CCD Double-Star Measurements at *Observatorio Astronómico Camino de Palomares* (OACP): 2nd Series

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Abstract: In this paper we present the results of CCD Theta/Rho measurements for 105 double and multiple stars (146 pairs) observed in 2008. With this series we begin a complete review of Stein's catalog. We use the new UCAC3 catalog for updating proper motion data of the STI pairs. Two uncataloged new pairs are reported.

Introduction

As a continuation of a previous paper published in this journal (Masa, 2009a), we present the second series of measurements carried out by CCD imaging at OACP observatory during summer 2008. The telescope, the CDD camera, and the used methods are the same as those explained in the former article. All the composite frames have been registered with the following optical train: T200 Newton + Barlow 3x + CCD Meade DSI Pro; Effective Focal Length: 3480 mm; Plate scale: 0.44 arsec pixel^{-1}; FOV: 3.6' x 4.8'. For analyses and reduction of the CCD records we used the Reduc software package, written by Florent Losse.

Our current observing run is centered on Stein's pairs (see Masa, 2009b; Masa, 2010 for details). To make a whole re-measurement of all double stars contained in this list is our intention. Stein's double stars were discovered on photographic plates and have remained neglected for a long time, due principally to the weak magnitude of the components. A number of these pairs have only the discovery measurement by Stein around 1908-1917 (~9%) and most of the systems have only two or three historical measures (~62%). In addition, this project will carry out other interesting tasks: to update coordinates when necessary, to detect relative motion between the components, to update the proper motion data, to reveal common proper motion and to search for possible new components.

Nevertheless, the list presented here also contains double stars of other observers, generally placed in the vicinity of the STIs. Among others, there are a relevant number of J, BU, ES and STF stars and, due to their neglected character, we decided to include them. Likewise, the measures of twelve pairs from the Catalog of Rectilinear Elements have been listed. These systems were used for calibration purposes.

A total of 59 STI doubles have been measured, all of them located in Cassiopeia. STI1376, STI1567AB and STI1567AC have been confirmed by our observations, as well as another six pairs of the secondary subset of targets.

In several STI doubles (five in number) we observed that in our unfiltered images the B component is the brighter (Figure 1). This effect is seen in similar magnitude pairs. The original old plates measured by Stein had a blue light-sensitive emulsion, whereas a modern unfiltered CCD, in general, has a better response to the red and infrared colors. If a component is blue and the other one is red, the first one will seem to be brighter in a plate which is sensitized to the blue light (B band); but, on the other hand, the same star will be perceived as less luminous when registered with an unfiltered CCD sensor, being now the red star more dominant than the blue one. This is the reason of the observed photometric discrepancies. In these cases we give the position angle according to the historical trend and we write a brief comment in the Notes.

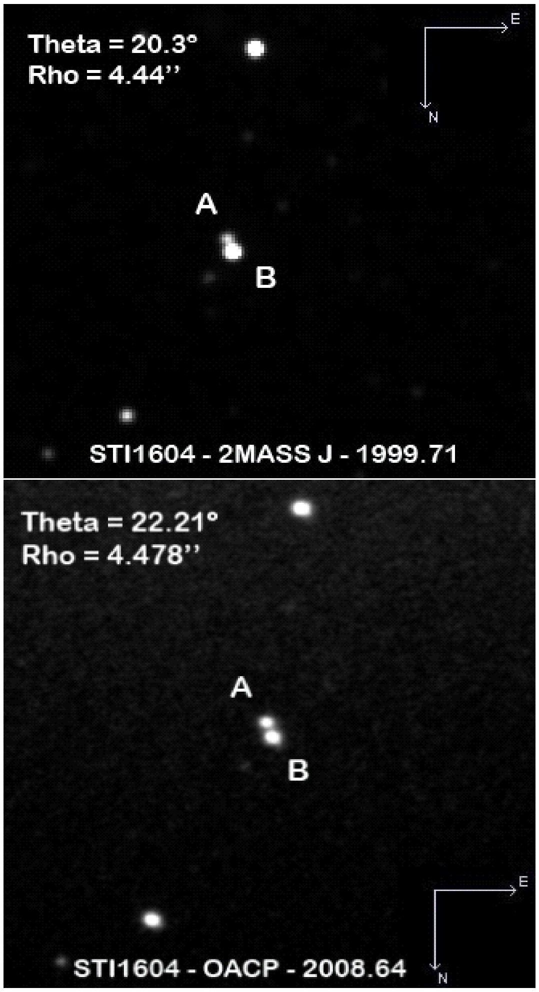

Figure 1. STI1604 imaged by 2MASS (J Band) and OACP (unfiltered). In both examples the B component is the brighter. The effect is more acute on the 2MASS near-infrared plate. According to *The Third Photometric Magnitude Difference Catalog* the Dm value in J-band is -1.55 (note the negative sign). The instrumental Dm measured by Reduc on our unfiltered CCD image is 0.54. The relative astrometry of the pair is give in concordance with the historical measures.

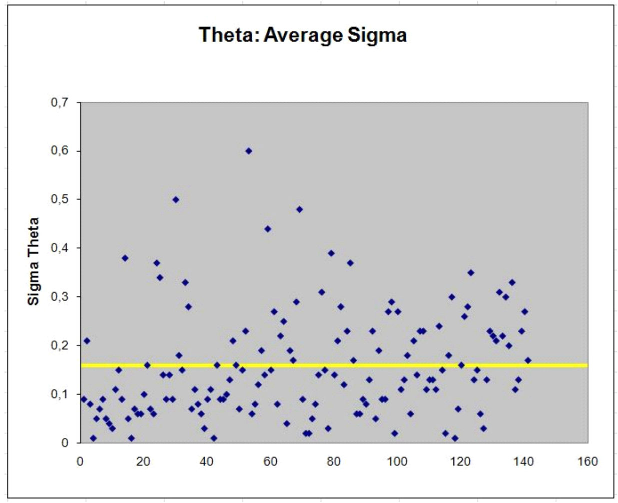

Figure 2. Internal errors in Position Angle.

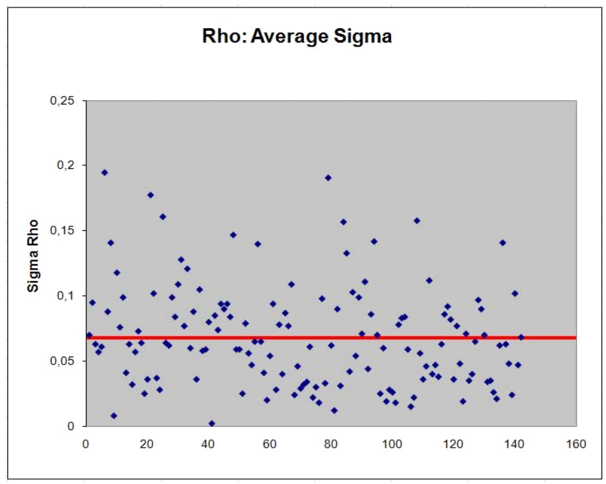

Figure 3. Internal errors in Separation.

The Measures

The results of measurements are presented in Table 1. A total of 146 measurements are listed. They belong to 105 double or multiple systems. The data structure in the table (from left to right) is as follows:

Columns 1 and 2: Identifier of the WDS catalog and name of the system. Note: the new pairs are labeled in Column 1 as "*uncat*". The precise coordinates (J2000) for the main star are reported in the section *Discoveries*.

Columns 3 and 4: Magnitudes for each component, given in WDS catalog. Note: the V magnitudes that we calculated in this work are highlighted with cursive boldface type.

Column 5: The epoch of the observation, given in fractional Besselian year.

Column 6: Position Angle.

Column 7: Angular Separation.

Column 8: Number of composite images measured for each pair.

Column 9: Number of nights.

Column 10: Index to the Notes.

