Student Measurements of the Double Star STFA 35

Mark Brewer [1], Grace Bateman [2], Benjamin Funk [2], Isabella Giles [2], Lindsey Gillette [2], Tara Izadi [2], Logan Moreno[2], Mikayla Rangel [2], Savanna Salazar [2], and Travis Gillette [3]

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

Abstract A team of 7th and 8th grade students and a high school teaching assistant measured the double star STFA 35 using an 8-inch Meade Schmidt-Cassegrain telescope. The students determined the separation and the position angle of the double star using an astrometric eyepiece. The separation and position angle were determined to be 61.0 arc seconds and 311.3 degrees, respectively. The results were compared to the latest epoch listed in the Washington Double Star Catalog.

Introduction

A three-day double star workshop was held with a selected group of 7th and 8th grade students from Vanguard Preparatory Academy. Students broke into three teams to contribute observations of double stars. The team that conducted the present study measured and reported the separation and position angle of the double star STFA 35, better known as Nu Draco. The observations were made at Vanguard Preparatory Academy. Figure 1 shows the team members for the present study.

Figure 1: Team members for the present study. Top Row (left to right): Savanna Salazar, Ben Funk, Logan Moreno, Isabela Giles, and Mark Brewer. Bottom Row (left to right): Lindsey Gillette, Tara Izadi, Grace Bateman, and Mikayla Rangel.

The star system STFA 35 was selected from the Washington Double Star (WDS) Catalog due to its brightness and wide separation. The magnitudes of the primary and secondary stars are both listed as 4.9 and the most recently measured separation is 62 arc seconds according to the WDS Catalog.

Equipment and Procedures

The students used an 8-inch Meade Schmidt-Cassegrain telescope equipped with a 12.5mm Celestron Micro Guide eyepiece. The telescope was mounted on a CG-5 German equatorial. A stopwatch which reads to the nearest hundredth of a second was used for calibrating the linear scale of the eyepiece.

Figure 2: Selected team gathering data

Figure 2 shows the students collecting data. A calibration star, Dubhe, was used to determine the scale constant. Dubhe was aligned in the center of the eyepiece and the drive motor was disabled so the angle of the stars drift could be determined. The drive motor was enabled once the star's drift angle was determined, and the eyepiece was rotated so the star would drift along the linear scale. The above procedure was repeated several times until the star drifted precisely down the linear scale.

The star's drift time in seconds along the linear scale was then measured by starting a stopwatch once the star's centroid drifted across the first division mark and stopped once it drifted across the last division mark. Ten observations were recorded to determine an average, standard deviation, and standard mean of the error. The scale constant was determined in arc seconds per division.

The scale constant was then calculated by 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 (81.48); *d* is the declination of the calibration star in degrees (61.7506); and *D* is the number of division marks on the linear scale (60). The scale constant for this telescope and eyepiece combination was 9.6 arc seconds per division.

To obtain the separation, the double star was aligned on the linear scale and the division marks between the primary and secondary star were estimated to the nearest 0.1 divisions. The stars were repositioned along the linear scale for each recorded observation to reduce bias. Ten observations were recorded to determine an average, standard deviation, and standard error of the mean. The scale constant was multiplied by the average separation in divisions to determine the separation in arc seconds.

To determine the position angle, the primary and secondary stars were aligned on the linear scale with the primary star position at the 30 division mark (the center of the eyepiece). The drive motor was disabled to allow the stars to drift to the inner protractor. The drive motor was enabled once the primary star reached the protractor and the angle was recorded in degrees. Ten measurements were recorded to determine an average, standard deviation, and standard error of the mean.

Results and Discussion

On Friday, March 20, 2015 (B2015.21447), observations took place with a hazy sky and a breeze with fair observing conditions. The results are shown in Table 1 with a comparison to the most recent observation reported in the WDS Catalog.

Parameters	# Obs.	Av.	S.D.	S.E.M.	WDS	Difference
Scale Constant (as/div)	10	9.6	0.84	0.26	NA	NA
Separation (arc sec)	10	61.0	0.45	0.14	62	-1.0
Position Angle (degrees)	10	311.3	1.00	0.31	311.0	0.3

Table 1: Student Measurements of STFA 35.

Figures 3 and 4 show how the separation and position angle of STFA 35 have changed since its first reported measurement in 1690. The separation has remained constant while the position angle has steadily declined.

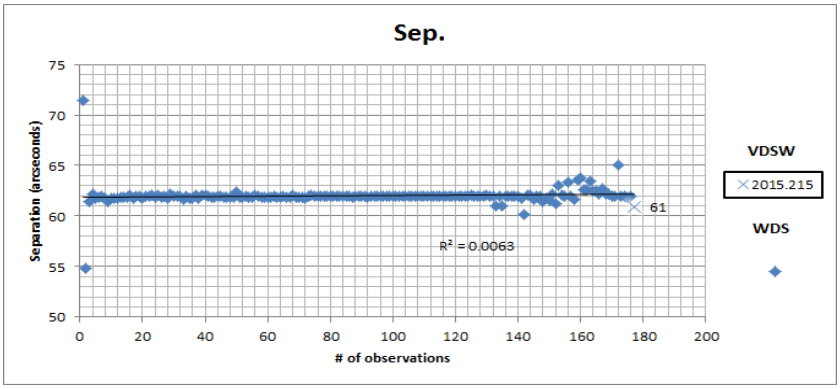

Figure 3: Students measurement of separation plotted with all measurements of STFA 35 listed in the WDS.

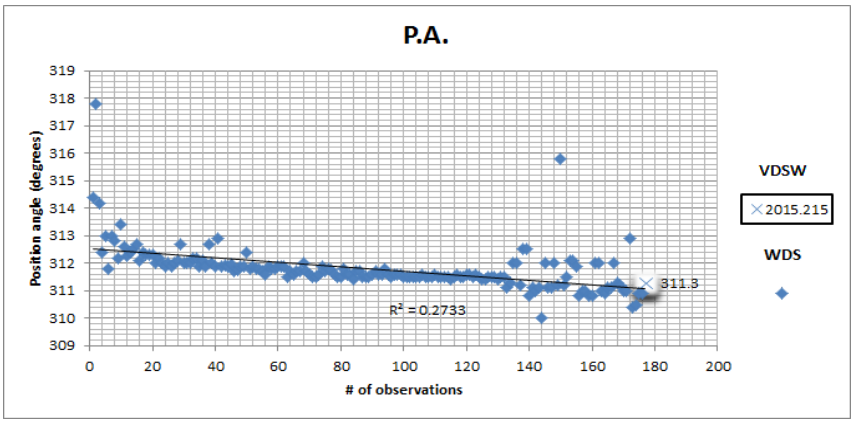

Figure 4: Students measurement of position angle plotted with all measurements of STFA 35 listed in the WDS.

The measured separation differed by -1.0 arc seconds from the WDS value. This is about two standard deviations but within the seeing limits of the study. Additionally, the measured position angle is 0.3 degrees away from the WDS value, which is less than one standard deviation. The authors are satisfied with this result.

Conclusion

The observations made of the double star STFA 35 compared favorably to the last measurements listed in the WDS Catalog. The goals set by the students to contribute measurements of a double star to the WDS Catalog and to report their observations were completed with success. These measurements may be used by future astronomers to estimate the orbit of the double star STFA 35.

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