Multi-wavelength mass calibration of galaxy clusters for cosmology

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*Underlined are the collaborators present in this conference.

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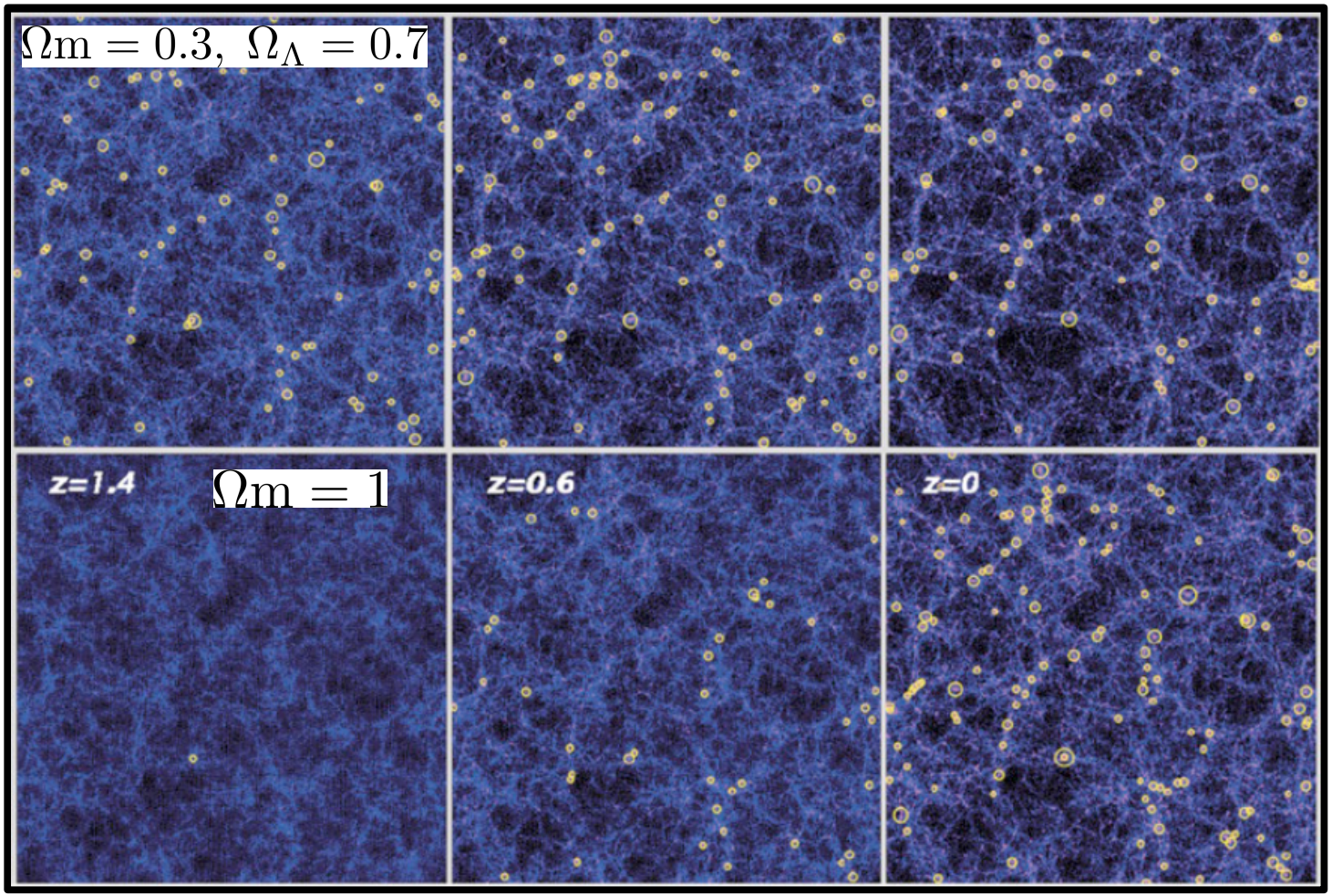
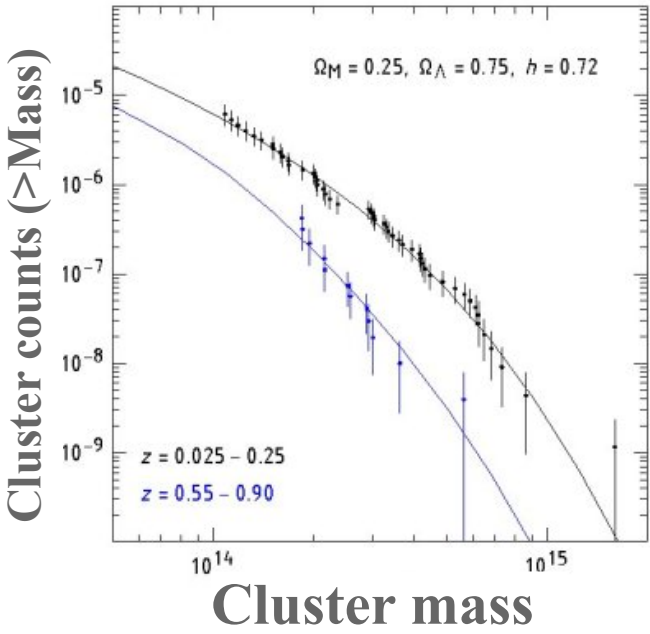
Cosmological probes

