Clustering tomography on the final BOSS DR12 galaxy sample

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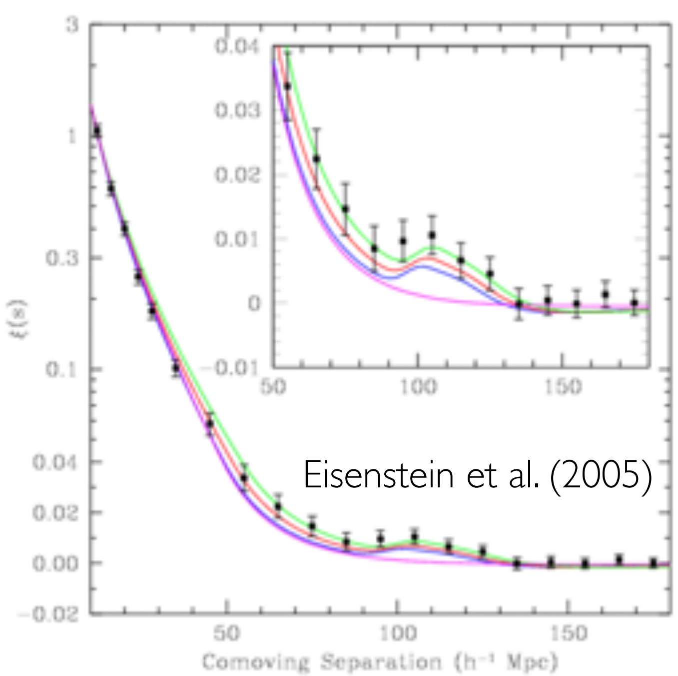
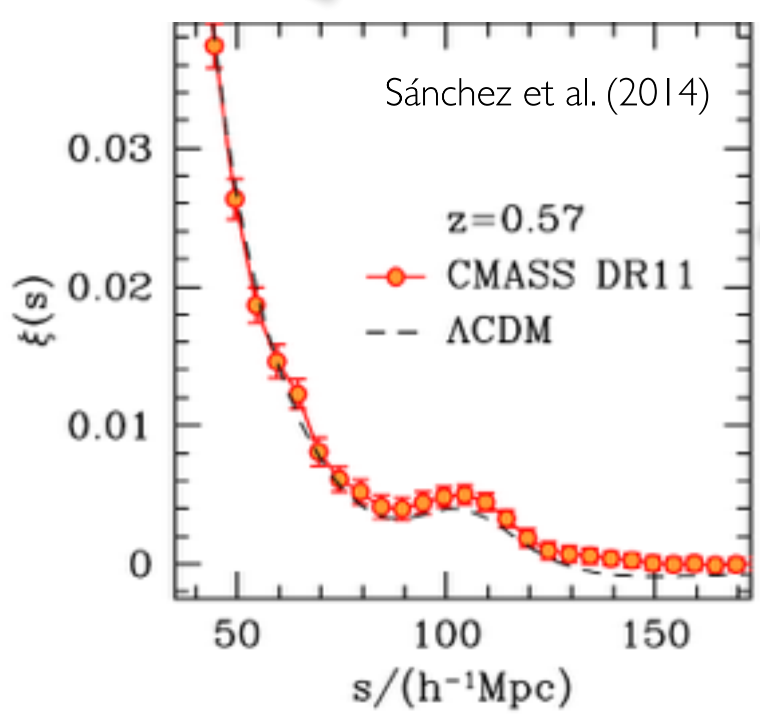
OUTLINE

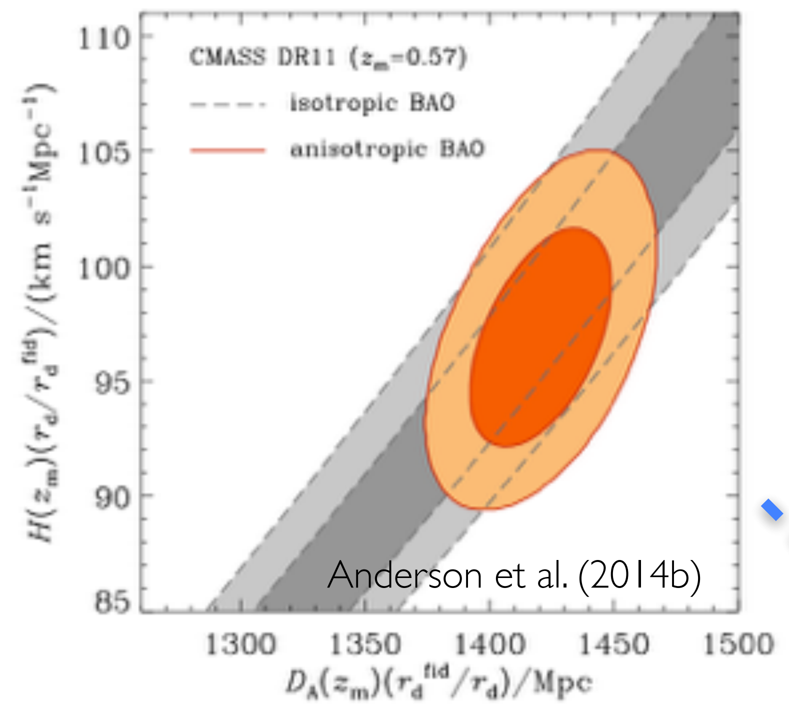
- Introduction.
- Clustering Tomography.
- Update on the clustering tomography on BOSS-DR12 galaxy sample.
- Summary.

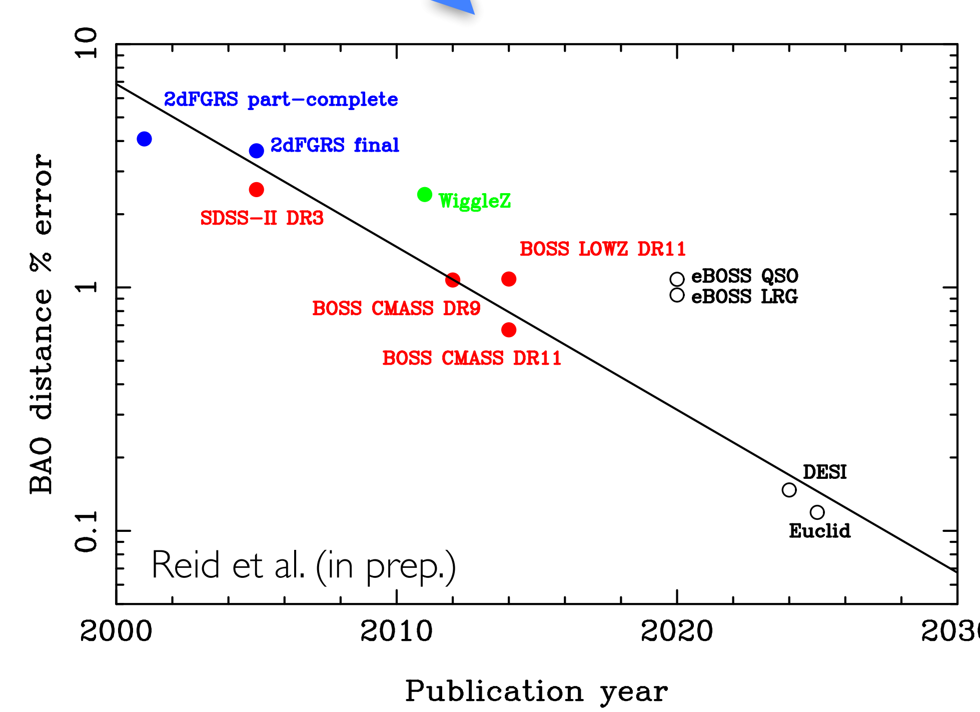
INTRODUCTION

BAO are a great tool for observational cosmology.







