The KiDS-450 weak-lensing power spectrum, neutrinos, and baryons

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& the KiDS collaboration

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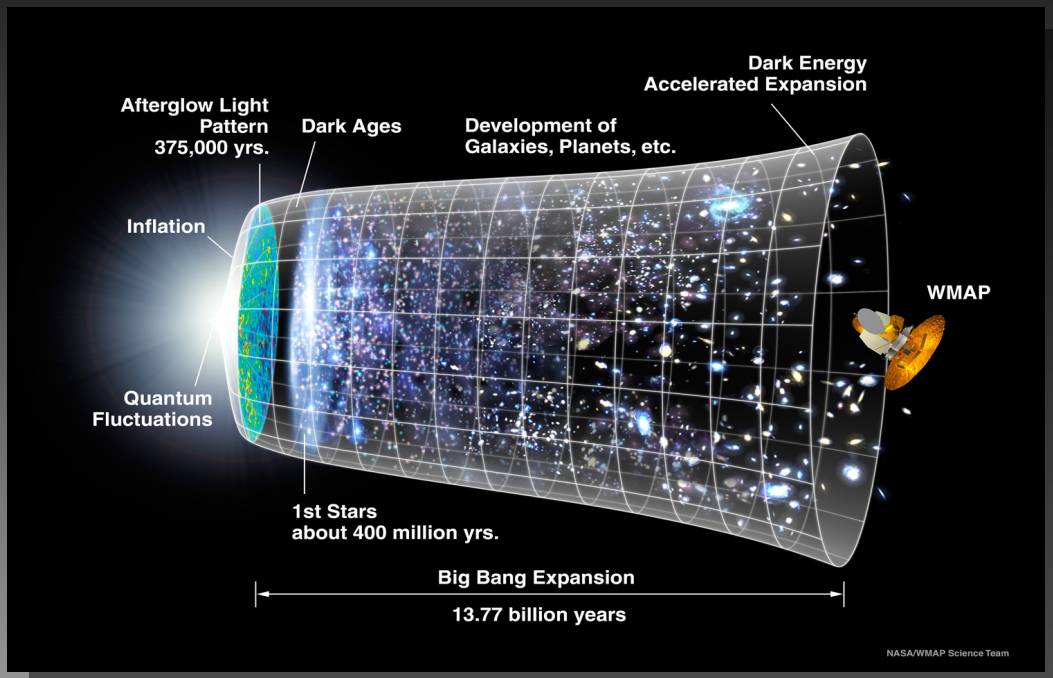
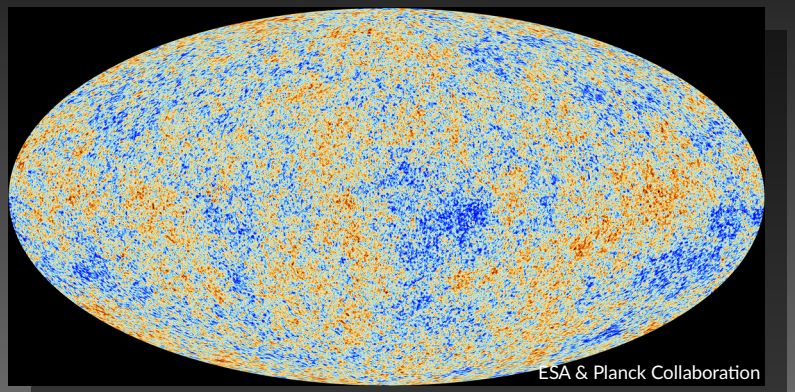
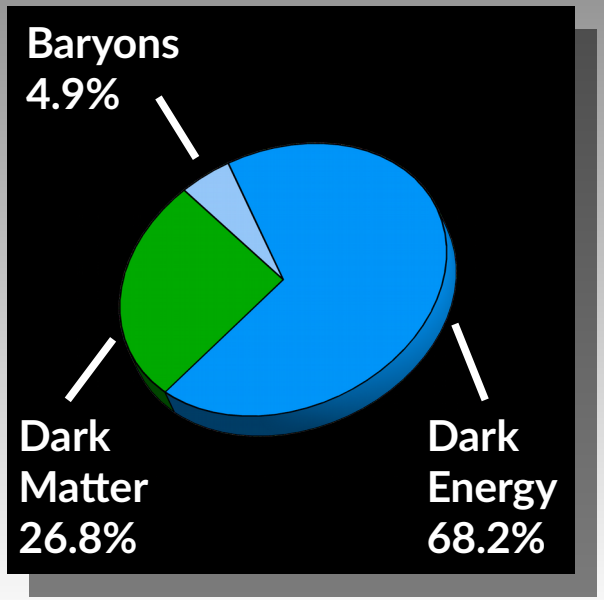
I. Introduction

Cosmological model:







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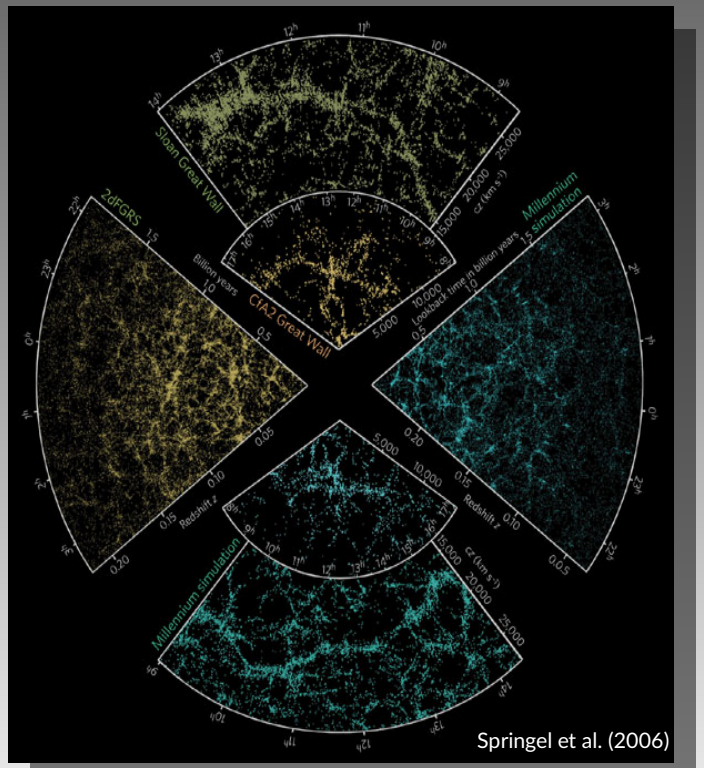
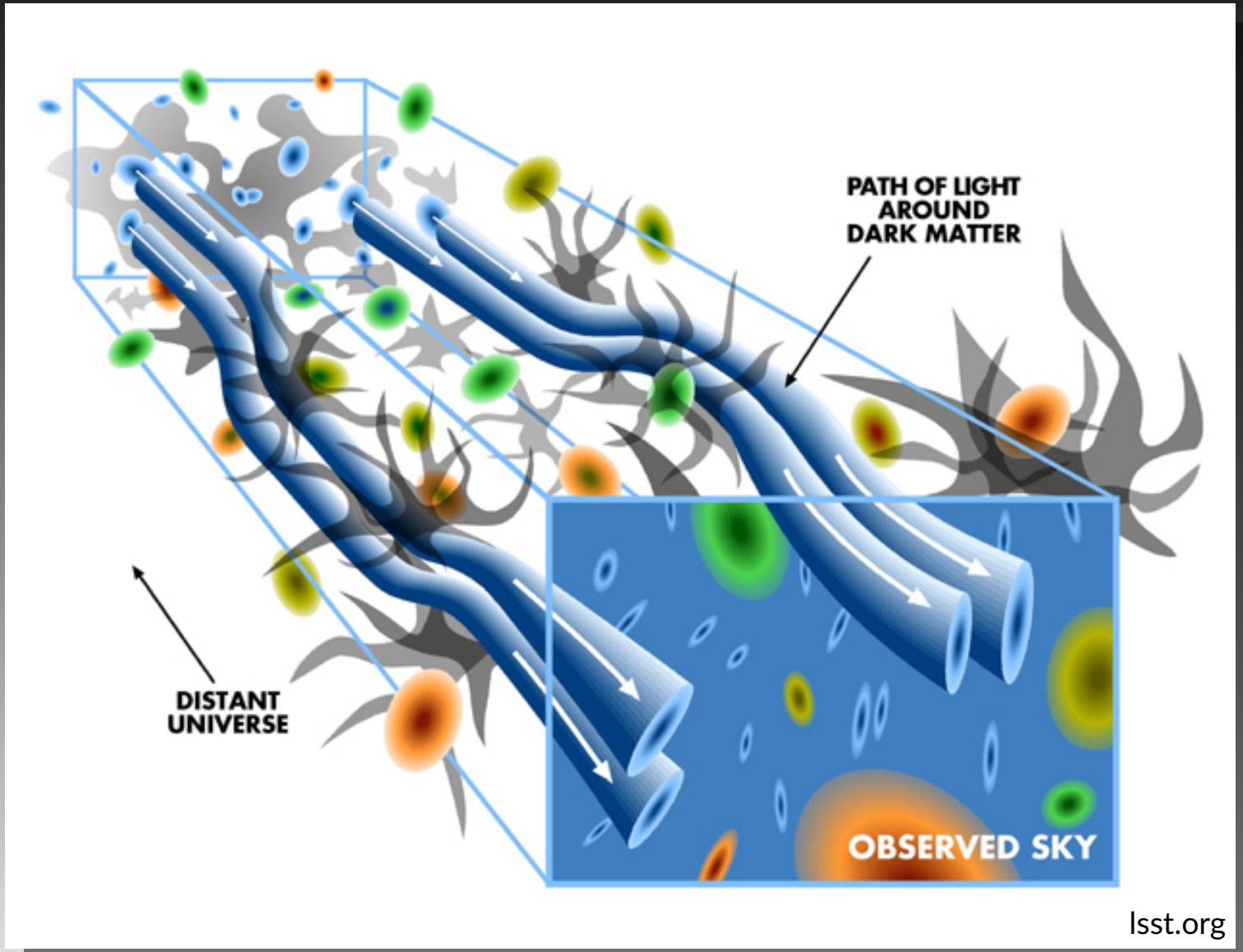


