CCD Astrometric Measurements of WDS 13513-3928 (HJ 4618) Using the iTelescope Network

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Abstract: Astrometric measurements of WDS 13513-3928 were made using the iTelescope network. The position angle and separation of the two-star system were found to be 51.1 degrees and 28.3 arcseconds.

Introduction

WDS 13513-3928 (HJ 4618) was chosen from the Washington Double Star catalog (WDS) after meeting these specific selection criteria: right ascension between 12 and 18 hours, delta magnitude of 3 or less, separation sufficient to allow for each star to be separate on the image, and large changes in position angle (Theta) and distance between the pair's stars (Rho) as indicated by past observations. Its low declination made telescopes in Australia best suited for CCD imaging.

HJ 4618 was first observed by John Herschel in 1834 and has since been measured a total of ten times. This project added another data point to this set, to assist in future determination of whether the system is gravitationally bound or a visual double star.

Equipment and Method

HJ 4618 was measured from Australia's T32 wide deep field telescope from the iTelescope Network. T32 has a large CCD chip that allows the telescope to take wide pictures of the sky. The Planewave Ascension 200HR mount's accuracy does not require active guidance, thus decreasing the session setup time when imaging. The F/Ratio is f/6.8 and with a CCD 9um pixel size the resolution is 0.63 arcsecs per pixel.

CCD images were taken by Australia's T32 at epoch 2017.2450. with exposures of 80 ms and 160 ms for luminance and HA filters, 5 images in total. Each image was analyzed in MaximDL, where the PinPoint Astrometry function was used to set the World Coordinate System (WCS) right ascension and declination coordinates in the image for further processing. Mira Pro x64, a robust astrometry program, was used for measuring Theta and Rho of HJ 4618. Averages were found of the measurements.

The A and B stars were located and Mira was used to measure the separation distance from the stars' centroids and the separation angle of the pair. These measurements were recorded into Microsoft Excel to calculate statistics and plot the new data points visually as a graph relative to the previous measurements' points. Figures 1 and 2 show examples of CCD images that were analyzed in Mira, with the A and B stars labeled. Figure 1 is an example of an image taken with a luminance filter while Figure 2 was taken with a hydrogen-alpha filter.

Theta and Rho measurements from the CCD images, Table 1, are outlined along with basic statistics. These include the average and standard deviation of the measurements for position angle and separation distance as well as the standard errors for the averages. The historical measurements, including our 2017 measurements, are outlined in Table 2 and plotted in Figure 3.

Discussion

No measured values were omitted because our CCD images produced consistent values as the separation distances were far enough for the images to portray

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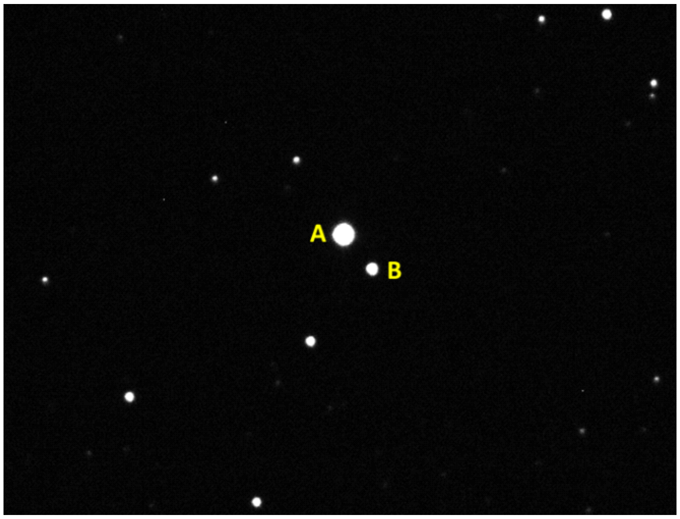

Figure 1. Luminance filter w/ 80s exposure.

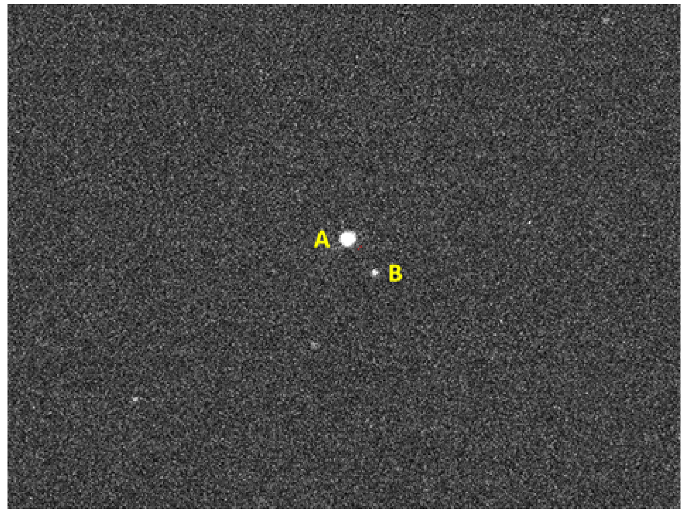

Figure 2. Hα filter with 160 s exposure.

