Baltic Astronomy, vol. 14, 179–203, 2005.

SEVEN-COLOR PHOTOMETRY OF THE OPEN CLUSTER NGC 1647 AREA

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Received 2005 March 20

Abstract. The area of the open cluster NGC 1647 in Taurus is investigated by CCD photometry in the Vilnius seven-color system. Magnitudes and color indices are determined for 433 stars down to $V = 15.0$ mag in the 45′ diameter area. For 252 of them photometric spectral and luminosity classes, interstellar reddenings, extinctions and distances are obtained. According to the CDS WEBDA database, 89 of them have a high cluster membership probability. Their mean distance from the Sun is 555±74 pc, excluding four stars which seem to be field stars. The main sequence starts at spectral class B7 V which corresponds to a cluster age of about 150 million years. Cluster members show a differential interstellar extinction ranging from 0.8 to 1.8 mag. The mean extinction of the cluster stars is 1.12±0.25 mag. Interstellar extinction in the area is dominated by the Taurus dark cloud complex at 160 pc. Color excesses of individual stars correlate well with the 100 μm dust thermal emission intensity. The cluster shape is investigated by counting stars down to $K = 15.6$ mag and is found to be elongated in the direction roughly perpendicular to the Milky Way, with the flattening ∼0.4.

Key words: stars: fundamental parameters – clusters: individual (NGC 1647) – methods: photometric – Vilnius photometric system

1. INTRODUCTION

The open cluster NGC 1647 is situated beyond the Taurus dark cloud complex only a few degrees from the Hyades cluster, with the center equatorial coordinates $\alpha(2000) = 4^{\rm h}46.0^{\rm m}$ and $\delta(2000) = +19°04'$ and Galactic coordinates ℓ=180.4°, b=–16.8°. The diameter of the cluster is about 45′.

The earliest photographic studies of the cluster are listed by Hassan (1972). A wide dispersion of the distance values obtained by different authors is a consequence of low accuracy of the photographic photometry and its calibration, as well as a consequence of interference by numerous foreground and background stars. Naturally, the results based on photoelectric and photographic photometry in the *UBV* system published by Hoag et al. (1961) and Johnson et al. (1961) are more accurate. They estimated the cluster distance at 550 pc, color excess E_{B-V} = 0.39 and turning-point of the main sequence at B–V = –0.09 (spectral class B9). New photoelectric photometry in *UBV* and spectral classification were published by Turner (1992) who obtains a distance of 540 pc and E_{B-V} = 0.30, using the cluster memberships determined by Francic (1989) from proper motions. By the variable extinction method Turner (1976, 1992) has estimated an almost normal value of the total-to-selective extinction R in the cluster direction (between 2.86 and 3.09). Turner also confirmed that the cepheid SZ Tau is a member of NGC 1647. Hackwell et al. (1991) from the IUE observations also find that the extinction law in the cluster direction is typical for general interstellar space.

Geffert et al. (1996), from a new proper motion survey, confirmed the membership probabilities of stars determined by Francic (1989). However, his proper motions do not confirm membership of the cepheid SZ Tau.

More than 30 stars in the cluster area were classified spectroscopically in the MK and similar systems by Zug (1933), Svolopoulos (1962), Hoag & Applequist (1965) and Turner (1984, 1992). These spectra are very useful for the cluster membership determination. However, spectral classification so far was limited on stars brighter than V = 11 mag. For fainter stars the only criteria of the cluster membership were proper motions.

Trying to increase the number of fainter stars with MK classification we have initiated CCD photometry of NGC 1647 in the Vilnius seven-color photometric system. The instrumentation, the methods of observations and classification are the same as in our previous paper on the NGC 2395 area (Zdanavičius et al. 2004).

2. OBSERVATIONS AND REDUCTIONS

The cluster area was observed with the same equipment as described in our previous paper (Zdanavičius et al. 2004). Here we repeat some information. The Maksutov 35/51 cm telescope of the Molėtai Observatory equipped with a VersArray 1300B CCD camera of Princeton Instruments was used. The CCD chip has 1340×1300 pixels of 20×20 μm size. The linear area of the chip is 26.8×26.0 mm, corresponding to a field of view 1.26×1.22 degrees. However, in the present paper we present the results of photometry only for the area with a diameter of 50′ centered on the cluster. The chip is cooled by liquid nitrogen to –110°C. A set of round filters of the *Vilnius* system of 6 cm diameter was used. Other details about the instrumentation are given by Zdanavičius & Zdanavičius (2003).

Observations took place on five nights – 2003 March 24, 26, 27 and 2004 October 13, 14. The exposure time for the U filter was 6–30 min, for P – 6 min, for X – 1–10 min, for the remaining filters – 1 min. In each filter up to ten exposures were obtained. The total number of exposures used is 52.

The magnitudes of stars were obtained by aperture photometry using the standard IRAF program package. Registered CCD counts were corrected for a small nonlinearity (Zdanavičius & Zdanavičius 2003). For flat-fielding we used skyflats in each filter, averaging from more than 20 frames taken in evening and/or morning twilight.

For transformation of magnitudes and color indices to the standard system we used color equations described in Zdanavičius et al. (2004). Zero points of magnitudes and color indices were fixed by using 12 standard stars observed photoelectrically with the 1.5 m telescope of the University of Arizona on Mt. Lemmon. The magnitudes V and six color indices for these stars are listed in Table 1. Star No. 3 has not been used as a standard due to larger deviations from the mean relation among the standard and instrumental magnitudes.

The results of CCD photometry for 433 stars down to 15 mag are given in Table 2. For the faintest and reddest stars (including the stars with large interstellar reddening) the ultraviolet color indices are of low accuracy and are not given. Color indices with standard errors 0.05–0.10 mag are marked by a colon. The identification numbers of stars given in Tables 1 and 2 correspond to the WEBDA database. In the overlapping area they coincide with the numbers in the Cuffey (1937) survey. The faintest stars in the whole area and the stars at the northern edge of the area which are absent in the WEBDA database are numbered starting from 1001. Standard stars are identified in Figure 1. Optical and physical binary stars were excluded from the catalog.

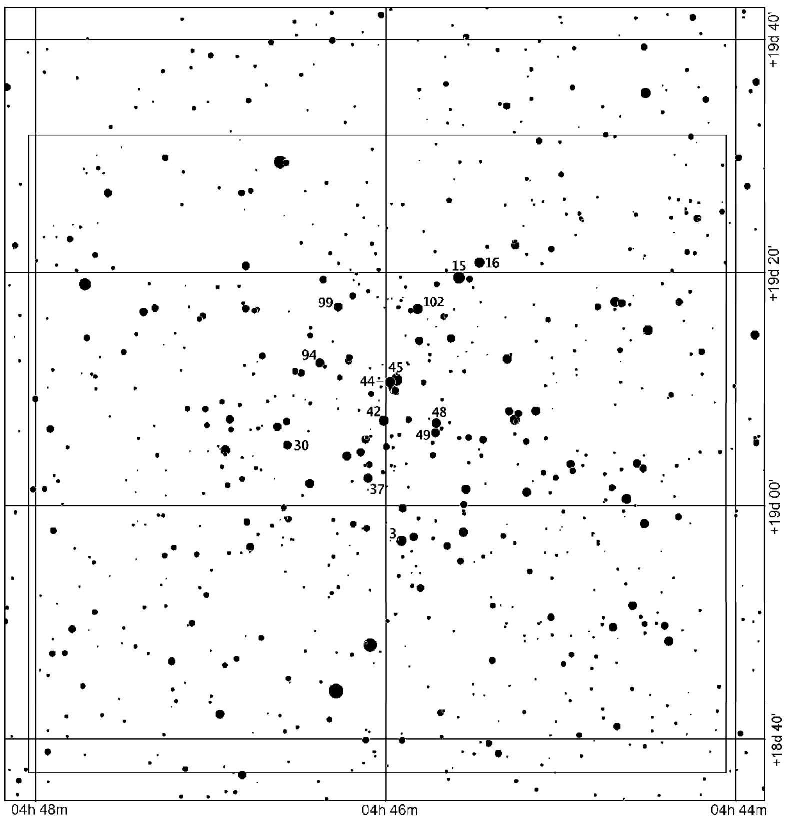

Fig. 1. Identification chart of the NGC 1647 area. Photoelectrically measured stars are marked by their WEBDA numbers.

3. CLASSIFICATION, COLOR EXCESSES AND DISTANCES

The stars were classified using the photometric classification method based on a comparison of 14 reddening-free Q-parameters of the program stars with about 8000 stars with known MK spectral classification. The method is described in more detail in our earlier papers (see, e.g., Laugalys & Straižys 2002; Straižys et al. 2002). The accuracy of the method for normal solar composition stars is ±1 spectral subclass. The accuracy of luminosity classes depends on spectral class: for B, A, F and early G subclasses the accuracy is about ±1 luminosity class, for late G and K–M stars the accuracy is about ±0.5 of a luminosity class.

Table 1. Photoelectric standards in NGC 1647 measured in 2003 with the 1.5 meter telescope on Mt. Lemmon, Arizona. For each star the second row gives the rms errors. n is the number of independent observations.

HD, HDE, BD Webda No.	α (2000)	δ (2000)	V	U–V	P–V	X–V	Y–V	Z–V	V–S	n
286016	04 45 54.3	+18 56 59	9.610	2.035	1.485	0.876	0.416	0.145	0.386	
3			0.019	0.015	0.012	0.016	0.011	0.012	0.013	1
30123	04 45 34.7	+19 19 42	8.585	2.101	1.505	0.966	0.456	0.159	0.535	
15			0.015	0.015	0.012	0.013	0.006	0.006	0.012	2
284842	04 45 27.8	+19 20 56	9.339	3.173	2.683	1.815	0.700	0.297	0.709	
16			0.016	0.015	0.012	0.014	0.006	0.006	0.008	2
286001	04 46 33.5	+19 05 14	10.997	2.669	1.954	1.047	0.449	0.146	0.384	
30			0.016	0.015	0.014	0.012	0.004	0.005	0.008	2
286004	04 46 05.8	+19 02 22	10.150	2.278	1.619	0.851	0.385	0.132	0.346	
37			0.015	0.035	0.016	0.017	0.004	0.006	0.014	2
285995	04 46 00.5	+19 07 19	9.667	2.353	1.686	0.888	0.414	0.145	0.348	
42			0.015	0.017	0.012	0.012	0.011	0.006	0.006	2
285996	04 45 58.1	+19 10 39	9.221	2.035	1.401	0.788	0.391	0.136	0.349	
44			0.015	0.015	0.012	0.016	0.004	0.005	0.014	2
30170	04 45 56.0	+19 10 52	8.870	1.974	1.411	0.825	0.402	0.140	0.377	
45			0.015	0.015	0.012	0.013	0.008	0.007	0.008	2
+18 708	04 45 42.3	+19 07 07	10.419	2.254	1.617	0.897	0.424	0.143	0.374	
48			0.016	0.015	0.013	0.012	0.004	0.006	0.014	2
285994	04 45 42.6	+19 06 19	10.062	2.529	1.808	0.989	0.454	0.162	0.396	
49			0.017	0.016	0.012	0.013	0.008	0.006	0.007	2
284839	04 46 22.4	+19 12 19	9.676	1.936	1.380	0.772	0.375	0.131	0.340	
94			0.017	0.016	0.013	0.012	0.014	0.009	0.015	2
284840	04 46 16.1	+19 17 07	10.086	2.430	1.734	1.019	0.490	0.167	0.442	
99			0.016	0.016	0.012	0.014	0.004	0.005	0.007	2
284841	04 45 48.7	+19 16 56	9.323	2.183	1.534	0.889	0.436	0.150	0.399	
102			0.016	0.016	0.013	0.013	0.004	0.005	0.009	2

Table 2. The results of CCD photometry of the NGC 1647 field. Identification numbers are from the Webda database at CDS. Additional stars are numbered by 1001–1476.

