Latest KiDS cosmic shear results: KiDS-VIKING-450

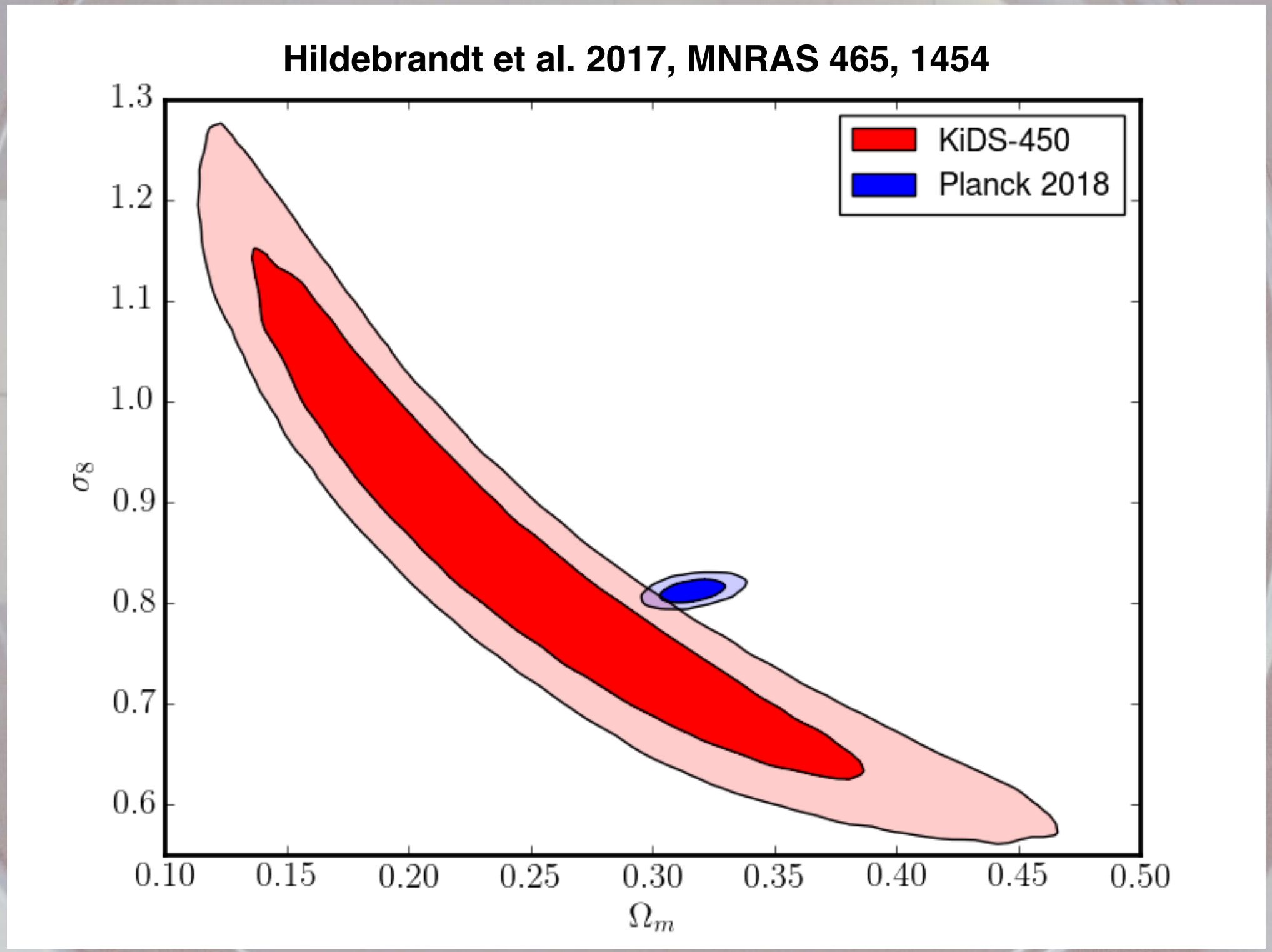
Konrad Kuijken
Leiden Observatory

Hildebandt, Köhlinger, van den Busch, Heymans, Joachimi, Arun Kannawadi, Wright, + many more KiDS

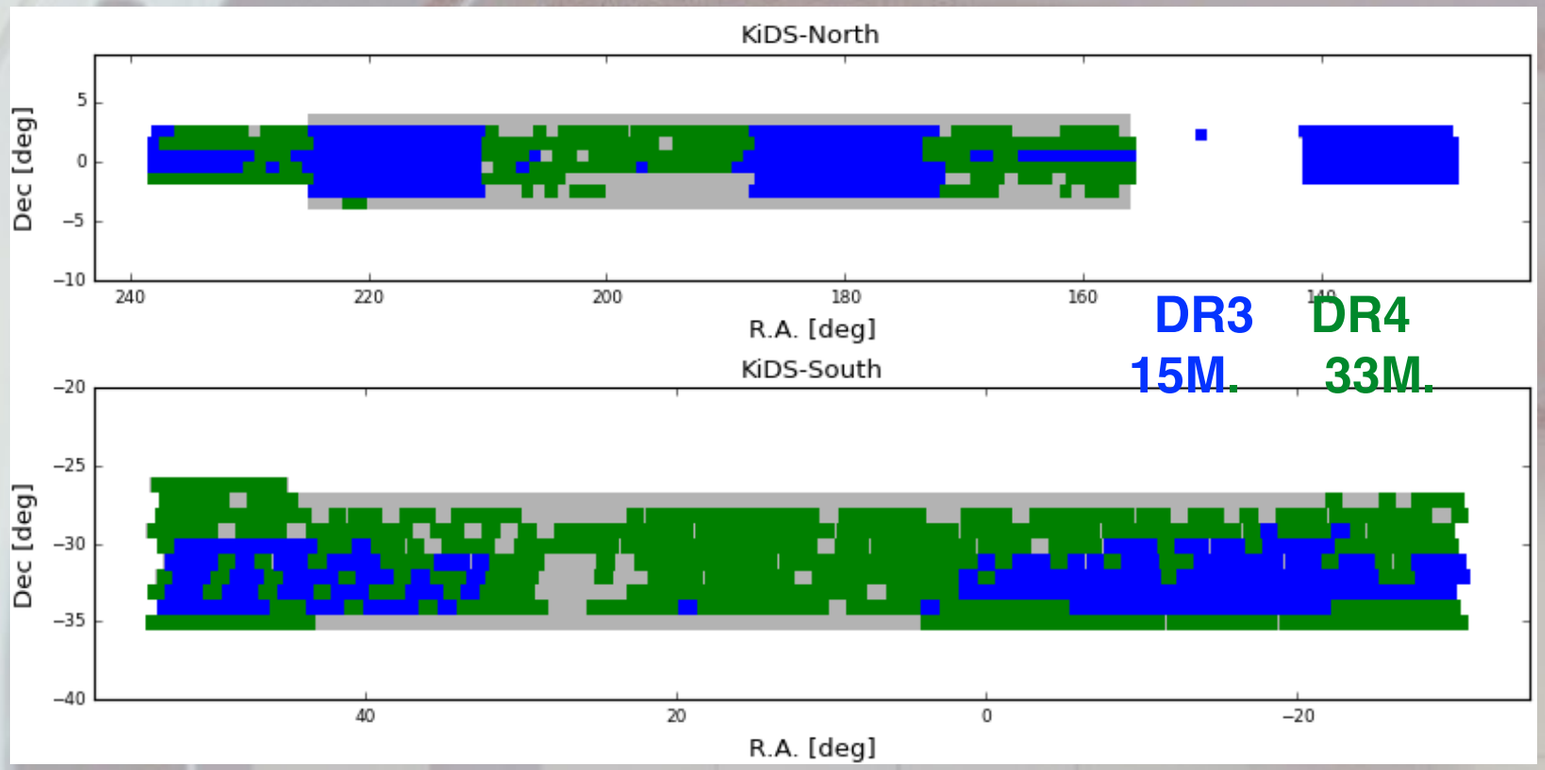
Alex Amon, Joachim Harnois-Déraps, Harry Johnston, Naomie Robertson, Cristóbal Sifón

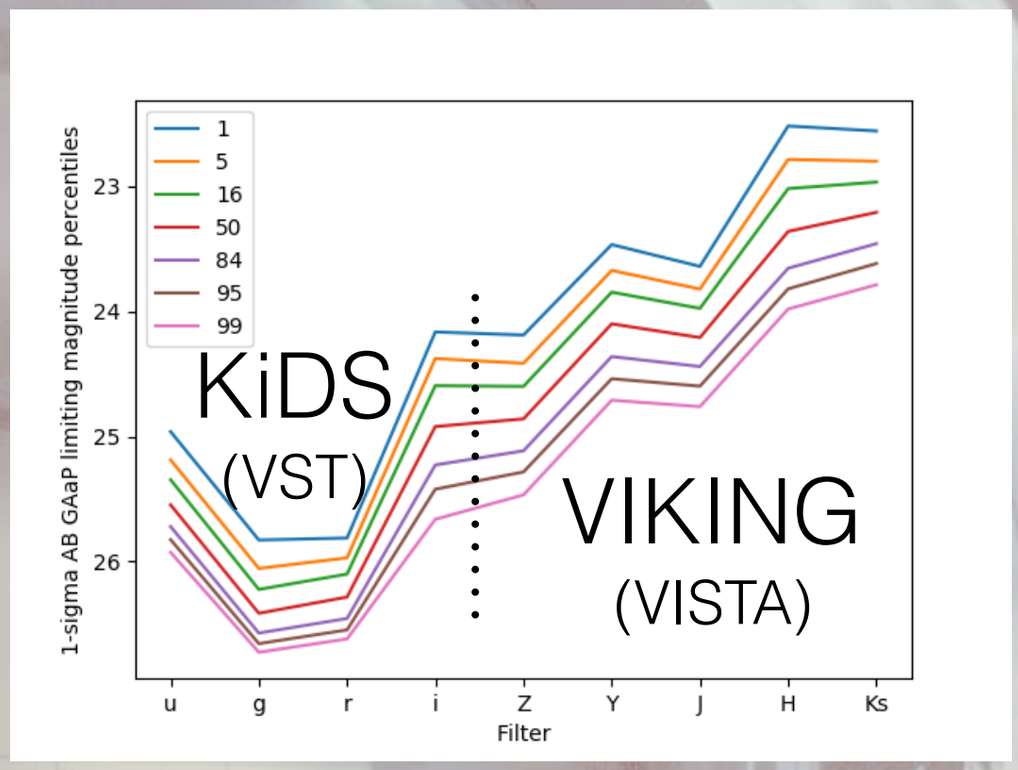
2016: KiDS-450 —> 2018: KV450

Hendrik Hildebrandt et al.:
arXiv:1812.06076



The Kilo-Degree Survey: basic stats





Final area **1350 deg²**

Lensing images (r):

