ASTROPHYSICS GROUP, DEPARTMENT OF PHYSICS AND ASTRONOMY

Estimating the Magnification Bias for Galaxy Surveys with Complex Sample Selection Functions

Maximilian von Wietersheim-Kramsta

PhD Student

Collaborators: Benjamin Joachimi, Jan Luca van den Busch

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Institute of Astronomy,
University of Edinburgh

KiDS

Why even bother with the magnification bias?

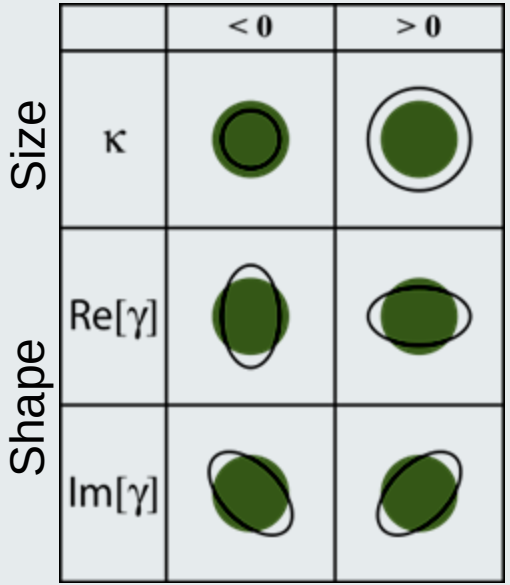
Neglecting it can lead to **significant biases** in cosmological parameters inferred from (Duncan et al. 2013):

- **Galaxy Clustering** (position-position correlations)

- **Galaxy-Galaxy Lensing** (position-ellipticity correlations)

How is the bias induced?

WEAK LENSING =



SHEAR

+

Credit: Constance Mahony

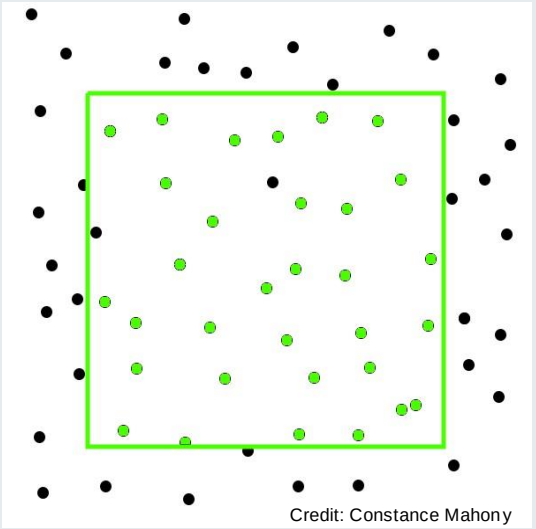
MAGNIFICATION

How is the bias induced?

MAGNIFICATION

=

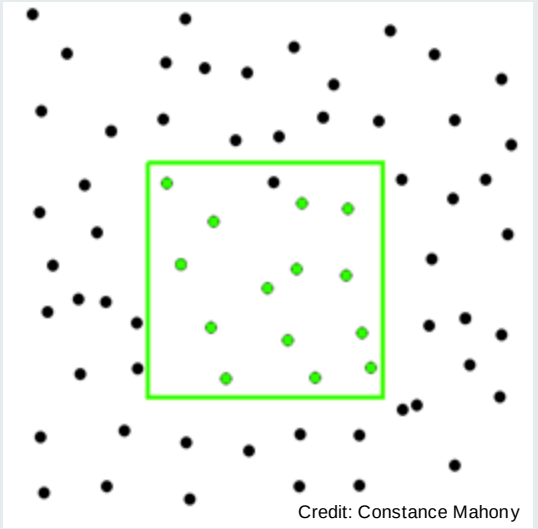
Increase/reduction in observed flux brings some sources across flux limit



