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Discovery of the Longest-period Classical Cepheid in the Milky Way

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Abstract

We report the discovery of the classical Cepheid OGLE-GD-CEP-1884 (= GDS_J1535467-555656) with the longest pulsation period known in our Galaxy. The period of 78.14 days is nearly 10 days longer than that of the previous record-holding Cepheid, S Vulpeculae, and thus, OGLE-GD-CEP-1884 can be categorized as the first ultra-long-period Cepheid in the Milky Way. This star is present in the ASAS-SN and Gaia DR3 catalogs of variable stars, but it has been classified as a long-period variable in those catalogs. Based on more than 10 yr of the photometric monitoring of this star carried out by the OGLE project in the *I* and *V* bands and a radial velocity curve from the Gaia Focused Product Release, we unequivocally demonstrate that this object is a fundamental-mode classical Cepheid. By employing the mid-infrared period–luminosity relation, we determine the distance to OGLE-GD-CEP-1884 (4.47 ± 0.34 kpc) and place it on the Milky Way map, along with about 2400 other classical Cepheids. We also discuss the potential of finding additional ultra-long-period Cepheids in our Galaxy.

Unified Astronomy Thesaurus concepts: Cepheid variable stars (218); Delta Cepheid variable stars (368); Cepheid distance (217)

1. Introduction

The Optical Gravitational Lensing Experiment (OGLE) is a long-term sky survey involving regular photometric observations of about 2 billion stars in our Galaxy and in the Magellanic Clouds (Udalski et al. 2015). One of the major achievements of the project is the OGLE Collection of Variable Stars (OCVS)—a catalog currently comprising approximately 1.1 million variable stars of various types. Compared to other modern large catalogs of variable stars, OCVS distinguishes itself through the method used for object classification, which relies on the visual inspection of light curves. Thanks to this traditional approach, the OGLE group has identified several new classes and subclasses of variable stars, e.g., peculiar W Virginis stars (Soszyński et al. 2008), anomalous double-mode RR Lyrae stars (Soszyński et al. 2016), or Blue Large-Amplitude Pulsators (Pietrukowicz et al. 2017).

The extensive OGLE databases have been utilized to discover about half of the classical Cepheids currently known in the Milky Way (Udalski et al. 2018; Soszyński et al. 2020; Pietrukowicz et al. 2021). Classical Cepheids (also known as δ Cephei variables or type I Cepheids) are relatively young ($\lesssim$400 Myr) and luminous (10^2–$10^5\,L_\odot$) radially pulsating stars, 4–20 times more massive than the Sun. The best-known characteristic of Cepheids is the period–luminosity relation (Leavitt law) they fulfill, which is commonly employed for measuring intergalactic distances (e.g., Riess et al. 2016) and studying the structure of galaxies (e.g., Skowron et al. 2019a, 2019b). The pulsation periods of fundamental-mode Cepheids range from 1 to over 200 days, but the majority oscillate with periods below 10 days. Above this limit, the number of Cepheids decreases with increasing periods. The longest-period classical Cepheid known so far in our Galaxy was S Vulpeculae (Fernie 1970; Pietrukowicz et al. 2021), with a period of 68.65 days.

Recently, Gaia Collaboration et al. (2023) published radial velocity curves for 9614 stars classified as long-period variables (LPVs), or, in other words, pulsating red giants. Most of these objects are relatively bright, above the saturation limit of the OGLE photometry ($I \approx 11$ mag). Nevertheless, we successfully extracted OGLE light curves for over 1000 stars from this list. A visual inspection of these data confirmed that the vast majority of them are indeed LPVs. However, one variable object, with a period of 78.14 days, drew our special attention due to the distinctive morphology of its light curve.

OGLE-GD-CEP-1884 (also known as GDS_J1535467-555656, ASASSN-V J153546.74-555656.1, Gaia DR3 5883587875302126592; hereafter OGLE-GD-CEP-1884) was first identified as a variable star (albeit without a specific classification) by Hackstein et al. (2015) based on photometric data acquired during the Bochum Galactic Disk Survey. Then, Jayasinghe et al. (2019) examined the light curve of this star from the All-Sky Automated Survey for Supernovae (ASAS-SN) and categorized it as a semiregular variable—one of the subclasses of LPVs. Finally, this object was included in the Gaia Data Release 3 (DR3) catalog of variable stars (Lebzelter et al. 2023), where it was also classified as an LPV. In this Letter, we demonstrate that the ASAS-SN and Gaia classifications of OGLE-GD-CEP-1884 are incorrect. The shapes of the light and radial velocity curves unequivocally indicate that it is a classical Cepheid with the longest pulsation period known in the Milky Way. Up to now, this star has been absent from the OGLE collection of classical Cepheids (Udalski et al. 2018; Soszyński et al. 2020) because the OGLE search for Cepheids was restricted to objects with periods shorter than 50 days. In Table 1, we provide basic observational parameters of OGLE-GD-CEP-1884, including its equatorial and Galactic coordinates, pulsation period, mean magnitudes in various passbands,

