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ORBITS OF SEVEN EDGE–ON VISUAL DOUBLE STARS

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SUMMARY: The orbital elements and the corresponding astrophysical quantities are given for the following double stars: WDS 00174+0853 = A 1803, WDS 02231+7021 = MLR 377, WDS 05484+2052 = STT 118, WDS 06425+6612 = MLR 318, WDS 13100+1732 = STF1728, WDS 16294-2626 = GNT 1, WDS 21074-0814 = BU 368AB.

Key words. binaries: visual

1. INTRODUCTION

Seven edge–on binaries are analysed in the present paper. In addition to the orbital elements, we also present dynamical parallaxes, masses and absolute magnitudes.

The initial orbital elements are obtained by applying five dimensional grid search (Todorović, 2004). The elements thus obtained are subsequently corrected by combining the Eichhorn and Xu (1990) procedure and a minimisation for $(O-C)$ by means of the modified Marquardt algorithm.

2. RESULTS AND COMMENTS

All analysed systems already have calculated orbits (Hartkopf et al., 2005) but determined up to 20 years. In Table 1, the orbital elements for epoch J2000.0 with their errors are given. The corresponding astrophysical quantities are presented in Table 2. The dynamical parallaxes and the absolute magnitudes are determined applying the method proposed by Angelov (1993). The apparent magnitudes and the spectral types are taken from the WDS Catalog (Mason et al., 2005).

In Table 3, the measurements with their residuals are given. The measurements for which the quadrant correction is applied, have label *.

In Table 4 the ephemerides for the period 2005.0 – 2010.0 are given.

Figures 1–7 show the graphs of the new apparent orbits, together with the measurements (•) and the corresponding ephemerides (○). The arrows show the direction of motion.

WDS 00174+0853 = A 1803: Ling (1984) found a shorter period than Baize (1987). Our elements, presented here, are closer to the Baize's, whereas our value for inclination is by about 5° higher than his which he determined at exactly 90°. The dynamical parallax (12.3 mas) is in good agreement with that of Hipparcos (15.3 mas).

WDS 02231+7021 = MLR 377: Muller's (1991) elements yield residuals exceeding 10° in $(O-C)_\theta$ for the measurements from 1999. Our elements provide a better fit to the observations; however the obtained dynamical parallax (15.46 mas) is several times that of Hipparcos (3.39 mas). This can be accounted for by the fact that the measurements cover a short orbit arc (only 15°) and, therefore, the orbital elements are determined with large errors (Table 1). The discrepancy between $\pi_{\rm dyn}$ and $\pi_{\rm HIP}$ is due to the large errors of the values of period P and semimajor axis a.

WDS 05484+2052= STT 118: The elements derived by Tokovinin (1986) require a correction in the position angle for almost all measurements. Our dynamical parallax (6.0 mas) agrees better with that of Hipparcos (5.48 mas) than the value of 10.3 mas found by Tokovinin.

WDS 06425+6612 = MLR 318: For this system we obtain fits of similar quality with periods of 939.18 years and 417.21 years. We prefer the elements corresponding to the shorter period because then we have a better agreement for the parallax (18.06 mas) with the value given in Hipparcos (14.03 mas). Muller (1991) found 120 years for the period.

WDS 13100+1732 = STF1728: This orbit is well covered by observations. From 1827 a total of 672 measurements have been collected. Several authors calculated the orbital elements for this pair, the last were Hartkopf et al. (1989). The elements presented herewith slightly differ from those of Hartkopf et al. (1989). Since this is an edge-on orbit, a partial eclipse of the components is expected in July 2014.

WDS 16294–2626 = GNT 1: This is a system with known ascending node. The period obtained by us is by about 50 % higher than the Baize's (1978) one, so that the parallax (6.04 mas) coincides with the Hipparcos value (5.4 mas).

WDS 21074–0814 = BU 368AB: The dynamical parallax resulting from our elements (8.61 mas) is in a better agreement with that of Hipparcos (7.5 mas) than the Baize's (1984) value (11 mas).

