Will Hartley ETH Zurich

Hartley et al. (2013) – MNRAS, 431, 3045 – arxiv 1303.0816
Hartley et al. (2015) – MNRAS, 451, 1613 – arxiv 1406.6058
Paranjape et al. (2015) – arxiv 1503.08212

Q6: The cosmological setting:

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John Kormendy: Yes!

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Structure – TTT, correctly accounting for progenitors

Quenching (apparent stellar mass cut-off) – halo mass (hot static gas halo)

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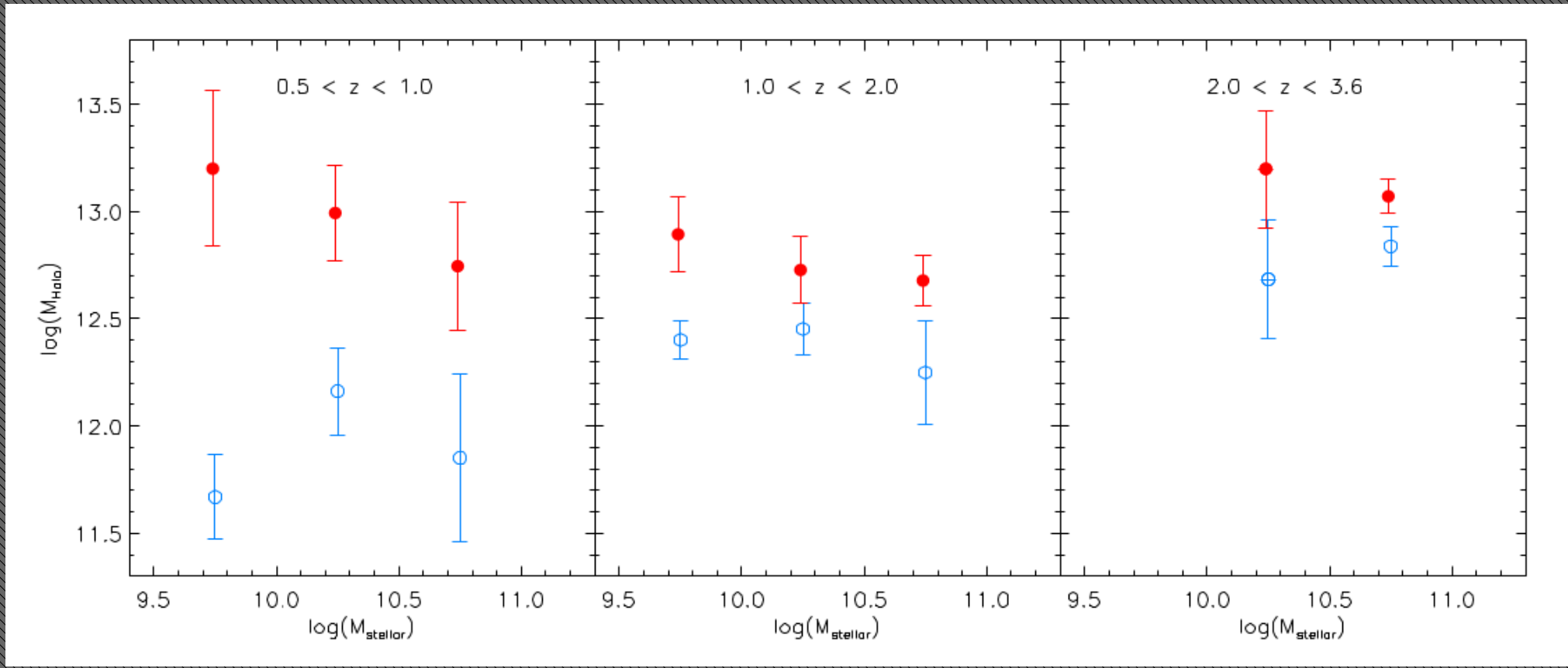
M_{crit} for quenching galaxies...

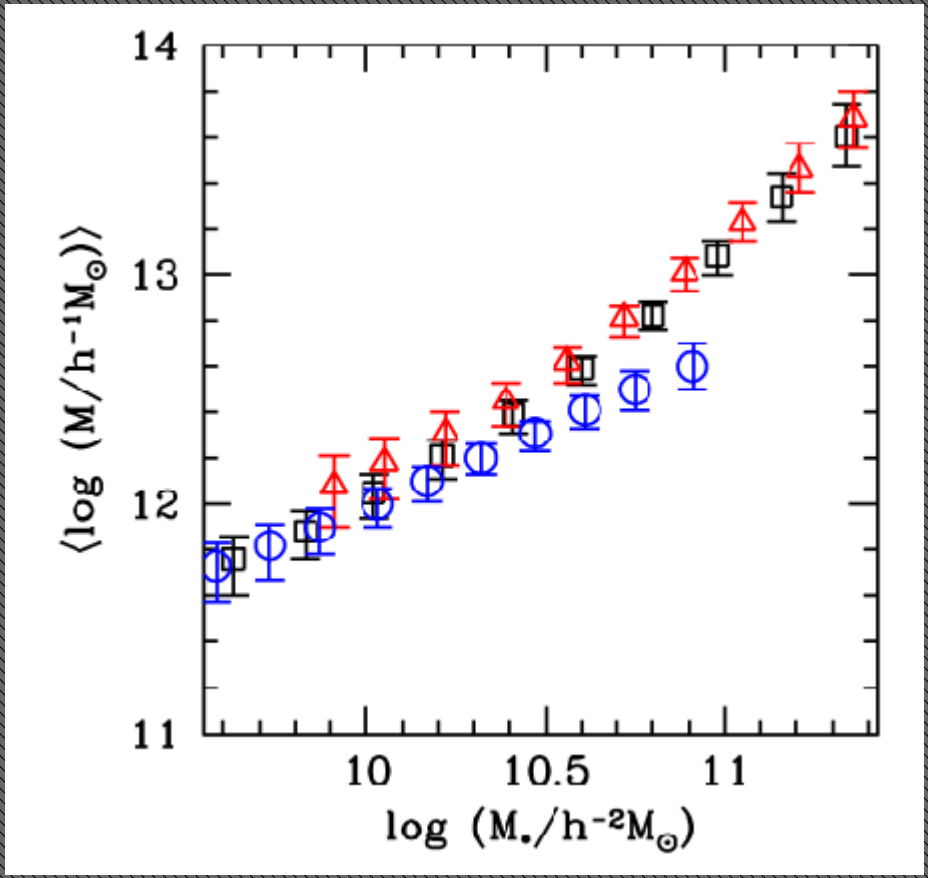
Results from correlation fn using UKIDSS UDS data (K depth = 24.3) are consistent with a halo mass cut-off.



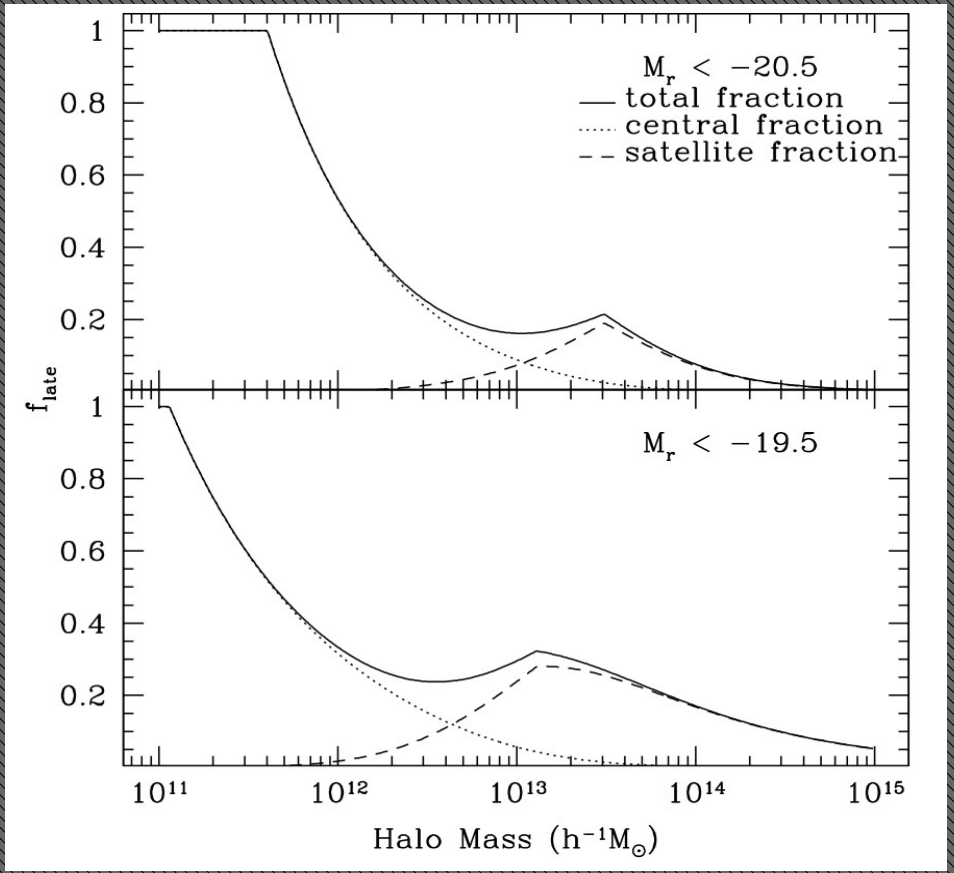
Hartley et al. 2013

But at z=0, when we model the contribution of satellites, we see that central passive fraction grows over ~1 - 1.5 orders of magnitude in halo mass.

