Cosmological Constraints from Galaxy Cluster Statistics in KiDS

An overview on the cosmological results from KiDS-DR3 based on cluster statistics, and perspectives for the KiDS-1000 analysis

Giorgio Lesci
giorgio.lesci2@unibo.it

Dipartimento di Fisica e Astronomia "Augusto Righi" - Alma Mater Studiorum Università di Bologna

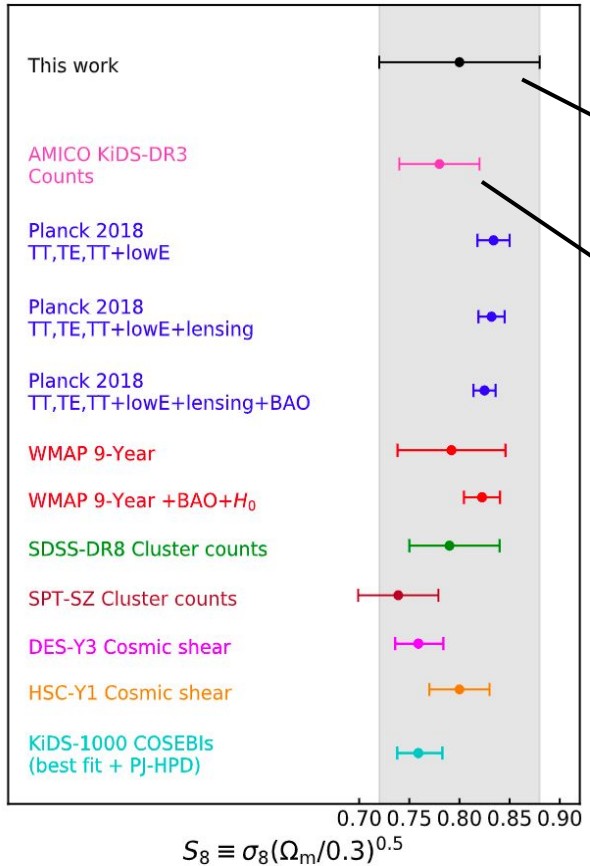
AMICO clusters cosmology in KiDS-DR3

AMICO: Adaptive Matched Identifier of Clustered Objects

Sample of galaxy clusters in the AMICO KiDS-DR3 catalogue (Maturi et al. 2019):

- Effective area: 377 deg^2;
- z ∈ [0.1, 0.8] (WL mass calibration up to z = 0.6);
- 7988 clusters (3652 in the counts analysis).

Right plot: S_8 from counts and clustering analyses.



Clustering
(Lesci et al. 2022, b)

Counts
(Lesci et al. 2022, a)

AMICO clusters cosmology in KiDS-1000

AMICO KiDS-1000 catalogue: Maturi et al. in prep.

Observational improvements:

Five additional photometric bands ($ZYJHK_s$) from VIKING survey
-> huge improvement of the photo-zs.

Effective area: 840 deg^2 (vs 377 deg^2 in KiDS-DR3).

~ 25000 clusters with SN > 3.5 (vs ~8000 in DR3).

Reliable weak lensing signal up to z = 0.8 (vs z < 0.6 in DR3).

Improvements in the analysis:

Blinding.

Joint analysis of WL, counts and clustering.

AMICO clusters cosmology in KiDS-1000

Joint analysis of WL, counts and clustering (Lesci et al. in prep.)