ID	α (2000)	δ (2000)	V	U–V	P–V	X–V	Y–V	Z–V	V–S	Ph. sp.
3.*	4 45 54.3	+18 56 59	9.632	2.006	1.456	0.834	0.378	0.153	0.431	B7.5 IV
4.*	4 45 53.8	+18 59 46	10.896	2.491	1.784	0.922	0.422	0.145	0.359	a2 V
5.*	4 45 32.9	+18 57 41	10.152	2.061	1.516	0.906	0.419	0.183	0.396	a
6.	4 45 32.8	+19 00 04	12.156	4.900	4.241:	2.887	1.147	0.488	1.099	k2 III:
7.	4 45 43.3	+19 04 21	12.425	2.805	2.177	1.478	0.669	0.238	0.645	f4 V
8.	4 45 31.0	+19 05 52	12.468	2.994	2.252	1.349	0.571	0.199	0.527	a
9.	4 45 26.1	+19 05 40	11.579	2.994	2.203	1.310	0.579	0.200	0.528	a7 IV-V
10.*	4 45 11.2	+19 01 11	10.249	2.396	1.769	1.091	0.531	0.187	0.499	b8:
11.	4 45 11.4	+19 05 33	11.948	3.065	2.286	1.379	0.612	0.216	0.566	a7 V
12.	4 45 04.7	+19 05 48	13.600	3.376	2.631	1.921	0.886	0.306	0.884	g5-HB:
13.*	4 45 37.2	+19 14 25	10.831	2.954	2.126	1.250	0.530	0.179	0.472	A3 V
14.	4 45 48.0	+19 14 13	11.384	2.896	2.075	1.177	0.523	0.180	0.482	a7 IV
15.*	4 45 34.7	+19 19 42	8.579	2.095	1.505	0.944	0.462	0.167	0.507	B7.5 III
16.*	4 45 27.8	+19 20 56	9.337	3.175	2.700	1.819	0.709	0.315	0.716	k0 V
17.	4 45 24.8	+19 22 21	13.572	3.244	2.570	1.848	0.867	0.327	0.782	f8 V
18.*	4 46 47.7	+19 20 43	10.849	2.494	2.047	1.422	0.592	0.229	0.594	g1 V
19.	4 47 22.5	+19 16 42	10.958	4.073	3.424	2.429	1.003	0.385	0.980	g8 III
21.	4 47 25.6	+19 10 08	13.801	2.813	2.247	1.549	0.695	0.257	0.686	f8 V
22.*	4 46 54.6	+19 04 48	9.072	1.952	1.386	0.737	0.362	0.122	0.312	b8 V
23.*	4 46 53.0	+19 07 26	10.943	2.389	1.717	0.877	0.388	0.140	0.333	a3 V
24.	4 47 01.6	+19 08 19	11.751	2.712	1.985	1.075	0.460	0.170	0.394	a5 V
25.	4 47 07.6	+19 08 23	12.514	1.578	1.248	0.797	0.388	0.135	0.359	f-sd:
26.	4 46 55.8	+19 08 58	12.646	3.408	2.818	2.020	0.897	0.341	0.872	g5 V
27.	4 46 49.7	+19 08 41	13.287	2.815	2.205	1.529	0.688	0.249	0.665	f7 V
28.	4 46 33.6	+19 07 16	11.376	2.796	2.079	1.174	0.514	0.182	0.464	a7 V
29.*	4 46 36.8	+19 06 49	10.694	2.416	1.696	0.894	0.413	0.143	0.366	a0 V
30.*	4 46 33.5	+19 05 14	10.992	2.676	1.956	1.038	0.445	0.154	0.377	a5 V
31.*	4 46 25.7	+19 01 55	10.336	2.284	1.600	0.833	0.394	0.135	0.345	b9.5 V
32.	4 46 34.6	+18 59 50	12.862	2.682	2.121	1.419	0.646	0.239	0.600	f5 V
33.	4 46 47.2	+18 58 36	11.137	2.851	2.100	1.200	0.543	0.189	0.494	a6 V
34.*	4 46 46.0	+18 56 26	10.599	2.384	1.710	0.893	0.429	0.151	0.360	b9.5 V
35.	4 46 10.6	+18 58 24	11.675	2.728	1.996	1.093	0.486	0.172	0.431	a5 V
36.	4 46 06.1	+18 58 03	12.723	3.258	2.826	1.891	0.755	0.338	0.784	k0 V
37.*	4 46 05.7	+19 02 22	10.142	2.262	1.623	0.849	0.394	0.140	0.339	b9 V
38.	4 46 12.1	+19 12 48	12.441	3.015	2.585	1.775	0.722	0.297	0.748	g9 V
39.*	4 46 13.0	+19 04 19	10.327	3.076	2.552	1.768	0.757	0.284	0.740	g5 IV-V
40.	4 46 08.3	+19 04 37	11.120	2.928	2.520	1.716	0.696	0.292	0.701	g9 V
42.*	4 46 00.5	+19 07 19	9.674	2.360	1.681	0.892	0.409	0.145	0.357	a0 V
43.	4 46 04.7	+19 09 39	13.120	3.065	2.373	1.640	0.753	0.273	0.729	f6 V
44.*	4 45 58.1	+19 10 39	9.224	2.042	1.409	0.799	0.392	0.140	0.352	b8 III
45.*	4 45 56.0	+19 10 52	8.863	1.998	1.433	0.852	0.411	0.156	0.363	B7.5 IV
46.	4 45 56.4	+19 09 57	11.705	2.800	2.091	1.194	0.526	0.188	0.474	A5 V
47.	4 45 51.5	+19 07 25	12.429	2.859	2.216	1.437	0.645	0.230	0.608	f3 V
48.*	4 45 42.3	+19 07 07	10.426	2.269	1.615	0.891	0.420	0.142	0.381	B9.5 V
49.*	4 45 42.6	+19 06 19	10.068	2.537	1.798	0.991	0.456	0.154	0.410	a
50.*	4 45 32.0	+19 01 25	10.036	1.900	1.442	0.898	0.432	0.153	0.428	b6 V
51.*	4 45 15.3	+19 07 23	9.985	2.328	1.674	0.989	0.476	0.158	0.420	a
52.	4 45 17.2	+19 08 06	11.429	3.167	2.471	1.765	0.801	0.287	0.775	f-g
53.*	4 45 14.1	+19 07 57	11.478	2.830	2.049	1.145	0.505	0.165	0.457	a7 IV
54.*	4 45 08.1	+19 08 10	10.095	2.188	1.594	0.951	0.452	0.147	0.413	a
55.*	4 45 17.9	+19 12 41	10.288	2.272	1.669	1.031	0.505	0.172	0.469	b7 V
56.	4 44 46.9	+19 17 06	12.217	3.110	2.269	1.342	0.607	0.222	0.554	a7 V
58.*	4 44 38.8	+19 17 26	10.933	3.129	2.299	1.413	0.637	0.229	0.583	a7 V
59.*	4 44 29.8	+19 15 07	9.727	2.513	1.791	1.123	0.543	0.194	0.507	a
60.*	4 44 19.2	+19 17 34	11.535	2.951	2.094	1.203	0.556	0.209	0.484	a5 IV
61.	4 44 11.4	+19 13 17	12.569	3.402	2.489	1.526	0.684	0.256	0.633	a7 IV
62.	4 44 31.3	+19 03 12	11.268	2.710	1.961	1.180	0.575	0.198	0.522	b9.5 V
63.	4 44 33.4	+19 03 37	10.916	6.025	5.161	3.576	1.416	0.612	1.351	K4 III
64.	4 44 42.0	+19 01 34	12.336	3.388	2.537	1.735	0.777	0.283	0.740	f5 III

Table 2 (continued)

ID	α (2000)	δ (2000)	V	U–V	P–V	X–V	Y–V	Z–V	V–S	Ph. sp.
65.*	4 44 37.1	+19 00 34	9.564	2.274	1.836	1.243	0.538	0.211	0.527	f8 V
66.*	4 44 30.9	+18 58 26	10.271	2.507	1.746	1.023	0.518	0.175	0.509	b8–a
67.	4 44 19.3	+18 59 02	12.571	4.702	3.985	2.790	1.177	0.459	1.105	k0 III
69.*	4 44 22.7	+18 48 21	10.164	2.762	2.059	1.148	0.495	0.191	0.463	a5m:
70.*	4 44 35.0	+18 51 22	10.504	2.243	1.651	0.941	0.455	0.169	0.429	b8 IV
71.*	4 44 41.7	+18 49 31	10.670	2.485	1.783	0.976	0.470	0.168	0.397	b9 V
72.	4 45 03.0	+18 50 23	11.854	2.983	2.327	1.560	0.712	0.253	0.690	f3 V
73.*	4 45 21.0	+18 38 39	11.389	2.769	2.040	1.080	0.458	0.172	0.423	a5 V
74.	4 45 24.2	+18 39 31	12.089	2.883	2.183	1.199	0.503	0.189	0.453	a5m:
75.	4 45 53.9	+18 39 43	11.918	3.213	2.785	1.891	0.819	0.345	0.786	g8 V
76.	4 46 06.3	+18 39 48	12.375	2.763	2.053	1.108	0.474	0.171	0.422	a5 V
78.*	4 47 12.9	+18 46 38	11.334	2.599	1.950	1.058	0.478	0.171	0.406	a4 V
79.*	4 47 53.5	+18 57 49	11.685	2.744	2.027	1.091	0.480	0.178	0.399	a5 V
80.	4 48 00.5	+19 01 26	12.490	2.859	2.178	1.337	0.566	0.224	0.514	f
81.	4 47 54.4	+19 06 37	11.383	2.743	2.127	1.441	0.649	0.239	0.648	f5 V
82.*	4 47 59.6	+19 09 14	11.645	2.668	1.955	1.045	0.470	0.167	0.404	a3 V
83.	4 47 41.9	+19 14 28	12.049	2.837	2.164	1.336	0.570	0.205	0.540	a pec
84.*	4 47 42.7	+19 19 08	8.878	5.737	4.907	3.435	1.247	0.596	1.250	k5 III
85.	4 47 02.4	+19 16 20	11.919	2.881	2.169	1.366	0.593	0.216	0.557	a pec
86.	4 47 03.5	+19 16 04	12.974	2.863	2.195	1.435	0.645	0.240	0.627	f3 V
87.*	4 46 47.7	+19 16 58	11.481	2.604	1.899	1.005	0.436	0.154	0.370	a3 V
88.	4 46 48.5	+19 17 26	13.934	2.894	2.231	1.628	0.728	0.260	0.728	
91.	4 46 41.9	+19 12 56	12.270	4.451	3.816	2.638	1.067	0.436	1.026	k0 III
92.	4 46 30.7	+19 11 37	12.462	3.982	3.362	2.358	0.980	0.359	0.949	g8 III
93.	4 46 28.7	+19 11 26	11.683	2.697	1.971	1.067	0.448	0.163	0.394	a5 V
94.*	4 46 22.4	+19 12 19	9.671	1.920	1.378	0.771	0.364	0.131	0.336	b8 V
95.	4 46 20.4	+19 12 00	13.463	2.875	2.290	1.619	0.746	0.282	0.658	f8 V
96.	4 46 15.4	+19 11 04	12.649	3.089	2.336	1.448	0.625	0.231	0.591	a pec
97.	4 46 12.5	+19 12 32	11.770	2.939	2.133	1.212	0.534	0.193	0.466	a6 IV
99.*	4 46 16.1	+19 17 07	10.090	2.419	1.723	1.020	0.501	0.171	0.456	b8 IV:
100.	4 46 21.2	+19 19 31	11.593	2.435	1.680	0.938	0.431	0.161	0.405	b9 IV:
101.	4 46 11.0	+19 18 05	12.340	2.959	2.170	1.289	0.537	0.198	0.499	A7m:
102.*	4 45 48.7	+19 16 56	9.330	2.168	1.512	0.884	0.427	0.150	0.405	B8 III
103.	4 45 51.1	+19 16 48	12.607	2.972	2.297	1.596	0.721	0.277	0.664	f-g
104.	4 45 55.2	+19 17 05	13.495	3.095	2.372	1.654	0.765	0.274	0.731	f5 IV
105.*	4 46 35.8	+19 29 39	8.500	5.060	4.281	3.047	1.219	0.467	1.173	k0 III
106.	4 46 49.0	+19 27 01	12.182	3.101	2.408	1.712	0.757	0.280	0.763	g0 V
107.	4 46 46.0	+19 27 11	13.084	4.648	3.939:	2.776	1.132	0.442	1.097	k1 III
108.	4 46 56.9	+19 27 25	14.248	3.649	3.066:	2.173	0.892	0.360	0.931	k0 V
110.	4 47 39.2	+19 21 38	12.409	3.443	2.876	2.040	0.858	0.333	0.864	g8 IV-V
111.	4 47 33.0	+19 20 31	13.582	2.923	2.286	1.648	0.732	0.268	0.727	g0 V
113.	4 46 09.3	+18 55 51	13.813	3.097	2.552	1.814	0.823	0.294	0.811	g0 V
115.*	4 47 18.7	+19 17 02	11.158	2.476	1.777	0.929	0.405	0.152	0.359	a5 V
116.	4 46 11.1	+19 02 07	13.976	3.130	2.625	1.805	0.804	0.304	0.806	g3 V
119.	4 47 29.5	+19 13 14	12.581	3.218	2.689	1.893	0.820	0.320	0.817	g5 V
123.	4 47 45.2	+19 14 02	15.058	3.686		2.012	0.872	0.342	0.864	g7 V:
124.	4 46 16.3	+18 57 35	13.985	2.851	2.307	1.620	0.741	0.292	0.712	f8 V
126.	4 47 52.4	+19 11 45	14.484	2.504	1.826	1.049	0.499	0.176	0.421	b9 V:
127.	4 47 40.4	+19 11 21	13.909	2.857	2.238	1.480	0.667	0.263	0.648	f4 V
128.	4 47 39.1	+19 11 08	13.296	3.124	2.356	1.507	0.655	0.259	0.621	b9 IV:
129.	4 47 39.0	+19 10 05	13.959	2.947	2.352	1.681	0.758	0.280	0.746	f9 V
130.	4 47 34.2	+19 07 42	14.659	2.780	2.144	1.470	0.672	0.266	0.645	f-g
131.	4 47 18.8	+19 06 53	14.460	3.016	2.404:	1.781	0.805	0.291	0.783	g
132.	4 47 16.9	+19 06 21	15.112	2.877	2.282	1.606	0.714	0.253	0.723	f9 V
134.	4 47 48.6	+19 05 03	13.016	3.208	2.670	1.860	0.794	0.315	0.771	g5 IV
135.	4 47 53.2	+19 02 36	13.740	3.062	2.424	1.739	0.761	0.278	0.759	g
136.	4 47 51.8	+19 02 09	13.215	2.805	2.040	1.104	0.479	0.183	0.412	a3 V
139.	4 47 46.2	+18 56 19	14.376	2.839	2.148	1.470	0.663	0.244	0.641	f5 V
140.	4 46 29.9	+18 40 54	13.739	3.249	2.618	1.825	0.831	0.297	0.810	g0 V
141.	4 47 39.7	+18 55 07	13.597	3.395	2.826	1.978	0.854	0.330	0.837	g5 IV
143.	4 47 39.4	+18 50 47	12.688	2.964	2.545	1.767	0.779	0.296	0.757	g

