Double Star System: WDS 01171-2314 (HWE3)

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Abstract: Data was collected from observing the double star system WDS 01171-2314 (HWE3). The current measurements taken show theta of 287.7°, and rho of 7.83". Compared with previous data from the Washington Double Star Catalog, the two stars in the system have not moved substantially in the 140 years they have been observed.

Introduction

The research objective was to measure the position angle (theta) and the separation (rho) of WDS 01171-2314 (HWE 3) and compare it to previously documented data to determine the star system's nature as either a gravitationally bound binary star, or an optical double star. Data from the first observation in 1875 and most recent in 2015, as indicated in the Washington Double Star Catalog (WDS), are very similar (Mason and Hartkopf, 2016). Additional data was retrieved data from the GAIA database for inclusion in the study and showed the most recent observation in 2015.5, with a theta measured as 288° and rho 7.6".

Materials and Methods

The images were taken with an SBIG camera paired with a 0.4-meter telescope provided by the Los Cumbres Observatory (LCO) worldwide network. The LCO images have a resolution of 0.571"/pixel. The telescope and camera used to take the images is located in Chile at an altitude of 2198 meters, Figure 1.

The filters and exposure times used were a Sloan red filter (RP) for four seconds, a Sloan green filter (GP) for four seconds, a Sloan infrared filter (IP) for six seconds, and a Bessel V filter (V) for four seconds. There were a total of 63 images taken, with 18 images for the red filter and 15 images each for the other three filters. The images were taken in 2018.845 (Besselian Epoch).

Each image was processed through the Our Solar Siblings (OSS) Pipeline (Fitzgerald, 2018), which calibrated all images and put the World Coordinate System (WCS) coordinates into each FITS header. The images were then measured using Mira Pro x64, which found the centroid of each star, then measured the position and separation angle.

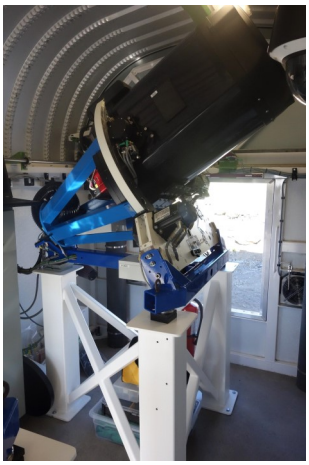

Figure 1. LCO Telescope kb26.

Data and Results

Table 1 shows the mean, standard deviation, and standard deviation of position and separation angles measured for each filter. Table 2 shows the mean, standard deviation, and standard deviation of the position and separation angle data collection of all combined filter measurements.

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Table 1. Data sorted by filter type

Filter	Number of Images	Theta (Mean)	Standard Deviation	Rho (Mean)	Standard Deviation
IP	15	287.78° ± 0.020°	0.01	7.83" ± 0.003"	0.08"
GP	15	287.58° ± 0.038°	0.02	7.82" ± 0.004"	0.15"
RP	18	287.76° ± 0.023°	0.01	7.83" ± 0.003"	0.09"
V	15	287.67° ± 0.037°	0.02	7.83" ± 0.005"	0.14"

Table 2. All data averaged together.

	Mean	Standard Deviation	Standard Deviation of the Mean
Theta	287.70°	± 0.14°	± 0.018°
Rho	7.83"	± 0.02"	± 0.002"

Discussion

A negligible change was observed in the theta and rho values between the historical trend and the current observation data. Figure 2 visually represents the historical data for HWE 3 in a scatterplot, with the current observation added and labeled as 2018. Table 3 lists each historical data point with the accompanying date and the current observation written in italics.

Discrepancies were found between the GAIA and SIMBAD data for this star system. SIMBAD indicates the possibility that this system may be a triple-star system (SIMBAD WEB), Figure 3. The three possible stars are two from the Tycho catalog (TYC 6425-1209-1 & TYC 6425-2478-1) and one from the Henry Draper catalog (HD 7776). Taken collectively, this would appear to be triple star system with TYC 6425-1209-1 and HD 7776 being spaced approximately 0.03" apart and TYC 6425-2478-1 being the possible third star. However, the WDS reports this as a two-star system.

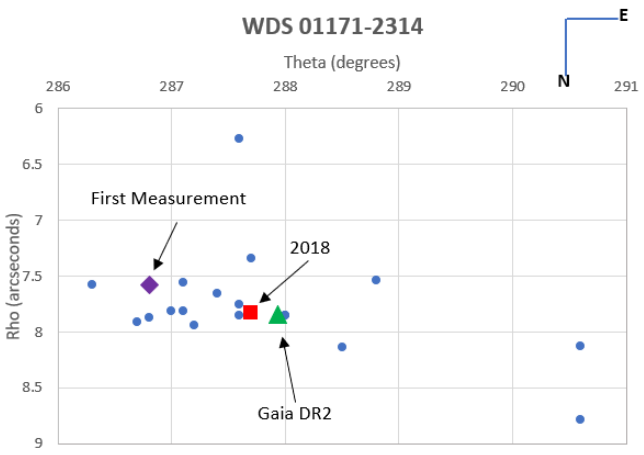

Figure 2. Current observation as compared to previous historical data (observations).

The RA and Dec measurements of TYC 6425-1209-1 and HD 7776 are two slightly different measurements of Right Ascension 01 17 05.622 Declination -23 14 18.87 and Right Ascension 0117 05.61862 and Declination -23 14 18.8357 respectively. The DSS image, via ALADIN, Figure 4, shows the area in question. In Figure 4, the North and East indications differ from what is traditionally displayed in Double Star papers. However, the orientation has been left in the original orientation per the DSS and GAIA images as provided by ALADIN. The resolution of Figure 4 does not permit clear identification of all stars in the region.

