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CCD photometry of the galactic open star clusters— I. King 10

V. Mohan[1], A. K. Pandey[1], D. C. Paliwal[1], Ram Sagar[2] and H. S. Mahra[1]
[1] Uttar Pradesh State Observatory, Manora Peak, Naini Tal 263 129
[2] Indian Institute of Astrophysics, Bangalore 560 034

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Abstract. CCD photometry of the open cluster King 10 has been carried out in the *UBVRI* photometric passbands down to $V \sim 19.5$ mag. The reddening for the cluster region is found to be variable. A distance of 3.2 kpc has been estimated for the cluster. The age of the cluster is estimated to be less than 50 Myr.

Key words : photometry—young star clusters—reddening

1. Introduction

The globular star clusters, being remnants of the formation of the galaxy, can provide information about the early phases of the Galactic evolution, whereas the galactic (or open) star clusters in contrast, have been forming and dissolving rather continuously since the formation of galactic disc which took place about 10 Gyr ago. Therefore, open star clusters can be used to trace the subsequent evolution of the Galaxy and its present dynamical state. Open clusters are also good tools to analyse the large scale properties of the disc of our own Galaxy and to test the theories of stellar and galactic evolution (see *e.g.* Janes 1979; Janes & Adler 1982; Pandey *et al.* 1988; Palous *et al.* 1977). To obtain fundamental informations for such studies cluster's distance, age and interstellar extinction inside the star cluster are mandatory which can be derived from the colour-magnitude (CM) and colour-colour (CC) diagrams of the star cluster. Such diagrams are lacking for most of the distant open star clusters. With the introduction of charge coupled device (CCD) detectors, it is now possible to have observations of these unstudied open clusters with a moderate size (~ 1 meter class) telescope. In order to study main evolutionary aspects of these unobserved open clusters as well as to increase the data base for testing the available models of stellar and galactic evolution, we have started CCD observations of distant open star clusters. In this first paper of the series we present the photometric results of King 10.

The open cluster King 10 = C 2252 + 589 ($l = 108^\circ.49$, $b = -0^\circ.40$) has been classified as Trumpler class II 1 m (Lynga 1987). The King 10 is included in the list of suspected old star clusters by Janes (1990). In this paper we describe the *UBVRI* CCD photometric observations of the stars in the field of King 10. These observations have been used to study the interstellar extinction across the cluster region and to estimate the age, distance and other parameters of the star cluster.

2. Observations

The *UBVRI* photometric observations were obtained, using a photometrics CCD system at the f/13 Cassegrain focus of the 104-cm telescope of the Uttar Pradesh State Observatory (UPSO) on three nights during October-November 1990. In order to improve the *S/N* ratio the observations were taken in binning mode of 2 × 2 pixels. In this setup, each pixel of 384 × 576 size CCD corresponds to 0.66 arc sec and the entire chip covers a field of ~ 2.0 × 3.0 arc min. The details of the present system have been described by Mohan *et al.* (1991). Two overlaping regions called North and South (see figure 1) were imaged in each passband to cover the entire cluster region. Multiple exposures with exposure times ranging from 10 sec to 9000 sec depending on the presence of bright stars and filters used were obtained. The log of observations has been given in table 1. A number of flats were taken in each filter by observing the twilight sky. Landolt (1983) standard stars were observed for calibration purposes.

3. Data reduction

The observations have been reduced using the Micro VAX-II system of the UPSO. Clean images have been obtained using the ESO MIDAS software package. The cleaned CCD frames in the same filter having similar exposure times were coadded. The total exposure time in each filter for each region has been tabulated in table 1. The photometry was done using the DAOPHOT profile-fitting software (Stetson 1987). The stellar point spread function (PSF) used by the DAOPHOT was evaluated from the several uncontaminated stars present in each frame. For a few bright stars which were saturated in the long exposure frames, only aperture photometry was carried out using short exposure frames. Table 2 gives the X and

Table 1. Log of observations of King 10

Filter	North Region			South Region		
	Date	No. of frames and exposure	Total exposure	Date	No. of frames and exposure	Total exposure
I	Oct 21, 1990	4 × 10s		Oct 21, 1990	2 × 10s	
	Nov 9, 1990	2 × 150s	300s	Nov 10, 1990	3 × 150s	450s
R	Oct 21, 1990	4 × 10s		Oct 21, 1990	2 × 10s	
	Nov 9, 1990	2 × 150 s	300s	Nov 10, 1990	3 × 150s	450s
V	Oct 21, 1990	2 × 100s		Oct 21, 1990	2 × 60s	
	Nov 9, 1990	2 × 300s	600s	Nov 10, 1990	3 × 300s	900s
B	Nov 9, 1990	2 × 300s	600s	Nov 10, 1990	4 × 600s	2400s
U	Nov 9, 1990	5 × 600s	3000s	Nov 10, 1990	6 × 600s	3600s

