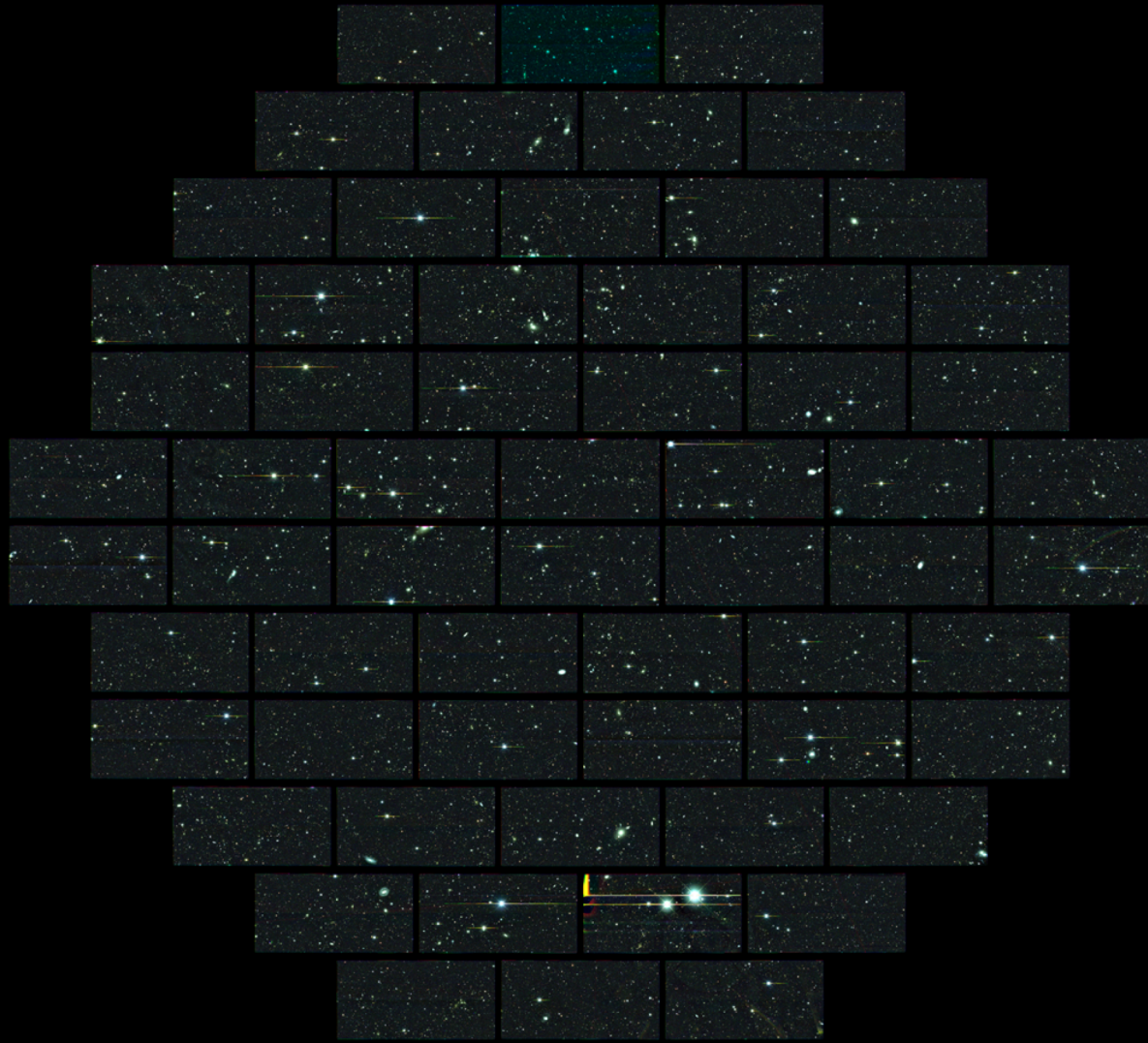# DES Y1 constraints on extended cosmological models from lensing and clustering
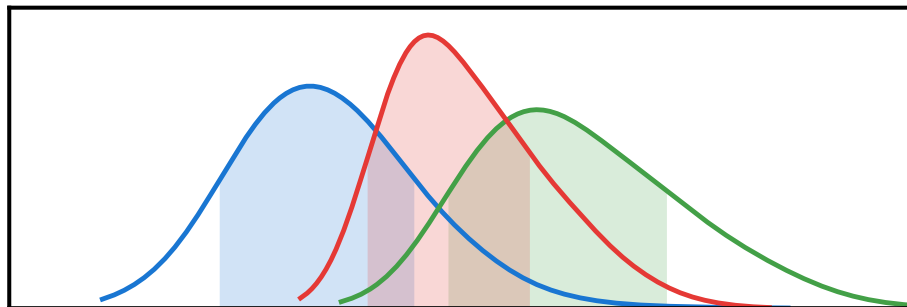
Agnès Ferté

