Baltic Astronomy, vol.1, 216–238, 1992.

CLASSIFICATION OF POPULATION II SUPERGIANTS AND RELATED STARS IN THE VILNIUS SYSTEM

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Received February 26, 1992 .

Abstract. The results of photometric classification in the Vilnius system of 117 Population II supergiants, suspected supergiants and related stars are given. Their photometric spectral types, intrinsic colour indices $(Y-V)_0$, colour excesses E_{Y-V}, metallicities [Fe/H] and absolute magnitudes M_V are determined. It is shown that the system allows us to detect the UU Herculis–type supergiants photometrically. The analyzed SRd star sample falls into two groups of metallicity and luminosity. Our photometric classification assigns luminosity classes from III to V to 37 F–K stars with $|b| > 16°$ classified by Bartaya (1979) from objective prism spectra as supergiants.

Key words: supergiant stars – Population II stars – UU Herculis-type stars – photometric classification – Vilnius photometric system

1. Introduction

A part of Population II stars evolve into supergiants when they reach the tip of the asymptotic giant branch (AGB) and the post-AGB stage. Space density of such stars, because of their rapid evolution, is not as high as for other Population II stars (e.g. subdwarfs, metal-deficient giants, RR Lyrae-type stars, horizontal branch stars). This is also confirmed by the H-R diagrams of globular clusters. However, high luminosity and location at high galactic latitudes where interstellar extinction is low allows us to observe a rather large number

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of these stars even among bright stars. Similarly to other Population II stars, this group of stars can be distinguished by low metallicity, high space velocity or location at high galactic latitudes. Some types of variable stars such as SRd, W Virginis and RV Tauri also belong to Population II supergiants. The description of these variables is presented in the monograph "Metal-deficient stars" by Straižys (1982) and in the catalogue of Population II supergiants of A–F spectral classes (Bartkevičius, 1992).

Population II supergiants were first detected by Bidelman (1951). Later on there followed discussion concerning their chemical composition, formation and evolution (Abt, 1960; Searle et al., 1963; Fernie, 1981; Fernie and Garrison, 1984). The discussion became especially active after the works of Sasselov (1984, 1986), Bond (1970), Luck et al. (1983) and Luck and Bond (1984a,b). At first the UU Herculis-type supergiants were considered of normal metallicity. Later on Bond and his group showed that a part of Population II supergiants exhibit mild and intermediate metal-deficiency. Five F supergiants located at high galactic latitudes were attributed by Sasselov to the UU Herculis-type group. The group includes BD+38°2803 (UU Her, F2 Ib–cF8), HD 112374 (BS 4912, LN Hya, F3 Ia), HD 161796 (V 814 Her, F3 Ib), HD 163506 (89 Her, BS 6685, V 441 Her, F2 Ibe) and HD 177300 (BL Tel, F5 I + M). Sasselov (1984) also has suspected that a large number of UU Herculis-type stars may be among F-supergiants at high galactic latitudes classified by Bartaya (1979) from the objective prism spectra of 166 Å/mm dispersion and has presented an additional list of 33 suspected UU Herculis-type stars selected from this catalogue. The mentioned works encouraged us to analyse the properties of Population II supergiants using the Vilnius photometric system.

2. Observational data and method of classification

The Vilnius system colour indices of 117 Population II supergiants and related stars have been taken from Lazauskaitė and Tautvaišienė (1990) and Straižys et al. (1989) and after dereddening are presented in Table 1 along with their equatorial coordinates, V magnitudes and the number of observations.

The sample of stars under investigation consists of supergiants with $|Z| > 400$ pc, a few well-known UU Herculis-type stars, supergiants of spectral classes F, G and K with $|b| > 16°$ classified by Bartaya (1979) and variables of SRd and RV Tauri types. Some

Table 1. Vilnius system intrinsic colour indices of Population II supergiants and related stars

No	Star		α(1950.0)	δ(1950.0)	V	$(U-P)_0$	$(P-X)_0$	$(X-Y)_0$	$(Y-Z)_0$	$(Z-V)_0$	$(V-S)_0$	n
1.	HD	2207	$00^h23^m37^s$	51°00.'2	7.92	0.76	0.73	0.90	0.38	0.21	0.58	2
2.	HDE	236429	00 27 10	59 56.1	8.95	0.78	0.78	0.95	0.38	0.22	0.57	2
3.	BD	+46°186	00 49 38	47 03.5	9.95	0.55	0.72	0.79	0.34	0.17	0.39	2
4.	HD	6474	01 03 48	63 30.4	7.65	1.04	1.00	1.40	0.59	0.35	0.86	4
5.	HD	7672	01 14 04	−02 45.8	5.47	0.55	0.77	1.07	0.43	0.27	0.68	2
6.	BD	+84°19	01 14 24	84 52.2	8.91	1.03	1.49	2.01	0.79	0.50	1.13	2
7.	HD	8065	01 19 18	78 28.0	6.06	0.60	0.43	0.21	0.18	0.11	0.22	5
8.	HD	9549	01 31 37	45 20.6	8.66	0.62	0.76	0.45	0.18	0.10	0.26	2
9.	HD	9861	01 34 15	46 12.3	7.78	0.53	0.60	0.55	0.26	0.15	0.39	2
10.	BD	+44°367	01 43 42	45 27.7	9.17	0.55	0.67	0.48	0.22	0.14	0.32	2
11.	HD	18474	02 56 24	47 01.0	5.48	0.72	0.77	1.01	0.41	0.25	0.64	7
12.	HD	21018	03 18 23	04 31.5	6.38	0.64	0.77	1.02	0.42	0.25	0.64	1
13.	HD	21269	03 23 54	34 15.0	6.74	0.75	0.84	1.20	0.52	0.31	0.78	6
14.	HD	25878	04 04 46	53 13.8	9.20	0.63	0.58	0.83	0.38	0.30	-	2
15.	HD	34250	05 14 06	28 51.1	6.79	0.98	0.83	0.50	0.26	0.13	0.41	1
16.	BD	+53°979	05 57 42	53 18.3	10.00	-	-	1.63	0.71	0.44	1.05	2
17.	HD	41870	06 05 34	22 37.5	9.28	0.89	0.92	0.94	0.37	0.22	0.60	2
18.	HD	46276	06 31 03	43 06.4	7.52	0.56	0.71	0.48	0.20	0.09	0.30	3
19.	HD	46528	06 32 34	44 46.5	9.43	0.64	0.75	0.60	0.22	0.13	0.34	3
20.	HD	46703	06 33 49	53 33.6	9.00	1.06	0.75	0.50	0.29	0.16	0.45	7
21.	HD	49709	06 48 15	43 43.8	8.38	0.61	0.74	0.56	0.23	0.12	0.37	3
22.	HD	50103	06 50 16	46 16.8	7.84	0.56	0.91	1.18	0.45	0.26	0.72	2
23.	HD	51832	06 58 21	61 23.0	7.94	0.70	0.73	0.63	0.26	0.15	0.44	3
24.	HD	52497	06 59 22	24 17.3	5.18	0.59	0.79	1.14	0.42	0.25	0.61	3
25.	HD	56243	07 15 33	59 20.8	6.81	0.79	1.37	1.96	0.56	0.48	1.02	3