Does this cast doubt on a halo mass cause for quenching?
Should we look for something else that correlates with stellar mass?



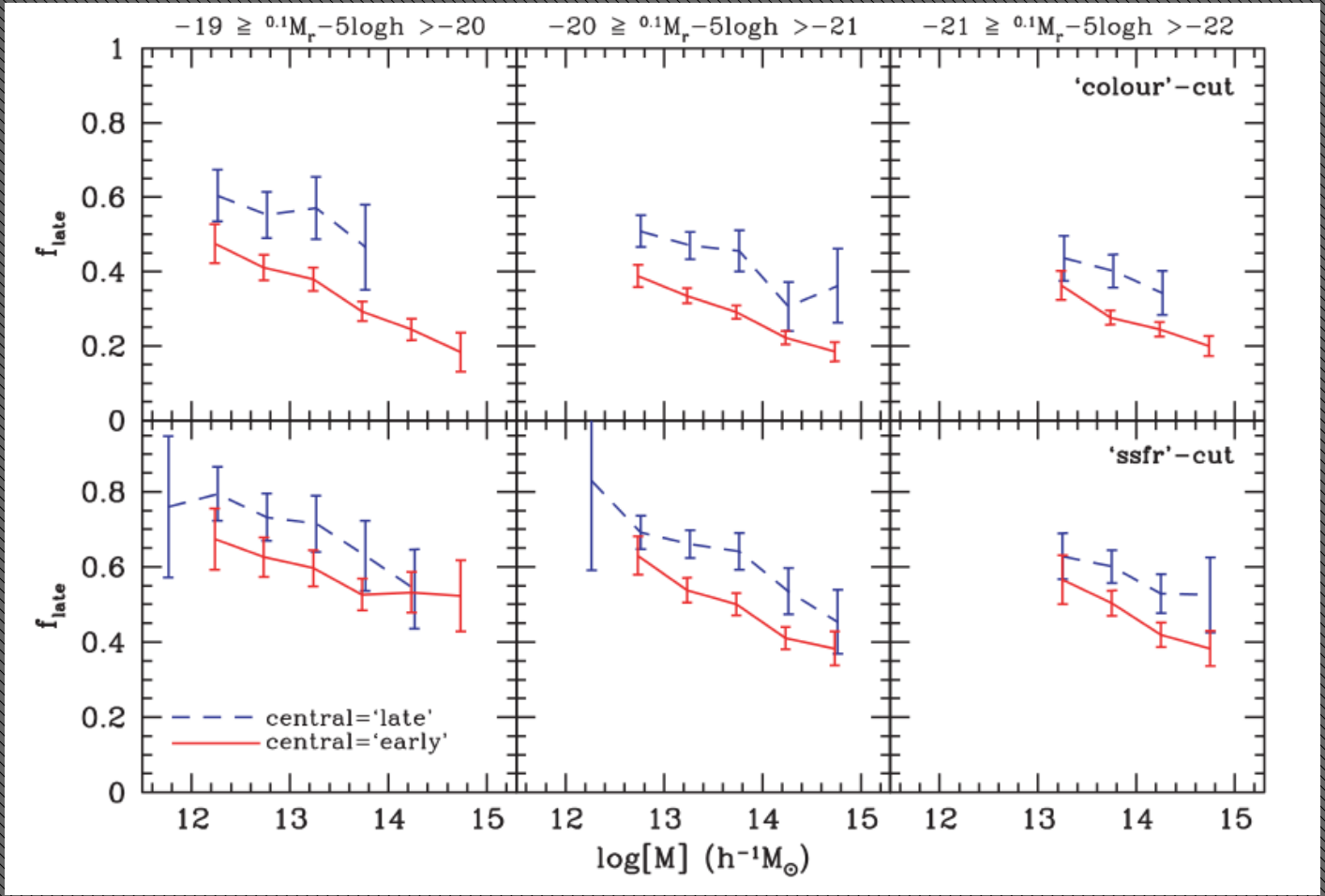
More et al. (2011)



Ross & Brunner (2009)

A new angle: Galactic conformity

Star-formation properties of central and satellite galaxies appear to be (somewhat) coupled.



Weinmann et al (2006)

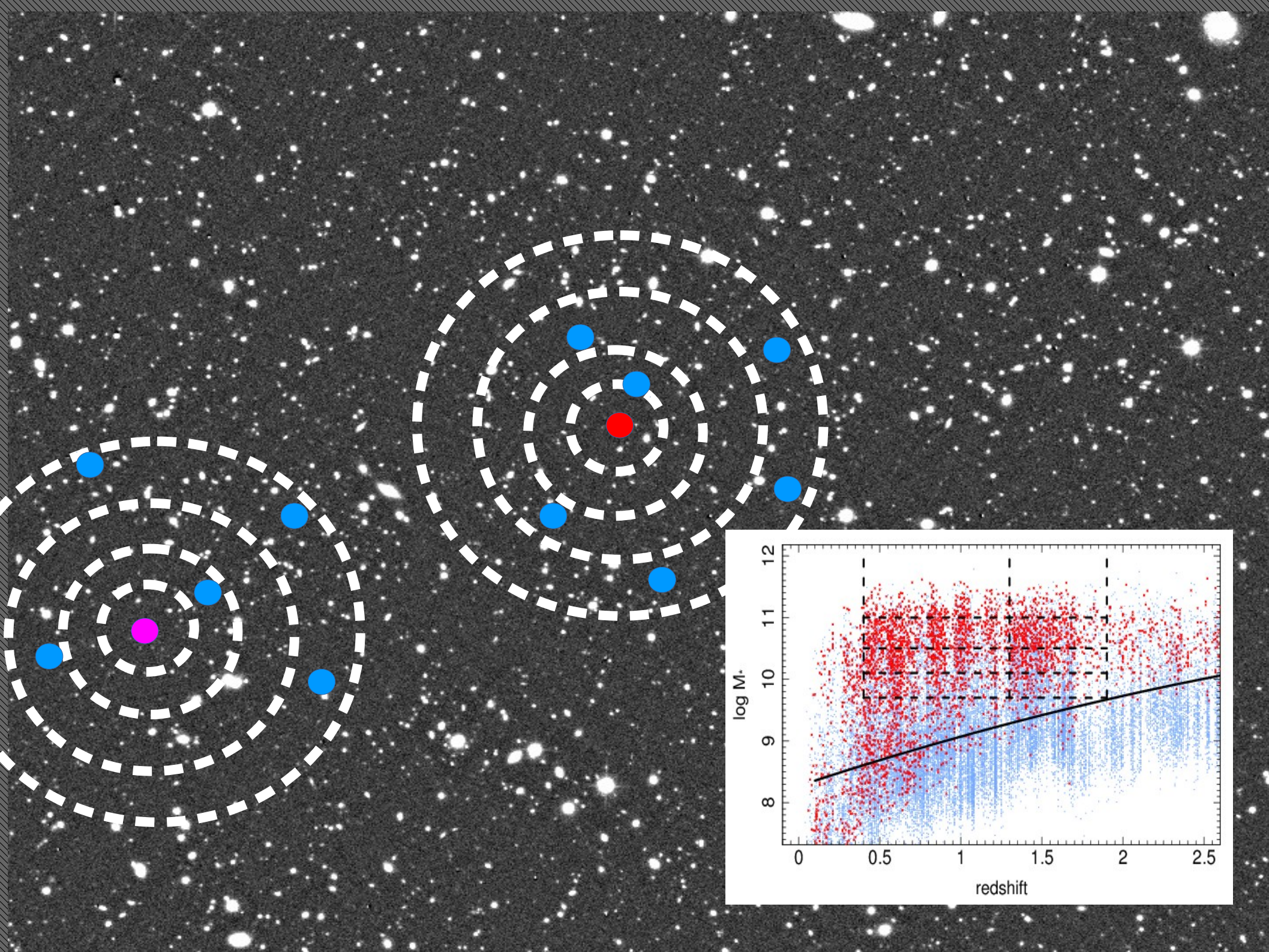
How can we explain conformity?

