A&A 396, 933–935 (2002)
DOI: 10.1051/0004-6361:20021459

Astronomy & Astrophysics

Nice Observatory CCD measurements of visual double stars (4th series)⋆

G. Morlet[1,2], M. Salaman[1,3], and R. Gili[1,4]

[1] Observatoire de la Côte d'Azur, Département Fresnel, BP 229, 06304 Nice Cedex, France
[2] 25 Bd. Arago, 75013 Paris, France
[3] 284 route des Choseaux, 74320 Sevrier, France
[4] 161 Av. Ste Marguerite, Clos Ste Marguerite, 06210 Nice, France

Received 16 September 2002 / Accepted 1 October 2002

Abstract. We present 176 measurements of 167 visual double stars, made in 2000 and 2001 with the 50 cm refractor of the Nice Observatory and attached CCD camera, using an algorithm based on the adjustment of a tridimensional mathematical surface (Table 1). Position angle, angular separation and magnitude difference are given. 33 new binaries (HDS and TDS) discovered by Hipparcos were measured.

Key words. astrometry – stars: binaries: visual

1. Introduction

We present the results of measurements of binaries made at the Nice Observatory, including pairs with orbital motion or rarely measured since their discovery and also double stars measured or discovered by the Hipparcos satellite. This work is the continuation of a programme which began in 1997 with the 50 cm refractor.

2. Image acquisition

We used a Hi-SIS23 CCD camera mounted on the 50 cm refractor (F = 7501 mm).

The camera is equipped with a KAF-401E sensor composed of 768×512 pixels of 9×9 μm size. The maximum sensitivity of this sensor corresponds to a wavelength of 590 nm, close to the wavelength corresponding to the minimum focus of the refractor lens (Fig. 1). The former camera (see Salaman et al. 1999, 2000) had a KAF-400 sensor whose maximum sensitivity was about 800 nm.

The images were acquired using a Barlow 2x lens which gives a resulting focal length of 15 524 ± 30 mm (see Salaman et al. 1999, 2000). The focal length is checked on pairs recently measured by speckle interferometry. The scale on the sky is 0.1196″ per pixel. The sensor orientation is checked by recording the motion of the stars in right ascension. The resulting error in the position angle calibration is close to ±0.2°.

The Rayleigh resolution limit is 0.296″.

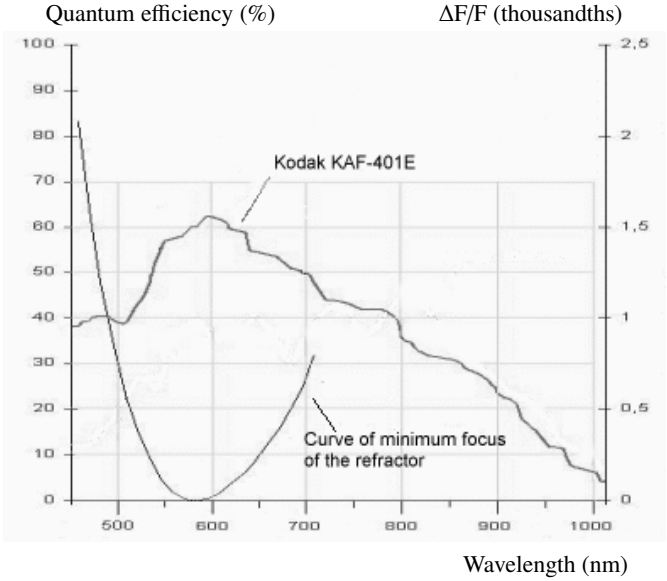

Fig. 1. Sensitivity of the KAF-401E sensor versus wavelength.

The program of acquisition is QMIPS32 (Buil et al. 1997, QuickMips32 V.1.8), using a 128×128 pixel windowing. Image sequence acquisition (from 150 to 300 per binary) is performed unselectively by the program QMIPS32. For each binary, an exposure time, as short as possible (from 0.02 s to 1 s) is chosen depending of the stellar magnitude and quality of seeing.

Table 1. Measurements of visual double stars.

Send offprint requests to: G. Morlet, e-mail: gmorlet@noos.fr

⋆ Table 1 is only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/396/933

Table 2. Comparison, for the orbital binaries, between our observations (O) and calculated positions (C).

