

# **KiDS-450: The tomographic weak lensing power spectrum and constraints on cosmological parameters**

(MNRAS in print; [arXiv:1706.02892](https://arxiv.org/abs/1706.02892))

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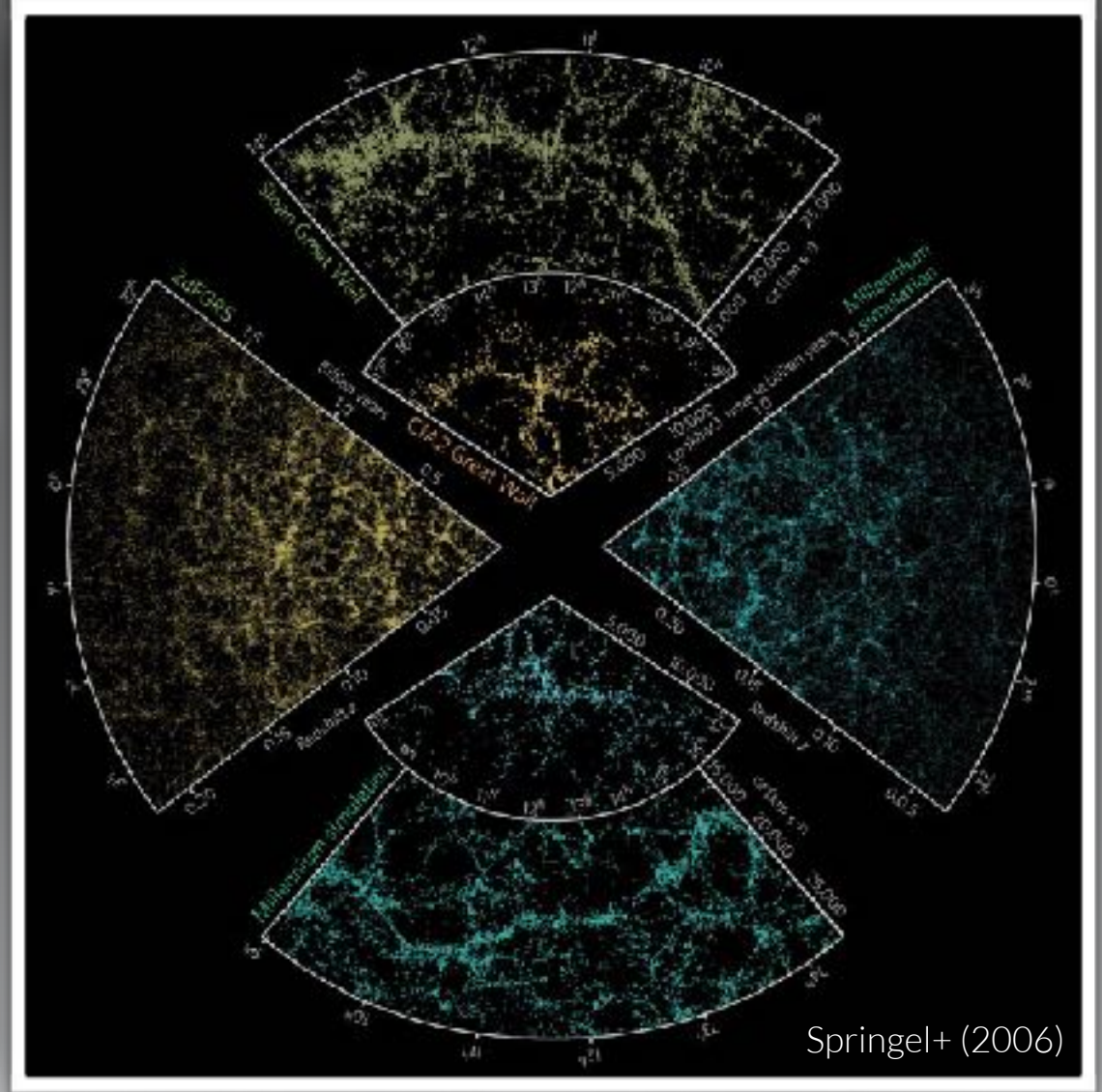
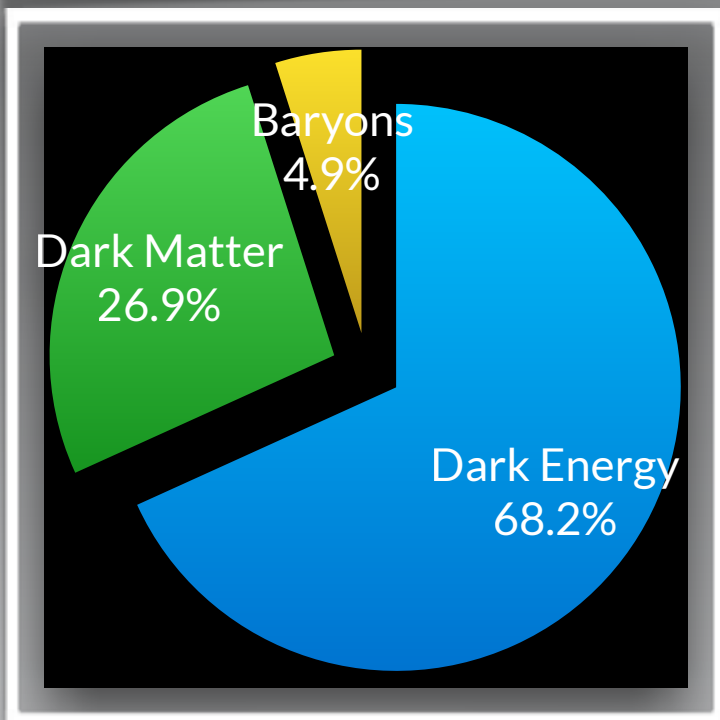
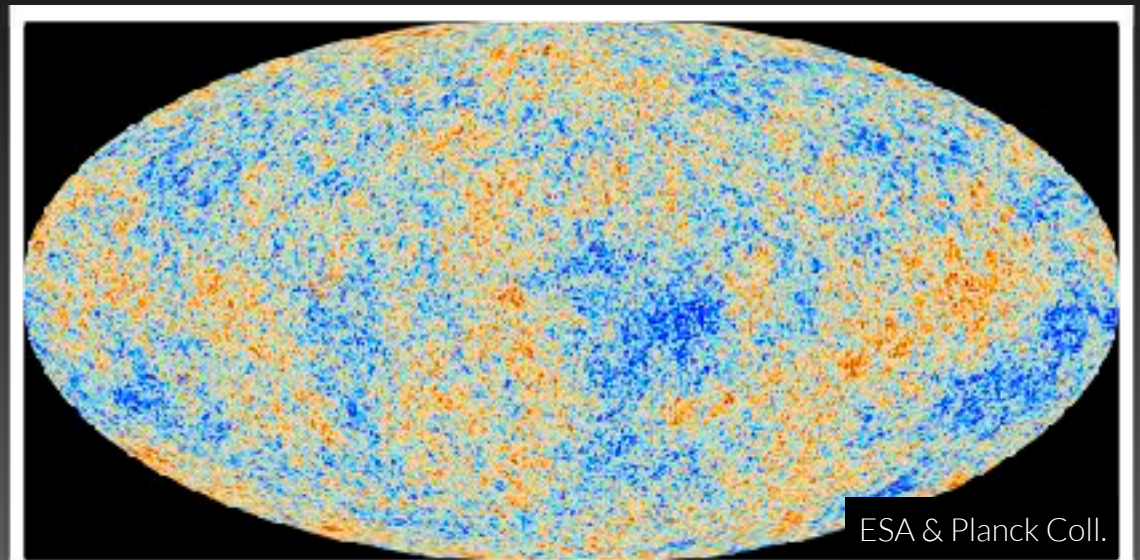
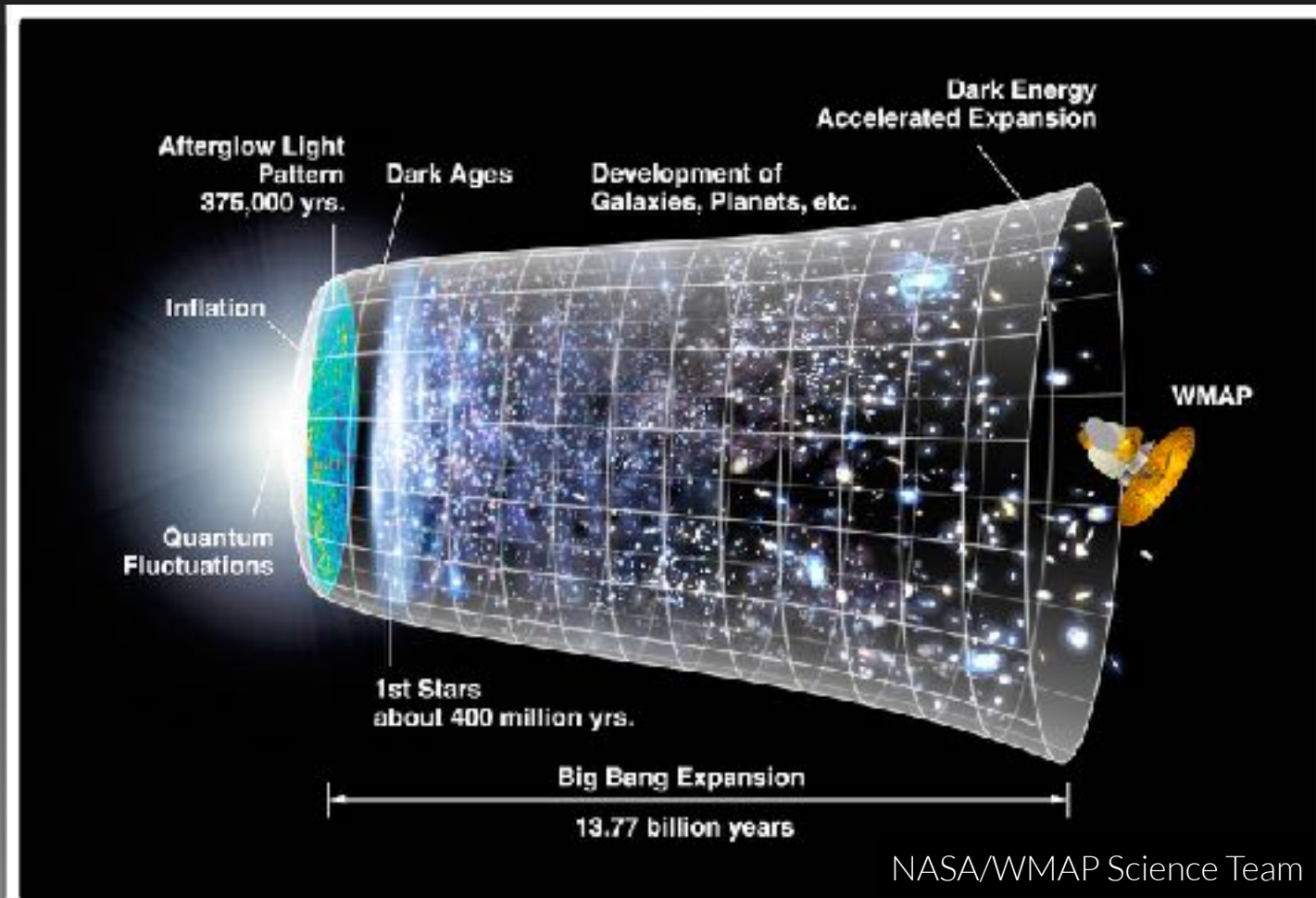
COSMO-17

