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CCD photometry of galactic open star clusters—II. NGC 7419

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Abstract. CCD photometric observations of open cluster NGC 7419 in *UBVRI* passbands have been made down to V = 19.5 mag. Reddening across the cluster region is found to be variable. The mean visual absorption of 5.30 mag and a distance of 2 kpc have been estimated for the cluster. The cluster age has been estimated to be nearly 40 Myr and less than 40 Myr, using the convective core overshooting isochrones and empirical isochrones respectively.

Key words : open cluster—photometry

1. Introduction

NGC 7419 (C2252 + 605) is a small galactic star cluster of diameter ~ 5' in Cepheus lying within the galactic plane (l = 109°.13, b = + 1°.14). Trumpler class I 2 m has been assigned to the cluster in the catalogue of Lynga (1987). This faint cluster has not been studied in detail before, but with the advent of charge couple devices (CCD) it is now possible to study such faint clusters even with a moderate sized (~ 1 metre class) telescope.

From objective-prism infrared spectroscopic observations of NGC 7419, Blanco *et al.* (1955) have concluded that the cluster contains four early M supergiants and a late M star which is suspected to be a supergiant. A total visual absorption of 5.0 mag and a distance of 6 kpc have been obtained based upon the red and infrared magnitudes of the stars in the cluster region. van de Hulst *et al.* (1954) have obtained a distance of 3.3 kpc for the cluster. Moffat & Vogt (1973) have given a value of 6.0 kpc for the distance of the cluster. Fawley & Cohen (1974) have obtained near infrared observations for the M stars in the cluster and a distance of 4.7 kpc and an A_v of 4.5 mag are derived for the cluster. Recently from CCD *UBV* photometry of NGC 7419, Beauchamp & Moffat (1991) have obtained a distance of 3.6 kpc and $< E\,(B - V) >$ = 2.04 ± 0.10 (σ) mag. Lynga (1987) have given a value of 1.92 kpc for the distance of the cluster.

The aim of this paper is to describe the *UBVRI* CCD photometric observations of the stars in the field of NGC 7419. These observations have been used to study the interstellar extinctions across the cluster region and to estimate age, distance and other parameters of the cluster.

2. Observations

The observations of NGC 7419 were carried out in the *U, B,V, R* and *I* passbands using a photometrics CCD system having a 384 × 576 pixel Thomson chip, at the f/13 Cassegrain focus of the 104-cm reflector of the Uttar Pradesh State Observatory (UPSO) during October-November 1991. In this set up the entire CCD chip covers a field of 2.0 × 3.0 sq arc-min of the sky. In order to improve the *S/N* ratio the observations were taken in binning mode of 2 × 2 pixel. The details of the present system have also been described by Mohan *et al.* (1991). The two overlapping regions named West and East (figure 1) were taken in each passband to cover the entire cluster region. Multiple exposures were taken with exposure times ranging from 1 second to 600 seconds, depending on the presence of bright stars and filter used. The observing details are given in table 1. A number of flats were also taken in each passband by observing the twilight sky. Landolt (1983) standard stars were also observed for calibration purposes.

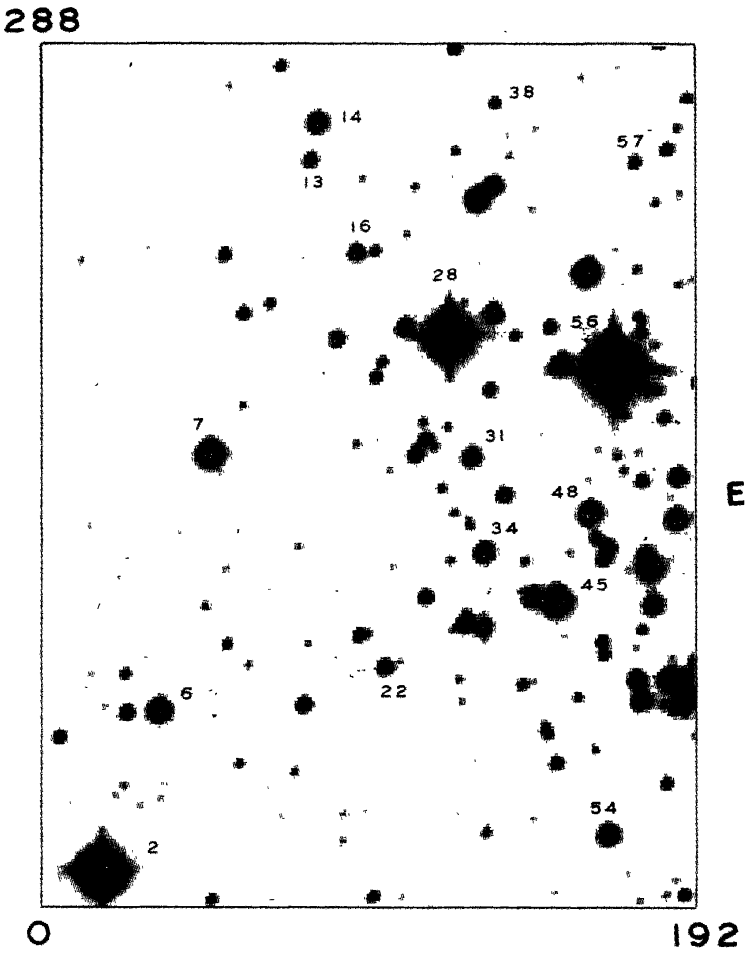

Figure 1a. Identification map for the West region of the cluster NGC 7419.