Seeing **0.7”**
Depth **25ᵐ** (5σ AB)
PSF Ellipticity 0.03

Colours:
ugriZYJHK$_s$

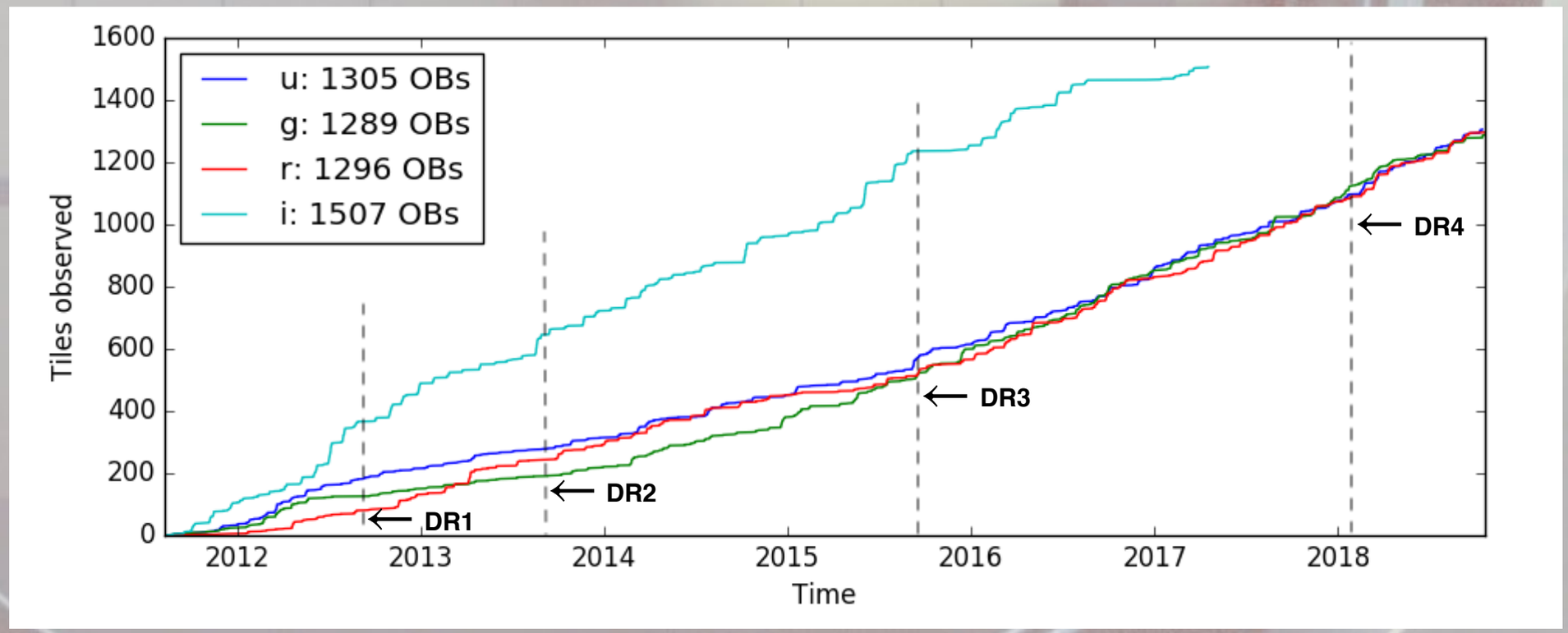
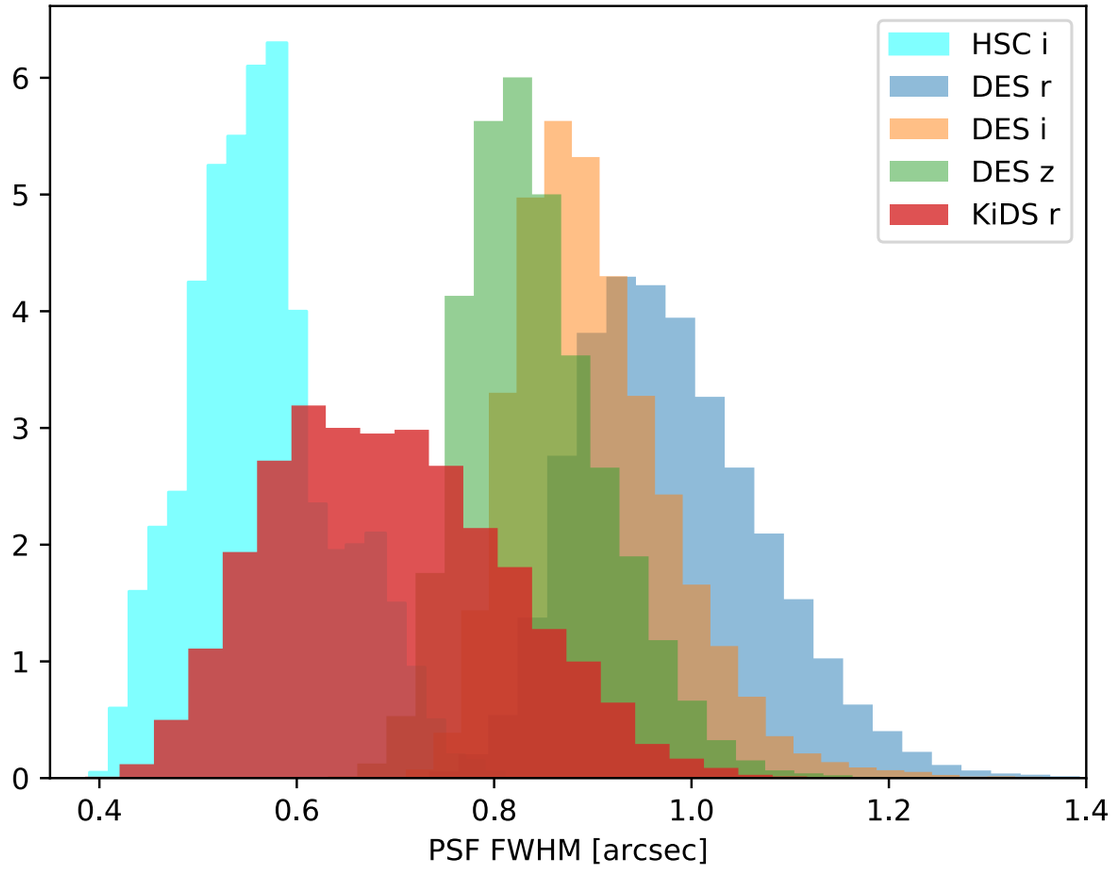
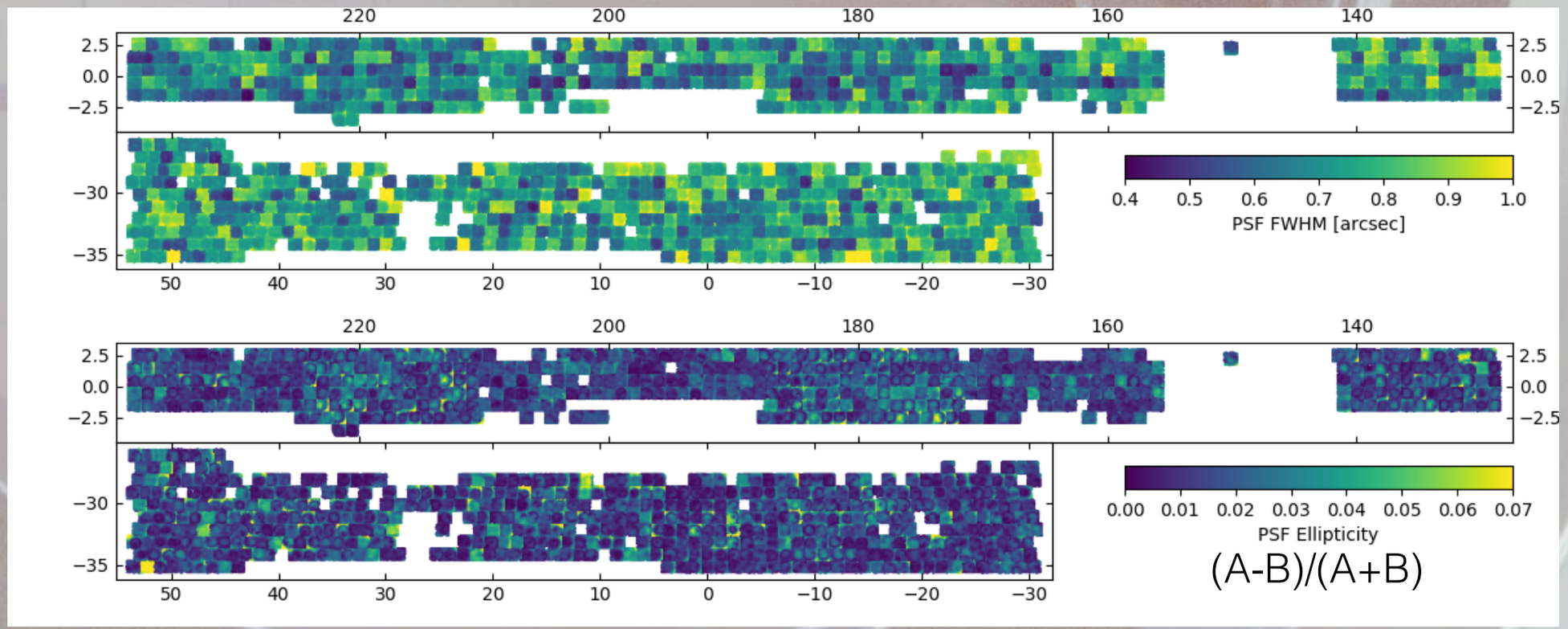


