DIFFERENTIAL PHOTOMETRY OF ECLIPSING BINARY SYSTEM V798Her IN GLOBULAR CLUSTER NGC 6341

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Abstract

We present the photometric study of an eclipsing binary star V798Her in the globular cluster NGC 6341. The observations were obtained in Johnson's B, V, & R filters using 0.8m Tarleton telescope and a CCD photometer. The observed light curves after the determination of light elements show that V798Her is a W UMa contact binary system with a period of 0.2951110 days. Wilson Devinney Mathematical Model version of 2017 was used for the analysis and obtaining the photometric solution of V798Her.

Introduction

The globular cluster NGC 6341 was observed for 26 nights during the months of April-August 2013. The data of the target star V798Her was obtained in the FITS (Flexible Image Transport System) format in B, V and R filters. The exposure time was 120s, 60s, and 40s for B, V, and R filters, respectively.

Star	Identifier	B	V	R	α (2000)	δ (2000)
V798Her	GSC 3085-1387	----	14.31	----	17 16 38.24	43 12 14.5
C1	TYC 3085-0751	14.55	13.50	----	17 16 36.25	43 14 00.4
C2	TYC 3085-1461	14.00	13.16	----	17 16 27.20	43 10 40.7
C3	TYC 3085-1539	13.87	12.83	----	17 16 49.88	43 10 41.2

Table 1: Identification Data of V798Her and Comparison Stars

The data was reduced using the GCX Astronomical Image Processing software and the Python scripts. For differential photometry, we selected three comparison stars near the target system (V798Her).

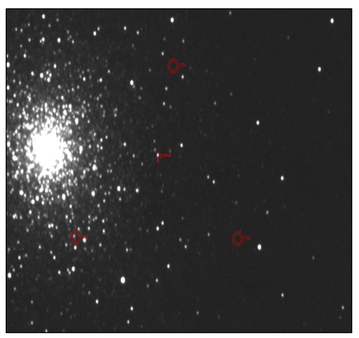

Figure 1: V798Her & Comparison Stars Selected in GCX software

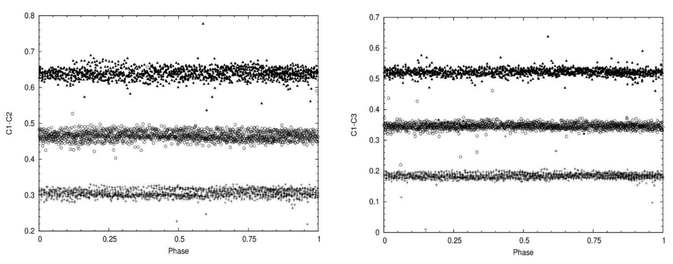

Figure 2: The difference in magnitude of comparison stars 1 & 2 and 1 & 3 is constant. Triangles represent B-filter, circles represent V-filter and plus sign represents R-filter.

Period Determination

The published period of V798Her is 0.346178 days [1] and we determined the period using the P_search 15f software with the Fourier transform technique to be 0.295111(±0.0…5(9)) days.

Epoch of Minima

The published epoch of minima of V798Her is in Heliocentric Julian Date 2427340.089 [1] and we determined the epoch of minima for V798Her using the software Minima25c with the Kwee and van Woerden technique to be H.J.D. 2456412.898(±0.0001). The observed light elements of V798Her is shown in Eq.1

$$\boldsymbol{Min.(I)} = H.J.D.2456412.898\ (\pm 0.0001) + 0^{d}.295111(\pm 0.0\ldots 5(9))\mathrm{E}$$

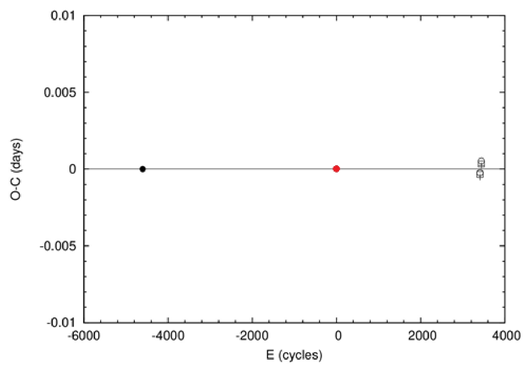

Figure 3: Observed minus calculated graph after 1st order correction. Red circle represents the observed value, black circle represents the published period and plus signs represents the calculated values in B, V and R filters.

O-C Diagram

Fig 3. shows the O-C diagram and the first order least square calculation indicate the new derived period and epoch have been determined correctly and therefore no further period analysis was attempted.

Global Mass Ratio

The global mass ratio determined for V798Her is **0.8**. It is the smallest sum of the squares of the residual value in the plot.