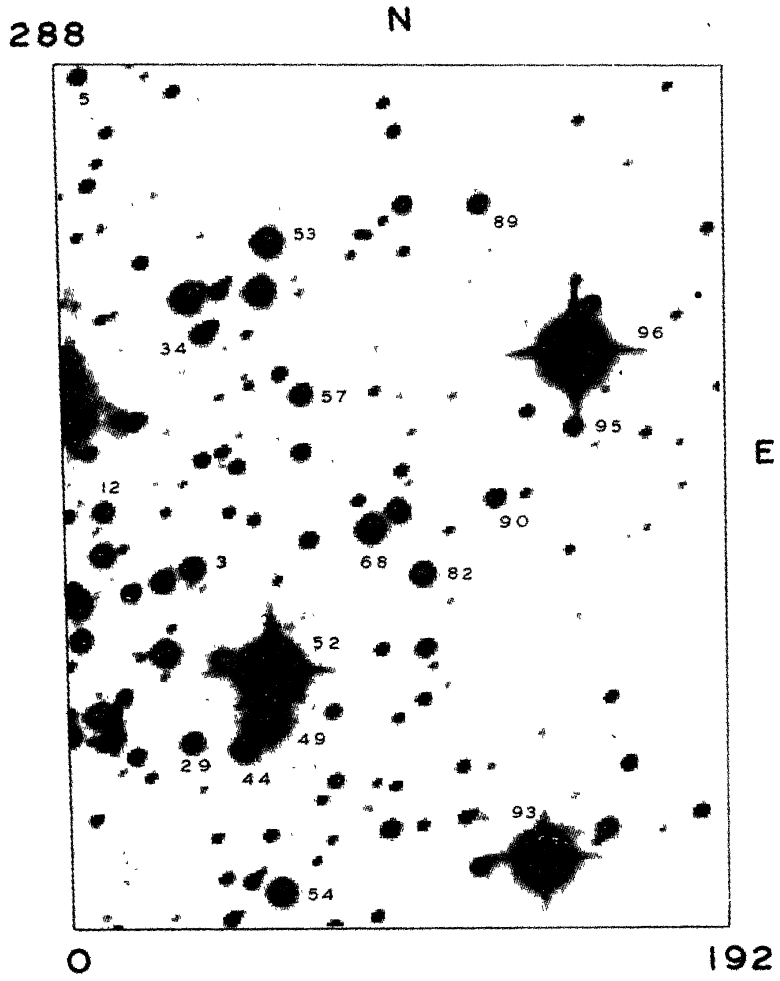

Figure 1b. Identification map for the East region of the cluster NGC 7419.

Table 1. Log of observations

	West region						East region			
Filter	11/12 Oct. 91		12/13 Oct. 91		2/3 Nov. 91		12/13 Oct. 91		2/3 Nov. 91	
	a	b	a	b	a	b	a	b	a	b
U	3	600	—	—	3	600	3	600	3	600
B	1	600	—	—	2	600	2	600	2	600
	1	60			1	60			1	300
V	1	300	—	—	2	300	1	300	2	300
	1	10			1	20	1	120	1	60
R	1	120	—	—	1	120	1	120	1	120
	1	2			1	3	1	5	1	5
I	1	120	1	60	1	120	1	120	1	120
			1	1.5	1	2	1	1	1	1

Note : Column a and b for each night show the number of frames observed and exposure time in seconds respectively.

3. Data reduction

The observations have been reduced using the Micro Vax II system of UPSO. Clean images have been obtained using the ESO MIDAS software package. The cleaned frames in the same filter having similar exposures times were coadded. The photometry was done using the DAOPHOT profile-fitting software (Stetson 1987). The stellar point-spread-function (PSF) was evaluated from the several uncontaminated stars present in each frame. For a few bright stars which were saturated in the long exposure frames, short exposure frames were used. Table 2 gives the X and Y co-ordinates as well as photometric data of the stars measured in the East and West cluster fields.

The mean errors in the individual observations of colour indices and magnitudes were estimated and these are listed in table 3 as a function of brightness.

4. Interstellar extinction

To estimate the interstellar extinction in the cluster region, we have used the $(U-B, B-V)$ diagram. The intrinsic zero-age-mainsequence (ZAMS) given by Mermilliod (1981) was fitted to the mainsequence stars of spectral type earlier than A0 in the cluster field and we have found that the $E\ (B-V)$ for cluster stars varies from 1.54 to 1.88 mag (figure 2). The slope $E\ (U-B)/E\ (B-V)$ was taken to be equal to 0.72 (Johnson & Morgan 1953). The observed dispersion in the $E\ (B-V)$ values cannot be due to errors in the data and other parameters such as rotation, duplicity etc. which can produce a maximum variation of 0.11 mag in $E\ (B-V)$ for MS stars (*cf.* Burki 1975). Therefore, we conclude that the reddening is non uniform across the cluster field. The interstellar extinction for individual MS stars has also been derived using the Q-method (Johnson & Morgan 1953). The frequency distribution of $E\ (B-V)$ obtained for probable MS cluster members is shown in figure 3.

