

SEVEN-COLOR PHOTOELECTRIC PHOTOMETRY OF STARS IN THE HYADES CLUSTER

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Abstract. 98 stars of the Hyades cluster in the magnitude interval $4.5 < V < 13.5$ have been observed photoelectrically in the Vilnius seven-color photometric system. The zero-age main sequences in magnitude vs. color index diagrams are determined, using the individual parallaxes of the stars to remove the intrinsic dispersion in magnitude, resulting from a considerable spatial extent of the cluster. Absolute magnitudes of red giants of the cluster, calculated by means of individual distance moduli, are compared with some calibrations of spectral type in absolute magnitudes for the field giants.

Key words: methods: observational – techniques: photometric: Vilnius photometric system – open clusters: the Hyades

1. Introduction

The Hyades cluster plays a crucial role being one of cornerstones for distance determination in our Galaxy. The distance modulus for the Hyades, resulting from a group parallax, serves as a basis for the zero-point determination of the compound zero-age main sequence (ZAMS) of open clusters. Moreover, the Hyades stars, as having no reddening, provide directly the intrinsic color indices for main-sequence stars. These circumstances have led to numerous investigations of the Hyades cluster in the past and among them, to a number of photometric investigations in various photometric systems.

Our interest in photometry of the Hyades in the Vilnius photometric system is based on a need to know a firmly determined location of the ZAMS on the color-magnitude diagrams intended to

be used for the determination of the distances of intermediate-age open clusters. The first observations of the Hyades in the Vilnius system made in 1974 have been used for the determination of the intrinsic color indices of the zero-age main sequence by Straizys et al. (1982). The results of their photometry have been published in the General Photometric Catalogue of Stars Observed in the Vilnius System (Straizys and Kazlauskas 1993). However, that photometry contains only A–F–G stars of the Hyades. We decided to repeat their observations and to extend them to the Hyades stars as faint as 13 mag.

2. Results of observations

98 stars in the region of the Hyades cluster were observed in 1987/90 with the 1 m reflector of the Institute of Theoretical Physics and Astronomy (Vilnius, Lithuania), situated at the Maidanak Observatory in Uzbekistan. In the observations, a standard set of filters of the Vilnius system was used in combination with a photomultiplier FEU-79 working in the photon counting mode.

Two auxiliary stars separated by $\sim 4^h$ in the hour angle were observed each hour for determination of the atmospheric extinction by the Nikonov method modified by Zdanavičius (1975). The method is also described by Straizys (1977, 1992). Reduction equations between the instrumental and the standard system were based on observations of 33 standard stars in the Cygnus region. The mean square errors of a single observation, as calculated from observations of the standard stars, are as follows: ± 0.015 mag for the color indices $U-V$ and $P-V$, ± 0.010 mag for the indices $X-V$, $Y-V$, $Z-V$ and $V-S$ and ± 0.02 for the V magnitude.

For observation, the probable members of the Hyades cluster were chosen from the proper motion lists of van Bueren (1952), Pels and Oort (1975) and Hanson (1975). Later on, after our observations have been made, a new, highly precise radial velocity survey by Griffin et al. (1988) and the proper motion catalogue by Schwan (1991) were published.

The results of our observations are listed in Table 1, where the star numbers are those of van Bueren (VB), Pels and Oort (P) and Hanson (H). In the column designated by “ n ”, the number of independent observations is given. The remarks contain a short information, mostly about the binarity. Almost all stars in the table are

