DARK ENERGY SURVEY

On behalf of the DES collaboration

Ciemat

Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

Baryon Acoustic Oscillations in DES-Y3 data

Juan Mena-Fernández[1]
(juan.mena@ciemat.es)

Collaborators:
A. Carnero[2], E. Sánchez[1], J. Asorey[1], D. Sánchez[1],
M. Rodríguez[1], I. Sevilla[1], J. de Vicente[1]

[1]Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT)
[2]Instituto de Astrofísica de Canarias (IAC)

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The DES-Y3 BAO sample

The DES-Y3 BAO sample is a photometric red galaxy sample selected using the *griz* bands and a photometric redshift estimate. It is built looking for a good compromise between **photo-z accuracy and number density**. It is selected with the cuts

$$\begin{aligned} 1.7 &< i - z + 2(r - i) \quad \text{(color selection)}, \\ 17.5 &< i < 19 + 3z_{ph} \quad \text{(flux selection)}, \\ 0.6 &< z_{ph} < 1.1 \quad \text{(photo-z range)}. \end{aligned} \tag{1}$$

- The DES-Y3 BAO sample is divided in **5 redshift bins** with bounds [0.6, 0.7, 0.8, 0.9, 1.0, 1.1].
- We will focus on how the BAO is measured from the **Angular Correlation Function (ACF)**.
- Since **the ACF of the DES-Y3 data is still blinded**, we will measure the BAO in a set of **1000 lognormal mocks** (simulated galaxy catalogs) instead.

Methodology

1. Generate the 1000 lognormal mocks. Firstly, we have to **fix an input cosmology** (in this case, **MICE cosmology**) and the **redshift distributions of the galaxies** (we will use the ones of the DES-Y3 BAO sample).
2. Calculate the ACFs of each mock and their **full covariance matrix**, $(\mathrm{cov})^{z_{bin_1},z_{bin_2}}_{\theta_i,\theta_j}$.
3. **Obtain the BAO scale of each mock** by minimizing the χ^2

$$\chi^2_{mock}(\vec{p}) = \sum_{z_{bin_{1,2}}} \sum_{i,j} \left[\omega^{z_{bin_1}}_{mock}(\theta_i) - \omega^{z_{bin_1}}_{model}(\theta_i; \vec{p}^{\,z_{bin_1}})\right] (\mathrm{cov}^{-1})^{z_{bin_1},z_{bin_2}}_{\theta_i,\theta_j} \times \left[\omega^{z_{bin_2}}_{mock}(\theta_j) - \omega^{z_{bin_2}}_{model}(\theta_j; \vec{p}^{\,z_{bin_2}})\right], \quad (2)$$

where

$$\omega^{z_{bin}}_{model}(\theta, \vec{p}^{\,z_{bin}}) = A^{z_{bin}} \omega^{z_{bin}}_{template}(\alpha \cdot \theta) + B^{z_{bin}} + \frac{C^{z_{bin}}}{\theta} + \frac{D^{z_{bin}}}{\theta^2}. \quad (3)$$

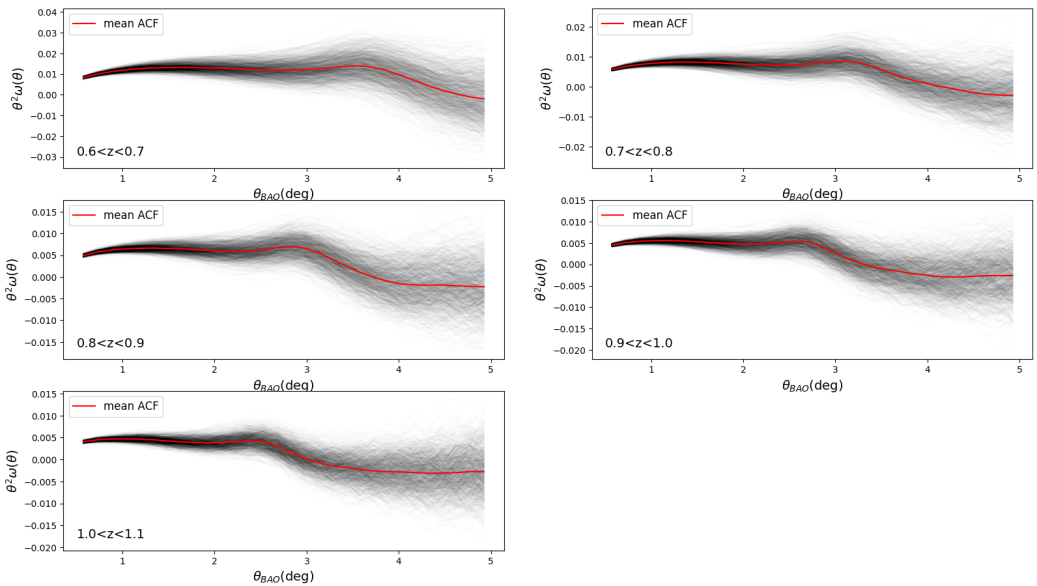
$\boldsymbol{\omega^{z_{bin}}_{template}(\theta)}$ **is the theoretical ACF computed for a given cosmology**. The BAO scale is given in terms of the **shift** α with respect to the template cosmology, $\alpha = \theta^{template}_{BAO}/\theta^{mock}_{BAO}$.

