The Webb Deep-Sky Society

Double Star Section Circular No 32

Contents

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Editorial

The number of measures included in these Circulars is now 87698.

Observer	WDS code	Pairs	Measures	Method/source
A. Alzner	ALZ	74	180	Meca-Precis double-image micrometer
J.- F. Courtot	CTT	40	151	RETEL, homemade filar, Lyot micrometer
A. Debackère	DBR	10	10	Internet astrometry
W. Knapp	KPP	247	247	Internet astrometry
TOTALS		371	588	

Bob Argyle, 2024 December

Useful sites

The following websites also contain a considerable amount of interesting material for the serious double star observer and no claim is made for the completeness of the list. If anyone knows of any others please contact me:

The Washington Double Star catalogue - the complete reference for visual double stars - updated nightly. The site also contains the Sixth Catalogue of Visual Binary Star Orbits and much more at `http://www.crf.usno.navy.mil` with a mirror site at `http://www.astro.gsu.edu/wds`

Journal for Double Star Observations (`www.jdso.org`)

Etoiles Doubles (in French)
A newly established on-line journal and freely available from `www.etoilesdoubles.org`

El Observador de Estrellas Dobles (in Spanish)
(`www.elobservadordeestrellasdobles.wordpress.com`)
(Unfortunately this publication has closed down. The website currently contains all 27 of the published bulletins.)

Observatori Astronòmic del Garraf (`www.oagarraf.net`)

Il Bollettino delle Stelle Doppie (in Italian)
(`https://sites.google.com/site/ilbollettinodellestelledoppie/`)

In addition the Stelle Doppie Double Star Database run by Gianluca Sordiglioni allows the WDS catalogue to be quizzed with various search parameters. You can get a user name and password at `http://stelledoppie.it`

Acknowledgements

Much of the work presented here has made use of the Washington Double Star Catalogue maintained at the U.S. Naval Observatory (see above).

MICROMETRIC MEASURES OF DOUBLE STARS IN 2023

Jean-François Courtot, Chaumont, France

Introduction

The measurements presented here have been made during 2023 using two different telescopes: - a homemade 205-mm (8-inch) Newtonian and either a RETEL filar micrometer at a power of x508 or a Lyot double-image micrometer at x464, a 279-mm (11-inch) Schmidt-Cassegrain telescope at x430 up to x640 with different homemade filar micrometers[1] and a homemade double-image micrometer at x614.

The measurement procedures have been outlined in previous circular DSSC 23[2]. Further indications on some observed peculiarities with double-image micrometers can also be found in DSSC 24-25[3,4].

Measurements have been arranged as usual in Table 1. Epochs are in Julian years. In last column, "T205" denotes the 205-mm Newtonian telescope, "C11" the 11-inch Schmidt-Cassegrain, "L" is for the Lyot double-image micrometers whilst "F" indicates that a filar micrometer has been used. Table 2 gives a short comment on each measured pair. Table 3 gives O-C residuals with recently computed orbits. As a complement, it has been found also of some interest to compare GAIA parallaxes (π_G) of measured pairs with dynamic parallaxes (π_d) determined from Kepler's Third law for binary stars as follows[9]:

$$\pi_d = a/(P^2(M_A + M_B))^{1/3}$$

With π_d in arc-seconds, a, the semi-major axis of the true orbit also in arc-seconds, P, the period in Julian years. M_A and M_B , the masses of components expressed in solar masses. Masses have been determined here using the mass-luminosity relation with GAIA luminosity data. When no GAIA luminosity data were available, luminosities have been determined using apparent magnitudes and GAIA parallaxes. Some additional approximation for masses may result in this case but observed stars having here large parallaxes, i.e. being close to the Sun, interstellar absorption may be neglected. Moreover the mentioned approximation is of relatively little importance since, in the above equation, only the cube root of masses counts for dynamic parallax determination.

Ideally, GAIA and computed dynamic parallaxes of primary stars should coincide. This is the case (±0.1 mas) in Table 3 for two pairs: STF 412 AB (orbit by Scardia, 2002, grade 3) and STF 2130 AB (orbit by Heintz, 1981, grade 4). Some other orbits do excellently as well with a relative difference between π_G and π_d of a few percent only: STF 1670 (Scardia, 2007: 3%), STF 1768 (Soderhjelm, 1999: 2%), STF2509 (Zirm, 2014: 2%), STF 1834 (Seymour, 2000: 1%), BU 648 (Izmailov, 2019: 1%), SHJ345AB (Tokovinin, 2020: 1%). In other cases, the relative differences are higher, up in a few occurences over 150% for a few preliminary orbits. This test is particularly sensitive to the value of the semi-major axis and, with less importance, to the period ($P^{2/3}$) of the orbit and could be used to improve at least some preliminary orbits.

As usual also, besides known orbital pairs, a few other pairs with uncertain status have been measured. When available, GAIA-DR2/3 proper motions, parallaxes, luminosity and radial velocities data have been used to investigate their true nature using Dommanget's criteria[5,6]. The following procedure is described in DSSC28[7].

Table 1: Measures

Pair	R.A.	Dec.	Va	Vb	PA(°)	Sep(″)	Epoch	N	Obs.	Method
STF314AB,C	02529	+5300	7.0	7.3	316.6	1.57	2023.098	4	CTT	T205/L
STF412AB	03344	+2428	6.6	6.9	351.1	0.78	2023.115	4	CTT	T205/L
BU535	03443	+3217	3.9	6.7	20.0	1.08	2023.132	4	CTT	T205/L
STF728	05308	+0557	4.4	5.8	43.0	1.37	2023.189	4	CTT	T205/L
STF1104AB	07294	−1500	6.4	7.0	45.0	1.70	2023.250	4	CTT	T205/L
STF1338AB	09210	+3811	6.7	7.1	319.5	1.22	2023.266	4	CTT	T205/L
STT215	10163	+1744	7.3	7.5	176.3	1.54	2023.335	4	CTT	T205/L
STF1670AB	12417	−0127	3.5	3.5	354.2	3.32	2023.392	4	CTT	T205/L
STF1692AB	12560	+3819	2.9	5.5	228.7	19.24	2023.426	4	CTT	T205/F+C11/F
BU799AB	13048	+7302	6.6	8.5	266.3	1.32	2023.408	4	CTT	C11/F
BU799AC	13048	+7302	6.6	11.1	16.9	91.47	2023.406	4	CTT	C11/F
STT261	13120	+3205	7.4	7.6	340.3	2.69	2023.418	5	CTT	C11/F
STF1768AB	13375	+3618	5.0	7.0	94.4	1.71	2023.435	4	CTT	T205/L+F
STF1825	14165	+2007	6.5	8.4	152.5	4.33	2023.452	4	CTT	C11/F
STF1834	14203	+4830	8.1	8.3	101.3	1.73	2023.455	4	CTT	C11/F
STF1878	14421	+6116	6,3	9,2	313,3	3,96	2023.473	4	CTT	C11/F
STF1909	15038	+4739	5.2	6.1	207.1	0.55	2023.482	4	CTT	C11/L
STF1937AB	15232	+3017	5.6	6.0	347.6	0.61	2023.508	4	CTT	C11/L
HU149	15246	+5413	7.5	7.6	268.3	0.76	2023.517	4	CTT	C11/L
STF2118AB	16564	+6502	7.1	7.3	65.5	1.01	2023.541	4	CTT	C11/L
STF2130AB	17053	+5428	5.7	5.7	356.1	2.62	2023.567	4	CTT	C11/F
STF2138AB	17102	+5430	9.0	9.4	133.5	22.33	2023.567	4	CTT	C11/F
STF2140AB	17146	+1423	3.5	5.4	102.4	4.79	2023.614	4	CTT	C11/F+T205/F
STF2140AD	17146	+1423	3.5	11.1	38.6	78.12	2023.617	4	CTT	C11/F+T205/F
STF2308AB	18002	+8000	5.7	6.0	231.6	18.64	2023.627	4	CTT	C11/F+T205/F
STT358AB	18359	+1659	6.9	7.1	144.2	1.66	2023.635	4	CTT	C11/F+T205/F
HU937	18462	+6412	8.9	9.9	332.2	1.11	2023.653	5	CTT	C11/F
BU648AB	18570	+3254	5.3	8.0	222.8	1.22	2023.662	4	CTT	C11/F
STF2454AB	19062	+3026	8.3	9.7	287.9	1.39	2023.681	4	CTT	C11/F
STF2509	19169	+6312	7.4	8.2	328.8	1.89	2023.679	4	CTT	C11/F
STF2576FG	19464	+3344	8.5	8.6	155.2	3.13	2023.697	4	CTT	C11/F+T205/F
STF2603	19482	+7016	4.0	6.9	20.6	3.10	2023.688	4	CTT	C11/F
STF2596	19540	+1518	7.3	8.7	295.8	2.35	2023.722	4	CTT	T205/F
STF2613AB	20014	+1045	7.5	8.0	357.6	3.50	2023.734	4	CTT	T205/F
STF2658AB	20136	+5307	7.2	9.4	103.0	5.30	2023.740	4	CTT	T205/F
STF2658AC	20136	+5307	7.2	10.3	204.3	67.08	2023.752	4	CTT	T205/F
BU152	20423	+5723	7.2	8.0	81.2	1.21	2023.788	4	CTT	C11/F+T205/F
STT437AB	21208	+3227	7.2	7.4	17.4	2.46	2023.819	3	CTT	C11/F+T205/F+L
SHJ345AB	22266	−1645	6.3	6.4	106.8	1.22	2023.807	1	CTT	T205/L

Table 2: Notes

Pair	ADS	Notes
STF314AB,C	-	BDS 1459. Orbital pair. Very slow direct relative motion in 198 yrs. Getting wider: $+0''.3$.
STF412AB	2616	Orbital pair, retrograde relative motion: 280° in 193 yrs. Getting wider. Clearly split with gap using the T205-mm.

BU535	2726	o Per. Slow retrograde relative motion: 38° in 145 yrs. Separation without any noticeable change. No GAIA DR2/3 parallax, proper motion, radial velocity nor luminosity data for secondary: Dommanget criteria undetermined. From DR2/3 equatorial coordinates, relative position for 2015.5: 29°.7, 0″.95: position angle not exactly compatible with micrometric measurements.
STF728	4115	Orbital pair, retrograde relative motion: 162° in 193 yrs. Getting wider. Relative position for 2015.5 from GAIA-DR2 equatorial coordinates: 48°.3, 1″.13 (USN 1999 orbit: 44°.3, 1″.32).
STF1104AB	6126	Long period orbital pair, direct relative motion: in 112° in 192 yrs. Getting closer.
STF1338AB	7307	Long period orbital pair, direct relative motion: 198° in 194 yrs. See Table 3 for residuals with three orbits by M. Scardia published in IAU Circ. 147 (2002) & 209 (2023).
STT215	7704	Long period orbital pair, retrograde relative motion: 91° in 179 yrs. Getting wider.
STF1670AB	8630	γ Vir. Orbital pair, retrograde relative motion. Second revolution since W. Struve. Getting wider.
STF1692AB	8706	Cor Caroli. Very slow retrograde relative motion: 5° in 246 yrs. Getting closer. Using Herschel's 1777 measurement, first Dommanget criterion: 44″ . Second criterion: 18″ (measured :19″). Physical or optical status presently undetermined. Relative position from GAIA-DR2 equatorial coordinates (2015.5): 228°.6, 19″.11 ; measured (2023.4): 228°.7, 19″.24.
BU799AB	8772	Very long period orbital pair. Direct relative motion: 28° in 142 yrs.
BU799AC	-	Nearly fixed since 1899. No GAIA luninosity nor radial velocity data for A. Dommanget criteria undetermined.
STT261	8814	Very long period orbital pair. Retrograde relative motion: 19° in 180 yrs.
STF1768AB	8974	Orbital pair. Retrograde relative motion: 341° in 192 yrs.
STF1825	9192	Very long period orbital pair. Retrograde relative motion: 33° in 193 yrs.
STF1834	9229	Long period orbital pair. Direct relative motion: in 349° in 192 yrs.
STF1878	9357	Very long period orbital pair. Retrograde relative motion: 22° in 191 yrs.
STF1909	9494	Orbital pair. Direct relative motion: 334° in 191 yrs. Getting wider. '8'-shape using the C11. No complete gap however.
STF1937AB	9617	Orbital pair. 5th revolution since W. Struve (1826). Getting wider. Just split using the C11.
HU149	9628	Long period orbital pair. Slow retrograde relative motion: 26° in 123 yrs. Getting wider. Clearly split with gap using the C11.
STF2118AB	10279	Orbital pair. Retrograde relative motion: 180° in 191 yrs. Getting closer. From GAIA DR2 equatorial coordinates, relative position for 2015.5: 65°.8 , 1″.22 (Scardia ephemeris: 67°.2, 1″.30 − Izmailov ephemeris: 65°.7, 0″.99).
STF2130AB	10345	Orbital pair. Retrograde relative motion: 150 ° in 123 yrs. Getting wider.
STF2138AB	10386	Very long period orbital pair. Retrograde relative motion: 4° in 193 yrs; separation without any noticeable change. From GAIA-DR2 equatorial coordinates, relative position for 2015.5: 133°.4, 22″.16. O-C residual for GAIA measurement with Pko 2021 orbital elements: +0°.7, +0″.07 (compare with Table 3). First Dommanget criterion: 139″ , second criterion: 182″ , both compatible with an orbital motion.
STF2140AB	10418	α Her. Very long period orbital pair. Retrograde relative motion: 15° in 194 yrs. Getting wider: +0″.14.
STF2140AD	10418	No rotation since Burnham (1890). Getting closer: −6″.7. No GAIA-DR2/3 data for A. Dommanget criteria undetermined. Large rectilinear relative motion, significantly different parallaxes and proper motions for B and D: likely an optical pair.
STF2308AB	11061	Very long period orbital pair. Direct relative motion: 2° in 191 yrs (precession correction on 1832 position angle: −6°.1). Getting closer: −2″ . First Dommanget criterion: 24″ (measured: 19″), compatible with a possible orbital motion. No GAIA-DR2/3 radial velocity data. Second criterion undetermined however. Relative position from GAIA-DR2 equatorial coordinates for 2015.5: 231°.3, 18″.86, compatible with micrometric measurements.
STT358A	11483	Orbital pair. Retrograde relative motion: 82 ° in 178 yrs. Getting closer.
HU937	11692	Orbital pair. Direct relative motion: in 176° 119 yrs. Getting wider.
BU648AB	11871	Orbital pair. Retrograde relative motion. Third revolution since Burnham (1878). Getting closer.
STF2454AB	12040	Orbital pair. Direct relative motion: 85° in 192 yrs. Getting wider.
STF2509	12296	Orbital pair. Retrograde relative motion: 22° in 191 yrs. Getting wider.
STF2576FG	12889	Orbital pair. Retrograde relative motion. Completing its first revolution since W. Struve. No GAIA data for this pair.

STF2603	13007	Long period orbital pair. Direct relative motion: 29° in 191 yrs. Getting wider.
STF2596	13082	Long period orbital pair. Retrograde relative motion: 56° in 192 yrs.
STF2613AB	13256	Long period orbital pair. Direct relative motion: 8° in 194 yrs. Getting closer: $-1''.2$.
STF2658AB	13560	Long period orbital pair. Retrograde relative motion: 22° in 192 yrs. Separation without any noticeable change. ADS reference not mentioned for this pair in 6th USNO Orbit Catalogue.
STF2658AC	13560	Apparent relative displacement: $37''$ in 191 yrs mainly due to A proper motion. significantly different GAIA parallaxes for A (21.3 mas) and C (1.0 mas). First Dommanget criterion: $0''.006$ (measured: $67''$). Clearly an optical pair.
BU152	14196	Orbital pair. Retrograde relative motion: 29° in 147 yrs. Getting wider.
STT437AB	14889	Long period orbital pair. Retrograde relative motion: 50° in 178 yrs. Getting wider.
SHJ345AB	15934	Long period orbital pair. Direct relative motion: 164° in 200 yrs.

Table 3: Residuals from known orbits

Pair	ADS	Residual(O-C)		Author	Date	Gr.	Period (years)	π_G (mas)	π_d (mas)	$(\pi_d - \pi_G)/$ $0.01\pi_G$
STF314AB,C		+1°.5	$-0''.01$	Izmailov	2019	4	1185	5.3	13.6	+157%
STF412AB	2616	+2°.0	$0''.00$	Scardia	2002	3	522	5.4	5.4	0%
STF728	4115	−0°.6	$-0''.02$	USN	1999	4	614	9.2	12.7	+38%
STF1104AB	6126	+2°.9	$-0''.35$	Hopmann	1969	5	1091	27.3	25.6	−6%
		+2°.2	$-0''.03$	Izmailov	2019	4	550	27.3	24.3	−11%
STF1338AB	7307	−8°.2	$+0''.23$	Scardia	2002	3	303	14.9	20.9	+40%
		+1°.4	$0''.00$	Scardia	2002	?	444	14.9	19.7	+32%
		+0°.2	$+0''.04$	Scardia	2023	?	382	14.9	18.6	+25%
STT215	7704	−0°.8	$-0''.06$	Zaera	1984	4	670	9.3	11.3	+22%
		+1°.7	$+0''.06$	Izmailov	2019	4	468	9.3	11.4	+23%
STF1670AB	8630	+0°.7	$+0''.01$	Scardia	2007	2	169	86.0	83.0	−3%
BU799AB	8772	−1°.0	$-0''.08$	Izmailov	2019	5	1659	7.5	20.6	+176%
STT261	8814	+2°.1	$+0''.04$	Izmailov	2019	4	772	13.7	14.7	+7%
STF1768AB	8974	+1°.8	$+0''.08$	Soderhjelm	1999	3	228	18.0	17.7	−2%
		+1°.0	$0''.00$	Izmailov	2019	3	245	18.0	16.6	−8%
STF1825	9192	+0°.1	$-0''.05$	Izmailov	2019	5	1085	30.1	51.8	+72%
STF1834	9229	−2°.8	$+0''.10$	Seymour	2000	3	376	13.9	13.8	−1%
		−2°.3	$+0''.08$	WSI	2015	3	413	13.9	13.4	−4%
STF1878	9357	−0°.7	$-0''.16$	Izmailov	2019	5	1555	74.1	43.2	−42%
STF1909	9494	−1°.0	$+0''.06$	Zirm	2011	2	210	77.2	87.2	+13%
		+1°.3	$+0''.09$	Izmailov	2019	2	215	77.2	82.6	+7%
STF1937AB	9617	+1°.7	$+0''.05$	Muterspaugh	2010	1	42	No data		
HU149	9628	−1°.8	$+0''.11$	Zirm	2015	4	770	No data		
STF2118AB	10279	−1°.3	$-0''.30$	Scardia	1981	4	578	14.1	11.7	−17%
		+1°.0	$+0''.12$	Izmailov	2019	3	321	14.1	15.5	+10%
STF2130AB	10345	+3°.4	$+0''.01$	Heintz	1981	4	672	36.8	36.9	0%
		+1°.3	$0''.00$	Izmailov	2019	3	424	36.8	37.6	+2%
STF2138AB	10386	+0°.9	$+0''.25$	Pulkova Obs.	2021	5	4478	47.1	88.2	+87%
STF2140AB	10418	+0°.1	$+0''.15$	Baize	1978	4	3600	9.9	11.9	+20%
STF2308AB	11061	+0°.6	$-0''.10$	Kiselev	1996	5	18000	22.0	24.0	+10%
STT358AB	11483	+2°.7	$+0''.20$	Heintz	1995	4	380	28.9	26.6	−8%
		−0°.4	$+0''.04$	Izmailov	2019	4	513	28.9	20.6	−28%
HU937	11692	−1°.5	$+0''.02$	USN	2006	4	226	9.7	20.3	+109%
BU648AB	11871	+1°.8	$+0''.10$	Heintz	1994	2	61	66.6	68.1	+2%
		−0°.9	$+0''.03$	Izmailov	2019	2	63	66.6	65.8	−1%

STF2454AB	12040	$-4^\circ.0$	$-0''.01$	Mason	2014	4	559	13.1	16.2	+24%
STF2509	12296	$+0^\circ.6$	$+0''.02$	Zirm	2014	4	627	12.7	13.0	+2%
STF2576FG	12889	$+1^\circ.8$	$-0''.03$	Soderhjelm	1999	2	232	No data		
STF2603	13007	$-1^\circ.5$	$-0''.11$	Izmailov	2019	5	2753	21.3	25.3	+19%
STF2596	13082	$+0^\circ.2$	$+0''.37$	Izmailov	2019	4	2971	10.4	28.5	+174%
STF2613AB	13256	$+2^\circ.3$	$+0''.05$	Izmailov	2019	4	2106	12.6	19.6	+56%
STF2658AB	13560	$-2^\circ.5$	$-0''.07$	Izmailov	2019	5	5632	21.3	47.8	+124%
BU152	14196	$0^\circ.0$	$+0''.04$	Izmailov	2019	4	737	6.9	7.9	+14%
STT437AB	14889	$-1^\circ.0$	$0''.00$	Izmailov	2019	4	1218	14.0	21.8	+56%
SHJ345AB	15934	$+0^\circ.2$	$-0''.06$	Tokovinin	2020	4	2000	51.5	51.8	−1%

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MICROMETER MEASURES OF DOUBLE STARS WITH A 32.5-CM F19 CASSEGRAIN AND A MECA PRECIS DOUBLE IMAGE MICROMETER 2023.32 to 2024.43

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Results and Method

The total number of positive measurements is 180 on 74 double stars. Most of the pairs are in orbital motion. All measurements were obtained by using a 32.5-cm f/19 Cassegrain sited in Hemhofen (latitude N49° 42′) close to Erlangen, Germany. The telescope was designed and constructed in 1996 by Peter Grosse, employee of Zeiss Jena.
The limit for clearly resolvable stars is 0″40.
The following micrometer was used: a MECA PRECIS Double Image Micrometer with a spar plate (type Bernard Lyot) with magnifications of 390x, 490x, 620x, 690x, 770x. Mostly, the 620x magnification was applied. On each night, the distance and the PA each are set two to ten times (mostly four times).
When the distance is less than about 0″.4, the distance is measured as well as estimated, and the final value is the mean value. Mostly, the difference between the two methods does not exceed 0″.05.
Residuals were calculated for 66 pairs with known orbits and the corrections for precession were taken into account. In some cases, the residuals were additionally calculated for older orbit calculations that are included in the WDS Master file database.

Table 1 - Measures.

