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ABSTRACT
We present relative astrometric measurements of visual binaries made during the first semester of 2006, 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 217 new measurements of 194 objects, with angular separations in the range $0''.1$ — $4''.2$, and an average accuracy of $0''.01$. The mean error on the position angles is $0^\circ.5$. About half of those angles could be determined without the usual 180-degree ambiguity by the application of triple-correlation techniques. We also present a revised orbit for ADS 277 for which the previously published orbit resulted in a large residual from our measurements.

Key words: Stars: binaries: close – binaries: visual – individual : ADS 277 — astrometry — techniques: interferometric

1 INTRODUCTION

This paper is the fifth of a series (Scardia et al. 2005a, 2005b, 2007a, 2008a, herein: Papers I, II, III and IV), whose purpose is to contribute to the determination of binary orbits, using speckle observations made in Merate (Italy) 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). PISCO was developed at *Observatoire Midi-Pyrénées* and first used at *Pic du Midi* from 1993 to 1998. More information about the context and the purpose of this program can be found in Paper I.

This paper presents the results of the observations performed during the first semester of 2006. In Sect. 2, we briefly describe our sample, the instrumental setup and the reduction procedure. The astrometric measurements are presented and discussed in Sect. 3. In Sect. 4 we present a revised orbit for ADS 277, whose measurement led to a large angular residual with the previously published orbit.

2 OBSERVATIONS AND DATA REDUCTION

The purpose of our long term program is to monitor the relative motion of all visual binaries accessible with PISCO on the Zeiss telescope in Merate, for which new measurements are needed to improve their orbits. Our sample consists of visual binaries with the following characteristics, which are imposed by instrumental or atmospheric limitations:

- declination north of -5 degrees,
- brighter than 9.5 magnitude in V,
- magnitude difference less than 4,
- angular separation smaller than $\approx 4''.5$.

The last limitation was chosen so that the binary systems fit inside the isoplanatic patch of the atmosphere, which is a theoretical necessary condition for speckle measurements. The distribution of the angular separations measured in this paper is displayed in Fig. 1 and shows a maximum for $\rho \approx 0''.7$.

The observations were carried out with the PISCO speckle camera with the ICCD detector (CCD intensified with a micro-channel plate) belonging to Nice University (France). Details about the telescope and the instrumentation can be found in Paper I and in Prieur et al. (1998). For each observation, a series of about 10 000 short-exposure frames were digitized and processed in real-time with a Pentium III PC, to compute the mean auto-correlation with Worden's (1977) method (which subtracts most part of the continuum), the mean power spectrum and the integration of the individual frames. Those frames were also recorded

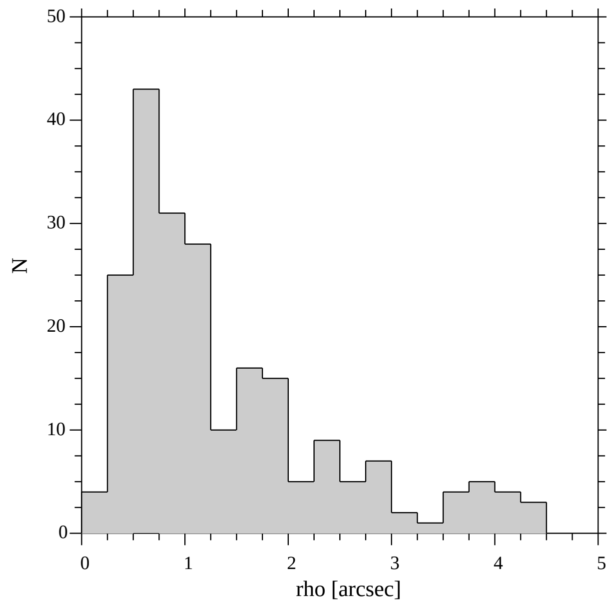

Figure 1. Histogram of the angular separations of the 217 measurements reported in this paper.

on a SVHS video tape for archiving and further processing such as the quadrant determination.

As the auto-correlation function is symmetric relative to the origin, it does not contain information about the location of the faintest companion. This is the origin of the well-known 180-degree ambiguity of binary speckle measurements. This ambiguity can be solved by using the mean triple-correlation function of the elementary frames (Weigelt, 1977) or a restricted version of this function as proposed by Aristidi et al. (1997), which is the method we use (see Paper III).

The positions of the secondary peaks of the mean auto-correlations were carefully measured with an interactive program that fitted and subtracted the residual background. The details of this procedure with an evaluation of the reliability of the determination of the errors can be found in Paper III. For the binaries with the smallest separations (i.e. $\rho \lesssim 0''.3$) we also subtracted a model of the central background pattern to the auto-correlation images, as described in Paper IV.

3 ASTROMETRIC MEASUREMENTS

The astrometric measurements of the observations made during the first semester of 2006 are displayed in Table 1. The designation of the binary is reported in the first three columns: the WDS name (Washington Double Star Catalogue, Mason et al. 2007) 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), 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.

The characteristics of the PISCO R and V filters were given in Table 1 of Paper III. Some objects, like ADS 8959 and 10107, were observed without any filter because they were too faint for successful observations with either the V or R filter to be obtained. For average atmospheric conditions, this generally concerns the objects fainter than $m_v \approx 9$ (with the 20 mm eyepiece). In this case we report W (for "white" light) in the filter column (Col. 5). The corresponding bandpass is that of the ICCD detector, with a central wavelength of about 650 nm, close to that of the R filter.

The errors reported in Cols. 8 and 10 were computed by adding quadratically the calibration errors to the standard deviations of series of measurements obtained with the same data sets (see Paper III). As for the previous papers of this series, the minimum (one-sigma) errors for the angular separation (Col. 8) were set to $0''.003$ for close pairs and to 0.05% of ρ for wide pairs, on the basis of the uncertainties coming from the determination of the centres of the auto-correlation peaks (estimated at 0.1 pixel in the elementary frames) and those affecting the scale calibration (i.e., 0.05%), respectively. Similarly, the minimum (one-sigma) errors for the position angle (Col. 10) were estimated at $0^\circ.3$. The average values of the errors of the 217 measurements reported in this table are $0''.011 \pm 0''.006$ and $0^\circ.5 \pm 0^\circ.4$ for ρ and θ, respectively. The validity of our error determination was studied in detail in Paper III.

In Table 1 we also report the only one case of non-detection, i.e., for CHR 179Aa, which may indicate that its separation was smaller than the angular resolution of our telescope (i.e. $\rho \lesssim 0''.13$).

The position angles presented in Col. 9 follow the standard convention with the North corresponding to $\theta = 0^\circ$ and the East to $\theta = 90^\circ$. Those angles were measured on the auto-correlation functions, which generally leads to an ambiguity of 180°. When the triple correlation files allowed us to solve this ambiguity (see Sect. 2 and 3.1), an asterisk was added in Col. 9 to indicate that our determination is absolute. Otherwise, our angular measurements have been reduced to the quadrant reported in the "Fourth Catalogue of Interferometric Measurements of Binary Stars" (Hartkopf et al. 2007, hereafter IC4).

