Updates from simulations

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Euclid CMBX SWG meeting 2018 @ Ferrara

Outline

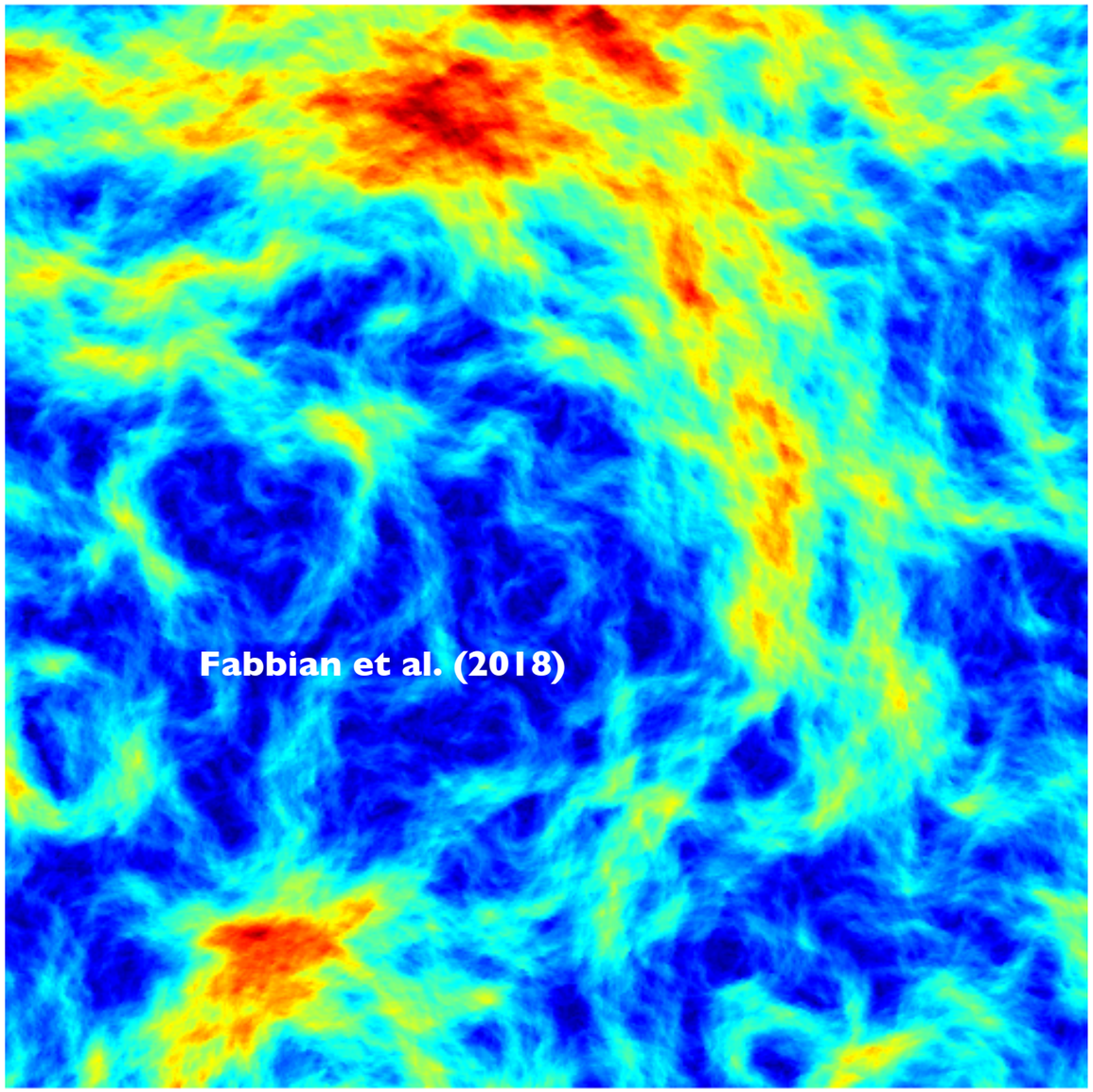
- Recent results on CMB lensing estimation with higher-order effects and implications fro cross-correlation
- Updates from Flagship team
- Summary of light cone comparison project
- Updates on covariances
- Updates on simulation activity in non-standard cosmology