- Evolution of gravitational clustering in simulations



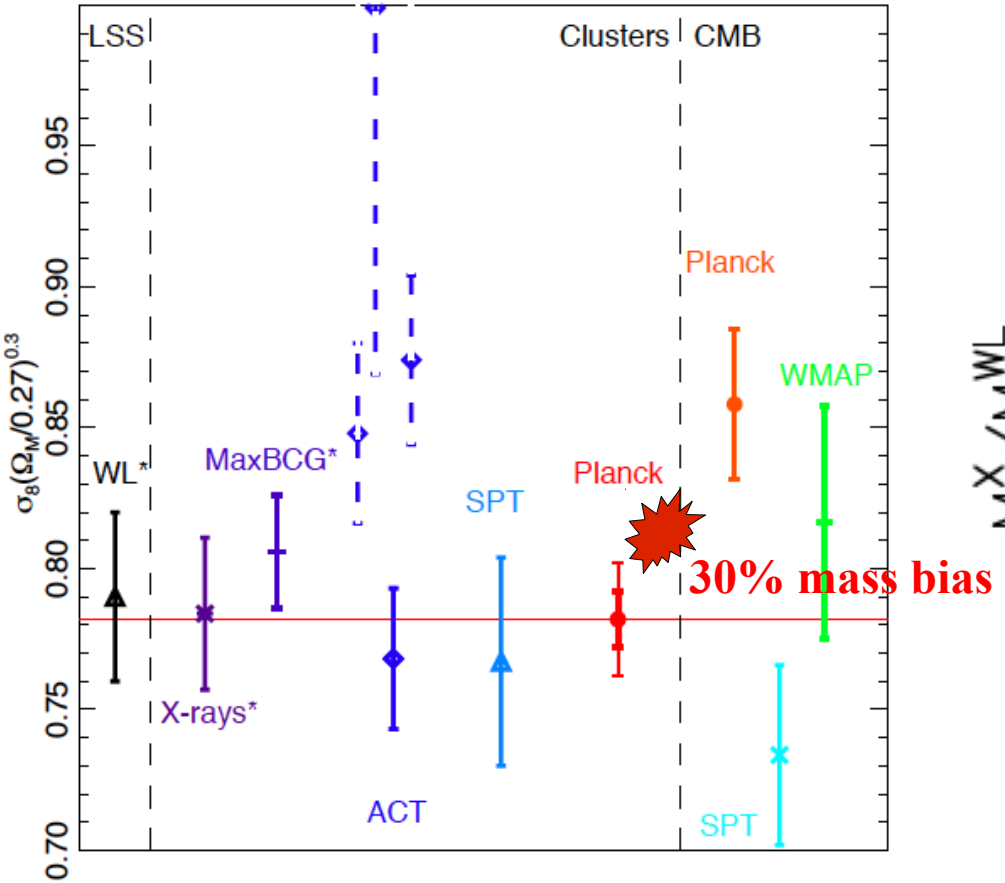
Borgani & Guzzo 01



Vikhlinin et al. 09

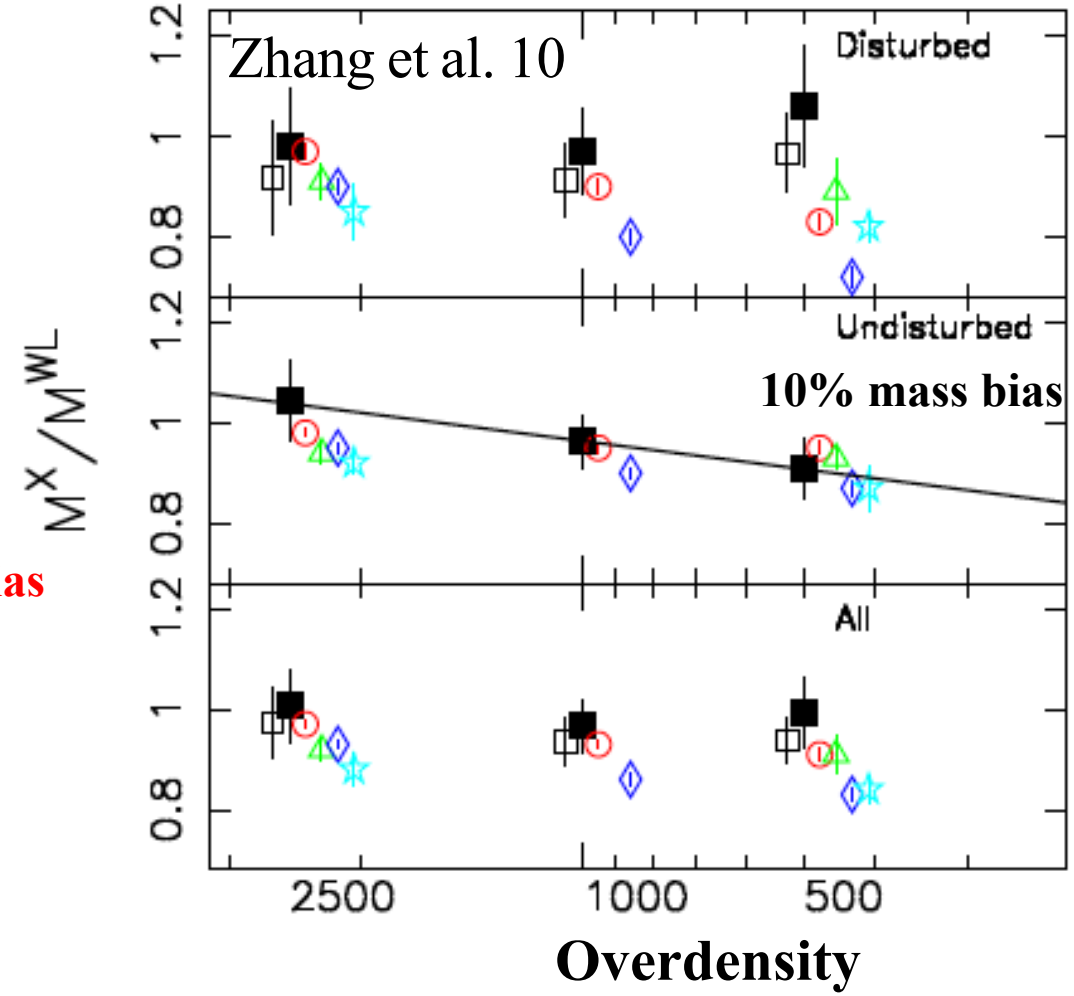
Cosmological probes

- Comparison between LSS, cluster & CMB probes



Planck coll. 13, Etienne's talk

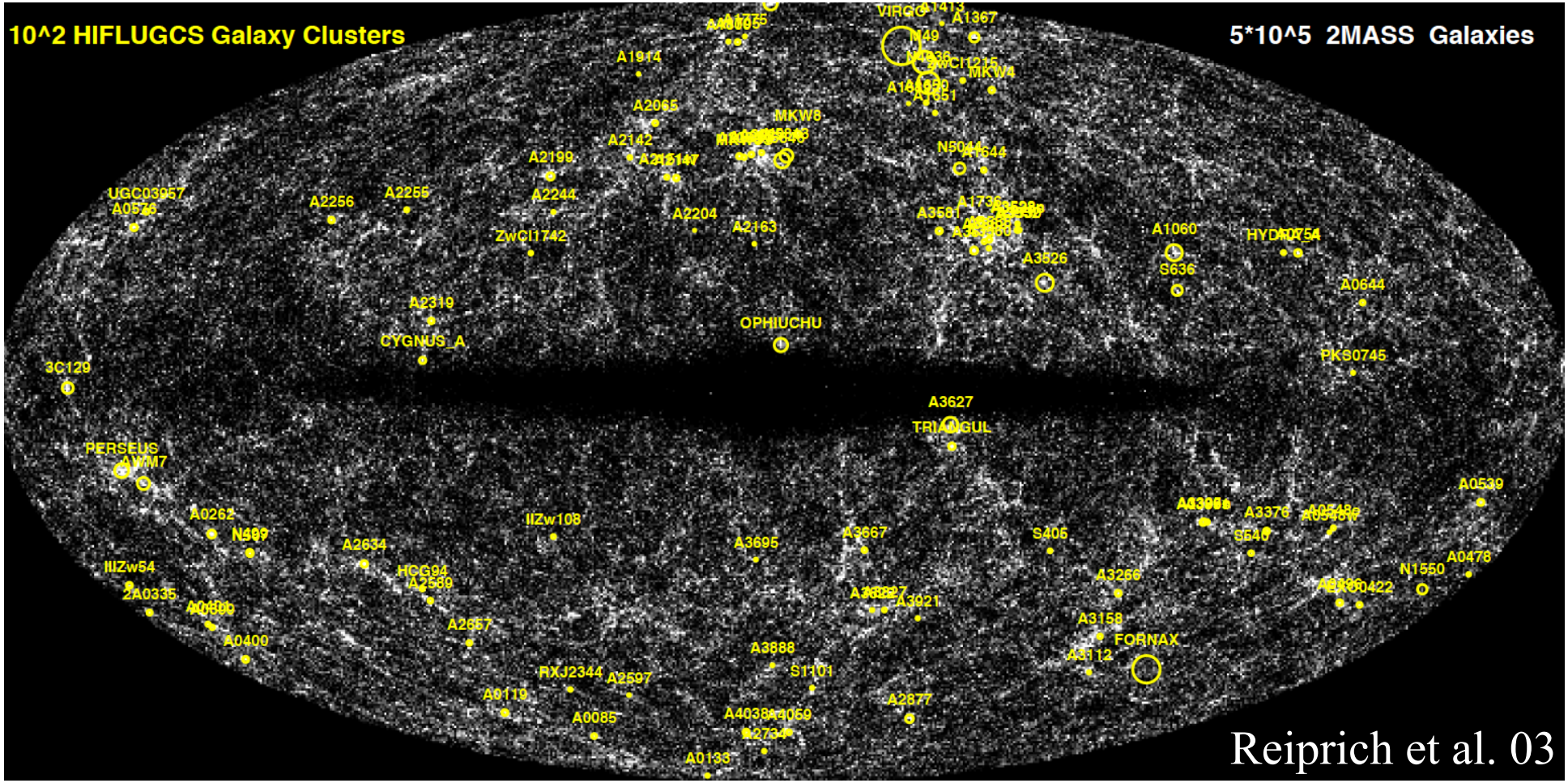
Degenerate between mass calibration & cosmological constraint



See also Nagai+07, Piffaretti+Valdarnini+08; Mahdavi+08, 13; Zhang+08; Vikhlinin+09; Okabe+10, 14; Hoekstra+13; Kettula+13

HIFLUGCS cluster sample

- From *ROSAT* All-Sky Survey (Reiprich & Böhringer 02)

