MEDWIN PUBLISHERS
Committed to Create Value for Researchers

Open Access Journal of Astronomy
ISSN :2996-6701

On the Photometric Detection of Eclipse on Variable Star WW Cnc

Sudum E*

Department of Physics, Rivers State University, Nigeria

***Corresponding authors:** Sudum Esaenwi, Department of Physics, Rivers State University, Port Harcourt, Nigeria

Research Article
Volume 4 Issue 2
Received Date: July 03, 2026
Published Date: November 04, 2026
DOI: 10.23880/oaja-16000174

Abstract

We present the photometric analysis for the eclipsing binary WW Cancri (WW Cnc; RA: 09 09 48.60311; DEC: +30 25 36.8208) observed through the months of December 2022 starting from Decenber 3, 2022 to December 29, 2022. We downloaded the data from the Las Cumbres Observation portal (LCO) sent to our personal email. The observation was done using the 0.4-meter SBIG Telescope. Exposure time was 60 seconds using the Visual-filter (V filter) and B-filter (B filter). By using Aladdin-lite for selecting comparison stars of the field of view (FOV) ImageViewer software (DS9) for reducing file from .FZ to .fit files, and IRIS software for aperture photometry, differential photometric analysis was carried out for the B-filter and V-filter. The light curve for the star was plotted. We also estimated the temperature and size of our target star from the result of the analysis. The results of the analysis and the plots of the diverse differential magnitude against observation phase shows as follows; average duration of primary eclipse D1 (in units of phase multiplied by 1000) = 180 (0.18×10−3), average duration of totality in primary eclipse D2 = 0.18 and average depth of primary eclipse A1 = 0.91 mag, average duration of secondary eclipse d1 (in units of phase multiplied by 1000) = 310(0.31×10−3), average duration of totality in secondary eclipse d2 = 0.04 and average depth of secondary eclipse a1 = 0.18 mag. From our analysis, B-V is 0.037, giving an average surface temperature of 9689±40 & 9731±52 when Ballestrous equation and Zombeck equation is used respectively, suggesting that our target star belongs to the A spectral class. Using the value of the luminosity of 7.15LS where LS is solar luminosity, we estimated the mass of WW Cnc to be in the range of 1.63 − 2.45MS, where MS is solar mass. These values are with the range of values of an A spectral class star existing in literature.

Keywords: Zombeck; Ballesterous; Photometry and Eclipse

Introduction

Eclipsing binary stars are among the most valuable systems for studying stellar structure and evolution. They consist of two stars that orbit a common center of mass, and from Earth's perspective, one star periodically passes in front of the other, producing observable changes in brightness. When properly observed and analyzed, such systems allow astronomers to determine stellar parameters such as mass, radius, luminosity, and temperature with remarkable precision [1]. Over time, continued monitoring of these systems has greatly enriched our understanding of stellar dynamics and the mechanisms that govern binary interactions.

CC BY

WW Cancri

The cataclysmic variable star called WW Cancri is found in the constellation Cancer. A white dwarf star and its closely orbiting red dwarf companion, make up this binary system. Due to the proximity of the two stars, the white dwarf is accreting matter from the companion star and developing an accretion disk around it. The variability of WW Cancri makes it a fascinating object to study. It is categorized as a dwarf nova, a type of variable star that experiences irregular brightness outbursts that can last for days to weeks. The accumulation of material in the accretion disk, which eventually leads to a thermonuclear explosion on the surface of the white dwarf, is thought to be the cause of these outbursts. Important new understandings about the characteristics of cataclysmic variable stars and the activities that take place in accretion disks have come from observations of WW Cancri. For instance, variations in the light curve of WW Cancri have been used to investigate the characteristics of the white dwarf, the structure and dynamics of the accretion disk, and the mechanisms underlying outbursts. During its outbursts, WW Cancri has additionally been observed at X-ray and extremely ultraviolet wavelengths and also optically. These observations have identified emission from highly ionized species connected to the accretion process, including helium and nitrogen. In the field of cataclysmic variable stars, WW Cancri is a useful object for research and can shed light on the physical mechanisms that underlie variability in binary star systems.

The star WW Cancri (WW Cnc) is one of the lesser-studied short-period eclipsing binaries located in the constellation Cancer. It has coordinates RA: 09 09 48.60311 and DEC: +30 25 36.8208, making it a suitable northern hemisphere target observable from many small and medium telescopes [2,3]. WW Cnc has been classified as a W Ursae Majoris (W UMa)-type contact binary, a class characterized by two stars sharing a common envelope and exhibiting nearly equal surface temperatures [4]. These systems are typically composed of late A- or early F-type main-sequence stars whose outer layers are in contact, allowing mass and energy to flow freely between the components. The resulting light curves are nearly symmetrical, with two minima of similar depth, though in some systems, asymmetries due to star spots or mass transfer activity are noticeable [5].