Table 1. Results of photometry in the Vilnius system

No.	V	U-V	P-V	X-V	Y-V	Z-V	V-S	n	Remarks
VB 2	7.76	2.51	2.02	1.36	0.55	0.21	0.53	2	
5	9.34	3.32	2.88	1.93	0.70	0.36	0.71	2	
8	6.34	2.16	1.66	1.06	0.44	0.16	0.42	3	HR 1233, SBO*
9	8.64	2.67	2.20	1.50	0.59	0.26	0.60	2	SB, $P > 7$ yr.
13	6.57	2.15	1.67	1.07	0.44	0.16	0.42	3	
16	7.03	2.16	1.66	1.07	0.44	0.17	0.42	2	
17	8.43	2.65	2.20	1.49	0.58	0.23	0.58	2	
19	7.08	2.26	1.79	1.20	0.49	0.19	0.47	2	
20	6.23	2.20	1.68	1.07	0.45	0.17	0.39	1	HR 1319, 48 Tau
21	9.10	2.96	2.51	1.69	0.62	0.27	0.65	1	
22	8.28	2.76	2.29	1.58	0.61	0.27	0.63	1	SB, $d = 0''.12$
26	8.58	2.78	2.34	1.58	0.61	0.26	0.60	2	
27	8.44	2.73	2.29	1.56	0.61	0.25	0.59	2	
29	6.86	2.37	1.87	1.26	0.52	0.20	0.50	1	ADS 3135, 55 Tau, VBO*
33	5.24	2.19	1.59	0.81	0.32	0.13	0.27	1	HR1356, 58 Tau, SB1
35	6.79	2.13	1.65	1.07	0.45	0.16	0.41	2	δ Sct-type var. V696 Tau
36	6.77	2.18	1.70	1.10	0.46	0.17	0.43	2	
39	7.81	2.60	2.14	1.46	0.60	0.25	0.59	1	SB, $P > 7$ yr
42	8.81	2.79	2.36	1.59	0.61	0.26	0.61	2	Binary?
43	9.35	3.22	2.80	1.87	0.70	0.32	0.71	2	SB
46	9.08	3.08	2.65	1.77	0.65	0.30	0.68	2	
47	4.78	2.16	1.54	0.71	0.27	0.10	0.23	1	HR 1380, 64 Tau, SB
49	8.19	2.44	1.96	1.34	0.54	0.21	0.52	1	
50	7.57	2.44	1.98	1.34	0.54	0.22	0.57	2	Binary?
51	6.93	2.19	1.70	1.11	0.46	0.18	0.43	2	
52	7.77	2.43	1.97	1.34	0.55	0.21	0.53	2	Binary?
53	5.95	2.22	1.67	1.02	0.39	0.16	0.40	2	HR 1385
59	7.44	2.34	1.86	1.27	0.52	0.20	0.50	1	SB, $P > 7$ yr
63	8.04	2.52	2.05	1.40	0.54	0.22	0.56	2	SB, $P \approx 7$ yr
64	8.13	2.54	2.08	1.41	0.54	0.19	0.58	2	
65	7.39	2.30	1.84	1.24	0.51	0.19	0.49	2	
68	5.88	2.18	1.64	0.93	0.38	0.14	0.36	1	HR 1408, 76 Tau
73	7.82	2.45	1.99	1.35	0.55	0.21	0.53	2	
74	5.00	2.22	1.61	0.80	0.30	0.11	0.26	1	HR 1414, 79 Tau
77	6.98	2.24	1.77	1.18	0.49	0.19	0.47	2	SBO, $P = 239$ d
78	6.87	2.19	1.70	1.12	0.47	0.18	0.44	2	
79	8.93	3.02	2.55	1.73	0.64	0.29	0.65	2	
85	6.48	2.16	1.68	1.08	0.45	0.16	0.43	1	
86	7.00	2.22	1.72	1.16	0.48	0.20	0.45	2	
88	7.74	2.29	1.85	1.24	0.51	0.18	0.49	1	
90	6.35	2.17	1.68	1.04	0.44	0.17	0.42	2	HR 1436
91	8.91	3.13	2.66	1.81	0.68	0.33	0.70	1	SB, $P > 15$ yr
92	8.65	2.79	2.34	1.58	0.60	0.25	0.61	2	
93	9.36	3.19	2.74	1.86	0.67	0.32	0.69	2	

Table 1 (continued)