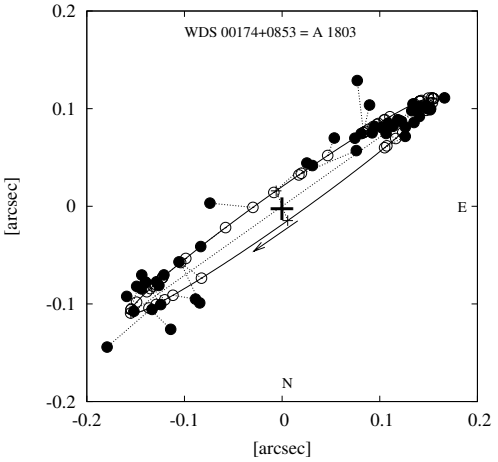

Fig. 1. *WDS 00174+0853.*

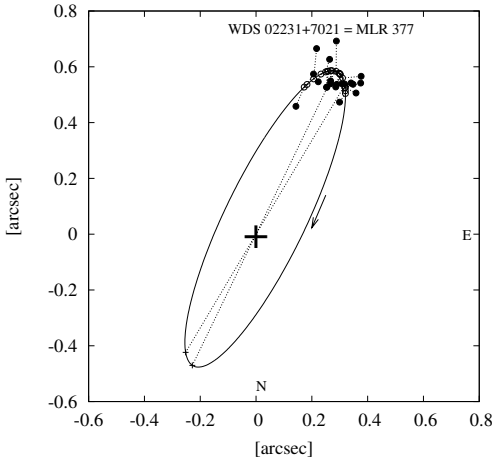

Fig. 2. *WDS 02231+7021.*

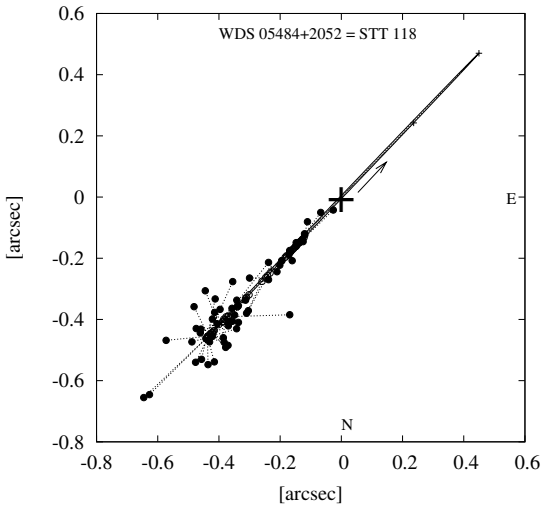

Fig. 3. *WDS 05484+2052.*

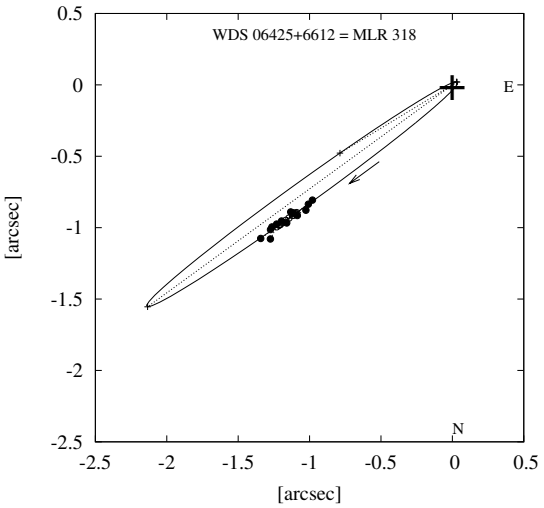

Fig. 4. *WDS 06425+6612.*

Table 1. Orbital elements.

