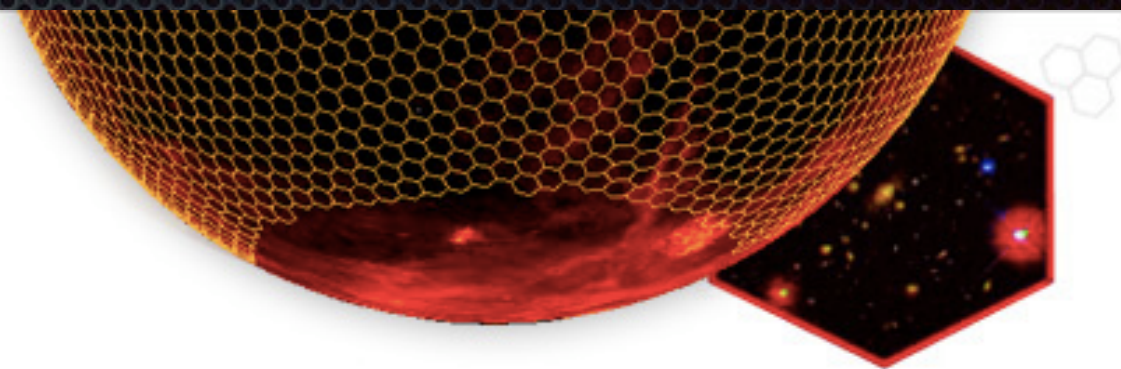


# Clustering in the LSS Benchmark sample

**Javier Sánchez on behalf of 2 pt SWG:** M. Crocce, A. Bauer, R. Cawthon, P. Fosalba, E. Gaztañaga, T. Giannantonio, B. Leistedt, R. Miquel, A. Ross, C. Sánchez, E. Sánchez, I. Sevilla, F.Sobreira++  
**CIEMAT, Madrid, Spain**  
**FNAL**



THE DARK ENERGY SURVEY





# Outline

- ✦ The Benchmark galaxy sample
- ✦ Photo-z
- ✦ Star galaxy separation
- ✦ Other spatial varying systematics
- ✦ Clustering results
- ✦ Evaluation of the systematics
- ✦ Cosmological results
- ✦ Conclusions



# Benchmark sample

SPTe objects:

DEC > -61 DEG (REMOVE LMC)

MAG MODEL (CRAZY COLORS):

$0 < g - r < 3$

$0 < r - i < 2$

$0 < i - z < 3$

MAG AUTO I < 22.5 (COMPLETENESS CUT)

MAGLIM\_AUTO\_I > 22.5 (COMPLETENESS CUT)

FRACDET > 0.8

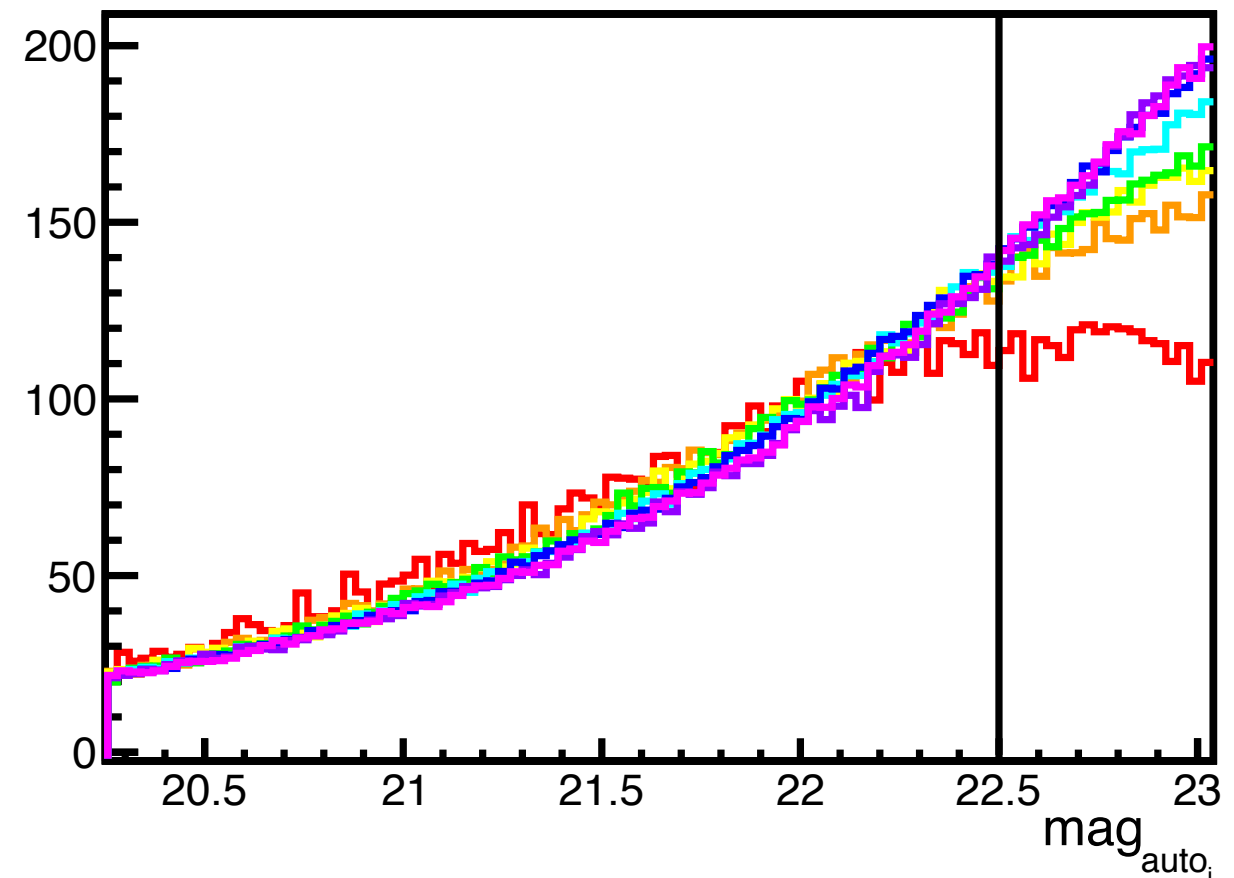
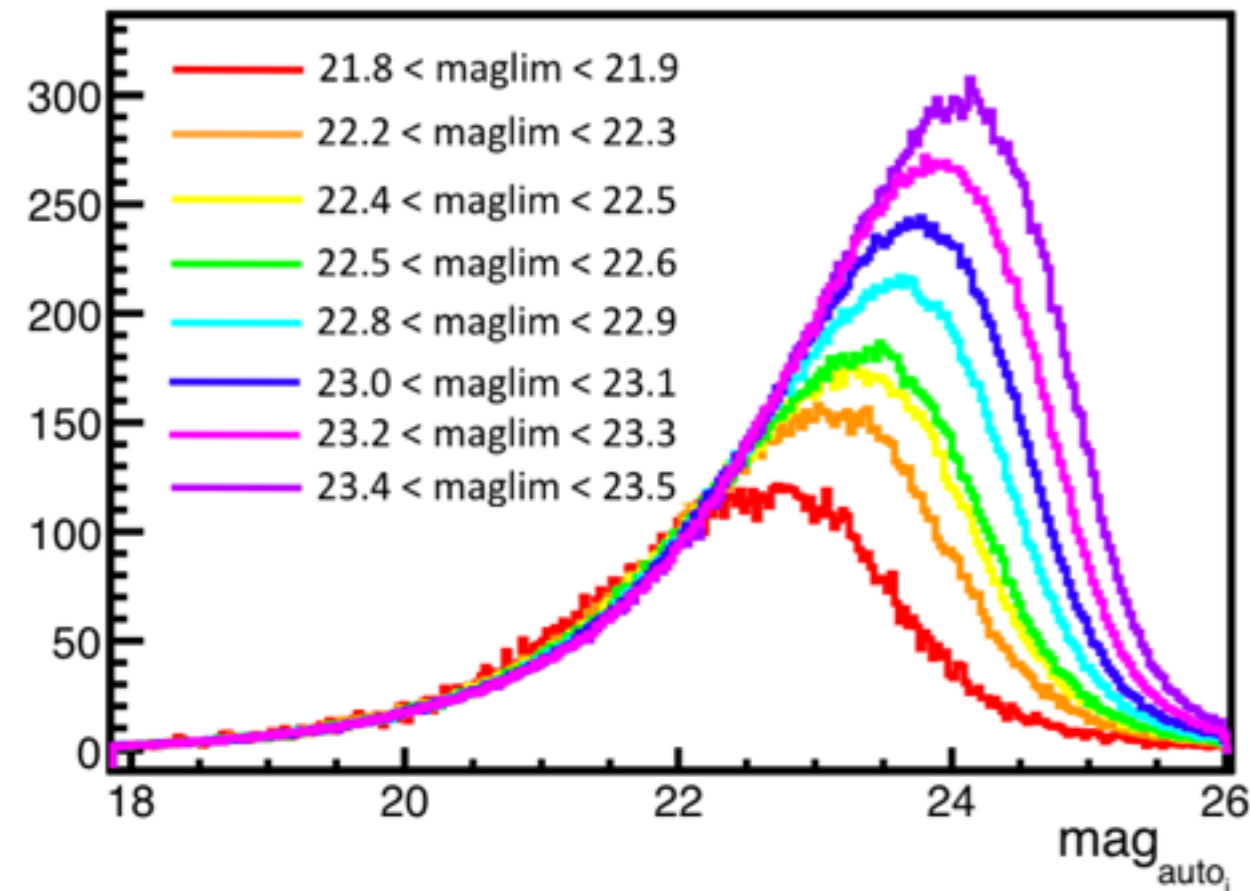
4 Million objects.

Used for different analyses:

CMB x LSS

Counts in Cells

Weak Lensing x Galaxies



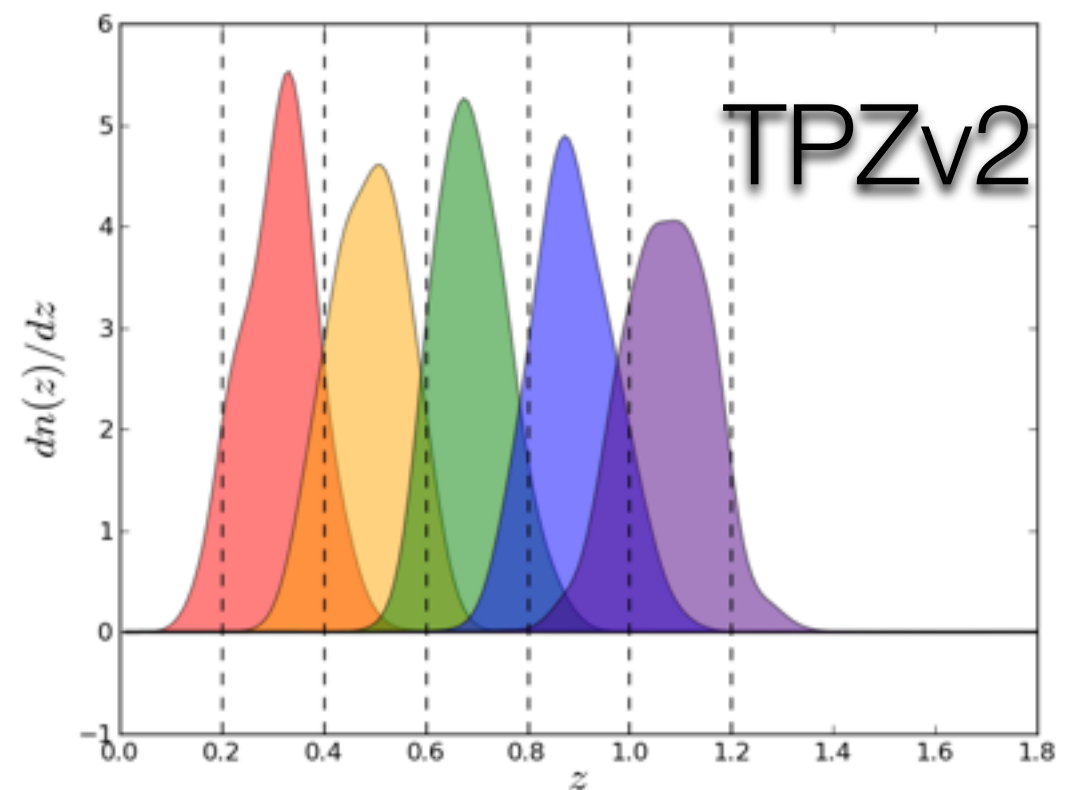
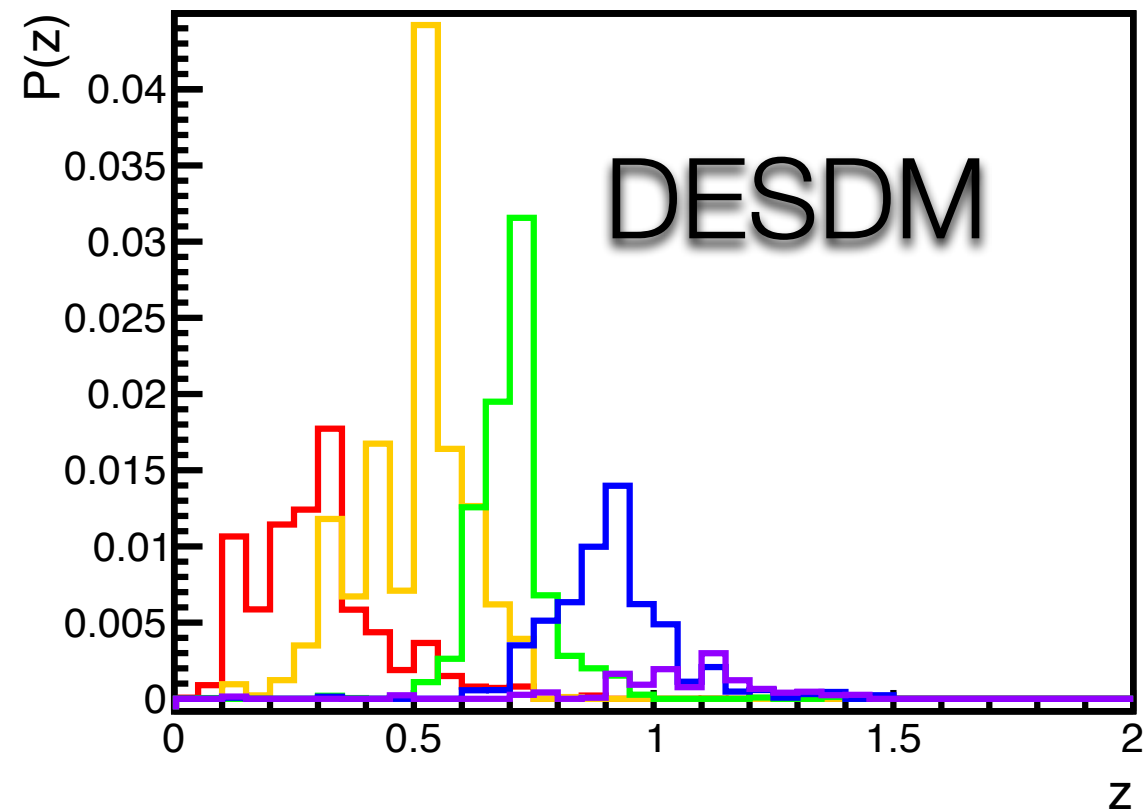


# Photo-z

5 photo-z bins from 0.2 to 1.2 with 0.2 bin width.

