CLUSTERING PROPERTIES OF COLD DARK MATTER UNIVERSES AND THE CfA REDSHIFT SURVEY: A UNIFORM COMPARISON

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We have compared the properties of galaxy groups in the CfA redshift survey to those in the cold dark matter simulations of Davis, Efstathiou, Frenk and White (1985). Redshift catalogs (four realizations) were made from the open universe (unbiased; mass follows light) simulations at expansion factors of 1.8 (Ω=.3, labelled T1) and 3.2 (Ω=.2, labeled T2) relative to initial conditions, and from the biased formation version of the Ω=1 simulation (5 realizations) at expansion factor 1.4. The T1, T2 and biased catalog sets were volume limited at distances of 5000, 3000 and 6500 km s^{-1} respectively, and magnitude limited ($m \leq 14.5$) beyond. They were then randomly culled by 25%, 9% and 10%, respectively, to match the density of comparison versions of the CfA Redshift Survey which were similarly volume limited. We have devised a percolation type grouping algorithm which lets the linking distance on the sky increase with distance in the magnitude limited regions, while keeping the radial velocity linking criteria fixed. We've verified that this produces groups with density contrast uncorrelated with distance and (unlike the Geller-Huchra criteria) M/L uncorrelated with group size for the open models. M/L may, however, show a slight negative correlation with distance.

We have compared the properties of group catalogs made from these redshift catalogs using a range of linking cutoffs. The biased formation Ω=1 catalogs produce groups with properties in good agreement with corresponding CfA groups at all linking cutoffs. The T1 and T2 group catalogs are in significant conflict with the corresponding CfA groups in the following areas; too few galaxies are grouped. The characteristic rise and fall of group number is delayed to significantly larger cut-offs, and dispersions and group size are larger, producing M/L's a factor of two too high. There is a hint that M/L may be correlated with cluster size in the CfA data, possibly indicating dark matter less clustered than the galaxies. The biased and unbiased models do not differ significantly in their percolation properties - all percolate at cutoffs$\sim$75% of that for a Poisson distribution. The CfA survey percolates more easily yet, at $\sim$ 60% of Poisson.

We conclude that not only does biasing allow an Ω=1 universe to be compatible in the observations, it actually provides a good fit where the best fitting unbiased models do not.

References

Davis, M., Efstathiou, G., Frenk, C., and White, S. D. M., 1985, Ap.J 292, 371
Geller, M. J. and Huchra, J., 1983, Ap. J Supp. 22, 61

J. Kormendy and G. R. Knapp (eds.), Dark Matter in the Universe, 284.