Name WDS	$P[^y]$	$n[^\circ/y]$	T	$a['']$	e	$i[^\circ]$	$\Omega[^\circ]$	$\omega[^\circ]$
A 1803	35.527	10.13319	1931.575	0.1901	0.0376	94.792	125.307	91.209
00174+0853	±0.010	±0.00292	±0.177	±0.0621	±0.0054	±1.593	±0.159	±1.752
MLR 377	161.259	2.23	1918.14	0.587	0.115	104.33	154.1	199.1
02231+7021	±83.563	±1.16	± 13.85	±0.195	±0.339	±15.43	±21.9	±50.6
STT 118	508.016	0.70864	1805.610	0.64550	0.01520	89.670	136.280	121.110
05484+2052	±0.100	±0.00014	±0.681	±0.00665	±0.00018	±0.009	±0.007	±1.086
MLR 318	417.209	0.86288	2278.120	1.29550	0.94340	96.110	122.340	318.770
06425+6612	±52.787	±0.10918	±83.805	±0.02819	±0.10249	±5.936	±5.960	±0.011
STF 1728	25.789	13.97787	1963.392	0.68708	0.52271	90.077	191.858	99.947
13100+1732	±0.254	±0.00010	±0.641	±0.06289	±0.13227	±3.918	±5.071	±9.907
GNT 1	1217.536	0.29568	1273.670	2.92750	0.07860	80.750	90.990	0.010
16294-2626	±81.521	±0.01980	±64.033	±0.03447	±0.04429	±0.072	±1.788	±5.226
BU 368AB	251.058	1.43393	1958.090	0.50040	0.55440	88.550	91.570	128.570
21074-0814	±31.109	±0.17768	±10.865	±0.05308	±0.04143	±0.387	±0.585	±8.835

Table 2. Dynamical elements.

Name WDS	m_A–m_B	Sp	M_A	M_B	$\mathcal{M}_{A\odot}$	$\mathcal{M}_{B\odot}$	$\pi_{\rm dyn}$(mas)	$\pi_{\rm HIP}$(mas)
A 1803 00174+0853	8.38 – 7.78	F7V	2.578	3.108	1.551	1.383	12.291	15.31 ± 1.35
MLR 377 02231+7021	8.42 – 8.70	F5	4.367	4.647	1.079	1.026	15.46	3.39 ± 2.24
STT 118 05484+2052	6.32 – 7.57	B9Vn	0.227	1.477	2.715	2.004	6.04	5.48 ± 0.88
MLR 318 06425+6612	7.28 – 9.34	F8	3.564	5.624	1.259	0.861	18.06	14.03 ± 1.05
STF 1728 13100+1732	4.85 – 5.53	F5V – F6V	3.650	4.330	1.237	1.087	57.55	69.81 ± 27.58
GNT 1 16294-2626	0.96 – 5.4	M1	0.227	1.477	2.715	2.004	6.04	5.40 ± 1.68
BU 368 21074-0814	7.56 – 8.24	A0	2.235	2.915	1.677	1.441	8.61	7.50 ± 1.09

Table 3. Measurements and $(O-C)$[1].