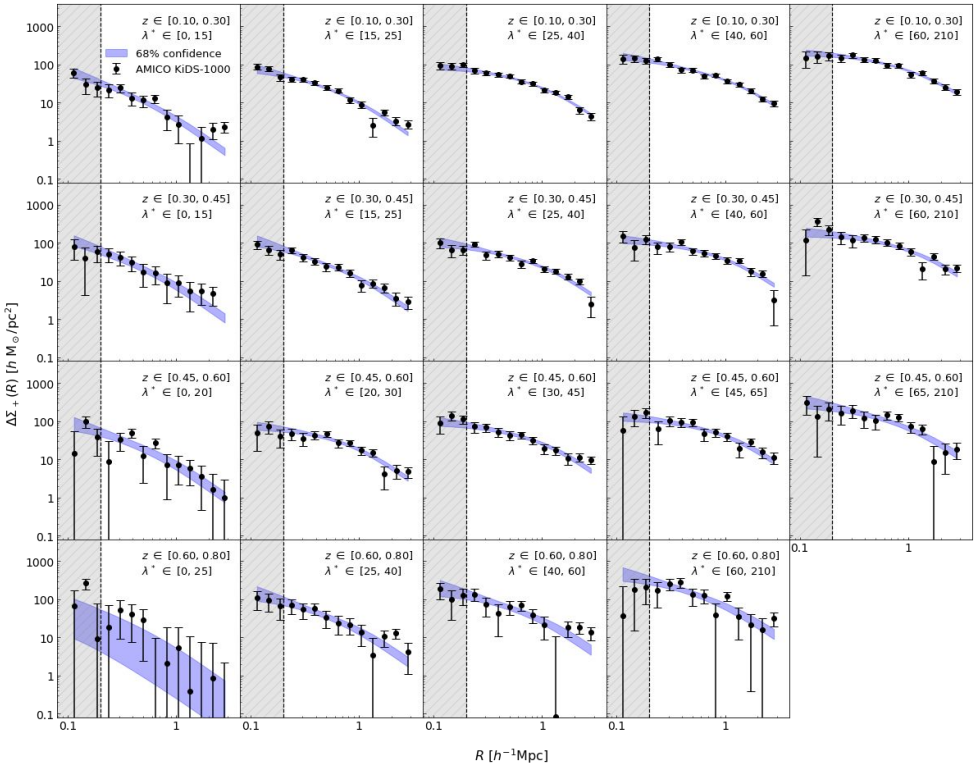
First step: deriving the M-λ scaling relation directly from the $\Delta\Sigma_+(R)$ stacked profiles.

$$\langle \Delta\Sigma(R_{\rm eff}|\lambda^*_{\rm eff}, z_{\rm eff})\rangle = \int_0^\infty {\rm d}M\ \Delta\Sigma(R_{\rm eff}|M, z_{\rm eff})\, P(M|\lambda^*_{\rm eff}, z_{\rm eff})$$

Advantages:

- the mass calibration depends on cosmology;
- the local properties of clusters are propagated into the cosmological posteriors…

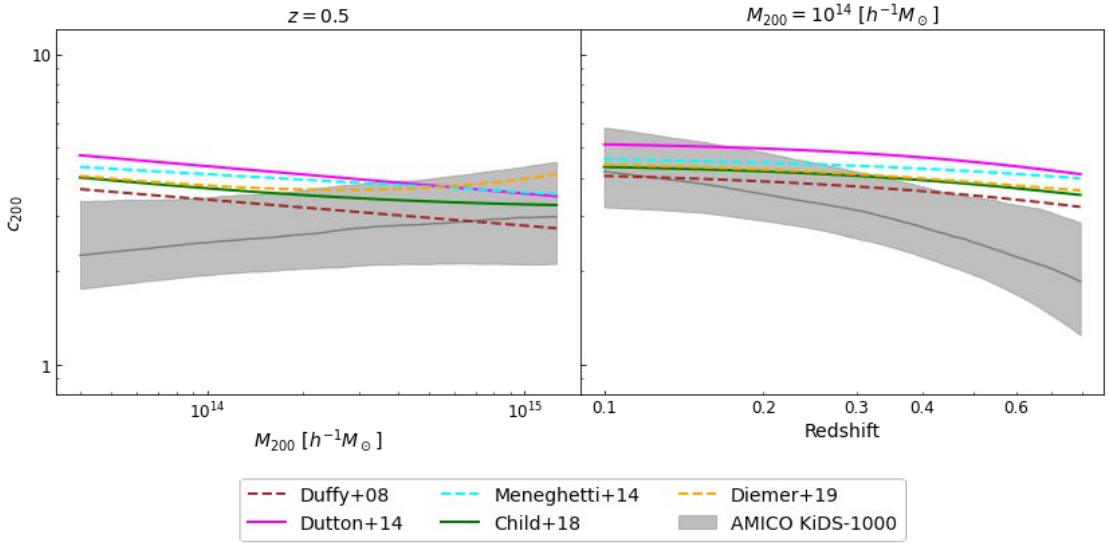
… and with this regard, if we manage to constrain the M-λ relation through this modelling, for sure we can also constrain the mass-concentration (M-c) relation!



AMICO clusters cosmology in KiDS-1000

Constraining the M-c relation

$$\log c = c_0 + c_M \log \frac{M}{10^{14} M_\odot / h} + c_z \log \frac{1+z}{1+z_{\rm piv}}$$



Summary

- Cosmological constraints in KiDS-DR3
  - counts;
  - clustering.

- Analysis of the AMICO KiDS-1000 catalogue
  - huge improvements in the dataset, blinding;
  - joint likelihood describing stacked profiles and cluster statistics;
  - cluster physical properties propagated into the cosmological results.

Thank you for your attention!