LAM
LABORATOIRE D'ASTROPHYSIQUE DE MARSEILLE

GECO

Results of KiDS

Nicolas Martinet (Postdoc @ LAM)
On behalf of the KiDS collaboration

Colloque National Dark Energy
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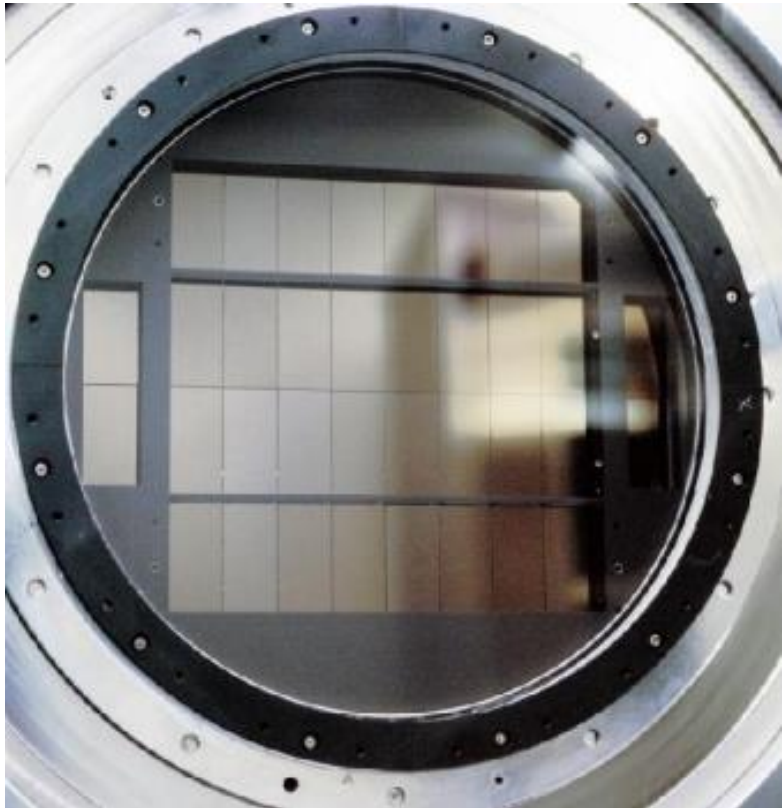
cnes
CENTRE NATIONAL D'ÉTUDES SPATIALES