Image quality

- Median 0.7”
- PSF ellipticity low
- Image scale constant
- Benign PSF patterns



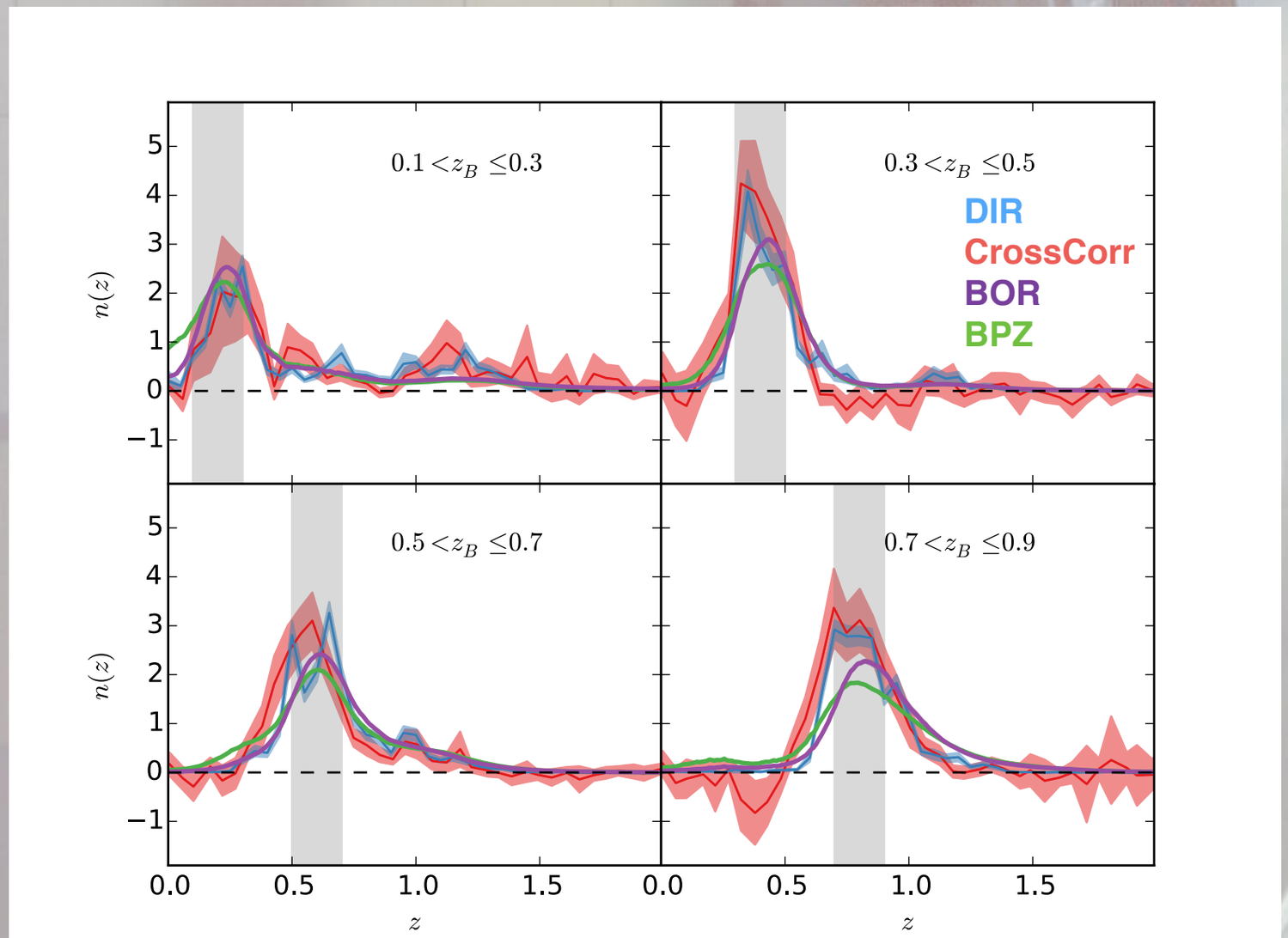


Shear measurements

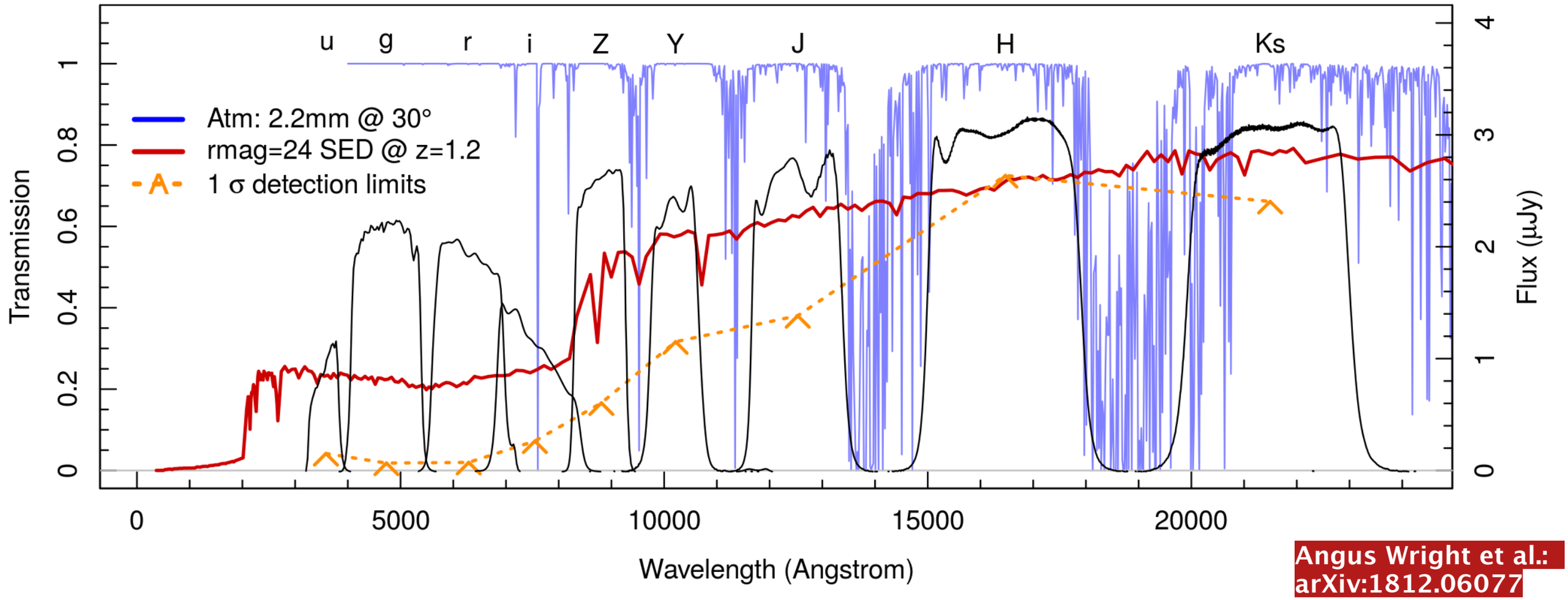
- ***Lensfit***
  - forward modelling code,
  - simultaneous fit to all sub-exposures with individual PSFs,
    - likelihood function for each source ellipticity.
- Self-calibration (response of best-fit model to shear)
- Calibration verified with **realistic image simulations**
- Conservative estimate of systematic shear calibration error: 2%.

Photometric redshifts

- KiDS-450: u+g+r+i GAaP photometry
- Classify into tomographic bins using BPZ, then estimate n(z)
- **DIR**ect reweighting of ***deep spec-z catalogues*** to match 4-D magnitude distributions
- Only works if :
  - mag. space covered
    - r<~24 (C3R2)
  - Relation unique



