.9002 3417728, Tmag: 1438.3095 1454.5725 4856064, Tmag:	11.91, Te ht be slig 0.5001 - 13.47, Te 0.5001 0.8268	htly off 125 60 eff: - K 40 110 eff: 5393	90 - , Dist: 2 25 75	t: 1822.5 3.4 - 2485.24 p 2.2 5.9	3 pc 3.3 c 2.6 3.9
Comments A Comments F 177810207 Additional in Comments A Comments F 178953404 Additional in Comments A Comments F 190895730	A: Ellipsoidal B: heavily-bler 106.524515 nformation: T A: blended ecli B: blended ecli 69.096433 nformation: T A: - B: Period may 134.131178	variations; he aded eclipses; -3.007379 CGV-24, Gaia ipses ipses -25.587820 CGV-25, Gaia CGV-25, Gaia be an intege -40.236827	A B EDR3 3 A B EDR3 4 A B EDR3 4 A B B	aded eclipses is might be s 1.422857 1.737808 10798498705 3.182144 28.005157 39430232686 sted value 0.459147 0.658889	6370176, Tmag: ; ephemeris mig slightly off 1493.1115 1492.9002 3417728, Tmag: 1438.3095 1454.5725 4856064, Tmag: 1519.026	11.91, Te ht be slig 0.5001 - 13.47, Te 0.5001 0.8268 11.62, Te - -	htly off 125 60 eff: - K 40 110 eff: 5393 85 40	90 , Dist: 2 25 75 3 K, Dis	t: 1822.5 3.4 - 2485.24 p 2.2 5.9 t: 332.55 - -	3 pc 3. c 2. 3. pc

$$\label{eq:test} \begin{split} \text{TGV-N} &= \text{TESS}/\text{Goddard}/\text{VSG} \text{ quadruple candidate -N, } \text{Phase}_s = \text{Secondary phase}, \ \text{Dep}_n = \text{Depth of eclipse } n, \\ \text{Dur}_n &= \text{Duration of eclipse } n, \ \text{Teff} = \text{Composite effective temperature, } \text{ppt} = \text{parts-per-thousand} \end{split}$$

ID	RA	Γ

TIC ID	RA	Dec	Binary	Period	T ₀	$Phase_s$	Dep_p	Dep_s	Dur_p	Durs
-	degrees	degrees	-	d	BJD-2457000	-	ppt	ppt	hr	hr
Comments	B: heavily-ble	0	ephemeri				TT.	II.		
200094011	86.782967	0.298943	A	2.135567	1473.4704	0.5016	180	55	6.3	4.8
			В	2.437293	1475.0203	0.4993	230	60	8.7	6.3
Additional	information: 7	GV-27, Gaia	EDR3 32		8160512, Tmag:					
	A: heavily-ble					,	,		1	
	0	,	-	0	ephemeris migh	t be sligh	tly off			
201310151	4.111881	-58.141759	A	5.538208	1335.888	0.4655	59	52	2.7	2.6
			В	8.485997	1346.3409	0.6407	120	37	3.2	3.1
Additional	information: 7	GV-28, Gaia	EDR3 49	91840011705	1127424, Tmag:	14.29, T	eff: – K	, Dist: 9	959.11 pc	
Comments .	A: –									
Comments 2	B: -									
204698586	185.551846	-24.224846	А	0.84381	1571.127	0.5109	40	13	1.8	1.9
			В	11.006707	1575.2285	_	125	_	-	_
Additional	information: 7	GV-29, Gaia	EDR3 35	51283547631	3571072, Tmag:	10.84, T	eff: 6392	2 K, Dis	st: 557.44	pc
Comments .	A: –									
Comments	B: –									
207137124	43.702325	-56.810784	А	0.995134	1354.9037	0.4994	50	45	1.4	1.3
			В	32.155225	1379.1547	0.5011	180	30	6.8	6.0
Additional	information: 7	GV-30, Gaia	EDR3 47	72811430542	1574528, Tmag:	13.49, T	eff: 5451	1 K, Dis	st: 626.58	b pc
Comments	A: Period mig	ht be half of t	the quote	value; depth	n differences bet	ween sect	ors;			
	Potential a	psidal motion								
Comments 2	B: depth differ	rences betwee	n sectors;	secondary h	neavily-blended;	potential	apsidal	motion	L	
219469945	241.047908	43.030301	А	2.717596	1959.7065	0.5014	125	43	4.1	4.0
			В	14.965529	1957.7099	0.4821	80	20	6.3	7.3
Additional	information: 7	GV-31, Gaia	EDR3 13	38370827801	9279616, Tmag:	12.04, T	eff: 6323	3 K, Dis	st: 873.32	2 pc
Comments .	A: –									
Comments	B: Potential E	TVs; SB3 in	Kounkel (et al. (2021)						
232087348	30.996867	-70.737328	А	2.614296	1325.4831	0.4988	150	40	4.7	4.8
			В	9.648651	2050.0082	_	10	_	_	-
Additional	information: 7	GV-32, Gaia	EDR3 46	69317866347	8574464, Tmag:	12.32, T	eff: 6154	4 K, Dis	st: 899.26	\mathbf{pc}
Comments .	A: Ellipsoidal	variations								
Comments	B: heavily-ble	nded eclipses								
239872462	87.514177	34.417596	А	0.935825	1817.9507	0.5007	55	30	-	_
			В	2.961924	1819.4395	_	60	_	-	-
Additional	information: 7	ГGV-33, Gaia	EDR3 34	45450360132	4455040, Tmag:	11.14, T	eff: – K	, Dist: 1	1940.21 p	с
Comments	A: Ellipsoidal	variations								
Comments	B: heavily-ble	nded eclipses;	ephemeri	is might be s	slightly off					
250119205	221.669507	-53.195218	А	2.426677	1601.8218	0.4998	50	25	3.5	3.6
			В	5.097049	1601.5004	0.5002	80	40	4.6	4.8
Additional	information: 7	FGV-34, Gaia	EDR3 58	89476675179	2531328, Tmag:	10.25, T	eff: 9090	0 K, Dis	st: 671.86	i pc
Comments .	A: –									
Comments 2	B: –									
251757935	46.959379	54.066164	А	1.203606	1790.9094	_	110	_	_	_
			В	1.524962	1792.6865	0.4984	116	107	4.7	4.4

$$\label{eq:test} \begin{split} \text{TGV-N} &= \text{TESS/Goddard/VSG} \text{ quadruple candidate -N, } \text{Phase}_s = \text{Secondary phase}, \ \text{Dep}_n = \text{Depth of eclipse } n, \\ \text{Dur}_n &= \text{Duration of eclipse } n, \ \text{Teff} = \text{Composite effective temperature, } \text{ppt} = \text{parts-per-thousand} \end{split}$$

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TIC ID	RA	Dec	Binary	Period	T_0	$Phase_s$	Dep_p	Dep_s	Dur_p	Dur_s
-	degrees	degrees	-	d	BJD-2457000	-	ppt	ppt	hr	hr
			EDR3 4	47114998986	540672, Tmag:	11.51, Te	ff: 7736	K, Dist:	1665.22	\mathbf{pc}
	A: heavily-ble	-								
Comments I	B: heavily-bler	nded eclipses								
255532033	240.549599	-44.712993	А	4.173996	1629.2844	0.5638	140	130	7.0	7.7
			В	12.927714	1638.7287	-	80	-	-	-
Additional i	information: 7	GV-36, Gaia	EDR3 59	99130696508	3680128, Tmag	: 10.34, T	eff: 8685	5 K, Dist	t: 8414.3	6 pc
Comments A	A: –									
Comments I	B: –									
256158466	266.899180	-79.379329	А	5.774547	1627.0833	0.4966	131	128	3.1	3.4
			В	7.454373	1647.7103	0.5014	110	75	3.5	3.2
Additional i	information: T	GV-37, Gaia	EDR3 5	77645290969	6577152, Tmag	: 14.08, T	eff: 4505	5 K, Dist	t: 713.86	\mathbf{pc}
Comments A	A: Nearly-iden	tical primary	and seco	ndary eclips	es (secondary v	ery slightl	y offset	from ph	ase 0.5);	
	potential el	lipsoidal varia	ations; po	tential ETV	s; potential co-	noving qu	intuple	with TI	C 150875	56606
Comments I	B: –									
257776944	220.351703	-71.048111	А	1.225515	1627.1031	-	120	_	_	_
			В	3.304494	1632.8798	0.4985	38	20	_	-
Additional i	information: T	GV-38, Gaia	EDR3 5	79800388736	7982848, Tmag	9.42, Tet	ff: 9720	K, Dist:	993.91	pc
Comments A	A: –									-
Comments I	B: –									
Comments 1										
	63.922207	47.422198	А	2.446538	1819.2142	0.5001	230	190	6.0	5.9
260056937		47.422198				0.5001		190	6.0	5.9
260056937	63.922207		В	5.998071	1818.4123	_	25	-	-	-
260056937 Additional i	63.922207 information: 7	GV-39, Gaia	В	5.998071		_	25	-	-	-
260056937 Additional i Comments A	63.922207 information: T A: Ellipsoidal	GV-39, Gaia variations	В	5.998071	1818.4123	_	25	-	-	_
260056937 Additional i Comments A Comments I	63.922207 information: T A: Ellipsoidal B: heavily-ble	TGV-39, Gaia variations nded eclipses	B EDR3 2	5.998071 34153100062	1818.4123 678400, Tmag:	_	25 : 8030 F	-	-	_
260056937 Additional i Comments A	63.922207 information: T A: Ellipsoidal	GV-39, Gaia variations	B EDR3 23 A	5.998071 34153100062 1.697811	1818.4123 678400, Tmag: 1765.9711	_	25 : 8030 H 15	-	-	_
260056937 Additional i Comments I 264402353	63.922207 information: T A: Ellipsoidal B: heavily-bler 323.090421	CGV-39, Gaia variations nded eclipses 78.695151	B EDR3 23 A B	5.998071 34153100062 1.697811 8.096013	1818.4123 678400, Tmag: 1765.9711 1769.7168	_ 9.85, Teff _ _	25 : 8030 F 15 17	 X, Dist: 	- 742.95 p - -	
260056937 Additional i Comments 1 264402353 Additional i	63.922207 information: T A: Ellipsoidal B: heavily-bler 323.090421 information: T	CGV-39, Gaia variations aded eclipses 78.695151 CGV-40, Gaia	B EDR3 23 A B EDR3 23	5.998071 34153100062 1.697811 8.096013 28472159700	1818.4123 678400, Tmag: 1765.9711	_ 9.85, Teff _ _	25 : 8030 F 15 17	 X, Dist: 	- 742.95 p - -	
260056937 Additional i Comments I 264402353 Additional i Comments I	63.922207 information: T A: Ellipsoidal B: heavily-blen 323.090421 information: T A: Ellipsoidal	CGV-39, Gaia variations nded eclipses 78.695151 CGV-40, Gaia variations; see	B EDR3 23 A B EDR3 23	5.998071 34153100062 1.697811 8.096013 28472159700	1818.4123 678400, Tmag: 1765.9711 1769.7168	_ 9.85, Teff _ _	25 : 8030 F 15 17	 X, Dist: 	- 742.95 p - -	
260056937 Additional i Comments I 264402353 Additional i Comments I	63.922207 information: T A: Ellipsoidal B: heavily-blen 323.090421 information: T A: Ellipsoidal B: Potential E	TGV-39, Gaia variations <u>nded eclipses</u> 78.695151 TGV-40, Gaia variations; sec TVs	B EDR3 2 A B EDR3 2 condary u	5.998071 34153100062 1.697811 8.096013 28472159700 inclear	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag	_ 9.85, Teff _ _	25 : 8030 F 15 17 eff: 6358	 X, Dist: 	- 742.95 p - -	
260056937 Additional i Comments I 264402353 Additional i Comments I	63.922207 information: T A: Ellipsoidal B: heavily-blen 323.090421 information: T A: Ellipsoidal	CGV-39, Gaia variations nded eclipses 78.695151 CGV-40, Gaia variations; see	B EDR3 2 A B EDR3 2 condary u	5.998071 34153100062 1.697811 8.096013 28472159700 inclear 2.997813	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag 1766.3538	_ 9.85, Teff _ _	25 : 8030 F 15 17 eff: 6358 60	 X, Dist: 	- 742.95 p - -	
260056937 Additional i Comments I 264402353 Additional i Comments I 265274458	63.922207 information: T A: Ellipsoidal B: heavily-blen 323.090421 information: T A: Ellipsoidal B: Potential E 357.694256	CGV-39, Gaia variations aded eclipses 78.695151 CGV-40, Gaia variations; see TVs 73.156742	B EDR3 23 A B EDR3 23 condary u A B	5.998071 34153100062 1.697811 8.096013 28472159700 inclear 2.997813 57.333800	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag: 1766.3538 1781.2291	– 9.85, Teff – – : 11.65, T – –	25 : 8030 H 15 17 eff: 6358 60 265	– K, Dist: – 3 K, Dist – –	- 742.95 p - - : 1025.1	c
260056937 Additional i Comments I 264402353 Additional i Comments I 265274458 Additional i	63.922207 information: T A: Ellipsoidal B: heavily-blen 323.090421 information: T A: Ellipsoidal B: Potential E 357.694256 information: T	CGV-39, Gaia variations nded eclipses 78.695151 CGV-40, Gaia variations; sec TVs 73.156742 CGV-41, Gaia	B EDR3 23 A EDR3 23 condary 10 A B EDR3 23	5.998071 34153100062 1.697811 8.096013 28472159700 inclear 2.997813 57.333800	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag 1766.3538	– 9.85, Teff – – : 11.65, T – –	25 : 8030 H 15 17 eff: 6358 60 265	– K, Dist: – 3 K, Dist – –	- 742.95 p - - : 1025.1	c
260056937 Additional i Comments I 264402353 Additional i Comments I 265274458 Additional i Comments I	63.922207 information: T A: Ellipsoidal B: heavily-bler 323.090421 information: T A: Ellipsoidal B: Potential E 357.694256 information: T A: depth differ	CGV-39, Gaia variations <u>aded eclipses</u> 78.695151 CGV-40, Gaia variations; sec <u>TVs</u> 73.156742 CGV-41, Gaia rences betwee	B EDR3 23 A B EDR3 23 condary 0 A B EDR3 23 n sectors	5.998071 34153100062 1.697811 8.096013 28472159700 mclear 2.997813 57.333800 22810107750	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag: 1766.3538 1781.2291 1418240, Tmag:	- 9.85, Teff - : 11.65, T - - : 12.03, T	25 : 8030 H 15 17 eff: 6358 60 265 eff: 7972	- X, Dist: - - - - - - 2 K, Dist	- 742.95 p - - : 1025.1	c
260056937 Additional i Comments I 264402353 Additional i Comments I 265274458 Additional i Comments I	63.922207 information: T A: Ellipsoidal B: heavily-bler 323.090421 information: T A: Ellipsoidal B: Potential E 357.694256 information: T A: depth differ B: period may	CGV-39, Gaia variations aded eclipses 78.695151 CGV-40, Gaia variations; sec TVs 73.156742 CGV-41, Gaia rences betwees be an integer	B EDR3 23 A B EDR3 23 condary 0 A B EDR3 23 n sectors	5.998071 34153100062 1.697811 8.096013 28472159700 mclear 2.997813 57.333800 22810107750	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag: 1766.3538 1781.2291	- 9.85, Teff - : 11.65, T - - : 12.03, T	25 : 8030 H 15 17 eff: 6358 60 265 eff: 7972	- X, Dist: - - - - - - 2 K, Dist	- 742.95 p - - : 1025.1	c
260056937 Additional i Comments I 264402353 Additional i Comments I 265274458 Additional i Comments I Comments I	63.922207 information: T A: Ellipsoidal B: heavily-blen 323.090421 information: T A: Ellipsoidal B: Potential E 357.694256 information: T A: depth differ B: period may due to blen	CGV-39, Gaia variations nded eclipses 78.695151 CGV-40, Gaia variations; sec TVs 73.156742 CGV-41, Gaia rences betwee be an integer ided eclipses	B EDR3 23 A B EDR3 23 condary 0 A B EDR3 23 n sectors c of the li	5.998071 34153100062 1.697811 8.096013 28472159700 inclear 2.997813 57.333800 22810107750 sted value; r	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag: 1766.3538 1781.2291 1418240, Tmag: neasured depths	- 9.85, Teff - : 11.65, T - - : 12.03, T	25 : 8030 H 15 17 eff: 6358 60 265 eff: 7972 eff: 7972	- X, Dist: - - - - - - 2 K, Dist	- 742.95 p - - : 1025.1	c
260056937 Additional i Comments I 264402353 Additional i Comments I 265274458 Additional i Comments I	63.922207 information: T A: Ellipsoidal B: heavily-bler 323.090421 information: T A: Ellipsoidal B: Potential E 357.694256 information: T A: depth differ B: period may	CGV-39, Gaia variations aded eclipses 78.695151 CGV-40, Gaia variations; sec TVs 73.156742 CGV-41, Gaia rences betwees be an integer	B EDR3 23 A B EDR3 23 condary u A B EDR3 23 n sectors c of the li	5.998071 34153100062 1.697811 8.096013 28472159700 mclear 2.997813 57.333800 22810107750	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag: 1766.3538 1781.2291 1418240, Tmag:	- 9.85, Teff - : 11.65, T : 12.03, T s might be	25 : 8030 F 15 17 eff: 6358 60 265 eff: 7972 e slightly 40	- X, Dist: - - - - - - 2 K, Dist	- 742.95 p - - : 1025.1 - - : 827.91	c
260056937 Additional i Comments I 264402353 Additional i Comments I 265274458 Additional i Comments I 265274458 Additional i Comments I 266657256	63.922207 information: T A: Ellipsoidal B: heavily-bler 323.090421 information: T A: Ellipsoidal B: Potential E 357.694256 information: T A: depth differ B: period may due to blen 119.266500	CGV-39, Gaia variations <u>aded eclipses</u> 78.695151 CGV-40, Gaia variations; sec <u>TVs</u> 73.156742 CGV-41, Gaia rences betwee be an integer <u>ded eclipses</u> 4.186727	B EDR3 23 A B EDR3 22 condary u A B EDR3 22 condary u A B EDR3 22 condary u A B EDR3 23 Condary u	5.998071 34153100062 1.697811 8.096013 28472159700 inclear 2.997813 57.333800 22810107750 sted value; r 4.919396 6.870338	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag: 1766.3538 1781.2291 1418240, Tmag: neasured depths 1492.7016 1495.591	- 9.85, Teff - - : 11.65, T : 12.03, T s might be - 0.5222	25 : 8030 F 15 17 eff: 6358 60 265 eff: 7972 e slightly 40 50	- X, Dist: - - - - - - - 2 K, Dist y off - - - - - - - - - - - - -	- 742.95 p - - : 1025.1 - - : 827.91 - 2.0	c 0 pc
260056937 Additional i Comments I 264402353 Additional i Comments I 265274458 Additional i Comments I 266657256 Additional i	63.922207 information: T A: Ellipsoidal B: heavily-blen 323.090421 information: T A: Ellipsoidal B: Potential E 357.694256 information: T A: depth differ B: period may due to blen 119.266500 information: T	CGV-39, Gaia variations <u>aded eclipses</u> 78.695151 CGV-40, Gaia variations; sec <u>TVs</u> 73.156742 CGV-41, Gaia rences betwee be an integer <u>ded eclipses</u> 4.186727	B EDR3 23 A B EDR3 22 condary u A B EDR3 22 condary u A B EDR3 22 condary u A B EDR3 23 Condary u	5.998071 34153100062 1.697811 8.096013 28472159700 inclear 2.997813 57.333800 22810107750 sted value; r 4.919396 6.870338	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag: 1766.3538 1781.2291 1418240, Tmag: neasured depths 1492.7016	- 9.85, Teff - - : 11.65, T : 12.03, T s might be - 0.5222	25 : 8030 F 15 17 eff: 6358 60 265 eff: 7972 e slightly 40 50	- X, Dist: - - - - - - - 2 K, Dist y off - - - - - - - - - - - - -	- 742.95 p - - : 1025.1 - - : 827.91 - 2.0	c 0 pc
260056937 Additional i Comments I 264402353 Additional i Comments I 265274458 Additional i Comments I 266657256 Additional i Comments I	63.922207 information: T A: Ellipsoidal B: heavily-blen 323.090421 information: T A: Ellipsoidal B: Potential E 357.694256 information: T A: depth differ B: period may due to blen 119.266500 information: T A: –	CGV-39, Gaia variations <u>aded eclipses</u> 78.695151 CGV-40, Gaia variations; sec <u>TVs</u> 73.156742 CGV-41, Gaia rences betwee be an integer <u>ded eclipses</u> 4.186727	B EDR3 23 A B EDR3 22 condary u A B EDR3 22 condary u A B EDR3 22 condary u A B EDR3 23 Condary u	5.998071 34153100062 1.697811 8.096013 28472159700 inclear 2.997813 57.333800 22810107750 sted value; r 4.919396 6.870338	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag: 1766.3538 1781.2291 1418240, Tmag: neasured depths 1492.7016 1495.591	- 9.85, Teff - - : 11.65, T : 12.03, T s might be - 0.5222	25 : 8030 F 15 17 eff: 6358 60 265 eff: 7972 e slightly 40 50	- X, Dist: - - - - - - - 2 K, Dist y off - - - - - - - - - - - - -	- 742.95 p - - : 1025.1 - - : 827.91 - 2.0	c 0 pc
260056937 Additional i Comments I 264402353 Additional i Comments I 265274458 Additional i Comments I 266657256 Additional i	63.922207 information: T A: Ellipsoidal B: heavily-blen 323.090421 information: T A: Ellipsoidal B: Potential E 357.694256 information: T A: depth differ B: period may due to blen 119.266500 information: T A: –	CGV-39, Gaia variations <u>aded eclipses</u> 78.695151 CGV-40, Gaia variations; sec <u>TVs</u> 73.156742 CGV-41, Gaia rences betwee be an integer <u>ded eclipses</u> 4.186727	B EDR3 23 A B EDR3 22 condary u A B EDR3 22 condary u A B EDR3 22 condary u A B EDR3 23 Condary u	5.998071 34153100062 1.697811 8.096013 28472159700 inclear 2.997813 57.333800 22810107750 sted value; r 4.919396 6.870338	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag: 1766.3538 1781.2291 1418240, Tmag: neasured depths 1492.7016 1495.591	- 9.85, Teff - - : 11.65, T : 12.03, T s might be - 0.5222	25 : 8030 F 15 17 eff: 6358 60 265 eff: 7972 e slightly 40 50	- X, Dist: - - - - - - - 2 K, Dist y off - - - - - - - - - - - - -	- 742.95 p - - : 1025.1 - - : 827.91 - 2.0	c 0 pc
260056937 Additional i Comments I 264402353 Additional i Comments I 265274458 Additional i Comments I 266657256 Additional i Comments I	63.922207 information: T A: Ellipsoidal B: heavily-blen 323.090421 information: T A: Ellipsoidal B: Potential E 357.694256 information: T A: depth differ B: period may due to blen 119.266500 information: T A: –	CGV-39, Gaia variations <u>aded eclipses</u> 78.695151 CGV-40, Gaia variations; sec <u>TVs</u> 73.156742 CGV-41, Gaia rences betwee be an integer <u>ded eclipses</u> 4.186727	B EDR3 23 A B EDR3 22 condary u A B EDR3 22 condary u A B EDR3 22 condary u A B EDR3 23 Condary u	5.998071 34153100062 1.697811 8.096013 28472159700 inclear 2.997813 57.333800 22810107750 sted value; r 4.919396 6.870338	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag: 1766.3538 1781.2291 1418240, Tmag: neasured depths 1492.7016 1495.591	- 9.85, Teff - - : 11.65, T : 12.03, T s might be - 0.5222	25 : 8030 F 15 17 eff: 6358 60 265 eff: 7972 e slightly 40 50	- X, Dist: - - - - - - - 2 K, Dist y off - - - - - - - - - - - - -	- 742.95 p - - : 1025.1 - - : 827.91 - 2.0	c 0 pc
260056937 Additional i Comments I 264402353 Additional i Comments I 265274458 Additional i Comments I 266657256 Additional i Comments I 266657256	63.922207 information: T A: Ellipsoidal B: heavily-blen 323.090421 information: T A: Ellipsoidal B: Potential E 357.694256 information: T A: depth differ B: period may due to blen 119.266500 information: T A: – B: –	CGV-39, Gaia variations <u>aded eclipses</u> 78.695151 CGV-40, Gaia variations; sec <u>TVs</u> 73.156742 CGV-41, Gaia rences betwee be an integer <u>ded eclipses</u> 4.186727 CGV-42, Gaia	B EDR3 23 A B EDR3 22 condary u A B EDR3 22 condary u A B EDR3 23 condary u A B EDR3 23 condary u	5.998071 34153100062 1.697811 8.096013 28472159700 inclear 2.997813 57.333800 22810107750 sted value; r 4.919396 6.870338 09518406036	1818.4123 678400, Tmag: 1765.9711 1769.7168 3238272, Tmag: 1766.3538 1781.2291 1418240, Tmag: neasured depths 1492.7016 1495.591 0074368, Tmag:	- 9.85, Teff - - : 11.65, T : 11.65, T : 12.03, T : 12.03, T : 0.5222 : 13.17, T	25 : 8030 H 15 17 eff: 6358 60 265 eff: 7972 40 50 eff: 5514	- X, Dist: - - 3 K, Dist - 2 K, Dist y off - 44 4 K, Dist	- 742.95 p - - - : 1025.1 - - : 827.91 - : 827.91 - : 776.35	c 0 pc

