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PHOTOELECTRIC PHOTOMETRY OF STARS IN THE VILNIUS SYSTEM IN KAPTEYN AREAS SA 2, 4 AND 6

K. Černis and V. Jasevičius

Institute of Theoretical Physics and Astronomy, Goštauto 12, Vilnius 2600, Lithuania

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Abstract. Photoelectric photometry in the Vilnius system of 114 standard stars in Kapteyn areas SA 2, 4 and 6 is presented with mean square errors of the arithmetic mean ± 0.005 mag. Photometrically determined spectral types and luminosity classes of the stars are also presented.

Key words: photoelectric photometry – Vilnius photometric system – standard stars.

1. Introduction

The main standard areas for colour equation determination in the Vilnius photometric system are the Cygnus Standard Region (Zdanavičius et al., 1969; Zdanavičius and Černienė, 1985), the Aquila Standard Region (Zdanavičius et al., 1969) and the North Celestial Pole region (Černis et al., 1989). However, all of them contain relatively bright stars of magnitudes 4 to 6, which are too bright for large aperture telescopes. To overcome this difficulty, it was decided to establish three more standard areas at $+75°$ declination spaced equally by 8^h of right ascension and containing stars in the range of 7–9 mag. The observer in the Northern hemisphere at every moment can choose one of these areas which is near the upper culmination.

Send offprint requests to: K. Černis

2. Observations and their results

The three areas coincide with Kapteyn Selected Areas 2, 4 and 6 at +75°. Positions of the areas and stellar magnitude ranges for each of them are presented in Table 1. Candidate stars of different spectral types have been selected from Bartaya (1979) catalogue. The number of stars is 26 in SA2, 40 in SA4 and 48 in SA6.

Table 1. Information about the standard areas and the mean square errors of the catalogue

Region	$\alpha(1950)$	$\delta(1950)$	Number of stars	V magnitude range	Number of ties to CSR
SA2	$23^h.6 - 0^h.5$	$74° - 76°$	26	8–9	5
SA4	$7^h.6 - 8^h.6$	$74° - 76°$	40	7–9	2
SA6	$15^h.7 - 16^h.7$	$73° - 76°$	48	7–9	3

Region	σ_V	σ_{U-P}	σ_{P-X}	σ_{X-Y}	σ_{Y-Z}	σ_{Z-V}	σ_{V-S}	$\frac{\sum n}{N}$
SA2	0.004	0.004	0.004	0.003	0.002	0.002	0.003	7.0
SA4	0.006	0.005	0.005	0.006	0.005	0.003	0.004	4.0
SA6	0.005	0.005	0.004	0.004	0.003	0.003	0.003	5.3

The stars were observed with the 1-meter reflecting telescope at the Maidanak Observatory in Uzbekistan in 1986-1991 using a one-channel photometer which is equipped with a FEU-79 photomultiplier (S-20 cathode) and works in a photon counting mode. To increase the accuracy, the stars were observed near the upper culmination point during the nights of stable transparency. No less than 10^4 impulses were collected for each star and each filter during a single observation. Each star was observed on several nights 4 to 7 times, and each area was independently tied to the basic standard area in Cygnus (Zdanavičius and Černienė, 1985) 2 to 4 times. Magnitudes and colour indices of the observed stars were transformed outside the atmosphere using Nikonov's method taking into account dependence of atmospheric extinction coefficients on spectral types, luminosity classes and interstellar reddenings of stars (Zdanavičius, 1975). Colour coefficients in the obtained relations between the instrumental and standard systems were close to 1.0. Mean square errors of the mean magnitudes and colour indices derived as described by Bartašiūtė (1984) are presented in Table 1. One can see that most