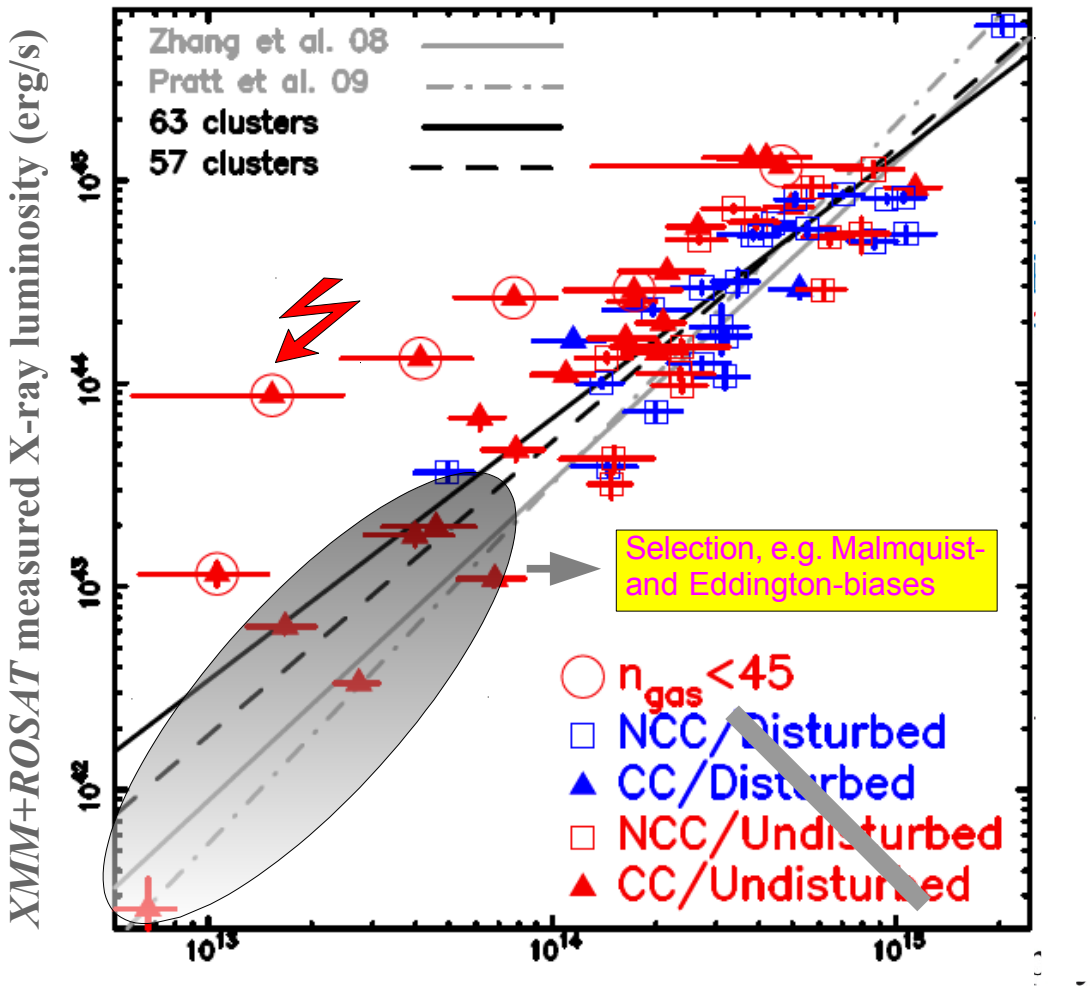


Flux-limit 2.e-11erg/s/cm^2; 2/3 sky

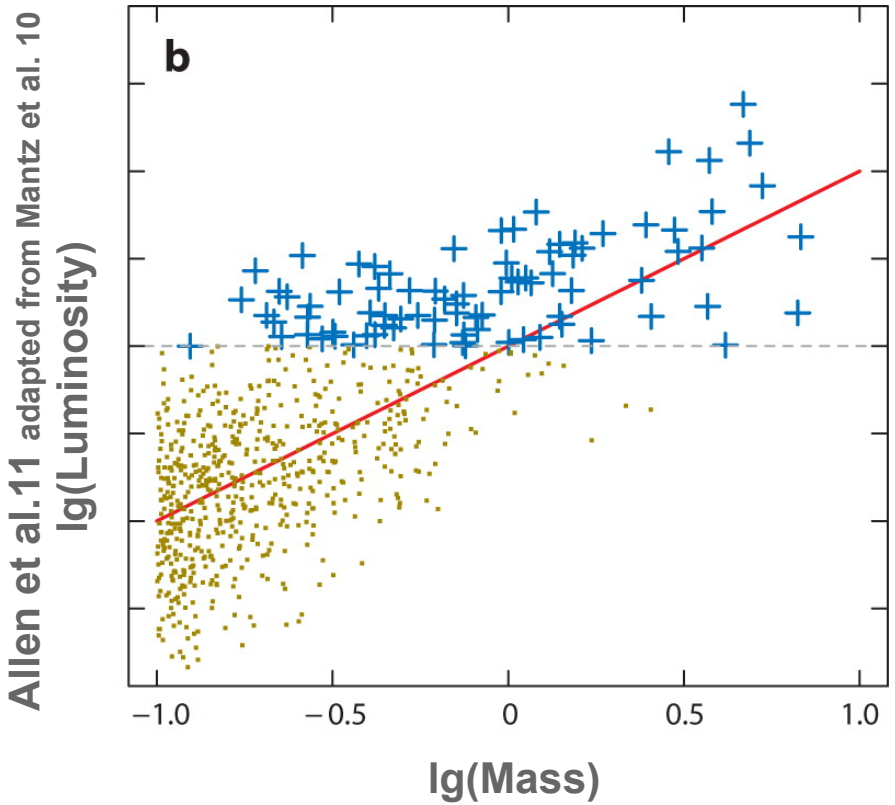
Preliminary results: luminosity vs mass

- Selection bias

Zhang et al. in prep.



