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Speckle observations with PISCO in Merate: X. Astrometric measurements of visual binaries in 2009

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We present relative astrometric measurements of visual binaries, made in 2009 with the speckle camera PISCO at the 102 cm Zeiss telescope of Brera Astronomical Observatory, in Merate. Our sample contains orbital couples as well as binaries whose motion is still uncertain. We obtained 345 new measurements of 259 objects, with angular separations in the range $0''.18$ — $4''.6$, and an average accuracy of $0''.011$. The mean error on the position angles is $0^\circ.6$. Most of the position angles were determined without the usual 180° ambiguity with the application of triple-correlation techniques and/or by inspection of the long integration files.
We also present the new revised orbits we have computed for xxxx

1 Introduction

This paper deals with the results of speckle observations of visual binary stars made in Merate (Italy) in 2009 with the Pupil Interferometry Speckle camera and COronagraph (PISCO) on the 102 cm Zeiss telescope of *INAF – Osservatorio Astronomico di Brera* (OAB, Brera Astronomical Observatory). It is the tenth of a series (Scardia et al. 2005a, 2006, 2007a, 2008a, Prieur et al. 2008, Scardia et al. 2009a, Prieur et al., 2009, Scardia et al., 2010, Prieur et al., 2010, herein: Papers I to IX), whose purpose is to contribute to the determination of binary orbits. PISCO was developed at *Observatoire Midi-Pyrénées* (France) and first used at *Pic du Midi* from 1993 to 1998. It was moved to Merate in 2003 and used there since.

We briefly describe our observations in Sect. 2. Then we present and discuss the astrometric measurements in Sect. 3. Finally in Sect. 4 we propose new revised orbits for ADS partly derived from those observations and infer estimate values for the component masses.

2 Observations and description of the sample

The observations were carried out with the PISCO speckle camera with the ICCD (Intensified Charge Coupled Device) detector belonging to Nice University (France). This instrumentation is presented in Prieur et al. (1998) and our observing procedure is described in detail in Paper VI. For the present observations, thanks to an improvement of our software and a faster computer, we were also able to compute in real time the restricted triple correlation (Aristidi et al., 1997) that we use for resolving the 180° ambiguity (see Sect. 3.2).

The description of our sample can be found in our previous papers (e.g., Paper VI). It basically includes all the visual binaries for which new measurements are needed to improve their orbits, that are accessible with our instrumentation.

The distribution of the angular separations measured in this paper is displayed in Fig. 1a and shows a maximum for $\rho \approx 0''.7$. The largest separation of $4''.6$ was obtained for ADS 6175. The smallest separation was measured for HU 66AB (ADS 11344), with $\rho = 0''.18$. This is rather close to the diffraction limit $\rho_d = \lambda/D \approx 0''.13$ for the Zeiss telescope (aperture $D = 1.02$ m) and the R filter ($\lambda = 650$ nm).

Likewise, the distribution of the apparent magnitudes m_V and of the difference of magnitudes Δm_V between the two components are plotted in Figs. 1b and 1c, respectively. The telescope aperture and detector sensitivity lead to a limiting magnitude of about $m_V = 9$ (Fig. 1b) and a limiting Δm_V of about 4.5 (Fig. 1c).

Using the Hipparcos parallaxes, we were able to construct the HR diagram of those binaries, which is displayed in Fig. 2. We only plotted the objects for which the relative uncertainty on the parallax was

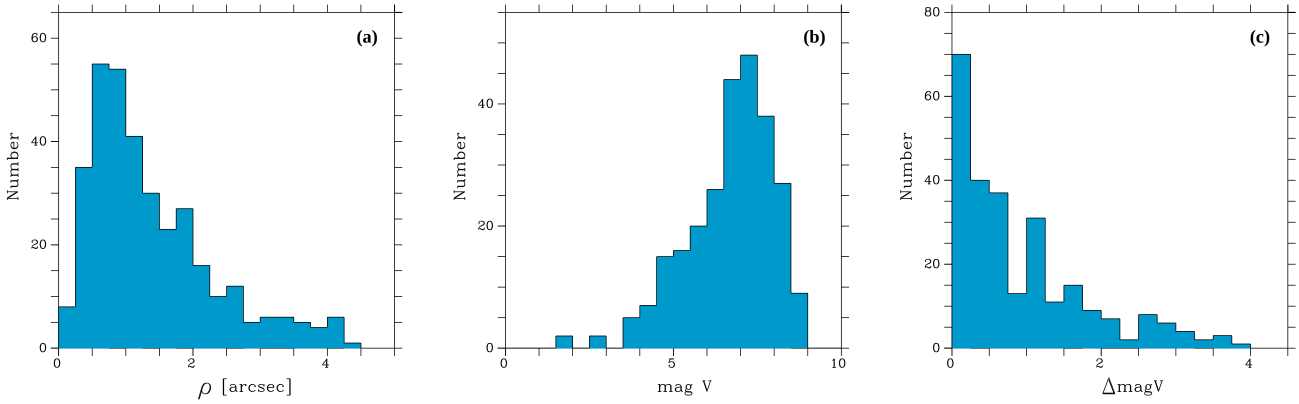

Fig. 1 Distribution of the angular separations of the 345 measurements of Table 1 (a), of the total visual magnitudes (b) and of the differences of magnitude between the two components of those binaries (c).

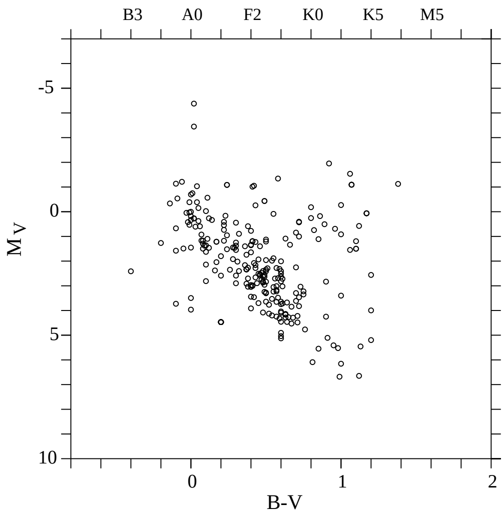

Fig. 2 HR diagram of the binaries measured in Table 1, for which Hipparcos parallaxes were obtained with a relative error smaller than 50% (i.e., 251 objects).

smaller than 50%. It can be seen that a large part of the HR diagram is covered by our sample. In the future we would like to acquire a more sensitive detector in order to observe fainter (and cooler) main sequence stars.

3 Astrometric measurements

The astrometric measurements of the observations made in 2009 are displayed in Table 1. For each object, we report its WDS name (Washington Double Star Catalogue, Mason et al. 2010, hereafter WDS Catalogue) in Col. 1, the official double star designation in Col. 2 (sequence is "discoverer-number"), and the ADS number in Col. 3 (Aitken, 1932). For each observation, we then give the epoch in Besselian years (Col. 4), the filter (Col. 5) and the focal length of the eyepiece used for magnifying the image (Col. 6), the angular separation ρ (Col. 7) with its error (Col. 8) in arcseconds, and the position angle θ (Col. 9) with its error (Col. 10) in degrees. In Col. 11, we report some notes and some information about the secondary peaks of the auto-correlation files (e.g. diffuse or elongated). For the systems with a known orbit, the $(O-C)$ (Observed minus Computed) residuals of the ρ and θ measurements are displayed in Cols. 13 and 14, respectively. The corresponding authors are given in Col. 12, using the style of the OC6 references. The correspondence with the references of this paper is indicated at the end of Table 1. Unless explicitly specified, the measurements refer to the AB components of those systems.

