Fullshape fitting of the angular correlation function of galaxies from the Dark Energy Survey Y1 data

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Ciemat
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

Outline. From BAO to model constrains

- What are **baryon acoustic oscillations** ?
- Statistical tools:

  ACFs, fullshape fitting and

  Application to **DES sample**
- **Testing the method**: lognormal mocks
- **Some results**. Constraining parameters for DESY1 data.

Blanco telescope and star trails (Reidar Hahn, Fermilab)

Baryon Acoustic Oscillations (BAO)

> BAO as a **standard ruler**

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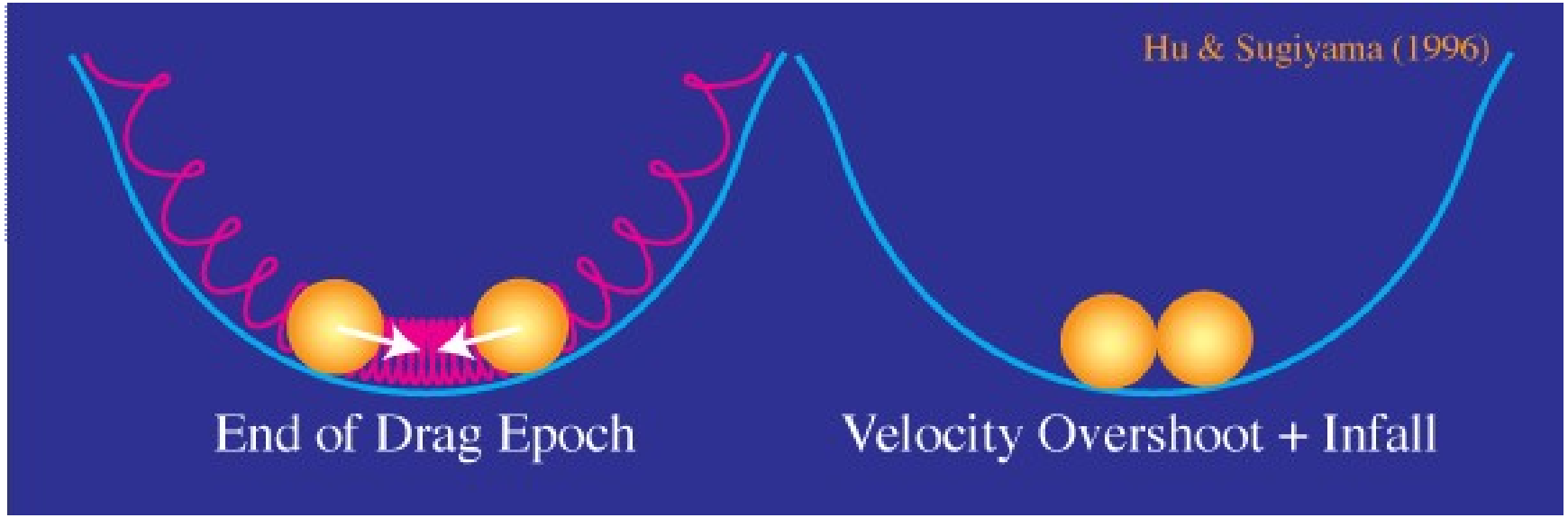

Wayne Hu webpage http://background.uchicago.edu/~whu/power/bao.html

Baryon Acoustic Oscillations (BAO)

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>Once this process ended, acoustic waves froze leaving **a signal in the distribution of galaxies**

