KiDS

Cosmological results from the Kilo Degree Survey

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and
the KiDS collaboration

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DFG Deutsche Forschungsgemeinschaft

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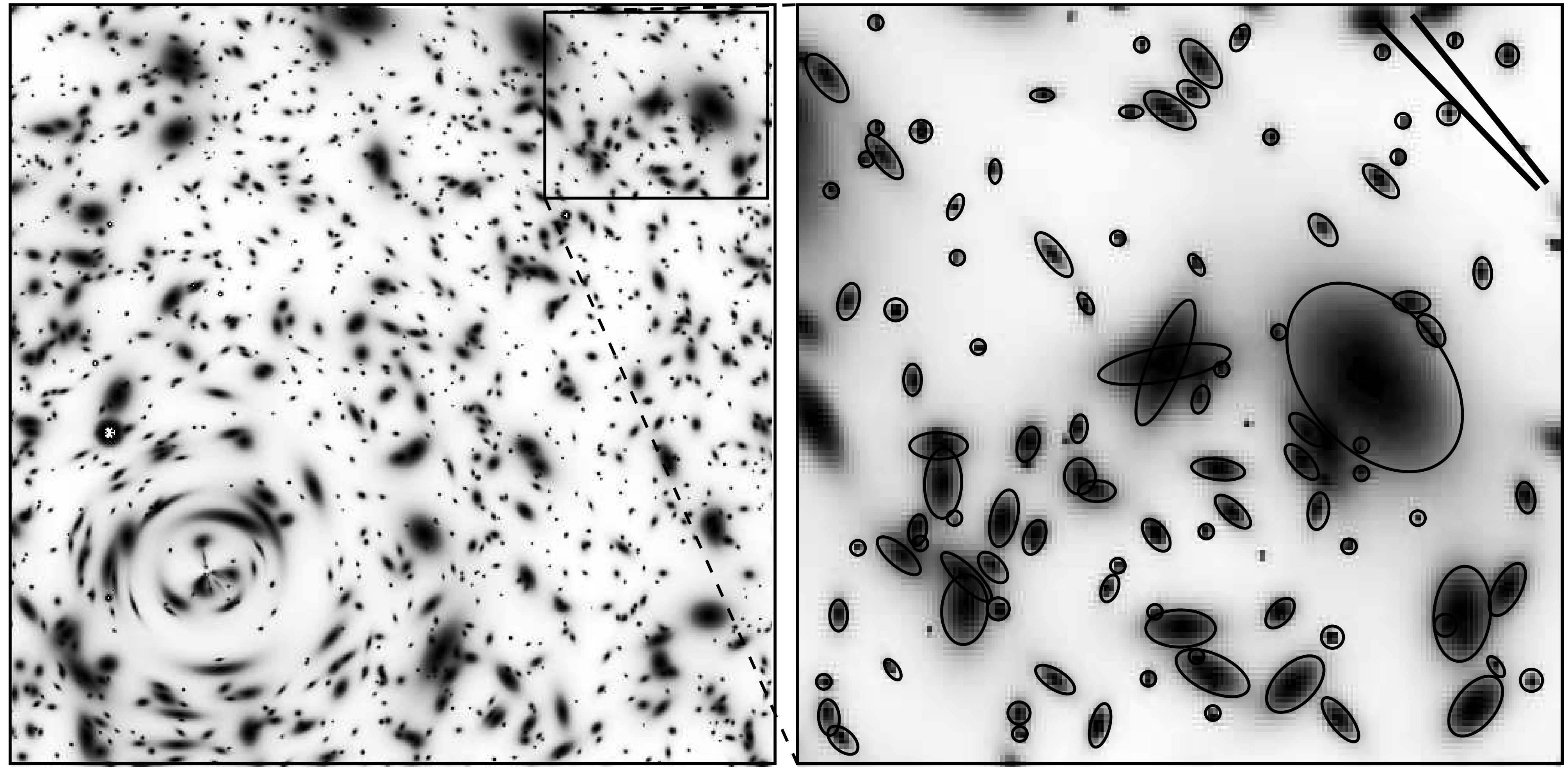
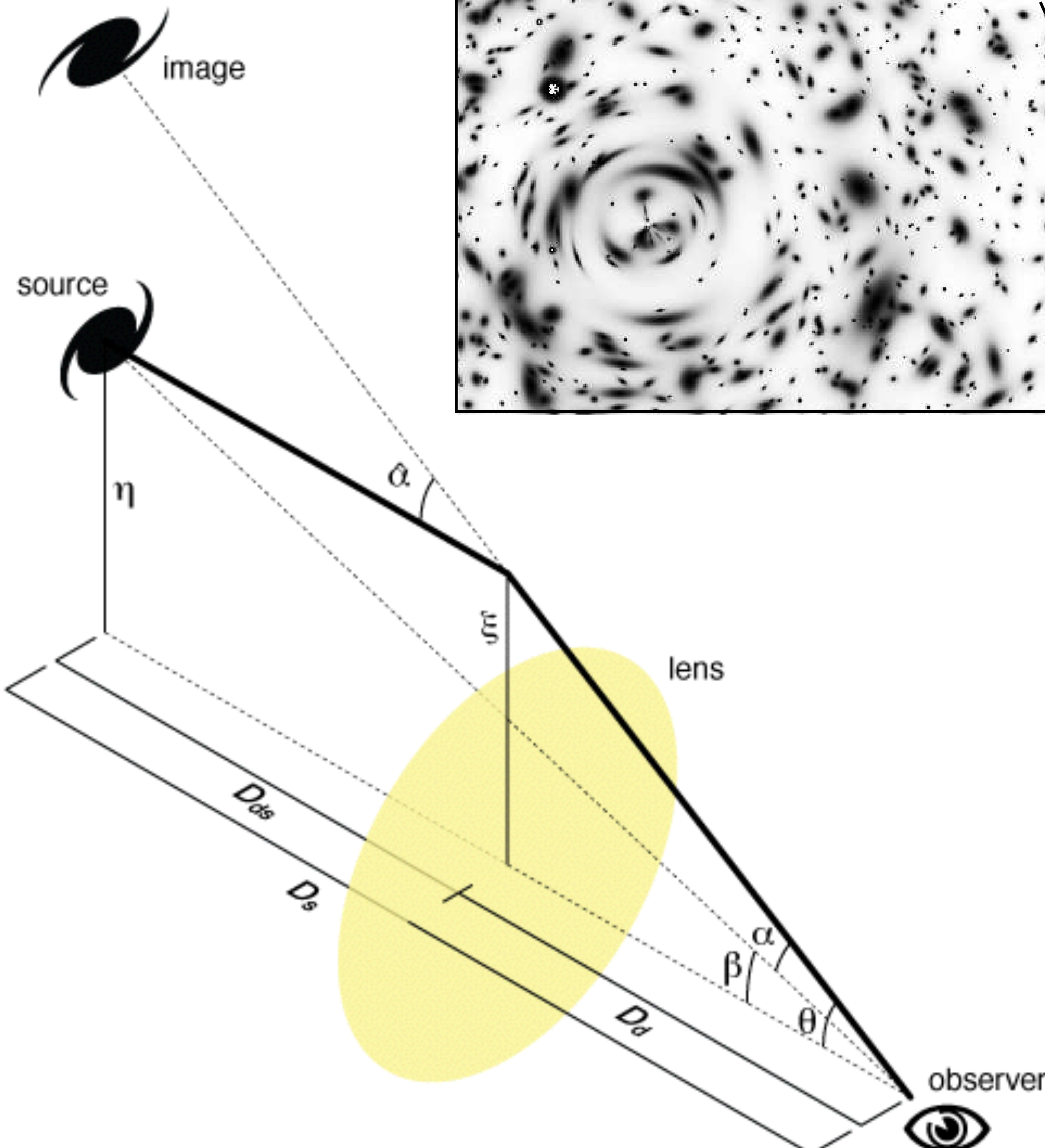
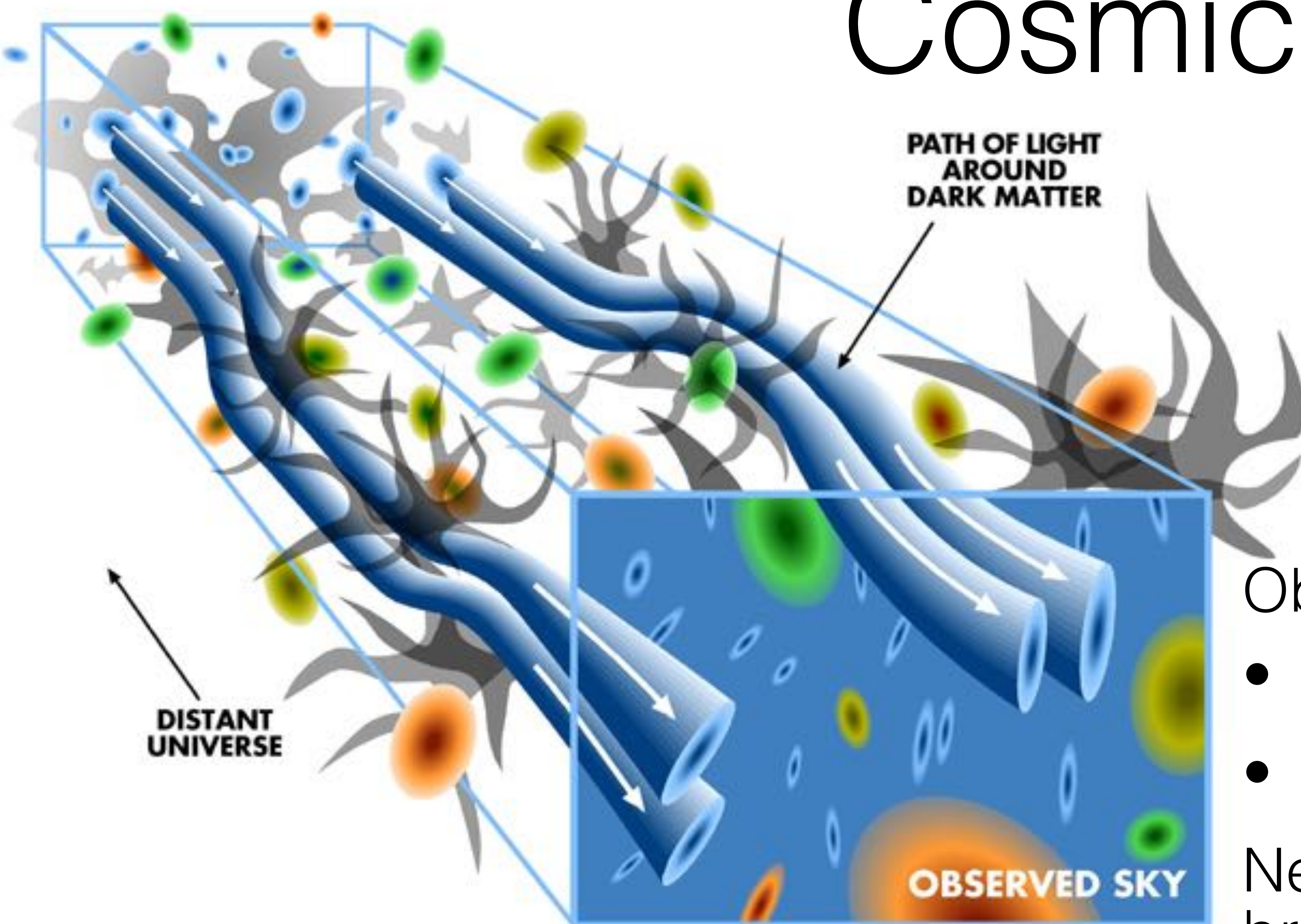