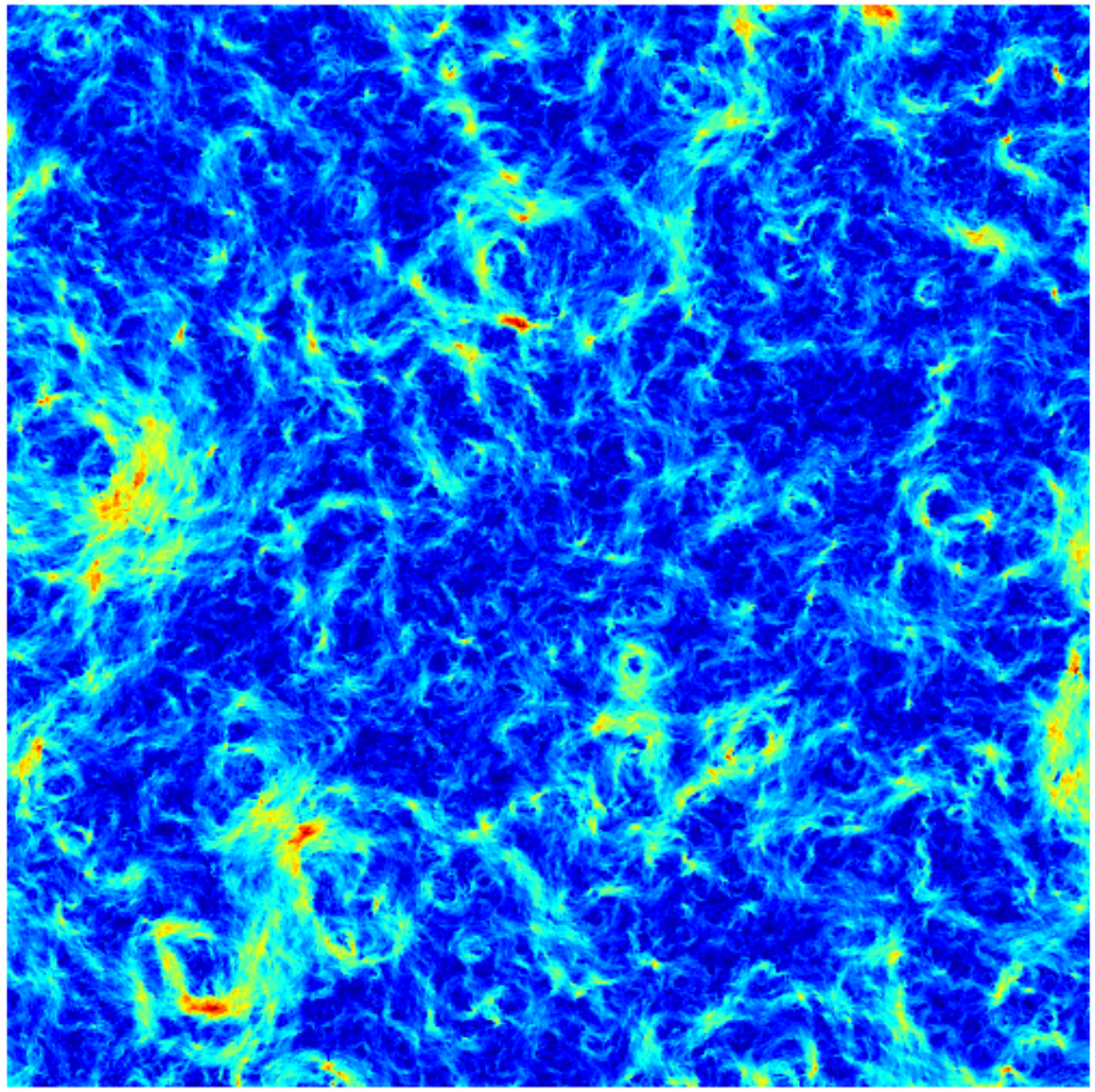
Higher-order CMB lensing in a nutshell

$$\mathbf{d}^{post-Born} = \nabla\psi^{eff} + \nabla \times \Omega^{eff}$$

Gradient−like displacement

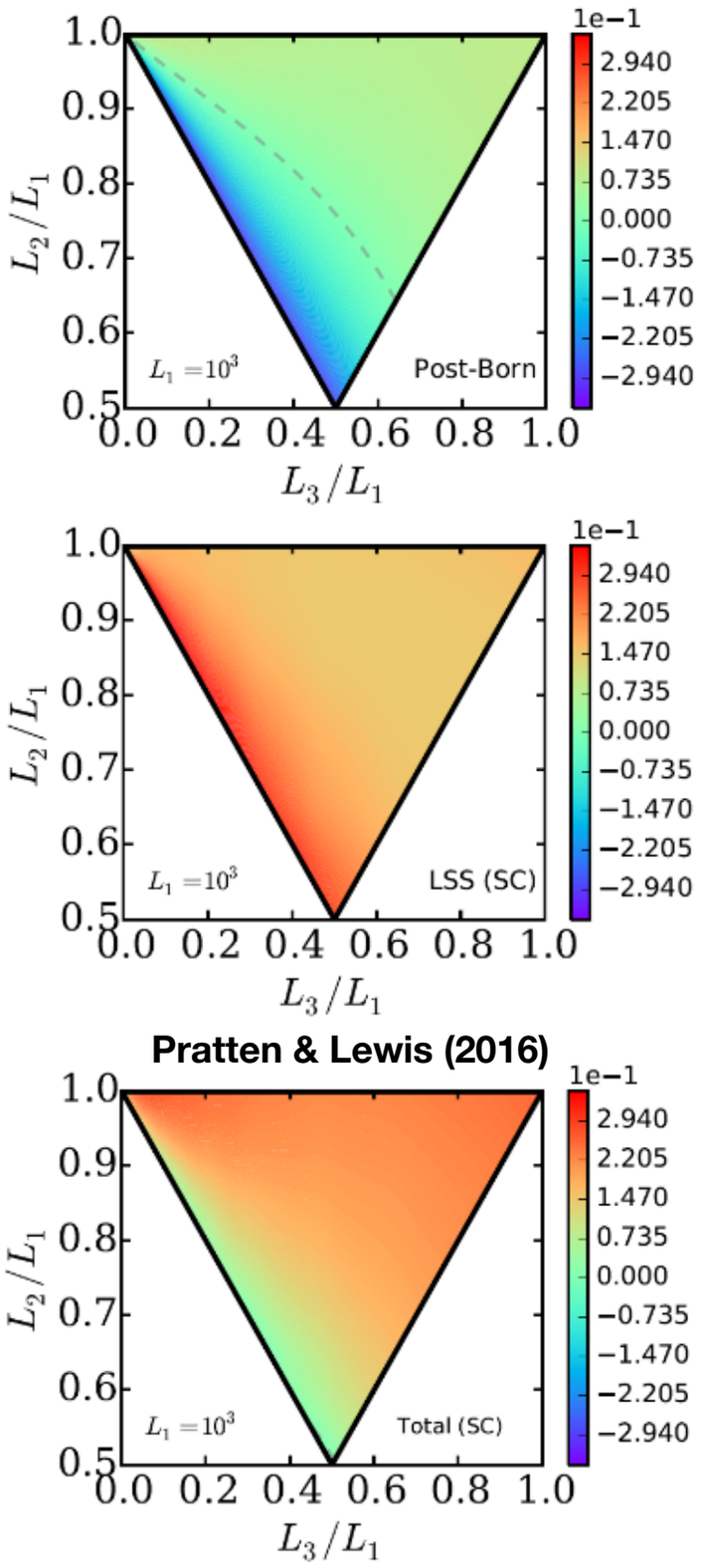
Curl−like displacement

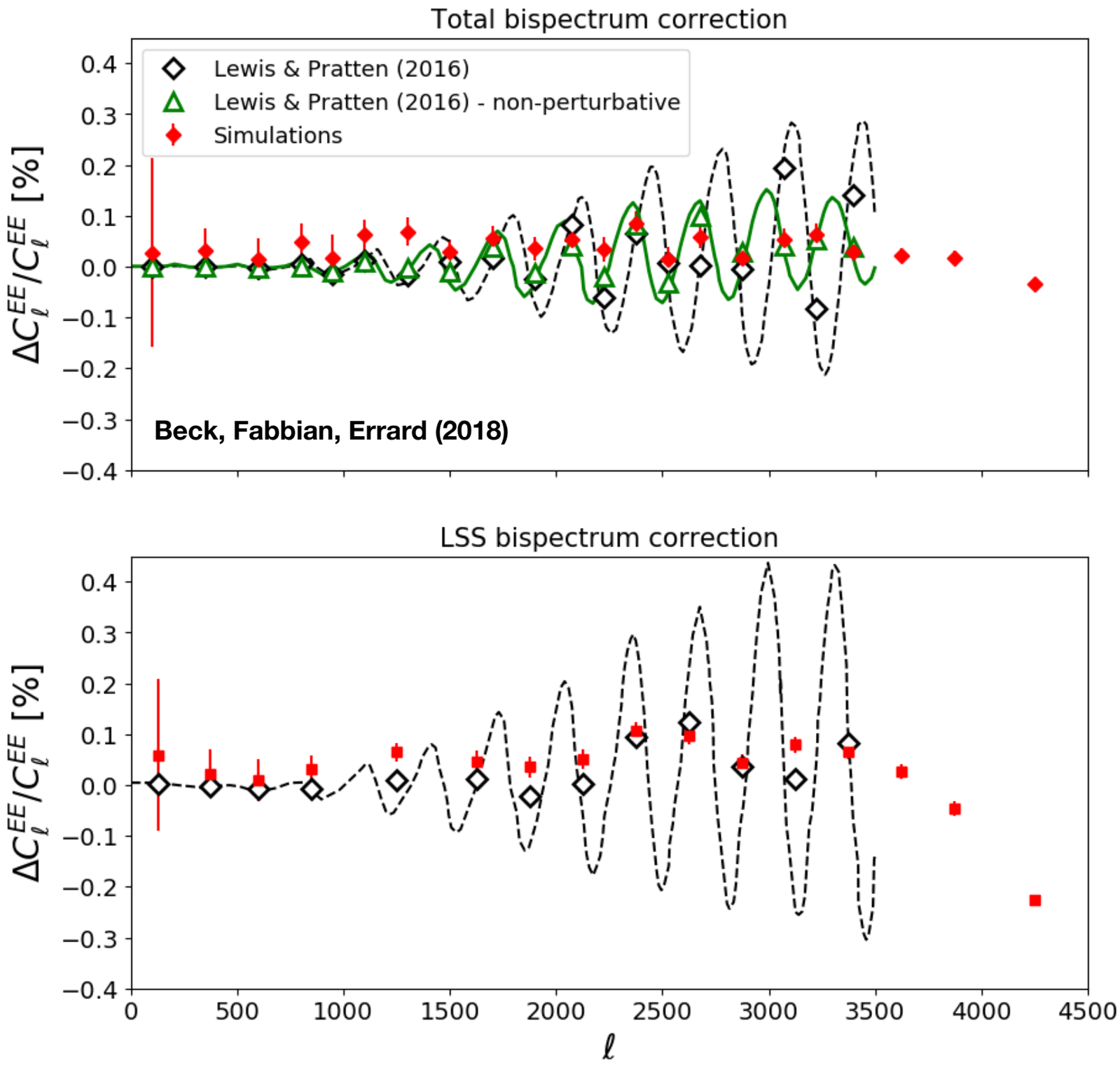




Higher-order corrections: non-Gaussianities

$$(L_2 L_3)^{1/2}\, b^{\kappa\kappa\kappa}_{L_1 L_2 L_3} / (C^{\kappa\kappa}_{L_1} C^{\kappa\kappa}_{L_2} C^{\kappa\kappa}_{L_3})^{1/2}$$