Table 2 (continued)

ID	α (2000)	δ (2000)	V	U–V	P–V	X–V	Y–V	Z–V	V–S	Ph. sp.
146.	4 47 25.4	+18 47 51	13.170	3.277	2.836	1.943	0.813	0.341	0.811	k0 V
147.	4 47 21.1	+18 47 17	13.634	2.744	2.219	1.538	0.710	0.236	0.694	f8 V
148.	4 47 18.6	+18 49 43	14.467	2.995	2.436	1.797	0.816	0.304	0.771	g2 V
150.	4 46 34.1	+18 40 32	13.149	3.092	2.593	1.834	0.814	0.324	0.801	g2 V
152.	4 47 25.1	+18 55 22	15.127	2.856	2.080	1.632	0.734	0.290	0.699	g
153.	4 47 15.4	+18 55 44	12.386	2.793	2.222	1.587	0.738	0.269	0.729	f7 V
154.	4 47 12.3	+18 56 24	12.752	3.203	2.480	1.634	0.725	0.259	0.626	am:
155.	4 47 26.2	+18 58 21	14.147	3.228	2.647	1.895	0.866	0.324	0.788	g1 V
156.	4 47 22.1	+18 58 22	14.926	3.105	2.557	1.721	0.797	0.291	0.753	f8 V
157.	4 46 43.4	+18 57 30	14.060	3.039	2.484	1.773	0.831	0.333	0.753	g0 V
158.	4 46 44.0	+19 03 14	13.705	2.971	2.373	1.689	0.760	0.274	0.715	f8 V
159.	4 47 09.2	+18 59 13	15.058	3.147	2.475:	1.732	0.824	0.260	0.802	f5 V:
160.	4 47 03.3	+18 58 16	14.861	4.026		2.360	1.046	0.409	0.969	g
161.	4 47 04.5	+18 55 47	12.948	4.378	3.695	2.580	1.072	0.413	1.006	k0 III
162.	4 47 03.4	+18 52 58	14.269	3.152	2.622	1.847	0.824	0.301	0.798	g3 V
163.	4 47 01.0	+18 52 21	12.998	2.771	2.150	1.457	0.676	0.235	0.637	f5 V
164.	4 47 06.0	+18 49 52	12.065	2.885	2.186	1.316	0.635	0.228	0.573	a-f
167.	4 46 54.8	+18 46 15	12.897	2.965	2.258	1.301	0.542	0.197	0.499	am:
168.	4 46 50.8	+18 46 51	12.869	2.943	2.273	1.487	0.684	0.242	0.631	f1 V
169.	4 46 42.3	+18 48 37	12.472	3.028	2.444	1.723	0.773	0.269	0.770	g0 V
170.	4 46 59.4	+18 54 28	14.145	2.951	2.501	1.707	0.787	0.279	0.733	g
171.	4 46 53.4	+18 55 54	13.099	2.934	2.288	1.549	0.705	0.255	0.700	f5 V
174.	4 46 38.5	+18 58 15	13.682	3.776	3.306	2.216	0.878	0.407	0.924	k2 V
178.	4 46 53.8	+19 01 46	12.769	2.892	2.271	1.556	0.711	0.251	0.672	f5 V
179.	4 46 48.9	+19 02 19	12.792	3.133	2.314	1.421	0.620	0.231	0.585	Am:
180.	4 46 55.8	+19 03 22	13.440	3.638	3.250	2.164	0.835	0.487	0.900	k3 V
181.*	4 46 56.5	+18 42 03	9.822	1.864	1.382	0.746	0.356	0.128	0.331	b7 V
183.	4 47 00.9	+19 06 57	12.888	2.752	2.174	1.515	0.701	0.248	0.695	f7 V
188.	4 46 43.4	+19 06 42	13.812	3.311	2.637	1.919	0.869	0.311	0.872	g0 V
189.	4 46 42.1	+19 06 54	14.662	3.294	2.762:	1.952	0.841	0.329	0.843	g7 V:
190.	4 46 40.1	+19 09 00	14.213	2.977	2.364:	1.722	0.757	0.257	0.792	g
191.	4 47 11.4	+18 43 10	13.023	2.772	2.260	1.582	0.719	0.259	0.709	f8 V
192.	4 46 44.9	+19 11 23	14.076	2.880	2.129	1.388	0.606	0.218	0.608	f
194.	4 47 12.8	+18 44 12	13.216	2.726	2.188	1.497	0.693	0.263	0.630	f5 V
195.	4 47 15.2	+19 30 02	12.049	2.962	2.159	1.254	0.532	0.195	0.490	A5m:
196.	4 46 47.7	+19 16 05	14.852	2.908	2.183	1.461	0.655	0.270	0.691	f
197.	4 46 57.3	+19 18 52	13.290	2.980	2.386	1.685	0.755	0.292	0.737	f8 IV
199.	4 46 25.3	+19 15 20	14.044	3.051	2.368	1.750	0.795	0.280	0.793	g-MDG:
200.	4 46 25.6	+19 14 41	12.672	3.034	2.278	1.410	0.609	0.220	0.564	am:
201.	4 46 31.3	+19 09 30	14.610	3.043	2.568	1.779	0.784	0.305	0.803	g3 V
202.	4 46 25.5	+19 08 51	13.218	2.933	2.259	1.579	0.705	0.254	0.668	g-MDG:
203.	4 46 20.0	+19 04 45	15.046			2.057	0.878	0.323	0.897	g
205.	4 46 00.6	+19 02 54	13.350	2.862	2.220	1.576	0.732	0.291	0.640	f7 V
207.	4 45 56.3	+19 03 24	14.748	3.083:	2.403:	1.797	0.835	0.321	0.813	f-g
210.	4 45 59.3	+19 05 04	12.416	2.847	2.142	1.310	0.558	0.200	0.511	a pec
211.	4 45 54.9	+19 06 06	13.337	2.840	2.203	1.529	0.702	0.260	0.667	f5 V
212.	4 45 57.5	+19 06 00	13.289	2.772	2.194	1.493	0.684	0.237	0.664	f5 V
214.	4 45 43.5	+19 05 24	13.665	2.943	2.366	1.724	0.798	0.311	0.780	g0 V, MD:
215.	4 45 34.4	+19 05 49	13.923	3.024	2.414	1.712	0.769	0.281	0.763	g0 V
217.	4 45 26.6	+19 04 20	13.498	3.384	2.547	1.680	0.770	0.269	0.738	f3 V
219.	4 45 25.5	+19 01 56	15.069			1.993	0.936	0.317	0.904	f-g
221.	4 45 32.6	+18 59 18	13.863	3.125	2.534	1.806	0.824	0.303	0.787	g0 V
222.	4 45 42.3	+18 58 40	14.062	3.066	2.391	1.702	0.772	0.254	0.770	f-g
223.	4 45 48.4	+18 58 52	13.653	2.918	2.357	1.652	0.752	0.284	0.719	f8 V
224.*	4 45 49.9	+18 57 17	11.193	2.614	1.892	0.992	0.451	0.157	0.382	a5 IV
225.	4 45 43.2	+18 57 10	13.808	3.743	3.082	2.162	0.922	0.383	0.891	g8 IV
226.	4 45 38.4	+18 56 31	11.913	5.201	4.453	3.078	1.279	0.485	1.204	k1.5 III
227.	4 45 33.9	+18 55 14	12.466	4.766	4.041	2.848	1.218	0.448	1.161	k0 III
228.	4 45 53.8	+18 55 34	14.741	3.853	2.944	2.274	1.004	0.354	1.029	g
229.	4 45 49.2	+18 54 49	14.879	3.608:	2.792:	2.080	0.906	0.351	0.917	g
231.	4 45 55.1	+18 53 58	14.003	3.185	2.696	1.925	0.864	0.320	0.844	g8 IV

Table 2 (continued)

ID	α (2000)	δ (2000)	V	U–V	P–V	X–V	Y–V	Z–V	V–S	Ph. sp.
232.	4 45 50.3	+18 53 07	13.471	3.070	2.419	1.673	0.789	0.286	0.721	f5 V
233.	4 45 47.5	+18 52 53	11.705	3.934	3.501	2.354	0.809	0.538	0.935	k5 V
234.	4 45 44.8	+18 50 19	13.782	3.184	2.583	1.812	0.840	0.292	0.805	g0 V
235.	4 45 58.9	+18 50 03	13.316	4.372	3.735	2.591	1.086	0.418	1.029	k0 III
237.	4 46 16.0	+18 53 01	13.247	2.776	2.197	1.480	0.674	0.235	0.650	f5 V
238.	4 46 18.1	+18 52 29	13.274	4.229	3.583	2.500	1.039	0.405	0.957	k0 III
239.	4 46 19.1	+18 52 08	14.706	4.026		2.416	1.019	0.392	0.958	g8 III
241.	4 46 34.1	+18 54 20	14.908			2.234	0.977	0.396	0.879	k0 V
242.	4 46 19.2	+18 54 54	14.065	2.912	2.350	1.681	0.743	0.259	0.732	g0 V
243.	4 46 17.5	+18 55 36	13.176	3.018	2.511	1.793	0.795	0.320	0.777	g3 V
244.	4 46 21.3	+18 55 47	15.204	3.187:		1.965	0.809	0.307	0.878	g5
250.	4 46 17.8	+18 58 46	13.561	2.834	2.172	1.477	0.675	0.236	0.644	f5 V
255.	4 46 48.8	+19 04 09	13.967	2.953	2.353	1.666	0.761	0.280	0.746	f8 V
259.	4 46 23.8	+18 49 11	14.600	3.121	2.632	1.852	0.816	0.292	0.807	g5 V
260.	4 46 27.2	+18 47 29	14.305	3.895:	3.071	2.133	0.973	0.354	0.926	f-g
261.	4 46 33.0	+18 45 08	12.869	3.713	3.171	2.223	0.980	0.364	0.965	g8 IV:
262.	4 46 35.9	+18 41 56	13.883	4.530:	3.810:	2.636	1.066	0.428	1.023	k1 III
269.	4 45 23.0	+18 46 40	12.251	4.933	4.185	2.917	1.216	0.469	1.153	k1 III
270.	4 45 22.9	+18 51 22	12.589	3.486	2.857	1.988	0.907	0.330	0.856	g2 V
271.	4 45 10.2	+18 54 21	13.416	3.302	2.563	1.789	0.849	0.297	0.805	f5 V
273.	4 45 19.2	+18 57 21	13.135	3.315	2.519	1.636	0.754	0.269	0.727	f5 V
274.	4 45 15.4	+18 56 47	14.544	3.460	2.824:	2.022	0.904	0.341	0.897	g3 V
275.	4 45 01.0	+18 55 44	14.721	3.422	2.499	2.014	0.921	0.320	0.885	
277.	4 45 02.6	+18 53 46	14.356	4.049:	3.298:	2.345	1.045	0.400	1.037	g5
280.	4 45 12.0	+18 48 49	14.964	3.100	2.552:	1.804	0.844	0.331	0.810	g0 V:
281.	4 44 58.7	+18 46 24	13.005	3.915	3.238	2.301	1.010	0.397	0.992	g8 IV
283.	4 44 56.2	+18 48 48	14.742	3.097		1.685	0.808	0.284	0.741	f-g
284.	4 44 47.4	+18 46 59	14.025	3.418	2.929	2.025	0.896	0.346	0.866	g5 V
285.	4 44 48.9	+18 45 59	14.002	3.181	2.416	1.537	0.688	0.269	0.624	a5m:
286.	4 44 49.2	+18 44 14	14.522	4.147:		2.469	1.051	0.380	1.065	g7 III-IV
287.	4 44 45.1	+18 42 28	14.371	3.069	2.523:	1.774	0.827	0.291	0.830	f8 V
289.	4 44 53.3	+18 40 13	12.809	3.025	2.397	1.638	0.758	0.273	0.718	f5 V
291.	4 45 08.1	+18 45 04	15.132	3.227:	2.481:	1.762	0.864	0.290	0.837	f-g
292.	4 45 17.2	+18 44 33	14.990	3.555	2.723:	2.055	0.976	0.366	0.906	g
293.	4 45 40.8	+18 42 10	12.411	5.192	4.423	3.019	1.236	0.514	1.166	k2 III
295.	4 45 38.8	+18 37 07	14.146	3.264	2.561	1.815	0.845	0.282	0.814	f
296.	4 45 29.2	+18 38 37	14.429	3.035	2.440	1.630	0.756	0.268	0.755	f
299.	4 44 30.9	+18 49 48	13.039	2.991	2.294	1.513	0.688	0.260	0.664	f2 V
300.	4 44 32.2	+18 50 25	13.929	3.126	2.526	1.834	0.876	0.303	0.827	f8 V
301.	4 44 26.7	+18 49 53	14.357	3.191	2.578	1.837	0.844	0.318	0.777	g0 V
302.	4 44 37.3	+18 53 17	14.300	3.157	2.487	1.810	0.836	0.307	0.819	f9 V
303.	4 44 40.0	+18 54 33	14.656	4.407:		2.587	1.134	0.410	1.091	g
305.	4 44 46.7	+18 56 41	14.076	3.176	2.565	1.786	0.826	0.297	0.784	f9 V
306.	4 44 46.8	+18 56 56	14.664	3.108	2.499	1.690	0.801	0.306	0.723	f5 V
309.	4 44 51.6	+18 58 54	15.033	3.296:	2.659:	1.917	0.888	0.315	0.806	g0 V:
310.	4 44 58.7	+18 59 27	13.678	2.999	2.444	1.688	0.777	0.269	0.747	f8 V
311.	4 45 03.1	+19 01 06	14.230	4.628		2.817	1.074	0.614	1.203	m2 V
313.	4 45 05.5	+19 02 50	13.101	3.305	2.614	1.894	0.873	0.301	0.872	f8 V
314.	4 45 01.3	+19 02 26	12.894	3.264	2.459	1.548	0.694	0.225	0.657	a7 V
315.	4 44 55.5	+19 03 01	12.489	3.081	2.300	1.379	0.604	0.214	0.534	am:
316.*	4 44 56.2	+19 03 34	11.046	2.730	1.975	1.151	0.542	0.177	0.483	f0
318.	4 44 50.9	+19 04 22	14.575	3.525	3.089:	2.134	0.931	0.318	0.973	g
320.	4 44 41.4	+19 04 34	14.985	3.411:	2.682:	1.957	0.914	0.300	0.947	f8 V:
321.	4 44 44.6	+19 02 45	13.733	3.277	2.697	1.919	0.888	0.314	0.844	g1 V
322.	4 44 38.8	+19 03 10	13.578	3.191	2.490	1.714	0.788	0.267	0.766	f
323.	4 44 31.1	+19 04 19	14.868	3.622:	2.855:	2.074	0.969	0.364	0.910	f8 V:
324.	4 44 19.8	+19 03 27	13.724	3.045	2.400	1.700	0.791	0.293	0.760	f6 V
328.	4 44 01.0	+19 04 56	15.098	3.137	2.421	1.667	0.776	0.280	0.771	f5 V
330.	4 44 21.9	+19 09 35	13.186	4.477	3.766:	2.748	0.951	0.631	1.095	k7 V
331.	4 44 11.4	+19 11 22	13.977	3.537	2.794	2.046	0.948	0.344	0.936	g
332.	4 44 15.0	+19 13 05	14.370	3.084:	2.353	1.664	0.791	0.287	0.750	f5

