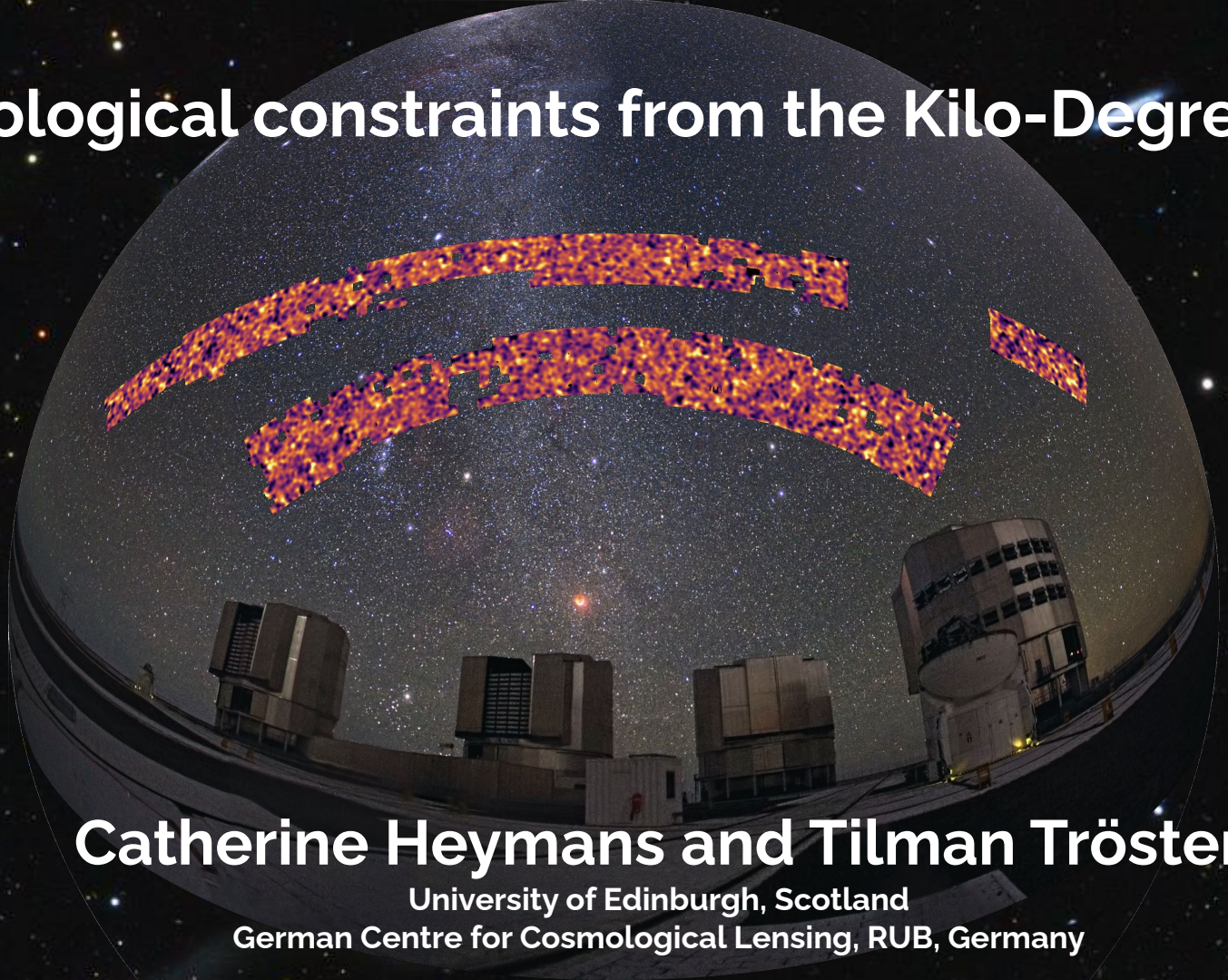
Cosmological constraints from the Kilo-Degree Survey



Catherine Heymans and Tilman Tröster

University of Edinburgh, Scotland

German Centre for Cosmological Lensing, RUB, Germany

KiDS-1000 Publications

Methodology: Joachimi, Lin, Asgari, Tröster, Heymans et al.

Photometric Redshifts: Hildebrandt, van den Busch, Wright et al.

Shear Measurements: Giblin, Heymans, Asgari et al.

Cosmic Shear Cosmology: Asgari, Lin, Joachimi et al.

3x2pt Cosmology: Heymans, Tröster et al.

