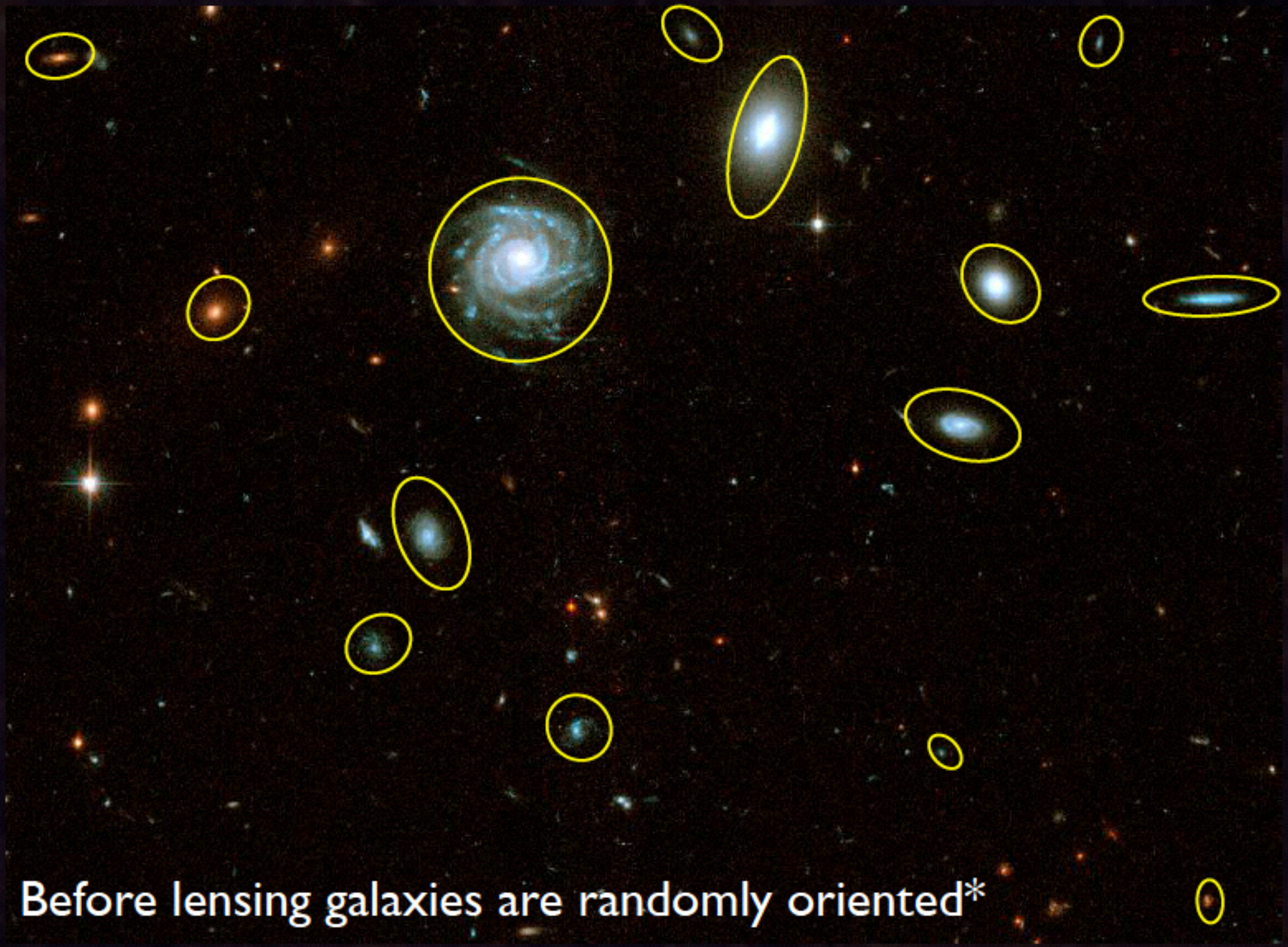
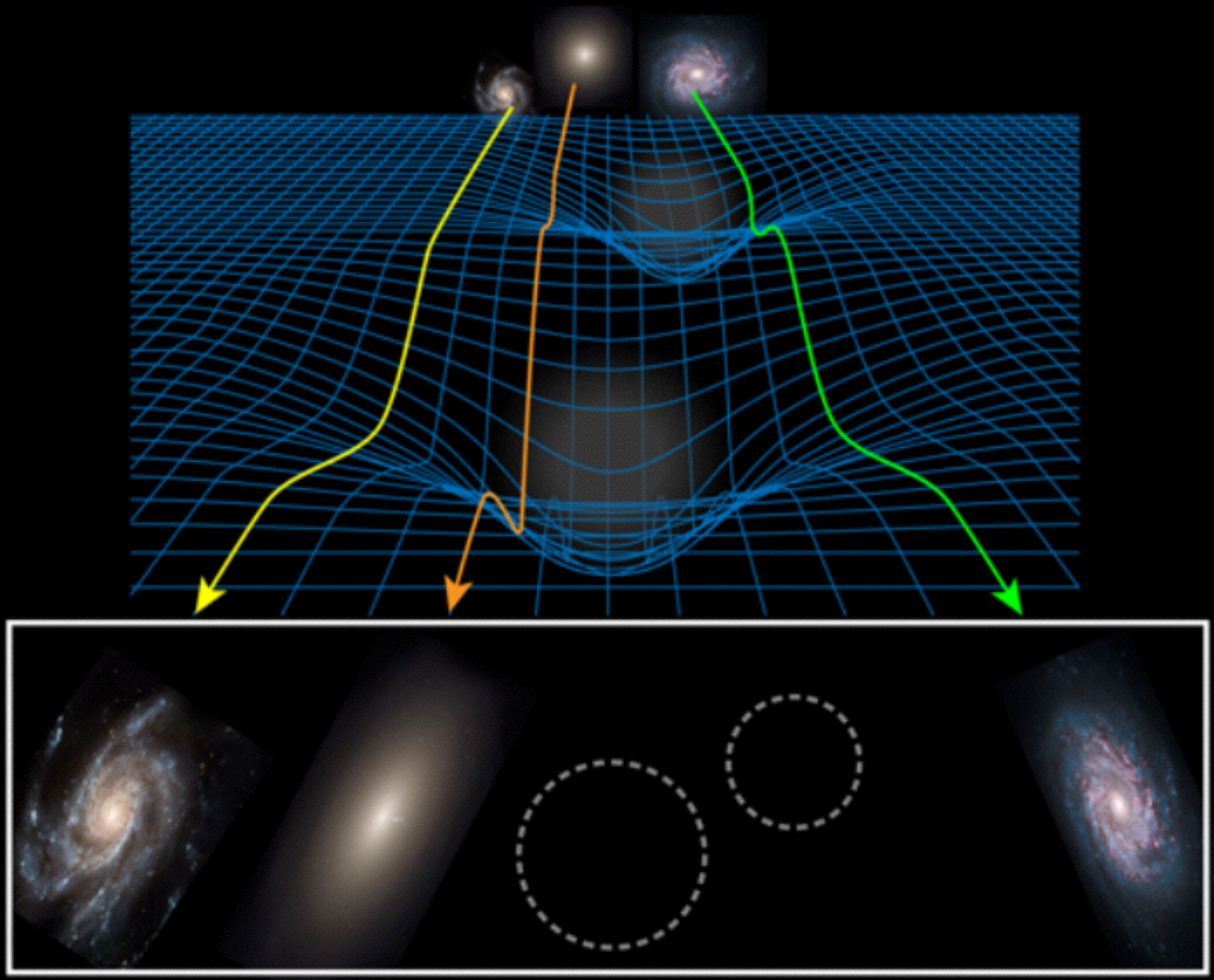
KiDS weak lensing with low and high resolution data