In this table, the position angle has not been corrected for precession, and is thus based on the epoch of observation

1. Pair = Name of star
2. Component (cL = center of luminosity)
3. RA 2000
4. Dec 2000
5. dm = estimated magnitude difference
6. PA(°)
7. Separation(″)
8. Epoch
9. N = number of nights
10. observer
11. note indicated

Observer: Andreas Alzner Method: 325mm Cassegrain, Double image micrometer

Pair + Comp	RA	Dec	dm	PA(°)	Sep(″)	Epoch	N	Obs.	Note
STF202	0202.0	+0246	1.0	257.9	1.87	2024.07	2n	Alz	
STF216	0211.4	+6221	–	301.4	0.29:	2024.07	1	Alz	note
STF299 AB	0243.3	+0314	2.5	299.2	1.86	2024.07	1	Alz	
STF346	0305.4	+2515	0.0	258.7	0.53	2024.08	2	Alz	
STF412	0334.4	+2428	0.1	168.8	0.81	2024.13	2	Alz	
STT74	0412.3	+0939	0.9	290.9	0.58	2024.11	2	Alz	note
STT95	0505.5	+1948	0.5	293.0	0.94	2024.11	4	Alz	
WNC2 A–cL(BC)	0523.9	−0052	0.3	157.7	3.17	2024.13	2	Alz	

STF728	0530.8	+0557	1.3	44.1	1.31	2024.18	2	Alz	
STF742	0536.4	+2200	0.6	274.9	4.10	2024.13	2	Alz	
STF749	0537.1	+2655	0.0	317.7	1.19	2024.10	2	Alz	
STF787	0546.0	+2119	0.7	52.8:	0.63	2024.17	2	Alz	note
STT124	0558.9	+1248	1.2	299.0	0.70	2024.17	3	Alz	note
STT159	0657.3	+5825	1.4	236.0	0.71	2024.19	1	Alz	
STT170	0717.6	+0918	0.8	277.1	0.71	2024.19	1	Alz	
STF1074	0720.5	+0024	0.3?	171.8	0.72	2024.19	1	Alz	
STF1338	0921.0	+3811	0.3	318.8	1.23	2023.32	2	Alz	
STF1355	0927.3	+0614	0.0	358.0	1.74	2023.32	2	Alz	
STF1372	0937.1	+1614	–	253:	0.3:	2023.32	2	Alz	
STT229	1048.0	+4107	0.1	252.2	0.66	2023.32	2	Alz	
STF1517	1113.7	+2008	0.2	314.0	0.75	2023.32	2	Alz	
STF1523 AB	1118.2	+3132	0.4	140.9	2.42	2023.32	2	Alz	note
			0.4	137.2	2.48	2024.34	3	Alz	
STF1527	1119.0	+1416	1.0	313.6	0.63	2023.32	2	Alz	
STF1536	1123.9	+1032	2.6	88.8	2.31	2024.34	3	Alz	
STF1647	1230.6	+0943	0.6	249.3	1.25	2024.32	2	Alz	
STF1670	1241.7	−0127	0.0	353.4	3.26	2023.40	4	Alz	
			0.0	351.9	3.37	2024.33	2	Alz	
STT261	1312.0	+3205	0.2	338.7	2.60	2023.40	2	Alz	
STF1785	1349.1	+2659	0.5	194.4	2.59	2024.39	2	Alz	
STT278	1412.2	+4411	0.3	264.4	0.40	2023.40	3	Alz	
STF1863	1438.0	+5135	0.1	59.2	0.67	2023.40	4	Alz	
STF1865	1441.1	+1344			round	2024.39	2	Alz	
STF1879	1446.3	+0939	0.9	80.2	1.72	2023.43	3	Alz	
STF1883	1448.9	+0557	0.1	275.1	1.09	2023.43	3	Alz	
STT288	1453.4	+1542	0.7	154.4	0.89	2023.40	2	Alz	
STF1909	1503.8	+4739	0.8	206.3	0.55	2023.40	6	Alz	
			0.6	213.5	0.64	2024.38	4	Alz	
HDS2127	1506.3	+5950	1.2?	35.8	0.40	2024.43	1	Alz	note
STF1932	1518.3	+2650	0.0	268.3	1.58	2023.40	2	Alz	
STF1937	1523.2	+3017	0.2	346.0	0.57	2023.40	2	Alz	
			0.4	355.5	0.65	2024.42	2	Alz	
STF1938 BC	1524.5	+3723	0.4	1.8	2.23	2023.43	3	Alz	
STF1989	1539.6	+7959	0.7	20.9	0.62	2023.47	3	Alz	
STF2034	1548.7	+8337	0.4	108.8	1.09	2023.47	2	Alz	
STF1985	1555.9	−0210	1.5	354.7	6.03	2023.44	1	Alz	
STF1988	1556.8	+1229	0.3	247.5	1.74	2023.40	2	Alz	
STT303	1600.9	+1316	0.3	174.1	1.63	2023.44	2	Alz	
D15	1643.9	+4329	0.3	312.6	0.59	2023.44	2	Alz	
STF2118	1656.4	+6502	0.2	65.4	0.93	2023.47	2	Alz	
STT327	1714.1	+5608	0.3	338.8	0.39	2023.48	1	Alz	
STF2218	1740.3	+6341	1.3	308.6	1.46	2023.48	1	Alz	
STT349	1753.0	+8354	0.5	51.4	0.54	2023.48	1	Alz	
STF2320	1827.8	+2442	1.9	357.7	0.97	2023.70	2	Alz	
STT354	1832.0	+0647	0.8	217.9	0.49	2023.70	2	Alz	
STT359	1835.5	+2336	0.1	4.4	0.79	2023.70	2	Alz	
STT358	1835.9	+1659	0.2	144.8	1.64	2023.70	2	Alz	
BU648	1857.0	+3254	2.5	223.7	1.11	2023.70	2	Alz	
STF2437	1901.9	+1910	0.2	1.5	0.52	2023.72	2	Alz	

STT387	1948.7	+3519	0.8	87.8	0.47	2023.70	3	Alz
STF2606	1958.5	+3317	0.7	147.4	0.64	2023.70	2	Alz
STT395	2002.0	+2456	0.3	128.1	0.72	2023.71	4	Alz
STT400	2010.2	+4357	0.5	324.1	0.67	2023.72	4	Alz
STF2672	2021.6	+2346	0.1	356.0	0.74	2023.71	2	Alz
STF2695	2032.0	+2548	>0	264:	0.3:	2023.70	1	Alz
STT413	2047.4	+3629	1.1	358.9	0.97	2023.74	4	Alz
STT418	2054.8	+3242	0.0	283.7	0.95	2023.75	3	Alz
BU156	2100.8	+4635	1.8	234.4	0.97	2023.73	3	Alz
STF2746	2101.8	+3916	1.0	323.0	1.26	2023.74	4	Alz
STT527	2108.0	+0509	1.2	107.6	0.45:	2023.73	3	Alz
H 1 48	2113.7	+6424	0.0	246.6	0.86	2023.78	2	Alz
AGC13	2114.8	+3803	2.9	170.3	0.92	2023.75	2	Alz
STF2807	2117.6	+8231	0.4	309.9	1.81	2023.78	1	Alz
BU163	2118.6	+1134	1.3	256.2	1.02	2023.72	2	Alz
STT437	2120.8	+3227	0.1	18.4	2.45	2023.74	5	Alz
STT435	2121.4	+0253	0.1	240.0	0.74	2023.76	3	Alz
STF2799	2128.9	+1105	0.0	257.4	1.90	2023.77	2	Alz
BU74	2135.2	+2124	1.4	338.0	0.95	2023.74	3	Alz
STF2924	2233.0	+6955	0.8?	246.1	0.47	2023.78	1	Alz

Table 2 - Notes to individual stars

Pair	ADS	Note
STF216	1682	A first orbit (P = 410 yrs, a $=0''.434$) was calculated in 2024 by A. Alzner, I. Coster and R. Leadbeater. Details can be found elsewhere in this issue.
STT74	3053	The companion is currently in the fourth quadrant, the difference in brightness was clearly visible. Hence, the two speckle results (Scardia (2016.10), Tokovinin (2020.84), both resolving the quadrant ambiguity) and the visual measurements by the author show, that the companion so far has never been seen on the eastern side of the main star. A new orbit was therefore calculated by the author in 2024. P (113 yrs) becomes much shorter than earlier computations (Alzner (2003): P = 185, Mason (2019): P = 272.5) the eccentricity much larger. Details are given elsewhere in this issue.
STT124	4562	Baize's provisional orbit from 1988 fails as the distance continues to increase slowly. A new orbit was calculated by the author in 2024. STT124 is particularly interesting as the main star is a G8 giant and the A5V companion (perhaps a SB?) taking into account the Hipparcos parallax becomes about four times brighter than expected from the MLR. Details are given elsewhere in this issue.
STF787	4349	Position angles scattered.
STF1523	8119	AB: P=59.84 (Heintz 1996, grade 1); Aa-A: P = 1.834 yrs (Heintz 1996, grade 9). Residuals have been calculated combining AB (Heintz 1996) and Aa-A (Heintz 1996).
HDS2127	-	Slow direct motion. Since HIP discovery, the position angle has increased by around 20 degrees, the distance is almost constant at around 0.4 arc seconds.

Table 3 - Residuals from known orbits

Pair	Comp.	ADS	Residual(O-C) PA(°)	Sep(″)	Orbit	Date	Grade	Period (yrs)
STF202		1615	+0.2	+0.02	Scardia	2015	4	3267.4
			−0.9	+0.01	Izmailov	2019	4	1946.9984
STF216		1682	+1.8	+0.03	Alz/Cos/Lead	2024	TBD	410
STF299		2080	−1.0	+0.01	Alzner	2023	TBD	914
STF346		2336	−1.0	−0.01	Heintz	1981	3	227
STF412		2616	−0.1	+0.03	Scardia	2002	3	522.16
STT74		3053	+183.1	+0.01	Mason	2019	4	272.5
			(companion now in the 4th quadrant)					
			+1.3	+0.07	Alzner	2024	TBD	113
STT95		3672	−1.6	−0.03	Jasinta	1996	4	760.34
			0.0	+0.03	Izmailov	2019	4	897.7634
WNC2	A−BC	3991	−0.4	0.00	Rica Romero	2013	5	923
STF728		4115	+0.4	−0.09	Seymour	1999	4	613.69
STF742		4200	−1.9	−0.07	Hopmann	1973	5	2959
STF749		4208	+0.9	+0.04	Izmailov	2019	4	773.2358
STF787		4349	+0.6	0.00	Zirm	2014	5	920
STT124		4562	−8.7	+0.43	Baize	1988	5	140
			−0.5	+0.05	Alzner	2024	TBD	450
STT159		5586	−2.8	0.00	Alzner	2000	3	262
STT170		5958	−2.0	+0.02	Scardia	2018	3	289.2
STF1338		7307	−0.6	+0.05	Scardia	2023	3	381.5
STF1355		7380	+0.9	+0.03	Ling	2011	4	591
			+1.3	+0.05	Izmailov	2019	4	1073.7339
STF1372		7456	−1.9	−0.02	Alzner	2005	3	371
STT229		7929	+0.9	+0.05	Alzner	2020	3	335.4
STF1517		8094	−0.6	−0.01	Rica Romero	2015	4	924
STF1523	AB	8119	+0.3	−0.02	Heintz	1996	1	59.84
			−0.3	−0.04				
STF1527		8128	−2.0	−0.02	Scardia	2011	3	551.36
			−2.1	+0.03	Tokovinin	2012	3	415
STF1536		8148	−0.1	−0.00	Soederhjelm	1999	2	186
			−0.4	+0.00	Izmailov	2019	2	184.4572
STF1647		8575	−1.1	+0.01	Izmailov	2019	4	1010.6613
STF1670		8630	+0.1	−0.05	Scardia	2007	2	169.104
			−0.5	−0.04				
			+0.2	−0.03	Mason	2021	2	169.4
			−0.3	−0.03				
STT261		8814	+0.6	−0.03	Kiselev	2012	4	860.8
STF1785		9031	−1.6	+0.03	Heintz	1988	2	155.75
			−0.8	+0.00	Izmailov	2019	2	156.1355
STT278		9159	−3.9	−0.01	Hartkopf	2009	3	506.77
STF1863		9329	+1.0	+0.02	Zirm	2013	4	538
STF1879		9380	−1.1	0.00	Mason	1999	3	253
			−0.6	−0.01	Izmailov	2019	3	256.8328
STF1883		9392	−1.2	+0.02	Izmailov	2019	2	225.5118
			−1.3	0.00	Josties/Mason	2021	2	245.8

STT288		9425	+1.2	−0.01	Heintz	1998	4	313
STF1909		9494	−0.9	+0.07	Zirm	2011	2	209.8
			−0.9	+0.01				
			+1.4	+0.10	Izmailov	2019	2	214.7628
			+0.6	+0.05				
STF1932		9578	−0.2	−0.03	Scardia	2015	2	203.145
			−0.3	−0.01	Izmailov	2019	2	196.628
STF1937		9617	+0.7	+0.02	Muterspaugh	2010	1	41.63
			+1.0	+0.00				
STF1938	BC	9626	+0.5	0.00	Kiyaeva	2014	2	265
STF1989		9769	+1.2	+0.03	Hartkopf	2008	3	171.62
STF1985		9842	−0.6	−0.02	Izmailov	2019	5	2307.2358
STT303		9880	−0.5	−0.01	Zirm	2015	4	1460
			−0.7	+0.03	Izmailov	2019	4	1114.4707
D15		10188	+2.4	−0.01	Alzner	2007	2	120.05
STF2118		10279	+1.2	+0.04	Izmailov	2019	3	321.3131
STT327		10425	−1.8	−0.02	Mason	2011	2	88.402
STF2218		10728	+3.0	+0.07	Zirm	2015	4	2130
			+3.2	+0.08	Izmailov	2019	4	1051.1579
STT349		11006	−4.9	0.00	Heintz	1995	4	433
STT354		11432	−1.5	−0.07	Zirm	2013	4	426
STT359		11479	+1.5	+0.03	Scardia	2009	3	219.3
STT358		11483	+0.4	+0.01	Mason	2018	4	444.6
			+0.3	+0.02	Izmailov	2019	4	512.7404
BU648		11871	+0.3	−0.07	Izmailov	2019	2	63.2489
STF2437		11956	+2.1	−0.04	Scardia	2008	4	804.6
STT387		12972	+1.9	+0.04	Josties/Mason	2021	2	165.0
STF2606		13196	−0.8	+0.03	Zirm	2015	4	455
STT395		13277	−0.1	+0.02	Izmailov	2019	4	709.37
STT400		13461	+0.9	+0.03	Heintz	1997	2	85.61
STF2672		13750	+2.4	+0.10	Ling	2019	4	764
STF2695		13964	+4.8	−0.13	Alzner	2005	3	269
STT413		14296	−0.1	+0.06	Izmailov	2019	4	800.7968
STT418		14421	+0.7	+0.03	Zirm	2013	4	787
			+0.8	+0.03	Izmailov	2019	4	709.1513
STT527		14666	+4.2	+0.01	Popovic	1995	4	561.15
H 1 48		14783	+1.3	+0.04	Josties/Mason	2021	3	82.76
AGC13		14787	+1.5	−0.09	Muterspaugh	2010	2	49.626
STF2807		14921	+0.4	+0.06	Izmailov	2019	5	2818.9854
BU163		14839	−0.5	+0.07	Fekel	1997	2	78.54
STT437		14889	+0.1	−0.01	Izmailov	2019	4	1218.0962
STT435		14894	−1.1	+0.05	PkO	2018	5	3542
STF2799		15007	+0.1	0.00	Izmailov	2019	4	1108.405
STF2924		16057	+6.4	+0.06	Prieur	2010	2	218.8

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This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France and of the Washington Double Star Catalog maintained at the U.S. Naval Observatory.

REVISED ORBITAL ELEMENTS FOR WDS04123+0939 = ADS3053 = STT74 = HD26547 AND WDS05589+1248 = ADS4562 = STT124 = HD40369

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STT 74 - Basic data

Position:	RA = 05 58 53.2 Dec = +12 48 29.7
Mags:	8.3m – 8.8m (values from WDS)
Spectral types:	F0
Colour index:	$B - V = 0.38$
Hipparcos parallax:	None
Gaia parallax:	None
Trig. parallax:	None
Correction for precession:	$\theta(2000) = \theta(t)$ - 0°.00504(t - 2000)

Introduction

The calculation for this binary was performed in order to adapt the latest measurements and to correct the quadrant setting of earlier orbit solutions (Alzner (Inf. Circular 149, 1, 2003) and Josties and Mason (Inf. Circular 199,1, 2019)).

Both previous calculations had placed the measurements by Otto Struve and Johann Madler in the first/second quadrant. In addition, Josties and Mason put the measurements after 1993.10 (starting 2003.95 after a gap of 11 years) into the second quadrant.

Among the measurements starting 2003.95 and later, there are three having determined the fourth quadrant: two speckle results (Scardia (2016.10), Tokovinin (2020.84), both resolving the quadrant ambiguity) and one recent visual measurement (Alzner, (2024.07), binary resolved with a 325-mm Cassegrain, showing the companion in the fourth quadrant, this obseration is published elsewhere in this issue).

The author therefore concludes, that the companion is moving in a high eccentricity orbit with all measurements in the fourth quadrant except two (Hartkopf (1989.71) and Hartkopf (1993.10)). Also, the normal place combining the early measurements by Struve and Madler is now located in the fourth quadrant.

The history of the motion can be described as follows:
- First measurements by Struve and Madler on 1847.34
- Long gap without complete measurements until 1895, first periastron in 1883.79
- Long series of measurements from 1895 to 1993
- Gap of almost 11 years with no measurements, second periastron 1996.79
- Next series of measurements starting 2003.95

Method of calculation

Approximate initial elements were obtained by an 'educated guess'. It was clear from the outset that a least squares fit would converge quickly, especially as more than one complete cycle had passed. Indeed, a differential correction in polar coordinates, applied to the start orbit fixed the final elements in a few iterations.

Two measurements in the 19th century (by A.P.Smith and G.M. Seabroke, (both on epoch 1885.19, and both giving the angle only) could not be fitted and had to be rejected.

New orbital elements for epoch 2000 and the errors on those orbital elements, obtained from the covariance matrix and errors of measurements are given below.

P = 113.0 yrs	dP(yr) = ± 2.1
T = 1996.79	dT(yr) = ± 0.83
$a = 0''.329$	da = ± $0''.014$
e = 0.914	e = ± 0.017
$i = 108^\circ.6$	di = ± $3^\circ.2$
$\Omega = 111^\circ.1$	dΩ = ± $2^\circ.4$
$\omega = 16^\circ.9$	dω = ± $7^\circ.4$

The dynamical parallax becomes 10.10 mas giving a total mass of 2.71 solar masses. These results fit better with a spectral type of approximately F4 for component A, a main sequence star.

Residuals

Epoch	P.A.	Sep.	n	Observer	Res PA	Res rho
1847.34	277.2	0.40	3	Ma2,Stt1	−5.7	−0.13
1859.05	unresolved		1	Se	(280°.6,	0″.43)
1865.77	elongated		1	D	(278°.7,	0″.35)
1865.96	unresolved		1	D	(278°.6,	0″.35)
1885.19	277.2	–	2	Smt1, Sbk1	−37.8	(0″.05)
1895.68	295.1	0.41	5	StH2,A3	+1.8	+0.08
1898.32	293.3	0.37	9	A3,Hu6	+0.9	−0.00
1902.57	294.2	0.42	7	Doo2,Bry1,Hu3,A1	+3.0	−0.01
1909.58	287.6	0.42	5	Wz1,Lau1,Fur1,J2	−2.1	−0.08
1913.35	289.6	0.46	5,4	Vdk1,Wz1,0,Bry1,A2	+0.5	−0.07
1924.58	288.4	0.49	6	VBs2,A1,Fur3	+0.9	−0.10
1927.07	289.5	0.43	3	Fur	+2.3	−0.17
1934.82	288.1	0.53	3	Baz	+1.9	−0.08
1938.63	284.7	0.64	20	Rab14,Dur2,Vou4	−1.1	+0.03
1943.36	282.6	0.56	10	Rab6,Vou4	−2.6	−0.04
1954.14	276.5	0.57	8	Baz4,Rab4	−7.3	+0.00
1962.81	284.6	0.49	18	Hei4,B4,Wor7,Cou3	+2.1	−0.02
1966.12	280.3	0.46	4	Hei	−1.6	−0.03
1972.74	269.7	0.39	1	Pop	−10.8	−0.04
1977.06	282.4	0.46	3	Hln	+3.1	+0.08
1984.46	276.3	0.271	4	McA	+0.3	+0.004
1985.85	276.1	0.245	1	McA	+1.0	+0.002
1986.89	273.8	0.225	1	McA	−0.4	+0.001
1987.75	274.5	0.210	1	McA	+1.1	+0.003
1989.18	275.0	0.15	6	Hei4,Cou2	+3.3	−0.03
1989.71	269.0	0.167	1	Hrt	−1.9	+0.001
1993.10	254.4	0.084	1	Hrt	−5.9	−0.000
2003.95	295.4	0.234	1	Hrt	−0.6	+0.001
2007.10	289.8	0.232	1	Pru	−3.2	−0.067
2009.42	294.0	0.349	2	Tok1, Msn1	+1.0	+0.008
2011.85	290.9	0.38	1	Gur	−1.3	+0.001
2014.76	292.6	0.429	1	Tok	+1.2	+0.011
2016.10	290.5	0.442	1	Sca	−0.5	+0.007
2017.68	285.9	0.495	1	WS	−4.8	+0.042
2018.94	287.3	0.450	4	WS	−3.1	−0.016
2020.84	290.8	0.497	2	Tok	+0.8	+0.012

2024.08	291.2	0.58	2	Alz	+1.7	+0.07

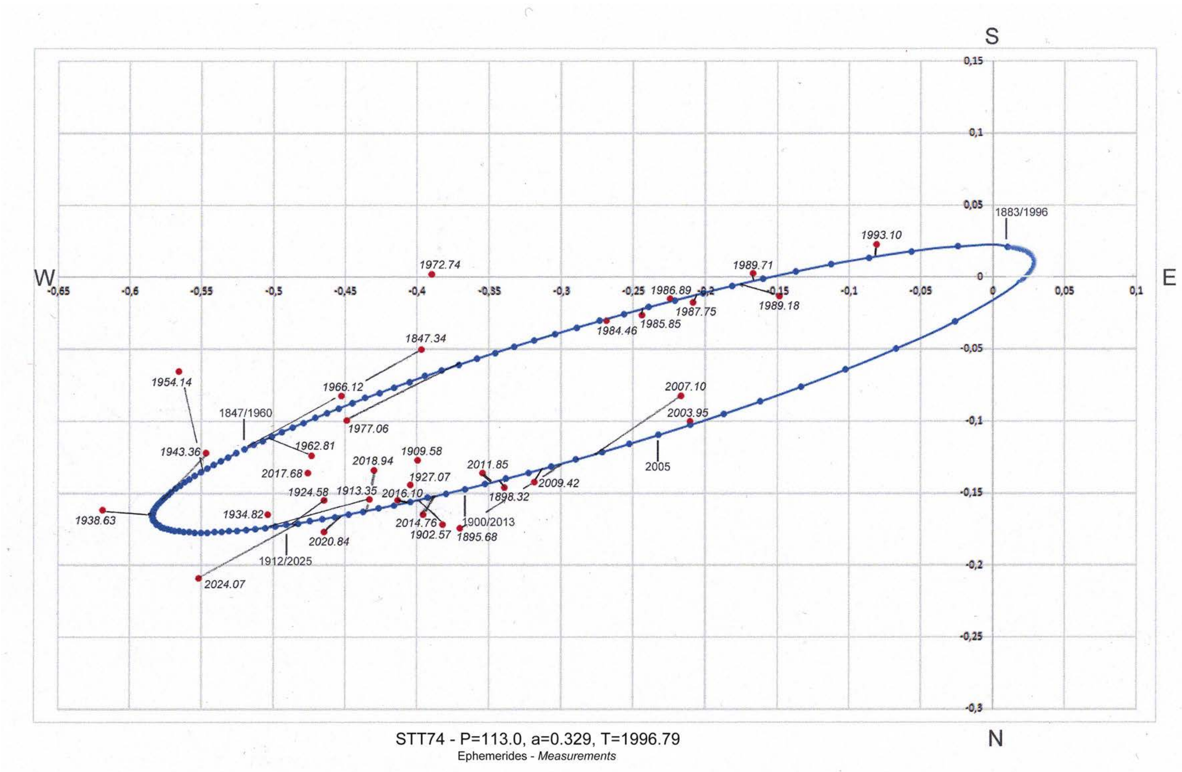

Figure 1: Plot of orbit and normal places of HD26547 = STT74

Ephemeris

2024.0	289°.5	0″.512
2025.0	289.3	0.520
2026.0	289.1	0.527
2027.0	289.0	0.534
2028.0	288.8	0.541
2029.0	288.7	0.547
2030.0	288.5	0.553

Comparison with previous orbits:

	Alz(2003)	Josties/Mason(2019)	Alz(2024)
P(yrs)	185	273	113.0
$a('')$	0.51	0.728	0.329
Dynamical Parallax($''$)	0.0116	0.0130	0.0101
Mass Sum ($M_\odot$)	2.49	2.34	2.71

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Spectral type: simbad:1993yCat.3135....0C: VizieR Online Data Catalog: Henry Draper Catalogue and Extension, published in Ann. Harvard Obs. 91-100 (1918-1925)
Fluxes: 2000A&A, 355L, 27H
A&A, volume 355, L27-30 (2000/3-2).
Høg E., Fabricius C., Makarov V.V., Urban S., Corbin T., Wycoff G., Bastian U., Schwekendiek P. and Wicenec A., *The Tycho-2 catalogue of the 2.5 million brightest stars.*

STT 124 - Basic data

Position:	RA = 05 58 53.2 Dec = +12 48 29.7
Mags	6.11m - 7.37m (values from WDS)
Spectral type:	G8III+A5V (2008ApJS..176..216A)
Trigonometric parallax:	4.25(0.25) mas (weighted mean from Gaia EDR3 and Hipparcos new reduction)
Precession:	$\theta(2000) = \theta(t)$ - 0°.00571 (t - 2000)

Introduction

This calculation for STT124 was performed as the three previous orbits by Baize and Starikova (Baz1981b, Sta1985, Baz1988d) no longer represent the motion: they give decreasing distances for 2020 of 0″.20 (Baz1981b), 0″.30 (Sta1985) and 0″.32 (Baz1988). On the other hand, the distance has now grown to over 0.6 arcseconds and continues to increase.

However, it must be emphasized that Baize and Starikova adapted their orbital solutions very well to the measurement data - almost 40 years ago they simply did not have more observational material available.

Method of calculation

First, a preliminary set of orbital elements was estimated by taking into account the previous orbits and the later measurements after 1990: primarily, P, a and e had to be increased. Then differential correction in polar coordinates was applied to the preliminary orbit, and finally, a number of test orbits with periods from P = 300 to P = 800 years was calculated in order to get an estimation for the error of the quantity a^3/P^2.

The historical measurement data were obtained from the WDS database. There are two important observations by Aitken on 1921.88 obtained at the 36-inch Lick refractor which are described in the ADS by the observer as follows: "pair with slight elongation in np to sf direction, 2n". The entry in the WDS database for this observation is 1921.88 0″.135 e 2n.

From the study of many observations by Aitken at Lick Observatory, the author has set the distance for this observation to 0″.09. During the orbit adjustment it turned out that in 1921.88 the companion was in the fourth quadrant. (as are all other positive measurements up to today).

Another important observation at Lick observatory at the 36-inch was performed in 1899.717. W.J. Hussey describes the star as "perfectly round with powers of 1000 and 1500". Indeed, the orbital solutions give for this time distances of about 0″.05.

The single measurement by Otto Struve in 1873.25 (228°.8, 0″.50) is obviously spurious. Negative observations were reported by H. Struve (1894.18, 2n), by G.C. Comstock (1894.26 & 1896.24, 5n), and by S.J. Brown (1898.19, 1n). For this period, the new orbit gives distances less than 0″.04.