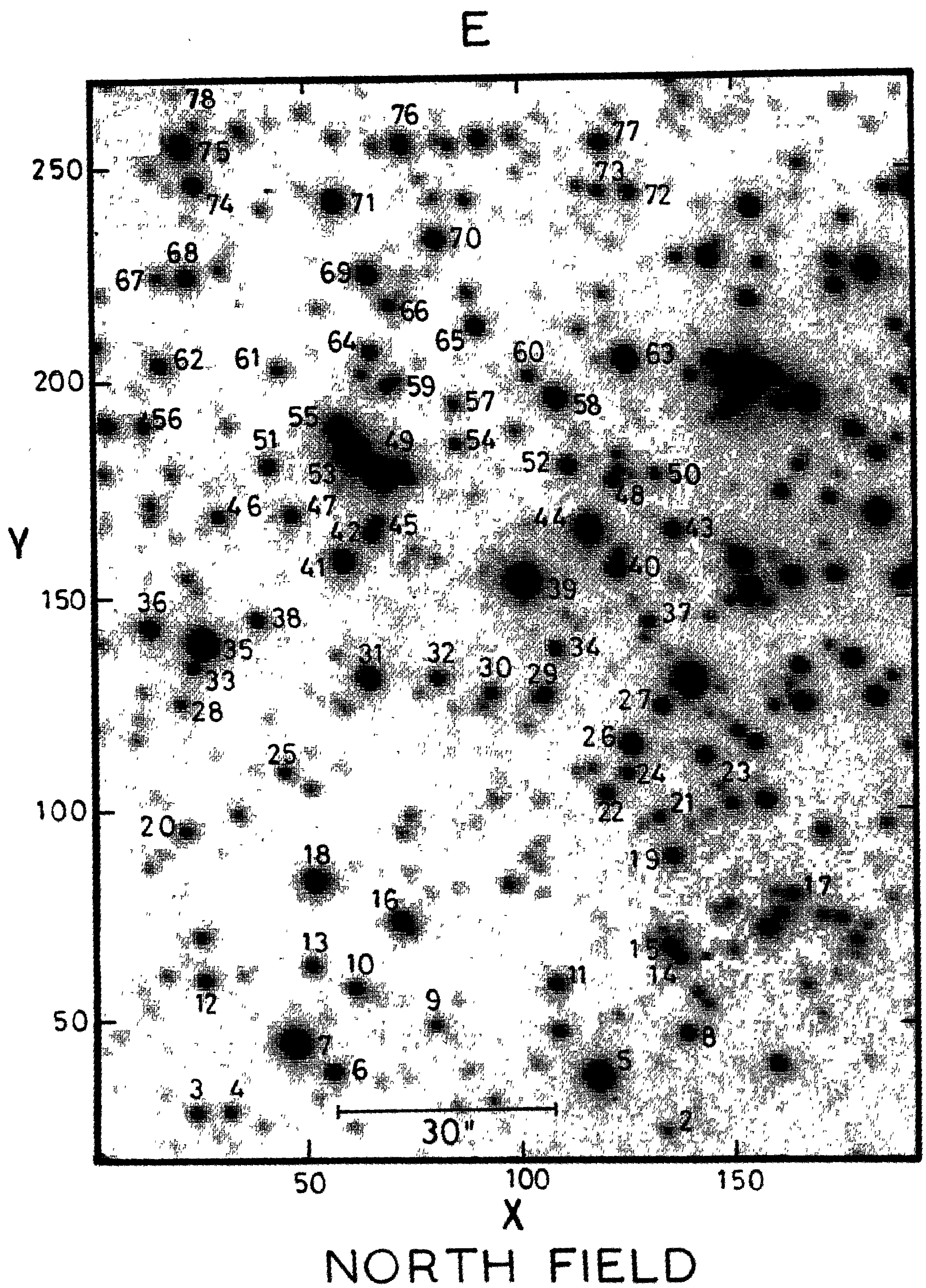

Figure 1a. Identification map for the North region of the cluster King 10.

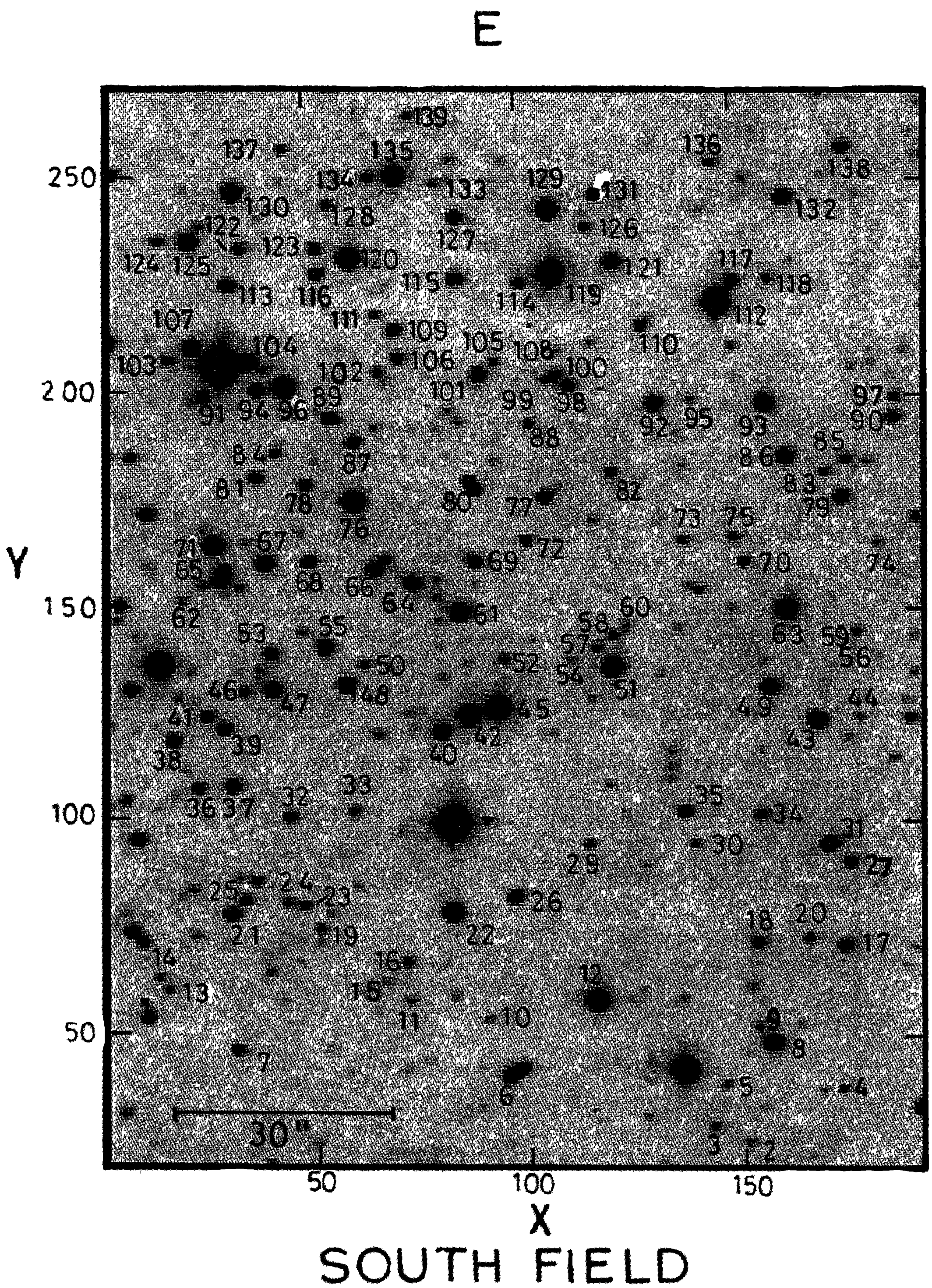

Figure 1b. Identification map for the South region of the cluster King 10.