Lensing reconstruction basis

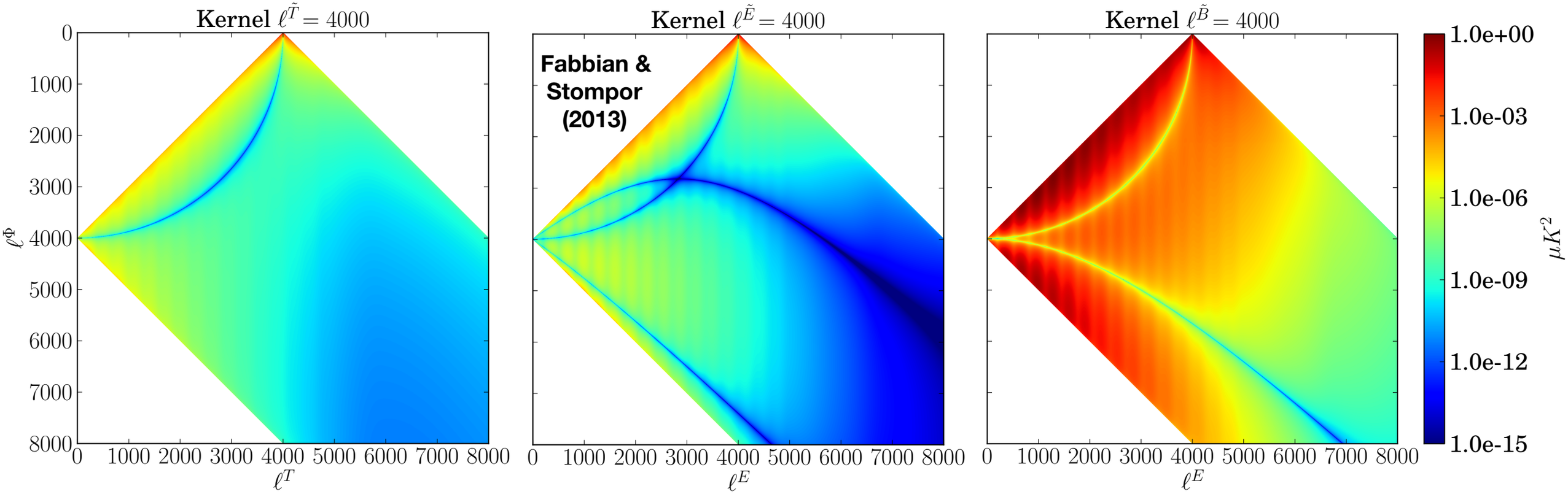
- Lensing is a convolution in harmonic-domain

$$\delta\Theta(\boldsymbol{l}) = \int \frac{d^2 l'}{(2\pi)^2} \tilde{\Theta}(\boldsymbol{l}') W(\boldsymbol{l}', \boldsymbol{L}) \qquad W(\boldsymbol{l}, \boldsymbol{L}) = -[\boldsymbol{l} \cdot \boldsymbol{L}]\phi(\boldsymbol{L})$$

$$d_\alpha(\boldsymbol{L}) = \frac{A_\alpha(L)}{L} \int \frac{d^2 l_1}{(2\pi)^2} x(\boldsymbol{l}_1) x'(\boldsymbol{l}_2) F_\alpha(\boldsymbol{l}_1, \boldsymbol{l}_2) \qquad \langle x(\boldsymbol{l}) x'(\boldsymbol{l}') \rangle_{\rm CMB} = f_\alpha(\boldsymbol{l}, \boldsymbol{l}') \phi(\boldsymbol{L})$$

$$\langle d_\alpha(\boldsymbol{L}) \rangle_{\rm CMB} = d(\boldsymbol{L}) \equiv L\phi(\boldsymbol{L}) \qquad \langle d_\alpha(\mathbf{L}) d^*_\beta(\mathbf{L}') \rangle = (2\pi)^2 \delta(\mathbf{L} - \mathbf{L}')(C_L^{dd} + N^{(0)}_{\alpha\beta}(L)$$

$$+ \text{ higher-order terms}).$$



Quadratic CMB lensing estimators in a nutshell

- Non-Gaussianity in deflection field biases CMB lensing reconstruction with quadratic estimators (Böhm+2016)
  - Only non-linear LSS bispectrum included so far
- Exploit our numerical simulation setup to isolate single sources of bias at all scales
  - Lens same primordial CMB realizations with different combination of deflection fields
- Clean measurements of reconstruction biases

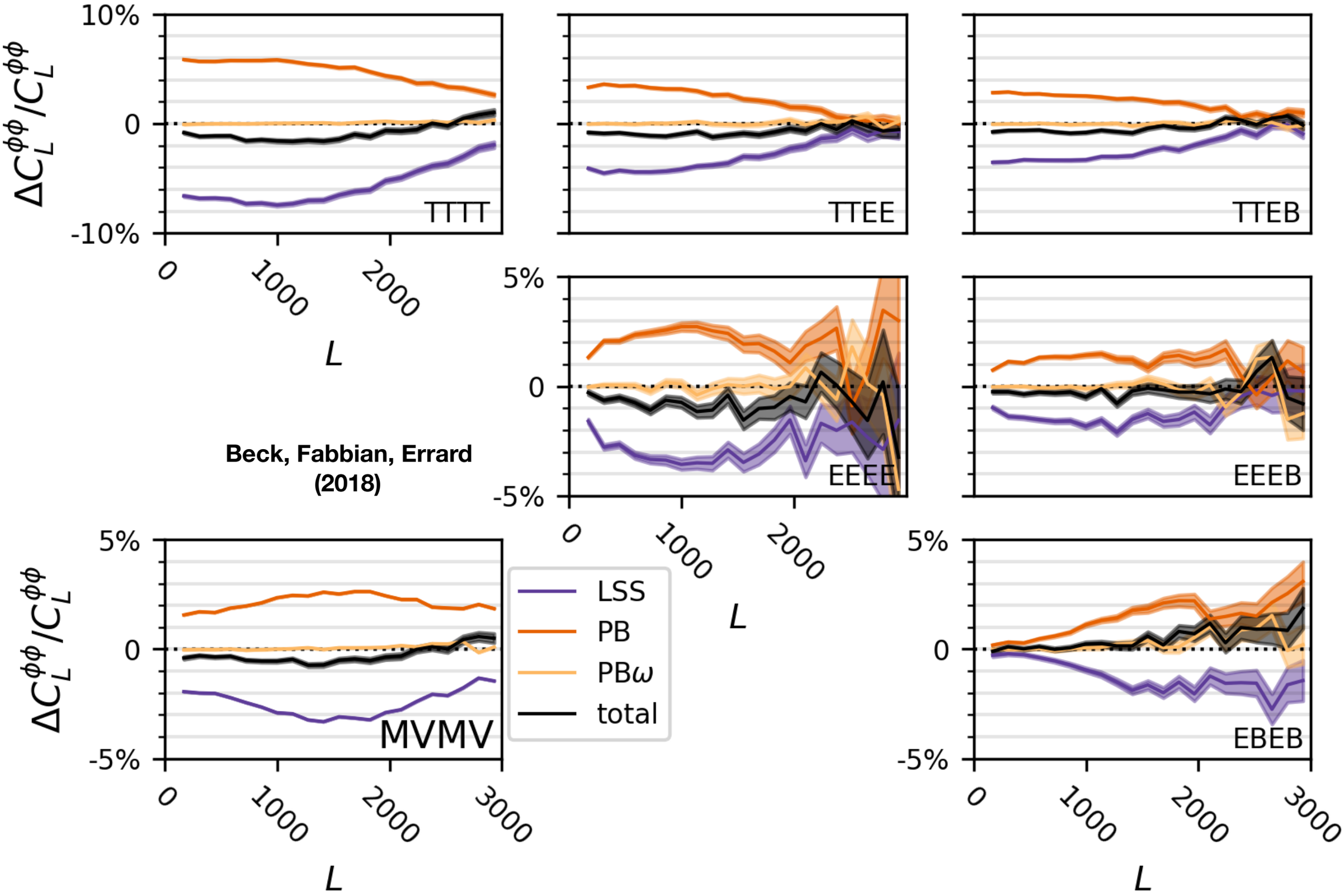
$$d_\alpha(\mathbf{L})^{Post-Born} - d_\alpha(\mathbf{L})^{Born,Gauss} \rightarrow \text{All terms}$$

$$d_\alpha(\mathbf{L})^{PB,grad} - d_\alpha(\mathbf{L})^{Born,Gauss} \rightarrow \kappa\kappa\kappa^{LSS}$$

