

Metallicities and quenching of satellites: the EAGLE view

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Bahé et al. 2017a, MNRAS 464, 508
Bahé et al. 2017b, MNRAS 470, 4186



Ringberg,
15.12.2017



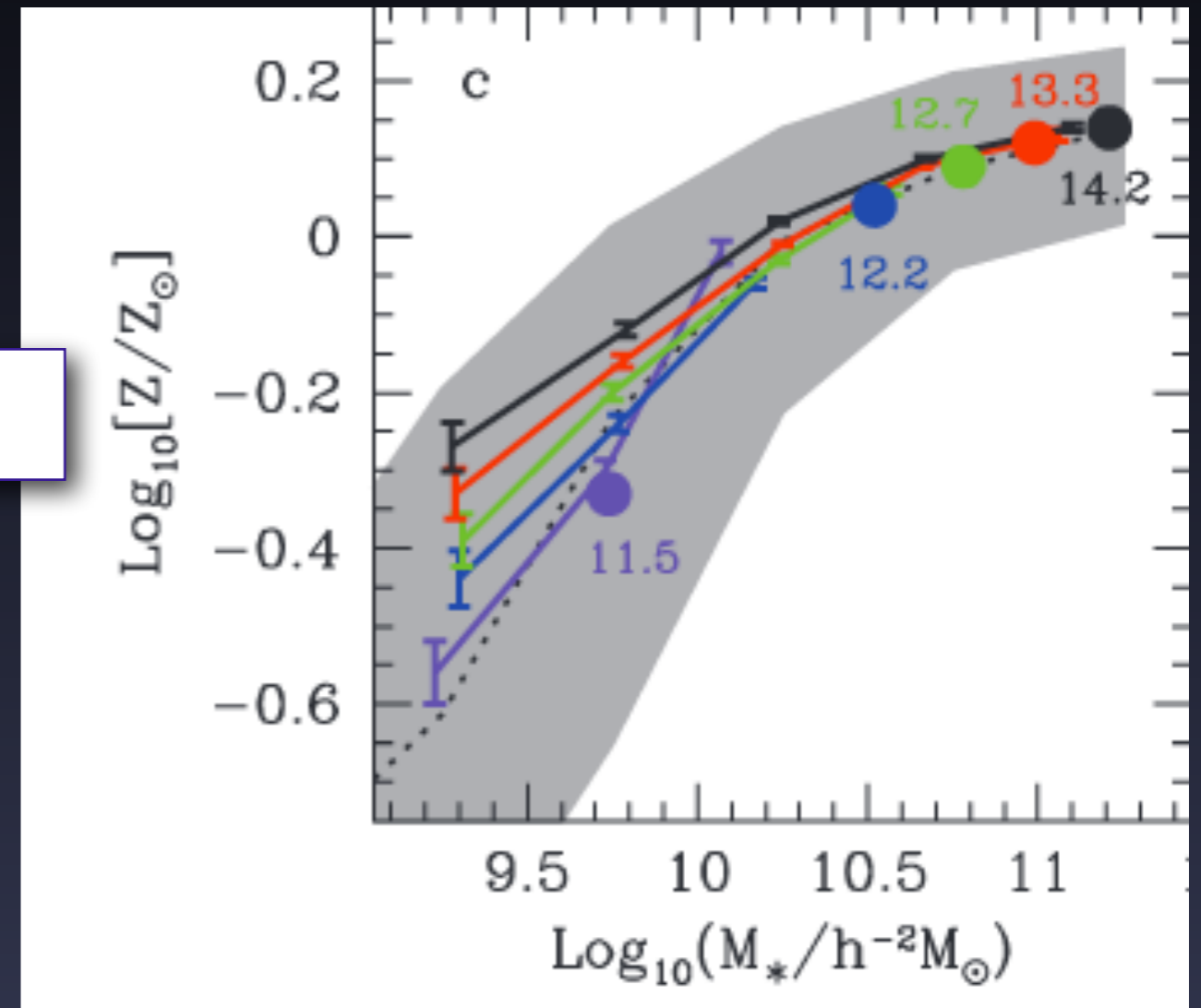
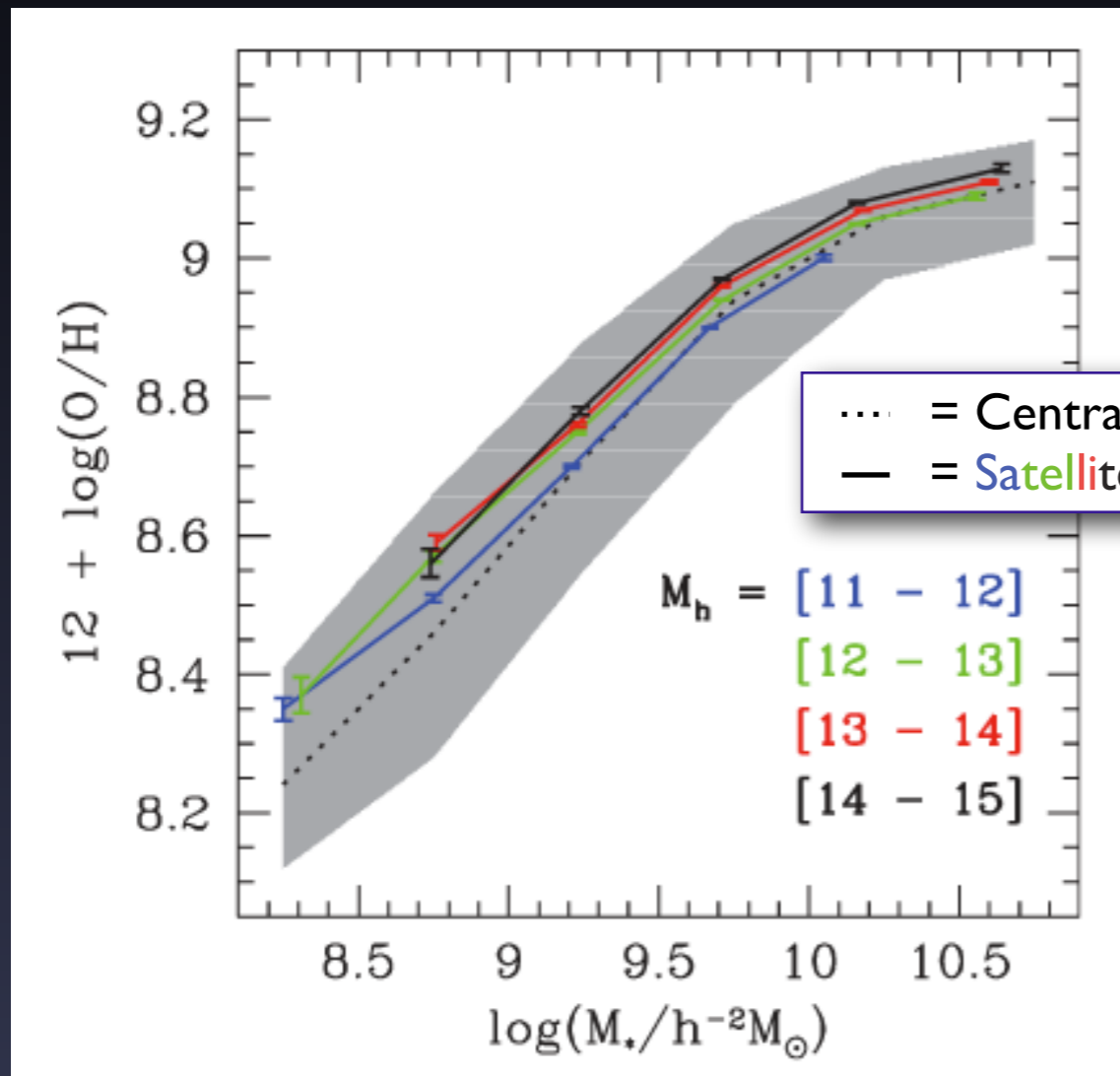
Metallicity and environment (observations)

Ionized gas

[Pasquali et al., 2012]

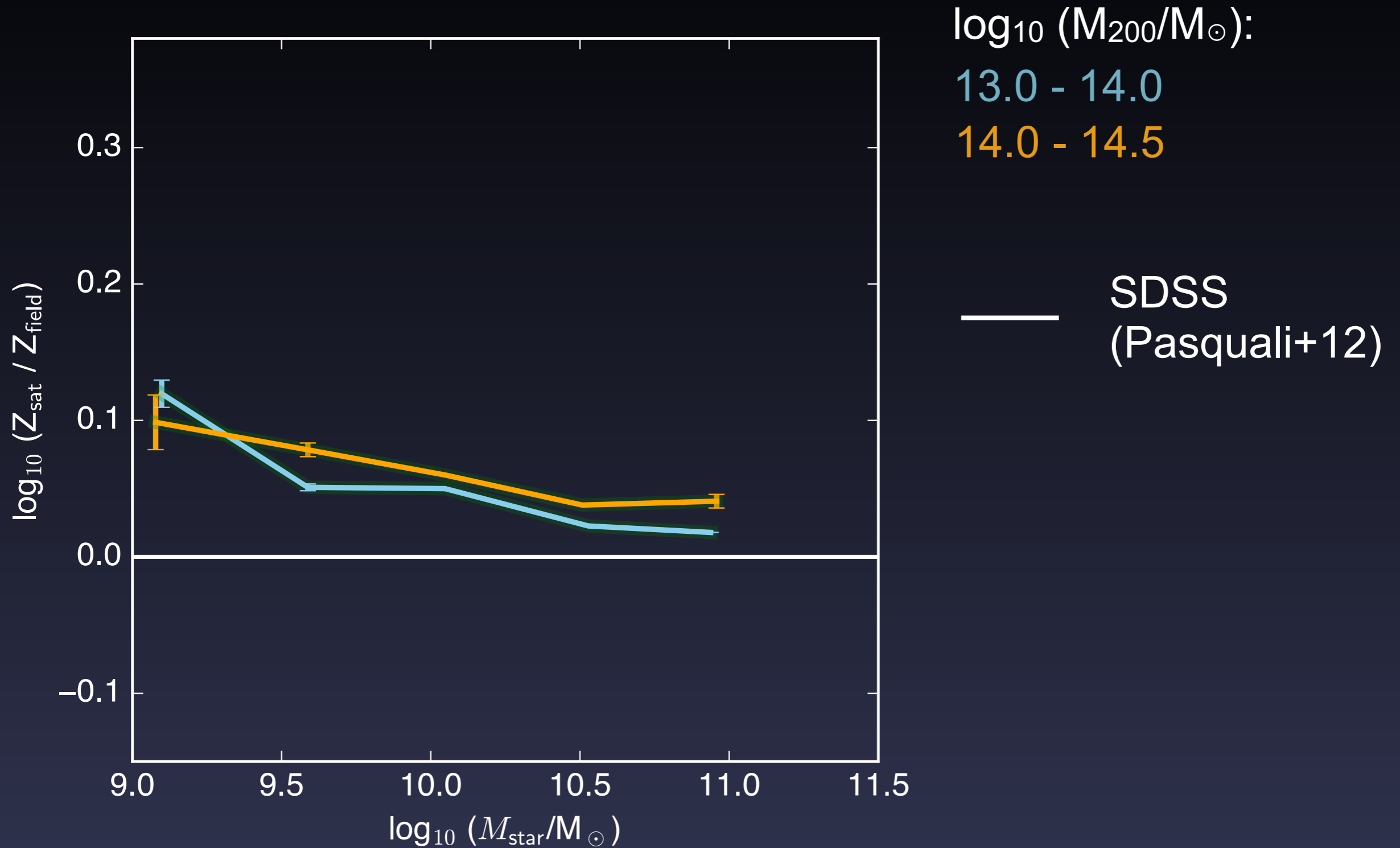
Stars

[Pasquali et al., 2010]

