Euclid CMBXC-SWG Meeting: Update

G. Frittoli, G. Benevento, M. Migliaccio, N. Bartolo

23-24 October, Milan

Ongoing works:

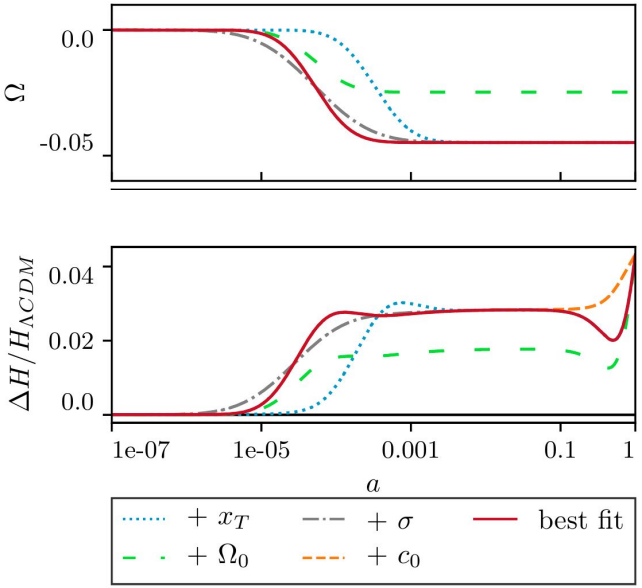
- CMBXC forecasts in the Effective Field Theory of Dark Energy

- WP9: Relativistic effects beyond LCDM

- Forecasts for DR1

Transitional Planck Mass in the EFT of DE contest

$$S = \int d^4x\sqrt{-g}\left\{\frac{m_0^2}{2}\left[1+\Omega(\tau)\right]R + \Lambda(\tau) - a^2 c(\tau)\delta g^{00} + \frac{M_2^4(\tau)}{2}(a^2\delta g^{00})^2 - \frac{\bar{M}_1^3(\tau)}{2}a^2\delta g^{00}\delta K_\mu^\mu - \frac{\bar{M}_2^2(\tau)}{2}(\delta K_\mu^\mu)^2 - \frac{\bar{M}_3^2(\tau)}{2}\delta K_\nu^\mu \delta K_\mu^\nu + \frac{a^2\hat{M}^2(\tau)}{2}\delta g^{00}\delta R^{(3)} + m_2^2(\tau)(g^{\mu\nu}+n^\mu n^\nu)\partial_\mu(a^2 g^{00})\partial_\nu(a^2 g^{00})\right\} + S_m[g_{\mu\nu}]$$



- We explored what a model defined directly from the EFT action can tell about cosmological tensions

- Changing the Planck mass opportunely can shift the sound horizon scale measured by CMB towards lower values and reduce and the Hubble tension (see Benevento et al. 2022)

$$\Omega(x) = \frac{\Omega_0}{2}\left(1 - ERF\left(\frac{(x_T - x)}{\sqrt{2\pi}\sigma}\right)\right)$$

Transitional Planck Mass in the EFT of DE contest

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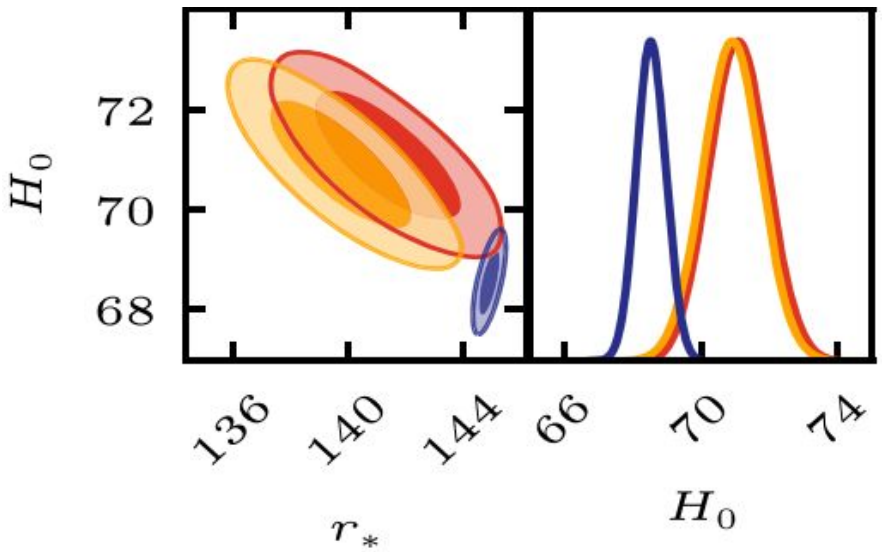
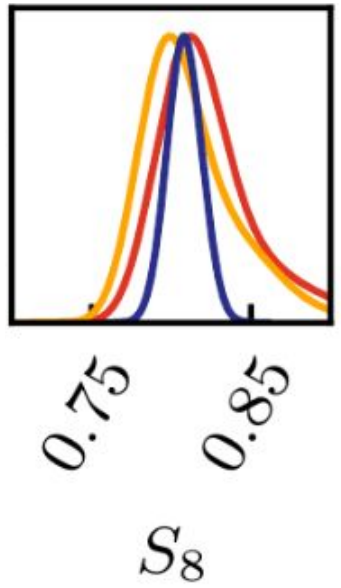


