New Astrometric Measurements of WDS06084-1109 AC

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Abstract

We selected the star WDS06084-1109BU to investigate as a double star and test its potential as a true binary. We performed astrometric measurements using AstroImageJ, taking our data from the Washington Double Star Catalog (WDS) and from images we acquired with the Las Cumbres observatory (LCO) network. We analyzed past measurements of WDS06084-1109AC as well as our new measurements. From our new measurements we determined the current separation to be 10.134 arc seconds with a position angle of 260.183. We were able to find the proper motion and parallax of the stars from the Gaia Database. We concluded that star components A and C are not a binary pair.

Introduction

We decided to research the star WDS06084-1109BU. This is a triple star system, and we have selected to observe the AC component because it has not been observed since 2015. We measured stars A and C. This is because stars A and B are too close to be measurable by our telescope and there is a large difference between the magnitudes of the A and B components. The ultimate goal of our paper was to determine whether or not the A and C components are physically associated.

Methods

We took 10 images with Las Cumbres Observatory Global Telescope (LCOGT) 0.4-meter telescopes which are equipped with SBIG STL 6303 cameras. The telescopes used were located at the Las Cumbres' Teide Observatory in Tenerife, Spain. The images had exposure times of 5 seconds with a Sloan 'r' filter. We used the software AstroImageJ (Collins, 2017) to determine the position angle and separation of the double stars. We also requested historical data from Rachel Matson at the USNO (Matson, 2022) so that we could create a graph of the recorded positions and chart the movement of the stars over time. We compiled the historical data and added the point we measured (Figure 2), to create a scatter plot data chart.

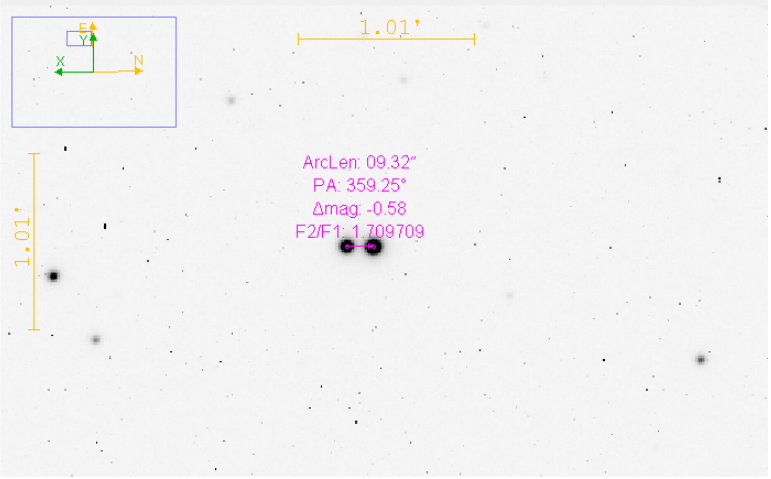

Figure 1: Sample image of Star WDS 06084-1109BU.

Results

Table 1 shows the analysis of the images we received from LCO, Teide Observatory. Our table includes the mean, standard deviation, and standard error for arc length in seconds and position angle in degrees.

Star	Date	images		Arc length (sec)	PosAng (deg)
WDS06084-1109BU 17AC	2022.76	10	Mean	10.134	260.183
			St. dev.	0.087	0.413
			St. error	0.028	0.13

Table 1: Information on our images of star WDS06084-1109BU 17AC, including the date taken, arc length (sec) and the position angle.

Year	Theta	Rho
1871	244.1	10
1872	244.1	10
1876	244.5	8.95
1892	246.8	8.77
1898	249.1	9.32
1902	251.2	9.521

1902	252.0	9.439
1904	253.2	9.12
1904	247.0	9.030
1907	247.9	9.03
1917	252.7	9.59
1925	249.6	9.22
1933	248.1	8.93
1963	253.5	9.72
1991	257.3	9.91
1991	257.3	9.89
1998	258.8	9.89
2002	256.9	10.02
2015	259.5	10.15

Table 2: Historical data from the Washington Double Star catalog.

Discussion

We requested historical data for this system from the USNO, (Matson, 2022). The historical data consist of 18 data points starting in 1871 and ending in 1991; the historical data is shown in Table 2. Stars A and B were too close together for the telescope to resolve. However, a plot of the A and C components is shown in Figure 2, which was produced using Plot Tool (Harshaw 2020). Although the initial 1871 observation appears somewhat discrepant, the remaining observations appear to show that the C component is moving linearly with respect to the A component. In an effort to explore this, a linear trendline was fitted to the historical data and our new measurement, and the 1871 observation was omitted from this fit. The result, which is shown in Figure 2, is quite linear, with an R-squared value of 0.91. We also tested the fit of a second-order polynomial, which yielded an R-squared value of 0.7, which means that a linear fit better conforms to the data. This suggests that the A and C components are not physically associated with each other.

