Astronomy & Astrophysics manuscript no.
(will be inserted by hand later)

Speckle interferometry of nearby multiple stars. II. *

I. Balega[1], Y.Y. Balega[1], A.F. Maksimov[1], E.A. Pluzhnik[1,3], D. Schertl[2], Z.U. Shkhagosheva[1,3], and G. Weigelt[2]

[1] Special Astrophysical Observatory, N.Arkhyz, Karachai-Cherkesia, 369167 Russia
[2] Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-53121 Bonn, Germany
[3] Isaac Newton Institute of Chile, SAO RAS Branch

Received date; accepted

Abstract. This paper is a continuation of diffraction-limited speckle interferometry of binary and multiple stars carried out at the 6-m telescope of the Special Astrophysical Observatory in Zelenchuk. The program has concentrated on nearby ($\pi > 10$ mas) close binaries discovered or measured during the Hipparcos mission. Here, we present 132 measurements of relative positions and magnitude differences for 99 pairs and 8 measurements for 6 triple systems. 54 entries in the paper are new Hipparcos binaries. New triple systems with late-type dwarf components, discovered in the course of observations, are HIP 8533 and HIP 25354.

Key words. stars: binaries (including multiple) – techniques: interferometry

1. Introduction

This paper continues presentations of the results of binary and multiple star speckle interferometry based upon observations made at the 6-m BTA telescope of the Special Astrophysical Observatory in Zelenchuk. Precise speckle measurements of binary stars carried out over many years remain the main effective source of orbital parameters. Most of our program objects are nearby low-mass main-sequence stars discovered or measured by Hipparcos. The purposes of this study are: (1) to select new pairs exhibiting relatively fast orbital motion; (2) to derive the orbital elements of the newly discovered pairs; (3) to obtain accurate magnitude differences for the components of binary and mutiple systems. Together with the Hipparcos parallaxes and differential magnitudes, the orbits allow the estimation of mass sums of the components, their luminosities, and spectral types. The mass ratios, period, and eccentricity distributions can be studied for our sample stars.

2. Observations and results

The observations presented here were obtained in October 1999 using the new speckle camera developed in 1998 (Maksimov et al. 2003). The first results from the speckle program with this new instrument were reported in Balega et al. (2002 hereafter B02).

The image motion-compensated seeing (FWHM) during the observations was $1''.0 - 1''.5$. Filters with the following center wavelength/bandwidth were used: 545 nm/30 nm (centre of the V-band), 610 nm/20 nm (G), 800 nm/60 nm (centre of the R-band). In the following, they are designated as V', G', and R'.

Relative positions and magnitude differences of each binary were derived from the ensemble averaged power spectrum of speckle interferograms without compensation of the atmospheric transfer function. Magnitude difference between the components of a binary was estimated from the contrast of the fringes measured at different circle radii of the power spectrum (see B02). The 180° ambiguity of the position angle θ^o was overcome by the Walker method (Walker1981).

A double-slit pupil mask was used for direct calibration of the measurements. In addititon, an independent calibration was performed by observations of standard speckle interferometric binaries with slow orbital motion.

Table 1 contains 132 measurements of 99 binary stars. The entries for each system are presented in the same condensed format used in B02. Columns 1 through 3 list the designation of the system: the Hipparcos number (ESA 1997), the name of the star or its catalog number, and the discovery designation. The next columns contain the epoch-2000 coordinates, the epoch of observations given as the fractional Basselian year. They are followed by the measured position angles θ^o given in degrees, angular distances ρ in mas, and their errors. The θ^o values have not

Send offprint requests to: Y. Balega, e-mail: balega@sao.ru
* Based on data collected at the Special Astrophysical Observatory, Russia

been corrected for precession and are thus based upon the equinox for the epoch of observation. Magnitude differences Δm, together with their errors, are listed in Columns 10 and 11. The final column gives the filter indication (as central wavelength/FWHM in nm). Note that in the discovery designation column the HDS (Hipparcos Double Stars) numbers are included, following the upgraded daily Washington Double Star Catalog, maintained at the US Naval Observatory (Mason et al. 2003). The table lists 53 HDS entries, from which 16 have been observed by speckle interferometry for the first time.

