New Observations of WDS 23516+0814

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Abstract

We report on our observations of the double star system WDS23516+0814 (CHE 506, HD 223638). We selected a double star system with a few historical observations to contribute to the determination of its possible orbit.

1. Introduction

One of the goals of our research is to learn how double star systems are studied. Our measurements of position angle and separation represent a contribution for the future determination of the possible orbit of the star system WDS 23516+0814 if it eventually turns out to be a true binary. We selected this double star system considering it had few previous observations. We analyzed the available data in combination with our measurements to evaluate if it is consistent with a physical system.

2. Equipment and Methods

We selected a double star system using the program Stelle Doppie (e.g. Sordiglioni, G., et al. 2023) and considering systems with apparent magnitude between $9 < m < 11$, angular separation between $5" < \Delta\Theta < 10"$ and $\Delta m < 3$. We also considered systems with a limited number of existing observations, preferably between 12 and 25. Table 1 lists the parameters of the binary star system selected WDS 23516+0814 (coordinates and apparent magnitudes).

Table 1. Basic data of the stars in the binary system WDS23516+0814.

Name	RA (2000.0)	DEC (2000.0)	m_1	m_2
WDS23516+0814	$23^h\ 51^m\ 16.67^s$	+08° 37' 41.9"	9.75	10.70

Our observations were made using a 0.4m telescope with the DeltaRho 350 + QHY600 camera from Las Cumbres Observatory (LCOGT) (e.g. Lombardi, et al. 2023). We submitted 13 observation requests using the observing portal and specifying the coordinates, the exposure time and filter (Bessell-V).

3. Data

A total of 10 observations were acquired from LCOGT with Bessell-V filter and exposure time of 1s. Table 2 shows our measurements of position angle (PA) in degrees (°) and the separation (SEP) in arcseconds ("), alongside the archive name from LCOGT. The PA and SEP were measured using the AstroImageJ software (e.g. Collins, et al 2017).

Table 2. Measurements with AstroImageJ of WDS 23516+0841.

Obs Date	PA (°)	SEP (")
2023-10-19	79.42	8.81
2023-10-19	79.44	8.85
2023-10-28	79.83	8.74
2023-10-28	79.23	8.91
2023-10-28	80.55	8.13
2023-10-28	79.80	8.69
2023-11-08	79.28	8.90
2023-11-14	79.58	8.73
2023-10-23	80.07	8.79
2023-10-28	79.88	8.88

Table 3 shows the average measurements, standard deviation, and standard error of the mean for the PA (°) and SEP (") of WDS23516+0841, which were acquired using AstroImageJ.

Table 3. Average measurement of PA and SEP and errors

	PA (°)	SEP (")
Mean	79.71	8.86
Standard deviation	0.41	0.16
Standard error of the mean	0.13	0.07

4. Discussion

To compare our measurements with the historical data available for this system we made a plot of the data. Table 4 shows the historical data for WDS23516+0841, which were requested from the U.S. Naval Observatory (Date, PA (°), SEP ("), telescope aperture (m), RA ("), and DEC (")).

Table 4. Historical data of WDS23516+0841

Date	P.A. (degrees)	Sep (arc sec)	Telescope Aperture (m)	RA (arc sec)	DEC (arc sec)	References
1897.82	81.7	8.529	0.3	8.439665455	-1.231214038	WFC1998
1910.95	82.6	8.9	0.4	8.825873345	-1.14628081	Che1910
1919.8	82.3	9.099	0.3	9.016956134	-1.219140301	WFC1998
1929.35	81.8	8.794	0.2	8.704092175	-1.254278843	WFC1958b
1958.73	74.7	8.534	0.2	8.231533009	-2.251892608	WFC1975
2000.72	79.5	8.97	1.3	8.819796521	-1.634652664	Hrt2012b
2000.758	79.2	8.905	0.2	8.747267968	-1.668630606	Hrt2012b
2006.991	79.3	8.82	0.3	8.666644866	-1.637579548	UC_2013b
2010.5	78.4	9.02	0.4	8.835768751	-1.813722849	Wly2008b
2012.831	79.34	8.922	0.2	8.768025702	-1.650396708	UR_2015
2013.957	79.23	8.914	0.2	8.756981929	-1.665732122	UR_2015
2014.729	79.3	8.92	0.2	8.764906145	-1.656146209	UR_2015

2016.818	78.6	8.954	0.7	8.777348098	-1.769823826	WSI2017b

We searched for information related to the stars in SIMBAD and found the data listed in Table 5.

Table 5: Data of the stars of WDS23516+0841 listed in Gaia DR3

Name of star	Spectral type	Proper Motion RA (mas/yr)	Error Proper Motion RA (mas/yr)	Proper Motion DEC (mas/yr)	Error Proper Motion DEC (mas/yr)	Distance (pc)
WSD23516+0841	F8	-0.922	0.022	7.463	0.013	214.4238
AG+08 3266	~	~	~	~	~	~

Figure 1 shows a historical data graph with the primary star (WDS23516+0841) at the origin. The points represent the location of the secondary star (AG+08 3266). We calculated the-x-values by multiplying the separation by the sine of the position angle [x = Sep * sin(PA)], while the y-values were obtained by the negative value of the separation (SEP) times the cosine of the position angle [y = -Sep * cos(PA)]. The graph shows an orbit consistent with curvature (second order polynomial fit).

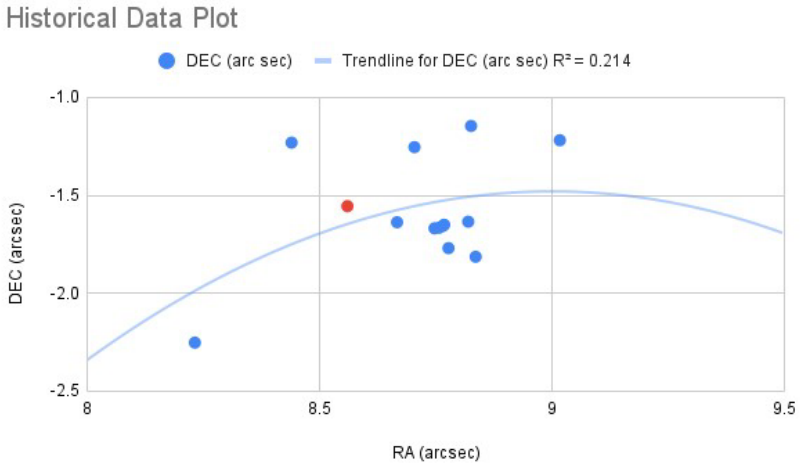

Figure 1: Graph of WDS23516+0841 Orbit. The horizontal axis is RA (arcseconds), and the vertical axis is DEC (arcseconds). The primary star is at the origin, blue is historical data, and red is our measurement.

5. Conclusions

This article allowed us to find and observe the latest data for the double system WDS23516+0418. Its nature continues to be uncertain. More observations of PA and SEP will be required to establish the orbit if indeed it is a physical pair. It would be helpful to obtain data regarding the proper motion and spectral type of the secondary star to understand if this is a physical pair.

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