Jet Propulsion Laboratory

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Measure position and shape of galaxies:
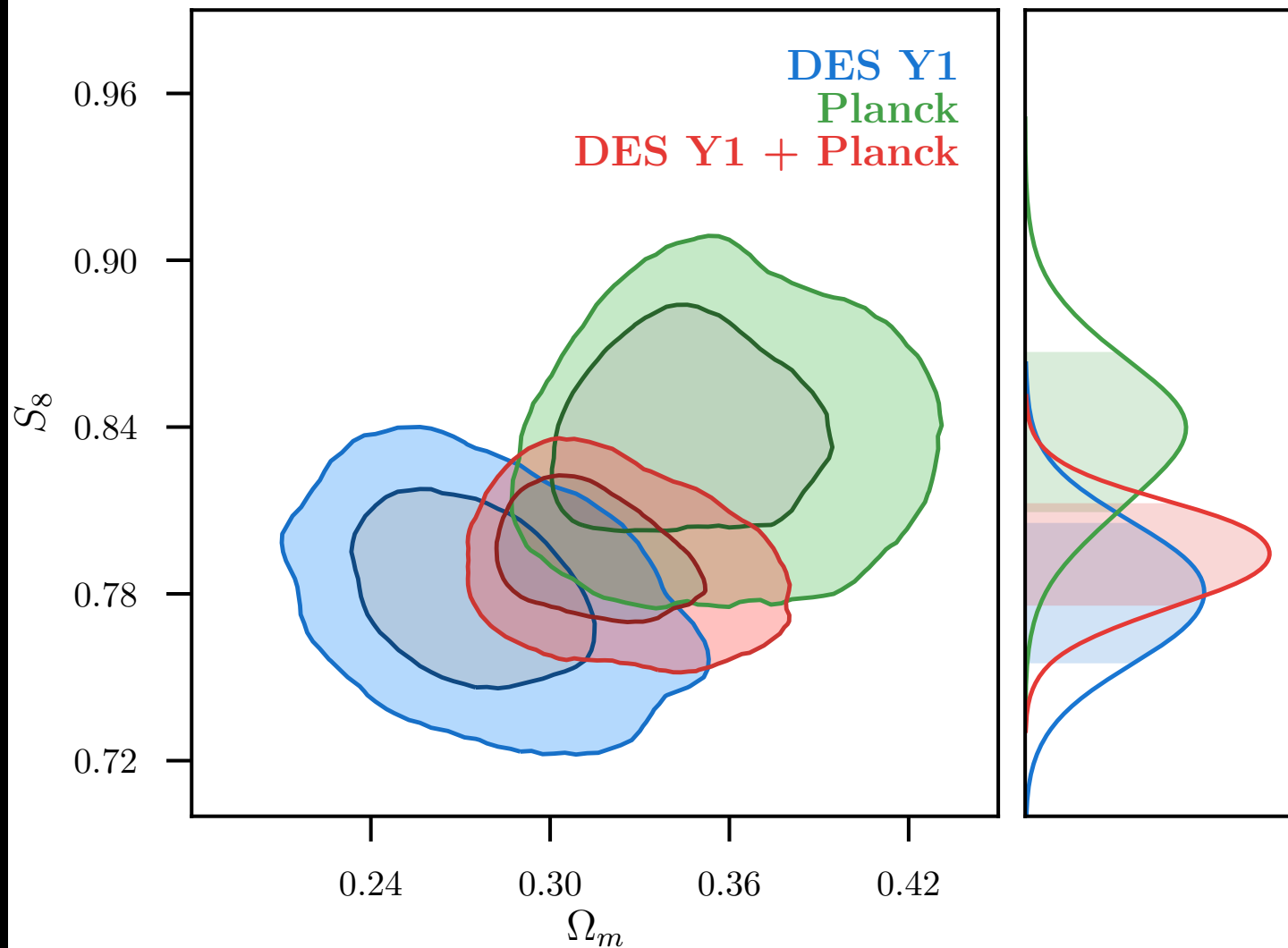
- Shape x Shape = shear due to matter distribution
- Shape x Position = galaxy-galaxy lensing, galaxies mass
- Position x Position = clustering of matter

