

## Observation of the Double Star System HD 21599

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### Abstract

This study focuses on observing and analyzing the HD215990 double star system to contribute a measurement of position angle (PA) and separation (SEP) that will help in obtaining a precise orbit in the future. We selected this double star system utilizing the Stelle Doppie program. We combine our measurements with the historical data from the Washington Double Star Catalog (WDS).

### 1. Introduction

The objective of this research is to be able to observe and analyze the HD215990 double star system to obtain a new value for PA and SEP. We used the Stelle Doppie program to select a double with a magnitude difference ( $\Delta m$ ) of 3, an apparent magnitude within the range of  $9 < m < 11$ , a SEP between 5 and 10 arcseconds, and a requirement of 12-25 recorded observations. We selected HD 215990. The name of the primary star is TYC 3222-1938-1 with a magnitude of 9.91 and the name of the secondary star is HD 215990 with a magnitude of 10.07.

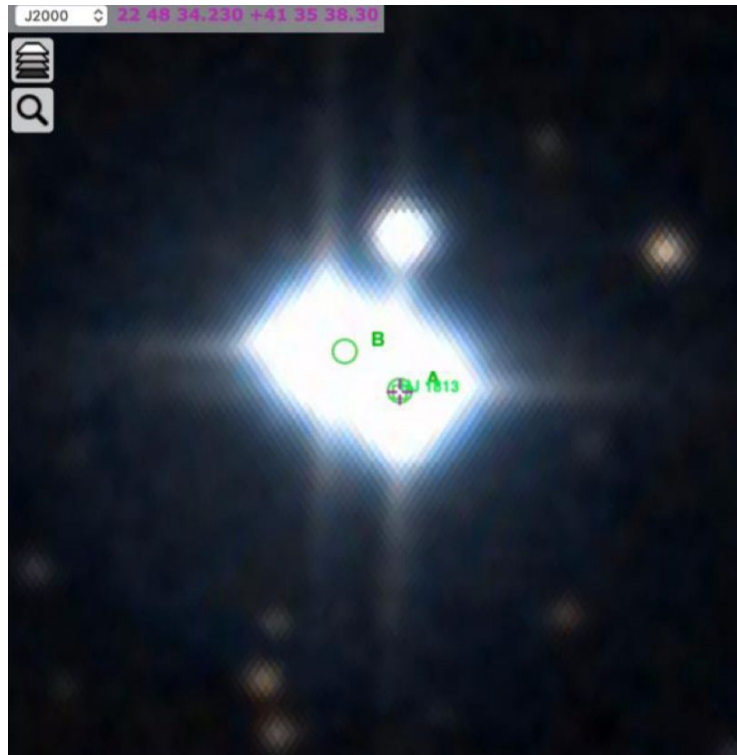
### 2. Equipment and Methods

Table 1 provides basic data of the double star system HD 215990. Column 1: name, from Stelle Doppie; columns 2,3: RA (2000.0), DEC (2000.0), Column 4: Apparent magnitude, from SIMBAD; column 5: spectral type, from Gaia DR3; column 6: parallax (mas), column 7: parallax error (mas), column 8: proper motion in RA (mas/yr), column 9: error of proper motion in RA (mas/yr), column 10: proper motion in DEC (mas/yr), column 11: error proper motion in DEC (mas/yr).

Table 1. Binary System HD 215990.

Name	RA (2000.0) (h,m,s)	DEC (2000.0) (°, ', '')	m	Spectral type (quality)	parallax (mas)	parallax error (mas)	pmRA (mas/yr)	error pmRA (mas/yr)	pmDEC (mas/yr)	error pmDEC (mas/yr)
HD 215990	22 48 34.97	+41 35 42.8	10.07	F5 E	3.4261	0.0137	-14.256	0.008	-5.798	0.014
TYC 3222- 1938-1	22 48 34.23	+41 35 38.3	9.91	A2 D	3.5423	0.0602	-15.277	0.034	-5.231	0.058

In Figure 1 we show an image of HD215990 taken from Stelle Doppie (Digitized Sky Survey).



*Figure 1: Photo of the binary system, taken from Stelle doppie. Star A is the primary star called TYC 3222-1938-1 and its pair, Star B, is called HD215990*

The observations made were conducted utilizing a robotic telescope from Las Cumbres Observatory (LCOGT) telescope network. The chosen camera was 0m4 SCICAM QHY600, with an exposure count set at 1s for the preliminary test. Each exposure had a duration of 2s and used a Bessell-V filter.

### 3. Data

Table 2 provides our measurements of position angle and separation for 9 images taken with a 0.4m robotic telescope from Las Cumbres Observatory (LCOGT). All nine observations were taken on October 19, 2023, with a Bessell-V filter. Both stars exhibited a circular appearance in the images. We measured the PA and SEP using AstroImageJ. We obtained an average PA=  $61^\circ$  and standard deviation=  $1^\circ$ . We found an average SEP =  $9.3''$  and standard deviation =  $0.4''$ .

Table 2. Observation of HD 215990 with 0.4m telescope.

<i>Exp Time (s)</i>	<i>PA (deg)</i>	<i>SEP (arcsec)</i>
0.999	61.52	9.32
0.999	60.54	9.41
1	61.33	8.49
1	61.52	9.32
0.999	62.48	8.81
1	60.39	9.12
0.999	62.93	10
1	59.87	9.39
1	62.78	9.58

#### 4. Discussion

A request was made to Dr. Brian Mason for the historical data pertaining to the double star system HD 215990. Table 3 lists column 1: date, column 2: PA (degrees), column 3: SEP (arcsec), column 4: telescope aperture (m), column 5: PA (radians), column 6: the number of nights and column 7: reference from WDS. This data was used to generate the plot in Figure 2

Table 3. Historical Data for HD 215990.

