Double Star Observations with a 150mm Refractor from 2017 to 2019

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Abstract: I present 246 measurements of 76 pairs made from 2017 to 2019. For 26 pairs, residuals were calculated.

All observations were made with my 150/3000 folded refractor, filter 11 (yellow – green) and a Alccd QHY 5-II camera. Most observations were made with a 1.4x teleconverter (TK1.4 in Table 1, imaging scale 0.19744 a.s. per pixel), some at direct focus (0.25739 a.s. per pixel, f in Table 1) and only one with a 2x teleconverter (TK2 in Table 1, 0.1385 a.s. per pixel).

For every star and observing run 50 to 100 video files were taken with SharpCap 2.8 and stacked with Registax 5 or Registax 6. The pictures were measured with Reduc 3.88; the number of pictures used for the results is given as "Nr" in Table 1. The residuals were calculated with Binary Star Calculator and are given in Table 2, with "N" meaning the number of nights in which the star was observed.

In Table 3, some measurements and residuals for STF2199 are listed.

Acknowledgements

This paper made use of the Washington Double Star Catalog [1] and the Sixth Catalog of Orbits of Visual Binary Stars [2], both maintained at the U.S. Naval Observatory. Noncommercial software used was: Binary Star Calculator by Brian Workman [3]; Reduc 3.88 by Florent Losse; Registax 5 and Registax 6 by Coer Berrevoets and SharpCap by Robin Glover.

References

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Table 1
Double star measurements from 2017 to 2019

Designation	WDS ident	θ	ρ	Date	Nr	Name	Notes
STF 3053 AB	00026+6606	70.45	15.20	2018.804	76		TK1,4
STF 060 AB	00491+5749	325.5	13.41	2017.829	42	η Cas	TK1,4
STF 88 AB	01057+2128	158.8	29.75	2018.88	14	ψ_1 Psc	TK1,4
STF 100 AB	01137+0735	62.9	22.82	2018.88	29	ζ Psc	TK1,4
STF 174	01501+2217	164	2.85	2018.875	31	1 Ari	TK1,4
		164.4	2.85	2018.877	33		TK1,4
STF 180	01535+1918	1	7.39	2018.875	28	γ Ari	TK1,4
		0.8	7.4	2018.877	23		TK1,4
STF 924 AB	06323+1747	211	19.94	2017.122	26	20 Gem	TK1,4
STF 948 AB	06462+5927	66.4	1.88	2017.136	39	12 Lyn	TK1,4
		66.8	1.89	2017.193	32		TK1,4
STF 948 AC	06462+5927	308.9	8.80	2017.136	35	12 Lyn	TK1,4
		308.8	8.84	2017.193	28		TK1,4
STF 1110 AB	07346+3153	54	5.21	2017.095	40	α Gem	TK1,4
		53.7	5.24	2017.120	55		TK1,4
		53.5	5.23	2017.122	44		TK1,4
		53.7	5.22	2017.136	43		TK1,4
		53.2	5.24	2018.135	59		f
		52.5	5.45	2018.146	65		TK1,4
		52.6	5.41	2018.149	87		TK1,4
		53.3	5.41	2018.193	36		TK1,4
		52.4	5.38	2019.124	39		TK1,4
		52.5	5.34	2019.132	50		TK1,4
STF 1196 AB	08122+1739	16.1	1.17	2017.193	81	ζ Cnc	TK1,4
		15.6	1.06	2017.196	69		TK1,4
		16.3	1.08	2017.199	61		TK1,4
		16.5	1.1	2017.204	64		TK1,4
		11.4	1.04	2018.193	31		TK1,4
		10.8	1.14	2018.218	85		TK1,4
		11.8	1.17	2018.229	63		TK1,4
		8.7	1.18	2019.214	60		TK1,4
		8.4	1.21	2019.22	62		TK1,4
STF 1196 AC		61.1	6.32	2017.193	63	ζ Cnc	TK1,4
		61.3	6.29	2017.196	81		TK1,4
		61.4	6.27	2017.199	59		TK1,4
		61.1	6.31	2017.204	40		TK1,4
		61.1	6.21	2018.193	30		TK1,4
		61	6.21	2018.218	68		TK1,4
		61.2	6.23	2018.229	59		TK1,4
		61.2	6.22	2019.214	82		TK1,4
		60.9	6.22	2019.22	67		TK1,4
STF 1333	09184+3522	50.3	1.76	2018.3	36		TK1,4
STF 1334 AB	09188+3648	223.9	2.52	2018.3	26	38 Lyn	TK1,4
		223.4	2.62	2018.302	47		TK1,4
STF 1338 AB	09219+3811	312.8	0.94	2017.196	50		TK1,4
		309.7	1.04	2017.199	50		TK1,4
		310.5	1.08	2017.204	58		TK1,4
		309.4	0.93	2017.207	60		TK1,4
		313.1	1.08	2018.242	48		TK1,4
		313.2	0.99	2018.267	39		TK1,4
		314.5	1.04	2018.292	38		TK1,4
		312.4	1.07	2018.302	41		TK1,4
STT 215	10163+1744	175.5	1.37	2018.267	20		TK1,4
		175.7	1.5	2018.292	35		TK1,4
		176.3	1.66	2019.299	16		TK1,4
		177.2	1.46	2019.302	41		TK1,4
		175.1	1.42	2019.305	27		TK1,4