II. Cosmic Shear


A370
NASA/ESA

Lensing statistic:



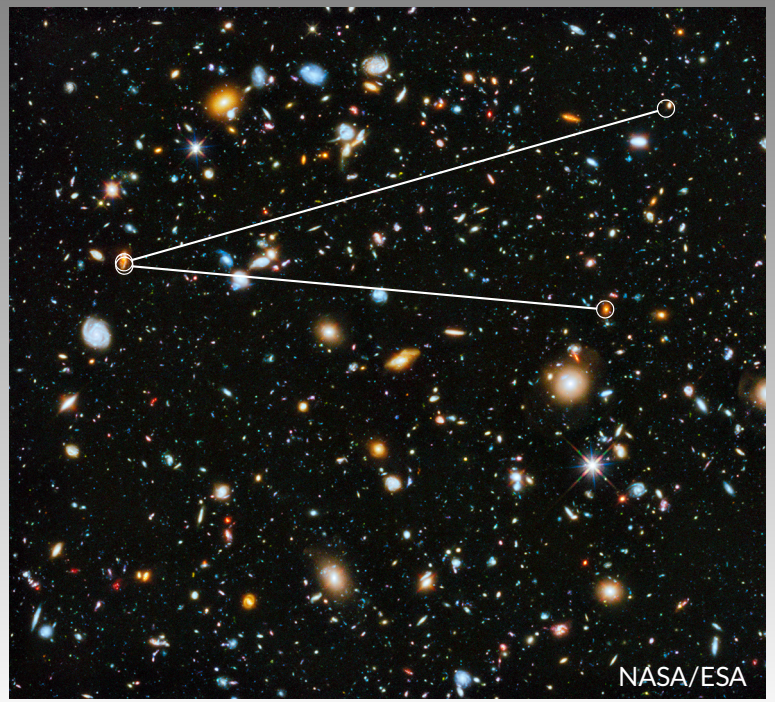
shear-shear
(i.e. cosmic shear)

Lensing of LSS:

Theory:

$$C_{\mu\nu}^{\mathrm{EE}}(\ell) = \frac{9\Omega_{\mathrm{m}}^2 H_0^4}{4c^4} \int_0^{\chi_{\mathrm{H}}} \mathrm{d}\chi \frac{g_\mu(\chi) g_\nu(\chi)}{a^2(\chi)} P_\delta\left(k = \frac{\ell}{f_{\mathrm{K}}(\chi)}; \chi\right)$$

"geometry" "physics"



measurements:

correlation functions ⟺ **power spectra**

Goal:

measure **weak-lensing power spectrum** of cosmic shear:

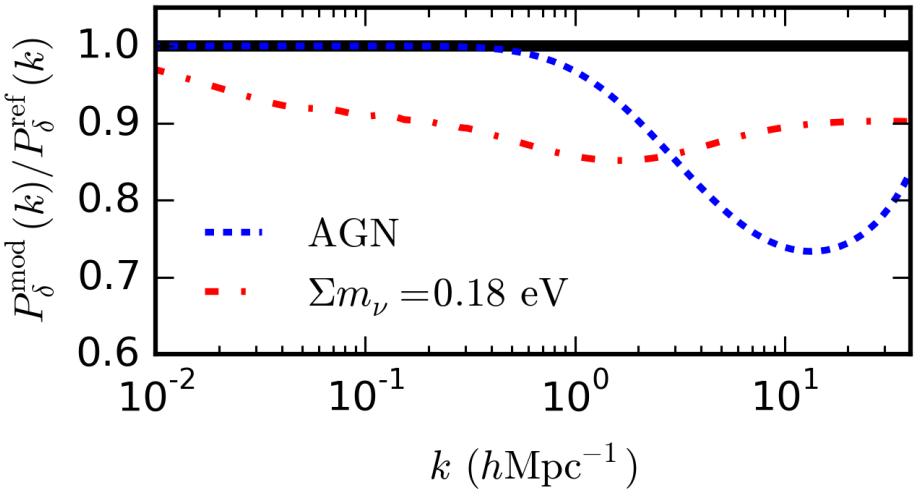
- include low multipoles (large scales)
- in redshift bins

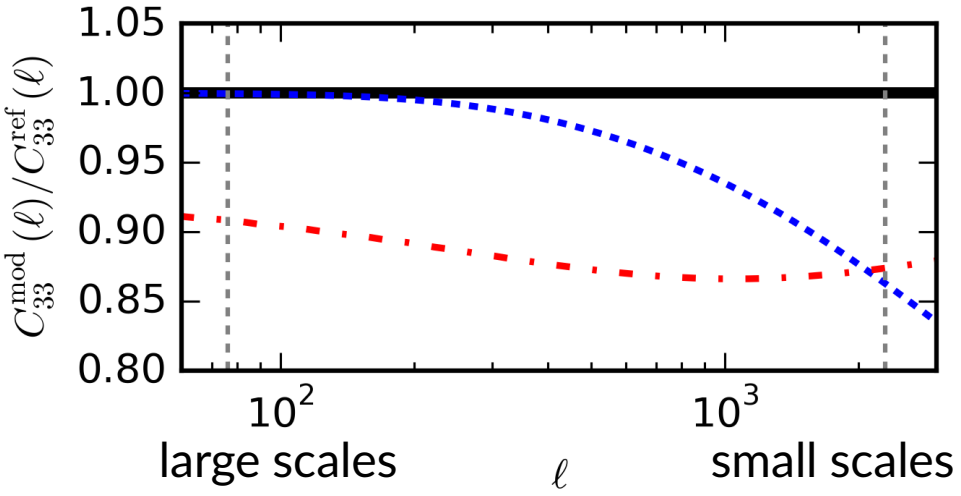
Why?