Table 2. *UBVRI* magnitudes in the field of King 10

S. No.	X	Y	U – B	B – V	V – R	R – I	V
			NORTH FIELD				
1	32.57	6.65	*	1.094	0.633	0.747	16.026
2	133.21	23.59	*	0.705	0.686	0.931	19.234
3	24.02	27.54	*	1.256	0.658	0.823	18.004
4	31.77	27.80	*	1.196	0.618	0.832	18.299
5	117.00	36.27	0.109	0.892	*	*	14.633
6	55.58	37.24	*	1.248	0.762	0.881	17.440
7	46.70	43.97	0.175	0.934	*	*	14.572
8	138.00	46.38	*	1.121	0.647	0.792	17.604
9	79.33	48.29	*	1.509	0.870	1.005	19.112
10	60.97	56.83	*	1.177	0.641	0.823	17.880
11	107.49	57.95	*	0.835	0.773	0.867	17.954
12	26.14	58.65	*	1.242	0.768	0.875	18.050
13	51.02	62.11	*	1.355	0.879	0.917	18.565
14	136.69	64.21	*	1.082	0.646	0.758	18.139
15	133.99	66.73	0.522	0.998	0.549	0.708	17.118
16	71.39	72.68	0.483	0.995	0.561	0.746	16.435
17	162.67	79.26	*	1.215	0.700	0.849	18.285
18	51.62	82.33	*	1.999	1.204	1.243	17.142
19	134.71	88.47	0.478	1.049	0.594	0.761	17.284
20	21.94	94.32	*	1.348	0.808	0.961	18.725
21	131.98	97.61	*	1.257	0.737	0.881	18.667
22	119.50	103.15	*	1.037	0.627	0.763	17.687
23	145.98	104.76	*	1.585	0.832	1.151	20.239
24	124.43	107.91	*	1.081	0.575	0.734	17.823
25	45.07	108.33	*	1.245	0.708	0.913	18.650
26	125.28	114.63	0.209	0.891	0.498	0.621	15.768
27	132.56	123.85	*	0.731	0.587	0.689	17.306
28	21.10	124.29	*	1.176	0.732	0.873	18.775
29	105.28	126.52	*	1.219	0.640	0.819	17.625
30	92.78	126.97	*	1.341	0.726	0.875	18.022
31	64.25	130.44	0.241	0.994	0.555	0.737	15.862
32	80.32	130.45	*	1.233	0.605	0.822	17.812
33	23.73	132.89	*	1.065	0.651	0.886	18.240
34	107.74	137.41	*	1.182	0.631	0.823	17.615
35	25.90	138.62	0.021	0.853	0.518	0.624	14.175
36	13.66	142.37	0.425	0.978	0.564	0.742	16.590
37	129.48	143.89	*	1.149	0.584	0.804	17.789

(Continued)

Table 2. Continued

S. No.	*X*	*Y*	*U – B*	*B – V*	*V – R*	*R – I*	*V*
			NORTH FIELD				
38	38.82	144.39	*	1.093	0.583	0.801	17.565
39	99.98	153.61	0.108	0.950	0.599	0.635	13.746
40	121.90	156.56	0.755	1.027	0.590	0.743	16.417
41	58.51	158.41	0.180	0.926	0.531	0.697	15.783
42	64.95	164.67	*	1.351	0.719	0.820	17.334
43	135.26	165.71	0.929	1.173	0.632	0.807	17.161
44	115.40	165.84	0.076	0.939	0.591	0.695	14.816
45	66.50	167.55	*	1.130	0.649	0.848	18.014
46	30.03	168.78	*	1.199	0.628	0.828	18.011
47	46.84	169.10	– 0.072	1.448	0.745	0.863	17.741
48	121.39	177.17	*	1.126	0.747	0.864	17.885
49	67.45	178.56	0.124	0.991	*	*	13.994
50	131.46	178.84	*	1.362	0.710	0.836	18.556
51	41.53	180.66	*	1.142	0.661	0.849	17.515
52	110.90	180.78	0.800	1.065	0.594	0.741	16.896
53	60.71	183.89	0.065	0.914	*	*	13.577
54	84.98	185.91	*	1.443	0.887	0.977	18.768
55	57.70	189.46	0.182	0.959	0.563	0.702	15.233
56	12.60	190.24	*	1.299	0.774	0.923	18.250
57	84.49	195.34	*	1.288	0.803	0.938	18.655
58	108.08	196.62	0.269	1.000	0.561	0.706	15.852
59	69.08	199.64	*	1.049	0.693	0.840	18.078
60	101.83	201.99	*	1.285	0.824	0.867	18.386
61	43.86	203.44	*	1.245	0.726	0.873	18.478
62	16.48	204.46	*	1.204	0.676	0.862	17.593
63	124.33	205.91	0.147	0.981	0.552	0.713	15.441
64	65.23	207.73	*	1.131	0.676	0.828	17.738
65	89.63	213.80	0.696	1.177	0.630	0.789	16.880
66	69.39	218.90	*	1.282	0.823	0.935	18.543
67	16.06	225.30	*	1.349	0.775	1.036	18.965
68	22.85	225.45	0.653	1.068	0.603	0.799	17.060
69	64.41	226.15	0.393	1.047	0.614	0.765	16.364
70	80.17	234.36	0.186	1.024	0.579	0.738	16.279
71	56.87	243.31	0.377	1.009	0.568	0.753	15.909
72	125.51	245.65	*	1.180	0.626	0.808	17.501
73	118.40	245.95	0.270	1.217	0.633	0.849	18.053
74	24.58	247.23	0.455	1.102	0.640	0.825	16.838

(Continued)