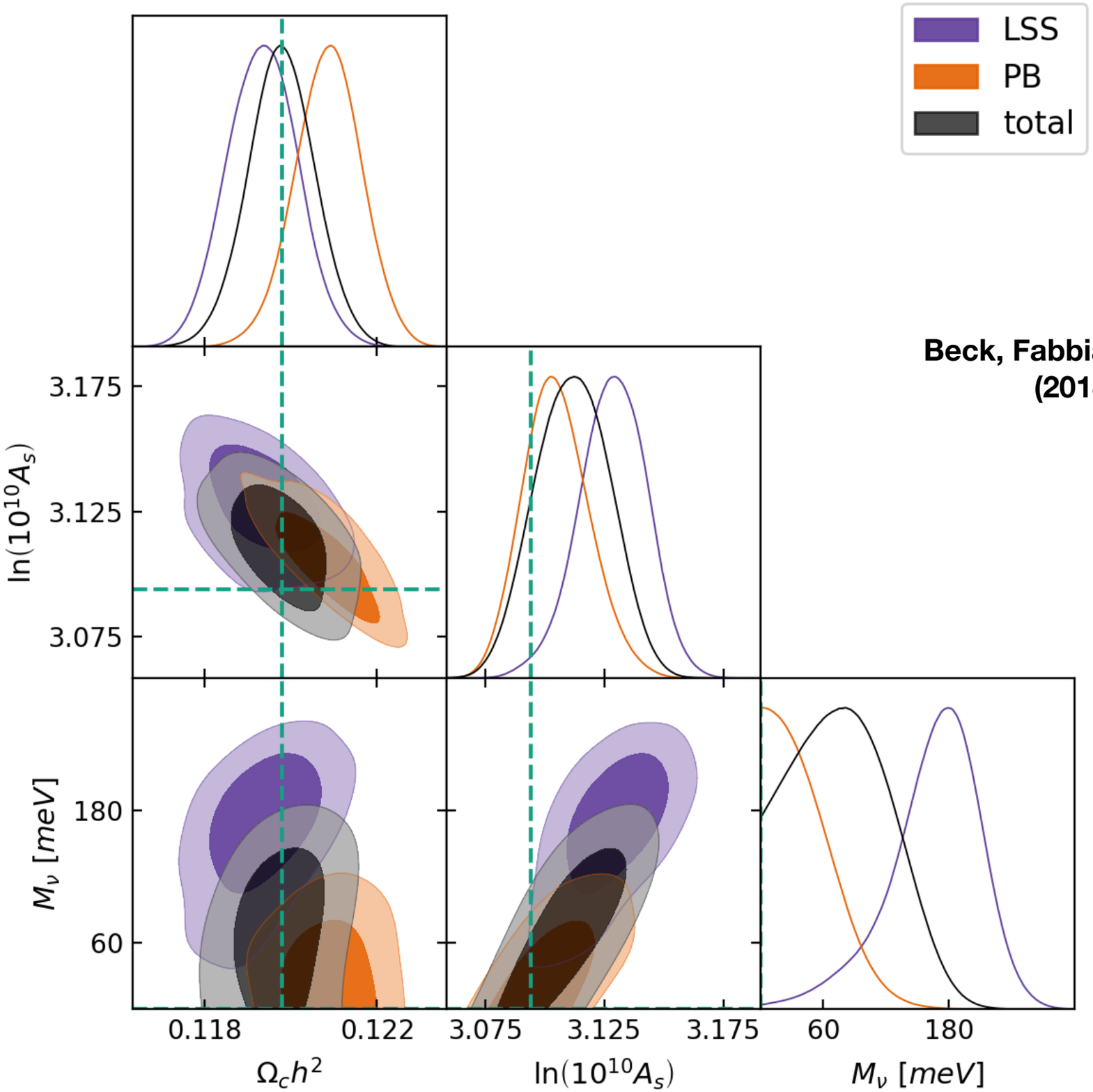
$$d_\alpha(\mathbf{L})^{PB,grad} - d_\alpha(\mathbf{L})^{Born} \rightarrow \kappa\kappa\kappa^{Post-Born}$$

$$d_\alpha(\mathbf{L})^{Post-Born} - d_\alpha(\mathbf{L})^{PB,grad} \rightarrow \kappa\kappa\omega + \kappa\omega\omega$$