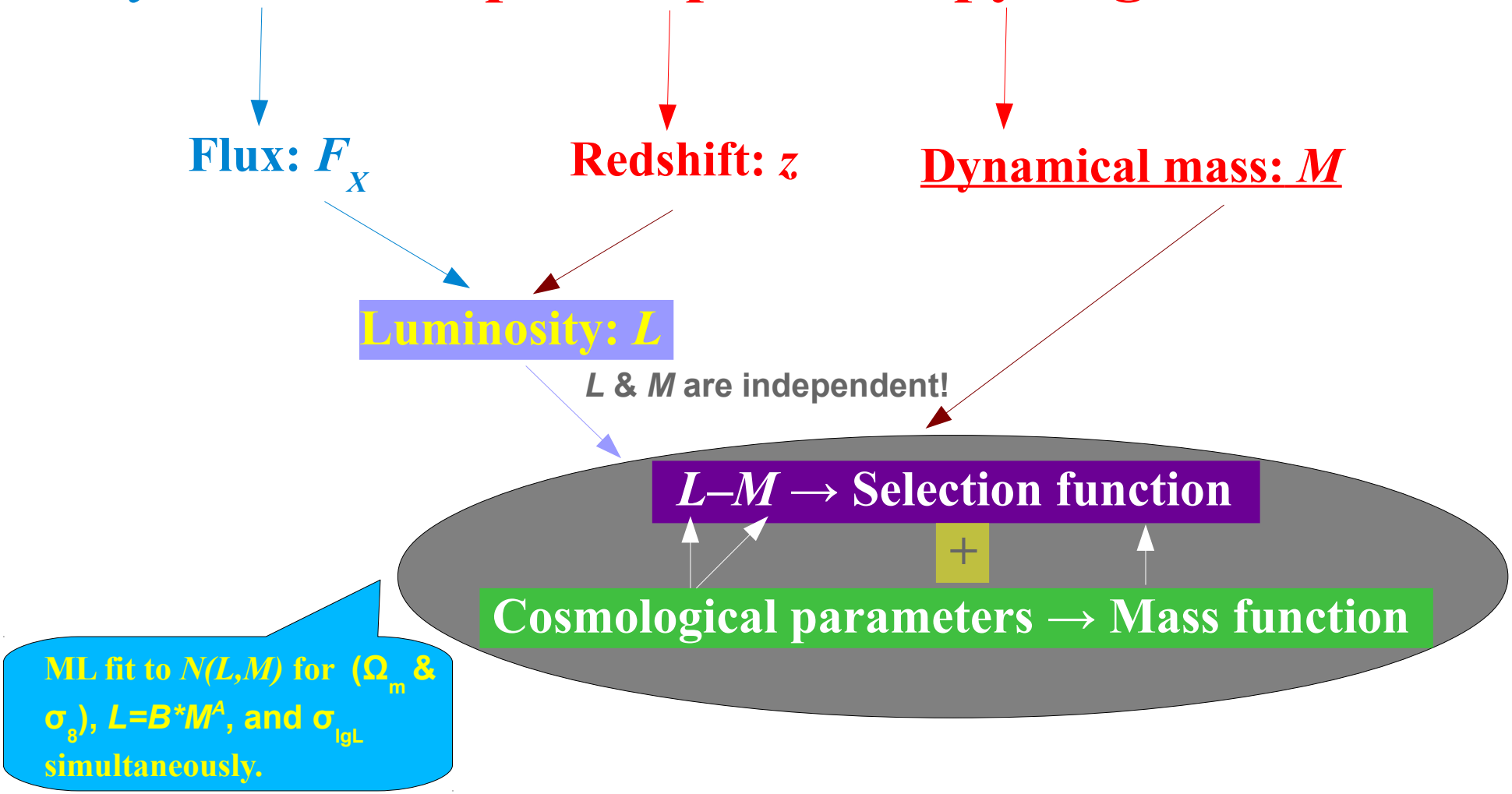
Luminosity-limited sample



See also Marguerite's talk

Preliminary results: X-ray + optical surveys

- X-ray clusters + optical spectroscopy of gal members



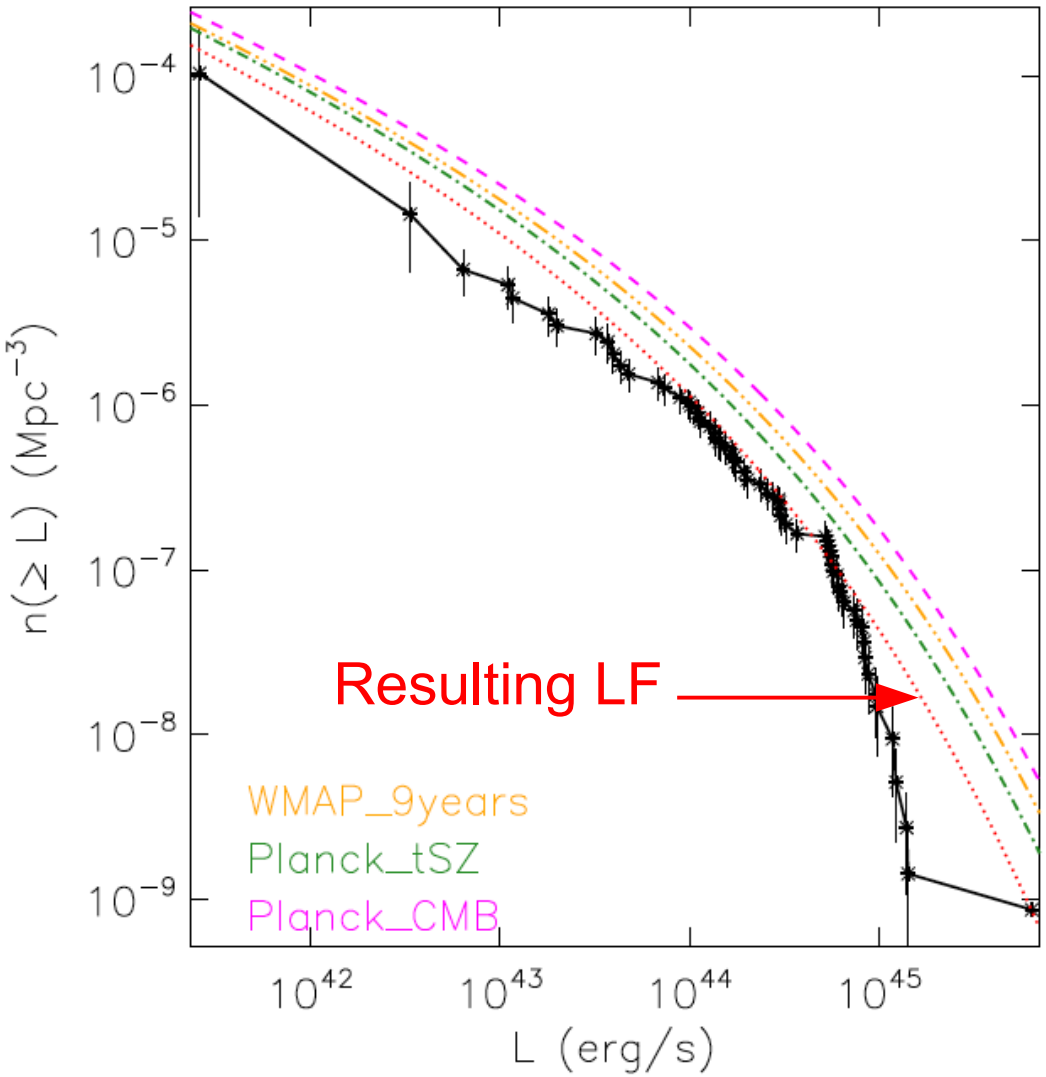
$$\ln \mathcal{L} = \sum_i \ln N(L_i, M_i; \Omega_\mathrm{m}, \sigma_8, A, B, \sigma_{\log_{10} L}) - \int\int