KiDS-450 photo-z

&

KiDS-VIKING

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Philosophy of KiDS-450 photo-z

- Use one of the photo-z codes that “won” PHAT (BPZ). Not a critical choice!

- Concentrate on photometry and photo-z calibration.

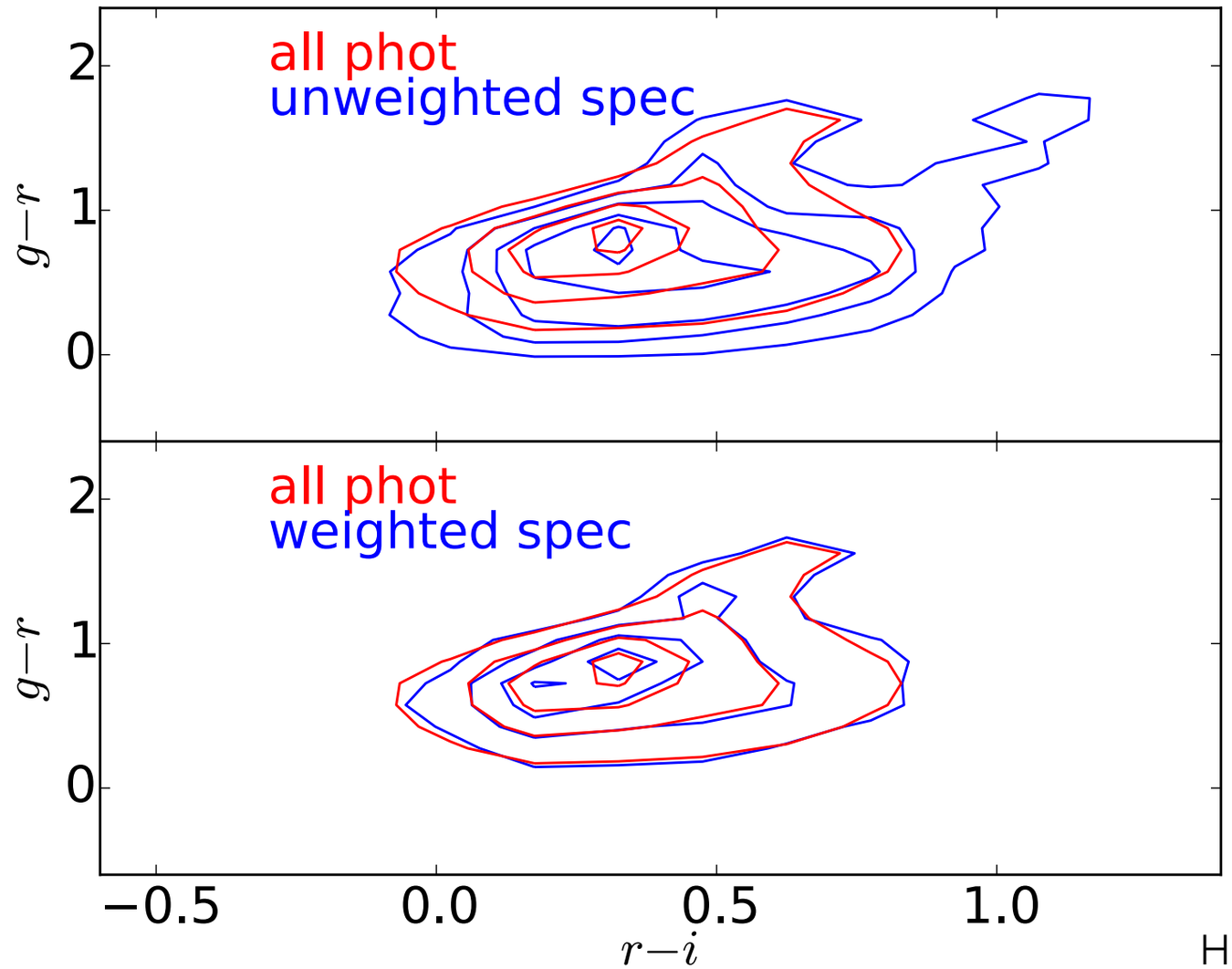
- **Apply the Euclid roadmap.**

- Fully propagate errors to cosmology.

- Apply lessons learned to future KiDS releases and Euclid.

Direct photo-z calibration

- Re-weight spec-z surveys to be more representative
- Only works if:
  - Magnitude space is fully covered (r<~24; C3R2).
  - Unique relation between magnitudes and redshifts (VIKING).

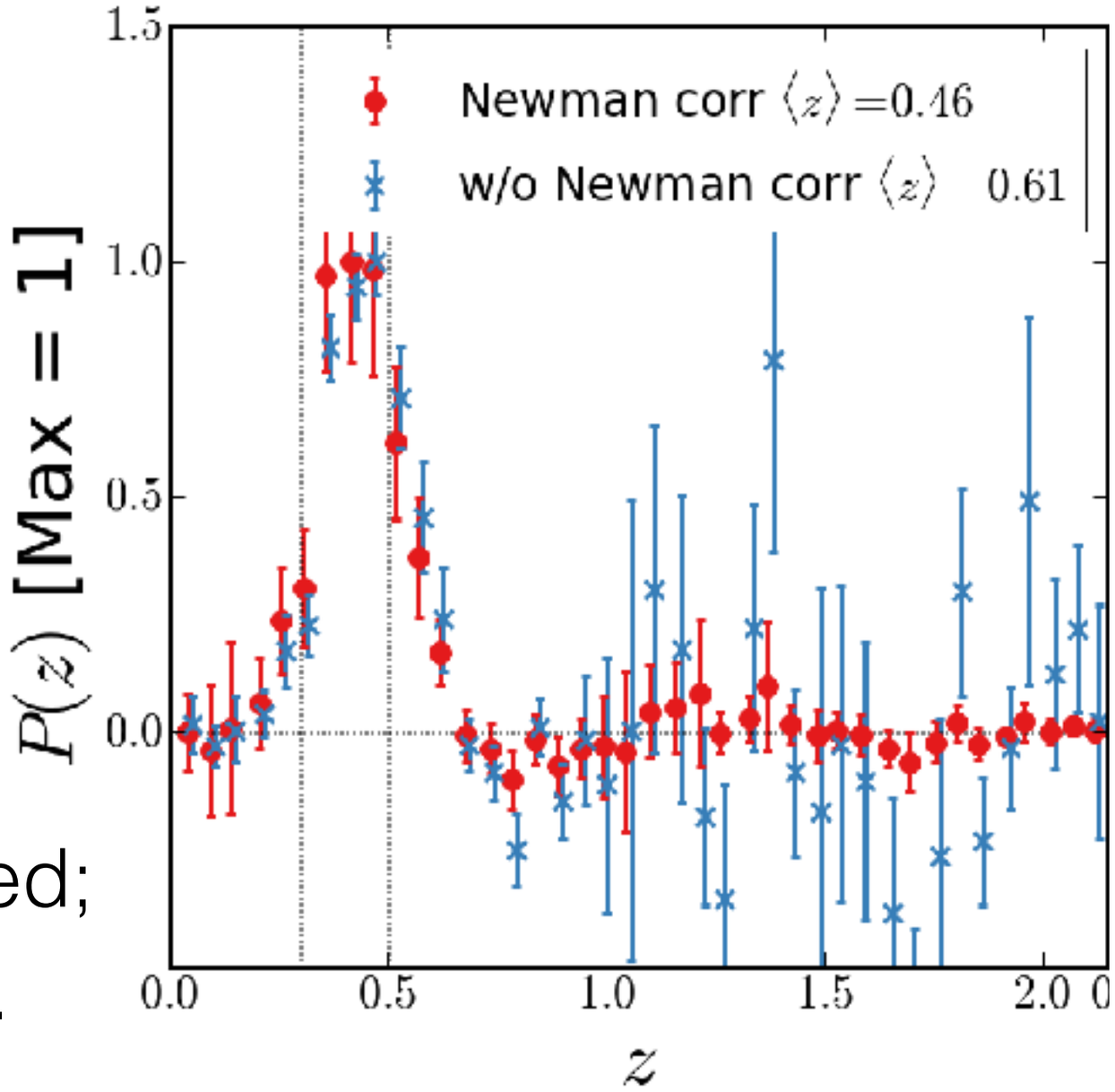


KiDS

Hildebrandt, Viola et al. (2017)

Cross-corr. photo-z cal.

- Angular cross-correlation of galaxies with known and unknown redshifts
- Angular auto-correlation to correct for galaxy bias
- Only works if
  - full redshift range is covered;
  - outliers are ‘well-behaved’.