Table 1
Parameters of OGLE-GD-CEP-1884

R.A. (J2000.0):	15:35:46.70
Decl. (J2000.0):	−55:56:56.4
Galactic longitude (deg):	324.522733
Galactic latitude (deg):	−0.125534
Pulsation period (day):	78.140 ± 0.011
Mean *V*-band magnitude (OGLE):	16.83
Mean *I*-band magnitude (OGLE):	11.40
Mean *G*-band magnitude (Gaia):	12.84
Mean *J*-band magnitude (2MASS):	7.47
Mean *H*-band magnitude (2MASS):	6.14
Mean K_S-band magnitude (2MASS):	5.51
Parallax (Gaia) (mas):	0.176 ± 0.077
Proper motion (Gaia) (mas yr^{-1}):	5.88 ± 0.08
Mean radial velocity (Gaia) (km s^{-1}):	-72.3 ± 0.4
Velocity component *U* (km s^{-1}):	-9.9 ± 8.5
Velocity component *V* (km s^{-1}):	220.8 ± 3.9
Velocity component *W* (km s^{-1}):	-3.4 ± 1.8

parallax, proper motion, and mean radial velocity from Gaia DR3.

2. Observational Data

The *VI*-band observations of OGLE-GD-CEP-1884 were obtained as part of the OGLE-IV survey (Udalski et al. 2015) carried out with the 1.3 m Warsaw Telescope at Las Campanas Observatory in Chile. The telescope is equipped with a mosaic camera comprising 32 CCD chips with a pixel scale of 0.″26 and a total field of view of 1.4 degrees^2. Around 180 *I*-band observations of our target were secured between 2013 May and 2024 March, with a break of more than 2 yr (2020–2022) during the COVID-19 pandemic. The integration time of the *I*-band observations was 30 s. In the *V*-band filter, a total of 26 data points were collected, including 12 measurements obtained in the years 2010–2011, 5 observations in 2015–2016, and 9 points gathered between 2024 January and March. The initial *V*-band observations were conducted with an integration time of 180 s. Then, starting from 2015, the exposure time was reduced to 30 s. A comprehensive description of the instrumentation, photometric reductions, and astrometric calibrations of the OGLE-IV data can be found in the work of Udalski et al. (2015).

3. Classification of OGLE-GD-CEP-1884

The upper and middle panels of Figure 1 display the *I*- and *V*-band light curves of OGLE-GD-CEP-1884, folded with a period of 78.14 days. Throughout more than a decade of OGLE photometric monitoring, the period, amplitudes, and shapes of the light curves have consistently remained stable, exhibiting only slight fluctuations (up to ± 0.04 mag in the *I* band) in average brightness. These fluctuations manifest as the minor scattering of points in the light curves presented in Figure 1. Such variations could be attributed to observational errors or may indicate actual changes occurring within the star or in the circumstellar and interstellar matter between us and the object.

The orange curves drawn together with the points in Figure 1 do not depict arbitrary functions fitted to the OGLE photometry. Instead, they represent template light curves of a classical Cepheid with a period of 78.14 days, calculated using the code provided by Pejcha & Kochanek (2012). Fitting these model light curves to the observations only involved scaling

