

The Separation and Position Angle of WDS 07343-0313 HJ 56

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Abstract: The purpose of this investigation was to make a position angle and separation measurement of the double star WDS 07343-0313 HJ 56 and add that point to the historical measurements of this double star. Astrometric data of the double star system were obtained through the Las Cumbres Observatory Global Telescope (LCOGT) Network using several of their 0.4-meter telescopes. The separation was measured to be 7.18" and the position angle to be 148.77°. Based on historical data, from 1825 to 2015, the separation changed from 4.0" to 7.1", and the position angle has changed from 135° to 149°. There appears to be movement indicated by the data; however, when the first measurement, made by John Herschel in 1825 is disregarded, there is no obvious change in separation or position angle over the last 129 years.

Introduction

First discovered in 1825 by John Herschel, this double star has 19 historical observation measurements, most recently in 2015. According to Stelle Doppie, the nature of this double is uncertain. The reported separation has changed from 4.0" to 7.1" between 1825 and 2015, and the reported position angle has changed from 135° to 149° during the same time frame. The magnitudes of the primary and secondary stars are listed as 9.54 and 9.87, respectively. The seeming change in separation and position angle, along with the uncertainty of the nature of the double, suggested this double star was a potential candidate for further study.

Equipment and Procedures

Fifty images were taken from March 12 to March 26, 2021, using LCOGT 0.4-meter telescopes with SBIG STL 6303 cameras. One of the telescopes used is shown in Figure 1. The telescopes used were located at the Teide Observatory in Tenerife, Spain, the Cerro Tololo in Chile, and the South African Astronomical Observatory. Image exposure times of 2 seconds were requested with a clear, or, in the case of 10 images, red filter.

Figure 1. One of ten 0.4 meter telescopes part of the LCOGT Network [0.4m in Chile].

The images were automatically reduced through the LCOGT pipeline. The software AstroImageJ (Collins, 2017) was used on each reduced image to determine the separation (ρ) and position angle (θ) of the double stars. The average value and standard deviation for ρ and θ were calculated and added to the historical data obtained from Brian Mason at the US Naval Observatory. The historical and new data were plotted using PlotTool (Harshaw, 2020) and analyzed for evidence of an orbit that would signify a physical double star. Information about the motion of the stars from the Gaia Early Data Release 3 (EDR3) was obtained from the VizieR Catalog.

Results

For each of the reduced images, the separation and position angle were measured using AstroImageJ. Figure 2 shows an example of the measurements obtained from one of the images. In the figure, the primary star is to the bottom right. The separation was measured as 7.18" and the position angle of the secondary star relative to the primary star was 148.78°

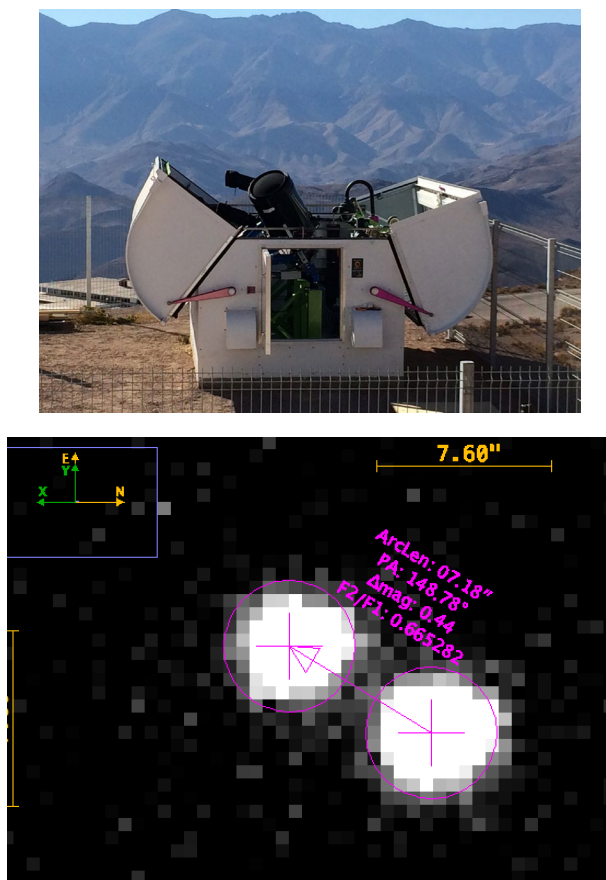


Figure 2. Separation and position angle measurement example for WDS 07343-0313 using AstroImageJ.

The mean, standard deviation, and standard error of the mean were calculated and are shown in Table 1.

	Theta (°)	Rho (")
Mean Value	148.77	7.18
Standard Deviation	1.00	0.16
Standard Error of the Mean	0.144	0.0241

Table 1. Statistical values of the separation (θ) and position angle (ϕ) measurements of WDS 07343-0313 HJ 56 obtained from 50 images.

The historical data for WDS 07343-0313 HJ 56 was obtained from the United States Naval Observatory and is shown in Table 2. The last row in Table 2 includes the measurement data obtained in this study.