Hildebrandt, Viola et al. (2017)

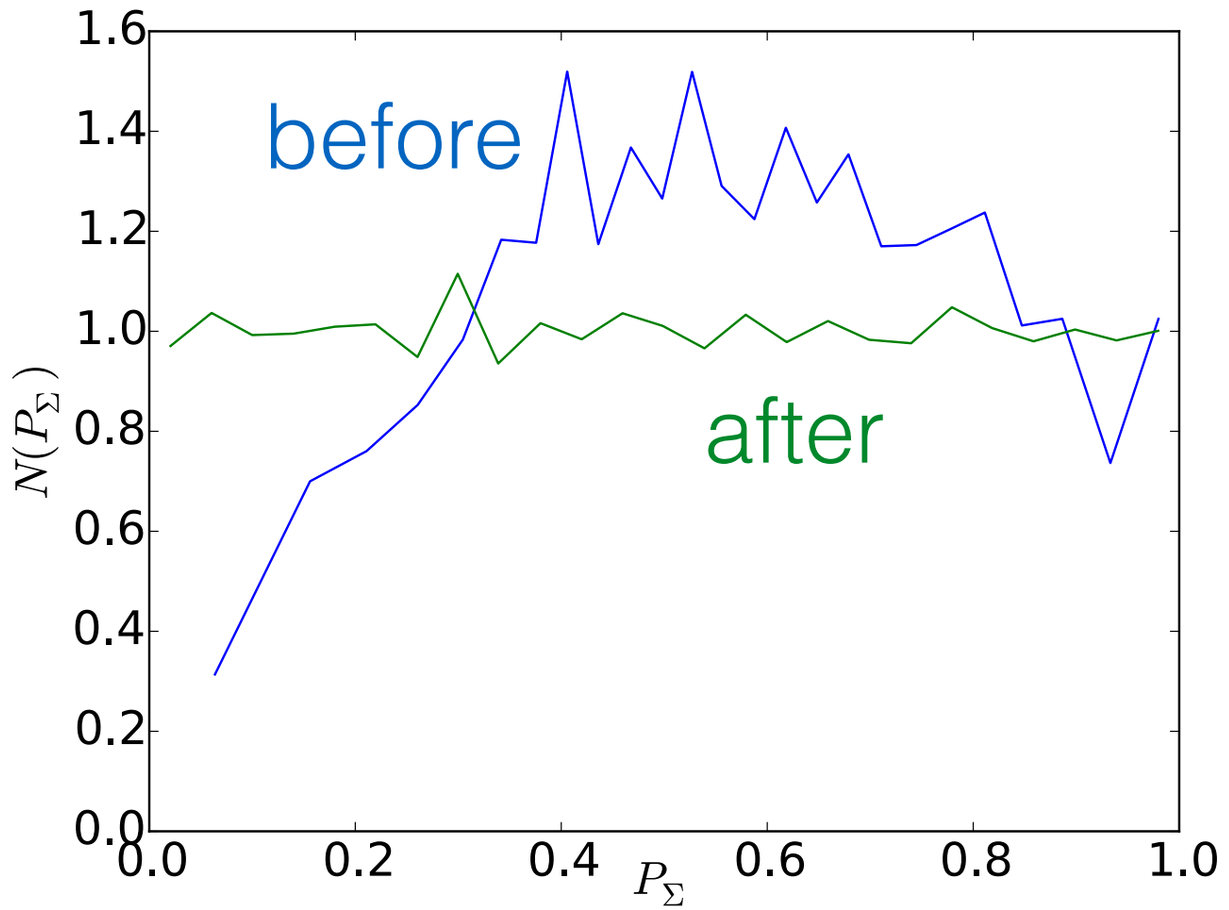
KiDS

Photo-z

Photo-z calibration (3 - Re-calibration of *P(z)*)

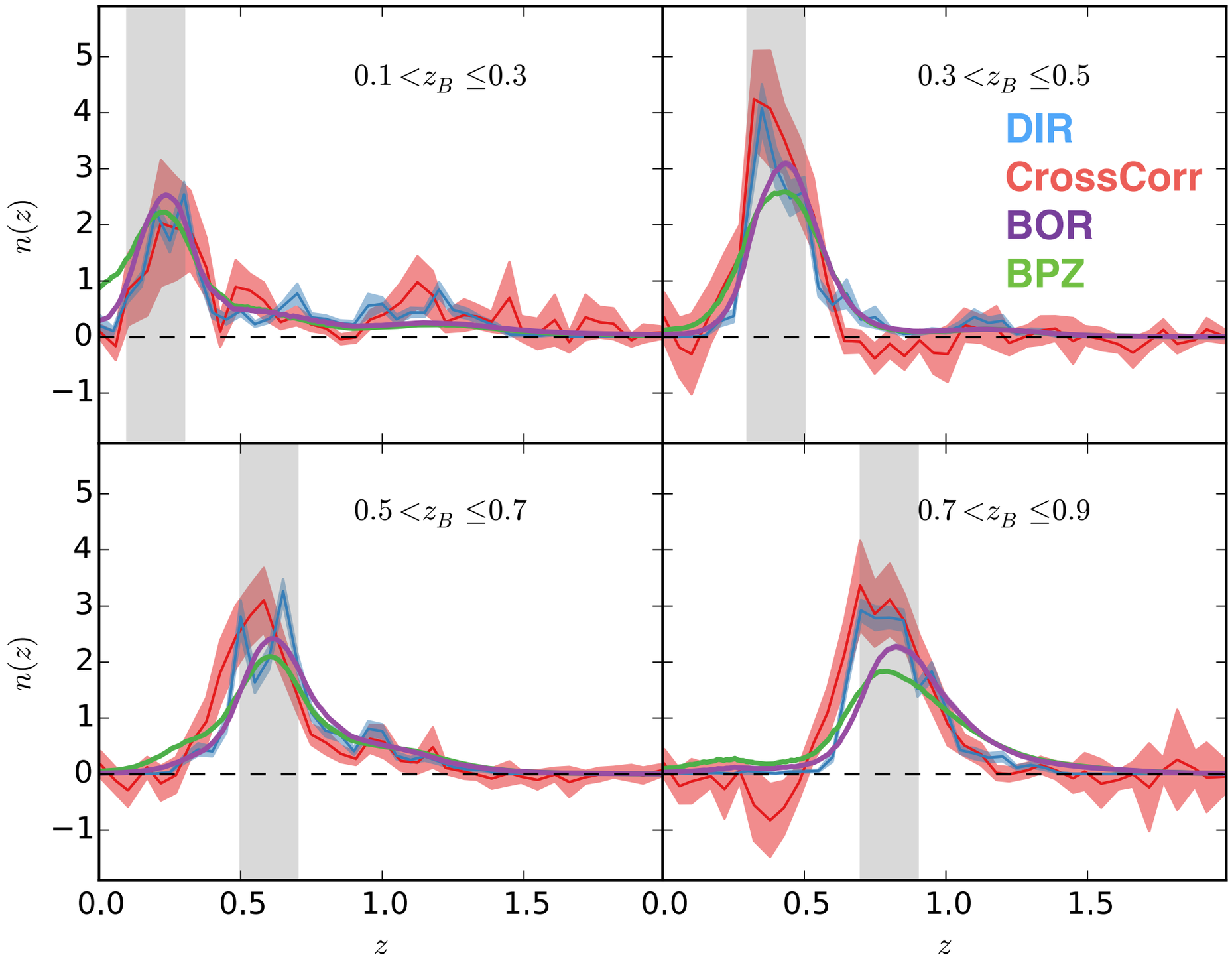
- Integrate *P(z)* from BPZ for each training galaxy as suggested by Bordoloi et al. (2010):

$$P_\Sigma(z_{\rm spec}) = \int_0^{z_{\rm spec}} P(z')\,{\rm d}z'$$



Hildebrandt, Viola et al. (2017)