The characteristics of the R and RL filters used for obtaining those measurements are given in Table 2 of Paper IX. Some objects were observed with no filter because they were too faint. This is indicated with W (for "white" light) in the filter column (Col. 5 of Table 1). In that case, the bandpass and central wavelength correspond to that of the ICCD detector.

Like for the other papers of this series, we interactively processed each auto-correlation file and obtained a series of measurements with different background estimates and simulated noise. The measures and errors displayed in Table 1 were derived from the mean values and the standard deviation of those multiples measurements (see Paper III for more details). The average values of the errors of the 345 measurements reported in this table are $0''.011 \pm 0''.007$ and $0°.56 \pm 0°.38$ for ρ and θ, respectively.

There is only one unresolved object: COU 773. This is compatible with the ephemeris of xxxxx's orbit that gives $\rho = 0''.xxxx$, which is smaller than the diffraction limit of the Zeiss telescope.

Table 1 Measurements of binaries with PISCO in 2009 (begin.).

WDS	Name	ADS	Epoch	Fil.	Eyep. (mm)	ρ ($''$)	σ_ρ ($''$)	θ ($^\circ$)	σ_θ ($^\circ$)	Notes	Orbit	$\Delta\rho$(O-C) ($''$)	$\Delta\theta$(O-C) ($''$)
00134+2659	STT2	161	2009.960	R	10	0.415	0.003	161.3*	0.4		Ole2001	0.04	5.8
00210+6740	HJ1018	283	2009.960	R	20	1.683	0.008	86.8*	0.3		Sod1999	−0.08	−0.9
00218+6628	STT7	296	2009.960	W	20	0.886	0.008	126.9*	0.7				
00442+4614	STF52	616	2009.957	W	20	1.373	0.008	3.0*	0.3				
00481+2533	HO306	662	2009.034	R	20	1.458	0.015	159.3*	0.6				
00504+5038	BU232	684	2009.034	R	20	0.880	0.008	250.4	0.9		Sca2006a	0.02	−1.5
00516+6859	BU781	692	2009.062	W	20	1.058	0.009	23.0*	0.8				
00521+1036	STF67	709	2009.957	W	20	2.241	0.011	349.9*	0.4				
00527+6852	STF65	710	2009.062	W	20	3.292	0.034	39.5*	0.8				
00528+5638	BU1AC	719	2009.062	W	20	3.949	0.032	133.4*	0.3				
00528+5638	BU1AB	719	2009.062	W	20	1.530	0.020	81.3*	0.4				
01004+1803	BRT1927	–	2009.957	W	20	1.908	0.010	171.8*	0.3				
01197+6135	KR11	1062	2009.081	W	20	1.975	0.010	57.9*	0.9				
01198−0031	STF113	1081	2009.081	R	20	1.647	0.008	20.4*	0.6				
01201+4357	DA8	1079	2009.081	W	20	2.642	0.013	141.1*	0.3				
01208+5612	BU782	1089	2009.081	W	20	3.171	0.016	82.0*	0.3				
01283+4247	AC14	1161	2009.034	R	20	0.780	0.008	91.1*	2.1				
01355+3118	STF137	1243	2009.081	W	20	3.381	0.019	85.0*	0.3				
01493+4754	STF162	1438	2009.034	R	20	1.944	0.034	199.2*	0.3				
01559+0151	STF186	1538	2009.081	R	20	0.858	0.008	245.5	0.4		Sta1980a	−0.33	2.8^Q
02037+2556	STF208	1631	2009.111	R	20	1.275	0.008	340.9*	0.3		Hei1996a	−0.13	−2.7
02123+2357	STF226	1696	2009.111	R	20	1.761	0.013	231.9*	0.6				
02140+4729	STF228	1709	2009.108	R	20	0.844	0.015	290.2*	0.4		Sod1999	−0.01	−1.4
02213+3726	STF250	1790	2009.108	W	20	3.174	0.035	135.7*	0.3				
02313+4703	A968	1908	2009.075	W	20	1.694	0.028	26.2*	0.4				
02331+5828	STF272	1933	2009.075	W	20	1.941	0.047	215.7*	1.2				
02471+3533	BU9	2117	2009.111	R	20	1.006	0.008	209.6*	0.7				
03054+2515	STF346	2336	2009.081	R	10	0.406	0.003	253.6	0.7	Elongated	Hei1981a	−0.04	−2.8
03127+7133	STT50BC	2377	2009.081	R	20	0.887	0.008	130.4	0.8	New comp.			
03127+7133	STT50AB	2377	2009.081	R	20	1.037	0.008	150.6	0.5		Sca2001g	0.10	0.9
03177+3838	STT53	2446	2009.144	R	20	0.676	0.010	240.4	1.5		Alz1998a	0.03	−1.7
03280+5511	STF386	2537	2009.144	W	20	2.635	0.013	58.4*	1.4				
03306+4947	HLD8	2574	2009.144	W	20	2.311	0.062	176.6*	1.3				
03344+2428	STF412	2616	2009.081	R	10	0.712	0.004	353.7	0.3		Sca2002a	−0.01	0.1
03350+6002	STF400	2612	2009.138	R	20	1.568	0.008	266.4*	0.8		Sey2000a	0.08	−1.1
03356+3141	BU533	2628	2009.138	R	20	1.049	0.010	221.6*	0.4				
03372+0121	A2419	2647	2009.163	W	20	0.770	0.008	99.9*	0.3				
03401+3407	STF425	2668	2009.139	R	20	1.970	0.010	61.9*	0.3				
03443+3217	BU535	2726	2009.139	R	20	1.046	0.008	22.8*	0.3				
03446+3551	HO504	2729	2009.144	W	20	1.108	0.029	192.4	0.3				
03520+0632	KUI15	–	2009.139	R	20	0.785	0.011	207.2*	0.4				
04041+3931	STF483	2959	2009.163	R	20	1.409	0.013	56.6*	0.5		Bdl2006b	−0.02	0.0
04064+4325	A1710	2980	2009.139	R	20	0.636	0.008	132.8*	0.9		Hei1982c	0.02	0.1^Q
04139+0916	BU547	3072	2009.139	R	20	1.231	0.009	340.7*	0.6	Faint			
04159+3142	STT77	3082	2009.081	R	20	0.540	0.016	292.4	0.3		Sta1985	−0.02	−1.4
04182+2248	STF520	3114	2009.081	R	20	0.590	0.010	77.0	1.8		Hrt2001b	0.03	−1.7
04225+5136	STF522	3147	2009.081	W	20	1.491	0.020	211.5	0.9				
04301+1538	STF554	3264	2009.163	R	20	1.535	0.008	16.6*	0.5		Baz1980a	−0.12	0.7
05010+1430	D6	3600	2009.163	W	20	1.103	0.011	101.8*	0.4				
05055+1948	STT95	3672	2009.163	R	20	0.903	0.009	297.1*	0.3				
05103+3718	STF644	3734	2009.199	R	20	1.625	0.012	221.4*	0.3				
05135+0158	STT517	3799	2009.199	R	20	0.700	0.022	240.0	1.4		Msn1999a	0.05	−0.9
05177+0441	STF678	3873	2009.207	W	20	3.625	0.018	102.6*	1.2				
05238+5334	A1560	3952	2009.207	W	20	1.152	0.011	219.3	1.1				

