

# Detailed Analyses of Binary OCs

Seval Taşdemir, Deniz Cennet Çınar

Binary and Multiple Stars in the Era of Big Sky Surveys  
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# Detailed Analysis

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## Astrometric and Photometric Data

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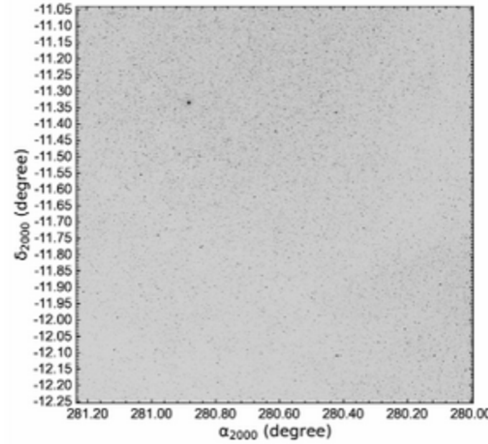


Figure 1: Identification chart of clusters.

Table 1: Fundamental parameters of CWNU 266 and HSC 224.

Parameter	CWNU 2666	HSC 224
Astrometric Parameters		
$(\alpha, \delta)_{J2000}$ (Decimal)	(281.02, -11.90)	(280.23, -11.80)
$(l, b)_{J2000}$ (Decimal)	(21.49, -03.79)	(21.23, -03.05)
Cluster members ( $P \geq 0.5$ )	106	146
$\mu_{\alpha} \cos \delta$ (mas yr $^{-1}$ )	$0.646 \pm 0.155$	$0.665 \pm 0.131$
$\mu_{\delta}$ (mas yr $^{-1}$ )	$-0.769 \pm 0.124$	$-0.728 \pm 0.107$
$\varpi$ (mas)	$0.537 \pm 0.006$	$0.530 \pm 0.005$
$d_{\varpi}$ (pc)	$1863 \pm 102$	$1857 \pm 169$
kmeans	25	34
Astrophysical Parameters		
$E(G_{BP} - G_{RP})$ (mag)	$0.975 \pm 0.025$	$0.807 \pm 0.016$
$A_G$ (mag)	$1.816 \pm 0.047$	$1.503 \pm 0.030$
[Fe/H] (dex)	$0.010 \pm 0.05$	$0.010 \pm 0.05$
Age (Myr)	$160 \pm 15$	$140 \pm 15$
$G - M_G$ (mag)	$13.192 \pm 0.051$	$12.857 \pm 0.034$
$d_{iso}$ (pc)	$1885 \pm 44$	$1866 \pm 29$

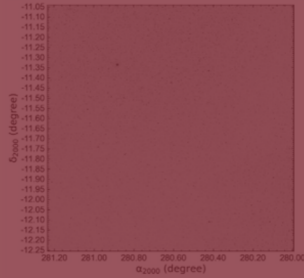


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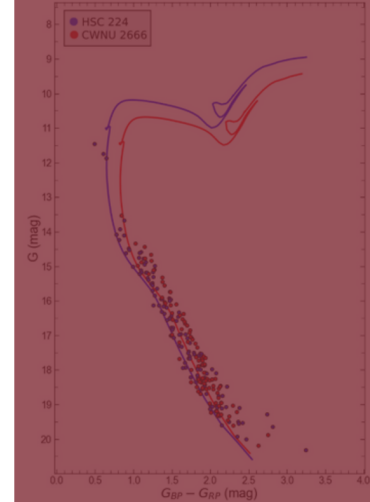


Figure 2: Color-magnitude diagram (CMD) for the studied cluster HSC 224 and CWNU 2666. Different colour show the  $0.5 > P$  with cluster. The best solution of fitted isochrones (41 Gyr and 67 Gyr) are inferred as the blue actively.

## Conclusion and Future Works

In the literature, we identified and validated that CWNU 2666 and HSC 224 form a cluster by analyzing their positions in the 2D celestial coordinate system, the 3D galactic system, proper motion, parallax, and CMD.

Future SED analyses will be performed for the most likely member stars of each cluster and compared with the model atmosphere parameters in the spectral studies in the future. In addition, the total masses of the clusters will be calculated and a comparison will be made. These analyses aim to provide a perspective on the previous interactions and formation of each other.

