Problems with KiDS?

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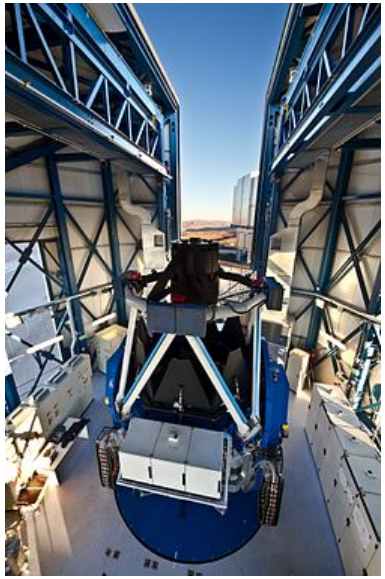
w/ Edo van Uitert, Fabian Koehlinger & the KiDS team

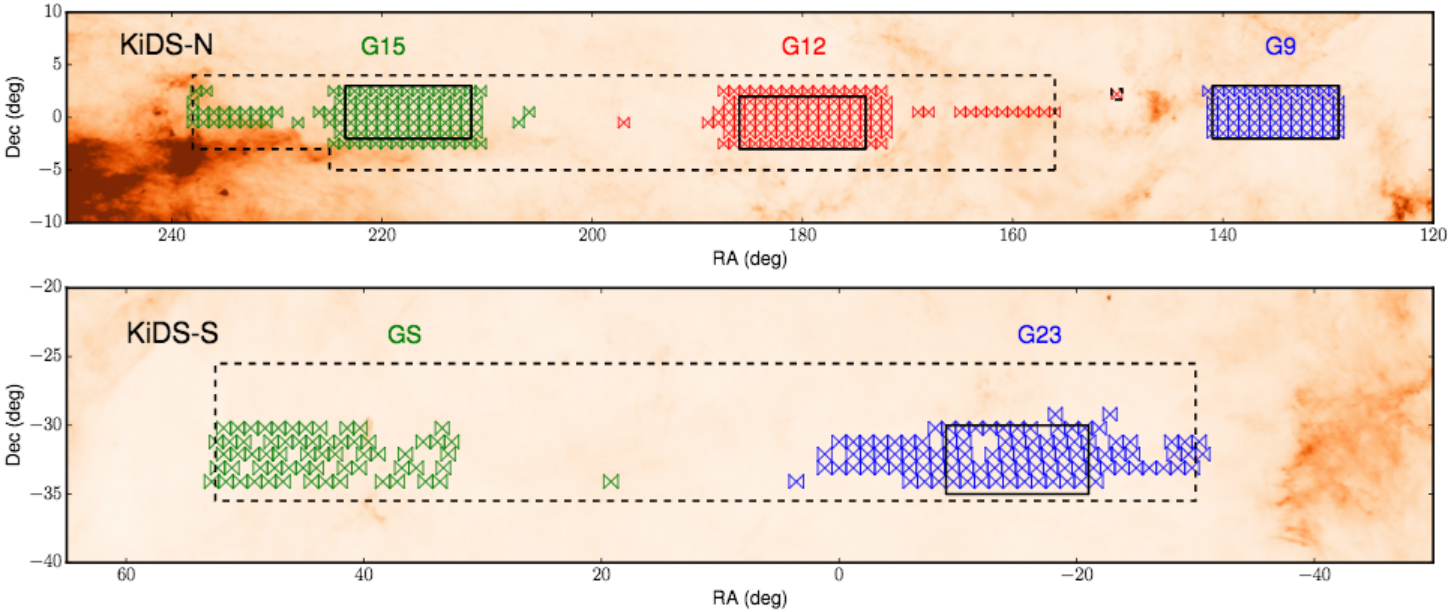
The survey



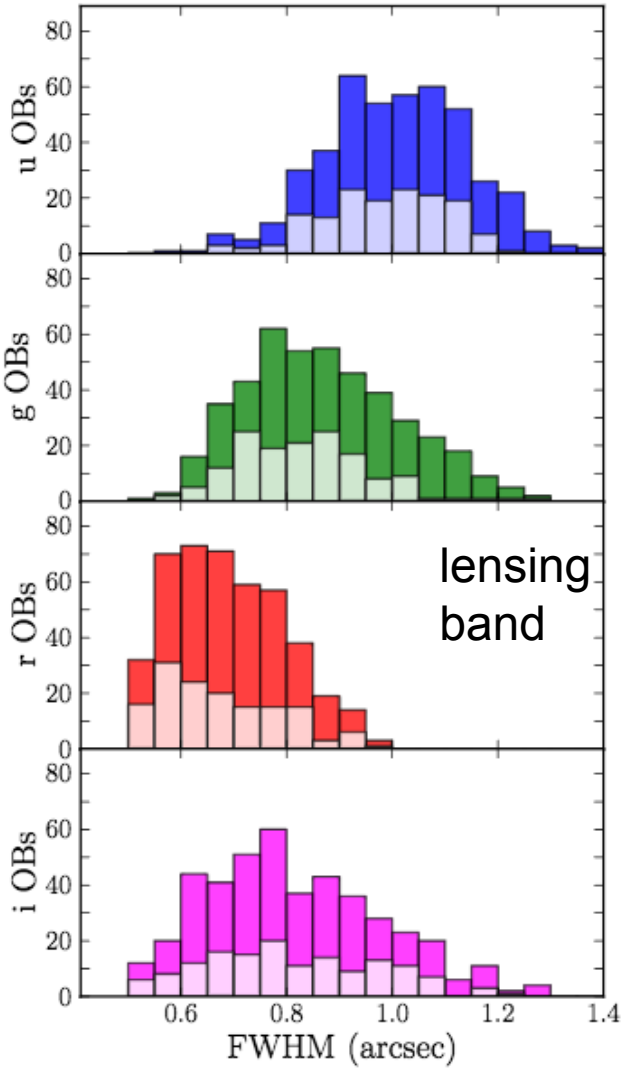
Kilo Degree Survey

- on the VLT Survey Telescope
- aim: ~1500 deg^2 (end 2018)
- ugri + zYJHK (VIKING)
- prioritised overlap with GAMA
- ESO Public Survey: raw data instantly public

  http://kids.strw.leidenuniv.nl/DR3/index.php
- current papers based on 450 deg^2



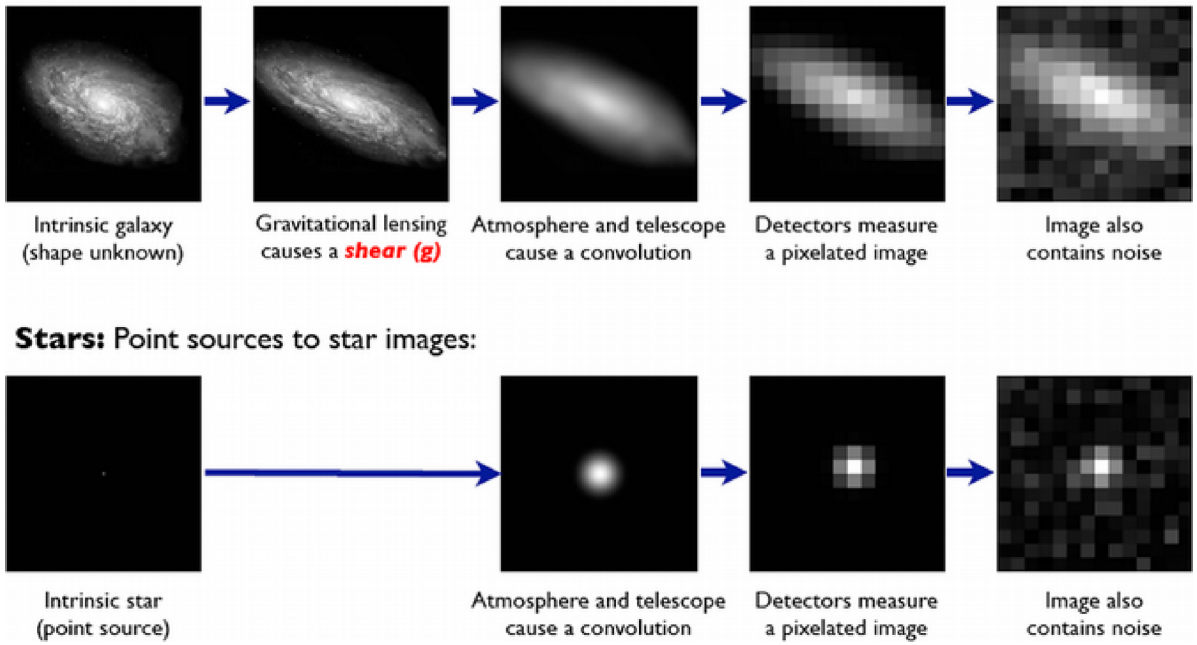
Shear measurement



de Jong et al. (2017)

