

Double Star Measurements for 2010/2011

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Abstract: I report 88 measurements of double stars from 2010.90 to 2011.46. The observations were conducted with the T11 robotic telescope located at the GRAS/iTelescopes Observatory, Mayhill, NM, USA (<http://www.itelescope.net/>). Discussion includes notes on a number of the observed doubles. Information about instrumentation, methodology and results is included.

Introduction and Instrumentation

I have been imaging double stars for a number of years using the equipment at GRAS/iTelescopes (hereafter iTelescopes). During this observing period the facility changed ownership.

The program of measuring the visual doubles used the T11 remote telescope at the GRAS Observatory. The instrument is a Planewave 20 in Dall-Kirkham Astrogaph with a focal length of approximately 2280 mm. The CCD camera is a FLI ProLine PL11002M with 9 μm square pixels. The field of view is 36.2 X 54.3 arc-secs. The OTA is mounted on a Planewave Ascension 200HR.

The instrument is capable of quickly and accurately slewing to a selected double star. The system takes about one minute to cycle through an exposure and save the resulting image in a FITS format. Taking 5 to 6 exposures per double star allows 6 doubles to be imaged per hour. To maximize telescope time, the FITS images are stored on the GRAS server and are retrieved later to analyzed by suitable software (in my case MPO Canopus). The relatively short focal length of this system restricts measurements of doubles to pairs > 10 arcseconds in most cases.

Methods

Imaging was done by entering the coordinates of the double into the robotic telescope's web interface. A test exposure was done and checked for centering and proper exposure. If all was well an exposure run of 5 to 7 images through a clear filter was done for each pair. Exposures typically ran about 10-15 seconds for 10-13 magnitude doubles. After the observing session was completed, the images were retrieved from an ftp site provided by the iTelescope observatory.

Each image in the exposure sequence was examined and any trailed or sub-par images were discarded. MPO Canopus was used to reduce the images (Warner 2006). Any image that the software could not reach a plate solution was also discarded. Canopus produces an astronomic solution to the image based on the UCAC2.0 catalog (Zacharias et al. 2004) or the MSOSC catalog (USNO and Tycho data) in areas not covered by UCAC2.0. The software measures double stars using a subroutine built into Canopus. It also produces a great amount of information about the astrometric solution. All images were copied to archival CD-ROM material and are available by request from the author. Each starting and ending image was blinked - just in case.