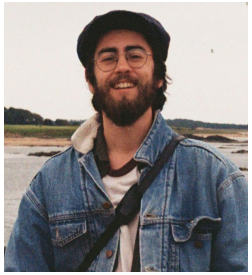
KiDS


Benjamin Joachimi


Chieh-An Lin


Jan Luca van den Busch


Angus H Wright


Ben Giblin

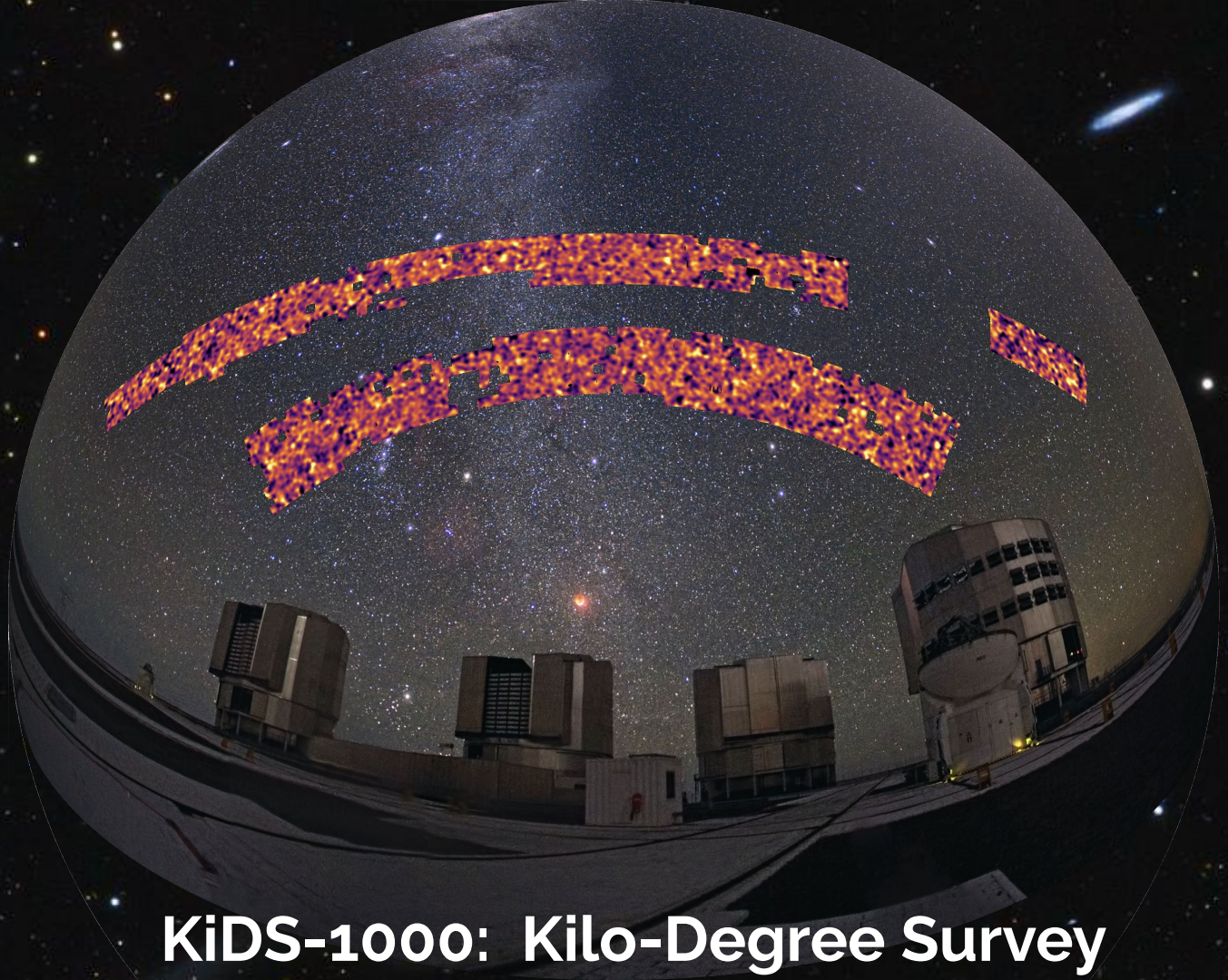

Marika Asgari


Tilman Tröster


Konrad Kuijken

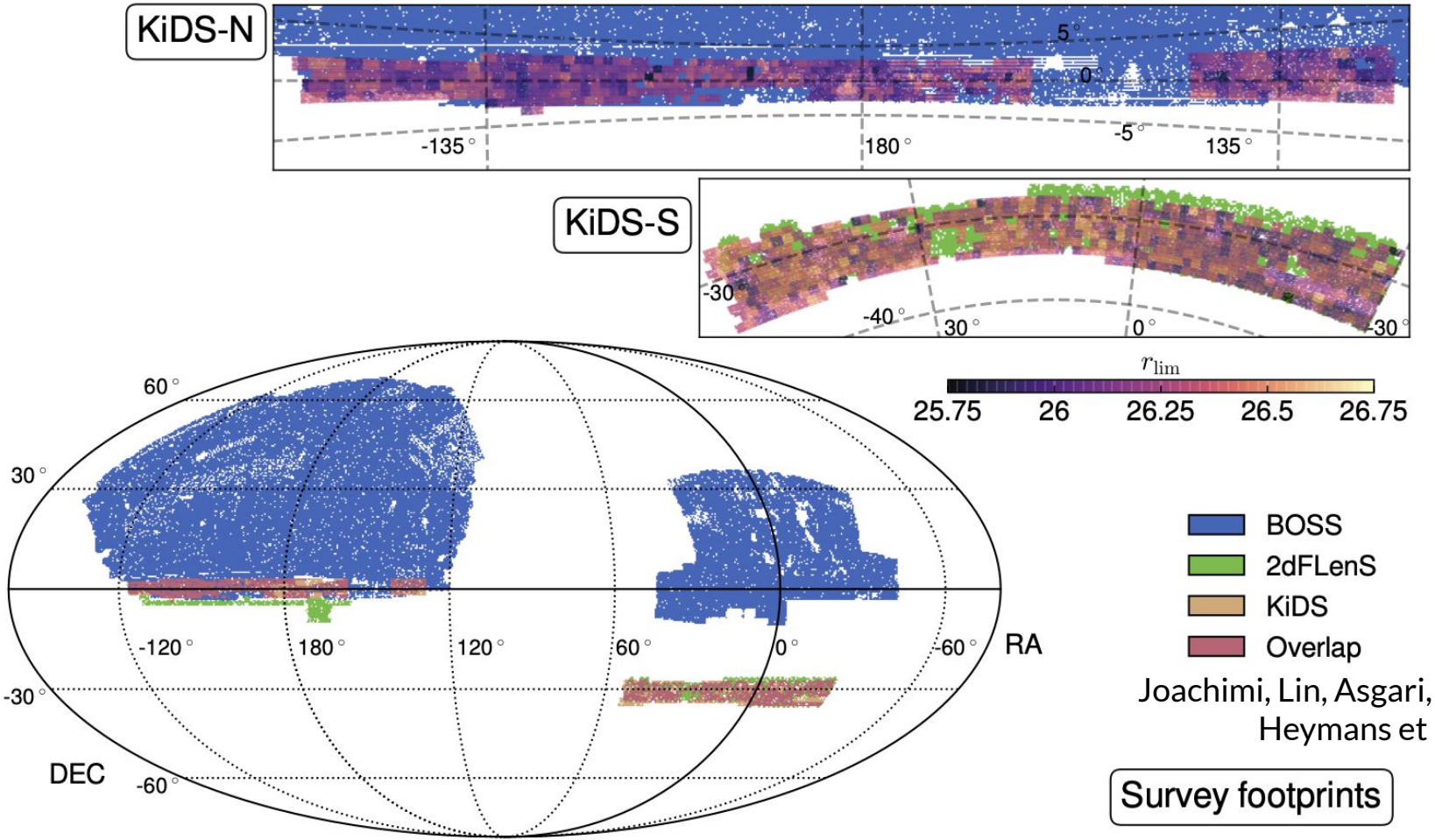

Hendrik Hildebrandt


Catherine Heymans



KiDS-1000: Kilo-Degree Survey

KiDS, BOSS and 2dFLenS



Joachimi, Lin, Asgari, Tröster, Heymans et al. 2020

Survey footprints

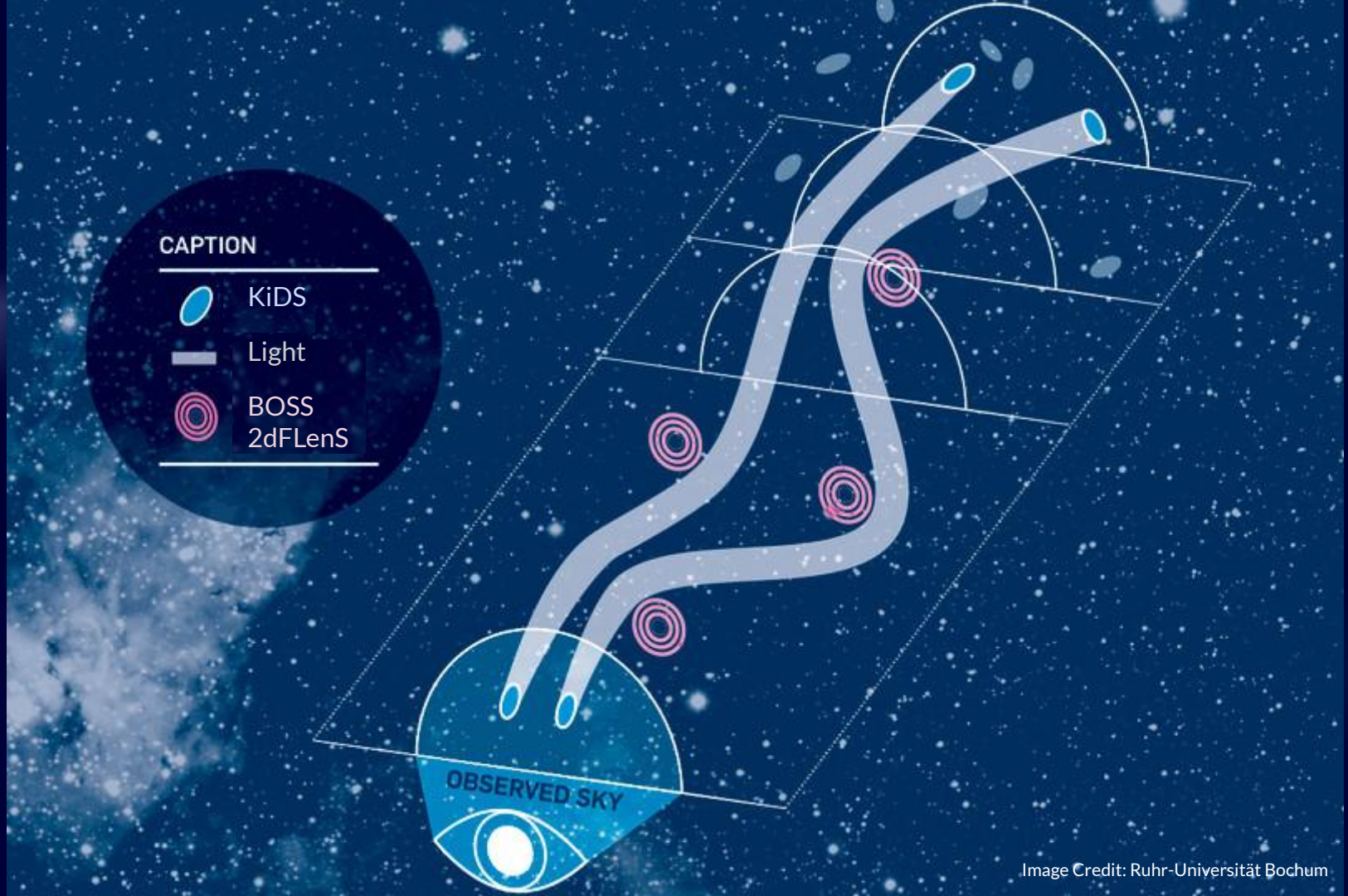


Image Credit: Ruhr-Universität Bochum

KiDS:
Shape, 3D position
(ra,dec, $z_{photometric}$)

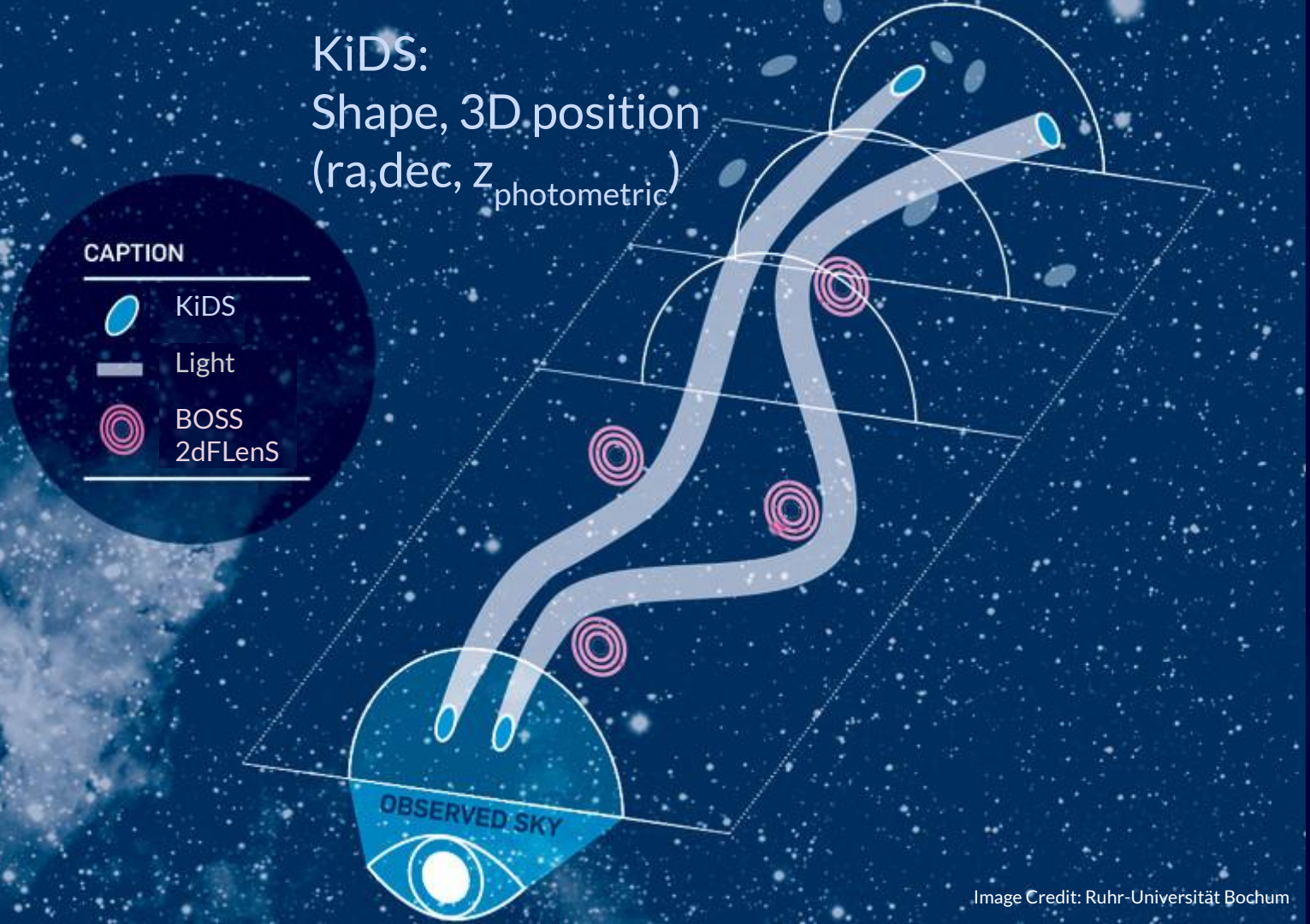
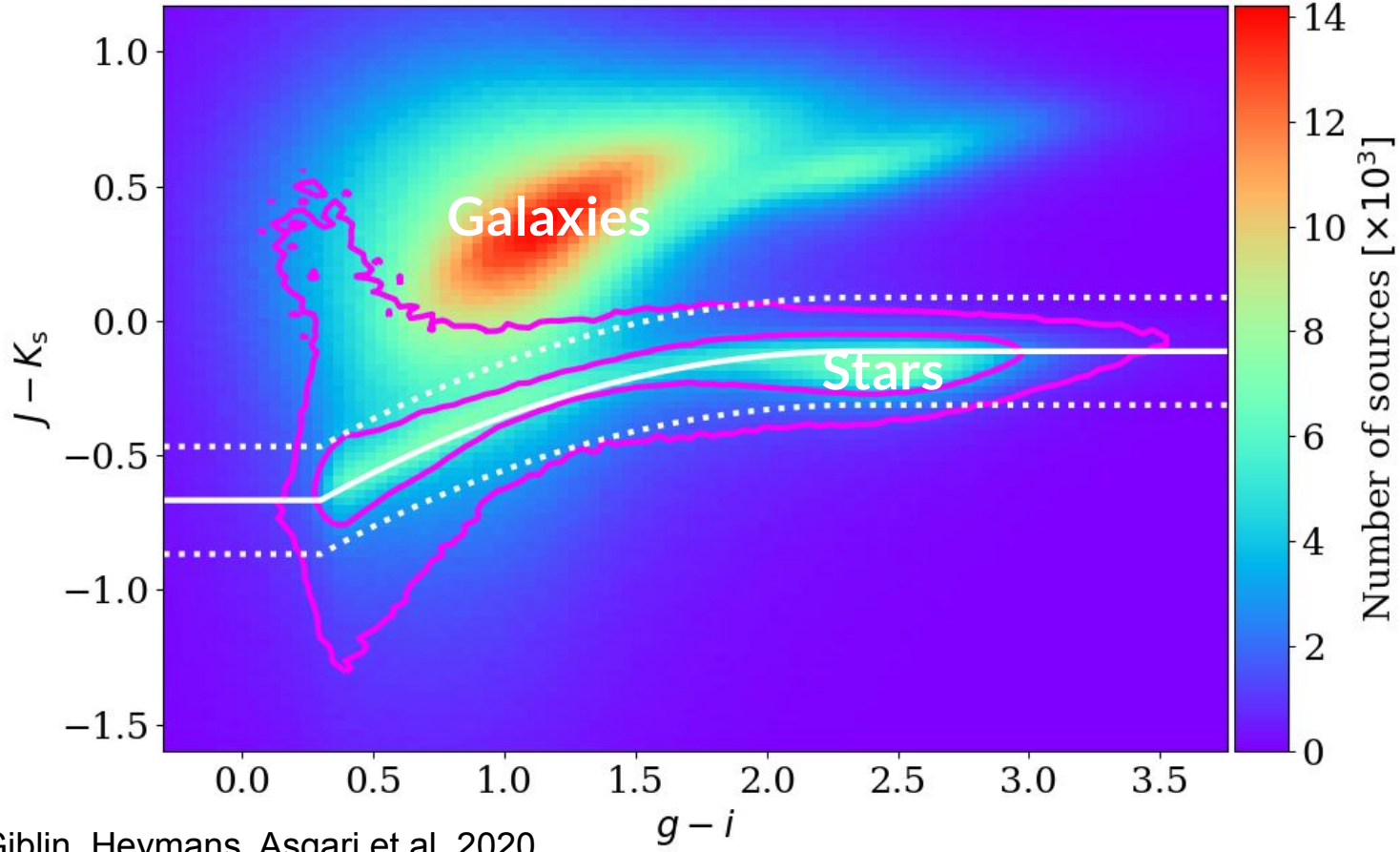