TIC ID	RA	Dec	Binary	Period	T_0	Phase_s	Dep_p	Dep_s	Dur_p	Dur_s
-	degrees	degrees	-	d	BJD-2457000	-	ppt	ppt	hr	h
	momentum	dumps								
Comments	-	-	depths mi	ght be slight	tly off due to sys	stematics	at			
	momentum	dumps								
269811101	350.883799	60.886918	А	1.094351	1767.6151	0.5032	260	175	4.4	4.4
			В	1.660019	1778.8075	_	95	_	4.1	4.'
					3799424, Tmag:	13.30, T	eff: – K	, Dist: -	- pc	
	0	-		0	be slightly off					
			primary		olended; measur		ight be			
271186951	132.355842	-46.868040	А	1.731754	1520.1093	0.5026	80	45	5.4	3.5
			В	2.094425	1520.5993	0.5018	280	40	6.5	6.3
					2860032, Tmag:			$3 \mathrm{K}, \mathrm{Dis}$	t: 2230.7	72 pc
	e	-		0	e variability; pot	ential ET	Vs			
Comments	B: heavily-ble	nded eclipses;	promine	nt lightcurve	variability					
274791367	149.395501	-57.049303	А	1.207163	1544.2019	0.4998	110	100	4.9	4.
			В	14.311675	1551.6412	—	115	_	_	-
Additional	information: Л	GV-46, Gaia	1 EDR3 5	25951150495	3856640, Tmag:	10.97, T	eff: – K	, Dist: 3	8114.95 p	oc
Comments	A: Period mig	ht be half of	the listed	value; depth	n differences bet	ween sect	ors			
Comments	B: heavily-ble	nded eclipses								
278352276	307.503640	48.607056	А	12.403102	1686.0153	0.5986	125	100	8.7	9.
					1004 0740	0.9019	85	20	7.2	7.
			В	18.810761	1684.6749	0.3913	60	20	1.2	1
Additional	information: 7	GV-47, Gaia			1684.6749 3645952, Tmag:					
			1 EDR3 2	08374870846		10.00, T	eff: 7150	5 K, Dis	t: 754.23	3 pc
Comments	A: prominent	ETVs; promi	n EDR3 20 nent syste	08374870846 ematics betw	3645952, Tmag	10.00, T ondary pe	eff: 7150 eriod mi	5 K, Dis ght be s	t: 754.23 lightly d	3 pc
Comments	A: prominent	ETVs; promi	n EDR3 20 nent syste	08374870846 ematics betw	3645952, Tmag: veen sectors; sec	10.00, T ondary pe	eff: 7150 eriod mi	5 K, Dis ght be s	t: 754.23 lightly d	3 pc lifferen
Comments Comments	A: prominent B: prominent	ETVs; promi ETVs; promi	n EDR3 20 nent syste nent syste	08374870846 ematics betw ematics betw	3645952, Tmag: veen sectors; sec veen sectors; mea	10.00, T ondary pe asurement	eff: 7150 eriod mi ts might	5 K, Dis ght be s be slig	t: 754.23 lightly d htly off	3 pc lifferen 6.
Comments Comments 283940788	A: prominent B: prominent 8.851436	ETVs; promi ETVs; promi 62.901596	n EDR3 20 nent syste <u>nent syste</u> A B	08374870846 ematics betw ematics betw 0.876867 8.167894	3645952, Tmag: veen sectors; sec reen sectors; mes 1765.7469	10.00, T ondary pe asurement 0.4940 0.3044	eff: 7156 eriod mi ts might 30 165	5 K, Dis ght be s be slig 10 130	t: 754.23 lightly d htly off 6.5 6.6	3 pc lifferen 6.4 8.4
Comments Comments 283940788 Additional	A: prominent B: prominent 8.851436	ETVs; promi ETVs; promi 62.901596 CGV-48, Gaia	n EDR3 20 nent syste <u>nent syste</u> A B	08374870846 ematics betw ematics betw 0.876867 8.167894	3645952, Tmag: veen sectors; sec veen sectors; mei 1765.7469 1769.557	10.00, T ondary pe asurement 0.4940 0.3044	eff: 7156 eriod mi ts might 30 165	5 K, Dis ght be s be slig 10 130	t: 754.23 lightly d htly off 6.5 6.6	3 pc lifferen 6.4 8.4
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Comments Comments 283940788 Additional Comments 284814380 Additional Comments 285655079 Additional Comments 285681367 Additional Comments	A: prominent $\begin{bmatrix} B: & prominent \\ C: & p$	ETVs; promi ETVs; promi 62.901596 CGV-48, Gaia variations nded eclipses; 64.818018 CGV-49, Gaia -57.122535 CGV-50, Gaia 64.580199 CGV-51, Gaia	A EDR3 24 nent syste A B A EDR3 43 A EDR3 53 A EDR3 53 A EDR3 53 A EDR3 54	08374870846 ematics betw ematics betw 0.876867 8.167894 30724888397 1 ETVs 4.079268 4.986977 24420699465 2.456281 6.691905 88265765410 2.366008 3.970279	3645952, Tmag: veen sectors; sec reen sectors; mer 1765.7469 1769.557 553280, Tmag: 1796.4922 1799.1701 597184, Tmag: 1631.341 1627.9654 3107072, Tmag: 1791.9779 1791.6442	 10.00, T ondary person asurement 0.4940 0.3044 11.47, Te: 0.4998 0.2950 11.54, Te: 0.5153 0.4507 11.96, T 0.3457 0.2687 	eff: 7156 eriod mi 30 165 ff: 7384 175 70 ff: 8669 220 110 eff: 8463 135 130	6 K, Dis ght be s be sligj 10 130 K, Dist 128 37 K, Dist 200 97 3 K, Dis 4 200 97 3 K, Dis	t: 754.2 ; dightly d atly off 6.5 6.6 : 4917.7 ; 6.2 5.7 : 2573.12 7.5 5.8 t: 1701.5 4.4 5.4	3 pc lifferen 6. 8. 1 pc 6. 5. 2 pc 6. 7. 55 pc 4. 5.
Comments Comments 283940788 Additional Comments Comments Comments 285655079 Additional Comments Comments 285681367 Additional	A: prominent $\begin{bmatrix} B: & prominent \\ C: & p$	ETVs; promi ETVs; promi 62.901596 CGV-48, Gaia variations nded eclipses; 64.818018 CGV-49, Gaia -57.122535 CGV-50, Gaia 64.580199 CGV-51, Gaia	A EDR3 24 nent syste A B A EDR3 43 A EDR3 53 A EDR3 53 A EDR3 53 A EDR3 54	08374870846 ematics betw ematics betw 0.876867 8.167894 30724888397 1 ETVs 4.079268 4.986977 24420699465 2.456281 6.691905 88265765410 2.366008 3.970279	3645952, Tmag: veen sectors; sec reen sectors; mer 1765.7469 1769.557 553280, Tmag: 1796.4922 1799.1701 597184, Tmag: 1631.341 1627.9654 3107072, Tmag: 1791.9779 1791.6442	 10.00, T ondary person asurement 0.4940 0.3044 11.47, Te: 0.4998 0.2950 11.54, Te: 0.5153 0.4507 11.96, T 0.3457 0.2687 	eff: 7156 eriod mi 30 165 ff: 7384 175 70 ff: 8669 220 110 eff: 8463 135 130	6 K, Dis ght be s be sligj 10 130 K, Dist 128 37 K, Dist 200 97 3 K, Dis 4 200 97 3 K, Dis	t: 754.2 ; dightly d atly off 6.5 6.6 : 4917.7 ; 6.2 5.7 : 2573.12 7.5 5.8 t: 1701.5 4.4 5.4	3 pc lifferen 6. 8. 1 pc 6. 5. 2 pc 6. 7. 55 pc 4. 5.

$$\label{eq:test} \begin{split} \text{TGV-N} &= \text{TESS}/\text{Goddard}/\text{VSG} \text{ quadruple candidate -N, } \text{Phase}_s = \text{Secondary phase}, \ \text{Dep}_n = \text{Depth of eclipse } n, \\ \text{Dur}_n &= \text{Duration of eclipse } n, \ \text{Teff} = \text{Composite effective temperature, } \text{ppt} = \text{parts-per-thousand} \end{split}$$