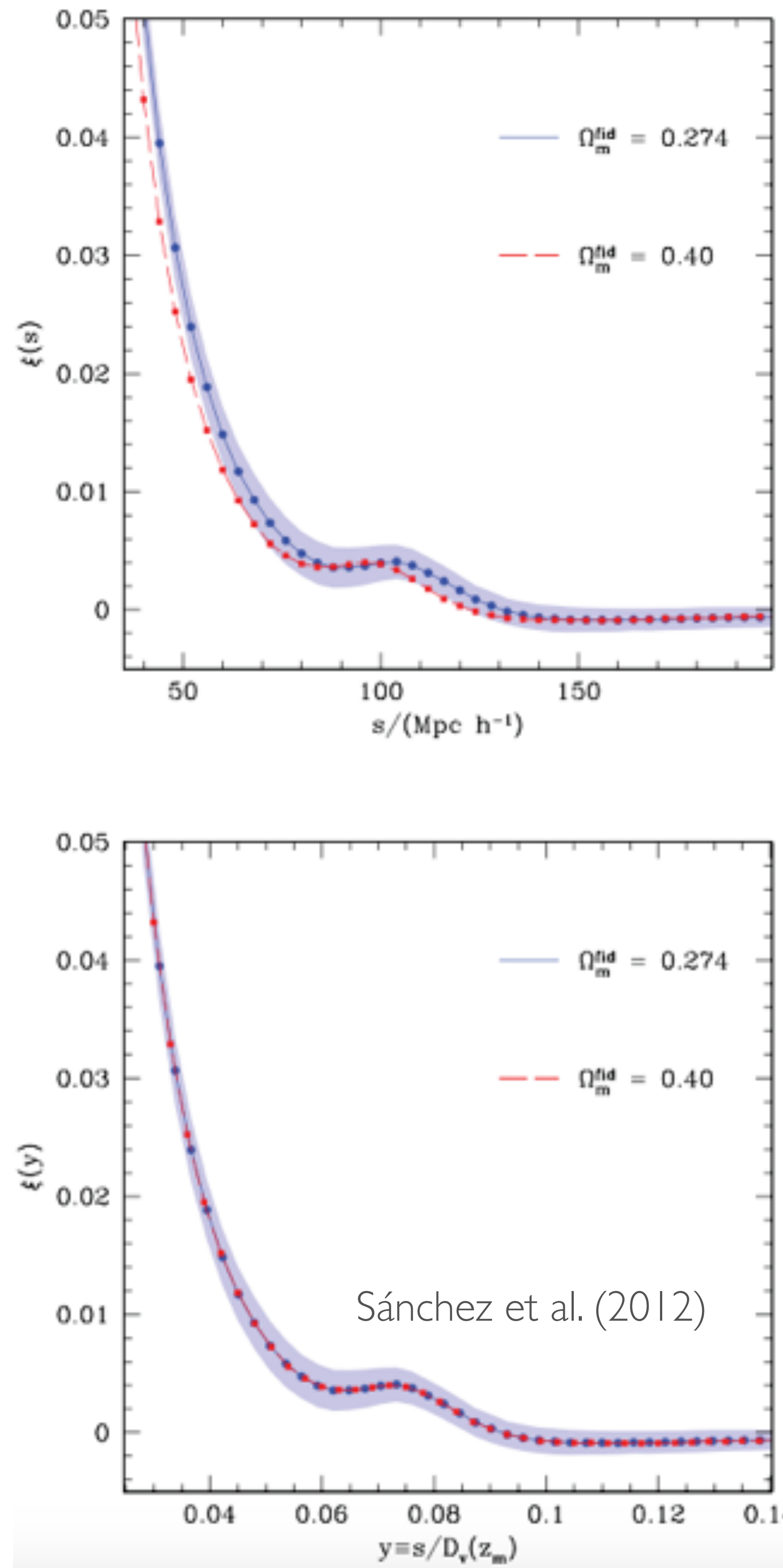


INTRODUCTION

- Requires the assumption of a **fiducial cosmology** to transform RA, DEC, z into physical distances.

- **Averages** the signal over large cosmological volumes, **ignoring light-cone effects**.

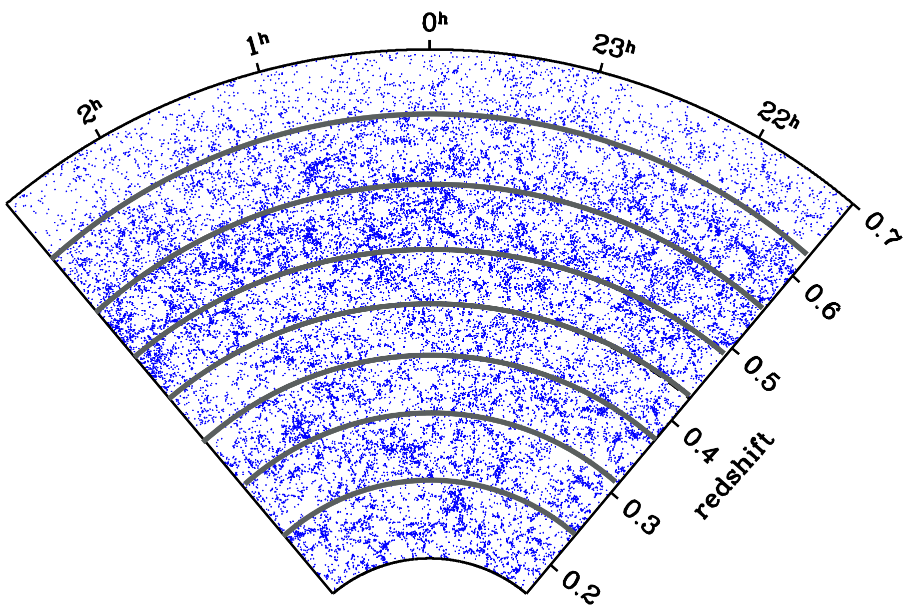
- Gives **only one distance** measurement for a large redshift range.



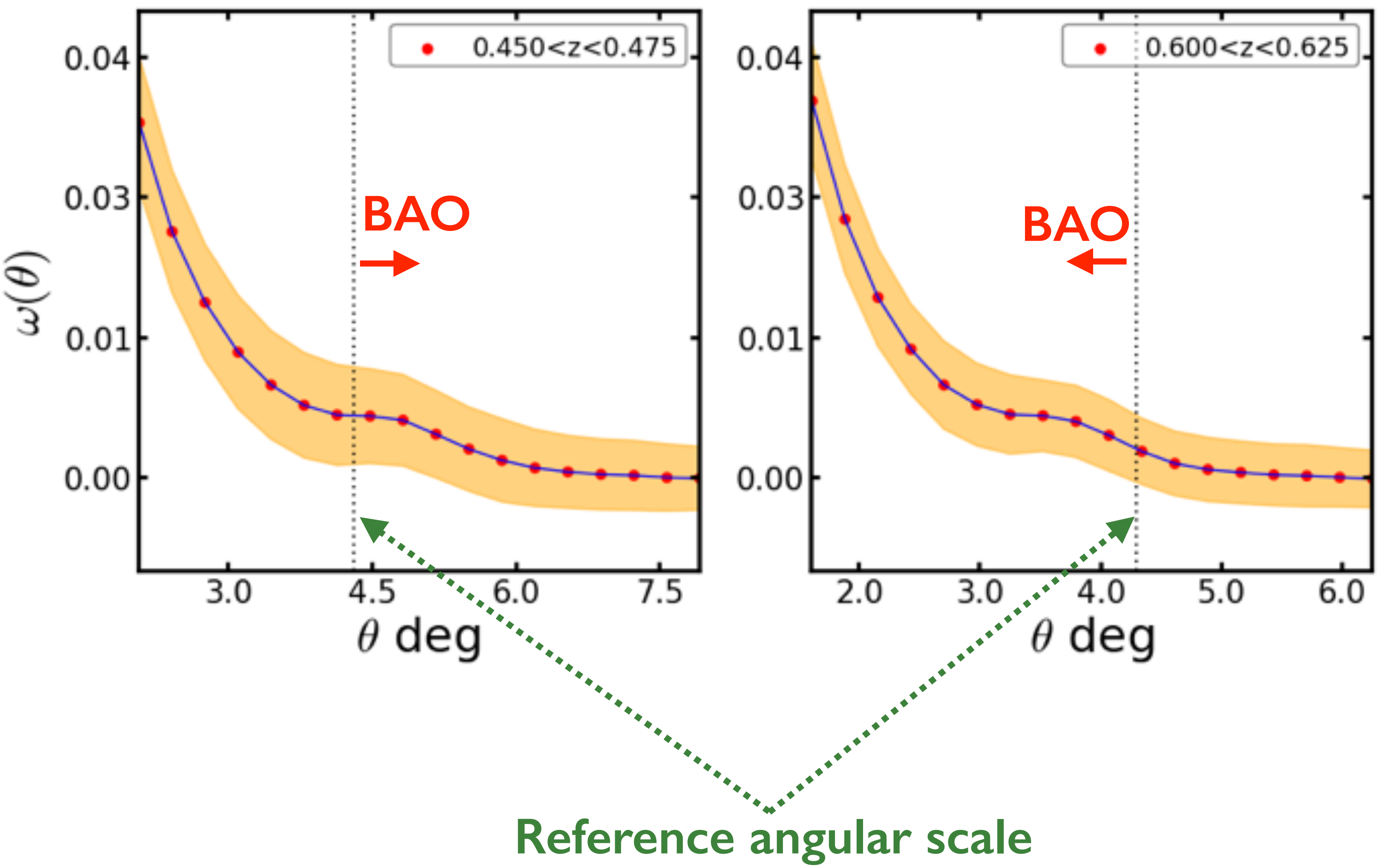
INTRODUCTION

A way to avoid these assumptions is to use **angular clustering** measurements (see e.g. Crocce et al. 2011b, Ross et al. 2011, Asorey et al. 2012, Di Dio et al. 2014, Salazar-Albornoz et al. 2014).

- ☑ **Cosmology independent** measurements.
- ☑ Requires division in redshift bins (shells), **allowing** the study of **light-cone effects**.
- ☑ Exploits the information of the **$D_A(z)$** evolution.