- Physical:
  e.g. some property of the halo makes it more efficient
  at quenching both central and satellites.
  or, the process that quenches the central (or satellite)
  changes the physical state of the halo.
  → expected redshift evolution: weak to none? Will depend on
  process assumed.

- Large-scale environmental effect:
  e.g. competitive accretion of gas.
  → expected redshift evolution: clear z = 0 → 2
  (Hearin et al. 2015)
  → small effect which should already be (partly) included
  in S-A models

- Assembly bias / Pre-heating:
  → signal at extra-halo scales also – can possibly be predicted.

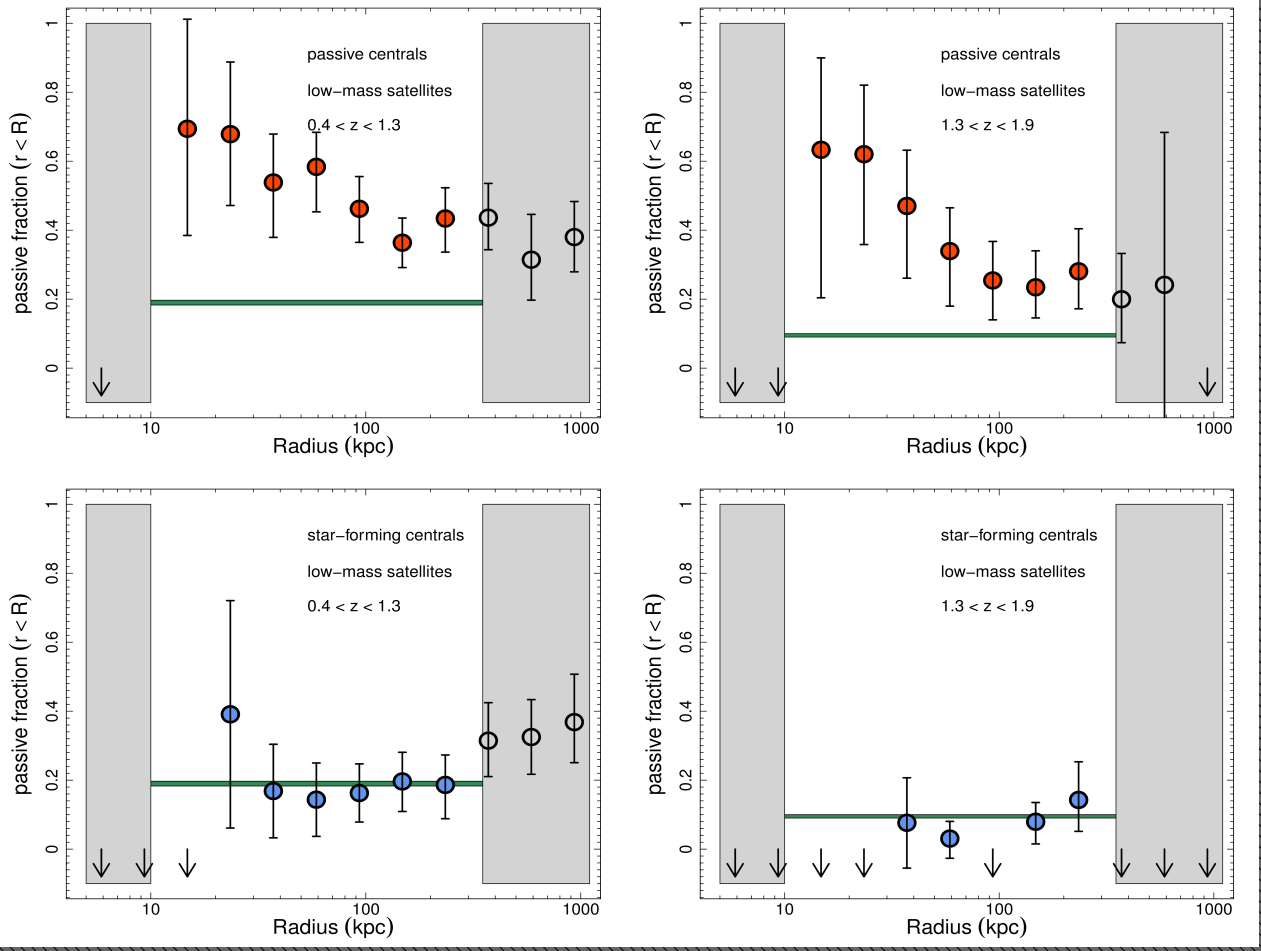
Up to this point all conformity results have been at z=0. Redshift evolution is key to distinguish possibilities.


log M*
8
9
10
11
12
0
0.5
1
1.5
2
2.5
redshift

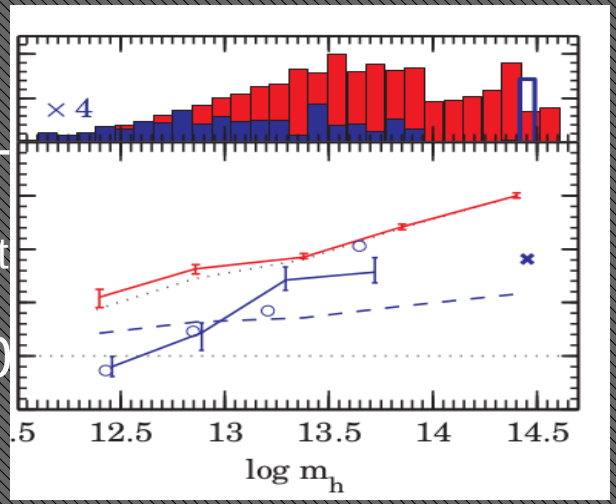
Passive: 10.5 < log M* < 11.
SFing: log M* > 11.

Define, satellite quenching efficiency:
$\varepsilon_{sat} = (f_{p,sat} - f_{p,cen}) / (1 - f_{p,cen})$
$\varepsilon_{sat,\ s\text{-}f} \sim 0$
$\varepsilon_{sat,\ pass} \sim 0.15 - 0.3$

Expected halo masses (from LSS results in Hartley et al. 2013),
$\log (M_H) \sim 12.5 - 13$



Hartley et al. (2015)



Knobel et al. (2014)

