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A COMPARISON OF MULTIFRACTAL BEHAVIOR IN GALAXY SAMPLES FROM SDSS

J. E. García-Farieta[1] and R. A. Casas-Miranda[1]

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Editors: Mario Armando Higuera Garzón & Santiago Vargas Domínguez

We studied the spatial distribution of galaxies with samples from the Sloan Digital Sky Survey (SDSS) including observational holes in the masks. From a multifractal formalism and using the sliding window technique for each sample, we have determined the fractal dimension and the lacunarity spectrum. Aditionally, the scale of homogeneity was determined for each struture parameter. Our results show that the galaxy clustering exhibits a behavior that depends on the radial distance, revealing that the hierarchical distribution is not a fractal at large-scales, with a transition to homogeneity on large scales below 130 Mpc/h.

The large-scale structure of the Universe has been extensively studied since the publication of the first galaxy surveys. Some analysis with high-redshift samples shows the existence of fractal correlations (Celerier & Thieberger 2005). Fractal analysis is a useful mathematical tool that quantifies galactic clustering using data from galaxy surveys by calculating quantities such as the fractal dimension, making it possible to establish relationships between these values and other statistical descriptors. The transition to a homogeneity scale r_H can be defined according to (Yadav, et al. 2010) as the value of r above which the fractal dimension D_q is equal to the dimension of the physical space in which the points are distributed, i.e., $D = 3$.

We have take synthetic samples based on SDSS DR7, DR10, DR11 and SDSS-BOSS footprint. We determine the fractal dimension D_q using the sliding window technique, it was applied to the logarithm of the correlation integral as a function of the logarithm of the comoving distance r, i.e., $\log(C_q) \propto \log(r)$. From Fig. 1 it is possible to obtain the behaviour of

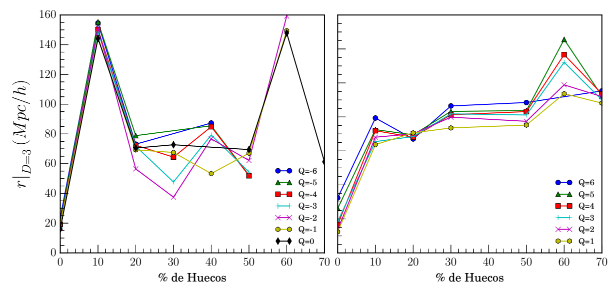

Fig. 1. Comparison of homogeneity scale r_H as a function of the hole density: left, low-density environments; right, high-density environments.

D_q in terms of the structure parameter. The holes cause shifts in the homogeneity scale proportional to the density of holes and weakly fractal behaviour with $2.9 < D_q < 3.0$ for a sample with about 40% holes. Our analysis is complemented by the lacunarity spectrum, which explain the hole distribution and the effect of border holes, and indicates how the set of points fills the masks. In high-density regions, there is a strong tendency to homogeneity because the values of the fractal dimension are very close of the physical space dimension $2.97 \leq D|_{r_H} \leq 3.03$. $D_{q\geq 0}$ increases for large r values to reach homogeneity, this means that on average, the space is completely filled at greater depths than r_H. Finally, for $r > 80$ Mpc/h, the fractal behaviour disappears.

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[1]Universidad Nacional de Colombia - Sede Bogotá, Departamento de Física, Av. Cra 30 No 45-03, Bogotá, Colombia (joegarciafa@unal.edu.co).