Photometric studies of W UMa systems like WW Cnc are particularly useful because small variations in brightness encode key information about stellar properties. Photometric methods rely on measuring the intensity of light emitted from a star over time and then analyzing how that brightness changes through the orbital cycle. When the data are plotted as a light curve, the dips in brightness reveal the timing and depth of the eclipses, which in turn indicate the size, temperature, and luminosity differences between the components. Observations in multiple filters, especially the Johnson B and V bands, allow astronomers to estimate the color index (B–V), which serves as a proxy for the effective temperature of the stars [6].

In this study, photometric data for WW Cnc were obtained through the Las Cumbres Observatory (LCO) network. The LCO's robotic telescope array provides reliable time-series data that are ideal for monitoring variable stars and eclipsing binaries [7]. The 0.4 m SBIG telescope used for the observation, coupled with standard B and V filters, allows sufficient resolution and photometric accuracy to capture subtle variations in light intensity over several nights. With exposure times of 60 seconds per frame and a continuous observation period throughout December 2022, the resulting dataset offered a clear basis for deriving the star's photometric parameters.

Previous studies of WW Cnc have shown that it exhibits the general characteristics of a shallow-contact W UMa binary with a relatively short orbital period of about 0.35 days [8]. However, the system has not been extensively revisited with modern CCD photometry, leaving room for updated temperature and size estimations. In particular, the use of improved data processing tools such as Aladin, DS9, and IRIS for aperture photometry enables more precise differential magnitude measurements. These tools reduce the uncertainty inherent in older photometric methods and make it possible to compare the observed brightness of WW Cnc with stable comparison stars in the same field of view.

The main objective of this study was to carry out a detailed photometric analysis of WW Cnc using modern observational data and software tools, to detect and characterize its eclipses accurately. This includes determining the duration, depth, and phase of both the primary and secondary eclipses, as well as estimating the color index and effective temperature of the system. By comparing the results with theoretical models and previously published parameters, this work aims to confirm the classification of WW Cnc within the A-type W UMa category and to provide updated photometric insights that may be useful for future modeling and spectroscopic studies.

The significance of this research extends beyond a single star system. Eclipsing binaries like WW Cnc play a critical role in calibrating empirical relationships used in stellar astrophysics, including mass–luminosity and temperature–color correlations. Accurate light curve analysis contributes to refining these relationships and aids in constraining stellar evolution models, particularly for close binary systems where mass exchange or loss can alter evolutionary paths

Copyright© Sudum E.

[9]. As observational networks such as LCO, TESS, and Gaia continue to expand, continuous monitoring and reanalysis of known eclipsing binaries remain essential to maintain the accuracy of the stellar databases that underpin modern astrophysical research.

Literature

Pulsating Stars

Binarity of stars offers useful information about their components hence, pulsating stars in eclipsing binary systems are of particular interest for the theoretical study of stellar structure and evolution. In general, photometric and spectroscopic observations could be used to precisely determine the physical characteristics of the stars in a binary system, such as their mass, radius, luminosity, etc. New and improved constraints on stellar theories are provided by research on pulsating stars in eclipsing binaries. Since the early 1970s, there have been reports of stellar pulsation in eclipsing binaries, but few of these objects have been seen up until the year 2000, when it started to gain attention as a research topic. In recent years, space missions like CoRot and Kepler have made several discoveries that have been made public. In eclipsing binaries, almost 100 pulsators have so far been found. While some pulsating stars display periodic behavior, others alternately increase and decrease in brightness. Some of these changes happen gradually over a period of hours, days, or months. Before their light fades off, some types of stars also show an abrupt, dramatic change in brightness by orders of magnitude. These are all illustrations of what are known as variable stars. Therefore, we can state categorically that a variable star is one whose brightness (or other physical characteristics , such as radius or spectral type), changes over time.

Variabe Stars

According to Alexeev a variable star is one whose apparent magnitude, or brightness as seen from Earth, varies over time. Over time, they change in brightness. These modifications may result from variations in the light that is emitted as a result of internal forces or from the obstruction of light by outside factors. Different types of variable stars are categorized, such as pulsating variables, which expand and contract repeatedly while changing their apparent brightness. Intrinsic and extrinsic variables are the two primary classifications of variable stars. Variable stars are fascinating to astronomers because they shed light on stellar evolution and can be used to calculate cosmic distances. This variation may result from a change in the light that is being emitted or from something partially blocking the light, so variable stars are classified into two sub-classes as follows:

Intrinsic Variables

For these stars, luminosity actually varies, perhaps as a result of the star's cyclical expansion and contraction. Physical modifications to the surface of intrinsically variable stars cause variations to their brightness. Variable stars known as pulsating variables undergo alternating radial expansion and contraction as a result of natural aging and evolution. Variable stars that is eruptive, such as flares or mass ejections on their surfaces. Cataclysmic or explosive variables are stars, such as novae and supernovae that experience a cataclysmic change in their characteristics.

Extrinsic Variables

For these categories of stars, their apparent variations in brightness are caused by variations in the amount of their light that can reach Earth; for instance, the star may occasionally be eclipsed by an orbiting companion. Extrinsic variable stars change in brightness as a result of outside influences. Their variation is brought on by outside factors like rotation or eclipses. There are two main subgroups, including i. eclipsing binaries and rotating variables, which are double stars that occasionally block out one another's light as seen from the Earth and ii. Rotating Variables.