Table 2 (continued)

ID	α (2000)	δ (2000)	V	U–V	P–V	X–V	Y–V	Z–V	V–S	Ph. sp.
333.	4 44 39.4	+19 13 24	12.848	3.254	2.396	1.522	0.678	0.247	0.629	a-f
334.	4 44 39.1	+19 10 40	14.295	3.248	2.578:	1.892	0.845	0.302	0.830	g0 V
337.	4 45 04.9	+19 10 23	14.475	3.250	2.699:	1.920	0.891	0.314	0.863	g0 V
338.	4 44 54.9	+19 13 21	14.617	3.375:	2.559:	1.832	0.851	0.287	0.829	f-g
339.	4 44 54.3	+19 15 29	14.352	4.287:		2.565	1.036	0.502	1.079	k3 V
340.	4 45 08.0	+19 14 10	14.470	3.236	2.668:	1.872	0.832	0.275	0.840	g2 V:
341.	4 45 04.1	+19 15 59	13.158	4.441	3.599	2.601	1.124	0.409	1.099	g
343.	4 45 06.2	+19 20 54	14.521	3.130	2.464	1.895	0.872	0.341	0.853	g0 V:
344.	4 45 02.9	+19 22 08	12.284	3.027	2.228	1.312	0.556	0.204	0.510	a5m:
345.	4 45 11.2	+19 21 40	14.314	3.104	2.386:	1.599	0.715	0.265	0.720	g0 V
346.	4 45 30.8	+19 19 32	12.486	3.124	2.342	1.397	0.642	0.249	0.522	a7 V
347.	4 45 29.7	+19 18 49	14.513	3.286	2.619:	1.890	0.902	0.313	0.848	f6 V
348.	4 45 27.2	+19 17 34	15.015	3.536:	2.740:	2.113	0.969	0.336	0.952	g
349.	4 45 36.2	+19 16 55	15.093	3.315:	2.374:	1.650	0.746	0.285	0.740	f-g
353.	4 45 44.5	+19 13 02	14.515	2.934	2.348	1.705	0.772	0.269	0.757	f8 V
354.	4 45 44.6	+19 12 31	14.557	2.715	2.218:	1.543	0.693	0.218	0.714	f
355.	4 45 37.4	+19 11 36	14.680	3.192	2.587	1.885	0.834	0.311	0.825	g2 V
356.	4 45 46.6	+19 10 39	12.936	5.456	4.669:	3.310	1.292	0.545	1.235	k-m III
358.	4 45 37.7	+19 07 10	14.352	3.335	2.667:	1.927	0.956	0.435	0.667	f-g
359.	4 45 40.4	+19 06 38	14.006	3.174	2.659	1.974	0.890	0.359	0.788	g8 III
363.	4 46 05.8	+19 18 29	13.668	3.069	2.385	1.693	0.763	0.272	0.764	f8 V
366.	4 46 09.9	+19 20 00	14.342	3.599	2.834	2.117	0.898	0.344	0.917	g
367.	4 46 11.7	+19 20 23	15.066	3.531:	2.697:	2.037	0.945	0.315	0.912	g
368.	4 46 15.8	+19 20 55	14.516	4.094		2.477	1.025	0.419	0.994	k0 III
369.	4 46 18.8	+19 21 47	13.681	3.120	2.442	1.722	0.796	0.283	0.749	f6 V
373.	4 46 27.3	+19 27 08	14.982	3.439:	2.599:	2.024	0.980	0.333	0.889	g
374.	4 46 20.0	+19 27 52	13.738			4.053	1.601	0.687	1.550	k5-m2 III
375.	4 46 13.3	+19 23 24	13.942	3.302	2.602	1.846	0.845	0.296	0.821	g1 V
376.	4 46 04.4	+19 22 35	13.986	3.377	2.595:	1.910	0.892	0.316	0.798	f-g
378.	4 46 02.3	+19 20 22	14.098	3.314	2.716	1.964	0.865	0.306	0.897	g3 V
379.	4 45 54.5	+19 19 44	15.140	3.490:		2.118	0.921	0.346	0.954	g
382.	4 45 38.8	+19 20 19	14.843	3.154	2.553:	1.989	0.920	0.430	0.727	
384.	4 45 59.2	+19 23 55	14.748	3.567	2.879	2.162	0.953	0.352	0.942	g
385.	4 45 54.0	+19 25 57	13.765	3.042	2.328	1.647	0.719	0.240	0.734	g
386.	4 45 57.5	+19 26 03	14.738	4.228:		2.600	1.142	0.421	1.059	g
387.	4 46 06.2	+19 27 53	15.139	3.465:	2.508:	2.027	0.875	0.289	0.909	m5 III:
388.	4 46 04.4	+19 30 44	14.471	3.252	2.647:	1.875	0.823	0.325	0.863	g2 V:
390.	4 45 34.3	+19 29 38	14.565	3.169	2.322:	1.598	0.740	0.268	0.675	f
391.	4 45 27.1	+19 29 43	14.355	4.045	3.133:	2.428	1.059	0.415	1.043	g
392.	4 45 11.4	+19 28 12	14.203	4.558:		2.699	1.113	0.426	1.082	k0 III
394.	4 45 18.7	+19 25 54	13.911	3.287	2.574	1.829	0.835	0.294	0.803	f8 IV
395.	4 45 08.8	+19 25 55	15.048	3.086	2.472:	1.785	0.831	0.311	0.794	f8 V
396.	4 45 05.8	+19 26 14	15.121	3.147:	2.354:	1.816	0.787	0.339	0.838	g:
397.	4 44 58.6	+19 26 28	14.511	3.221:	2.502	1.726	0.786	0.304	0.778	f
398.	4 44 57.7	+19 25 08	14.511	3.416:	2.751:	2.057	0.915	0.360	0.880	g
399.	4 44 53.3	+19 25 10	13.661	3.649	2.915	2.101	0.987	0.362	0.963	g0 V
403.	4 44 21.5	+19 20 15	13.875	3.656	2.944	2.186	0.975	0.354	0.965	g
404.	4 44 25.0	+19 19 11	14.228			3.009	1.269	0.510	1.226	k1 III
405.	4 44 15.4	+19 18 26	13.593	3.128	2.413	1.729	0.805	0.310	0.778	f7 IV
406.	4 44 36.1	+19 17 17	14.499	3.307:	2.651:	1.958	0.924	0.325	0.831	f9 V:
407.	4 44 41.3	+19 16 54	14.484	3.091:	2.451:	1.681	0.761	0.266	0.711	f5 V:
408.	4 44 11.9	+19 04 36	14.629	3.581:	2.656:	2.037	0.951	0.366	0.931	g
409.	4 44 22.8	+19 09 20	14.831	3.646:	2.713:	2.075	0.938	0.370	0.916	g
411.	4 44 59.5	+19 28 35	13.122	4.005	3.092	2.311	1.040	0.378	1.021	g
412.	4 45 07.2	+19 31 28	12.085	2.895	2.123	1.256	0.532	0.196	0.501	a7 V
414.	4 45 18.2	+19 34 30	11.663	2.890	2.068	1.199	0.511	0.197	0.483	a8 V
423.	4 47 17.9	+19 04 22	13.254	3.228	2.612	1.868	0.835	0.309	0.805	g2 V
424.*	4 47 34.8	+19 26 57	10.730	5.268	4.497	3.143	1.188	0.523	1.172	k3 III
425.	4 47 47.9	+19 23 00	11.726	2.802	2.026	1.142	0.466	0.182	0.446	A5m:
443.	4 45 45.0	+19 13 53	15.058	3.351:		2.062	0.966	0.368	0.803	g
451.	4 44 34.1	+18 59 56	14.811	3.325	2.783:	1.920	0.868	0.322	0.834	g3 V

Table 2 (continued)

ID	α (2000)	δ (2000)	V	U–V	P–V	X–V	Y–V	Z–V	V–S	Ph. sp.
453.	4 44 33.9	+19 25 03	13.933	3.368	2.651	1.938	0.887	0.320	0.869	g
454.	4 44 45.4	+18 49 43	14.048	2.974	2.400	1.666	0.784	0.307	0.755	f8 V
458.	4 46 47.6	+18 48 47	15.193	3.229:		1.896	0.793	0.285	0.848	g
460.	4 47 43.3	+18 44 30	12.463	2.818	2.222	1.537	0.685	0.255	0.669	f8 V
462.	4 47 47.2	+18 49 21	11.664	4.475	3.820	2.631	1.057	0.418	0.994	k0 III
463.	4 47 49.6	+18 47 20	12.557	2.773	2.148	1.323	0.588	0.216	0.557	a8 V
1001.	4 46 11.3	+18 37 13	14.582	3.379	2.536	1.603	0.757	0.258	0.786	a7 V
1003.	4 45 58.8	+18 37 35	14.852	3.182:	2.484:	1.752	0.814	0.296	0.813	f5 V:
1004.	4 46 32.9	+18 37 55	14.724	3.912:		2.365	0.956	0.457	0.934	k2 V
1005.	4 45 18.0	+18 38 24	14.925	3.835:		2.254	1.017	0.457	0.881	g
1007.	4 46 03.4	+18 38 49	14.596	4.245:		2.470	1.050	0.406	1.011	k0 IV
1009.	4 45 33.1	+18 38 47	15.352	2.955:	2.299:	1.638	0.774	0.323	0.762	f6 V:
1013.	4 45 40.5	+18 40 05	13.843	3.301	2.680	1.910	0.890	0.320	0.818	g0 V
1015.	4 45 03.1	+18 40 14	15.116	3.555:		1.962	0.951	0.328	0.938	f5
1016.	4 46 06.4	+18 40 39	15.283	3.407:		1.980	0.845	0.330	0.880	g5
1022.	4 45 12.1	+18 42 11	13.714	3.117	2.577	1.852	0.842	0.335	0.839	g2 V
1024.	4 46 59.7	+18 43 05	14.127	4.114:	3.533:	2.409	1.029	0.407	0.936	k0 IV:
1027.	4 46 59.5	+18 43 36	14.410	3.979	3.408:	2.370	0.999	0.379	0.968	k0 IV
1028.	4 44 56.5	+18 43 13	14.779	4.321:		2.595	1.160	0.422	1.076	g
1030.	4 45 29.5	+18 43 47	15.244	3.138:		1.821	0.832	0.307	0.823	g
1032.	4 44 57.9	+18 43 50	15.186	3.163:	2.473:	1.817	0.859	0.327	0.809	f5 V:
1033.	4 47 08.5	+18 44 46	14.562	3.910:	3.146:	2.279	0.936	0.413	0.891	k0 IV
1035.	4 46 21.8	+18 44 51	14.120	4.058	3.404	2.400	1.008	0.457	0.895	k0 IV
1044.	4 47 25.9	+18 47 08	15.184	3.385		1.867	0.841	0.297	0.802	g
1048.	4 46 11.4	+18 47 08	13.775	3.493	2.973	2.062	0.920	0.365	0.839	g7 V:
1049.	4 46 59.6	+18 47 30	14.980	3.415	2.753	2.055	0.897	0.412	0.847	g-k
1050.	4 46 16.5	+18 47 22	14.930	4.325:		2.673	1.181	0.439	1.035	g
1053.	4 46 01.5	+18 47 26	14.970	3.366:	2.594:	1.920	0.944	0.425	0.655	f-g
1056.	4 47 30.2	+18 48 09	14.722	2.971	2.426:	1.739	0.784	0.297	0.809	g
1061.	4 47 29.4	+18 49 29	14.137	3.624	3.143:	2.145	0.906	0.416	0.850	k0 V
1067.	4 45 36.4	+18 49 12	15.058	3.545:	2.604:	2.016	0.936	0.355	0.881	g
1068.	4 47 07.5	+18 49 42	14.484	3.041	2.375	1.649	0.777	0.290	0.724	f5 V
1069.	4 44 30.7	+18 49 00	14.102	4.134	3.354:	2.409	1.053	0.388	1.002	g
1075.	4 44 24.0	+18 49 38	11.478	2.748	2.051	1.133	0.493	0.198	0.443	a5 V
1081.	4 47 22.4	+18 51 15	13.656	4.637:	3.865:	2.717	1.088	0.445	1.000	k1 III
1083.	4 47 15.0	+18 51 19	13.728	3.483	2.873	2.023	0.883	0.333	0.834	g2 V
1090.	4 47 44.7	+18 53 05	14.997	3.049	2.788:	1.873	0.819	0.316	0.779	g
1092.	4 46 05.0	+18 52 44	15.281	3.596:		2.141	0.856	0.382	0.895	k1 V
1093.	4 47 16.6	+18 53 10	14.814	3.223	2.454:	1.847	0.843	0.317	0.778	g
1096.	4 44 25.0	+18 52 33	15.066	3.370:	2.626:	1.946	0.865	0.316	0.914	g
1097.	4 44 48.1	+18 52 47	14.971	3.330	2.686:	1.953	0.859	0.324	0.929	g3 V:
1104.	4 45 47.9	+18 54 12	14.924	3.671:		2.183	1.015	0.399	0.916	g3 V:
1105.	4 44 20.9	+18 53 48	15.267	3.211:	2.337:	1.736	0.837	0.310	0.783	f-g
1112.	4 47 41.2	+18 55 34	14.543	2.869	2.276	1.531	0.728	0.252	0.647	f4 V
1113.	4 44 32.8	+18 54 36	14.922	3.872:		2.249	1.008	0.379	0.965	g
1120.	4 46 49.1	+18 55 55	15.149	3.043	2.228:	1.712	0.810	0.259	0.783	g
1122.	4 45 26.1	+18 55 37	13.810	5.057		3.025	1.291	0.479	1.181	k0 III
1129.	4 45 05.0	+18 55 58	14.880	4.069:		2.454	1.094	0.447	1.082	g8
1151.	4 45 04.6	+18 57 58	15.113	3.413		2.015	0.901	0.334	0.923	g3 V:
1154.	4 46 35.8	+18 58 46	15.140	2.828:	2.297:	1.570	0.779	0.282	0.610	f3 V:
1157.	4 47 15.9	+18 59 07	13.797	3.289	2.721	1.951	0.868	0.328	0.844	g3 V
1159.	4 47 17.4	+18 59 10	14.454	3.520	2.864:	2.033	0.870	0.345	0.890	g5 IV:
1167.	4 47 50.3	+19 00 08	15.020	3.136	2.436:	1.785	0.837	0.289	0.771	f-g
1171.	4 44 38.1	+18 59 29	14.257	3.395	2.773	1.969	0.910	0.320	0.909	g1 V
1176.	4 44 44.8	+19 00 18	14.742	3.241:	2.573:	1.814	0.840	0.281	0.823	a-f
1179.	4 47 56.6	+19 01 26	13.052	4.727	3.899:	2.844	1.145	0.579	1.306	
1181.	4 44 44.2	+19 00 32	14.553	3.665:	2.890:	2.139	0.995	0.380	0.946	g2 V:
1188.	4 45 51.7	+19 01 35	15.010	3.045	2.286	1.624	0.760	0.291	0.721	f
1190.	4 47 28.6	+19 02 13	14.849	3.465	2.656	2.038	0.899	0.358	0.849	g3 V:
1193.	4 47 21.3	+19 02 26	14.868	3.041	2.380:	1.743	0.822	0.264	0.755	g
1197.	4 46 37.9	+19 02 18	15.180	2.869	2.381:	1.647	0.771	0.304	0.766	f8 V:

