



# Clustering of the eBOSS quasar sample in Fourier space

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PhD student

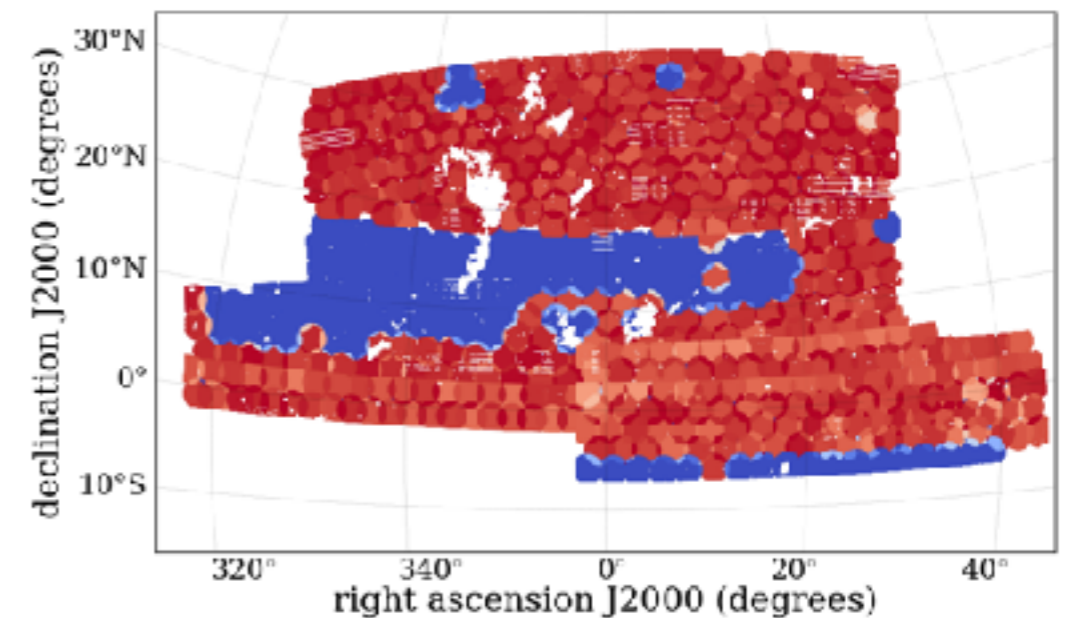
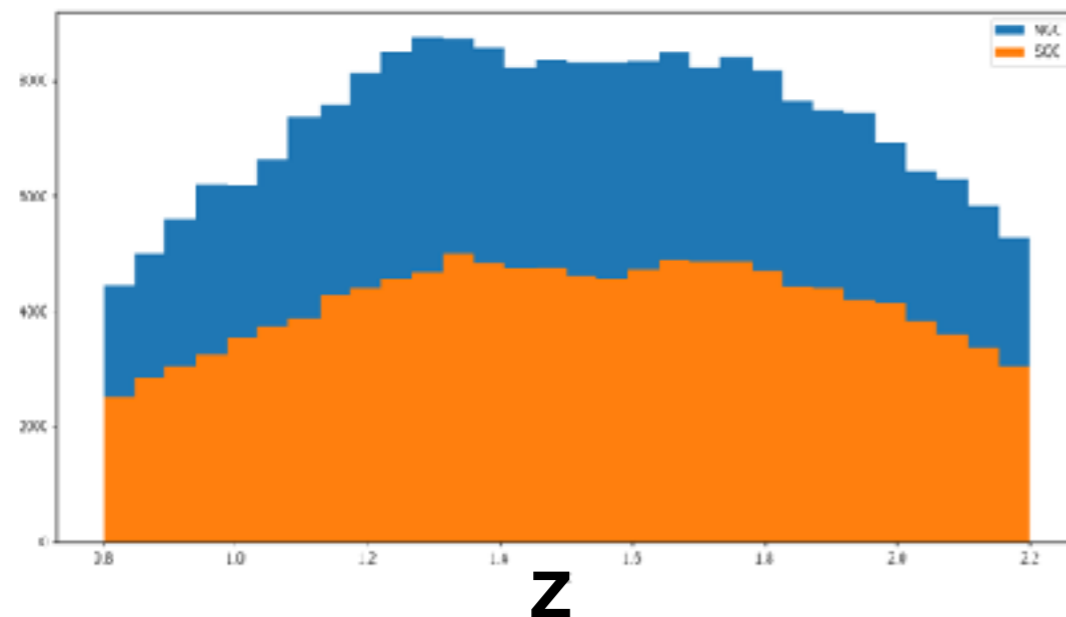
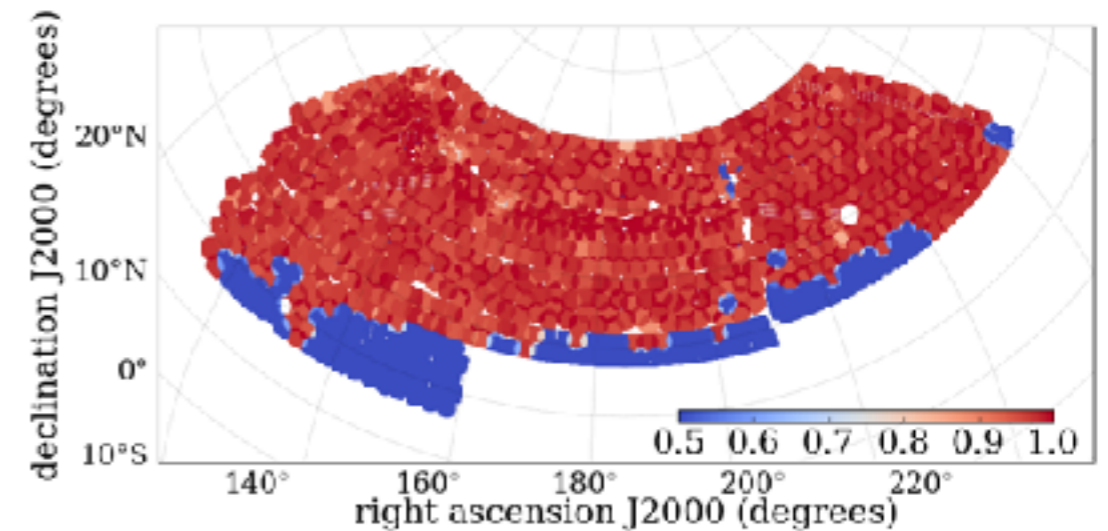
eBOSS/DESI meeting  
Saclay - April 7, 2019

# Data v5

- Mean  $N(z)$   $[h/\text{Mpc}]^3 \sim 1.74 \cdot 10^{-5}$  (NGC) &  $1.58 \cdot 10^{-5}$  (SGC)
- Mean redshift  $\sim 1.52$

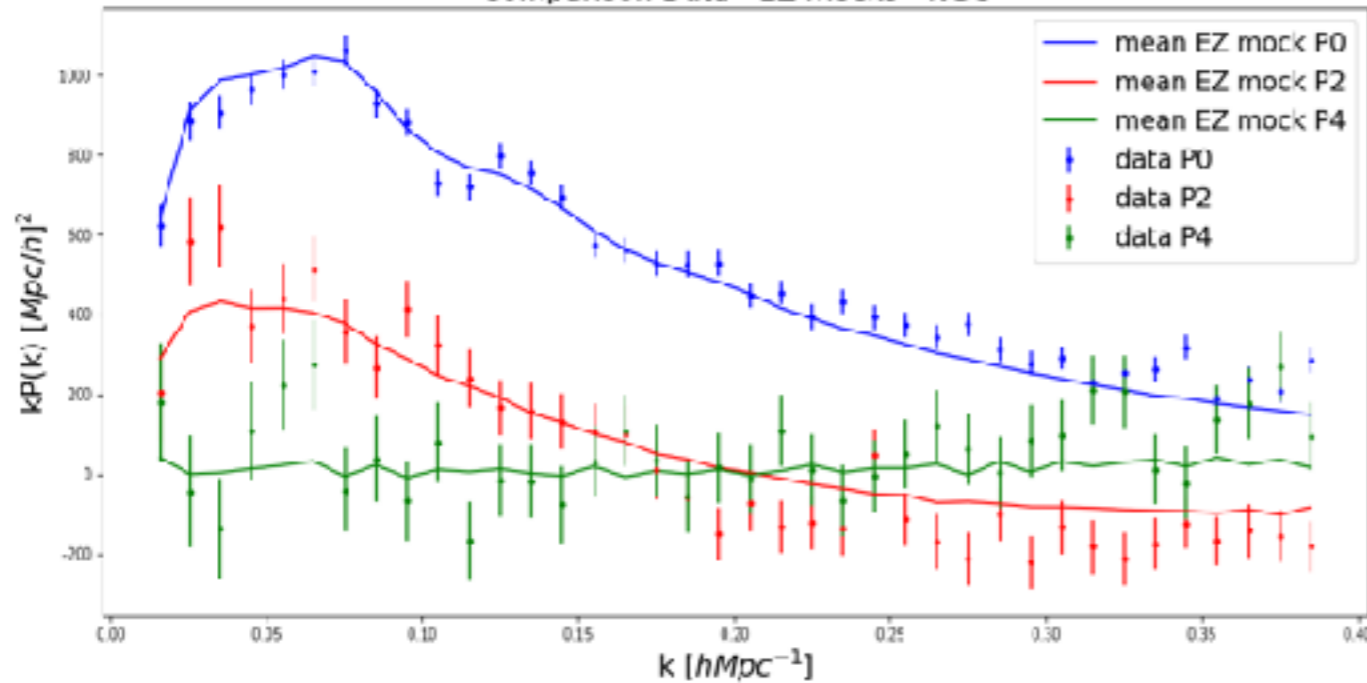
Survey area [deg<sup>2</sup>]