Paris, 29 August 2017

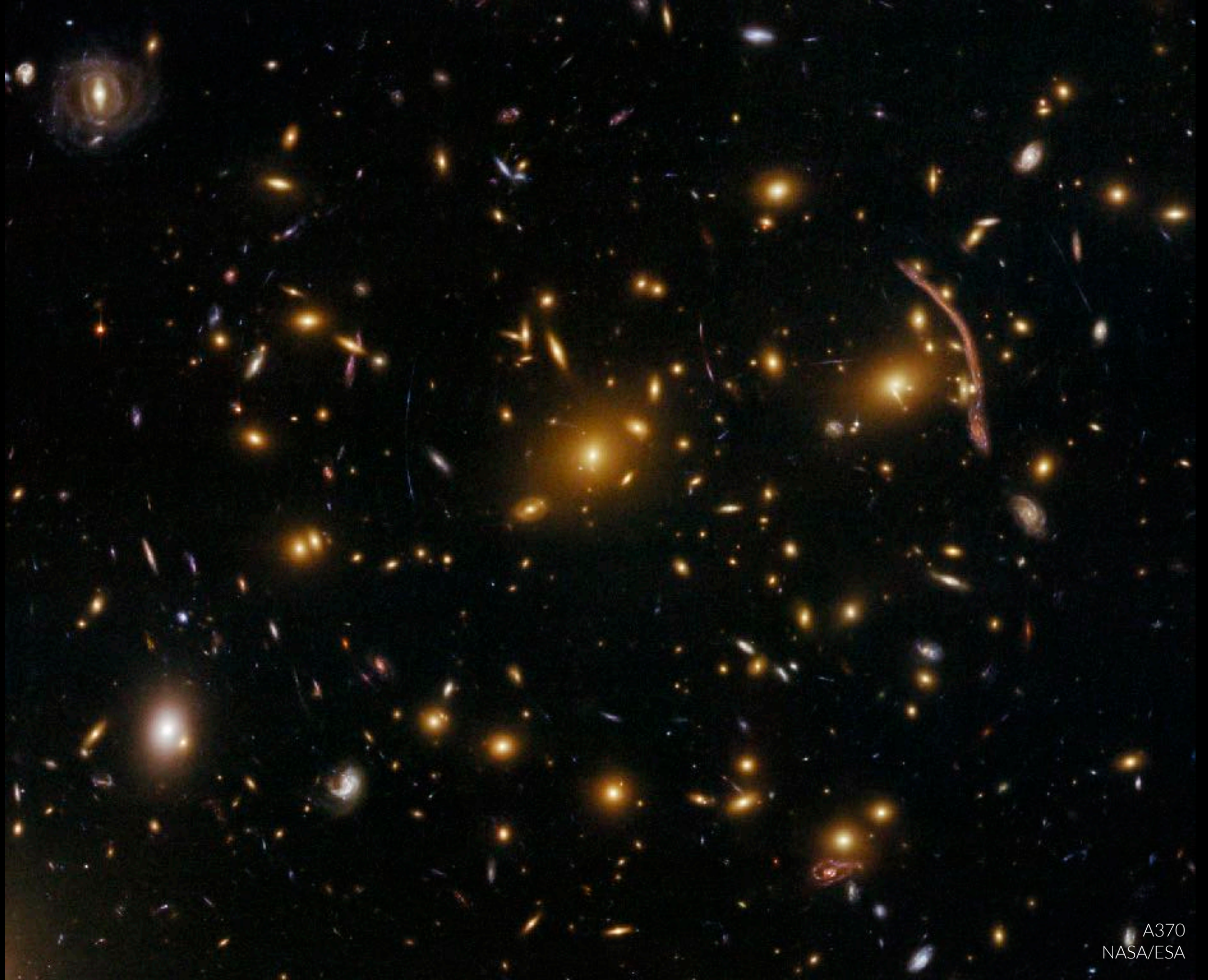
# I. Introduction



# Cosmological concordance: $\Lambda$ CDM



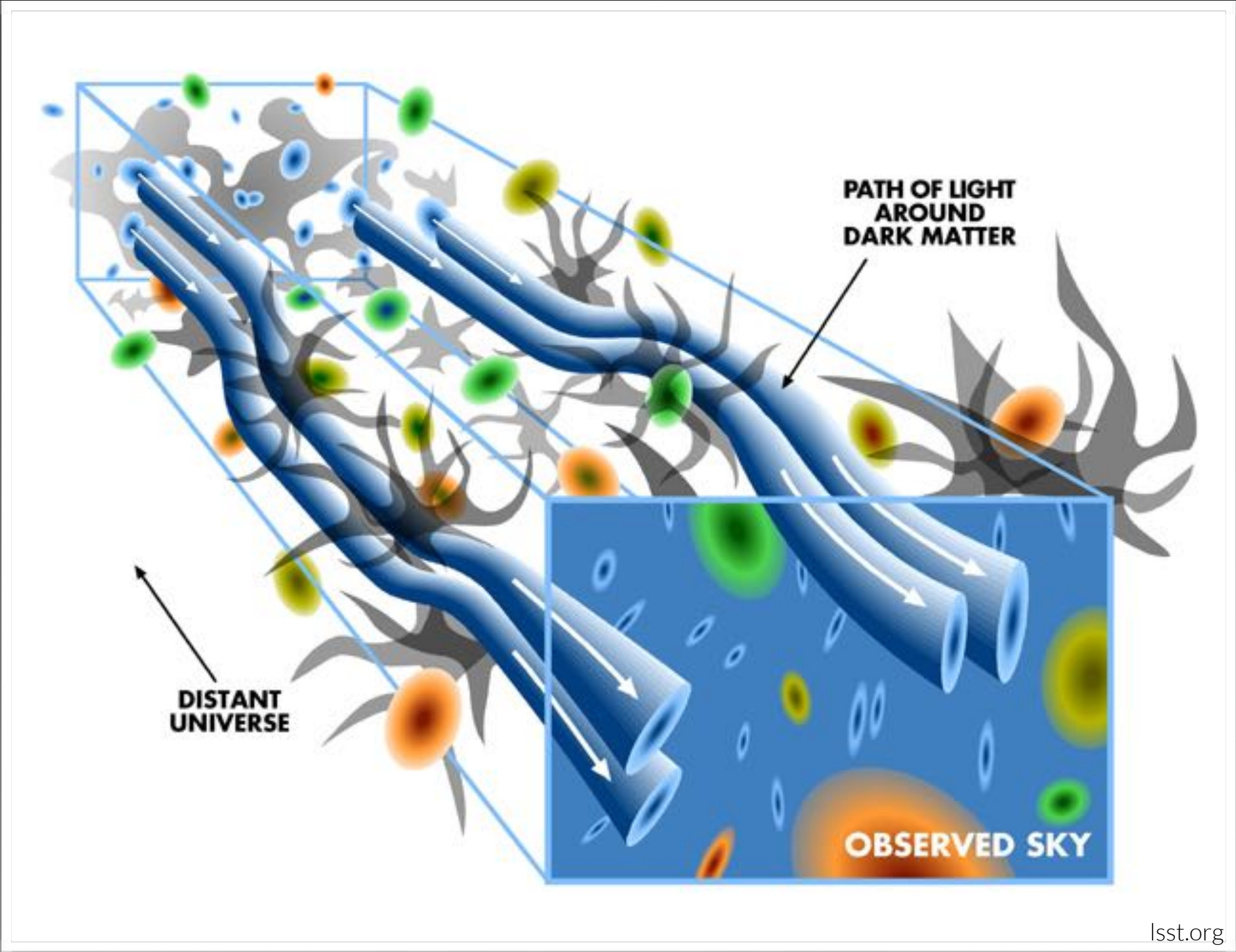




# II. Cosmic Shear



# Lensing of LSS:

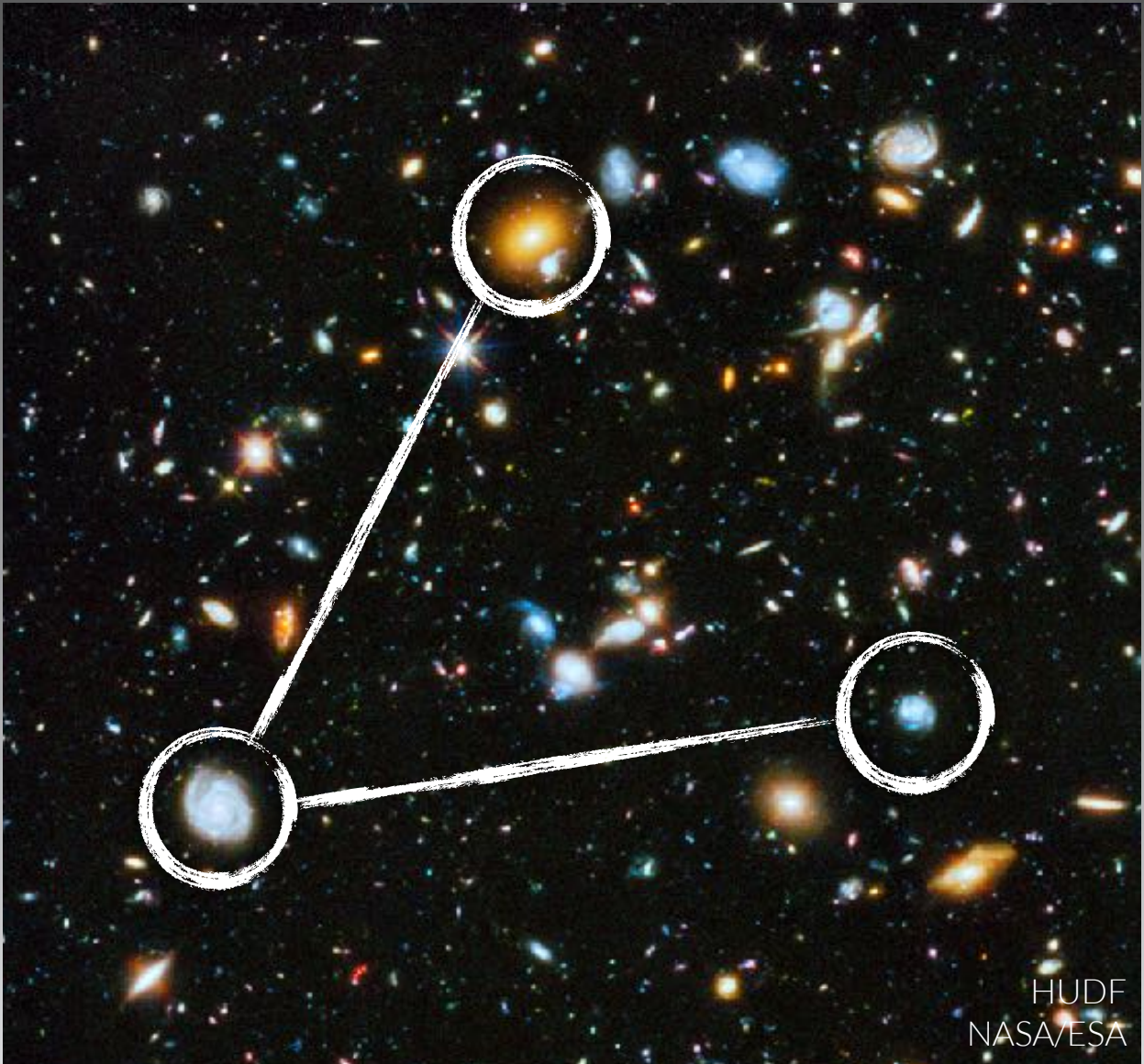


lsst.org

shear-shear  
(i.e. cosmic shear)

