STT Doubles with Large ΔM – Objects Nearby

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Abstract: Following our series of reports on STT doubles with large delta_M, we are submitting measurements of WDS objects which were by chance found nearby in the images taken of the STT doubles. In these cases we did not suspect any issues with the current WDS catalog data, but wanted to make use of existing image material as any double star visited is worth a current measurement.

As a follow up to our STT reports we decided to finish our project with the many double stars found near the STT objects which we investigated. All values are based on WDS data as of August 2016 and are shown in Table 1.

1. Photometry and Astrometry Results

From the available several hundred images taken with iTelescope remote telescopes, we selected the best suited for measurements of nearby objects. The selected images were then plate solved with Astrometrica with URAT1 reference stars with Vmags in the range 10.5 to 14.5mag. The RA/Dec coordinates resulting from plate solving with URAT1 reference stars in the 10.5 to 14.5mag range were used to calculate Sep and PA using the formula provided by R. Buchheim (2008). *Err_PA* is the error estimation for PA in degrees calculated as arctan (Err_Sep/Sep) assuming the worst case that *Err_Sep* points perpendicular to the separation vector. *Mag* is the photometry result based on URAT1 reference stars with Vmags between 10.5 and 14.5mag. *Err_Mag* is calculated as

$$Err\_Mag = \sqrt{dVmag^2 + \left[2.5\log_{10}\left(1+1/SNR\right)\right]}$$

with *dVmag* as the average Vmag error over all used reference stars and *SNR* is the signal to noise ratio for the given star. The results are shown in Table 2.

In the next step we took a closer look at a few objects listed with the WDS V-code indicating physical relationship, comparing the WDS data with the data in the star catalogs available in Aladin/VizieR for positions allowing calculation of proper motion data (Table 3.). Additionally we have one case with a possible third component of BRT 1204 found in an Aladin image, but not listed in the WDS. We were unable to resolve this component in our own images, so we've used the available star catalog data in Aladin/Vizier. Also included is CPM analysis of a possible third component of ES 1585 which is not listed in the WDS, but which we've labeled as C (see Figure 7.).

2. Historical Research, Catalog Comparison and Summary

After researching each object in this report for historical information as well as other interesting material, we decided to include information on the group of stars shown in Figure 1.

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Table 1. WDS Catalog Data per August 2016 for the Objects Found Nearby STT Doubles with Large ΔM

WDS ID	Name		RA	Dec	Sep	M1	M2	PA	Con
00049+4554	VYS 1	AB	00:04:55.300	+45:54:52.6	2.9	10.50	10.50	208	And
00049+4540	BU 997	AB	00:04:57.530	+45:40:25.6	3.9	7.64	9.39	337	And
05098+4856	DAM1026	AB	05:09:46.589	+48:56:16.7	6.3	12.30	13.40	346	Aur
05175+3312	CTT 4	AB	05:17:31.709	+33:12:05.9	108.8	7.74	11.73	105	Aur
05175+3312	CTT 4	AC	05:17:31.709	+33:12:05.9	111.6	7.74	10.96	283	Aur
05175+3312	CTT 4	AD	05:17:31.709	+33:12:05.9	94.3	7.74	11.35	271	Aur
05175+3312	CTT 4	AE	05:17:31.709	+33:12:05.9	114.3	7.74	12.27	269	Aur
05187+3331	ES 59	AB	05:18:41.811	+33:31:27.2	13.9	8.46	9.59	10	Aur
05187+3331	ES 2611	AE	05:18:41.811	+33:31:27.2	74.8	8.46	12.13	170	Aur
05410+1620	BPM 151	AB	05:41:00.881	+16:20:07.4	107.3	14.19	14.95	50	Tau
05460+2606	J 1906	AB	05:45:59.000	+26:06:35.9	7.6	12.00	12.00	335	Tau
05461+2605	J 1907	AB	05:46:07.090	+26:05:29.4	9.0	11.00	11.50	234	Tau
05463+2542	BRT 138	AB	05:46:16.410	+25:42:06.0	6.0	8.38	11.20	119	Tau
06312+1656	FOX 147	AC	06:31:09.990	+16:56:19.0	47.3	6.20	11.41	346	Gem
06314+1646	BPM 282	AB	06:31:22.229	+16:45:44.9	73.9	12.79	15.27	324	Gem
06315+1535	BRT1204	AB	06:31:33.911	+15:34:44.9	5.3	10.50	11.50	79	Gem
06420+2528	TDS4042	AB	06:42:00.580	+25:28:10.9	1.7	10.09	11.65	80	Gem
07070+2444	POU2442	AB	07:07:00.510	+24:43:36.9	3.6	12.40	12.60	351	Gem
07285+3437	CBL 24	AB	07:28:30.990	+34:37:04.4	34.1	12.19	14.30	86	Gem
07445+2415	POU2883	AB	07:44:28.929	+24:14:25.7	10.5	12.70	12.90	82	Gem
07455+3431	GRV 740	AB	07:45:35.900	+34:31:04.9	76.0	10.93	11.73	204	Gem
09207+5116	ARN 71	AD	09:20:43.759	+51:15:57.8	231.1	6.19	7.89	52	UMa
12227+0325	CBL 380	AB	12:22:44.440	+03:24:40.1	39.7	14.40	18.00	338	Vir
17525+1530	L 17	AB	17:52:30.762	+15:31:31.0	2.2	10.50	11.20	288	Her
17525+1530	WLY 20	AC	17:52:30.762	+15:31:31.0	38.2	11.90	12.47	122	Her
18477+1029	BRT1310	AB	18:47:43.552	+10:28:01.0	3.9	12.47	12.86	21	Aql
18485+1045	STF2396	AB	18:48:29.152	+10:44:47.4	76.5	8.08	11.25	336	Aql
18485+1045	STF2396	AD	18:48:29.152	+10:44:47.4	199.4	8.08	10.83	36	Aql
18485+1045	STF2396	AC	18:48:29.152	+10:44:47.4	198.5	8.08	10.14	6	Aql
19162+1612	BPM1005	AB	19:16:10.999	+16:12:10.6	73.2	14.02	15.55	267	Aql
19164+1612	BPM1006	AC	19:16:22.748	+16:12:18.6	94.0	14.90	14.80	312	Aql
19164+1612	BPM1006	AB	19:16:22.748	+16:12:18.6	4.2	14.90	16.00	337	Aql
19304+5015	TDT1508	AB	19:30:21.272	+50:14:36.6	2.1	11.45	11.77	207	Cyg
19548+0636	J 3032	AB	19:54:55.892	+06:36:53.6	4.0	11.00	13.80	21	Aql
21181+3500	SLE 383	AB	21:18:08.642	+35:00:04.5	15.1	10.49	11.92	58	Cyg
21183+3456	BU 289	AC	21:18:18.200	+34:55:36.2	12.7	9.13	13.00	252	Cyg
21183+3456	SLE 384	AD	21:18:18.200	+34:55:36.2	43.0	9.13	11.98	190	Cyg
21183+3456	FYM 142	AE	21:18:18.200	+34:55:36.2	36.7	9.13	13.50	95	Cyg
21183+3456	FYM 142	AF	21:18:18.200	+34:55:36.2	45.7	9.13	14.90	200	Cyg
21183+3456	FYM 142	AG	21:18:18.200	+34:55:36.2	68.2	9.13	13.70	272	Cyg
21183+3456	FYM 142	DF	21:18:17.678	+34:54:53.7	4.9	11.98	14.90	277	Cyg
21183+3456	FYM 142	EI	21:18:21.221	+34:55:33.8	7.1	13.50	15.70	279	Cyg
21183+3456	FYM 142	GH	21:18:12.659	+34:55:38.5	4.7	13.70	14.60	81	Cyg
21214+4301	ES 1585	AB	21:21:29.143	+43:00:51.0	18.7	10.17	13.60	230	Cyg

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Table 2: Photometry and astrometry results for the double star objects nearby the imaged STT objects. Date is the Bessel epoch and N is the number of images used for the reported values. iT in the Notes column indicates the telescope used with aperture. number of images and exposure time given. Observation method is "C"

