Dark Energy Survey Year 1

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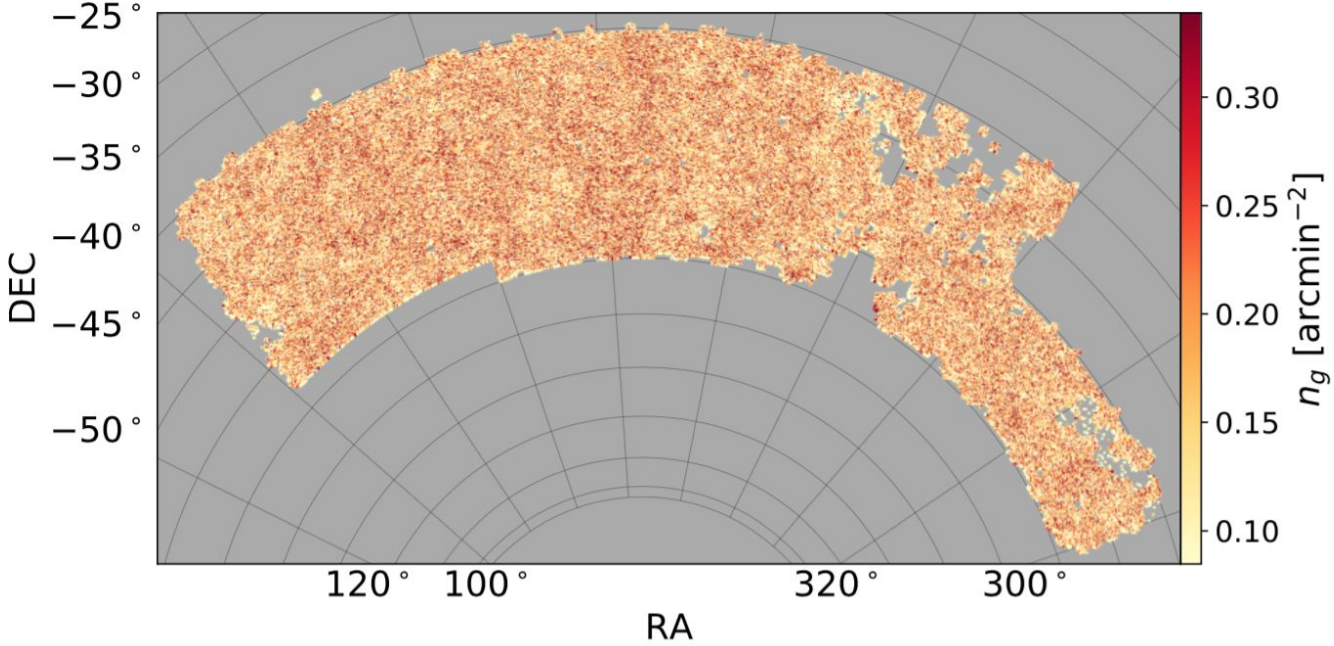
on behalf of the DES Collaboration
SCLSS Oxford, April 19 2018



Cosmological Constraints from Galaxy Clustering and Weak Lensing - samples

Galaxy position “lens” sample

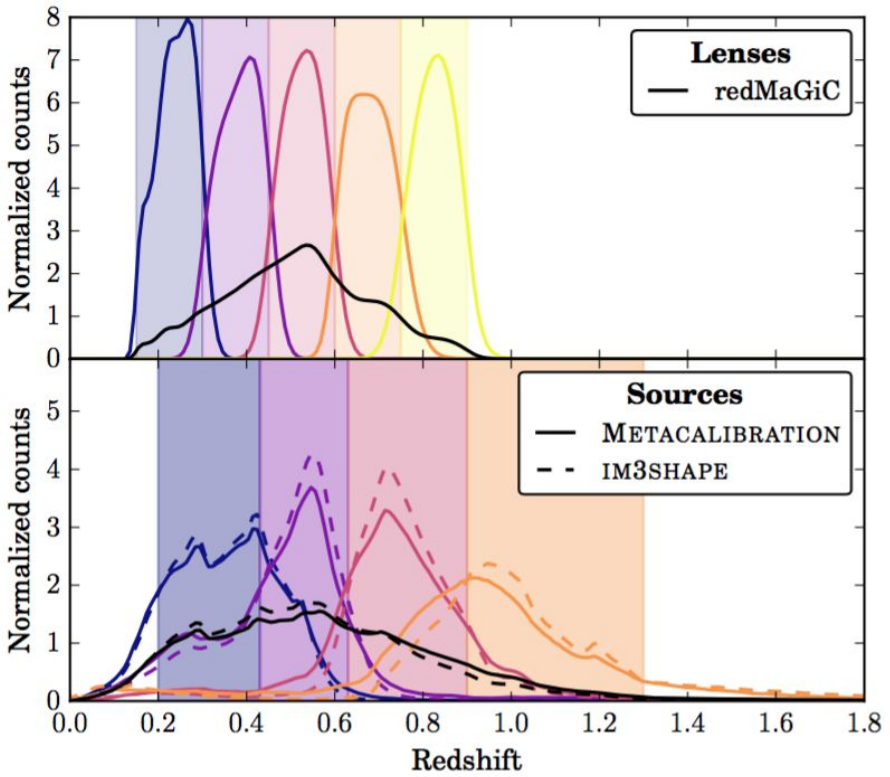
- redMaGiC - selection of red sequence DES galaxies. 0.6M galaxies.