- better handling of scale mixing in multipole space (compared to real space analyses)
- covariances
- account for scale dependent features:

  ➡ **Neutrinos**, baryon feedback (e.g. Harnois-Déraps+ 2015)!
- independent analysis pipeline

Baryons & neutrinos:



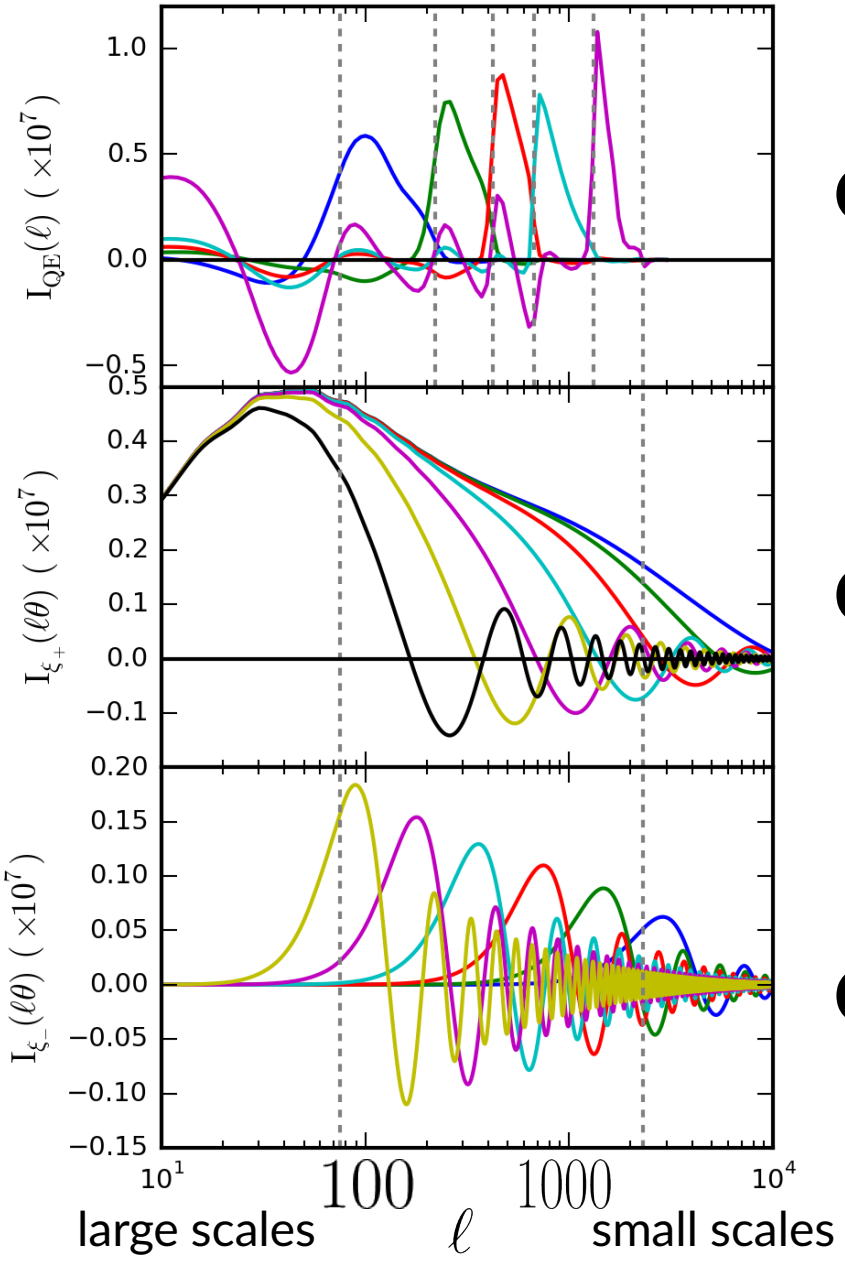


FK+ (in prep.)

integration over lensing kernel ("geometry")

- AGN feedback from OWLS after Harnois-Déraps+ (2015)
- 3 degenerate, massive neutrinos with Σm_ν = 0.18 eV

Comparing QE to CF:



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

multipole range:

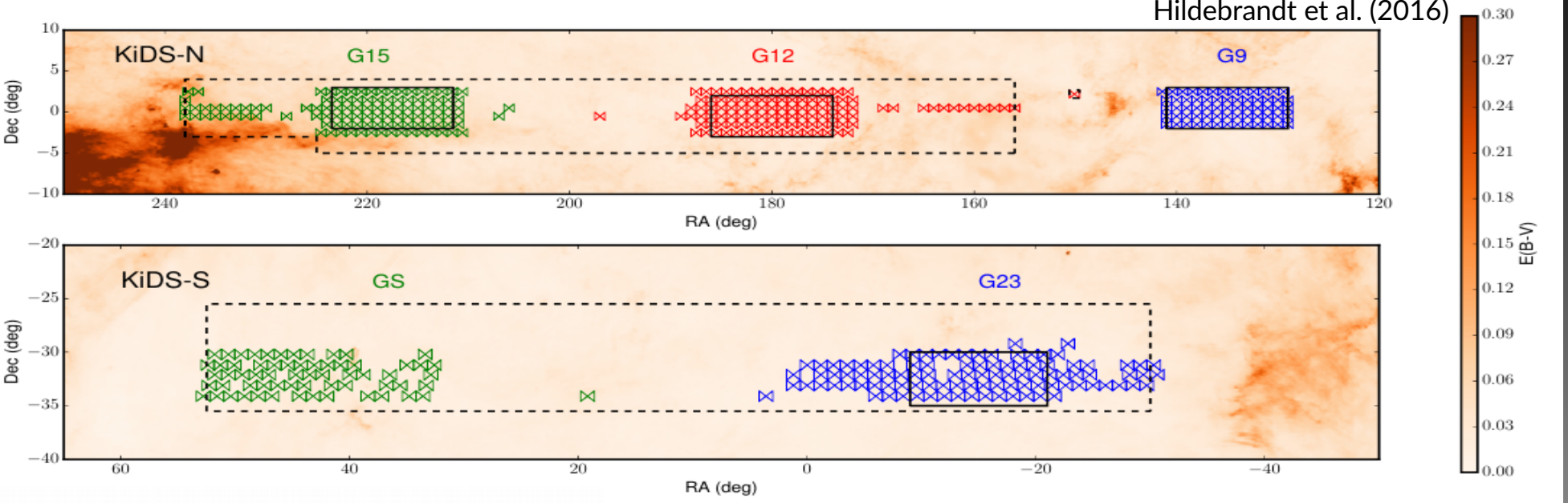
76 – 2300

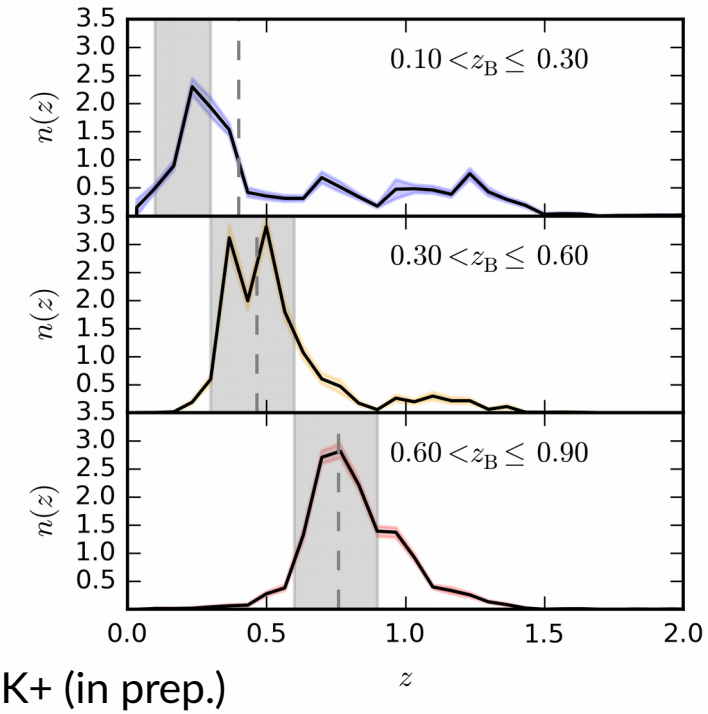
k-modes (@z_{med} ~ 0.4):

0.05 Mpc^{-1} – 1.50 Mpc^{-1}

The KiDS-450 data:

Hildebrandt et al. (2016)





