CCD Measurements of the Double Star STF 1744AB

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Abstract: Measurements of the double star STF 1744AB were conducted with an 8 inch telescope and a CCD camera was used. The plate scale was determined to be 0.8933 arc seconds per pixel. The software called Astroart was used to determine the separation and position angle, which were 14.9 arc seconds and 155.0 degrees. The Washington Double Star catalog was used as a comparison. Three goals were set: (1) understand the setup and operations of the telescope and the equipment used, (2) understand if the plate scale, separation, and position angle could be determined, (3) and observe, record, and report.

Introduction

On July 26-27, 2014 measurements were gathered of the double star STF 1744AB. The observations were conducted at the Lewis Center for Educational Research's Thunderbird campus located in Apple Valley. An 8 inch Schmidt Cassegrain telescope on a CG5 German Equatorial mount equipped with a NEXIMAGE 5 CCD camera were used. Astroart 5.0 was used to determine the x and y coordinates of the primary and secondary stars. A plate scale equation was used to determine the plate scale of the telescope-camera combination in arc seconds per pixel. Two dimensional vector displacement equations were used to determine the separation and position angle in arc seconds and degrees. The Washington Double Star Catalog (WDS) lists the precise coordinates of the double star to be 132355.42+545531.5. Over 450 measurements have been documented in the WDS, with the first epoch of separation and position angle to be 13.9 arc seconds and 143 degrees. The last epoch lists the separation and position angle to be 14.5 arc seconds and 154 degrees respectively. The WDS lists the primary and secondary stars magnitude as 2.23 and 3.88. Figure 1 is a photograph of the observing team.

Figure 1. The authors from left to right: Mark Silva, Mark Brewer, Stacey Elderbaum, Evyn Hernandez, Celine Shay, and Gabriel Cacace.

Equipment and Procedures

An 8-inch Celestron Schmidt Cassegrain telescope with a focal length of 2032 millimeters was used. A Neximage 5 CCD camera was used (see Figures 2 and 3). The dimension of the CCD chip is 5700 by 4300 microns with a pixel size of 8.8 by 8.8 microns with four times binning.

The following equation was used to determine the plate scale of the telescope-camera combination:

$$Z = \frac{(206264.806)(0.0088)}{2032}$$

where Z equals the plate scale in units of arc seconds

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Figure 2. In the forefront is the author Mark Silva's 8 inch Celestron Schmidt Cassegrain telescope.

per pixel, 206264.806 equals one arc second per radian, 0.0088 equals the pixel size in units of millimeters, and 2032 equals the focal length of the telescope in units of millimeters.

The separation is given by

$$C = \sqrt{\Delta A^2 + \Delta B^2}$$

where C equals the separation in units of pixels, ΔA equals the pixel difference of the stars on the x axis in units of pixels, ΔB equals the pixel difference of the stars in the y axis in units of pixels.

The position angle is given by

$$\theta = \arctan\left(\frac{\Delta B}{\Delta A}\right)$$

where θ equals the position angle in units of degrees.

Observations

Observations of the double star STF 1744AB were made on July 26, 2014 (B2014.568). A single frame bitmap image was captured of the double star. The exposure time was set to 0.1 second (see Figures 4 and 5). The plate scale was determined to be 0.8933 arc seconds per pixel. The separation was determined to be 14.8 arc seconds. The position angle was determined to be 155.0 degrees. A difference of -0.5 arc seconds and 1.0 degrees were determined by comparison of the last epoch listed in the Washington Double Star Catalog. The large difference in position angle was found to be the camera angle. A drift analysis should have been included to correct the camera angle.

Figure 3: An image of the NEXIMAGE 5 CCD camera

Figure 4. An image of STF 1744AB.

Figure 5. An enlarged image of Figure 4.

Conclusion

The measurements gathered were not as accurate as hoped. The camera angle was not included in the observations, which skewed the measurements from determining a precise position angle. Had the drift analysis been done, the results would have compared favorably with the last epoch listed in the WDS. The goals set to understand the operations of the telescope and equipment were met, as well as the goals to determine the plate scale of the telescope-camera combination, separation, and position angle, and observe, record and report.

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