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Binary star speckle measurements during 1992-1997 from the SAO 6-m and 1-m telescopes in Zelenchuk

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Abstract. We present the results of speckle interferometric measurements of binary stars made with the television photon-counting camera at the 6-m Big Azimuthal Telescope (BTA) and 1-m telescope of the Special Astrophysical Observatory (SAO) between August 1992 and May 1997. The data contain 89 observations of 62 star systems on the large telescope and 21 on the smaller one. For the 6-m aperture 18 systems remained unresolved. The measured angular separation ranged from 39 mas, two times above the BTA diffraction limit, to 1593 mas.

Key words: stars: binaries: visual — techniques interferometric — catalogs

1. Introduction

Regular speckle interferometric measurements of binary stars have been made with the 6-m telescope of the Special Astrophysical Observatory (SAO) in Zelentchuk using the television photon-counting system since 1983 (Balega et al. 1994). 800 measurements collected before 1993 were used for orbits computation and determination of fundamental stellar parameters for different types of stellar population. At that time the photon-centroiding procedure used for speckle detection was an obligatory technique, providing the digital data compression and real-time image processing. However, the photon-centroiding is the reason for non-linearity of speckles recording and is followed by so-called photon-counting hole effect which considerably limits the effective cut-off frequency of speckle observations (Thiebaut 1994). Moreover, the use of intensified television tubes for photon-counting image recording entails unstable field geometry that causes additional deterioration of the accuracy.

These imperfections and the small scanning field (256×256 pixels) advanced us in 1995 to develop the new CCD-based speckle interferometer for the 6-m BTA telescope (Maksimov et al. 1999). In addition, in the same period the speckle group of the SAO was involved in infrared interferometric observations at the BTA carried out in cooperation with G.Weigelt's group from Max-Planck-Institute for Radioastronomy, Bonn. Therefore in the period 1992–1997 measurements of binaries at visible wavelengths were performed at the observatory only episodically.

Here we give the measurements collected at different occasions from the 6-m BTA telescope and the 1-m telescope in the period 1992–1997 using the old camera. The hard-wired digital correlator has not been used for real-time photon coordinates processing; image autocorrelation functions were reconstructed from recorded frame-by-frame data samples by means of the computer post-processing.

2. Speckle-measurements

From August 1992 the speckle camera with the photon-counting television detector was used at the 6-m telescope during 5 observing runs for observations of 62 binary and multiple systems. 18 pairs from the list remained unresolved, mainly known as binaries from spectroscopy. In November 1994 observations of 21 stars were performed at the SAO 1-m telescope. In this data set 8 stars were not resolved. All the measurements with the 6-m aperture were made through the 600/130 nm bandpath window, while with the 1-m instrument the 600/200 nm filter has been used.

Information about the measurements is gathered in Cols. (1) to (6) of Tables 1 and 2. The first three columns list the Washington Double Star Catalogue number

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Table 1. Binary star speckle measurements from the 6-m BTA telescope