The mean internal uncertainties for Theta and Rho (given as the average of standard deviation of all measurements) were 0.16º and 0.07" respectively (Figures 2 and 3). These errors are similar to the values determined during another OACP observing runs

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Table 1: Relative Astrometry of the Observed Pairs

WDS Id.	Discoverer	WDS Mags.		Epoch Besselian Year	Theta (deg)	Rho (a.s.)	N img.	Nights	Notes
00311+5648	ES 2	8.97	9.50	2008.6873	112.51	5.882	4	1	1
00332+5642	STI1376	12.05	13.60	2008.6873	64.93	7.524	3	1	2
00350+5636	ES 3	8.65	9.50	2008.6872	158.06	8.262	4	1	3
00355+5841	STF 38	8.66	8.97	2008.5615	144.27	17.078	3	1	4
00366+5628	STI1392	11.85	11.90	2008.6872	344.09	13.171	5	1	5
00376+5649	STI1398	11.10	12.00	2008.6027	90.21	14.225	6	1	6
00378+5645	STI1400	11.10	12.60	2008.6027	143.47	7.897	6	1	7
00378+5618	STI1401AC	10.00	12.20	2008.6871	155.36	12.767	4	1	8
00378+5618	STI1401BC	11.10	12.60	2008.6871	33.67	9.349	3	1	8
00393+5635	STI1405	9.60	11.80	2008.6026	216.79	10.995	5	1	9
00404+5624	STI1408	12.30	12.70	2008.6038	188.02	12.882	12	2	10
00428+5607	STI1416	11.94	12.40	2008.6381	28.99	11.978	11	2	11
00428+5631	STI1417	10.61	12.70	2008.6366	276.63	6.978	8	2	12
00440+5608	STI1421	11.66	11.72	2008.6707	251.06	13.016	5	1	13
00473+5651	STI1427	8.96	11.60	2008.6734	253.35	15.588	3	1	14
00486+5701	STI1432	13.10	13.10	2008.6735	17.35	7.304	4	1	15
00489+5612	STI1433	10.20	11.30	2008.6737	87.70	11.314	4	1	16
00493+5623	STI1434	12.40	13.20	2008.6736	166.6	3.509	2	1	17
00502+5600	STI1440	11.17	11.90	2008.6846	329.53	14.550	5	1	18
00505+5610	STI1443	12.50	13.10	2008.6846	284.86	11.522	2	1	19
00516+5555	STI1450	9.66	12.20	2008.6847	73.10	8.994	5	1	20
00515+5630	DAL 11	8.17	11.29	2008.6735	231.14	41.016	3	1	21
00527+5603	STI1455	13.10	13.10	2008.6844	30.54	10.123	3	1	22
01084+6136	STI 185	11.22	12.90	2008.6463	122.30	8.784	3	1	23
01091+6138	STI 187	11.90	12.20	2008.6465	276.02	7.305	3	1	24
01113+6121	SMA 18	11.00	11.50	2008.6463	130.56	12.663	6	1	25
01121+6111	KR 10AB	9.60	10.60	2008.6462	278.03	3.553	3	1	26
01132+6142	LV 14AC	6.50	12.20	2008.6465	207.87	42.666	3	1	27
01192+5821	STI1560	9.94	10.19	2008.6439	324.57	13.974	7	1	28
01193+5903	STI1558	8.50	13.80	2008.6379	8.27	10.714	3	1	29
01195+5904	STI1563	14.70	14.70	2008.6379	44.24	8.152	4	1	30
01195+5816	ES 408AB	10.20	10.30	2008.6438	162.41	3.114	2	1	31
01195+5816	ES 408AC	10.20	10.02	2008.6438	345.12	91.933	3	1	31
01195+5816	ES 408CD	10.20	11.50	2008.6438	89.09	3.974	1	1	31
01196+5816	STI1565AB	12.02	13.12	2008.6438	139.26	14.323	5	1	32
01196+5816	STI1565AC	12.02	13.18	2008.6438	155.19	10.656	3	1	32
01196+5816	STI1565AD	12.02	13.40	2008.6438	118.02	5.203	2	1	32
01196+5816	STI1565BE	13.12	13.11	2008.6438	232.28	16.775	3	1	32
01196+5816	STI1565CE	13.18	13.11	2008.6438	216.19	14.120	3	1	32

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CCD Double-Star Measurements at *Observatorio Astronómico Camino de Palomares ...*

Table 1 (*continued*): Relative Astrometry of the Observed Pairs

WDS Id.	Discoverer	WDS Mags.		Epoch Besselian Year	Theta (deg)	Rho (a.s.)	N img.	Nights	Notes
01196+5818	STI1564	11.80	11.90	2008.6439	178.72	8.066	5	1	33
01196+5820	ES 1808AB	10.35	13.90	2008.6439	334.77	7.099	5	1	34
01196+5820	ES 1808AC	10.35	13.90	2008.6439	191.66	14.018	6	1	34
01196+5820	ES 1808AD	10.35	14.00	2008.6439	135.75	9.395	1	1	34
01197+5814	STI1567AB	13.00	13.20	2008.6436	114.31	3.867	1	1	35
01197+5814	STI1567AC	13.00	13.50	2008.6436	196.27	5.106	1	1	35
01202+5819	MLB 153	10.87	14.40	2008.6439	156.75	4.856	5	1	36
01202+5904	STI1573	14.40	14.40	2008.6380	148.53	10.312	4	1	37
01210+5920	STI1576	12.70	13.70	2008.6378	111.88	6.728	4	1	38
01211+5809	STI1577	12.06	12.80	2008.6436	330.78	4.908	4	1	39
01216+5805	STI1581	12.70	13.70	2008.6434	97.89	5.947	3	1	40
01226+5759	STI1588	13.40	14.40	2008.6434	140.18	7.887	2	1	41
01234+5809	STF 115AB-C	6.40	12.80	2008.6433	285.73	60.299	2	1	42
01234+5809	LYS 8DE	10.99	11.84	2008.6433	95.92	43.486	5	1	42
01234+5809	LYS 8DF	10.99	---	2008.6433	338.57	23.569	5	1	42
01243+5858	ES 1712AB	7.90	9.33	2008.6381	2.06	47.766	5	1	43
01243+5858	ES 1712BC	9.33	13.90	2008.6381	298.01	5.015	4	1	43
01245+6012	STI 210	11.85	13.50	2008.6297	80.05	15.144	8	2	44
01248+5929	STI1600	13.05	13.16	2008.6355	95.83	8.800	3	1	45
01252+5849	STI1603	11.15	11.10	2008.6381	52.08	5.815	4	1	46
01252+5858	STI1604	13.20	14.00	2008.6382	22.21	4.478	4	1	47
01258+6014	BUP 19	2.68	11.50	2008.6297	60.21	111.716	4	1	48
01264+5929	STI 213	11.96	12.00	2008.6354	282.91	11.432	3	1	49
01267+5913	STI1610	12.02	12.90	2008.6353	101.23	10.445	3	1	50
01274+5955	STI 216	***12.23***	***12.56***	2008.6271	178.09	10.567	4	1	51
Uncat	MRI 5BC	***12.56***	***13.63***	2008.6271	321.62	5.402	5	1	51
01274+6017	BU 1102 A-BC	7.96	10.70	2008.6242	265.02	63.711	6	2	52
01283+6023	STI 219	10.88	12.50	2008.6255	37.29	6.569	6	1	53
01284+6002	STI 221	10.65	11.72	2008.6272	183.00	15.014	8	1	54
01287+6027	OL 134	11.75	11.96	2008.6270	71.19	1.933	2	1	55
01289+6003	STI 222	12.05	12.80	2008.6271	75.24	5.600	7	1	56
01295+5918	STI1623	12.12	13.00	2008.6339	41.73	10.922	6	2	57
01299+6025	STI 223	11.79	12.00	2008.6271	92.04	8.367	4	1	58
01338+5929	STI1629	11.90	13.10	2008.6299	103.96	13.905	5	1	59
01342+5950	STI 233	10.74	13.40	2008.6299	138.51	5.587	5	1	60
01351+5909	STI1631	14.30	14.90	2008.6298	221.60	7.014	5	1	61
01371+5850	STI1639	11.58	14.70	2008.6301	20.77	13.220	4	1	62
01374+5838	STT 33AB	7.26	8.96	2008.6300	77.38	27.069	3	1	63
01374+5838	DOB 2AC	7.26	10.29	2008.6300	109.36	107.932	3	1	63
01374+5838	DOB 2BC	8.96	10.29	2008.6300	118.94	86.173	3	1	63
01506+6208	STI 313	12.70	13.20	2008.6655	244.87	12.372	4	1	64

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Table 1 (*continued*): Relative Astrometry of the Observed Pairs