Table 1 continues on the next page.

Double Star Observations with a 150mm Refractor from 2017 to 2019

Table 1 (continued). Double star measurements from 2017 to 2019

Designation	WDS ident	θ	ρ	Date	Nr	Name	Notes
STF 1424 AB	10200+1950	126.2	4.69	2017.207	36	γ Leo	TK1,4
		126.2	4.68	2017.226	58		TK1,4
		126.6	4.73	2018.242	61		TK1,4
		126.2	4.7	2018.261	53		TK1,4
		126.3	4.73	2018.267	40		TK1,4
		126.3	4.74	2018.294	42		TK1,4
		126.6	4.77	2019.223	37		TK1,4
		126.8	4.81	2019.228	36		TK1,4
S 612	10459+3041	173.6	196.37	2019.277	38	42 LMi	f
STF 1487	10556+2445	112.7	6.62	2017.328	38	54 Leo	TK1,4
STF 1523 AB	11182+3132AB	165	1.88	2017.273	120	ξ Uma	TK1,4
		166.7	1.92	2017.289	56		TK1,4
		164	1.87	2017.298	67		f
		159.2	2.04	2018.292	39		TK1,4
		159.1	2.07	2018.294	34		TK1,4
		155.9	2.11	2019.244	61		TK1,4
		156.1	2.11	2019.247	37		TK1,4
		155.9	2.10	2019.25	64		TK1,4
STFA 19	11279+0251	181.9	88.73	2018.297	36	τ Leo	TK1,4
STF 1622	12161+4040	259.6	11.57	2017.399	26	2 CVn	TK1,4
STF 1670	12417-0127	1.5	2.55	2017.311	45	γ Vir	TK1,4
		1.7	2.66	2017.320	37		TK1,4
		359.9	2.7	2018.305	63		TK1,4
		359.8	2.73	2018.338	50		TK1,4
		359.4	2.67	2018.341	19		TK1,4
		357.5	2.79	2019.303	62		TK1,4
		357.9	2.83	2019.329	63		TK1,4
STT 261	13120+3205	338.2	2.63	2018.349	23		TK1,4
		338.5	2.63	2018.352	24		f
STF 1768 AB	13375+3618AB	92.7	1.58	2017.355	27	25 CVn	TK2
		94.6	1.65	2017.358	70		TK1,4
		95.2	1.65	2017.377	23		TK1,4
		92.5	1.6	2018.344	38		TK1,4
		92.7	1.6	2018.346	41		f
		92.9	1.59	2018.349	37		TK1,4
		93.1	1.67	2018.352	43		f
		92.8	1.66	2019.359	54		TK1,4
		92.8	1.56	2019.362	22		TK1,4
		94.3	1.68	2019.37	25		TK1,4
STF 1821	14135+5147	235.4	13.67	2017.454	22	κ Boo	TK1,4
STFA 26	14162+5122	32.6	39	2017.465	40	ι Boo	TK1,4
STF 1825	14165+2007	152.7	4.37	2018.368	48		f
		152.8	4.38	2018.376	41		f
STF 1835 AB	14234+0824	194.4	6.34	2017.437	28		TK1,4
		194.8	6.3	2017.443	42		TK1,4
STF 1850	14286+2817	261.2	25.5	2017.451	35		TK1,4
STF 1864 AB	14407+1625	111.5	5.52	2017.388	27	π Boo	TK1,4
		111.5	5.51	2017.394	34		TK1,4
		111.5	5.54	2018.376	35		f
		111.6	5.49	2018.382	46		f
STF 1877 AB	14450+2704	343.7	2.99	2017.416	35	ε Boo	TK1,4
		343.8	2.79	2017.418	53		TK1,4
		343.8	2.92	2018.429	35		TK1,4
		344.7	2.93	2018.431	40		TK1,4
STF 1884	14484+2422	55.4	2.19	2018.428	44		f
		55.3	2.19	2018.431	41		f