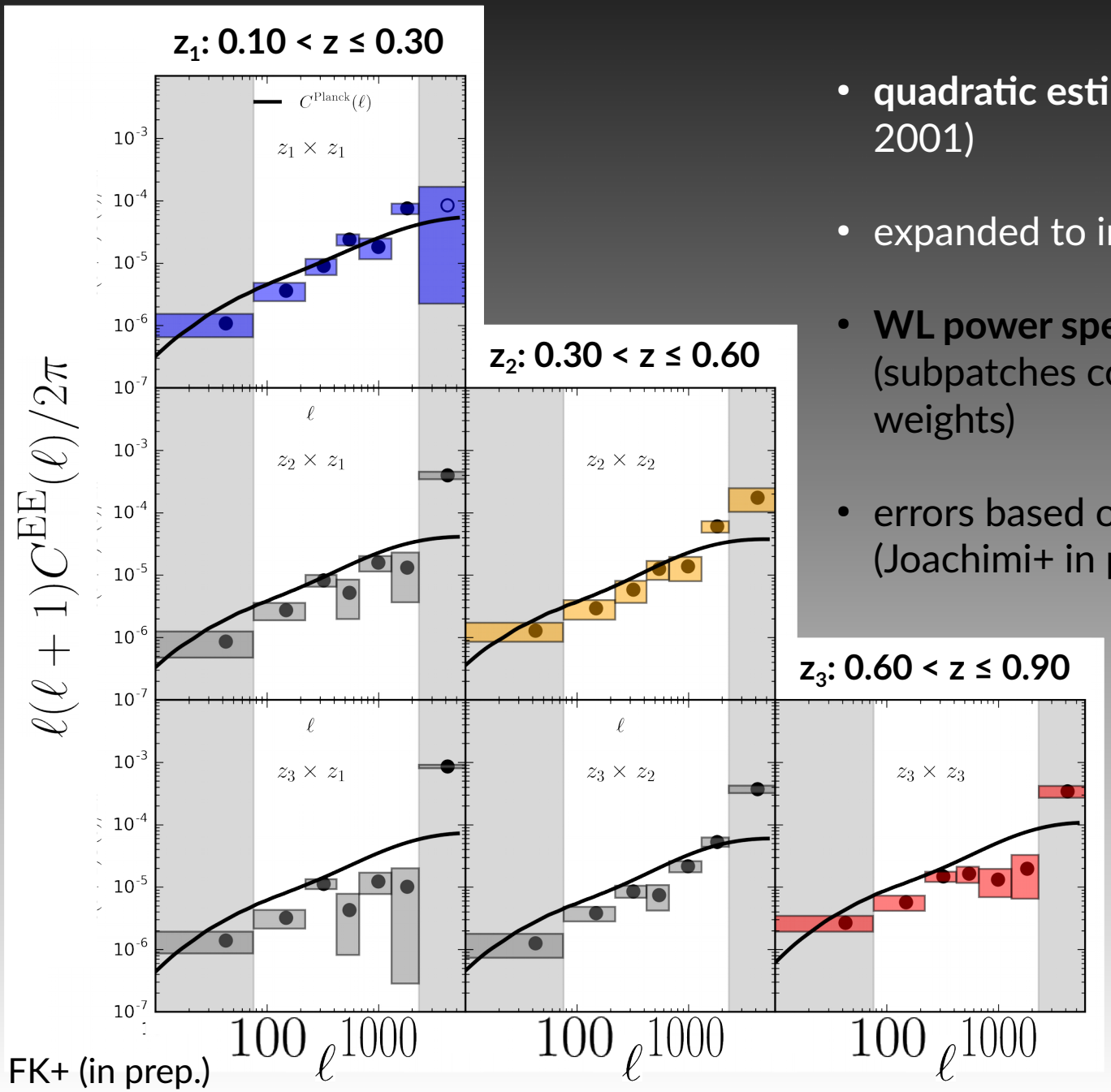
FK+ (in prep.)

- A_{eff} ~ 325 deg^2
- 3 redshift slices:

  z_1: 0.10 < z ≤ 0.30 → z_{med} ~ 0.39
  z_2: 0.30 < z ≤ 0.60 → z_{med} ~ 0.46
  z_3: 0.60 < z ≤ 0.90 → z_{med} ~ 0.76

- $n_{eff}(z_{1/2/3})$ ~ 2.3 gals/arcmin^2

Results: Multipole Space



FK+ (in prep.)

- **quadratic estimator (QE)** method (Hu & White 2001)
- expanded to include **redshift bins** (FK+ 2016)
- **WL power spectra from KiDS-450** (subpatches combined with effective area weights)
- errors based on **analytical covariance** (Joachimi+ in prep.)

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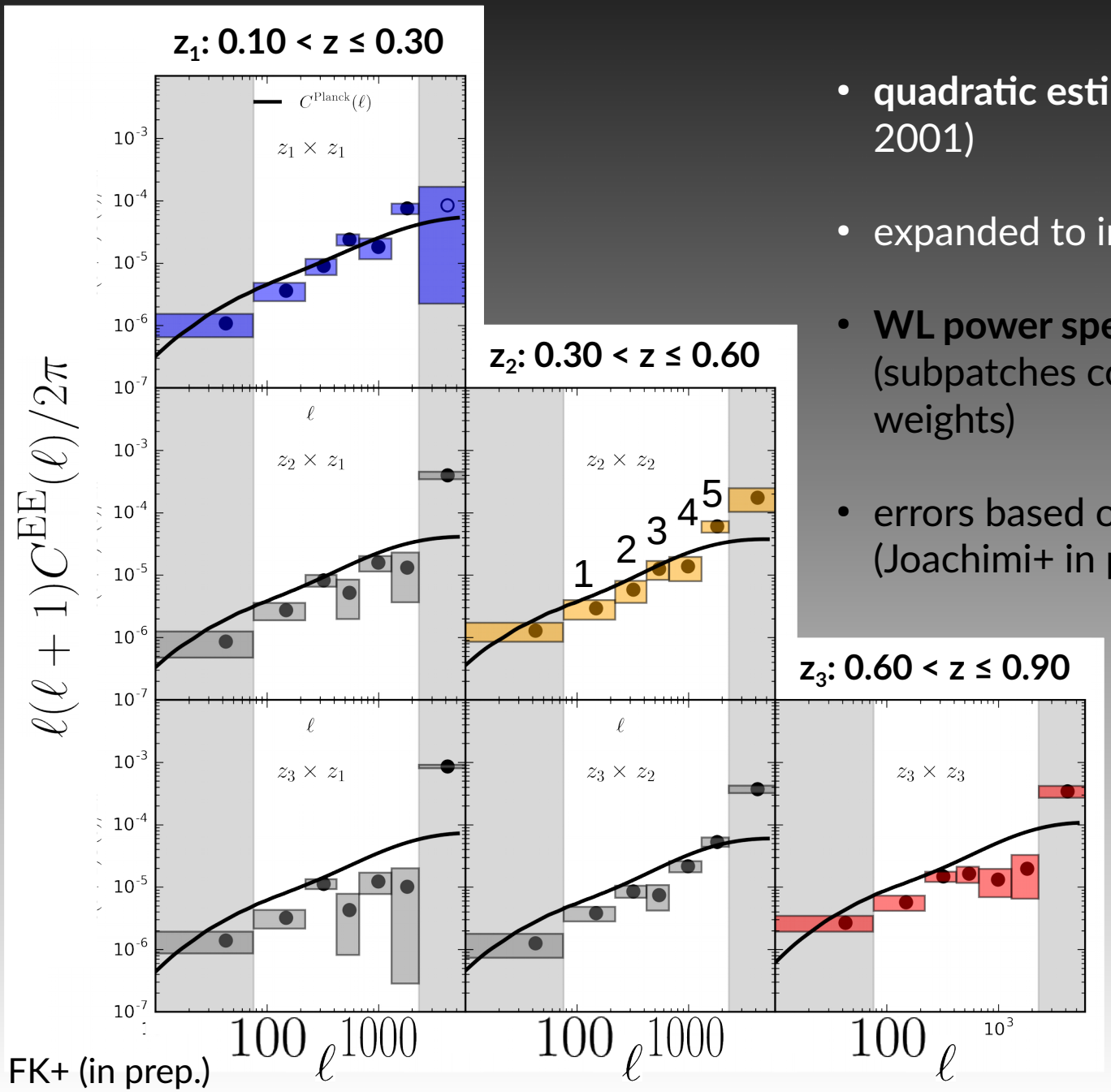