# Lensing of LSS:

$$C_{\mu\nu}^{\text{EE}}(\ell) = \int_0^{\chi_H} \frac{q_\mu(\chi)q_\nu(\chi)}{f_K^2(\chi)} P_\delta \left( k = \frac{\ell + 0.5}{f_K(\chi)}, \chi \right)$$



HUDF  
NASA/ESA

'geometry'

'physics'

measurements:

Real space



2PCF



Fourier space

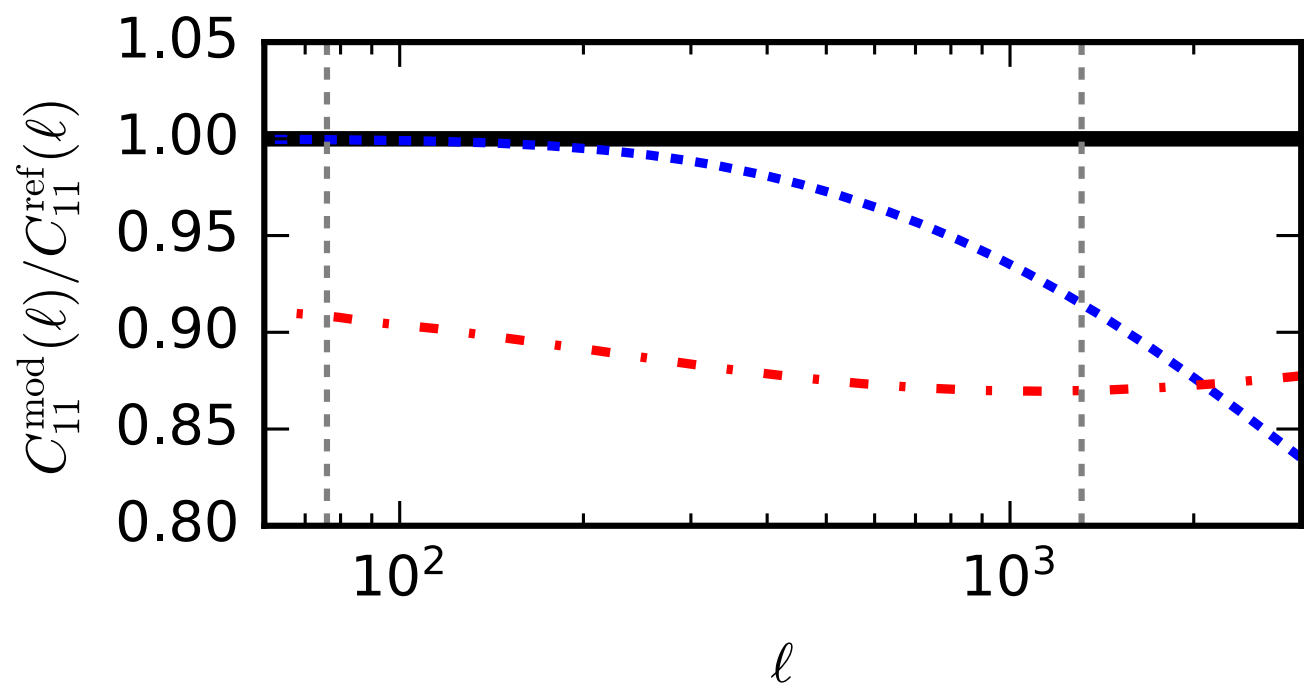
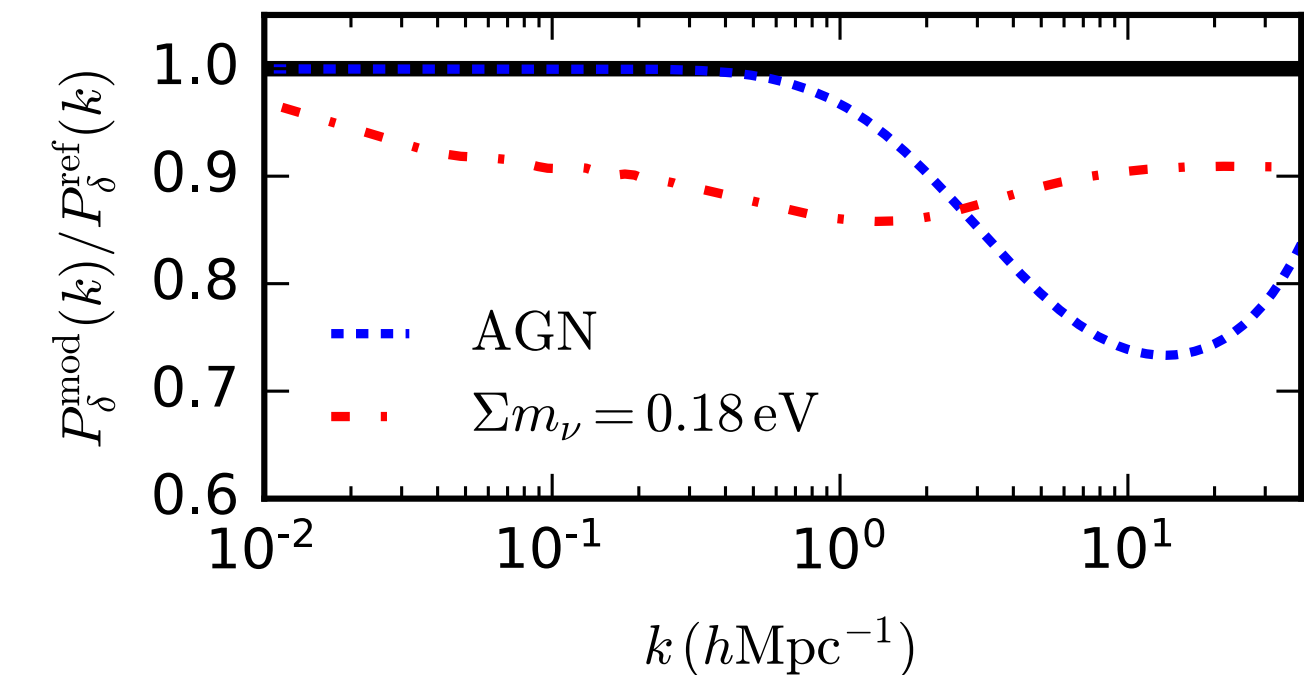