FLUX MAGNIFICATION

+

Increase/reduction in the solid angle behind the lens



LENSING DILUTION

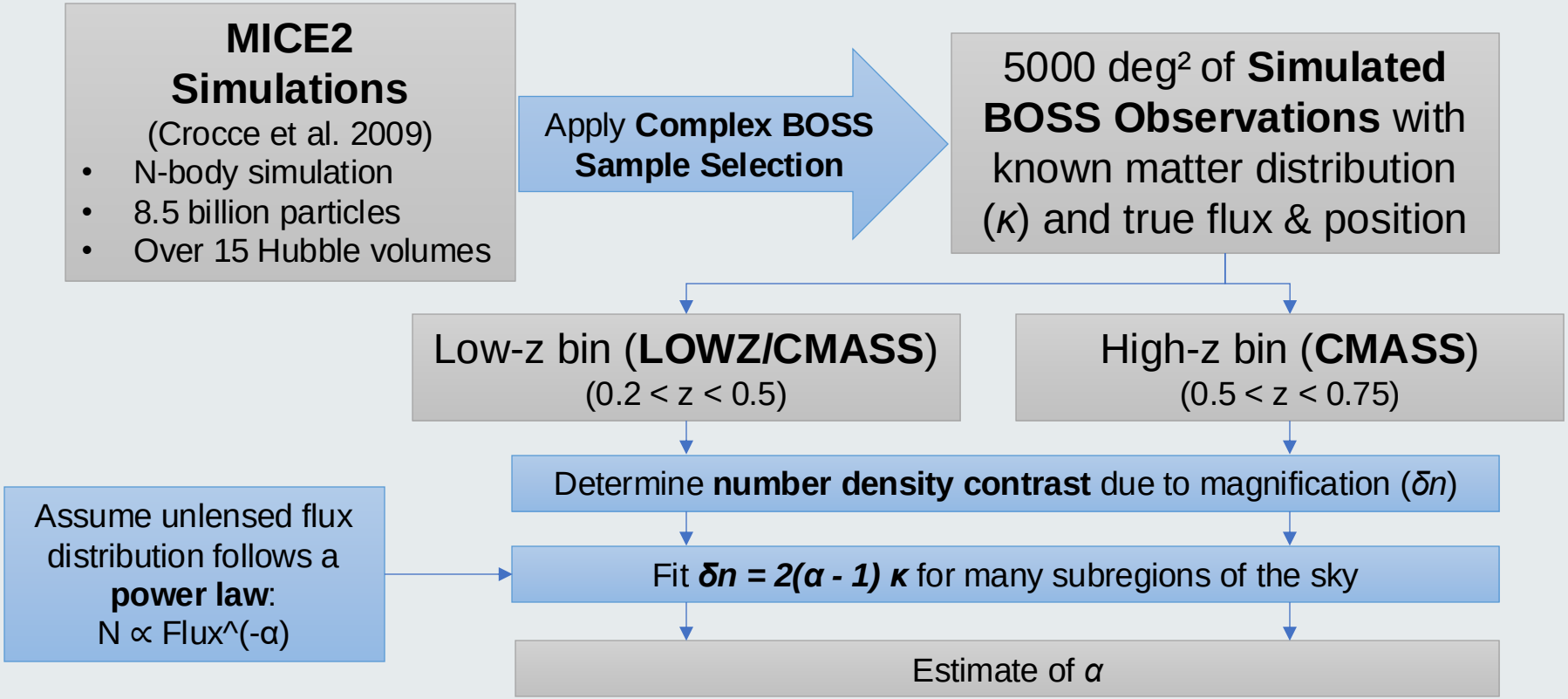
How do we estimate this bias?

For **flux limited** surveys, it is ‘easy’:

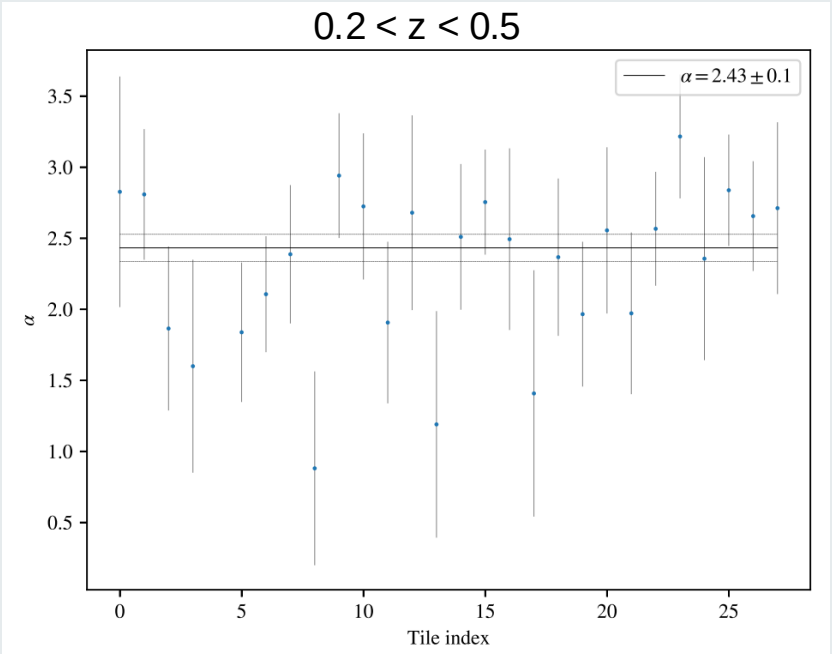
- Determine the galaxy count distribution with respect to flux
- Find scale of bias near flux limit

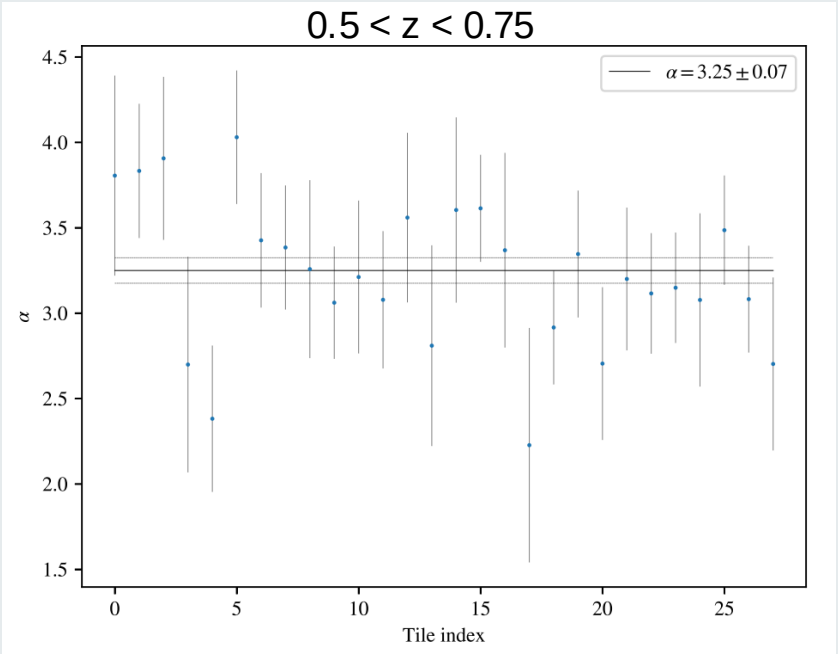
But what do we do when the survey is not flux limited?

