

Double Star Measurements with a 12-inch Newtonian Telescope, Annual Report of 2020

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Abstract: This report shows the results on 2018 double star measurements from 2020.

Methodology

In 2020 218 double stars were measured. As in previous years, pairs with large magnitude differences were of interest, so the observations from 2017 to 2019 were continued (Schlimmer, 2018, 2019, 2021).

Most observations in this report were done with a 12-inch Newtonian telescope in combination with a CMOS QHY5L II Color camera. Focal length is 1500 mm, reproduction scale is 0.518 as per pixel. The reproduction scale was determined by comparison of test measurements with different binaries with known orbits, optical double stars with constant separation and also with proper motion stars.

In cases of separation $< 3''$ focal length was magnified with a Barlow lens. In a few cases the measurement were done with a 5-inch refractor.

For each measurement a video with 100 or 200 frames were recorded. Every frame is like a single measurement. Data analyses were done with REDUC software Version 5 (Losse, 2016). For each frame separation and position angle will be automatically analyzed by the ELI interface. The standard deviation for measurements of the separation is usually smaller than $\pm 0.15''$. The standard deviation for measurements of position angle depends on the separation of both components. For

double stars with separation of about $5''$ the standard deviation for position angle is usually $\pm 1^\circ$.

The following table shows the measurements of separation and position angle of 218 components from 2020. Brightness and coordinates are taken from The Washington Double Star catalog, downloaded in August 2020. Date is given in Besselian years. N gives the numbers of observation nights. Usually every double star will be observed only for one night (N=1).

Notes:

ES 127: Explore Scientific 5-inch refractor were used for measurements
2 x Barlow: A Barlow lens was used to enlarge the focal length

References:

Losse, Florent, Reduc Software, 2016
<http://www.astrosurf.com/hfosaf/uk/tdownload.htm#reduc>

Mason, B.D., Wycoff, G.L. and Hartkopf, W.I, 2016, The Washington Double Star Catalog, Astrometry Department, U.S. Naval Observatory,
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Acknowledgements:

This research has made use of the Washington Double Star Catalog maintained at the U.S. Naval Observatory.

Table of Measurements:

RA + DEC	Name	Mags	PA	Sep	Date	N	Notes
00084+2905	H 5 32AB	2.22, 11.11	286	93.05	2020.002	1	
00087+5006	ES 443	9.26, 12.2	32.3	4.94	2020.886	1	
00095+5017	ES 745	10.4, 10.6	183.3	2.47	2020.886	1	
00105+5540	ES 930	11.24, 11.33	339.3	2.74	2020.886	1	
00114+5205	ES 40AB	9.49, 12.5	72.1	4.43	2020.886	1	
00133+4636	ES 1194	10.7, 11.4	292.9	5.19	2020.886	1	
00205+4911	ES 1197	8.43, 11.4	107.4	5.62	2020.886	1	
00354+6152	ES 1866AB	8.35, 12.9	358.6	4.6	2020.886	1	
00392+4921	STT 16	5.62, 10.48	22.5	12.52	2020.002	1	
00491+5749	STF 60AB	3.52, 7.36	326.3	13.57	2020.002	1	
00528+5638	BU 1AC	8.58, 8.89	134.7	3.76	2020.002	1	
00528+5638	BU 1AD	8.58, 9.66	194.6	9.01	2020.002	1	
01137+2435	STF 99AB	4.65, 9.11	226.8	7.53	2020.002	1	
01137+0735	STF 100AB	5.22, 6.26	63.5	23.07	2020.002	1	
02039+4220	STF 205A, BC	2.31, 5.02	63.6	9.81	2020.002	1	
02224+5551	BU 875	5.24, 12.0	161.5	11.5	2020.002	1	
02433+0314	STF 299AB	3.54, 6.18	298.6	1.92	2020.002	1	5 x Barlow
02442+4914	STF 296AB	4.16, 10.	306.1	21.15	2020.002	1	
02500+2716	STT 47AB	3.63, 11.04	295.7	34.74	2020.002	1	
02500+2716	H 5 116AC	3.63, 10.66	238	27.69	2020.002	1	
03061+7925	STF 320	5.72, 9.15	232.4	4.56	2020.002	1	
03213+4743	ES 464	10.16, 10.67	67.3	7	2020.103	1	
03416+3942	ES 166	8.95, 12.48	4.2	4.59	2020.103	1	
03449+5119	ES 876	10.4, 11.9	70.1	4	2020.103	1	
03452+4235	ES 2601AB	3.81, 12.1	50.5	32.53	2020.103	1	
03573+5104	ES 877	9.68, 11.6	72.2	5.79	2020.103	1	

