

THE RATIO OF LUMINOUS TO FAINT RED SEQUENCE GALAXIES IN X-RAY AND OPTICALLY SELECTED LOW-Z CLUSTERS

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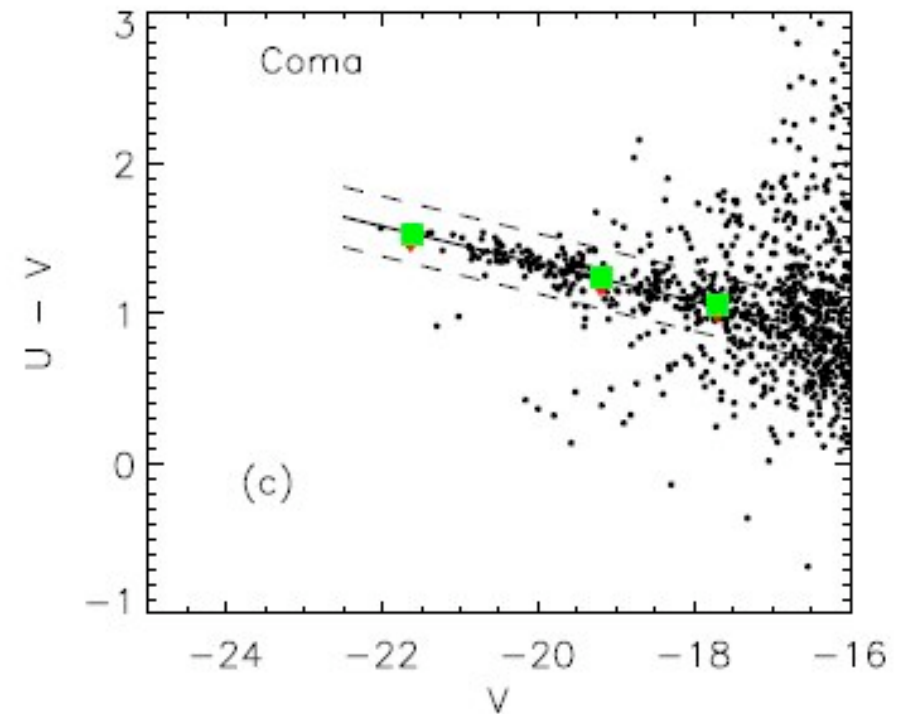


OVERVIEW

- Recent issues about the Colour-Magnitude Relation (CMR)
- Our work
 - stacked CMR
 - lum/faint ratios
- Summary
- Discussion

CMR

- Important because it tells us about the build up of elliptical galaxies
- Studies of CMR build-up have provided:
 - clues to Es downsizing (Thomas et al. 2005) as
 - function of redshift
 - function of environment

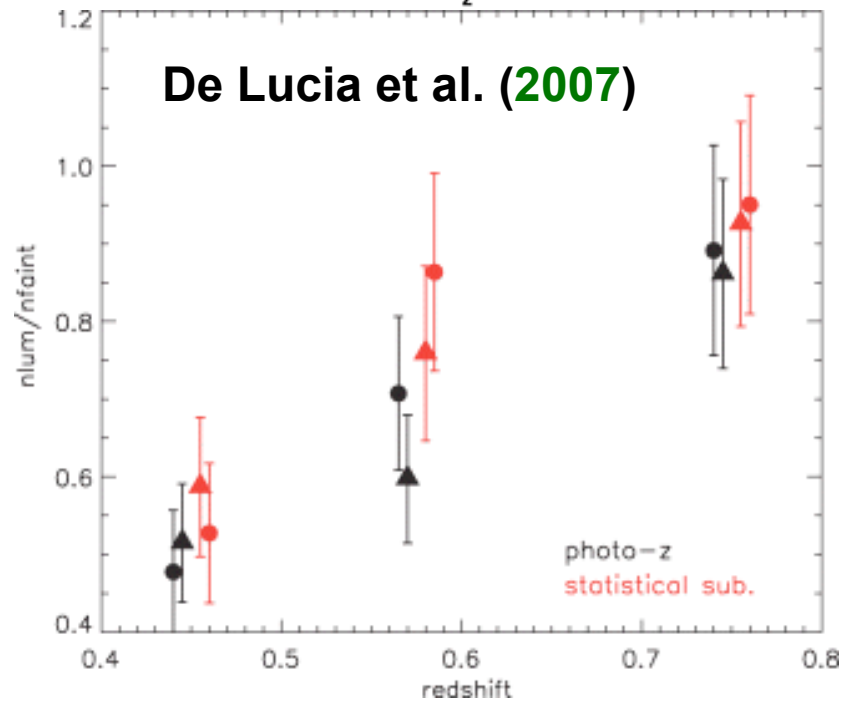
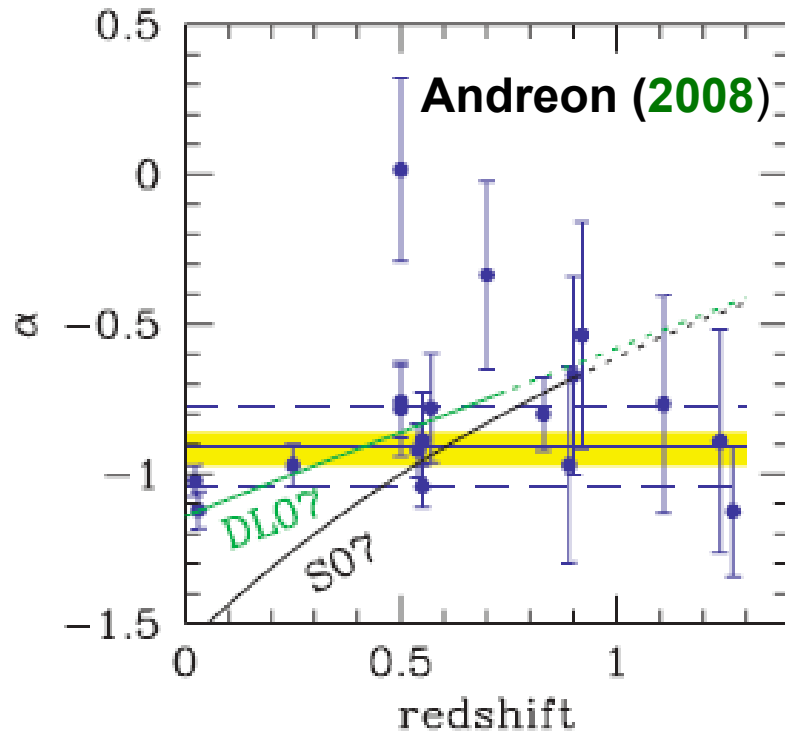
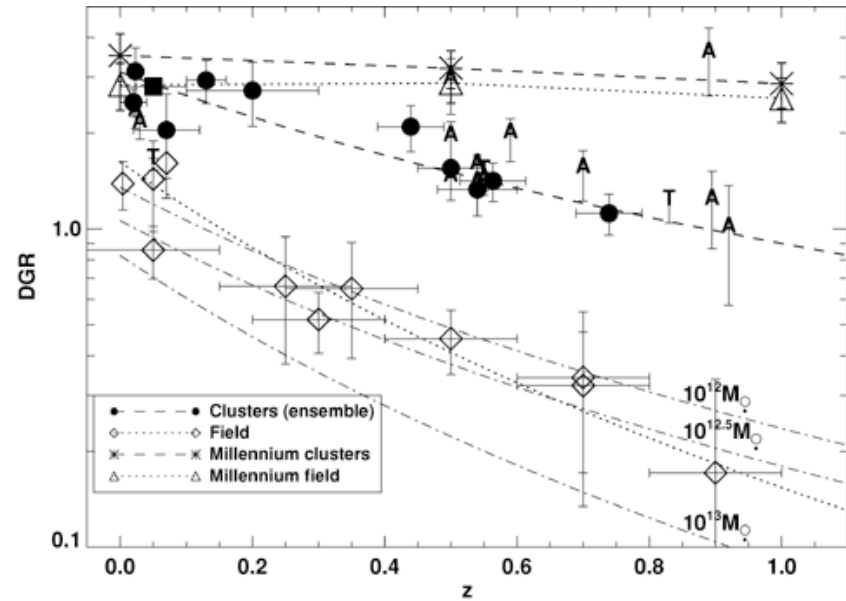