KiDS

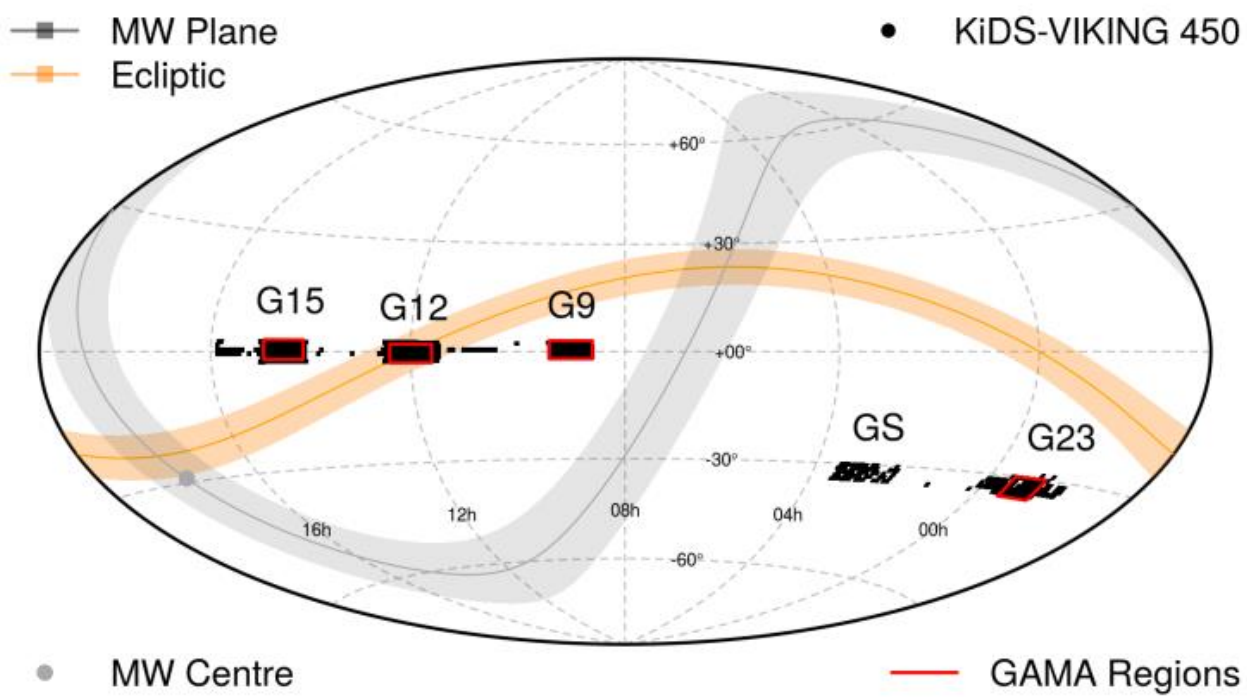


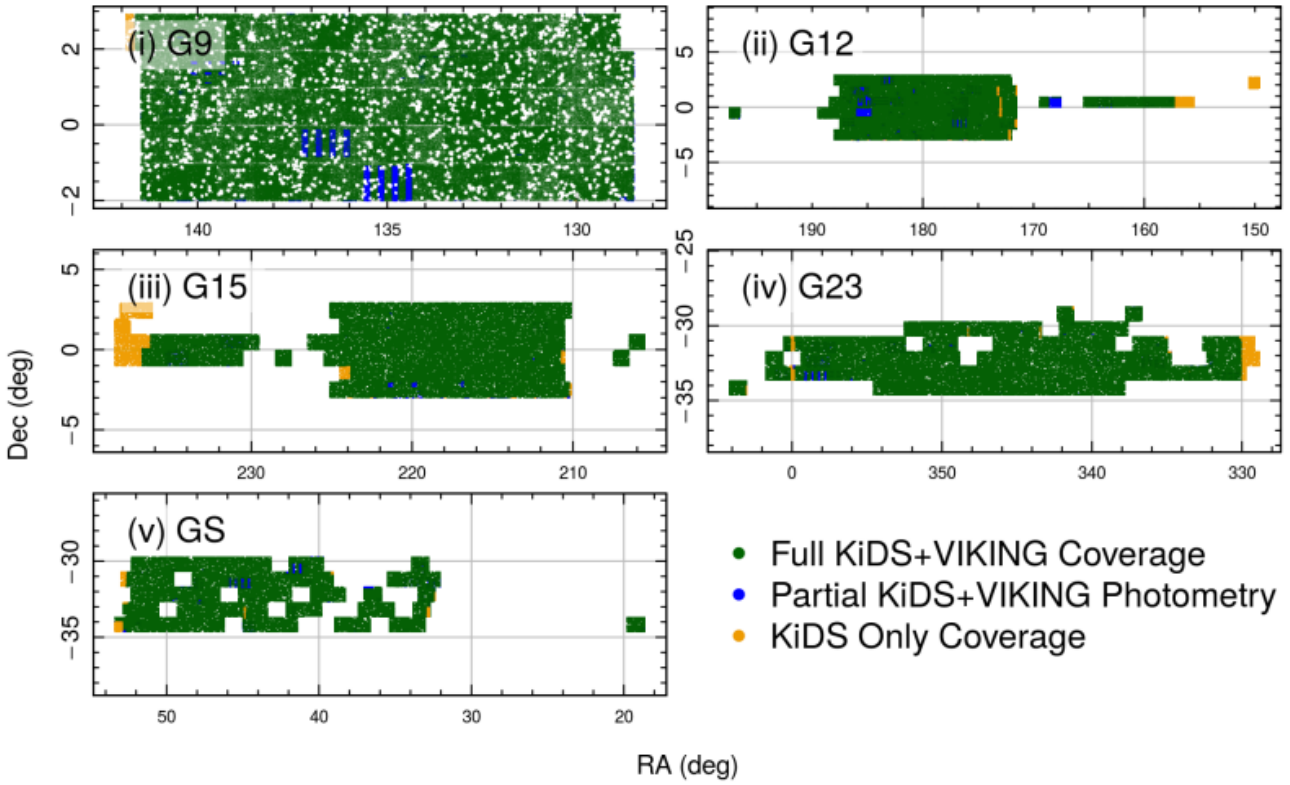
Stage III cosmic shear surveys

	KiDS+VIKING	HSC	DES
Mirror [m]	2.6 + 3.9	**8.2**	4.0
Focus (optical)	**Cassegrain**+Prime	Prime	Prime
FOV [deg²]	1.0	1.8	**3.0**
Area [deg²]	1350	1400	**5000**
Filters	***u****gri*+*ZY****JHKs***	*grizy*	*griz(y)*
Seeing [arcsec]	**0.7**	**0.6**	0.9
Source density [gal/arcmin²]	~9	**~22**	~7
Depth	***r*~24**	*i*~24.5	***r*~23.5**

Courtesy Hendrik Hildebrandt

KiDS footprint (from Wright et al. 2019)

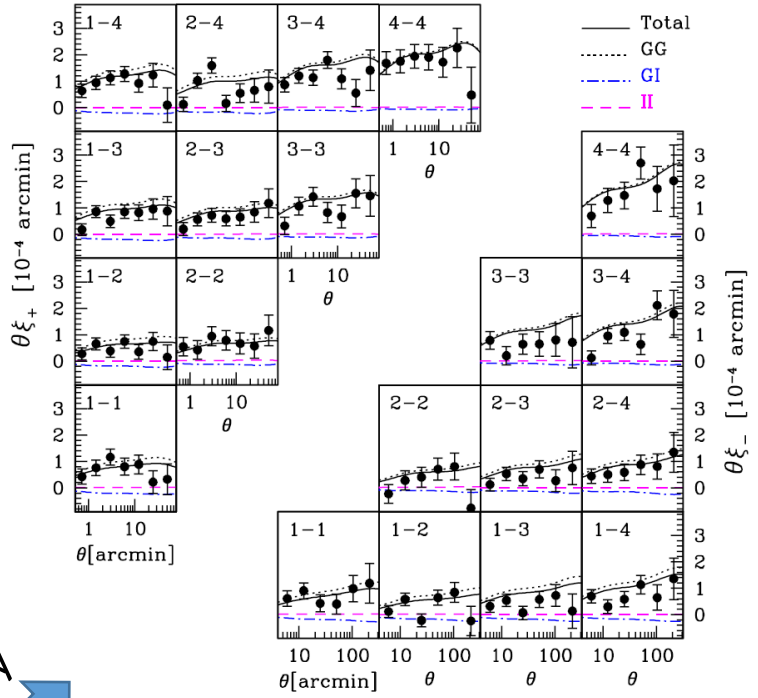




Cosmic shear

Estimator: shear 2PCF

$$\hat{\xi}^{ij}_{\pm}(\theta) = \frac{\sum_{ab} w_a w_b \left[\epsilon^i_t(\vec{x}_a)\epsilon^j_t(\vec{x}_b) \pm \epsilon^i_\times(\vec{x}_a)\epsilon^j_\times(\vec{x}_b)\right]}{\sum_{ab} w_a w_b}$$



Systematic biases

- Shear calibration (m, c)
- Mean redshift (Δz)
- Intrinsic alignment (A_{IA})
- Baryons (B)

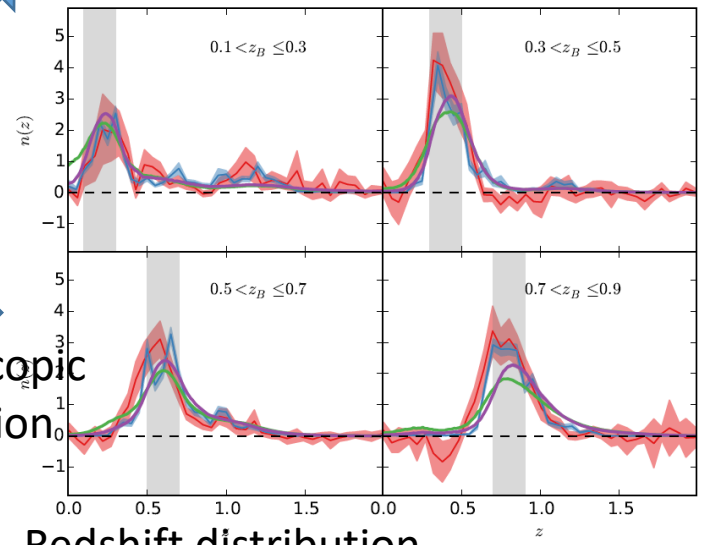
Ellipticities (ε_1, ε_2)

Observations

Tomography

Redshifts (z)

Spectroscopic calibration



Redshift distribution

Cosmological parameters (e.g. Ω_m, σ_8)