WDS Id.	Discoverer	WDS Mags.		Epoch Besselian Year	Theta (deg)	Rho (a.s.)	N img.	Nights	Notes
01506+6229	STI 312	11.90	12.30	2008.6655	110.20	5.319	8	1	65
01533+6233	STI 318	9.61	14.20	2008.6654	355.37	13.064	4	1	66
01536+6324	PTT 3	10.32	10.78	2008.6651	135.27	3.925	3	1	67
01541+6223	MLB 251	11.40	11.43	2008.6653	56.48	3.640	4	1	68
01551+2847	STF 183AB-C	7.67	9.26	2008.5808	162.28	5.564	5	1	69
01554+6218	STI 323	12.27	13.80	2008.6652	245.67	11.970	4	1	70
01569+6353	STI 326	10.31	12.10	2008.6627	142.75	13.610	5	1	71
01599+6324	STI 332	11.60	12.00	2008.6629	26.03	7.802	3	1	72
Uncat	MRI 6	***8.64***	***13.36***	2088.6629	72.33	6.236	9	1	73
03023+4124	STF 337AB	7.99	9.34	2008.6164	162.85	17.773	6	1	74
03023+4124	WAL 20AC	7.99	8.89	2008.6164	209.62	98.023	6	1	74
03023+4124	WAL 20CD	8.89	12.62	2008.6164	191.59	20.724	5	1	74
03025+4137	ES 1512	9.50	9.70	2008.6165	127.43	5.478	9	1	75
03303+5254	STF 392	7.45	10.34	2008.6189	347.07	26.168	3	1	76
03345+5335	HJ 2192AB	9.50	11.43	2008.6190	239.02	30.400	5	1	77
03345+5335	HJ 2192AC	9.50	11.60	2008.6190	88.36	52.468	5	1	77
03579+4001	STF 471AB	2.85	8.88	2008.6874	10.44	8.746	3	1	78
03598+4009	MLB 17	11.14	12.80	2008.6875	28.40	8.520	3	1	79
04016+3840	STF 476AB	7.96	8.21	2008.6876	289.50	25.881	4	1	80
04016+3840	STF 476BC	9.20	12.20	2008.6876	209.84	70.134	4	1	80
04038+3758	ES 2085	8.42	12.14	2008.6876	268.70	4.322	2	1	81
04044+3747	ES 2461	***11.22***	***11.62***	2008.6877	228.01	8.022	4	1	82
18583-2306	ARA2251	10.75	12.80	2008.6268	235.22	10.241	4	1	83
19042-2254	H N 129	6.90	9.16	2008.5776	307.97	8.003	2	1	84
19302+0254	STF2532AB	6.09	10.60	2008.5860	3.00	32.937	5	1	85
19302+0254	STF2532BD	10.60	13.10	2008.5860	133.94	34.044	3	1	85
19341+0723	BU 653AB	4.58	13.10	2008.5696	289.02	56.182	4	1	86
19341+0723	BU 653AC	4.58	13.10	2008.5696	299.42	55.776	3	1	86
19341+0723	BU 653AD	4.58	12.60	2008.5696	333.70	86.030	5	1	86
19341+0723	BU 653AE	4.58	9.55	2008.5696	62.28	167.364	3	1	86
19341+0723	BU 653AF	4.58	12.90	2008.5696	2.34	46.484	4	1	86
19341+0723	BU 653BC	13.10	13.10	2008.5696	207.05	10.150	2	1	86
19428+0823	STF2562AB	6.95	8.69	2008.6080	251.39	27.405	4	1	87
19428+0823	STF2562AC	6.95	12.50	2008.6080	288.70	82.498	5	1	87
19428+0823	STF2562AD	6.95	9.89	2008.6080	221.61	117.784	4	1	87
19428+0823	STF2562BC	8.69	12.30	2008.6080	304.01	62.895	5	1	87
19428+0823	STF2562BD	8.69	9.89	2008.6080	213.37	94.950	2	1	87
19476+0955	J 493	9.80	13.60	2008.5917	117.83	7.094	5	1	88
19479+1002	AG 391	7.72	9.19	2008.5916	296.09	52.552	3	1	89
19510+0854	J 3019	9.90	13.00	2008.6560	216.85	7.252	6	2	90
19510+1006	J 1867AB	8.60	11.60	2008.5808	130.22	84.267	4	1	91

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CCD Double-Star Measurements at *Observatorio Astronómico Camino de Palomares* ...

Table 1 (*conclusion*): Relative Astrometry of the Observed Pairs

WDS Id.	Discoverer	WDS Mags.		Epoch Besselian Year	Theta (deg)	Rho (a.s.)	N img.	Nights	Notes
19510+1006	J 1867BC	11.60	11.60	2008.5808	2.38	5.127	4	1	91
19510+1025	J 124AB	5.11	13.50	2008.5805	249.46	19.040	3	1	92
19510+1025	J 124AC	5.11	13.70	2008.5805	219.96	22.141	4	1	92
19510+1025	POP1228AD	5.11	13.20	2008.5805	121.56	51.230	3	1	92
19510+1025	POP1228AE	5.11	13.00	2008.5805	147.66	83.576	3	1	92
19520+1018	WEB 8	10.50	11.50	2008.5807	42.89	15.522	5	1	93
20014+0657	STF2612	8.29	9.87	2008.5887	53.90	42.620	6	1	94
20014+0658	J 2568	12.00	13.00	2008.5887	312.18	3.629	2	1	95
20032+0042	HDO 316AC	8.81	11.70	2008.6163	189.33	16.790	4	1	96
20053+0027	HJ 2927AB	6.90	11.40	2008.6162	125.09	24.101	6	1	97
20053+0027	BU 1482BC	11.48	12.60	2008.6162	180.95	3.705	4	1	97
20066+0735	STTA198AB	7.12	7.55	2008.5670	185.42	65.520	10	2	98
20066+0735	STTA198AC	7.12	13.40	2008.5477	173.25	35.747	3	1	98
20113-0008	S 735	7.16	7.98	2008.6133	210.42	55.832	4	1	99
20133-0041	BAL 920	11.48	12.20	2008.6135	268.77	16.678	6	1	100
20140-0052	BU 1485A-BC	7.87	10.12	2008.6133	103.27	74.195	9	1	101
20140-0052	ABT 15AD	7.87	12.90	2008.6133	226.36	80.349	8	1	101
20140-0052	BU 1485BC-D	10.12	11.70	2008.6133	65.55	23.596	6	1	101
20368+1444	STF2703AB	8.35	8.42	2008.5943	289.52	25.442	7	1	102
20368+1444	STF2703AC	8.35	8.76	2008.5943	233.52	77.782	7	1	102
20368+1444	STF2703AD	8.35	***12.86***	2008.5943	346.89	86.001	4	1	102
20368+1444	STF2703BC	8.42	8.76	2008.5943	215.17	66.954	7	1	102
20414+4517	H N 73	1.25	11.70	2008.5476	105.02	76.508	3	1	103
22590+2745	STF2967	8.61	9.84	2008.5778	5.13	6.743	4	1	104
23100+1426	STF2986	6.61	8.88	2008.5725	269.96	31.602	4	1	105

Notes

In the following, the acronyms “CPM” and “Relfix” mean Common Proper Motion and Relatively Fixed.

1. ES 2. In Cas. Relfix.
2. STI1376. In Cas. Only one official measure. Confirmed. Great shift in Theta (11º decreasing) and Rho (3,5" decreasing) since 1911. Additional measure from 2MASS (epoch 1999.8575): 64.836º, 7.654" confirms our values. No proper motion for B.
3. ES 3. In Cas. Relfix. UCAC3 pm: A = 8.4 -14.1; B = -0.1 -18.9
4. STF 38. In Cas. Similar and small proper motions. Fixed.
5. STI1392. In Cas. Theta Relfix. Rho slowly decreasing. Incompatible proper motions. Probably optical.
6. STI1398. In Cas. Only three official measures. Theta stable. Rho slowly increasing.
7. STI1400. In Cas. Only three official measures. Theta slowly increasing. Rho slowly decreasing. CPM.
8. STI1401AC. In Cas. Only three official measures. Theta slowly increasing. Rho Relfix. STI1401BC: Only three official measures. Theta increasing. Rho decreasing. CPM.
9. STI1405. In Cas. Only six official measures. Theta decreasing. Rho slowly decreasing.
10. STI1408. In Cas. Only four official measures. Theta increasing. Rho stable.
11. STI1416. In Cas. Only four official measures. Theta increasing. Rho decreasing.
12. STI1417. In Cas. Only four official measures. Theta and Rho slowly increasing.
13. STI1421. In Cas. Relfix. CPM.
14. STI1427. In Cas. Only five official measures. Theta increasing. Rho Relfix.
15. STI1432. In Cas. Theta increasing. Rho decreasing.
16. STI1433. In Cas. Theta and Rho decreasing.