De Lucia et al. (2005)

Redshift

- What gives the best result:
 - LF faint end α ?
 - lum to faint ratio?

Gilbank & Balogh (2008)

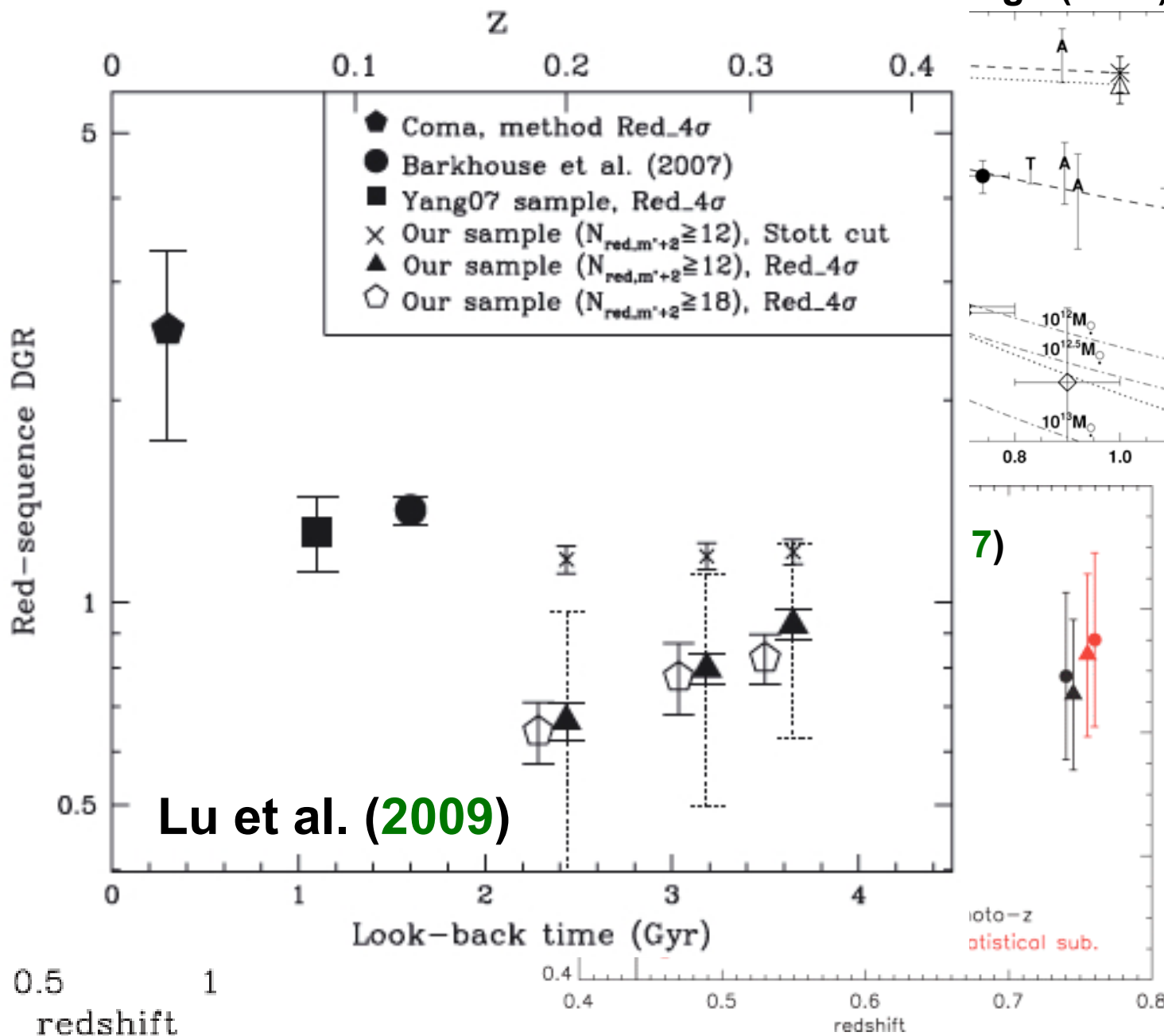
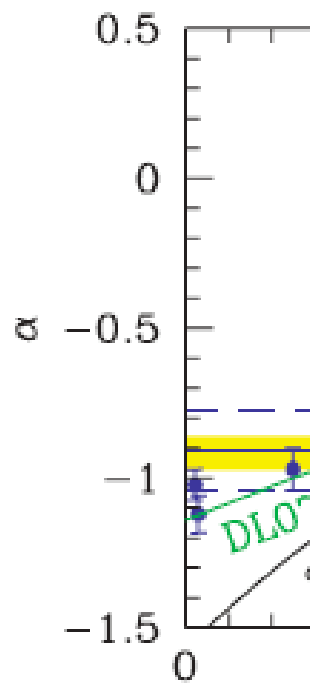


Redshift

Gilbank & Balogh (2008)

