Double Star Photometry – April 2019

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Abstract: The WDS catalog contains per June 2019 about 148,500 objects. About 50,000 of these come with a magnitude for the primary with single digit precision indicating rather an estimation than a precise measurement and over 16,000 objects are listed with magnitudes in the blue or red band (WDS note codes B/K/R/I) thus in need of a measurement in the V band. After eliminating all objects not suited for resolution with the tools currently available to me (too small angular separation, too faint, too bright) about 26,000 objects remained as targets of interest for this project. The selection criterion for the objects for a specific report is then at a given point of time simply the currently highest given altitude to eliminate atmospheric effects as far as possible – so this is then a more or less random selection out of the mentioned 26,000 objects. This report covers 46 such objects from images taken end of April 2019 with V-filter to allow for visual magnitude measurement by differential photometry. All objects were additionally checked for potential gravitational relationship using GAIA DR2 parallaxes.

1. Introduction

One single image was taken for all selected WDS objects with iTelescope iT24 with V-filter and 20 seconds exposure time and the imaging conditions were overall quite favourable.

The images were plate solved with Astrometrica using the URAT1 catalog with reference stars in the Vmag range of 8.5 to 16.5 giving not only RA/Dec coordinates but also photometry results for all reference stars used including an average Vmag error. The objects were then located in the center of the image and astrometry/photometry was then done by the rather comfortable Astrometrica procedure with point and click at the components delivering RA/Dec coordinates and Vmag measurements based on all reference stars used for plate solving.

2. Results of Photometry and Catalog Checking

The measurement results are given in Table 1 with the following structure:

- WDS = WDS ID
- Disc = Discoverer code
- C = Components (AB if blank)
- RA/Dec = Positions for primary and secondary in HH:MM:SS.sss/DD.MM.SS.ss format
- dRA/dDec = Plate solving errors for RA and Dec in arcseconds
- Sep = Calculated separation in arcseconds
- e_Sep = Separation error
- PA = Calculated position angle in degrees
- e_PA = Position angle error
- Mag = Vmags for both components measured by differential photometry
- e_Mag = Magnitude errors
- SNR = Signal to noise ratio for both components
- dVmag = Plate solving error in Vmag
- Date = Julian observation epoch
- Notes = Additional comments below Table 1

3. Cross-Match with Gaia DR2

All listed objects were additionally cross-matched with Gaia DR2 to check for potential gravitational relationship (PGR) – the results are given in Table 2 with

(Text continues on page 28)