Using data in the GAIA, only two stars were apparent in the region identified by small squares from ALADIN, Figure 5. Though it is not possible to determine which database is more accurate, the discrepancies in RA and Dec position could be attributed to the difference in epoch and methodologies between the Henry Draper and Tycho catalog measurements and it is possible that HWE3 remains a two-star system, with the SIMBAD reported stars TYC 6425-1209-1 and HD 7776 possibly being the same star. The two stars shown in Figure 5 from GAIA have a theta and rho similar to the historical measurements outlined in this paper.

Using additional GAIA catalog data, both stars in the system have similar proper motion RA and Declination; any difference is trivial. The near identical radial velocity values found in Table 4 are expected of a physical pair. The parallax data from Table 4 was converted to Parsec and Light Year distances for both stars, Figure 6. The parallax data suggests that both stars are lo-

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Table 3. The 2015.5 data point is from the GAIA catalog, while all points before that are from the WDS catalog. The italicized numbers are the current observation.

Date	Theta	Rho		Date	Theta	Rho
1875.85	286.8	7.58		1922.96	287.4	7.66
1877.87	286.8	7.58		1931.9	287.6	7.75
1877.86	286.8	7.87		1962.9	288.5	8.14
1885.74	288.8	7.54		1991.25	288	7.856
1891.77	287.2	7.94		1991.55	287	7.818
1909.79	286.7	7.91		1991.795	288	7.851
1909.84	287.6	6.274		1998.63	287.1	7.81
1921.89	290.6	8.79		1999.556	287.6	7.851
1921.89	290.6	8.126		2010.5	287.1	7.56
1921.9	287.7	7.34		2015.5	287.93	7.84
1921.9	286.3	7.579		*2018.*	*287.7*	*7.83*

N	Identifier	*dist(asec)*	Otype	ICRS (J2000) RA	ICRS (J2000) DEC
1	TYC 6425-1209-1	*0.04*	*	01 17 05.622	-23 14 18.87
2	HD 7776	*0.07*	**	01 17 05.61862	-23 14 18.8357
3	TYC 6425-2478-1	*7.87*	*	01 17 05.0763060216	-23 14 16.481978821

Figure 3. SIMBAD identified objects with in 10 arcseconds of the primary star.

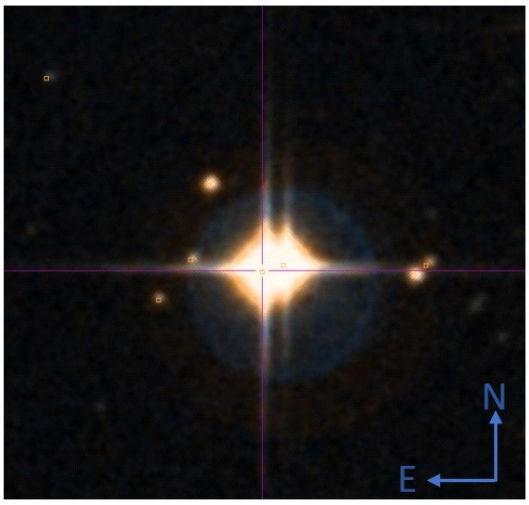

Figure 4. DSS image from ALADIN

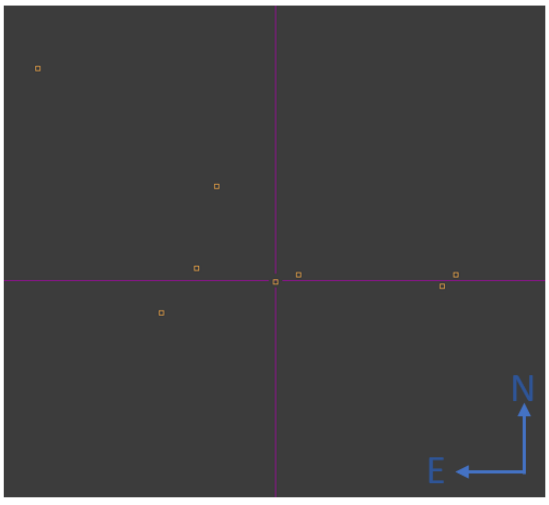

Figure 5. Gaia image from ALADIN

Table 4. Gaia Proper Motion, Parallax, and Radial Velocity Data

Star	Proper Motion RA	Proper Motion Dec	Radial Velocity	Parallax
Primary	18.05 ± 0.17	-0.7 ± 0.13	2.42 ± 0.73	5.5 ± 0.07
Secondary	17.79 ± 0.93	1.75 ± 0.90	0.86 ± 0.49	5.2 ± 0.42

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cated close to each other in space; there is significant overlap when the margin of error is considered.

Conclusion

Astronomical measurements of position angle and separation in 2018.845 of the double star system HWE 3 were made using the KB26 telescope in the LCO network. Analysis of 63 images taken with four different filters revealed that the rho and theta data did not vary significantly from historical data in a noticeable pattern. There is significant overlap between the parallax data and the stars are, therefore, statistically identical. Collectively, the radial velocity, parallax, and proper motion data are typical of a physical pair. The data taken from observations and databases indicates a possible binary star system.

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SIMBAD Web: https://simbad.u-strasbg.fr/simbad/sim-basic?Ident=01+17+05.62+-23+14+18.9&submit=SIMBAD%20search (Accessed 2/6/2018).