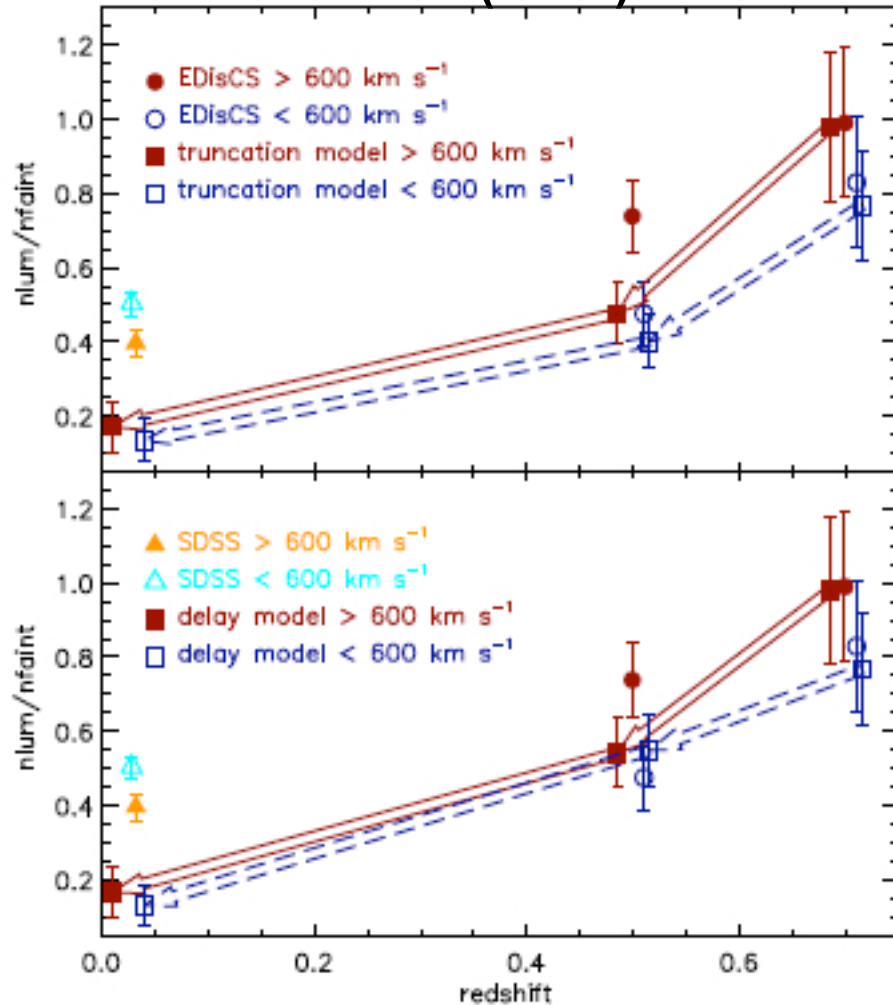
- What result

- LF
- Lu

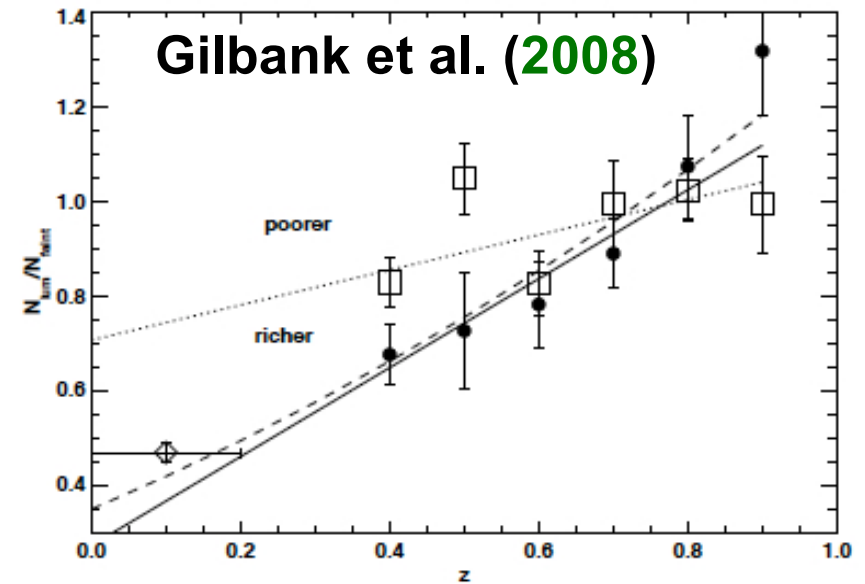


Mass

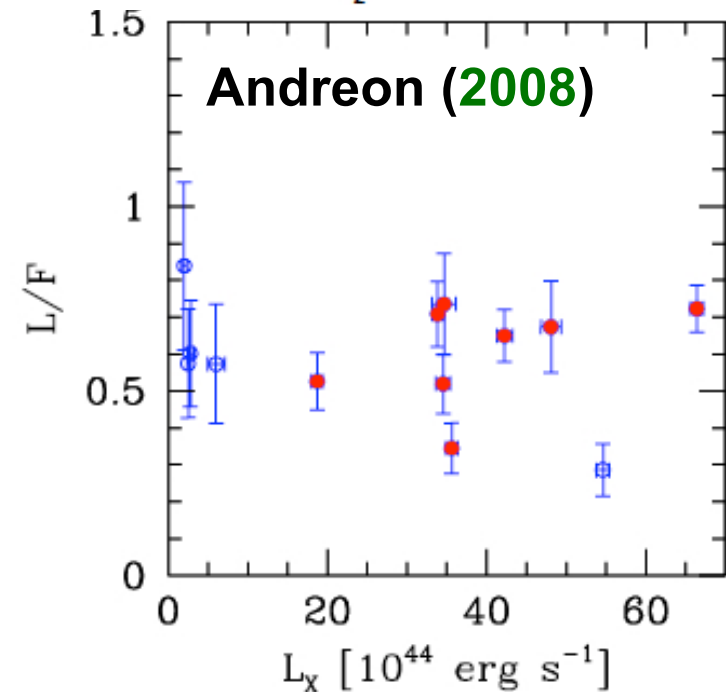
De Lucia et al. (2007)



Gilbank et al. (2008)



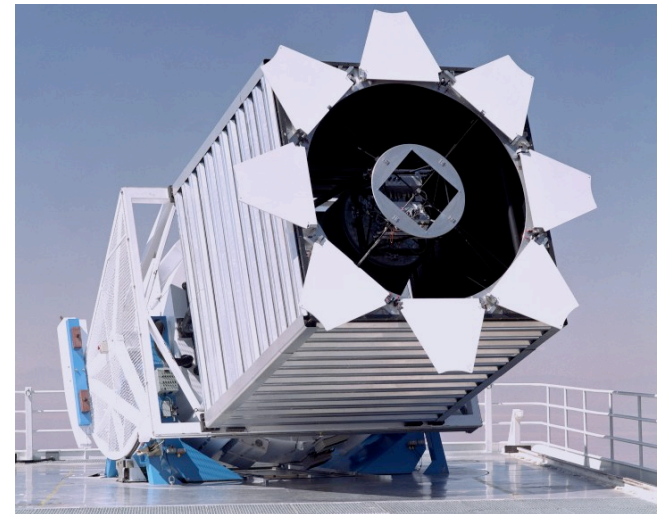
Andreon (2008)



Gilbank & Balogh (2008): no lum/faint vs. mass corr. (high mass sample)

What do we want to do?