Different Photo-z codes used:

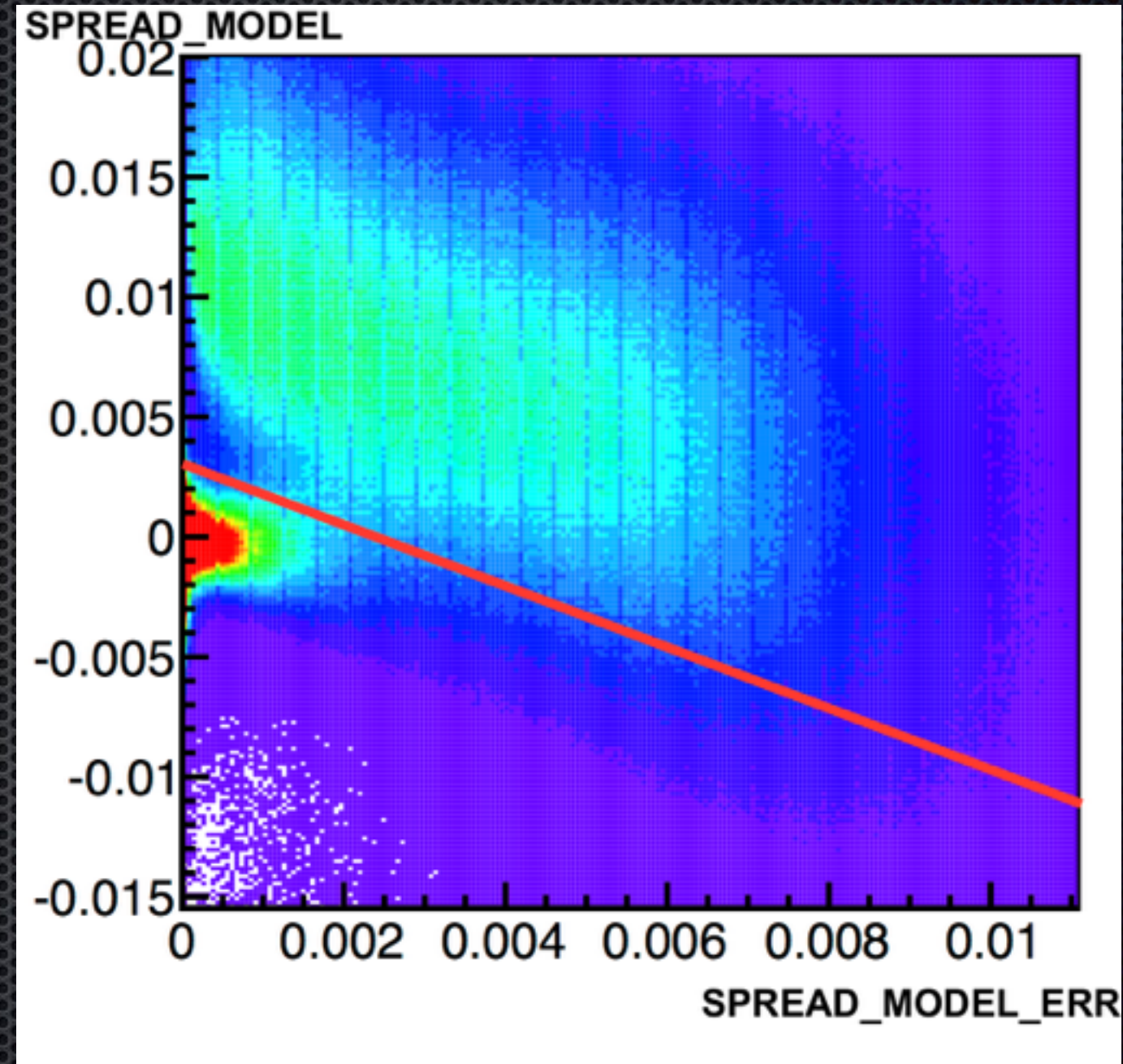
- DESDM: Highly correlated with systematics
- TPZ: Less sensitive to systematics
  - 2 different calibration runs





# Star galaxy separation

- Star Galaxy separation with 2 different techniques:
  - MODEST\_CLASS
    - 1 Galaxy
    - 2 Star
  - TPZsg CLASS:
    - $TPZsg < 0.14$  (Gal)
    - $TPZsg > 0.9$  (Star)



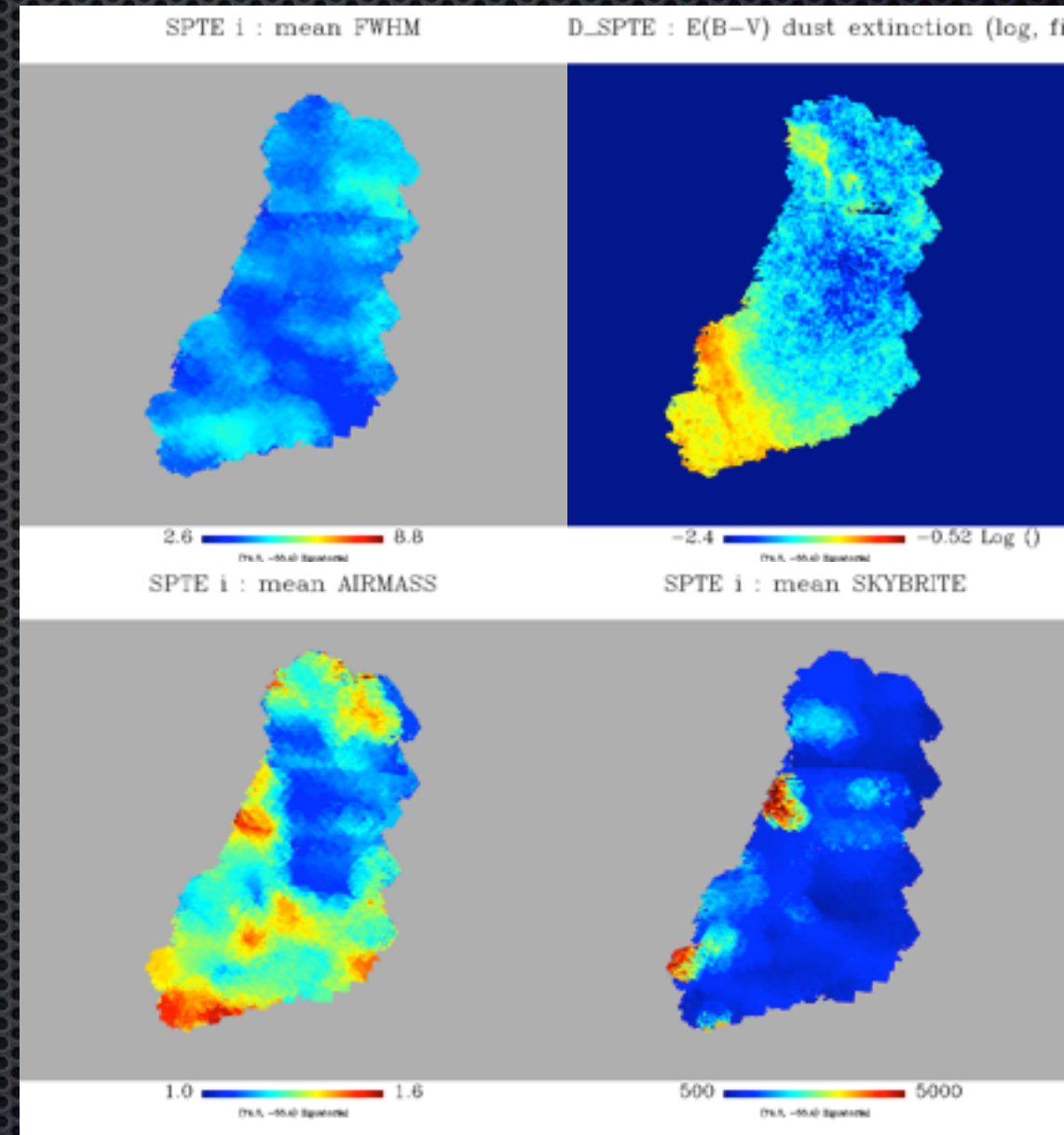


# More Systematics

- ✦ Evaluate the correction due to different systematics using the Ho et al. technique and Boris'+Anne's maps

$$\langle \delta_g^O \delta_g^O \rangle = \langle \delta_g^T \delta_g^T \rangle + \sum_{i,j} \alpha_{ij} \langle \delta_{sys_i} \delta_{sys_j} \rangle$$

- ✦ Identify leading systematics, make cuts and reiterate until convergence (Martín C, Anne B. + +)
- ✦ Correct leading systematics using cross-correlations (Martín C., Anne B., Tommasso G., Flavia S., JS.++)

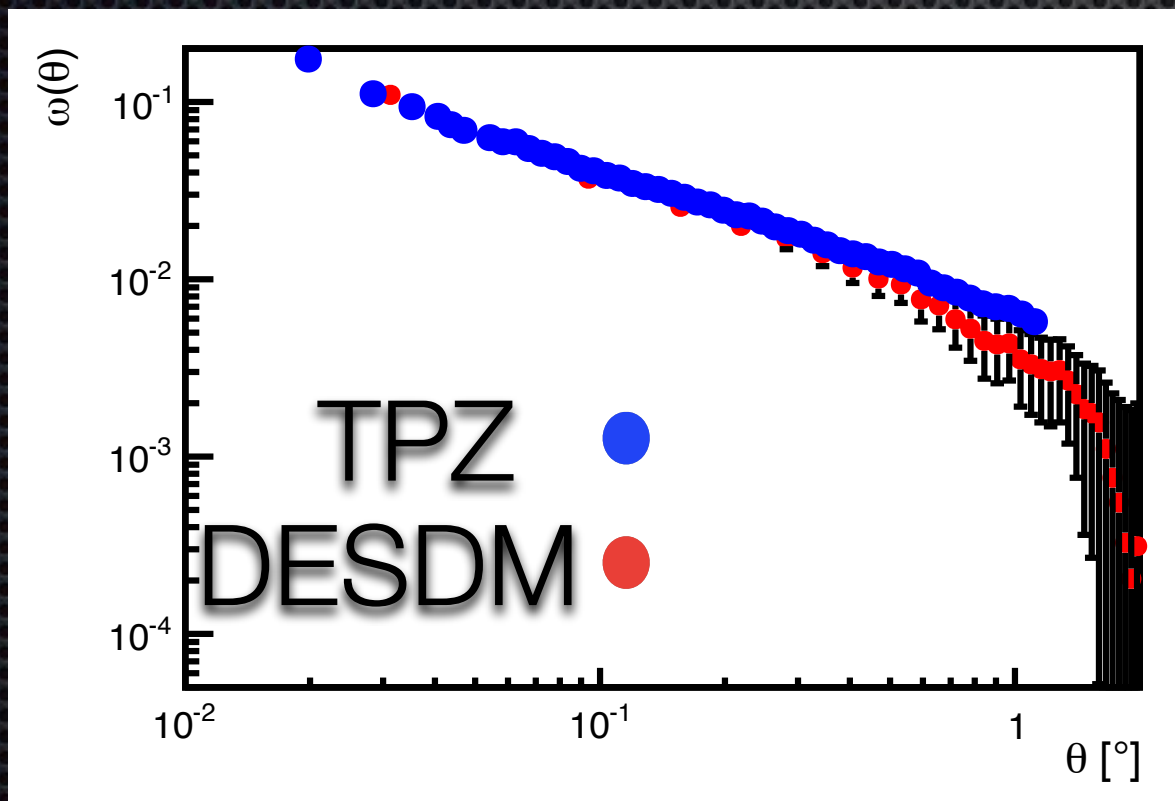


Credit: B. Leistedt

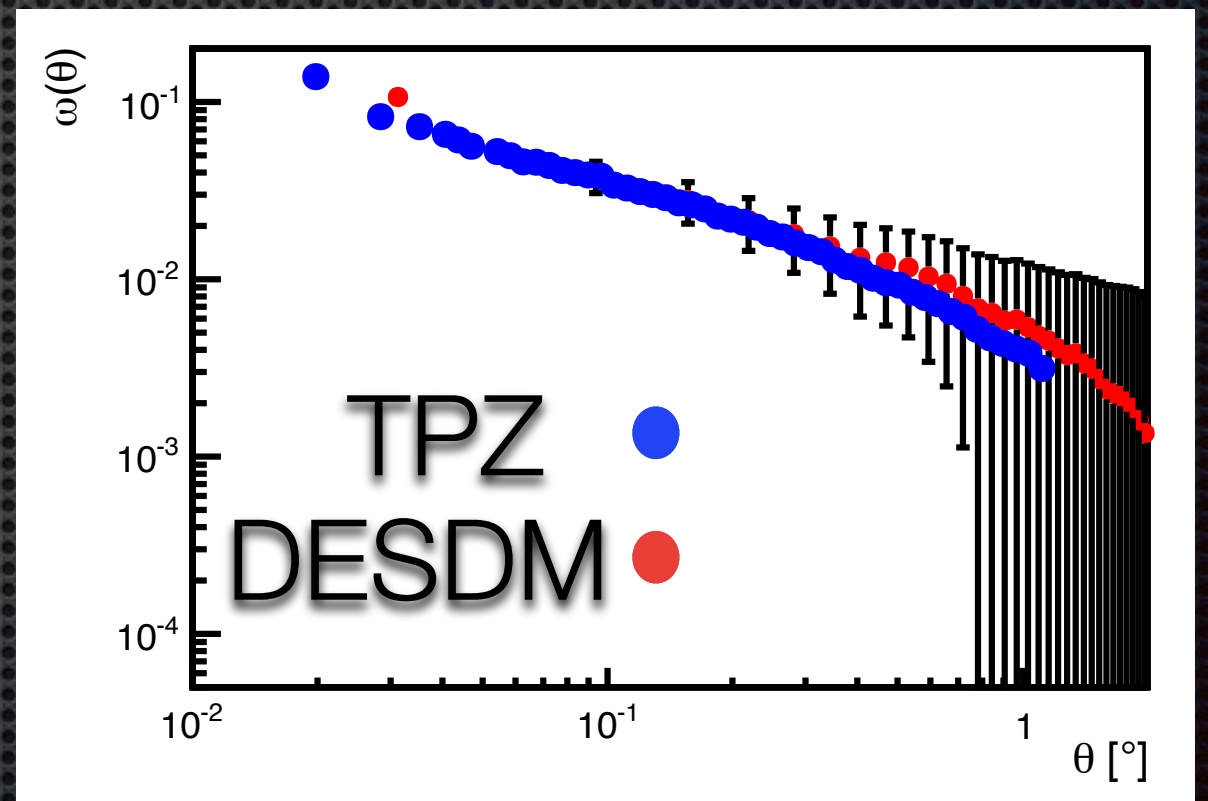


# Clustering results

- Different groups and codes (pair counts, cl's, healpix, tree codes, GPU): Tom, Flavia, Anne, Martín, JS. ++
- DESDM+MODEST results systematic error corrected. TPZ-v2+TPZsg uncorrected.