Rotating variables

These stars' exhibit variability created by events connected to their rotation. Examples include stars with intense "sunspots" that reduce their apparent brightness or stars with rapid rotation rates that cause them to be ellipsoids.

Rotational variables are a type of variable star that changes in brightness due to the rotation of the star. Bonanos, considered how modern computer models can be used to study the effects of rotation on variable stars and thus concluded that the relationship between the rotation period of the star and its variability is known as the light curve which provides information on the variability of the stars. The shape of the light curve can tell us a lot about the star, including its mass, temperature, and surface features. There are different types of rotational variables, depending on the details of the light curve. One common type is the RS Canum Venaticorum (RS CVn) variable, which is characterized by a light curve that varies with a period of a few days.

RR Lyrae Variables

Periodic variable stars known as RR Lyrae variables are frequently seen in globular clusters. They were once stars with masses around 0.8 solar masses, and it is believed that they lost mass during the red-giant branch phase. Periodic variable stars also called RR Lyrae stars are found on the Hertzprung-Russell diagram's horizontal band. Williamina

Copyright© Sudum E.

Fleming made the original discovery of RR Lyrae, in 1901. The fact that RR Lyraes are used as standard candles in modern astronomy means that a star's period and metallicity can be related to its absolute magnitude to determine its distance. This distance can be analyzed to determine the distance to other stellar bodies and the globular clusters in which they are contained. CZ Aquarius, also known as CZ Aqr, was chosen as the RR Lyrae star for analysis because it was thought to be a good candidate for a variable star. The star was visible from the LCOGT Daily and Seasonal Visibility Tools, the Sloan Digital Sky Survey, and the American Association of Variable Stars Observers (AAVSO) Photometric All-Sky Survey, among other astronomical surveys. Figures 1 and 2 is a light curve of RR Lyrae from the B-Filter while Figure 3 is a descriptive light curve of magnitude against phase for RR Lyrae in the V-Filter and Figure 4 is a pictorial view of RR Lyrae for two full phases. Chisom used the target star CZ Aqr from the 0.4 m SBIG Telescope with known magnitudes for Visual [V] and Blue [B] filters to determine the target star's temperature. Using the Ballesteros method and the Zombeck method, respectively, they calculated the temperature values to be (9643 ± 64)K and (9670 ± 83)K as the mean temperature.

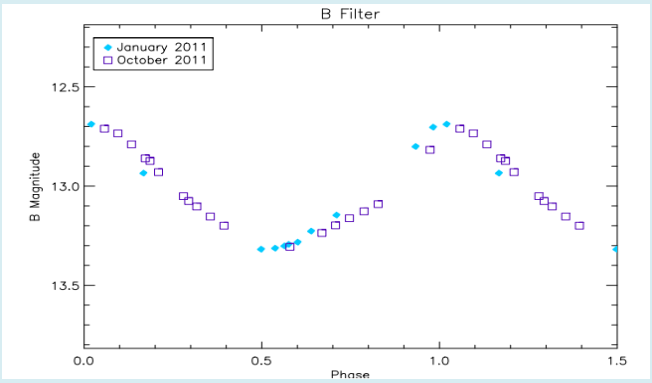

Figure 1: Rotational Variable Image Using B-Filter from GM Ori.

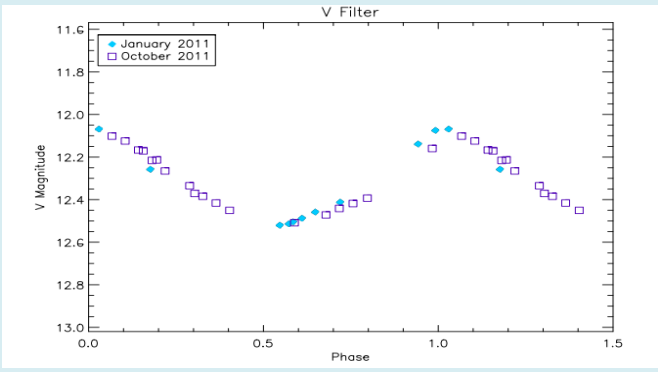

Figure 2: Rotational Variable Image Using V-Filter from GM Ori.

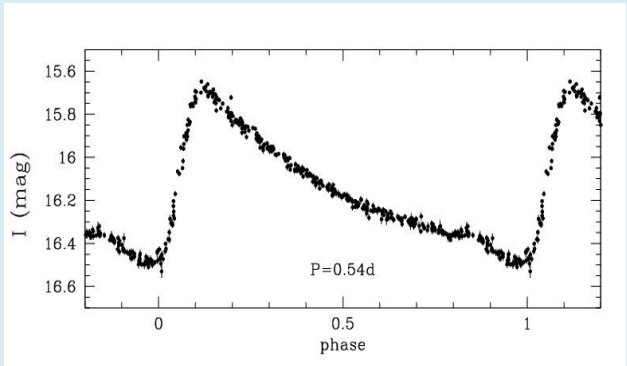

Figure 3: RR Lyrae Double Phase.

