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CCD Photometry of Young Open Clusters in Large Magellanic Cloud: NGC 1712, NGC 1722, and NGC 1727

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ABSTRACT

Color-Magnitude diagrams of the young LMC open clusters NGC 1711, 1712, 1722, and 1727 shows that all of them are very young objects. NGC 1722 and 1727 contain a considerable amount of primordial diffused matter and their main sequences are practically unevolved. NGC 1712 is more evolved and its age is comparable to that of the young populous cluster NGC 1711. The approximate luminosity functions of NGC 1722 and 1727 are practically identical and different from the luminosity functions of NGC 1711 and 1712. This difference may be an evolutionary effect.

1. Introduction

The clusters NGC 1712, 1722, and 1727 form a very pronounced complex composed of stars and luminous inter- and circumstellar matter. The diffused light is particularly well visible in NGC 1727 and 1722 and is almost absent in NGC 1712.

The clusters NGC 1722 and 1727 were observed on the night 18/19 February 1988 with the 1-m Swope telescope at Las Campanas equipped with the 800 × 800 pixel TI CCD camera. The scale of the field was 0.435″ per pixel. Exposure times were 200 or 300 s. Images of the field F117-11 (Stobie *et al.* 1985) were used for calibration of the instrumental system.

After standard procedures of flat-fielding and de-biasing with the aid of the Las Campanas programs, all the images were reduced with DAOPHOT package (Stetson 1982) on the micro-VAX computer at Las Campanas. Procedure PEAK was used throughout. The obtained magnitudes were reduced for the effect of atmospheric extinction by using the average extinction coefficients for the Las Campanas Mountain; the values of 0.37 and 0.24 were adopted for B and V filters, respectively.

The cluster NGC 1712 was observed on the night of November 22, 1986 with the same telescope and with the RCA 320 × 516 pixel CCD camera. The observations served for the search of variable stars in the cluster and were described elswere (Kubiak 1990a). They were obtained and reduced in the same way as the observations described above.

The total area covered by usefull images is shown in Fig. 1. It containes the main part of NGC 1712 (to the right in Fig. 1.), part of 1722 (center of the figure) and most of NGC 1727 (upper left). The points in Fig. 1 correspond to those stars only for which both B and V magnitudes could be determined. The sizes of the points are approximately proportional to V-magnitudes.

