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CCD and micrometric observations of visual double stars

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Abstract. Relative positions and separations for 65 visual binaries are given. CCD frames were taken at the 1-m coudé telescope and micrometric observations were carried out at the 65-cm refractor, both at the Venezuelan National Observatory. The visual double stars observed were selected from the Ramón María Aller Observatory program list. In addition, we also observed several long period double stars with poorly determined orbital elements.

Key words: astrometry — binaries: visual

1. Introduction

In 1994, a scientific collaboration between the Centro de Investigaciones de Astronomía (CIDA, Venezuela) and the Ramón María Aller Observatory (University of Santiago de Compostela, Spain) began with the purpose to carry out joint research on double and multiple stars, especially to gather observational data for southern stars from the Venezuelan National Observatory. As a result of this program, we report here relative positions of several binaries.

2. Observations

Observations were carried out from May 1994 to August 1997 at the Venezuelan National Observatory. Two telescopes were used: the 1-m coudé reflector, equipped with a CCD camera, and the 65-cm. Zeiss refractor with a filar micrometer. The CCD camera is based on a Thomson TH-7883 chip, which features 574 × 384 pixels 23 μm square, giving a scale factor of 0.23 arcsec/pixel at the coudé focus. However, when the seeing conditions were good, a 1.5 × Barlow lens was used sparingly. The technique adopted to take CCD frame has been described in a previous paper (Abad & Della Prugna 1994). In brief, multiple images of the visual binary are taken onto a single CCD frame, shifting the telescope in R.A. by a small amount between exposures. To determine the scale factor, double stars from the Second List of Wide Visual Binaries were observed (Brosche & Sinachopoulos 1989). These were also observed at the refractor, in order to ascertain the screw-value of the filar micrometer. Previous micrometric observations at this telescope were carried out by A. Valbousquet (Valbousquet 1980) and C. Prieto (Prieto 1997). In this work, micrometric observations were carried out by one of the authors (FDP).

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3. Results

The following table gives relevant data for the visual binaries observed. An asterisk indicates a micrometric observation. All CCD measurements include results from each observation. When several measurements with similar epochs are available for the same double star, the mean Separation and Position Angle are given for the mean epoch after the dashed line. Errors are calculated from the totality of images of the pair for similar epochs. Stars in the table are arranged in increasing R.A. and the magnitudes of the pair are those given in the original list. The table is arranged in the following order:

WDS	WDS catalogue number (Worley & Douglass 1996),
ADS or Name	ADS number or name of the pair (Aitken R.G. 1932),
magnitudes	magnitudes of the components (Worley & Douglass 1996),
t	epoch of the observations,
θ	Position Angle in degrees,
σ_θ	error of Position Angle,
n_θ^0	number of observations for Position Angle.
ρ	Separation of the components in arcsecs,
σ_ρ	error of Separation,
n_ρ^0	number of observations for Separation,