Magnification Bias from Simulations



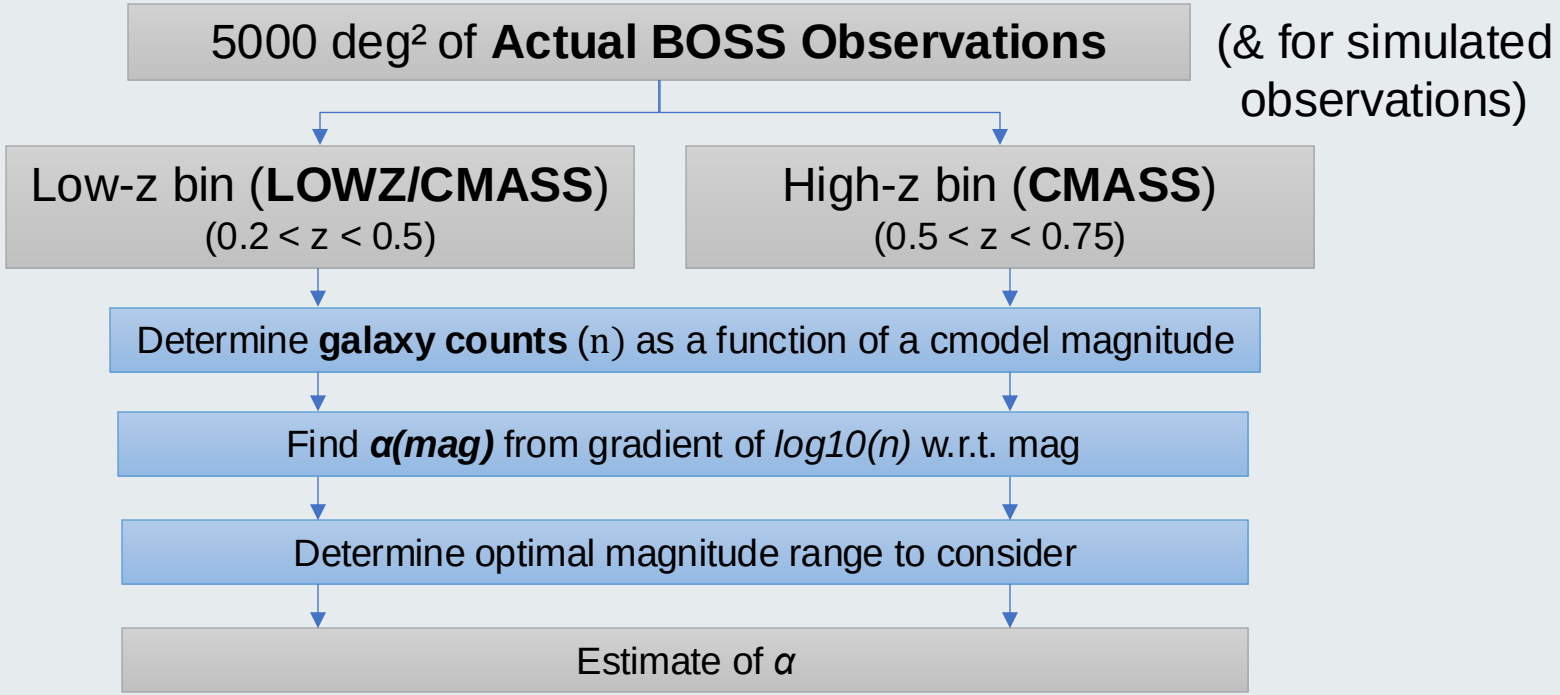
Magnification Bias from Simulations





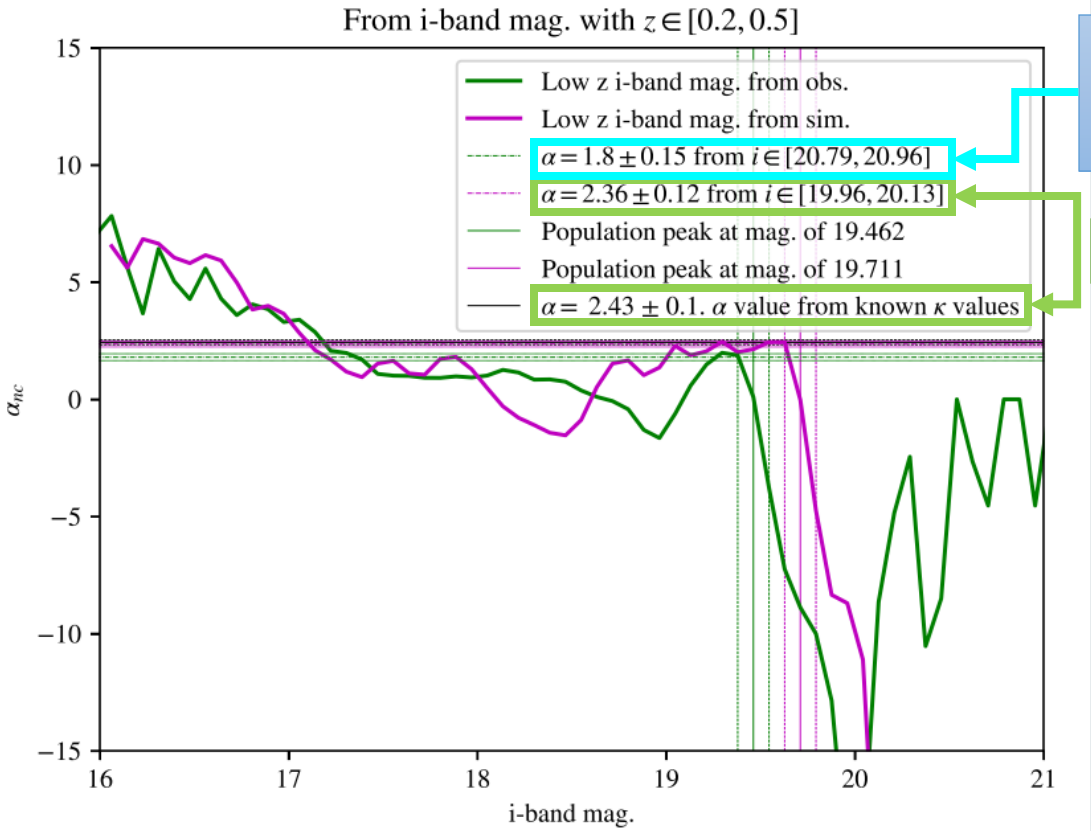
Alpha estimates for 28 subregions of 5000 deg² (**black line** shows weighted mean)