TIC ID	$\mathbf{R}\mathbf{A}$	Dec	Binary	Period	T_0	$Phase_s$	Dep_p	Dep_s	Dur_p	Dur
-	degrees	degrees	-	d	BJD-2457000	-	ppt	ppt	hr	h
			В	4.128543	1818.6702	0.4151	200	200	9.9	10.
Additional	information: 7	GV-52, Gaia	EDR3 4	63122720055	223168, Tmag:	9.60, Teff	: 8693 I	K, Dist:	2234.99	\mathbf{pc}
Comments	A: heavily-ble	nded eclipses;	ephemer	is might be s	slightly off; pote	ential ETV	Vs			
Comments	B: -									
292318612	31.769613	42.338435	А	1.665448	1792.9663	_	130	_	_	
			В	1.733857	1792.3033	_	140	_	_	
Additional	information: T	GV-53. Gaia	EDR3 3		704704, Tmag:	13.25. Tei	ff: 3959	K. Dist:	296.69	рс
	A: potential E	,			, 0	,		,		1
Comments	-									
300446218	111.594902	-66.281066	А	5.557302	1659.78	0.4925	50	30	2.3	2.
000110210	111.001002	00.201000	В	7.862233	1662.1022	0.4913	85	60	3.1	2
Additional	information. T	CV 54 Caia			3812224, Tmag:					
					pths listed are f				00.87 pc	
Comments	-			; $\operatorname{III} \subset \mathbf{v} \mathbf{\Sigma}$; de	puis listed are i	of Sector	20 whe	le		
a .	-	are the deep			(1) (1) (1) (1)	a .	0.0 1			
Comments	-		,	; in CVZ ; dej	pths listed are f	or Sector	26 whei	re		
	=	are the deep								
306903715	98.004532	16.585394	А	4.86821	1471.9531	-	24	-	_	
			В	6.516885	1472.6149	—	32	_	—	
Additional	information: 7	GV-55, Gaia	EDR3 3	36940724249	0695168, Tmag:	13.36, T	eff: – K	, Dist: –	\mathbf{pc}	
C	Δ.									
Comments	A: -									
Comments										
		51.221643	A	2.492484	1766.5396	0.5002	70	38	3.3	3.
Comments	B: -	51.221643	A B	2.492484 4.742467	1766.5396 1766.2003	0.5002 0.4885	70 90	38 63	$3.3 \\ 4.1$	
Comments 307119043	<u>B: –</u> 14.827524		В	4.742467		0.4885	90	63	4.1	4
Comments 307119043 Additional	<u>B: –</u> 14.827524	FGV-56, Gaia	В	4.742467	1766.2003	0.4885	90	63	4.1	4
Comments 307119043 Additional Comments	B: – 14.827524 information: T A: potential E	TGV-56, Gaia TVs	В	4.742467	1766.2003	0.4885	90	63	4.1	4
Comments 307119043 Additional Comments	B: – 14.827524 information: T A: potential E B: blended ecl	TGV-56, Gaia TVs	В	4.742467 04537094094	1766.2003	0.4885	90 : 7815 I	63	4.1	4
Comments 307119043 Additional Comments Comments	B: – 14.827524 information: T A: potential E B: blended ecl	TGV-56, Gaia TVs ipses	B EDR3 4	4.742467 04537094094 1.401379	1766.2003 988800, Tmag: 1547.7899	0.4885	90 : 7815 F 75	63	4.1	4
Comments 307119043 Additional Comments Comments 309025182	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452	TGV-56, Gaia TVs ipses -27.707244	B EDR3 4 A B	4.742467 04537094094 1.401379 1.680424	1766.2003 988800, Tmag: 1547.7899 1548.1386	0.4885 9.77, Teff _ _	90 : 7815 F 75 114	63 K, Dist: 	4.1 468.08 p	4 oc
Comments 307119043 Additional Comments 309025182 Additional	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T	TGV-56, Gaia TVs ipses -27.707244 TGV-57, Gaia	B EDR3 4 A B	4.742467 04537094094 1.401379 1.680424	1766.2003 988800, Tmag: 1547.7899	0.4885 9.77, Teff _ _	90 : 7815 F 75 114	63 K, Dist: 	4.1 468.08 p	4 oc
Comments 307119043 Additional Comments 309025182 Additional Comments	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl	TGV-56, Gaia TVs ipses -27.707244 TGV-57, Gaia ipses	B EDR3 4 A B	4.742467 04537094094 1.401379 1.680424	1766.2003 988800, Tmag: 1547.7899 1548.1386	0.4885 9.77, Teff _ _	90 : 7815 F 75 114	63 K, Dist: 	4.1 468.08 p	4 oc
Comments 307119043 Additional Comments 309025182 Additional Comments Comments	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl B: blended ecl	TGV-56, Gaia TVs ipses -27.707244 TGV-57, Gaia ipses ipses	B EDR3 4 A B EDR3 5	4.742467 04537094094 1.401379 1.680424 46640327504	1766.2003 988800, Tmag: 1547.7899 1548.1386 5876096, Tmag:	0.4885 9.77, Teff - 10.87, T	90 : 7815 F 75 114 eff: 6828	63 K, Dist: - 8 K, Dis	4.1 468.08 p - - t: 825.89	4 oc) pc
Comments 307119043 Additional Comments 309025182 Additional Comments	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl	TGV-56, Gaia TVs ipses -27.707244 TGV-57, Gaia ipses ipses	B EDR3 4 A EDR3 5 A	4.742467 04537094094 1.401379 1.680424 46640327504 4.198947	1766.2003 988800, Tmag: 1547.7899 1548.1386 5876096, Tmag: 1819.386	0.4885 9.77, Teff _ _	90 : 7815 F 75 114 eff: 6829 40	63 K, Dist: 	4.1 468.08 p	4 oc) pc
Comments 307119043 Additional Comments 309025182 Additional Comments Comments 309262405	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl B: blended ecl 89.424588	TGV-56, Gaia TVs ipses -27.707244 TGV-57, Gaia ipses ipses 34.988493	B EDR3 44 B EDR3 54 A B	4.742467 04537094094 1.401379 1.680424 46640327504 4.198947 6.908918	1766.2003 988800, Tmag: 1547.7899 1548.1386 5876096, Tmag: 1819.386 1818.9338	0.4885 9.77, Teff - - 10.87, T 0.5003 -	90 : 7815 H 75 114 eff: 6823 40 35	63 K, Dist: - 8 K, Dis 30 -	$ \begin{array}{c} 4.1 \\ 468.08 \text{ p} \\ - \\ - \\ \text{t: } 825.89 \\ \hline 4.0 \\ - \\ \end{array} $	4) pc 5
Comments 307119043 Additional Comments 309025182 Additional Comments Comments 309262405 Additional	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl B: blended ecl 89.424588 information: T	TGV-56, Gaia TVs ipses -27.707244 TGV-57, Gaia ipses ipses 34.988493 TGV-58, Gaia	B EDR3 44 B EDR3 54 A B	4.742467 04537094094 1.401379 1.680424 46640327504 4.198947 6.908918	1766.2003 988800, Tmag: 1547.7899 1548.1386 5876096, Tmag: 1819.386	0.4885 9.77, Teff - - 10.87, T 0.5003 -	90 : 7815 H 75 114 eff: 6823 40 35	63 K, Dist: - 8 K, Dis 30 -	$ \begin{array}{c} 4.1 \\ 468.08 \text{ p} \\ - \\ - \\ \text{t: } 825.89 \\ \hline 4.0 \\ - \\ \end{array} $	4) pc 5
Comments 307119043 Additional Comments 309025182 Additional Comments 309262405 Additional Comments	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl 89.424588 information: T A: potential E	TGV-56, Gaia TVs ipses -27.707244 TGV-57, Gaia ipses ipses 34.988493 TGV-58, Gaia TVs	B EDR3 44 B EDR3 54 A B	4.742467 04537094094 1.401379 1.680424 46640327504 4.198947 6.908918	1766.2003 988800, Tmag: 1547.7899 1548.1386 5876096, Tmag: 1819.386 1818.9338	0.4885 9.77, Teff - - 10.87, T 0.5003 -	90 : 7815 H 75 114 eff: 6823 40 35	63 K, Dist: - 8 K, Dis - 30 -	$ \begin{array}{c} 4.1 \\ 468.08 \text{ p} \\ - \\ - \\ \text{t: } 825.89 \\ \hline 4.0 \\ - \\ \end{array} $	4) pc 5
Comments 307119043 Additional Comments 309025182 Additional Comments 309262405 Additional Comments Comments	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl 89.424588 information: T A: potential E B: blended ecl	TGV-56, Gaia TVs ipses -27.707244 TGV-57, Gaia ipses ipses 34.988493 TGV-58, Gaia TVs ipses	B EDR3 4 B EDR3 5 A B EDR3 3	4.742467 04537094094 1.401379 1.680424 46640327504 4.198947 6.908918 45196180102	1766.2003 988800, Tmag: 1547.7899 1548.1386 5876096, Tmag: 1819.386 1819.388 1818.9338 2167552, Tmag:	0.4885 9.77, Teff - - 10.87, Te 0.5003 - 13.03, Te	90 : 7815 F 75 114 eff: 6823 40 35 eff: 8210	63 K, Dist: - 8 K, Dis - 30 - 6 K, Dis	$ \begin{array}{c} 4.1 \\ 468.08 \\ p \\ - \\ t: 825.89 \\ \hline 4.0 \\ - \\ t: 3713.1 \\ \end{array} $	4) pc 5 15 pc
Comments 307119043 Additional Comments 309025182 Additional Comments 309262405 Additional Comments	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl 89.424588 information: T A: potential E B: blended ecl	TGV-56, Gaia TVs ipses -27.707244 TGV-57, Gaia ipses ipses 34.988493 TGV-58, Gaia TVs	B EDR3 44 B EDR3 54 B EDR3 34 A A	4.742467 04537094094 1.401379 1.680424 46640327504 4.198947 6.908918	1766.2003 988800, Tmag: 1547.7899 1548.1386 5876096, Tmag: 1819.386 1818.9338	0.4885 9.77, Teff - - 10.87, T 0.5003 -	90 : 7815 F 75 114 eff: 6828 40 35 eff: 8210 150	63 K, Dist: - 8 K, Dis - 30 -	$ \begin{array}{c} 4.1 \\ 468.08 \text{ p} \\ - \\ - \\ \text{t: } 825.89 \\ \hline 4.0 \\ - \\ \end{array} $	4) pc 5 15 pc
Comments 307119043 Additional Comments Comments Comments Comments 309262405 Additional Comments Comments Comments 311838200	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl 89.424588 information: T A: potential E B: blended ecl 181.861947	TGV-56, Gaia TVs ipses -27.707244 TGV-57, Gaia ipses 34.988493 TGV-58, Gaia TVs ipses -70.489362	B EDR3 4 B EDR3 5 A EDR3 3 A B	4.742467 04537094094 1.401379 1.680424 46640327504 4.198947 6.908918 45196180102 2.13397 2.496180	1766.2003 988800, Tmag: 1547.7899 1548.1386 5876096, Tmag: 1819.386 1818.9338 2167552, Tmag: 1604.3638 1604.849	0.4885 9.77, Teff - - 10.87, T 0.5003 - 13.03, T 0.4350 0.5043	90 : 7815 H 75 114 eff: 6823 40 35 eff: 8210 150 50	$ \begin{array}{r} 63 \\ K, Dist: \\ - \\ - \\ $	$ \begin{array}{c} 4.1 \\ 468.08 \\ p \\ - \\ - \\ t: 825.89 \\ \hline 4.0 \\ - \\ t: 3713.1 \\ \hline 4.7 \\ 6.1 \\ \end{array} $	4) pc 5 1.5 pc 4
Comments 307119043 Additional Comments Comments Comments Comments 309262405 Additional Comments Comments 311838200 Additional	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl B: blended ecl 89.424588 information: T A: potential E B: blended ecl 181.861947 information: T	TGV-56, Gaia TVs ipses -27.707244 TGV-57, Gaia ipses 34.988493 TGV-58, Gaia TVs ipses -70.489362 TGV-59, Gaia	B EDR3 4 B EDR3 5 A EDR3 3 A B	4.742467 04537094094 1.401379 1.680424 46640327504 4.198947 6.908918 45196180102 2.13397 2.496180	1766.2003 988800, Tmag: 1547.7899 1548.1386 5876096, Tmag: 1819.386 1818.9338 2167552, Tmag: 1604.3638	0.4885 9.77, Teff - - 10.87, T 0.5003 - 13.03, T 0.4350 0.5043	90 : 7815 H 75 114 eff: 6823 40 35 eff: 8210 150 50	$ \begin{array}{r} 63 \\ K, Dist: \\ - \\ - \\ $	$ \begin{array}{c} 4.1 \\ 468.08 \\ p \\ - \\ - \\ t: 825.89 \\ \hline 4.0 \\ - \\ t: 3713.1 \\ \hline 4.7 \\ 6.1 \\ \end{array} $	4) pc 5 1.5 pc 4
Comments 307119043 Additional Comments Comments Comments Comments 309262405 Additional Comments Comments 311838200 Additional	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl 89.424588 information: T A: potential E B: blended ecl 181.861947	TGV-56, Gaia TVs ipses -27.707244 TGV-57, Gaia ipses 34.988493 TGV-58, Gaia TVs ipses -70.489362 TGV-59, Gaia	B EDR3 4 B EDR3 5 A EDR3 3 A B	4.742467 04537094094 1.401379 1.680424 46640327504 4.198947 6.908918 45196180102 2.13397 2.496180	1766.2003 988800, Tmag: 1547.7899 1548.1386 5876096, Tmag: 1819.386 1818.9338 2167552, Tmag: 1604.3638 1604.849	0.4885 9.77, Teff - - 10.87, T 0.5003 - 13.03, T 0.4350 0.5043	90 : 7815 H 75 114 eff: 6823 40 35 eff: 8210 150 50	$ \begin{array}{r} 63 \\ K, Dist: \\ - \\ - \\ $	$ \begin{array}{c} 4.1 \\ 468.08 \\ p \\ - \\ - \\ t: 825.89 \\ \hline 4.0 \\ - \\ t: 3713.1 \\ \hline 4.7 \\ 6.1 \\ \end{array} $	4) pc 5 1.5 pc 4
Comments 307119043 Additional Comments 309025182 Additional Comments Comments Comments Comments 309262405 Additional Comments 311838200 Additional Comments	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl B: blended ecl 89.424588 information: T A: potential E B: blended ecl 181.861947 information: T	FGV-56, Gaia TVs ipses -27.707244 FGV-57, Gaia ipses ipses 34.988493 FGV-58, Gaia TVs ipses -70.489362 FGV-59, Gaia ipses	B EDR3 4 B EDR3 5 A EDR3 3 A B	4.742467 04537094094 1.401379 1.680424 46640327504 4.198947 6.908918 45196180102 2.13397 2.496180	1766.2003 988800, Tmag: 1547.7899 1548.1386 5876096, Tmag: 1819.386 1818.9338 2167552, Tmag: 1604.3638 1604.849	0.4885 9.77, Teff - - 10.87, T 0.5003 - 13.03, T 0.4350 0.5043	90 : 7815 H 75 114 eff: 6823 40 35 eff: 8210 150 50	$ \begin{array}{r} 63 \\ K, Dist: \\ - \\ - \\ $	$ \begin{array}{c} 4.1 \\ 468.08 \\ p \\ - \\ - \\ t: 825.89 \\ \hline 4.0 \\ - \\ t: 3713.1 \\ \hline 4.7 \\ 6.1 \\ \end{array} $	4) pc 5 1.5 pc 4
Comments 307119043 Additional Comments 309025182 Additional Comments Comments Comments Comments 309262405 Additional Comments 311838200 Additional Comments	B: – 14.827524 information: T A: potential E B: blended ecl 151.007452 information: T A: blended ecl 89.424588 information: T A: potential E B: blended ecl 181.861947 information: T A: blended ecl	FGV-56, Gaia TVs ipses -27.707244 FGV-57, Gaia ipses 34.988493 FGV-58, Gaia TVs ipses -70.489362 FGV-59, Gaia ipses ipses	B EDR3 4 B EDR3 5 A EDR3 3 A B	4.742467 04537094094 1.401379 1.680424 46640327504 4.198947 6.908918 45196180102 2.13397 2.496180	1766.2003 988800, Tmag: 1547.7899 1548.1386 5876096, Tmag: 1819.386 1818.9338 2167552, Tmag: 1604.3638 1604.849	0.4885 9.77, Teff - - 10.87, T 0.5003 - 13.03, T 0.4350 0.5043	90 : 7815 H 75 114 eff: 6823 40 35 eff: 8210 150 50	$ \begin{array}{r} 63 \\ K, Dist: \\ - \\ - \\ $	$ \begin{array}{c} 4.1 \\ 468.08 \\ p \\ - \\ - \\ t: 825.89 \\ \hline 4.0 \\ - \\ t: 3713.1 \\ \hline 4.7 \\ 6.1 \\ \end{array} $) pc 5.

$$\label{eq:test} \begin{split} \text{TGV-N} &= \text{TESS/Goddard/VSG} \text{ quadruple candidate -N, } \text{Phase}_s = \text{Secondary phase, } \text{Dep}_n = \text{Depth of eclipse } n, \\ \text{Dur}_n &= \text{Duration of eclipse } n, \\ \text{Teff} = \text{Composite effective temperature, } \text{ppt} = \text{parts-per-thousand} \end{split}$$

TIC ID	$\mathbf{R}\mathbf{A}$	Dec	Binary	Period	T_0	Phase_s	Dep_p	Dep_s	Dur_p	Dur_{s}
-	degrees	degrees	-	d	BJD-2457000	-	ppt	ppt	hr	h
Comments	A: heavily-ble	nded eclipses								
Comments	B: heavily-bler	nded eclipses;	potentia	l ETVs						
317863971	110.567508	3.031925	А	3.526276	1507.8495	0.4994	135	32	5.2	5.3
			В	3.733625	1499.5708	0.5857	60	15	3.8	5.0
Additional	information: Л	GV-61, Gaia	EDR3 3	13614842763	8162176, Tmag:	10.24, T	eff: 8506	6 K, Dis	t: 732.24	\mathbf{pc}
Comments	A: blended ecl	ipses; depth o	difference	s between se	ctors					
Comments	B: blended ecl	ipses; depth a	lifference	s between se	ctors					
321471064	175.527634	-62.267268	А	0.342094	1571.8063	_	75	_	_	-
			В	1.557273	1575.3683	_	65	_	_	-
Additional	information: T	GV-62, Gaia	EDR3 5	33337449277	8342400, Tmag:	11.91, T	eff: 7202	2 K, Dis	t: 833.28	\mathbf{pc}
Comments	A: heavily-ble	nded eclipses								
Comments	B: heavily-bler	nded eclipses;	period n	nay be twice	the listed value;					
	secondary t	oo blended a	nd too lo	w SNR for r	eliable measuren	nents				
322727163	309.716625	50.466821	А	1.156328	1714.2718	_	35	_	_	-
			В	1.640142	1713.8436	0.4997	110	75	6.2	6.
Additional	information: 7	GV-63, Gaia	EDR3 2	18038791215	8160512, Tmag:	10.65, T	eff: 7877	7 K, Dis	t: 826.96	\mathbf{pc}
Comments	A: heavily-ble	nded eclipses;	ephemer	is might be a	slightly off; seco	ndary too	low SN	IR and t	oo blend	ed
Comments	B: heavily-bler	nded eclipses;	ephemer	is, depth and	d duration might	t be sligh	tly off			
327885074	331.328300	59.445019	А	2.79561	1742.8408	0.4849	120	100	8.0	8.7
			В	3.345351	1743.5301	_	15	-	-	-
Additional	information: T	GV-64, Gaia	EDR3 2	19986084289	5906176, Tmag:	12.75, T	eff: 9444	4 K, Dis	t: 8892.6	1 pc
Comments	A: depth differ	ences betwee	n sectors							
Comments	B: heavily-bler	nded eclipses;	measure	ments might	be slightly off;]	potential	ETVs			
328181241	43.153958	3.347882	А	22.625534	1430.1497	0.6359	150	60	12.9	18.0
			В	26.418506	1436.3582	0.8410	170	140	6.2	8.4
Additional	information: Л	GV-65, Gaia	EDR3 4	65750119124	9536, Tmag: 10	.57, Teff:	5183 K	, Dist: 6	518.86 pc	
Comments	A: heavily-ble	nded eclipses;	flare in \$	S31? extra e	vent near 1427					
Comments	B: secondary h	neavily-blende	ed Sector	31						
336882813	92.390615	14.628986	А	2.625028	1468.7932	_	10	-	_	-
			В	6.422862	1470.9941	0.6251	65	30	4.7	4.
Additional	information: 7	GV-66, Gaia	EDR3 3	34525622476	8675584, Tmag:	11.40, T	eff: 612	1 K, Dis	t: 2288.4	$3~{ m pc}$
Comments	A: –									
Comments	B: potential E	TVs								
344541836	317.850729	57.620410	А	2.409932	1713.8429	0.6529	45	40	3.4	4.4
			В	2.755276	1713.3358	0.5010	30	11	5.0	3.(
Additional	information: T	GV-67 Gaia	EDB3 2		4119936, Tmag:					
nuunionai				100010-0001	1110000, 1 mag.	1.11, 10	,	D 150. 10	0.02 pc	
	A: False positi	,		10001020001	11100000, 1111ag.	, 10.		2150.10	.0.02 pc	

348651800121.724336-12.435678А 2.0778671496.19940.503010 $\mathbf{5}$ 4.0 4.1В 3.8362461493.86730.4756604.23.915Additional information: TGV-68, Gaia EDR3 5727738565990859008, Tmag: 11.40, Teff: - K, Dist: 675.02 pc Comments A: Bright field star in central pixel Comments B: Bright field star in central pixel 357810643138.466380 -61.279782 A 3.1208291545.991715_

Continued on next page

$$\label{eq:test_result} \begin{split} \text{TGV-N} &= \text{TESS}/\text{Goddard}/\text{VSG} \text{ quadruple candidate -N}, \\ \text{Phase}_s &= \text{Secondary phase}, \\ \text{Dep}_n &= \text{Depth of eclipse } n, \\ \text{Dur}_n &= \text{Duration of eclipse } n, \\ \text{Teff} &= \text{Composite effective temperature, } \\ \text{ppt} &= \text{parts-per-thousand} \end{split}$$

