PHOTOMETRY OF OPEN CLUSTER KING 12

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Abstract. Photoelectric magnitudes of 30 stars in the field of King 12 have been obtained. The reddening is variable across the cluster. A distance of 2.49 kiloparsecs has been estimated for the cluster. It is concluded that the age of the cluster lies between NGC 2362 and NGC 884 groups.

1. Introduction

The open cluster King 12 ($\alpha_{1950} = 23^h50^m5$, $\delta_{1950} + 61°41$) has been assigned a class I $2p$ by Ruprecht (1966). Haug (1970) has obtained photometric magnitudes of three stars in the cluster field. The cluster was put on our observing program during the year 1983. Photoelectric magnitudes have been obtained for 30 stars in the cluster field. The identification chart of the cluster obtained by enlargement from POSS chart is shown in Figure 1.
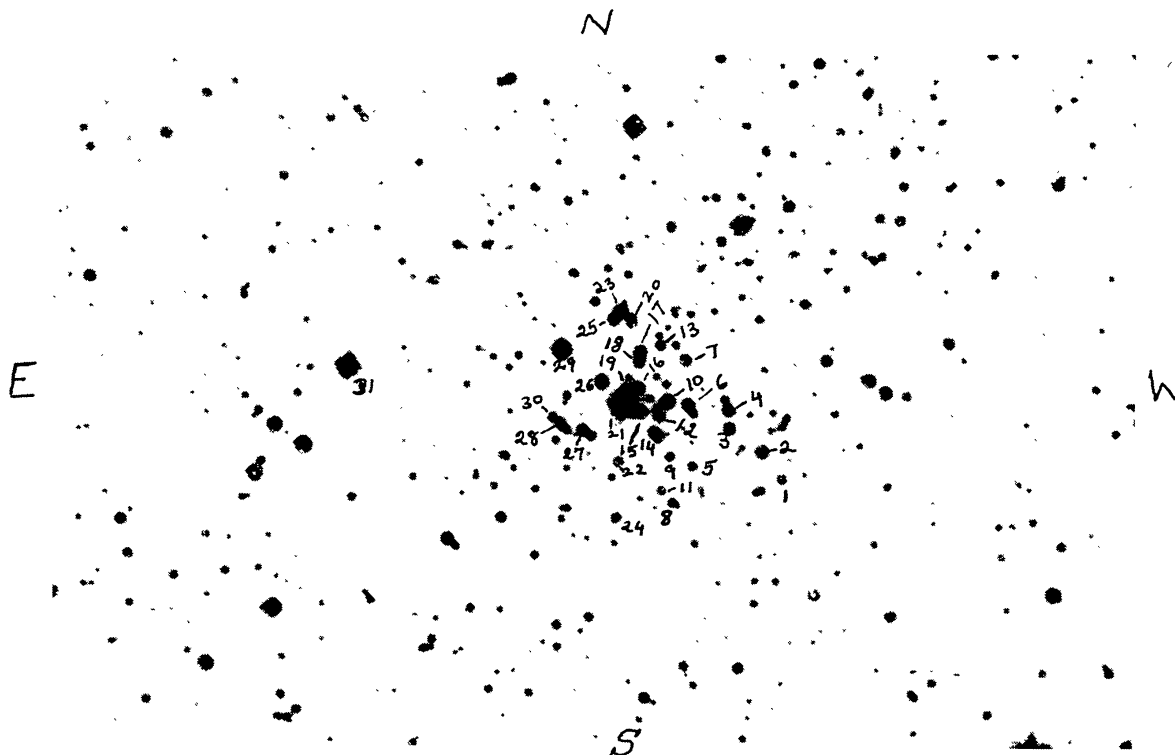

Fig. 1. Identification chart for King 12 obtained from POSS chart.

2. Observations

The observations of King 12 were carried out during the period November to December 1983 on the 104 cm reflector of the Observatory using the thermoelectrically cooled ($-20\,°C$) EMI 6094S photomultiplier and standard UBV filters. Each star was observed at least on two different nights. Star Nos. 29 and 31 were taken as comparison stars. The differential instrumental magnitudes were determined using nightly extinction coefficients and these were subsequently standardised in the UBV system. The magnitudes and colours of the stars thus obtained are listed in Table I. The accuracy of the observations is $\pm 0\overset{m}{.}02$ in V and $(B - V)$ and $\pm 0\overset{m}{.}025$ in $(U - B)$ for stars of $V \approx 13^m$. The V, $(B - V)$, and $(U - B)$ magnitudes of the three stars observed by Haug (1970) along with the magnitudes obtained by us are given in Table II for comparison. There is appreciable difference for star Nos. 21 and 29 between the two measures. However, the magnitudes of the two stars obtained by us on different nights lie within the observational error.