In Col. 11, a flag is set to one for all the systems for which an orbit was found in the literature, e.g. mainly from the "Sixth Catalogue of Orbits of Visual Binary Stars" (Hartkopf & Mason, 2007), hereafter OC6. The residuals derived from the corresponding ephemerides will be discussed in Sect. 3.2.

3.1 Quadrant determination

As mentioned in Sect. 2, we have used the restricted triple-correlation technique of Aristidi et al. (1997) to try solving the 180° ambiguity in the θ measurements made from the auto-correlation files and determine the quadrant containing the companion. For each observation, we examined the location on the triple-correlation file of the faintest secondary spot, which corresponded to that of the companion. When the signal-to-noise ratio was good enough, we were able to unambiguously determine the location of this spot and thus solve the 180° ambiguity. This occurred in 115 out of 217 measurements, i.e. 53% of the total (marked with an asterisk in Col 9 of Table 1). When checking whether those "absolute" θ values were consistent with the values tabulated in

Table 1. Measurements of visual binaries between January and June 2006 (begin).

WDS	Name	ADS	Epoch	Fil.	Eyep. (mm)	ρ (arcsec)	σ_ρ (arcsec)	θ (deg.)	σ_θ (deg.)	Orb.	Notes
00014+3937	HLD 60	17178	2006.012	R	20	1.275	0.008	170.4*	0.3	1	
00022+2705	BU 733AB	17175	2006.012	R	20	0.823	0.014	244.2*	0.7	1	
00028+0208	BU 281AB	9	2006.012	R	20	1.562	0.008	162.9*	0.3	0	
00039+2759	A 429AB	24	2006.017	R	20	0.551	0.008	332.5	1.1	0	
00047+3416	STF3056AB	32	2006.017	R	10	0.719	0.009	142.6*	0.3	0	
00048+4358	A 203	39	2006.020	R	20	1.903	0.010	347.4*	0.3	0	
00049+4540	BU 997	41	2006.020	R	20	3.946	0.020	337.0*	0.3	0	
00049+5832	STF3057	36	2006.028	R	20	3.850	0.019	297.8*	0.3	0	
00059+1805	STF3060AB	60	2006.055	R	20	3.398	0.017	132.5*	0.3	0	Diffuse
00063+5826	STF3062	61	2006.028	R	20	1.509	0.008	339.6*	0.3	1	
00118+2825	BU 255	147	2006.036	R	20	0.492	0.013	69.2*	0.5	0	
00118+6608	STT 1	145	2006.039	R	20	1.553	0.018	211.7*	0.3	0	
00134+2659	STT 2AB	161	2006.012	R	10	0.404	0.003	164.5*	0.3	1	
00137+0635	BU 998	167	2006.017	R	20	1.291	0.026	107.6	0.5	0	
00162+7657	STF 13	207	2006.025	R	20	0.949	0.008	50.6	0.5	1	
00167+3638	STF 19	220	2006.036	R	20	2.327	0.012	139.7*	0.3	0	
00192+5942	KR 4	263	2006.028	R	20	2.235	0.011	180.9*	0.3	0	
00205+4531	A 647	277	2006.036	R	20	0.685	0.017	106.4*	0.9	1	
00206+1219	BU 1015	281	2006.017	R	20	0.460	0.011	98.6*	1.2	1	
00209+3259	AC 1	285	2006.017	R	20	1.842	0.009	287.9*	0.3	0	
00210+6740	HJ 1018	283	2006.025	R	20	1.697	0.009	87.2	0.3	1	
00226+5417	A 907	304	2006.036	R	20	0.807	0.013	212.2	1.7	0	
00308+4732	BU 394	416	2006.028	R	20	0.478	0.007	94.1*	0.3	1	
00310+3406	STF 33	421	2006.031	R	20	2.808	0.016	212.6	0.3	0	
00318+5431	STT 12	434	2006.036	R	10	0.313	0.003	202.7	0.8	1	
00334+4739	A 911	461	2006.039	R	20	0.649	0.008	315.2	0.5	0	
00376+2240	HU 411	524	2006.039	R	20	0.686	0.014	107.8	0.7	0	
00402+4715	BU 257	559	2006.031	R	20	0.657	0.008	248.8*	0.4	0	
00442+4614	STF 52	616	2006.053	R	20	1.385	0.008	4.1	0.3	0	
00452+5333	HLD 3	626	2006.039	R	20	2.985	0.017	51.3*	0.3	0	
00455+4324	BU 865AB	627	2006.031	R	20	1.267	0.014	192.5	0.4	0	
00499+2743	STF 61	683	2006.031	R	20	4.291	0.021	115.2*	0.3	0	
00504+5038	BU 232AB	684	2006.025	R	20	0.892	0.008	249.6	0.3	1	
00546+1911	STT 20AB	746	2006.012	R	10	0.547	0.003	186.3*	0.4	1	
00550+2338	STF 73AB	755	2006.012	R	10	0.979	0.005	317.4*	0.3	1	
00551+2811	A 437AB	758	2006.066	R	20	2.980	0.015	29.0	0.3	0	
00554+3040	BU 500	768	2006.017	R	20	0.496	0.017	120.9*	1.5	0	
01014+1155	BU 867	828	2006.066	R	20	0.631	0.008	355.9	0.6	1	
01015+6922	A 2901	836	2006.026	R	10	0.440	0.004	59.7	0.8	1	
01030+4723	STT 21	862	2006.025	R	20	1.203	0.008	174.7*	0.3	1	
01037+5026	HU 517AB	871	2006.067	R	20	0.553	0.008	27.4	1.1	0	
01095+4715	STT 515AB	940	2006.028	R	10	0.506	0.003	121.8*	0.3	1	
01097+2348	BU 303	955	2006.031	R	10	0.629	0.005	292.0	0.4	0	
01112+3743	HO 215	–	2006.039	V	10	0.094	0.004	225.4	2.3	0	
01119+4748	BU 398	978	2006.053	R	20	1.848	0.010	43.9	0.3	0	
01191+8052	STT 28AB	1030	2006.056	R	20	0.854	0.008	285.9*	0.4	0	
01356+7227	A 816	1226	2006.026	R	20	0.876	0.008	128.2*	0.3	0	
01401+3858	STF 141	1305	2006.031	R	20	1.677	0.008	302.6	0.3	0	
01424−0645	A 1	1345	2006.091	R	20	0.825	0.008	250.2	0.7	1	Elongated
01437+0934	BU 509	1360	2006.094	R	20	0.656	0.008	53.0	0.5	1	
01493+4754	STF 162Aa-B	1438	2006.039	R	20	1.915	0.018	200.3*	0.3	0	
01546+5956	A 953	1509	2006.037	R	20	0.819	0.012	63.2	0.9	0	
01559+0151	STF 186	1538	2006.031	R	10	0.926	0.005	244.6	0.8	1	
01564+6116	STF 182AB	1531	2006.026	R	20	3.572	0.018	123.6	0.3	0	

Table 1. Measurements of visual binaries between January and June 2006 (cont.).

