

Astrometry of WDS 13472-6235

Emily Gates¹, Brighton Garrett¹, Phoebe Corgiat¹, Marissa Ezzell¹,
Jon-Paul Ewing¹, and Richard Harshaw²

1. Paso Robles High School, CA

2. Institute for Astronomical Research (InStAR)

Abstract: Double star system WDS 13472-6235 was observed and analyzed with images taken using the Las Cumbres Observatory 0.4-m telescope at the Cerro Tololo Observatory. The stars were found to have a separation of 9.30" and a position angle of 318.01°. This star does not currently have an orbit calculated and the data we found in our observations was collected in order to help somebody else calculate an orbit in the future. As it stands now, it is undecided as to whether or not WDS 13472-6235 is truly physical or is an optical system.

Introduction

A group of four students from Paso Robles High School (Figure 1) came together through the school's Field Studies Collaborative: Astrometry Research Seminar with the goal of observing the double star, WDS 13472-6235 (Figure 2). The goal of this group was to contribute data so that future observers could better understand the system and have the resources to potentially determine the nature of the double star and find its potential orbit.

Since its initial discovery in 1897 by the Cordoba Observatory, this double star has only been observed eight times. The previous most recent observation of WDS 13472-6235 was in 1998. The team chose this double star since it had so few observations and had not been observed in so long.

The spectral class of the star is G8Ia, meaning that it is a yellow supergiant. The magnitude of the primary star is 7.19 and the magnitude of the secondary star is 9.9 producing a difference in magnitude of 2.71. WDS 13472-6235, located in the Centaurus constellation, is a quadruple system in which only the aforementioned primary and secondary stars are visible using ground-based telescopes.

Equipment and Procedures

The images used to gather data in this study were taken through the Las Cumbres Observatory (LCO)



Figure 1. Team Alcor in front of the 60" telescope at the Mount Wilson Observatory



Figure 2. Image of WDS 13472-6235 taken from LCO's 0.4-m telescope at the Cerro Tololo Observatory

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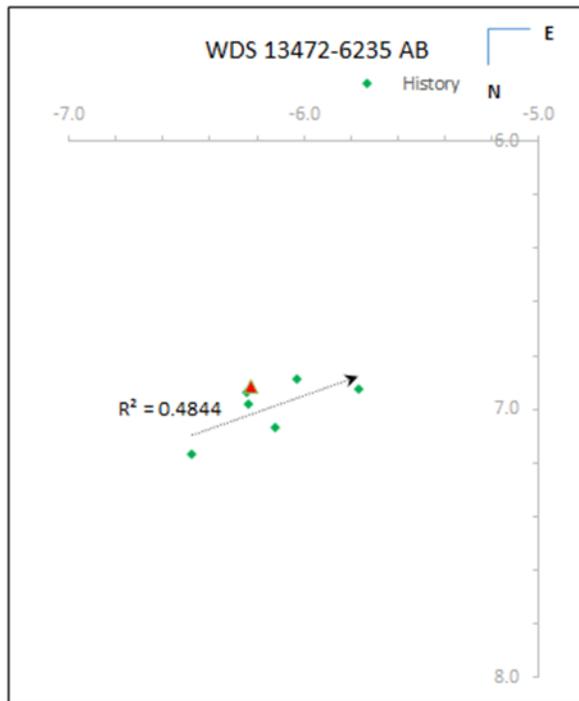


Figure 3. Plot of the historical measurements of 13472-6235 AB (green diamonds) with our data point shown by the red triangle; this data will eventually lead to a calculated orbital plot. Units on X and Y axis are in arc seconds.

Global Sky Partners program (2019); the LCO telescope used to acquire these images was at the Cerro Tololo Observatory located in Region IV, Chile. At this location, an SBIG STL-6303 camera on a 0.4-m telescope was used to take 28 images of WDS 13472-6235 at three different exposure times: 0.5 seconds (10 images), 1 second (9 images), and 2 seconds (9 images). The exposure lengths were determined by the magnitude of the primary star (7.19).

