数値シミュレーションで繋ぐ
中高赤方偏移銀河と近傍銀河の関係

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(Carnegie Observatories,
⇒ Mullard Space Science Laboratory,
University College London from Oct.2008)

- z=1~3

  formation of bright (elliptical) galaxies?

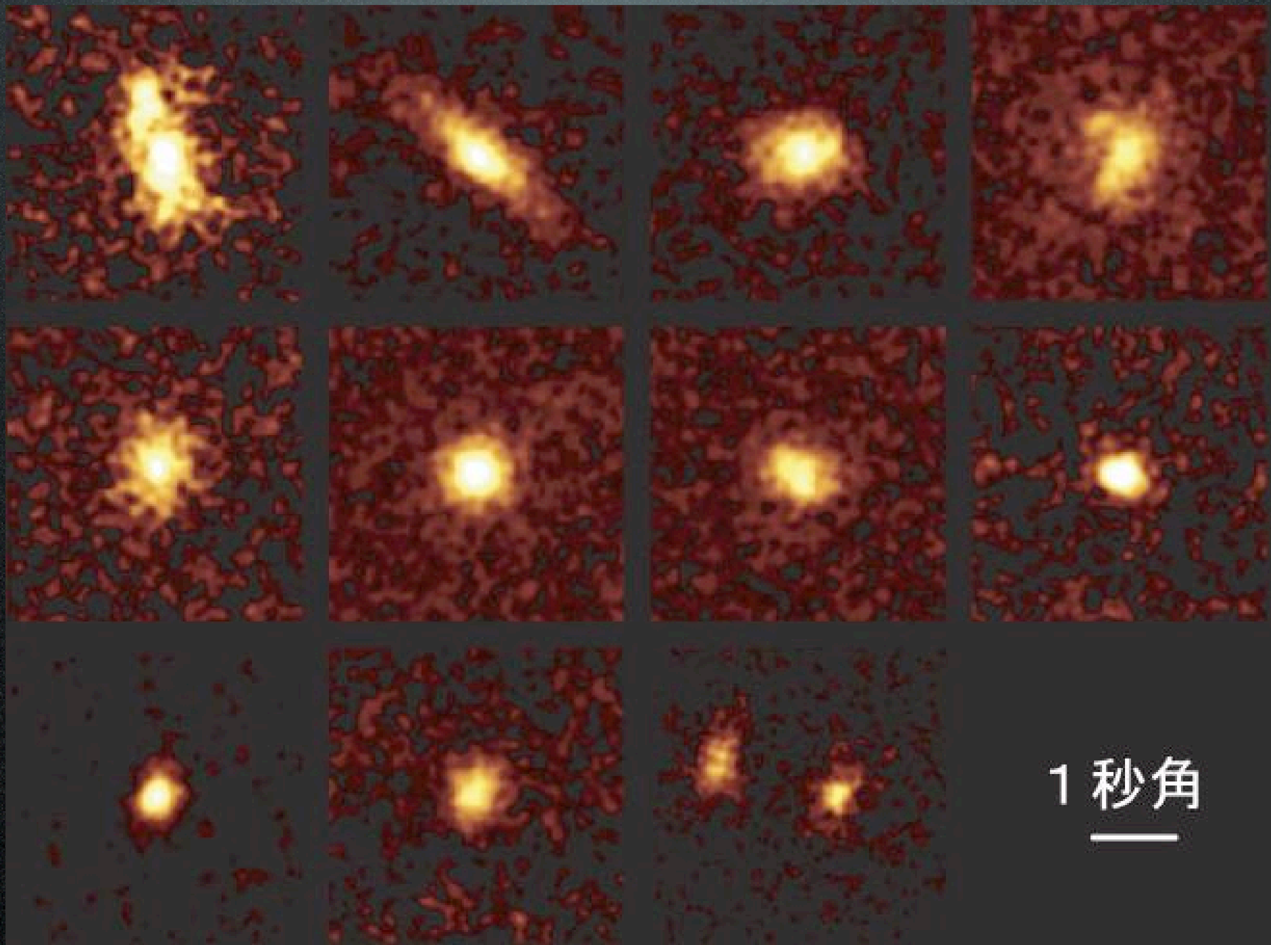
- z=0~1

  formation of disk?

- z=0

  the Milky Way: Galactic Archeology

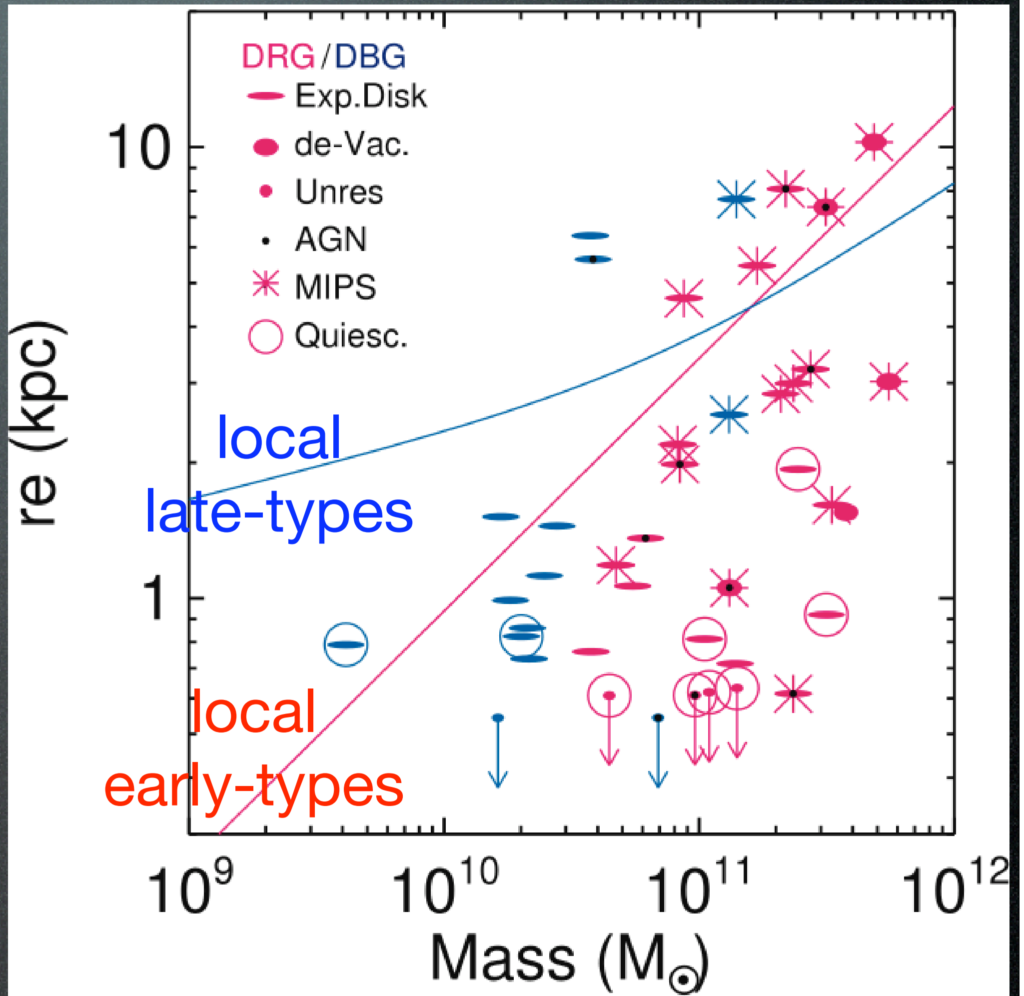
$z=1\sim3$: formation of bright ellipticals?



Subaru/IRCS+AO: Akiyama et al. (2008)