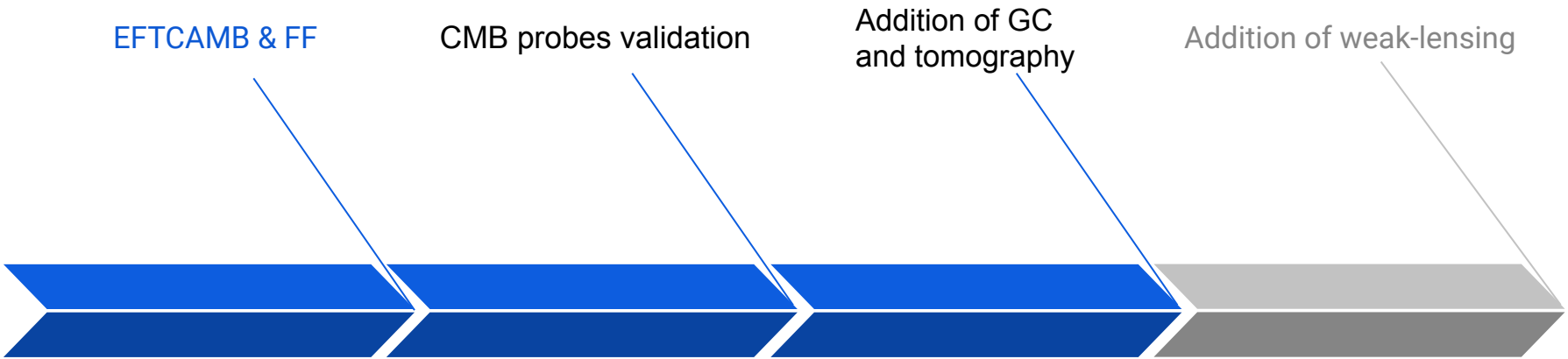


Forecasts with EFTCAMB

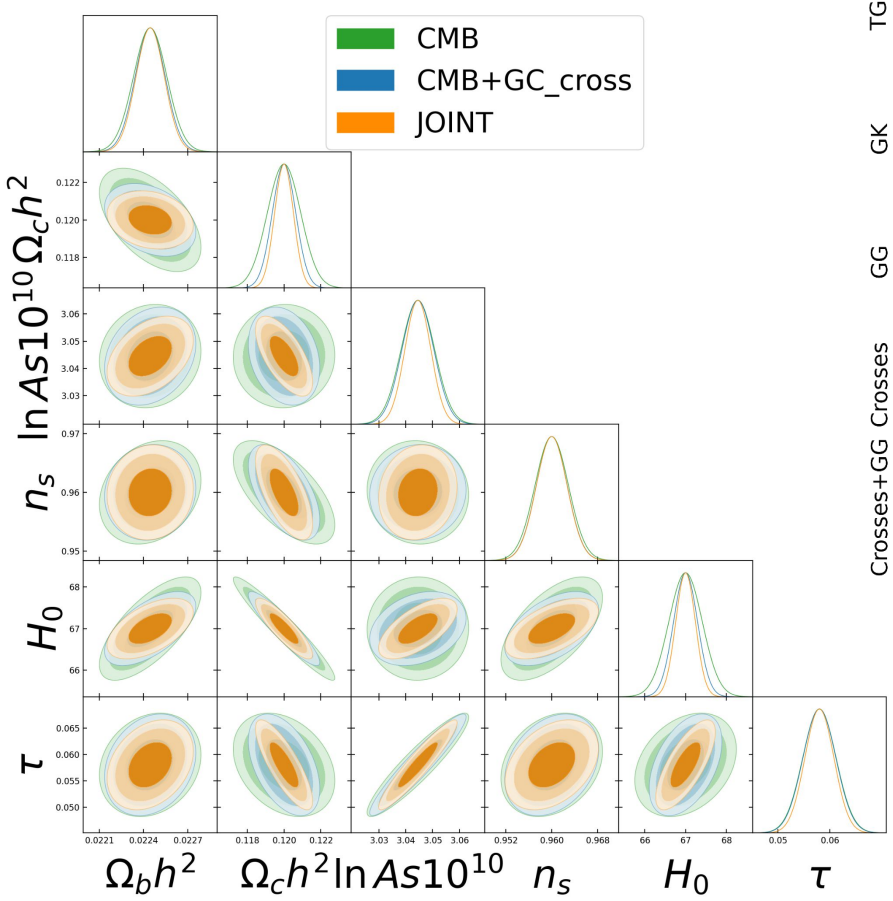
We implemented a Python Fisher Forecast (FF) code that interfaces with EFTCAMB