17. STI1434. In Cas. Only two official measures. Great shift in Theta decreasing.
18. STI1440. In Cas. Only four official measures. Theta and Rho increasing.
19. STI1443. In Cas. Only three official measures. Relfix. CPM.
20. STI1450. In Cas. Only four official measures. Theta and Rho decreasing.
21. DAL 11. In Cas. CPM. Fixed. The A component shows elongation in direction 30º or 35º. UCAC3 pm for A is double. This facts suggest the existence of a unreported close companion co-moving with the main star. The pm for this hypothetical C component is 62.7 -80.6: a triple system?
22. STI1455. In Cas. Only three official measures. Precise coordinate (J2000): 00 52 43.78; +56 02 15.1. Great shift in Theta. Rho increasing. Optical.
23. STI 185. In Cas. Only three official measures. Theta increasing. Rho slowly decreasing. CPM.
24. STI 187. In Cas. Only three official measures. Theta increasing. CPM.
25. SMA 18. In Cas. Only two official measures. Theta decreasing. Rho increasing. UCAC3 pm: A = -37.1 -55.3; B = -4.5 -2.2. Optical.
26. KR 10AB. In Cas. Theta slowly decreasing. Rho stable. The C component has not been identified.
27. LV 14AC. In Cas. The C component of BU 258. Only three official measures. UCAC3 pm: C = -3.5 1.7.
28. STI1560. In Cas. Theta and Rho decreasing. CPM.
29. STI1558. In Cas. Only two official measures. Theta increasing. Rho decreasing.
30. STI1563. In Cas. Only three official measures. Theta increasing. Rho stable. CPM.
31. ES 408AB. In Cas. Only three official measures (last in 1945). Relfix. ES 408AC: Theta stable. Rho increasing. ES 408CD: Also known as STI1562. Dispersion of measures in Theta. Rho slowly increasing. UCAC3 pm: C = -15.5 -2.0; D = 1.6 -3.2.
32. STI1565AB. In Cas. Only three official measures. Relfix. STI1565AC: Only two official measures. Theta slowly decreasing. Rho stable. STI1565AD: Only two official measures. Theta increasing. Rho decreasing. No proper motion for D. STI1565BE: Only two official measures. Theta and Rho decreasing. CPM. STI1565CE: Only two official measures. Theta decreasing. CPM.
33. STI1564. In Cas. Theta decreasing. Rho Relfix. CPM.
34. ES 1808AB. In Cas. Only two measures (last in 1924). Additional measure from 2MASS (epoch 1999.7042): 334.361º, 6.868". UCAC3 pm: A = -3.8 -0.7; B = -3.4 -43.7. ES 1808AC: Theta decreasing. Rho increasing. UCAC3 pm: C = -3.2 -0.5. CPM. ES 1808AD: Only one measure (1920). Confirmed. Theta and Rho increasing. Difficult: poor signal. Additional measure from 2MASS (epoch 1999.7042): 135.851º, 9.723".
35. STI1567AB. In Cas. Only one official measure. Confirmed. In our unfiltered images B is the brighter. The original Vatican's measure (1911.97) doesn't appear in WDS index catalog. There is only one measure from 2MASS (1999). No proper motion for the components. Theta increasing. Rho decreasing STI1567AC: Only one official measure from 2MASS. Confirmed. In our unfiltered images C is the brighter. The original Vatican measure (1911.97) doesn't appear in WDS index catalog. There is only one measure from 2MASS (1999). No proper motion for the components. Theta slowly increasing. Rho Relfix.
36. MLB 153. In Cas. Only three official measures. Relfix. Difficult. Measured with Surface.
37. STI1573. In Cas. Only two official measures. In our unfiltered images B is the brighter. Relfix.
38. STI1576. In Cas. Only four official measures. Theta increasing. Rho Relfix. CPM.
39. STI1577. In Cas. Only four official measures. Theta decreasing. Rho increasing. No proper motion for B.
40. STI1581. In Cas. Only five official measures. Theta decreasing. Rho stable. CPM.
41. STI1588. In Cas. Only three official measures. Relfix. CPM.
42. STF 115AB-C. In Cas. AB close orbital, P = 216 years. Theta and Rho increasing. LYS 8DE: Only six official measures. Relfix. LYS 8DF: Only four official measures. Theta decreasing. Rho Relfix.
43. ES 1712AB. In Cas. Theta and Rho decreasing. ES 1712BC: Only two official measures. Relfix.
44. STI 210. In Cas. Only three official measures. Theta and Rho increasing. CPM.
45. STI1600. In Cas. Only two official measures. Theta slowly decreasing. Rho stable. CPM.
46. STI1603. In Cas. Only four official measures. Theta increasing. Rho Relfix. Great Dm: our instrumental value is Dm = 3.31. The similar WDS magnitudes are not congruent with our observation. Curiously, the B component is not detected by 2MASS, but an elongated shape is present in some old DSS plates. To solve this enigmatic fact we check the available plates by means of the IRSA Finder Chart facility, a visualization tool that allows cross-comparison of images from various surveys of different wavelengths and different epochs. The result is shown in Figure 8. As we can see, STI1603 is unseen in all red and infrared plates. The secondary is hiding in the glare of a very saturated principal star. At an intermediate level, our unfiltered OACP image shows a dim B component and a clear split of the

couple. We believe this is an extreme case of the effect explained above (Figure 1), so that the primary is a very red star. In fact, we found that the *Catalogue of Stellar Spectral Classifications* (Skiff, 2010) gives a spectrum M5 for the principal star. It is remarkable that in this class of situations a neglected pair might be lost if we do not check all available wavelengths.

47. STI1604. In Cas. Only three official measures. In our unfiltered images B is the brighter. Theta increasing. Rho Relfix. CPM.
48. BUP 19. In Cas. (delta Cas). A spectroscopic and (perhaps) eclipsing binary. Only two official measures. Not observed since 1925. Incompatible proper motions. Great variation of Theta and Rho: high proper motion of A. Optical.
49. STI 213. In Cas. Same as STI1607. Neglected: not observed since 1914. Only four official measures. Great variation of Theta and Rho.
50. STI1610. In Cas. Only two official measures. Theta increasing. Rho decreasing.
51. STI 216. In Cas. Only two official measures. Theta and Rho decreasing. In our unfiltered images B is the brighter. MRI 5BC: Possible CPM uncatalogued pair. See Discoveries.
52. BU 1102 A-BC. In Cas. Incompatible proper motions. Rho increasing. The BC pair: CPM, too close (0.9") for our instrument.
53. STI 219. In Cas. Only two official measures. Relfix. CPM.

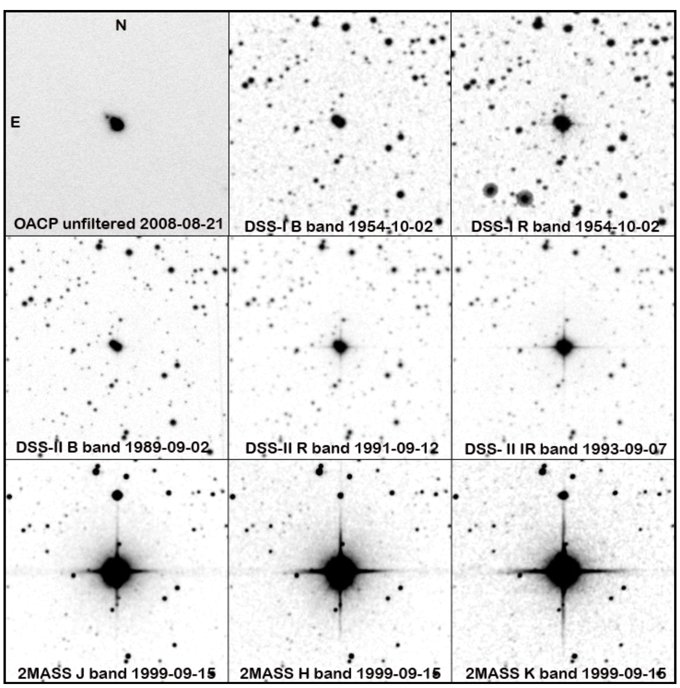

Figure 8. An overview of STI1603 along the time at different wavelengths.

54. STI 221. In Cas. Only three official measures. Theta and Rho slowly increasing. Incompatible proper motions. Surely optical.
55. OL 134. In Cas. Only four official measures. Fast increasing in angle. Rho Relfix. Elongated shape in our images. Measured with Surface.
56. STI 222. In Cas. Only six official measures. Theta decreasing. Rho increasing.
57. STI1623. In Cas. Only three official measures. Relfix. CPM.
58. STI 223. In Cas. Only four official measures. Theta fast increasing since 1901. Rho slowly decreasing.
59. STI1629. In Cas. Only two official measures. Theta slowly decreasing. Rho slowly increasing. A faint star close to A component (258.7º, 3"). This star (UCAC3 299-031834) has high proper motion (-107.9 ± 4.8; -11.2 ± 4.7) so is not associated with de principal.
60. STI 233. In Cas. Only four official measures. Theta decreasing. Rho increasing.
61. STI1631. In Cas. Only two official measures. Theta slowly decreasing. Rho very slowly increasing. CPM.
62. STI1639. In Cas. Only four official measures. Relfix. CPM.
63. STT 33AB. In Cas. Incompatible proper motions. Optical. Included in the Catalog of Rectilinear Elements. DOB 2AC: Relfix since 1902. DOB 2BC: Relfix since 1902.
64. STI 313. In Cas. Relfix since 1908. CPM.
65. STI 312. In Cas. Theta decreasing. Rho increasing. CPM.
66. STI 318. In Cas. Only two official measures. Theta and Rho decreasing. Incompatible proper motions. Optical.
67. PTT 3. In Cas. OL 114 and STI 317 are identical. According to WDS is a CPM pair; nevertheless, UCAC3 pm: A = -13.7 12.7; B = -4.3 -2.1.
68. MLB 251. In Cas. Only five official measures. UCAC3 pm: A = -33.8 -17.3; B = 16.8 16.5.
69. STF 183AB-C: In Tri. A physical triple system. The orbital AB pair, too close. The star C is a CPM companion with the AB pair.
70. STI 323. In Cas. Only two official measures. Relfix.
71. STI 326. In Cas. Only two official measures. Theta fast decreasing (about 7º since 1913). Rho Relfix.
72. STI 332. In Cas. Only three official measures. Theta and Rho increasing. CPM.
73. MRI 6. Uncatalogued pair. See Discoveries.
74. STF 337AB. In Per. Incompatible proper motions. Optical. WAL 20AC: Incompatible proper motions. Optical. Included in the Catalog of Rectilinear Elements. WAL 20CD: Only one official measure (1944). Confirmed. Theta increasing (about 11º since discovery). Rho increasing (5").

