A STUDY OF THE SPATIAL VARIATION OF MASS FUNCTIONS IN SOME YOUNG OPEN CLUSTERS

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ABSTRACT   The effect of mass segregation on cluster mass functions has been studied and it is found that the slope of the mass function is steeper in the outer parts of open clusters. Since dynamical relaxation time is always larger than the age of the clusters, it is inferred that the observed mass segregation might have taken place at the time of cluster formation.

INTRODUCTION

In a few open clusters mass segregation, i.e. massive stars tend to lie near the cluster center, is an established fact (Sagar, *et al.* 1988; and references therein). Therefore, the mass function in the outer parts of the cluster may be different from that of the nucleus region. The knowledge of the spatial variation of mass function in open clusters has an important bearing on their dynamical evolution.

In the present work an effort has been made to study the spatial variation of the mass function within a few young clusters, using only the reliable cluster members.

OBSERVATIONAL DATA

In the present study we have included 11 open clusters. The effect of mass segregation in a few of these clusters has been observed by Sagar, *et al.* (1988). The observational data for nine clusters NGC 581, 654, 2264, 6530, 6611, 6823, 6913, Tr 1 and IC 1805, have been taken from the catalog of Myakutin, *et al.* (1984), while for another two clusters, NGC 869 and 884, have been taken from the catalog of Muminov (1983). The details of the method used for mass estimation of cluster members are given by Sagar, *et al.* (1986).

SPATIAL VARIATION OF MASS FUNCTIONS

The point of maximum stellar density has been considered as the cluster centre which has been determined with an accuracy of $\tilde{1}$ arc sec (cf. Sagar, *et al.*

1988). The cluster region is then divided into two, three or four concentric regions depending upon the total number of stars in the cluster so that each region has generally more than 20 stars. The cumulative mass function has been constructed for each cluster by counting the number of stars, N, having masses within the limit of the interval, M, and using the relation

$$log\ N\ =\ -X\ log\ M\ +\ const;$$

where X is the slope of the cumulative mass function. Using a least squares linear regression the values of the slope, their standard errors and correlation coefficients have been obtained. Assuming normal error distribution, statistical significance levels for differences in the values of X for regions I and II have also been obtained. Except for NGC 6611 and 6823, the statistical confidence level is above 98% in all other cases. The variation of mass function with radial distance for each cluster is shown in Figure 1.
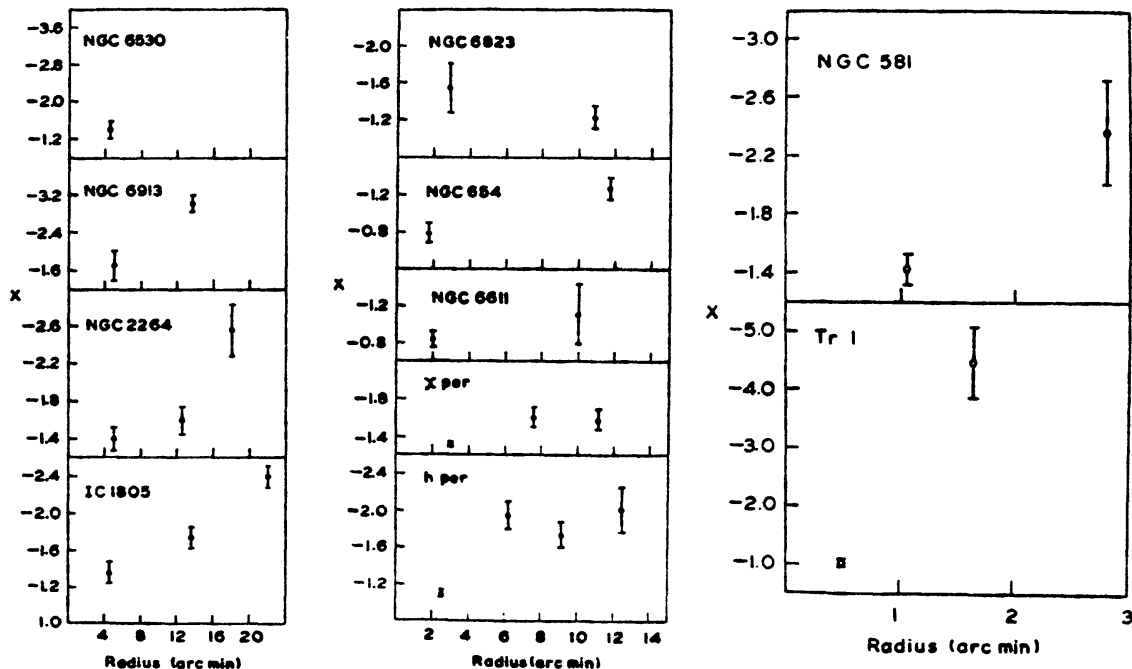

Fig. 1. The spatial variation of mass function in young open clusters.

EFFECT OF MASS SEGREGATION ON MASS FUNCTION

Figure 1 manifests that the slope of the mass function is steeper in the outer parts of open clusters except NGC 6823, which suggests a preferential concentration of massive stars towards the centre than the outer region of the clusters. NGC 6611 and 6823 do not show statistically significant difference in the slope mass functions for the inner and outer regions. A possible reason for this could be completeness limit of present data ($\tilde{8}\ M_\odot$) in both the clusters. Sagar, et al. (1988) also could not study the effect of mass segregation in NGC 6611 and 6823 because of the completeness limit.

It is interesting to note that Burki (1978) has concluded that the slope of the mass spectrum is steeper in central regions than in outer regions of the newly formed clusters. However, in case of three common clusters i.e. NGC 654, 6823 and IC 1805 the findings of Burki (1978) are based on a smaller cluster region compared to present study. In the case of NGC 869 and 884 the values of r_{cl} used by Burki (1978) are comparable to the boundary of the outer regions used in the present study. The result obtained by Burki for these two clusters, that the massive stars show a higher degree of central concentration than the less massive stars, is in agreement with the result obtained in the present study.

Dynamical relaxation may be one of the possible reasons for the variation in the value of the slope of the mass function, X. Clusters used in the present study have already been studied by Sagar, *et al.* (1988) and they have concluded that except Tr 1, the other ten clusters are not dynamically relaxed, and therefore, the observed variation in the value of X in these clusters might be a result of the star formation process.

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