WDS	Name	ADS	Epoch	Fil.	Eyep. (mm)	ρ ($''$)	σ_ρ ($''$)	θ ($^\circ$)	σ_θ ($^\circ$)	Notes	Orbit	$\Delta\rho$(O-C) ($''$)	$\Delta\theta$(O-C) ($''$)
05247+6323	STF677	3956	2009.199	R	20	1.095	0.034	119.1*	1.7	Diffuse	Hei1996c	−0.07	−3.5
05302+4117	STF715	4083	2009.207	W	20	0.840	0.008	202.8*	0.5	Elongated			
05307+1154	A2705	4109	2009.207	W	20	0.962	0.022	249.3*	0.7				
05308+0557	STF728	4115	2009.081	R	20	1.238	0.012	45.0*	0.4		Sey1999b	−0.02	0.0
05312+0318	STF729	4123	2009.139	R	20	1.890	0.029	27.3*	0.4				
05339+4447	STF727	4137	2009.081	W	20	2.191	0.011	58.0*	0.3				
05352+3358	AG97	4165	2009.163	W	20	2.075	0.024	269.7*	0.3				
05364+2200	STF742	4200	2009.139	R	20	4.124	0.026	273.4*	0.3		Hop1973b	0.00	−1.4
05371+2655	STF749	4208	2009.081	R	20	1.109	0.018	141.4*	0.3		Sca2005c	−0.05	0.1^Q
05371+4150	STF736	4204	2009.139	R	20	2.560	0.015	359.7*	0.3				
05399+3757	STT112	4243	2009.081	R	20	0.866	0.011	50.0*	0.4				
05474+2939	BU560	4371	2009.139	R	20	1.661	0.011	125.0*	0.4				
05480+0627	STF795	4390	2009.139	R	20	1.030	0.008	219.0*	0.5				
06228+1734	STF899	4991	2009.081	R	20	2.142	0.021	17.9*	0.3				
06277+1822	COU41	–	2009.207	W	20	1.187	0.015	40.6	1.2				
06289+4007	STF905	5088	2009.207	W	20	1.948	0.014	128.1*	0.3				
06462+5927	STF948	5400	2009.081	R	20	1.875	0.012	68.8*	0.3		WSI2006b	0.00	−0.2
06573+5825	STT159	5586	2009.139	R	10	0.625	0.003	229.6*	0.6		Alz2000a	−0.02	−0.4
07128+2713	STF1037	5871	2009.139	R	20	1.015	0.008	308.8	0.4		Sod1999	−0.02	−0.8
07176+0918	STT170	5958	2009.267	R	10	0.236	0.004	341.5*	1.0		Hei2001	−0.03	−15.5
07303+4959	STF1093	6117	2009.264	W	20	0.860	0.008	201.1*	0.5		Sca1984d	0.07	−1.1
07346+3153	STF1110	6175	2009.264	V	20	4.615	0.023	58.1*	0.3		Hei1988a	−0.01	−0.1
07417+3726	STT177	6276	2009.267	R	20	0.528	0.014	150.3	1.6		Hei1982c	0.01	2.6
07486+2308	WRH15	6378	2009.267	R	10	0.273	0.003	32.2*	1.0		Sey2002	0.00	−0.4
08024+0409	STF1175	6532	2009.267	R	20	1.395	0.008	282.5*	0.3		Ole2001	0.03	−4.5
08041+3302	STT187	6549	2009.267	R	10	0.410	0.003	340.0	0.3		Msn1999a	0.00	−0.5
08095+3213	STF1187Aa-B	6623	2009.207	R	20	3.042	0.030	22.1*	0.7		Ole2001	0.11	0.8
08507+1800	A2473	7039	2009.265	R	10	0.256	0.003	81.7	0.7		Hrt2000c	0.05	−3.3
08531+5457	A1584	7054	2009.139	R	20	0.627	0.008	83.4*	0.3		Hei1991	−0.02	−1.9
08539+1958	COU773	–	2009.267	R	20	–	–	–	–	Unres.			
08554+7048	STF1280	7067	2009.207	R	20	2.315	0.012	350.3*	0.3		Hei1997	0.03	−0.7
09006+4147	KUI37	–	2009.265	R	10	0.456	0.005	289.0*	0.5		Sod1999	0.01	−0.9
09104+6708	STF1306	7203	2009.207	R	20	4.167	0.022	350.0*	0.3	NF	Sca1985c	0.05	−0.2
09179+2834	STF3121	7284	2009.207	R	20	0.547	0.009	213.9	0.5		Sod1999	−0.01	1.6
09210+3811	STF1338	7307	2009.139	R	20	1.070	0.012	299.2	0.5		Sca2002b	−0.04	−0.7
09245+0621	STF1348	7352	2009.267	R	20	1.936	0.010	314.3	0.3				
09245+1808	A2477	7341	2009.207	R	20	0.419	0.008	358.1	1.8		Ari1999	0.03	−3.3
09273+0614	STF1355	7380	2009.267	R	20	1.803	0.032	353.1*	0.4				
09285+0903	STF1356	7390	2009.267	R	10	0.722	0.008	101.8*	0.5		Sod1999	0.00	2.3
09521+5404	STT208	7545	2009.265	R	10	0.342	0.007	290.8*	0.8		Hei1996c	−0.03	−1.5
10163+1744	STT215	7704	2009.265	R	20	1.459	0.008	177.2*	0.5		Zae1984	−0.07	−2.1
10205+0626	STF1426	7730	2009.349	R	20	0.916	0.008	310.3*	0.7		Sca2006b	0.01	−0.8
10227+1521	STT216	7744	2009.330	R	20	2.194	0.014	234.2*	0.3	NF	Hei1978a	0.16	2.4
10250+2437	STF1429	7758	2009.330	W	20	0.755	0.008	160.2*	0.6		Zul1981	0.03	−0.4
10269+1713	STT217	7775	2009.330	R	20	0.749	0.008	149.1*	0.5		Hei1975b	0.02	1.0
10397+0851	STT224	7871	2009.330	R	20	0.505	0.008	142.9*	0.6		Hei1984b	−0.07	−5.7
11037+6145	BU1077	8035	2009.385	V	10	0.557	0.003	24.9*	0.3		Sca2005a	−0.02	−6.1
11037+6145	BU1077	8035	2009.382	R	10	0.569	0.009	25.5*	0.7		Sca2005a	−0.02	−6.1
11037+6145	BU1077	8035	2009.207	V	10	0.542	0.005	26.1*	0.3				
11136+5525	A1353	8092	2009.207	R	20	0.577	0.008	211.4*	0.4		Doc1999b	0.03	−0.4
11137+2008	STF1517	8094	2009.396	R	10	0.638	0.003	317.6	0.9		Hop1970	0.40	15.5
11182+3132	STF1523	8119	2009.265	R	20	1.594	0.008	215.0*	0.3		Sod1999	0.01	−1.7
11190+1416	STF1527	8128	2009.385	R	10	0.323	0.003	175.3	0.6		WSI2006b	−0.60	2.2^Q
11190+1416	STF1527	8128	2009.265	R	10	0.311	0.003	174.6	0.6				