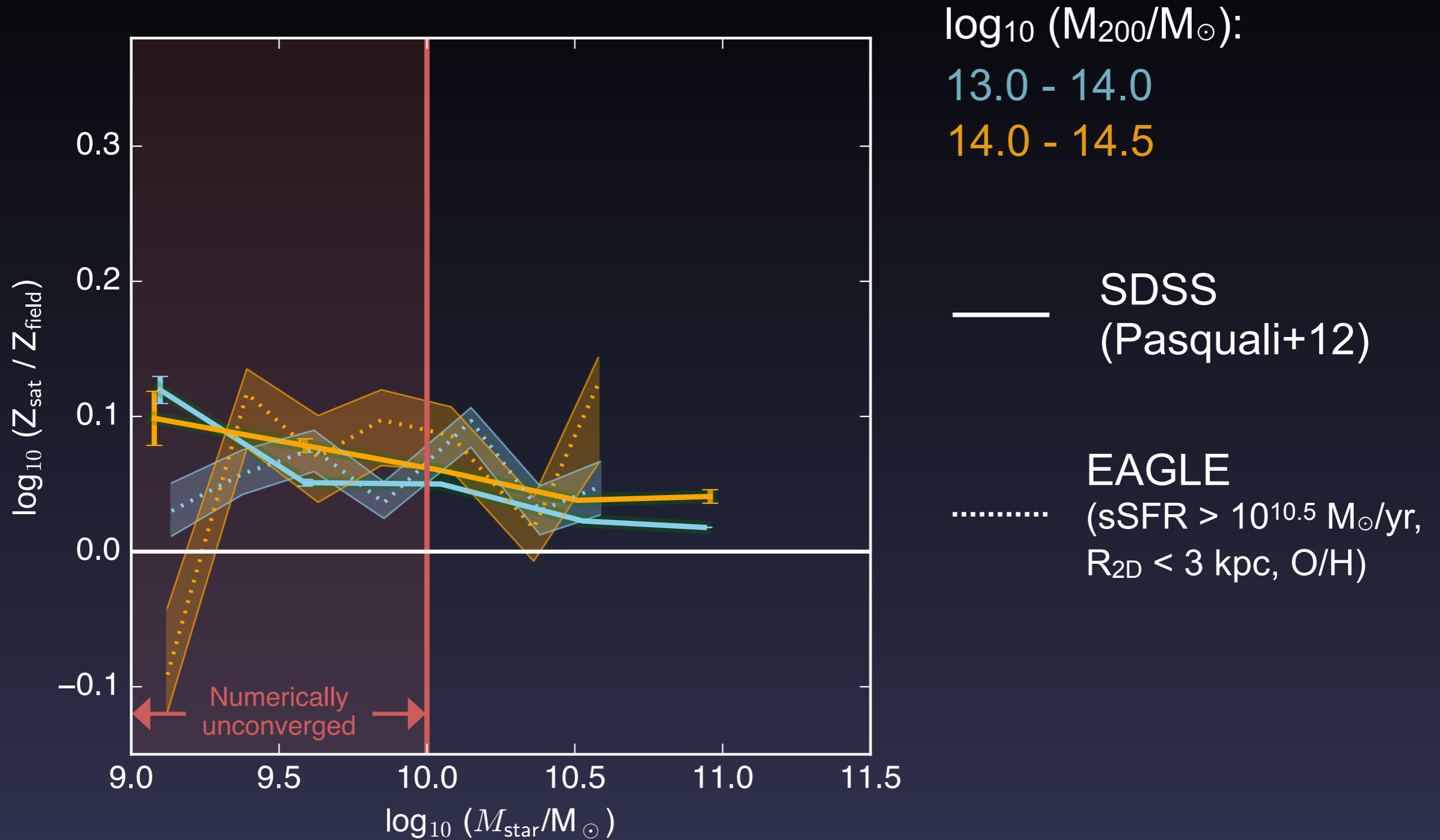


Consistent picture for stars and gas:
Metallicity is higher in satellites than centrals of same mass

Eagle: Satellite metallicities (gas)

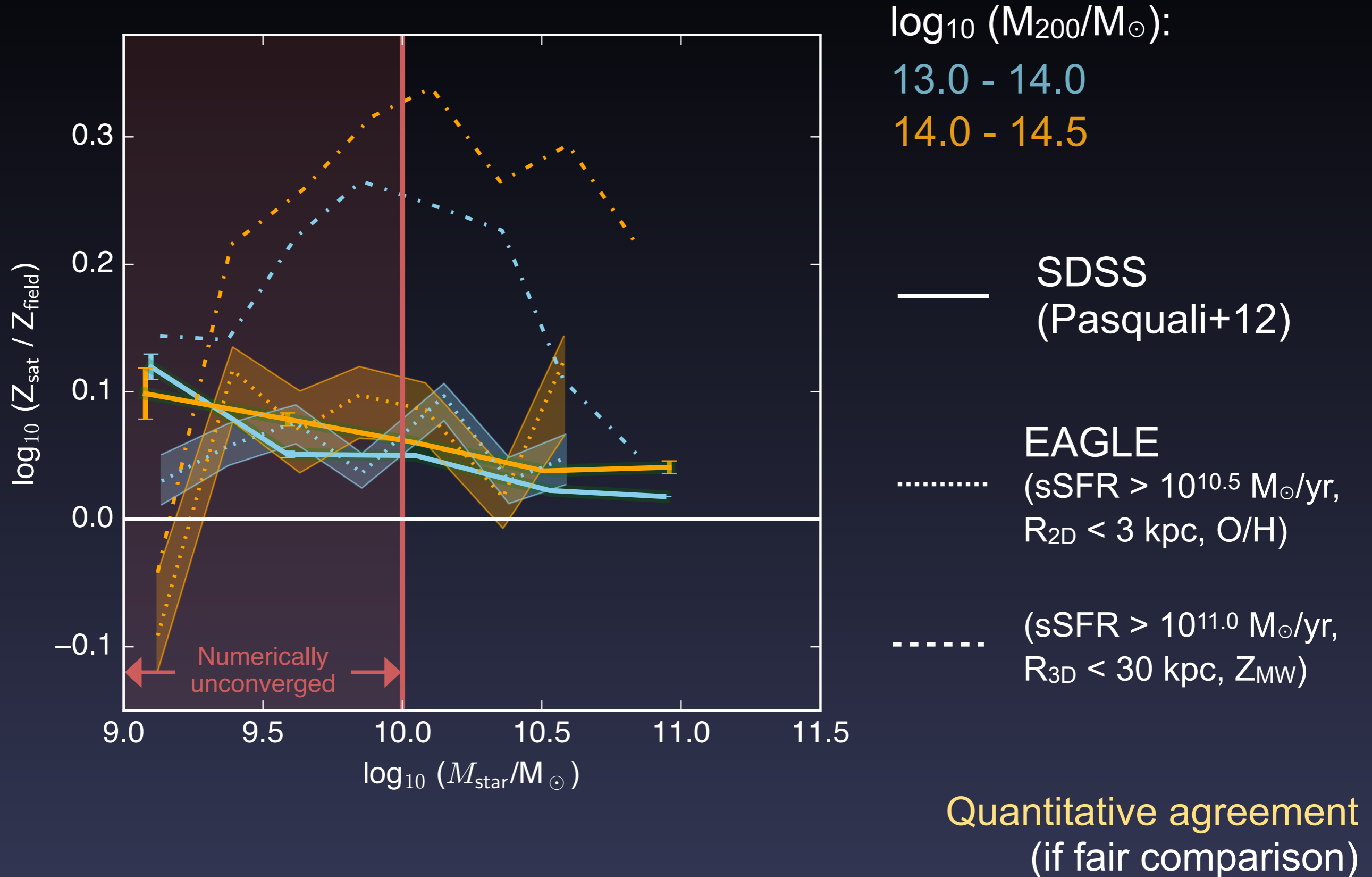


Eagle: Satellite metallicities (gas)

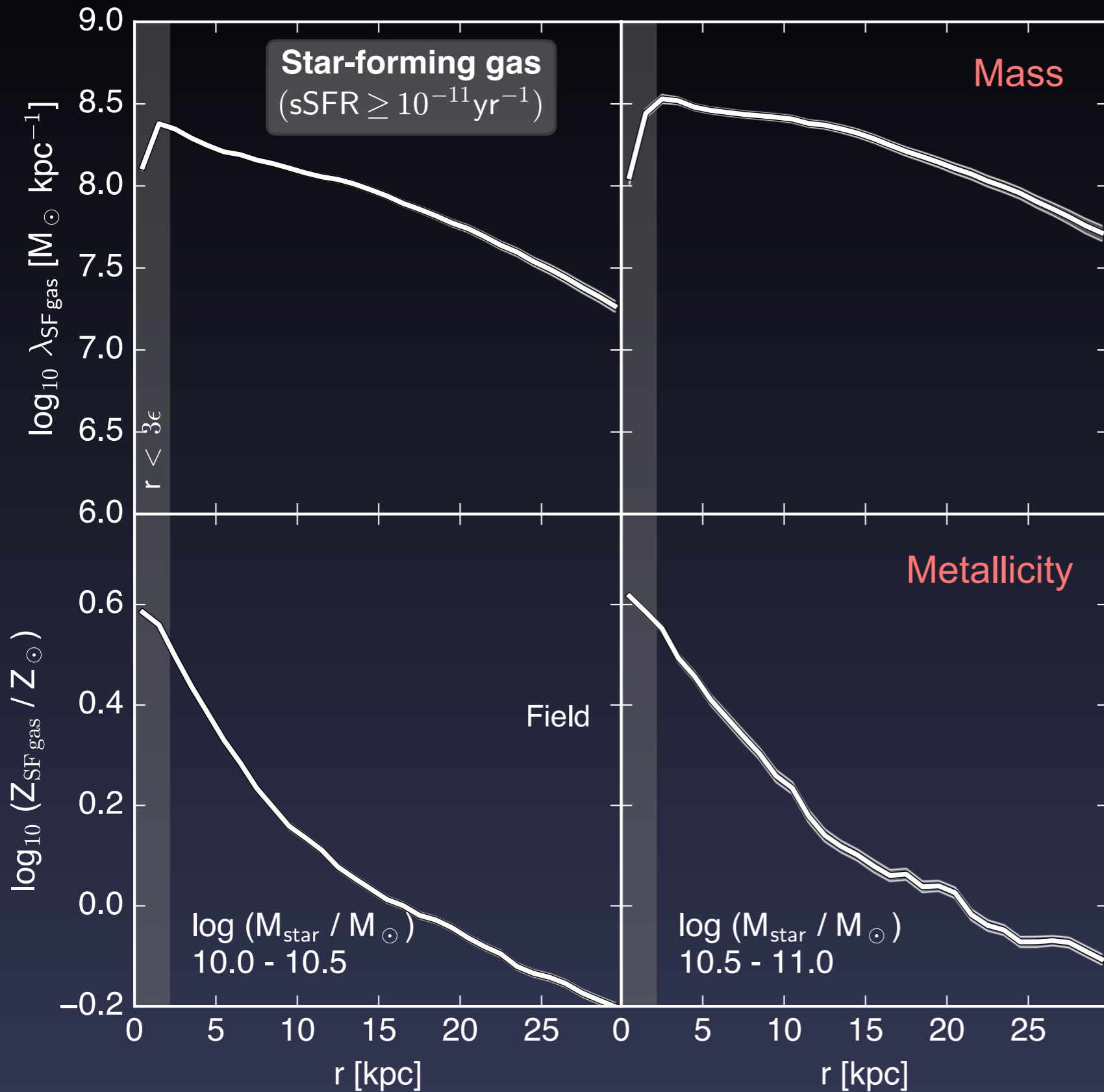


Eagle: Satellite metallicities (gas)