Table 2 (continued)

ID	α (2000)	δ (2000)	V	U–V	P–V	X–V	Y–V	Z–V	V–S	Ph. sp.
1199.	4 45 09.1	+19 02 07	14.988	3.431	2.664:	2.021	0.924	0.310	0.956	g
1200.	4 44 25.0	+19 02 06	14.905			2.665	1.129	0.551	1.158	k2.5 V
1201.	4 47 24.7	+19 03 05	15.240	3.255		1.851	0.871	0.382	0.792	g
1204.	4 46 42.4	+19 03 06	14.498	3.511	3.002:	2.067	0.886	0.345	0.889	g8 V:
1211.	4 45 57.6	+19 03 27	14.319	3.322:	2.757:	1.974	0.853	0.322	0.861	g5 V:
1213.	4 46 05.3	+19 03 32	12.180	2.819	2.176	1.427	0.640	0.247	0.593	f3 V
1216.	4 45 31.0	+19 03 42	14.627	3.232	2.625	1.908	0.855	0.294	0.822	g1 V
1239.	4 44 05.0	+19 04 36	13.663	3.274	2.638	1.877	0.865	0.334	0.856	f9 V
1240.	4 47 24.3	+19 05 47	14.098	3.799	3.251	2.286	0.977	0.387	0.956	k0 V
1248.	4 46 04.7	+19 05 59	14.555	3.556	3.137:	2.076	0.854	0.317	0.930	g-k
1254.	4 46 23.8	+19 06 16	14.998			2.617	1.093	0.427	1.049	k0 III
1255.	4 46 45.9	+19 06 32	14.557	3.039	2.554:	1.794	0.807	0.306	0.803	g2 V
1257.	4 45 15.5	+19 06 12	14.553	3.159	2.547	1.770	0.830	0.295	0.783	f6 V
1275.	4 46 08.8	+19 08 14	14.742	3.282	2.692:	1.975	0.825	0.321	0.888	g
1283.	4 45 40.2	+19 09 09	14.484	3.012	2.478	1.788	0.816	0.295	0.783	g0 V
1284.	4 46 37.5	+19 09 27	14.854	2.911	2.272:	1.610	0.717	0.256	0.741	g0 V:
1286.	4 44 06.8	+19 08 56	15.221	2.918:	2.338:	1.689	0.782	0.271	0.752	f8 V:
1289.	4 47 55.4	+19 10 12	15.169	3.560:		2.078	0.876	0.346	0.913	g7 V:
1294.	4 46 01.3	+19 10 16	14.716	3.472	3.074:	2.060	0.902	0.370	0.881	k0 V
1302.	4 46 02.0	+19 11 01	15.133	3.143	2.364:	2.039	0.882	0.454	0.602	
1305.	4 47 53.8	+19 11 42	13.866	2.975	2.393	1.691	0.763	0.294	0.741	g0 V
1312.	4 46 48.1	+19 12 06	14.346	4.329:		2.701	0.987	0.592	1.121	k5 V
1315.	4 44 54.4	+19 11 44	15.104	3.435:	2.687:	2.154	0.862	0.328	0.965	g
1319.	4 47 37.6	+19 12 49	14.577	2.886	2.235	1.576	0.696	0.269	0.685	f8 IV:
1327.	4 45 02.6	+19 12 45	14.943	3.475	2.683:	2.052	0.942	0.292	0.945	g
1330.	4 47 08.6	+19 13 36	14.713			2.938	1.124	0.501	1.056	k3 III
1331.	4 46 27.6	+19 13 36	14.919	4.057:		2.508	1.037	0.393	0.992	k0 III
1337.	4 46 47.3	+19 14 05	15.179	2.804	2.299:	1.585	0.693	0.251	0.784	g0 V:
1341.	4 47 24.9	+19 14 47	13.665	3.469	2.959	2.048	0.814	0.351	0.866	k1 V
1343.	4 46 35.6	+19 14 38	15.337	2.878	2.250:	1.546	0.660	0.253	0.683	g0 V:
1344.	4 47 12.0	+19 14 51	14.797	4.480:		2.842	0.975	0.631	1.030	k5 V
1347.	4 47 31.9	+19 15 12	14.867	3.030	2.517:	1.777	0.775	0.296	0.763	g2 V
1348.	4 46 44.4	+19 15 10	15.168	2.969	2.467:	1.785	0.773	0.246	0.834	g
1352.	4 44 38.1	+19 15 16	14.845	3.699	2.847:	2.184	0.956	0.380	0.925	g
1360.	4 44 17.6	+19 15 54	14.942			2.944	1.159	0.501	1.148	k2.5 III
1365.	4 47 07.1	+19 17 08	15.100	3.966:		2.420	0.978	0.405	0.981	k0 III
1373.	4 47 33.3	+19 17 56	15.142	4.038:		2.446	0.965	0.368	0.994	k0 III
1375.	4 45 08.9	+19 17 18	14.988	3.607:	2.653:	2.088	0.956	0.330	0.950	
1379.	4 46 02.6	+19 17 58	15.210	3.501:	2.587:	2.066	0.924	0.434	0.850	
1386.	4 47 08.3	+19 19 01	15.254	3.072:	2.489:	1.698	0.784	0.300	0.703	f8 V:
1387.	4 46 50.0	+19 19 00	14.189	3.068	2.382	1.795	0.811	0.284	0.796	g
1388.	4 47 20.8	+19 19 11	13.825	3.054	2.411	1.732	0.785	0.293	0.769	f9 V
1389.	4 45 52.7	+19 18 53	14.462	3.326	2.611:	1.911	0.835	0.302	0.883	g0 V:
1392.	4 46 09.1	+19 19 08	14.882	3.621:	2.736:	2.088	0.952	0.360	0.873	g
1393.	4 45 42.2	+19 19 08	13.325	5.987:		3.700	1.696	0.567	1.612	
1394.	4 46 10.8	+19 19 28	14.810	3.036	2.358:	1.737	0.804	0.276	0.731	g
1396.	4 46 30.6	+19 19 38	15.349	2.788		1.527	0.739	0.244	0.686	
1400.	4 47 26.0	+19 20 14	14.887	4.130:		2.410	1.021	0.378	1.037	g8:
1410.	4 47 27.3	+19 21 28	15.183	3.593:		2.114	0.890	0.355	0.941	g8:
1417.	4 45 42.8	+19 21 55	15.096	3.703:		2.251	0.941	0.362	1.005	g6:
1424.	4 46 28.8	+19 22 41	14.253	4.135:	3.381:	2.466	1.057	0.427	1.026	k0 IV
1432.	4 47 09.5	+19 25 55	13.956	3.634	3.015:	2.200	0.938	0.367	0.924	g5:
1433.	4 46 09.5	+19 25 54	14.864			2.848	1.145	0.555	1.329	k-m
1435.	4 46 31.9	+19 26 11	15.085	3.000	2.290:	1.586	0.719	0.239	0.703	g
1440.	4 45 09.5	+19 26 21	15.203	3.128:	2.464:	1.745	0.819	0.289	0.796	f5 V:
1448.	4 45 36.1	+19 28 12	14.953	3.747		2.363	1.038	0.408	1.015	g8:
1450.	4 46 44.2	+19 28 59	14.606	4.265:		2.483	1.061	0.400	1.061	g8:
1456.	4 45 42.4	+19 31 11	15.150	3.068:	2.336:	1.852	0.862	0.334	0.788	g
1457.	4 46 13.7	+19 33 04	14.254	2.893	2.183	1.426	0.642	0.267	0.633	f2 V:
1458.	4 45 38.3	+19 33 01	14.283	3.464	2.769:	2.045	0.922	0.354	0.892	g2 V
1460.	4 47 53.9	+18 47 15	12.219	2.892	2.195	1.426	0.641	0.246	0.622	f1 V

Table 2 (continued)

ID	α (2000)	δ (2000)	V	U–V	P–V	X–V	Y–V	Z–V	V–S	Ph. sp.
1463.	4 47 52.7	+18 49 46	14.638	2.646	2.136	1.472	0.671	0.267	0.654	f8 V
1464.	4 47 29.1	+18 41 26	13.810	2.755	2.094:	1.545	0.720	0.264	0.718	g0
1465.	4 47 36.8	+18 41 56	13.178	2.947	2.495	1.758	0.769	0.299	0.767	g
1469.	4 47 09.1	+19 28 48	14.093	3.159	2.362	1.660	0.735	0.258	0.744	g0 V:
1471.	4 44 59.9	+19 31 21	13.895	3.111	2.158	1.344	0.610	0.243	0.578	f
1473.	4 44 40.2	+18 41 00	11.597	3.063	2.374	1.617	0.740	0.277	0.720	f5
1475.	4 46 48.7	+18 36 49	10.816	4.470	3.826	2.644	1.117	0.417	1.066	k0 III
1476.	4 47 08.3	+18 37 20	12.548	2.798	2.131	1.344	0.602	0.213	0.601	f0 V

Notes:

3. HDE 286016 (A0); other spectral types B9, B7.5 IV;
4. BD 18 711 (A0); other spectral types A1, A0 Vn
5. HDE 286014 (A0)
9. Other spectral type A3
10. HDE 286007 (A5)
13. HDE 284843 (A0); other spectral types A3, A3 V, non-member? unresolved binary?
15. HD 30123 (B9); other spectral types B7, B8 III, B7 Ve, B7.5 IIIev; standard
16. HDE 284842 (K0); other spectral type K0 V; standard
18. HDE 284837 (F5)
22. HD 30263 (A0); other spectral types B8, B8 II, B8 III, B8 IVn
23. HDE 285998 (B8)
28. Other spectral types A3, A3 Vn
29. HDE 285997 (B8); other spectral types A2, A0 IV, B9.5 Vn
30. HDE 286001 (A0); other spectral types A2, A2 V; standard
31. HDE 286003 (B8); other spectral type A2
34. HDE 286017 (B9)
37. HDE 286004 (B8); other spectral types A0, B9.5 IV; standard
39. HDE 286002 (F5); other spectral types G0, G8 III
40. Other spectral type G3
42. HDE 285995 (A0); other spectral types A0, B9.5 IV; standard
44. HDE 285996 (A0); other spectral types B9, B8 IVnn; standard
45. HD 30170 (A0); other spectral types B9, B7.5 IVn; standard
46. Other spectral type A2
48. BD 18 708 (B8); other spectral type A0; standard
49. HDE 285994 (B8); standard
50. HDE 286006 (A2); other spectral type B7, non-member? variable?
51. AG 19 382 (B8); other spectral type B9 IVnn
53. HDE 285993 (B5); other spectral type A5
54. HDE 285992 (B8); other spectral types A0 V, B8 IVn
55. HDE 284844 (B8); other spectral types B9, B7 V
58. HDE 284734 (A2)
59. HDE 284732 (A0)
60. HDE 284733 (A)
65. HDE 286009 (G0)
66. HDE 286010 (B8)
69. HDE 286012 (A3)
70. HDE 286011 (B9)
71. HDE 286013 (A0)
73. HDE 286022 (A0)
78. HDE 286018 (A2)
79. HDE 286000 (A)
82. HDE 285999 (A)
84. HDE 284835 (K5)
87. HDE 284838 (A)
93. Other spectral type A4
94. HDE 284839 (A0); other spectral types A0, B9 III, B7 Vn; standard
99. HDE 284840 (B9); other spectral types B9, B9 IV, B9 IVn; standard
102. HDE 284841 (B8); other spectral types B8, B9 III, B8IVnn; standard
105. HD 30233 (K2)
115. HDE 284836 (A0)
181. HD 30283 (B9)
224. HDE 286015 (A); other spectral types A0, A0 V
316. HDE 286008 (A0)
424. HDE 284834 (K5)

The results of the photometric classification of stars are given in the last column of Table 2. The lower-case letters are used to indicate that our spectral types are determined from photometry using the calibration in MK spectral types. The number of stars with reliable spectral types is 252. In some cases only the spectral class is given. For a part of stars at the limiting magnitude the classification accuracy was too low, and in such cases we give only an approximate spectral class. Spectral types obtained by other authors are listed in notes at the end of the table (for references see Turner 1992).

For the stars with reliable two-dimensional spectral types color excesses E_{Y-V} were calculated as the differences between the observed Y–V and the intrinsic color indices $(Y$–$V)_0$ for various spectral and luminosity classes, taken from Straižys (1992, Tables 66–69 and 73). The distance of a star was calculated by the equation:

$$5\log r = V - M_V + 5 - A_V, \quad (1)$$

where $A_V = 4.16E_{Y-V}$. The absolute magnitudes were taken from the Straižys (1992) tabulation according to the spectral and luminosity classes, with a correction of –0.1 mag, bringing the M_V scale to the distance modulus of the Hyades V–$M_V = 3.3$. For the majority of stars the absolute magnitude error is <0.5 mag.

The V magnitudes, Y–V color indices and photometric spectral types of the stars are repeated in Table 3. The table also contains absolute magnitudes M_V, extinctions A_V, distances r and cluster membership probabilities. The values of distances at $r > 500$ pc are rounded to the nearest number multiple of 10.

4. INTERSTELLAR EXTINCTION VS. DISTANCE

Figure 2 shows the interstellar extinction A_V plotted against distance r in kpc for all stars from Table 3. The following conclusions can be made.

1. A steep rise of interstellar extinction takes place at 160 pc, the distance of the Taurus dark cloud complex.

2. The increase of star density at about 500 pc is due to the presence here of the cluster NGC 1647 stars.

3. All stars at distances >200 pc are considerably reddened, and the reddening is non-uniform in the area. The extinction values are scattered between 0.6 and 2.2 mag. The limiting magnitude effect is shown by the curve which corresponds to the stars of $V = 15$ mag and of the absolute magnitude $M_V = +1$. This absolute magnitude roughly corresponds to A-type stars of luminosities V–IV–III and K giants. With a few exclusions, these stars are the most luminous in our catalog. Above this curve only a few more luminous stars with low interstellar extinction are observed. The stars with larger extinctions are cut out by the limiting magnitude at $V = 15$.

4. In the areas of low interstellar extinction stars are observed up to a distance of 5 kpc. At a Galactic latitude of –17° these stars are at 1.4 kpc from the Galactic plane. Most of them are G5–K5 giants.

5. Some late-type giants are suspected to be metal-deficient stars (see Table 2). Since their absolute magnitudes and intrinsic colors are uncertain, we were not able to plot them on the A_V vs. distance diagram.

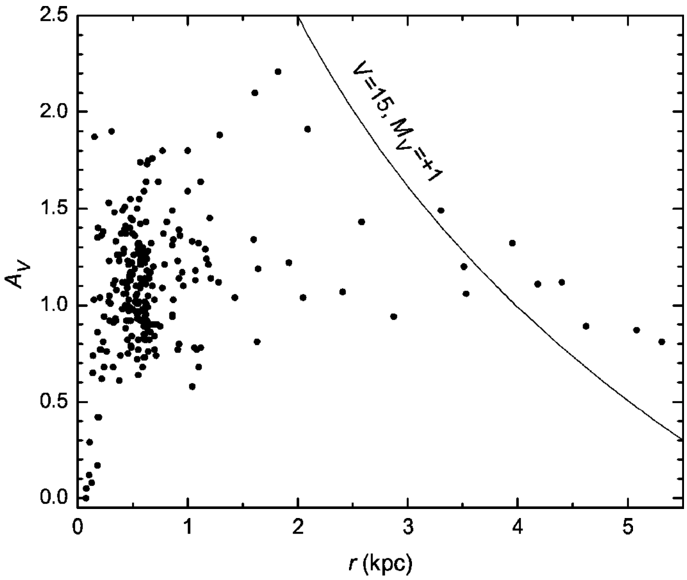

Fig. 2. Interstellar extinction vs. distance in the NGC 1647 area.

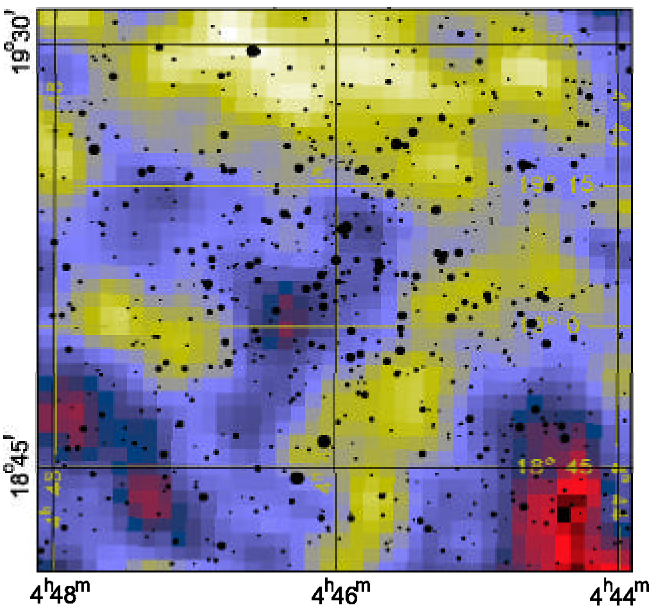

Fig. 3. The stars in the NGC 1647 area overlapped with the IRAS 100 μm thermal emission map from SkyView. White areas correspond to the high dust column density and red areas – the low dust column density.

Table 3. Photometric classification, extinctions and distances.

ID	Ph. sp.	V	M_V	$Y–V$	A_V	r (pc)	Memb.
3.*	b7.5 IV	9.61	–0.5	0.416	1.29	580	0.99
4.	a2 V	10.90	1.2	0.422	0.83	600	0.99
6.	k2 III	12.16	0.6	1.147	1.14	1210	0.00
7.	f4 V	12.43	3.3	0.669	0.92	443	0.99
9.	a7 IV-V	11.58	1.9	0.579	1.22	493	0.99
11.	a7 V	11.95	2.2	0.612	1.40	473	0.98
13.*	a3 V	10.83	1.4	0.530	1.29	420	0.99
14.	a7 IV	11.38	1.6	0.523	0.97	580	0.99
15.	b7.5 III	8.58	–1.0	0.462	1.38	429	0.99
17.	f8 V	13.57	4.0	0.867	1.49	408	0.99
18.	g1 V	10.85	4.4	0.592	0.17	178	0.00
19.	g8 III	10.96	0.8	1.003	1.22	610	0.00
21.	f8 V	13.80	4.0	0.695	0.76	640	0.95
22.	b8 V	9.07	0.0	0.362	0.98	414	0.99
23.	a3 V	10.94	1.4	0.388	0.68	590	0.99
24.	a5 V	11.75	1.8	0.460	0.86	660	0.99
26.	g5 V	12.65	5.0	0.897	1.35	181	0.00
27.	f7 V	13.29	3.8	0.688	0.77	550	0.99
28.	a7 V	11.38	2.2	0.514	1.00	432	0.99
29.	a0 V	10.69	0.7	0.413	0.99	640	0.99
30.	a5 V	10.99	1.8	0.445	0.79	485	0.00
31.	b9.5 V	10.34	0.4	0.394	1.02	610	0.99
32.	f5 V	12.86	3.5	0.646	0.72	540	0.99
33.	a6 V	11.14	2.0	0.543	1.12	407	0.99
34.	b9.5 V	10.60	0.4	0.429	1.14	650	0.99
35.	a5 V	11.68	1.8	0.486	0.92	620	0.99
36.	k0 V	12.72	5.9	0.755	0.42	192	0.00
37.	b9 V	10.14	0.4	0.394	1.02	560	0.99
38.*	g9 V	12.44	5.7	0.722	0.42	183	0.99
39.	g5 IV-V	10.33	4.0	0.757	0.65	136	0.00
40.	g9 V	11.12	5.7	0.696	0.29	107	0.00
42.	a0 V	9.67	0.7	0.409	0.98	403	0.99
43.	f6 V	13.12	3.6	0.753	1.13	481	0.99
44.	b8 III	9.22	–0.8	0.392	1.13	600	0.99
45.	b7.5 IV	8.86	–0.5	0.411	1.12	431	0.99
46.	a5 V	11.71	1.8	0.526	1.14	570	0.99
47.	f3 V	12.43	3.1	0.645	0.92	482	0.99
48.	b9.5 V	10.43	0.5	0.420	1.11	580	0.99
50.*	b5.5 V	10.04	–0.8	0.432	1.37	780	0.99
53.	a7 IV	11.48	1.6	0.505	0.88	630	0.99
55.	b7 V	10.29	–0.3	0.505	1.64	620	0.99
56.	a7 V	12.22	2.2	0.607	1.32	550	0.98
58.	a7 V	10.93	2.2	0.637	1.53	280	0.17
60.	a5 IV	11.54	1.3	0.556	1.27	620	0.99
61.	a7 IV	12.57	1.6	0.684	1.64	730	
62.	b9.5 V	11.27	0.5	0.575	1.75	640	0.99
63.	k4 III	10.92	0.4	1.416	1.74	570	0.00
64.	f5 III	12.34	1.9	0.777	1.32	670	0.00
65.	f8 V	9.56	4.0	0.538	0.08	127	0.00
67.	k0 III	12.57	0.7	1.177	1.64	1120	0.00

Table 3. (continued)

ID	Ph. sp.	V	M_V	$Y–V$	A_V	r (pc)	Memb.
70.	b9.5 V	10.50	0.5	0.455	1.23	570	0.99
71.	b9 V	10.67	0.4	0.470	1.28	640	0.99
72.	f3 V	11.85	3.1	0.712	1.13	339	0.00
73.	a5 V	11.39	1.8	0.458	0.73	600	
75.	g8 V	11.92	5.5	0.819	0.74	139	
76.	a5 V	12.38	1.8	0.474	0.80	920	
78.	a4 V	11.33	1.6	0.478	0.89	600	0.98
79.	a5 V	11.69	1.8	0.480	0.90	630	
81.	f5 V	11.38	3.5	0.649	0.76	263	
82.	a3 V	11.65	1.4	0.470	1.03	700	
84.	k5 III	8.88	0.2	1.247	0.74	388	0.00
86.	f3 V	12.97	3.1	0.645	0.94	610	0.99
87.	a3 V	11.48	1.4	0.436	0.90	690	0.99
91.	k0 III	12.27	0.7	1.067	1.24	1170	0.00
92.	g8 III	12.46	0.8	0.980	1.12	1280	0.00
93.	a5 V	11.68	1.8	0.448	0.82	650	0.99
94.	b8 V	9.67	0.0	0.364	1.01	540	0.99
95.	f8 V	13.46	4.0	0.746	0.98	500	0.99
97.	a6 IV	11.77	1.5	0.534	1.10	680	0.99
99.	b8 IV:	10.09	–0.4	0.501	1.59	600	0.99
100.	b9 IV:	11.59	0.0	0.431	1.21	1190	0.00
102.	b8 III	9.33	–0.8	0.427	1.28	590	0.99
104.	f5 V	13.50	3.5	0.765	1.27	550	0.99
105.	k0 III	8.50	0.7	1.219	1.87	152	
106.	g0 V	12.18	4.3	0.757	0.94	239	0.00
107.	k1 III	13.08	0.7	1.132	1.34	1600	0.93
108.	k0 V	14.25	5.9	0.892	1.05	289	
110.	g8 IV-V	12.41	5.5	0.858	1.03	148	0.00
111.	g0 V	13.58	4.3	0.732	0.84	490	0.92
113.	g0 V	13.81	4.3	0.823	1.15	469	0.97
115.	a5 V	11.16	1.8	0.405	0.64	550	0.97
116.	g3 V	13.98	4.7	0.804	0.97	464	
119.	g5 V	12.58	5.0	0.820	1.04	203	0.00
124.	f8 V	13.99	4.0	0.741	0.90	660	
126.	b9 V:	14.48	0.4	0.499	1.49	3300	
127.	f4 V	13.91	3.3	0.667	0.94	860	0.00
129.	f9 V	13.96	4.1	0.758	0.98	600	0.98
132.	f9 V	15.11	4.1	0.714	0.78	1120	0.18
134.	g5 IV	13.02	3.0	0.794	0.74	710	0.00
136.	a3 V	13.22	1.4	0.479	1.04	1430	
139.	f5 V	14.38	3.5	0.663	0.78	1060	0.91
140.	g0 V	13.74	4.3	0.831	1.13	467	0.88
141.	g5 IV	13.60	3.0	0.854	0.95	860	0.00
146.	k0 V	13.17	5.9	0.813	0.62	217	0.00
147.	f8 V	13.63	4.0	0.710	0.73	610	0.77
148.	g2 V	14.47	4.6	0.816	0.97	610	0.00
150.	g2 V	13.15	4.6	0.814	0.93	343	0.00
153.	f7 V	12.39	3.8	0.738	0.92	347	0.00
155.	g1 V	14.15	4.4	0.866	1.26	510	0.00
156.	f8 V	14.93	4.0	0.797	1.14	920	
157.	g0 V	14.06	4.3	0.831	1.19	520	0.97