The measured angular separations in Table 1 range from a minimum value of 16 mas for the close binary HR 233 to 1859 mas for the components of HIP 103767. In speckle interferometry an accuracy of the measurements is a function of many parameters: seeing, stellar magnitude, magnitude difference, angular separation, etc. For most of our data the typical value of the error is 0.5–2 mas in ρ and 0.2–0.5° in θ^o. This corresponds to the relative error of the vector measurements in the range 0.1–2%; however, in some cases of very close pairs, the error can reach 10% (see e.g. HIP 17932=CHR 126 with $\rho = 21$ mas).

For 25 systems, indicated by an asterisk following their θ^o values, the 180° position angle ambiguity was not resolved.

111 magnitude differences for 92 binaries are given in Table 1. The mean-square errors of Δm measurements vary widely from 0.01^m to 0.75^m, corresponding to different conditions of observation. In 12 cases, indicated by colons, the Δm measurements are uncertain, while for 7 pairs no Δm value is given. In all these cases, except α Aur, the binaries were too wide to fit the entrance window of the detector.

Measurements of 6 triple systems are listed in Table 2. For all the systems the angle θ is given starting at the position of the brighter component. To avoid possible confusion in the components' identification, we designate them as A,B,C, according to their relative brightness. Additional components to known binaries were discovered in HIP 8533 and HIP 25354. The reconstructed geometry and differential magnitudes of HIP 8533 are shown in Fig.1. A third companion close to the primary star is also suspected in the M2-type binary HIP 39402. However, this result needs confirmation. No estimation of the magnitude difference was made for this system. Specific notes concerning the measured triple systems are given in Subsection 2.1. The close spectroscopic subsystem BAG 15 (B02) in the triple system HIP 111805 was not resolved during the 1999 run; therefore, it is given as a Table 1 entry. Three triples, ADS 14749, ADS 16214, and ADS 16904, with early spectral type components were included in the program as speckle interferometry calibration targets.

For 32 Hipparcos pairs absolute magnitudes and spectral types of the components were estimated using our Δm measurements, Hipparcos parallaxes, and Hipparcos median magnitudes Hp. Spectral types for the luminosity class V were taken from (Lang 1992). The results are presented in Table 3. For three pairs (HIP: 93119, 94960, and 103067) the absolute magnitudes do not correspond to $(B-V)$ and $(V-I)$ colors of main sequence stars. The increased luminosity of these binaries can be caused by the presence of a third companion or by the evolved status of the companions. The values in Table 3, combined with 63 values from the first paper of the program, give a total of 95 absolute magnitudes and spectral types of the components.

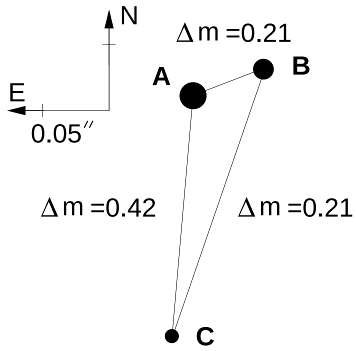

Fig. 1. Geometry of the triple system HIP 8533. The size of the circles corresponds to relative brightness of the components.

2.1. Notes to triple systems

HIP 8533. The system was included in the observing list as a component solution binaty of the Hipparcos Catalogue (ESA 1997). Until then, there was only one measurement of the star, by Muller (Worley & Douglass 1997), who resolved it as a binary (MLR 297) with ρ=300 mas and Δm=0.8. We found the star to be a triple system with a low level of hierarchy: the ratio between the short and the long vector is 0.26. Based on the Hipparcos parallax of the system, we define absolute magnitudes of the three components: 5.8, 6.0, and 6.2, corresponding to spectral types G8 and K0.

HIP 25354. A new triple star with high hierarchy. The main component is a K8 star, while the secondary is a double with M-type components. Because of large separation between the A-star and the BC, the magnitude differences for A-B or A-C cannot be measured with our camera.

HIP 39402. An additional component at a distance of 40 mas from the secondary is suspected in the system. Magnitude difference is between 1.5 and 2 magnitudes.

HIP 101955. This observation confirms the fast orbital motion of the spectroscopic subsystem BAG 14. Differential magnitudes and estimated absolute magnitudes coincide with the observations of the previous year.