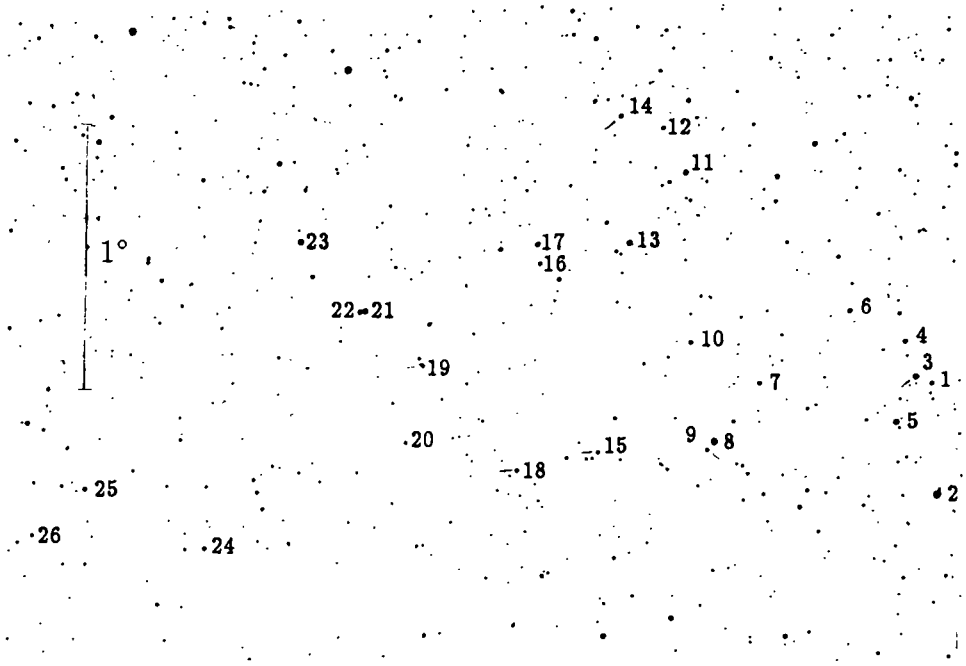

Fig. 1. The identification chart of stars in SA2 area (Table 2).

thoroughly observed is SA2, while the least number of observations and the largest errors are in SA4. This is caused by somewhat poorer observational conditions on Maidanak mountain in winter and spring seasons. Additionally, tie-up of this area to the basic standard area in Cygnus was rather complicated because of low position of the area in the sky during the observations. The present observational program also included a part of SA6 stars earlier observed by Meištas (1988).

Stellar magnitudes and colour indices of the stars transformed outside the atmosphere and reduced to the CSR standards of the Vilnius system are presented in Tables 2–4. The Tables also include spectral types and luminosity classes determined in this paper from reddening-free diagrams calibrated in terms of spectral type and absolute magnitude M_V (Straižys et al., 1982). The observed stars are identified in Figs. 1–3.