Galaxy shape “source” samples

- Im3shape (21.9M) and Metacalibration (34.8M)

Measure three 2-point functions (3x2pt)
Shear-shear, galaxy-shear, galaxy-galaxy

$$\xi_{\pm}(\theta), \gamma_t(\theta), w(\theta)$$



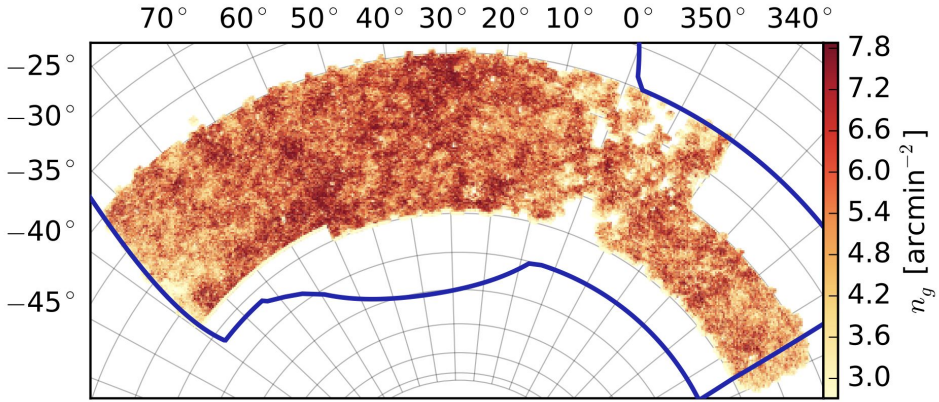
Shape Measurement

Having two catalogs give us extra confidence in our results.

- Primary catalog: Metacalibration
  - Internal calibration scheme using PSF deconvolution + shear + reconvolution
  - Similar to KiDS *self-calibration*

- Secondary catalog: Im3shape
  - Calibrated with simulations

- Blending is limiting factor leading to 2% residual multiplicative error



Intrinsic Alignments

$$C_{GG}^{(obs)}(l) = C_{GG}(l) + C_{GI}(l) + C_{IG}(l) + C_{II}$$

$$C_{gG}^{(obs)}(l) = C_{gG}(l) + C_{gI}(l)$$

Modelling the intrinsic alignment of galaxy shapes using the non-linear alignment model (Bridle & King 2017). Two parameters:

A_{IA} IA amplitude

η_{IA} IA z dependence

For cosmic shear only and future analyses we also use Tidal Alignment-Tidal Torquing (Blazek et al 2017) model

Shear calibration

(Zuntz et al. 2017, Samuroff et al 2017)

Calibrate multiplicative and additive shear bias

$$g_i = (1 + m_i) g_i^{\rm true} + \alpha e_i^{\rm PSF} + c_i$$

Marginalised over m_i in shear-shear and galaxy-shear modelling.

Prior:

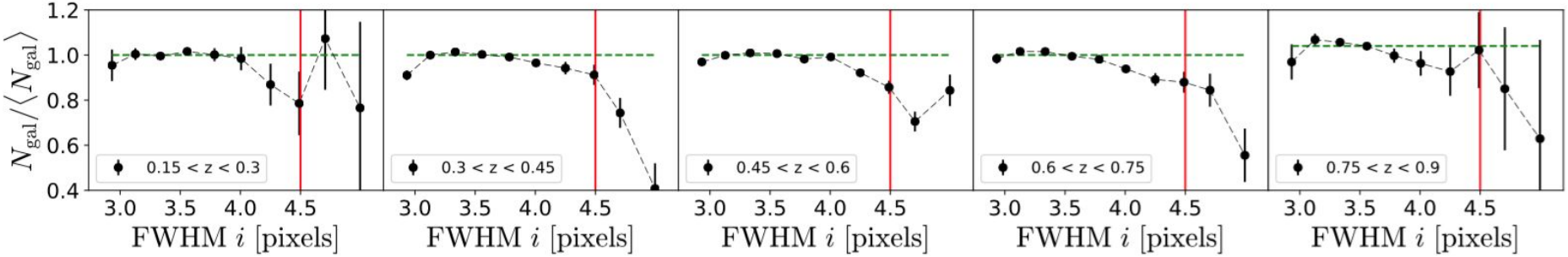
Metacalibration: 0.012 +/- 0.023

Im3shape: 0.000 +/- 0.025

Sky systematics (Elvin-Poole et al 2017)

The number density correlated with a number of survey properties.

The additional structure causing galaxy clustering measurements to bias high.



Correlations removed from analysis by weighting galaxies by the inverse of fitted correlation.

Uncertainty in weights shown to be negligible for Y1 errors.

Photo-z validation (Davis et al 2017, Ross et al 2017, Gatti et al 2017)

The bias in the BPZ redshift distribution is modelled in the cosmology analysis:

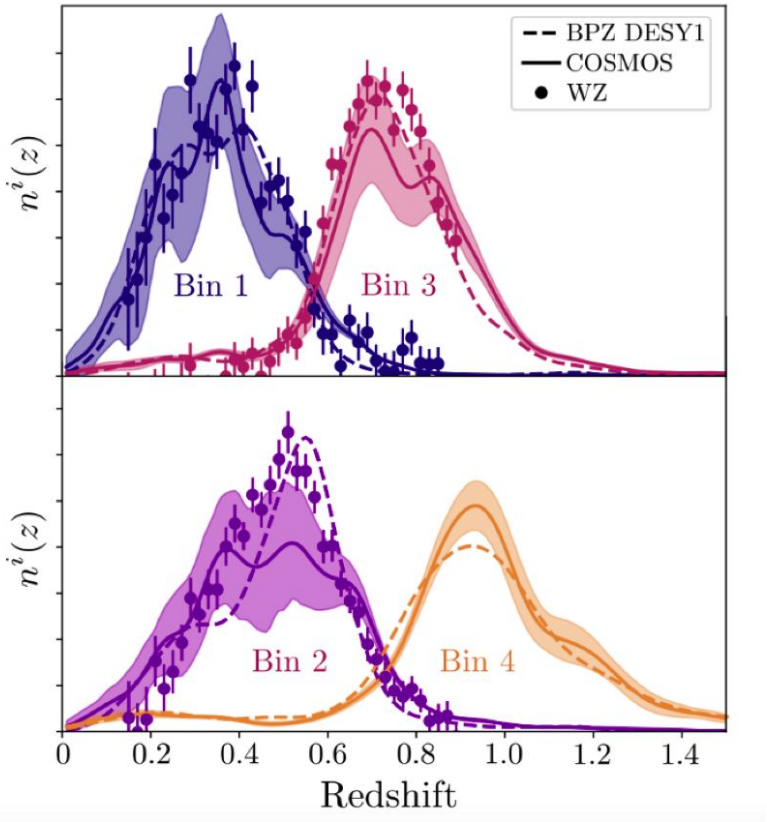
$$n^i(z) = n^i_{PZ}(z - \Delta z^i)$$

Validated with 3 methods:

COSMOS: We find the true mean of the samples using COSMOS sample. We also compare with a subset with spectra in COSMOS (Hoyle, Gruen et al 2017)

WZ: Use angular cross-correlation with samples that overlap with DES and have known redshifts (Davis, Gatti et al 2017, Ross et al 2017)

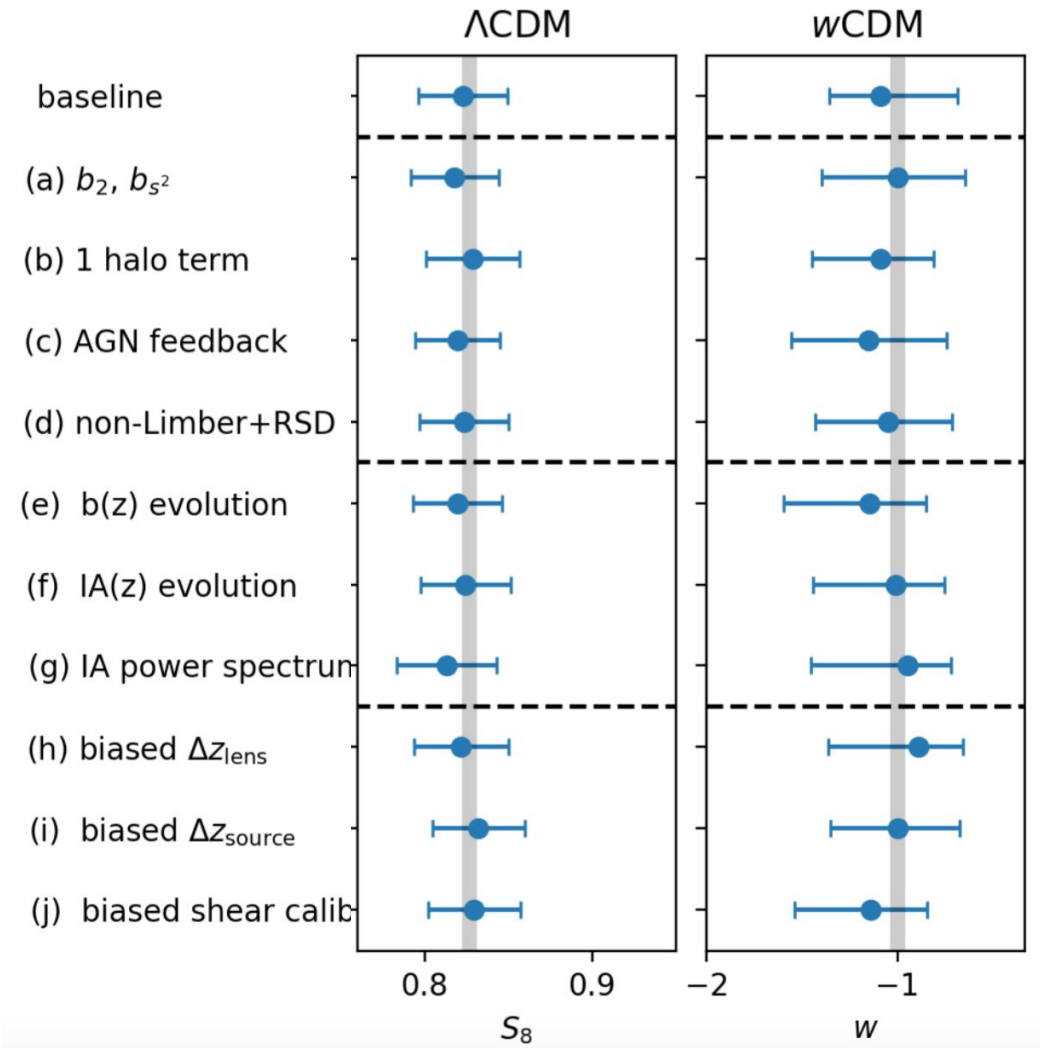
SHEAR-RATIO: Ratio of shear-galaxy cross-correlations for sources at different redshifts (Prat, Sanchez et al 2017)



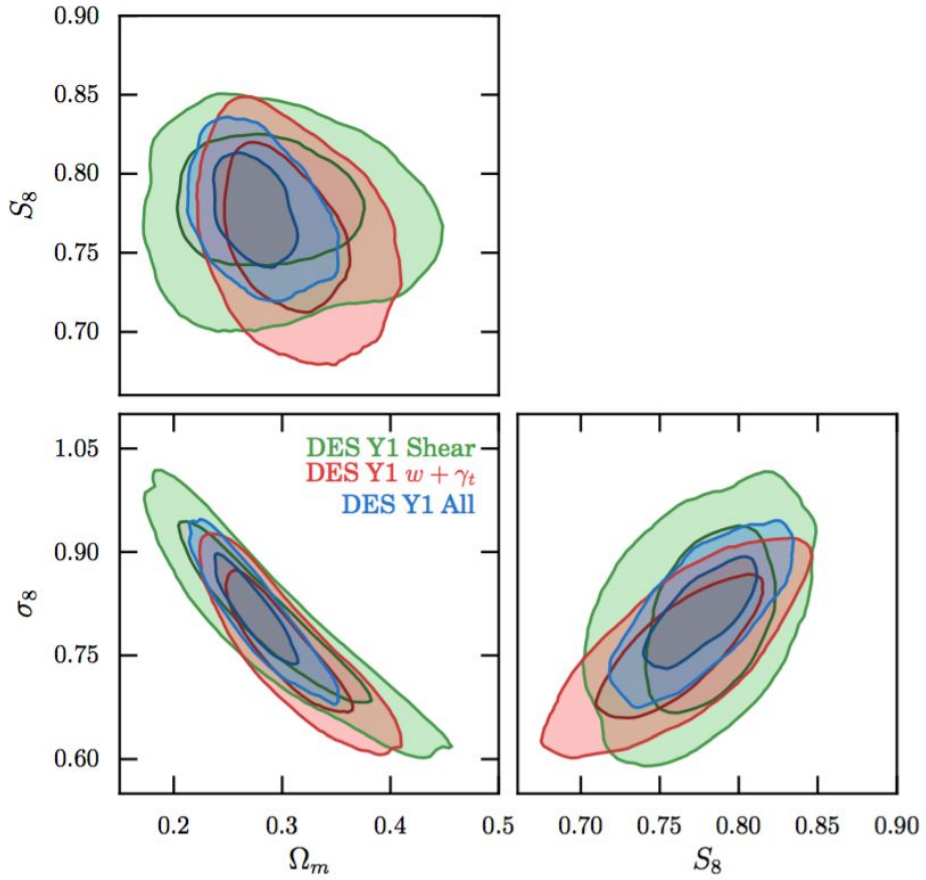
Scale Cuts (Krause et al 2017)

