SCIENCE CASE – OTHER COSMOLOGY PROBES

Clusters: spectroscopy

Andrea Biviano (INAF/Oss. Astr. Trieste)
Stefano Borgani (Univ. of Trieste)
Barbara Sartoris (Univ. of Trieste)

Galaxy clusters:

sensitive probes of cosmology

constrain DE through:

number density $d^2N/(dM\ dz)$

&

power spectrum $P(k)$

Galaxy clusters:

sensitive probes of cosmology

constrain DM through:

mass-density profile, $\rho(r)$

&

analysis of subclustering

How many clusters will Euclid-NIS detect?
and how many galaxies in them?

Need:

- cluster galaxy luminosity functions (LF)
- relation between mass and richness
- the evolution of the two above
- theoretical mass function of clusters

Cluster galaxy luminosity functions

Hα:

Combine several LF determinations

(Iglesias-Páramo+02, Balogh+02, Umeda+04, Kodama+04)

Evolution = field galaxy LF (Geach+09)

Integrate LF down to survey limit

Cluster galaxy luminosity functions

DMD:

K-band LF (Lin, Mohr, Stanford 2003)

Conversion K → H → H_{AB}

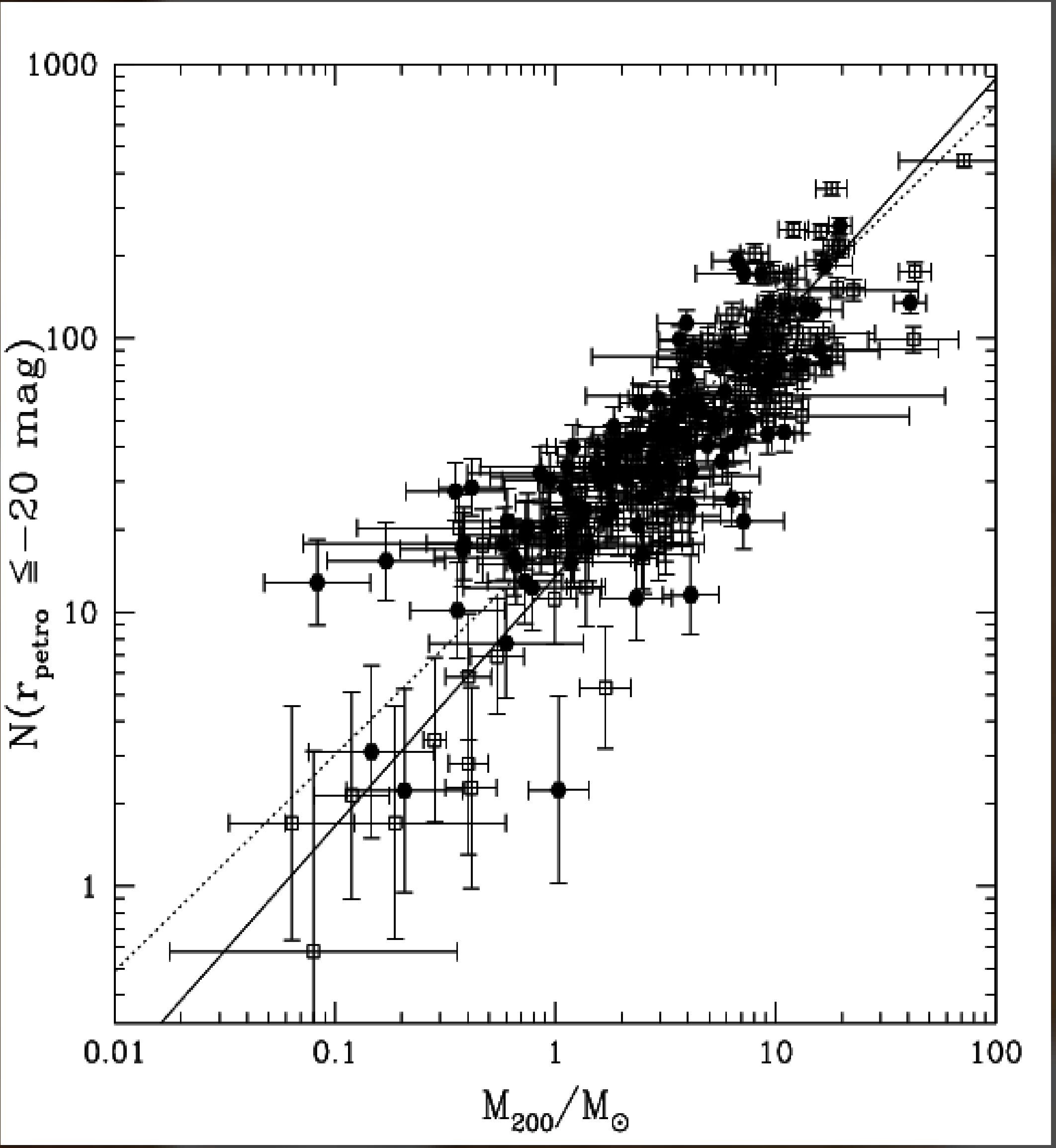
Passive evolution (Mannucci+01, Kodama+Arimoto 97)

Integrate LF down to survey limit

Cluster mass – richness relation

Assume $M \propto N$

(Popesso+07)