## References



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## Analyses

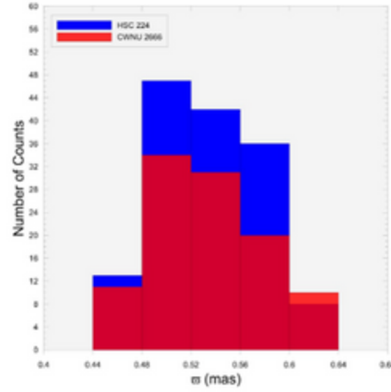


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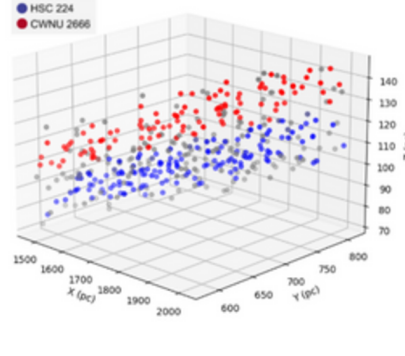


Figure 3: The 3D distribution of most likely stars of HSC 224 (Blue), and CWNU 2666 (Red). Also, grey circles represent the stars which are out of the limit radii of clusters.

- 1 In this study, a spatial separation was performed by considering the central coordinates of the binary open clusters.
- 2 The limit radii of the clusters was determined taking into account the CMD and VPD as 24 arcmin.
- 3 Taking into account the the results of the photometric completeness limit the membership probability analysis and the limiting radius we identified 106 and 146 members for the cluster CWNU 2666 and HSC 224, respectively with probabilities ( $P \geq 0.5$ ).
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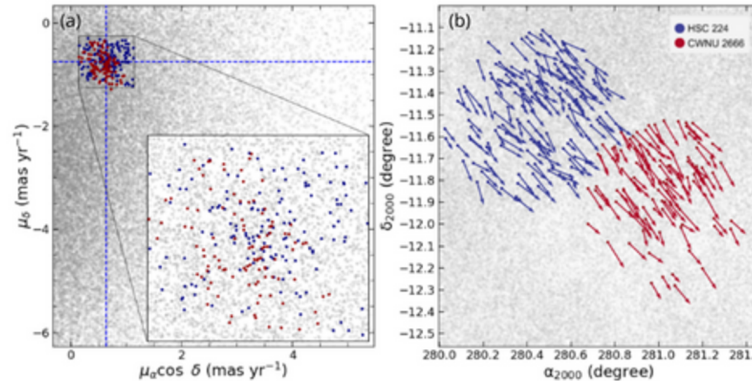


Figure 4: Vector Point Diagram (a) and proper-motion velocity vectors (b) of HSC 224 and CWNU 2666. In panel (a), the magnified boxes reveal regions with a high concentration of member stars in the VPDs, and mean proper-motion values are indicated by the intersection of blue dashed lines.

## Purpose and Perspective of the Study

The aim of this study is to conduct a comprehensive photometric and astrometric analysis of the close binary open clusters (CBOCs) CWNU2666 and HSC224, as cataloged by Hunt & Reffert (2023). This research focuses on accurately identifying and differentiating the member stars of these two clusters, which are closely aligned in both motion and space via the Gaia DR3 photometric and astrometric data.

By achieving a clear separation in positional and color space, the study seeks to determine the fundamental astrophysical and astrometric parameters of each cluster. The findings are expected to contribute to a better understanding of the clusters' formation history and stellar evolution of the binary open clusters.

## Astrometric and Photometric Data

The photometric and astrometric analyses of HSC 224 and CWNU 266 utilized data from the Gaia DR3 catalogue (DR3, Gaia Collaboration et al. 2023). Astrometric and photometric data were generated based on the equatorial coordinates provided by Hunt & Reffert (2023) ( $\langle \alpha, \delta \rangle = (18^h 44^m 05^s.3347906, \delta = -11^\circ 54' 21''.783347)$ ).

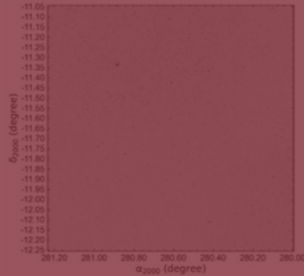


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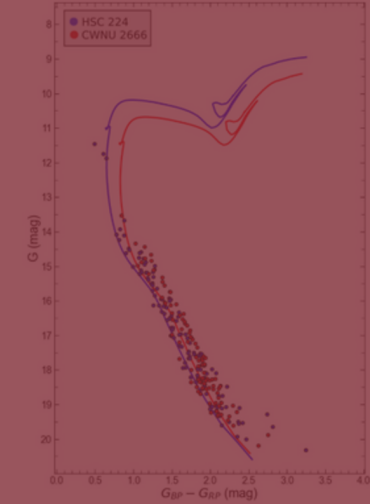


Figure 5: Colour-magnitude diagram for the studied cluster HSC 224 and CWNU 2666. Different colour show the distribution of stars ( $0.5 > P$ ) with cluster. The best solution of fitted isochrones (41 Gyr and 67 Gyr) are inferred as the blue lines, respectively.