$$0.4 < z < 0.6$$

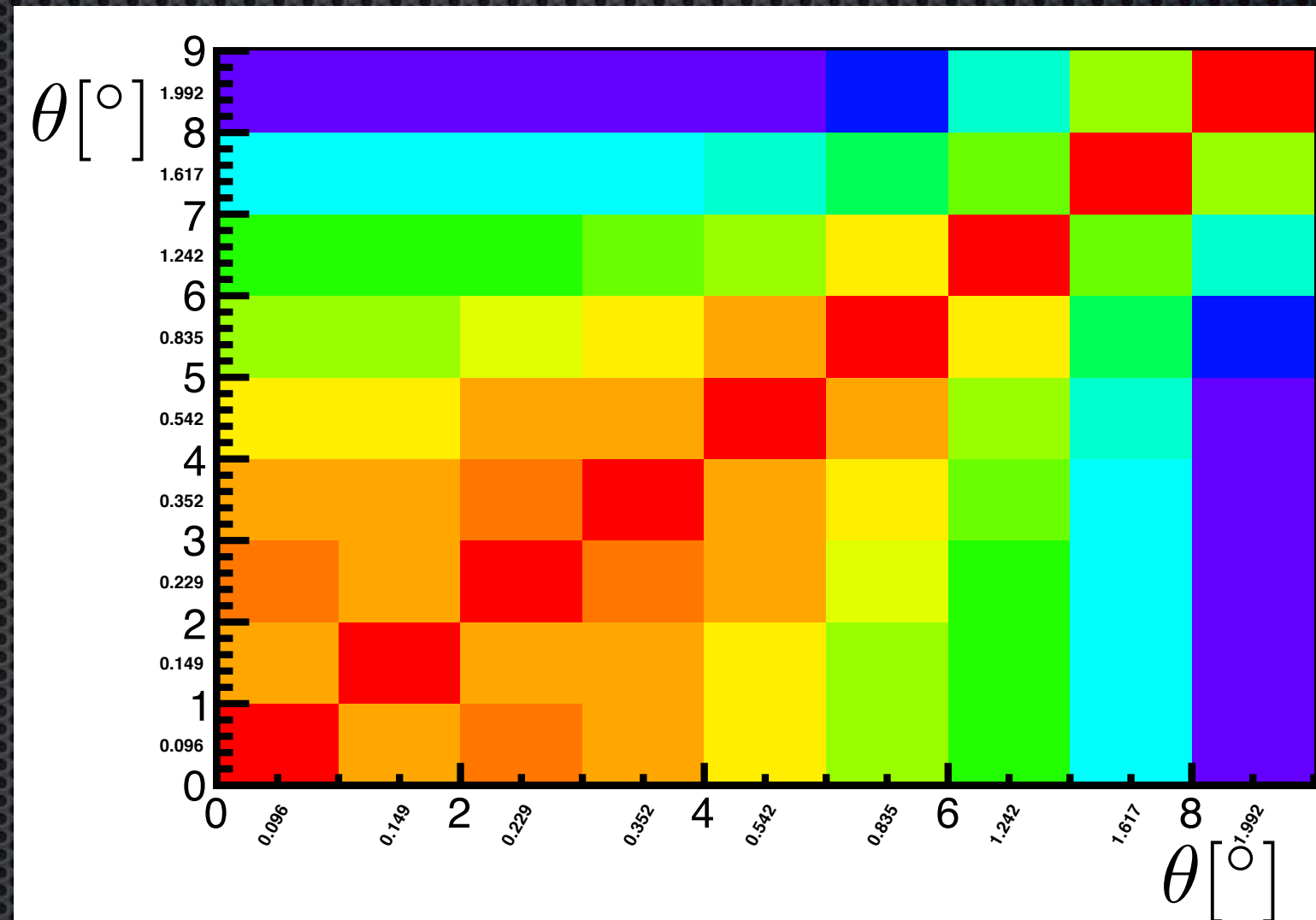


$$0.6 < z < 0.8$$



# Clustering results

- ✦ Covariance matrices computed using different methods: Jackknife, MC, Simulations, theoretical gaussian

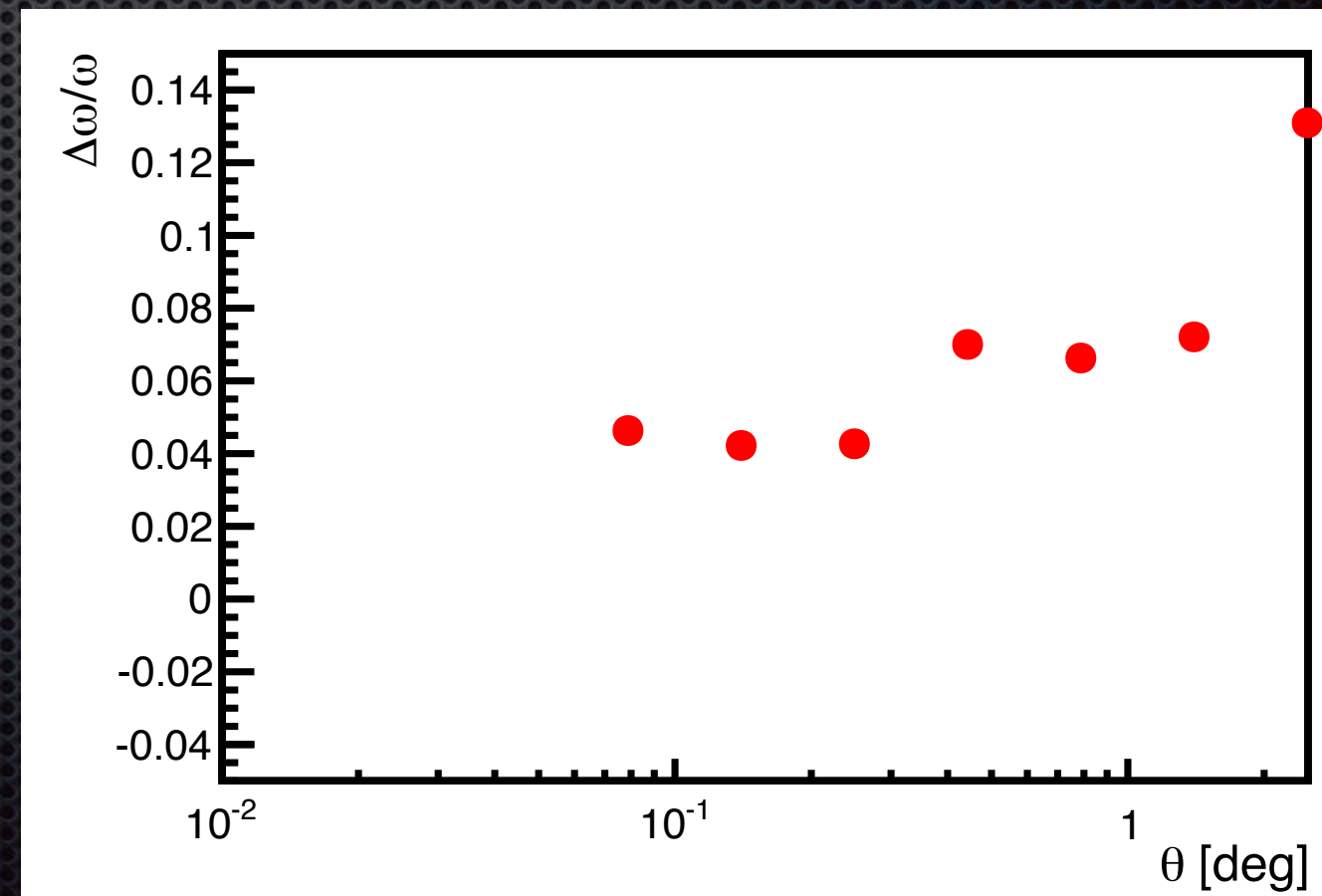
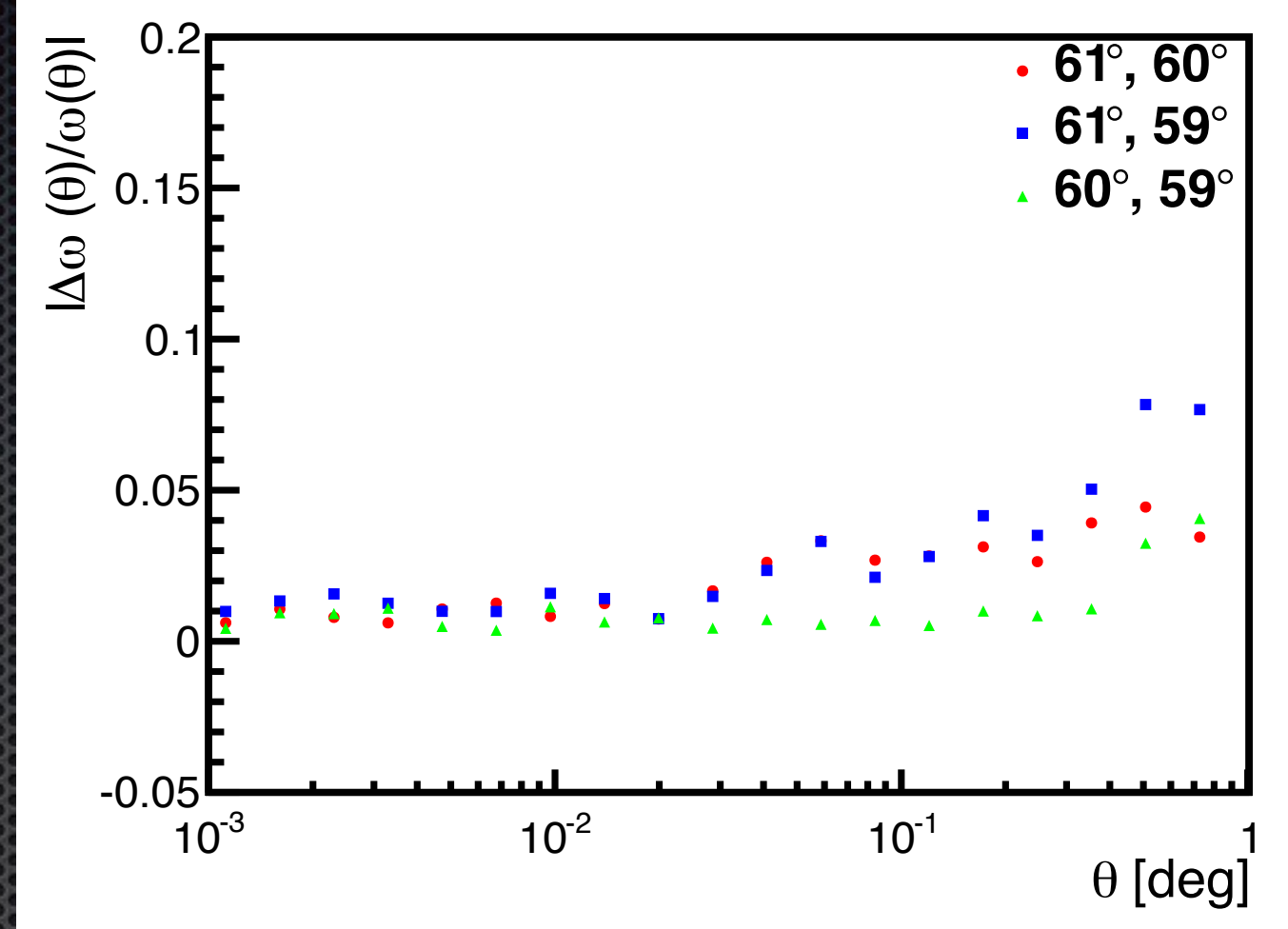




# Systematics

- ✦ Robust declination cut:
  - ✦ Computed the relative difference in clustering of the -61 deg cut. Differences under 5%