Table 1. Data for the visual binaries observed

WDS	ADS or NAME	$magnitudes$	t	θ	σ_θ	n_θ^0	ρ	σ_ρ	n_ρ^0
$00184+4401$	$246AB$	$8.1-11.0$	1997.660	63.69	0.09	3	35.30	0.04	3
			1997.660	64.18	0.04	3	35.25	0.02	3
			1997.663	63.92	0.04	3	35.19	0.05	3
			1997.663	64.38	0.04	3	35.24	0.06	3
			– – ––	– – ––	– – ––	––	– – ––	––	––
			1997.662	64.04	0.27	11	35.24	0.06	11
$01398-5612$	$DUN5$	$5.9-5.8$	1994.948	191.36	0.51	5	10.96	0.05	3
			1995.025	192.28	0.25	8	11.27	0.05	6
			1997.660	191.00	0.21	5	11.35	0.04	5
			1997.660	192.10	0.22	6	11.25	0.08	6
			1997.666	191.71	0.33	4	11.26	0.06	3
			1997.666	191.85	0.15	4	11.24	0.05	3
			– – ––	– – ––	– – ––	––	– – ––	––	––
			1996.702	191.73	0.43	29	11.28	0.08	29
$01456-2503$	$1394AB$	$5.5-8.3$	1994.866	26.68	0.14	8	4.95	0.01	8
			1994.874	26.76	0.14	8	4.96	0.01	8
			1994.874	27.21	0.16	6	4.92	0.02	5
			– – ––	– – ––	– – ––	––	– – ––	––	––
			1994.871	26.86	0.26	21	4.94	0.02	21
$01456-2503$	$1394AB$	$5.5-8.3$	1997.663	25.89	0.60	4	4.87	0.03	3
$02020+0246$	$1615AB$	$4.3-5.2$	1997.663	273.88	0.51	3	1.74	0.04	3
$02198-3527$	$HJ3494$	$8.8-9.0$	1994.874	253.69	0.48	6	2.03	0.01	6
			1995.025	250.39	0.86	4	1.97	0.03	4
			– – ––	– – ––	– – ––	––	– – ––	––	––
			1994.934	252.37	1.74	10	2.00	0.03	10
$02442+4914$	$2081AB$	$4.1-10.0$	1994.866	304.01	0.14	6	20.07	0.07	6
$02475+1922$	$2122AB$	$7.4-8.3$	1994.866	308.87	0.07	6	3.63	0.01	6
$03121-2859$	2402	$4.0-6.6$	1994.863	299.98	0.26	8	4.56	0.03	8
			1994.874	299.26	0.30	7	4.56	0.03	7
			1995.025	299.34	0.87	4	4.57	0.09	4
			– – ––	– – ––	– – ––	––	– – ––	––	––
			1994.901	299.58	0.58	19	4.56	0.05	19
$03122+3713$	2390	$8.1-8.3$	1994.863	126.84	0.45	4	2.71	0.01	4
			1994.863	127.26	0.09	6	2.71	0.01	6
			– – ––	– – ––	– – ––	––	– – ––	––	––
			1994.863	127.20	0.15	10	2.71	0.01	10

Table 1. continued

WDS	ADS or NAME	$magnitudes$	t	θ	σ_θ	n_θ^0	ρ	σ_ρ
$03368+0035$	2644	$5.9-8.8$	1994.866	260.23	0.28	5	6.63	0.03
			1995.025	269.06	1.00	4	6.64	0.04
			– – ––	– – ––	– – ––	––	– – ––	––
			1994.946	269.15	0.70	9	6.63	0.03
$03485-3147$	$HJ3596$	$8.3-8.6$	1994.948	137.92	0.30	6	9.03	0.03
$03522-4133$	$RST1260$	$10.9-11.1$	1994.866	285.81	1.04	5	2.14	0.05
			1994.874	286.17	0.24	4	2.13	0.02
			1995.025	287.88	1.86	5	2.12	0.03
			– – ––	– – ––	– – ––	––	– – ––	––
			1994.925	286.37	1.24	14	2.13	0.04
$03575-0101$	2894	$8.2-10.2$	1994.863	16.70	0.21	6	11.04	0.02
			1994.866	17.26	0.20	7	11.07	0.03
			– – ––	– – ––	– – ––	––	– – ––	––
			1994.865	17.00	0.35	13	11.06	0.03
$04037-4745$	$HU1362$	$9.5-10.5$	1994.866	56.38	0.31	5	2.44	0.04
$04153-0739$	$3093BC$	$9.5-11.2$	1995.025	336.82	0.16	5	8.89	0.02
$04166-1005$	$BU548$	$7.5-12.0$	1994.948	344.58	0.42	3	6.26	0.03
$04403-5857$	$HJ3683$	$7.3-7.5$	1995.025	91.77	0.21	5	3.25	0.02
$04496-5353$	$I342$	$8.4-8.8$	1995.025	141.31	0.81	7	2.82	0.01
$05110+0245$	$HEI652$	$9.8-10.1$	1994.863	54.67	1.34	6	1.63	0.04
			1994.874	54.43	0.17	3	1.60	0.02
			1995.027	55.64	1.47	5	1.60	0.01
			– – ––	– – ––	– – ––	––	– – ––	––
			1994.920	54.97	1.34	16	1.61	0.02
$05258-2721$	$RST133$	$10.6-10.6$	1994.874	164.21	0.33	4	1.31	0.03
			1994.874	163.20	1.15	3	1.28	0.01
			– – ––	– – ––	– – ––	––	– – ––	––
			1994.874	164.12	0.49	8	1.30	0.03
$(*)05308+0557$	4115	$4.5-5.7$	1995.100	48.30	0.40	2	1.22	0.08
$05364+2200$	4200	$7.2-7.8$	1994.863	272.54	0.05	7	3.99	0.01
			1995.025	272.65	0.23	4	3.98	0.02
			1995.112	272.74	0.18	4	3.96	0.02
			– – ––	– – ––	– – ––	––	– – ––	––
			1994.973	272.62	0.18	15	3.98	0.02
$(*)$	4200	$7.2-7.8$	1995.100	272.20	0.50	2	4.03	0.09