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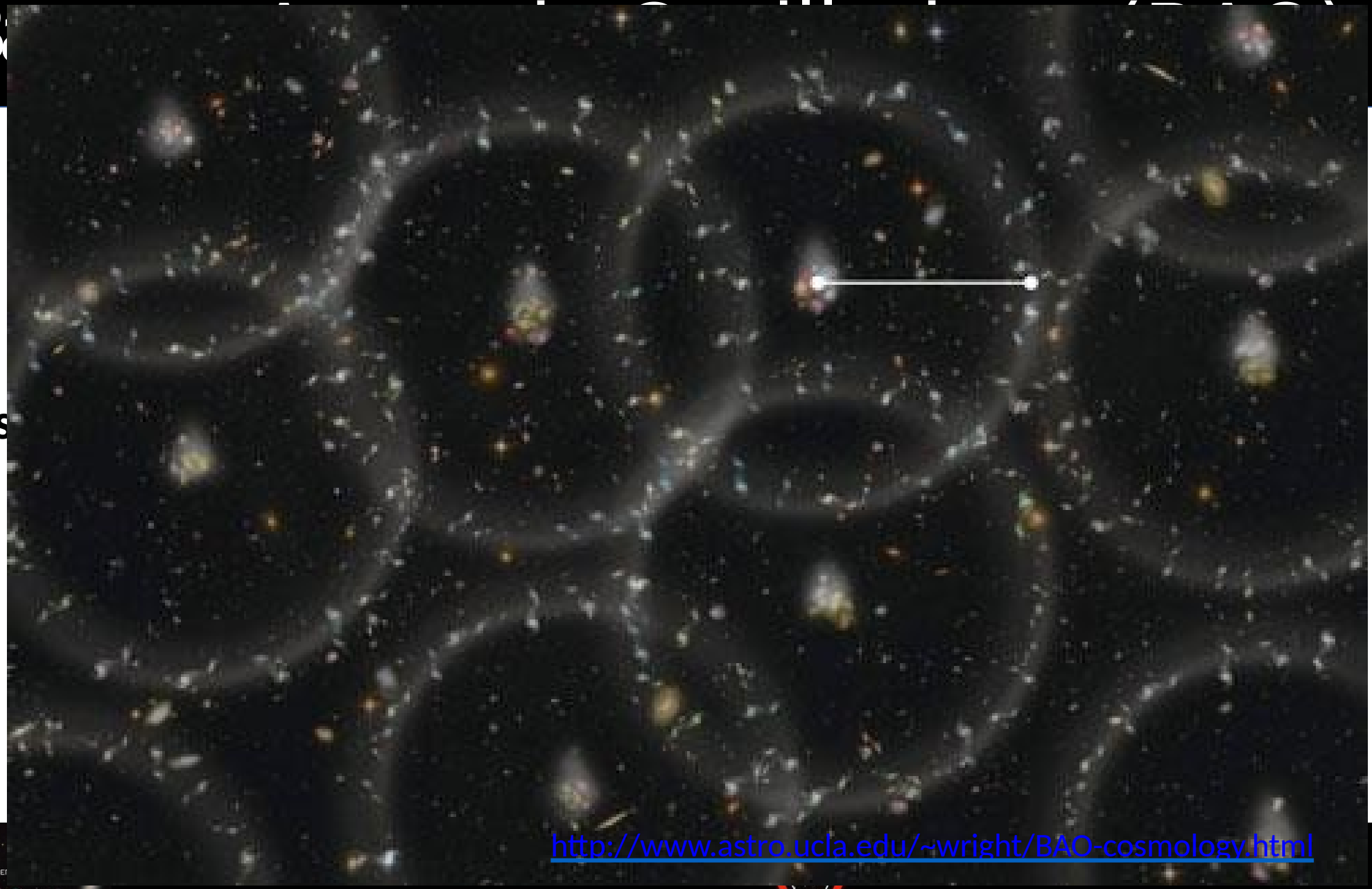

http://www.astro.ucla.edu/~