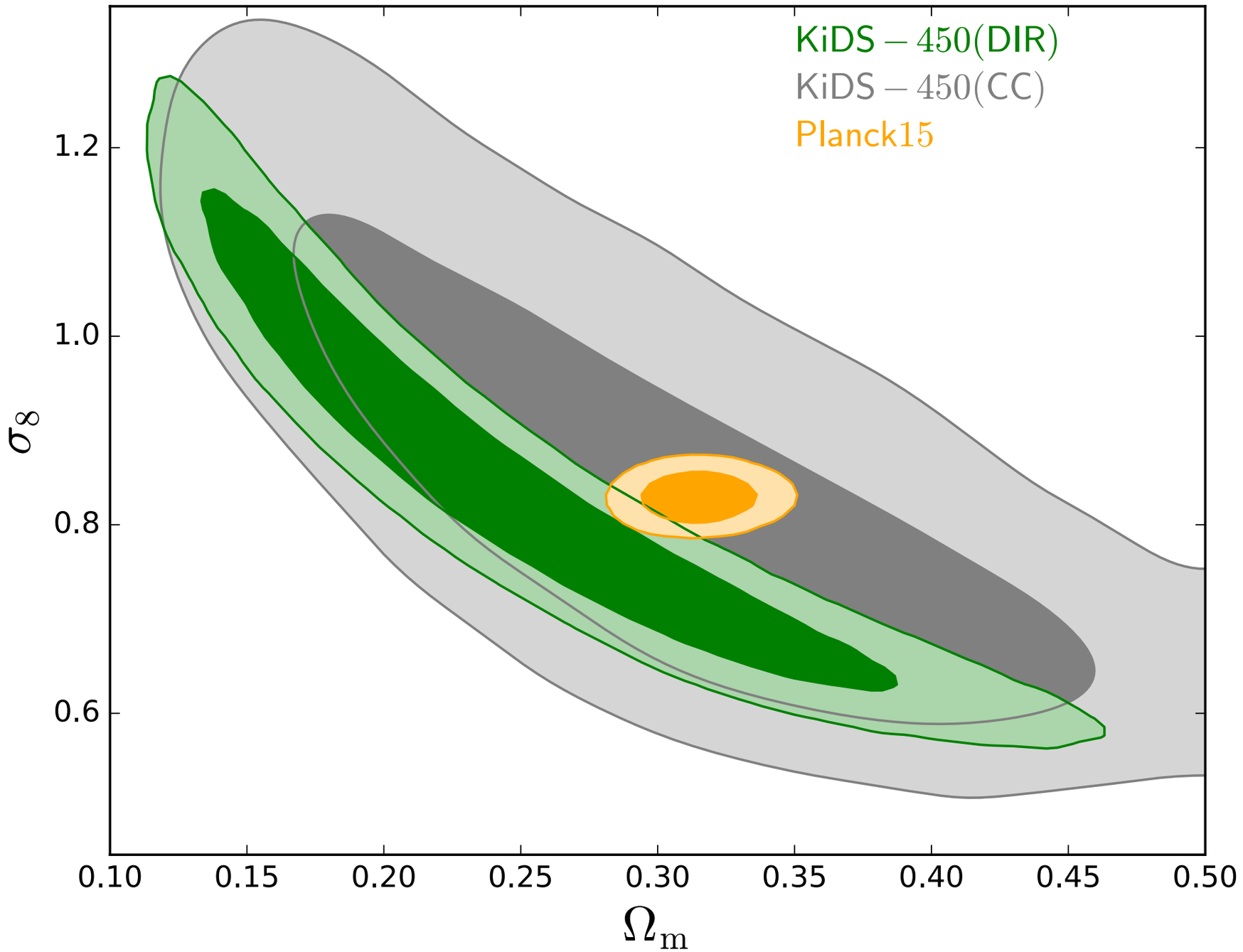
Photo-z calibration



For DIR method: $\sigma_{<z>}$~1% (no sample variance included)

Hildebrandt, Viola et al. (2017)

Photo-z calibration



Systematic error budget

Scenario	Relative error on S_8
Total error	5.2 %
Statistical error	3.7 %
Systematic error	3.6 %
Shear calibration	1.65 %
Intrinsic alignments	1.67 %
Baryon feedback	2.63 %
Photo-z errors (DIR)	**0.84 %**
Photo-z errors (CC)	**16.1 %**

- Sample variance in redshift calibration unaccounted for.
- Survey inhomogeneities unaccounted for.
- Need to improve a lot on CC.