Reconstruction biases vs reconstruction channel



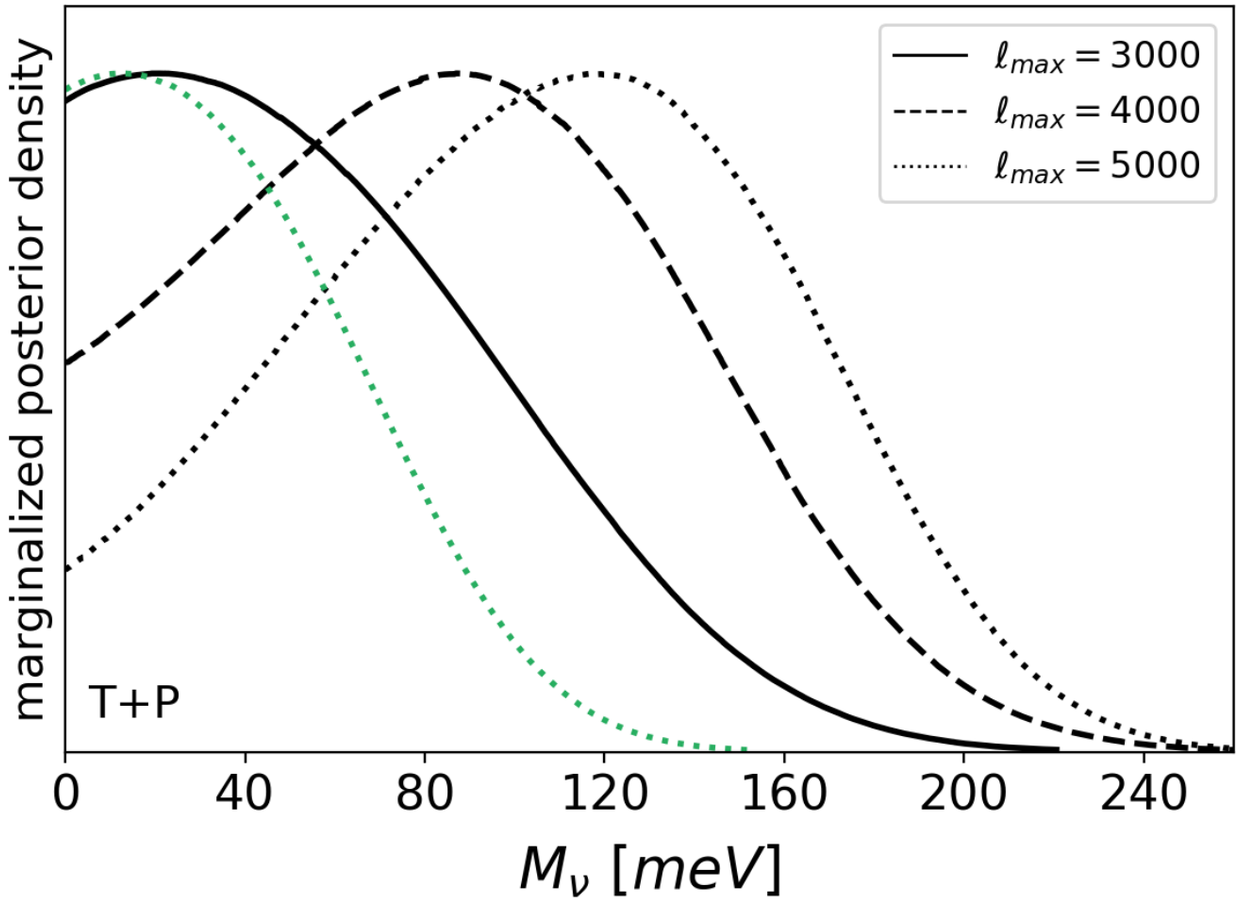
Biases on cosmological parameters

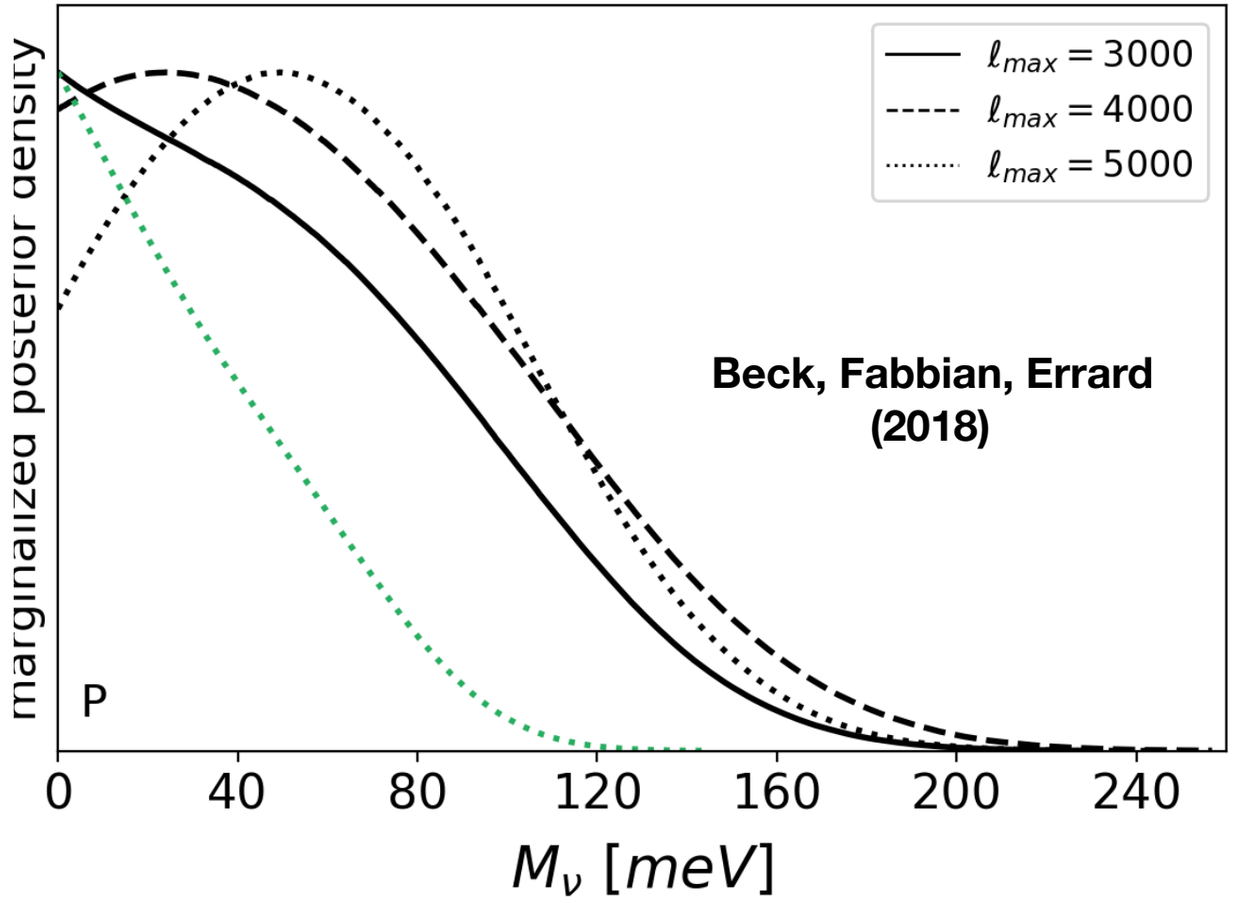


Beck, Fabbian, Errard (2018)

Neutrino mass estimation

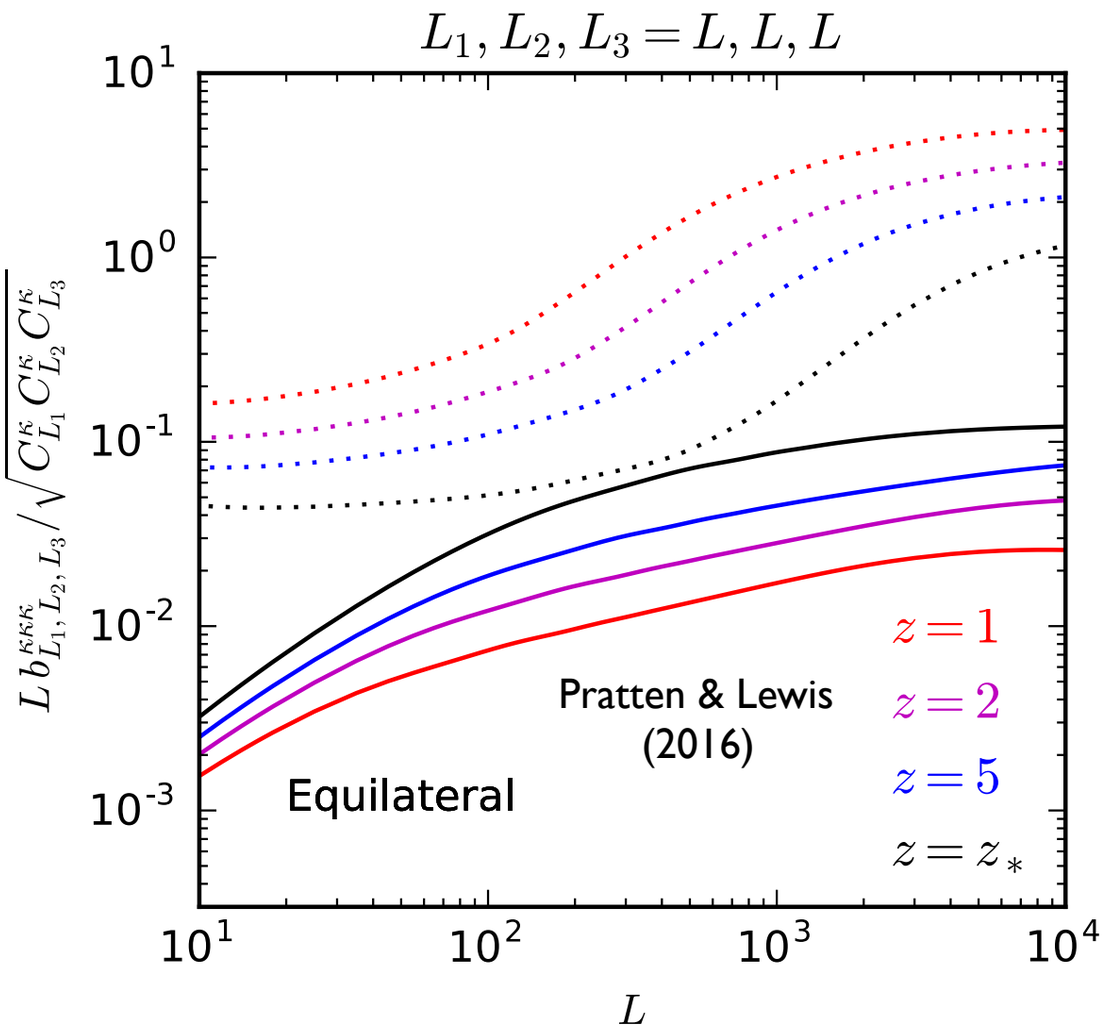
- Shape of the bias highly dependent on the maximum multipole included in the lensing reconstruction
- Bias on cosmological parameters at 1-2 sigma: neutrino mass more affected!
- Combination of data set potentially more robust but possible inconsistencies due to biases





Biases for cross-correlation studies

- Cross-correlation with high-redshift tracer: could reduce the cross-correlation bias
- Correlation with low-redshift tracer: enhance bias (e.g. z<0.5)