Table 1. Theta and Rho for each Measurement

Image	Position Angle	Separation Distance
Image 1	51.27°	28.37"
Image 2	51.28°	28.34"
Image 3	50.66°	28.34"
Image 4	51.21°	28.42"
Image 5	51.30°	28.11"
Mean	**51.10°**	**28.30"**
Standard Deviation	**0.27°**	**0.12"**
Std. Error of Mean	**0.054°**	**0.024"**

Table 2. Historical Measurements from the WDS with this Paper's 2017 Measurements Included

Observation Date (year)	Position Angle	Separation Distance
1834.48	339.6°	12.00"
1907.49	18.5°	16.06"
1913.63	22.5°	17.67"
1920.17	25.4°	17.60"
1929.43	28.9°	18.27"
1959.46	38.5°	21.30"
1998.523	48.1°	25.92"
1999.29	48.4°	26.06"
2004.36	49.0°	26.74"
2010.5	50.1°	27.42"
2017	*51.1°*	*28.30"*

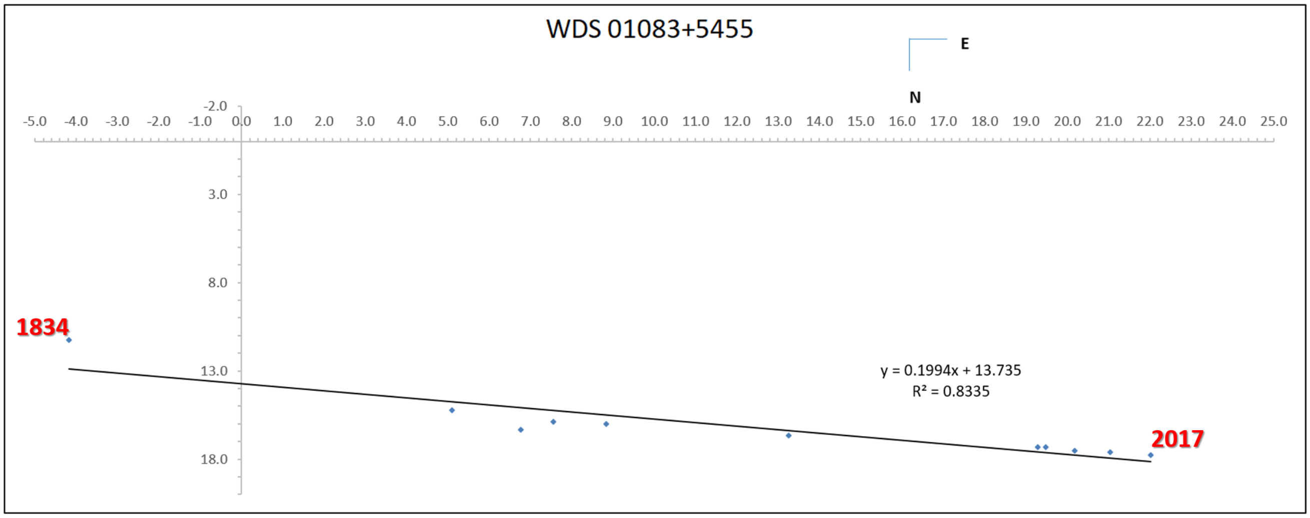

Figure 3. Plot of the historical measurements from 1834 through 2017 from Table 2. The axis are in arcseconds with the A component at the origin.

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two distinct stars, not fused together. Figure 3 shows a graph of the historical position angle and distance measurements, converted into X and Y coordinates, from the data recorded in the WDS and the 2017 images. The first data point, labeled 1834, appears to be lacking in accuracy because it is visually spaced far away from the other points on the graph. However, the gap of time between this point and the chronological next point is 73.01 years while the mean gap in time between the next four measurements and their chronological neighbors is 7.313 years. The major difference in time gaps (73.01>>7.313) accounts for the visual separation in the graph, therefore reassuring the validity of the first data point. Plus, the 1834 measurement is consistent with the linear trend across the rest of the graph with the trend line (R^2) close to one indicating a near linear fit.

Conclusion

Our observed data is consistent with the WDS catalog as our measurements show a clear linear trend line similar to WDS. The data suggest that the pair could be an optical double.

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About the Authors: The primary authors are all students of Westview High School in San Diego, California and have a strong passion for astronomy. Their research was conducted as part of an Astronomy Research Seminar run by Boyce Research Initiatives and Education Foundation (BRIEF).