	NGC	SGC	Total
<b>DR14</b>	1214.6	898.3	2212.9
<b>DR16</b>	2843.5	1825.2	4668.7



# Data v5

Comparison Data - EZ mocks - NGC

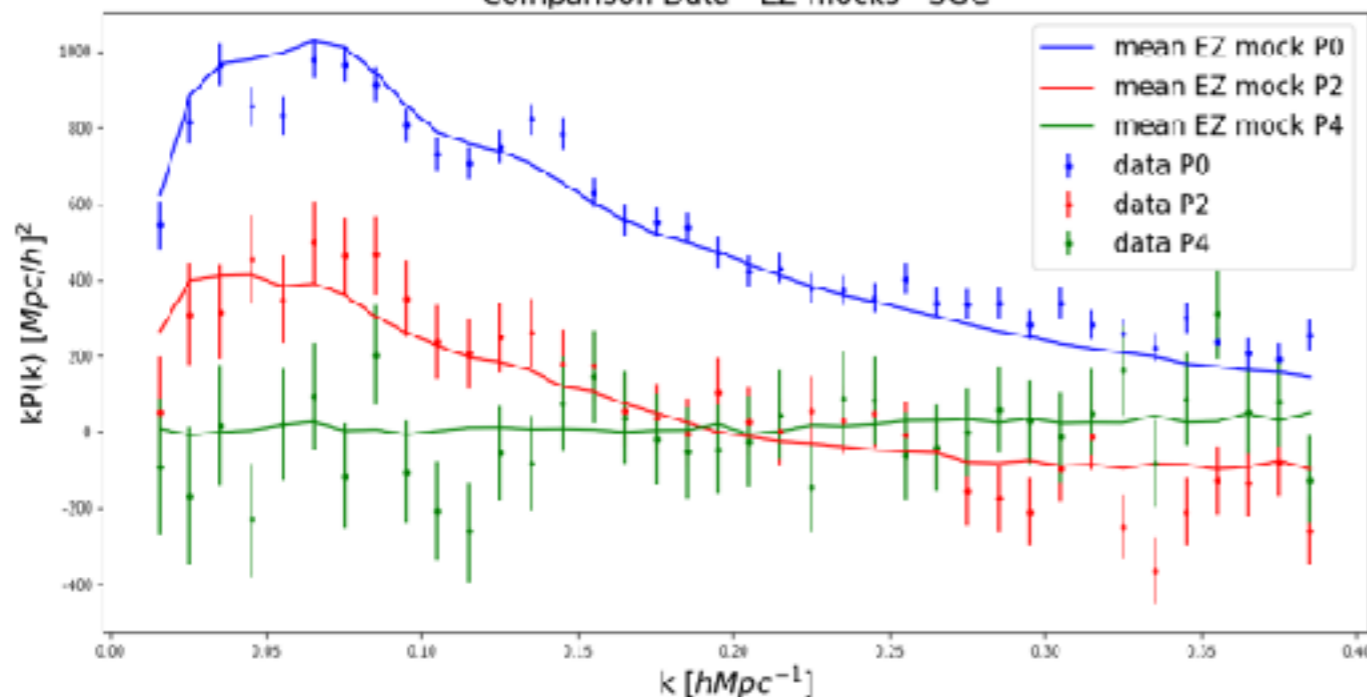


- BAO analysis :  
Fit with k-range = [0.02,0.23]

- Full shape analysis :  
Fit with k-range = [0.02,0.3]

- Data are in agreement with EZ mocks on BAO analysis k-range, small differences above  $k=0.25$  h/Mpc

Comparison Data - EZ mocks - SGC



# BAO analysis

- Wiggle / No-wiggle technique
- Measurement of the isotropic alpha

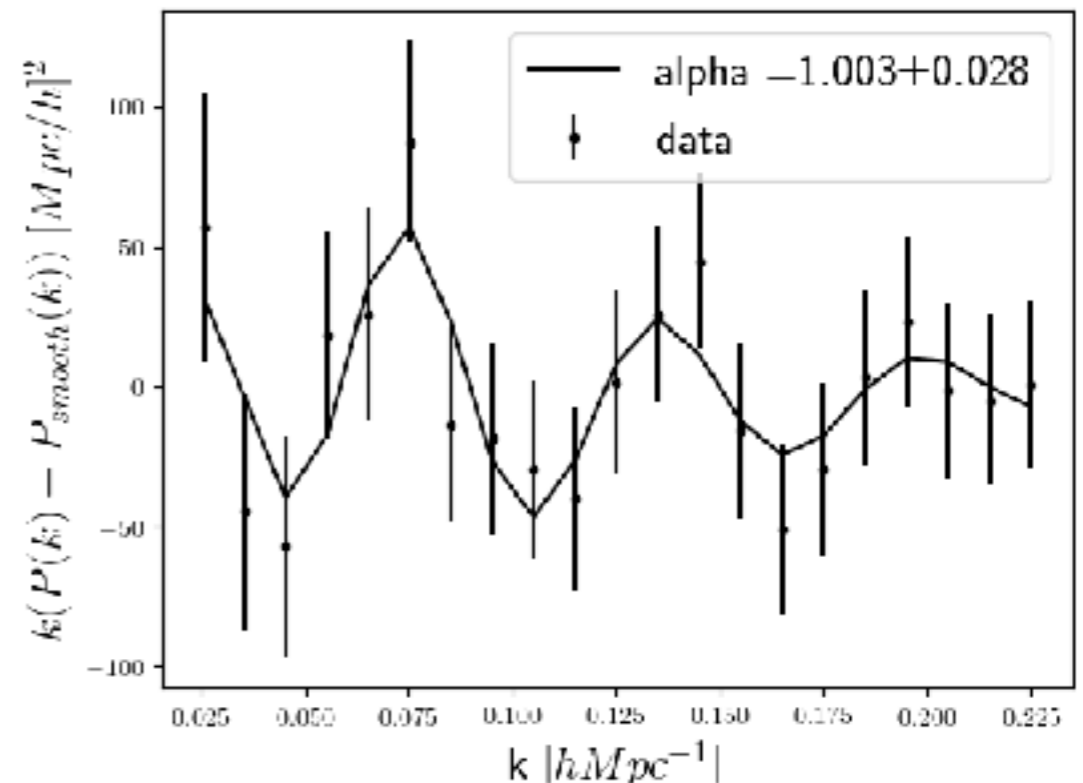
$$\alpha = \frac{D_V(z)r_d^{\text{fid}}}{D_V^{\text{fid}}(z)r_d}$$

$$P(k) = P_{sm} \left\{ 1 + [\mathcal{O}_{\text{lin}}(k/\alpha) - 1] e^{-1/2 \Sigma_{\text{nl}}^2 k^2} \right\}$$

$$P_{sm}(k) = B^2 P_{\text{nw}}(k) + A_1 k + A_2 + A_3 k^{-1}$$

$$\mathcal{O}_{\text{lin}}(k/\alpha) = P_{\text{lin}} / P_{\text{nw}}$$

Example of the fit on one EZ mock



# Full shape analysis

- TNS Model implemented by Arnaud de Mattia
- Window function treatment (Wilson et al. 2016)
- Anisotropic case