The weights for the overall consistent positive measurements did need little revision. The derived orbital elements and the errors of those elements, obtained from the covariance matrix and errors of measurements are as follows:

P = 450 yrs	ΔP(yr) = ± 150 yrs
T = 1904.41	ΔT(yr) = ± 3.57 yrs
e = 0.827	Δe = ± 0.049
a = 0″.437	Δa = ± 0″.055
i = 85°.1	Δi = ± 2°.8
Ω = 120°.9	ΔΩ = ± 1°.6
ω = 358°.8	$\Delta\omega$ = ± 11°.8

Observations and residuals from the orbit

Epoch	P.A.	Sep.	n	Observer	Res(θ)	Res(ρ)
1843.22	325°.0	0″.30	2	Mad2	+21°.3	−0″.11
1845.72	306.4	0.42	2	Stt2	+2.6	+0.02
1866.15	324.8	elong.	1	D1	+19.6	(0.27)
1873.25	229.5	0.50	1	Stt1	(306	0.21)
1894.18	–	–	2	StH2	(348	0.02)
1895.24	–	–	5	Com5	(32	0.01)
1898.19	–	–	1	Brs1	(106	0.03)
1899.72	–	–	1	Hu1	(112	0.05)
1921.88	315.4	0.09(est)	2	A2	+26.	(+0.01)
1935.51	293.4	0.14	2,1	Kui1,B1	−1.8	−0.06
1939.97	280.2	0.21	3	WRH3	−15.7	−0.03
1950.71	306.3	0.21	1	WRH1	+9.3	−0.10
1954.69	296.7	0.33	18	Baz10,Mlr5,VBs3	−0.5	−0.01
1960.69	299.7	0.32	22	B12,Cou3,Cdy4,Wor4	+2.1	−0.05
1964.71	295.7	0.40	4	Baz4	−2.1	+0.00
1969.44	297.0	0.42	7	Wor4,Baz3	−1.0	−0.00
1975.69	298.8	0.43	7	Beh3,Wor4	+0.6	−0.03
1979.92	298.5	0.498	3	McA2,Tok1	+0.1	+0.021
1982.47	299.3	0.48	6	Hei6	+0.8	−0.01
1982.92	299.0	0.490	4	McA3,Tok1	+0.5	−0.001
1986.08	298.4	0.511	4	Tok1,Bnu1,McA2	−0.2	+0.006
1986.84	301.2	0.52	7	Wor4,Hei3	+2.6	+0.01
1988.14	298.3	0.508	4	LBu1,McA2,Hrt1	−0.3	−0.007
1991.25	299.5	0.523		HIP	+0.8	−0.005
1992.88	296.5	0.55	4	TYC1,WS3	−2.2	+0.02
1995.53	299.2	0.541	2	Hrt2	+0.4	−0.005
1996.35	300.4	0.51	6	Alz6	+1.6	−0.04
2001.77	298.7	0.555	5	Hor3,Msn1,Hrt1	−0.3	−0.016
2006.49	297.5	0.58	3	Alz3	−1.6	−0.01
2012.22	299.0	0.594	1	Pru1	−0.2	−0.014
2016.06	295.1	0.72	1	StJ1	−4.2	+0.10
2016.12	299.1	0.627	2	Gii2	−0.2	+0.006
2018.84	299.2	0.6332	2	Tok2	−0.1	+0.003
2023.27	298.4	0.67	5	Alz5	−1.0	+0.03

Ephemeris

2024.0	299°.4	0.″646
2025.0	299.4	0.649
2026.0	299.4	0.652
2027.0	299.5	0.655
2028.0	299.5	0.658
2029.0	299.5	0.660
2030.0	299.5	0.663

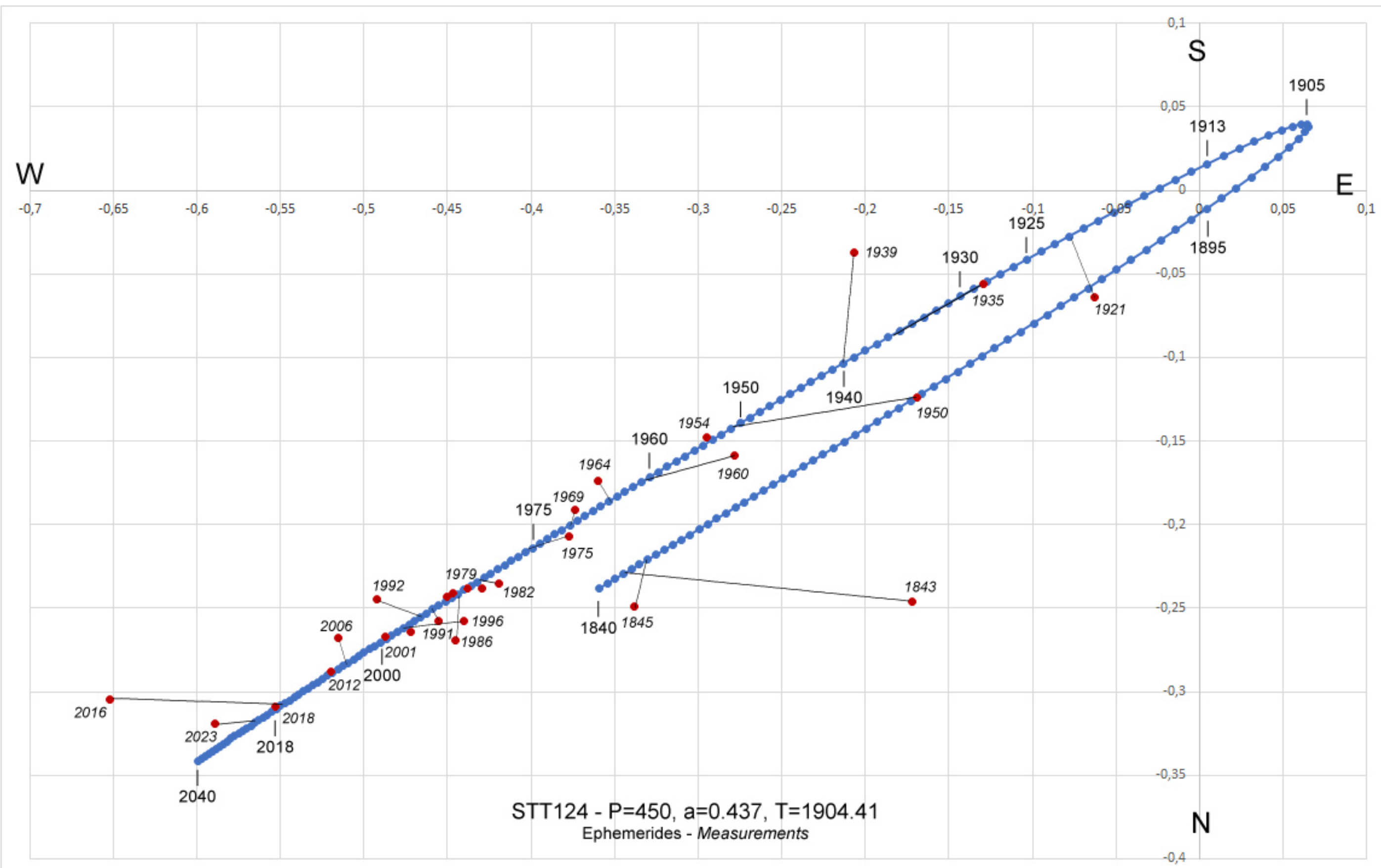

Figure 2: Plot of orbit and normal places of HD 40369 = STT 124

Discussion

The orbital elements are still quite uncertain, but not only Otto Struve's two measurements in 1845.72 confirm the physical nature of the system, the motion is clearly nonlinear. However, as long as the distance continues to increase, P and a cannot be determined much more precisely.

The trigonometric parallax: 4.25(±0.25) mas is the weighted mean from the following two values (SIMBAD database): Plx 1 = 4.2749(±0.3303), Gaia EDR3, 2020 Plx 2 = 4.11(±0.76), Hipparcos new reduction, 2007

The error of the quantity a^3/P^2 is estimated as $\pm\ 1.11 \times 10^{-7}$. This is calculated from the test orbits, which cover a period of 300 to 800 years. Together with the trigonometric parallax and its uncertainty, the total mass becomes 5.37 ± 1.74 solar masses (the orbits by Starikova 1985 and Baize 1988 combined with the actual trigonometric parallax yield 15 and 18 solar masses, respectively).

With a galactic latitude of -5.5 degrees for STT 124 and a parallax value 4.25 mas ($r = 235.35$ pc), the extinction is 0.34 mags. The corrected apparent visual magnitudes are: A: 5.77m B: 7.03m and the absolute visual magnitudes become: A: -1.09m B: $+0.17$m

The value for A is similar to that of the KIII giant alpha UMa A, whereas the value for B is better suited to an A subgiant.

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Acknowledgements

I thank Rachel Matson of the US Naval Observatory for sending the measurement data for STT124. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France and of the Washington Double Star Catalog maintained at the U.S. Naval Observatory.

FIRST ORBIT FOR WDS02114+6221 = ADS1682 = STF216 = HD13196

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STF 216 - basic data

Position:	RA = 02 11 21.5 Dec = +62 20 52
Magnitudes:	8.1m, 9.0m (values from WDS) (1)
Spectral type:	F0 (value from WDS) (1)
Trigonometric parallax:	2.8591(±0.4458) (from Gaia DR2)
Precession:	theta (2000) = $\theta(t)$ - 0°.00651(t - 2000)

Orbit calculation

This first calculation for the visual binary STF216 was performed as the measurements by W.D. Heintz (1990.93) and the single speckle measurement by Rene Gili (2009.63) led to a definition of periastron passage.

For the discussion, the spectrum was measured, classified and the interstellar extinction was determined. Then the dynamical parallax, masses and absolute visual magnitudes were calculated.

Finally, the radius and the surface gravity log g were calculated for the components of STF216.

Method of calculation

First, a preliminary set of orbital elements was obtained by means of a graphical method described by P. Couteau[2]. Then differential correction in polar coordinates were made and applied to the preliminary orbit[3]. Finally, a number of test orbits with periods from P = 535 to P = 320 yrs were calculated in order to check the reliability of errors of orbital elements derived from the covariance matrix and the residuals.

Surprisingly, the single (and important!) speckle measurement on 1983.71 by McA could not be used for the orbit calculation. Also, when skipping the only other speckle measurement by Gili and the latest (uncertain) 2024 measurement, the McA measurement could not be reproduced. Perhaps, this measurement belongs to another pair. The quadrants for 1969.17 (Worley) and 1973.88 (Heintz) had to be flipped.

The weights for the other overall consistent measurements did need little revision except the value for the 1965.85 position angle. The orbital elemnts for STF216 and the corresponding errors in those elements, obtained from the covariance matrix and errors of measurements are as follows:

P = 410 yrs	dP = ± 104 yrs
T = 1981.0	dT = ± 4.0 yrs
e = 0.929	de = ± 0.032
a = 0″.434	da = ± 0.081
i = 122°.4	di = ± 11°.9
Ω = 61°.2	dΩ = ± 10°.7
ω = 309°.7	dω = ± 15°.3

Residuals (the historical measurement data were obtained from WDS[1]

Epoch	P.A.	Sep.	n	Observer	Res(θ)	Res(ρ)	
1835.62	270°.2	0″.63	5	StF3, Mad2	+0°.9	−0″.00	
1849.42	265.6	0.66	5	Stt5	−2.6	+0.04	
1858.02	265.7	0.53	4	Se3, Stt1	−1.7	−0.08	
1868.30	267.2	0.60	6	D6	+0.7	+0.00	
1881.74	266.8	–	1,0	Big1,0	+1.6	–	
1906.13	265.3	0.55	3	A1, Wz2	+2.7	+0.03	
1924.13	266.0	0.57	4	B4	+5.9	+0.11	
1941.11	253.9	0.35	3	Baz3	−3.1	−0.4	
1951.96	249.7	0.29	16	Baz6,VBs4,Mrz2,Mlr4	−4.5	−0.03	
1961.78	251.3	0.26	12	VBs1,Hei4,Wor3,B4	+0.9	+0.01	
1965.85	263.8	0.21	2	VBs2	+15.7	−0.01	
1969.17	249.8	0.19	4	Wor4	+4.2	+0.00	
1973.88	246.9	0.14	3	Hei3	+7.5	+0.01	
(1983.71	13.0	0.221	1	McA1	−21.7	+0.168)	not used
1990.93	354.1	0.1	2	Hei2	+10.1	+0.01	
2009.63	307.6	0.206	1	Gii1	−1.2	+0.013	
2024.07	301.2	0.29	1	Alz	+1.8	+0.03	

Ephemeris

2024.0	299°.5	0.″264
2025.0	299.0	0.268
2026.0	298.5	0.273
2027.0	298.1	0.277
2028.0	297.7	0.281
2029.0	297.3	0.286
2030.0	296.9	0.290

Radial velocity of A with respect to B calculated according to the formula given by Paul Couteau, *L'Observation des Étoiles doubles visuelles*, 1978[4]:

1981	18.6 km/s
1990	11.2
2000	7.4
2010	5.6
2020	4.6
2030	3.8
2040	3.2

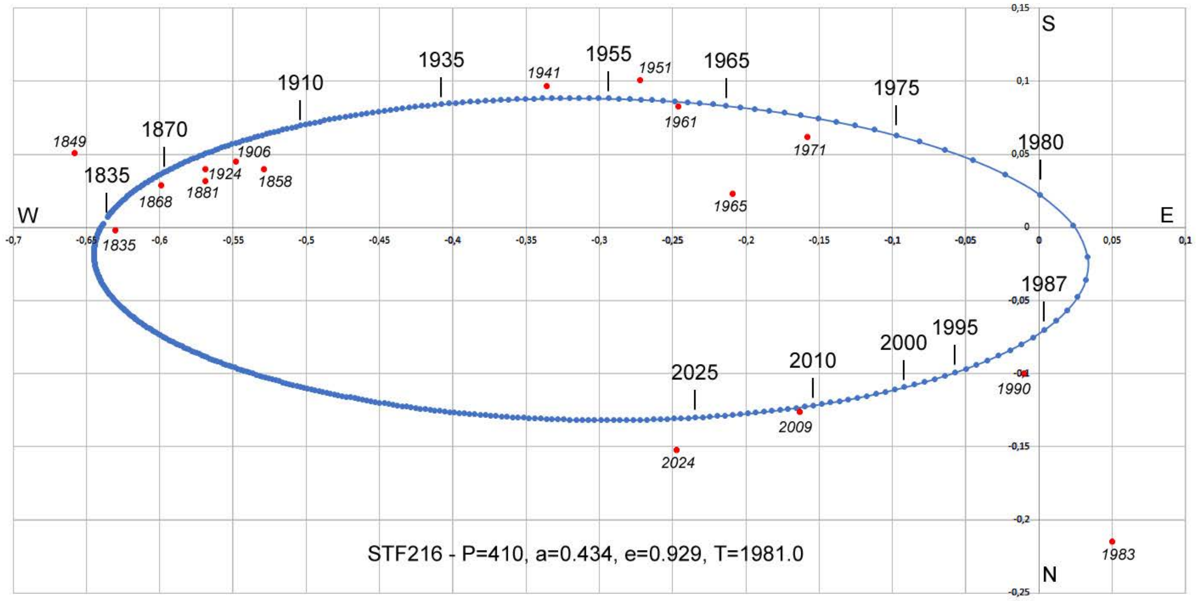

Figure 1: Plot of orbit and normal places of HD13196 = STF216

Available Data: Trigonometric Parallax, Extinction and Spectral type

Trigonometric Parallax

The only value for the trigonometric parallax: 2.8591(±0.4458) mas from GAIA DR2 was not used for investigation, as the separation of STF216 was below the resolution limit of Gaia.

Spectral types

After first estimations of the dynamical parallax and with spectral type F0 in the HD Catalog, and taking into account the delta m of the WDS (0.9), the possible decomposition is A9III – F2IV. The combined spectrum was remeasured at medium and low resolution.

Extinction

Since the galactic latitude of STF216 is only slightly less than one degree, the extinction must be taken into account. A total interstellar extinction of 0.33 was calculated with a formula given by Parenago (1940)[5]. Since this is an estimation only, the remeasured spectrum of HD13196 was used to derive the extinction from the colour excess $E(B-V)$.

HD13196 - Spectral Classification and Interstellar Extinction

Spectra at medium (2 Angstrom) and low (12 Angstrom) resolution were recorded by R.L. at Three Hills Observatory in north west England using LHIRES III and ALPY 600 spectrographs mounted on a 0.28-m aperture telescope. The spectra were reduced using ISIS software[6]]

The medium resolution spectrum covers 4020-4520 Angstrom, the region most useful for spectral classification. This spectrum was rectified using a low order spline fit to the continuum. The low resolution spectrum covers the full visible wavelength range and was calibrated in relative flux at the top of the atmosphere using as a reference a hot main sequence star of known spectral class with low interstellar (IS) extinction.

The digitized spectra can be downloaded from the BAA Spectroscopy Database[7]

The spectra are a composite of the two components. No features specific to either component were evident in the spectra.

The medium resolution spectrum (fig 2) gives a good match to F0 MK standard spectra[8] confirming the classification given in the HD catalogue[9]. It was not possible however to constrain the luminosity class to better than III-V from the spectrum.

The low resolution spectrum is a good match to the proposed A9III/F2IV system with some

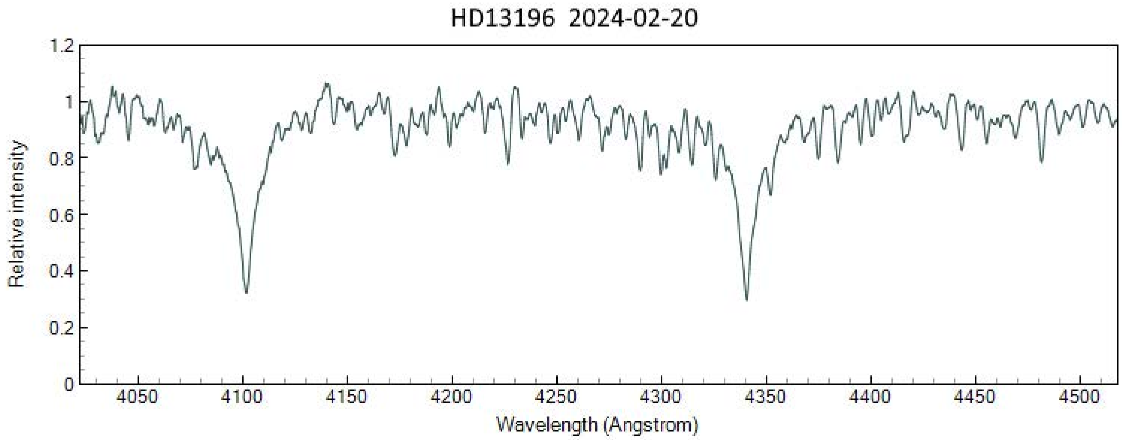

Figure 2: Medium resolution spectrum

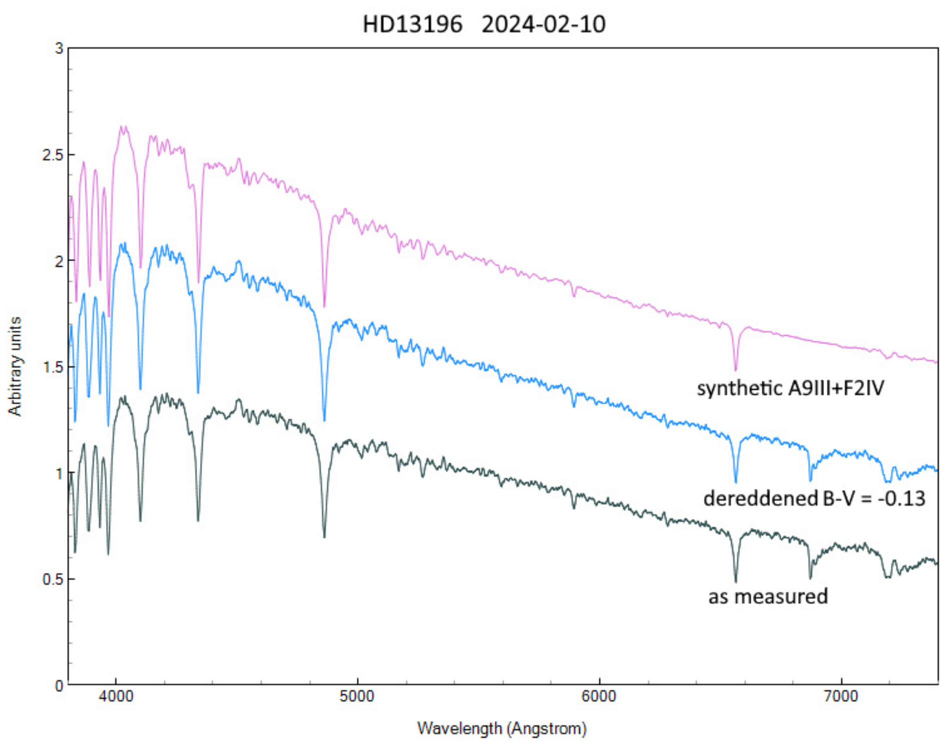

Figure 3: Low resolution spectrum compared with synthesized spectrum

reddening due to interstellar dust. Fig 3 shows the spectrum as-measured and then de-reddened by $(B-V) = -0.13$ to match the continuum of an A9III/F2IV spectrum synthesised from the Pickles Library of Stellar Spectra[10]. The extinction can also be estimated by comparing the colour index $(B-V)$ measured from photometry compared with what would be expected from the spectral classification to give an independent estimate of the colour excess E(B-V).

Photometry is available from the Tycho-2 catalogue[11] which gives a colour index in the Tycho passbands $(BT - VT) = 0.464$. This then can be transformed to the Johnson system[12] to give $(B - V) = 0.44$. The expected $(B - V)$ based on the F0 spectra classification = 0.31[13]. The resulting colour excess $E(B\mathrm{V})$ is therefore 0.13, in agreement with the result from the low resolution spectrum. This colour excess corresponds to a total extinction in V (Av) of 0.40.

Dynamical Parallax and masses

Using visual magnitudes 8.1 and 9.0, a combined spectrum F0, the calculated orbital parameters P and an interstellar total extinction V $(Av) = 0.40$, the following results were obtained for the dynamical parallax, masses and absolute visual magnitudes[14]

Dynamical parallax:	0.00481 mas (r = 208 pc)
Total mass:	4.4 solar masses
Individual masses:	A = 2.4 solar masses B = 2.0 solar masses
Absolute visual magnitude A:	$1.^m1$
Absolute visual magnitude B:	$2.^m0$

Note: The calculation gives $\pi_{dyn} = 4.81$ mas resulting in a total mass of 4.4 $M_\odot$. But in view of the fact, that B is possibly a subgiant the dynamical parallax and the values for the calculated masses should be considered with caution.

Radius and Surface gravity log g

With the dynamical parallax given as 4.81 mas the component A has a calculated luminosity of $31L_\odot$ and the B component has $14L_\odot$.

GAIA DR2 gives the pair a T_{eff} of 6778K. The pair are below the resolution of GAIA so individual T_{eff} are not available in GAIA DR2. The paper by René Andrae *et al.* (2018)[15] confirms that stars in the galactic plane can have significant errors 'of up to 400K' in their T_{eff} values and can appear significantly cooler. The T_{eff} for a star of class F0 is 7300K. Due to the pair being close to the galactic plane and the possible error in the GAIA T_{eff} value, we have chosen to use the spectral data as a basis to calculate the radius and the log g.

Using the values 7450 ± 100K for the primary and 7050 ± 100K for the secondary based on the spectral type and class of A9III/F2IV.

The T_{eff} values give a radius of component A of $3.3 - 3.4R_\odot$ and component B $2.4 - 2.5R_\odot$. The values for log g for component A are $3.7 - 3.8$ and for component B they are $3.9 - 4.0$. A paper by T. Angelov (1996)[16] of surface gravity along the main sequence, supports the analysis that the A component is a giant. The log g of the B component is much closer to the main sequence but due to the relatively sparse data, sub-giant class (IV) cannot be ruled out.

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DOUBLE STAR MEASUREMENTS 2023

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Abstract

Photometric and astrometric measurements from CCD images taken in 2023 with remote telescopes

Method

This article reports photometric and astrometric measurements obtained by processing CCD images taken 2022 with the remote telescopes iT24 in Auberry, California and iT32 in Siding Spring, New South Wales, Australia with a V filter.

The selected objects for this report are faint and wide pairs assumed physical with the highest possible altitude during nights without Moon to eliminate atmospheric imaging effects as far as possible. This report covers about 280 such objects, including some WDS objects that happened to be by chance in close visual proximity to the selected targets, which are in most cases optical pairs.

Measurements of optical pairs seem, at least to some degree, a waste of time and effort; however, such measures often allow for corrections of erroneous WDS data. These measures also give reason for checking Gaia DR3 parallax and proper motion data allowing deciding if a pair is clearly optical or not.

In addition, a few images were taken with the iT72 remote telescope in Chile to test the better resolution according to the technical description. Several pairs with separation ∼2 arseconds were selected but the results were only positive for equal bright (which means in this case mag. 13 or fainter) pairs with separation larger than 2″ .

The intention was, to take two or more images in different nights for all selected objects, but unfavourable imaging conditions often reduced this to a single image. The images were plate solved with Astrometrica using the GAIA DR2 catalog with reference stars in the magnitude range of 8.5 to 16.5 for astrometric measurements (i.e. calculating theta and rho). In a second step the images were again plate-solved with Astrometrica using the UCAC4 catalog for photometry in the visual band. Plate solving with UCAC4 is due to the lack of reliable proper motion data meanwhile a bit imprecise leading in a few cases to missing photometric measurements.

The objects were located in the center of the image and astrometry/photometry was done by the rather comfortable Astrometrica procedure with point and click at the components delivering RA/Dec coordinates and V mag. measurements based on all reference stars used for plate solving. The error range of the reported visual magnitudes is calculated from the average plate solving V mag. error of the image and the signal to noise ratio of the components. The error ranges for separation and position angle of the components are calculated from the average plate solving RA/Dec position errors.

