The Zeldovich Universe: Genesis and Growth of the Cosmic Web
Proceedings IAU Symposium No. 308, 2014
R. van de Weygaert, S. Shandarin, E. Saar, J. Einasto, eds.

DOI: 00.0000/X000000000000000X

The place of the Local Group in the cosmic web

Jaime E. Forero-Romero[1]

[1]Departamento de Física, Universidad de los Andes,
Cra. 1 No. 18A-10, Edificio Ip
Bogotá, Colombia
email: `je.forero@uniandes.edu.co`

Abstract. The place of the local group in the cosmic web.

Keywords. cosmology: large-scale structure of universe; cosmology:dark matter; cosmology: simulations; Galaxy: formation

1. Introduction

Forero-Romero et al. (2009)

2. Finding the cosmic web in numerical simulations

We use a web finding algorithm based on the tidal tensor computed from the gravitational potential field computed over a grid. We define the tensor as:

$$T_{ij} = \frac{\partial^2 \phi}{\partial r_i \partial r_j}, \tag{2.1}$$

where the index $i = 1, 2, 3$ refers to the three spatial directions in euclidian space and ϕ is a normalized gravitational poterntial that satisfies the following Poisson equation $\nabla^2 \phi = \delta$, where δ is the matter overdensity.

The algorithms finds the eigenvalues of this tensor, $\lambda_1 > \lambda_2 > \lambda_3$, and use them to classify each cell in the grid as a peak, filament, sheet or void if three, two, one or none of the eigenvectors is larger than a given threshold $\lambda_{\rm th}$. Each eigenvalue has associated to it an eigenvector (e_1, e_2, e_3) which are the natural basis to define local directions in the web.

3. Local Groups in cosmological simulations

4. Halo alignments with the cosmic web

5. The place of the Local Group in the Cosmic Web

6. Conclusions

Here, we have summarized results on the expected place of the Local Group in the cosmic web. Our results are based on cosmological N-body simulations and the tidal web method to define the cosmic web. We constructed different Local Groups samples from dark matter halo pairs that fulfill observational kinematic constraints.

We found a tight correlation of the LG pairs' total mass with the scalar web properties (overdensity, ellipticity and prolateness). For the LG pairs closer to the observational

constraints their total mass is in the range $1 \times 10^{12} \mathrm{M}_\odot < M_{LG} < 4 \times 10^{12} \mathrm{M}_\odot$ preferred overdensity value is constrained to be in the range $0 < \delta < 1$.

We also found a tight aligment of the pairs with the cosmic web. The vector joining the two LG halos is aligned with the lowest eigenvector and antialignned with the highest eigenvector. This means that pairs are aligned along the filaments and lie along sheets. These alignments are tighter as the pairs' kinematic conditions are closer to observations.

References

Forero-Romero, J. E., Contreras, S., & Padilla, N. 2014, MNRAS, 443, 1090

Forero-Romero, J. E., Hoffman, Y., Bustamante, S., Gottlöber, S., & Yepes, G. 2013, ApJL, 767, L5

Forero-Romero, J. E., Hoffman, Y., Gottlöber, S., Klypin, A., & Yepes, G. 2009, MNRAS, 396, 1815

Forero-Romero, J. E., Hoffman, Y., Yepes, G., Gottlöber, S., Piontek, R., Klypin, A., & Steinmetz, M. 2011, MNRAS, 417, 1434

González, R. E., Kravtsov, A. V., & Gnedin, N. Y. 2013, ApJ, 770, 96

—. 2014, ApJ in press, http://arxiv.org/abs/1312.2587

González, R. E., & Padilla, N. D. 2010, MNRAS, 407, 1449

Hoffman Y., Metuki O., Yepes G., Gottlöber S., Forero-Romero J. E., Libeskind N. I., Knebe A., 2012, MNRAS, 425, 2049