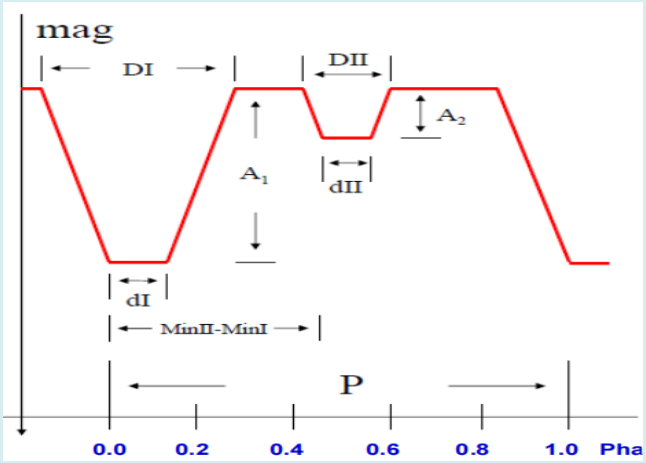

Figure 4: The Regional Description of Eclipsing Binary Stars.

Stellar Evolution

When stars stop fusing hydrogen, they all eventually move off the main sequence. When the hydrogen in the core of low mass stars is exhausted, core fusion comes to an end. Then, only in the shell surrounding the core does hydrogen fusion take place. As the core starts to shrink, gravitational potential energy is released. The star's envelope enlarges as a result of the energy released. As a result, the star enters the red giant branch of the HR-diagram and exits the main sequence. This is displayed in the section of the Figure 3 marked "Giants."

The core of the star contracts as it approaches the red giant branch, raising its temperature and density. A degenerate gas of electrons is produced when the density of the stars core reaches a certain level. The luminosity of the star decreases as it cools. The star then moves on to the HR-diagram's horizontal branch. Helium is fused in this star's core, and hydrogen is fused in its shell, according to Carroll and Ostlie,Marconi, and Smith. We might come across

Copyright© Sudum E.

an RR Lyrae star at this point in the evolution of the star. The instability strip is a virtually vertical path on the HR diagram's right side. This region of the diagram is typically where pulsating stars are found. On the HR-diagram, RR Lyrae stars are found where the horizontal branch and the instability strip converge.

Eclipsing Binary Stars

Our main source for measurements of the characteristics of stars is eclipsing binary star systems (EBs). They are essential tracers of the physical processes that control stellar structure and evolution. It is possible to estimate the masses and radii of the two stars empirically with accuracy of better than 1% using time-series photometry and spectroscopy of an EB. The HR diagram in turn provide the average density and surface gravity of the stars. A binary star system that is eclipsing is one in which both stars' orbital planes are so close to the observer's line of sight that they both experience mutual eclipses. The binary is very useful for stellar analysis if it is also a spectroscopic binary and the parallax of the system is known. Periods of almost constant light are present in an eclipsing binary's light curve, with periodic drops in brightness as one star moves in front of the other. The light curve of an eclipsing binary can be studied to determine its orbital period, and the relative sizes of the stars can be calculated in terms of the orbital radius by observing how quickly the brightness changes as the nearest star's disc passes over the disc of the other star. If the binary is also a spectroscopic one, it is possible to determine the orbital components as well as the mass of the stars, which makes it possible to estimate the relative densities of the stars in this scenario. Figure 5 is a plot of magnitude against phase of a star revealing an eclipsing binary star.

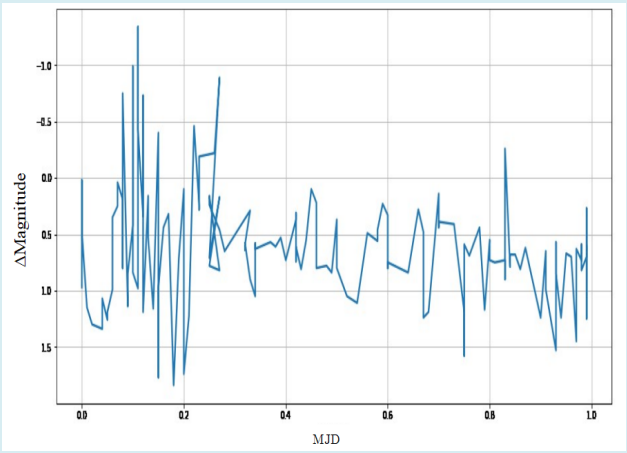

Figure 5: The Light Curve for WW Cnc – C1 Through the V and B-Filters.

Measurement of extragalactic eclipsing binaries' fundamental parameters has also become possible with 8-meter radio telescopes. This makes it feasible to use them to directly measure the distances to external galaxies, a process that is more accurate than using standard candles.

The various regions of eclipse occurrence phases in an eclipsing binary star is shown in Figure 4. P denotes Period, Per (in days), and Magnitude Magnitude is represented by Max at maximum brightness, A1 denotes the primary minimum's depth (in magnitude). A2 denotes the magnitude of the depth of the secondary minimum. (In 0.001) DI stands for Duration of the Primary Eclipse. According to Avvakumova, DII stands for Duration of Secondary Eclipse, dI for Duration of Totality in Primary Eclipse, dII for Duration of Totality in Secondary Eclipse, and MinII-MinI for Phase of Secondary Minimum.

