High-order statistics: from theory to observations

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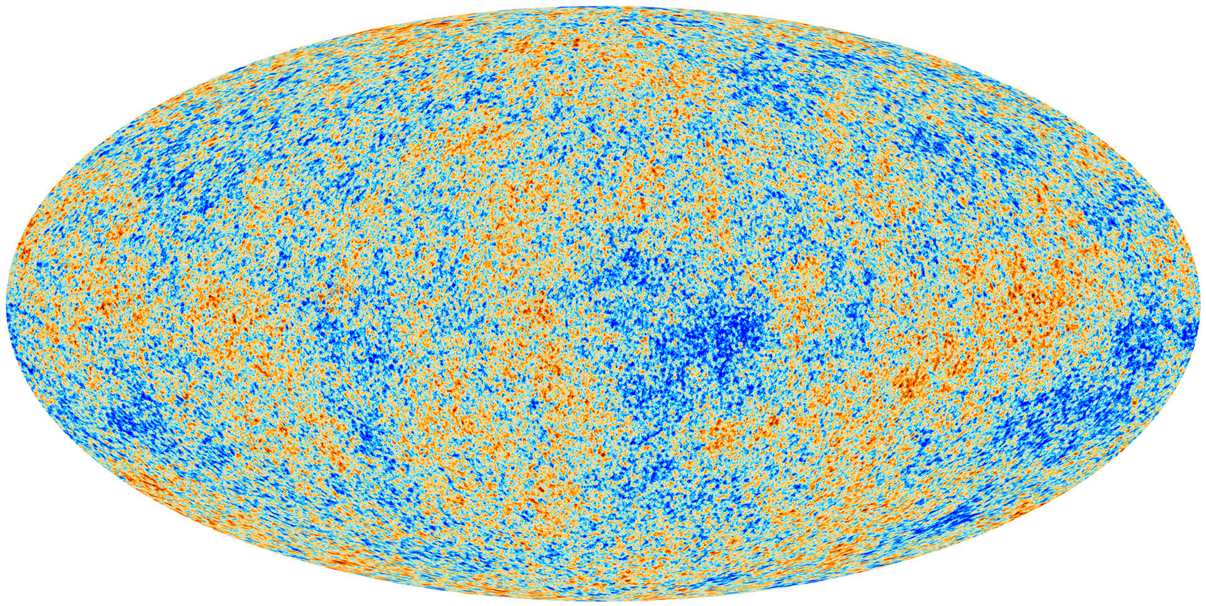
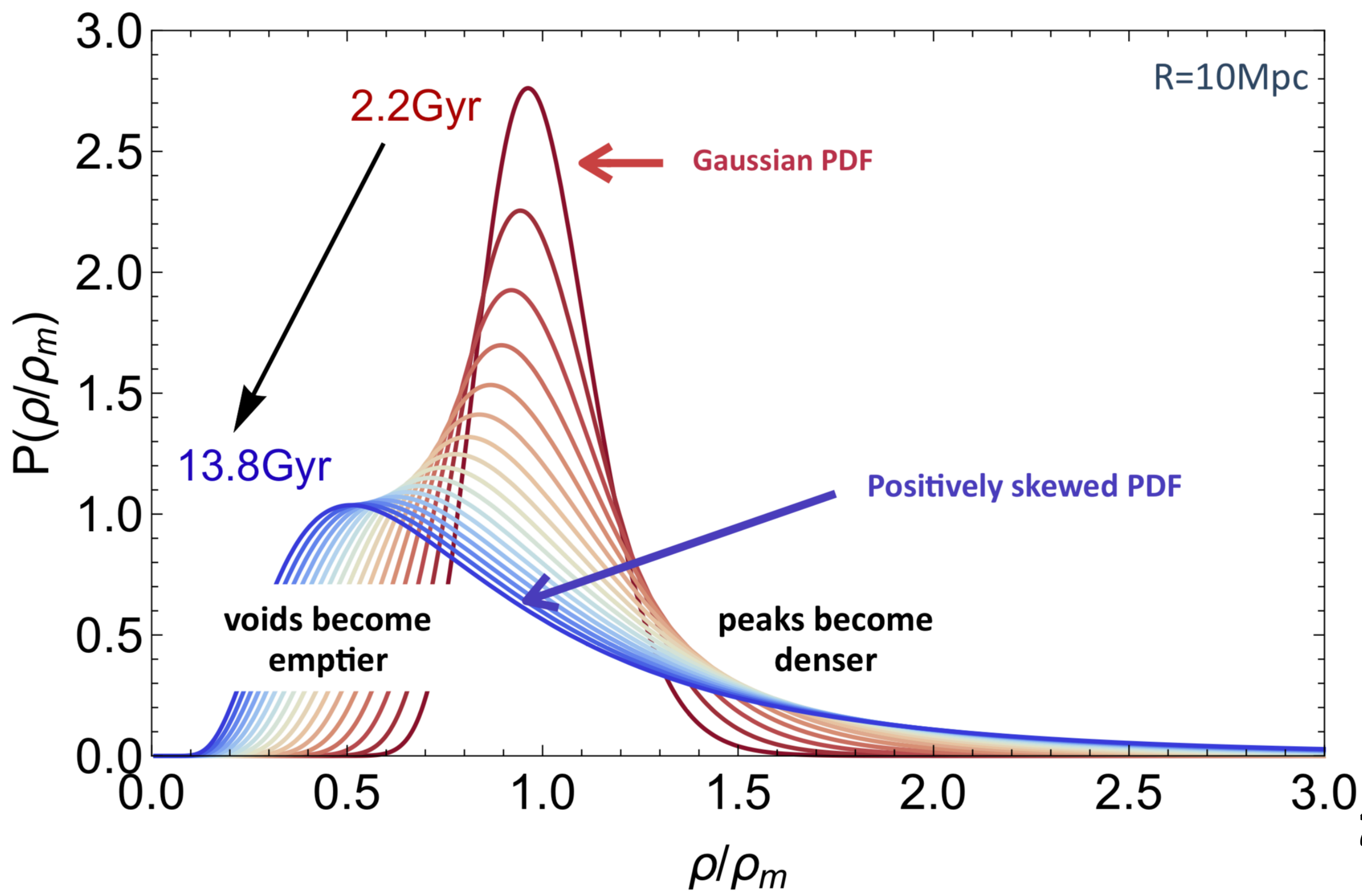
euclid consortium