Name		RA	Dec	dRA	dDec	Sep	Err Sep	PA	Err PA	Mag	Err Mag	SNR	dVmag	Date	N	Notes
VYS 1	A	00 04 55.386	45 54 53.82	0.03	0.03	2.842	0.042	207.555	0.855	11.844	0.043	74.95	0.04	2015.774	5	iT24 0.61m stack 5x3s
	B	00 04 55.260	45 54 51.30							11.792	0.043	74.92				
BU 997	A	00 04 57.550	45 40 24.58	0.03	0.03	3.773	0.042	337.284	0.644	7.561	0.040	258.45	0.04	2015.774	5	iT24 0.61m stack 5x3s
	B	00 04 57.411	45 40 28.06							9.512	0.044	62.14				
DAM 1026	A	05 09 46.575	48 56 16.42	0.10	0.10	6.817	0.141	348.494	1.188	12.058	0.119	23.61	0.11	2016.108	5	iT24 0.61m stack 5x3s. SNR B <20
	B	05 09 46.437	48 56 23.10							13.639	0.138	12.54				
CTT 4	A	05 17 31.715	33 12 05.30	0.12	0.10	108.863	0.156	105.024	0.082	7.713	0.103	40.42	0.10	2016.108	5	iT24 0.61m stack 5x1s
	B	05 17 40.092	33 11 37.08							11.517	0.108	26.96				
CTT 4	A	05 17 31.715	33 12 05.30	0.12	0.10	111.908	0.156	283.045	0.080	7.713	0.103	40.42	0.10	2016.108	5	iT24 0.61m stack 5x1s
	C	05 17 23.029	33 12 30.56							10.896	0.107	27.92				
CTT 4	A	05 17 31.715	33 12 05.30	0.12	0.10	94.517	0.156	271.152	0.095	7.713	0.103	40.42	0.10	2016.108	5	iT24 0.61m stack 5x1s
	D	05 17 24.186	33 12 07.20							11.352	0.108	25.83				
CTT 4	A	05 17 31.715	33 12 05.30	0.12	0.10	113.113	0.156	269.108	0.079	7.713	0.103	40.42	0.10	2016.108	5	iT24 0.61m stack 5x1s. SNR E <20
	E	05 17 22.704	33 12 03.54							12.454	0.125	14.04				
CTT 4	A	05 17 31.715	33 12 05.30	0.12	0.10	41.905	0.156	167.177	0.214	7.713	0.103	40.42	0.10	2016.108	5	iT24 0.61m stack 5x1s. Additional component F with SNR <20
	F	05 17 32.456	33 11 24.44							12.744	0.125	13.97				
ES 59	A	05 18 41.804	33 31 26.97	0.12	0.10	13.876	0.156	9.388	0.645	8.415	0.105	35.00	0.10	2016.108	5	iT24 0.61m stack 5x1s
	B	05 18 41.985	33 31 40.66							9.461	0.106	30.00				
ES 2611	A	05 18 41.804	33 31 26.97	0.12	0.10	78.072	0.156	169.283	0.115	8.415	0.105	35.00	0.10	2016.108	5	iT24 0.61m stack 5x1s. SNR E<20
	B									12.738	0.131	12.26				

Table 2 continues on next page.

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Name		RA	Dec	dRA	dDec	Sep	Err Sep	PA	Err PA	Mag	Err Mag	SNR	dVmag	Date	N	Notes
BPM 151	A	05 41 00.897	16 20 07.51	0.12	0.11	107.338	0.163	49.948	0.087	14.163	0.126	28.29	0.12	2016.026	5	iT27 0.7m stack 5x3s. SNR B>20. This object is listed in the WDS catalog with code V - the reason for this may not be common proper motion, see text.
	B	05 41 06.605	16 21 16.58							15.218	0.139	15.16				
J 1906	A	05 45 59.003	26 06 35.98	0.06	0.06	7.509	0.085	335.634	0.647	13.510	0.105	13.49	0.07	2016.085	5	iT18 0.32m stack 5x3s. SNR for both compo-nents <20
	B	05 45 58.773	26 06 42.82							13.487	0.100	14.74				
J 1907	A	05 46 07.103	26 05 29.45	0.06	0.06	9.058	0.085	233.718	0.537	12.607	0.083	24.31	0.07	2016.085	5	iT18 0.32m stack 5x3s. SNR for B <20
	B	05 46 06.561	26 05 24.09							13.506	0.107	12.88				
BRT 138	A	05 46 16.420	25 42 05.93	0.06	0.06	6.052	0.085	118.095	0.803	8.237	0.070	184.35	0.07	2016.085	5	iT18 0.32m stack 5x3s. A too bright for reli-able photometry
	B	05 46 16.815	25 42 03.08							11.578	0.078	31.93				
FOX 147	A	06 31 09.970	16 56 18.31	0.10	0.09	47.282	0.135	345.716	0.163	6.151	0.070	249.27	0.07	2015.281	5	iT24 0.61m stack 5x1s. A too bright for reli-able photometry
	C	06 31 09.157	16 57 04.13							11.424	0.074	44.64				
BPM 282	A	06 31 22.247	16 45 44.72	0.10	0.09	69.013	0.135	333.739	0.112	12.663	0.085	21.65	0.07	2015.281	5	iT24 0.61m stack 5x1s. SNR for B <20. Why this object is listed with WDS code V is un-clear - most likely is not common proper mo-tion. See text.
	B	06 31 20.121	16 46 46.61							13.401	0.106	13.09				
BRT 1204	A	06 31 33.911	15 34 44.88	0.10	0.09	5.430	0.135	77.558	1.419	11.920	0.077	33.31	0.07	2015.281	5	iT24 0.61m stack 5x1s. SNR for B <20
	B	06 31 34.278	15 34 46.05							13.215	0.099	15.15				
TDS 4042	A	06 42 00.600	25 28 09.72	0.08	0.08	-	0.113	-	-	10.023	0.071	88.98	0.07	2015.281	5	iT24 0.61m stack 5x1s. No trace of a compan-ion. Bogus?
	B										-					
POU 2442	A													2015.281	5	iT24 0.61m stack 5x1s. No resolution of both components. Faintest stars in the used im-age ~13.5mag -> both components have to be fainter than that
	B															
CBL 24	A	07 28 30.634	34 37 06.30	0.13	0.11	-	0.170	-	-	12.231	0.098	26.78	0.09	2015.281	5	iT24 0.61m stack 5x1s. No resolution of B. Faintest stars in the image ~13.5mag
	B										-					

Table 2 continues on next page.

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Name		RA	Dec	dRA	dDec	Sep	Err Sep	PA	Err PA	Mag	Err Mag	SNR	dVmag	Date	N	Notes
POU 2883	A													2015.291	2	iT21 0.43m stack 2x0.5s. No resolution of both components. Faintest stars in the image ~12.2 -> both components have to be fainter than that
	B															
GRV 740	A	07 45 35.941	34 31 04.45	0.08	0.10	75.971	0.128	204.172	0.097	10.738	0.102	50.36	0.10	2015.297	5	iT21 0.43m stack 5x1s
	B	07 45 33.424	34 29 55.14							11.795	0.106	29.32				
ARN 71	A	09 20 43.718	51 16 00.07	0.16	0.16	230.374	0.226	51.437	0.056	6.251	0.090	435.84	0.09	2015.376	5	iT11 0.51m stack 5x3s. Both components too bright for reliable photometry. V-coded WDS object. Comparison 2MASS to URAT1 does not support CPM - difference in pm direction is ~6.5° and difference in speed is ~15mas/yr
	D	09 21 02.911	51 18 23.68							7.880	0.090	318.64				
CBL 380	A													2015.456	4	iT24 0.61m 4x1s. WDS V-coded object No resolution of A and B - both component fainter than 13.6mag
	B															
L 17	A	17 52 30.775	15 31 31.19	0.08	0.09	2.359	0.120	291.379	2.922	11.840	0.074	44.16	0.07	2015.476	6	iT24 0.61m stack 6x1s. Overlapping star disks
	B	17 52 30.623	15 31 32.05							12.137	0.076	34.81				
WLY 20	A	17 52 30.775	15 31 31.19	0.08	0.09	38.103	0.120	121.661	0.181	11.840	0.074	44.16	0.07	2015.476	6	iT24 0.61m stack 6x1s
	C	17 52 33.019	15 31 11.19							12.447	0.077	33.60				
STF 2396	A	18 48 29.358	10 44 36.74	0.06	0.06	82.005	0.085	336.723	0.059	7.869	0.070	399.98	0.07	2015.555	5	iT24 0.61m stack 5x3s. A too bright for reliable photometry. A shows high speed proper motion resulting in a rapid change also in separation
	B	18 48 27.159	10 45 52.07							11.158	0.071	108.92				
STF 2396	A	18 48 29.358	10 44 36.74	0.06	0.06	203.176	0.085	4.743	0.024	7.869	0.070	399.98	0.07	2015.555	5	iT24 0.61m stack 5x3s. A too bright for reliable photometry. A shows high speed proper motion resulting in a rapid change also in separation
	C	18 48 30.498	10 47 59.22							9.948	0.070	172.62				
STF 2396	A	18 48 29.358	10 44 36.74	0.06	0.06	203.651	0.085	34.878	0.024	7.869	0.070	399.98	0.07	2015.555	5	iT24 0.61m stack 5x3s. A too bright for reliable photometry. A shows high speed proper motion resulting in a rapid change also in separation
	D	18 48 37.260	10 47 23.81							10.934	0.071	122.12				
BRT 1310	A	18 47 43.502	10 27 59.97	0.07	0.07	3.811	0.099	21.334	1.488	12.005	0.104	36.23	0.10	2015.557	5	iT24 0.61m stack 5x1s
	B	18 47 43.596	10 28 03.52							12.929	0.111	21.94				