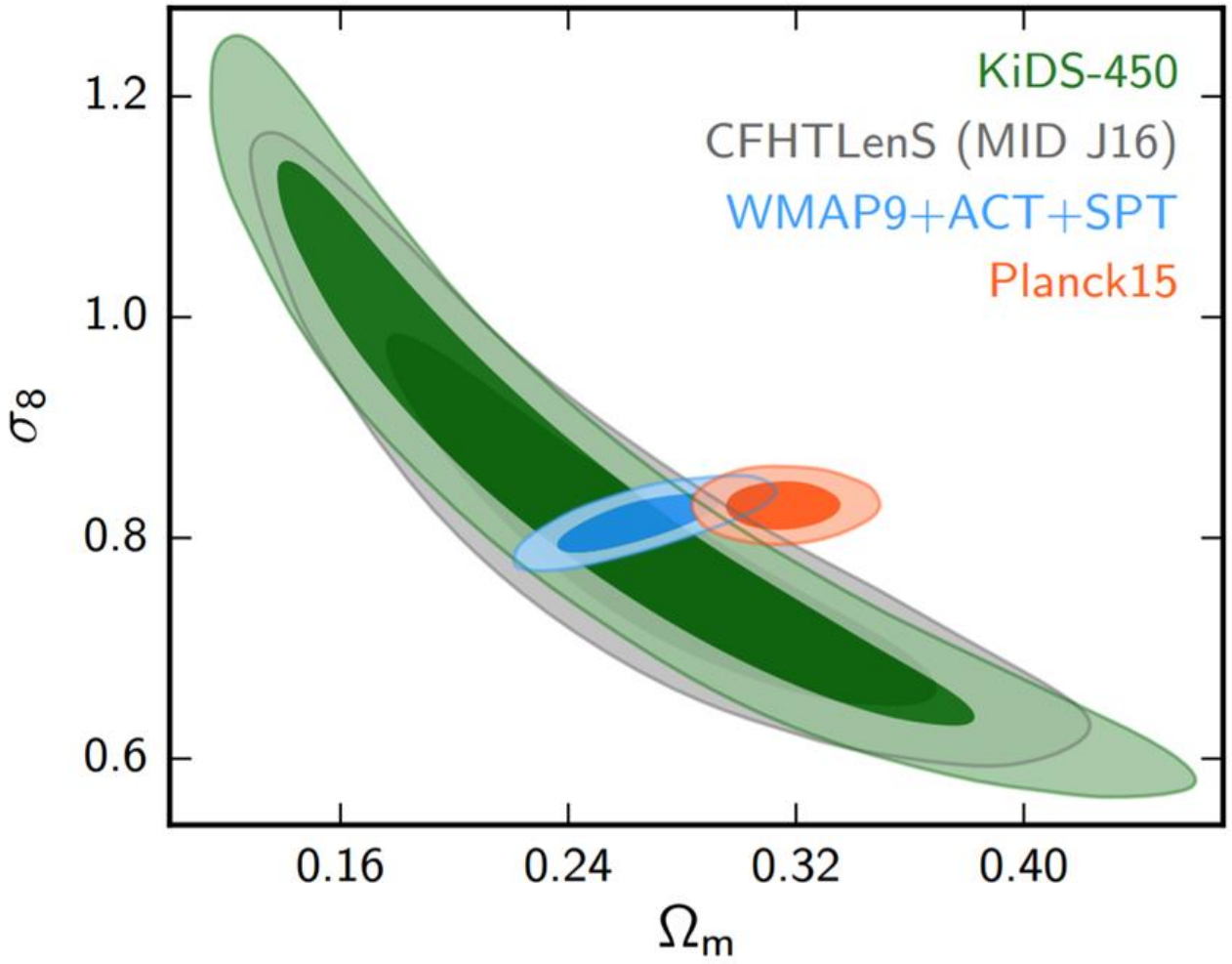
Theoretical prediction

$$\xi^{ij}_{\pm}(\theta) = \frac{1}{2\pi}\int \mathrm{d}\ell\, \ell\, P^{ij}_{\kappa}(\ell)\, J_{0,4}(\ell\theta)$$

$$P^{ij}_{\kappa}(\ell) = \int_0^{\chi_H} \mathrm{d}\chi\, \frac{q_i(\chi) q_j(\chi)}{[f_K(\chi)]^2}\, P_\delta\left(\frac{\ell}{f_K(\chi)}, \chi\right)$$

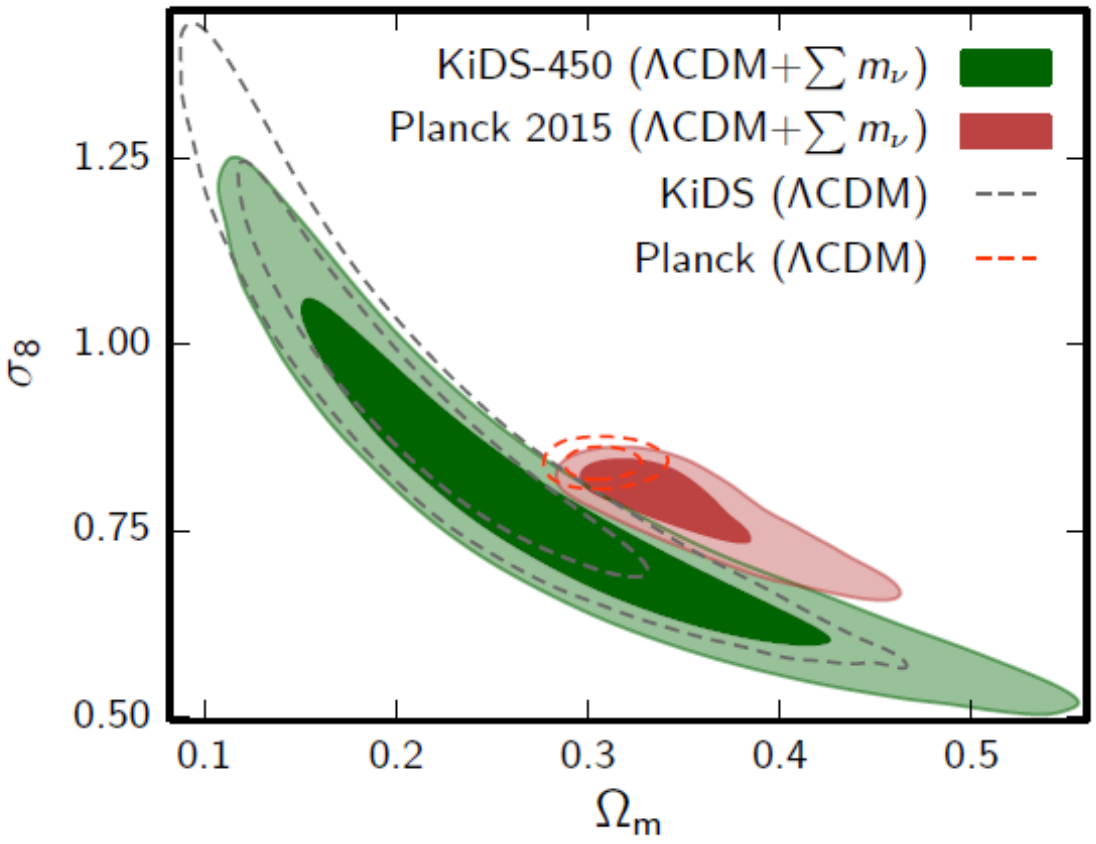
$$q_i(\chi) = \frac{3H_0^2\Omega_m}{2c^2}\frac{f_K(\chi)}{a(\chi)}\int_\chi^{\chi_H} \mathrm{d}\chi'\, n_i(\chi')\frac{f_K(\chi'-\chi)}{f_K(\chi')}$$

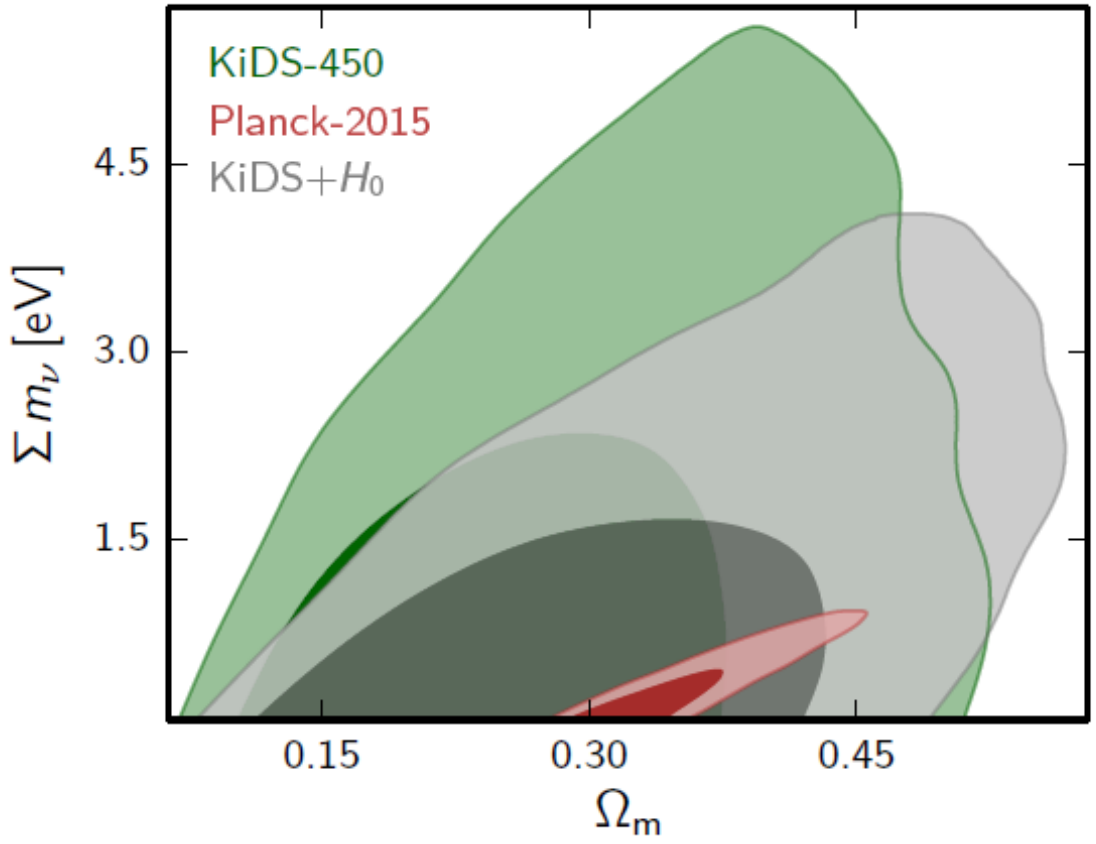
KiDS-450 constraints (Hildebrandt et al. 2017)