## Conclusion and Future Works

From the literature, we identified and validated that CWNU 2666 and HSC 224 form a binary cluster by analyzing their positions in the 2D celestial coordinate system, the 3D coordinate system, proper motion, parallax, and CMD.

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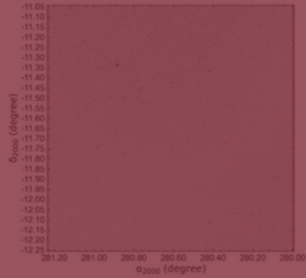


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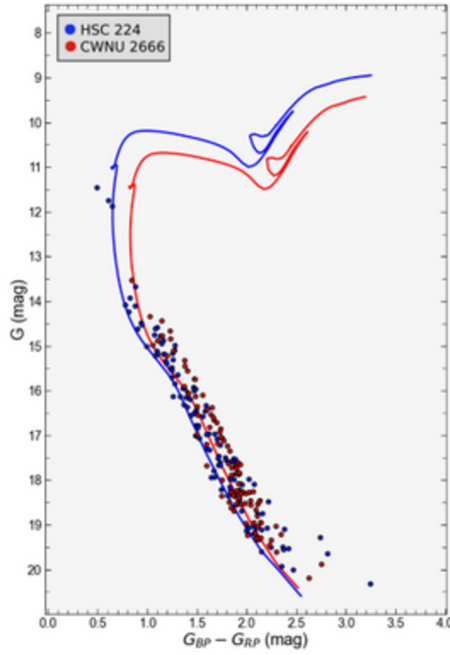


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Drawing from the literature, we identified and validated that CWNU 2666 and HSC 224 form a physical binary cluster by analyzing their positions in the 2D celestial coordinate system, the 3D Cartesian coordinate system, proper motion, parallax, and CMD.

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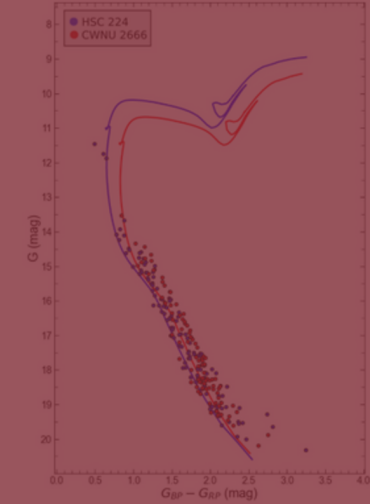


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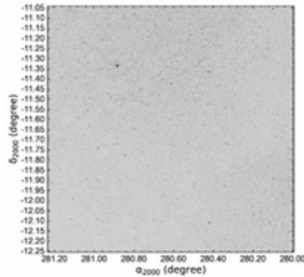


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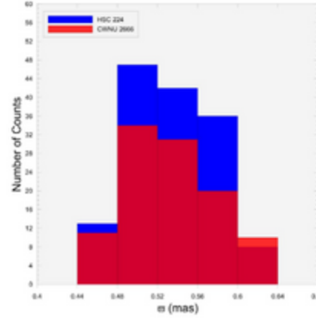


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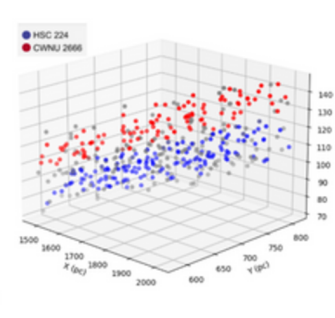


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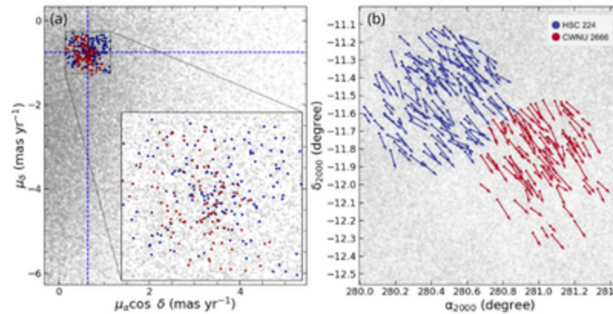


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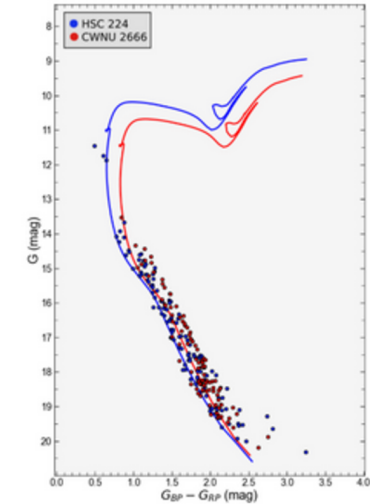


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