Alexandra Amon
University of Edinburgh

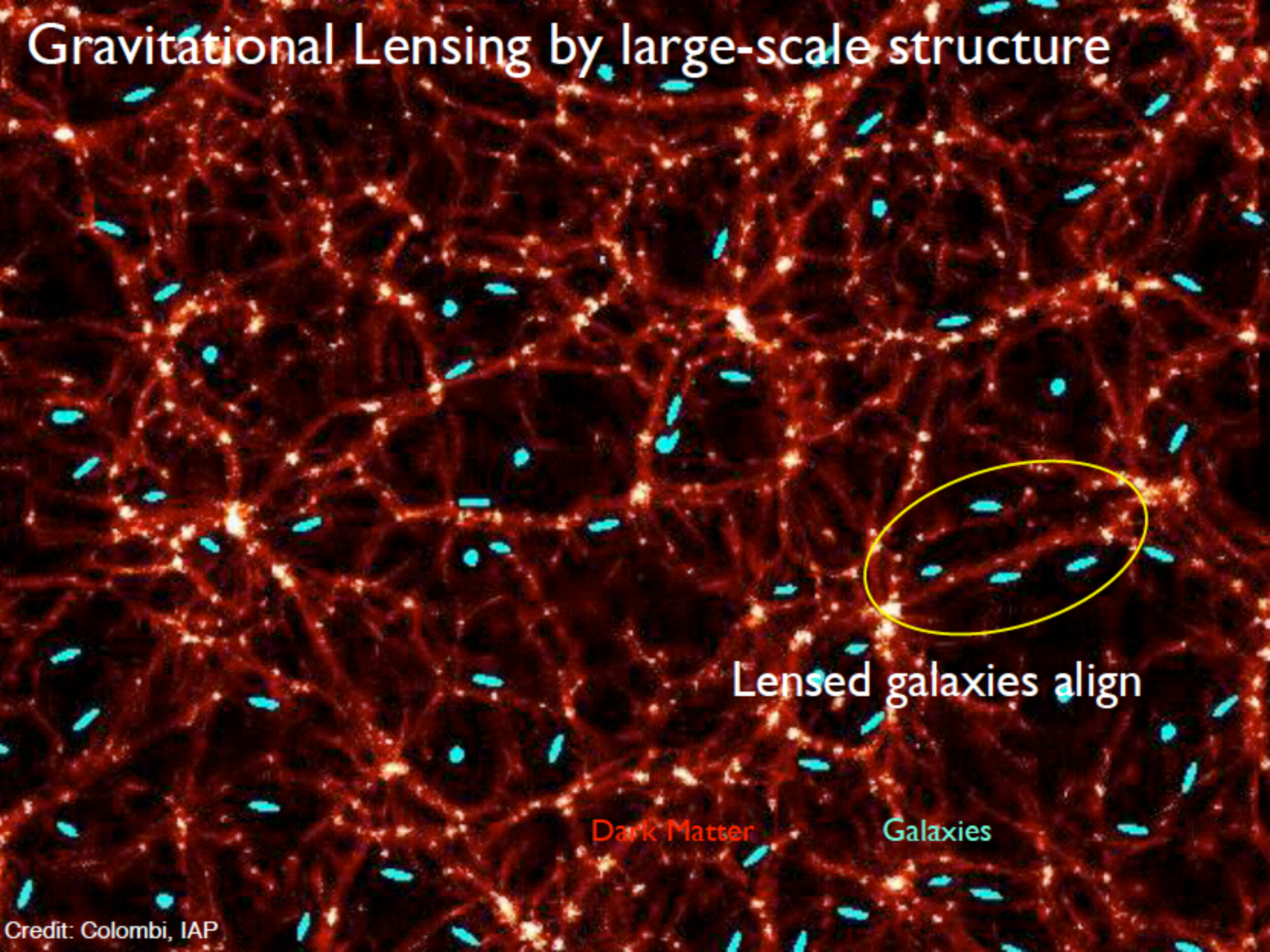
Prof. Catherine Heymans and Prof. Chris Blake and KiDS Collaboration


Before lensing galaxies are randomly oriented*



Credit: Stonebraker, APS

Gravitational Lensing by large-scale structure

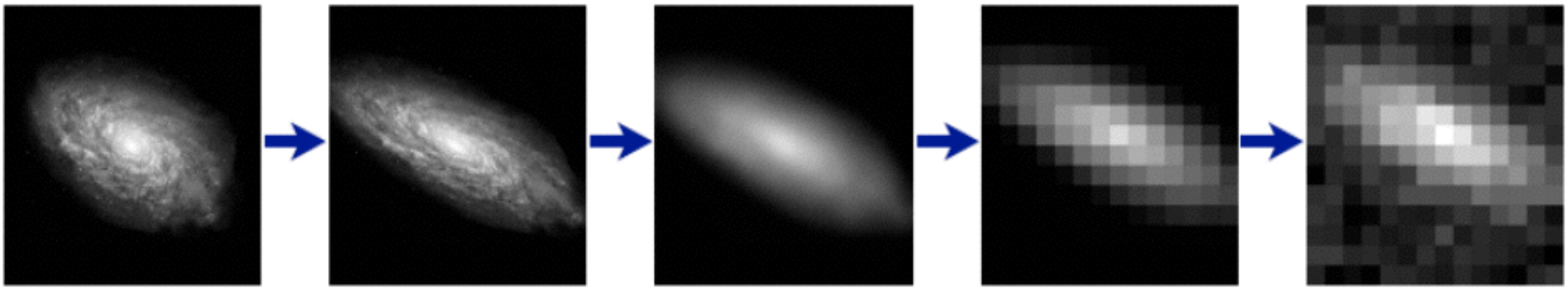


Lensing changes the shape of galaxies by 1%

Telescopes and the atmosphere change their shapes by 15%

The Forward Process.

Galaxies: Intrinsic galaxy shapes to measured image:



Intrinsic galaxy (shape unknown)