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RA + DEC	Name	Mags	PA	Sep	Date	N	Notes
03579+4001	STF 471AB	2.85, 8.88	11.8	8.83	2020.103	1	
03580-1331	HJ 3608AC	3.13, 12.00	255.3	57.58	2020.043	1	ES 127
03598+5054	ES 954	10.28, 12.12	355.1	3.14	2020.103	1	
04233+6321	ES 1883	9.1, 10.9	238.7	3.65	2020.103	1	
04237+4741	ES 1225	10.5, 11.7	134.6	4.03	2020.103	1	
05050+4831	ES 1229	10.35, 11.8	258.3	5.47	2020.103	1	
05145-0812	STF 668A, BC	0.3, 6.8	202.6	10.27	2020.103	1	
06010+5219	ES 711	10.29, 11.40	276.8	2.2	2020.229	1	
06065+3856	ES 285	10.32, 10.6	169.1	2.55	2020.229	1	
06106+3744	ES 2279	10.35, 12.5	290.4	6.17	2020.229	1	
06235+4717	ES 1236	9.53, 11.4	270.4	6.49	2020.229	1	
06410+0954	STF 950AC	4.66, 9.9	15.3	16.92	2020.229	1	
06410+0954	STF 950AH	4.66, 9.81	167.6	89.57	2020.229	1	
06410+0954	STF 950AK	4.66, 10.40	56.7	106.46	2020.229	1	
06410+0954	STF 950AM	4.66, 9.75	104.8	179.78	2020.229	1	
06410+0954	D 11EP	8.86, 10.4	41.9	3.6	2020.229	1	
06451-1643	AGC 1AB	-1.47, 8.44	67	11.18	2020.171	1	Sirius B
06512+4030	ES 67	9.26, 10.50	308.3	5.6	2020.259	1	
06521+4024	ES 68AB	8.65, 11.3	77.8	8.85	2020.259	1	
07007+4527	ES 1324AB	10.05, 11.4	179	7.06	2020.229	1	
07058+4134	ES 1633	10.4, 10.6	28.5	3.05	2020.259	1	
07066+3142	ES 340	10.08, 10.60	140.5	5.5	2020.229	1	
07346+3153	STF1110AB	1.93, 2.97	52.6	5.38	2020.292	1	
07372+4802	ES 1143	9.03, 12.0	281.8	4.15	2020.259	1	
07466+4556	ES 587	9.29, 10.98	83.7	5.08	2020.292	1	
07522+2843	SMR 70	11.2, 14.	345.3	5.83	2020.259	1	
07523+2842	ES 421	10.00, 13.0	218.1	6.5	2020.259	1	
07544+3646	ES 2102	9.79, 12.8	273.9	7.79	2020.259	1	
07564+0415	ES 906	7.75, 12.84	289.9	5.39	2020.259	1	
07566+5017	ES 905	10.72, 13.4	235.5	3.26	2020.259	1	
07567+3743	ES 179	11.39, 11.45	89.7	4.45	2020.292	1	
07568+5018	ES 906	11.14, 12.3	289.9	5.39	2020.259	1	
08006+4200	ES 1538	10.1, 10.9	221.9	2.59	2020.259	1	
08080+4611	ES 1144AB	10.2, 10.27	336.9	6.61	2020.292	1	
08083+2533	ES 425AB	8.17, 12.8	285.6	4.65	2020.267	1	
08136+5316	ES 71	10.6, 10.7	284.3	3.06	2020.292	2	
08167+4053	ES 593BC	9.9, 10.1	211.3	4.67	2020.292	1	
08167+3216	ES 293	10.92, 11.3	213.5	4.63	2020.292	1	
08196+5316	ES 714	9.83, 13.2	194	7.83	2020.292	1	
08245+3409	ES 2345AB	10.57, 11.04	212.8	5.92	2020.267	1	
08249+2828	ES 426	11.5, 11.7	285.7	4.2	2020.276	1	