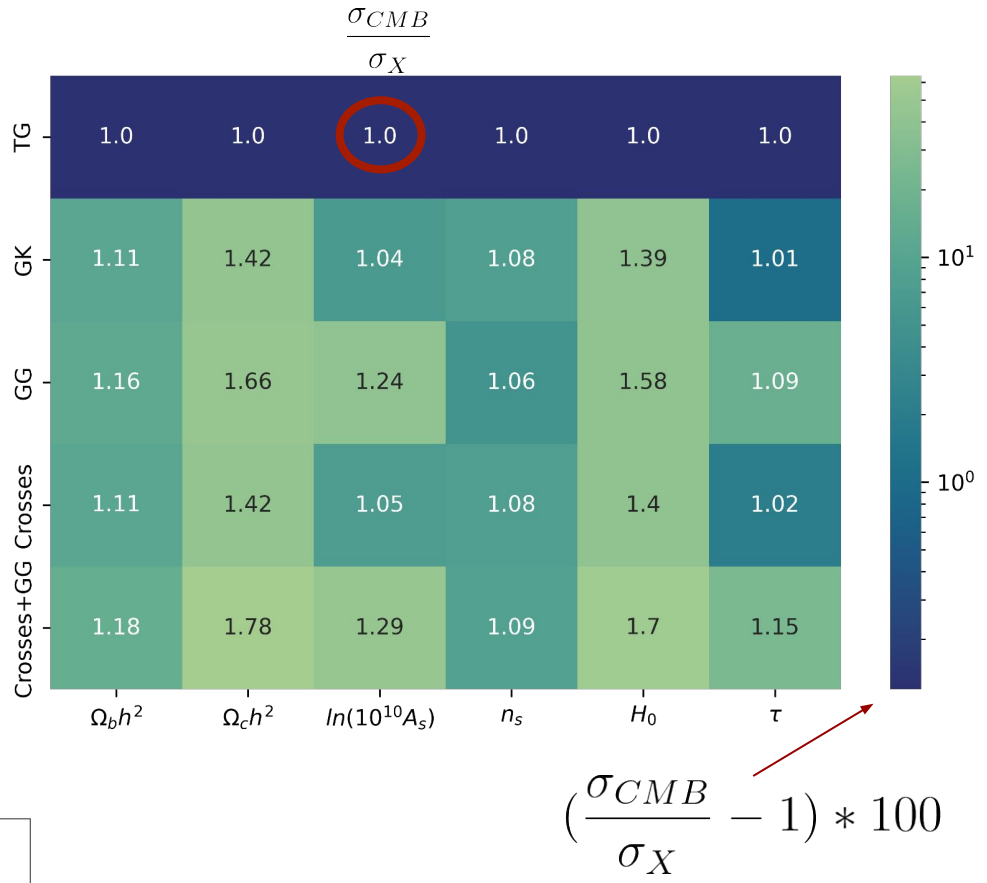
- It computes inputs for FF, interfacing with the EFTCAMB python wrapper
  (we can test all the models implemented there)