WDS	Disc	C	RA	Dec	dRA	dDec	Sep	Err Sep	PA	Err PA	Mag	Err Mag	SNR	dVmag	Date	Notes
12596+4502	BVD 226		12 59 36.300	45 01 53.01	0.07	0.13	19.11155	0.14765	308.548	0.443	12.526	0.061	128.10	0.06	2019.31764	1)
			12 59 34.890	45 02 04.92							14.537	0.064	47.65			
12359+3758	CBL 596		12 35 56.596	37 58 02.32	0.05	0.09	8.17342	0.10296	178.342	0.722	15.469	0.053	30.61	0.04	2019.31492	1) 2)
			12 35 56.616	37 57 54.15							16.296	0.074	17.03			
13064+3042	CRB 93		13 06 22.262	30 41 42.65	0.04	0.03	25.97269	0.05000	107.061	0.110	13.808	0.043	73.11	0.04	2019.31770	1)
			13 06 24.187	30 41 35.03							14.476	0.045	51.05			
13005+2900	CVR 131		13 00 30.056	28 59 39.00	0.08	0.09	35.28610	0.12042	310.208	0.196	15.444	0.073	25.53	0.06	2019.31765	1) 2)
			13 00 28.002	29 00 01.78							16.202	0.088	16.42			
13038+3210	CVR 132		13 03 49.959	32 09 59.77	0.06	0.05	9.72754	0.07810	231.917	0.460	15.847	0.076	22.64	0.06	2019.31769	1) 2)
			13 03 49.356	32 09 53.77							16.209	0.085	17.64			
12467+3327	DAM 709		12 46 43.687	33 26 49.29	0.03	0.03	5.11083	0.04243	65.985	0.476	15.943	0.060	20.62	0.03	2019.31500	1) 2)
			12 46 44.060	33 26 51.37							16.424	0.082	13.69			
12353+3634	ES 2166		12 35 15.841	36 33 30.68	0.09	0.03	4.69447	0.09487	357.499	1.158	12.433	0.041	106.71	0.04	2019.31491	1)
			12 35 15.824	36 33 35.37							12.691	0.041	103.47			
12397+3714	ES 2167		12 39 47.064	37 11 19.54	0.05	0.05	6.19500	0.07071	272.313	0.654	11.555	0.060	191.44	0.06	2019.31495	1)
			12 39 46.546	37 11 19.79							12.485	0.061	132.57			
13065+3240	ES 2471		13 06 32.721	32 40 00.16	0.05	0.08	8.34188	0.09434	39.140	0.648	10.104	0.060	308.25	0.06	2019.31771	1)
			13 06 33.138	32 40 06.63							13.862	0.063	61.51			
13097+3355	GRV 864		13 09 44.701	33 56 09.37	0.08	0.07	24.61192	0.10630	214.389	0.247	11.060	0.060	215.37	0.06	2019.31773	1)
			13 09 43.584	33 55 49.06							11.096	0.060	217.67			
12525+3155	HJ 524		12 52 30.300	31 55 17.71	0.04	0.08	21.78332	0.08944	111.943	0.235	10.224	0.050	279.44	0.05	2019.31761	1)
			12 52 31.887	31 55 09.57							12.299	0.051	136.39			
12319+4034	HJ 2614		12 31 49.680	40 35 01.78	0.05	0.05	25.14680	0.07071	243.882	0.161	11.346	0.050	214.31	0.05	2019.31489	1)
			12 31 47.698	40 34 50.71							12.632	0.051	126.51			
12468+4125	HJ 2620		12 46 48.115	41 25 02.82	0.05	0.05	14.36222	0.07071	293.035	0.282	13.065	0.071	105.05	0.07	2019.31500	1)
			12 46 46.940	41 25 08.44							13.858	0.072	71.05			
12308+3640	J 1023		12 30 46.190	36 39 35.07	0.06	0.05	5.16415	0.07810	172.502	0.866	11.373	0.050	183.29	0.05	2019.31489	1)
			12 30 46.246	36 39 29.95							11.860	0.051	124.31			
18292+1742	J 2912		18 29 17.382	17 41 51.55	0.12	0.13	6.26732	0.17692	142.168	1.617	11.202	0.120	143.64	0.12	2019.31505	1)
			18 29 17.651	17 41 46.60							13.738	0.124	35.87			

Table 1. Results for measured WDS objects

Table 1 continues on the next page.