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08358+0637	STF1245AB	5.98, 7.16	25.1	10.12	2020.25	2	
08358+0637	STF1245AC	5.98, 10.70	109.1	99.75	2020.24	1	
08358+0637	STF1245AD	5.98, 11.91	292	109.09	2020.24	1	
08358+0637	STF1245AE	5.98, 9.60	206.5	113.18	2020.24	1	
08397+0546	STF1255AB	7.33, 8.56	30.8	26.12	2020.264	3	
08496+4526	ES 597	9.37, 12.7	267.6	7.37	2020.259	1	
09134+5133	ES 716	9.46, 12.17	294.3	7.59	2020.267	1	
09207+5116	STT 199AB	6.19, 10.0	141.5	5.38	2020.267	1	
09234+5136	ES 718AB	10.16, 12.5	24	7.58	2020.267	1	
09390+5735	ES 1784	10.28, 12.9	286.7	6.38	2020.267	1	
10185+3630	HJ 2525	11.80, 12.00	67.9	13.69	2020.375	2	
10200+1950	STF1424AB	2.37, 3.64	127.4	4.63	2020.292	1	
10347+4639	ES 918	12.0, 12.2	188.9	3.41	2020.38	1	
10368-1332	STF1453AB	8.99, 9.81	229.9	8.5	2020.317	1	
10476-1516	STF1474BC	7.0, 7.59	14.6	6.64	2020.317	1	
11006+3832	ES 304	10.7, 12.0	88.5	5.01	2020.371	1	
11034+3823	ES 1641	10.41, 14.7	343.9	5.03	2020.371	1	
11185+3306	STF1524AB	3.64, 10.1	147.1	7.04	2020.371	1	
11245+2037	STF1537	8.23, 9.07	359.7	2.04	2020.388	1	
11346+4052	ES 1401	12.0, 12.5	326.8	6.52	2020.38	1	
11385+4405	ES 1153	9.78, 12.74	259.2	5.76	2020.407	1	
11398+2811	A 560	9.16, 12.5	359.4	4.83	2020.371	1	
11438+4411	ES 123AB	11.33, 11.45	203.8	6.78	2020.407	1	
11438+4411	ES 123AC	11.33, 11.04	273	44.57	2020.407	1	
11448+2826	ES 435AB	11.66, 11.8	346.7	7.19	2020.371	1	
11480+2013	STFB 7AB	4.59, 9.03	355.8	75.54	2020.388	1	93 Leo
11500+5041	ES 723	10.84, 10.90	298.9	5.77	2020.38	1	
11527+5647	ES 1826	8.95, 12.8	216.9	5.53	2020.484	1	
11534+4317	ES 1154	11.92, 12.37	337.6	3.52	2020.407	1	
11536+4255	STT 240	8.11, 10.71	318.2	8.39	2020.407	1	
11560+2159	STF1582	8.09, 9.53	75.7	12.27	2020.388	1	
12043+2128	STF1596	6.18, 7.48	234.1	3.44	2020.388	1	2 Com
12081+5528	STF1603AB	7.82, 8.26	83, 3	22.38	2020.484	1	
12100+4636	ES 725	10.36, 10.86	59.3	6.54	2020.407	1	
12164+4444	A 1781	10.23, 11.00	302	2.66	2020.407	1	
12207+2255	STF1634	8.77, 9.90	147.5	5.31	2020.388	1	
12207+1748	HO 52	4.74, 12.9	41.6	9.25	2020.388	1	11 Com
12239+4441	ES 1155	10.9, 11.8	201.7	3.58	2020.371	1	
12269+2816	SMR 58	4.4, 12.	206.4	15.95	2020.371	1	g Com
12397+4028	ES 1402AB	10.6, 11.6	26.6	3.62	2020.407	1	
12406+4017	HJ 2617AB	8.41, 9.61	1.7	5.73	2020.407	1	