Table 1 (continued)

No		Star	$\alpha(1950.0)$	$\delta(1950.0)$	V	$(U-P)_0$	$(P-X)_0$	$(X-Y)_0$	$(Y-Z)_0$	$(Z-V)_0$	$(V-S)_0$	n
26.	HD	56167	$07^h16^m20^s$	69°45′.9	8.45	0.49	0.97	1.47	0.45	0.40	0.67	2
27.	HD	58807	07 26 29	61 11.9	9.10	0.51	0.62	0.59	0.27	0.14	0.43	3
28.	HD	58965	07 27 08	60 36.1	9.17	0.50	0.59	0.62	0.29	0.16	0.48	2
29.	HD	58966	07 27 13	60 34.4	8.80	0.49	0.61	0.61	0.28	0.15	0.48	2
30.	HD	73759	08 38 21	45 02.4	7.94	0.65	0.70	0.64	0.27	0.16	0.45	8
31.	HD	74132	08 40 29	45 38.1	8.26	0.52	0.63	0.58	0.26	0.14	0.40	6
32.	HD	74327	08 41 40	44 22.0	8.84	0.59	0.64	0.60	0.27	0.13	0.43	8
33.	HD	75555	08 48 59	45 05.2	8.11	0.61	0.63	0.68	0.28	0.16	0.47	8
34.	HD	77912	09 00 10	38 51.1	4.62	0.62	0.92	1.29	0.47	0.29	0.73	5
35.	HD	84800	09 45 36	43 53.9	7.72	0.60	0.83	0.40	0.13	0.08	0.18	4
36.	HD	85015	09 47 10	44 14.2	8.36	0.51	0.58	0.56	0.25	0.16	0.42	6
37.	BD	+30°2034	10 29 48	29 49.8	10.34	0.69:	0.92	1.44	0.56	0.30	0.78	2
38.	HD	99829	11 26 43	44 37.9	9.15	0.49	0.57	0.62	0.26	0.15	0.43	6
39.	HD	101841	11 40 46	28 19.9	7.69	0.63	0.67	0.57	0.26	0.15	0.42	4
40.	HD	102102	11 42 38	43 29.0	8.03	0.61	0.77	0.55	0.17	0.11	0.25	2
41.	HD	102570	11 45 57	46 24.5	8.28	0.51	0.61	0.60	0.25	0.14	0.41	4
42.	HD	103036	11 49 17	−05 29.0	8.27	0.92	1.12	1.46	0.65	0.36	0.95	2
43.	BD	−20°4124	14 54 25	−21 22.0	10.28	0.75:	0.78:	1.04	0.47	0.24	0.73	2
44.	HD	135148	15 10 55	12 38.6	9.38	0.83	1.06	1.52	0.63	0.34	0.87	4
45.	HD	137569	15 24 00	14 52.0	7.86	0.65	0.47	0.19	0.12	0.08	-	4
46.	HD	141021	15 43 24	45 50.6	8.60	0.52	0.62	0.59	0.25	0.16	0.39	2
47.	HD	141527	15 46 31	28 18.5	5.86	0.66	0.60	0.79	0.34	0.29	-	2
48.	HD	141531	15 46 52	09 45.8	9.15	0.79:	0.94	1.27	0.61	0.28	0.82	3
49.	HD	142438	15 51 06	46 12.0	8.84	0.56	0.87	1.14	0.44	0.28	0.68	3
50.	HD	144921	16 05 21	25 02.5	8.23	0.96	1.06	1.71	0.77	0.42	1.08	4

Table 1 (continued)

No.	Star		α(1950.0)	δ(1950.0)	V	$(U-P)_0$	$(P-X)_0$	$(X-Y)_0$	$(Y-Z)_0$	$(Z-V)_0$	$(V-S)_0$	n
51.	BD	+38°2803	$16^h34^m12^s$	38°04′.1	8.92	1.09	0.74	0.59	0.32	0.17	0.51	9
52.	HD	152905	16 52 46	43 29.2	7.04	0.55:	0.94	1.27	0.45	0.31	0.70	1
53.	HD	156947	17 15 53	60 43.4	6.32	0.63	1.06	1.40	0.48	0.34	0.76	1
54.	HD	160823	17 39 30	04 23 0	6.97	0.67	0.72	0.97	0.43	0.25	0.64	2
55.	BD	+44°2763	17 43 33	44 45 5	9.12	0.62	0.70	0.65	0.25	0.15	0.40	3
56.	HD	161796	17 43 41	50 03.8	6.98	1.30	0.80	0.50	0.23	0.12	0.38	3
57.	HD	161695	17 43 47	31 31.4	6.22	0.80	0.55	0.19	0.11	0.07	0.17	2
58.	HD	162036	17 45 16	45 53.7	7.92	0.64	0.68	0.58	0.24	0.14	0.37	3
59.	HD	162714	17 49 58	−06 08.0	6.38	0.76	0.84	1.18	0.36	0.26	0.61	2
60.	HD	163506	17 53 24	26 03.4	5.39	1.18	0.72	0.46	0.23	0.12	0.34	1
61.	HD	164136	17 56 35	30 11.5	4.41	0.77	0.73	0.52	0.26	0.13	0.42	3
62.	HD	165462	18 03 33	−00 27.1	6.34	0.66	0.83	1.13	0.45	0.27	0.70	3
63.	HD	167944	18 14 40	12 02.9	7.20	0.59	0.83	0.69	0.25	0.18	0.44	5
64.	CD	−30°15602	18 19 30	−30 16.0	11.83	0.59	0.40	0.26	0.15	0.09	0.29	4
65.*	HD	170756	18 28 09	21 49.9	7.50*	0.58	0.74	0.34	0.12	0.07	0.18	2
					8.23*	0.91	0.91	0.87	0.39	0.21	0.59	2
					7.30*	0.65	0.59	0.42	0.28	0.17	0.47	3
66.	HD	171496	18 33 04	−24 28.7	8.52	0.60	0.73	0.97	0.38	0.24	0.58	2
67.	HD	172594	18 38 51	−14 36.8	6.42	1.21	0.80	0.52	0.20	0.14	0.34	2
68.	HD	173666	18 42 55	44 50.3	8.08	0.64	0.71	0.59	0.26	0.16	0.40	3
69.*	HD	173819	18 44 48	−05 45.6	6.68*	0.97	1.05	1.34	0.66	0.33	0.89	1
					6.85*	0.75	1.10	0.86	0.61	0.19	0.75	1
70.	HD	174974	18 51 09	−22 48.5	4.84	0.62	0.93	1.44	0.47	0.32	0.67	3
71.	BD	+46°2573	18 52 41	46 54.5	9.30	0.70	1.27	1.88	0.51	0.49	0.93	3
72.	BD	+45°2798	18 55 14	45 28.4	9.18	0.56	1.05	1.42	0.48	0.33	0.75	3