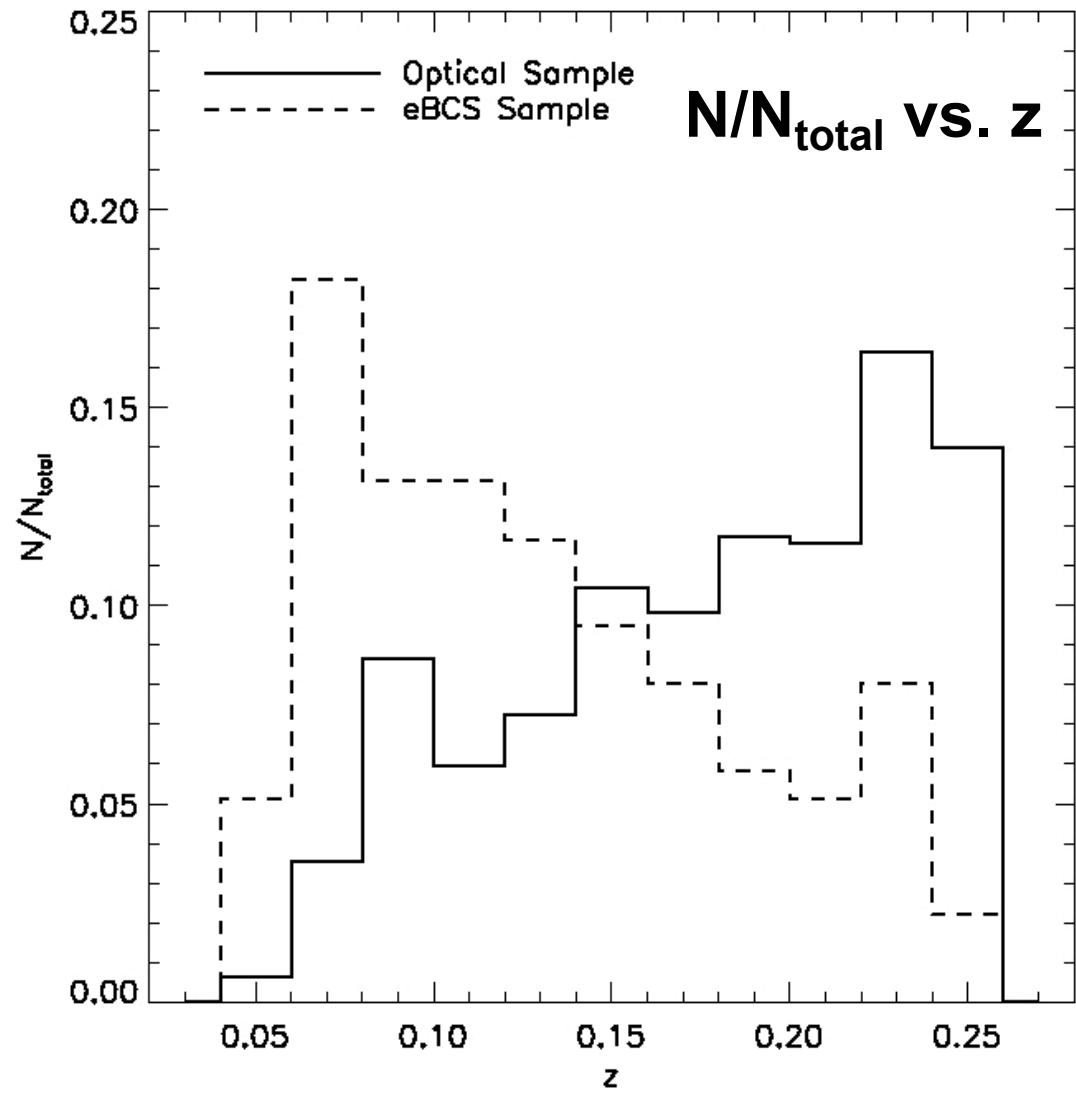
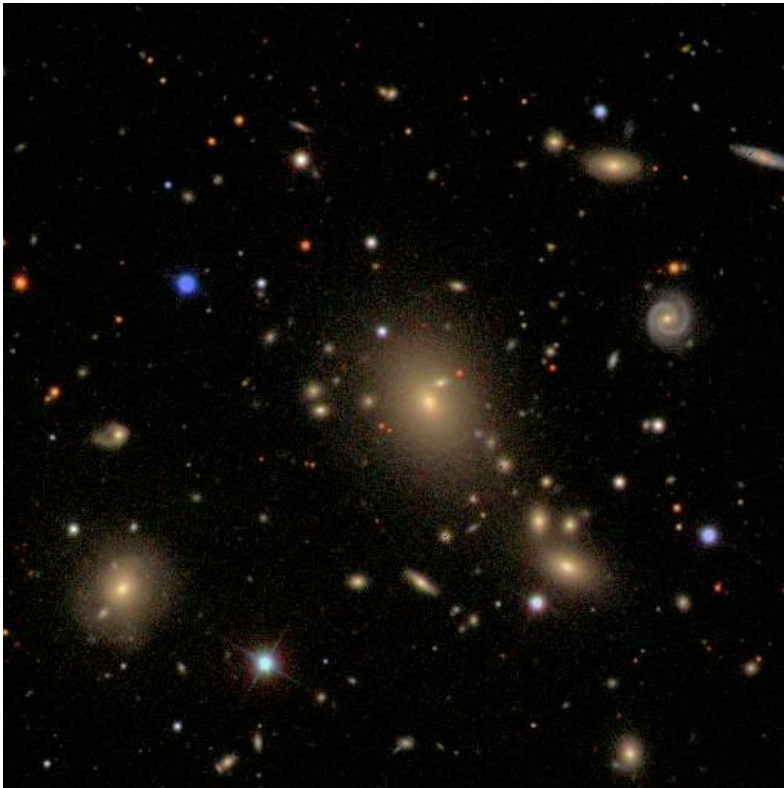
- To study the CMR (lum/faint ratios) with z and cluster mass
- Low- z ($0.05 < z < 0.26$)
- Optically selected clusters: 342 maxBCG (B sample) + 280 HMF (HB sample), Bahcall et al. (2003)
- X-Ray selected clusters: 137 from the extended Brightest Cluster Survey (eBCS), Ebeling et al. (1998; 2000)
- Using SDSS DR6 data