HIP 116726. In B02 the measurement for CHR 149 was erroneously given as for the AC component. The correct entry is: CHR 149=BC, $\theta = 43.1° \pm 2.0°$.

3. Summary

We continue the speckle study of binaries discovered by Hipparcos and other nearby low-mass systems. The aim is to select binaries with fast relative motion in order to determine new orbits and to combine the Hipparcos parallaxes with the speckle interferometric Δm measurements to derive absolute magnitudes and spectral types of the components.

The presented sample of stars includes 54 new Hipparcos doubles with parallaxes above 10 mas and separations of less than $\sim 1''$. From these, 17 entries have been observed in 1999 by speckle interferometry for the first time. Two new triple systems were discovered among the objects of the program: HIP 8533 and HIP 25354. For 32 new Hipparcos pairs, absolute magnitudes and spectral types of components were derived from our Δm measurements and Hipparcos parallaxes under the assumption that the components are the main-sequence stars.

Acknowledgements. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France, and the Washington Double Star Catalog of the US Naval Observatory. The speckle interferometry program at the 6-m telescope has been supported by the Russian Foundation for Basic Research through grant No. 01-02-16563a. Additional support for this work was provided by the Russian Federal Program Astronomia through contract No. 40.022.1.1.1101.

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Table 1. Binary star measurements