- First 450 deg^2, *ugri* filters
- 2.3σ tension with Planck
- Possible explanations:
  - Low statistics
  - Systematic biases in KiDS
  - Systematic biases in Planck
  - New physics
- No tension for DES or HSC

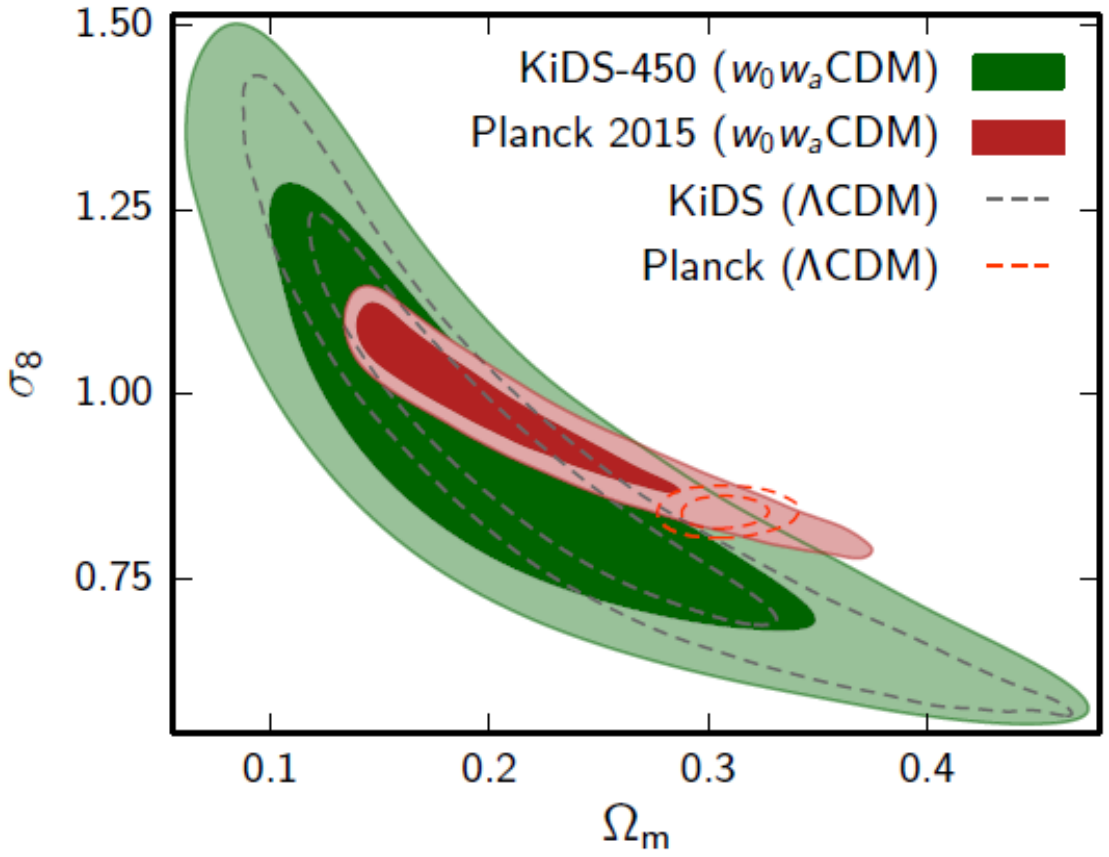
Beyond ΛCDM: Neutrinos (Joudaki et al. 2017)

