



THE DARK ENERGY SURVEY

DES Y1 Cosmology Results & Testing gravity with LSS

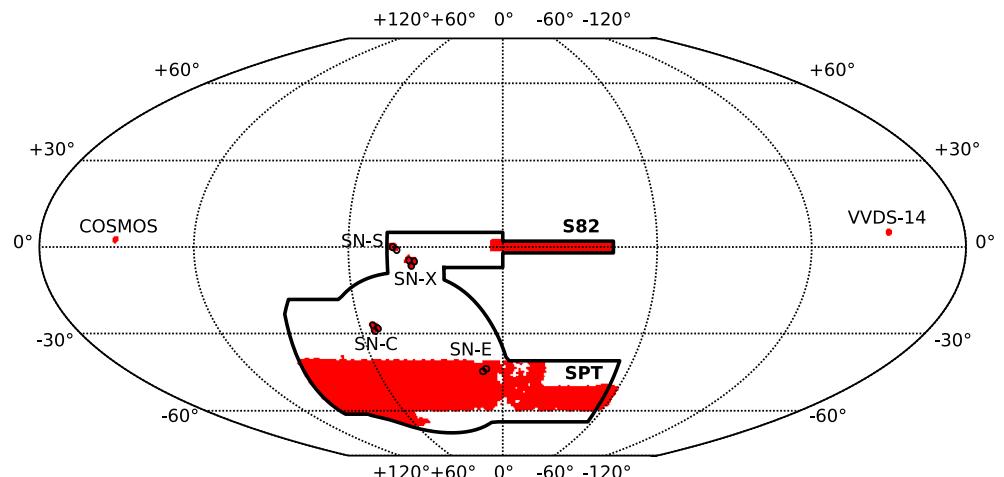
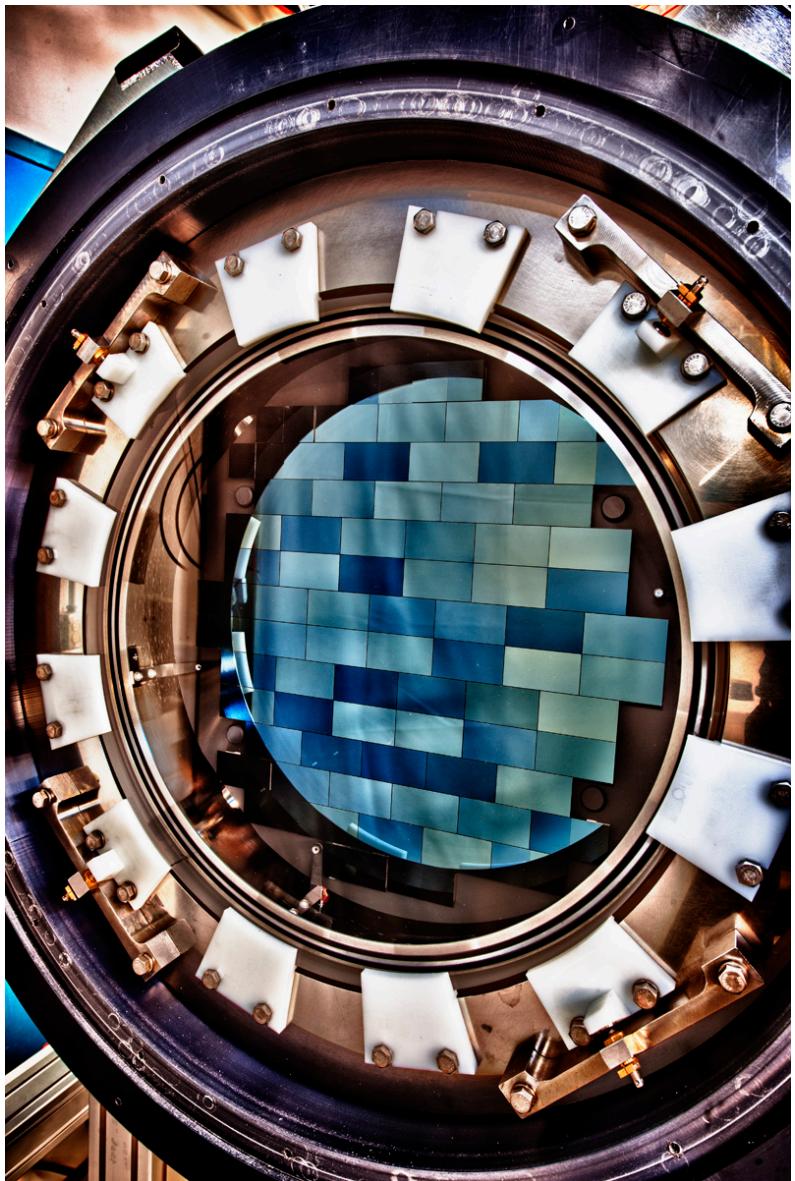
Agnès Ferté