How to describe the cosmic web?

- From Gaussian initial conditions for the density field (fully described by the power spectrum)



[Gravitation - expansion]

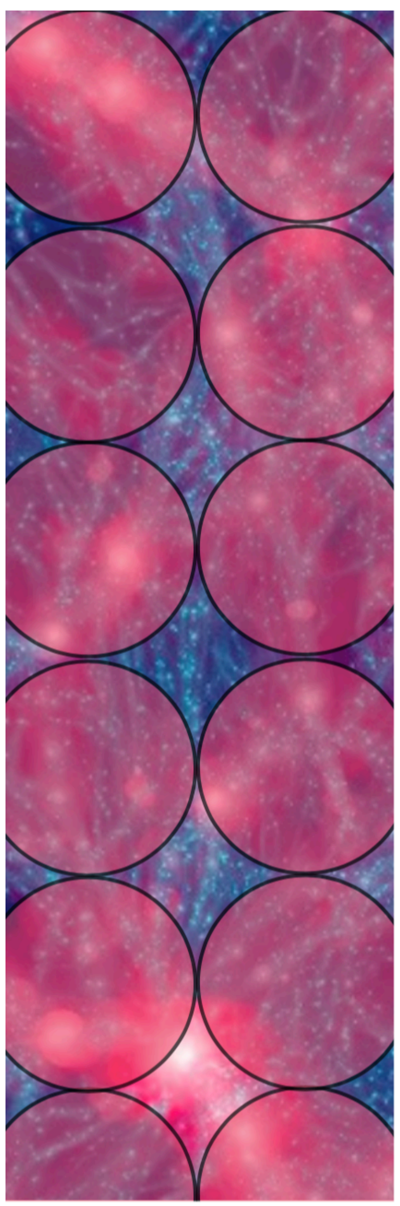


- To the cosmic web : non gaussian density field

Need to study high order statistics (bispectrum and beyond)