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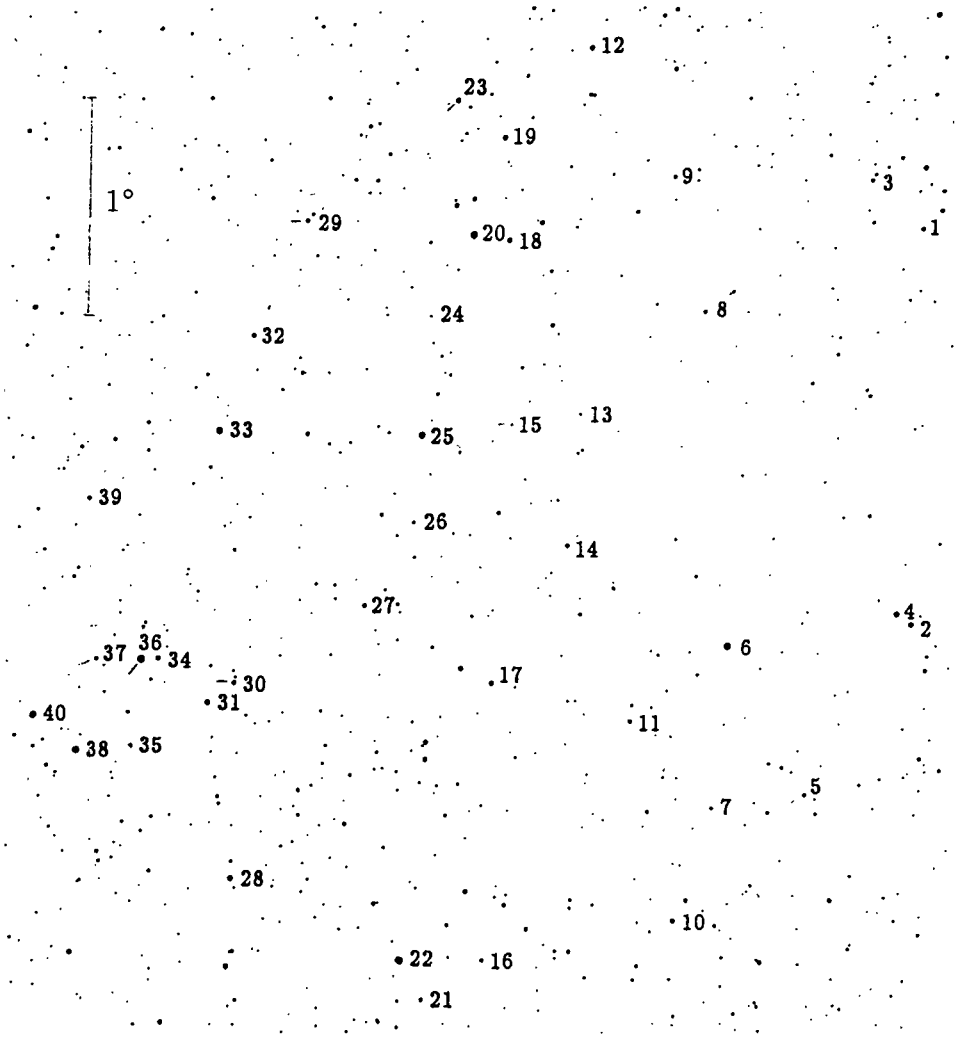

Fig. 2. The identification chart of stars in SA4 area (Table 3).