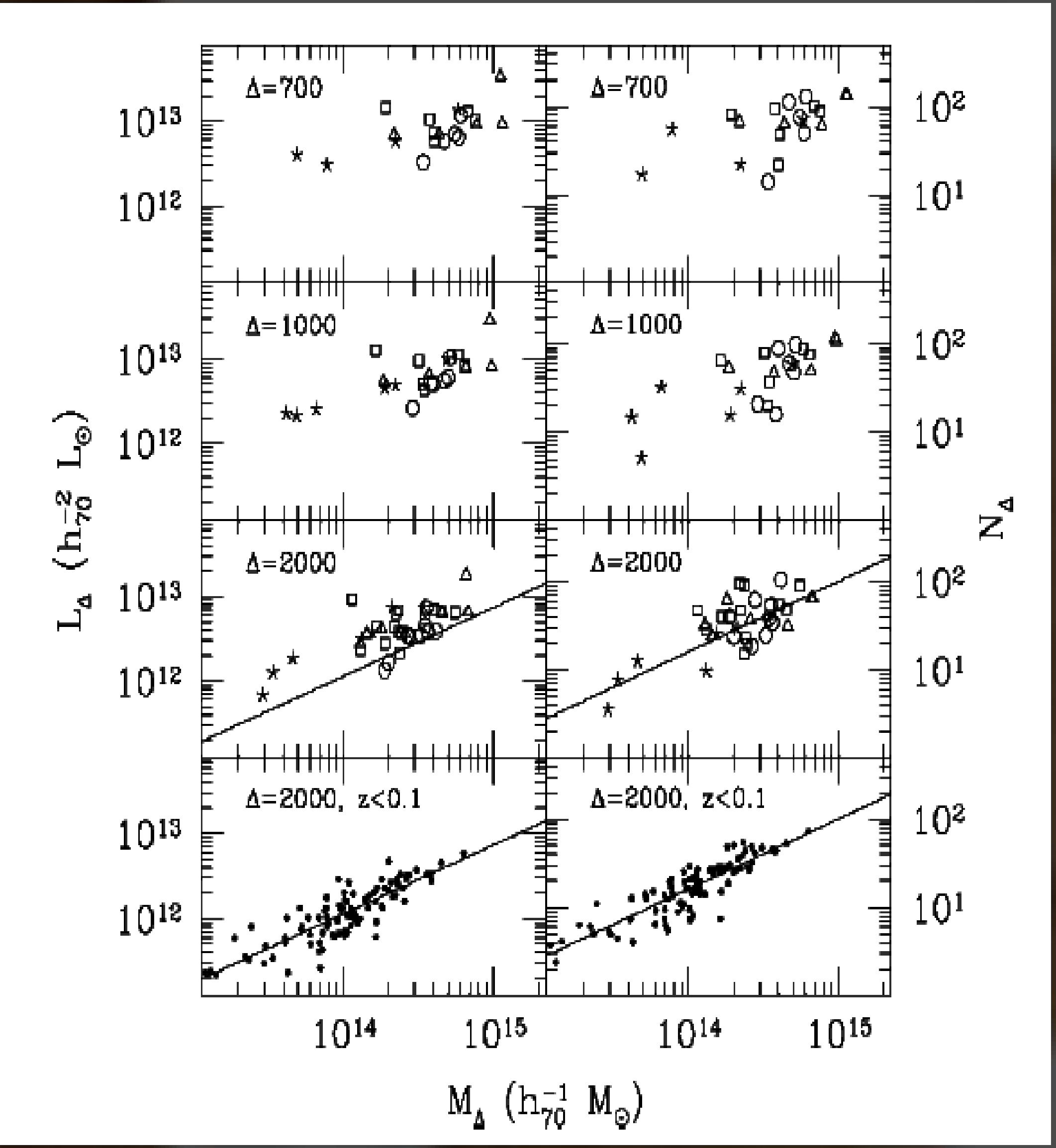
Cluster mass – richness relation

Assume M ∝ N

(Popesso+07)

Assume no evolution

(Lin+06)