The mean $(E\ (B-V))$ for the cluster comes out to be 1.71 ± 0.19 (σ) mag. Using the most acceptable value of total to selective absorption $R = 3.1$, the mean visual absorption A_v, comes out to be 5.30 mag. Blanco *et al.* (1955) derived a total visual absorption of 5.0 mag, however, Fawley & Cohen (1974) have found $A_v = 4.5$ mag. The mean value of $A_v = 6.76 \pm 0.35$ (σ) obtained by Beauchamp & Moffat (1991) seems to be relatively higher as compared to the values obtained by earlier authors and also in the present study. It is interesting to note that the mean visual absorption $A_v = 5.3$ mag higher than the general absorption in the direction of NGC 7419. Pandey and Mahra (1987) have found an absorption of ~ 2.5 mag for the distance of 2.0 kpc towards this region. A mean visual absorption of 2.0 to 3.0 mag have been found by Nickel and Klare (1980) in the direction of $l = 107°$ to 113° near the galactic plane. The cluster NGC 7380 ($l = 112°.76$, $b = +0°.46$) and Mark 50 ($l = 111.36$, $b = -0.02$) nearly in the direction of NGC 7419 show a range of mean A_v from 1.8 to 3.4 mag (see Leisawitz 1980). Therefore, it seems that the general reddening is higher in the cluster region itself.

5. Distance to the cluster

Colour-magnitude diagrams $(V, B-V)$ and $(V, V-I)$ are plotted in figures 4 and 5 respectively. A broad but well defined cluster MS is clearly visible in the magnitude range $15.0 > V > 19.5$ mag. To estimate the distance to the cluster we have fitted the ZAMS given

Table 2. Magnitudes and colours of the stars in the field of NGC 7419

Star ID	*X*	*Y*	*(U − B)*	*(B − V)*	*V*	*(V − R)*	*(R − I)*	*(V − I)*	Remark
West region									
1	7.30	277.64	*	1.492	16.588	0.928	1.101	2.015	
2	19.20	26.58	*	3.362	13.823	2.408	2.216	4.640	M
3	25.99	52.39	*	1.047	19.130	1.184	1.222	2.400	
4	26.35	85.25	*	2.037	18.424	1.256	1.349	2.596	
5	26.55	73.78	*	1.840	17.118	1.241	1.292	2.501	
6	35.91	74.23	0.773	1.788	14.753	1.149	1.225	2.366	M
7	50.90	150.67	0.725	0.679	13.941	1.089	1.173	2.254	
8	55.20	209.90	*	1.810	17.412	1.123	1.238	2.350	
9	59.45	58.96	*	1.513	18.867	1.266	1.336	2.595	
10	60.75	192.63	*	1.615	17.281	1.096	1.151	2.239	
11	71.90	266.12	*	1.468	17.880	1.185	1.163	2.345	
12	78.12	76.19	*	1.951	16.906	1.310	1.329	2.633	
13	80.41	237.82	*	1.489	16.583	1.121	1.139	2.255	
14	82.42	248.88	1.013	1.720	15.349	1.354	1.244	2.602	M
15	88.16	184.82	*	1.680	16.878	1.100	1.192	2.283	
16	93.48	210.62	0.839	1.485	16.050	1.060	1.087	2.142	M
17	93.78	154.04	*	1.775	18.985	1.149	1.245	2.385	
18	94.23	96.85	*	1.628	17.195	1.038	1.108	2.138	
19	98.47	19.57	*	*	17.919	1.206	1.252	2.452	
20	99.35	173.68	*	1.905	17.395	1.009	1.155	2.152	
21	99.36	211.26	*	1.621	18.059	1.098	1.121	2.214	
22	101.72	87.31	*	1.772	16.493	1.018	1.176	2.287	
23	107.86	188.65	*	1.498	16.016	0.987	1.169	2.141	
24	110.76	150.83	0.720	1.561	16.367	1.008	1.105	2.104	M
25	113.75	108.42	*	1.555	16.649	1.008	1.106	2.105	
26	113.99	155.28	*	1.632	16.953	1.055	1.149	2.195	
27	118.74	140.98	*	1.635	18.211	1.131	1.140	2.214	
28	120.33	185.29	1.232	1.238	10.478	0.653	0.583	1.239	
29	122.54	271.82	1.006	1.578	16.820	1.175	1.168	2.345	M
30	125.49	100.48	0.448	1.703	15.813	1.083	1.156	2.231	M
31	127.32	149.90	0.866	1.560	15.494	1.026	1.092	2.110	M
32	129.02	225.99	0.875	1.464	14.670	1.097	1.084	2.178	M
33	130.60	98.81	*	1.651	16.425	1.081	1.161	2.234	
34	130.83	121.52	*	1.538	15.210	1.020	1.192	2.104	
35	132.76	169.91	*	1.645	17.330	1.004	1.176	2.167	
36	133.71	192.61	*	2.471	16.719	1.605	1.580	2.183	
37	133.89	230.18	0.761	1.593	15.967	1.264	1.203	2.467	M

(Continued)