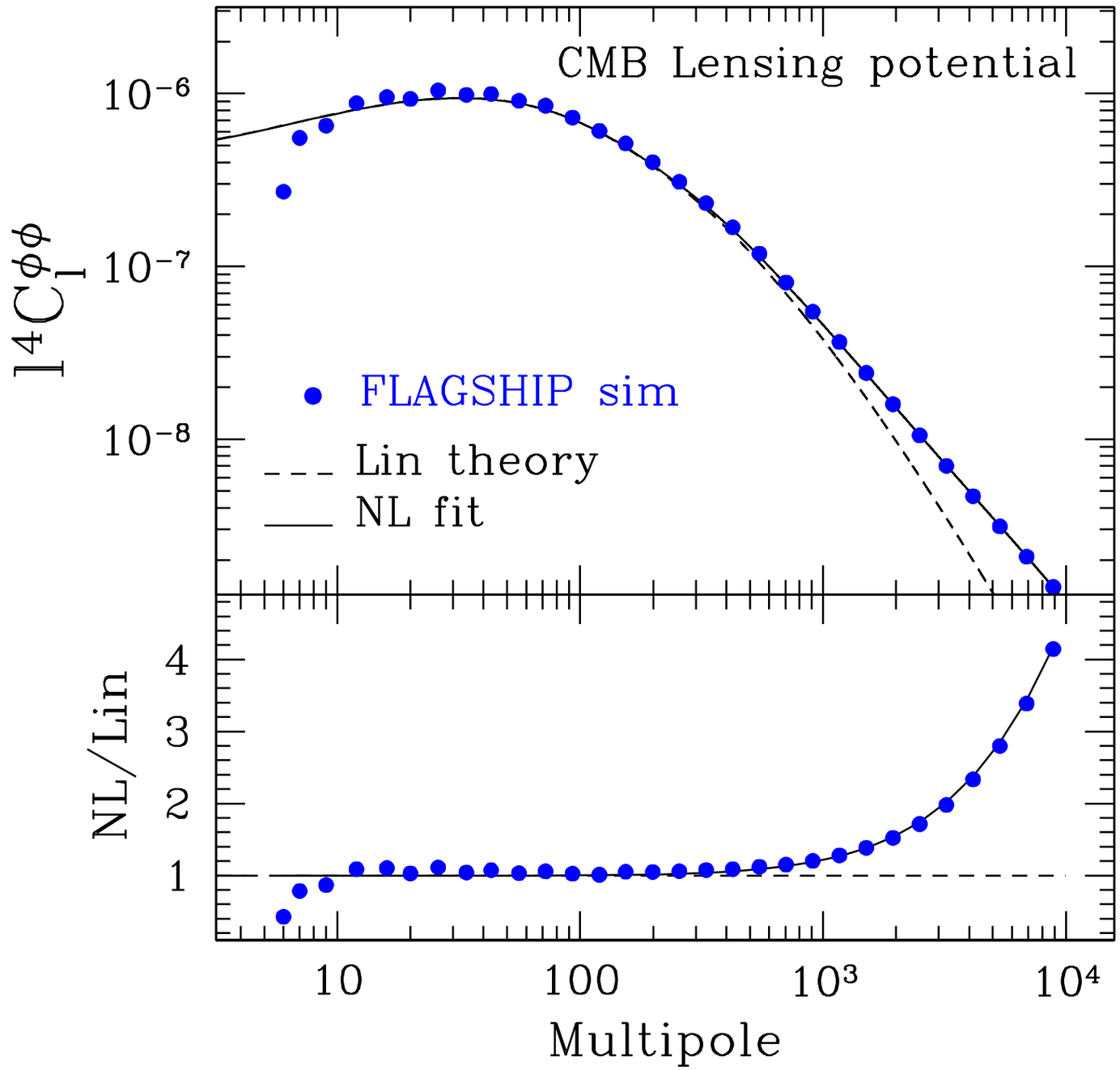


CMB lensing - weak lensing shear cross-correlation

Preliminary

Fabbian et al. (2018, in prep.)

Results from Flagship

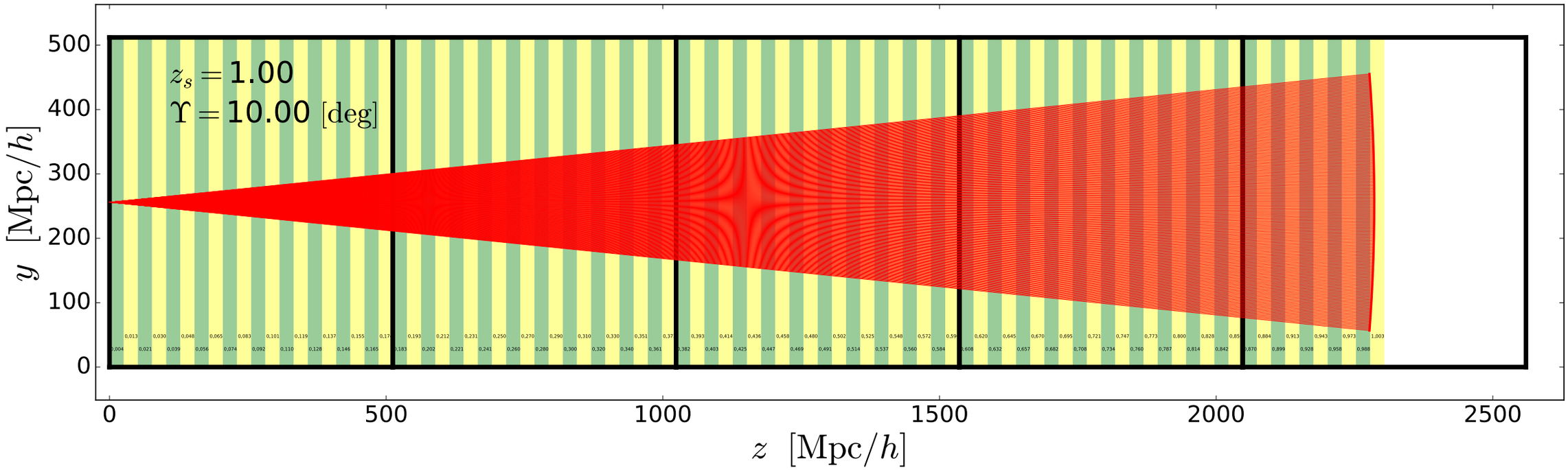


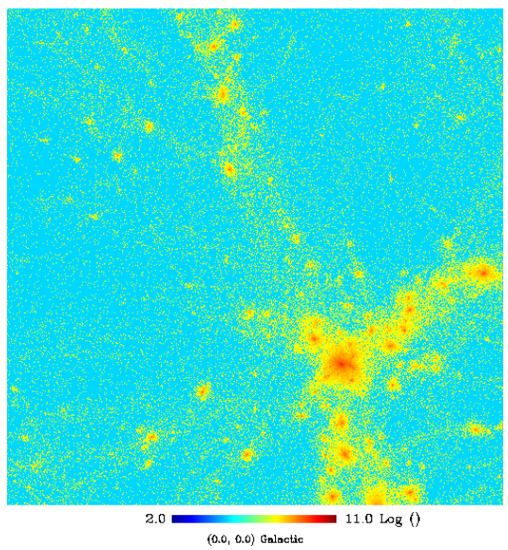
From Pablo Fosalba

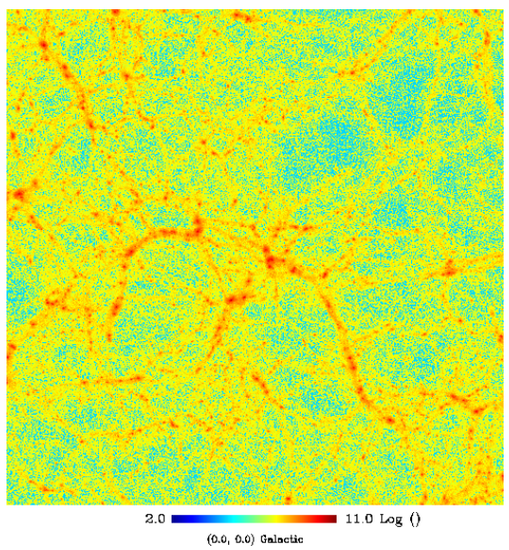
- Noise but no news from SWG leader despite multiple request
- Need to pursue an internal simulation strategy for “quicker" studies