To further investigate the motions of these stars, we investigated the parallax and proper motion of the A and C components of this system. These measurements were retrieved from the Gaia database (Gaia Collaboration, et al., 2020a), and are represented in Table 2. One way to measure the "goodness" of Gaia measurements is with the re-normalized unit weight error (RUWE; Lindegren 2018). For well behaved measurements, the RUWE should be close to 1.0, which is what is seen for the A and C components of this system. Since the RUWE value for the B component is so large, we must be cautious in interpreting these measurements.

The parallax, shown in the second column, is very different between the A and C components, which suggests that these components are separated by ~365 pc. Additionally, their proper motion values are quite dissimilar. This suggests that these components are not physically associated. The Gaia data together with the linear motion seen with the historical measurements suggests that the A and C components of WDS06084-1109 are not physically associated.

Component	Parallax (mas)	Distance-range calculation w/ pace (pc)	RA Proper Motion (mas/year)	Dec Proper Motion (mas/year)	RUWE
A	11.65±0.026	85.6- 86.0	11.83±0.024	-14.26±0.021	1.068
B	12.45±0.156	79.3 - 83.34	6.49±0.141	-15.792±0.13	9.552
C	2.22±0.015	447.4 - 453.5	-1.486±0.014	-0.45±0.013	1.096

Table 3: GAIA measurements of parallax and proper motion for WDS06084-1109BU 17AC.

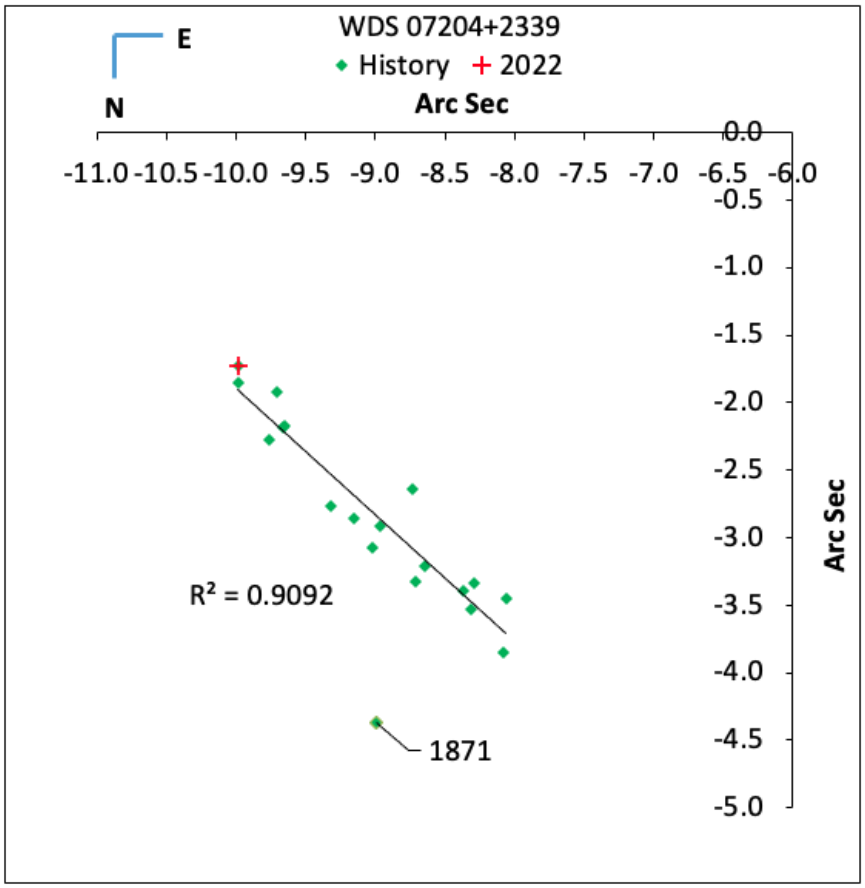

Figure 2: The historical data with a linear fit and its associated R-squared value. This suggests that the stars are not physically associated.

Acknowledgements

This project was made possible by the collaboration with Southern Utah University, and has made use of AstroImageJ. We also would like to thank Dr. Rachel Mattson for providing us with the historical measurements. the SIMBAD database, operated at CDS, Strasbourg, France, and Washington Double Star Catalog maintained at the U.S. Naval Observatory. This work makes use of observations from the Las Cumbres Observatory global telescope network, and data from the European Space Agency (ESA) mission Gaia (https://www.cosmos.esa.int/gaia), processed by the, Gaia Data Processing and Analysis Consortium (DPAC, https://www.cosmos.esa.int/web/gaia/dpac/consortium). Funding for the DPAC has been provided by national institutions, in particular the institutions participating in the Gaia Multilateral Agreement.

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