WHAT DETERMINES THE MORPHOLOGICAL FRACTIONS IN CLUSTERS OF GALAXIES?

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A reexamination of Dressler's (1980) sample of nearly 6000 galaxies in 55 clusters shows that the morphology-clustercentric radius relation is more fundamental than the morphology-local density relation. This conclusion is supported by improved correlations when the projected clustercentric radius is used as the independent parameter, and by a comparison of galaxies with the same normalized clustercentric radii but different values of the projected local density (Figure 1).

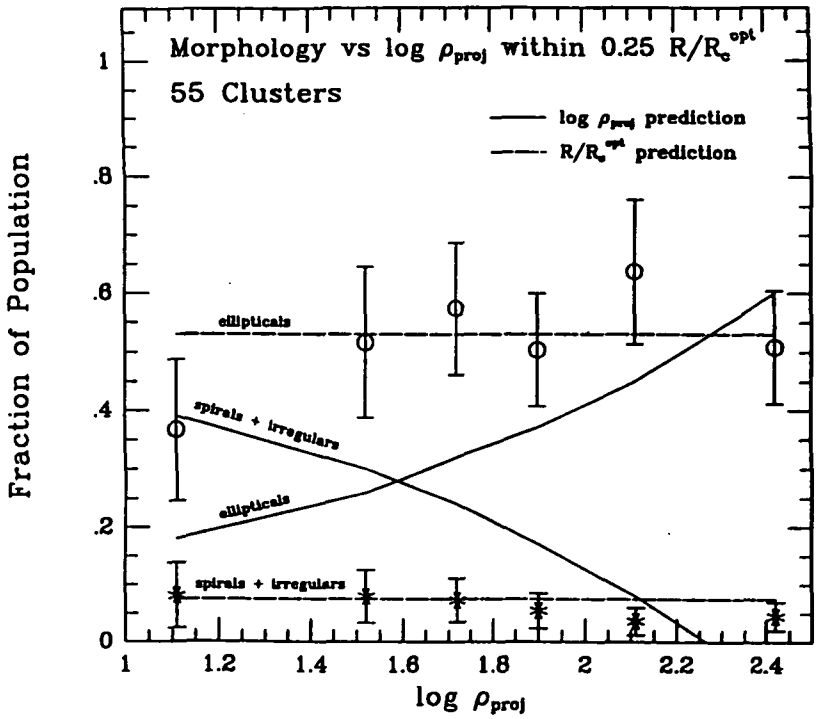

Figure 1 - The morphology-density relation for the galaxies within 0.25 R/R_c^{opt} of the cluster centers (where R_c^{opt} is the radius where the cumulative density falls below 20 galaxies Mpc^{-2}). The solid lines are the predictions for the morphology-density relation; the dashed lines are the predictions for the morphology-radius relation. Only the ellipticals and the spiral + irregular galaxies are shown for clarity. The data clearly favor the morphology-radius relation.

Figure 2 shows that the elliptical fraction in the outer regions of clusters is relatively constant for all types of clusters, with a slight rise from about 10% in the outermost regions to about 16% at R = 0.5 Mpc. For smaller radii, the elliptical fraction rises rapidly, reaching values of 60 - 70 % near the center of the cluster. The S0 fraction rises moderately as the center is approached, and then falls sharply within about 0.2 Mpc of the center. The spiral fraction falls moderately as the clustercentric radius decreases. The spiral fraction is essentially zero at the cluster center, even though spirals dominate everywhere else in the universe.

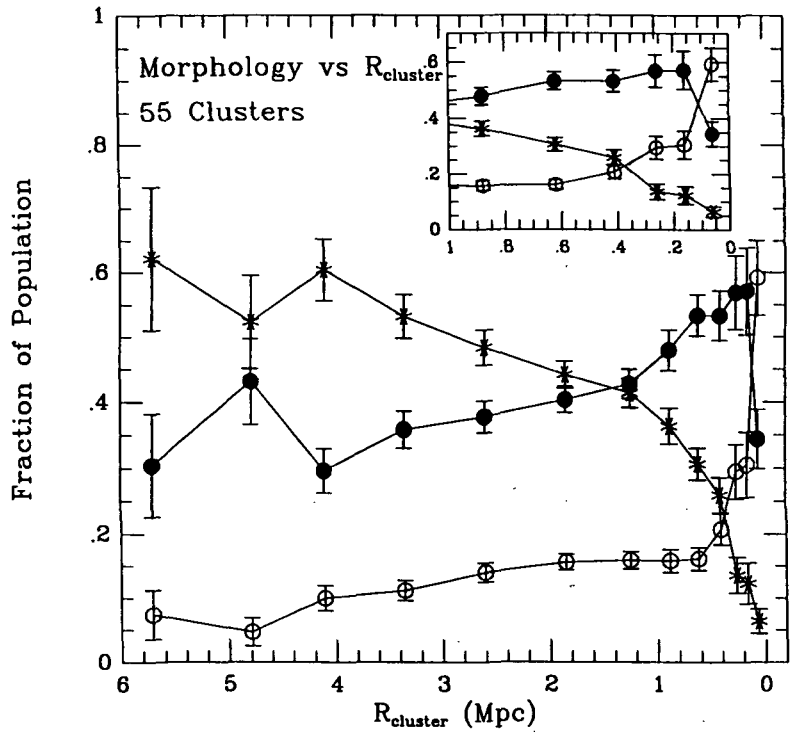

Figure 2 - The morphology-clustercentric radius relation for Dressler's (1980) 55 clusters.

The morphology-radius relation, when normalized by a characteristic cluster radius, R_c^{opt}, does not vary as a function of the number density within 0.5 Mpc, the x-ray luminosity, or the velocity dispersion of the cluster. This surprising result means that only one parameter is needed to determine the morphological fractions in clusters, namely R/R_c^{opt}.

These results indicate that some property of the cluster center plays the key role in determining the morphological fractions in clusters, and suggests the possibility that a destructive mechanism is controling the morphological fractions rather than a formation mechanism. Based on these results, we have developed the following simple model. The three basic assumptions are: 1) the intrinsic morphological mix of galaxies is E/S0+S+I = 10/90 %, 2) elliptical galaxies form first, followed by the cluster collapse, S0 galaxies, and finally, spiral and irregular galaxies, 3) during the cluster collapse, galaxies which are still protogalactic clouds of gas are destroyed, and the gas from these failed galaxies forms most of the intracluster medium. This simple model can explain a wide range of observations, and suggests that roughly half of the intracluster gas resulted from "failed" galaxies.

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Whitmore, B. C., Gilmore, D., and Jones, C. 1992, in preparation.