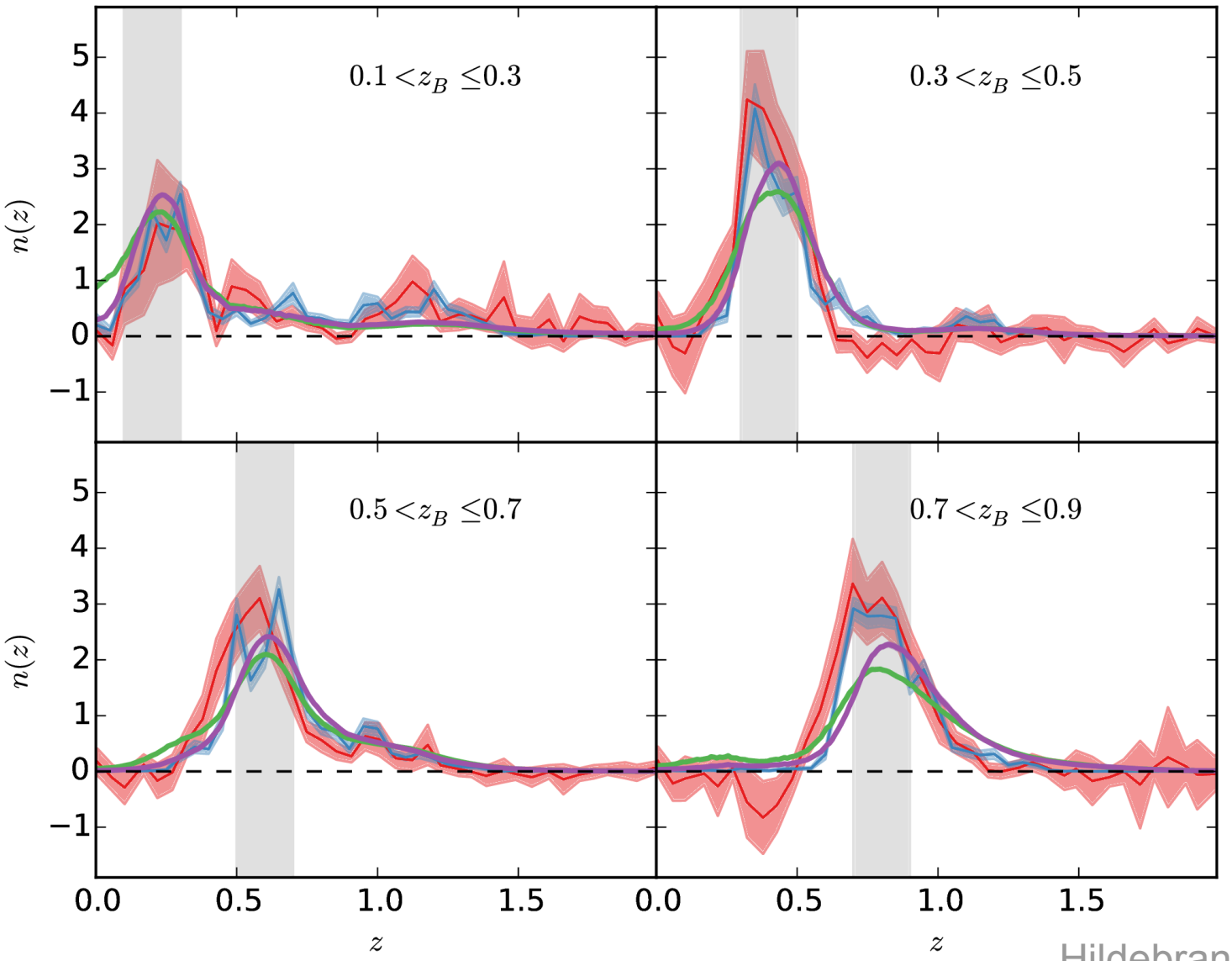
- likelihood fitting of galaxy model
  *lens*fit Miller et al. (2013)
- fit ellipticity, centroid, flux, size, bulge-to-disc
- calibrate on image simulations

Fenech Conti et al. (2017)



GREAT08

Redshift distributions



BPZ output (stacked)

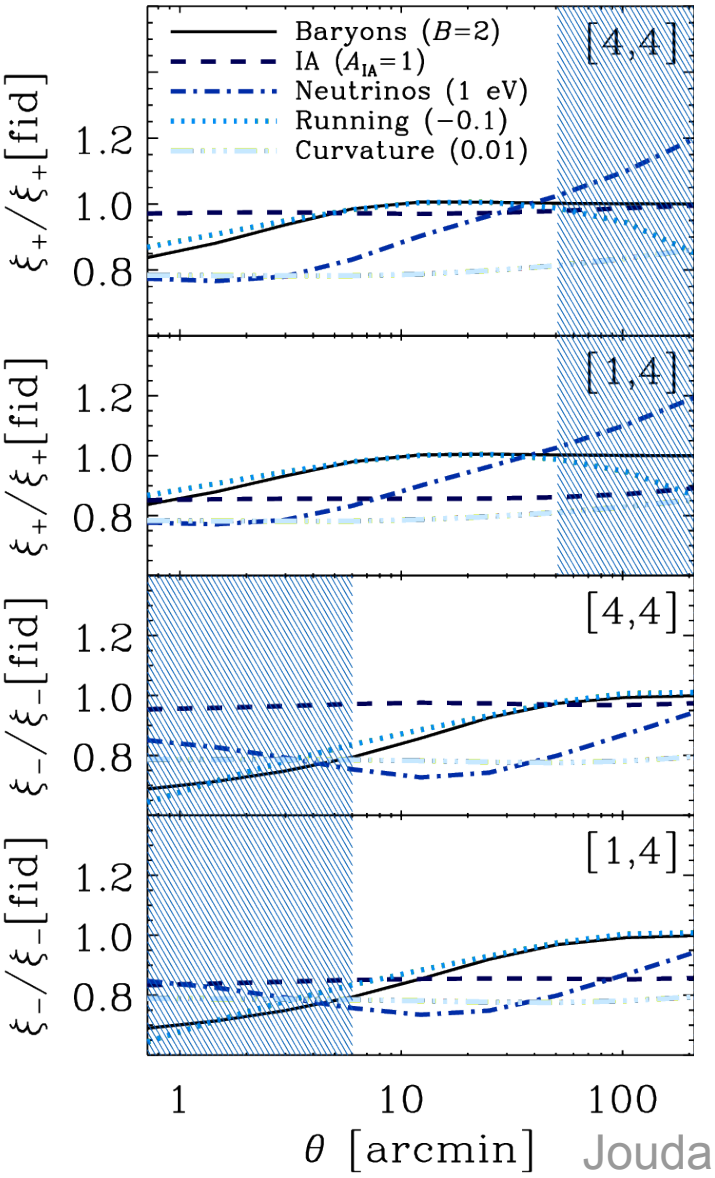
global re-calibration

clustering cross-correlation

direct spec-z calibration w/ reweighting

Hildebrandt et al. (2017)

Modelling



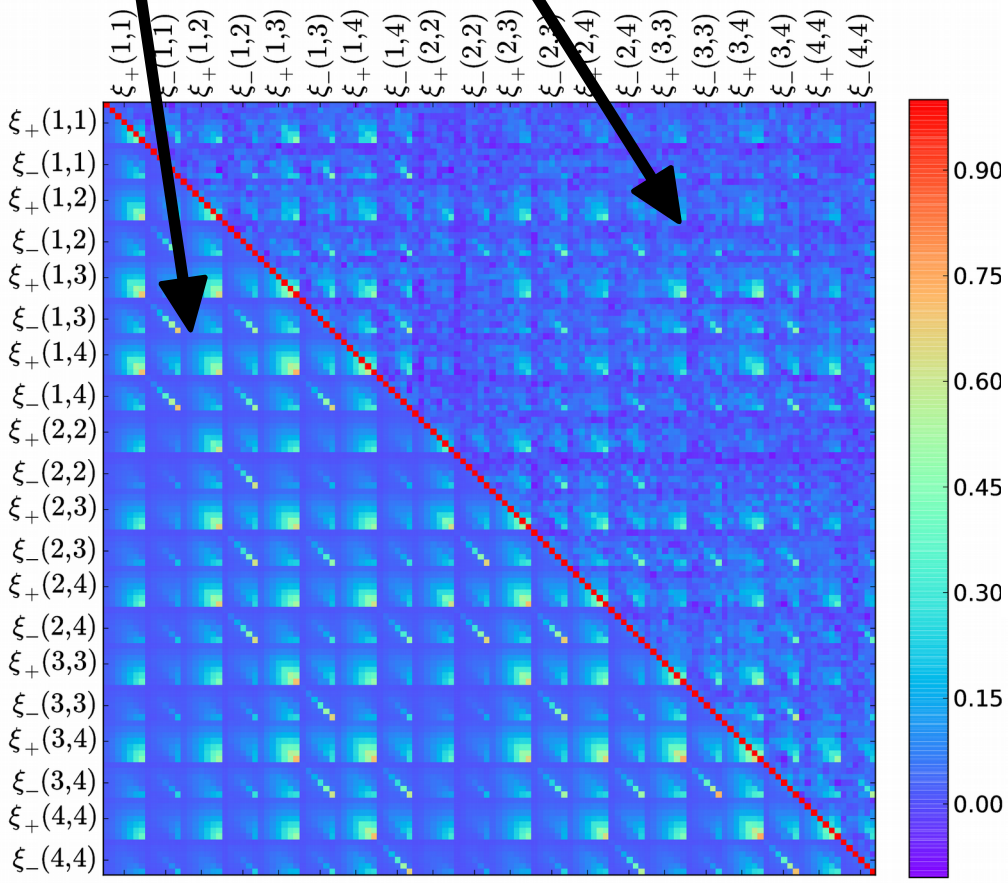
Joudaki et al. (2017)

- Matter power spectrum:
  halo model-based fit incl. one parameter to account for baryon feedback
  Mead et al. (2015)
- Intrinsic alignments:
  tidal alignment model (for all galaxies) incl. non-linear extension with free amplitude
- Massive neutrinos:
  shown to be insensitive → set to 0
- Limber and flat-sky approximations

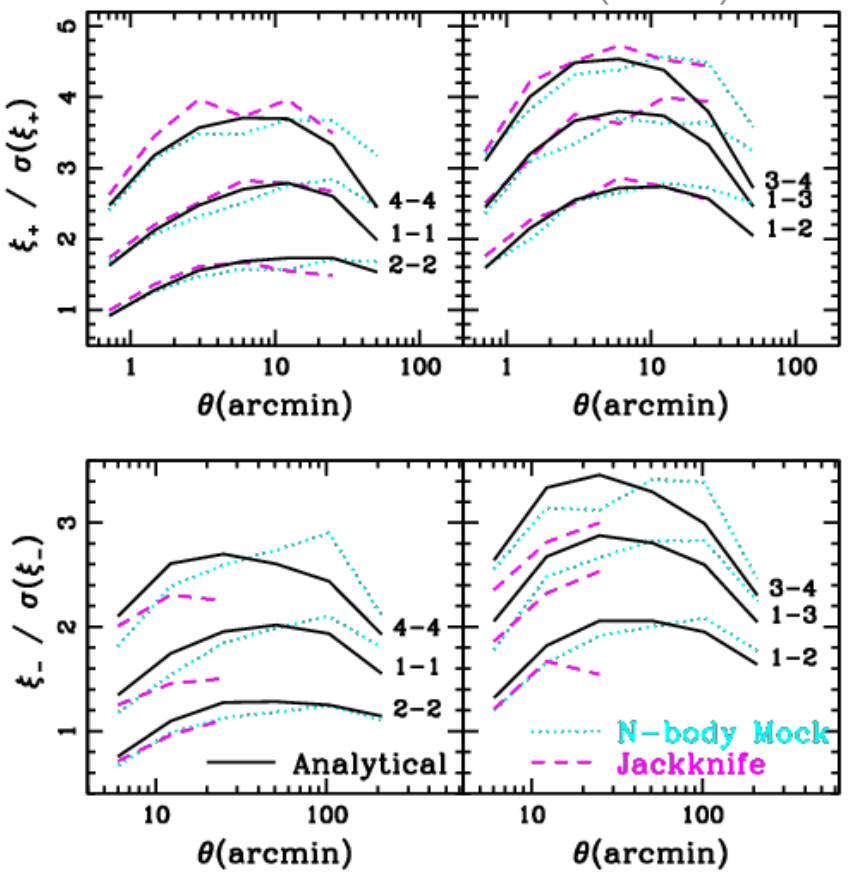
Error bars

analytic, halo model-based
e.g. Takada & Hu (2013)