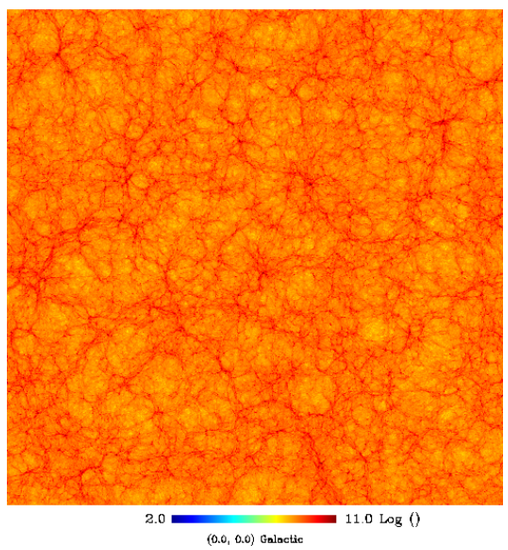
Lightcone comparison in a nutshell

- Two set of IC, Euclid cosmology, 512 Mpc/h, 1024 particles
- Compare convergence 2-point correlation, power spectrum, PDF, …



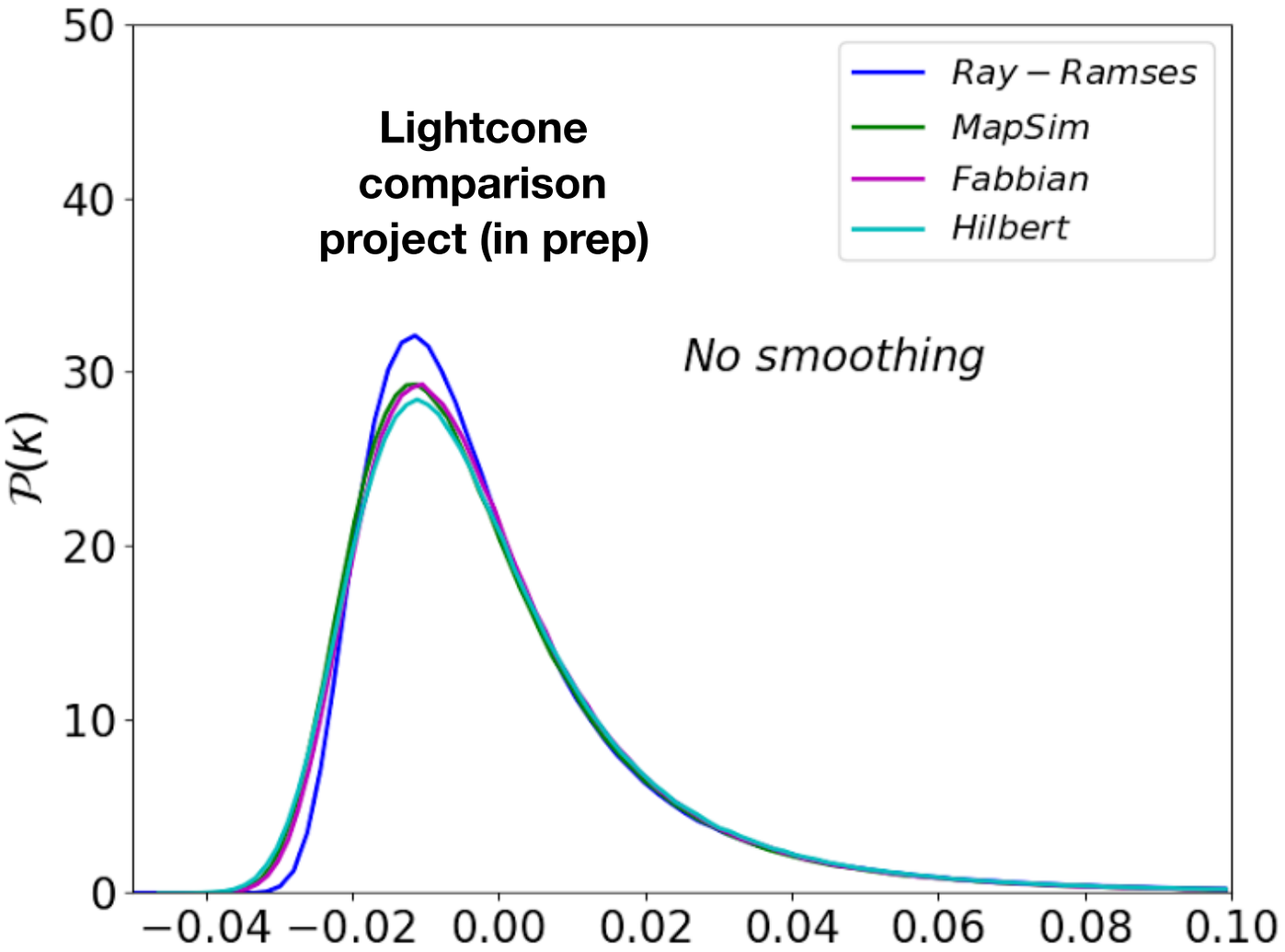


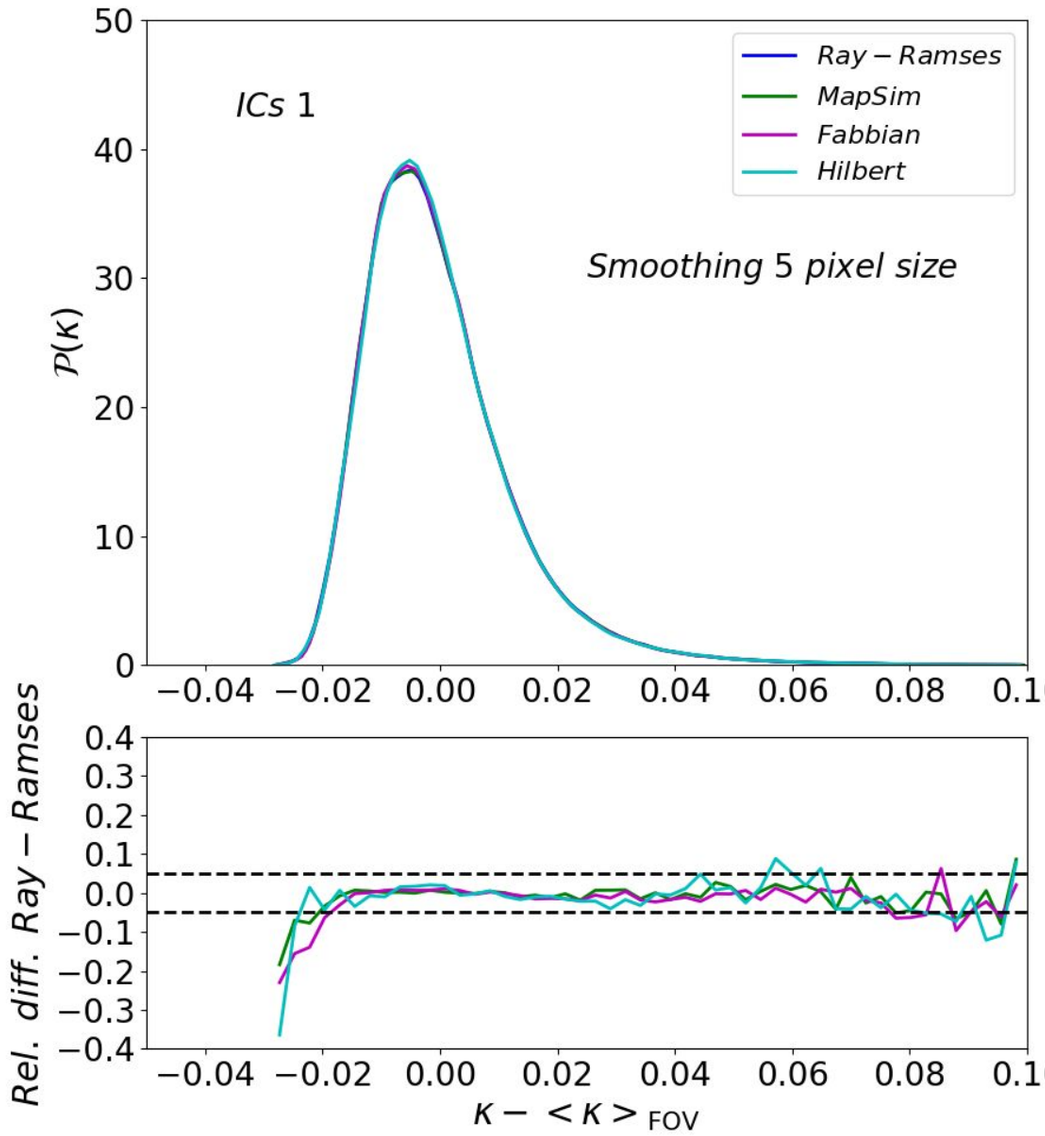




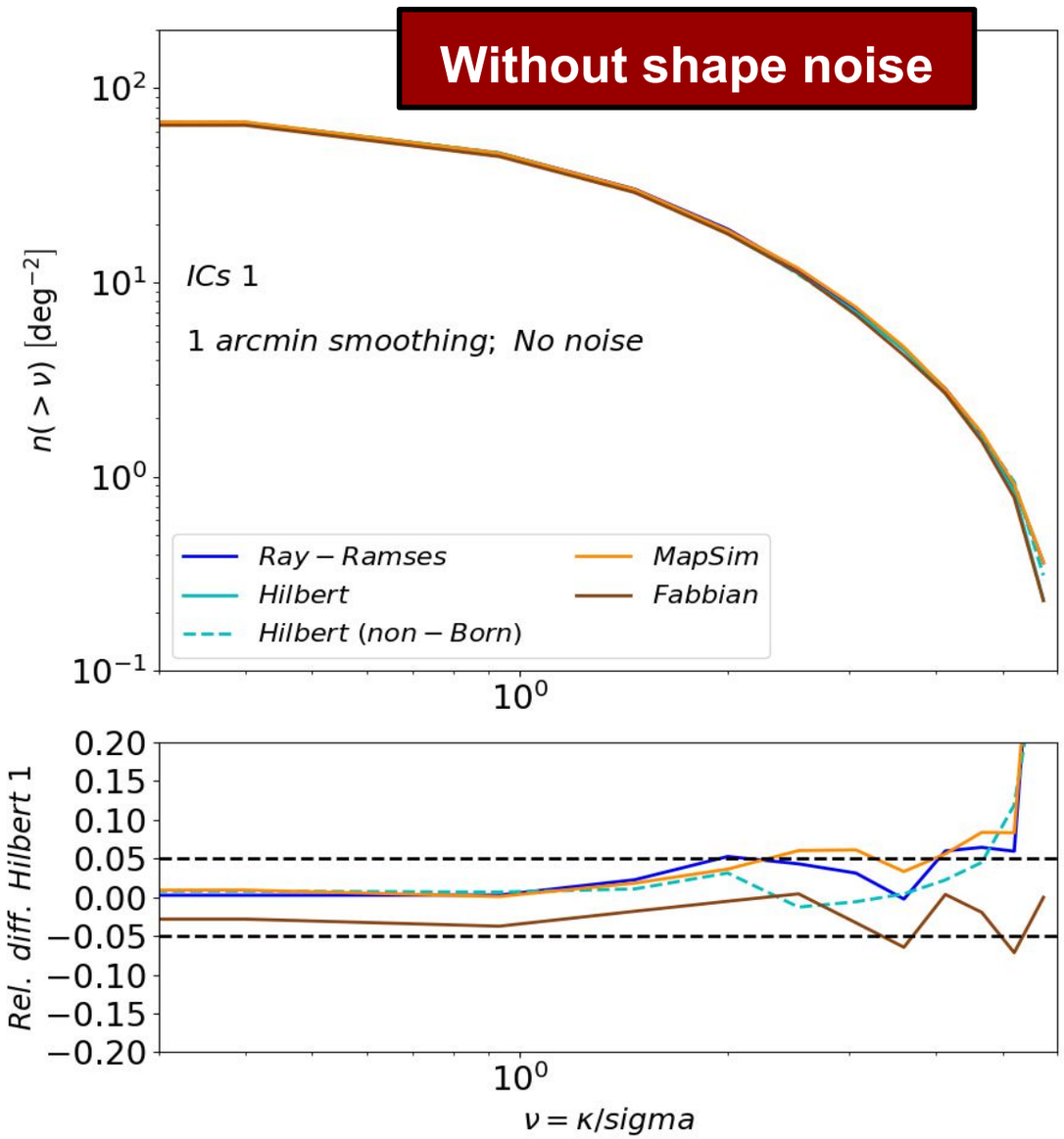