Limiting M_{200} of detectable richness≥n clusters

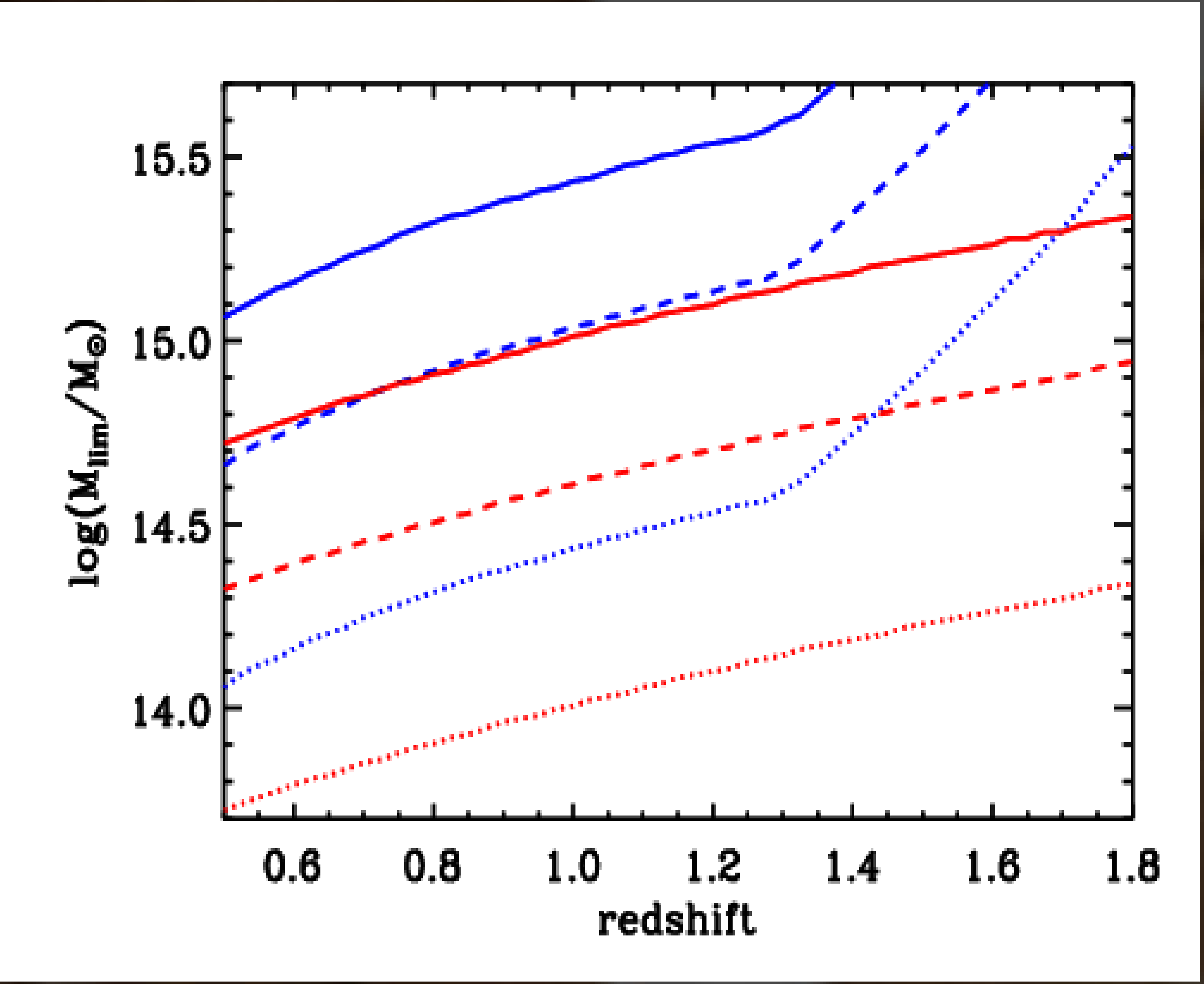
DMD

Hα

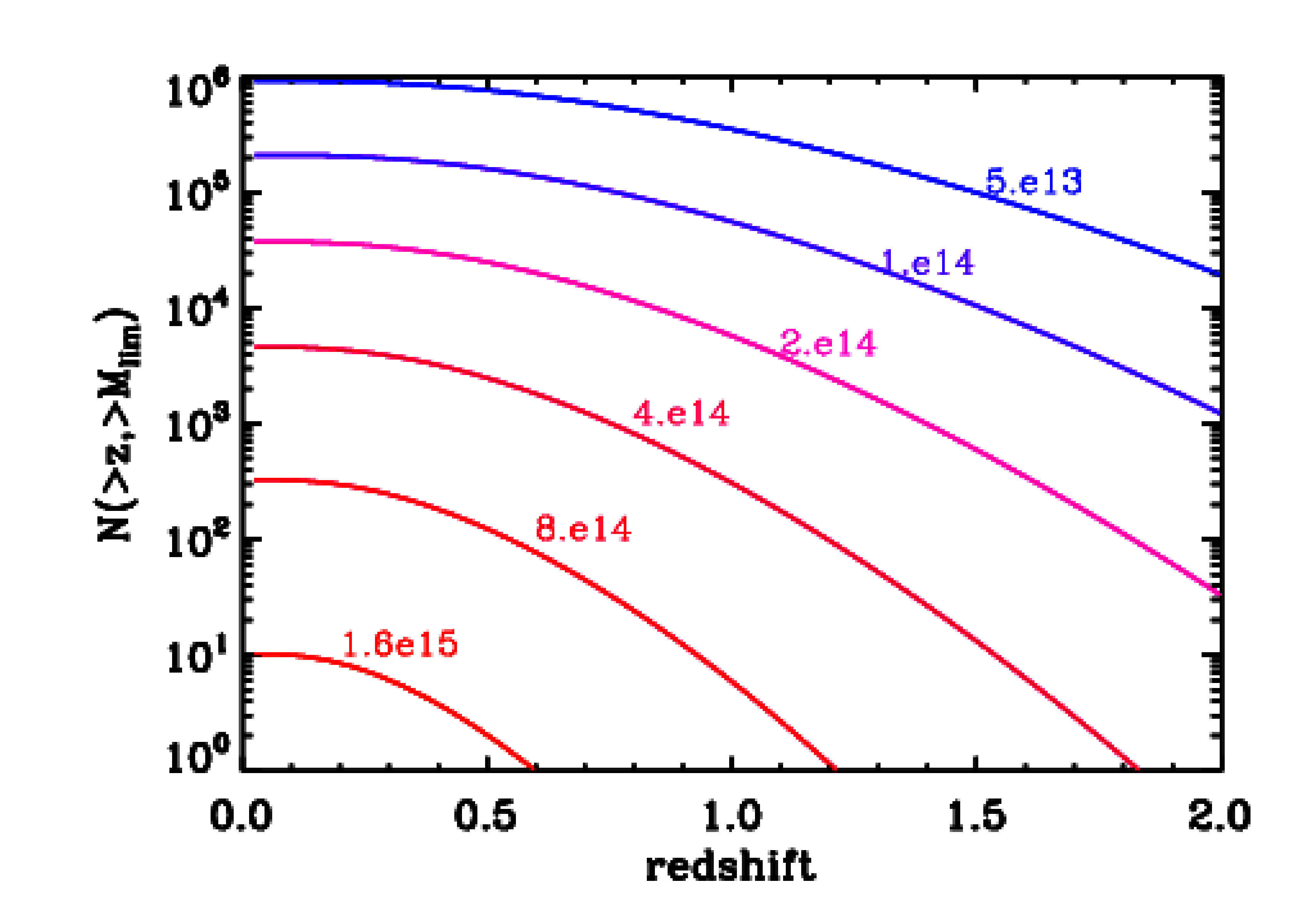
n=50

n=20

n=5



Number of clusters with mass≥M_{200} above a given z, in YB 2.3.5 cosmology



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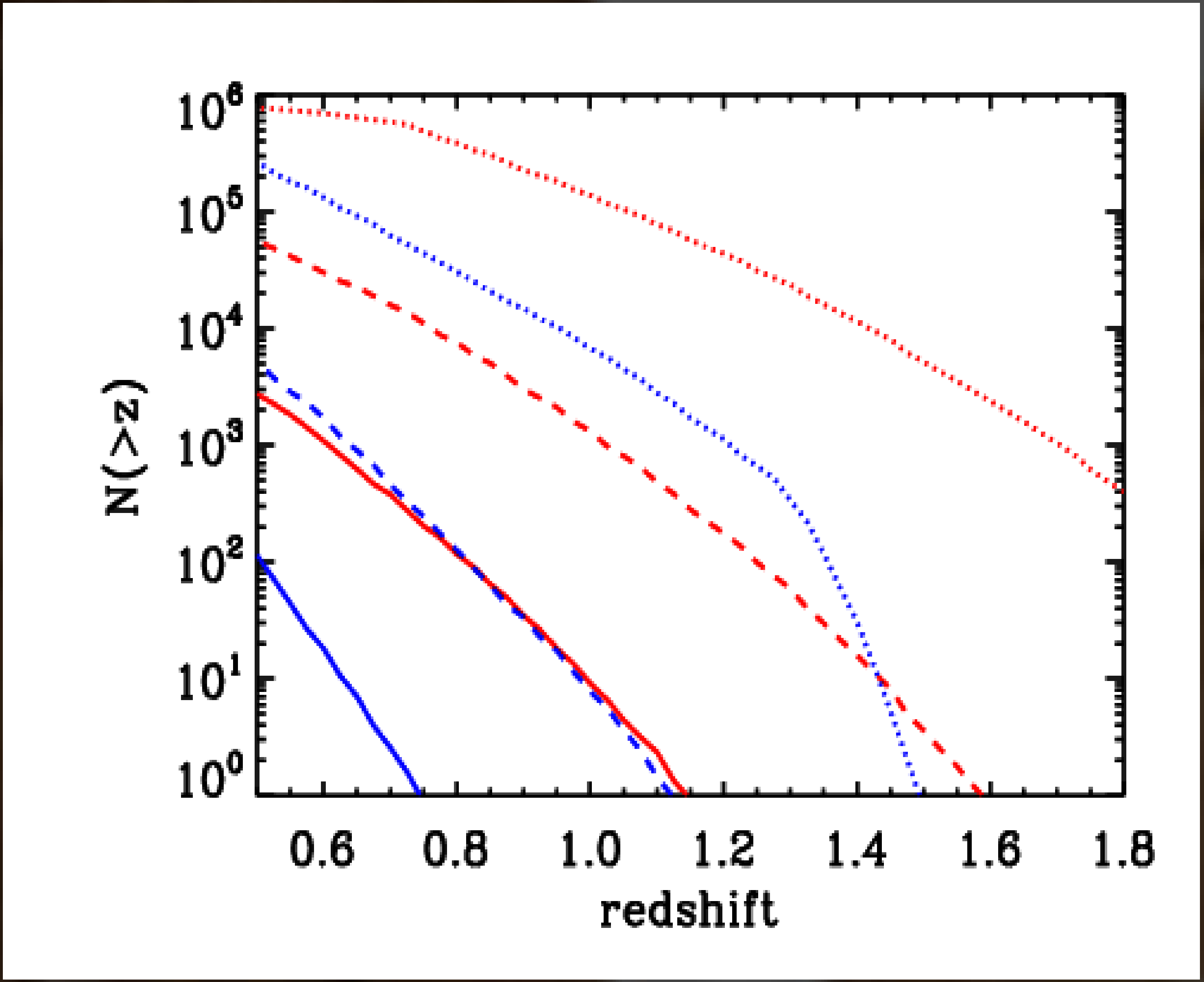