- It is under testing against results by Euclid Prep: XV, Ilić et al 2021 —--> missing weak-lensing with IA



Forecasts for LCDM

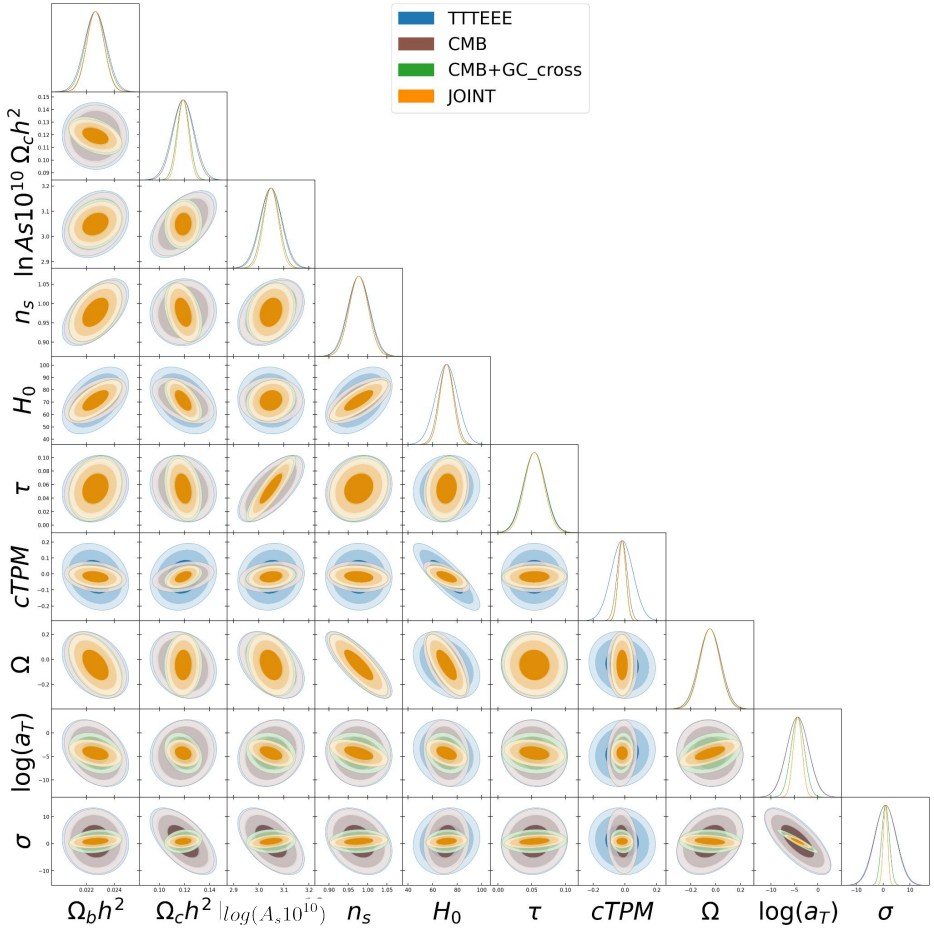


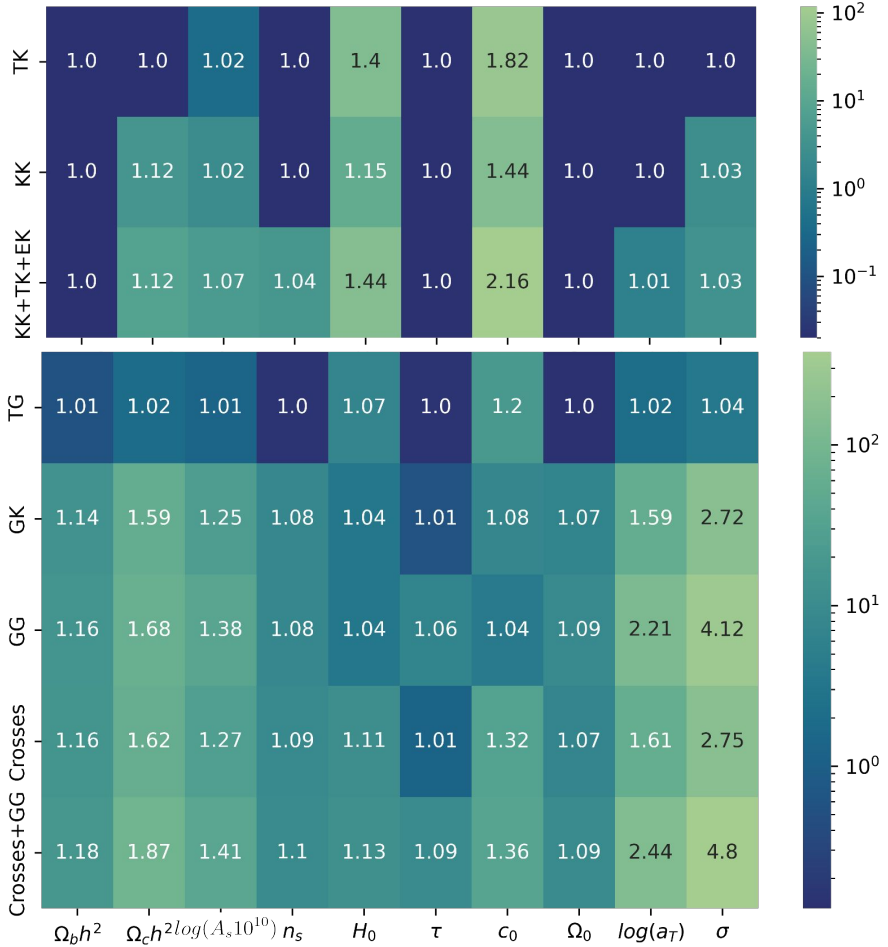


$$\left(\frac{\sigma_{CMB}}{\sigma_X} - 1\right) * 100$$