Table 2. Continued

Star ID	X	Y	(U − B)	(B − V)	V	(V − R)	(R − I)	(V − I)	Remark
West region									
38	134.50	255.20	*	1.633	18.170	1.364	1.288	2.652	
39	136.95	138.78	0.870	1.593	16.401	1.088	1.137	2.220	M
40	142.33	82.48	*	1.631	17.879	1.033	1.158	2.180	
41	143.05	119.21	*	1.534	18.507	1.115	1.161	2.270	
42	145.15	108.30	*	2.736	16.741	1.829	1.628	3.464	
43	150.54	188.71	*	1.524	17.303	1.139	1.172	2.305	
44	152.03	59.20	*	1.834	17.759	1.219	1.310	2.520	
45	152.08	106.87	0.673	1.595	13.700	1.097	1.115	2.208	M
46	153.53	177.24	0.851	1.511	15.268	1.087	1.132	2.214	M
47	156.15	121.77	*	1.504	19.293	1.161	1.097	2.258	
48	161.95	133.42	0.635	1.434	14.513	0.947	1.007	1.947	M
49	163.86	125.95	*	1.248	17.673	1.121	1.114	2.232	
50	164.79	152.30	*	0.577	19.430	1.031	1.092	2.116	
51	165.56	95.25	*	1.526	17.724	1.054	1.103	2.110	
52	165.83	119.64	*	1.531	16.795	1.005	1.060	2.058	
53	166.14	91.33	*	1.479	17.690	1.070	1.129	2.192	
54	167.04	37.91	0.884	1.760	15.279	1.171	1.240	2.408	M
55	167.45	123.06	0.586	1.417	16.503	0.967	1.047	2.005	M
56	168.59	175.32	3.175	2.974	12.813	2.275	2.099	4.375	M
57	175.24	237.48	*	1.519	17.278	1.127	1.118	2.242	
58	175.37	83.98	0.630	1.432	16.073	0.965	1.082	2.037	M
59	175.86	205.97	*	1.363	18.455	1.137	1.054	2.192	
60	176.78	77.68	0.725	1.676	15.642	1.114	1.182	2.288	M
61	177.18	143.23	*	1.454	17.216	1.015	1.059	2.069	
62	177.25	186.91	*	1.414	17.821	1.105	1.126	2.273	
63	177.64	121.81	*	1.470	17.503	0.968	1.024	1.986	
East region									
1	3.38	112.51	0.631	1.399	13.736	0.891	0.979	1.860	M
2	4.38	101.44	0.494	1.391	15.047	0.894	0.975	1.861	M
3	5.50	221.03	*	1.454	18.804	1.242	1.277	2.513	
4	5.70	165.15	*	1.505	18.280	1.237	1.650	2.859	
5	6.60	269.12	0.891	1.585	16.212	1.067	1.119	2.179	M
6	7.82	157.11	*	1.586	17.754	1.133	*	*	
7	8.24	48.65	*	1.633	17.612	1.085	1.164	2.240	
8	8.74	236.60	*	1.504	17.140	1.071	1.137	2.225	
9	9.29	79.10	0.641	1.567	14.660	0.985	1.068	2.004	M
10	11.27	126.87	0.547	1.477	15.106	1.084	1.101	2.170	M

(Continued)

Table 2. Continued

Star ID	*X*	*Y*	*(U − B)*	*(B − V)*	*V*	*(V − R)*	*(R − I)*	*(V − I)*	Remark
East region									
11	11.81	243.21	*	1.574	18.539	1.134	1.120	2.252	
12	11.89	139.71	0.538	1.426	15.498	0.930	1.009	1.932	M
13	13.37	15.36	*	1.756	17.506	1.095	1.170	2.257	
14	13.79	80.42	*	1.540	17.239	0.932	1.165	2.080	
15	13.98	72.74	0.671	1.526	15.894	0.970	1.096	2.056	M
16	14.67	252.29	*	1.602	17.863	1.103	1.131	2.229	
17	17.06	85.04	*	1.678	17.074	1.014	1.094	2.099	
18	17.14	169.45	*	1.488	17.865	1.025	1.255	2.300	
19	19.41	115.73	0.520	1.351	15.742	0.852	0.941	1.784	M
20	20.18	67.24	0.345	1.512	16.448	1.044	1.117	2.153	M
21	21.24	166.31	0.568	1.461	16.217	0.921	1.047	1.956	M
22	22.24	273.81	*	1.549	17.582	1.102	1.122	2.119	
23	23.96	213.43	*	1.655	17.325	1.020	1.109	2.121	
24	24.38	61.14	*	1.866	18.353	1.083	1.110	2.287	
25	28.61	118.87	0.501	1.583	15.423	1.096	1.104	2.197	M
26	28.90	97.58	0.692	1.486	14.344	0.967	1.017	1.978	M
27	31.17	105.34	*	1.891	19.147	1.117	0.955	2.079	
28	34.05	264.28	*	1.524	17.190	0.940	0.928	1.856	
29	36.38	70.86	*	2.420	16.281	1.552	1.484	3.035	
30	36.82	202.55	0.451	1.538	14.194	1.118	1.080	2.196	M
31	37.42	122.62	0.712	1.531	14.836	0.996	1.040	2.030	M
32	40.69	154.66	*	1.563	17.209	1.049	1.171	2.199	
33	40.90	275.74	0.385	1.329	15.393	0.937	0.968	1.899	M
34	41.23	192.13	0.567	1.431	15.511	0.941	1.003	1.937	M
35	43.21	42.98	*	1.459	18.063	1.117	1.222	2.329	
36	45.31	95.58	0.844	1.543	16.065	0.996	1.112	2.096	M
37	45.78	30.91	*	1.778	17.982	1.237	1.343	2.570	
38	46.32	205.01	0.506	1.740	16.489	1.135	1.154	2.284	M
39	46.81	157.17	*	1.571	17.496	0.964	1.028	1.985	
40	46.99	18.75	*	1.664	16.893	1.068	1.132	2.193	
41	48.06	187.88	*	1.105	20.028	1.198	1.098	2.298	
42	48.29	139.18	*	1.603	17.971	1.077	1.172	2.240	
43	50.87	152.55	*	1.478	16.909	0.968	1.029	1.990	
44	51.69	69.05	0.478	1.631	14.425	1.016	1.084	2.099	M
45	52.99	29.95	*	1.677	16.915	1.067	1.126	2.186	
46	54.37	192.10	*	1.362	18.648	1.025	1.100	2.117	
47	54.75	176.66	*	1.001	18.874	1.175	1.052	2.231	