Mellier (1999)



Credit: Michael Sachs

Cosmic shear



Credit: LSST

Observables:

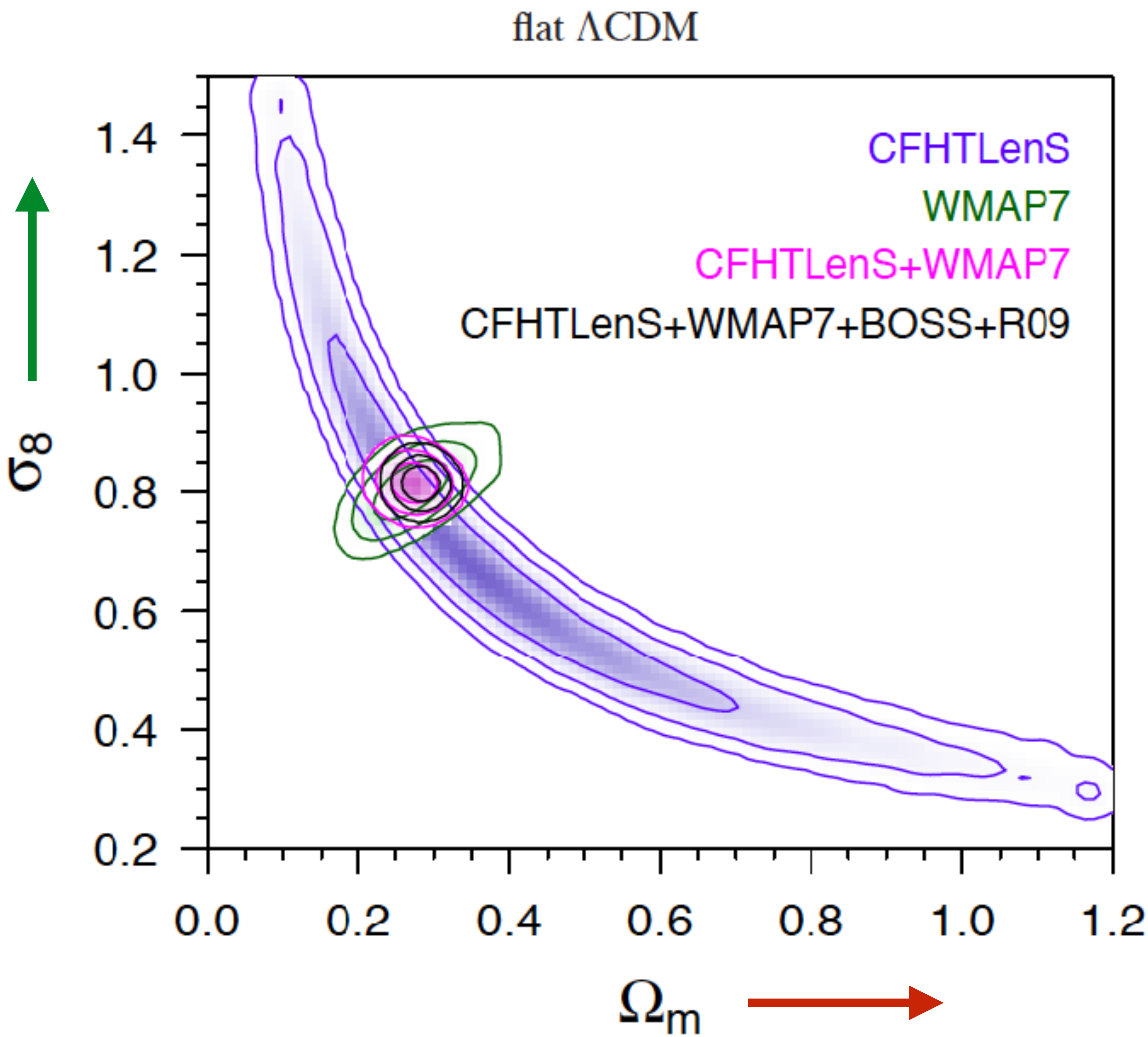
- Ellipticities
- Photo-z

Need to be calibrated extremely well!

=>

tomographic 2pt shear corr. fct.