Image Credit: Ruhr-Universität Bochum

Stars for the PSF, Galaxies for the Cosmology

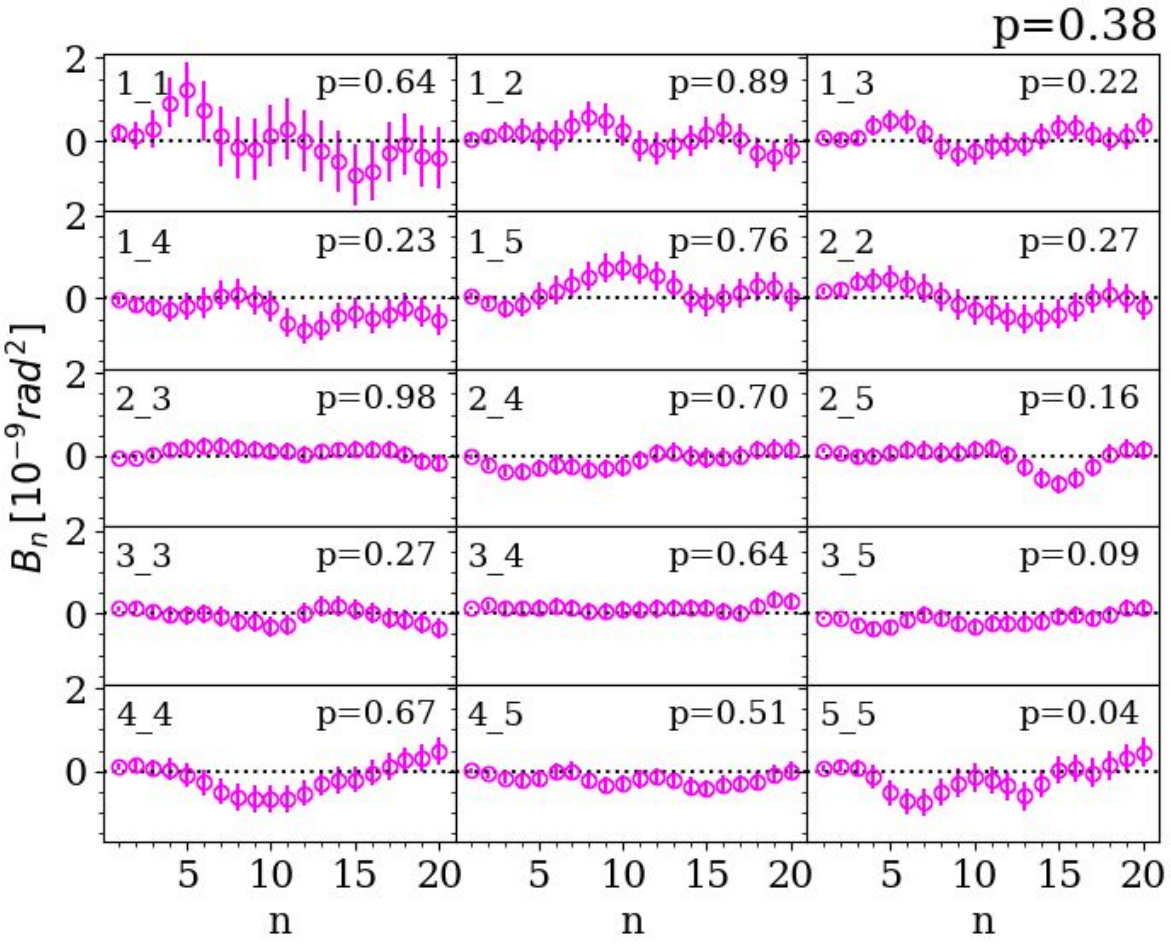


Giblin, Heymans, Asgari et al. 2020

Shear null tests

Full Seminar: https://youtu.be/r_hMWpI6xd0

- B-modes consistent with pure noise
- PSF model accuracy size/shape requirements easily met
- Instrumental defects quantified
- Shear-ratio test passed