Single bin for GC in the pessimistic case
For CMB probes we considered Planck 2018

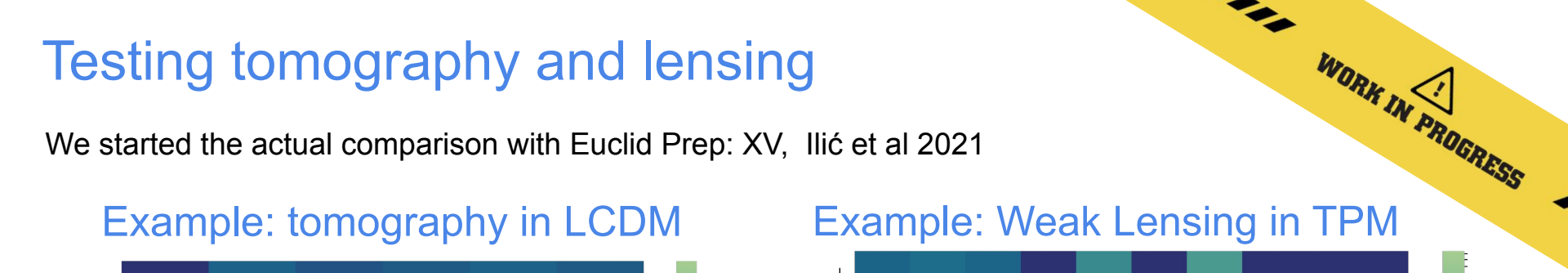
Forecasts for TPM





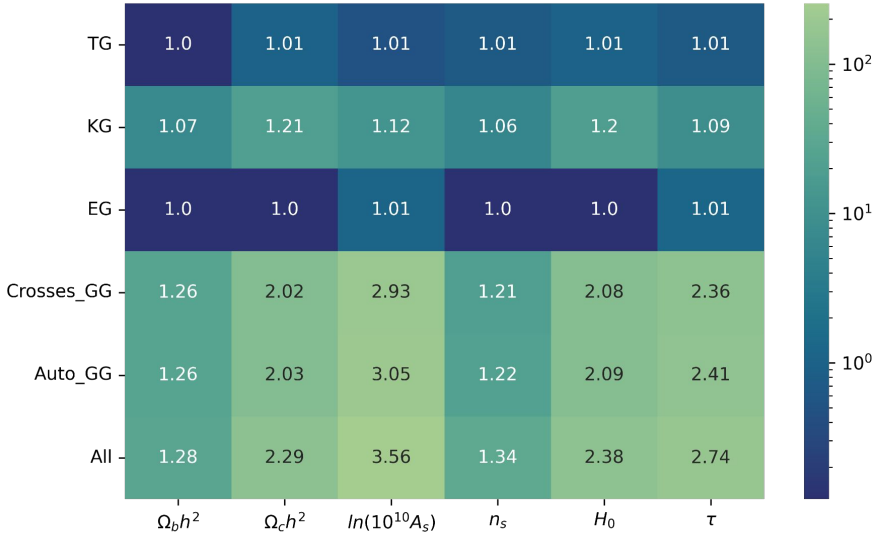
Single bin for GC in the pessimistic case
For CMB probes we considered Planck 2018