WDS	Name	ADS	Epoch	Fil.	Eyep. (mm)	ρ (arcsec)	σ_ρ (arcsec)	θ (deg.)	σ_θ (deg.)	Orb.	Notes
01593+2450	STF 194	1579	2006.037	R	20	1.253	0.011	278.2	0.3	0	
02020+0246	STF 202AB	1615	2006.012	V	20	1.857	0.009	269.1*	0.3	1	
02037+2556	STF 208AB	1631	2006.037	R	20	1.246	0.014	338.7*	0.4	1	
02140+4729	STF 228	1709	2006.026	R	10	0.908	0.005	287.9*	0.3	1	
02157+2503	COU 79	–	2006.053	R	10	0.182	0.003	254.1	1.1	1	
02309+5311	HJ 2139AB	1903	2006.037	R	20	3.804	0.019	297.8	0.3	0	
02388+3325	STF 285	2004	2006.017	R	20	1.701	0.009	163.1*	0.3	0	
02389+6918	STF 278	1985	2006.056	R	20	0.505	0.008	28.5	0.7	0	
02446+2928	STF 300	2091	2006.094	R	20	3.151	0.016	314.1*	0.3	0	
02470+5007	ARG 9	2112	2006.026	R	20	2.604	0.013	149.9	0.3	0	
02475+1922	STF 305AB	2122	2006.012	R	20	3.614	0.018	307.2*	0.3	1	
02529+5300	STF 314AB-C	2185	2006.026	R	20	1.579	0.008	313.2*	0.3	0	
02563+7253	STF 312AB	2204	2006.039	R	20	1.912	0.010	43.1*	0.3	0	
02589+2137	BU 525	2253	2006.031	R	10	0.560	0.006	87.4	0.5	1	
03054+2515	STF 346AB	2336	2006.067	R	10	0.388	0.003	252.8	0.5	1	
03122+3713	STF 360	2390	2006.017	R	20	2.819	0.014	125.4*	0.3	1	
03140+0044	STF 367	2416	2006.037	R	20	1.189	0.019	134.5	0.3	1	
03175+6540	STT 52AB	2436	2006.039	R	10	0.491	0.003	59.6	0.7	1	
03177+3838	STT 53	2446	2006.017	R	20	0.707	0.008	244.0	0.6	1	
03196+6714	HU 1056	2452	2006.039	R	20	1.113	0.019	260.9	0.3	0	
03206+1911	STF 377AB	2478	2006.053	R	20	1.166	0.011	110.5	0.7	0	
03233+2058	STF 381	2504	2006.012	R	20	1.062	0.008	107.0*	0.3	0	
03291+5956	STF 385	2544	2006.053	R	20	2.316	0.012	162.2*	0.3	0	
03293+4503	STF 391	2559	2006.018	R	20	3.936	0.020	95.3	0.3	0	
03302+5922	STF 389Aa-B	2563	2006.031	R	20	2.625	0.013	71.4*	0.4	0	
03344+2428	STF 412AB	2616	2006.012	R	10	0.715	0.004	355.1	0.4	1	
”	”	”	2006.053	R	10	0.715	0.004	355.2	0.3	1	
”	”	”	2006.094	R	10	0.719	0.004	354.8	0.3	1	
03350+6002	STF 400AB	2612	2006.031	R	20	1.539	0.009	265.5*	0.4	1	
03354+3341	STF 413	2625	2006.053	R	20	2.387	0.012	123.8	0.4	0	
03356+3141	BU 533	2628	2006.012	R	20	1.068	0.008	221.3*	0.3	0	
”	”	”	2006.067	R	20	1.070	0.008	221.9*	0.3	0	
03401+3407	STF 425	2668	2006.012	R	20	1.960	0.010	63.0	0.3	0	
03407+4601	STT 59	2669	2006.053	R	20	2.787	0.014	355.3*	0.3	0	
03427+6950	STF 419AB	2678	2006.039	R	20	2.961	0.015	72.6*	0.3	0	
03454+4952	HU 103AB	2736	2006.053	R	20	1.161	0.011	202.4	0.3	0	
03521+4048	STT 66	2815	2006.056	R	20	0.983	0.011	145.6	0.3	0	
03571+6107	STT 67	2867	2006.056	R	20	1.715	0.009	49.0*	0.3	0	
04041+3931	STF 483	2959	2006.067	R	20	1.398	0.008	57.8*	0.4	1	
04069+3327	STT 71AB	2990	2006.067	R	20	0.773	0.008	229.3	0.5	0	
04076+3804	STT 531AB	2995	2006.094	R	20	2.422	0.032	357.3*	0.3	1	
04100+8042	STF 460	2963	2006.067	R	10	0.751	0.005	137.2	0.3	1	Elongated
04115+4152	BU 546	3038	2006.094	R	20	0.922	0.014	227.5	0.6	0	
04182+2248	STF 520	3114	2006.056	R	20	0.559	0.008	74.9	0.5	1	
04268+5539	STF 531	3207	2006.094	R	20	0.961	0.008	321.6*	0.3	0	
04381+4207	STF 565AB	3338	2006.094	R	20	1.330	0.008	167.0*	0.3	0	
04385+2656	STF 572AB	3353	2006.094	R	20	4.280	0.021	189.7	0.3	0	
05079+5459	STF 635	3689	2006.094	R	20	0.980	0.015	303.1	0.6	0	
05135+0158	STT 517AB	3799	2006.053	R	10	0.653	0.004	239.2	0.4	1	
05308+0557	STF 728	4115	2006.201	R	20	1.223	0.008	45.6*	0.4	1	
05371+2655	STF 749AB	4208	2006.094	R	20	1.148	0.008	320.9	0.3	1	
”	”	”	2006.198	R	20	1.125	0.011	141.2*	0.3	1	
05480+0627	STF 795	4390	2006.198	R	20	1.082	0.008	218.2*	0.3	0	
06135+1015	HO 22	4823	2006.245	R	20	0.960	0.027	208.1	1.1	0	
”	”	”	2006.253	R	20	0.968	0.016	209.8	0.7	0	
06250+4233	A 2356	5016	2006.253	R	20	0.906	0.011	261.0	0.5	0	

Table 1. Measurements of visual binaries between January and June 2006 (cont.).