ANGULAR CORRELATION FUNCTIONS IN REDSHIFT-SHELLS

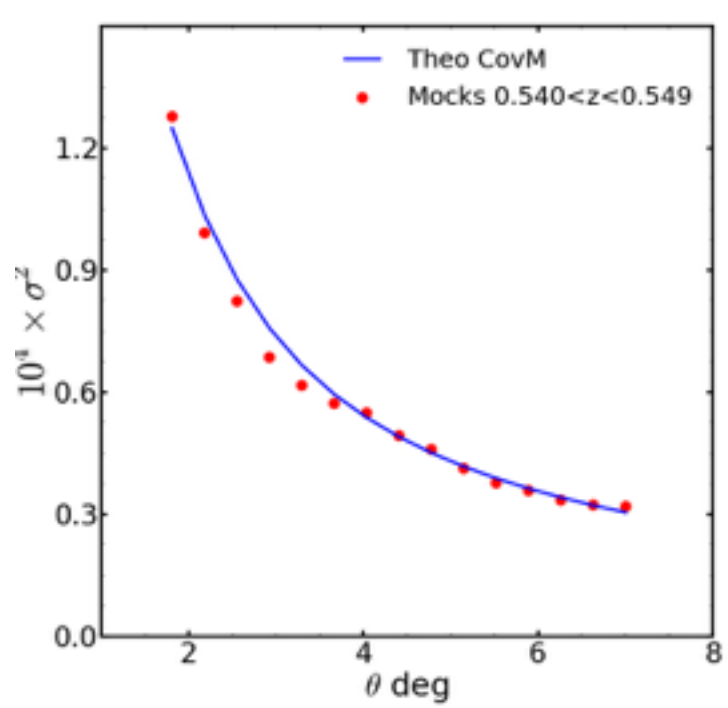


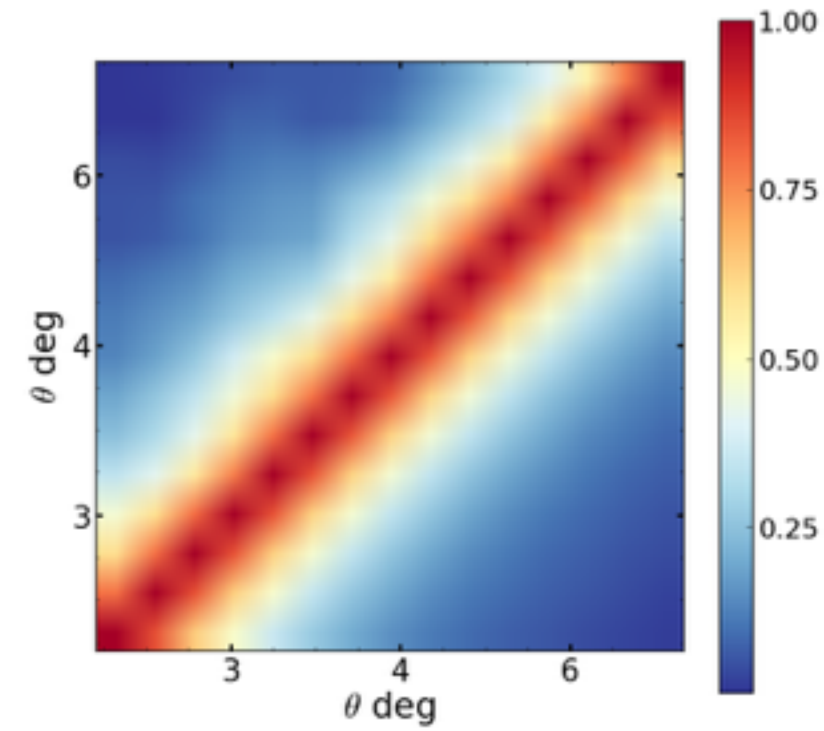
ANGULAR CORRELATION FUNCTIONS IN REDSHIFT-SHELLS

- We extract cosmological information through **full-shape fits**.

$$\omega(\theta) = \int dz_1 \phi(z_1) \int dz_2 \phi(z_2) \xi(z_1, z_2, \theta)$$

- **Large number of mock** catalogs is needed to make a good direct estimate of the covariance matrix. We use an **analytical** form instead.



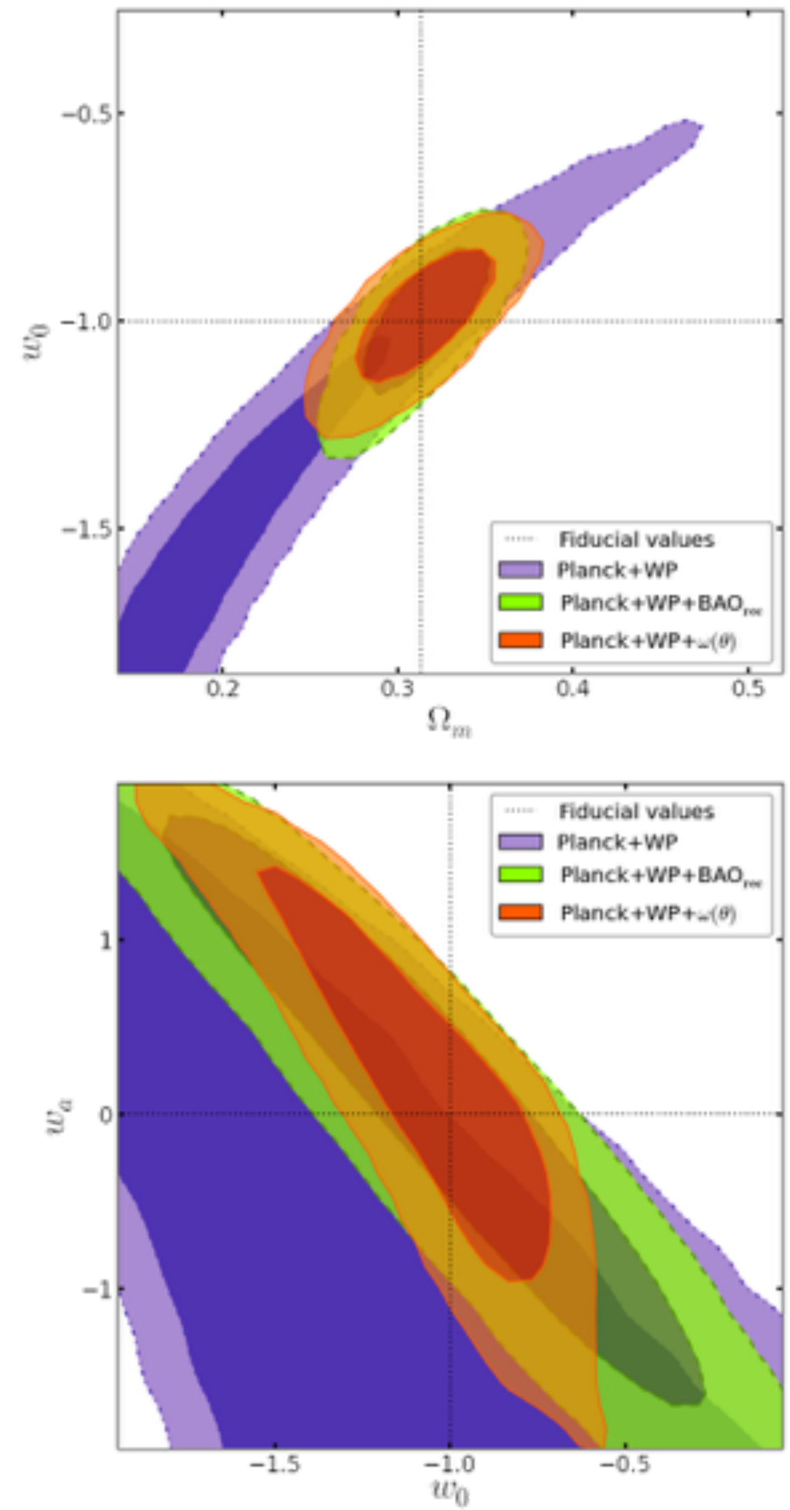


ANGULAR CORRELATION FUNCTIONS IN REDSHIFT-SHELLS

Forecast for BOSS DR12

- Constraints on constant w_{DE} comparable to those of isotropic BAO post-recon.
- **Improved** constraints on time-dependent $w_{\mathrm{DE}}(a)$, parametrized as (Chevallier & Polanski 2001, Linder 2003):