WDS	NAME		DATE	Observations (O)		Calculated (C)		Grade	Reference	Residuals O–C	
identifier	of the pair		of observ.	θ°	ρ''	θ°	ρ''			θ°	ρ''
00014+3937	HLD 60	AB	2000.724	173.3	1.23	173.6	1.20	4	Hei 1963 a	−0.3	0.03
00014+3937	HLD 60	AB	2001.783	172.6	1.24	173.2	1.20	4	Hei 1963 a	−0.6	0.04
00167+3629	STT 4	AB	2000.730	132.7	0.33	135.7	0.32	2	Alz 2000 a	−3.0	0.01
00583+2124	BU 302	AB	2000.730	185.3	0.27	182.3	0.43	4	Zul 1997 b	3.0	−0.16
02022+3643	A 1813	AB-C	2001.786	206.1	1.39	202.1	1.14	5	Hei 1973 a	4.0	0.25
02182+3920	A 207	AB	2000.735	348.0	0.52	355.9	0.37	4	Sca 2001 d	−7.9	0.15
02202+2949	A 961	AB	2000.738	285.0	0.39	284.7	0.33	5	Hei 1969 b	0.3	0.06
02379+2003	A 2219	AB	2000.738	153.6	0.41	146.8	0.36	5	Hei 1997	6.8	0.05
						146.2	0.38	5	Hei 1997	7.4	0.03
02407+2637	STT 43	AB	2000.735	354.3	0.74	353.9	0.74	4	Sca 2001 d	0.4	0.0
02407+2637	STT 43	AB	2001.786	353.1	0.72	352.9	0.73	4	Sca 2001 d	0.2	−0.01
03177+3838	STT 53	AB	2000.735	249.6	0.74	249.7	0.72	3	Alz 1998 a	−0.1	0.02
03463+2411	BU 536	AB	2000.738	180.9	0.91	176.9	0.62	5	Pop 1995 a	4.0	0.29
04064+4325	A 1710	AB	2000.738	318.4	0.61	317.4	0.60	3	Hei 1982 c	1.0	0.01
04064+4325	A 1710	AB	2001.791	318.7	0.64	316.8	0.61	3	Hei 1982 c	1.9	0.03
04091+2839	HO 326	AB	2000.738	279.5	0.41	284.2	0.45	5	Hei 1997	−4.7	−0.04
04170+1941	HO 328	AB	2000.738	5.8	0.50	4.1	0.46	3	Hei 1978 a	1.7	0.04
12422+2622	A 1851	AB	2001.350	313.3	0.48	312.9	0.47	2	Hei 1998	0.4	0.01
12533+2115	STF 1687	AB	2001.381	185.1	1.08	186.1	1.04	3	Hei 1997	−1.0	0.04
13235+2914	HO 260	AB	2001.350	83.0	1.46	83.7	1.32	4	AmC 1978	−0.7	0.14
13258+4430	A 1609	AB	2001.370	10.0	0.48	10.1	0.47	2	Hei 1991	−0.1	0.01
13375+3618	STF 1768	AB	2001.353	99.3	1.79	98.8	1.77	3	Sod 1999	0.5	0.02
13491+2659	STF 1785	AB	2001.353	173.2	3.32	174.2	3.30	2	Hei 1988d	−1.0	0.02
14426+1929	HU 575	AB	2001.350	185.5	0.71	185.4	0.67	2	Sod 1999	0.1	0.04
14515+4456	STT 287	AB	2001.353	353.5	0.84	353.7	0.87	4	Hei 1997	−0.2	−0.03
14534+1542	STT 288	AB	2001.378	164.3	1.21	165.3	1.19	4	Hei 1998	−1.0	0.02
15183+2650	STF 1932	Aa-B	2001.350	260.0	1.58	260.1	1.61	2	Hei 1965c	−0.1	−0.03
15245+3723	STF 1938	BC	2001.353	8.5	2.27	8.2	2.24	2	Sod 1999	0.3	0.03
15360+3948	STT 298	AB	2001.361	160.2	0.61	160.2	0.60	1	Sod 1999	−0.0	0.01
16289+1825	STF 2052	AB	2001.350	123.6	2.08	123.6	2.01	2	Sod 1999	0.0	0.07
16518+2840	STF 2107	AB	2001.350	97.7	1.43	99.3	1.35	3	Sca 1984a	−1.6	0.08
20550+2805	BU 367	AB	2000.735	135.5	0.43	137.9	0.40	3	Hei 1962	−2.4	0.03
21410+2920	STT 448	AB	2001.780	183.1	0.28	172.7	0.25	4	Alz 1998a	10.4	0.03
21501+1717	COU 14	AB	2000.730	254.3	0.32	254.6	0.30	2	Hrt 1989	−0.3	0.02
22100+2308	COU 136	AB	2000.730	31.3	0.50	29.5	0.50	4	Cou 1999b	1.8	0.00
22302+2228	HU 388	AB	2000.727	56.8	0.49	63.7	0.48	5	Baz 1976	−6.9	0.01
22402+3732	HO 188	AB	2001.780	217.5	0.40	219.5	0.31	3	Doc 1986b	−2.0	0.09
22419+2126	STF 2934	Aa−B	2001.775	59.2	1.30	61.0	1.17	5	Hei 1981a	−1.8	0.13
22514+2623	HO 482	AB	2000.732	21.6	0.49	21.1	0.46	3	Sta 1982b	0.5	0.03
22514+2623	HO 482	AB	2001.783	22.8	0.51	20.4	0.46	3	Sta 1982b	2.4	0.05
22537+4445	BU 382	AB	2000.732	224.2	0.90	223.8	0.91	2	Sod 1999	0.4	−0.01
23375+4426	STT 500	AB	2000.732	9.8	0.49	8.8	0.46	4	Zul 1981	1.0	0.03

These images are stored on the computer hard disk. A selection is subsequently made out of the dome, thanks to a homemade program which allows the best 30 to 50 images to be selected of the sequence, according to the light intensity peak.