Table 1 continues on the next page.

Double Star Observations with a 150mm Refractor from 2017 to 2019

Table 1 (continued). Double star measurements from 2017 to 2019

Designation	WDS ident	θ	ρ	Date	Nr	Name	Notes
STF 1888 AB	14514+1906	300.3	5.53	2017.388	38	ξ Boo	TK1,4
		300	5.52	2017.394	43		TK1,4
		299	5.45	2018.357	41		f
		299.1	5.44	2018.368	36		f
		299.7	5.33	2019.365	36		TK1,4
		299.6	5.53	2019.368	29		TK1,4
STT 288	14534+1542	158.1	0.99	2017.416	21		TK1,4
STT 291	15006+4717	155.6	35.58	2018.385	27		f
STFA 28AaBC	15245+3723	170.7	109.13	2017.396	25	μ Boo	TK1,4
		170.7	108.87	2018.385	29		f
STF 1938 BC	15245+3723	3.2	2.26	2017.402	46	μ Boo	TK1,4
		3.5	2.16	2017.405	26		TK1,4
		3	2.26	2018.401	42		f
		2.6	2.28	2018.408	35		f
		2.4	2.25	2019.414	30		TK1,4
		2.1	2.24	2019.431	31		f
STF 1954 AB	15348+1032	172.2	3.97	2018.423	38	δ Ser	f
		171.9	4.05	2018.426	41		f
STF 1965	15394+3638	306	6.37	2018.450	39	ζ CrB	f
STF 2010 AB	16081+1703	13.6	27.01	2018.450	37	κ Her	f
STF 2032 AB	16147+3352	238.5	7.29	2017.432	63	σ CrB	TK1,4
		238.6	7.29	2017.435	29		TK1,4
		238.7	7.28	2018.423	37		f
		238.8	7.28	2018.426	21		f
		238.6	7.31	2019.458	34		TK1,4
		238.8	7.31	2019.461	33		TK1,4
STFA 30 AC	16361+5255	193.1	90.23	2018.489	27	16&17 Dra	f
		193.1	90.22	2018.492	47		f
STF 2078 AB	16361+5255	103.8	3.1	2018.489	80	17 Dra	f
		103.8	3.1	2018.492	35		f
STF 2118 AB	16564+6502	66.5	0.96	2017.479	33	20 Dra	TK1,4
		64.5	0.91	2017.487	36		TK1,4
		66.1	0.94	2017.492	36		TK1,4
STF 2130 AB	17053+5428	1.1	2.58	2017.473	38	μ Dra	TK1,4
		0.7	2.57	2017.478	34		TK1,4
		359.3	2.56	2018.483	24		f
		359.3	2.55	2018.486	36		f
STF 2140	17146+1423	102.9	4.84	2018.533	42	α Her	f
		103	4.83	2018.535	44		TK1,4
		103.2	4.82	2018.538	29		TK1,4
		102.9	4.87	2019.504	35		TK1,4
		103	4.78	2019.510	29		TK1,4
STF 2161Aab	17237+3709	320.9	4.14	2019.504	49	ρ Her	TK1,4
		320.8	4.13	2019.510	39		TK1,4
STFA 35	17322+5511	310.6	62.14	2017.544	24	ν Dra	TK1,4
STFA 34 AB	17346+0935	190.1	41.24	2018.549	33	53 Oph	f
STF 2199	17386+5546	54.4	2.03	2017.544	24		TK1,4
		54.6	2.01	2017.547	10		TK1,4
		54.5	2.06	2018.483	25		f
		53.6	2.03	2018.486	21		f
		54	2.04	2018.492	23		f
STF 2241 AB	17419+7209	12.5	30.1	2017.547	45	ψ Dra	TK1,4
H 6 2 AC	18006+0256	142	54.5	2018.505	26	67 Oph	f
STF 2264	18015+2136	256.4	6.39	2018.519	43	95 Her	f
		256.4	6.37	2018.524	37		f
STF 2308 AB	18002+8000	231	18.72	2017.511	39	40 & 41 Dra	TK1,4
		231.8	18.68	2017.531	35		TK1,4
STF 2308 AC	18002+8000	128.6	225.25	2017.531	32	41 Dra	f