Table 3. (continued)

ID	Ph. sp.	V	M_V	$Y–V$	A_V	r (pc)	Memb.
158.	f8 V	13.71	4.0	0.760	1.01	550	0.00
161.	k0 III	12.95	0.7	1.072	1.19	1640	0.00
162.	g3 V	14.27	4.7	0.824	1.02	520	0.00
163.	f5 V	13.00	3.5	0.676	0.82	550	0.99
168.	f1 V	12.87	2.9	0.684	1.21	580	0.97
169.	g0 V	12.47	4.3	0.773	0.92	289	0.00
171.	f5 V	13.10	3.5	0.705	0.95	540	0.99
174.	k2 V	13.68	6.4	0.878	0.77	203	0.00
178.	f5 V	12.77	3.5	0.711	1.00	456	0.00
181.	b7 V	9.82	–0.3	0.356	0.90	720	0.53
183.	f7 V	12.89	3.8	0.701	0.82	452	0.92
188.	g0 V	13.81	4.3	0.869	1.39	424	0.99
189.	g7 V:	14.66	5.3	0.841	0.99	474	0.00
191.	f8 V	13.02	4.0	0.719	0.75	456	0.81
194.	f5 V	13.22	3.5	0.693	0.85	600	
197.	f8 V	13.29	4.0	0.755	1.06	440	0.99
201.	g3 V	14.61	4.7	0.784	0.92	630	0.98
205.	f7 V	13.35	3.8	0.732	0.93	540	0.99
211.	f5 V	13.34	3.5	0.702	0.98	590	0.99
212.	f5 V	13.29	3.5	0.684	0.91	600	0.99
214.	g0 V	13.67	4.3	0.798	1.09	453	0.97
215.	g0 V	13.92	4.3	0.769	0.97	550	0.99
217.	f3 V	13.50	3.1	0.770	1.43	620	0.99
221.	g0 V	13.86	4.3	0.824	1.17	478	0.98
223.	f8 V	13.65	4.0	0.752	0.96	550	0.99
224.	a2 V	11.19	1.2	0.451	1.00	630	0.99
225.	g8 IV	13.81	3.1	0.922	1.03	870	0.00
226.	k1.5 III	11.91	0.7	1.279	1.80	770	0.00
227.	k0 III	12.47	0.7	1.218	1.80	1000	0.00
231.	g8 IV	14.00	3.1	0.864	0.77	1080	0.00
232.	f5 V	13.47	3.5	0.789	1.29	550	0.97
233.	k5 V	11.71	7.2	0.809	0.05	79	0.00
234.	g0 V	13.78	4.3	0.840	1.21	463	0.00
235.	k0 III	13.32	0.7	1.086	1.22	1920	0.00
237.	f5 V	13.25	3.5	0.674	0.82	610	0.99
238.	k0 III	13.27	0.7	1.039	1.04	2050	0.00
239.	g8 III	14.71	0.8	1.019	1.20	3510	0.68
241.	k0 V	14.91	5.9	0.977	1.33	348	
242.	g0 V	14.07	4.3	0.743	0.82	620	0.98
243.	g3 V	13.18	4.7	0.795	0.91	326	0.00
250.	f5 V	13.56	3.5	0.675	0.84	700	0.00
255.	f8 V	13.97	4.0	0.761	1.01	620	0.97
259.	g5 V	14.60	5.0	0.816	0.93	550	0.93
262.	k1 III	13.88	0.7	1.066	0.94	2870	
269.	k1 III	12.25	0.7	1.216	1.59	1000	0.00
270.	g2 V	12.59	4.6	0.907	1.36	215	0.00
271.	f5 V	13.42	3.5	0.849	1.55	479	0.99
273.	f5 V	13.14	3.5	0.754	1.16	499	0.97
274.	g3 V:	14.54	4.7	0.904	1.37	500	0.97
280.	g0 V	14.96	4.3	0.844	1.21	790	0.53

Table 3. (continued)

ID	Ph. sp.	V	M_V	$Y{-}V$	A_V	r (pc)	Memb.
281.	g8 IV	13.01	3.1	1.010	1.36	520	0.00
284.	g5 V	14.03	5.0	0.896	1.26	360	0.00
287.	f8 V	14.37	4.0	0.827	1.20	690	
289.	f5 V	12.81	3.5	0.758	1.11	447	
293.	k2 III	12.41	0.6	1.236	1.45	1200	0.00
299.	f2 V	13.04	3.0	0.688	1.11	620	0.99
300.	f8 V	13.93	4.0	0.876	1.44	500	0.00
301.	g0 V	14.36	4.3	0.844	1.22	590	0.88
302.	f9 V	14.30	4.1	0.836	1.24	620	0.95
305.	f9 V	14.08	4.1	0.826	1.21	570	0.98
306.	f5 V	14.66	3.5	0.801	1.36	930	0.91
310.	f8 V	13.68	4.0	0.777	1.06	540	0.99
311.	m2 V	14.23	9.9	1.074	0.00	75	0.00
313.	f8 V	13.10	4.0	0.873	1.48	334	0.00
314.	a7 V	12.89	2.2	0.694	1.73	630	0.99
321.	g1 V	13.73	4.4	0.888	1.37	395	0.00
324.	f6 V	13.72	3.6	0.791	1.26	600	0.72
328.	f5 V	15.10	3.5	0.776	1.29	1160	
330.	k7 V	13.19	8.0	0.951	0.12	103	0.00
334.	g0 V	14.30	4.3	0.845	1.31	550	0.96
337.	g0 V	14.48	4.3	0.891	1.50	540	0.96
339.	k3 V	14.35	6.6	1.036	1.40	186	0.03
343.	g0 V:	14.52	4.3	0.872	1.42	570	0.78
345.	g0 V	14.31	4.3	0.715	0.77	700	0.17
346.	a7 V	12.49	2.2	0.642	1.55	560	0.99
347.	f6 V	14.51	3.6	0.902	1.76	680	0.97
353.*	f8 V	14.52	4.0	0.772	1.09	770	0.98
355.	g2 V	14.68	4.6	0.834	1.14	610	0.98
363.	f8 V	13.67	4.0	0.763	1.05	530	0.98
368.	k0 III	14.52	0.7	1.025	1.06	3530	0.35
369.	f6 V	13.68	3.6	0.796	1.32	560	0.99
374.	k5 III	13.74	0.2	1.601	2.21	1820	
375.	g1 V	13.94	4.4	0.845	1.23	457	0.97
378.	g3 V	14.10	4.7	0.865	1.27	419	0.98
392.	k0 III	14.20	0.7	1.113	1.43	2580	
394.	f8 IV	13.91	2.7	0.835	1.39	920	
395.	f8 V	15.05	4.0	0.831	1.34	870	
399.	g0 V	13.66	4.3	0.987	1.90	308	0.00
404.	k1 III	14.23	0.7	1.269	1.91	2090	0.37
405.	f7 IV	13.59	2.6	0.805	1.31	860	
412.	a7 V	12.08	2.2	0.532	1.09	570	
414.	a8 V	11.66	2.4	0.511	0.92	461	
423.	g2 V	13.25	4.6	0.835	1.11	325	
424.	k3 III	10.73	0.5	1.188	1.16	650	
451.	g3 V	14.81	4.7	0.868	1.24	600	0.87
454.	f8 V	14.05	4.0	0.784	1.05	640	0.00
460.	f8 V	12.46	4.0	0.685	0.61	378	
462.	k0 III	11.66	0.7	1.057	1.10	960	
463.	a8 V	12.56	2.4	0.588	1.14	650	
1001.	a7 V	14.58	2.2	0.757	1.88	1290	
1003.	f5 V:	14.85	3.5	0.814	1.33	1040	

Table 3. (continued)

ID	Ph. sp.	V	M_V	$Y{-}V$	A_V	r (pc)	Memb.
1004.	k2 V	14.72	6.4	0.956	1.01	299	
1007.	k0 IV	14.60	3.1	1.050	1.32	1100	
1013.	g0 V	13.84	4.3	0.890	1.37	441	
1022.	g2 V	13.71	4.6	0.842	1.06	417	
1027.	k0 IV	14.41	3.1	0.999	1.18	1070	
1035.	k0 IV	14.12	3.1	1.008	1.17	950	
1048.	g7 V:	13.78	5.3	0.920	1.23	285	
1061.	k0 V	14.14	5.9	0.906	1.02	282	
1068.	f5 V	14.48	3.5	0.777	1.23	910	
1075.	a5 V	11.48	1.8	0.493	0.92	570	
1081.	k1 III	13.66	0.7	1.088	1.07	2410	
1083.	g2 V	13.73	4.6	0.883	1.26	379	
1092.	k1 V	15.28	6.1	0.856	0.78	486	
1097.	g3 V:	14.97	4.7	0.859	1.17	660	
1112.	f4 V	14.54	3.3	0.728	1.13	1070	
1122.	k0 III	13.81	0.7	1.291	2.10	1610	
1157.	g3 V	13.80	4.7	0.868	1.23	378	
1171.	g1 V	14.26	4.4	0.910	1.45	485	
1177.	k3 V	14.82	6.6	0.863	0.68	322	
1200.	k2.5 V	14.91	6.5	1.129	0.77	212	
1213.	f3 V	12.18	3.1	0.640	0.88	435	
1216.	g1 V	14.63	4.4	0.855	1.24	630	
1239.	f9 V	13.66	4.1	0.865	1.41	434	
1240.	k0 V	14.10	5.9	0.977	1.38	231	
1254.	k0 III	15.00	0.7	1.093	1.32	3950	
1255.	g2 V	14.56	4.6	0.807	1.00	620	
1257.	f6 V	14.55	3.6	0.830	1.43	810	
1283.	g0 V	14.48	4.3	0.816	1.18	630	
1284.	g0 V:	14.85	4.3	0.717	0.77	910	
1294.	k0 V	14.72	5.9	0.902	1.08	351	
1305.	g0 V	13.87	4.3	0.763	0.97	520	
1312.	k5 V	14.35	7.2	0.987	0.86	181	
1319.	f8 IV:	14.58	2.7	0.696	0.81	1630	
1330.	k3 III	14.71	0.5	1.124	0.89	4620	
1331.	k0 III	14.92	0.7	1.037	1.11	4180	
1337.	g0 V:	15.18	4.3	0.693	0.68	1100	
1341.	k1 V	13.67	6.1	0.814	0.68	239	
1344.	k5 V	14.80	7.2	0.975	0.81	230	
1347.	g2 V	14.87	4.6	0.775	0.89	750	
1360.	k2.5 III	14.94	0.6	1.159	1.12	4400	
1365.	k0 III	15.10	0.7	0.978	0.87	5080	
1373.	k0 III	15.14	0.7	0.965	0.81	5310	
1388.	f9 V	13.83	4.1	0.785	1.10	530	
1424.	k0 IV	14.25	3.1	1.057	1.49	860	
1458.	g2 V	14.28	4.6	0.922	1.51	428	
1460.	f1 V	12.22	2.9	0.641	1.03	465	
1463.	f8 V	14.64	4.0	0.671	0.58	1040	
1469.	g0 V:	14.09	4.3	0.735	0.85	610	
1475.	k0 III	10.82	0.7	1.117	1.30	590	
1476.	f0 V	12.55	2.7	0.602	0.95	620	

Notes:

3. Photoelectric data are used (Table 1)
13. Non-member, unresolved binary?
38. Metal-deficient? Non-member
50. Non-member?
353. Non-member?

6. The 100 μm dust emission map of the area based on IRAS and COBE satellite observations (see Schlegel et al. 1998 and http://skyview.gsfc.nasa.gov) shows very uneven distribution of dust emission in our area: the lowest emission is seen at its center and the strongest emission in the northern part. Figure 3 shows the 100 μm map overlapped with the star map. We find that the most reddened stars fall behind the areas of the strongest infrared emission.