N(L, M; \Omega_\mathrm{m}, \sigma_8, A, B, \sigma_{\log_{10} L})\, \mathrm{d}\log_{10} L\, \mathrm{d}\log_{10} M$$

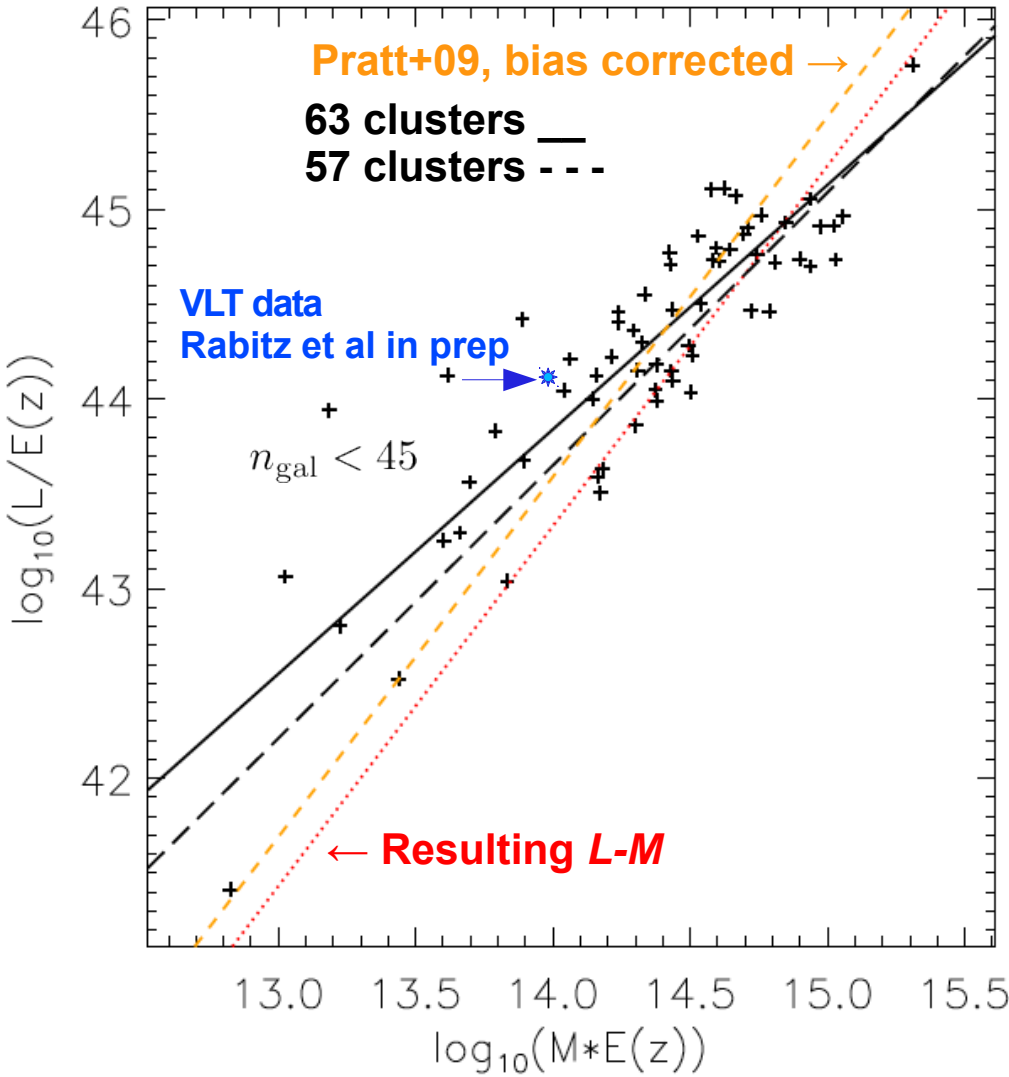
Preliminary results: LF and *L-M*

- Exploring the parameter space is ongoing:

$$(\Omega_{\rm m}, \sigma_8), L = AM^B, \sigma_{\lg L}$$

Zhang et al. in prep.