	RA	Dec	Binary	Period	T_0	Phase_s	Dep_p	Dep_s	Dur_p	Dur_s
	degrees	degrees	-	d	BJD-2457000	-	ppt	ppt	hr	hr
			В	20.528963	1563.6067	0.1628	80	15	7.3	11.4
Additional i	Information:	ΓGV-69, Gaia	EDR3 5	29890662861	9404672, Tmag:	7.03, Tef	f: 13910) K, Dis	t: 555.82	\mathbf{pc}
Comments .	A: False posit	ive for TIC 3	57810555;	Potential sl	ight centroid off	set (<0.1	pixels)	but no	known so	urce
	at the loca	tion; offset po	otentially	due to the s	trong stellar var	iability or	n timesc	ales		
	$\operatorname{comparable}$	e to the eclips	e duratio	n; Member o	of Cl Platais 8 of	pen (galae	etic) Clu	ıster		
Comments 1	B: False posit	ive for TIC 35	57810555;	Potential sl	ight centroid off	set (<0.1	pixels)	but no l	known so	urce
	at the loca	tion; offset po	otentially	due to the s	trong stellar var	iability or	n timesc	ales		
	comparable	e to the eclips	e duratio	n; Member o	of Cl Platais 8 of	pen (galae	etic) Clu	ıster		
367448265	78.382438	35.653053	А	0.418238	1816.2930	_	20	_	_	_
			В	1.865520	1816.8633	0.5044	205	180	4.3	4.3
Additional i	nformation: 7	ΓGV-70, Gaia	EDR3 18	85395080832	205440, Tmag:	7.83, Teff:	9212 F	K, Dist:	330.94 p	с
Comments .	A: heavily ble	ended eclipses;	ellipsoida	al variations						
Comments I	B: heavily ble	nded eclipses;	potential	ETVs; ellip	soidal variations	8				
370440624	143.232035	-68.681123	А	2.235057	1572.7416	0.5004	50	15	2.6	2.8
			В	8.704980	1589.1513	0.5183	55	40	4.5	4.9
Additional i	information:	ΓGV-71, Gaia	EDR3 5	24382965163	5260544, Tmag:	11.34, Te	eff: 6542	2 K, Dis	t: 672.99	\mathbf{pc}
Comments A	A: –									
Comments 1	B: heavily-ble	nded eclipses								
375325607	315.793095	55.469314	А	1.311984	1711.9648	0.4972	45	25	4.8	3.5
			В	9.223201	1719.9224	0.3231	75	50	6.9	8.6
Additional i	information:	ΓGV-72, Gaia	EDR3 2	18891108147	2114304, Tmag:	12.00, Te	eff: – K	, Dist: 1	359.01 p	с
Comments .	A: heavily-ble	nded eclipses:	measure	ments might	be slightly off					
Comments 1	B: heavily-ble	nded eclipses;	measure	ments might	be slightly off					
386202029	104.069404	15.809043	А	1.05668	1470.0427	0.5010	110	90	6.0	6.0
			В	1.252423	1469.0895	0.5054	240	150	5.5	5.5
Additional i	information:	ΓGV-73, Gaia	EDR3 3	35504267282	9484032, Tmag:	13.24, Te	eff: 7096	6 K, Dis	t: 3995.3	$8 \mathrm{\ pc}$
~	A. hoorily hlo	ndad aalinaaa	measure	ments might	be slightly off;	Ellipsoida	l variati	ions		
Comments 1	A: neavily-ble	ended echpses;		montes might						
	0	÷ ,	measurer	0	be slightly off;	Ellipsoida	l variati	ons		
	0	ended eclipses;	measurer A	0	be slightly off; 1545.8437	Ellipsoida –	l variati 75	ions _		
Comments 1	B: heavily-ble	ended eclipses;		nents might		Ellipsoida – 0.5527		ions — 35	- 4.8	5.0
Comments 1 387096013	B: heavily-ble 140.130575	ended eclipses; -54.410580	A B	ments might 2.134084 6.144240	1545.8437	- 0.5527	75 40	-35		
Comments 1 387096013	B: heavily-ble 140.130575	ended eclipses; -54.410580	A B	ments might 2.134084 6.144240	1545.8437 1544.9975	- 0.5527	75 40	-35		
Comments 1 387096013 Additional i Comments 4	B: heavily-ble 140.130575 information: 7 A: –	ended eclipses; -54.410580	A B EDR3 53	ments might 2.134084 6.144240	1545.8437 1544.9975	- 0.5527	75 40	-35		
Comments 1 387096013 Additional i Comments 4	B: heavily-ble 140.130575 information: 7 A: –	nded eclipses; -54.410580 TGV-74, Gaia	A B EDR3 53	ments might 2.134084 6.144240	1545.8437 1544.9975	- 0.5527	75 40 eff: – K	-35		
Comments 1 387096013 Additional i Comments 1	B: heavily-ble 140.130575 information: 7 A: – B: secondary 1	nded eclipses; -54.410580 TGV-74, Gaia heavily blende	A B EDR3 53 ed	ments might 2.134084 6.144240 31063171756	1545.8437 1544.9975 1703168, Tmag:	– 0.5527 12.02, Te	75 40	- 35 , Dist: 3	920.34 p	c
Comments 1 387096013 Additional i Comments 1 389836747	B: heavily-ble 140.130575 information: 7 A: - B: secondary 1 23.295470	nded eclipses; -54.410580 TGV-74, Gaia heavily blende 61.585307	A B EDR3 5 ed A B	ments might 2.134084 6.144240 31063171756 2.56703 2.730402	1545.8437 1544.9975 1703168, Tmag: 1792.2945	- 0.5527 12.02, Te 0.4970 -	75 40 eff: - K 180 20	– 35 , Dist: 3 130 –	8920.34 p 8.2 –	С
Comments I 387096013 Additional i Comments I 389836747 Additional i	B: heavily-ble 140.130575 information: 7 A: – B: secondary 1 23.295470 information: 7	nded eclipses; -54.410580 TGV-74, Gaia heavily blende 61.585307	A B EDR3 5 ed A B	ments might 2.134084 6.144240 31063171756 2.56703 2.730402	1545.8437 1544.9975 1703168, Tmag: 1792.2945 1794.4352	- 0.5527 12.02, Te 0.4970 -	75 40 eff: - K 180 20	– 35 , Dist: 3 130 –	8920.34 p 8.2 –	С
Comments 1 387096013 Additional i Comments 1 389836747	B: heavily-ble 140.130575 information: 7 A: - B: secondary 1 23.295470 information: 7 A: -	nded eclipses; -54.410580 TGV-74, Gaia heavily blende 61.585307	A B EDR3 5 ed A B	ments might 2.134084 6.144240 31063171756 2.56703 2.730402	1545.8437 1544.9975 1703168, Tmag: 1792.2945 1794.4352	- 0.5527 12.02, Te 0.4970 -	75 40 eff: - K 180 20	– 35 , Dist: 3 130 –	8920.34 p 8.2 –	
Comments I 387096013 Additional i Comments I 389836747 Additional i Comments I Comments I	B: heavily-ble 140.130575 information: 7 A: - B: secondary 1 23.295470 information: 7 A: - B: -	nded eclipses; -54.410580 TGV-74, Gaia heavily blende 61.585307 TGV-75, Gaia	A B EDR3 5 ed A B EDR3 5	ments might 2.134084 6.144240 31063171756 2.56703 2.730402 10748306738	1545.8437 1544.9975 1703168, Tmag: 1792.2945 1794.4352 071680, Tmag:	– 0.5527 12.02, Te 0.4970 – 10.36, Tef	75 40 eff: - K, 180 20 f: 8874	- 35 , Dist: 3 130 - K, Dist	8920.34 p 8.2 - : - pc	8.2
Comments I 387096013 Additional i Comments I 389836747 Additional i Comments I	B: heavily-ble 140.130575 information: 7 A: - B: secondary 1 23.295470 information: 7 A: -	nded eclipses; -54.410580 TGV-74, Gaia heavily blende 61.585307	A B EDR3 53 ed A B EDR3 53 A	nents might 2.134084 6.144240 31063171756 2.56703 2.730402 10748306738 3.381354	1545.8437 1544.9975 1703168, Tmag: 1792.2945 1794.4352 071680, Tmag: 1817.713	- 0.5527 12.02, Te 0.4970 -	75 40 eff: - K 180 20 f: 8874 90	– 35 , Dist: 3 130 –	8920.34 p 8.2 –	c
Comments I 387096013 Additional i Comments I 389836747 Additional i Comments I 391620600	B: heavily-ble 140.130575 information: 7 A: - B: secondary 1 23.295470 information: 7 A: - B: - 71.640389	nded eclipses; -54.410580 TGV-74, Gaia heavily blende 61.585307 TGV-75, Gaia 44.753662	A B EDR3 53 ed A B EDR3 53 A B	nents might 2.134084 6.144240 31063171756 2.56703 2.730402 10748306738 3.381354 6.473460	1545.8437 1544.9975 1703168, Tmag: 1792.2945 1794.4352 071680, Tmag: 1817.713 1835.8181	- 0.5527 12.02, Te 0.4970 - 10.36, Tef 0.5003 -	75 40 eff: - K, 180 20 f: 8874 90 20	- 35 , Dist: 3 130 - K, Dist 40 -	8920.34 p 8.2 - : - pc 2.9 -	c 8.2 - 3.1 -
Comments I 387096013 Additional i Comments I 389836747 Additional i Comments I 391620600 Additional i	B: heavily-ble 140.130575 information: 7 A: - B: secondary 1 23.295470 information: 7 A: - B: - 71.640389 information: 7	nded eclipses; -54.410580 TGV-74, Gaia heavily blende 61.585307 TGV-75, Gaia 44.753662	A B EDR3 53 ed A B EDR3 53 A B	nents might 2.134084 6.144240 31063171756 2.56703 2.730402 10748306738 3.381354 6.473460	1545.8437 1544.9975 1703168, Tmag: 1792.2945 1794.4352 071680, Tmag: 1817.713	- 0.5527 12.02, Te 0.4970 - 10.36, Tef 0.5003 -	75 40 eff: - K, 180 20 f: 8874 90 20	- 35 , Dist: 3 130 - K, Dist 40 -	8920.34 p 8.2 - : - pc 2.9 -	c 8.2 - 3.1 -
Comments I 387096013 Additional i Comments I 389836747 Additional i Comments I 391620600 Additional i Comments A	B: heavily-ble 140.130575 information: 7 A: - B: secondary 1 23.295470 information: 7 A: - B: - 71.640389 information: 7 A: -	ended eclipses; -54.410580 FGV-74, Gaia heavily blende 61.585307 FGV-75, Gaia 44.753662 FGV-76, Gaia	A B EDR3 5: ed A EDR3 5: A EDR3 20	nents might 2.134084 6.144240 31063171756 2.56703 2.730402 10748306738 3.381354 6.473460 04904785092	1545.8437 1544.9975 1703168, Tmag: 1792.2945 1794.4352 071680, Tmag: 1817.713 1835.8181	- 0.5527 12.02, Te 0.4970 - 10.36, Tef 0.5003 - 11.95, Tef	75 40 eff: - K, 180 20 f: 8874 90 20 f: 5950		8920.34 p 8.2 - : - pc 2.9 - : 460.63 p	c 8.2 - 3.1 - -

$$\label{eq:test} \begin{split} \text{TGV-N} &= \text{TESS}/\text{Goddard}/\text{VSG} \text{ quadruple candidate -N, Phase}_s = \text{Secondary phase}, \text{Dep}_n = \text{Depth of eclipse } n, \\ \text{Dur}_n &= \text{Duration of eclipse } n, \text{Teff} = \text{Composite effective temperature, ppt} = \text{parts-per-thousand} \end{split}$$

	RA	Dec	Binary	Period	T ₀	Phase_s	Dep_p	Dep_s	Dur_p	Dur_s
-	degrees	degrees	-	d	BJD-2457000	-	ppt	ppt	hr	hr
	-	might be sligh	-	1	1010 0 000	0 80 10				
392229331	54.767927	61.064204	A	1.822309	1819.0783	0.5040	148	47	3.6	3.6
			В	2.255905	1820.5001	0.4959	141	52	3.9	3.8
		l'GV-77, Gaia	EDR3 4	86430957815	961344, Tmag:	10.34, Te	f: 8028	K, Dist	: 644.45	pc
Comments .										
Comments 2		00 10 00 F 1					-			
399492452	163.985711	-69.196354	A	1.75514	1571.7531	-	5	-	-	-
			B	9.152187	1577.7638	0.6281	215	210	11.0	12.8
		,		23192523924	9670912, Tmag:	10.39, 1	eff: 6216	o K, Dis	st: 923.85	pc
	A: ephemeris :	0 0	·	1				1 . 1 1	. 1.1. 0	
					matics; depth m	ieasureme		ht be sl	ightly off	
408147984	213.482501	-59.643098	A	1.072756	1601.2922	-	65	-	-	-
			B	3.804398	1604.1065	0.5025	23 7 V	10	5.5	5.5
				86702053717	3073024, Tmag:	11.10, T	еп: – К	, Dist: 1	1458.91 p	с
	A: very-short				1.1.1 0					
	B: heavily-ble	1 /		0	0 1	0.4010				
414026507	336.837717	56.740362	A	4.229981	1746.723	0.4212	70	55	7.5	8.5
			В	6.455288	1768.2955	0.5305	135	114 	9.7	9.3
					4657280, Tmag:	10.61, 1	eff: 918	(\mathbf{K}, \mathbf{D})	st: 2993.3	5 pc
	A: potential E		blended	eclipses						
	B: heavily-ble			2 150000	1 400 00 00	0 2010	1.40		F 0	
414475823	224.211179	-57.685879	A	3.478022	1602.0353	0.5010	140	90	5.8	5.6
A 1 1. (* 1 1			B	3.657410	1602.5871	0.4862	215	205	6.0	5.9
		LGV-81. Gaia	EDR3 5	88073261972	8164736, Tmag:	11.79, 1	eff: 7790	э К, Dis	st: 1539.2	U nc
		_ , _ ,								o pe
Comments .	A: –	,								o pe
Comments Comments	A: – B: –			4 (202500	1070.0440	0 5000	100	100		_
Comments .	A: –	22.200757	A	4.630508	1873.9443	0.5006	160	120	3.3	3.4
Comments Comments 414969157	A: – B: – 141.176162	22.200757	В	6.928951	1880.0717	0.4718	110	50	3.3 3.8	3.4
Comments Comments 414969157 Additional	A: – <u>B: –</u> 141.176162 information: 7	22.200757 FGV-82, Gaia	В	6.928951		0.4718	110	50	3.3 3.8	3.4
Comments Comments 414969157 Additional Comments	A: – B: – 141.176162 information: T A: potential E	22.200757 FGV-82, Gaia	В	6.928951	1880.0717	0.4718	110	50	3.3 3.8	3.4
Comments Comments 414969157 Additional Comments Comments	A: – B: – 141.176162 information: T A: potential E B: –	22.200757 FGV-82, Gaia TVs	B EDR3 6	6.928951 38215205129	1880.0717 955584, Tmag:	0.4718	110 ff: 5358	50	3.3 3.8 : 854.30	3.4
Comments Comments 414969157 Additional Comments	A: – B: – 141.176162 information: T A: potential E	22.200757 FGV-82, Gaia	B EDR3 6	6.928951 38215205129 2.00191	1880.0717 955584, Tmag: 1739.3903	0.4718	110 ff: 5358 13	50	3.3 3.8 : 854.30 2.8	3.4
Comments Comments 414969157 Additional Comments 427092089	A: – B: – 141.176162 information: 7 A: potential E B: – 321.112009	22.200757 TGV-82, Gaia TVs 64.380683	B EDR3 6 A B	6.928951 38215205129 2.00191 2.086000	1880.0717 955584, Tmag: 1739.3903 1740.3478	0.4718 13.52, Tei 	110 ff: 5358	50 K, Dist 	3.3 3.8 : 854.30 2.8 3.0	3.4 3.1 pc
Comments Comments 414969157 Additional Comments 427092089 Additional	A: – B: – 141.176162 information: T A: potential E B: – 321.112009 information: T	22.200757 FGV-82, Gaia TVs 64.380683 FGV-83, Gaia	B EDR3 6 A B	6.928951 38215205129 2.00191 2.086000	1880.0717 955584, Tmag: 1739.3903	0.4718 13.52, Tei 	110 ff: 5358	50 K, Dist 	3.3 3.8 : 854.30 2.8 3.0	3.4 3.1 pc
Comments Comments Additional Comments Additional Additional Additional Comments Additional Comments Comments Comments Additional Comments Comments Additional Comments Comments Additional Comments Additional Comments Com	A: – <u>B: –</u> 141.176162 information: 7 A: potential E <u>B: –</u> 321.112009 information: 7 A: heavy blen	22.200757 FGV-82, Gaia TVs 64.380683 FGV-83, Gaia ds	B EDR3 6 A B	6.928951 38215205129 2.00191 2.086000	1880.0717 955584, Tmag: 1739.3903 1740.3478	0.4718 13.52, Tei 	110 ff: 5358	50 K, Dist 	3.3 3.8 : 854.30 2.8 3.0	3.4 3.1 pc
Comments Comments 414969157 Additional Comments 427092089 Additional Comments Comments	A: – B: – 141.176162 information: T A: potential E B: – 321.112009 information: T A: heavy blend B: heavy blend	22.200757 FGV-82, Gaia TVs 64.380683 FGV-83, Gaia ds	B EDR3 6 A B EDR3 2	6.928951 38215205129 2.00191 2.086000 22033907946	1880.0717 955584, Tmag: 1739.3903 1740.3478 3012480, Tmag:	0.4718 13.52, Tei 	110 ff: 5358 13 10 eff: 8760	50 K, Dist 	3.3 3.8 : 854.30 2.8 3.0	3.4 3.1 pc
Comments Comments Additional Comments Additional Additional Additional Comments Additional Comments Comments Comments Additional Comments Comments Additional Comments Comments Additional Comments Additional Comments Com	A: – <u>B: –</u> 141.176162 information: 7 A: potential E <u>B: –</u> 321.112009 information: 7 A: heavy blen	22.200757 FGV-82, Gaia TVs 64.380683 FGV-83, Gaia ds ds	B EDR3 6 A EDR3 2 A	6.928951 38215205129 2.00191 2.086000 22033907946 0.449904	1880.0717 955584, Tmag: 1739.3903 1740.3478 3012480, Tmag: 1518.8906	0.4718 13.52, Tei - - 11.98, Tei - -	110 ff: 5358 13 10 eff: 8760 70	50 K, Dist – – 0 K, Dis –	3.3 3.8 : 854.30 2.8 3.0 st: 1170.0	3.4 3.1 pc
Comments Comments 414969157 Additional Comments 427092089 Additional Comments Comments 434452777	A: – B: – 141.176162 information: T A: potential E B: – 321.112009 information: T A: heavy blend B: heavy blend 139.740446	22.200757 FGV-82, Gaia TVs 64.380683 FGV-83, Gaia ds ds ds -20.557157	B EDR3 6 A EDR3 2 A B	6.928951 38215205129 2.00191 2.086000 22033907946 0.449904 8.040997	1880.0717 955584, Tmag: 1739.3903 1740.3478 3012480, Tmag: 1518.8906 1524.9251	0.4718 13.52, Tet - - 11.98, Te - 0.4979	110 ff: 5358 13 10 eff: 8760 70 70	50 K, Dist – – 0 K, Dis – 20	$3.3 \\ 3.8 \\ : 854.30$ $2.8 \\ 3.0 \\ \\ 1170.0 \\ - \\ 8.0$	3.4 3.1 pc 5 pc
Comments Comments 414969157 Additional Comments 427092089 Additional Comments 434452777 Additional	A: - B: - 141.176162 information: 7 A: potential E B: - 321.112009 information: 7 A: heavy blend 139.740446 information: 7	22.200757 FGV-82, Gaia TVs 64.380683 FGV-83, Gaia ds ds ds -20.557157 FGV-84, Gaia	B EDR3 6 A EDR3 2 A B EDR3 5	6.928951 38215205129 2.00191 2.086000 22033907946 0.449904 8.040997 67662910800	1880.0717 955584, Tmag: 1739.3903 1740.3478 3012480, Tmag: 1518.8906 1524.9251 2652416, Tmag:	0.4718 13.52, Tet - - 11.98, Te - 0.4979	110 ff: 5358 13 10 eff: 8760 70 70	50 K, Dist – – 0 K, Dis – 20	$3.3 \\ 3.8 \\ : 854.30$ $2.8 \\ 3.0 \\ \\ 1170.0 \\ - \\ 8.0$	3.4 3.1 pc 5 pc
Comments Comments 414969157 Additional Comments Comments Comments Comments 434452777 Additional Comments	A: $-$ B: $-$ 141.176162 information: T A: potential E B: $-$ 321.112009 information: T A: heavy blender B: heavy blender 139.740446 information: T A: blended state	22.200757 FGV-82, Gaia TVs 64.380683 FGV-83, Gaia ds ds -20.557157 FGV-84, Gaia ar too faint to	B EDR3 6 A EDR3 2 A B EDR3 5 be source	$\begin{array}{c} 6.928951\\ 38215205129\\ \hline \\ 2.00191\\ 2.086000\\ 22033907946\\ \hline \\ 0.449904\\ 8.040997\\ 67662910800\\ e \ (\Delta T \sim 8 \ n \end{array}$	1880.0717 955584, Tmag: 1739.3903 1740.3478 3012480, Tmag: 1518.8906 1524.9251 2652416, Tmag: nag)	0.4718 13.52, Tet - - 11.98, Te - 0.4979	110 ff: 5358 13 10 eff: 8760 70 70	50 K, Dist – – 0 K, Dis – 20	$3.3 \\ 3.8 \\ : 854.30$ $2.8 \\ 3.0 \\ \\ 1170.0 \\ - \\ 8.0$	3.4 3.1 pc 5 pc
Comments Comments 414969157 Additional Comments 427092089 Additional Comments 434452777 Additional Comments Comments	A: – B: – 141.176162 information: T A: potential E B: – 321.112009 information: T A: heavy blend B: heavy blend 139.740446 information: T A: blended sta B: completely	22.200757 FGV-82, Gaia TVs 64.380683 FGV-83, Gaia ds ds ds -20.557157 FGV-84, Gaia ar too faint to blended eclip	B EDR3 6 A B EDR3 2 A B EDR3 5 be source ses; ephe	$\begin{array}{c} 6.928951\\ 38215205129\\ \hline \\ 2.00191\\ 2.086000\\ 22033907946\\ \hline \\ 0.449904\\ 8.040997\\ 67662910800\\ e \ (\Delta T \sim 8 \ n \\ meris \ might \end{array}$	1880.0717 955584, Tmag: 1739.3903 1740.3478 3012480, Tmag: 1518.8906 1524.9251 2652416, Tmag: nag) be off	0.4718 13.52, Tei - - 11.98, Tei - 0.4979 10.56, Tei	110 ff: 5358 13 10 eff: 8760 70 70 eff: 7272	50 K, Dist – – 0 K, Dis – 20 2 K, Dis	$3.3 \\ 3.8 \\ 3.8 \\ 3.0 $	3.4 3.1 pc 5 pc
Comments Comments 414969157 Additional Comments Comments Comments Comments 434452777 Additional Comments	A: $-$ B: $-$ 141.176162 information: T A: potential E B: $-$ 321.112009 information: T A: heavy blender B: heavy blender 139.740446 information: T A: blended state	22.200757 FGV-82, Gaia TVs 64.380683 FGV-83, Gaia ds ds -20.557157 FGV-84, Gaia ar too faint to	B EDR3 6 A EDR3 2 A EDR3 2 A EDR3 5 be source ses; ephe A	$\begin{array}{c} 6.928951 \\ 38215205129 \\ \hline \\ 2.00191 \\ 2.086000 \\ 22033907946 \\ \hline \\ 0.449904 \\ 8.040997 \\ 67662910800 \\ e \ (\Delta T \sim 8 \ n \\ meris \ might \\ \hline \\ 5.442645 \end{array}$	1880.0717 955584, Tmag: 1739.3903 1740.3478 3012480, Tmag: 1518.8906 1524.9251 2652416, Tmag: nag) be off 1471.014	0.4718 13.52, Tet - - 11.98, Te - 0.4979	110 ff: 5358 13 10 eff: 8760 70 70 eff: 7272 70	50 K, Dist – – 0 K, Dis – 20	$3.3 \\ 3.8 \\ : 854.30$ $2.8 \\ 3.0 \\ \\ 1170.0 \\ - \\ 8.0$	3.4 3.1 pc 5 pc
Comments Comments 414969157 Additional Comments 427092089 Additional Comments 434452777 Additional Comments Comments Comments 438226195	A: $-$ B: $-$ 141.176162 information: T A: potential E B: $-$ 321.112009 information: T A: heavy blended 139.740446 information: T A: blended state B: completely 96.502751	22.200757 FGV-82, Gaia TVs 64.380683 FGV-83, Gaia ds ds ds -20.557157 FGV-84, Gaia ar too faint to blended eclip 15.216367	B EDR3 6 A B EDR3 2 A B EDR3 5 b be source sess; ephe A B	$\begin{array}{c} 6.928951\\ 38215205129\\ \hline \\ 2.00191\\ 2.086000\\ 22033907946\\ \hline \\ 0.449904\\ 8.040997\\ 67662910800\\ e \ (\Delta T \sim 8 \ n\\ \hline \\ meris \ might\\ 5.442645\\ 11.697926\\ \end{array}$	1880.0717 955584, Tmag: 1739.3903 1740.3478 3012480, Tmag: 1518.8906 1524.9251 2652416, Tmag: nag) be off	0.4718 13.52, Tei - - 11.98, Tr 0.4979 10.56, Tr 0.6180 -	110 ff: 5358 13 10 eff: 8760 70 70 eff: 7272 70 10	50 K, Dist – – 0 K, Dis – 20 2 K, Dis – 20 2 K, Dis	3.3 3.8 : 854.30 2.8 3.0 	3.4 3.1 pc 5 pc 5 pc 8.0 5 pc 7.0

$$\label{eq:test} \begin{split} \text{TGV-N} &= \text{TESS/Goddard/VSG} \text{ quadruple candidate -N, } \text{Phase}_s = \text{Secondary phase}, \ \text{Dep}_n = \text{Depth of eclipse } n, \\ \text{Dur}_n &= \text{Duration of eclipse } n, \ \text{Teff} = \text{Composite effective temperature, } \text{ppt} = \text{parts-per-thousand} \end{split}$$