SLICS 900+ dark matter simulations
Harnois-Deraps et al. (2015)

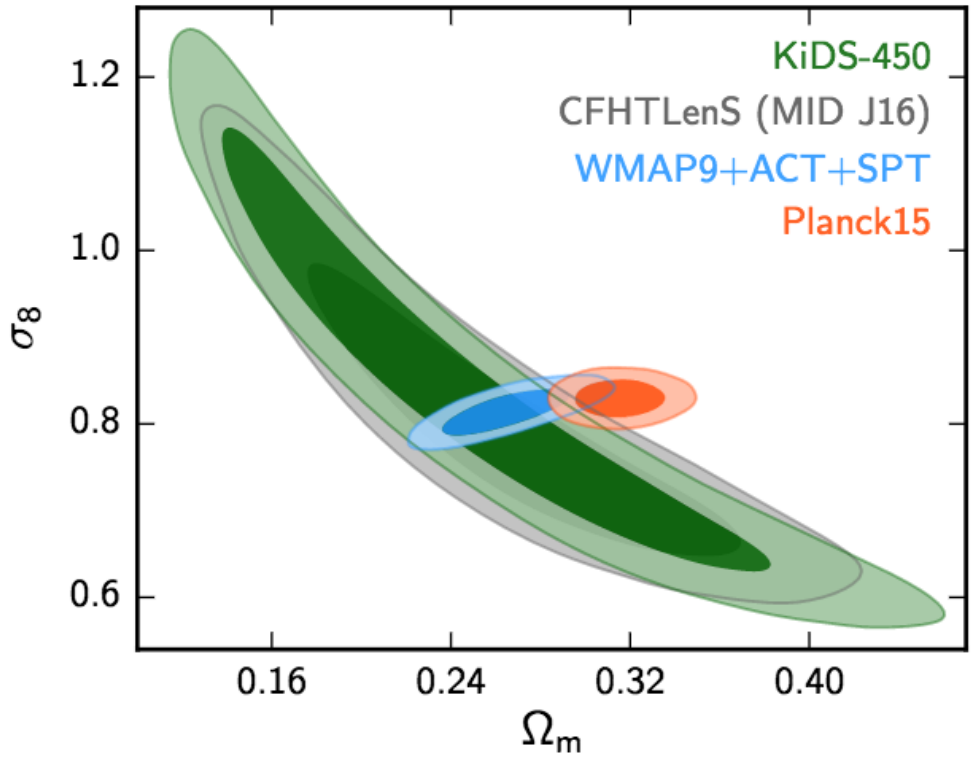


Hildebrandt et al. (2017)

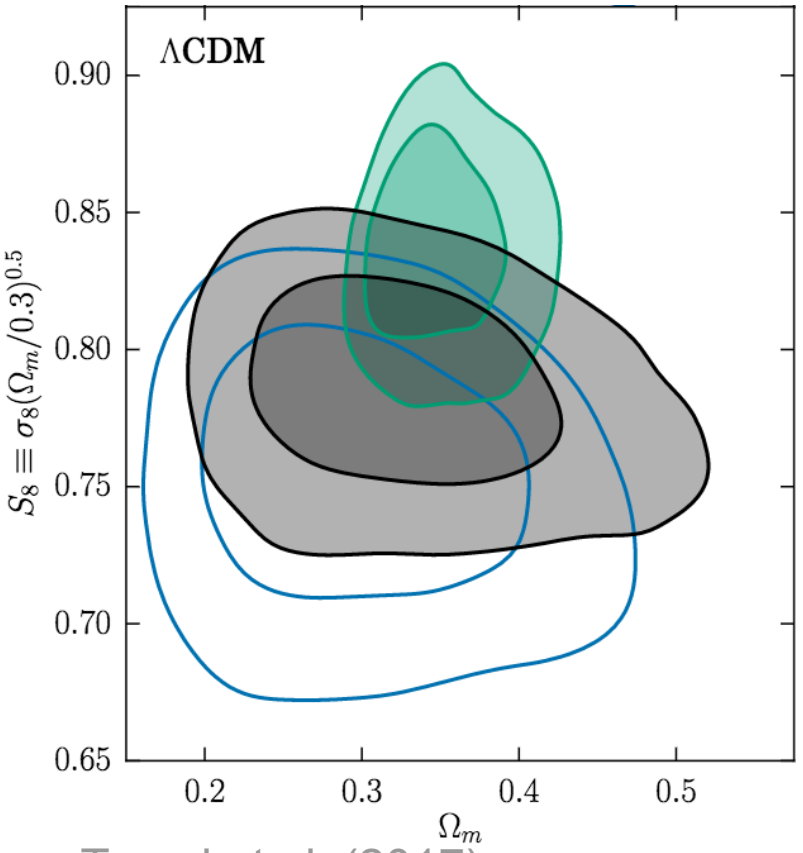


use analytic covariance because
- no noise
- more trustworthy on large scales
- negligible computation time

KiDS-450 cosmic shear bananas



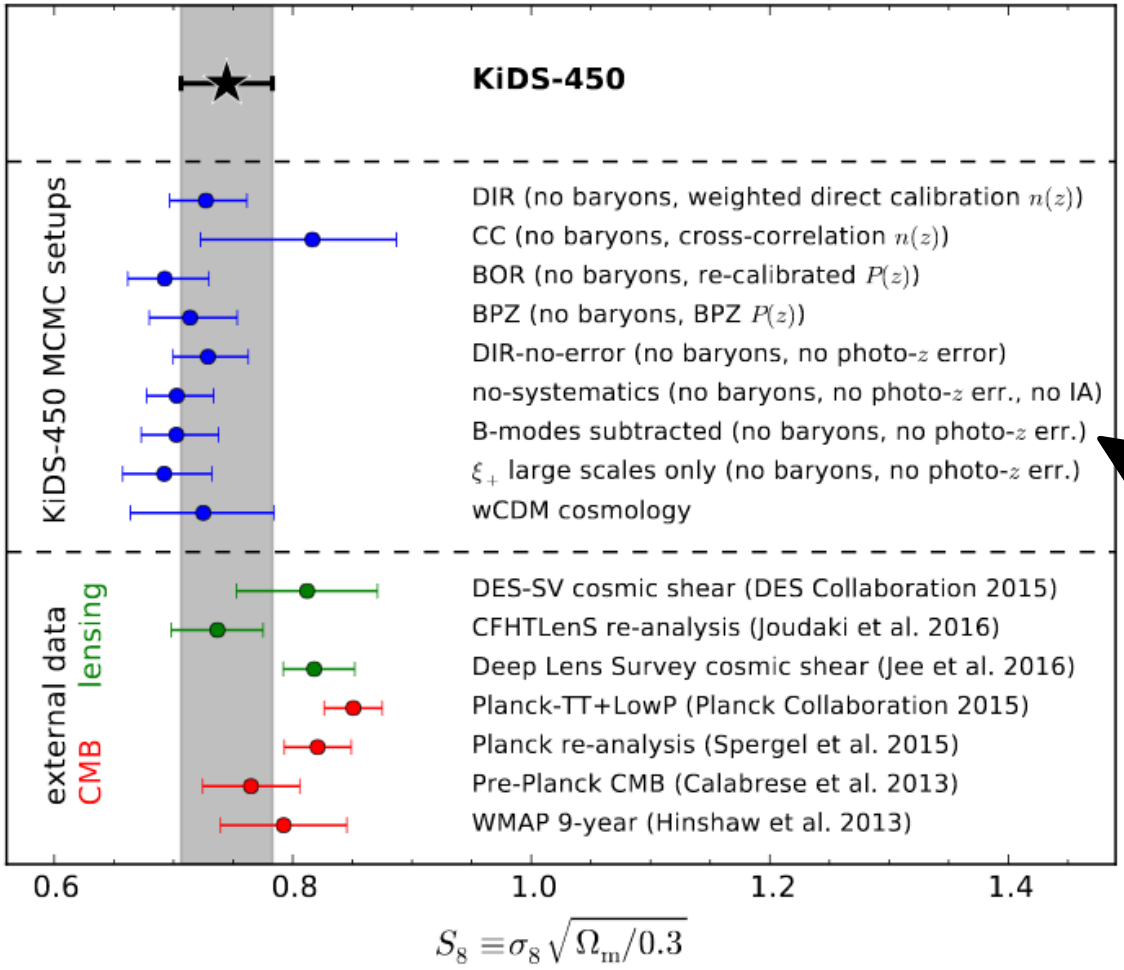
Hildebrandt et al. (2017)



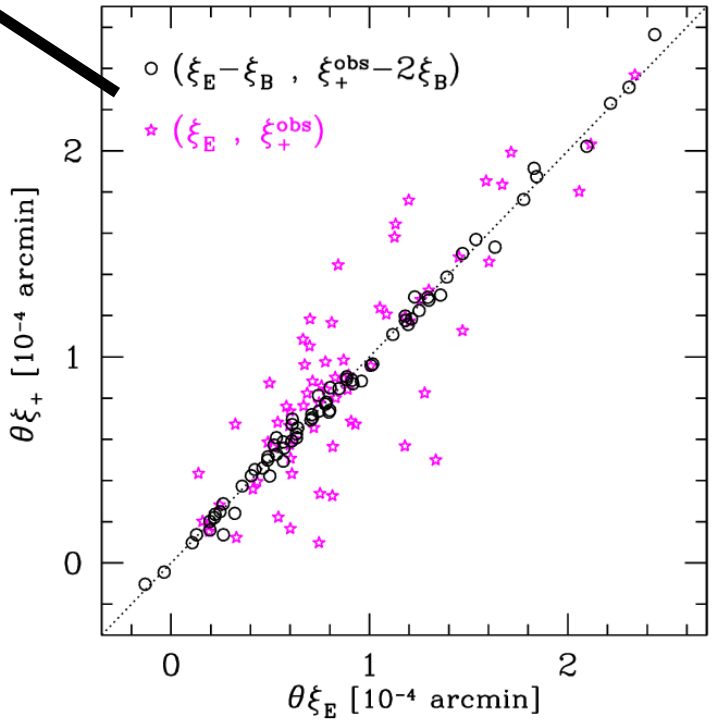
Troxel et al. (2017)

- good agreement with final CFHTLenS analysis & WMAP9+ACT+SPT
- 2.3σ 'discrepancy' in S_8 with Planck15; 'substantial' discordance of posteriors

Consistency checks



- detected B-modes at <3σ
- originate from small scales



There is no easy fix...