WDS	Name	ADS	Epoch	Fil.	Eyep. (mm)	ρ (arcsec)	σ_ρ (arcsec)	θ (deg.)	σ_θ (deg.)	Orb.	Notes
06555+3010	STF 981	5570	2006.258	V	20	1.183	0.008	305.5	0.8	1	
07028+1305	HO 342	5725	2006.253	R	20	1.198	0.014	86.2*	0.3	0	
"	"	"	2006.258	R	20	1.162	0.023	86.6*	0.8	0	
07128+1511	WEI 14	5875	2006.253	R	20	2.121	0.026	161.1*	0.3	0	
"	"	"	2006.266	R	20	2.133	0.014	160.5*	0.3	0	
07128+2713	STF1037AB	5871	2006.269	R	20	1.067	0.014	310.2*	0.4	1	
07148+5233	STF1033AB	5896	2006.266	R	20	1.577	0.008	276.1*	0.4	0	
07176+0918	STT 170	5958	2006.269	R	10	0.246	0.004	17.5	2.0	1	
07274+1519	STF1094	6086	2006.269	R	20	2.533	0.015	95.3	0.3	0	
07303+4959	STF1093	6117	2006.269	R	20	0.885	0.019	201.2*	1.0	1	
07345+1218	STF1116	6180	2006.283	R	20	1.773	0.014	96.1*	0.4	0	
07346+3153	STF1110AB	6175	2006.267	V	20	4.400	0.022	60.0*	0.3	1	
07359+4302	STT 174	6191	2006.267	R	20	2.167	0.011	88.1*	0.3	0	
07401+0514	STF1126AB	6263	2006.267	R	20	0.880	0.008	172.4*	0.5	0	
08056+2732	STF1177	6569	2006.253	R	20	3.504	0.029	350.0*	0.3	0	
08413+2029	BU 585	6930	2006.283	R	10	0.347	0.006	79.5	0.9	0	
08432+3849	BU 209	6946	2006.253	R	20	1.282	0.008	8.5*	0.3	0	
08508+3504	STF1282	7034	2006.253	R	20	3.562	0.018	277.4*	0.3	0	
08514+5732	STF1275AB	7033	2006.267	R	20	1.888	0.009	197.9*	0.3	0	
08539+1958	COU 773	–	2006.310	V	10	0.148	0.005	56.9*	3.5	1	
09033+4740	HU 720	7153	2006.269	R	20	0.731	0.023	133.2	1.3	0	
09104+6708	STF1306AB	7203	2006.258	R	20	4.109	0.021	350.9*	0.3	1	
"	"	"	2006.267	R	20	4.076	0.020	350.8*	0.3	1	
"	"	"	2006.308	R	20	4.106	0.021	350.8*	0.8	1	
09210+3811	STF1338AB	7307	2006.253	R	10	1.062	0.008	295.9*	0.3	1	Elongated
09285+0903	STF1356	7390	2006.308	R	10	0.671	0.004	96.4*	0.3	1	
09300+4216	A 1985	7398	2006.267	R	20	1.513	0.017	25.0	0.3	0	
09513+6037	STF1381	7536	2006.269	R	20	0.889	0.008	189.5	0.5	0	
09521+5404	STT 208	7545	2006.310	R	10	0.311	0.009	281.7*	0.4	1	
10056+3105	STF1406	7632	2006.269	R	20	0.805	0.020	218.5	1.3	0	
10151+1907	STF1417	7695	2006.269	R	20	2.385	0.035	77.2	0.9	0	
10163+1744	STT 215	7704	2006.253	R	20	1.441	0.017	177.9*	0.3	1	
10205+0626	STF1426AB	7730	2006.283	R	20	0.913	0.011	310.1*	0.7	1	
"	"	"	2006.308	R	20	0.922	0.016	308.4	1.2	1	
10279+3642	HU 879	7780	2006.310	V	10	0.416	0.004	220.5*	0.5	1	
10397+0851	STT 224	7871	2006.360	R	20	0.517	0.009	146.9*	1.3	1	
10557+0044	BU 1076	7982	2006.308	R	20	1.152	0.011	55.6*	1.0	1	
11037+6145	BU 1077AB	8035	2006.270	V	10	0.429	0.005	58.4*	1.8	1	Diffuse
"	"	"	2006.310	V	10	0.425	0.004	57.2*	0.6	1	
11136+5525	A 1353	8092	2006.360	R	20	0.579	0.010	213.0*	1.0	1	
11158+4227	COU1904	–	2006.308	R	20	0.433	0.011	210.8	1.8	0	
11182+3132	STF1523AB	8119	2006.311	V	20	1.703	0.011	237.4*	0.5	1	
11239+1032	STF1536AB	8148	2006.360	R	20	1.906	0.010	103.8*	0.3	1	
11308+4117	STT 234	8189	2006.371	R	20	0.502	0.009	166.2*	0.4	1	
11323+6105	STT 235AB	8197	2006.371	R	20	0.714	0.011	11.8*	1.0	1	
11363+2747	STF1555AB	8231	2006.371	R	10	0.719	0.004	147.6	0.3	1	
11390+4109	STT 237	8252	2006.267	R	20	2.002	0.010	244.6*	0.3	1	
11520+4805	HU 731	8325	2006.267	R	20	1.078	0.017	129.3	0.7	1	
12244+2535	STF1639AB	8539	2006.371	R	20	1.735	0.012	324.5*	0.5	1	
12257+4444	STF1642	8546	2006.311	R	20	2.455	0.021	179.1	0.3	0	
12272+2701	STF1643	8553	2006.371	R	20	2.711	0.014	6.5	0.5	1	
12291+3123	STT 251	8569	2006.311	R	20	0.738	0.008	56.6*	2.0	1	
12306+0943	STF1647	8575	2006.371	R	20	1.340	0.008	245.3	0.3	1	
12321+7449	STF1654	8591	2006.360	R	20	3.768	0.019	22.8*	0.3	0	
12345+0558	BU 797AB	8598	2006.360	R	20	0.619	0.021	145.5	0.7	0	
12360+1124	STF1661	8606	2006.360	R	20	2.366	0.012	251.2*	0.3	0	Faint
12409+0850	STF1668	8625	2006.371	R	20	1.146	0.012	186.4	0.3	0	

Table 1. Measurements of visual binaries between January and June 2006 (end).