Royal Observatory, Edinburgh

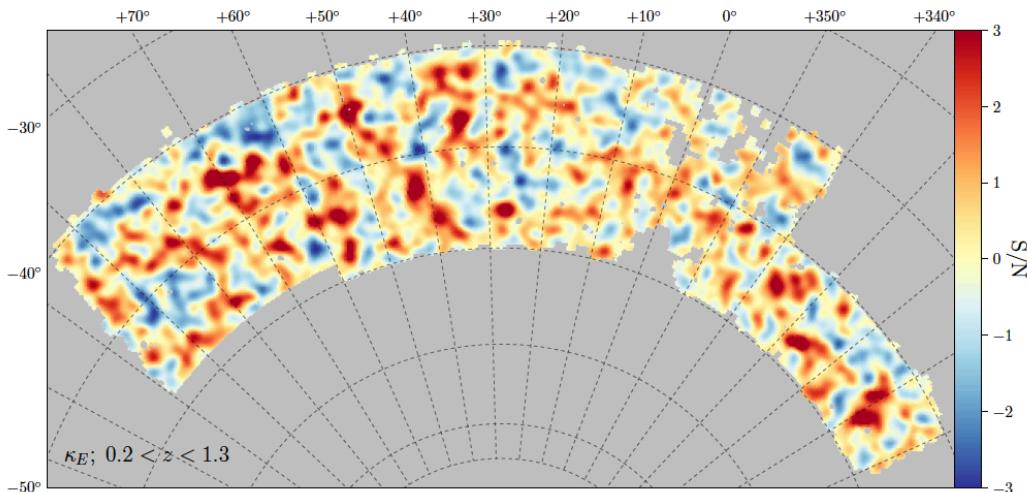
DES Y1 Cosmology Results

From 3x2pt statistics

DES Y1

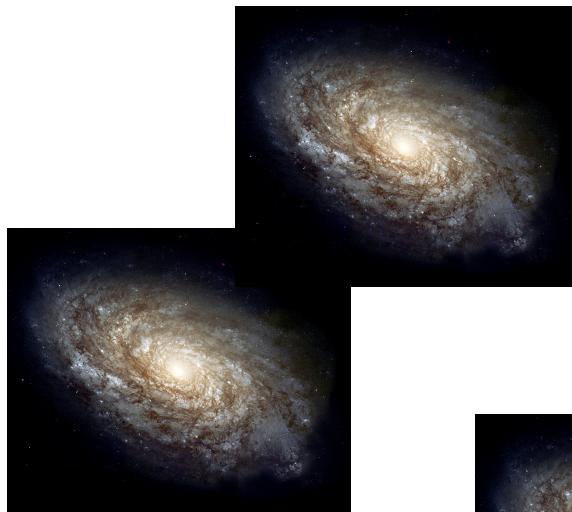


From Drlica-Wagner, et al, 2017



From Chang et al, 2017

Observables



Shape

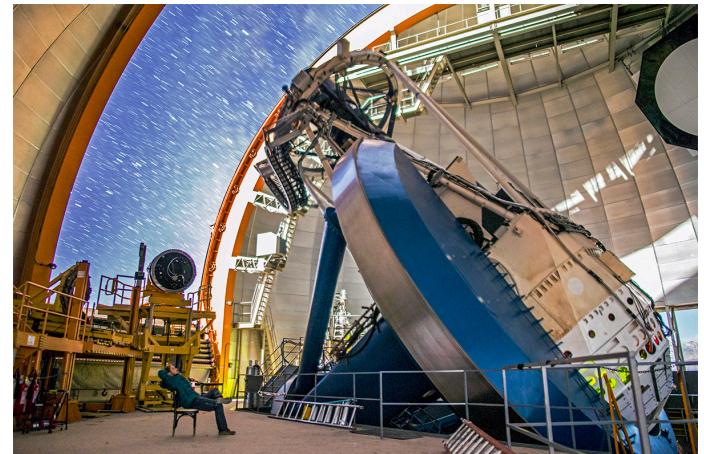
Source



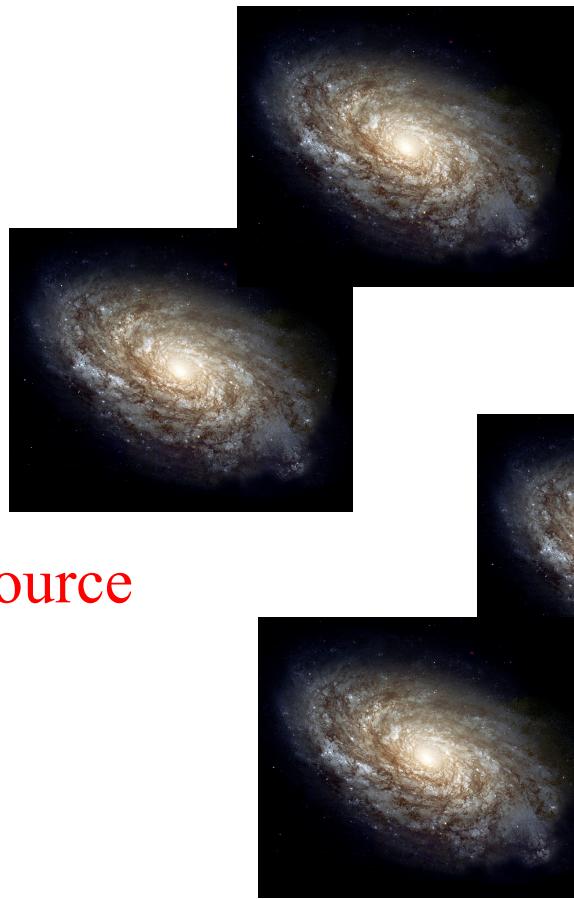
Lens



Position

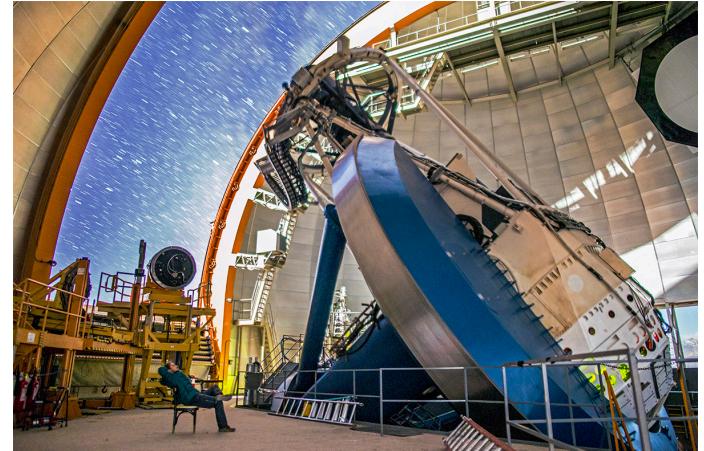
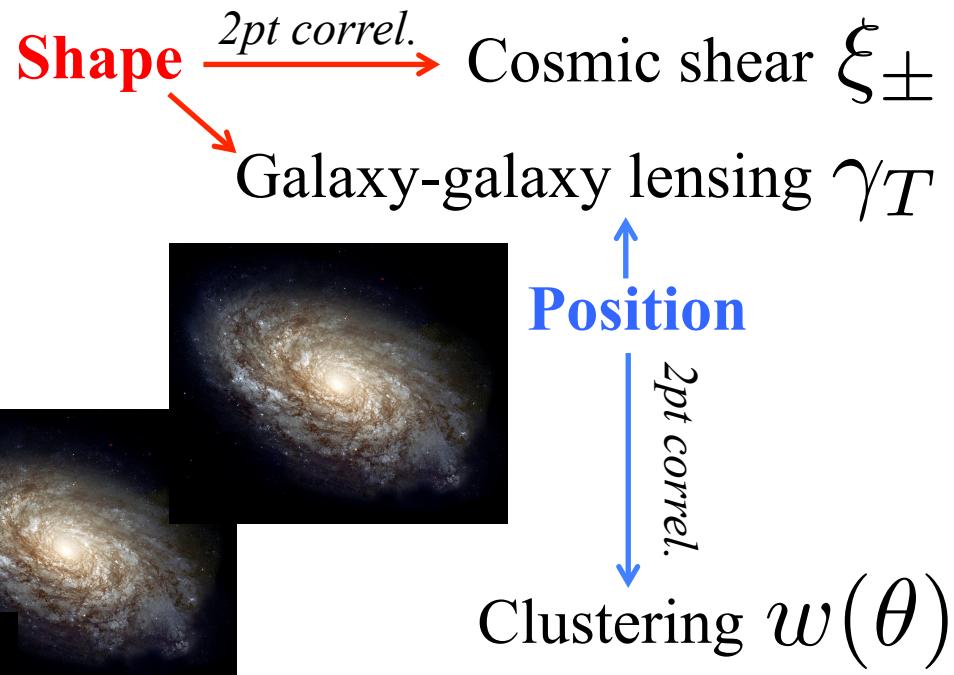