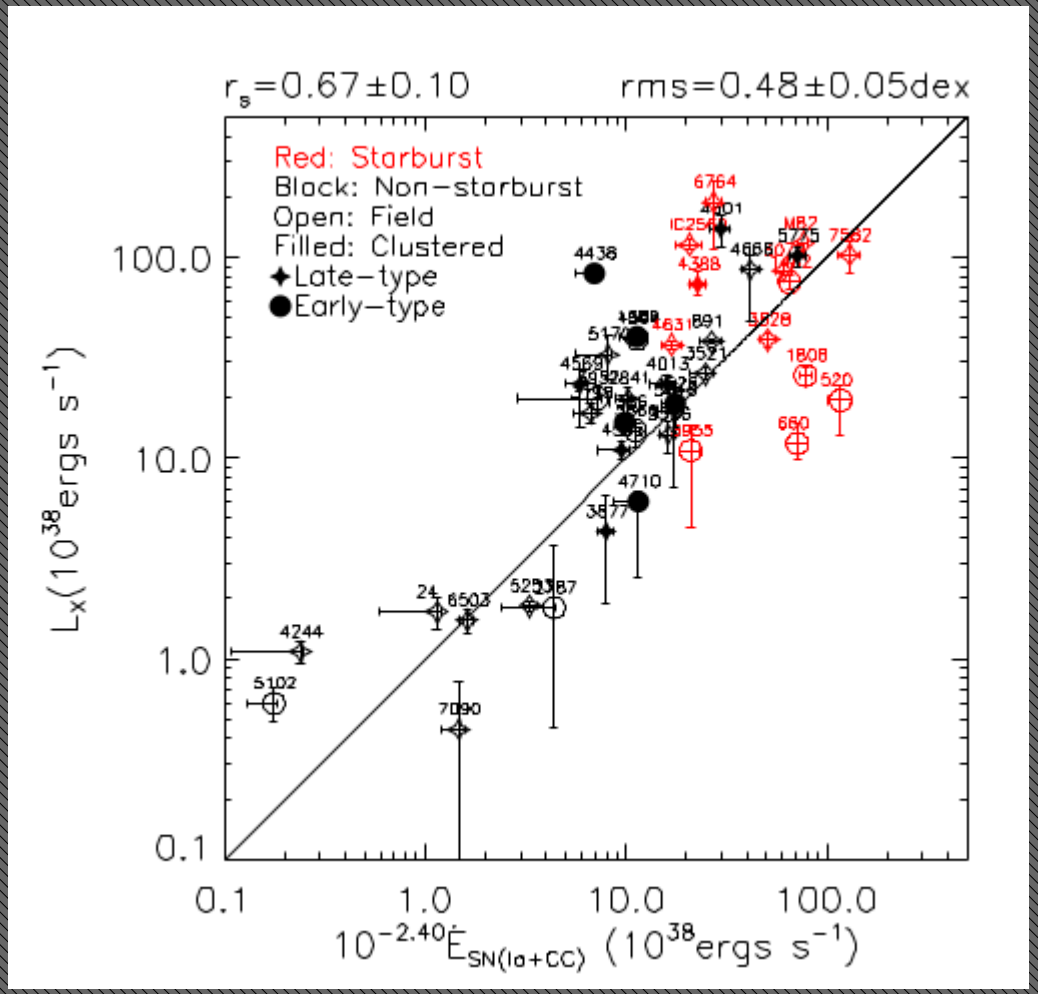
z=0 → z~2
increasing redshift

No clear evolution between z=0 and z~2!

→ how do we establish a physical halo-scale connection that allows some range in quenching halo masses?

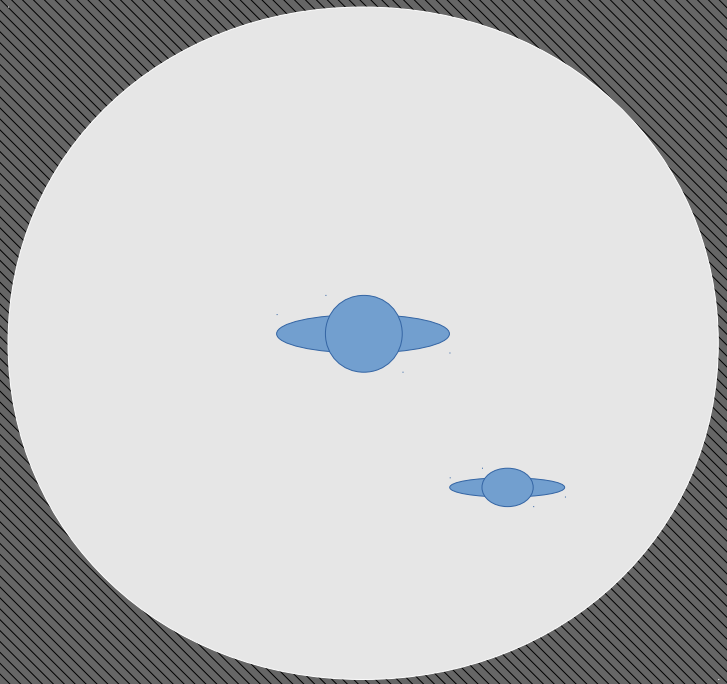
How might we establish a physical connection?

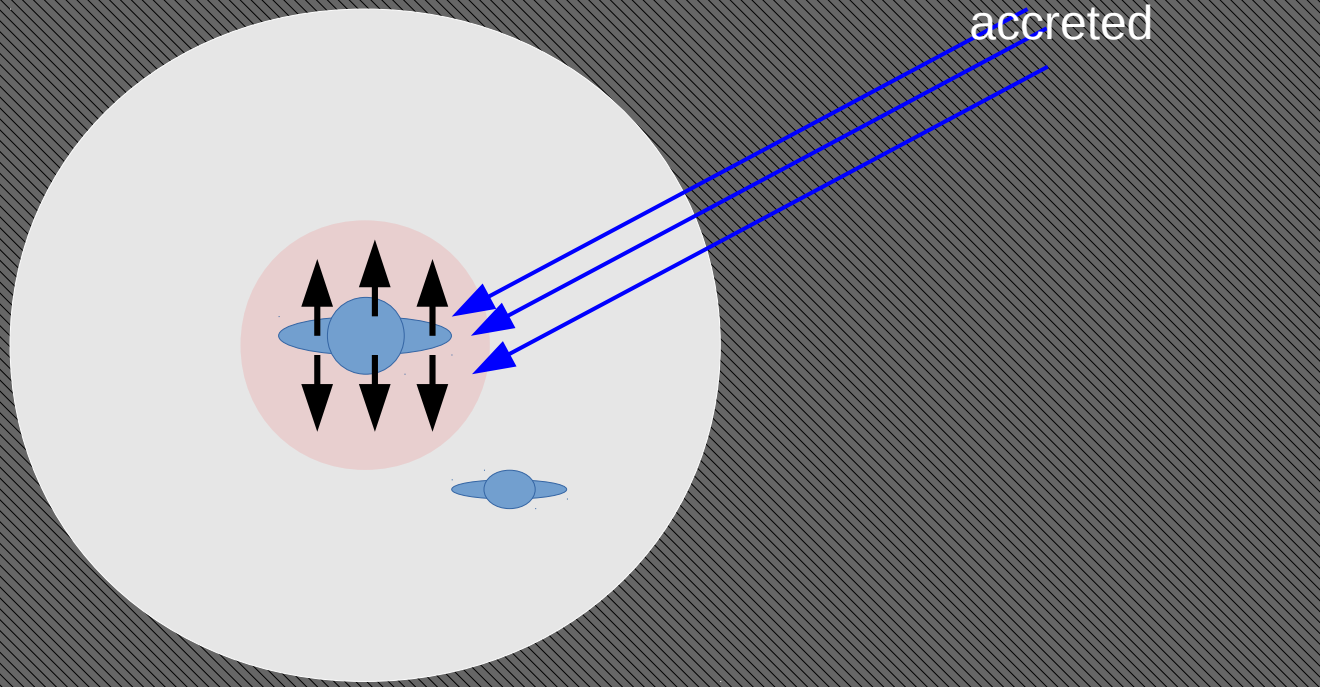
Expected energy output from SNe (based on SFR), correlates with coronal X-ray emission.