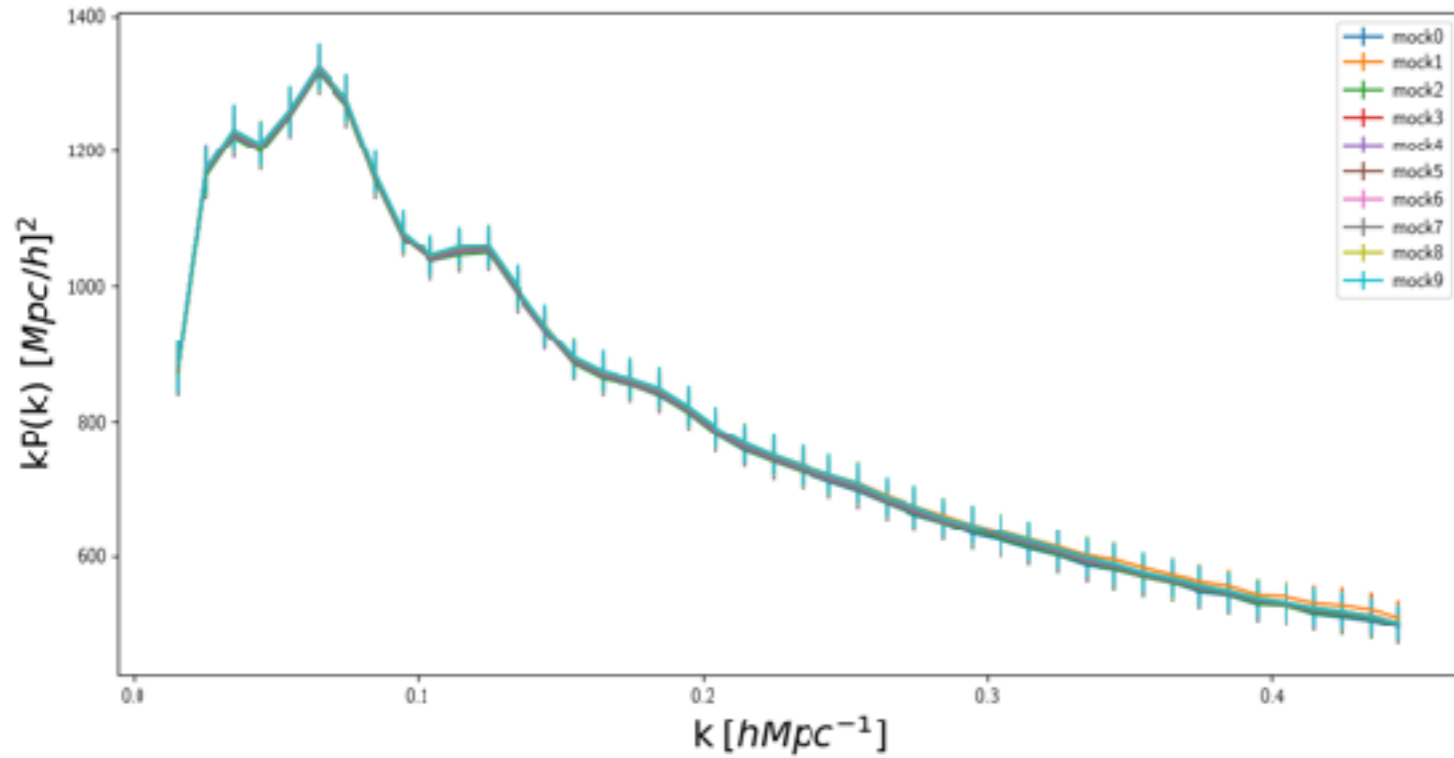
$$\alpha_{\perp} = \frac{D_A(z)r_s^{\text{fid}}}{D_A^{\text{fid}}(z)r_s} \quad \alpha_{\parallel} = \frac{H^{\text{fid}}(z)r_s^{\text{fid}}}{H(z)r_s} \quad f(z) \simeq (\Omega_m(z))^{\gamma}$$

# Analysis of the quasar OuterRim mocks - periodic power spectrum

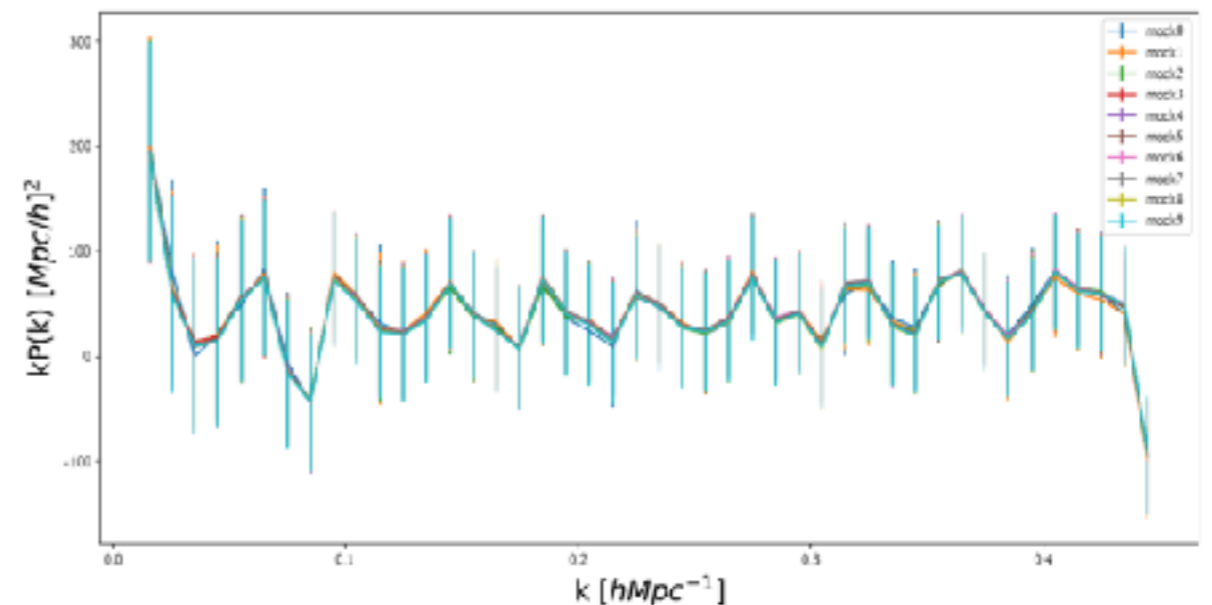
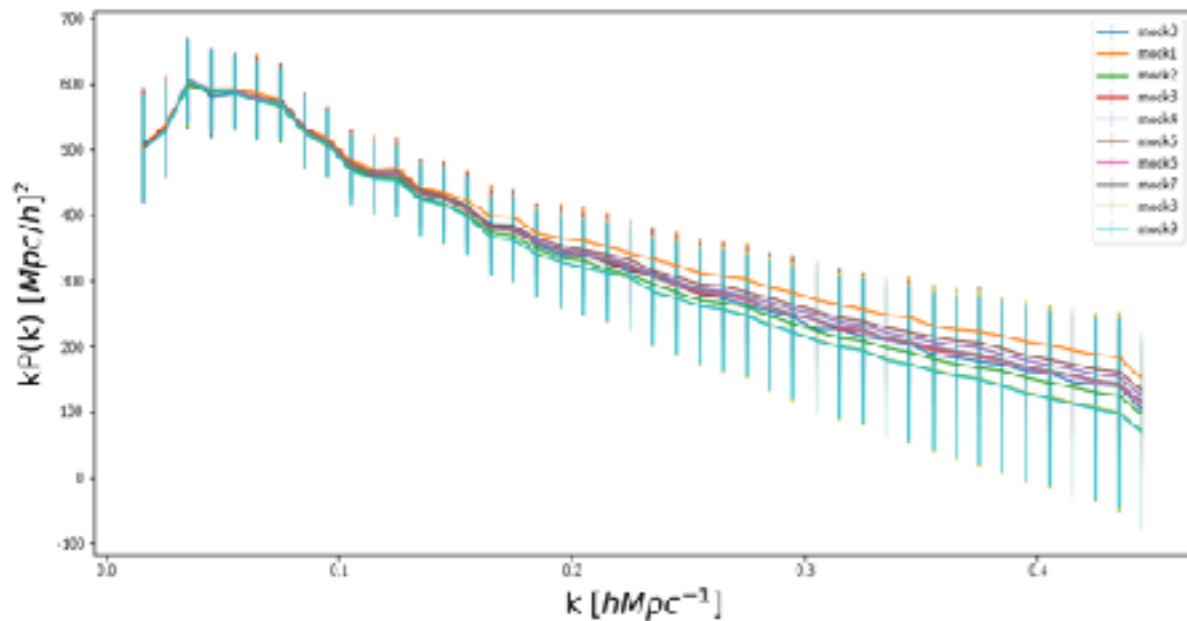
- 1 snapshot of the OuterRim box ( $L=3\text{Gpc}$ ,  $z=1.433$ ) with different HODs implemented by Alex Smith
- Periodic power spectrum
- Gaussian covariance matrix

	Mock0	Mock1	Mock2	Mock3	Mock4	Mock5	Mock6	Mock7	Mock8	Mock9
HOD	Smooth Step + PL	Gaussian	Top hat + PL	Gaussian + PL	Smooth Step + PL	Sharp Step + PL	Gaussian + PL	Top hat + PL	Gaussian	Sharp Step + PL
Satellites positions	Particles	NFW	NFW	Particles	NFW	NFW	NFW	Particles	NFW	NFW
Satellites %	19 %	7 %	60 %	21 %	8 %	17 %	56 %	24 %	100 %	42 %