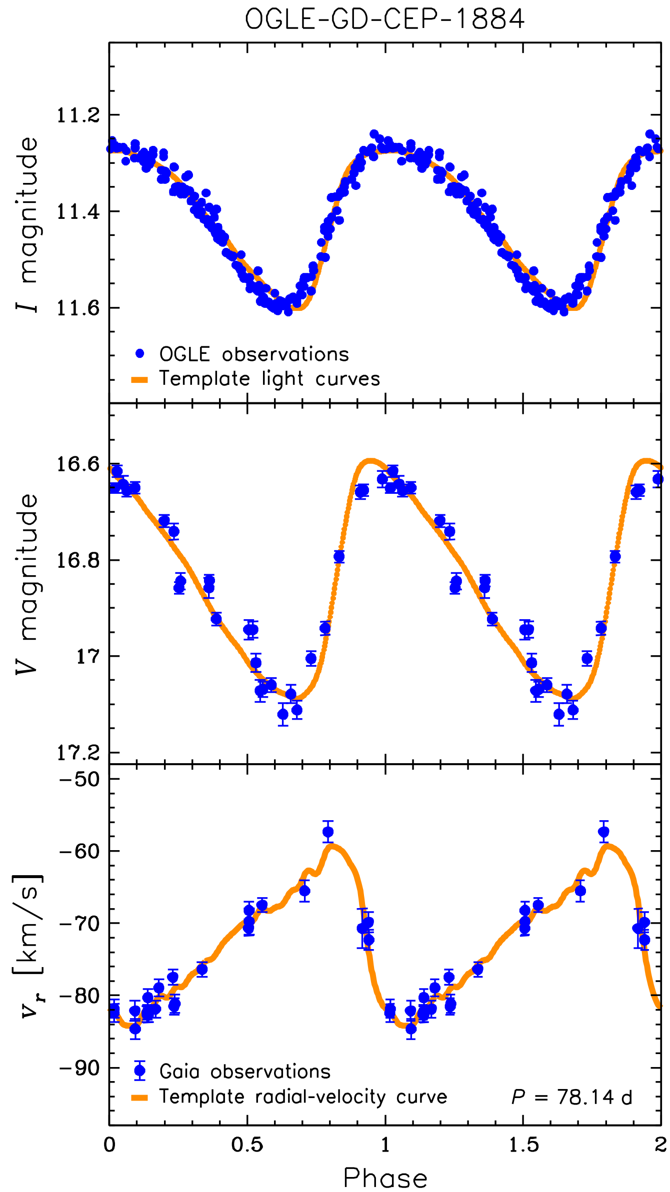

Figure 1. Phase-folded *I*-band (upper panel) and *V*-band (middle panel) OGLE light curves of OGLE-GD-CEP-1884 and radial velocity curve of this star from the Gaia Focused Product Release (Gaia Collaboration et al. 2023, lower panel). The orange curves depict template light and radial velocity curves of a classical Cepheid with a period of 78.14 days generated using the code provided by Pejcha & Kochanek (2012).

their amplitudes and adjusting the mean brightness and phases. A good agreement between the shapes of the observed and template light curves is visible in Figure 1, strongly supporting the hypothesis that OGLE-GD-CEP-1884 is a classical Cepheid. Also, the observed amplitude ratio and relative phase shift between *I*- and *V*-band light curves satisfactorily agree with the model. Small differences between the templates and observations ($\lesssim 0.05$ mag) may arise from the different metallicity of our star compared to that assumed in the model (Pejcha & Kochanek 2012), as well as minor deviations of the OGLE-IV filters from the standard filters of the Johnson–Cousins photometric system (Udalski et al. 2015).

Let us explore the possibility that OGLE-GD-CEP-1884 may be a variable star of a different type than a classical Cepheid. This object has been categorized as an LPV in both the ASAS-SN