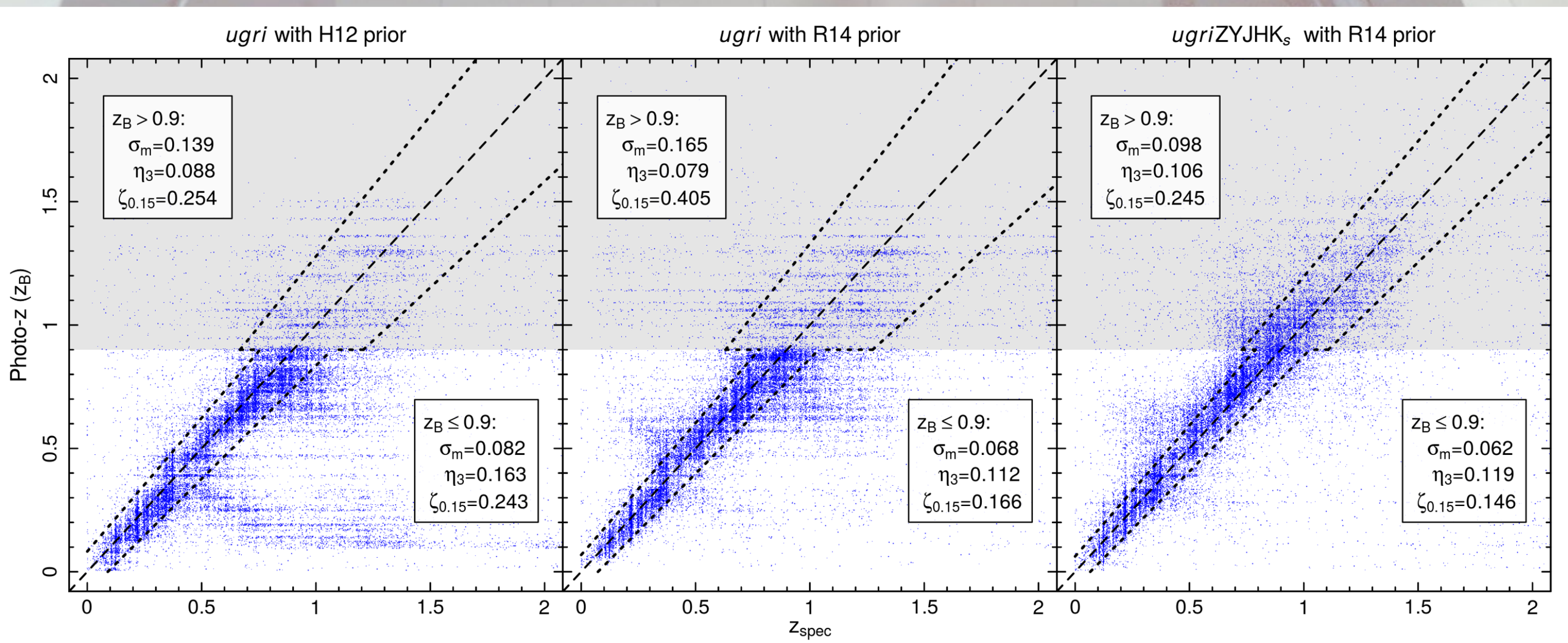
Photometric redshifts - KV450



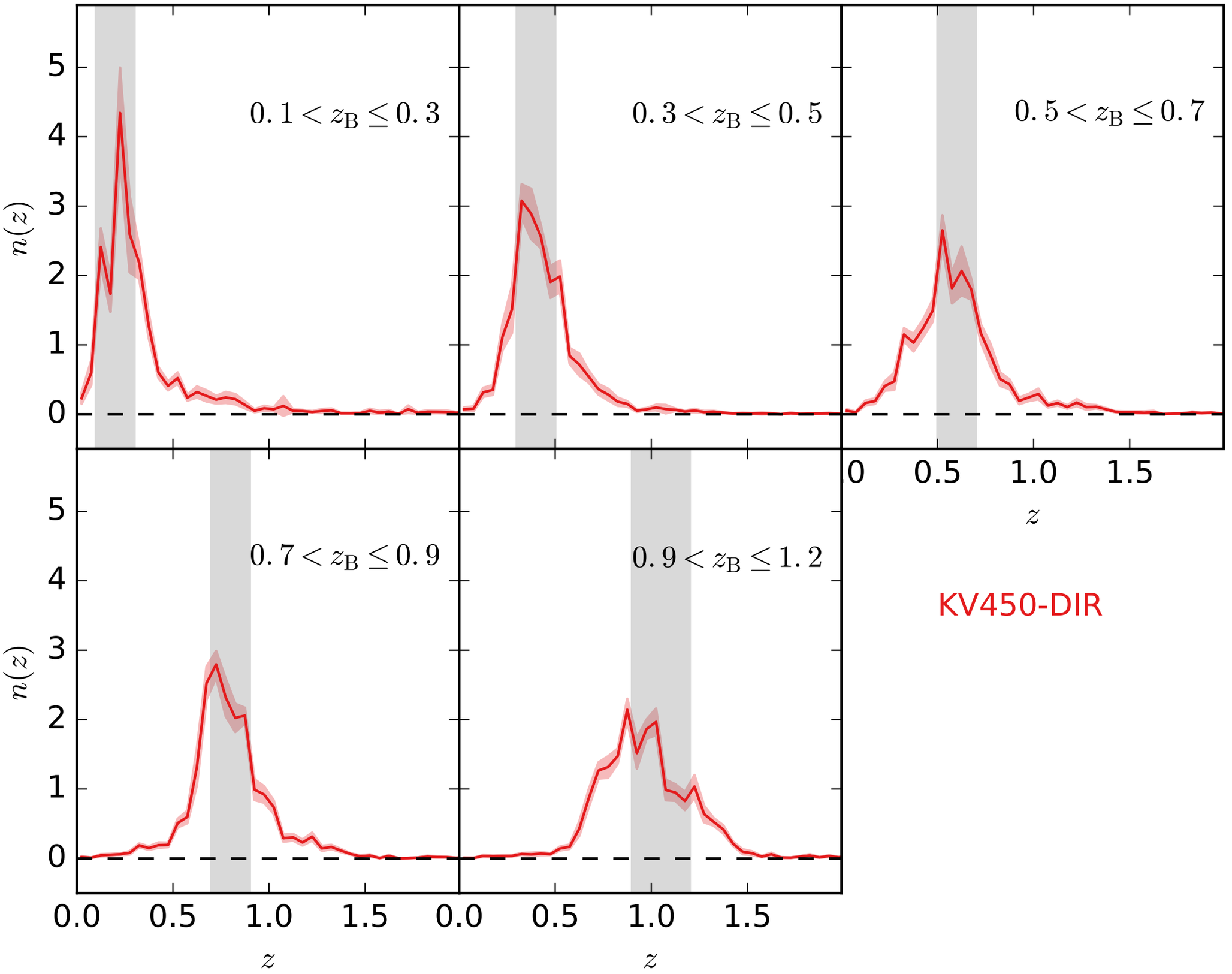
Angus Wright et al.: arXiv:1812.06077

- Include 5-band VIKING survey ZYJHK$_s$ (depth 23-21, 5σ)

