Astronomic Analysis of Double Star WDS 22445+2525 (POU5744)

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Abstract:

Observations were made of the double star WDS 22445+2525 (POU5744) with a right ascension of 22^h 44^m 27.37^s, and a declination of 25° 25' 13.4". Ten images were requested on July 14, 2021 at 10:00 a.m., and astronomical measurements were taken. The current position angle was found to be 111.46° and the separation was found to be 7.93 arcseconds. These measurements are consistent with the historical data and will add to the study of this double star.

Introduction

The objective of this research was to select a probable binary star system from the Washington Double Star Catalog (WDS) and the European Space Agency's GAIA astrometric star data, and to publish observational data on the current position angle and separation measurements to add to the historical measurements of this double star. WDS 22445+2525 POU5744 has a right ascension of 22^h 44^m 27.37^s, a declination of 25° 25' 13.4", a primary magnitude of 13.40, and a secondary magnitude of 13.40 (22445+2525 POU5744, 2021*)*. It is located in the northern constellation Pegasus, and it has been observed 9 times, with the original observation recorded in 1905 by Abel Pourteau in his *Catalogue des Étoiles Doubles de la Zone + 24o de la Carte Photographique du Ciel* (Star Catalog Duplicates of the + 24 ° Zone of the Photographic Card of the Sky) (Smith, 2012). Observations from past measurements show that the position angle has changed from 112.50° to 111.46°**,** and the separation has changed from 7.90 arcseconds to 7.93 arcseconds.

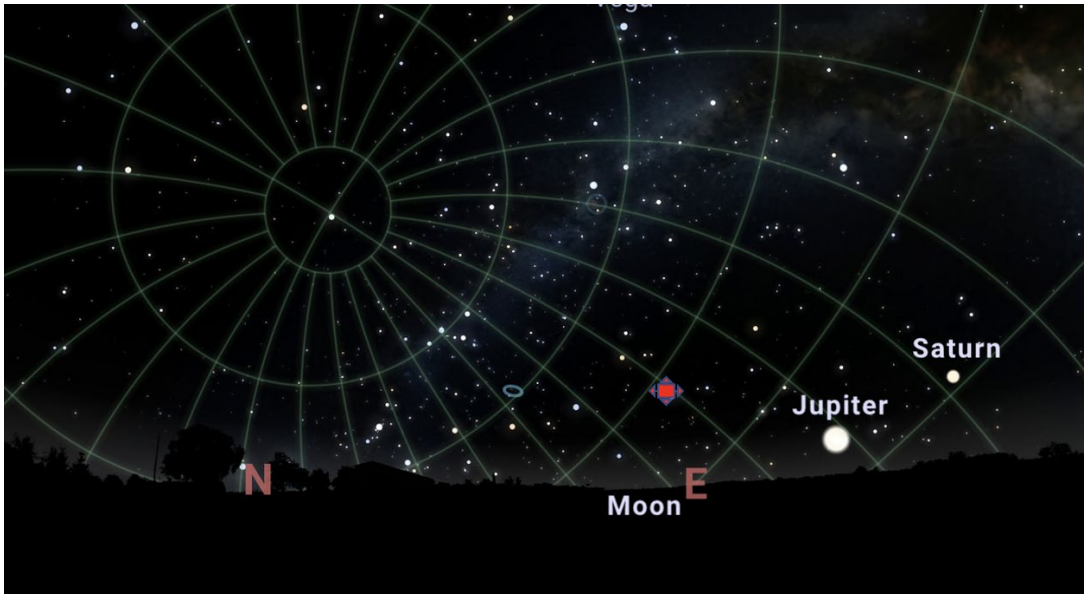

Figure 1: Location of binary star WDS 22445+2525 in the constellation of Pegasus, shown by the marker. Credit: Stellarium.com

Equipment and Methods:

