Double Star Observations with a 150mm Refractor in 2016

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Abstract: I present 20 measurements of 50 pairs made in 2016. For 26 stars, residuals were calculated.

As in previous years[1-4], in 2016 the 150/3000mm folded refractor with filter 11 and the cameras DMK 21 and Alccd QHY 5-II were used for double star observing. A new adapter for the Alccd QHY 5-II camera was acquired, with a slight change in imaging scale (see below). For stars with small distances, teleconverters 1.4x and 2x were used.

The imaging scales for the different optical setups are:

- DMK 21 at direct focus (f; D): 0.384 a.s. per pixel
- DMK 21 with teleconverter 1.4x (TK 1.4; D): 0.297322 a.s. per pixel
- DMK 21 with teleconverter 2x (TK 2. D): 0.19876 a.s. per pixel
- QHY 5 – II at direct focus (f; A): 0.25739 a.s. per pixel
- QHY 5 – II with teleconverter 1.4 (TK1.4; A): 0.19744 a.s. per pixel
- QHY 5 – II with teleconverter 2x (TK2; A): 0.1385 a.s. per pixel

Table 1 gives the double star measurements for 50 pairs. Residuals for 26 pairs are given in Table 2. Tables 3 and 4 give the residuals STF 1306 and STT 437, respectively.

Acknowledgements

This paper made use of the Washington Double Star Catalog[5] and the Sixth Catalog of Orbits of Visual Binary Stars[6], both maintained at the U.S. Naval Observatory. Noncommercial software used was: *Binary Star Calculator* by Brian Worman[7]; *Reduc 3.88* by Florent Losse; *Registax 5* by Coer Berrevoets, and *SharpCap* by Robin Glover.

References

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Table 1. Double Star Observations in 2016
"Nr" is the number of video files used for the measurement.

Designation	WDS ident	θ	ρ	Date	Nr	Name	Notes
STF 060 AB	00491+5749AB	325.1 325 323.3 324.9 324.9	16.615 13.38 13.38 13.38 13.37	2016.87 2016.906 2016.909 2016.922 2016.931	15 74 38 30 26	η Cas	f; Al f; Al f; AL TK1,4; Al TK1,4; Al
STF 73 AB	00550+2338	330.9 330.2 330.3	1.16 1.35 1.05	2016.022 2016.909 2016.931	76 32 39	36 And	TK2; Al TK1,4; Al TK1,4; Al
STFA 5	02370+2439	274.8	37.93	2016.057	39	30 Ari	f; D
STFA 7	03311+2744	233.9	44.12	2016.076	41		f; D
STF 401	03313+2743	269.5	11.41	2016.076	43		f; D
STF 427	03406+2846	207.7	7.02	2016.077	39		f; D
STTA 38 AB	03446+2754	52.2	135.97	2016.077	32		f; D
STF 528	04226+2538	24.9	19.42	2016.996	46	χ Tau	TK1.4; Al
STF 764	05413+2929	14.5	26	2016.057	41		f; D
STF 900 AB	06238+0436	29.2 29.5	12.17 12.05	2016.189 2016.191	35 30	8 Mon	f; D
STF 948 AB	06462+5927	66.7 67.3	1.84 1.83	2016.189 2016.192	69 51	12 Lyn	TK2; D
STF 948 AC		308.9 308.8	8.51 8.52	2016.189 2016.192	47 31	12 Lyn	TK2; D
STF 982 AB	06546+1311	142.9 143.3	7.23 7.13	2016.164 2016.172	33 76	38 Gem	TK2; D
STF 1110 AB	07346+3153	53.8 54.2 54.1	4.97 4.95 4.89	2016.161 2016.164 2016.172	101 92 65	α Gem	TK2; D
STF 1196 AB	08122+1739	15.7 17.3 18.9 16.3 17.5	0.99 1.13 1.14 0.96 1.14	2016.194 2016.2 2016.211 2016.238 2016.234	26 77 59 41 42	ζ Cnc	TK2; A TK2; D TK2; D TK2; D TK2; D
STF 1196 AC	08122+1739	62.2 61.2 61.1 61.4 61.6	6.26 6.1 6.13 6.09 6.1	2016.194 2016.2 2016.211 2016.238 2016.243	24 80 39 42 34	ζ Cnc	TK2; A TK2; D TK2; D TK2; D TK2; D
STF 1306 AB	09104+6708	347.5 348.5	4.33 4.23	2016.252 2016.276	12 17	σ^2 Uma	TK2; D TK2; D
STF 1333	09184+3522	49.3 49.5	1.84 1.88	2016.2 2016.210	38 28		TK2; D TK2; D
STF 1334ABb	09188+3648	222.5 222.7	2.55 2.55	2016.208 2016.210	55 58	38 Lyn	TK2; D TK2; D
STF 1338 AB	09219+3811	311 310.2	1.06 1.1	2016.2 2016.211	67 23		TK2; D TK2; D
STF 1424 AB	10200+1950	126.3 126.1	4.59 4.57	2016.208 2016.238	60 71	γ Leo	TK2; D TK2; D
STF 1523 AB	11182+3132	167.3 169.1 168.8	1.87 1.86 1.85	2016.279 2016.301 2016.304	63 48 82	ξ Uma	TK2; D TK2; D TK2; D
STF 1670 AB	12417-0127	2.3 2.9 3.5 3.5	2.47 2.35 2.36 2.36	2016.326 2016.334 2016.342 2016.345	28 64 42 46	γ Vir	f; A TK2; D TK2; D TK2; D
STF 1768 AB	13375+3618	96.8 94.5 95.3	1.72 1.69 1.76	2016.348 2016.35 2016.353	22 40 67	25 CVn	TK2; D TK2; D TK2; D
STF 1864 AB	14407+1625	111.9 111.3 111.8	5.29 5.32 5.37	2016.383 2016.43 2016.432	35 35 34	π Boo	TK2; D TK2; D TK2; D
STF 1877 AB	14450+2704	343.7 343.9	2.91 2.83	2016.364 2016.367	70 34	ε Boo	TK2; D TK2; D