Predictions on DE w:

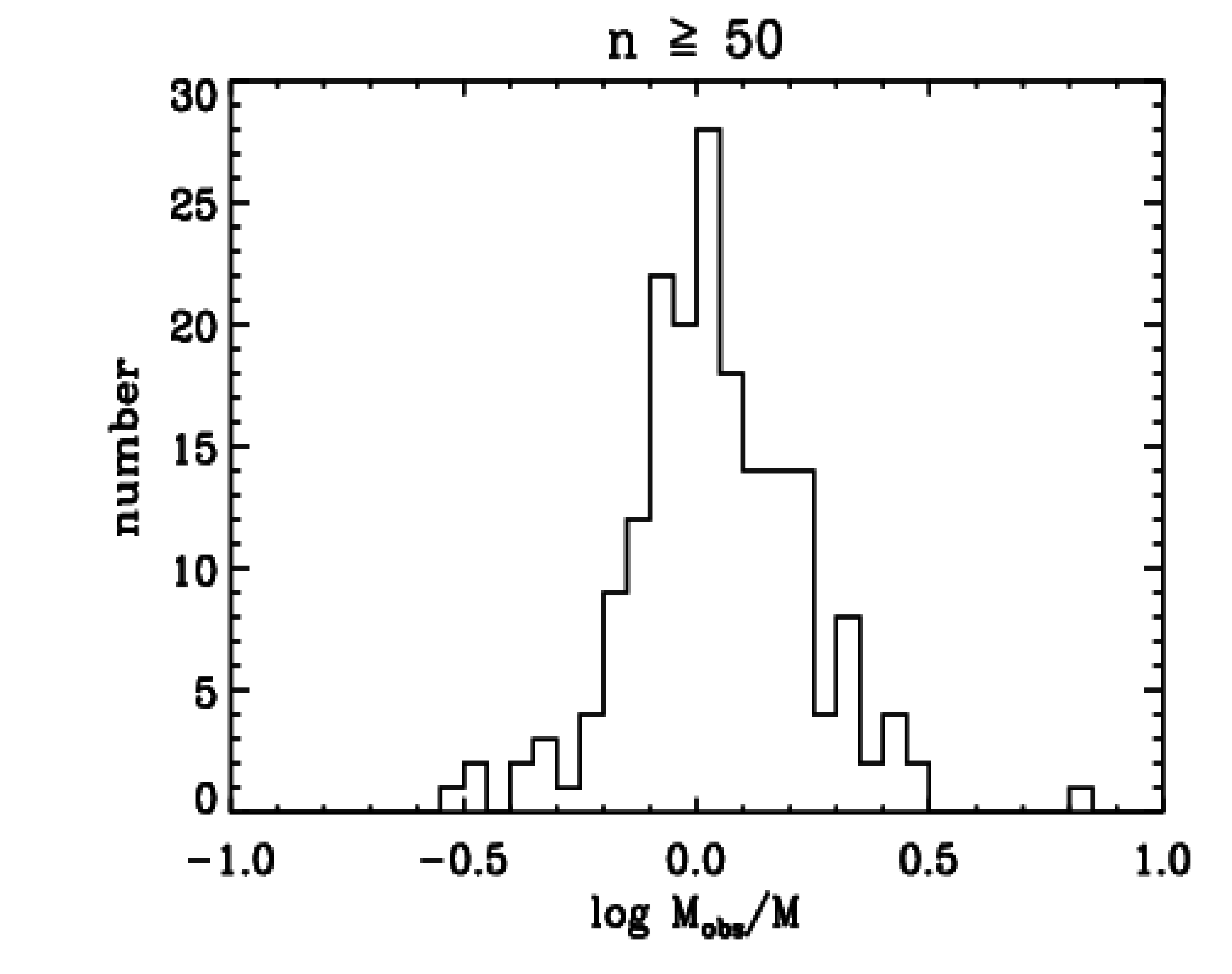
depend on the bias and scatter in M_{obs}-M

$$p(M^{\rm obs}|M) = \frac{1}{\sqrt{2\pi\sigma^2_{\ln M}}} \exp\left[-x^2(M^{\rm obs})\right]$$

$$x(M^{\rm obs}) \equiv \frac{\ln M^{\rm obs} - \ln M - \ln M^{\rm bias}}{\sqrt{2\sigma^2_{\ln M}}}$$