Mass-size relation at z~2.5

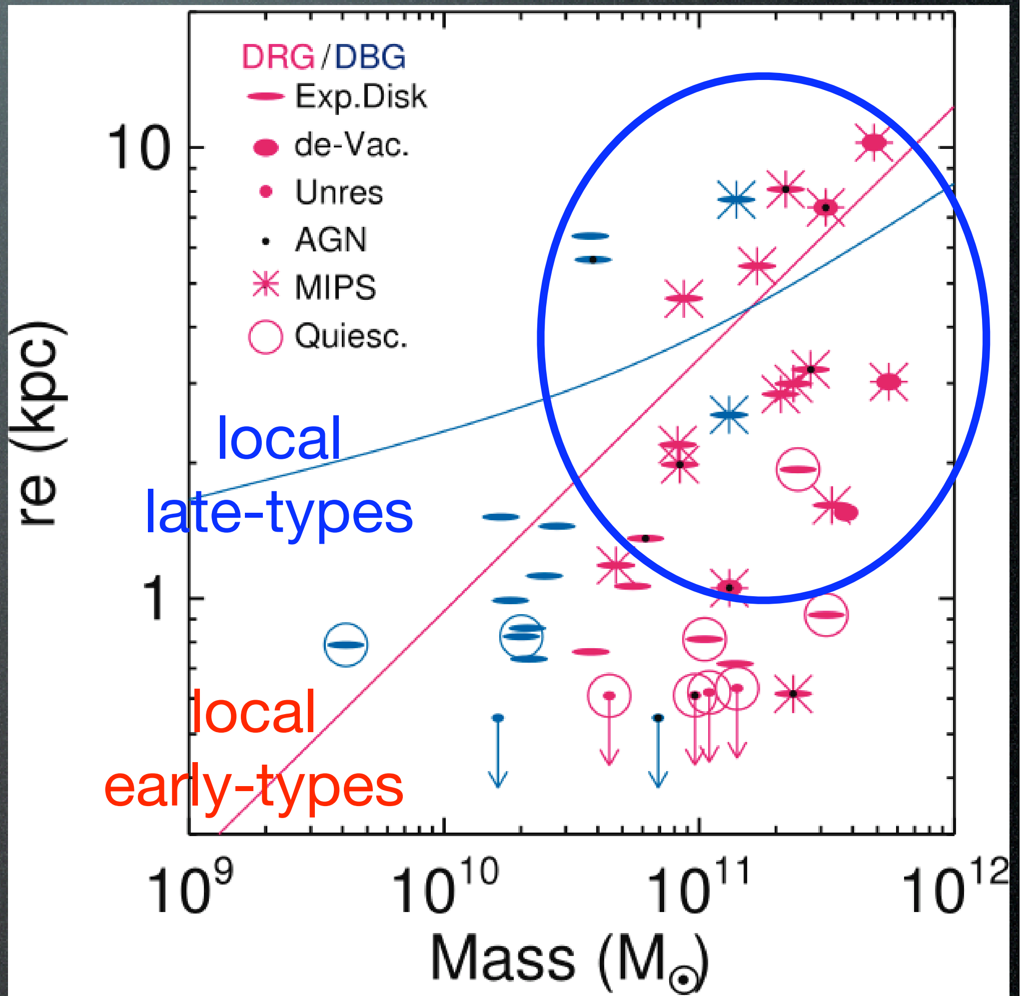
- Quiescent bright galaxies are extremely compact
- How to make them?
  smooth, monolithic collapse (DK 01)?
- How to make them bigger?
  multiple dry minor mergers?



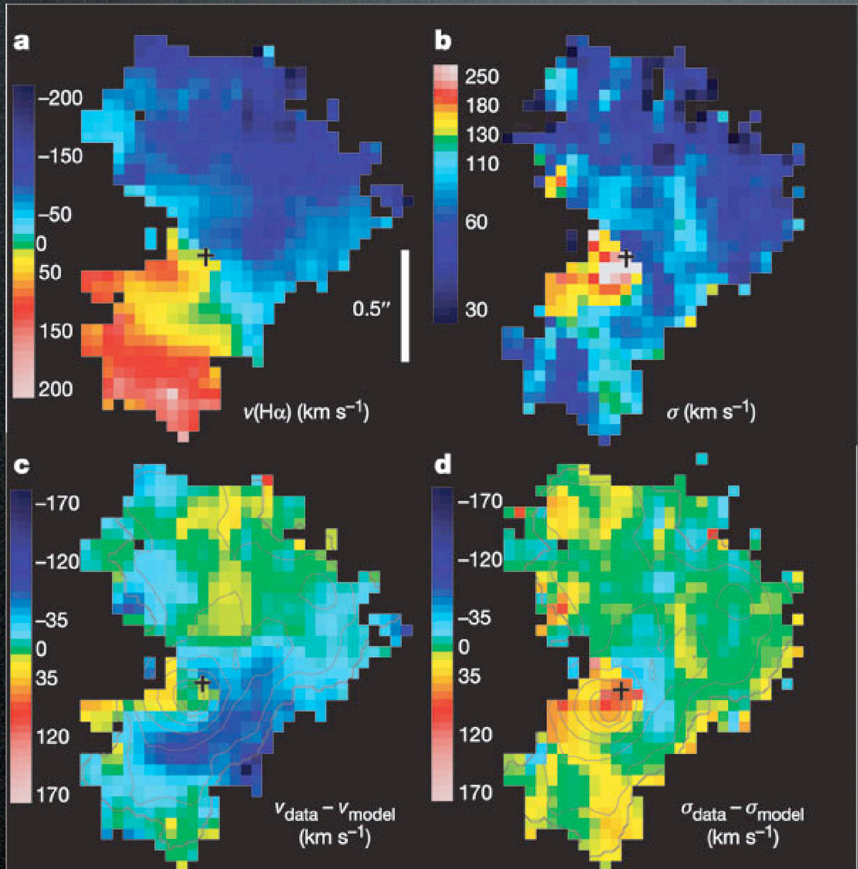
Toft et al. (07)

Mass-size relation at z~2.5

- star-forming galaxies are more “reasonable” size



Large rotating disks at z~2.
Are they progenitors of local disk?



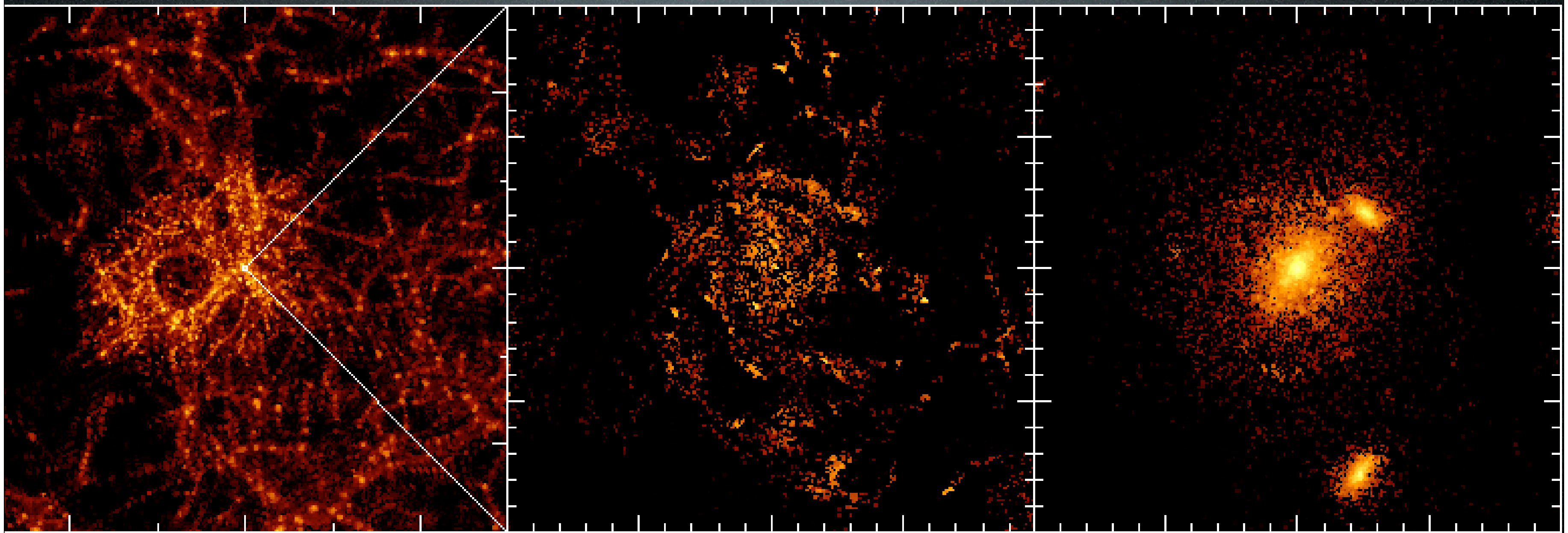
$M_s \sim 8 \times 10^{10} M_\odot$

$M_{dyn}(<8.8\ \mathrm{kpc}) \sim 10^{11} M_\odot$

BzK-15504: Vrot~230 km/s disk at z=2.38

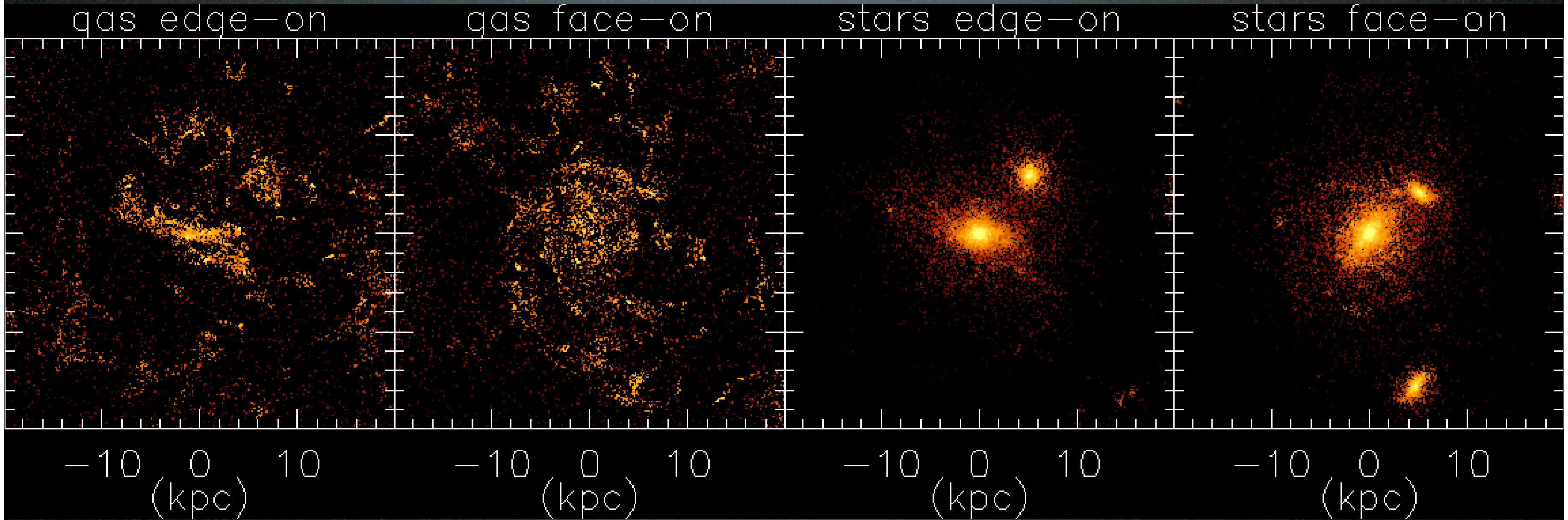
Genzel et al. (2006)

ΛCDM can make a such galaxy?