TABLE I

Photoelectric magnitudes and colours of stars in King 12

Star no.	V	$B - V$	$U - B$	$E(B - V)$
1	$14\overset{m}{.}47$	$0\overset{m}{.}48$	$0\overset{m}{.}14$	$0\overset{m}{.}54$
2	13.23	0.39	-0.17	0.53
3	12.30	1.53	1.17	0.60
4	13.25	0.71	0.24	0.60
5	14.91	0.53	0.21	0.58
6	13.62	0.44	-0.25	0.62
7	13.88	0.43	-0.07	0.55
8	14.95	0.45	0.32	0.64
9	15.14	0.58	0.47	0.56
10	12.77	0.38	-0.27	0.55
11	15.22	0.57	0.18	0.64
12	13.90	0.52	0.08	0.61
13	14.91	0.50	0.20	0.55
14	13.48	0.43	-0.18	0.59
15	13.52	0.55	0.08	0.65
16	14.76	0.43	0.13	0.61
17	13.18	0.36	-0.21	0.52
18	14.40	0.49	0.01	0.60
19	10.74	0.36	-0.55	0.63
20	14.47	0.56	0.02	0.69
21	10.37	0.33	-0.56	0.59
22	14.36	0.73	0.27	0.67
23	12.62	0.38	-0.32	0.58
24	14.30	0.55	0.06	0.66
25	13.69	0.73	0.41	0.63
26	12.50	0.57	-0.35	0.60
27	13.38	0.74	0.27	0.68
28	14.49	0.54	0.00	0.67
29	10.90	0.41	-0.48	0.67
30	14.73	0.67	0.42	0.69

TABLE II

Comparison of present observations with that of Haug (1970)

Star no.		Haug			Present		
Haug	Present	V	$B-V$	$U-B$	V	$B-V$	$U-B$
61–83A	21	$10^{m}31$	$0^{m}35$	$-0.^{m}62$	$10^{m}37$	$0^{m}33$	$-0.^{m}56$
61–83B	19	10.72	0.36	-0.53	10.74	0.36	-0.65
61–85	29	10.95	0.42	-0.51	10.90	0.41	-0.48