Bias and scatter of M_{obs}-M:

use cosmological N-body simulations *(Borgani et al. 2004)*



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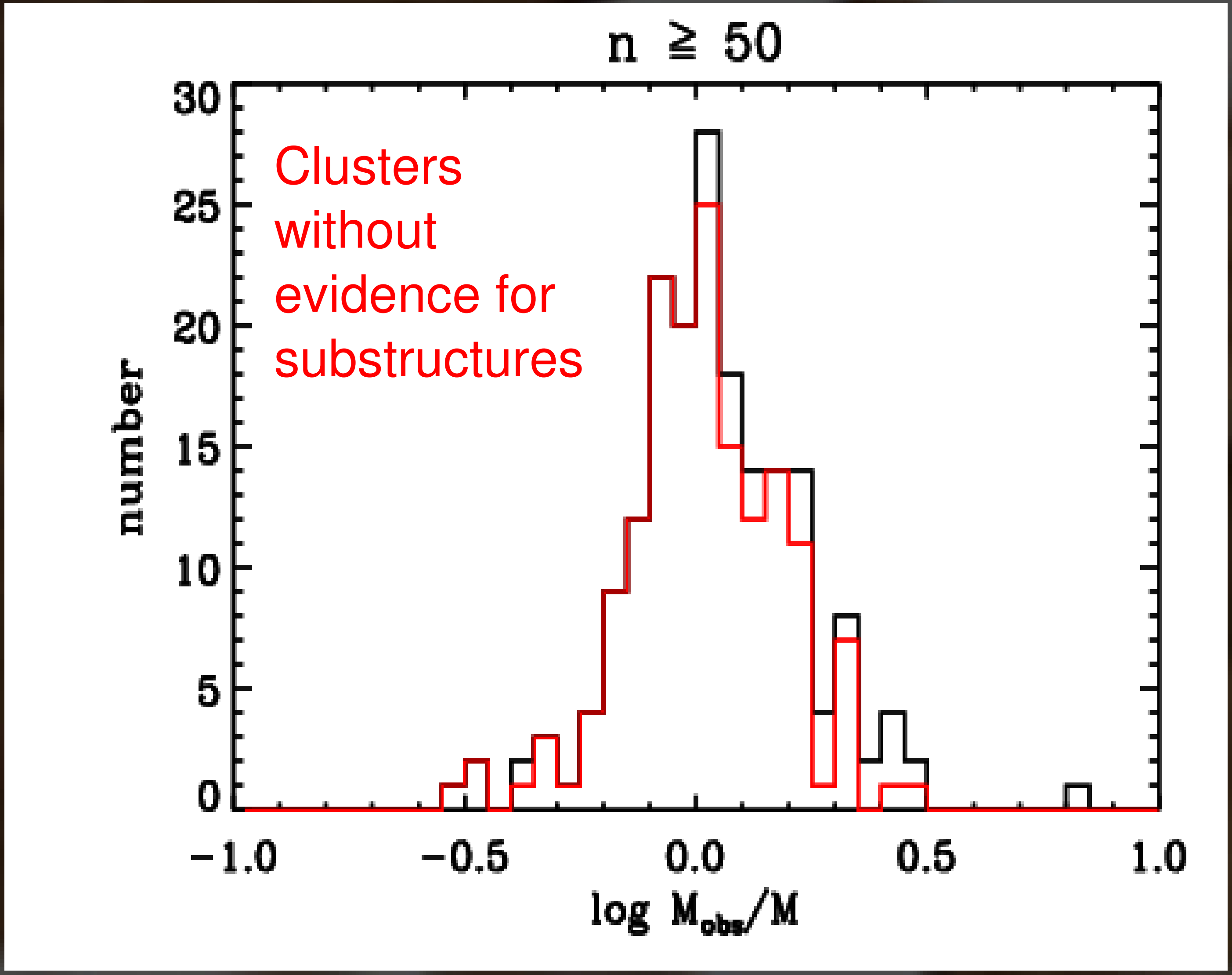


Predictions on DE $w=w_0+w_a\,(1-a)$

Adopting Planck priors, *and*

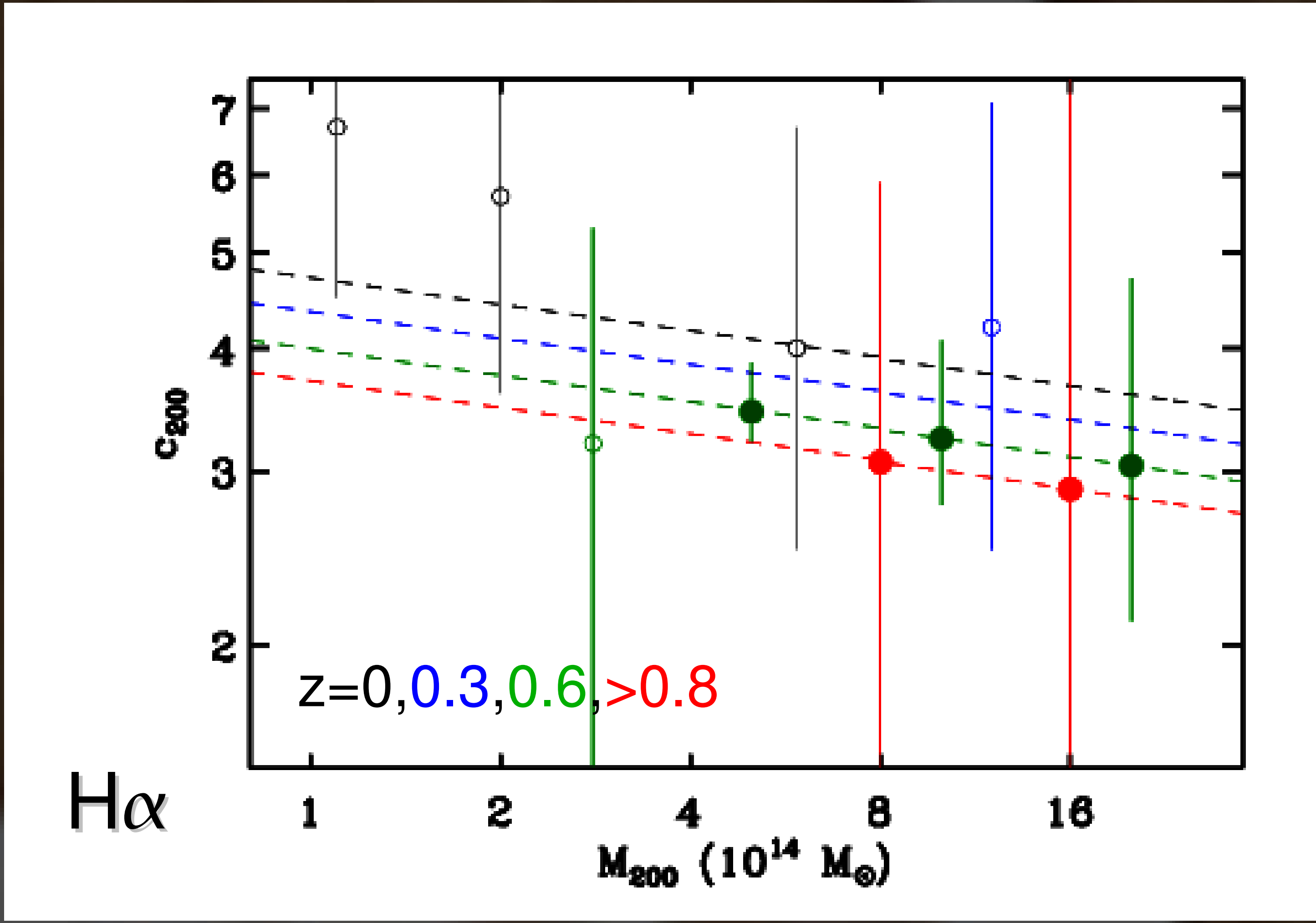
$\ln M^{bias}=0\pm0.15$, $\sigma_{\ln M} = 0.4\pm0.3$, evolution $\propto(1+z)^{1\pm1}$