ΛCDM

wCDM

DES Y1+Planck+BAO+SN

$$w = -1.00^{+0.05}_{-0.04}.$$

From DES collab, PRD 98, 2018

DES Y1 lensing and clustering to answer 4 questions

Work with Lucas Secco, Andresa Campos, Dragan Huterer, Danielle Leonard, Su-Jeong Lee, Jack Elvin-Poole, Scott Dodelson, Jessie Muir, Vivian Miranda, Michael Troxel, …
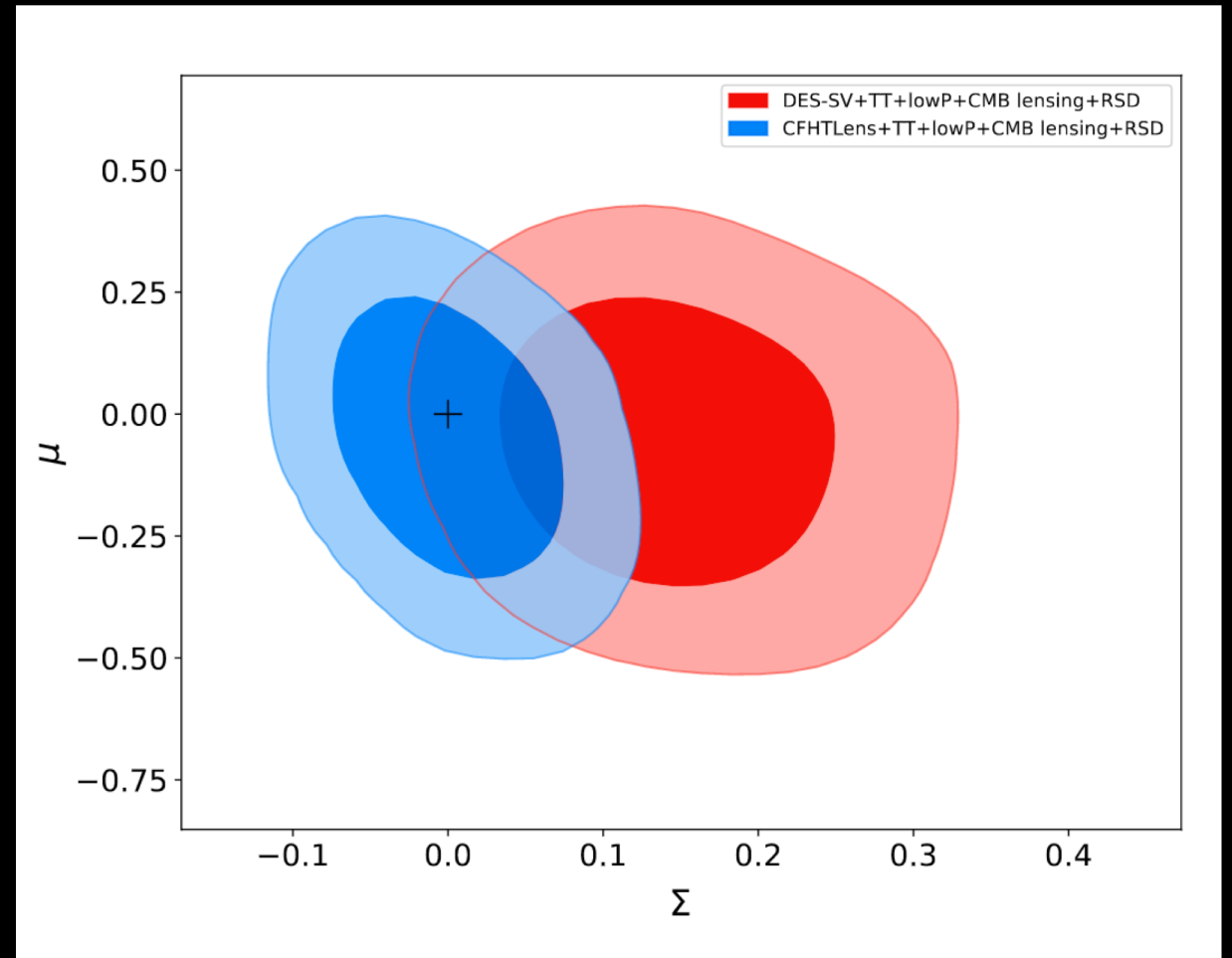
- Is the DE equation of state varying with time? $\rightarrow$ $w(a) = w_0 + w_a (1-a)$