Real vs. Fourier space

Power spectrum analysis:

- quadratic estimator Hu & White (2001)
- extended to tomography

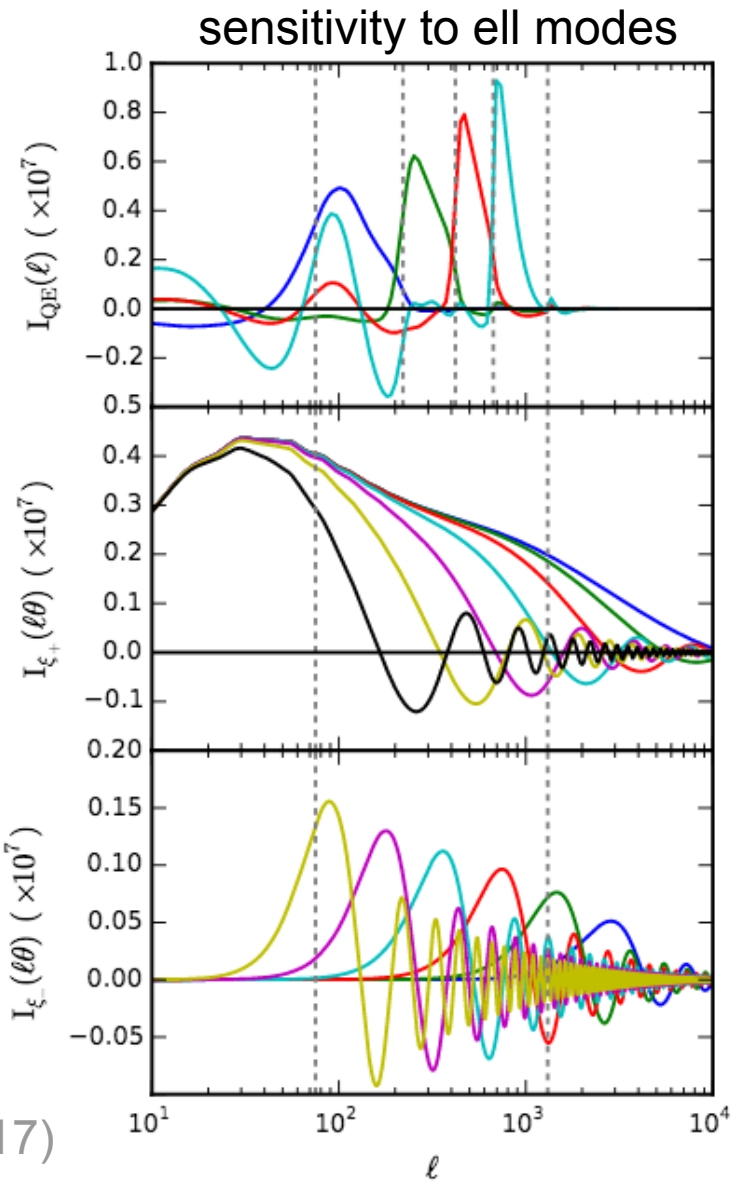
+

- localised probe of matter power spectrum
- simple covariance structure
- better suited for probe combination
- direct E/B-mode decomposition

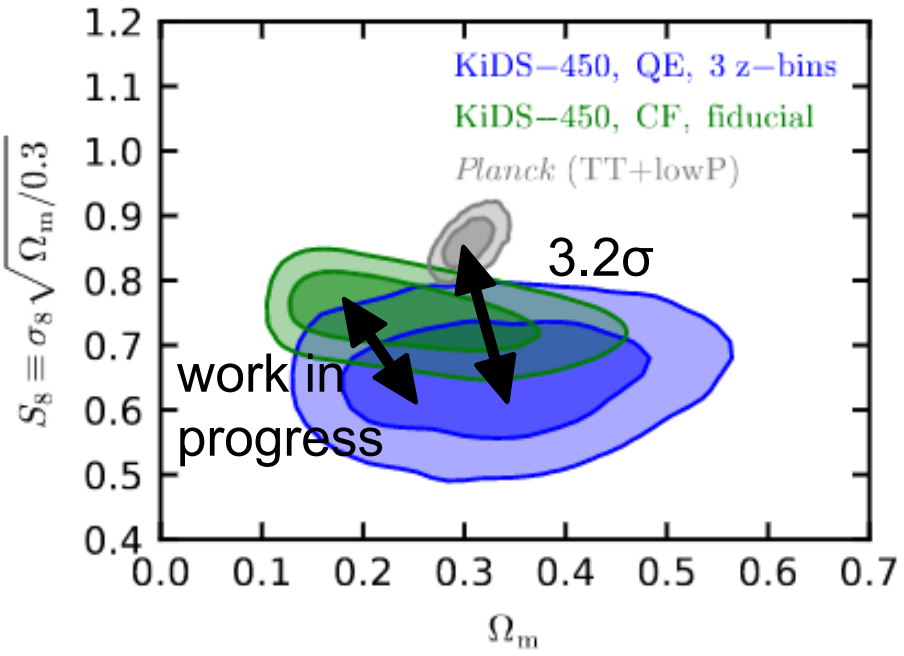
–

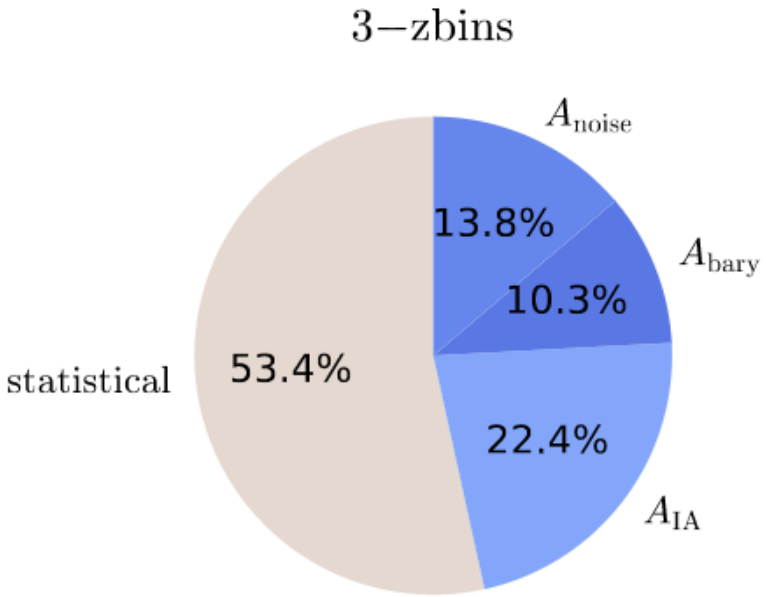
- sensitive to mask/survey geometry
- requires noise correction
- requires patience and/or HPC

Koehlinger et al. (2017)



KiDS-450 power spectrum constraints

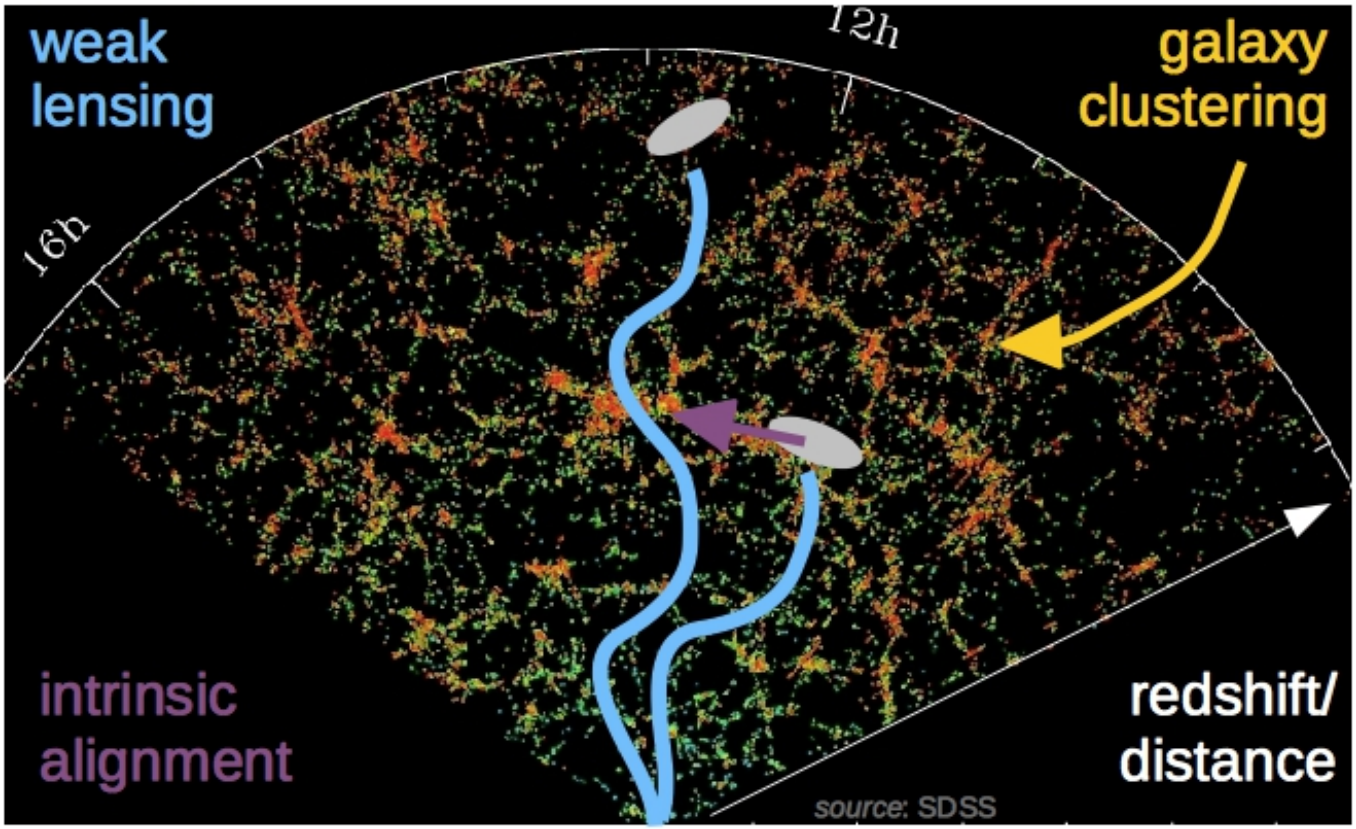




Relevant differences in the analyses:

- power spectra restricted to larger scales
- fewer tomographic bins with different redshift ranges
- no B-modes detected in the power spectrum analysis

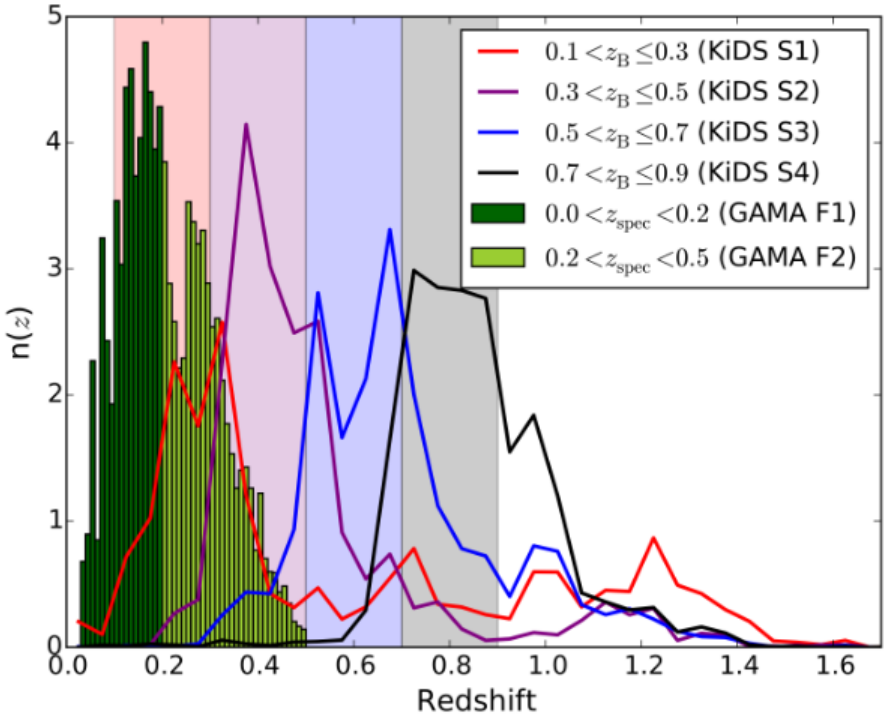
The case for joint LSS analysis



Joint clustering/weak lensing analysis enables self-calibration of intrinsic alignments, galaxy bias, n(z) uncertainties, etc.

Bernstein (2009); BJ & Bridle (2010)

Analysis setup



cosmic shear

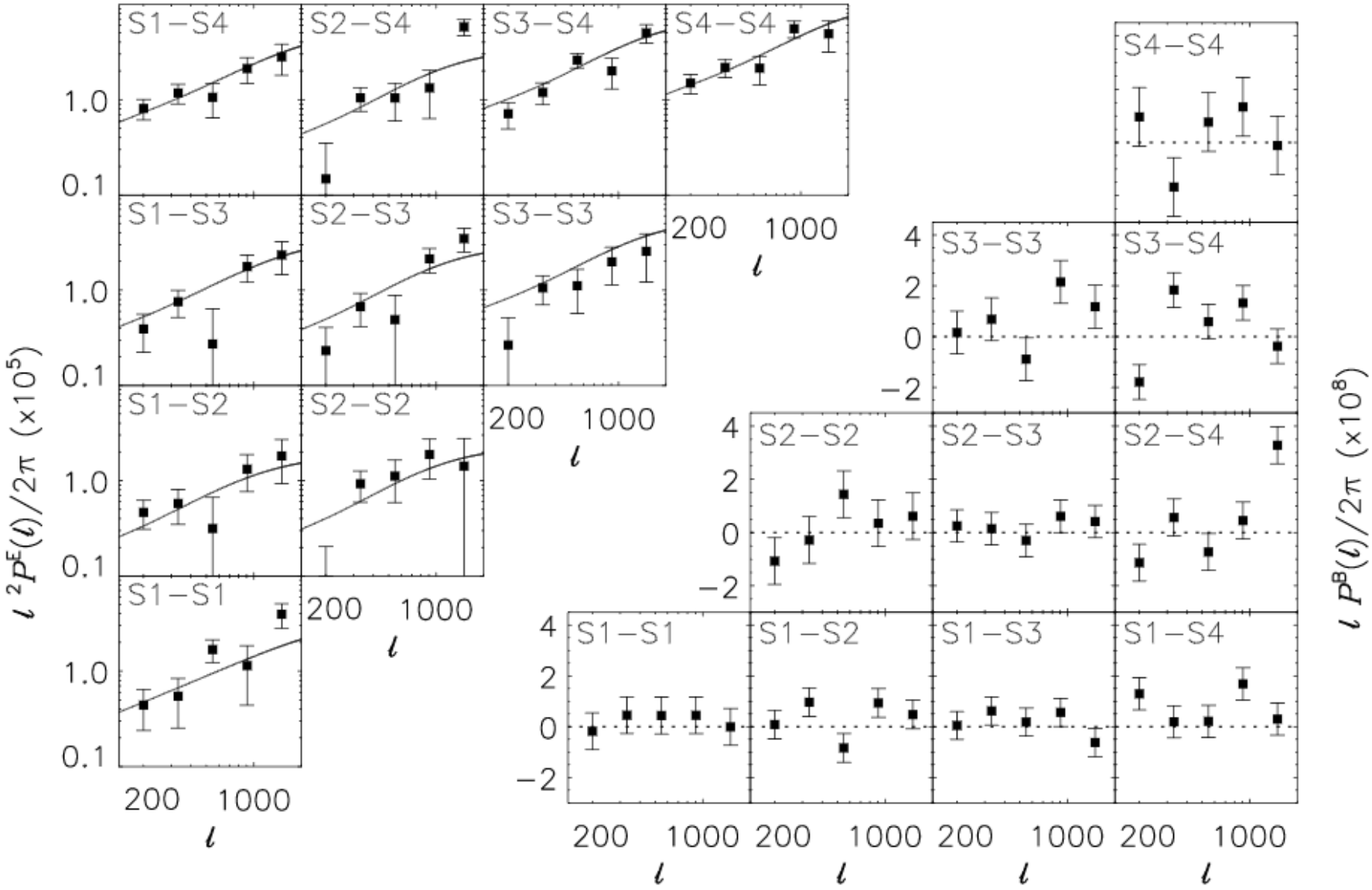
clustering

galaxy-galaxy lensing

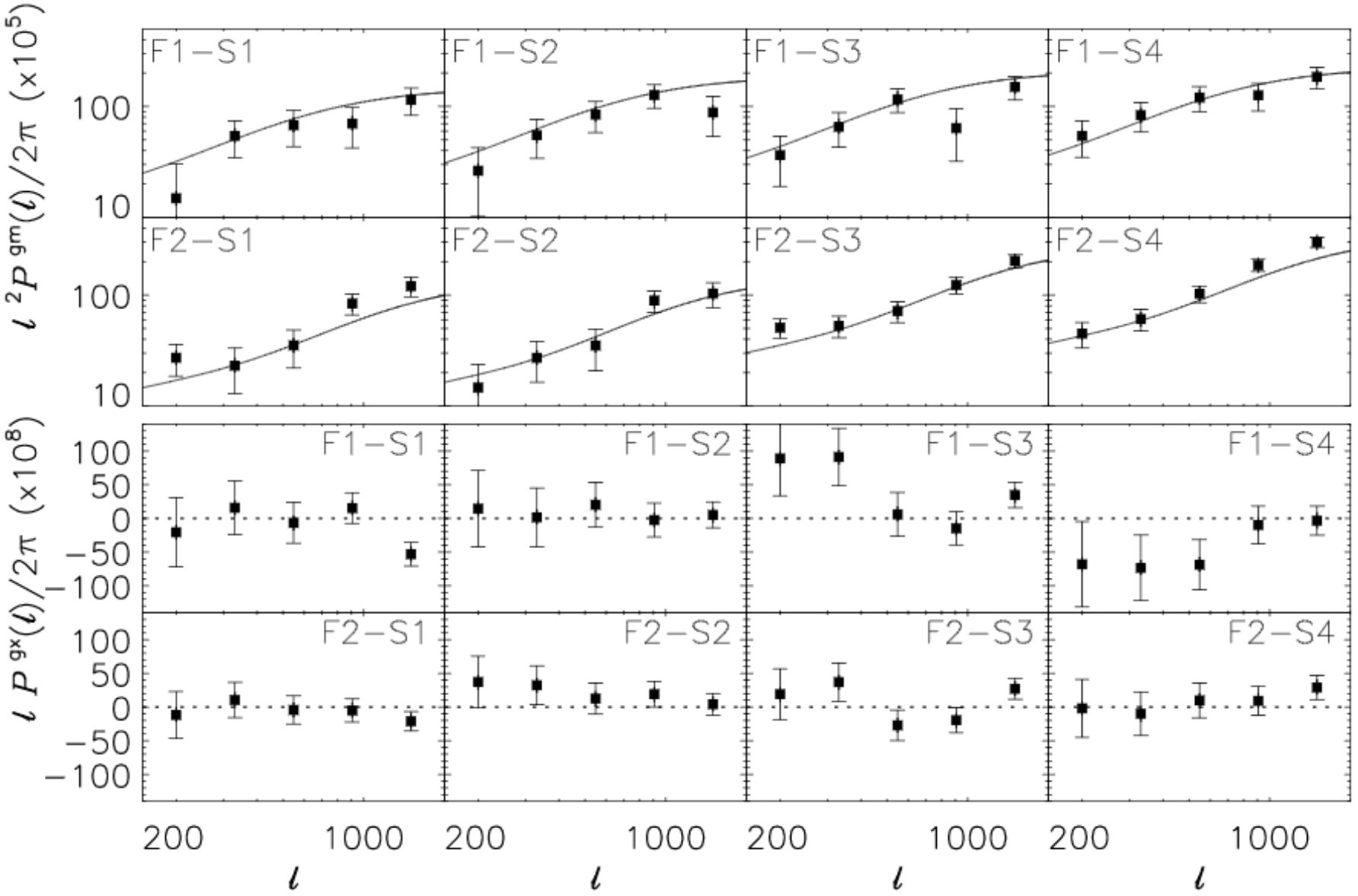
van Uitert, BJ, et al. (2017)