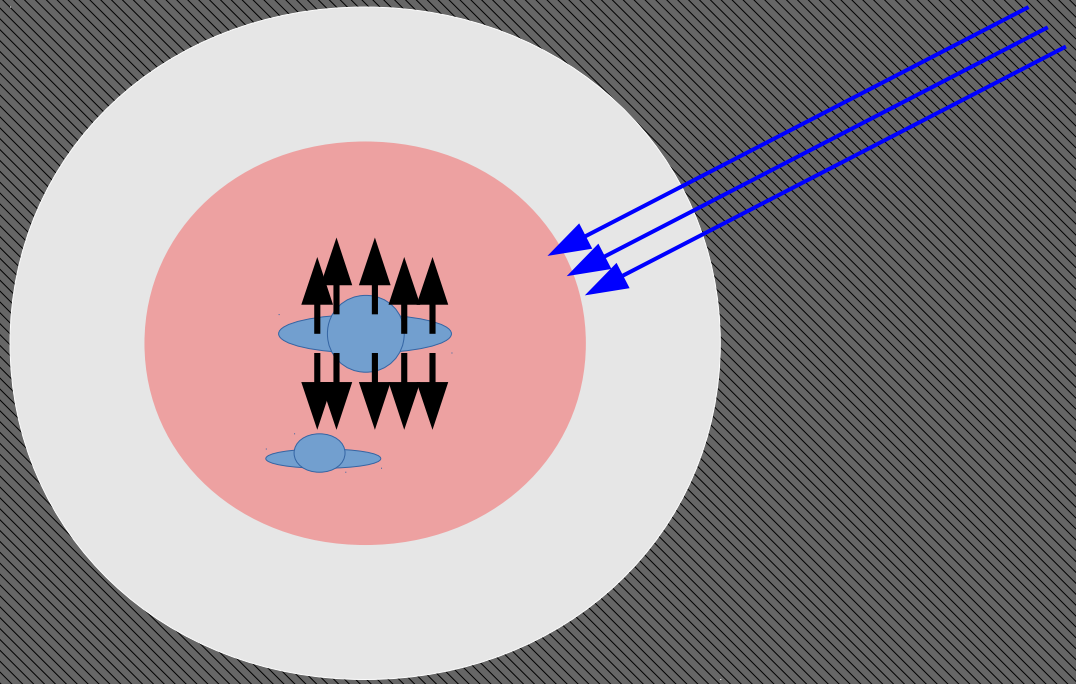


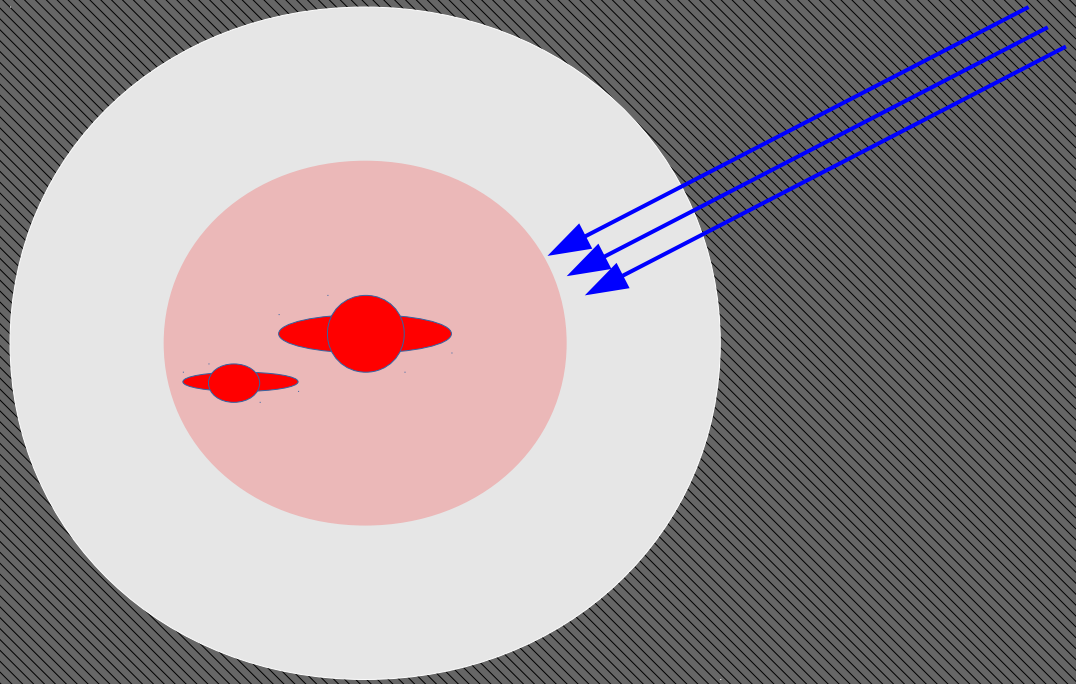
Li & Wang 2013

A Maerchen hotel fairytale...



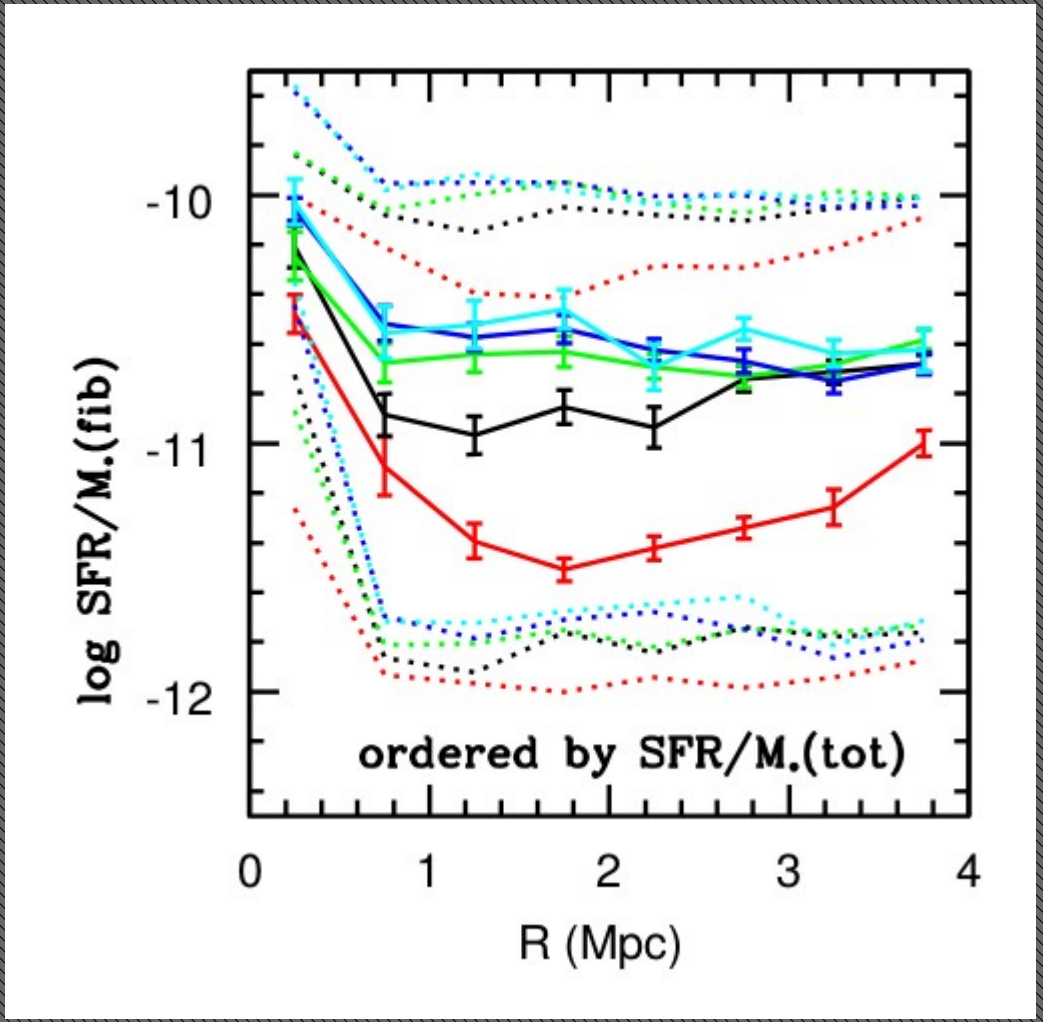

Multi-phase gas
accreted





The other horse in the race...

Star-formation properties of galaxies correlate even on super-halo scales.



