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CCD MEASUREMENTS OF DOUBLE AND MULTIPLE STARS AT NAO ROZHEN

R. Pavlović[1], Z. Cvetković[1], D. Olević[1], A. Strigachev[2], G. M. Popović[1] and B. Novaković[1]

[1] *Astronomical Observatory, Volgina 7, 11160 Belgrade 74, Serbia and Montenegro*

[2] *Institute of Astronomy, Bulgarian Academy of Sciences, 72 Tsarigradsko Chausse Blvd., 1784 Sofia, Bulgaria*

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SUMMARY: With the 2-m telescope of the Bulgarian National Astronomical Observatory at Rozhen observations of fifteen multiple stars were carried out during one night - October 17/18, 2004. In the paper we present the results for the position angle and separation for ten multiple stars (27 pairs) which could be measured.

Key words. binaries: visual

1. INTRODUCTION

The observations of fifteen multiple stars were obtained by using the CCD camera with the 2-m telescope at the Bulgarian NAO Rozhen on October 17/18, 2004. The telescope is of the Ritchey-Chretien-Coude type with the focal length of 16 m. The frames were obtained by using the Photometrics AT200 CCD camera. The chip dimensions are 1024×1024 pixels, the pixel size is 24×24 micrometers. The angle corresponding to one pixel is 0.31 arcsec. For each star pair ten frames were obtained (5 in B filter and 5 in V filter).

For ten double or multiple stars (27 pairs) the position angle and separation were measured, whereas in the case of the other five the star images were not separated and the measurements could not be carried out. The reasons are the proximity of the components, the limiting capabilities of the CCD camera, the exposure duration and seeing. The measurements were posible for the following stars: WDS 00057+4549, WDS 00174+0853, WDS 02231+7021, WDS 03101+2145, WDS 03344+2428, WDS 04159+3142, WDS 21074-0814, WDS 21156+4352, WDS 21182+3035 and WDS 23103+3229.

The frames were measured by using the programme AIP4WIN (version 1.4.21).

A total of 27 pairs was measured of which for only one the orbit has been calculated and the orbital elements are given in the Sixth Catalog of Orbits of Visual Binary Stars (Hartkopf and Mason 2003). In the case of this binary the measurements were compared to the ephemerides.

The residuals $(O - C)$ according to the orbits Pop1996b (Popović and Pavlović 1996) and Kiy2001 (Kiyaeva et al. 2001) are within the error limits. They are given in Table 2.

For 13 pairs of these multiple stars the first measurements of the position angle and separation are given.

The results are given in Tables 1 and 2. The designations used: WDS - identification in WDS Catalogue (Mason et al. 2003); Disc. - double-star name after the discoverer; Mult. - designation for pair components; HIP - identification in Hipparcos Catalogue (ESA 1997); Epoch - observational epoch; θ [°] - position-angle in degrees; ρ [″] - separation in secands of arc; n - number of measured frames; Auth. - measurement author's name, G. M. Popović (Pop),