Gravitational lensing causes a ***shear (g)***

Atmosphere and telescope cause a convolution

Detectors measure a pixelated image

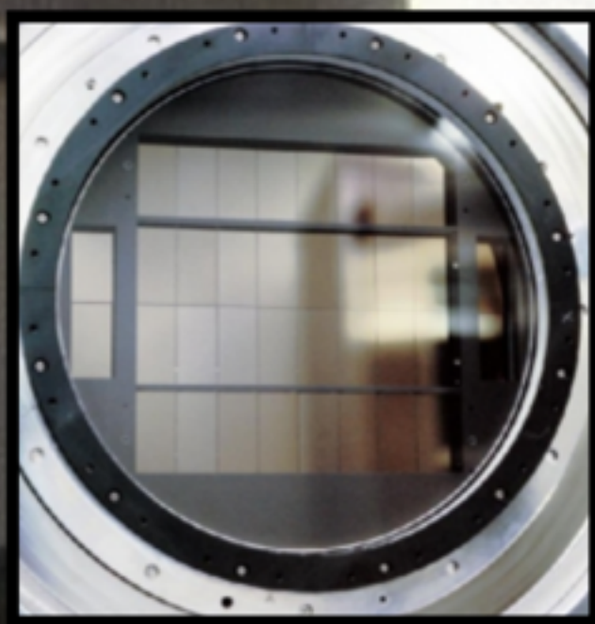
Image also contains noise

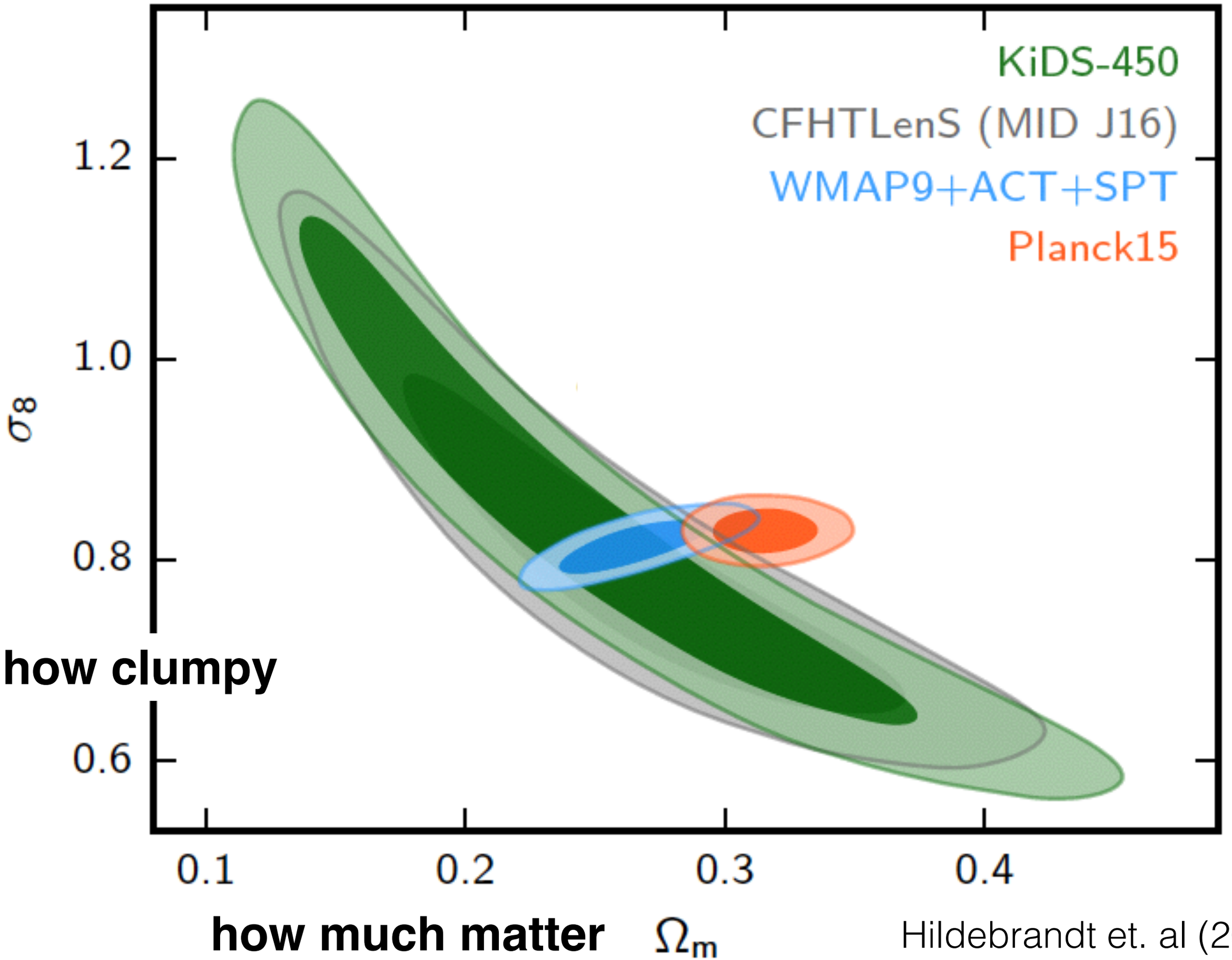
Need high resolution data!

Bridle et al.

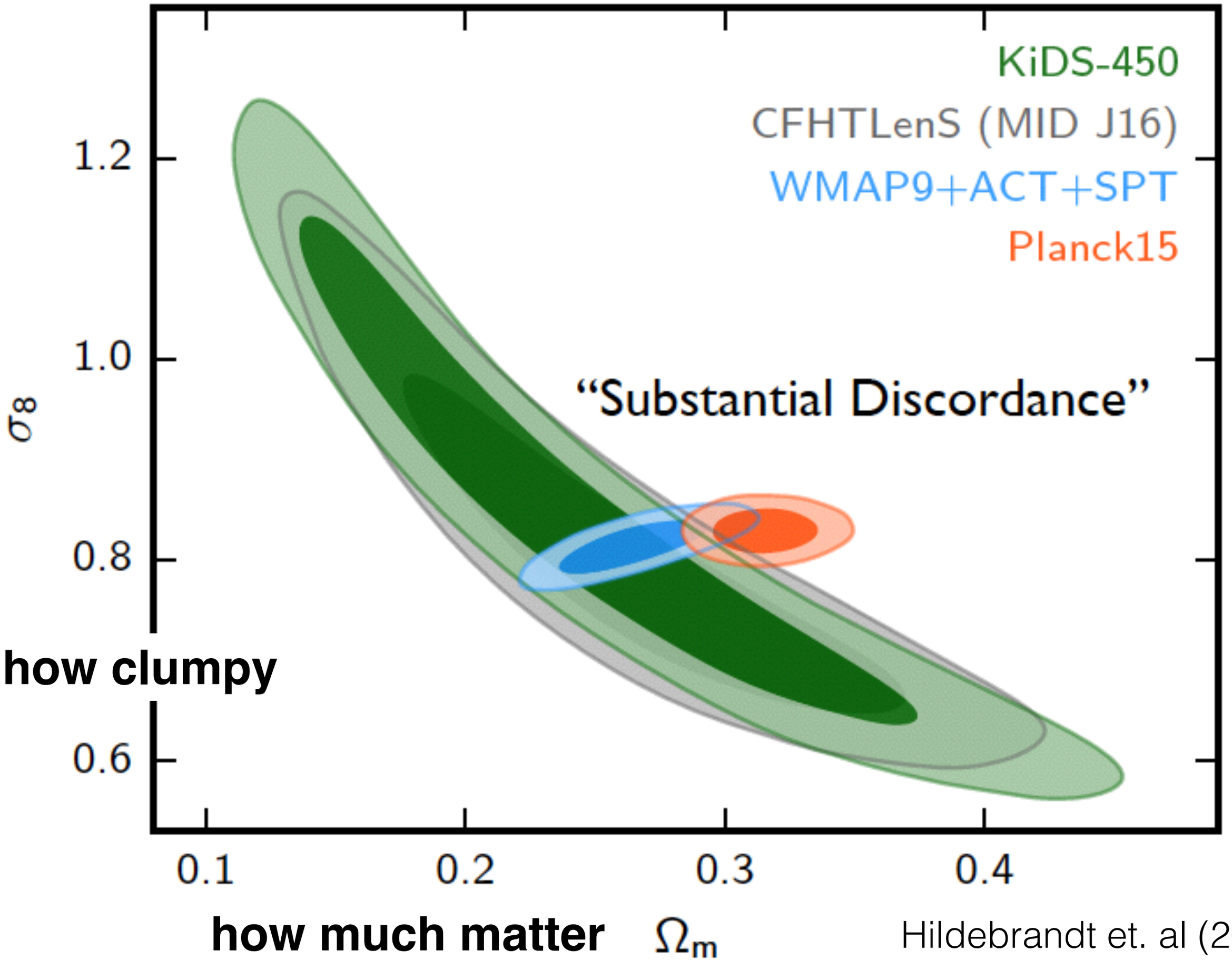
KiDS

- 1500 sq. deg. survey
- VLT Survey Telescope (VST)
- four bands: *ugri*
- same footprint as VIKING
- overlap with 2dF, GAMA, SDSS, COSMOS, DEEP2