WDS	Disc	C	RA	Dec	dRA	dDec	Sep	Err Sep	PA	Err PA	Mag	Err Mag	SNR	dVmag	Date	Notes
13024+4308	KPP 856		13 02 24.798	43 07 57.42	0.08	0.09	7.12698	0.12042	194.499	0.968	11.871	0.090	152.07	0.09	2019.31766	1)
			13 02 24.635	43 07 50.52							12.339	0.090	115.37			
12548+4105	KPP1796		12 54 46.001	41 05 02.15	0.06	0.17	13.93698	0.18028	237.881	0.741	10.963	0.060	238.49	0.06	2019.31762	1)
			12 54 44.957	41 04 54.74							13.424	0.061	84.04			
12359+3600	KPP2139		12 35 51.410	36 00 19.58	0.06	0.06	17.44376	0.08485	2.991	0.279	11.457	0.070	198.19	0.07	2019.31491	1)
			12 35 51.485	36 00 37.00							14.014	0.072	64.89			
12283+3710	KZA 34		12 28 13.920	37 10 01.17	0.07	0.10	6.46396	0.12207	244.233	1.082	12.750	0.051	100.24	0.05	2019.31487	1)
			12 28 13.433	37 09 58.36							12.541	0.051	118.46			
12285+3722	KZA 35		12 28 27.166	37 22 02.85	0.05	0.06	32.69580	0.07810	27.279	0.137	10.307	0.060	302.40	0.06	2019.31487	1)
			12 28 28.423	37 22 31.91							13.847	0.062	71.43			
12473+2959	LDS4268		12 47 14.513	30 00 19.29	0.08	0.07	6.27032	0.10630	55.960	0.971	11.553	0.100	137.66	0.10	2019.31501	1)
			12 47 14.913	30 00 22.80							11.880	0.100	119.69			
12576+3514	LDS5764		12 57 39.821	35 13 27.47	0.07	0.08	16.03069	0.10630	226.375	0.380	10.607	0.060	279.64	0.06	2019.31764	1)
			12 57 38.874	35 13 16.41							13.270	0.061	94.18			
12523+3836	NI 30		12 52 16.017	38 35 42.37	0.07	0.07	10.70876	0.09899	158.889	0.530	14.644	0.055	44.58	0.05	2019.31761	1)
			12 52 16.346	38 35 32.38							14.463	0.054	51.57			
12556+2933	SKF 490		12 55 34.367	29 32 32.70	0.02	0.02	4.61002	0.02828	179.838	0.352	14.689	0.039	43.57	0.03	2019.31762	1)
			12 55 34.368	29 32 28.09							14.948	0.041	37.85			
13016+2924	SKF 491		13 01 34.415	29 23 48.38	0.02	0.03	8.92912	0.03606	143.959	0.231	13.481	0.032	86.95	0.03	2019.31765	1)
			13 01 34.817	29 23 41.16							14.457	0.036	54.61			
12424+3653	SKF2593		12 42 25.055	36 53 07.37	0.02	0.03	20.95542	0.03606	2.822	0.099	12.382	0.031	149.00	0.03	2019.31499	1)
			12 42 25.141	36 53 28.30							13.956	0.034	70.51			
12463+3341	SKF2594	A	12 46 20.924	33 41 22.04	0.02	0.04	6.83159	0.04472	156.187	0.375	10.400	0.040	268.53	0.04	2019.31499	1)2)
		C	12 46 21.145	33 41 15.79							17.355	0.300	3.17			
12473+3811	SKF2596		12 47 15.102	38 11 06.18	0.02	0.02	6.60055	0.02828	99.593	0.246	12.324	0.061	129.97	0.06	2019.31503	1)
			12 47 15.654	38 11 05.08							14.632	0.065	40.95			
12487+3437	SKF2598		12 48 43.645	34 37 23.30	0.02	0.02	20.54103	0.02828	299.805	0.079	11.990	0.031	146.83	0.03	2019.31503	1)
			12 48 42.201	34 37 33.51							15.033	0.045	31.32			
12382+4212	SKF2652		12 38 09.287	42 12 12.14	0.03	0.04	125.84146	0.05000	125.961	0.023	9.823	0.040	300.96	0.04	2019.31494	1)
			12 38 18.453	42 10 58.25							11.483	0.040	214.61			

Table 1 (continued). Results for measured WDS objects

Table 1 continues on the next page.