Results

Table 1: Results for measured WDS objects

WDS_ID	Comp	Date	PA	e_PA	Sep	e_Sep	M1	e_M1	M2	e_M2	N
02272+4101		2023.86674	3.743	0.752	4.59480	0.06030	12.087	0.050	12.914	0.051	2
02323+3507		2023.86675	314.068	0.329	12.96173	0.07441	13.998	0.046	14.805	0.046	2
02367+3621		2023.86676	291.818	0.466	6.95547	0.05657	12.998	0.045	14.793	0.047	2

02392+2917		2023.86677	101.978	0.234	16.50319	0.06734	11.261	0.060	13.367	0.060	2
02411+3648		2023.86677	49.862	0.317	14.11635	0.07810	13.201	0.055	14.118	0.056	2
02548+2535		2023.86678	18.549	0.862	4.69917	0.07071	14.270	0.057	15.076	0.060	2
02574+4614		2023.86679	187.539	0.431	8.42813	0.06364	12.974	0.070	13.935	0.071	2
03041+2806		2023.86680	211.362	0.478	8.47964	0.07071	14.123	0.051	14.443	0.051	2
03045+4400		2023.86681	51.679	0.196	22.77932	0.07778	11.530	0.060	12.629	0.060	2
03053+4356		2023.86681	135.748	0.464	9.59822	0.07778	11.674	0.060	14.660	0.061	2
03083+3501	AB	2023.86681	260.745	0.271	17.22410	0.08148	10.849	0.045	12.271	0.045	2
03083+3501	CD	2023.86681	332.252	0.816	5.72442	0.08148	11.918	0.045	14.440	0.053	2
03200+3845		2023.86682	158.194	0.835	5.57964	0.08145	12.441	0.115	12.472	0.115	2
03203+3857		2023.86682	204.394	1.334	3.50269	0.08145	13.182	0.116	13.406	0.116	2
03211+3902		2023.86682	190.958	0.379	12.31977	0.08145	10.130	0.115	12.482	0.115	2
03238+4718		2023.86683	37.260	0.407	11.45935	0.08148	10.748	0.070	12.646	0.070	2
03257+4354		2023.86684	173.029	0.846	5.52082	0.08148	11.803	0.071	13.055	0.072	2
03360+2936		2023.86684	21.002	0.310	15.68198	0.08485	14.569	0.046	14.570	0.046	2
03421+4048		2023.86685	343.463	0.414	11.75115	0.08485	14.124	0.061	14.751	0.061	2
03454+3759		2023.86686	272.130	0.381	13.31695	0.08852	14.664	0.046	14.029	0.046	2
03461+3535		2023.86687	54.422	0.593	7.20096	0.07444	13.227	0.075	14.828	0.077	2
03475+4534		2023.86688	348.939	0.495	7.80011	0.06734	12.354	0.075	12.650	0.075	2
03525+4209		2023.86688	250.713	0.744	5.98007	0.07778	11.013	0.075	12.832	0.078	2
03561+2758		2023.86689	129.965	0.091	42.54995	0.06734	12.903	0.055	13.901	0.056	2
03566+2746		2023.86689	214.791	1.115	3.44537	0.06734	12.328	0.057	12.435	0.057	2
03591+3246		2023.86556	272.174	0.331	11.07039	0.06403	12.990	0.071	13.616	0.071	1
04047+4058		2023.86556	219.177	0.937	4.32152	0.07071	13.566	0.041	13.591	0.041	1
04052+3232		2023.86557	255.657	0.587	8.27552	0.08485	13.195	0.050	13.651	0.051	1
04262+4220		2023.86558	14.722	0.393	10.29806	0.07071	11.869	0.050	13.696	0.050	1
06541-2209		2023.05288	190.799	0.354	14.90394	0.09220	14.102	0.060	16.389	0.065	1
07092+4118		2023.07144	50.508	0.095	55.86427	0.09220	14.540	0.050	18.402	0.145	1
07159-2934		2023.06660	199.325	0.449	9.02870	0.07071	12.084	0.060	13.972	0.060	1
07178-3130		2023.06381	313.648	0.756	6.70026	0.08855	12.291	0.060	12.917	0.060	2
07188-3356		2023.06382	249.698	0.233	19.19478	0.07811	12.863	0.060	15.174	0.061	2
07190-3501		2023.06380	265.450	0.830	6.36515	0.09220	12.734	0.060	13.931	0.061	2
07198-3352		2023.06382	129.249	0.612	7.31031	0.07811	11.144	0.060	13.013	0.060	2
07203-2647		2023.06663	239.636	0.338	14.40176	0.08485	13.443	0.060	14.461	0.061	1
07207-3207		2023.06662	348.780	0.393	10.31719	0.07071	11.013	0.060	12.072	0.060	1
07208-3116		2023.06658	60.522	0.767	5.83221	0.07810	10.990	0.060	14.515	0.069	1
07208-3213		2023.06662	321.122	0.502	8.06697	0.07071	12.738	0.060	14.210	0.060	1
07209-3219		2023.06662	257.822	0.365	11.09258	0.07071	11.221	0.060	12.958	0.060	1
07209-3222		2023.06662	259.774	0.260	15.60218	0.07071	11.405	0.060	14.771	0.061	1
07210-3111	AB	2023.06658	12.765	0.602	7.43374	0.07810	11.973	0.060	16.396	0.120	1
07210-3111	AC	2023.06658	330.384	0.516	8.67306	0.07810	11.973	0.060	15.032	0.064	1
07214-3102	AB	2023.06658	136.785	0.450	9.94794	0.07810	12.650	0.060	12.933	0.060	1
07214-3102	AC	2023.06658	52.983	0.331	13.53722	0.07810	12.650	0.060	13.401	0.060	1
07214-3102	AD	2023.06658	95.207	0.341	13.11209	0.07810	12.650	0.060	15.491	0.062	1
07214-3102	AE	2023.06658	141.650	0.190	23.55150	0.07810	12.650	0.060	14.491	0.061	1
07214-3102	AF	2023.06658	200.553	0.182	24.63810	0.07810	12.650	0.060	13.123	0.060	1
07214-3112	AB	2023.06658	283.858	0.570	7.84915	0.07810	11.024	0.060	16.387	0.074	1
07214-3112	AC	2023.06658	116.039	0.452	9.90936	0.07810	11.024	0.060	14.283	0.061	1
07216-3102		2023.06658	203.077	1.137	3.93487	0.07810	14.607	0.061	14.349	0.061	1
07231-3313		2023.06661	160.043	0.463	9.67070	0.07810	11.957	0.060	13.857	0.060	1
07240-2554		2023.06381	314.893	0.763	6.93480	0.09220	9.932	0.060	11.684	0.061	2

07240-3102		2023.06104	185.171	0.756	6.98844	0.09220	11.726	0.070	15.075	0.072	1
07240-3339		2023.06104	244.392	0.939	5.62229	0.09220	10.815	0.050	12.843	0.051	1
07241-4003		2023.05289	125.367	0.159	33.11910	0.09220	9.670	0.060	17.975	0.144	1
07242-3216	AB	2023.06379	60.873	0.886	5.73040	0.08852	12.905	0.060	15.209	0.064	2
07242-3216	AC	2023.06379	173.398	0.808	6.27792	0.08852	12.905	0.060	15.472	0.071	2
07242-3216	CD	2023.06379	164.479	1.280	3.95935	0.08852	15.472	0.071	15.622	0.062	2
07246-3104	AB	2023.06104	18.873	1.108	4.76624	0.09220	11.795	0.070	13.926	0.071	1
07246-3104	AC	2023.06104	263.956	0.434	12.15727	0.09220	11.795	0.070	15.044	0.071	1
07255-3204		2023.06384	179.151	0.690	7.35202	0.08852	11.825	0.060	14.117	0.061	2
07260-3216	AB	2023.06384	116.431	0.617	8.22239	0.08852	10.125	0.060	13.426	0.061	2
07260-3216	AC	2023.06384	287.601	0.603	8.41652	0.08852	10.125	0.060	16.113	0.087	2
07265-3213	AB	2023.06384	181.300	1.400	3.55762	0.08684	13.220	0.061	13.797	0.061	4
07265-3213	AC	2023.06384	114.943	1.051	4.74874	0.08684	13.220	0.061	13.118	0.060	4
07267-3108	AB	2023.06660	311.363	0.431	8.51964	0.06403	11.673	0.070	13.746	0.071	1
07267-3108	AC	2023.06660	158.130	0.622	5.89420	0.06403	11.673	0.070	15.160	0.074	1
07267-3108	AD	2023.06660	139.613	0.248	14.82237	0.06403	11.673	0.070	15.161	0.071	1
07268-3207	AB	2023.06384	228.328	0.674	7.38210	0.08684	11.608	0.060	15.846	0.074	4
07268-3207	AC	2023.06384	94.329	0.487	10.22826	0.08684	11.608	0.060	16.107	0.064	4
07278-3326		2023.06664	337.536	0.244	16.57806	0.07071	10.841	0.060	14.255	0.061	1
07284-2826		2023.06666	168.872	0.235	19.06848	0.07810	10.444	0.060	15.327	0.061	1
07286-2627		2023.06383	296.009	0.654	7.45700	0.08515	10.797	0.060	10.876	0.060	2
07318+3731		2023.05779	225.848	0.852	6.20186	0.09220	12.810	0.082	13.070	0.084	1
07318+4108		2023.05780	71.631	0.464	8.72625	0.07071	11.670	0.103	13.763	0.108	1
07341+3539		2023.05771	181.509	0.720	5.09177	0.06403	11.188	0.060	11.621	0.061	1
07354+3848		2023.05782	111.573	0.839	5.33055	0.07810	14.270	0.081	14.968	0.085	1
07370-2755		2023.06664	313.074	0.246	16.45818	0.07071	11.525	0.060	14.922	0.061	1
07395+3817		2023.05773	351.742	0.334	10.98389	0.06403	10.534	0.040	12.167	0.040	1
07406+3534		2023.05778	211.804	1.056	5.00086	0.09220	12.624	0.062	13.011	0.064	1
07406-2653		2023.06240	312.005	1.322	3.69098	0.08515	11.872	0.060	12.787	0.061	2
07406-3142	AC	2023.06662	85.466	0.707	6.32470	0.07810	11.122	0.060	12.106	0.060	1
07409-2707		2023.06240	190.748	0.921	5.29795	0.08515	11.254	0.060	12.201	0.060	2
07409-3141		2023.06662	348.934	0.394	11.37144	0.07810	10.587	0.060	12.002	0.061	1
07420-3448		2023.06665	260.693	0.280	18.85913	0.09220	13.553	0.060	14.683	0.061	1
07440+4217		2023.05774	27.067	0.137	17.77694	0.04243	15.389	0.032	16.255	0.035	1
07442-2806		2023.06239	280.416	1.049	5.03774	0.09220	14.057	0.061	14.609	0.061	2
07444+4204		2023.05774	40.389	0.129	18.90580	0.04243	11.067	0.030	12.786	0.030	1
07452+4302		2023.05787	46.512	0.150	16.17235	0.04243	14.302	0.041	15.606	0.043	1
07460-3231		2023.06659	50.636	0.624	7.78885	0.08485	11.904	0.060	11.449	0.060	1
07479-2537		2023.05287	237.292	0.464	12.23243	0.09899	11.954	0.060	15.305	0.062	1
07492+3222		2023.05788	141.497	0.682	5.94195	0.07071	12.221	0.040	15.391	0.049	1
07503+3211		2023.05772	189.565	0.428	7.56517	0.05657	10.862	0.040	11.518	0.040	1
07529+3632		2023.05781	249.865	0.969	5.08380	0.08602	12.885	0.104	13.761	0.111	1
07541+3601		2023.05784	149.048	0.398	13.25804	0.09220	12.160	0.050	14.358	0.051	1
07552+3757		2023.05784	293.255	0.665	7.00221	0.08145	14.496	0.051	14.714	0.051	2
07554+3755		2023.05784	2.849	0.727	6.42304	0.08145	15.520	0.054	15.680	0.055	2
07554+3818		2023.05777	293.341	0.648	8.15251	0.09220	12.800	0.060	13.269	0.060	1
07556+3752		2023.05784	86.668	0.779	5.96587	0.08145	14.384	0.051	14.447	0.051	2
07587+4053		2023.05786	126.490	0.280	17.33733	0.08485	12.349	0.040	15.086	0.043	1
08004+4243		2023.05497	142.308	0.715	5.40796	0.06734	11.146	0.062	12.114	0.066	2
08006+3431		2023.05785	249.454	0.182	17.77990	0.05657	13.238	0.040	14.279	0.041	1
08010+3454	AB	2023.05783	55.717	1.089	4.52702	0.08602	13.406	0.060	13.783	0.061	1

08010+3454	AC	2023.05783	229.740	0.096	51.45228	0.08602	13.406	0.060	13.619	0.060	1
08018+3526		2023.05776	43.659	0.376	12.92382	0.08485	10.149	0.050	12.941	0.050	1
08036+4016		2023.05778	271.634	0.365	13.32789	0.08485	12.921	0.050	13.311	0.050	1
08100-4214		2023.05285	76.151	0.172	30.79022	0.09220	13.827	0.070	15.029	0.071	1
08100-4241		2023.05285	34.737	0.658	8.03147	0.09220	12.119	0.070	12.703	0.070	1
08101-4228		2023.05285	308.173	1.040	5.08056	0.09220	11.868	0.070	15.441	0.080	1
08102+3347		2023.05496	295.399	0.786	5.41985	0.07444	10.958	0.046	11.487	0.048	2
08113-4227		2023.05285	83.228	0.375	14.07814	0.09220	10.978	0.070	11.185	0.070	1
08169-1644		2023.05286	185.787	0.865	6.55340	0.09899	12.215	0.061	15.996	0.093	1
08172+3515		2023.05776	80.260	0.729	5.55646	0.07071	12.358	0.051	12.580	0.051	1
08452+3539		2023.11518	152.490	1.025	4.63189	0.08260	14.521	0.058	16.440	0.077	3
08501+3712		2023.13446	134.677	0.697	6.97572	0.08485	12.538	0.041	13.648	0.041	2
08587+4050		2023.13438	214.883	1.047	4.45562	0.08148	12.025	0.036	13.235	0.042	2
09058+3325		2023.13445	261.343	0.666	7.00918	0.08148	11.773	0.051	12.259	0.051	2
09087+4230		2023.13443	283.975	0.793	5.88100	0.08148	11.618	0.041	11.830	0.041	2
09150+4006		2023.13176	266.372	0.488	9.95573	0.08485	15.754	0.043	16.609	0.048	1
09150+4311		2023.13453	75.393	0.557	11.93557	0.11598	10.703	0.077	14.863	0.079	2
09165+3021		2023.13439	80.896	0.960	4.86114	0.08148	15.023	0.036	15.743	0.038	2
09169+3540		2023.13452	288.913	0.586	11.89246	0.12148	13.013	0.065	12.738	0.063	2
09193+3831		2023.13447	186.517	0.565	7.54892	0.07444	14.844	0.063	14.706	0.062	2
09203+3944		2023.13455	205.583	0.501	13.79781	0.12069	12.816	0.055	14.607	0.056	2
09226+3321		2023.13438	320.348	0.863	4.69469	0.07071	12.131	0.046	12.658	0.047	2
09263+3353		2023.13440	66.122	0.932	5.21616	0.08485	12.875	0.071	13.149	0.071	2
09292+4318	AB	2023.13454	353.179	0.333	22.06118	0.12845	10.439	0.066	11.550	0.066	2
09292+4318	AC	2023.13454	122.218	0.101	72.81879	0.12845	10.439	0.066	13.802	0.066	2
09296+4312		2023.13454	297.761	0.596	12.47167	0.12845	13.738	0.066	15.034	0.067	2
09320+3743		2023.13444	120.750	0.760	6.14340	0.08148	12.062	0.040	15.647	0.058	2
09322+3139		2023.13441	179.496	0.956	5.08520	0.08485	10.523	0.045	11.537	0.046	2
09341+3826		2023.13451	301.890	0.790	10.10820	0.13951	10.644	0.061	11.863	0.062	2
09358+3553		2023.13447	94.713	0.569	7.48957	0.07441	12.672	0.046	12.628	0.046	2
09358+4040		2023.13455	13.349	0.210	22.18110	0.08148	10.227	0.045	14.394	0.046	2
09439+4057		2023.13452	180.623	0.525	11.48588	0.10508	13.897	0.061	15.160	0.062	2
09521+4315		2023.13448	6.036	0.584	7.68765	0.07837	13.565	0.076	13.614	0.076	2
09522+3930		2023.13442	302.192	0.779	5.19834	0.07071	11.926	0.050	13.106	0.051	2
10001+3901		2023.13444	117.381	0.568	6.09650	0.06030	12.118	0.035	12.451	0.036	2
10034+3935		2023.13449	110.893	0.499	8.55125	0.07441	12.009	0.081	12.266	0.081	2
10041+3949		2023.13441	209.943	0.987	5.13549	0.08852	11.410	0.046	12.492	0.047	2
10434+4348		2023.13707	287.590	0.542	12.63807	0.11928	14.699	0.061	16.523	0.086	2
10445-3700		2023.21054	69.491	2.076	2.34051	0.08485	13.203	0.052	14.211	0.059	1
12047-3757		2023.21054	95.308	2.442	2.16175	0.09220	14.401	0.055	15.303	0.062	1
12432-3743		2023.21055	144.954	0.367	13.26492	0.08485	11.599	0.050	17.571	0.058	1
13483+3326		2023.37247	213.558	0.447	7.31415	0.05708	12.163	0.040	11.945	0.040	2
13531+3100		2023.37248	266.472	0.206	16.73459	0.06030	13.009	0.090	13.370	0.090	2
13537+4027		2023.37249	171.856	0.887	4.85000	0.07511	12.850	0.046	13.057	0.047	2
13540+4016		2023.37249	238.910	0.497	8.65566	0.07511	13.200	0.045	13.636	0.046	2
13550+3135		2023.37250	140.614	0.475	7.74360	0.06405	13.758	0.075	15.150	0.076	2
13557+3145		2023.37250	298.808	0.198	18.53093	0.06405	14.370	0.076	17.474	0.083	2
14098+3544		2023.37251	35.498	0.720	5.36766	0.06743	12.451	0.046	14.363	0.051	2
14103+4008		2023.37252	182.773	0.518	8.30068	0.07503	12.486	0.050	14.447	0.051	2
14111+3454		2023.37253	38.855	0.366	11.65959	0.07441	13.120	0.050	14.807	0.051	2

14141+3354		2023.37254	210.708	1.555	3.39863	0.09220	15.876	0.050	16.642	0.057	2
14188+2908		2023.37255	175.841	0.210	19.33090	0.07071	12.236	0.040	14.513	0.040	2
14231+4106		2023.37256	55.269	0.500	9.75245	0.08515	11.345	0.040	13.422	0.040	2
14292+4009		2023.37257	12.885	0.723	6.45248	0.08148	11.461	0.055	12.428	0.056	2
14354+3349		2023.37257	158.225	0.384	11.63347	0.07778	10.364	0.040	16.534	0.051	2
14374+4744		2023.37258	54.131	0.294	15.88000	0.08148	13.867	0.040	14.471	0.040	2
14446+3606		2023.37261	21.238	0.206	20.65793	0.07441	13.358	0.050	14.311	0.050	2
14512+4518		2023.37262	218.167	0.742	7.37020	0.09558	12.967	0.056	13.560	0.056	2
14514+2750		2023.37263	34.494	0.318	15.30590	0.08485	14.231	0.040	14.898	0.041	2
14518+2759		2023.37263	39.600	0.293	16.57297	0.08485	12.252	0.040	12.711	0.040	2
14523+3344	AB	2023.37264	283.689	0.240	21.08646	0.08852	12.914	0.030	13.142	0.030	2
14589+4137		2023.37265	47.782	1.405	3.46020	0.08485	14.283	0.049	14.539	0.051	2
14592+3956	AB	2023.37266	17.109	0.716	6.82189	0.08515	15.771	0.041	16.464	0.043	2
14592+3956	AC	2023.37266	309.692	0.086	56.72692	0.08515	15.771	0.041	15.772	0.041	2
14592+3956	BC	2023.37266	303.052	0.090	54.47146	0.08515	16.464	0.043	15.772	0.041	2
15101+4208		2023.37267	147.443	0.541	9.38516	0.08852	12.003	0.050	12.694	0.050	2
15124+3650		2023.37268	268.917	0.708	6.59887	0.08148	11.219	0.035	14.379	0.042	2
15170+4109		2023.37269	146.635	0.385	11.06938	0.07441	14.631	0.051	14.605	0.051	2
16072+3402		2023.45464	90.672	0.558	4.36392	0.04243	11.064	0.040	15.544	0.048	2
16072+3536		2023.45480	295.922	0.108	22.60061	0.04243	11.485	0.040	14.387	0.040	2
16074+3548		2023.45480	146.530	0.187	13.02499	0.04243	12.262	0.040	13.008	0.040	2
16076+3547		2023.45480	154.856	0.069	35.00763	0.04243	14.497	0.040	15.090	0.041	2
16088+3635		2023.45463	341.890	0.155	17.12850	0.04621	15.313	0.046	16.980	0.050	2
16138+4518		2023.45474	63.518	0.192	12.63674	0.04243	12.729	0.035	13.707	0.035	2
16173+3804		2023.45461	342.232	0.235	3.44431	0.01414	13.239	0.040	14.158	0.041	2
16219+3229		2023.45465	30.934	0.175	4.64000	0.01414	12.822	0.045	13.966	0.046	2
16245+4001		2023.45466	162.550	0.374	6.49387	0.04243	15.817	0.036	17.755	0.053	2
16255+3645		2023.45476	280.876	0.142	17.14557	0.04243	13.812	0.040	14.585	0.040	2
16321+4536		2023.45472	182.199	0.555	4.37903	0.04243	17.701	0.055	17.957	0.062	2
16324+4545		2023.45472	328.401	0.206	11.81702	0.04243	11.767	0.040	13.968	0.040	2
16404+2842		2023.45467	316.714	0.391	7.80971	0.05328	13.269	0.040	17.068	0.047	2
16413+3505	AB	2023.45478	218.165	0.110	22.16974	0.04243	16.293	0.042	19.283	0.116	2
16460+3324		2023.45471	255.317	0.233	10.41569	0.04243	11.575	0.040	14.802	0.041	2
16490+4458		2023.45471	34.695	0.254	9.58400	0.04243	11.811	0.040	13.417	0.040	2
16542+3805		2023.45481	7.049	0.107	22.65624	0.04243	12.595	0.040	14.991	0.041	2
16548+3415		2023.45473	84.790	0.212	12.49966	0.04621	11.071	0.050	13.891	0.050	2
16550+3409		2023.45473	257.525	0.263	10.06908	0.04621	16.820	0.053	18.509	0.079	2
16554+4029		2023.45479	266.353	0.118	22.47963	0.04621	12.135	0.035	14.273	0.035	2
16555+3558		2023.45469	284.163	0.306	8.66434	0.04621	13.063	0.050	14.873	0.050	2
16558+3410		2023.45473	219.610	0.052	51.38980	0.04621	14.521	0.050	16.842	0.054	2
16558+3513		2023.45469	237.385	0.265	9.16536	0.04243	13.216	0.040	14.325	0.040	2
16566+3037		2023.45470	24.510	0.282	9.39672	0.04621	11.834	0.050	12.881	0.050	2
16591+3146		2023.45462	306.001	0.228	3.54713	0.01414	15.413	0.051	15.724	0.052	2
16598+4553		2023.45466	219.103	0.168	4.82597	0.01414	13.089	0.050	13.724	0.050	2
17004+4239		2023.45477	140.711	0.119	20.45339	0.04243	14.491	0.050	15.087	0.050	2
17051+3418		2023.45468	23.054	0.098	8.22702	0.01414	12.037	0.055	14.846	0.056	2
17076+3823		2023.45475	219.540	0.161	15.10677	0.04243	12.206	0.050	12.766	0.050	2
19570+3621		2023.62175	293.919	0.665	6.09203	0.07071	13.228	0.140	14.051	0.140	1
19584+3751		2023.62443	114.681	0.133	24.30721	0.05657	10.467	0.120	13.162	0.120	2
19590+3750		2023.62443	200.119	0.191	16.99722	0.05657	12.630	0.120	12.869	0.120	2
19590+3759		2023.62443	156.950	0.626	5.17842	0.05657	11.236	0.120	11.697	0.120	2

20068+3628		2023.62177	42.265	0.535	6.85097	0.06403	11.046	0.090	14.436	0.091	1
20072+3616	AB	2023.62177	171.496	0.198	18.56412	0.06403	10.850	0.090	12.508	0.090	1
20072+3616	AC	2023.62177	348.923	0.126	29.14293	0.06403	10.850	0.090	12.602	0.090	1
20072+3616	AE	2023.62177	282.252	0.030	120.95474	0.06403	10.850	0.090	10.795	0.090	1
20072+3616	CD	2023.62177	192.017	0.381	9.64129	0.06403	12.602	0.090	13.474	0.090	1
20072+3616	EF	2023.62177	19.896	0.496	7.39114	0.06403	10.795	0.090	15.475	0.096	1
20075+3618		2023.62177	133.007	0.289	12.71118	0.06403	11.898	0.090	12.890	0.090	1
20075+3619		2023.62177	286.282	0.207	17.72640	0.06403	10.811	0.090	17.047	0.095	1
20076+3627	AB	2023.62177	164.844	0.127	28.97802	0.06403	12.440	0.090	13.164	0.090	1
20076+3627	BC	2023.62177	111.851	0.157	23.29475	0.06403	13.164	0.090	12.963	0.090	1
20110+4041		2023.62711	322.617	0.218	14.87537	0.05657	13.170	0.080	14.939	0.080	1
20140+3726		2023.62712	254.468	0.357	9.07468	0.05657	12.604	0.080	12.644	0.080	1
20150+3729		2023.62712	227.566	0.166	19.56339	0.05657	11.736	0.080	14.666	0.080	1
20150+3743		2023.62712	341.254	0.154	21.04641	0.05657	11.210	0.080	11.517	0.080	1
20213+3726		2023.62446	335.055	0.216	16.90162	0.06364	12.795	0.055	13.517	0.055	2
20214+3720		2023.62446	301.373	0.347	10.52577	0.06364	11.952	0.055	13.096	0.055	2
20216+3725	AB	2023.62446	286.129	0.506	7.19897	0.06364	10.569	0.055	11.571	0.055	2
20216+3725	AC	2023.62446	128.675	0.239	15.29804	0.06364	10.569	0.055	11.866	0.055	2
20264+4520		2023.62447	89.617	0.696	4.63534	0.05657	13.365	0.100	13.831	0.101	2
20301+3636		2023.62447	209.365	0.544	6.71791	0.06364	10.216	0.055	13.993	0.061	2
20353+3313		2023.62448	191.354	0.055	73.48863	0.07071	13.153	0.065	13.706	0.065	2
20354+3301		2023.62448	305.564	0.162	24.95668	0.07071	13.665	0.065	13.830	0.065	2
20400+4405		2023.62449	144.783	0.181	20.15374	0.06364	13.159	0.065	13.453	0.065	2
20435+3212		2023.62450	224.790	0.388	12.59162	0.08485	10.480	0.070	14.793	0.071	2
20539+4115		2023.62450	93.164	0.394	11.32284	0.07778	13.083	0.060	14.486	0.060	2
20542+4111		2023.62450	275.893	0.573	7.79845	0.07778	10.574	0.060	13.736	0.062	2
20567+3047		2023.62451	200.057	0.426	10.01226	0.07438	14.344	0.110	14.861	0.110	2
20569+3818		2023.62452	247.237	0.497	8.95507	0.07778	12.007	0.101	12.861	0.100	2
20573+3215		2023.62720	28.165	0.328	9.89113	0.05657	.	.	.	.	1
20578+3202		2023.62720	310.589	0.481	6.73192	0.05657	.	.	.	.	1
20598+3126		2023.62721	1.860	0.063	51.24701	0.05657	.	.	.	.	1
21003+3134		2023.62721	160.491	0.314	10.33325	0.05657	.	.	.	.	1
21050+3347		2023.62722	282.823	0.145	22.34834	0.05657	10.949	0.110	14.475	0.110	1
21062+4249		2023.62722	29.253	0.156	8.19508	0.02236	12.672	0.100	13.212	0.100	1
21077+3009		2023.62723	334.365	0.250	8.27445	0.03606	11.298	0.080	13.301	0.080	1
21086+3201		2023.62724	310.217	0.115	7.06223	0.01414	12.773	0.080	15.054	0.081	1
21131+3249		2023.62725	155.304	0.376	8.62926	0.05657	11.364	0.060	11.527	0.060	1
21133+3248		2023.62725	345.806	0.135	24.06457	0.05657	10.806	0.060	14.153	0.060	1
21133+3803		2023.62725	211.051	0.142	22.80838	0.05657	10.546	0.100	10.555	0.100	1
21138+3800		2023.62725	19.545	0.480	6.74885	0.05657	12.093	0.100	13.143	0.100	1
21138+3812		2023.62725	326.592	0.212	15.26152	0.05657	12.529	0.100	12.856	0.100	1
21140+3755		2023.62725	27.543	0.304	10.64665	0.05657	11.320	0.100	11.949	0.100	1
21140+3809		2023.62725	356.847	0.154	21.02181	0.05657	11.993	0.100	12.115	0.100	1
21140+4051		2023.62726	31.930	0.326	9.93284	0.05657	12.475	0.080	12.175	0.080	1
21144+3753		2023.62725	258.498	0.465	6.97084	0.05657	10.877	0.100	13.031	0.100	1
21144+3803	AB	2023.62725	136.347	0.303	10.71145	0.05657	11.389	0.100	11.983	0.100	1
21144+3803	AC	2023.62725	182.652	0.135	23.99570	0.05657	11.389	0.100	13.670	0.100	1
21150+3611	BC	2023.62727	247.335	0.304	10.66604	0.05657	12.591	0.080	13.025	0.080	1
21385+3942		2023.70795	208.102	0.608	5.32815	0.05657	12.673	0.060	12.921	0.060	2
21465+3506		2023.70795	281.732	0.096	10.94240	0.01825	13.193	0.080	14.558	0.080	2
21541+3633		2023.70793	139.501	0.311	10.40905	0.05657	10.862	0.055	14.487	0.055	2

