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# LUMINOSITY SEGREGATION AND LOCAL DENSITY OF GALAXIES IN CLUSTERS

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ABSTRACT: The luminosity segregation of galaxies in clusters is studied and it is shown that the D and cD galaxies are the only morphological species that show a segregated distribution.

RESUMO: Estuda-se a segregação de luminosidade das galáxias em aglomerados e mostra-se que as galáxias D e cD são as únicas especieis morfológicas que apresentam distribuição segregada.

## I. Introduction

It is commonly believed that collisional relaxation processes in clusters of galaxies should lead to mass-segregated distributions which could be observed as an excess of bright galaxies in central, denser region of the cluster. It has also been suggested that mass segregation may be already present during cluster formation phase because the first formed clumps of galaxies will preferentially condense around the most massive objects and because subsequent mergers between these clumps do not destroy mass segregation. Mergers between galaxies in these clumps or in the core of the cluster may diminish the total number of massive galaxies therefore supressing the excess of bright galaxies in the densest regions of the cluster. However some residual luminosity segregation may still be present and it seems reasonably to expect it remains a positive correlation between the average luminosity of galaxies and local density of galaxies.

## II. The analysis

In order to investigate these predicted effects about 30 clusters with redshifts lower than 0.05 were selected from Dressler's catalogue of clusters of galaxies (Dressler, 1980). After correction of Dressler's $m_V$ magnitudes for interstellar absorption (Sandage, 1972) about 1276 galaxies were found brighter than $M_V \doteq -20$. These galaxies are distributed morphologically according to fig. 1.

The local density of galaxies within these clusters selected as above was then calculated following a procedure similar to the one employed by Geller and Beers (1982). For each cluster we constructed a set of four grids of fixed size (0.24 Mpc or 0.48 Mpc depending on cluster and $H_0$ = 100 Km $s^{-1}$ $Mpc^{-1}$, $q_0$ = 1/2), but shifted from each other so that each box overlaps in 50% with their neighbours. The local density estimator associated to a particular galaxy in then given by the average of counts in the four boxes in which the galaxy falls.

The values of local density calculated as above were corrected for a uniform background of 8 ± 5 gal/$(^o)^2$ (Dressler, 1980). Moreover, as the absolute magnitude limit varies from cluster to cluster, we made a correction for variation in sampling of the galaxy luminosity function at different redshifts (Dressler, 1980; Huchra, Geller, 1982). A Schechter luminosity function with the CfA redshift survey parameters (Davis, Huchra, 1982) was adopted and all densities were refered to magnitude limit $M_{B(0)}$ = - 17.5 (with B(0) - V $\simeq$ 1.3), the same limit used by Dressler (1980).

## III. Results

Figure 2 shows the distribution of the 1276 galaxies brighter than $M_V$ = - 20 binned in 1 mag in magnitude and 0.25 in log $\sigma$ (galaxies $Mpc^{-2}$). Figure 2a corresponds to all galaxies while figures 2b-2c shows the morphological groups D+cD, E, S$\phi$ and S. Figure 3 shows the mean densities associated to each distribution appearing in figure 2. The error bars are the standard deviations of the means. Figures 2a and 3a shows that galaxies brighter than $M_V$ = -22 tend segregate towards high density regions whereas, on the contrary, fainter galaxies appear predominantly in low density regions. A K-S one sided test shows that galaxies in magnitude range of - 22 $\leq M_V$ < - 24 are more segregated than those in the range - 20 $\leq M_V$ < - 22 at a significance level of $\alpha = 4 \times 10^{-5}$. However, as it can be seen in figs. 3b to 3e, it seems that this tendency of bright galaxies to populate the densest region is uniquely due to the contribution of D and cD galaxies, which constitute the brightest set of galaxies of our sample. A K-S test shows that D and cD galaxies are more segregated than normal elliptical at a significance level of $\alpha = 2 \times 10^{-4}$. The mean densities of other morphological types appear to be nearly independent of magnitude. Figure 3e indicates some segregation of S galaxies brighter then $M_V$ = -22 but with no statistical significance ($\alpha$ = .03 for a one-sided K-S).