Observables



Source

Lens



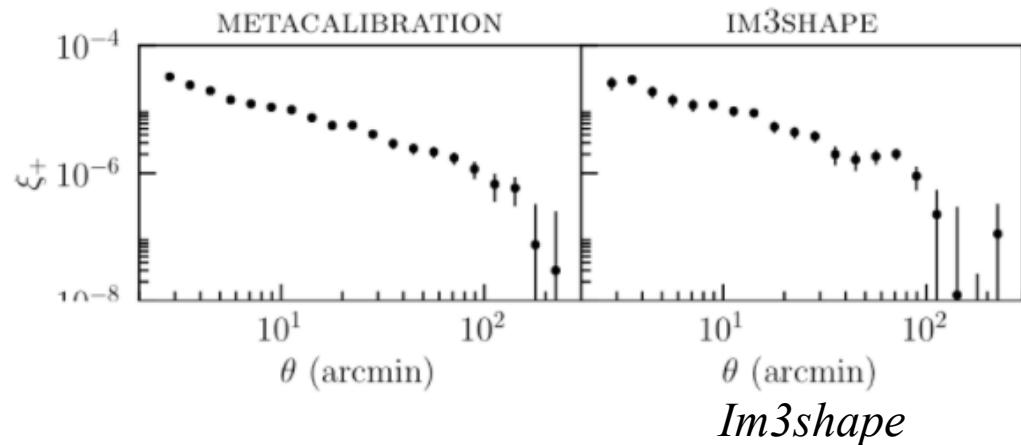
Galaxies

- Lens galaxies: redMaGiC catalog.

- Source galaxies:

Galaxy shapes

MetaCalibration



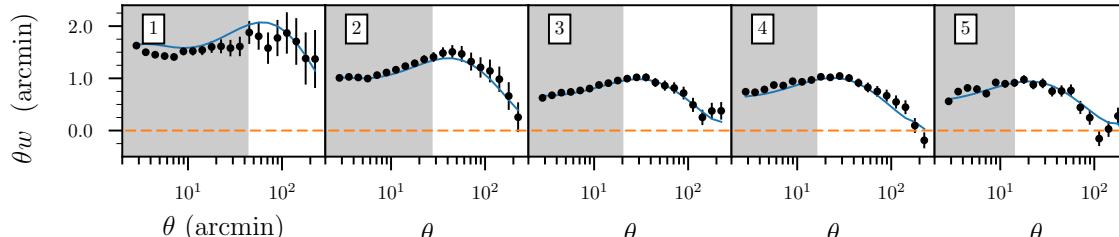
Shear a simulation image with the psf. Get the response.

(Huff et al, 2017)

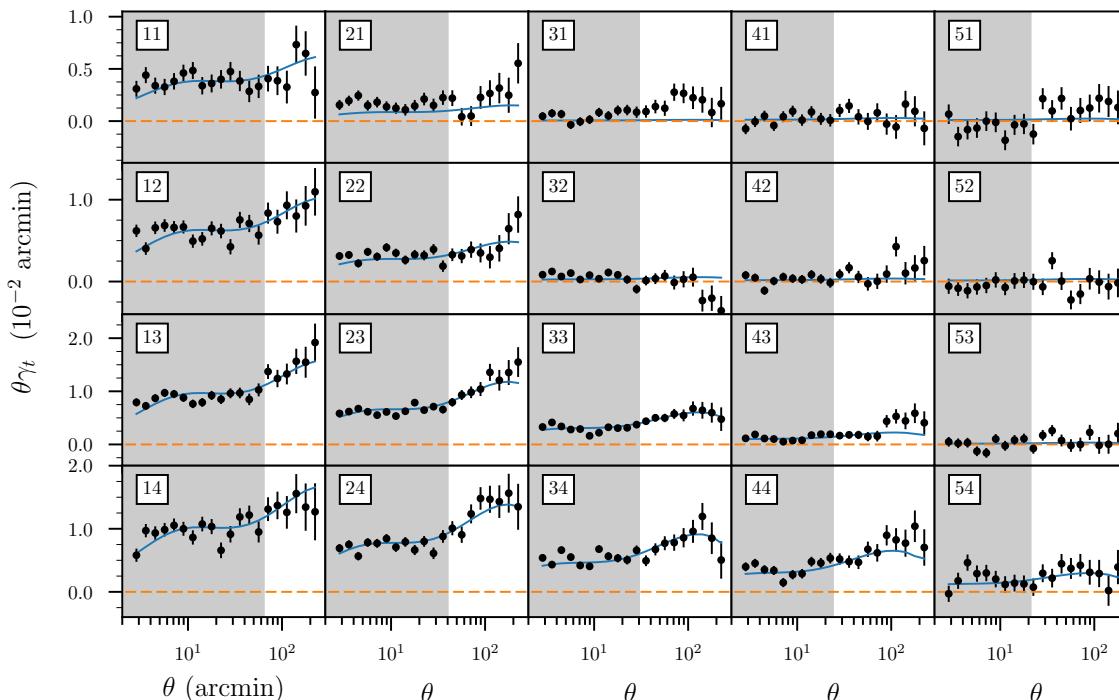
Fitting a bulge or a disc model to the galaxies
(Zuntz et al, 2013)

Photometric redshifts (Hoyle et al, 2017)