3 Reddening

Reddening across the cluster has been determined using the colour-colour diagram of the cluster shown in Figure 2. The slope of the reddening line has been taken to be 0.72 (Johnson and Morgan, 1953) and the intrinsic Main Sequence has been taken from
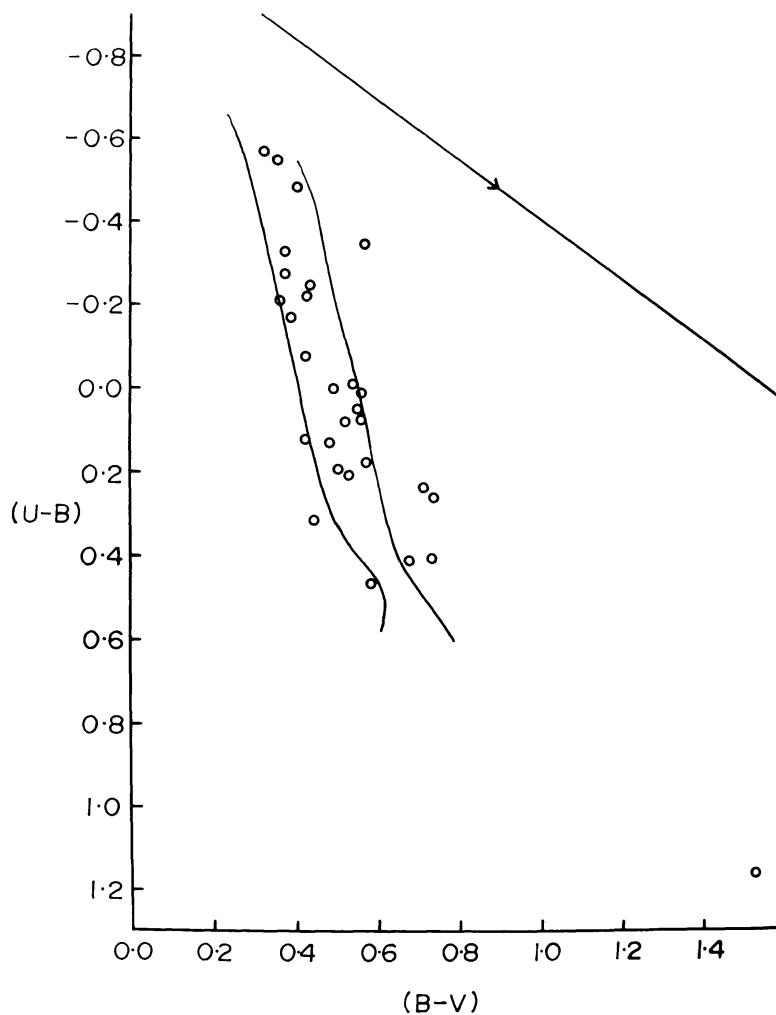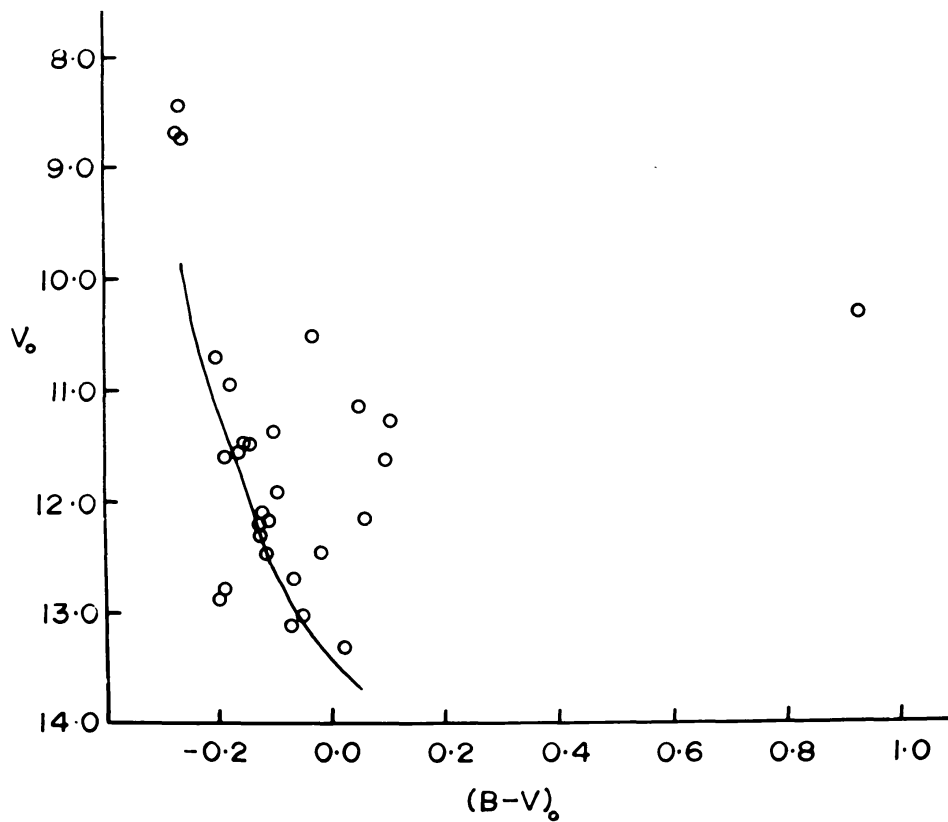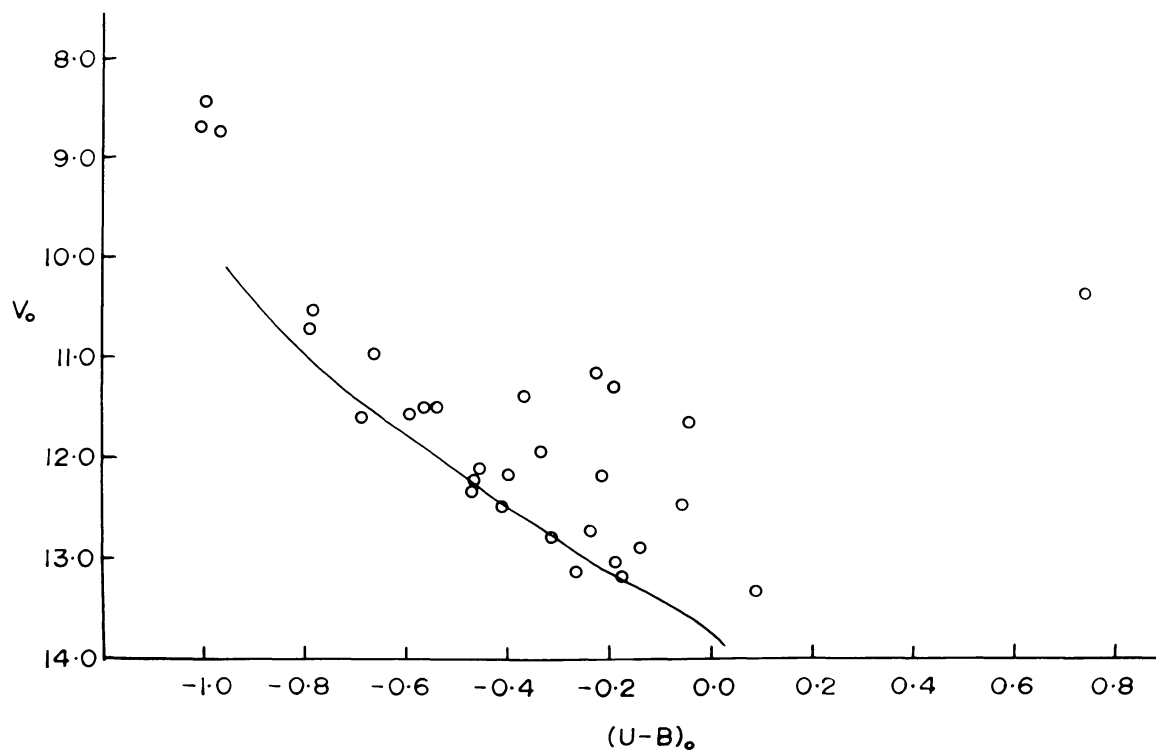