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Name		RA	Dec	dRA	dDec	Sep	Err Sep	PA	Err PA	Mag	Err Mag	SNR	dVmag	Date	N	Notes
BPM 1005	A	19 16 11.013	16 12 10.25	0.06	0.06	73.267	0.085	267.340	0.066	13.942	0.069	31.11	0.06	2015.555	5	iT24 0.61m stack 5x3s. SNR B <20. This object is WDS listed with V-code. Comparison 2MASS to URAT1 does definitely not support CPM
	B	19 16 05.932	16 12 06.85							15.527	0.104	12.31				
BPM 1006	A	19 16 22.761	16 12 18.55	0.04	0.05	4.730	0.064	336.870	0.776	15.011	0.088	16.29	0.06	2015.557	5	iT24 0.61m stack 5x3s. SNR A <20 and B <10
	B	19 16 22.632	16 12 22.90							16.181	0.146	7.67				
BPM 1006	A	19 16 22.761	16 12 18.55	0.04	0.05	93.979	0.064	311.441	0.039	15.011	0.088	16.29	0.06	2015.557	5	iT24 0.61m stack 5x3s. SNR A and B <20
	C	19 16 17.870	16 13 20.75							15.473	0.103	12.48				
TDT 1508	A	19 30 21.270	50 14 36.49	0.04	0.04	-	0.057	-	-	11.515	0.051	90.44	0.05	2015.632	5	iT24 0.61m stack 5x3s. No resolution of B, not even a hint of an elongation. Bogus assumed
	B										-					
J 3032	A	19 54 55.888	06 36 53.34	0.08	0.11	4.425	0.136	21.741	1.761	12.929	0.056	41.23	0.05	2015.569	5	iT24 0.61m stack 5x3s. 2MASS positions give 4" separation per 2000.671 but A shows some proper motion in about the opposite direction of the PA leading to an increase of sep over time
	B	19 54 55.998	06 36 57.45							14.011	0.064	26.68				
SLE 383	A	21 18 08.629	35 00 04.40	0.03	0.03	15.170	0.042	58.439	0.160	10.437	0.050	170.12	0.05	2015.621	5	iT24 0.61m stack 5x3s
	B	21 18 09.681	35 00 12.34							11.916	0.051	89.32				
BU 289	A	21 18 18.240	34 55 36.41	0.03	0.03	12.988	0.042	251.412	0.187	8.596	0.050	325.33	0.05	2015.621	5	iT24 0.61m stack 5x3s. Mag A is combined A+B (with 0,8" too close for resolution)
	C	21 18 17.239	34 55 32.27							13.018	0.054	51.97				
SLE 384	A	21 18 18.240	34 55 36.41	0.03	0.03	43.309	0.042	189.298	0.056	8.596	0.050	325.33	0.05	2015.621	5	iT24 0.61m stack 5x3s. Mag A is combined A+B (with 0,8" too close for resolution)
	D	21 18 17.671	34 54 53.67							12.075	0.052	83.18				
FYM 142	A	21 18 18.240	34 55 36.41	0.03	0.03	36.714	0.042	94.014	0.066	8.596	0.050	325.33	0.05	2015.621	5	iT24 0.61m stack 5x3s. Mag A is combined A+B (with 0,8" too close for resolution)
	E	21 18 21.218	34 55 33.84							14.326	0.064	26.90				
FYM 142	A	21 18 18.240	34 55 36.41	0.03	0.03	45.882	0.042	199.836	0.053	8.596	0.050	325.33	0.05	2015.621	5	iT24 0.61m stack 5x3s. Mag A is combined A+B (with 0,8" too close for resolution). SNR F <20
	F	21 18 16.974	34 54 53.25							15.006	0.076	18.57				
FYM 142	A	21 18 18.240	34 55 36.41	0.03	0.03	68.786	0.042	271.574	0.035	8.596	0.050	325.33	0.05	2015.621	5	iT24 0.61m stack 5x3s. Mag A is combined A+B (with 0,8" too close for resolution)
	G	21 18 12.649	34 55 38.30							13.977	0.062	29.74				
FYM 142	A	21 18 18.240	34 55 36.41	0.03	0.03	61.547	0.042	274.370	0.039	8.596	0.050	325.33	0.05	2015.621	5	iT24 0.61m stack 5x3s. Mag A is combined A+B (with 0,8" too close for resolution)
	H	21 18 13.250	34 55 41.10							14.913	0.073	19.80				
SLE 384	D	21 18 17.671	34 54 53.67	0.03	0.03	8.583	0.042	267.195	0.283	12.075	0.052	83.18	0.05	2015.621	5	iT24 0.61m stack 5x3s. SNR F <20. WDS data for Sep and PA seems in error
	F	21 18 16.974	34 54 53.25							15.006	0.076	18.57				

Table 2 concludes on next page.

STT Doubles with Large ΔM – Objects Nearby

Table 2 (conclusion). Photometry and astrometry results for the double star objects nearby the imaged STT objects. Date is the Bessel epoch and N is the number of images used for the reported values. iT in the Notes column indicates the telescope used with aperture. number of images and exposure time given. Observation method is "C"

Name		RA	Dec	dRA	dDec	Sep	Err Sep	PA	Err PA	Mag	Err Mag	SNR	dVmag	Date	N	Notes
FYM 142	E	21 18 21.218	34 55 33.84	0.03	0.03	9.137	0.042	272.886	0.266	14.326	0.064	26.90	0.05	2015.621	5	iT24 0.61m stack 5x3s. SNR I <10. WDS data for Sep and PA seems in error. URAT1 values per 2013.532 are 9.357" and 273.66°
	I	21 18 20.476	34 55 34.30							16.316	0.145	7.51				
FYM 142	G	21 18 12.649	34 55 38.30	0.03	0.03	7.904	0.042	69.252	0.308	13.977	0.050	325.33	0.05	2015.621	5	iT24 0.61m stack 5x3s. WDS data for Sep and PA seems in error. URAT1 values per 2013.532 are 7.775" and 69.452°
	H	21 18 13.250	34 55 41.10							14.913	0.062	29.74				
ES 1585	A	21 21 29.283	43 00 52.58	0.04	0.05	19.249	0.064	229.622	0.191	10.095	0.060	183.92	0.06	2015.621	5	iT24 0.61m stack 5x3s
	B	21 21 27.946	43 00 40.11							13.745	0.068	34.22				
ES 1585	A	21 21 29.283	43 00 52.58	0.04	0.05	26.872	0.064	221.454	0.137	10.095	0.060	183.92	0.06	2015.621	5	iT24 0.61m stack 5x3s. ES1585 is actually a triple
	C	21 21 27.661	43 00 32.44							14,651	0,078	21,48				
ES 1585	B	21 21 27.946	43 00 40.11	0.04	0.05	8.283	0.064	202.174	0.443	13.745	0.068	34.22	0.06	2015.621	5	iT24 0.61m stack 5x3s. ES1585 BC might be a potential CPM pair
	C	21 21 27.661	43 00 32.44							14.651	0.078	21.48				