Historical observation data was obtained from Dr. Brian Mason Ph.D. with the U.S. Naval Observatory on July 19, 2021 (U.S. Naval Observatory, 2021). New measurements were documented using the Las Cumbres Observatory (Las Cumbres Observatory, 2021), a 0.4-meter telescope on Mt. Haleakala in Hawaii, which sits at approximately ten thousand feet above sea level. Images were initially requested on July 7, 2021, at 7:00 p.m. with an exposure time of two seconds using a clear filter, but upon evaluation, the quality of the images was not sufficient for research purposes and so images were requested on July 14, 2021, at 10:00 a.m. with a twenty-second exposure time. This exposure time provided clear images that allowed the position angle and separation to be measured accurately using *AstroImageJ* software, as pictured in Figure 2 (Collins et al., 2017)

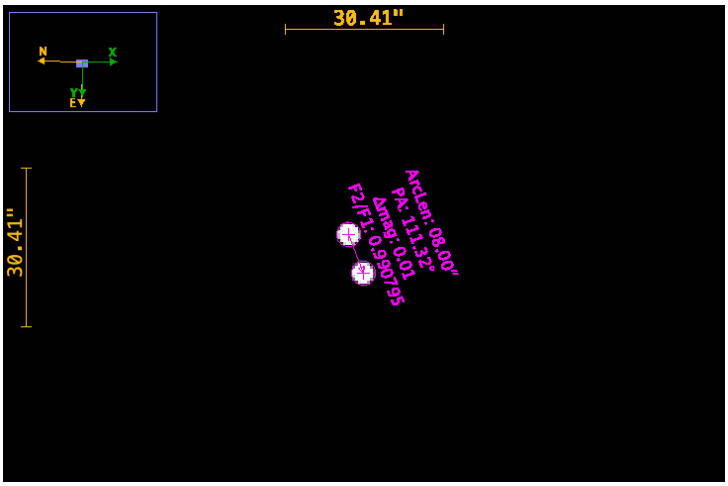

Figure 2: Image from LCO Observation Portal of binary pair WDS 22445+2525

Results

Table 1 shows the individual measurements of the ten images studied, along with the average position angle and separation. The average position angle was 111.50 degrees and the average separation was 7.93 arcseconds.

Image Number	Position Angle (°)	Separation (arcsec)	Delta Mag
1	111.30	7.77	0.01
2	111.32	8.00	0.01
3	111.84	7.94	0.01
4	111.28	7.92	0.01
5	111.32	7.87	0.02
6	111.39	7.95	0.00
7	111.74	7.97	0.01
8	111.40	7.95	0.03
9	111.91	7.92	0.02
10	111.44	7.96	0.01
Mean	111.50	7.93	0.01
Std. Dev.	0.23	0.06	0.01
S.E.M.	0.08	0.02	0.01

Table 1. Measurements of WDS 22445+2525 over multiple images taken on July 14, 2021.

Table 2 shows the change in the position angle and separation over time, based on historical and current data collected between 1905 and 2021. Figures 2 and 3 demonstrate how the secondary star has moved in the sky over time according to the collective data. Except for the initial measurements, this graph shows that the measurements recorded in this study are consistent with the historical data.

WDS 22445+2525					
Date	Primary Magnitude	Secondary Magnitude	Delta Mag	Position Angle (degrees)	Separation (arcseconds)
1905-07	13.20	13.00	0.20	112.50	7.90
1998-07	11.97	11.76	0.22	111.10	7.97
2001-06	13.36	13.34	0.02	111.10	7.91
2012-07	13.22	13.19	0.03	111.23	7.96
2013-08	13.30	13.24	0.06	111.22	7.96
2014-08	13.33	13.21	0.09	111.20	7.96
2015-05*	13.33	13.25	0.05	111.23	7.96

2021-07*	13.40	13.40	0.01	111.50	7.90
Notes: *Data displayed is the average of available data on the given date.					