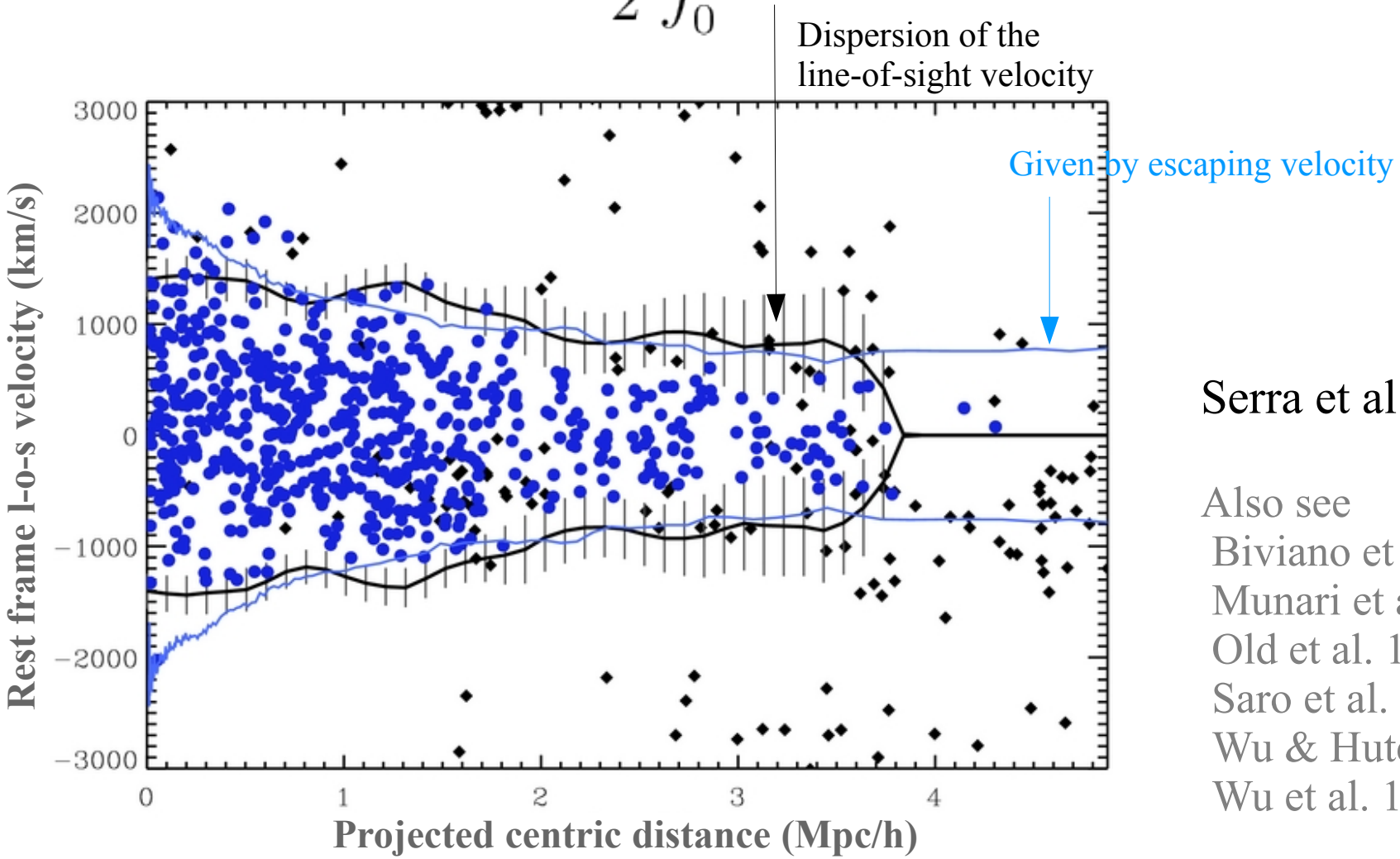




Required optical spec-z for mass+cosmology

- Dynamical mass estimate

$$GM(\leq r) = \frac{1}{2}\int_0^r \mathcal{A}^2(r')\mathrm{d}r'$$

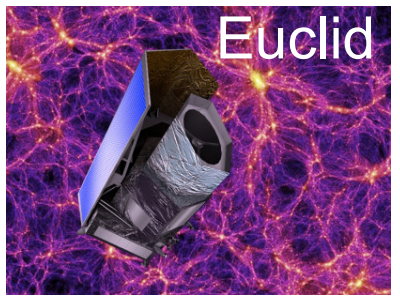


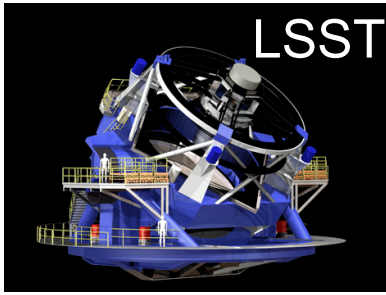
Serra et al. 13

Also see
Biviano et al. 06
Munari et al. 13
Old et al. 13,14
Saro et al. 13
Wu & Huterer 13
Wu et al. 13

eROSITA cluster survey & its follow-up

- Redshifts: X-ray spec-*z*, optical spec-*z* and photo-*z*
  - Optical spectroscopy: follow-up
    - eBOSS/SPectroscopic IDentification of *ERosita* Sources
      - *eROSITA* clusters in the northern sky
    - 4MOST
      - *eROSITA* clusters in the southern sky
    - Individual target follow-ups with telescopes
  - Optical and near-IR: finding clusters, photo-*z* & lensing
    - Dark Energy Survey
    - Hyper Suprime-Cam Survey
    - Large Synoptic Survey Telescope
    - Euclid