Prediction

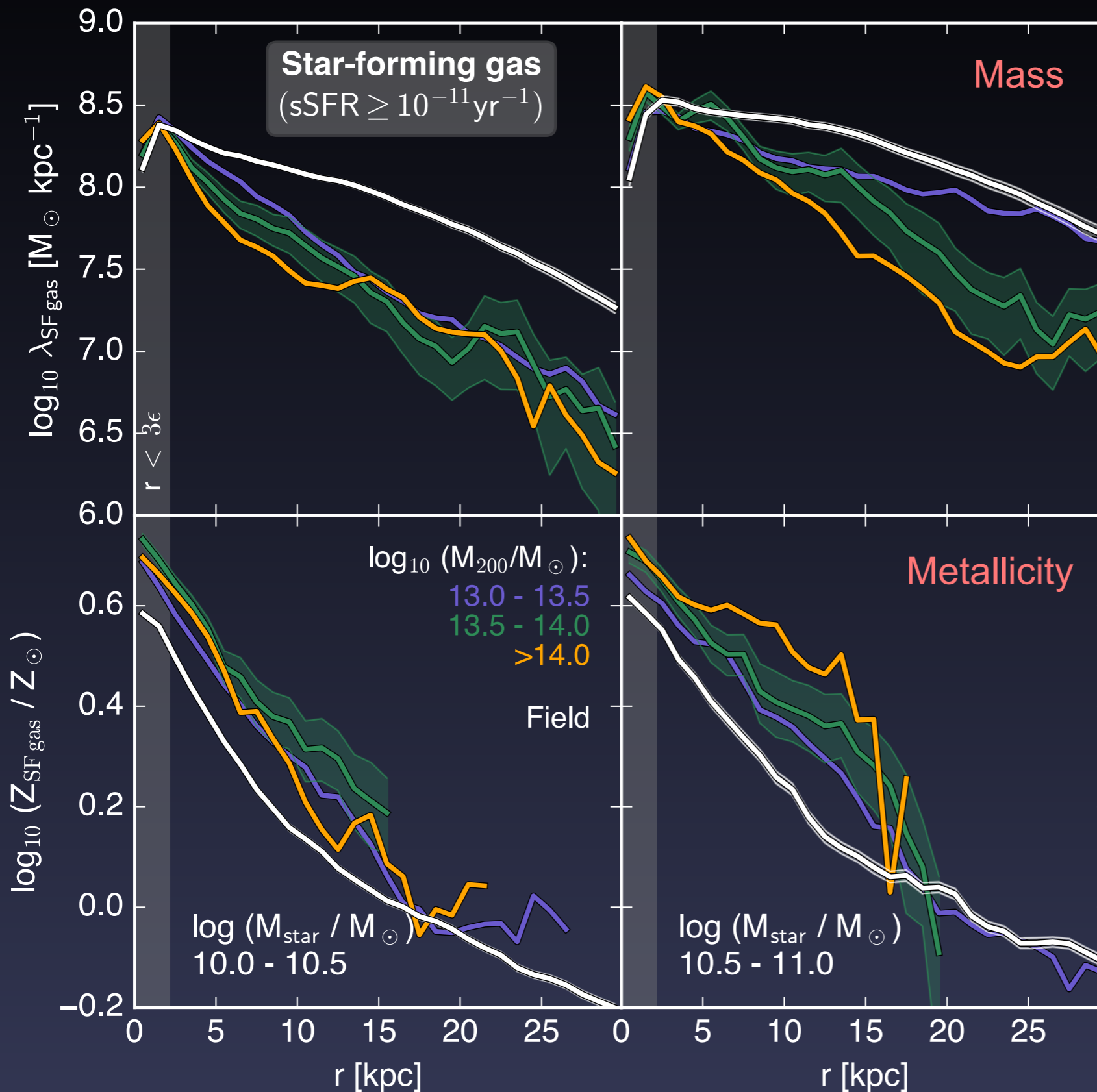


Origin of gas metallicity excess



Origin of gas metallicity excess

Prediction + Interpretation



Preferential lack of (metal-poor) gas from outskirts

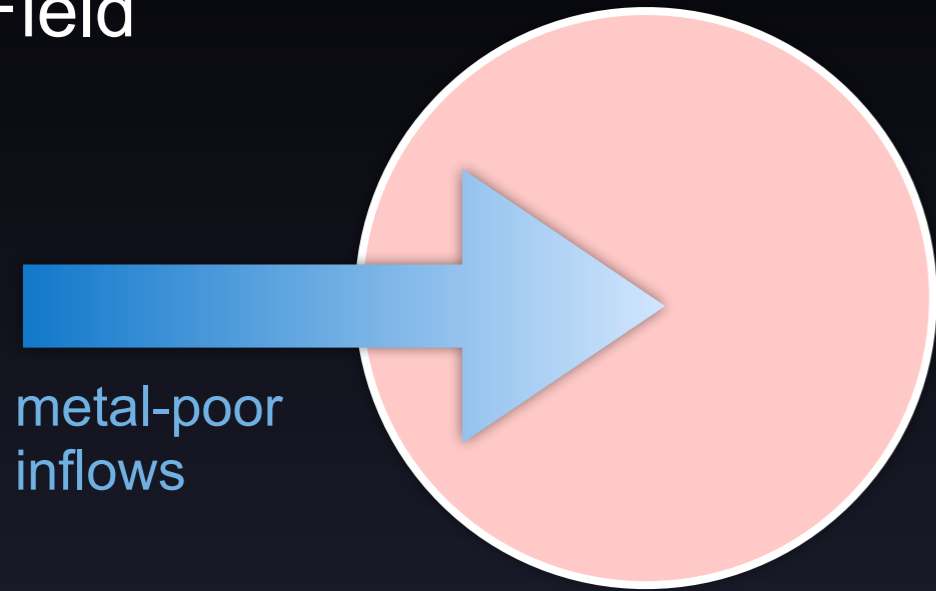
→ ram pressure stripping

[see also Genel 16]

Metallicity also enhanced **at** fixed radius...

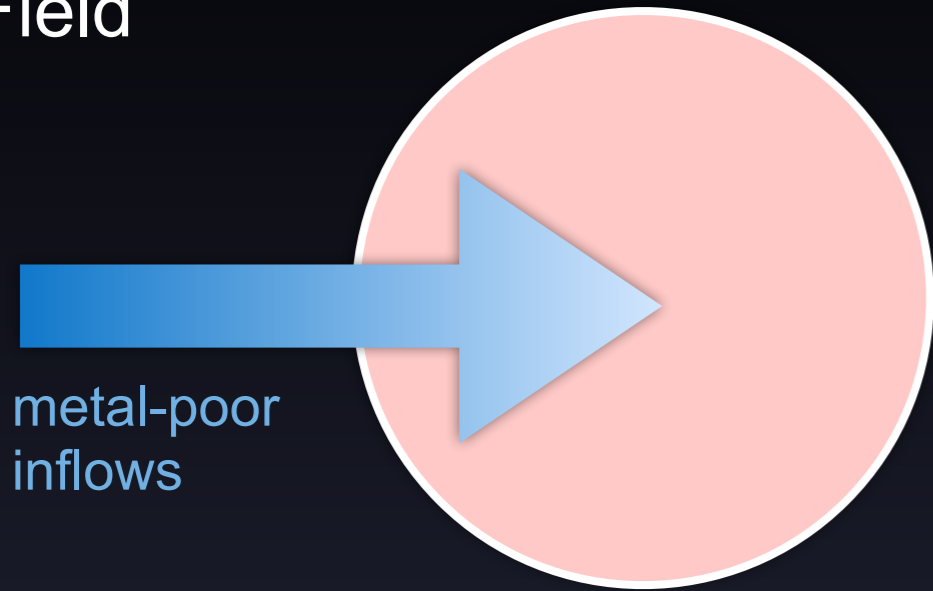
Origin of gas metallicity excess

Field



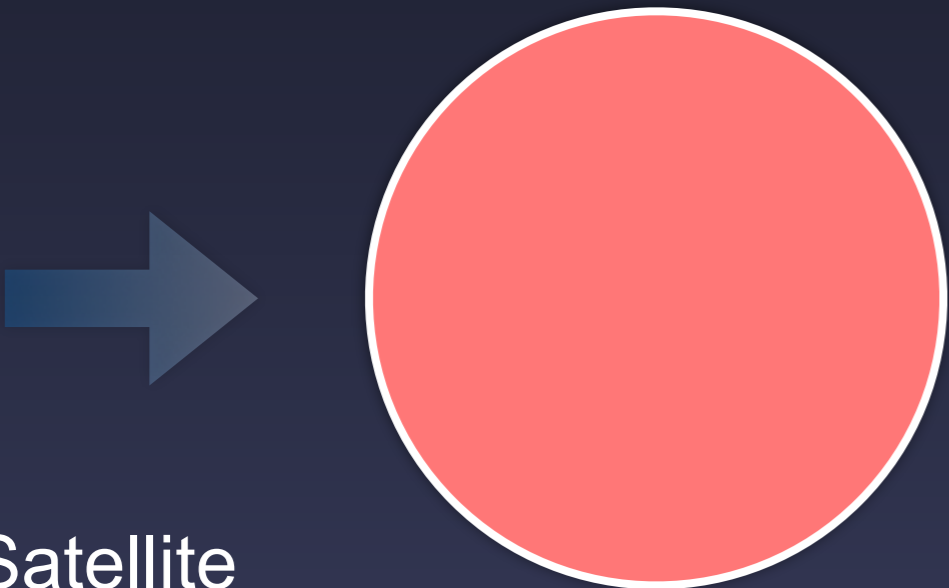
Origin of gas metallicity excess

Field



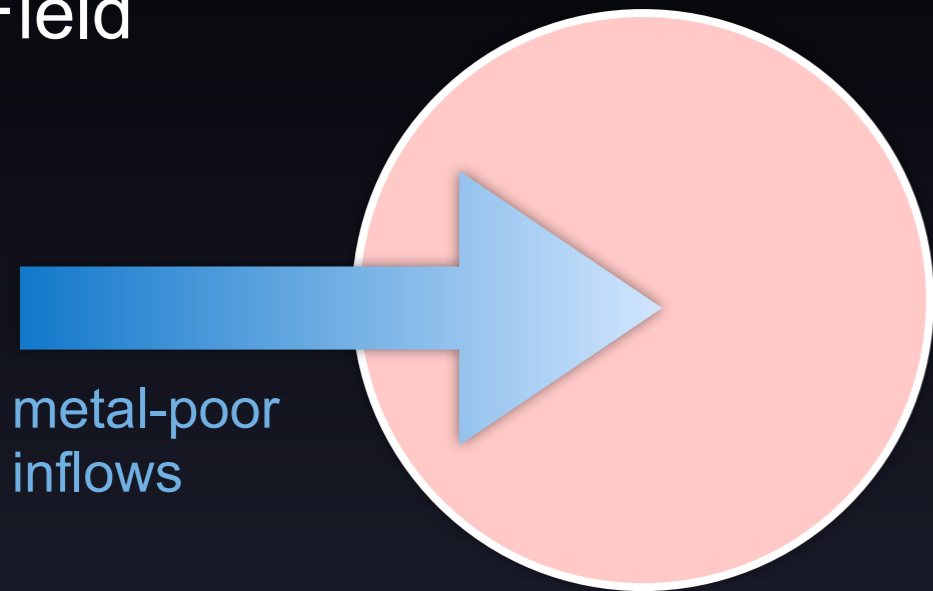
“Suppressed dilution”

Satellite



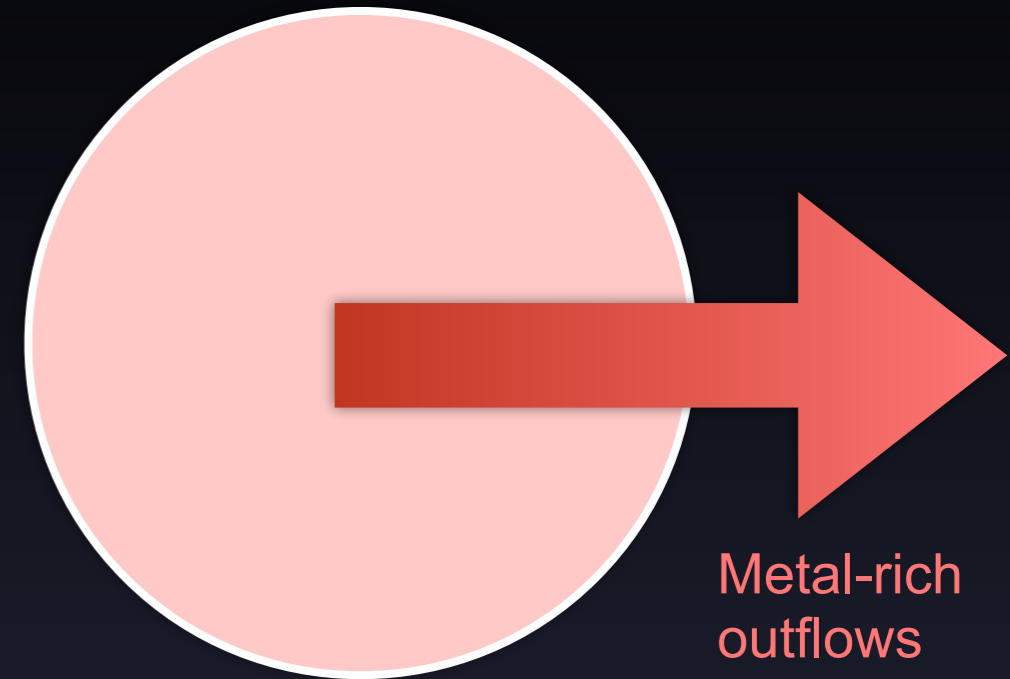
Origin of gas metallicity excess

Field



metal-poor inflows

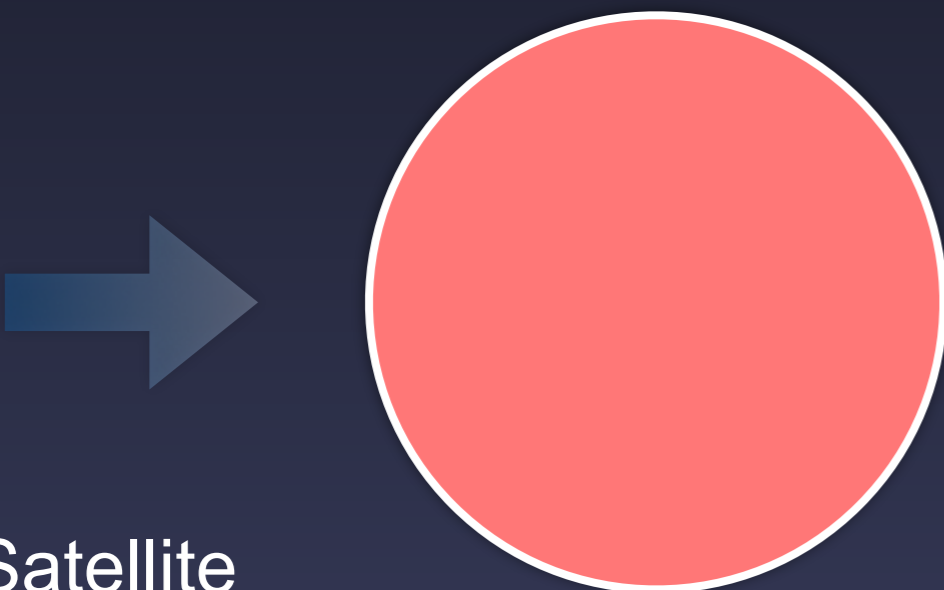
"Suppressed dilution"