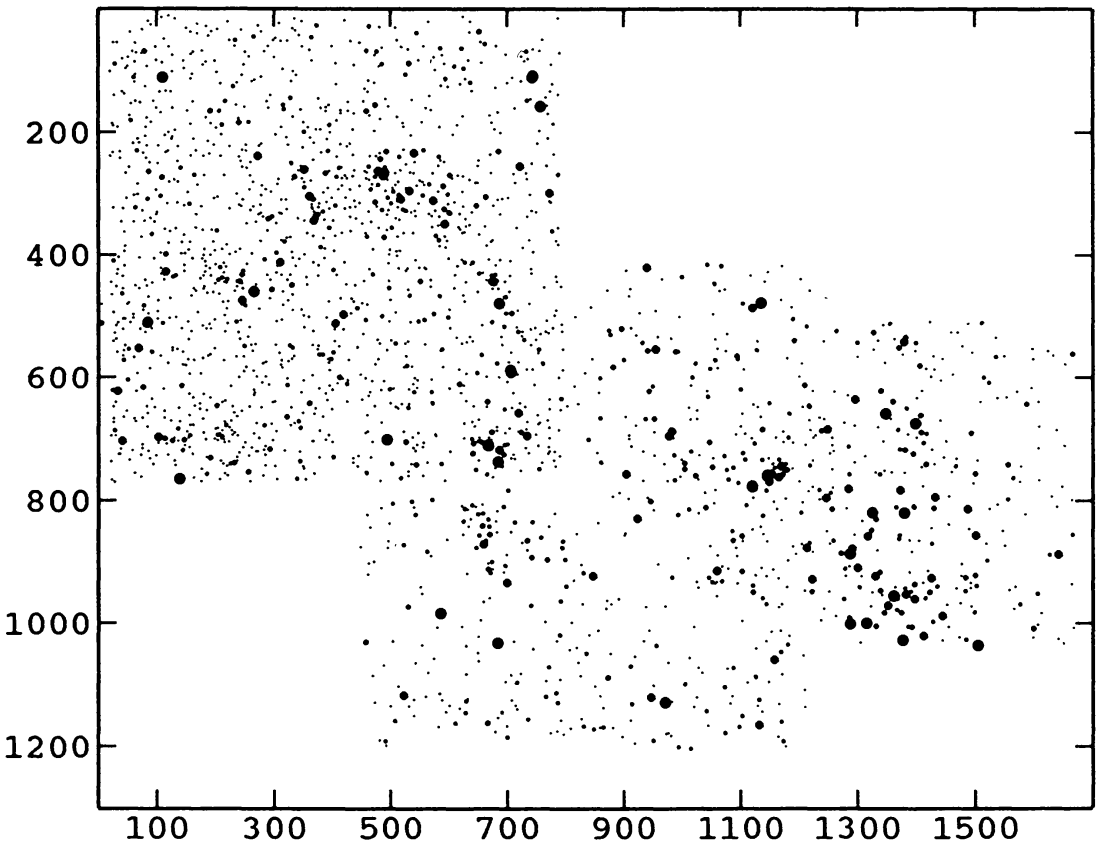

Fig. 1. Complex of the three young open clusters NGC 1712, 1722, and 1727 in Large Magellanic Cloud. Shown are stars for which both V and B magnitudes are measured. The size of symbols is approximately proportional to the V-brightness. NGC 1712 occupies the lower right part of the field, NGC 1722 is in its center and NGC 1727 - in the upper left. North is up and East is left. Axes are scaled in pixels.

2. Color-Magnitude diagrams and luminosity functions

As it can be seen from Fig. 1 the distinction between particular clusters of the complex - maybe with exception of NGC 1712 - is rather difficult. If we follow, however, the catalogue description of the clusters we may determine the approximate limits of the particular groups of stars and plot their color magnitude diagrams. They are shown in Fig. 2. Essentially there is no

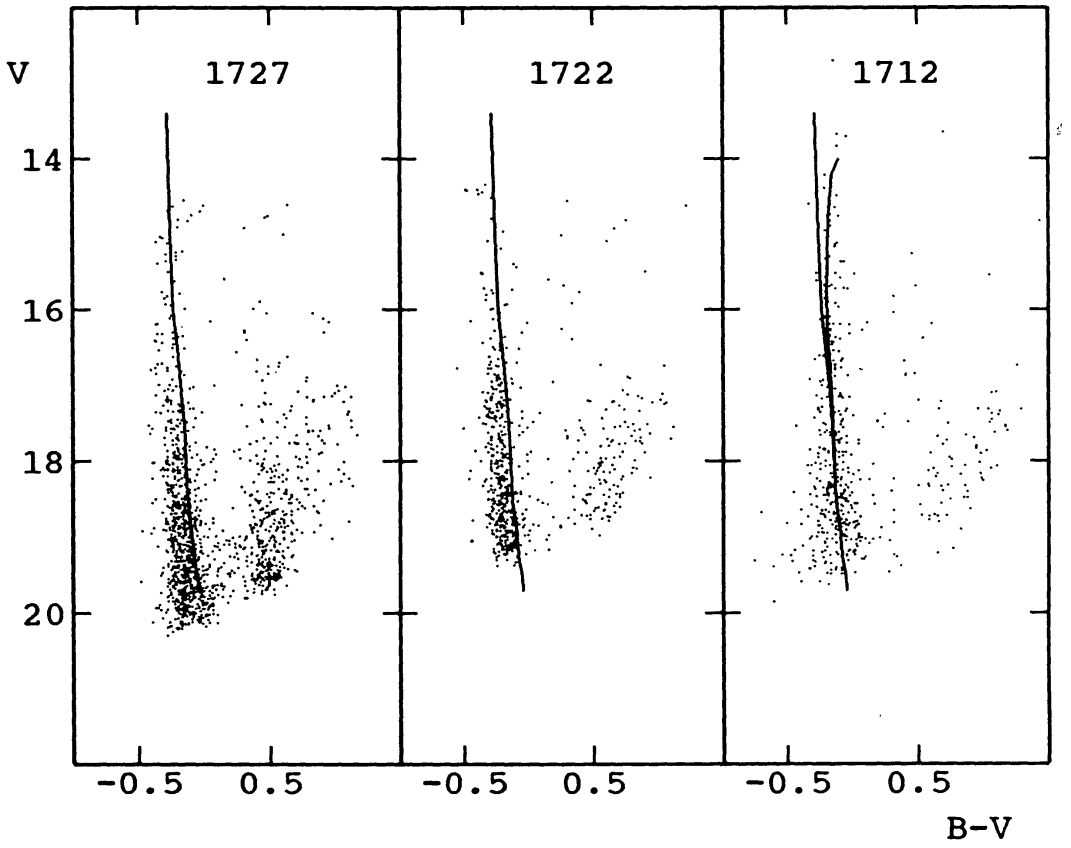

Fig. 2. Color-Magnitude diagrams for the clusters NGC 1727, 1722, and 1712. The continuous lines - identical in all three diagrams - represent the population I zero age main sequence shifted by 18.6 mag in V to account for the distance modulus to the Large Magellanic Cloud; no interstellar reddening is assumed. The additional smooth line fitted to the diagram of NGC 1712 is an isochrone corresponding to the age 2×10^7 years.