	$\mathbf{R}\mathbf{A}$	Dec	Binary	Period	T_0	$Phase_s$	Dep_p	Dep_s	Dur_p	Dur_{t}
-	degrees	degrees	-	d	BJD-2457000	-	ppt	ppt	hr	h
Comments .										
Comments 1					cumbinary plan	et;				
	Two more e	eclipses in Sec	ctor 33 (o	ne blended v	with A)					
439511833	143.595968	-56.106778	А	6.594526	1548.0668	0.5291	40	4	3.9	4.
			В	11.048213	1552.4717	0.5091	85	30	6.4	6.
Additional i	information: T	GV-86, Gaia	EDR3 5	30709610047	2398080, Tmag:	10.58, T	eff: – K	, Dist: 8	63.20 pc	
Comments .	A: –									
Comments 1	B: –									
441794509	263.598849	74.472259	А	4.668622	1716.1273	0.5014	30	4	4.0	4.
			В	14.785724	1739.0617	_	15	-	_	
Additional i	information: T	GV-87, Gaia	EDR3 1	65566629439	6195200, Tmag:	12.18, T	eff: 622	1 K, Dis	t: 892.90) pc
Comments .	A: secondary t	oo low SNR f	for reliab	le measurem	ents					
Comments 1	B: potential E'	TVs								
443862276		7.254959	А	3.073838	1494.1607	0.4993	90	85	4.2	4.
			В	7.040997	1494.5507	0.5086	60	55	4.6	5
Additional i	information: T	GV-88, Gaia	EDR3 3	09773891306	5529472, Tmag:	13.72, T	eff: 6398	8 K. Dis	t: 2253.9	94 pc
					there are ETVs			,		1
	-	h differences l				,				
Comments 1					ry and secondary	v periods				
454140642	64.773473	0.900042	А	10.3928	1445.5657	0.4828	100	90	5.3	5
		0.0000				0.2020			0.0	
Additional i Comments .	A: Confirmed				1454.4599 5492608, Tmag:	0.4552 9.85, Tei	105 ff: 6592	100 K, Dist:	6.0 358.89	
Additional i Comments 2 Comments 2	A: Confirmed B: –	quadruple (K	EDR3 3 ostov et a	25565998145 al. 2021a)	5492608, Tmag:	9.85, Tei	ff: 6592	K, Dist:	358.89	pc
Additional i Comments 2 Comments 2	A: Confirmed		EDR3 33 ostov et a	25565998145 al. 2021a) 6.2628	5492608, Tmag: 1573.606	9.85, Tei 0.4969	ff: 6592	K, Dist:	5.8	рс 5.
Additional i Comments 2 Comments 2 458740670	A: Confirmed B: – 160.808111	quadruple (K -57.895051	EDR3 3 ostov et a A B	25565998145 al. 2021a) 6.2628 7.020700	5492608, Tmag: 1573.606 2288.216	9.85, Tei 0.4969 0.5050	ff: 6592 140 100	K, Dist: 60 25	5.8 6.2	рс 5. 6
Additional i Comments 2 Comments 2 458740670 Additional i	A: Confirmed B: – 160.808111 information: T	quadruple (K -57.895051 CGV-90, Gaia	EDR3 3 ostov et a A B EDR3 5	25565998145 al. 2021a) 6.2628 7.020700 35112731059	5492608, Tmag: 1573.606 2288.216 8407680, Tmag:	9.85, Tel 0.4969 0.5050 12.03, Te	ff: 6592 140 100 eff: 8480	K, Dist: 60 25 0 K, Dis	5.8 6.2 t: 1829.9	рс 5. 6
Additional i Comments 1 Comments 1 458740670 Additional i	A: Confirmed B: – 160.808111 information: T A: Depth chan	quadruple (K -57.895051 CGV-90, Gaia ages between s	EDR3 3 ostov et a A B EDR3 5 sectors; e	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o	9.85, Tei 0.4969 0.5050 12.03, T ff; Conta:	ff: 6592 140 100 eff: 8480 minator	K, Dist: 60 25 0 K, Dis for 458	5.8 5.8 6.2 t: 1829.9 740798;	рс 5. 6
Additional i Comments 2 Comments 2 458740670 Additional i	A: Confirmed B: – 160.808111 information: T A: Depth chan Member of	quadruple (K -57.895051 CGV-90, Gaia ges between s Cl VDBH 99	EDR3 3 ostov et a A B EDR3 5 sectors; e – Open	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl	5492608, Tmag: 1573.606 2288.216 8407680, Tmag:	9.85, Tei 0.4969 0.5050 12.03, T ff; Conta:	ff: 6592 140 100 eff: 8480 minator	K, Dist: 60 25 0 K, Dis for 458	5.8 5.8 6.2 t: 1829.9 740798;	рс 5. 6
Additional i Comments 2 458740670 Additional i Comments 2	A: Confirmed B: – 160.808111 information: T A: Depth chan Member of produce det	quadruple (K -57.895051 CGV-90, Gaia ges between s Cl VDBH 99 tected eclipses	EDR3 3 ostov et a A B EDR3 5 sectors; e - Open s as conta	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea	9.85, Tei 0.4969 0.5050 12.03, Te ff; Conta: rby stars	ff: 6592 140 100 eff: 8480 minator but too	60 25 0 K, Dis for 458 faint to	5.8 6.2 t: 1829.9 740798;	рс 5. 6
Additional i Comments 2 458740670 Additional i Comments 2	A: Confirmed B: – 160.808111 information: T A: Depth chan Member of produce det B: Depth chan	quadruple (K -57.895051 CGV-90, Gaia ges between s Cl VDBH 99 tected eclipses ges between s	EDR3 3 ostov et a A EDR3 5 sectors; e – Open s as conta sectors; e	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination phemeris mig	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea ght be slightly o	9.85, Tei 0.4969 0.5050 12.03, T ff; Conta: rby stars ff; Conta:	ff: 6592 140 100 eff: 8480 minator but too	K, Dist: 60 25 D K, Dis for 4587 faint to for 4587	5.8 6.2 t: 1829.9 740798;	рс 5. 6
Additional i Comments 2 458740670 Additional i Comments 2	A: Confirmed B: – 160.808111 information: T A: Depth chan Member of produce det B: Depth chan Member of	quadruple (K -57.895051 CGV-90, Gaia ges between s Cl VDBH 99 tected eclipses ges between s Cl VDBH 99	EDR3 3: ostov et a A B EDR3 5: sectors; e - Open s as conta sectors; e - Open	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination phemeris mig (galactic) Cl	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea	9.85, Tei 0.4969 0.5050 12.03, T ff; Conta: rby stars ff; Conta:	ff: 6592 140 100 eff: 8480 minator but too	K, Dist: 60 25 D K, Dis for 4587 faint to for 4587	5.8 6.2 t: 1829.9 740798;	рс 5. 6
Additional i Comments 1 458740670 Additional i Comments 1 Comments 1	A: Confirmed B: – 160.808111 information: T A: Depth chan Member of produce det B: Depth chan Member of produce det	quadruple (K -57.895051 CGV-90, Gaia ges between s Cl VDBH 99 tected eclipses ges between s Cl VDBH 99 tected eclipses	EDR3 3 ostov et a A B EDR3 5 sectors; e - Open s as conta sectors; e - Open s as conta	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination phemeris mig (galactic) Cl amination	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea ght be slightly o uster; many nea	9.85, Tei 0.4969 0.5050 12.03, Te ff; Contar rby stars ff; Contar rby stars	ff: 6592 140 100 eff: 848(minator but too minator but too	60 25 0 K, Dis for 4587 9 faint to for 4587 9 faint to	5.8 6.2 t: 1829.9 740798; 740798;	рс 5. 6. 94 рс
Additional i Comments 2 458740670 Additional i Comments 2	A: Confirmed B: – 160.808111 information: T A: Depth chan Member of produce det B: Depth chan Member of	quadruple (K -57.895051 CGV-90, Gaia ges between s Cl VDBH 99 tected eclipses ges between s Cl VDBH 99	EDR3 3: ostov et a A B EDR3 5: sectors; e - Open s as conta sectors; e - Open s as conta	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination phemeris mig (galactic) Cl amination 1.054483	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea ght be slightly o uster; many nea 1439.1191	9.85, Tei 0.4969 0.5050 12.03, T ff; Contai rby stars ff; Contai rby stars 0.5030	ff: 6592 140 100 eff: 8480 minator but too 15	K, Dist: 60 25 D K, Dis for 4587 faint to faint to 14	5.8 6.2 t: 1829.9 740798; 740798; 1.5	5. 6.)4 pc
Additional i Comments 2 458740670 Additional i Comments 2 Comments 2 459959916	A: Confirmed B: - 160.808111 information: T A: Depth chan Member of produce det B: Depth chan Member of produce det 71.489665	quadruple (K -57.895051 CGV-90, Gaia ages between s Cl VDBH 99 tected eclipses Cl VDBH 99 tected eclipses Cl VDBH 99 tected eclipses 4.829619	EDR3 3 ostov et a A B EDR3 5 sectors; e - Open s as conta sectors; e - Open s as conta A B	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination phemeris mig (galactic) Cl amination 1.054483 8.768239	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea ght be slightly o uster; many nea 1439.1191 1438.7434	9.85, Tei 0.4969 0.5050 12.03, Tr ff; Contai rby stars ff; Contai rby stars 0.5030 0.5032	ff: 6592 140 100 eff: 8480 minator but too minator but too 15 50	K, Dist: 60 25 D K, Dis for 4587 o faint to for 4587 o faint to 14 30	5.8 6.2 t: 1829.9 740798; 740798; 1.5 4.4	рс 5 6)4 рс 1 4
Additional i Comments 2 458740670 Additional i Comments 2 459959916 Additional i	A: Confirmed B: - 160.808111 information: T A: Depth chan Member of produce det B: Depth chan Member of produce det 71.489665 information: T	quadruple (K -57.895051 CGV-90, Gaia ages between s Cl VDBH 99 tected eclipses Cl VDBH 99 tected eclipses Cl VDBH 99 tected eclipses 4.829619	EDR3 3 ostov et a A B EDR3 5 sectors; e - Open s as conta sectors; e - Open s as conta A B	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination phemeris mig (galactic) Cl amination 1.054483 8.768239	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea ght be slightly o uster; many nea 1439.1191	9.85, Tei 0.4969 0.5050 12.03, Tr ff; Contai rby stars ff; Contai rby stars 0.5030 0.5032	ff: 6592 140 100 eff: 8480 minator but too minator but too 15 50	K, Dist: 60 25 D K, Dis for 4587 o faint to for 4587 o faint to 14 30	5.8 6.2 t: 1829.9 740798; 740798; 1.5 4.4	рс 5 6)4 рс 1 4
Additional i Comments 2 458740670 Additional i Comments 2 459959916 Additional i Comments 2	A: Confirmed B: - 160.808111 information: T A: Depth chan Member of produce det B: Depth chan Member of produce det 71.489665 information: T A: -	quadruple (K -57.895051 CGV-90, Gaia ages between s Cl VDBH 99 tected eclipses Cl VDBH 99 tected eclipses Cl VDBH 99 tected eclipses 4.829619	EDR3 3 ostov et a A B EDR3 5 sectors; e - Open s as conta sectors; e - Open s as conta A B	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination phemeris mig (galactic) Cl amination 1.054483 8.768239	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea ght be slightly o uster; many nea 1439.1191 1438.7434	9.85, Tei 0.4969 0.5050 12.03, Tr ff; Contai rby stars ff; Contai rby stars 0.5030 0.5032	ff: 6592 140 100 eff: 8480 minator but too minator but too 15 50	K, Dist: 60 25 D K, Dis for 4587 o faint to for 4587 o faint to 14 30	5.8 6.2 t: 1829.9 740798; 740798; 1.5 4.4	рс 5 6)4 рс 1 4
Additional i Comments 2 458740670 Additional i Comments 2 459959916 Additional i Comments 2 Comments 2	A: Confirmed B: - 160.808111 information: T A: Depth chan Member of produce det B: Depth chan Member of produce det 71.489665 information: T A: - B: -	quadruple (K -57.895051 CGV-90, Gaia ages between s Cl VDBH 99 tected eclipses Cl VDBH 99 tected eclipses 4.829619 CGV-91, Gaia	EDR3 3 ostov et a A B EDR3 5 sectors; e - Open s as conta sectors; e - Open s as conta A B EDR3 3	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination phemeris mig (galactic) Cl amination 1.054483 8.768239 28176850353	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea ght be slightly o uster; many nea 1439.1191 1438.7434 2006016, Tmag:	9.85, Tei 0.4969 0.5050 12.03, Ti ff; Contai rby stars ff; Contai rby stars 0.5030 0.5022 12.82, Ti	ff: 6592 140 100 eff: 8480 minator but too 15 50 eff: 619	K, Dist: 60 25 D K, Dis for 4587 faint to for 4587 faint to 14 30 7 K, Dis	$ \begin{array}{r} 358.89 \\ \overline{)} \\ 5.8 \\ 6.2 \\ t: 1829.9 \\ 740798; \\ 740798; \\ \hline 1.5 \\ 4.4 \\ t: 1078.4 \\ \end{array} $	pc 5. 6. 94 pc
Additional i Comments 2 458740670 Additional i Comments 2 Comments 2 459959916	A: Confirmed B: - 160.808111 information: T A: Depth chan Member of produce det B: Depth chan Member of produce det 71.489665 information: T A: -	quadruple (K -57.895051 CGV-90, Gaia ages between s Cl VDBH 99 tected eclipses Cl VDBH 99 tected eclipses Cl VDBH 99 tected eclipses 4.829619	EDR3 3: ostov et a A B EDR3 5: sectors; e - Open s as conta s as conta A B EDR3 3: A	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination phemeris mig (galactic) Cl amination 1.054483 8.768239 28176850353	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea ght be slightly o uster; many nea 1439.1191 1438.7434 2006016, Tmag: 1518.9443	9.85, Tei 0.4969 0.5050 12.03, Tr ff; Contai rby stars ff; Contai rby stars 0.5030 0.5022 12.82, Tr 0.5414	ff: 6592 140 100 eff: 8480 minator but too minator but too 15 50 eff: 619' 20	K, Dist: 60 25 0 K, Dis for 4587 o faint to for 4587 o faint to 14 30 7 K, Dis 15	$\begin{array}{c} 5.8\\6.2\\t: 1829.9\\740798;\\1.5\\4.4\\t: 1078.4\\3.7\end{array}$	pc 5. 6.)4 pc 1. 4. 18 pc 4.
Additional i Comments 2 458740670 Additional i Comments 2 459959916 Additional i Comments 2 Comments 2 461614217	A: Confirmed B: - 160.808111 information: T A: Depth chan Member of produce det B: Depth chan Member of produce det 71.489665 information: T A: - B: - 129.293558	quadruple (K -57.895051 CGV-90, Gaia ages between s Cl VDBH 99 tected eclipses ges between s Cl VDBH 99 tected eclipses 4.829619 CGV-91, Gaia	EDR3 3 ostov et a A B EDR3 5 sectors; e - Open s as conta s as conta s as conta A B EDR3 3 A B	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination phemeris mig (galactic) Cl amination 1.054483 8.768239 28176850353 2.288076 9.365512	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea 1439.1191 1438.7434 2006016, Tmag: 1518.9443 1519.3945	9.85, Tei 0.4969 0.5050 12.03, Tei ff; Contai rby stars ff; Contai rby stars 0.5030 0.5022 12.82, Tei 0.5414 0.5071	ff: 6592 140 100 eff: 848(minator but too minator but too 15 50 eff: 619' 20 75	K, Dist: 60 25 0 K, Dis for 4587 o faint to for 4587 o faint to 14 30 7 K, Dis 15 50	$\begin{array}{r} 358.89 \\ \hline 5.8 \\ 6.2 \\ t: 1829.9 \\ 740798; \\ 740798; \\ 1.5 \\ 4.4 \\ t: 1078.4 \\ \hline 3.7 \\ 7.8 \end{array}$	pc 5. 6. 94 pc 1. 4. 8 pc 4. 7.
Additional i Comments 2 458740670 Additional i Comments 2 459959916 Additional i Comments 2 461614217 Additional i	A: Confirmed B: - 160.808111 information: T A: Depth chan Member of produce det B: Depth chan Member of produce det 71.489665 information: T A: - B: - 129.293558 information: T	quadruple (K -57.895051 CGV-90, Gaia ages between s Cl VDBH 99 tected eclipses ges between s Cl VDBH 99 tected eclipses 4.829619 CGV-91, Gaia	EDR3 3 ostov et a A B EDR3 5 sectors; e - Open s as conta s as conta s as conta A B EDR3 3 A B	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination phemeris mig (galactic) Cl amination 1.054483 8.768239 28176850353 2.288076 9.365512	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea ght be slightly o uster; many nea 1439.1191 1438.7434 2006016, Tmag: 1518.9443	9.85, Tei 0.4969 0.5050 12.03, Tei ff; Contai rby stars ff; Contai rby stars 0.5030 0.5022 12.82, Tei 0.5414 0.5071	ff: 6592 140 100 eff: 848(minator but too minator but too 15 50 eff: 619' 20 75	K, Dist: 60 25 0 K, Dis for 4587 o faint to for 4587 o faint to 14 30 7 K, Dis 15 50	$\begin{array}{r} 358.89 \\ \hline 5.8 \\ 6.2 \\ t: 1829.9 \\ 740798; \\ 740798; \\ 1.5 \\ 4.4 \\ t: 1078.4 \\ \hline 3.7 \\ 7.8 \end{array}$	pc 5 6 94 pc 1 4 8 pc 4 7
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Additional i Comments 2 458740670 Additional i Comments 2 459959916 Additional i Comments 2 461614217 Additional i Comments 2	A: Confirmed B: - 160.808111 information: T A: Depth chan Member of produce det B: Depth chan Member of produce det 71.489665 information: T A: - B: - 129.293558 information: T	quadruple (K -57.895051 CGV-90, Gaia ages between s Cl VDBH 99 tected eclipses Cl VDBH 99 tected eclipses 4.829619 CGV-91, Gaia -43.823310 CGV-92, Gaia aded eclipses	EDR3 3 ostov et a A B EDR3 5 sectors; e - Open s as conta s as conta s as conta A B EDR3 3 A B	25565998145 al. 2021a) 6.2628 7.020700 35112731059 phemeris mig (galactic) Cl amination phemeris mig (galactic) Cl amination 1.054483 8.768239 28176850353 2.288076 9.365512	5492608, Tmag: 1573.606 2288.216 8407680, Tmag: ght be slightly o uster; many nea 1439.1191 1438.7434 2006016, Tmag: 1518.9443 1519.3945	9.85, Tei 0.4969 0.5050 12.03, Tei ff; Contai rby stars ff; Contai rby stars 0.5030 0.5022 12.82, Tei 0.5414 0.5071	ff: 6592 140 100 eff: 848(minator but too minator but too 15 50 eff: 619' 20 75	K, Dist: 60 25 0 K, Dis for 4587 o faint to for 4587 o faint to 14 30 7 K, Dis 15 50	$\begin{array}{r} 358.89 \\ \hline 5.8 \\ 6.2 \\ t: 1829.9 \\ 740798; \\ 740798; \\ 1.5 \\ 4.4 \\ t: 1078.4 \\ \hline 3.7 \\ 7.8 \end{array}$	pc 5. 6. 94 pc 1. 4. 8 pc 4. 7.