WDS	Disc	C	RA	Dec	dRA	dDec	Sep	Err Sep	PA	Err PA	Mag	Err Mag	SNR	dVmag	Date	Notes
12568+4029	SKF2656		12 56 49.092	40 29 01.18	0.03	0.03	16.65733	0.04243	113.492	0.146	11.328	0.030	222.81	0.03	2019.31763	1)
			12 56 50.431	40 28 54.54							15.633	0.041	25.99			
12320+3406	SKF2708		12 32 00.310	34 05 30.74	0.05	0.08	24.69309	0.09434	114.067	0.219	11.543	0.050	184.14	0.05	2019.31490	1)
			12 32 02.125	34 05 20.67							12.907	0.051	108.06			
12365+3135	SKF2709		12 36 31.365	31 35 22.22	0.04	0.03	6.12574	0.05000	340.378	0.468	9.767	0.040	341.16	0.04	2019.31493	1)
			12 36 31.204	31 35 27.99							13.437	0.045	54.32			
13029+2935	SLE 908		13 02 56.274	29 34 57.31	0.06	0.06	8.93717	0.08485	234.104	0.544	13.803	0.015	70.28	0.03	2019.31768	1)
			13 02 55.719	29 34 52.07							14.800	0.039	41.92			
13065+2819	SLE 911		13 06 28.633	28 19 23.87	0.08	0.04	6.84299	0.08944	151.787	0.749	12.786	0.051	116.49	0.05	2019.31770	1)
			13 06 28.878	28 19 17.84							14.099	0.053	58.94			
13076+2822	SLE 914		13 07 33.373	28 22 09.95	0.03	0.03	8.56133	0.04243	32.132	0.284	14.539	0.047	44.75	0.04	2019.31772	1)
			13 07 33.718	28 22 17.20							15.081	0.054	29.47			
13086+2920	SLE 915		13 08 35.570	29 19 44.45	0.07	0.07	21.98829	0.09899	151.976	0.258	12.261	0.061	121.70	0.06	2019.31773	1)
			13 08 36.360	29 19 25.04							13.967	0.063	55.01			
12400+4102	SMH 17		12 40 00.643	41 01 31.02	0.04	0.07	12.05396	0.08062	210.274	0.383	13.057	0.051	98.97	0.05	2019.31497	1)
			12 40 00.106	41 01 20.61							13.186	0.051	95.53			
12525+2910	SMH 18		12 52 27.217	29 09 31.01	0.06	0.05	13.49652	0.07810	186.856	0.332	14.083	0.062	63.82	0.06	2019.31761	1)
			12 52 27.094	29 09 17.61							15.908	0.075	24.04			
12406+3444	UC 2383		12 40 35.811	34 44 20.79	0.04	0.05	11.14705	0.06403	103.859	0.329	15.539	0.072	27.27	0.06	2019.31497	1)
			12 40 36.689	34 44 18.12							15.771	0.073	25.25			
12494+4023	UC 2409		12 49 21.736	40 22 33.87	0.09	0.08	17.13774	0.12042	184.704	0.403	15.417	0.082	24.46	0.07	2019.31504	1)
			12 49 21.613	40 22 16.79							15.363	0.080	27.22			
13026+3523	UC 2459		13 02 37.424	35 23 06.93	0.07	0.07	15.40424	0.09899	96.710	0.368	15.631	0.083	24.29	0.07	2019.31766	1) 2)
			13 02 38.675	35 23 05.13							16.154	0.094	16.86			
13032+3944	UC 2461		13 03 09.992	39 44 27.66	0.08	0.09	23.74498	0.12042	29.189	0.291	14.796	0.065	44.29	0.06	2019.31768	1) 2)
			13 03 10.996	39 44 48.39							16.202	0.082	19.09			
13048+3355	UC 2472		13 04 49.713	33 55 20.61	0.13	0.08	8.64258	0.15264	71.377	1.012	16.387	0.087	16.81	0.06	2019.31769	1) 3)
			13 04 50.371	33 55 23.37							16.740	0.104	12.35			
12411+4316	UR 7		12 41 05.007	43 15 30.66	0.04	0.04	5.07058	0.05657	359.136	0.639	12.227	0.051	144.78	0.05	2019.31498	1)
			12 41 05.000	43 15 35.73							12.931	0.051	105.35			
12576+3650	WRS 3		12 57 36.820	36 49 29.43	0.05	0.07	14.85286	0.08602	343.081	0.332	11.655	0.080	184.41	0.08	2019.31763	1)
			12 57 36.460	36 49 43.64							12.446	0.080	136.24			