22013+4515		2023.70803	26.813	0.197	16.49332	0.05657	10.240	0.070	12.804	0.070	2
22016+4528		2023.70803	292.621	0.415	7.81271	0.05657	11.101	0.070	16.063	0.079	2
22017+4517		2023.70803	255.828	0.255	12.70291	0.05657	11.792	0.070	12.260	0.070	2
22034+4250		2023.70792	305.151	0.494	2.47447	0.02121	11.394	0.080	11.632	0.080	2
22036+4251		2023.70792	4.517	0.323	3.77173	0.02121	14.114	0.080	14.285	0.081	2
22100+2935		2023.70802	1.081	0.213	3.80068	0.01414	14.536	0.056	15.385	0.057	2
22104+3913		2023.70804	14.193	0.359	3.36786	0.02121	14.593	0.066	15.541	0.068	2
22190+3039		2023.70750	109.540	0.791	3.25905	0.04495	13.176	0.040	13.384	0.040	3
22198+3045		2023.70750	210.004	0.480	5.36191	0.04495	12.008	0.040	12.099	0.040	3
22208+4658		2023.70751	176.562	0.155	19.17118	0.05185	12.140	0.110	13.900	0.110	3
22231+3220		2023.70792	297.913	1.119	2.53223	0.04950	15.286	0.062	15.412	0.062	2
22236+3231		2023.70792	346.172	0.265	10.68979	0.04950	11.037	0.055	14.610	0.056	2
22239+3226		2023.70792	324.660	0.373	7.59496	0.04950	10.888	0.055	10.827	0.055	2
22246+3227	BC	2023.70792	21.336	0.221	12.81849	0.04950	12.456	0.055	12.258	0.055	2
22266+3224		2023.70748	16.252	0.246	3.28808	0.01414	12.873	0.057	12.946	0.057	3
22286+3851		2023.70752	165.524	0.065	14.94103	0.01688	11.802	0.060	12.412	0.060	3
22291+3844		2023.70752	310.989	0.262	3.69967	0.01688	14.018	0.061	14.176	0.061	3
22327+4129		2023.70749	354.085	0.272	3.56232	0.01688	13.275	0.060	13.517	0.061	3
22337+2952		2023.70799	232.995	0.249	3.25764	0.01414	14.720	0.061	15.023	0.062	2
22347+4237		2023.70794	245.857	0.449	6.32002	0.04950	11.006	0.050	14.800	0.056	2
22363+2840		2023.70801	319.391	0.057	14.15352	0.01414	12.100	0.060	15.549	0.061	2
22369+2834		2023.70801	244.023	0.068	11.98665	0.01414	16.992	0.067	18.378	0.107	2
22385+3754		2023.70801	319.592	0.356	7.43973	0.04621	12.797	0.050	14.438	0.050	2
22456+2755		2023.70797	155.317	0.287	8.47429	0.04243	13.091	0.040	14.833	0.041	2
22488+3140		2023.70747	265.039	0.362	6.70653	0.04243	12.422	0.040	12.770	0.040	3
22574+3531		2023.70560	106.548	0.103	7.88820	0.01414	12.525	0.055	13.502	0.055	3
22583+3717		2023.70800	115.498	0.355	7.45692	0.04621	13.024	0.050	12.985	0.050	2
23001+3649		2023.70804	90.199	0.282	8.62836	0.04243	12.669	0.060	13.014	0.060	2
23019+3642		2023.70804	146.294	0.452	5.37353	0.04243	10.843	0.060	13.460	0.062	2

Content description

WDS_ID	001-010	a10	WDS Designator
Comp	012-016	a5	left justified component designator. If blank this is AB
Date	018-027	f10.5	Observation date, in years
PA	030-036	f7.3	position angle theta, in degrees
e_PA	038-043	f6.3	formal theta error, in degrees
Sep	046-054	f9.5	separation rho, in arcseconds
e_Sep	057-063	f7.5	rho error, in arcseconds
M1	066-071	f6.3	primary magnitude, in V mag
e_M1	073-077	f5.3	primary magnitude error, in V mag
M2	080-085	f6.3	secondary magnitude, in V mag
e_M2	087-091	f5.3	secondary magnitude error, in Vmag
N	093-094	i2	number of nights averaged into mean measure

Table 2: Additional notes for measured WDS objects
Notes contain Gaia DR3 proper motion data for the measured objects if not already listed in WDS Catalog as well as WDS note code suggestions ("T" for assumed physical pairs with same parallax

and proper motion within the given error range and "S" for assumed optical pairs due to different parallax and proper motion).

WDS_ID	Comp	Notes
02272+4101		Proper motion −023−016/−023−016. WDS note code "T"
02323+3507		Proper motion +039+022/+039+023. WDS note code "T"
02367+3621		Proper motion −055−024/−055−024. WDS note code "T"
02392+2917		Proper motion +022−025/+022−025. WDS note code "T"
02411+3648		Proper motion −026−031/−026−031. WDS note code "T"
02548+2535		Proper motion 000−034/−001−034. WDS note code "T"
02574+4614		Proper motion +036−019/+036−019. Plx not similar enough to assume a physical pair
03041+2806		Proper motion −032−019/−032−019. WDS note code "T"
03045+4400		Proper motion +031−019/+031−019. WDS note code "T"
03053+4356		Proper motion +035−012/+038−015. Plx and pm similar, but not similar enough to assume a physical system
03083+3501	AB	Proper motion +014−010/+012−009. WDS note code "T"
03083+3501	CD	Proper motion −059+011/−059+011. WDS note code "T"
03200+3845		Proper motion +005−009/+005−009. WDS note code "T"
03203+3857		Proper motion +052−013/+052−012. WDS note code "T"
03211+3902		Proper motion −006−008/−006−009. WDS note code "T"
03238+4718		Proper motion +016−066/+016−066. WDS note code "T"
03257+4354		Proper motion +023−026/+019−022. Plx similar, pm different. Physical? WDS note code "Z"
03360+2936		Proper motion −026−051/−024−051. WDS note code "T"
03421+4048		Proper motion +056−058/+056−058. WDS note code "T"
03454+3759		Proper motion +032−053/+031−053. WDS note code "T"
03461+3535		Proper motion +032−037/+032−036. WDS note code "T"
03475+4534		Proper motion +033−028/+034−030. Plx and pm similar, but not similar enough to assume a physical pair
03525+4209		Proper motion +057−045/+057−045. WDS note code "T"
03561+2758		Proper motion +030−057/+027−039. WDS note code "S"
03566+2746		Proper motion +007−027/+009−028. WDS note code "T"
03591+3246		Proper motion +055−023/+055−023. WDS note code "T"
04052+3232		Proper motion +054−024/+053−024. WDS note code "T"
04262+4220		Proper motion +025−020/+026−021. WDS note code "T"
07159−2934		Proper motion −017−042/−016−042. WDS note code "T"
07178−3130		Proper motion −002−001/−001−001. Plx and pm similar, but insignificant
07188−3356		Proper motion −033+062/−033+062. WDS note code "T"
07188−3356		Proper motion −033+062/−033+062. WDS note code "T"
07190−3501		Proper motion −014+040/−014+040. WDS note code "T"
07198−3352		Proper motion +037+055/+038+055. WDS note code "T"
07203−2647		Proper motion +012−039/+011−038. WDS note code "T"
07207−3207		Proper motion −001 000/−001+003. WDS note code "S"
07208−3116		Proper motion −002+002/ 000+005. WDS note code "S"
07208−3213		Proper motion −002+004/−001+002. WDS note code "S"
07209−3219		Proper motion −011+006/−003+001. WDS note code "S"
07209−3222		Proper motion −005+008/−001+002. WDS note code "S"
07210−3111	AB	Proper motion −002+001/−002+001. Plx and pm similar, but insignificant
07210−3111	AC	Proper motion −002+001/+001−008. WDS note code "S"
07214−3102	AB	Proper motion +002 000/−003+006. WDS note code "S"
07214−3102	AC	Proper motion +002 000/−003+008. WDS note code "S"
07214−3102	AD	Proper motion +002 000/ 000+003. WDS note code "S"
07214−3102	AE	Proper motion +002 000/ 000+002. WDS note code "S"
07214−3102	AF	Proper motion +002 000/−009+005. WDS note code "S"
07214−3112	AB	Proper motion −001+004/+004−005. WDS note code "S"
07214−3112	AC	Proper motion −001+004/−008+006. WDS note code "S"
07216−3102		Proper motion −002+003/−012+006. WDS note code "S"
07231−3313		Proper motion −004+004/−007+001. WDS note code "S"
07240−2554		Proper motion −003+003/−003+003. Plx and pm similar, but insignificant

07240−3102		Proper motion −002+001/−001+002. WDS note code "S"
07240−3339		Proper motion 000+001/−007+002. WDS note code "S"
07242−3216	AB	Proper motion −005+006/−008+005. Plx and pm slightly different, but insignificant
07242−3216	AC	Proper motion −005+006/−003+003. WDS note code "S"
07242−3216	CD	Proper motion −003+003/−002+003. WDS note code "S"
07246−3104	AB	Proper motion +003+004/−002+003. WDS note code "S"
07246−3104	AC	Proper motion +003+004/−002+002. WDS note code "S"
07255−3204		Proper motion −008−001/ 000+001. WDS note code "S"
07260−3216	AB	Proper motion −003+010/ 000−003. WDS note code "S"
07260−3216	AC	Proper motion −003+010/−002+004. WDS note code "S"
07265−3213	AB	Proper motion −002+003/ 000+001. WDS note code "S"
07265−3213	AC	Proper motion −002+003/−003+003. WDS note code "S"
07267−3108	AB	Proper motion −003+003/+001+002. WDS note code "S"
07267−3108	AC	Proper motion −003+003/−001+003. WDS note code "S"
07267−3108	AD	Proper motion −003+003/−002+003. WDS note code "S"
07268−3207	AB	Proper motion −013+014/−001+002. WDS note code "S"
07268−3207	AC	Proper motion −013+014/−001+002. WDS note code "S"
07278−3326		Proper motion −004+057/−004+057. WDS note code "T"
07284−2826		WDS note code "T"
07286−2627		Proper motion −006+005/−008+003. WDS note code "S"
07318+3731		Proper motion −005−004/−005−003. WDS note code "T"
07318+4108		Proper motion +018−033/+018−033. WDS note code "T"
07341+3539		Proper motion 000−002/ 000−002. Plx and pm similar, but insignificant
07354+3848		WDS note code "T"
07370−2755		Proper motion 000−062/+003−058. Plx and pm similar, but not similar enough to assume a physical pair. Delete WDS note code "V"
07395+3817		Proper motion −013−035/−014−035. WDS note code "T"
07406+3534		Proper motion −002−023/−009−017. WDS note code "S"
07406−2653		Proper motion −002+004/−001+005. Delete WDS note code "B". Plx and pm similar but insignificant
07406−3142	AC	Proper motion −002+003/−002+003. Plx and pm similar, but insignificant
07409−2707		Proper motion −004+001/−001−008. Delete WDS note code "B". WDS note code "S"
07409−3141		Delete WDS note code "R". Proper motion −002+003/−002+003. Plx and pm similar, but insignificant
07420−3448		Proper motion +012−031/+012−031. WDS note code "T"
07440+4217		Proper motion −010−019/−011−019. WDS note code "T"
07442−2806		Proper motion −007+010/−002+002. WDS note code "S"
07444+4204		Proper motion +001−039/+001−039. Small difference in Gaia DR3 plx does not support physical pair assumption
07452+4302		Proper motion −004−059/−004−059. Delete WDS note code "R". Add WDS note code "T"
07460−3231		Proper motion B −005−012, no Gaia DR3 plx and pm data for A
07492+3222		Proper motion −022−028/−019−029. WDS note code "T"
07503+3211		Proper motion −002+001/+010−004. Plx similar, but pm too different for a physical pair. WDS note code "S"
07529+3632		Proper motion −030−018/−032−019. WDS note code "T"
07541+3601		Proper motion +068−028/+071−028. WDS note code "T"
07552+3757		Proper motion −002+002/ 000−033. WDS note code "S"
07554+3755		Proper motion −001−007/+002−007. Plx and pm similar, but values (especially for plx) seem insignificant
07554+3818		Proper motion −020−055/−020−056. WDS note code "T". Delete WDS note code "R"
07556+3752		Proper motion −003−009/−003−009. WDS note code "T"
07587+4053		Proper motion −022−054/−022−054. WDS note code "T"
08004+4243		Proper motion −007−002/−008−003. WDS note code "S"
08006+3431		Proper motion +018−044/+018−044. Replace WDS note code "S" with "T"
08010+3454	AB	Proper motion −003−003/−003−003. Plx and pm similar, but values too small to be significant. Delete WDS note code "R"
08010+3454	AC	Proper motion −003−003/−004−003. Plx and pm similar, but values too small to be significant
08018+3526		Proper motion +007 000/+008+001. WDS note code "T"
08036+4016		Proper motion −016−033/−016−032. WDS note code "T"

08100−4241		Proper motion −007−025/−001+016. WDS note code "S"
08102+3347		Proper motion −001−076/ 000−077. WDS note code "T"
08113−4227		Proper motion −003+007/−004+008. Plx and pm similar, but insignificant
08172+3515		Proper motion −001−006/−001−006. WDS note code "T"
08501+3712		Proper motion +004−001/+004 000. Plx too different for a physical pair. WDS note code "S"
08587+4050		Proper motion +001−012/+001−012. Plx different, pm similar
09058+3325		Proper motion +013−030/+013−030. WDS note code "T"
09087+4230		Proper motion −023−030/−024−030. WDS note code "T"
09150+4006		Proper motion −050−044/−050−044. Delete WDS note code "R". WDS note code "T"
09150+4311		Proper motion −061+020/−061+021. WDS note code "T"
09165+3021		Proper motion +063−003/+063−005. WDS note code "T"
09169+3540		Quadrant issue? Proper motion −001−007/−003−001. WDS note code "S"
09193+3831		Quadrant issue? Proper motion −239−001/−235−001. WDS note code "T"
09203+3944		Proper motion −045 000/−045 000. WDS note code "T"
09226+3321		Proper motion −018−012/−019−012. Pm similar, but plx different
09263+3353		Proper motion −022−012/−022−012. WDS note code "T"
09292+4318	AB	Proper motion −006−048/+006−019. WDS note code "S"
09292+4318	AC	Proper motion −006−048/+002−008. WDS note code "S"
09296+4312		Proper motion −022−028/−019−027. WDS note code "T"
09320+3743		Proper motion −029−019/−030−017. WDS note code "T"
09322+3139		Proper motion +011−028/+011−026. WDS note code "T"
09341+3826		Proper motion −002+002/−017−019. WDS note code "S"
09358+3553		Proper motion −003−009/−017−005. WDS note code "S"
09358+4040		Proper motion −025−065/−025−065. WDS note code "T"
09439+4057		Proper motion −065−057/−065−057. WDS note code "T"
09521+4315		Proper motion +033−003/+033−003. WDS note code "T"
09522+3930		Proper motion −025−024/−008−006. WDS note code "S"
0001+3901		Proper motion −002−021/−002−021. WDS note code "T"
10034+3935		Proper motion −001−004/+006−022. WDS note code "S"
10041+3949		Proper motion −018−013/−018−013. WDS note code "T"
13483+3326		Proper motion −054+013/−051+014. Plx and pm similar, but not similar enough to assume a physical pair
13531+3100		Proper motion −025+033/−026+032. WDS note code "T"
13537+4027		Proper motion −010−014/−011−014. WDS note code "T"
13540+4016		Proper motion −066+015/−066+016
13550+3135		Proper motion −046+023/−045+023. WDS note code "T"
13557+3145		Delete WDS note code "R". Proper motion −052−006/−053−007. WDS note code "T"
14098+3544		Proper motion −037+018/−036+018. WDS note code "T"
14103+4008		Proper motion −006−054/−006−054. WDS note code "T"
14111+3454		Proper motion +031−031/+030−031. WDS note code "T"
14188+2908		Proper motion −064−030/−064−033. WDS note code "T"
14231+4106		Proper motion −006−034/−006−034. WDS note code "T"
14292+4009		Proper motion −036+006/−038+005. WDS note code "T"
14374+4744		Proper motion −012−053/−011−056. WDS note code "T"
14446+3606		Proper motion −024+032/−024+032. WDS note code "T"
14512+4518		Proper motion −046−011/−046−008. WDS note code "T"
14514+2750		Proper motion +001−039/+001−040. WDS note code "T"
14518+2759		Proper motion −035−021/−033−022. WDS note code "T"
14523+3344	AB	Proper motion −039+008/−039+007. WDS note code "T". Primary is a double itself
14589+4137		Proper motion −059+025/−058+024. WDS note code "T"
15101+4208		Proper motion +028−044/+028−047. WDS note code "T". Actually a triple (see WDSS)
15124+3650		Proper motion +013−053/+014−053. WDS note code "T"
15170+4109		Proper motion −052+022/−052+022. WDS note code "T"
16072+3402		Proper motion +095−002/+096−005. WDS note code "T"
16072+3536		Proper motion −034−013/−035−013. WDS note code "T"
16074+3548		Proper motion +012−034/+011−033. WDS note code "T"
16076+3547		Proper motion −002−005/−009+002. WDS note code "S"
16088+3635		Proper motion −024+114/−024+114. WDS note code "T"
16138+4518		Proper motion −038+032/−042+035. WDS note code "T"
16173+3804		Proper motion −034+002/−033+001. WDS note code "T"

16219+3229		Proper motion +003−013/+003−013. Plx and pm similar, but plx insignificant
16255+3645		Proper motion +018−028/+019−027. WDS note code "T"
16321+4536		Delete WDS note code "R"
16324+4545		Proper motion +019−028/+019−028. WDS note code "T"
16413+3505	AB	Proper motion −169+004/−169+004. WDS note code "T". Secondary a physical pair itself
16460+3324		Proper motion −001−060/+001−059. WDS note code "T"
16490+4458		Proper motion +008−032/+009−032. WDS note code "T"
16542+3805		Proper motion −016+034/−019+037. Plx and pm similar; however, too different to suggest a physical pair. Delete WDS note code "V"
16548+3415		Proper motion +011−046/+011−046. WDS note code "T"
16550+3409		WDS note code "T". Delete WDS note Code "R"
16554+4029		Proper motion −011−028/−011−028. WDS note code "T"
16555+3558		Proper motion −001+061/−001+062. WDS note code "T"
16558+3410		Proper motion −060+009/−060+009. WDS note code "T"
16558+3513		Proper motion −041−004/−041−004. WDS note code "T"
16566+3037		Proper motion −030+011/−030+011. WDS note code "T"
16591+3146		Proper motion +043−039/+043−038. WDS note code "T"
16598+4553		Proper motion −016+028/−016+029. WDS note code "T"
17004+4239		Proper motion +004−041/+004−041. WDS note code "T"
17051+3418		Proper motion +020−032/+021−032. WDS note code "T"
17076+3823		Proper motion −007+033/−006+033. WDS note code "T"
19570+3621		Proper motion +038−029/+038−028. WDS note code "T"
19584+3751		Proper motion −085−007/−086−009. WDS note code "T"
19590+3750		Proper motion 000+008/−007−011. Plx similar, but pm too different for a physical pair. WDS note code "S"
19590+3759		Proper motion −003−009/+009+005. Plx and pm different. WDS note code "S"
20068+3628		Proper motion +040+011/+041+011. WDS note code "T"
20072+3616	AB	Proper motion −001−010/+002 000. WDS note code "S"
20072+3616	AC	Proper motion −001−010/−003 000. WDS note code "S"
20072+3616	AE	Proper motion −001−010/+007+001. WDS note code "S"
20072+3616	CD	Proper motion −003 000/−001−002. WDS note code "S"
20072+3616	EF	Proper motion +007+001/−004−006. WDS note code "S"
20075+3618		Proper motion +001+008/−002−005. WDS note code "S"
20075+3619		Proper motion −018−014/−005−006. WDS note code "S"
20076+3627	AB	Proper motion +001+007/−003−006. WDS note code "S"
20076+3627	BC	Proper motion −003−006/+001−001. WDS note code "S"
20110+4041		Proper motion −011−033/−011−033. WDS note code "T"
20140+3726		Proper motion 000−005/+001−006. WDS note code "S"
20150+3729		Proper motion −028−024/−028−026. Plx a bit too different for a physical pair
20150+3743		Proper motion 000−010/+005−017. WDS note code "S"
20213+3726		Proper motion +017+032/+016+033. WDS note code "T"
20214+3720		Proper motion +001−005/−003−005. Plx and pm similar but insignificant
20216+3725	AB	Proper motion −004−006/−001−005. WDS note code "S"
20216+3725	AC	Proper motion −004−006/−004−006. WDS note code "T"
20264+4520		Proper motion −003−018/−003−018. WDS note code "T"
20301+3636		Proper motion −064−013/−062−013
20353+3313		Proper motion −009−010/−015−016. WDS note code "S"
20354+3301		Proper motion +046+029/+046+029. WDS note code "T"
20400+4405		Proper motion +038+014/+036+014. WDS note code "T"
20435+3212		Proper motion −026−023/−025−023. WDS note code "T"
20539+4115		Proper motion +016−030/+016−029. WDS note code "T"
20542+4111		Proper motion −003−004/−004−004. WDS note code "T", however plx and pm values small
20567+3047		Proper motion +199+091/+197+088. WDS note code "T"
20569+3818		Proper motion +034−004/+034−004. WDS note code "T"
20573+3215		Proper motion +027+073/+026+075. WDS note code "T". No photometry results due to failed plate solving using UCAC4
20578+3202		Proper motion −002−003/−002−004. Plx similar, pm insignificant. WDS note code "Z". No photometry results due to failed plate solving using UCAC4
20598+3126		Proper motion −005−004/−001+003. WDS note code "S". No photometry results due to failed plate solving using UCAC4

21003+3134		Proper motion +044+035/+040+038. WDS note code "T". No photometry results due to failed plate solving using UCAC4
21050+3347		Proper motion −025−031/−025−031. WDS note code "T"
21062+4249		Proper motion +037+001/+037+001. WDS note code "T"
21077+3009		Proper motion +035−024/+035−024. WDS note code "T"
21086+3201		Proper motion −016−031/−016−031. WDS note code "T"
21131+3249		Proper motion −004−007/+001−007. WDS note code "S"
21133+3248		Proper motion −032−023/−031−022. Pm similar, but plx too different to assume a physical pair
21133+3803		Stardisks A and B saturated. Proper motion 000−016/+059+044. WDS note code "S"
21138+3800		Proper motion +043+017/+043+017. WDS note code "T"
21138+3812		Proper motion −007+006/+013+006. WDS note code "S"
21140+3755		Proper motion −009−007/−006−007. WDS note code "S"
21140+3809		Proper motion −002−006/+001−001. WDS note code "S"
21140+4051		Proper motion +035+013/+035+014. WDS note code "T"
21144+3753		Proper motion +002−002/−001−004. WDS note code "S"
21144+3803	AB	Proper motion +002+001/−001−002. WDS note code "S"
21144+3803	AC	Proper motion +002+001/+012−009. WDS note code "S"
21150+3611		Proper motion +041+014/+040+014. WDS note code "T". Change component designations AB to BC as KPP1425 is actually identical with components B and C of SEI1469AB and SEI1470AC (no idea why two pairs are listed for a triple)
21385+3942		Proper motion +003−002/+008−004. WDS note code "S"
21465+3506		Proper motion +040+003/+040+003. WDS note code "T"
21541+3633		Proper motion +055+021/+055+020. WDS note code "T"
22013+4515		Proper motion +031+010/+030+012. WDS note code "T"
22016+4528		Proper motion +144+104/+144+103. WDS note code "T"
22017+4517		Proper motion −008−009/+002 000. WDS note code "S"
22034+4250		Proper motion +008+007/+007+006. WDS note code "T"
22036+4251		Proper motion −002−025/−002−025. WDS note code "T"
22100+2935		Proper motion +074+015/+074+016. WDS note code "T"
22104+3913		Proper motion −041−039/−040−039. WDS note code "T"
22198+3045		Proper motion −004−005/−004−006. Plx and pm similar, but values are too small to be significant
22208+4658		Proper motion +055−001/+054−001. WDS note code "T"
22231+3220		Proper motion −011−281/−001−004. WDS note code "S". Delete WDS code "R". Primary very fast pm, secondary slow pm. Secondary might be a physical double itself, plx and pm are similar but insignificant
22236+3231		Proper motion −018−033/−019−034. WDS note code "T"
22239+3226		Proper motion +014+002/+013+002. WDS note code "T"
22246+3227	BC	Proper motion −009−007/−008−007. WDS note code "T"
22266+3224		Proper motion +037−010/+038−010. WDS note code "T"
22286+3851		Proper motion −002−004/+007−012. WDS note code "S"
22291+3844		Proper motion −036−030/−036−030. WDS note code "T"
22327+4129		Proper motion +061+009/+061+008. WDS note code "T"
22337+2952		Proper motion −005−009/−006−009. WDS note code "T"
22363+2840		Proper motion +031+043/+031+043. WDS note code "T"
22369+2834		Proper motion −007−048/−007−048. WDS note code "T". Delete WDS note "R"
22385+3754		Proper motion −003−002/−003−002. Plx and pm similar but insignificant
22456+2755		Proper motion −047−009/−046−009. WDS note code "T"
22488+3140		Proper motion −010−033/−010−036. WDS note code "T"
22574+3531		Proper motion −010−034/−011−034. Plx different but pm similar
22583+3717		Proper motion +025−007/+024−007. WDS note code "T"
23001+3649		Proper motion −006−005/−002−010. WDS note code "S"
23019+3642		Proper motion −011−010/ 000−004. WDS note code "S". Re WDS23019+3642 COU 843 Aa,Ab: Proper motion −011−010/−011−010. WDS note code "T"

Side results

Two of the measured pairs were found to be most likely physical triples:

14523+3344	KPP2427	A is double again. Create new WDS object Aa,Ab. Proper motion −039+008/−039+007. WDS note code "T"
16413+3505	KPP3414	B is double again. Create new WDS object Ba,Bb. Proper motion −169+004/−170+005. WDS note code "T"

Gaia DR3 measures (magnitudes are G mags):

WDS_ID	Comp	Date	PA	e_PA	Sep	e_Sep	M1	e_M1	M2	e_M2	N
14523+3344	Aa,Ab	2016.0	228.992	0.006	1.81488	0 00020	12.601	0.003	17.610	0.004	1
16413+3505	Ba,Bb	2016.0	109.675	0.015	1.51656	0 00040	19.080	0.004	19.329	0.014	1

Summary

Most of the measured objects are listed in the WDS Catalog with estimated visual magnitudes based on Gaia G mags, which were mostly confirmed by photometry results within the measurement error range. All objects with older V mag estimations show in most cases the expected larger magnitude deltas.