WDS	Name	ADS	Epoch	Fil.	Eyep. (mm)	ρ (arcsec)	σ_ρ (arcsec)	θ (deg.)	σ_θ (deg.)	Orb.	Notes
12417−0127	STF1670AB	8630	2006.308	V	10	0.467	0.003	86.7	0.9	1	
”	”	”	2006.311	R	10	0.464	0.004	86.1	0.3	1	
”	”	”	2006.360	R	10	0.485	0.003	83.5	0.3	1	
”	”	”	2006.371	R	10	0.483	0.003	83.0*	0.3	1	
”	”	”	2006.376	R	10	0.485	0.003	83.0	0.3	1	
”	”	”	2006.398	R	10	0.491	0.003	82.2*	0.3	1	
”	”	”	2006.439	R	10	0.496	0.003	79.9	0.3	1	
”	”	”	2006.442	R	10	0.506	0.003	79.9	0.3	1	
”	”	”	2006.447	R	10	0.514	0.007	79.9	0.5	1	
”	”	”	2006.450	R	10	0.498	0.003	79.6	0.3	1	
”	”	”	2006.453	R	10	0.500	0.003	79.6	0.3	1	
”	”	”	2006.464	R	10	0.501	0.003	79.1*	0.3	1	
”	”	”	2006.475	R	10	0.505	0.004	78.9	0.4	1	
”	”	”	2006.477	R	10	0.514	0.005	78.4	0.3	1	
”	”	”	2006.497	R	10	0.504	0.005	78.3	0.4	1	
12493+2733	CHR 179Aa	–	2006.447	R	10	–	–	–	–	0	Unresolved
12533+2115	STF1687AB	8695	2006.447	R	20	1.135	0.008	190.5*	0.3	1	
12564−0057	STT 256	8708	2006.398	R	20	1.028	0.008	98.8	0.5	0	
13007+5622	BU 1082	8739	2006.360	R	20	1.218	0.010	92.5*	0.4	1	
13039−0340	BU 929	8759	2006.442	R	20	0.571	0.008	196.4*	0.6	0	
13100+1732	STF1728AB	8804	2006.398	R	10	0.520	0.003	12.2	0.3	1	
13120+3205	STT 261	8814	2006.442	R	20	2.493	0.021	338.7*	0.3	0	
13207+0257	STF1734	8864	2006.450	R	20	1.104	0.008	175.3*	0.3	0	
13284+1543	STT 266	8914	2006.442	R	20	1.966	0.032	356.7	0.5	0	
13341+6746	STF1767	8959	2006.450	W	20	4.150	0.021	344.1*	0.3	0	
13343−0019	STF1757AB	8949	2006.453	R	20	1.915	0.010	131.3*	0.3	1	
13367+6947	STF1771	8976	2006.453	R	20	1.806	0.009	79.8	0.3	0	
13375+3618	STF1768AB	8974	2006.447	R	20	1.784	0.010	97.2*	0.3	1	
13396+1045	BU 612AB	8987	2006.447	R	10	0.283	0.003	205.6	0.3	1	
13461+0507	STF1781	9019	2006.453	R	20	0.870	0.008	187.3	0.4	1	
13491+2659	STF1785	9031	2006.450	R	20	3.206	0.016	177.6*	0.8	1	
14131+5520	STF1820	9167	2006.450	R	20	2.689	0.035	119.1*	0.4	1	
14148+1006	KUI 66	–	2006.477	R	20	1.013	0.008	108.4*	0.4	0	
14153+0308	STF1819	9182	2006.439	R	20	0.886	0.014	186.1*	0.7	1	
14203+4830	STF1834	9229	2006.439	R	20	1.576	0.010	102.9	0.3	1	
14323+2641	A 570	9301	2006.447	R	10	0.194	0.004	72.3	2.3	1	
14369+4813	A 347	9324	2006.450	R	20	0.577	0.008	248.0	1.4	1	
14380+5135	STF1863	9329	2006.450	R	20	0.689	0.009	61.5*	0.4	0	
14407+3117	STF1867	9340	2006.478	R	20	0.722	0.008	355.6	0.5	0	
14411+1344	STF1865AB	9343	2006.448	R	10	0.642	0.003	296.9*	0.3	1	
14416+5124	STF1871	9350	2006.475	R	20	1.841	0.018	310.4	0.3	0	
14417+0932	STF1866	9345	2006.478	R	20	0.761	0.008	203.7	0.6	0	
14450+2704	STF1877AB	9372	2006.453	V	20	2.852	0.014	342.9*	0.3	0	Diffuse
14463+0939	STF1879AB	9380	2006.448	R	20	1.712	0.009	84.4*	0.3	1	
14489+0557	STF1883	9392	2006.475	R	20	0.915	0.008	279.2	0.3	1	
14515+4456	STT 287	9418	2006.448	R	20	0.742	0.008	357.0	0.8	1	
14534+1542	STT 288	9425	2006.497	R	20	1.111	0.008	162.7*	0.4	1	
15245+3723	STF1938BC	9626	2006.497	R	20	2.269	0.023	6.6*	0.4	1	
16280+2632	BU 813	10071	2006.497	R	20	1.185	0.012	175.8	0.3	0	
16326+2314	BU 817	10107	2006.497	W	20	0.955	0.012	327.2	1.3	0	
16511+0924	STF2106	10229	2006.497	R	20	0.716	0.008	174.2*	0.8	1	

IC4, we found a good agreement for all objects, except for ADS 416 and 4208.

ADS 416: our quadrant determination (Q=2) seems robust with a clear contrast between the two secondary peaks of the triple correlation. It is nevertheless in contradiction with the fourth quadrant given by the orbit of Zulevic (1997) in OC6. Note that we were unable to determine the quadrant for our observation made in 1998.666 with PISCO at Pic du Midi (Scardia et al. 2000a), and it was reported in IC4 as $\theta = 262°$ in 1998.666 to be consistent with other data.

ADS 4208: here also our quadrant determination (Q=2) for the observation of 2006.198 seems clear, because of the good signal-to-noise ratio obtained in the quadrant file. It is consistent with our previous determination made in 2005.215 (Paper III) and with the space-based Tycho measurement (Høg et al., 2000). Note that the two components of ADS 4208 have small difference in magnitude in V: $\Delta_{m_V} = 0.01$, which explains the difficulty of determining the quadrant in this spectral band.

3.2 Comparison with published ephemerides

The $(O - C)$ (Observed minus Computed) residuals of the measurements for the 86 systems with a known orbit of Table 1 are displayed in Table 2 in Cols. 6 and 7 for the separation ρ and position angle θ, respectively. The orbital elements used for computing the ephemerides were retrieved from OC6 and from our last publications (Scardia et al. 2007b, 2008b). The corresponding bibliographic references are indicated in Col. 3. The ρ values in Col. 5 are the relevant observed separations, taken from Col. 7 of Table 1. They are repeated here for the convenience of the reader, to be able to identify the cases when ρ is small. For ADS 277, we also give the residuals obtained with our new orbit presented in Sect. 4, for comparison.

We noted a 180-degree discrepancy of the position angle between our measurements and the published ephemerides for ADS 416, 1538, 2253, 4208 and 8325. This is indicated with the superscript ^{Q} in Col. 7.

For most of the objects of Table 2, the equinox of the orbital elements found in OC6 is 2000.0, and thus the precession correction of our angular measurements was negligible. Such a correction was only necessary for ADS 1538, 2122, and 7390 for which the tabulated equinox is 1900.0 in OC6.

We have reported in Table 2 the residuals computed with the most recent orbits found in OC6, but for some objects, we also give the $O - C$ values relative to old orbits found in the previous issues of OC6. This includes ADS 161AB, 828, 1345, 1709, 2446, 2612AB, 2959, 5871AB, 7730AB, 8804AB and 9626BC, for which the "old" and "new" orbits lead to comparable residuals.

Note also that we have already used the measurements of ADS 1345, 7730 and 8630 reported in Table 1 to revise the orbits of those objects (see Scardia et al, 2007b, 2008b).

Fig. 2 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. In this figure it also appears that ADS 277 has the largest residual: we propose a new orbit for this object in Sect. 4. The average values computed with the 110 residuals of Table 2 are $< \Delta\rho_{O-C} > = 0''.02 \pm 0''.10$ and $< \Delta\theta_{O-C} > = -0°.16 \pm 1°.9$. The small values obtained for those offsets provide a new validation of our calibration made in Nov. 2005 with a grating mask (see Paper III), which appears to be in good agreement with the measurements made by the other observers.