Fig. 2. Colour-colour diagram of King 12.

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Fig. 3. $V_0, (B - V)_0$ diagram of King 12.

Fig. 4. $V_0, (U - B)_0$ diagram of King 12.

Mermilliod (1981). The maximum and minimum values of the reddening estimated by sliding fit method are $E(B - V)_{max} = 0\overset{m}{.}69$ and $E(B - V)_{min} = 0\overset{m}{.}52$. Thus, the differential reddening $\Delta E(B - V)$ comes out to be $0\overset{m}{.}17$. Since the value of $\Delta E(B - V)$ is greater than $0\overset{m}{.}11$, therefore, using the criteria given by Burki (1975), we infer that the reddening across the cluster is non-uniform.

For all cluster stars lying on the Main Sequence, Q method (Johnson and Morgan, 1953) has been used for estimating the reddening. For other stars lying away from the Main-Sequence, the reddening for nearby stars has been applied. The values of reddening for individual stars, thus estimated are given in column 5 of Table I and these have been applied for the subsequent discussions.

4. Distance

The relation $A_v = 3.25E(B - V)$ (Moffat and Schmidt-Kaler, 1976), has been used to compute the unreddened magnitudes V_0 of the cluster stars. The distance modulus obtained by fitting the ZAMS given by Mermilliod (1981) to the lower portions of the
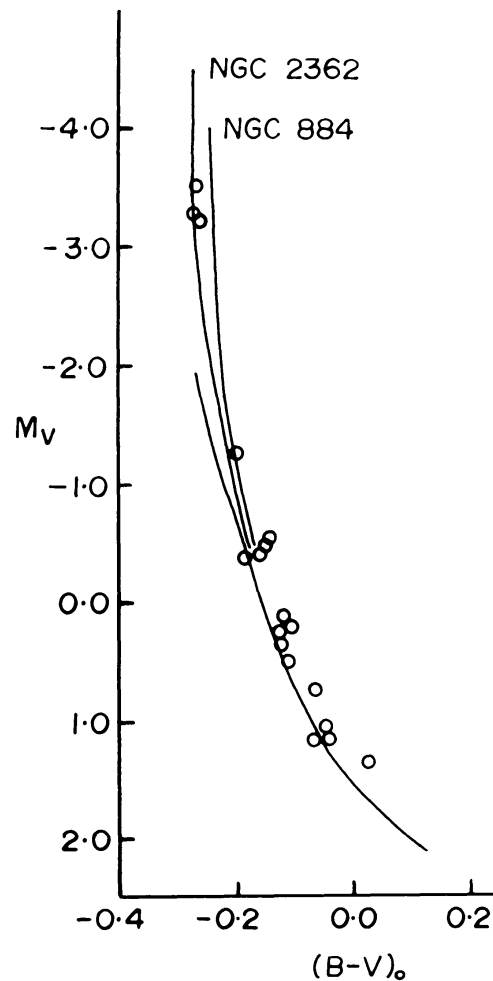