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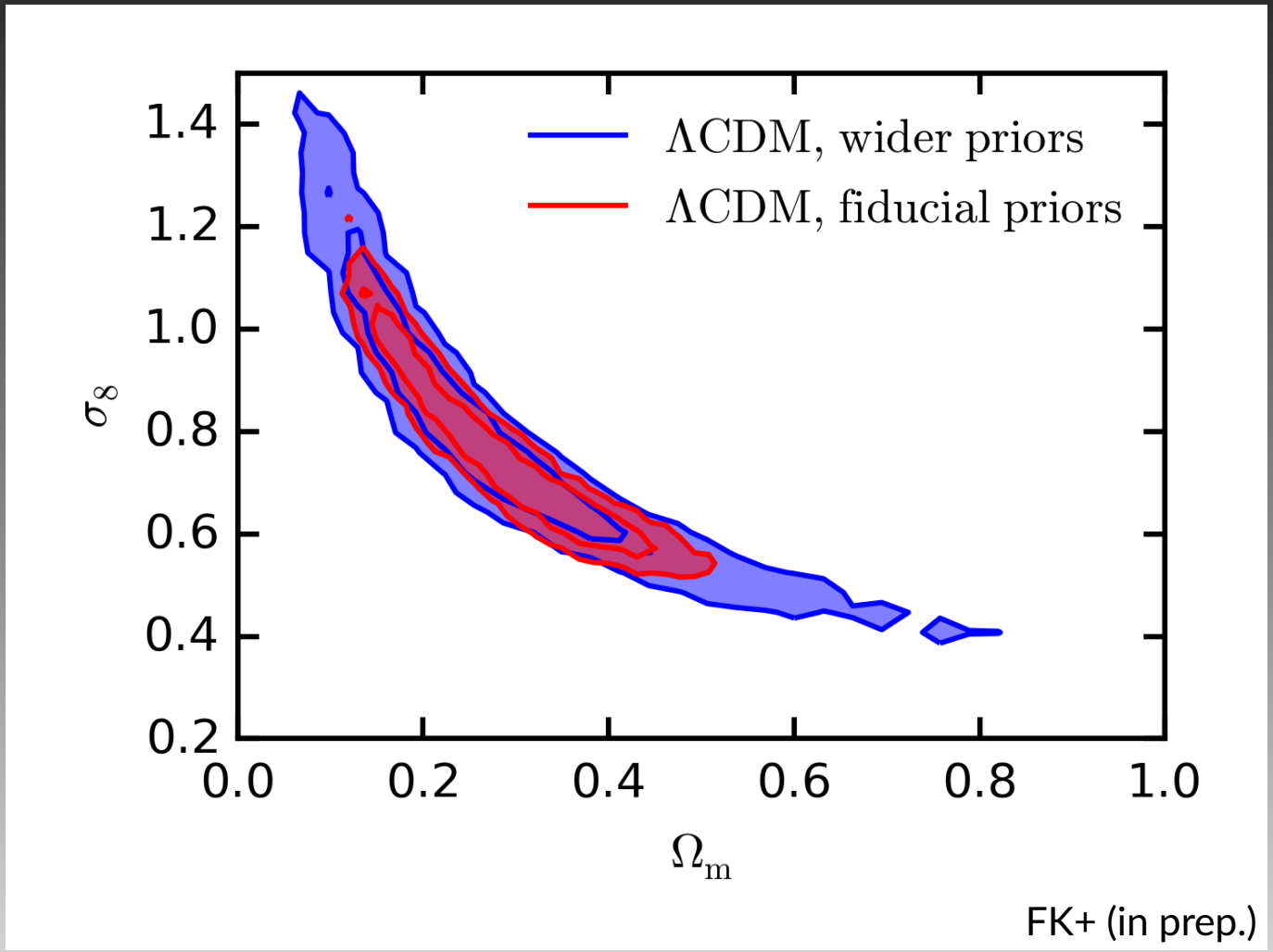

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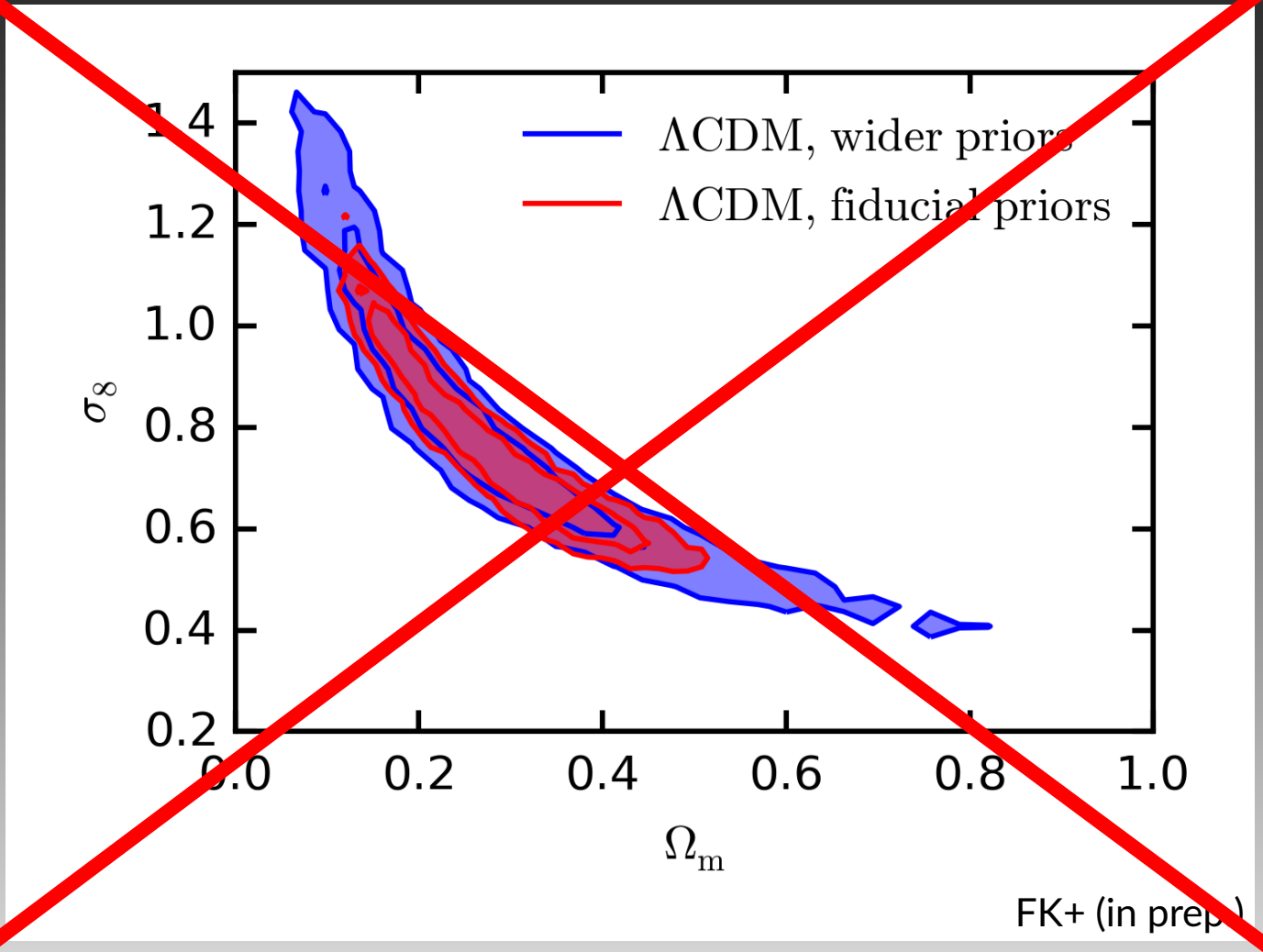

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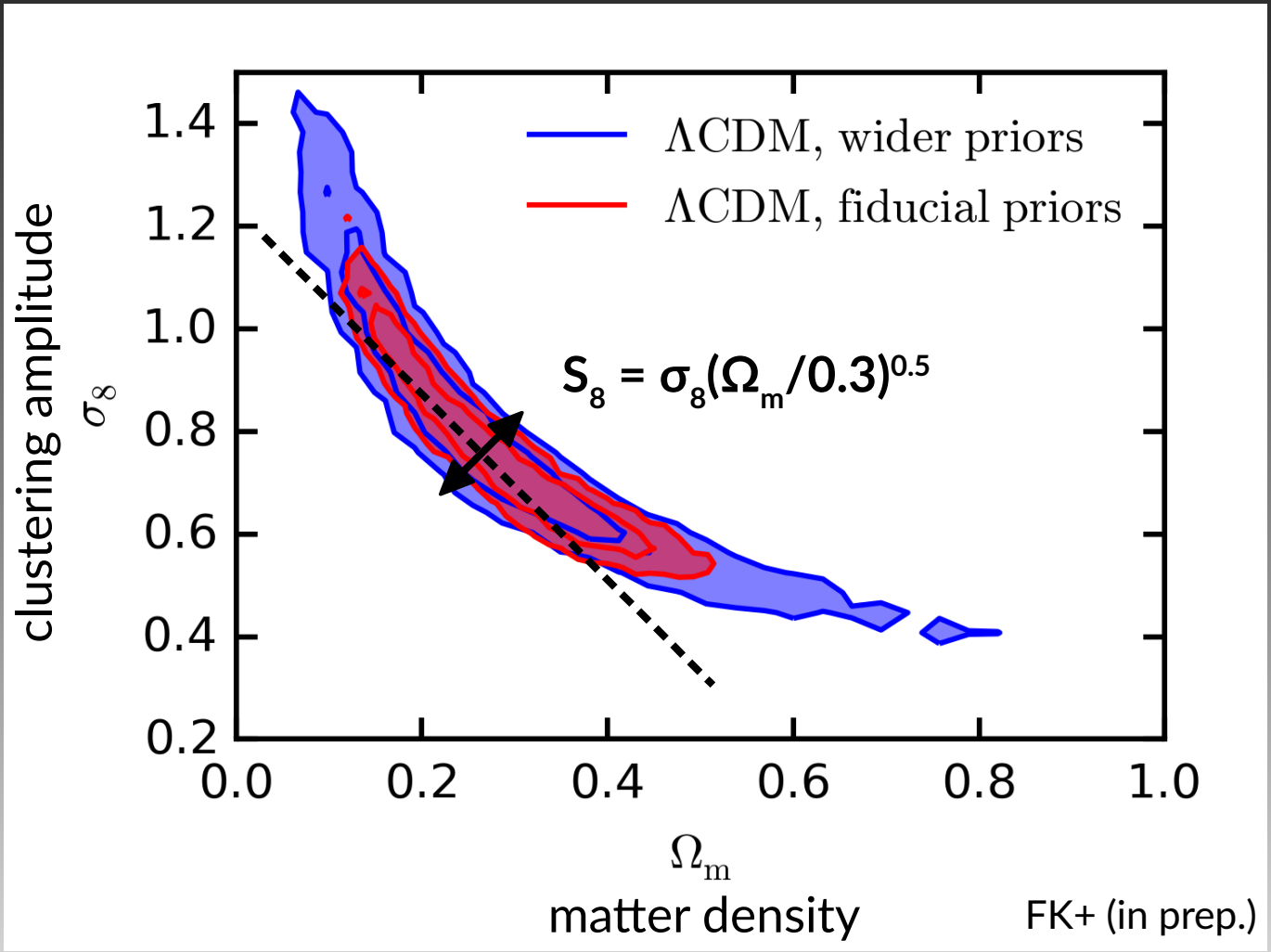