Large deviation statistics

Mathematical theory which can be applied in the limit of small variance of the density field (up to $\sigma = 1$) to predict an analytic PDF in specific geometries (spheres for the main part, cylinders)



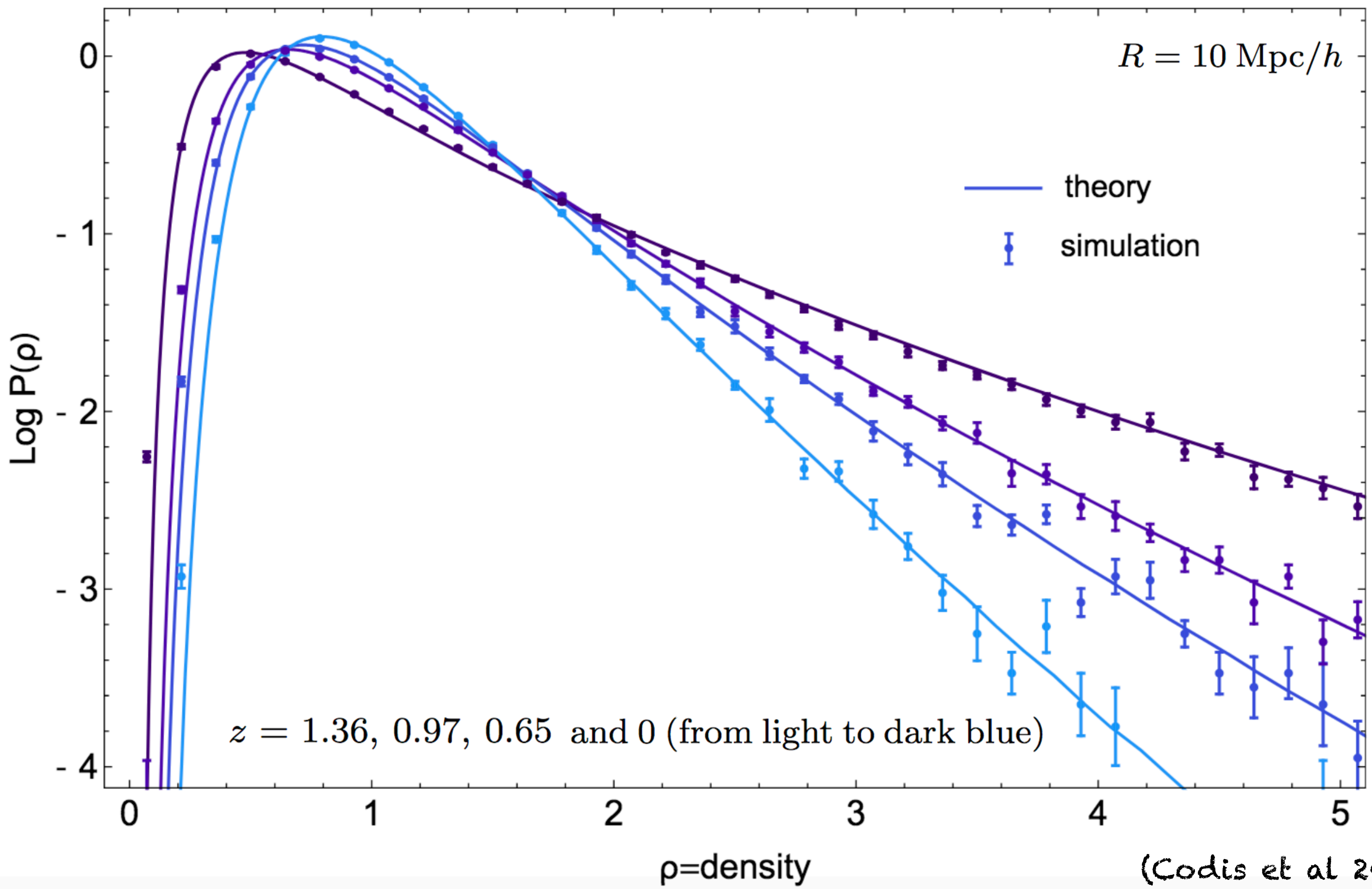
- Different initial conditions can lead to the same final state, spherical (respectively cylindrical) symmetry however implies that the most likely path is described by spherical (respectively cylindrical) collapse dynamics