Table 1 continues on the next page.

Double Star Observations with a 150mm Refractor from 2017 to 2019

Table 1 (continued). Double star measurements from 2017 to 2019

Designation	WDS ident	θ	ρ	Date	Nr	Name	Notes
STF 2272 AB	18055+0230	124.1	6.59	2017.471	28	70 Oph	TK1,4
		123.5	6.59	2017.473	46		TK1,4
		122.8	6.65	2018.505	47		f
		122.4	6.63	2018.516	48		f
		121.8	6.68	2019.488	78		TK1,4
		122.2	6.67	2019.491	51		TK1,4
		122	6.72	2019.501	82		TK1,4
STF 2280 AB	18078+2606	182.77	14.323	2018.524	19	100 Her	f
STF 2289	18101+1629	221.1	1.2	2017.656	66		TK1,4
		220.5	1.19	2017.659	44		TK1,4
		221.6	1.29	2018.519	45		TK1,4
		223.1	1.22	2018.535	43		TK1,4
		223.4	1.17	2018.538	39		TK1,4
		222.1	1.24	2018.546	41		TK1,4
STF 2323 AB	18239+5848	348.2	3.76	2017.487	30	39 Dra	Al, TK1,4
		348	3.72	2017.492	36		Al, f
STF 2323 AC	18239+5848	19.5	89.02	2017.487	30	39 Dra	Al, TK1,4
		19.7	88.89	2017.492	37		Al, f
STF 2382 AB	18443+3940	346.2	2.28	2017.468	45	ε Lyr	TK1,4
		345.5	2.26	2017.471	32		TK1,4
		344.7	2.23	2018.494	44		f
		345	2.24	2018.497	44		f
		344.8	2.26	2018.500	38		f
		345.5	2.29	2019.481	18		TK,14
		344.3	2.22	2019.483	42		TK1,4
		345.5	2.27	2019.485	38		TK1,4
		345.6	2.28	2019.499	40		TK1,4
STF 2383CcD	18443+3940	75.3	2.42	2017.468	29	5 Lyr	TK1,4
		75.4	2.46	2017.471	34		TK1,4
		75.1	2.38	2018.497	20		f
		75.3	2.39	2018.500	43		f
		74.5	2.43	2019.481	29		TK1,4
		75.2	2.49	2019.483	31		TK1,4
		74.2	2.36	2019.485	34		TK1,4
		74.9	2.40	2019.499	32		TK1,4
STF 2417	18562+0412	103.7	22.51	2017.656	38	θ Ser	TK1,4
		103.7	22.52	2017.659	36		TK1,4
STF 2579 AB	19450+4508	215.3	2.65	2017.618	29	δ Cyg	TK1,4
		215.2	2.71	2017.64	39		TK1,4
STF 2583 AB	1948+1149	102.3	1.38	2017.618	29	π Aql	TK1,4
		102.7	1.4	2017.64	38		TK1,4
		102.7	1.46	2019.559	27		TK1,4
		102.6	1.3	2019.576	41		TK1,4
		103.8	1.36	2019.581	33		TK1,4
STF 2603	19482+7016	21	3.13	2017.599	31	ε Dra	TK1,4
		20.4	3.15	2017.602	33		TK1,4
STF 2605	19556+5226	174.9	2.75	2017.599	38	Ψ Cyg	TK1,4
		175.1	2.86	2017.602	45		TK1,4
H 5 47 AB	20014+5006	150	41.89	2018.642	49	26 Cyg	f
		150	41.78	2018.645	21		f
STF 2727	20467+1607	265	8.91	2019.713	38	γ Del	TK1,4
STF 2737 AC	20591+0418	66.3	10.55	2019.644	35	ε Equ	TK1,4
		66.5	10.58	2019.663	33		TK1,4
STF 2758 AB	21069+3845	152.7	31.75	2017.662	23	61 Cyg	TK1,4
		152.8	31.75	2017.667	34		TK1,4
		152.8	31.77	2018.732	58		f
		152.8	31.76	2018.735	59		f
		153	31.81	2019.652	42		f
		152.9	31.79	2019.663	38		f