Metal-rich outflows

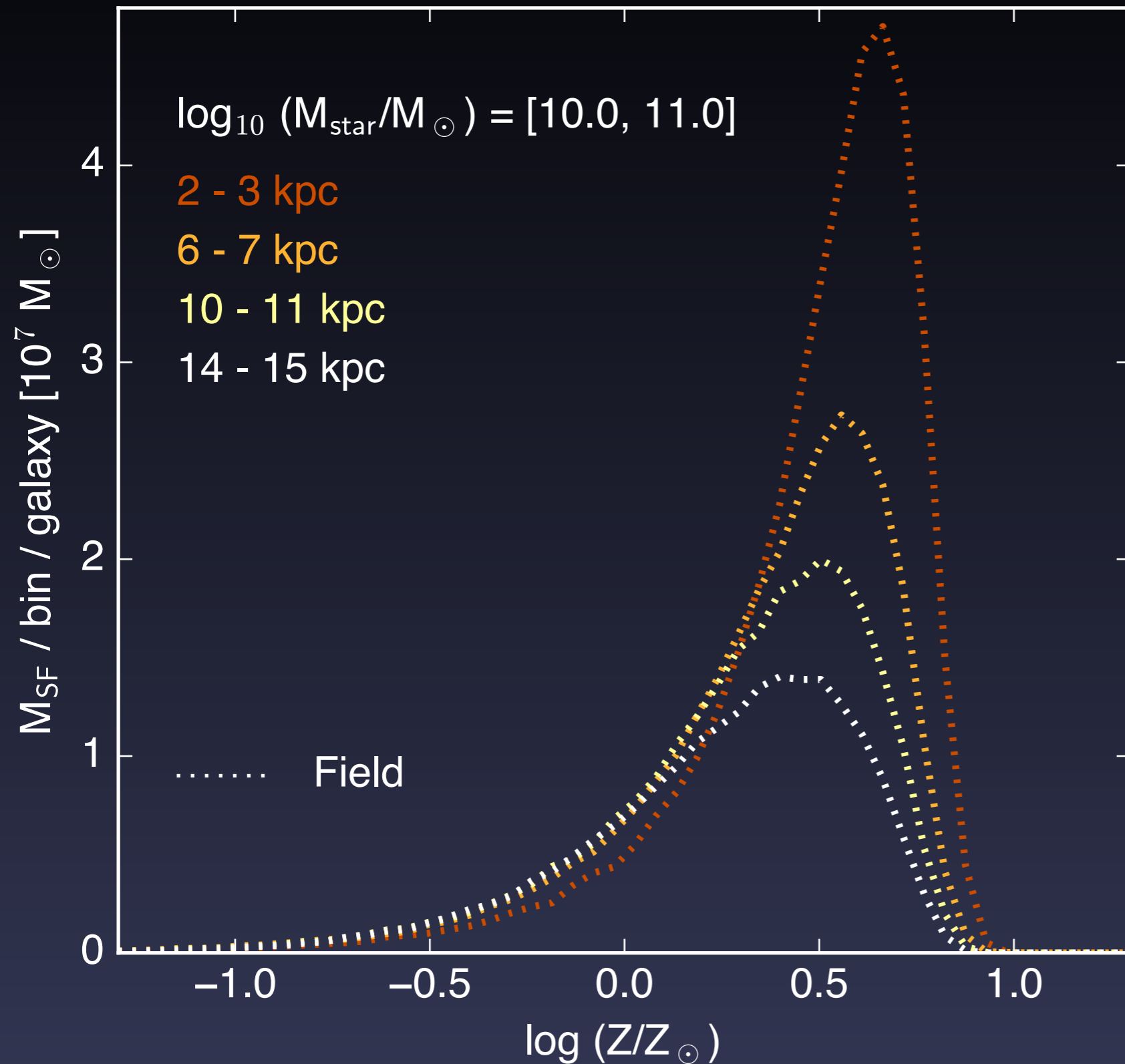
"ICM confinement"

Satellite



(but see YMB+12)

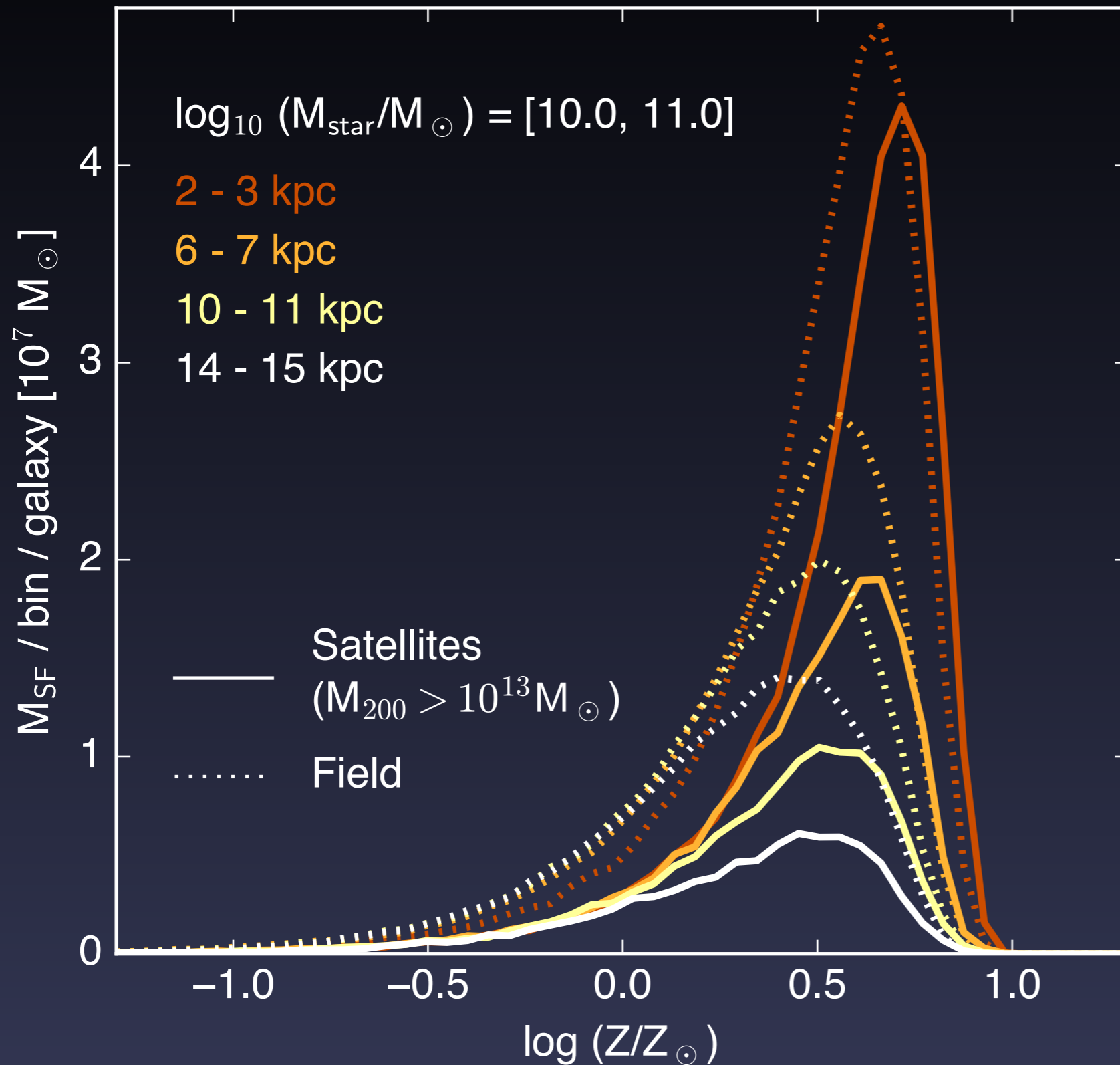
Origin of gas metallicity excess



Distribution of
particle metallicities
in radial bins

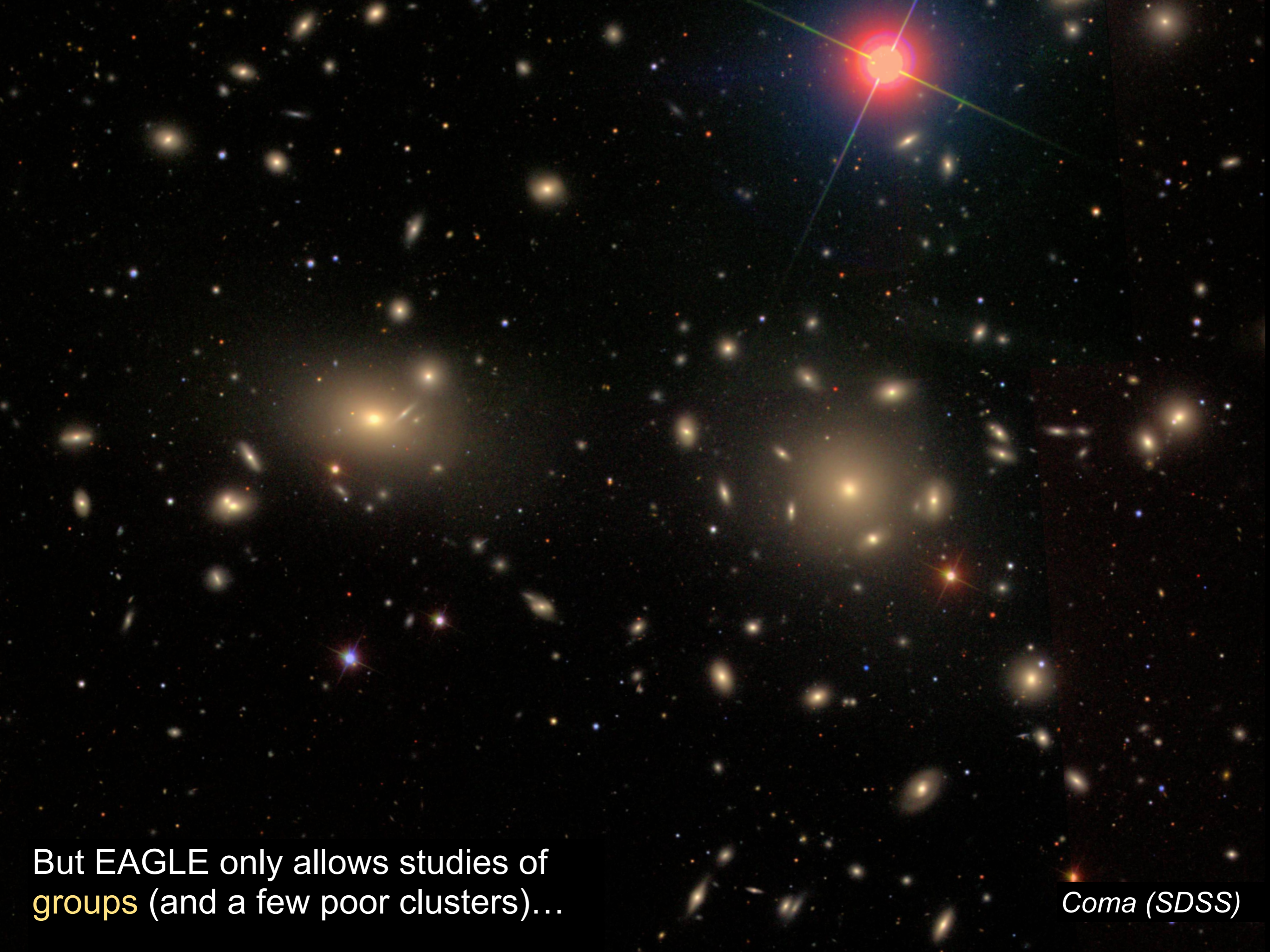
Origin of gas metallicity excess

Interpretation



Distribution of particle metallicities in radial bins

Preferential absence of metal-poor particles in satellite galaxies
→ “strangulation”



But EAGLE only allows studies of **groups** (and a few poor clusters)...