(Continued)

Table 2. Continued

Star ID	X	Y	(U − B)	(B − V)	V	(V − R)	(R − I)	(V − I)	Remark
East region									
48	55.51	137.00	*	1.579	17.526	1.024	1.103	2.119	
49	58.25	76.85	0.532	1.579	13.089	1.000	1.102	2.092	M
50	58.31	204.54	0.377	1.566	14.248	1.135	1.120	2.253	M
51	58.85	43.57	*	1.590	17.450	1.039	1.098	2.130	
52	59.54	91.74	*	3.137	12.904	2.255	2.064	4.323	M
53	60.97	218.85	0.534	1.533	14.345	1.180	1.144	2.323	M
54	61.66	26.43	0.650	1.717	14.198	1.048	1.098	2.141	M
55	63.57	180.10	*	1.574	17.169	1.116	1.173	2.282	
56	69.58	156.80	0.706	1.321	15.690	0.846	0.922	1.760	M
57	69.77	173.96	0.431	1.513	15.419	1.079	1.095	2.169	M
58	70.04	204.19	*	1.081	19.359	1.148	1.103	2.250	
59	71.15	130.74	0.742	1.521	16.145	0.952	1.031	1.975	M
60	73.89	54.07	*	1.504	18.100	1.050	1.120	2.162	
61	76.61	15.58	*	1.729	16.670	1.223	1.245	2.463	
62	77.49	79.85	*	1.639	17.113	0.967	1.100	2.055	
63	77.96	59.67	*	1.658	16.959	1.006	1.127	2.118	
64	85.41	215.01	*	1.427	18.903	1.129	1.174	2.297	
65	86.05	142.23	*	1.476	17.630	0.952	0.981	1.952	
66	88.06	221.18	*	1.283	18.431	1.111	1.046	2.157	
67	89.43	19.23	*	1.537	17.689	1.070	1.162	2.224	
68	89.45	133.67	0.571	1.448	14.049	0.978	1.006	1.981	M
69	91.40	174.69	*	1.467	18.355	0.982	1.080	2.053	
70	92.10	98.32	*	1.640	17.542	1.077	1.162	2.230	
71	93.64	45.07	0.875	1.730	16.073	1.148	1.176	2.318	M
72	95.50	260.12	*	1.256	17.808	1.020	1.027	2.042	
73	95.67	57.92	*	1.458	18.084	1.023	1.111	2.126	
74	96.68	77.67	*	1.589	18.428	1.063	1.200	2.251	
75	98.05	138.59	0.772	1.351	15.491	0.871	1.084	1.940	M
76	98.33	251.55	*	1.333	17.297	1.039	0.993	2.032	
77	98.87	150.94	0.369	1.304	17.337	0.914	0.991	1.896	
78	100.46	229.63	0.512	1.361	15.993	1.026	1.000	2.023	M
79	100.82	215.91	*	1.533	18.749	1.446	1.279	2.732	
80	103.24	46.17	*	1.719	17.912	1.073	1.139	2.205	
81	104.07	83.51	*	1.666	17.552	1.070	1.155	2.216	
82	104.40	120.40	0.589	1.520	14.999	1.135	1.088	2.223	M
83	104.85	98.53	0.650	1.564	15.919	1.001	1.060	2.054	M
84	111.43	282.26	*	1.669	18.631	1.255	1.186	2.242	

(Continued)