Table 1 concludes on the next page.

Double Star Observations with a 150mm Refractor from 2017 to 2019

Table 1 (conclusion). Double star measurements from 2017 to 2019

Designation	WDS ident	θ	ρ	Date	Nr	Name	Notes
STF 2822 AB	21441+2845	320.7	1.53	2017.667	42	μ Cyg	TK1,4
		320.8	1.56	2018.650	37		TK1,4
		321.1	1.54	2018.658	40		TK1,4
		321.4	1.6	2019.636	34		TK1,4
		321.9	1.54	2019.652	26		TK1,4
STF 2822 AD	21441+2845	197.1	43	2019.639	25	μ Cyg	f
		197	43	2019.652	32		f
STF 2909	22288-0001	161.7	2.34	2017.788	84	ζ Aqr	TK1,4
		162	2.33	2017.832	66		TK1,4
		160.9	2.28	2018.738	66		TK1,4
		160.7	2.3	2018.740	73		TK1,4
		160.5	2.22	2019.811	39		TK1,4
		159.3	2.27	2019.814	35		TK1,4
		160.6	2.4	2019.818	28		TK1,4
STF 3050 AB	23595+3343	341.5	2.47	2018.804	82		TK1,4
		341	2.43	2018.872	36		TK1,4

Table 2. Residuals for Double Stars from 2017 to 2019

Designation	WDS ident	Date	N	θ	ρ	Δθ	Δρ	Ref
STF 948 AB	06462+5927	2017.2	2	66.6	1.88	4.8	0.18	Pop1996b
						0.7	-0.03	WSI2006b
STF 1110 AB	07346+3153	2017.1	4	53.7	5.23	0	0.03	Hei1988a
						0.7	0.09	Doc1985c
		2018.1	4	52.8	5.38	-0.4	0.2	Hei1988a
						0.4	0.26	Doc1985c
		2019.1	2	52.5	5.36	-0.2	0.03	Hei1988a
						0.6	0.11	Doc1985c
STF 1196 AB	08122+1739	2017.2	2	16.1	1.11	4.2	-0.03	Sod1999
						3.3	-0.02	WSI2006b
		2018.2	3	11.3	1.14	2.7	-0.01	Sod1999
						1.8	0	WSI2006b
		2019.2	2	8.5	1.20	3.1	0.06	Sod1999
						2.3	0.07	WSI2006b
STF 1338 AB	09219+3811	2017.2	3	310.5	1	-6.3	0	Sca2002b
		2018.3	2	313.3	1.05	-5.5	0.05	Sca2002b
STT 215	10163+1744	2018.3	2	175.6	1.45	-2.3	-0.12	Zae1984
		2019.3	3	176.4	1.49	-1.3	-0.09	Zae1984
STF 1424 AB	10200+1950	2017.2	2	126.2	4.68	-0.1	0.21	Rab1958
		2018.3	4	126.4	4.72	0	0.24	Rab1958
		2019.2	2	126.7	4.79	0.3	0.31	Rab1958
STF 1523 AB	11182+3132AB	2017.3	3	165.1	1.89	0.7	-0.06	Msn1995
		2018.3	2	159.2	2.05	-0.4	0.01	Msn1995
		2019.2	3	155.9	2.11	0.2	-0.01	Msn1995
STF 1670	12417-0127	2017.3	2	1.6	2.6	0.1	0	Sca2007
		2018.3	2	359.8	2.7	-0.1	-0.01	Sca2007
		2019.3	2	357.7	2.81	-0.7	-0.4	Sca2007
STT 261	13120+3205	2018.4	2	338.4	2.63	0.1	0.03	Kis2012
STF 1768 AB	13375+3618	2017.4	1	94.3	1.63	-0.1	-0.05	Sod1999
		2018.3	4	92.8	1.62	-1.3	-0.05	Sod1999
		2019.4	3	93.2	1.64	-0.6	-0.02	Sod1999

Table 2 continues on the next page.