$$w_{\mathrm{DE}}(a) = w_0 + w_{\mathrm{a}}(1 - a)$$

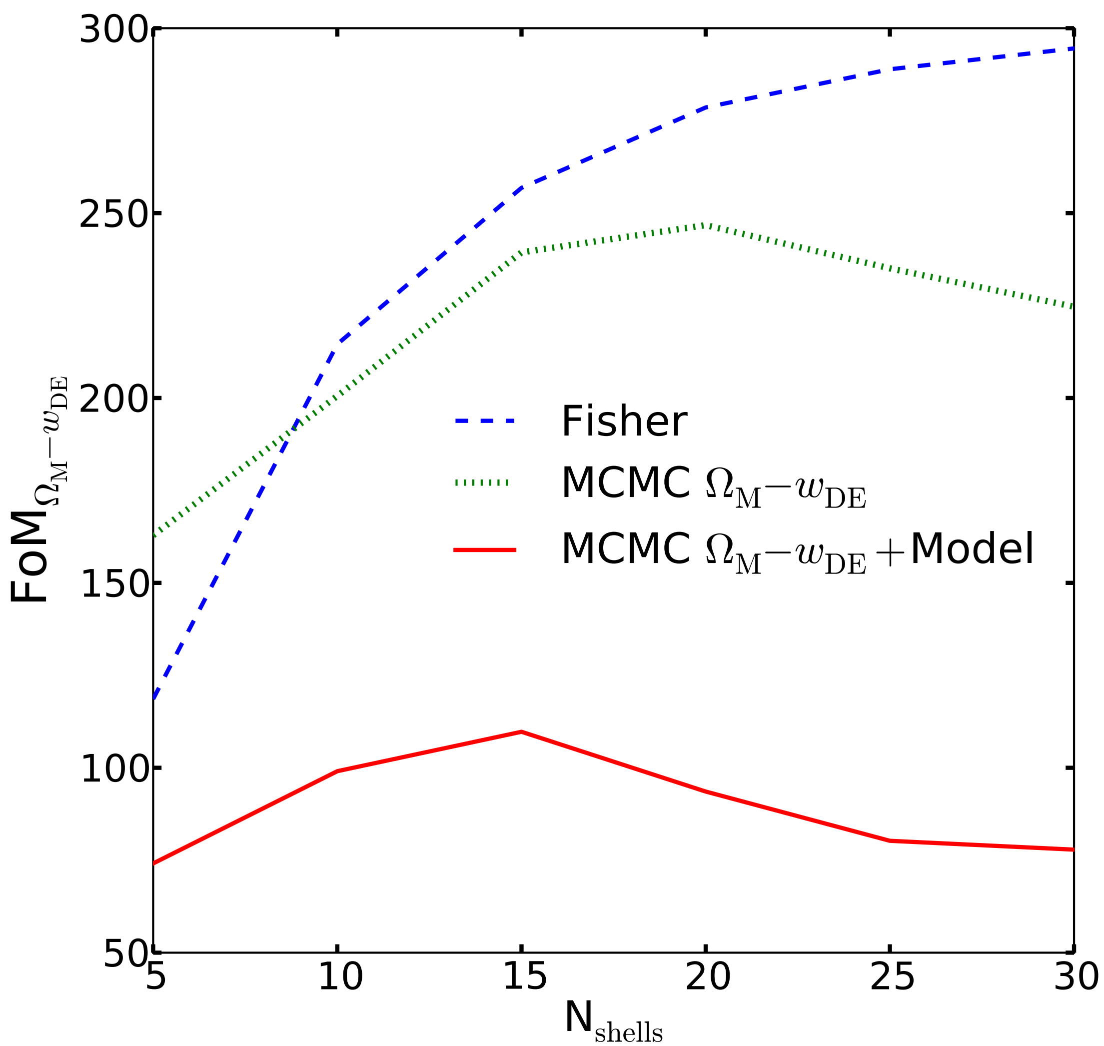


Salazar-Albornoz et al. (2014)

CLUSTERING TOMOGRAPHY ON BOSS-DR12

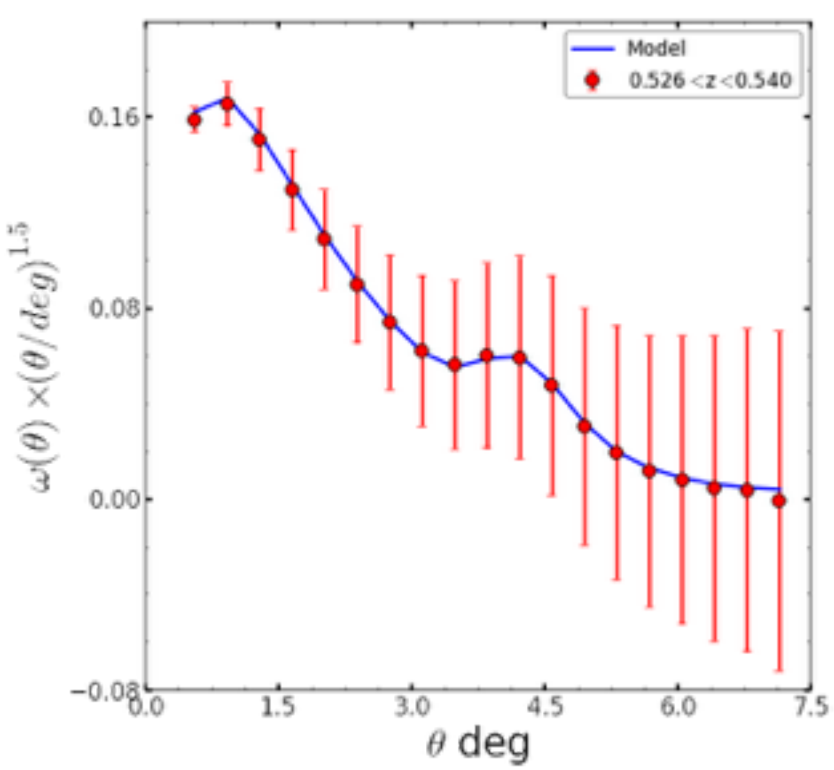
Optimization of the number of bins

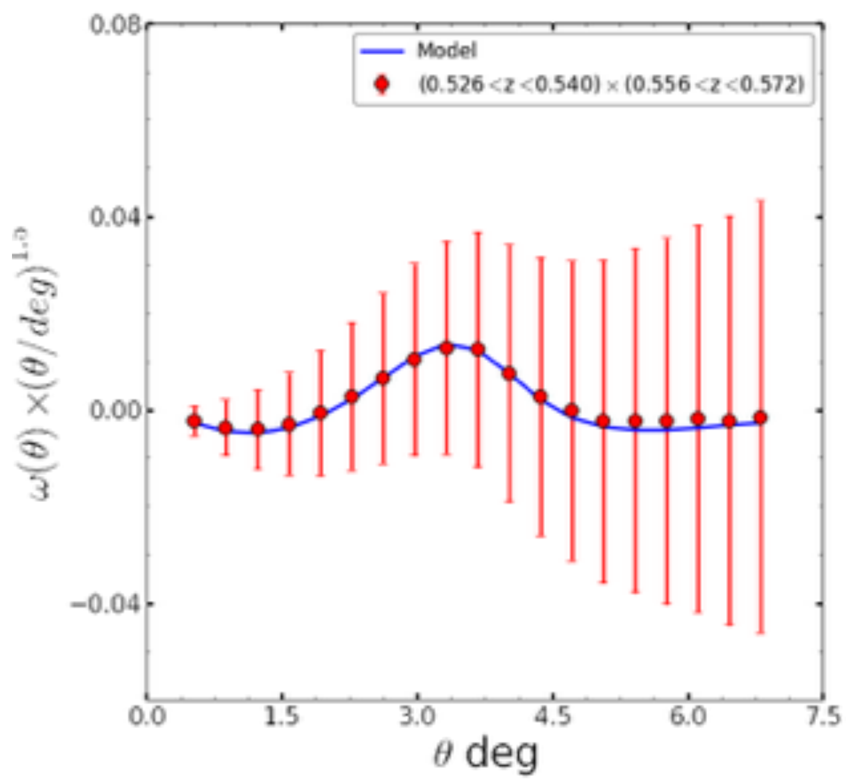
- ★ Based on Di Dio et al. (2014).
- ★ **15** shells for **CMASS**
  $0.43 < z < 0.7$ (~60k objects per shell).
- ★ **18** shells for **combined sample**
  $0.2 < z < 0.7$ (~ 70k objects per shell).
- ★ Two **cross-correlations** per shell.

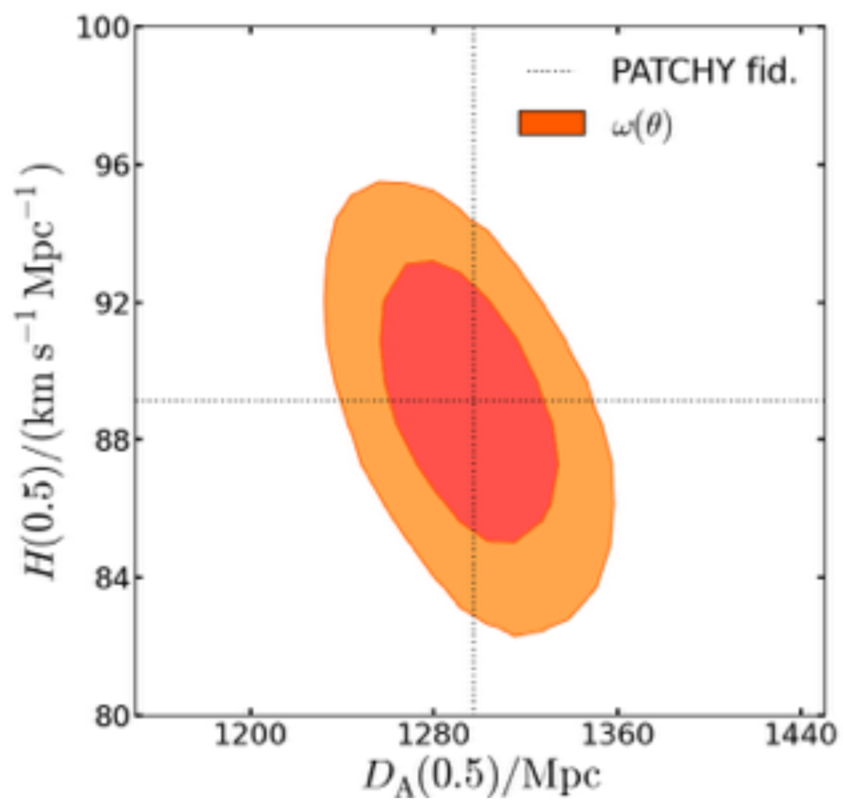


CLUSTERING TOMOGRAPHY ON BOSS-DR12

Test of model (gRPT+bias+RSD) against mocks.