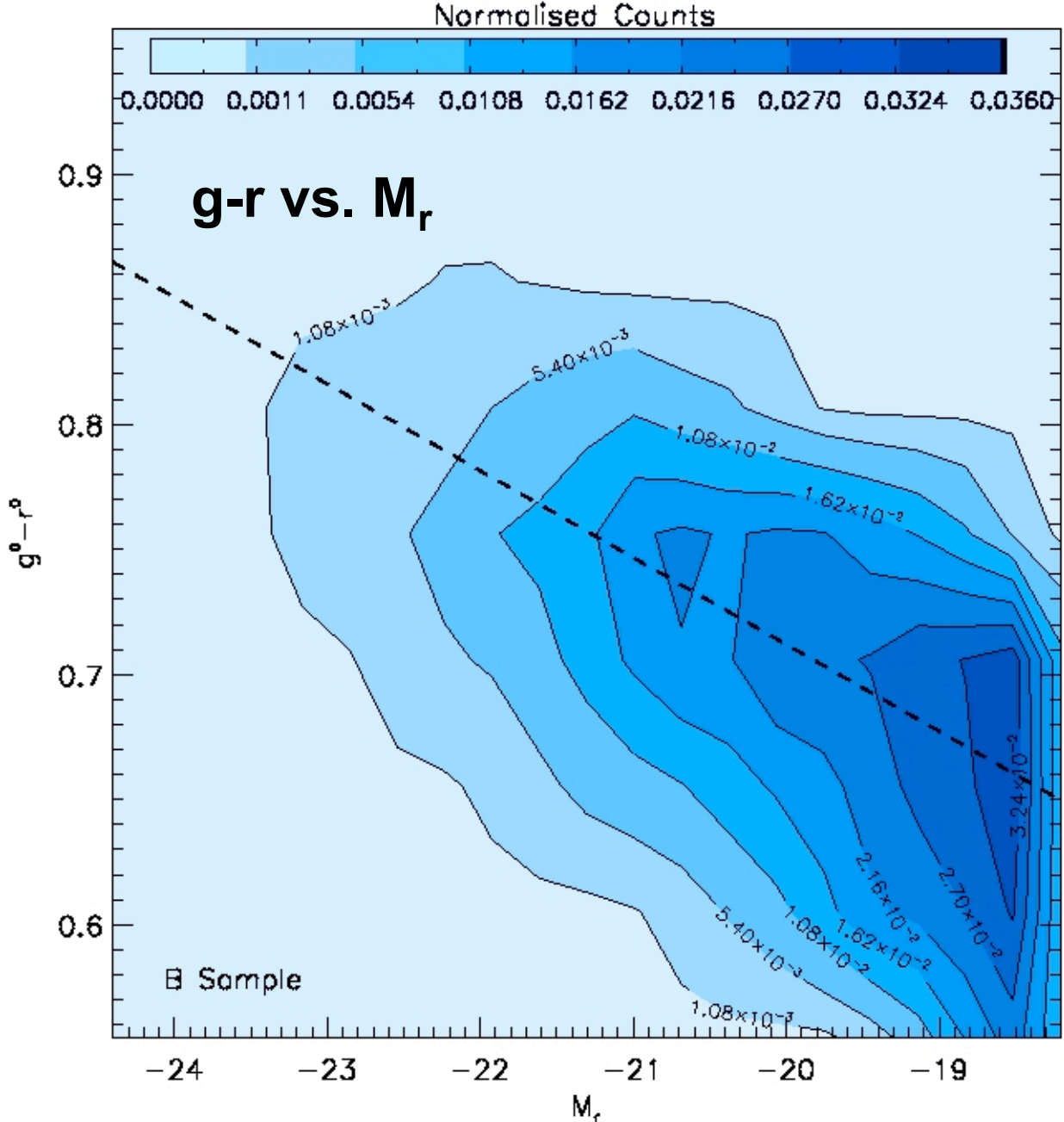
Sample selection

- maxBCG (Koester et al. 2007)
 - selects groups and clusters dominated by red bright ($\sim L^*$) galaxies
- Hibrid Matched Filter (Kim et al 2002)
 - Finds clusters with approximately Plummer density profiles and Schechter luminosity function
- eBCS:
 - flux limited sample ($f_x > 2.8 \times 10^{-12} \text{ erg cm}^{-2} \text{ s}^{-1}$) from *RASS* data in the northern emisphere ($\delta \geq 0$ deg; $|b| \geq 20$ deg)

SAMPLES



STACKED CMR



Galaxies with $R < 1$ Mpc



Iterative biweight fit: M-locators (Beers et al. 1990)



Colour cut: galaxies within a scatter of 0.2 mag from best-fit CMR



Passive evolution correction



Biweight fit

STACKED CMR

Sample	slope
eBCS	$-0.036^{+0.001}_{-0.001}$
B	$-0.035^{+0.003}_{-0.002}$
HB	$-0.032^{+0.002}_{-0.003}$

Bootstrap for determining errors on slope

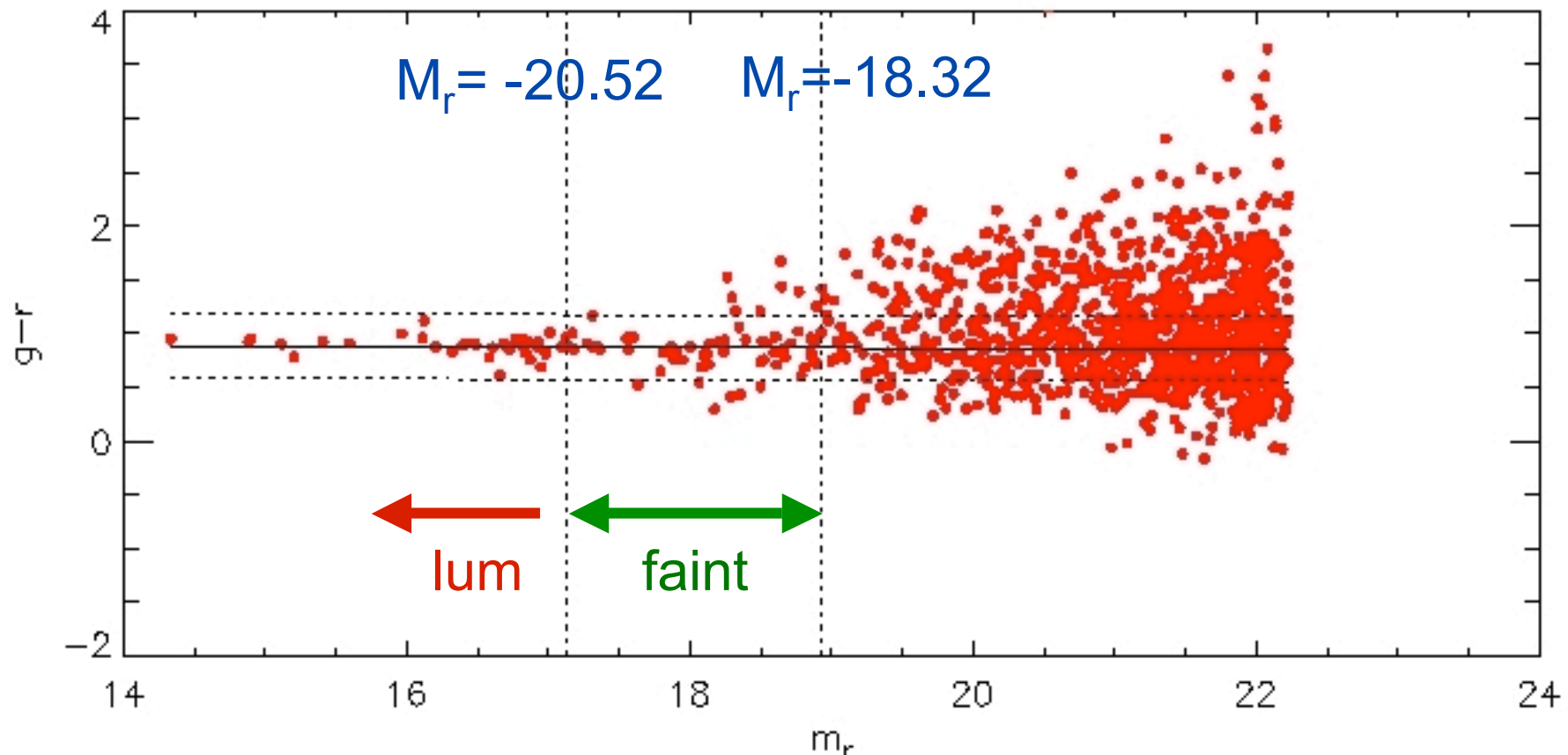
Slope values consistent within 2σ of each other and similar to those obtained in observational studies using similar rest-frame colours (e.g. Stott et al. 2009)

Lum/Faint Ratio

Lums: $M_r < -20.52$

Faints: $-20.52 < M_r < -18.32$

Limits transformed in
apparent magnitude



Mean: weighted average
among 17 control regions
(De Filippis et al., in prep.)