HIP	Name/ Catalog No.	Discoverer designation	Coord. 2000	Epoch 1999.0+	$\theta°$	σ_θ	ρ *mas*	σ_ρ *mas*	Δm	$\sigma_{\Delta m}$	Filter
823		HDS 23	00101+3825	.8155	295.4*	0.3	172.7	0.8	0.22	0.14	R'
1055	BD +19°020	HDS 29	00132+2023	.8156	172.4	0.2	578.7	0.7	1.15	0.03	R'
1233	ADS 197	A 1256	00153+4412	.8212	222.8*	0.9	37.7	0.6	0.28	0.12	G'
1987	HD 2057	HDS 56	00251+4803	.8211	76.0	1.0	117.5	2.0	2.39	0.09	R'
3361	BD +12°081	HDS 93	00428+1249	.8156	98.6	0.3	220.3	0.8	1.16	0.03	R'
3951	HR 233	MCA 2	00507+6415	.8210	273.0*	1.5	16.0	0.4	1.08	0.08	G'
4267	ADS 746	STT 20	00546+1911	.8129	193.7	0.2	518.0	0.4	1.03	0.03	G'
4809	HD 6009	HDS 134	01017+2518	.8128	49.5*	0.3	88.5	0.3	0.19	0.04	G'
4849	GJ 3071	HDS 135	01024+0504	.8129	6.6	0.3	305.4	0.8	1.66	0.05	G'
4990	ADS 873	HO 213	01040+3528	.8129	109.0	0.2	299.6	0.5	0.65	0.07	G'
				.8129	109.2	0.2	298.6	0.5	0.71	0.05	R'
				.8129	108.8	0.2	298.6	0.4	0.58	0.06	V'
				.8129	108.9	0.2	299.0	0.4	0.57	0.06	G'
				.8155	109.3	0.2	299.1	0.6	0.65	0.04	R'
				.8155	109.1	0.2	297.8	0.4	0.53	0.02	V'
				.8155	109.3	0.2	298.4	0.3	0.53	0.02	G'
5531	HD 6840	HDS 155	01108+6747	.8211	180.4	0.3	121.2	0.4	0.75	0.03	G'
6060	ADS 1040	STF 102	01178+4901	.8209	275.0	0.2	476.9	0.6	0.89	0.04	V'
				.8209	274.7	0.4	478.0	3.0	0.82	0.05	G'
				.8212	275.5	0.2	476.0	0.8	0.90	0.03	R'
6694	BD+12°0176	HEI 305	01260+1315	.8156	115.8*	0.2	476.1	0.5	0.14	0.09	R'
6730		HDS 188	01267+1123	.8156	183.1*	0.2	704.0	1.0	0.15	0.19	R'
7338		HDS 211	01345+7804	.8179	288.1	0.6	136.0	2.0	2.28	0.04	R'
7397		HDS 213	01354+1126	.8157	39.9*	1.7	25.1	0.8	0.00	0.72	R'
10438	HR 640	MCA 6	02145+6631	.8210	78.4	0.3	94.6	0.3	1.27	0.02	G'
11253	HD 14874	HDS 314	02249+3039	.8130	283.9	0.3	351.0	2.0	2.57	0.06	G'
11352	HD 15013	HDS 318	02262+3428	.8130	228.3	0.3	96.5	0.4	0.16	0.05	G'
12153	HR 763	MCA 7	02366+1227	.8130	43.0*	0.4	29.7	0.2	0.08	0.09	G'
12640	HR 793	BLA 1	02424+2001	.8130	281.2	0.3	44.7	0.2	0.46	0.02	V'
13117		HDS 366	02487+0002	.8212	38.6	0.4	1553.0	8.0			R'
14075	HD 18774	HDS 385	03014+0615	.8184	86.0*	0.5	55.0	0.5	0.17	0.16	V'
14230	HD 18940	HDS 389	03035+2304	.8131	335.6	1.1	44.9	0.9	1.74	0.03	V'
14524	GJ 3202	HDS 396	03076-0358	.8185	162.5*	0.2	363.8	0.9	0.14	0.12	R'
14669	GJ 125	HDS 404	03095+4544	.8186	8.6	0.2	509.4	0.7	1.72	0.02	R'
15368		HDS 414	03181+0803	.8185	308.4	0.2	910.0	2.0	1.06:	0.14	R'
15597	HD 20716	HDS 418	03209+2031	.8212	340.1	0.3	589.9	3.0	3.70:	0.20	G'
15737	HD 20893	HDS 423	03228+2045	.8131	291.9	0.3	464.0	2.0			G'
16042	HD 21242	CHR 9	03266+2843	.8185	41.0*	3.8	42.0	3.0	2.77	0.13	V'
17932	HR 1176	CHR 126	03501+4458	.8214	72.3*	0.5	21.0	2.0	1.37	0.08	V'
18089	HR 1199	Kui 15	03520+0632	.8186	207.5	0.2	737.5	0.4	0.48:	0.02	R'
				.8186	207.5	0.2	738.3	0.4			G'
				.8187	207.4	0.2	738.9	0.4			V'
				.8213	207.6	0.2	738.9	0.4			G'
				.8213	207.5	0.2	739.2	0.4			V'
	HD 25811	BAG 4	04063+1952	.8185	259.4*	0.4	68.1	0.5	0.18	0.12	G'
				.8213	258.9*	0.4	68.3	0.4	0.23	0.27	V'
19472	HD 285465	HEI 35	04102+1722	.8185	205.6	0.7	60.4	0.8	1.29	0.04	G'
19591	HD 284163	CHR 14	04119+2338	.8186	178.3	0.2	266.7	0.6	1.32	0.01	R'
20227	HD 27323	HDS 555	04201+3108	.8187	29.1	0.5	324.0	3.0	3.60	0.10	G'
20553	HD 27836	HDS 564	04242+1445	.8187	261.2	0.4	189.0	2.0	2.65	0.06	G'
20605		HDS 566	04248+1552	.8159	1.2	0.2	449.0	1.0	0.31	0.14	R'
20679	HD 27990	COU 2682	04258+1800	.8188	270.2	0.3	137.7	0.5	0.83	0.02	R'
20745	HD 286798	WOR 15	04268+1240	.8160	42.6	0.3	209.3	0.7	0.22	0.08	R'
20777	DF Tau	THB 1	04271+2542	.8188	91.9	0.6	100.0	1.0	0.23	0.11	R'
20895		HDS 576	04287+2613	.8160	125.4	0.4	167.7	0.9	0.17	0.09	R'
21092		HDS 585	04312+0157	.8187	272.8	0.4	304.0	2.0	0.89	0.04	R'

Table 1. (continued)