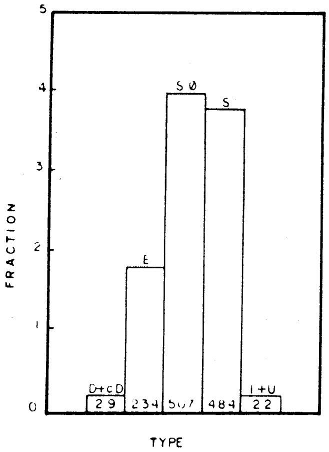


FIG 1

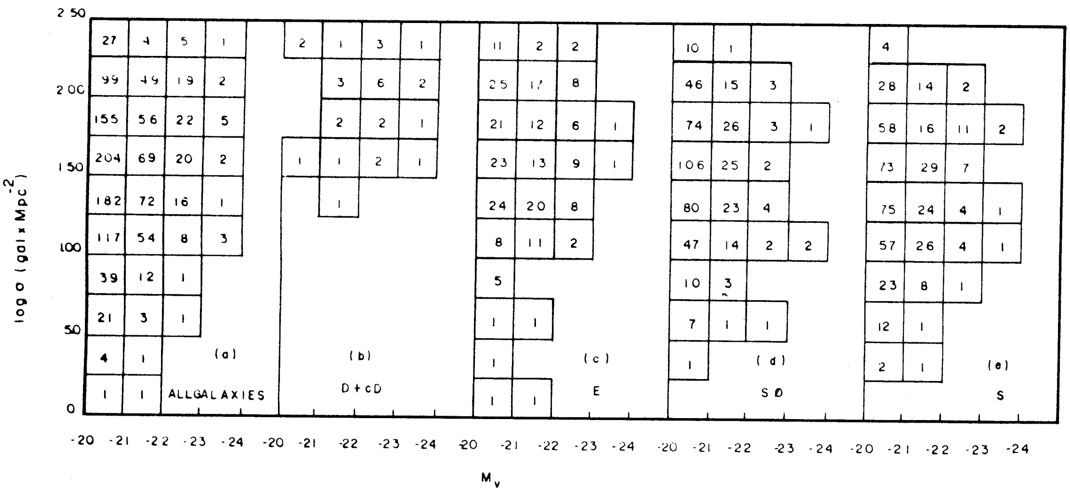


FIG 2

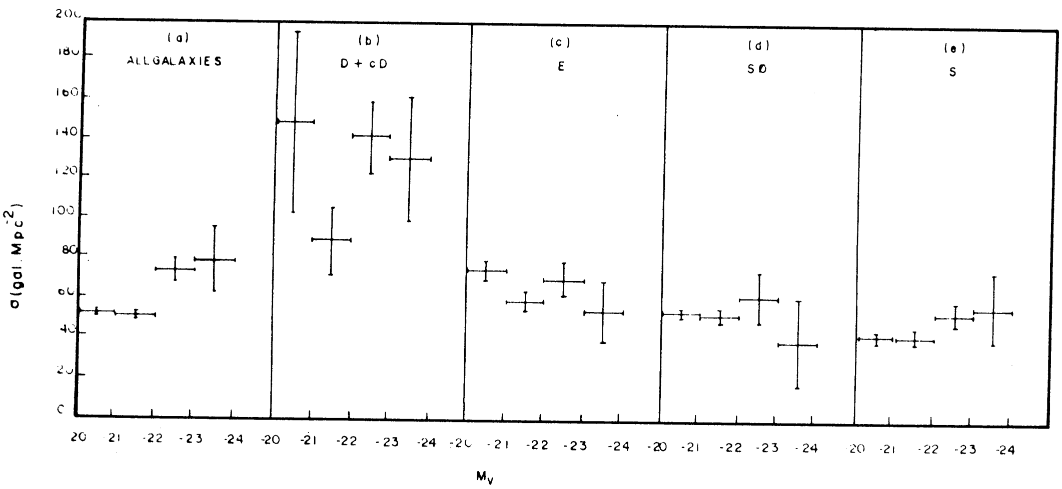


FIG. 3

## IV. Discussion

The results of previous section shows that only D and cD galaxies appear to be segregated. As demonstrated by Beers and Geller (1983), these galaxies are found preferentially in regions with relatively high densities. Figure 3b shows that the typicals environments of these galaxies have densities greater than 100 galaxies $Mpc^{-2}$. The other morphological types, however, are not segregated.

These results could be analised within the giant galaxies formation theories (see White, 1982, for a review). The relaxation time in the central regions of dense clusters is near $10^9$ years and so some relaxation must be occured in these clusters. Due to two-body interactions the most massive objects migrates towards the cluster center, establishing the segregation. These firstly segregated objects could be the seeds of D and cD galaxies, wich could then grow by a sequence of mergers and/or by cooling accretion flow of intergalactic gas.

## V. References

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