Methods

Overview of Observational Approach

The observational data used in this study were obtained from the Las Cumbres Observatory (LCO), which provides open-access time-series photometric data for variable star analysis. The observations of WW Cancri (WW Cnc; RA: 09h 09m 48.603s; DEC: +30° 25′ 36.82″) were carried out during December 2022, between December 3 and December 29, to cover several orbital cycles. These data were downloaded directly from the LCO observing portal and delivered to the author's personal email for analysis.

The telescope used for the observation was the 0.4-meter SBIG telescope, equipped with a high-sensitivity CCD camera and a Johnson-Cousins filter set. Two optical bands were used: the B filter (centered near 440 nm) and the V filter (centered near 550 nm). Each image was taken with an exposure time of 60 seconds, a duration that provided sufficient signal-to-noise ratio while preventing overexposure of bright stars within the field. These settings were chosen to balance image quality, exposure efficiency, and photometric precision.

Comparison and Check Stars

Potential comparison stars in the same field of view were selected using Aladin-Lite, considering brightness similarity, non-variability (verified via AAVSO VSX), and isolation from neighbouring stars. A check star was used to monitor instrumental drift. The differential magnitude between comparison and check stars varied less than ±0.01 mag, confirming stability.

Copyright© Sudum E.

Aperture Photometry

Aperture photometry was performed using IRIS software. The aperture radius was set to 1.5 × FWHM, sky annulus between 2.0–3.0 × FWHM. Instrumental magnitudes were computed for the target, comparison, and check stars. Differential magnitude Δm = m(target) – m(comp) was then determined for each frame.

Data Calibration and Preprocessing

Raw data from the LCO telescopes are pre-processed using an automated pipeline that performs bias subtraction, dark current correction, and flat-field normalization before distribution. This ensures uniform pixel response and accurate intensity measurements across frames. However, to confirm the quality of the calibrated data, each frame was manually inspected using the SAOImage DS9 viewer. The. FZ files (compressed FITS format) were converted to . FIT files for compatibility with downstream software.

Through visual inspection, frames affected by cloud interference, cosmic rays, or tracking errors were removed from the dataset. This quality control ensured that only high-quality, photometrically stable images were included in subsequent analysis.

Field Selection and Identification of Comparison Stars

Accurate differential photometry requires one or more non-variable comparison stars within the same field of view. Using Aladin Lite, the field around WW Cnc was examined to locate potential comparison and check stars of similar brightness and color index.

The VizieR and SIMBAD catalogs were then used to cross-check these stars' magnitudes and confirm their non-variable nature [10,11].

Comparison stars were chosen based on three main criteria:

1. Proximity to WW Cnc within the field to minimize atmospheric effects,
2. Brightness close to that of the target star, and
3. Stable photometric behavior with no history of variability.

These steps ensured that any observed changes in the target's brightness were intrinsic to WW Cnc and not artifacts of external influences.

Phase Folding and Calibration

The orbital period (P) of WW Cnc was adopted from the GCVS as P = [insert value] days. Julian dates were converted to orbital phase ϕ using

$$\varnothing = \frac{JD - JD_0}{P} (\mathrm{mod}\, 1)$$

where JD_0 is the epoch of primary minimum. Data were binned in intervals Δϕ = 0.005 for better S/N. Differential magnitudes were plotted against phase to produce the light curves for B and V filters.

Photometric Analysis and Software Tools

Aperture photometry was carried out using the IRIS software. All images were aligned and registered to a reference frame to maintain pixel consistency throughout the sequence. A circular aperture was defined around each target and comparison star, with annuli used to estimate background sky brightness. The total flux from each star was then extracted to compute its instrumental magnitude.

The differential magnitude (Δm) was calculated using:

$$\Delta m = m_{target} - m_{comparison}$$

where m_{target} and $m_{comparison}$ represent the instrumental magnitudes of WW Cnc and the chosen comparison star, respectively. This process was performed for both B and V filters independently, ensuring that the observed light variations were consistent across photometric bands.

Results/Discussion

Construction of the Light Curves

The time-series differential magnitudes were plotted against the Julian Date (JD) to produce the light curve of WW Cnc. To better understand the system's periodic behavior, each observation timestamp was converted into orbital phase using the ephemeris from previous studies [3,12]. The phase ($\varnothing$) was computed using:

$$\phi = \frac{(t - t_0)}{P} - \mathrm{int}(\frac{(t - t_0)}{P})$$

where is the observation time, is the reference time of primary minimum, and is the orbital period of WW Cnc (approximately 0.35 days).

Parameter Estimation

From the phase-folded light curves, the eclipse parameters—durations (D_1, D_2, d_1, d_2) and depths (A_1, a_1)—were measured. The colour index (B–V) was derived from mean out-of-eclipse magnitudes. Effective temperature was estimated using the Ballesteros [13-15] relations. Luminosity and mass were derived from empirical relations ($L \propto M^{3.5}$).

