

**CHAPTER VIII**  
**GALAXIES AND CLUSTERS**

## THE LUMINOSITIES AND SIZES OF DISK GALAXIES IN CLUSTERS

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**ABSTRACT.** Our examination of the absolute luminosities and sizes of  $\sim 500$  lenticular and spiral members of several clusters has revealed appreciable differences in the galaxy luminosity-diameter relationships for different clusters.

### 1. INTRODUCTION

The study of the properties of galaxies located in different regions can allow us to clarify the extent of the influences of environment in the formation and evolution of galaxies. In this study we shall focus our attention on the galaxy luminosity-size relationship, considering the luminosities and radii of about 500 lenticular and spiral galaxies which are very likely to belong to the clusters Virgo, Hercules, Pegasus I, A262, Zwicky 74-23, A1367, and A1656.

### 2. SIZES AND LUMINOSITIES OF CLUSTER GALAXIES

For our sample of galaxies we have gathered together the isophotal diameters  $a$  (reduced to the galactic pole and zero inclination) in arc min at the 25 B- mag. arc sec<sup>-2</sup> brightness level from the RC2 catalogue (de Vaucouleurs et al., 1976) or (when not available therein) from the UGC catalogue (Nilson, 1973). We have converted the original UGC diameters according to the relations given in RC2. We have also taken the corrected blue total magnitudes  $B_1^0$  from RC2; when they are not available therein, the values of  $B_1^0$  come from the Zwicky magnitudes converted by us into the  $B_1$  system according

to Auman et al.'s (1982) precepts.

The distance of the galaxies of a given cluster was evaluated by means of the Hubble law with an assumed constant  $H_0 = 100 \text{ km s}^{-1} \text{ Mpc}^{-1}$  and the cluster galactocentric recession velocity.

The distance makes it possible to determine the absolute linear diameters  $D$  at the 25 B- mag. arc sec<sup>-2</sup> brightness level and the absolute blue total luminosity  $L$  in the RC2 system.

### 3. ANALYSIS

A standard linear regression analysis of the fit of the diameters  $D$  (in Kpc) and luminosities  $L$  (in solar units) to the function

$$\text{Log } L - \langle \text{Log } L \rangle = b (\text{Log } D - \langle \text{Log } D \rangle) \quad (1)$$

- for lenticulars, early-type spirals, late-type spirals and irregulars and all spirals - evidences appreciable differences in the apparent and true slopes of the regression lines for different cluster.. We have evaluated the true slope  $s$  on the reasonable assumption that the r.m.s. error of  $\text{Log } D$  is on average 0.04 (this is the average r.m.s. error of the values of  $\text{Log } a$  listed in RC2). For example in the case of lenticulars, the slopes  $s$  of Virgo ( $s=1.97 \pm 0.12$  for  $N=59$ ) and Pegasus I ( $s=2.2 \pm 0.2$  for  $N=5$ ) are significantly higher than those of Coma cluster ( $s=1.25 \pm 0.17$  for  $N=30$ ); in this respect, little can be said about Hercules ( $s=1.48 \pm 0.33$  for  $N=5$ ) and Z74 - 23 ( $s=1.61 \pm 0.36$  for  $N=8$ ), for which the errors associated to the estimates of  $s$  are rather large. In particular, the smallest ( $D \lesssim 15$  Kpc) lenticulars of Virgo and Pegasus I are appreciably less luminous than the corresponding Coma members.

We have verified that the character of the luminosity-diameter relations does not appear to depend on the presently observed main properties of clusters, such as richness, Rood and Sastry's and Bautz and Morgan's classifications, velocity dispersion, viral radii, crossing time, fraction of spiral members, extent of the HI deficiency of cluster spirals.

Initial conditions occurring at the time of galaxy formation rather than secular processes are thus probably responsible for the observed differences in the power-law relationship between luminosity and diameter.

## REFERENCES

- Auman, J.R., Hickson, P., Fahlman, G.G., 1982, *Publ. Astron. Soc. Pacific* 94, 19.
- de Vaucouleurs, G., de Vaucouleurs, A., Corwin, H., 1976, *Second Reference Catalogue of Bright Galaxies* (Univ. of Texas Press, Austin).
- Nilson, P., 1973, *Uppsala General Catalogue of Galaxies*, *Ann. Uppsala Astron. Obs.* 6.

## DISCUSSION

BIRKINSHAW: Might there be a cluster-dependent classification problem which could affect your results (as, for example, for anaemic spirals)?

GIURICIN: Cluster membership assignments and galaxy classifications are reliable for the relatively bright galaxies that we consider.