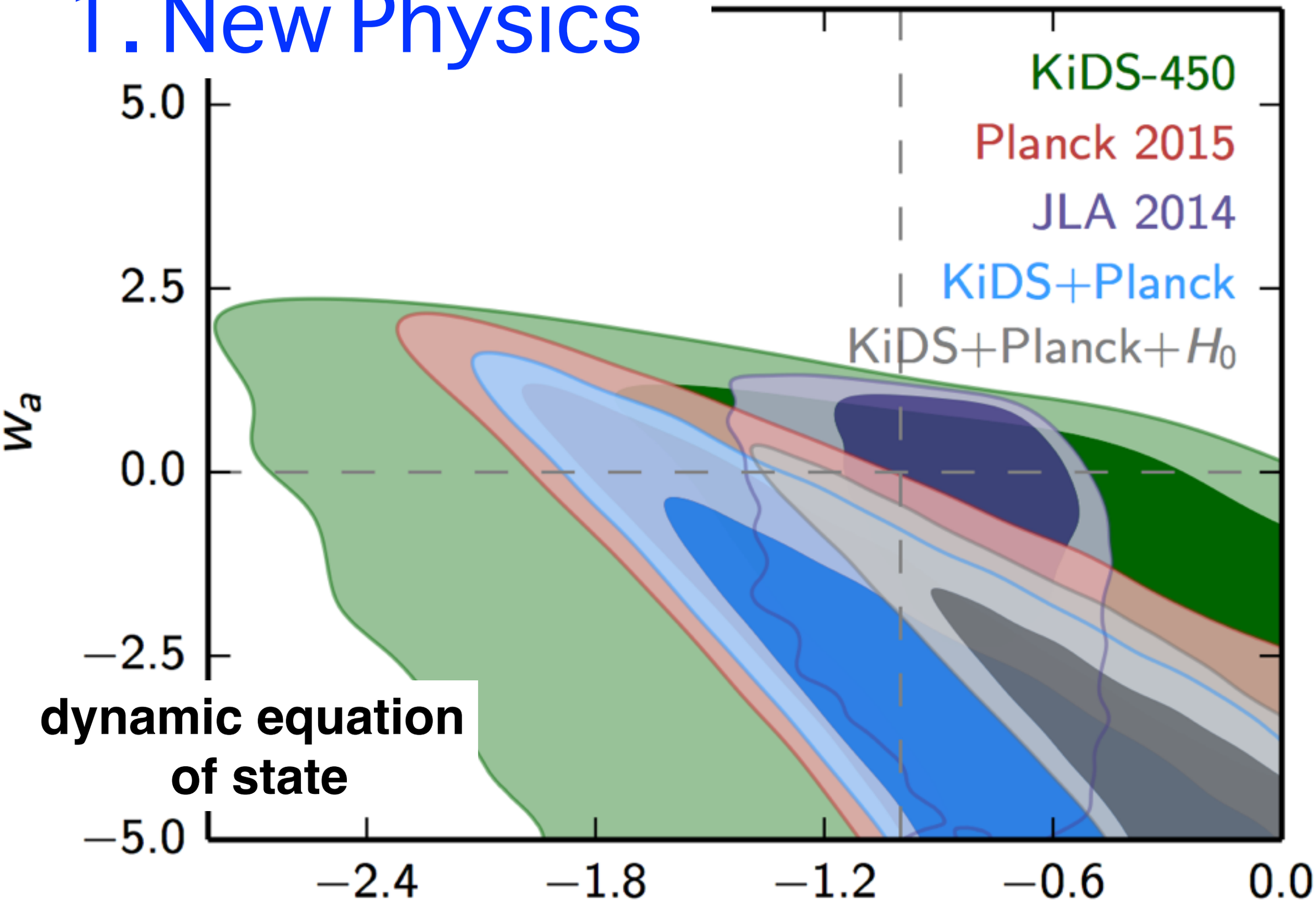


Hildebrandt et. al (2016)



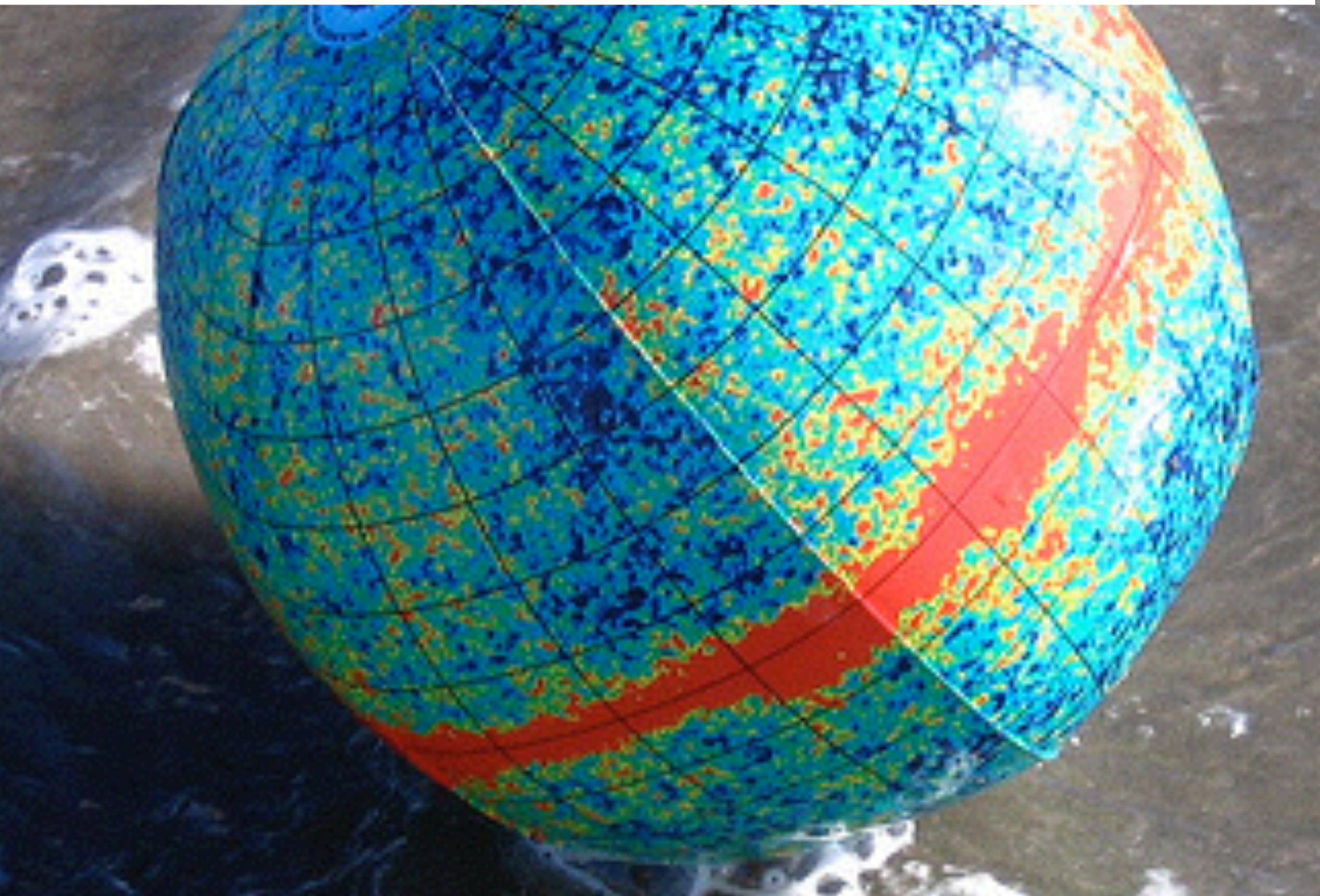
Hildebrandt et. al (2016)

1. New Physics



Joudaki et. al (2016)