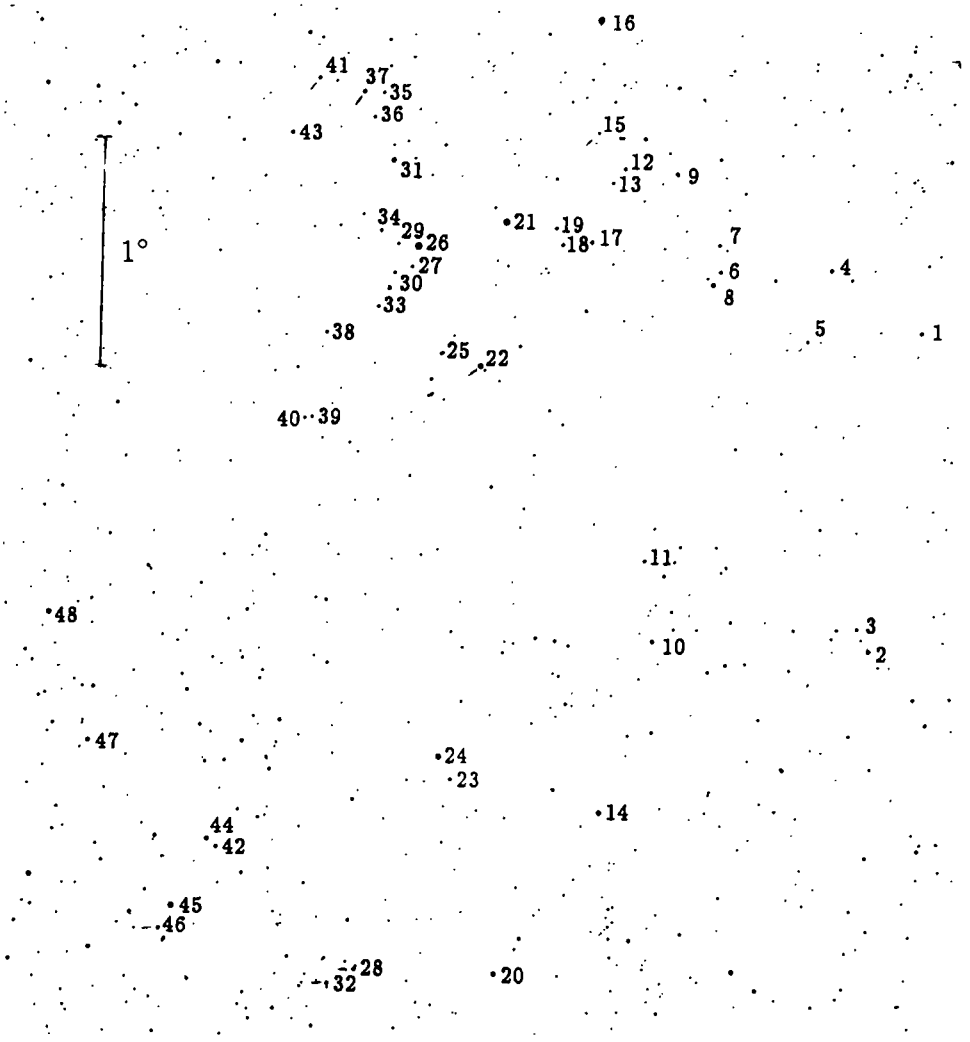

Fig. 3. The identification chart of stars in SA6 area (Table 4).

Table 2. Results of photoelectric photometry in SA2

No.	BD	HD	α(1950)	δ(1950)	Sp	V	$U-P$	$P-X$	$X-Y$	$Y-Z$	$Z-V$	$V-S$	n
1.	74°1030	222339	$23^h36^m43^s$	+75°26'6	A0 V	8.792	0.609	0.843	0.344	0.201	0.078	0.198	6
2.	74 1032	222386	23 37 01	75 00.9	A1 V	5.931	0.607	0.850	0.376	0.170	0.086	0.191	6
3.	74 1033	222448	23 37 40	75 28.5	F0 V	7.286	0.562	0.653	0.571	0.277	0.150	0.410	9
4.	75 889		23 38 07	75 36.7	G9 III	8.416	0.571	1.001	1.299	0.539	0.311	0.780	5
5.	74 1034	222598	23 39 02	75 18.4	K0.5 III	7.338	0.557	1.014	1.291	0.482	0.316	0.751	9
6.	75 891	222851	23 41 20	75 44.6	A1 V	8.210	0.574	0.847	0.354	0.143	0.070	0.145	8
7.	74 1042	223484	23 47 06	75 29.1	G8 III	8.510	0.608	0.986	1.284	0.547	0.312	0.789	6
8.	74 1047	223778	23 49 57	75 16.0	K3 V	6.377	0.405	0.942	1.283	0.313	0.416	0.794	9
9.	74 1049		23 50 26	75 14.1	A1 III	9.073	0.856	0.890	0.403	0.229	0.123	0.282	6
10.	75 896		23 51 14	75 39.0	A1 III	8.598	0.789	0.903	0.402	0.239	0.101	0.261	5
11.	75 897	223959	23 51 16	76 18.3	B3 V	8.361	0.324	0.400	0.271	0.207	0.094	0.256	8
12.	75 899		23 52 38	76 28.6	F8 V	9.074	0.482	0.609	0.742	0.332	0.209	0.504	5
13.	75 901	224402	23 54 54	76 02.2	B9.5 III	7.752	0.662	0.759	0.299	0.176	0.096	0.199	9
14.	75 902	224454	23 55 22	76 31.5	G8 IV-V	8.848	0.452	0.814	1.026	0.415	0.260	0.653	6
15.	74 1055		23 56 30	75 12.0	F6 V	9.316	0.470	0.598	0.620	0.312	0.153	0.449	5
16.	75 905		0 00 26	75 57.4	F8 V	9.246	0.515	0.614	0.757	0.351	0.203	0.546	6
17.	75 906	225063	0 00 37	76 01.8	A2 V	8.333	0.774	0.906	0.447	0.241	0.118	0.289	6
18.	74 1059	225178	0 01 38	75 09.5	F8 IV	8.793	0.463	0.597	0.670	0.336	0.169	0.471	5
19.	75 2	551	0 07 31	75 33.0	K5 III	8.185	0.828	1.455	2.133	0.694	0.558	1.150	6
20.	74 3	650	0 08 20	75 15.0	F8 V	9.321	0.472	0.600	0.690	0.326	0.180	0.500	6