WDS	Name	ADS	Epoch	Fil.	Eyep. (mm)	ρ ($''$)	σ_ρ ($''$)	θ ($^\circ$)	σ_θ ($^\circ$)	Notes	Orbit	$\Delta\rho$(O-C) ($''$)	$\Delta\theta$(O-C) ($''$)
11190+1416	STF1527	8128	2009.207	R	10	0.316	0.007	172.6	0.6				
11190+1416	STF1527	8128	2009.396	R	10	0.322	0.005	175.5*	0.3				
11190+1416	STF1527	8128	2009.382	R	10	0.319	0.004	175.2	0.9		WSI2006b	−0.60	2.2^Q
11190+1416	STF1527	8128	2009.330	R	10	0.317	0.005	174.9	0.3				
11190+1416	STF1527	8128	2009.390	R	10	0.313	0.003	175.1	0.7		WSI2006b	−0.60	2.2^Q
11190+1416	STF1527	8128	2009.349	R	10	0.302	0.003	175.4*	0.3				
11239+1032	STF1536	8148	2009.331	R	20	1.930	0.014	100.9*	0.3		Sod1999	−0.03	−0.1
11308+4117	STT234	8189	2009.265	R	20	0.489	0.008	171.2	1.1		Doc2001f	0.01	0.3
11323+6105	STT235	8197	2009.265	R	20	0.770	0.008	20.5*	0.3		Sod1999	−0.01	1.8
11363+2747	STF1555	8231	2009.390	R	10	0.729	0.004	148.9*	0.4		Doc2004a	0.04	−0.3
11388+6421	STF1559	8249	2009.391	R	20	1.957	0.010	322.9*	0.3				
11390+4109	STT237	8252	2009.391	R	20	2.024	0.014	244.1*	0.5		Sey2002	0.02	−0.9
11486+1417	BU603	8311	2009.396	R	20	1.025	0.017	335.0*	0.9		Bdl2006b	−0.06	−0.9
11520+4805	HU731	8325	2009.391	W	20	1.094	0.008	308.6*	0.3	Elongated	Lin1992b	0.14	−1.0
11537+7345	BU794	8337	2009.391	R	20	0.524	0.011	50.3*	1.0		Sod1999	0.03	0.1
12108+3953	STF1606	8446	2009.396	R	20	0.444	0.014	157.3*	1.2		Msn1999a	−0.02	2.5
12244+2535	STF1639	8539	2009.396	R	20	1.788	0.009	323.9*	0.3		Ole2000b	0.00	0.2
12306+0943	STF1647	8575	2009.396	W	20	1.279	0.011	246.7*	0.6		Hop1970	0.02	−3.2
12409+0850	STF1668	8625	2009.382	R	20	1.131	0.008	187.1	0.6				
12417−0127	STF1670	8630	2009.385	R	20	1.258	0.009	28.6*	0.6		WSI2006b	−0.03	2.2
12417−0127	STF1670	8630	2009.448	RL	20	1.258	0.009	27.2*	0.5				
12417−0127	STF1670	8630	2009.382	R	20	1.244	0.008	28.3*	0.7		WSI2006b	−0.03	2.2
12417−0127	STF1670	8630	2009.330	R	20	1.231	0.008	28.6*	0.3				
12592+8256	STF1720	8738	2009.385	W	20	1.622	0.014	329.3*	0.5	Elongated			
13007+5622	BU1082	8739	2009.382	R	20	1.098	0.008	99.0*	0.3		Sca2005a	−0.13	2.3
13048+7302	BU799	8772	2009.385	R	20	1.367	0.012	265.7*	0.3				
13064+2109	COU11	–	2009.385	R	20	1.693	0.008	315.8*	0.4				
13128+4030	A1606	8820	2009.391	W	20	1.290	0.008	196.3*	0.4				
13375+3618	STF1768	8974	2009.391	R	20	1.750	0.010	96.7*	0.3		Sod1999	0.02	0.0
14131+5520	STF1820	9167	2009.505	R	20	2.694	0.013	119.7*	0.3		Kiy1998	0.06	−1.4
14531+7811	HU908	9445	2009.541	R	20	1.536	0.008	237.4*	0.4				
14568+7050	STF1905	9460	2009.541	W	20	2.826	0.014	161.0*	0.3				
15038+4739	STF1909	9494	2009.538	R	20	1.695	0.008	58.9*	0.4		Sod1999	0.04	−0.3
15056+1138	STF1907	9498	2009.538	W	20	0.886	0.008	169.9*	1.7				
15116+1007	A1116	9530	2009.538	W	20	0.843	0.018	233.0*	1.1				
15232+3017	STF1937	9617	2009.391	R	10	0.564	0.003	160.6*	0.3		WSI2006b	−0.01	−1.3
15245+3723	STF1938BC	9626	2009.391	R	20	2.276	0.011	5.9*	0.3	(BC??)	Sod1999	0.03	0.4
15246+5413	HU149	9628	2009.541	R	20	0.658	0.011	270.8	0.4				
15264+4400	STT296	9639	2009.599	W	20	2.099	0.019	274.8*	0.3	Elongated			
15278+2906	JEF1	–	2009.541	R	10	0.203	0.008	131.4*	1.7	Diffuse	Sod1999	−0.01	−1.6
15329+3122	COU610	–	2009.599	R	20	0.825	0.008	198.7*	0.7				
15360+3948	STT298	9716	2009.541	R	20	1.058	0.008	177.9*	0.5		Sod1999	−0.02	0.2
16133+1332	STF2021Aa-B	9969	2009.593	R	20	4.091	0.020	356.1*	0.3		Hop1970	0.53	2.9
16137+4638	A1642	9975	2009.539	W	20	0.747	0.008	182.0*	1.2		Hrt2001b	0.00	−0.1
16145+0531	STF2023	9974	2009.615	W	20	1.902	0.010	224.0*	0.3				
16160+0721	STF2026	9982	2009.593	W	20	3.407	0.017	17.6*	0.3		Hei1963a	−0.01	−0.5
16231+4738	STF2047	10038	2009.599	W	20	1.830	0.009	324.6*	0.3				
16238+6142	STF2054	10052	2009.599	R	20	0.979	0.008	351.0*	0.5				
16279+2559	STF2049	10070	2009.612	R	20	1.125	0.008	195.1*	0.3				
16289+1825	STF2052	10075	2009.541	R	20	2.236	0.017	120.2*	0.3		Lmp2001a	0.02	−0.1
16309+0159	STF2055	10087	2009.612	R	20	1.418	0.008	36.9*	0.5		Hei1993b	−0.03	0.1
16309+3804	STF2059	10093	2009.612	W	20	0.373	0.016	181.9	2.1	Elongated			
16326+4007	STT313	10111	2009.615	R	20	0.934	0.008	129.9*	0.3				
16362+5255	STF2078	10129	2009.637	R	20	3.113	0.016	104.1*	0.3				