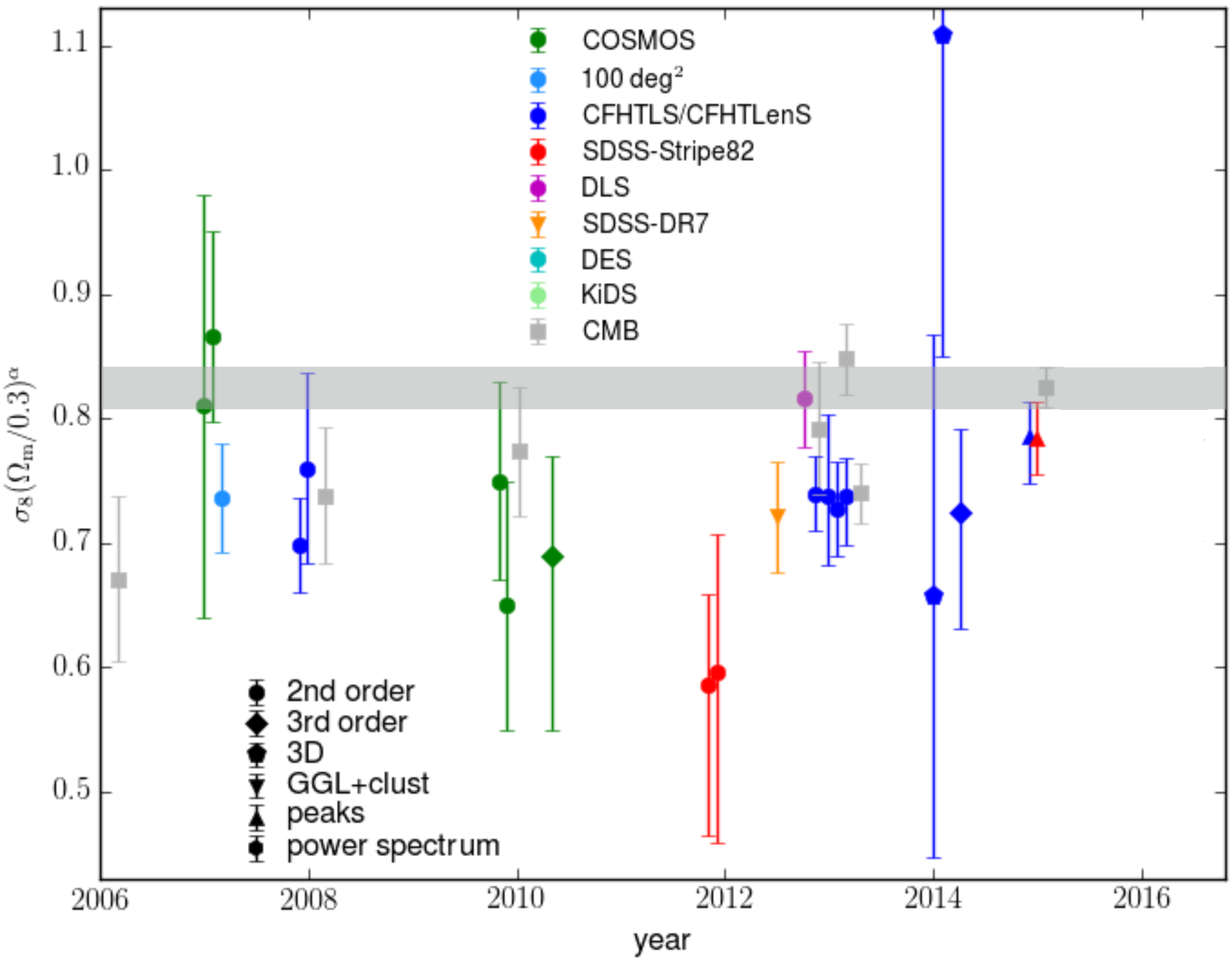
Cosmological constraints



Kilbinger et al. (2013)

- Measure **amount** of **clustered** matter
- $S_8 = \sigma_8 \, (\Omega_m/0.3)^{0.5}$

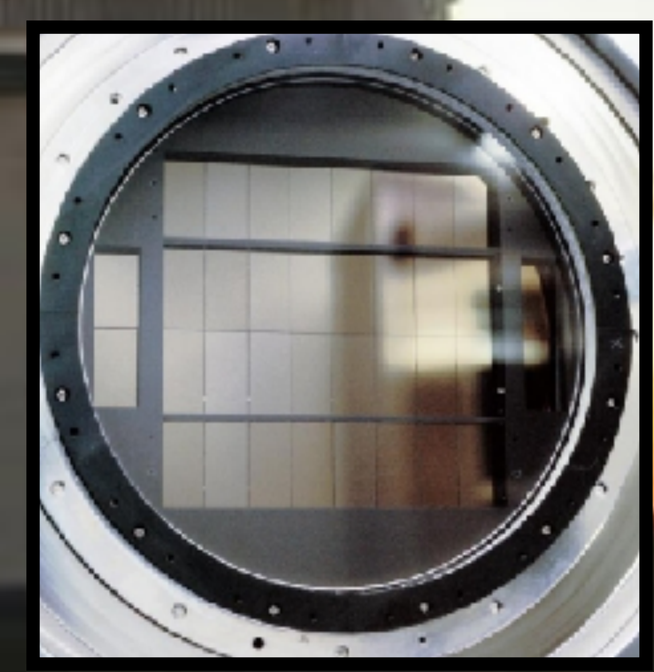
S_8 results over the years



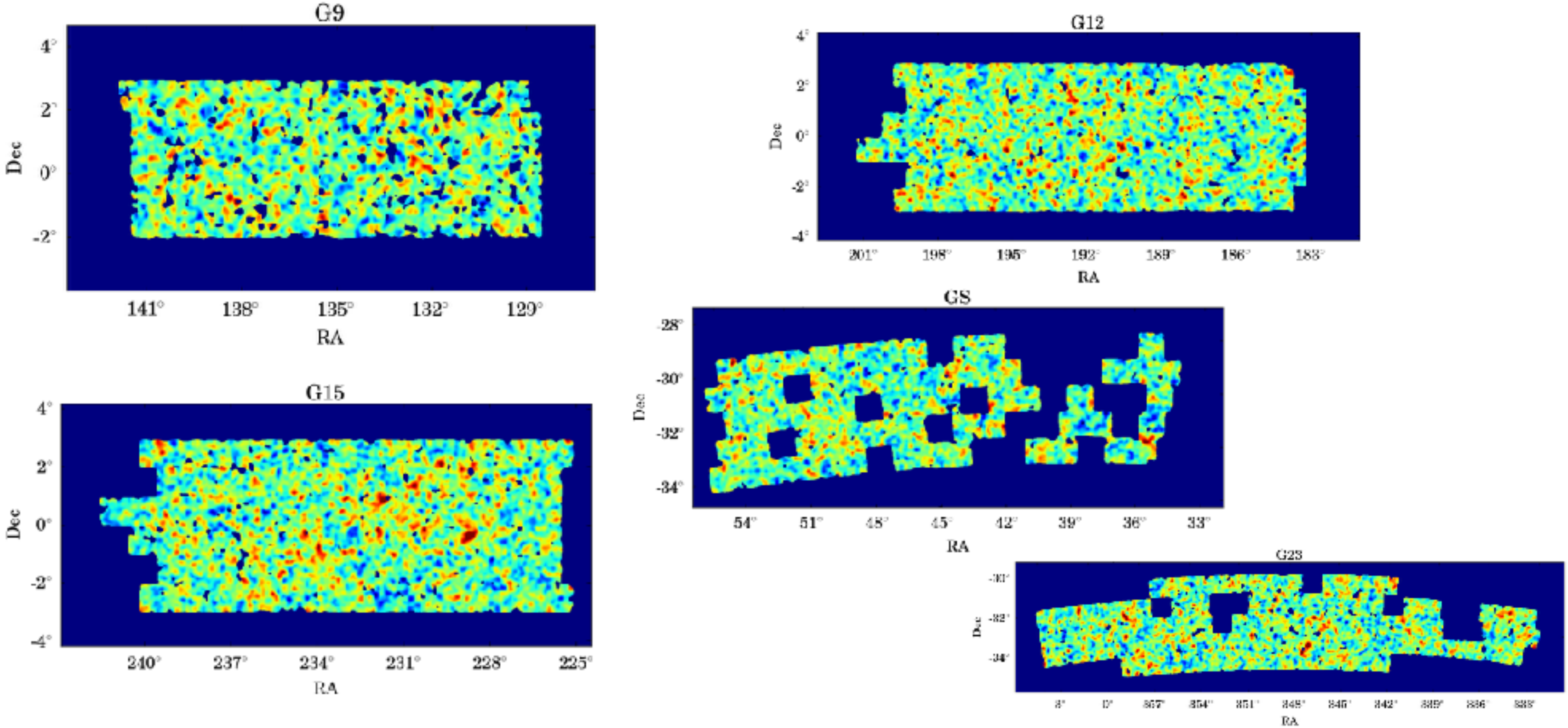
Kilbinger (2015)

KiDS

- 1350 sq. deg. survey
- VLT Survey Telescope (VST)
- Four bands: *ugri* (photo-z)
- Shapes down to r~24
  ~8 gal/arcmin^2
- Overlap with VIKING (ZYJHKs)



Cosmic shear with KiDS-450



- 450 deg^2 (observations up to July 2015).