Coma (SDSS)

The Hydrangea galaxy cluster simulations

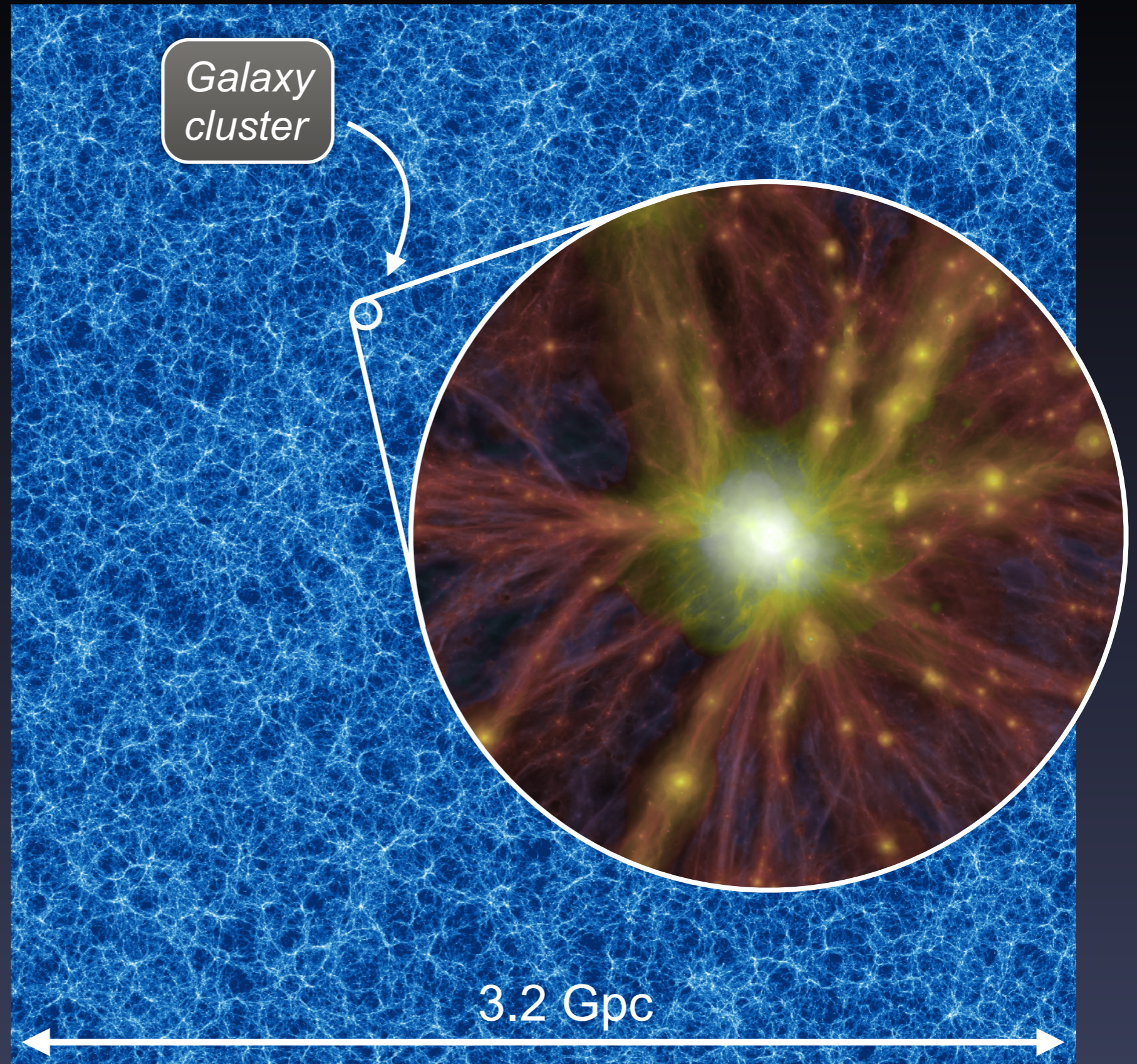
Need: large volumes and high resolution

24 zoom-in re-simulations, based on EAGLE model (out to $10 r_{200c}$)

6 additional zooms to $5 r_{200}$ for ICM studies (David Barnes @ Manchester)

35 million CPU-hr from Gauss Centre for Supercomputing

GCS
Gauss Centre for Supercomputing



“Hydrangea...”

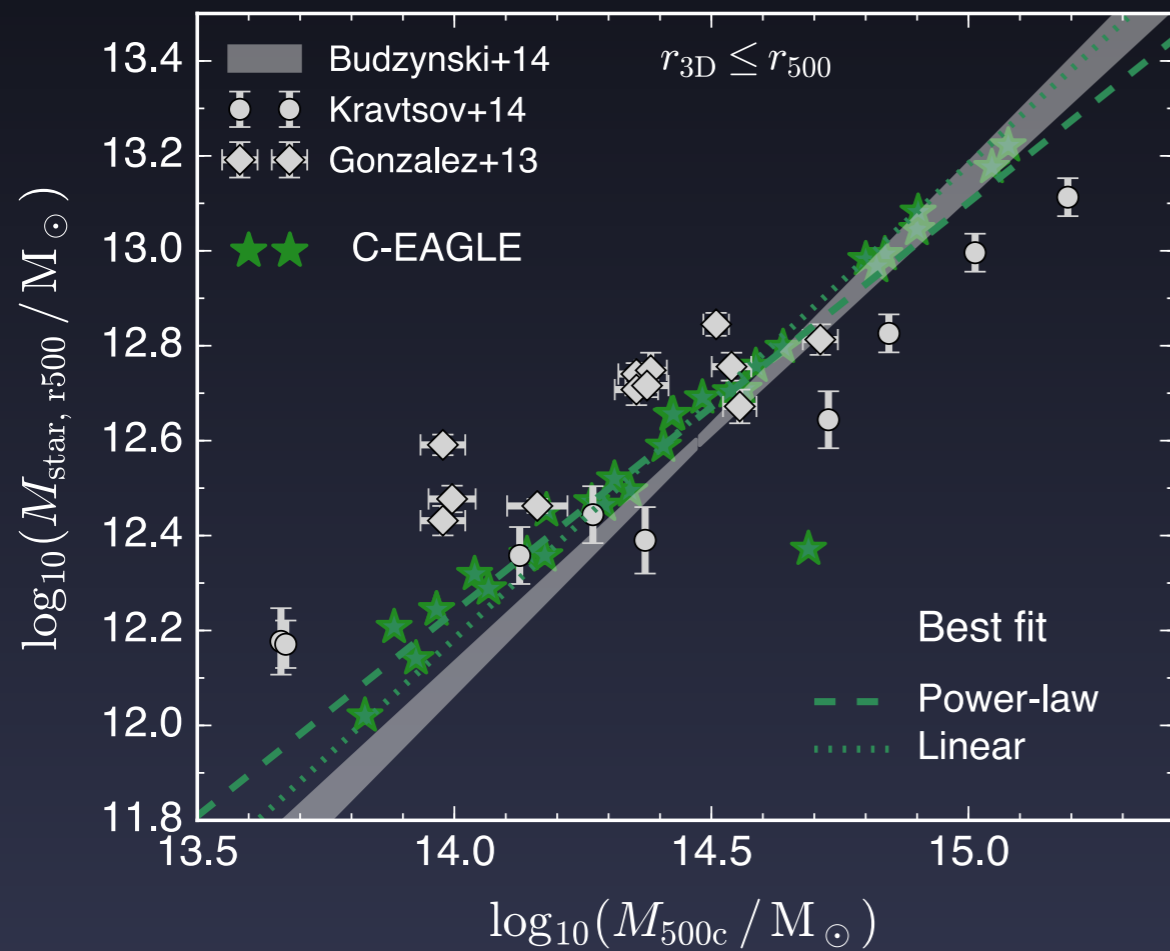


*Hydrangea
macrophylla*



Stellar mass in haloes and BCG

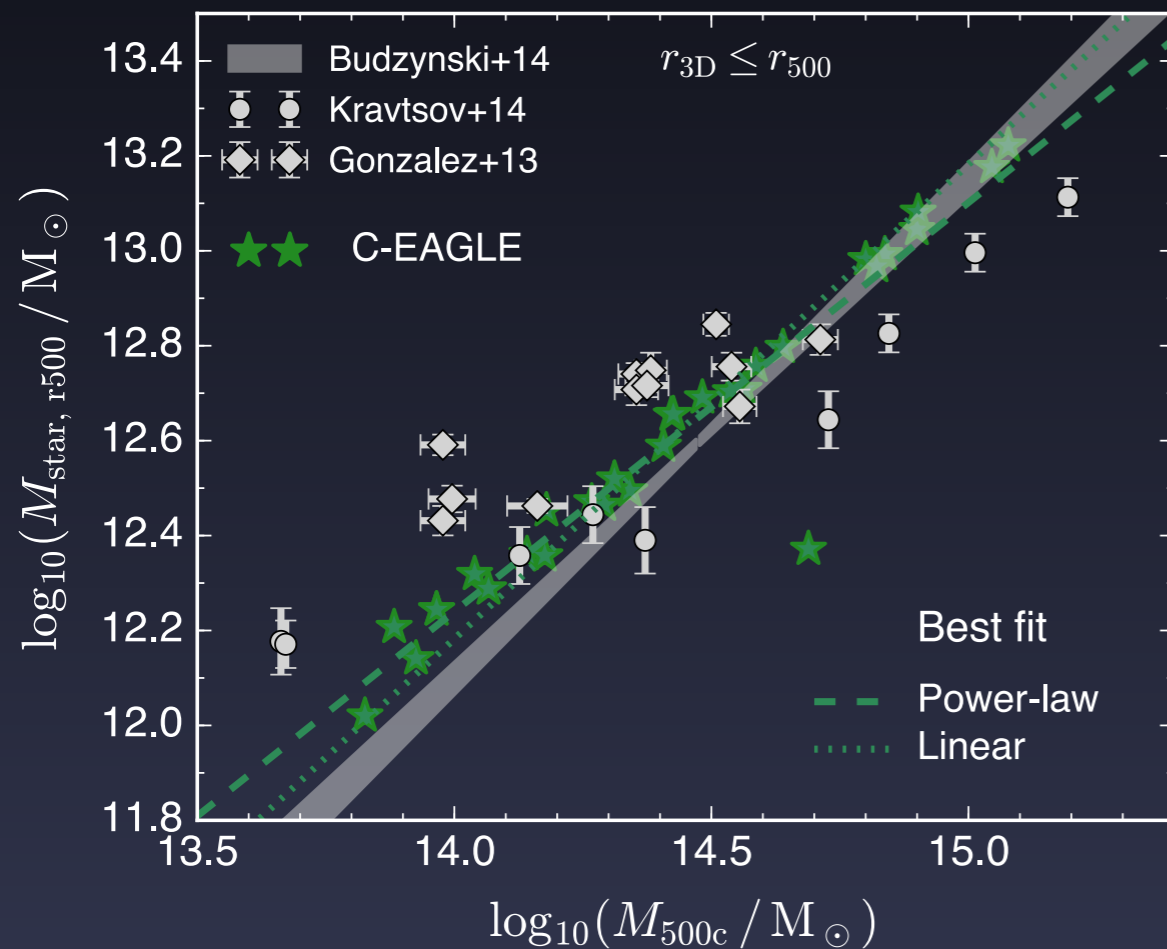
Total stellar mass within r_{500} -
quite good



