Two Cuesta College Teams Observe Albireo

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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 Carro, and Eric Weise observed Albireo at the Orion Observatory using Carro's 11 inch telescope.

the Washington Double Star catalog (WDS).

Equipment and Procedures

An equatorial 8 inch Meade Schmidt-Cassegrain telescope and an alt-az Celestron C11, each equipped with a Celestron Micro Guide eyepiece, were used to independently measure Albireo's separation and position angle. Stopwatches which read to the 0.01 seconds was used for drift timings.

To determine the scale constant of the 11 inch telescope, the observers positioned the primary star of Albireo on the east end of the linear scale and disengaged the tracking motors. The observers using the 11 inch telescope calculated the average time for the star to reach the west end of the linear scale to be 32.5 seconds. The team then calculated the scale constant to be 7.2 arc seconds per division using the following equation:

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

where Z is the scale constant in arc seconds per division, t is the average drift time, δ is the declination of the primary star of Albireo (27.95°), and 60 is the number of divisions on the linear scale. Due to limited observing time with the 8 inch telescope, we used the scale constant of 10.1 arc seconds per division determined by another project using the same telescope and eyepice (Johnson *et al.* 2013).

To measure the separation, the observers positioned the telescope so both the primary and secondary stars were along the linear scale. The observers then estimated the number of divisions between the two stars to the nearest 0.1 divisions (8 inch) and 0.25 divisions (11 inch), as instructed by the telescope operators (Johnson on the 8 inch and Carro on the 11 inch). To reduce bias, the stars were repositioned onto different divisions of the scale for each trial. The measurements were analyzed using Microsoft Excel to find the average, standard deviation, and standard error of the mean. The averages were multiplied by the scale constants to find the separations in arc seconds.

To measure the position angle of Albireo, the observers positioned the primary star at the center of the linear scale of the Micro Guide eyepiece. The right ascension motor was turned off momentarily to allow the star to drift with the Earth's rotation, and the observer estimated and recorded to the nearest degree where the star crossed the protractor. The team with the 8 inch used the inner protractor while the team with the 11 inch used the outer protractor. To reduce systematic error, the observers using the 8 inch telescope rotated the eyepiece 180° after each trial, although this was not done with the 11 inch telescope. A 90° correction was applied as required for the Micro Guide eyepiece (Teague 2004). Twelve trials were completed and analyzed using Microsoft Excel to find the average, standard deviation, and standard error of the mean.

Table 1: The averages, standard deviations, and standard errors of the mean for the measured separations with both telescopes and position angle with the 8 inch.

Telescope	8 inch Sep.	11 inch Sep.	8 inch PA
# Obs.	12	10	12
Average	35.4″	36.0″	54.6°
St. Dev.	2.4″	0.9″	2.2°
St. Err. Mean	1.0″	0.2″	0.6°

Results and Analysis

Table 1 shows the average separations measured with both telescopes and the average position angle measured with the 8 inch, as well as their standard deviations and standard errors of the mean. The separation measurements are within one standard deviation of each other and within 1.5 standard deviations of the most recently reported WDS value of 34.8". We found the position angle derived with the 8 inch to also be within one standard deviation of the most recent observation in the WDS of 54°. However, the position angle measurement made with the 11 inch was 18° different from the WDS catalog value. There was not enough time left at end of the class to resolve this issue.

Conclusions

With the use of two telescopes, we measured Albireo's separation and position angle. This was a valuable experience for young college students learning science by doing science. With the merger of two observing teams, the students were able to communicate and compare results in a single paper, thus limiting new literature on this popular double star.

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