wright/BAO-cosmology.html

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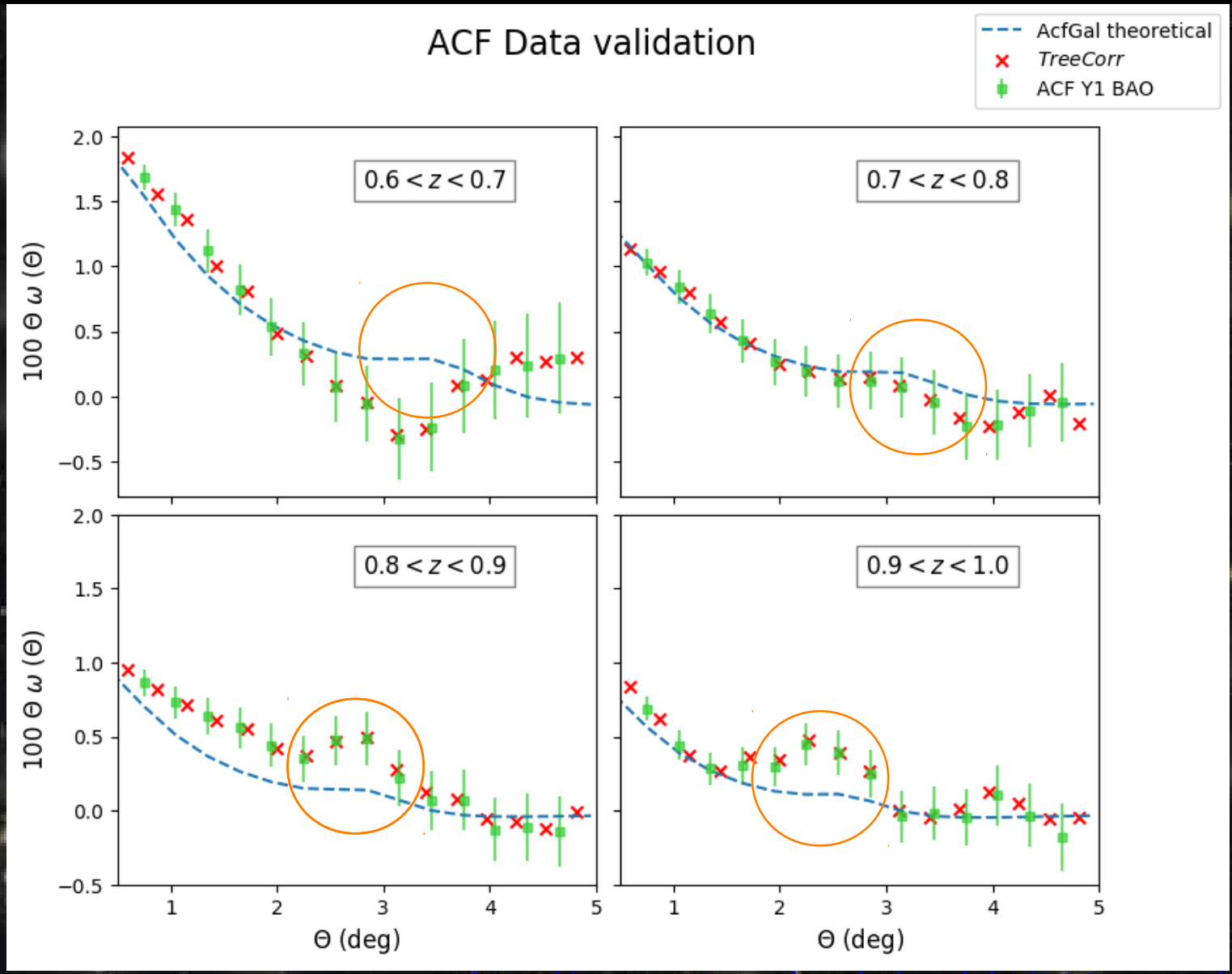