Table 2 (continued)

No.	BD	HD	α(1950)	δ(1950)	Sp	V	$U-P$	$P-X$	$X-Y$	$Y-Z$	$Z-V$	$V-S$	n
21.	75° 4	919	$0^h11^m14^s$	+75°45′0	M3 III	7.195	0.996	1.433	1.936	0.791	0.527	1.258	10
22.	75 5	947	0 11 34	75 44.7	G8 III	7.715	0.615	0.938	1.228	0.530	0.304	0.754	9
23.	75 7	1359	0 15 34	75 59.9	B8 V	7.142	0.448	0.585	0.205	0.105	0.061	0.134	9
24.	74 8	1742	0 19 37	74 47.4	A6 V	8.511	0.559	0.694	0.535	0.260	0.132	0.362	6
25.	74 14	2520	0 26 56	74 58.0	F9 V	8.376	0.452	0.614	0.765	0.348	0.215	0.547	9
26.	74 16		0 29 21	74 43.0	B5.5 V	9.812	0.463	0.569	0.399	0.312	0.154	0.358	6

Notes:

8. VB, ADS 17062, Δm=4.9, D=5″5, measured together.
20. VB, ADS 133, Δm=0.4, D=2″0, measured together.
21. VB, IDS00085N7528, a pair with 75°5, D=76″, measured separately.

Table 3. Results of photometry and photometric classification in SA4

No.	BD	HD	α(1950)	δ(1950)	Sp	V	$U-P$	$P-X$	$X-Y$	$Y-Z$	$Z-V$	$V-S$	n
1.*	76°293	61010	$7^h38^m42^s$	+75°55′0	A7 V	8.399	0.550	0.753	0.523	0.208	0.132	0.309	3
2.	74 334	61690	7 41 36	74 06.9	F8 V	8.090	0.465	0.556	0.722	0.297	0.202	0.484	4
3.	76 296	61744	7 42 20	76 09.4	F8 IV-V	8.846	0.563	0.626	0.754	0.338	0.205	0.526	3
4.	74 335	61906	7 42 32	74 10.1	K4 III	7.154	0.797	1.334	1.896	0.495	0.527	0.996	3
5.	73 389	63346	7 49 17	73 21.5	K0 III	8.789	0.562	0.941	1.296	0.451	0.323	0.722	3

Table 3 (continued)

No.	BD	HD	α(1950)	δ(1950)	Sp	V	$U-P$	$P-X$	$X-Y$	$Y-Z$	$Z-V$	$V-S$	n
6.	74° 338	64307	$7^h54^m15^s$	+74°03′3	K3.5 III	5.335	0.750	1.306	1.915	0.538	0.471	0.956	8
7.	73 393	64600	7 55 27	73 18.6	G5 V	9.162	0.425	0.631	0.847	0.321	0.241	0.560	3
8.	75 321	64487	7 55 33	75 35.3	K1 III	7.996	0.603	1.061	1.385	0.461	0.349	0.767	3
9.	76 303	64932	7 57 47	76 12.6	F9 V	8.856	0.465	0.611	0.747	0.315	0.212	0.507	3
10.	73 395	65155	7 58 01	72 47.7	A7 V	8.365	0.583	0.737	0.519	0.215	0.138	0.324	4
11.	73 397	65732	8 00 51	73 42.6	A5 V	8.692	0.560	0.783	0.489	0.179	0.127	0.241	4
12.	77 313	66344	8 04 42	76 47.2	K0.5 III	8.106	0.598	1.042	1.462	0.507	0.364	0.810	3
13.	75 325		8 04 43	75 06.8	sdO	9.493	-0.024	-0.025	-0.037	0.035	0.004	0.016	10
14.*	74 348	66633	8 05 24	74 30.7	F0V	8.045	0.535	0.683	0.556	0.227	0.153	0.356	3
15.	75 331		8 09 41	75 03.2	G9 III-IV	9.962	0.544	0.881	1.173	0.431	0.297	0.690	3
16.	72 403	67787	8 10 01	72 35.4	A6 V	9.268	0.651	0.744	0.513	0.229	0.147	0.361	3
17.	74 351		8 10 15	73 51.9	F0 V	8.126	0.543	0.694	0.545	0.215	0.153	0.341	3
18.	76 308	67707	8 10 34	75 53.9	F7 V	7.589	0.469	0.573	0.667	0.292	0.194	0.467	4
19.	76 309	67869	8 11 22	76 22.1	G0 V	8.060	0.468	0.626	0.794	0.341	0.230	0.545	4
20.	76 310	68375	8 13 19	75 54.8	G7 III	5.517	0.544	0.852	1.149	0.427	0.277	0.686	10
21.	72 406	68682	8 13 41	72 23.6	F3 V	8.997	0.502	0.622	0.612	0.283	0.185	0.433	3
22.*	72 409	68951	8 15 12	72 33.9	M1 III	5.977	0.790	1.385	2.030	0.578	0.546	1.081	8
23.	76 316	68769	8 15 17	76 31.6	K0 III	8.087	0.586	0.956	1.305	0.463	0.312	0.761	3
24.*			8 16 05	75 33.0	A7 V	10.841	0.612	0.718	0.564	0.232	0.181	0.348	2
25.*	75 334	69054	8 16 12	74 58.7	K0 III	6.378	0.577	0.971	1.282	0.449	0.311	0.732	5