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WDS ID	Discoverer	RA	DEC	PA	SEP	Epoch	No.	PAsd	SEPs	Notes
04429+5532	STI2066	0443.80	5532.00	358.90	14.49	2010.902	6	0.21	0.02	1
05061+6232	STI 549	0507.10	6234.00	311.40	13.84	2010.841	5	0.25	0.04	
05064+2433	POU 541 ?	0506.90	2435.00	40.80	19.33	2011.145	5	0.22	0.16	2
05079+2425	POU 554	0508.60	2426.00	106.00	10.63	2011.131	5	0.6	0.11	
05081+2427	POU 556	0508.80	2428.00	58.70	2.31	2011.131	5	1.75	0.32	
05086+2507	POU 558	0509.30	2507.00	21.90	13.96	2011.131	6	0.22	0.08	
05087+2501	POU 559AB	0509.50	2502.00	336.60	19.07	2011.131	5	0.42	0.09	
05092+2428	POU 564	0509.90	2429.00	133.50	9.49	2011.074	5	0.57	0.36	
05111+5440	STI2087	0512.20	5440.00	112.10	9.25	2010.902	5	0.66	0.26	
05137+2418	POU 589	0514.40	2419.00	180.90	12.84	2011.074	5	1.46	0.39	
05138+2417	POU 592AC	0514.50	2418.00	324.30	9.05	2011.074	3	0.77	0.33	
05214+2343	POU 679	0522.10	2344.00	128.20	5.29	2011.074	6	1.1	0.67	
05225+4621	ES 1231AC	0523.30	4621.00	18.50	18.33	2010.842	5	0.1	0.02	
05230+5432	STI2096	0523.90	5433.00	32.50	10.55	2010.842	5	0.27	0.05	3
05238+5904	STI2097	0524.70	5905.00	183.50	6.40	2010.841	5	0.43	0.19	
05268+5623	STI2099	0527.70	5624.00	300.20	36.38	2010.902	4	0.14	0.05	
05315+2318	POU 698	0532.20	2318.00	122.90	10.86	2010.841	5	0.16	0.02	
05316+2312	POU 699	0532.20	2312.00	278.40	8.16	2010.841	5	1.62	0.32	
05314+2313	POU 696	0532.60	2313.00	98.00	14.87	2010.841	5	0.65	0.11	4
05321+2409	POU 709	0535.80	2410.00	243.20	10.48	2011.145	3	0.35	0.12	
05316+6310	STI 567	0533.00	6310.00	153.80	12.34	2010.841	5	0.23	0.05	5
05325+2404	POU 713	0533.10	2405.00	121.15	13.63	2011.131	4	0.3	0.08	
05328+6359	ES 1886	0533.90	6400.00	34.40	9.88	2010.902	5	0.86	0.22	
05337+2312	POU 721	0534.40	2312.00	322.10	6.49	2011.145	11	0.49	0.24	
05338+2315	POU 723	0534.50	2316.00	158.80	10.77	2011.145	10	0.52	0.15	
05336+2313	POU 719	0534.60	2314.00	20.50	9.67	2011.145	10	0.44	0.07	
05340+2309	POU 725	0534.60	2310.00	89.10	13.67	2011.145	11	0.34	0.19	
05342+2401	POU 728	0534.90	2401.00	46.00	15.47	2011.074	5	0.36	0.21	
05347+2346	POU 733	0535.30	2346.00	84.40	14.13	2011.074	5	0.43	0.04	
05347+2346	POU 736	0535.60	2443.00	157.05	12.43	2011.145	10	0.2	0.12	
05350+2445	POU 738	0535.70	2445.00	51.50	9.34	2011.145	4	0.4	0.09	
05358+2305	POU 741AB	0536.30	2305.00	296.00	20.60	2011.074	6	0.14	0.06	6
05358+2305	POU 742AC	0536.30	2305.00	329.80	17.91	2011.074	6	0.19	0.07	
05373+2453	POU 754	0538.00	2453.00	350.40	15.05	2011.131	5	0.41	0.05	7
05382+2429	POU 764	0538.90	2429.00	53.90	19.12	2011.131	5	0.38	0.28	
05446+6320	STI 579	0545.60	6321.00	123.90	7.58	2010.841	5	0.69	0.14	
05463+2423	POU 771	0547.00	2424.00	9.80	10.55	2011.131	5	0.32	0.05	
05469+4250	ES 1626	0548.70	4250.00	262.70	7.49	2010.902	5	0.66	0.25	
05492+2454	POU 786	0549.90	2455.00	353.50	17.02	2011.074	5	0.24	0.09	8
05511+2344	POU 794	0551.80	2344.00	266.60	9.35	2011.074	5	0.77	0.09	9

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Double Star Measurements for 2010/2011

