Measurement of Star System 00304-0947 CHE 27

Amanda Tran, Audrey Lee, Samuel O'Neill, Abigail Wu, and Allen Priest
The Cambridge School, San Diego, California

Abstract: Position angle (theta) and separation (rho) measurements were obtained from multiple images of the star system WDS 00304-0947 CHE 27 using a Celestron C11 SCT. From our 2017 measurements, CHE 27 has a position angle of 223.54° and separation of 20.86" arcseconds. Data recorded for CHE 27, when plotted, proved to be consistent with the trend displayed in the known historical data.

Introduction

Double Star system WDS 00304-0947 CHE 27 was imaged with telescopes equipped with CCD cameras to measure the position angle (theta) in degrees and the separation (rho) in arcseconds. Measurements were compared to data provided by the 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

The star system CHE 27 has not been confirmed as a double star system by the United States Naval Observatory. However, the B component exhibits a fair amount of movement relative to the A component, and thus we chose to image this star with the goal of adding a data point to help in determination of the association, gravitational or not, of this pair.

According to the historical data provided by the US Naval Observatory, CHE 27 does not have a proposed orbit in the Sixth Catalog of Orbits of Visual Binary Stars. The system was discovered by Stanislas Chevalier in 1900. Notes from the Washington Double Star Catalogue indicate that a measurement taken shortly after in 1901 agreed with the measurements by Chevalier. The notes predict the ability to confidently classify this system. There have been nine previous measurements recorded in the Washington Double Star Catalog, the last being in 2010, Figure 1. Our hopes were that providing a new data point would allow us to add additional analysis to the nature of this system.

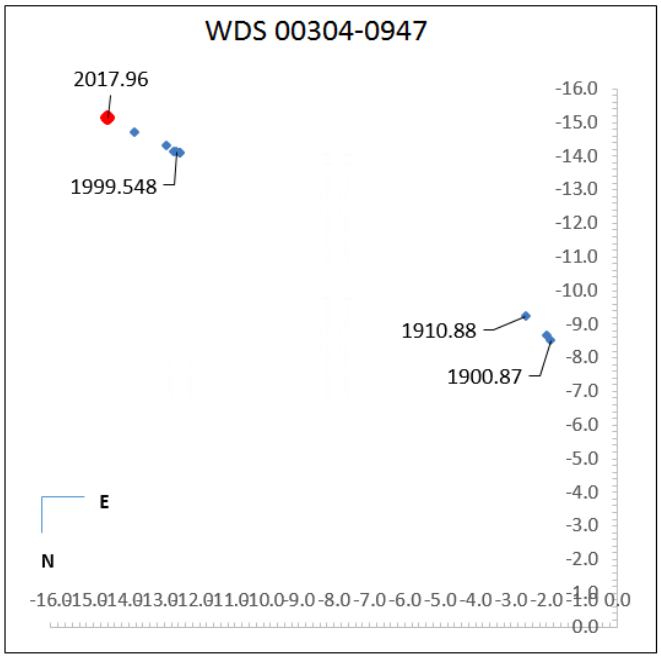

Figure 1. Historical measurements of WDS 00304-0947 plotted using an Excel tool developed by Richard Harshaw.

Equipment

Images of CHE 27 were taken with a Celestron C11 SCT, which did not require any online coordination as this telescope was not part of any remote/robotic tele-

Measurement of Star System 00304-0947 CHE 27

scope network but provided by our instructor in Terra Del Sol (California Northern Hemisphere). It has a 70x magnification, with a resolution of 0.42 arcseconds per pixel, and an aperture of 279.4mm.

Procedures and Methods

Imaging the Stars

Images from the Celestron C11 SCT were taken in Tierra del Sol by our mentor, Mr. Allen Priest. Red and luminance filters were used when taking these images. Once the images were taken, they were delivered to the Boyce Astro Research Computer (BARC) Server on a remote desktop for processing.

Processing and Measuring the Stars

Once all the images had been acquired 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

Seven images were used in the measurement of CHE 27, Figure 2. After acquiring these images, we were able to collect separation and angle data using the processes described above. Additionally, the mean, standard deviation, and standard error were also calculated, Table 1. The stars in this system have a mean current position angle (theta) of 223.54° and a separation distance (rho) of 20.86" arcseconds. Figure 1 indicates the position of these mean measurements relative to the historical measurements for this star pair.