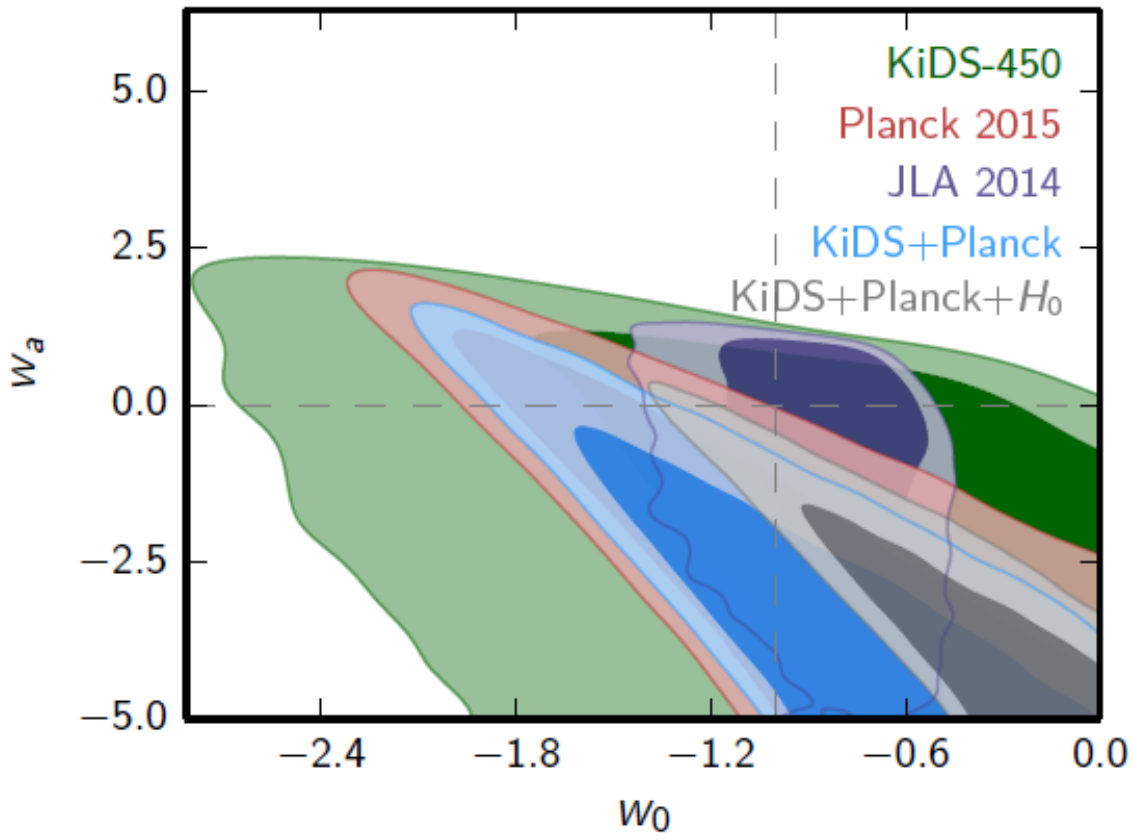




- Massive neutrinos cannot solve the tension

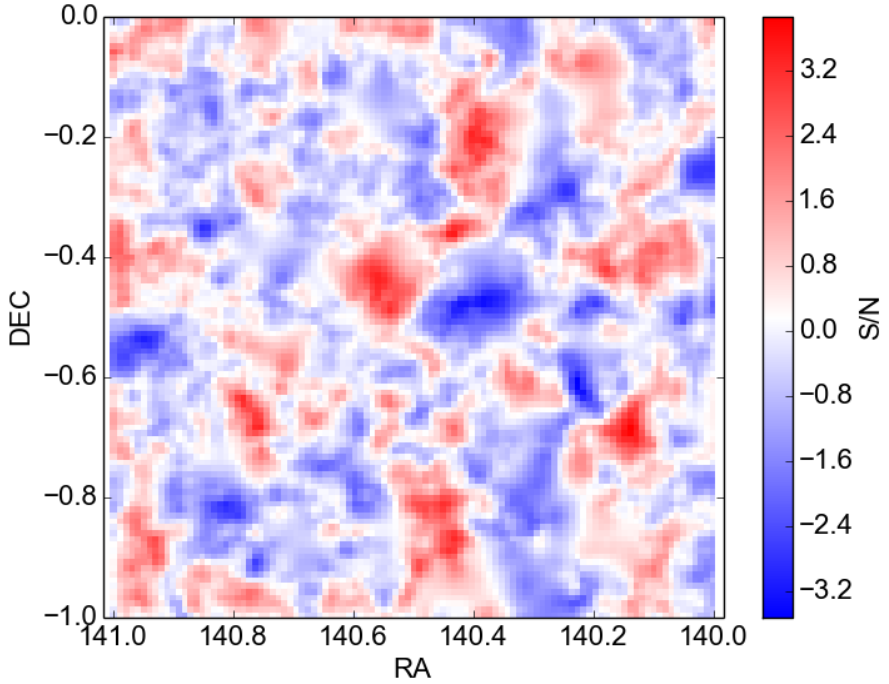
Beyond ΛCDM: Dark Energy (Joudaki et al. 2017)

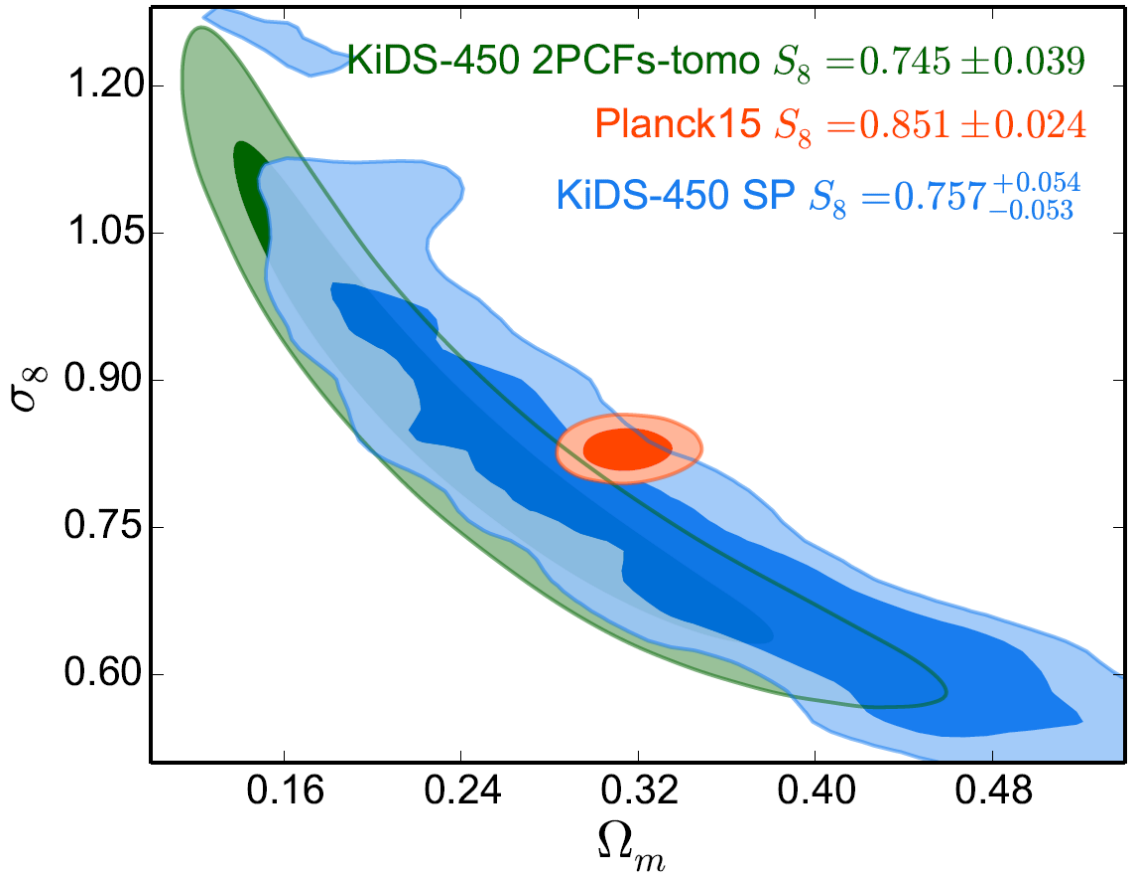




- Evolving DE can solve the tension

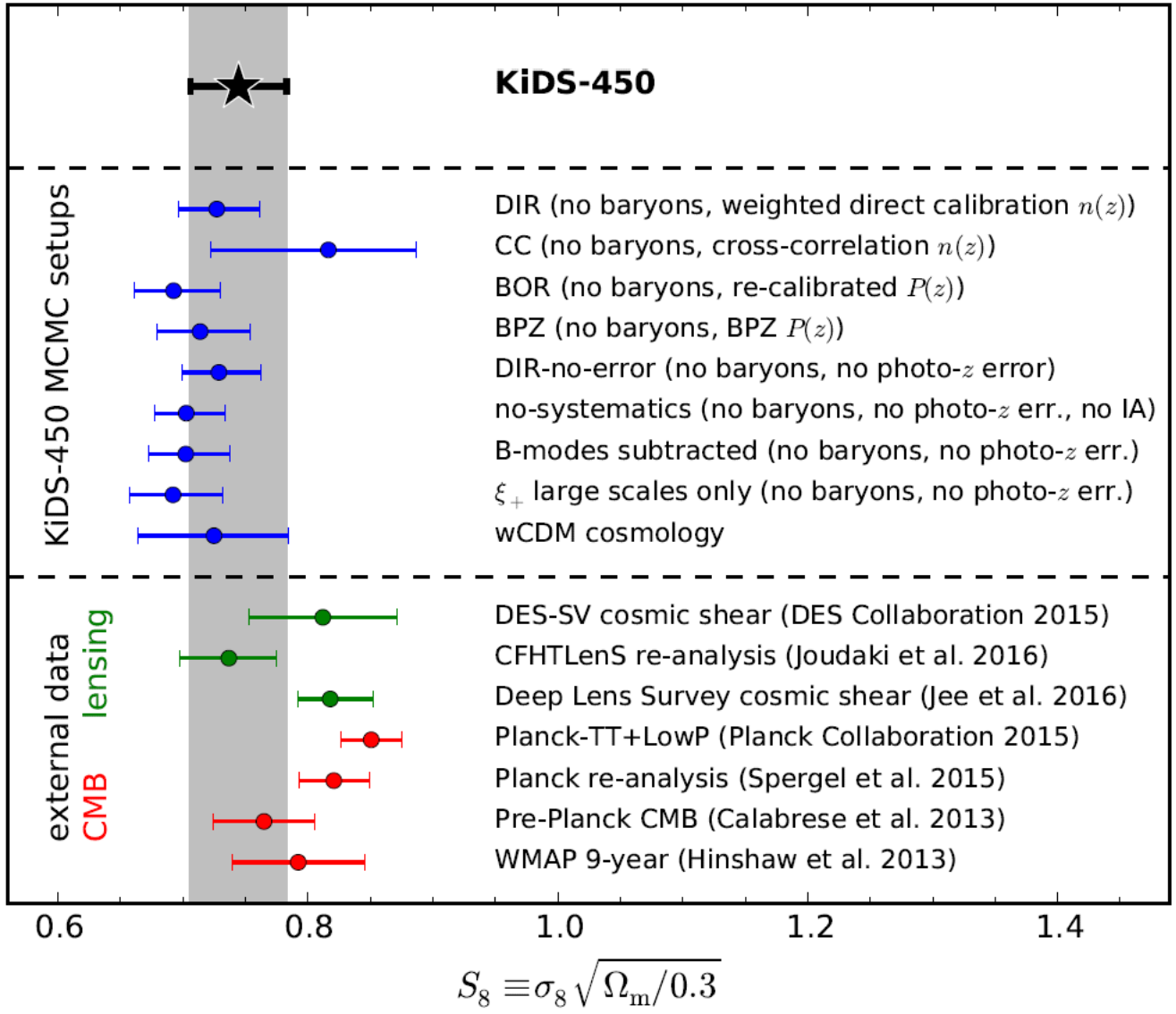
Improving statistics with mass map peaks (Martinet et al. 2018)