Table 1 (continued)

No.	Star		$\alpha(1950.0)$	$\delta(1950.0)$	V	$(U-P)_0$	$(P-X)_0$	$(X-Y)_0$	$(Y-Z)_0$	$(Z-V)_0$	$(V-S)_0$	n
73.	HD	180583	$19^h13^m59^s$	27°50′.2	6.16	0.68	0.66	0.63	0.22	0.12	0.37	3
74.	HD	181276	19 15 57	53 16.5	3.77	0.54	0.92	1.17	0.40	0.26	0.64	6
75.	BD	+27°3334	19 16 17	27 45.1	9.58	0.41	0.51	0.50	0.14	0.10	0.26	2
76.	HD	183098	19 23 27	61 06 2	7.68	0.56	1.01	1.32	0.46	0.31	0.72	3
77.	HD	183344D	19 26 40	07 08.9	6.84	0.70	0.83	1.09	0.43	0.25	0.60	1
78.	HD	183968	19 27 51	59 39.6	7.97	0.66	1.23	1.59	0.50	0.38	0.80	3
79.	BD	+8°4122	19 28 36	08 24.0	9.81	0.13	0.08	0.12	0.10	0.06	0.10	2
80.	HD	185018A	19 34 31	11 09.6	7.98	0.63	0.72	0.98	0.38	0.22	0.57	2
81.	HDE	232078	19 35 57	16 41.6	8.59	0.86	1.18	1.95	0.73	0.45	-	4
82.	HD	185732	19 36 15	60 35.7	8.50	0.75	0.73	0.56	0.23	0.14	0.39	3
83.	HD	186253	19 39 07	59 43 4	7.73	0.57	0.68	0.54	0.23	0.14	0.37	3
84.	HD	187982	19 49 55	24 51 8	5.52	0.72	0.40	0.17	0.14	0.07	0.15	2
85.	HD	188650	19 52 59	36 51 8	5.78	0.57	0.73	0.88	0.35	0.21	0.55	2
86.	HD	190390	20 02 20	11 44 5	6.37	1.06	0.76	0.51	0.31	0.17	0.48	8
87.	HD	191010	20 04 39	25 32.4	8.14	0.60	0.84	1.12	0.44	0.27	0.65	6
88.	HD	191546	20 07 00	43 54.8	8.40	0.73	0.70	0.60	0.25	0.15	0.39	2
89.	HD	194130	20 17 22	77 15.3	8.77	0.52	0.60	0.55	0.25	0.15	0.38	3
90.		PU Vul	20 19 01	21 24.7	8.55	0.82	0.40	0.24	0.14	0.10	0.33	3
91.	HD	194012	20 20 32	14 23.4	6.14	0.46	0.56	0.68	0.32	0.18	0.48	3
92.*	HDE	340667	20 34 24	26 25.8	8.16*	0.74	0.77	1.07	0.35	0.28	0.57	1
					8.73*	0.85	0.86	1.10	0.34	0.23	0.56	1
93.	HD	197177D	20 39 01	32 07.7	5.53	0.57	0.88	1.04	0.42	0.27	0.64	2
94.	BD	+42°3935	20 58 16	42 24.1	9.83	0.70	0.97	1.39	0.42	0.28	0.64	2
95.	HD	201078	21 04 24	30 59.0	5.67	0.84	0.73	0.65	0.26	0.15	0.42	1
96.	HD	201251	21 04 53	47 26 8	4.55	0.79	1.32	2.06	0.63	0.52	1.02	2

Table 1 (continued)

No.	Star		α(1950.0)	δ(1950.0)	V	$(U-P)_0$	$(P-X)_0$	$(X-Y)_0$	$(Y-Z)_0$	$(Z-V)_0$	$(V-S)_0$	n
97.	HD	202314	$21^h12^m02^s$	29°41′.6	6.17	0.61	0.90	1.26	0.47	0.28	0.68	2
98.	HD	203156D	21 17 22	38 01.5	5.85	0.72	0.69	0.61	0.28	0.17	0.47	2
99.	HD	204075	21 23 49	−22 37.7	3.76	0.55	0.86	1.12	0.42	0.26	0.66	2
100.	HD	204293	21 24 38	31 58.3	8.52	0.91	0.58	0.21	0.12	0.08	0.18	2
101.	HD	206778	21 41 44	09 38.7	2.39	0.79	1.26	1.93	0.63	0.43	0.92	9
102.	HD	207673	21 47 38	40 54.9	6.44	0.85	0.53	0.20	0.13	0.06	0.18	2
103.	HD	208501	21 53 12	56 22.4	5.77	0.40	0.28	0.22	0.15	0.04	0.19	1
104.	HD	210221	22 05 34	53 03.8	6.11	1.06	0.64	0.26	0.16	0.09	0.21	2
105.	HD	214714A	22 37 18	37 19.9	6.04	0.54	0.69	0.91	0.37	0.22	0.57	3
106.	BD	+39°4926	22 43 54	39 51.0	9.25	1.25	0.75	0.27	0.16	0.09	0.25	10
107.	HD	215684A	22 44 00	51 50.5	7.42	1.08	0.84	0.35	0.19	0.10	0.27	3
108.	HD	217476	22 57 58	56 40.6	6.00	1.00	0.89	1.13	0.51	0.31	0.74	3
109.	HD	218356	23 04 42	25 12.0	4.75	0.62	0.97	1.57	0.53	0.40	0.86:	5
110.	HD	221858	23 33 12	−30 13.0	9.49	0.69	0.77	1.07	0.48	0.25	0.70	3
111.	BD	+46°4128	23 39 02	47 19.1	8.86	1.03	1.26	1.91	0.73	0.44	1.03	2
112.	HD	222717	23 40 27	44 37.0	8.30	0.51	0.60	0.56	0.27	0.14	0.39	2
113.	HD	223153	23 44 27	45 56.4	7.88	0.62	1.09	1.44	0.50	0.33	0.78	2
114.	BD	+45°4352	23 51 15	46 11.6	9.28	0.70	1.36	1.89	0.54	0.46	0.92	3
115.	HD	224014	23 51 52	57 13.3	4.81	0.93	1.08	1.70	0.64	0.44	0.92	2
116.	HD	224165	23 53 02	47 04.7	6.02	0.61	0.97	1.38	0.49	0.29	0.70	3
117.	HD	224507	23 55 54	46 01.8	8.01	0.62	1.19	1.56	0.52	0.36	0.81	2

Notes: 65. Var: AC Her, J.D.2443728, 2445591 and 2446628.
69. Var: R Sct, J.D.2447012 and 2447030.
92. Var: V Vul, J.D.2447011 and 2447026.