Year	Theta (°)	Rho (")
1825	135	4

1892.16	150.7	7.2
1892.17	150.7	7.9
1892.17	150.5	7.922
1893.19	150.6	6.68
1894.12	148.8	6.9
1894.12	148.6	6.952
1903.3	148.2	7.33
1910.81	148	7.48
1938.19	149.5	7.23
1979.999	149	7.3
1983.2	146.97	7.48
1991.71	148.9	7.173
1998.94	148.3	7.17
2000.103	148.5	7.19
2004.983	148.9	6.91
2010.5	148.4	7.16
2014.132	148.57	7.161
2015	148.496	7.162
2015.048	148.56	7.133
2021	148.77	7.18

Table 2. Historical data and current measurements for WDS 07343-0313 HJ 56

Discussion

The objective of this research was to determine the current position angle and separation of the stars in the double star system WDS 07343-0313 HJ 56. Because of the initial measurements made by Herschel in 1825, the position angle and separation of the double star system appears to have changed over time lending to the possibility this is a physical double. Upon closer inspection of the historical data, the position angle and separation hasn't varied significantly from 1892 to the present. John Herschel's observation appears to be an outlier since his value is more than 3 SD from the mean. The measurements obtained in March 2021, $\rho = 7.18''$ and $\theta = 148.77^\circ$, are within the same range/uncertainty of the measurements from 1892-2015 and plots of the measurements show no obvious orbital pattern.

Based on a comparison with historical data, there has been no change in either the position angle or separation in the past six years. A review of the historical data suggests the original measurements obtained by John Herschel may not be accurate. The historical and current data were plotted using the Plot Tool (Harshaw, 2020). The results are displayed in Figure 3.

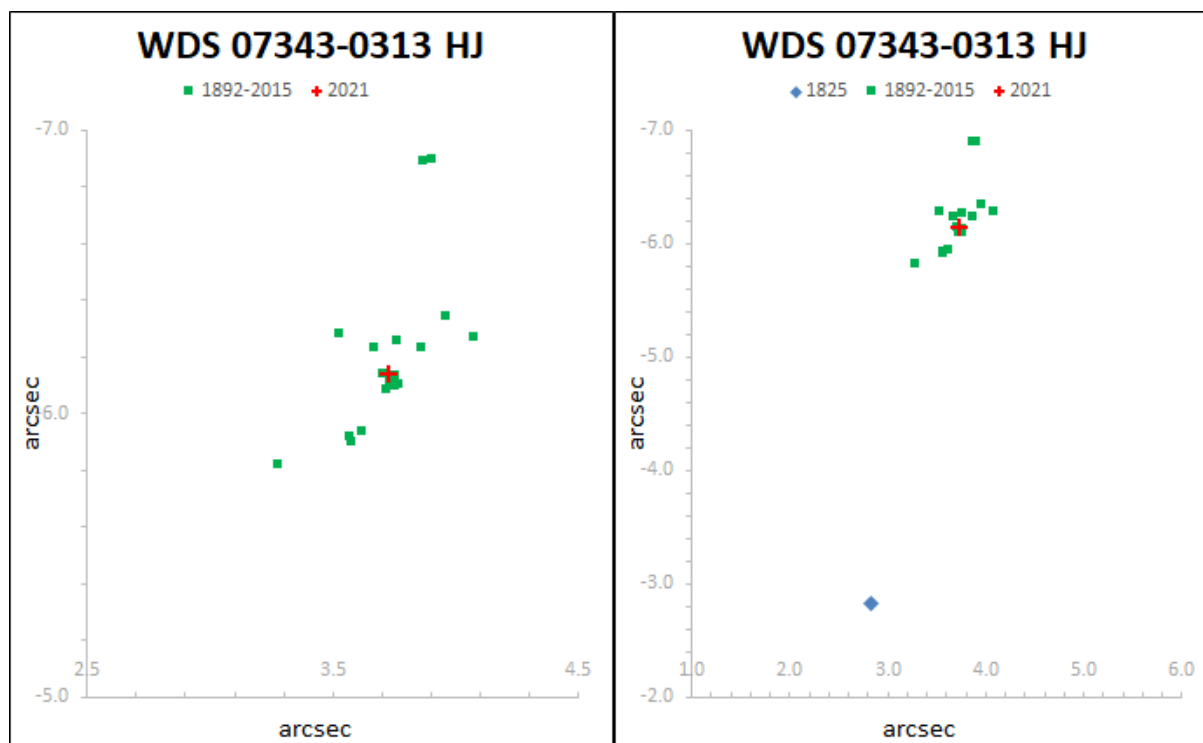


Figure 3. Plot of WDS 07343-0313 historical data with the present data shown in red.

Gaia proper motion and parallax data were examined. The parallax values of 0.1583 mas for the primary star and 1.507 mas for the secondary star differ by a factor of 10 suggesting the stars are at different distances from Earth and therefore not physically bound. Furthermore, the values for the proper motion in declination of the primary and secondary stars are significantly different, again suggesting it is not a binary system. Gaia parallax and proper motion values are presented in Table 3.

Star	A	B
Gaia Source ID (EDR3)	3060830128790533376	3060830128790909056
Parallax (mas)	0.1583	1.5070
Parallax err (mas)	0.5327	0.0260
PM (mas/yr)	6.200	5.593
PM RA (mas/yr)	-5.287	-5.363
PM RA err (mas/yr)	0.589	0.025
PM DEC (mas/yr)	3.238	1.588
PM DEC err (mas/yr)	0.468	0.021

Table 3. Parallax and proper motion values for WDS 07343-0313 HJ 56 A and B from Gaia EDR3.

A separation distance of 25,582 AU was calculated in the Plot Tool.

Conclusion

The separation and the position angle of WDS 07343-0313 HJ 56 was found to be 7.18'' and 148.77° respectively. These values were different from the original 1825 measurement from Herschel but were not significantly different from the nearly constant historical values from

1892-2015. The efforts of this project suggest that the double star WDS 07343-0313 HJ 56 is an optical rather than physical system.

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