Table 3 (continued)

No.	BD	HD	α(1950)	δ(1950)	Sp	V	$U-P$	$P-X$	$X-Y$	$Y-Z$	$Z-V$	$V-S$	n
26.	74°356	69090	$8^h16^m22^s$	+74°34′.7	A0 V	9.506	0.559	0.789	0.305	0.107	0.095	0.120	3
27.	74 361	69827	8 19 25	74 10.5	K1 III	8.430	0.568	0.960	1.353	0.459	0.343	0.741	3
28.	73 416	71207	8 26 28	72 51.6	K4.5 III	7.409	0.838	1.422	2.038	0.612	0.543	1.136	3
29.	76 326	71067	8 26 29	75 54.5	G2 V	8.634	0.428	0.564	0.784	0.311	0.220	0.520	4
30.	74 365	71387	8 27 46	73 45.5	G8 III	8.493	0.567	0.872	1.178	0.441	0.293	0.680	3
31.	73 420	71703	8 29 22	73 39.0	K1 IV	7.485	0.536	1.005	1.326	0.410	0.349	0.736	3
32.	75 341	71657	8 29 27	75 21.1	F6 V	8.291	0.501	0.595	0.663	0.283	0.186	0.456	7
33.*	75 342	71973	8 31 03	74 53.8	A4 m	6.231	0.565	0.757	0.570	0.208	0.142	0.318	3
34.	74 369	72391	8 33 05	73 49.3	F6 V	8.494	0.472	0.543	0.646	0.283	0.191	0.444	4
35.*	73 424	72557	8 34 03	73 24.3	F2 V	8.479	0.574	0.663	0.623	0.249	0.173	0.395	3
36.	74 370	72582	8 34 12	73 48.4	K0 III	6.145	0.580	0.957	1.307	0.449	0.319	0.732	5
37.	74 373	73130	8 37 08	73 46.6	G1 V	9.357	0.469	0.589	0.770	0.305	0.212	0.498	3
38.	75 428	73190	8 37 28	73 20.9	A1 V	6.901	0.604	0.800	0.315	0.102	0.084	0.136	5
39.	74 374	73531	8 39 25	74 29.9	F8 IV	8.717	0.565	0.586	0.801	0.342	0.216	0.552	4
40.	73 430	73797	8 40 34	73 28.5	A1 V	7.289	0.576	0.831	0.329	0.116	0.094	0.125	3

Notes:

1. ADS 6283, Δm=1.9, D=1″.3. Measured together.
14. ADS 6608, Δm=1.0, D=0″.4. Measured together.
22. ADS 6724, Δm=3.0, D=44″. Measured A component only.
24. BSD 635, Bartaya 75°21.
25. ADS 6736, Δm=3.3, D=10″.5. Measured together.
33. ADS 6872, Δm=3.5, D=1″.8. Measured together.
35. ADS 6890, AB Δm=0, D=0″.2., AC Δm=0.6, D=0″.5. Measured together.