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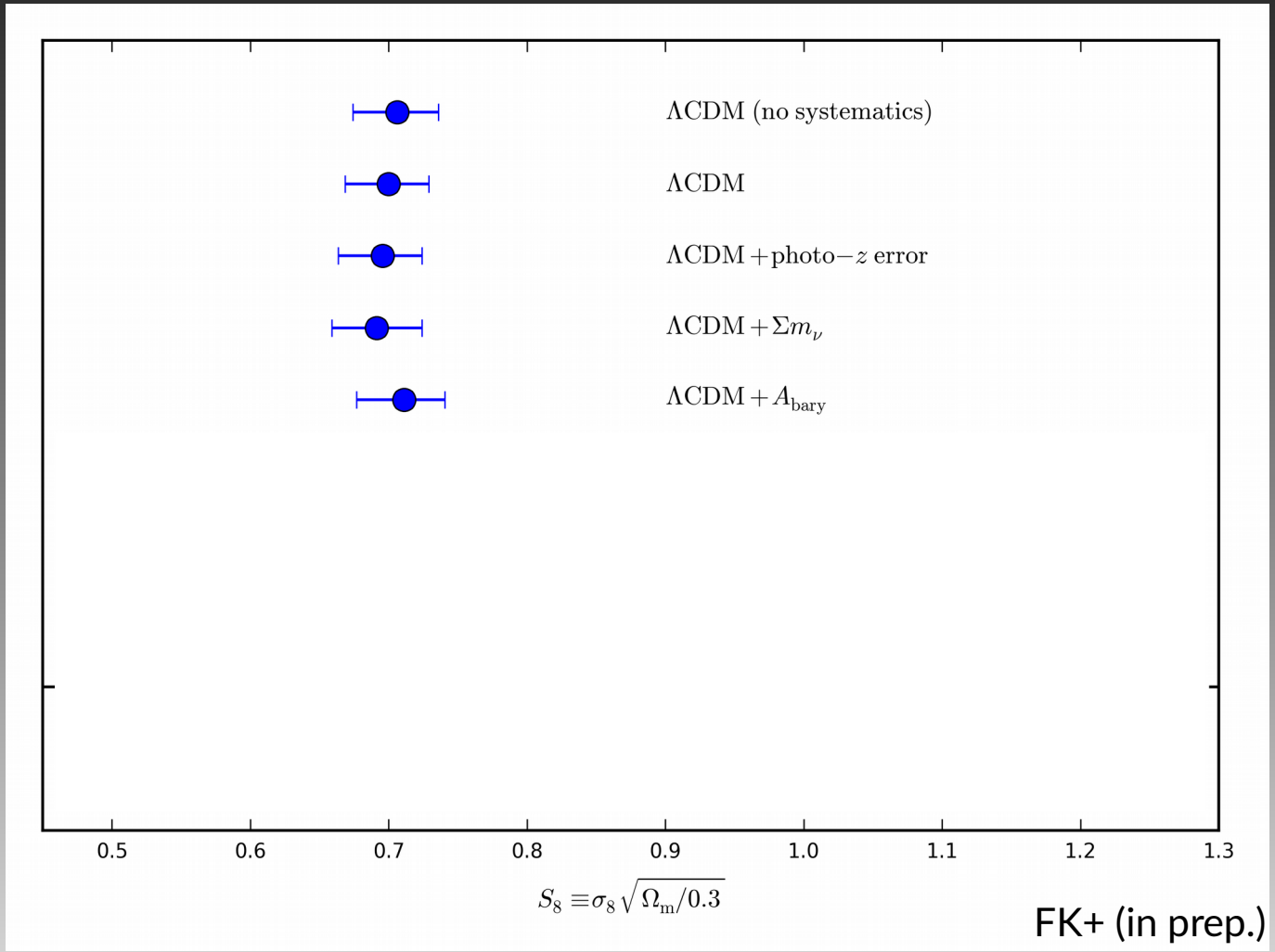

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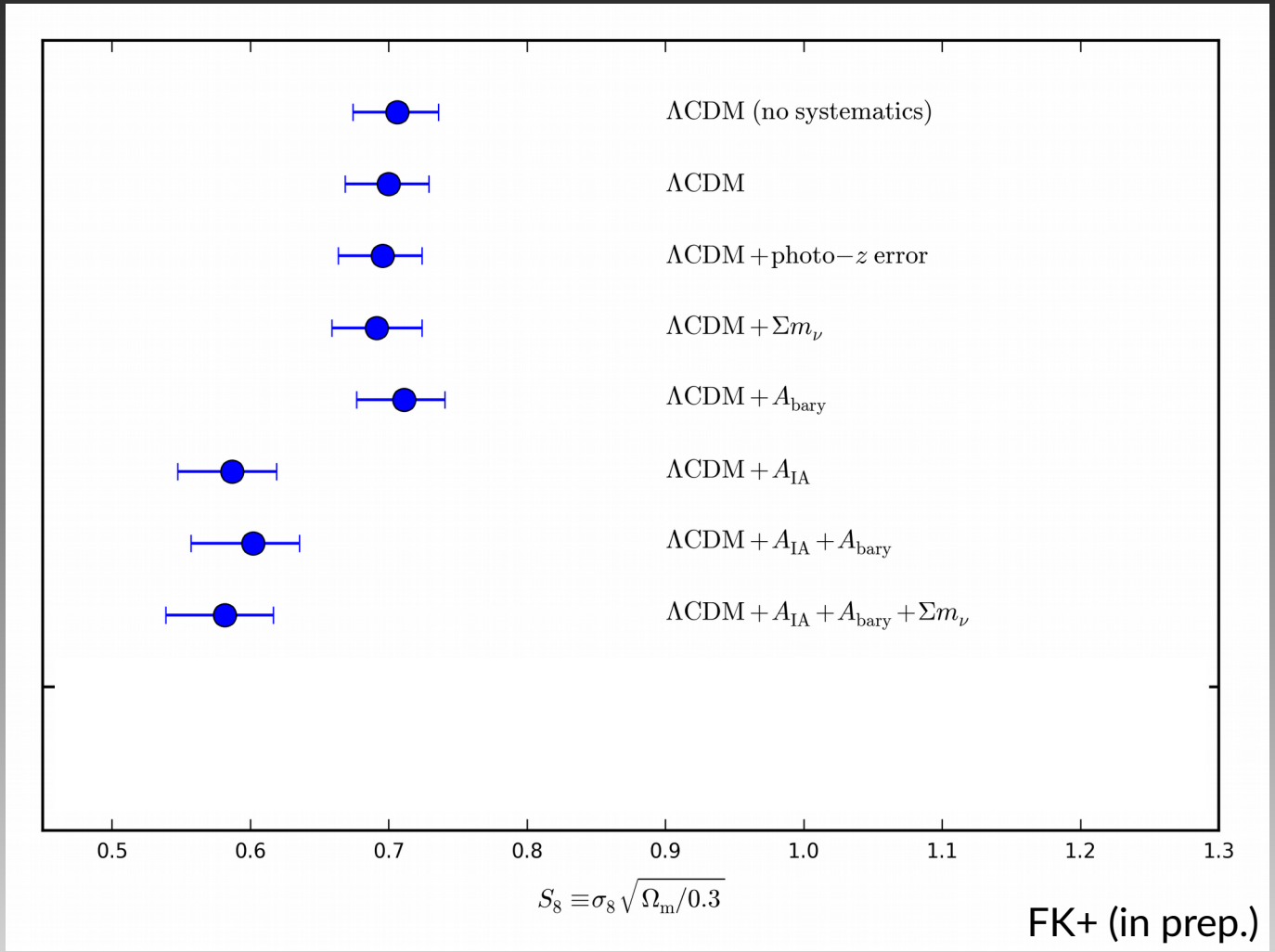

