RevMexAA (Serie de Conferencias), **40**, 116–116 (2011)

THE MORPHOLOGY OF SUPERCLUSTERS OF GALAXIES

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We have studied superclusters of galaxies in a volume-limited sample extracted from the SDSS/DR7 and also from simulations. The density field method was applied to identify superclusters. We have used the Minkowski Functionals to classify them as filaments or pancakes. Our results showed that filaments tend to be richer and larger structures, suggesting that pancakes evolve to filaments.

We have used a volume-limited sample of galaxies from SDSS/DR7 (Abazajian et al. 2009) and simulated light-cones (Croton et al. 2006), considering $M_r < -21$ and $0.04 < z < 0.155$ (Costa-Duarte et al. 2011). The SDSS and mock samples consist of 120.013 and 99.850 galaxies, respectively. Distances were calculated using the standard cosmology: $\Omega_m = 0.3$, $\Omega_\Lambda = 0.7$ and $H_0 = 100h$ km s^{-1} Mpc^{-1}.

Using the density field method to identify superclusters, the luminosity density of the galaxy distribution at a certain point $\mathbf{r}$ is

$$D(\mathbf{r}) = \sum_i K(|r - r_i|, \sigma) L_i W(r_i, z), \qquad (1)$$

where K is the Epanechnikov's kernel, L_i is the luminosity of the i-th galaxy, σ is the smoothing parameter and $W(r_i, z)$ represents the statistical weight, taking into account the selection effects. We considered 3D cells with 4h^{-1}Mpc, $\sigma =$ 8h^{-1}Mpc and a minimum volume of superclusters, $V = 128$(h^{-1}Mpc)^3. Two threshold density values were chosen, maximizing the number of structures ($D_1 = 3.0\bar{D}$) and constraining the largest structure to 120h^{-1}Mpc ($D_1 = 6.0\bar{D}$). To identify these structures we used the friends-of-friends algorithm.

A morphological classification were applied using the best-fit ellipsoid and Minkowski Functionals (Sahni et al. 1998), classifying them as filaments ($K_1/K_2 \leq 1.0$) or pancakes ($K_1/K_2 > 1.0$).

Figure 1 shows the luminosity and richness of SDSS superclusters as function of the morphological parameter K_1/K_2. Statistical tests show that filaments tend to be richer, larger and consequently more luminous than pancakes.

We also compared the distributions of semimajor axis of simulated and observed superclusters,

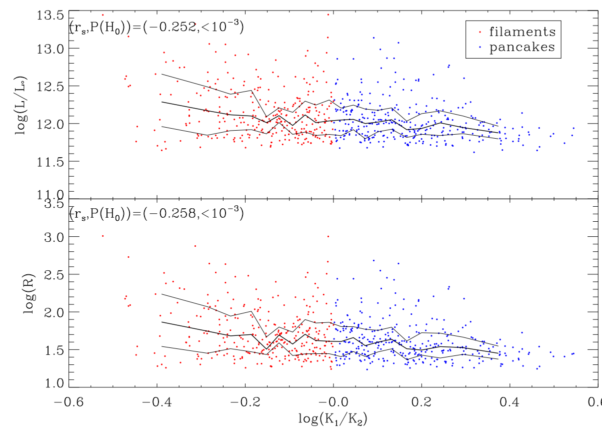

Fig. 1. The luminosity and richness of SDSS superclusters as function of the parameter K_1/K_2.

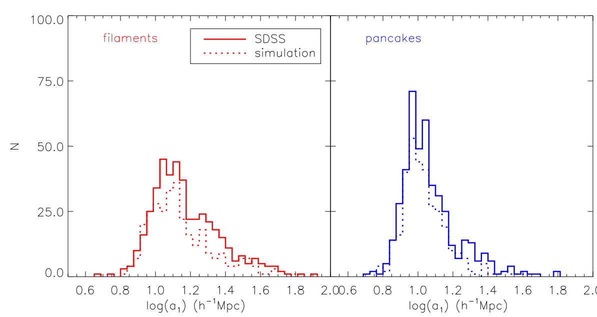

Fig. 2. The semimajor axis distribution of simulated and SDSS filaments and pancakes.

as shown in the Figure 2. Our results show that filaments and pancakes present distinct distributions of size (a_1), indicating that filaments and pancakes represent two different classes of structures in the Universe, suggesting that pancakes evolve to filaments.

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