Discovery of a new double star in constellation Draco

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Abstract: In the constellation Draco a new optical double star has been found. Its visual magnitude is about 11.3, distance is about 5 arc seconds and position angle is 315 degree. A short discussion about the parallaxes and proper motion based on Gaia EDR 3 data shows more about the real nature of both components.

Observation

During my observation program of Espin's double stars I found a new double star only 8 arc minutes north of ES 788. This star isn't listed in WDS catalog or marked as a double star in the planetary software Redshift 7 which is used by the author for telescope control (Redshift, 2012).

The new double star is located between TYC 3552 -878-1 and TYC 3552-1204-1 (figure 1). Coordinates for the primary are 18h 51' 31.26'' in R.A. and +51° 24' 19.21'' in declination. The visual brightness is about the same as TYC 3552-878-1, which is listed with 11.28 mag in the SIMBAD database. Distance of the companion is 4.98 arc seconds, position angle is 314.6 degree. Difference in brightness is about 1.2 mag. Five observations were done in September 2020 with a 12-inch Newtonian telescope. Focal length was 1500 mm, reproduction scale was about 0.5 pxl /arc second by using QHY5L II Color camera and 0.7 pxl/ arc second by using Canon EOS1100D camera. With QHY5L II short videos with 100 frames were recorded, data analyses were done with REDUC software (Losse, 2016).

Figure 2: New double star, 100 frames stacked, QHY5L II Color camera.

Figure 1: extract from wide area picture, the new double star is marked with an arrow, Canon EOS1100D, exposure time 10s.

Parallax and Proper Motion

Information about its parallax and proper motion can be found in Gaia Data Release 3. Parallax of the primary (source ID 2144524522910377088) is 1.490 ± 0.021 mas parallax of the secondary (source ID 2144524522910376960) is 1.582 ± 0.1067 mas. Due to the mean error of the parallax for the secondary of about 6.7%, the value isn't reliable. The mean error of the parallax for the primary is less than then median error (0.05 mas) for all parallax measurements from Gaia for stars up to 12 magnitudes.

With 3.26/P (P-parallax in arc second) the distance in light years for each of the components can be calculated. The distance between them is given by d = SQR (d´2 + (P2-P2´)2), with d´=P1 sin α (see figure 3a). In cases of double star observations the separation is

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Dm/mag	PA/deg	SEP/as	DATE	CAMERA	Frames
1.3	314.2 ± 0.12	5.04 ± 0.01	2020.697	QHY5L II Color	49
n.a.	314.5 n.a.	4.84 n.a.	2020.714	Canon EOS1100D	n.a.
1.0	313.9 ± 0.24	4.88 ± 0.03	2020.719	QHY5L II Color	29
1.3	315.5 ± 0.13	5.05 ± 0.01	2020.722	QHY5L II Color	37
1.2	315.1 ± 0.09	5.09 ± 0.01	2020.725	QHY5L II Color	37

Table 1: The Measurements

measured. Separation is the angle α at which both components appear. This value is independent of the physical distance of the pair and usually in the range of less arc seconds (α << 0°). It follows that d´ << P1. For P1 ≠ P2 the physical distance between both components can be calculated approximately by the difference of their parallaxes d ≈ |P2- P1| (see figure 3b).