WDS	Name	ADS	Epoch	Fil.	Eyep. (mm)	ρ ($''$)	σ_ρ ($''$)	θ ($^\circ$)	σ_θ ($^\circ$)	Notes	Orbit	$\Delta\rho$(O-C) ($''$)	$\Delta\theta$(O-C) ($''$)
16420+7353	MLR198	–	2009.637	R	10	0.219	0.005	250.0	0.9		Sey2002	−0.05	48.3
16448+3544	STF2097	10193	2009.637	W	20	1.924	0.015	79.3*	0.3				
16458+3538	STF2101	10203	2009.670	R	20	4.115	0.021	47.5*	0.3				
16483+0244	BU43	10217	2009.645	R	20	1.392	0.008	54.9	0.5				
16514+0113	STT315	10230	2009.645	R	10	0.643	0.003	313.3*	0.3	Elongated	Doc1991f	−0.02	0.5
16518+2840	STF2107	10235	2009.593	R	20	1.426	0.008	100.8*	0.5		Sca2003c	0.04	−1.5
16540+2906	A350	10253	2009.656	W	20	0.594	0.010	148.7*	1.1				
16564+6502	STF2118	10279	2009.541	R	20	1.037	0.008	66.5*	0.5		Sca2002d	−0.12	−0.8
16567+1408	STT318	10270	2009.656	R	20	2.840	0.026	242.3*	0.3	NF			
16567+1408	STT318	10270	2009.656	R	20	0.209	0.009	301.1	2.0	Artefacts?			
16581+1509	STT319	10277	2009.656	R	20	0.846	0.008	64.3*	0.4				
17020+0827	STF2114	10312	2009.593	R	20	1.318	0.009	194.4*	0.3				
17053+5428	STF2130	10345	2009.541	R	20	2.394	0.012	8.5*	0.3		Hei1981b	0.04	1.9
17082−0105	A1145	10355	2009.659	R	20	0.663	0.008	346.5*	0.3		WSI2006b	0.02	−0.5
17131+5408	STF2146	10410	2009.593	W	20	2.664	0.013	224.4*	0.3				
17166−0027	A2984	10429	2009.599	R	20	0.810	0.008	14.7*	0.5		Ole1993	−0.22	1.5
17240+3835	HU1179	10531	2009.689	R	10	0.271	0.003	274.6*	0.4		Hrt2000b	0.01	3.0
17246+1536	STF2160	10528	2009.667	R	20	3.813	0.019	65.9*	0.3				
17266+3546	STF2168	10558	2009.612	W	20	2.295	0.011	201.4*	0.3				
17290+5052	STF2180	10597	2009.612	R	20	3.047	0.019	259.2	0.3				
17304−0104	STF2173	10598	2009.713	R	10	0.722	0.004	155.7*	0.3		Pbx2000b	−0.02	−0.7
17320+0249	STT331	10614	2009.637	W	20	1.000	0.021	350.4*	1.5				
17350+6153	BU962	10660	2009.593	R	20	1.055	0.011	317.2*	0.5		Sod1999	−0.03	−1.1
17386+5546	STF2199	10699	2009.686	W	20	2.030	0.010	56.0*	0.3		Pop1995a	0.11	1.8
17400−0038	BU631	10696	2009.689	W	10	–	–	–	–	Too elongated			
17400−0038	BU631	10696	2009.689	R	10	0.255	0.003	90.3	1.1				
17403+6341	STF2218	10728	2009.541	R	20	1.466	0.008	311.8*	0.3				
17412+4139	STF2203	10722	2009.541	R	20	0.741	0.017	293.2	0.3				
17434+3357	HO560	10742	2009.637	W	20	1.334	0.015	263.1*	0.3				
17436+2237	HU1285	10743	2009.686	W	20	0.596	0.012	214.9	1.1		Sey2002	0.07	0.7
17464+0542	STF2212	10779	2009.659	W	20	3.220	0.020	341.0	0.4				
17512+4454	STF2242	10849	2009.637	R	20	3.352	0.017	325.8	0.3				
17520+1520	STT338	10850	2009.615	R	20	0.811	0.008	165.3*	0.4				
17533+4000	BU130	10875	2009.645	V	20	1.585	0.011	110.3*	0.5	NF			
17533+4000	BU130	10875	2009.645	RL	20	1.567	0.020	110.1*	0.6	NF			
17533+4000	BU130	10875	2009.637	R	20	1.574	0.027	110.1	0.7				
17541+2949	AC9	10880	2009.615	W	20	1.067	0.008	241.0*	0.5				
17564+1820	STF2245	10905	2009.656	R	20	2.613	0.013	111.1*	0.3				
17571+0004	STF2244	10912	2009.683	R	10	0.631	0.003	98.4	0.3		Hei1997	0.10	−1.8
18014+6557	STF2284	11016	2009.667	W	20	3.589	0.018	191.6*	0.3				
18018+0118	BU1125	10990	2009.659	R	10	0.488	0.007	139.6*	0.3		Pop2000a	−0.10	−0.9
18025+4414	BU1127AB	11010	2009.683	R	20	0.740	0.010	53.0*	0.8				
18070+3034	AC15	11077	2009.659	RL	20	1.089	0.012	311.8*	0.4		Sod1999	0.01	1.8
18078+2606	CHR67Aa	11089	2009.656	R	10	0.242	0.007	136.1	1.0	NF	Msn2001a	−0.04	-6.4^Q
18096+0400	STF2281	11111	2009.713	R	10	0.633	0.003	288.4*	0.3		Sod1999	−0.01	1.2
18096+0609	STF2283	11110	2009.615	W	20	0.646	0.013	55.9*	1.0				
18097+5024	HU674	11128	2009.683	R	20	0.736	0.008	215.9*	0.7		Sey2002	0.14	1.9
18101+1629	STF2289	11123	2009.686	R	20	1.231	0.008	219.4*	0.5		Hop1964b	−0.01	2.9
18113+6915	STF2307	11178	2009.667	W	20	4.349	0.022	205.5*	0.3				
18118+3327	HO82	11149	2009.656	RL	20	0.686	0.010	218.3*	0.8				
18121+2739	STF2292	11155	2009.615	W	20	0.867	0.022	274.7*	0.5				
18126−0329	A83	11154	2009.670	W	20	0.739	0.010	303.3*	0.4	Elongated			
18126+3836	BU1091	11170	2009.593	W	20	0.710	0.011	319.9*	0.5				
18146+0011	STF2294	11186	2009.686	W	20	1.307	0.010	93.2*	0.3		WRH1935b	0.31	1.8