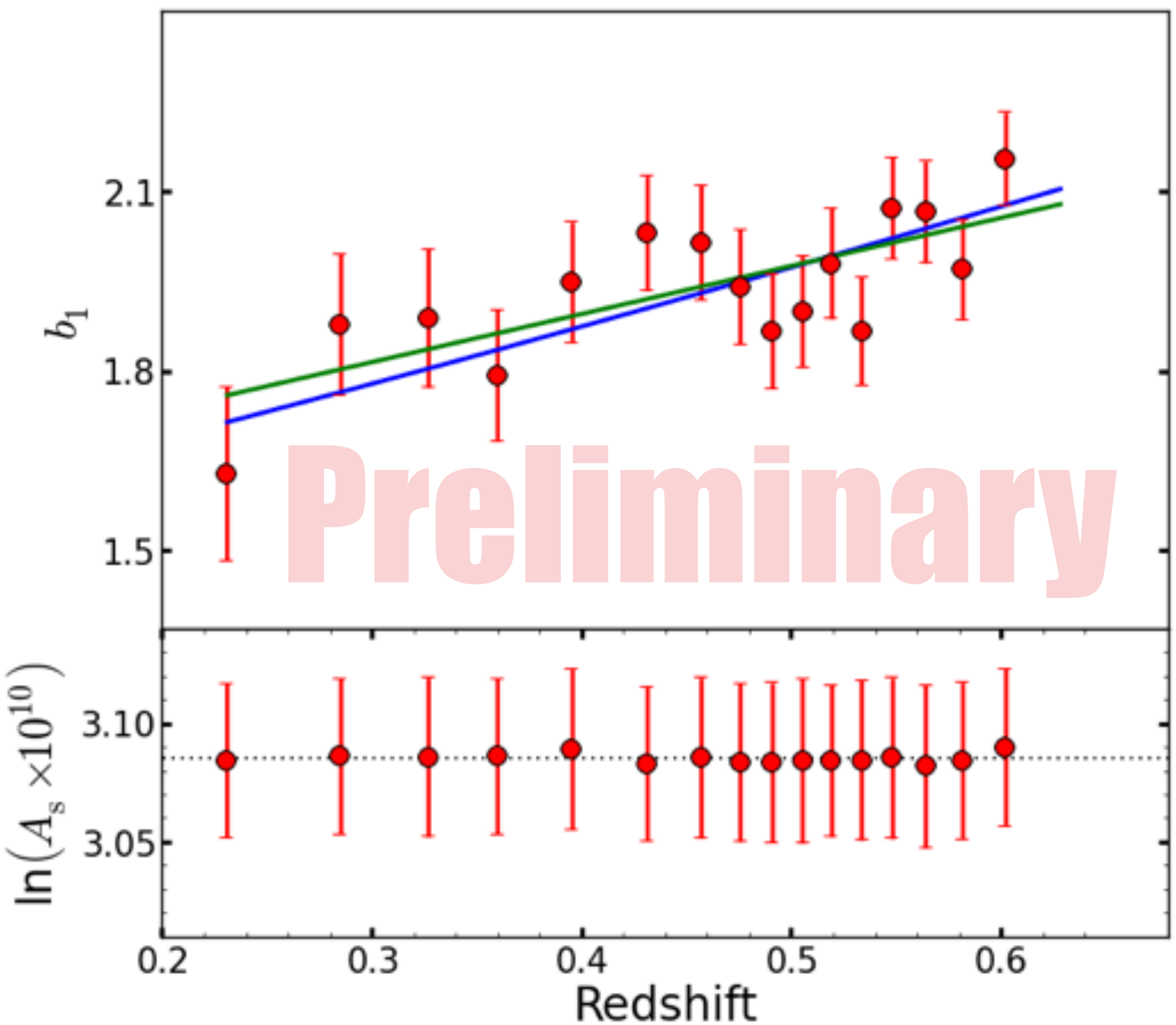






Patchy mocks (F. Kitaura's talk)

CLUSTERING TOMOGRAPHY ON BOSS-DR12



- Linear galaxy bias constraints **shell-by-shell** (Planck prior for $\mathbf{A_s}$).
- Bias evolution **consistent** with

$$b(z) \propto \frac{1}{D(z)}$$

- We will test the **impact** on cosmological constraints for **different assumptions** of **b(z)**.

CLUSTERING TOMOGRAPHY ON BOSS-DR12

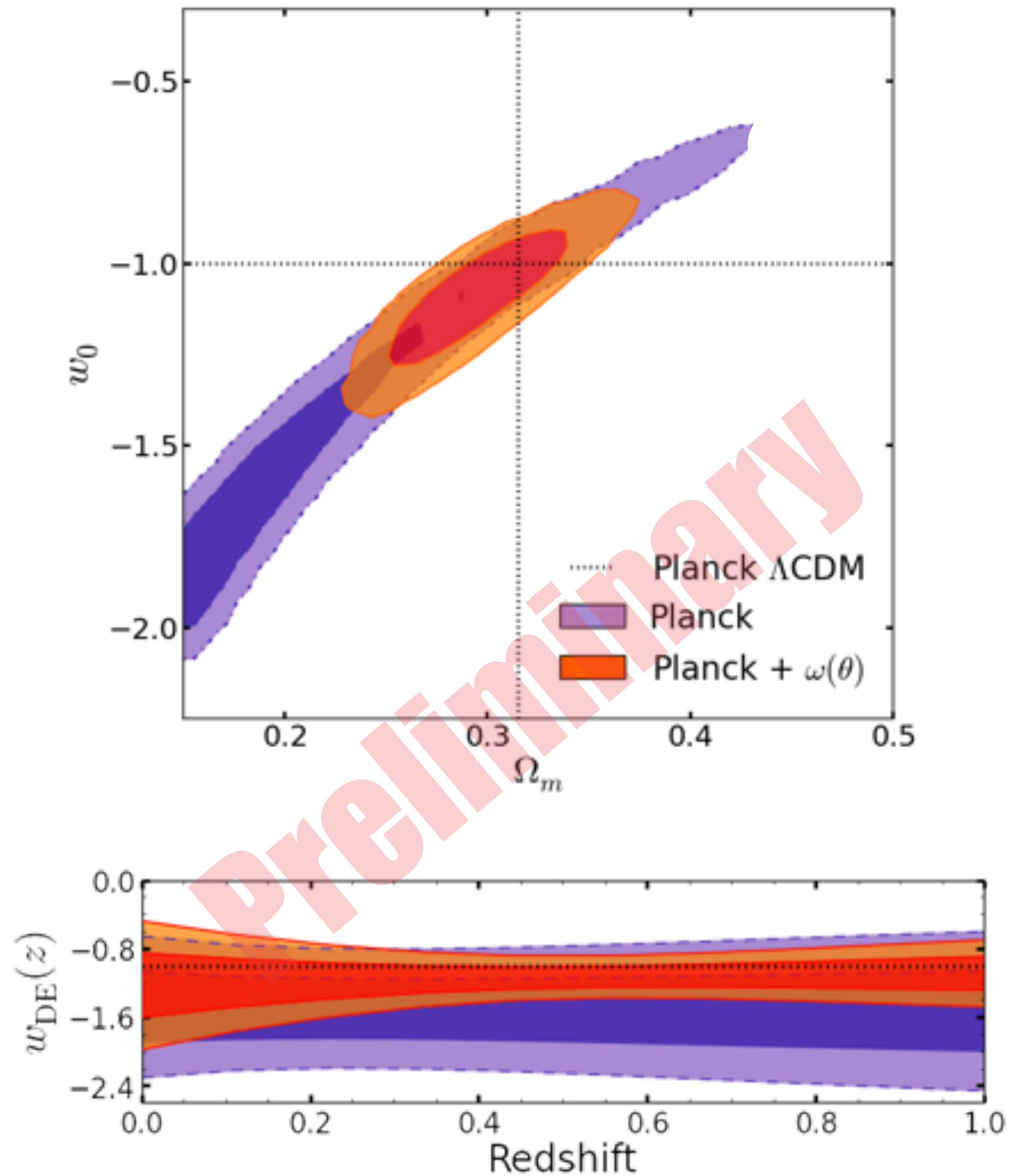
★ **Preliminary constraints**

➡ **Assuming** $b(z) \propto \dfrac{1}{D(z)}$

➡ Using Planck TT+lowTEB (arXiv: 1502.01589) **distance priors.**

➡ Preliminary constraints on two parameter spaces, **wCDM** and **w_0w_aCDM** with