4 NEW ORBIT OF ADS 277 — A 647

As shown in Fig.2, Heintz (2001)'s orbit of ADS 277 leads to a large residual in the position angle. To revise this orbit, we have used our last measurement with PISCO and the 31 other available observations contained in the data base maintained by the United States Naval Observatory. The new orbital elements computed with the analytical method of Kowalsky (1873) are presented in Table 3. In this table, Ω is the position angle of the ascending node, measured in the plane of the sky from north through east and ω is the longitude of the periastron in the plane of the true orbit, measured from the ascending node to the periastron, in the direction of motion of the companion, i is the inclination of the orbit relative to the plane of the sky, e the eccentricity, T the epoch of periastron passage, P the period, n the mean angular motion, and a is the semi-major axis. The four parameters A, B, F, and G are the Thiele-Innes constants (useful for an easier computation of the ephemerides). Convergence could not be obtained for Hellerich (1925)'s least-squares minimisation, which explains the absence of error bars in this table.

The corresponding $(O - C)$ residuals are given in Table 4. For each measurement, the date in Besselian years is given in Col. 1, the measurements of ρ and θ (reduced to equinox 2000) in Cols. 2 and 4, respectively, and the corresponding $(O-C)$ residuals in ρ and θ in Cols. 3 and 5, respectively. In Col. 6, we indicate the method used for those measurements, using the same convention as the US Naval Observatory:

A = Refractor, micrometer;
B = Reflector, micrometer;
C = Comparison image micrometer;
F = CCD astrometry;
S = Speckle interferometry;
T = Hipparcos or Tycho type observation.

Our measurement is surprisingly the first and only measurement obtained with speckle interferometry. The mean standard deviations of those residuals are $0''.08$ and $3°.3$ for ρ and θ, respectively.

The apparent orbit is shown in Fig. 3 as a solid line and the observational data used for the calculation of the orbital elements are plotted as circles or small crosses. The PISCO measurement corresponds to the open circle, the micrometric measurements to the small crosses and the other measurements to the filled circles. The orientation of the graphs conforms to the convention adopted by the observers of visual binary stars. The big cross indicates the location of the primary component, and the straight line going through this point is the line of apsides. The sense of rotation of the companion is indicated with an arrow.

The ephemerides for 2008–2017 are presented in Table 5, with the date in Besselian years in Col. 1, the angular separation ρ in Col. 2 and the position angle θ in Col. 3.

Using the Hipparcos parallax, $\pi = 0''.0092 \pm 0''.00102$, the semi-major axis would be equal to 103 AU and the total mass of the system would be 7.9 $\mathfrak{M}_\odot$, which is in excess for a system of this spectral type (F5). The dynamic parallax computed with Baize-Romani's method (Couteau 1978) is $0''.013$, which is also larger than the Hipparcos value. This new orbit should be considered as preliminary only, due to the incomplete coverage of the orbit with the observations (see Fig. 3).

Table 2. Residuals of the measurements of Table 1 with published orbits. In Col. 7, ^{Q} indicates discrepant quadrants between our measurements and those orbits (begin.).

ADS	Name	Orbit	Epoch	ρ(O) (arcsec)	$\Delta\rho$(O-C) (arcsec)	$\Delta\theta$(O-C) (deg.)
17178	HLD 60	Heintz (1963)	2006.012	1.275	0.05	−1.3
17175	BU 733AB	Söderhjelm (1999)	2006.012	0.823	0.00	3.0
61	STF3062	Söderhjelm (1999)	2006.028	1.509	−0.02	0.2
161	STT 2AB	Scardia et al. (2000a)	2006.012	0.404	−0.02	−0.8
”	”	Olevic &Janovic (2001)	”	”	0.04	5.1
207	STF 13	Olevic &Janovic (2001)	2006.025	0.949	0.05	−0.3
277	A 647	Heintz (2001)	2006.036	0.685	0.09	8.0
”	”	This paper	”	”	0.03	2.7
281	BU 1015	Scardia et al. (2000b)	2006.017	0.460	0.01	−4.6
283	HJ 1018	Söderhjelm (1999)	2006.025	1.697	−0.06	−0.4
416	BU 394	Zulevic (1997)	2006.028	0.478	−0.04	0.0^Q
434	STT 12	Ling et al. (2005)	2006.036	0.313	0.06	−0.4
684	BU 232AB	Scardia et al. (2008a)	2006.025	0.892	0.04	−0.9
746	STT 20AB	Docobo &Ling (2007)	2006.012	0.547	0.01	−0.1
755	STF 73AB	Docobo &Costa (1990)	2006.012	0.979	−0.02	−0.6
828	BU 867	Baize (1993)	2006.066	0.631	0.08	2.7
”	”	Cvetkovic &Novakovic(2006)	”	”	0.05	1.2
836	A 2901	Novakovic (2006)	2006.026	0.440	0.03	−1.0
862	STT 21	Heintz (1966)	2006.025	1.203	0.12	−0.9
940	STT 515AB	Scardia et al.(2001a)	2006.028	0.506	0.01	−0.7
1345	A 1	Novakovic (2006)	2006.091	0.825	0.01	0.4
”	”	Scardia et al. (2008b)	”	”	−0.01	−0.2
1360	BU 509	Heintz (1988)	2006.094	0.656	−0.06	−4.4
1538	STF 186	Mourao (1977)	2006.031	0.926	0.05	-2.7^Q
1615	STF 202AB	Scardia (1983b)	2006.012	1.857	0.06	1.7
1631	STF 208AB	Heintz (1996a)	2006.037	1.246	−0.11	−3.1
1709	STF 228	Scardia (1981a)	2006.026	0.908	−0.06	0.0
”	”	Söderhjelm (1999)	”	”	−0.01	−0.2
–	COU 79	Hartkopf et al. (1996)	2006.053	0.182	0.02	−1.2
2122	STF 305AB	Rabe (1961)	2006.012	3.614	−0.10	0.1
2253	BU 525	Costa (1978)	2006.031	0.560	0.05	-3.3^Q
2336	STF 346AB	Heintz (1981)	2006.067	0.388	−0.04	−2.8
2390	STF 360	Mason et al. (2004)	2006.017	2.819	0.02	−0.9
2416	STF 367	Heintz (1963)	2006.037	1.189	0.07	3.1
2436	STT 52AB	Heintz (1998)	2006.039	0.491	0.09	4.3
2446	STT 53	Scardia (1981b)	2006.017	0.707	0.08	3.8
”	”	Alzner (1998)	”	”	0.03	−1.1
2612	STF 400AB	Scardia (1981b)	2006.031	1.539	0.02	−2.2
”	”	Seymour &Mason (2000a)	”	”	0.07	−1.4
2616	STF 412AB	Scardia et al. (2002a)	2006.012	0.715	0.00	0.4
”	”	”	2006.053	0.715	0.00	0.5
”	”	”	2006.094	0.719	0.00	0.1
2959	STF 483	Couteau (1990)	2006.067	1.398	0.14	1.5
”	”	Brendley &Mason (2006)	”	”	0.02	−0.5
2963	STF 460	Scardia (2003a)	2006.067	0.751	0.04	−2.9
2995	STT 531AB	Heintz (1986b)	2006.094	2.422	0.14	2.4
3114	STF 520	Hartkopf &Mason (2001)	2006.056	0.559	0.02	−1.9
3799	STT 517AB	Mason et al. (1999)	2006.053	0.653	0.01	−1.1
4115	STF 728	Seymour &Hartkopf (1999)	2006.201	1.223	−0.01	0.3
4208	STF 749AB	Scardia et al. (2007a)	2006.094	1.148	−0.01	−1.1
”	”	”	2006.198	1.125	−0.03	-0.8^Q
5570	STF 981	Hopmann (1971)	2006.258	1.183	0.03	5.1
5871	STF1037AB	Scardia (1983a)	2006.269	1.067	0.04	0.5
”	”	Söderhjelm (1999)	”	”	−0.01	−0.9
5958	STT 170	Docobo et al. (2007)	2006.269	0.246	0.00	−0.1
6117	STF1093	Scardia (1984)	2006.269	0.885	0.09	0.5
6175	STF1110AB	Docobo &Costa (1985)	2006.267	4.400	0.03	0.4
–	COU 773	Couteau (1999)	2006.310	0.148	−0.05	2.2
7203	STF1306AB	Scardia (1985)	2006.258	4.109	0.09	−1.0
”	”	”	2006.267	4.076	0.05	−1.1
”	”	”	2006.308	4.106	0.08	−1.1