WDS	Name	ADS	Epoch	Fil.	Eyep. (mm)	ρ ($''$)	σ_ρ ($''$)	θ ($^\circ$)	σ_θ ($^\circ$)	Notes	Orbit	$\Delta\rho$(O-C) ($''$)	$\Delta\theta$(O-C) ($''$)
18208+7120	STT353	11311	2009.683	R	10	0.491	0.003	266.5*	0.4		Ana2005	-0.00	−1.1
18218+2130	BU641	11287	2009.615	R	20	0.775	0.011	341.1	1.1				
18239+5848	STF2323	11336	2009.656	R	20	3.728	0.019	348.3*	0.3	NF			
18250−0135	AC11	11324	2009.689	R	20	0.883	0.008	355.8*	0.3		Hei1995	0.05	1.1
18250+2724	STF2315	11334	2009.684	R	20	0.657	0.008	118.7*	0.4		WSI2004b	0.03	−0.6
18253+4846	HU66BC	11344	2009.656	R	20	0.941	0.012	27.7*	0.4	Outer peaks			
18253+4846	HU66AB	11344	2009.656	R	20	0.179	0.013	40.8	1.9	In-out peaks			
18253+4846	STT351AC	11344	2009.656	R	20	0.768	0.008	24.6*	0.3	Inner peaks			
18261+0047	BU1203	11339	2009.689	R	20	0.479	0.020	157.3*	1.1		Pop1996b	-0.00	1.9
18269+0625	STT350	11349	2009.659	W	20	1.827	0.009	166.3*	0.3				
18272+0012	STF2316	11353	2009.689	R	20	3.679	0.018	319.6*	0.3				
18272+0012	STF2316	11353	2009.689	R	10	0.216	0.012	296.9	2.3	Elongated			
18278+2442	STF2320	11373	2009.659	R	20	1.110	0.014	359.6	0.7				
18295+2955	STF2328	11397	2009.667	W	20	3.689	0.018	71.5*	0.3	Elongated			
18310+0123	STF2324	11410	2009.667	W	20	2.366	0.012	148.2*	0.3				
18314+0628	STF2329	11420	2009.667	W	20	4.229	0.021	43.0*	0.3				
18320+0647	STT354	11432	2009.659	W	20	0.616	0.012	211.7*	1.4				
18339+5221	A1377	11468	2009.714	R	10	0.240	0.003	125.2*	0.7		Sca1984e	-0.00	−3.4
18355+2336	STT359	11479	2009.684	R	20	0.740	0.008	5.5*	1.0		Sym1964b	0.01	1.1
18359+1659	STT358	11483	2009.684	R	20	1.641	0.009	150.6*	0.3		Pal1998b	0.24	3.0
18360+1144	STT357	11484	2009.670	R	20	0.391	0.011	83.5	1.3		Val1981d	0.04	8.1
18374+7741	STT363	11584	2009.714	R	20	0.447	0.012	338.9*	0.6	Elongated	Alz2006c	−0.01	−4.9
18384+0850	HU198	11524	2009.670	R	20	0.461	0.008	125.8*	1.3	1			
18389+5221	STF2368	11558	2009.670	R	20	1.888	0.009	140.3*	0.3				
18413+3018	STF2367	11579	2009.659	R	10	0.392	0.008	74.3	0.3	NF	Pbx2000b	-0.00	−0.4
18443+3940	STF2383Cc-D	11635	2009.612	R	20	2.372	0.012	78.6*	0.3	(CD pair)	Doc1984b	0.00	0.2
18443+3940	STF2382AB	11635	2009.612	R	20	2.329	0.012	347.7*	0.3	(AB pair)	Nov2005	−0.01	−0.0
18455+0530	STF2375	11640	2009.659	RL	20	2.562	0.013	119.7*	0.3	Elongated			
18458+3431	STF2390	11669	2009.670	R	20	4.213	0.021	154.9*	0.3				
18469+5920	STF2410	11697	2009.615	W	20	1.691	0.009	85.7*	0.3				
18472+3125	STF2397	11685	2009.670	W	20	3.896	0.021	267.0*	0.3	NF			
18540+3723	BU137	11811	2009.615	W	20	1.552	0.008	162.4*	0.3				
18545+2037	STF2415	11816	2009.670	RL	20	1.999	0.010	289.4*	0.4	NF			
18549+3358	STT525	11834	2009.741	RL	20	1.779	0.012	129.7*	0.6	NF			
18559+0323	A2193	11844	2009.746	W	20	0.884	0.008	355.0*	0.7				
18570+3254	BU648	11871	2009.741	RL	20	1.052	0.011	257.4*	0.5		Sod1999	0.02	1.0
18571+2606	STF2422	11869	2009.667	R	20	0.767	0.008	70.9	0.6				
18575+5814	STF2438	11897	2009.741	R	20	0.843	0.010	358.3*	0.6		Hrt2001a	0.01	0.1
18576+3209	A260	11879	2009.746	W	20	0.895	0.008	245.1*	0.3				
18581+4711	AG366	11899	2009.667	R	20	1.459	0.008	190.1	0.3				
18588+0207	MIL6	11891	2009.817	W	20	0.546	0.009	86.5*	0.7	Elongated			
18594+2936	STF2430	11914	2009.667	W	20	1.537	0.008	187.1*	0.4				
19019+1910	STF2437	11956	2009.744	W	20	0.600	0.011	9.8*	1.0		Sca2006a	0.03	0.8
19037+3545	STF2448	12002	2009.667	W	20	2.445	0.012	191.1*	0.3				
19042+3245	BRD4	12008	2009.714	W	20	2.535	0.013	310.1*	0.3				
19055+3352	HU940	12033	2009.689	W	20	0.488	0.008	191.3*	1.2		Hei2001	0.01	0.2
19062+3026	STF2454	12040	2009.744	W	20	1.324	0.011	289.2*	0.8		Sta1982b	−0.01	0.3
19070+1104	HEI568	–	2009.689	R	10	0.298	0.004	271.2	0.8				
19078+3856	STF2469	12075	2009.714	W	20	1.230	0.008	125.6*	0.3				
19079+2948	STF2466	12071	2009.714	W	20	2.398	0.012	101.9*	0.3	Elongated			
19126+1651	BU139	12160	2009.744	R	20	0.650	0.008	135.4*	0.5				
19159+2727	STT371	12239	2009.744	R	20	0.866	0.008	159.8*	0.4				
19160+1610	STT368	12236	2009.746	R	20	1.143	0.008	218.7*	0.5				
19169+6312	STF2509	12296	2009.746	R	20	1.810	0.009	328.1*	0.3				