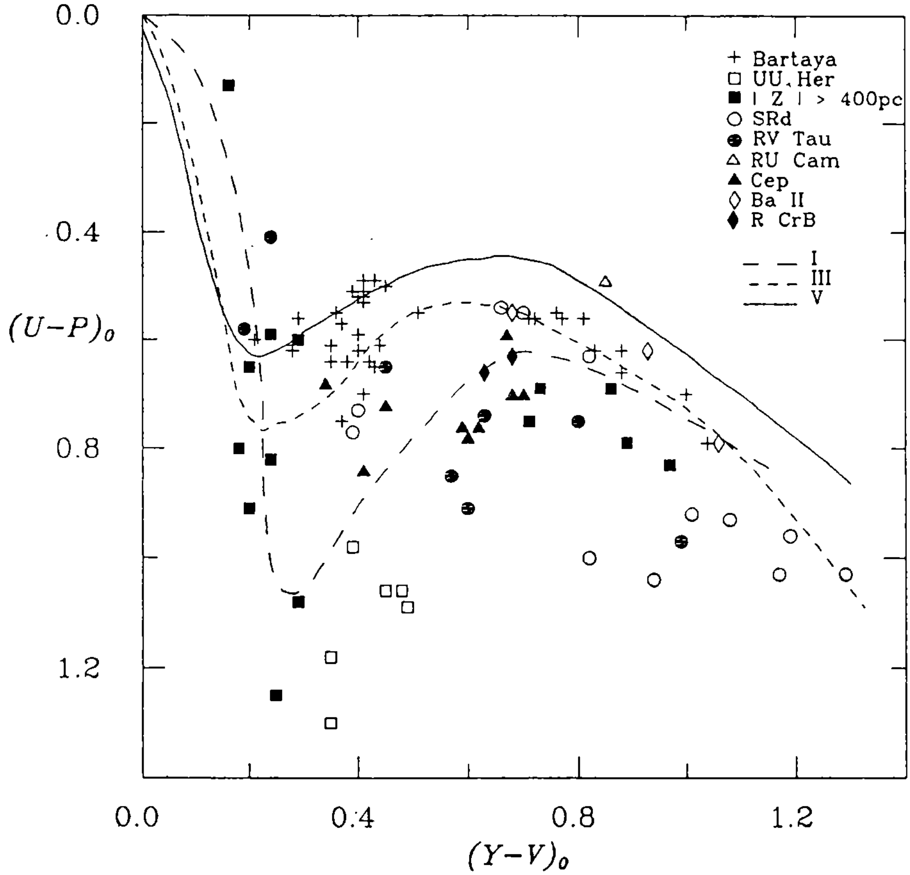

Fig. 1. The $(U–P)_0$, $(Y–V)_0$ diagram for investigated stars.

cepheids and normal supergiants with exact MK spectral classes and a few barium and R Corona Borealis-type stars are also included for comparison. Fig. 1 shows the positions of investigated stars in the diagram of intrinsic colour indices $(U-P)_0$, $(Y-V)_0$ which is very sensitive to luminosity. Mean sequences of normal supergiants, giants and dwarfs are shown, too.

Photometric classification was carried out using techniques presented by Bartkevičius and Sperauskas (1983) and Sperauskas (1987a,b). The photometric spectral type (spectral class, luminosity class and metallicity class), intrinsic colour index $(Y-V)_0$, colour excess E_{Y-V}, metallicity [Fe/H] and the absolute magnitude M_V were determined. Some investigated stars were classified earlier by Bartkevičius and Sperauskas (1983), Bartkevičius and Tautvaišienė

(1987) and Sperauskas (1987a). Their results have been used directly, when there were no additional observations. The results of classification are presented in the following sections alongside with the discussion on peculiarities and reliability of the classification for separate groups of the investigated stars. We must note in advance that the accuracy of our classification for metal-poor supergiants is lower than that for normal supergiants. Especially, this is valid for Population II supergiant variables.

3. Classification results and discussion

3.1. UU Herculis-type stars

Classification results for the UU Herculis-type stars are given in Table 2. The sample of five well known stars of this group was supplemented with the star HD 34250. Its colour indices are very close to those of the UU Herculis-type stars. We noted this star in 1983 during compilation of the MDPH catalogue (Bartkevičius, 1990).

Table 2. Classification results of UU Herculis-type stars

No.	HD/BD	Sp(Vilnius)	$(Y-V)_0$	E_{Y-V}	[Fe/H]	M_V	Sp(Lit)
1.	34250	MD I pec-F0:	0.39	0.30:	−1.5:	−3.0	F0e
2.	46703	MDE-F0 Iab	0.45	0.08	−2.0:	−3.8	cFwl
3.*	+38°2803	MD I-F3:	0.49	0.03	−1.1	−4.5	F2 Ib-G0
4.	161796	F2 Ia pec	0.35	0.11:	0.0	−7.0	F3 Ib
5.*	163506	F1 Iab	0.35	0.06	0.0:	−6.8	F2 Ibe
6.*	190390	MD I-F0:	0.48	0.09:	−1.6	−4.0	F1 III

Notes: 3. Var: UU Her.
5. Var: V441 Her.
6. VB?

Classification of the UU Herculis-type stars was carried out by intercomparison of mean values of their colour-indices and Q parameters since light and colour variation of these stars is rather small. All UU Herculis-type stars have large values of $(U-P)_0$ and in Fig. 1 they are below the sequence of normal supergiants. Table 2 data show that four UU Herculis-type stars from the observed sample have low metal abundances and the two remaining ones have solar metallicity. The absolute magnitudes of these two groups of stars also differ by about 2.5 mag. The parameters of UU Herculis-type stars determined in this work probably are not as exact as for normal stars since the sample of peculiar comparison stars is not sufficient. However, their metallicities are close to those determined by other methods (see Table 3). According to the literature, the absolute magnitudes of UU Herculis-type stars are within −4 to −8 for metal-deficient objects, and within −6 to −9 for stars of normal metallicity (Bartkevičius, 1992). However, the theory of stellar evolution and observations of globular clusters indicate that Population II stars are not brighter than $M_V \approx -5$.