Incompatible proper motions. Optical.

75. ES 1512. In Per. Theta increasing. Rho increasing.
76. STF 392. In Per. Stable since 1831. PM of B not listed in WDS. CPM according to the PPMX catalog: A = 30.15 -30.25; B = 30.24 -34.94.
77. HJ 2192AB. In Cam. Incompatible proper motions. Optical. Included in the Catalog of Rectilinear Elements. HJ 2192AC: Only one official measure (1915). Confirmed. Theta and Rho decreasing due to the PM of A. Optical.
78. STF 471AB. In Per. Epsilon Per. A is a Beta Lyrae-type binary. Relfix. Difficult: great Dm.
79. MLB 17. In Per. Only three official measures. Theta slowly decreasing. Rho slowly increasing.
80. STF 476AB. In Per. Included in the Catalog of Rectilinear Elements. Optical. STF 476BC: In Per. Only three official measures. Theta decreasing. Rho increasing. UCAC3 pm: C = 2.7 -10.4. Proper motion of B is erroneous in this WDS entry (the correct value from Tycho2 is -47.2 14.4). Incompatible proper motions. Optical.
81. ES 2085. In Per. Theta increasing. Rho Relfix.
82. ES 2461. In Per. Only four official measures. Great shift in Theta. Rho fixed. In our unfiltered images B component is the brighter. V magnitudes derived from CMC14 r' mag. and (J - KS) colour are VA = 11.22; VB = 11.62. UCAC3 pm: B = 0.3 -5.5.
83. ARA2251. In Sgr. Only three official measures. Stable since 2000.
84. H N 129. In Sgr. Also HDO 151. CPM.
85. STF2532AB. In Aql. Neglected. Not measured since 1983. The pair is stable. STF2532BD: Only two official measures. The pair is stable.
86. BU 653AB. In Aql (mu Aql). Included in the Catalog of Rectilinear Elements. High proper motion of A. Theta and Rho increasing. Optical. BU 653AC: Included in the Catalog of Rectilinear Elements. Theta and Rho increasing. Optical. BU 653AD: Included in the Catalog of Rectilinear Elements. Theta decreasing. Rho increasing. Optical. BU 653AE: Included in the Catalog of Rectilinear Elements. Incompatible proper motions. Theta and Rho decreasing. Optical. BU 653AF: Theta decreasing. Rho increasing. Optical BU 653BC: Theta and Rho increasing. Optical.
87. STF2562AB. In Aql. Relfix. CPM. STF2562AC: Only four official measures. Theta decreasing. Rho increasing. STF2562AD: Incompatible proper motions. Theta decreasing. Rho increasing. STF2562BC: Only four official measures. Theta decreasing. Rho decreasing. STF2562BD: Incompatible proper motions. Theta decreasing. Rho increasing.
88. J 493. In Aql. Difficult. Only four official measures. Theta and Rho increasing.
89. AG 391. In Aql. Incompatible proper motions. Theta and Rho increasing. Optical.
90. J 3019. In Aql. Only one official measure. Confirmed. Theta decreasing. Rho slowly increasing. Precise coordinate (J2000): 19 50 59.63 +08 56 28.4. Additional measure from 2MASS (epoch 2000.5721): 216.951º, 7.176". UCAC3 pm: A = 0.8 -2.7.
91. J 1867AB. In Aql. Only two official measures. Theta stable. Rho increasing. J 1867BC: Only two official measures. Theta increasing. Rho Relfix.
92. J 124AB. In Aql (omicron Aql). Very high proper motion of A component. Neglected. Not measured since 1958. Great change in angle at an approximated ratio of 0.863 degrees per year (according to four official measures). Our measure of Theta matches well with this proportion. Additional measure from 2MASS (epoch 2000.5721): 243.55º, 17.645”. The distance values are all discordant; there is not a clear tendency. In our unfiltered images the B component is weaker than the C one. J 124AC: Theta slowly decreasing. Rho Relfix. POP1228AD: Only three official measures. Theta increasing. Rho decreasing. POP1228AE: Only three official measures. Theta increasing. Rho decreasing.
93. WEB 8. In Aql. Near to STF2590. Only three official measures. Neglected. Not measured since 1920. Incompatible proper motions (not listed in the WDS). UCAC3 pm: A = -4.2 -18.3; B = 15.3 17.1. A clear optical pair.
94. STF2612. In Aql. Incompatible proper motions. Included in the Catalog of Rectilinear Elements. Optical.
95. J 2568. In Aql. Nearby to STF2612. Only one official measure (1943). Confirmed. Precise coordinate for the system (J2000): 20 01 26.73 +06 57 35.4. UCAC3 pm: A = 60.7 -51.5. Additional measure from 2MASS (epoch 2000.3272): 309.824º, 3.592''. Theta and Rho increasing.
96. HDO 316AC. In Aql. Only four official measures. Relfix.
97. HJ 2927AB. In Aql. Theta decreasing. Rho increasing. BU 1482BC: Only one official measure. Confirmed. Theta and Rho decreasing since 1901. Difficult.
98. STTA198AB. In Aql. Fixed. CPM. Physical. STTA198AC: In Aql. Only two official measures. Poor signal of C. Theta Relfix since 1901. Rho decreasing.
99. S 735. In Aql. Incompatible proper motions. Optical.
100. BAL 920. In Aql. Only three official measures. Similar proper motions. Stable since 1896. UCAC3 pm: A = 7.9 4.8; B = 9.6 9.4.
101. BU 1485A-BC. In Aql. Incompatible proper mo-

tions. Included in the Catalog of Rectilinear Elements. Optical pair. ABT 15AD: Only one official measure. Confirmed. Great shift since 1921 due to the high pm of A component. Theta decreasing. Rho increasing. Optical. BU 1485BC-D: Rho decreasing. Optical.

102. STF2703AB. In Del. CPM. Theta increasing. Rho decreasing. STF2703AC: Incompatible proper motions. Included in the Catalog of Rectilinear Elements. Optical. STF2703AD: Only four official measures. UCAC3 pm: D = 7.5 -0.2. Magnitude V of D component derived from CMC14 r' mag. and J -K colour is VD = 12.86. Theta and Rho Relfix. STF2703BC: Incompatible proper motions. Included in the Catalog of Rectilinear Elements. Optical.

103. H N 73. In Cyg. (alpha Cyg, Deneb). Not measured since 1998. Theta Relfix. Rho fast decreasing.

104. STF2967. In Peg. Similar proper motions. The historical measures show some dispersion in Theta. Rho stable.

105. STF2986. In Peg. Also LDS1066. CPM.

Table 2. Proper motion data extracted from UCAC-3 catalog.

WDS Id.	Discoverer		UCAC3 id.	μ(α) mas·year^{-1}	Error ±	μ(δ) mas·year^{-1}	Error ±
00332+5642	STI1376	A	294-012339	8.2	0.8	-1.1	0.8
		B	---	---	---	---	---
00366+5628	STI1392	A	293-013899	-5.5	0.9	2.1	0.7
		B	293-013892	0.8	1.0	-5.2	1.3
00376+5649	STI1398	A	294-013972	-5.9	0.8	-0.9	1.4
		B	294-013980	3.2	1.7	-4.3	8.3
00378+5645 *	STI1400	A	294-014047	4.5	1.7	4.7	0.5
		B	294-014053	-1.1	4.7	5.6	4.9
00378+5618	STI1401AC	A	293-014327	6.1	1.6	-6.1	0.7
		C	293-014330	-2.9	4.7	-9.9	4.9
00378+5618 *	STI1401BC	B	293-014328	-2.0	2.8	-3.4	1.3
		C	293-014330	-2.9	4.7	-9.9	4.9
00393+5635	STI1405	A	294-014622	-16.1	0.7	6.7	0.6
		B	294-014613	3.8	1.5	2.0	0.9
00404+5624	STI1408	A	293-015206	51.8	10.4	-20.6	3.5
		B	293-015205	16.1	5.0	-15.7	5.2
00428+5607	STI1416	A	293-016142	4.4	1.1	2.5	0.7
		B	293-016149	-1.1	1.7	-3.2	0.5
00428+5631	STI1417	A	294-016050	-1.9	1.7	-3.5	2.9
		B	294-016046	-18.4	5.0	3.0	5.2

Table 2 continued on next page.