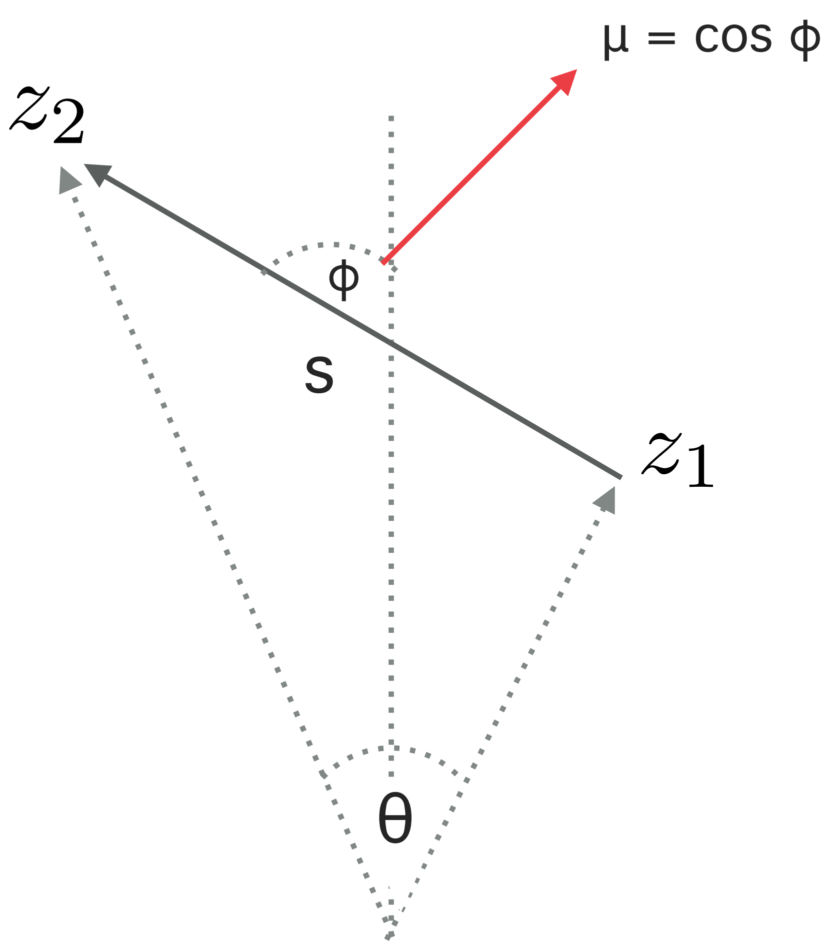
$$w_{\rm DE}(a) = w_0 + w_{\rm a}(1-a)$$



SUMMARY

- **Clustering tomography** is a good alternative to traditional BAO analysis.
- It uses **angular** auto- and cross-correlation functions in **thin redshift-shells** as cosmological prove.
- We apply this tomographic approach to analyse the galaxy clustering using on **BOSS-DR12**.
- Final analysis on BOSS coming soon.

Back up slides…



$$\omega(\theta) = \int\int dz_1 dz_2 \phi(z_1)\phi(z_2)\xi(s,\mu)$$

$$s = \sqrt{r^2(z_1) + r^2(z_2) - 2r(z_1)r(z_2)\cos\theta}$$

$$\mu = \frac{r^2(z_1) - r^2(z_2)}{s||\vec{r}(z_1) + \vec{r}(z_2)||}$$

The full covariance matrix can be obtained as:

$$\mathrm{Cov}_{\mathrm{i,j}}^{(\mathrm{m,n}),(\mathrm{p,q})} = \sum_{\ell,\ell' \geq 2} \left(\frac{2\ell + 1}{4\pi} \right)^2 \mathrm{L}_{\ell}(\cos\theta_{\mathrm{i}}) \mathrm{L}_{\ell'}(\cos\theta_{\mathrm{j}}) \mathrm{Cov}_{\ell,\ell'}^{(\mathrm{m,n}),(\mathrm{p,q})}$$

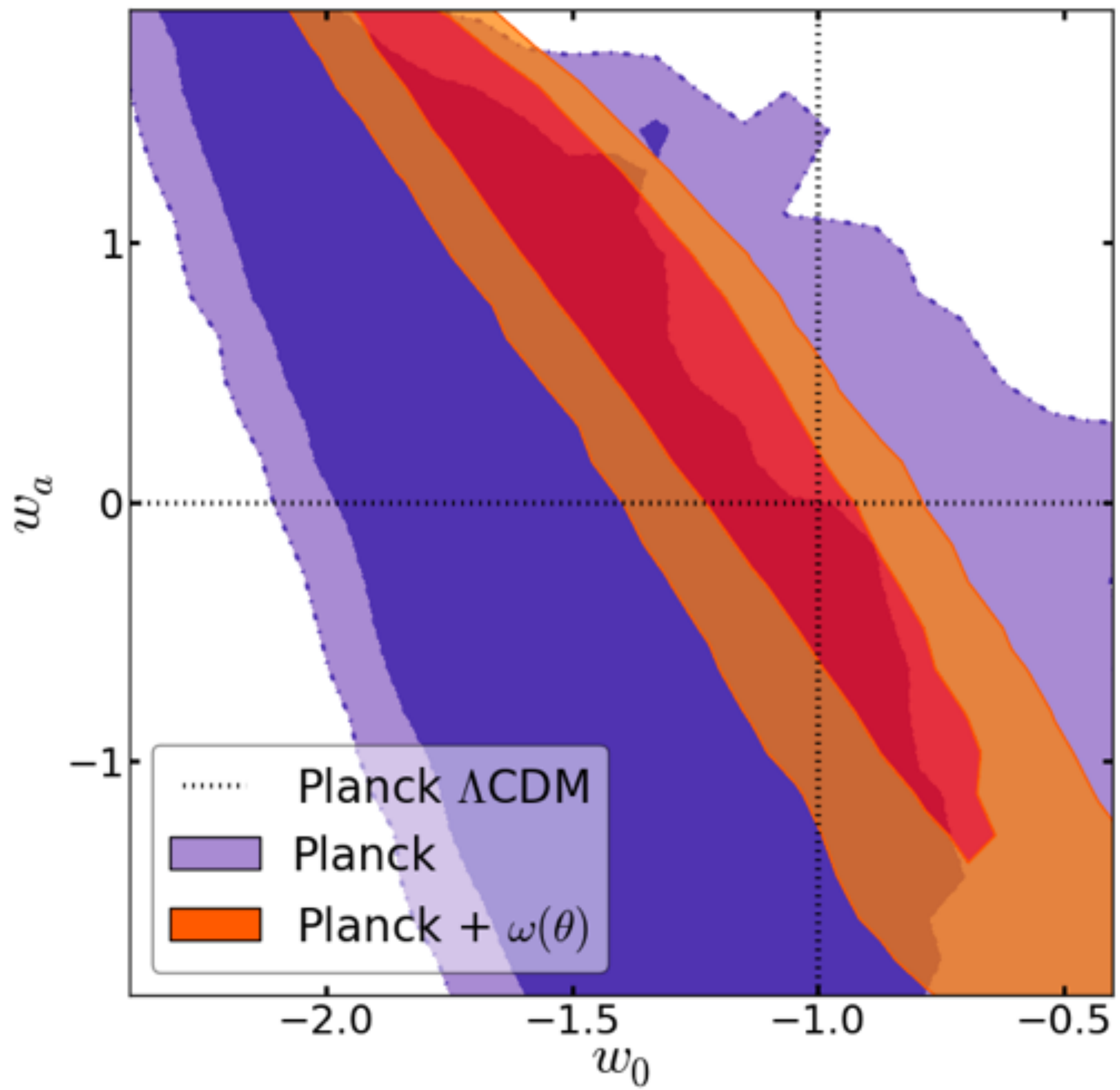
where

$$\mathrm{Cov}_{\ell,\ell'}^{(\mathrm{m,n}),(\mathrm{p,q})} = \delta_{\ell\ell'} \frac{\hat{\mathrm{C}}_{\ell}^{(\mathrm{m,p})} \hat{\mathrm{C}}_{\ell}^{(\mathrm{n,q})} + \hat{\mathrm{C}}_{\ell}^{(\mathrm{m,q})} \hat{\mathrm{C}}_{\ell}^{(\mathrm{n,p})}}{\mathrm{f}_{\mathrm{sky}}(2\ell + 1)}$$