Acknowledgements

The following tools and resources have been used for this research:
- Washington Double Star Catalog
- GAIA DR2 and DR3 Catalog
- UCAC4 catalog
- Remote telescopes
  iT24: 610mm CDK with 3962mm focal length. Resolution 0.625 arcsec/pixel. V−filter. Located in Auberry, California. Elevation 1405m
  iT32: 430mm CDK with 2912mm focal length. Resolution 0.64 arcsec/pixel. V−filter. Located in Siding Spring, Australia. Elevation 1122m
  iT72: 510mm CDK with 3411mm focal length. Resolution 0.359 arcsec/pixel. V−filter. Located in Rio Hurtado Valley, Chile. Elevation 1710m
- Aladin Sky Atlas v12.0
- AAVSO VPhot
- Astrometrica v4.10.0.427
- AstroPlanner v2.2
- MaxIm DL6 v6.08

MEASUREMENTS OF DOUBLE STARS WITH ROBOTIC TELESCOPES IN 2023

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Abstract

These observations and measurements were made with the LCO Global Telescope Network. I used the catalogue Gaia DR3 from June 13th, 2022. This is how I added the parallax of the components of each observed pairs when known, the *G*-band magnitude (specific to Gaia), and the precise coordinates of each component. The aim of this work is to measure the polar coordinates of the observed pairs but also to determine whether they are optical or physical couples. In the latter case, when the components have same parallax and if they have common proper motion within the errors, one can conclude their probable physicality.

Explanation of Table 1

1. Discoverer & Number
2,3. GAIA-DR3 absolute stellar parallax (mas) & standard error of parallax (mas), or in some cases the UCAC5 catalogue when no information is provided by GAIA-DR3
4-7. GAIA-DR3 Proper motion in RA direction (mas/yr), standard error of proper motion in right ascension (mas/yr), proper motion in declination (mas/yr), standard error of proper motion in declination (mas/yr), or in some cases the UCAC5 catalogue when no information is provided by GAIA-DR3
8. Mean date of observation
9. Number of Observations
10,11. Position Angle (θ) and standard error
12,13. Separation ($''$) and standard error
14. Magnitude of first component (in *G* band, GAIA-DR3) (above) Magnitude of second component (in *G* band, GAIA-DR3) (below)
15. Observatory code
16. Notes
17. J2000 arcsecond coordinates (GAIA-DR3), and in some cases the UCAC5 catalogue

Table 1: Measures

Pair	π	ϵ	μ_α	ϵ	μ_δ	ϵ	Epoch	n	θ	ϵ	ρ	ϵ	Mag.	Tel.	N	Precise posn.
STF 98 A	5.9302	0.0395	14.774	0.040	-10.790	0.031	2023.111	3	248.68	0.21	19.598	0.052	7.0	Z21		011252.99+320431.6
B	5.2903	0.2115	11.806	0.190	-16.046	0.152							8.3	V38		011251.56+320424.5
MLB 644A	1.0906	0.0387	2.986	0.044	-3.120	0.034	2023.096	1	18.3		6.21		9.8	V39		062123.86+284923.9
B	1.3139	0.0139	-9.665	0.016	-17.148	0.013							12.7			062124.04+284930.1
POU 1311A	0.4709	0.0189	1.529	0.021	-5.763	0.016	2023.124	1	319.7		18.94		13.0	W87		062446.01+241946.4
B	1.0119	0.0158	-0.117	0.018	2.205	0.014							13.2			062445.12+240008
POU 1312A	0.4982	0.0170	-0.889	0.017	-3.750	0.013	2023.124	1	272.4		11.28		10.8	W87	2	062457.88+242046.5
B	2.4271	0.0192	37.422	0.020	-6.424	0.014							13.6			062457.00+242047.0
POU 1320A	0.9660	0.0173	-0.085	0.022	3.809	0.016	2023.124	1	192.1		13.18		12.9	W87		062523.54+242457.4
B			-4.1	4.7	0.0	4.9							13.2			062523.44+242444.6
POU 1324A	0.9681	0.0220	-0.951	0.024	-4.265	0.018	2023.124	1	129.7		13.49		14.0	W87	2	062549.49+241206.9
B	0.3963	0.1875	1.415	0.201	-3.568	0.158							14.0			062550.25+241158.3
POU 1326A	1.6487	0.0167	-5.602	0.019	-10.104	0.013	2023.124	1	194.3		9.41		13.1	W87		062601.50+242948.6
B	0.3446	0.0145	0.268	0.017	-2.858	0.012							12.3			062601.32+242939.3
DBR 4B	1.0683	0.0200	-3.939	0.022	-11.530	0.018	2023.148	1	73.53	0.18	4.357	0.042	13.6	V39	2	062708.52+242839.1
C	0.7770	0.0415	1.373	0.045	-8.492	0.038							15.5			062708.8+242840.3
POU 1332A	1.2779	0.0126	1.087	0.015	-6.267	0.012	2023.148	1	323.67	0.02	15.450	0.040	12.6	V39	2	062709.19+242826.5
B	1.0683	0.0200	-3.939	0.022	-11.530	0.018							13.6			062708.52+242839.1
POU 1334A	0.8308	0.018	61.310	0.022	-7.219	0.017	2023.148	1	354.09	0.17	9.101	0.018	13.6	V39	2	062719.11+243047.8
B	0.5885	0.0194	-0.947	0.023	-0.009	0.018							14.1			062719.04+243056.7
POU 1333A	2.8937	0.0153	-21.089	0.018	-11.767	0.014	2023.148	1	290.75	0.03	10.934	0.013	10.8	V39	2	062718.14+242705.1
B	0.8387	0.0147	-0.493	0.019	-0.028	0.014							12.6			062717.36+242708.8
DBR 6 A	0.1902	0.0167	-0.287	0.020	-1.402	0.016	2023.148	1	164.33	0.28	7.218	0.053	13.8	V39	2	062726.85+243152.8
B	0.4761	0.0378	0.907	0.038	-5.053	0.031							14.9			062726.99+243145.9
AG 112 A	2.4069	0.0233	-3.310	0.026	-9.878	0.020	2023.148	1	208.37	0.18	2.836	0.005	9.7	V39	5	062730.03+243200.8
B			-4.0	1.7	-13.0	1.7							9.8			062729.93+243158.4
OPI 12 A	2.4069	0.0233	-3.310	0.026	-9.878	0.020	2023.148	1	338.08	0.07	42.369	0.040	9.7	V39	2	062730.03+243200.8
C	0.8889	0.0155	-1.017	0.017	-1.275	0.014							11.1			062728.9+243239.6
POU 1337A	2.2222	0.0152	-2.052	0.017	-8.809	0.013	2023.148	1	140.76	0.04	16.890	0.040	12.1	V39	1	062734.94+243628.9
B	2.2247	0.0155	-2.183	0.017	-8.761	0.014							13.4			062735.72+243615.8
HJ 390 A	1.0140	0.0135	1.473	0.016	-5.161	0.013	2023.148	1	227.40	0.03	14.081	0.013	10.9	V39		062807.13+241753.3
B	0.8384	0.0240	1.511	0.029	-5.742	0.023							11.5			062806.37+241743.8
BRT 241A	0.6117	0.0182	-3.968	0.021	-0.813	0.016	2023.006	3	28.53	0.24	4.635	0.034	11.1	V37	2	063640.45+293631.9
B	0.2902	0.0270	0.631	0.029	-2.805	0.024							13.0			063640.61+293635.8
DBR 274A	0.3680	0.0140	0.066	0.014	-0.215	0.012	2023.127	1	56.75	0.13	5.087	0.025	12.0	Q63	2	065304.97+223627.3
B	0.2487	0.0191	-0.156	0.021	-2.228	0.018							13.3			065305.28+223630.2
DBR 275A	1.6684	0.0140	-1.349	0.014	-6.268	0.013	2023.127	1	188.54	0.13	1.760	0.027	12.6	Q63		065339.06+224516.3

B	1.5931	0.0187	-1.076	0.019	-6.111	0.018							13.3			065339.04+224514.6
DBR 276A	1.9603	0.0159	13.093	0.016	-19.811	0.014	2023.108	1	308.27	0.16	5.171	0.01	12.3	V39	2	065957.58+222734.9
B	1.2628	0.0162	-5.620	0.017	-6.821	0.014							13.1			065957.31+222737.8
KPP 1476A	4.2213	0.0175	-6.291	0.016	-47.895	0.013	2023.108	1	290.97	0.06	11.081	0.014	10.6	V39	3	070012.97+222636.2
B	4.2935	0.0212	-8.387	0.022	-49.552	0.019							11.1			070012.22+222640.2
DBR 299A	1.0265	0.0157	-0.318	0.015	-0.532	0.016	2023.191	1	109.45	0.54	4.205	0.397	12.7	K92		070231.79-082439.5
B	0.9989	0.1210	0.423	0.122	-0.686	0.122							14.7			070232.07-082441.2
DBR 300A	0.9739	0.0154	-1.056	0.015	-0.570	0.015	2023.191	1	282.41	0.15	5.133	0.030	13.5	K92		070239.20-081816.5
B	1.0092	0.0183	-0.916	0.018	-0.676	0.017							13.6			070238.86-081815.4
DAM 1202A	1.0069	0.0207	-1.137	0.023	-0.729	0.020	2023.191	1	316.05	0.78	6.526	0.025	9.9	K92		070241.89-081846.1
B	0.9853	0.0147	-0.366	0.015	-0.449	0.014							13.1			070241.58-081841.5
BRT 392A	1.0260	0.0210	-0.430	0.022	-0.160	0.020	2023.191	1	209.09	0.05	5.228	0.006	11.7	K92	1	070251.41-082145.5
B	1.0201	0.0172	-0.799	0.017	-0.817	0.015							12.3			070251.24-082150.1
HJ 748 A	0.9481	0.0341	0.033	0.036	-2.089	0.036	2023.191	1	171.52	0.06	6.802	0.049	8.3	K92		070258.18-082051.9
B	1.0375	0.0206	-1.042	0.021	-0.533	0.021							11.1			070258.25-082058.8
HJ 748 A	0.9481	0.0341	0.033	0.036	-2.089	0.036	2023.191	1	356.85	0.03	15.504	0.035	8.3	K92	4	070258.18-082051.9
C	1.0506	0.0168	-08.835	0.017	-0.596	0.015							12.8			070258.12-082036.5
ABH 59 A	0.9481	0.034	10.033	0.036	-2.089	0.036	2023.191	1	130.68	0.41	46.104	0.164	8.3	K92	4	070258.18-082051.9
D	1.0341	0.0177	-0.929	0.019	-0.414	0.016							12.8			070300.54-082121.8
ABH 59 A	0.9481	0.0341	0.033	0.036	-2.089	0.036	2023.191	1	78.18	0.56	45.573	0.167	8.3	K92	4	070258.18-082051.9
E	0.8727	0.0269	-0.046	0.026	-0.806	0.023							11.7			070301.19-082042.4
ABH 59 A	0.9481	0.0341	0.033	0.036	-2.089	0.036	2023.191	1	63.27	0.24	74.546	0.233	8.3	K92		070258.18-082051.9
F	1.0263	0.0156	-0.578	0.015	-0.439	0.014							12.7			070302.67-082018.3
ABH 59 A	0.9481	0.0341	0.033	0.036	-2.089	0.036	2023.191	1	50.56	0.16	80.223	0.530	8.3	K92		070258.18-082051.9
G	1.0421	0.0163	-0.674	0.015	-0.420	0.015							12.2			070302.35-08 000.8
ABH 59 A	0.9481	0.0341	0.033	0.036	-2.089	0.036	2023.191	1	47.69	0.09	69.410	0.283	8.3	K92		070258.18-082051.9
H	1.0141	0.0183	-0988	0.019	-0.593	0.018							13.2			070301.64-082005.2
ABH 59 A	0.9481	0.0341	0.033	0.036	-2.089	0.036	2023.191	1	310.97	0.20	62.440	0.189	8.3	K92		070258.18-082051.9
I	0.9701	0.0203	-0.999	0.020	-0.772	0.019							11.0			070255.01-082010.8
ABH 59 A	0.9481	0.0341	0.033	0.036	-2.089	0.036	2023.191	1	299.89	0.53	58.987	0.204	8.3	K92	4	070258.18-082051.9
J	1.1721	0.0139	-5.760	0.015	-1.374	0.013							12.4			070254.75-082022.4
DAM 1203A	1.0994	0.028	70.939	0.029	-0.458	0.026	2023.191	1	74.1		5.82		9.3	K92		070254.91-081756.7
B	1.0067	0.0217	-0.345	0.020	-0.757	0.022							13.7			070255.30-081755.1
DAM 1204A	1.0518	0.0424	-0.466	0.050	-0.303	0.045	2023.191	1	2.68	0.21	5.556	0.019	10.8	K92	6	070258.73-082555.7
B	-	-	-	-	-	-							12.7			070258.74-082550.2
HLD 84 A	2.0670	0.0211	-0.699	0.024	-3.854	0.023	2023.191	1	39.19	0.01	5.014	0.006	10.0	K92		070328.35-082740.8
B	2.0702	0.0229	-1.140	0.025	-4.039	0.022							10.3			070328.56-082736.9
HLD 84 A	2.0670	0.0211	-0.699	0.024	-3.854	0.023	2023.191	1	34.11	0.02	76.070	0.005	10.0	K92	2	070328.35-082740.8
C	2.9113	0.0279	5.123	0.029	-1.507	0.025							10.8			070331.03-082641.9
SHT 5 A	2.0670	0.0211	-0.699	0.024	-3.854	0.023	2023.191	1	18.38	0.01	17.355	0.021	10.0	K92	2	070328.35-082740.8
D	0.9673	0.0217	-0.392	0.022	-0.305	0.021							14.3			070328.73-082724.2

DBR 301A	0.9131	0.0184	-1.537	0.019	-1.030	0.015	2023.228	1	149.89	0.35	4.215	0.039	13.7	648	3	071003.91+154228.1
B	0.9362	0.0183	-1.522	0.020	-0.907	0.015							13.5			071004.05+154224.5
J 703 A	12.1621	0.0149	-93.491	0.017	14.670	0.017	2023.228	1	291.44	0.16	11.237	0.011	11.6	648	2,4	071037.33+154318.2
B	2.7513	0.0142	-12.041	0.016	-5.168	0.013							12.0		7	071037.92+154314.3
BRT 2664A	2.7216	0.0200	-0.578	0.015	-4.490	0.014	2023.238	1	38.84	0.40	3.331	0.004	10.9	Z24	3	071806.78-130400.3
B	2.6313	0.0186	-0.246	0.016	-3.774	0.014							11.1			071806.92-130357.7
BRT 2664A	2.7216	0.0200	-0.578	0.015	-4.490	0.014	2023.238	1	232.85	0.08	4.992	0.026	10.9	Z24	2	071806.78-130400.3
C	0.5045	0.0185	-1.136	0.013	0.526	0.012							13.6			071806.49-130403.6
DBR 280A	0.6526	0.0181	-0.151	0.016	-1.592	0.015	2023.238	1	128.9	1.24	2.432	0.012	13.4	Z24	2	071849.84-130854.1
B	0.8196	0.0309	-3.955	0.026	-1.901	0.025							14.7			071849.97-130855.7
BAL 802A	0.7704	0.0243	-0.103	0.022	-1.317	0.019	2023.110	1	92.49	0.12	17.889	0.011	9.3	W87	2	072351.65-004220.5
B	0.4909	0.0132	-0.472	0.012	3.520	0.011							12.3			072352.84-004221.4
TVB 215A	3.5628	0.0131	-3.961	0.010	-0.256	0.012	2023.201	1	64.09	0.51	26.738	0.015	12.9	Q63		091005.40-343820.5
B	3.5098	0.0110	-4.173	0.009	-0.400	0.011							13.2			091007.34-343808.6
BRT 2966A	4.5932	0.0188	-20.621	0.015	3.374	0.017	2023.256	1	257.3		3.59		10.4	Q63	18	091431.92-303205.0
B	4.5799	0.0139	-20.956	0.011	3.288	0.013							12.2			091431.65-303205.8
KPP 189A	4.3370	0.0185	28.643	0.016	-43.345	0.016	2023.256	1	159.88	0.40	3.341	0.001	14.6	Q63	3	091444.18-302033.8
B	4.3645	0.0221	28.497	0.019	-42.725	0.019							15.0			091444.27-302036.9
LDS 261A	33.9035	0.0176	-250.218	0.015	104.046	0.015	2023.256	1	15.84	0.06	4.156	0.008	12.1	Q63	1	091507.26-302006.9
B	33.9387	0.0164	-244.833	0.014	108.118	0.014							12.2			091507.34-302003.0
HRG 61 A	1.9483	0.0132	-16.832	0.015	3.990	0.012	2023.009	1	270.97	0.16	14.751	0.023	11.0	W87	2	112419.71-594437.9
B	2.7140	0.0117	-24.548	0.014	10.904	0.011							11.5			112417.78-594437.9
HRG 61 B	2.7140	0.0117	-24.548	0.014	10.904	0.011	2023.009	1	248.85	0.13	17.380	0.007	11.5	W87	2	112417.78-594437.9
C	1.5141	0.0167	-14.641	0.019	1.406	0.015							11.0			112415.61-594444.1
KPP 1113A	10.4380	0.0165	36.851	0.022	-45.854	0.015	2023.304	2	145.13	0.48	8.785	0.042	10.4	W85	3	130605.08-083237.9
B	10.4227	0.0151	36.242	0.021	-46.774	0.014							13.3			130605.42-083245.1
KPP 1201A	7.4027	0.1267	57.614	0.112	-73.588	0.101	2023.311	4	27.24	0.23	9.295	0.033	12.7	W85	3	142751.99-134359.2
B	7.4537	0.0263	56.185	0.022	-73.780	0.021							12.8			142752.28-134350.9
ITF 32 A	0.6619	0.021	23.934	0.026	-0.062	0.020	2023.662	1	12.49	0.34	4.664	0.103	13.6	E10	39	181456.18-223551.9
B	1.4755	0.0208	-5.708	0.026	-5.355	0.021							13.6			181456.27-223547.2
DBR 310A	0.3036	0.0187	1.562	0.025	-3.909	0.020	2023.678	1	64.67	0.57	2.075	0.022	13.7	E10		181631.21-182937.1
B	0.3472	0.0210	-0.430	0.028	-2.119	0.022							14.0			181631.35-182936.2
DBR 311A	0.4684	0.0208	-4.680	0.025	-0.938	0.019	2023.678	1	101.24	0.33	3.104	0.010	14.3	E10		181634.64-182950.7
B	0.4944	0.0285	-0.366	0.034	-4.104	0.026							15.0			181634.85-182951.2
DBR 312A	0.8794	0.1205	-1.030	0.136	-3.184	0.101	2023.678	1	37.08	0.39	4.396	0.009	13.0	E10		181634.75-183508.9
B	0.6368	0.0162	0.611	0.019	-2.679	0.014							13.3			181634.94-183505.5
VVV 53 A	28.8721	0.0360	-0.599	0.039	-265.439	0.031	2023.666		16.69	0.08	4.592	0.062	14.8	E10	3	181642.28-344637.2
B	28.8447	0.0993	-2.611	0.109	-262.113	0.087							14.6			181642.33-344632.8
DBR 290A	0.6394	0.0188	0.925	0.020	-1.955	0.017	2023.678		285.16	0.27	2.523	0.032	14.0	E10	2	181828.67-134412.8
B	0.9579	0.0224	-10.273	0.024	-10.132	0.020							14.4			181828.86-134412.4
DBR 291C	0.5352	0.0236	0.220	0.026	-1.519	0.020	2023.678		299.07	0.22	3.054	0.009	13.5	E10		181836.45-134718.9

D	0.5721	0.0217	-0.073	0.020	-1.665	0.017							13.5			181836.65-134719.4
SNA 87 H	0.5945	0.025	30.162	0.026	-1.502	0.021	2023.678	2	139.84	0.51	3.298	0.042	8.6	E10	2	181836.04-134736.4
J	0.6400	0.042	60.487	0.052	-1.793	0.046							13.8			181836.20-134739.1
SNA 88 A	0.9165	0.2775	1.954	0.277	-0.792	0.218	2023.678	2	247.06	0.47	3.458	0.108	8.0	E10	2	181836.42-134802.4
D	0.5554	0.0304	0.236	0.039	-1.457	0.027							13.7			181836.19-134803.9
SNA 88 A	0.9165	0.2775	1.954	0.277	-0.792	0.218	2023.678	2	304.62	0.13	6.589	0.006	8.0	E10	2	181836.42-134802.4
G	0.4681	0.0323	-1.613	0.041	-1.360	0.030							13.2			181836.05-1347587
VVV 55 A	16.0991	0.0222	54.965	0.024	-95.281	0.016	2023.667	1	103.34	0.91	2.729	0.036	13.5	E10	3	181926.82-314205.8
B	16.4822	0.0995	57.704	0.096	-96.885	0.070							16.0			181927.02-314206.3
GRV 1262 A	6.2475	0.0245	-19.399	0.021	-5.258	0.018	2023.677	2	209.91	0.82	1.626	0.020	12.5	E10	3	182630.08-022620.3
B	6.2707	0.0299	-18.537	0.027	-3.568	0.023							12.7			182630.02-022622.3
KPP 4341 A	11.9788	0.016	415.462	0.016	-90.238	0.014	2023.675	1	145.16	0.36	2.115	0.006	12.6	E10	3	184806.54-432947.0
B	11.9046	0.024	414.512	0.024	-91.634	0.021							13.4			184806.66-432948.7
KPP 4341 A	11.9788	0.0164	15.462	0.016	-90.238	0.014	2023.675	1	293.31	0.18	5.311	0.016	12.6	E10	3	184806.54-432947.0
C	11.9335	0.0252	15.564	0.023	-87.752	0.020							14.2			184806.10-432945.1
CPO 84 A	56.9423	0.0249	215.484	0.027	135.858	0.024	2023.675	1	21.22	0.51	2.073	0.004	11.2	E10	3	184841.297-464708.7
B	56.8982	0.0260	179.829	0.028	123.829	0.026							11.3			184841.455-464706.4
DBR 13 A	0.9673	0.0129	-19.458	0.013	-3.034	0.013	2023.896	1	127.47	0.26	4.451	0.035	13.5	V37	2	230239.32+512119.9
B	1.2038	0.0176	14.332	0.019	4.013	0.019							14.4			230239.62+512117.1
DBR 1 A	1.3276	0.0167	-1.033	0.017	-2.664	0.017	2023.896	1	285.43	0.13	11.159	0.004	10.5	V37		230310.09+512020.6
B	1.2301	0.0155	-1.267	0.016	-2.863	0.016							11.4			230308.94+512023.6
BKO 930 A	2.3373	0.0121	9.792	0.012	-8.354	0.012	2023.896	1	17.19	0.08	6.194	0.050	13.4	V37		230318.61+511548.0
B	0.3173	0.0243	-2.238	0.024	-1.556	0.025							15.2			230318.84+511553.8
BKO 932 A	0.7890	0.0158	0.072	0.016	-0.778	0.016	2023.896	1	133.61	0.29	8.136	0.007	14.1	V37	2	230321.80+511251.6
B	0.6061	0.0201	-4.646	0.020	-0.377	0.021							14.8			230322.44+511246.0
BKO 931 A	0.8125	0.0111	5.586	0.011	1.104	0.011	2023.896	1	275.86	0.27	10.178	0.014	12.7	V37		230324.86+511357.7
B	0.8604	0.0137	3.276	0.013	-3.174	0.014							13.2			230323.79+511358.8
DBR 14 A	0.6043	0.0107	-1.277	0.010	-1.707	0.011	2023.896	1	222.29	0.07	5.639	0.006	12.3	V37		2230339.09+511616.0
B	1.2027	0.0174	-0.021	0.017	-5.454	0.018							14.2			230338.68+511611.9
DBR 2 A	1.3740	0.0140	1.987	0.013	-1.138	0.013	2023.896	1	94.43	0.18	12.248	0.045	11.0	V37	2	230438.27+512229.3
B	0.4861	0.0110	-5.038	0.010	-4.279	0.009							12.5			230439.59+512228.45
DBR 3 A	8.527	0.0668	8.527	0.061	-3.210	0.061	2023.896	1	30.27	0.14	23.234	0.047	11.3	V37	2	230451.62+511923.6
B	0.2665	0.0202	-1.505	0.019	0.714	0.017							12.0			230452.89+511943.6
DBR 3 A	8.527	0.0668	8.527	0.061	-3.210	0.061	2023.896	1	48.44	0.36	13.291	0.139	11.3	V37	2	230451.62+511923.6
C	0.4051	0.0292	1.974	0.028	4.208	0.025							15.6			230452.68+511932.2
ROE 94 A	7.9409	0.0575	-55.170	0.052	-65.572	0.070	2023.896	1	25.15	0.42	24.498	0.058	11.9	V37	2	230455.34+512122.1
C	0.3324	0.0113	-0.596	0.011	1.498	0.010							13.1			230456.27+512142.6
HJ 1846A	1.4216	0.1499	5.694	0.212	1.958	0.284	2023.896	1	140.93	0.07	9.219	0.013	11.8	V37	2	230505.19+511844.8
B	4.5819	0.0129	27.400	0.012	26.337	0.011							11.8		10	230505.73+511836.9