← **Background** →

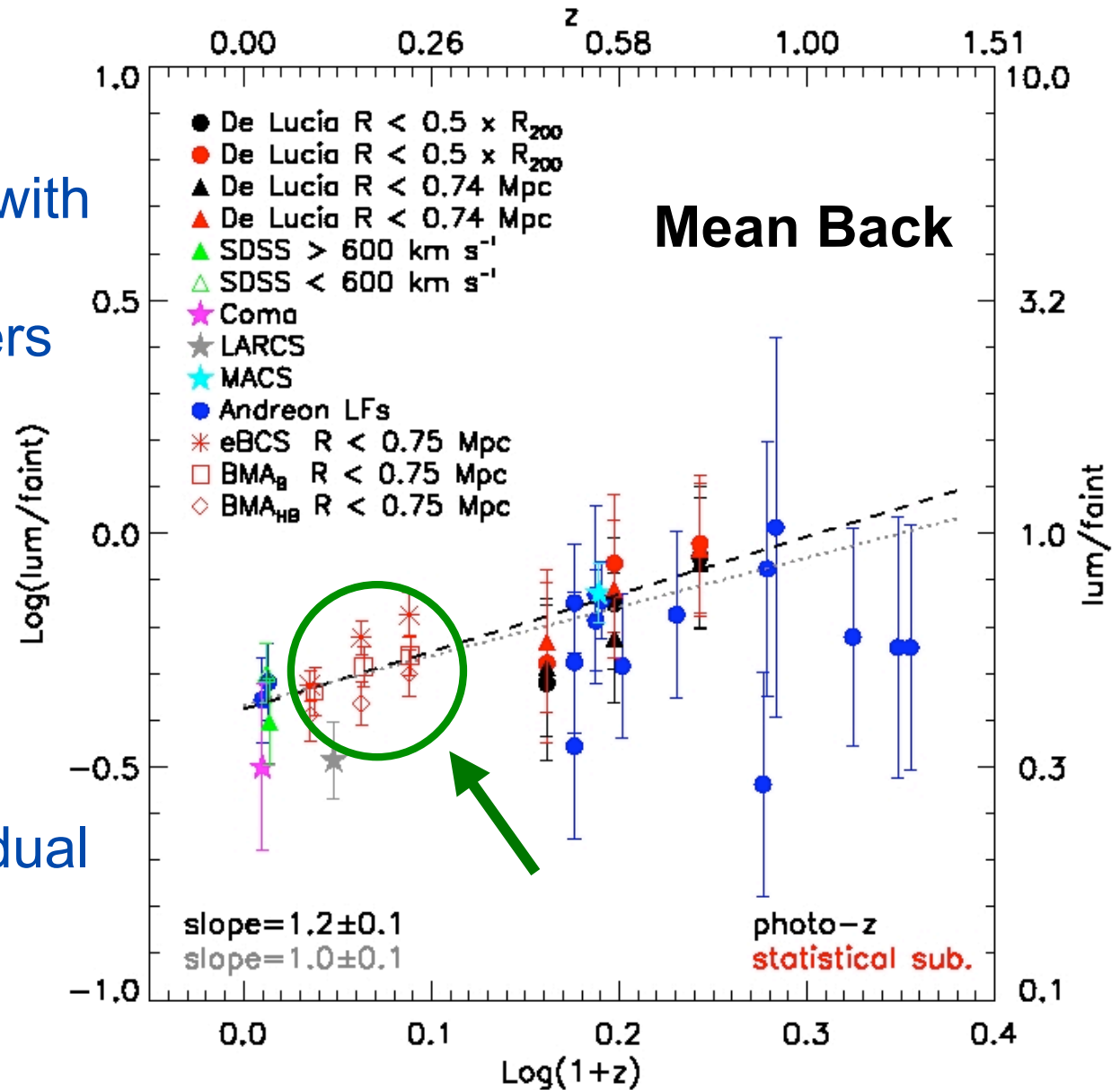
Local: annulus within
 $2 < R < 3$ Mpc from cluster
centroid

Lum/Faint Ratio

Our results consistent with De Lucia et al. (2007) values for SDSS clusters

Best fit line: only statistical samples used

Andreon (2008): individual clusters ($0.02 < z < 1.3$)