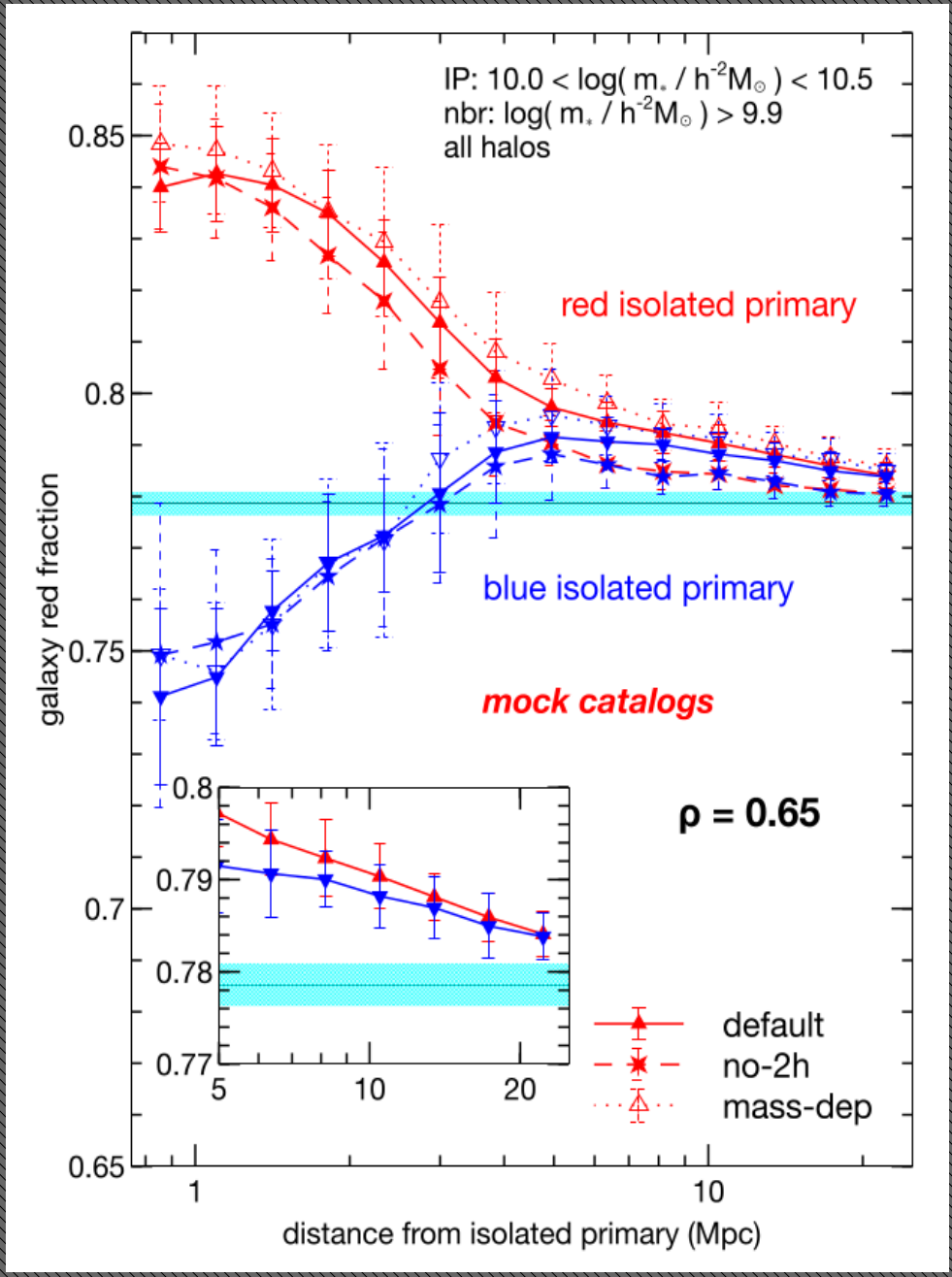
Kauffmann et al. (2013)

→ Populate N-body simulation with a known red+blue HOD.
(Skibba &Sheth 2009)

→ Galactic conformity within halos put in by hand to match Yang et al. group catalogue.

→Correlate conformity with halo concentration (solid lines), or arbitrarily (dashed).

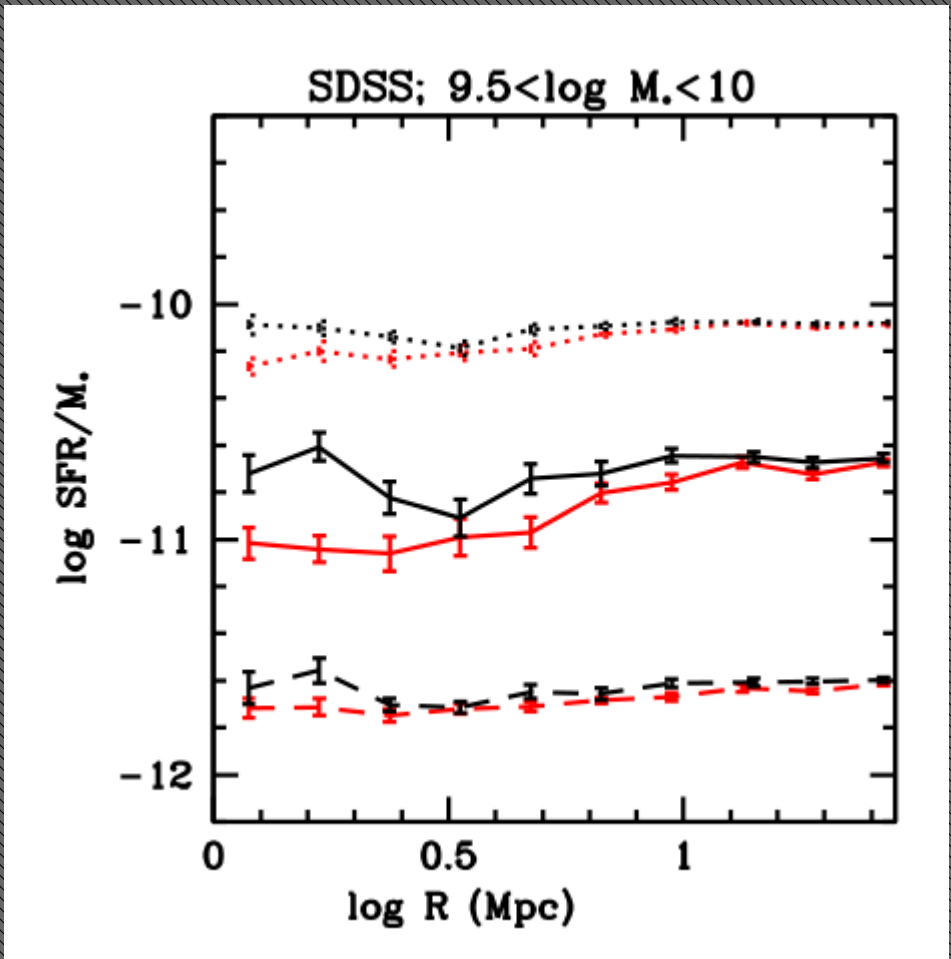
→ Identify a simple observable.



Paranjape, Kovac, Hartley & Pahwa (2015)

Latest results show a conformity-like signal out to 10 Mpc.

Assembly bias? Pre-heating? Inability to control for halo mass?



Kauffmann (2015)

Q6: The cosmological setting (my non-unique answers):

Are galaxies ultimately simple manifestations of cosmic structure formation or are they complex organisms influenced but not controlled by the larger Universe around them?

Yes. Structure formation is vital for quenching but it can occur earlier due to galaxy level processes.

What physics sets the limit in growth of stellar mass of galaxies, and why do galaxies quench just as they reach high efficiencies in baryonic conversion into stars?

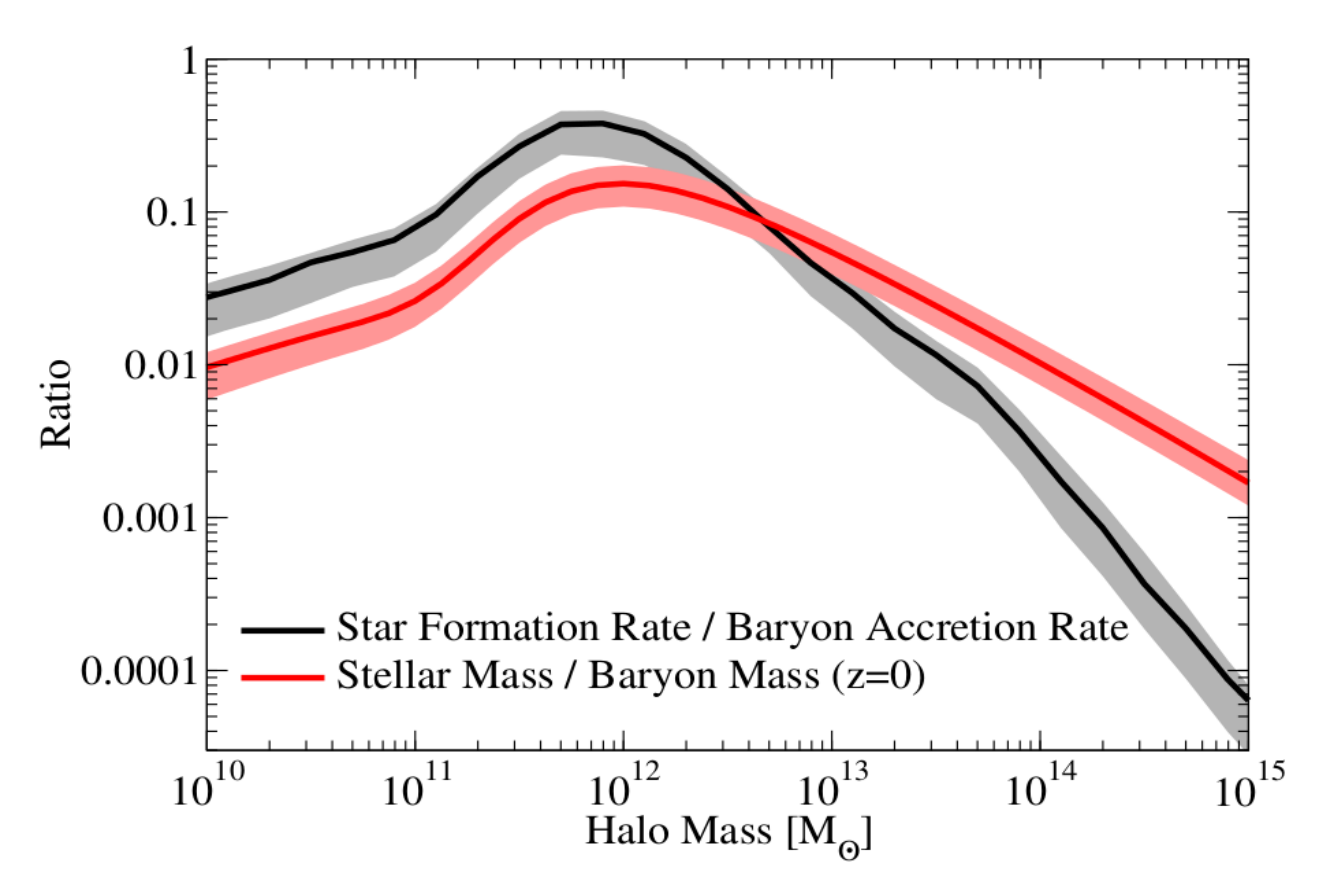
Halo mass - principally. But many galaxies never reach it, perhaps precisely *because* their SF efficiency is so high at higher mass.