Using the program AstroImageJ (Collins, et al. 2017), the team analyzed the acquired images to find the position angle and separation of the pair for all 28 images. To accomplish this, an aperture radius of two was selected for the measurements on all the images. The averages and errors in the results were then calculated. The team's averaged data point and the data points from past observations were then plotted in Figure 3, which shows the change in the position of the stars relative to one another within a cartesian coordinate system.

Results

The position angle was calculated to be 318.01° and the separation to be 9.30 arc seconds. The observations were taken on April 17th, 2019 and are displayed in Table 1.

Discussion

In AstroImageJ an aperture radius of two was selected as it fit the smaller star in the pair seen in all of the images. There were a few outliers when the data was first calculated, but after uploading the image again to AstroImageJ and allowing the program to calculate the radius, the data corrected itself in the program and we removed the remaining outliers. It was also noted that the exposure time of the image had no correlational results on the data.

When analyzing the data that was collected, we used the Excel Spreadsheet Plotting Tool 3.10 created and described by Richard Harshaw (2018) to create a plot graph that will eventually lead to an orbital plot. (Figure 3)

The data collected by our team follows the trend of past data. While analyzing the data, though, we decided to reject some of the past observations due to them being outliers; those particular data points did not follow the trend line of all of the data acquired over the years. The past observations that were omitted were taken from Chesneau (2014), which observed the stars Aa and Ac, and from the Hipparcos satellite, which observed Aa and Ab. These points were omitted because our team wanted to calculate the distance between the two larger stars, A and B.

The parallax the GAIA satellite reported back to us was deemed unreliable since the parallax was less than 5 milliarcseconds.

Conclusion

The objective of this research was to acquire more data on the separation and position angle of the double star WDS 13472-6235 while also gaining experience in the field of Astrometry. The results collected by our team proved to be consistent with previously collected data, but no further conclusions can be made on the orbit of the stars or if the pair is an optical double or true binary system due to the overall lack of data at hand.

Acknowledgements

We would like to thank Cora Karamitsos, Rachel Freed, and Rick Wasson for editing and giving suggestions for our paper; Karen Collins for developing AstroImageJ, the tool we used to calculate our results; Brian Mason for supplying us with historical data on our star from the US Naval Observatory, which allowed us to compare our results to past observations; Dave Rowe and his GDS (GAIA Double Star) Selection Tool that helped us choose which star to observe; and finally, Rachel Freed, Jimmy Ray, and all of the professionals who helped and supported us through this experience, we wouldn't have been able to do this without all of

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Exp. Time (s)	0.5		1		2	
Image Number	PA (deg)	Sep (as)	PA (deg)	Sep (as)	PA (deg)	Sep (as)
1	317.77	9.41	318.05	9.21	318.84	9.18
2	318.24	9.38	317.97	9.26	318.29	9.30
3	317.68	9.33	318.38	9.38	318.72	9.22
4	317.28	9.31	317.59	9.25	318.30	9.23
5	317.71	9.27	317.37	9.33	317.71	9.30
6	318.10	9.45	317.98	9.33	319.02	9.24
7	318.11	9.19	318.46	9.38	318.65	9.21
8	318.08	9.21	317.86	9.19	318.10	9.24
9	317.06	9.46	318.12	9.39	317.08	9.43
10	317.68	9.37	-	-	-	-
Mean	317.77	9.3438	317.98	9.303	318.30	9.261
Std. Dev.	0.38	0.093	0.34	0.076	0.61	0.074
Std. Err. of Mean	0.12	0.029	0.16	0.025	0.20	0.025

Avg of all 3 exposures	PA (deg)	Sep (as)
Mean	318.01	9.30
Std. Dev.	0.49	0.085
Std. Err. of Mean	0.093	0.016

Table 1: Separation and Position Angle for all 28 images measured using AstroImageJ

you. This work makes use of observations from the LCO Network Global Sky Partners Program. This research has made use of the Washington Double Star Catalog maintained at the U.S. Naval Observatory.

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Rowe, D. A., personal correspondence