VIPERS+VVDS

GAMA

SDSS+2dFLenS

KiDS-450

16000

8000

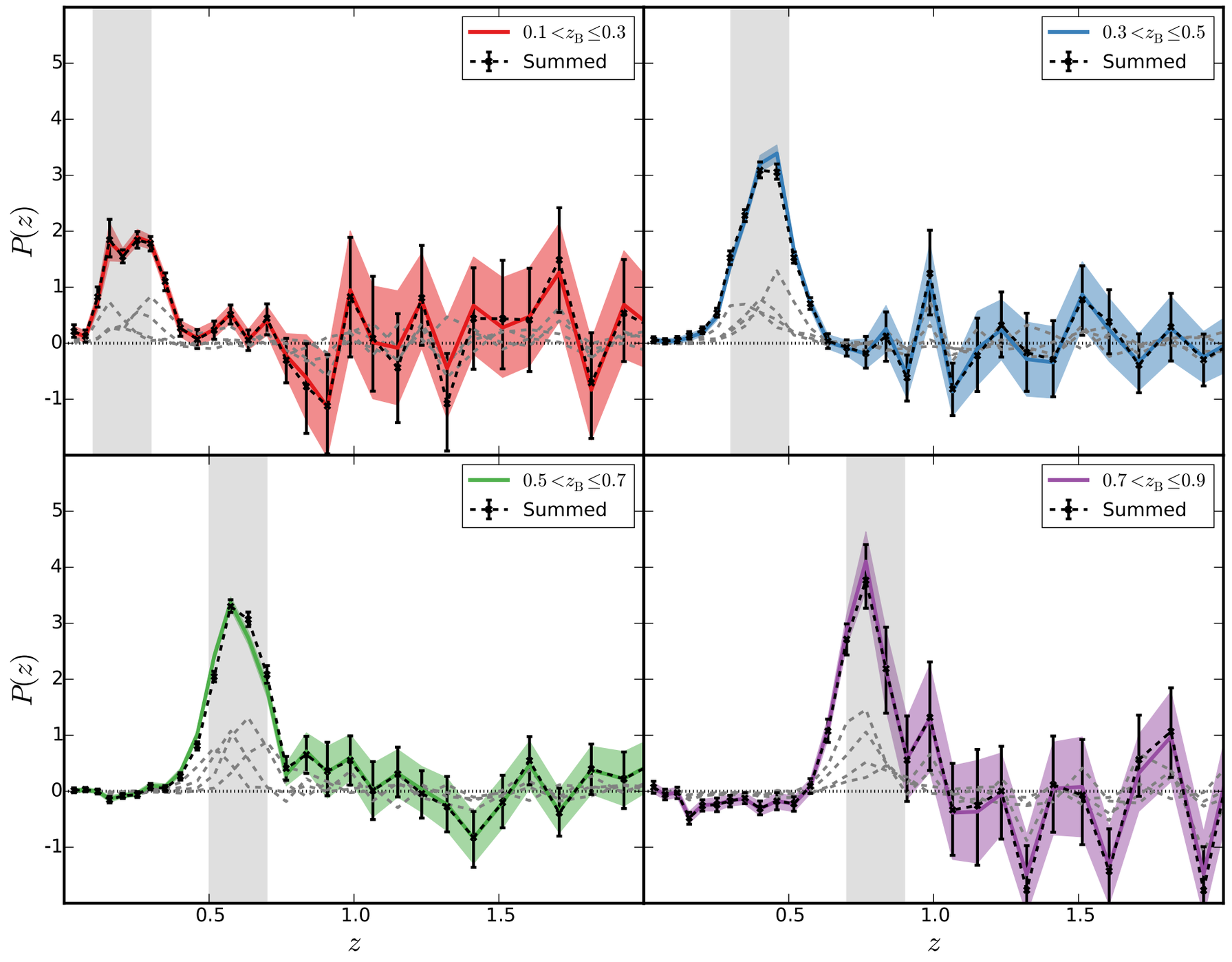
0

N

0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4

z

the-wizz using GAMA/SDSS

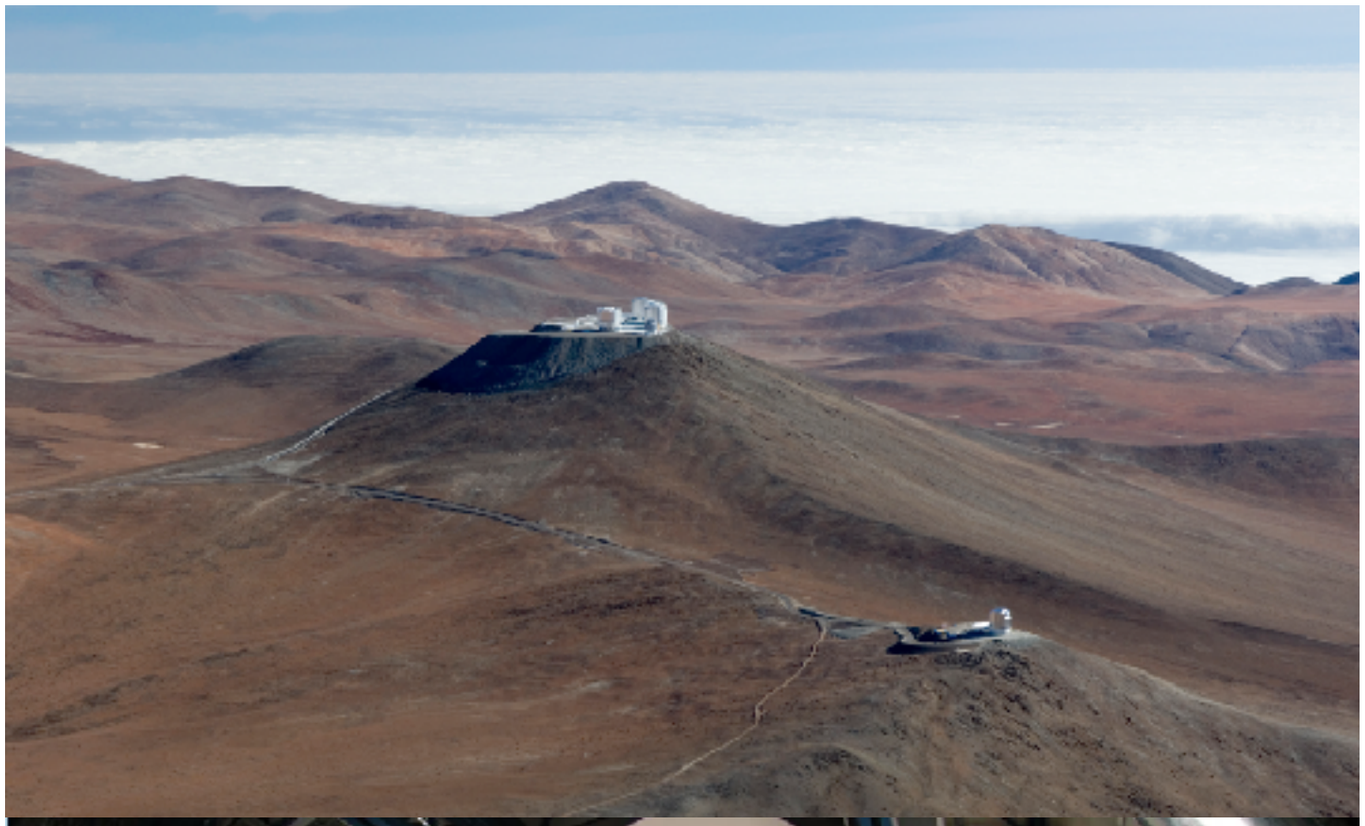


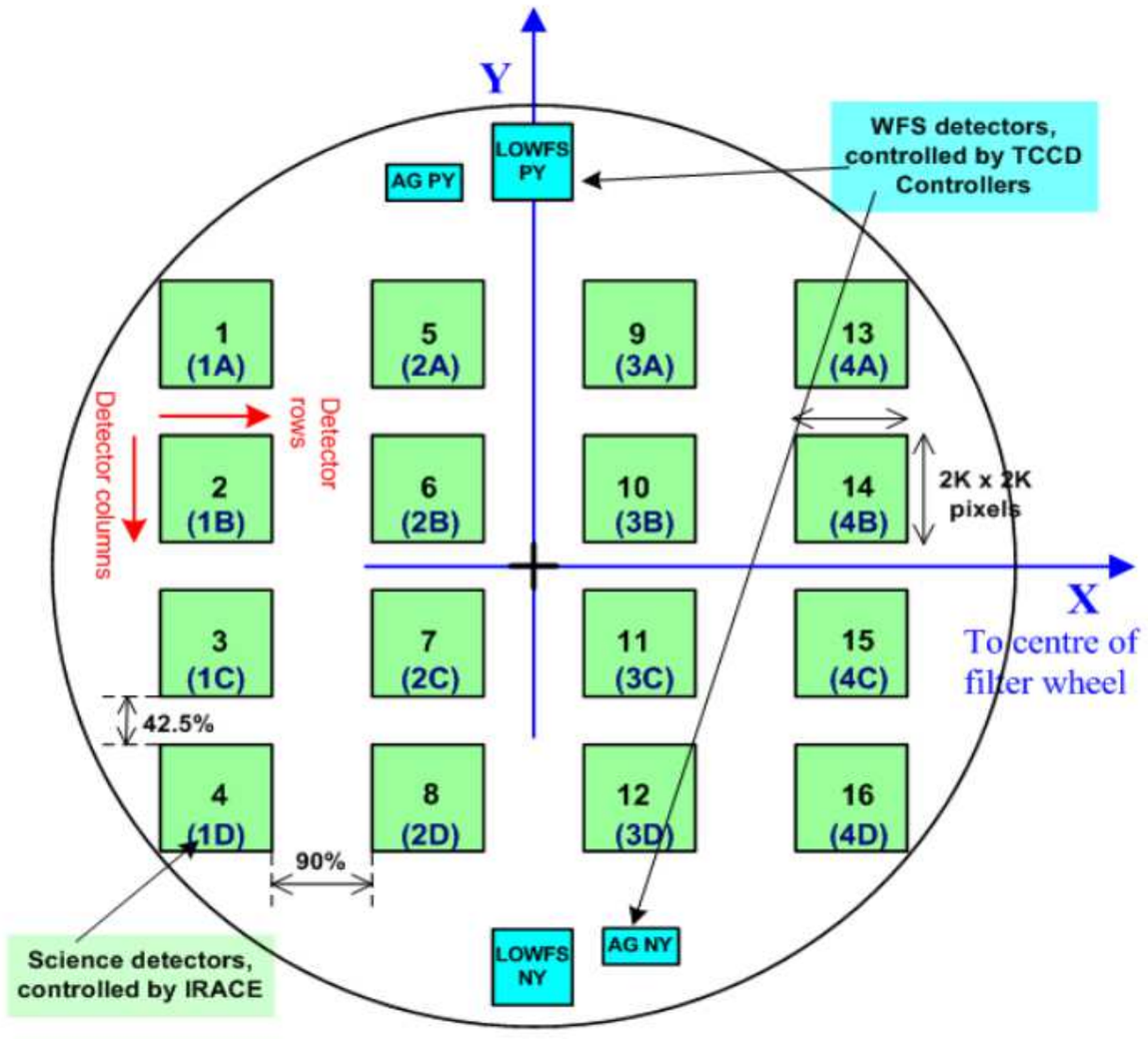
Morrison et al. (2017)

Lessons learned from KiDS-450

- Photo-z aren't that important! Don't use individual P(z).
- Sample variance important but hard to quantify.
- Dimensionality of magnitude space matters.
- Cross-corr. requires very good angular selection fct.
- Galaxy bias correction crucial for 4-band photo-z bins.
- Plan calibration early.
- Redundancy.