Thanks!

Hartley et al. (2013) – MNRAS, 431, 3045 – arxiv 1303.0816
Hartley et al. (2015) – MNRAS, 451, 1613 – arxiv 1406.6058
Paranjape et al. (2015) – arxiv 1503.08212

A maximum stellar mass for galaxies...

'Efficiency' of converting baryons to stars increases with halo mass,
but then abruptly turns-over.



Behroozi et al. 2013

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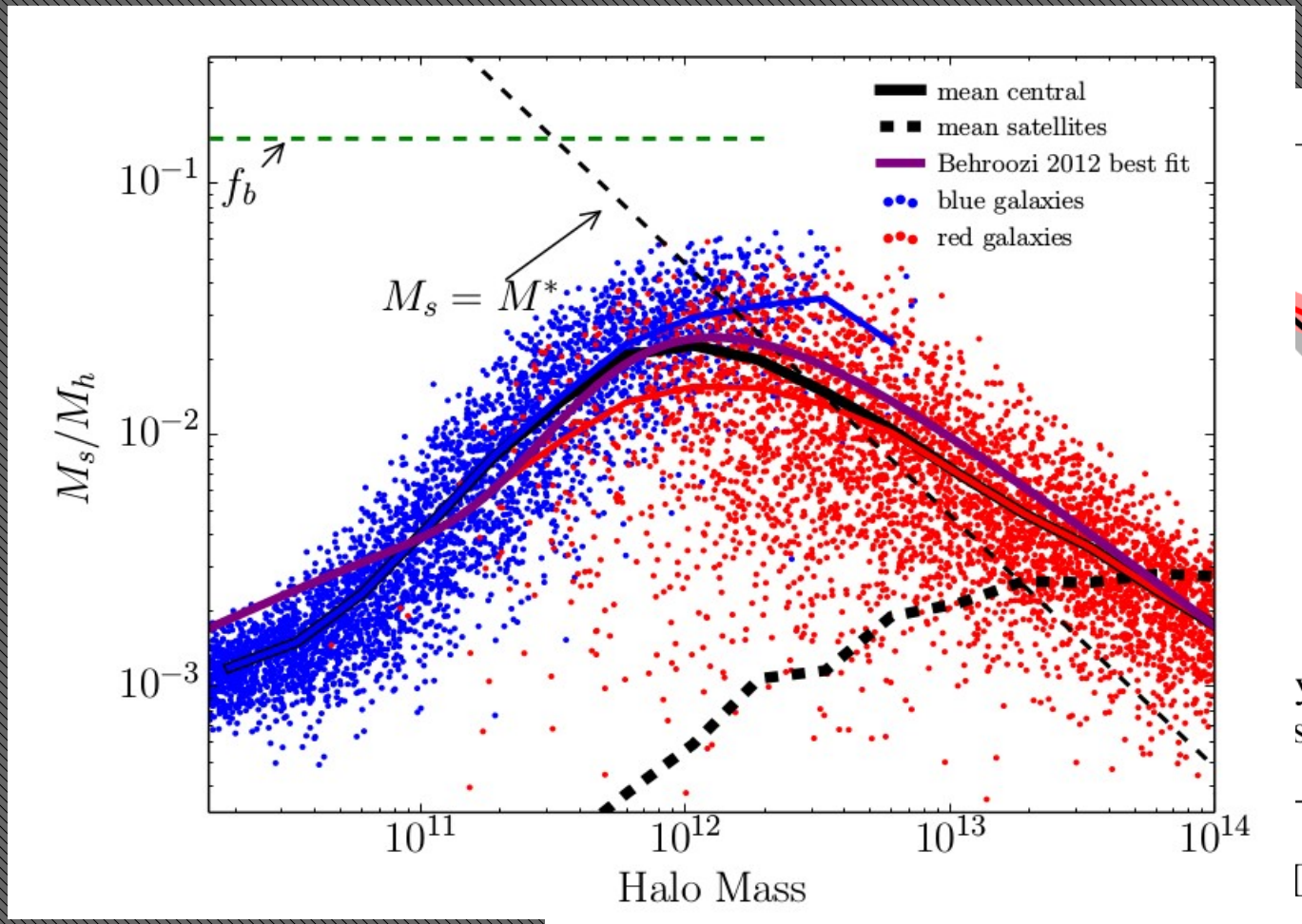
Explains turn-over in M* / Mh plot (but not normalisation or overall shape).



