New double star in Centaurus

Rolf Hitschfeld[1], Carmen Gloria Soto[2], Mila Bunce[3], Maximillian Reinke[4]

1. Kopernikus Foundation, Chile
2. Primary teacher of Kopernikus School, Chile
3. Student of Kopernikus School, Chile
4. Student of Kopernikus School, Chile

Abstract:

A new possible double star has been found in Centaurus. Measurements of the position angle and separation of the new component of the star system WDS 14039-6219 were made on images taken by telescopes from the Las Cumbres Observatory (LCO) equipped with CCD cameras**.** Its visual magnitude is 12.91, the separation is 8.48 arcseconds and the position angle is 198.24 degrees. A short discussion about the parallaxes and proper motion based on Gaia EDR 3 data shows more about the real nature of both components. Archive data from 2012 is also used to provide another data point for the system.

Observation

Damico et. al (2019) identified a possible D component in WDS 14039-6219. This star is not listed in the WDS catalog. Observations with LCO telescopes and archive information were used in order to determine the nature of this new component star. Ten images were taken on April 17th and 21st, 2021 with the SBIG STL-6303 camera at the Siding Spring, Australia, LCO telescope site.

The new double star is listed in Gaia EDR3 with the identifier 5866056475969247872 and is located beside the primary star listed in Gaia EDR3 as 5866056475969251456 (Figure 1). Coordinates for the primary are 14h 03’ 51.39’’ in right ascension and -62° 18’ 43.5’’ in declination. There is a considerable difference in the visual brightness between both stars. The primary star is listed in Gaia with 8.74 mag and the companion star has a magnitude of 12.91. The separation of the new double star is 8.48 arc seconds, position angle is 198.24°. The data of this observation is presented in Table 1.

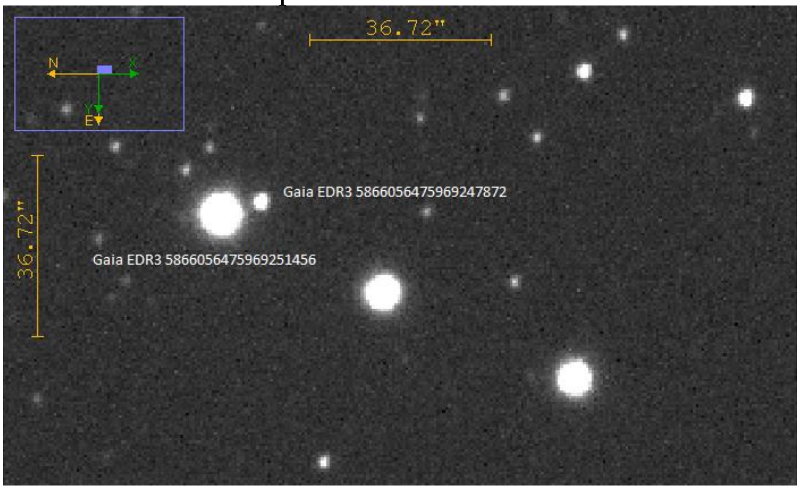

Figure 1: The image shows the possible new component star in Centaurus and their Gaia identifiers.

Table 1: Separation and position angle measurements in 2021 for the D component of WDS 14039-6219.

Obs #	Separation (arcsec)	Position angle (deg)	Exposure time (sec)	Date-obs (BJD)
1	8.44	198.33	1.23	2459322.17
2	8.51	197.94	1.23	2459322.17
3	8.45	198.18	1.23	2459322.17
4	8.54	198.74	1.23	2459322.17
5	8.45	198.48	1.24	2459322.18
6	8.52	198.39	1.23	2459322.18
7	8.44	197.83	1.23	2459322.18
8	8.50	198.39	1.23	2459322.18
9	8.48	198.15	1.23	2459322.18
10	8.43	199.65	1.29	2459327.56
Mean	8.48	198.24		
Stand. dev.	0.04	0.28		
SEM	0.01	0.09		

Parallax and Proper Motion

Information of both stars is available in Gaia Early Data Release 3. Parallax and proper motion data is presented in table 2. An estimation of the distance between both stars can be calculated from the absolute value of the difference of the distance to earth of the stars, which can be obtained from parallax values and the formula distance_to_earth [parsecs] = 1000/parallax [miliarcseconds] (Schlimmer, 2021). The calculated distance between the stars is 203.01 parsec. Even considering the error in Gaia's measurements, the stars would not be closer than 78.44 parsec.

Table 2: Gaia Data for both components

	Primary Gaia EDR3 5866056475969251456	**Secondary Gaia EDR3 5866056475969247872**
Parallax(mas)	0.553367732	0.497481012
Parallax error(mas)	0.017671077	0.016614687
pmra(mas/yr)	-5.2260	-5.2938
pmra error	0.0115	0.0124
pmdec(mas/yr)	-2.424548213	-2.499671527

pmdec error	0.014277109	0.013582503
Magnitude	8.74	12.91

From another point of view, and assuming that the stars are at the mean parallax value, so close enough to be physical, it is possible to estimate the minimum separation for the stars using the formula minimum_separation [AU] = mean_distance_to_stars [parsecs] * separation [arcseconds]. Considering a mean distance to stars of 1908.62 parsecs and a separation of 8.48 arcseconds, the minimum separation between the stars is 16185.11 AU or 0.2559 light-years.