Table 2. Continued

S. No.	*X*	*Y*	*U* − *B*	*B* − *V*	*V* − *R*	*R* − *I*	*V*
			NORTH FIELD				
75	21.55	256.21	0.395	0.916	0.816	0.833	15.794
76	72.28	257.12	0.457	0.990	0.760	0.818	17.140
77	118.66	257.31	0.734	1.078	0.792	0.855	17.209
78	35.32	260.27	*	1.031	0.954	0.924	19.028
			SOUTH FIELD				
1	38.71	17.16	*	1.301	0.884	0.848	19.531
2	150.28	22.60	*	1.355	0.928	0.897	19.754
3	142.13	26.55	*	1.406	0.887	0.914	19.111
4	171.78	35.52	*	1.442	0.915	0.879	19.145
5	144.86	36.36	*	− 1.359	1.052	0.843	19.669
6	94.05	38.21	0.262	1.125	0.380	0.720	16.333
7	31.00	44.23	*	2.034	1.279	1.276	18.590
8	155.50	46.35	*	2.392	1.320	1.351	16.462
9	152.24	49.92	*	1.311	0.874	0.947	19.380
10	89.26	51.54	*	1.097	0.942	0.881	20.016
11	71.26	55.87	*	1.480	1.010	0.881	19.584
12	114.38	56.19	0.180	0.968	0.596	0.687	14.890
13	15.12	58.49	*	1.382	0.950	0.992	19.667
14	12.99	61.35	*	1.424	0.913	0.956	19.469
15	65.66	60.48	*	1.200	0.804	0.849	20.078
16	70.42	65.10	*	1.662	1.031	0.950	18.935
17	172.41	69.52	0.598	1.108	0.587	0.679	17.520
18	152.20	70.04	*	2.201	1.352	1.255	18.964
19	50.24	73.02	*	1.866	1.138	1.028	19.326
20	164.16	71.06	*	1.367	0.844	0.820	18.949
21	29.55	76.34	0.561	1.105	0.593	0.787	17.004
22	80.76	76.94	0.591	1.187	0.707	0.734	15.471
23	46.70	78.40	*	1.302	0.794	0.827	18.780
24	42.62	79.14	*	1.465	0.860	0.898	19.173
25	32.78	79.76	*	1.223	0.683	0.859	18.125
26	95.47	80.67	0.750	1.167	0.623	0.792	17.067
27	173.66	89.28	*	1.223	0.643	0.765	17.959
28	54.86	92.13	*	0.839	0.368	*	20.602
29	112.91	93.08	*	1.785	0.853	0.922	19.062
30	137.71	93.11	*	1.758	0.922	0.987	19.338
31	168.71	93.45	0.529	1.006	0.555	0.748	16.496

(Continued)

Table 2. Continued

S. No.	X	Y	U − B	B − V	V − R	R − I	V
			SOUTH FIELD				
32	43.06	99.26	*	1.266	0.697	0.812	18.216
33	57.96	100.82	*	1.298	0.952	0.797	19.254
34	153.09	100.26	*	1.419	0.760	0.791	18.496
35	135.02	100.92	0.734	1.101	0.636	0.765	17.609
36	21.97	105.99	*	1.201	0.632	0.815	18.151
37	29.77	106.52	0.630	1.088	0.532	0.715	16.907
38	15.96	117.33	0.831	1.208	0.667	0.841	17.192
39	27.88	120.22	0.612	1.074	0.596	0.742	17.204
40	78.18	119.69	0.267	1.008	0.538	0.718	16.035
41	23.80	122.95	*	1.202	0.661	0.829	17.916
42	84.27	123.33	0.165	0.984	0.591	0.727	15.047
43	165.57	122.75	0.254	1.003	0.535	0.714	16.158
44	175.90	123.36	*	1.749	0.988	0.971	20.069
45	91.05	125.33	0.133	0.982	0.606	0.682	14.252
46	32.51	128.83	0.388	1.431	0.859	0.779	18.869
47	38.86	129.33	0.508	1.221	0.675	0.784	16.616
48	55.93	130.59	0.350	0.989	0.568	0.720	16.422
49	154.80	130.45	0.363	0.975	0.510	0.701	16.526
50	60.07	135.36	*	1.780	1.017	0.953	19.234
51	118.04	135.13	0.196	0.935	0.577	0.667	15.123
52	92.86	136.87	*	1.302	0.825	0.834	18.837
53	38.52	137.98	0.677	1.327	0.704	0.813	17.493
54	108.27	136.69	*	1.318	1.119	0.996	20.327
55	50.79	139.57	0.366	1.086	0.626	0.765	16.597
56	179.90	138.30	− 1.009	0.112	− 0.127	− 0.148	19.961
57	114.44	139.71	*	1.860	1.175	1.123	19.217
58	118.55	142.72	*	1.480	0.982	0.821	18.952
59	175.15	143.77	− 0.409	1.304	0.964	0.818	19.335
60	121.44	144.95	*	1.454	1.102	0.801	19.541
61	82.32	147.93	0.204	0.973	0.526	0.706	15.513
62	18.14	150.33	*	1.645	0.888	0.873	19.508
63	158.55	149.03	0.035	0.926	0.567	0.684	15.126
64	71.36	154.94	0.276	0.989	0.552	0.718	16.509
65	27.19	155.96	0.548	1.481	0.548	0.875	15.669
66	65.45	158.00	0.621	1.101	0.570	0.796	16.727
67	36.99	159.46	0.300	1.032	0.550	0.696	16.148
68	47.23	159.80	0.596	1.186	0.686	0.760	17.577

(Continued)