- Is the Universe flat? $\rightarrow$ Ω_k

- How many families of neutrinos? $\rightarrow$ N_{eff}

DES Y1 lensing and clustering to answer 4 questions

- Is GR a good theory of gravity on cosmological scales? → Σ_0 and μ_0

$$k^2\Psi = -4\pi G a^2(1 + \mu(a))\rho\delta$$
$$k^2(\Psi + \Phi) = -8\pi G a^2(1 + \Sigma(a))\rho\delta$$

$$\mu(z) = \mu_0 \frac{\Omega_\Lambda(z)}{\Omega_\Lambda} , \quad \Sigma(z) = \Sigma_0 \frac{\Omega_\Lambda(z)}{\Omega_\Lambda}$$
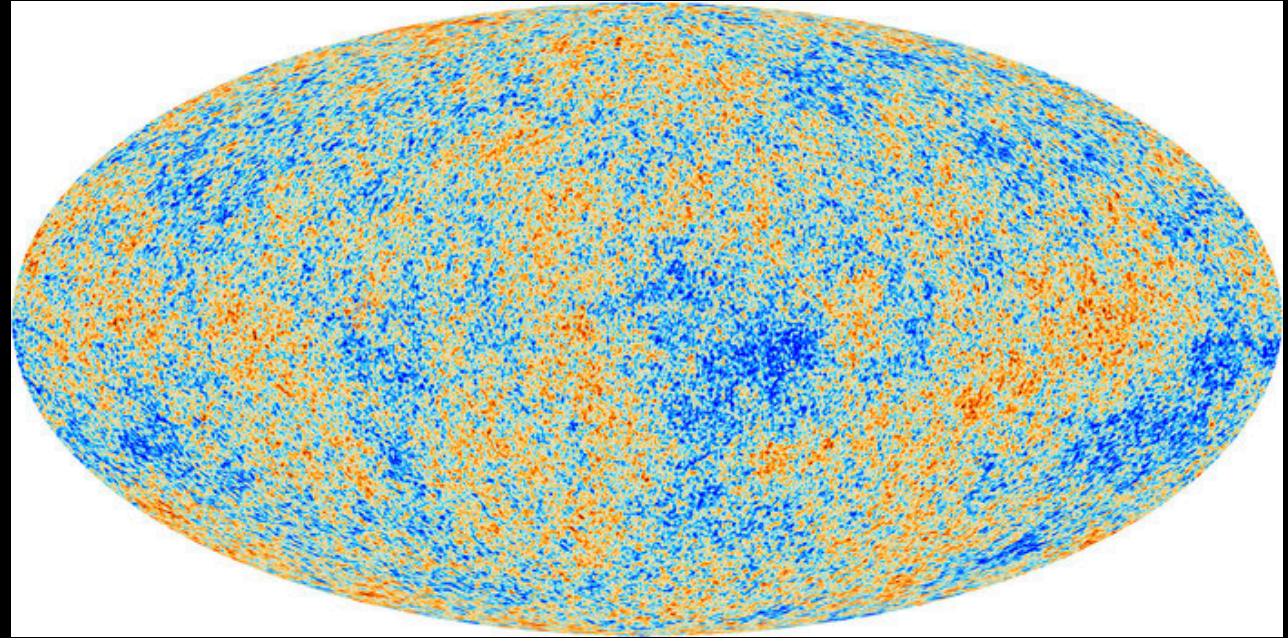