- LDP allows us to compute the PDF from initial conditions taking spherical (respectively cylindrical) collapse as the mean dynamics

- Enters the middle non linear regime where standard perturbation theory breaks down

Large deviation statistics

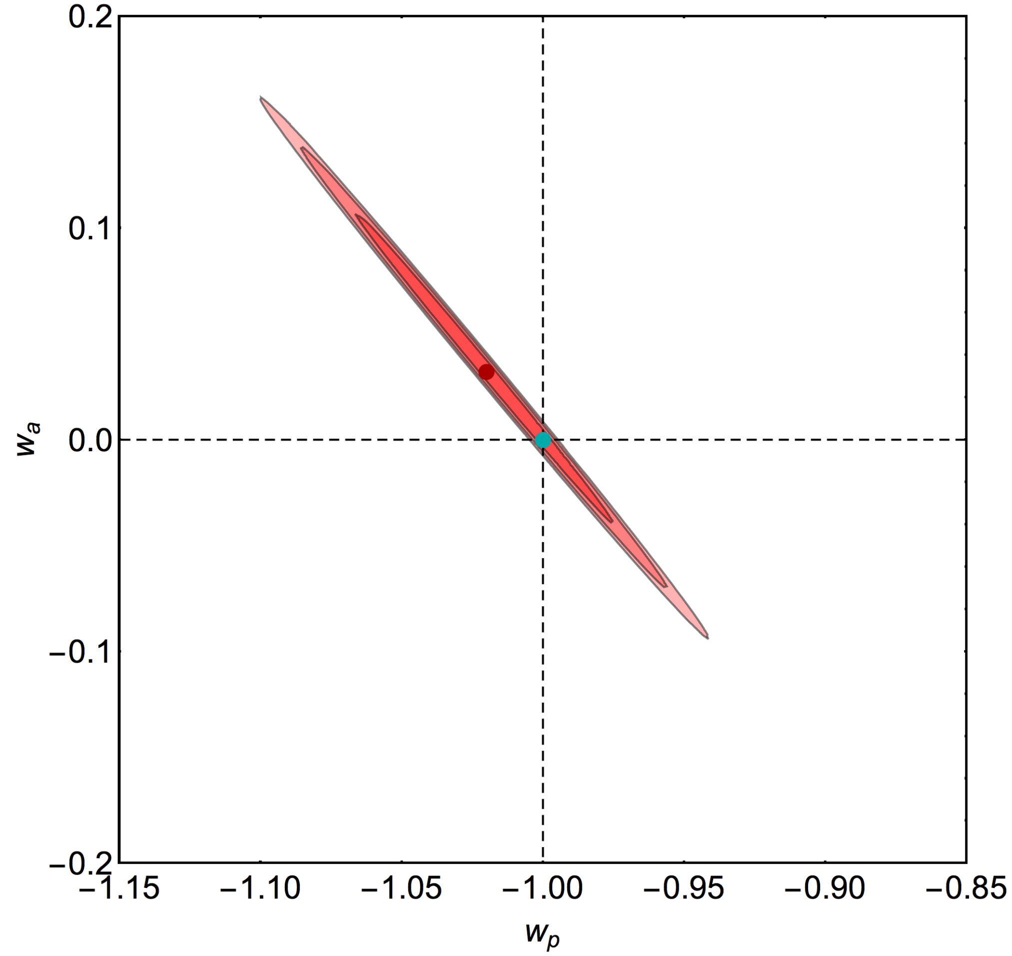
The formalism is applied to simulations (Horizon) and matches very well, here the PDF is computed in spheres of radius R