Table 3: Catalog research for some objects of specific interest. CPM rating according to Knapp and Nanson 2016

Name	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
ARN 71 AD	09:20:43.759	+51:15:57.8	231.1	52	6.19	7.89	-36	145		-37	140						2008		WDS09207+5116 data per 08/2016
	140.18233500	51.2660410	231.083	51.461	6.1	7.7									1.3	E2	1998.928		2MASS. M1 and M2 estimated from J- and K-band
	140.18211780	51.2666283	230.794	51.479			-32.51	140.48	6.13	-44.68	125.69	6.17			0.2	Eu	2013.923	CBA	URAT1. PM data calculated from position comparison with 2MASS. Result does not support CPM - difference in pm direction is ~6.5° and difference in speed is ~15mas/yr
	140.18210366	51.2666639	230.811	51.480			-32.42	139.53	5.74	-42.61	125.38	5.74			0.96	Hg	2015	BBA	GAIA DR1. PM data calculated from position comparison with 2MASS. Result does not fully support CPM - some difference in pm direction and speed and Sep/PM >3000yrs
Name	**RA**	**Dec**	**Sep "**	**PA °**	**M1**	**M2**	**pmRA1**	**pmDec1**	**e_pm1**	**pmRA2**	**pmDec2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
CBL 380	12:22:44.440	+03:24:40.1	39.7	339	14.4	18	-125	62		-120	54						2010		WDS12227+0325 data per October 2016. CPM well confirmed by URAT1 and GAIA DR1 positions in comparison with 2MASS
	185.68521300	3.4111540	39.702	338.773	13.1	15.5									1.3	E2	2000,795		2MASS. M1 and M2 estimated from J- and K-band
	185.68472560	3.4113497	39.716	338.904	14.48		-127.21	51.17	9.74	-122.86	55.15	9.86			0.2	Eu	2013,841	AAB	URAT1. PM data calculated from position comparison with 2MASS
	185.68468711	3.4113710	39.731	338.869			-133.04	54.99	5.97	-129.42	58.60	5.97			0.96	Hg	2015	AAA	GAIA DR1. PM data calculated from position comparison with 2MASS. Sep/PM<1000yrs
Name	**RA**	**Dec**	**Sep"**	**PA°**	**M1**	**M2**	**pmRA1**	**pmDec1**	**e_pm1**	**pmRA2**	**pmDec2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
BPM 1005 AB	19:16:10.999	+16:12:10.6	73.2	267	14.02	15.55	1	-24		5	-8						2001		WDS19162+1612 data per 08/2016
	289.04583300	16.2029250	73.174	267.228	13.8	15.1									1.3	E2	1999.803		2MASS. M1 and M2 estimated from J- and K-band
	289.04589060	16.2028561	73.272	267.419	13.98	15.56	14.22	-17.71	6.06	6.38	-0.59	6.05	K3	K4	0.2	Eu	2013.819	CCC	URAT1. PM data calculated from position comparison with 2MASS does definitely not support CPM. Spc according to B-V color index

Table 3 concludes on next page.

STT Doubles with Large ΔM – Objects Nearby

Table 3 (conclusion). Catalog research for some objects of specific interest. CPM rating according to Knapp and Nanson 2016

Name	RA	Dec	Sep "	PA °	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
BPM 1006 AB	19:16:22.748	+16:12:18.6	4.2	337	14.90	16.00	17	-28									2000		WDS19164+1612 data per 08/2016
	289.09482300	16.2051680	4.199	337.032	14.4										1.3	E2	2000.319		2MASS. M1 estimated from J- and K-band
	289.09483470	16.2051617	4.120	336.299	14.91		2.99	-1.68	6.27	1.69	-8.62	6.29	>M4		0.2	Eu	2013.819	CCC	URAT1. PM data calculated from position comparison with 2MASS - result does definitely not support CPM. Spc according to B-V color index
Name	RA	Dec	Sep"	PA°	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	Spc1	Spc2	Ap	Me	Date	CPM Rat	Source/Notes
BPM 1006 AC	19:16:22.748	+16:12:18.6	94.0	312	14.90	14.80	17	-28		3	-18						2001		WDS19164+1612 data per 08/2016
	289.09482300	16.2051680	94.112	311.429	14.4										1.3	E2	2000.061		2MASS. M1 estimated from J- and K-band
	289.09483470	16.2051617	94.105	311.456	14.91	15.30	2.99	-1.68	6.27	5.39	0.46	6.07	>M4		0.2	Eu	2013.819	CCC	URAT1. PM data calculated from position comparison with 2MASS - result does definitely not support CPM. Spc according to B-V color index
Name	**RA**	**Dec**	**Sep"**	**PA°**	**M1**	**M2**	**pmRA1**	**pmDec1**	**e_pm1**	**pmRA2**	**pmDec2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
BRT 1204 AC	06 31 33.91	+15 34 44.9			10.50		-11	-11									2000		WDS06315+1535 data per 08/2016 for A, C not listed
	97.89127900	15.5791400	11.129	80.372	11.8	15.7									1.3	E2	1997.800		2MASS. M1 estimated from J- and K-band
	97.89128361	15.5790934	11.121	79.583			0.93	-9.76	6.29	-1.05	-1.05	6.29			0.96	Hg	2015	CCC	GAIA DR1. PM data calculated from position comparison with 2MASS - result does definitely not support CPM
Name	**RA**	**Dec**	**Sep"**	**PA°**	**M1**	**M2**	**pmRA1**	**pmDec1**	**e_pm1**	**pmRA2**	**pmDec2**	**e_pm2**	**Spc1**	**Spc2**	**Ap**	**Me**	**Date**	**CPM Rat**	**Source/Notes**
ES 1585 BC	21 21 27.946	43 00 40.11			13.75	14.65	4.92	-21.21	5.23	6.68	-20.63	5.23						BAC	So far no WDS object. Potential CPM pair even if rather slow PM, but Sep/PM<1000yrs
	320.36640300	43.0112460	8.378	202.112	13.7	14.7									1.3	E2	1998.782		2MASS. M1 and M2 estimated from J- and K-band
	320.36643329	43.0111505	8.358	201.954			4.92	-21.21	5.23	6.68	-20.63	5.23			0.96	Hg	2015	BAC	GAIA DR1. PM data calculated from position comparison with 2MASS

STT Doubles with Large ΔM – Objects Nearby

Star	RA	Dec	Mags	PA	Sep	1900+	N	Obs
Anon AB	05175	+3312	7.7,9.5	104.3	98.27	97.07	1	JC
Anon AC	05175	+3312	7.7,9.5	282.3	113.57	97.07	1	JC
Anon AD	05175	+3312	7.7,9.5	269.9	102.77	97.07	1	JC
Anon AE	05175	+3312	7.7,10.	0 268.7	116.24	97.07	1	JC

