Measurements of Secondary Components of Epsilon Lyrae, WDS 18443+3940STFA 37BD

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Abstract: Using a Celestron 9.25 inch SCT, I measured the secondary components of the famous Double Double system Epsilon Lyrae during the spring of 2018. The average angular separation found for BD was 211.5 arc seconds and the position angle was 172 degrees. While the position angle was in keeping with the 11 other measurements in the WDS catalog for these components, the separation was not in line with the latest published measurement; however, it was more consistent with the 10 previous measurements, leading me to conclude that the last published separation in the WDS catalog may be an outlier.

Introduction

I observe mostly from a suburb of Portland, Oregon, meaning I contend with moderate to heavy light pollution, cloudy skies for most of the year and a low average of good seeing. Nevertheless, I believe valuable double star observations can be made, and so in May 2016 I requested a list of binary systems from Brian Mason with the U.S. Naval Observatory, which maintains the Washington Double Star catalog. I requested objects within or near the constellation Lyra, as this constellation is easily visible and reaches high in the sky during the summer months at my location. My parameters included an apparent magnitude limit of 9 to 10 and a separation of 2" to 700". Mason sent me a list of 22 systems. WDS 18443+3940STFA 37BD was one of them, and I chose it because it was the brightest, I had observed the system as part of the Astronomical League's double star observing program and it was easy to find.

An additional consideration I must take into account for measuring binary systems is that I'm using Meade's 12mm Astrometric illuminated reticle eyepiece to make the measurements. I must be cognizant of the brightness of the illumination that this eyepiece plays upon the reticle (the linear scale and the protractor scales). Along with the light pollution, the illumination from the eyepiece, even at its lowest level of brightness, can make faint stars impossible to see and measure.

The Observations

I used a Celestron 9.25-inch SCT with its Advanced VX computerized German equatorial mount.

As any amateur astronomer who has observed Epsilon Lyrae will attest, these four stars are a treat to see in a telescope. But for scientific accuracy and publication purposes I had to confirm I was measuring the correct two stars, BD. It was not necessarily obvious, because all four stars appear white and are near the same magnitude. Therefore, I sketched the four stars as seen in my eyepiece and also measured the separation and position angles of each pair. Using the WDS catalog as a guide, I was able to compare my observations (position angles and separations) to all the components listed in the catalog for this system. I then was able to positively identify the two stars to measure. Both are the secondary stars to the primaries of each pair.

The measurements are given in Table 1. I used the 12mm illuminated reticle in conjunction with a 2X Barlow. The dates are given in fractional Besselian years.

Discussion

From the average of all 83 measures made on nine nights from April 2018 to June 2018, I found, using the SCT, the position angle was 172 degrees and an average angular separation of 211.5". The last published measure in WDS for BD was made in the year 2000. The separation data point for that year was 209.6". The first data point was published in 1903. The separation

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Table 1. My Measurements of Epsilon Lyrae

PA	SEP (avg)	DATE	#MEAS.
172	211.1	2018.240	12
N/A	213.1	2018.249	10
172	212.5	2018.298	15
N/A	211.0	2018.303	15
N/A	210.8	2018.317	2
N/A	211.2	2018.361	10
172	210.9	2018.402	10
172	211.1	2018.410	2
172	211.3	2018.429	7

Mean Separation: 211.5″
Standard Deviation: 1.0″
Standard Error: 0.11″

Table 2. Past Measurements of ε Lyrae BD

PA	SEP	DATE
172.6	212.17	1903.26
172.3	212.499	1905.02
172.8	212.42	1909.60
172.4	212.39	1910.63
172.5	212.385	1913.4
172.4	211.234	1941.05
171.8	211.214	1980.7
171.7	211.32	1982.391
171.7	211.212	1991.25
171.7	211.203	1991.67
172.0	209.57	2000.26

at that time was 212.2". At this writing, there are a total of 11 published measures.

I requested all 11 measures of this system from Mason. I carefully examined the list he sent me and found that the 10 previous measurements were closer to my measurements and not the last published measure of 2000. There is a slight trend to a smaller separation, but from 1903 (measure one) to 1991 (measure 10), the change was only about 1". But from 1991 (measure 10) to 2000 (measure 11), the change during those years jumped to about 1.6". This sudden jump caused me to wonder if the 2000 measurement was an outlier.

The published measurements in WDS from 1903 to 2000 are given in Table 2. The dates are given in fractional Besselian years.

Notes

The star I used for timing purposes with the SCT to determine arc seconds per segment on the reticle linear scale was β Bootis. The average of 40 timings with the 12mm reticle plus the 2X Barlow on the nights of April 18, 2018 (20) and June 18, 2018 (20) resulted in an average of 22.96 seconds.

Using the mathematical equation for reticles described in Argyle (2012) on pages 161 and 162 (15.04 cos δ, where δ is the declination of a star, multiplied by the number of seconds and divided by 50 segment divisions for Meade's reticle), I found one segment with the 12mm reticle plus the 2X Barlow equaled 5.27". This number was multiplied with the measured number of segments of the secondary stars. Rounding was done at the end of the calculations.

Other stars were timed and run through the same mathematical equation. The results were mostly the same, but even a hundredth of an arc second difference per segment made a significant impact on the end number, plus/minus an arc second. I used the timings from β Bootis because I made the most timings on the star and resulted in separations closest to published values.

References

Observing and Measuring Double Stars, Second Edition, R.W. Argyle, editor, Springer, New York 2012.

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