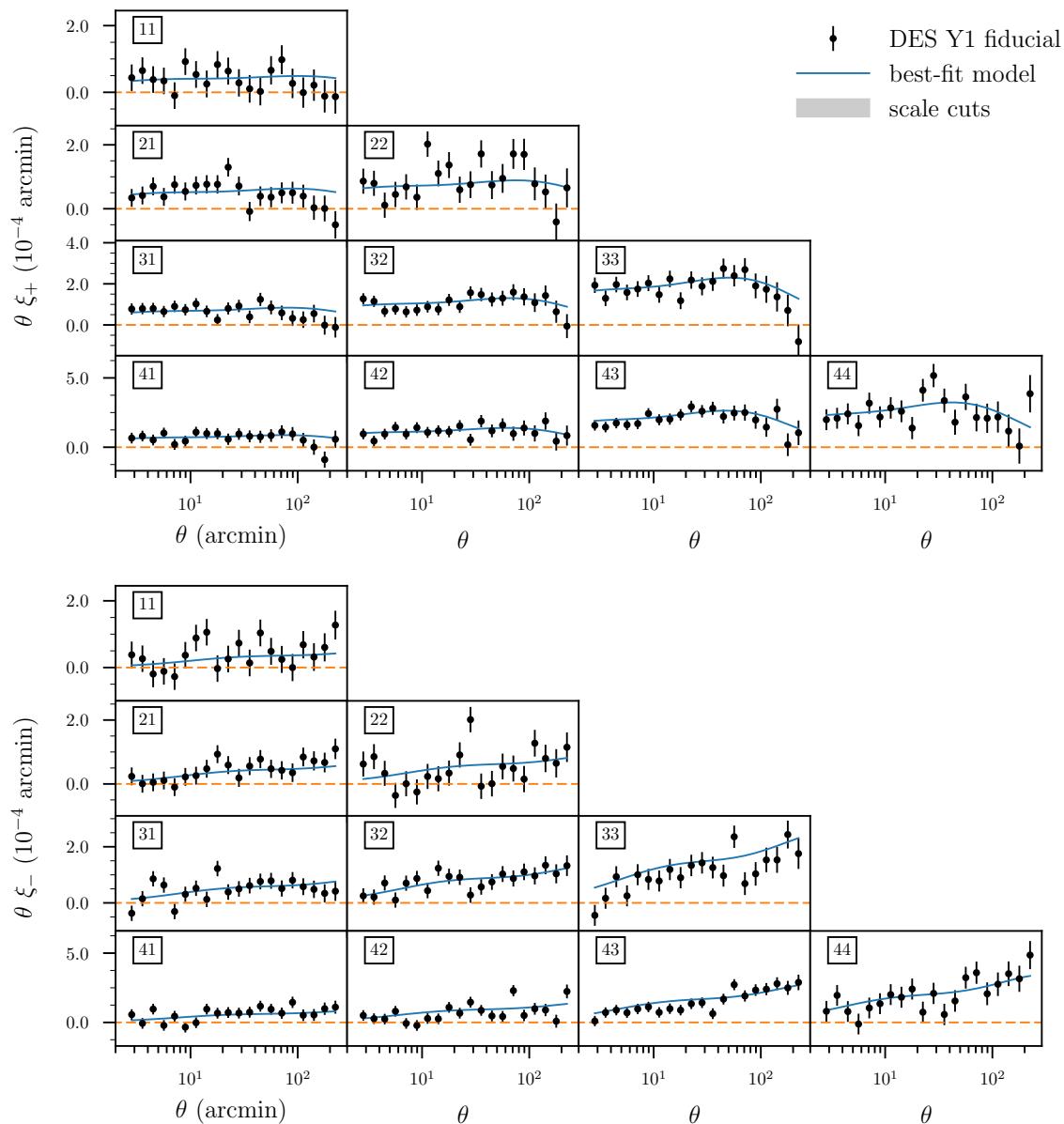
Measurements: clustering and g-g lensing



◆ DES Y1 fiducial
— best-fit model
■ scale cuts

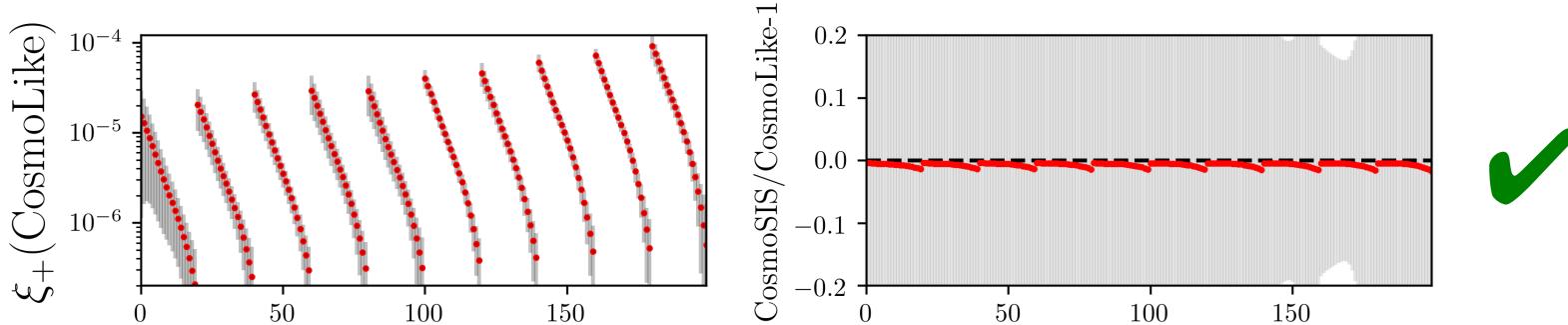


Measurements: cosmic shear



From measurements to cosmology

- Tests on N-body simulation
- Blinding in the shear catalog and the parameter estimation
→ 12 steps to validate before unblinding
 - e.g. CosmoSIS and CosmoLike



From Krause *et al*, 2017

- MCMC/Multinest to estimate the cosmological constraints and the Bayes factor.