HIP	Name/ Catalog No.	Discoverer designation	Coord. 2000	Epoch 1999.0+	θ°	σ_θ	ρ *mas*	σ_ρ *mas*	Δm	$\sigma_{\Delta m}$	Filter
21280	HD 285931	CHR 17	04340+1510	.8188	216.6	0.3	140.6	0.4	1.22	0.02	G'
				.8188	216.4	0.3	140.7	0.5	1.23	0.02	G'
				.8214	216.6	0.4	141.2	0.7	1.38	0.05	V'
22550	ADS 3475	BU 883	04512+1104	.8159	79.1*	0.2	230.2	0.4	0.33	0.09	R'
23317		HDS 650	05009+6107	.8160	339.2	0.2	347.3	0.8	1.50	0.03	R'
23418		HDS 654	05020+0959	.8160	162.0	0.2	1077.3	0.9	0.90:	0.07	R'
23699	HD 32641	STT 97	05056+2304	.8161	150.3	0.2	360.1	0.4	1.09	0.02	R'
24608	α Aur	ANG 1	05167+4600	.8182	50.1	0.4	55.5	0.4			V'
26220	θ Ori A	PTR 1	05353-0523	.8189	175.1*	0.9	212.0	4.0	3.23	0.75	V'
26221	θ Ori C	WGT 1	05353-0523	.8189	33.5*	1.9	42.0	2.0	1.03	0.11	G'
28832	ADS 4660	A 1951	06052+0708	.8135	42.8	0.3	448.0	2.0			R'
				.8135	42.6	0.3	449.0	2.0			G'
				.8135	42.6	0.3	449.0	2.0			V'
29269	HD 39861	HDS 841	06102+8131	.8161	196.4	0.2	647.8	0.6	1.40	0.03	V'
30272	ADS 4950	STF 881	06221+5922	.8216	140.7	0.2	673.7	0.6	1.29:	0.02	V'
34524	HD 54322	CHR 216	07092+1903	.8161	325.3	0.4	145.3	0.9	1.89	0.03	V'
39402		HDS 1149	08033+5251	8217	284.1	0.8	133.0	2.0	0.27	0.19	R'
40167	ADS 6650	STF 1196	08122+1739	.8162	86.6	0.2	821.9	0.5			V'
40818	HR 3269	FIN 346	08198+0357	.8190	63.6	0.2	255.8	0.3	0.47	0.04	V'
				.8190	63.7	0.2	256.3	0.2	0.37	0.02	G'
				.8190	63.7	0.2	257.0	0.5			R'
43861	HD 76261	HDS 1291	08561+3626	.8216	328.6*	0.3	765.0	3.0	3.11:	0.19	V'
43948	GJ 330	HDS 1296	08571+1139	.8162	222.4	0.2	523.7	0.7	1.41	0.03	R'
44471	ADS 7158	A 1585	09036+4709	.8217	27.6*	0.5	43.0	0.4	0.28	0.31	V'
44955	GJ 336	COU 1561	09095+3250	.8162	206.2	0.2	822.6	0.8	1.16:	0.04	R'
46199	HD 81105	HDS 1353	09252+4606	.8216	326.9	0.6	264.0	3.0	2.45	0.11	V'
60444	GJ 3722	HDS 1745	12236+6711	.8217	171.4*	1.4	88.0	3.0	0.25	0.26	R'
93119		WOR 26	18582+7519	.8178	151.7*	0.3	167.3	0.5	0.17	0.08	R'
94076	HR 7272 A	CHR 84	19091+3436	.8205	165.9	0.5	89.8	0.7	2.01	0.05	V'
94679	ADS 12239	STT 371	19159+2727	.8204	159.9	0.2	884.4	0.5	0.56:	0.02	R'
				.8204	160.0	0.2	885.2	0.4	0.65:	0.02	G'
				.8204	160.1	0.2	883.3	0.6	0.72:	0.02	V'
94720	ADS 12248	CHR 85	19164+1433	.8205	217.7	0.6	51.5	0.6	1.42	0.05	V'
94960	HD 181148	HDS 2734 Aa	19194-0136	.8178	193.9	0.2	478.7	0.6	0.36	0.04	R'
95178	HD 183678	HDS 2740	19218+7708	.8181	355.7	0.3	442.0	3.0	3.18	0.09	G'
95299	HD 182085	HDS 2745	19233-0635	.8205	27.2	0.3	1069.0	4.0	3.09:	0.22	R'
95995	GJ 762.1	MCA 56	19311+5835	.8179	204.1	0.2	85.8	0.2	0.27	0.04	G'
96656	GJ 765.2	MLR 224	19391+7625	.8128	348.3	2.3	46.0	2.0	0.76	0.08	G'
97496	ζ Sge	AGC 11	19490+1909	.8150	140.9	0.2	136.3	0.2			V'
				.8150	140.7	0.2	136.5	0.3			G'
				.8150	140.5	0.2	136.4	0.3	0.39	0.35	R'
103067	BD+42°3895	COU 2542	20530+4258	.8151	94.2	0.2	246.9	0.5	0.81	0.03	R'
103502		HDS 2989	20582+4011	.8151	149.5	0.2	279.2	0.6	0.96	0.02	R'
103767	HD 200406	HDS 2997	21016+4730	.8180	234.0	0.2	1859.0	3.0			G'
103810	ADS 14575	STF 2751	21021+5640	.8179	354.3	0.2	1624.5	0.9			V'
				.8179	354.5	0.2	1624.8	0.9			G'
				.8179	354.7	0.2	1625.4	0.8			R'
104075	HD 200746	HDS 3004	21051+0757	.8207	340.5	0.5	323.0	3.0	3.25	0.16	G'
104383	BD-05°5480	HDS 3013	21088-0426	.8178	287.5	0.2	302.2	0.5	1.67	0.04	R'
104581	BD+16°4472	HEI 187	21111+1704	.8151	257.0	0.2	1114.0	1.0	0.98:	0.04	R'