Table 2. Residuals of the measurements of Table 1 with published orbits (end).

ADS	Name	Orbit	Epoch	ρ(O) (arcsec)	$\Delta\rho$(O-C) (arcsec)	$\Delta\theta$(O-C) (deg.)
7307	STF1338AB	Scardia et al. (2002b)	2006.253	1.062	0.05	−1.8
7390	STF1356	van Dessel (1976)	2006.308	0.671	0.00	−1.0
7545	STT 208	Heintz (1996b)	2006.310	0.311	−0.03	−2.9
7704	STT 215	Zaera (1984)	2006.253	1.441	−0.08	−1.9
7730	STF1426AB	Novakovic (2006)	2006.283	0.913	−0.01	−0.2
”	”	”	2006.308	0.922	0.00	−1.9
”	”	Scardia et al. (2008b)	2006.283	0.913	0.00	−0.2
”	”	”	2006.308	0.922	0.01	−1.9
7780	HU 879	Mason &Hartkopf (2001)	2006.310	0.416	0.00	0.7
7871	STT 224	Heintz (1984)	2006.360	0.517	−0.06	−4.6
7982	BU 1076	Morel (1970)	2006.308	1.152	0.04	5.6
8035	BU 1077AB	Scardia et al. (2005a)	2006.270	0.429	−0.02	−2.2
”	”	”	2006.310	0.425	−0.03	−2.9
8092	A 1353	Docobo &Ling (1999)	2006.360	0.579	0.04	−0.2
8119	STF1523AB	Mason et al. (1995)	2006.311	1.703	0.01	0.2
8148	STF1536AB	Söderhjelm (1999)	2006.360	1.906	0.03	−0.2
8189	STT 234	Docobo &Ling (2001)	2006.371	0.502	0.01	−1.0
8197	STT 235AB	Söderhjelm (1999)	2006.371	0.714	−0.02	3.1
8231	STF1555AB	Docobo &Ling (2004)	2006.371	0.719	0.03	−1.1
8252	STT 237	Seymour et al. (2002)	2006.267	2.002	0.01	−0.8
8325	HU 731	Ling (1992)	2006.267	1.078	0.15	-0.8^Q
8539	STF1639AB	Olevic &Popovic (2000)	2006.371	1.735	−0.03	0.5
8553	STF1643	Olevic &Cvetkovic (2003)	2006.371	2.711	0.03	0.7
8569	STT 251	Scardia et al. (2003b)	2006.311	0.738	0.08	−2.9
8575	STF1647	Hopmann (1970)	2006.371	1.340	0.07	−3.7
8630	STF1670AB	Scardia et al.(2007b)	2006.308	0.467	0.00	0.7
”	”	”	2006.311	0.464	−0.01	0.3
”	”	”	2006.360	0.485	0.00	0.1
”	”	”	2006.371	0.483	0.00	0.1
”	”	”	2006.376	0.485	0.00	0.4
”	”	”	2006.398	0.491	0.00	0.6
”	”	”	2006.439	0.496	−0.01	0.2
”	”	”	2006.442	0.506	0.00	0.4
”	”	”	2006.447	0.514	0.01	0.6
”	”	”	2006.450	0.498	−0.01	0.4
”	”	”	2006.453	0.500	−0.01	0.5
”	”	”	2006.464	0.501	−0.01	0.5
”	”	”	2006.475	0.505	−0.01	0.8
”	”	”	2006.477	0.514	0.00	0.4
”	”	”	2006.497	0 504	−0.01	1.2
8695	STF1687AB	Heintz (1997)	2006.447	1.135	0.10	−1.0
8739	BU 1082	Scardia et al.(2005a)	2006.360	1.218	−0.09	1.6
8804	STF1728AB	Söderhjelm (1999)	2006.398	0.520	0.05	0.2
”	”	Mason et al. (2006)	”	”	0.01	−0.2
8949	STF1757AB	Heintz (1988)	2006.453	1.915	0.01	0.4
8974	STF1768AB	Söderhjelm (1999)	2006.447	1.784	0.04	−0.3
8987	BU 612AB	Mason et al. (1999)	2006.447	0.283	−0.02	−0.5
9019	STF1781	Heintz (1986a)	2006.453	0.870	0.02	5.1
9031	STF1785	Heintz (1988)	2006.450	3.206	0.02	−0.6
9167	STF1820	Kiyaeva et al. (1998)	2006.450	2.689	0.08	−0.5
9182	STF1819	Houser (1987)	2006.439	0.886	0.00	−0.6
9229	STF1834	Seymour &Mason (2000b)	2006.439	1.576	0.05	−0.5
9301	A 570	Heintz (1991)	2006.447	0.194	0.00	1.8
9324	A 347	Docobo &Ling (2004)	2006.450	0.577	0.00	0.2
9343	STF1865AB	Scardia et al. (2007c)	2006.448	0.642	−0.02	−0.3
9380	STF1879AB	Mason et al. (1999)	2006.448	1.712	0.00	−0.3
9392	STF1883	Seymour &Mason (2000b)	2006.475	0.915	0.01	−0.2
9418	STT 287	Heintz (1997)	2006.448	0.742	−0.08	1.0
9425	STT 288	Heintz (1998)	2006.497	1.111	−0.01	−0.3
9626	STF1938BC	Scardia (1986)	2006.497	2.269	0.04	0.0
”	”	Söderhjelm (1999)	”	”	0.02	0.1
10229	STF2106	Scardia et al. (2001b)	2006.497	0.716	−0.02	1.1