Fig. 5. M_v, $(B - V)_0$ diagram of King 12.

$[V_0, (B - V)_0]$ and $[V_0, (U - B)_0]$ colour magnitude diagrams shown in Figures 3 and 4 comes out to be $11\overset{m}{.}85$ and $12\overset{m}{.}10$, respectively. Thus, the mean value of the distance modulus for the cluster is estimated to be $11\overset{m}{.}98$ which corresponds to a distance of 2.49 kiloparsecs.

5. Membership

The kinemitical data are not available for the cluster. On the basis $[V_0, (B - V)_0]$ and $[V_0, (U - B)_0]$ diagrams the following conclusions are drawn:

(1) The stars numbered 8 and 16 lie below the Main Sequence in the $[V_0, (B - V)_0]$ diagram. Therefore, these stars are background stars.

(2) The stars numbered 3, 4, 12, 15, 22, 25, 26, 27, and 30 lie considerably above the Main Sequence in the $[V_0, (B - V)_0]$ and $[V_0, (U - B)_0]$ diagrams. Therefore, these stars are foreground stars.

6. Age

$[M_v, (B - V)_0]$ and $[M_v, (U - B)_0]$ diagrams for the cluster members have been plotted in Figures 5 and 6, respectively. The age of the post-Main-Sequence cluster stars has been estimated using the composite isochrones given by Mermilliod (1981). From the
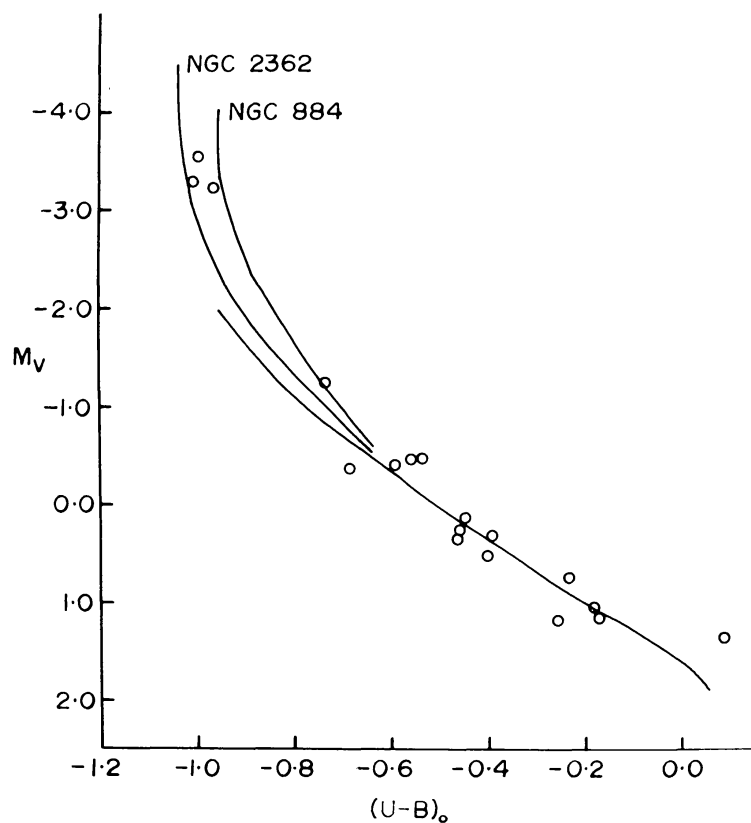

Fig. 6. $M_v, (U - B)_0$ diagram of King 12.

$[M_v, (B - V)_0]$ and $[M_v, (U - B)_0]$ diagrams the age of the cluster lies between NGC 2362 and NGC 884 groups.

Acknowledgement

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