Table 2. Continued

S. No.	X	Y	U − B	B − V	V − R	R − I	V
			SOUTH FIELD				
69	85.73	160.03	0.609	1.100	0.620	0.745	17.035
70	148.93	160.23	*	1.105	0.637	0.679	18.107
71	25.14	163.61	0.665	1.052	0.535	0.669	15.527
72	97.96	165.01	1.228	1.215	0.668	0.743	18.076
73	134.80	165.36	*	1.515	1.003	0.920	19.142
74	179.86	164.84	*	1.325	0.913	0.904	20.014
75	146.55	166.06	*	1.258	0.771	0.756	18.713
76	57.40	174.17	0.084	0.963	0.556	0.755	15.073
77	102.33	175.35	0.625	1.013	0.563	0.669	17.234
78	46.44	177.84	*	1.194	0.630	0.763	18.031
79	171.46	175.69	0.726	1.136	0.656	0.805	17.235
80	85.39	177.51	*	1.279	1.089	0.738	17.361
81	35.23	179.56	0.599	1.126	0.636	0.728	17.684
82	117.71	181.20	*	1.130	0.693	0.737	18.235
83	167.47	181.49	*	1.637	0.835	0.826	18.972
84	39.63	185.57	*	1.139	0.716	0.762	18.410
85	172.43	184.61	*	1.577	0.909	0.886	18.721
86	158.34	185.17	0.441	1.001	0.518	0.688	16.511
87	57.57	188.26	0.783	1.100	0.608	0.720	17.291
88	98.66	192.78	*	1.171	0.761	0.787	18.560
89	52.03	193.89	0.610	1.188	0.671	0.770	17.309
90	183.23	194.61	0.687	1.264	0.735	0.814	17.798
91	22.59	198.78	0.566	1.101	0.635	0.947	17.353
92	127.71	197.81	0.367	0.978	0.530	0.686	16.301
93	153.34	197.88	0.613	1.099	0.587	0.723	15.873
94	35.49	200.43	0.421	1.403	0.688	0.782	17.341
95	136.28	198.81	*	1.347	1.051	0.777	19.450
96	41.33	201.21	0.079	0.950	*	*	14.902
97	183.68	199.49	*	1.269	0.798	0.794	18.587
98	107.70	201.72	*	1.169	0.643	0.732	17.777
99	95.49	202.79	*	0.029	1.186	1.032	21.160
100	103.81	203.91	*	1.213	0.923	0.449	17.555
101	86.72	204.40	0.533	1.027	0.579	0.701	16.730
102	62.21	204.87	0.240	1.174	0.732	0.892	18.600
103	14.75	207.44	*	1.105	0.931	0.835	18.402
104	33.34	207.30	0.294	1.037	0.781	0.605	16.473

(Continued)

Table 2. Continued

S. No.	X	Y	U − B	B − V	V − R	R − I	V
			SOUTH FIELD				
105	90.44	207.56	*	1.266	0.788	0.815	18.836
106	67.85	208.25	*	1.289	0.748	0.833	17.778
107	20.20	210.42	0.175	0.970	0.642	0.864	16.366
108	105.48	210.12	*	1.454	0.861	0.871	19.965
109	66.95	214.69	*	1.274	0.632	0.776	17.557
110	124.64	216.25	*	1.257	0.707	0.729	17.796
111	62.74	218.33	*	1.722	1.227	1.440	19.401
112	142.04	221.59	0.051	0.797	0.549	0.651	13.779
113	28.46	225.14	0.628	1.152	0.626	0.798	16.978
114	96.05	225.93	*	1.204	0.742	0.619	18.113
115	81.29	226.92	0.354	1.069	0.561	0.709	16.609
116	49.04	228.01	*	1.538	0.870	0.835	17.660
117	146.01	226.75	*	1.126	0.639	0.717	17.173
118	154.47	227.27	*	1.565	0.949	0.842	18.995
119	103.39	228.30	0.049	0.808	0.565	0.625	13.892
120	56.30	231.62	0.759	1.012	0.570	0.558	14.967
121	117.68	231.15	0.563	1.187	0.601	0.753	16.492
122	31.28	233.75	*	1.335	0.677	0.785	18.123
123	48.60	233.85	*	1.338	0.734	0.842	17.829
124	12.24	235.51	*	1.468	0.854	0.744	18.507
125	19.29	235 38	0.172	1.052	0.592	0.759	15.996
126	111.68	239.34	*	1.363	0.832	0.732	18.779
127	81.14	241.38	0.852	1.132	0.590	0.730	17.171
128	51.49	244.07	*	1.317	0.891	0.892	19.049
129	102.66	243.40	0.595	0.946	0.489	0.589	15.068
130	29.55	247.02	0.344	1.124	0.667	0.809	16.044
131	113.70	246.71	0.817	1.169	0.679	0.747	17.846
132	157.68	246.42	0.698	0.907	0.436	0.589	16.171
133	76.46	249.26	*	1.445	0.979	0.825	19.514
134	61.08	250.73	*	1.358	0.719	0.779	18.546
135	66.94	251.13	0.187	0.941	0.543	0.653	15.168
136	140.95	254.46	*	1.333	1.115	0.856	19.056
137	41.11	257.06	*	1.096	1.176	0.889	19.299
138	171.33	258.35	*	1.240	0.888	0.780	17.787
139	70.34	265.36	*	1.274	1.104	0.819	19.461
140	11.80	279.28	*	1.484	1.085	0 327	18.178
141	79.33	278.73	0.630	0.982	0.747	0.692	17.095

Y coordinates as well as photometric data of the stars measured in the North and South cluster fields.

4. Interstellar extinction

To estimate the interstellar extinction in the vicinity of the star cluster, we used the $(U - B)$ versus $(B - V)$ diagram. By fitting the intrinsic zero-age main sequence (ZAMS) given by Mermilliod (1981) to the main sequence (MS) stars of spectral type earlier than A0 in the cluster field, we find that the value of the $E(B - V)$ varies from 1.00 to 1.32 mag (figure 2). The slope $E(U - B)/E(B - V)$ was taken to be equal to 0.72 (Johnson & Morgan