3yr WMAP cosmology

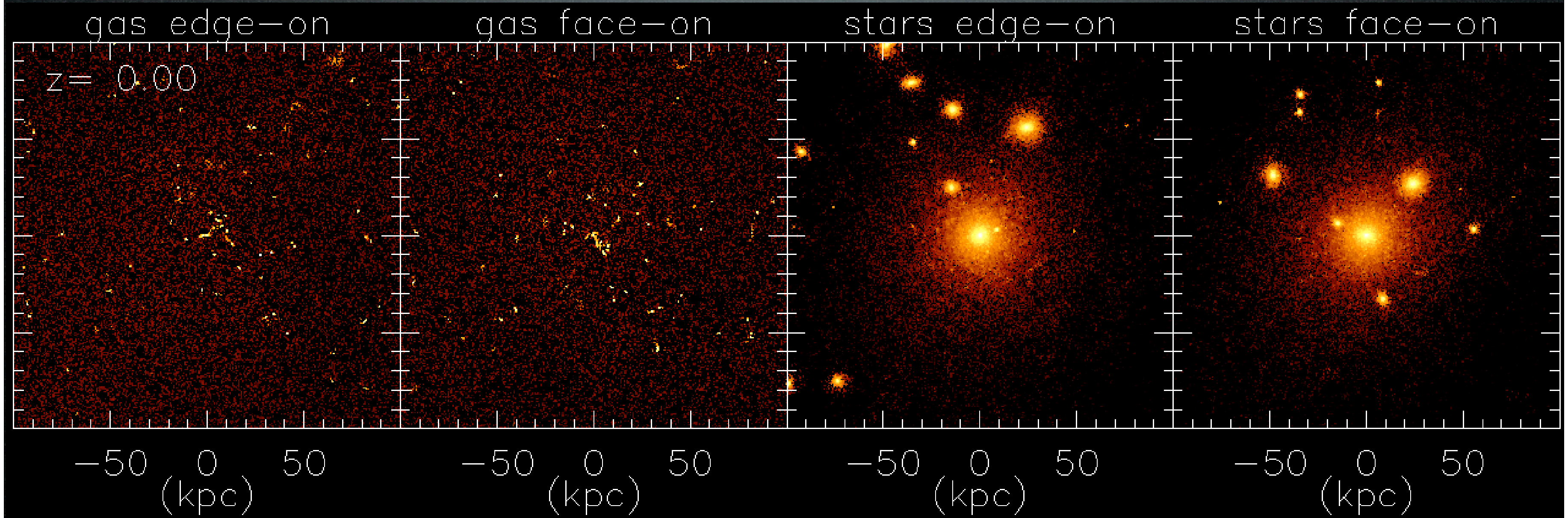
A simulated disk at z=2.34



Vrot,gas~200 km/s, a bit smaller but similar properties to BzK-15504 (Genzel et al.)

How do they evolve?

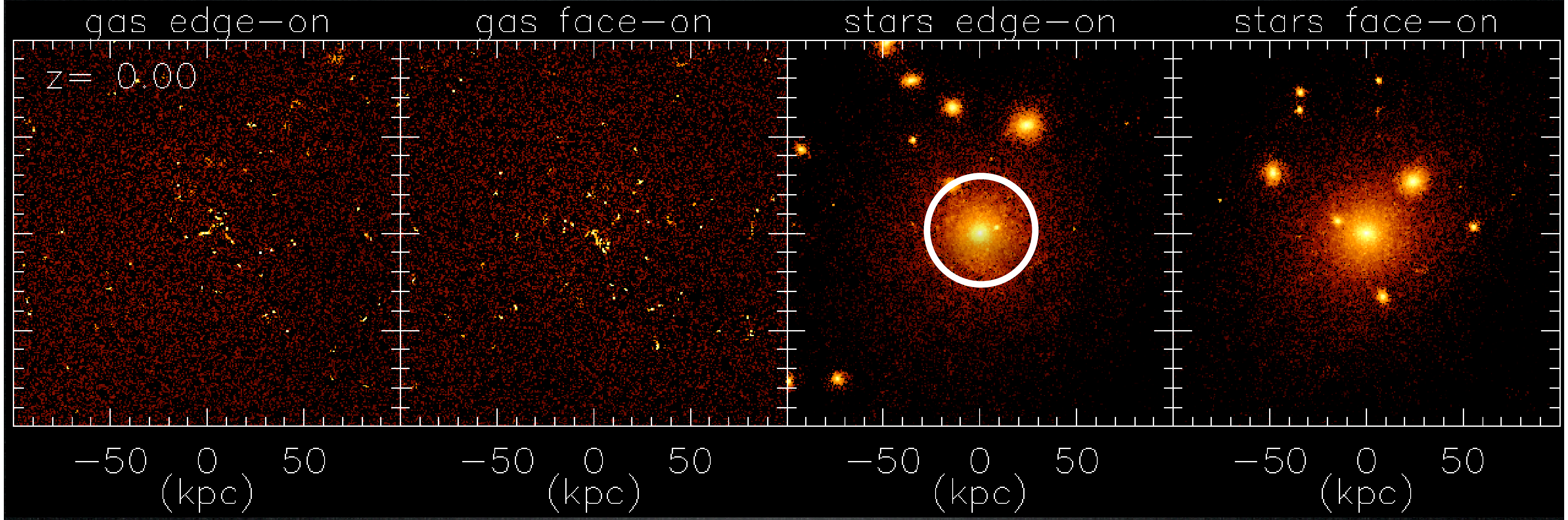
Brightest galaxy in a group at z=0.



Mvir(z=2.34) = $1 \times 10^{12} M_\odot$

Mvir (z=0)= $8 \times 10^{12} M_\odot$

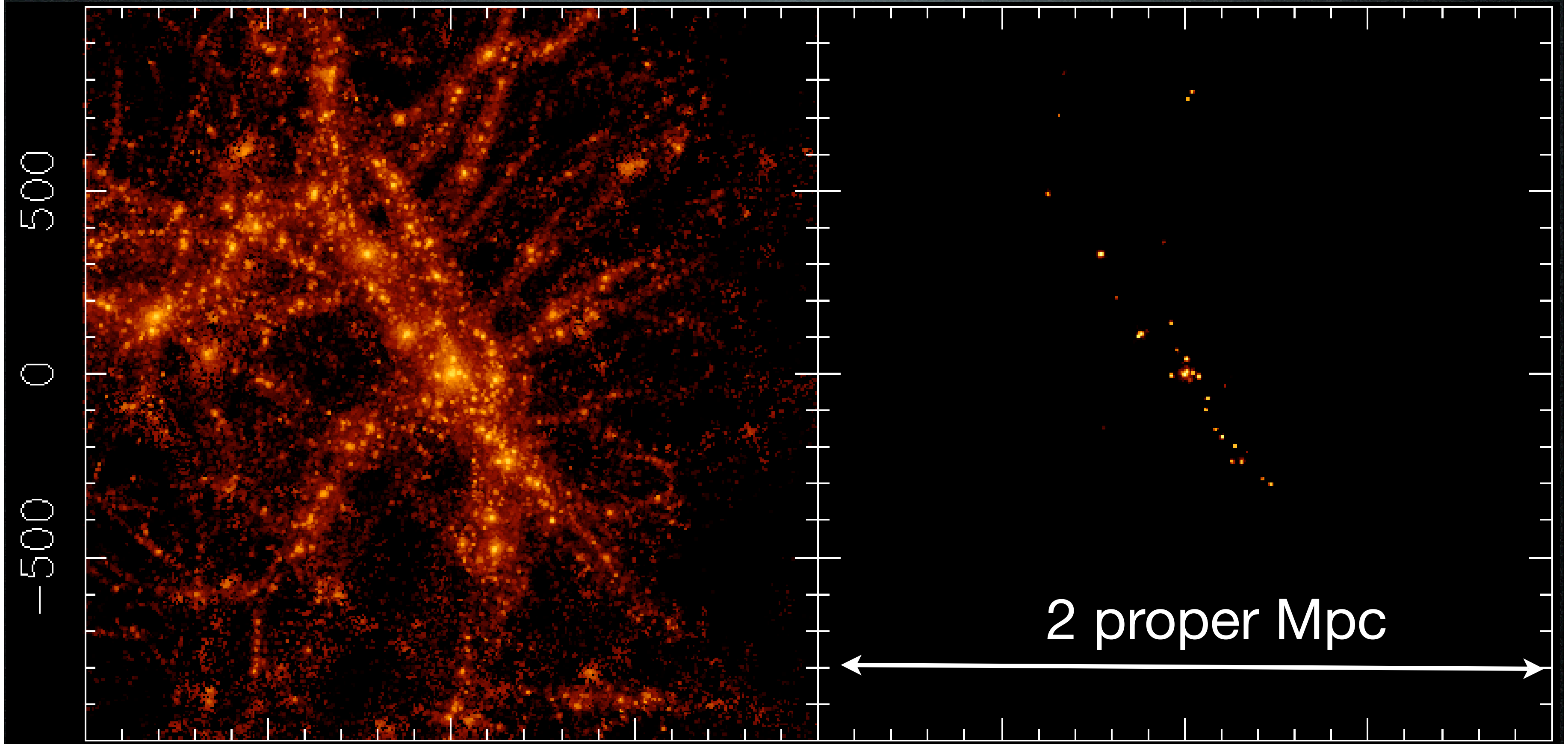
Progenitors of brightest galaxy in a group at z=0?