WDS 00174+0853 = A 1803							WDS 00174+0853 = A 1803						
t	$\theta_t[^\circ]$	$\varrho['']$	n	Obs	$\Delta\theta[^\circ]$	$\Delta\varrho['']$	t	$\theta_t[^\circ]$	$\varrho['']$	n	Obs	$\Delta\theta[^\circ]$	$\Delta\varrho['']$
1908.75	300.1	0.14	4	A	−0.6	−0.002	1976.6166 *	120.1	0.184	1	McA	−4.1	−0.003
1909.76	319.5	0.13	2	A	20.5	0.011	1977.6350 *	125.3	0.186	1	McA	1.9	0.007
1917.36	149.1	0.15	2	A	17.0	0.037	1978.68 *	122.7	0.15	3	Hei	0.4	−0.013
1921.64	122.4	0.16	2	A	−4.0	−0.026	1978.952	309.0	0.16	2	Hln	7.0	0.000
1922.70	123.7	0.20	1	A	−1.8	0.009	1979.7730 *	120.4	0.167	1	McA	−0.4	0.024
1926.74	122.7	0.15	2	A	1.2	0.005	1982.68	.	.	2	Hei	(291.9	0.067)
1932.73	.	.	2	A	(324.0	0.046)	1982.858 *	116.3	0.093	1	Tok	5.7	0.031
1934.83	298.3	0.12	3	A	−13.3	0.009	1983.9602 *	87.5	0.074	1	Bag	−4.5	0.044
1936.61	299.0	0.16	1	Vou	−9.5	0.006	1984.778	150.2	0.051	1	Tok	−59.9	0.034
1937.64	317.8	0.17	1	B	10.4	−0.001	1985.745 *	306.9	0.095	1	Tok	−24.8	0.058
1943.63	299.2	0.16	2	Vou	−2.4	0.004	1985.8429	143.4	0.052	1	McA	−6.2	0.012
1943.78	298.8	0.17	4	VBs	−2.7	0.017	1986.6515	.	.	1	Bag	(139.7	0.063)
1945.543	301.	0.15	4	Vou	2.6	0.038	1986.8859	142.6	0.088	1	McA	4.6	0.018
1946.70	.	.	2	Jef	(294.5	0.080)	1988.5041	129.2	0.119	1	Ism	−2.7	0.004
1947.70	.	.	1	Jef	(287.0	0.051)	1988.6552	130.8	0.125	1	McA	−0.8	0.006
1952.88	319.2	0.137	4	Fin	7.0	0.024	1988.8618	133.1	0.102	1	Ism	1.9	−0.021
1953.59	132.6	0.11	3	Mlr	1.9	−0.020	1989.04	125.4	0.15	5	LBu	−5.4	0.021
1953.88 *	308.2	0.13	6	VBs	−1.9	−0.006	1989.7174	126.8	0.148	1	Hrt	−2.9	0.004
1953.92 *	308.1	0.138	3	Fin	−2.0	0.000	1991.25 *	308.	0.17	1	HIP	0.1	−0.001
1957.76 *	304.5	0.18	2	Mlr	−1.4	−0.009	1991.7156	126.0	0.174	1	Hrt	−1.3	−0.003
1958.32 *	305.8	0.14	4	B	0.3	−0.050	1991.729	126.4	0.165	1	Lin	−0.9	−0.012
1962.67 *	305.0	0.13	4	B	4.2	−0.005	1991.729	126.0	0.149	1	Cou	−1.3	−0.028
1965.77	.	0.15	3	Mlr	(105.9	0.045)	1991.8934	126.2	0.170	1	Hrt	−0.9	−0.009
1965.779	.	.	1	Wor	(105.7	0.045)	1993.8442	124.6	0.179	1	Bag	−0.8	−0.011
1969.824	.	.	1	Cou	(313.2	0.095)	1993.9250	125.0	0.180	1	Hrt	−0.4	−0.010
1970.01	.	0.14	1	Mlr	(312.7	0.101)	1994.8672	303.3	0.182	1	Hrt	−1.3	−0.005
1971.690	317.	0.13	1	Wor	7.8	−0.014	1995.6068	124.0	0.179	1	Hrt	0.0	−0.001

Table 4. Ephemerides.

Name	2005.0		2006.0		2007.0		2008.0		2009.0		2010.0	
	$\theta[^\circ]$	$\rho['']$	$\theta[^\circ]$	$\rho['']$	$\theta[^\circ]$	$\rho['']$	$\theta[^\circ]$	$\rho['']$	$\theta[^\circ]$	$\rho['']$	$\theta[^\circ]$	$\rho['']$
A 1803	314.6	0.085	311.4	0.114	309.5	0.139	308.2	0.160	307.1	0.176	306.1	0.186
MLR 377	145.9	0.570	145.4	0.560	144.8	0.549	144.1	0.537	143.5	0.526	142.8	0.513
STT 118	319.2	0.074	319.5	0.066	320.0	0.059	320.6	0.051	321.3	0.043	322.5	0.035
MLR 318	146.0	0.570	145.4	0.560	144.8	0.549	144.2	0.537	143.5	0.526	142.8	0.513
STF 1728	191.6	0.439	191.6	0.504	191.5	0.559	191.5	0.600	191.4	0.624	191.4	0.626
GNT 1	276.5	2.677	276.6	2.669	276.7	2.662	276.7	2.654	276.8	2.646	276.8	2.638
BU 368AB	279.1	0.103	279.9	0.095	280.8	0.086	281.9	0.078	283.3	0.070	285.0	0.062