- derive power spectra as integrals over correlation functions
- joint analytic covariance, verified on N-body simulations
- same model as KiDS-450 + linear effective galaxy bias

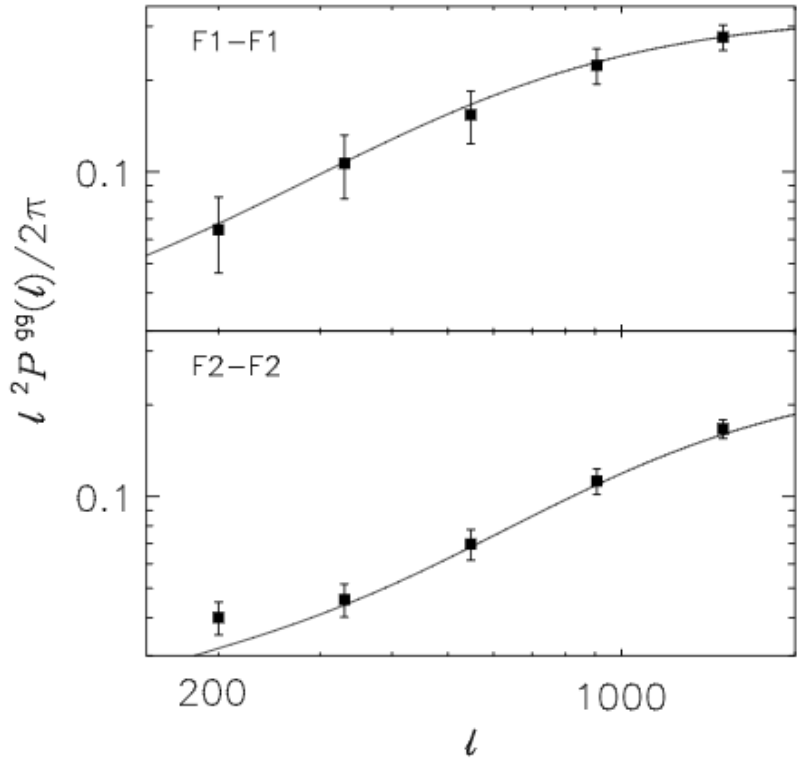
Signals – cosmic shear



Signals – galaxy-galaxy lensing

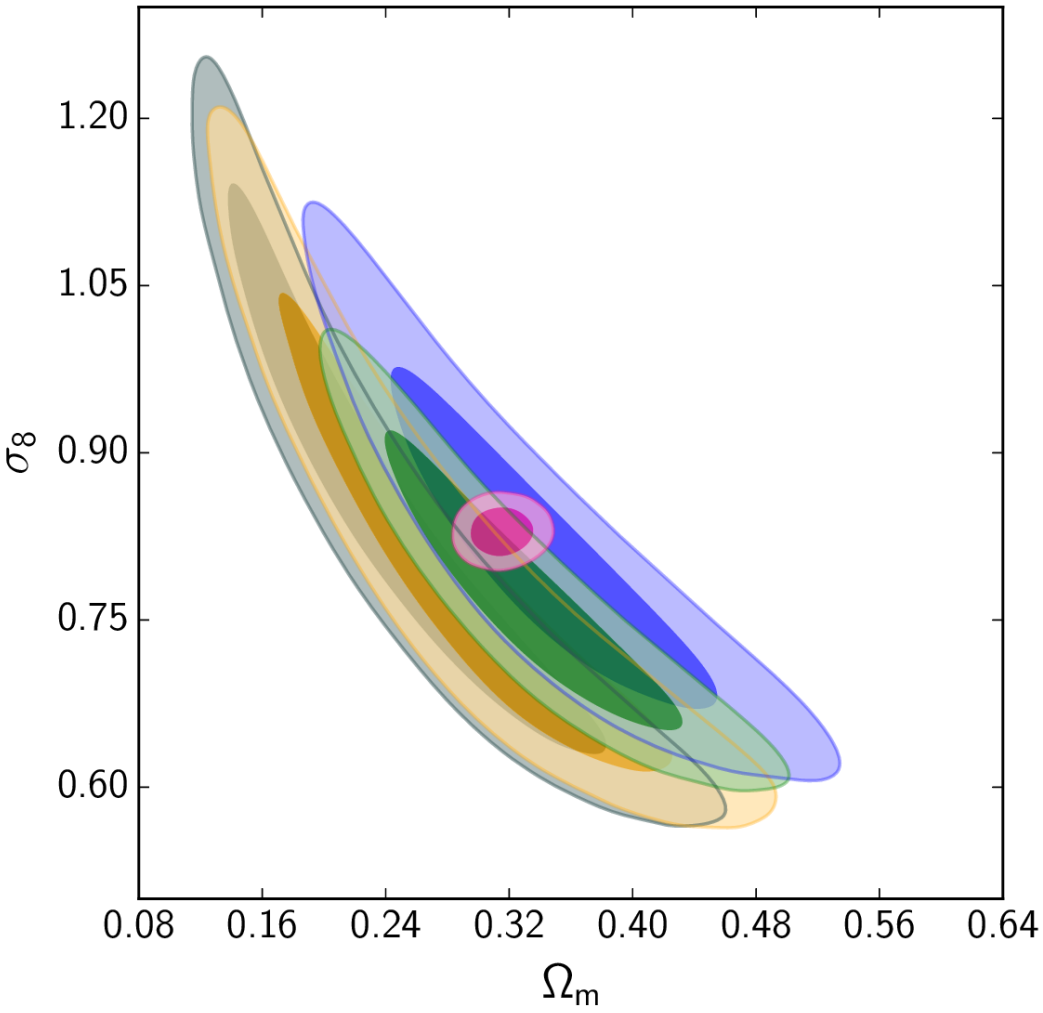


Signals – angular clustering



- mimics approach to photometric surveys
  → more information in the clustering signal
  → see Shahab's talk

Parameter constraints



KiDS-450 (real space)

Cosmic shear only (power spectrum)

Clustering & galaxy-galaxy lensing

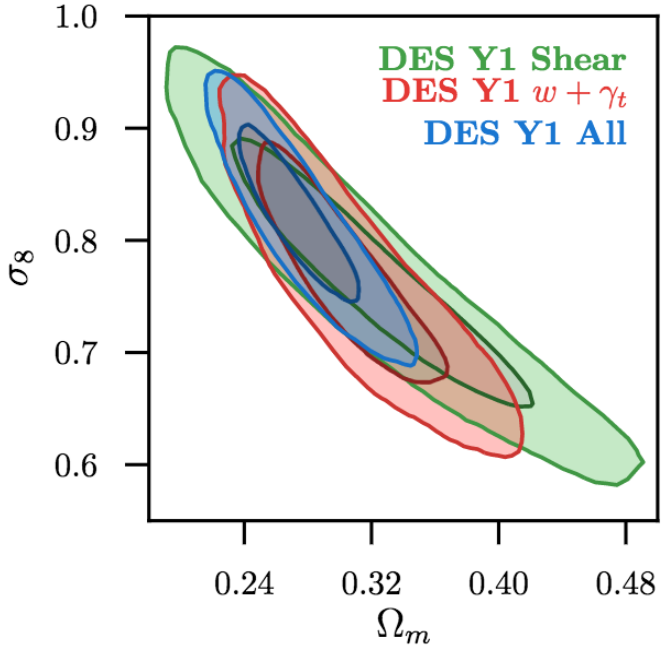
Joint large-scale structure

Planck

● and ● differ by 1.6σ but are quasi-independent

van Uitert, BJ, et al. (2017)