Table 1 concludes on next page.

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Table 1 (conclusion). Double Star Observations in 2016
"Nr" is the number of video files used for the measurement.

Designation	WDS ident	θ	ρ	Date	No	Name	Notes
STF 1888 AB	14514+1906AB	301.5 302 301.1	5.45 5.51 5.45	2016.383 2016.427 2016.432	29 25 35	ξ Boo	TK2; D TK2; D TK2; D
STF 1932 AB	15183+2650	266.2 264.7	1.52 1.53	2016.364 2016.367	15 8		TK2; D TK2; D
STT 288	14534+1542	158.8	0.9	2016.433	29		TK2; D
STF 1938 BC	15245+3723	3.8 3.8	2.2 2.2	2016.441 2016.468	12 30	μ Boo	TK2; D TK2; D
STF 1965	15394+3638	305.9	6.14	2016.441	39	ζ CrB	TK2; D
STF 2032 AB	16147+3352	238.4 238.5	7 7	2016.476 2016.548	41 44	σ CrB	TK2; D TK2; D
STF 2118 AB	16564+6502	68.7 71.1 67.9	1 0.95 0.86	2016.624 2016.627 2016.649	52 85 65	20 Dra	TK2; D TK2; A TK2; D
STF 2130 AB	17053+5428	1.2 2.5 1.3 1.5	2.46 2.49 2.47 2.46	2016.52 2015.597 2016.616 2016.621	55 23 30 35	μ Dra	TK2; D TK2; D TK2; D TK2; D
STF 2272 AB	18055+0230	124.8 124.5	6.26 6.3	2016.548 2016.55	80 68	70 Oph	TK2; D TK2; D
STF 2289	18101+1629	221.8	1.25	2016.55	32		TK2; D
STF 2382 AB	18443+3940	346 345.7	2.19 2.19	2016.523 2016.545	42 41	ε Lyr	TK2; D
STF 2383CcD	18443+3940	76.1 75.8	2.32 2.3	2016.523 2016.545	27 35	5 Lyr	TK2; D
STF 2579 AB	19450+4508	215.9 215.7 214.5 215.7	2.58 2.68 2.69 2.45	2016.545 2016.585 2016.627 2016.63	27 32 23 41	δ Cyg	TK2; D TK2; D TK2; AL TK2; D
STF 2583 AB	1948+1149	103.6 103.3 103.4	1.44 1.37 1.33	2016.631 2016.638 2016.645	54 12 50	π Aql	TK2; D TK2; D TK2; D
STF 2716 AB	20410+3218	43.9 44.3	2.76 2.69	2016.725 2016.731	42 31	49 Cyg	f; D f; D
STF 2726	20456+3043	70 71.2 70.4	6.22 6.27 6.61	2016.706 2016.75 2016.764	39 45 16	52 Cyg	f; D f; D f; D
STF 2725	20462+1554	11.6	6.2	2016.706	36		f; D
STF 2727	20467+1607	265.9 265.5	8.89 8.94	2016.704 2016.706	36 36	γ Del	f; D f; D
STF 2741	20585+5028	24.4 24.8	1.9 1.92	2016.692 2016.701	36 67		TK2; D TK2; D
STF 2751	21021+5640	355.5 356	1.57 1.58	2016.692 2016.701	42 52		TK2; D TK2; D
STF 2758 AB	21069+3845	152.6 152.7 152.6	31.61 30.54 31.66	2016.652 2016.662 2016.692	76 24 29	61 Cyg	f; D TK2; D f; D
STT 432	21143+4109	114.3 113.9	1.29 1.27	2016.687 2016.690	26 55		TK2; D TK2; D
STT 437	21208+3227	18.6 19.2	2.38 2.49	2016.665 2016.684	43 44		TK2; D TK1.4; Al
STF 2822 AB	21441+2845	319.5 318.1 319.3 318.5 319.4	1.58 1.6 1.62 1.65 1.56	2016.646 2016.665 2016.668 2016.684 2016.687	39 32 56 35 31	μ Cyg	TK2; D TK2; D TK2; D TK1,4; Al TK2; D
STF 2909	22288-0001	162.2 162.7	2.32 2.35	2016.829 2016.832	132 87	ζ Aqr	TK1,4; Al TK1,4; Al
STF 3050AB	23595+3343	340.3	2.44	2016.829	85		TK1,4; Al

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Table 2. Residuals for double stars in 2016
"N" is the number of nights used for the observations (as listed in Table 1).