2. Planck has missed something?



3. KiDS has missed something?

OBSERVATIONS

telescope design
observing conditions

PHOTOMETRY CALIBRATION

4 methods

SHAPE MEASUREMENT

new shape measurement code
image simulations

COVARIANCE

analytic prescription
mock simulations

REDUNDANCY

2 image processing pipelines
2 correlation function estimators
BLINDING

3. KiDS has missed something?

OBSERVATIONS

telescope design
observing conditions

PHOTOMETRY CALIBRATION

4 methods

SHAPE MEASUREMENT

new shape measurement code
image simulations

COVARIANCE

analytic prescription
mock simulations

REDUNDANCY

2 image processing pipelines
2 correlation function estimators
BLINDING

3. KiDS has missed something?

OBSERVATIONS

telescope design
observing conditions

PHOTOMETRY CALIBRATION

4 methods

SHAPE MEASUREMENT

new shape measurement code
image simulations

COVARIANCE

analytic prescription
mock simulations

REDUNDANCY

2 image processing pipelines
2 correlation function estimators
BLINDING

3. KiDS has missed something?

OBSERVATIONS

telescope design
observing conditions

PHOTOMETRY CALIBRATION

4 methods

SHAPE MEASUREMENT

new shape measurement code
image simulations

COVARIANCE

analytic prescription
mock simulations

REDUNDANCY

2 image processing pipelines
2 correlation function estimators
BLINDING

3. KiDS has missed something?

OBSERVATIONS

telescope design
observing conditions

PHOTOMETRY CALIBRATION

4 methods

SHAPE MEASUREMENT

new shape measurement code
image simulations

COVARIANCE

analytic prescription
mock simulations

REDUNDANCY

2 image processing pipelines
2 correlation function estimators
BLINDING

3. KiDS has missed something?

OBSERVATIONS

telescope design
observing conditions

PHOTOMETRY CALIBRATION

4 methods

SHAPE MEASUREMENT

new shape measurement code
image simulations

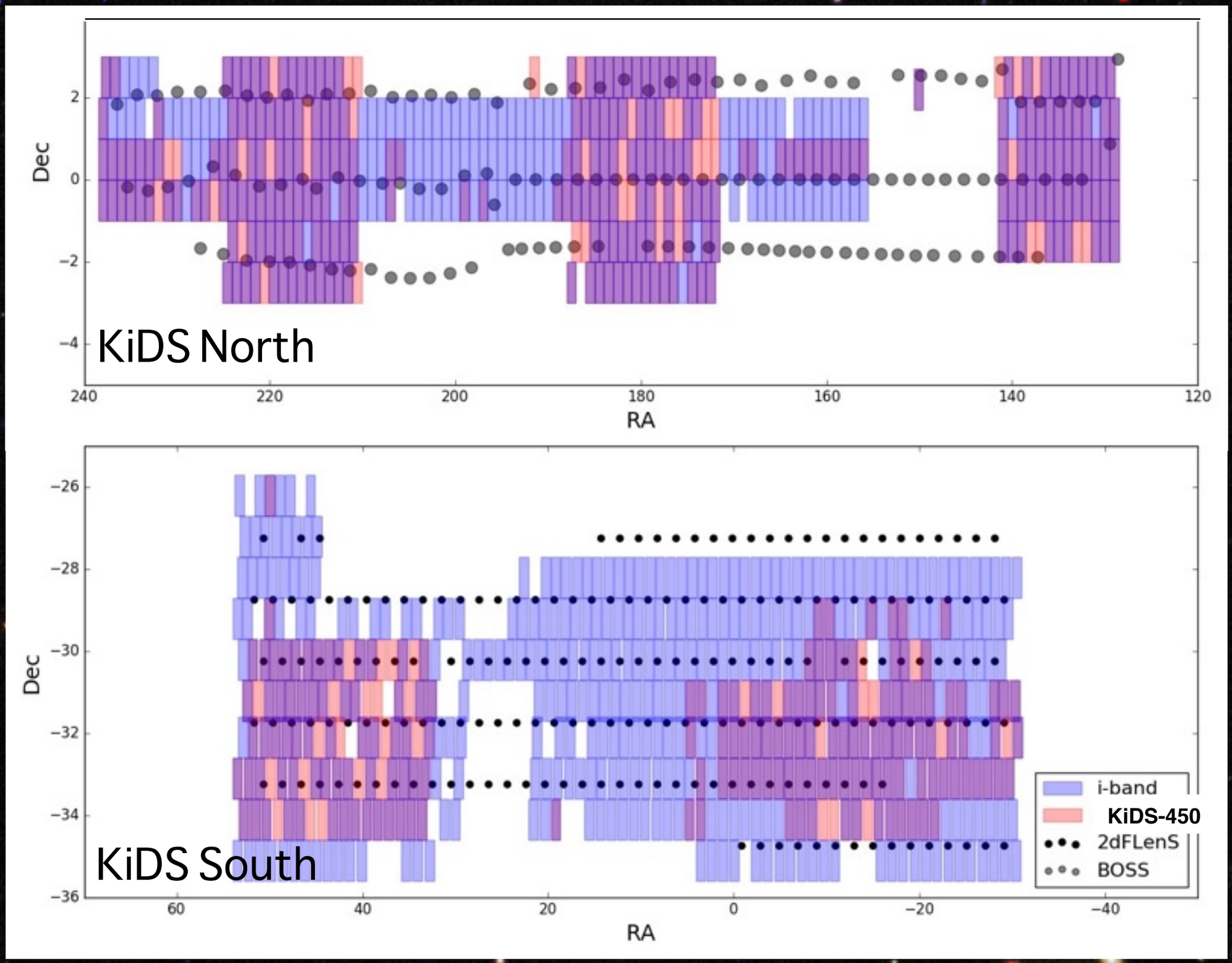
COVARIANCE

analytic prescription
mock simulations

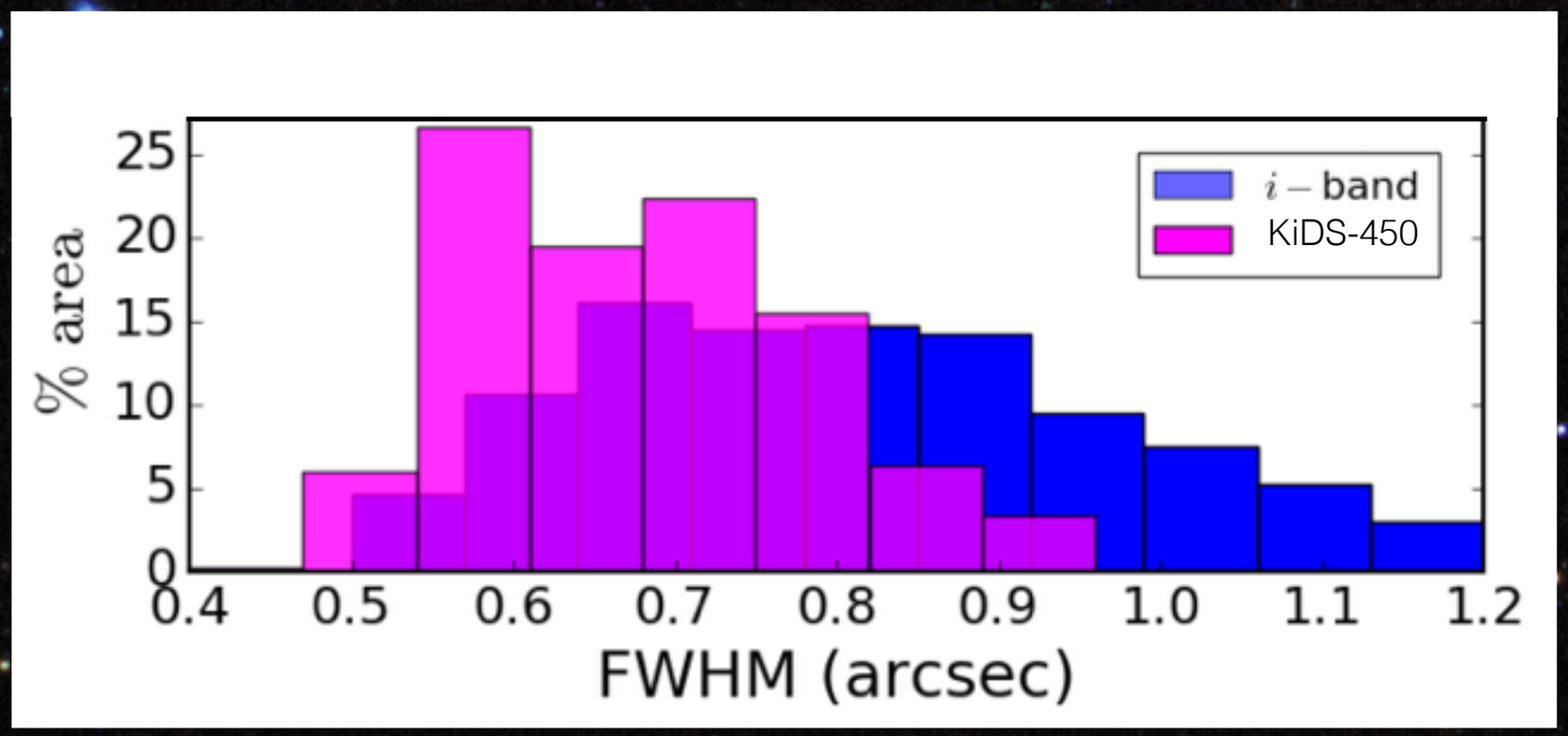
REDUNDANCY

2 image processing pipelines
2 correlation function estimators
BLINDING

KiDS i-band


Dec
2
0
−2
−4
240
220
200
180
160
140
120
RA
KiDS North
−26
−28
−30
−32
−34
−36
60
40
20
0
−20
−40
Dec
RA
KiDS South
i-band
KiDS-450
2dFLenS
BOSS