Table 1. continued

WDS	ADS or NAME	$magnitudes$	t	θ	σ_θ	n_θ^0	ρ	σ_ρ
$05408+0329$	$HEI666$	$9.8-11.9$	1994.863	249.87	1.03	3	2.43	0.03
$(*)05407-0157$	$4263AB$	$2.0-4.2$	1994.500	164.50	0.80	2	2.33	0.11
$05467-2328$	$RST2397$	$10.0-10.0$	1995.027	306.68	0.41	4	1.32	0.02
$06003-3102$	$HJ3823AC$	$7.8-8.3$	1995.025	7.59	0.37	4	2.34	0.01
			1995.027	7.71	0.27	5	2.29	0.01
			1995.115	8.53	0.33	4	2.41	0.03
			– – ––	– – ––	– – ––	––	– – ––	––
			1995.056	7.93	0.52	15	2.35	0.05
$06047-4505$	$HJ3834AB$	$5.9-9.4$	1995.071	218.11	0.55	4	5.72	0.04
$06048-4828$	$DUN23$	$7.2-7.5$	1995.025	209.70	0.18	5	2.45	0.03
			1995.027	208.96	0.16	6	2.50	0.02
			– – ––	– – ––	– – ––	––	– – ––	––
			1994.026	209.30	0.41	11	2.48	0.03
$06344+1445$	5197	$8.1-8.2$	1994.863	310.68	0.43	8	1.70	0.02
			1995.071	309.20	1.45	5	1.69	0.02
			1995.071	311.06	0.29	7	1.71	0.01
			1995.112	309.07	1.07	5	1.65	0.02
			– – ––	– – ––	– – ––	––	– – ––	––
			1995.018	310.27	1.03	27	1.69	0.03
$(*)$	5197	$8.1-8.2$	1995.100	309.70	0.80	2	1.82	0.10
$06546+1311$	$5559AB$	$4.7-7.7$	1994.863	145.37	0.18	8	7.22	0.03
			1995.025	144.63	0.37	6	7.06	0.08
			1995.027	146.42	0.38	5	7.14	0.04
			1995.115	144.72	0.19	6	7.11	0.02
			– – ––	– – ––	– – ––	––	– – ––	––
			1994.996	145.24	0.72	23	7.15	0.06
$(*)$	$5559AB$	$4.7-7.7$	1995.100	145.40	0.40	2	7.12	0.10
$07201+2159$	5983	$3.5-8.5$	1994.863	222.40	0.55	6	5.83	0.04
			1995.025	224.03	0.37	5	5.65	0.07
			1995.027	223.09	0.68	5	5.78	0.04
			– – ––	– – ––	– – ––	––	– – ––	––
			1994.949	223.18	0.87	15	5.80	0.05
$(*)$	5983	$3.5-8.5$	1995.100	223.80	0.70	2	5.96	0.14
$07294-1500$	$6126AB$	$6.1-7.7$	1994.863	21.53	0.49	9	1.86	0.05
			1995.071	22.34	1.23	5	1.86	0.03
			– – ––	– – ––	– – ––	––	– – ––	––