Table 2. Continued

Star ID	*X*	*Y*	*(U − B)*	*(B − V)*	*V*	*(V − R)*	*(R − I)*	*(V − I)*	Remark
East region									
85	112.41	133.35	*	1.302	18.487	0.944	0.986	1.924	
86	115.39	63.57	*	1.542	17.620	1.079	1.169	2.239	
87	115.86	48.45	*	1.597	17.041	1.028	1.100	2.120	
88	119.51	33.43	0.442	1.650	16.352	1.049	1.125	2.166	M
89	122.54	229.39	0.486	1.243	15.550	0.992	0.927	1.945	M
90	126.19	142.59	0.442	1.472	15.803	1.106	1.066	2.171	M
91	135.19	143.87	*	1.767	18.245	1.039	1.064	2.099	
92	135.89	168.12	*	1.374	17.492	1.016	1.086	2.094	
93	138.37	35.68	*	3.135	13.007	2.152	1.968	4.085	M
94	147.76	127.28	*	1.559	18.449	1.006	1.085	2.084	
95	149.55	163.38	0.713	1.352	16.061	1.005	1.014	2.016	M
96	150.24	185.24	*	3.271	15.053	3.886	2.952	6.884	
97	150.92	206.44	*	1.370	18.805	1.156	1.512	2.642	M
98	152.64	254.33	*	1.274	18.248	1.042	1.036	2.074	
99	155.40	199.74	*	2.081	17.659	1.700	1.563	3.267	
100	157.34	44.72	0.744	1.649	15.616	1.021	1.089	2.103	M
101	159.05	83.47	*	1.557	17.497	0.976	1.053	2.021	
102	164.00	63.92	*	1.589	16.586	0.991	1.054	2.039	
103	170.70	161.46	*	1.320	18.334	1.145	1.130	2.273	
104	178.82	264.16	*	1.317	18.514	1.120	1.095	2.213	
105	184.98	49.52	*	1.564	16.627	0.935	1.054	1.979	

Table 3. Photometric errors of observations as a function of *V* magnitude

V magnitude	*(U − B)*	*(B − V)*	*V*	*(V − R)*	*(R − I)*	*(V − I)*
< 15.0	0.025	0.008	0.010	0.013	0.019	0.020
15.0 – 16.0	0.030	0.014	0.016	0.015	0.014	0.017
16.0 – 17.0	0.041	0.031	0.016	0.011	0.013	0.015
17.0 – 18.0	—	0.034	0.018	0.015	0.014	0.017
> 18.0	—	0.034	0.058	0.010	0.016	0.013
for all	0.028	0.029	0.016	0.014	0.015	0.016

by Schmidt-Kaler (1982) in the *(V, B − V)* CMD and the ZAMS given by Walker (1985) for *(V, V − I)* CMD on the bluest envelope of data points in figures 4 and 5 respectively and a distance modulus $(m - M)_v = 16.8$ mag has been obtained for the cluster. From figure 5 it seems that the relation $E\ (V - I) = 1.25 \times E\ (B - V)$ (Walker 1985) is not valid for this cluster. Using the mean $E\ (B - V) = 1.71$ mag for the cluster and $A_v = 3.1 \times 1.71$, the true distance modulus $(m - M)_0$ come out to be 11.50 mag which corresponds to a distance of

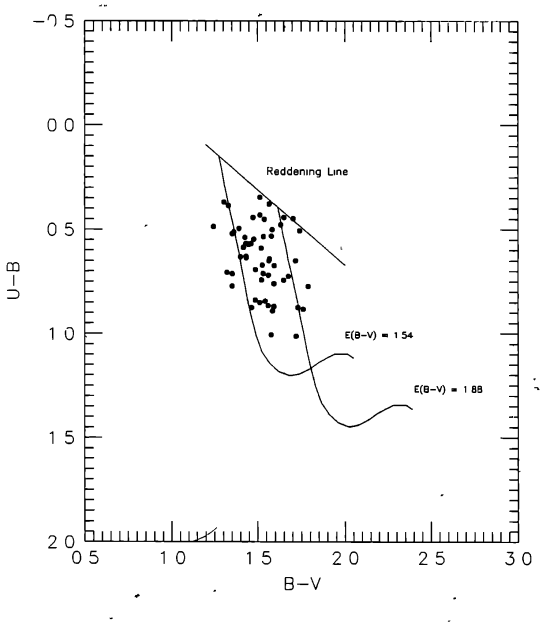

Figure 2. The colour–colour diagram for the cluster region.

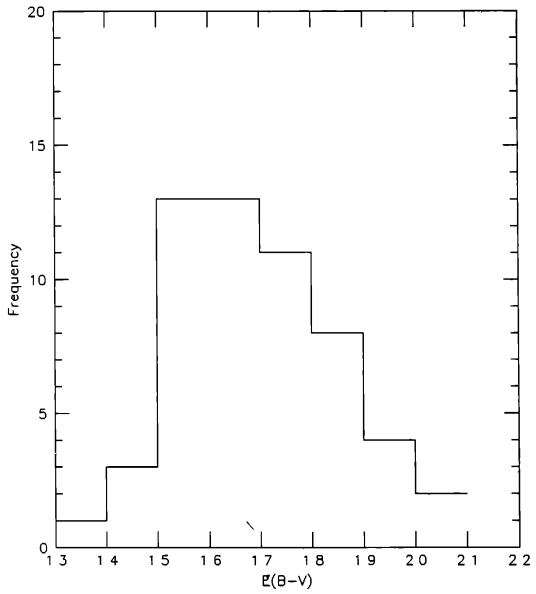

Figure 3. The frequency distribution of $E(B-V)$ of the stars in the region of NGC 7419 obtained from Q-method.