Table 1 (conclusion). Results for measured WDS objects

Table 1 Notes

1) 1) iT24 1x20s
2) 2) SNR B<20
3) 3) SNR A and B <20

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Object	Comp	PA	e_PA	Sep	e_Sep	Plx1	e_Plx1	Plx2	e_Plx2	Min_D_AU	Median_AU	Max_D_AU	LPGR	M1_50	M2_50
BVD 226		308.479	0.000	19.09402	0.00003	6.0651	0.0244	6.0947	0.0174	3115	175323	946838	56.43	0.80439	0.60096
CBL 596		178.140	0.000	7.84613	0.00006	5.1038	0.0366	5.2106	0.0507	1519	827186	2847287	8.08	0.60082	0.49982
CRB 93		107.053	0.000	25.93866	0.00003	8.2057	0.0189	8.1676	0.0223	3155	118498	488056	82.24	0.65112	0.64980
CVR 131		310.235	0.000	35.11917	0.00004	5.6245	0.0330	5.6807	0.0425	6159	378847	1889128	26.60	0.54998	0.50078
CVR 132		232.799	0.000	9.81869	0.00005	4.6329	0.0370	4.6946	0.0388	2075	596142	2797625	16.25	0.54875	0.50830
DAM 709		67.435	0.001	5.16618	0.00007	1.8087	0.0424	1.8166	0.0512	2839	2819793	20246472	3.84	0.70024	0.65078
ES 2166		357.490	0.001	4.72871	0.00006	2.1806	0.0428	2.1681	0.0432	2121	1832433	12172445	5.91	1.03544	1.00212
ES 2167		272.261	0.001	6.16502	0.00007	5.8182	0.0494	5.9035	0.0578	1045	521908	2510900	18.79	0.90509	0.79494
ES 2471		39.314	0.000	8.35662	0.00005	6.6569	0.0570	6.7932	0.0205	1233	621848	1852300	6.38	1.05990	0.64987
GRV 864		214.415	0.000	24.59458	0.00004	7.4057	0.0306	7.3710	0.0335	3302	152081	854212	63.03	0.87792	0.88962
HJ 524		111.824	0.003	21.67120	0.00110	3.9984	0.0535	-0.0088	0.9517	56090	326019759	17964918566342	0.00	1.20801	1.11770
HJ 2614		243.519	0.000	25.09931	0.00005	2.3827	0.0382	3.4587	0.0323	19988895	26923986	33807977	0.00	1.26902	0.85352
HJ 2620		292.753	0.000	14.23427	0.00004	4.0367	0.0339	1.0769	0.0221	121037854	140417226	160265566	0.00	0.82209	0.99142
J 1023		172.445	0.004	5.18992	0.00032	6.5976	0.0562	6.5169	0.2763	775	947789	7523756	11.49	0.84511	0.89612
J 2912		142.266	0.005	6.33772	0.00052	0.6996	0.0351	2.8760	0.3994	78054729	222340770	312871510	0.00	1.12132	0.86972
KPP 856		194.191	0.000	7.26244	0.00006	2.2535	0.0252	2.2585	0.0637	3179	1886374	13680208	5.60	1.10955	1.06280
KPP1796		237.865	0.000	13.91535	0.00008	3.3206	0.0387	2.9230	0.0857	50277	8458060	19881063	0.00	1.08782	0.84588
KPP2139		3.067	0.000	17.50379	0.00009	2.6373	0.0546	2.9065	0.0746	7986	7251995	17354752	0.09	1.06736	0.74675
KZA 34		246.636	0.001	6.42455	0.00006	2.0571	0.0461	2.0533	0.0457	3061	2148031	14865770	4.93	1.02680	1.00305
KZA 35		27.259	0.000	32.68862	0.00004	1.3964	0.0351	0.8315	0.0212	68412902	100320981	133323595	0.00	1.12079	1.04994
LDS4268		56.043	0.001	6.26569	0.00006	4.5078	0.0413	4.4827	0.0411	1385	439437	2685588	23.97	0.96707	0.92452
LDS5764		226.712	0.001	16.03564	0.00031	46.8354	0.2763	49.5475	0.1263	115041	240943	360117	7.04	0.60244	0.25947