Benefits of adding near-IR

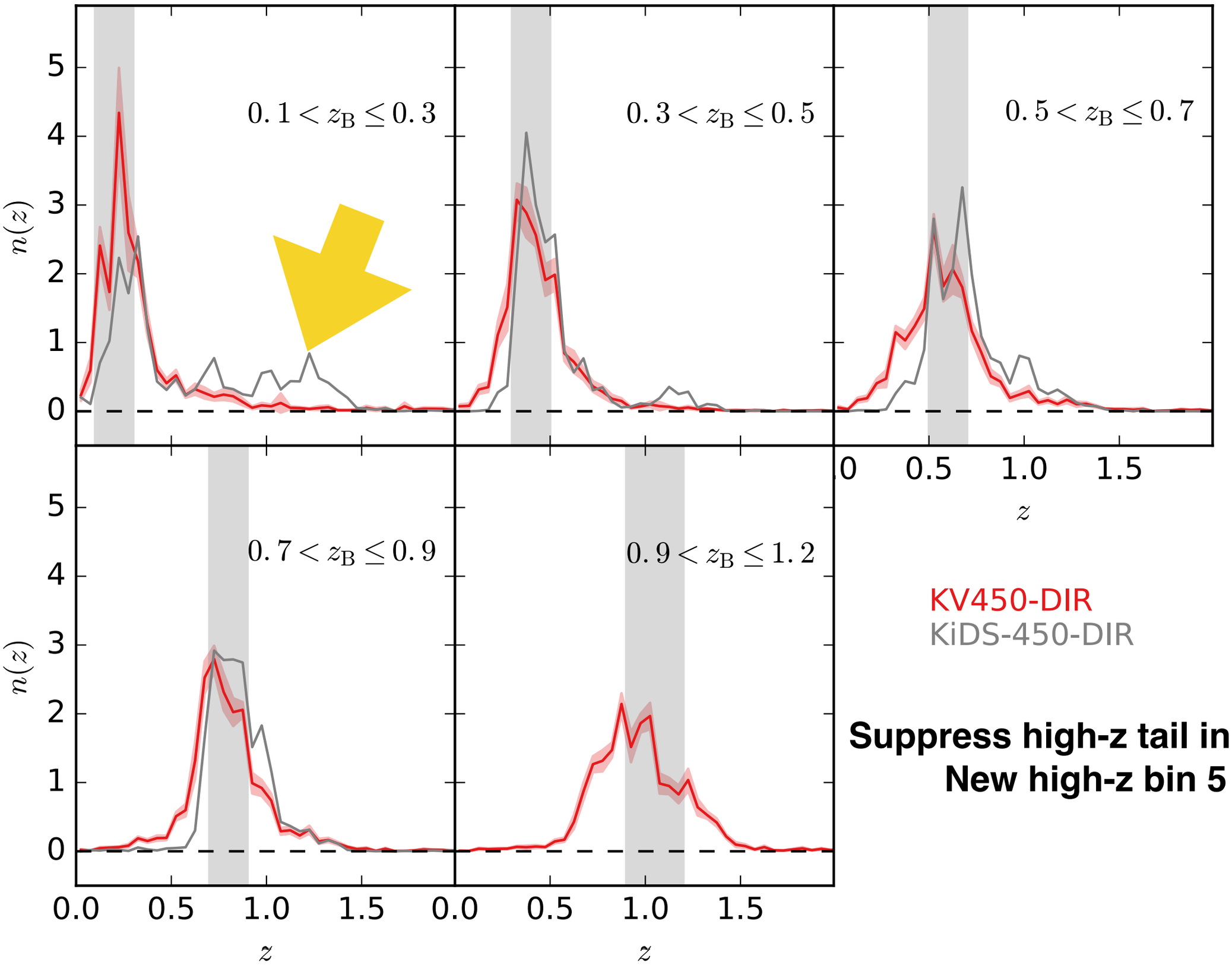


KV450 tomographic bins



KV450-DIR

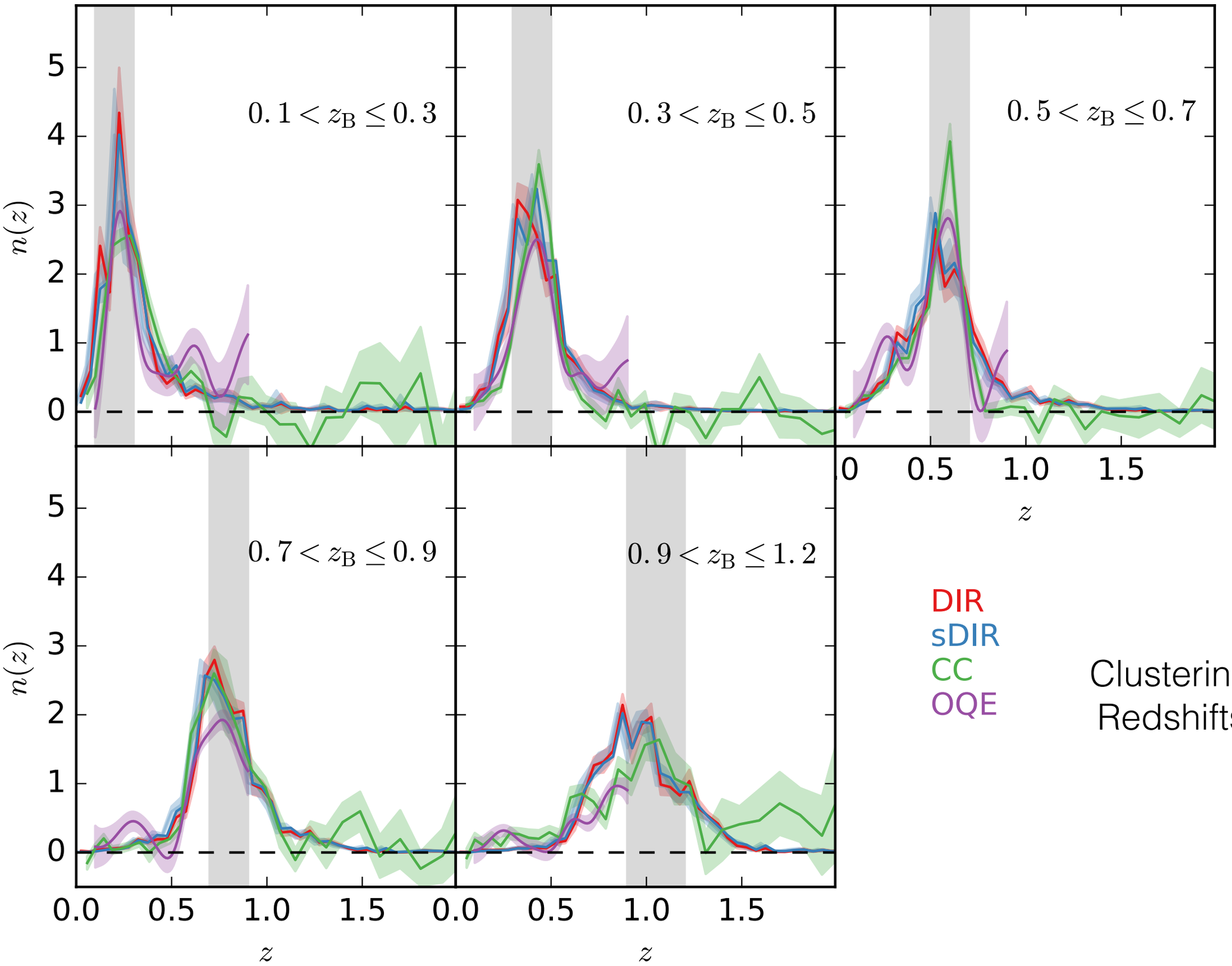
KV450 tomographic bins



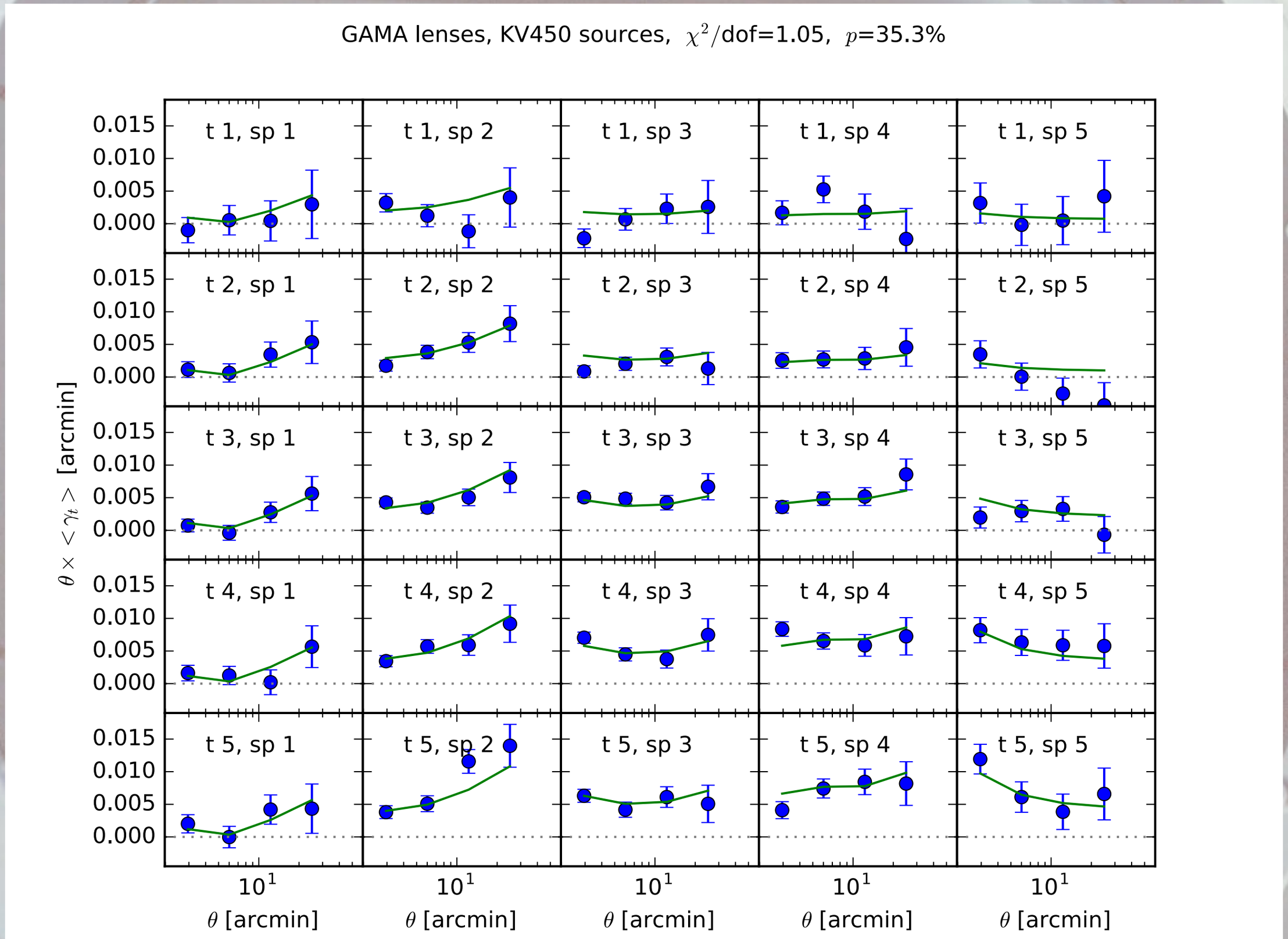
KV450-DIR
KiDS-450-DIR

Suppress high-z tail in bin 1
New high-z bin 5

KV450 tomographic bins

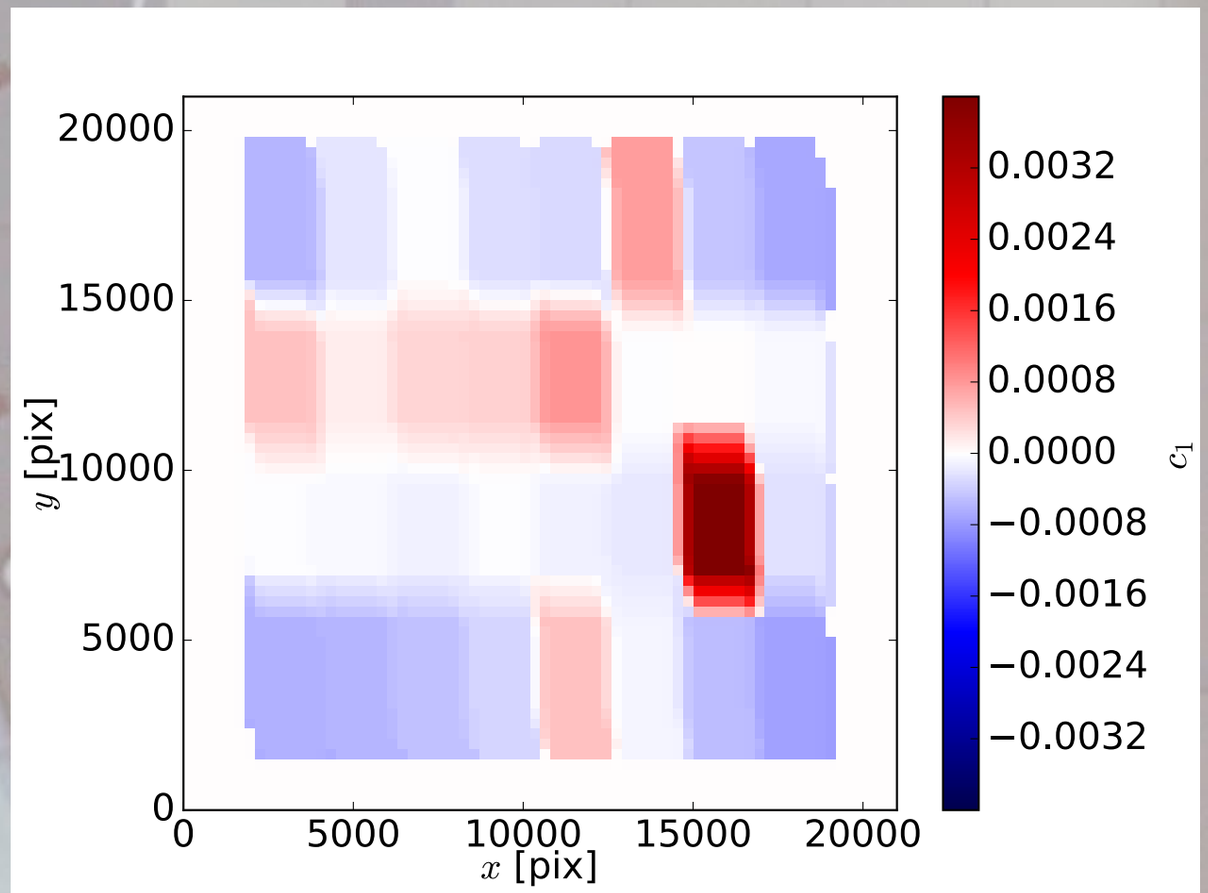