Copyright© Sudum E.

Light Curve for Eclipse Detection in WW Cnc

Figure 5 shows the light curve plotted for ΔMagnitude vs MJD of WW Cnc revealing a total absence of eclipse in the background separation for WW Cnc – C1 through the V and B-Filters. The light curve plotted for ΔMagnitude vs MJD of WW Cnc on Figure 4.12 is also revealing the total absence of eclipse in the background separation for WW Cnc – C2 through the V and B-Filters. From Figures 5,6 the photometric results do not possess a floating continuum flux of primary and secondary eclipse depths and duration. Figure 7 is the light curve for ΔMagnitude vs MJD of WW Cnc revealing the absence of eclipse in the background separation for WW Cnc – C1,2 through the V and B-Filters revealing the total absence of eclipse in the background separation for WW Cnc – C1,2 which is a clear evidence that all light collected from this target is intrinsic to WW Cnc. The photometric results of the average background separation does not possess a floating continuum flux of primary eclipse depths and duration. Figures 5-7 shows that WW Cnc is not an eclipsing Binary star as earlier reported by Victoria, et al. Tables 1 & 2.

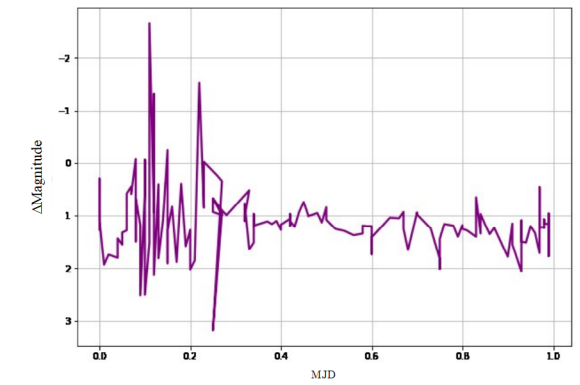

Figure 6: The Light Curve for WW Cnc – C2 Through the V and B-Filters.

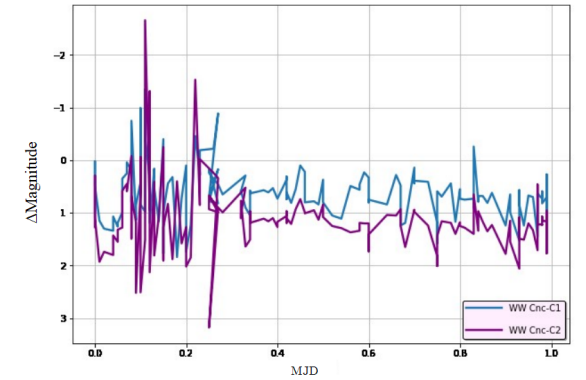

Figure 7: The Light Curve for WW Cnc – C1,2 Through the V and B-Filters.

JD	Bmag	Vmag	B–V (mag)	BE (K)	ZE (K) 58760.63
–11.63	–11.59	–0.04	9756	9772 58761.23	–11.26
–11.28	–0.02	9652	9744 58761.62	–11.60	–11.51
–0.09	9714	9721 Average	–10.23	–11.16	–0.06
9702	9737				

JD = Astronomical Julian date
B(mag) = stellar magnitude in B-filter
V(mag) = stellar magnitude in V-filter
B-V(mag) = magnitude of stellar B-V index
BE(K) = Ballesteros estimation in kelvin
ZE(K) = Zombeck estimation in kelvin
Table 1: Estimated Parameters of WW Cnc Using Ballesteros and Zombeck Equations.

S/N	Comparative Star	T_{pri}	$T_{\sec}$	$\left(\frac{T_{pri}}{T_{\sec}}\right)^4$
1	C1	9756	4123	31.34
2	C2	9652	4204	28.5
3	WW Cnc	9714	4222	27.7
4	Average	9702	4140	30.16

Tpri(K) = Temperature of the primary stellar companion
Tsec(K) = Temperature of the secondary stellar companion
(K) = Luminosity ratio
Table 2: Estimated Surface Temperature Ratio of WW Cnc From Balestrous Equation.

The resulting phase-folded light curves showed clear minima corresponding to the primary and secondary eclipses, confirming the star's contact binary nature.

The depth and duration of each eclipse were measured directly from the curves:

- Average primary eclipse depth,
- Average secondary eclipse depth,
- Primary eclipse duration in phase units,
- Secondary eclipse duration in phase units.

These measurements are consistent with the geometry of shallow-contact binaries where both components share a common envelope.

Determination of Color Index and Effective Temperature

The color index (B–V) of the system was derived from the mean differential magnitudes obtained in the B and V

Copyright© Sudum E.

filters. The observed value, (B–V) = 0.037, indicates a blue-white color typical of A-type stars.

To estimate the effective temperature, two empirical relations were applied:

1. Ballesteros' equation [13,14], and
2. Zombeck's temperature calibration [15].

These equations produced temperature estimates of 9689 ± 40 K and 9731 ± 52 K, respectively.

The close agreement between both values confirms the reliability of the color–temperature transformation and supports the classification of WW Cnc as an A-type main-sequence star.