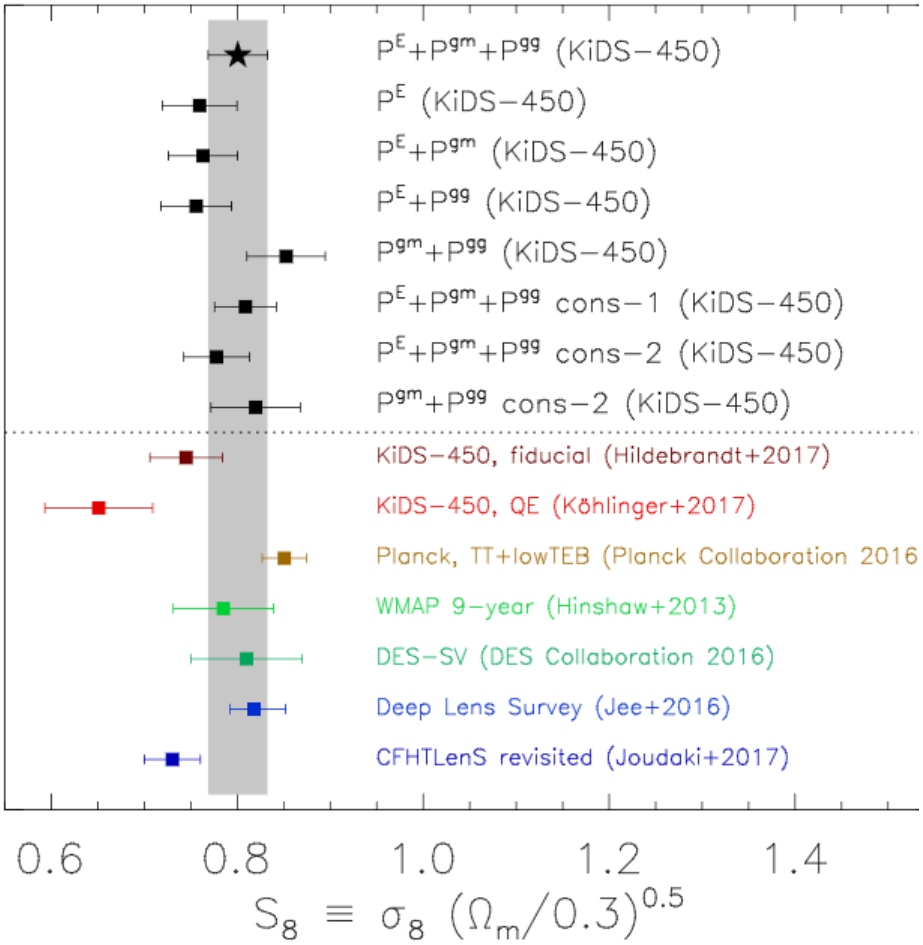
DES comparison



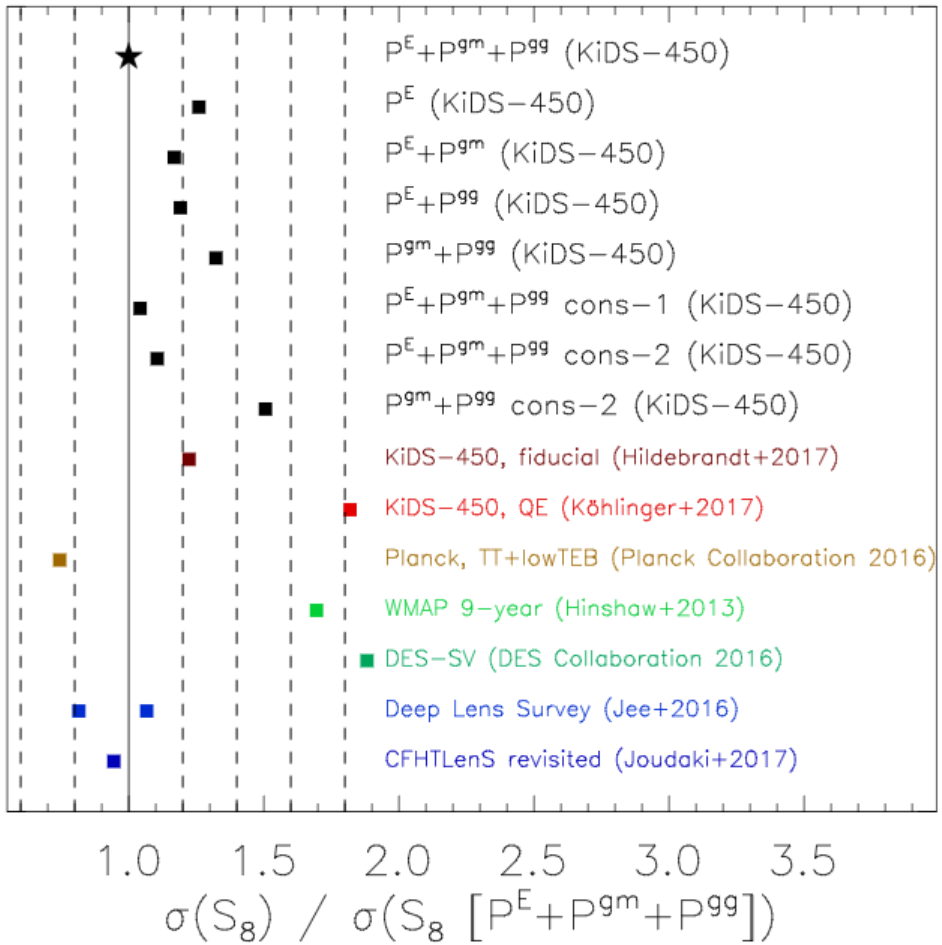
DES Y1 (2017)

Consistency

consistency checks

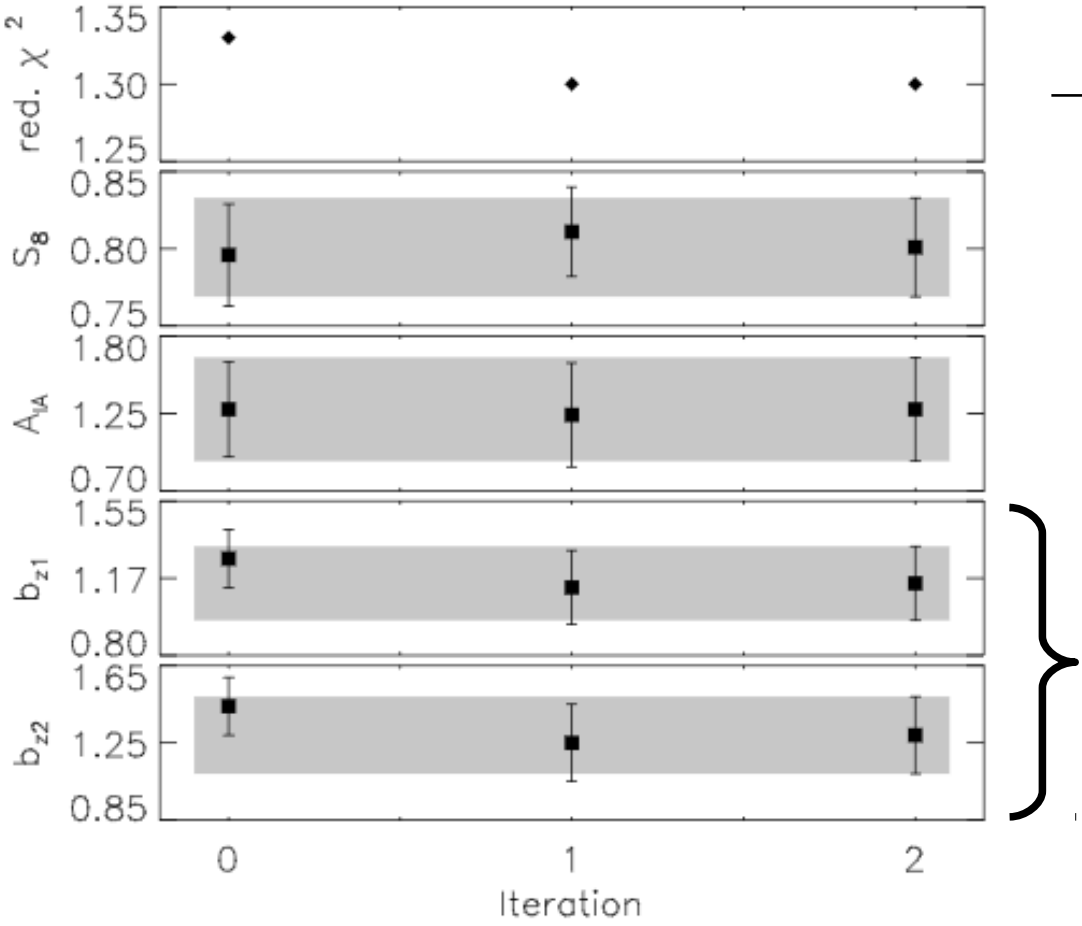


constraining power



Iterative covariance modelling

fiducial parameters → covariance model → iteration 0 inference
→ iteration 0 best-fit parameters → covariance model → iteration 1 inference
→ iteration 1 best-fit parameters → covariance model → iteration 2 inference



→ converged at iteration 2

fiducial values: b=1

Is there a problem?

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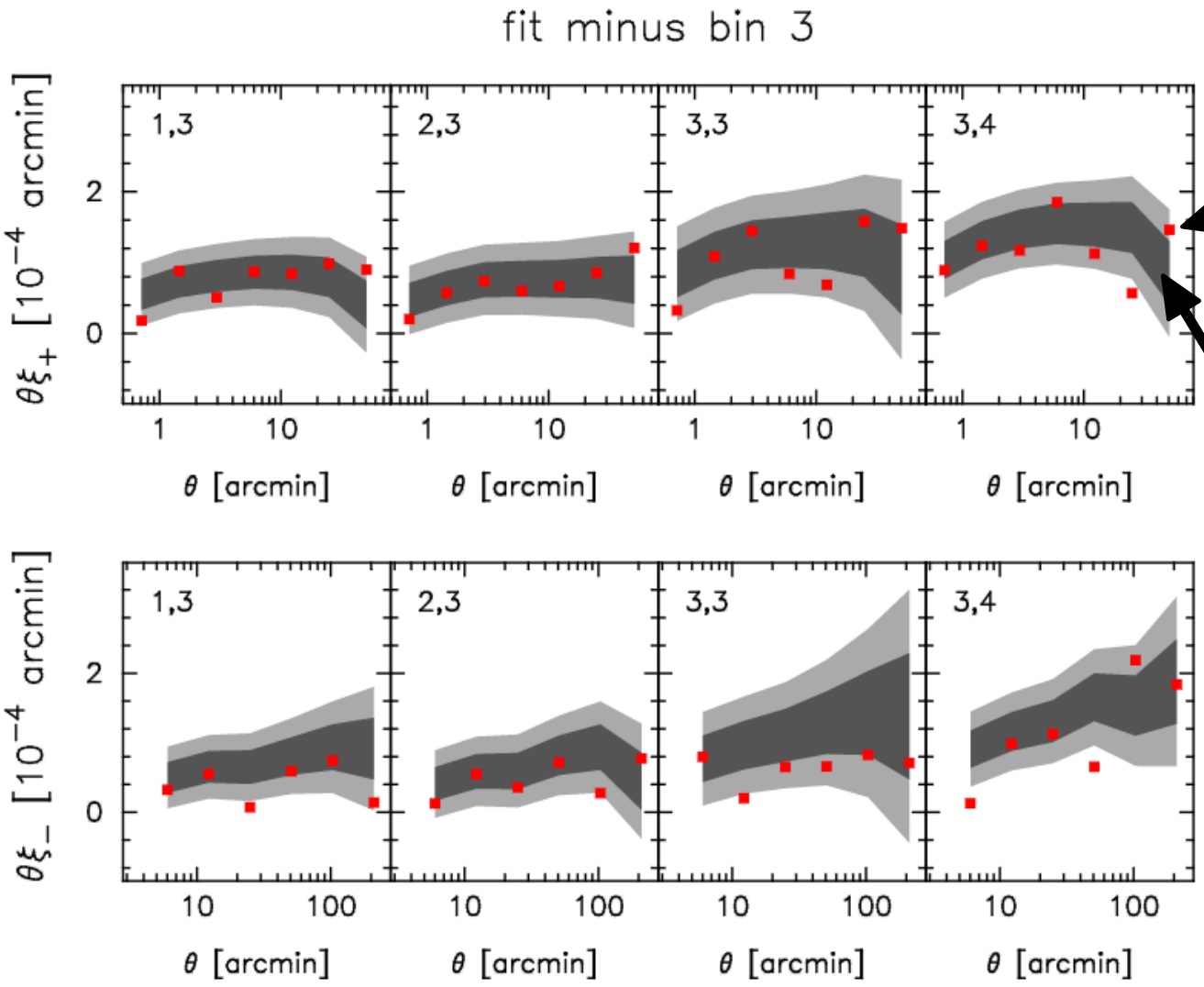
Problems with KiDS