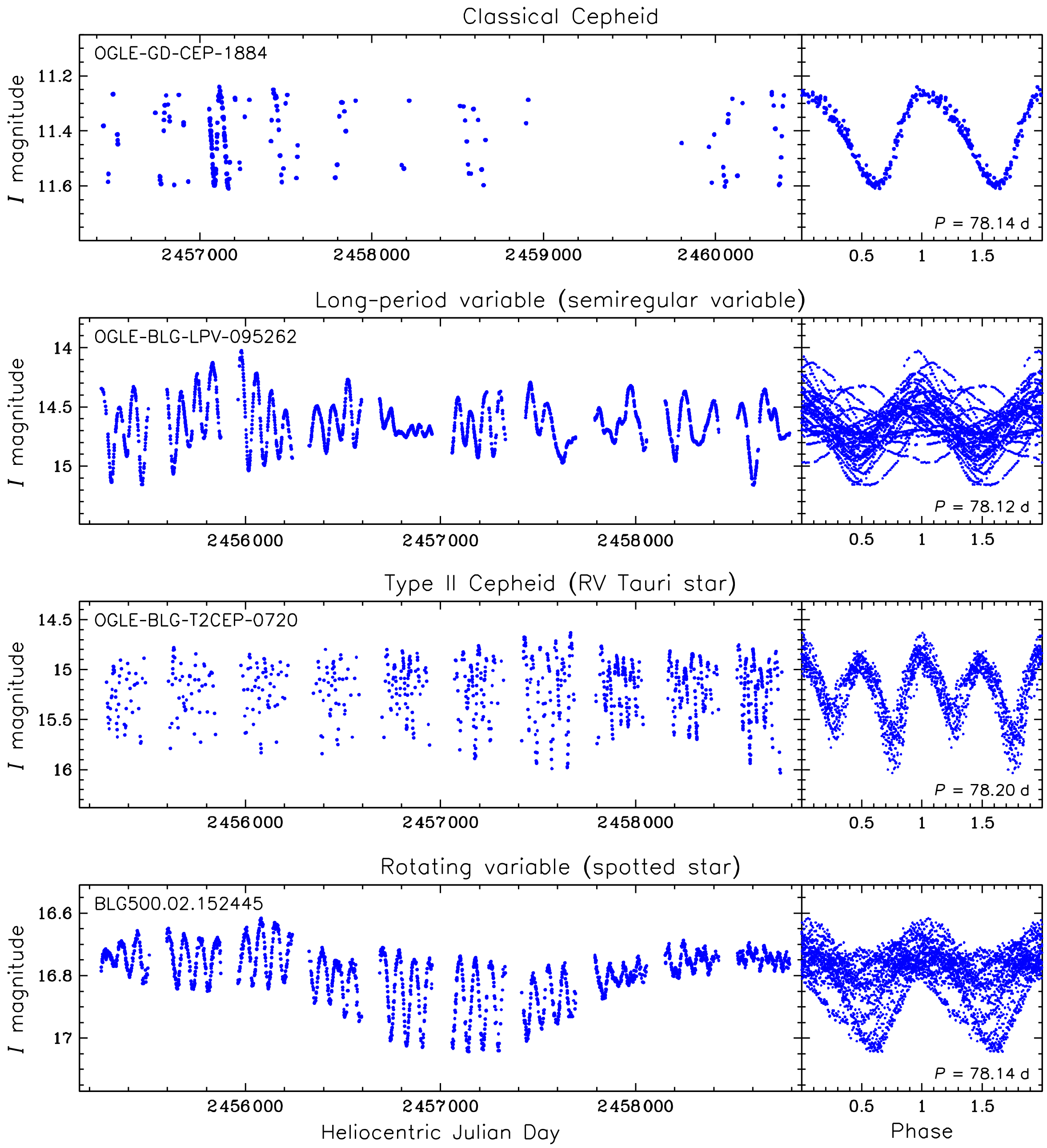

Figure 2. Unfolded (left panels) and phase-folded (right panels) *I*-band light curves of OGLE-GD-CEP-1884 (upper panels) and three example variable stars with periods nearly identical to that of OGLE-GD-CEP-1884: a semiregular variable from the OGLE collection of LPVs in the Galactic bulge (Soszyński et al. 2013), an RV Tauri star from the OGLE collection of type II Cepheids in the bulge (Soszyński et al. 2017), and a spotted variable star from the Galactic bulge (Iwanek et al. 2019). Note the differences between the light curve of a classical Cepheid and those of other types of variable stars.

(Jayasinghe et al. 2019) and Gaia DR3 (Lebzelter et al. 2023) catalogs of variable stars, presumably due to its apparent red color ($V - I = 5.43$ mag, $G_{BP} - G_{RP} = 5.25$ mag). In Figure 2, we once again present the *I*-band light curve of OGLE-GD-CEP-1884 (upper panels), but this time also in the unfolded version (left panel). Additionally, in the second panels from the top, we show the light curve of a semiregular variable from the OGLE collection of LPVs in the Galactic bulge (Soszyński et al. 2013). From the huge OGLE catalog, we selected a typical semiregular variable with a primary period almost identical to that of OGLE-GD-CEP-1884. As the name suggests, semiregular variations show significant phase and amplitude fluctuations, quite distinct from what can be observed in the light curve of OGLE-GD-CEP-1884. While the photometric residuals of our target exhibit some dispersion of points, this light curve is far more stable than what is observed in any LPV with a pulsation period of around 80 days. Due to its modest amplitudes of light changes (about 0.33 mag in the *I* band and 0.49 mag in the *V* band), OGLE-GD-CEP-1884 cannot be classified as a Mira variable either, as it is generally accepted that the Miras' light curves have amplitudes above 0.8 mag in the *I* band and 2.5 mag in the *V* band.