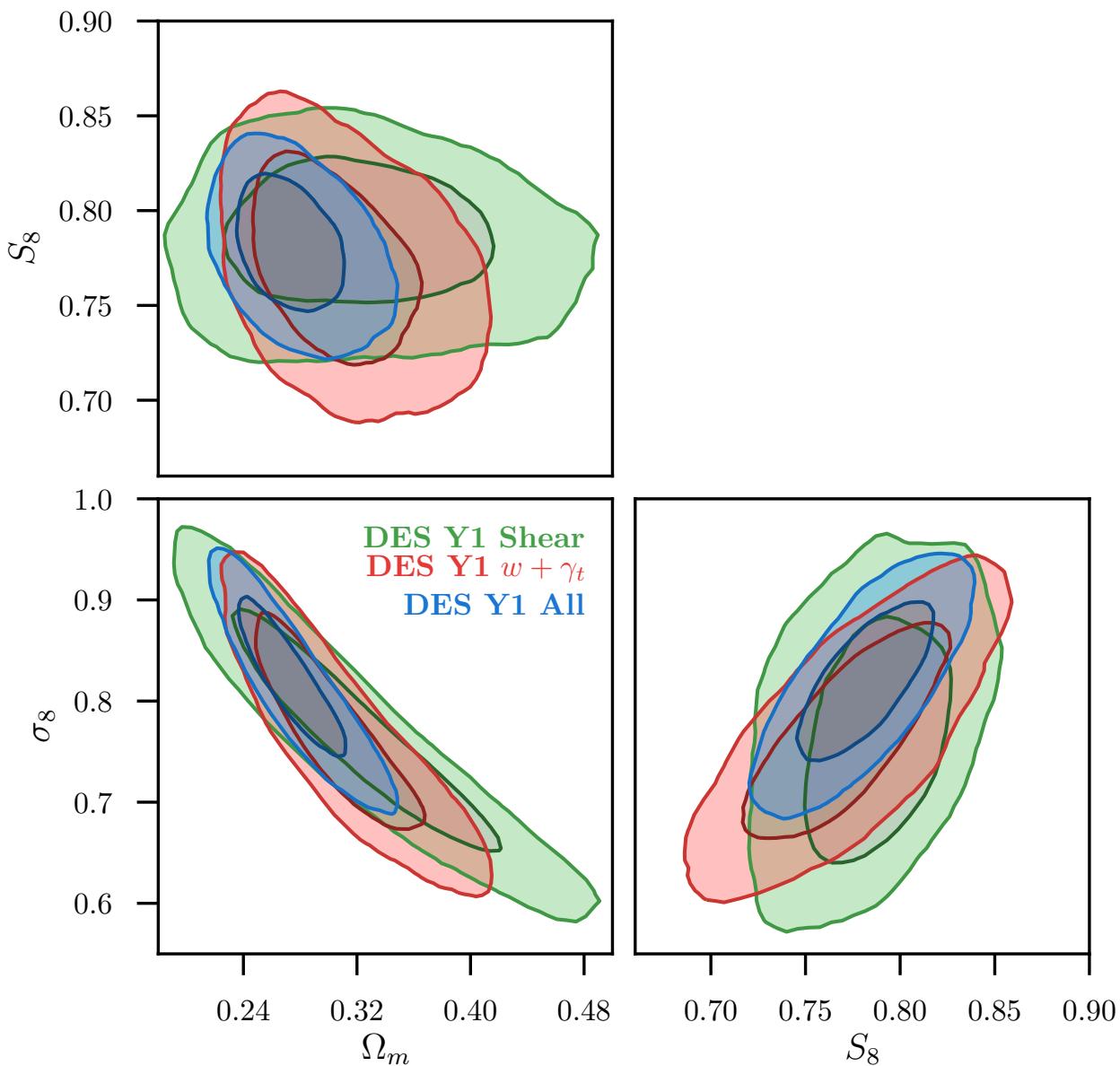
Can we combine the data sets?

Bayes factor: which hypothesis between H_0 and H_1 is favoured?

$$R = \frac{P(\vec{D}|H_0)}{P(\vec{D}|H_1)} = \frac{P(H_0|\vec{D})P(H_1)}{P(H_1|\vec{D})P(H_0)}$$

$R > 0.1$: condition to combine data.

Λ CDM from DES Y1



External data sets

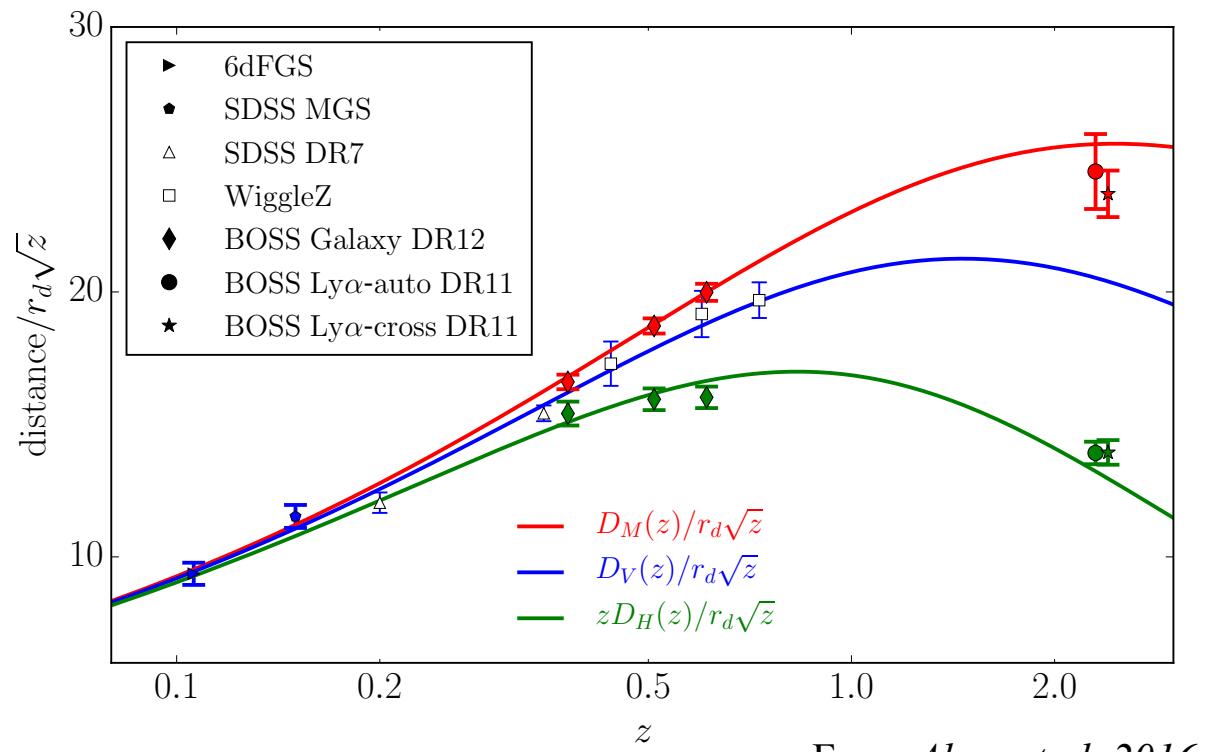
CMB:

Planck TT + lowP

Background:

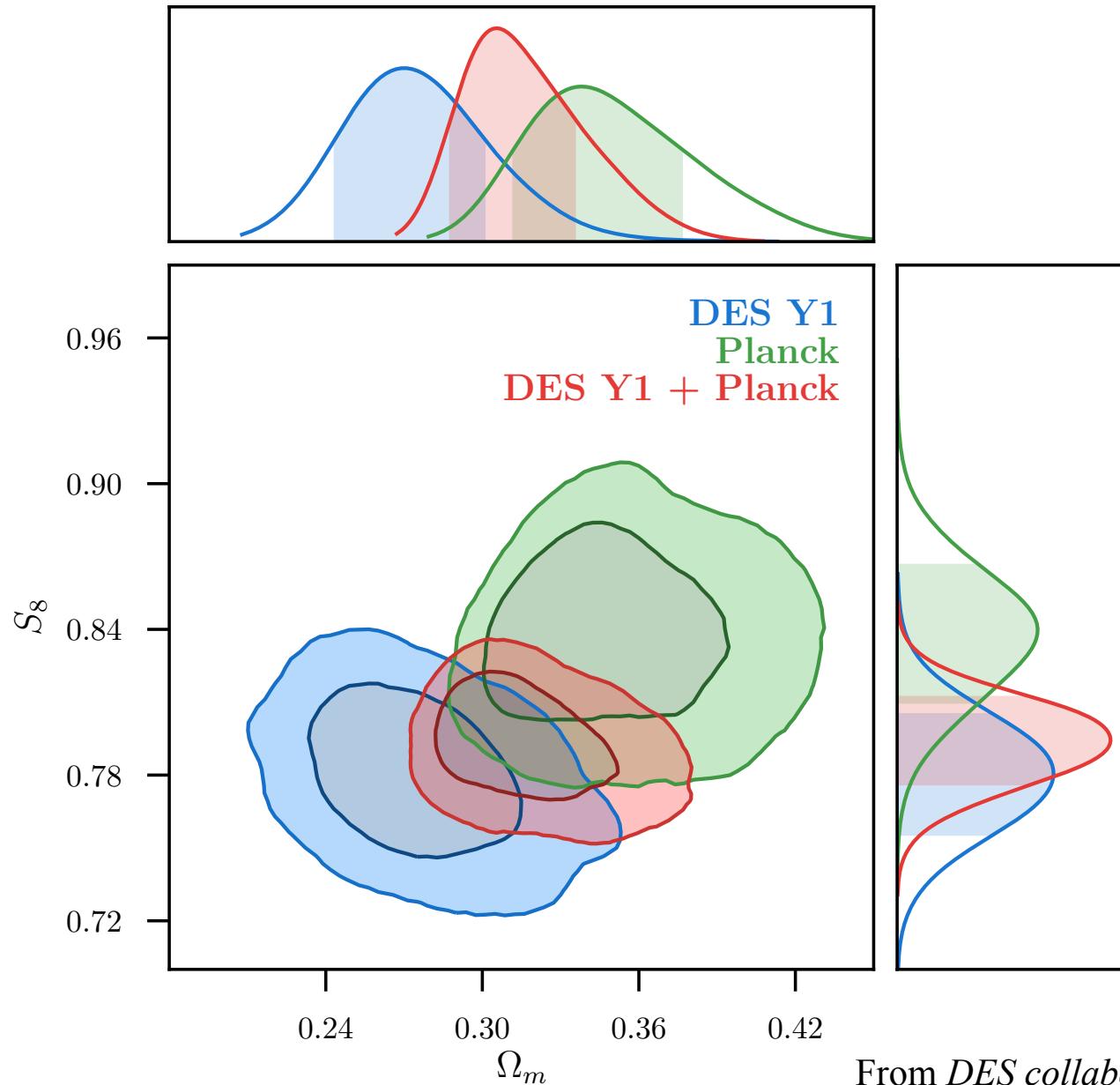
BAO: BOSS DR12, 6dFGS, MGS

Supernovae: JLA



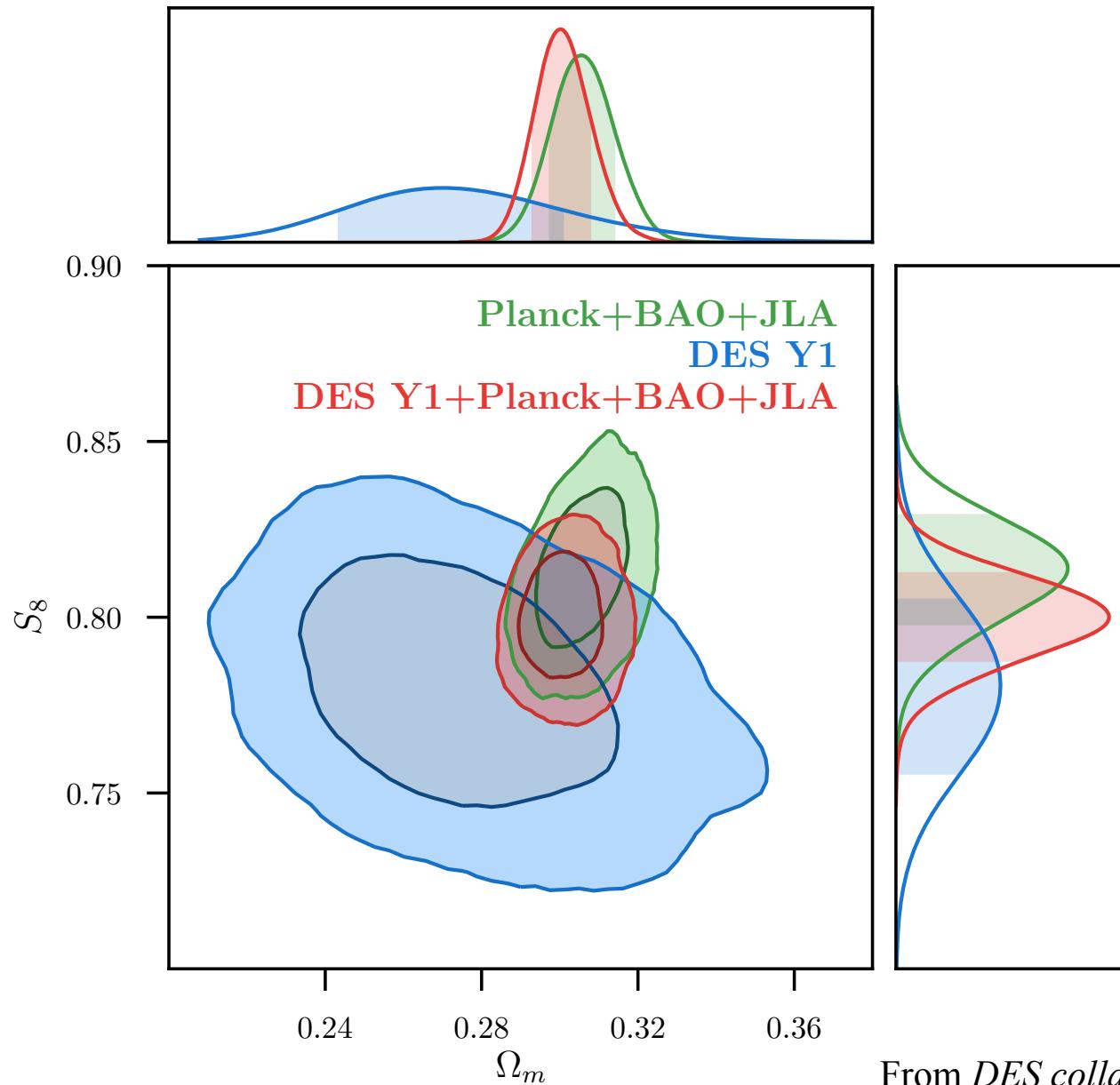
From Alam *et al*, 2016

Λ CDM: low vs high redshift

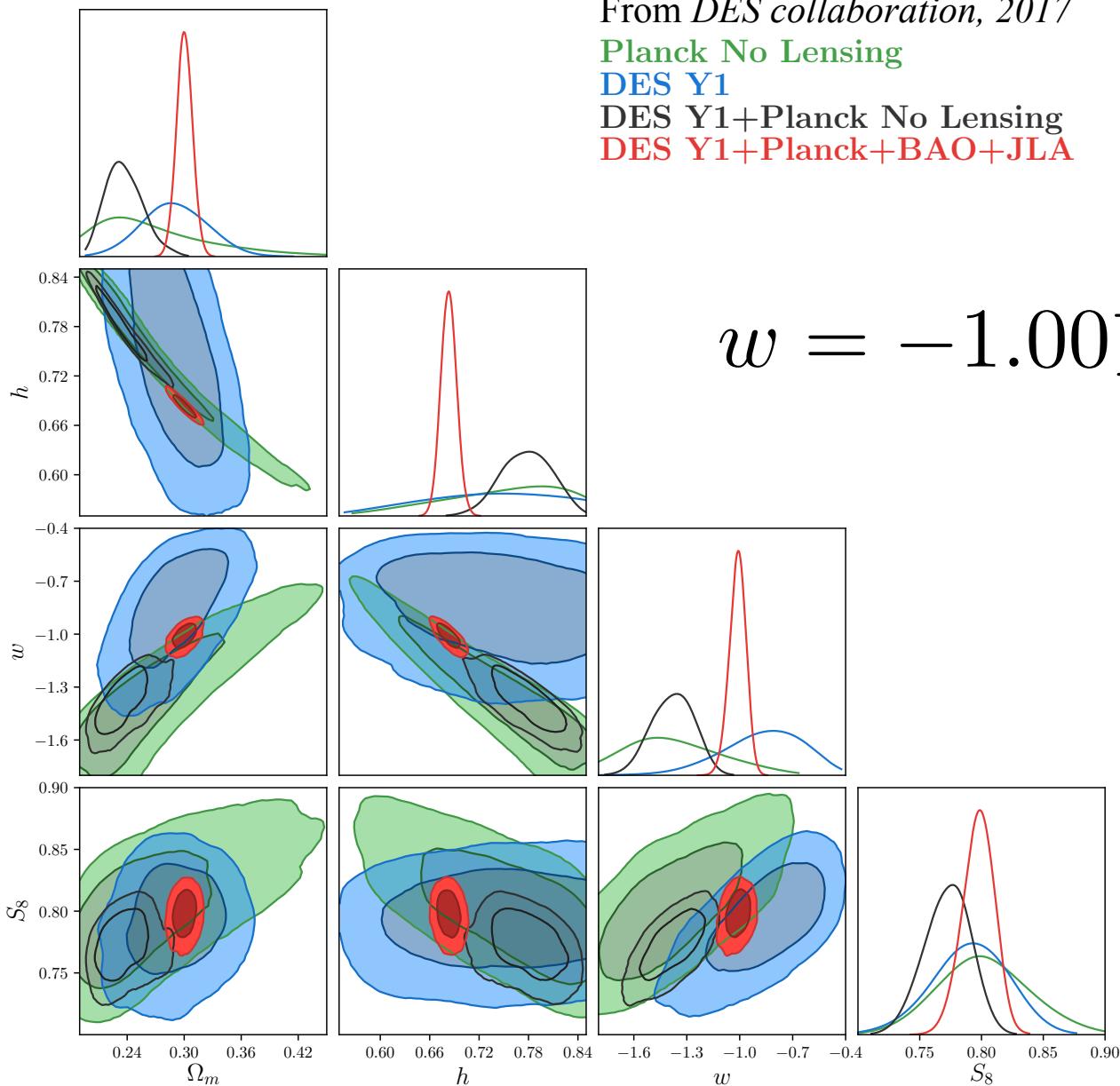


From *DES collaboration, 2017*

Λ CDM: thightest constraints



wCDM: combination



Beyond Λ /wCDM

Testing gravity