KiDS i-band

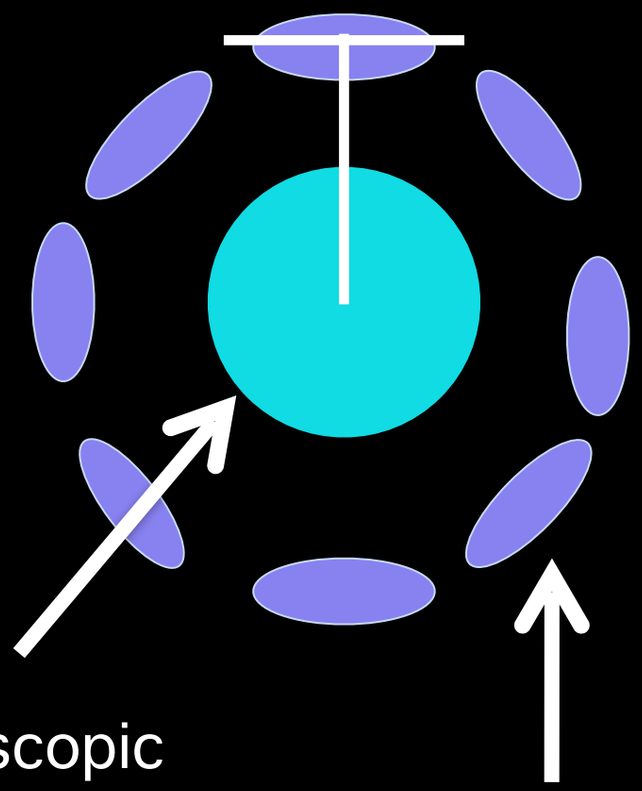


815 sq. deg.

i<24.3

z_{med}=0.61

Galaxy - Galaxy Lensing



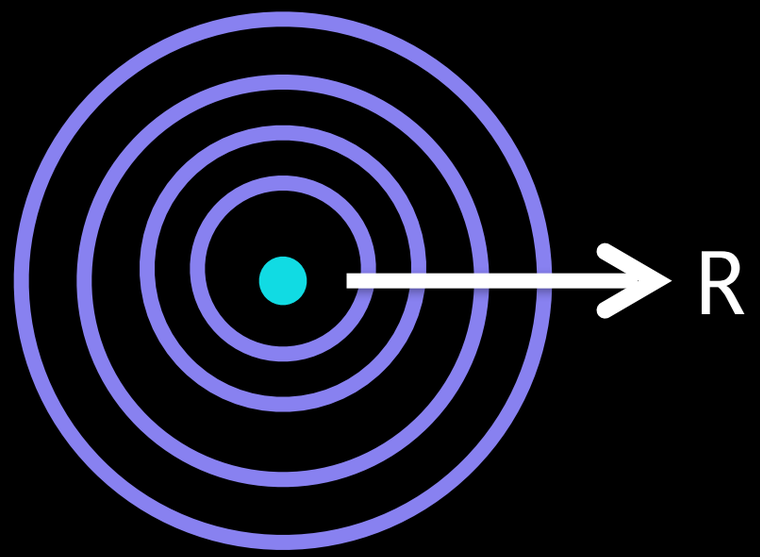
spectroscopic foreground ‘lens’