Table 2. Measurements of WDS 22445+2525 between 1905 and 2021

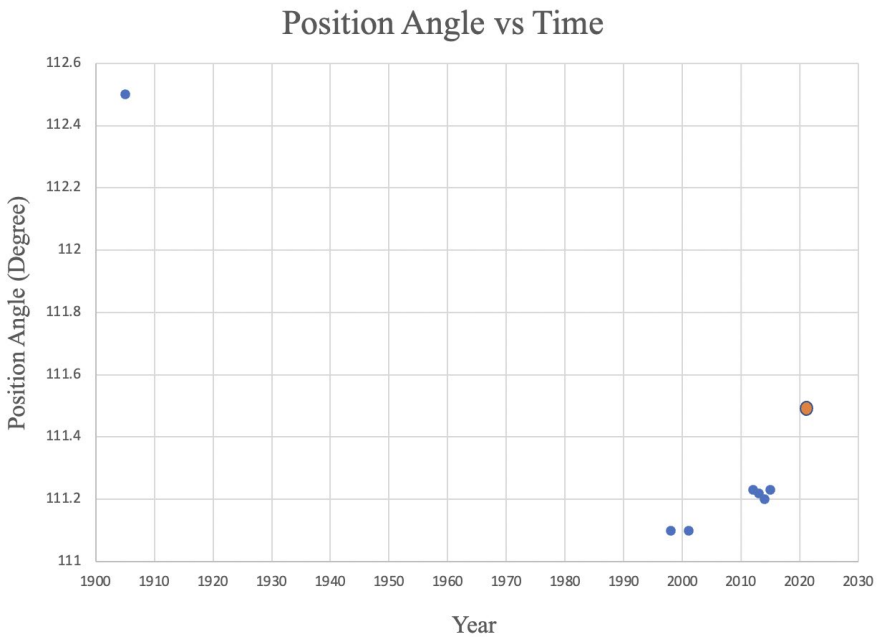

Figure 2: Historical data collected on binary system WDS 22445+2525,showing the change in position angle over time. The red point is the current 2021 observation.

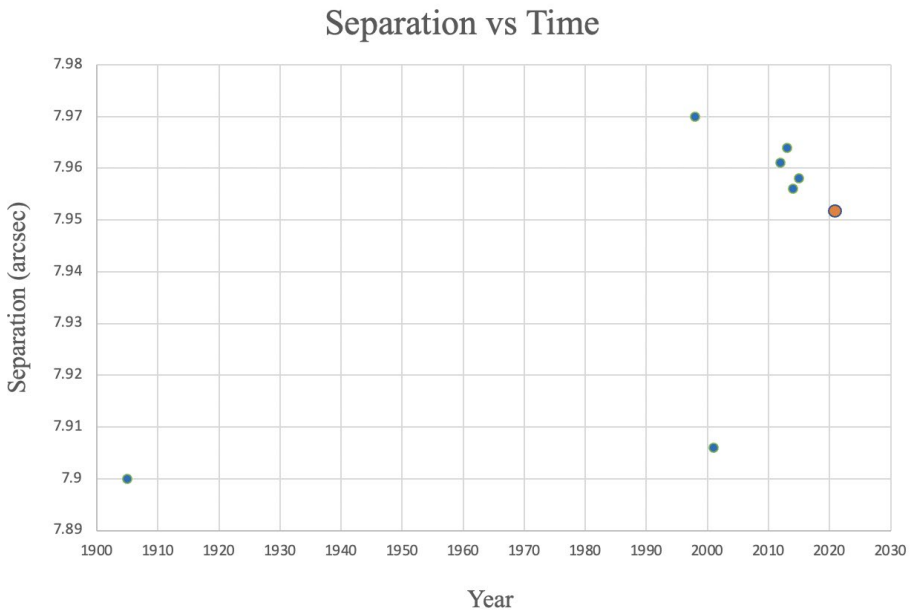

Figure 3: Historical data collected on binary system WDS 22445+2525, showing the change in separation over time. The red point is the current 2021 observation.