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Baryon Acoustic Oscillations (BAO)

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> Suitable way of **constraining** the value of cosmological parameters.

Angular Correlation Function (ACF)

> The analysis is applied to the **Dark Energy Survey Y1** data

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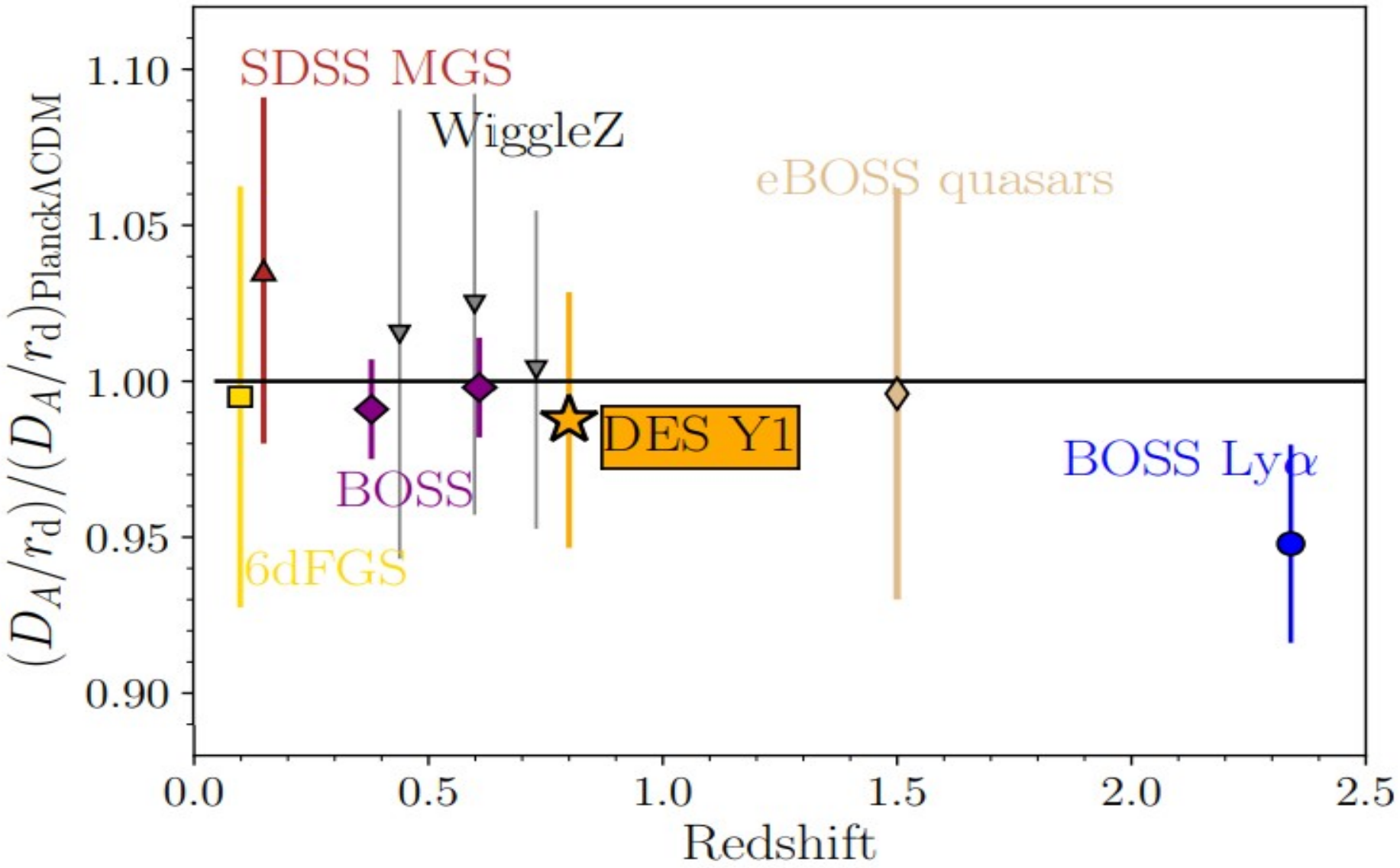