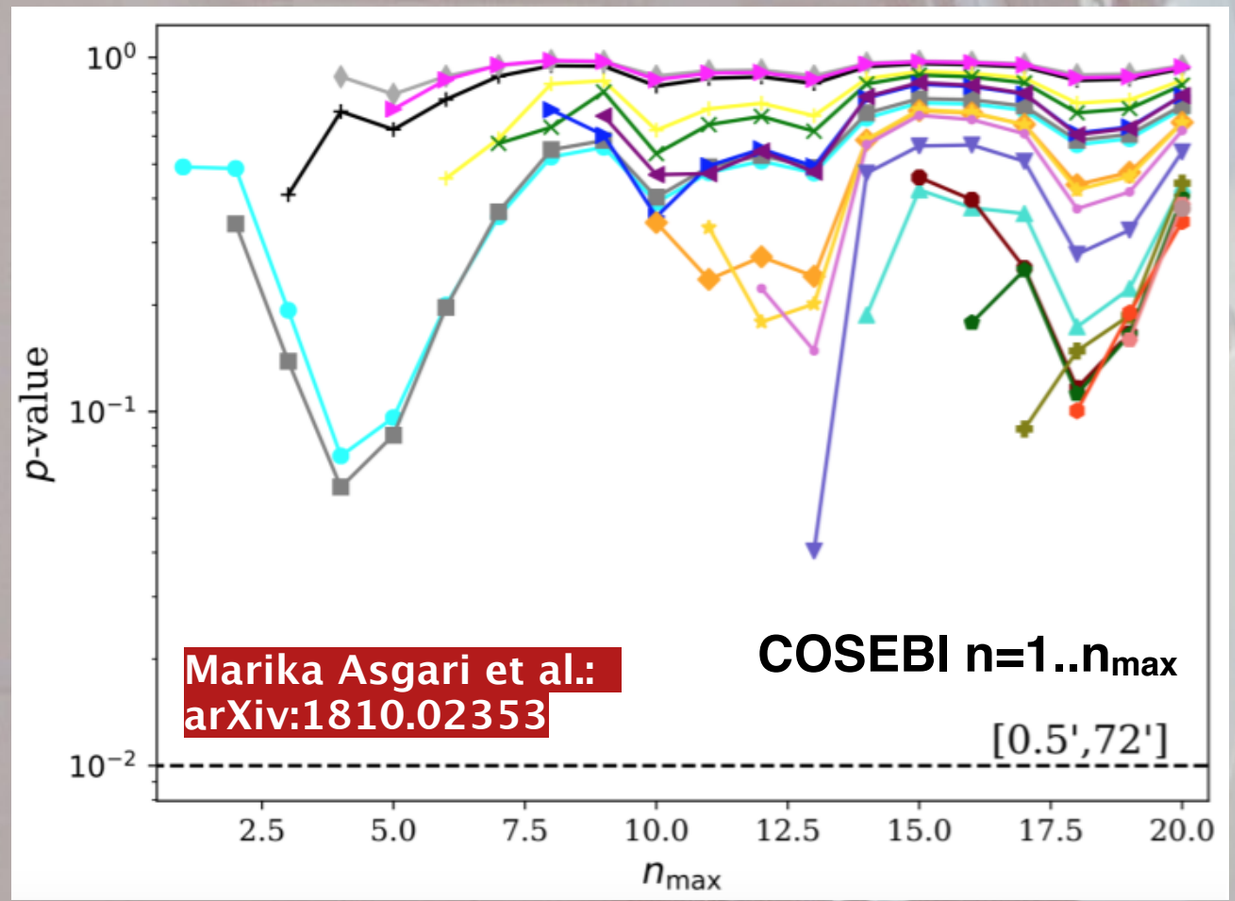
Shear ratio test



B modes

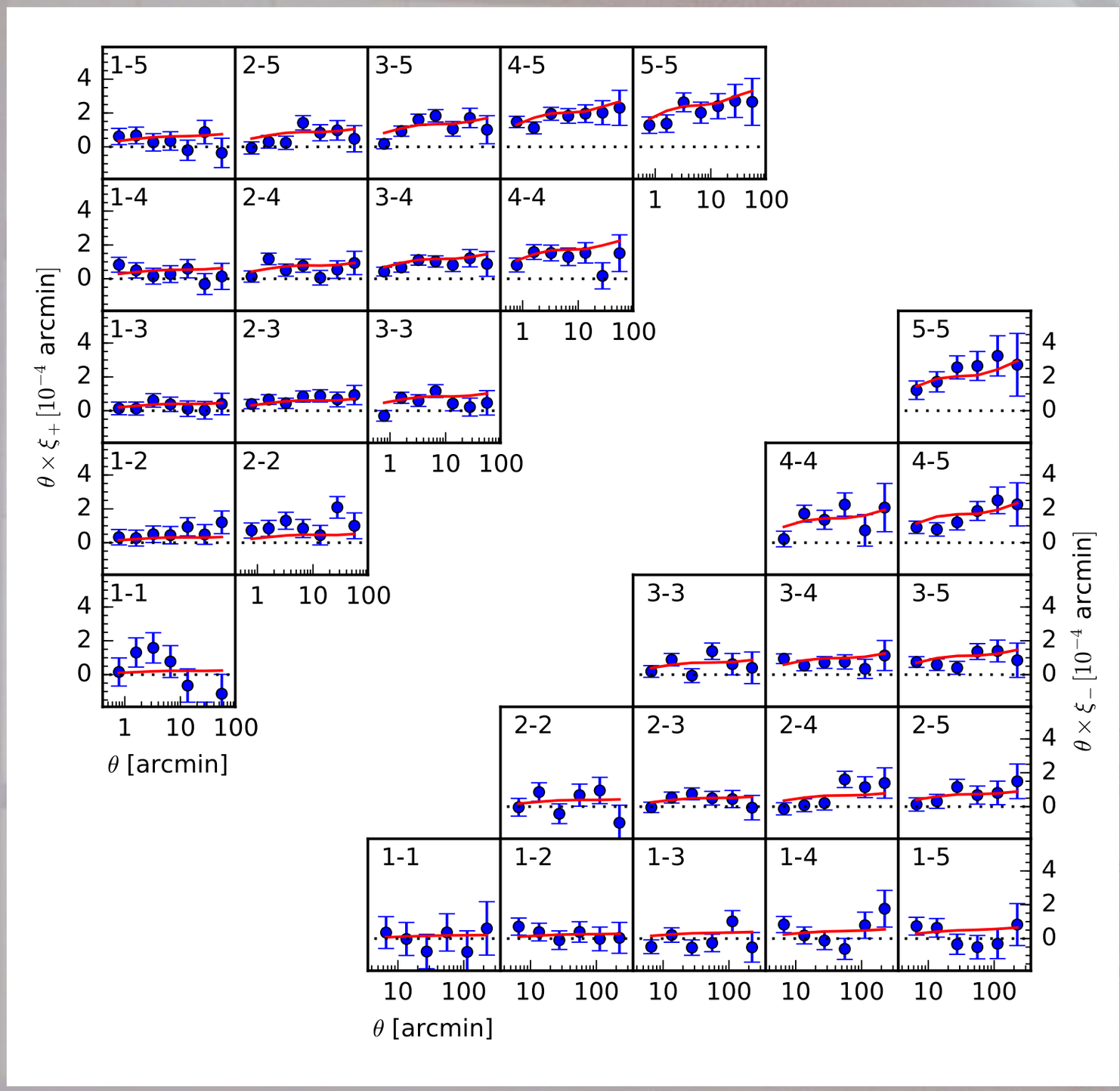
- Improved c-term correction (weak ellipticity dependence on PSF magnitude)





- Demonstrate with COSEBI's

Shear correlation functions $\xi_{\pm}$



- (fixed error in bin centres of correlation functions)