Table 2 (*continued*): Proper motion data extracted from UCAC-3 catalog.

WDS Id.	Discoverer		UCAC3 id.	μ(α) mas·year^{-1}	Error ±	μ(δ) mas·year^{-1}	Error ±
00440+5608 *	STI1421	A	293-016476	1.5	2.5	-7.3	1.1
		B	293-016471	3.1	1.9	-8.3	0.9
00473+5651	STI1427	A	294-017742	9.2	1.1	-12.1	0.9
		B	294-017735	-4.9	1.8	-5.8	1.8
00486+5701	STI1432	A	PPMX	-18.43	3.1	11.51	3.1
		B	PPMX	-11.29	3.1	-2.59	3.1
00489+5612	STI1433	A	293-017929	0.4	0.8	-4.9	1.1
		B	293-017941	4.5	0.9	0.3	0.9
00493+5623	STI1434	A	293-018041	9.9	0.9	5.0	1.0
		B	293-018042	38.4	1.9	-7.1	1.9
00502+5600	STI1440	A	292-017531	1.3	1.7	0.4	1.3
		B	292-017528	-2.2	1.8	17.3	6.6
00505+5610 *	STI1443	A	293-018359	-7.8	1.8	-7.5	3.4
		B	PPMX	-2.08	3.1	-9.38	3.1
00516+5555	STI1450	A	292-017947	4.3	1.2	-7.2	0.9
		B	292-017952	-0.2	4.7	2.6	3.2
00527+5603	STI1455	A	293-018974	-1.1	5.0	-5.3	5.2
		B	293-018979	25.7	5.0	-2.8	5.2
01084+6136 *	STI 185	A	304-022010	0.3	1.9	-1.8	0.8
		B	304-022018	3.5	4.3	-4.0	4.5
01091+6138 *	STI 187	A	304-022387	0.6	1.7	-1.7	1.0
		B	304-022381	-1.8	1.6	-0.2	0.7
01192+5821 *	STI1560	A	297-030058	-1.2	0.9	0.4	1.6
		B	297-030069	-1.2	0.7	-1.3	1.3
01193+5903	STI1558	A	299-025990	-6.2	0.7	-2.1	0.6
		B	PPMX	-0.68	2.9	-15.17	2.9
01195+5904 *	STI1563	A	299-026078	-0.7	1.3	-3.7	3.4
		B	299-026087	-3.1	2.9	0.6	2.5
01196+5816	STI1565AB	A	297-030176	-20.4	6.2	14.6	1.1
		B	297-030190	-4.5	4.7	0.8	0.9
01196+5816	STI1565AC	A	297-030176	-20.4	6.2	14.6	1.1
		C	297-030184	-4.4	4.8	-3.5	5.0
01196+5816	STI1565AD	A	297-030176	-20.4	6.2	14.6	1.1
		D	297-030186	---	---	---	---
01196+5816 *	STI1565BE	B	297-030190	-4.5	4.7	0.8	0.9
		E	297-030171	-2.8	1.3	1.2	2.6
01196+5816 *	STI1565CE	C	297-030184	-4.4	4.8	-3.5	5.0
		E	297-030171	-2.8	1.3	1.2	2.6
01196+5818 *	STI1564	A	297-030167	-4.8	7.5	-1.2	1.7
		B	297-030168	-2.0	4.8	-1.7	4.1

Table 2 continued on next page.

Table 2 (*continued*): Proper motion data extracted from UCAC-3 catalog.

WDS Id.	Discoverer		UCAC3 id.	μ(α) mas·year⁻¹	Error ±	μ(δ) mas·year⁻¹	Error ±
01197+5814	STI1567AB	A	297-030249	---	---	---	---
		B	297-030253	---	---	---	---
01197+5814	STI1567AC	A	297-030249	---	---	---	---
		C	297-030244	---	---	---	---
01202+5904	STI1573	A	299-026283	0.7	2.1	1.7	1.1
		B	299-026285	2.5	4.3	-6.3	2.2
01210+5920 *	STI1576	A	299-026538	-3.2	1.0	-1.2	0.7
		B	299-026544	-4.2	1.2	-4.1	0.5
01211+5809	STI1577	A	297-030912	2.2	0.8	-6.2	1.1
		B	297-030911	---	---	---	---
01216+5805 *	STI1581	A	297-031125	-12.7	1.2	-1.0	2.9
		B	297-031131	-7.6	2.0	-6.6	1.8
01226+5759 *	STI1588	A	296-032124	12.3	1.5	-5.1	1.7
		B	296-032129	17.4	1.9	-10.5	3.4
01245+6012 *	STI 210	A	301-034752	-4.4	1.6	-1.8	1.3
		B	301-034768	-0.4	1.0	-4.2	1.4
01248+5929 *	STI1600	A	299-028039	2.1	2.3	-4.8	2.5
		B	299-028046	6.9	2.5	-4.3	3.1
01252+5849	STI1603	A	298-027660	-1.9	0.5	-2.4	1.4
		B	298-027666	7.9	1.7	-8.2	1.7
01252+5858 *	STI1604	A	298-027665	-4.4	3.2	-1.0	1.7
		B	PPMX	0.96	2.2	-3.84	2.2
01264+5929	STI 213	A	299-028789	24.0	4.7	-16.2	0.7
		B	299-028778	-6.2	0.7	-1.6	0.9
01267+5913	STI1610	A	299-028958	25.8	1.3	-2.0	1.1
		B	299-028968	2.8	1.4	-0.4	2.1
01274+5955	STI 216	A	300-031496	8.1	4.2	2.9	4.6
		B	300-031495	-2.8	1.4	-2.9	2.5
Uncat	MRI 5BC	B	300-031495	-2.8	1.4	-2.9	2.5
		C	300-031490	---	---	---	---
01283+6023 *	STI 219	A	301-035964	0.7	2.0	-5.6	1.1
		B	301-035969	2.0	3.9	-7.2	4.7
01284+6002	STI 221	A	301-036019	3.4	0.8	-2.0	1.9
		B	301-036018	-6.9	0.9	-2.8	1.3
01289+6003	STI 222	A	301-036204	-7.2	3.9	-3.2	3.2
		B	301-036208	-0.6	1.6	4.5	3.6
01295+5918 *	STI1623	A	299-030151	1.1	1.0	-4.1	0.6
		B	299-030158	3.5	1.0	-1.6	0.9
01299+6025	STI 223	A	301-036575	3.2	1.2	0.3	2.5
		B	301-036580	2.1	1.9	-5.3	1.5

Table 2 continued on next page.

Table 2 (*conclusion*): Proper motion data extracted from UCAC-3 catalog.

WDS Id.	Discoverer		UCAC3 id.	μ(α) mas·year⁻¹	Error ±	μ(δ) mas·year⁻¹	Error ±
01338+5929	STI1629	A	299-031839	-1.7	2.2	6.1	0.8
		B	299-031846	-2.7	1.1	0.5	0.9
01342+5950	STI 233	A	300-034966	-3.1	0.8	0.8	1.0
		B	300-034970	7.1	3.7	-8.5	7.5
01351+5909 *	STI1631	A	299-032181	-18.2	4.5	-5.1	4.9
		B	299-032178	-18.0	4.5	-10.8	4.9
01371+5850 *	STI1639	A	298-031621	1.4	1.0	0.3	0.8
		B	298-031626	2.4	9.1	0.6	7.8
01506+6208 *	STI 313	A	305-033578	8.5	1.9	-2.3	2.3
		B	305-033570	11.3	5.1	-3.6	2.4
01506+6229 *	STI 312	A	305-033582	-4.8	3.3	-5.5	1.7
		B	305-033586	-1.8	2.4	-0.5	1.7
01533+6233	STI 318	A	306-038584	-2.4	0.6	-0.4	0.7
		B	306-038583	7.3	1.5	-6.7	6.1
01554+6218	STI 323	A	305-035119	-10.4	0.7	2.0	1.4
		B	305-035110	-3.9	2.0	-1.9	1.5
01569+6353	STI 326	A	308-034454	-12.0	1.0	-15.1	0.9
		B	308-034457	-0.6	1.2	-2.9	1.7
01599+6324 *	STI 332	A	307-040078	-3.2	0.9	-0.7	1.7
		B	307-040079	-1.3	1.9	-4.9	1.4

(Continued from page 244)

(Masa, 2009a). This fact demonstrates the repeatability of our optical train.