$M_{vir}(z=2.34) = 1 \times 10^{12} M_{\odot}$

$M_{vir}(z=0) = 8 \times 10^{12} M_{\odot}$

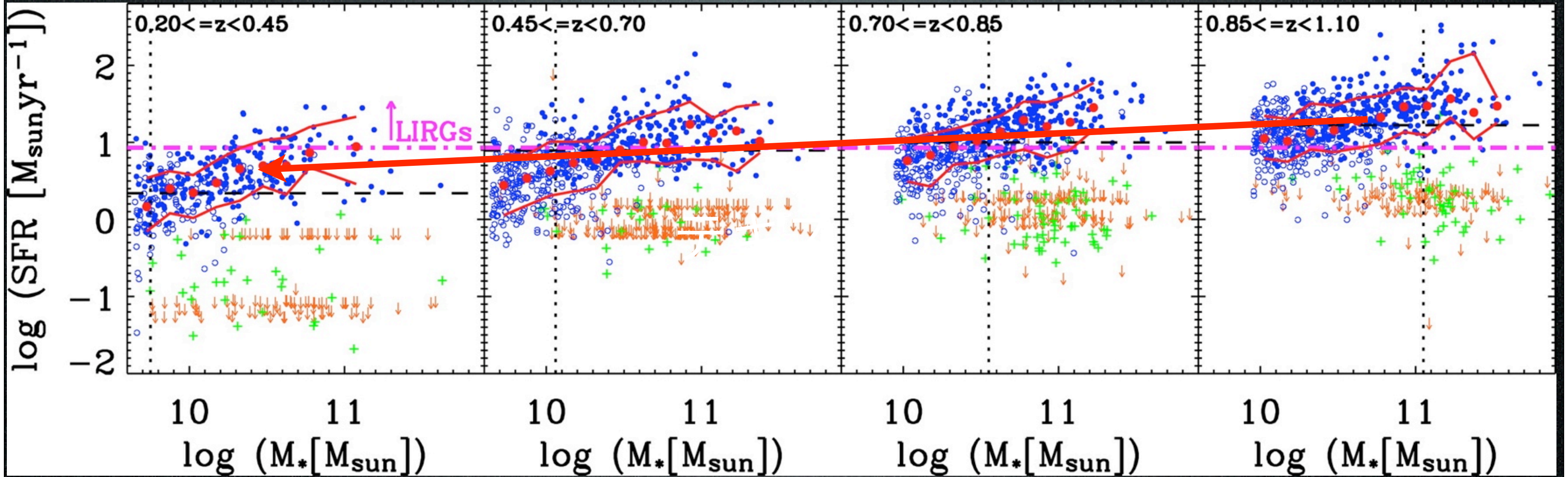
Progenitors at z=2.34 of brightest galaxy in a group?



DM progenitor galaxies

z=0~1: SFR vs. Ms

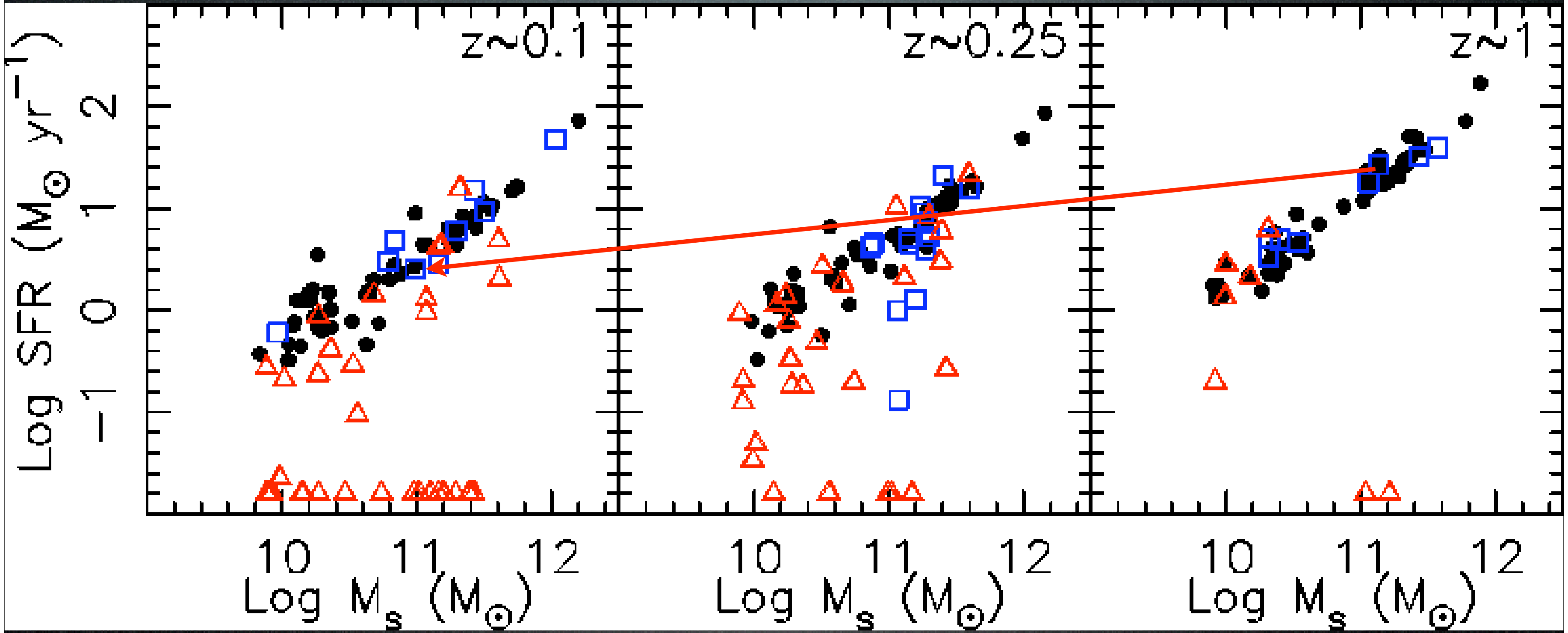
AEGIS: Noeske et al. (07)



Main Sequence of SFR for star-forming galaxies

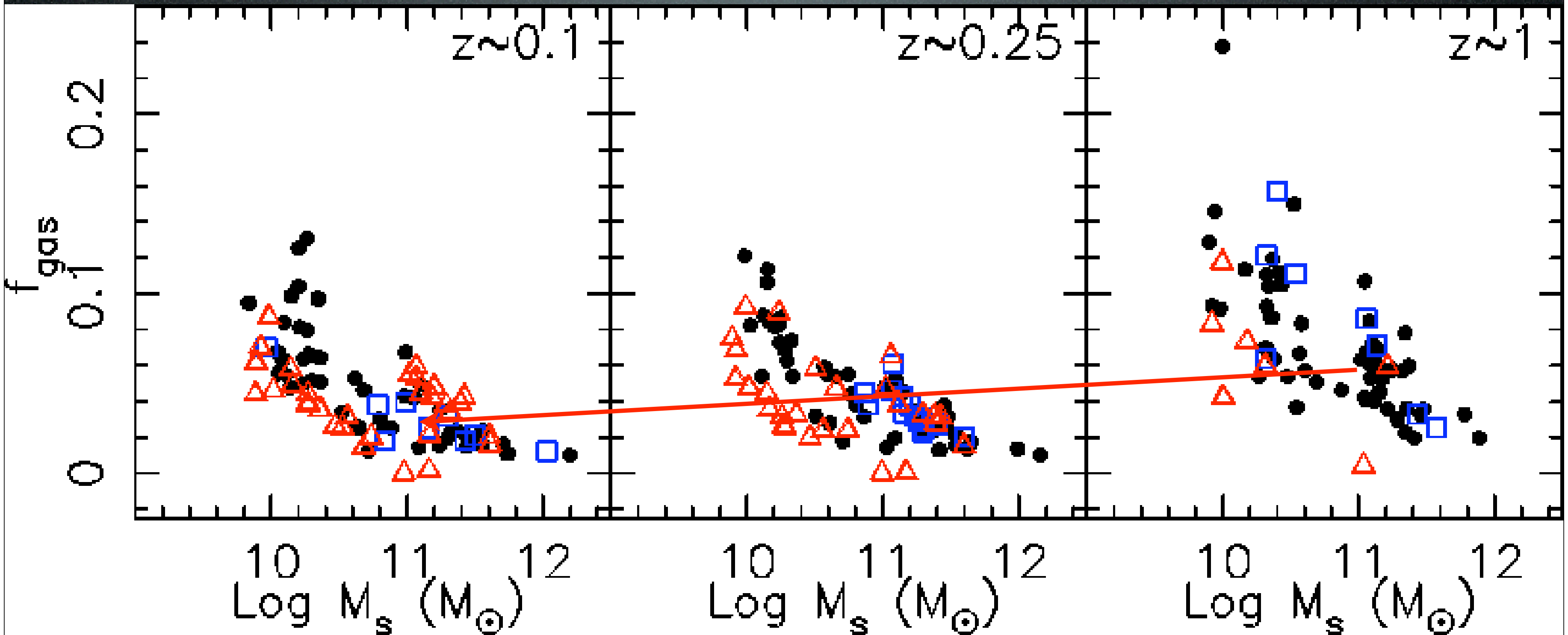
gradual decline in SFR

SFR vs. Ms for simulated galaxies.

