EFFECTS OF DATA INCOMPLETENESS AND METALLICITY ON THE MASS FUNCTIONS OF YOUNG LMC STAR CLUSTERS

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ABSTRACT. The young globular clusters in the Magellanic Clouds offer a good number statistic and a reasonably wide mass interval which are required for the derivation of any statistically reliable slope of the Initial Mass Function (IMF). Elson *et al.* (1989) and Mateo (1988) are amongst those few who utilized this potential first. These authors, however, arrive at different conclusions. Elson *et al.* find quite flat mass function slopes in comparison with the values given by Mateo. Here we present IMF slopes based on B, V CCD photometry for four young LMC clusters, NGC 1711, 2004, 2164 and 2214 and discuss the effects on them of cluster metallicity and of uncertainties in the incompleteness of the data.

The data were obtained with the Danish 1.5m telescope at the European Southern Observatory, La Silla, Chile, between 4 and 7 November, 1988 in good photometric conditions. B and V magnitudes were obtained with DAOPHOT. We performed artificial star experiments with, in total, ~ 13,000 stars to derive the completeness factor, $\mathbf{f_c(m)}$, of the photometry.

In deriving the IMF slope, we assumed a power law $dN/dm = m^{-(1+x)}$ and applied the following procedure. Raw star counts were first corrected for incompleteness and for field star contamination. We used the convective overshooting isochrones by Bertelli *et al.* (1990) for the mass-luminosity relations of the individual clusters.

The application of $\mathbf{f_c(m)}$ to the star counts derived from a single B or V frame alone, is simple. However, the completeness factor for a colour-magnitude diagram (CMD) is a different matter. Mateo (1988), for instance, regarded the two $\mathbf{f_c(m)}$ values as independent and expressed the "effective" $\mathbf{f_c(m)}$ value for a V, (B-V) CMD as the product $\mathbf{f_c(V)}$ x $\mathbf{f_c(B)}$. We believe that this approach is not strictly correct. The location of the stars is exactly the same as in the B and V frames and so the overlap of star images is topographically identical except for the differences due to colour effects. Indeed, a comparison of the slope of the luminosity function (LF) obtained from the V frame alone, with that from the V, (B-V) CMD with the $\mathbf{f_c(V)}$ and the $\mathbf{f_c(V)}$ x $\mathbf{f_c(B)}$ corrections, respecitvely, reveals a substantial amount of difference. The product apparently overcorrects the LF. On the other hand, the "effective" $\mathbf{f_c(m)}$ value cannot be larger than the smaller value of the pair $(\mathbf{f_c(B)},\mathbf{f_c(V)})$, so this is the minimum correction. In Table 1, therefore, we have collected the IMF slopes for all the three cases.

For the clusters under study, we adopted the reddening values from Cassatella *et al.* (1987) and a distance modulus of 18.6 mag. The cluster metallicities are still under debate, and so we give x values for different metallicities to demonstrate its effect. Ages of the clusters were derived using the convective overshooting models given by Bertelli *et al.* (1990) and the procedure described by Chiosi *et al.* (1989) and Vallenari *et al.* (1990a). An observed CMD is compared with a synthetic one generated from a Monte-Carlo simulation with the constraint of having the

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same number of evolved stars. The resulting ages for NGC 1711, 2004 and 2214 are listed in the Table. The age of NGC 2164 is taken from Vallenari *et al.* (1990b).

The slope of IMF (x) has been derived from a least squares fit to the statistics of the mass distribution. The errors given are formal errors resulting from the linear regression to the data points. Table 1 demonstrates that the choice of the various incompleteness corrections and modelling parameters has a large effect on the slope of the final mass function. We note that the agreement with the result of Mateo (1988) in the case of the only common cluster, NGC 1711, is excellent when we imitate his procedure as closely as possible. It is, however, clear from our analysis that the cumulative effect of the choice of the metallicity and incompleteness correction on the value of x can be ~ 1 dex; (note the differences with the values given by Richtler and de Boer (1989) which are only due to the choice of another isochrone.) To derive a truly reliable IMF, one needs a reliable metallicity as well.

Table 1. Mass function slopes for young LMC star clusters

Cluster	E(B-V)	age	Z	x_1	x_2	x_3
NGC 1711	0.14	6×10^7	0.02	2.1±0.3	1.8±0.4	2.4±0.4
		1.5×10^8	0.001	1.5±0.3	1.2±0.3	1.8±0.3
NGC 2004	0.09	4×10^7	0.02	1.1±0.1	1.0±0.1	1.4±0.1
		1×10^8	0.001	0.9±0.1	0.9±0.1	1.0± 0.2
NGC 2164	0.10	2×10^8	0.004	0.5±0.4	0.5±0.4	0.8±0.4
NGC 2214	0.07	2×10^8	0.004	1.3±0.3	1.0±0.3	1.6±0.3

x^1 = IMF slope using f_c(V) for incompleteness correction

x^2 = IMF slope using minimum of (f_c(B),f_c(V)) for incompleteness correction

x^3 = IMF slope using (f_c(B) x f_c(V)) for incompleteness correction (cf. Mateo 1988)

Conclusions

Given the sensitivity of the slope of IMF to the choice of the completeness factor and to the effects of metallicity, it is at the moment futile to claim the existence of a universal IMF or to claim proof for differences in IMFs.

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