Table 1. CCD Measurements of Double Stars

WDS	Disc.	Mult.	HIP	Epoch 2004+	$\theta[^\circ]$	ρ [″]	n	Auth.	Obs	Notes
00057+4549	STT 547	AB	473	0.7950	183.7	6.01	10	Pop	Ole-Pal-Cve	O
					183.7	6.00	10	Cve		
					182.8	6.11	10	Ole		
					183.8	6.00	10	Pal		
					183.8	5.99	10	Nov		
00057+4549	STT 547	AE	473	0.7950	353.4	54.27	8	Pop	Ole-Pal-Cve	N
					353.5	54.24	10	Cve		
					353.6	54.22	10	Pal		
					353.5	54.24	10	Nov		
00057+4549	STT 547	AD	473	0.7950	226.0	102.67	8	Pop	Ole-Pal-Cve	
					226.1	102.74	10	Cve		
					226.1	102.69	6	Nov		
00057+4549	POP 217	AP	473	0.7950	0.1	9.62	10	Pop	Ole-Pal-Cve	N
					0.1	9.63	10	Cve		
					0.2	9.62	10	Pal		
					0.0	9.61	10	Nov		
00057+4549	POP	AQ	473	0.7950	127.2	21.72	6	Pop	Ole-Pal-Cve	N
					128.0	21.67	8	Cve		
00057+4549	POP	AX	473	0.7950	213.6	10.14	5	Pop	Ole-Pal-Cve	N
					214.4	10.31	5	Cve		
00057+4549	POP	AY	473	0.7950	79.0	197.84	7	Pop	Ole-Pal-Cve	N
					79.4	197.74	10	Cve		
00057+4549	POP	Yy	473	0.7950	188.2	9.77	10	Pop	Ole-Pal-Cve	N
					188.5	9.69	10	Cve		
00174+0853	STF 22	AB-C	1392	0.7951	234.8	3.93	9	Pop	Ole-Pal-Cve	
					234.7	3.94	10	Cve		
					234.2	4.06	10	Ole		
					235.2	3.91	10	Pal		
					234.7	3.91	10	Nov		
00174+0853	STF 22	AB-D	1392	0.7951	150.8	65.70	9	Pop	Ole-Pal-Cve	N
					150.8	65.69	10	Cve		
					150.8	65.56	10	Nov		
02231+7021	CVE 1	AB-C	11120	0.7954	43.2	65.42	5	Cve	Ole-Pal-Cve	N
03101+2145	POP	AB-C	14715	0.7954	44.2	47.49	10	Pop	Ole-Pal-Cve	N
					44.2	47.57	9	Cve		
03101+2145	POP	AB-D	14715	0.7954	158.5	53.40	5	Pop	Ole-Pal-Cve	N
					159.0	53.25	5	Cve		

Table 1. Continued

WDS	Disc.	Mult.	HIP	Epoch 2004+	$\theta[^\circ]$	ρ [″]	n	Auth.	Obs	Notes
03344+2428	STF 412	AB-C	16664	0.7954	54.8	21.98	10	Pop	Ole-Pal-Cve	
					54.8	22.00	10	Cve		
					54.8	22.02	10	Pal		
					54.8	22.01	10	Nov		
04159+3142	STTA 43	AB-C	19883	0.7955	42.4	55.44	10	Pop	Ole-Pal-Cve	
					42.5	55.44	10	Cve		
					42.2	54.00	10	Ole		
					42.6	55.44	10	Pal		
					42.5	55.42	10	Nov		
04159+3142	STT 77	AB-D	19883	0.7955	315.3	129.77	10	Pop	Ole-Pal-Cve	
					315.4	129.77	10	Cve		
					315.5	129.75	10	Pal		
04159+3142	POP	AB-E	19883	0.7955	156.6	61.54	10	Pop	Ole-Pal-Cve	N
					156.8	61.63	10	Cve		
04159+3142	POP	AB-F	19883	0.7955	191.8	60.07	10	Pop	Ole-Pal-Cve	N
					191.8	60.28	6	Cve		
21074−0814	BU 368	AB-C	104272	0.7948	38.6	15.45	10	Pop	Ole-Pal-Cve	
					38.8	15.39	10	Cve		
21074−0814	BU 368	CD	104272	0.7948	298.5	5.38	10	Pop	Ole-Pal-Cve	
					299.2	5.79	7	Cve		
21074−0814	POP	AB-E	104272	0.7948	116.9	50.54	3	Pop	Ole-Pal-Cve	N
21182+3035	HO 154	AB	105162	0.7947	210.2	3.28	9	Pop	Ole-Pal-Cve	
					211.0	3.38	10	Cve		
					211.4	3.49	10	Ole		
					211.8	3.30	10	Pal		
					210.7	3.43	5	Nov		
21182+3035	POP	AC	105162	0.7947	138.8	8.78	8	Pop	Ole-Pal-Cve	N
					140.1	8.80	8	Cve		
22156+4352	POP	AB-C		0.7947	73.8	84.10	10	Pop	Ole-Pal-Cve	N
22156+4352	POP 23	CD		0.7947	189.6	2.16	10	Pop	Ole-Pal-Cve	N
23103+3229	BU 385	AB-C	114415	0.7950	76.8	56.99	10	Pop	Ole-Pal-Cve	N
					76.9	56.99	10	Cve		
					77.0	56.79	10	Ole		
					77.0	57.02	10	Pal		
					76.9	57.00	10	Nov		
23103+3229	BU 385	AB-D	114415	0.7950	116.8	220.91	10	Pal	Ole-Pal-Cve	
					116.8	221.10	10	Cve		