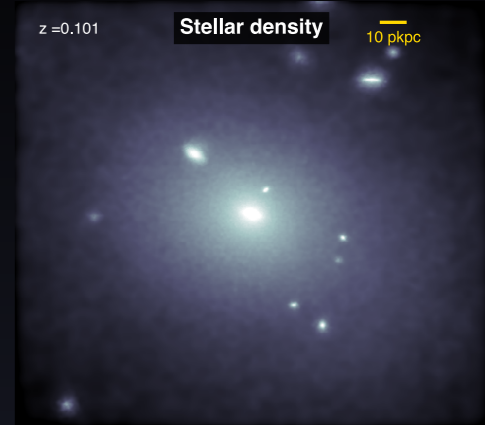
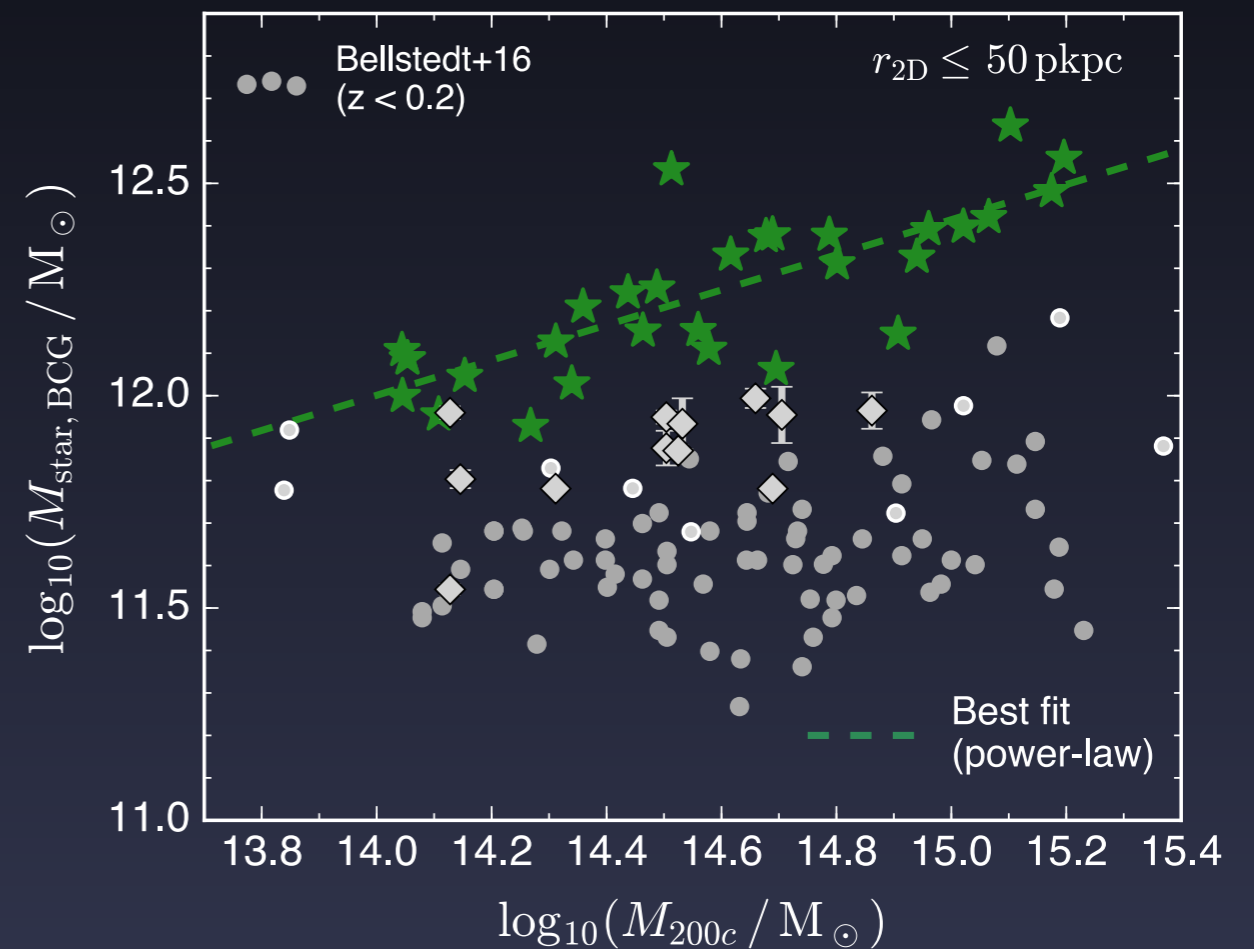
Stellar mass in haloes and BCG

Failure

Total stellar mass within r_{500} -
quite good



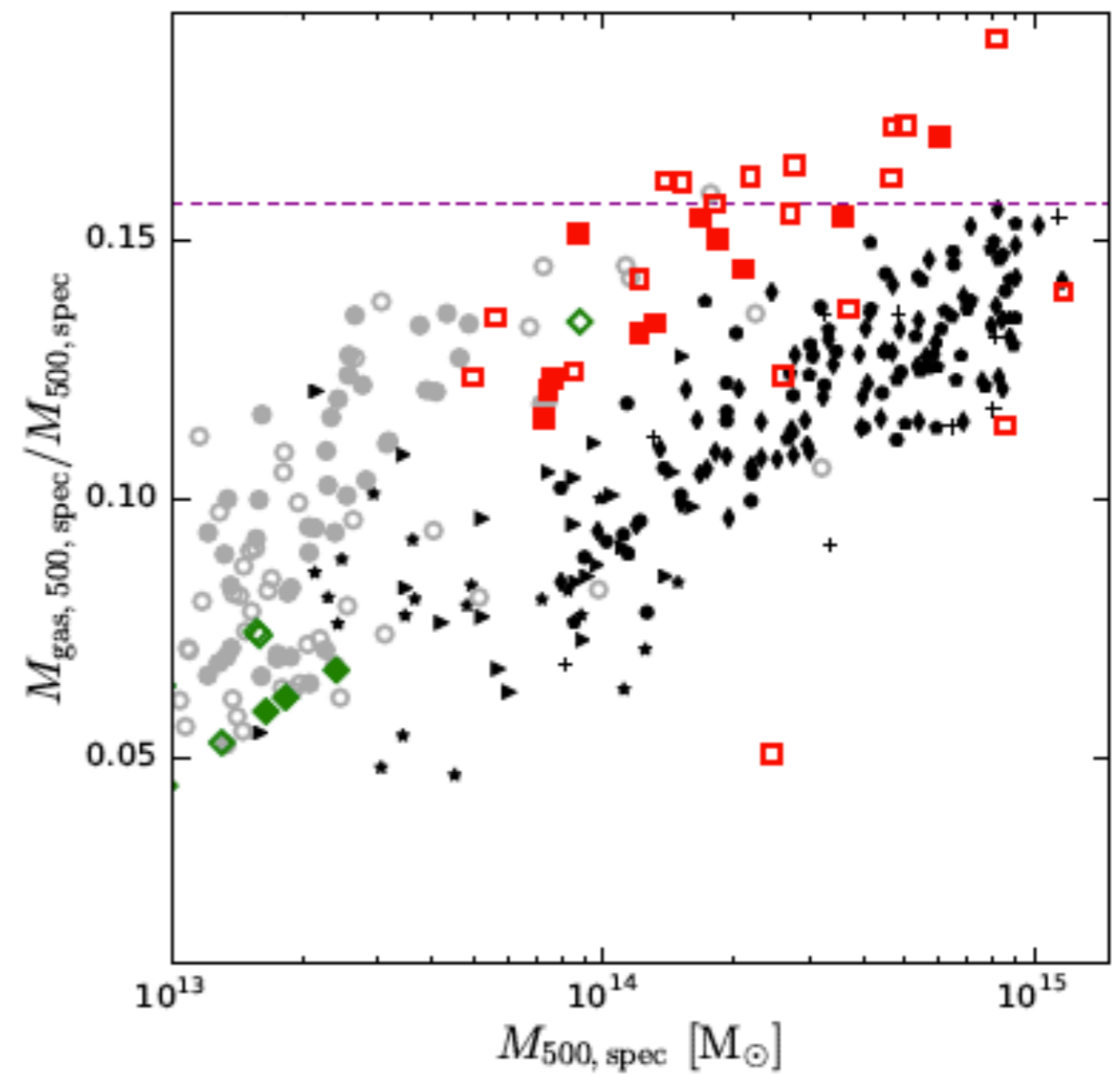
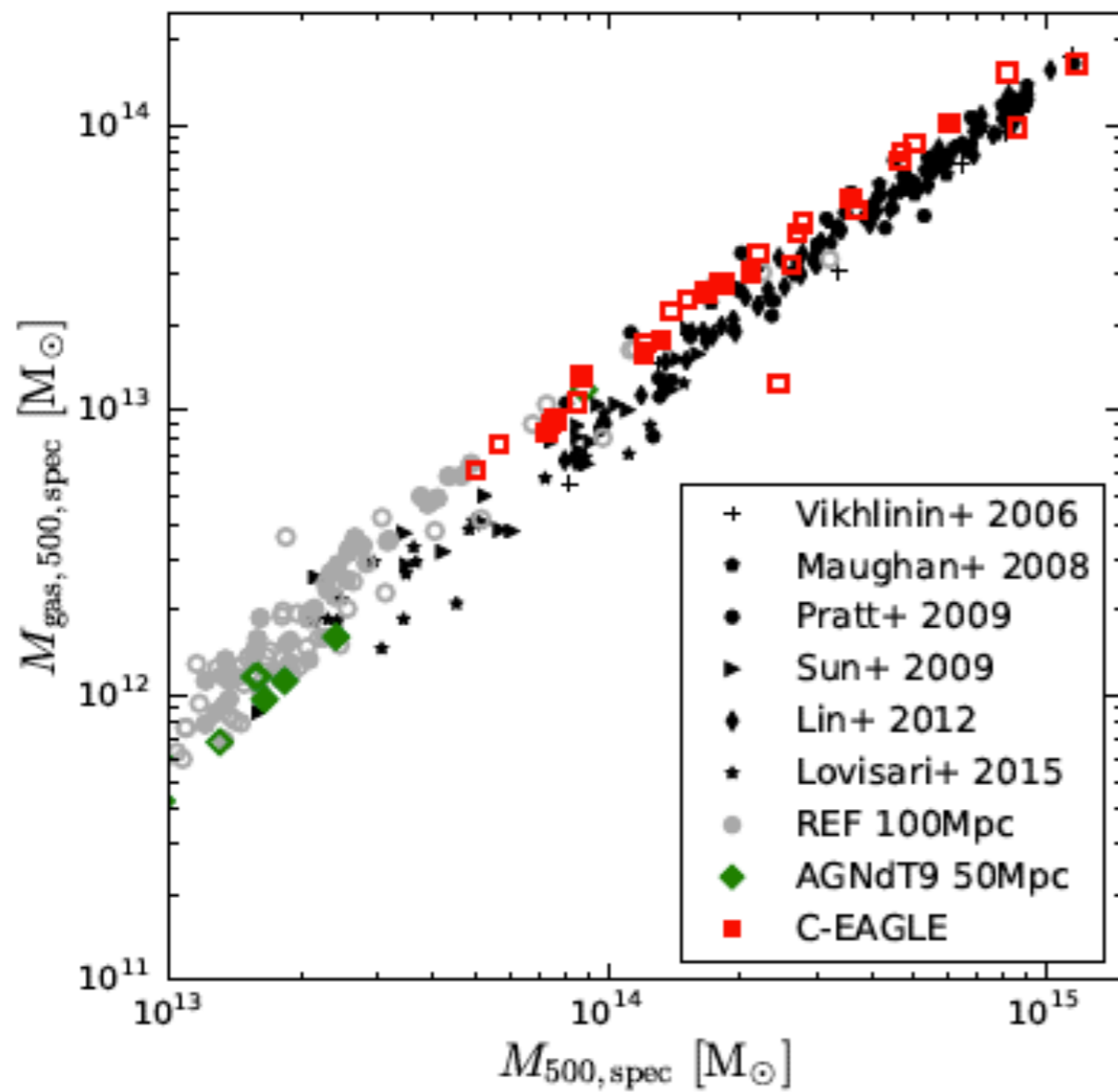
BCG stellar mass -
not so good



