

Double Star Research Seminars

A Student-Teacher Prospective

Eric Weise

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My Introduction to Research





The Fruits of Our Labor

A Comparison of the Astrometric Precision and Accuracy of Double Star Observations with Two Telescopes

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Abstract: Using a manual Meade 6" Newtonian telescope and a computerized Meade 10" Schmidt-Cassegrain telescope, students from Arroyo Grande High School measured the well-known separation and position angle of the bright visual double star Albireo. The precision and accuracy of the observations from the two telescopes were compared to each other and to published values of Albireo taken as the standard. It was hypothesized that the larger, computerized telescope would be both more precise and more accurate.

Introduction

The objective of this project was to compare the precision and accuracy of visual astrometric observations of a double star made with two different telescopes. Precision is the repeatability (reliability) of the observations, i.e. how well the observers agree among themselves. Accuracy, on the other hand, is agreement with some already well-established value. Highly precise and accurate astrometric measurements are desired because they will be more strongly weighted in later analyses of a binary system. Since our objective was to evaluate both the precision and accuracy of our astrometric observations, as opposed to obtaining new values on a neglected or rapidly changing double star, we chose the double star Albireo because it has a well established separation and position angle that change only slowly over time.

This project was part of the Fall 2008 Physics Research Seminar at Cuesta College's South Campus in Arroyo Grande, California. As suggested by Johnson (2007), visual observations of double stars are well

suited to one semester research seminars. Ten student first time observers attending Arroyo Grande High School met with experienced observers Genet, Johnson, and White on September 19th, 2008 (B2008.718) at the Marble residence in Arroyo Grande to observe Albireo (Marble et al, 2008).

The observers were divided into two teams: Alvarez, Kight, Navarro, Schachter, Summers, Weise, Mires and Genet used a manual 6", f/6 Newtonian telescope with a clock drive; Fishbein, Hyland, Lopez, Rosas, Johnson, and White used a computer controlled 10", f/10 Meade LX200 Schmidt-Cassegrain telescope. A 12 mm Meade astrometric eyepiece was used with the 6" telescope while a 12.5 mm Celestron Micro Guide eyepiece was used with the 10" telescope. Stopwatches that read out to the nearest 0.01 second were used in the calibration of the linear scales of both eyepieces.

Prior to the observations, the authors hypothesized that with a longer focal length (100" versus 36") and larger aperture (10" versus 6"), the separations

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because he's still afraid of driving and flying."**

Double Star Research

Teaching, observing, and writing papers in 45 days.



Two Cuesta College Teams Observe Albireo

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2. Central Coast Astronomical Society, San Luis Obispo, CA
3. San Diego University, San Diego, CA
4. Cuesta College, San Luis Obispo, CA
5. California Polytechnic State University, San Luis Obispo, CA
6. BIOLA University, Los Angeles, CA

Abstract: Two student teams observed the visual double star Albireo. One team used an 8 inch telescope while the other team used an 11 inch telescope. The teams found the separation to be $35.4''$ and $36.0''$, respectively. The 8 inch team measured the position angle to be 54.7° . Both separation measurements and the position angle measurement of the 8 inch telescope are close to the most recent observation in the Washington Double Star catalog. The 11 inch team's position angle had an unresolved problem.

Introduction

The 2012 Cuesta College Introduction to Astronomy summer course consisted of students from Cuesta College and California Polytechnic State University. Two separate observing groups unwittingly measured the same double star, Albireo (STFA 43 AB). Not wishing to produce two papers observing the same star on the same night, the groups merged to compare and jointly report their measured separations and position angles. Observations were made on June 25th, 2012 (B2012.483) at the Orion Observatory in Santa Margarita, California.

This project had two objectives: 1) expose students to quantitative measurements through the observation of double stars and 2) compare their measurements to the most recent observation reported in



Figure 1: Zachery Noble, Joseph Richardson, Anna Greene, Joseph Camo, and Eric Weise observed Albireo at the Orion Observatory using Camo's 11 inch telescope.

Comparing Two Calibration Methods of a Micro Guide Eyepiece using STF 1744AB

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4. California Polytechnic State University, San Luis Obispo, CA

Abstract: Students at Cuesta College measured the double star STF 1744 AB and used two methods to calibrate the linear scale of the eyepiece. The drift method yielded a separation of 14.9 ± 0.6 arc seconds, which was 0.2 arc seconds different from the average of ten recent observations. Calibrating the scale by measuring the scale with a caliper gave a separation of 14.6 ± 0.5 arc seconds which was 0.1 arc seconds different from the average of ten recent observations. We concluded that the physical measurement of the linear scale is an appropriate method for the calibration of an eyepiece.

Introduction

This project began as an astrometric inquiry into a double star, but pursuing our scientific curiosity we decided to compare two methods of calibrating the linear scale in the Celestron Micro Guide eyepiece. We observed the double star STF 1744 AB (Mizar) at Orion Observatory on June 28, 2012 (B2012.489). Ultimately there were two goals that this research group completed: 1) to learn how to locate and measure the astrometric parameters of double stars and 2) to compare two methods of calibrating the linear scale in a Micro Guide eyepiece.

Methods

Measurements of STF 1744 AB were made with an eleven inch Celestron telescope on a German equatorial mount. A Celestron Micro Guide eyepiece was used for the measurements. Two calibration methods were used to determine the number of arc



Figure 1: The STF 1744 AB team. From left to right: Eric Weise, Ryan Gelston, Bryan Reinhardt, Austin Ross, Tori Gibson, and Tess Downs.

seconds per division in the eyepiece.

In the first method, the eyepiece was aligned

Visual Measurements of the Double Star STFA 38 AD

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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 outskirts 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.

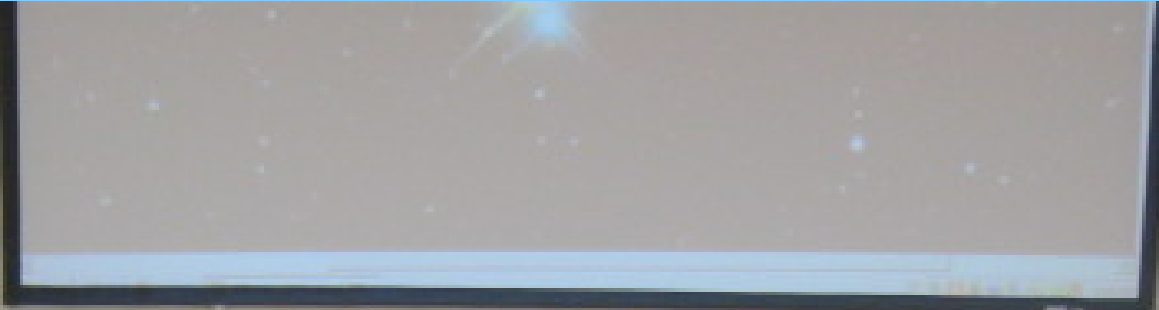
Equipment and Procedures

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



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

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|--------|--------|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 |
| Pr | Nd | Pm | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu | | | |
| 147.08 | 148.91 | 149 | 150.36 | 151.96 | 152.93 | 154.92 | 156.91 | 158.91 | 160.93 | 162.93 | 164.93 | 167.26 | 169.06 | 170.94 | 172.94 |
| 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
| Pa | U | Np | Pu | Am | Cm | Bk | Cf | Es | Fm | Md | No | Lr | | | |
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Future Plans

- UCSD Astrophysics Club
- Preuss High School at UCSD
- Continue to work with Dr. Russ Genet