Table 1. continued

WDS	ADS or NAME	$magnitudes$	t	θ	σ_θ	n_θ^0	ρ	σ_ρ
$07346+3153$	$6175AB$	$2.0-2.9$	1995.027	71.39	0.29	6	3.44	0.04
			1995.115	69.80	0.33	7	3.39	0.07
			– – – –	– – – –	– – – –	– –	– – – –	– –
			1995.074	70.53	0.85	12	3.42	0.05
$07346+3153$	$6175AB$	$2.0-2.9$	1997.123	68.84	0.46	4	3.58	0.03
			1997.123	–	–	0	3.73	0.07
			– – – –	– – – –	– – – –	– –	– – – –	– –
			1997.123	68.84	0.46	4	3.68	0.10
$07494-3033$	$I186$	$8.2-8.4$	1995.071	245.77	2.33	5	1.45	0.02
$(*)08024+0409$	6532	$8.5-10.4$	1995.100	275.60	0.90	2	1.45	0.05
$08095+3213$	6623	$7.1-8.0$	1994.863	23.89	0.10	8	2.86	0.02
			1995.025	24.28	0.21	5	2.90	0.03
			1995.027	23.92	0.07	6	2.88	0.01
			1995.115	23.05	0.77	5	2.75	0.03
			– – – –	– – – –	– – – –	– –	– – – –	– –
			1994.992	23.80	0.55	25	2.85	0.06
$(*)$	6623	$7.1-8.0$	1995.100	23.80	1.00	2	2.95	0.15
$08122+1739$	$6650AB-C$	$5.1-6.2$	1994.863	74.90	0.51	9	6.08	0.04
			1995.025	74.75	0.06	5	6.08	0.01
			1995.027	75.22	0.38	4	6.05	0.04
			– – – –	– – – –	– – – –	– –	– – – –	– –
			1994.949	74.93	0.44	17	6.07	0.04
$(*)$	$6650AB-C$	$5.1-6.2$	1995.200	76.60	1.00	3	6.27	0.10
$08122+1739$	$6650AB-C$	$5.1-6.2$	1997.123	73.12	0.30	5	5.89	0.06
			1997.123	73.73	0.15	5	5.95	0.06
			– – – –	– – – –	– – – –	– –	– – – –	– –
			1997.123	73.43	0.38	10	5.92	0.06
$08221-4059$	$HJ4087AB$	$7.7-8.0$	1995.071	266.54	1.48	4	1.45	0.01
$09144+5241$	$7251AB$	$7.6-7.7$	1994.863	91.32	0.22	3	17.34	0.03
			1995.025	91.27	0.29	6	17.34	0.06
			1995.027	91.61	0.06	3	17.26	0.01
			1995.134	91.40	0.15	4	17.36	0.05
			– – – –	– – – –	– – – –	– –	– – – –	– –
			1995.022	91.37	0.25	16	17.33	0.06
$(*)$	$7251AB$	$7.6-7.7$	1995.100	91.80	0.30	2	17.39	0.13
$09144+5241$	$7251AB$	$7.6-7.7$	1997.370	92.31	0.05	4	17.36	0.06
			1997.370	92.64	0.15	4	17.32	0.02

Table 1. continued

WDS	ADS or NAME	$magnitudes$	t	θ	σ_θ	n_θ^0	ρ	σ_ρ
$10200+1950$	$7724AB$	$2.6-3.8$	1995.025	123.35	0.23	5	4.60	0.04
			1995.027	124.81	0.17	6	4.61	0.02
			1995.115	122.85	0.60	4	4.39	0.07
			1995.132	124.16	0.13	5	4.60	0.01
			1995.134	124.70	0.33	8	4.59	0.11
			– – ––	– – ––	– – ––	––	– – ––	––
			1995.089	124.26	0.63	24	4.59	0.07
$(*)$	$7724AB$	$2.6-3.8$	1995.100	125.20	0.70	2	4.63	0.24
$(*)11137+2008$	8094	$7.6-7.8$	1995.100	324.00	1.90	2	0.62	0.07
$(*)12306+0943$	8575	$8.1-8.4$	1995.700	243.40	0.60	2	1.39	0.14
$13491+2659$	9031	$7.7-7.9$	1997.370	171.31	0.08	6	3.33	0.01
			1997.370	170.78	0.11	6	3.36	0.01
			– – ––	– – ––	– – ––	––	– – ––	––
			1997.370	171.05	0.28	12	3.34	0.02
$13550-0804$	$9053AB$	$6.5-7.7$	1995.132	97.87	0.48	6	3.57	0.05
			1995.133	97.24	0.43	5	3.50	0.04
			– – ––	– – ––	– – ––	––	– – ––	––
			1995.132	97.70	0.45	10	3.53	0.04
$(*)14587-2739$	9453	$6.3-6.6$	1996.000	358.00	1.00	2	0.61	0.06
$15038+4739$	9494	$5.3-6.2$	1997.660	54.53	0.77	5	1.99	0.01
			1997.660	53.17	0.52	5	2.02	0.02
			– – ––	– – ––	– – ––	––	– – ––	––
			1997.660	53.85	0.94	10	2.00	0.02
$15183+2650$	$9578Aa-B$	$7.1-7.6$	1997.660	258.18	0.43	7	1.56	0.01
			1997.660	258.75	0.25	7	1.54	0.01
			– – ––	– – ––	– – ––	––	– – ––	––
			1997.660	258.55	0.33	14	1.55	0.01
$15245+3721$	$9626BC$	$7.2-7.8$	1997.660	10.60	0.39	5	2.25	0.01
			1997.660	10.86	0.71	5	2.26	0.01
			– – ––	– – ––	– – ––	––	– – ––	––
			1997.660	10.73	0.59	10	2.26	0.01