Testing tomography and lensing



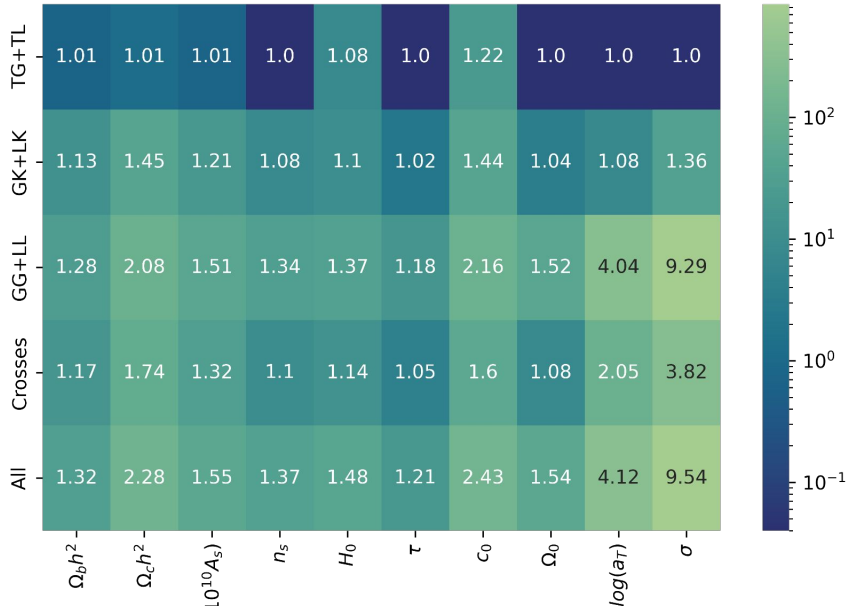
We started the actual comparison with Euclid Prep: XV, Ilić et al 2021

Example: tomography in LCDM



- 10 bins for GC in the pessimistic case
- For CMB probes we considered Planck 2018

Example: Weak Lensing in TPM



- 1 bin for GC and 1 bin for WL convergence, in the pessimistic case
- For CMB probes we considered Planck 2018

WP9: Relativistic effects beyond LCDM

Working with the WP9 of the Theory Group.

Project lead by F. Pace, D. Bertacca, F. Lepori

Aim

- Study the impact of relativistic contributions in Modified Gravity both at the level of the spectra and their impact on cosmological forecasts