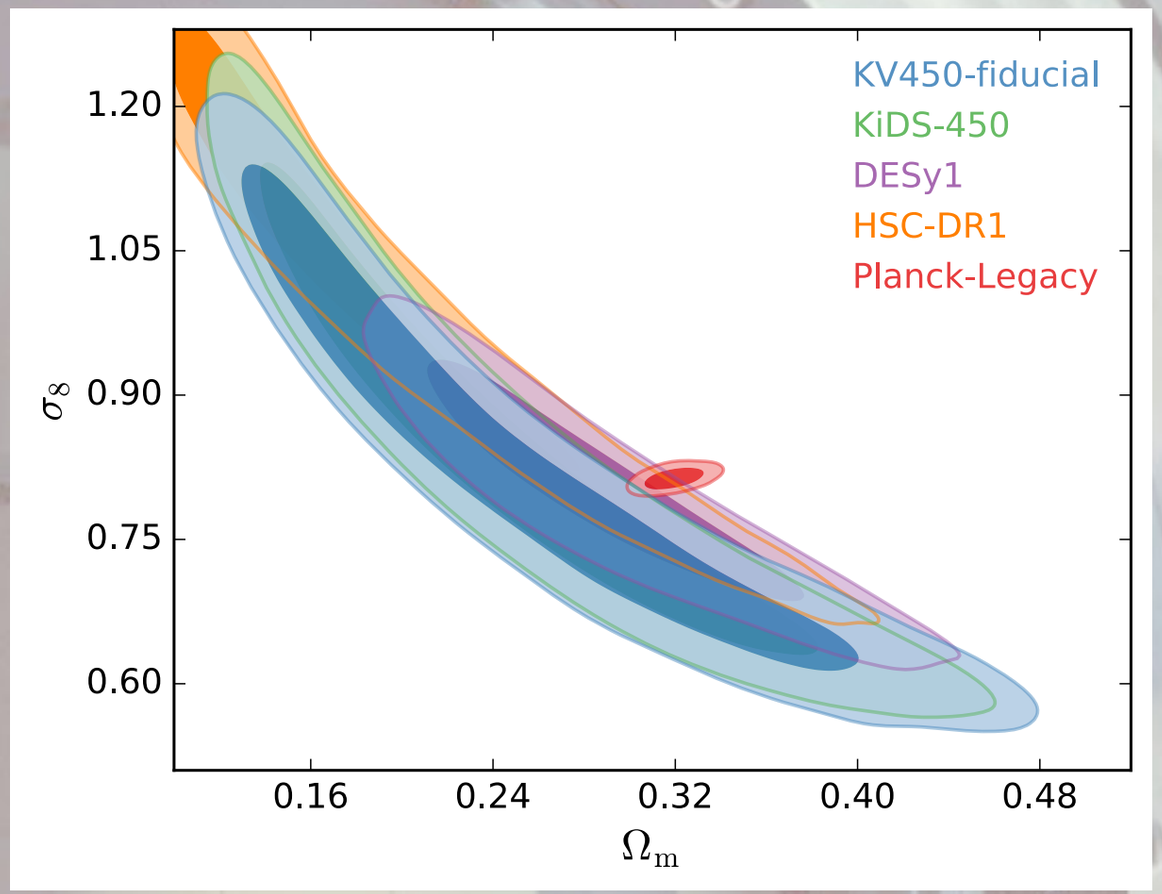
Modelling ingredients

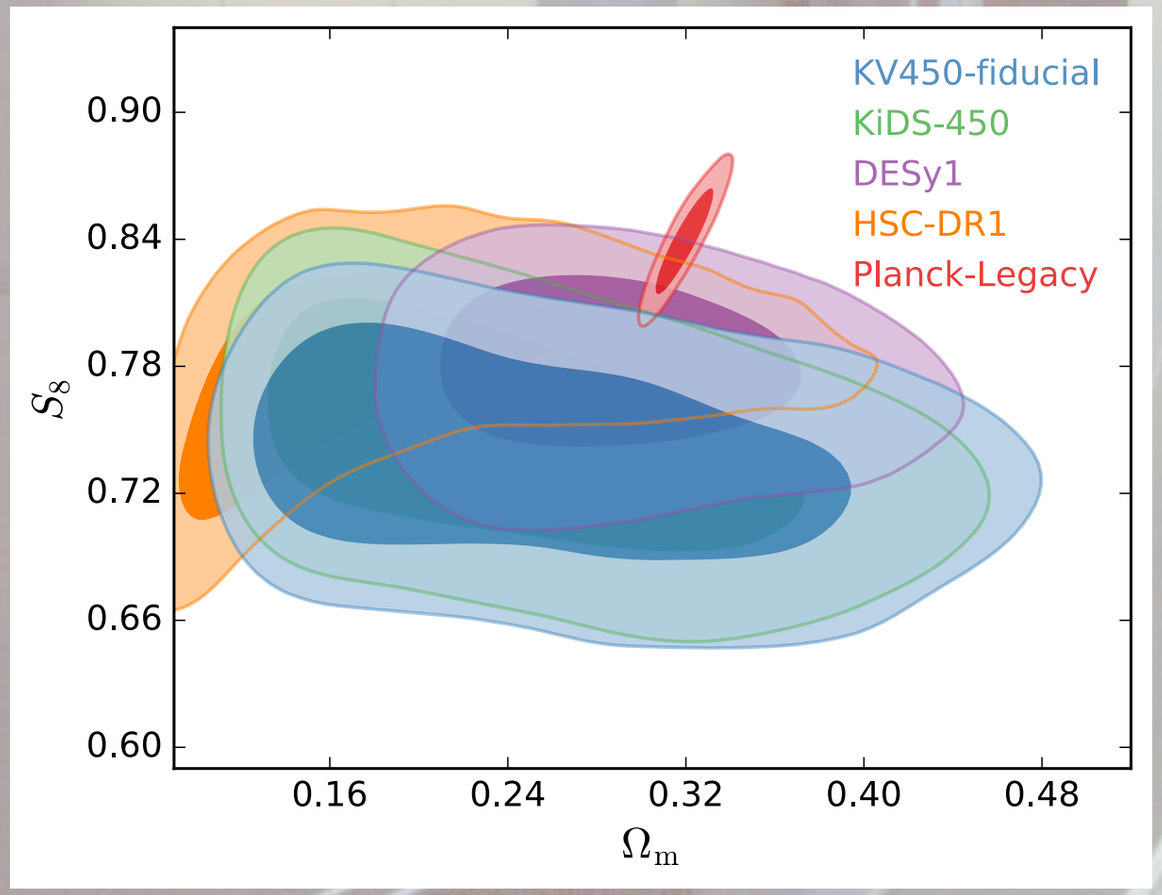
- Power spectrum incl. ν, **baryonic** effects (CLASS, HMcode)
- n(z) — **blinded** (3 sets: truth + 2 sabotaged)
- **Intrinsic alignment** (non-linear linear model)
- Error params (**redshift shifts**, **shear calibration** errors)
- Integrate over **θ bins**
- Covariance matrix
- Priors
- Two cosmology pipelines

Parameter	Symbol	Prior
CDM density	$\Omega_{\rm CDM}h^2$	$[0.01, 0.99]$
Scalar spectrum ampl.	$\ln(10^{10}A_{\rm s})$	$[1.5, 5.0]$
Baryon density	$\Omega_{\rm b}h^2$	$[0.019, 0.026]$
Scalar spectral index	$n_{\rm s}$	$[0.7, 1.3]$
Hubble parameter	h	$[0.64, 0.82]$
IA amplitude	$A_{\rm IA}$	$[-6, 6]$
Baryon feedback ampl.	B	$[2.00, 3.13]$
Constant c-term offset	δc	0.0000 ± 0.0002
2D c-term amplitude	A_c	1.01 ± 0.13
Redshift offset bin 1	δz_1	0.000 ± 0.039
Redshift offset bin 2	δz_2	0.000 ± 0.023
Redshift offset bin 3	δz_3	0.000 ± 0.026
Redshift offset bin 4	δz_4	0.000 ± 0.012
Redshift offset bin 5	δz_5	0.000 ± 0.011

