FRACTAL DIMENSION IN THE LARGE SCALE DISTRIBUTION OF GALAXIES

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In this work, we start from the definition of fractal dimension and by the number counting of galaxies to investigate that if the large scale distribution of galaxies has really a fractal structure. A fractal dimension in a distribution of objects is defined as

$$D = \frac{d\ \mathrm{Ln} N(R)}{d\ \mathrm{Ln}\ R}, \qquad (1)$$

where N(R) is the number of objects within scale R. To find out D from number counting we have to pay attention to that the distribution of galaxies could not be a regular fractal map. The N(R) would understand as a statistical average. To avoid the edge effect appearing in the number counting we compare it with that obtained from an average by many times Monte Carlo sampling which is a uniform distribution and would have $D_r = 3$. From eq. (1) we get

$$D - 3 = \frac{d\ \mathrm{Ln}(N(R)/N_r(R))}{d\ \mathrm{Ln}\ R}. \qquad (2)$$

That is, if the result forms a straight line on the $\mathrm{Ln}(N(R)/N_r(R))$–Ln R diagram, then the large scale distribution of galaxies is most likely to be fractal. As we have done in former work (Xia, Deng and Zhou, 1986), four samples completed in absolute magnitude have been formed from CfA catalog. The samples and the results obtained are listed in table 1.

TABLE I

Range of abs. mag.	Number of galaxies	$\frac{d\mathrm{Ln}(N(R)/N_r(R))}{d\ \mathrm{Ln}\ R}$	D
-18.5--19.5	147	-0.8	2.2
-19.5--20.5	293	-0.9	2.1
-20.5--21.5	277	-1.0	2.0
-21.5--22.5	204	-0.9	2.1

These results show that the large scale distribution of galaxies is likely to be fractal with fractal dimension about 2. It means that the distribution of galaxies is sheet-form and is compatible with bubbly model.

Xia, X.-Y., Deng, Z.-G., and Zhou, Y.-Y., 1986, Proc. of IAU Symp No. 124, p. 647 (D. Reidel Pub. Co., Holland)

J. Audouze et al. (eds.), Large Scale Structures of the Universe, 555.

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