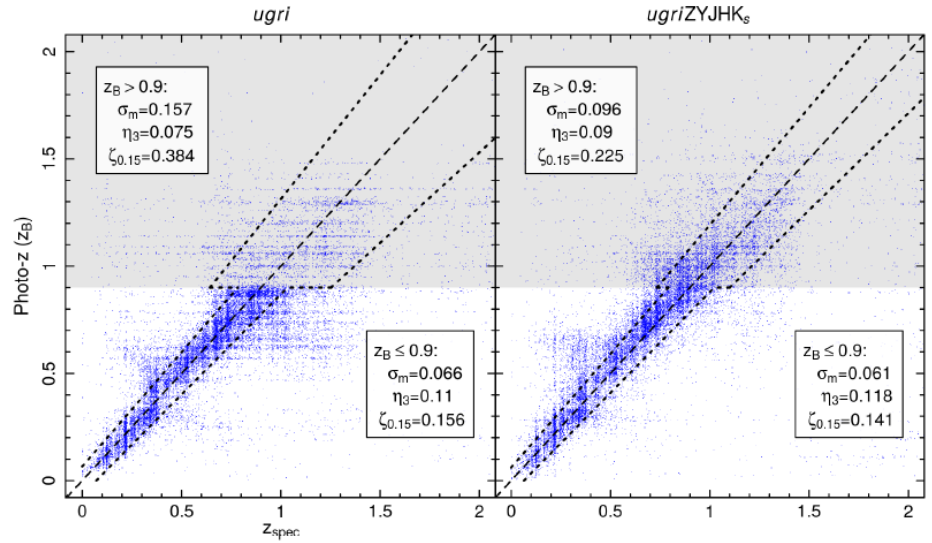
- Peak amplitude distribution = higher-order weak-lensing statistics
- Peaks + 2PCF improve constraints by 20%
- Knowledge of peak systematic biases not yet sufficient to perform the full combination (but stay tuned….)

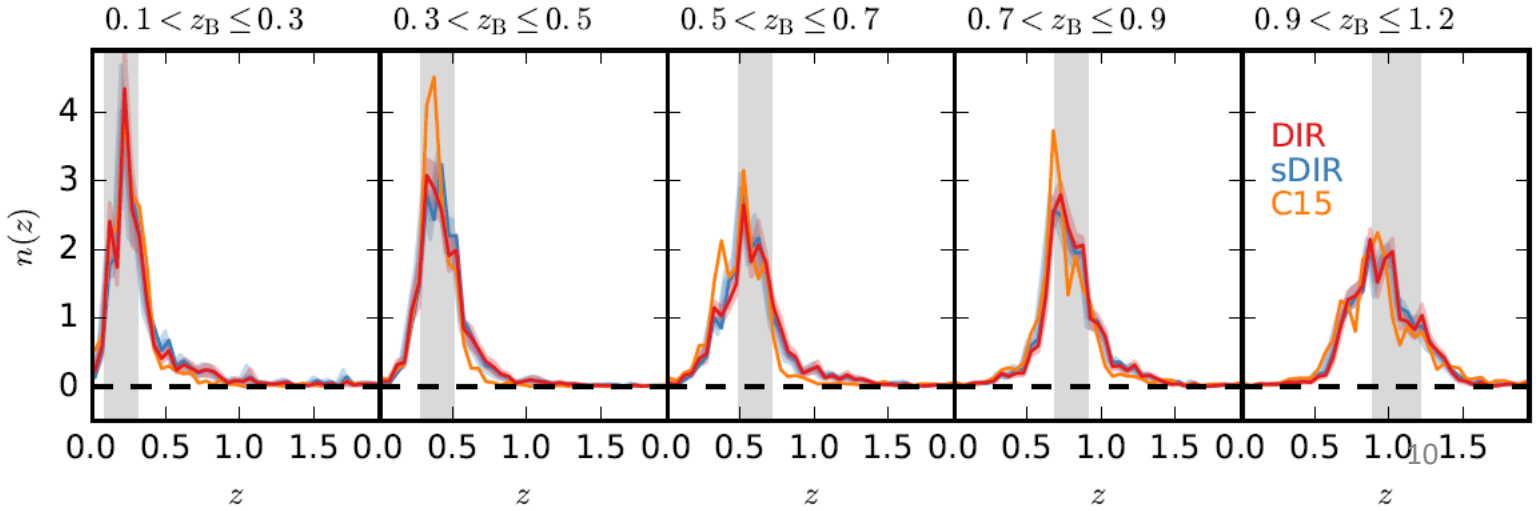
Weak lensing systematics (Hildebrandt et al. 2017)



Improving the redshift distribution (Hildebrandt et al. 2019, Wright et al. 2019)

- Add IR VIKING data to KiDS
- Improves high-z estimates
- One additional tomographic bin