5. CLUSTER MEMBERSHIP

Figure 4 shows the interstellar extinction plotted against distance for 87 cluster members. The membership probability is taken according to the WEBDA database and is based on proper motions of the stars. It is shown in the last column of Table 3. We considered that the stars are cluster members when their membership probability is $\geq$0.95. One can see that most of the cluster members are distributed between 400 and 700 pc. According to Turner (1992) the distance of the cluster is 540 pc. If we accept that the distance determination accuracy by our method is 25% (see Straižys et al. 2001), at this distance the error is 135 pc. Due to this error the cluster stars may be scattered between 405 and 675 parsecs (apparent distances). This approximately corresponds to the scatter boundaries in Figure 4. However, two stars with high membership probability, Nos. 50 and 353 are more distant than the expected far edge of the scatter. Probably, these two stars may be considered as non-members, accidentally having the same value and direction of proper motions as the cluster stars. In Figure 4 these stars are shown by crosses. Star No. 50 has very discordant spectral classifications: b5.5 V in our catalog, A2 in HDE and B7 in Zug (1933). It may happen that the star is an unresolved binary or peculiar. The third star which cannot be a cluster member is No. 38 – it is much too close to the Sun. Star No. 13 is in the cluster's distance range but it is too bright to be on the main sequence.

For the 85 cluster members plotted in Figure 4 we obtain the following average distance and extinction values: r = 555$\pm$74 pc and A_V = 1.12$\pm$0.25 mag (the standard deviations).

Figure 5 shows the apparent V, Y–V diagram for all classified stars in the area, including the foreground and background stars. As is evident from Figure 1, most of these stars are affected by different amounts of interstellar extinction. The direction of the shift due to interstellar reddening and extinction is indicated by an arrow in the right upper corner of the diagram. Since the cluster stars show different reddening values, and the plot contains many field stars, the cluster main sequence here is not well defined.

The color-magnitude diagram V_0 vs. $(Y-V)_0$ for the cluster members is shown in Figure 6. The broken line is the zero-age main sequence shifted to the lower part of the scattered main sequence of the cluster with the true distance modulus $V - M_V$ = 8.69 which corresponds to a distance of 555 pc. It seems that this distance is a good estimate for the cluster. It is quite close to a value of 540 pc obtained by Turner (1992).

The main sequence starts at spectral class B7 V which corresponds to a cluster age of about 150 million years. It is interesting to note that the main sequence of the cluster disappears at $(Y - V)_0$ = 0.56 which corresponds to the G2 spectral class. Absolutely fainter stars of the cluster probably are absent in our catalog: with the expected extinction of 1.1 mag they should be very close to the limiting magnitude.

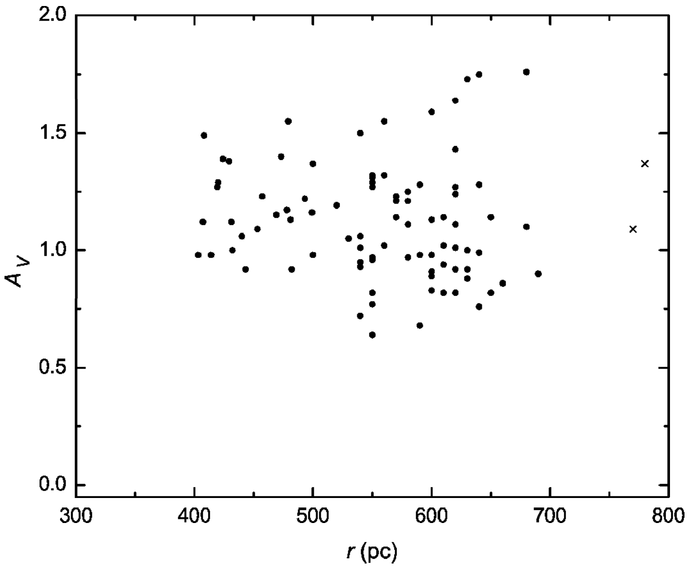

Fig. 4. Interstellar extinction vs. distance for the NGC 1647 cluster members. Membership is taken from the WEBDA database. Two stars shown by crosses probably are field stars, see the text.

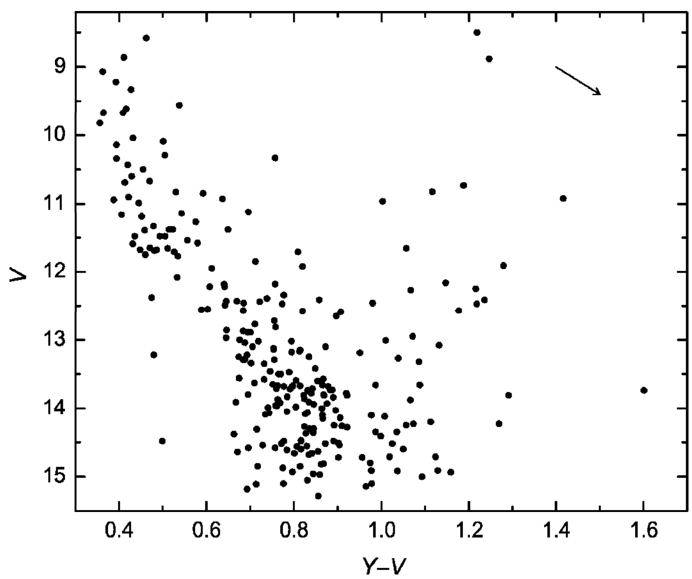

Fig. 5. Color-magnitude diagram in the NGC 1647 area. The arrow shows the shift of a star with the interstellar reddening $E_{Y-V} = 0.10$ mag.

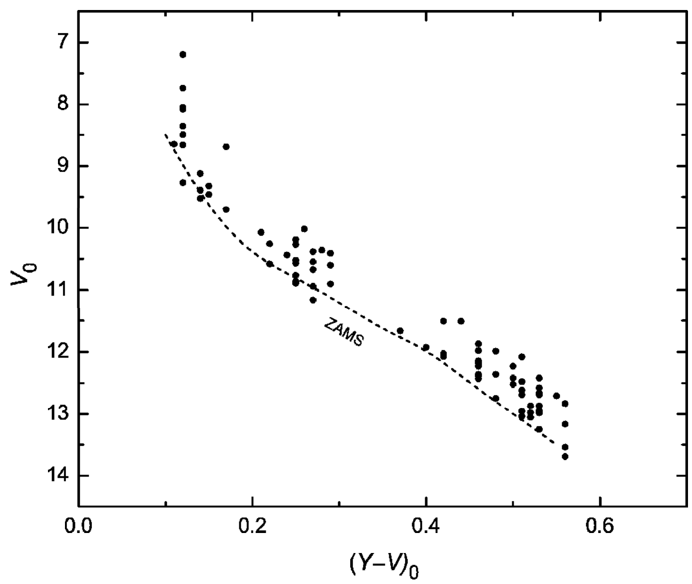

Fig. 6. Intrinsic color-magnitude diagram for the cluster members. The zero-age main sequence is shown, shifted to the lower envelope of the NGC 1647 stars.

6. THE SHAPE OF THE CLUSTER

The distribution of stars within a cluster evolves during the cluster's evolution. The initial distribution of stars is predetermined by the structure of the parent molecular cloud. Later on gravitational interactions of stars virialize the system. Subsequently self-gravity competes with external disturbances in shaping the star cluster. A star cluster residing in an environment with little tidal influence, e.g., being away from the Galactic disk, bulge or giant molecular clouds, especially a massive and compact cluster, may keep its integrity for a long time before it eventually dissolves.

Chen et al. (2004) studied the morphology of Galactic open clusters using the 2MASS point source catalog. They find that all open clusters are elongated. This happens even among the young clusters (a few million years old), for which the morphology reflects the elongated and often filamentary shapes of the parent molecular clouds. In general, the shape of the inner core of an open cluster is governed by the self-gravity of member stars, whereas the outer halo is more vulnerable to external disturbances. For example, open clusters far from the Galactic disk show more circular halos. Several open clusters are found to have prominent tidal distortion, e.g., Berkeley 17 (Chen et al. 2004), NGC 2395 (Zdanavičius et al. 2004), or show evidence of disintegration, e.g., NGC 2420 (Chen et al. 2004).

Here we present the results of the analysis of the morphology of NGC 1647 by the same probabilistic starcount technique outlined in Chen et al. (2004). Stars brighter than $K{\sim}15.6$ mag, the 3σ limit of the 2MASS catalog, in the $40'\times$

40′ field centered around NGC 1647 are considered. The infrared data reveal the intrinsic shape of a cluster more readily than visible data which suffer larger dust obscuration. For NGC 1647 this is particularly advantageous because the star cluster is seen behind the foreground dust clouds of the Taurus complex.

For each 2MASS star in the field, a clustering parameter, equivalent to the membership probability, is computed, from which an effective surface density of cluster member stars is estimated (Chen et al. 2004). An ellipse is fitted to the contour for which the density distribution drops to 3 times the background fluctuation. This is defined as the boundary of the halo of the cluster. The flattening of the ellipse, $f = 1 - (b/a)$, where a and b are the semimajor and semiminor axes, and the average size, $(a + b)/2$, are evaluated. The same shape and size parameters can be estimated at where the effective density becomes 1/2 and 1/3 of the maximum value, which mark respectively the inner and outer cores of a cluster.

Our analysis shows that NGC 1647 has a loose structure with a flattened shape $f \sim 0.4$. Because of the projection effect, the actual shape of the cluster can be even flatter. The stellar distribution already can be seen in Figure 7a to elongate in the northeast-southwest direction (roughly perpendicular to the Milky Way). The average radius of the cluster is 18.9′, which at a distance of 540 pc corresponds to a physical radius of about 3 pc, a norm among Galactic open clusters. Within the boundary of NGC 1647 there are some 530±20 stars brighter than K~15.6 mag. The outer and inner cores have 12.5′ and 9.1′ radii, with flattening 0.2 and 0.1, respectively. Since the cluster is close to the Galactic disk ($z \sim 165$ pc), the distortion may originate from the disk tidal force.

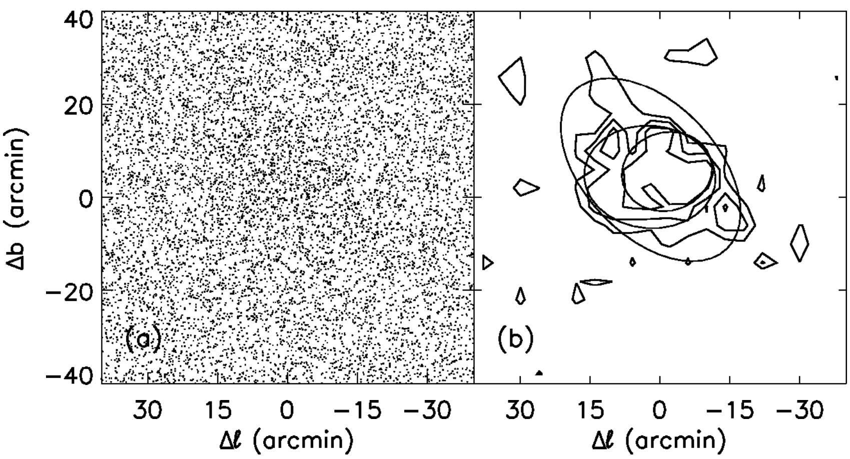

Fig. 7. Panel (a). The surface distribution of stars with $K < 15.6$ in the 40′× 40′ field centered on NGC 1647. Panel (b) The effective density contour fitted with ellipses to obtain the flattening $f = 1 - (b/a)$. The three contours mark respectively the halo, and the 1/2 and 1/3 levels of the maximum stellar number density.

7. CONCLUSIONS

Seven-color CCD photometry and two-dimensional classification of 433 stars in the open cluster NGC 1647 area in Taurus makes it possible to investigate the interstellar extinction in this direction and to determine the distance and membership of the cluster. We find that the interstellar extinction shows a sharp increase at a distance of 160 pc, which may be related with the complex of the Taurus dark clouds. There is no evidence that the extinction increases behind these clouds. The range of the extinction values is between 0.6 and 2.2 mag. The spread of the cluster members is observed between the apparent distances 400 and 700 pc. These distance differences appear as a consequence of the photometric distance determination errors. If the actual diameter of the cluster is 40′, at a distance of 555 pc this corresponds to 6.4 pc only.

The cluster shows a differential interstellar reddening: the values of A_V are scattered between 0.8 and 1.8 mag, with the average value 1.1 mag. The surface distribution of interstellar extinction is in a qualitative agreement with the dust infrared emission at 100 μm as mapped by the IRAS satellite. Four stars, which according to proper motions are considered to be cluster members, probably are background and foreground stars. One of them may be peculiar.

We find that the mean distance of the 85 cluster stars is 555±74 pc. This value is confirmed both by the mean distance value of the cluster members and by the intrinsic magnitude-color diagram of the cluster stars. This distance value is quite close to that obtained by Turner (1992). The hottest cluster stars are at spectral class B7 V, and this means that the cluster age is about 150 million years. We do not find any evidence for metal-deficiency of the cluster members.

From star counts in the infrared K passband we conclude that NGC 1647 has a loose structure and a flattened shape with $f \sim 0.4$ probably caused by a tidal force of the Galactic disk. The cluster is elongated in the direction roughly perpendicular to the Milky Way.

ACKNOWLEDGMENTS. This work was supported by the National Science Council of Taiwan, the Ministry of Education and Science of Lithuania, and by the American Astronomical Society Chretien Grant of 2000. CWC and WPC acknowledge support by grants NSC-93-2112-M-008-028 and NSC-93-2112-M-008-040. The use of the WEBDA database of the CDS at Strasbourg is acknowledged.

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