Table 3. Parameters $\delta(PXY)$ and mean [Fe/H] from the literature for UU Herculis-type stars

Name	$\delta(PXY)$	[Fe/H] mean	References
HD 34250	0.33	–	
HD 46703	0.22	-1.6	Luck and Bond (1989)
BD +38°2803	0.21	-1.2	Klochkova and Panchuk (1989), Cardelli (1989)
HD 161796	0.07	-0.45	Luck and Bond (1989), Klochkova and Panchuk (1988a)
HD 163506	0.03	-0.30	Luck and Bond (1989)
HD 190390	0.28	-2.0	Fernie (1986a)

In the process of classification of UU Herculis-type stars we have tested suitability of the diagrams proposed by Sperauskas (1987a,b) for determination of metallicities and colour excesses of the RR Lyrae-type stars. We have found that the $(P-X)_0-(X-Y)_0$, $(Y-V)_0$ diagram suggested by Sperauskas is also suitable for metallicity determination of UU Herculis-type stars. Their deviation from the mean line of luminosity of V and III stars $\delta[(P-X)_0-(X-Y)_0]$ (quoted later as $\delta(PXY)$), is rather sensitive to metallicity. Table 3 presents deviations $\delta(PXY)$ for the investigated UU Herculis-type stars and the metallicities determined by other authors. The attempt to determine colour excesses for UU Herculis-type stars using the method proposed by Sperauskas (1987b) for RR Lyrae-type stars, was not successful: it gives unreliable results for metal-deficient supergiants.

Our data and MK spectral classification indicate that the stars HD 161796 and HD 163506 have a similar temperature. However, their $(b-y)_0$ indices (indicators of temperature in the $uvby\beta$ system) are very different, $\Delta(b-y)_0 = 0.16$ (Fernie, 1986a,b; Arellano Ferro et al., 1989). The difference of Hβ index is moderate, $\Delta\beta = 0.02$ mag.

3.2. Supergiants with $|Z| > 400$ pc

We find that 24 supergiants of the observed sample are located farther off than 400 pc from the galactic plane. Results of their classification are collected in Table 4. Among them we find 4 UU Herculis-type stars, 4 SRd variables and some peculiar objects, such as the metal-deficient supergiant BD+39°4926 (Bond and Luck, 1987) and a nova-like variable PU Vul (Belyakina et al., 1984). Our M_V gives their distance from the galactic plane being ≈ 2 kpc. PU Vul was observed in the Vilnius system in July, 1986 (J.D. 2446638.2 – 2446640.2).

3.3. SRd-type variables

Classification results for the analyzed SRd variables, including 5 stars from Table 4, are presented in Table 5. It was impossible to determine metallicity for RU Cep since the spectral class of this star is too late. As can be seen from Table 5, the analyzed SRd star sample falls into two groups of metallicity and luminosity. Seven SRd-type stars have mean metallicity [Fe/H] $= -1.5$ and mean $M_V = -3.2$, and other five stars have -0.1 and $+0.8$, respectively. In the $(U-P)_0$, $(Y-V)_0$ diagram (Fig. 1) the metal-deficient SRd stars fall under the line of normal supergiants. i.e. into the region of metal-deficient giants. Stars with normal metallicity are situated in the region of normal giants. The $(U-P)_0$ indices of F-type solar metallicity SRd variables HD 164136 (ν Her) and HD 191546 (V 395 Cyg) are about 0.3 mag less than for the same temperature UU Herculis-type metal-deficient stars, and even by 0.5 mag less when compared with the solar metallicity UU Herculis-type stars.

We must note that classification of HD 217476 (V 509 Cas, BS 8752) and HD 224014 (ϱ Cas) in the Vilnius system is unreliable. These two stars are among the brightest supergiants of our Galaxy: their $M_V = -9.5$ (Morgan et al., 1981). A special classification method is required for very bright supergiants.

Table 4. Classification results for supergiants with $|Z| \geq 400$ pc

No.	HD/BD	Sp(Vilnius)	$(Y\text{-}V)_0$	E_{Y-V}	[Fe/H]	M_V	Z, pc
1.	8065	B8 Ib	0.29	0.26		-6.0	+420
2.	137569	A0 Ib	0.20	0.00		-5.4	+3530
3.	161695	A0 Ib	0.18	0.03	0.0:	-4.8	+680
4.	-30°15602	A0 Ia	0.24	0.11		-6.4	-4690
5.	+804122	B1 Ib	0.16	0.27		-5.6	+580
6.*	PU Vul	A2 Ia	0.24	0.28	0.0	-8.0	-1710
7.	204293	A1 Ib	0.20	0.12	0.0	-5.0	-890
8.	+39°4926		0.25	0.08			-2070
9.*	2207	F8 Ib	0.59	0.01	0.0	-4.5	-590
10.*	+84°19	M2 Ib:	1.29	0.15		-4.5	+1320
11.*	+53°979	MDGE?-K7 Ib	1.15	0.18:	-2.0:	-4.5	-1440
12.	46703	MDE-F0 Iab	0.45	0.08	-2.0:	-3.8	+1040
13.	+30°2034	MD-G6 I-II	0.86	0.05	-0.6	-3.0:	+3610
14.*	103036	MDGE-K1	1.01	0.03	-1.7	-2.5	+1100
15.	-20°4124	MDG-G5 pec	0.71	0.10:	-1.3	-2.5	+1580
16.	135148	MDG(I)-G7: pec	0.97	0.03:	-1.5	-3.0	+2290
17.	141531	MDG(I)-G7: pec	0.89	0.03	-1.5:	-3.5::	+2260
18.*	144921	MDGE-K0	1.19	0.05	-1.6	-3.2	+1270
19.*	+38°2803	MD I-F3:	0.49	0.03	-1.1	-4.5	+3210
20.	161796	F2 Ia pec	0.35	0.11:	0.0	-7.0	+2570
21.*	163506	F1 Iab	0.35	0.06	0.0:	-6.8	+950
22.*	215684A	F1 I-II pec	0.29	0.09	0.0	-6.0:	-430
23.	221858	MDG-G5 II	0.73	0.02	-0.8	-1.5:	+1460
24.*	+46°4128	(MDG)-M0 II:	1.17	0.21	-0.7:	-3.0	-480

Notes: 6. Var: PU Vul.
9. Var: TU Cas.
10. Var: RU Cep.
11. Var: Z Aur.
14. Var: TY Vir.
18. Var: SX Her.
19. Var: UU Her.
21. Var: V441 Her.
22. cA5, rFHB(*uvby*).
24. Var: WY And.