Table 1. (continued)

HIP	Name/ Catalog No.	Discoverer designation	Coord. 2000	Epoch 1999.0+	$\theta°$	σ_θ	ρ mas	σ_ρ mas	Δm	$\sigma_{\Delta m}$	Filter
105187	BD+65°1572	HDS 3032	21185+6613	.8180	143.8	0.2	752.1	0.7	0.93	0.03	R'
105371	HD 203220	HDS 3038	21206+1310	.8207	305.8	0.3	215.0	1.0	2.45	0.06	G'
106394	HD 205142	HDS 3065	21330+2408	.8208	244.8	0.2	531.0	2.0	2.45	0.05	G'
106972	GJ 4210	HDS 3083	21399+2737	.8152	77.9	0.6	105.0	2.0	1.23	0.03	R'
107181		HDS 3092	21426+0233	.8152	57.4	0.3	254.0	1.0	1.05	0.05	R'
108917	ξ Cep	MCA 69	22038+6438	.8127	78.4	0.5	66.7	0.5	1.47	0.03	V'
109281	HD 210211	HDS 3145	22083+2409	.8208	354.4	0.3	92.9	0.3	0.57	0.04	G'
109951	HD 211276	HDS 3158	22161-0705	.8152	70.5	0.3	297.1	0.8	1.87	0.04	V'
111685	GJ 4287	HDS 3211	22375+3923	.8153	17.5	0.2	272.1	0.5	1.43	0.03	R'
111805	ADS 16138	HO 295	22388+4419	.8208	150.2	0.2	190.6	0.3	0.31	0.04	G'
112422	BD +32°4510	HDS 3233 Aa	22463+3319	.8154	102.1	0.3	232.0	2.0	1.12	0.03	R'
112695	HD 216027	HDS 3241	22493+1517	.8208	16.9*	0.7	92.9	0.3	2.29	0.08	V'
113852	HD 217944	HDS 3285	23034+5834	.8210	117.2*	0.6	380.0	4.0	3.02	0.15	G'
114576	ADS 16591	A 2298	23126+0241	.8209	116.2	0.2	222.4	0.4	0.42	0.07	V'
114922	GJ 893.4	HDS 3316	23167+1937	.8153	46.2	0.4	106.8	0.6	0.16	0.09	R'
114927	BD+33°4679	HDS 3315	23167+3441	.8154	222.9*	0.5	96.5	0.8	0.37	0.07	R'
				.8154	222.8*	0.5	96.3	0.8	0.26	0.09	R'
115666	ADS 16748	HO 489	23260+2742	.8153	224.2	0.2	526.0	1.0	0.33	0.06	V'
				.8206	224.1	0.2	525.4	0.4	0.36	0.07	G'
				.8206	224.6	0.2	526.4	0.4	0.88	0.04	R'
				.8207	224.0	0.2	524.7	0.7	0.29	0.06	V'
118287	ADS 17151	A 1498	23595+5441	.8127	87.2	0.4	380.0	3.0			V'
				.8127	86.5	0.3	379.0	2.0			G'
				.8181	86.5	0.2	377.1	0.5	0.34	0.03	V'
				.8181	86.5	0.2	377.8	0.6	0.58	0.03	G'
				.8181	86.3	0.2	377.9	0.6			R'