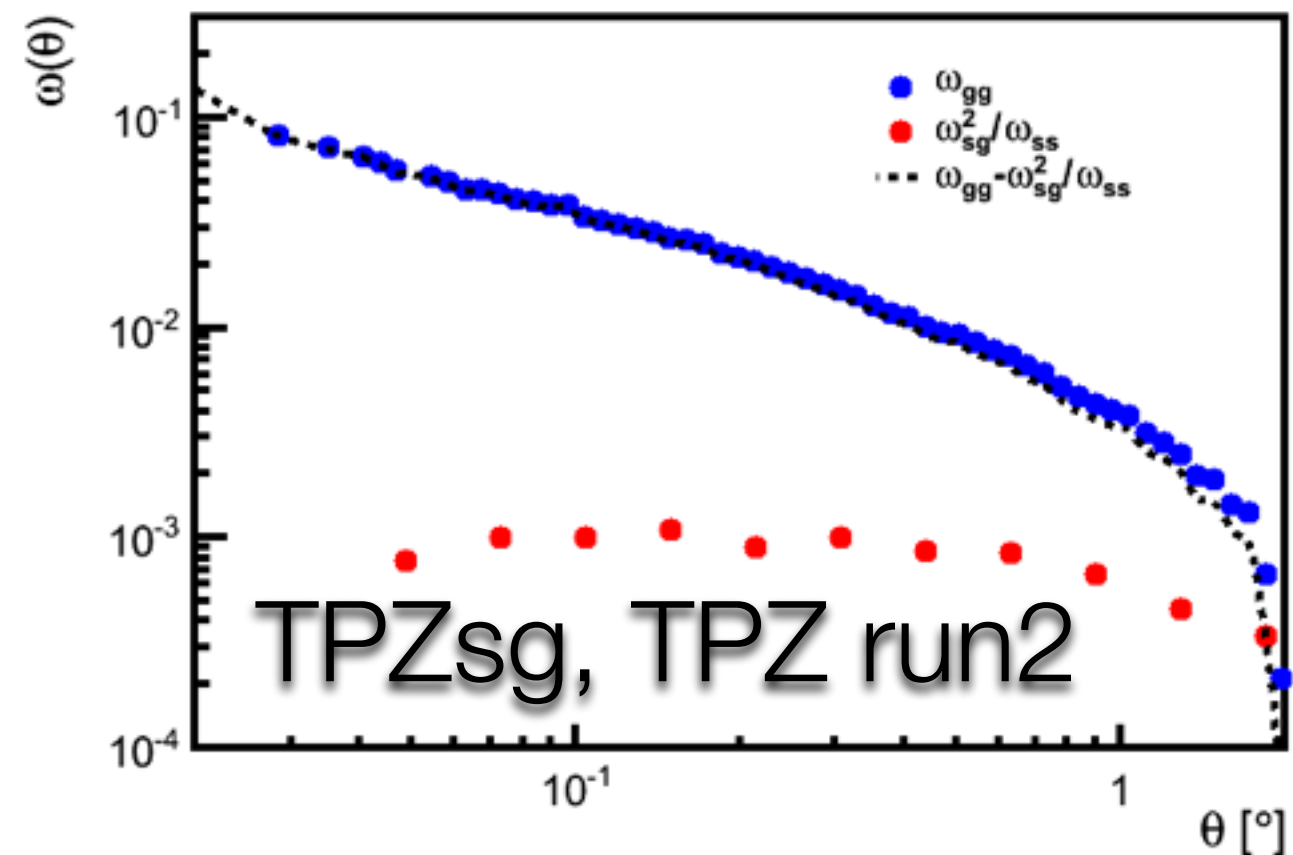
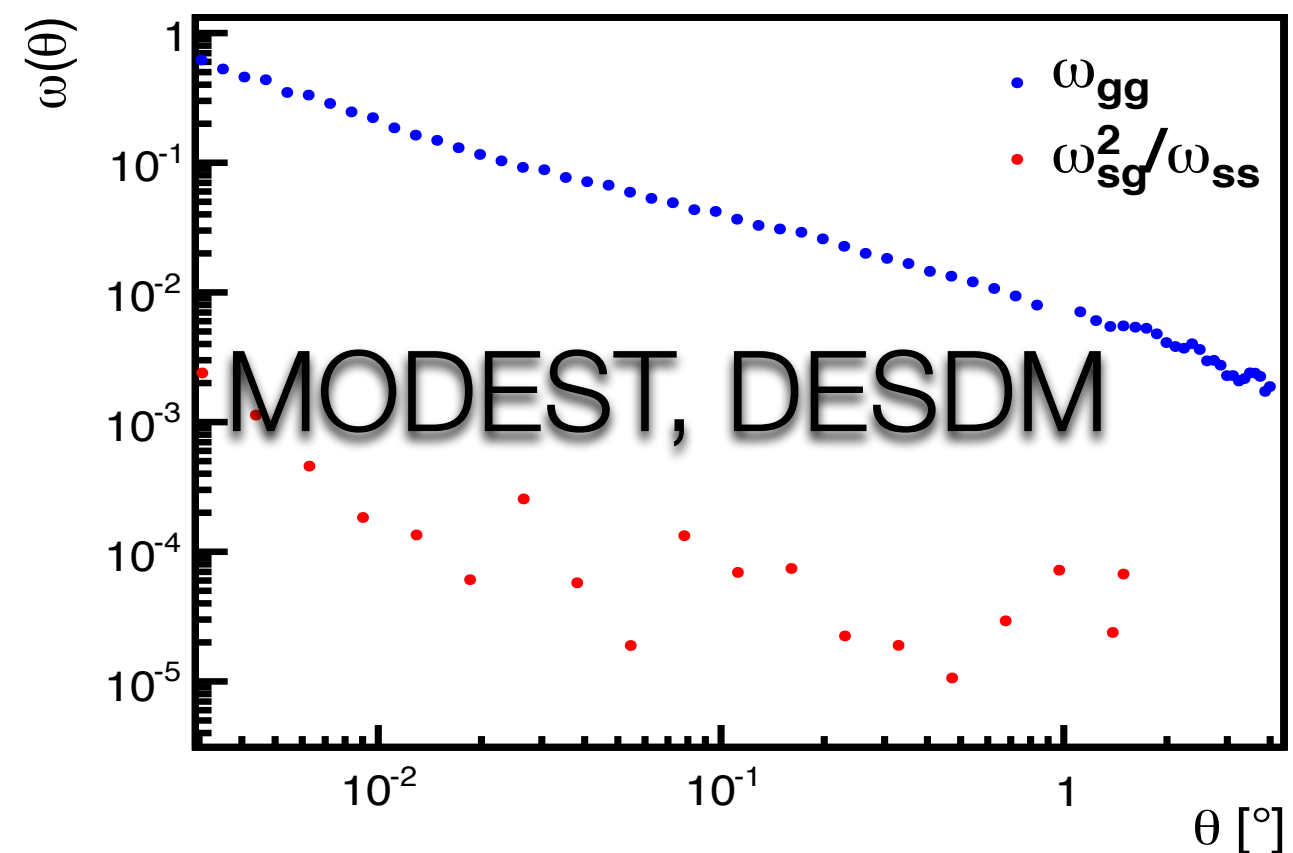
- ✦ FRACDET CUT:
  - ✦ 1.2 % area lost with  $\text{FRACDET} > 0.8$  CUT
  - ✦ Differences  $\sim 7\%$





# Systematics: Star/Galaxy

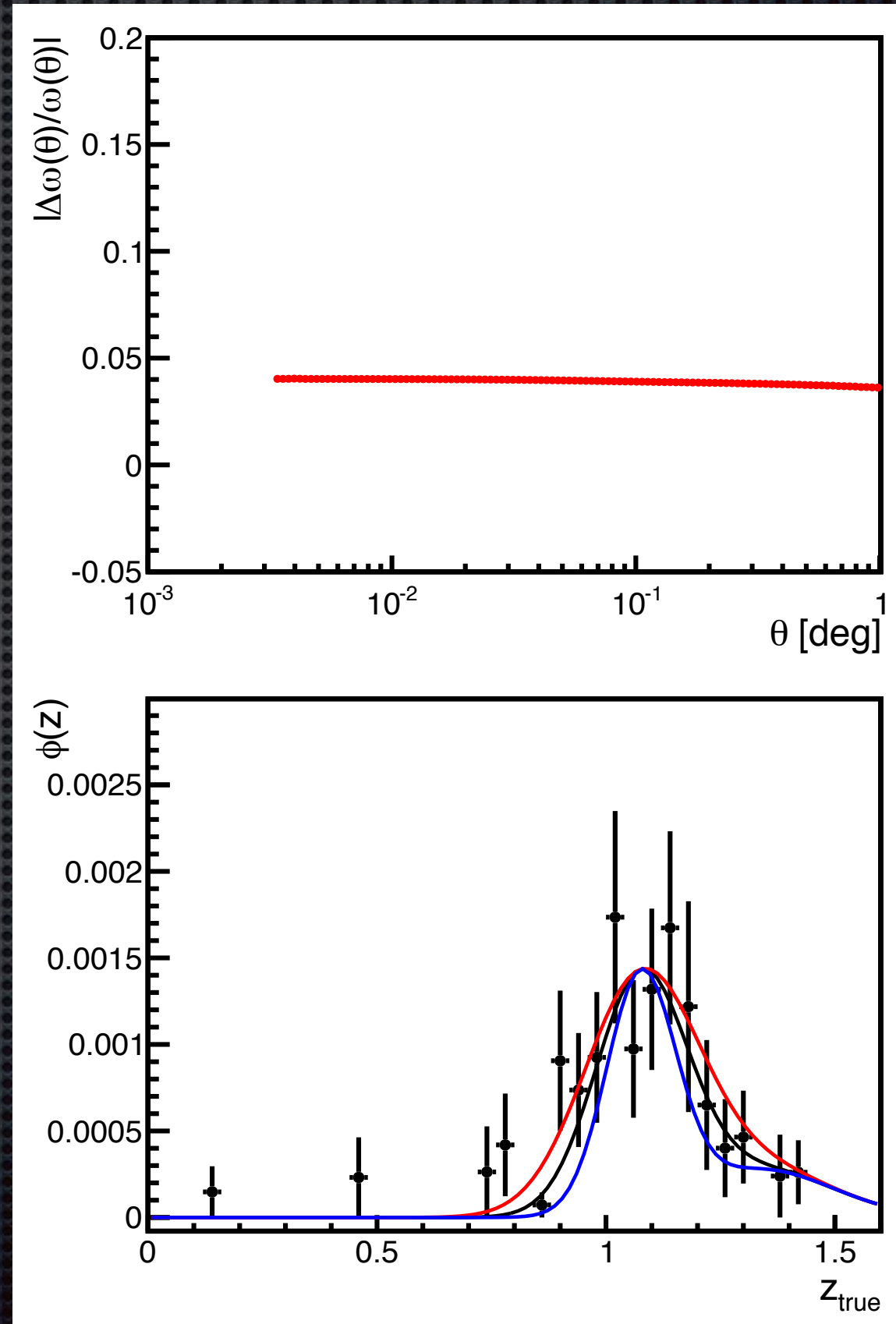
- Evaluated the correction due to stellar contamination with two different separators:
  - MODEST\_CLASS
  - TPZsg
- Correction negligible for both of them. Stellar contamination under 4% for MODEST\_CLASS (with DESDM and TPZ photoz) 1% for test sample with TPZsg class (Nacho++)





# Systematics: Photo-z

- ✦ Fit calibration sample to sum of two gaussians and project using these fits
- ✦ Results using theoretical prediction for DESDM: less than 4% for every redshift bin
- ✦ Computing it for TPZ

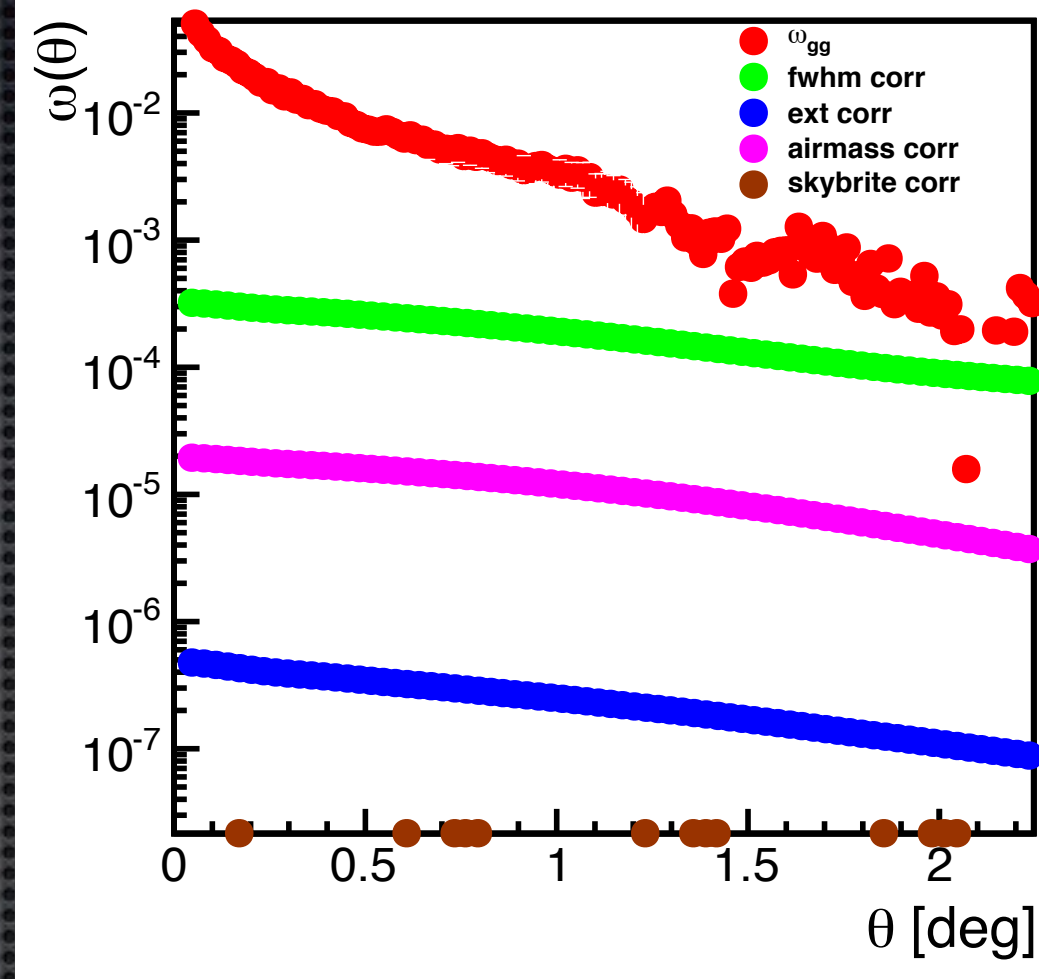




# Systematics: Others

- Leading systematics for TPZ:
  - $0.2 < z < 0.4$ : Seeing, Airmass
  - $0.6 < z < 0.8$  Seeing
  - $1.0 < z < 1.2$  Seeing