- Tomographic analysis: 4 photo-z slices
  $0.1<z_{phot}<0.3$, $0.3<z_{phot}<0.5$,
  $0.5<z_{phot}<0.7$, $0.7<z_{phot}<0.9$

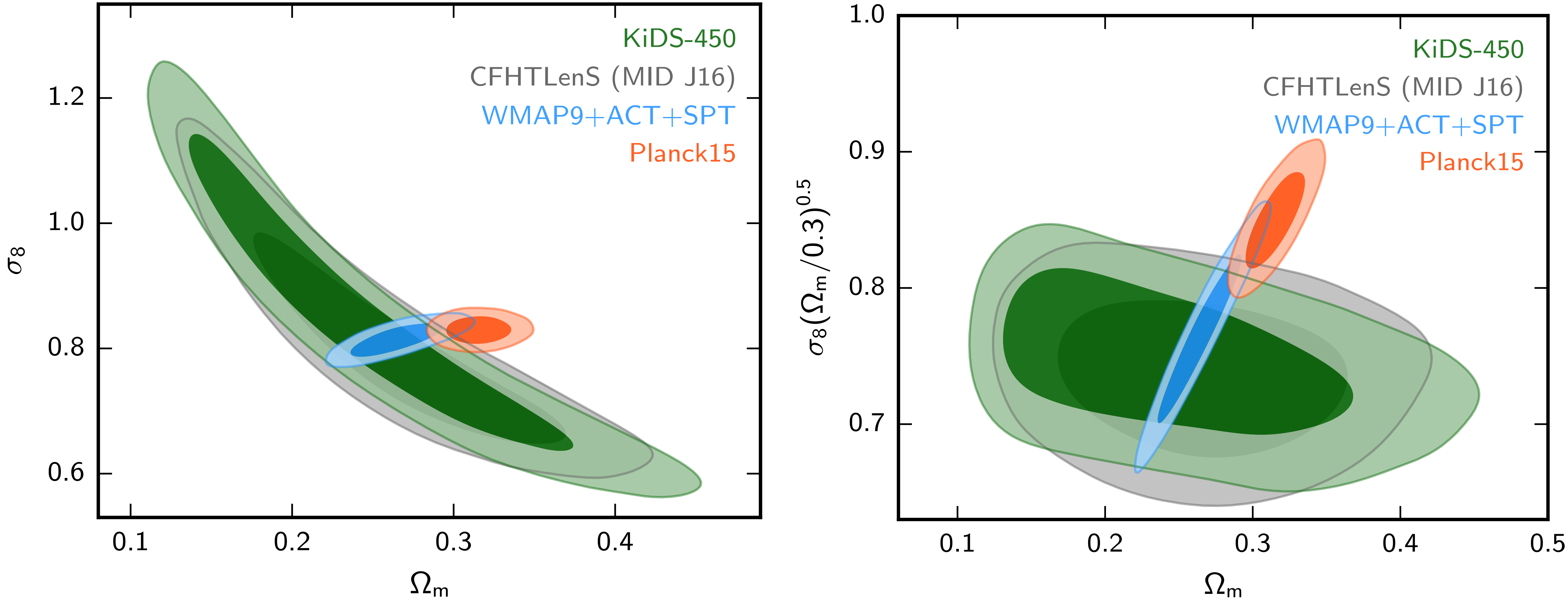
KiDS

Hildebrandt, Viola et al. (2017)

Systematic error control

- Shapes measurement systematics:
  - Telescope/camera design
  - Observing conditions
- Photo-z systematics:
  - Survey design (shallow and wide)
  - 3 redundant techniques to calibrate redshift distribution
- Theoretical systematics:
  - Careful selection of radial range
  - Redundancy
- Psychological systematics:
  - Blinding

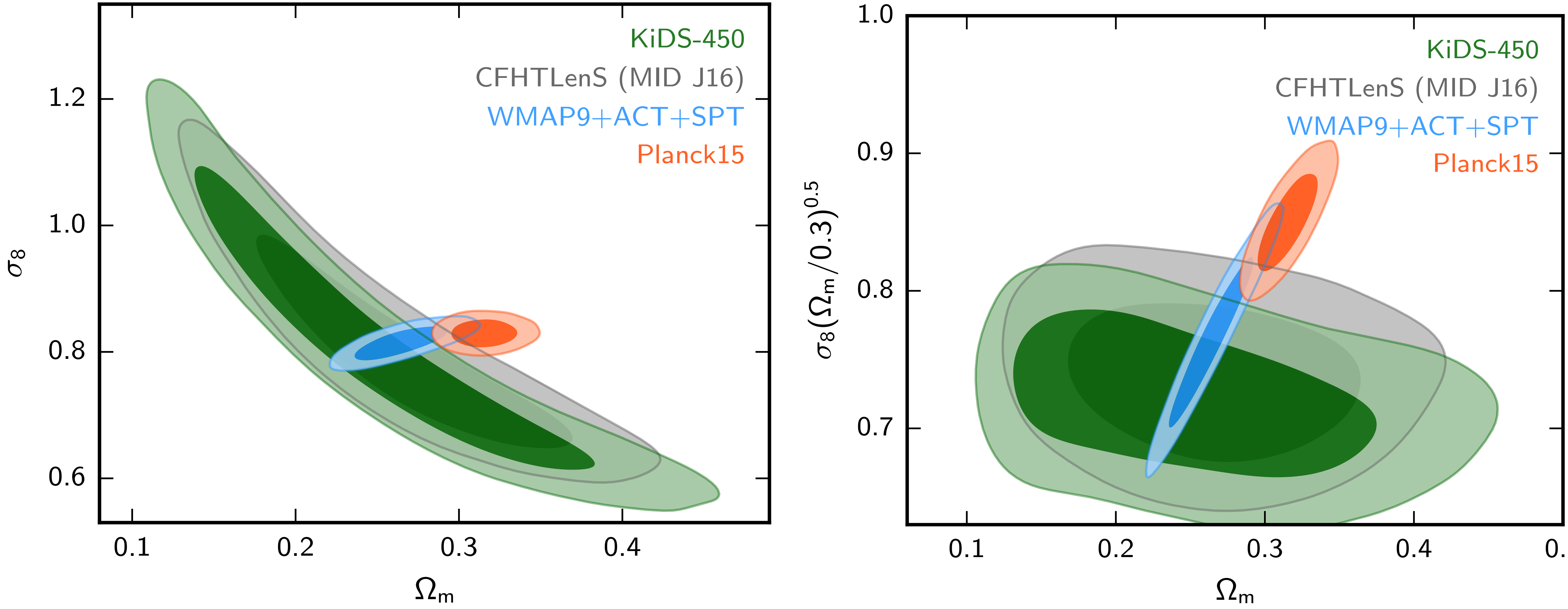
KiDS-450: Results (blind-1)



- S_8=0.745±0.039 2.3σ discrepancy with Planck

Hildebrandt, Viola et al. (2017)

KiDS-450: Results (blind-2)

