Student Measurements of STFA 10AB (Theta Tauri)

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Abstract: Eighth grade students at Vanguard Preparatory School measured the double star STFA 10AB using a 22-inch Newtonian Alt/Az telescope and a Celestron Micro Guide eyepiece. Bellatrix was used as the calibration star. The calculated means of multiple observations of STFA 10AB resulted in a separation of 45.18,\textquoteleft a scale constant of 7.88 arcseconds per division, and position angle of 257.9.\degree These measurements were compared to the most recent values in the Washington Double Star Catalog.

Introduction

On March 11-13, 2016, eleven eighth grade students (Figure 1) observed the double star, q Tauri, at Vanguard Preparatory Double Star Workshop. The calibration star (Bellatrix) had a right ascension of 0.5 hours 25 minutes 7.86 seconds, and a declination of 6.3497. The Observations were made at 34° 29’ 19.84’’ North latitude and 117° 09’ 47.48’’ West longitude. Students were planning to measure the double star Theta Taurus on March 4-6, but the sky was cloudy and the weather was windy. The students used video recordings of Theta Taurus that had been recorded on Thursday, March 10 (B2016.191904), to determine the scale constant, separation, and position angle.

Equipment

The team used a 22-inch Newtonian Alt/Az telescope with a Celestron Micro Guide eyepiece attached to a Bell and Howell High Definition Video Camera shown in Figure 2.

Procedures

The star Bellatrix in the constellation Orion was used to calibrate the linear scale of the eyepiece. The students positioned Bellatrix on the edge of the linear scale, then the sidereal motor was disengaged to allow the star to drift parallel to the linear scale. Using a stop-
watch that reads to the nearest hundredth of a second, the students determined the amount of time it took the star to drift. A total of fifteen drifts was recorded to determine the scale constant using the equation

\[ Z = \frac{15.0411 \cos(\text{dec})}{D} \]

\( Z \) is the scale constant in arcseconds per division; 15.0411 is the Earth's rotational rate in arcseconds per second; \( t \) is the average drift time in seconds (63.24); \( \cos(\text{dec}) \) is the declination of the calibration star in degrees; and \( D \) is the number of division marks on the linear scale (60).

**Observation and Analysis**

The results the students got from the 22-inch Newtonian telescope and the eyepiece was a scale constant of 7.88 arcseconds per division. Theta Tauri (STFA 10AB) has an apparent magnitude of +3.14, a right ascension of 04h 28m 34.49603sec, and a declination of +15° 57' 43.8494". The stars are separated by 337 arcseconds and their position angle was 346° as listed in the WDS. Figures 3 and 4 show the appearance of q Tauri in our eyepiece. The stars are spectroscopic binaries and have closer companions.

15 observations were gathered to determine an average time of drift of 31.61, standard deviation of 0.44, and standard error of mean 0.11. Five separate measurements were gathered to determine an average of 45.18 arcseconds, a standard deviation of .46, standard error of mean 0.2, with a published value of 337 difference of 18.82 and difference of 5.43%. Ten position angle measurements were gathered to determine an average of 257.9 standard deviation of 4.84, standard error of mean 1.53 with a published value of 346 and difference of 1.9 and 0.55%. The measurements are summarized in Table 1.

**Conclusion**

The students produced a small difference from the observations recorded in 2011 of one standard deviation. The students compared it to a published value of 337 difference of 18.82 and difference of 5.43%. The measured separation differs from the WDS.
value

by 4.2 standard deviations. An error may have occurred due to the students’ level of experience.

Acknowledgements

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References


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<thead>
<tr>
<th>Parameters</th>
<th># Obs</th>
<th>Mean</th>
<th>SD</th>
<th>Standard Error of Mean</th>
<th>WDS Value</th>
<th>Difference</th>
<th>% Difference</th>
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<tbody>
<tr>
<td>Scale Constant a.s./division</td>
<td>15</td>
<td>7.88</td>
<td>44</td>
<td>0.11</td>
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<td>Separation (a.s.)</td>
<td>5</td>
<td>45.18</td>
<td>.46</td>
<td>.21</td>
<td>337</td>
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<td>5.43%</td>
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<tr>
<td>Position Angle (degrees)</td>
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<td>257.90</td>
<td>4.84</td>
<td>1.53</td>
<td>346</td>
<td>1.9</td>
<td>0.55%</td>
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Table 1: Measurements of STFA 10AB. Performed on 2016.175