Magnification Bias from Observations



Magnification Bias from Observations

For 0.2 < z < 0.5, we consider the i-band



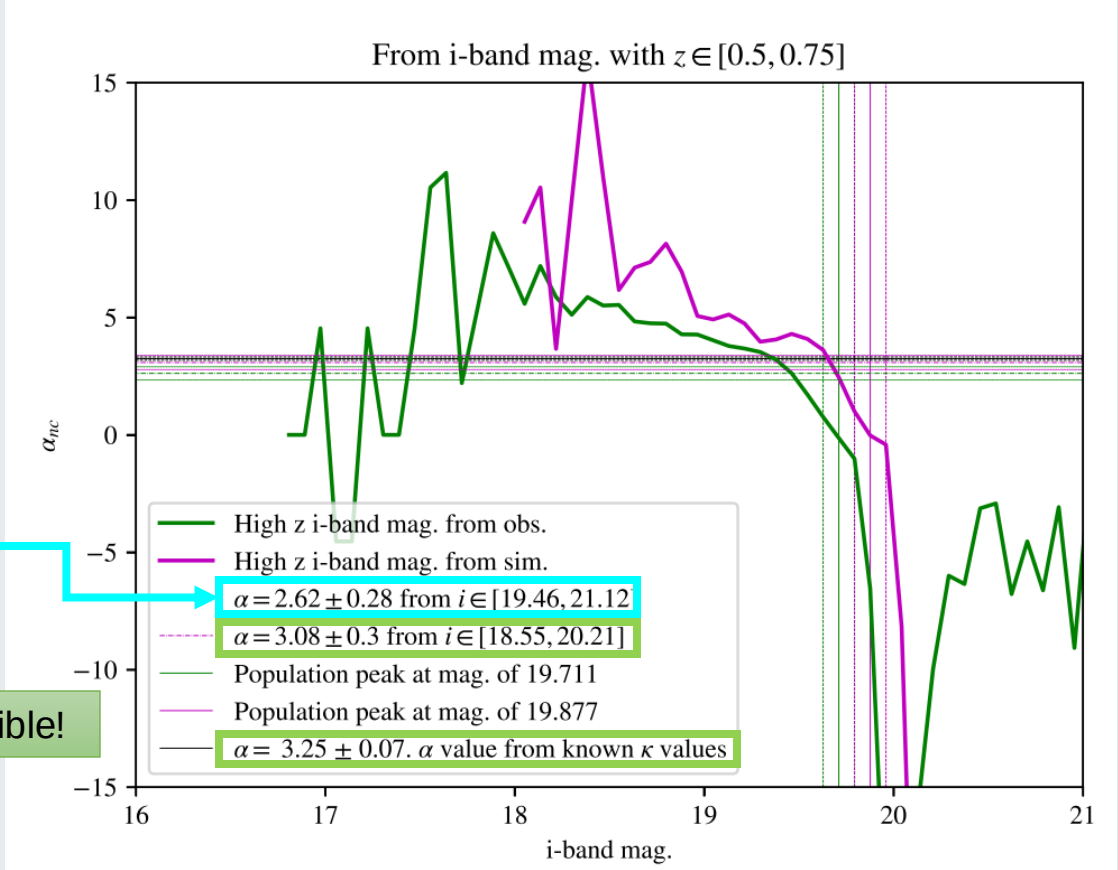
=> This estimate from the real obs. should be unbiased

Compatible!