PS





# Scale-dependent physics:



large scales

small scales

$P_{\delta}(k)$

$C(l)$

integration  
over  
lensing kernel

Baryon feedback:

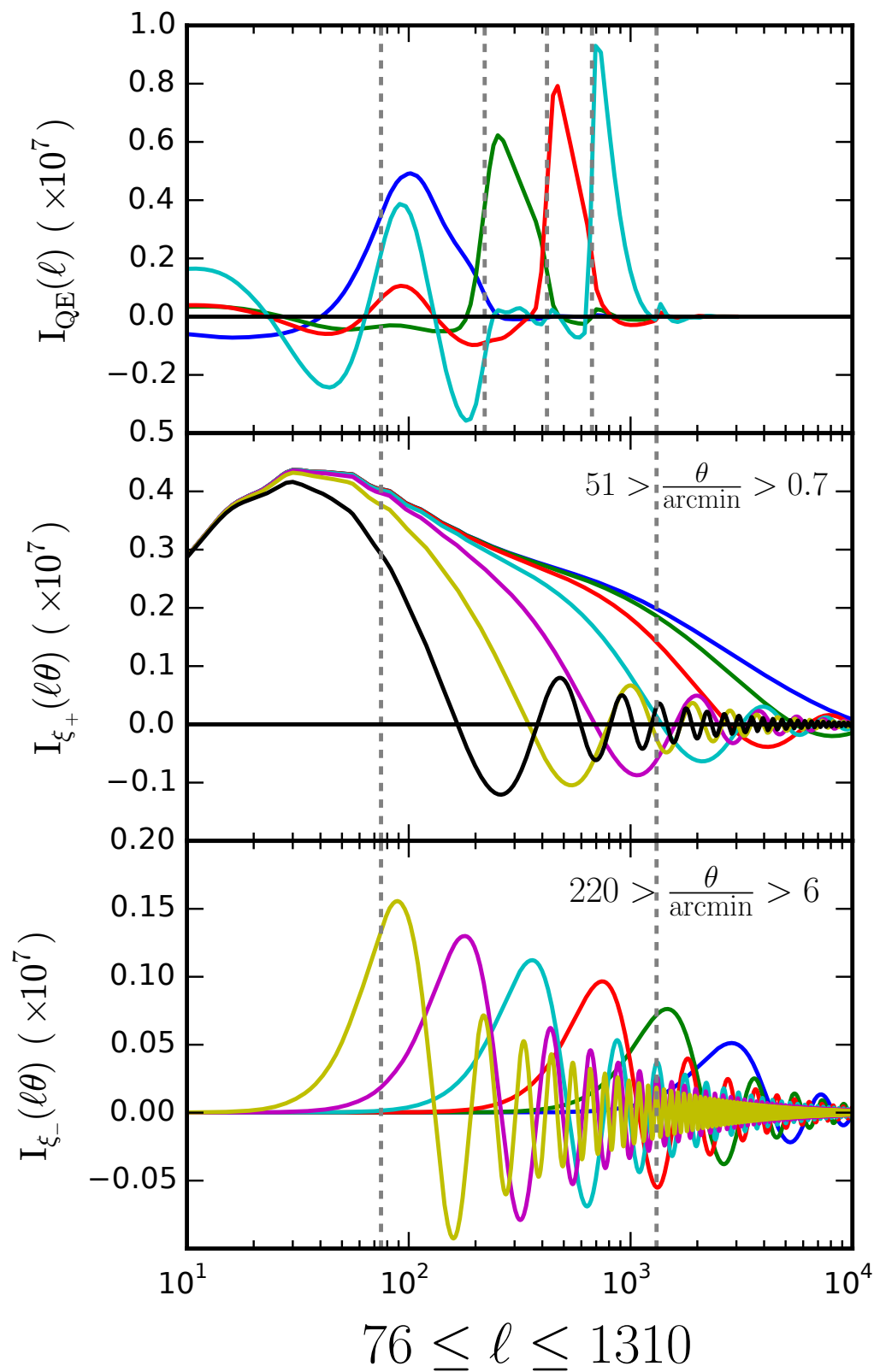
AGN model from OWLS (Schaye+ 2010, van Daalen+ 2011) following Harnois-Déraps+ (2015)

3 degenerate, massive neutrinos:

CLASS (Blas+ 2011, Audren & Lesgourgues 2011) incl. HALOFIT (Takahashi+ 2012, Bird+ 2012)



# Real space vs. Fourier space:



**QE**

**CF<sub>+</sub>**

**CF<sub>-</sub>**

$$W(\ell) \times C_{\mu\nu}^{EE}(\ell)$$

multipole range:

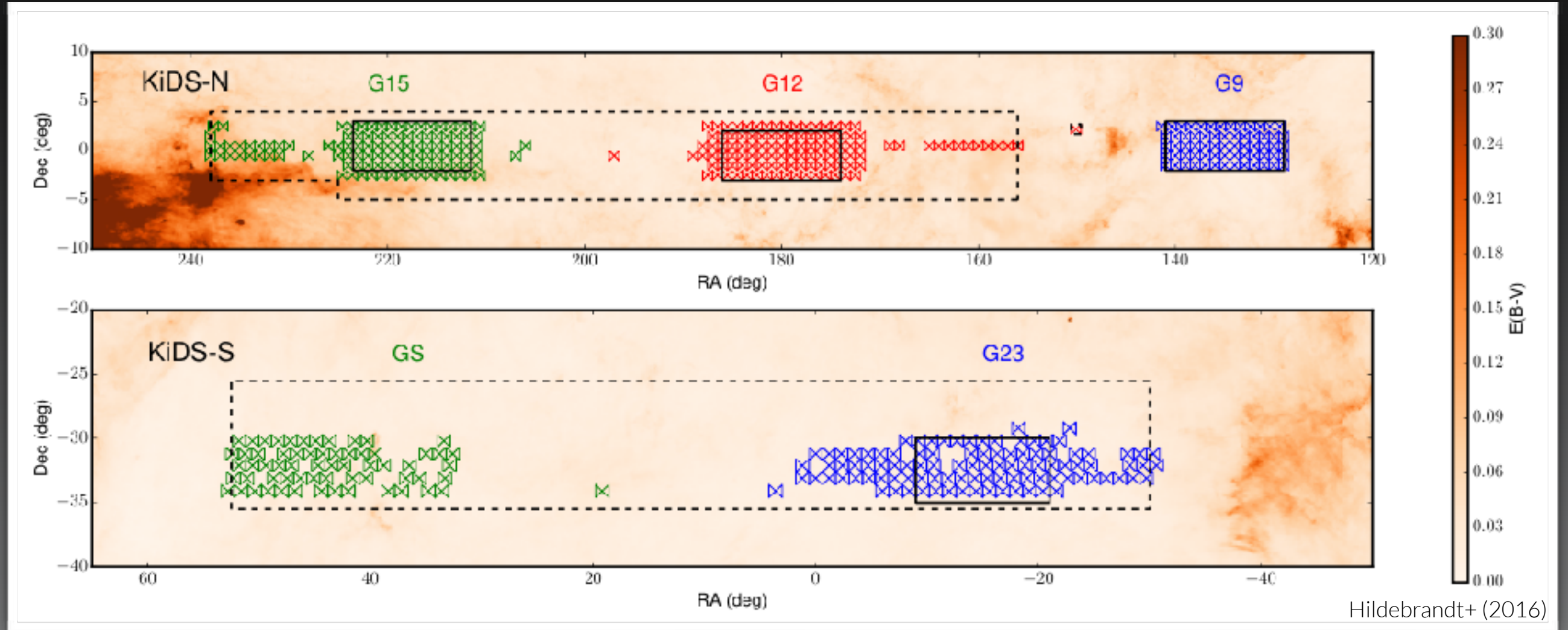
**76 – 1310**



k-modes (@  $z_{\text{med}} = 0.4$ ):

