BAO distortions in the Non Linear Power Spectrum

The precise measurement of the properties of the Baryonic Acoustic Oscillations (BAO) in the Power Spectrum (PS) of the galaxy or cluster distribution has been proposed as a means to determine cosmological parameters, mainly the Dark Energy equation of state. We present preliminary results on the analysis of the BAOs in the non linear dark matter halo-halo PS (hPS) measured from N-body simulations.

Precision Cosmology requires to understand the non linear distortions of the PS at the scales of the BAO (5). We use a model for the non-linear hPS expressed in terms of a simple parametric form that we have tested against the "L-BASICC" simulations (1).

Fig. 1 shows the effects on the PS due to different Mass Assignment Schemes (MAS) and to different ways of correcting the effects of the Fast Fourier Transform (FFT).

We choose to use as MAS the Triangular Shape Cloud (TSC) corrected as in (4). Fig. 2 shows the hPSs computed using a mesh with $N_c^3 = 392^3$ grid points while fig. 3 shows the corresponding correlation matrices.

We fit the hPS as in (2, 5):

$P^{hh}(k|m) = b_{eff}^2(m) P_{dw}(k)$,

where

$b_{eff}^2(m) = b_1^2(m)\left(\frac{1+Qk^2}{1+Ak+Bk^2}\right)$,

$P_{dw}(k) = G(k)P_{lin}(k)+$
$+(1-G(k))P_{nw}(k)$

and

$G(k) = exp\left(-k^2/2k_\star^2\right)$

with $k_\star$ and Q as free parameters.

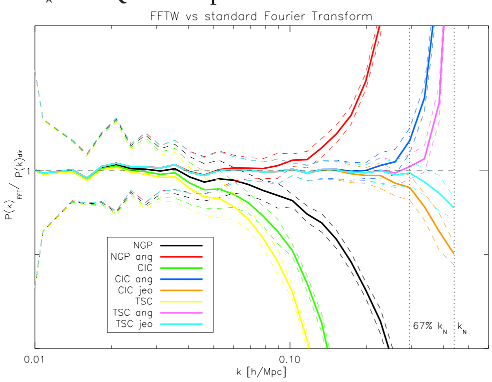

Figure 1. Ratio between the hPS computed with FFTW (Fastest Fourier Transform in the West: www.fftw.org) and with the standard FT for a grid of $N_c^3 = 200^3$ points. NGP: Nearest Grid Point, CIC: Cloud In Cell, TSC: Triangular Shape Cloud. The corrections are as in (1)(ang) and (4)(jeo). The vertical dotted lines indicate the Nyquist frequency and its 67%.

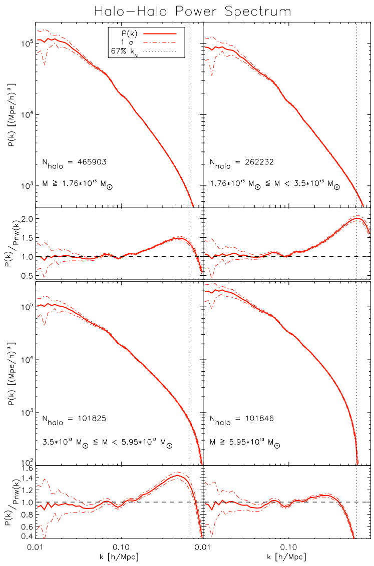

Figure 2. Measured hPS in four different mass bins. For each panel the upper part shows the measured hPS (solid line) with a $1\sigma - error$ (slash-dotted line). The lower part shows the ratio of the hPS with respect to a non-wiggle linear PS (PS_{nw}) normalized with the proper linear bias. The vertical dotted line represent the 67% of the Nyquist frequency.

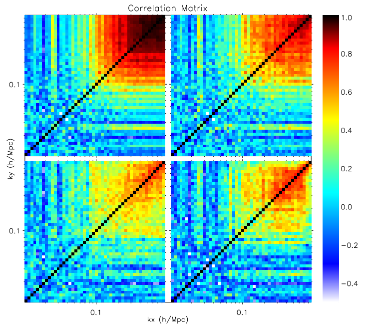

Figure 3. Correlation matrices for the same mass bins as in fig 2. Significant correlation is detected for $k \geq 0.1\ h/Mpc$.

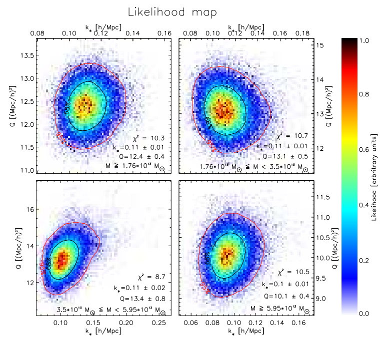

Figure 4. Maps of the likelihood functions for $k \leq 0.2\ h/Mpc$. The legends contain the mass bins, the values of parameters obtained from the analysis and the best χ^2.

Fig 4 shows the likelihood maps obtained with the Markov Chain MonteCarlo (MCMC) technique. While we find no evidence of a mass dependence in $k_\star$, we do find it for Q. The value of $k_\star$ is compatible with the theoretical prediction from Renormalized Perturbation Theory ($k_\star = 0.117\ h/Mpc$ (5)) and with the one measured in (5). This model appears to work well for $k \leq 0.25\ h/Mpc$ (6).

We will extend this analysis also through the Halo Model (3).

References:

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