As OGLE-GD-CEP-1884 has been ruled out as a pulsating red giant, its apparent red color can only be explained by substantial interstellar reddening in the direction of this object. Given that it is situated in the sky close to the Galactic bulge and nearly at the plane of the Milky Way, the notable extinction toward these regions is not surprising (see Section 4.1).

Table 2
Mid-IR Magnitudes and Distances of OGLE-GD-CEP-1884

Catalog	W1 (mag)	d_{W1} (pc)	W2 (mag)	d_{W2} (pc)	W3 (mag)	d_{W3} (pc)	W4 (mag)	d_{W4} (pc)	I3 (mag)	d_{I3} (pc)	I4 (mag)	d_{I4} (pc)
AllWISE	4.96	4319	4.90	4417	4.98	4461	4.68	4275	…	…	…	…
unWISE	5.36	5121	4.96	4543	…	…	…	…	…	…	…	…
CatWISE	5.38	5161	4.72	4092	…	…	…	…	…	…	…	…
Spitzer GLIMPSE	…	…	…	…	…	…	…	…	4.99	4483	4.91	4741

Is it possible that OGLE-GD-CEP-1884 represents a different type of pulsating star than classical Cepheids? Within the family of radial pulsators, similar periods can be achieved by type II Cepheids of the RV Tauri subtype. The third panels from the top of Figure 2 present a typical time-series photometry of an RV Tauri star from the OGLE collection (Soszyński et al. 2017). A distinctive feature of this type of variable star is the alternating deeper and shallower minima of the light curve, a pattern not observed in OGLE-GD-CEP-1884. Moreover, light curves of RV Tauri stars usually exhibit larger amplitudes and show significant variability from cycle to cycle. The absence of these characteristics eliminates the possibility that OGLE-GD-CEP-1884 is a type II Cepheid.

The last type of stellar variability that we considered as a potential explanation for OGLE-GD-CEP-1884 is the rotation of a chromospherically active (spotted) star. Theoretically, spots on the surface of a star can produce a light curve that closely mimics the luminosity changes of a pulsating star. However, light curves of spotted stars continuously change their shape as the spot coverage evolves on the stellar surface. This effect is clearly visible in the lower panels of Figure 2 that display the OGLE time-series photometry a typical spotted variable (Iwanek et al. 2019). The stability of brightness variations observed over a period of more than 10 yr unequivocally rules out the possibility that OGLE-GD-CEP-1884 is a spotted star.

The ultimate confirmation of the hypothesis that our object is a classical Cepheid is the characteristic triangular shape of its radial velocity curve published by Gaia Collaboration et al. (2023). The lower panel of Figure 1 shows velocity measurements from the Gaia Focused Product Release with the fitted synthetic radial velocity curve generated by the Pejcha & Kochanek (2012) code. To achieve the optimal alignment of the template radial velocity curve with the observations, we shifted its phase by 0.05 relative to the *V*-band model light curves. We attribute this discrepancy to inaccuracies present in both the template and observed radial velocity and light curves.

Considering the above findings, OGLE-GD-CEP-1884 has been added to the OGLE Collection of Galactic Cepheids[4] (Udalski et al. 2018; Soszyński et al. 2020). Here, we provide not only the basic parameters of variable stars but also their long-term OGLE light curves, enabling researchers to conduct comprehensive studies on these objects.

4. Discussion

4.1. Distance to OGLE-GD-CEP-1884

The classical Cepheid with the longest-known pulsation period is expected to be the most luminous one in the Milky Way. To directly determine the absolute magnitude of this object, knowledge of its distance is necessary. Unfortunately, the trigonometric parallax of OGLE-GD-CEP-1884 (Table 1) published by Gaia Collaboration et al. (2021) has a relative uncertainty exceeding 40%, leading to significant uncertainty in the distance. According to Bailer-Jones et al. (2021), the geometric distance to OGLE-GD-CEP-1884 falls within the range of 3640–5712 pc (68% confidence interval), with a median value of 4646 pc.

This result can be compared to the distance determined from the period–luminosity relation obeyed by classical Cepheids. In order to minimize the effect of interstellar extinction, we utilized mid-infrared (mid-IR) observations of OGLE-GD-CEP-1884 and mid-IR period–luminosity relations rather than the optical ones, to calculate the Cepheid distance.