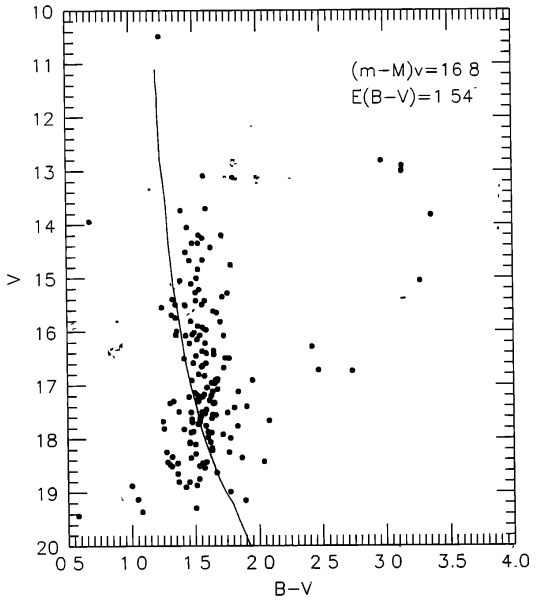

Figure 4. The colour-magnitude diagram ($V, B-V$) for all stars measured in the West and East regions of NGC 7419. The full line represents the ZAMS taken from Schmidt-Kaler (1982).

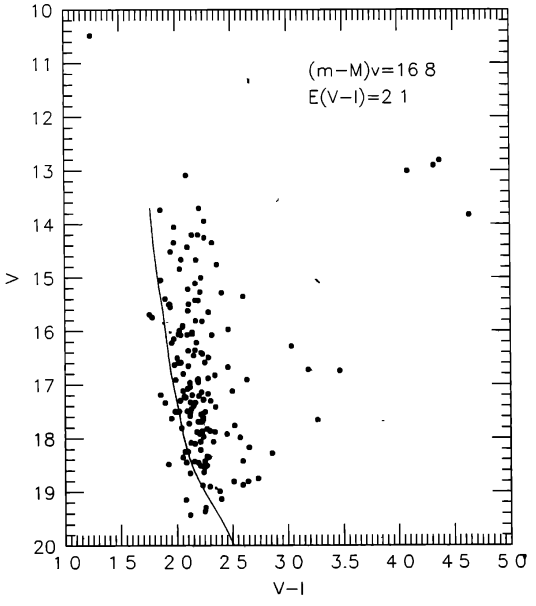

Figure 5. The colour-magnitude diagram ($V, V-I$) for all stars measured in the West and East regions of NGC 7419. The full line represents the ZAMS taken from Walker (1985).

2.0 kpc. The distance determined by us is in good agreement with the distance given by Lynga (1987). Blanco *et al.* (1955) and Fawley & Cohen (1974) have obtained the distance on the basis of the spectroscopic observations of giant stars only.

Since the proper motion and spectroscopic studies are not available for the stars (except for 4 or 5 stars) in the cluster region, the discrimination of non-members from the observed

sample has been carried out using photometric criteria only. We have considered only those stars as members which lie in between blue envelope of the MS and the red envelope (obtained by shifting the MS for the maximum value of $E\ (B-V)$ in the $(V, B-V)$ CMD). This choice should not reject cluster member and yield a sample suitable for further analysis. The member stars are assigned as 'M' in table 2. The giant stars are the detected members of this cluster. However the star no. 28 (West region), which is designated by 'f' by earlier authors, is a giant star but this star has been considered as a non-member because the visual absorption shown by this star is too small (Blanco *et al.* 1955).

6. Age of the cluster

To estimate the age of the cluster, we have used the observations of those stars for which individual reddening could be obtained. The reddening corrections of surrounding stars are used to get the V_0, $(B-V)_0$ and $(U-B)_0$ of the giant stars. The $(M_v, (U-B)_0)$ and $(M_v, (B-V)_0)$ diagrams for cluster stars are shown in figures 6 and 7 respectively. The open circles represent the data for giant stars corrected by using the bluest envelope of CCD (*cf.* figure 2, $E\ (B-V) = 1.54$ mag). Since stellar evolutionary effects are clearly visible in the CMDs of the cluster, an accurate estimation of cluster age is possible. We have estimated the cluster age by fitting the empirical isochrones (Mermilliod 1981) for NGC 3766, α-per and NGC 2516 groups. The dereddened CMDs suggest that the cluster is young having age < 40 Myr. The convective core overshooting isochrones given by Maeder & Maynet (1991) have also been fitted in the dereddened CMDs (figures 8 and 9). They are going up to advanced stage of evolution to the giant members of the cluster. From the convective core

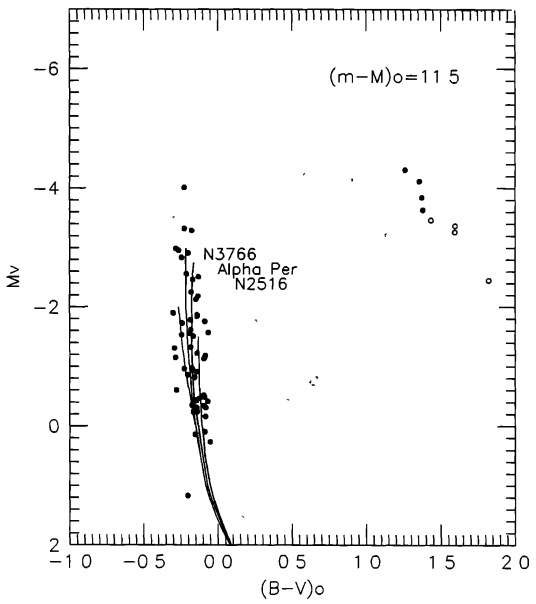

Figure 6. The M_v, $(B-V)_0$ diagram of NGC 7419. The isochrones are of Mermilliod (1981). The open circles represent the data of giant stars corrected by using the bluest envelope of CCD (cf. figure 2, $E\ (B-V) = 1.54$ mag).