**$0.07 h\text{Mpc}^{-1} - 1.21 h\text{Mpc}^{-1}$**

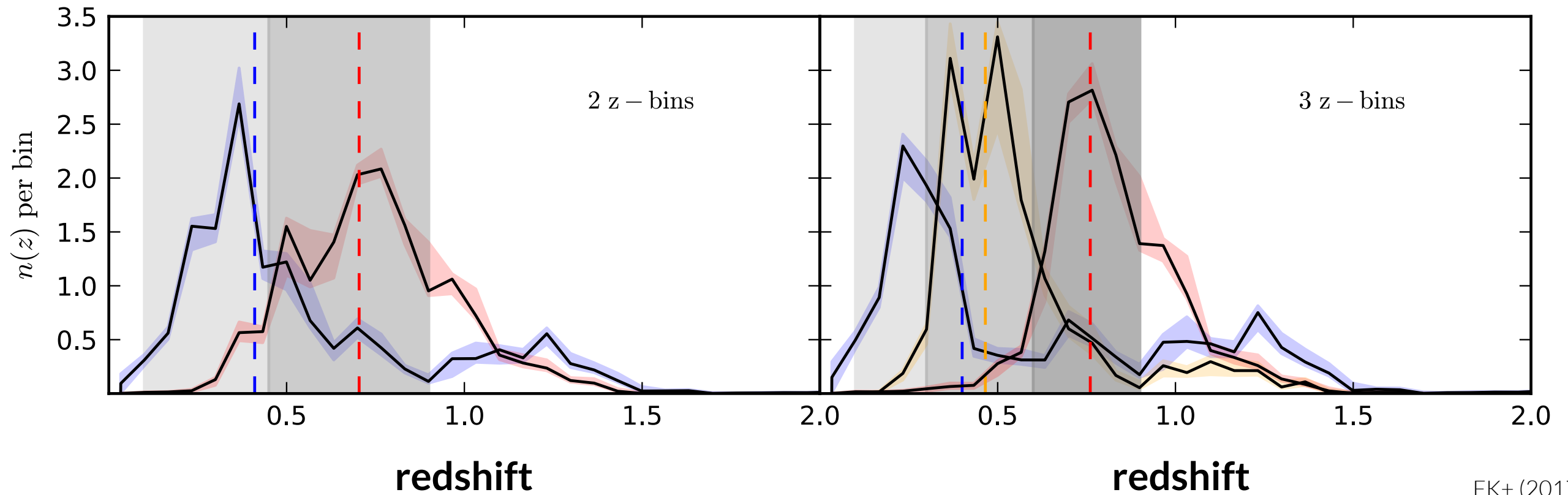
# The KiDS-450 data:



- KiDS = Kilo Degree Survey
- ongoing ESO optical survey in 4 bands ( $u, g, r, i$ )
- using OmegaCAM at the VLT Survey telescope (VST) in Chile
- targeting  $1350 \text{ deg}^2$ , for this study  $\sim 450 \text{ deg}^2$  are being used



# The KiDS-450 data:



- shapes estimated with *lensfit* (Miller+ 2013, Fenech-Conti+ 2017)
- calibrated with dedicated suite of image simulations (Fenech-Conti+ 2017)
- photometric redshifts directly calibrated through reweighting in magnitude space, *DIR* method (Hildebrandt+ 2017)
- effective area for lensing,  $A_{\text{eff}} \sim 325 \text{ deg}^2$
- shear data split into 2 and 3 z-bins:

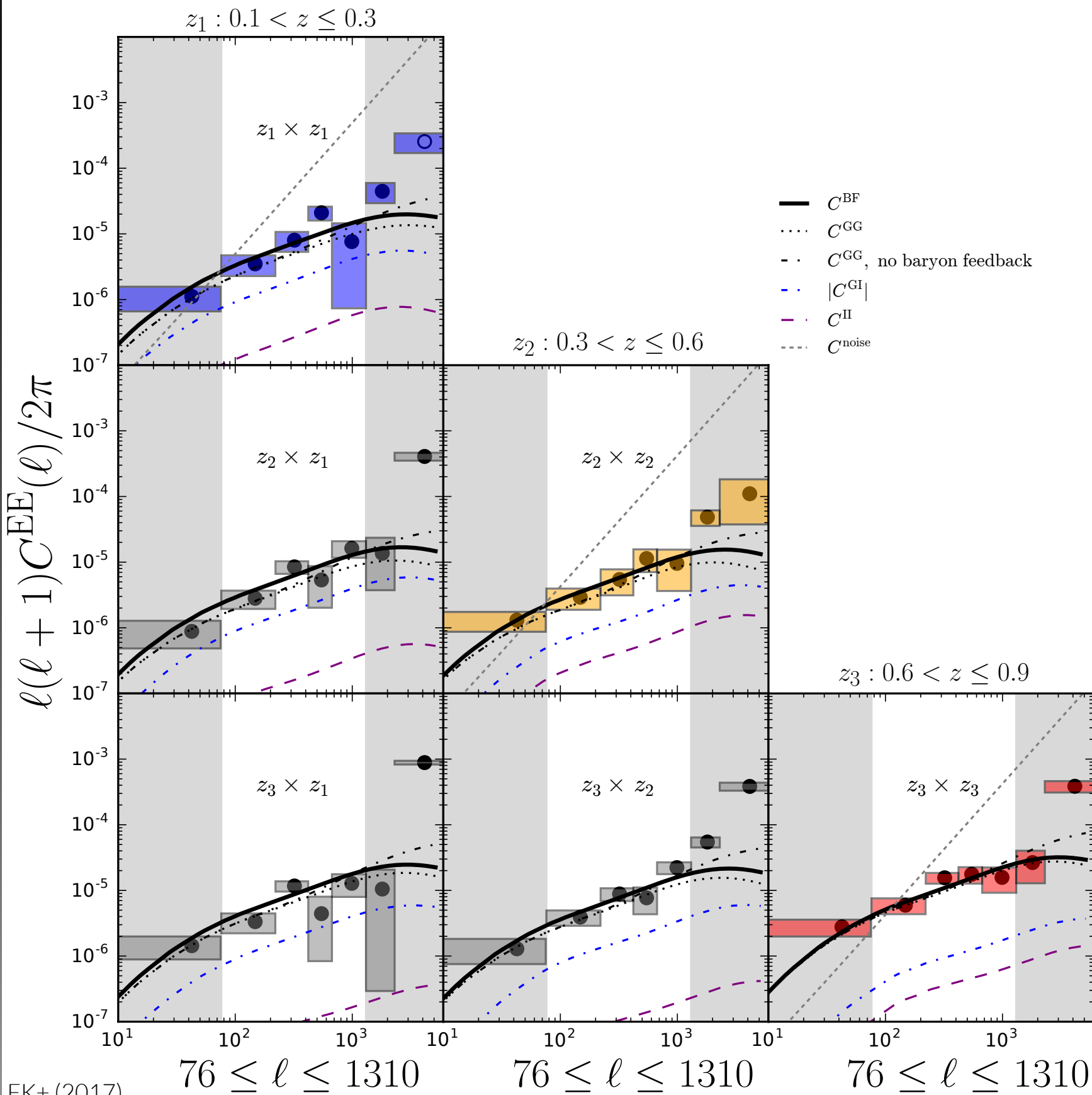
$$z_1: 0.1 < z < 0.3 (z_{\text{med}} \sim 0.39)$$