Coord. 2000	Name/Catalog no.	Discoverer designation	Epoch 1990.0+	θ (°)	ρ (mas)
00055+3406	ADS 51 AB	HU 1201	4.9424	307.5	179
00546+1911	ADS 746 AB	STT 20	4.9425	198.6	504
00575+3738	BD +36°159	COU 1054	4.9426	216.5	117
01040+3528	ADS 873	HO 213	2.6112	103.4	310
			4.9425	104.8	298
02020+6154	HD 12208		3.8388	UR	
			3.8416	UR	
02280+0158	HR 719	KUI 8	2.6122	36.2	516
02290+6724	ADS 1860 A	CHR 6	3.8416	UR	
04184+2135	51 Tau	MCA 14	4.9430	180.7	148
			4.9456	181.2	147
04399+5329	ADS 3358 AB	BU 1295	3.8391	175.2	215
	ADS 3358 AC	STF 566	3.8391	203.8	782
05056+2304	HD 32641	STT 97	4.9457	152.8	363
05210+4408	BD +43°1251	COU 2365	4.9432	196.0	310
06052+0708	ADS 4660	A 1951	4.9432	42.4	466
07201+2159	δ Gem A		3.8396	UR	
08071+5407	ADS 6578	A 1333	4.9433	208.4	392
12238+5410	ADS 8535 AB	STT 249	7.3910	261.7	389
12244+4305	ADS 8540	STT 250	7.3910	347.8	363
			7.3938	347.9	360
13106+3556	RS CVn		7.3938	UR	
13112+3050	ADS 8811 AB	A 1359	7.3911	138.7	251
13195+3507	ADS 8861 A	BAG 11	3.3488	188.4	65
13198+4747	ADS 8862	HU 644	7.3938	129.6	232
13320+3108	BD +31°2500	WOR 24	7.3911	23.5	403
14104+2506	12 Boo		7.3912	UR	
14158+1018	ADS 9185 AB	A 1101	7.3912	195.2	232
	ADS 9185 C		7.3912	UR	
14160-0704	ADS 9186	HU 138	7.3939	15.7	539
14310-0548	HD 127352	RST 4529	7.3939	241.2	177
14380+5135	ADS 9329	STF 1863	7.3911	65.4	663
14492+1013	ADS 9397	A 2983	7.3939	234.0	59
14562+2928	ADS 9444 A		3.3490	UR	
15121+1859	HR 5654	COU 189	7.3941	142.9	472
15183+2650	ADS 9578 A	CHR 45	7.3940	UR	
	ADS 9578 B		7.3940	UR	
	ADS 9578	STF 1932	7.3940	257.2	1593
15245+3723	ADS 9626 A	CHR 181	7.3913	251.1	89
15420+0027	ADS 9747	A 2176	7.3913	156.0	165
			7.3940	155.1	161
15521+1052	BD +11°2874	BAG 7	3.3491	56.4	109
			3.3516	56.2	103
			7.3913	135.7	102
16059+1041	BD +11°2910	HDS 2273 A	7.3914	317.4	291
16133+1332	ADS 9969 A	CHR 52	7.3941	UR	
	ADS 9969 B		7.3941	UR	
16171+5516	BD +55°1823	GL 616.2	3.3492	157.2	63
			3.3517	155.0	61
16235+3321	ADS 10036 AB	VBS 26	7.3942	39.6	175
	ADS 10036 C		7.3942	UR	
16384+3514	BD +35°2844	COU 985	7.3915	27.9	156
17146+1423	α Her A	CHR 139 Aa	7.3942	UR	

Table 1. continued

Coord. 2000	Name/Catalog no.	Discoverer designation	Epoch 1990.0+	θ (°)	ρ (mas)
17217+3958	HR 6469	MCA 47	2.6086	321.2	69
17314+0243	ADS 10607 AB	A 2386	7.3943	UR	
17364+6820	BD +68°946	CHR 62	3.3493	352.3	282
17530+8354	ADS 11006	STT 349	7.3944	45.2	441
17572+2400	HR 6697	MCA 50	2.6087	183.7	105
17584+0428	BD +04°3562	KUI 84	7.3916	14.9	176
18001+8000	41 Dra	BAG 6	7.3944	328.2	86
18018+0118	ADS 10990 AB	BU 1125	7.3916	117.7	555
18078+2606	ADS 11089 A	CHR 67	7.3917	332.3	265
	ADS 11089 B		7.3917	UR	
18338+1744	ADS 11454 AB	HU 322	2.6087	89.1	201
			7.3916	81.2	148
			7.3944	80.7	144
	ADS 11454 CD	WAK 21	7.3815	78.9	406
			7.3944	79.0	405
18455+0530	ADS 11640 A	FIN 332 Aab	7.3945	326.0	82
	ADS 11640 B	FIN 332 Bab	7.3945	129.7	137
19391+7625	HD 186922	MLR 224	3.3512	151.7	35
			3.8438	264.7	52
19490+1909	ADS 12973 AB	AGC 11	7.3918	150.3	195
20216+1930	HD 193797	COU 327 AB	3.8383	80.7	52
			4.7236	102.0	39
20329+4154	HD 195987		3.8383	UR	
			3.8410	UR	
20551+1311	BD +12°4499		3.8411	76.5:	103:
21193+5837	ADS 14864 A	BAG 9	2.6063	118.4	99
21446+2539	ADS 15281 AB	BU 989	7.3945	124.1	240
22140+5707	BD +56°2737		3.8385	UR	
			3.8411	UR	
			3.8440	UR	
22479+6504	HD 216014		3.8440	UR	
22570+2441	HD 216963	COU 542	3.8414	312.7	179
			4.9423	323.2	203
23019+4220	HR 8762	MCA 77	2.6121	347.5	186
23595+5441	ADS 17151	A 1498	2.6067	86.7	390
			2.6120	87.9	376

(Worley & Douglass 1997) or the epoch-2000 coordinate, the name of the star or its catalogue number in common use, and the discoverer designation. Column four lists the epoch of the observation in fractional Besselian year. Columns (5) and (6) contain the measured position angle θ in degrees and angular separation ρ in milli-arcseconds. The note "UR" stands for cases when the binary was not resolved. This might indicate or too close companions (less than 20 mas for the 6-m telescope, and 120 mas for the 1-m telescope), or too large magnitude difference (more than 3 magnitudes), or very bad seeing, or the combination of these factors. Most of unresolved at the BTA objects belong to spectroscopic binaries included into the program following the proposal of A. Tokovinin (private communication). In one case (BD +12°4499 = GJ 1259), the position measurement is followed by the colons, indicating uncertain resolution which must be confirmed in the future.

