THE FIELD LUMINOSITY FUNCTION AND NEARBY GROUPS OF GALAXIES

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We have assembled a catalog of radial velocities and magnitudes on a homogeneous system (the corrected Harvard, B(o) magnitudes of de Vaucouleurs) for over 4000 galaxies. Using this catalog, we have compiled a magnitude limited sample of ∿ 1000 galaxies with nearly complete radial velocity data. The magnitude limit is 13.0 and the galaxies are primarily from the Shapley-Ames catalog plus a few low and high surface brightness objects properly included in a magnitude limited sample. My colleagues, M. Davis, M. Geller and I are presently analyzing the dynamical properties of this sample. I would like to briefly describe a new determination of the field luminosity function and density plus our initial experiments with the use of a redshift catalog to select groups of galaxies.

The luminosity function $\Phi(M)\,dM$ can be derived from a magnitude limited sample simply by counting the number of galaxies in an absolute magnitude interval and dividing by the sampled volume (e.g., Schecter, 1976, and references therein). This method avoids the special assumptions, other than homogeneity, required in other determinations (e.g., Holmburg, 1969, Turner and Gott, 1976b). The major improvement in our estimate is the use of a larger sampling volume, thus 4 times as many galaxies as most previous estimates. Figure 1 shows our separate determinations for the North and South galactic caps $H_0 = 50$ Km s^{-1} Mpc^{-1}, $|b^{II}|>40^0$, and galactic absorption equal to 0.2 csc (b^{II}). Even in this sample, below M = -16 there are relatively few galaxies and the sampling radius indicates that we are dominated by the Local group. In addition, the difference between N and S indicates that we are not yet free of the local density enhancement. A fit of the Schecter (1976) Function to the combined N + S sample gives $\alpha = -1.24$, $L^* = 2.9 \times 10^{10}$ or $M^* = -20.67$, $\phi^* = 0.0055$ and a corresponding luminosity density of 1.8×10^8 $L_\odot$ Mpc^{-3}. If we assume that the shape has been derived accurately and then correct for the density enhancement by scaling the surface counts to the expected values from deeper samples -- e.g., the E + 2S sample of Gott and Turner (1976) -- ϕ^* and the luminosity density are ½ of the above values. A more detailed study of the luminosity function is in preparation.

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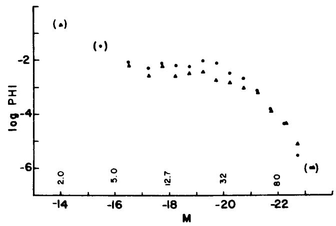

Fig. 1. Log Φ in galaxies per cubic megaparsec per magnitude interval. NGC = circles, SGC = triangles. Sample depth v megaparsecs is shown along the bottom.

Previous identifications of groups of galaxies have been based either on limited and subjective data or only two dimensional criteria (de Vaucouleurs, 1976; Turner and Gott, 1976a). M. Geller and I are experimenting with algorithms for the selection of groups of galaxies using a redshift catalog. Three problems are important. Selection criteria should be commutative, should not impose arbitrary limits on group size or velocity dispersion, and should attempt to separate groups superposed on the sky. One algorithm is based on the projected redshift separation $S = (v_1^2+v_2^2-2v_1v_2 \cos\theta_{12})^{\frac{1}{2}}/50$. Another, suggested by P. Schechter, is based on luminosity density enhancements. The simplest is based on "boxes" in redshift space defined by maximum velocity and projected separation parameters - $\Delta v_{12} < \Delta v_{max}$, $\Delta D_{12} = 100 \tan\theta_{12} /(v_1+v_2) < \Delta D_{max}$. Figure 2 shows a typical group catalog map.

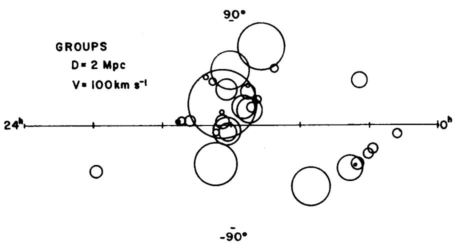

Fig. 2. Groups of galaxies, $n \geqslant 4$ members, selected by box algorithm.

Groups are found by association -- a galaxy is searched for companions inside ΔD,Δv, then the companions are searched for additional companions, etc. Our preliminary analysis shows that certain group structures (e.g., M81, Fornax, Centaurus, NGC 1023 groups) persist over almost all reasonable ranges of selection parameters. Subclustering is found in Virgo for small values of ΔD,Δv.

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DISCUSSION

Gursky: To my eye there were many de Vaucouleurs groups that were not found in your computer searches. What is the reason for these discrepancies?

Huchra: There are several reasons for this. The plots do not show groups of fewer than 4 members and we are working with a magnitude-limited sample - thus we miss faint members in some groups. Also, some de Vaucouleurs groups may not be real. In fact, I am impressed with the amount of correspondence.

de Vaucouleurs: May I remind you again that in searching for physical groups one must also take into consideration morphological types, degree of resolution, magnitudes, diameters, evidence for interaction, etc. The current computer methods are too crude to find all types of groups.

Huchra: The reasons for "experimenting" as we are, are that when deeper samples are used, the only available data will be magnitudes and redshifts, so objective methods need to be developed.

Ostriker: A comment on selection by velocity. If the true velocity dispersion is, say, Gaussian, the $\langle \Delta v^2 \rangle$ moment will have a large contribution from the small number of objects in the Maxwellian tail. If these are thrown out simply because their contribution seems too large, then one will systematically underestimate $\langle \Delta v^2 \rangle$. You do not make this error, but other investigators have done it, thus partially explaining the differences between your results and theirs.

Davis: Could you comment on the experiments you and Geller have made concerning the effect of Δv on the measured velocity dispersions within the observed groups?

Huchra: We find that the mean number-weighted velocity dispersion of the groups found with reasonable values of Δv asymptotically approach ≈ 300 km s^{-1} even for very large values of Δv. We have not, however, completely analysed all the selection effects that may be important.

Fall: How do your groups compare with Turner-Gott groups?

Huchra: I have not compared these catalogues at different magnitude limits yet.

Abell: What kind of magnitudes did you use?

Huchra: I have used B(0) magnitudes - this system is the easiest to measure and can be easily extended to fainter galaxy catalogues because of its close correspondence to Zwicky magnitudes. My preference is for galaxy magnitudes that can easily be measured and require little extrapolation.

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