Table 2: Cross references - WDS names to DR3 catalogue numbers

WDS name	DR3 no. (A)	DR3 no. (B)
STF98 AB	313645316845541376	313645316845541632
MLB 644AB	3433778734853541760	3433778734853540736
POU 1311AB	3383632105455082368	3383635060392581760
POU 1312AB	3383632552131660416	3383632552131661696
POU 1320AB	3383638874323462912	3383638870024783744
POU 1324AB	3383620698021906688	3383620693723163264
POU 1326AB	3383663578975251584	3383663574676667264
DBR 4BC	3383649766360297472	3383649006153158272
POU 1332AB	3383649010446053888	3383649766360297472
POU 1334AB	3383655053461267456	3383655053461140480
POU 1333AB	3383648769928274688	3383648834348625152
DBR 6AB	3383655195198885888	3383655195198886912
AG 112 ABA	3383655504436521216	3383655504436521856
OPI 12 ACA	3383655504436521216	3383655573155992832
POU 1337AB	3383658077118352384	3383658047057102208
HJ 390AB	3383461165757251584	3383455290241990912
BRT 241AB	3434847558936049920	3434847558938465152
DBR 274AB	3378731062437299840	3378731066732364288
DBR 275AB	338023375553020953	338023375552851763
DBR 276AB	336797010777444748	336797011207236544
KPP 1476AB	336806068004428441	336806068434332326
DBR 299AB	305156031805654272	305156031805654246
DBR 300AB	305156571252913523	305156571253539456
DAM 1202AB	305156564381591667	305156563951808806
BRT 392AB	305156231092130534	305156230662346880
HJ 748AB	305156224220181004	305156224220181043
HJ 748AB	305156224220181004	305156224220180723
ABH 59 AD	305156224220181004	305156216918102003
ABH 59 AE	305156224220181004	305156227656154150
ABH 59 AF	305156224220181004	305156227656153472
ABH 59 AG	305156224220181004	305156814777549286
ABH 59 AH	305156224220181004	305156227656153446
ABH 59 AI	305156224220181004	305156244836023961
ABH 59 AJ	305156224220181004	305156244405880806
DAM 1203AB	3051571377590895232	305157138189219302
DAM 1204AB	3051560524214936448	305156059293616268
HLD 84 AB	305154794855138060	305154794855137971
HLD 84 AC	305154794855138060	305154818907077632
SHT 5AB	305154794855138060	305154794855137651
DBR 301AB	335990824800313984	335990825229876544
J 703AB	335988450971949670	335988450542238899
BRT 2664 AB	303305134547390553	3033051345473904256
BRT 2664 AC	303305134547390553	3033051345473907712
DBR 280AB	303303539825444339	3033035402558342272
BAL 802AB	3110378211547657728	3110331276145044992
TVB 215AB	562456087588064780	562456084152090662
BRT 2966AB	563485038057017497	563485038056818624
KPP 189AB	563486147876352294	563486147876352268
LDS 261AB	563486020745049190	56348602074504911
HRG 61 AB	533906236950784384	533906237386241856
HRG 61 B	533906237386241856	533906237386205593
KPP 1113AB	362796832385954368	362796832815531302
KPP 1201AB	630003783428369036	630003783857987673
ITF 32 AB	409048957676768371	409048957671658752
DBR 310AB	409488432037317593	409488432471893286
DBR 311 AB	409488425599944089	409488435907865523

DBR 312AB	4094882602383605888	4094882602396240768
VVV 53 AB	4038572836732034048	4038572836708198400
DBR 290 AB	4146613494899763840	4146613490608344960
DBR 291 CD	4146610913628014080	4146610913628015872
SNA 87 H	4146599166888812032	4146599166883964928
SNA 88 AB	4146599132529067520	4146599132524213376
SNA 88 A	4146599132529067520	4146599132529069184
VVV 55	4046224372538944256	4046224372441738496
GRV 1262 AB	4270300233668667392	4270300237963917696
KPP 4341 AB	6715229161693406336	6715229165988699776
KPP 4341 C	6715229161693406336	6715229161698614400
CPO 84 AB	6704729998176610176	6704729998176610560
DBR 13 AB	1989103091131770368	1989103022412294912
DBR 1 AB	1989105015277160832	1989105015277158656
BKO 930 AB	1989092955009037440	1989092955009035904
BKO 932 AB	1989091477540311680	1989091477540312704
BKO 931 AB	1989091924216904192	1989091924216902784
DBR 14 AB	1989092091713543552	1989092096015591680
DBR 2 AB	1995099071634139776	1995096112394371840
DBR 3 AB	1995095081602222080	1995095081602221824
DBR 3	1995095081602222080	1995095085904499200
ROE 94 AB	1995096288487634944	1995096288495337728
HJ 1846 AB	1992092796385289344	1992092800686038784

Observatory code

MPC code E10: T2.00m, FTS, Siding Spring Observatory, Australia, LCO
MPC code Q63: T1.00m, Siding Spring Observatory, Australia, LCO
MPC code K92: T1.00m, Sutherland, South Africa, LCO
MPC code V37: T1.00m, McDonald Observatory, Fort Davis, Texas, USA, LCO
MPC code V38: T1.40m, McDonald Observatory, Fort Davis, Texas, USA, LCO
MPC code V39: T1.00m, McDonald Observatory, Fort Davis, Texas, USA, LCO
MPC code W85: T1.00m, Interamerican Observatory, Cerro Tololo, Chile, LCO
MPC code W87: T1.00m, Interamerican Observatory, Cerro Tololo, Chile, LCO
MPC code Z21: T0.40m, Teide Observatory, Tenerife, Canary island, Spain, LCO
MPC code Z24: T1.00m, Teide Observatory, Tenerife, Canary island, Spain, LCO
MPC code 648: T0.50m, Robert Mutel Telescope, Winer Observatory, Sonoita, Arizona, USA, University of Iowa

Notes

1. Physical pair, recent measurements in GAIA-DR3 (Gaia Collaboration, 2022) indicate same parallax and common proper motions within the errors margins.
2. Optical pair, recent measurements in GAIA-DR3 (Gaia Collaboration, 2022) indicate that neither the parallax nor the proper motions are common within the error margins.
3. Note in the WDS : “Proper motion or other technique indicates that this pair is physical" or “Statistically the same parallax within the errors and similar proper motion or other technique indicates that this pair is physical"
4. Note in the WDS : “Proper motion or other technique indicates that this pair is non-physical”.
5. AG 112 AB: Component B identifiers are different in the GAIA-DR3 and UCAC5 catalogues.
6. Component B of DAM 1204: no indication of parallax and proper motion in the Gaia DR3 catalogue and not listed in the UCAC5 catalogue.
7. Included in the ORB6 2023 catalogue, Date = 2006, Grade = 5, P = 1360.2 years, a = $12''.7$, i = $113°.4$, $\Omega = 96°.2$, T = 3235.4, e = 0.85, $\omega = 177°.1$, Equinox = 2000
8. BRT 2966: the magnitude of the B component indicated in the WDS catalogue (10.40) is very different from the magnitudes provided by the GAIA-DR3 catalogue ($G = 12.16$, $BP = 12.54$ and $RP = 11.57$). Gaia DR3 Part6. Performance Verification (Gaia Collaboration 2022). Synthetic

photometry generated from the Gaia BP/RP mean spectra gives magnitudes $B = 13.15$, $V = 12.37$, $R = 11.92$ and $I = 11.51$

9. ITF 32: the WDS note "V" indicates that this pair is physical, but the GAIA-DR3 data give different parallaxes and proper motions for the component.
10. The GAIA-DR3 catalogue indicates that the component A of HJ 1846 is in fact composed of two stars identified by GAIA-DR3 1992092800677611904 and 1992092796385289344 with G magnitudes respectively 12.535 and 12.611. The global magnitude of the A component is obtained by applying the law of composition of magnitudes which gives $G = 11.820$

Explanation of Table II

Col.1	Usual name
Col.2,3	Difference between our measures of $\theta°$ and ρ'' called "O" and the oldest measures of $\theta°$ and ρ'' listed into the WDS catalogue and their uncertainties.
Col.4	Date of the first reliable measure into the WDS catalogue.
Col.5	Interval (in years) between the earlier reliable measures and our measures.

Table III (O-WDS)

Name		(O-WDS)θ		(O-WDS)ρ		Date	Interval
POU 1337		−0.14	±0.11	0.000	±0.042	2001.050	22.098
BRT 392		+0.49	±0.21	+0.001	±0.026	2000.047	23.144
DBR 301		−1.41	±0.35	0.075	±0.039	2017.916	5.312
BRT 2664	AB	+1.14	±0.41	+0.051	±0.008	1999.989	23.202
BRT 2966		+0.40	±0.10	+0.057	±0.017	1999.138	24.118
KPP 189		−0.973	±0.40	−0.005	±0.001	2015.500	7.756
LDS 261		+1.44	±0.06	+0.193	±0.016	1999.143	24.113
KPP 1113		+0.14	±0.51	+0.009	±0.049	2013.314	9.990
KPP 1201		+0.14	±0.38	−0.060	±0.092	1999.551	23.760
ITF 32		−2.11	±1.06	−0.249	±0.119	1999.547	24.115
VVV 53		−1.35	±0.08	+0.140	±0.062	2016.000	7.666
VVV 55		2.32	±0.91	+0.066	±0.036	2015.500	8.167
GRV 1262		−0.47	±0.82	−0.011	±0.020	2016.000	7.677
KPP 4341	AB	+0.28	±0.36	−0.003	±0.006	2015.500	8.175
KPP 4341	AC	+0.71	±0.27	+0.078	±0.030	1998.498	25.177
CPO 84	AB	−6.29	±0.51	−0.234	±0.004	2015.500	8.175

References

Zacharias, N, *et al.*, UCAC5, 2017

Acknowledgements

This research has made use of:
- observations from the Las Cumbres Observatory global telescope network.
- the Washington Double Star Catalog maintained at the U.S. Naval Observatory.
- the VizieR catalogue access tool, CDS, Strasbourg, France. The original description of the VizieR service was published in A&AS 143, 23

- the Gaia EDR3 Catalog and the Gaia DR3 Catalog
- the REDUC software
- the WDSTOOL data base
Special thanks to:
- Florent Losse, `Reduc`[1] software (`http://www.astrosurf.com/hfosaf/uk/tdownload.htm#reduc`)
- David Chiron, WDSTOOL[2] data base (`http://wdstool.com/`)

ASTRONOMICAL ASSOCIATION OF QUEENSLAND 2023/4 PROGRAMME - BLUE STAR OBSERVATORY - MEASUREMENT OF SOUTHERN MULTIPLE STARS

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Abstract

This paper presents results of an ongoing 2023 - 24 programme of photographic measurements of southern multiple stars. All results were obtained using an Atik 460EX mono CCD camera used in conjunction with an equatorially mounted 400-mm F4.5 Newtonian reflector.

The mean 95% confidence intervals for the new measures are $\pm 0^\circ.039$ in PA and $\pm 0''.228$ in separation.

System	Last listed measure			New measure			Comment
	PA °	Sep.″	Epoch	PA°	Sep.″	Epoch∗	
STF1019AC	292	38.2	2011	295.669	38.006	2024.008	Increase in PA over 13 yrs.
D12 AB	282	6.4	2003	282.957	6.374	2024.008	Little probable change over 20 yrs.
HJ 4734	246	10.5	1999	245.932	11.226	2023.515	Small increase in separation over 32 yrs
DON 880	178	3.3	1998	177.402	2.970	2023.515	Possible small decrease in both axes
BRT1016	126	4.6	1999	125.260	4.276	2023.515	Possible small decrease in both axes over 24 yrs
HJ 5325 AB	267	18.9	1999	266.574	18.864	2023.712	Little probable change over 24 yrs
HJ 5325 AC	97	32.2	1999	96.676	31.600	2023.712	Little probable change over 24 yrs.

∗ Epochs of new measures given in Besselian years as the average of the observations making up the measure.

Also included in a separate table below are the details of three possible new pairs found while studying the seven known pairs. These new pairs were located usually within or near the instrument field of view while searching for/imaging the known pairs.

System	RA	Dec.	Mags	PA(°)	Sep(″)	Epoch∗
					(2020+)	
Possible new pair near B1501 Columba	06 01 27.07	-41 03 46	15.63,16.32	225.270	10.697	4.008
Possible new pair near (S.W.) of TDS9450 Vela	15 11 51.95	-66 42 14	13.07,13.48	95.557	14.091	3.513
Possible new pair near (E.) of TDS9450 Vela	15 13 52.91	-66 38 28	14.36,15.25	84.74	6.230	3.51

∗ Epochs of new measures given in Besselian years as the average of the observations making up the measure.

Introduction

These latest results are part of an on-going programme commenced in 2008 by the Double Star Section of the Astronomical Association of Queensland. The target stars were selected from the Washington Double Star Catalogue (WDSC) and were observed in Queensland, Australia from a latitude of approximately 27° S.

Method

Nightly sets of one hundred images were obtained with the equipment described above, after which the images were stacked using Atik DAWN software and then analyzed using the astrometric double star program Reduc([1]. Approximately ten stacked images of each target were taken per night for seven nights and the results averaged to obtain measures of separation and position angle with sufficient confidence.

Full details of the method are given in Napier-Munn and Jenkinson[2]. Subsequent work on the errors inherent in the method is described in Napier-Munn and Jenkinson[3]. As proficiency has grown in the use of this equipment with the 400-mm reflector, close doubles with considerable magnitude difference between the components have been successfully measured.

Fellow AAQ member Des Janke provided invaluable assistance processing the original FITS image files into JPEG photographs, along with his use of Gaia DR2 to gather details of the possible new pairs.

Results

For all of the systems shown below the WDSC information is first reproduced, showing the epoch 2000 position, magnitudes, separation, PA, and the last recorded measurement. The new measurements are then given in tabular form, including the mean and standard deviation and 95% confidence limits. Any uncertainties between the images and the last recorded measurements are discussed. Finally a conclusion is given as to whether any movement of the component stars has occurred in PA or separation, based on the P-value for the t-test comparing the new mean values with the catalogued value ($P < 0.05$ is considered as evidence of change).

Results as detailed in the tabulated summary above:

∗ The seven sets of multiples as detailed above all show no large discrepancies when compared to their previous measures.

∗ As part of the procedure to check these pairs, full frame FOV images were also obtained and examined for possible new pairs nearby. Using the Cartes Du Ciel charting software with the Gaia DR2 catalogue, Des Janke identified three possible candidates for study. These possible new pairs as submitted in the second table were also imaged and measured.

Please note that all attached images are aligned with North to the bottom and East to the right.

STF1019 AC Monoceros RA. 07 05 50 DEC. -10 39 36 Last Measure 2011 MAG. 6.51 & 9.55 PA. SEP. 38″.2

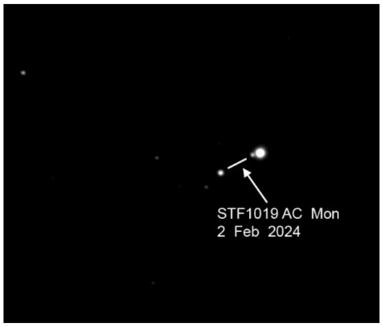


Figure 1: STF1019 AC in Monoceros

Date	No. images	PA°	Sep″
07 December 2023	10	295.43	37.625
08 December 2023	10	295.57	38.095
09 December 2023	10	295.92	37.784
10 December 2023	10	295.75	38.045
31 January 2024	10	295.78	38.103
01 February 2024	10	295.63	38.177
02 February 2024	10	295.6	38.21
Mean		295.669	38.006
Standard deviation		0.161	0.218
95% CI ±		0.149	0.201
P(t) movement		0.000	0.056

Table 3: Individual measures of STF1019 AC

COMMENTS: Increase in PA over 13 years. Little probable change in separation.

D12 AB Monoceros RA. 07 05 50 DEC. -10 39 36 Last Measure 2003 MAG. 6.51 10.08 PA. SEP. 6″.4

Figure 2: D 12 in Monoceros

Date	No. images	PA°	Sep″
07 December 2023	10	280.46	5.707
08 December 2023	10	282.61	6.504
09 December 2023	10		
10 December 2023	10	283.76	6.404
31 January 2024	10	284.27	6.523
01 February 2024	10	283.57	6.551
02 February 2024	10	283.07	6.554
Mean		282.957	6.374
Standard deviation		1.350	0.331
95% CI ±		1.417	0.348
P(t) movement		0.143	0.854

Table 4: Individual measures of D 12 AB

COMMENTS: Little probable change over twenty years. Poor quality images 09 December 2023 not used.

HJ4734 Lupus RA. 15 11.3D C. -5 21 Last Measure 199 MAG. 5.43 & 12.30 PA. SEP. 10″.5

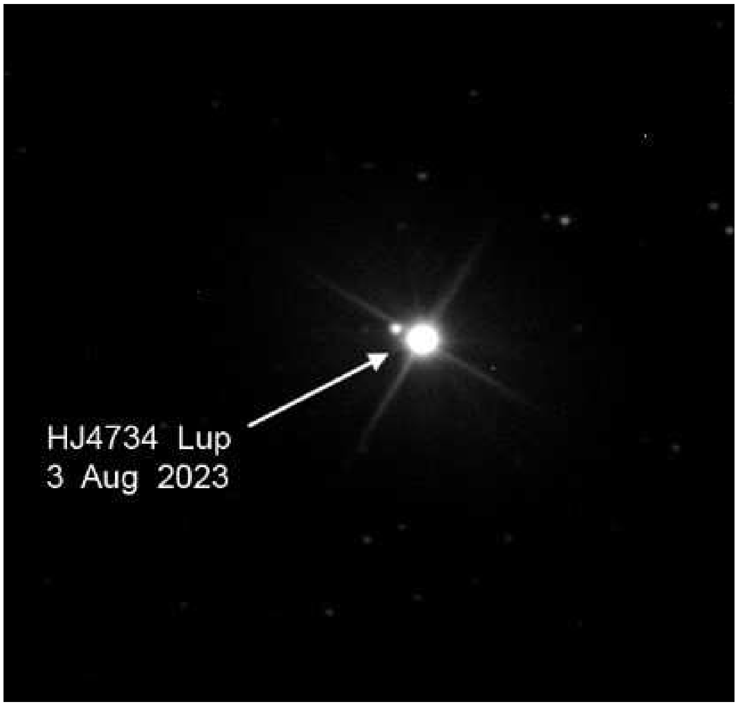


Figure 3: HJ 4734 in Lupus

Date	No. images	PA°	Sep″
13 May 2023	10	244.89	11.064
10 June 2023	10	245.42	11.328
11 June 2023	10	245.39	11.259
01 August 2023	10	245.82	11.234
02 August 2023	10	247.27	11.327
03 August 2023	10	246.8	11.141
Mean		245.932	11.226
Standard deviation		0.916	0.105
95% CI ±		0.962	0.110
P(t) movement		0.862	0.000

Table 5: Individual measures of HJ 4734

COMMENTS: Six night's imaging only due to inclement weather. Small increase in separation over 24 years.

DON880 Corona Australis RA. 18 04. DEC. -43 06 Last Measure 1998 MAG. 10.29 & 10.83 PA. SEP. 3″.3
COMMENTS: Six night's observations only due to inclement weather. Possible small decrease in separation over 25 years.

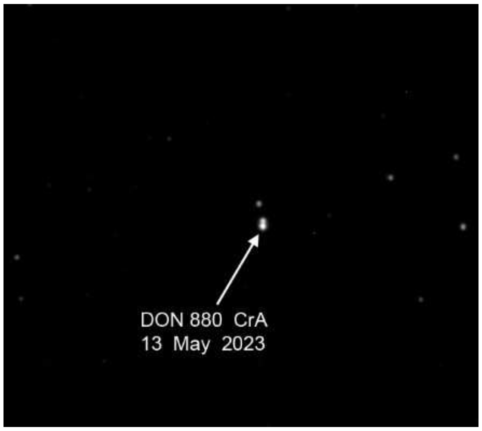


Figure 4: DON 880 in Corona Auatralis

Date	No. images	PA°	Sep″
13 May 2023	10	177.44	2.882
11 June 2023	10	177.37	3.201
30 July 2023	10	177.27	3.184
01 August 2023	10	177.41	2.842
02 August 2023	10	177.43	2.984
03 August 2023	10	177.49	2.726
Mean		177.402	2.970
Standard deviation		0.075	0.191
95% CI ±		0.079	0.201
P(t) movement		0.000	0.008

Table 6: Individual measures of DON 880

BRT1016 Corona Australis RA. 18 04. DEC. -45 22 Last Measure 1999 MAG. 12.80 & 13.11 PA. SEP. 4″.6

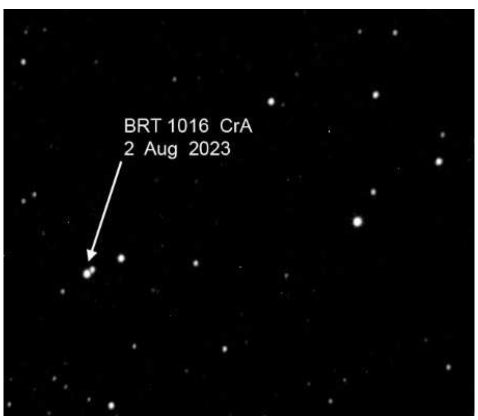


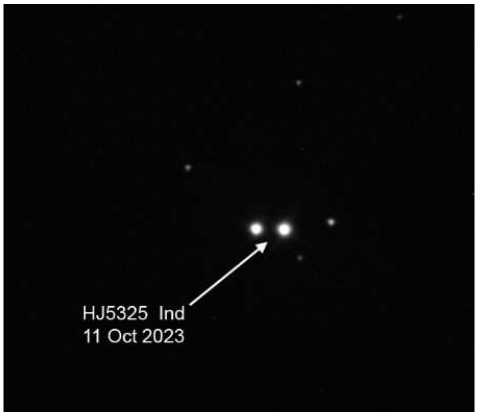
Figure 5: BRT1016 in Corona Australis

Date	No. images	PA°	Sep″
13 May 2023	10	125.45	4.317
11 June 2023	10	125.82	4.241
30 July 2023	10	124.81	4.538
01 August 2023	10	124.56	3.967
02 August 2023	10	125.65	4.200
03 August 2023	10	125.27	4.394
Mean		125.260	4.276
Standard deviation		0.489	0.193
95% CI ±		0.513	0.203
P(t) movement		0.014	0.009

Table 7: Individual measures of BRT1016

COMMENTS: Six night's observations only due to inclement weather. Possible small decrease in both axes over 24 years.

HJ5325 AB Indus RA. 22 23.7 DEC. -65 13 Last Measure 1999 MAG. 7.96 & 8.40 PA. SEP. 18″.9
COMMENTS: Little probable movement over 24 years.

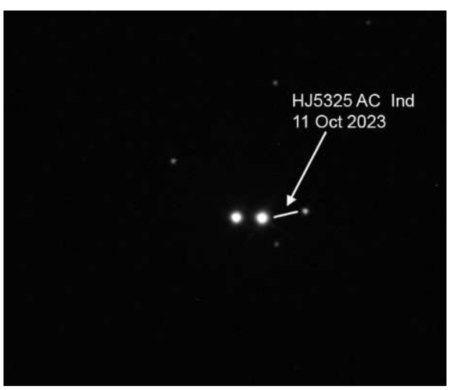


Date	No. images	PA°	Sep″
25 August 2023	10	266.38	18.840
29 August 2023	10	266.64	18.853
09 October 2023	10	266.66	18.899
10 October 2023	10	266.57	18.812
11 October 2023	10	266.50	18.864
12 October 2023	10	266.75	18.915
13 October 2023	10	266.52	18.866
Mean		266.574	18.864
Standard deviation		0.122	0.035
95% CI ±		0.112	0.032
P(t) movement		0.000	0.034

Figure 6: HJ 5325 AB in Indus

Table 8: Individual measures of HJ5325 AB

HJ5325 AC Indus RA. 22 23.7 DEC. -65 13 Last Measure 1999 MAG. 7.96 & 12.14 PA. SEP. 32″.2



Date	No. images	PA°	Sep″
25 August 2023	10	96.42	32.266
29 August 2023	10	96.59	32.159
09 October 2023	10	96.82	31.972
10 October 2023	10	96.51	31.954
11 October 2023	10	96.82	32.026
12 October 2023	10	96.8	31.896
13 October 2023	10	96.77	28.93
Mean		96.676	1.600
Standard deviation		0.166	1.184
95% CI ±		0.154	1.095
P(t) movement		0.002	0.229

Figure 7: HJ 5325 AC in Indus

Table 9: Individual measures of HJ5325 AC in Indus

COMMENTS: As with AB component, little probable movement over 24 years.