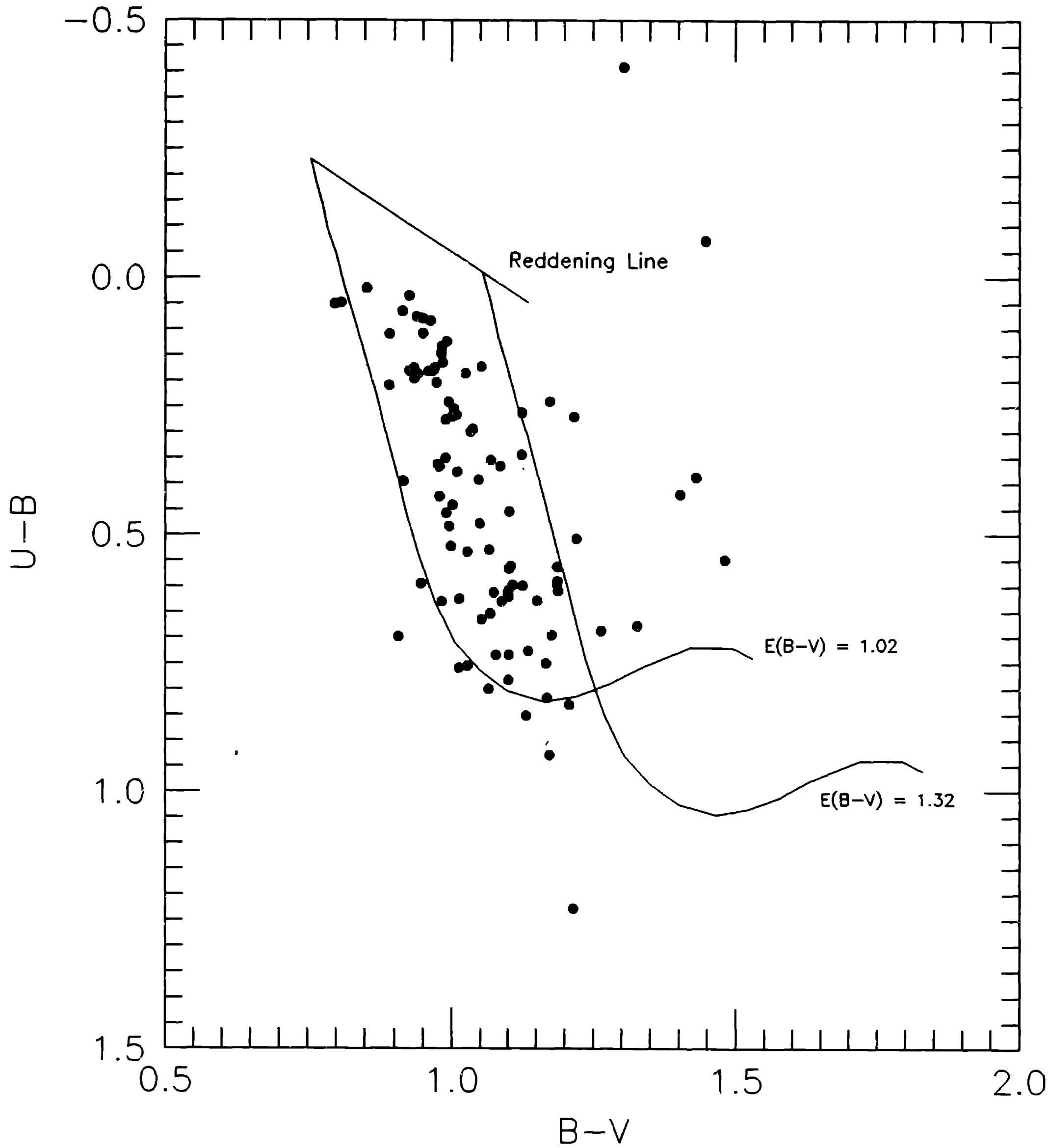

Figure 2. The colour-colour diagram for the cluster region.

1953). The dispersion in the E $(B - V)$ values cannot be due only to errors in the data, other parameters such as rotation, duplicity etc. can produce a maximum variation in $E(B - V)$ of the order of 0.11 mag for MS members (*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 estimated 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.

To study the spatial variation of reddening in the cluster field we divided the cluster into concentric annuli having a width of ~13 arc sec. The result is shown in figure 4. It seems that reddening is correlated with the distance from the cluster center in the sense that it decreases with increasing radial distance.

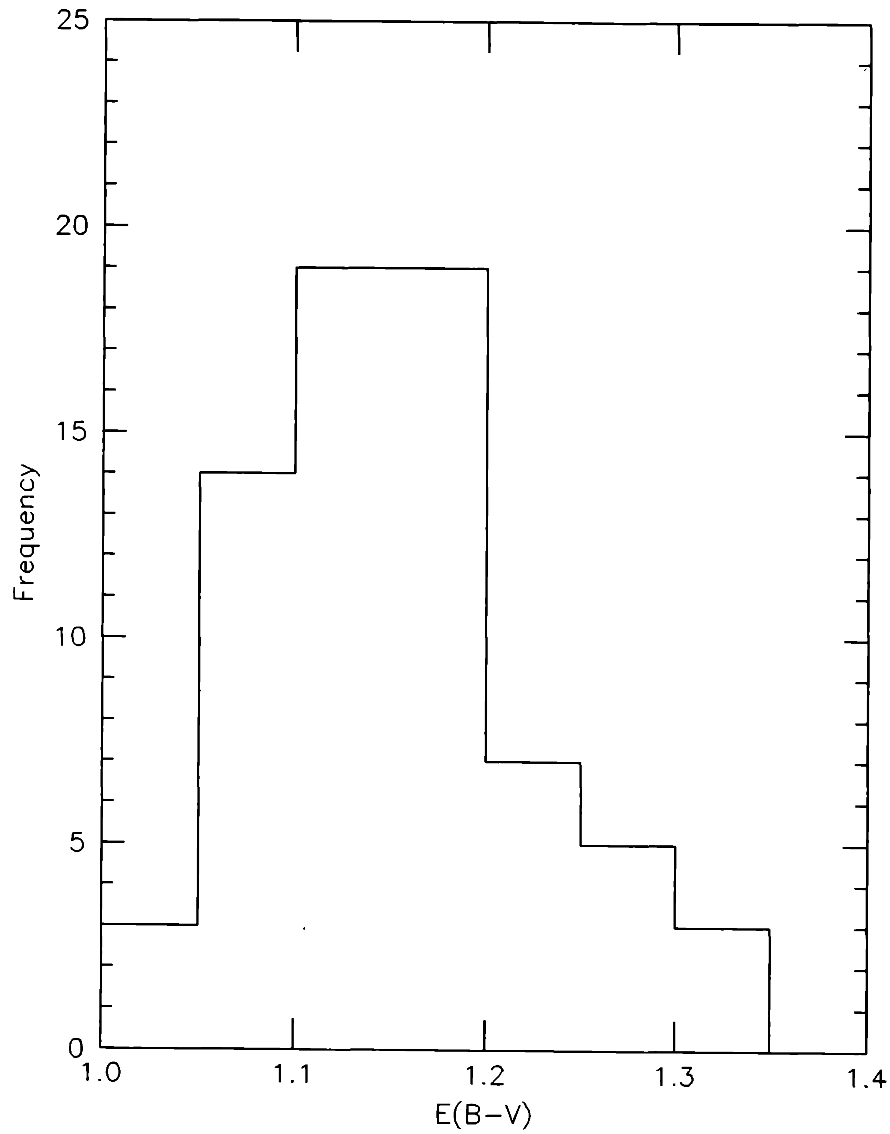

Figure 3. The frequency distribution of $E(B - V)$ obtained for probable MS cluster members.