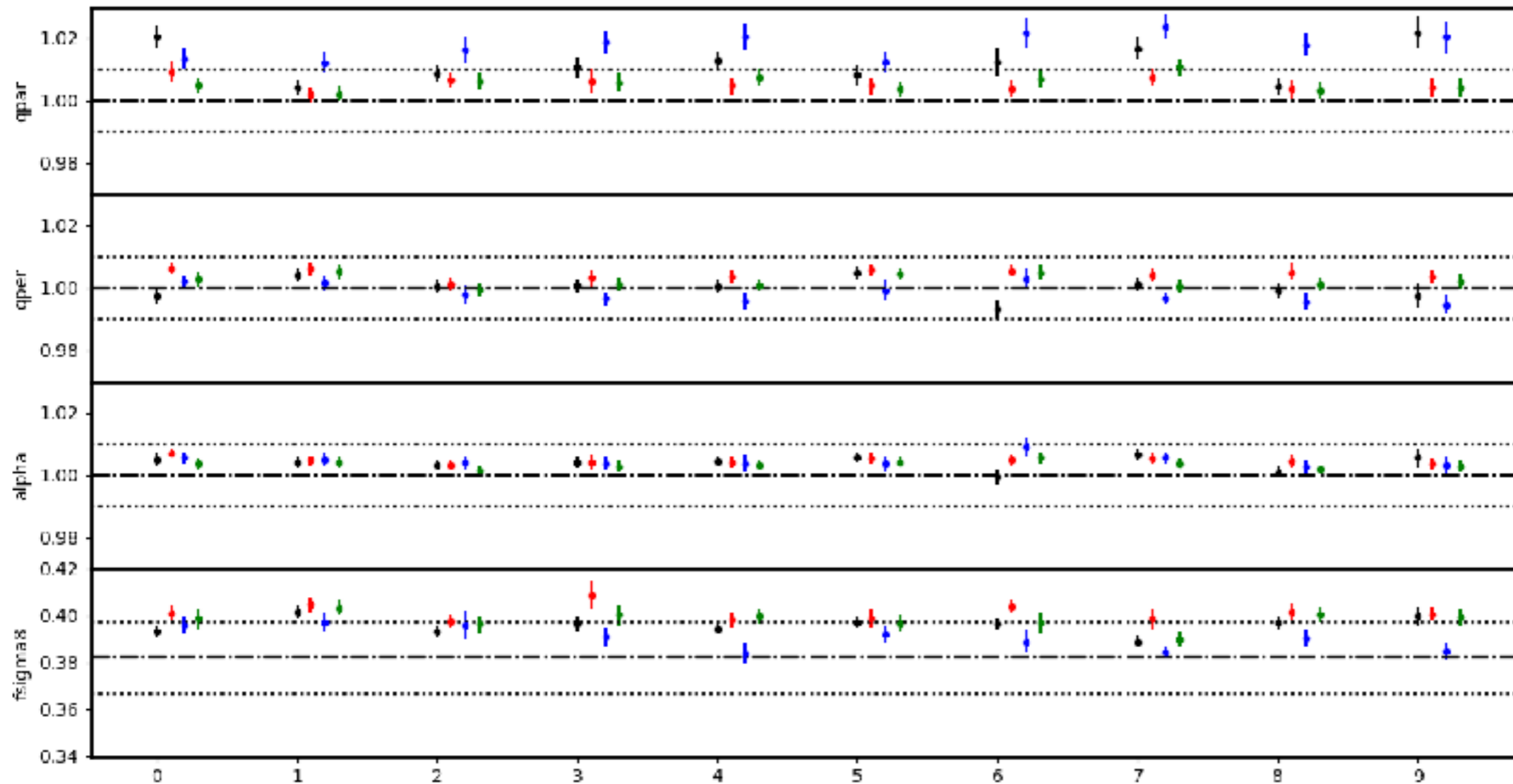
# Analysis of the quasar OuterRim mocks - periodic power spectrum



- Power spectrum in the no smearing case with different HOD
- All are consistent, small differences on small scales as expected