Possible new pairs

Possible new pair near TDS9450 RA. 15 11 51.95 DEC. -66 42 14 Last Measure n/a MAG. 13.07 & 13.48 PA. n/a SEP. n/a

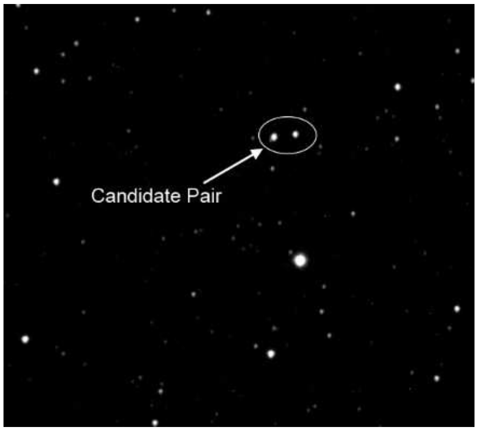


Figure 8: Possible new pair in Triangulum Australe

Date	No. images	PA°	Sep″
10 June 2023	10	95.63	14.062
11 June 2023	10	95.66	14.096
29 July 2023	10	95.53	14.136
01 August 2023	10	95.77	14.099
02 August 2023	10	95.33	14.06
03 August 2023	10	95.42	14.091
Mean		95.55	14.091
Standard deviation		0.163	0.028
95% CI ±		0.171	0.029
P(t) movement		n/a	n/a

Table 10: Possible new pair in Triangulum Australe

COMMENTS: Six night's observations only due to inclement weather. Possible new pair nearby (S.W.) of TDS9450. Gaia #DR2 5824496379545494272 (brighter component). Gaia #DR2 5824496379545493632 (fainter component).

Possible new pair near TDS9450 RA. 15 13 52.91 DEC. -66 38 28 Last Measure n/a MAG. 14.36 & 15.25 PA. n/a SEP. n/a

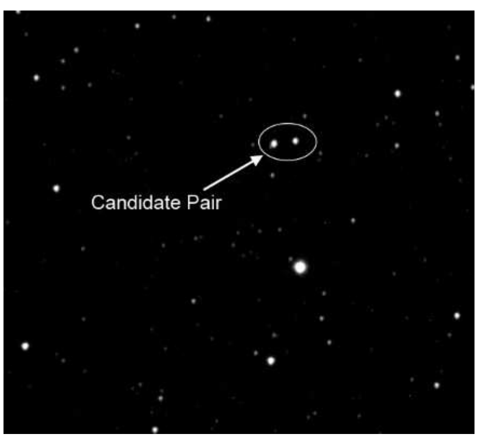


Figure 9: Possible new pair in Triangulum Australe

Date	No. images	PA°	Sep″
10 June 2023	10	84.56	6.257
11 June 2023	10	84.73	6.233
01 August 2023	10	84.91	6.170
02 August 2023	10	84.74	6.253
03 August 2023	10	84.79	6.237
Mean		84.746	6.230
Standard deviation		0.126	0.035
95% CI ±		0.157	0.044
P(t) movement		n/a	n/a

Table 11: Individual measures ofpossible new pair in Triangulum Australe

COMMENTS: Five night's observations only due to inclement weather. Possible new pair nearby (East) of TDS9450. Gaia #DR2 5824496379545494272 (brighter component). Gaia #DR2 5824496379545493632 (fainter component).

Possible new pair near B1501 Columba RA. 06 01 27.07 DEC. -41 03 46 Last Measure n/a MAG. 15.63 & 16.32 PA. n/a SEP. n/a

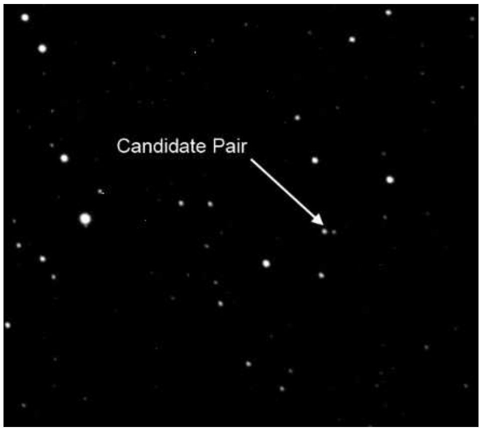


Figure 10: Possible new pair in Columba

Date	No. images	PA°	Sep″
06 December 2023	10	225.01	10.655
08 December 2023	10	225.14	10.686
09 December 2023	10	225.26	10.699
10 December 2023	10	225.26	10.714
31 January 2024	10	225.42	10.714
01 February 2024	10	225.37	10.690
02 February 2024	10	225.43	10.724
Mean		225.20	10.697
Standard deviation		0.154	0.023
95% CI ±		0.143	0.022
P(t) movement		n/a	n/a

Table 12: Individual measures of possible new pair in Columba

COMMENTS: Possible new pair NW of B1501. Gaia #DR2 2882347402682085376 (brighter component). Gaia #DR2 2882347398385827840 (fainter component).

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NEGLECTED DOUBLE STARS VERSUS GAIA DR3

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Abstract

An attempt to confirm a subset of neglected double stars in the WDS Catalog by matching with Gaia DR3 Catalogue data

Method

The Washington Double Star Catalogue currently lists about 156,000 objects, several thousand of which have not been measured for decades. The reasons for this, in addition to a few spurious "discoveries", are most likely simply data processing errors, ranging from incorrect data noted at discovery to errors in the many data entry steps and changes in star catalogues over time. Many such objects are listed with only one measurement, and were never observed again. This report covers a few hundred such pairs with only one observation. The selection was done in November 2023 by criteria reflecting the known double star resolution issues of Gaia DR3 and other practical issues such as precise position given as well as position angle and angular separation, given separation $0''.7$ or larger but smaller than $999''$, magnitude primary fainter than 6. A few objects with zero measurements were also excluded with in total 276 neglected double stars most likely suited for counter-checking with Gaia DR3 remaining.

The process itself was then straightforward: Selecting the given precise position for the primary in Aladin and loading Gaia DR3 to visually locate the proposed secondary − usually without success because most WD S objects are meanwhile already matched with Gaia DR3 if automatically possible within a reasonable error range for separation and position angle. The visual approach gives room for more flexibility in recognizing an otherwise not so obvious match especially when applying the available proper motion data for the discovery year − however, such an obvious match was a rare occurrence. In most cases, either the object at the specifie d position was a single star or else any potential secondaries were most obviously false positives, completely off in position angle and separation as well as in magnitude. We wanted to avoid having to declare too many neglected pairs as spurious, so we opted to err on the positive side by accepting the "the first measure might be erroneous, but "something is here" approach.

In all cases without a reasonable match at the specified position, we also examined the field of view of several arcminutes around the position to find a possible match nearby applying again the "the first measur e might be erroneous, but something is here" approach.

Results

The findings and suggestions of both authors are presented in comparison to show possible different assessments of the given evidence.

Table 1 - Results of comparing a subset of neglected WDS objects with Gaia DR3 data (we give here a stub with selected data for the first three objects, whilst the full table with all data is available as a spreadsheet for download. Objects outside our Galaxy excluded, see discussion below)

WDS_ID	DD	Comment & Suggestion - WK	Comment & Suggestion - JN
00033+8239	HJ 3234AB	No such pair at this position. However, AC confirmed. -> WDS note code "X"	No object at the 201° mark and 1″.3 distance. One additional 20th magnitude GAIA DR3 marker on the star.
00097-3846	WG 1	Potential most likely false positive match ~9′away at 001028.12-384652.5. Plx and pm similar Change precise position to 001028.12-384652.5. Add GAIA DR3 measure. Change magnitudes to 12.5/18.8. Proper motion - +014/006 -013/006. WDS note code "T"	No object anywhere near the 229° mark at 3″.4 distance, no GAIA EDR3 markers located on the star image other than the primary marker. GAIA EDR3 *G* mag for the primary is 11.366
00157+5035	DOO 1	No such pair in this field of view. -> WDS note code "X"	No object at the 240° mark and 1″.2 distance. Two other GAIA EDR3 markers on the object which are 17th and 18th mags.

Table 2 - Gaia DR3 measures for neglected WDS objects if suggested for WDS Catalog update

WDS ID	Comp	Date	PA	e_PA	Sep	e_Sep	M1	e_M1	M2	e_M2
00097-3846		2016.0	342.200	0.014	2.04407	0.00049	12.530	0.003	18.770	0.006
00244-4235		2016.0	54.413	0.001	2.20424	0.00002	11.093	0.008	10.534	0.003
00426-0652	AB	2016.0	145.525	0.001	2.25915	0.00006	11.460	0.003	14.439	0.003
00097-3846		2016.0	342.200	0.014	2.04407	0.00049	12.530	0.003	18.770	0.006
00244-4235		2016.0	54.413	0.001	2.20424	0.00002	11.093	0.008	10.534	0.003
00426-0652	AB	2016.0	145.525	0.001	2.25915	0.00006	11.460	0.003	14.439	0.003
01257-6725		2016.0	34.649	0.004	10.47948	0.00079	8.095	0.003	20.397	0.008
01472-0615		2016.0	255.055	0.569	1.19701	0.01189	9.250	0.003	.	.
02507+6249	AC	2016.0	128.846	0.000	46.99815	0.00003	9.039	0.003	15.161	0.003
02507+6249	AE	2016.0	70.033	0.000	42.61510	0.00004	9.039	0.003	15.905	0.003
03445+5044		2016.0	288.836	0.049	0.74980	0.00064	10.604	0.003	.	.
04100+2108		2016.0	170.666	0.001	1.41764	0.00003	11.852	0.003	12.023	0.003
04190-1751		2016.0	6.391	5.479	0.79259	0.07603	7.369	0.003	.	.
04508-4013		2016.0	299.864	0.002	2.83830	0.00007	9.179	0.003	15.106	0.003
04582+4403		2016.0	3.604	0.066	0.86924	0.00100	10.783	0.003	.	.
05057+0628		2016.0	44.869	0.218	0.69412	0.00264	9.684	0.003	.	.
05154+3241	Ca,Cb	2016.0	285.974	0.021	2.02705	0.00073	7.882	0.003	13.904	0.013
05346-1004		2016.0	154.592	0.003	4.02316	0.00019	8.862	0.003	17.762	0.008
05427+3344		2016.0	132.866	0.001	2.34808	0.00005	11.789	0.003	12.596	0.003
05447-5955	AB	2016.0	62.292	2.238	0.44394	0.01735	10.762	0.005	11.085	0.006
05488+1200		2016.0	1.888	0.001	11.86566	0.00019	6.903	0.003	16.557	0.003
06028+3907		2016.0	345.291	0.002	1.25960	0.00003	11.751	0.003	12.370	0.004
06156+5131		2016.0	152.455	0.016	0.85412	0.00024	9.595	0.003	.	.
06187+3224		2016.0	157.660	0.001	1.87405	0.00003	12.838	0.003	13.211	0.003
06214+2203		2016.0	123.869	0.004	1.18593	0.00009	11.110	0.003	11.871	0.003
06291-0311		2016.0	166.024	0.001	2.18309	0.00003	11.930	0.003	13.030	0.003

06395+6610		2016.0	84.684	0.001	4.31841	0.00011	8.772	0.003	17.360	0.006
06459-2920	AB	2016.0	64.448	0.001	2.80615	0.00006	10.744	0.003	16.128	0.004
07070+0131	AB	2016.0	40.525	0.001	1.79515	0.00004	11.258	0.003	11.493	0.003
07079+1053	AC	2016.0	165.784	0.000	55.64990	0.00005	8.289	0.003	15.095	0.003
07278-0940		2016.0	19.769	0.002	3.08881	0.00009	11.763	0.003	16.930	0.004
07467-2134		2016.0	348.504	0.004	0.99264	0.00007	9.793	0.003	.	.
08031-2107		2016.0	343.728	0.024	0.75369	0.00032	10.033	0.003	.	.
09284-4254		2016.0	13.327	0.009	0.99168	0.00015	9.686	0.003	.	.
09308-5138		2016.0	52.152	0.025	2.61222	0.00114	9.500	0.003	18.191	0.009
09318-7228		2016.0	30.474	0.023	9.13682	0.00371	7.689	0.003	20.814	0.020
10027-6013		2016.0	213.172	0.111	0.74064	0.00143	10.941	0.003	.	.
10386-3145		2016.0	267.087	0.000	21.37218	0.00003	11.112	0.003	15.162	0.003
10566-3635	AB	2016.0	323.657	0.003	2.30439	0.00011	8.679	0.003	13.534	0.003
11343-8507		2016.0	352.107	2.668	1.03852	0.04839	9.578	0.003	10.718	0.157
12360-7313		2016.0	340.306	0.006	1.32658	0.00014	14.187	0.003	14.696	0.003
13065-1028		2016.0	278.204	0.004	5.59184	0.00036	18.094	0.003	18.976	0.004
13148-6202	AC	2016.0	122.072	0.005	4.02152	0.00037	9.544	0.003	18.589	0.013
13201-1558		2016.0	257.467	0.000	350.29169	0.00006	11.831	0.003	16.163	0.003
14086+2349		2016.0	335.943	0.002	6.01467	0.00024	8.703	0.003	17.789	0.014
15036-2751	AC	2016.0	93.081	0.001	9.60965	0.00015	8.270	0.003	16.962	0.003
15211-3352		2016.0	213.951	0.014	2.87736	0.00068	9.529	0.003	17.610	0.006
15510-7259		2016.0	55.437	0.002	1.25599	0.00004	11.825	0.003	12.446	0.003
15517-0559	AB,C	2016.0	138.032	0.017	4.18208	0.00121	8.469	0.005	13.665	0.003
15527-7146		2016.0	126.675	0.001	3.00619	0.00006	10.722	0.003	16.311	0.003
15537-6311	AC	2016.0	189.324	0.000	16.30994	0.00002	8.488	0.003	13.467	0.003
15570+2002		2016.0	298.858	0.001	20.12303	0.00018	8.166	0.003	18.518	0.003
16132-5303		2016.0	253.416	0.004	1.94985	0.00014	12.248	0.003	14.612	0.004
16232-4833		2016.0	162.184	0.008	2.89112	0.00042	10.661	0.003	18.225	0.011
16284+0147		2016.0	328.583	0.007	1.00188	0.00013	9.980	0.003	.	.
16317-4013	AC	2016.0	62.706	0.000	10.79891	0.00008	7.087	0.003	14.379	0.003
16593-6235		2016.0	343.107	0.005	1.21486	0.00010	10.415	0.003	12.181	0.003
16595-2622		2016.0	118.147	0.001	2.46037	0.00005	8.896	0.003	13.151	0.003
17133-2908	AB	2016.0	268.870	0.010	4.24761	0.00078	9.540	0.003	19.040	0.007
17260-0245	AC	2016.0	19.743	0.003	19.70864	0.00093	11.447	0.003	20.352	0.006
17348-7034	BC	2016.0	260.506	0.001	1.31898	0.00003	11.766	0.003	11.989	0.003
17413-3135	DE	2016.0	150.381	0.002	4.24856	0.00012	11.731	0.003	17.231	0.003
17502-4801		2016.0	34.873	0.037	1.01746	0.00065	9.179	0.003	11.757	0.004
17530+1521	AB	2016.0	209.048	0.001	16.20404	0.00029	11.705	0.003	19.034	0.004
17530+1521	AC	2016.0	310.559	0.001	24.38136	0.00059	11.705	0.003	20.113	0.006
17551+3745	AD	2016.0	26.152	0.001	32.02134	0.00047	11.826	0.003	20.045	0.005
17563-5905		2016.0	114.359	0.000	5.98471	0.00003	9.910	0.003	12.619	0.003
17565-3408		2016.0	348.958	0.028	2.70962	0.00131	11.457	0.003	19.442	0.038
18140+2017		2016.0	169.607	0.035	1.60536	0.00098	9.822	0.003	14.582	0.004
18278+5622		2016.0	241.698	0.001	2.22531	0.00004	10.782	0.003	13.021	0.003
18334-3111		2016.0	24.394	0.002	2.00498	0.00006	10.944	0.003	11.809	0.003
18337+3726		2016.0	115.258	0.001	3.52579	0.00004	14.051	0.003	15.419	0.003
18373-7308		2016.0	41.646	0.000	3.77667	0.00002	13.044	0.003	13.802	0.003
19087-2311		2016.0	274.783	0.071	9.91397	0.01222	6.426	0.003	20.424	0.023
19097-2128		2016.0	31.794	0.000	45.54154	0.00003	8.010	0.003	13.124	0.003
19101+3252	AC	2016.0	89.645	0.000	4.12333	0.00003	8.124	0.003	12.861	0.003
19140+4005		2016.0	170.923	0.008	0.94130	0.00013	12.069	0.003	11.915	0.003

19141+3646		2016.0	118.418	0.001	1.48993	0.00003	12.245	0.003	13.451	0.004
19181-0638	AC	2016.0	230.663	0.002	6.41687	0.00020	11.417	0.003	17.315	0.003
19202+8629		2016.0	67.526	0.000	111.88129	0.00027	10.049	0.003	19.256	0.004
19233-0910	AC	2016.0	185.761	0.001	4.83706	0.00005	9.547	0.003	13.325	0.003
19296+2906		2016.0	44.967	0.000	6.49605	0.00004	11.248	0.003	16.245	0.003
19300+6630	BC	2016.0	197.648	0.001	3.51806	0.00007	11.257	0.003	12.789	0.003
19365+3427	AB	2016.0	76.919	0.000	4.91101	0.00002	13.670	0.003	13.958	0.003
19380+3610		2016.0	260.127	0.002	4.73189	0.00014	12.618	0.003	18.255	0.003
19401+3943		2016.0	137.947	0.012	0.84610	0.00018	10.645	0.003	11.538	0.005
19503+3558	AB	2016.0	100.477	0.000	7.95146	0.00003	11.158	0.003	11.770	0.003
19557+3805	BD	2016.0	250.103	0.000	6.68914	0.00004	13.946	0.003	15.632	0.003
20005+3531		2016.0	295.844	0.013	4.11715	0.00096	10.121	0.003	19.871	0.012
20121+4618	AB	2016.0	19.930	0.001	5.72422	0.00010	8.846	0.003	16.822	0.004
20121+4618	AD	2016.0	111.998	0.000	16.59659	0.00010	8.846	0.003	17.519	0.004
20154+6412	AC	2016.0	163.654	0.005	22.40210	0.00178	8.329	0.005	16.099	0.003
20169+3307	AB	2016.0	15.586	0.001	22.17236	0.00024	9.110	0.003	19.164	0.004
20198-0827		2016.0	49.771	0.002	3.90248	0.00011	8.832	0.003	16.134	0.006
20246+4904		2016.0	322.166	0.001	3.02426	0.00003	11.952	0.003	13.478	0.003
20327+1932	AD	2016.0	162.248	0.000	15.97999	0.00013	11.348	0.003	18.206	0.003
20354-5014	AB	2016.0	150.990	0.005	0.84551	0.00008	11.778	0.003	12.398	0.005
21023+3931	AG	2016.0	222.538	0.000	101.85601	0.00003	5.934	0.003	11.897	0.003
21050+1243	AD	2016.0	70.647	0.010	4.39147	0.00075	8.615	0.003	18.812	0.006
21221+4011		2016.0	301.371	0.001	7.43568	0.00009	10.382	0.003	17.788	0.003
21307+2258		2016.0	2.909	0.001	1.41833	0.00003	12.505	0.003	12.844	0.003
21318-4701		2016.0	336.236	0.001	2.00002	0.00003	10.825	0.003	13.270	0.003
21339-3806		2016.0	119.562	0.018	0.89484	0.00027	9.844	0.003	.	.
21433+8523		2016.0	262.923	0.000	5.66316	0.00003	11.667	0.003	14.626	0.003
22093+1142		2016.0	289.703	0.001	22.97165	0.00046	11.551	0.003	19.264	0.005
22132+5655		2016.0	325.749	0.000	5.49189	0.00003	10.232	0.003	13.281	0.003
22292+4526		2016.0	301.687	0.011	2.87878	0.00054	9.454	0.003	.	.
22322+4927		2016.0	126.348	0.004	1.04722	0.00006	10.975	0.003	12.630	0.003
22328+1024	AB	2016.0	146.996	0.000	40.10654	0.00024	9.109	0.003	16.527	0.003
22396+1121	AB	2016.0	79.524	0.001	11.44716	0.00023	10.242	0.003	18.343	0.003
22515-1419		2016.0	143.513	0.001	53.73496	0.00129	11.163	0.003	20.369	0.009
22526+4833		2016.0	214.089	0.000	5.25980	0.00003	11.664	0.003	15.286	0.003
22593+1212		2016.0	83.291	0.002	15.80512	0.00042	8.204	0.003	18.132	0.003
23043+5131		2016.0	307.693	2.261	0.76683	0.03028	9.617	0.003	.	.
23274+5016	AB	2016.0	64.139	0.001	2.99413	0.00003	11.387	0.003	14.167	0.003
23274+6123		2016.0	346.234	0.013	1.00694	0.00023	10.492	0.005	13.433	0.005
23550+4401		2016.0	59.276	0.000	11.40661	0.00006	9.128	0.003	15.968	0.003

Side results

In eight cases, unexpected side results were gained from checking the data of objects nearby the given positions for neglected double stars:
Table 3 - Side results (stub with selected data for the first three objects, full table with all data available as a spreadsheet for download)

WDS_ID	DD	Comp	Comment & Suggestion
03171+3648	ES 2557	AB	Gaia search for DAM 33 suggests some changes for ES 2557.

		-> Change component designation for ES 2557 AC to AB. Change magnitudes to 11.9/11.9. Proper motion +022-075/+021-073. WDS note code "T"
04200+1402	BUP 53 AC	The primaries of BUP 53 and BUP 54 near BAS 3 are obviously a very wide physical pair. -> Add BUP 53AC to the WDS Catalog. Add Gaia DR3 measure. Magnitudes are *G* mags. Proper motion +115-019/+114-021. WDS note code "T"
05416-0153	PAD 11 AB	BCK 2 C might offer a match for PAD 11 (initially not selected for this list due to PA -1) at precise position 054136.70-015243.2. -> Change precise position to 054136.70-015243.2. Add Gaia DR3 measure. Change magnitudes to 17.8/19.5. Proper motion -001-002/ 000-001. Plx and pm similar, but insignificant. Delete WDS note code "R"

Table 4 - Gaia DR3 measures for side results objects if suggested for WDS Catalog update (stub with selected data from the first three rows, full table in WDS short_format text file is available for download)

WDS_ID	Comp	Date	PA	e_PA	Sep	e_Sep	M1	e_M1	M2	e_M2
03171+3648	AB	2016.0	.	.	.	.	11.882	0.003	11.880	0.003
04200+1402	AC	2016.0	85.281	0.000	1836.90044	0.00010	5.511	0.003	5.644	0.003
05416-0153	AB	2016.0	154.301	0.013	2.06214	0.00048	17.794	0.008	19.452	0.005
10566-3635	Aa,Ab	2016.0	260.660	0.006	1.82032	0.00020	8.679	0.003	14.518	0.004
17380-4837		2016.0	278.654	0.000	3.78441	0.00003	11.221	0.003	12.052	0.003
21111+3618	AB	2016.0	210.733	0.000	21.19288	0.00004	6.490	0.003	12.264	0.003
22324-1056	Ea,Eb	2016.0	63.836	0.006	1.96892	0.00020	14.293	0.003	17.665	0.003
23221+6120	AB	2016.0	134.347	0.035	0.66936	0.00041	9.800	0.003	10.817	0.004

Discussion

From the total of 276 selected objects we found 31 (30 RMC 136 and one I 1152) objects, which are located outside our Galaxy in the Large Magellanic Cloud and should therefore not be listed in the WDS Catalog at all. These objects were simply deleted in our results table, with 245 remaining.

From the remaining 245 objects we found:

* For about 5% no sufficient Gaia DR3 data to come to any conclusions.
* For about 47% we suggest adding a Gaia DR3 measure as second observation (27% at the given precise position and 20% with a suggested change in position).
* For about half of them we assume an optical pair and for one sixth we assume a physical system, the rest remains undecided.
* For about one third of them we assume most likely false positives in the sense of “something is here".
* For about 47% we suggest WDS note code “X" for a spurious object.

Regarding discoverer designations: Besides RMC most discoverer designations occur with a single or very few references with the following exceptions:
25 objects are from van den Bos, about 40% of them were found to be spurious, 22 objects are from the Hipparcos Double Star Catalog, 19 of them were found to be spurious, 12 objects are

from Couteau, all but one are confirmed, 8 objects are from Damm, all but two are confirmed, 7 objects are from Espin, all but one are confirmed.

To check the existence of double stars measured only once and never seen again by simply counter-checking with a single other data source might seem to some degree incomplete research. However, the risk to declare a neglected pair erroneously as spurious seems with the given Gaia SR3 data precision acceptably small. Additionally, if such an object exists elsewhere outside a reasonable field of view around the specified position, then it is very likely that another double star astronomer meanwhile rediscovered it.

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VizieR B/wds - The Washington Visual Double Star Catalog (Mason+ 2001-2020)
VizieR I/355 - Gaia DR3 Catalogue (Gaia Collaboration 2022)
CDS Aladin Sky Atlas v12.0 with DSS2 colour images
The tables in the above paper can be found on the Webb Society website at:
`https://www.webbdeepsky.com/dssc/dssc32/`

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