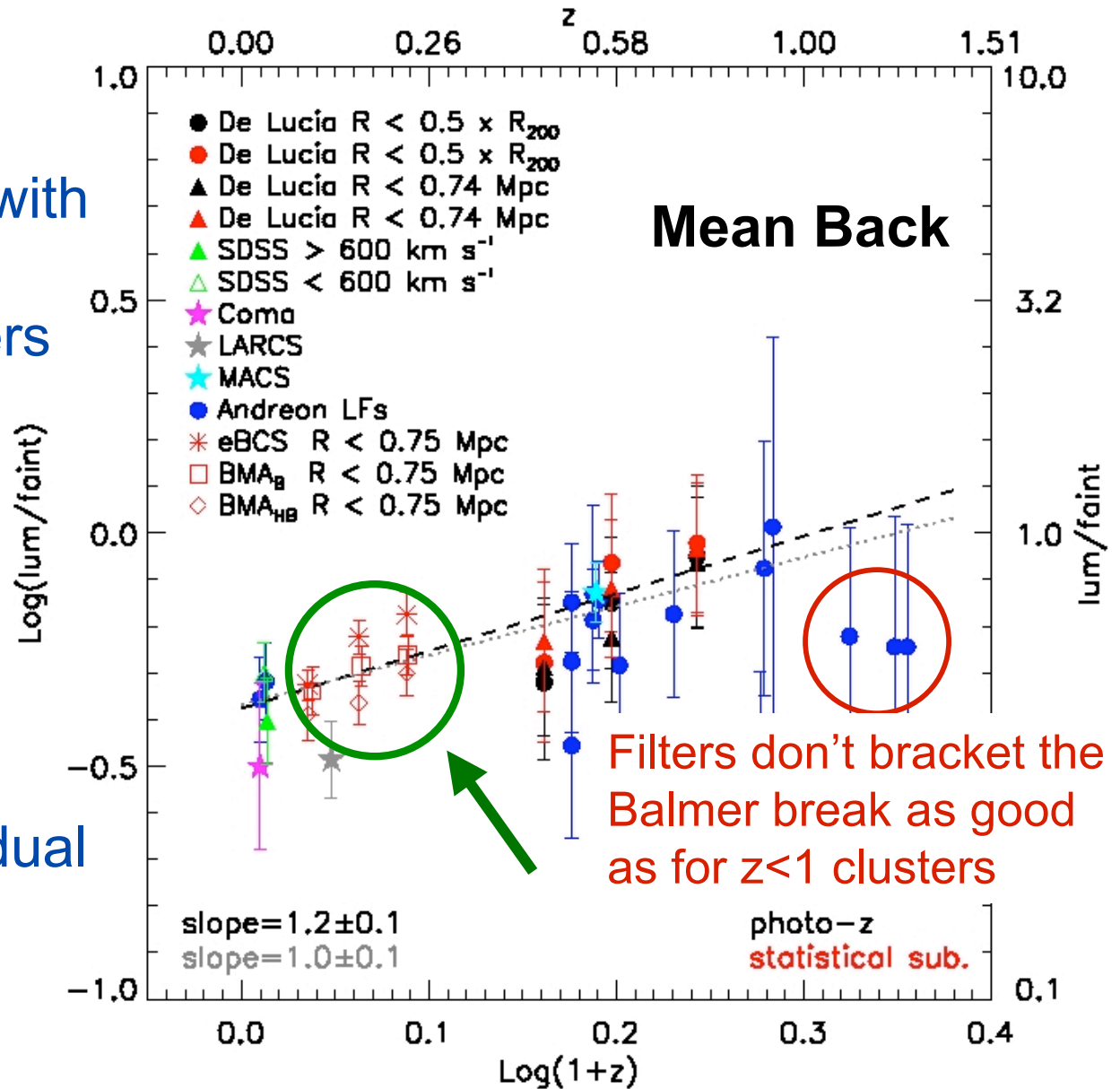


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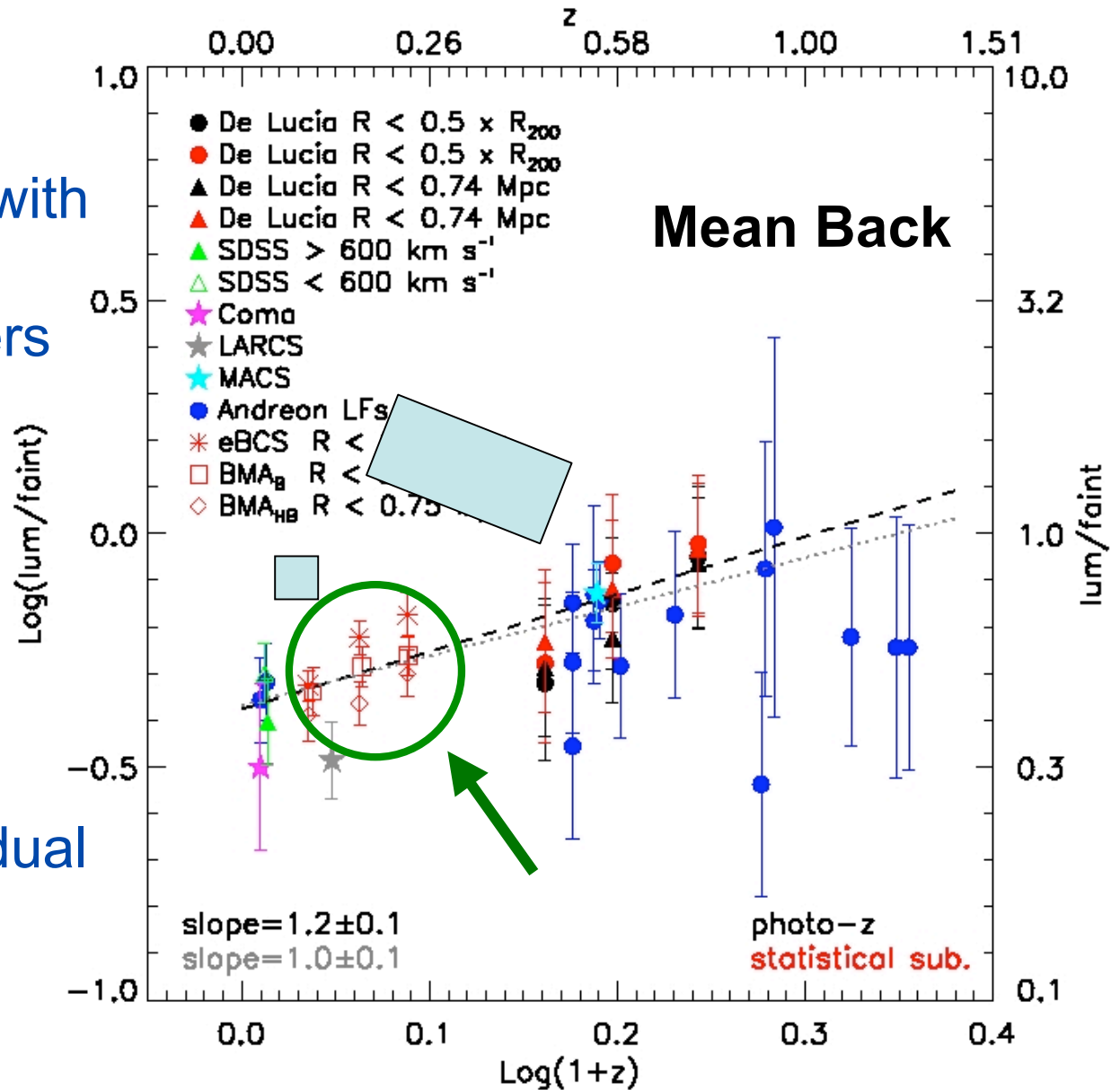