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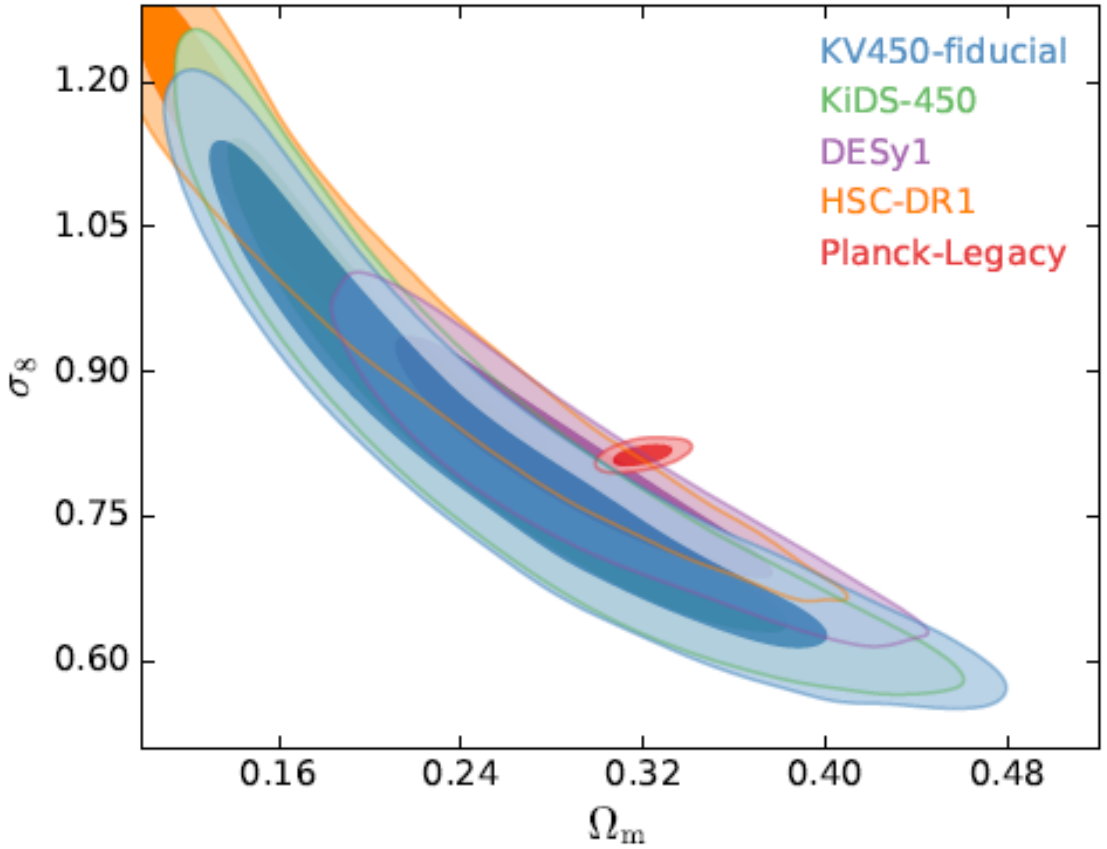
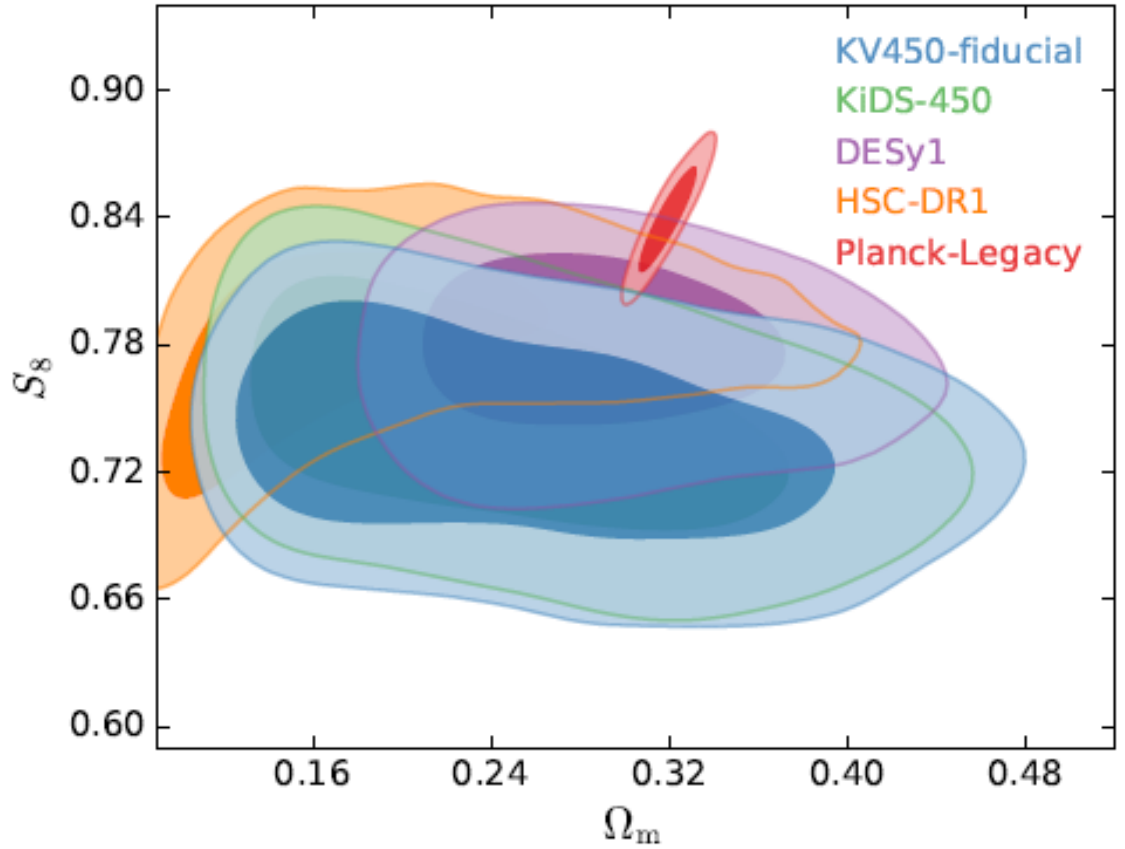
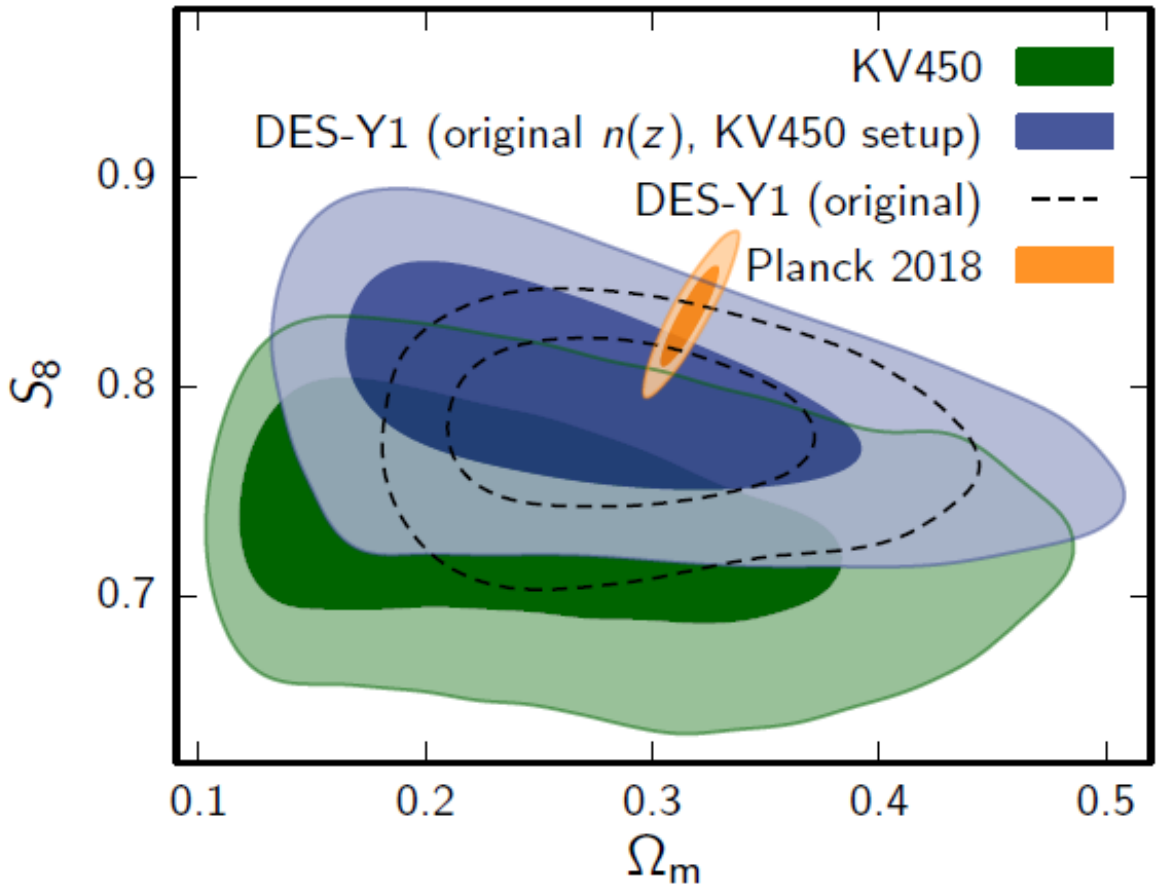




- KV450 (KiDS+VIKING) consistent with K450 (KiDS only) results

Re-analysis of DES with KiDS setup (Joudaki et al. 2019)