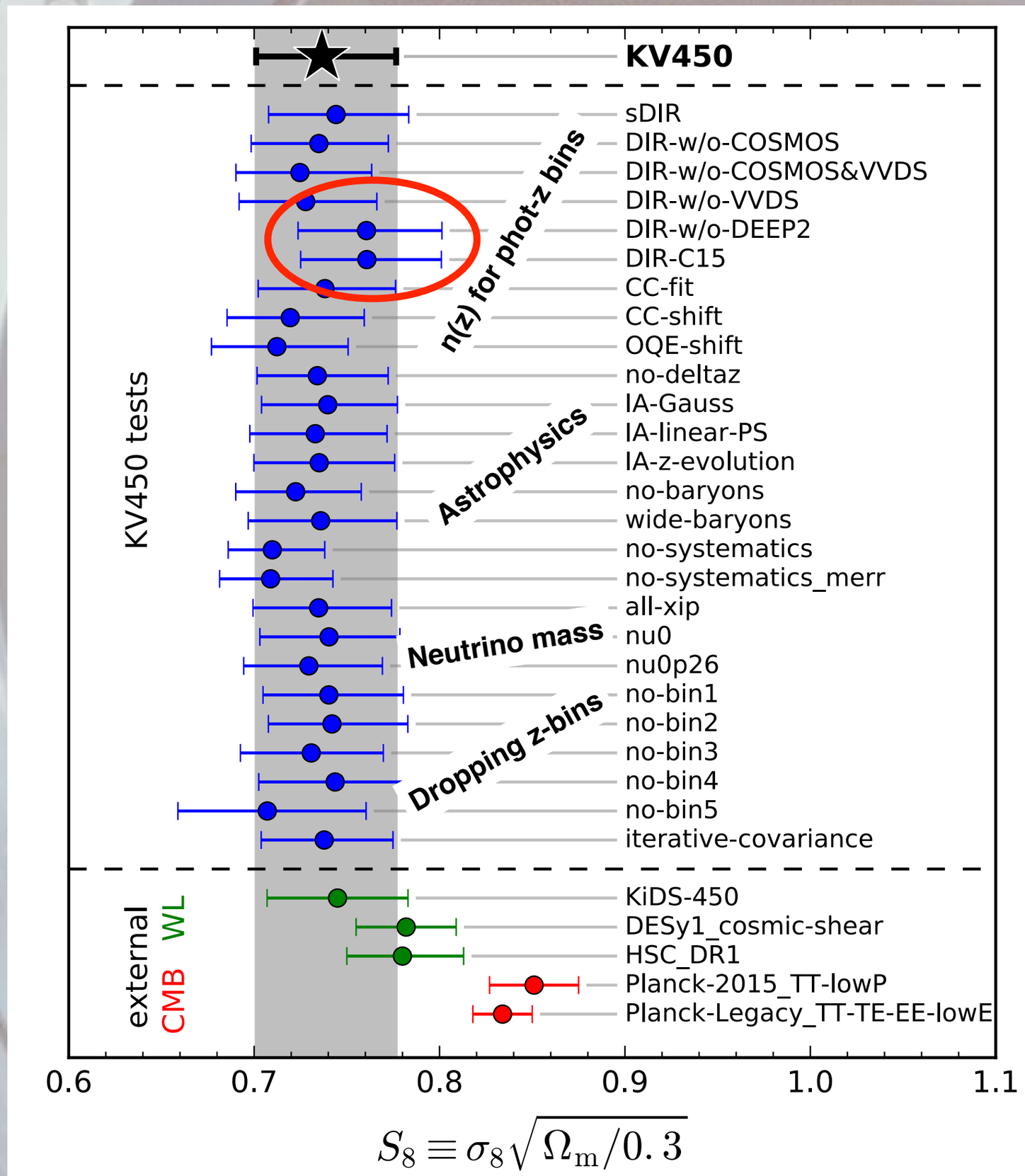
Results

- Despite the changes, KV450 constraints very close to KiDS-450.
- Min. $\chi^2_{181} = 180.6$
- 2.3σ ‘tension’ with Planck
- $S_8 = 0.737^{+0.040}_{-0.036}$

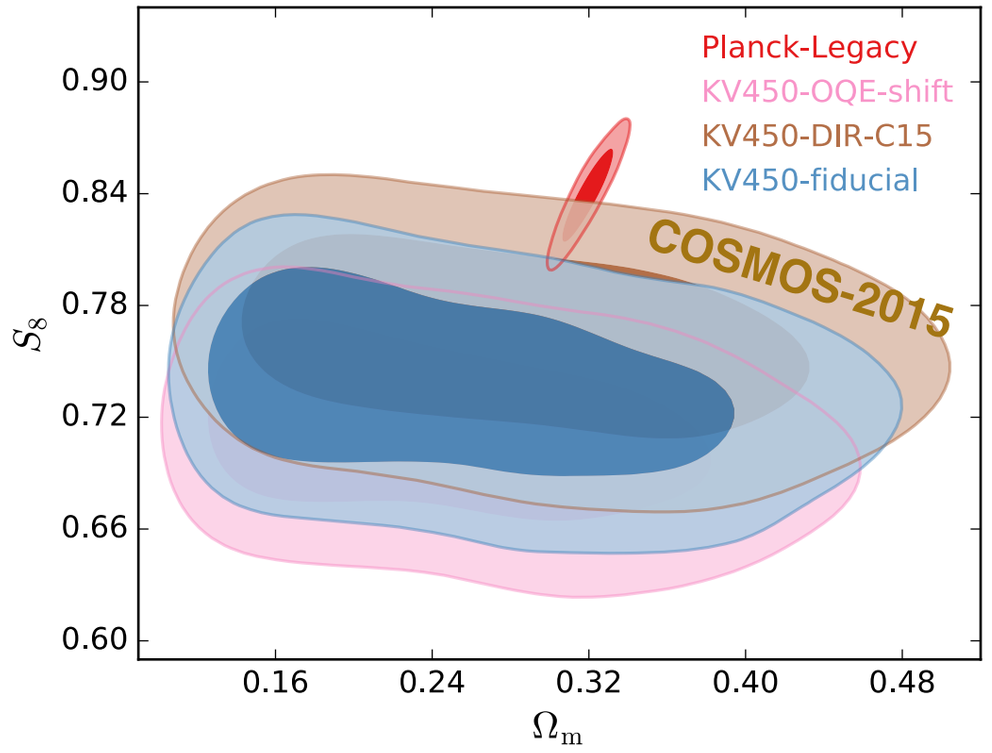




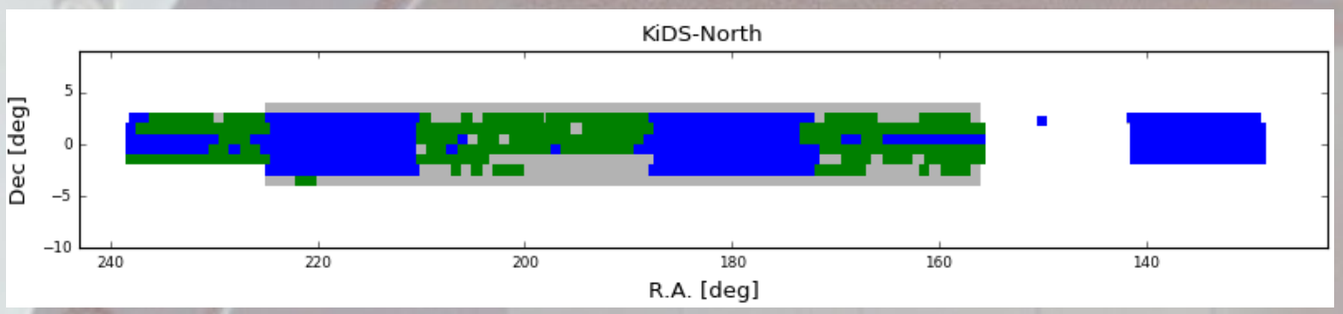
Results: systematic tests

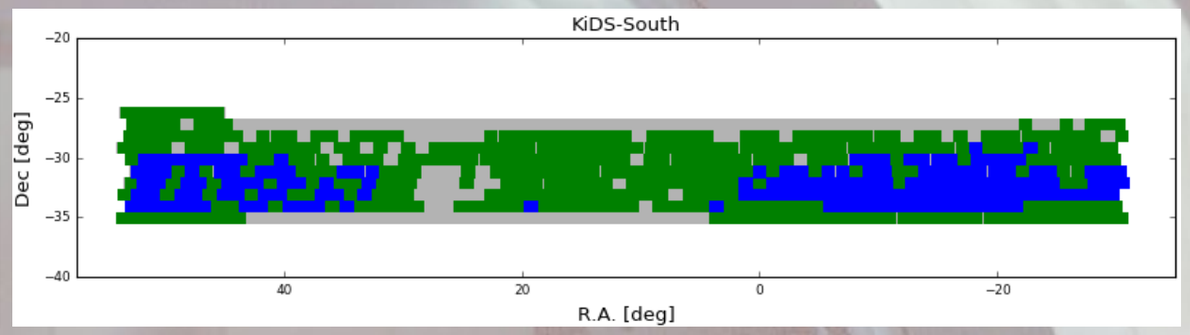


Deep spec-z crucial



Outlook





- DR4 analysis now ongoing (1006 tiles, 9 bands)
- Observations almost complete (1350 sq.deg.)
- ==> KiDS+VIKING area will triple
- Further improve phot-z calibration
  - '**KiDZ**' programme targeting deep spec-z surveys with VST and VISTA
  - Comparable precision clustering redshifts

Conclusions

- Robust 9-band photo-z + KIDS-450 shapes = KV450
- ~2σ tension in S_8 vs. Planck remains
- Working towards tripling sky area with KiDS-DR4 —> DR5
- Systematics are the limiting factor!
    - COSMOS-2015 vs. Spec-z calibration: 0.6σ

The KiDS Team

Konrad Kuijken
Massimo Viola
Henk Hoekstra
Marcello Cacciato
Maciek Bilicki
Andrej Dvornik
Christos Georgiou
MJ Vakili
Arun Kannawadi
Ricardo Herbonnet
Margot Brouwer
Cristobal Sifon
Ewout Helmich
Nancy Irrisari
Martin Borstad Eriksen
Arthur Jakobs
Fabian Köhlinger
Berenice Pila-Diez
Remco van der Burg
Elisabetta Semboloni

LEIDEN

Catherine Heymans
Ami Choi
Alexandra Amon
Yanchuan Chai
Benjamin Giblin
Alexander Mead
Joachim Harnois-Deraps
John Peacock
Tilman Troester

EDINBURGH

Alistair Edge

DURHAM

Hendrik Hildebrandt
Patrick Simon
Thomas Erben
Angus Wright
Axel Buddendiek
Alexandru Tudorica
Reiko Nakajima
Chris Morrison
Peter Schneider
Douglas Applegate
Dominik Klaes
Oliver Cordes
Tim Schrabback

BONN

Mario Radovich

PADUA

Lance Miller
Elisa Chisari
Julian Merten
Shahab Joudaki
Naomie Robertson

OXFORD

Kristian Zarb Adami
Ian Fenech Conti

MALTA

Edwin Valentijn
Jelte de Jong
Gijs Verdoes Kleijn
John McFarland
Hugo Buddelmeijer
Gert Sikkema
Kor Begeman
Andrey Belikov
Danny Boxhorn
Carlo Enrico Petrillo
Willem-Jan Friend
Leon Koopmans
Reynier Peletier

GRONINGEN

Nicola Napolitano
Massimo Brescia
Massimo Cappacioli
Stefano Cavuoti
Giovanni Covone
Massimo Dall'Ora
Fedor Getman
Aniello Grado
Francesco La Barbera
Giuseppe Longo
Maurizio Paolillo
Emanuella Puddu
Agatino Riffato
Nivya Roy
Creszenzo Tortora
Zhuoyi Huang

NAPLES

Chris Blake

SWINBURNE

Edo van Uitert
Benjamin Joachimi
Harry Johnston
Tom Kitching
Will Sutherland

LONDON

Ludovic van Waerbeke
Alireza Hojjati

VANCOUVER