# Analysis of the quasar OuterRim mocks - periodic power spectrum - Full shape



**kmin=0.02 kmax=0.3 (for l=0,2) 0.2 (for l=4) no Ag**

**kmin=0.02 kmax=0.3 (for l=0,2) 0.2 (for l=4)**

**kmin=0.02 kmax=0.3 (for l=0,2) no hexadecapole**

**kmin=0.05 kmax=0.3 (for l=0,2) 0.2 (for l=4)**

$$\alpha = \alpha_{\parallel}^{2/3} * \alpha_{\perp}^{1/3}$$

**Dotted lines : +/- 1% for alphas  
+/- 4% for f\*sigma8**

**DR16 errors :**

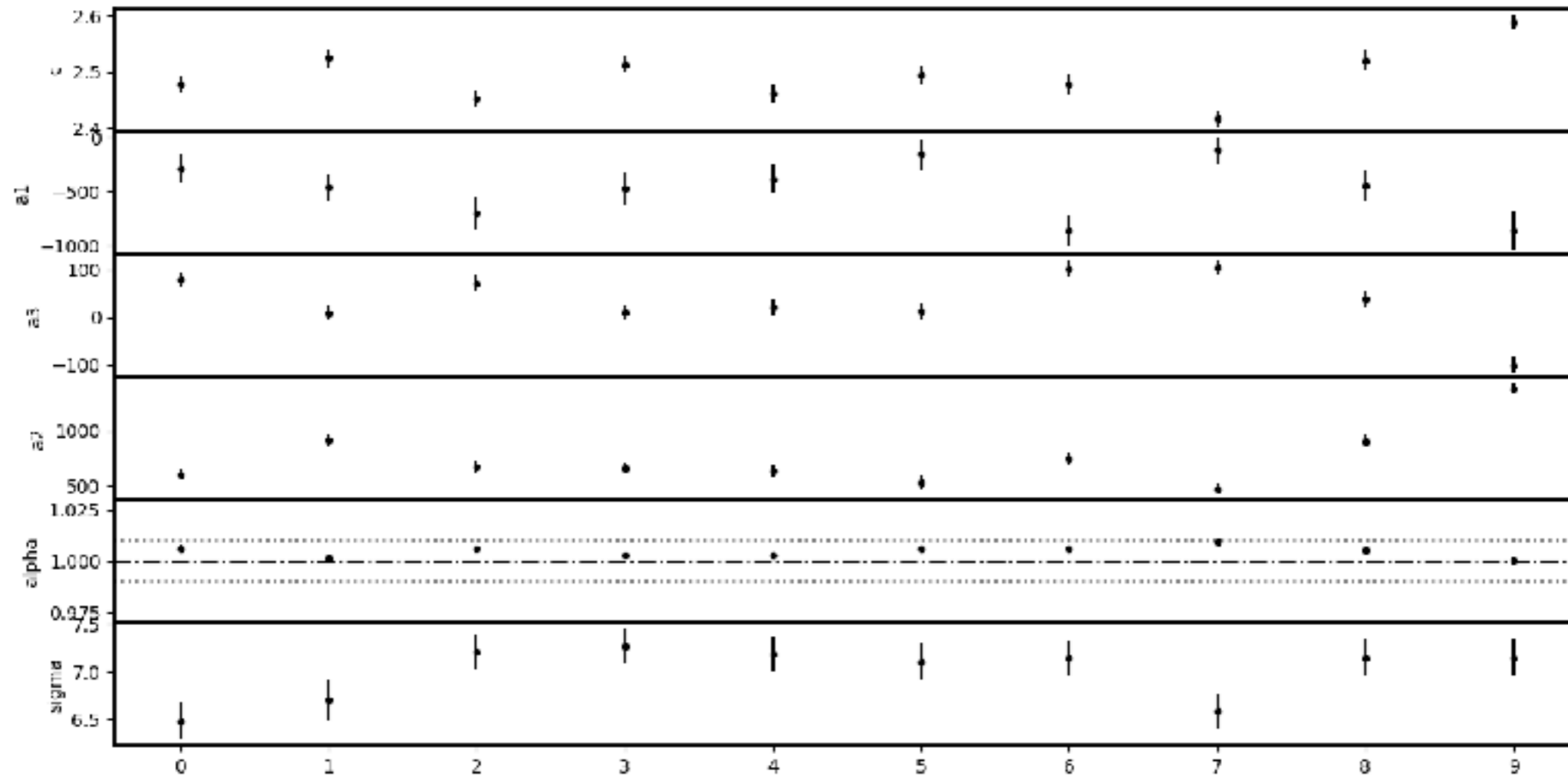
$\alpha_{\parallel} \sim 3-4\%$

$\alpha_{\perp} \sim 2.5\%$

**f\*sigma8 ~ 9%**



# Analysis of the quasar OuterRim mocks - periodic power spectrum - “BAO analysis”

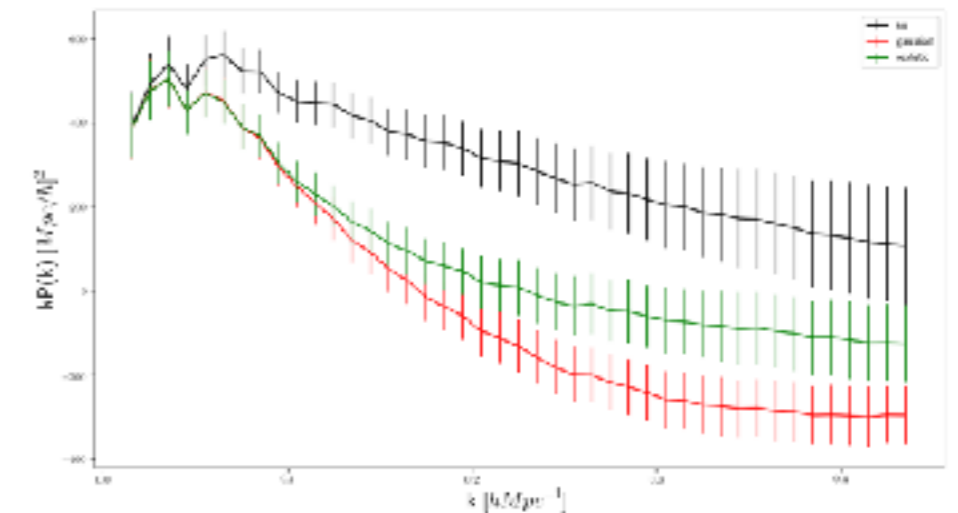
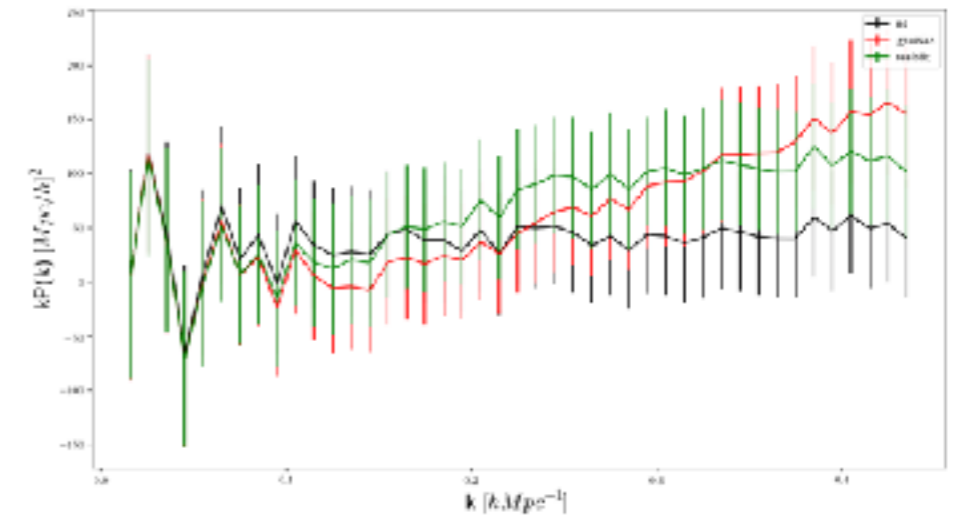
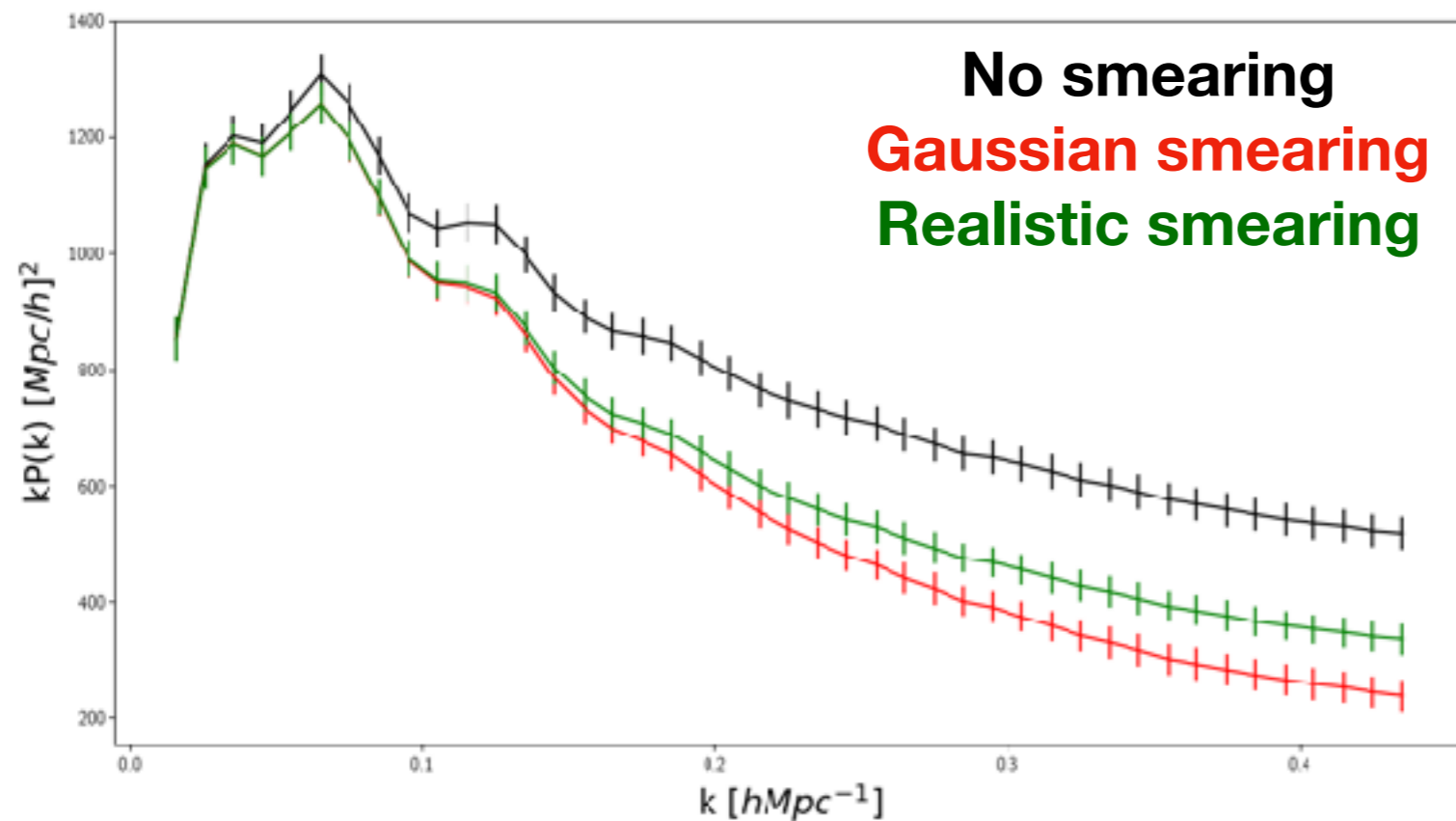