Discussion

The historical data, Table 2, provided by the United States Naval Observatory, coupled with our 2017 measurement, show a linear trend for CHE 27. There was an increase in both the angle separation and distance when contrasted to the last measurement taken of this system

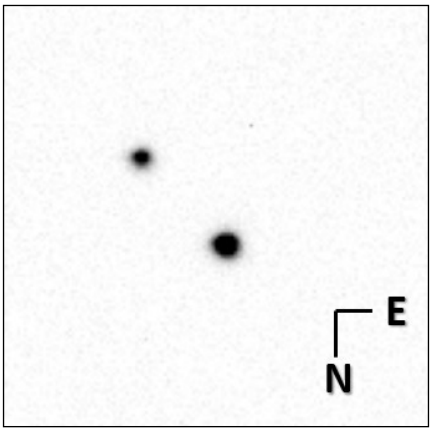

Figure 2. CHE 27 as imaged in 2017.

Table 1. Theta and Rho Measurement

Image	Theta (deg)	Rho (a.s.)
1	223.528	20.8963
2	223.44	20.8941
3	223.558	20.9016
4	223.635	20.8431
5	223.575	20.8565
6	223.622	20.8451
7	223.408	20.7915
Mean	**223.538**	**20.863**
Std. Dev.	**0.086**	**0.040**
Std. Error	**0.033**	**0.015**

Table 2. Historical Measurements

Date Observed	Theta (deg)	Rho (a.s.)
1900.87	192.5	8.72
1901.67	193	8.89
1910.88	195.7	9.6
1988.72	221.5	18.9
1998.816	221.22	18.76
1998.82	221.2	18.76
1999.548	221.4	18.83
2000	221.7	19.17
2010.5	222.8	20.06
2017.96	223.538	20.863

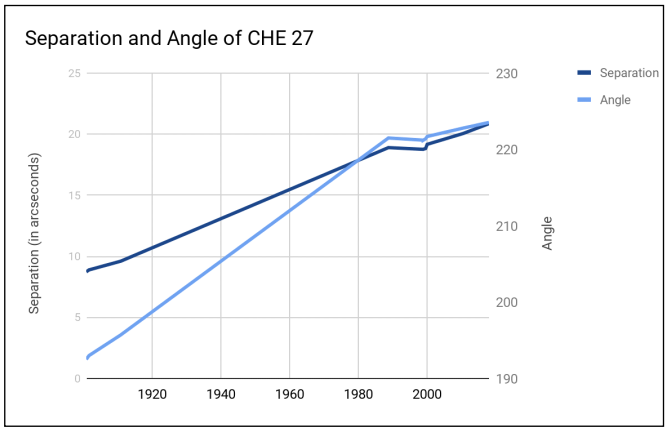

Figure 3. Angle and separation measurements of WDS 00304-0947 represented on a double axis graph.

in 2010. From the results recorded in the above section, we were able to calculate an increase of about 0.73° in angle and separation 0.8025" arcseconds in distance. A graph was created to show the change in theta and rho from observations since 1900, the first observation ever made on CHE 27, Figure 3.

Conclusion

Due to the increase in theta and rho from our recent measurements, our observations have supported the linear trend of this system as seen in previous measurements. There was a lack of observations from 1910 to 1988, which could've caused some uncertainty in the overall trend of this system's nature at that time, but since 1988, there has been consistency with this double star's measurements. Our recent measurements seem to confirm that this linear trend is consistent.

Acknowledgements

We would like to thank the United States Naval Observatory for providing access to historical measurement data through the Washington Double Star Catalog. In addition, we thank Pat and Grady Boyce of the Boyce Research Initiatives and Education Foundation (B.R.I.E.F) for providing access to the educational materials and for providing the funding which allowed us to use the iTelescope robotic telescope system along with other software tools. We are grateful to Mr. Allan Priest, our advisor, mentor, and teacher, for helping us to pursue all aspects of this amazing learning experience.

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