DES Collaboration arxiv.org/abs/1712.06209

Angular Correlation Function (ACF)

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> **Definition**

$$\delta P(\theta) = n^2 [1 + \omega(\theta)] \delta\Omega_1 \delta\Omega_2$$

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1. Distance between galaxies is smaller than curvature scale
2. Negligible galaxy clustering evolution with redshift

***We keep our analysis on linear regime (on-going work: include RPT)**

ACF - Equations

$$\omega(\theta) = \int_0^\infty dz_1\, \phi(z_1) \int_0^\infty dz_2\, \phi(z_1)\, \xi^{(s)}(z_1, z_2, \theta)$$

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$$\begin{aligned}\xi^{(s)}(z_1, z_2, \theta) = D(z_1)D(z_2) \Big[& b(z_1)b(z_2)\xi^{(0)}(z_1, z_2, \theta) \\ & + f(z_1)b(z_2)\xi^{(1)}(z_1, z_2, \theta) \\ & + f(z_2)b(z_1)\xi^{(1)}(z_1, z_2, \theta) \\ & + f(z_1)f(z_2)\xi^{(2)}(z_1, z_2, \theta)\Big]\end{aligned}$$

Testing the method: lognormal mocks

> **What is** a mock catalogue and **why** it is useful

About lognormal mocks. *Coles & Jones* (1991) 10.1093/mnras/248.1.1, *S. Avila et al (2018)* arXiv:1712.06232

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$$pdf(x) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(\log x - \mu)^2}{2\sigma^2}\right)\frac{dx}{x}$$

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Test … ock

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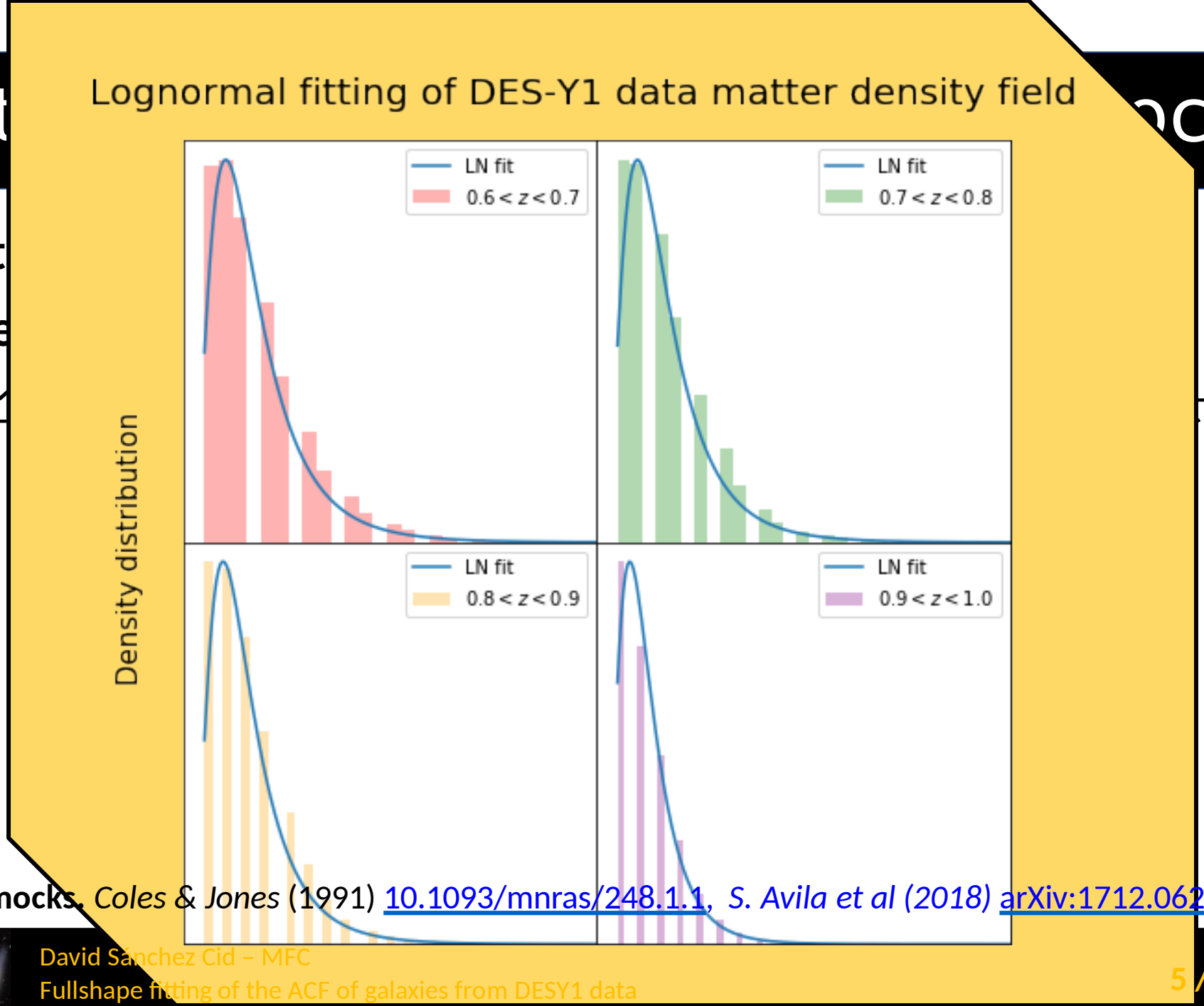