No.	V	U-V	P-V	X-V	Y-V	Z-V	V-S	n	Remarks
VB 94	6.59	2.16	1.67	1.08	0.45	0.17	0.42	2	
96	8.48	3.02	2.57	1.75	0.66	0.31	0.67	1	SB, $P \approx 13$ yr
97	7.91	2.49	2.03	1.38	0.55	0.22	0.54	4	
99	9.34	3.10	2.65	1.78	0.65	0.30	0.68	2	
100	6.00	2.17	1.66	1.02	0.42	0.15	0.40	2	HR 1459
102	7.50	2.45	1.97	1.34	0.54	0.22	0.54	1	SB, $P = 2$ yr
103	5.76	2.21	1.63	0.91	0.37	0.14	0.35	2	HR 1472, 89 Tau
109	9.38	2.95	2.50	1.68	0.64	0.28	0.64	2	
110	8.83	2.63	2.17	1.47	0.58	0.24	0.58	1	nm
111	5.38	2.16	1.60	0.84	0.33	0.11	0.30	1	HR 1507
113	7.22	2.32	1.87	1.27	0.52	0.20	0.51	1	SB
115	9.04	3.07	2.62	1.77	0.66	0.30	0.67	3	SB, $P \approx 4$ yr
118	7.69	2.41	1.93	1.30	0.52	0.21	0.51	3	
126	6.33	2.19	1.60	0.89	0.37	0.14	0.33	2	HR 1566
127	8.88	2.78	2.33	1.57	0.60	0.26	0.61	2	
128	6.74	2.17	1.69	1.11	0.46	0.17	0.43	2	101 Tau
129	4.62	2.19	1.55	0.71	0.27	0.10	0.22	2	HR 1620, 102 ι Tau
130	5.41	2.26	1.65	0.85	0.32	0.12	0.27	3	HR 1672, 16 Ori
131	6.00	2.26	1.65	0.89	0.33	0.13	0.29	2	HR 1670, ADS 3730A, VBO
132	8.59	2.64	2.20	1.46	0.60	0.25	0.56	2	ADS 3730B, VBO
135	8.95	3.17	2.75	1.84	0.66	0.33	0.68	1	nm, SB
140	8.90	2.79	2.34	1.61	0.62	0.28	0.64	1	doubtful member, SB
142	8.29	2.58	2.12	1.44	0.57	0.24	0.55	3	SB
143	7.88	2.31	1.83	1.23	0.51	0.21	0.47	1	
151	9.91	3.35	2.89	1.94	0.70	0.36	0.75	1	doubtful member, SB
158	7.99	2.48	1.98	1.33	0.54	0.21	0.53	1	nm, SB
183	9.66	3.28	2.82	1.91	0.68	0.34	0.71	2	
P 10	9.28	3.24	2.76	1.85	0.69	0.33	0.69	1	
14	11.26	4.36	3.77	2.65	0.93	0.62	1.05	2	
24	11.53	4.40	3.80	2.72	0.94	0.61	1.10	2	
25	11.91	4.46	3.76	2.72	0.98	0.60	1.18	2	
26	10.78	4.12	3.60	2.51	0.84	0.55	0.96	2	
36	10.28	3.56	3.17	2.17	0.72	0.41	0.81	1	
42	13.14	4.39	3.53	2.64	1.22	0.54	1.31	1	SB2
50	9.00	3.04	2.58	1.75	0.65	0.29	0.67	1	
52	9.47	3.36	2.86	1.93	0.70	0.35	0.72	2	
60	10.91	3.97	3.44	2.39	0.87	0.51	0.99	2	
65	10.68	4.14	3.61	2.51	0.85	0.55	0.94	2	
66	10.64	4.14	3.61	2.53	0.84	0.56	0.95	1	
79	11.76	4.44	3.77	2.72	0.99	0.59	1.14	2	
80	9.98	3.75	3.30	2.22	0.76	0.46	0.83	2	
87	13.18	4.84	3.88	2.72	1.15	0.60	1.23	1	

Table 1 (continued)