$$\label{eq:test} \begin{split} \text{TGV-N} &= \text{TESS/Goddard/VSG} \text{ quadruple candidate -N, } \text{Phase}_s = \text{Secondary phase, } \text{Dep}_n = \text{Depth of eclipse } n, \\ \text{Dur}_n &= \text{Duration of eclipse } n, \\ \text{Teff} = \text{Composite effective temperature, } \text{ppt} = \text{parts-per-thousand} \end{split}$$

	$\mathbf{R}\mathbf{A}$	Dec	Binary	Period	T ₀	$Phase_s$	Dep_p	Dep_s	Dur_p	Dur_s
-	degrees	degrees	-	d	BJD-2457000	-	ppt	ppt	hr	hr
			В	7.278400	1564.2055	0.2229	92	11	3.8	4.7
Additional	information: 7	GV-93, Gaia	EDR3 5	25826895374	3230976, Tmag:	12.97, T	eff: – K	, Dist: 1	184.02 p	oc
Comments	A: depth diffe	rences betwee	n sectors							
Comments	B: depth differ	rences betwee	n sectors							
470710327	357.329052	61.962787	А	1.104686	1765.1668	0.5025	60	50	5.8	5.5
			В	19.950922	1805.4542	-	70	_	_	_
Additional	information: 7	GV-94, Gaia	EDR3 2	01287672724	3918336, Tmag:	9.23, Te	ff: 8986	K, Dist	: 947.34	\mathbf{pc}
Comments	A: heavily-ble	nded eclipses;	Ellipsoid	al variations	3					
Comments	B: heavily-ble	nded eclipses;	measure	ments might	be slightly off					
141733685	129.855041	-47.360673	А	5.290886	1528.2575	0.4986	12	8	3.2	3.2
			В	7.372395	1525.0685	0.5587	220	130	5.5	6.9
			С	43.621521	1553.7523	0.4820	75	35	9.5	9.5
Additional	information: 7	GV-95, Gaia	EDR3 5	32939735737	4933760, Tmag:	11.82, T	eff: 129	37 K, D	ist: 1815	.40 pc
Comments	A: Potential o	n-target or co	-moving	sextuple (or	even a septuple); depth o	lifferenc	es betw	een	
	Cycle 1 and	d Cycle 3; pot	tential no	n-linear ET	Vs likely due to	dynamica	l intera	ctions w	vith bina	ry B;
	Measureme	ents based on	FITSCH	pipeline						
~	D. Dromin out	non lincon EU	TVa likola	duo to dun	amical interactio	na with l	inary A			
Comments	D: Prominent	non-inear El	L VS IIKely	uue to uyn	amicai mieracui	ms with i	лпагу г	1,		
Comments		ents based on	•	0	amicai interactio	ons with i	Jillary F	` ,		
		ents based on	FITSCH	pipeline	amicai interactio	nis with t	Jillary F	x ,		
	Measureme	ents based on	FITSCH	pipeline	2151.193		10			
Comments	Measureme C: Measureme	ents based on ents based on	FITSCH FITSCH	pipeline pipeline		- 0.5002		- 20	- 3.2	- 3.0
Comments	Measureme C: Measureme	ents based on ents based on	FITSCH FITSCH A	pipeline pipeline 1.305883	2151.193	_	10		- 3.2 3.4	
Comments 168789840	Measureme C: Measureme 63.520209	ents based on ents based on -31.922876	FITSCH FITSCH A B C	pipeline pipeline 1.305883 1.570013 8.217111	2151.193 2151.868	-0.5002 0.4991	10 40 55	20 10	3.4	
Comments 168789840 Additional	Measureme C: Measureme 63.520209	ents based on ents based on -31.922876	FITSCH FITSCH A B C EDR3 4	pipeline pipeline 1.305883 1.570013 8.217111 88295437043	2151.193 2151.868 2151.446	-0.5002 0.4991	10 40 55	20 10	3.4	
Comments 168789840 Additional	Measureme C: Measureme 63.520209 information: T A: Confirmed	ents based on ents based on -31.922876	FITSCH FITSCH A B C EDR3 4	pipeline pipeline 1.305883 1.570013 8.217111 88295437043	2151.193 2151.868 2151.446	-0.5002 0.4991	10 40 55	20 10	3.4	
Comments 168789840 Additional Comments	Measureme <u>C: Measureme</u> 63.520209 information: T A: Confirmed B: –	ents based on ents based on -31.922876	FITSCH FITSCH A B C EDR3 4	pipeline pipeline 1.305883 1.570013 8.217111 88295437043	2151.193 2151.868 2151.446	-0.5002 0.4991	10 40 55	20 10	3.4	
Comments 168789840 Additional Comments Comments	Measureme <u>C: Measureme</u> 63.520209 information: T A: Confirmed B: – C: –	ents based on ents based on -31.922876	FITSCH FITSCH A B C EDR3 4	pipeline pipeline 1.305883 1.570013 8.217111 88295437043	2151.193 2151.868 2151.446	-0.5002 0.4991	10 40 55	20 10	3.4	
Comments 168789840 Additional Comments Comments Comments	Measureme <u>C: Measureme</u> 63.520209 information: T A: Confirmed B: – C: –	ents based on ents based on -31.922876 TGV-96, Gaia sextuple (Pov	FITSCH FITSCH A B C EDR3 4 vell et al.	pipeline pipeline 1.305883 1.570013 8.217111 88295437043 2021)	2151.193 2151.868 2151.446 3742336, Tmag:	– 0.5002 0.4991 10.80, T	10 40 55 eff: 5730		3.4 st: – pc	3.3
Comments 168789840 Additional Comments Comments Comments	Measureme <u>C: Measureme</u> 63.520209 information: T A: Confirmed B: – C: –	ents based on ents based on -31.922876 TGV-96, Gaia sextuple (Pov	FITSCH FITSCH A B C EDR3 4 vell et al.	pipeline pipeline 1.305883 1.570013 8.217111 88295437043 2021) 4.446303	2151.193 2151.868 2151.446 3742336, Tmag: 1631.8797	- 0.5002 0.4991 10.80, T 0.4992	10 40 55 eff: 5730 40	20 10 0 K, Dis 25	3.4 et: - pc	3.3 4.9 4.9
Comments 168789840 Additional Comments Comments 1337279468	Measureme <u>C: Measureme</u> 63.520209 information: T A: Confirmed B: - <u>C: -</u> 252.514389	ents based on ents based on -31.922876 TGV-96, Gaia sextuple (Pov -44.034898	FITSCH FITSCH A B C EDR3 4 vell et al. A B C	pipeline pipeline 1.305883 1.570013 8.217111 88295437043 2021) 4.446303 5.939225 10.572127	2151.193 2151.868 2151.446 3742336, Tmag: 1631.8797 1635.2211 1650.3	- 0.5002 0.4991 10.80, T 0.4992 0.4999 0.3624	10 40 55 eeff: 5730 40 25 60	20 10 0 K, Dis 25 15 20	3.4 st: - pc 5.2 5.3 4.1	3.3 4.9 4.9 14.4
Comments 168789840 Additional Comments Comments 1337279468 Additional	Measureme <u>C: Measureme</u> 63.520209 information: T A: Confirmed B: - <u>C: -</u> 252.514389 information: T	ents based on ents based on -31.922876 FGV-96, Gaia sextuple (Pov -44.034898	FITSCH FITSCH A B C EDR3 4 vell et al. A B C EDR3 5	pipeline pipeline 1.305883 1.570013 8.217111 88295437043 2021) 4.446303 5.939225 10.572127 96441579687	2151.193 2151.868 2151.446 3742336, Tmag: 1631.8797 1635.2211 1650.3 6077952, Tmag:	- 0.5002 0.4991 10.80, T 0.4992 0.4999 0.3624 12.30, T	10 40 55 eff: 5730 40 25 60 eff: - K	20 10 0 K, Dis 25 15 20 , Dist: 9	3.4 st: - pc 5.2 5.3 4.1	3.3 4.9 4.9 14.4
Comments 168789840 Additional Comments Comments 1337279468 Additional	Measureme <u>C: Measureme</u> 63.520209 information: 7 A: Confirmed B: - <u>C: -</u> 252.514389 information: 7 A: Potential set	ents based on ents based on -31.922876 FGV-96, Gaia sextuple (Pov -44.034898 FGV-97, Gaia extuple/septu	FITSCH FITSCH A B C EDR3 4 vell et al. A B C EDR3 5 ple; Targ	pipeline pipeline 1.305883 1.570013 8.217111 88295437043 2021) 4.446303 5.939225 10.572127 96441579687 et nearly blocks	2151.193 2151.868 2151.446 3742336, Tmag: 1631.8797 1635.2211 1650.3 6077952, Tmag: ended with 1337	- 0.5002 0.4991 10.80, T 0.4992 0.4999 0.3624 12.30, T 279457 ar	10 40 55 eff: 5730 40 25 60 eff: - K ad 13372	20 10 0 K, Dis 25 15 20 , Dist: 9	3.4 st: - pc 5.2 5.3 4.1	3.3 4.9 4.9 14.4
Comments 168789840 Additional Comments Comments 1337279468 Additional	Measureme C: Measureme 63.520209 information: T A: Confirmed B: - C: - 252.514389 information: T A: Potential so $(\Delta T = 6.53)$	ents based on ents based on -31.922876 TGV-96, Gaia sextuple (Pow -44.034898 TGV-97, Gaia extuple/septu 3 mag, $\Delta T =$	FITSCH FITSCH A B C EDR3 4 vell et al. A B C EDR3 5 ple; Targ 7.25 mag	pipeline pipeline 1.305883 1.570013 8.217111 88295437043 2021) 4.446303 5.939225 10.572127 96441579687 et nearly ble); potential	2151.193 2151.868 2151.446 3742336, Tmag: 1631.8797 1635.2211 1650.3 6077952, Tmag:	- 0.5002 0.4991 10.80, T 0.4992 0.4999 0.3624 12.30, T 279457 ar	10 40 55 eff: 5730 40 25 60 eff: - K ad 13372	20 10 0 K, Dis 25 15 20 , Dist: 9	3.4 st: - pc 5.2 5.3 4.1	3.3 4.9 4.9 14.4
Comments 168789840 Additional Comments Comments 1337279468 Additional Comments	Measureme C: Measureme 63.520209 information: T A: Confirmed B: - C: - 252.514389 information: T A: Potential so $(\Delta T = 6.53)$ as a co-mo	ents based on ents based on -31.922876 FGV-96, Gaia sextuple (Pov -44.034898 FGV-97, Gaia extuple/septu 3 mag, ΔT = ving sextuple	FITSCH FITSCH A B C EDR3 4 vell et al. A B C EDR3 5 ple; Targ 7.25 mag	pipeline pipeline 1.305883 1.570013 8.217111 88295437043 2021) 4.446303 5.939225 10.572127 96441579687 et nearly ble); potential	2151.193 2151.868 2151.446 3742336, Tmag: 1631.8797 1635.2211 1650.3 6077952, Tmag: ended with 1337	- 0.5002 0.4991 10.80, T 0.4992 0.4999 0.3624 12.30, T 279457 ar	10 40 55 eff: 5730 40 25 60 eff: - K ad 13372	20 10 0 K, Dis 25 15 20 , Dist: 9	3.4 st: - pc 5.2 5.3 4.1	3.3 4.9 4.9 14.4
Comments 168789840 Additional Comments Comments 1337279468 Additional Comments	Measureme C: Measureme 63.520209 information: T A: Confirmed B: - C: - 252.514389 information: T A: Potential so $(\Delta T = 6.55)$ as a co-mov B: Potential E	ents based on ents based on -31.922876 FGV-96, Gaia sextuple (Pov -44.034898 FGV-97, Gaia extuple/septu 3 mag, ΔT = ving sextuple	FITSCH FITSCH A B C EDR3 4 vell et al. A B C EDR3 5 ple; Targ 7.25 mag	pipeline pipeline 1.305883 1.570013 8.217111 88295437043 2021) 4.446303 5.939225 10.572127 96441579687 et nearly ble); potential	2151.193 2151.868 2151.446 3742336, Tmag: 1631.8797 1635.2211 1650.3 6077952, Tmag: ended with 1337	- 0.5002 0.4991 10.80, T 0.4992 0.4999 0.3624 12.30, T 279457 ar	10 40 55 eff: 5730 40 25 60 eff: - K ad 13372	20 10 0 K, Dis 25 15 20 , Dist: 9	3.4 st: - pc 5.2 5.3 4.1	3.3 4.9 4.9 14.4

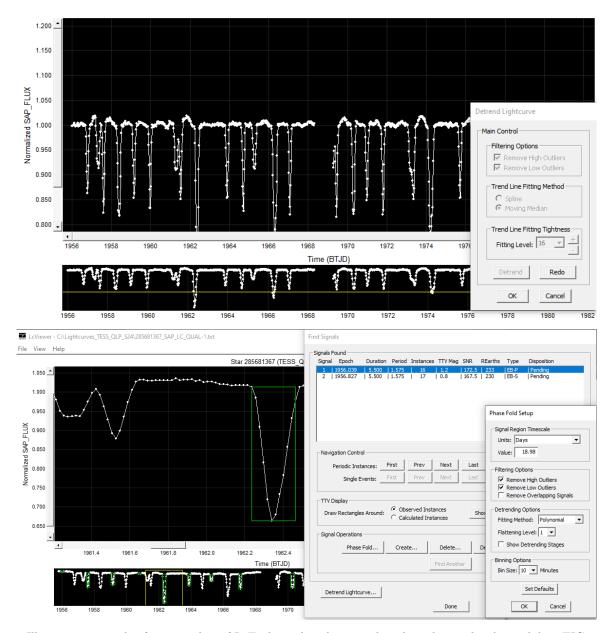


Figure 1. Illustrative example of a screenshot of LcTools used to detect and analyze the quadruple candidate TIC 285681367. The upper panels show the detrended *TESS* QLP lightcurve of the target, along with the detrending options. The lower panels show the phase-folding setup, options and results, as well as a zoomed-in section of the lightcurve centered on a particular eclipse used to fix the ephemeris.

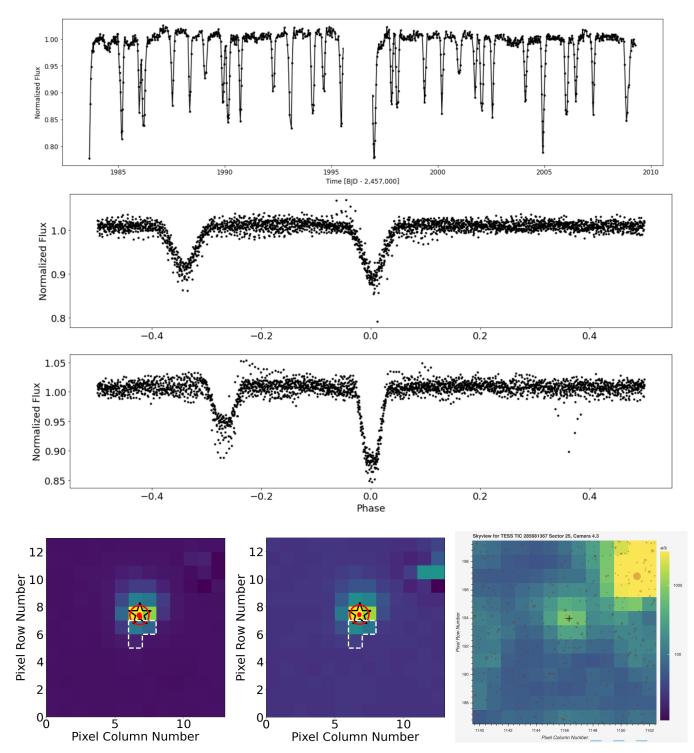


Figure 2. Upper panel: long-cadence *TESS* eleanor lightcurve of TIC 285681367, showing two sets of eclipses with period $P_A = 2.37$ days and $P_B = 3.97$ days. Second and third panels from top: Phase-folded lightcurve for binary A and binary B, respectively. For clarity, the lightcurve was disentangled such that the eclipses of the other binary were removed (Powell et al. 2021). Lower left and middle panels: *TESS* difference images $(13 \times 13 \text{ pixels})$ for P_A and PB, respectively, showing the pixels changing during the corresponding primary eclipses. The axes represent the corresponding relative pixel number along the x-axis (pixel column number) and y-axis (pixel row number). The small red symbols represent the measured photocenter for the individual primary eclipses of each respective binary and the large red circle shows the corresponding average photocenters. The black star is the catalog position of the target and the dashed contour represent eleanor's aperture used to extract the target's FFI lightcurve. Lower right panel: Skyview image (also 13×13 pixels) of the target's *TESS* aperture showing known nearby sources down to G = 21 mag. The photocenter analysis shows that both sets of eclipses are on-target.

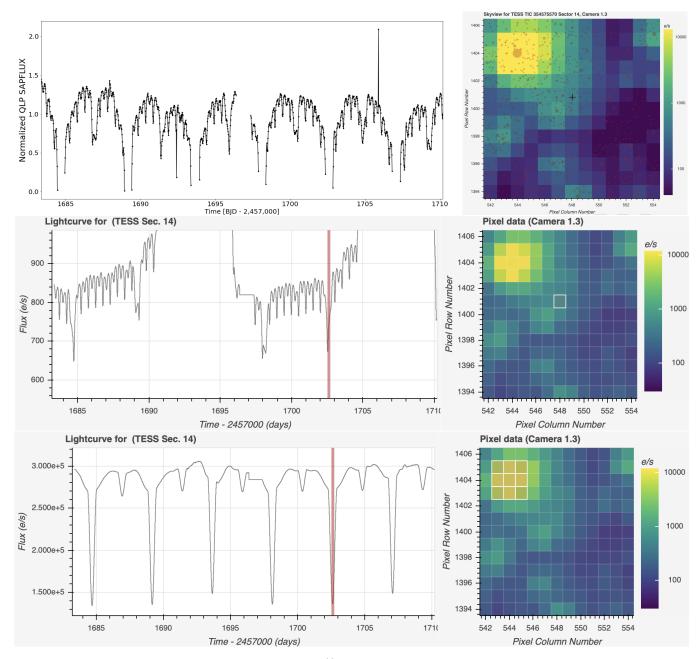


Figure 3. Example quadruple false positive for scenario (i) described in 3.1. First row, left panel: Sector 14 QLP lightcurve of TIC 354575570 as used by the visual surveyors for the detection of two apparent sets of eclipses. First row, right panel: 15×15 pixels Skyview image of the target's *TESS* aperture showing known nearby sources. Middle and lower rows: Lighkurve visualization of the selected pixels (white contours in right panels) and the corresponding lightcurve (left panels). The target is a quadruple false positive as one of the EBs is clearly off-target.