Only consider mag. range near turn-off where power law should be obeyed

Magnification Bias from Observations

For 0.5 < z < 0.75, we consider the i-band

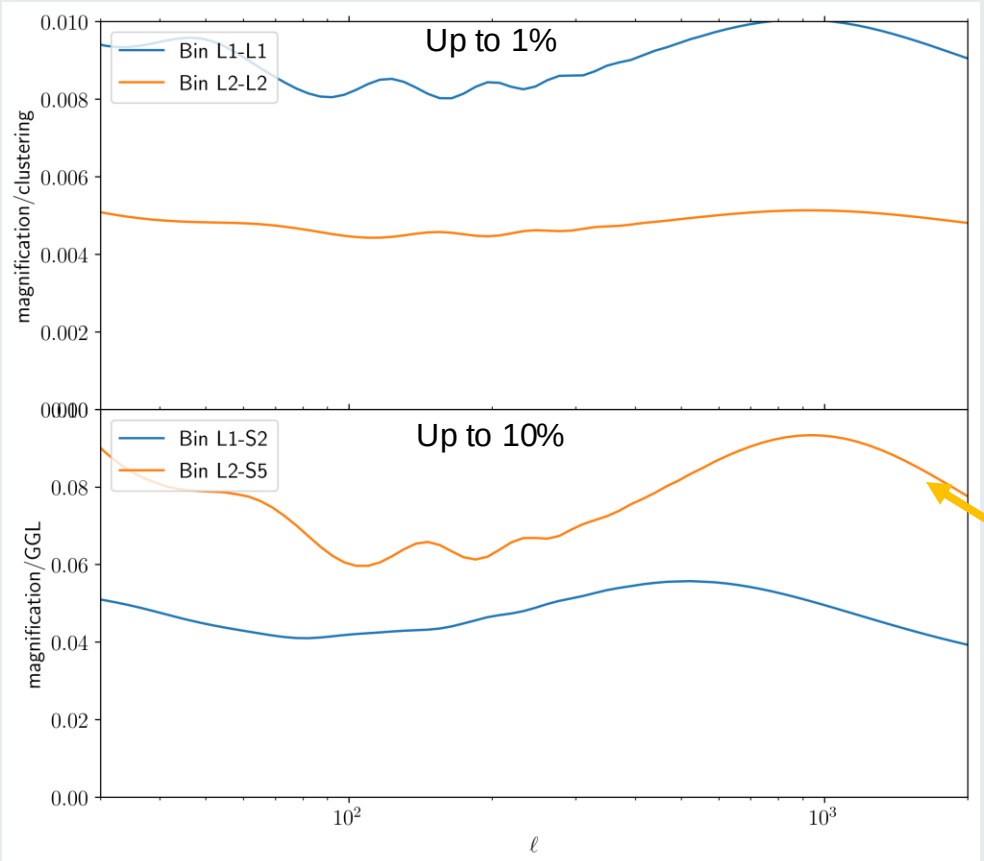


=> This estimate from the real obs. should be unbiased

Compatible!

Can consider the whole mag. range below turn-off within 2MASS sample

Forecasting for KiDS+BOSS Analysis



Magnification bias if **α = 3**

L: Lens bin
- L1: (0.2 < z < 0.5)
- L2: (0.5 < z < 0.75)

S: Source bin
- S2: (0.3 < z < 0.5)
- S5: (0.9 < z < 1.2)

High-z GGL in KiDS+BOSS would barely be biased (roughly equal to uncertainties) at **α = 3**

BUT we found that α = 2.62 ± 0.28

→ Nothing to worry about… for now!