- Leading systematics for DESDM:
  - Seeing for every redshift bin

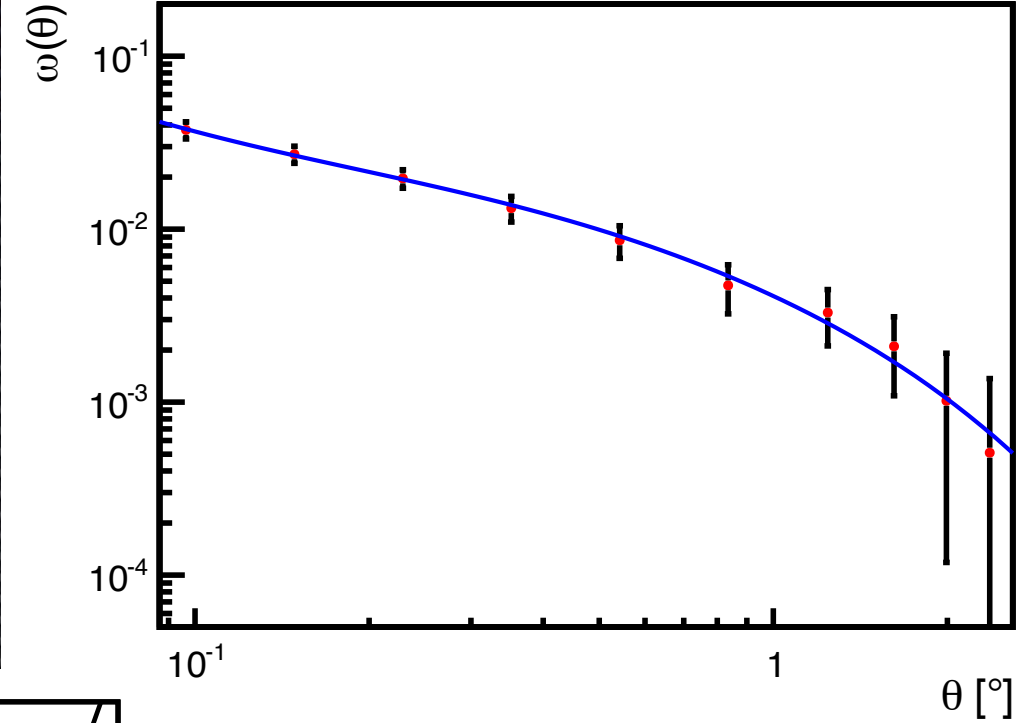
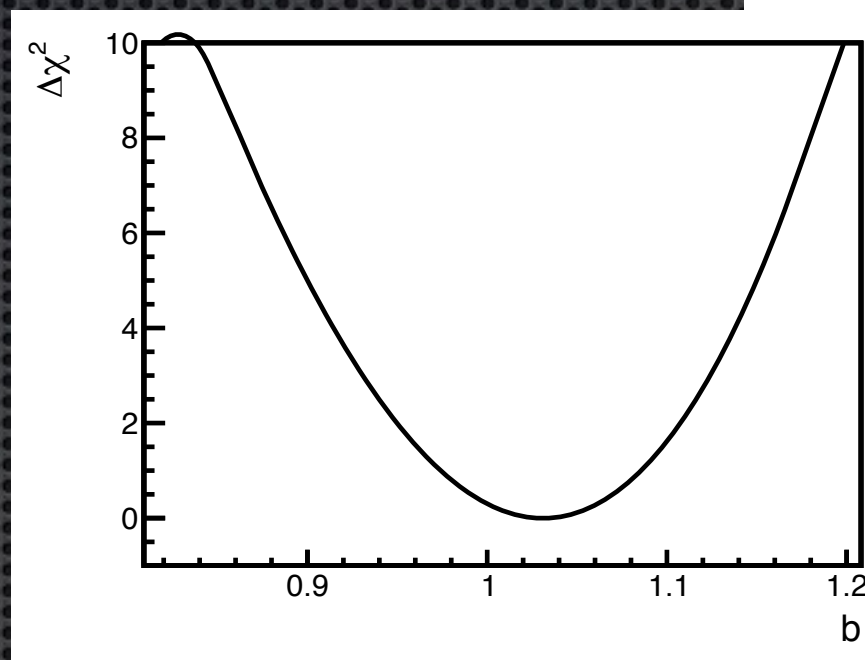


We apply the corresponding corrections!!

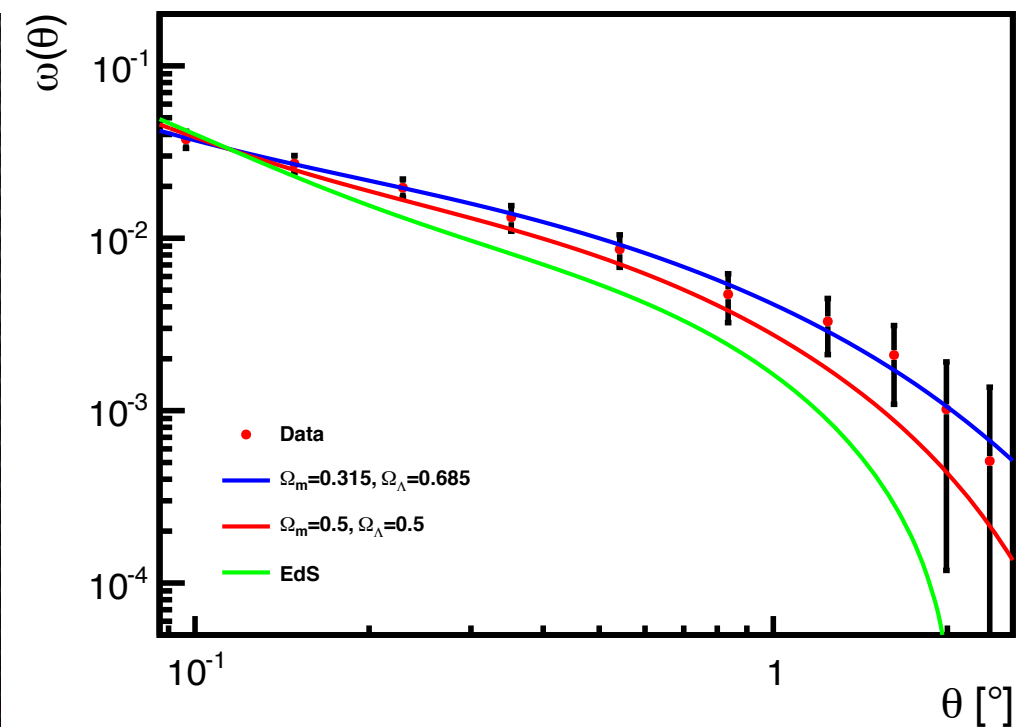


# Cosmological results

- Fix cosmological parameters. Extract galaxy bias
- Longer term: HOD fitting
- Longer term: MCMC marginalization



DES DM  
 $0.4 < z < 0.6$





# Conclusions and next steps

- ✦ We provided a robust sample to the DES collaboration
- ✦ It is being used by multiple groups in many analyses!
- ✦ We computed the angular correlation function and obtained the same results for different codes and groups
- ✦ We have systematic uncertainties under control for the clustering analysis
- ✦ Next step will be to extract cosmology!