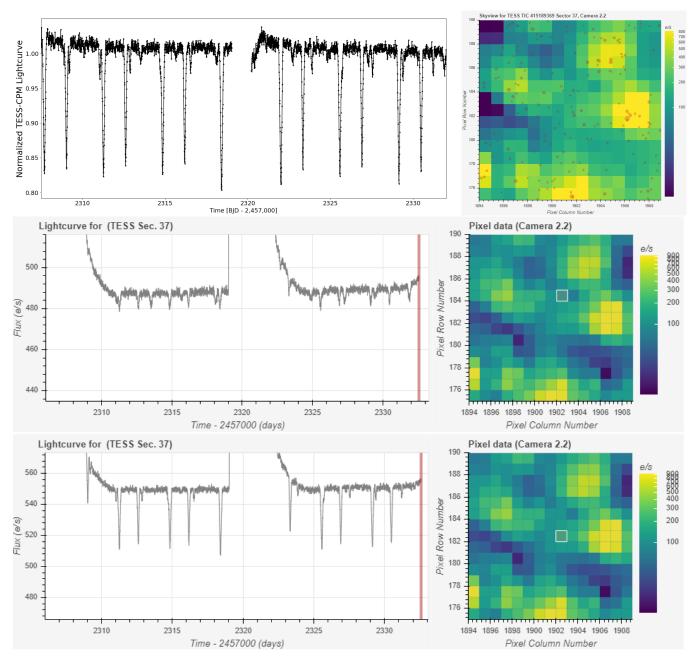


Figure 4. Same as Fig. 3 but for false positive scenario (ii). First row, left panel: TESS-CPM lightcurve for TIC 415189369 (Hattori et al. 2020, AAS, 23515705H). The target is a quadruple false positive as the relative depths of the two sets of eclipses scale differently depending on the selected pixel. Middle and lower rows: Lighkurve visualization of the selected pixels (white contours in right panels) and the corresponding lightcurve (left panels).

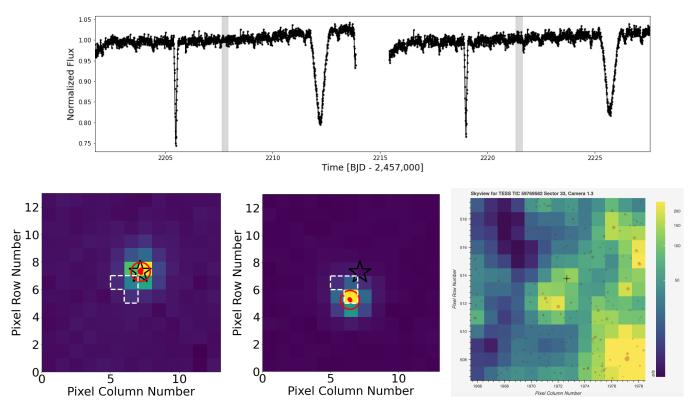


Figure 5. Long-cadence *TESS* eleanor lightcurve (upper panel) and photocenter analysis (lower left and middle panels) of TIC 59769582. The analysis shows that binary A with $P_A = 1.57$ days is on-target (lower left panel), while binary B with $P_B = 13.5$ days is off-target (lower middle panel), about 2 pixels SW of TIC 59769582. The lower right panel shows Skyview image of the *TESS* aperture for TIC 59769582 (at the center of the image, marked with a plus symbol), highlighting the source of the P_B eclipses (red arrow). This is an example of on-target EB + Field Star EB false positive.

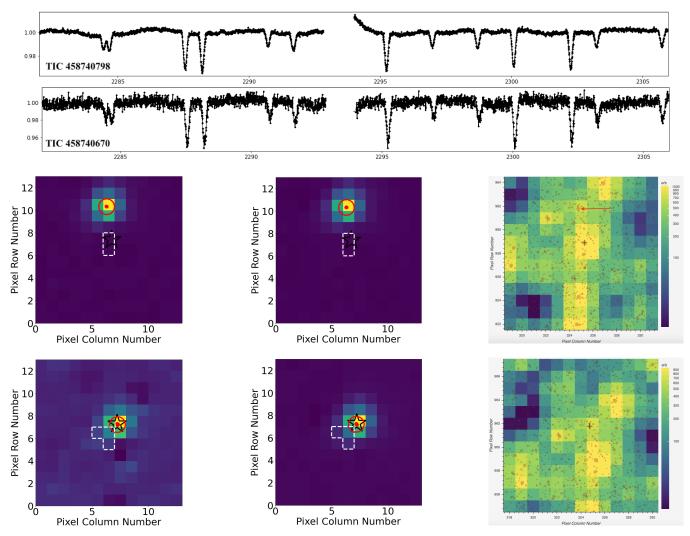


Figure 6. An example of a nominal false positive (TIC 458740798) caused by a genuine quadruple candidate (TIC 458740670) in the field. First row: Long-cadence *TESS* **eleanor** lightcurve of TIC 458740798 for Sector 36 (the false positive). Second row: same as first row but for TIC 458740670 (the quadruple). Note how all eclipses are deeper on TIC 458740670, already indicating that it is the source of the eclipses. Third row, left and middle panels: photocenter analysis for TIC 458740798, showing the difference images (left for binary A with P = 6.26-days, middle for binary B with P = 7.02-days), along with the PRF-based measurements of the individual photocenters (small red dots) and average photocenter (large open circle). The black star symbol indicates the catalog position of TIC 458740798. The measured photocenters are centered on a location about 3 pixels above TIC 458740798 – near the position of TIC 458740670. Third row, right panel: Skyview image of the *TESS* aperture for TIC 458740670 (red arrow). Fourth row: same as third row but for TIC 458740670 – a genuine quadruple candidate – showing that the measured photocenters coincide with the location of TIC 458740670. Note that Eleanor's aperture for TIC 458740670 is adjacent to the target and as a result the true eclipse depths are larger than those seen in the lightcurve (second row).



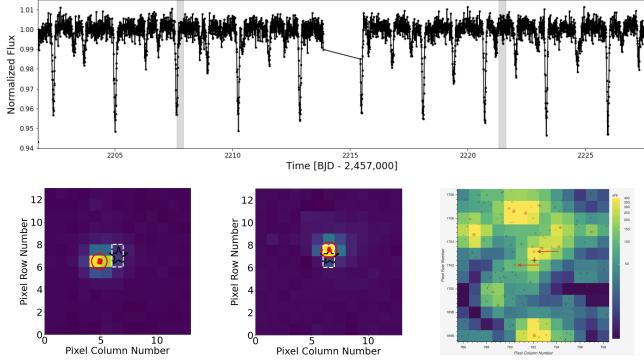


Figure 7. Same as Figure 5 but for TIC 262535168. The two EBs seen in the lightcurve originate from two different targets, neither of which is TIC 262535168, as highlighted on the Skyview image. This is an example of a false positive due to field EB (star 1) + field EB (star 2).

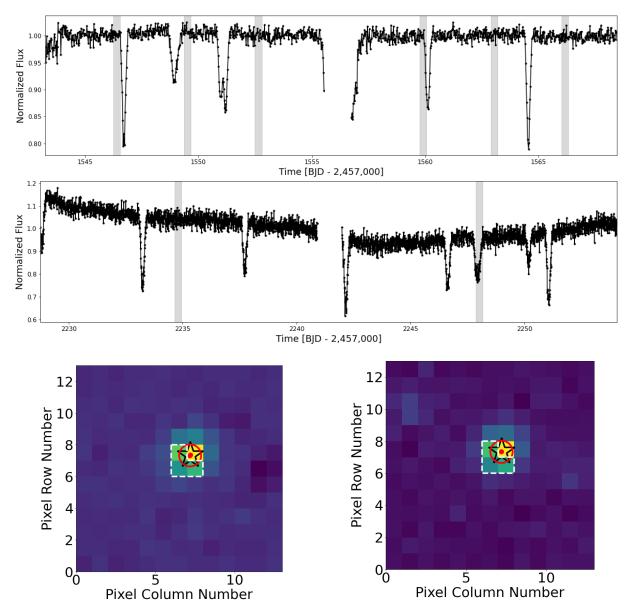


Figure 8. First and second row: Long-cadence *TESS* eleanor lightcurve of TIC 53201931, a triply-eclipsing triple star producing a pair of tertiary elipses in Sector 9 (first row, 30-min cadence) and in Sector 34 (second row, 10-min cadence). Third row, left and right panels: photocenter measurements for the inner binary (left, with a period of 8.9-days) and for the third star (right, with a period that is \sim 700/N, where N is an integer). Note how the pair of tertiary eclipses change shape and order – the "smoking gun" signature of a third star orbiting the EB. This is an example of on-target false positive quadruple due to a triple star.

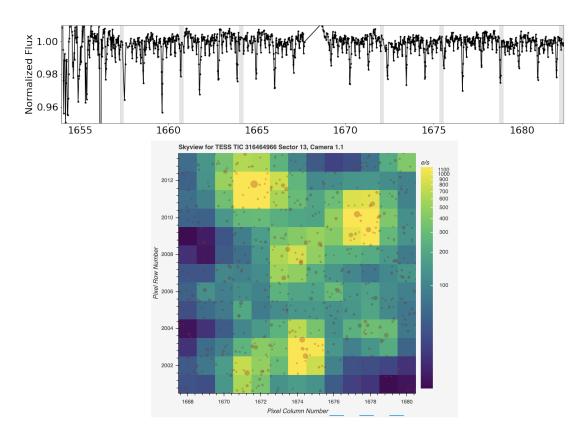


Figure 9. Upper panel: Long-cadence *TESS* eleanor lightcurve of PTIC 316464966 showing two sets of eclipses, with periods of P1 = 1.06 days and P2 = 0.24 days. The *TESS* Input Catalog lists two stars separated by about 1.11 arcsec, TIC 1821336783 and TIC 1821336772, with respective magnitudes of T = 13.83 mag and T = 14.27 mag. Either star can produce either set of eclipses, and the separation between them is too small for reliable photocenter measurements. This is an example of a potential false positive due to blended stars that are too far apart to be of interest for this study (in this case ~ 1000 AU).

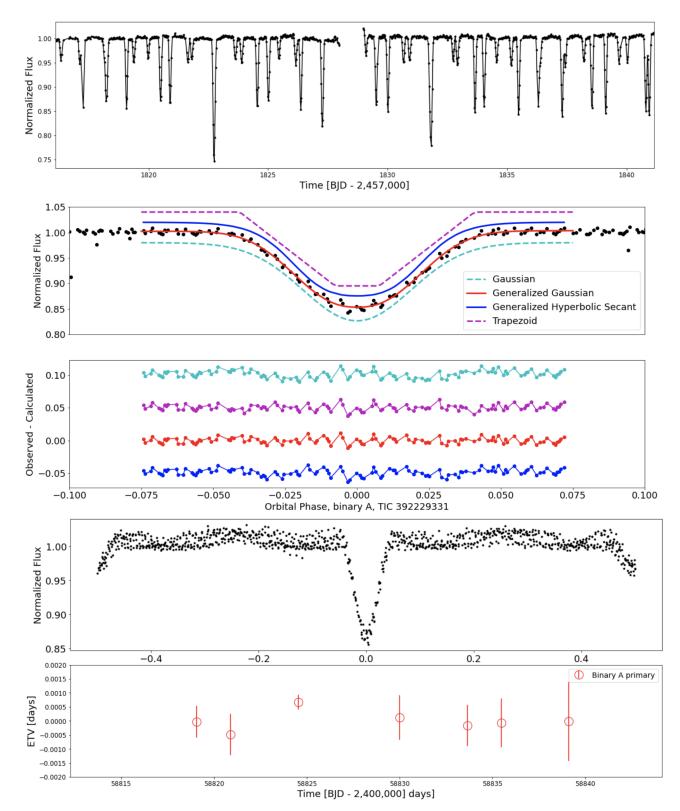


Figure 10. Upper panel: lightcurve for quadruple candidate TIC 392229331 exhibiting four sets of eclipses with two different periods. Second panel from top: Trapezoid (magenta), gaussian (cyan), generalized gaussian (red) and generalized hyperbolic secant (blue) fits to the phase-folded, primary eclipses of Binary A (zoomed-in on phase between -0.1 and 0.1). The blended eclipses have been removed and the lightcurve has been detrended. The magenta, blue, and cyan curves are vertically offset for clarity. Third panel from top: Residuals, in terms of (observed-calculated), for the four respective functions. Fourth panel from top: the undetrended, phase-folded lightcurve of binary A using the ephemeris determined by the fits to the individual eclipses. The secondary eclipse is clearly-distinguished. The eclipses of Binary B have been removed for clarity; Last panel: measured eclipse timing variations for the primary eclipses of Binary A, showing no significant trends.

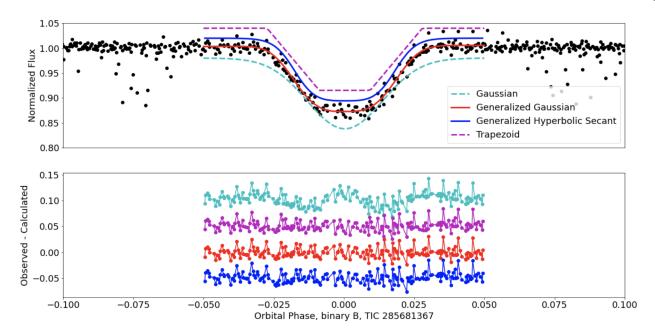


Figure 11. Same as second and third panels in Figure 10 but for a primary eclipse of binary B of TIC 285681367 (see Fig. see 2). Here the generalized Gaussian and hyperbolic secant functions are clearly the better representation of the eclipse compared to a Gaussian. The flatter/sharper the eclipse bottom is, the better the former two fit the data.

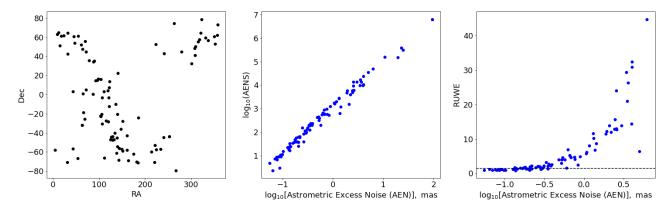


Figure 12. Left panel: RA and Dec of the quadruple candidates in this catalog. Middle panel: The respective astrometric_excess_noise (AEN) and astrometric_excess_noise_sig (AENS) as measured by Gaia. We note that both are on a logarhitmic scale. Right panel: Corresponding distribution of the renormalized unit weight error (RUWE) as a function of the astrometric_excess_noise. The dashed horizontal line indicates RUWE = 1.5, the value above which the astrometry is likely affected by a presumptive wide companion.

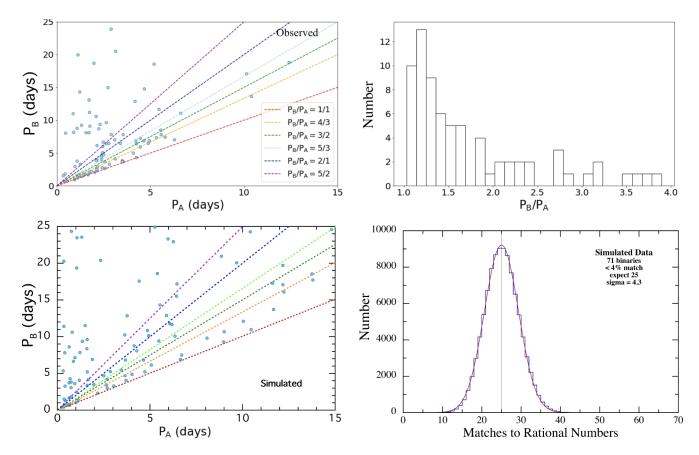


Figure 13. Upper left: Measured period ratios between P_B and P_A for the 97 quadruple candidates from *TESS* that pass vetting tests, compared to select integer ratios. Upper right: Distribution of the number of systems with periods ratio P_A/P_B smaller than 4 (72 out of 97 systems). Lower left: Same as upper left but for a simulated set of systems. Lower right: Number of simulated systems with period ratios that match to within 4% one of the rational numbers 1:1, 5:4, 4:3, 3:2, 5:3, 2:1, 5/2, or 3:1. See text and Table 3 for details.

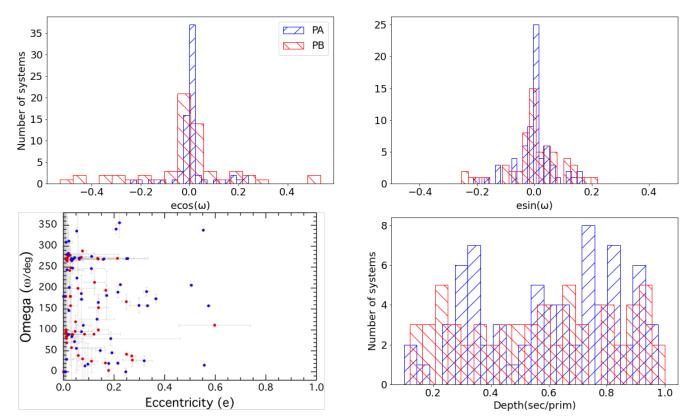


Figure 14. Upper panels: Measured $e\cos(\omega)$ (left panel) and $e\sin(\omega)$ (right panel) for the corresponding binary A (blue) and B (red) for each quadruple candidate exhibiting both primary and secondary eclipses. Most $e\cos(\omega)$ and $e\sin(\omega)$ ratios cluster around zero. Lower left panel: Corresponding eccentricity and omega values with the associated measured uncertainties, calculated by propagating the uncertainties in $e\cos(\omega)$ and $e\sin(\omega)$ into those for e and ω . Lower right panel: Eclipse depth ratios, showing no clear preference.



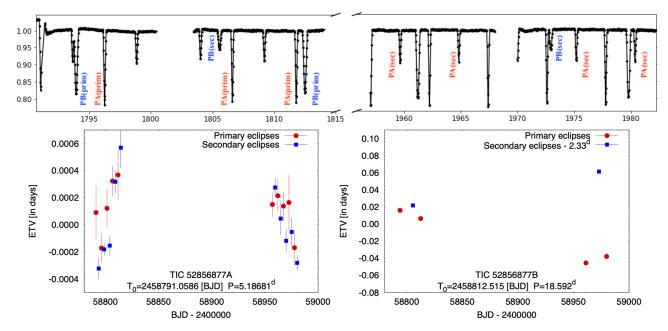


Figure 15. Upper panel: FFI lightcurve of quadruple candidate TIC 52856877. The system consists of two EBs with $P_A = 5.1868$ and $P_B = 18.5864$ days, highlighted in the figure. Lower panels: Measured eclipse-time variations for P_A (left panel) and P_B (right panel), indicating dynamical interactions between the two binaries and suggesting that the system is gravitationally-bound.

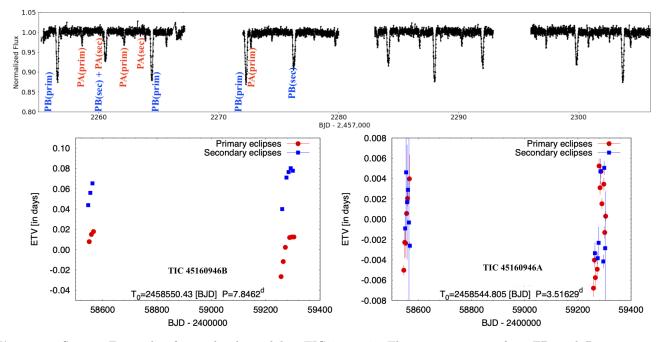


Figure 16. Same as Fig. 15 but for quadruple candidate TIC 45160946. The system consists of two EBs with $P_A = 3.5163$ and $P_B = 7.8462$ days, highlighted in the figure. Lower panels: Measured eclipse-time variations for P_A (left panel) and P_B (right panel), indicating dynamical interactions between the two binaries and suggesting that the system is gravitationally-bound.

