

THREE DIMENSIONAL ANALYSIS OF GROUPS OF GALAXIES

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A systematic and automatic classification of groups of galaxies has been made only in two dimensions up to now (Turner and Gott, 1976). They investigated the projected density of galaxies at the sky. In this analysis one can correct for foreground and background galaxies and superimposed groups only statistically. The properties of the groups and their member galaxies will often not be recognized correctly. Therefore, a three dimensional analysis is proposed.

A very powerful method is taken from the cluster theory (for details c.f. Bock, 1974). For example a hierarchy is built up for the groups, keeping always the dispersion in the groups to a minimum. In this case one has to scale the different coordinates in order to compare them. And one has to define where to cut the hierarchy, i.e. where above the general background groups are assumed to be real (Materne, 1977; in preparation). The so found groups should be tested for reality: i) the crossing times should be lower than the Hubble time; ii) the groups should be distinct; iii) the groups should follow a luminosity-velocity relation. A final test is to fit a distribution function to the groups and see if they are stable against the fitting procedure.

This was done for all Shapley-Ames galaxies and DDO dwarf galaxies in a region around the Leo group of de Vaucouleurs (1976). The hierarchical clustering yielded six groups to which a Gaussian distribution function was fitted:

$$n(r, v) = \frac{1}{2\pi \sigma_r^2} \exp\left(-\frac{(r-r_c)^2}{2\sigma_r^2}\right) \frac{1}{\sqrt{2\pi} \sigma_v} \exp\left(-\frac{(v-v_c)^2}{2\sigma_v^2}\right)$$

It was found that the six groups follow the postulates i), ii), and iii). In addition it was found that the groups seem to be dynamically bound with conventional mass-to-light ratios.

Literature:

Bock, H.H. 1974, *Automatische Klassifikation*, Vandenhoeck and Ruprecht, Göttingen.

Turner, E.L. and Gott, J.R. 1976, *Astrophys. J. Suppl.* 32, 409.
de Vaucouleurs, G. 1976, in *Galaxies and the Universe*, ed. A. and M. Sandage, J. Kristian, University of Chicago Press, Chicago and London, p. 557.

DISCUSSION

de Vaucouleurs: I would like to clear up a misconception about the groups of galaxies which we have catalogued. We look not only at the distribution of galaxies on the sky but also their velocities, their morphological types, the degree of resolution and so on. An experienced observer takes into account many different parameters when he assigns objects to a group.

Materne: I would agree but I was able to rediscover your groups in the regions of sky analysed.

Zeldovich: Weighting by a Gaussian function is a very important improvement over simply dividing space into cells, especially at the highest levels of a hierarchy. This was noted in the review by Novikov and myself in *Advances of Astronomy* (1965).

Gouguenheim: I wish to mention that Paturel has used the same method to study the Virgo Cluster; he found several sub-groups and his general conclusion is in agreement with the discussion of Tully and Fisher (*Astro. Astrophys.*, 1977, 54, 661).