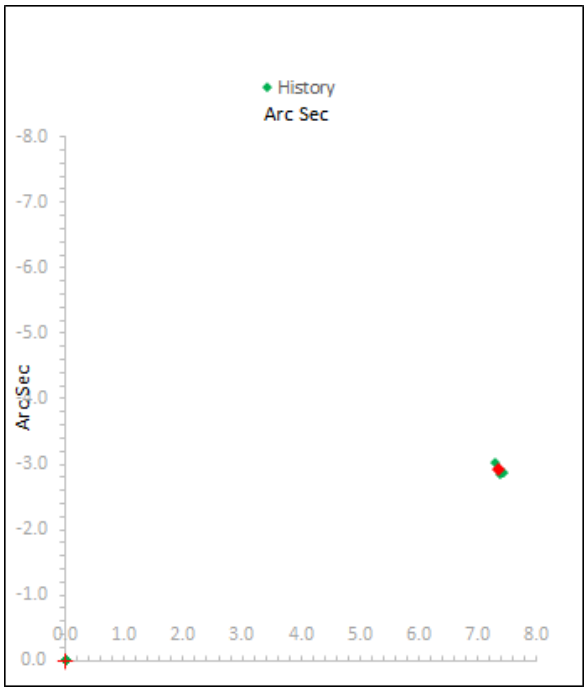

Figure 4: Angular separation of star B relative to star A at the origin (bottom left). Historical data is shown in green and the current 2021 data point is shown in red.

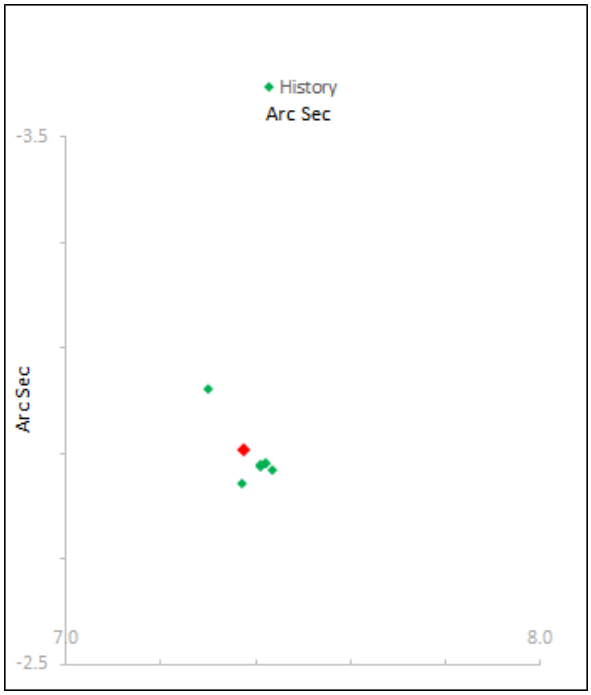

Figure 5: Close-up view of the angular separation of star B relative to star A at the origin (off-screen, bottom left). No clear orbital path can be seen in the historical data.

Tables 3 and 4 show the parallax measurements and proper motion data of this pair, taken from the Gaia survey (Gaia 2020). Because of the limits of instrumentation, parallax values under five milliarcseconds are not as reliable (Harshaw, 2020). However, since the values for both the primary and secondary are similar, it indicates that this is most likely a physical double.

Star	Total PM (mas / year)	PM RA (mas / year)	PM Dec (mas / year)	Parallax (mas)	Parallax Error (mas)
Primary	30.05	-15.50	-25.74	2.18	0.02
Secondary	30.09	-15.45	-25.81	2.22	0.02

Table 3. Gaia proper motion and parallax data for WDS 22445+2525 (Epoch 2016)

Conclusion

This study recorded a separation of 7.23 arcseconds, and a position angle of 111.50 degrees, for the double star system WDS 22445+2525. Over time, the position angle has gradually increased except for the initial measurement. Because of this discrepancy, this study has brought up questions concerning the accuracy of the initial measurements. However, this observation was recorded in 1905 by Abel Pourteau, who photographed the sky using an instrument with a 34-cm, f/10 photographic reflector and a guiding telescope of the same length with an opening of 25-cm (Barthalot, 2021). Pourteau completed the measurements by hand using a microscope (Smith, 2012) which may account for this outlier. Overall, the parallax and proper motion data from 1998-2021 showed values that are consistent with a physical binary. However, because of the low number of historical data points, and potentially very long periods, additional measurements are needed to confirm this.

Acknowledgments

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