CCD and Gaia Measurements Indicate that WDS 14574 +8529 AE is an Optical Double

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Abstract

The Double Star System WDS 14574 + 8529 AE was observed with the Great Basin Observatory telescope. The images were processed and plate solved using AstroImageJ and then the position angle and separation were measured. Our measurements of θ = 173° and ρ = 38.2" were compared to the only other measurement, which dates to 1999, of θ = 177° and ρ = 36.3". Since two measurements are insufficient to determine whether the system is physical, we also acquired parallax and proper motion data from the Gaia database. These data indicate that the system is not physically related, as the A component is at a distance of 400 pc while the E component is only 149 pc away.

Introduction

The goal of this project was to obtain additional measurements for the separation and position angle of WDS 14574 + 8529 AE, as seen in Figure 1, to help determine if it is a binary system. Although this system has components A through E, for this study only the A and E components were measured. The AE component was first observed in 1999, but has not been observed since. However, the AB component has 16 measurements in the WDS, the AC component has 27, and the D component has 3 measurements. WDS 14574 + 8529 AE was selected because it was sufficiently bright and at an appropriate altitude for observation by the Great Basin Observatory (GBO). This project was conducted by high school students at SUCCESS Academy DSU, an early college high school, in collaboration with Southern Utah University.

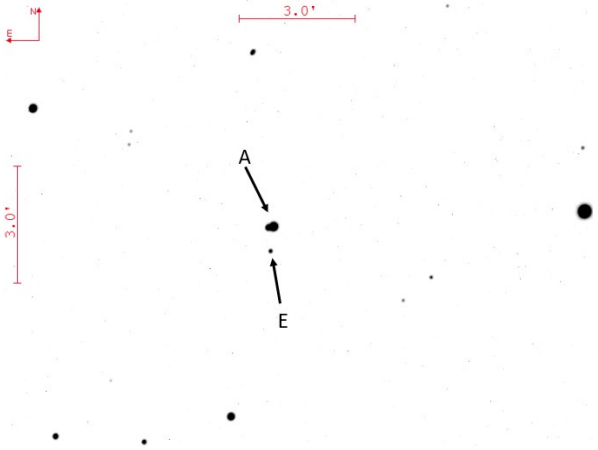

Figure 1. Finder chart of WDS 14574 + 8529 AE. The plate scale of this image is 0.4 arcsec/pixel.

Methods

The telescope used in this study is located in the Great Basin Observatory at the Great Basin National Park in Nevada. The GBO is managed by the Great Basin National Park and the Great Basin National Park Foundation; it is operated in collaboration with four educational partners: University of Nevada-Reno, Western Nevada College, Southern Utah University, and Concordia University. The GBO uses an SBIG STX 16803 camera mounted to a PlaneWave CDK700 0.7 m telescope. This produces a focal ratio of f/6.5, giving a field of view of 27X27 arcminutes, and a plate scale of 0.4 arcsec per pixel (Anselmo et al. 2018). A total of 20 pictures of WDS 14574 + 8529 AE were taken on February 15th, 2020 with an

exposure time of 120 seconds in the V filter. This exposure time was chosen in order to avoid overexposing the stars. The images were calibrated using dark, flat, and bias frames with AstroImageJ 3.4.0 (Collins et al. 2017). They were then plate solved using astrometry.net (Lang et al. 2010). These measurements were performed using AstroImageJ 3.4.0 as well. While measuring, the centroid feature was used to help measure separation (ρ) and position angle (θ).

Results

The results of our measurements are shown in Table 1. This table shows the mean separation, in arcseconds, and position angle, in degrees. Additionally, the standard deviation and standard error of these measurements are reported.

WDS No.	Nights	Date	Observations		θ°[deg]	ρ" [arcsec]
14574+8529 AE	1	Feb. 15, 2020	20	Mean	173.4	38.20
				Std. Dev	0.99	0.71
				Std. Error	0.22	0.16

Table 1. Measurements of separation and position angle for WDS 14574 + 8529 AE.

Discussion

Table 2 shows the historical data of WDS 14574 + 8529 AE from the Washington Double Star Catalog (Mason 2020). The only historical measurement was from 1999. Figure 2 shows the plot of this measurement together with our new measurement. In this plot, the A component is plotted at the origin and the position of the E component is shown for the two measurements. Although this plot appears to show that the E component is moving in a linear fashion, more measurements are clearly needed, since a set of two measurements is insufficient to differentiate between linear and orbital motion.

To further investigate whether the A and E components are gravitationally bound, we extracted the parallax and proper motion data for this pair from the Gaia DR2 database (Gaia Collaboration et al. 2018). Table 3 shows the Gaia measurements for this pair: both parallax and proper motion are shown. It can be seen that the parallax of these stars are quite different, with the E component at a distance of about 150 pc, while the A component is at a distance of about 400 pc. The proper motions of the stars are also dissimilar, which indicates that the stars are not physical. This seems to indicate that the apparent linear motion seen in Figure 2 is in fact representative of the actual motion of the pair.

Epoch	θ°[deg]	ρ"[arcsec]
1999.29	177	36.3
2020.126	173.426	38.200

Table 2. Historical Data for WDS 14574 + 8529 AE.

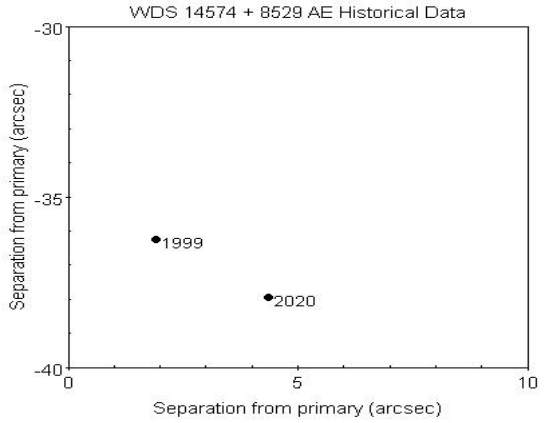

Figure 2. Plot of the motion of WDS 14574+8529 AE over the last two decades. The only historical measurement of this pair in the WDS is from 1999.

Component	Parallax [mas]	Distance (pc)	Proper Motion RA (mas/yr)	Proper Motion DE (mas/yr)
A	2.494±0.015	399-403	-22.020±0.024	0.792±0.023
E	6.726±0.022	148-149	-115.185±0.040	66.031±0.038

Table 3. Gaia parallax and proper motion data for WDS 14574 + 8529 AE. These measurements show that the A and E components are separated by at least 250 pc, which shows that the stars are not physical.

Acknowledgments

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