From Ferté et al, 2018

External data sets

CMB: Planck 2015 TT+lowP+lensing

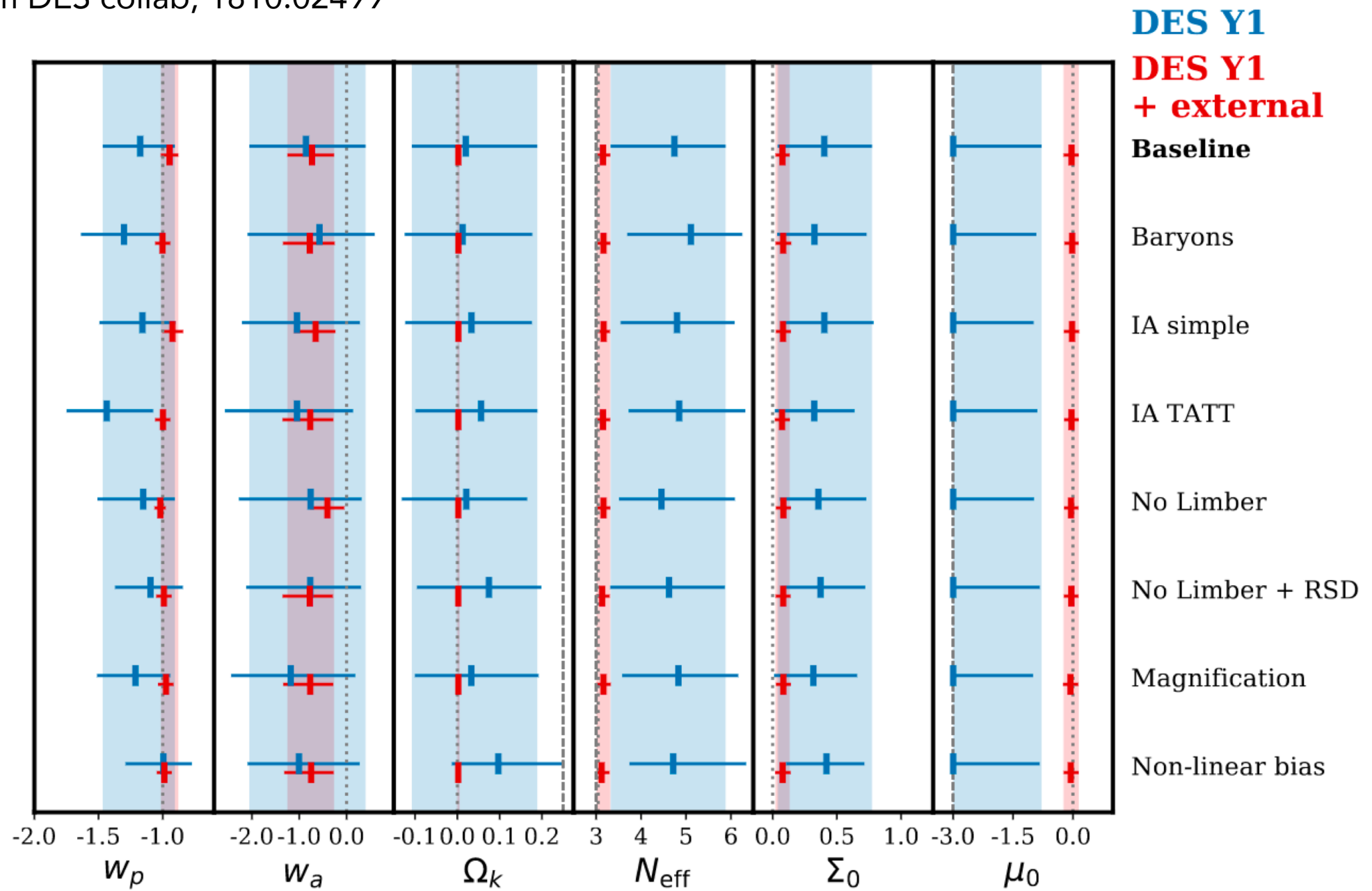BAO: 6dfgs, BOSS DR12, mgs

RSD: BOSS DR12

SN: Pantheon

Validation tests

Simulated DES Y1 data vector shifted by a systematic effect:
- Baryonic effects
- Intrinsic alignment
- Non linear bias
- Limber approximation
- Magnification

➜ Test that these systematics effects don't produce evidence for extended models.