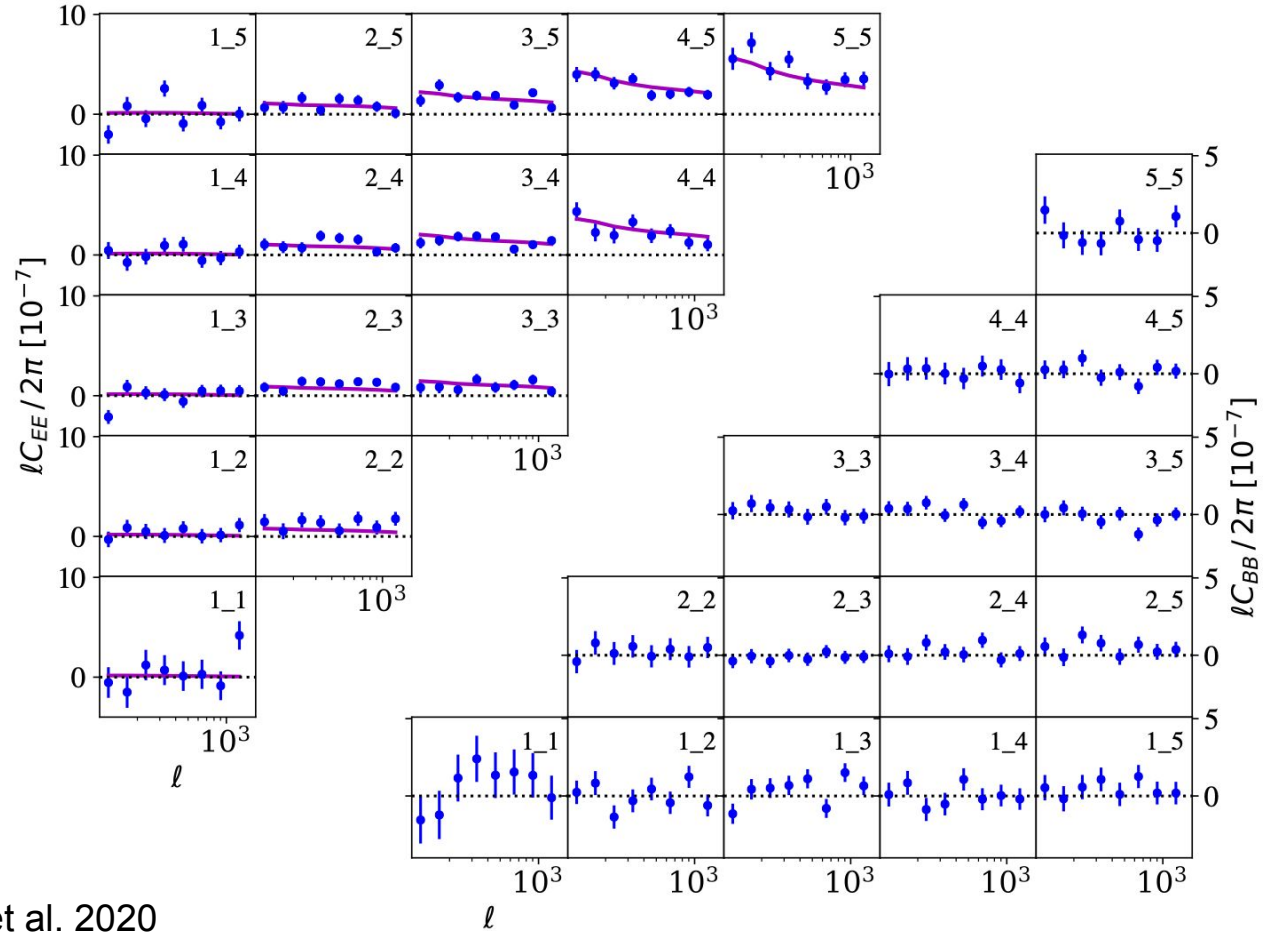


Giblin, Heymans, Asgari et al. 2020

Cosmic Shear

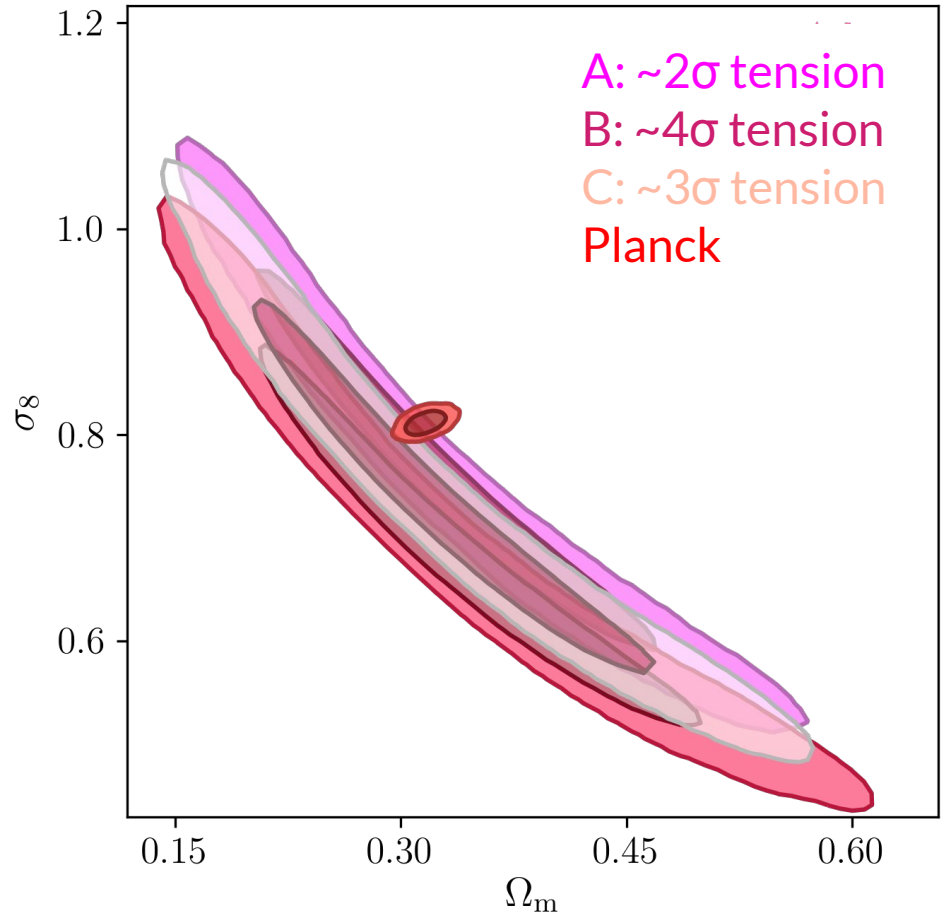
The theoretical model includes

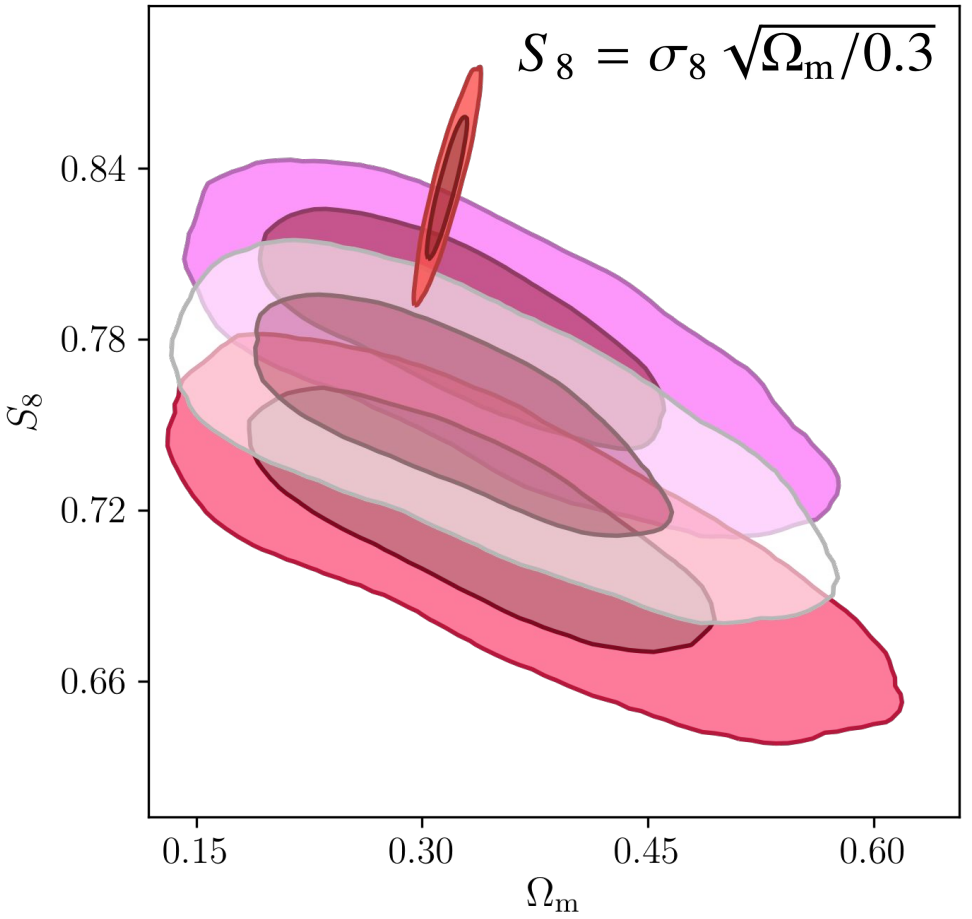
- Flat ΛCDM
- Intrinsic Galaxy Alignments
- Baryon Feedback
- Photometric Redshift Calibration Uncertainty
- Shear Calibration Uncertainty



Asgari, Lin, Joachimi et al. 2020

Blind Analysis

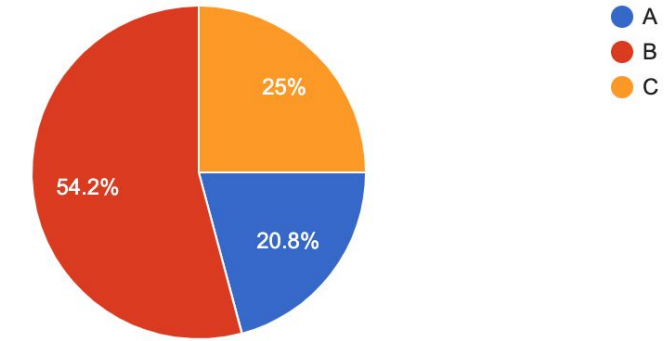




Unconscious/conscious bias!

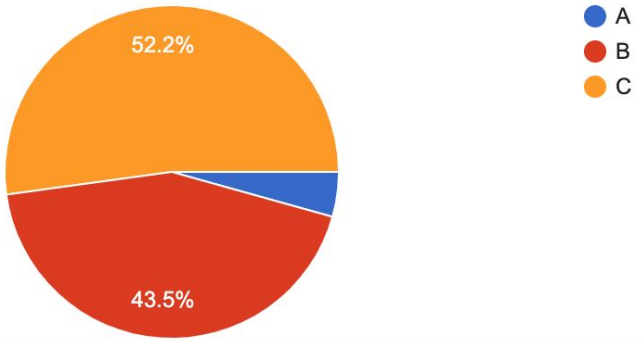
Choose the one that you would like to be the truth.

24 responses

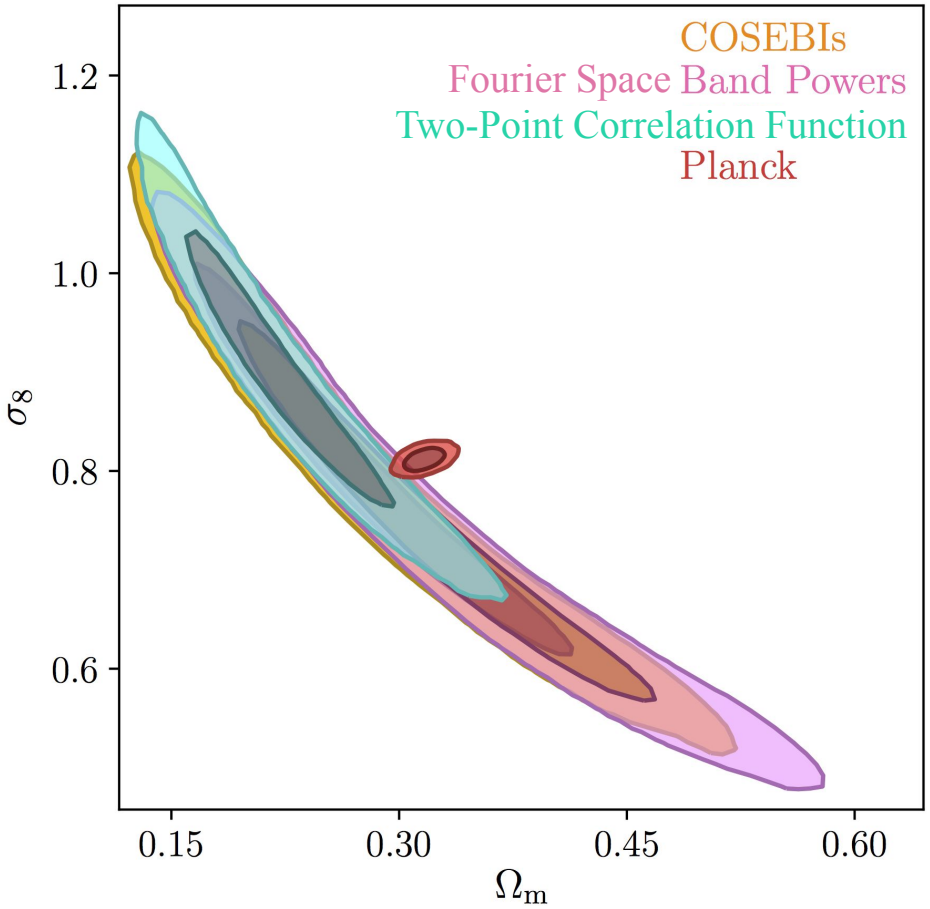


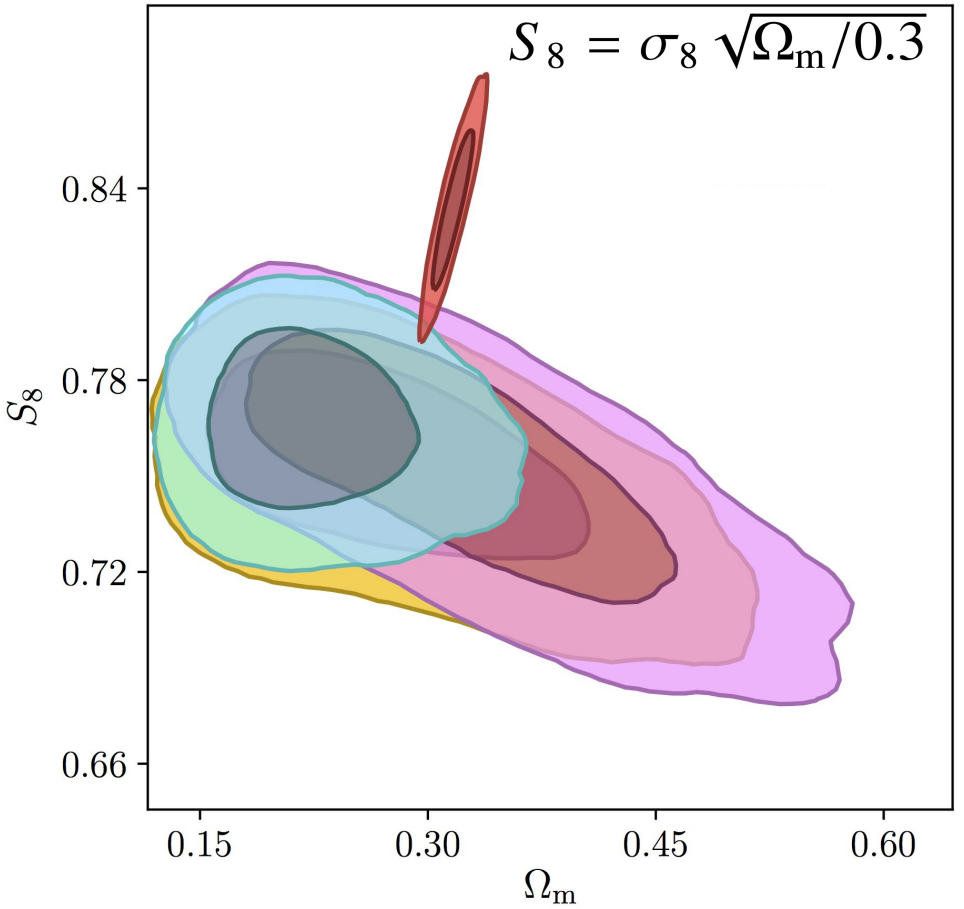
Which one do you think is the truth?

