HIGH PRECISION PHOTOMETRY OF 10000 STARS IN M3

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ABSTRACT
A new Color-Magnitude Diagram for M3 is presented. 10000 stars have been measured down to V = 22 with an internal accuracy better than 0.03 mag to get complete and very accurate samples over well defined areas.

As well known, the knowledge of the age of the cluster system and of the primordial helium abundance derived from star counts in globular clusters can put constraints to any cosmological model. However, it is also known that most of the results and deductions depend on reliability of theoretical evolutionary tracks. Therefore, it is fundamental to make first appropriate checks of the models (see also Renzini, this volume).

Globular clusters can be considered the "best laboratories" to study and test stellar evolutionary theory and, in particular, to assess whether:

i) "classical input physics" (e.g. reaction rates, opacity,....) is correct enough to guarantee meaningful results;
ii) "left-out classical physics" (e.g. rotation, diffusion, non-convective mixing,...) is actually important;
iii) "left-out non-classical physics" (e.g. massive neutrinos, WIMPs ...) plays a role.

The best "observable" to do this check is the star luminosity function. In fact, the knowledge of individual luminosities and number of stars per luminosity bin allows (among others): i) a "tracking" of the hydrogen-profile from the turnoff up to the red giant tip and ii) the

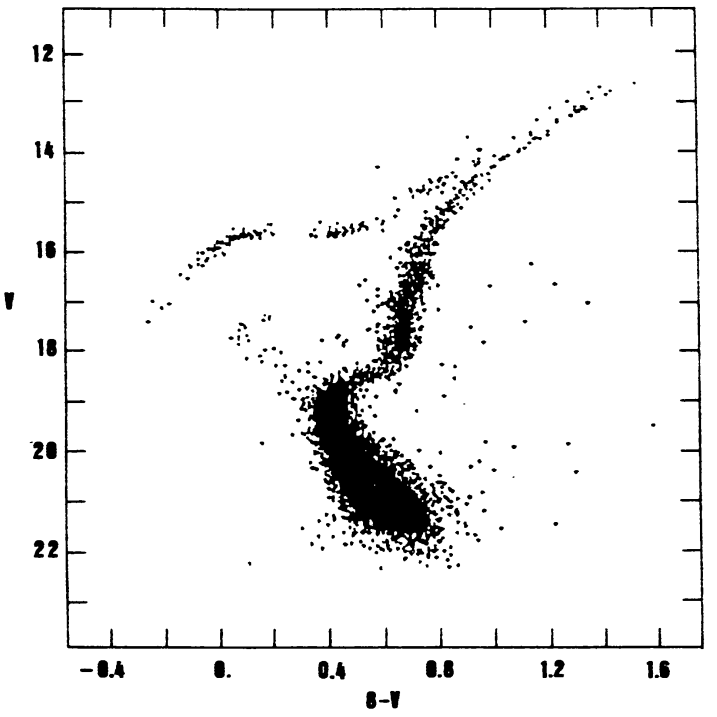
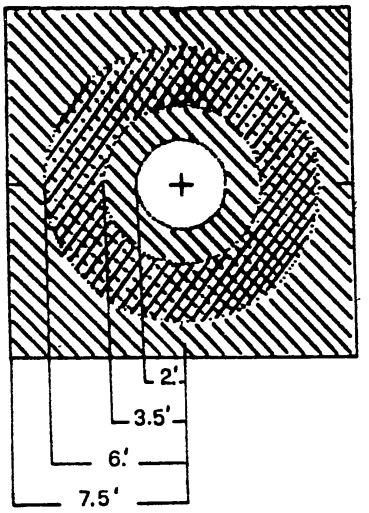


Fig. 1: CMD of M3, composite sample.



Sample counts:

Bright		Deep	
AGB	38	AGB	10
HB	226	HB	82
RGB	860	RGB	342
BS	20	SGB	764
		MS	8628
		BS	53
Total	1144		9879

Fig. 2: Observed fields and number of stars in each individual sample.

determination of the relative contributions to the total cluster light from stars in the various evolutionary stages. Proper information can however be obtained only using very populous and complete samples. As stressed by Crocker and Rood (1984), finding statistically significant features in the differential luminosity function requires samples of more than 1000 stars in the upper five magnitude range of the CMD. Moreover, using the formula obtained by Renzini (1981):

$$N(j) = 1.7 \times 10^{-11} \times L(tot) \times t(j)$$

one gets for instance that a total luminosity L(tot) = 5×10^4 Lo should be sampled to find (statistically) 1 star (N(j) = 1) representative of a particular evolutionary stage whose duration is t(j) = 10^6 years .

The present work is a first step towards the acquisition of samples fulfilling the quoted requirements. The description of the results and a complete discussion are in preparation. Here we simply present the Color-Magnitude Diagram (see Fig. 1) obtained from the reduction of a wide collection of Palomar plates. More than 10000 stars have been measured down to V = 22 in two different areas (see Fig. 2). In the first, with 3.5 < r < 6.0 arcmin, photometric completeness has been achieved down to V = 21.5 and an algorithm to correct for losses due to unrecoverable crowding and blending has been experimentally computed. In the second, within a square field of 15 x 15 arcmin (see Fig. 2), completeness has been extended only to V = 18, well below the horizontal branch.

Many tests made on the data guarantee an internal photometric accuracy better than 0.03 mag at V = 21. Therefore, both the total population of each branch and the relative star number ratios are "bona fide" representative of the corresponding evolutionary time-scales.

REFERENCES

Crocker,D.A. and Rood,R.T. 1984, in 'Observational Tests of the Stellar Evolutionary Theory' A. Maeder and A. Renzini Eds., Reidel, p.159.

Renzini,A. 1981, Ann. Phys. Fr. 6,87.