# Visual Measurements of the Double Star STFA 38 AD

Jolyon Johnson[1], Eric Weise[2], Russell Genet[3,4], Michael Anderson[3], Samantha Choy[4], Melinda Hart[3], Bailey Kelley[3], Zachery Noble[3], Samantha Spurlin[3], Bret Tabrizi[3], and Sheena Wu[4]

1. California State University, Chico, CA
2. University of California, San Diego, CA
3. Cuesta College, San Luis Obispo, CA
4. California Polytechnic State University, San Luis Obispo, CA

**Abstract**: Students from Cuesta College and California Polytechnic State University measured the separation and position angle of the double star STFA 38 AD (Zeta Lyrae). The students analyzed the data and calculated a separation of 44.3 arc seconds and a position angle of 150.4°. These observations are within one standard deviation of 10 recent observations. Similar proper motion vectors suggest that STFA 38 AD could be a true binary star.

## Introduction

This project was part of a summer 2012 introductory astronomy course at Cuesta College. On Wednesday, June 27, 2012 (B2012.486), eight students from Cuesta College and California Polytechnic State University, San Luis Obispo, observed the double star STFA 38 AD at the Orion Observatory. The observatory is distant from bright city lights in a sparsely-populated outskirt of Santa Margarita, California. It was a clear night which allowed unobstructed observation with few clouds and no wind.

The three goals of this project were to: (1) give students the opportunity to observe and make their first quantitative measurements; (2) properly record and process data with statistical calculations; and (3) compare the results with recent observations.

Figure 1. Astronomy students at the Orion Observatory. Front row (left to right): Bret Tabrizi, Bailey Kelley, Samantha Spurlin, Sheena Wu, and Melinda Hart; Back Row: Eric Weise, Jolyon Johnson, Zachery Noble, and Michael Anderson.

## Equipment and Procedures

Observations were made with an equatorially-mounted 8 inch Meade Schmidt-Cassegrain telescope with a clock drive. A Celestron Micro Guide eyepiece

was used for separation and position angle measurements, while a stopwatch which reads to one hundreth of a second was used to measure the drift time for calibrating the eyepiece.

The drift method was used to calibrate the linear scale on the eyepiece. Drift times were found by lining up Gamma Draconis on the east end of the linear scale and turning off the tracking motor. Researchers individually timed the travel of the star from one end of the linear scale to the other. Each researcher made two observations for a total of sixteen. The calibration equation used was:

$$Z = \frac{15.0411\, t \cos(\delta)}{60}$$

where $Z$ is the scale constant in arc seconds per division, 15.0411 is the number of arc seconds the earth rotates per second, $t$ is the averaged measured drift time (64.52 seconds), $\delta$ is the declination of Gamma Draconis (51.48°), and 60 is the number of divisions on the linear scale of the eyepiece. The number of arc seconds per division was calculated to be 10.1.

Separation was determined by aligning the primary and secondary stars along the linear scale and estimating the separation to a tenth of a division. To increase precision, the researchers repeated the process a total of 15 times, measuring the separation at multiple points along the linear scale. The average was then multiplied by the scale constant.

The position angle was estimated by placing the primary star on the center of the linear scale and ensuring both stars were aligned on the linear scale. After centering, the telescope's tracking motor was disabled. The researchers estimated to the nearest degree where the primary star crossed the inner protractor due to Earth's rotation (Teague 2004). After each researcher made an observation, recorded their data, and rotated the eyepiece 180° to reduce systematic error, the process was repeated 15 times. A 90° correction was applied as required for Celestron Micro Guide eyepieces (Teague 2004).

The initial data was recorded in a notebook and transcribed onto a Microsoft Excel spreadsheet. The spreadsheet was used to calculate the average, standard deviation, and the standard error of the mean for each set of measurements.

## Results and Analysis

STFA 38 AD is located at right ascension 18h 44.8m and declination +37° 36m with a primary magnitude of 4.3 and a secondary magnitude of 5.6. Table 1 shows the average separations and position angles, as well as standard deviations and standard errors of the mean of the researchers' measurements and the last 10 observations provided by Brian Mason (Mason 2012).

The average separation measurement was 44.3", only 0.3" more than the average of the previous 10 measurements, which was 44.0" (Mason 2012). The average position angle measured was 150.4°, which is 0.5° more than the average of the previous 10 measurements, which was 149.8° (Mason 2012). The measurements are within one standard deviation of the average of the previous 10 observations.

According to the WDS catalog, the primary star has proper motion vectors of +25 milliarcseconds right ascension and +24 milliarcseconds declination per year. The secondary star has vectors of +20 milliarcseconds right ascension and +21 milliarcseconds declination per year (Mason 2012). These numbers are similar and suggest that the two stars may form a true binary star system.

## Conclusion

Overall, the researchers effectively utilized a

Table 1. Observed measurements of STFA 38 AD compared to recent observations in the Washington Double Star catalog.

| | Sep. | Mason Sep. | PA | Mason PA |
|---|---|---|---|---|
| # Obs. | 16 | 10 | 16 | 10 |
| Average | 44.3″ | 44.0″ | 150.4° | 149.8° |
| St. Dev. | 0.3″ | 0.5″ | 1.5° | 0.7° |
| St. Err. Mean | 0.1″ | 0.2″ | 0.4° | 0.2° |

telescope to observe and measure the double star STFA 38 AD. The researchers used their measurements to compare the current position of the star to prior observations. Additionally, the researchers considered the proper motion vectors of the stars and hypothesize that the double star may be a gravitationally bound binary.

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## References

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*Jolyon Johnson is a Geology graduate of California State University, Chico. Eric Weise is a Physics major at University of California, San Diego. Both were science advisors for this introductory astronomy class. Samantha Choy and Sheena Wu are students at California Polytechnic State University, San Luis Obispo. Michael Anderson, Melinda Hart, Bailey Kelley, Zachery Noble, Samantha Spurlin, and Bret Tabrizi are students at Cuesta College. Russell Genet taught the astronomy course and is an Adjunct Professor of Astronomy at Cuesta College as well as a Research Scholar in Residence at California Polytechnic State University, San Luis Obispo.*