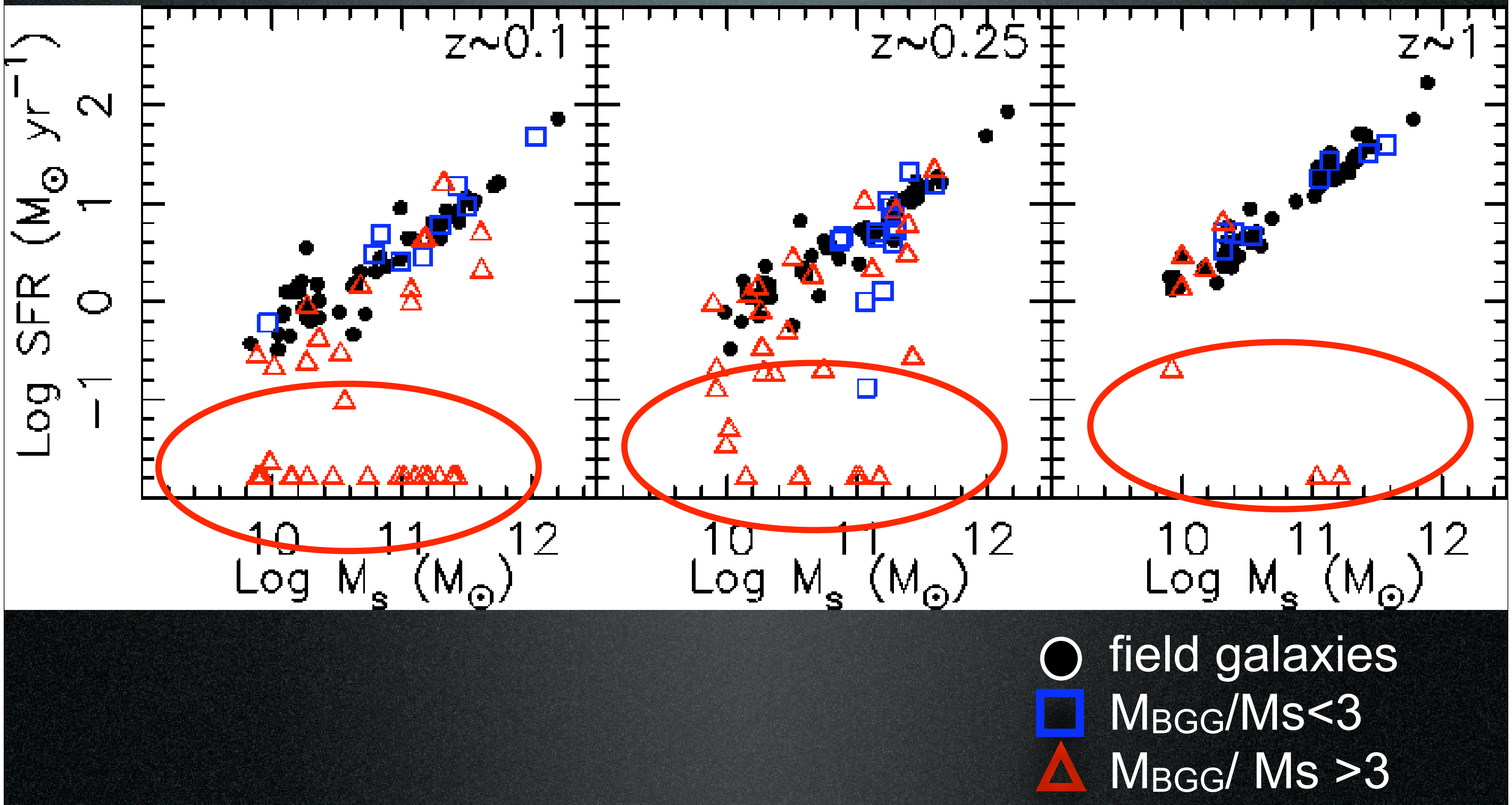


Main Sequence of SFR for star-forming galaxies

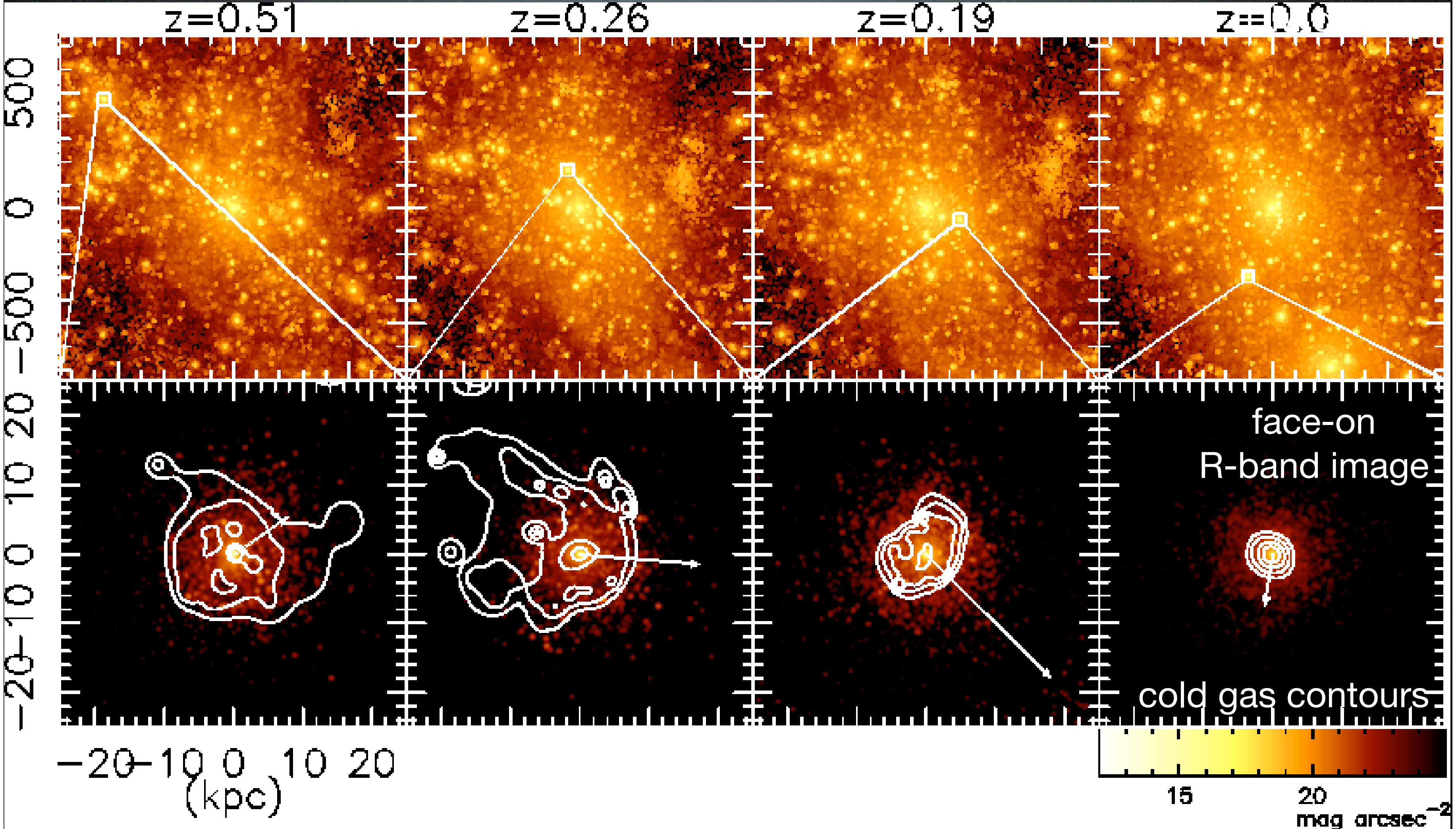
gas fraction decreases with decreasing z
→ decrease in SFR?



SF is suppressed in groups?