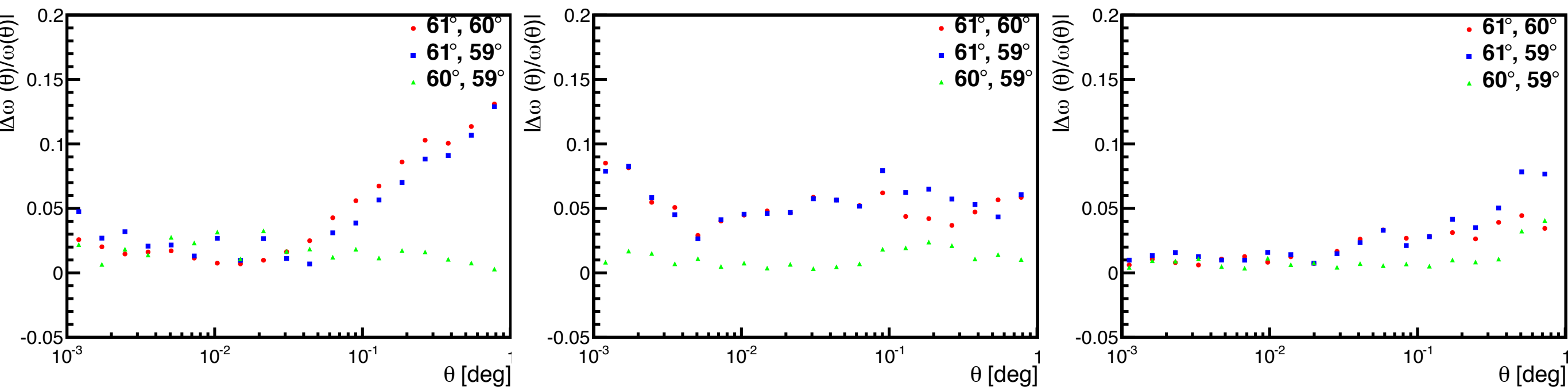




BACKUP



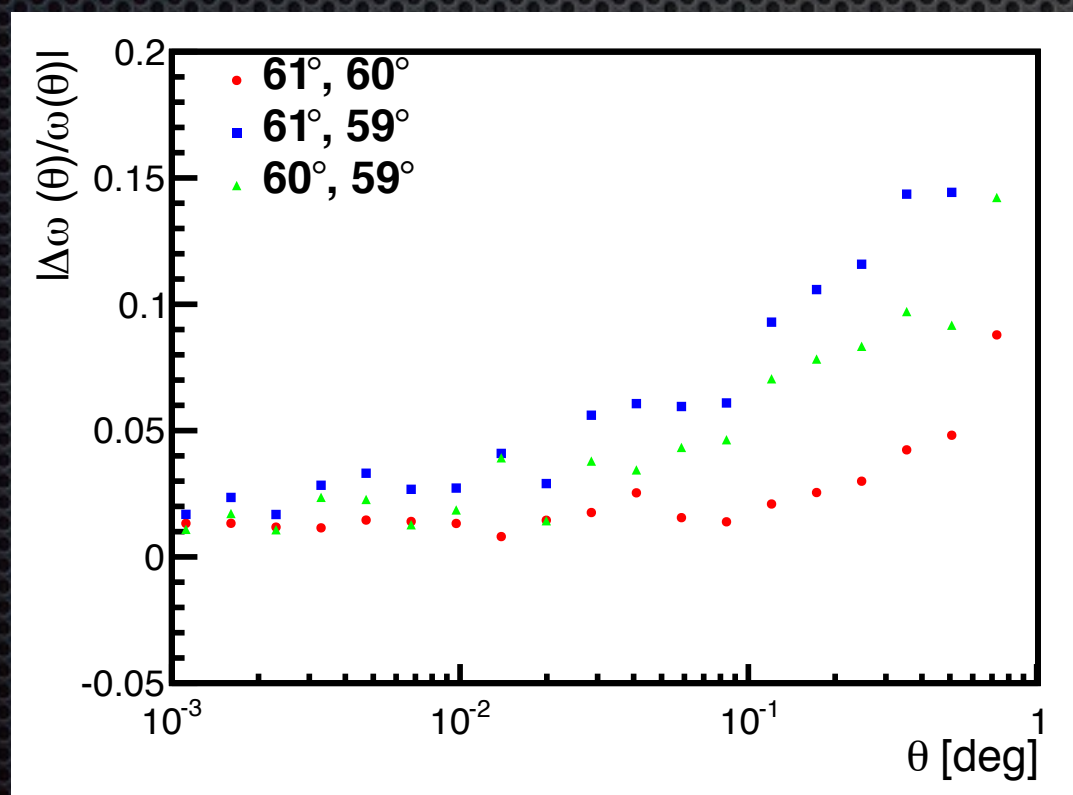
# BACKUP: Declination



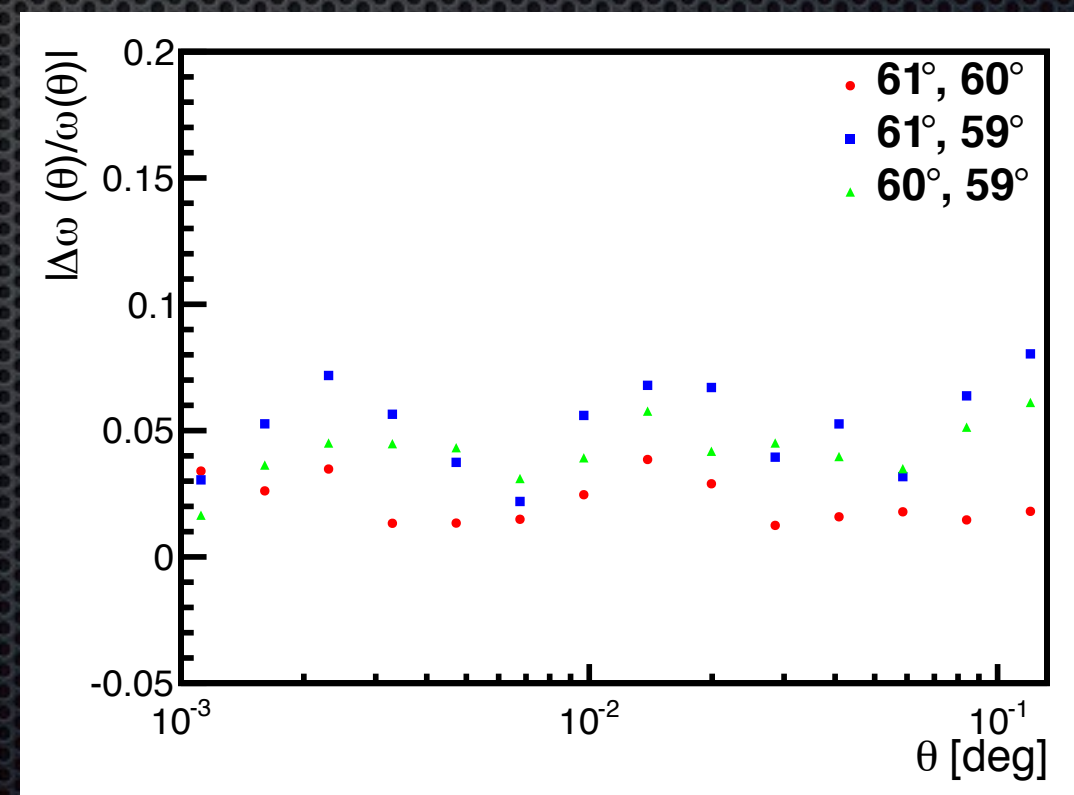
$0.2 < z < 0.4$

$0.4 < z < 0.6$

$0.6 < z < 0.8$



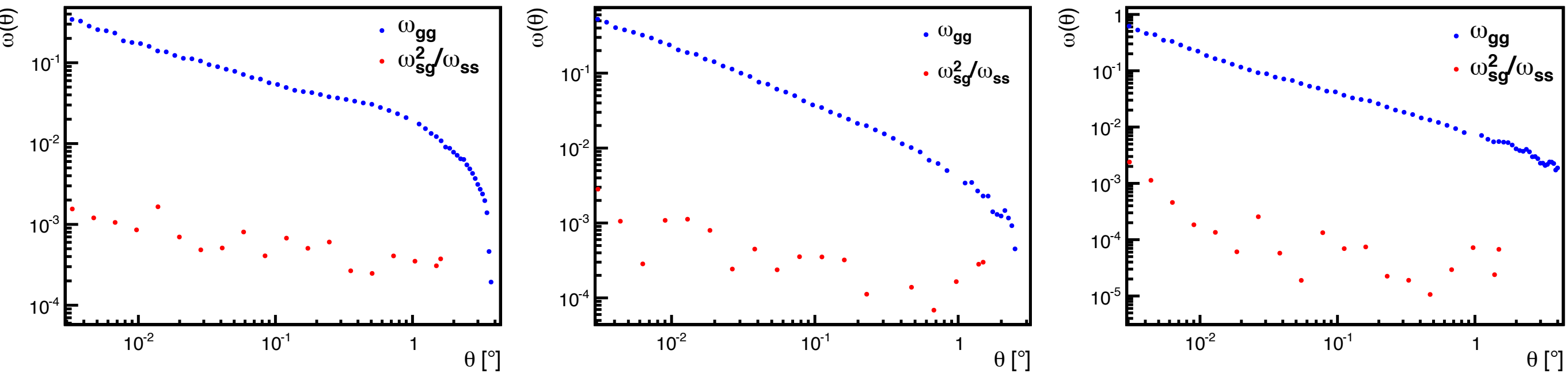
$0.8 < z < 1.0$



$1.0 < z < 1.2$



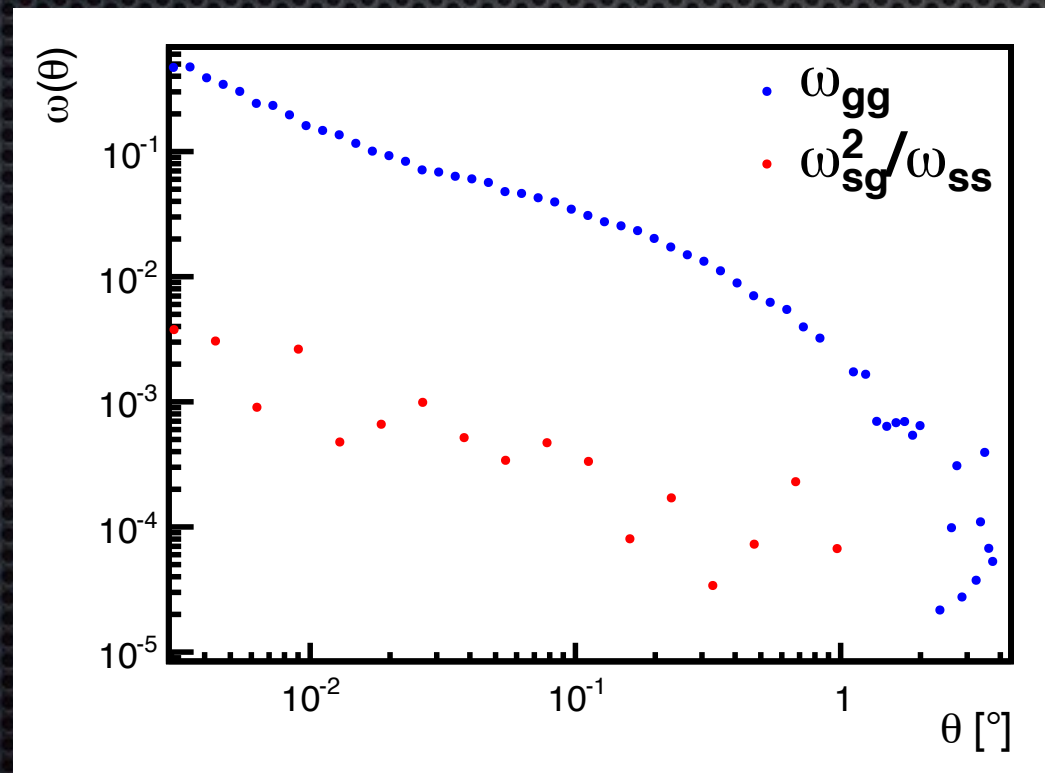
# MODEST CLASS, DESDM, S/G CORR



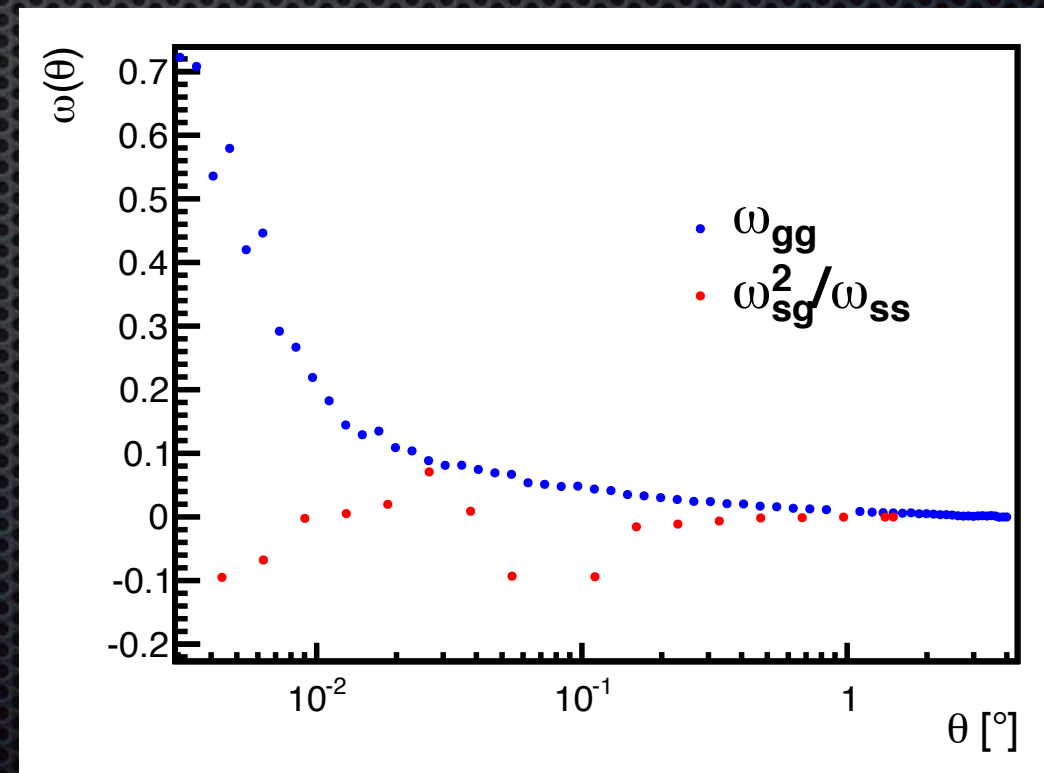
$0.2 < z < 0.4$

$0.4 < z < 0.6$

$0.6 < z < 0.8$



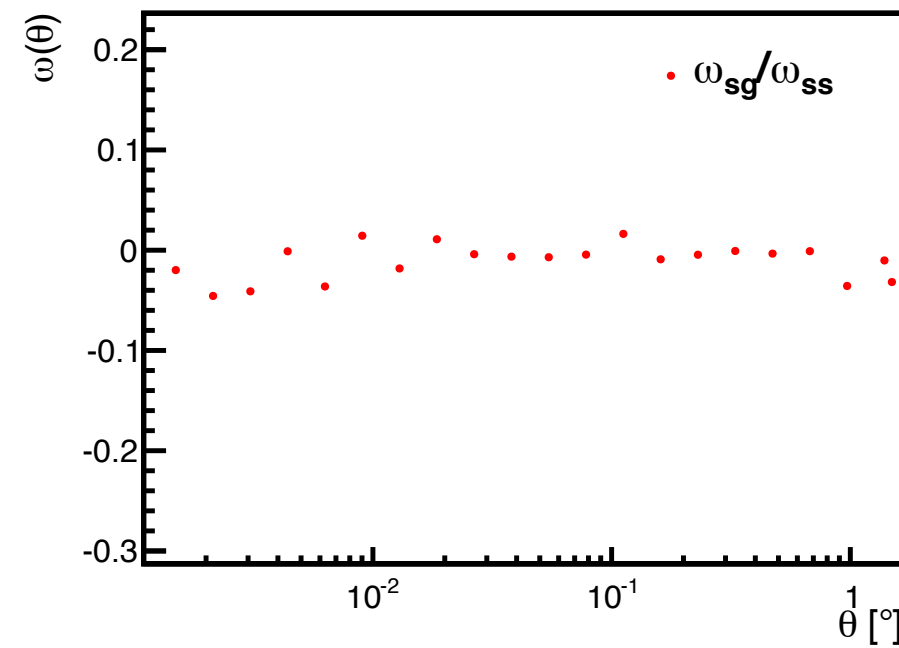
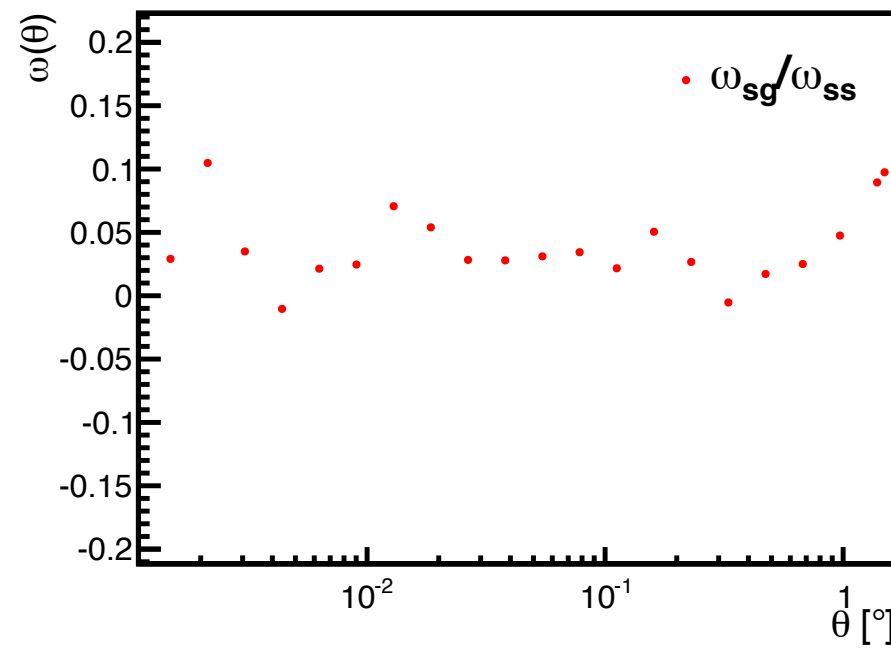
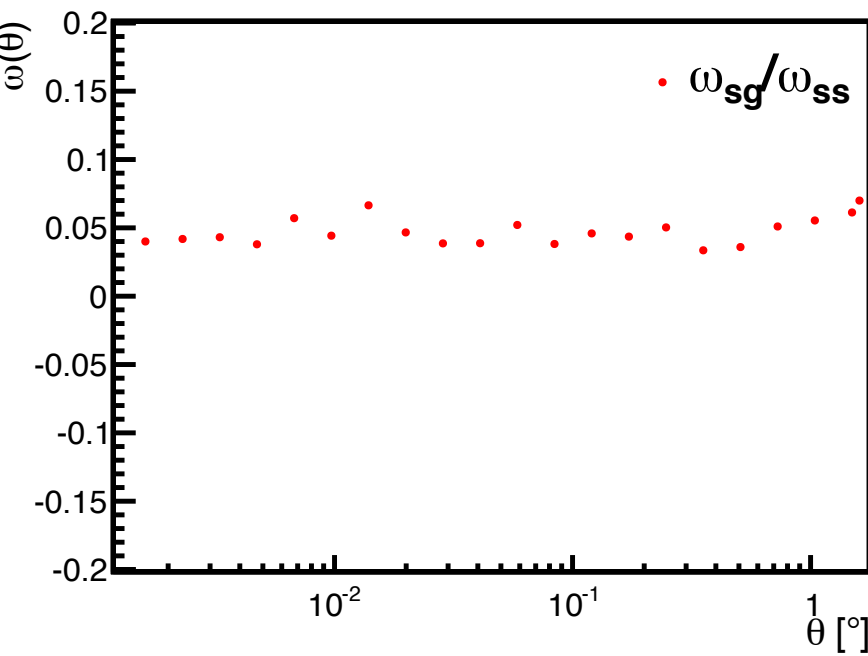
$0.8 < z < 1.0$



$1.0 < z < 1.2$



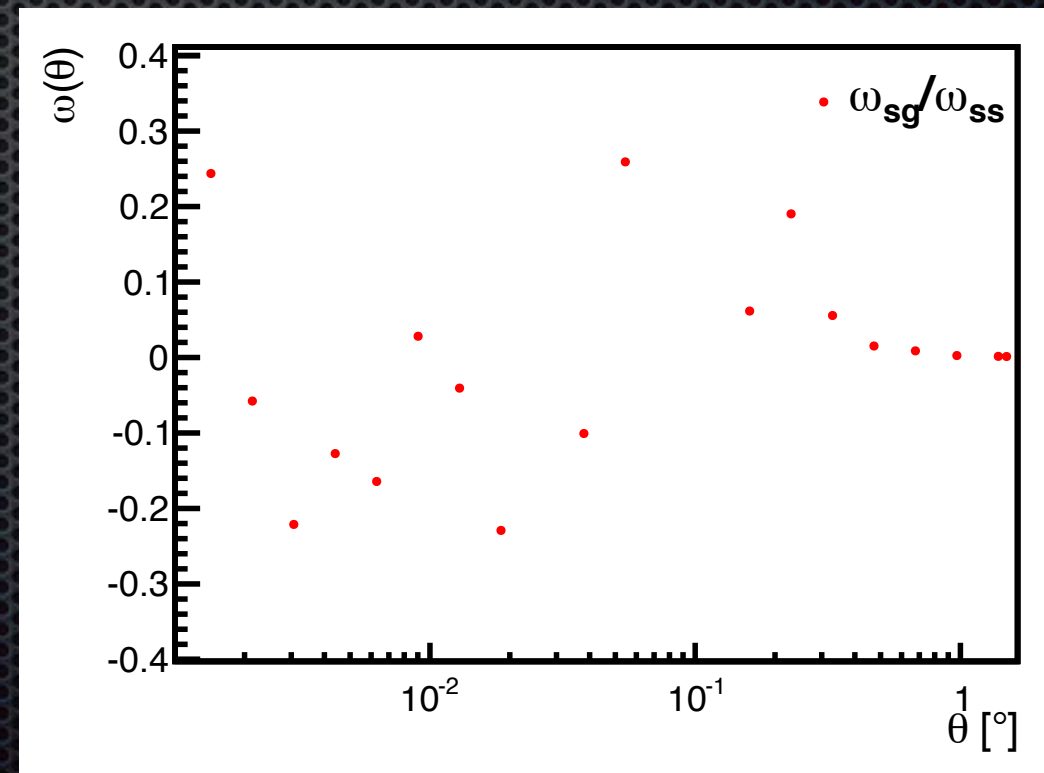
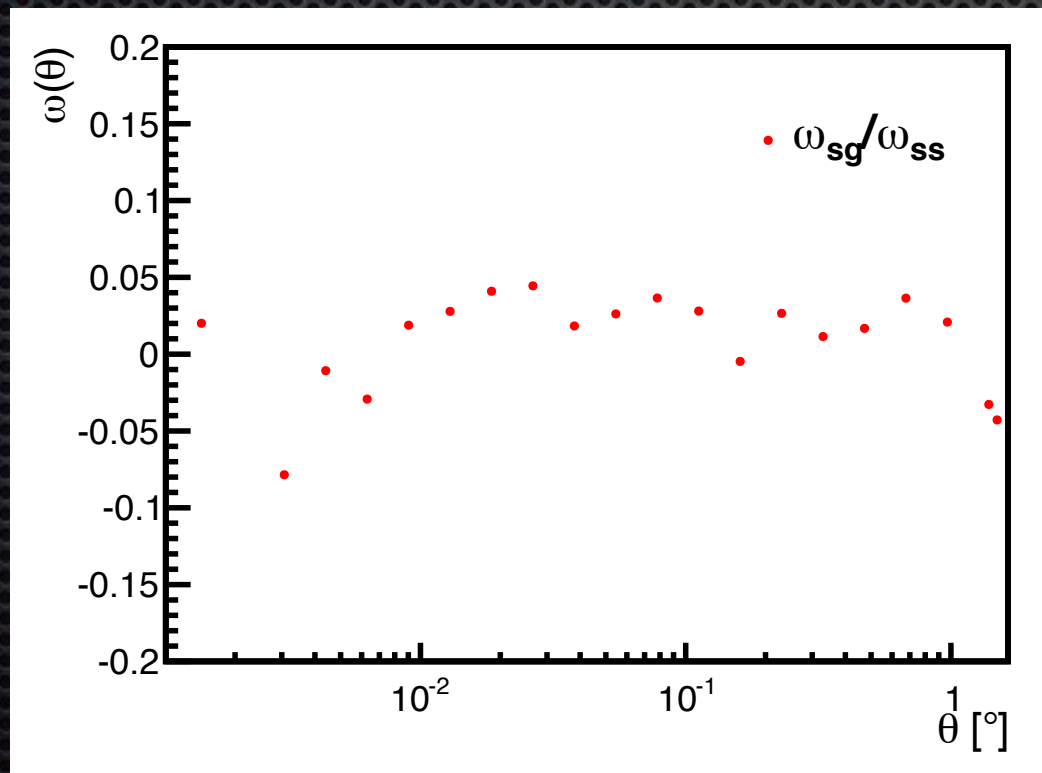
# MODEST CLASS, DESDM, S/G CORR