WORK IN PROGRESS

Predictions on mass profile constraints

Assuming NFW:

$$\rho_{NFW} = \frac{\rho_0}{(cr/r_{200})(1+cr/r_{200})^2}$$



Lines: therорetical predictions from Duffy+08

Circles: current observational results

Dots: predictions for EUCLID-NIS

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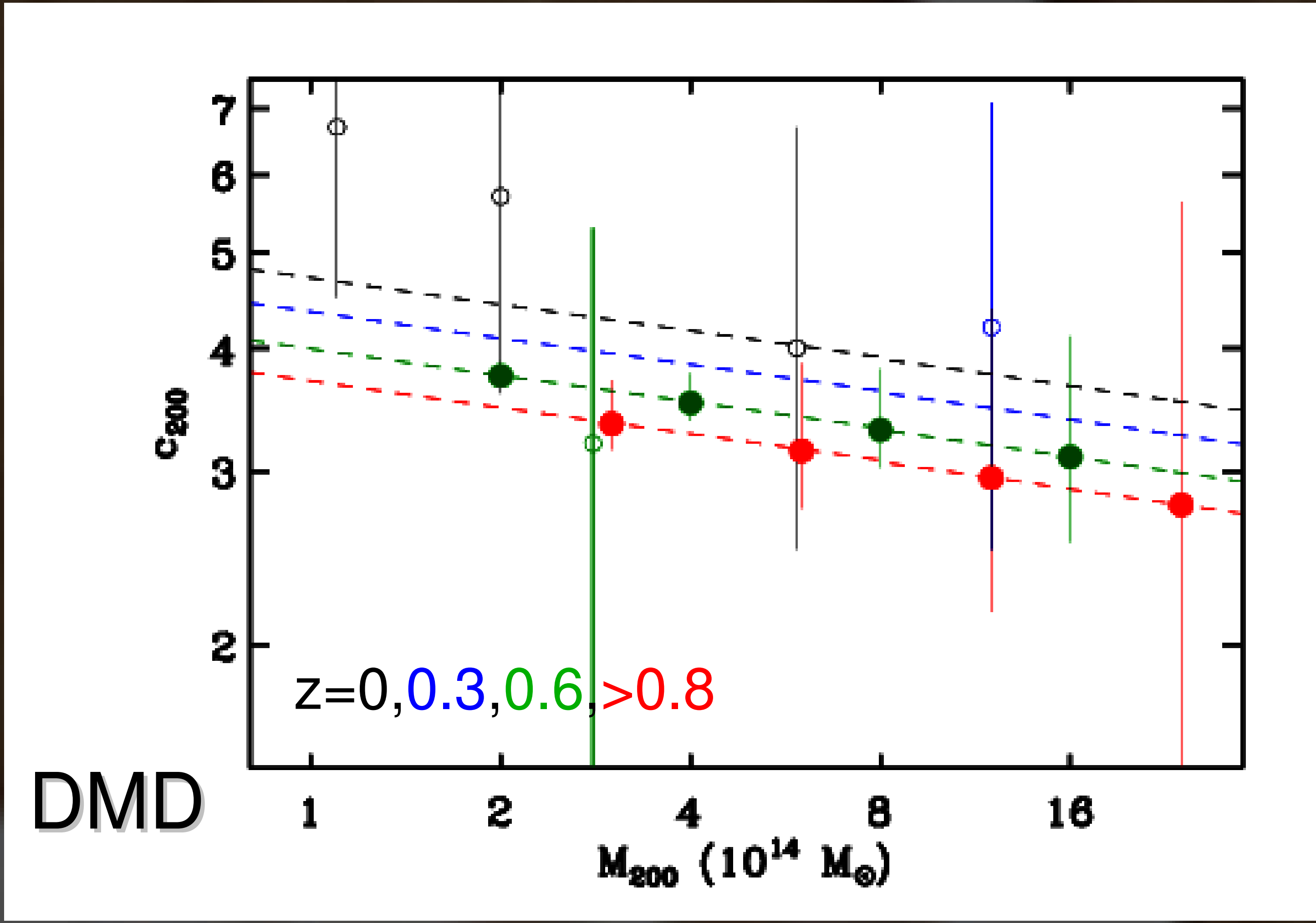

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Dots: predictions for EUCLID-NIS

Synergy with an X-ray mission: eROSITA

Euclid-NIS (Hα or DMD):
<z> estimates (based on ≥5 galaxies)
for all eROSITA clusters ($\sim 10^5 > 3\ 10^{14}\ M_\odot$)
⇨ significant improvement on cosmological constraints

Euclid-NIS (DMD):
internal structure and detailed kinematics
for ≈200 massive clusters (based on ≥100 galaxies)
⇨ several Bullet Clusters, constrain DM properties
(in synergy with Weak Lensing from Euclid-VIS)