From DES collab, 1810.02499

DES Y1
DES Y1 + external

The case of modified gravity

- Procedure for small scales: throw away 123 data points + use of halofit

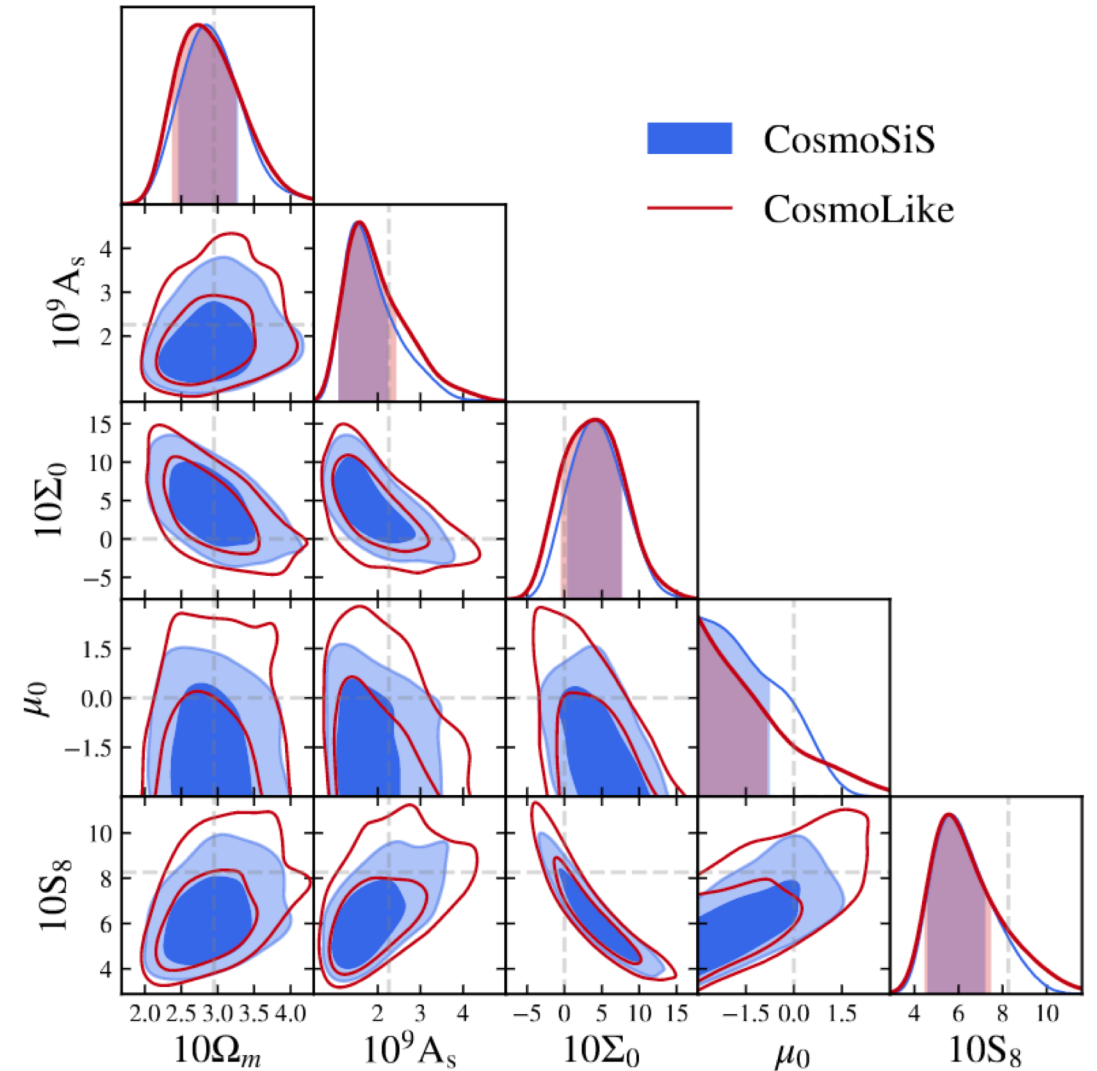- Pipeline comparison: Cosmosis (modified MGCamb) vs Cosmolike.

FIG. 7. Constraints on Ω_m, A_s, S_8, Σ_0 and μ_0 using DES Y1 simulated date for `CosmoSIS` (blue contours) and `CosmoLike` (red).