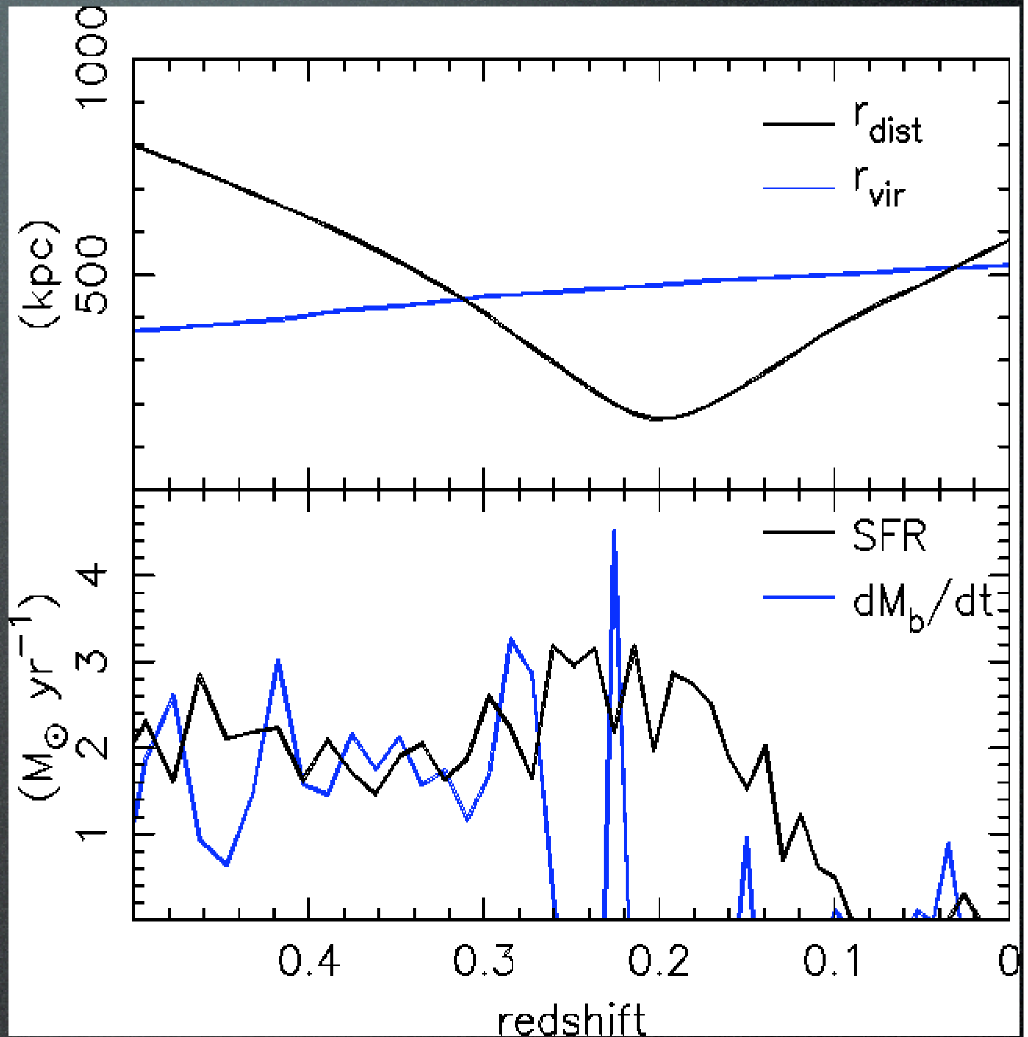


a disk galaxy with Vrot~150 km/s falling into a group with $M_{vir}=8x10^{12}M_\odot$

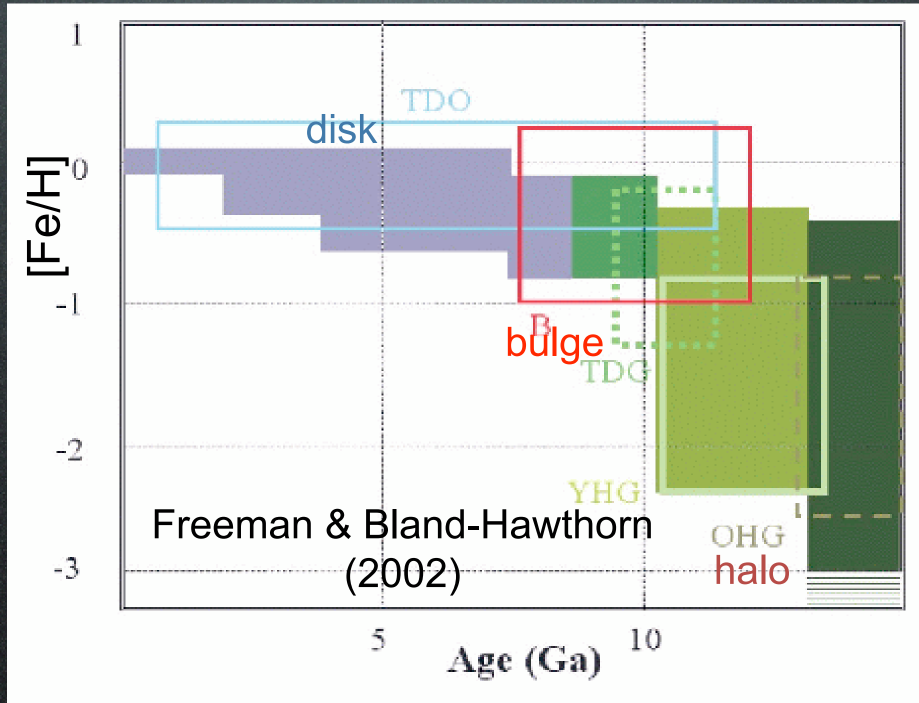


SF stops due to strangulation

- the galaxy falls into the group around z=0.3.
- gas accretion stops around z=0.26.
- SF stops around z=0.1.



z=0: Galactic Archeology



The Milky Way stars = fossils
from the epoch of the Galaxy formation

RAVE, SEGUE and GAIA

6D phase space information and chemical composition for more than 1 billion stars

MSSL/UCL is building "RVS" for GAIA!

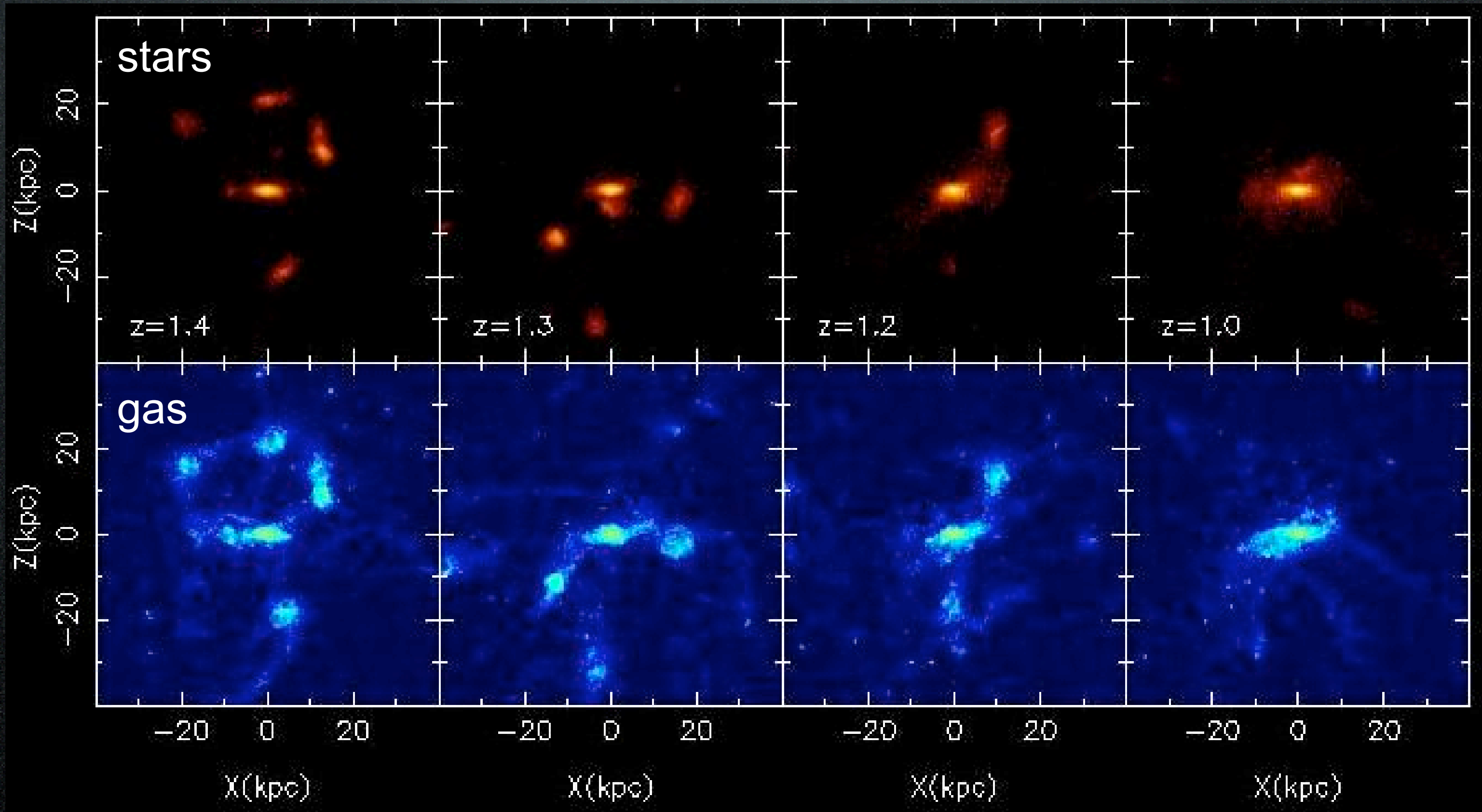
To extract useful information from such massive data set, theoretical hypotheses and predictions are crucial!

