LANIAKEA IN A COSMOLOGICAL CONTEXT

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A partir de observaciones del flujo cósmico local se ha definido nuestro supercúmulo local, Laniakea. En este trabajo presentamos un estudio sobre simulaciones de N-cuerpos con el fin de establecer la significancia de Laniakea en un contexto cosmológico. Exploramos diferentes algoritmos para definir supercúmulos a partir del campo de velocidades de la materia oscura en las simulaciones. Resumimos las propiedades de la población de supercúmulos por su abundancia a un volumen total y distribución de forma. Encontramos que supercúmulos similares en tamaño y estructura a Laniakea son poco comunes en un contexto cosmológico amplio.

Recent observations used local cosmic flow information to define our local supercluster, Laniakea. In this work we present a study on large cosmological N-body simulations aimed at establishing the significance of Laniakea in a cosmological context. We explore different algorithms to define superclusters from the dark matter velocity field in the simulations. We summarize the properties of the supercluster population by their abundance at a given total volume and its shape distribution. We find that superclusters similar in size and structure to Laniakea are relatively uncommon on a broader cosmological context.

Tully et al. defined our home supercluster, Laniakea, as the region where the peculiar velocity flows converge. Laniakea is found to be contained in a 160 Mpc/h diameter sphere containing a very dense region called the Great Attractor. We designed a method to find superclusters in dark matter N-body simulations and tested our method in a simulation of boxsize 250 Mpc/h. We based our method on the analysis of the eigenvalues λ_1, λ_2 and λ_3 of the velocity shear tensor:

$$\Sigma_{\alpha\beta} = -\frac{1}{2H_0}\left(\frac{\partial v_\alpha}{\partial x_\beta} + \frac{\partial v_\beta}{\partial x_\alpha}\right). \quad (1)$$

From these eigenvalues we form two dimensionless quantities: the fractional anisotropy (FA):

$$FA = \frac{1}{\sqrt{3}}\sqrt{\frac{((\lambda_1-\lambda_3)^2 + (\lambda_2-\lambda_3)^2 + (\lambda_1-\lambda_2)^2)}{\lambda_1^2+\lambda_2^2+\lambda_3^2}}, \quad (2)$$

which tells us if a collapse or expansion is anisotropic (FA=1) or isotropic (FA=0) and the velocity divergence, normalized by the Hubble constant:

$$VDH = \lambda_1 + \lambda_2 + \lambda_3 = \frac{-\nabla\cdot\vec{v}}{H_0}, \quad (3)$$

which tells us if the velocity flows are collapsing (dense region, $VDH > 0$). We are looking for regions dense ($VDH > 0$), containing a highly dense locality ($VDH > 1.0$), as Laniakea, and bellow a certain threshold of FA. We use a modified Friends-Of-Friends algorithm, after an CIC interpolation and a finite elements calculation. We resume our results in **Figure 1** and find that: **Laniakea is atypically larger** than the detected superclusters and **our method is robust** as the largest regions are detected independently of the FA thresholds and modifying the grid size in the interpolation do not influence our results.

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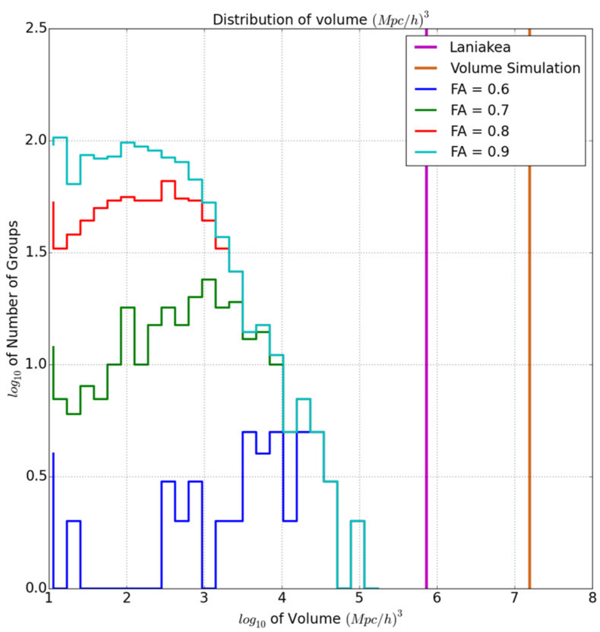

Fig. 1. Distributions of volumes for different seed FA thresholds.