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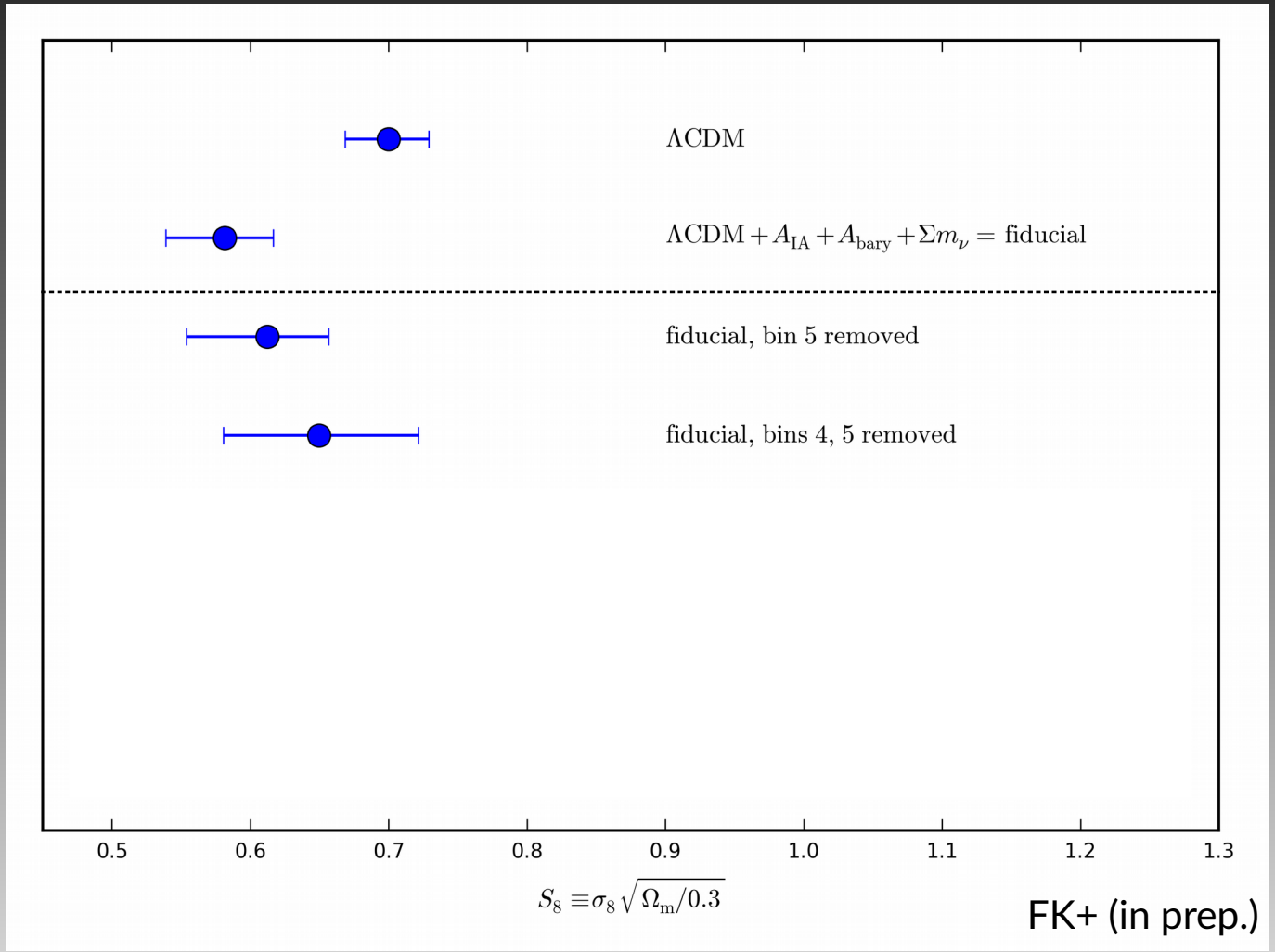

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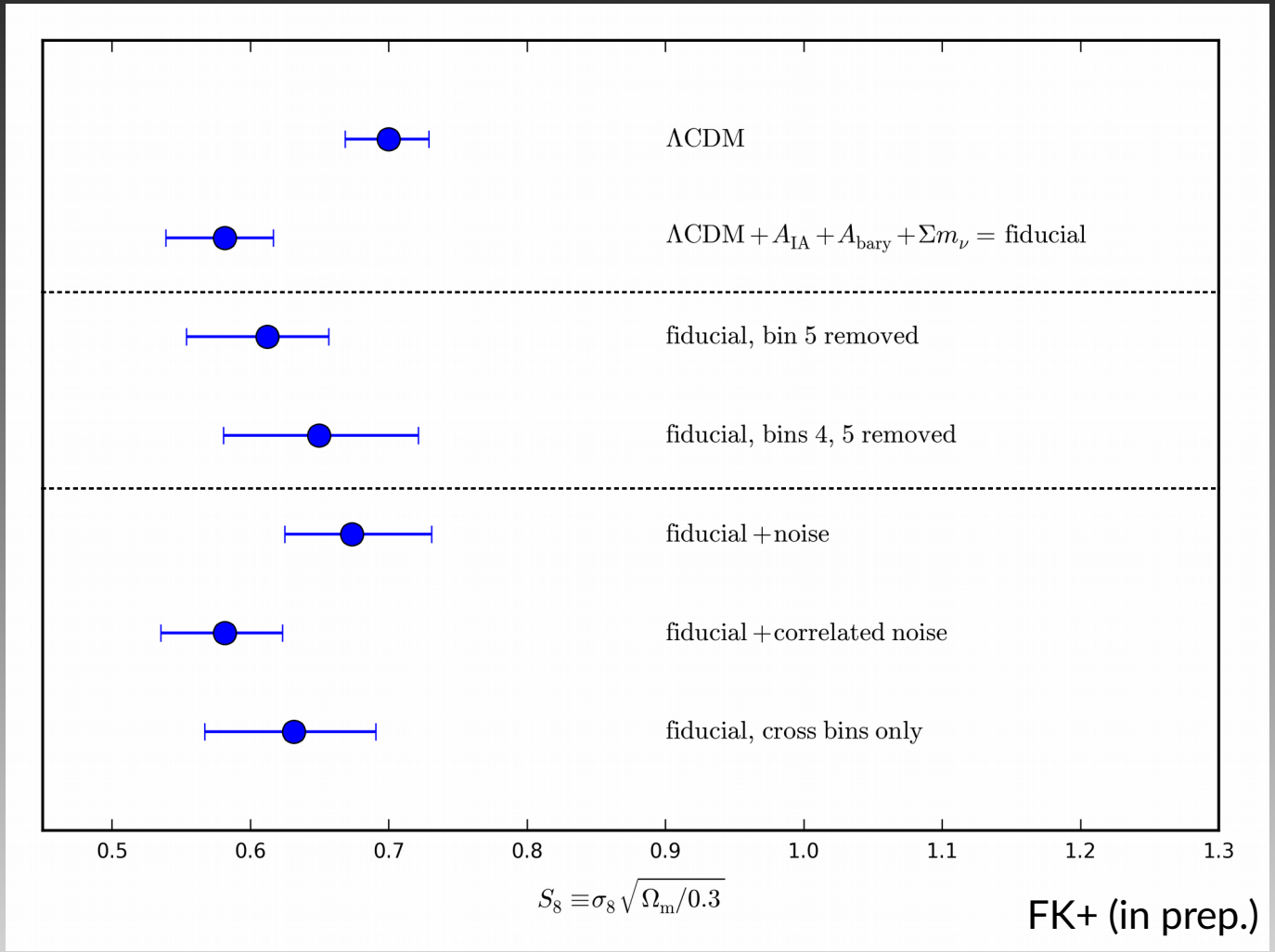