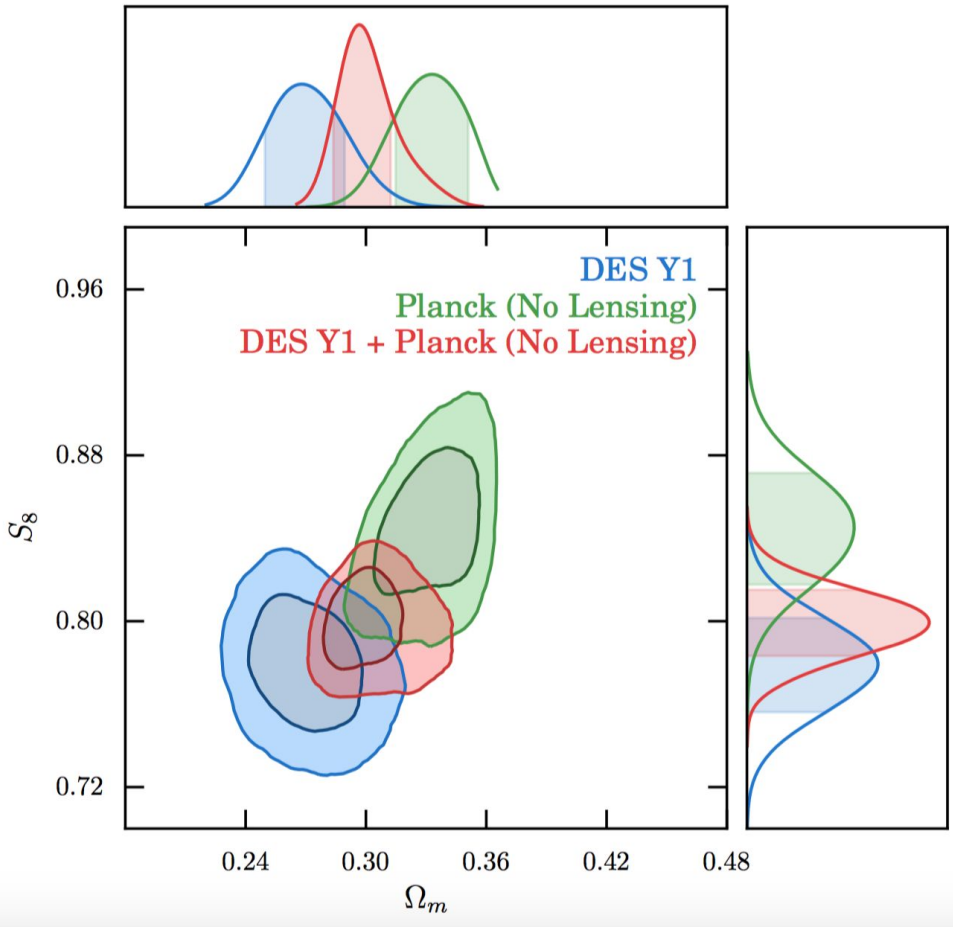
Angular scale cuts are chosen such that Ω_m, $\sigma_8(\Omega_m/0.3)^{0.5}$ and w are not biased from an artificially contaminated data vector.

Scales chosen for Year 1: 12Mpc for galaxy-shear, 8Mpc for clustering and cosmic shear