Webb Society Double Star Circular No. 7 (1998), p. 8

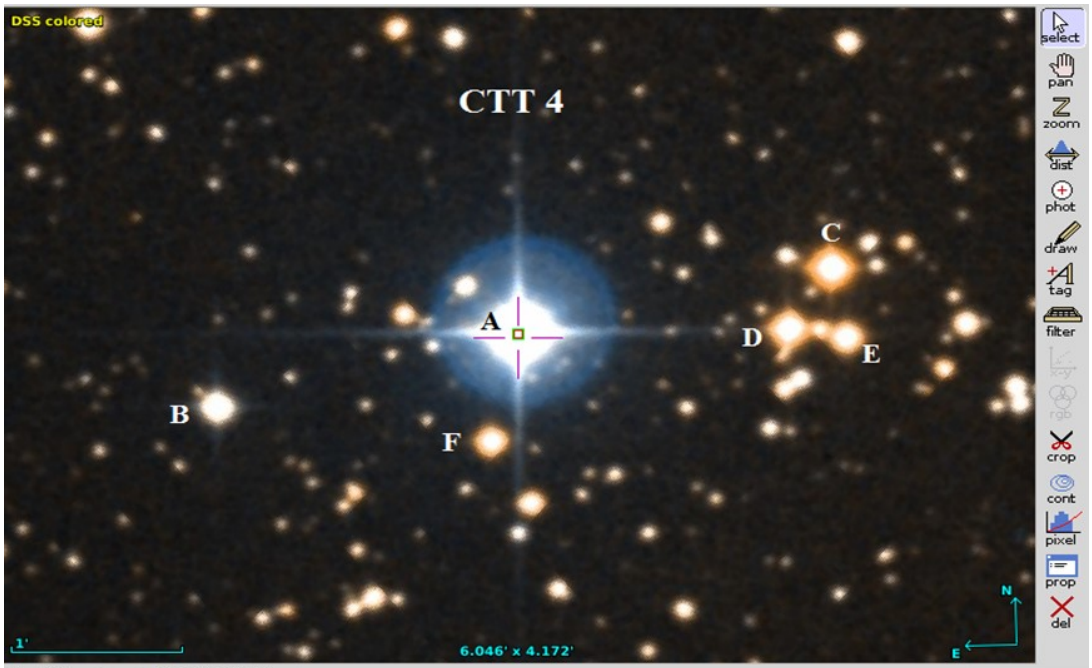
Figure 1. Original observational data for CTT 4.

(Continued from page 299)

CTT 4: This is an interesting multiple star with A, B, C, D, and E components. There's also an additional star not included in the WDS which we've added to our measurements (see Table 1.) because it's closer than the other components and is similar in magnitude (our report identifies that star as the F component). J-F. Courtot published what appear to be the first measures of this multiple star in Webb Society Double Star Circular No. 7 (1998). The measures for the AB, AC, AD, and AE pairs are all labeled as ANON, and all are dated 1997.07 (Figure 1.) The WDS shows first measures for those pairs with dates of 1940, 1934, 1981, and 1982, respectively (Figure 2.), which is an indication they were culled from photographic plates.

There is no distance published for any of the components, but a check of GAIA found a parallax for the primary of 7.15, which works out to 456 light years (no parallax was listed for the other components). Proper motion data was absent in the most recent GAIA data (I/337), but we found URAT1 had PM data for all of the components, including the star we added as F. (That data is shown at the bottom of Figure 2).

BRT 1204: The WDS lists data for just two components, but Aladin's image (Figure 3.) shows three components, all of which are virtually in a straight line with each other. The third one, however is faint and probably wasn't seen by Barton – the derived visual magnitude from URAT1 J and K values is 15.614. The exposure time for our image of BRT 1204 was too short to reveal the third star, so we turned to the GAIA data in Aladin to get measures. The AC pair measured 11.12" and 79.6°, and the BC pair measured 5.742" and



	V	WDS	Disc	Comp	Obs1	Obs2	pa1	pa2	sep1	sep2	mag1	mag2	DM	RAJ2000	DEJ2000
	VizieR	05175+3312	CTT 4	AB	1940	2002	106	105	111.7	108.8	7.74	11.73	+33 994	05 17 31.71	+33 12 05.9
	VizieR	05175+3312	CTT 4	AC	1934	2011	281	283	111.2	111.6	7.74	10.96		05 17 31.71	+33 12 05.9
	VizieR	05175+3312	CTT 4	AD	1981	2002	270	271	94.2	94.3	7.74	11.35		05 17 31.71	+33 12 05.9
	VizieR	05175+3312	CTT 4	AE	1982	2002	269	269	114.4	114.3	7.74	12.27		05 17 31.71	+33 12 05.9

	URAT1	RAJ2000	DEJ2000	Epoch	f.mag	e f....	pmRA	pmDE	Jmag	Hmag	Kmag	Vmag
A	617-089416	79.3821847	33.2015536	2013.658	7.99	0.041	20.9	-32.4	7.557	7.592	7.566	
B	616-087526	79.4170275	33.1937336	2013.652	11.815	0.012	5.5	-10.5	11.287	11.29	11.242	11.732
C	617-089291	79.345855	33.2084783	2013.693	9.843	0.019	0.4	-5.9	7.76	6.958	6.721	10.96
D	617-089305	79.3507717	33.2019697	2013.674	10.544	0.013	6.7	-6	8.905	8.364	8.204	11.354
E	617-089284	79.3441342	33.2011281	2013.672	11.627	0.012	3.1	-10.1	10.202	9.689	9.554	12.273
F	616-087396	79.3853047	33.1901292	2013.697	11.806	0.012	5.6	-6.9	9.99	9.331	9.138	12.738

Figure 2. Aladin image of CTT 4 with WDS and URAT1 data. Note the identification of the F component.

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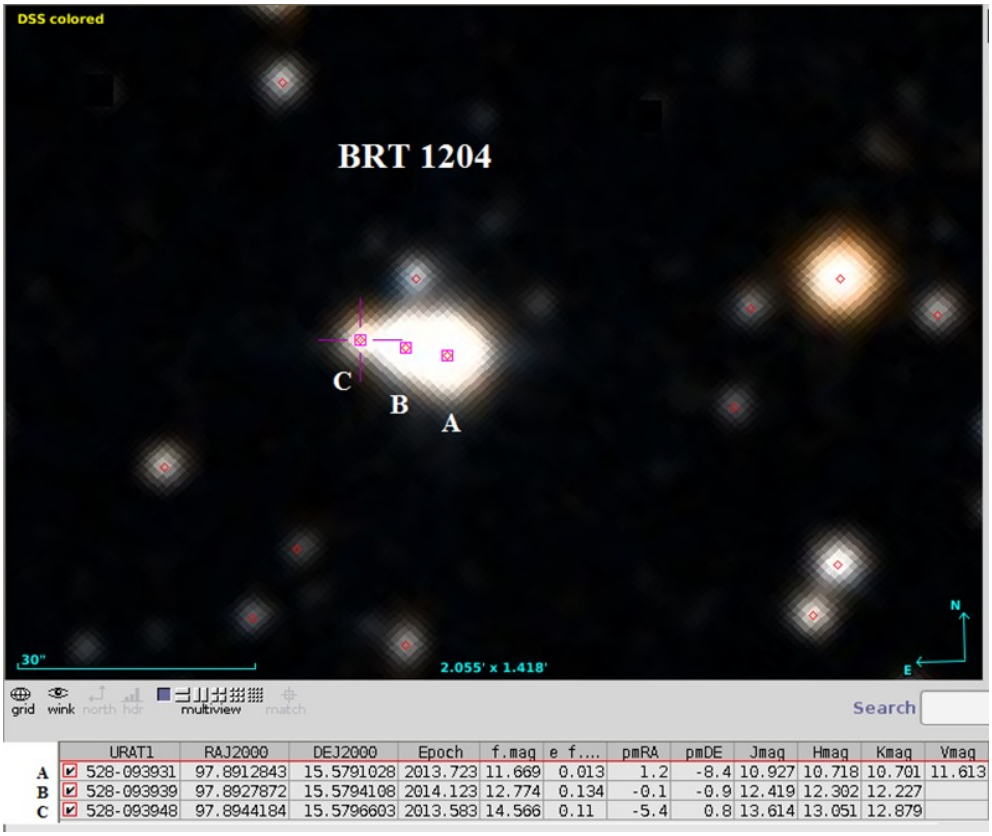

	URAT1	RAJ2000	DEJ2000	Epoch	f.mag	e f...	pmRA	pmDE	Jmag	Hmag	Kmag	Vmag
A	528-093931	97.8912843	15.5791028	2013.723	11.669	0.013	1.2	-8.4	10.927	10.718	10.701	11.613
B	528-093939	97.8927872	15.5794108	2014.123	12.774	0.134	-0.1	-0.9	12.419	12.302	12.227	
C	528-093948	97.8944184	15.5796603	2013.583	14.566	0.11	-5.4	0.8	13.614	13.051	12.879	

Figure 3. Aladin image of BRT 1204 with the additional component labeled as C.

