New Observation of WDS 22057+7151 KPP2538

Vanessa Delorey, Jacob Galarza, Max Jensen, Mariana De Oliveira

Advanced Math and Science Academy, Marlborough, Massachusetts.

vdelorey2022@student.amsacs.org

Abstract

Astrometric measurements were made of the position angle and separation of the double star WDS 22057+7151 using images taken on 16 November 2021 with a 0.4 m telescope in the Las Cumbres Observatory Global Telescope network (LCOGT) located at the Teide observatory in the Canary Islands. The 2021 observations yielded a separation of 22.861 arcseconds and a position angle of 52.481 degrees. We recommend classifying this system as a common proper motion double.

1. Introduction

We chose these double stars through the Boyce Astro Research Assistant (https://boyce-astro.org/), then we evaluated them through Stelle Doppie (https://www.stelledoppie.it/index2.php). We selected this system because it had a moderate number of previous observations spanning over a century, but not so many as to firmly establish its nature: the year of the first observation was 1895 and the latest before our own—its fourteenth—was in 2015. The magnitude of the primary star is 11.1 while the magnitude of the secondary star is 12.50.

2. Equipment and Methods

First, we investigated possible candidates for our project. We looked for systems with fewer than 30 prior observations, ideally with a history that goes back many decades and without a record more recent than Gaia's 2015 observations. For practical purposes related to our equipment, we wanted systems with a separation of at least a few arcseconds and magnitudes between roughly 7 and 12. KPP2538 met all of these criteria.

We then requested photos from the Las Cumbres Observatory global telescope network (LCOGT) using one of the 0.4-meter telescopes at Teide Observatory in the Canary Islands equipped with a SBIG STL-6303 camera. Our exposure count was 10 with a 60 second exposure time and the PanSTARS-w filter on the camera.

The software AstroImageJ (Collins et al., 2017) was used to measure the position angle (θ) and separation (ρ). We measured the distance between the stars in each image, shown as a purple line on the image of our double stars in Figure 1. The averages of the separation and position angle were then calculated along with standard deviation and standard error of the mean.

Motion within the system throughout its observed history was visualized with Plot Tool (Harshaw, 2020).

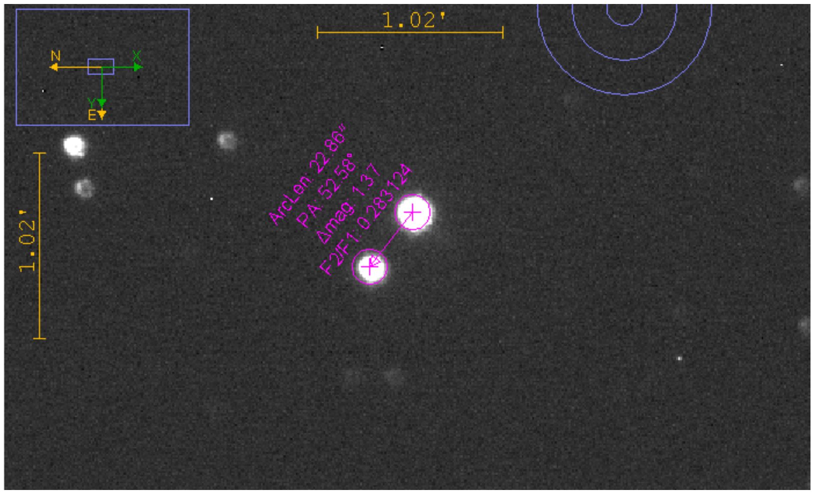

Figure 1: AstroImageJ double star photo

3. Data and Results

The average separation was 22.861" and the average position angle was 52.481°, as seen in Table 1. In Table 2, historical data about the system from the USNO are shown. In Table 3 are data about the system from the Gaia mission.

Table 1. The measurements of WDS 22057+7151.

WDS 22057+7151		
Image	Position Angle (°)	Separation (")
1	52.5	22.871
2	52.3	22.871
3	52.4	22.851
4	52.4	22.896
5	52.5	22.875
6	52.6	22.855
7	52.5	22.859
8	52.6	22.847
9	52.4	22.816
10	52.5	22.871
Mean	52.5	22.861
Standard Deviation	0.00132	0.306
Standard Error of the Mean	4.17412	0.0967

Table 2. USNO data for WDS 22057+7151. [1]

Year	θ (°)	ρ (")
1895.73	53.3	23.53
1953.524	52.486	22.84
1988.7	52.624	23.03
1993.45	52.660	22.85
2000.46	52.6	22.90
2003.737	52.289	22.67
2003.751	52.5	22.92
2010.5	52.490	22.94
2012.044	53.315	22.92
2012.662	52.45	22.91
2013.640	52.44	22.92
2014.701	52.43	22.92
2015	52.443	22.91
2015.5	52.442	22.91

[1] Data appear here exactly as they do in the WDS catalog, including varied precision levels.

Table 3. Gaia data for WDS 22057+7151.