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RA + DEC	Name	Mags	PA	Sep	Date	N	Notes
12417-0127	STF1670AB	3.48, 3.53	183.8	2.46	2020.415	1	ES 127 2x Barlow
12560+3819	STF1692AB	2.85, 5.52	229.5	19.27	2020.407	1	Cor Caroli
13026+5625	KR 41	9.7, 10.1	332.6	3.48	2020.484	1	
13149-1122	SHJ 162AB	7.11, 8.18	45.2	114.23	2020.415	1	ES 127
13152+4838	ES 732AB	10.93, 10.98	87.7	3.45	2020.407	1	
13163+1715	STF1733	8.99, 10.37	128.4	4.93	2020.388	1	
13486+4821	BU 802	7.56, 11.78	227	3.24	2020.484	1	
13519+5137	ES 736	9.67, 13.12	270.7	9.9	2020.484	1	
13589+5306	STF1795	6.91, 9.83	2.6	8.18	2020.484	1	
14203+0817	HJ 1252	8.73, 11.75	271.3	12.04	2020.484	1	
14234+0827	STF1835A, BC	5.03, 6.78	196.9	6.35	2020.484	1	
14312+4807	ES 961	10.71, 11.0	319.8	6.58	2020.445	1	
14375+4743	ES 609AB	10.23, 11.9	14.9	4.51	2020.445	1	
14407+1625	STF1864AB	4.88, 5.79	114.2	5.43	2020.484	1	
14450+2704	STF1877AB	2.58, 4.81	346	2.68	2020.445	1	
14514+1906	STF1888AB	4.76, 6.95	296.6	5.23	2020.445	1	
15076+5056	ES 774	10.53, 10.92	230.9	3.23	2020.445	1	
15121+3419	ES 2417	11.22, 11.7	169	4.29	2020.445	1	
15200+4603	ES 75AB, C	11.02, 10.74	34.7	4.48	2020.445	1	
15498+4349	ES 1554	11.0, 11.2	3.26	4.98	2020.484	1	
15554+5303	ES 965	11.05, 11.16	328.1	4.94	2020.484	1	
16051+5426	ES 743	9.71, 12.8	12.4	5.45	2020.484	1	
16126+5748	ES 1793	8.74, 11.52	55.6	5.63	2020.445	1	
16405+4020	ES 1647	10.4, 11.6	22.7	3.12	2020.601	1	
16415+4007	J 1124	10.37, 11.0	276	3.87	2020.601	1	
16420+4031	BRT 339	11.1, 11.6	280.3	4.79	2020.601	1	
16473+5218	ES 970	10.02, 12.2	302.3	3.45	2020.601	1	
17005+4817	ES 1090	10.6, 10.6	275.7	5.56	2020.601	1	
17016+4244	ES 633	7.34, 11.8	259.7	6.8	2020.601	1	
17109+4357	ES 1412	11.0, 11.1	133.5	3.58	2020.601	1	
17146+1423	STF2140AB	3.48, 5.40	102.7	4.68	2020.596	1	
17222+3609	ES 2227	11.26, 11.46	16.6	4.84	2020.601	1	
17261+3550	ES 2228	11.22, 11.25	32.3	4.93	2020.601	1	
17266+3546	STF2168	8.80, 9.08	203.4	2.29	2020.601	1	
17272+3630	TDT 361	11.46, 11.41	320.4	2.59	2020.601	1	
17298+4334	ES 1414	10.95, 11.4	227.6	6.98	2020.601	1	
17307+6231	ES 1832	9.9, 12.4	158.3	3.27	2020.601	1	
17322+5236	ES 777	8.15, 12.2	349.1	6.08	2020.601	1	
17341+2959	ES 468	10.65, 11.38	11.2	2.31	2020.672	1	2 x Barlow
17343+1519	GLP 7	8.87, 11.26	244.4	9.2	2020.596	1	

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17349+1519	STT 332AB	8.19,11.15	110.8	10.46	2020.596	1	
17353+5210	ES 635	9.50,12.6	242.6	5.87	2020.601	1	
17355+3932	ES 2015	11.0,11.6	32	4.81	2020.596	1	
17362+5425	ES 637	10.65,10.84	294.7	4.04	2020.601	1	
17383+4500	ES 1257AB	10.45,10.9	298.2	2.52	2020.686	1	2 x Barlow
17437+3655	ES 2168	11.0,11.6	299.2	6.88	2020.596	1	
17493+5011	ES 974	10.85,11.03	348.2	2.62	2020.637	1	
17595+3803	ES 2478	10.5,11.0	234	4.33	2020.637	1	
18177+3455	ES 2231	10.08,11.84	257.4	7.59	2020.662	2	
18312+6608	ES 1911	9.20,11.89	292.6	5.72	2020.686	1	
18319+5110	ES 784	10.00,10.5	65.1	7.1	2020.686	1	
18340+5045	ES 786	11.33,11.6	322.9	5.85	2020.686	1	
18399+5106	ES 787	8.93,11.69	37.8	8.26	2020.686	1	
18443+3940	STF2382AB	5.15,6.10	345.1	2.19	2020.692	2	2 x Barlow
18443+3940	STF2383CD	5.25,5.38	74.7	2.36	2020.692	1	2 x Barlow
18451+4746	ES 1161	11.0,11.2	269.9	3.19	2020.686	1	
18467+4303	ES 1425	9.89,10.30	231	4.43	2020.686	1	
18481+4122	ES 1561	9.6,11.5	125	6.51	2020.697	1	
18484+3612	ES 2023	8.73,12.0	244.8	6.49	2020.697	1	
18504+3614	ES 2024	10.92,14.5	350.6	6.41	2020.697	1	
18508+4543	ES 1264	10.37,11.5	113.9	2.99	2020.697	1	
18517+5116	ES 788	9.41,11.99	317.3	3.28	2020.714	3	
18521+5120	STF2416AB	8.67,11.17	157.4	20.27	2020.719	1	
18521+5120	STF2416AC	8.67,9.41	39.3	122.46	2020.719	1	
18548+3611	ES 2029	10.02,11.36	207.5	5.09	2020.697	1	
18554+4052	ES 1657	10.4,11.0	355.1	3.74	2020.697	1	
18569+3112	ES 2422	8.96,12.0	180.5	5.48	2020.708	1	
18593+6347	ES 1844AB	9.6,10.5	18.5	2.48	2020.708	1	
18596+6301	HU 939	8.27,11.89	47.4	3.56	2020.708	1	
19021+3640	ES 1965	10.71,12.5	246	7.5	2020.708	1	
19033+6104	ES 1796	9.61,13.4	99.6	5.9	2020.708	1	
19066+6116	ES 191	10.33,11.15	240.3	6.08	2020.708	1	
19086+3755	STF2472AB	8.38,10.44	339.5	22.93	2020.708	1	
19086+3755	STF2473CD	10.29,10.45	293.8	6.33	2020.708	1	
19108+3207	ES 350	9.12,9.9	234.1	5.48	2020.719	1	
19117+3212	ES 2368	8.92,12.4	298.4	4.75	2020.725	1	
19132+3125	ES 2423	10.5,10.5	9	3.19	2020.725	1	
19138+2546	ES 482	9.91,12.2	171.9	4.17	2020.725	1	
19228+4120	ES 1661	10.39,12.9	152.8	3.44	2020.725	1	
19463+1037	DAL 44AD	2.86,11.4	268.7	54.25	2020.725	1	
19463+1035	BU 55AB	11.7,11.9	29.7	3.89	2020.725	1	