Phenomenological parametrisation

$$ds^2 = a^2 [- (1 + 2\Psi) d\tau^2 + (1 - 2\Phi) dx^2]$$

Modification of laws of gravity:

- Poisson equation
- Lensing
- Anisotropic stress
- Growth of structure

→ Parameters $Q, R, \Sigma, \mu, \gamma, \dots$

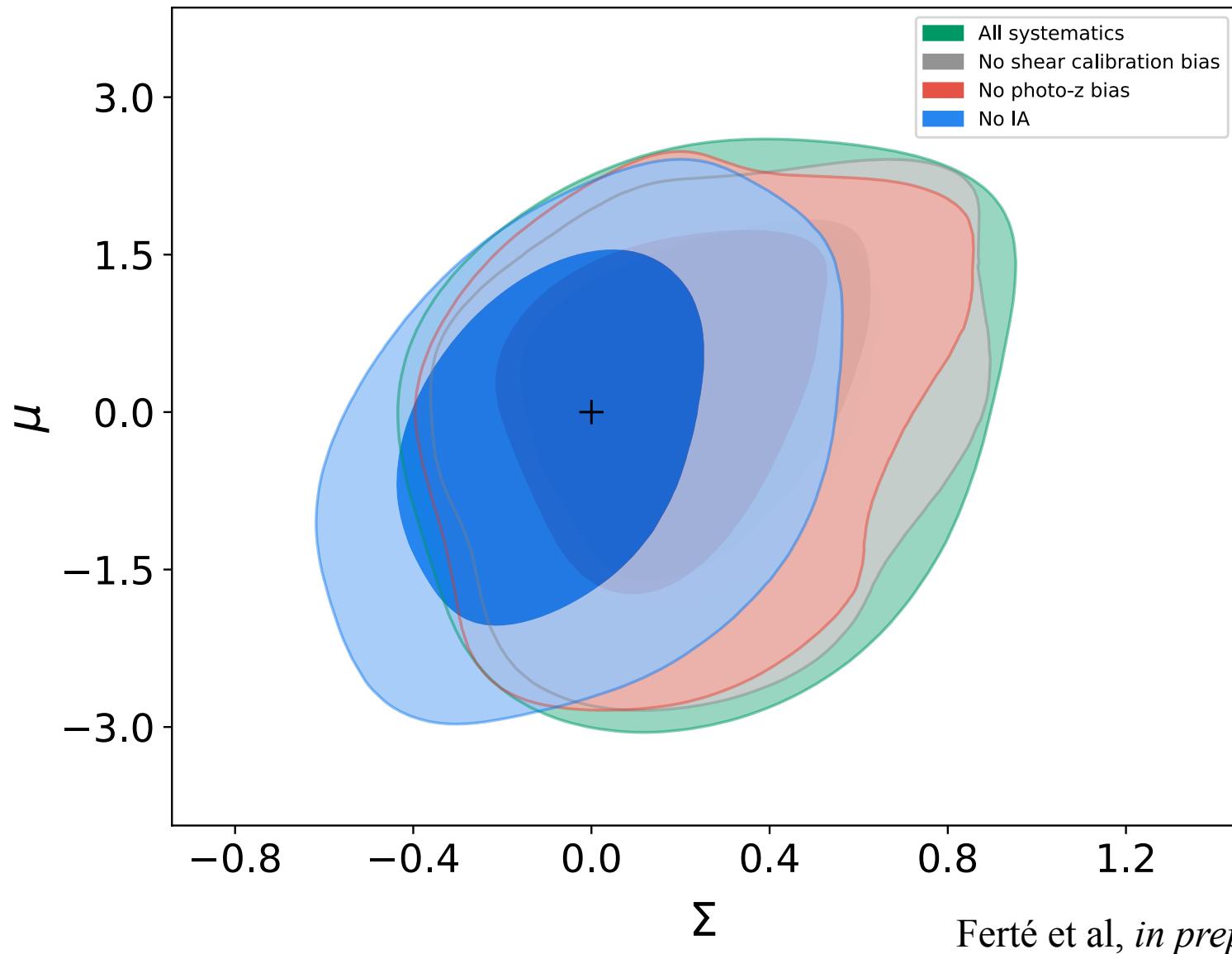
$$k^2(\phi + \psi) = -8\pi G a^2 (1 + \Sigma(a, k)) \bar{\rho} \delta$$