tangentially- sheared KiDS background galaxy

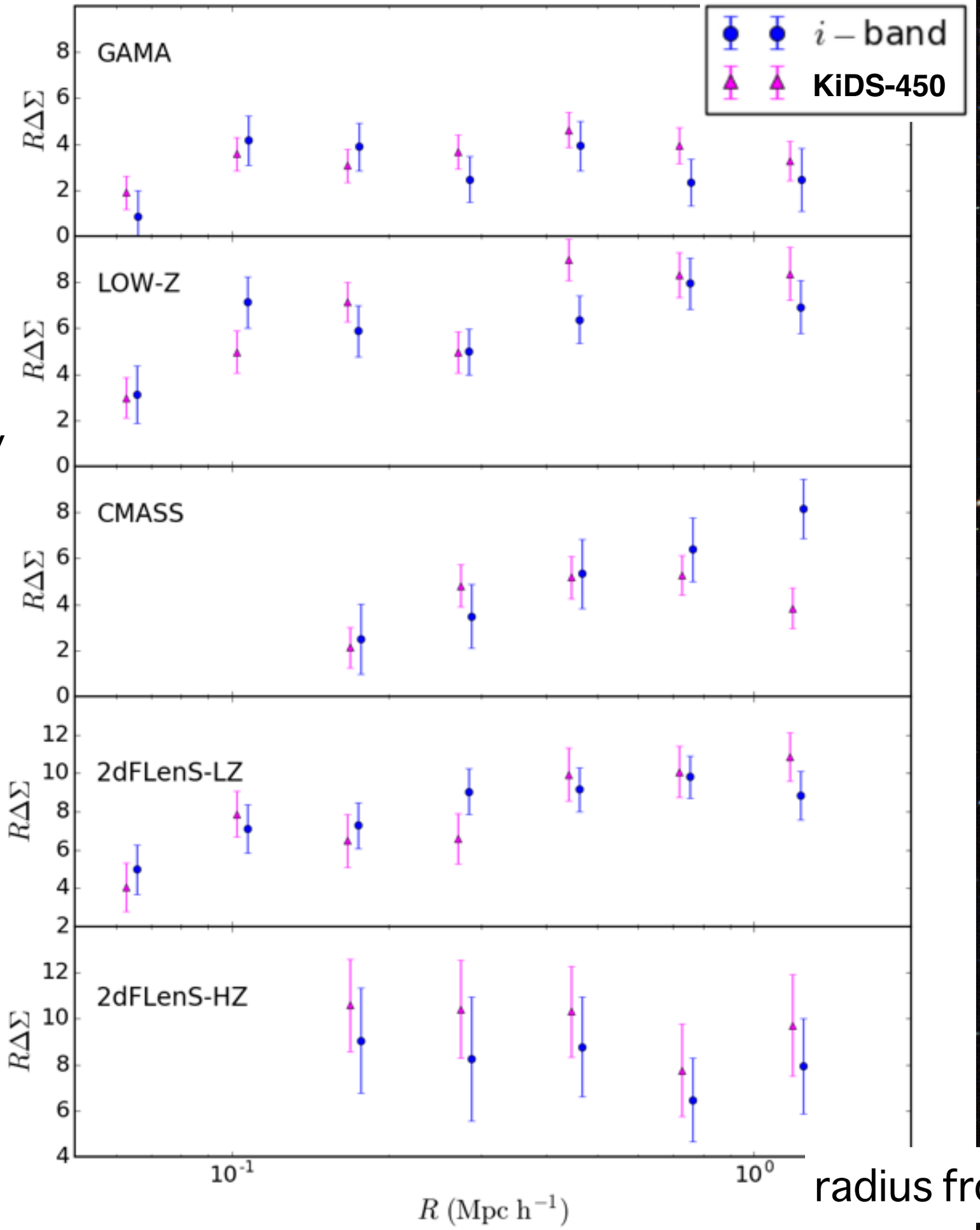
shapes and estimated photo-z’s

differential projected surface mass density

$\Delta\Sigma(R)$



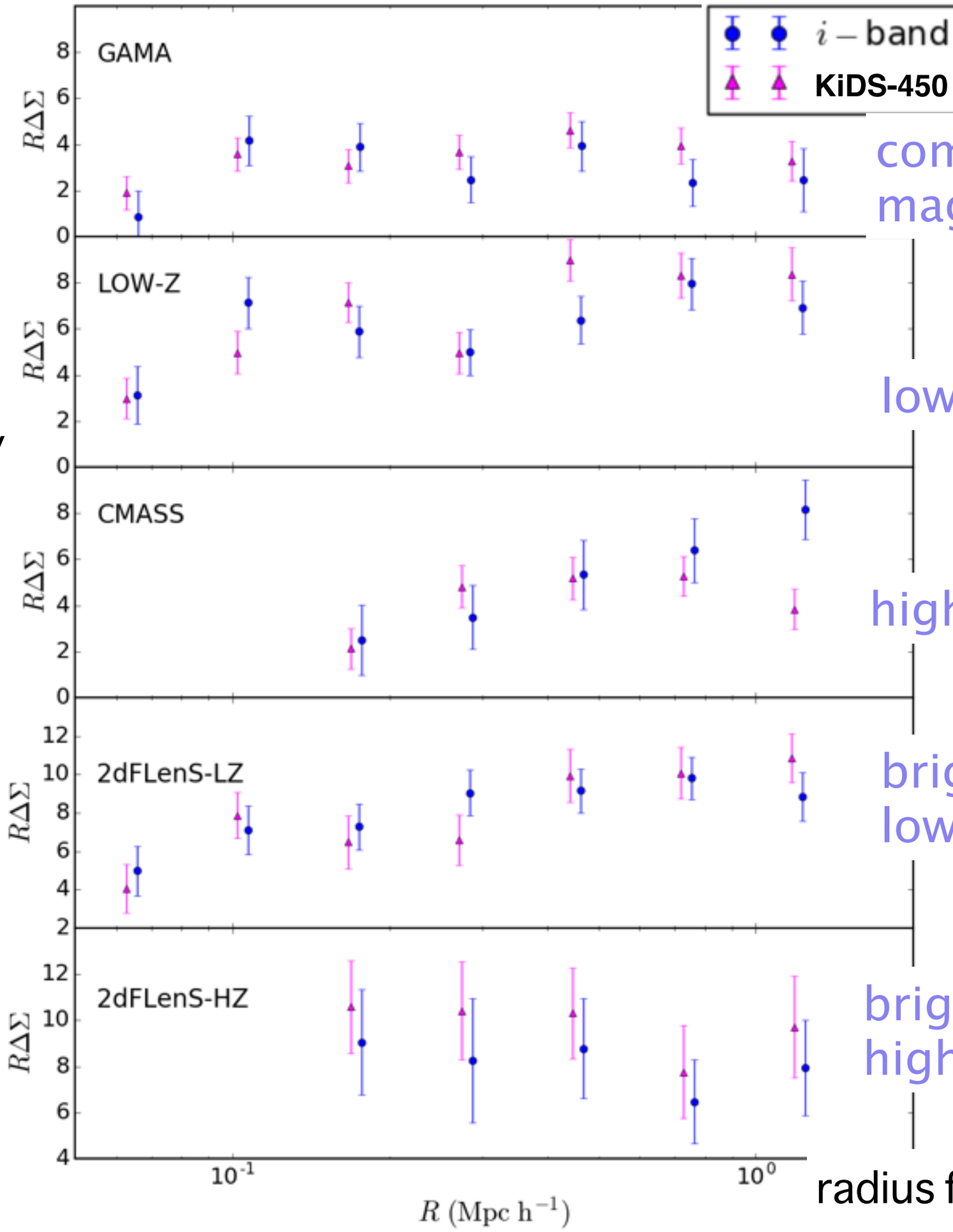
galaxy-galaxy lensing signal



radius from the lens

Amon et. al (in prep)

galaxy-galaxy lensing signal



complete mag-limited

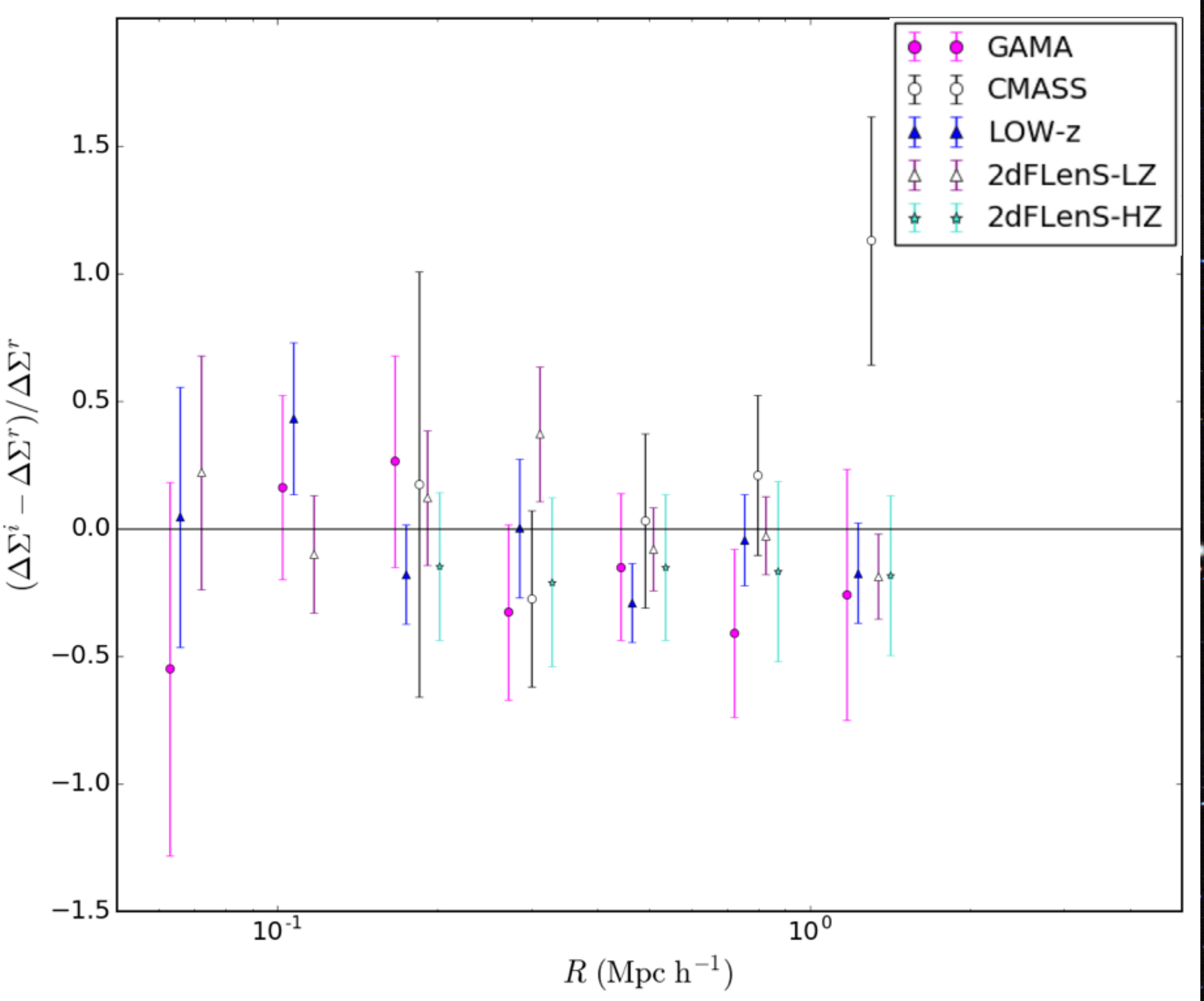
low-z LRGs

high-z LRGs

brighter low-z LRGs

brighter high-z LRGs

radius from the lens


GAMA
CMASS
LOW-z
2dFLenS-LZ
2dFLenS-HZ
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
10^{-1}
10^{0}
$(\Delta\Sigma^i - \Delta\Sigma^r)/\Delta\Sigma^r$
R (Mpc h^{-1})