81.1° (Epoch 2015.0 for both measures). URAT1 has proper motion data for all three stars, which is shown at the bottom of Figure 3. GAIA has PM data for A (-010.5 -010.9) and B (+015.7 +003.9) which is considerably different from URAT1, but shows no data for the third star. At any rate, there is no evidence of common proper motion between the three stars (see Table 3. for AC evaluation).

There's a marked difference between the first and last position angles shown in the WDS (96 degrees in 1904, 79.2 degrees in 2000), as well as a notable difference between first and last and separations (4.5" and 5.338"). Our measures (Table 2) showed the AB pair with a position angle of 77.558° and a separation of 5.430" (2015.281). In addition, the WDS shows only three observations of the pair.

POU 2883: The WDS lists magnitudes of 12.7 and 12.9 for the A and B components of POU 2883, but in the Aladin image the secondary appears to be at least equivalent in magnitude to the primary, if not brighter (right half of Figure 4.). A look at the 2MASS infrared image clearly shows the secondary to be brighter (left half of Figure 4.), as does a 1993 POSSII.F image. However, 1995 POSSII.F and 2000 POSSII.N images showed the pair to be very similar in size. But in looking at the URAT1 data we again find the secondary is the brighter of the two stars with an f.mag of 12.764, compared to an f.mag of 12.914 for the primary. The J and K magnitudes in URAT1 follow the same pattern, working out to visual magnitudes of 13.285 for the secondary and 13.351 for the primary. Turning to the UCAC4 catalog, we also find the secondary is brighter with an fmag of 13.027 and the primary with an f.mag of 13.156. (UCAC4 list a Vmag for the secondary of 13.022, but has no Vmag value for the primary). It should also be noted that based on the URAT1 and UCAC4 data, it appears the WDS magnitudes are too bright for both stars. Our attempt to photograph the pair was unsuccessful because the glare from 3.7 magnitude STT 179 limited our magnitude resolution to 12.2.

STF 2396: This is another multiple star, which also includes a high proper motion primary. F.G.W. Struve first measured the AB pair in 1829 at 11.74" and 232.8 degrees. The most recent WDS measure shows a separation of 76.5" and 336 degrees, which is indicative of the high proper motion. In his 1906 Double Star Catalog, S.W. Burnham included a graph showing the

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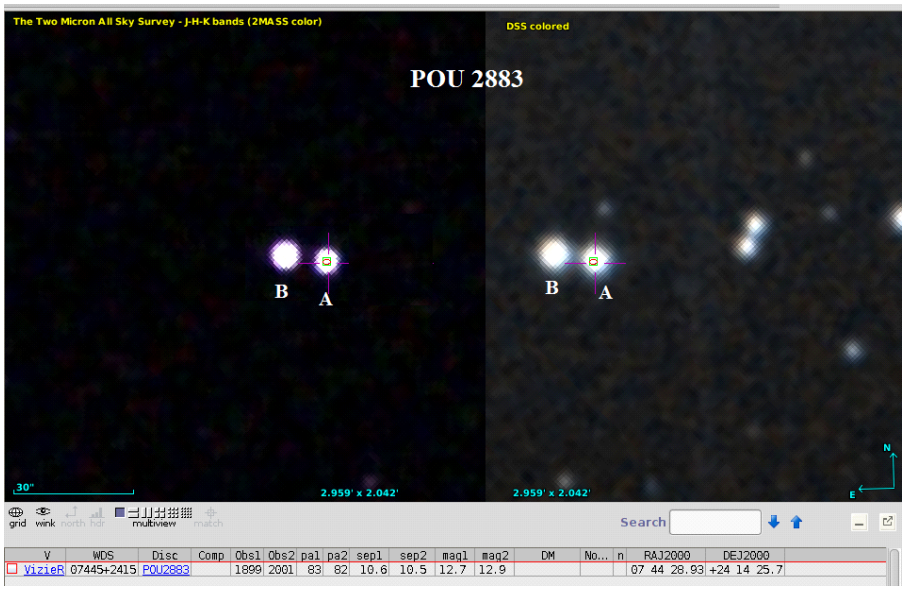

Figure 4. POU 2883, 2MASS IR image on left, Aladin image on right.

primary's motion based on measures from 1825 through 1905 (left half of Figure 5.). STF 2396 also found its way into his 1913 Proper Motion Catalog, which credits B. von Engelhardt with the first measures of the C and D components in 1891. The most recent proper motion from GAIA (bottom right of Figure 5.) shows the primary with motion of +129 in RA and -437.1 in declination. B has motion of +003.7 +006.3, C of 000.2 -009, and D of +004 +007, indicating these are optical components with the possible exception of the similarity in motion between the B and D components. However, a CPM check of those components showed no shared motion.

J 3032: Jonckheere first measured this pair in 1944 at 4" and 30° (top half of Figure 6.). The most recent measure in the WDS from 2000 is 3.991" and 20.8 degrees, which results in a considerable change in position angle and virtually no change in separation. Our 2015.569 measure of the pair is 4.425" and 21.741°. There are only a total of three measures listed in the

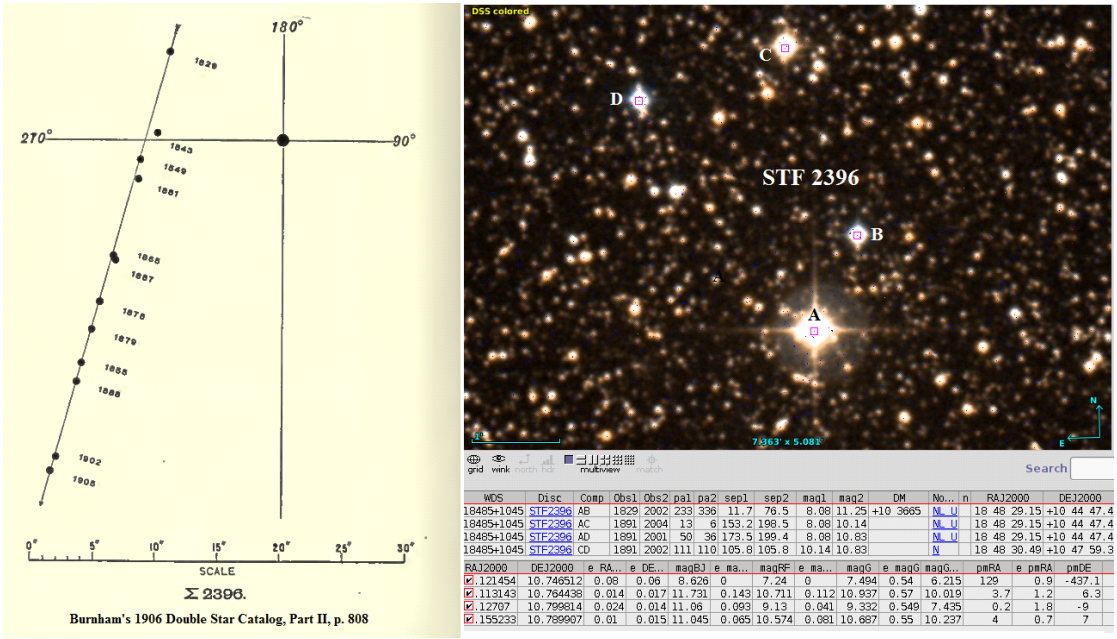

Figure 5. STF 2396, S.W. Burnham's PM chart on left, Aladin image on right with WDS and GAIA data.

