Measurements of Nine Double-Star Systems in Lyra, Cygnus

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Abstract

Using a Celestron 9.25-inch Schmidt Cassegrain Telescope (SCT) during the spring and summer of 2021, I observed and measured the position angle and separation in arc seconds of nine double-star systems in Lyra and Cygnus, including a re-measure of Epsilon Lyrae BD (WDS 18443+3940STFA 37BD), after my results of this system were reported in the January 2019 edition of the Journal of Double Star Observations (JDSO). In that paper, I concluded a previous measure published in the Washington Double Star (WDS) catalog of that system may have been an outlier, and while that may still be true, observations made by different observers using different equipment can result in a reasonable latitude in reported results. My own observations of the system differ in this paper from the one I reported in January 2019 by 1 arc second. For the rest of the pairs I observed, six out of eight were in line with published measures but two were not. WDS 19364+3541 ARN 82 AB was around 11 arc seconds off from the last published measure. And WDS 19355+4626 STTA 187 ABC was a curious triple. While the AB and BC systems were close to the same as published measures, the AC pair measure was noticeably different than what is published in the WDS catalog. I intend to reobserve and remeasure these two systems in 2022 to see if I can determine why the discrepancies exist.

1. Introduction:

I am an amateur astronomer in Lake Oswego, Oregon, a suburb of Portland. Working from a list of double stars sent to me by Dr. Brian Mason at the U.S. Naval Observatory, I observed and measured the position angle and separation in arc seconds of nine systems including Epsilon Lyrae BD (WDS 18443+3940STFA 37BD), which I reported results for in January 2019 in the Journal of Double Star Observations (JDSO). I remeasured this system to further understand variations in measurements between different observers and even those made by myself at different times. I also measured eight more systems sent to me by Dr. Mason to compare my results to previously published data and to continue observing and measuring these systems to contribute more data to the Washington Double Star (WDS) catalog. Additionally, I timed more stars across the linear scale of my astrometric eyepiece to shore up the accuracy of how many arc seconds fit into one segment of my linear scale.

Here are the nine systems I measured for this paper: WDS 18443+3940STFA 37BD; WDS 19365+4101GUI 25 AC; WDS 19331+3254 HU 948 AB,C; WDS 19571+3105AG 243; WDS 19355+4626 STTA 187 AB; WDS 19355+4626 STTA 187 AC; WDS 19355+4626 STTA 187 BC; WDS 19364+3541 ARN 82 AB; and WDS 19583+3147 KU 126.

2. Equipment and Methods:

I used a Celestron 9.25-inch SCT with its Advanced VX computerized German equatorial mount. To make the measurements of separation and position angle, I used Meade's 12mm Astrometric Illuminated Reticle eyepiece coupled with a 2X Barlow. I measured the separation and position angle of each system at least 10 times over at least three observing sessions. The exceptions were WDS 18443+3940STFA 37BD (seven nights) and WDS 19331+3254 HU 948 AB,C (four nights). I have reported my results in Tables 1-9. The dates are given in Julian years.

For the 2019 paper, I had only timed one star to determine the number of arc seconds per segment on my reticle's linear scale. That star was β Bootis. For this paper, in addition to the previous result for β Bootis, I used timings of Eta Herculis, Epsilon Herculis, Iota Persei and 30 Persei across the reticle's linear scale. From the averages of the timings of all these stars, including β Bootis, I determined the number of arc seconds for each segment was 5.29. The equation I used to determine arc seconds/segment is described in Argyle (2012) on pages 161 and 162 (15.04cos 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)

3. Data:

Table 1: WDS 18443+3940STFA 37BD (Epsilon Lyrae BD)

Separation (arc sec)	Position Angle	Date (Julian)	Number of Measures
213.7	170	2021.1971	10
211.8	N/A	2021.2436	10
212.5	N/A	2021.2491	10
213.0	172	2021.2710	10
212.5	171	2021.2956	7
212.0	172	2021.4845	10
212.0	171	2021.4298	10

Average Separation: 212.5"
Average Position Angle: 171
Standard Deviation of Separation: 0.67
Standard Error: 0.253

Table 2: Measurements of WDS 19365+4101GUI 25 AC

Separation (arc sec)	Position Angle	Date (Julian)	Number of Measures
168.5	160	2021.2956	10
169.0	160	2021.3039	10
168.8	160	2021.5065	10

Average Separation: 168.8"
Average Position Angle: 160
Standard Deviation of Separation: 0.25
Standard Error: 0.144

Table 3: WDS 19331+3254 HU 948 AB,C

Separation (arc sec)	Position Angle	Date (Julian)	Number of Measures
63.0	65	2021.4188	10
63.2	65	2021.4216	10
63.5	65	2021.4572	10
63.5	65	2021.4599	10

Average Separation: 63.3"
Average Position Angle: 65
Standard Deviation of Separation: 0.24
Standard Error: 0.12