Convergence 1-point PDF

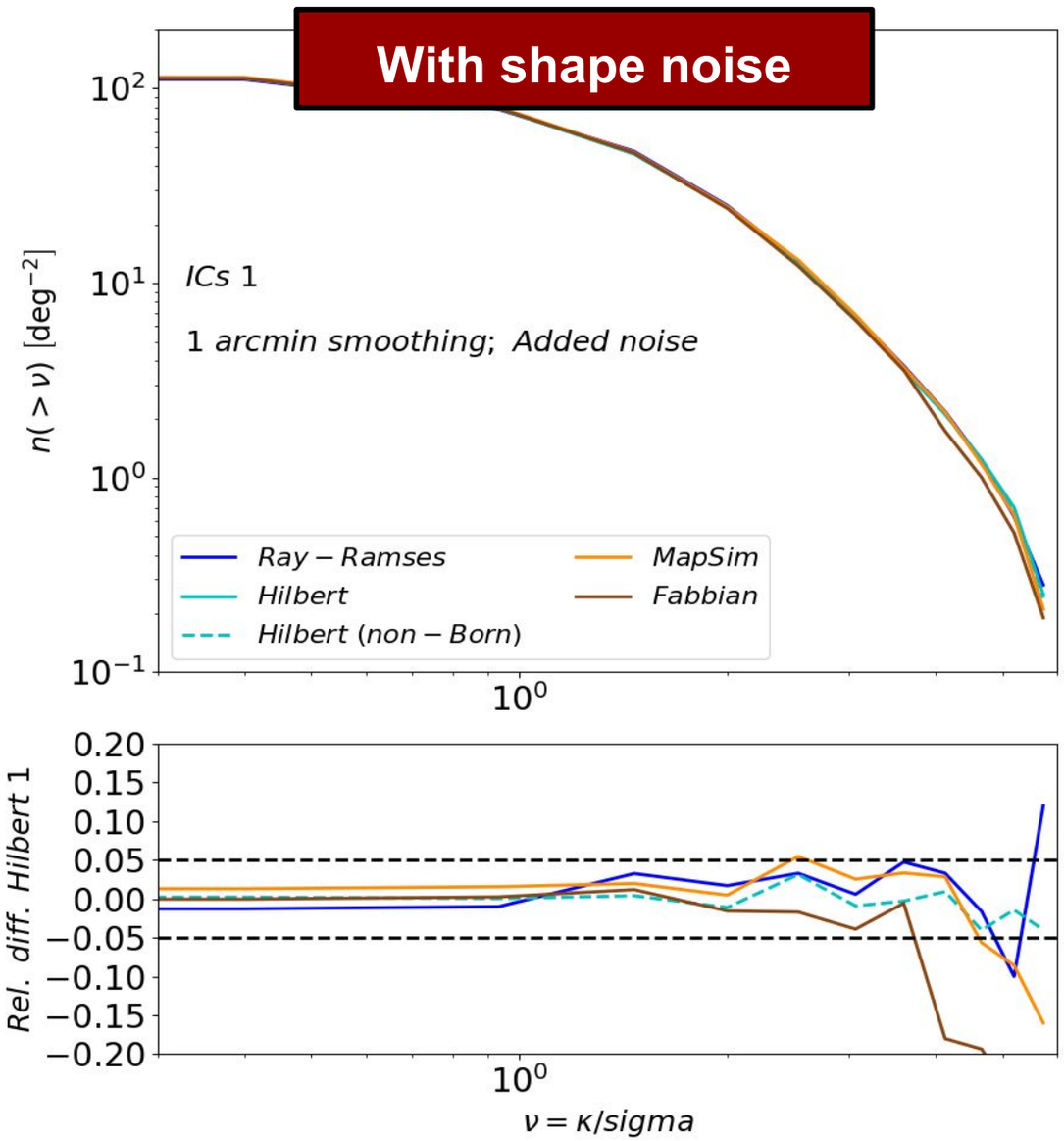
- Few issues related to smoothing and different maps resolution solved
- Overall accuracy ~ 5%, some residual discrepancies on the tails,
- FOM yet to be defined





Lensing peak counts





Lightcone comparison project (in prep)