Table 4. Results of photometry and photometric classification in SA6

No.	BD	HD	α(1950)	δ(1950)	Sp	V	$U-P$	$P-X$	$X-Y$	$Y-Z$	$Z-V$	$V-S$	n
1.	75°574		$15^h40^m32^s$	+75°26′0	K1 V	8.311	0.654	1.106	1.536	0.526	0.358	0.861	4
2.	74 630	142005	15 46 08	73 59.4	G9 III	7.766	0.576	0.889	1.216	0.435	0.307	0.696	4
3.	74 631		15 46 48	74 05.8	F2 V	9.172	0.508	0.614	0.589	0.247	0.175	0.367	1
4.	76 573		15 46 58	75 45.4	G3 V	8.499	0.466	0.630	0.818	0.346	0.210	0.542	5
5.	75 575		15 49 07	75 26.3	F6 V	9.076	0.461	0.565	0.636	0.301	0.159	0.458	4
6.	76 577	143684	15 55 35	75 46.6	A8 V	8.211	0.632	0.791	0.529	0.188	0.120	0.283	7
7.	76 578	143703	15 55 36	75 53.9	A5 V	8.846	0.595	0.840	0.452	0.151	0.082	0.175	7
8.	75 579	143803	15 56 10	75 43.1	G5 III	6.848	0.561	0.769	1.029	0.423	0.245	0.647	8
9.	76 580	144344	15 58 52	76 13.8	G2 IV	8.102	0.480	0.612	0.843	0.370	0.215	0.587	9
10.	74 650	144652	16 01 04	74 04.4	K0.5 III	7.847	0.599	1.015	1.345	0.456	0.322	0.710	4
11.	74 651	144758	16 01 34	74 26.8	K0 III	8.334	0.588	0.942	1.282	0.450	0.321	0.731	4
12.	76 584		16 02 57	76 15.5	K1.5 III	8.688	0.651	1.192	1.533	0.481	0.381	0.819	5
13.	76 587		16 03 56	76 11.6	F2 V	9.168	0.545	0.632	0.594	0.257	0.151	0.393	5
14.	73 707	145368	16 04 41	73 16.9	F7 V	6.813	0.476	0.577	0.671	0.299	0.191	0.466	5
15.	76 589		16 05 07	76 25.2	A1 III	9.941	0.667	0.778	0.263	0.110	0.057	0.130	5
16.	77 616	145622	16 05 08	76 55.7	A1.5 III	5.692	0.728	0.850	0.314	0.137	0.081	0.179	15
17.	76 590		16 05 34	75 55.3	K4 III	7.851	0.821	1.426	2.081	0.573	0.540	1.069	5
18.*	76 591		16 07 50	75 54.5	F8 V	8.700	0.499	0.594	0.724	0.334	0.195	0.530	5
19.	76 592		16 08 20	75 58.9	G0 V	9.028	0.479	0.620	0.744	0.312	0.187	0.492	5
20.	72 718	146585	16 11 11	72 31.3	A1 V	7.909	0.575	0.801	0.356	0.164	0.093	0.162	5

Table 4 (continued)