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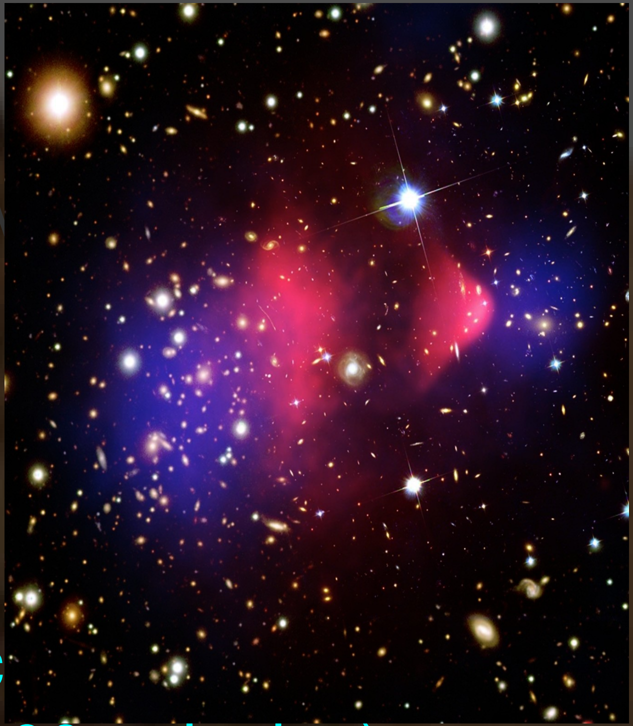

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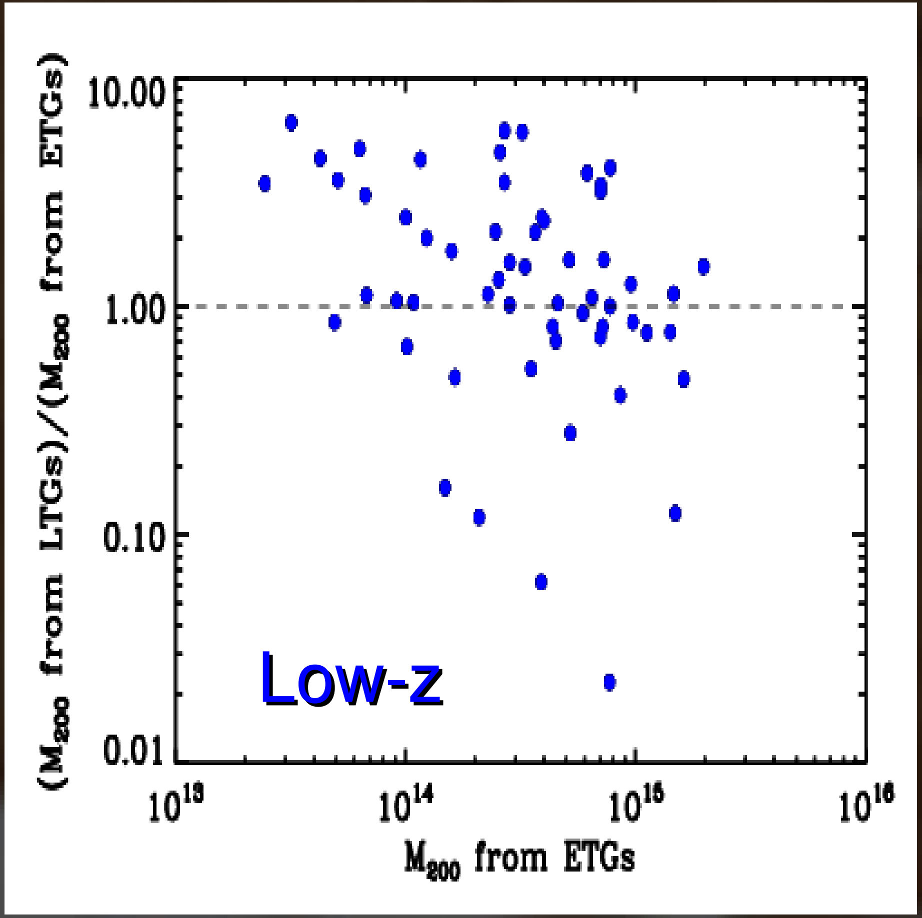
The mass calibration: problems and improvements

Masses based on Emission-line galaxies may be biased



...but things get better in more distant clusters...