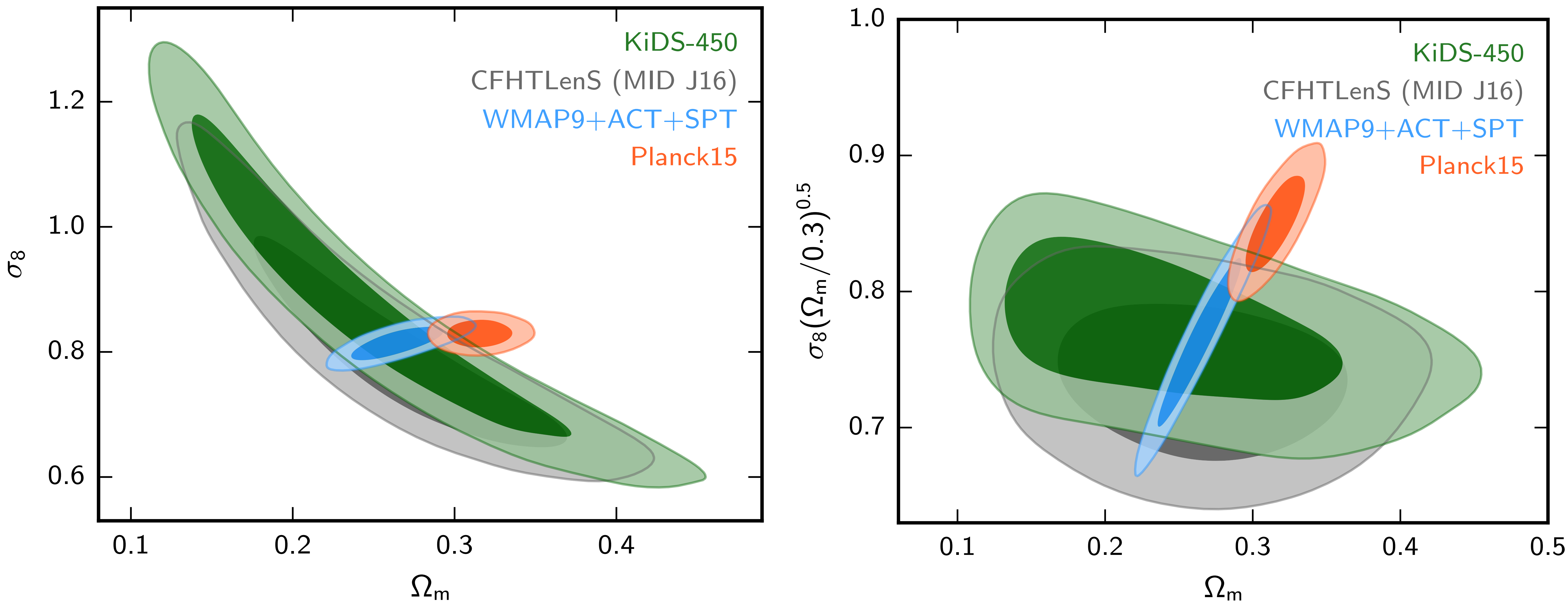


- S_8=0.720±0.039 2.8σ discrepancy with Planck

Hildebrandt, Viola et al. (2017)

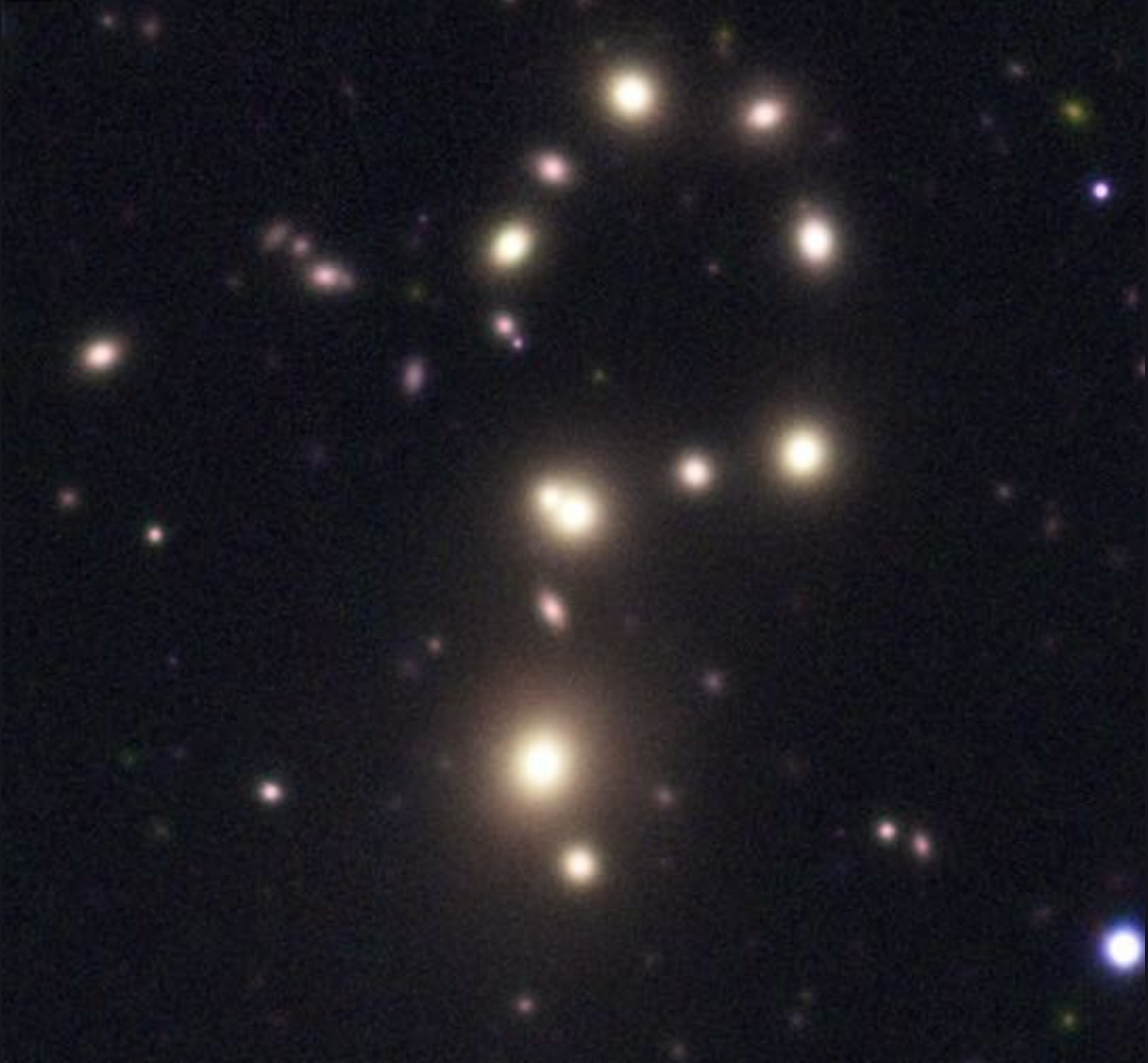
KiDS

KiDS-450: Results (blind-3)

