

# Data and Analysis of the Double Stars STFA 10AB and STFA 1744AB

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**Abstract:** Eighth grade students at Vanguard Preparatory School measured the double stars STFA 10AB and STFA 1744AB. A 22-inch Newtonian Alt/Az telescope and a 14-inch Celestron Schmidt Cassegrain telescope were used. The star Bellatrix was used as the calibration star to determine the scale constant of the 22-inch telescope to be 7.8 "/tick marks. The double star STFA 1744AB was used as the calibration star to determine the scale constant of the 14-inch telescope to be 5.1 "/tick marks. The separation and position angle of STFA 10AB was determined by the 22-inch telescope to be 347.9" and 339.3°. The separation and position angle of STFA 1744AB was determined by the 14-inch telescope to be 3.6" and 158.1°. The measurements that were calculated were compared to the most recent measurements listed in the Washington Double Star Catalog.

## Introduction

Vanguard Preparatory School held a double star workshop from March 11 through March 13, 2016. Thirty-three students were separated into three different groups to collect three sets of data from double stars. This team pictured in Figure 1 measured the scale constant, the position angle, and separation of STFA 10 AB and STFA 1744 AB. The measurements and calculations were done at Vanguard Preparatory School. The double star STFA 10AB is located in the constellation Taurus. The Washington Double Star Catalog lists the right ascension and declination as 04h 28m 39.74s and +15d 52m 15.2s. The WDS lists the magnitudes of primary and secondary stars as 3.41 and 3.94. The double star STFA 1744 AB is located in the constellation Ursa Major. The Washington Double Star Catalog lists the right ascension and declination of STFA 1744 AB as 13h 24m 18.4s and +54d 52m 33s. The magnitudes of the primary and secondary stars are listed as 2.23 and 3.88.



Figure 1: Team members for the present study. Top Row (left to right): Dayton Teeter, Andres Sanchez, Sam Bowden, Corielyn Hall, Cassandra Salazar, Danielle Renna, and Mark Brewer. Bottom Row (left to right): Fatima Rodriguez, Marisa Arcilla, Anthony Hall, Jacqueline DeBlase, and Alyssa Hernandez.

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Figure 2: An image of the 22-inch Newtonian Alt/ Az telescope with a Celestron 12.5 mm Micro Guide eyepiece.

A 22-inch Newtonian Alt/Az telescope, shown in Figure 2, was used to measure the scale constant, separation, and position angle of STFA 10AB. A 14-inch Celestron Schmidt Cassegrain telescope, shown in Figure 3, was used to measure the scale constant, separation, and position angle of STFA 1744AB.

### Equipment and Procedures

Data was gathered from a 22-inch Newtonian Alt/Az telescope equipped with a Celestron 12.5 mm Micro Guide Eyepiece fitted with a Bell and Howell High Definition Video Camera. The use of the video camera eliminates the need for the drive motor and negates the field rotation common in Alt/Az telescopes. The 14-inch Celestron Schmidt-Cassegrain telescope equipped with a Celestron 12.5mm Micro Guide astrometric eyepiece was used.

The drift time was determined by timing the star's movement along the linear scale. The star was positioned on the outer edge of the eyepiece. The drive motor was turned off so the observers could watch the star drift. The star drift was timed with a stopwatch that reads to the nearest hundredth of a second. The stopwatch was started as soon as the star's centroid crossed the first tick mark on the linear scale, and the stopwatch was stopped as soon as the star's centroid crossed the last tick mark on the linear scale. A total of 15 drift times were recorded to determine an average, a standard deviation, and standard mean of the error.