Results: constraints on extended models
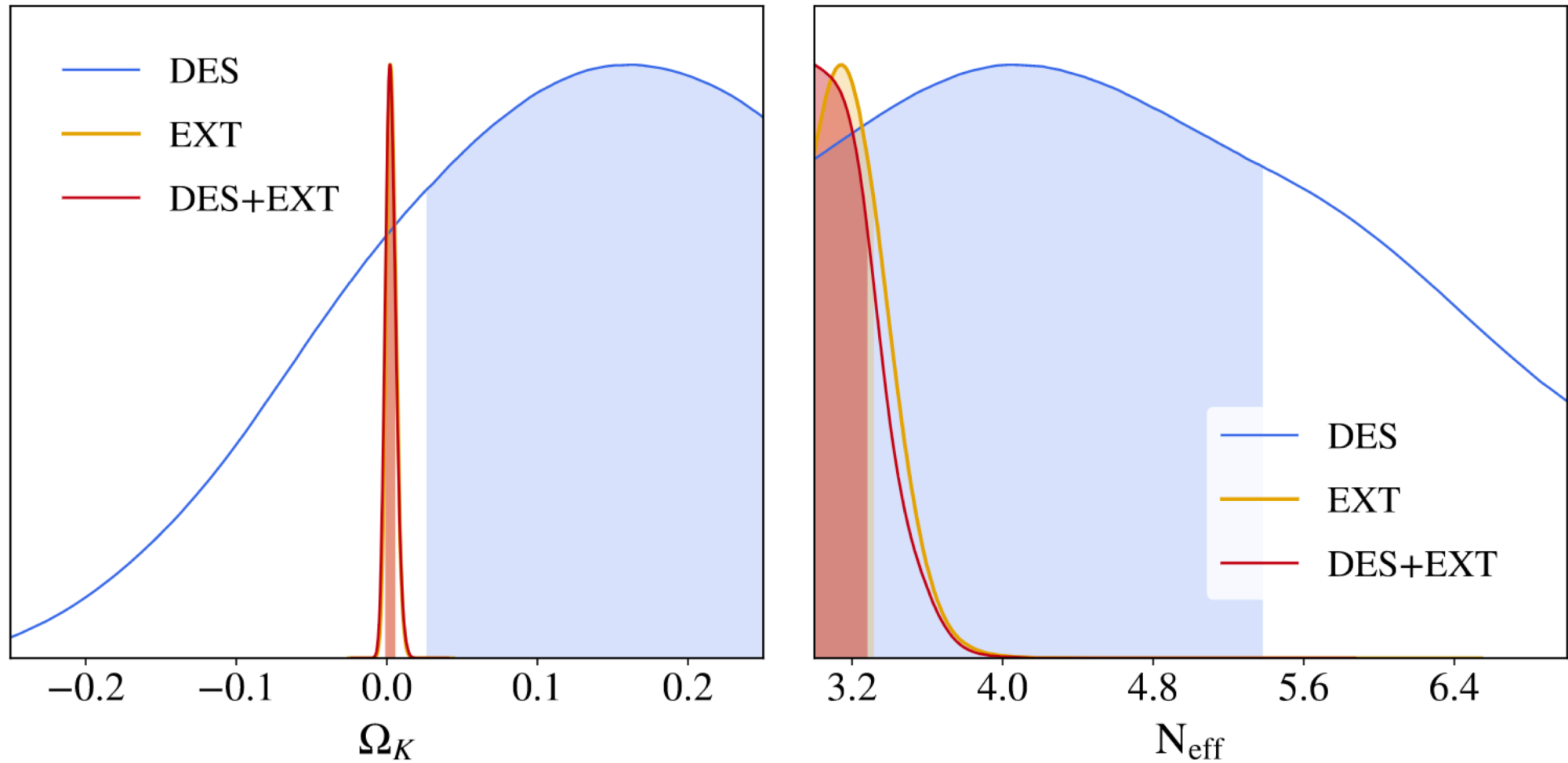
Results: constraints on extended models