$0.2 < z < 0.4$

$0.4 < z < 0.6$

$0.6 < z < 0.8$

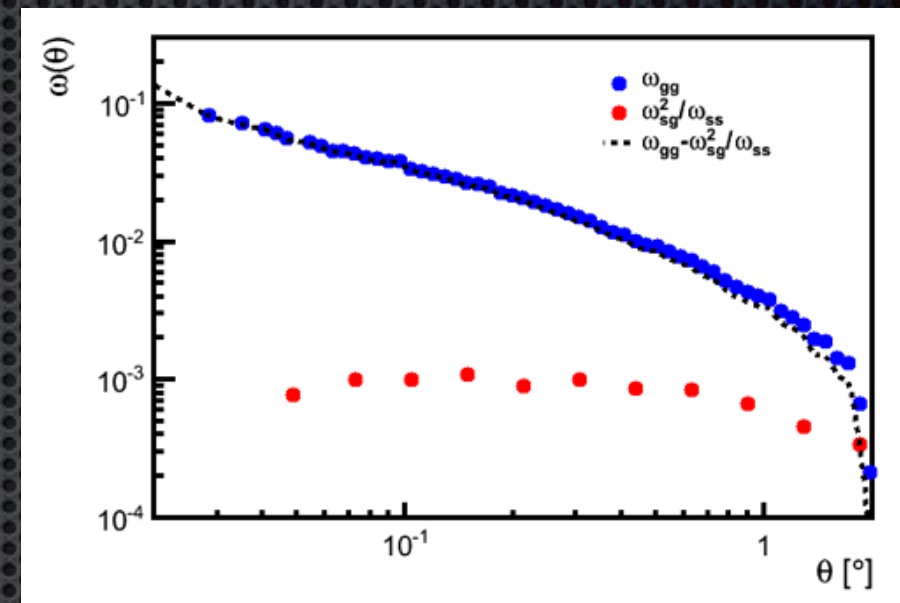
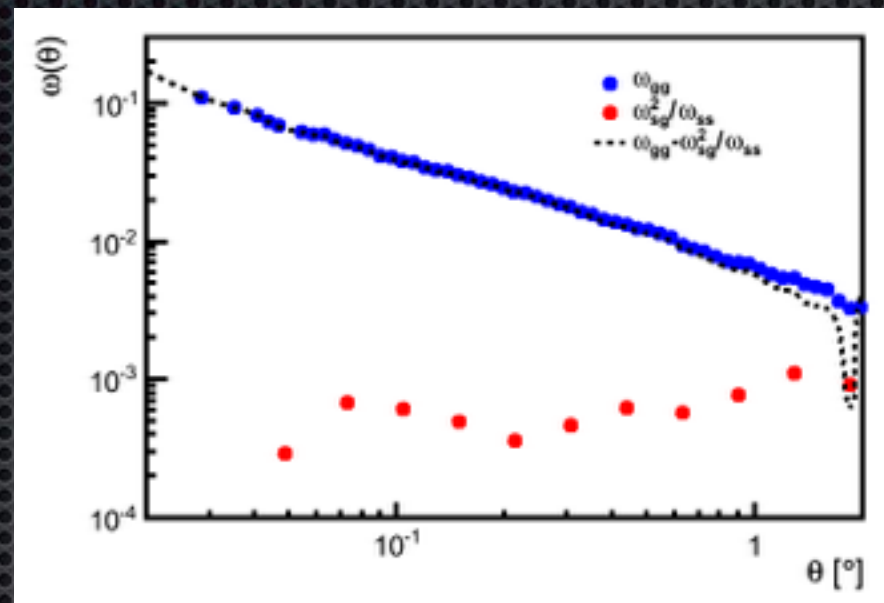
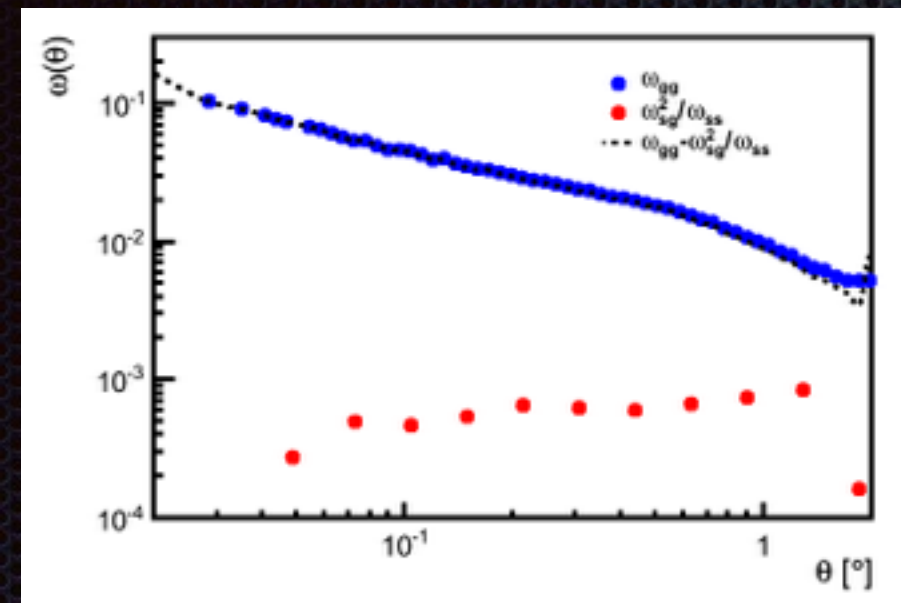


$0.8 < z < 1.0$

$1.0 < z < 1.2$



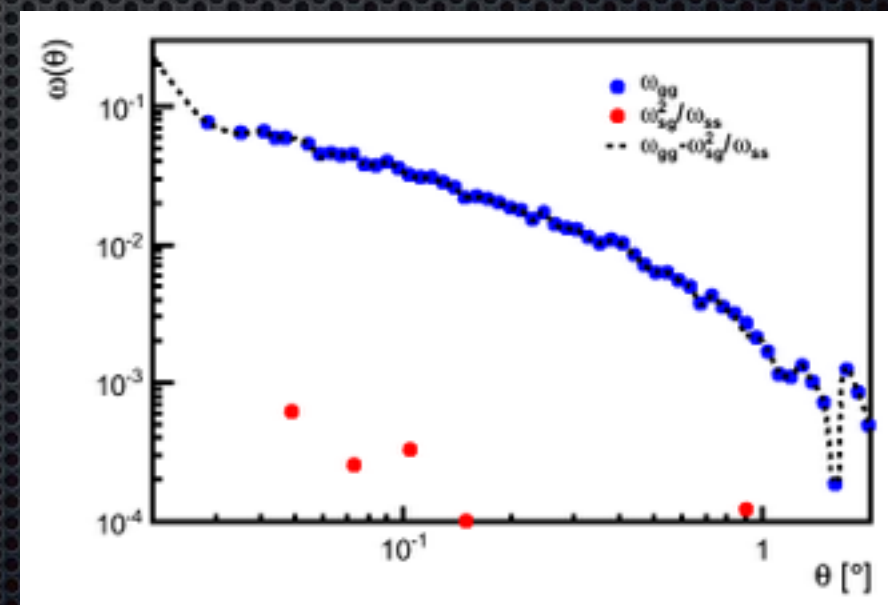
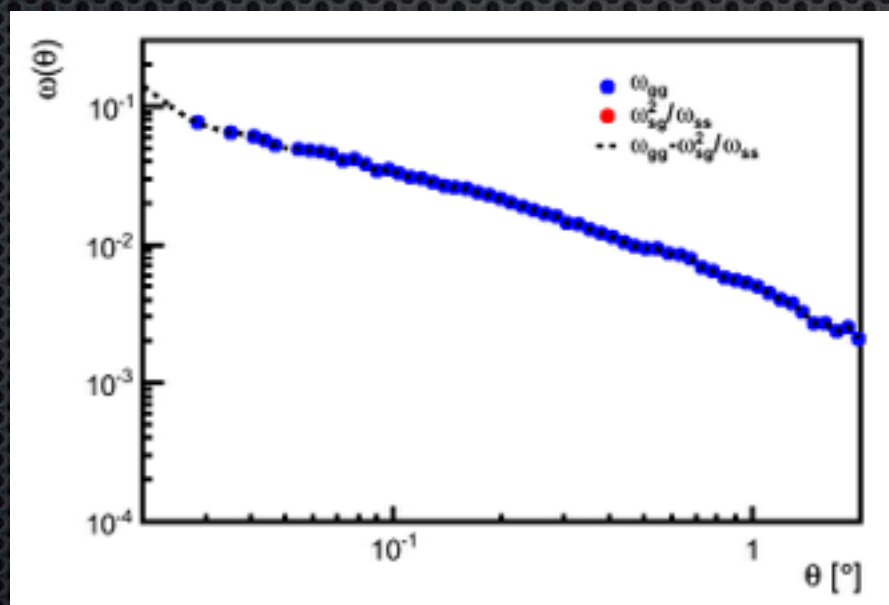
# TPZ\_v2, TPZsg