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19177+2302	BU248	12287	2009.746	RL	20	1.695	0.008	128.3*	0.3	NF			
19186+2157	STF2499	12298	2009.757	W	20	2.600	0.013	323.6*	0.3				
19186+5358	A1393	12315	2009.746	W	20	0.701	0.008	253.0*	0.8				
19202+3411	HU1300	12334	2009.741	W	20	0.727	0.008	181.8*	0.5				
19252+0227	STF2513	12414	2009.741	W	20	1.984	0.010	328.8*	0.3				
19252+3708	HJ1395	12427	2009.741	W	20	2.802	0.017	63.0*	0.3				
19266+2719	STF2525	12447	2009.615	W	20	2.126	0.019	289.4*	0.3		Hei1984b	0.02	−0.6
19269+1204	A1181	12452	2009.684	W	20	0.716	0.011	199.4*	1.3				
19334+6203	STF2553	12626	2009.684	W	20	0.973	0.008	128.6*	0.3				
19346+1808	STT375	12623	2009.684	W	20	0.648	0.021	183.5*	1.8				
19389+5150	BU656	12758	2009.741	W	20	0.888	0.011	271.1*	0.4				
19406+6240	STF2574	12803	2009.820	R	20	0.510	0.008	89.5	1.3				
19413+3043	BU145	12786	2009.684	W	20	0.809	0.027	271.7*	0.8				
19426+1150	STT380	12808	2009.817	R	10	0.394	0.003	75.9*	0.3				
19429+4043	STT383	12831	2009.757	R	20	0.795	0.008	14.9*	0.6				
19438+3819	STT384	12851	2009.757	R	20	1.049	0.008	196.3	0.5				
19450+4508	STF2579	12880	2009.656	RL	20	2.679	0.013	219.1*	0.3		Sca1983a	0.00	−1.0
19458+4033	STT385	12904	2009.820	W	20	1.261	0.008	50.5*	0.4				
19464+3344	STF2576	12889	2009.656	R	20	2.868	0.018	159.2*	0.3		Lmp2001a	−0.02	0.4
19471+3321	HU758	12930	2009.818	W	20	0.897	0.010	144.2*	0.7				
19487+1149	STF2583	12962	2009.714	R	20	1.458	0.008	104.7*	0.3				
19535+2405	DJU4	–	2009.744	RL	20	1.385	0.012	244.8*	0.7		Pop2002a	0.36	−2.8
19540+1518	STF2596	13082	2009.757	W	20	2.019	0.010	299.3*	0.3				
19556+5226	STF2605	13148	2009.757	RL	20	2.876	0.014	175.4*	0.3				
19576+1524	A1663	13166	2009.757	W	20	1.291	0.008	236.3*	0.5				
19585+3317	STF2606	13196	2009.757	R	20	0.714	0.010	145.1*	1.1				
19594+3206	A378	13212	2009.861	R	20	0.907	0.008	292.3*	0.4				
20020+2456	STT395	13277	2009.757	R	10	0.800	0.004	125.0*	0.3				
20040+1221	A1194	13314	2009.741	W	20	1.028	0.013	316.5	0.5				
20043+3033	STF2626	13329	2009.741	W	20	0.975	0.010	127.7*	0.5				
20056+6342	STF2642	13392	2009.746	W	20	1.793	0.009	189.1*	0.3				
20074+3543	STT398	13405	2009.741	W	20	0.938	0.012	81.4*	1.0				
20080+4223	A382	13415	2009.746	RL	20	1.682	0.011	96.1*	0.3	NF			
20102+4357	STT400	13461	2009.746	R	20	0.643	0.011	335.4	0.6		Pbx2000b	0.02	1.7
20144+4206	STT403	13572	2009.746	R	20	3.395	0.030	154.3	0.3	Artefacts?			
20144+4206	STT403	13572	2009.746	R	20	0.942	0.008	170.1	0.5				
20198+4522	STT406	13723	2009.818	R	20	0.289	0.008	102.1	1.4		Sta1977b	−0.19	−5.7
20303+1054	BU63	13920	2009.818	R	20	0.907	0.008	349.6*	0.4				
20370+1203	STF2701	14063	2009.757	W	20	2.042	0.010	221.1*	0.4				
20375+1436	BU151	14073	2009.757	R	10	0.374	0.003	21.7*	0.5		Sod1999	−0.01	0.0
20423+5723	BU152	14196	2009.861	R	20	1.180	0.008	82.4*	0.6				
20449+1219	STF2723	14233	2009.818	R	20	1.038	0.009	136.1*	0.5				
20450+1244	BU64	14238	2009.818	W	20	0.664	0.010	353.1	0.5		Hei1995	0.20	−1.4
20471+2525	BU364	14286	2009.818	W	0	0.788	0.008	70.4	0.3				
20478+0600	BU65	14293	2009.818	RL	20	1.491	0.008	198.9*	0.5				
20481+2727	BU66	14312	2009.747	W	20	1.051	0.012	168.3*	0.3				
20486+5029	BU366	14331	2009.747	W	20	1.481	0.008	129.6*	0.3				
20511+0623	STF2730	14359	2009.741	W	20	3.307	0.020	333.2*	0.3				
20531+2909	STT417	14397	2009.741	W	20	0.882	0.008	27.5*	0.6	Elongated			
20591+0418	STF2737	14499	2009.747	R	10	0.535	0.003	284.8	0.4		Zel1965	0.02	1.2
20595+5013	BU68	14520	2009.861	W	20	1.922	0.010	148.5*	0.3				
20598+6152	BU472	14540	2009.861	W	20	0.775	0.008	15.3*	0.5				
21015+6643	HU959	14578	2009.861	W	20	1.291	0.008	161.3*	0.3	Elongated			
21055+6210	HU765BC	14634	2009.861	W	20	0.787	0.008	28.0*	0.8				

WDS	Name	ADS	Epoch	Fil.	Eyep. (mm)	ρ ($''$)	σ_ρ ($''$)	θ ($^\circ$)	σ_θ ($^\circ$)	Notes	Orbit	$\Delta\rho$(O-C) ($''$)	$\Delta\theta$(O-C) ($''$)
21183+3456	BU289	14837	2009.820	W	20	0.795	0.012	127.0*	0.3				
21186+1134	BU163	14839	2009.757	W	20	0.801	0.008	257.4*	1.5		Sod1999	0.01	0.6
21199+4307	COU2439	–	2009.820	W	20	0.722	0.011	265.4*	0.9				
21227+5214	HU591	14931	2009.820	W	20	0.725	0.008	128.1*	0.3				
21237+5518	A1892	14945	2009.820	W	20	0.752	0.008	348.6*	0.5				
21268+4228	A619	14992	2009.960	W	20	0.747	0.013	59.6*	0.7				
21446+2539	BU989	15281	2009.940	R	10	0.262	0.003	115.5*	0.5		Sod1999	−0.01	−2.2
21523+6306	STF2845	15417	2009.943	W	20	1.974	0.010	173.0*	0.3				
21555+1053	BU75	15447	2009.861	W	20	0.962	0.008	22.6*	0.4		Hei1996a	−0.01	0.3
22257+5631	A1463	15933	2009.957	W	20	0.917	0.008	333.0*	0.3				
22288−0001	STF2909	15971	2009.941	RL	20	2.137	0.011	168.9*	0.3		Ole2004a	−0.08	−4.6
22288−0001	STF2909	15971	2009.820	R	20	2.109	0.011	169.2*	0.3				
22288−0001	STF2909	15971	2009.957	R	20	2.123	0.011	168.9*	0.3				
22419+2126	STF2934	16185	2009.818	W	20	1.361	0.008	57.6*	0.3		Hei1981a	0.14	0.7
22425+3917	BU176	16198	2009.820	W	20	2.565	0.013	53.7*	0.3				
22485+5409	AG424	16280	2009.818	W	20	2.234	0.011	134.6*	0.3				
22509+5303	BU1332	16310	2009.821	W	20	1.505	0.008	128.8*	0.3				
22557+1547	HU987	16373	2009.941	W	20	1.139	0.010	78.0*	0.3		Hei1984a	0.16	−0.0
22569+1151	STF2958	16389	2009.957	RL	20	3.893	0.019	13.9*	0.3	NF			
23079+7523	STT489	16538	2009.957	RL	20	1.111	0.008	353.1*	0.9		Sod1999	−0.01	−1.0
23133+2205	STF2990	16602	2009.941	W	20	2.536	0.013	55.9*	0.3	Diffuse			
23340+3120	BU720	16836	2009.957	R	0	1.312	0.008	100.0*	0.3		Sta1982b	0.78	−3.9
23375+4426	STT500	16877	2009.957	R	10	0.464	0.003	10.3	0.7		Zul1981	0.04	−4.3

Note: In column 9, the exponent * indicates that the position angle θ could be determined without the 180° ambiguity.

3.1 Multiple systems

ADS 719: this object is known as a wide triple system. In 2009, we measured the AB and AC pairs, with $\rho = 3.95$ and $\rho = 1.53$, respectively.

ADS 2377 (new discovery): although this star is only catalogued as a binary, the secondary peaks of our auto-correlations are clearly double in the observations made in 2009.081 (see Fig. 3). However, we were unable to see those features in our previous observations in 2005 (Paper xxx). We propose to call this pair STT 50BC, where C is the new component.