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- **Sensitive parameters** to BAO tracer were chosen

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Testing the method: lognormal mocks

Model	Parameter	General meaning	Needed for ...
Flat ΛCDM	Ω_m	Matter density fraction	Background evolution
	H_0	Expansion rate	Background evolution
	Ω_b	Baryon density fraction	Thermal history
	A_s, σ_8	Variance of cosmic density structure	Structure formation
	n_s	Structure scale-dependence power law	Structure formation
ΛCDM	Ω_k	Curvature abundance	Background evolution
νCDM	Ω_ν	Neutrino density fraction	Small–scale structure
	Massive(ν)	Number of massive neutrinos	Small–scale structure
	Massless(ν)	Number of massless neutrinos	Small–scale structure
wCDM	w	Dark energy constant equation of state	Background evolution
Extended DE	w_a, w_p, ...	Dark energy varying equation of state	Background evolution

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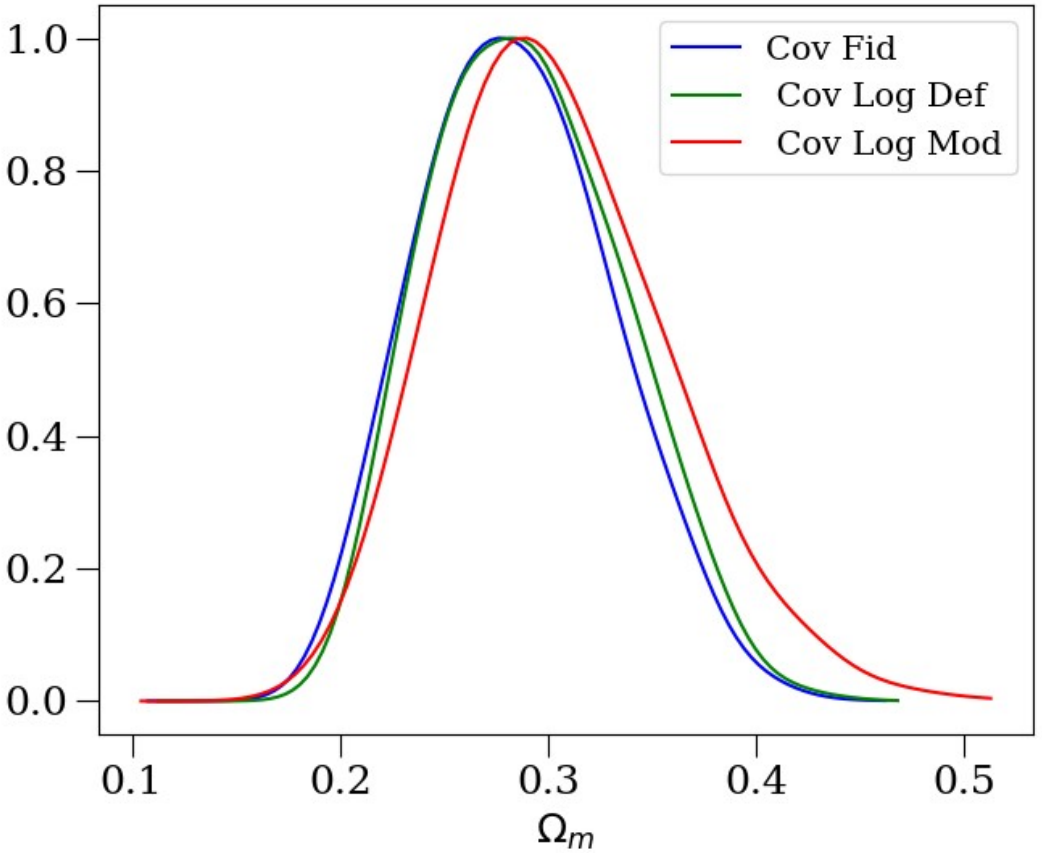
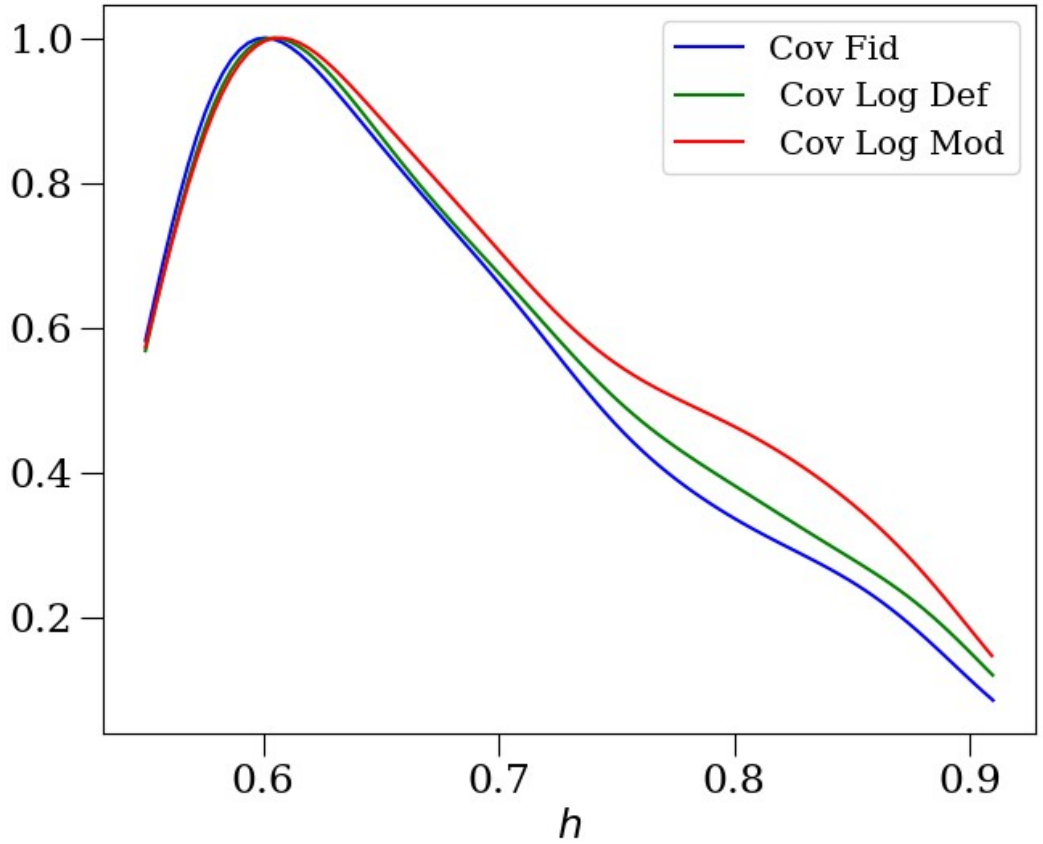
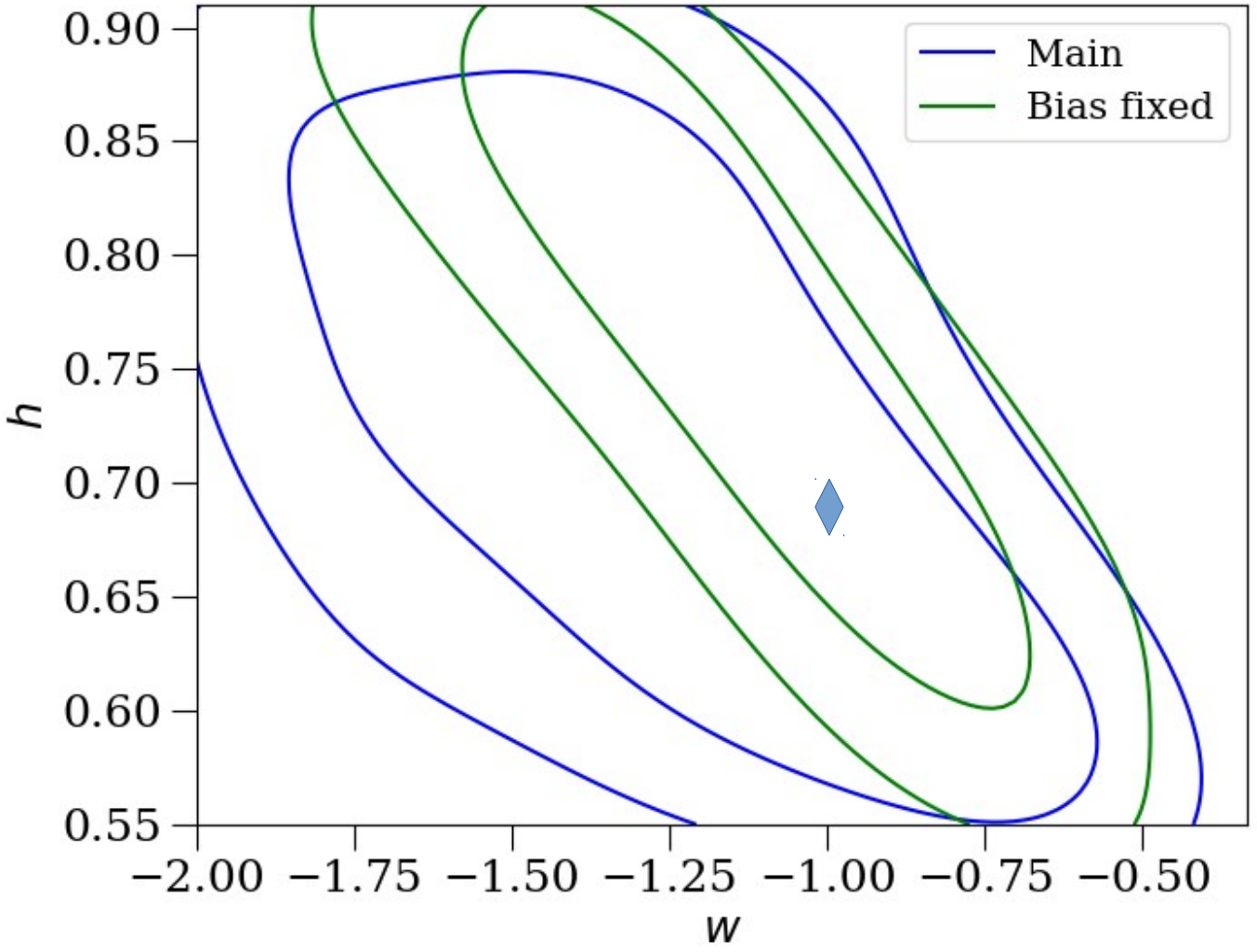
Some results using lognormal mocks