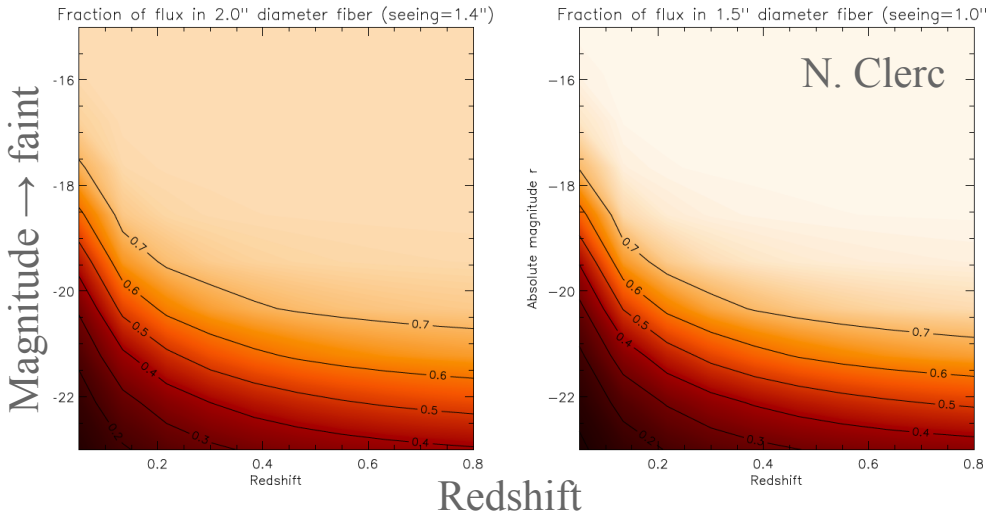




Merloni et al. (2012) and references therein

Results: sampling HIFLUGCS galaxy spec-z

- At the *cluster redshift* and *z=0.2, 0.4, 0.6 & 0.8* Zhang et al. in prep.
  - eBOSS/SPIDERS configuration (based on info from Clerc/Merloni)
    - I_{lim}=21
    - closest fiber distance of 55”/65”
  - 4MOST configuration (based on info from Schwope)
    - r_{lim}=22, 4X/position
    - closest fiber distance of 20”
  - ~~10 and 5 redshifts/cluster~~
  - Method
    - Galaxy luminosity function model
    - Flux-loss of the aperture magnitude
    - ...



Results: optical spec-z based mass estimates

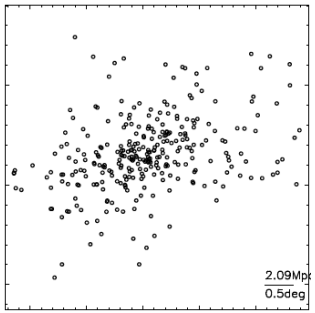
- Re-sampled 13467 spec-z using 4MOST configuration

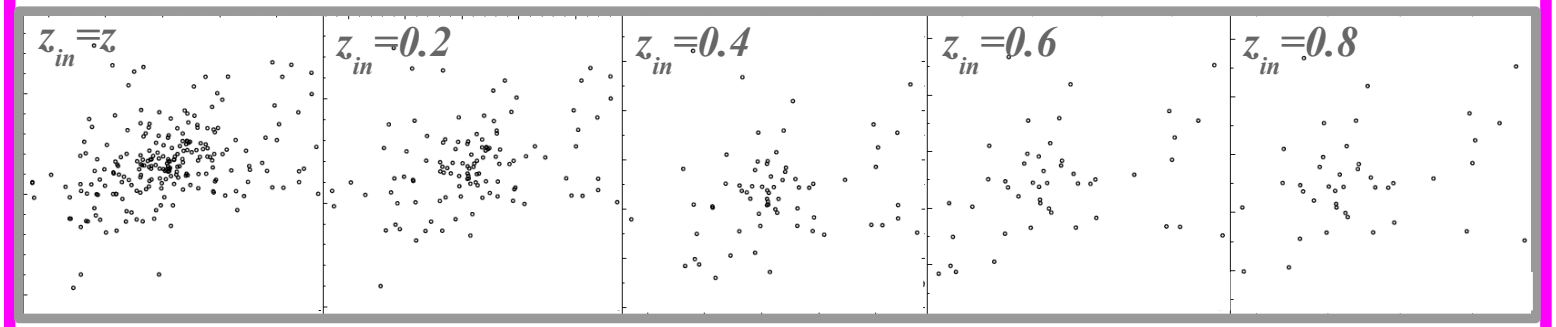
Collisional distance ↓ *Limiting magnitude* Zhang et al. in prep.

Observations: A2256

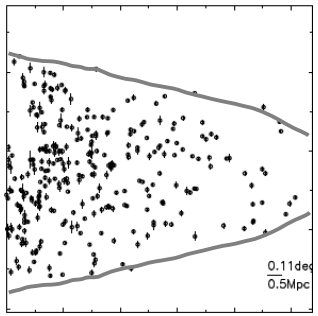
Simulations: re-sampled galaxy members using coming survey setups