$$z_2: 0.3 < z < 0.6 (z_{\text{med}} \sim 0.46)$$

$$z_3: 0.6 < z < 0.9 (z_{\text{med}} \sim 0.76)$$

$$\left. \begin{array}{l} z_1: 0.1 < z < 0.3 (z_{\text{med}} \sim 0.39) \\ z_2: 0.3 < z < 0.6 (z_{\text{med}} \sim 0.46) \\ z_3: 0.6 < z < 0.9 (z_{\text{med}} \sim 0.76) \end{array} \right\} \rightarrow n_{\text{eff}}(z_{1,2,3}) \sim 2.3 \text{ arcmin}^{-2}$$

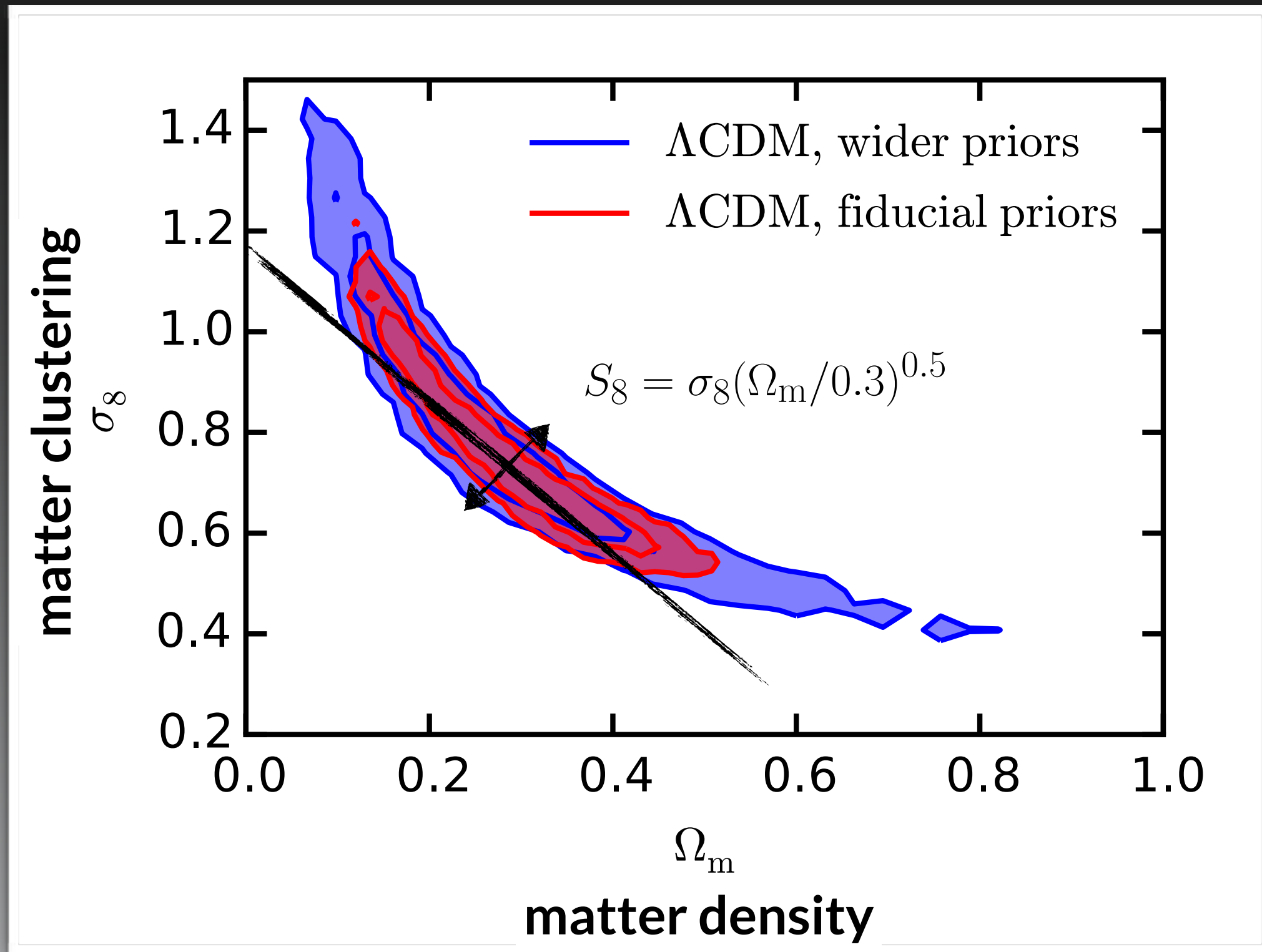
# Cosmic shear power spectrum:



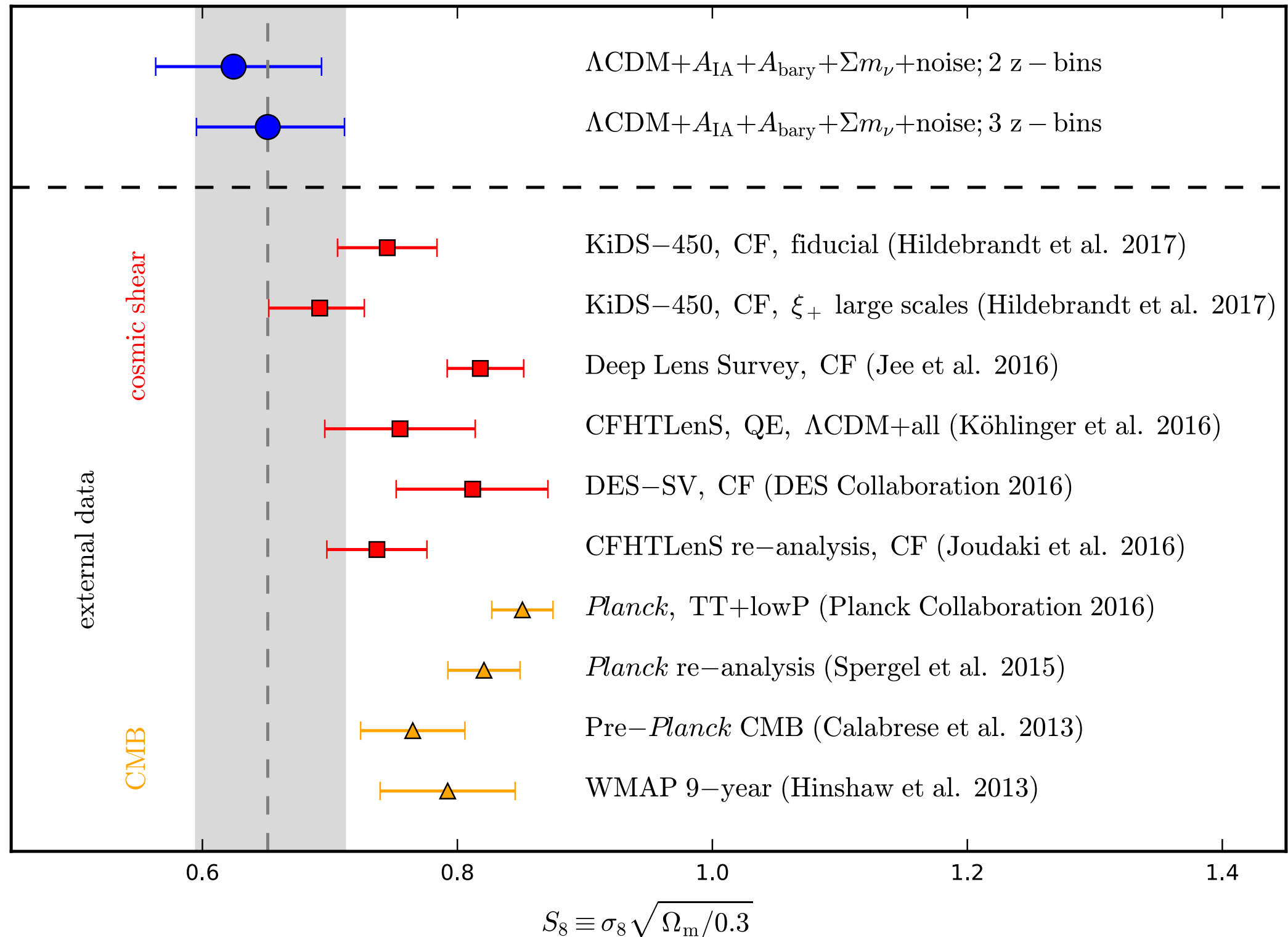
- quadratic estimator (QE) method (Hu & White 2001)
- expanded to include redshift bins (FK+ 2016)
- errors based on analytical covariance



# Cosmological constraints:



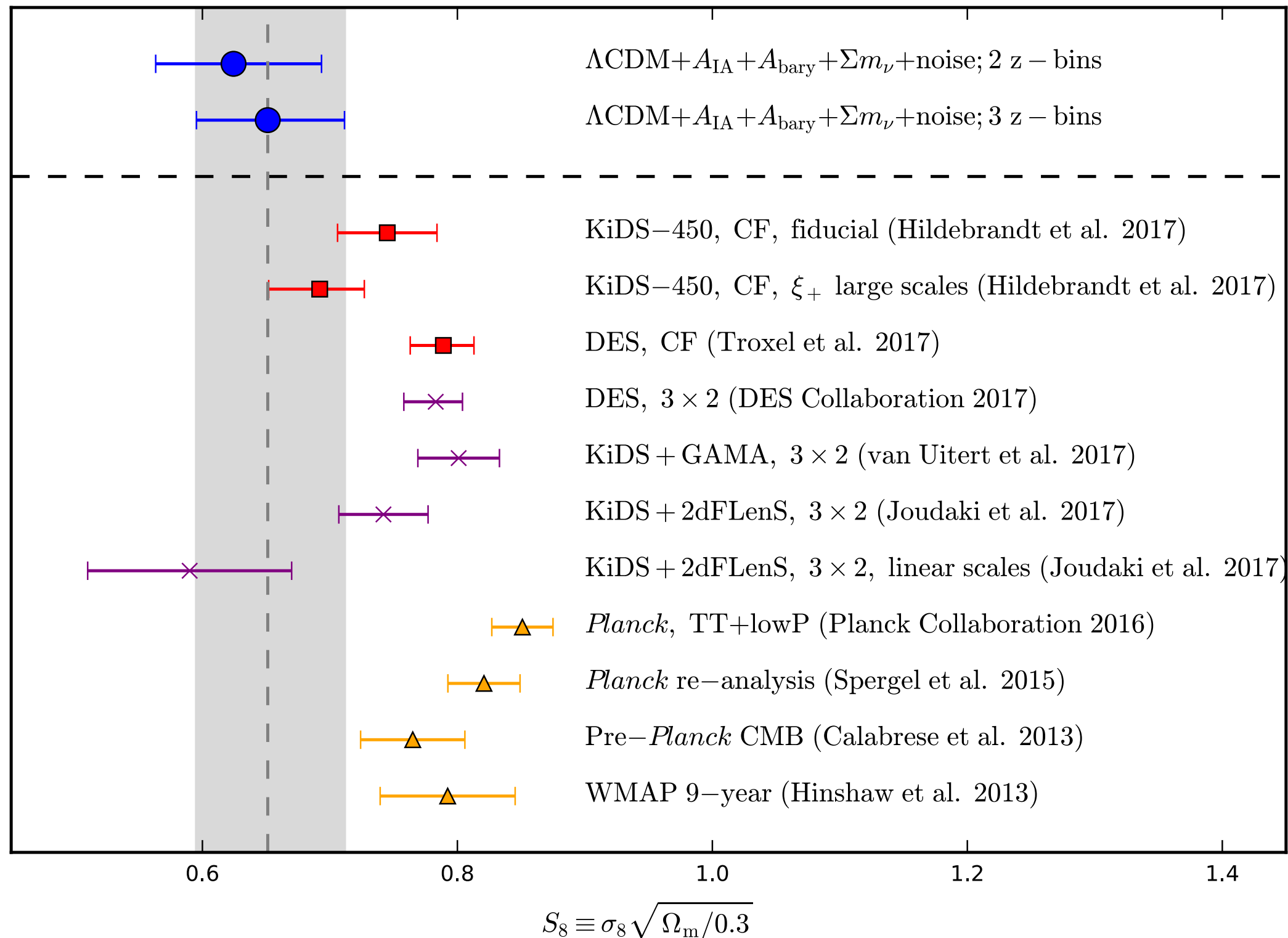
# Cosmological constraints:



FK+ (2017)



# Cosmological constraints (updated):



# III. Summary



- measured tomographic weak lensing power spectrum in multipole range 76 – 1310 in 2 and 3 z-bins
- constraint on  $S_8$  in tension with *Planck* and other results (beware of scale cuts and physical nuisances though)
- internal consistency of cosmic shear estimators in KiDS being followed up right now, stay tuned!
  
- Data are public:  
[kids.strw.leidenuniv.nl/sciencedata.php](http://kids.strw.leidenuniv.nl/sciencedata.php)
- QE-code is public:  
[bitbucket.org/fkoehlin/qe\\_public](https://bitbucket.org/fkoehlin/qe_public)
- Likelihood-code is public:  
[bitbucket.org/fkoehlin/kids450\\_qe\\_likelihood\\_public](https://bitbucket.org/fkoehlin/kids450_qe_likelihood_public)