The main component of the visual pair ADS 8861 AB = GL 507 AB was first resolved in 1993 – named here as BAG 11. The system represents a couple of M-dwarfs orbiting around their mass center with a period of only 200 days. Because its spectrum shows the lines of both components (Tokovinin 1997), the binary becomes one of the promising new sources for the precise mass determination in the lower part of the HR-diagram.

Note that for new binaries resolved with the 6-m telescope here we follow the abbreviations already given in the Third Catalog of Interferomeric Measurements of Binary Stars (Hartkopf et al. 1999). To avoid possible mismatch in the discoverer designations of newly resolved pairs with the BTA telescope, we give their cross-identification in

Table 2. Binaries measurements from the SAO 1-m telescope

Coord. 2000	Name/Catalog no.	Discoverer designation	Epoch 1994.0+	θ (°)	ρ (mas)
00046+4206	ADS 30 A	CHR 122	.8988	UR	
01040+3528	ADS 873	HO 213	.8988	107	310
01579+4734	BD +46°483	COU 2353	.8988	UR	
02090+3540	HD 13102	COU 1067	.8989	22	189
02157+2503	21 Ari	COU 79	.8989	25	160
02415+4053	HD 16656	COU 1511	.8989	323	146
02500+2716	ADS 2159 A	MCA 10	.8990	UR	
02537+3820	ADS 2200 AB	BU 524	.8990	218	134
03048+5330	γ Per	WRH 29	.8990	65	199
03327+3540	HD 21847		.8991	UR	
03437+2339	HD 23157	CHR 11	.8991	UR	
03470+2431	HD 23568	CHR 124	.8991	UR	
04536+2522	ADS 3501 A	CHR 127	.8992	325	178
05056+2304	HD 32641	STT 97	.8991	152	367
05272+1758	ADS 4038 A	MCA 19	.8992	UR	
05373+4404	HD 36948	CHR 21	.8993	UR	
06024+0939	ADS 4617 AB	A 2715	.8993	19	385
08198+0357	HR 3269	FIN 346	.8996	65	264
08468+0625	ADS 6993 AB	SP 1 AB	.8996	155	264
23260+2742	ADS 16748 AB	HO 489	.8987	226	547
23340+3120	ADS 16836	BU 720	.8987	270	524

Table 3. Binaries first resolved at the BTA telescope

Name/Catalog no.	Discoverer designation	Coord. 2000	Date 1900+	ρ (mas)	Ref.	Note
ADS 784 A	BAG 10	00568+6022	94.7	30	Sch98	a
6 Per	BAG 1	02134+5104	81.9	40	Bag84b	b
66 Ari = HR 1048	BAG 2	03284+2248	86.7	33	Bag89a	
Gl 150.2	BAG 8	03448+4602	93.8	186	Sch97	a
BD +19°662	BAG 4	04063+1952	84.8	66	Bag87	c
BD +23°1346	BAG 5	06255+2327	84.8	105	Bag87	d
BD +11°2252	BAG 3	10367+1101	83.9	72	Bag85a	
Gl 507 A	BAG 11	13195+3507	93.3	65	this paper	
4 UMi = HR 5321	BNU	14088+7733	84.3	20	Bnu86	
Gl 600	BAG 7	15521+1052	90.2	77	Bag91a	
41 Dra = ADS 11061 A	BAG 6	18001+8000	93.3	102	Bag97	e
HR 8164	BAG 9	21193+5837	81.7	96	Bag84b	b

a) Not included yet in Third CHARA Catalog.
b) Joint observations with the French speckle team.
c) Listed as CHR 13 in the Third CHARA Catalog.
d) Listed as CHR 23 in the Third CHARA Catalog.
e) Listed as STF 2308 A in the Third CHARA Catalog.

Table 3. In addition to the identification and coordinates is the year of first resolution and corresponding angular separation, followed by a first reference and notes.

For the BTA observations an accuracy of the position measurement is about 3 mas in ρ and 2° in θ, while the typical accuracy for the 1-m telescope is 8 mas in ρ and 4° in θ. Spatial calibration of the data was made by the observation of binaries with definitive orbits from the catalog of Worley & Heintz (1983) and other well-defined speckle binaries.

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database, operated at CDS, Strasbourg, and the Third Catalog of Speckle Interferometric Measurements of Binary Stars, provided by the Georgia State University CHARA research group.

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List of objects