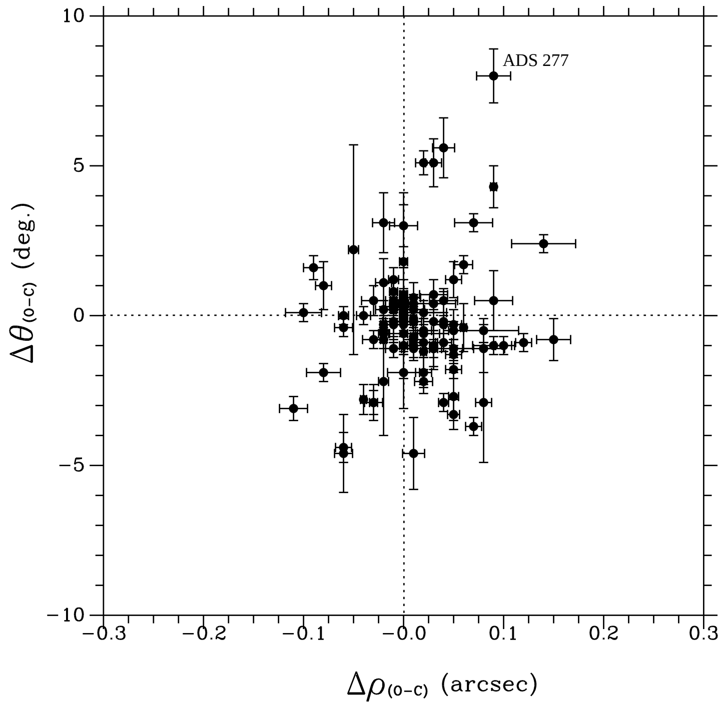

Figure 2. Residuals of our measurements from the published orbits.

Table 3. New orbital elements of ADS 277.

Ω (2000)	ω (deg.)	i (deg.)	e	T (yr)	P (yr)	n (deg./yr)	a (arcsec)	A (arcsec)	B (arcsec)	F (arcsec)	G (arcsec)
39.4	136.8	122.0	0.292	1876.010	372.7	0.96592	0.947	-0.31540	-0.70363	-0.73313	-0.12879

5 CONCLUSION

In the first semester of 2006, we performed 217 observations of 194 visual binaries with PISCO in Merate. When adding those made since 2004, the total reaches 903 observations, which is about twice the number of binary observations made with PISCO on the 2-meter Bernard Lyot telescope of *Pic du Midi* during the period 1993–1998. The new exploitation of PISCO in Merate has thus already provided a significant contribution to the measurements of close visual binary stars.

The measurements reported here have already been used to revise the orbits of ADS 1345, 7730 and 8630 (Scardia et al., 2007b, 2008b). In this paper, we also present new orbital elements for ADS 277, for which the residual in θ was the largest obtained in our measurement set. We hope that our measurements will be useful to the astronomical community and help to improve the accuracy of many other orbits in the future.

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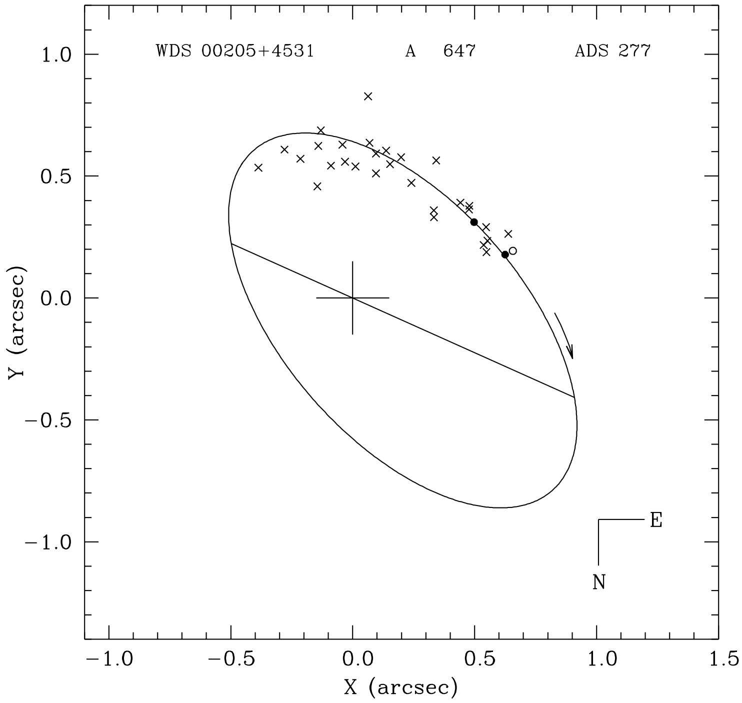

Figure 3. New orbit of ADS 277.

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Table 4. ADS 277: $O-C$ residuals of our new orbit. The symbol ^{P} indicates our PISCO measurement.

Epoch	ρ(O) (arcsec)	$\Delta\rho$(O-C) (arcsec)	θ(O) (deg.)	$\Delta\theta$(O-C) (deg.)	Method
1904.540	0.660	−0.065	215.9	−0.1	A
1918.660	0.670	−0.058	204.7	0.3	A
1921.680	0.610	−0.112	200.6	−1.3	A
1928.640	0.640	−0.063	192.8	−3.1	A
1932.890	0.480	−0.209	197.5	5.6	A
1933.720	0.550	−0.136	189.3	−1.9	A
1933.730	0.700	0.014	190.7	−0.5	A
1944.530	0.540	−0.103	178.8	−1.6	A
1944.570	0.630	−0.013	183.8	3.4	A
1944.850	0.560	−0.082	183.2	3.1	B
1952.050	0.600	−0.014	170.8	−1.3	A
1954.630	0.830	0.225	175.6	6.6	A
1954.980	0.640	0.036	173.8	5.2	A
1955.860	0.620	0.019	167.2	−0.3	C
1958.060	0.520	−0.074	169.4	4.6	B
1962.880	0.610	0.029	161.0	2.3	A
1963.890	0.570	−0.008	164.4	7.0	A
1968.930	0.530	−0.039	153.0	2.4	A
1969.864	0.660	0.092	148.7	−0.7	A
1974.820	0.490	−0.075	137.2	−5.4	A
1977.660	0.470	−0.096	134.8	−3.9	A
1982.830	0.590	0.019	131.5	−0.1	A
1983.740	0.600	0.028	127.3	−3.1	A
1986.740	0.610	0.032	128.3	1.9	A
1991.250	0.587	−0.004	122.1	1.4	T
1991.930	0.620	0.027	118.1	−1.8	T
1994.920	0.690	0.086	112.4	−3.7	A
1996.980	0.580	−0.032	108.9	−4.8	A
1999.742	0.580	−0.044	112.0	1.5	B
1999.742	0.600	−0.024	113.0	2.5	B
2002.759	0.650	0.012	105.9	−1.3	F
2006.036	0.685^P	0.030	106.4^P	2.7	S

Table 5. New ephemeris of ADS 277.

Epoch	ρ (arcsec)	θ (deg.)
2008.0	0.665	101.8
2009.0	0.671	100.8
2010.0	0.677	99.8
2011.0	0.682	98.8
2012.0	0.688	97.9
2013.0	0.694	97.0
2014.0	0.700	96.1
2015.0	0.706	95.2
2016.0	0.712	94.3
2017.0	0.718	93.5

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