Date	PA (degrees)	SEP (arcsec)	telescope aperture (m)	PA (Radians)	RA (arc sec)	DEC (arc sec)	number of nights	reference
1828	64.7	5.5	0.5	1.129228026	4.9724540231	-2.350468249	2	HJ_1831
1895.91	65.4	9.101	0.3	1.141445331	8.274957828	-3.78857149	1	WFC1998
1895.99	62.1	9.532	0.3	1.083849465	8.424053986	-4.46030699	1	WFC1998
1904.98	61.6	9.36	0.4	1.075122819	8.233510642	-4.451842597	2	Es_1906a
1906.02	61.8	9.45	1	1.078613478	8.328317622	-4.465604728	1	Bu_1906
1916.72	60.9	9.13	0.5	1.062905514	7.977540396	-4.440242023	2	Doo1923
1917.74	62.3	9.75	0.3	1.087340124	8.632587851	-4.532209946	3	Ptt1921
1919.74	60.9	9.25	0.2	1.062905514	8.082393063	-4.498602269	2	Frk1919a
1929.67	61.8	9.154	0.2	1.078613478	8.0674518	-4.325729702	1	WFC1958a
1958.72	61.6	9.245	0.2	1.075122819	8.132351056	-4.397145813	1	WFC1975
1991.63	61.2	9.45	0.3	1.068141502	8.281098126	-4.55257222	1	TYC2002
1998.77	61.3	9.4	1.3	1.069886831	8.245173939	-4.514100876	1	TMA2003
2002.707	61.3	9.418	0.2	1.069886831	8.26096257	-4.522744899	4	UC_2013b
2005.574	61.3	9.38	0.2	1.069886831	8.227631016	-4.504496406	1	Arn2006f
2006.737	61.2	9.4	0.2	1.068141502	8.237282792	-4.528484537	3	Spn2007

2010.5	61.4	9.43	0.4	1.071632161	8.279379458	-4.51406422	1	WIS2012
2012.777	61.51	9.403	0.2	1.073552023	8.264300266	-4.485281499	5	UR_2015
2013.733	61.28	9.422	0.2	1.069537766	8.262891245	-4.527550362	12	UR_2015
2014.776	61.31	9.417	0.2	1.070061364	8.260874582	-4.52082295	9	UR_2015
2015	61.275	9.423	1	1.069450499	8.263373046	-4.528752024	1	Kpp2018m
2016.88	61.1	9.438	0.7	1.066396173	8.262634206	-4.561219133	1	WSI2017b

### Historical data plot

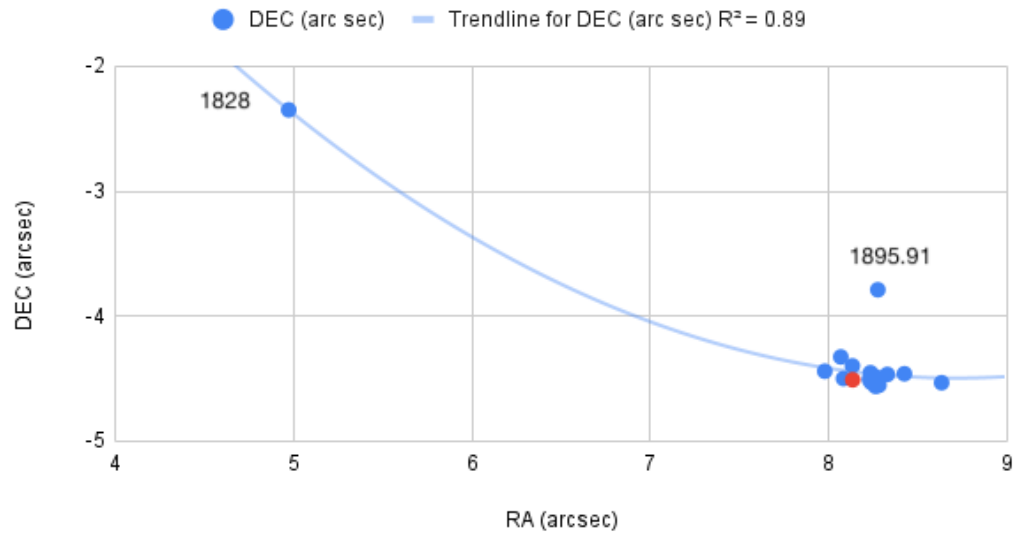


Figure 2: Shows a graph of the historical data of HD 215990. Blue dots are the historical data, and the red dot is our measurement. The blue line is a second order polynomial fit of the data

The reported spectral types for the primary star TYC 3222-1938-1: A2 D and the secondary star HD215990: F5 E, provided by SIMBAD. The proper motion data of HD215990 is consistent with a physical pair. The primary star is 920.55 ly away and the secondary star is 955.34 ly away.

## 5. Conclusions

Our observations allowed us to provide two new measurements of PA and SEP for HD 215990. The available data of the system (proper motion and parallax) supports that this is a physical pair. This system would benefit from more observations to obtain a more precise orbit.

## Acknowledgements

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