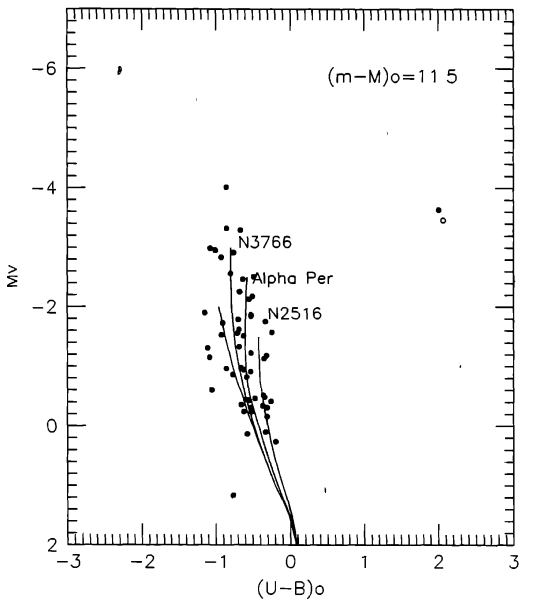

Figure 7. The M_v, $(U-B)_0$ diagram of NGC 7419. The isochrones are of Mermilliod (1981). Notations are as in figure 6.

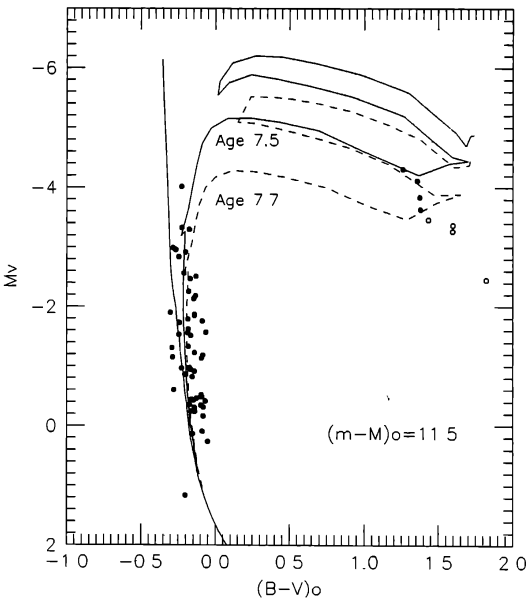

Figure 8. The M_v, $(B - V)_0$ diagram ot NGC 7419. The isochrones are of Maeder & Maynet (1992). Notations are as in figure 6.

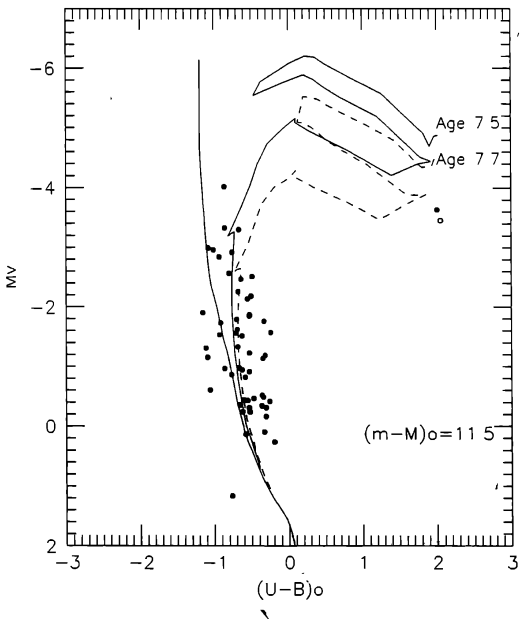

Figure 9. The M_v, $(B - V)_0$ diagram of NGC 7419. The isochrones are of Maeder & Maynet (1992). Notations are as in figure 6.

overshooting isochrones the age of the cluster comes out to be nearly 40 Myr. A rough estimate of the age ~ 3×10^6 yrs of NGC 7419 has been given by Fawley and Cohen (1974).

7. Conclusions

The CCD photometry of the cluster in *UBVRI* photometric passbands down to $V = 19.5$ mag indicates a well defined MS of the cluster and a true distance modulus of 11.50 mag corresponding to a distance of 2.0 kpc has been obtained for the cluster. The age of the cluster is estimated to be ~ 40 Myr. The reddening in the cluster region is found to be variable having $\Delta E\ (B - V) = 0.38$ mag. Photometric observations of giant stars agree with the spectroscopic observations given by Fawley & Cohen (1974). A slight disagreement in the luminosity class of these giant stars may be due to incorrect reddening correction, because the actual reddening for the individual giant stars could not be derived using the Q-method.

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