Updating Proper Motions

In general, the proper motions of the STI stars do not appear in WDS, especially for the majority of the weak secondary components. In order to improve the information on the proper motion data we have used the new catalog, UCAC3, via Aladin software (Bonnarel et al, 2000). When UCAC3 does not provide information, data from PPMX catalog (Roeser *et al.*, 2008) was used. UCAC3 data show that ~1/3 of the observed 59 STI pairs in this sample are, within the errors, common proper motion pairs. Nevertheless, these pairs are placed near the Galactic Plane (their average galactic latitude is around -4º) and the proper motions are very small: the typical case of the distant background stars (background stellar contamination). Because the proper motions are small and their *sigmas* have, frequently, high values, we suggest periodic re-observations of these newly-detected CPM pairs in order to check their kinematic evolution. This will serve to discard or to confirm the predicted co-moving trajectory of the components. Moreover, the application of the probability theory (Grocheva & Kiselev, 1998) provides a valuable method to identify physical binary systems without the need of long-term observations. This powerful tool is based on the estimation of the probability of the random disposition of two or more stars, which have similar proper motions on small angular distance, ρ. True physical pairs will have the lowest of such probabilities. We may carry out this type of study on the STI CPM candidates in the future.

The new proper-motion values in RA and DEC as well as their respective uncertainties are reported in Table 2. The supposed CPM pairs are indicated by an asterisk (*) in the Column 1 the same way as in the *Notes* section.

Discoveries

Two new pairs were found. They are listed in order of increasing right ascension. By means of the same methods as the ones previously used (Masa, 2007) in order to analyze data found in the literature, the following conclusions were drawn:

MRI 5BC

This is a new component for STI 216 (Figure 4). The historical relative astrometry (three measures) and the opposite proper motions from UCAC 3 (Table 2) suggest that the AB pair is optical. The new C component is placed close to the B one at J2000 coordinates RA = 01h 27m 24.323s and DEC = +59º 54' 56.45". Near-infrared photometry is provided by

Table 3. Relative astrometry of MRI 5BC.

Source	Filter	Scale (arsec pix^{-1})	Rotation (°)	Epoch	θ°	σθ	ρ''	σρ
2MASS	*Measure from catalog positions*			1999.7400	321.64	--	5.394	--
IPHAS	Sloan *z* / H-alpha	0.33	0	2003.7839	321.71	0.45	5.315	0.037
OACP	CCD Unfiltered	0.44	-1.01	2008.6629	321.62	0.19	5.402	0.036

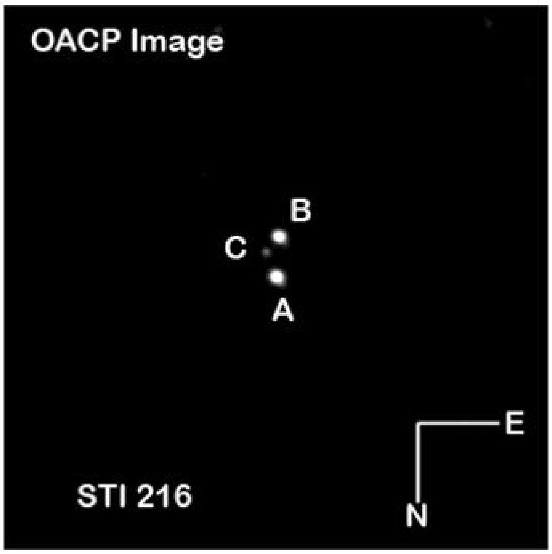

Figure 4: MRI 5BC: the new C component for STI 216.

2MASS (J, H, Ks = 12.521, 12.323, 12.136). Likewise, UCAC3 gives centroid fit-model magnitudes (*f.mag*) as well as aperture photometry (*a.mag*) derived from the new pixel data reductions (in a native 579-642 nm bandpass: this is between visual (V) and red (R)). The values for the C component are *f.mag* = 14.290; *a.mag* = 13.237. We derived the V magnitude using Pavlov's equations (Pavlov, 2009). Pavlov derived two transformations crossing the LONEOS photometric catalog and the UCAC3 and using the 2MASS *(J - K$_S$)* color index. The expressions are:

$$V = 0.531\ (J_{2MASS} - K_{2MASS}) + 0.9060\ fMag_{UCAC3} + 0.95 \pm 0.08$$

$$V = 0.529\ (J_{2MASS} - K_{2MASS}) + 0.9166\ aMag_{UCAC3} + 0.83 \pm 0.08$$

The V magnitude for C component given as the mean of the values derived from the above equations is V = 13.634 ± 0.08. Similarly, the V magnitudes for A and B components are 12.227 and 12.556 in this order. No de-reddening was made.

No proper motions were found for this star in the literature. Nevertheless, the faint new companion seems to share proper motion with the B component. It can be seen by means of a RGB composite image made by Aladin software and using both DSS (1954) and 2MASS (1999) plates.

In addition, we report three measures of relative astrometry (Table 3) covering a period of ~9 years. The results confirm a fixed character of the pair. In order to validate this hypothesis more relative astrometry measurements are needed in the future. In the same way, we checked the AC pair but the measures show a shift of 1º in Theta (decreasing) in an identical time period.

MRI 6

This pair is located at position (J2000) RA = 01h 59m 43.458s and DEC = +63º 18' 50.95", near STI 332, in Cassiopeia (Figure 5). The A component (= HD11959; HIP9321) is a well-studied star and we found many references in the literature about their properties. No comments on duplicity have been reported up to now. Nevertheless, we have found a faint companion star that may be bound with the main one. Since the pair is located near the Galactic Plane (b_A = +1.4516º; b_B = +1.4526º), we corrected the 2MASS NIR photometry for reddening and extinction by means of a procedure similar to those given in the preceding work (Masa, 2009a). The definitive color excess and the total absorption values for A and B components respectively are: [$E(B-V)_0$ = 0.07; A_V = 0.22] and [$E(B-V)_0$ = 0.12; A_V = 0.37]. Later, we derived the visual magnitude (V) of the A component by doing the transformation of the de-reddened 2MASS JHKS magnitudes (Bilir et al., 2008). The mean result was: V_0A = 8.64. Also, the magnitudes in B, R, and IC bands were derived.

According to several sources consulted in the literature, the main component is an A3V star (Skiff, 2010). By means of the spectral distribution of energy in BVIJHKS bands we conclude that the primary has, effectively, a spectral type A3V. The absolute visual magnitude (M_VA = 0.93) was derived according to the equation given by Reid & Murray (1992):

$$M_V = 0.427 + 8.121(B - V) - 1.777(B - V)^2$$

By combining spectra and absolute magnitude, the photometric distance placed the main star at 349 pc. Hipparcos recorded a parallax of moderate precision for the A component, $\pi = 2.68 \pm 1.18$ mas (373 ± 164 pc) in good agreement with our distance.

There is no spectral data for the secondary in the literature. Our spectral study was carried out taking into account some particular characteristics. It is clear that the precision of our spectral type estimation depends on the quality of the 2MASS NIR photometry. For the B component the 2MASS's *contamination and confusion flag* has a value: *Cflg = ccc*. The three "*c*" characters (one character per band [JHKs]) indicate a certain level of *"photometric confusion. Source photometry is biased by a nearby star that has contaminated the background estimation"* and the position of the source might be affected too. Therefore, this uncertainty in the JHK_S fluxes has a significant weight over the derived visual magnitude and over the spectrum.

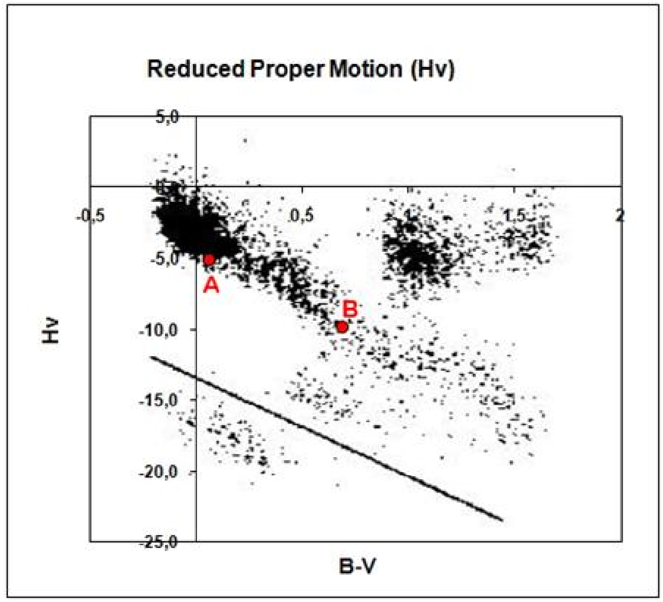

Figure 6. Luminosity classes confirmation. (Adapted from Jones, Eric M., 1972, *Reduced-Proper-Motion Diagrams. II. Luyten's White-Dwarf Catalog*, AJ, 177, 245-250)

