Astrometry of STF 1510

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Abstract: Our team made an astrometric measurement of the double star STF 1510 and found the separation to be 5.52 arc seconds and the position angle to be 327.95 degrees. Our analysis of historic observations as well as our own did not support the contention that STF 1510 is a binary, nor did it eliminate the possibility that it could be a very long-period binary.

Introduction

A group of students from Paso Robles High School formed an astrometry seminar research team (Figure 1). The main goals of the team's research were observations and the analysis of the binary star STF 1510, to help further the information on the orbit of the stars, as well as gain experience measuring binary stars. Through observations and analysis, despite the longevity of this specific orbit, additional data was contributed to hopefully lead to more discoveries about this double star. This was done to help either disprove or support the published elliptical orbit. In order to do this, observations of the double star system and the measurement of its position angle (in degrees) and the separation (in arcseconds) were needed. This binary star was chosen due to its extremely long elliptical period, along with the possibility of past measurements straying from the orbital path into a linear path and being considered an optical binary star.

The first published research on (STF 1510= WDS 11080 + 5249A/B= HD 96527= HIP 54407= BD+53 1466= SAO 27918= TYC 3824-17-1= UCAC4 715-050214) was in 1830, and the most recent one was in 2017. The binary was initially discovered by Frederick William Herschel in 1830, however, Friedrich Georg Wilhelm von Struve is attributed as the discoverer of the binary by making multiple published observations with a larger telescope in 1832. STF 1510 has been

Figure 1. Team members - Laura Santos, Monica Rodriguez, Jiseelle Jimenez, Morgan Harrington, Mandy Lee, Paulina Mondragon Lopez, Leslie Ramirez, Elizabeth Phillips, and Instructor Jon-Paul Ewing

studied for almost 200 years, yet all of the past observations indicate that the orbital period is tremendously long with the data points concentrated only in a certain area of the orbit.

The Hipparcos data point, represented by the red "H", is the satellite telescope used to observe the double star in the early 1990s. The WDS orbit in Figure 2 was calculated recently (Kiselev, et al 2012). The previous measurements made on this orbit are shown by the pink and green points along the orbital path of this star in the graph above. The pink shows the measurement

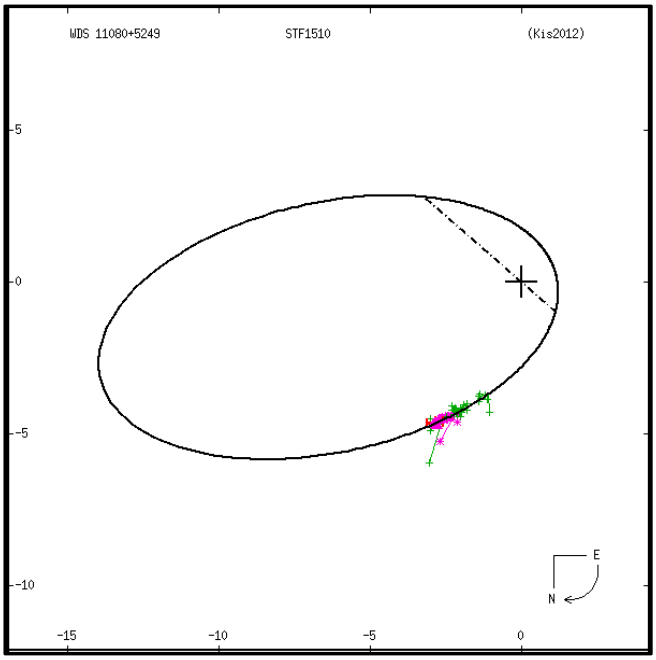

Figure 2. STF 1510 Orbit

made from photographs, while the green shows the measurements made through the use of an eyepiece micrometer.

Equipment and Procedures

Las Cumbres Observatory (LCO) kindly provided observing time to obtain the digital images. Images of STF 1510 were taken on a 0.4 meter telescope at Tenerife, Spain, at three different exposures. There were 10 images taken at exposures of 5 seconds, 1 second, and 0.5 seconds each, producing 30 images total. It was concluded that the images taken at the longest exposure time (5.23s) produced clearer images that could be analyzed more accurately. Figure 3 shows an example image.