OGLE-GD-CEP-1884 has been observed in the mid-IR domain by the Wide-field Infrared Survey Explorer (WISE; Wright et al. 2010) in the W1 [3.4 μm], W2 [4.6 μm], W3 [12 μm], and W4 [22 μm] bands. We found one counterpart within 1″ from the location of the Cepheid in the AllWISE (Cutri et al. 2014), unWISE (Schlafly et al. 2019), and CatWISE (Marocco et al. 2021) catalogs. The mid-IR light curve of the Cepheid, containing 28 individual observations, is also available from the AllWISE Multiepoch Photometry Database, although all data points are clustered at roughly two epochs (MJD ≈ 55,251 and MJD ≈ 55,433 days). Given the long pulsation period of OGLE-GD-CEP-1884, these observations should in fact be considered as only two data points; therefore, we did not include the light curve in further analysis. The AllWISE magnitudes are available in all four WISE bands, while the unWISE and CatWISE are in the W1 and W2 bands only since they are largely based on observations taken during the postcryogenic NEOWISE mission (Mainzer et al. 2011). The saturation limits reported for WISE are approximately 8, 7, 3.8, and −0.4 mag for W1, W2, W3, and W4 bands, respectively. However, the WISE profile-fitting photometry, which for the saturated stars is based on the amount of flux in the wings of the point-spread function, is considered to be reliable up to approximately 2.0, 1.5, −3.0, and −4.0 mag in W1, W2, W3, and W4 bands, respectively.

The Cepheid has also been observed by the Spitzer Space Telescope (Werner et al. 2004) in the I1 [3.6 μm], I2 [4.5 μm], I3 [5.8 μm], and I4 [8.0 μm] bands as part of the Galactic Legacy Infrared Midplane Survey Extraordinaire (GLIMPSE) program (Benjamin et al. 2003), although only the I3 and I4 mag are available because of the star's large brightness (the reported saturation limits for GLIMPSE observations are 7, 6.5, 4, and 4 mag in I1, I2, I3, and I4 bands, respectively).

All mid-IR brightness measurements of OGLE-GD-CEP-1884 from the WISE and Spitzer catalogs are listed in Table 2. Our Cepheid is a very bright star in the mid-IR wavelengths, much brighter than the saturation limit in the W1 and W2 bands, although still in the magnitude range considered reliable. On the other hand, there is a notable difference, of the order of 0.3 mag, between W1 measurements in AllWISE, unWISE, and CatWISE. This is most probably caused by different handling of saturated

[4] https://ogle.astrouw.edu.pl > OGLE Collection of Variable Stars https://www.astrouw.edu.pl/ogle/ogle4/OCVS/gd/cep/.