difference between diagrams for NGC 1727 and 1722: both are typical for the very young, almost unevolved open clusters. It is possible that the observed main sequences are slightly blue-shifted when compared with the standard main sequence. This could be a residual influence of the luminous matter on the observed colors of the cluster stars. This effect is absent in the case of NGC 1712 in accordance with apparent lack of diffused light in this cluster. The upper part of the main sequence of NGC 1712 suggests

also its more advanced evolutionary age. The 2×10^7 year isochrone is shown for comparison. It was calculated in approximate way, as described in Kubiak (1990b), from the grid of stellar models computed for population I abundances ($X = 0.70, Y = 0.28, Z = 0.02$) by Meader and Meynet (1988).

The slight difference between NGC 1722 and 1727 from one side and NGC 1712 from the other, may be also seen in their respective luminosity functions. The main sequence luminosity function was determined for stars bluer than $B - V = 0.15$ mag. and with V-brightness between 16 and 19 mag. In this range of magnitude the star sample seems to be essentially complete; using the results by Mateo (1988) we may assume at least that the completness correction is constant in this range. All the stars fullfiling the conditions given above were divided among twelve 0.25 mag. bins and the number of stars in each bin was devided by the total number of stars.

Results for the stars belonging to NGC 1727 and 1722 are shown in logarithmic scale in Fig. 3. The least square fit to the points is given by the linear equation

$$\log N = -18.32(\pm.97) + 0.93(\pm.05)\ V \qquad (1)$$

and is shown by the straight line.

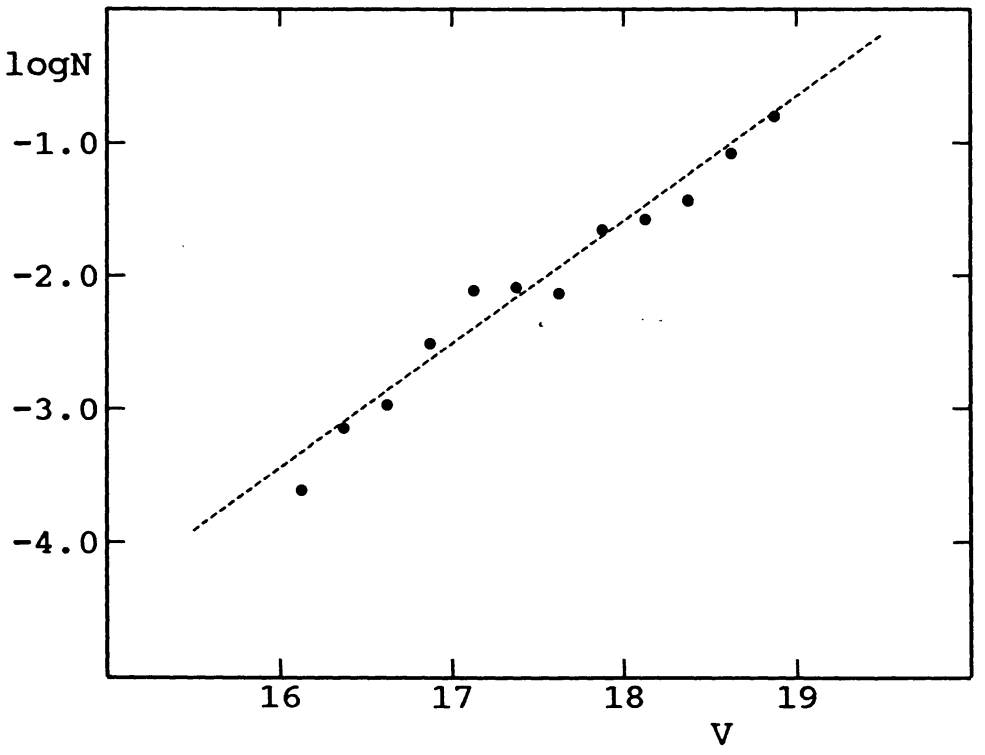

Fig. 3. Main sequence luminosity function for NGC 1722 and 1727. The line is a least square fit to the observational points.