WDS ID	Discoverer	RA	DEC	PA	SEP	Epoch	No.	PAsd	SEPsd	Notes
05518+5831	STI2111	0552.70	5831.00	122.70	13.54	2010.902	5	0.15	0.01	
05522+3901	ALI 812	0553.00	3901.00	36.90	9.21	2010.902	5	0.68	0.25	
05524+5450	STI2113	0553.30	5450.00	41.60	12.09	2010.902	5	0.49	0.05	
05527+2419	POU 800	0553.40	2419.00	322.40	8.32	2011.074	10	0.76	0.12	
05533+2419	POU 805	0554.00	2419.00	308.30	4.98	2011.074	15	1.22	0.38	10
05535+4434	ES 1379	0533.90	4436.00	339.00	8.95	2010.902	5	0.26	0.03	
05536+2423	POU 807	0554.30	2423.00	348.50	15.45	2011.074	5	0.11	0.08	
05538+2417	POU 808	0554.40	2417.00	44.90	13.82	2011.074	5	0.76	0.08	
05557+2308	POU 815	0556.30	2308.00	67.80	10.68	2011.131	5	0.22	0.11	
05558+2302	POU 818	0556.50	2303.00	129.10	7.35	2011.131	10	0.74	0.2	11
05566+1709	J 954	0557.20	1711.00	89.30	5.67	2010.902	5	1.13	0.23	
05587+2335	POU 833	0559.40	2335.00	162.90	11.51	2011.074	5	0.27	0.08	
05591+2437	POU 836	0559.80	2436.00	326.90	15.61	2011.074	5	0.56	0.07	
05597+2436	POU 839AB	0600.40	2437.00	230.70	10.94	2011.074	5	0.71	0.09	
06132+1334	J 1939AB	0613.90	1332.00	219.60	7.23	2010.842	5	0.3	0.02	
				219.61	7.13	2001.605				CMC14
				219.48	7.34	2000.325				UCAC2
				219.46	7.31	1999.710				UCAC4
				219.42	7.34	1997.800				2MASS
				219.37	7.35	1990.030				PPMXL
				222.04	6.88	1908.059				AC200.2
06132+1334	J 1929AC	0613.90	1332.00	34.60	13.88	2010.842	5	0.24	0.04	
				34.74	13.81	2001.062				CMC14
				34.77	13.77	2000.526				UCAC2
				34.76	13.77	2000.230				UCAC4
				34.71	13.81	1997.800				2MASS
				34.71	13.79	1990.030				PPMXL
				34.99	14.37	1908.059				AC200.2
	J 1929AD	0613.90	1332.00	33.20	23.07	2010.840	5	0.08	0.06	
				33.02	23.02	2001.062				CMC14
				33.09	23.02	2000.900				UCAC4
				33.08	33.08	1997.800				2MASS
	J 1929CD	0613.90	1333.00	30.90	9.26	2010.842	5	0.22	0.04	
07000+5913	STI 631	0700.90	5913.00	75.10	7.67	2011.216	10	0.49	0.27	
07010+2304	J 2449AC	0701.70	2303.00	339.10	18.24	2011.216	11	0.48	0.16	
07013+2351	POU2269	0701.90	2349.00	125.90	11.85	2011.216	11	1.57	0.29	12
07012+2304	POU2270	0701.90	2303.00	228.20	14.43	2011.216	9	0.62	0.27	13
07016+2337	POU2288	0702.30	2336.00	101.80	14.16	2011.216	11	1.29	0.58	
07016+2258	POU2290	0702.30	2257.00	40.60	14.77	2011.216	9	0.44	0.12	14

Table concludes on next page.

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WDS ID	Discoverer	RA	DEC	PA	SEP	Epoch	No.	PAsd	SEPs	Notes
07027+2322	HJ 408	0703.30	2321.00	74.10	14.93	2011.216	9	0.33	0.07	
07026+2253	POU2320	0703.30	2252.00	188.20	8.31	2011.216	4	1.21	0.24	
07034+2252	POU2341AB	0704.10	2251.00	93.20	8.82	2011.216	5	0.8	0.36	
07037+2407	POU2351	0704.40	2407.00	289.20	5.93	2011.216	10	1.26	0.46	
07037+2304	POU2352	0704.40	2304.00	270.30	10.42	2011.216	5	0.86	0.12	
12042+1635	COU 52	1204.80	1631.00	74.50	5.53	2011.380	5	0.5	0.3	
12185+5725	STI2280	1219.00	5720.00	175.50	20.86	2011.375	5	0.23	0.09	
12375+0843	BRT3218	1238.10	839.00	355.50	7.23	2011.380	5	0.76	0.19	
12391+2344	POU3129	1239.60	2340.00	137.40	13.63	2011.380	5	1.64	0.11	
12469+2959	LDS4265	1247.40	2956.00	230.80	7.76	2011.380	5	0.57	0.17	
12473+2959	LDS4268	1247.80	2957.00	56.10	5.50	2011.380	5	0.34	0.17	
12534+1758	HJ 218	1255.90	1755.00	276.30	12.80	2011.380	5	0.13	0.13	
14035+0227	SLE 925	1404.10	224.00	131.30	12.31	2011.451	5	0.49	0.12	
14037+3846	ALI1091	1404.20	3843.00	187.50	10.21	2011.451	5	0.44	0.08	
14040+1318	BPM 611 ?	1405.30	1342.00	258.70	22.33	2011.451	4	0.32	0.13	15
14051+1917	UC 190	1405.70	1914.00	46.60	20.98	2011.451	5	0.06	0.03	16
14060+5335	STI2306	1406.40	5332.00	89.60	14.06	2011.451	5	0.3	0.04	
14162+3235	TOB 132BC	1416.70	3233.00	346.90	18.68	2011.452	5	0.31	0.05	
14170+5044	DAM 79	1417.40	5041.00	54.20	13.10	2011.452	5	0.46	0.12	
14211+4942	UC 193	1421.50	4939.00	317.10	9.55	2011.452	5	0.49	0.16	17
14232+7607	LDS1790	1423.20	7604.00	164.20	131.82	2011.452	5	0.18	0.25	18
14230+3616	HJ 548AB	1423.40	3611.00	249.00	136.63	2011.452	5	0.06	0.17	
	HJ 548AC	1423.40	3611.00	286.60	123.23	2011.452	5	0.04	0.15	
	HJ 548AD	1423.40	3611.00	314.00	151.13	2011.452	5	0.06	0.14	
	HJ 548AE	1423.40	3611.00	347.50	134.29	2011.452	5	0.04	0.2	
	HJ 548AF	1423.40	3611.00	26.60	122.72	2011.452	5	0.04	0.16	
14372+7537	LDS1803	1437.10	7534.00	136.60	18.21	2011.457	5	0.46	0.1	
14397+1150	LDS 966	1440.20	1147.00	122.40	21.62	2011.457	6	0.35	0.12	
14408+6109	STI 769	1441.10	6107.00	289.20	13.63	2011.457	5	1.19	0.19	
14474+6321	STI 775	1447.60	6318.00	169.60	7.88	2011.457	3	0.12	0.24	