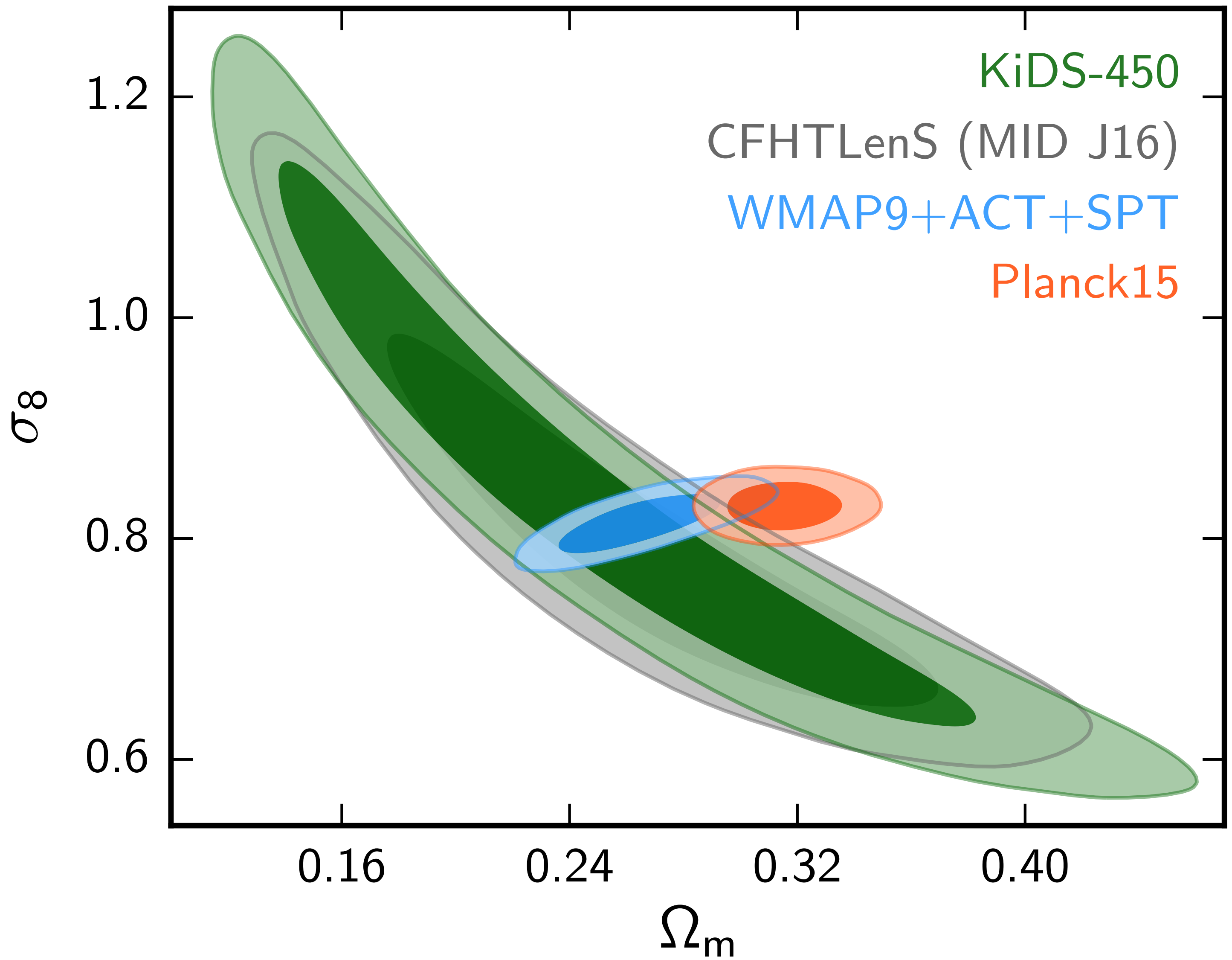


- S_8=0.772±0.039 1.7σ discrepancy with Planck

Hildebrandt, Viola et al. (2017)



Result

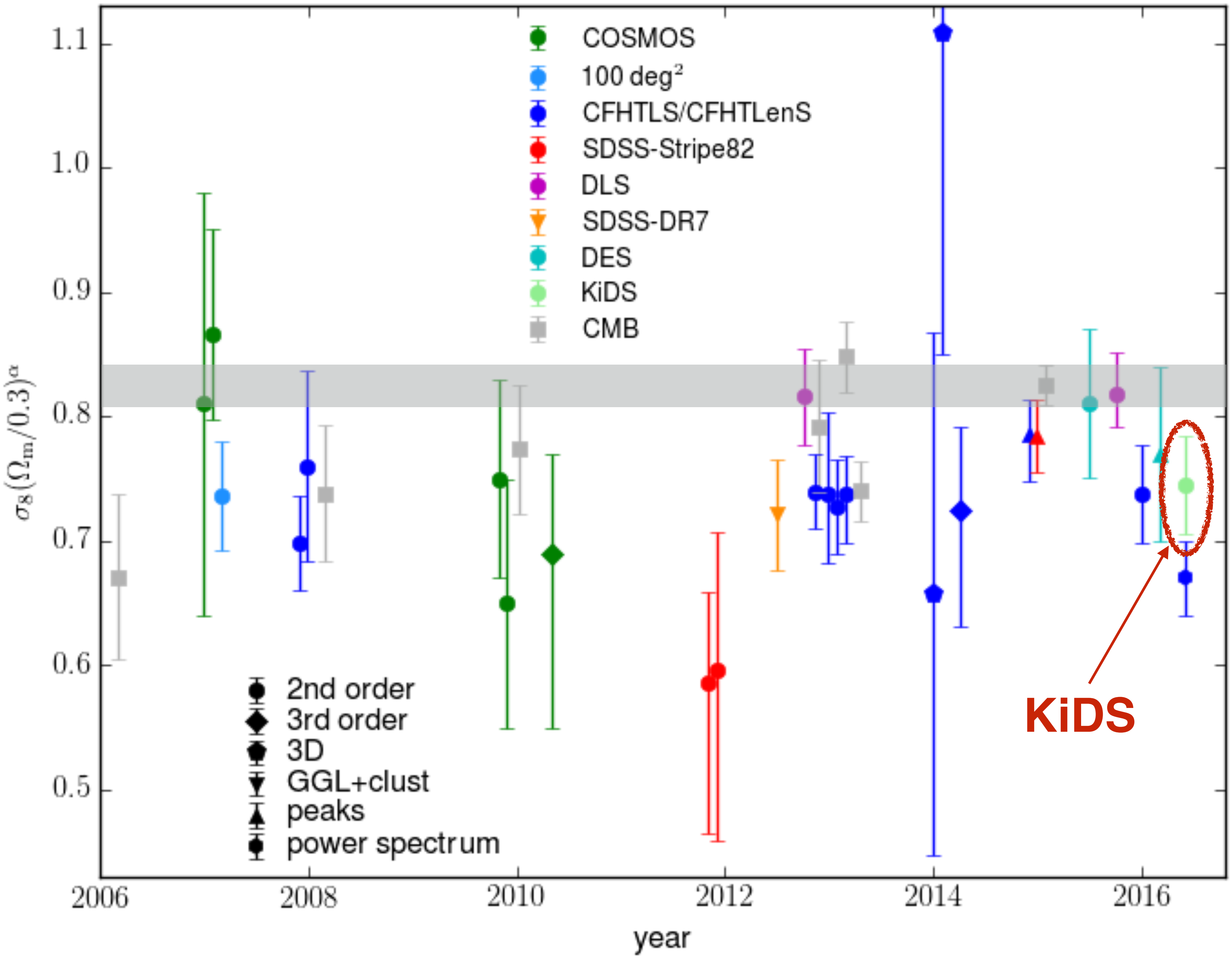


$\sigma_8\sqrt{(\Omega_m/0.3)}=0.745\pm0.039$

Systematics error as big as statistical error (0.027)

- S_8 constraint very similar to CFHTLenS, pre-planck CMB
- Tension with Planck — $2.7\sigma_{KiDS}$ in S_8
  (2.3σ discrepancy in full parameter space)

Hildebrandt, Viola et al. (2017)



S_8 results over the years

Kilbinger (2015; updated)

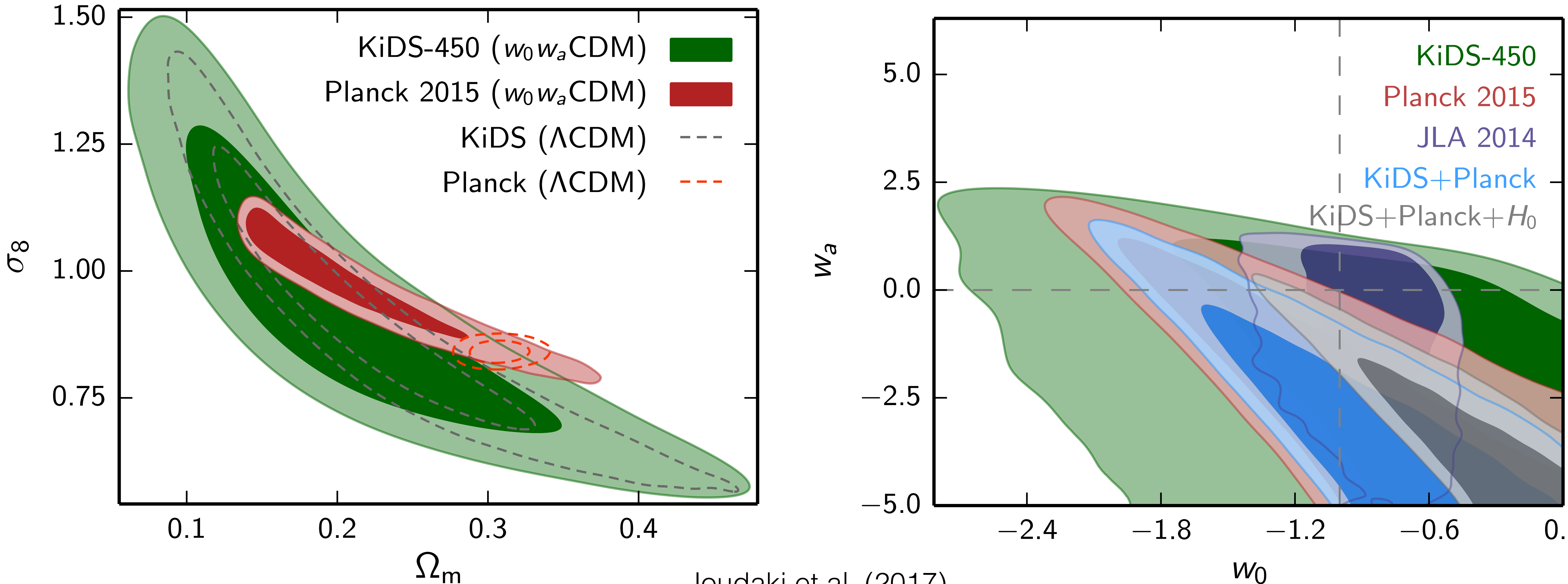
KiDS

Extended cosmologies

- Massive neutrinos.
- Non-zero curvature.
- Evolving dark energy.
- Modified gravity.
- Running spectral index.