VISTA and VIRCAM

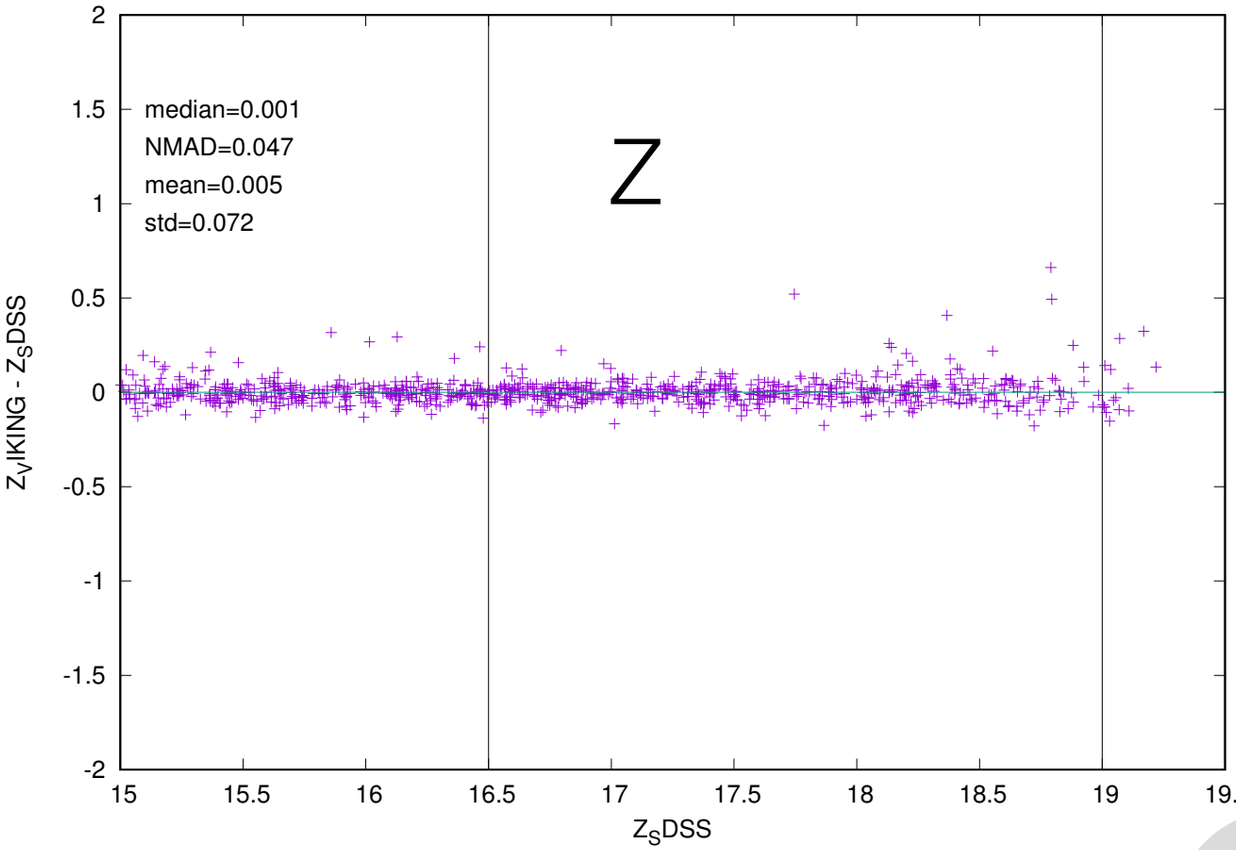


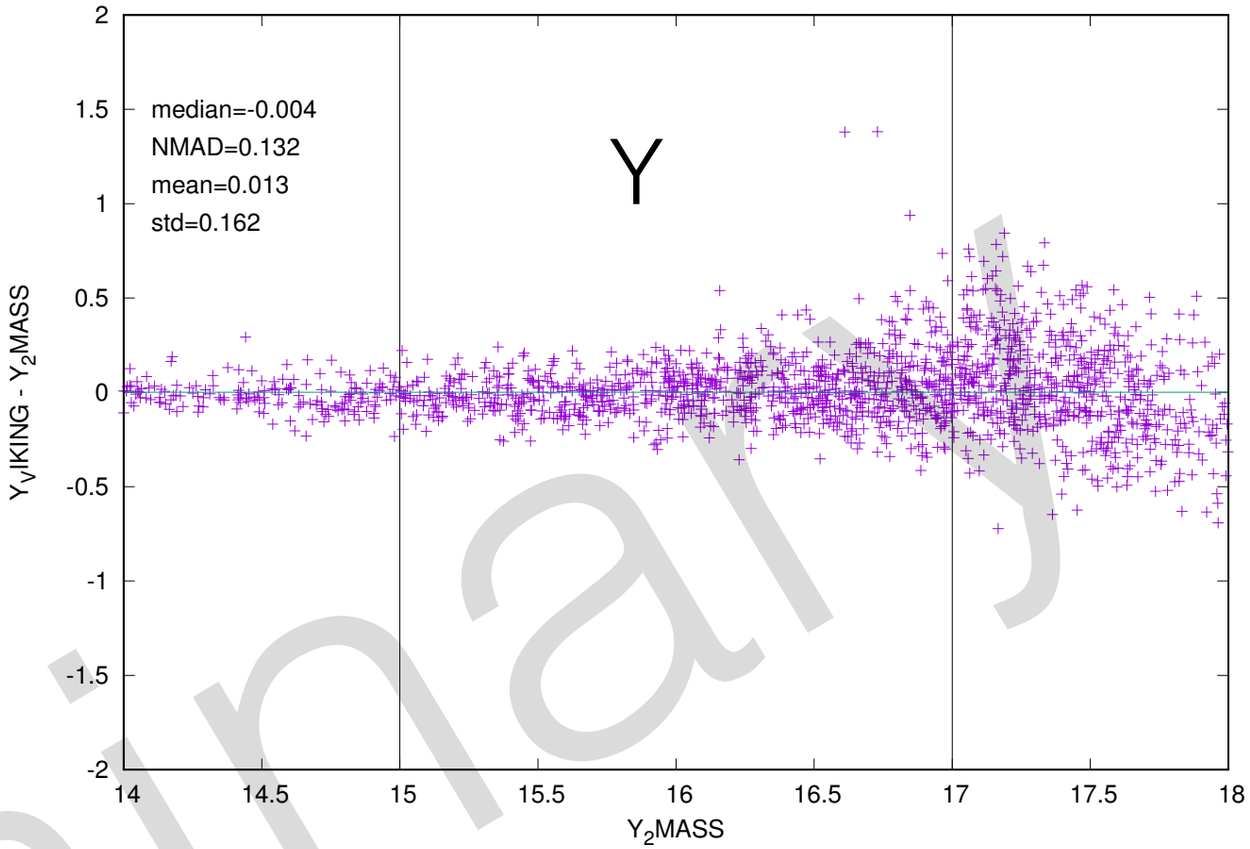


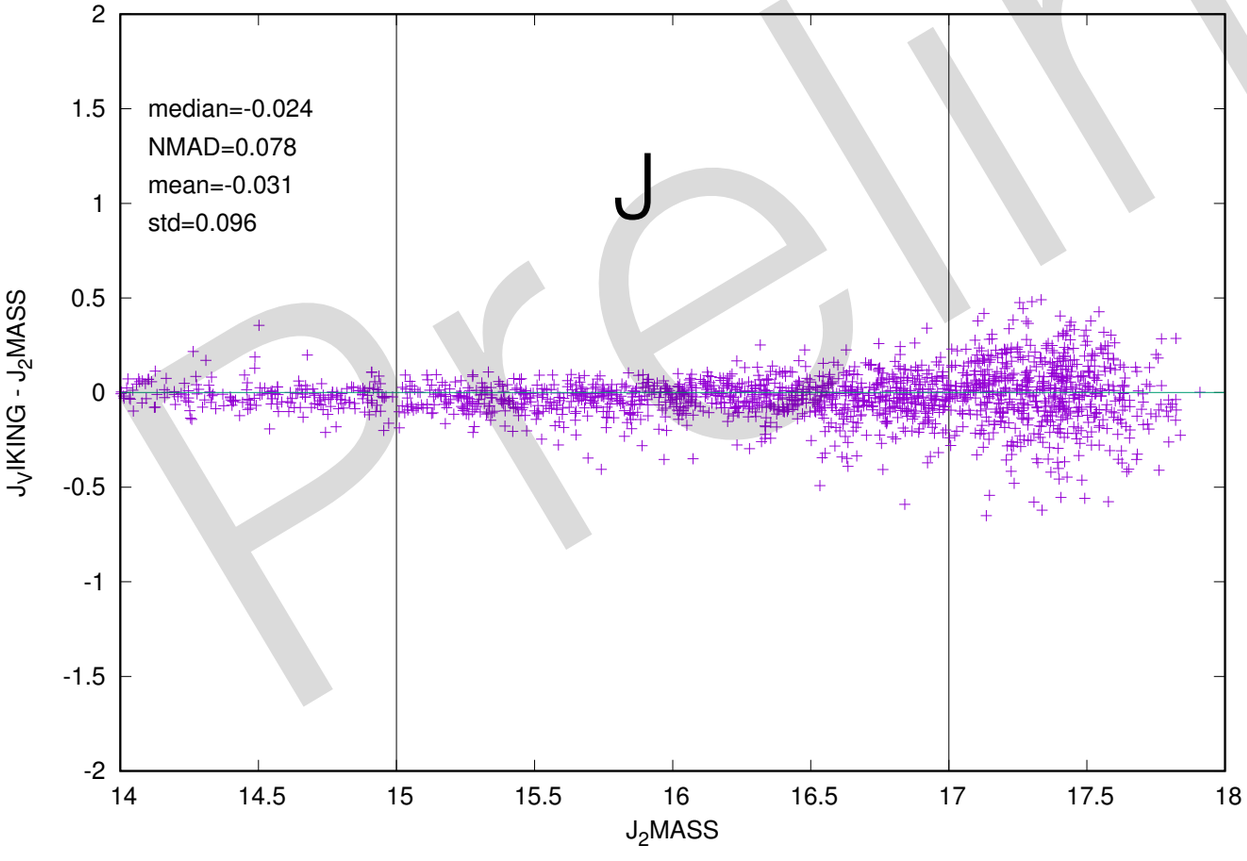
Data reduction

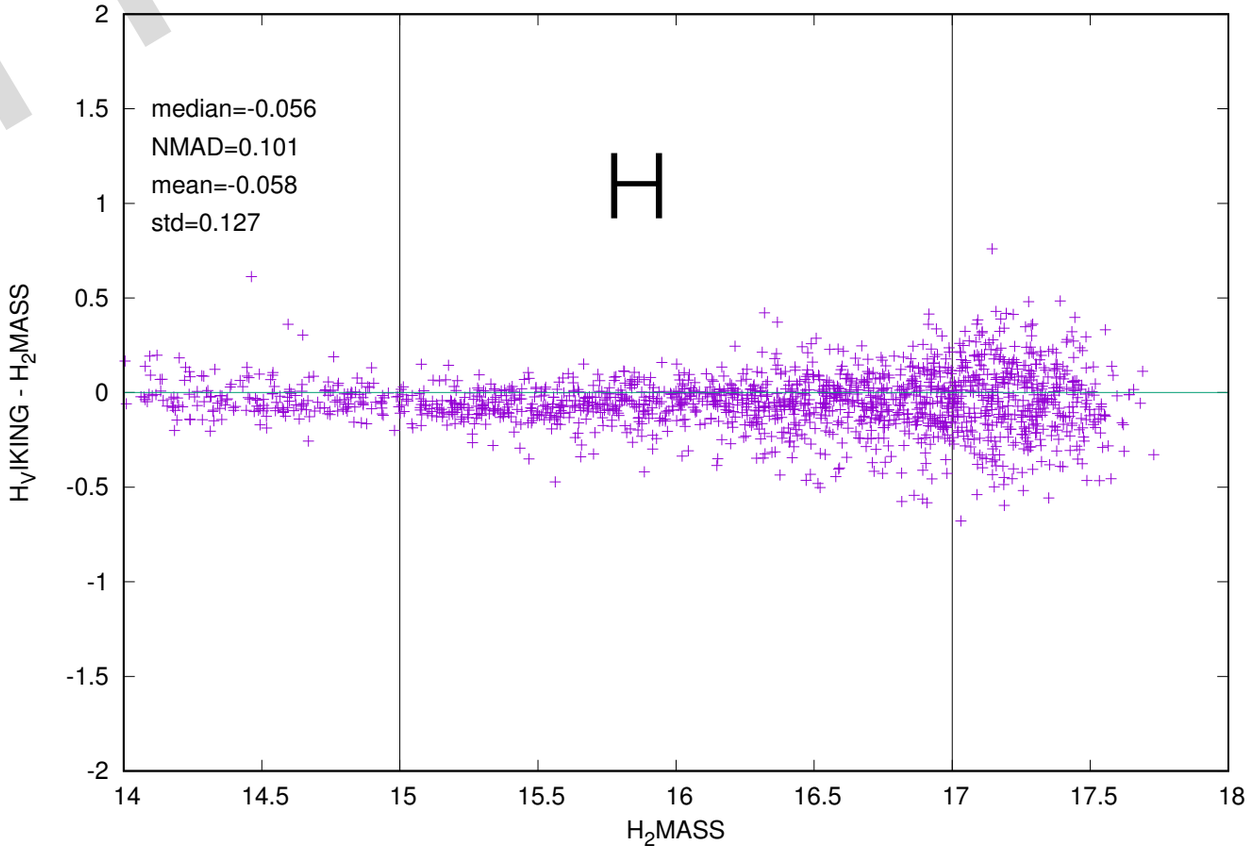
- Get pre-reduced data from CASU.
- Re-do background subtraction.
- Gaussianise PSF.
- Extract Gaussian aperture photometry on chip level.
- Combine multiple measurements of sources.
- Compare photometry to 2MASS/SDSS.
- Integrate 9-band photometry on KiDS tile level.

Photometric stability of 1-2.5% over survey area.