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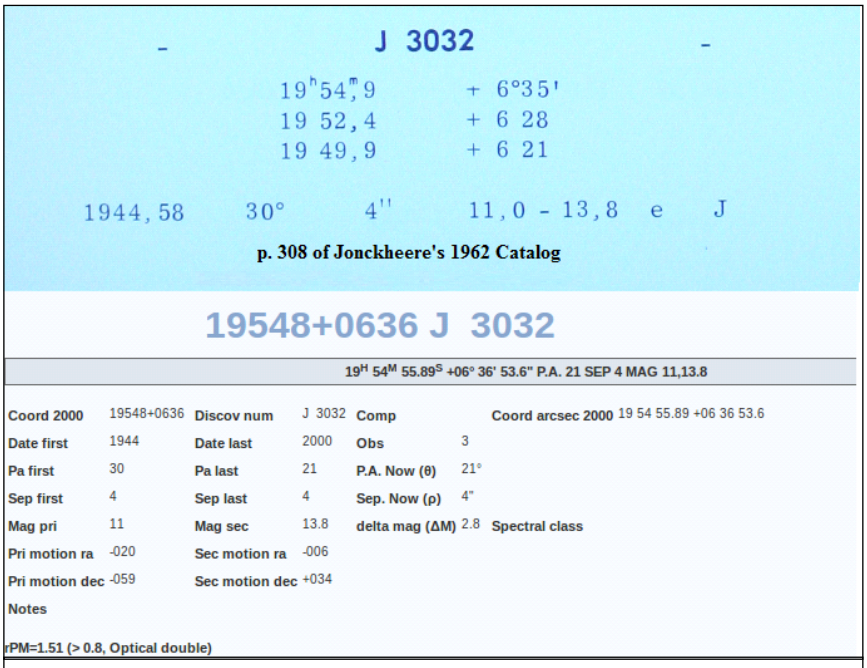
WDS, so our measure would bring the total to four.

The most recent GAIA data shows the A component with proper motion of -020.3, -059.0 and B with proper motion of -005.5, +033.6, which results in a gradual increase in separation and a northerly shift in position angle. So there's enough individual motion in the two stars to account for the difference between the 1944 measures and the later measures. In fact, Jonckheere's 1944 separation of 4" was most likely too wide. Based on the PM data, this is an optical pair, which is noted in the WDS as well.

The magnitudes shown in the WDS (11.0 and 13.8) are from Jonckheere's 1944 observation. We measured magnitudes of 12.929 and 14.011, which fits the general pattern of Jonckheere's magnitudes being too bright.



J 3032

19h54m,9 + 6°35'
19 52,4 + 6 28
19 49,9 + 6 21

1944,58 30° 4'' 11,0 - 13,8 e J

p. 308 of Jonckheere's 1962 Catalog

19548+0636 J 3032

19H 54M 55.89S +06° 36' 53.6" P.A. 21 SEP 4 MAG 11,13.8

Coord 2000	19548+0636	Discov num	J 3032	Comp		Coord arcsec 2000	19 54 55.89 +06 36 53.6
Date first	1944	Date last	2000	Obs	3		
Pa first	30	Pa last	21	P.A. Now (θ)	21°		
Sep first	4	Sep last	4	Sep. Now (ρ)	4"		
Mag pri	11	Mag sec	13.8	delta mag (ΔM)	2.8	Spectral class	
Pri motion ra	-020	Sec motion ra	-006				
Pri motion dec	-059	Sec motion dec	+034				
Notes							

rPM=1.51 (> 0.8, Optical double)

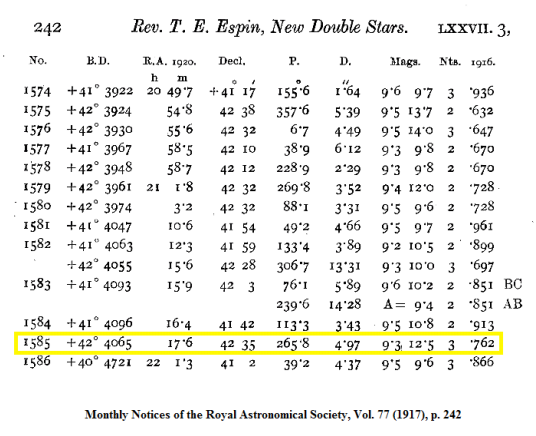
Figure 6. Jonckheere's 1962 catalog entry for J 3032 and WDS data from Stelledoppie below it.

ES 1585: The WDS shows only A and B components for ES 1585, but an obvious third star slightly fainter than the B component is located about 7.5" southwest of B (our photometry recorded a magnitude of 14.651 for that star, which is .9 of a magnitude fainter than the 13.745 we measured for the B component). A check of Espin's catalog entry in the MNRAS for 1917 shows his original observation identified only the A and B components (left half of Figure 7.). We've chosen to include the third component in our measurements, identifying it as C in our table.

The primary of ES 1585 has significant proper motion, especially given the parallax for it shown in GAIA, which works out to 424 light years. URAT1 shows PM data for A of +102.5 +107, for B of +004.2 -021.7, and for the star we labeled as C of +005.8 -020.9. There is enough similarity in the proper motion of the B component and the suggested C component to suggest CPM, which we've shown in Table 3.

2.1 Additional WDS Discrepancies

BPM 151: The WDS assigns a "V" code to this object, which is explained as: "Proper motion or other technique indicates that this pair is physical." The proper motion shown in the WDS for this pair is +004 -



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No.	B.D.	R.A. 1920. h	m	Decl. °	′	P. °	D. ″	Mags.		Nts.	1916.	
1574	+41° 3922	20	49·7	+41	17	155·6	1·64	9·6	9·7	3	·936	
1575	+42° 3924		54·8	42	38	357·6	5·39	9·5	13·7	2	·632	
1576	+42° 3930		55·6	42	32	6·7	4·49	9·5	14·0	3	·647	
1577	+41° 3967		58·5	42	10	38·9	6·12	9·3	9·8	2	·670	
1578	+42° 3948		58·7	42	12	228·9	2·29	9·3	9·8	2	·670	
1579	+42° 3961	21	1·8	42	32	269·8	3·52	9·4	12·0	2	·728	
1580	+42° 3974		3·2	42	32	88·1	3·31	9·5	9·6	2	·728	
1581	+41° 4047		10·6	41	54	49·2	4·66	9·5	9·7	2	·961	
1582	+41° 4063		12·3	41	59	133·4	3·89	9·2	10·5	2	·899	
	+42° 4055		15·6	42	28	306·7	13·31	9·3	10·0	3	·697	
1583	+41° 4093		15·9	42	3	76·1	5·89	9·6	10·2	2	·851	BC
						239·6	14·28	A=	9·4	2	·851	AB
1584	+41° 4096		16·4	41	42	113·3	3·43	9·5	10·8	2	·913	
1585	+42° 4065		17·6	42	35	265·8	4·97	9·3	12·5	3	·762	
1586	+40° 4721	22	1·3	41	2	39·2	4·37	9·5	9·6	3	·866	

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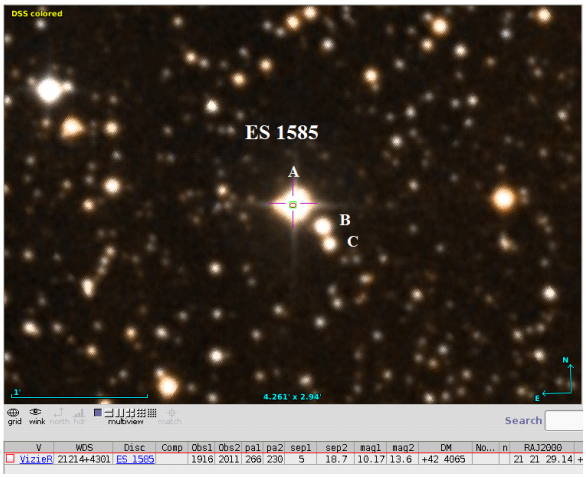

Figure 7. T.E. Espin's original observation record and Aladin image with WDS data.

007 for the primary and +010 +004 for the secondary, indicating the primary has a westward component of motion and the secondary an eastward component of motion. However, URAT1 shows proper motion for the pair of +002 +001.8 and +002.3 +001.6, which is more indicative of shared proper motion. The most recent data release from GAIA does not include proper motion data for either of the components, nor does it include parallax data for either of the pair, which would be helpful. At any rate, the WDS numbers argue against shared motion and the URAT1 rate of proper motion would seem to be too minor to use as a basis for concluding this pair is physical. It's not clear what other technique might indicate a physical connection between the two stars since parallax data is lacking.

BPM 282: This pair also has a WDS "V" code assigned to it, but again the proper motion numbers listed in the WDS are not indicative of shared motion (000 -006 for the primary, -004 -029 for the secondary). The URAT1 data is even more indicative of a lack of shared motion, with +005.7 -014.5 listed for the primary and -001.5 -009.5 for the secondary. Again, no proper motion or parallax data numbers are shown in the most recent GAIA data.