N.B.: AGN model not explicitly tuned for these quantities

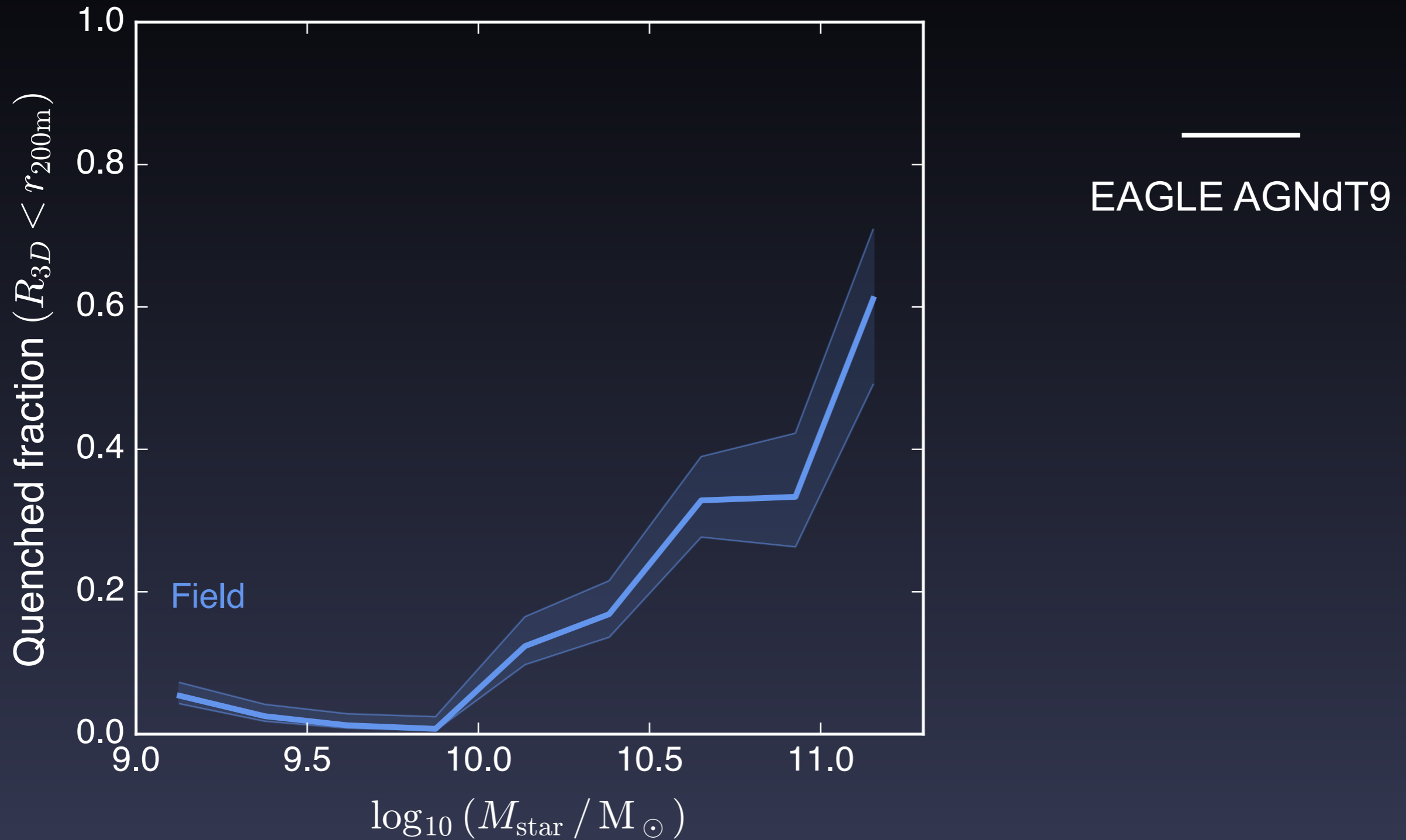
ICM properties: hot gas fractions

Failure



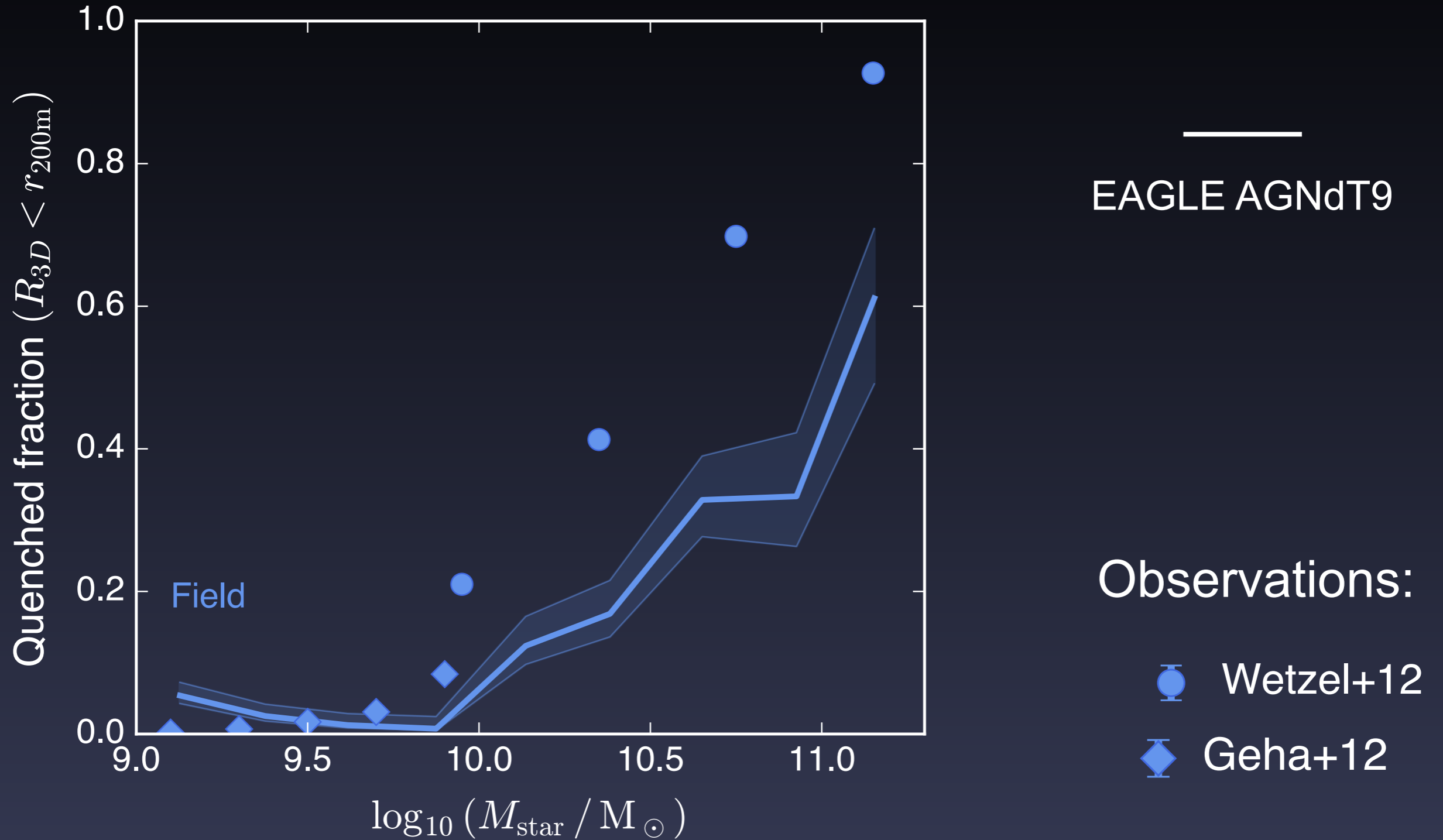
Clusters are noticeably too gas rich (N.B.: mock observational analysis may overestimate f_{gas} for simulations).

Passive galaxy fractions



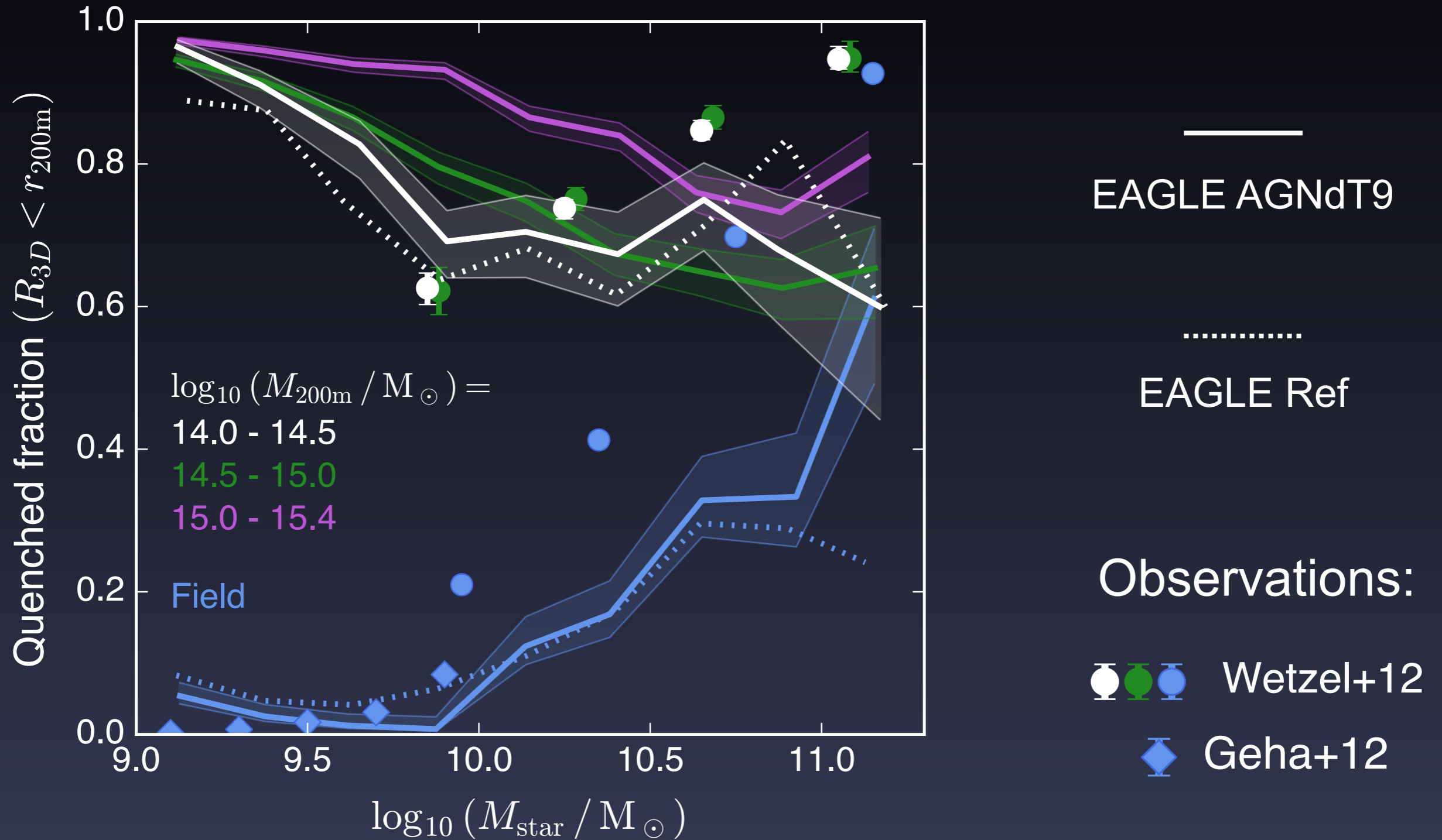
“Quenched”:
 $s\text{SFR} = \text{SFR}/M_{\text{star}} < 10^{-11} \text{ yr}^{-1}$

Passive galaxy fractions



“Quenched”:
 $s\text{SFR} = \text{SFR}/M_{\text{star}} < 10^{-11} \text{ yr}^{-1}$