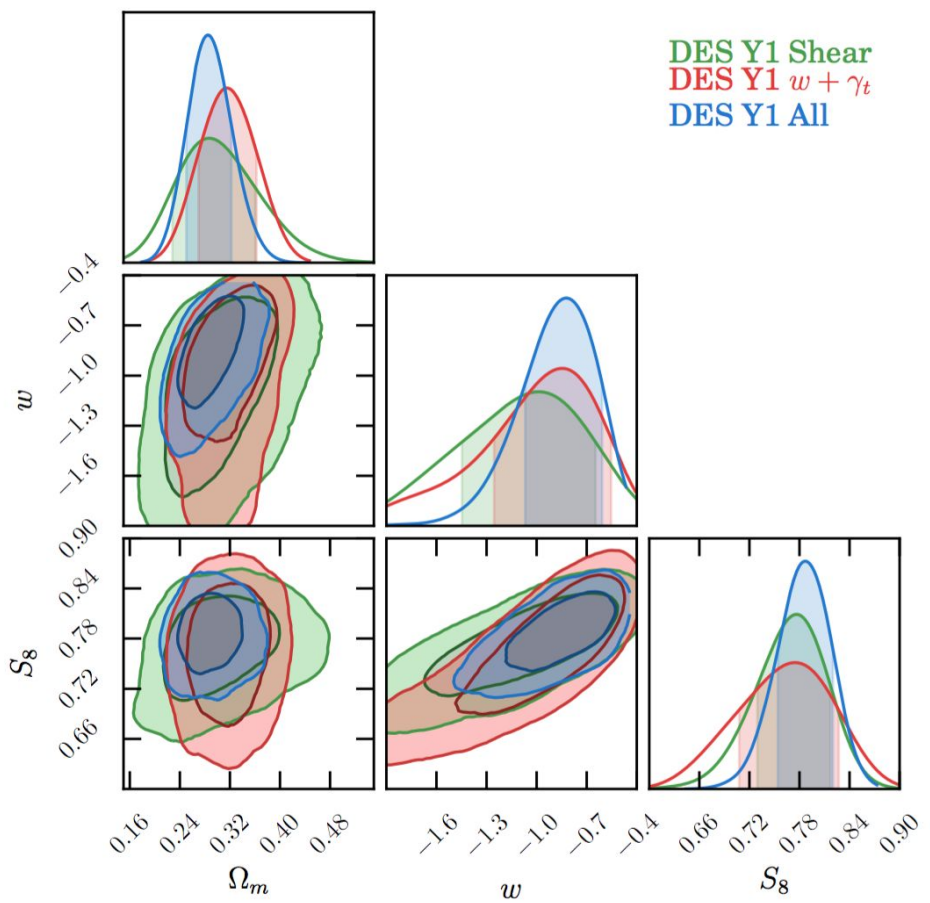


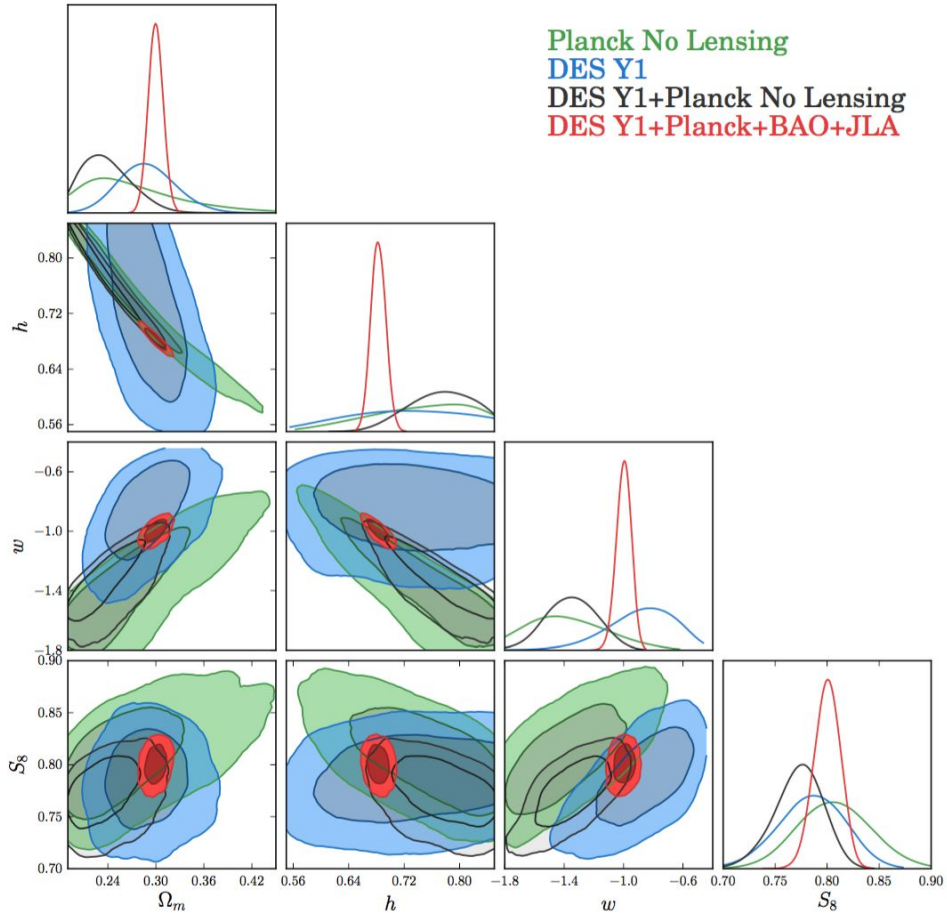
Cosmology Results LCDM





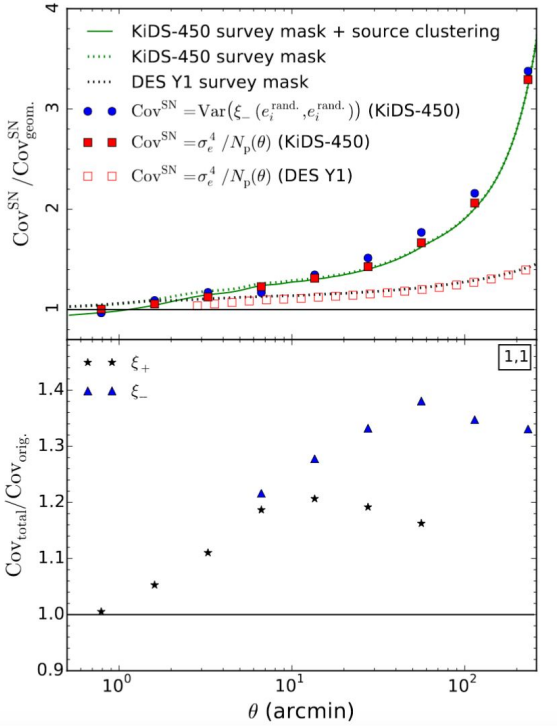
Cosmology Results wCDM





Shot noise covariance (NEW RESULT)

An update to the Y1 analysis: Testing the impact of the perfect geometry assumption in the shot noise covariance term.