and

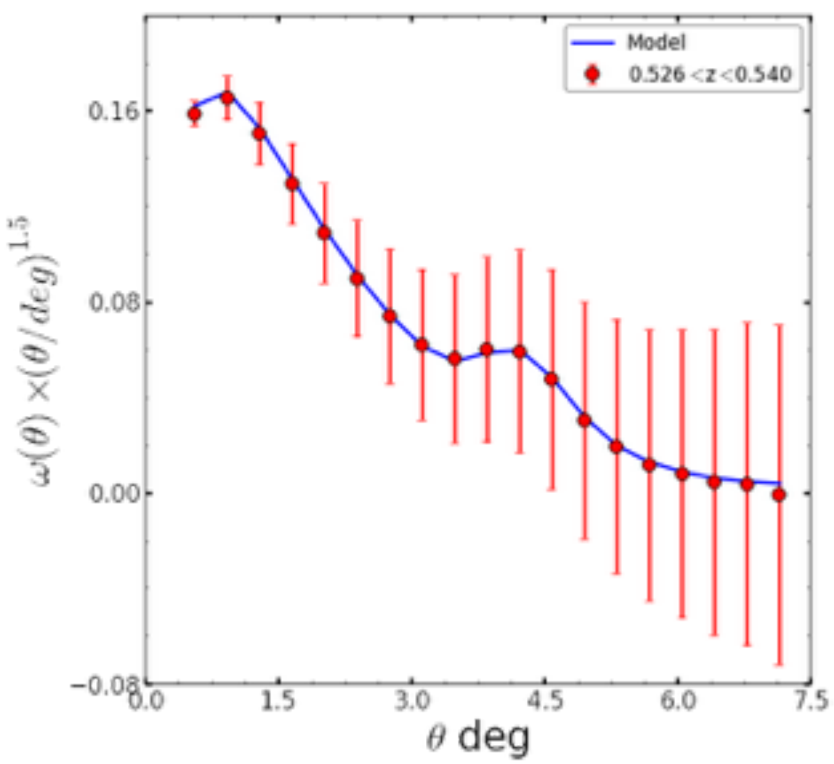
$$\hat{C}_{\ell}^{(\mathrm{p,q})} = C_{\ell}^{(\mathrm{p,q})} + \frac{\delta_{\mathrm{pq}}}{\bar{\mathrm{n}}^{\mathrm{p}}}$$

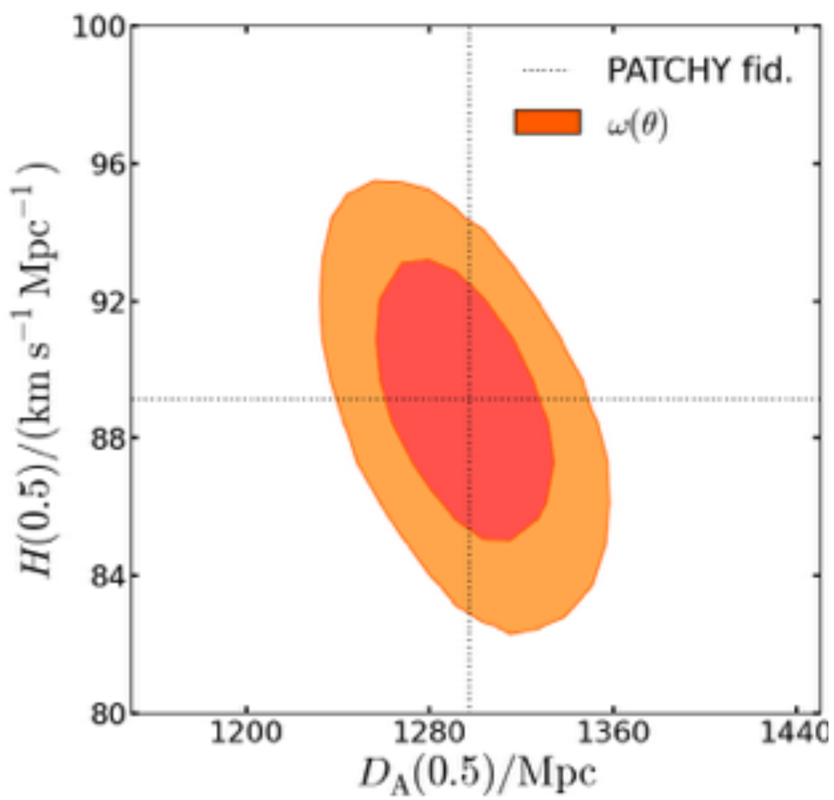
is the observed angular power spectrum.

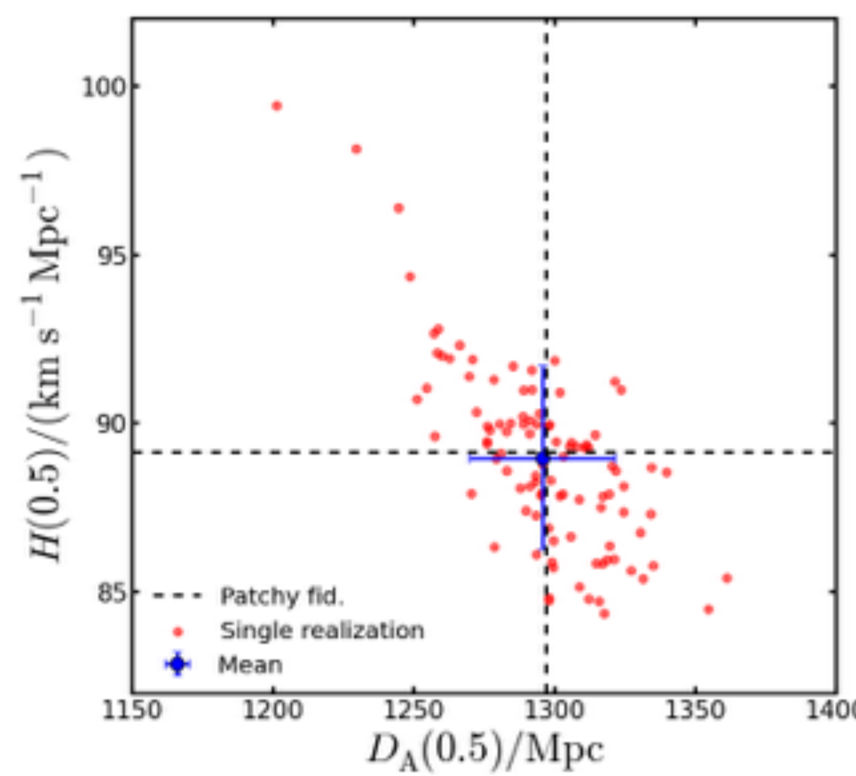

Planck ΛCDM
Planck
Planck + $\omega(\theta)$
w_a
w_0
1
0
−1
−2.0
−1.5
−1.0
−0.5

CLUSTERING TOMOGRAPHY ON BOSS-DR12

Test of model (gRPT+bias+RSD) against mocks.