Alphas for all versions are within 0.8%

**Dotted lines : +/- 1% for alphas**  
**Data error :  $\alpha = 2\%$**

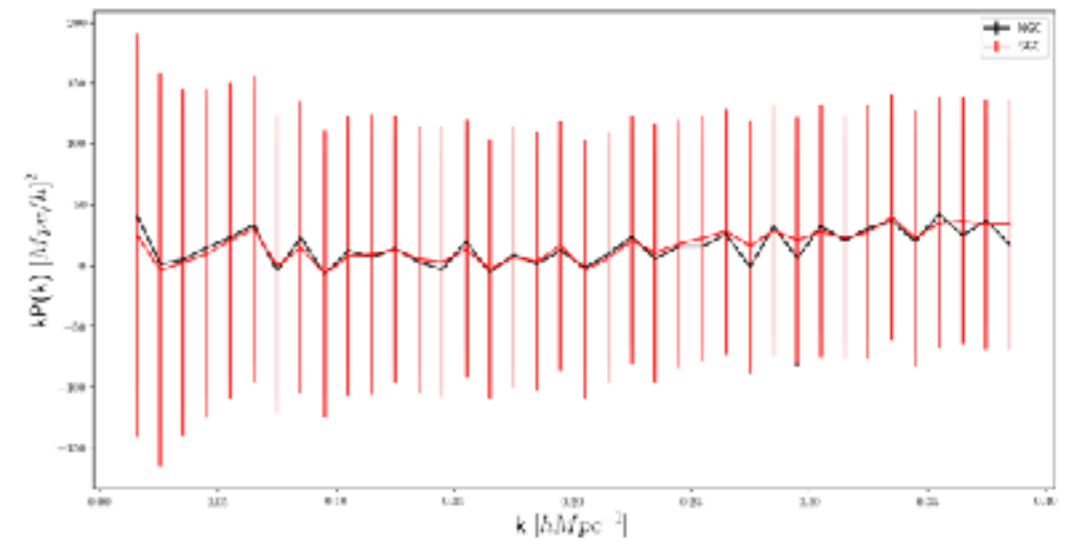
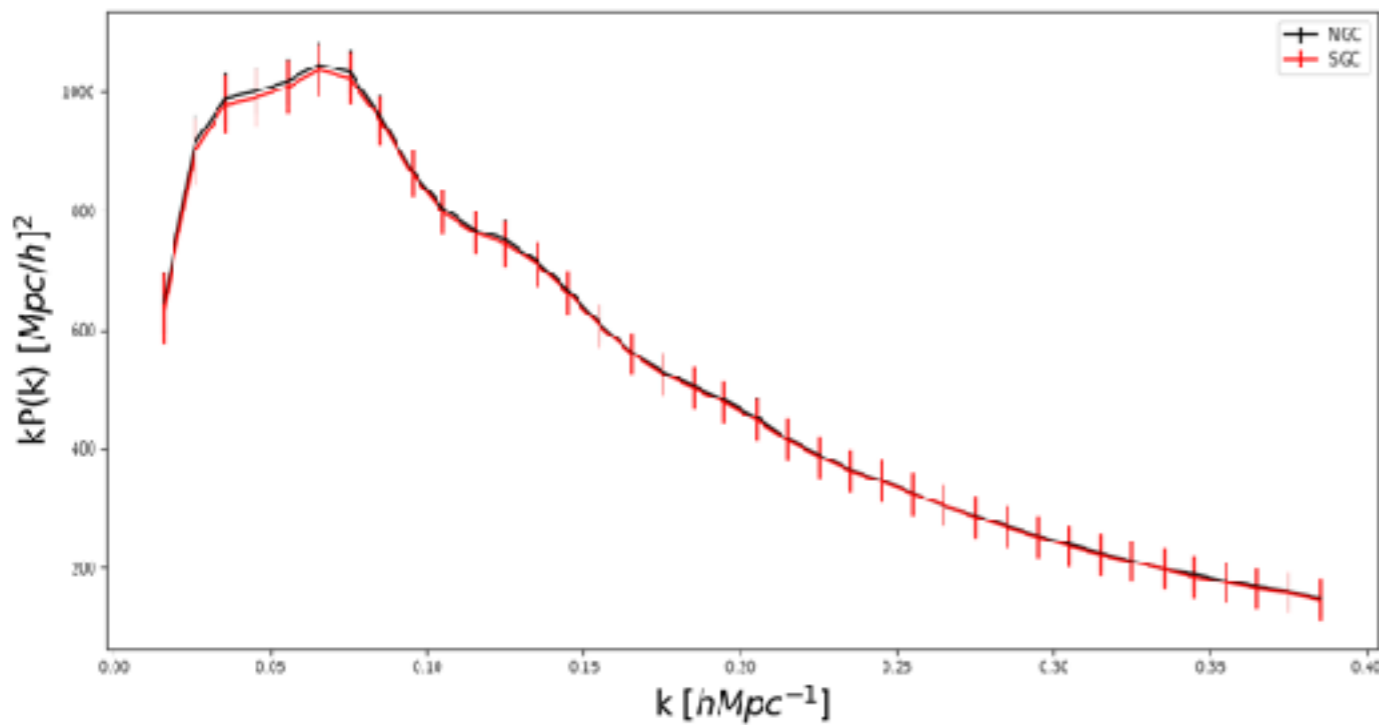
# OuterRim survey-like analysis

- RA, DEC, Z
- With window functions and wide angle corrections (Beutler et al. 2018)
- Covariance matrix from mocks
- Realistic smearing case : double gaussian

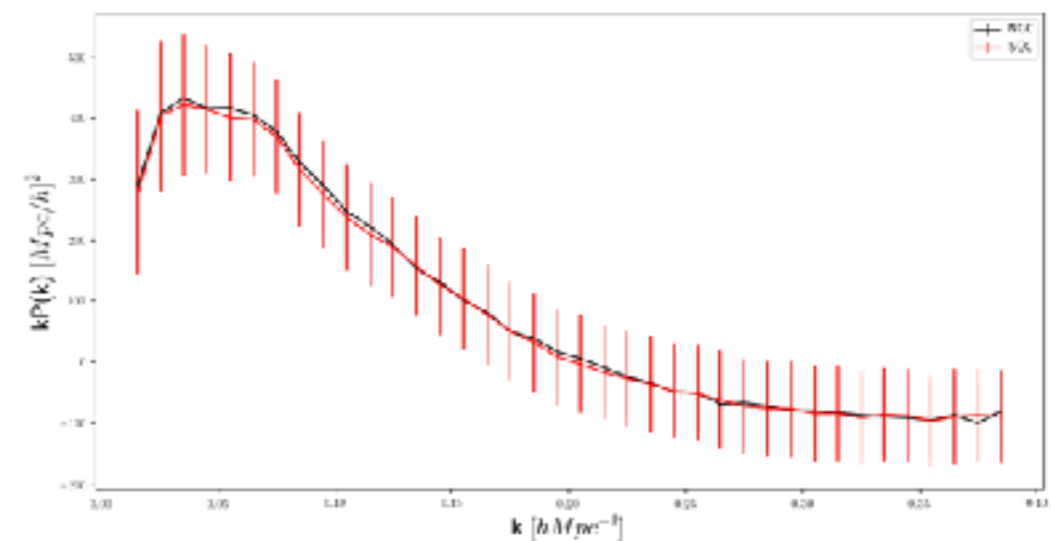


# EZ mocks

- 1000 EZ mocks with data v5 geometry



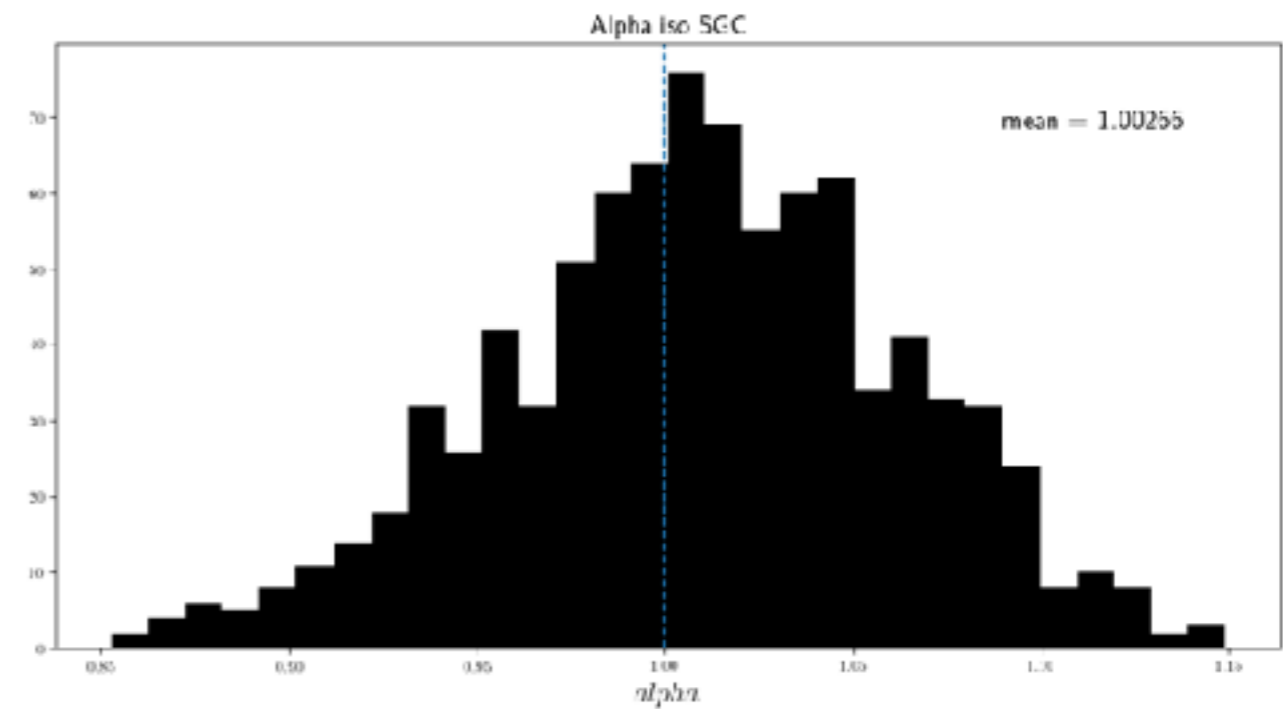
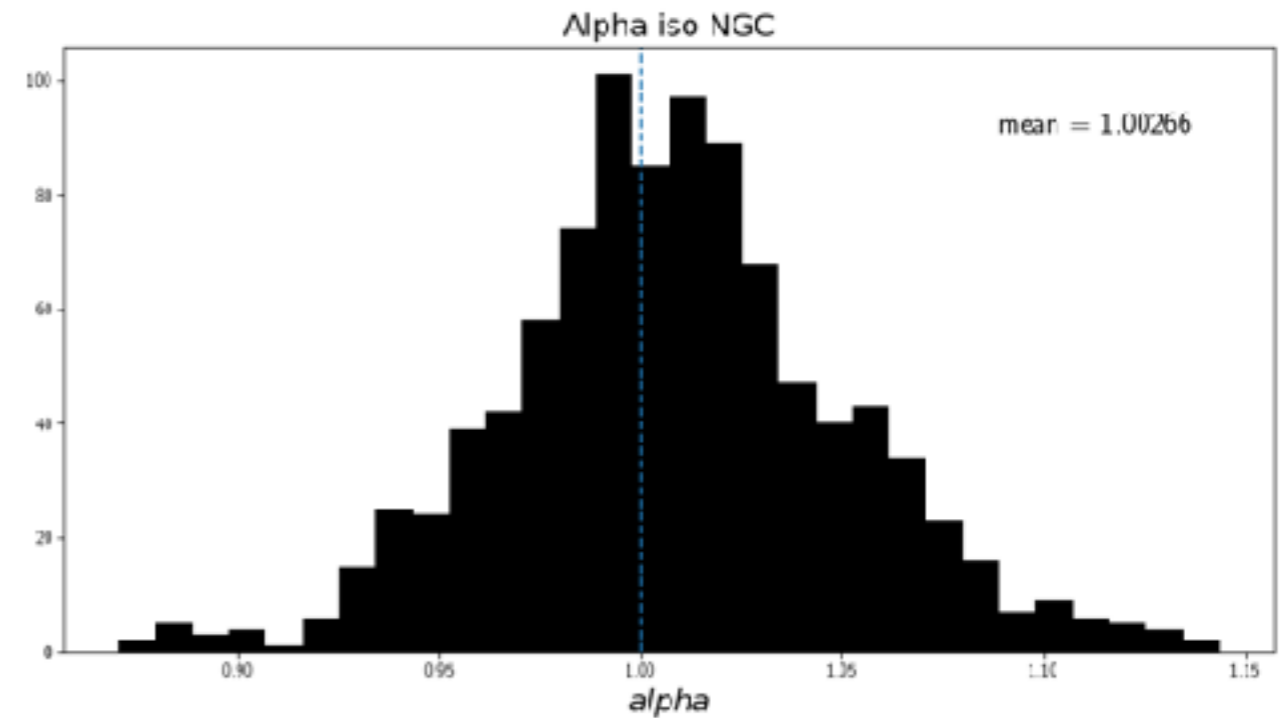
Mean of the NGC and SGC mocks are very similar