Proper Motion RA A ("/yr)	13.152
Proper Motion DEC A ("/yr)	85.200
Proper Motion RA B ("/yr)	13.401
Proper Motion DEC B ("/yr)	85.615
Parallax A (mas)	4.987
Parallax B (mas)	4.946

The historical data about this system are also shown in Figures 2 and 3, which were generated using Richard Harshaw's Plot Tool. In both cases the markers represent positions of the secondary star with respect to the primary, and they are connected in chronological order by lines. Our measurement is shown with a different marker style. Figure 2's axes are set such that the origin and primary star lie in the corner of the plot. Because the markers are so close to each other on this scale, showing very little motion as compared to their separation, we've also provided Figure 3 showing a zoomed-in view of just the measured relative positions with the primary far outside the bounds of the plot.

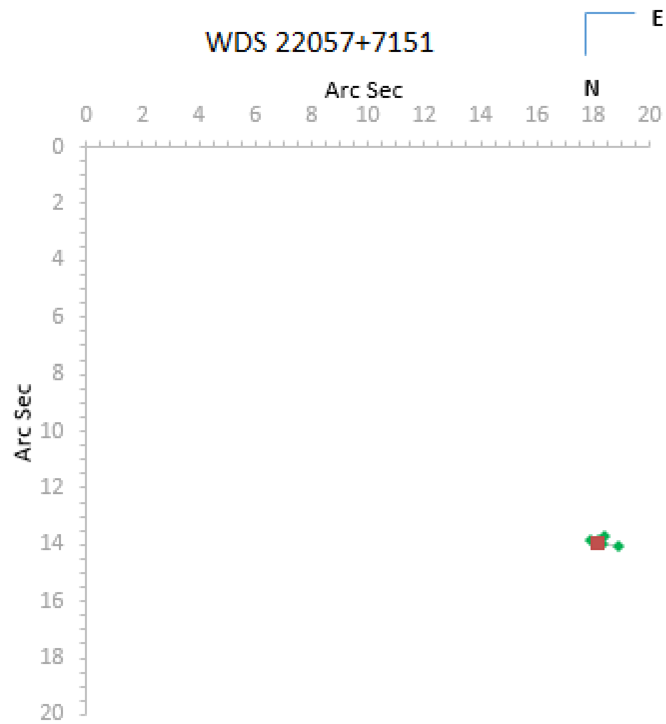

Figure 2: History of the system shown by Plot Tool

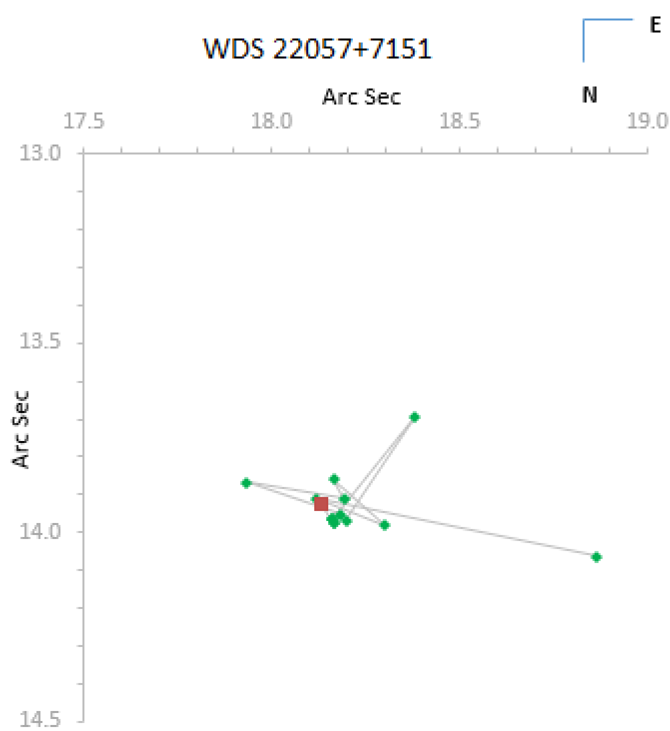

Figure 3: Zoomed-in Plot Tool

4. Discussion

Doubles can be inferred to be physical from a variety of different criteria, including not just solved orbits but also indications of true proximity and similar motions through the galaxy.

As seen in the Plot Tool visualizations, there was barely any relative motion in this system from 1895 to 2021. Noise or scatter in the reported positions seems to be overwhelming whatever true motion the system is displaying, especially since the earliest, easternmost measurement. If WDS 22057+7151 is a binary, it must have a very long period.

However, as seen in Table 3, the proper motions of the two stars as determined by the Gaia mission are very similar to each other: (13.152, 85.200) and (13.401, 85.615) measured in arcseconds/year. The parallax values, while right at the 5 mas threshold of reliability for Gaia, are also quite similar: 4.987 mas and 4.946 mas. These measurements mean that the stars are following almost the same trajectory through space.

Despite inconclusive nature of their relative motion, we therefore believe this system is a physical double, falling under the “common proper motion” double star umbrella.

5. Conclusions

Our measurement of relative position for WDS 22057+7151 falls within the same 0.1 arcsecond radius as the previous 70 years of observations, which as a whole do not display a clear directionality. Only the earliest measurement, from 1895, lies outside that range. Further observations decades in the future may eventually point toward an orbital solution, but for now the lack of relative motion and the corresponding similarity in their proper motions as measured by Gaia suggest that the system should be considered a “common proper motion” (CPM) physical double.

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