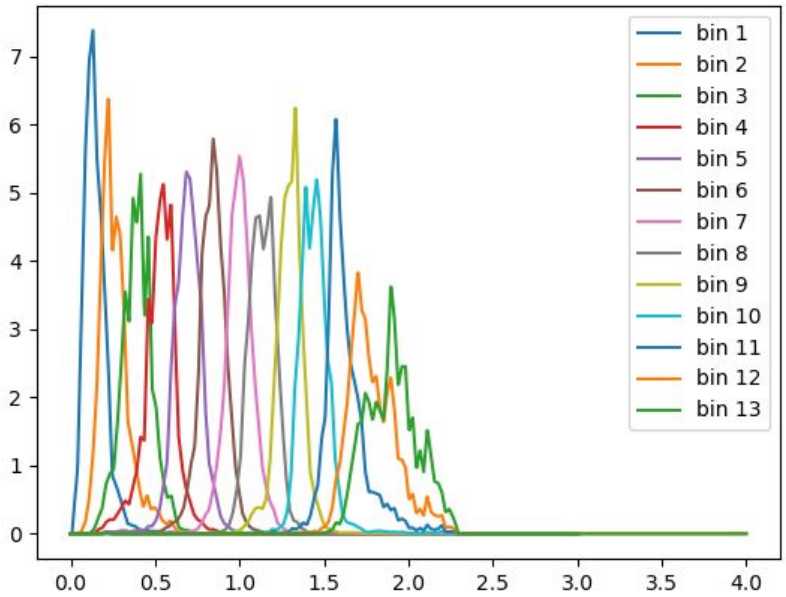
Models

LCDM, wCDM, but even more specific models:

- hi_class: Horndeski with alpha-parametrization, JBD
- EFTCAMB: Horndeski with EFT functions, Galileon, K-mouflage

Requisites and R&D:

We are using Flagship 1 distribution and preliminary tests have been made or are underway:



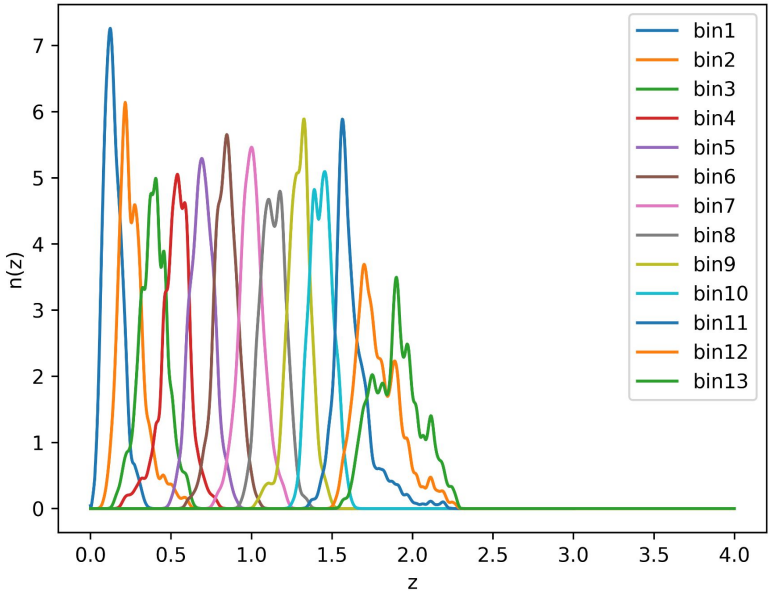
- Sub-percent agreement with CAMB and CLASS
- Limber/Non-Limber error assessment on the scales where relativistic contributions should take place

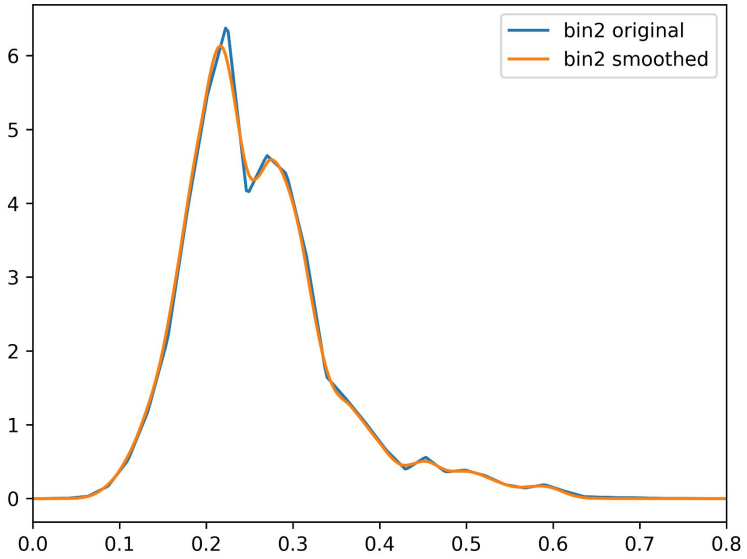
As for now: smoothing the n(z)s distributions and setting the Limber approximation switch at \ell=200, achieve the desired prerequisites.