Double Star Observations with a 150mm Refractor from 2017 to 2019

Table 2 (conclusion). Residuals for Double Stars from 2017 to 2019

Designation	WDS ident	Date	N	θ	ρ	Δθ	Δρ	Ref
		2017.4	2	300.2	5.53	-0.2	0.09	Sod1999
STF 1888 AB	14514+1906	2018.4	2	299	5.45	0.3	0.1	Sod1999
		2019.4	2	297.7	5.34	-0.4	0.08	Sod1999
STT 288	14534+1542	2017.4	1	158.1	0.99	0.8	0.01	Hei1998
		2017.4	2	3.3	2.22	0.3	0.01	Sca2013a
						0.5	-0.01	Sod1999
STF 1938 BC	15245+3723	2018.4	2	2.8	2.27	0.2	0.06	Sca2013a
						0.4	0.04	Sod 1999
		2019.4	2	2.3	2.25	0	-0.05	Sca2013a
						0.2	0.02	Sod 1999
		2017.4	2	238.5	7.29	-0.1	0.07	Rag2009
						-0.1	-0.03	Sca1979
STF 2032 AB	16147+3352	2018.4	2	238.7	7.28	-0.1	0.05	Rag2009
						-0.2	-0.06	Sca1979
		2019.5	2	238.7	7.31	-0.2	0.06	Rag2009
						-0.2	-0.05	Sca1979
STF 2118 AB	16564+6502	2017.5	1	65.7	0.94	-1	-0.2	Sca2002d
STF 2130 AB	17053+5428	2017.5	2	0.9	2.58	0.3	0.03	Pru2012
STF 2199	17386+5546	2017.5	2	54.5	2.02	2.3	0.08	Pop1995d
		2018.5	3	54.1	2.04	2.2	0.1	Pop1995d
		2017.5	2	123.7	6.59	-0.4	0.09	Pbx2000b
STF 2272 AB	18055+0230	2018.5	2	122.6	6.64	-0.6	0.07	Pbx2000b
		2019.5	3	122	6.69	-0.4	0.07	Pbx2000b
STF 2289	18101+1629	2017.6	2	220.9	1.2	5.4	-0.04	Hop1964b
		2018.5	4	222.5	1.23	7.1	-0.01	Hop1964b
		2017.5	2	345.9	2.27	0.3	-0.20	Gzl1956a
						0.7	0.03	Nov2006e
						0.6	-0.06	WSI2004b
		2018.5	3	344.8	2.24	-0.5	-0.22	Glz1956a
STF 2382 AB	18443+3940					-0.1	0.02	Nov2006e
						-0.2	-0.08	WSI2004b
		2019.5	4	345.2	2.26	0.2	-0.2	Glz1956a
						0.7	0.05	Nov2006e
						0.6	-0.05	WSI2004b
		2017.5	2	75.4	2.44	0.3	0.05	Doc1984b
STF 2383CcD	18443+3940	2018.5	2	75.2	2.39	0.5	-0.01	Doc1984b
		2019.5	4	74.7	2.42	0.4	0.02	Doc1984b