NI 30		159.322	0.000	10.63970	0.00006	15.3592	0.0441	15.4098	0.0446	689	49917	291424	99.77	0.49838	0.50138
SKF 490		179.649	0.010	4.64087	0.00078	0.7499	0.0343	-1.4745	0.8741	8284	412163369	1777380112183	0.00	1.04534	0.84764
SKF 491		143.751	0.001	8.91217	0.00010	0.5798	0.0751	0.8605	0.1081	14657	115087586	656203586	0.03	1.22050	0.99774
SKF2593		2.878	0.000	20.98699	0.00008	3.1984	0.0763	3.0644	0.0270	6721	2817897	9398334	2.32	0.99372	0.78981
SKF2594	AC	157.003	0.001	6.88694	0.00007	1.0401	0.0431	1.0718	0.0661	6204	10726134	74650190	1.00	1.25635	0.70770
SKF2596		99.145	0.000	6.60536	0.00005	4.4472	0.0357	4.4820	0.0268	1468	412007	2436543	25.40	0.87747	0.64991
SKF2598		299.917	0.000	20.58652	0.00005	0.7061	0.0349	0.9312	0.0316	1005902	70618575	159758728	0.00	1.04020	0.92864
SKF2652		125.985	0.000	125.81510	0.00006	4.5970	0.0403	4.4730	0.0463	27305	1242839	4065941	3.60	1.36481	0.96356
SKF2656		113.542	0.000	16.60596	0.00007	8.0826	0.0309	8.1351	0.0847	2032	225981	1591719	44.93	0.83938	0.54246
SKF2708		114.459	0.000	24.96447	0.00007	2.6064	0.0580	2.6182	0.0487	9276	1566568	10276360	6.99	1.05536	0.91110
SKF2709		340.198	0.000	6.17367	0.00005	3.6443	0.0437	3.7445	0.0323	1658	1512291	4944544	3.70	1.46054	0.78292
SLE 908		235.011	0.000	9.06448	0.00004	2.4739	0.0266	1.9654	0.0334	12912881	21558361	30250084	0.00	0.87912	0.79820
SLE 911		151.330	0.000	6.71560	0.00004	4.3322	0.0354	4.3772	0.0238	1526	509325	2 500 744	19.69	0.77791	0.64890
SLE 914		33.784	0.000	8.48413	0.00004	1.1973	0.0355	0.8983	0.0417	10201064	57293630	123286201	0.00	0.92422	0.90440
SLE 915		152.117	0.000	21.97615	0.00004	0.1222	0.0340	1.1631	0.0249	614182920	1511999042	1383571868948	0.00	0.97943	0.95267
SMH 17		210.840	0.000	12.09272	0.00004	1.1802	0.0347	1.3954	0.0280	4793727	26945460	54319895	0.00	1.15118	1.05843
SMH 18		186.770	0.000	13.55104	0.00006	0.9871	0.0372	0.3064	0.0569	169330402	464713144	4138557157	0.00	0.96279	0.88570
UC 2383		104.323	0.000	11.15556	0.00008	7.1033	0.0512	6.8893	0.0706	1583	903040	2492600	2.66	0.50011	0.50056
UC 2409		185.039	0.000	17.21795	0.00004	6.0951	0.0349	4.9543	0.0340	6208802	7792134	9485998	0.00	0.54975	0.50022
UC 2459		95.958	0.000	15.44458	0.00004	4.7239	0.0269	4.6845	0.0376	3253	406107	2278887	25.55	0.60026	0.54992
UC 2461		30.046	0.000	23.69732	0.00004	3.2548	0.0288	3.2297	0.0389	7191	734503	5249006	14.44	0.67409	0.60002
UC 2472		69.112	0.000	8.53277	0.00006	4.7581	0.0486	4.8578	0.0495	1761	894886	3682680	9.41	0.54669	0.44083
UR 7		359.250	0.002	5.08687	0.00022	8.1240	0.0500	6.2522	0.2159	3406109	7592982	13151359	0.00	0.84082	0.77279
WRS 3		343.375	0.000	14.79647	0.00004	7.2300	0.0381	3.6972	0.0373	24703033	27262263	29970220	0.00	0.87834	0.81560

