Measurements of Star System 00345-0433 STF 39AB,C

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Abstract: Position angle (theta) and separation (rho) measurements were obtained from multiple images of the star system WDS 00345-0433 STF 39AB,C using a 17" telescope in the iTelescope network. From our 2018 measurements, STF 39 AB,C has a position angle of 45.39° and separation of 20.08" arcseconds. Measurements of STF 39 suggests that it is not a double star system because the data available does not seem to portray any trend of the sort that one would expect in an orbit.

Introduction

Double Star system WDS 00345-0433 STF 39AB,C was imaged with a telescope equipped with a CCD camera to measure the position angle (theta) in degrees and separation (rho) in arcseconds. Measurements were compared to historical data provided by Washington Double Star Catalogue (WDS).

To select double star system candidates for research, a variety of catalogues were used to find stars that fit specific criteria. The star systems had to be a minimum of six arc seconds apart, and the difference in brightness had to be no more than six orders of magnitude. The Washington Double Star Catalog, the Sixth Catalog of Orbits of Visual Binary Stars, and Stelle Doppie were all utilized to find pairs which met the criteria previously stated.

Background

STF 39 was discovered and first measured in 1782 by Friedrich Georg Wilhelm von Struve. The AB,C system does not have a proposed orbit in the WDS and its nature as a double star system is said to be physical on Stelle Doppie (Stelle Doppie Web). STF 39 does have a proposed orbit in the WDS, Figure 1, yet this is for the A and B components and not the AB,C pair.

Equipment

Images were photographed using Telescope T-21 in Mayhill, New Mexico. T-21, a deep field telescope, is a 17" platform with a FLI-PL6303E CCD camera and has a resolution of 0.96 arc-secs/pixel and an aperture of 431 mm. It operates within the iTelescope network and

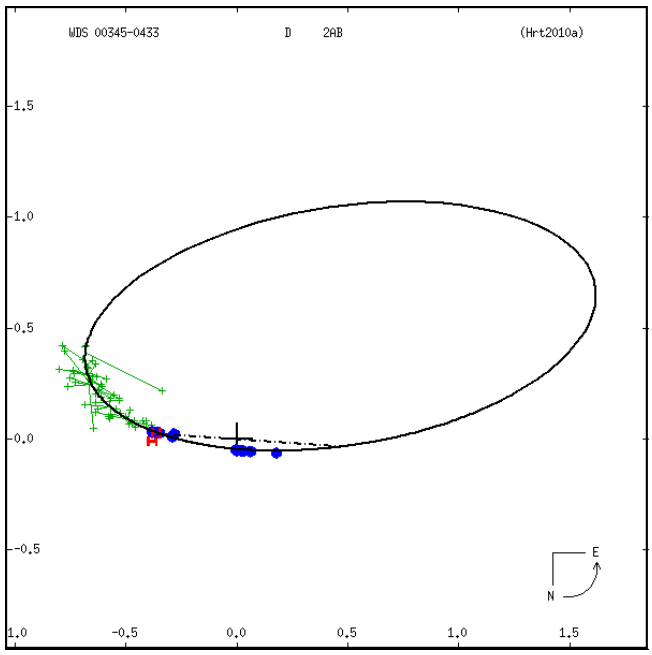

Figure 1. Proposed orbit provided by the USNO.

was selected due to its position in/visibility of the Northern hemisphere. Dark, Flat, and Bias calibration images were provided by the iTelescope network for all images taken with T-21.

Procedures and Methods

Imaging the Stars

Images were ordered from T-21 on the iTelescope

network, with exposure lengths and light filters specified by us, see Figures 2 and 3. Once complete, the requested images were then delivered to the Boyce Astro Research Computer (BARC) Server on a remote desktop for further processing.

Processing and Measuring the Stars

Once all the images had been taken and transferred to the BARC server, they were exported to MaxImDL to be calibrated and plate solved. The process of plate solving was conducted in order to properly orient the image in the sky with the correct Right Ascension and Declination. The PinPoint Astrometry program (included in MaximDL) was used to complete the plate-solving process by comparing stars in our images against the United States Navy UCAC-4 catalog.