George Efstathiou and Pablo Lemos
Kavli Institute for Cosmology Cambridge and Institute of Astronomy, Madingley Road, Cambridge, CB3 OHA.

Cross-validation [sort of]

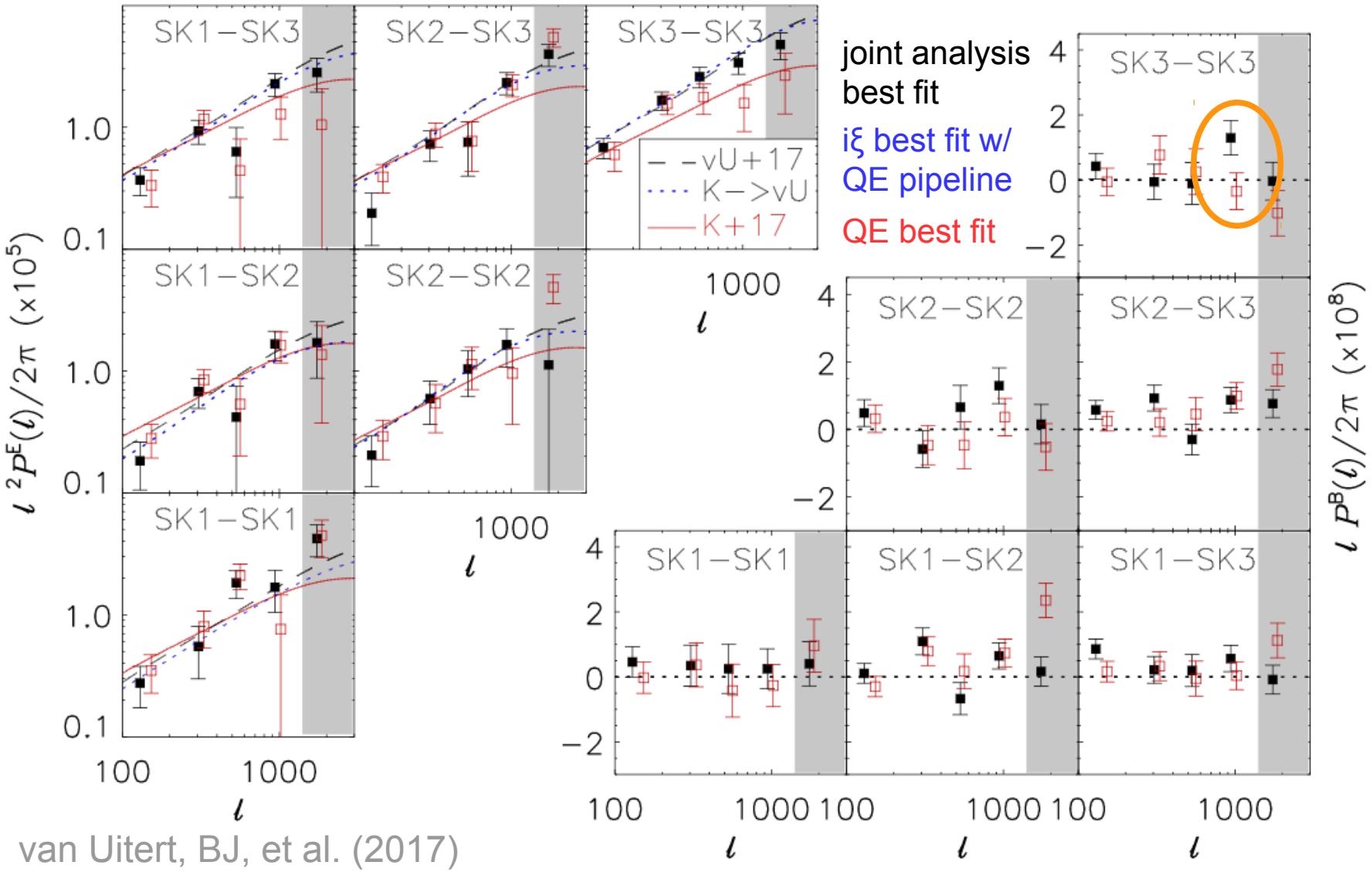


Beware of a posteriori choices!

Efstathiou & Lemos (2017)

Comparing power spectrum approaches

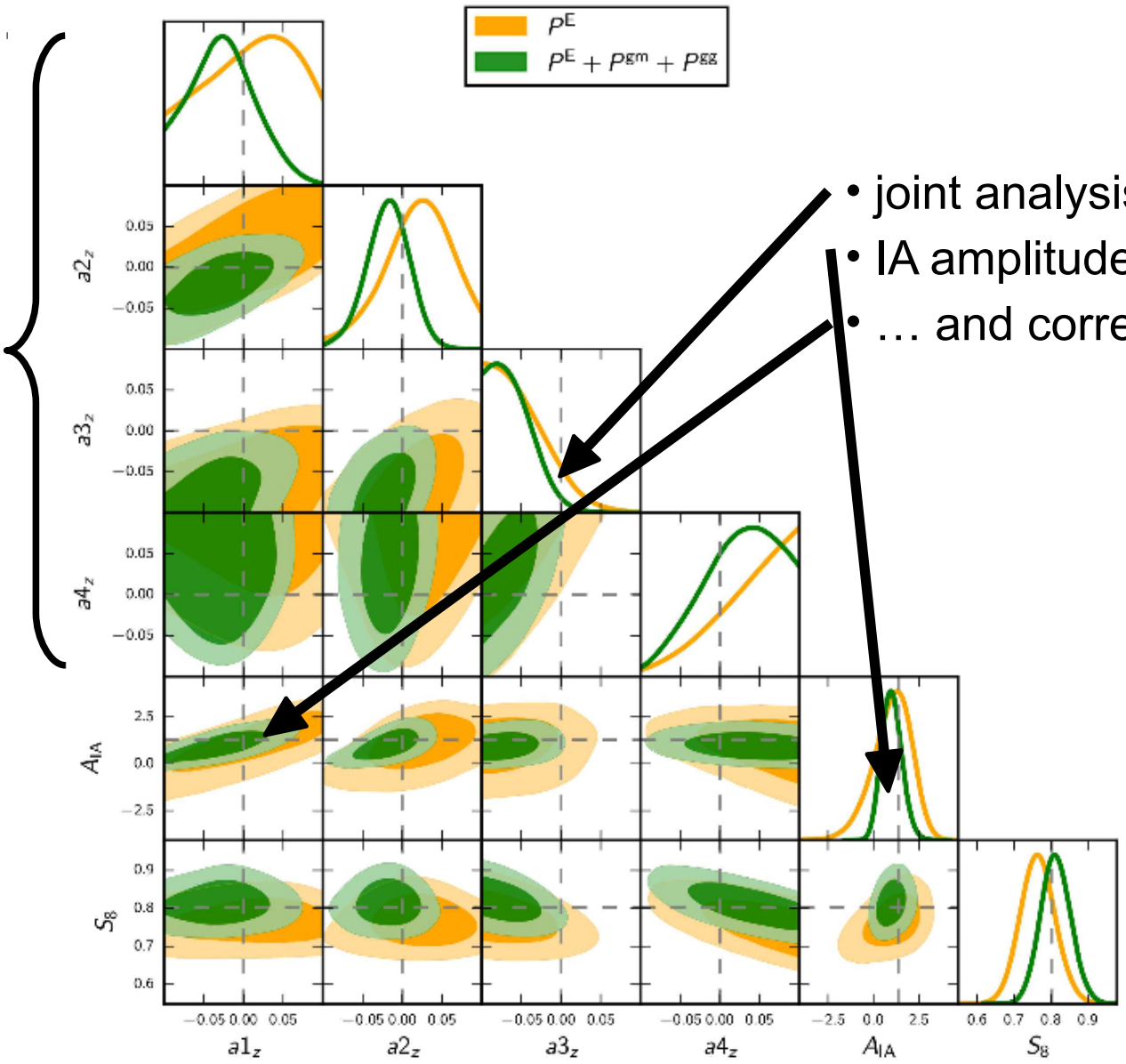
integrated over ξ (iξ) quadratic estimator (QE)



van Uitert, BJ, et al. (2017)

Fidelity of redshift distributions

shifts in the tomographic redshift distribution



- joint analysis prefers shift of bin 3
- IA amplitude unexpectedly high
- … and correlated with n(z)

Conclusions

- There is evidence for low-level tension internal to KiDS-450, related to redshift distributions and small-scale B-modes.
- None of these residual systematics can fully explain the discrepancy with Planck (and independent probes see the same).

- Clustering/weak lensing joint analysis improves constraints and calibrates systematics – it should become the default approach.
- More effort required to accurately quantify consistency between measurements, and thresholds for tension and probe combination.

Coming soon:

- 9-band KiDS+VIKING photometric redshifts
- Intrinsic alignment priors from KiDS+GAMA