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RA + DEC	Name	Mags	PA	Sep	Date	N	Notes
20000+1736	SMR 7	10.1,11.4	263.9	4.04	2020.725	1	
20176-1230	HJ 607AC	4.24,9.6	227.9	47.36	2020.705	1	
20181-1233	AGC 12AD	3.66,10.50	158.7	153.4	2020.705	1	
21526+4513	ES 522	9.6,11.6	138.1	3.09	2020.845	1	
21547+4916	ES 525	8.77,10.7	122.6	5.28	2020.845	1	
22025+4714	ES 528	10.10,12.7	147.6	3.23	2020.845	1	
22029+4717	A 781	9.54,11.24	197.4	2.63	2020.845	1	
22071+4820	ES 833	11.07,11.39	260.5	3.14	2020.845	1	
22133+3207	ES 388	10.05,10.6	263.6	7.7	2020.845	1	
22155+3450	ES 214	9.9,12.3	172.9	3.47	2020.845	1	
22156+3811	ES 2530	11.14,11.6	304.2	5.06	2020.845	1	
22216+4704	ES 1279	8.76,12.5	301.9	5.79	2020.845	1	
22226+3328	ES 390	9.65,10.44	268.9	8.22	2020.853	1	
22355+4844	ES 841	12.07,12.15	94.2	2.69	2020.859	1	
22398+4843	ES 843	10.66,10.98	206.6	8.33	2020.859	1	
22514+4823	ES 850	9.28,12.0	222.8	7.77	2020.859	1	
22525+4828	HEI 87	11.4,12.0	280	5.21	2020.859	1	
22550+4842	ES 855	10.7,11.3	230.6	2.52	2020.859	1	
22587+3422	ES 2204	10.6,10.7	167.3	2.78	2020.859	1	
23038+2805	HJ 1842AB	2.65,12.0	214.8	130.05	2020.002	1	
23038+2805	HJ 1842AC	2.65,10.54	102.9	240.14	2020.002	1	
23104+3308	ES 397	10.2,12.4	222.5	3.59	2020.859	1	
23186+3621	ES 219	11.20,11.6	310.4	3.45	2020.859	1	
23335+4919	ES 110AB	10.16,11.2	37.7	5.37	2020.886	1	
23335+4919	ES 110AC	10.16,11.57	340.6	17.71	2020.886	1	
23397+4248	ES 1600	11.23,11.4	305.9	6.63	2020.886	1	
23457+4856	ES 862AB	9.40,12.8	39.6	7.24	2020.886	1	
23457+4856	ES 862AC	9.40,13.5	236	11.2	2020.886	1	
23457+4856	ABH 180AD	9.40,14.78	184.7	20.57	2020.886	1	