No.	<i>V</i>	<i>U-V</i>	<i>P-V</i>	<i>X-V</i>	<i>Y-V</i>	<i>Z-V</i>	<i>V-S</i>	<i>n</i>	Remarks
P 90	9.77:	4.59	3.07	2.09	0.73	0.40	0.77	2	SB
92	9.55	3.44	2.99	2.00	0.72	0.38	0.76	2	
101	10.85	4.02	3.55	2.44	0.82	0.54	0.92	1	
107	8.96	2.83	2.38	1.60	0.61	0.26	0.60	2	
H 172	12.51	4.53:	3.93	2.79	1.10	0.61	1.20	2	
203	12.75	4.72	4.09	2.86	1.15	0.64	1.18	2	
336	11.63	4.45	3.74	2.73	1.05	0.62	1.16	2	
401	12.99	4.48	3.86	2.77	1.14	0.61	1.20	2	
432	11.96	4.58	3.75	2.76	1.14	0.64	1.21	2	
442	11.90	4.60	3.87	2.76	1.04	0.64	1.16	2	
456	12.22	4.72	4.00	2.94	1.12	0.66	1.17	2	
476	12.70	4.59	3.81	2.78	1.10	0.61	1.22	2	

Remarks :

SB is a spectroscopic binary, SBO is a spectroscopic binary with a known orbit, VBO is a visual binary with a known orbit, nm is a nonmember.

members of the Hyades cluster confirmed by their proper motions and radial velocities.

The magnitude *V* in the Vilnius system for the main sequence stars and normal red giants is the same as in the *UBV* system (Straižys 1977, 1992). Therefore, it is possible to compare the *V* magnitudes from Table 1 and those from Johnson et al. (1962) in the *UBV* system. For 74 stars common to both samples, differences versus magnitude are plotted in Fig. 1. It is evident that there is a small difference of $\Delta V = 0.03 \pm 0.02$ mag (r.m.s. error) in the zero-point, independent of the magnitude. Further, we correct our magnitudes by this systematic error.

Color indices of the Vilnius system make it possible to plot at least six color-magnitude diagrams. One of such diagrams for the Hyades is shown in Fig. 2.

In order to obtain the intrinsic sequences of the Hyades in the color-magnitude diagrams, a corresponding line has been drawn through denser point clustering at the lower side of the main-sequence array. For conversion of the apparent magnitudes to the absolute ones, the distance of the cluster must be known. The distance to the Hyades has been determined by various methods, the

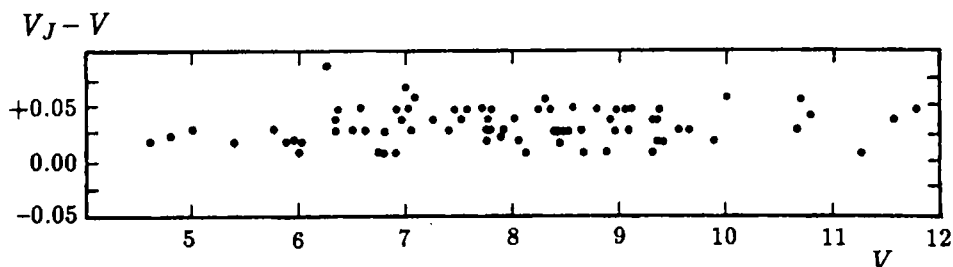


Fig. 1. Differences of the V_J magnitudes in the *UBV* system (Johnson et al. 1962) and the V magnitudes in the Vilnius system (Table 1) for the Hyades stars.

most precise being the method of group parallax. The older determinations were critically evaluated by Hanson (1980) who found the best mean value $V - M_V = 3.30 \pm 0.04$ mag. Since then, some new precise determinations have appeared which should also to be taken into account. Gunn et al. (1988) from extensive photoelectric radial velocity measurements of the cluster stars obtained practically the same value, $V - M_V = 3.28 \pm 0.10$ mag, by gradient method. Schwan (1991), using very precise proper motions for 145 Hyades members determined from the best positional catalogues, found a somewhat greater distance modulus, $V - M_V = 3.40 \pm 0.04$ mag, by the standard group parallax method. Patterson and Ianna (1991) combining new measures of the trigonometric parallaxes for 10 stars of the Hyades with the best older determinations for other cluster members, stated $V - M_V = 3.27 \pm 0.06$ mag. Peterson and Solenski (1988) from the dynamical parallaxes of the binaries got $V - M_V = 3.35 \pm 0.02$ mag. The straight mean value of these five distance moduli is $V - M_V = 3.32 \pm 0.05$ mag (interior mean square error) or 46.1 ± 1.0 pc. The weighted mean gives almost the same value of the modulus, 3.33 mag.