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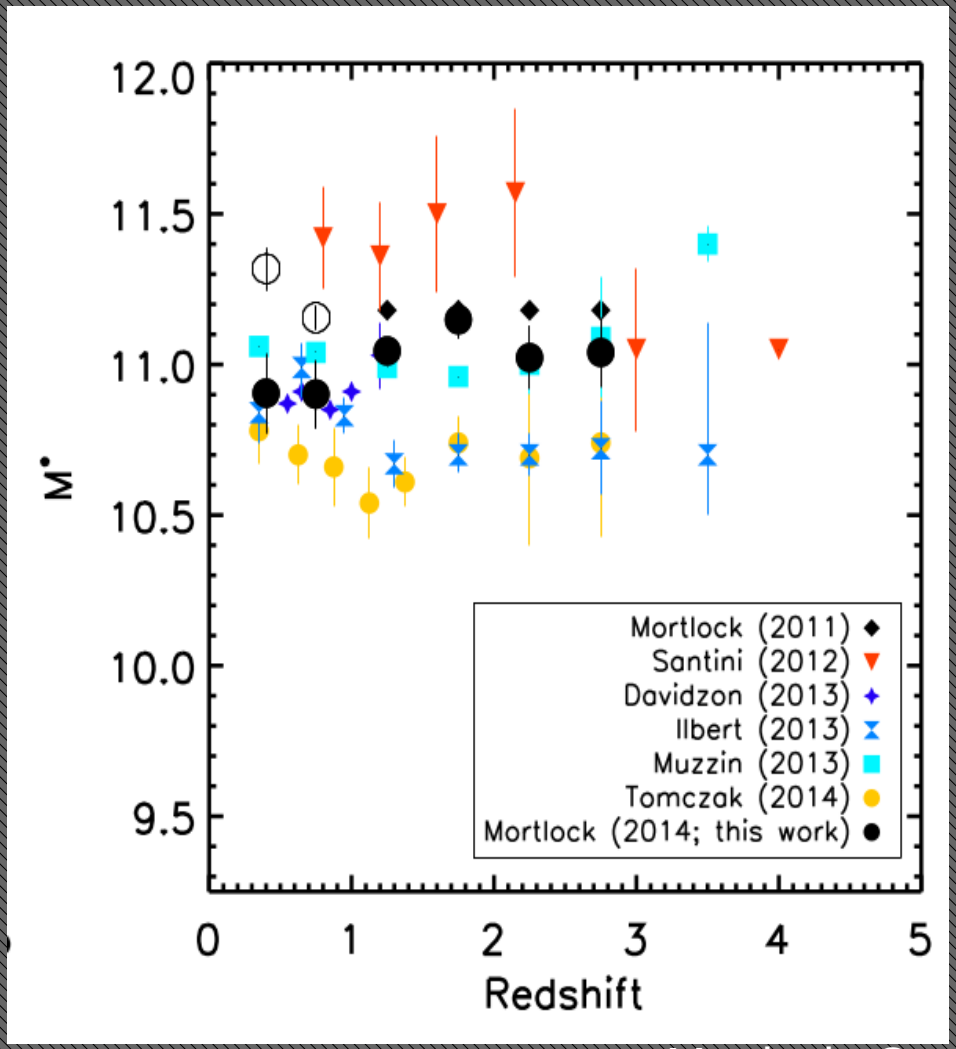
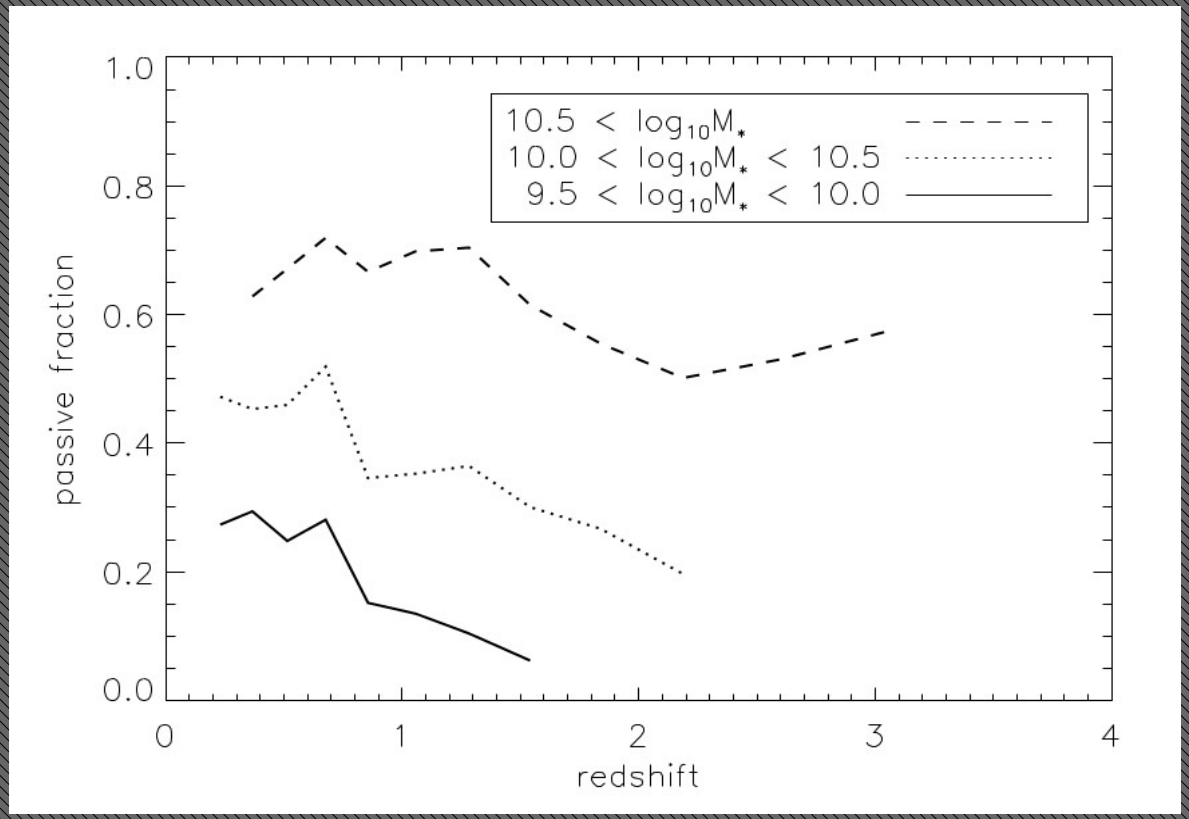
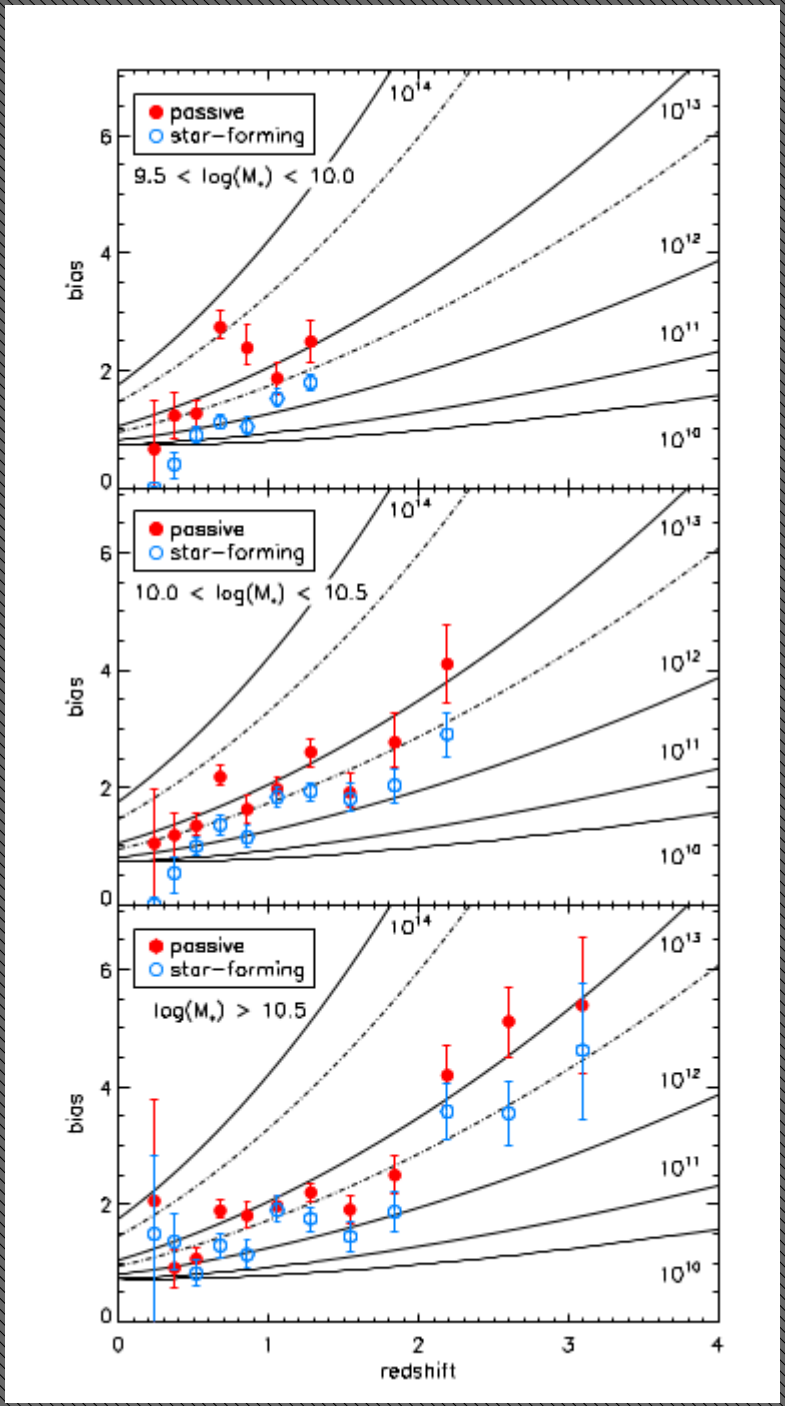


Mortlock, Conselice, WH et al. 2014



Hartley et al. 2013


passive
star−forming
9.5 < log(M*) < 10.0
10.0 < log(M*) < 10.5
log(M*) > 10.5
10^14
10^13
10^12
10^11
10^10
bias
redshift
0
1
2
3
4
6