Table 5. Classification results for SRd-type stars

No.	HD/BD	Sp(Vilnius)	$(Y-V)_0$	E_{Y-V}	[Fe/H]	M_V	Sp(Lit)
1.*	6474	MDGE-G9	0.94	0.31	−1.6	−3.0	G0-G4 Ia
2.*	7672	MD-G6 III	0.70	0.02	−0.6	+1.2	G5 IIIe
3.*	+84°19	M2 Ib:	1.29	0.15		−4.5	G6-M3.5 III
4.*	+53°979	MDGE?-K7 Ib	1.15	0.18:	−2.0:	−4.5	G0e-G6e
5.*	103036	MDGE-K1	1.01	0.03	−1.7	−2.5	G3p Ib
6.*	144921	MDGE-K0	1.19	0.05	−1.6	−3.2	G3ep-K0(M3)
7.*	156947	K1 III	0.82	0.00	0.0	+0.7	K1.5 IIIb
8.*	164136	F2 II-III	0.39	0.04	0.0	0.0:	F2 II
9.*	181276	G8 III	0.66	0.07	−0.1	+1.5	G9 III
10.*	191546	F2 III:	0.40	0.16	0.0:	+0.5	F8 Ib
11.*	217476	MDG:-G3 pec	0.82	0.17	−1.3:	−3.5:	F8e-K1 Ia-O + B1V
12.*	+46°4128	(MDG)-M0 II:	1.17	0.21	−0.7:	−3.0	G2e-K2(M3)
13.*	224014	MDG-K0	1.08	0.11	−1.5:	−3.0	G2 0e

Notes: 1. Var: V487 Cas.
2. Var: AY Cet, VB: $\Delta m = 5\overset{m}{.}7$, $d = 177\overset{''}{.}6$.
3. Var: RU Cep.
4. Var: Z Aur.
5. Var: TY Vir.
6. Var: SX Her.
7. Var: VW Dra.
8. Var: ν Her.
9. Var: κ Cyg.
10. Var: V395 Cyg.
11. Var: V509 Cas, [Fe/H] = +0.03, +0.1 (Cayrel de Strobel et al., 1985). Another version of classification: G0Iab, $(Y-V)_0 = 0.60$, $E_{Y-V} = 0.4$, [Fe/H] = 0.0, $M_V = -5.0$.
12. Var: WY And.
13. Var: ϱ Cas. Another version of classification: G7Ib, $(Y-V)_0 = 0.80$, $E_{Y-V} = 0.4$, [Fe/H]=0.0, $M_V = -4.0$.

A rather distant G supergiant with $\alpha(1950) = 23^h47^m26^s$, $\delta(1950) = +77°48\overset{'}{.}7$, $b = +15°$ and $V = 10.07$ has been found by Černis (1986). Its spectral type is G1 Ib, its metallicity is solar, $M_V = -5.5$ and its distance is 9.7 kpc from the Sun and 2.5 kpc from the galactic plane.

3.4. RV Tauri-type variables

Classification of five RV Tauri-type variables in the Vilnius system was unsuccessful (Table 6). They need a special calibration. Their colour excesses E_{Y-V} were determined using the results of other authors and the interstellar extinction dependence on distance in the areas where the investigated stars are situated. It is interesting that the variable EP Lyr was classified in the Vilnius system as a dwarf or subdwarf with $M_V = +3.5$. A similar value, $M_V = +5$, was obtained for this star by Dawson (1979) in the DDO photometric system.

Table 6. Classification results for RV Tauri-type stars

No.	HD/BD	Sp(Vilnius)	$(Y-V)_0$	E_{Y-V}	[Fe/H]	M_V	Sp(Lit)
1.*	41870	G0 Ib	0.59	0.37	0.0	–5.0	F8 Ib-G5 Ib
2.*	170756		0.19	0.13			F2p Ib-K4e(C0.0)
			0.60	0.13			
			0.45	0.13			
3.*	173819		0.99	0.20			G0 Iae-K2p(M3) Ibe
			0.80	0.20			
4.*	+27°3334		0.24	0.21			A4 Ib-G5p
5.*	340667		0.63	0.26			G4e-K3(M2)
			0.57	0.26			

Notes: 1. SS Gem.
2. AC Her, J.D.2443728, 2445591 and 2446628.
3. R Sct, J.D.2447012 and 2447030.
4. EP Lyr.
5. V Vul, J.D.2447011 and 2447026.

3.5. High galactic latitude supergiants from the Bartaya (1979) catalogue

In order to check the suggestion by Sasselov (1984) that the UU Herculis-type stars may be present among the stars classified as supergiants by Bartaya (1979), we analyzed 26 such stars of spectral class F having $|b| > 16^\circ.5$. The classification brought unexpected results (Table 7). No star was found to be a supergiant. For these stars the Vilnius three-dimensional classification gives the following spectral classes: F III for 7 stars, G III for 2, K III for 9, G IV for 1, A V, IV–V for 4 and F V, IV–V, IV for 14 stars. Then we

Table 7. Classification results for stars classified by Bartaya (1979) as supergiants

No.	HD/BD	Sp(Vilnius)	$(Y-V)_0$	E_{Y-V}	[Fe/H]	M_V	Sp(Bartaya)
1.	+46°186	G0 IV pec	0.51	0.00	+0.4	+1.5:	F0 I
2.	9549	A7 IV-V, λ Boo?	0.28	0.11	–0.3	+2.3	F0 I
3.	9861	MD?-F2 V	0.41	0.07	–0.4:	+3.0	F5 Ib
4.	+44°367	MD?-F1 V	0.36	0.06	–0.5:	+3.1	F0 Ib
5.	46276	A9 V	0.29	0.10	–0.1	+2.7	F0 I
6.	46528	F3 IV pec	0.35	0.09	+0.2:	+1.5:	F5 I
7.	49709	F1 IV	0.35	0.06	+0.3:	+2.2	F2 I
8.	50103	G9 III-IV	0.71	0.03	–0.1	+1.9	K0 I
9.	51832	F3 III	0.41	0.03	0.0	+1.0	F2 I
10.	56243	K5 III	1.04	0.00	–0.1	0.0	K4 I
11.	58807	F3 V	0.41	0.00	0.0	+3.1	F3 I
12.	58965	F5 V	0.45	0.00	–0.1	+3.4	F5 I
13.	58966	F5 V	0.43	0.00	0.0	+3.3	F5 I
14.	73759	F3 III	0.43	0.00	+0.1	+1.4	F3 I
15.	74132	F2 V	0.40	0.00	0.0	+3.0	F5 I
16.	74327	F3 V	0.40	0.00	+0.2	+2.6	F3 I
17.	75555	F5 III	0.44	0.00	0.0	+1.5	F5 I
18.	84800	A4 V	0.21	0.00	0.0	+1.6	A2 II
19.	85015	MD-F3 IV-V	0.41	0.00	–0.4	+3.3	F3 III
20.	99829	F6 V	0.41	0.00	+0.1:	+3.4	F5 I
21.	102102	A6 V	0.28	0.03	0.0	+2.1	F0 I
22.	102570	F3 IV	0.39	0.00	+0.2	+2.7	F2 I
23.	141021	F2 V	0.41	0.06	0.0	+3.1	F5 I
24.	142438	MD?-G5 III pec	0.72	0.00	–0.3	+0.5:	G5 I
25.	152905	K0 III	0.76	0.01	–0.1	+1.2	K0 Ib
26.	+44°2763	F4 III	0.40	0.00	+0.1	+1.0:	F2 I
27.	162036	F2 III	0.38	0.00	0.0	+1.5	F2 I
28.	173666	F1 III-IV	0.42	0.00	0.0	+2.0:	F2 I
29.	+46°2573	K4 III	1.00	0.08	–0.2	0.0	K4 I
30.	+45°2798	K1 III	0.81	0.00	0.0	+0.2	G8 I
31.	183098	K0 III	0.77	0.02	0.0	+1.2	K1 I
32.	183968	K2 III	0.88	0.01	+0.1	0.0	K3 I
33.	185732	F0 III	0.37	0.06	0.0	+1.4	F0 I
34.	186253	F0 IV-V	0.37	0.04	+0.1	+2.6	F0 I
35.	194130	F3 IV-V	0.40	0.06	–0.3	+3.0	F3 I
36.	222717	MD-F3 IV	0.41	0.00	–0.4	+3.5	F0 Ib
37.	223153	K1 III	0.83	0.08	–0.1	–0.2	K1 I
38.	+45°4352	K4 III	1.00	0.12	0.0	–0.2	K5 I
39.	224507	K2 III	0.88	0.05	0.0	+0.4	K2 I