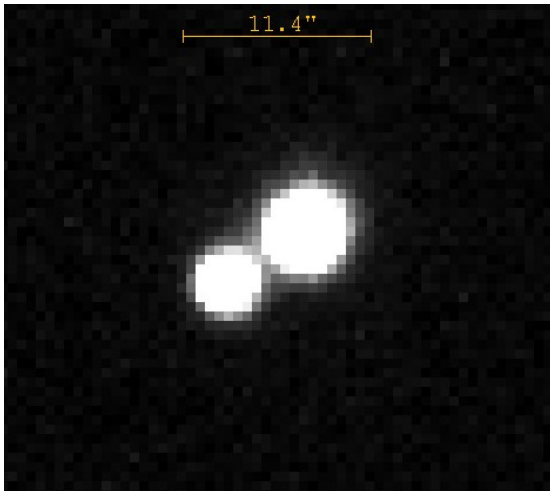

Figure 3: Image of our binary in AstroImageJ software

The 10 images were analyzed using the program AstroImageJ (Collins, et al. 2017), which gave us the primary and secondary stars' centroids' right ascension (RA) and declination (DEC). We then used a formula created by Robert Buchheim (2008) to calculate the average position angle and separation from the RA and DEC.

Results

The observations were taken on 2018.526. The position angle was calculated to be 327.95 degrees and separation as 5.52 arc seconds. These results are summarized in Tables 1 and 2.

Discussion

When trying to find the position angle and separation between the two stars in AstroImageJ, the program did not automatically output these values as expected. Therefore, we used the formula previously mentioned in the Equipment and Procedures section.

Overall, the data recorded of both the separation

Table 1: Calculated separation and position angle of 10 images

Image Number	Trial 1		Trial 2	
	Separation (as)	Position Angle (deg)	Separation (As)	Position Angle (deg)
1	5.5	328.42	5.56	329.31
2	5.55	328.27	5.55	328.05
3	5.54	327.87	5.48	329.18
4	5.51	327.91	5.52	328.05
5	5.57	327.39	5.59	328.11
6	5.57	327.39	5.49	327.32
7	5.34	326.72	5.32	327.32
8	5.52	328.53	5.54	328
9	5.59	327.42	5.57	327.87
10	5.59	327.98	5.59	327.77
Trial Average	5.53	327.79	5.52	328.1
Standard Deviation	0.07	0.56	0.08	0.67
Standard Error of Mean	0.02	0.18	0.03	0.21

Table 2: Averaged solutions using AstroImageJ

	Separation (Arcseconds)	Position Angle (degrees)
Average	5.52	327.95
Standard Deviation	0.08	0.62
Error	0.02	0.14

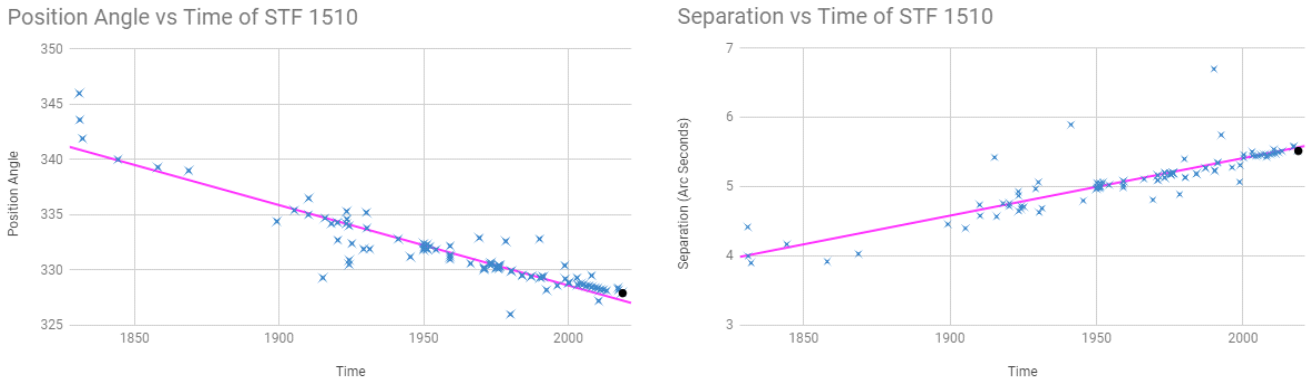

Figure 4. Position angle and separation versus time using historical data on STF 1510. A linear trend line is shown for reference.

and position angle (Figure 4) are pertinent to the previously published data which led to the current orbital path shown above.

Conclusion

The objective of this research was to gather data about the orbit of this binary star by measuring the position angle and separation along with gaining experience of measuring binary stars. The results are consistent with previous observations.

Acknowledgments

We thank Reed Estrada and Rick Wasson for reviewing the paper. Las Cumbres Observatory provided digital images of the binary star, which were later analyzed. Karen Collins developed AstroImageJ, which was used to analyze the images. Brian Mason, from the US Naval Observatory, provided historical observations of this binary star, which allowed us to create historic observational graphs.

References

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