The luminosity function obtained in the same way for the stars belonging to NGC 1712 looks different. It is shown in Fig. 4. For comparison in the

same figure are also shown the luminosity functions of the nearby young populous open cluster NGC 1711 as determined from observations by present author (Kubiak 1990b) and by Mateo (1988). The similarity of all these functions is striking. The main sequence luminosity functions of NGC 1711 and 1712, however, are markedly different from the main sequence luminosity function for the cluster NGC 1722 and 1727 determined previously. The

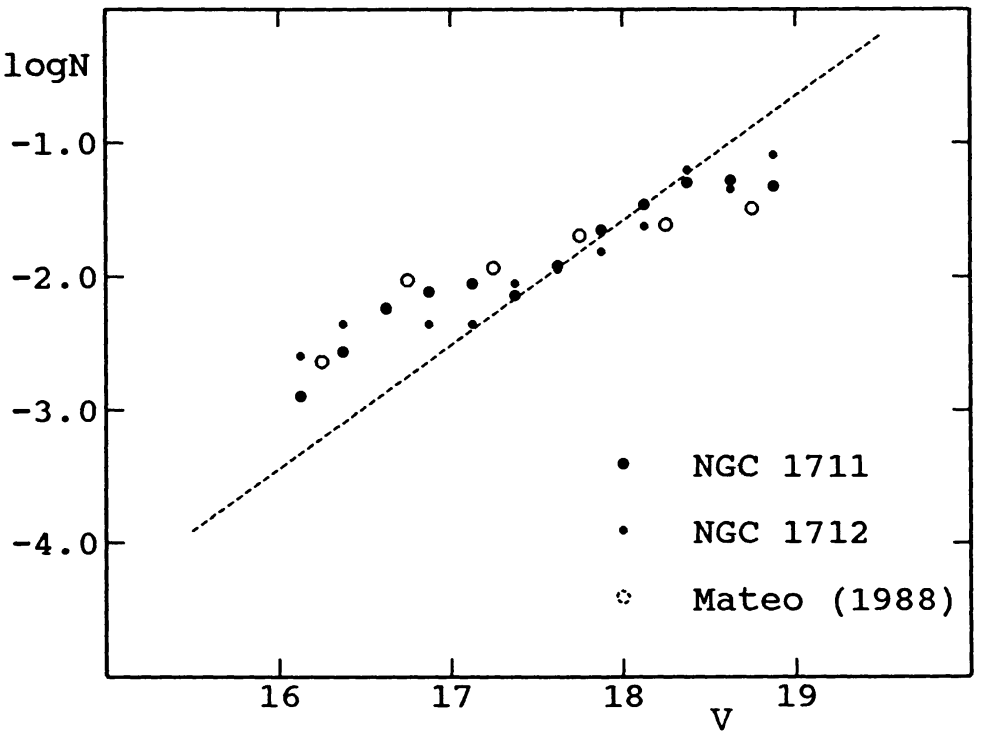

Fig. 4. Main sequence luminosity functions of NGC 1711 and 1712. Straight line is the same as in Fig. 3.

difference is certainly greater then the expected error of luminosity function determination resulting from the least square fit given by Eq. (1). The numerical data for the described luminosity function for all observed clusters are summarized in Table 1.

3. Conclusions

The complex of three young open clusters in Large Magellanic Cloud, NGC 1712, 1722, and 1727 although composed of groups of stars located in a close vicinity shows a small but real difference in age. Clusters NGC 1722 and 1727 are very young and their main sequences correspond practically to zero age; this is in accordance with the presence in them of the large amount of luminous matter - an obvious remnant of the primordial cloud. Also the relatively large number of points located on the color-magnitude diagram to the right from the main sequence may be interpreted as corresponding to

Table 1

Observed main sequence luminosity functions

V	NGC 1722 + 1727 S=714			NGC 1711 S=292			NGC 1712 S=289		
	N	N/S	log(N/S)	N	N/S	log(N/S)	N	N/S	log(N/S)
16.125	10	.014	-3.610	15	.028	-2.892	11	.038	-2.589
16.375	16	.022	-3.140	21	.039	-2.556	14	.048	-2.348
16.625	19	.026	-2.968	29	.054	-2.233	16	.055	-2.214
16.875	30	.041	-2.511	33	.061	-2.104	14	.048	-2.348
17.125	45	.061	-2.105	35	.065	-2.045	14	.048	-2.348
17.375	46	.062	-2.084	32	.059	-2.135	19	.065	-2.043
17.625	44	.060	-2.128	40	.074	-1.911	21	.072	-1.943
17.875	71	.096	-1.649	52	.096	-1.649	24	.082	-1.809
18.125	77	.104	-1.568	63	.116	-1.457	29	.099	-1.620
18.375	89	.120	-1.424	74	.137	-1.296	44	.150	-1.203
18.625	126	.171	-1.076	75	.139	-1.283	38	.130	-1.349
18.875	166	.225	-.800	72	.133	-1.324	49	.167	-1.095

stars evolving into the zero age main sequence. The nearby open cluster NGC 1712 is older, its age being approximately 2×10^7 years. It does not contain any remarkable amount of diffused matter. The main sequence luminosity function (although determined inside the range of three magnitudes only) of NGC 1712 resembles closely that of the young populous cluster NGC 1711 and is markedly different from the luminosity function of NGC 1722 and 1727. It may suggest that the differences in luminosity functions are related to the ages of the clusters rather than to their morphological type.

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