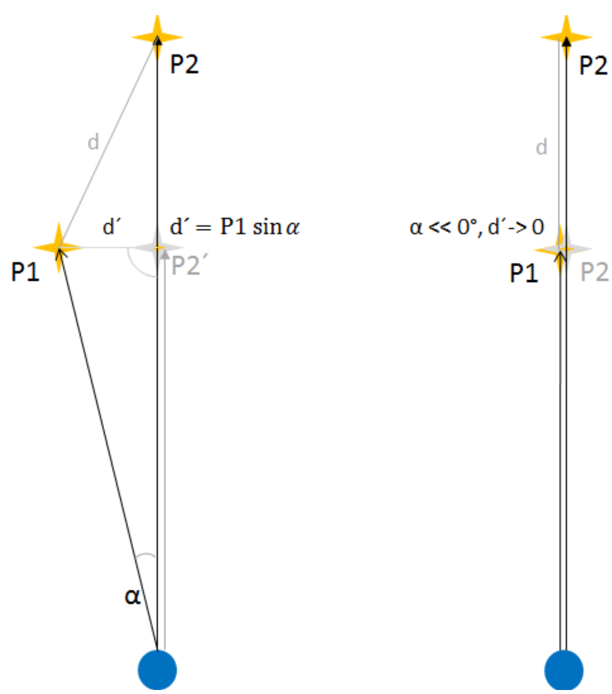

Figure 3: Parallaxes P, separation α, physical distance d between the double star components a) in general b) for α << 0°, d´ << P1 and P1 ≠ P2

With the given values for both components the distance between them can be estimated. Because of the mean errors 3 different cases should be considered. In the first case the distance can be calculated without the mean errors, in the second case the mean errors are calculated in the way that the components get closer, in last case the errors are calculated in the manner that the distance between both components get larger. As shown in table 2 the calculated distances are very different. Finally there is no statement about its true distance possible, but case 2 is unlikely.

Compared with known binaries the distance of the new double star is much too big for a physical related system, even if the mean error in parallax measurements is considered. Table 3 shows the parallaxes and distances for each component D1 and D2 and the distance d between them for some well-known binaries. The data are from Gaia EDR 3 release if available otherwise from DR 2 release.

It is noticeable at first glance that all these well-known binaries are much closer to the sun as the new double star, which is also reflected by its brightness. Also the distance between their components is much smaller.

Proper motion of the primary is -7.827 ± 0.0252 mas/yr in R.A. and -9.379 ±0.0476 mas/yr in declination, for the second component proper motion is –9.453 ± 0.283 mas/yr in R.A. and -9.587 ± 0.324 mas/yr in declination. Proper motions in declination are more or less similar, but values in R.A are slightly different. But not enough to make a difference. The proper motion between the components may differ e.g. STF1547 and STF1643 (see table 4), so it is useful to look at their parallaxes too (see table 5). This is why PM analysis alone is not very useful.

Except AG 1 and LDS 908 the distance between the components of the common proper motion pairs from table 4 are closer than 1 light year. The examples from table 4 and 5 are taken from a historical catalogue of proper motion stars (Wolf, 1919) in order of their R.A. coordinates. Only the common proper motion pairs of this catalogue were picked up and also observed by the author (Schlimmer, 2014-2016).

Finally the radial velocities of the new double star would also be of interest but it isn't known for the second component, so there is no further analysis of the relationship between them possible.

Name	P1/mas	P2/mas	D1/ly	D2/ly	d/ly	case
New ds	1.49	1.58	2187.92	2060.68	127.24	w/o
New ds	1.51	1.48	2157.51	2209.72	52.21	best
New ds	1.47	1.69	2219.20	1930.48	288.72	worst

Table 2: Estimation of the distance between both components in dependence of their mean error

Name	P1/mas	P2/mas	D1/ly	D2/ly	d/ly	Gaia
4 Eps Lyr	20.69	20.46	157.56	159.36	1.80	EDR3
5 Eps Lyr	20.34	20.45	160.28	159.38	0.90	EDR3
STF2025	51.81	51.79	62.92	62.95	0.02	EDR3
gam Del	28.14	27.89	115.87	116.89	1.03	EDR3
44 Boo	77.25	78.09	42.20	41.75	0.46	DR2
gam Vir	86.06	78.52	37.88	41.52	3.64	DR2
Zet Aqr	34.51	34.45	94.48	94.63	0.15	DR2
Mayer 80	33.92	33.91	96.10	96.13	0.03	EDR3
MLB 115	73.62	73.58	44.28	44.31	0.03	EDR3
Zet Cnc AB	40.89	41.15	79.73	79.22	0.50	EDR3
Zet Cnc AC	40.96	42.13	79.59	77.39	2.20	DR2
STF1300	54.15	54.17	60.21	60.18	0.02	DR2
STF2107	15.74	15.80	207.16	206.31	0.85	EDR3