$0.2 < z < 0.4$

$0.4 < z < 0.6$

$0.6 < z < 0.8$

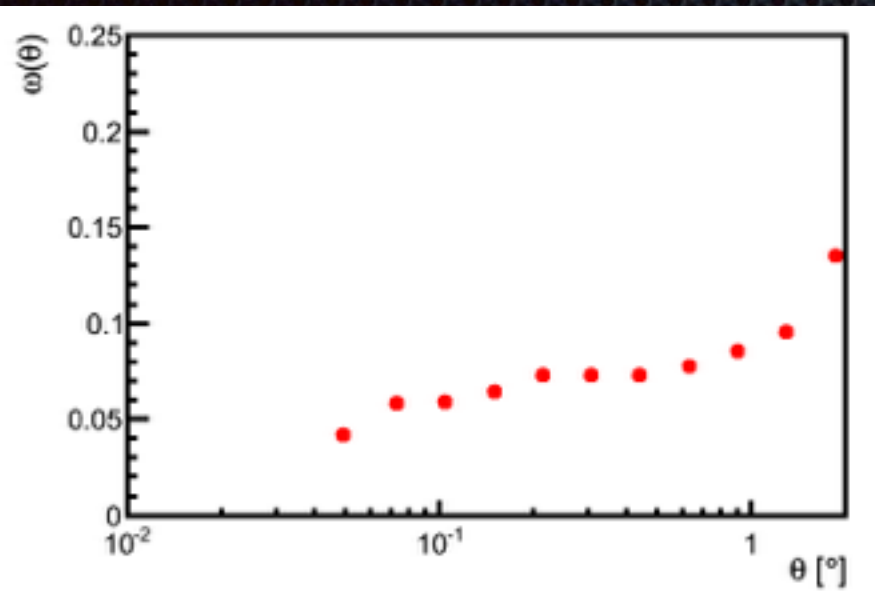


$0.8 < z < 1.0$

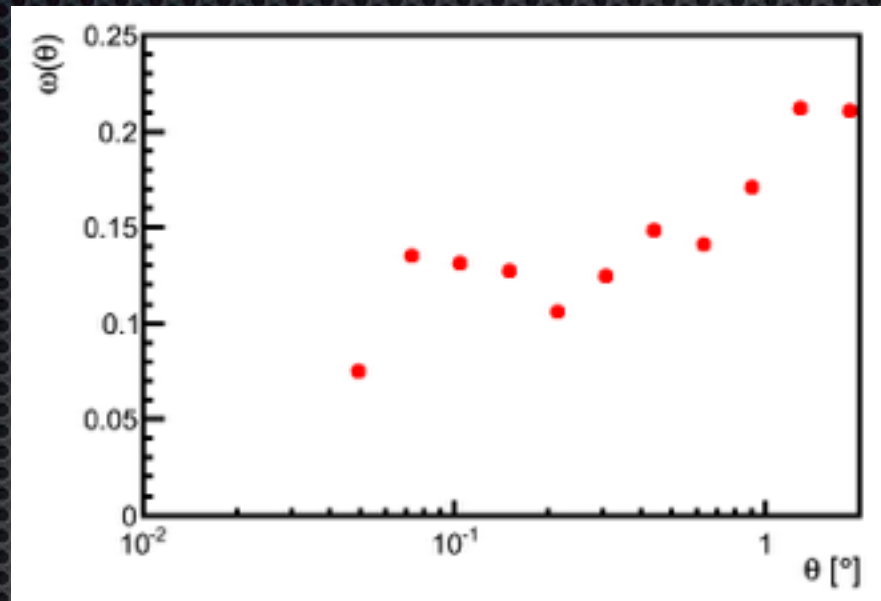
$1.0 < z < 1.2$



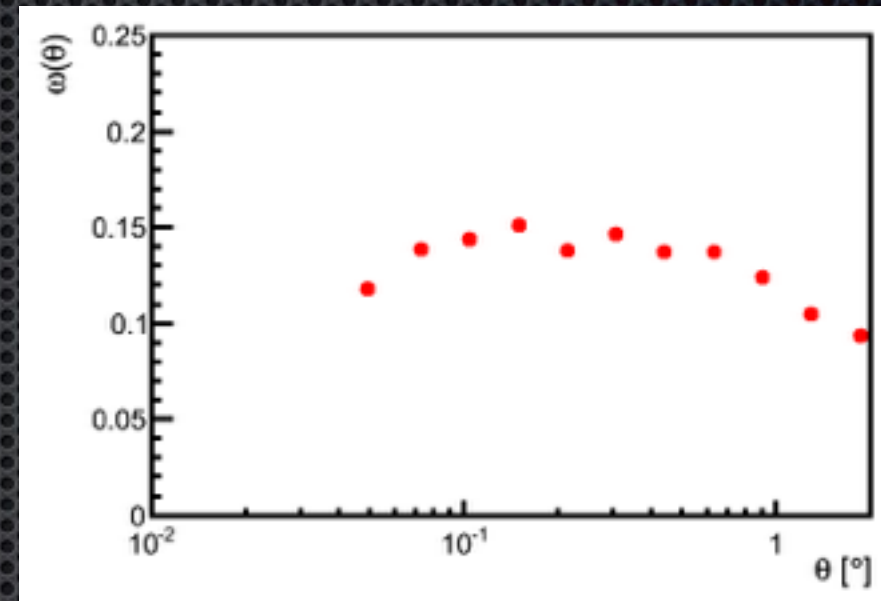
# TPZ\_v2,TPZsg



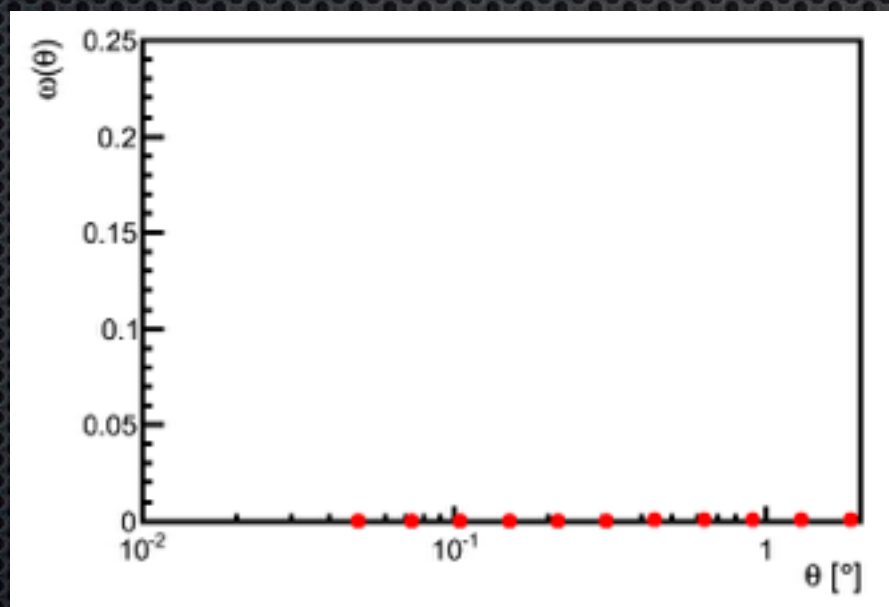
$0.2 < z < 0.4$



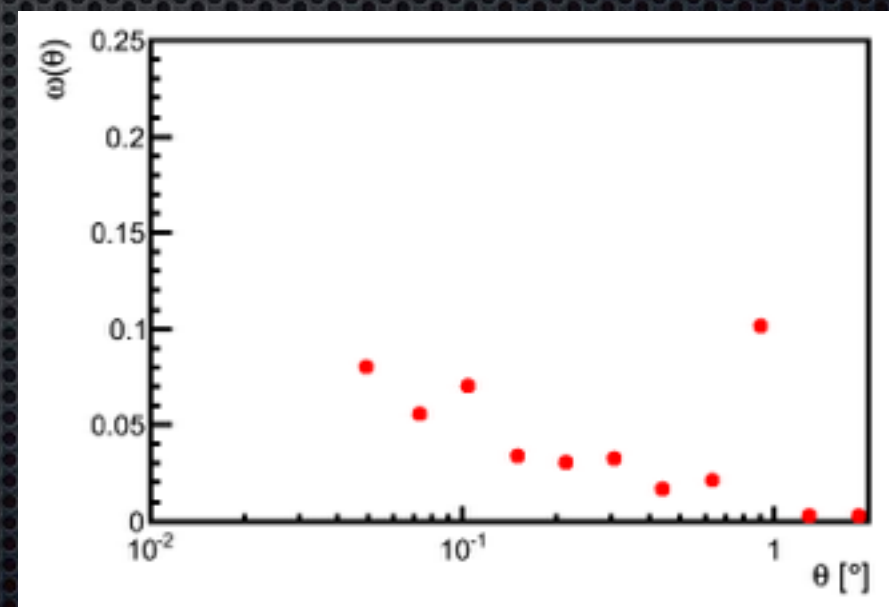
$0.4 < z < 0.6$



$0.6 < z < 0.8$



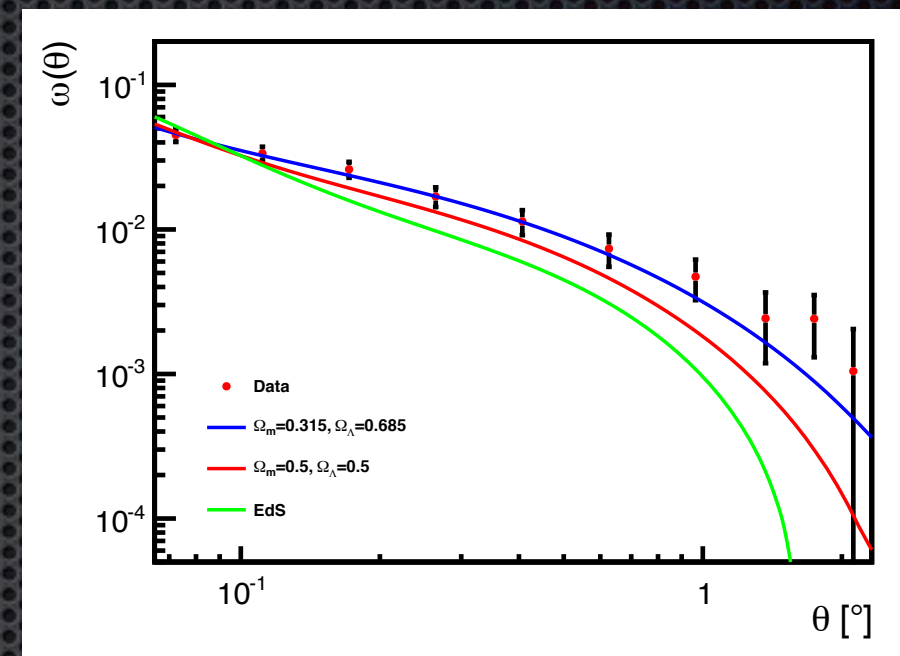
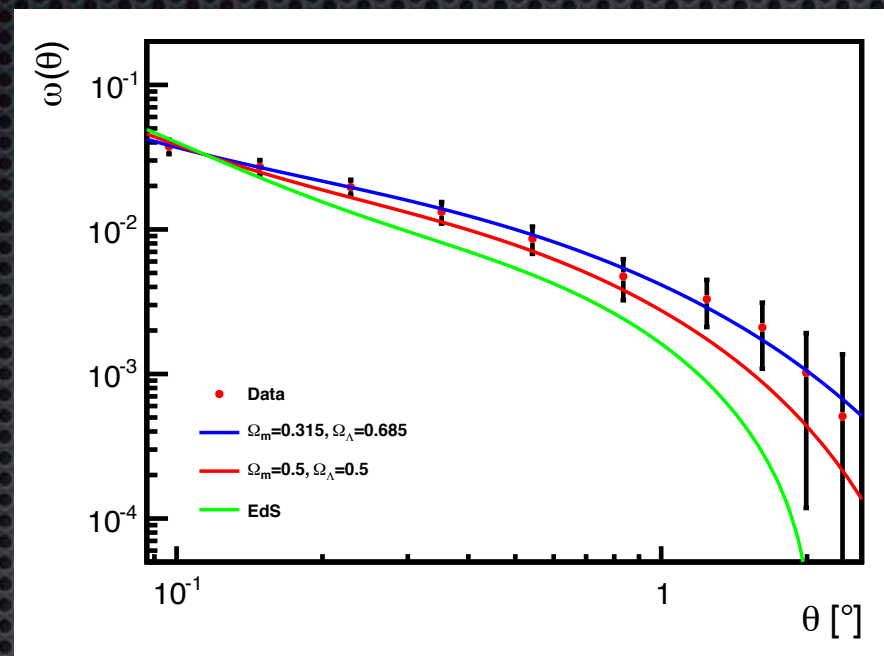
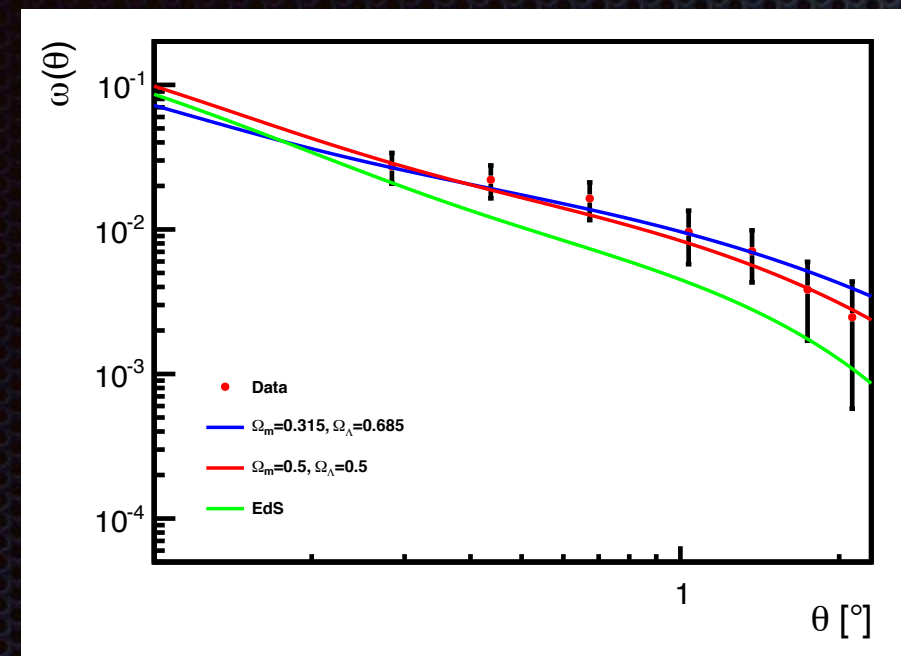
$0.8 < z < 1.0$



$1.0 < z < 1.2$



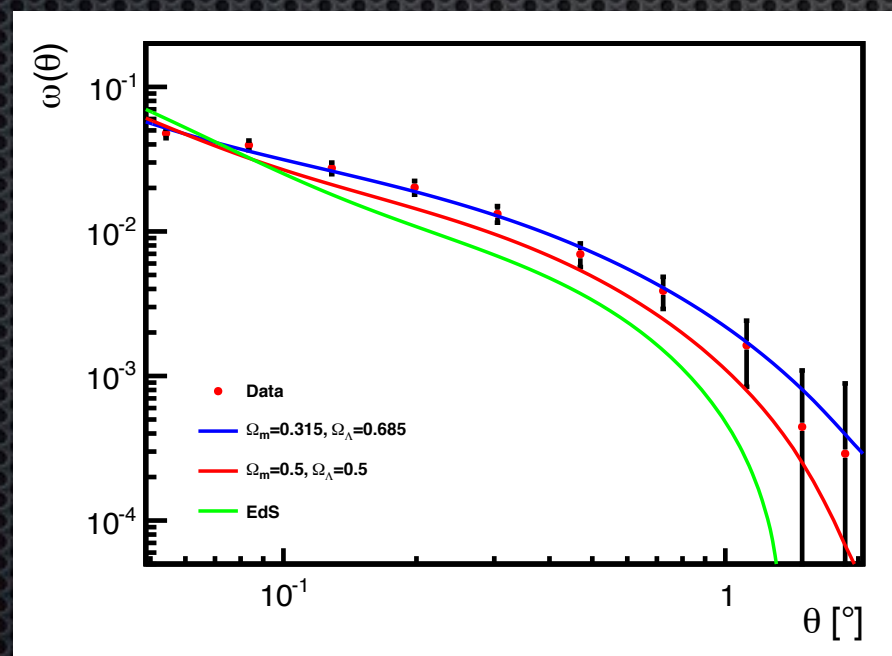
# FITS: DESDM, DIFFERENT MODELS



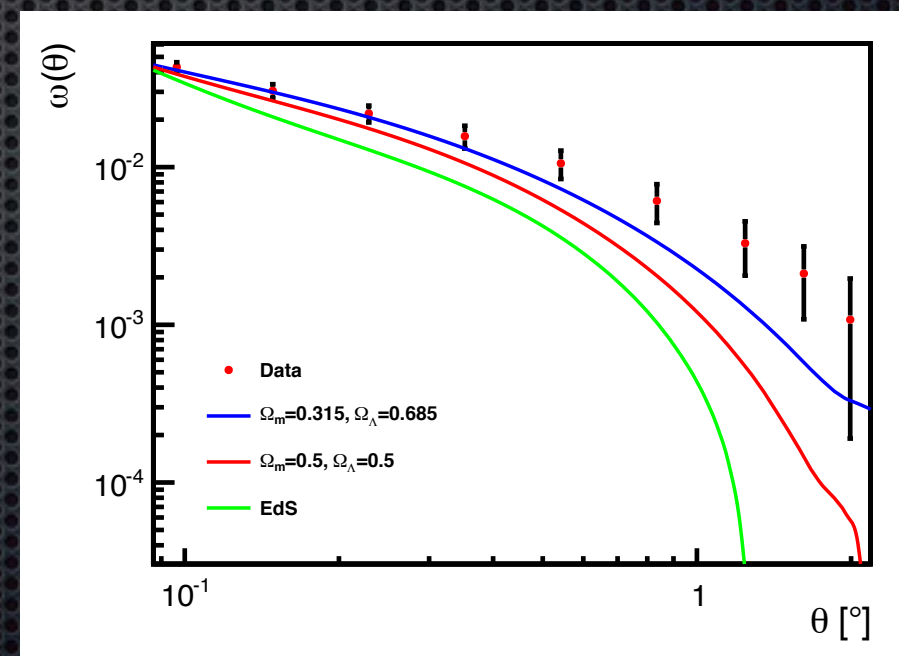
$0.2 < z < 0.4$

$0.4 < z < 0.6$

$0.6 < z < 0.8$



$0.8 < z < 1.0$



$1.0 < z < 1.2$