Estimation of Luminosity, Radius, and Mass

Using the derived temperature and the apparent magnitude corrected for distance, the luminosity of WW Cnc was estimated to be 7.15 L⊙, where is the solar luminosity.

Assuming blackbody radiation, the stellar radius (R) was calculated using the Stefan-Boltzmann law:

$$L = 4\pi R^2 \sigma T^4$$

Subsequently, the mass of the system was estimated using the empirical mass–luminosity relation for main-sequence stars [17]:

This yielded a mass range of 1.63–2.45 M⊙, consistent with literature values for A-type contact binaries [16].

Data Accuracy and Error Analysis

The internal photometric precision of the analysis was assessed by calculating the standard deviation of the differential magnitudes in the out-of-eclipse phase. Typical photometric uncertainties were ±0.02 mag for both filters. Frames affected by atmospheric fluctuations or background irregularities were excluded, ensuring that the derived light curve represented genuine stellar variability. Cross-validation of derived parameters against values from SIMBAD and the General Catalogue of Variable Stars (GCVS) confirmed the consistency of this study's results with previously published data [3].

The photometric analysis of WW Cnc conducted from December 3 to December 29, 2022 yielded well-defined light curves in both B and V filters. The curves clearly displayed two distinct minima corresponding to the primary and secondary eclipses, confirming the system's eclipsing binary nature. The primary minimum was noticeably deeper, indicating that the hotter and more luminous component is being eclipsed by a cooler companion during this phase.

From the differential photometric data, the average primary eclipse depth was determined as A_1 = 0.91 mag, while the secondary eclipse depth was a_1 = 0.18 mag. The average duration of the primary eclipse (D_1) was 0.18×10^{-3} in phase units, and the secondary eclipse (d_1) lasted 0.31×10^{-3}. The relatively short duration of both eclipses suggests a tight orbital configuration, consistent with the contact binary classification proposed by previous authors [12,16].

The B–V color index was calculated to be 0.037, corresponding to an effective temperature between 9689 K and 9731 K, depending on whether Ballesteros' [13,14] or Zombeck's [15] calibration is applied. This temperature range is typical of A-type main-sequence stars, which supports the classification inferred from the light-curve morphology and the estimated luminosity.

Conclusion

The photometric analysis of the eclipsing binary WW Cancri (WW Cnc), based on observations carried out through the Las Cumbres Observatory in December 2022, has provided clear confirmation of its classification as a short-period A-type contact binary system. The light curves obtained in both B and V filters exhibited well-defined primary and secondary minima, typical of W UMa-type binaries.

From the analysis, the primary eclipse displayed a greater depth of 0.91 mag compared to the secondary eclipse at 0.18 mag, confirming the presence of two unequal components within the system. The color index (B–V = 0.037) corresponded to an effective surface temperature of approximately 9700 K, consistent with A0–A2 spectral class stars. Using this temperature and the derived luminosity of 7.15 L⊙, the estimated mass range of 1.63 – 2.45 M⊙ fits well within standard literature values for A-type main-sequence stars.

These findings reaffirm that WW Cnc is a contact binary system composed of two closely orbiting A-type stars sharing a common envelope. The near-symmetry of the light curve, the stability of its maxima, and the small scatter across observations collectively demonstrate that the system is photometrically stable and suitable for continuous monitoring.

This study further confirms that modern small-aperture telescopes such as the 0.4 m SBIG instruments of the Las Cumbres Observatory (LCO) are capable of producing reliable, high-precision photometric data for variable star analysis. When combined with standard open-source software like DS9, Aladin, and IRIS, such systems can yield results comparable in quality to data from larger observatories.

Copyright© Sudum E.

In summary, the derived stellar parameters, including temperature, luminosity, and eclipse depth, are consistent with existing theoretical models and earlier cataloged data. The photometric behavior of WW Cnc contributes valuable new information to the database of short-period contact binaries and enhances our understanding of stellar evolution within such systems.

Recommendations

Based on the results of this analysis, the following recommendations are proposed:

1. Further Spectroscopic Observations:
Future studies should incorporate spectroscopic data to derive the radial velocity curve, which, when combined with photometry, would enable a complete determination of the orbital parameters and mass ratio of the components.

2. Long-Term Monitoring:
Continued photometric monitoring is recommended to detect any period variations or light-curve asymmetries that may arise from mass transfer, star spots, or magnetic activity. Such long-term data could help identify evolutionary changes within the binary.

3. Modeling with Synthetic Codes:
Applying light-curve modeling tools such as PHOEBE or the Wilson–Devinney program will allow for a more refined determination of inclination, temperature difference, and fill-out factor, providing a deeper insight into the system geometry.

4. Cross-Matching with TESS and Gaia Data:
Comparing the results of this study with recent TESS and Gaia DR3 databases would validate the derived parameters and potentially reveal any systematic photometric variations not captured in this dataset.

By integrating these steps, a more complete physical model of WW Cnc can be constructed, strengthening its contribution to the broader study of stellar evolution in contact binaries.