Joudaki et al. (2017)

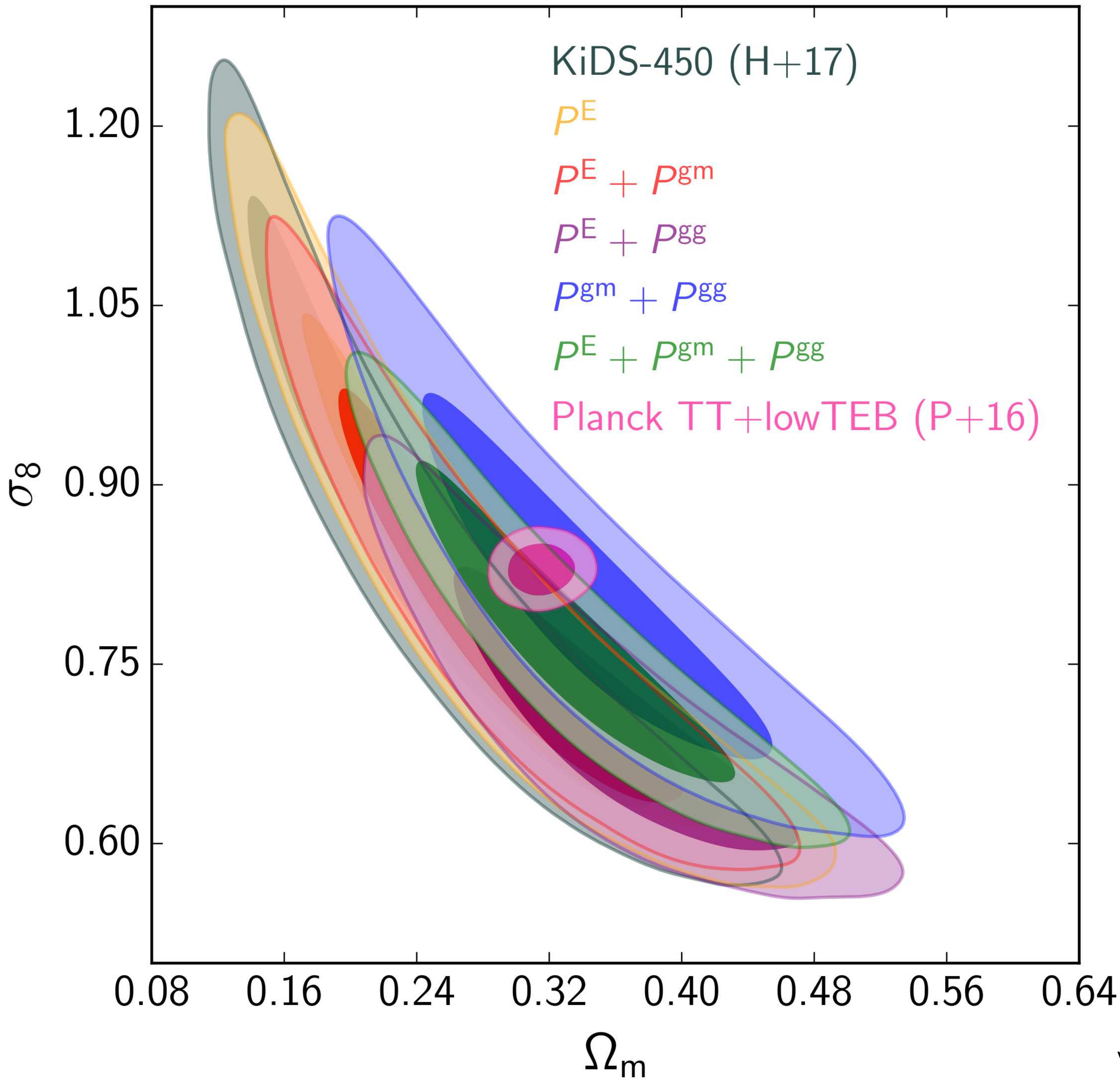
Evolving dark energy



Joudaki et al. (2017)

- Resolves tension between KiDS and Planck.
- Only extensions that is moderately favoured by the data.
- 3-σ deviation from a cosmological constant.
- Resolves tension between Riess et al. (2016) and Planck.