This value, as obtained by including some additional determinations, is somewhat more accurate than the one given previously by Dzērvītis and Paupers (1993).

With this value of the distance modulus, the apparent magnitudes have been transformed to the absolute ones. Some uncertainty in the position of the ZAMS, as derived in such a way, is caused by a considerable spread of the main-sequence array of the Hyades

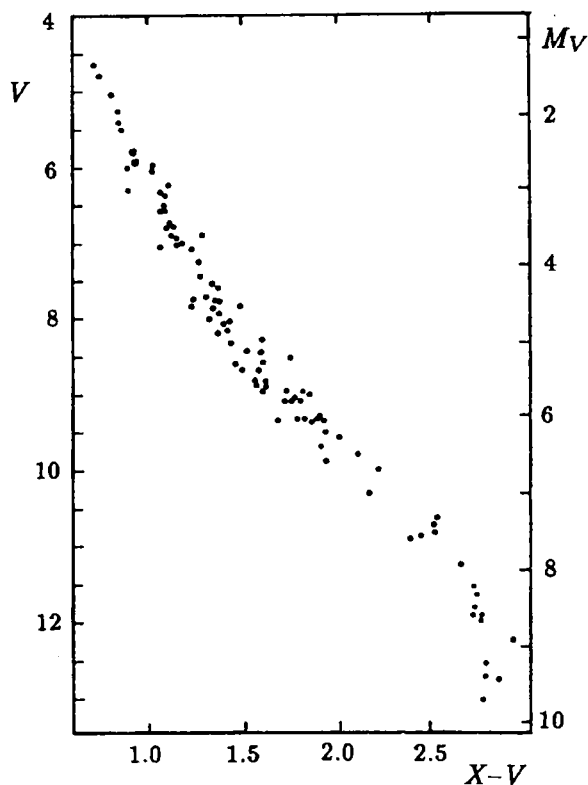


Fig. 2. The $V, X-V$ diagram for the main sequence stars of the Hyades. The scale of absolute magnitudes corresponds to $V-M_V = 3.32$ mag.

resulting from the fact that the size of the cluster is significant in comparison with its distance. Assuming a spherical shape for the cluster and taking into account that the most peripheral stars of the cluster are at $\sim 20^\circ$ from the cluster center, we expect a scattering of ± 1 mag around the mean position in the color-magnitude diagram.

An additional spreading of the main-sequence of the cluster is due to duplicity of stars which can cause (in the case of the components of equal brightness) a shift up to 0.75 mag upwards from the normal sequence. To avoid this effect, the known unresolvable binaries have been excluded from the program.

For outlining the position of the ZAMS, the peripheral stars of the cluster are most useful: the majority of them are expected to be at the mean cluster distance. Therefore, we tried to include such stars into the program and to consider them when locating the position of the ZAMS.

Another approach to the localization of the position of the ZAMS in a M_V vs. color index diagram is in using the individual distance moduli of stars calculated from their proper motions and radial velocities. According to the concept of the group parallax, the individual distance modulus of a cluster star with the proper motion μ and the space velocity v is

$$V - M_V = 5 \left(\log \frac{v \cdot \sin \lambda}{4.74\mu} - 1 \right), \quad (1)$$

where λ designates the angular distance of the star from the vertex point. The coordinates of the vertex point have been taken from Schwan (1991), where they are calculated from the most precise proper motions: $\alpha = 6^{\text{h}}30^{\text{m}}.7 \pm 1^{\text{m}}.7$, $\delta = 5^{\circ}59' \pm 11'$ (1950.0).