4. Calculate the **mean** and the **standard deviation** of the 1000 α values. We will use **two different template cosmologies** in order to compare the results.

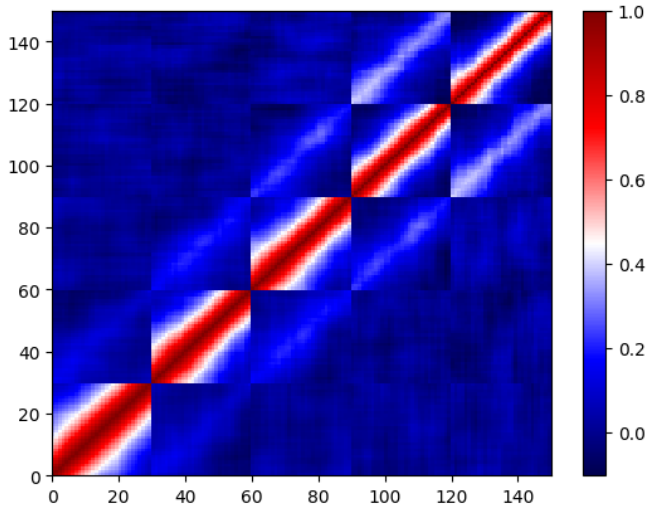
Results(I)

Correlation functions calculated from the mocks

ACFs of the 1000 mocks



Full correlation matrix



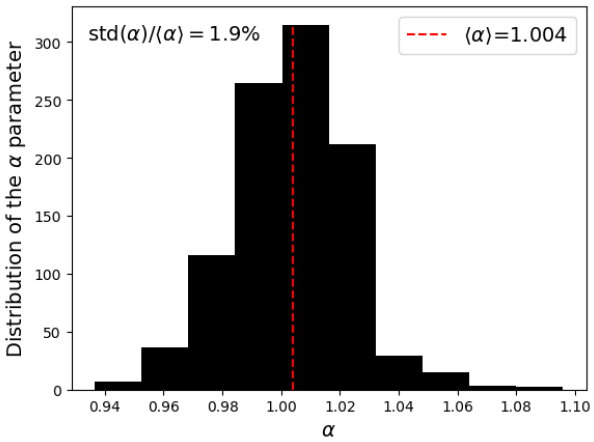
Template ACFs: two different cosmologies

	Ω_b	Ω_c	h	A_s or σ_8	n_s
MICE cosm.	0.044	0.206	0.7	$\sigma_8 = 0.8$	0.95
Planck cosm.	0.0494	0.2656	0.6727	$A_s = 2.101 \cdot 10^{-9}$	0.9649

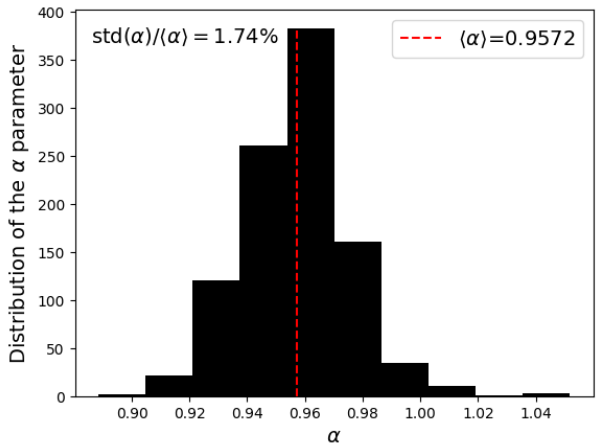
Results(II)

Fit results

1) Using the MICE template



2) Using the Planck template



Summary of the results

	MICE t.	Planck t.
$\langle\alpha\rangle$	1.0040	0.9572
$std(\alpha)/\langle\alpha\rangle$	1.9%	1.74%
$\alpha_{th}(z_{eff})$	1	0.9528

Conclusions

- We have obtained that $std(\alpha)/\langle\alpha\rangle \sim 2\%$. Also, $\langle\alpha\rangle/\alpha_{th} \approx 1.004$.
- The results **do not depend on the cosmology of the template** used to do the fits. This allows us to use this method with real data (for which we don't know the exact cosmology).

References

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