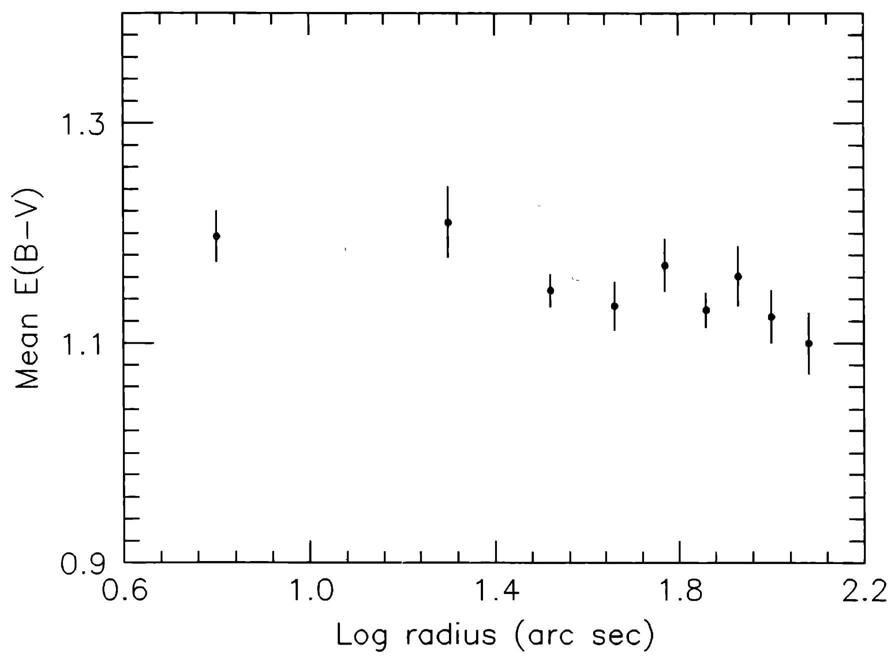

Figure 4. The spatial variation of reddening in the cluster field.

5. Colour magnitude diagrams and membership

The $V/(U-B)$, $V/(B-V)$ and $V\ (V-I)$ CM diagrams are plotted in figure 5. A broad but well defined cluster MS is clearly visible in the magnitude range $15.0 < V < 19.5$ mag. Presence of broad MS in the CMDs cannot be accounted in terms of observational errors. In addition to the presence of variable extinction across the cluster region, other main sources responsible for broad MS can be presence of field stars, binaries, variables and peculiars in the sample.

Since proper motion and spectroscopic studies are not available for the stars of the cluster region, the discrimination of non-members from the observed sample is difficult purely on photometric grounds because field stars at cluster distance and reddening will also occupy the main populated area of the CMDs. However, the stars located well away from the MS have very less probability of cluster membership. In order to get a less contaminated sample, we have considered only those stars which lie in between blue envelope of the MS and red envelope (obtained by shifting the MS for the maximum value of $E(B-V)$ in the $V/(B-V)$ CMD) as members of the cluster. This choice should not reject most of the cluster members and yield a sample suitable for further analysis. To identify the cluster members from the remaining stars, their precise proper motion and/or radial velocity measurements are required.

6. Distance to the cluster

To estimate the distance to the cluster we fit the ZAMS given by Mermilliod (1981) for $V/(U-B)$ and $V/(B-V)$ CMDs and the ZAMS given by Walker (1985) for $V/(V-I)$ CMD