Adjusting the redshift bins for CAMB:

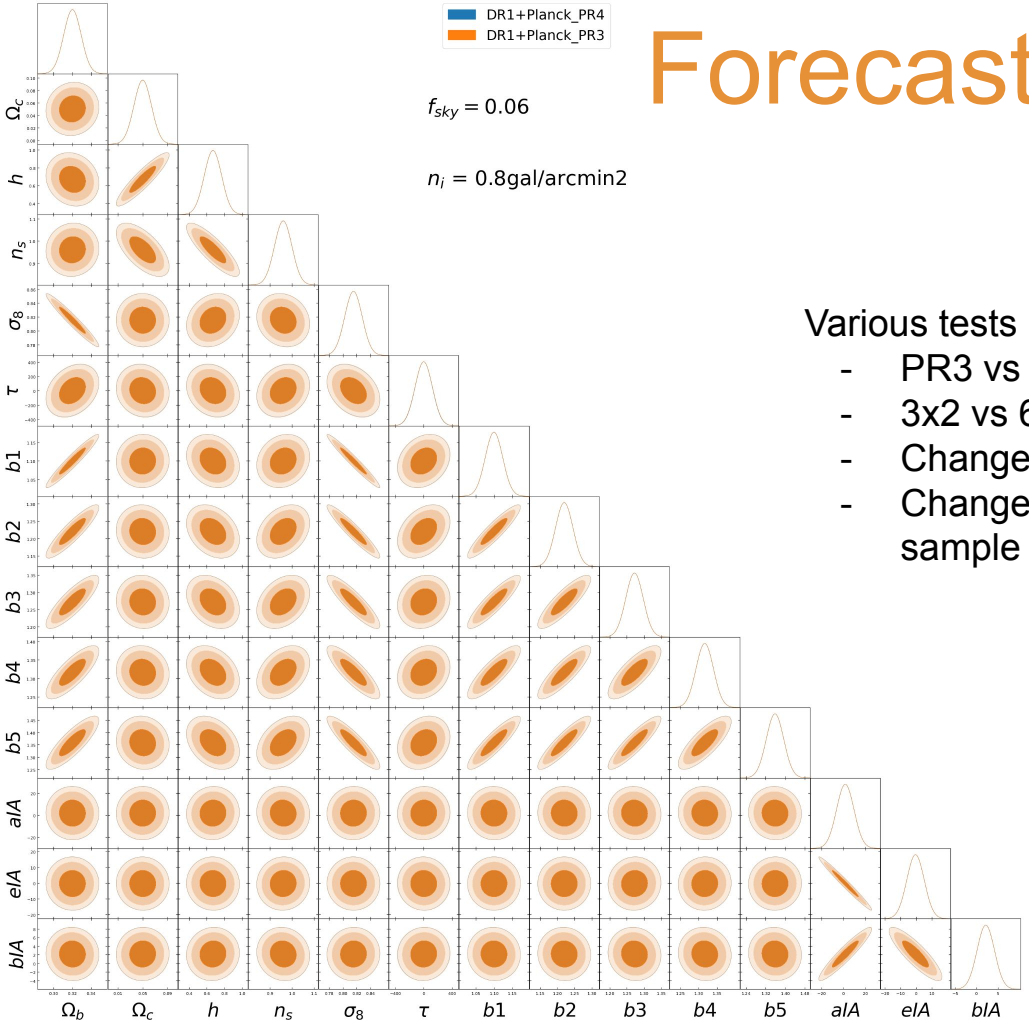
WORK IN PROGRESS

- Modified CAMB so that limber starts at the desired \ell
- Imposing that outside the bin there are no numerical fluctuations (zeros)
- $$\frac{1}{2}(1+tanh(a(x-x_1)))\frac{1}{2}(1-tanh(a(x-x_2)))$$
- Savitzky–Golay filter





Forecasts for DR1



More Tomorrow

Various tests in LCDM:

- PR3 vs PR4
- 3x2 vs 6x2: adding CMB lensing
- Change in f_sky
- Change in shot noise: DES cuts for the most conservative sample

BACKUP SLIDES

Distribution with all relativistic contributions:

First row:original n(z)
Second row: modified n(z)

Top left: with the original distribution, the calculation of the integral seems to fail when it has to switch to limber (it happens even at limber switch10 but it is smaller)

Bottom right: with the smoothed distribution, the limber switch at low ells generates a spike which we think it is given by a bug. This happens only at high redshift bins.