23 responses

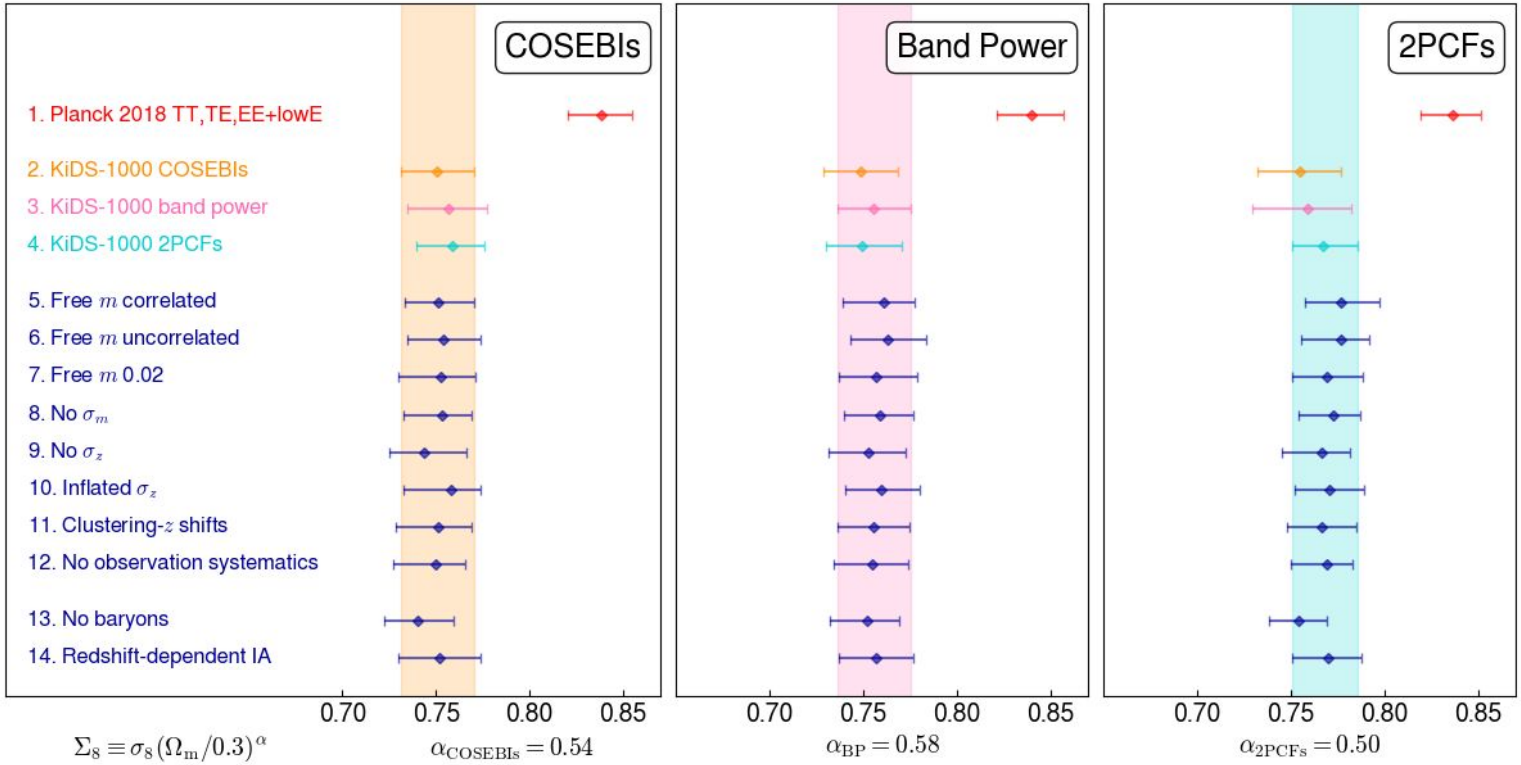


KiDS-1000 Cosmic Shear

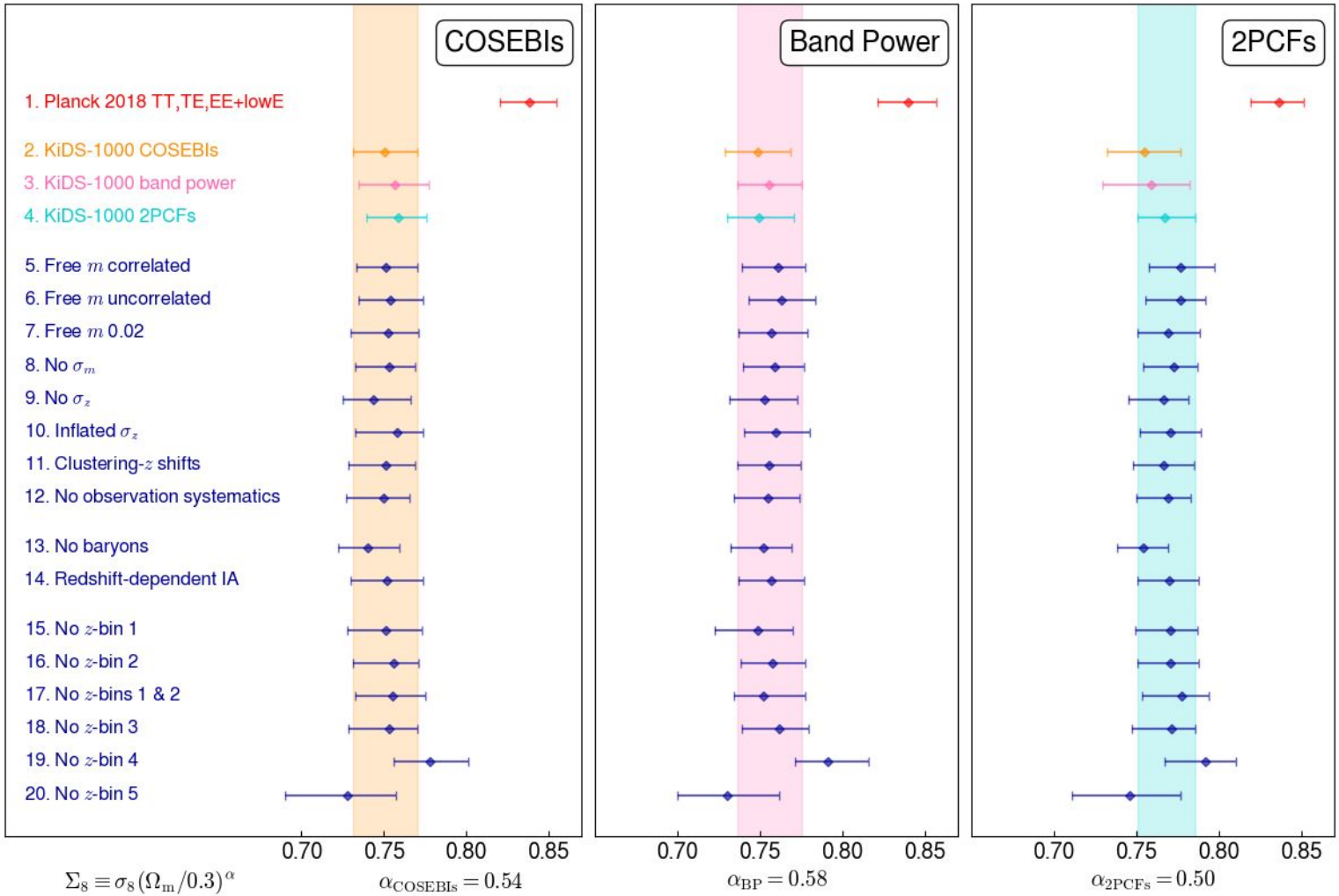




Asgari, Lin, Joachimi et al. 2020

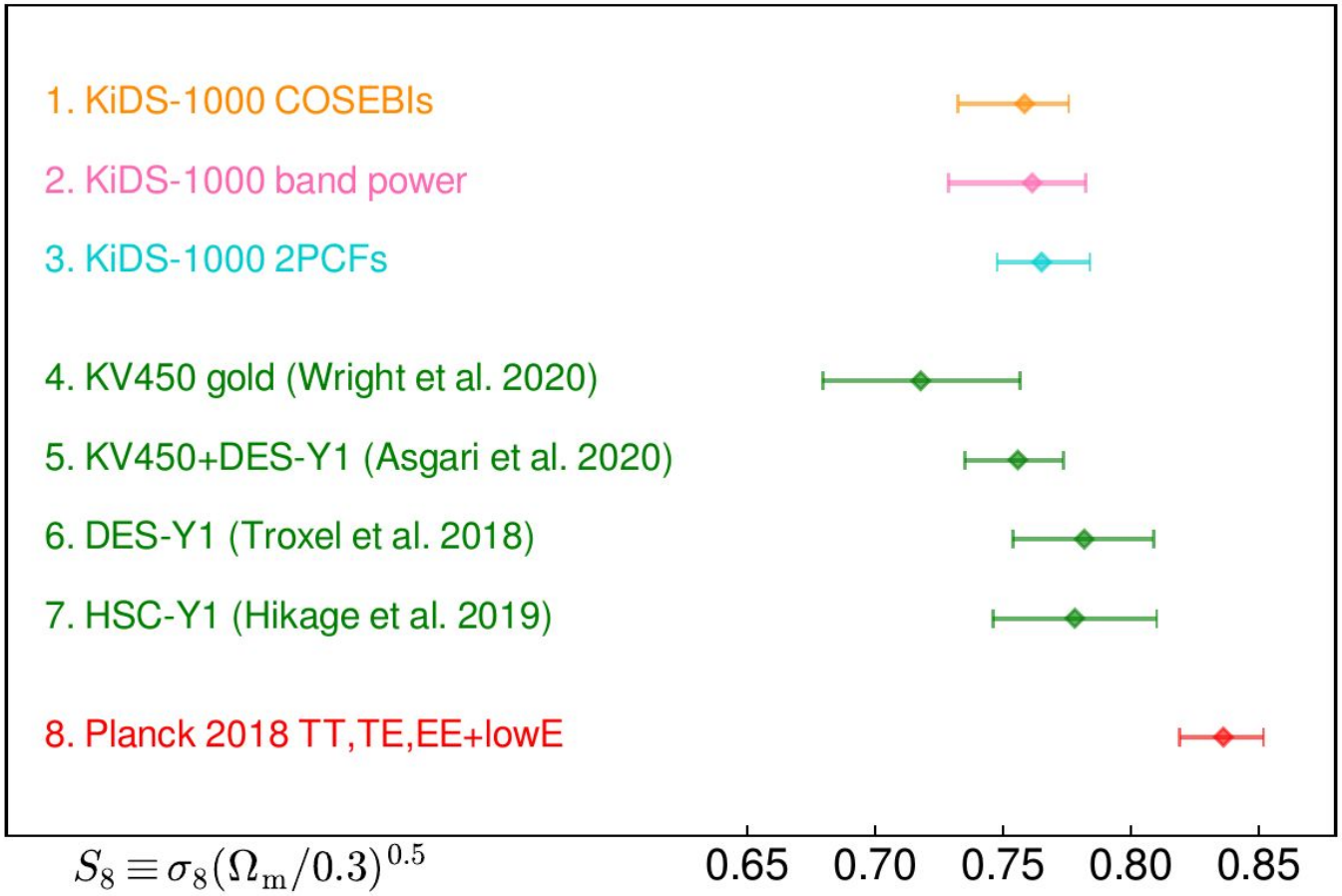


Asgari, Lin, Joachimi et al. 2020



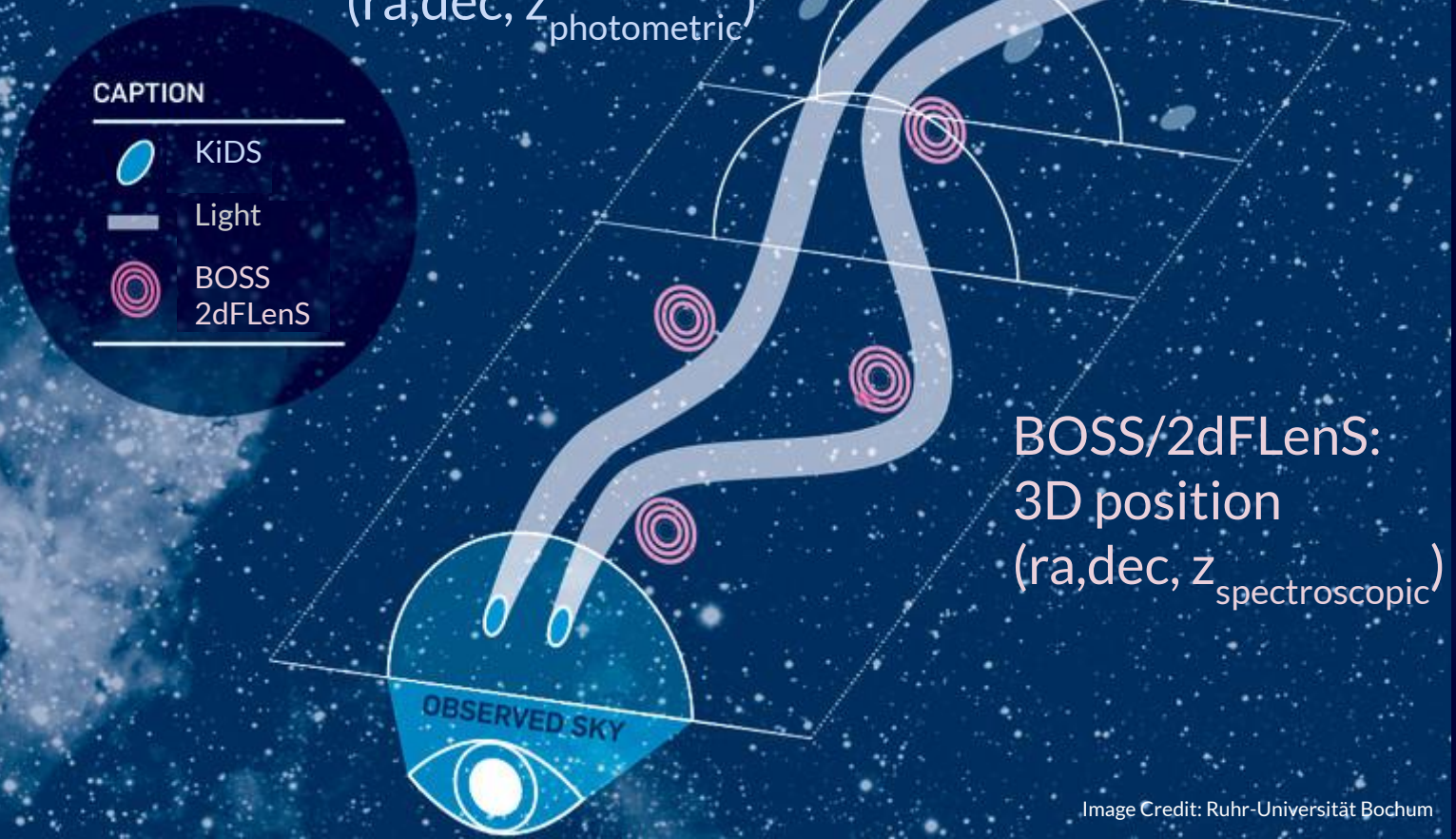
Asgari, Lin, Joachimi et al. 2020

Comparison with Planck, DES and HSC



Asgari, Lin, Joachimi et al. 2020

KiDS:
Shape, 3D position