ADS 11344: this object is known as a quadruple system. We already observed it in 2004.690, 2005.594, and 2007.671 (Paper VIII). In Paper VIII, we presented an image of the auto-correlation with clear double secondary peaks. In 2009, we also obtained similar peaks and could measure the AB and AC components. The innermost peaks correspond to STT 351AC and the outermost ones to HU 66BC. Finally, each couple composed by the big and small secondary peaks correspond to HU 66AB. (see Paper VIII).

ADS 11635: two known couples could be measured for this object: STF2382 AB and STF22383 CD.

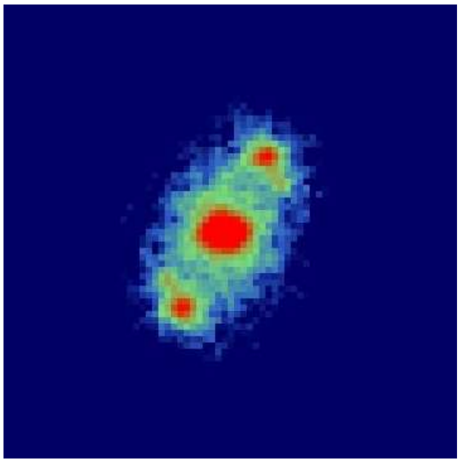

Fig. 3 Auto-correlation of the newly discovered triple system ADS 2377.

3.2 Quadrant determination

As our measurements were obtained from the *symmetric* auto-correlation files, the θ values first presented a 180° ambiguity. To resolve this ambiguity and determine the quadrant containing the companion, we have used Aristidi et al. (1997)'s method by computing and analysing restricted triple correlation (RTC hereafter) files. For the couples with the largest separations, a straightforward determination could be done when the companions were visible in the long integration files.

As a result, in Table 1, we are able to give the unambiguous (i.e. "absolute") position angles of 280 out of 345 measurements, i.e. 81% of the total. They are marked with an asterisk in Col 9. Otherwise, our angular measurements were reduced to the quadrant reported in the WDS catalogue, which is extracted from the "Fourth Catalogue of Interferometric Measurements of Binary Stars" (Hartkopf et al. 2010, hereafter IC4),

Our "absolute" θ values are consistent with the values tabulated in IC4 for all objects except for ADS 710, 2980, 8820, 9498, 9530, 10905, 11558 and 14839. For all those objects, there is a good contrast between the two secondary peaks of the RTC in all those cases, which is a good indication of the validity of our quadrant determination. We displays some parameters of all those objects in Table -4. In Col. 2, we indicate the quadrant (Q) we found with the RTC, using the usual convention of numbering them from 1 to 4 to indicate the North-East, South-East, South-West and North-West quadrants, respectively. In Col. 3 we recall the filter we have used (W indicates the absence of filter: the corresponding bandpass is close the R filter bandpass). In Col. 4 and 5, we give the differences of magnitude between the two components and the global spectral types found in the WDS catalogue, and the SIMBAD astronomical data base.

Except for ADS 14839, the small value of Δm_V can account for the difficulty of measuring the quadrant for all those binaries. Furthermore, the measurements from other observers reported in IC4 were all obtained in B or V, whereas we observed in R (or W which is similar). A quadrant inversion between V and R is likely, when the two stars have a different spectral type (e.g. blue primary and red secondary). This would well explain a different quadrant measurement in V (in the IC4) and in R (with PISCO).

For ADS 14839, there is instead a rather large difference of magnitude between the components (1.6 mag). Our estimation of Q=3 seems reliable in the RTC and is consistent with nearly all the observations made between 1977 and 2008, reported in IC4, and with our previous quadrant determination of 2004.950. The value Q=1 reported in the WDS Catalogue likely refers to the observation of Tok2010, made in 2008.7723, which departs from the other measurements. Indeed, in IC4 there are only 3 measurements with Q=1 among the 31 measurements obtained since 2000.

3.3 Comparison with published ephemerides

The $(O-C)$ (Observed minus Computed) residuals of the measurements for the 151 systems with a known orbit in Table 1 are displayed in Cols. 13 and 14 for the separation ρ and position angle θ, respectively. The orbital elements used for computing the ephemerides were retrieved from the "Sixth Catalogue of Orbits of Visual Binary Stars" (Hartkopf & Mason, 2010, hereafter OC6). The corresponding authors are given in Col. 12, using the style of the OC6 references.

Table -4 Objects with discrepant quadrants

Name	Q	Filter	Δm_V	Spectral type
ADS 710	1	W	0.01	A2
ADS 2980	2	R	0.01	G5
ADS 8820	3	W	0.01	K0
ADS 9498	2	W	0.01	G0
ADS 9530	3	W	0.2	A9V
ADS 10905	2	R	0.1	A0III
ADS 11558	2	R	0.1	F2
ADS 14839	3	W	1.6	G0

The residuals reported in this table were computed with a selection of valid orbits found in the "master" file of the OC6 catalogue. We did not always use the most recent orbits since sometimes older orbits led to equivalent or even smaller residuals. We think that the publication of many new orbits is not always scientifically justified. Indeed, a residual difference of 1–2° in θ and a few hundreds of arcseconds in ρ is meaningless, and two orbits leading to residuals in that range, can be regarded as equally good.

Fig. 4 shows that the residuals are well centered around the origin, with a rather large scatter that can be explained by the (old) age of many orbits. The mean values computed with the residuals of Table 1 are $< \Delta\rho_{O-C} >= xxxxx0''.00 \pm 0''.07$ and $< \Delta\theta_{O-C} >= xxxxx - 0^\circ.1 \pm 1^\circ.9$. The small values obtained for those offsets provide an additional validation of our calibration made with a grating mask (see Paper III).

In the following, we examine the cases of ADS xxxxx that appear with the largest residuals in Fig. 4.

4 Revised orbits of ADS xxxx

5 Conclusion

In 2009, we obtained 345 new measurements of 259 visual binaries with PISCO in Merate, with an average accuracy of $0''.011$ for the angular separation and $0^\circ.6$ for the position angles. The total number of measurements made in Merate since 2004 now exceeds 1100. This work is thus a good contribution to the continuing monitoring of long period visual binary systems, which is important for refining systemic stellar masses.

We have found a new component for ADS 2377, which is thus a new triple star system.

We have used the measurements reported here to revise the orbits of ADS xxxx and xxxx, whose elements are presented in this paper.

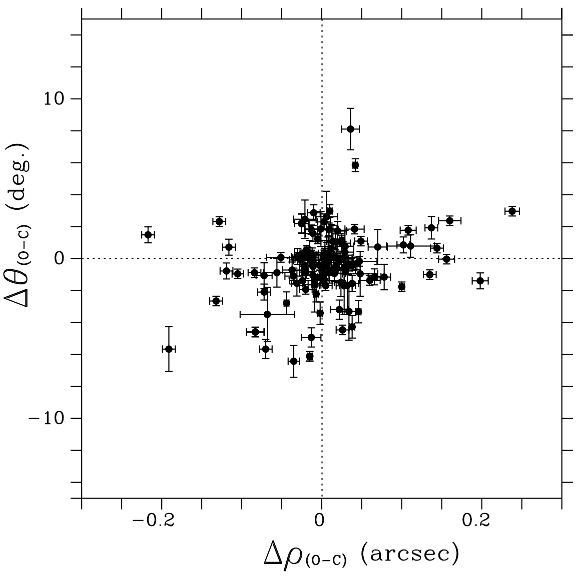

Fig. 4 Residuals of the measurements of Table 1 from the published orbits.

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