There are also discrepancies between the WDS data and our measures for this pair with regard to astrometry and photometry (Table 2). The WDS shows this pair with a separation of 73.9" and a position angle of 324° (2010). Our measures are 69.013" and a position angle of 333.739° (2015.281). The URAT1 data computes to a separation of 69.233" and a position angle of 333.563° (2013.628), while GAIA data results in a separation of 69.244" and a position angle of 333.566° (2015.0). Looking at magnitudes, the WDS shows values of 12.79 and 15.27, whereas we measured 12.663 and 13.401. UCAC4 and URAT1 both have Vmags for the pair of 12.740 and 13.343, so it appears the WDS value for the secondary is too faint by almost two magnitudes, which is also indicated by the Aladin image of BMP 282.

BPM 1005: This is another pair shown with a WDS "V" code and proper motion numbers that are not indicative of shared motion (+001 -024 and +005 -008). Nor does the proper motion data in URAT1 support shared motion, with numbers of +014.3 -017.7 and +006.4 and -000.6 (see Table 3.). And again, no data for either of the pair is shown in the recent GAIA release.

ARN 71: This is the AD pair of 37 UMA. The WDS also list this pair with a "V" code, and in this case the WDS proper motion data clearly shows a shared motion for the pair: -036 +145 and -037 +140. However the URAT1 data is more divergent, showing motion of -032.5 +140.5 and -044.6 +125.7. We used our CPM spreadsheet to compare 2MASS and URAT1 data, which showed the two components diverging by ~6.5° and with a speed difference of ~15mas/yr., numbers which argue against shared motion. (See first listing in Table 3.)

TDS 4042: The WDS lists this pair with a separation of 1.7" and a PA of 80°, and shows only one observation for it. However, TDS 4042 B isn't identified by either URAT1 or GAIA DR1. A look at the composite 2MASS J-H-K band image in Aladin shows a faint hint of an elongation, but at the wrong PA (~230°), and again no catalog object for B is identified in 2MASS. That elongation essentially disappears when individual J, H, and K band FITS images in Aladin are looked at closely. Nor is any elongation apparent in a 1949 POSSI.O image or in a 1996 POSSII.J image (both FITS images). Given the 1.7" separation and the close magnitudes (10.09 and 11.65) of the two stars it would seem a definite hint of elongation should be present, so it appears TDS 4042 is likely a bogus object.

TDT 1508: This pair is listed in the WDS with a separation of 2.1" and a PA of 207° and also with just one observation. Here again, no object for TDT 1508 B is identified in either URAT1 or GAIA DR1, although the latter catalog shows an object at a position angle of 273° with a separation of 4.736". The only magnitudes available in GAIA for the two objects are G magnitudes of 11.16 and 16.103, which at least from a magnitude differential standpoint differs considerably from the WDS magnitudes of 11.45 and 11.77. The composite 2MASS J-H-K band image in Aladin shows a slightly more defined elongation at a PA of about 285° and a separation of about 4.8". A look at the individual J, H, and K band FITS images in Aladin clearly show the elongation at 273°, but not the 285° elongation mentioned above, nor at the 207° position shown in the WDS. The 273° to 275° elongation is quite pronounced in both 1953 POSSI.O and 1988 POSSII.J FITS images in Aladin. We found a hint of the GAIA object at 273° by stacking two 5x3s images to 10x3s and measured a quite faint 15.6 magnitude star at the position in question. With SNR values of <10 and >5 for the two stacked images, our measure is not very reliable, but nevertheless it's obvious there's an object at the 273 degree location.

Here again, given the similar 11.45 and 11.77 magnitudes of this pair in the WDS, if an object was present at the WDS position of 207° and 2.1" separation, the elongation should be apparent in Aladin images. On the other hand, the object at 273° offers the possibility of a companion not identified previously.

POU 2442: The WDS lists this pair with magni-

tudes of 12.4 and 12.6 separated by 3.6" with a PA of 351°. We were unable to resolve either of the components during our imaging. The faintest stars visible in our images were in the 13.5 magnitude range, leading to the possibility that both stars are fainter than that, and a check of various catalogs tends to support that possibility. 2MASS lists J and K magnitudes for both components which convert to visual magnitudes of 14.300 for the primary and 14.340 for the secondary. UCAC4 shows a Vmag for the primary of 13.43, but has no Vmag for the secondary; however it includes f.mags for both components, showing the primary at 14.073 and the secondary at 14.376. GAIA lists only Gmags for the pair, 13.835 for the primary and 14.143 for the secondary, and URAT1 identifies the primary only, listing it with a Vmag of 13.449.

DAM 1026: The WDS shows a separation for this pair of 5.4" and 346° (2010), but our efforts resulted in slightly different numbers of 6.817" and 348.494° (2016.108). URAT1 data computes to a separation of 6.258" and a position angle of 344.345 (2013.596) and GAIA data results in a separation of 6.260" and a position angle of 344.473° (2015.0).

FYM 142 DF: There's a significant discrepancy between our measures for this pair and the WDS data. The latter measures, dated 2012, show FYM 142 DF with a separation of 4.9" and a position angle of 277° (2012), whereas our measures (2015.621) show the separation at 8.583" and the position angle at 267.195°. URAT1 data (2013.558) for this pair of stars shows a separation of 8.587" and a PA of 267.672°, while GAIA (2015.0) data shows a separation of 8.588" and a PA of 267.662.

FYM 142 EI: We also found some discrepancy between the WDS data and our measures for this pair. The WDS lists the pair at 7.1" and 279° (2012), while our measures are 9.137" and 272.886° (2015.621). Both the URAT1 and GAIA data show slightly larger numbers than ours: URAT1 data computes to 9.357" and 273.660° (2013.532) and GAIA's data comes out to 9.352" and 273.827° (2015.0).

FYM 142 GH: Here again we found significant discrepancy between the WDS data and our measures. The 2012 data shown in the WDS shows a separation of 4.7" and a position angle of 81°, while our measures show the separation at 7.904" and the position angle at 69.252° (2015.621). Again, the URAT1 and GAIA data result in measures similar to ours: URAT1 data computes to 7.775" and 69.452° (2013.554) and GAIA data results in measures of 7.789" and 69.409° (2015.0).

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- Washington Double Star Catalog as data source for the selected objects
- iTelescope: Images were taken with
  - ◊ iT24: 610mm CDK with 3962mm focal length. CCD: FLI-PL09000. Resolution 0.62 arcsec/pixel. V-filter. Located in Auberry. California. Elevation 1405m
  - ◊ iT11: 510mm CDK with 2280mm focal length. CCD: FLI ProLine PL11002M. Resolution 0.81 arcsec/pixel. B- and V-Filter. Located in Mayhill. New Mexico. Elevation 2225m
  - ◊ iT18: 318mm CDK with 2541mm focal length. CCD: SBIG-STXL-6303E. Resolution 0.73 arcsec/pixel. V-filter. Located in Nerpio. Spain. Elevation 1650m
  - ◊ iT21: 431mm CDK with 1940mm focal length. CCD: FLI-PL6303E. Resolution 0.96 arcsec/pixel. V-filter. Located in Mayhill. New Mexico. Elevation 2225m
- AAVSO VPhot for initial plate solving
- UCAC4 catalog
- URAT1 catalog
- Aladin Sky Atlas v9.0
- SIMBAD, VizieR
- 2MASS All Sky Catalog
- GAIA DR1 catalog
- AstroPlanner v2.2 for object selection. session planning and for catalog based counterchecks
- MaxIm DL6 v6.08 for plate solving on base of the UCAC4 catalog
- Astrometrica v4.9.1.420 for astrometry and photometry measurements

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$$Sep = \sqrt{\left[\left(RA_2 - RA_1\right)\cos\left(Dec_1\right)\right]^2 + \left(Dec_2 - Dec_1\right)^2}$$

in radians. and

$$PA = \arctan\left[\frac{(RA_2 - RA_1)\cos(Dec_1)}{Dec_2 - Dec_1}\right]$$

in radians depending on quadrant.

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