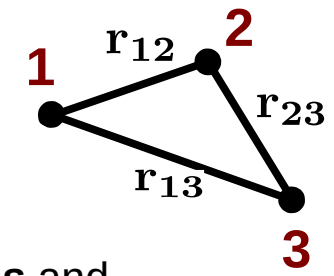
Using triangles to test gravity in galaxy surveys

Gustavo Niz (Univ. de Guanajuato, Mexico)



- N-point correlation functions characterise the matter density field in the Universe
- These measure characteristic polygon shapes in the matter distribution, representing the probability of finding N galaxies on the vertices of the polygon
- The ***Three Point Correlation Function (3PCF) searches for triangle configurations*** and complements the information on the popular two point statistics
- This ***3PCF naturally explores interactions***, in particular, the gravitational ones
- Measuring the 3PCF is computationally expensive, but with by using a multipole decomposition basis, one may achieve the same scaling as the naive 2PCF algorithms

We model the 3PCF of General Relativity (GR) and a representative model of Modified Gravity (*f(R)*) using Cosmological Perturbation Theory and compare it with the non-linear evolution of N-body simulations.

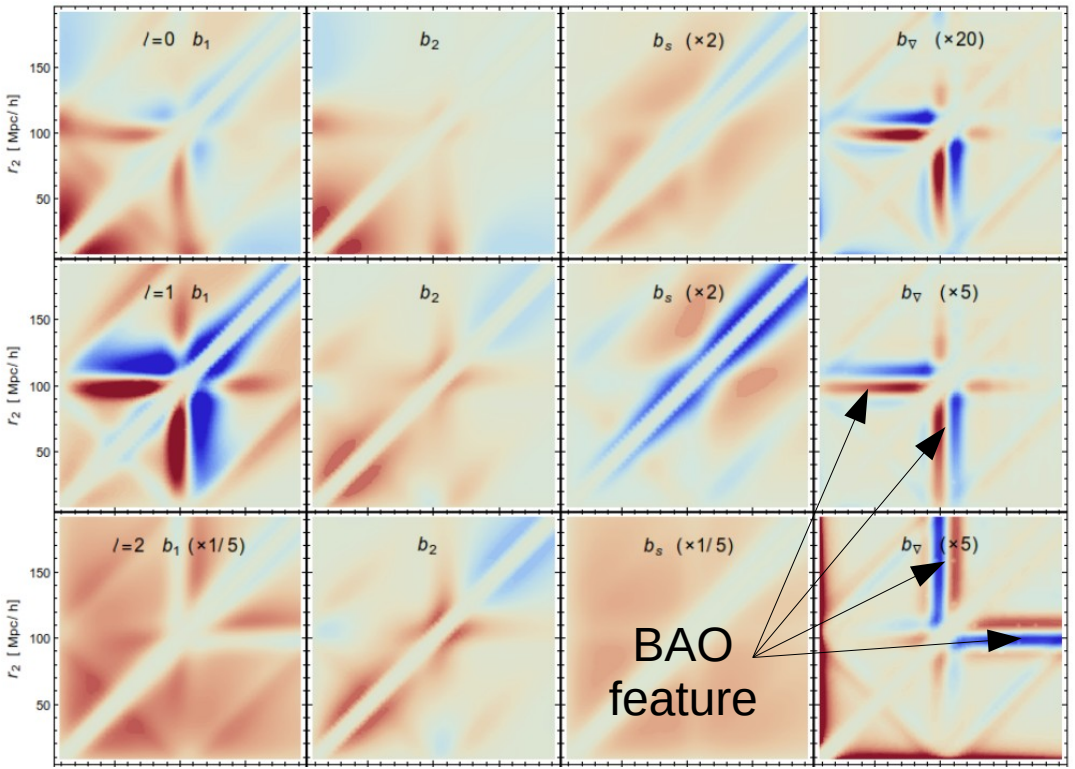
The model and Perturbations Theory

- We choose the Hu-Sawiki *f(R)* model
- We study the isotropic 3PCF, described by two triangle sides and its opening angle
- The non-linear density perturbation has a strong mode dependence which is not present in LambdaCDM
- We use a consistent biasing halo model to model the tree level 3PCF

$$\delta_h(\mathbf{x}) = b_0 + b_1\delta(\mathbf{x}) + \frac{b_{\nabla^2}}{a^2 m^2(a)}\nabla^2\delta + \frac{b_2}{2}\delta^2(\mathbf{x}) + b_{s^2}(s_{ij})^2 + \cdots .$$

- We use a multiple decomposition in the opening angle

Each bias 3PCF term in *f(R)* without diagonal



Monopole - 1st row, Dipole - 2nd row, Quadrupole - 3rd row,

The model and Perturbations Theory

- Differences of GR and *f(R)* are not necessarily where the signal is stronger
- We use N-body simulations to asses the Perturbation Theory description
  - (1024)^3 particles in 1Gpc box
  - 5 realisations and FoF halo finder
- PT captures signal on large scales and can fix bias parameters using MCMC and some consistency conditions
- Large 3PCF dispersion from only 5 realisations, but expect that DESI or LSST will have enough resolution to test gravity