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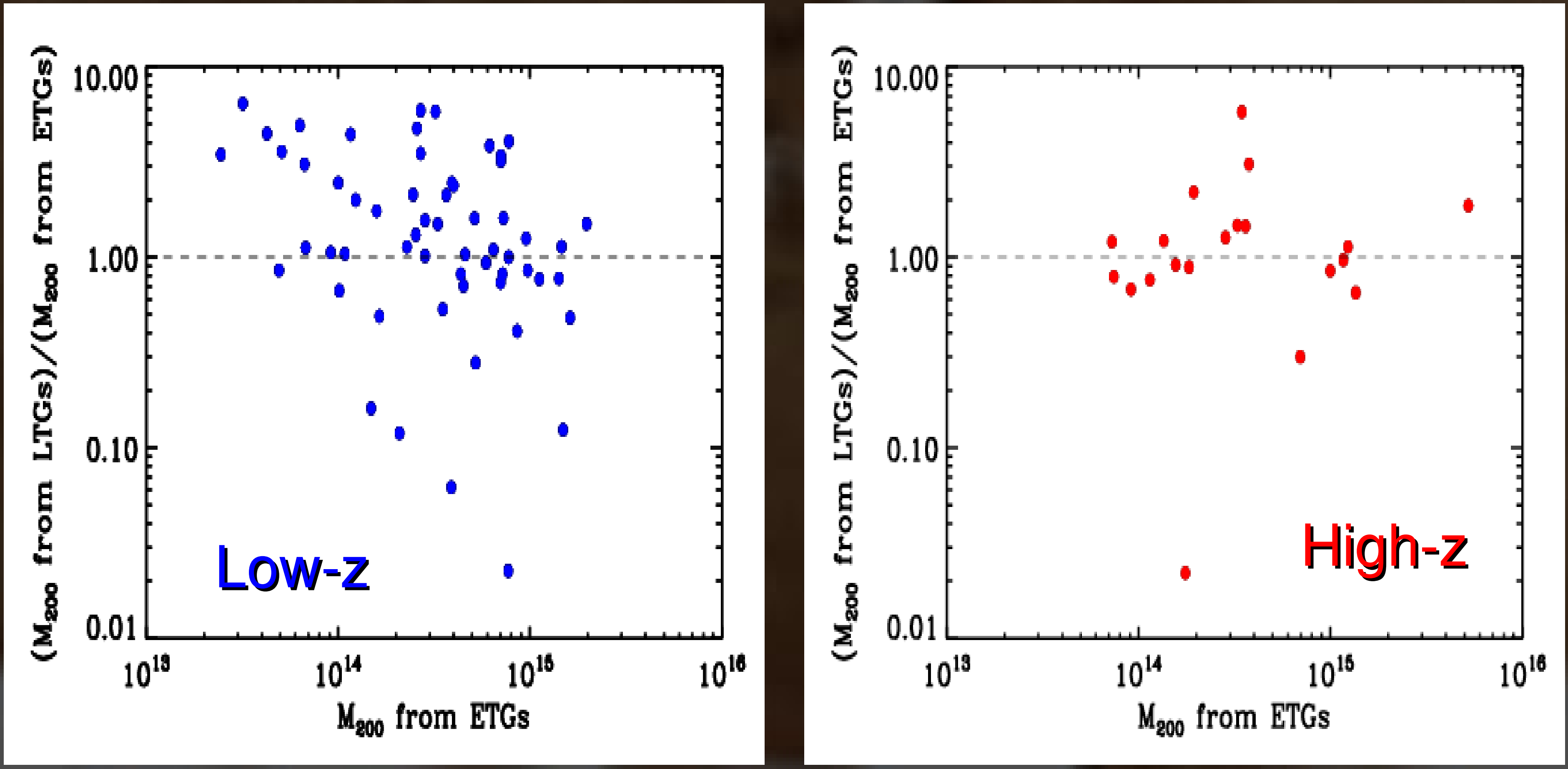

The mass calibration: problems and improvements

Bias and scatter in mass determinations
can profit from cross-calibration:

Euclid-NIS masses from kinematics
vs. Euclid-VIS Weak Lensing masses
vs. Euclid-NIP mass-estimates from richness/luminosity
vs. mass-estimates from X-ray and SZ

Oldest fragment of Euclid's Elements of Geometry

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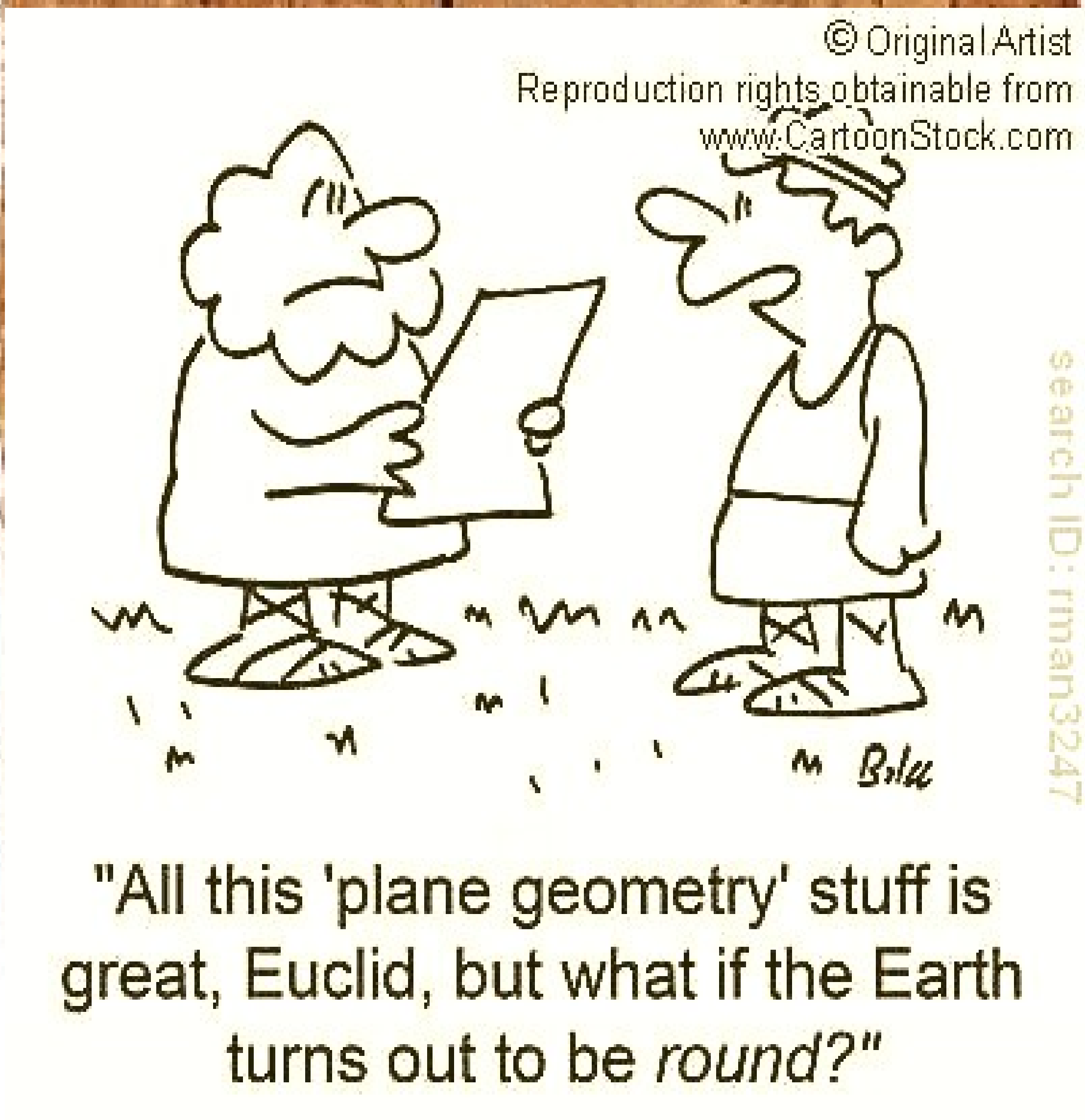

"All this 'plane geometry' stuff is great, Euclid, but what if the Earth turns out to be *round?*"