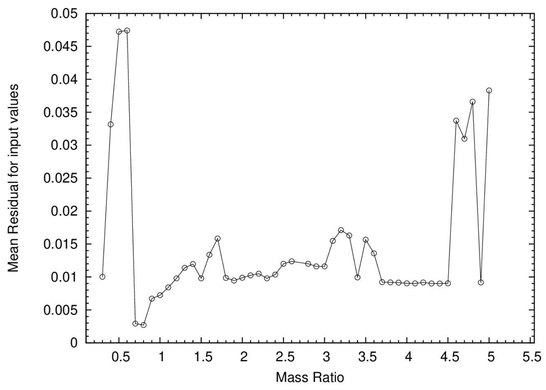

Figure 4: Global Mass Ratio

Results

For V798Her, the parameters obtained using the Wilson Devinney Mathematical Model for the lowest mean residual are listed in Table 2.

Table 2: Photometric Parameters of V798Her

Parameters	No Spot	Spot
$q\left(\frac{m_2}{m_1}\right)$	0.8850 ± 0.008	0.8966 ± 0.001
i (deg)	66.31 ± 0.17	66.13 ± 0.07
$\Omega_1 = \Omega_2$	3.5539 ± 0.003	3.5733 ± 0.003
$T_1(K)$	4920	4920
$T_2(K)$	4832 ± 0.005	4697 ± 0.0004
A_1^*	0.500	0.500
A_2^*	0.500	0.500
g_1	0.1933 ± 0.03	0.2438 ± 0.01
g_2	0.4454 ± 0.04	0.4364 ± 0.01
Mean Residual	0.00164	0.00098

*Assumed

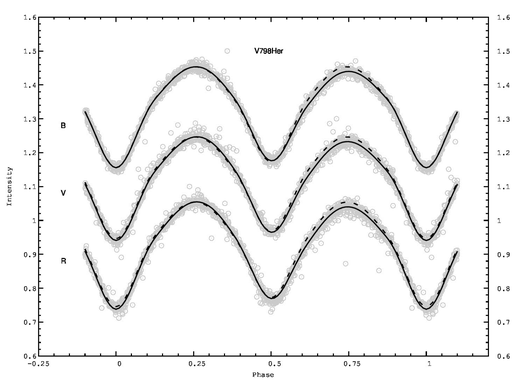

Figure 5: The observed and computed light curves of V798Her in B, V, and R filters, respectively. The circles represent the observed light curve, the dash line represents the no-spot solution, and the smooth curve represents the spot solution

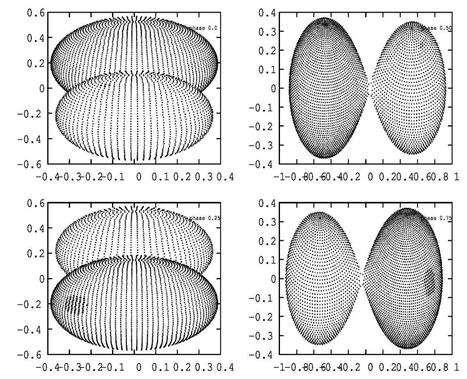

Figure 6: The configuration of V798Her at phase 0, 0.25, 0.5, and 1.

Conclusions

According to the Harvard classification scheme based on temperatures T_1& T_2 both stars belong to spectral type K where neutral metal lines are most prominent. The fill out factor calculated using the mathematical equation by Rucinski (1973) is

$$f_{Rucinski} = 0.9874 \cong 1$$

This indicates that the stars are in contact with the inner critical surfaces.

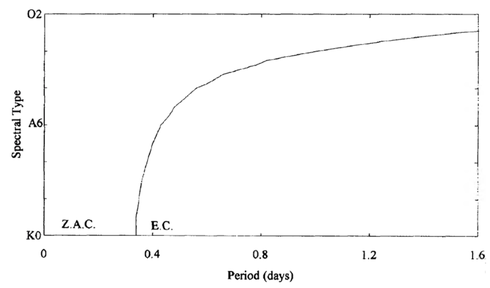

Figure 7: Period vs Spectral Type Diagram [2]

In period-spectral type diagram for contact binaries, V798Her appears to be a Zero Age Contact System with case A type mass transfer (core H-burning phase).

Acknowledgements

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- GCX Astronomical Image Processing and Photometry Software
- Wilson Devinney Mathematical Model version of 2017

References

[1] O. Hachenberg, "Der Aufbau des kugelförmigen Sternhaufens Messier 92. Mit 9 Abbildungen.," \zap, vol. 18, p. 49, Jan. 1939.

[2] S. N. Goderya, K.-C. Leung, and E. G. Schmidt, "Photometric Study of Selected Zero-Age Contact and Evolved Contact Binary Systems," in The Third Pacific Rim Conference on Recent Development on Binary Star Research, Jan. 1997, vol. 130, p. 219.