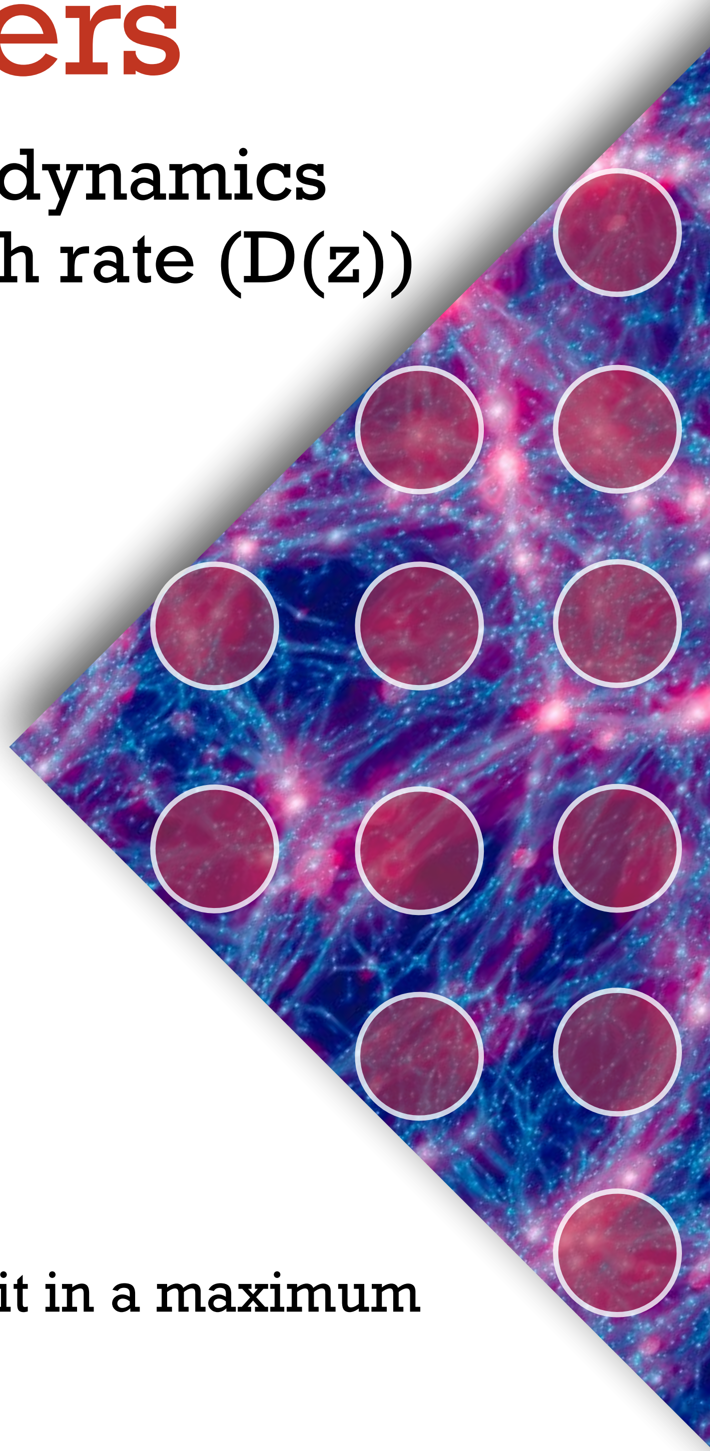
(Codis et al 2016b)

Usage for constraining cosmological parameters

Dependance on cosmology is found in the collapse dynamics (small influence), linear power spectrum and growth rate (D(z))



(Codis et al 2016b)



- Assuming that the PDF is exact, one can use the formalism to fit in a maximum likelihood sense the dark energy parameters

- Correlations between spheres at finite separation can be accounted for, as well as PDF for biased tracers (galaxies)

Application to lensing

We aim to apply the formalism developed for clustering to lensing

- The geometry is not a sphere anymore but a light-cone thus light cone filter to compute initial variance/corelation matrix of projected densities

- A different collapse dynamics must be applied (can cylinder work for sufficiently large cones?) and rescaling of the symmetry must be thought to allow for mass conservation

(See Reimberg et al 2017)