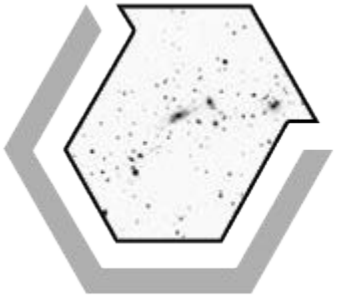
After the release of the DES Y1 results, we tested the impact of used the measured pair counts in the shot/shape noise covariance terms.

$$\mathrm{Cov}^{SN}(\xi_\pm^{ij}(\theta_1)\xi_\pm^{kl}(\theta_2)) = \frac{(\sigma_\epsilon^i \sigma_\epsilon^j)^2}{N_p^{ij}(\theta_1)} \delta_{\theta_1,\theta_2}(\delta_{ik}\delta_{jl} + \delta_{il}\delta_{jk})$$

Often assumed that $N_p^{ij} = 2\pi\theta\Delta\theta A\bar{n}^i\bar{n}^j$

Including this improves the DES fit to χ2/dof=1.16

Applying this to the KIDS-450 also improves χ2



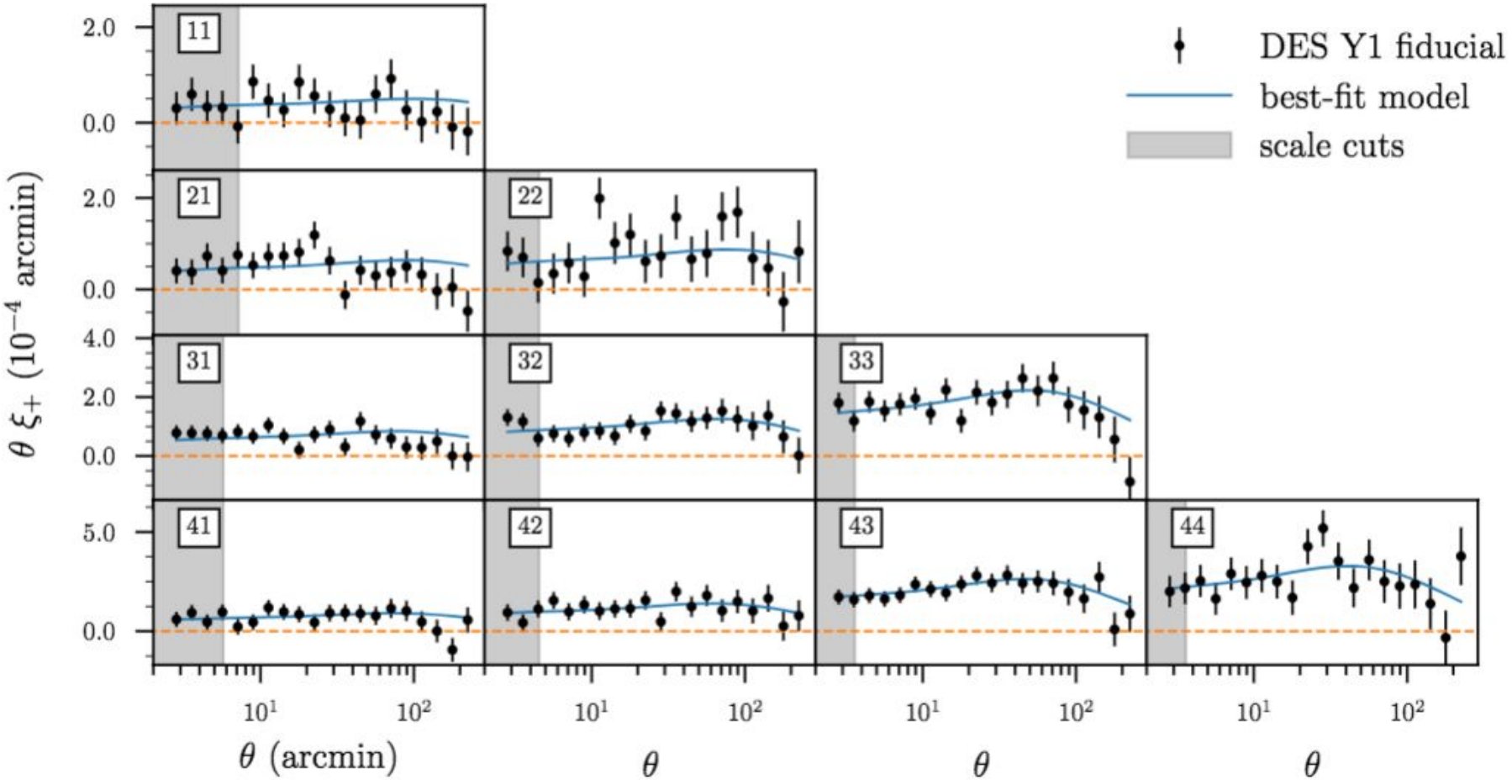
THE DARK ENERGY SURVEY

SCLSS Oxford, April 19 2018

Thanks!

Extra plots

Parameter	Prior
Cosmology	
Ω_m	flat (0.1, 0.9)
A_s	flat $(5 \times 10^{-10}, 5 \times 10^{-9})$
n_s	flat (0.87, 1.07)
Ω_b	flat (0.03, 0.07)
h	flat (0.55, 0.91)
$\Omega_\nu h^2$	flat$(5 \times 10^{-4}$,$10^{-2})$
w	flat $(-2,-0.33)$
Lens Galaxy Bias	
$b_i(i = 1, 5)$	flat (0.8, 3.0)
Intrinsic Alignment	
$A_{\rm IA}(z) = A_{\rm IA}[(1+z)/1.62]^{\eta_{\rm IA}}$	
$A_{\rm IA}$	flat $(-5, 5)$
$\eta_{\rm IA}$	flat $(-5, 5)$
Lens photo-z shift (red sequence)	
$\Delta z_{\rm l}^1$	Gauss $(0.001, 0.008)$
$\Delta z_{\rm l}^2$	Gauss $(0.002, 0.007)$
$\Delta z_{\rm l}^3$	Gauss $(0.001, 0.007)$
$\Delta z_{\rm l}^4$	Gauss $(0.003, 0.01)$
$\Delta z_{\rm l}^5$	Gauss $(0.0, 0.01)$
Source photo-z shift	
$\Delta z_{\rm s}^1$	Gauss $(-0.001, 0.016)$
$\Delta z_{\rm s}^2$	Gauss $(-0.019, 0.013)$
$\Delta z_{\rm s}^3$	Gauss $(+0.009, 0.011)$
$\Delta z_{\rm s}^4$	Gauss $(-0.018, 0.022)$
Shear calibration	
$m^i_{\rm METACALIBRATION}(i = 1, 4)$	Gauss $(0.012, 0.023)$
$m^i_{\rm IM3SHAPE}(i = 1, 4)$	Gauss $(0.0, 0.035)$