Table 2. Notes

WDS	Mult.	Notes
00057+4549	AB	Residual (O-C) from orbit Pop1996b (Popović and Pavlović 1996): (Pop) $-0\overset{\circ}{.}4$, $0\overset{''}{.}05$; (Cve) $-0\overset{\circ}{.}4$, $0\overset{''}{.}04$; (Ole) $-1\overset{\circ}{.}3$, $0\overset{''}{.}15$; (Pal) $-0\overset{\circ}{.}3$, $0\overset{''}{.}04$; (Nov) $-0\overset{\circ}{.}3$, $0\overset{''}{.}03$; Residual (O-C) from orbit Kiy201 (Kiyaeva et al. 2001): (Pop) $-0\overset{\circ}{.}1$, $-0\overset{''}{.}05$; (Cve) $-0\overset{\circ}{.}1$, $-0\overset{''}{.}06$; (Ole) $0\overset{\circ}{.}9$, $0\overset{''}{.}05$; (Pal) $0\overset{\circ}{.}0$, $-0\overset{''}{.}06$; (Nov) $0\overset{\circ}{.}0$, $-0\overset{''}{.}07$;
00057+4549	AE	Pop: In paper POP1997b (Popović and Pavlović 1997) component E erroneously identified labeled as C.
00057+4549	AP	Pop: This is a multilple of system ADS 48. First measurement from 1994.
00057+4549	AQ	Pop: First measurement. Component Q poorly visible in the frame.
00057+4549	AX	Pop: First measurement. Component X fainter than Q.
00057+4549	AY	Pop: First measurement.
00057+4549	Yy	Pop: First measurement.
00174+0853	AB-D	Pop: Component D better visible in filter V than in B.
02231+7021	AB-C	Cve: New pair. Pair AB = MLR 377.
03101+2145	AB-C	Pop: First measurement. Pair AB = BU 1030. A ring visible in the direction θ=$317\overset{\circ}{.}6$ with pair AB.
03101+2145	AB-D	Pop: First measurement.
04159+3142	AB-E	Pop: First measurement.
04159+3142	AB-F	Pop: First measurement.
21074−0814	AB-E	Pop: First measurement.
21182+3035	AC	Pop: First measurement.
22156+4352	AB-C	Pop: First measurement. Pair AB = COU 1981.
22156+4352	CD	Pop: First measurement.
23103+3229	AB-C	Pop: Pair AB = BU 385.

Z. Cvetković (Cve), D. Olević (Ole), R. Pavlović (Pal) and B. Novaković (Nov); Obs - observers; Notes - means that the star is followed by a comment (N) or the pair has an orbit (O).

The observational team at the NAO Rozhen that collected the frames for the measurements consisted of D. Olević, R. Pavlović and Z. Cvetković from Belgrade Astronomical Observatory and A. Strigachev from the Institute of Astronomy of Bulgarian Academy of Sciences.

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CCD МЕРЕЊА ДВОЈНИХ И ВИШЕСТРУКИХ ЗВЕЗДА НА НАО РОЖЕН

R. Pavlović[1], Z. Cvetković[1], D. Olević[1], A. Strigachev[2], G. M. Popović[1] and B. Novaković[1]

[1] *Astronomical Observatory, Volgina 7, 11160 Belgrade 74, Serbia and Montenegro*

[2] *Institute of Astronomy, Bulgarian Academy of Sciences, 72 Tsarigradsko Chausse Blvd., 1784 Sofia, Bulgaria*

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Стручни рад

У току ноћи 17/18. октобра 2004. године снимљено је 15 вишеструких система CCD камером на двометарском телескопу бугарске Националне Астрономске Опсерваторије на Рожену. У раду су дата мерења позиционог угла и растојања компоненти за епоху посматрања за 10 вишеструких система (27 парова) које је било могуће измерити.