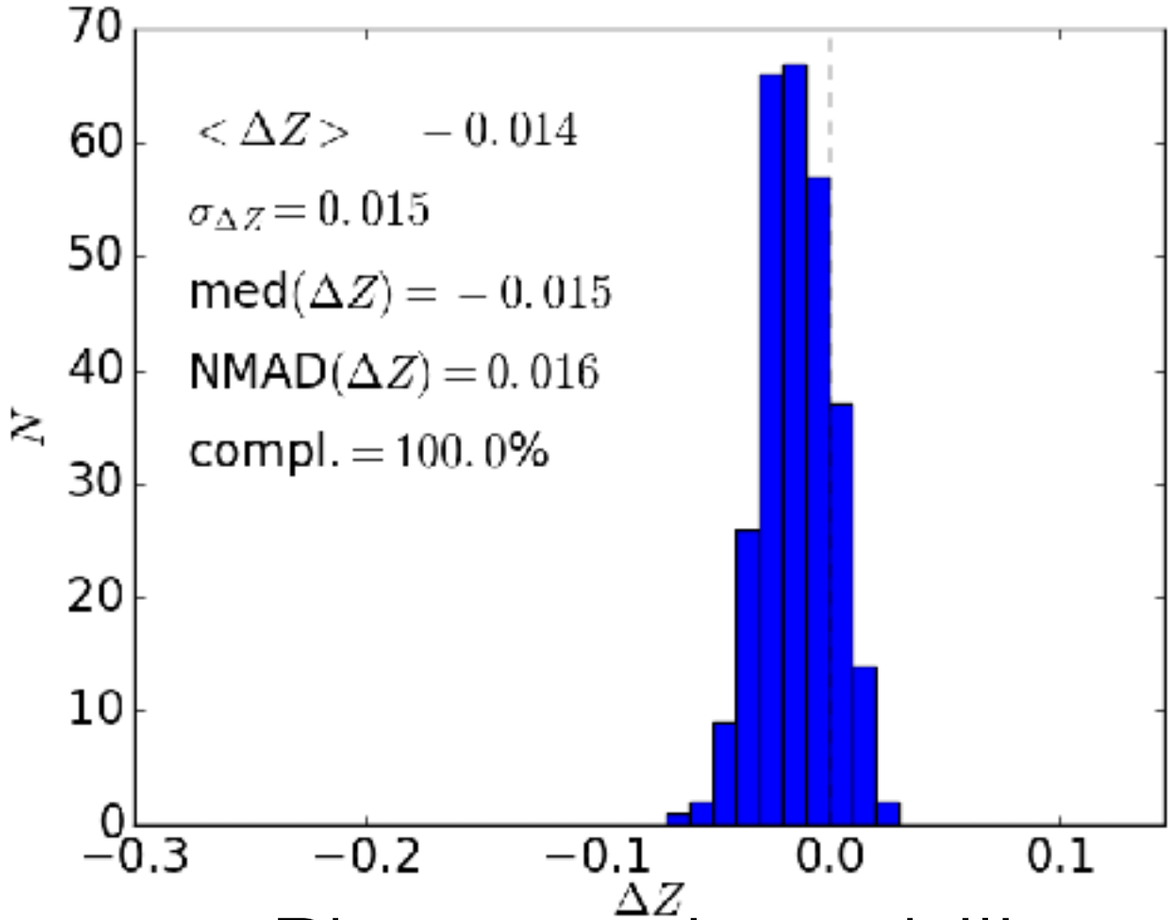


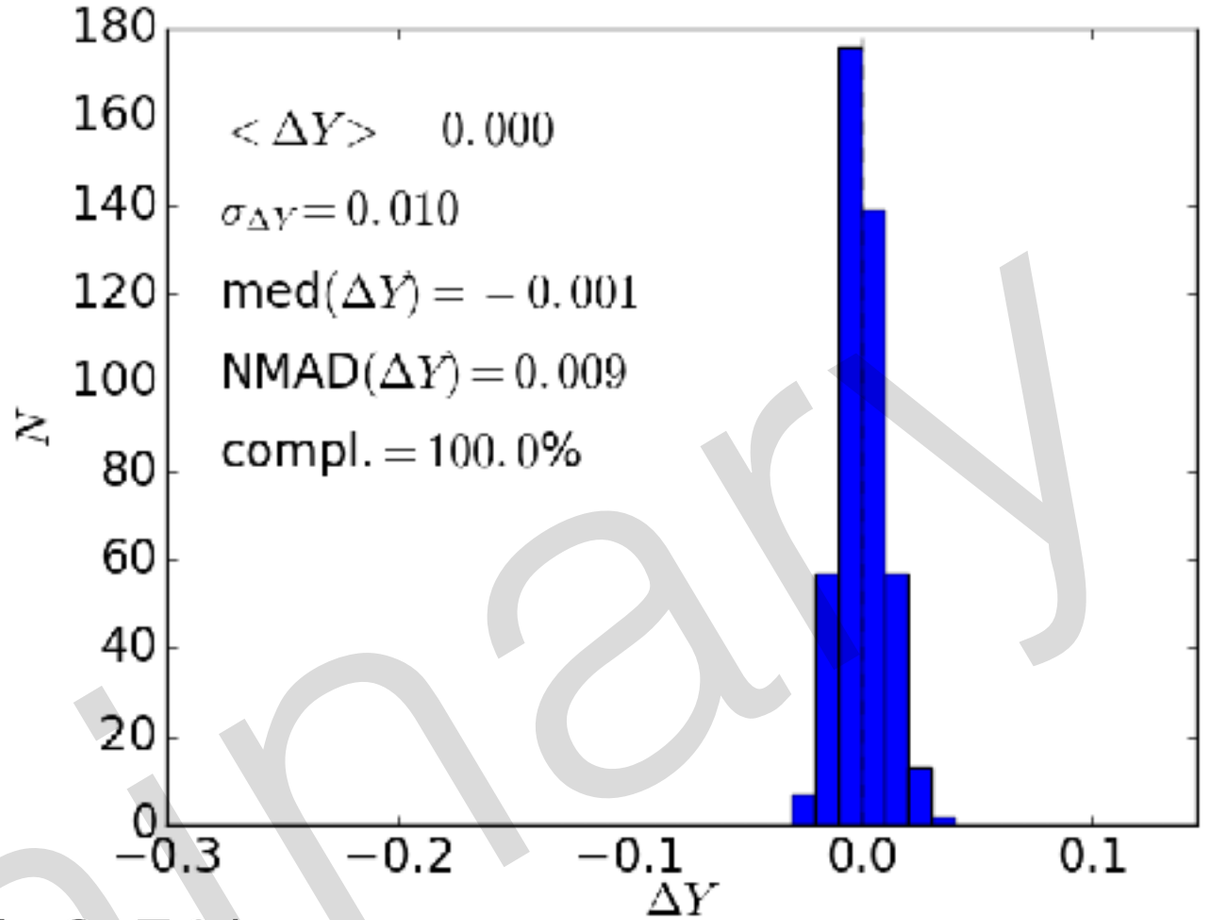




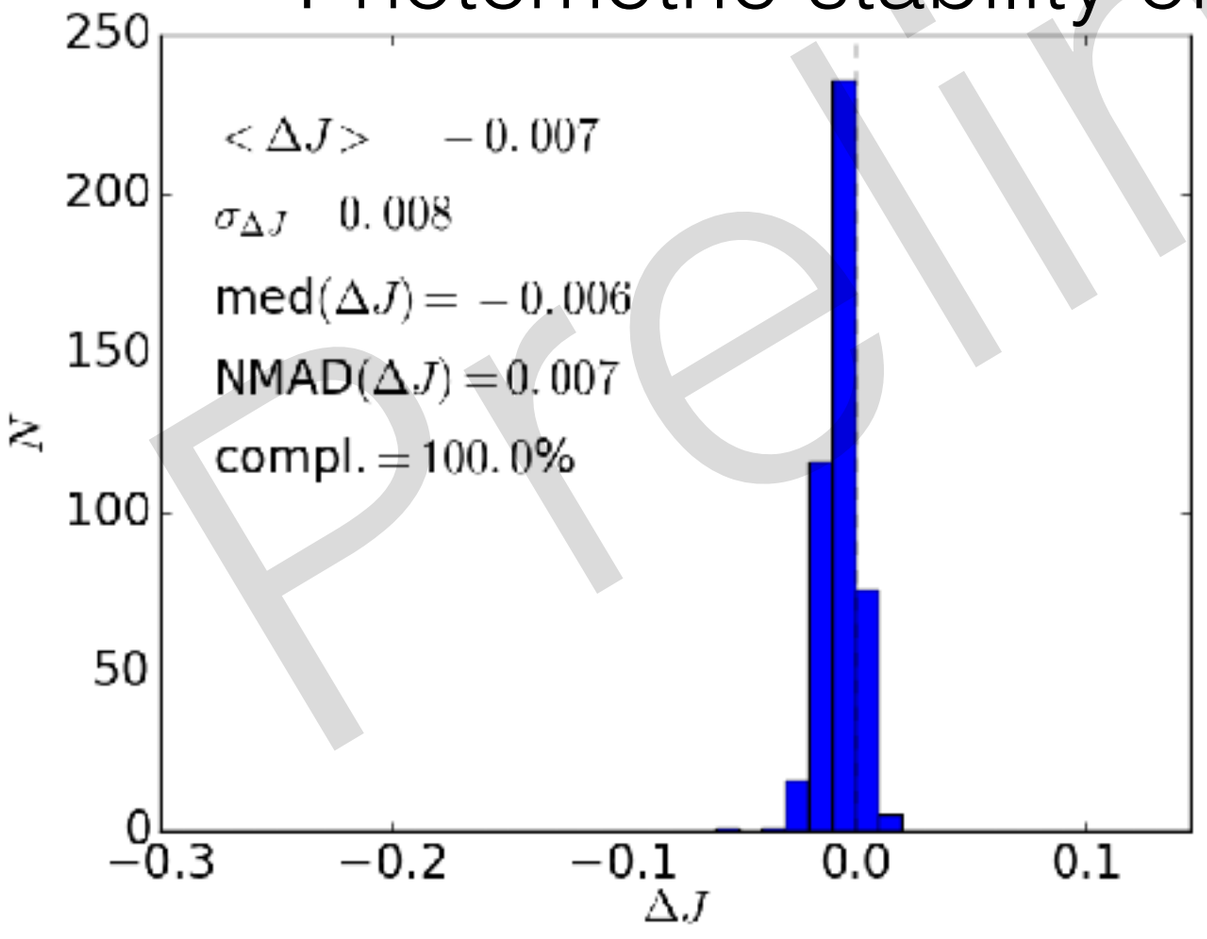