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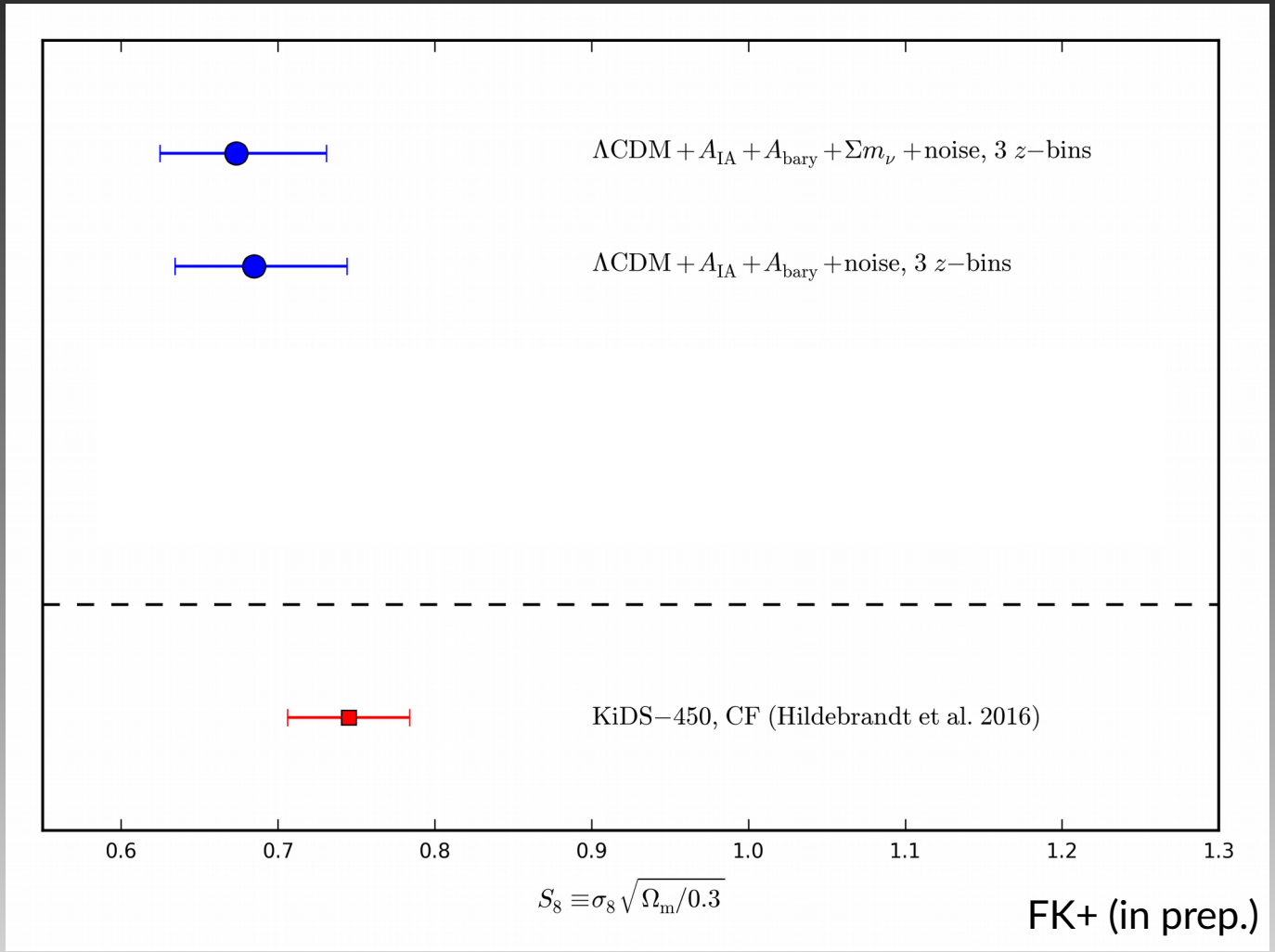

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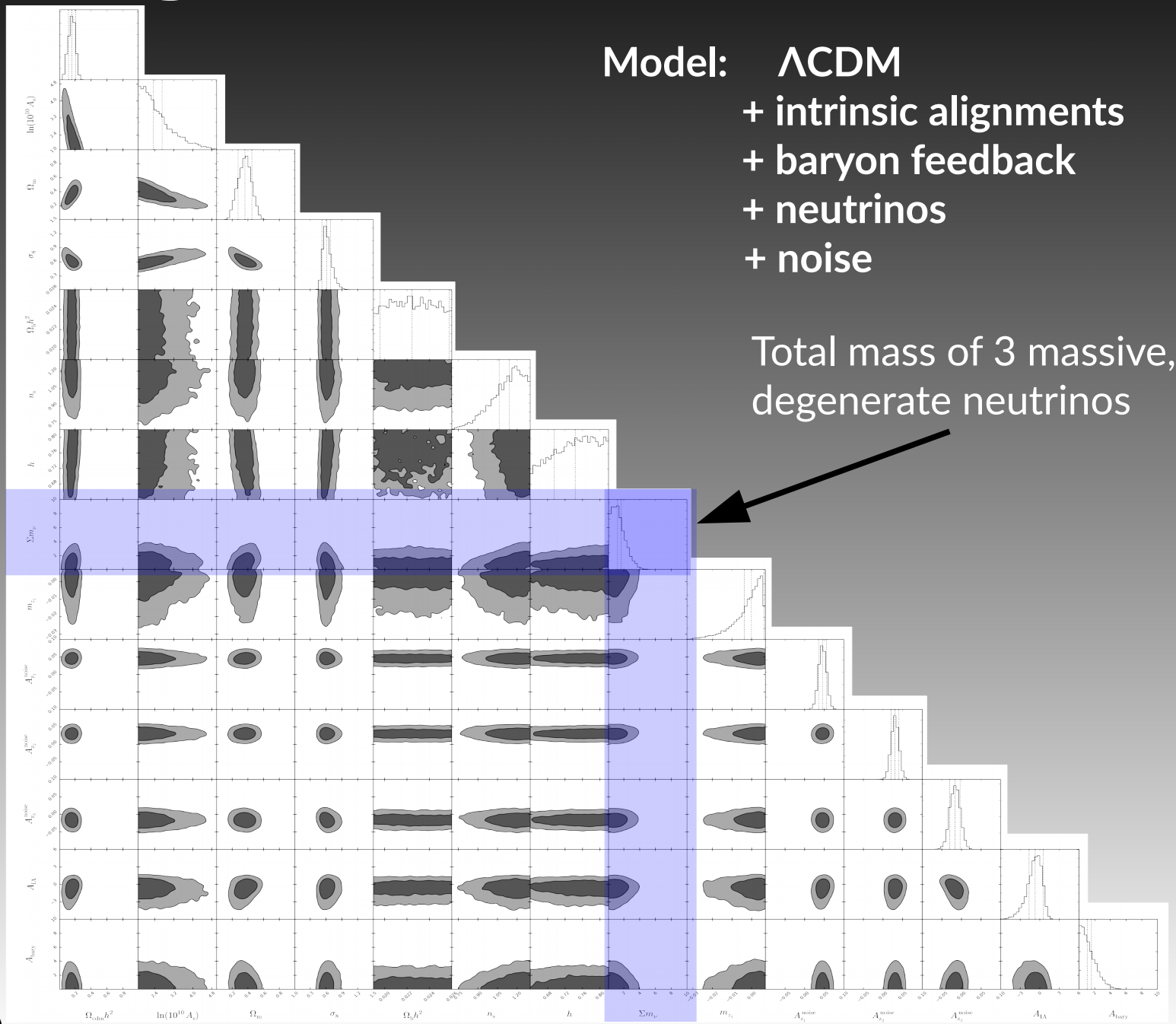

Model: ΛCDM
+ intrinsic alignments
+ baryon feedback
+ neutrinos
+ noise

Total mass of 3 massive, degenerate neutrinos

FK+ (in prep.)

III. Conclusions

- **A direct extraction of the lensing power spectrum is a "cleaner" way to compare data with theory.**

- **Probably an imperfect noise-removal causes a bias which can be mitigated at the cost of weaker constraints.**
  → more work required and ongoing

- **Power spectrum results show consistency with correlation-function analysis (derived with independent analysis pipeline).**