NOTES:

- Stein (STI) doubles were originally measured on blue sensitive plates. CCD and visual observations often reverse the magnitudes of the primary and secondary and this is the case here. "A" star is UCAC3 292-075838 catalog magnitude 12.04. "B" star is 292-075836 catalog magnitude 11.46.
- POU541 was not visible on my CCD image or POSSII plate. I'm reporting UCAC3 230-030956 as the "A" star and 230-030960 as "B". Match is fairly good to the 1897 measure and magnitudes, but not to the 1955 measurement.
- STI2096- "A" star is UCAC 290-082886.
- POU696- Position seems wrong. I'm measuring "A" star as UCAC3 227-036918 05 31. Position 54.12+23 12 36.1 and "B" star as UCAC3 227-036924, which seems to be a good match in PA and SEP.
- STI567- Only one previous measurement. "A" star is UCAC3 307-077823.
- POU741AB and POU 742AC POU 742AC see discussion section.
- POU754-Addition measurements extracted from Vizier: 1997.960 SEP 13.82 PA 349.79 ii/246 2MASS, 2000.21 SEP 14.149 PA 350.234 i/315 UCAC3, WDS 1951.854 Gellera has high residuals.
- POU786 "A" star is high proper motion TYC 1862-1151-1. Additional measurements extracted from Vizier: 1989.78 SEP 7.902 PA 261.248 I/289 UCAC2, 2000.101 SEP 7.937 PA 260.15 ii/246 2MASS, 2001.00 SEP 7.895 PA 260.251 I/315 UCAC3, WDS 1951.854 Gellera has high residuals.
- POU794- "B" star is much brighter in CCD image. "B" is UCAC3 230-043645 catalog mag 13.15. "A" star is 230-

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- 043647 catalog mag 13.95.
- 10. POU805-Not at listed position. I'm measuring UCAC3 229-046017 as "A" star, position 05 53 19.93+24 19 12.3 and "B" star as 229-046013.
- 11. POU818-Visual and CCD magnitudes are fainter. "A" star is UCAC3 227-043864 mag 14.26, "B" star is 227-043868 catalog mag 14.18.
- 12. POU2269-Faint! "A" star is UCAC3 228-078872, catalog mag 15.37. "B" star is 228-078878, catalog mag 14.75.
- 13. POU2270- Position wrong. I'm measuring "A" star as UCAC3 227-076190, position 07 01 14.1+23 03 51.3. "B" star is 227-076186
- 14. POU2290-"B" star is brighter. "A" star is UCAC3 226-077656, catalog mag 13.43. "B" is 226-077662, catalog mag 13.12.
- 15. BPM611-Not at listed position. I'm measuring "A" star as UCAC3 208-120316, Position 14 04 44.20+13 45 17.7. "B" star is 208-120315.
- 16. UC190-Likely CPM. "A" star is TYC 1471 579, PM in RA -38 DEC 47, "B" PM in RA -49 DEC 49.
- 17. UC193-Likely CPM. Similar proper motions.
- 18. LDS1790- Large, but different proper motions. "A" star is TYC 4559 2322, PM in RA-92, PM DEC 14. "B" star is UCAC3 333-031157 PM in RA -68.8, DEC 35.8

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Results

Table 1 shows the results for the 100 doubles measured.

