

The dynamics of mass segregation in star clusters

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Abstract. In this paper, using 2MASS photometry, we study the mass functions $\phi(M) = dN/dM \propto M^{-(1+\chi)}$ of a sample of nine clusters of ages varying from 6 Myr to 1.2 Gyr and galactocentric distances from 6 – 12 kpc. We look for evidence of mass segregation in these clusters and trace the variation in the value of χ in different regions of the cluster as a function of the parameter $\tau = t_{age}/t_{relax}$, galactocentric distances, age and size of the cluster.

Keywords: star clusters: parameters–IMF–mass segregation–2MASS

The distribution of mass amongst the stars born from a parent cloud, is described by the initial mass function (IMF)(Kroupa 2002). Mass segregation is the redistribution of stars according to their masses, thus leading to the concentration of high mass stars near the centre and the low mass ones away from the centre. This can take place as a result of dynamical interactions between stars in clusters or due to the star formation process. The variation of the MF of clusters in different regions of the cluster has been studied by (Hasan et al 2008, Sharma et al 2007). In this work, we studied a sample of nine clusters viz. NGC 6704, NGC 6005, NGC 6200, NGC 6604, IC 1805, NGC 2286, NGC 2489, NGC 2354 and NGC 1893 using photometric data from the Two Micron All Sky Survey (2MASS) (Skrutskie et al 2006). The 2MASS has the advantages of being homogeneous, all sky (enabling the study of the outer regions of clusters where the low mass stars dominate) and covering near infrared wavelengths where clusters can be well observed in their dusty environments (Bonatto & Bica 2005).

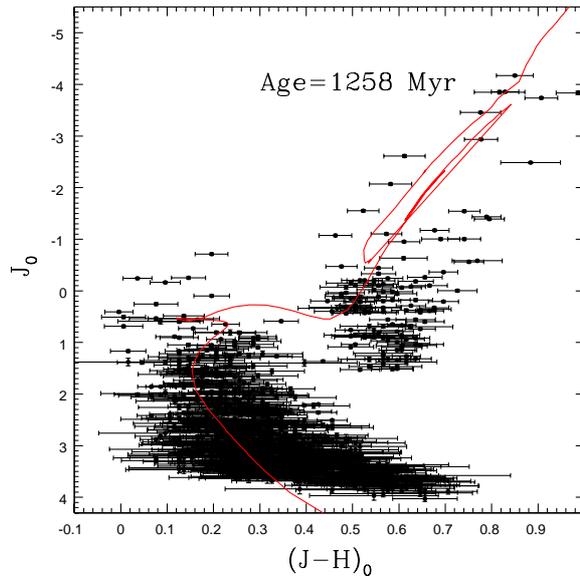
An example of isochrone fitting for NGC 6005 is shown in Fig. 1.

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Table 1. Cluster parameters obtained.

Cluster	Rad_{core} (pc)	Rad_{lim} (pc)	GC (kpc)	$E(B - V)$ (mag)	Distance (pc)	Age (Myr)	τ	χ
NGC 6704	1.8	6.7	6.11	0.69	2884	250	27.78	0.51
NGC 6005	0.84	2.76	7.24	0.4	1585	1258	241.9	2.99
NGC 6200	1.19	4.17	6.64	0.58	2050	6.3	4.2	0.89
NGC 6604	0.39	2.22	6.91	0.97	1700	6.3	3.2	-0.04
IC 1805	0.43	3.86	9.6	0.7	1479	4	0.53	-0.31
NGC 2286	1.24	8.37	10.74	0.3	2618	200	33.56	1.46
NGC 2489	0.47	4.2	9.17	0.4	1445	316	53.92	0.75
NGC 2354	1.22	6.68	9.15	0.13	1148	630	45	1.69
NGC 1893	3.1	12.66	12.11	0.7	3630	4	0.35	0.51

Parameters derived for the clusters have been shown in Table 1. Clusters were divided into regions (core, inner halo and outer halo) and the values of χ were found for each region as well as the overall cluster.

**Figure 1.** The absolute CMD of NGC 6005

The χ values of the clusters under study range from -0.04 to 2.99. Table 1 also shows the values of χ and τ for the clusters. It is interesting to note a very high confidence level ($p^1=0.002$) in the correlation (0.87) of χ with τ , and a correlation of 0.92 with $p=0.0004$ for χ and age. As clusters age, they have steeper values of χ . The χ value increases with age and τ , which is a clear

¹ $p \leq 0.05$ implies a confidence level larger than 95 %

indicator of the dynamical processes involved. χ also increases with galactocentric distance, indicating a larger number of low mass stars due to lesser evaporation of stars at larger galactocentric distances. A complete paper with detailed analysis and interpretation is in preparation. This work makes use of 2MASS and Virtual Observatory tools. It has been funded by the Department of Science and Technology, India under Women Scientist Scheme (PH).

References

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