STF 2579 AB	19450+4508	2017.6	2	215.2	2.68	-1.1	-0.07	Sca2012c
		2017.7	2	152.8	31.75	0.4	0.04	Pko2006b
						-0.1	-0.02	Kis1997
STF 2758 AB	21069+3845	2018.7	2	152.8	31.76	0.3	0	Pko2006b
						-0.3	-0.06	Kis 1997
		2019.7	3	153	31.8	0.3	-0.01	Pko2006b
						-0.2	-0.06	Kis 1997
		2017.7	1	320.7	1.53	2.2	0.03	Hei1995
STF 2822 AB	21441+2845	2018.7	2	321	1.55	-4	0.07	Hei1995
		2019.6	2	321.6	1.57	-4.6	0.1	Hei1995
		2017.8	1	161.8	2.34	0.2	0.03	Sca2010c
						-1.1	-0.12	Hei1984c
STF 2909	22288-0001	2018.7	2	160.8	2.29	0.3	-0.04	Sca2010c
						-1.2	-0.19	Hei1984c
		2019.8	3	160.1	2.29	0.8	0.07	Sca2010c
						-0.9	-0.23	Hei1984c
STF 3050AB	23595+3343	2018.8	1	341.3	2.46	-0.1	0.02	Hrt2011a
						-1.1	0.34	Sta1977b

Double Star Observations with a 150mm Refractor from 2017 to 2019

Table 3. Residuals for STF 2199

Date	N	θ	ρ	Δθ	Δρ	Obs	Ref	Notes
1924.52	4,3	76.8	1.73	-2.9	-0.01	Phillips	Pop1995d	[4]; a
1986.61	2	63.3	2.15	2.7	0.28	Gellera	Pop1995d	[4]; a
2001.328	4	61.8	2	5.3	0.10	Argyle	Pop1995d	[5]; a
2001.45	2	57.7	1.95	1.3	0.04	Alzner	Pop1995d	[6]
2002.44	1	57.2	1.99	1.0	0.08	Mason et. al.	Pop1995d	[7]
2006.56	2	56.2	1.95	1.2	0.03	Alzner	Pop1995d	[8]
2012.6	2	55.9	2.06	2.5	0.13	Maiwald	Pop1995d	[9]; b
2013.5	2	55.2	2.03	2	0.10	Maiwald	Pop1995d	[10]
2014.286	3	55.8	2.06	2.8	0.13	Argyle	Pop1995d	[11];a
2017.5	2	54.5	2.02	2.3	0.08	Maiwald	Pop1995d	
2018.5	3	54.1	2.04	2.2	0.1	Maiwald	Pop1995d	
2018.540	1	54.7	1.88	2.8	-0.06	Schlimmer	Pop1995d	[12], c
2018.594	1	53.9	1.95	2	0.01	Schlimmer	Pop1995d	[12], c

a) Residuals computed with *Binary Star Calculator* by Maiwald
b) Measurements from [6], residuals calculated for this article.
c) Measurements from [12], residuals calculated for this article.