DES Y1 fiducial
best-fit model
scale cuts
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32
33
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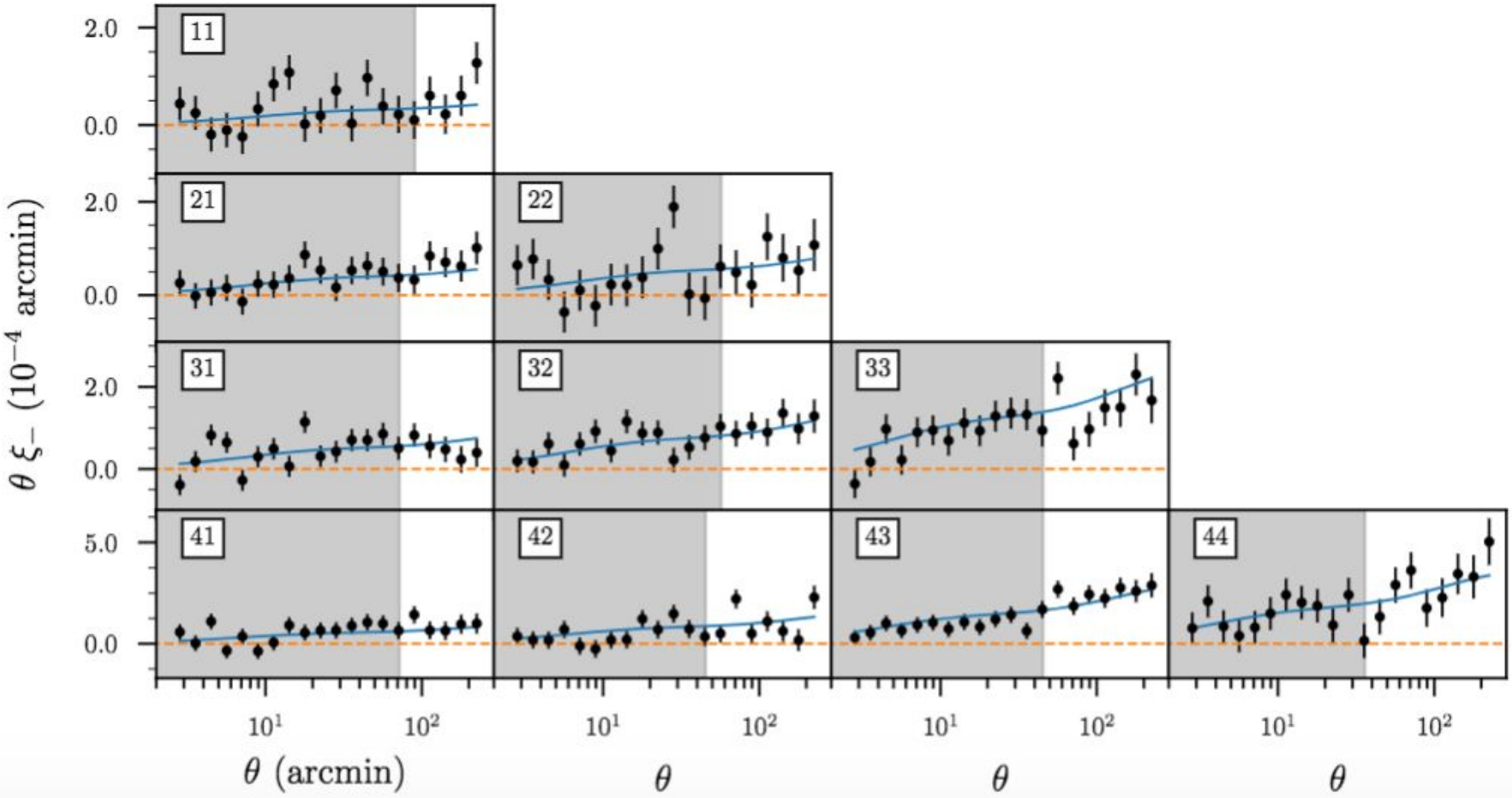
43
44
$\theta\,\xi_+$ (10^{-4} arcmin)
θ (arcmin)
θ
θ
θ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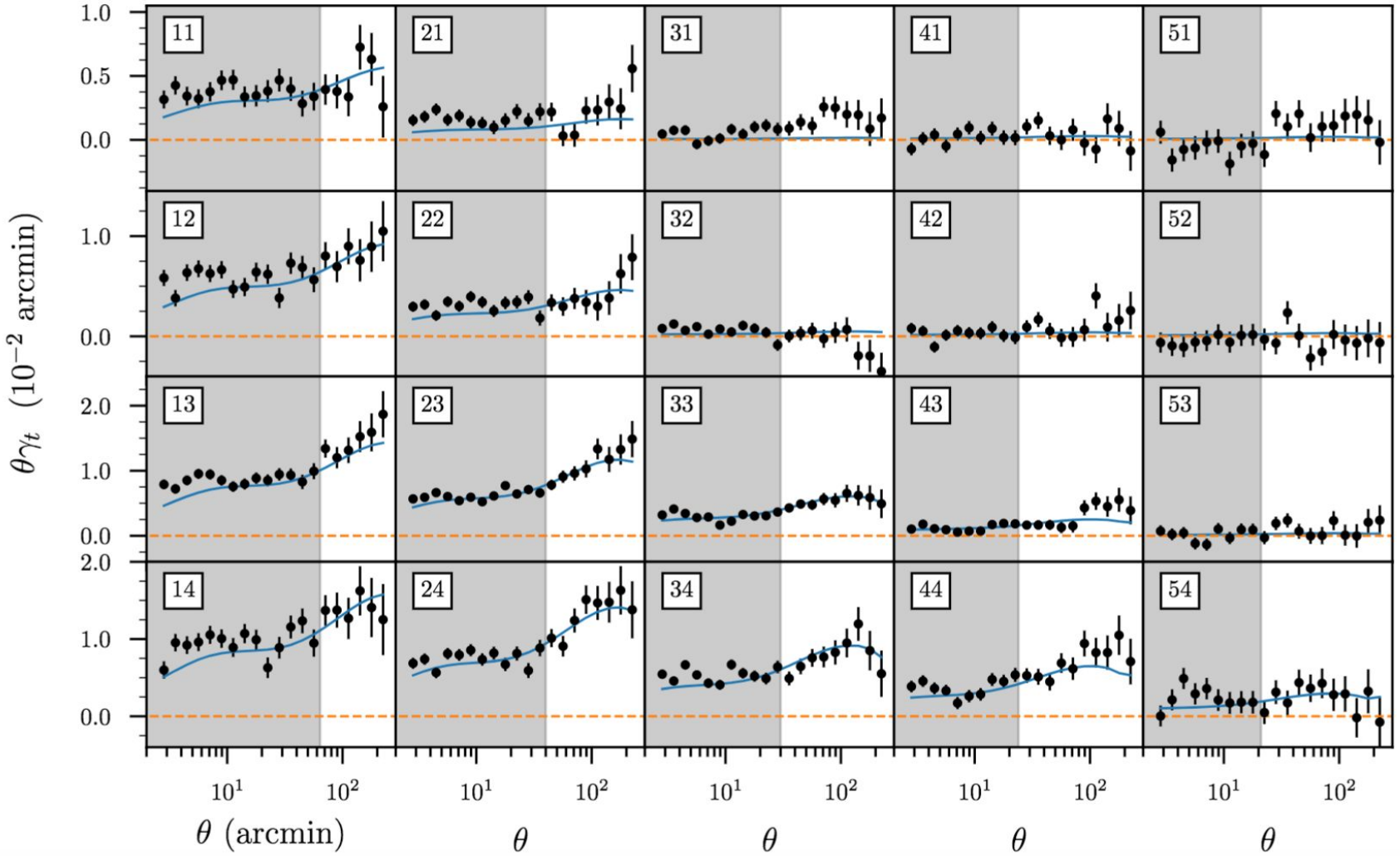
2.0
0.0
5.0
$\theta\,\xi_-$ (10^{-4} arcmin)
10^1
10^2
θ (arcmin)
θ