compared the results by Bartaya with the MK classification from the Jaschek (1978) catalogue (Table 8). Only 5 stars from 27 F-G-K Bartaya supergiants have luminosity class I. The remaining stars are of other luminosity classes: 2 are of luminosity class II, 11 stars are of luminosity class III or IV and 10 stars are of luminosity class V.

In order to check the Vilnius system classification results for supergiants, we have classified 11 normal supergiants with reliable MK spectral classes and 10 classical cepheids observed at the same time as the Bartaya stars. Photometric classification results are presented in Table 9 for supergiants and in Table 10 for cepheids. We have obtained colour excesses E_{Y-V} of cepheids by using E_{B-V} from Ivanov et al. (1983). We find a complete agreement between our photometrically determined luminosity classes and those from the MK classification.

Consequently, we conclude that either the quality of spectral material or its standardization did not permit Bartaya to recognize F–K supergiants. When our classification of the Bartaya supergiants was almost over, a paper by Arellano Ferro et al. (1989) appeared. It is based on observations in the $uvby\beta$ photometric system of 24 F-supergiants from the same Bartaya (1979) catalogue. Using $\log g$ sensitive diagram $(c_1)_0$, $(b-y)_0$ calibrated in terms of $\log g$ from Kurucz (1979) models the authors found 23 stars to have $\log g > 3.0$, which corresponds to luminosity classes from III to V. Only one star, BD+48°1872, was found to be a bright metal-deficient giant ($\log g \approx 2$, [Fe/H] ≈ -2). The parameter $(c_1)_0$ was found to be by 0.5 mag higher for UU Herculis-type stars than for supergiants from the Bartaya catalogue. Solar metallicity was derived for all investigated stars, except BD+48°1872.

Our attention was drawn to the star BD+46°186. Its classification in the Vilnius system is rather uncertain. Its metallicity is very high, [Fe/H] = +0.4. The index $V-S$ is unusually low in comparison to $Y-V$. This star was also analyzed by Arellano Ferro et al. (1989). Judging from the diagram $(c_1)_0$, $(b-y)_0$, its $\log g$ is close to 4.0. High metallicity is confirmed by very high negative Δm_1 value, -0.13. The absolute magnitude M_V was obtained according to the Antonello (1985) calibration for dwarfs and is equal to +1.58 (in the Vilnius system it is +1.5). Interstellar extinction for this star ($E_{Y-V} = 0.00$) is very uncertain in the Vilnius system, $E_{B-V} = 0.10$ was used by Arellano Ferro et al. (1989), $E_{b-y} = 0.14$ ($E_{B-V} = 0.20$) is obtained from the diagram $b-y$, β.

Table 8. Comparison of spectral classification by Bartaya (1979) and MK classification from Jaschek (1978)

No.	HD/BD	Sp(Bartaya)	Sp(MK)
1.	4488	K0 I	G8 III
2.	4817	K3 I	K5 Ib
3.	5552	B0 I	B1 Ia
4.	6182	B0 I	B1 Ib
5.	+61°220	B0 I	B7 Ib
6.	7720	B3 I	B5 II
7.	+61°252	A0 I	A1 Ia
8.	9549	F0 I	F5 Ia
9.	9861	F5 Ib	F5 V
10.	17971	F5 Ia	F5 Ia
11.	+44°995	K2 I	K0 V
12.	+45°991	F2 I	A8 V
13.	30987	F0 I	F0 V
14.	+43°1340	K3 I-II	K5 III
15.	+45°1172	K3 I	K5 III
16.	+44°1292	F2 I	F5 V
17.	+43°1366	F2 I-II	F5 V
18.	39152	K0 I	K0 II
19.	39415	F5 I	F5 V
20.	+45°1614	K5 I	K3 III
21.	+44°1778	K5 I	K2 III
22.	+45°1635	K5 I	K2 III
23.	76921	K0 I	G8 III
24.	83174	K3 I	K3 V
25.	85039	F5 I	F3 III
26.	99914	A5 I	Am
27.	102570	F2 I	F3 V
28.	200102	G2 I	G1 Ib
29.	200805	F2 I	F5 Ib
30.	204721	K0 I	K0 III
31.	+60°2519	F5 I	F4 V
32.	220102	F2 I	F5 II
33.	+60°2522	B0 I	O6.5 IIIf
34.	+61°2452	F2 I:	F1 IV
35.	+60°2542	B9 Ib	A2 Ib
36.	+60°2546	A2 Ib	A0 Ia
37.	+60°2553	B3 I	B2 II
38.	221439	K1 Ib	K0 III:p
39.	+60°2582	A0 Ia	B8 Iab
40.	+60°2615	B0 I:	B0.5 Ib

Table 9. Classification results for supergiants with normal chemical abundance

No.	HD/BD	Sp(Vilnius)	$(Y-V)_0$	E_{Y-V}	[Fe/H]	M_V	Sp(Lit)
1.	77912	G5 Ib	0.76	0.04	-0.1	-5.0:	G7 Ib-II, BaII?
2.	172594	F2 Ib	0.34	0.41	0.0	-5.0	F2 Ib
3.*	174974	G7 Ib	0.79	0.30	0.0	-4.0	K2 I
4.*	185018A	G0 Ib	0.60	0.11	0.0	-3.0	G0 Ib
5.	187982	A0 Ia	0.21	0.54	0.0	-7.0	A1 Ia
6.*	201251	K5 Ib-II	1.15	0.00	0.0	-3.7	K4 Ib-IIa
7.	202314	G5 I-II	0.75	0.11	-0.1	-3.0:	G6 Ib-IIa Ca1 Ba0.3
8.	207673	A1 Iab	0.19	0.33	0.0	-5.0	A2 Ib
9.	208501	B8 Ia	0.19	0.55	0.0	-6.5	B8 Ib
10.	210221	A5 Ia	0.25	0.27	0.0	-7.3	A3 Ib
11.	224165	G7 Ib	0.78	0.11	0.0	-2.5	G8 Ib

Notes: 3. VB: $5\overset{m}{.}8$, $2\overset{\prime\prime}{.}5$.
4. VB: $5\overset{m}{.}7$, $80\overset{\prime\prime}{.}$
6. VB: $8\overset{m}{.}3$, $15\overset{\prime\prime}{.}7$.