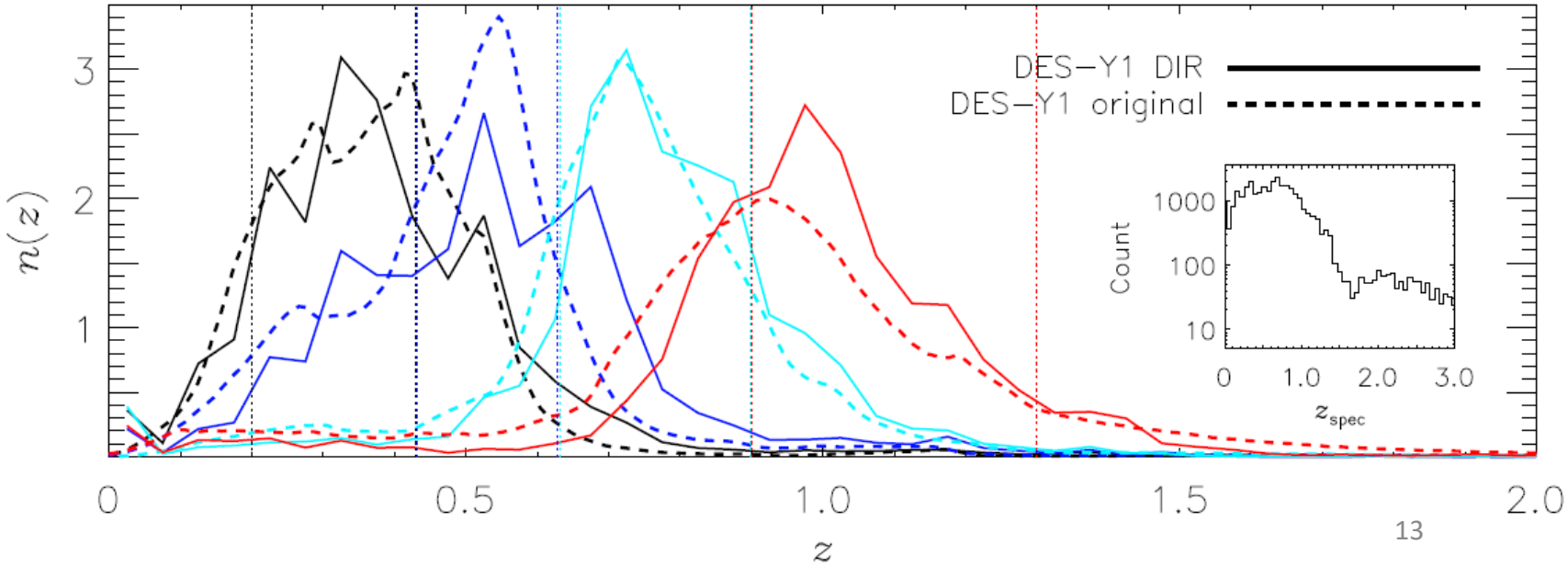
- Only difference left:
- DES n(z) based on COSMOS photoz calibration
- KiDS n(z) based on spectroscopic calibration



Re-analysis of DES with KiDS setup (Joudaki et al. 2019)

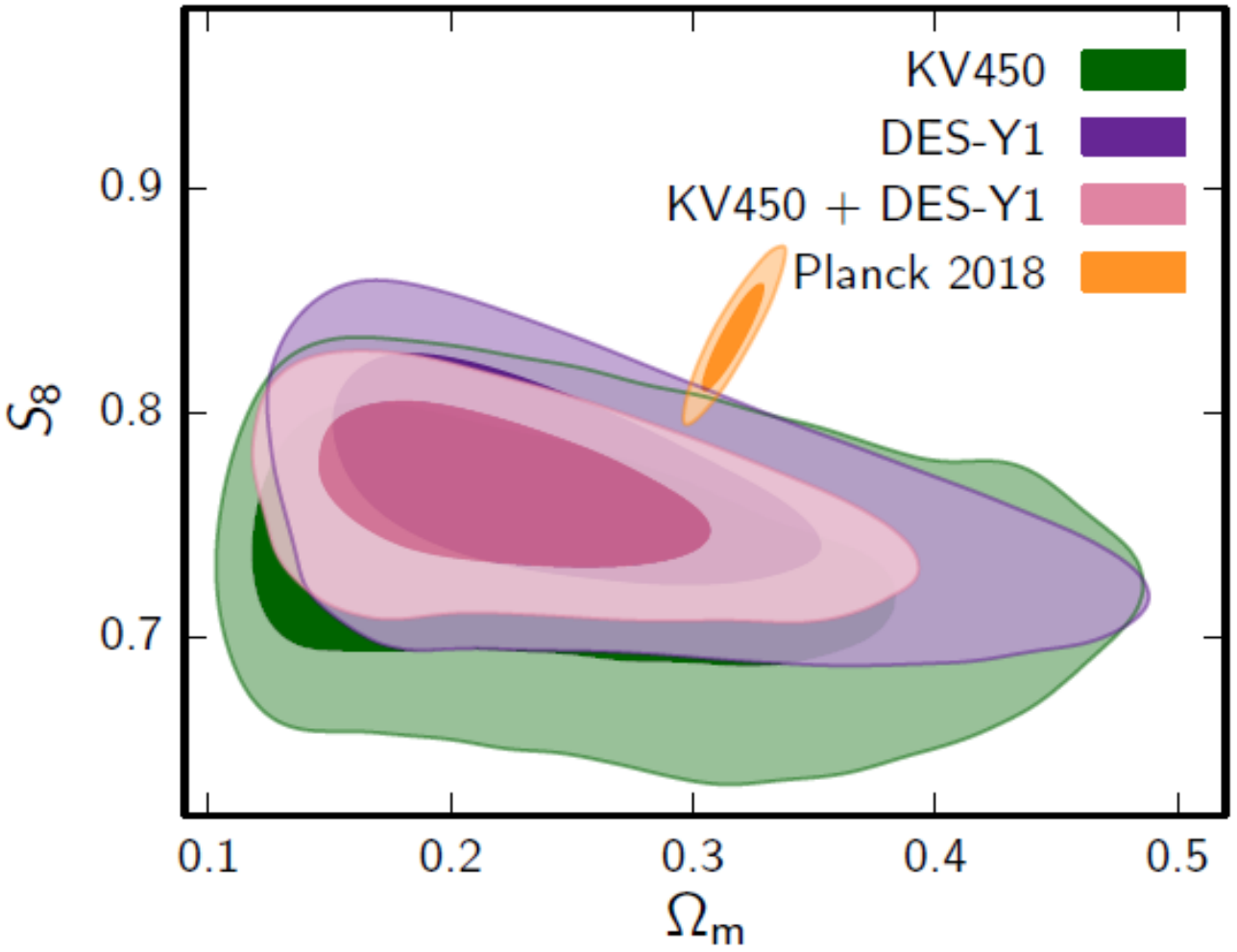
- Re-calibrate DES n(z) from KiDS spec-z sample
- Increases mean redshift of every tomographic bin
- Lower S_8 values

Tom. bin	COSMOS-2015 $< z >$	Spec-z (DIR) $< z >$
1	0.389 ± 0.016	0.403 ± 0.008
2	0.507 ± 0.013	0.560 ± 0.014
3	0.753 ± 0.011	0.773 ± 0.011
4	0.949 ± 0.022	0.984 ± 0.009



Impact of the redshift distribution (Joudaki et al. 2019)

- Same n(z) calibration -> perfect agreement between KiDS and DES
- Combination -> 2.5σ tension with Planck



Conclusions

- >2σ tension between weak lensing and CMB
- Could be explained by evolving dark energy
- Depends on the redshift calibration: photoz (DES) vs. specz (KiDS)
- Only 450 deg^2 out of 1350 deg^2 released so far
- Euclid will solve this question (if systematics are well understood)