Table 4: Measurements of WDS 19571+3105AG 243

Separation (arc sec)	Position Angle	Date (Julian)	Number of Measures
44.2	258	2021.4216	10
44.6	259	2021.4572	10
44.4	260	2021.4599	10

Average Separation: 44.4"
Average Position Angle: 259
Standard Deviation of Separation: 0.2
Standard Error: 0.115

Table 5: Measurements of WDS 19355+4626 STTA 187 AB

Separation (arc sec)	Position Angle	Date (Julian)	Number of Measures
67.3	285	2021.4599	10
66.6	285	2021.4626	10
67.2	285	2021.4654	10

Average Separation: 67"
Average Position Angle: 285
Standard Deviation of Separation: 0.38
Standard Error: 0.219

Table 6: WDS 19355+4626 STTA 187 AC

Separation (arc sec)	Position Angle	Date (Julian)	Number of Measures
131.6	254	2021.4626	10
131.4	254	2021.4654	10
130.5	255	2021.4763	10

Average Separation: 131.2"
Average Position Angle: 254
Standard Deviation of Separation: 0.59
Standard Error: 0.341

Table 7: Measurements of WDS 19355+4626 STTA 187 BC

Separation (arc sec)	Position Angle	Date (Julian)	Number of Measures
79.4	229	2021.4654	10
80.0	229	2021.4763	10
80.1	229	2021.4791	10

Average Separation: 79.8"
Average Position Angle: 229
Standard Deviation of Separation: 0.38
Standard Error: 0.219

Table 8: Measurements of WDS 19364+3541 ARN 82 AB

Separation (arc sec)	Position Angle	Date (Julian)	Number of Measures
43.9	34	2021.4791	10
43.2	34	2021.4845	10
43.3	34	2021.4873	10

Average Separation: 43.5"
Average Position Angle: 34
Standard Deviation of Separation: 0.38
Standard Error: 0.219

Table 9: Measurements of WDS 19583+3147 KU 126

Separation (arc sec)	Position Angle	Date (Julian)	Number of Measures
53.0	13	2021.4845	10
53.2	13	2021.4845	10
53.1	14	2021.4955	10

Average Separation: 53.1”
Average Position Angle: 13
Standard Deviation of Separation: 0.1
Standard Error: 0.057

4. Discussion:

My published measure for WDS 18443+3940STFA 37BD (Epsilon Lyrae BD) in the January 2019 edition of JDSO was 211.5 arc seconds. In this paper, it is 212.5, exactly 1 arc second difference. The difference is likely attributable to the fact that I used more calibration stars for this paper and because of personal biases and errors, including slightly different interpretations of what is seen in the telescope’s eyepiece.

The last published measure of this pair is from the year 2000 and is 209.57 arc seconds, which does seem like an outlier to my results and the rest of the measured separations (see my 2019 paper) for this pair but is not entirely unreasonable to get such a result.

Each observation is unique and is likely dependent on several factors, including equipment, seeing conditions and the interpretation of what is seen in the observer’s eyepiece. (For example, is the distance 1.2 segments or 1.3 segments between two stars on the linear scale? Often, it is difficult to tell, especially under less-than-ideal seeing conditions.)

It was helpful for me to keep these factors in mind when I compared my measurements of the other eight pairs in this paper to the results in the WDS catalog. Discrepancies could be explained by the uniqueness of each observation in six pairs, but two pairs fell outside this test.

The first pair outside the test was WDS 19364+3541 ARN 82 AB. The last published separation measurement in the WDS catalog was in 2019. The separation recorded there was 54.9 arc seconds. The average separation I recorded was 43.5. Incidentally, my measurement is the same as the first recorded one of this pair in 1897. Why the discrepancy of more than 11 arc seconds? There is nothing in my observations of this pair to lead me to believe I could have made an error as wide as 11 arc seconds. But currently, I do not know the answer.

The second pair (within a triple system) that appeared to fail the test was WDS 19355+4626 STTA 187 AC. The last published separation in the catalog was 128.3 arc seconds in 2015. My observed average separation, though, was 131.2. While not a catastrophic discrepancy, it is curious that my observations of AB and BC in this triple system are very close to the latest published measures in the WDS catalog, 66.9 and 79.9 respectively. Why would I be so close in measuring two pairs but not the third? (Note: There appears to be a fourth star associated with this system, AD, but I did not observe or measure this pair.)

On a more subjective note, WDS 19355+4626 STTA 187 ABC is just west of open cluster NGC 6811. A large portion of the cluster and ABC can be viewed in the same field of view of my telescope. Additionally, ABC resides in a rich star field. The stars and cluster combine to create a visual treat for observers.

5. Conclusion:

I plan to revisit, reobserve, and remeasure WDS 19364+3541 ARN 82 AB and WDS 19355+4626 STTA 187 ABC in 2022 and reevaluate any discrepancies.

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This research has made use of the Washington Double Star Catalog maintained at the U.S. Naval Observatory, as well supplemental information about double stars and observing them found on the Washington Double Star Catalog website.

References:

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