Ready for GAIA!
the virtual Milky Way project
(2012-)

- high resolution (~10^4 $M_\odot$) simulations of the MW analogue with different formation histories.
- generate virtual GAIA data.
- how the current stellar phase space and chemical distribution reflects the formation histories?
  ⇒ reconstruct the formation history.

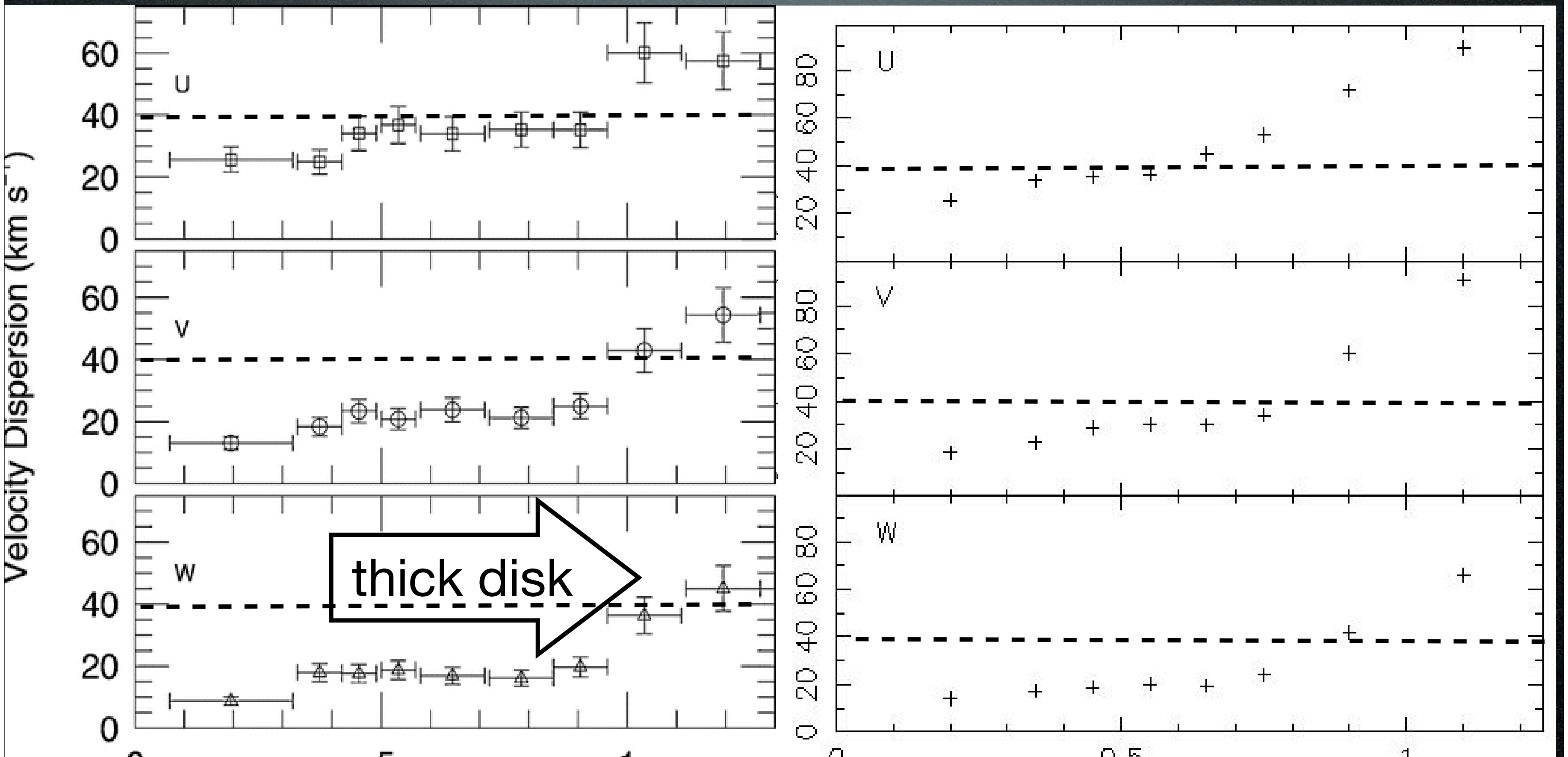
Thick disk formation

(Brook, DK et al. 04,05)



thick disk←high angular momentum gas
during multiple mergers of building blocks at z>1
before the formation of thin disk.

A hierarchical clustering scenario naturally produces a thick disk due to a violent accretion of the gas at $z>1$.



Freeman & Bland-Hawthorn (2002)

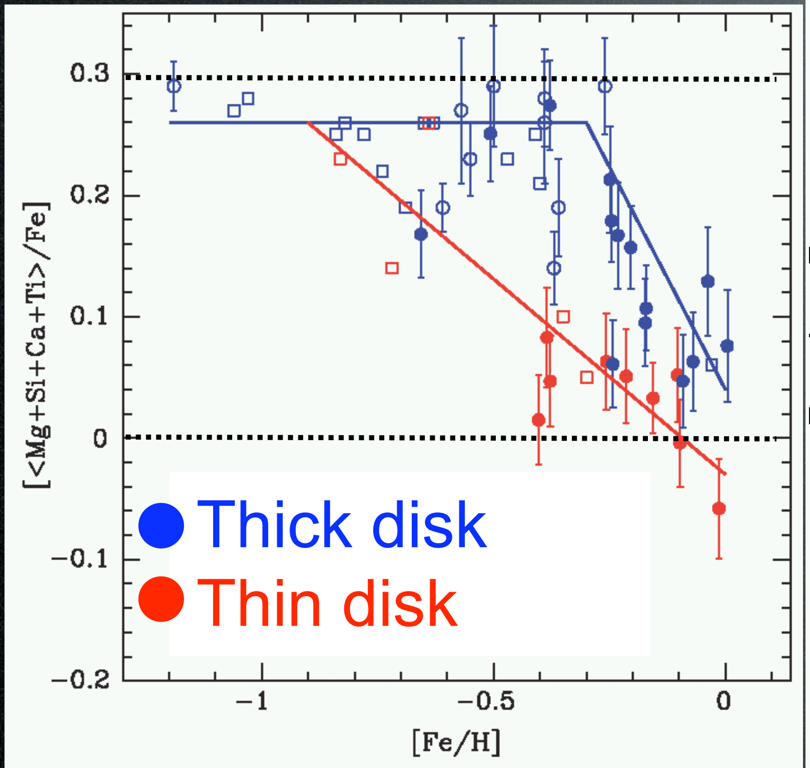
Observation

Simulation

[α/Fe] vs. [Fe/H] @ solar neighborhood

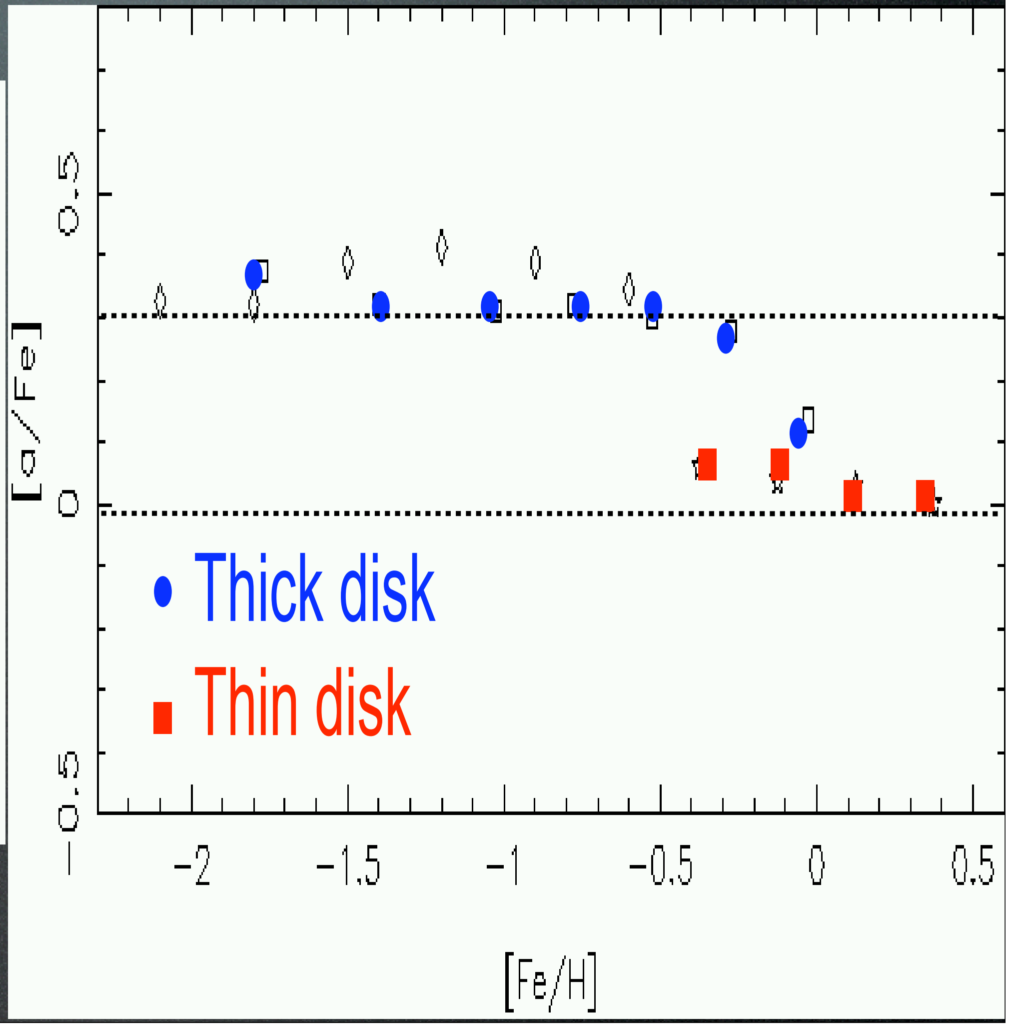
(Brook, ..., DK 05)