Table 10. Classification results for classical cepheids

No.	HD/BD	Sp(Vilnius)	$(Y-V)_0$	E_{Y-V}	[Fe/H]	M_V	Sp(Lit)
1.*	2207	F8 Ib	0.59	0.01	0.0	-4.5	F3 II-F5 II
2.*	236429	G0 Ib	0.60	0.40	0.0	-4.5	F5 Ib-G2 Ib
3.*	52497	G5 Ib	0.67	0.07	-0.1	-4.0	G5 IIa-Ib
4.*	162714	MD-G5 II pec	0.62	0.54	-0.3	-1.0	F8 Ib-G3 Ibv
5.*	180583	F5 II pec	0.34	0.21	0.0	-3.0	F6 Ib-II
6.*	183344D	G1 Ib	0.68	0.30	0.0	-5.0	F7-G1 I-IIv
7.*	+42°3935	G7 Ib	0.70	0.93	-0.2	-4.0	F5-G6 Ib
8.*	201078	F5 Ib	0.41	0.08	-0.1	-3.0	F7.5 Ib-IIv
9.*	203156D	F3 II-III	0.45	0.04	0.0	+1.0	F1 II

Notes: 1. Var: TU Cas.
2. Var: DL Cas.
3. Var: ω Gem.
4. Var: Y Oph.
5. Var: V473 Lyr.
6. Var: U Aql; VB: $5\overset{m}{.}5$, $1\overset{\prime\prime}{.}5$.
7. Var: TX Cyg.
8. Var: DT Cyg.
9. Var: V1334 Cyg, VB: $0\overset{m}{.}0$, $0\overset{\prime\prime}{.}1$.

Seven suspected UU Herculis-type stars from the Bartaya (1979) list were observed in the *UBV* system (Zsoldos, 1990) in order to test their variability. It was shown that these stars are not variables. HD 58965 may be an exception, but it is not of the UU Herculis type (the amplitude is smaller than 0.05 mag). An interesting result was found analyzing high dispersion spectra of the Bartaya supergiants HD 51832, HD 73759 and HD 85039 (Klochkova and Panchuk, 1988b). The authors have found that the metallic lines are unusually broad and overlapping, so detailed spectral analysis is impossible. However, the spectral lines of supergiants must not be so broad. The absolute magnitude $M_V = -0.8$ obtained for another investigated star, HD 185732, also excludes dependence of this star to supergiants.

3.6. Other stars

Classification results of the remaining stars are presented in Table 11. The list consists of supergiants with doubtful classification or some peculiarities and stars incorrectly classified earlier as supergiants. The discrepant classification results obtained by us and other authors require a more detailed spectral analysis.

Table 11. Classification results for other stars

No.	HD/BD	Sp(Vilnius)	$(Y-V)_0$	E_{Y-V}	[Fe/H]	M_V	Sp(Lit)
1.	18474	MD?-G3 IIb pec	0.66	0.08:	-0.5.	-4.0:	G5III, G8 III CHwk
2.*	21018	MD-G5 II-III	0.67	0.04	-0.3	-2.0:	G5 III
3.*	21269	MDGE?-G5, G0 Ib	0.83	0.04:	-1.5::	-1.0:	G0
4.*	25878		0.68	0.04			G1 I (C0-2.0)
5.*	56167		0.85	0.03			C0.1-C3.2e(K0-R0)
6.	77912	G5 Ib	0.76	0.04	-0.1	-5.0:	G7 Ib-II, BaII?
7.	+30°2024	MD-G6 I-II	0.86	0.05	-0.6	-3.0:	K3 III
8.	101841	F2 III-IV	0.41	0.00	0.0	+2.3	F3 II
9.	-20°4124	MDG-G5 pec	0.71	0.10.	-1.3	-2.5	
10.	135148	MDG(I)-G7: pec	0.97	0.03.	-1.5	-3.0	KO, CH
11.*	141527		0.63	0.00			C 0.0(F8pep)
12.	141531	MDG(I)-G7: pec	0.89	0.03	-1.5:	-3.5::	K2
13.	160823	MDG-G2 II-III	0.68	0.11	-0.7	-2.0	G2 II
14.	165462	MD-G8 II-III	0.72	0.14	-0.2	-2.0:	G8 IIp
15.	167944	F5 II:pec	0.43	0.20	0.0	-1.0	F8 III
16.	171496	G2 II-III pec	0.62	0.25:	0.0:	-1.0	G5, G-WMS
17.	232078	(MDG)-K0 Ib	1.18	0.36.	-1.1	-4.3	K3 IIp
18.	188650	G0 II-III	0.56	0.08	0.0	-1.0	G1 Ib-II CH1 Fe-1 Ca-1
19.	191010	MD-G5 II	0.71	0.07	-0.3	-2.0	G3 Ib
20.*	194012	MD-F6 V	0.50	0.00	-0.3:	+4.0	F8 V

Table 11 (continued)

No.	HD/BD	Sp(Vilnius)	$(Y-V)_0$	E_{Y-V}	[Fe/H]	M_V	Sp(Lit)
21.*	197177D	G2 IIp	0.69	0.04	−0.2	−1.0:	G8 IIb
22.	204075		0.68	0.02			G4 Ib, Ba II
23.	206778		1.06	0.05			K2 Ib, Ba II marg
24.*	214714A	G1 II-III	0.59	0.12	0.0	+0.5	G3 Ib-II CN-1 CH2 Fe-1
25.*	215684A	F1 I-II pec	0.29	0.09	0.0	−6.0:	F0
26.	218356		0.93	0.04			K0 Ibp, Ba IImarg
27.	221858	MDG-G5 II	0.73	0.02	−0.8	−1.5:	G5, G pec

Notes:
2. wk G-band.
3. cg 2, rG8 wl?(*uvby*).
4. Var: XX Cam.
5. Var: RU Cam
11. Var: R CrB.
20. F8 Ib.
21. VB: $2^{m}_{.}3$, $2''_{.}5$.
24. VB: $5^{m}_{.}7$, $19''_{.}5$, Opt.
25. cA5, rFHB(*uvby*).

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