# EZ mocks - BAO

	NGC	SGC
Average $\alpha$	1.00822	1.00939
Average $\alpha$ weighted by $1/\text{error}^2$	1.00266	1.00266

Expected value  $\alpha = 1.00101$

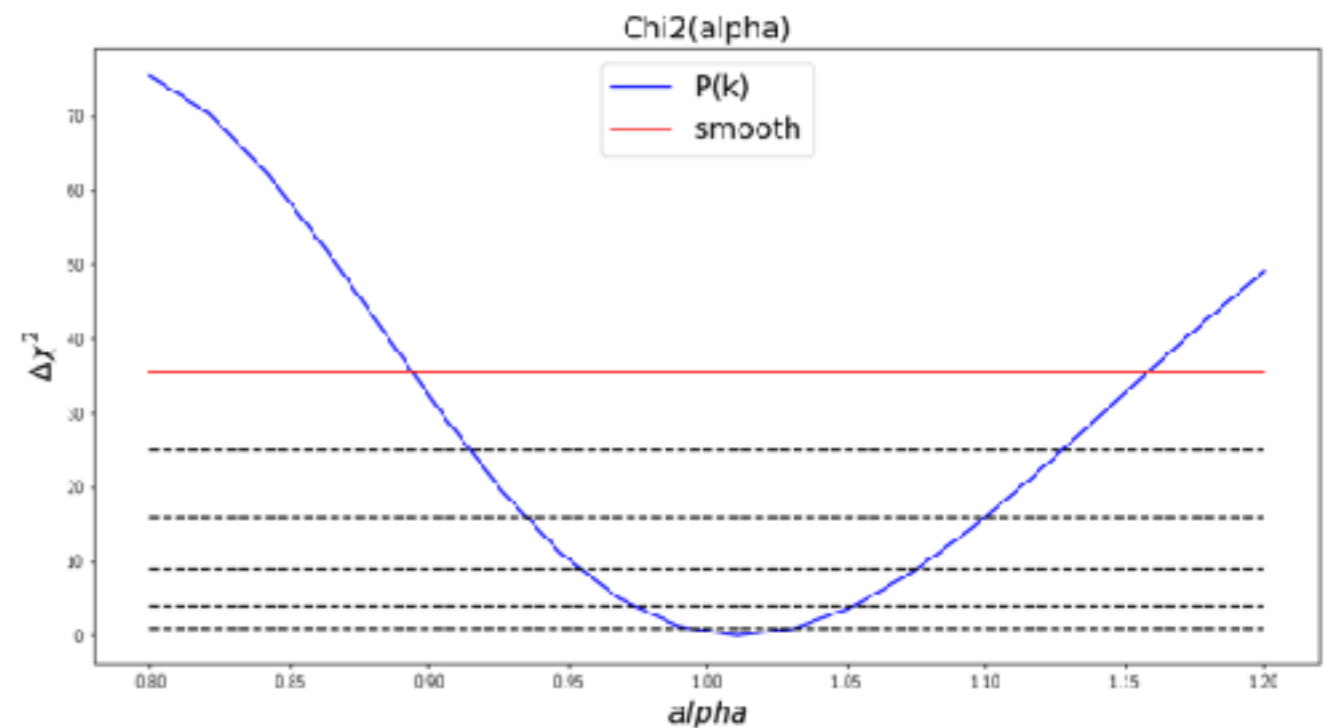
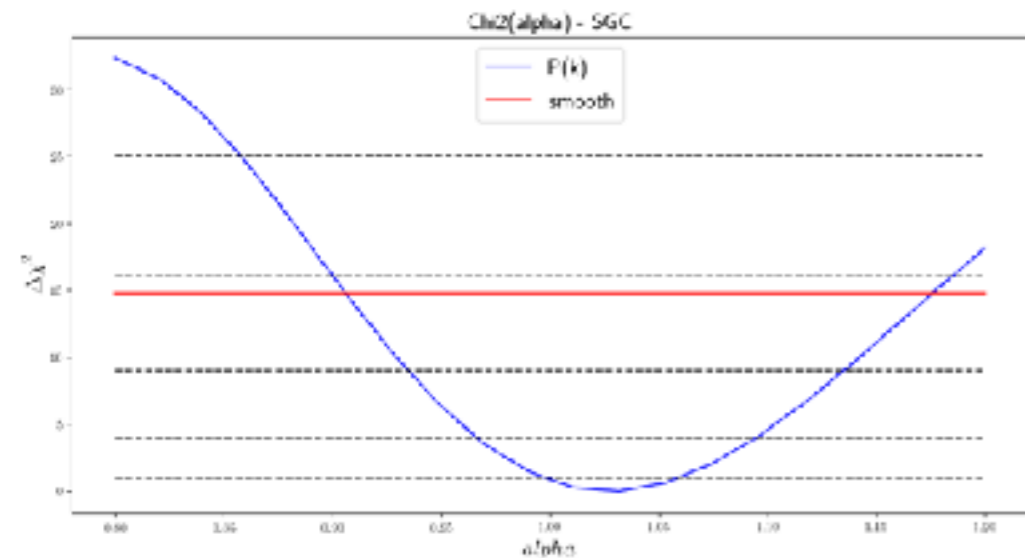
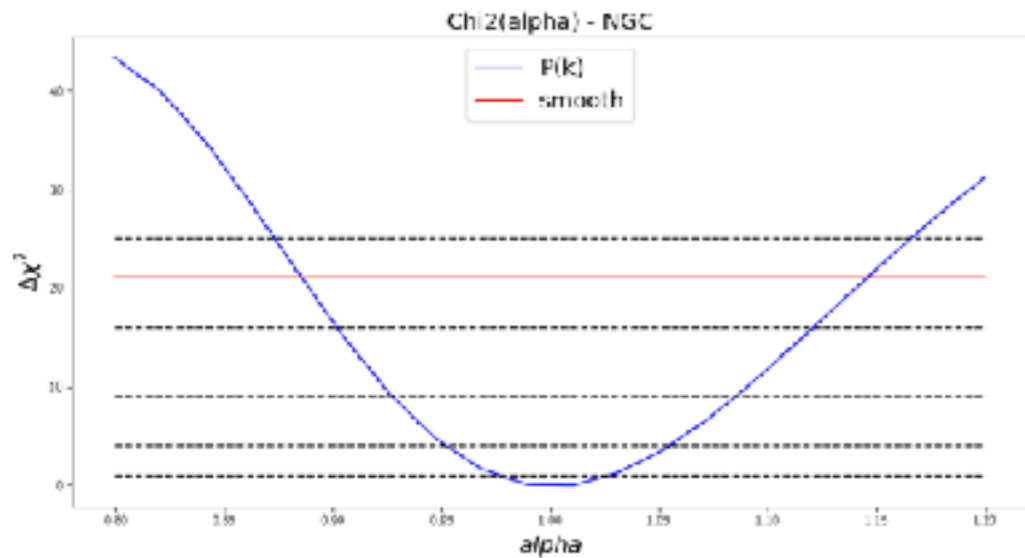