Archive data

In order to obtain another data point, older images of the stars were searched on the ESO science archive facility portal. One image taken in 2012 with the SDSS_r filter was found. Separation and Position Angle values are shown in Table 3. Current images of the stars were obtained using the same filter as the image from the ESO archive to have a better comparison of how much they have moved during the last 9 years The measurements from 2021 are presented in Table 4. The separation changed from 8.55 arcsec in 2012 to 8.43 arcsec in 2021 whereas the position angle shifted from 197.85° to 198.08°.

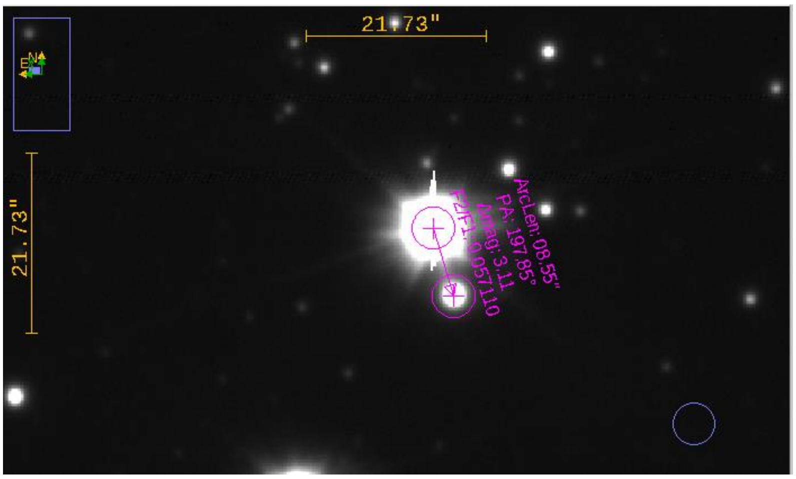

Figure 2: Image of the double star from VLT in 2012

Table 3: Separation and position angle measurements in 2012 for the D component of WDS 14039-6219 using a SDSS_r filter.

#Obs	Separation (arcsec)	Position angle (deg)	Exposure time (Sec)	Date-Obs (BJD)
1	8.55	197.85	25	2456106.5

Table 4: Separation and position angle measurements in 2021 for the D component of WDS 14039-6219 using a SDSS_r filter

Obs #	Separation (arcsec)	Position angle (deg)	Exposure time (sec)	Date-obs (BJD)
1	8.49	198.04	20.28	2459352.27
2	8.47	197.66	20.28	2459352.27

3	8.47	197.75	20.28	2459352.27
4	8.13	198.34	20.28	2459352.27
5	8.46	198.30	20.28	2459348.51
6	8.45	198.16	20.28	2459348.51
7	8.45	198.10	20.29	2459348.51
8	8.42	198.22	20.29	2459348.51
9	8.49	198.15	20.28	2459348.51
10	8.46	198.11	20.28	2459348.51
Mean	**8.43**	**198.08**		
Stand. dev.	**0.11**	**0.22**		

Discussion and Interpretation

The stars have similar parallax and proper motion values which may imply a physical pair, however the calculated distance between the stars is 203.01 parsec, which is too distant for a typical binary star. Even considering the measurements errors, the closest the stars can be is 78.44 parsecs, which is 40 or 50 times more distant than most known binary stars.

However, the derivation of physical quantities from Gaia astrometric measurements, should be treated carefully. As Luri et al. (2018) showed for Gaia DR2 data, the calculation of distances to stars using parallax values, has significant drawbacks and may be a biased estimator of real distances. Until the same analysis for Gaia DR3 is available and indicates something different, the calculation of the distance using parallax values should still be treated with precaution as conclusive evidence for the nature of this star system.

The calculation of minimum distance between stars, shows it might be possible to be physically bounded, although it does not tell anything regarding the real nature of the system.

Conclusion

The latest observation of the D component of WDS 14039-6219 yielded a position angle of 8.48 arcseconds and a separation of 198.24 degrees.

Archive data indicates a small change in separation and position angle during the last 9 years. Although it is useful to have archive data from 2012, it is impossible to conclude anything about the nature of the star with just two measurements.

Taking into account the available information from Gaia, it seems that this new double star is an optical double star. However, this evidence should not be treated as conclusive due to the limits of the derivation of physical quantities from Gaia astrometric measurements. More data is needed in the future to confirm the nature of the star system

Acknowledgement

This research was made with telescope images from Las Cumbres Observatory (https://observe.lco.global/).

To analyze and deepen this research, we received the collaboration of Boris Panes PhD PUC, researcher and particle physicist.

We want to thank the ESO science archive facility portal for the free service of their database to astronomy amateurs interested in the observation of double stars.

References

D'Amico, F., Sullivan, C., Boyce, G., Boyce, P.. (2019). Astrometric Measurements of WDS 14039-6219 (R 230). *JDSO* Vol 15 No 1.

Luri, X., Brown, A. G. A., Sarro, L. M., Arenou, F., Bailer-Jones, C. A. L., Castro- Ginard, A., de Bruijne, J., Prusti, T., Babusiaux, C., Delgado, H. E., (2018). Gaia Data Release 2: Using Gaia parallaxes, *Astronomy & Astrophysics*, 616, A9, 19.

Schlimmer, J. S. (2021). Discovery of a new double star in constellation Draco *JDSO Vol 17 No 1*.