Table 2: Results for DR2 cross-matched WDS objects

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(Continued from page 23)

the following structure:

- Object = Discoverer ID
- Comp = Components (AB if blank)
- PA = Position angle in degrees
- e_PA = Error position angle
- Sep = Separation in arcseconds
- e_Sep = Error separation
- Plx1 = Parallax primary in mas
- e_Plx1 = Error parallax primary
- Plx2 = Parallax secondary in mas
- e_Plx2 = Error parallax secondary
- Min_D_AU = Minimum spatial distance in AU between components (see Appendix)
- Med_D_AU = Median spatial distance in AU between components (see Appendix)
- Max_D_AU = Maximum spatial distance in AU between components (see Appendix)
- LPGR = Likelihood of potential gravitational relationship (see Appendix)
- M1_50 = DR2 StarHorse mass50 value primary
- M2_50 = DR2 StarHorse mass50 value secondary

All objects in Table 2 were already cross-matched with Gaia data in other reports, so the values given here on separation and position angle are referenced as input for assessing the likelihood of potential gravitational relationship but are not intended for updating the WDS catalog. For the 4 objects with LPGR > 50 WDS code "T" is suggested for likely physical by common parallaxes. For the objects with LPGR < 10 WDS code "U" for likely optical is suggested.

For objects with LPGR > 50 the minimum and median period of a potential orbit is calculated using the smallest and median spatial distance between the components as estimation for the semi-major axis assuming zero inclination (this assumption ignores the influence of eccentricity, so it is most likely that the observed separation for high eccentricity pairs is near apastron which means that the "real" semi-major axis might in most cases somewhat different) and using the mass50 values from the GAIA DR2 StarHorse catalog sharing the caveats of Anders et al. 2019 for using these data. The results are listed in Table 3 with the following structure:

Object = Discoverer ID

P_min_yr = Minimum period of a potential orbit

P_med_yr = Maximum period of a potential orbit

Object	P_min_yr	P_med_yr
BVD 226	147 496	62 267 755
CRB 93	156 266	35 961 665
GRV 864	143 495	44 856 536
NI 30	18 206	11 215 665

Table 3: Potential orbit periods in years

In all these cases the potential orbit period is far too long to detect any changes in separation and position angle by visual observation over a reasonable time frame.

Summary

A good part of the 46 measured objects shows the expected magnitude difference larger than 0.5 compared with the WDS catalog data especially for the secondary but for many objects the given WDS magnitudes were simply confirmed within the given error range. 4 objects have parallaxes and angular separations allowing for a higher than 50% likelihood for a spatial distance between the components of less than 200,000 AU (~1 parsec) suggesting potential gravitational relationship and 33 objects are most likely opticals.

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- Washington Double Star Catalog
- GAIA DR2 catalog
- DSS2 images
- Aladin Sky Atlas v10.0
- iTelescope
  - iT24: 610mm CDK with 3962mm focal length. Resolution 0.625 arcsec/pixel. V-filter. No transformation coefficients available. Located in Auberry, California. Elevation 1405 m
- AAVSO VPhot
- Astrometrica v4.10.0.427
- URAT1 catalog
- AstroPlanner v2.2
- MaxIm DL6 v6.08
- GAIA DR2 StarHorse catalog available through the Gaia@AIP services hosted by the Leibniz-Institute for Astrophysics Potsdam using the ADQL query interface at gaia.aip.de

References

Anders, F., Khalatyan, Arman, et al., 2019, "Photo-astrometric distances, extinctions, and astrophysical parameters for Gaia DR2 stars brighter than G = 18", *Astronomy & Astrophysics*, DOI 10.1051/0004-6361/201935765

Knapp, Wilfried R. A., 2018, "A New Concept for Counter-Checking of Assumed Binaries", *Journal of Double Star Observations*, **14** (3), 487-491.

Appendix

Description of the PGR assessment procedure

GAIA DR2 data for RA/Dec and Plx are used for a Monte Carlo simulation assuming a normal distribution for these parameters with the given error range as standard deviation. The spatial distance between the components is (according to Knapp 2018) calculated from the inverted simulated parallax data and the simulated angular separation using the law of cosine

$$sep = \sqrt{a^2 - 2ab\cos\gamma + b^2}$$

with a and b = distance vectors for the stars A and B in lightyears calculated as (1000/Plx)*3.261631 and γ = angular separation in degrees calculated as

$$\gamma = \arccos\left[\sin(DE1)\sin(DE2) + \cos(DE1)\cos(DE2)\cos(|RA1 - RA2|)\right]$$

The likelihood for potential gravitational relationship (LPGR) is the percentage of simulation results <200,000 AU (~1 parsec) out of the simulation sample with a size of 120,000

The given smallest, median and largest spatial distance between the components is the smallest, median and largest result out of the simulation sample.