Table 1. continued

WDS	ADS or NAME	$magnitudes$	t	θ	σ_θ	n_θ^0	ρ	σ_ρ	n_ρ^0
$15348+1032$	$9701AB$	$4.2-5.2$	1994.430	–	–	0	3.99	0.00	1
			1994.430	175.13	0.11	2	3.97	0.04	2
			1994.430	175.13	0.11	1	3.91	0.00	1
			1994.430	174.50	0.12	5	3.96	0.02	5
			1995.195	175.05	1.52	5	3.66	0.10	5
			1995.195	175.80	1.22	5	3.76	0.05	4
			1995.460	174.09	0.34	7	4.02	0.02	7
			– – – –	– – – –	– – – –	– –	– – – –	– –	– –
			1994.994	174.37	0.49	24	3.90	0.13	25
(*)	$9701AB$	$4.2-5.2$	1996.000	174.00	1.00	2	4.07	0.14	2
$15559-0210$	9842	$7.0-8.1$	1994.430	–	–	0	5.96	0.00	1
			1994.430	350.99	0.20	5	5.98	0.05	5
			1995.195	351.74	0.18	4	5.88	0.01	3
			1995.460	351.31	0.37	8	6.00	0.03	8
			– – – –	– – – –	– – – –	– –	– – – –	– –	– –
			1995.050	351.32	0.40	17	5.97	0.06	17
(*)	9842	$7.0-8.1$	1996.000	351.20	0.09	2	5.89	0.09	2
$16133+1332$	$9969AB$	$7.5-7.7$	1994.430	–	–	0	4.09	0.00	1
			1994.430	353.21	0.12	5	4.11	0.03	5
			1994.515	353.21	0.12	1	4.34	0.00	1
			1994.515	352.61	0.18	5	4.17	0.05	3
			1994.515	352.69	0.27	7	4.06	0.04	7
			1995.460	353.66	0.08	9	4.11	0.01	9
			1995.499	353.87	0.26	6	4.11	0.01	6
			– – – –	– – – –	– – – –	– –	– – – –	– –	– –
			1994.949	353.29	0.51	30	4.10	0.03	32
(*)	$9969AB$	$7.5-7.7$	1995.500	352.60	0.90	2	4.05	0.07	2
$16160+0721$	9982	$9.3-9.8$	1997.660	20.02	0.52	5	3.21	0.03	5
			1997.660	20.28	0.17	5	3.21	0.01	5
			1997.666	19.84	0.50	5	3.21	0.03	5
			1997.666	20.43	1.02	4	3.21	0.03	5
			– – – –	– – – –	– – – –	– –	– – – –	– –	– –
			1997.663	20.02	0.49	18	3.20	0.04	20
$16289+1825$	$10075AB$	$7.8-7.8$	1997.663	125.19	0.32	6	1.96	0.02	5
			1997.663	126.07	0.13	5	1.95	0.01	5
			– – – –	– – – –	– – – –	– –	– – – –	– –	– –
			1997.663	125.69	0.41	10	1.96	0.02	11