Conclusions and Future Plans

- It is possible to determine the scale of the magnification bias for **surveys with complex sample selection** from simulations and directly from observations

- Simulations are still however necessary to verify the estimates from the observations

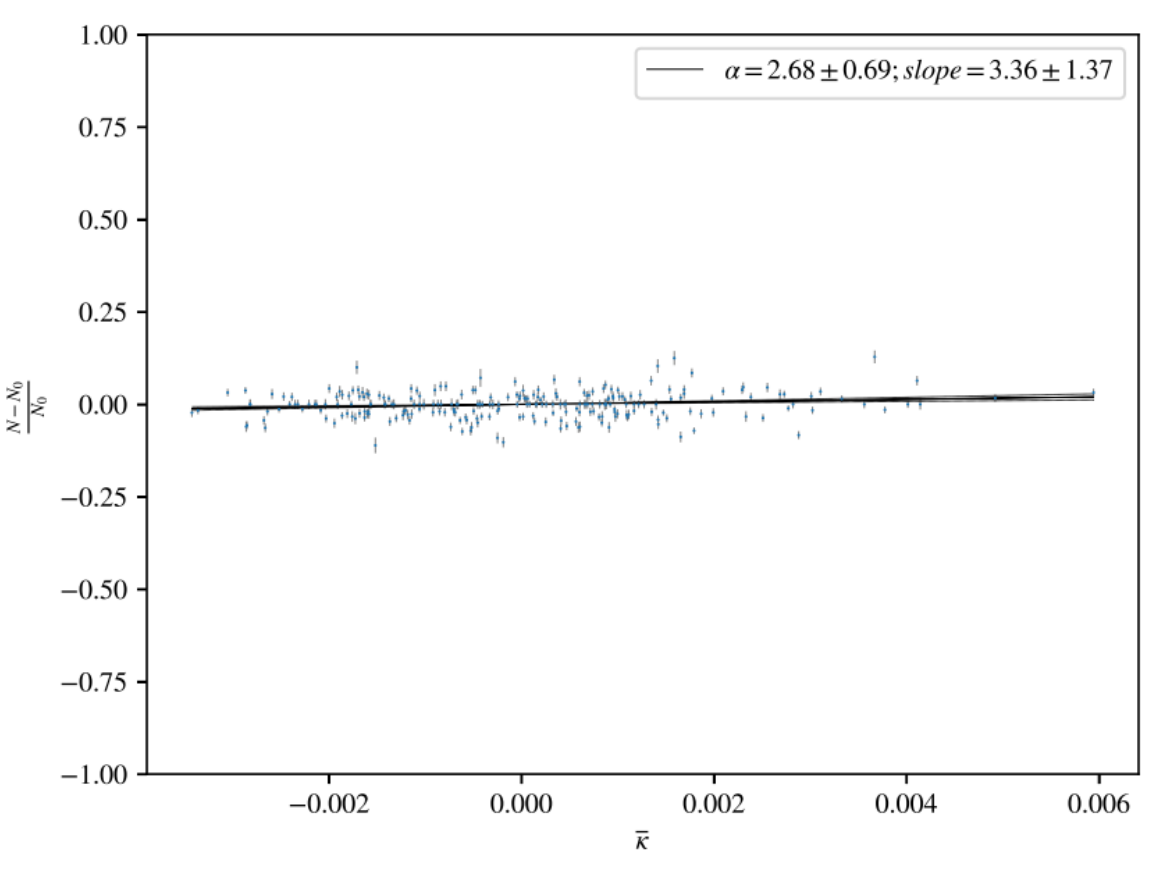
- The upcoming KiDS+BOSS analysis should not be biased due to magnification

- Future surveys which themselves are **not flux-limited (DESI)** and/or which have **greater overlap with BOSS (Euclid)**, may have to start considering magnification biases → Plan to make predictions for these surveys