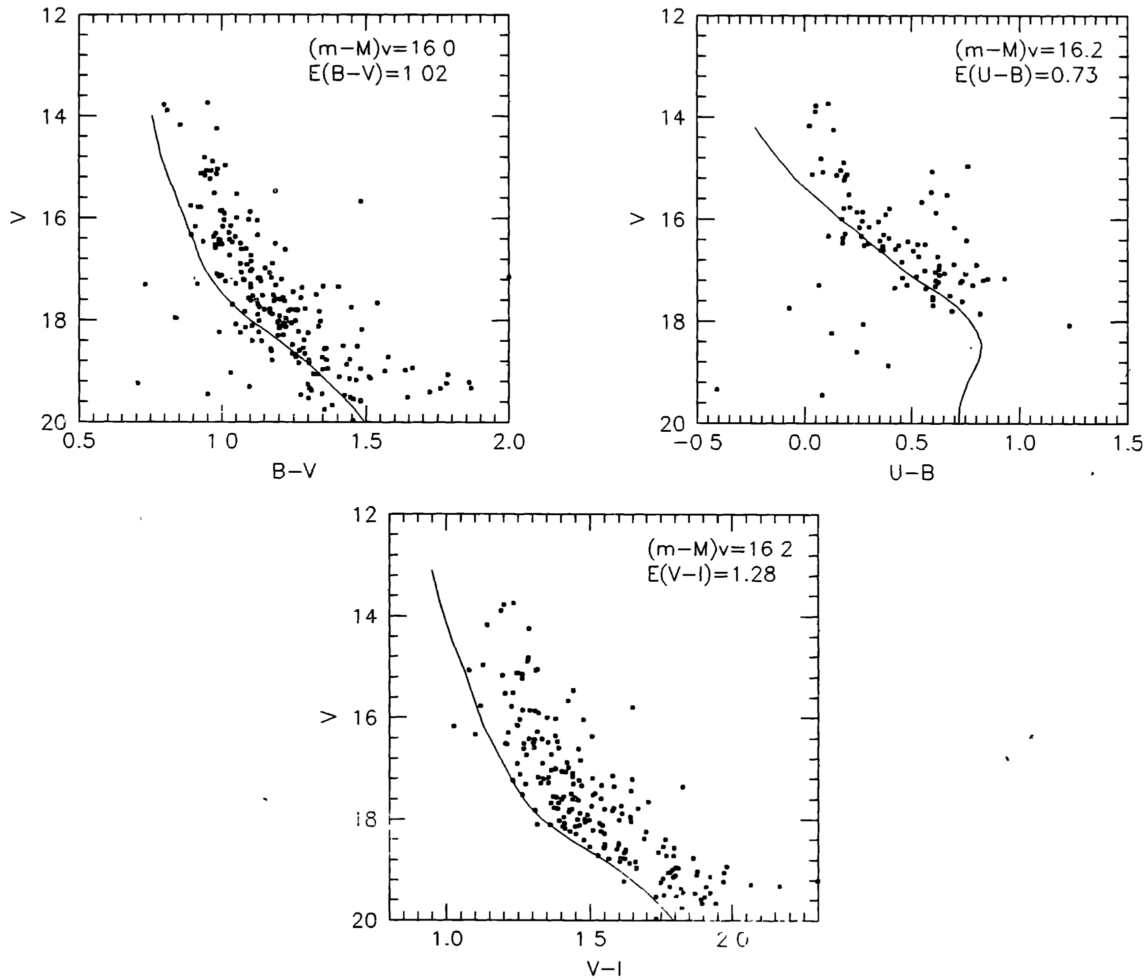

Figure 5. The colour-magnitude diagrams (V, $B-V$), (V, $U-B$) and (V, $V-I$) for stars measured in the region of King 10. The full line represents the ZAMS taken from Mermilliod (1981) and Walker (1985).

on the blue envelope of data points in figure 5 respectively and thus obtained distance modulii $(m-M)_v$ are 16.2, 16.0 and 16.2 mag respectively. The mean value of $(m-M)_v$ comes out to be 16.13 ± 0.10 (s.d.) mag. Using $E(B-V) = 1.16$ mag as mean value of reddening for the cluster and $A_v = 3.1 \times E(B-V)$ the true distance modulus $(m-M)_0$ comes out to be 12.53 ± 0.10 mag which corresponds to a distance of 3.21 ± 0.15 kpc. Thus the cluster is located at relatively large distance.

7. Age of the cluster

To estimate the age of the cluster we have used the data of those stars only for which individual reddening could be obtained. The $M_v/(B-V)_0$ and $M_v/(U-B)_0$ diagrams for such stars are shown in figure 6. As stellar evolutionary effects are clearly visible in the CMDs of the cluster, a relatively accurate estimation of cluster age is possible. We have estimated the cluster age by fitting the Mermilliod's (1981) isochrones for NGC 3766 and Alpha-Per

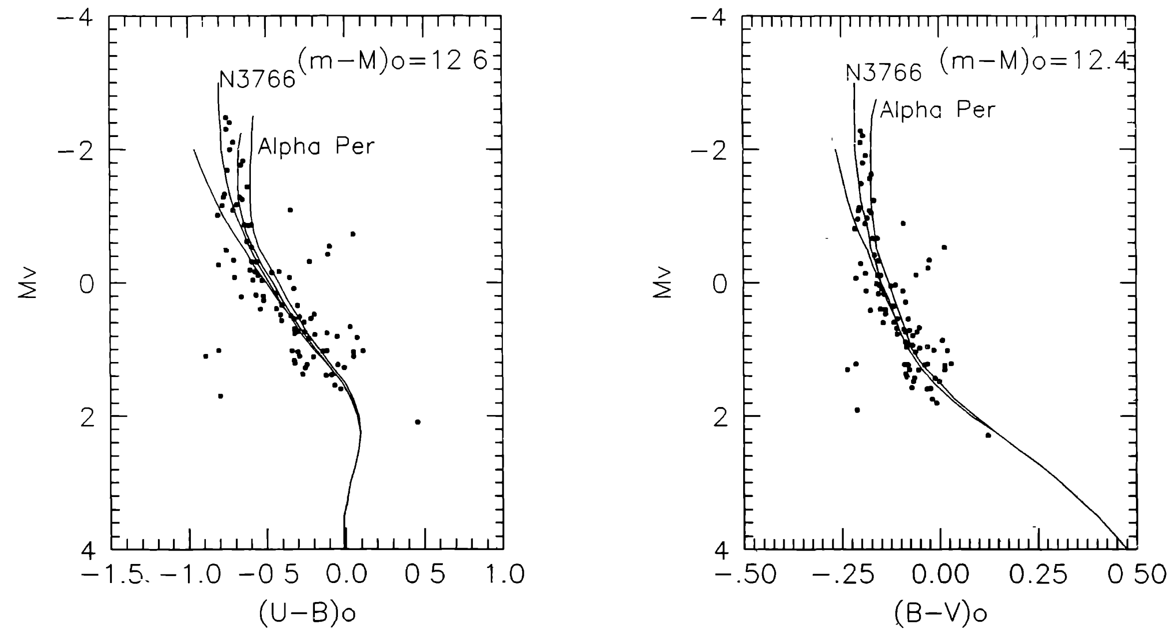

Figure 6. The $[M_v, (B-V)_0]$ and $[M_v, (U-B)_0]$ diagrams of King 10.

age groups in the dereddened CMDs of the cluster and these are shown in figure 6. The isochrones suggest that the cluster is young (age < 50 Myr) and is not an old object as suspected by Janes (1990). Therefore, King 10 may be very useful to study the process of star formation in star clusters since it is very young and may bear the imprints of star formation process in the cluster.

Pandey *et al.* (1990) from a sample of 173 clusters found that 64 clusters show variable reddenning and reddening decreases with increasing age of the cluster. This suggests that the dust and gas associated with the cluster's parent cloud is disrupted or blown away from the cluster during evolution of stars. From the work of Pandey *et al.* (1990) it can be found that a cluster of about the same age as King 10 retains enough dust and gas to account for a $\Delta E(B-V) \sim 0.2$ mag.

8. Conclusion

The CCD photometry of the cluster in *UBVR* and I photometric passbands down to $V \sim 19.5$ mag indicates a well defined ZAMS of the cluster which gives 12.53 mag as the value of true distance modulus. This corresponds to a distance of ~ 3.2 kpc. The age of the cluster is estimated to be less than 50 Myr. The reddening in the cluster region is found to be variable having $\Delta E(B-V) \sim 0.2$ mag.

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