The selection of the observed stars is made using the catalog of COU double stars discovered at Nice by P. Couteau (Couteau 1999), the Washington Double Star Catalog (Worley & Douglass 1997) updated at the time of the missions, and SIDONIe, Site Informatique des étoiles Doubles de Nice (Le Contel et al. 2001).

During our three missions, in 2000 from September 21st to October 1st, in 2001 from May 7th to 21st and from October 9th to 21st, the images of 167 binaries were acquired.

3. Reduction method and results

The acquired images are visually sorted, by eliminating those showing important distortions. The selected images (10 to 25) are composited (shift and add), using a homemade program, to increase the signal to noise ratio by a factor of 3 to 5. We verify that the *FWHM* does not exceed a maximum of 1.2″.

To measure composite images, we used a custom image reduction program (Salaman et al. 1999), which calculates the position angle, angular separation and magnitude difference.

If the composite image does not show two components obviously separated, it is treated by a wavelet filtering, which analyses the spatial frequencies of the image. The selective

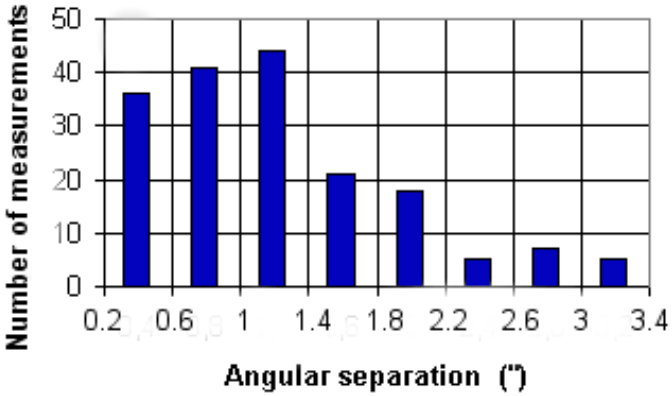

Fig. 2. Number of measurements versus angular separation.

extraction of the higher frequencies allows the determination of the separation of the components.

The internal uncertainty of astrometric measurements is estimated to be close to 1/10 of pixel, i.e. ±0.012″.

The measured angular separations range from 0.27″ to 3.34″ (see histogram Fig. 2).

The 176 measurements of 167 double stars performed in september 2000 then may and october 2001 are presented in Table 1.

Table 2 presents, for the binaries with known orbits from the Fifth Catalog of Orbits (Hartkopf et al. 2000), the comparison of astrometric measurements (O) with calculated positions (C).

The averages of the O–C are:

- on angles: average of all measurements: +0.13°
- on separations:
  average of all measurements: +0.039″ (1/3 pixel)
  - on grades 1, 2 and 3: +0.028″ (1/4 pixel)
  - on grades 1 and 2: +0.016″ (1/7 pixel).

Acknowledgements. We would like to thank J.-C. Valtier, Head of the Fresnel Department, who welcomed us at the Observatory. We also wish to thank D. Bonneau, J. Dommanget and P. Couteau, scientific advisers of the Binary Commission of the SAF for their help. We are grateful to Laurence Morlet for translating this paper.

References

Buil, C., Klotz, A., & Thouvenot, E. 1997, QuickMips 32
Couteau, P., & Gili, R. 1994, A&AS, 106, 377
Couteau, P. 1999, Catalogue de 2700 Étoiles doubles COU, Observatoire de la Côte d'Azur, département Augustin Fresnel, UMR 6528, 3ème Edition
Dommanget, J., & Nys, O. 1994, Catalogue des Composantes d'étoiles Doubles et Multiples (CCDM)*, Comm. Obs. R. Belgique, Ser A, N.115**
ESA, 1997, The Hipparcos Catalogue, ESA SP-1200*
Gili, R., & Couteau, P. 1997, A&AS, 126, 1
Gili, R., & Bonneau, D. 2001, A&AS, 378, 954
Morlet, G., Salaman, M., & Gili, R. 2000, A&AS, 145, 67
Hartkopf, W. I., Mason, B. D., & Worley, C. E. 2000, Fifth Catalog of Orbits of Visual Binary Stars, `http://ad.usno.navy.mil/wds/orb5.html`
Le Contel, D., Valtier, J.-C., & Bonneau, D. 2001, A&A, 377, 496, Site Informatique des étoiles Doubles de Nice (SIDONIe) `http://sidonie.obs-nice.fr`
Salaman, M., Morlet, G., & Gili, R. 1999, A&AS, 135, 499
Salaman, M., Morlet, G., & Gili, R. 2001, A&A, 369, 552
Thorel, J. C. 1996, A&AS, 115, 59
Thorel, J. C. 2000, A&AS, 147, 251
Worley, C. E., & Douglass, G. G. 1997, A&AS, 125, 523, Washington Double Star Catalog (WDS), `http://ad.usno.navy.mil/ad/wds`

* The catalogues are available from the CDS at Strasbourg
** Currently updated by the authors at the Royal Observatory of Belgium