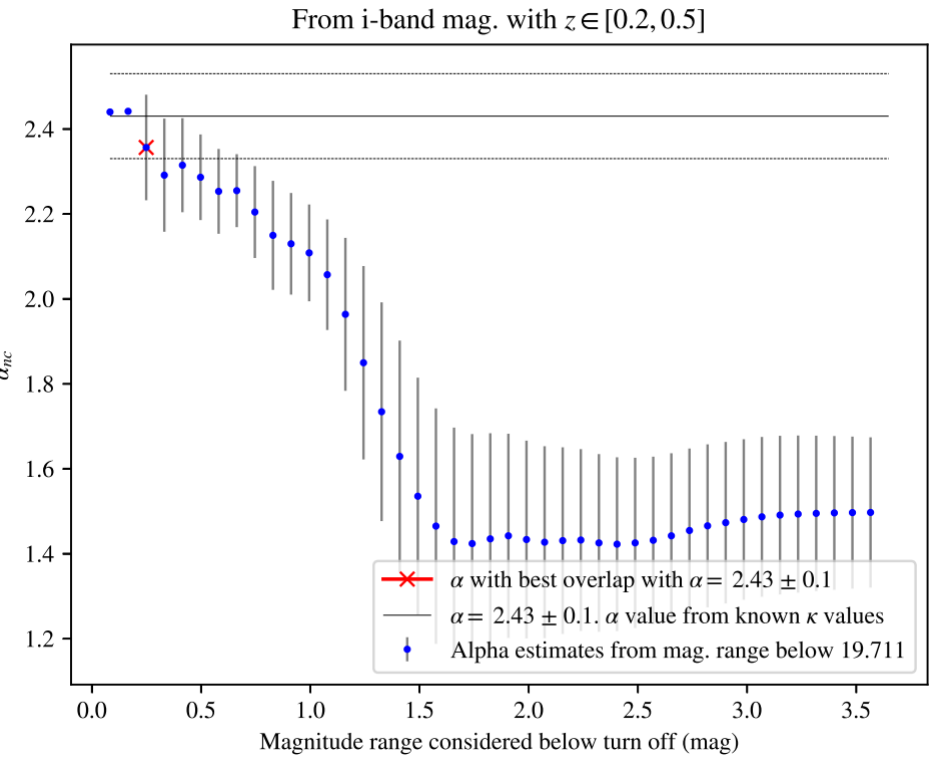
THANK YOU FOR YOUR ATTENTION

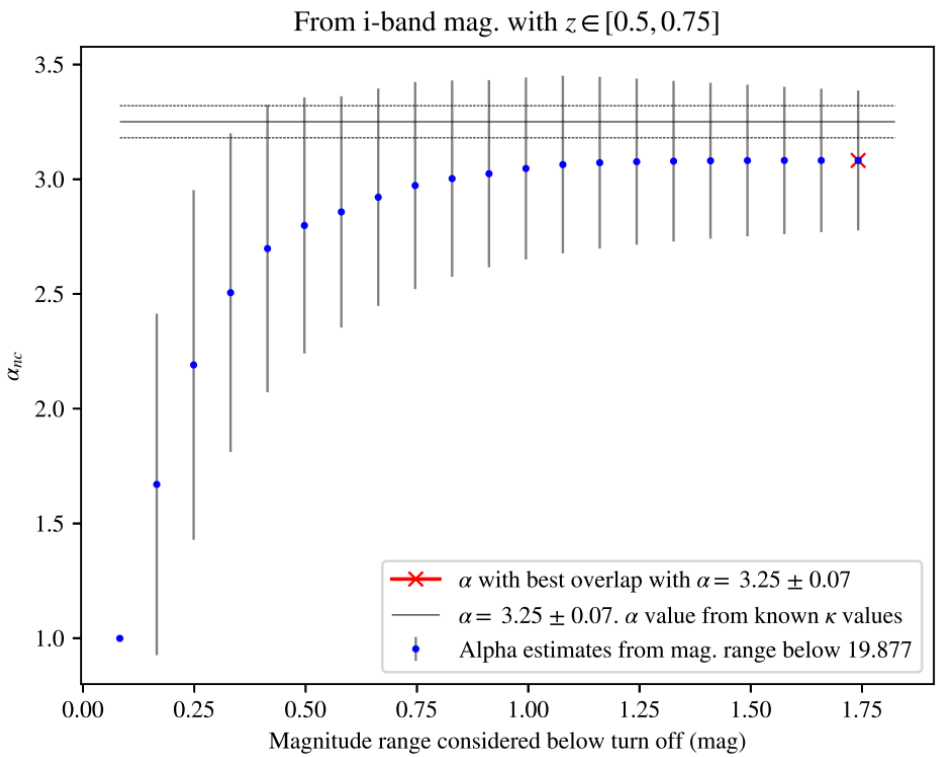
BONUS: *δn vs. κ* example

0.2 < z < 0.5



BONUS: *Best Magnitude Range*





BONUS: Low-z r-band