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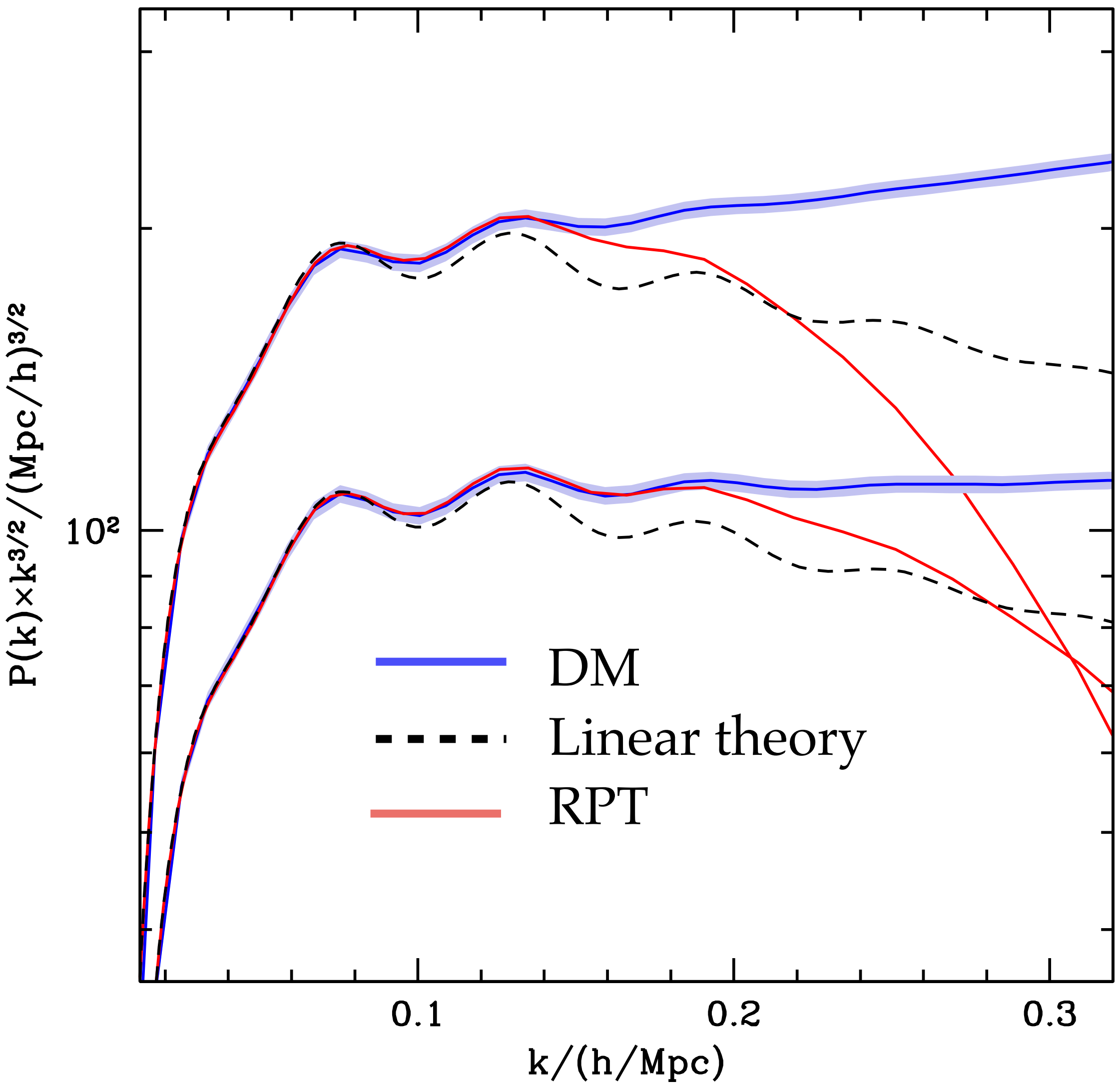
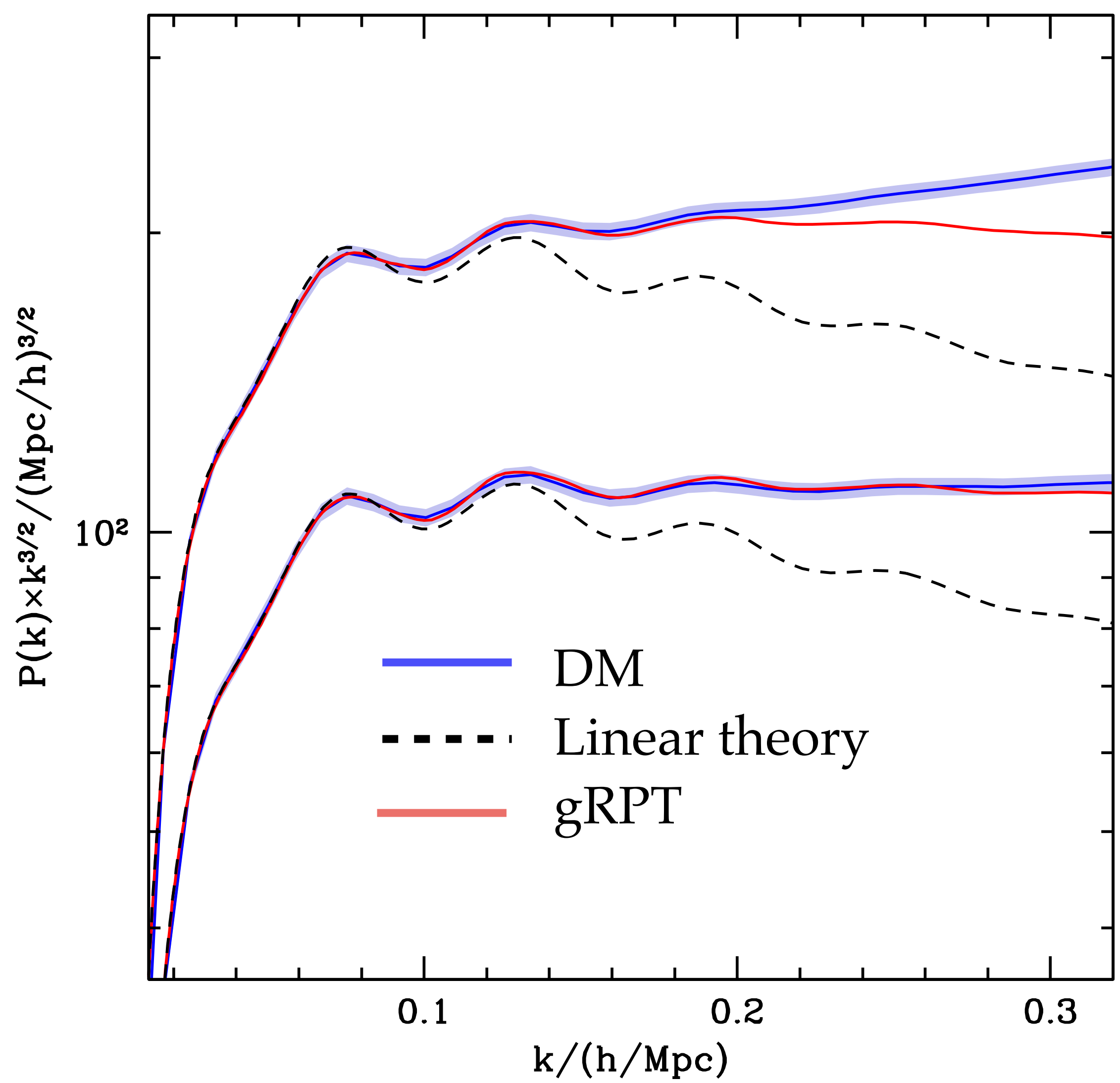


Ariel Sanchez' talk



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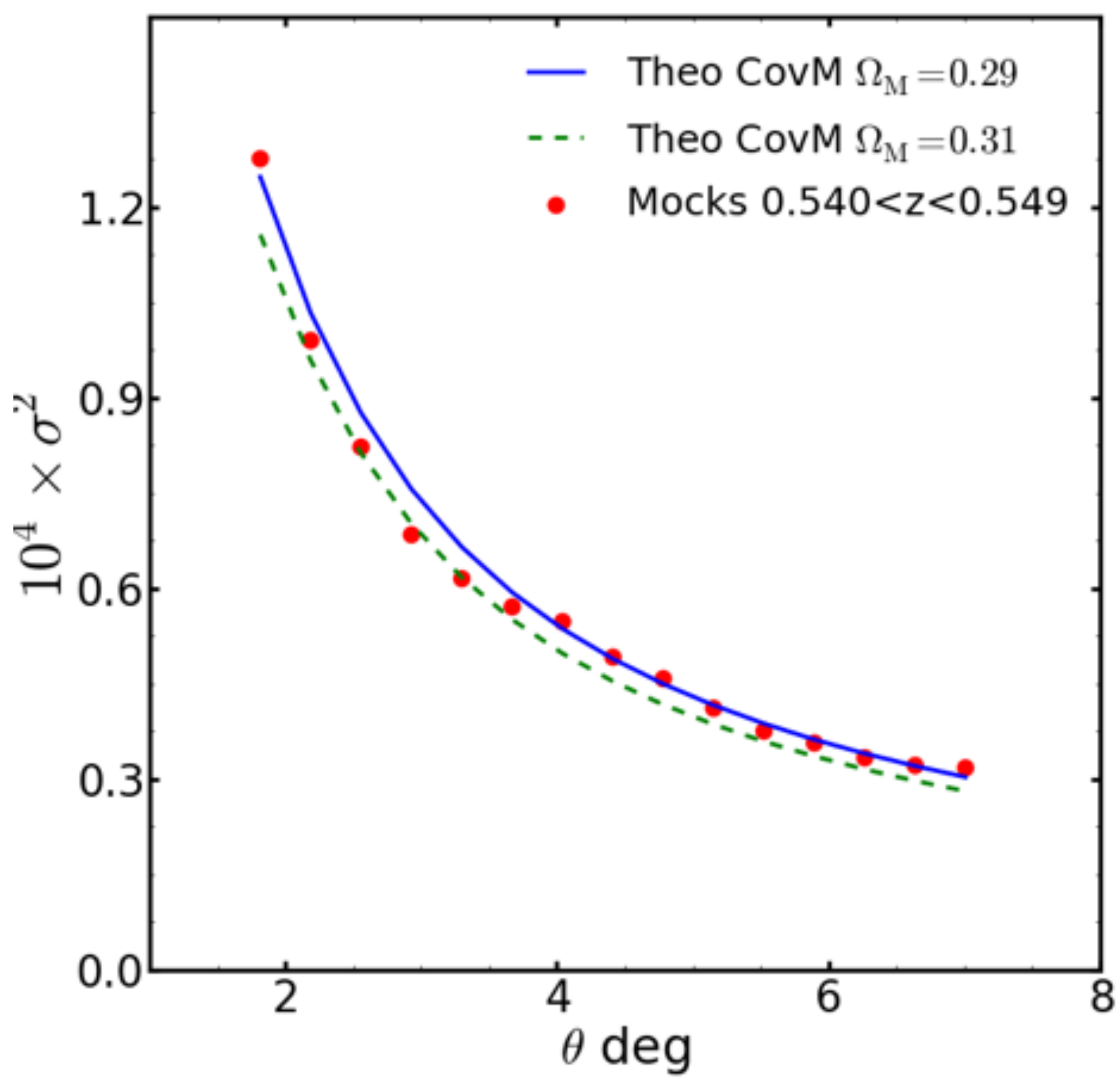
Theo CovM $\Omega_M = 0.29$
Theo CovM $\Omega_M = 0.31$
Mocks 0.540<z<0.549
1.2
0.9
0.6
0.3
0.0
$10^4 \times \sigma^2$
2
4
6
8
θ deg