Observation



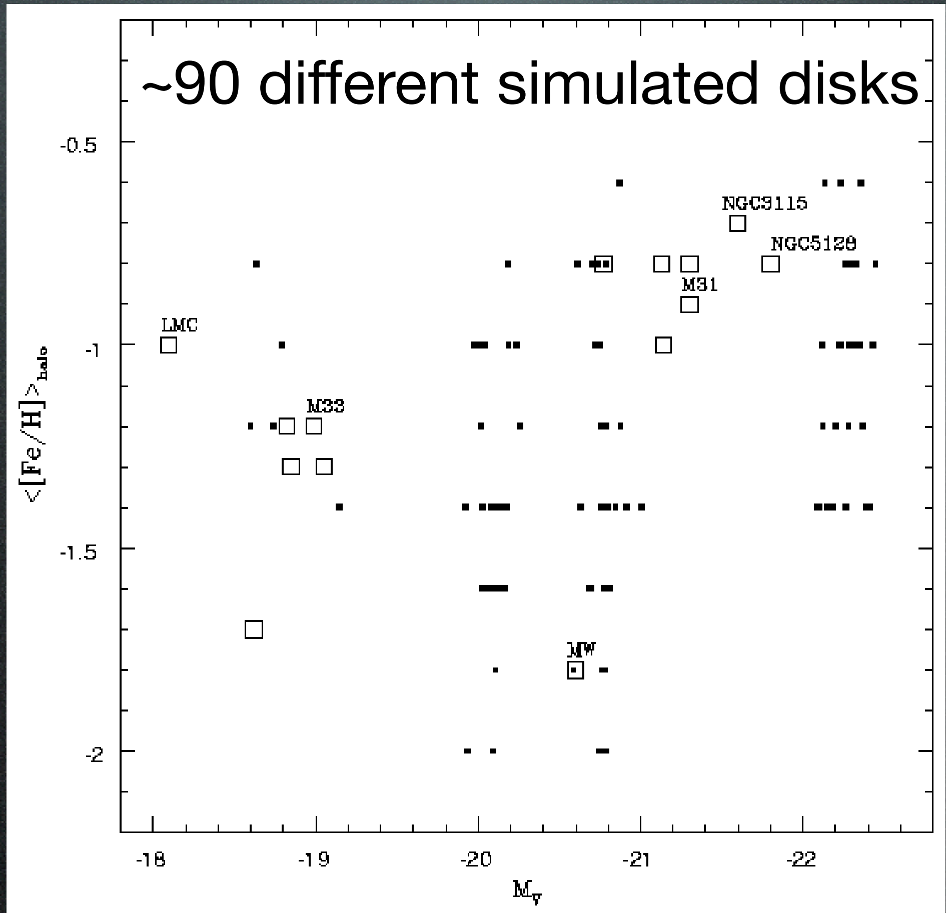
Brewer & Carney (04)

Simulation

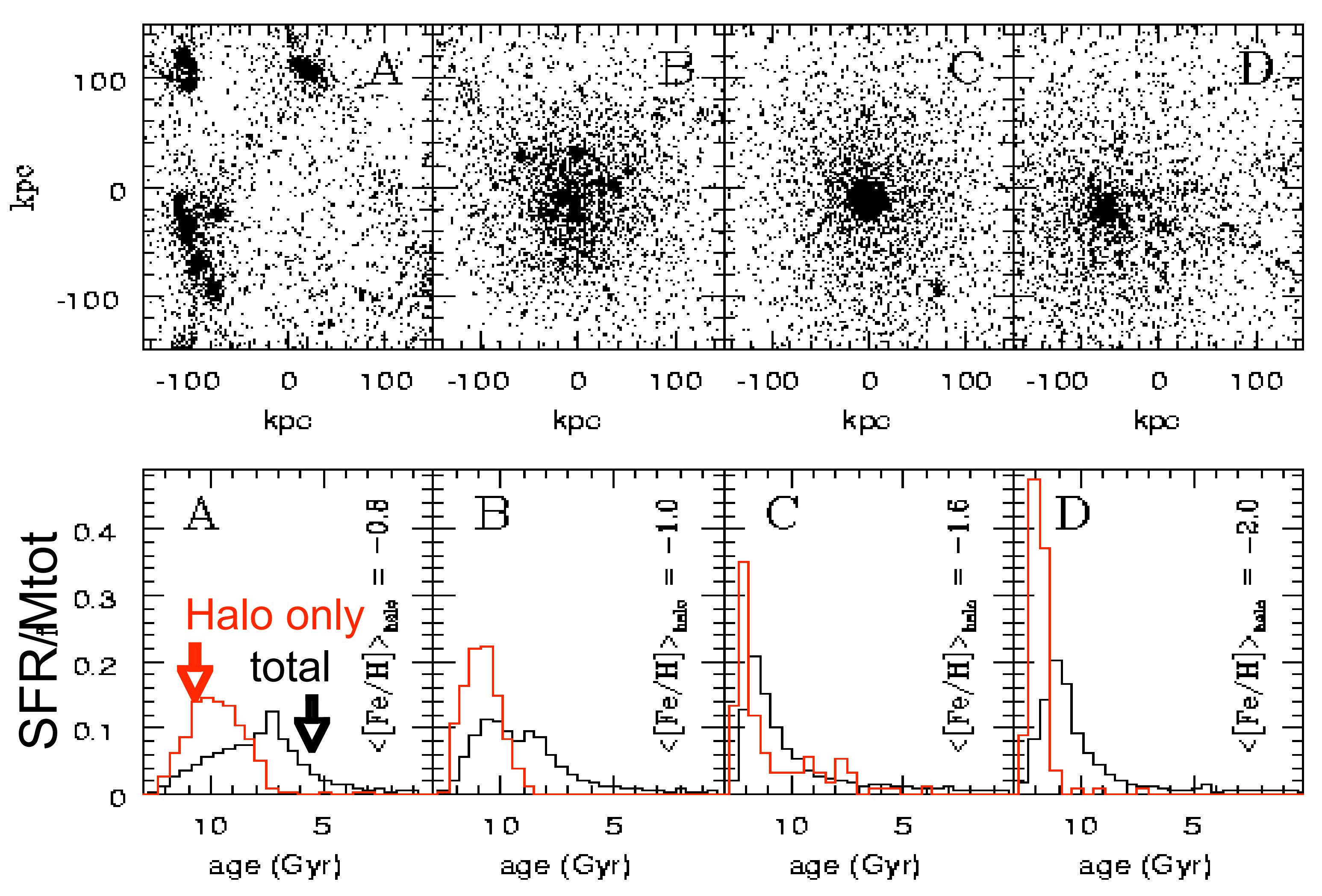


Stellar halo formation

(Renda ... DK et al. 2005)



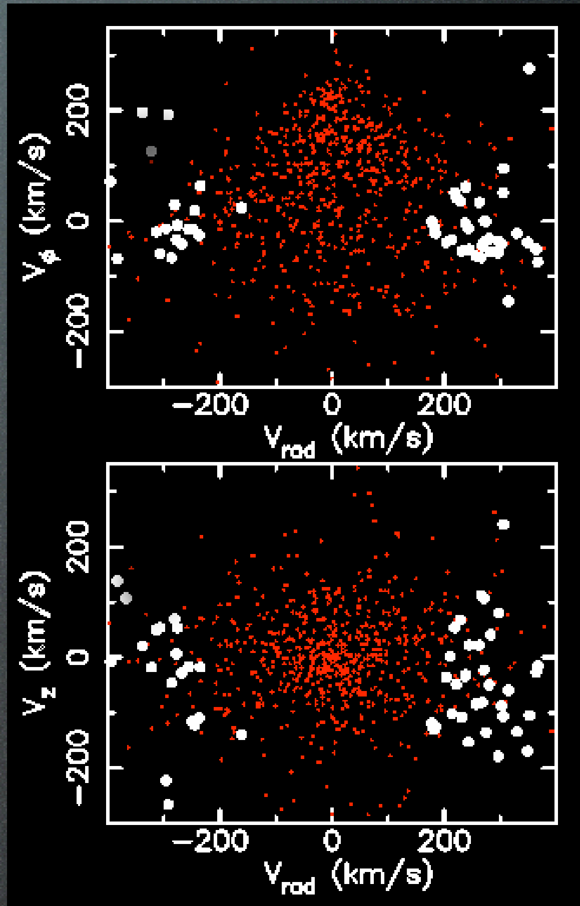
More extended merger history → more metal rich halo



chemical tagging of Galactic streams

w/Ivans (OCIW), Brook, Mottini (UW)

- high reso, high S/N spectra of stream stars.
- any difference in chemical composition from field stars?
- LCO and APO time!



Brook, DK et al. (2003)