Table 1. continued

WDS	ADS or NAME	$magnitudes$	t	θ	σ_θ	n^0	ρ	σ_ρ
$(*)16294-2626$	10074	$1.0-5.4$	1996.100	277.00	1.30	4	2.77	0.15
$17153-2636$	$10417AB$	$5.3-5.3$	1994.430	–	–	0	4.68	0.00
			1994.430	148.92	0.17	5	4.74	0.04
			1995.460	148.49	0.12	9	4.77	0.01
			1995.499	148.34	0.26	7	4.77	0.06
			1995.499	148.19	0.30	6	4.80	0.09
			– – – –	– – – –	– – – –	– –	– – – –	– –
			1995.266	148.46	0.33	29	4.77	0.06
$(*)$	$10417AB$	$5.3-5.3$	1996.100	147.80	0.70	4	4.73	0.07
$17146+1423$	$10418AB$	$3.5-5.4$	1994.430	–	–	0	4.32	0.00
			1994.430	105.58	0.43	6	4.71	0.04
			1994.515	105.58	0.43	1	4.74	0.00
			1994.515	105.72	0.34	5	4.63	0.07
			1995.460	107.82	0.37	8	4.94	0.04
			– – – –	– – – –	– – – –	– –	– – – –	– –
			1994.863	106.56	1.14	18	4.81	0.13
$(*)$	$10418AB$	$3.5-5.4$	1996.100	105.00	1.40	4	4.70	0.18
$(*)18101+1629$	11123	$6.5-7.3$	1996.100	219.80	1.00	3	1.17	0.05
$18154+1946$	11208	$8.2-9.0$	1997.666	30.38	0.43	5	5.19	0.05
$18443+3940$	$11635AB$	$5.1-6.0$	1994.430	–	–	0	2.47	0.00
			1994.430	350.95	1.58	6	2.41	0.04
			1995.460	351.72	0.19	10	2.47	0.01
			1995.460	353.10	1.00	8	2.53	0.04
			1995.499	353.23	1.18	9	2.51	0.05
			– – – –	– – – –	– – – –	– –	– – – –	– –
			1991.235	352.46	1.18	35	2.48	0.05
$(*)$	$11635AB$	$5.1-6.0$	1996.100	351.00	0.97	3	2.46	0.09
$18443+3940$	$11635Cc-D$	$5.1-5.4$	1994.430	83.21	0.83	1	2.35	0.00
			1994.430	86.72	0.27	6	2.34	0.04
			1995.499	84.05	0.41	8	2.30	0.04
			1995.499	83.21	0.83	8	2.28	0.04
			– – – –	– – – –	– – – –	– –	– – – –	– –
			1995.227	84.48	1.53	26	2.31	0.05
$(*)$	$11635Cc-D$	$5.1-5.4$	1996.100	84.40	0.70	3	2.31	0.10

Table 1. continued

WDS	ADS or NAME	$magnitudes$	t	θ	σ_θ	n^0	ρ	σ_ρ
$19143+1904$	12201	$7.9-9.4$	1994.430	–	–	0	2.36	0.00
			1994.430	235.72	2.94	4	2.35	0.08
			1995.460	238.33	0.23	8	2.18	0.03
			1995.460	238.19	0.26	9	2.13	0.04
			– – – –	– – – –	– – – –	– –	– – – –	– –
			1995.264	238.13	0.40	21	2.19	0.09
$(*)$	12201	$7.9-9.4$	1995.600	238.00	1.00	2	2.17	0.05
$(*)20012-3835$	$HDO294$	$8.2-8.9$	1995.600	24.20	0.60	2	1.12	0.10
$(*)20462+1554$	14270	$7.6-8.4$	1995.600	9.60	0.70	2	5.98	0.14
$(*)21031+0132$	$14573AB$	$6.7-7.3$	1995.600	119.50	1.20	2	1.30	0.10
$22038+6438$	$15600Aa-B$	$4.6-6.5$	1994.460	275.33	0.51	4	7.92	0.06
			1994.460	276.27	0.22	5	7.86	0.05
			1995.499	275.85	0.55	7	7.92	0.09
			1995.499	275.56	0.39	5	7.84	0.06
			– – – –	– – – –	– – – –	– –	– – – –	– –
			1995.054	275.78	0.56	21	7.89	0.08
$(*)$	$15600Aa-B$	$4.6-6.5$	1995.600	276.80	1.00	2	7.89	0.10

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