No.	BD	HD	α(1950)	δ(1950)	Sp	V	$U-P$	$P-X$	$X-Y$	$Y-Z$	$Z-V$	$V-S$	n
21.	76°594	146926	$16^h12^m13^s$	+76°00'.3	B8 III	5.436	0.461	0.540	0.171	0.093	0.060	0.114	14
22.	75 586	147142	16 13 46	75 20.1	K2 III	6.355	0.669	1.243	1.676	0.534	0.393	0.893	8
23.	73 712		16 14 31	73 25.0	G9 III	8.265	0.585	0.903	1.243	0.458	0.312	0.730	2
24.	73 713	147312	16 15 21	73 31.0	A2 IV-V	5.967	0.724	0.847	0.359	0.131	0.088	0.174	2
25.	75 587		16 16 41	75 23.2	G7.5 IV-V	9.032	0.467	0.770	1.021	0.382	0.248	0.653	5
26.	76 596	148048	16 18 56	75 52.3	F2 V	4.929	0.558	0.637	0.567	0.266	0.158	0.397	13
27.	76 597		16 19 20	75 46.7	F2 IV	8.991	0.627	0.716	0.596	0.227	0.144	0.351	5
28.	72 722	148083	16 20 02	72 30.3	F4 V	8.754	0.494	0.568	0.622	0.296	0.184	0.463	4
29.	76 598		16 20 32	75 51.7	F8 IV	9.750	0.541	0.629	0.772	0.330	0.191	0.511	2
30.	75 591		16 20 39	75 44.7	G7 III	8.845	0.548	0.851	1.158	0.458	0.264	0.718	5
31.	76 600	148432	16 21 22	76 15.9	A6 V	7.005	0.592	0.772	0.461	0.183	0.110	0.249	5
32.*	72 725	148361	16 21 42	72 25.9	Am	8.869	0.557	0.814	0.498	0.174	0.121	0.240	4
33.	75 592		16 21 44	75 35.0	A5 V	8.655	0.605	0.826	0.442	0.158	0.088	0.205	9
34.	76 601		16 21 57	75 56.0	K2 III	8.251	0.649	1.196	1.570	0.478	0.382	0.804	5
35.	76 603		16 22 35	76 33.7	F8.5 V	8.890	0.471	0.588	0.712	0.304	0.183	0.490	7
36.*	76 605		16 23 12	76 27.2	F4 IV	9.230	0.509	0.567	0.624	0.296	0.169	0.449	3
37.	76 606	148855	16 24 14	76 33.5	K5 III	7.390	0.810	1.404	2.090	0.611	0.525	1.076	7
38.	75 595		16 25 33	75 26.6	K1 III	8.874	0.642	1.101	1.483	0.490	0.341	0.826	6
39.	75 596		16 26 05	75 02.8	F1.5 V	9.336	0.557	0.652	0.588	0.259	0.150	0.393	5
40.	75 597		16 26 37	75 02.3	F8 V	9.387	0.490	0.578	0.652	0.329	0.196	0.509	7

Table 4 (continued)

No.	BD	HD	α(1950)	δ(1950)	Sp	V	$U-P$	$P-X$	$X-Y$	$Y-Z$	$Z-V$	$V-S$	n
41.*	76°609		$16^h28^m02^s$	+76°35′.9	F6.5 V	9.235	0.506	0.605	0.621	0.291	0.158	0.431	6
42.	73 724		16 29 45	73 00.8	F8 V	8.899	0.485	0.581	0.730	0.313	0.210	0.504	2
43.*	76 612	149698	16 29 48	76 20.5	G8 IV	8.033	0.570	0.822	1.146	0.442	0.287	0.696	7
44.	73 726	149682	16 30 24	73 02.7	K1 III	8.210	0.618	1.019	1.406	0.484	0.357	0.809	2
45.	72 734	150010	16 32 13	72 43.0	K3 III-IV	6.248	0.643	1.207	1.678	0.487	0.454	0.907	2
46.	72 736		16 32 51	72 36.2	A5 V	9.233	0.571	0.744	0.511	0.210	0.140	0.291	3
47.	73 733	151084	16 39 07	73 25.3	F8 V	8.067	0.486	0.603	0.727	0.305	0.206	0.473	2
48.*	74 680	151746	16 43 02	73 58.7	A5 V:	6.794	0.552	0.782	0.508	0.171	0.133	0.240	3

Notes:

18. ADS 9942, Δm=0.5, D=0′.5.
32. According to Bartaya (1979) A0m. Metallicity confirmed.
36. ADS 10055, Δm=0.0, D=5′.0. Measured together.
41. IDS 16298N7642, Δm=1.1, D=17′.7. Measured A component only.
43. IDS 16315N7627, Δm=3.0, D=0′.9.
48. Photometric indication of metallicity. Probable Am star.

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