Lum/Faint Ratio

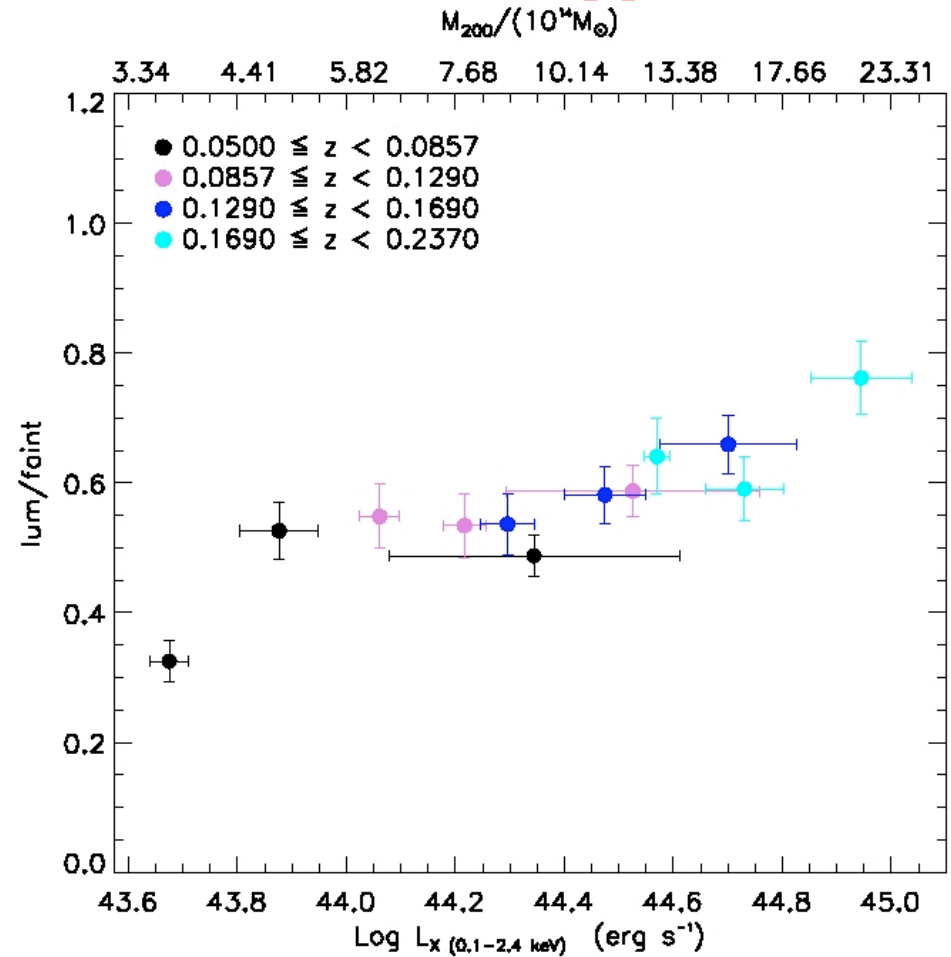
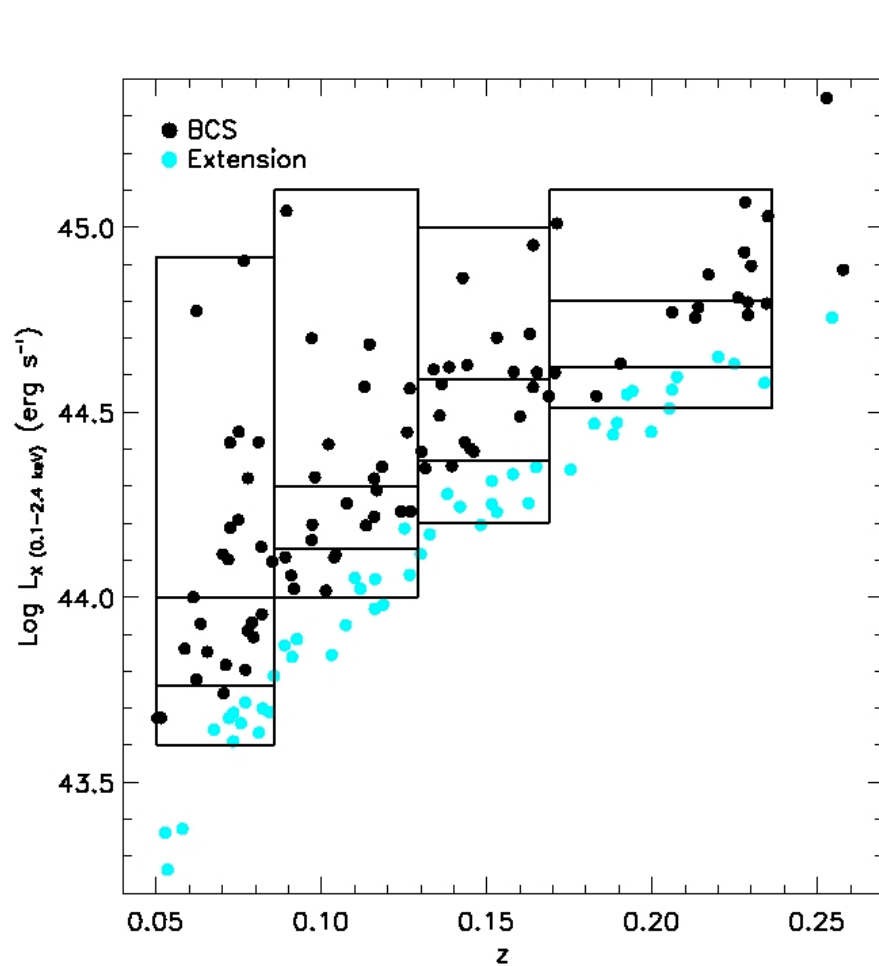
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Lum/Faint ratios vs L_x



Partial Spearman's correlation test



A=lum/faint
B=log(Lx)
C=z

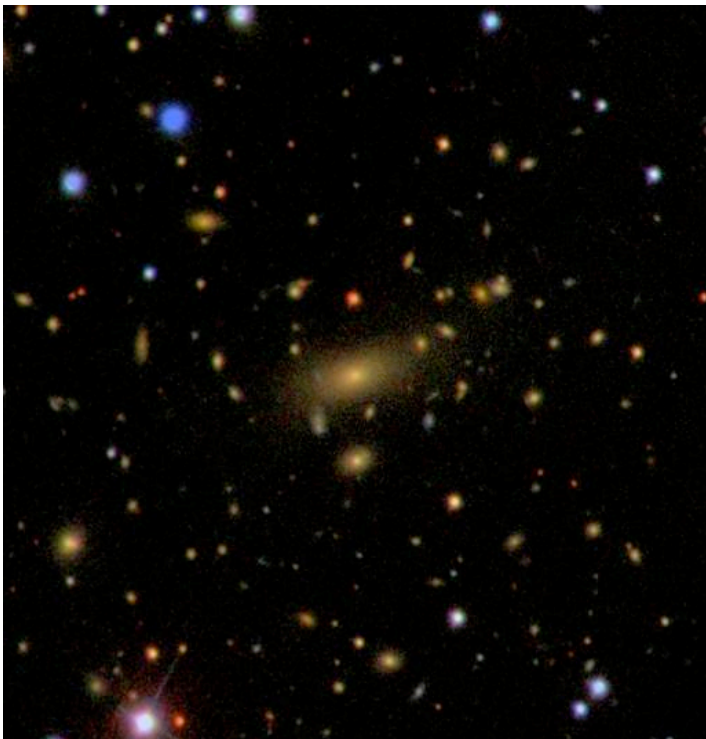
$r_{AB,C}$	$r_{AC,B}$	$r_{BC,A}$
0.02 ($\sim 45\%$)	0.15 ($\sim 2.5\%$)	0.66 ($< 0.05\%$)

No trend of lum/faint ratio as a function of L_x is found

Summary

- Our lum/faint ratios confirm a continuous trend in downsizing to low redshift: $\text{Log}(\text{lum}/\text{faint})=(1.2\pm 0.1)\text{Log}(1+z)$
- Partial Spearman rank correlation test, shows no lum/faint- L_x trend when L_x -z and lum/faint-z correlations are removed, in agreement with Gilbank & Balogh (2008) and Andreon (2008)
- Slopes consistent within 2σ of each other and similar to observation based values.

Discussion



- The question still remains as to the **process** by which the **CMR becomes populated with RSGs** (merging or stripping of spirals and irregulars?)
- The **lack of lum/faint- L_x correlation** seen suggests the late-time build-up of the CMR is **not related** to processes associated with the hot ICM depending on the cluster mass
- The degree of **evolution** in the lum/faint ratio at **high z** is still somewhat confused (J2215 has lum/faint= 2.2 ± 0.9)
- However at **low-z** a consensus has not been reached yet (e.g. comparison with **Lu et al. 2009**)

Thank you!
Any questions?

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