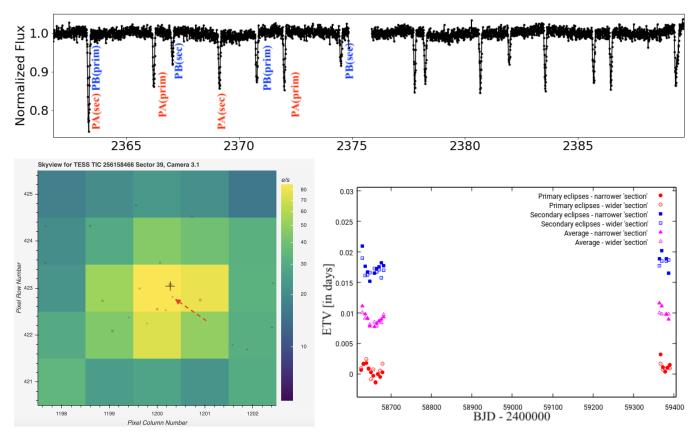


Figure 17. Upper panel: Same as Fig. 15 but for quadruple candidate TIC 256158466. The system consists of two EBs with $P_A = 5.7745$ and $P_B = 7.4544$ days, highlighted in the figure, both on-target. Lower left panel: Skyview image of the target for Sector 39, showing all Gaia sources down to G = 21 mag. We note that compared to Skyview images shown above, here the image is zoomed-in to a size of 5×5 pixels in order to highlight the position of the nearby field star TIC 1508756606 (5.65 arcsec separation, $\Delta T \approx 4.8$ mag fainter, marked with dashed red arrow). TIC 1508756606 has parallax and proper motion within one sigma of those of the target star and thus might be in a co-moving quintuple system with the quadruple TIC 256158466. Third panel: Measured eclipse-time variations for P_A using two lightcurve sections centered on each eclipse – narrow and wide – show potential sine-like variations only in the former case.

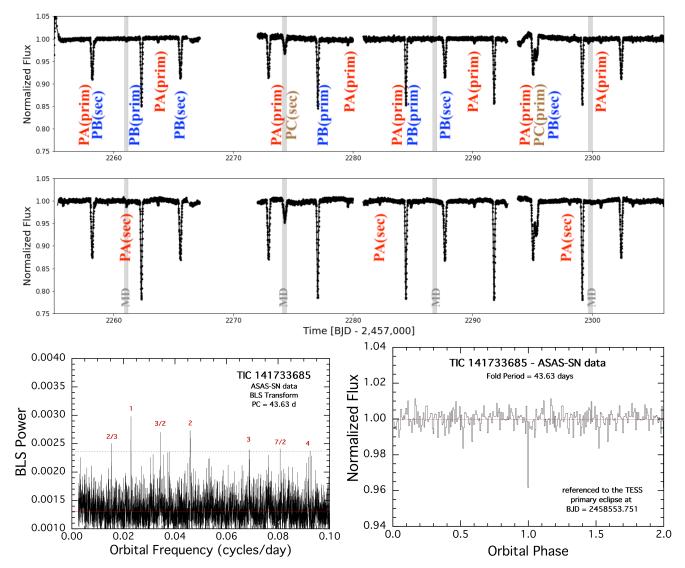


Figure 18. First panel from top: Same as Fig. 17 but for quadruple candidate TIC 141733685, showing the Sectors 35 and 36 eleanor data. The target exhibits three EBs with $P_A = 5.29$ days, $P_B = 7.37$ days, and $P_C = 43.63$ days, as highlighted in the figure. Second panel: same as first panel but showing the FITSH lightcurve; Lower left panel: BLS transform of the All-Sky Automated Survey for Supernovae (ASAS-SN) archival data for TIC 141733685 after removing binary A from the data train. The transform is plotted as a function of frequency in order to better identify harmonics. The orbital period of binary C is found to be 43.63 days ($\nu = 0.02292$ cycles/day). This peak is marked as "1" for the first harmonic. Other harmonics and subharmonics are also marked in red. Nearly all of the highest peaks (i.e., above the dotted line) are due to this period or its associated harmonics. Lower right panel: Folded, binned, and averaged lightcurve from the ASAS-SN archival data. There are 150 phase bins in the plot, each corresponding to ~0.3 days. The phasing is referenced to one of the *TESS* detected primary eclipses.

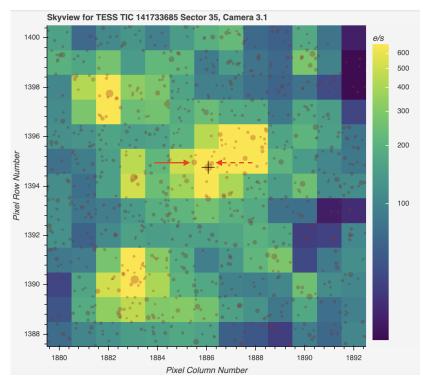


Figure 19. Skyview image of TIC 141733685 (black plus symbol) for Sector 35, showing all Gaia sources brighter than G = 21 mag. There is a nearby field star, TIC 141733688 (dashed arrow), separated from the target by 4.53 arcsec, and with magnitude difference $\Delta T \approx 3.15$ mag. Another field star, TIC 141733701 (solid arrow), has a separation of 12.6 arcsec and magnitude difference $\Delta T \approx 2.03$ mag. TIC 141733685 and TIC 141733688 have comparable parallax and, to a lesser degree, proper motion. See text for details.

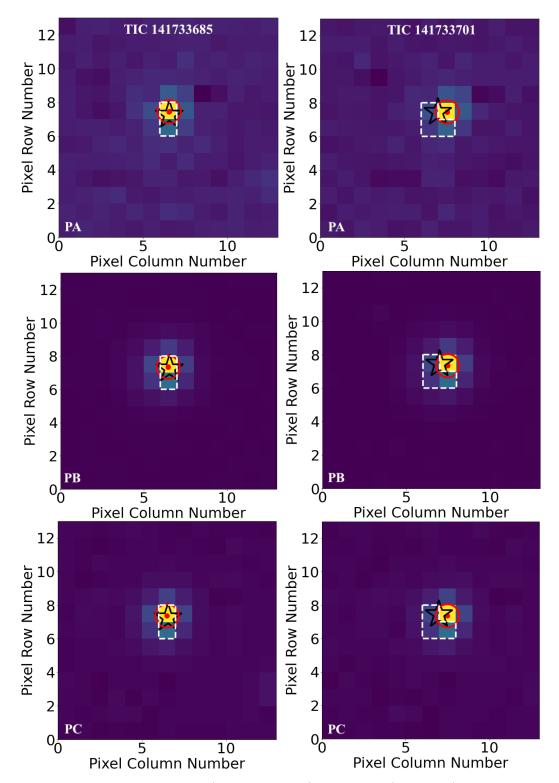


Figure 20. Photocenter analysis for $P_A = 5.29$ d (first row from top), $P_B = 7.37$ d (second row), and $P_C = 43.63$ d (third row) for TIC 141733685 (left panels), and the nearby field star TIC 141733701 (right panels) using Sector 35 data. The panels show the corresponding difference images along with the location of the respective target on the detector (black star, label "TIC"), the measured per-eclipse photocenters (small red symbols, label "Indiv Cent") and the average photocenters (large red symbols, label "Avg Cent"). The dashed white contours indicate the aperture used by eleanor for the respective target. For PC, there is a single eclipse detected in this sector (see Fig. 18), corresponding to a single photocenter measurement. Our analysis clearly rules out TIC 141733701 as a potential source of PA, PB, and P_C (right panels), and confirms that all three EBs are associated with TIC 141733685 (left panels). We note that the sky orientation of Fig. 19 is flipped along the x-axis (i.e. $x \rightarrow -x$) with respect to the images shown here.

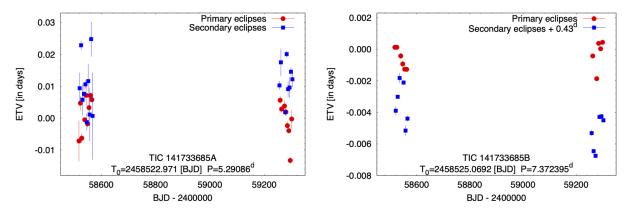


Figure 21. Measured ETVs for P_A (left) and P_B (right) for TIC 141733685, showing non-linear effects and indicating that the that the two are likely to be gravitationally-bound.



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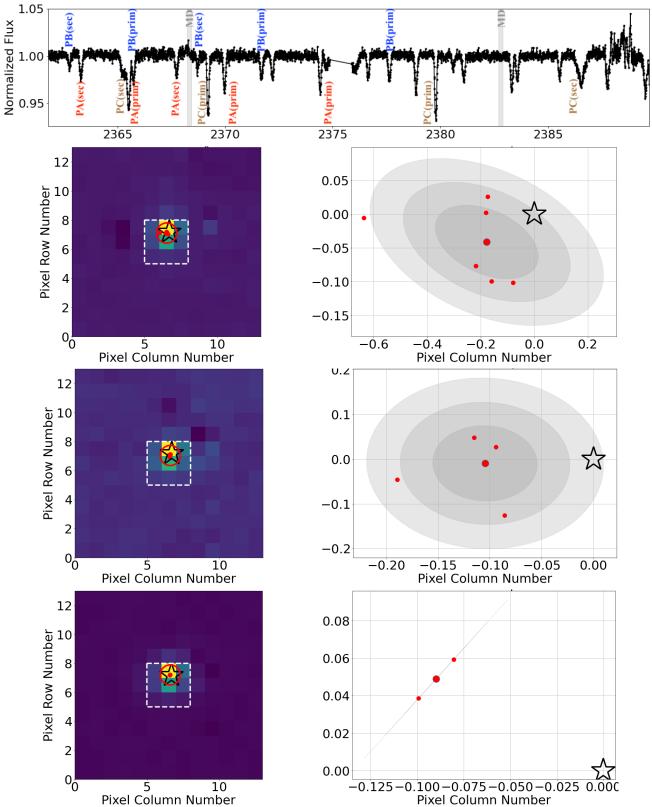


Figure 22. Upper panel: eleanor lightcurve for sextuple candidate TIC 1337279468, showing the Sector 39 data. The target exhibits three EBs with $P_A = 4.45$ days, $P_B = 5.94$ days, and $P_C = 10.57$ days, as highlighted in the panel. Second, third and fourth rows: Photocenter analysis of TIC 1337279468 for P_A (second row), P_B (third row) and P_C (fourth row) for Sector 39. The right panels show zoom-ins on the central pixel along with the corresponding confidence intervals (grey colors, $1-, 2-, 3-\sigma$, respectively) of the scatter in the measured photocenters. We note that there are only two eclipses of binary P_C in this sector, corresponding to two measured photocenters and thus the measured offset of 0.1 pixels (4th row, right panel) is not significant. Thus all three EBs originate from TIC 1337279468.

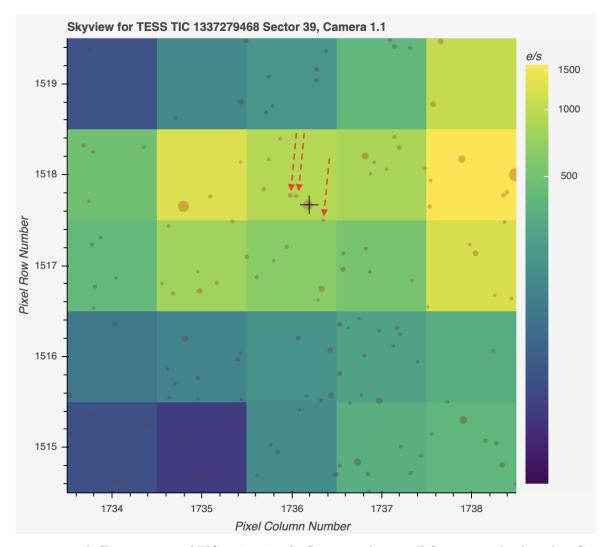


Figure 23. 5×5 pixels Skyview image of TIC 1337279468 for Sector 39, showing all Gaia sources brighter than G = 21 mag. There are three nearby field stars (TIC 1337279457, TIC 1337279471, and TIC 1337279458), all with separations of ~ 4 - 5 arcsec and magnitude differences $\Delta T = 5.5 - 6$ mag each (marked with dashed red arrows). None of them is bright enough to produce any of the eclipses seen in the target's lightcurve. The coordinates, parallax and proper motion for TIC 1337279468 and TIC 1337279471 are within ~ 1 σ , suggesting a potential co-moving septuple system.

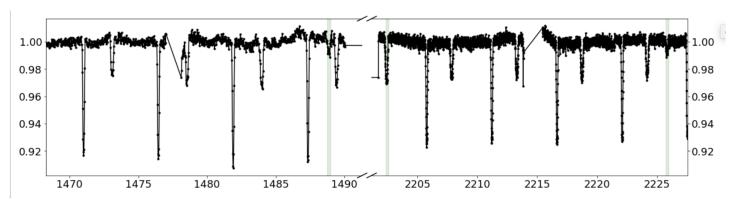


Figure 24. Lightcurve of TIC 438226195, highlighting the extra events in Sectors 6 and 33 (first and last green vertical bands) that mimic a circumbinary planet. Close inspection shows that the two events are due to a second EB with a period of ~ 11.7 days, with a third event blended with the first secondary eclipse in Sector 33 (second vertical green band), slightly deeper compared to the other secondaries in Sector 33.

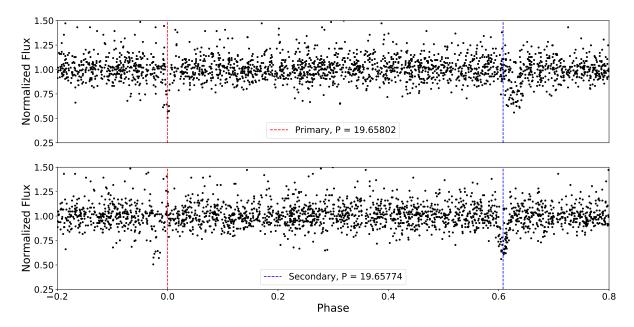


Figure 25. Phase-folded DASCH data of TIC 172900988 – an eclipsing binary hosting a transiting circumbinary planet. The upper panel shows the data folded on the primary eclipse (dashed red line) and the lower panel shows the data folded on the secondary eclipse (dashed blue line). The two eclipses follow slightly different periods due to the apsidal motion of the binary caused by dynamical perturbation from the planet.

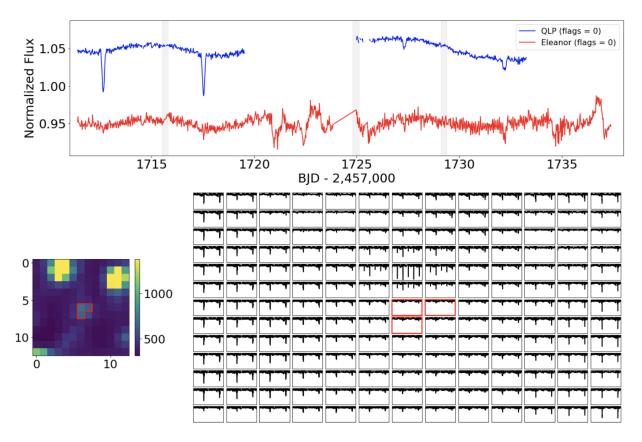


Figure 26. Upper panel: eleanor (red) and QLP (blue) lightcurves for TIC 13120007, showing clear eclipses in the latter but no eclipses in the former. The vertical grey bands indicate momentum dumps. Lower left panel: TESS' 13×13 pixels field of view centered on the target. The red contour indicates the aperture used by eleanor to extract the lightcurve. Lower right panel. Pixel-by-pixel eleanor data for TIC 13120007 showing that the source of the EB is 2 pixels above the target.

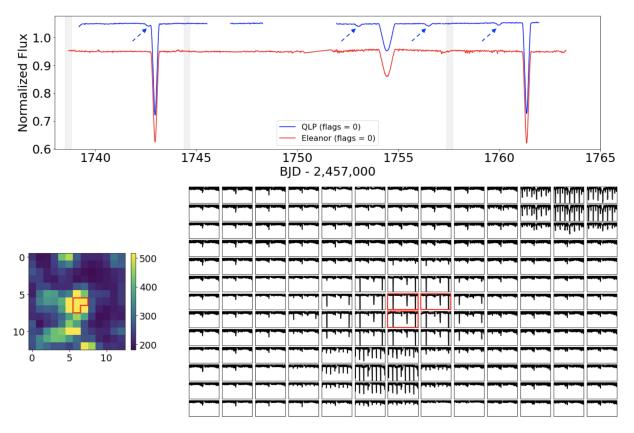


Figure 27. Same as Fig. 26 but for TIC 63708251. A potential quadruple candidate in QLP data (see blue curve in upper panel, and blue arrows) which is a false positive due to a nearby EB located about 5 pixels below the target. The vertical grey bands indicate momentum dumps. We note that there is another EB in the upper right corner of the pixel field of view.

	TIC	Period	Т0	RA	Dec	Sectors Obs	Comments
-	63459761	4.3621	1683.8108	308.5251	41.1359	14-15	$\operatorname{contamination}$
	63459765	4.3621	1683.8113	308.5181	41.1355	14-15, 41	
	63459804	4.3621	1683.8125	308.5183	41.1309	14-15, 41	
_	63459811	4.3620	1683.8125	308.5300	41.1297	14-15, 41	
	283940788	0.8768	1765.3137	8.8514	62.9015	17-18, 24	coincidence
	285609529	0.8767	1683.7647	296.2538	26.1412	14, 40-41	
_	285609535	0.8767	1683.7647	296.2518	26.14063	14, 40-41	
	370440624	2.2350	1572.7416	143.2320	-68.6811	9-11, 36-38	coincidence
	451982722	2.2334	1684.4948	296.5768	27.0600	14, 41	
_	451982756	2.2334	1684.4950	296.5829	27.0637	14, 41	

Table 2. Ephemerides cross-match between the quadruple candidates presented here and $\sim 30,000$ unvetted EB candidates from the GSFC *TESS* EB Catalog (Kruse et al. in prep)

Percentage	Observed	Simulated		
1%	7	6 ± 2		
2%	13	12 ± 3		
4%	24	25 ± 4		
8%	47	50 ± 6		

Table 3. Observed vs simulated numbers of systems with period ratios P_B/P_A within the listed percentage of 1:1, 5:4, 4:3, 3:2, 5:3, 2:1, 5:2, and 3:1.

TIC	Tmag	$Depth_A(\%)$	$Depth_B(\%)$	TIC	Tmag	$Depth_A(\%)$	Depth _B (
97356407	6.46	2	14	309025182	10.87	8	11
357810643	7.03	2	8	89278612	10.88	5	11
344541836	7.77	4	3	79140936	10.90	2	40
367448265	7.83	2	20	63459761	10.93	2	7
200094011	8.66	18	23	274791367	10.97	11	11
146810480	8.67	2	13	78568780	11.05	6	3
470710327	9.23	6	7	408147984	11.10	6	2
257776944	9.42	12	3	239872462	11.14	6	6
286470992	9.60	2	20	25818450	11.14	1	8
307119043	9.77	7	9	314802266	11.18	7	26
311838200	9.82	15	5	370440624	11.34	5	5
260056937	9.85	23	2	125952257	11.36	14	3
454140642	9.85	10	10	336882813	11.40	1	6
278352276	10.00	12	8	348651800	11.40	1	6
317863971	10.24	14	6	283940788	11.47	3	16
250119205	10.25	5	8	251757935	11.51	11	11
461614217	10.32	2	7	266771301	11.51	1	0
392229331	10.34	15	14	284814380	11.54	18	7
255532033	10.34	14	8	178953404	11.62	4	11
389836747	10.36	18	2	190895730	11.63	8	4
139944266	10.36	1	4	264402353	11.65	2	1
399492452	10.39	0	21	271186951	11.78	8	28
434452777	10.56	7	7	414475823	11.79	14	21
73296637	10.57	1	2	285681367	11.80	14	13
328181241	10.57	15	17	141733685	11.82	1	8, 22
439511833	10.58	4	8	321471064	11.91	8	6
414026507	10.61	7	13	161043618	11.91	8	5
52856877	10.62	22	20	130276377	11.93	7	4
322727163	10.65	4	11	391620600	11.95	9	2
139650665	10.74	11	3	285655079	11.96	22	11
123098844	10.79	4	8	9493888	11.98	15	9
168789840	10.80	1	4, 6	427092089	11.98	1	1
204698586	10.84	4	12				

Table 4. Quadruple candidates brighter than Tmag = 12 and eclipse depths greater than 1% (sorted by magnitude).