The space velocity v is related with the radial velocity v_r of the mass-center of the cluster:

$$v = v_r / \cos \lambda_c; \quad (2)$$

here λ_c is the angular distance between the cluster center and the vertex point. Taking for the coordinates of the cluster center $\alpha_c = 4^{\text{h}}24^{\text{m}}.6$, $\delta_c = 16^{\circ}39'$ (1950.0) (Gunn et al. 1988), we get $\lambda_c = 32^{\circ}64'$. With this value of λ_c and $v_r = 39.1$ km/s (at the cluster center), as stated by Detweiler (1984) and confirmed by Stefanik and Latham (1985), we obtain $v = 46.43$ km/s which should be used in formula (1). According to Griffin et al. (1988), the mean radial velocity of the cluster is somewhat greater, $v_r = 40.3$ km/s. However, the authors state that their value may contain a systematic error. Therefore, the previous value is preferred.

With the calculated individual distance moduli, the absolute magnitude vs. color index diagrams have been plotted and the position of the ZAMS has been read from a smooth line drawn through the medium of the points, ignoring the outstanding ones representing the known binaries. Both methods of the localization of the ZAMS show good coincidence. The average position of the ZAMS is given in Table 2. The brightest stars in the Hyades still lying on the ZAMS

Table 2. Intrinsic sequences of the Hyades ZAMS

M_V	$(U-V)_0$	$(P-V)_0$	$(X-V)_0$	$(Y-V)_0$	$(Z-V)_0$	$(V-S)_0$
3.5	2.19	1.73	1.12	0.46	0.18	0.44
4.0	2.32	1.84	1.22	0.51	0.19	0.49
4.5	2.44	1.98	1.32	0.55	0.21	0.53
5.0	2.62	2.13	1.44	0.58	0.24	0.58
5.5	2.82	2.37	1.61	0.63	0.29	0.64
6.0	3.17	2.75	1.81	0.67	0.35	0.69
6.5	3.48:	3.04:	2.04	0.73	0.41	0.76
7.0	3.80:	3.34:	2.24	0.79	0.55	0.88
7.5	4.11:	3.60	2.45	0.85	0.60	0.97
8.0	4.34	3.76	2.66	0.93	0.61	1.09
8.5	4.50	3.79:	2.73	1.02	0.62	1.16
9.0	4.56:	3.85:	2.78	1.10	0.61	1.18
9.5	4.58:	3.82	2.77	1.13	0.61	1.19

belong to the spectral class F2 V and their absolute magnitude is $M_V \approx 3.5$ mag.

The ZAMS of the Hyades usually serves for the distance determination of more remote clusters by means of the ZAMS fitting procedure. In this case one must take into account that the Hyades cluster has metal overabundance in comparison with solar abundance of the overwhelming majority of open clusters in the Galaxy. Metal abundance in the Hyades stars has been determined many times by both spectroscopic and photometric methods. Among the recent determinations by the high resolution spectroscopy, the $[\text{Fe}/\text{H}]$ value 0.20 ± 0.10 dex was found by Branch et al. (1980) for two Hyades G dwarfs and 0.15 ± 0.05 dex by Branch et al. (1978) for the giant δ Tau. In the same way, Gratton et al. (1982) determined $[\text{Fe}/\text{H}] = 0.17 \pm 0.06$ dex for three Hyades giants. By a new technique using the CORAVEL spectrum scans, Mayor (1980) got $[\text{Fe}/\text{H}] = 0.15 \pm 0.02$ dex for the Hyades dwarfs.

Among the recent determinations of the metal content in the Hyades stars obtained by photometric methods, the value $[\text{Fe}/\text{H}] = 0.12 \pm 0.09$ dex was deduced by Nissen (1988) from the uvby β -photometry of 42 Hyades dwarfs. Earlier, the narrow-band photometric indices of the Hyades giants have been used by Gustafsson et al. (1974) and Williams (1971) to get $[\text{Fe}/\text{H}] = 0.16 \pm 0.03$ dex and 0.22, respectively.