Designation	WDS ident	Date	N	θ	ρ	Δθ	Δρ	Ref.	Notes
STF 73 AB	00550+2338	2016.9	2	330.3	1.19	-1.1 -1	0.03 0.05	Doc1990b Mut2010b	
STF 948 AB	06462+5927	2016.2	2	67	1.84	4.7 0.7	0.14 -0.06	Pop1996b WSI2006b	
STF 1110 AB	07346+3153	2016.2	3	54	4.94	0.2 0.6	-0.2 -0.15	Hei1988a Doc1985c	
STF 1196 AB	08122+1739	2016.2	5	17.4	1.09	1.5 1.3	-0.04 -0.03	Sod1999 WSI2009b	1
STF 1306 AB	09104+6708	2016.3	2	348	4.27	0.2	-0.08	Sca1985c	2
STF 1338 AB	10200+1950	2016.2	2	310.8	1.07	-4.8	0.07	Sca2002b	3
STF 1424 AB	10200+1950	2016.2	2	126.2	4.58	0	O.11	Rab1958	
STF 1523 AB	11182+3132	2016.3	3	168.4	1.86	-1.2	-0.01	Msn1995	
STF 1670 AB	12417-0127	2016.3	4	3.1	2.37	-0.2	-0.09	Sca2007	
STF 1768 AB	13375+3618	2016.4	3	95.3	1.73	0.6	0.04	Sod1999	
STF 1888 AB	14514+1906	2016.4	3	301.5	5.47	0.3	-0.05	Sod1999	
STF 1932 AB	15183+2650	2016.4	2	265.7	1.52	-0.3 -0.1	-0.11 -0.1	Hei1965c Sca2013b	
STT 288	14534+1542	2016.4	1	158.8	0.9	0.9	-0.09	Hei1998	
STF 1938 BC	15245+3723	2016.5	2	3.8	2.2	0.9 0.5	-0.03 -0.01	Sod1999 Sca2013a	
STF 2032 AB	16147+3352	2016.5	2	238.5	7	0 0	-0.31 -0.21	Sca1979 Rag2009	
STF 2118 AB	16564+6502	2016.6	3	69.5	0.93	2.7	-0.21	Sca2002d	
STF 2130 AB	17053+5428	2016.6	4	1.5	2.47	0	-0.06	Pru2012	
STF 2272 AB	18055+0230	2016.5	2	124.7	6.28	-0.6	-0.13	Pbx2000b	
STF 2382 AB	18443+3940	2016.5	2	345.9	2.19	0 0.3 0.4	-0.28 -0.14 -0.06	Gzl1956a WSI2004b Nov2006e	
STF 2383CcD	18443+3940	2016.5	2	75.9	2.31	0.4	-0.08	Doc 1984b	
STF 2758 AB	19450+4508	2016.7	2	152.6	31.35	0.4 -0.2	-0.3 -0.36	Pko2006b Kis 1997	
STF 2579 AB	19450+4508	2016.6	3	215.5	2.58	-1.2	-0.16	Sca2012c	
STF 2758 AB	21069+3845	2016.7	3	152.6	31.42	0.5 -0.2	-0.2 -0.29	Pko2006b Kis1997	
STT 437	21208+3227	2016.7	2	18.9	2.44	0.3	0	Hrt2011a	4
STF 2822 AB	21441+2845	2016.7	5	319	1.61	-3.8	0.09	Hei1995	5
STF 2909	22288-0001	2016.8	1	162.4	2.33	-0.3	0.04	Sca2010b	
STF 3050 AB	23595+3343	2016.8	1	340.3	2.44	-0.3	0.03	Hrt2011a	

Notes to Table 2

1. The separation of this star is rather small for my telescope, so the variations in Δθ are rather large, but always positive [2,3,4].
2. Residuals for 2011 and 2012 in Table 3. Older measurements are from ref. [1].
3. Residuals for the previous years in refs. [3] and [4].
4. Residuals for 2012 and 2013 in Table 4. Older measurements are from ref. [1]3.
5. Star is known for large negative Δθ.

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Table 3. Residuals for STF 1306

Designation	WDS ident	Date	N	θ	ρ	Δθ	Δρ	Notes
STF 1306 AB	09104+6708	2011.3 2012.2 2016.3	2 1 2	349.8 349.6 348	4.42 4.4 4.27	0.3 0.4 0.2	0.23 0.18 -008	Sca1985c

Table 4. Residuals for ST4 437

Designation	WDS ident	Date	N	θ	ρ	Δθ	Δρ	Notes
STT 437	21208+3227	2012.7 2013.7 2016.7	1 2 2	19.5 20.2 18.9	2.48 2.49 2.44	0.3 1.1 0.3	0.06 -0.07 0	Hrt2011a