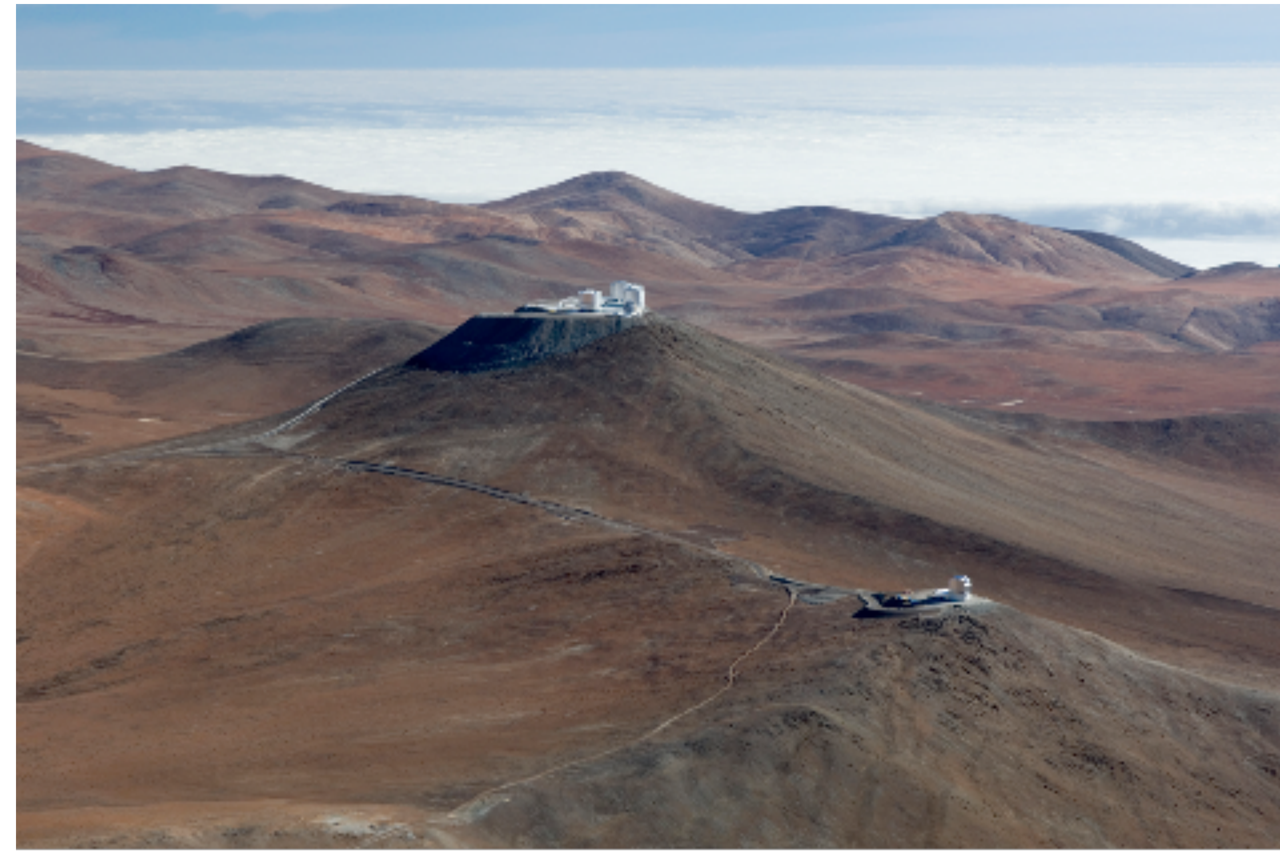
Combined probes

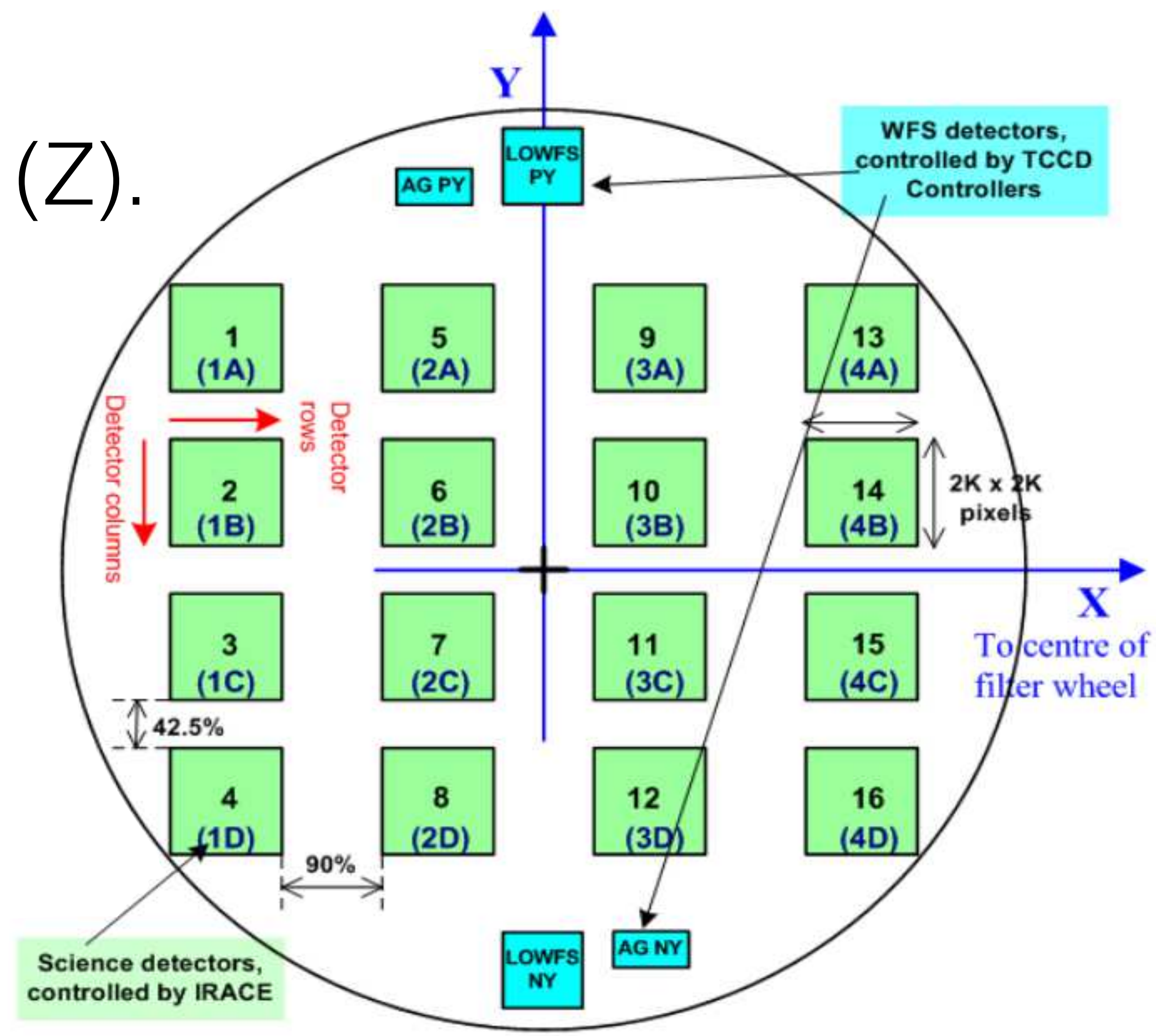


van Uitert et al. (2017)

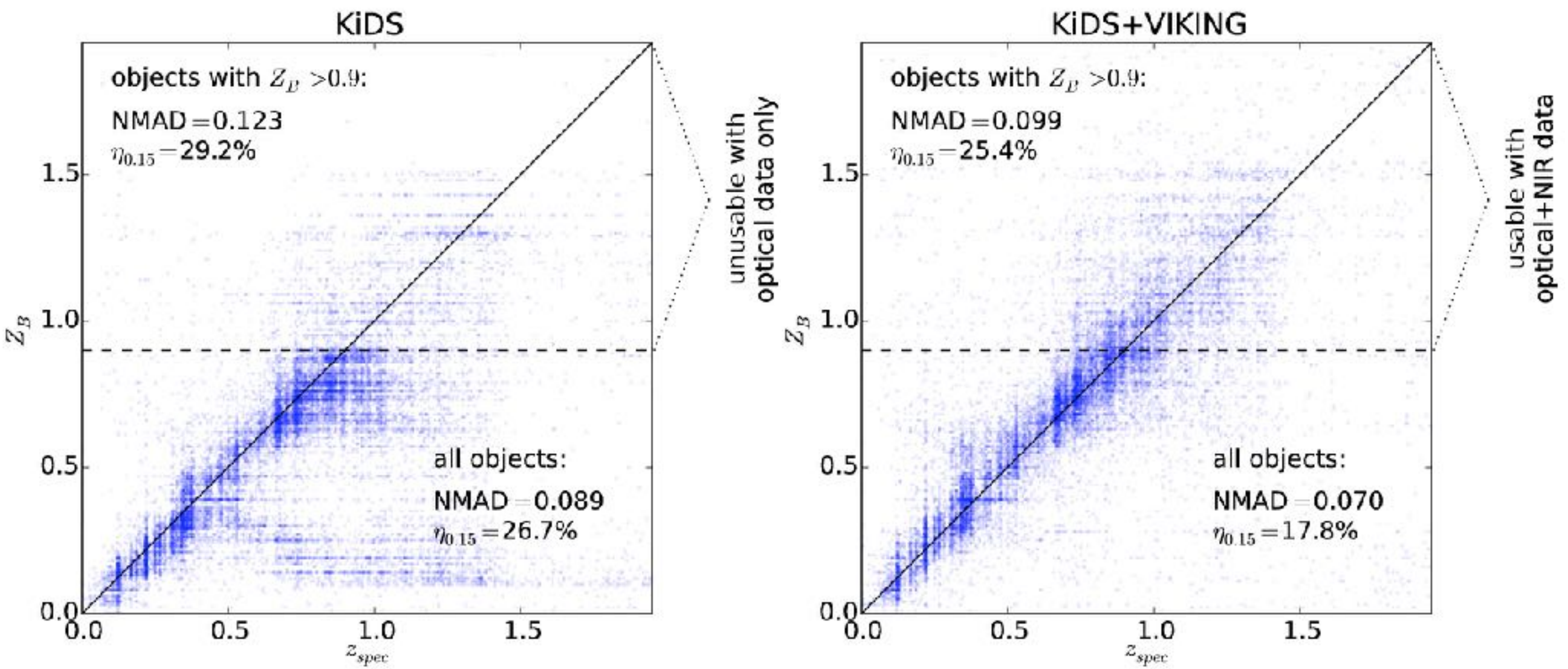
VIKING@VISTA

- Same footprint as KiDS.
- Already finished (1350deg²).
- ZYJHKs images.
- 5σ depths of 21.2 (Ks) to 23.1 (Z).





Photometric redshifts



KiDS Summary & Outlook

- KiDS-450 measures S_8 with ~5% error (1/2 syst., 1/2 stat.).
- Tension Planck versus lensing persists (~2.3σ).
- Emphasis on robustness, redundancy, blind analysis.
- All data public: http://kids.strw.leidenuniv.nl/cosmicshear2016.php
- Cosmic shear result tested further from different angles.
- ~900deg^2 now, 1350deg^2 by end 2018 => factor >2 improvement to robustly test ΛCDM and **prepare for Euclid**.