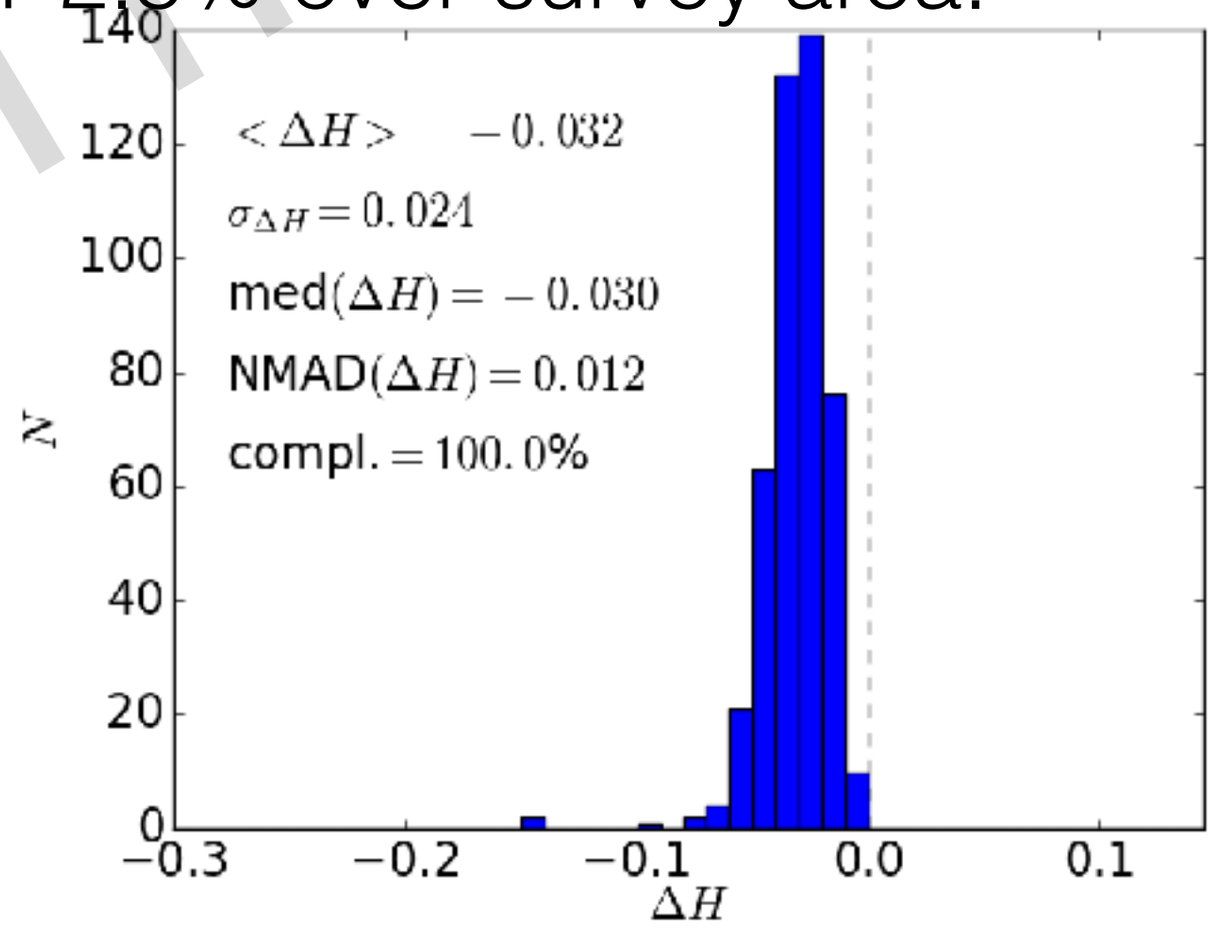
Preliminary





Photometric stability of 1-2.5% over survey area.