The mean value of all these determinations is $[\text{Fe}/\text{H}] = 0.17 \pm 0.02$ (internal m.s. error).

According to theoretical calculations of stellar models for the homogeneous chemical composition (cf. Vandenberg and Bridges 1984), an increase in metal abundance for the F, G, K dwarfs causes a brightening of the ZAMS by

$$\Delta M_V = -1.35 \cdot [\text{Fe}/\text{H}], \quad (3)$$

in the case of normal value of the helium abundance $Y = 0.25$ and the ratio of mixing length to pressure scale height, $\alpha = 1.5$. There is no indication that Y or α of the Hyades (and also of other intermediate age open clusters) may differ from these standard solar values. Moreover, a variation of the Y value within reasonable limits (0.20–0.30) is of negligible influence on the ZAMS luminosity. The choice of other value of α could give only a small effect on the shape of the ZAMS in a limited range of $M_V = 3.5 - 6.5$ mag. For $[\text{Fe}/\text{H}] = 0.17$ dex, we find a correction $\Delta M_V = 0.23$ mag to bring the ZAMS of the Hyades to the position corresponding to the solar metal abundance and thus suitable for the main sequence fitting procedure applicable to the clusters of normal chemical composition.

The Hyades cluster contains four red giants. Using their proper motions determined by Schwan (1991), we obtain from formula (1) the individual distance moduli and absolute magnitudes for them, as given in Table 3. The V values of these stars given in the table are averaged from different sources. Three of the Hyades giants are known binaries, but their companions are too faint, $\Delta V > 3.5$ mag (Baliunas et al. 1983), to influence significantly the M_V values.

Table 3. Red giants of the Hyades cluster

Name	BS	VB	V	$V - M_V$	M_V	Sp. type	Remarks
γ Tau	1346	28	3.65	3.34	0.3	K0 III	Binary resolved by speckle interferometry
δ Tau	1373	41	3.76	3.46	0.3	K0 III	Binary with known spectr. orbit, $P=530$ d
ϵ Tau	1409	70	3.53	3.37	0.15	G9.5 III	
θ^1 Tau	1411	71	3.84	3.39	0.45	K0 IIIb	Binary, $P \sim 6000$ d, $\Delta V = 3.5$ mag

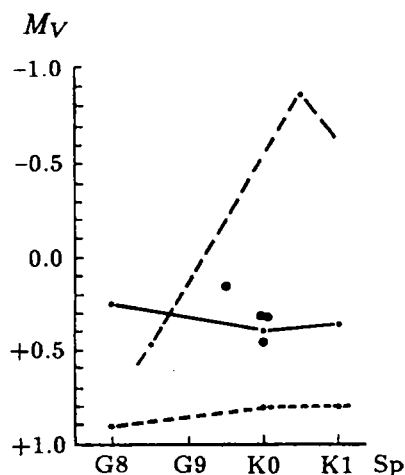


Fig. 3. The position of the Hyades giants (large dots) in the M_V , spectral class diagram. Broken lines are the calibrations of spectral classes in terms of absolute magnitude for giants in the solar vicinity: the solid line is for Mikami and Heck (1982), the dashed line is for Egret et al. (1982) and the dotted line is by Straižys and Kurilienė (1981).

In Fig. 3, the obtained absolute magnitudes of red giants of the cluster are plotted in the HR diagram along with some calibrations of spectral classes in terms of absolute magnitudes for the field G–K giants. Spectral classes for the Hyades giants are taken according to Egret et al. (1982). A good coincidence is evident between the location of the Hyades giants and the calibration by Mikami and Heck (1982) with the absolute magnitudes of field stars obtained by the maximum-likelihood method from their proper motions from the AGK3 catalogue. The compilative calibration by Straižys and Kurilienė (1981) gives absolute magnitudes for the G9–K0 giants by 0.3–0.7 mag fainter and more corresponding to the so-called clump red giants, i.e. the stars being in the phase of core helium burning. On the contrary, the absolute magnitudes given by Egret et al. (1982) for K0 giants are too bright by 0.4–1.0 mag in comparison with the Hyades giants. The absolute magnitudes of the Hyades giants, ranging between 0.15 and 0.45 mag, indicate that these giants are distinctly brighter than the clump giants having mean absolute magnitude $M_V \approx 0.9$ mag (Faulkner and Cannon 1973). Thus, the Hyades giants correspond to the stars on the first ascent red giant branch, which burn hydrogen in the shell.