(ra,dec, $z_{photometric}$)

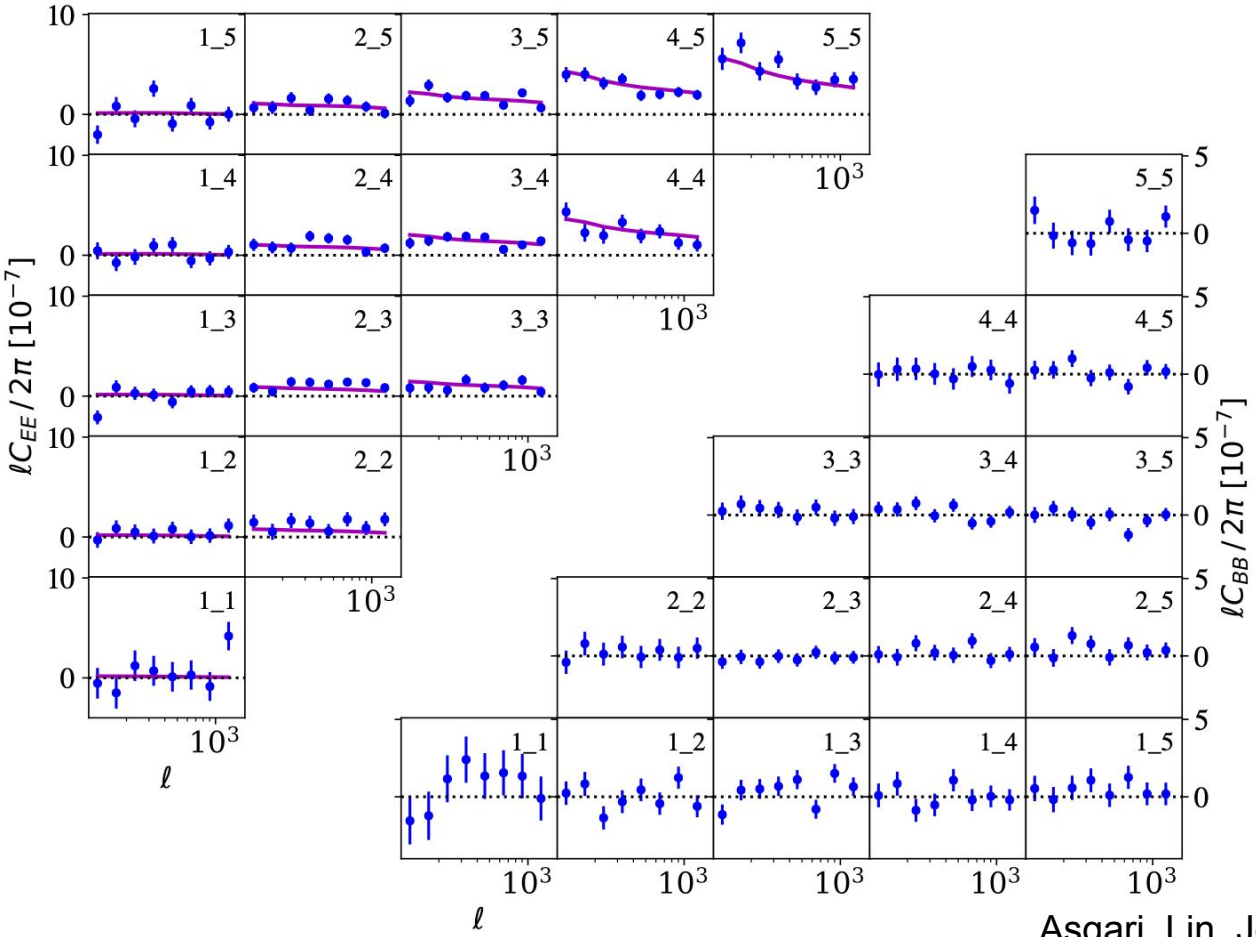


BOSS/2dFLenS:
3D position
(ra,dec, $z_{spectroscopic}$)

Image Credit: Ruhr-Universität Bochum

3x2pt: Cosmic Shear +

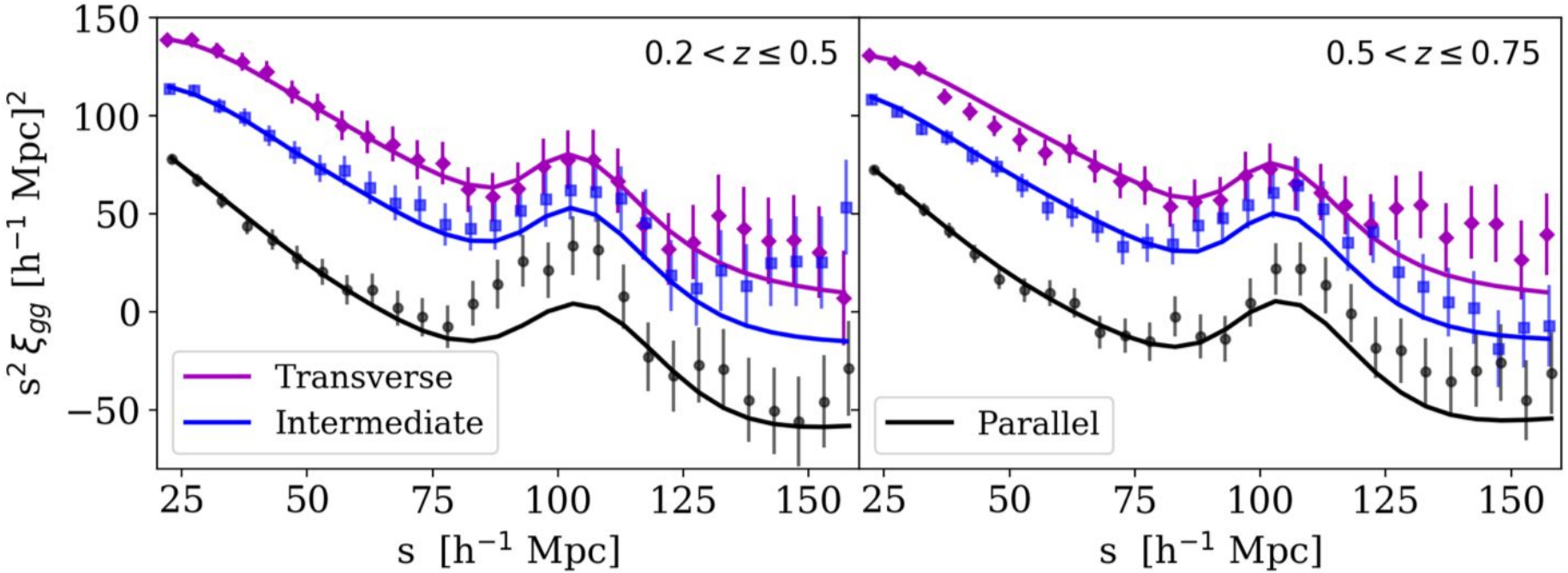
Band-Powers



Asgari, Lin, Joachimi et al. 2020

3x2pt: Cosmic Shear + Clustering +

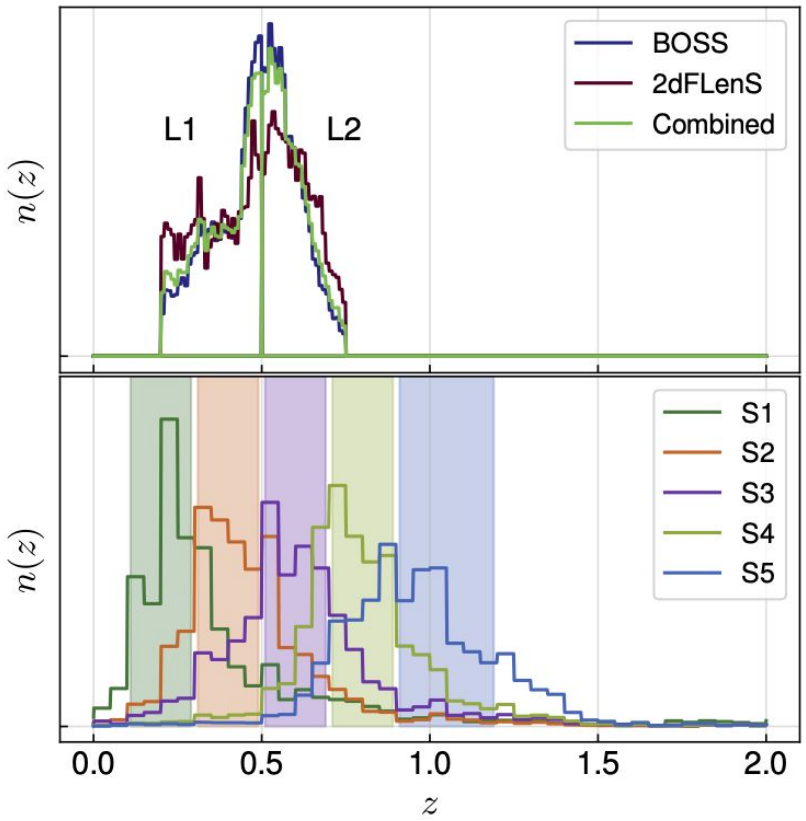
Anisotropic Galaxy Clustering: RSD + BAO



