GLOBAL VERSUS LOCAL MASS FUNCTIONS

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ABSTRACT: Multimass dynamical models are used to study the difference between a mass function determined in an outer field and the global mass function of the cluster. The differences are small.

McClure *et al.* (*Astrophys. J. Letters*, 15 Aug. 1986) have recently suggested that the mass functions of globular clusters correlate with their metallicities, citing seven examples for which they give the exponent x in the mass-function formula

$$N(m)\,dm = m^{-(1+x)}dm.$$

With decreasing metallicity their values of x range from -0.5 to $+2.5$.

Their mass functions are derived from observed luminosity functions in a single field in each cluster. Since the stars of different mass are distributed differently, however, a local mass function does not correctly reflect the global mass function of the cluster. The latter will not be directly observable until the era of Hubble Space Telescope, but it can be deduced reasonably well by fitting dynamical models to the observations in each cluster. The present note shows how great the differences should be, using models that fit the general characteristics of each cluster.

In the models, each stellar type has a lowered Maxwellian distribution with a modulus of precision that corresponds to its mass, the whole being in mutual dynamical equilibrium. The main groups have masses of 0.75, 0.60, 0.45, 0.30, and 0.15 $M_\odot$ respectively, with stars of 0.775 $M_\odot$ added to represent the red giants. In addition, the models contain white dwarfs, and small numbers of brown dwarfs and neutron stars, all of which have an inconsequential effect on the dynamics.

For each cluster the proportions of the groups from 0.15 to 0.775 $M_\odot$ were chosen according to a power law with the exponent given for that cluster by McClure *et al.* These proportions were imposed on the projected density distribution at the radial distance at which the luminosity function had been studied. The central concentration of each model was chosen to agree with the value given for that cluster.

J. E. Grindlay and A. G. Davis Philip (eds.),
The Harlow-Shapley Symposium on Globular Cluster Systems in Galaxies, 487–488.

The total number of stars of each type was integrated in each model, and was compared with the local mass function. The results are displayed in the figure, in which the circles represent the local mass function and the connected crosses the global one. The vertical zero point of each set of points is arbitrary; what matters is the difference in slope and curvature.

The models had isotropic velocity distributions. To investigate the effect of anisotropy, a model was calculated for M13 with anisotropy radius $4r_c$, near the value found by Lupton, Gunn, and Griffin (preprint); it is shown as M13A.

The following conclusions can be drawn. (1) Global mass functions tend to be less steep than local ones in the outer parts, but the differences are far too small to destroy the correlation shown by McClure *et al.*. (2) The difference is larger in a cluster where the central concentration is high and the observations are taken far out than in a cluster of lower concentration with observations closer to the center. (3) For a given outer mass function, anisotropic models imply a flatter global mass function than do isotropic models. (4) In general, the differences found here tend to bend the global mass function up from a power law, at the high-mass end.

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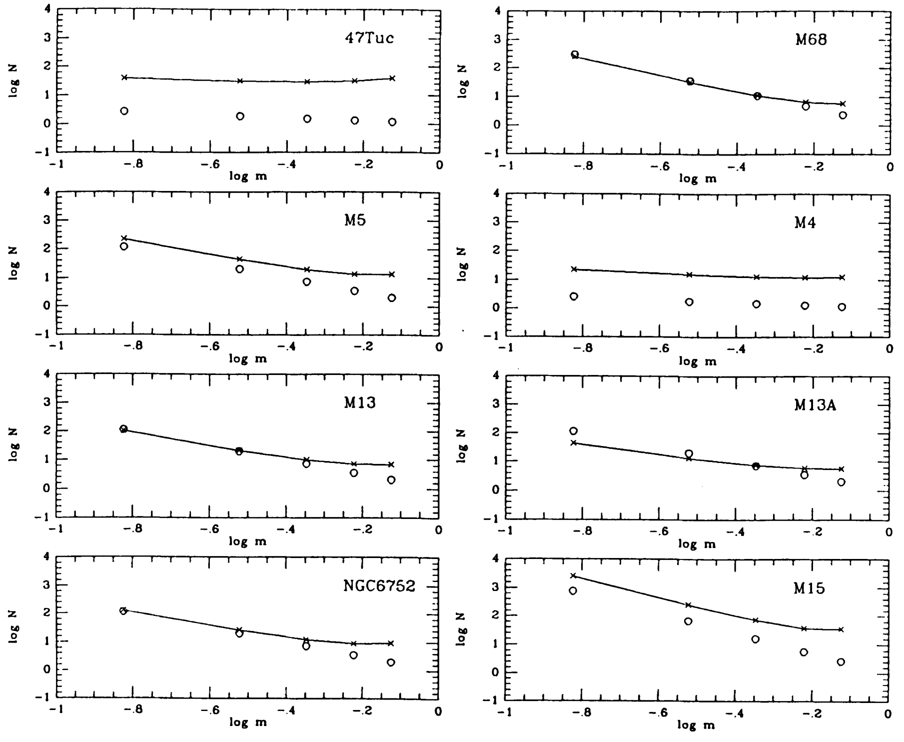

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