# Data v5 Errors

## Data errors

	BAO	Full shape		
	$\alpha_{iso}$	$f\sigma_8$	$\alpha_{par}$	$\alpha_{perp}$
DR14	0.040	0.064	0.062	0.052
DR16	~0.020	~0.034 (9%)	~0.031	~0.022

**Preliminary results**

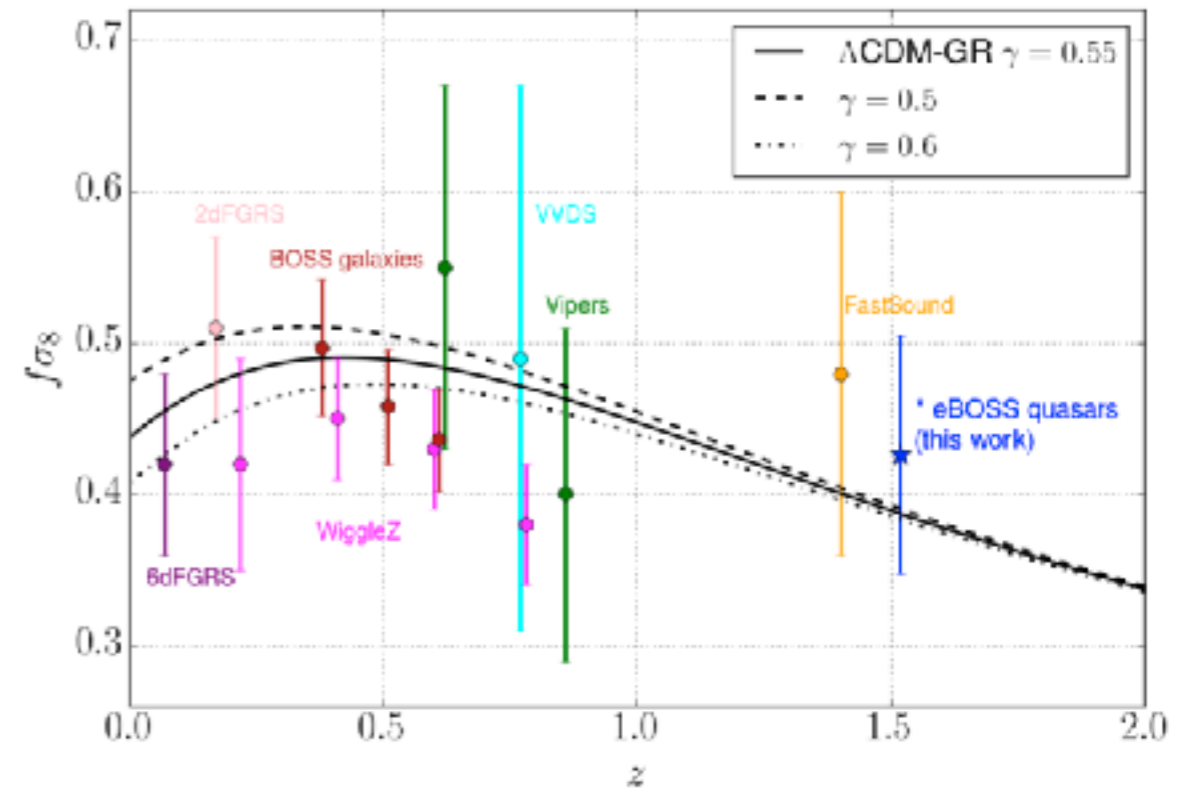
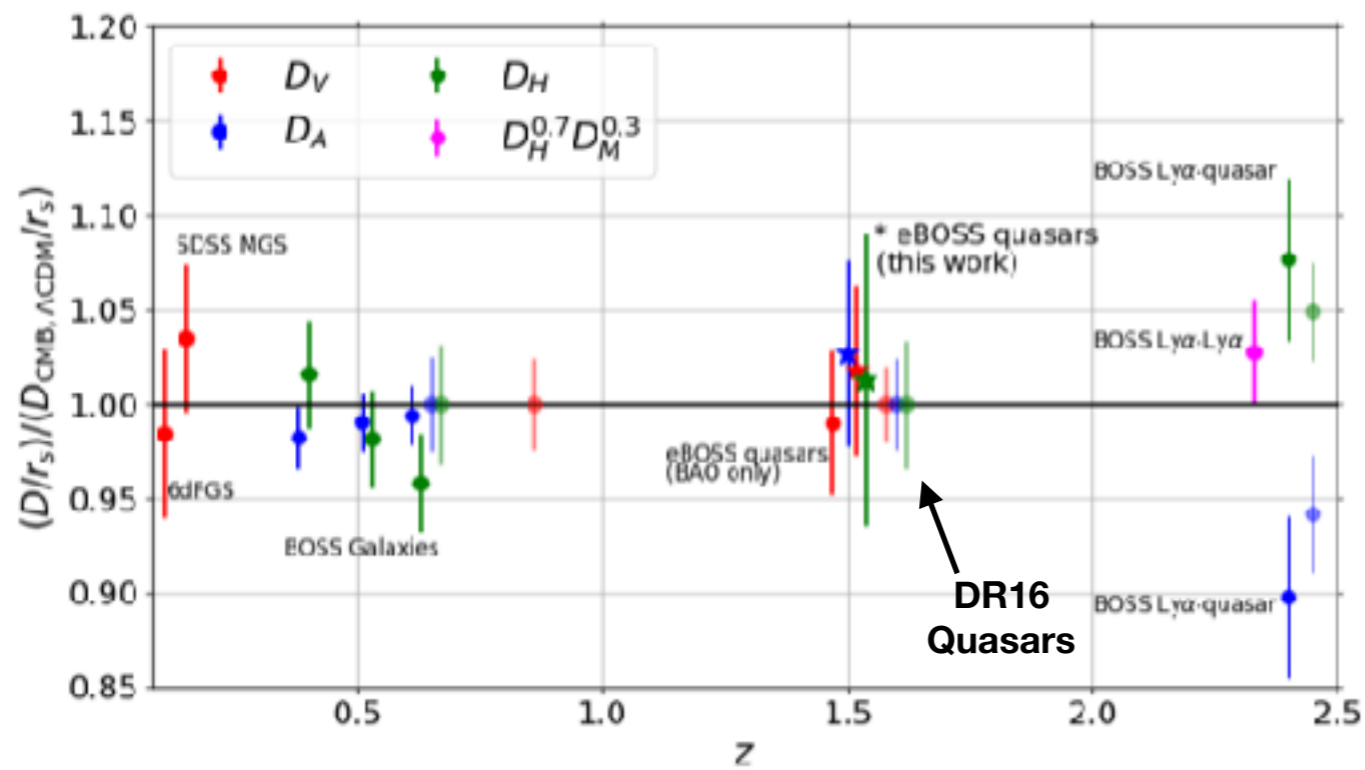


Dotted lines : sigma level

Chi2 scan

Chi2 value for fit without BAO wiggles

# Impact of eBOSS DR16 quasars



# Summary

- OuterRim mocks :
  - $\sim 0.7\%$  error on alphas for the full shape case with periodic power spectrum
  - 3-4% error on  $f\sigma_8$  with the periodic power spectrum
  - To do :
    - Study systematic shifts on  $f\sigma_8$
    - Analyse OuterRim with different smearing cases (gaussian and realistic)
- EZ mocks :
  - $\alpha_{\text{iso}}$  shift  $< 0.3\%$  for BAO analysis
  - To do :
    - Work on the full shape analysis
- Data :
  - BAO errors:  $\sigma_\alpha \sim 0.02$
  - Full shape errors:  $\sigma_{f\sigma_8} \sim 0.034$   $\sigma_{\alpha_{\parallel}} \sim 0.031$   $\sigma_{\alpha_{\perp}} \sim 0.022$