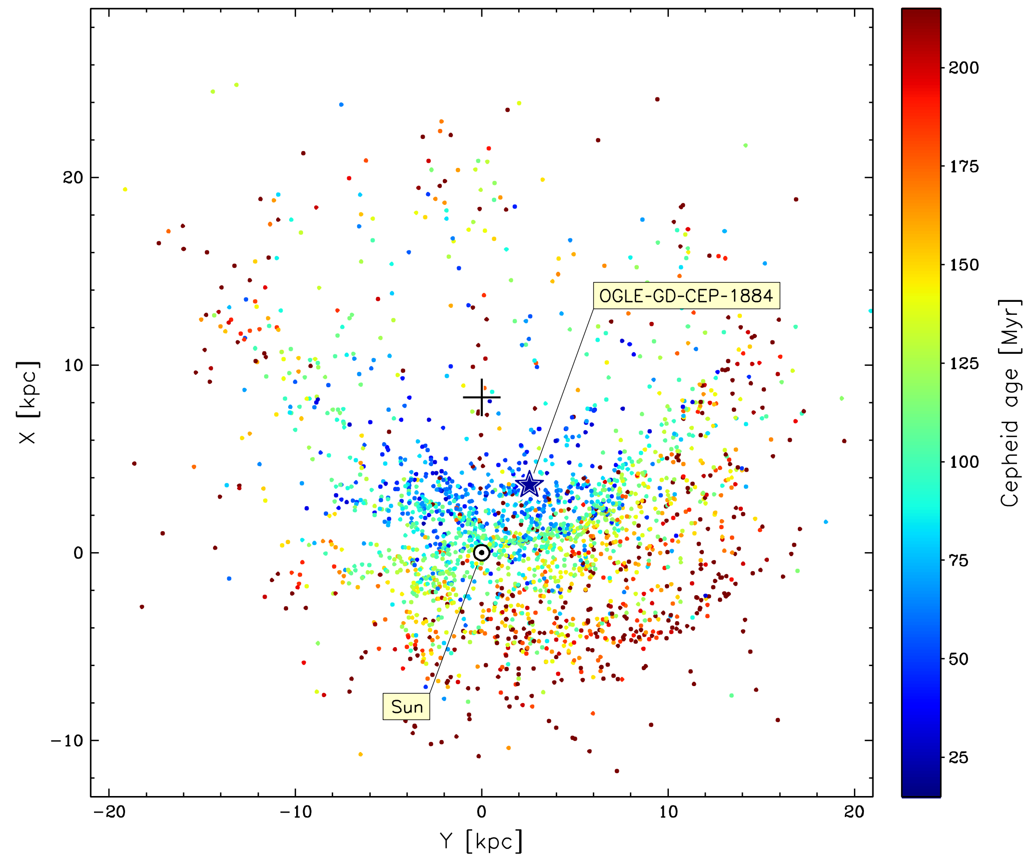

Figure 3. Face-on view of the Milky Way traced by 2388 classical Cepheids with distances measured using mid-IR period–luminosity relations (Skowron et al. 2019a, 2019b). The colors of the points indicate the ages of the Cepheids (as shown by the scale on the right side) derived from the period–age relation by Anderson et al. (2016). OGLE-GD-CEP-1884 is marked by the star symbol, the Sun is indicated by the white circle, and the Galactic center is shown by the black cross.

stars in the AllWISE, unWISE, and CatWISE projects. Schlafly et al. (2019) reported a magnitude offset of ∼0.2 mag among different catalogs for stars brighter than ∼8 mag in the W1 and W2 bands (see their Figure 7). On the other hand, W3 and W4 AllWISE magnitudes, as well as I3 and I4 GLIMPSE magnitudes are below the saturation limits.

We calculated the distance to the Cepheid using the mid-IR period–luminosity relations provided by Wang et al. (2018), calibrated specifically for the WISE and Spitzer passbands. The extinction, even though small at the mid-IR wavelengths, is nonnegligible within the Galactic plane; therefore, we used the *mwdust* 3D extinction maps that provide extinction values in the K_S band for a given on-sky location and distance (Bovy et al. 2016). The A_{K_S} extinction value was then transformed to the WISE and Spitzer bands using the mid-IR extinction curve from Xue et al. (2016). Since the extinction value is distance-dependent, we calculated the distances iteratively, initially assuming no extinction. Then, we extracted the A_{K_S} value for that distance, transformed it into the mid-IR bands, and recalculated the distance with extinction. The process was repeated until the distance did not change. Distance values in all available passbands are listed in Table 2. The extinction value extracted from *mwdust* is $A_{K_S} \approx 0.84$ mag, and after transforming to mid-IR $A_{W1} \approx 0.47$, $A_{W2} \approx 0.40$, $A_{W3} \approx 0.43$, $A_{W4} \approx 0.34$, $A_{I1} \approx 0.40$, and $A_{I2} \approx 0.39$ mag.

The final Cepheid distance, calculated as the median of all the individual measurements, is $d = 4472$ pc. We use the standard deviation of individual distances $\sigma = 332$ pc as the distance uncertainty, rather than relying on brightness uncertainties, which are significantly smaller than brightness differences between the WISE catalogs. When we reject all W1 and W2 measurements from Table 2, leaving only W3, W4, I3, and I4 mag, we coincidentally arrive at the same distance value, i.e., $d = 4472$ pc, with the standard deviation $\sigma = 166$ pc. As can be seen, the distance obtained from the Leavitt law agrees well with the distance derived from the Gaia parallax, providing additional confirmation that OGLE-GD-CEP-1884 is indeed a classical Cepheid.

The distance to the Cepheid can be coupled with its proper motion and mean radial velocity from Gaia (Table 1) to measure the 3D velocity vector of the object (Mróz et al. 2019). The velocity component toward the Galactic center is $U = -9.9 \pm 8.5$ km s^{-1}, in the direction of Galactic rotation $V = 220.8 \pm 3.9$ km s^{-1}, and toward the North Galactic pole $W = -3.4 \pm 1.8$ km s^{-1}. This velocity vector is consistent with the Galactic rotation curve measured from classical Cepheids (Mróz et al. 2019). It also confirms the classification of the star as a Cepheid—a velocity vector inconsistent with the rotation curve would indicate incorrect distance and/or classification.

