INTERNAL DYNAMICS OF MAGELLANIC CLOUD CLUSTERS

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1. INTRODUCTION

It is believed that stellar systems become mass-segregated on a time scale comparable to the two-body relaxation time (Tr). Globular clusters in the Magellanic Clouds have an extensive range in age and richness. Thus, in the clouds, there are candidate clusters with ratios of Tr to age both > 1 and < 1. Our objective is to study the radial density structure of clusters as a function of mass (magnitude) and compare with expectations based upon Tr. We report here preliminary results on two such clusters at the age extremes in our sample: NGC 458 (SMC) and 121SC03 (LMC).

2. REDUCTION AND ANALYSIS

The frames (B & V) were obtained on the 4 m PFCCD Cerro Tololo for both program clusters and E region standard star fields. DAOPHOT was used to reduce the raw image data. CM diagrams are displayed in Fig. 1 and best fit Vandenberg (1985) isochrones are overlayed on the plots. Single mass, isotropic King models were fit to the brightness profiles of both clusters. Reasonably tight constraints on Wo and the tidal radius (Rt) served to determine a unique overall density profile for the clusters. No obvious segregation was evident from the B & V frame comparison for NGC 458 since these had identical best fit parameters. A simple tidal calculation for Rt, based upon a point mass SMC model, gave 146" for NGC 458 which agreed well with the model parameter. Table I displays best fit quantities for the clusters (including the isochronal ones).

High central crowding caused severe counting deficiencies, so a modified version of the ADDSTAR routine in DAOPHOT was used to find the correction factors to the radial stellar count profiles. Multiple runs were needed to prevent severe biasing in all cases. At ~ 24" (1.6 and 1.0 core radii respectively), reliable factors were obtainable for most of the M.S. of NGC 458 and all of 121SC03. Completeness correction factors for three radial regions are given in the first half of Table II, whereas the ratios of the number of stars in three magnitude bins

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after correction (the corrected luminosity functions) are given in the 2nd half of the table. From Spitzer & Hart (1971), the half-mass relaxation time (Trh) for NGC 458 & 121SC03 is: 260 Million, 415 Million yrs., respectively. Trh/Age = 1.3, 0.04 respectively.

3. DISCUSSION

The preceding calculation predicts that NGC 458 should be unrelaxed with no mass segregation, while 121SC03 should be segregated. Inspection of Table II shows little evidence for segregation in NGC 458. The uncertainties ranged from 0.03 to 0.16 (bright to faint bin) with the inner and outer annuli having identical ratios within 1 sigma. The middle radius has an excess of faint stars however. For 121SC03, the bright stars are more centrally concentrated, but this is a marginal result because only a 12% mass difference exists along the sample range. We will examine surface density profiles as a function of mass.

TABLE I.

Best Fit Parameters (both Isochrones & King fits)

	Dist. Mod.	Age(yrs)	Y	Z	Wo	Rt	Mv	Mass(solar)	CHI SQ.
NGC 458	18.80	300 Mill.	0.25	0.01	4.40	121"	-7.5	25,000	0.89
121SC03	18.20	10 Bill.	0.25	0.006	3.60	143"	-5.7	5,890	1.45

TABLE II.

Correction factors and Relative number of stars in three radial bins

	Mag. Range	24-48"	48-72"	72-120"	Mag. Range	24-48"	48-72"	72-120"
NGC 458	16.2-19.2	1.0	1.0	1.0	16.2-18.2	0.089	0.058	0.084
	19.2-20.2	1.38	1.0	1.0	18.2-20.2	0.668	0.427	0.626
	20.2-21.2	2.00	1.67	1.40	20.2-21.2	1.000	1.000	1.000
121SC03	18.4-22.0	1.0	1.0	1.0	18.4-20.8	0.120	0.129	0.099
	22.0-23.2	1.85	1.36	1.18	20.8-22.0	0.251	0.200	0.217
					22.0-23.2	1.000	1.000	1.000

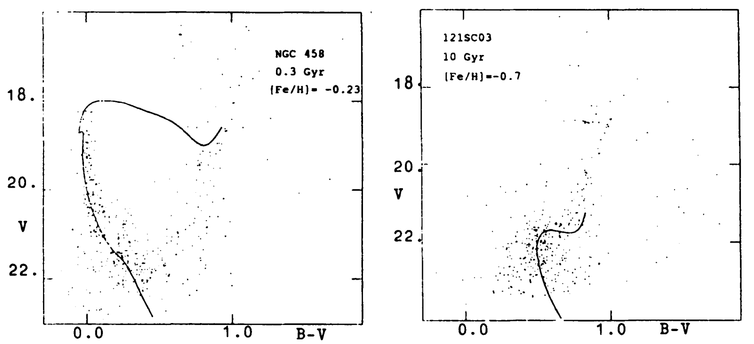

Fig. 1. CMD's of NGC 458 and 121SC03, with Vandenberg isochrones overlaid.

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