Adding DES significantly improve constraints on Σ_0

From DES collab, 1810.02499
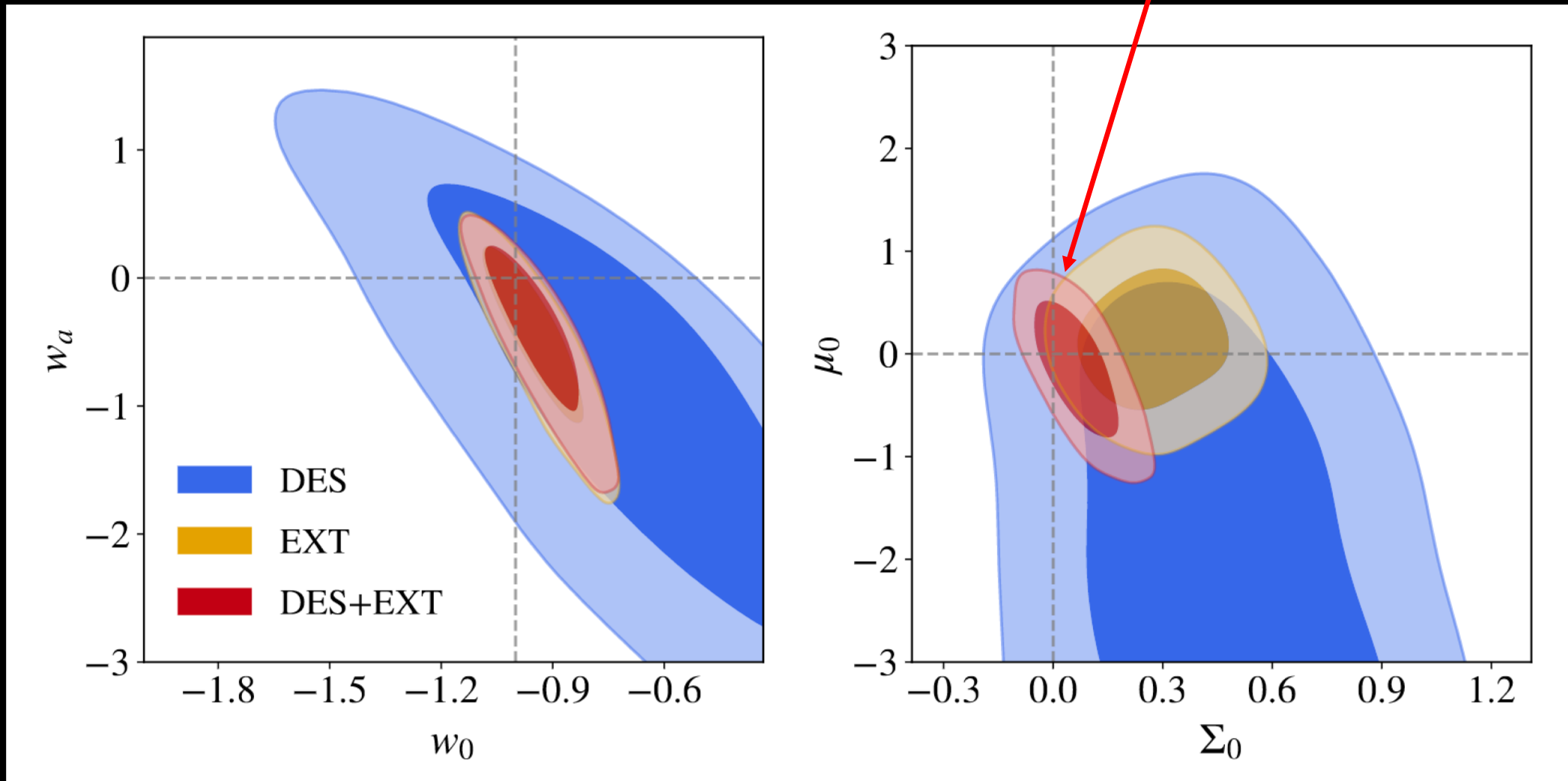
Challenges

- Runtime for parameters estimation: ~70 chains, ~50-100 proc, >48h. For Planck+DES Y1: ~1 week.

- Organisation

- Code comparison

- Varying neutrinos mass

- Scale cuts

- Blinding when dominated by ext data

Take away

- Main constraining power of DES Y1 on extended models: modified gravity

- No evidence for deviations to ΛCDM

- Setting up the pipeline for DES Y3:
  more data, more combination of observables, more models.

Curvature	DES Y1	External	DES Y1 + External
Ω_k	$0.163^{+0.087}_{-0.136}$	$0.0023^{+0.0035}_{-0.0030}$	$0.0020^{+0.0037}_{-0.0032}$

Number Rel. Species	DES Y1	External	DES Y1 + External
N_{eff}	< 5.38	< 3.32	< 3.28

Dynamical dark energy	DES Y1	External	DES Y1 + External
w_0	$-0.69^{+0.30}_{-0.29}$	$-0.96^{+0.10}_{-0.08}$	$-0.95^{+0.09}_{-0.08}$
w_a	$-0.57^{+0.93}_{-1.11}$	$-0.31^{+0.38}_{-0.52}$	$-0.28^{+0.37}_{-0.48}$
w_p	$-0.91^{+0.19}_{-0.23}$	$-1.02^{+0.04}_{-0.04}$	$-1.01^{+0.04}_{-0.04}$

Modified Gravity	DES Y1	External	DES Y1 + External
Σ_0	$0.43^{+0.28}_{-0.29}$	$0.26^{+0.14}_{-0.13}$	$0.06^{+0.08}_{-0.07}$
μ_0	—	$0.16^{+0.43}_{-0.47}$	$-0.11^{+0.42}_{-0.46}$