The only blue straggler of the Hyades cluster is 78 θ^2 Tau. Its individual distance modulus calculated in the same way as for other stars is $V - M_V = 3.37$ mag, which gives $M_V = 0.03$ mag. The star has spectral class A7 III and so, considered as a normal giant, is about 1 mag brighter than it should be according to the calibration by Straizys and Kurilienė (1981). It is known as a spectroscopic binary with a period of 141 d and has a determined spectroscopic orbit. Its low mass function indicates that the invisible companion cannot be responsible for the difference in absolute magnitude.

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References

- Baliunas S.L., Hartman L., Dupree A.K. 1983, ApJ, 271, 672
 Branch D., Bonnell J., Tomkin J. 1978, ApJ, 225, 902
 Branch D., Lambert D.L., Tomkin J. 1980, ApJ, 241, L83
 Detweiler H.L., Yoss K.M., Radick R.R., Becker S.A 1984, AJ, 89, 1038
 Dzērvītis U., Paupers O. 1993, Ap&SS, 199, 77
 Egret D., Keenan P.C., Heck A. 1982, A&A, 106, 115
 Faulkner D.J., Cannon R.D. 1973, ApJ, 180, 435
 Gratton L., Gaudenzi S., Rossi C., Gratton R.G. 1982, MNRAS, 201, 807
 Griffin R.F., Gunn J.E., Zimmerman B.A., Griffin R.E. 1988, AJ, 96, 172
 Gunn J.E., Griffin R.F., Griffin R.E., Zimmerman B.A. 1988, AJ, 96, 198
 Gustafsson B., Kjaergaard P., Anderson S. 1974, A&A, 34, 99
 Hanson R.B. 1975, AJ, 80, 379
 Hanson R.B. 1980, in Star Clusters (IAU Symp. 85), ed. J.E. Hesser, p. 71
 Johnson H.L., Mitchell R.T., Iriarte B. 1962, ApJ, 136, 75
 Mayor M. 1980, A&A, 87, L1
 Mikami T., Heck A. 1982, Publ. Astron. Soc. Japan, 34, 529
 Nissen P.E. 1988, A&A, 199, 146
 Patterson R.J., Ianna P.A. 1991, AJ, 102, 1091
 Pels G., Oort J.H., Pels-Kluyver H.A. 1975, A&A, 43, 423
 Peterson D.M., Solenski R. 1988, ApJ, 333, 256
 Schwan H. 1991, A&A, 243, 386
 Stefanik R.P., Latham D.W. 1985, in Stellar Radial Velocities (IAU Coll. 88), eds. A.G.D. Philip et al., p. 213
 Straizys V. 1977, Multicolor Stellar Photometry, Mokslas Publishers, Vilnius (in Russian)

- Straizys V. 1992. Multicolor Stellar Photometry, Pachart Publishing House, Tucson, Arizona
- Straizys V., Kazlauskas A. 1993, *Baltic Astronomy*, 2, 1
- Straizys V., Kurilienė G. 1981, *Ap&SS*, 80, 353
- Straizys V., Jodinskienė E., Kurilienė G. 1982, *Bull. Vilnius Obs.*, No. 60, 16
- van Bueren H. 1952, *Bull. Astron. Inst. Nederl.*, 11, 385
- VandenBerg D.A., Bridges T. 1984, *ApJ*, 278, 679
- Williams P.M. 1971, *MNRAS*, 153, 171
- Zdanavičius K. 1975, *Bull. Vilnius Obs.*, No. 41, 3