[1]This Table is too big to be published here and can be found at `http://saj.matf.bg.ac.yu/170/pdf/tab3.pdf`

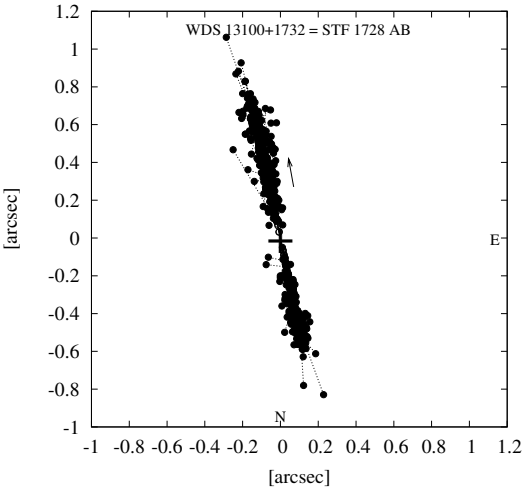

Fig. 5. *WDS 13100+1732.*

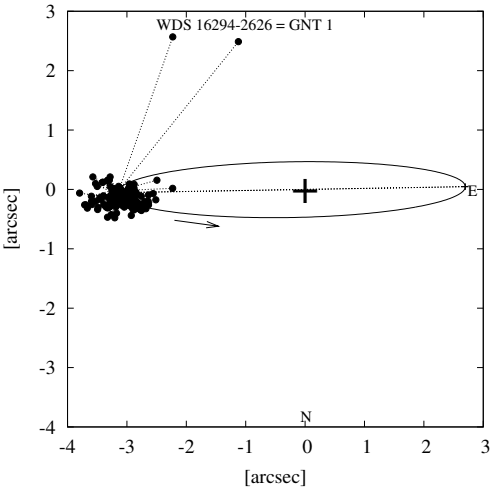

Fig. 6. *WDS 16294-2626.*

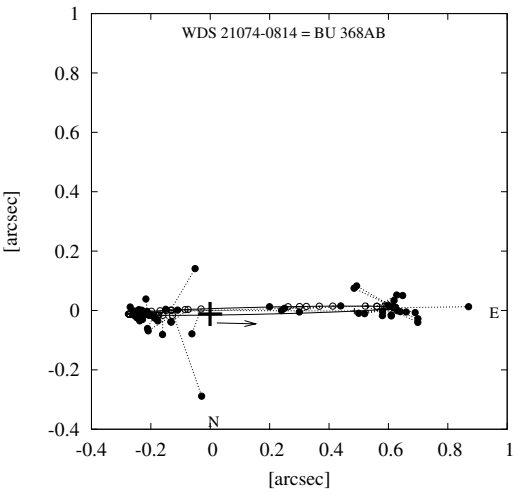

Fig. 7. *WDS 21074-0814.*

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ПУТАЊСКИ ЕЛЕМЕНТИ СЕДАМ ДВОЈНИХ СИСТЕМА

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У раду се дају путањски елементи и одговарајуће астрофизичке величине следећих двојних система: WDS 00174+0853 = A 1803, WDS 02231+7021 = MLR 377, WDS 05484+2052 = STT 118, WDS 06425+6612 = MLR 318, WDS 13100+1732 = STF1728, WDS 16294−2626 = GNT 1, WDS 21074−0814 = BU 368AB.