11
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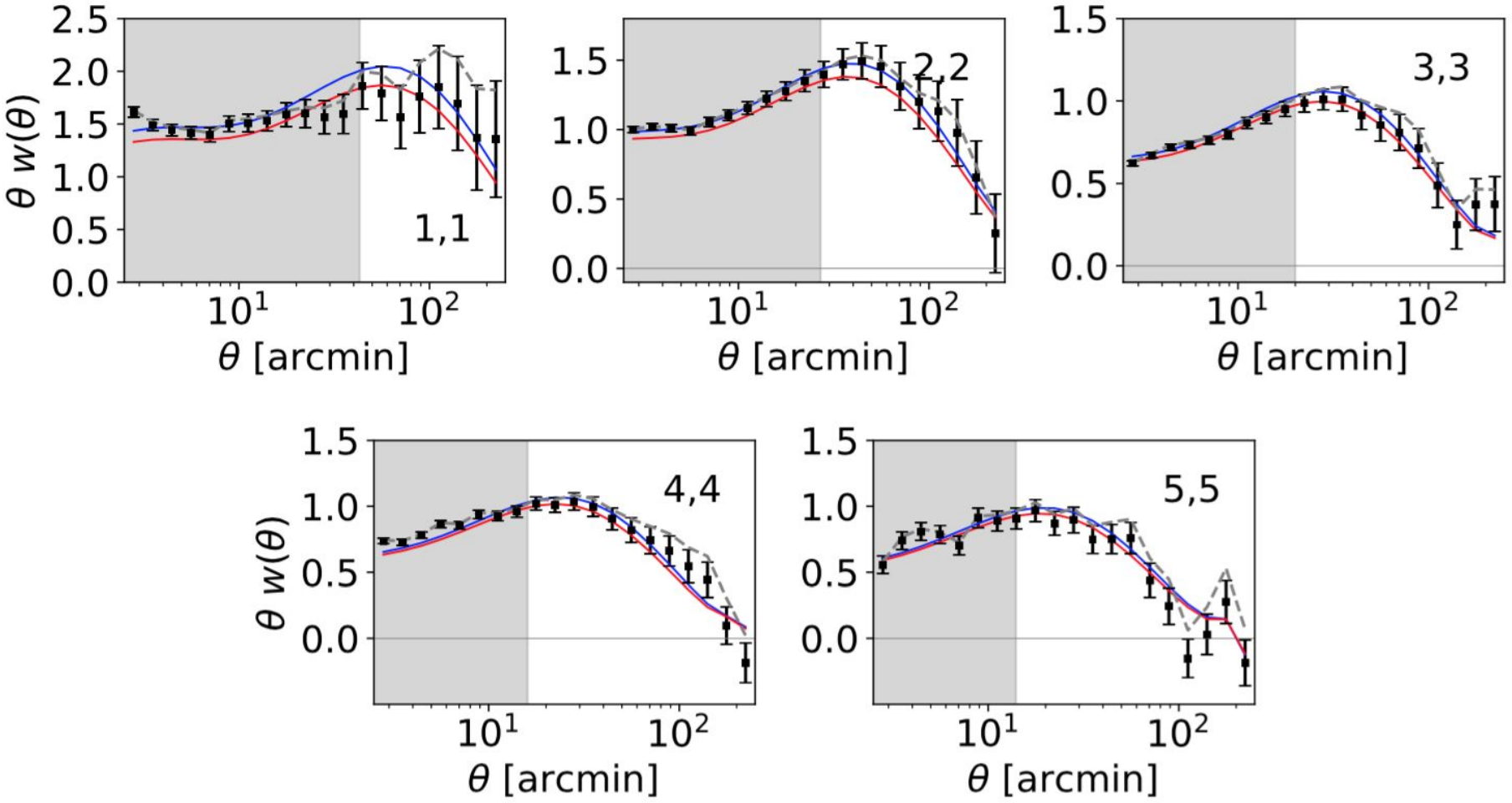
14
24
34
44
54
1.0
0.5
0.0
2.0
$\theta\gamma_t$ (10^{-2} arcmin)
10^1
10^2
θ (arcmin)
θ


θ w(θ)
θ [arcmin]
1,1
2,2
3,3
4,4
5,5