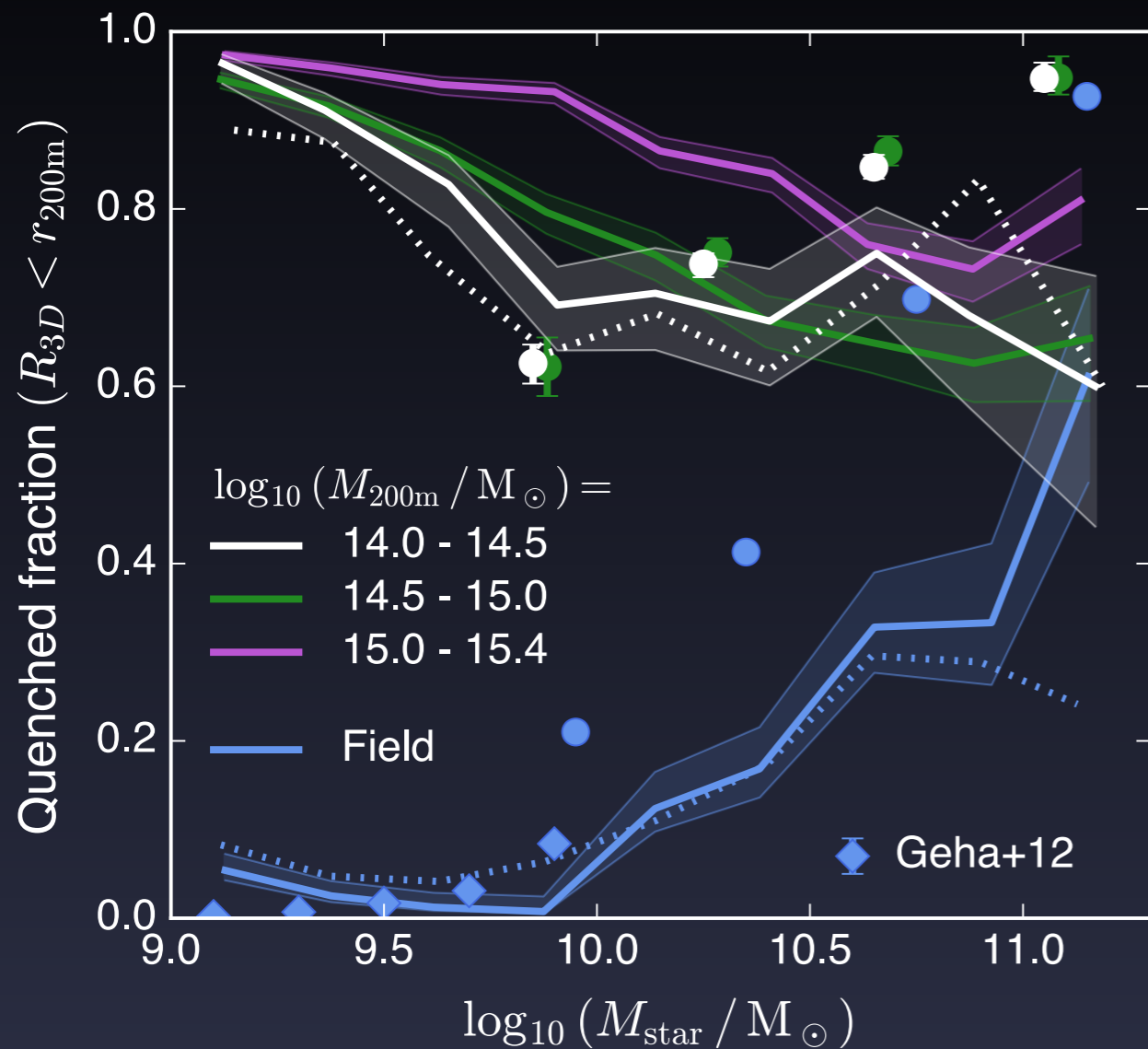
Passive galaxy fractions



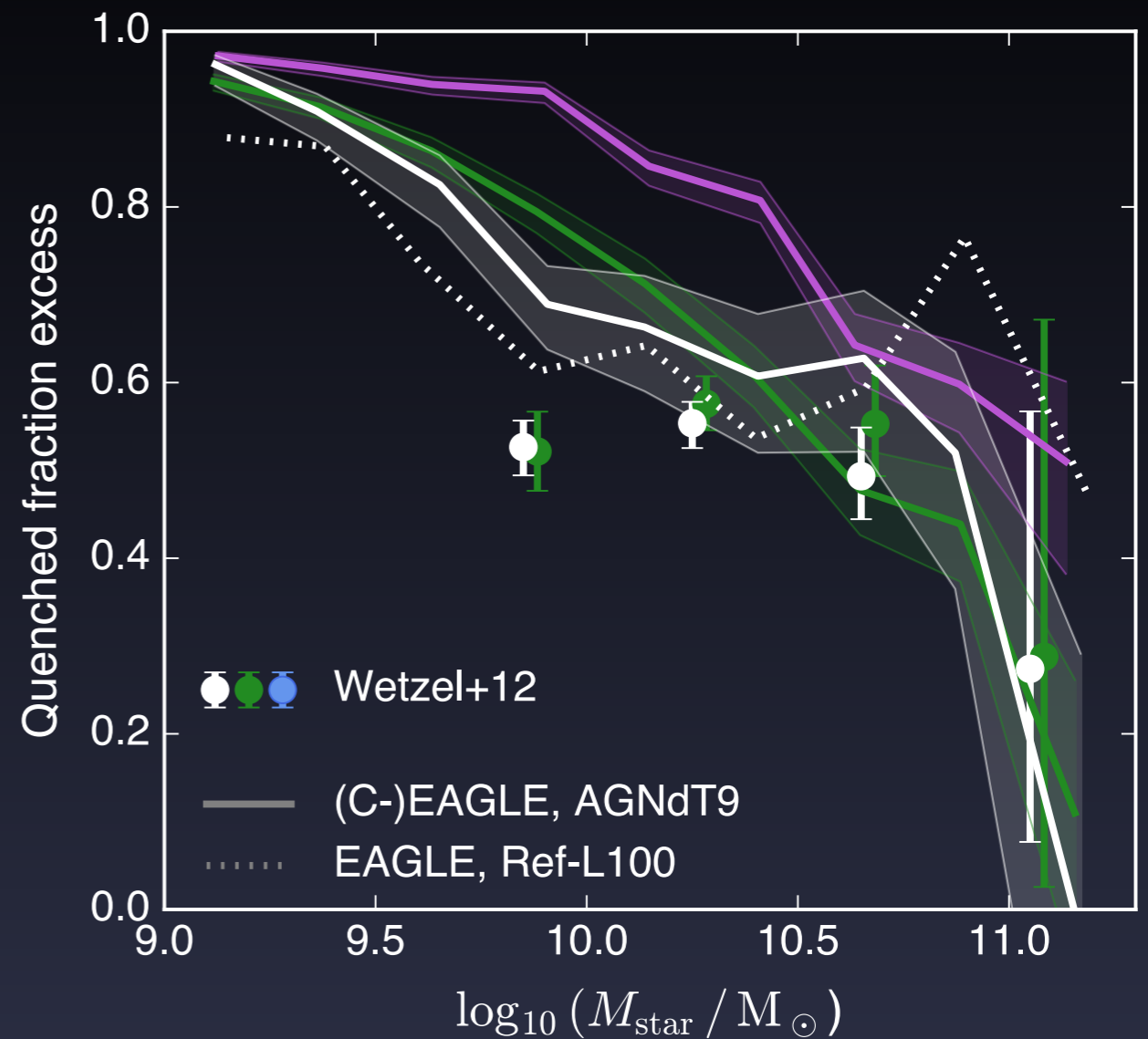
“Quenched”:
 $s\text{SFR} = \text{SFR}/M_{\text{star}} < 10^{-11} \text{ yr}^{-1}$

Passive galaxy fractions

Failure (?)



Massive galaxies (still)
not quenched
enough...



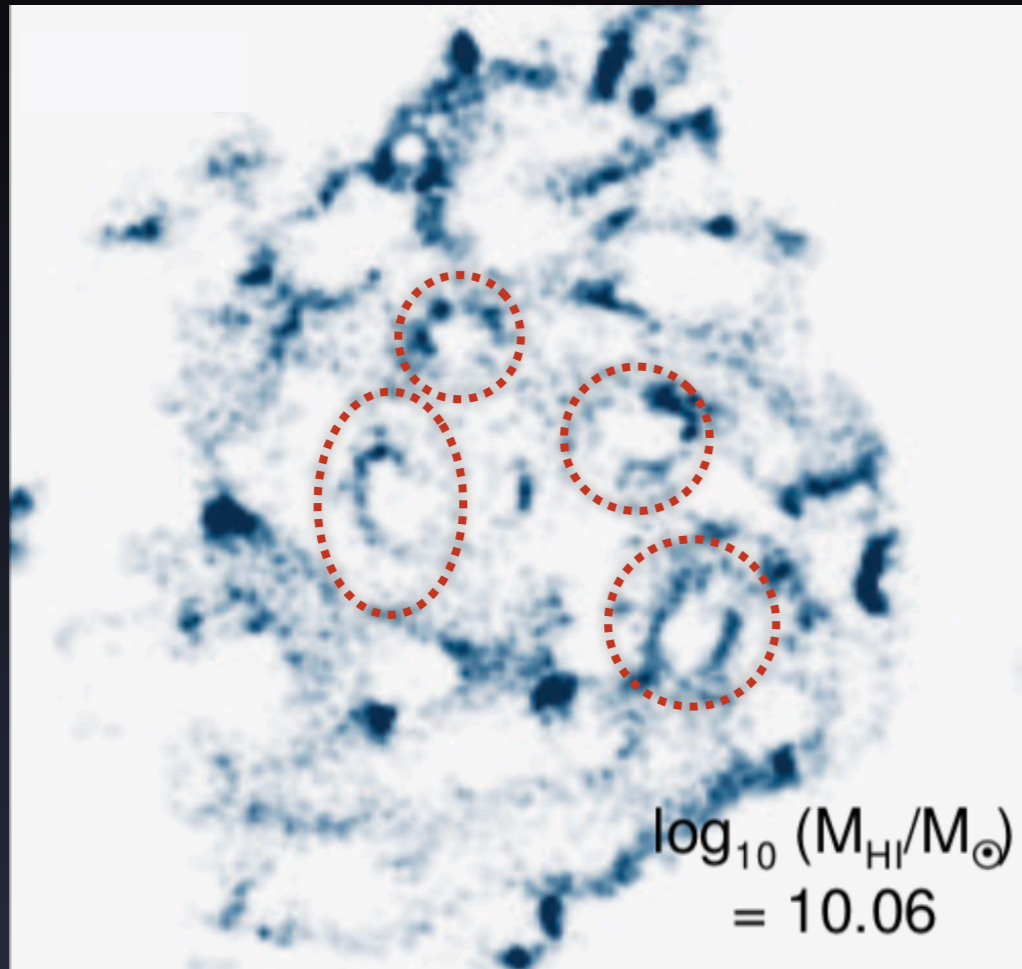
Environmental quenching
effect modelled quite well
(at $M_{\text{star}} > 10^{10} M_{\odot}$)

Passive galaxy fractions

Failure (?)

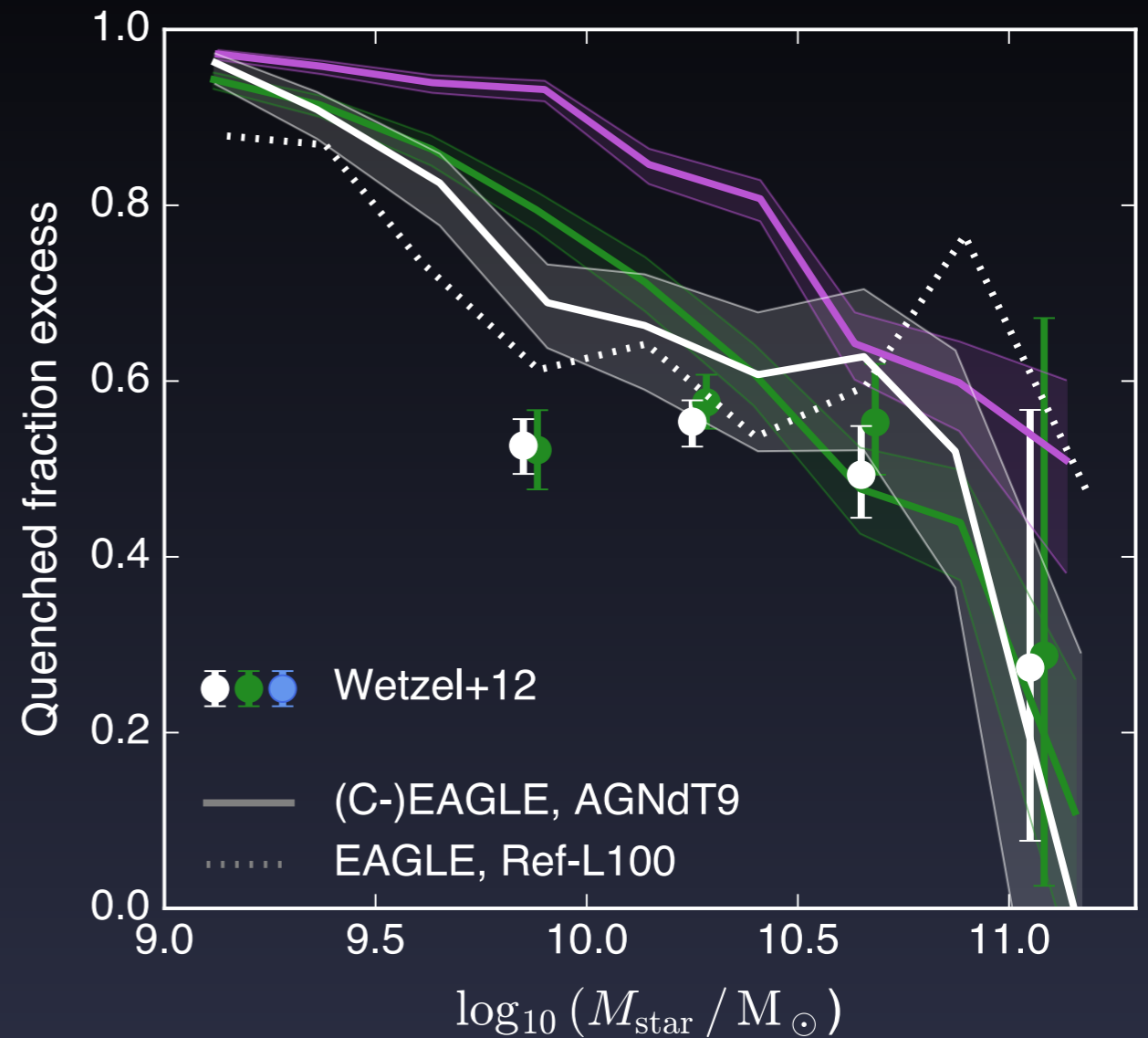
YMB+16

H I (field)



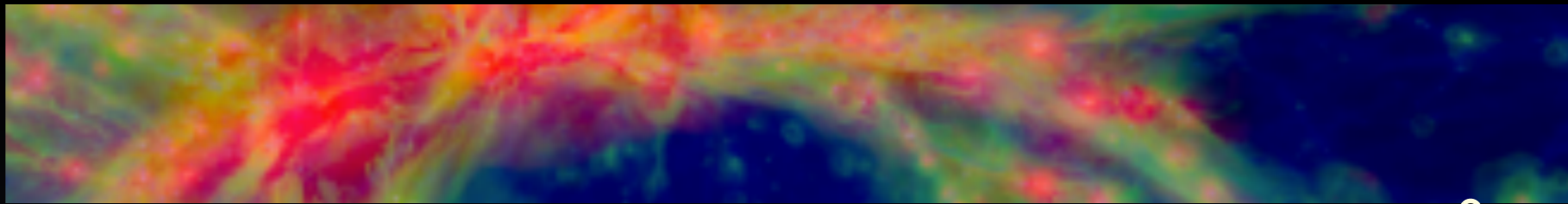
100 kpc

Might be related to **overly porous structure** of gas discs in EAGLE model



Environmental quenching effect modelled quite well (at $M_{\text{star}} > 10^{10} M_{\odot}$)

Summary



- EAGLE reproduces observed metallicity excess in satellite galaxies
- Metallicities raised due to stripping and prevention of inflows, not confinement
- Hydrangea cluster zooms based on EAGLE model
- Too high BCG and ICM masses
- Quenched fraction higher in clusters, but with second-order inaccuracies