The plate solved images were then imported into MiraPro to measure the position angle in degrees and the distance in arcseconds between the two stars. This was accomplished using its distance and angle function, which is able to locate the centroid of each stellar candidate. The measurements and data gathered from MiraPro were copied into Excel for statistical analyses: mean, standard deviation, standard error, and standard error percentage. Once all the data was collected from our processed images, historical data was ordered from the US Naval Observatory.

Results

The Position Angle (Theta) and Separation Distance (Rho) for each of the seven images acquired with iTelescope are outlined in Table 1. The Mean, Standard Deviation, and Standard Error are also calculated for these images.

Table 1. Image measurements and statistics for all seven images acquired in measuring WDS 00345-0433.

Image	Theta	Rho
1	45.1391	19.5583
2	46.1015	19.9555
3	44.6578	20.3332
4	44.9184	20.6401
5	44.4594	20.1468
6	45.4765	19.4361
7	46.9362	20.5064
Mean	**45.39**	**20.08**
Std. Deviation	**0.81**	**0.43**
Std. Error	**0.33**	**0.17**

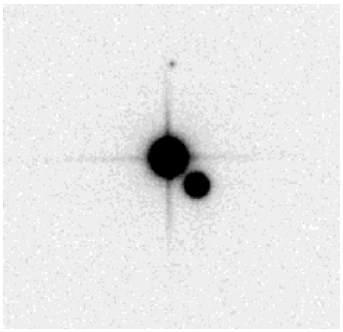

Figure 2. Red filter, 60 sec exposure.

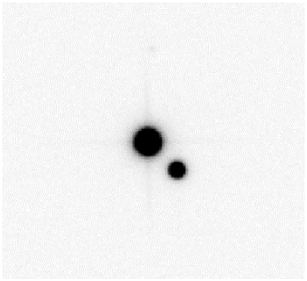

Figure 3. Red filter, 30 sec exposure

Discussion

STF 39 AB,C was studied because Stelle Doppie indicated this pair as a physical double. After analysis of our data, we found that while the two stars have very low proper and relative motion (Stelle Doppie considers star systems with proper motion lower than three, as physical), they appear to be a possible Common Proper Motion (CPM) pair.

The historical data provided 38 historical data points, displaying relatively similar theta and rho measurements. Figure 4, using an Excel plotting tool developed by Richard Harshaw, displays all historical points. In 1892, the historical record shows three observations were made, all with conflicting data points; at first its positional angle decreased by 0.7 degrees, then increased by 1.4 degrees - all in the span of one year. From its first observation in 1782 through its most recent observation in 2018, the double star system's angle and separation keep increasing and decreasing in such a pattern that it does not seem that it is moving elliptically. Instead, the data would suggest that they are moving in roughly the same direction -- linearly.

Conclusion

After analysis of our images, we concluded that the pair displays properties of a Common Proper Motion pair. Throughout our research, we also discovered that Stelle Doppie automatically deems a double star system

physical if and only if its proper motion is less than three, which is characteristic of this pair.

Acknowledgements

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References

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Stelle Doppie Web Double Star Database: https://www.stelledoppie.it/index2.php

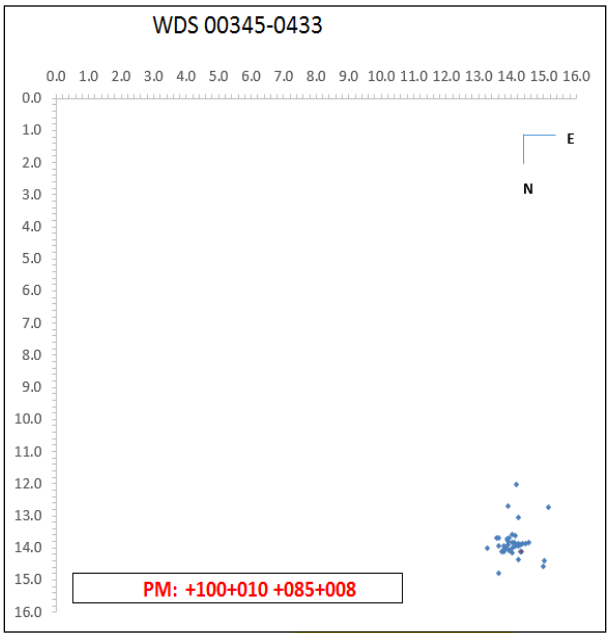

Figure 4. An X-Y plot of the position of the secondary star over time relative to the position of the primary star (in arcseconds) at (0,0)