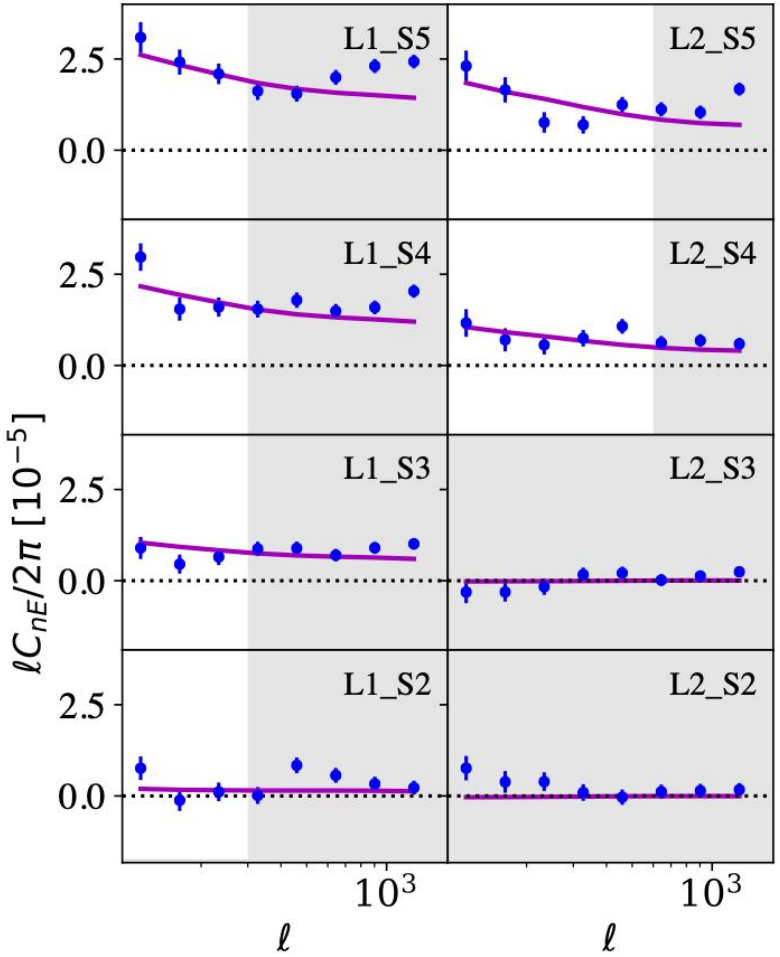
Theoretical Predictions includes fully non-linear galaxy bias model

BOSS DR12: Sanchez et al. 2017

3x2pt: Cosmic Shear + Clustering + Galaxy-Galaxy Lensing

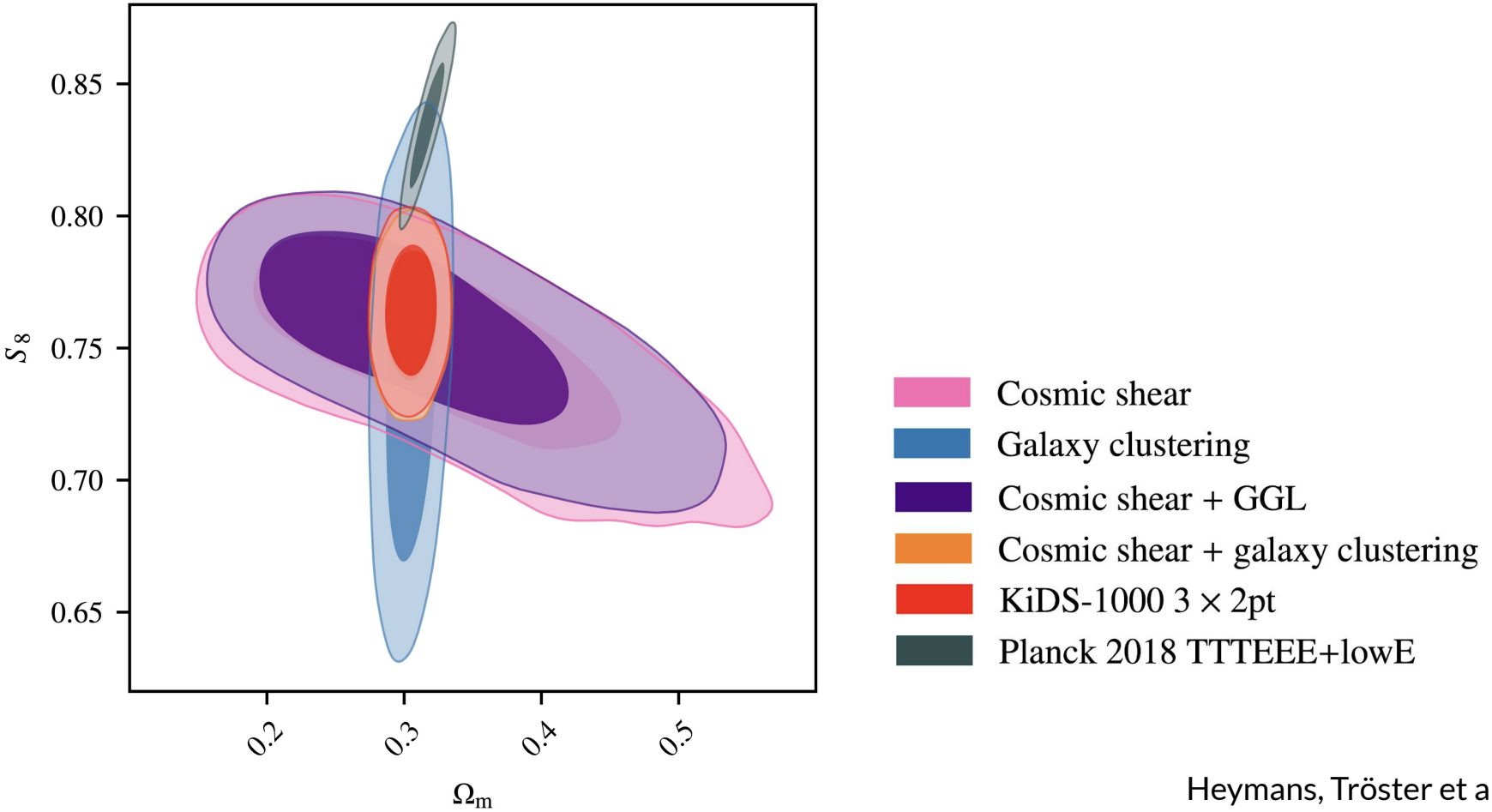


Joachimi, Lin, Asgari, Tröster, Heymans et al. 2020



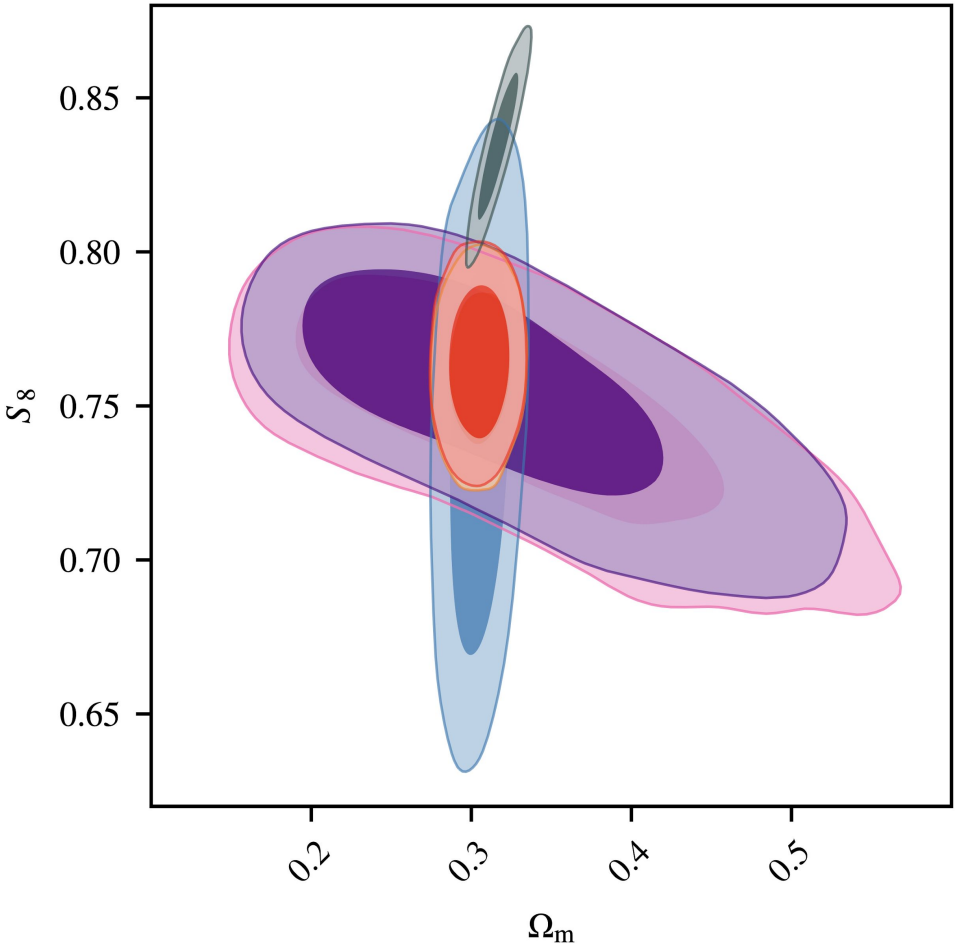
Heymans, Tröster et al. 2020

Consistency between Probes



Heymans, Tröster et al. 2020

Consistency between Probes and *Planck*



$$S_8 = \sigma_8 \sqrt{\Omega_m/0.3} = 0.766^{+0.020}_{-0.014}$$

KiDS-3x2pt and *Planck* differ in S_8 with a significance of 3.1σ

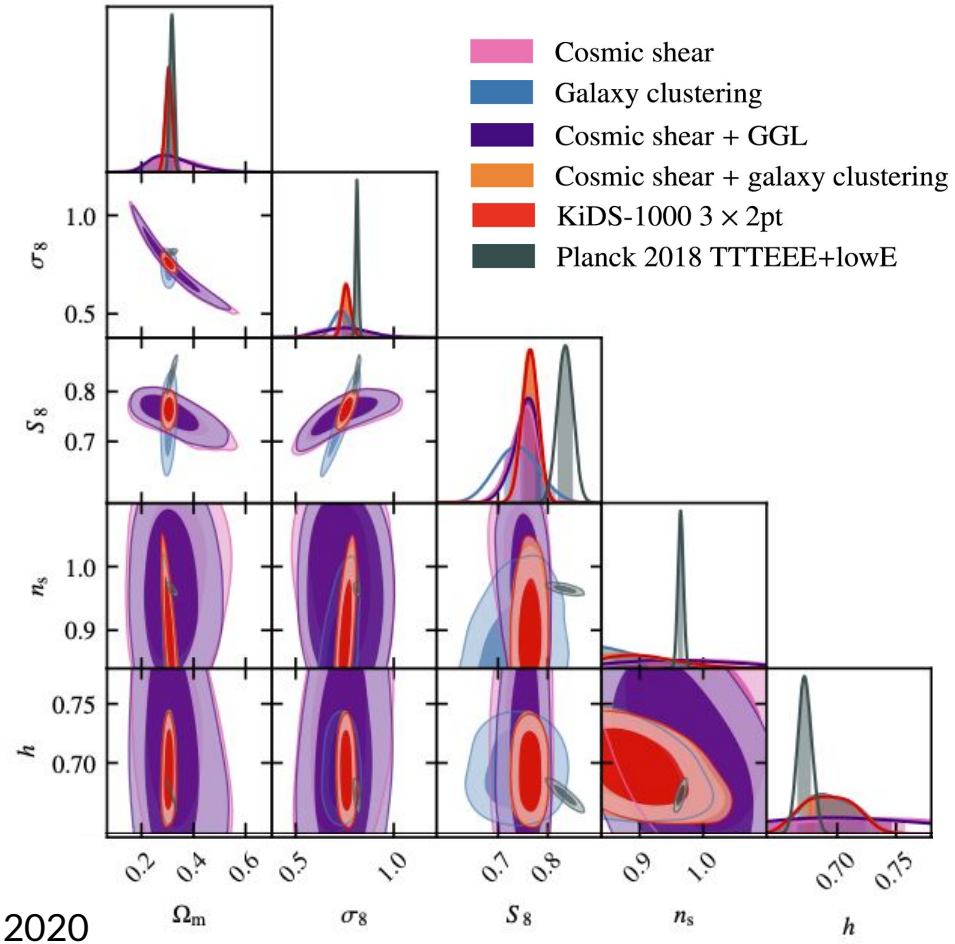
- Cosmic shear
- Galaxy clustering
- Cosmic shear + GGL
- Cosmic shear + galaxy clustering
- KiDS-1000 3 × 2pt
- Planck 2018 TTTEEE+lowE

Heymans, Tröster et al. 2020

KiDS-*Planck* Tension Metrics

Quantifying S_8 only leads to a ~ 3.1σ tension.

