# COSMOLOGY WITH THE COSMIC WEB

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**En esta presentación resumimos diferentes algoritmos que pueden ser utilizados para trazar la red cósmica en observaciones y simulaciones. Resumimos diferentes aplicaciones en formación de galaxias y cosmología, para terminar mostrando como el Dark Energy Spectroscopic Instrument (DESI) podría ser un buen lugar para aplicar estas técnicas.**

**This talk summarizes different algorithms that can be used to trace the cosmic web both in simulations and observations. We present different applications in galaxy formation and cosmology. To finalize, we show how the Dark Energy Spectroscopic Instrument (DESI) could be a good place to apply these techniques.**

The cosmic web is one of the most conspicuous features of the large-scale structure of the Universe. We describe in the following paragraphs some of its most important applications in studies of galaxy formation and cosmology.

**Finding the Cosmic Web**. We mainly use an algorithm based on the Hessian of the gravitational potential (also known as Tidal tensor) to define the cosmic web. This symmetric tensor can be diagonalized to find its eigenvalues. Depending on the number of eigenvalues (0,1,2,3) above a certain threshold we can classify a place in the cosmic web as one of the following types: peak, sheet, filament, void. This algorithm has been applied to simulations (Forero-Romero et al. 2009) and also dark matter fields reconstructed from observations (Munoz-Cuartas et al. 2011).

**Halo Alignments with the Cosmic Web**. The cosmic web also shows a strong correlation with the shape, angular momentum and peculiar velocities of dark matter halos. Forero-Romero et al. 2014 showed this over five orders of magnitude in halo mass $10^9$-$10^{14}$ $M_\odot$. The strongest alignments were present for the halo shape above a threshold mass of $10^{12}$ $M_\odot$. Below this mass all alignments presented a weak signal. This study is useful to quantify the degree of contamination in weak lensing studies (due to intrinsic alignments) and also to understand the strong alignments observed for the satellites in the Local Group (Forero-Romero & González 2015).

**Constraining Cosmological Parameters**. Using the cosmic web, Li et al. (2014), proposed a method based on the redshift dependence of the Alcock-Paczynski (AP) test to constrain cosmological parameters. The method uses the fact that the galaxy density gradient field should be isotropic as a function of redshift. That is, the filaments in the cosmic web should not have a preferred direction in comoving coordinates. Any radial or tangential anisotropy can only be produced by using the incorrect cosmological parameters to translate observed redshifts into comoving coordinates.

**Future Surveys**. The Dark Energy Spectroscopic Instrument (DESI) (DESI Collaboration 2016) is a ground based dark energy experiment that will study Baryon Acoustic Oscillations (BAO). It will measure more than 30 million galaxy and quasar redshifts in the redshift range $1.0 < z < 3.5$ to measure the BAO feature. Additionally, DESI will conduct a magnitude-limit survey with a median redshift of $z \approx 0.2$ comprising approximately 10 million galaxies, which will provide an excellent opportunity to extend the cosmic web studies presented so far.

## REFERENCES

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