$$k^2 \psi = -4\pi G a^2 (1 + \mu(a, k)) \bar{\rho} \delta$$

Our analysis

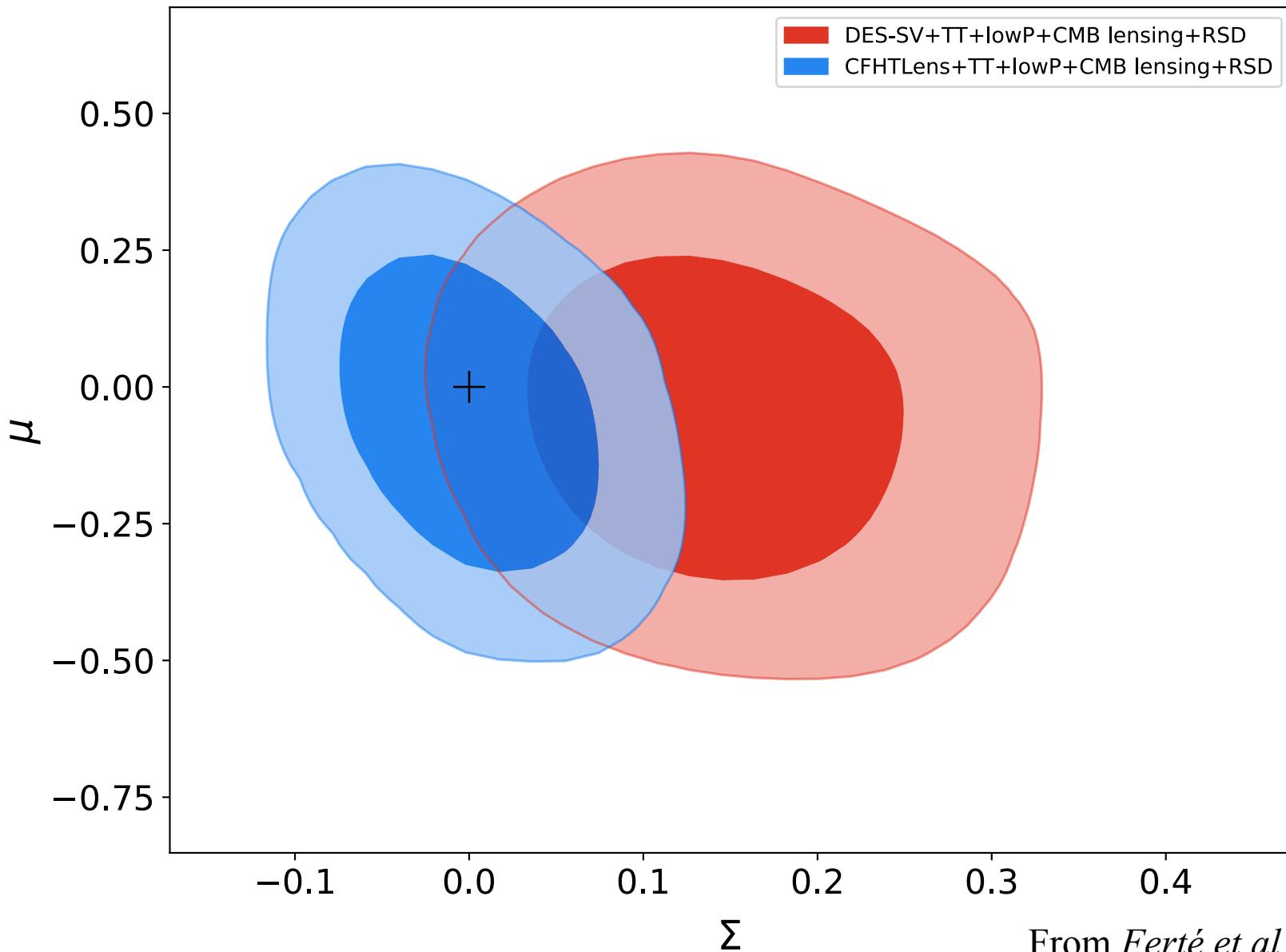
- Time dependance: $\Sigma(a) = \Sigma_0 \frac{\Omega_\Lambda(a)}{\Omega_0}$
- Data:
 - Weak lensing:** *CFHTLens, DES SV*
 - CMB:** *Planck 2015*
 - RSD:** *BOSS DR12, 6dFGS*
- Cosmossis code
 - Cosmological parameters estimation code
 - Joe Zuntz et al.*
 - Boltzmann code MGCamb
Camb modified with several models of MG
Hojjati et al.
 - Multinest sampler
 - Variations of A_s , n_s , τ , Ω_c , Ω_b , H_0 , Σ , μ
 - Include weak lensing systematics.

Weak Lensing constraints: impact of systematics



Ferté et al, *in prep.*

Results



From *Ferté et al, in prep.*

To take away

- LSS becoming as powerful as CMB to constrain some parameters
- Look out for DES Y3/5! And future WL surveys!
- Test of gravity for WL, with latest data
- Looking forward to DES Y1 MG

My two cents on challenges for DE/MG:

- Modeling non-linearities
- Systematics
- Statistical framework