Preliminary

Integration of VIKING

1. NIR data on spec-z fields **DONE**

   A. Keep 4-band photo-z

   B. Re-calibrate in 9D magnitude space

2. 9-band photo-z on calibration fields **DONE**

   A. Add 5th tomographic bin

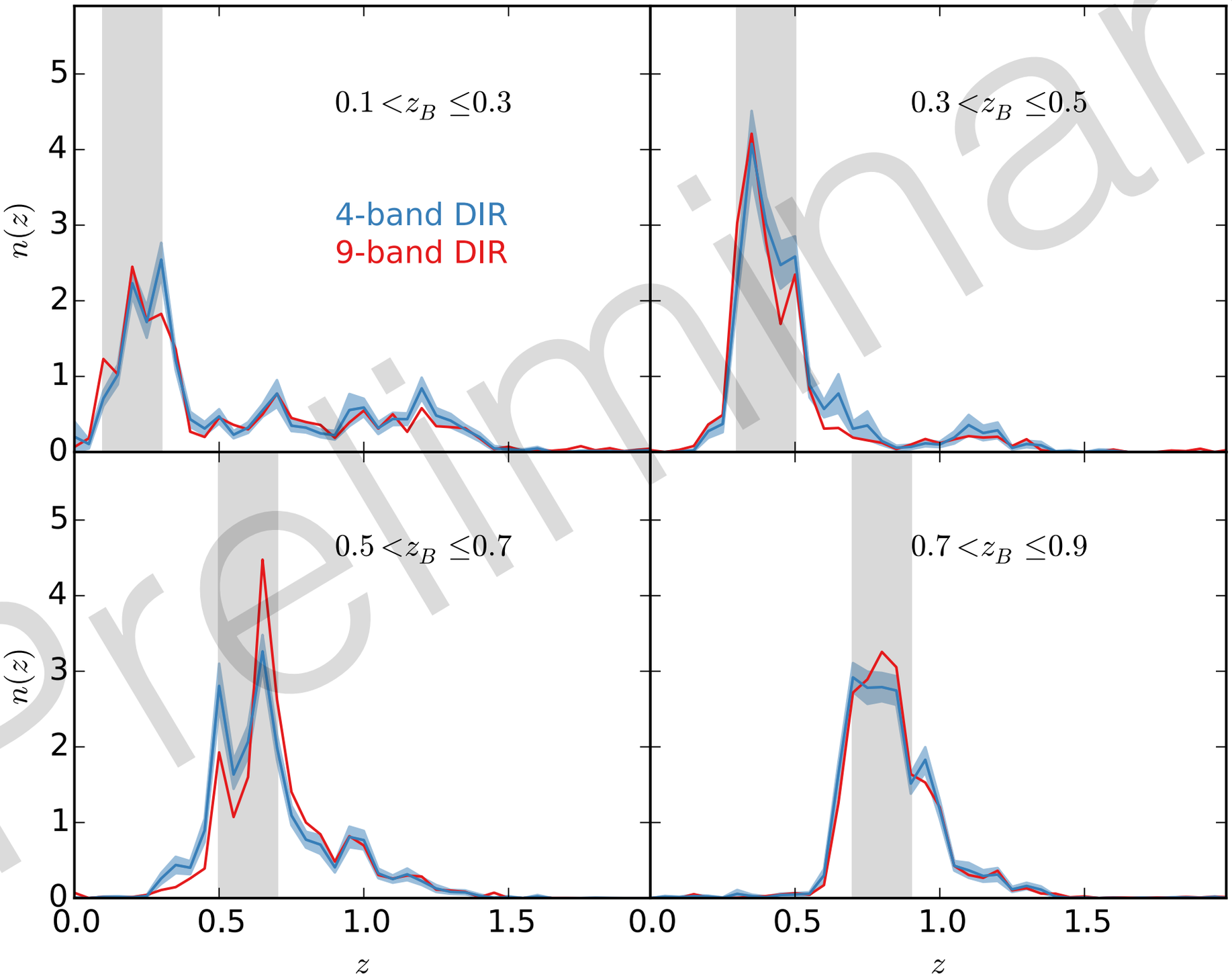
   B. Fisher analysis

3. Full NIR coverage => 5 bin tomography **IN PROGRESS**

Re-calibration in 9D

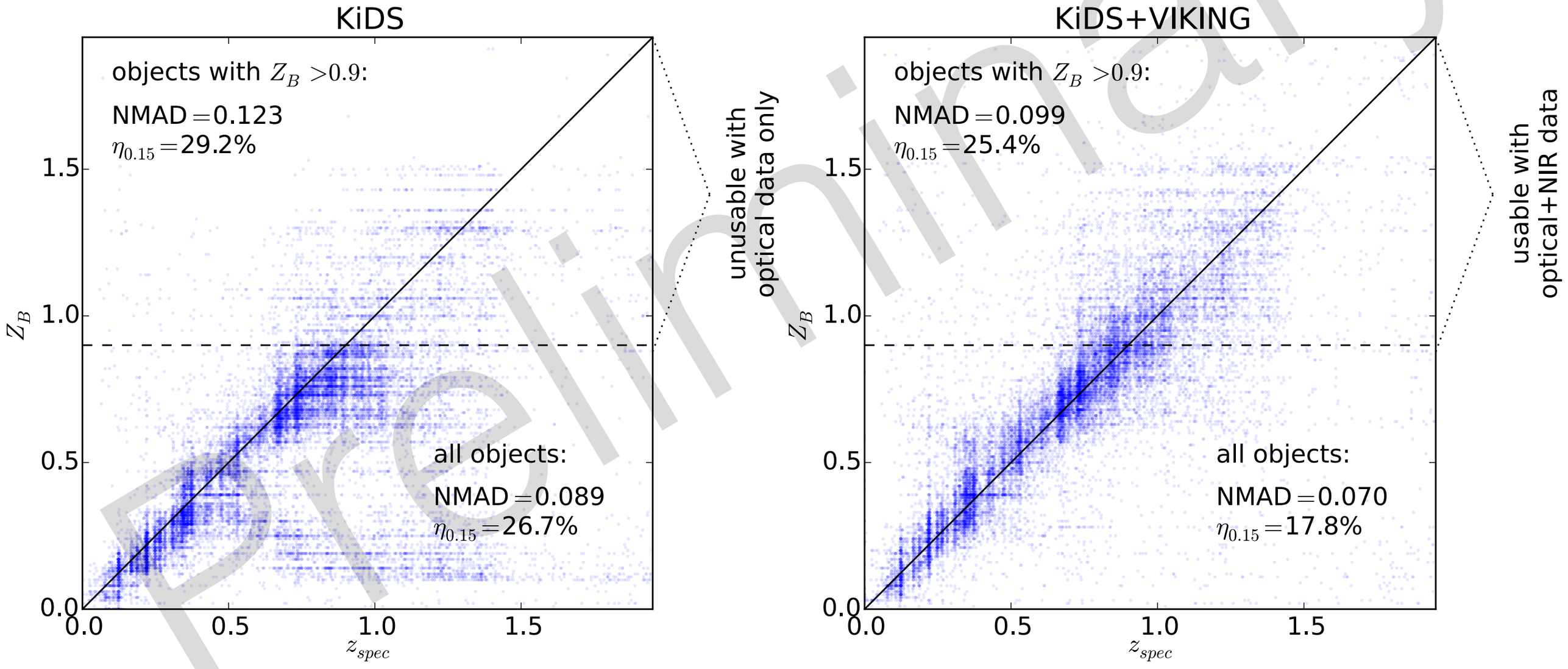
- Keep 4-band photo-z bins.
- Re-weight in 9D.
- 9D space is sparsely populated.
- Need robust estimator of density.
- How to treat non-detected objects?
- How to treat objects observed in <9 bands?

DIR redshift distributions



Preliminary

Photometric redshifts



Preliminary

4-band pz, 4-band calib. (KiDS-450)
4-band pz, 9-band calib.
9-band pz, 9-band calib.

$0.1<Z_B<0.3$

$N(z)$

z

Preliminary

4-band pz, 4-band calib. (KiDS-450)
4-band pz, 9-band calib.
9-band pz, 9-band calib.

$0.9<Z_B$

$N(z)$

z

Preliminary

Benefits of a 5th bin

- 5th tomographic bin with Z_B>0.9.
- ~1 gal/arcmin^2 (15% of all KiDS galaxies).
- High signal, large volume.
- Decrease S_8 error by ~20%, i.e. 3% error on S_8.
- Z_B>0.9 galaxy ~2.5x as valuable as average galaxy!
- **Need to understand redshift distribution and shear calibration!**

Outlook

- KiDS+VIKING 800deg^2 now, 1350deg^2 by end 2018
  => factor 2 improvement in statistical error w. 5th bin.

- New DIR calibration data to lower sample variance.

- CC with GAMA, BOSS, 2dFLenS.

- Proposal to cover VIPERS & VVDS with VISTA.

- Lower $\sigma_{<z>}$ from ~1% to Euclid requirement of 0.2%.