Discussion

One interesting double observed was J1929 AB and J1929 AC. Both were discovered by Jonckheere in 1941. When I observed the pairs in 2010, I immediately noticed a striking four-star asterism (see Figure 1). Jonckheere measured the "C" star, but did not, for some reason, include the "D" star, which is just as bright. The "A" star is 4UC518-022223. The "B" star is 4UC518-022220. The "C" star is 4UC518-022227, and the new "D" star is 4UC518-022230 with a catalog magnitude of 13.49.

Rectilinear Elements for J1929AC:

X0	-2.49304
XA	0.00226802
Y0	1.07731
YA	0.00548316
T0 lowest residual	4259.18
T0 average	4266.65
T0 standard deviation	10.9526
rho0	2.71585
theta0	113.37
relative motion x	-2.26802
relative motion y	5.48316
total relative motion	5.93372

R ²	0.97788
F-Statistic	221.119
P-Value	0.0000248841

The relative motions are in good agreement with UCAC4. The original Jonckheere measurement of the AB pair had high residuals compared with the rest of the measurements in WDS and was not used in the regression.

Conclusions on J1929

The AB and AC pairs are likely optical. The J1929 "B" and "C" stars have similar proper motions and may be a CPM pair. Probability indicates the new "D" star is likely associated with J1929C, but there is little other astrophysical data available.

Acknowledgements:

As usual, thanks to Dr. Mason and Dr. Hartkopf for being willing to work with amateurs and for answering numerous data requests. Special thanks to my sister Gail Smith for proofreading this article. Thanks to Brian Skiff of Lowell Observatory for a tutorial on extracting historical measures from Vizier.

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

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Warner, Brian, 2006, MPO Canopus, <http://www.minorplanetobserver.com/MPOSoftware/MPOCanopus.htm>

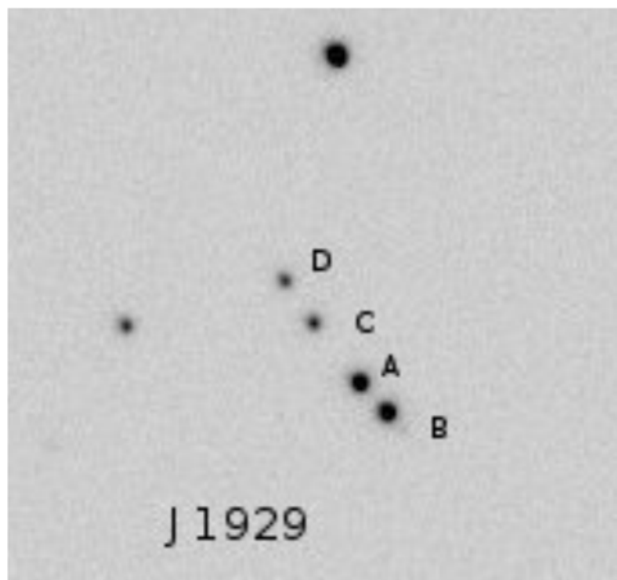


Figure 1. J1929 AB & AC shows four components in CCD image.

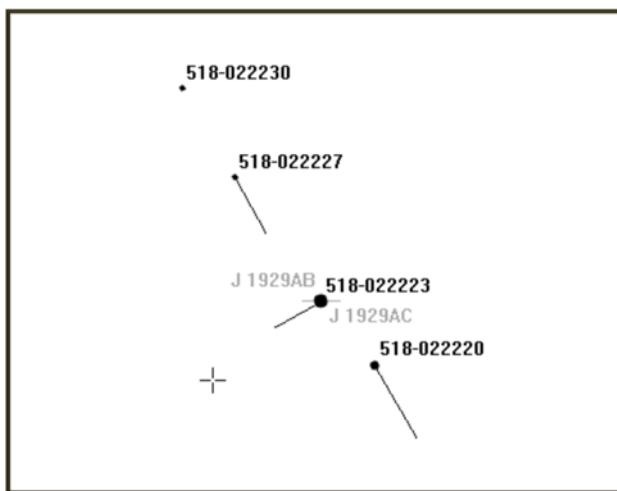


Figure 2. Guide 9 map of J1929AB and AC with 1000 year proper motion tracks.