The scale constant was determined by the follow-

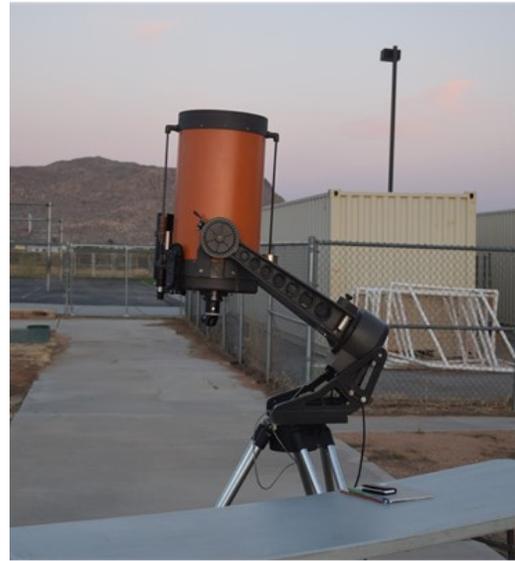


Figure 3: An image of the Celestron 14-inch Schmidt Cassegrain telescope.

ing equation

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

where  $Z$  equals the scale constant in units of "/tick marks, 15.0411 equals the earth's sidereal rotation rate in units of "/seconds,  $t$  equals the average drift time in units of seconds,  $\cos(dec)$  equals the cosine of the star's declination in degrees, and  $D$  equals the total displacement of the linear scale (60) in units of tick marks.

The separation was determined by aligning both stars on the linear scale. The eyepiece was adjusted so both stars aligned precisely. The tick marks between the star's centroids were recorded. A total of 10 measurements were recorded to determine an average, a standard deviation, and standard mean of the error for the separation. The scale constant was multiplied to the average separation for units to be determined in arc seconds.

The position angle was determined by aligning both stars on the linear scale. The eyepiece was adjusted so the stars were aligned precisely. The primary star was positioned on the 30 tick mark. The drive motor was turned off to allow the stars to drift to the outer protractor scale. The drive motor was turned on once the primary star reached the protractor, and the position angle was recorded. A total of 10 measurements were recorded to determine an average, a standard deviation, and a standard mean of the error for the position angle.

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Table 1: STFA 10AB. Measurements made on B2016.191904

Parameters	# Obs	Mean	SD	Standard Error of Mean	WDS Value	Difference	% Difference
Scale Constant a.s. / division	15	7.8	NA	NA	NA	NA	NA
Separation (a.s.)	15	347.9	0.62	0.18	341.2	6.7	1.93
Position Angle (degrees)	10	339.3	4.22	1.33	347	-7.7	2.27

Table 2: STFA 1744AB. Measurements made on B2016.194642

Parameters	# Obs	Mean	SD	Standard Error of Mean	WDS Value	Difference	% Difference
Scale Constant a.s. / div	5	5.14	NA	NA	NA	NA	NA
Separation (a.s.)	15	16.9	0.42	0.19	14.4	2.5	16.0
Position Angle (degrees)	10	158.0	0.64	0.19	153	5.0	3.21

### Observation and Analysis (STFA 10 AB)

On March 11, 2016 (B2016.191904) observations were gathered of the double star STFA 10 AB with a 22-inch Newtonian Alt/Az telescope. The scale constant was determined to be 7.8 "/tick marks. The average separation was 32.75 divisions. The average position angle was 249.3°. A separation and position angle difference of 6.7 and 7.7° was determined compared to the Washington Double Star Catalog. The results are summarized in Table 1.

### Observation and Analysis (STFA 1744AB)

On March 12, 2016 (B2016.194642) the double star STFA 1744AB was measured with a 14 inch Celestron Cassegrain telescope and a Celestron astrometric eyepiece. The scale constant was determined to be 5.4 arc seconds/divisions. The average separation was determined to be 3.3". The average position angle was determined to be to 158.1°. The standard error of means for position is 0.19 and separation is 0.19. A difference of -2.5 arc seconds and -5.1 degrees was determined for the data gathered compared to the Washington Double Star Catalog.

### Conclusion

The separation and position angle differences of STFA 10AB were compared to the Washington Double Star Catalog and determined to be 6.7" and -7.7°. The large differences were determined to be related to harsh weather conditions. The disturbances were greater as a storm front was moving in. The separation and position angle differences of STFA 1744AB were compared to the WDS and determined to be 2.5" and 5.0°. The large

differences were determined to be related to the experience of the authors.

### Acknowledgements

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