4.2. OGLE-GD-CEP-1884 on the Map of the Galaxy

Having the distance to OGLE-GD-CEP-1884, we can place it on the Galaxy map along with 2387 other classical Cepheids from Skowron et al. (2019a, 2019b). Figure 3 presents the top view of the Milky Way traced by Cepheids with the mid-IR measurements obtained from the WISE or Spitzer missions.

Points are color-coded according to the Cepheid ages, estimated using the period–age relations derived by Anderson et al. (2016). We assumed the initial rotation of $\omega = 0.5$ and took into account the metallicity gradient in our Galaxy reported by Genovali et al. (2014). Following Skowron et al. (2019a), we calculated the age of OGLE-GD-CEP-1884 assuming $\omega = 0.5$ as well, and an unknown crossing number and location of our Cepheid within the instability strip. The resulting age of OGLE-GD-CEP-1884 is 22 Myr. As noted by Anderson et al. (2016), individual Cepheid ages estimated with the above assumptions are uncertain by up to ∼50%.

Figure 3 shows that OGLE-GD-CEP-1884 aligns well with the general distribution of classical Cepheids in the Milky Way. Our variable is situated in the Norma Arm, in the region predominantly occupied by relatively young Cepheids. Its distance from the Galactic center is approximately 5.3 kpc. It is surprising that the most luminous Cepheid in the Galaxy, located relatively close to us, has not been identified until now.

4.3. OGLE-GD-CEP-1884 as an Ultra-long-period Cepheid

The pulsation period of OGLE-GD-CEP-1884 falls just below the arbitrary lower limit period of 80 days adopted for the so-called ultra-long-period (ULP) Cepheids (Bird et al. 2009). In fact, some authors include Cepheids with slightly shorter periods in this group. For example, Ngeow et al. (2015) considered the M31 variable 8-0326 (with a period of 74.43 days) as a candidate for a ULP Cepheid. Applying this relaxed definition, OGLE-GD-CEP-1884 can be recognized as the first ULP Cepheid identified in our Galaxy.

The significance of ULP Cepheids lies in their high absolute brightness, which enables distance measurements to galaxies up to ∼100 Mpc (e.g., Fiorentino et al. 2012), whereas the range of ordinary (shorter-period) classical Cepheids typically extends only to about 30 Mpc (e.g., Riess et al. 2016). To date, not a single ULP Cepheid has been identified in the Milky Way, which is challenging to explain given the prevalence of such objects in neighboring galaxies. For instance, the Large Magellanic Cloud hosts four ULP Cepheids (Payne-Gaposchkin 1971), the Small Magellanic Cloud—three (Payne-Gaposchkin & Gaposchkin 1966), M31—seven (Ngeow et al. 2015; Kodric et al. 2018), NGC 55—five (Pietrzyński et al. 2006), while NGC 4038—nine (Hoffmann et al. 2016; Riess et al. 2016). Cumulatively, a total of 72 ULP Cepheids have been identified within 26 neighboring galaxies so far (Musella 2022). The discovery of OGLE-GD-CEP-1884 suggests that ULP Cepheids are also present in our Galaxy, probably in the regions strongly affected by interstellar extinction. This finding underscores the need for current and future sky surveys to adopt more efficient methods of detecting and classifying variable stars.

5. Conclusions

We reported the discovery of the longest-period classical Cepheid known in the Galaxy. Its pulsation period, 78.14 days, is nearly 10 days longer than that of the second-longest-period Cepheid, S Vulpeculae. OGLE-GD-CEP-1884 is likely the most luminous, youngest, and most massive Cepheid known in the Milky Way. It can be utilized for improving the fitting of the Leavitt law, investigating the youngest structures of the Galaxy, and studying the evolution of massive stars.

OGLE-GD-CEP-1884 is quite a bright star in the sky, particularly at longer wavelengths, so it is surprising that it has been overlooked in existing catalogs of Cepheids until now. This suggests that there might be more such long-period classical Cepheids in the Galaxy that remain undetected, and the Milky Way does not differ in the number of long-period Cepheids compared to other galaxies. The fact that this star was misclassified as an LPV in the ASAS-SN and Gaia catalogs indicates the need for continuous improvement of algorithms for the automated classification of variable stars. For now, traditional visual inspection of light curves remains the most reliable method for classifying variable stars.

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