Table 2. Triple star measurements

HIP	Name/ Catalog No.	Discoverer designation	Coord. 2000	Epoch 1999.0+	$\theta°$	σ_θ	ρ mas	σ_ρ mas	Δm	$\sigma_{\Delta m}$	Filter
8533	AB		01500+7456	.8128	290.6	3.5	57.2	3.6	0.21	0.06	R'
	AC	MLR 297			175.0	1.2	181.9	3.6	0.42	0.06	
	BC				161.0	1.2	212.9	4.2	0.21	0.05	
25354	AB	HDS 711	05253+6511	.8160	232.7	1.0	1441.9	23.7			R'
	AC				235.6	0.8	1289.5	17.9			
	BC				29.6	3.3	167.6	9.6	0.47	0.30	R'
101955	AB	KUI 99	20396+0458	.8206	131.3	0.2	299.3	0.8	0.94	0.03	G'
	AC	BAG 14			105.7	0.3	164.2	0.7	1.14	0.03	
	BC				336.5	0.4	167.1	1.1	0.20	0.02	
104642	AB	ADS 14749	21118+5959	.8125	213.3	0.2	1033.9	1.0			G'
	AC	MCA 67			148.6*	5.5	25.0	2.5	0.56	0.05	
	BC				34.5	0.3	1023.4	2.8			
	AB			.8126	213.4	0.2	1030.3	1.4			V'
	AC				146.8*	4.1	28.4	2.1	0.60	0.04	
	BC				34.8	0.2	1019.3	2.5			
	AB			.8126	213.1	0.2	1032.9	1.2			R'
	AC				145.6*	6.3	24.3	2.7	0.42	0.07	
	BC				34.3	0.3	1023.8	3.6			
112170	AB	ADS 16214	22431+4710	.8209	301.0	0.2	493 .1	0.5	0.65	0.04	G'
	AC				311.1	0.2	498.6	1.2	1.49	0.04	
	BC	HU 91			32.4	0.8	87.7	1.2	0.84	0.02	G'
116726	AB	ADS 16904	23393+4543	.8212	150.8	0.3	242.2	1.2	0.13	0.06	V'
	AC				145.0	0.8	227.6	3.2	1.00	0.05	
	BC	CHR 149			26.2	6.7	27.7	3.3	0.86	0.04	

Table 3. Absolute magnitudes and spectral types of binary star components

HIP	M_A	M_B	Filter	Sp_A	Sp_B
1987	4.6	7.0	R'	G2	K4
6694	7.6	7.7	R'	K6	K6
7397	7.8	7.8	R'	K6	K6
15368	7.7	8.7	R'	K6	M0
19472	6.9	8.2	G'	K4	K7
19591	7.0	8.3	R'	K4	K8
20227	5.2	8.8	G'	G5	M0
20553	4.5	7.2	G'	G1	K4
20605	9.3	9.6	R'	M1	M1
20679	6.2	7.0	R'	K1	K4
20745	8.5	8.7	R'	K8	M0
21092	9.4	10.3	R'	M1	M3
29269	4.6	6.0	V'	G1	K0
34524	4.8	6.7	V'	G3	K3
39402	9.6	9.8	R'	M1	M2
43861	5.0	8.2	V'	G5	K7
43948	9.8	11.2	R'	M2	M4
44955	8.7	9.9	R'	M0	M2
46199	7.3	9.7	V'	K5	M2
60444	11.4	11.6	R'	M4	M4
93119	7.7	7.9	R'	K6	K6
94960	7.1	7.4	R'	K4	K5
95178	6.2	9.4	G'	K1	M1
95299	7.3	10.4	R'	K5	M3
103067	5.5	6.3	R'	G8	K2
103502	8.3	9.2	R'	K7	M1
104075	4.9	8.2	G'	G4	K7
104383	7.6	9.3	R'	K6	M1
104581	5.7	6.7	R'	G9	K3
105187	6.4	7.3	R'	K2	K5
109951	4.9	6.8	V'	G4	K3
112422	6.6	7.7	R'	K3	K6