Including additional parameters, which KiDS is mainly insensitive to, dilutes the overall tension to the ~ 2σ level.

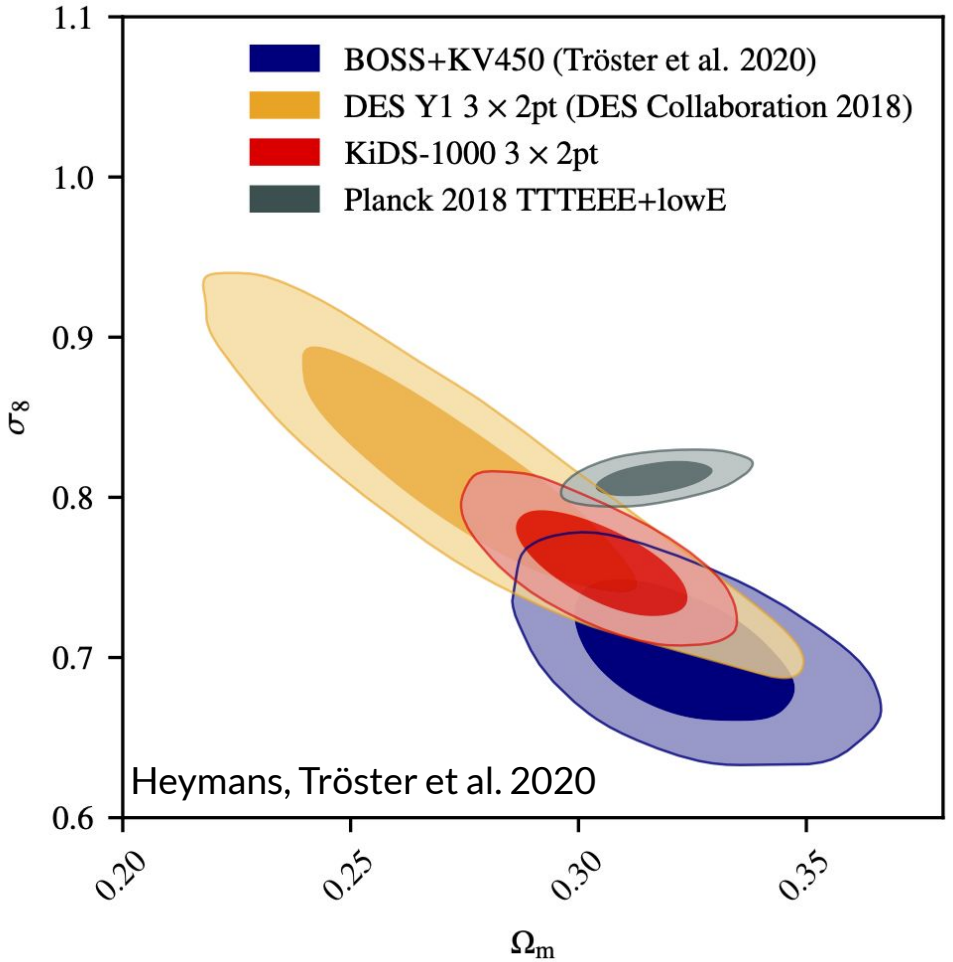


Heymans, Tröster et al. 2020

Summary

$$S_8 = \sigma_8 \sqrt{\Omega_m/0.3} = 0.766^{+0.020}_{-0.014}$$

- ~3σ "Tension" in S_8 is driven by differences in σ_8. The Universe is less "clumpy" than *Planck* predicts.
- This result is validated using
  - mock KiDS and BOSS galaxy surveys
  - KiDS image simulations and null-tests
  - spectroscopic-photometric clustering analysis
  - All identified systematic uncertainties folded through as nuisance parameters



Summary

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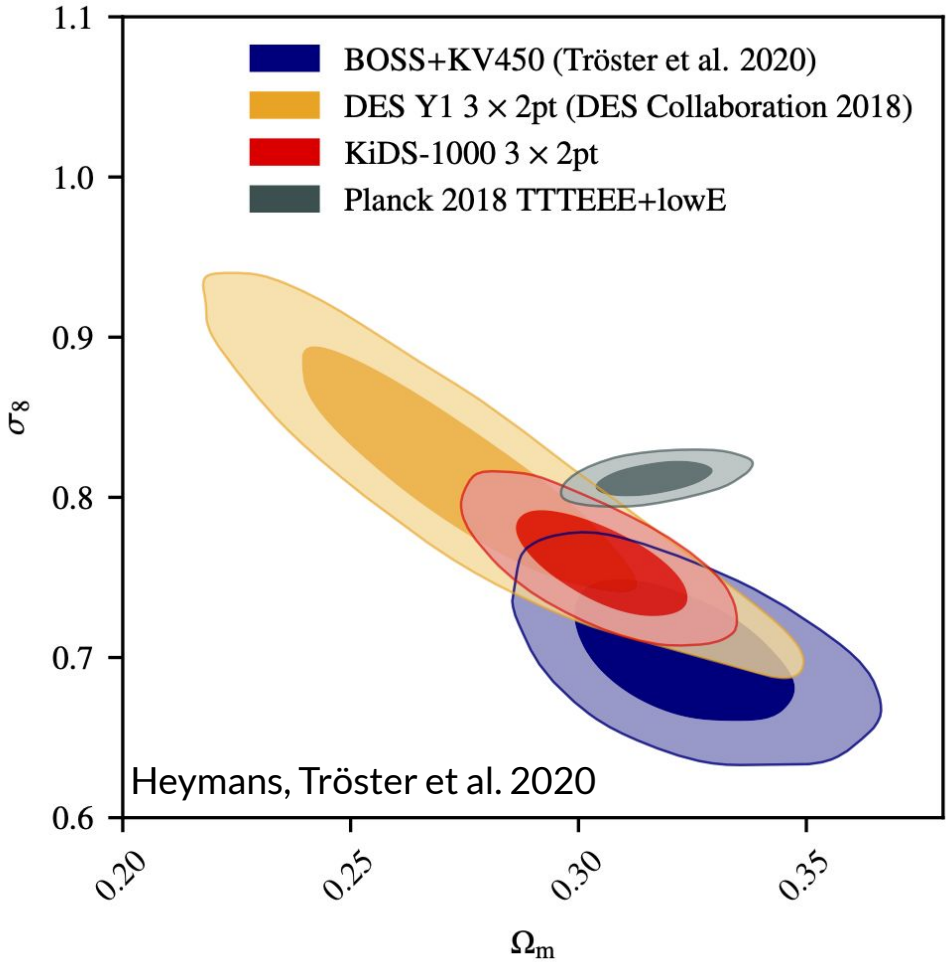
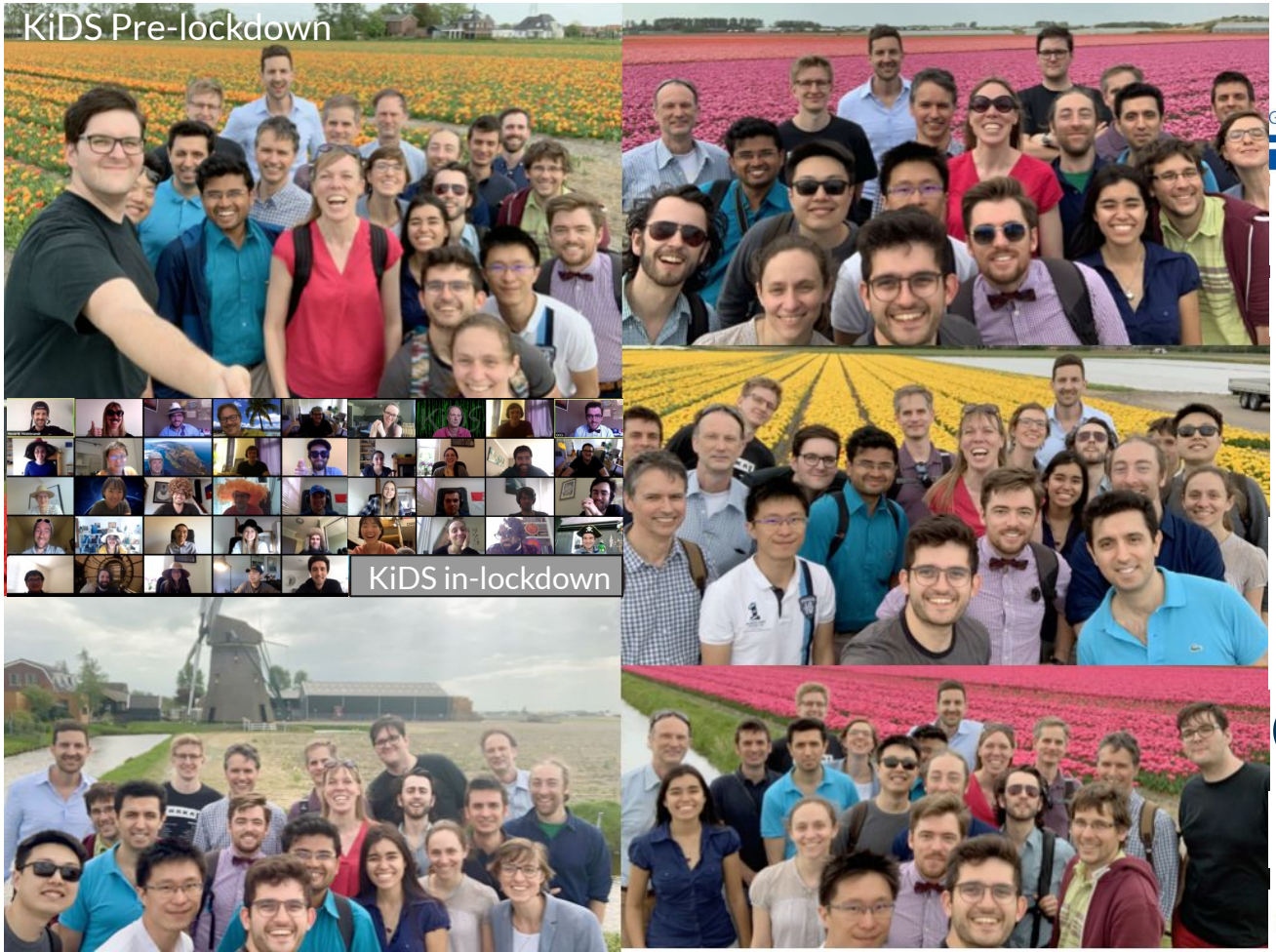


Thanks to KiDS and all our funders



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国家自然科学基金委员会 National Natural Science Foundation of China

Looking forward to your questions!

Image Credit: Giblin, Kuijken and the KiDS team. Original Background Credit: ESO/Beletsky