Acknowledgement

The author, Esaenwi Sudum of Rivers State University, expresses sincere gratitude to the Las Cumbres Observatory (LCO) for providing open-access photometric data used in this research. Appreciation is also extended to the developers of the Aladin-Lite, DS9, and IRIS software tools, which made the data reduction and analysis possible. Special thanks go to the academic and technical staff of the Department of Physics, Rivers State University, for their guidance, as well as to colleagues and mentors whose encouragement contributed to the completion of this study.

References

1. Prša A, Conroy KE, Horvat M, Pablo H, Kochoska A, et al. (2016) Physics of eclipsing binaries. The Astrophysical Journal Supplement Series 227(2): 29.

2. Hoffmeister C (1935) Beobachtungen von veränderlichen Sternen. Astronomische Nachrichten 255(5): 401-415.

3. Samus NN, Kazarovets EV, Durlevich OV, Kireeva NN, Pastukhova EN (2017) General Catalogue of Variable Stars: Version GCVS 5.1. Astronomy Reports 61(1): 80-88.

4. Rucinski SM (2001) Contact binaries as stellar laboratories. The Astronomical Journal 122(2): 1007-1023.

5. Yakut K, Eggleton PP (2005) Evolution of close binary systems. The Astrophysical Journal 629(2): 1055-1074.

6. Pecaut MJ, Mamajek EE (2013) Intrinsic colors, temperatures, and bolometric corrections of pre-main-sequence stars. The Astrophysical Journal Supplement Series 208(1): 9.

7. Brown TM, Baliber N, Bianco FB, Bowman M, Burleson B, et al. (2013) Las Cumbres Observatory Global Telescope Network. Publications of the Astronomical Society of the Pacific 125(931): 1031-1055.

8. Diethelm R (2009) A list of newly determined periods of variable stars. Information Bulletin on Variable Stars 5871: 1-3.

9. Eker Z, Soydugan F, Soydugan E, Bilir S, Yaz GK, et al. (2015) Main-sequence effective temperatures from the mass–luminosity relation. The Astronomical Journal 149(4): 131.

10. Ochsenbein F, Bauer P, Marcout J (2000) The VizieR database of astronomical catalogues. Astronomy and Astrophysics Supplement Series 143(1): 23-32.

11. Wenger M, Ochsenbein F, Egret D, Dubois P, Bonnarel F, et al. (2000) The SIMBAD astronomical database. Astronomy and Astrophysics Supplement Series 143(1): 9-22.

12. Diethelm R (2009) A list of newly determined periods of variable stars. Information Bulletin on Variable Stars 5871: 1-3.

13. Ballesteros FJ (2012) New insights into black bodies. Europhysics Letters 97(3): 34008.

14. Ballesteros FJ (2012) New accurate formula for colour–

Copyright© Sudum E.

temperature conversion. Astronomy & Astrophysics 339: 193-196.

15. Zombeck MV (2007) Handbook of Space Astronomy and Astrophysics (3rd edn.) Cambridge University Press, UK.

16. Rucinski SM (2001) Contact binaries as stellar laboratories. The Astronomical Journal 122(2): 1007-1023.

17. Eker Z, Soydugan F, Soydugan E, Bilir S, Yaz GK, et al. (2015) Main-sequence effective temperatures from the mass–luminosity relation. The Astronomical Journal 149(4): 131.

Copyright© Sudum E.

YOUR RESEARCH DESERVES GLOBAL VISIBILITY

• Publish • Discover • Share • Connect

MEDICAL	CLINICAL	LIFESCIENCES	PHARMA
90+ OPEN ACCESS JOURNALS		400+ RESEARCH TOPICS	

SUBMIT YOUR RESEARCH
Submit your manuscript through our online submission system.

REPRINTS
If you require a reprint of any article, please contact us.
info@medwinpublishers.com

BECOME A REVIEWER
Share your expertise and contribute to scholarly publishing.

SCAN TO EXPLORE MEDWIN JOURNALS

• Journals • Submit Manuscript • Reviewer Program • Article Tracking

Our Journals indexed in

Embase® ELSEVIER | PubMed National Library of Medicine NLM | Crossref | Google Scholar | INDEX COPERNICUS INTERNATIONAL | ISSN INTERNATIONAL STANDARD SERIAL NUMBER INTERNATIONAL CENTRE | ROAD DIRECTORY OF OPEN ACCESS SCHOLARLY RESOURCES | EuroPub | Scilit | WorldCat® | Academic Resource Index ResearchBib | ADVANCED SCIENCE INDEX | INTERNATIONAL Scientific Indexing | ICMJE INTERNATIONAL COMMITTEE of MEDICAL JOURNAL EDITORS

This article published by **Medwin Publishers,** 28475 Witherspoon Dr, Novi, MI 48377, United States, +1-248-247-6042, WhatsApp +1 (248) 275-1133, info@medwinpublishers.com

© 2026, by the Authors. The articles published from this journal are distributed to the public under "**Creative Commons Attribution License**" (https://creativecommons.org/licenses/by/4.0/). Therefore, upon proper citation of the original work, all the articles can be used without any restriction or can be distributed in any medium in any form.