2D cluster galaxies distribution in the sky

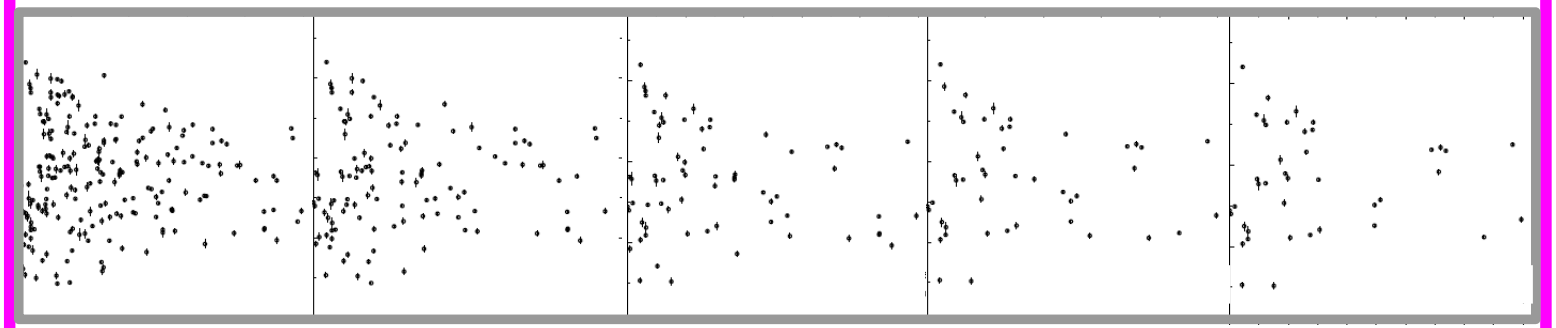




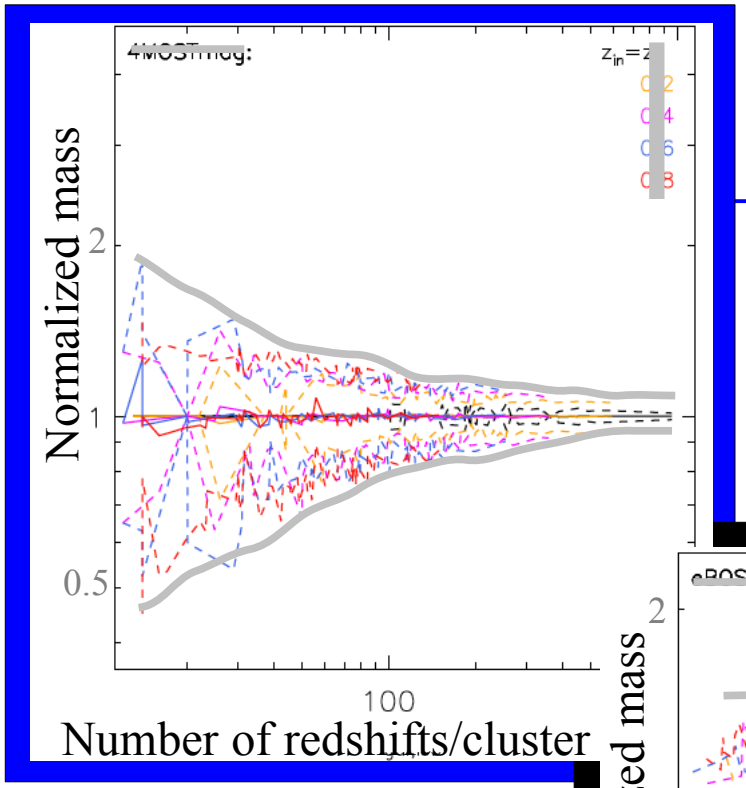
Line-of-sight velocity



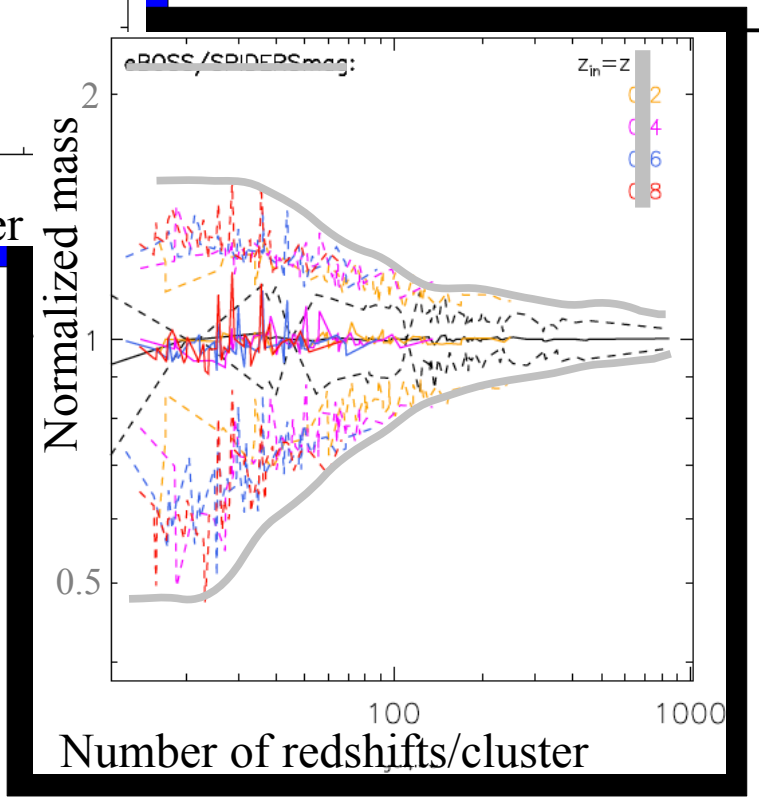
Projected distance



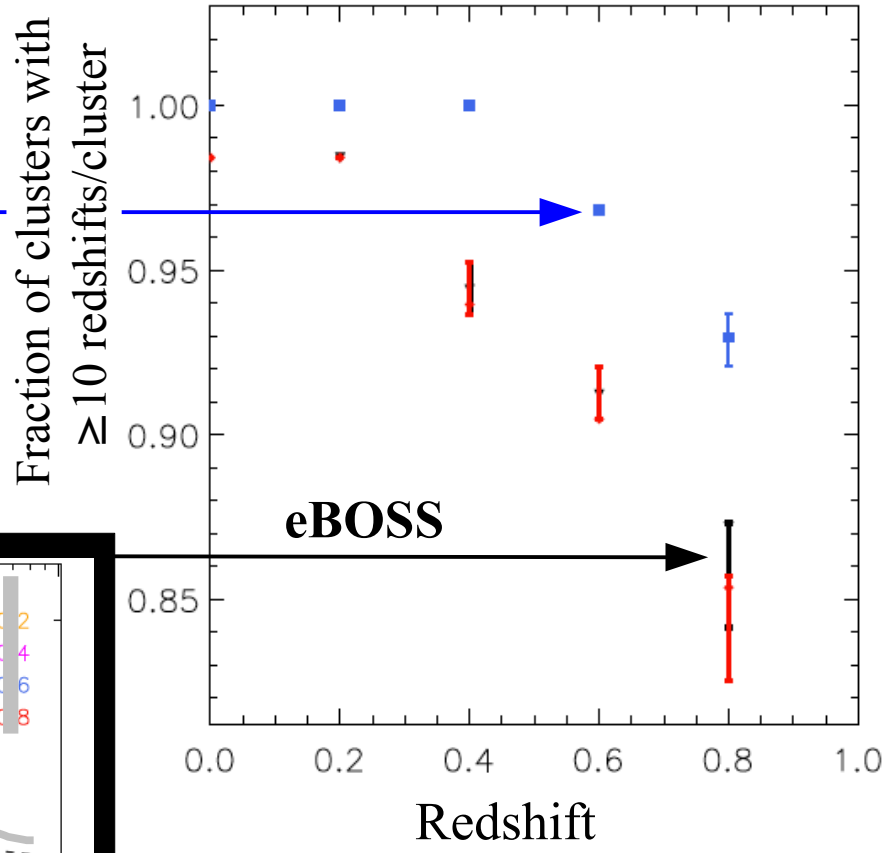
Results: mass uncertainty in spec-z surveys



4MOST



eBOSS



Zhang et al. in prep.

Summary

- Combining independent cluster mass proxies from multi-wavelength surveys can break the degeneracy between mass calibration and cosmological constraint.

- Ongoing/upcoming optical spectroscopic surveys like eBOSS/SPIDERS and 4MOST for example can serve this purpose in a stacked manner up to redshifts of 0.6 – 0.8.