After de-reddening the infrared magnitudes we obtained $V_{0\,JHK} = 13.30$. Also, the pair was resolved by SDSS. Again, we found a similar remark in relation to the quality of SDSS data: *"Caution: Magnitudes and other data for this object may be unreliable"*. If we derive the V magnitude by means of the transformation of the SDSS *ugriz* photometry (Smith *et al.*, 2002; Jester *et al.*, 2005; Karaali, Bilir & Tuncel, 2005; Lupton, 2005) the result is $V_{0\,ugriz} = 12.43$. Comparing this value with that one from 2MASS, we can see that there is a discrepancy in V magnitude of $\Delta V = V_{JHK} - V_{ugriz} = 0.87$. This fact, demonstrates that there is a clear inconsistency between the photometrical data of 2MASS and SDSS. Concerning the B component and in the basis of these particulars, the conclusion of our discussion is that the available photometric data should be taken warily. The distribution of spectral energy in de-reddened JHK_S bands, matches well with a spectrum G6V for the B component. The definitive V magnitude ($V_0B = 13.36$) and the absolute magnitude ($M_VB = 5.26$) are intrinsic values for a spectrum G6V. This synthetic photometry came from several magnitude/spectrum conversion tables (Zombeck, 1990)). According to these data we derived a photometric distance of 417 pc in good agreement with the 349 pc of the main star. The differential distance module of -0.39 magnitudes is assumed by the error margins and the probability for the two stars of being at the same distance rises to 91%.

For both components, the luminosity classes were verified by means of near-infrared two-color diagrams *(J - H)* vs. *(H - K_S)* as well as Reduced-Proper-Motion diagrams which sited the components on the main-sequence (Figure 6). The results of our spectrophotometric analysis are summarized in Table 4.

We report four measurements of relative astrometry for the pair (Table 5). Taking into account the particularities relative to the poor quality of the photometric and positional data, we decided to measure with *Reduc* several original plates from 2MASS, IPHAS and SDSS surveys. We include the *sigmas* of the measurements. The results are very congruent and show the pair fixed, practically, since 1999.

The literature gives proper motion values for the

Table 4: Results of the photometric study of MRI 6.

Star	J_0	H_0	K_{S0}	V_0	$(B - V)_0$	$(V - I_C)_0$	M_V	$V - M_V$	d	SpT
A	8.390	8.360	8.332	8.64	0.06	0.09	0.93	7.71	349	A3V
B	12.083	11.773	11.680	13.36	0.69	0.75	5.26	8.10	417	G6V

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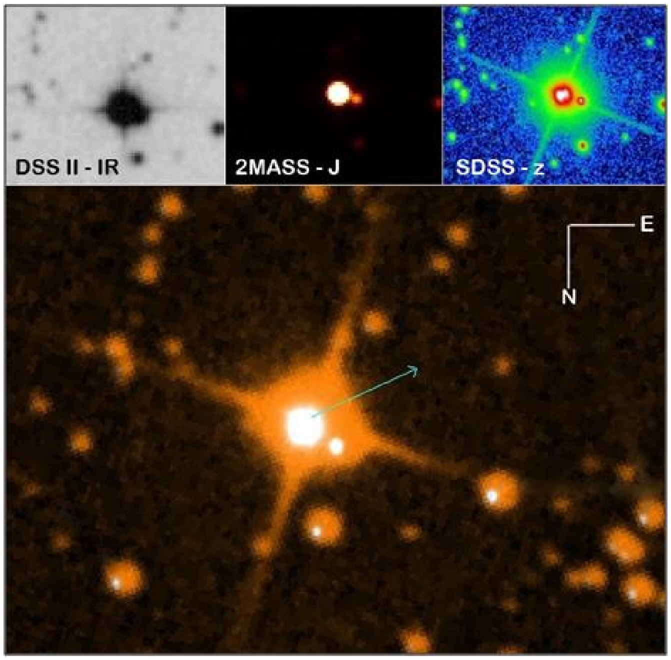

Figure 7. At the top, three frames showing the system along the time. Below, a composite image by Aladin. The orange stars: SSS UKST Red (R) plate (epoch 1992.74). The white stars: SDSS *z*-band plate (epoch 2005.99). The blue arrow is the proper motion vector from UCAC3.

primary, all of them are very similar. The most modern PM values came from the UCAC3 catalog (mpRA = 14.9 ± 2; mpDec = -12.6 ± 1.5 *mas*). There are not proper motion data for the secondary. Since the stellar sources are overlapped in the examined old plates, it is not possible to make a crude estimation of the proper motions. Though the system is resolved by 2MASS, IPHAS and SDSS surveys, the temporal baseline is too short. Despite this fact, no relative motion between the components was detected over the consulted plates by means of an Aladin *data cube*, so we think that the secondary is co-moving with the principal one (Figure 7). If the two stars are a CPM pair, and supposing an affinity of 95% in the proper motions, we obtained that the B component could have mpRA = 14.2 ± 2 *mas* and mpDEC = -12.0 ± 1.5 *mas* (we assign the same errors that those of the main star, typical values in the UCAC3 survey). Next, the referred Grocheva's probabilistic criterion were applied. Via Aladin we inquired the UCAC3 catalog in an area of 2º of radius centered on MRI 6. A total of 56,201 records (=*N*) were found. Following, we searched in this sample (within the errors) for stars with similar proper motions to our candidate. 182 stars (=*S*) verified the search conditions. Finally, the probability of stellar binarity came from the equation $P\mu = S/N$. According to the Grocheva's work a pair will be physical if $P\mu < 1\%$. In our research we found $P\mu = 0.32\%$, so MRI 6 could be a physical pair.

In addition, assuming again common proper motion we checked for binarity by means of the habitual characterization criteria used by LIADA Double-Star Group. The system is a bounded pair according to the most part of them. We determined a final probability of physical relation of 98%.

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This research has made use of the Washington Double Star Catalog (WDS), the Catalog of Rectilinear Elements, the Sixth Catalog of Orbits of Visual Binary Stars, The Third Photometric Magnitude Difference Catalog and the UCAC3 maintained at the U.S. Naval Observatory.

This research has made use of the All-sky Compiled Catalog of 2.5 million stars (ASCC-2.5, 2nd version) at:

http://webviz.u-strasbg.fr/viz-bin/VizieR?-source=I/280A.

This research has made use of the AC 2000.2: The Astrographic Catalogue on The Hipparcos System. Catalogue of Positions Derived from the Astrographic Catalogue Measures. Positions are from the Hippar-

Table 5: Additional relative astrometry of MRI 6

Source	Filter	Scale arsec pix^{-1}	Rotation (°)	Epoch	θ°	σθ	ρ''	σρ
2MASS	J-H-K	1.01	0	1999.0081	72.36	0.04	6.154	0.105
IPHAS	Sloan *i* / H-alpha	0.33	0	2003.7522	72.46	0.36	6.209	0.084
SDSS	Sloan *z*	0.3961	-15	2005.9938	72.44	0.02	6.282	0.030
OACP	CCD Unfiltered	0.44	-0.98	2008.6629	72.33	0.18	6.236	0.266

cos System (HCRS, J2000.0) at the Mean Epochs of Observation. (http://webviz.u-strasbg.fr/viz-bin/VizieR?-source=I/275).

This research has made use of the Astrophysics Data System (ADS) in order to consult several professional works.

Web Site: http://adswww.harvard.edu/index.html

This research has made use of data products from the Two Micron All Sky Survey (2MASS), which is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation.

This research has made use of DSS. The Digitized Sky Survey was produced at the Space Telescope Science Institute under U.S. Government grant NAGW-2166. The images of these surveys are based on photographic data obtained using the Oschin Schmidt Telescope on Palomar Mountain and the UK Schmidt Telescope. The plates were processed into the present compressed digital form with the permission of these institutions.

This research has made use of SuperCOSMOS Sky Surveys (SSS): Internet site:

http://www-wfau.roe.ac.uk/sss/

This research has made use of The Sloan Digital Sky Survey (SDSS) version 7. Internet site: http://www.sdss.org/

This research has made use of several images from IPHAS: *The INT/WFC Photometric Ha Survey of the Northern Galactic Plane*. (http://www.iphas.org/)

This research has made use of Aladin, an interactive software sky atlas allowing the user to visualize digitized images of any part of the sky, to superimpose entries from astronomical catalogs or personal user data files, and to interactively access related data and information from the SIMBAD, NED, VizieR, or other archives for all known objects in the field. Aladin is particularly useful for multi-spectral cross-identifications of astronomical sources, observation preparation and quality control of new data sets (by comparison with standard catalogues covering the same region of sky). Available at http://aladin.ustrasbg.fr/

This research has made use of Guide 8.0 astronomical software of Project Pluto. Internet site: http://www.projectpluto.com/

This research has made use of Reduc software by Florent Losse. Internet site:

http://www.astrosurf.com/hfosaf/

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