Summary

KiDS

OBSERVATIONS
telescope design
observing conditions

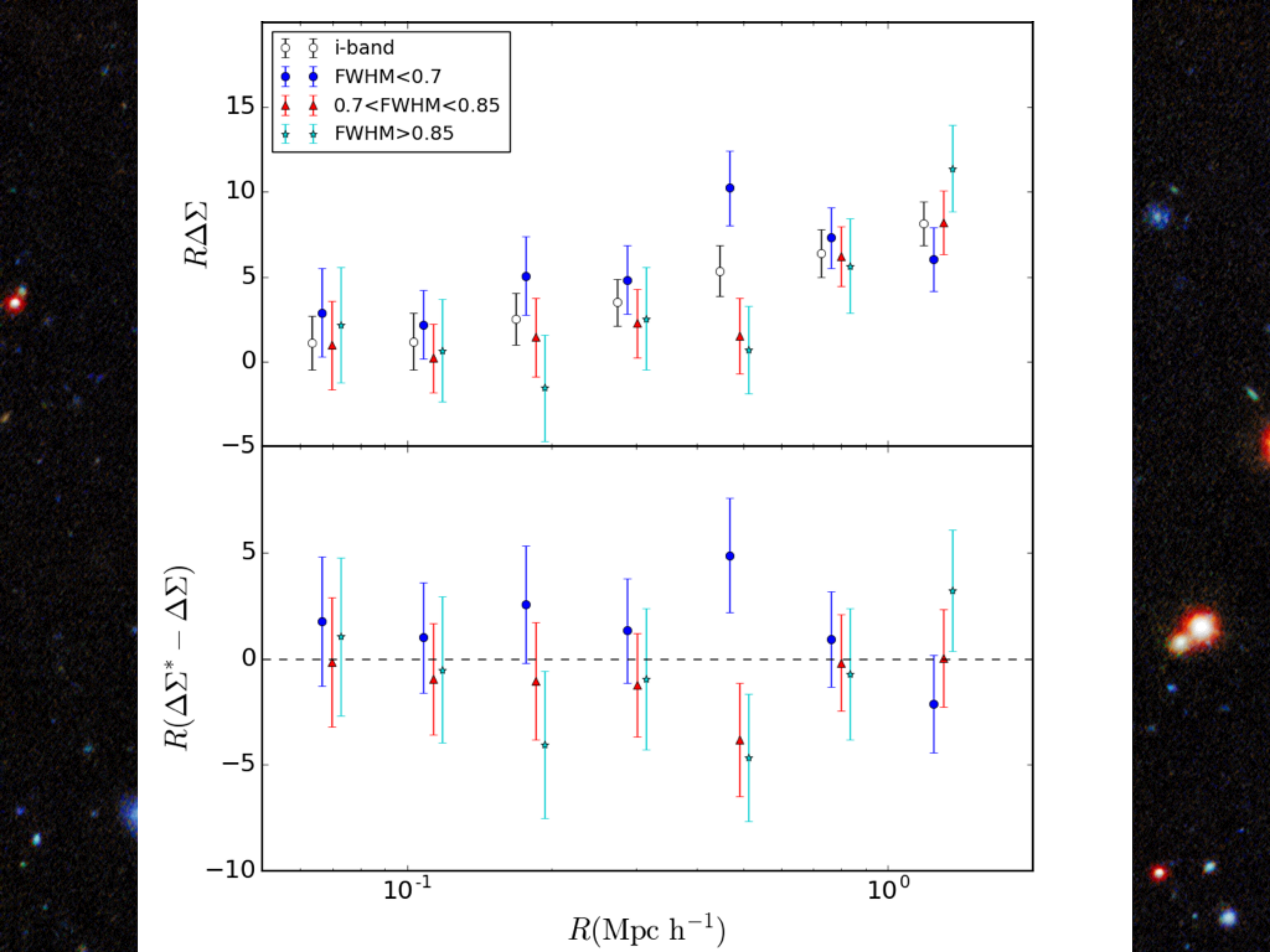
PHOTOMETRY CALIBRATION
4 independent methods

SHAPE MEASUREMENT
new shape measurement code
extensive suite of image simulations

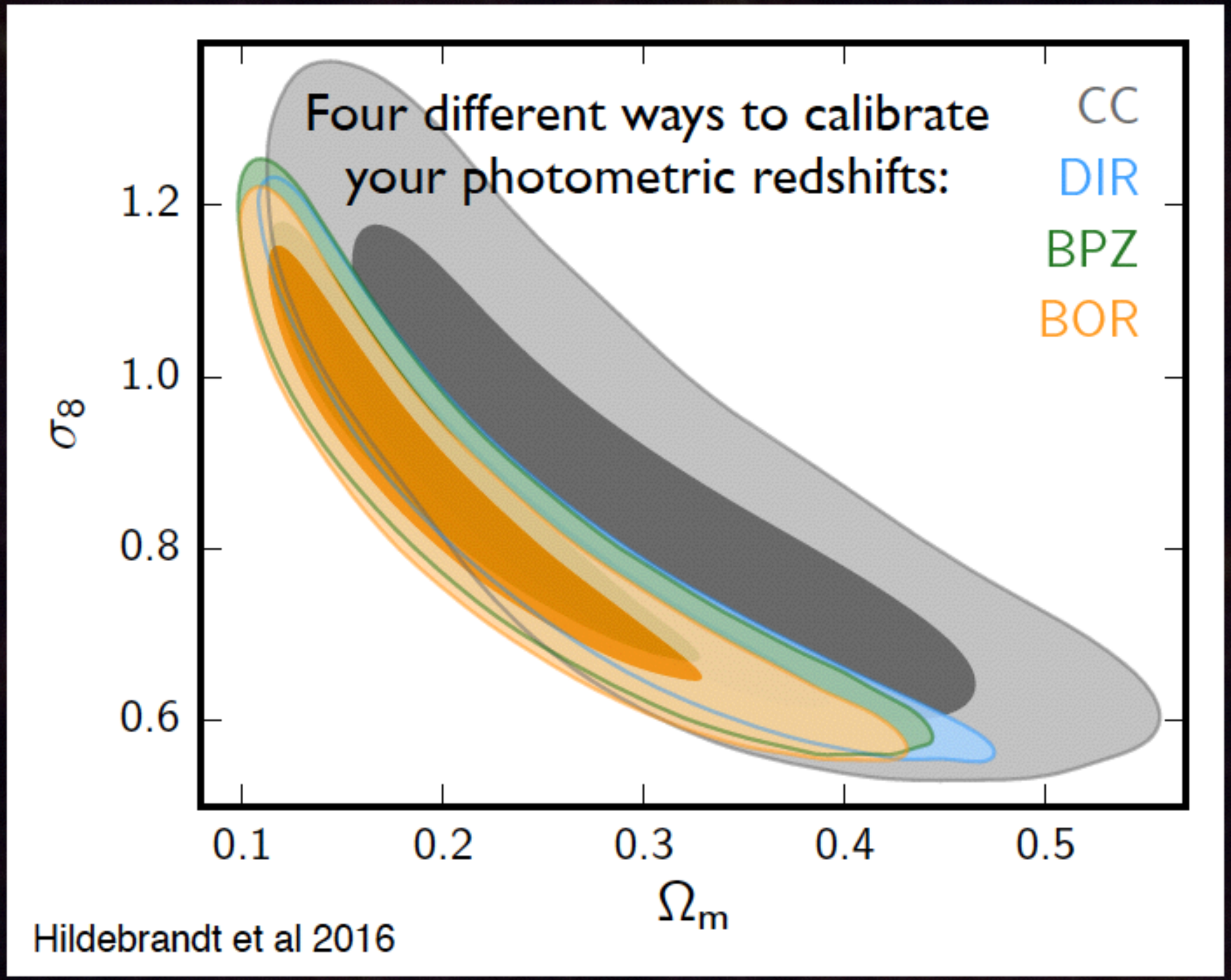
COVARIANCE
analytic prescription
mock simulations

REDUNDANCY
2 image processing pipelines
2 correlation function estimators

STRESS TEST
galaxy-galaxy lensing test of 2 different datasets on same patch of sky


i-band
FWHM<0.7
0.7<FWHM<0.85
FWHM>0.85
$R\Delta\Sigma$
$R(\Delta\Sigma^* - \Delta\Sigma)$
$R(\mathrm{Mpc\ h^{-1}})$
15
10
5
0
−5
5
0
−5
−10
10^{-1}
10^{0}

Redshift Calibration



Hildebrandt et al 2016