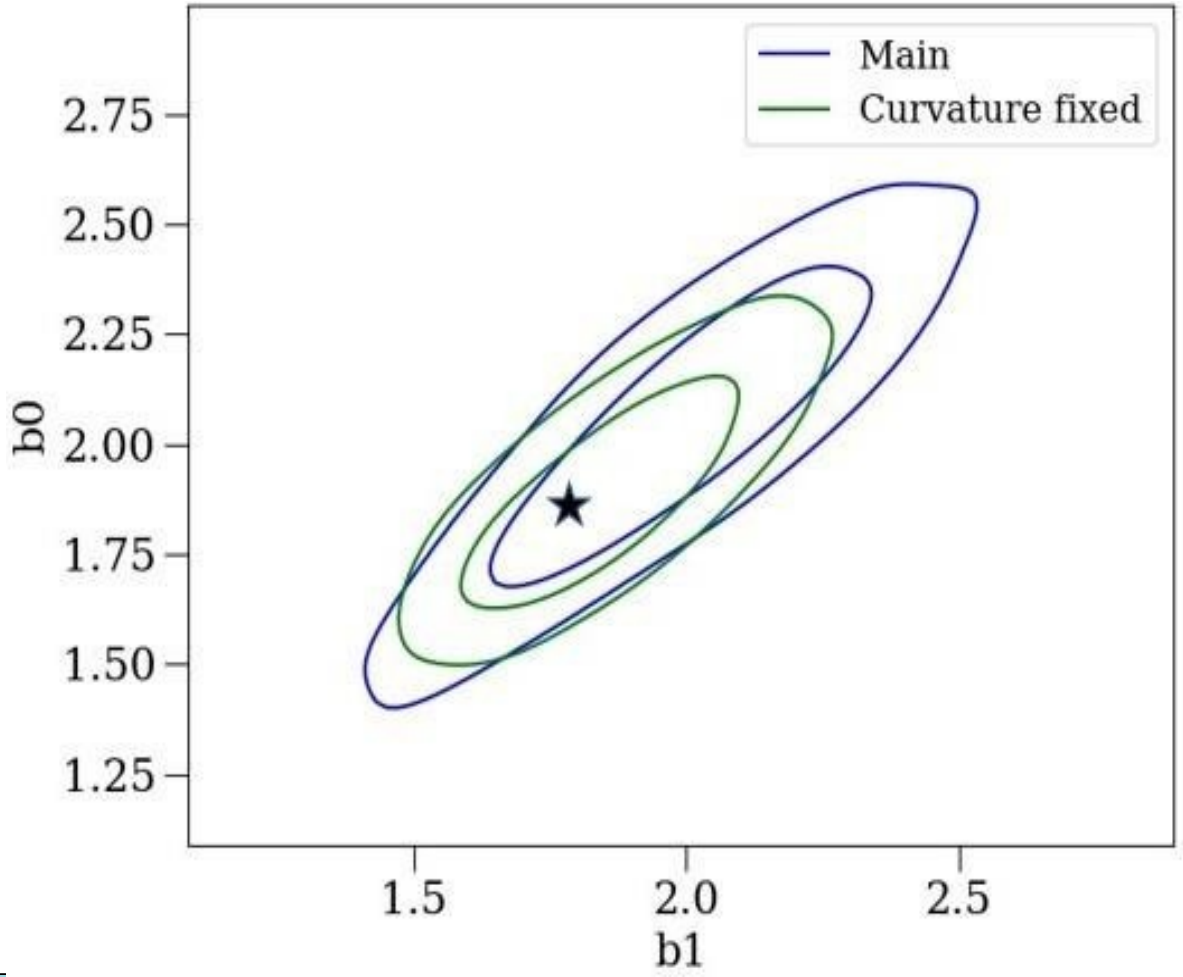


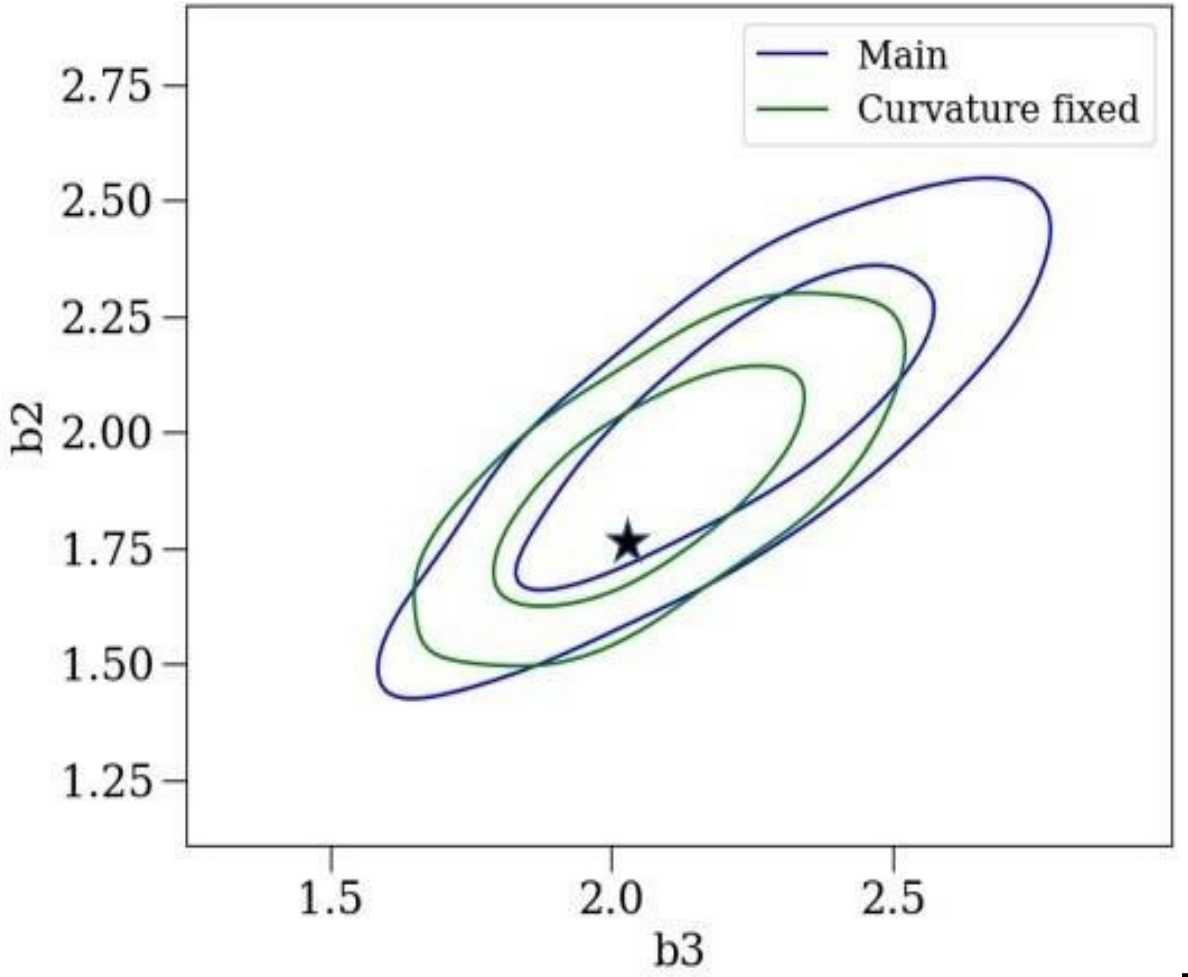
Negligible effect of underlying cosmology in covariance. Kodwani et al. (2018) arXiv:1811.11584

Some results DESY1 data: bias fixing



Some results DESY1: curvature fixing





Fullshape fitting of the ACF of galaxies from DES Y1

Thanks for your attention !