Vanguard Preparatory School Observations of the Double Star STF 1692

Serenity Anderson[1], Breck Buccola[1], Karen Garcia[1], Matthew Gosney[1], Jonathan Housatchenko[1], Lilian Martinez[1], Wyatt Myskow[1], Noah Renteria[1], Ruth Schlosser[1], Leone Thompson[1], Reed Estrada[2], and Chris Estrada[2].

1. Vanguard Preparatory School, Apple Valley, California
2. High Desert Research Initiative

Abstract Using a 22-inch Newtonian Alt/Az telescope and a Celestron Micro Guide eyepiece, students from Vanguard Preparatory observed the binary star Cor Caroli (STF 1692) and found a position angle of 228 degrees as well as an average separation of 21.10". This project was a part of the Vanguard Preparatory Double Star Workshop 2015 in Apple Valley, California.

Figure 1: Participants in the Vanguard Preparatory Double Star Workshop 2015.Back Row (left to right): Reed Estrada, Leone Thompson, Lilian Martinez, Jonathan Housachenko, Ruth Schlosser, Matthew Gosney, and Chris Estrada. Front Row (left to right): Serenity Anderson, Breck Buccola, Karen Garcia, and Wyatt Myskow

Introduction

Vanguard Preparatory School hosted a three day double star workshop from March 20 through March 22, 2015. The instructors selected eighth grade students attending Vanguard Preparatory. Three teams were formed of ten students each and were matched with their astronomer instructors, Chris Estrada, Reed Estrada, Mark Brewer, and Sean Gillette, to conduct observations. Figure 1 shows the team that participated in the present study.

The team in this study used a 22-inch Newtonian Alt/Az telescope with a Celestron Micro Guide eyepiece fitted with a Bell and Howell high definition video camera. The use of the video camera offsets the need for drive motors and negates the field rotation common in alt/az telescopes.

The star studied by this group of students is named Cor Caroli (STF 1692) which is Latin and means "Charles' Heart." This star was named by Edmund Halley, the Astronomer Royal, to honor King Charles II of Great Britain. The components of STF 1692 are separated by 19.3 arc seconds according to the Washington Double Star (WDS) Catalog which corresponds with a projected physical separation of 696 AU (given the average distance from Earth of 7,435,853 AU derived from their trigonometric parallaxes of 28.41 mas for the primary and 27.1 mas for the secondary).

Calibration

The bright star Phad (Gamma Ursae Majoris) in the constellation Ursa Major was used to calibrate the linear scale of the Celestron Micro Guide eyepiece for separation measurements. To do this, the eyepiece was rotated so that the sky would drift parallel to the linear scale. Phad was then positioned on the eastern edge of the linear scale. The sidereal motor was disengaged and the star moved across the linear scale. The authors estimated the amount of time it took for the star to drift to the western edge of the linear scale using a stopwatch which reads to the nearest 0.01 seconds. An average of 10 drift times was used to determine the scale constant using the equation

$$Z = \frac{15.0411 t cos(dec)}{D}$$

where Z is the scale constant in arc seconds per division; 15.0411 is the Earth's rotational rate in arc seconds per second; t is the average drift time in seconds (50.09); d is the declination of the calibration star in degrees (53.6868); D is the number of division marks on the linear scale (60). The results for the 22-inch Newtonian telescope and the eyepiece was a scale constant of 7.43 arc seconds per division.

Procedures

The telescope was pointed at STF 1692. The separation was determined by aligning both the primary and secondary stars along the linear scale, and the number of divisions between the stars was estimated to the nearest 0.1 divisions. The average value was multiplied by the scale constant to find the final separation. To find the position angle, the students looked through the telescope equipped with the astrometric eyepiece and let the primary star drift from the exact center to the inner protractor. The students then recorded the angle to the nearest degree. Ten measurements were then made to find the average position angle. A video camera was used to collect additional observations which were later analyzed. Figure 1 shows an example measurement of separation and Figure 2 shows an example measurement of position angle.

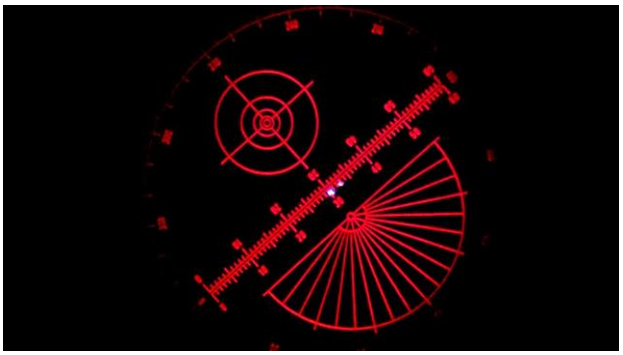

Figure 1: Stars aligned along the linear scale to measure separation.

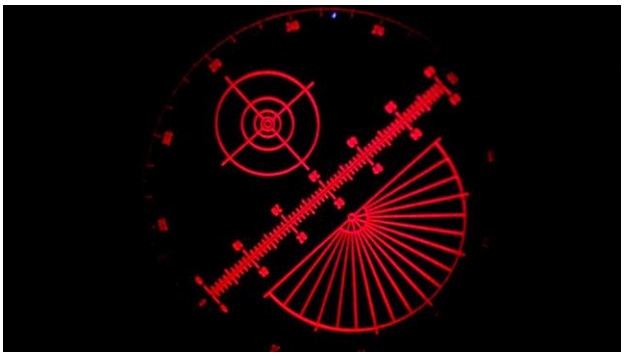

Figure 2: Primary star aligned to measure position angle. The star is at the top of the image.

Results and Discussion

Parameters	Obs	SD	SEM	WDS	Difference	Haas (2015)	Difference
Separation (arc sec)	21.1	0.2	0.1	19.3	1.80	19.3	1.8
Position Angle (degrees)	228	3.6	0.8	228	0	229	1

Table 1: The team's measured separation and position angle of the double star STF 1692 including standard deviations and standard errors of the mean. Comparisons are given to recent observations.

The measurement of the separation of STF 1692 was 21.1" while the WDS Catalog and Haas (2015) values were both 19.3". This difference of 1.8" was 9 standard deviations away from the measured value but also well within the seeing limits of our telescope. The measured position angle was 228°, identical to prior measurements for this double star in the WDS Catalog (228°). This measure is also 1° from the measure in Haas (2015) of 229°, well within one standard deviation. Table 1 summarizes the results and compares the present study to past observations.

Conclusions

The students in the Vanguard Preparatory Double Star Workshop 2015 successfully measured the separation and position angle of the double star STF 1692. They then compared their results to literature values and found them to be statistically consistent with past observations, given limitations in resolution. These measures may be used in future estimates of this double star's orbit, should it prove to be a physically bound binary system.

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