Table 3: Parallaxes and distances for some well-known binaries

WDS Name	PM1 RA Mas/yr	PM2 RA Mas/yr	dPM Ra Mas/yr	PM1 Dek Mas/yr	PM2 Dek Mas/yr	dPM Dek Mas/yr
ES 1867	147.26	148.799	1.54	-60.536	-57.88	2.66
AG 1	110.51	110.16	0.35	-62.55	-61.12	1.43
BU 1360	401.71	396.20	5.51	10.98	15.80	4.82
ES 2598	96.63	98.57	1.94	-91.39	-90.19	1.20
LDS9155AC	298.47	298.91	0.45	-119.69	-119.53	0.16
ES 560	68.68	68.90	0.22	-175.46	-172.58	2.88
LDS 907	-194.71	-196.97	2.26	-177.026	-177.56	0.53
LDS 908	-313.89	-315.44	1.55	-120.04	-121.98	1.94
STF1540	-725.95	-728.28	2.33	180.85	188.53	7.68
STF1547	-329.87	-315.62	14.25	-189.93	-181.12	8.81
WSTF1643	94.19	83.82	10.37	-247.84	-242.09	5.75

Table 4: Proper Motions for some common proper motion pairs

WDS Name	P1/mas	P2/mas	D1/ly	D2/ly	d/ly	Gaia
ES 1867	12.25	12.24	266.12	266.36	0.24	EDR3
AG 1	10.60	10.64	307.55	306.39	1.16	DR2
BU 1360	22.56	22.55	144.49	144.54	0.05	EDR3
ES2598	21.27	21.28	153.25	153.17	0.08	EDR3
LDS9155AC	18.23	18.22	178.81	178.92	0.12	EDR3
ES 560	27.48	27.48	118.62	118.63	0.01	EDR3
LDS 907	12.79	12.77	254.83	255.27	0.44	EDR3
LDS 908	16.35	16.97	199.39	192.13	7.26	EDR3
STF1540	54.92	54.91	59.36	59.37	0.01	EDR3
STF1547	42.65	42.34	76.43	77.00	0.57	EDR3
STF1643	36.50	36.51	89.31	89.29	0.02	EDR3

Table 5: Parallaxes and distances for common proper motion pairs from table 4

NAME	RA+DEC	dm	PA	SEP	DATE
n.a.	18 51 31.2 +51 24 20.9	1.2	314.6	4.98	2020.715

Table 6: Summary Information

Discussion and Interpretation

The main difficulty is the interpretation of the values found. On the one hand, significantly more data are required; on the other hand, a suitable scale is required to be able to interpret the results.

A very comprehensive analysis about parallaxes and proper motion of common proper motion pairs can be found in "A catalog of High Proper Motion Stars in the Northern Sky (HPMSNS)" (Knapp & Nanson, 2019) which contains parallaxes and proper motions for the components of 2038 pairs with separation < 60" and proper motions > 150 mas/yr. In 1027 cases the distance is smaller than 1.6 light years. This is similar to the distance between the sun and inner border of the oort cloud, which is the border of our solar system. The outer border of the oort cloud has a distance of about 3.2 light years and forms the transition to the interstellar medium. In 638 cases of the HPMSNS stars the distance of the components are greater of 4.24 light years, which is similar to the distance between the sun and proxima Centauri, which is part of the alpha Centauri system (in 4.365 light years). The mass of alpha Centauri is 1.1 Mo and we can assume there is no physical relationship between them. For more massive stars the limit in distance for physical relationship would be greater of course.

Conclusion

Taking these comparisons into account, even if the masses of both components aren't known it must be assumed that the new double star in constellation Draco is only an optical double star. With astrometric data of Gaia EDR 3 catalogue it can be shown that the distance between 52 and 289 light years doesn't fits neither a binary system nor a common proper motion pair, even if the proper motion is more or less similar. Our solar system and stars in neighborhood are suitable scales for interpretation the data for sun like stars and allow us to get an idea of the gravitational effect of more massive stars in cases of real binaries or common proper motion pairs.

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