MaGICC Dwarfs
the edge of galaxy formation

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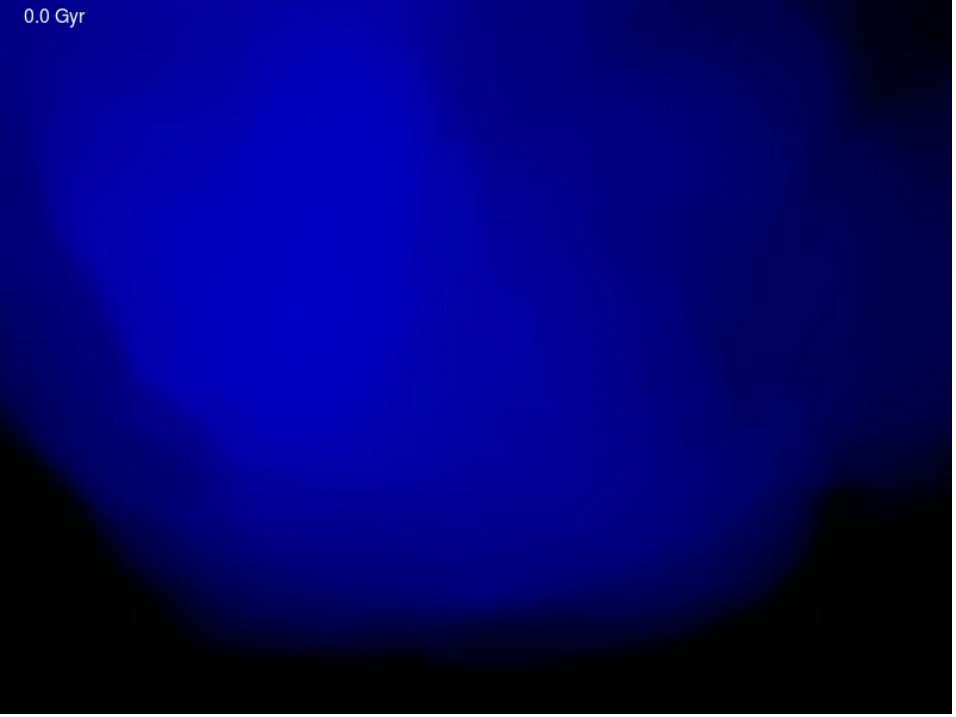
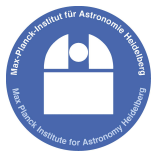
G. Stinson, R. Kannan, A. Dutton, C.Penzo,
L. Wang, X. Kang, C. Brook, A. Di Cintio

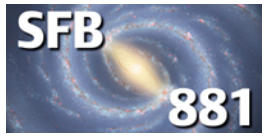
Potsdam – August 26th 2014



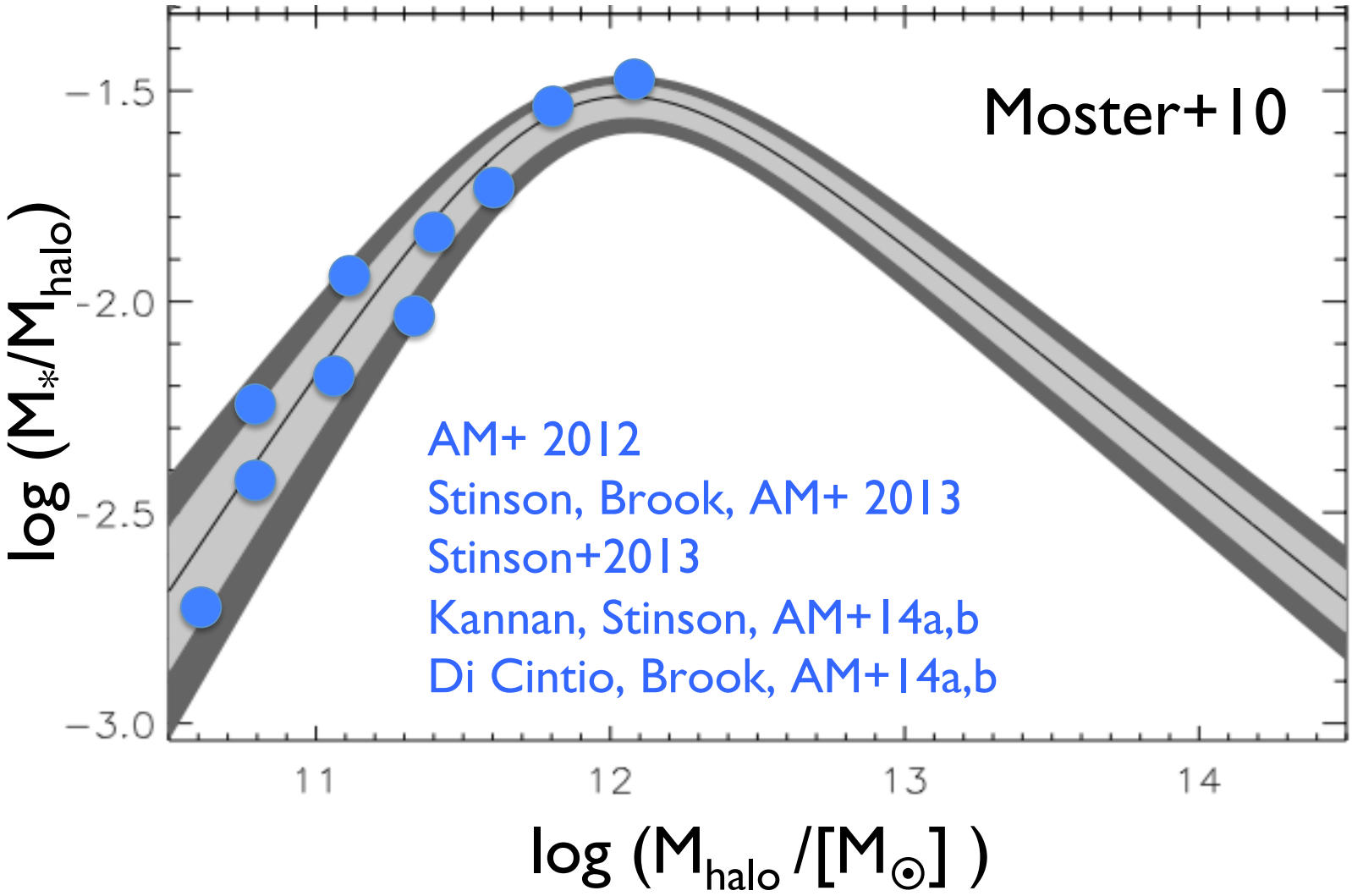
Nihao simulations
MaGICC project

Authors: *A.V. Macciò, G. Stinson et al.*
Code: *Gasoline2.0*





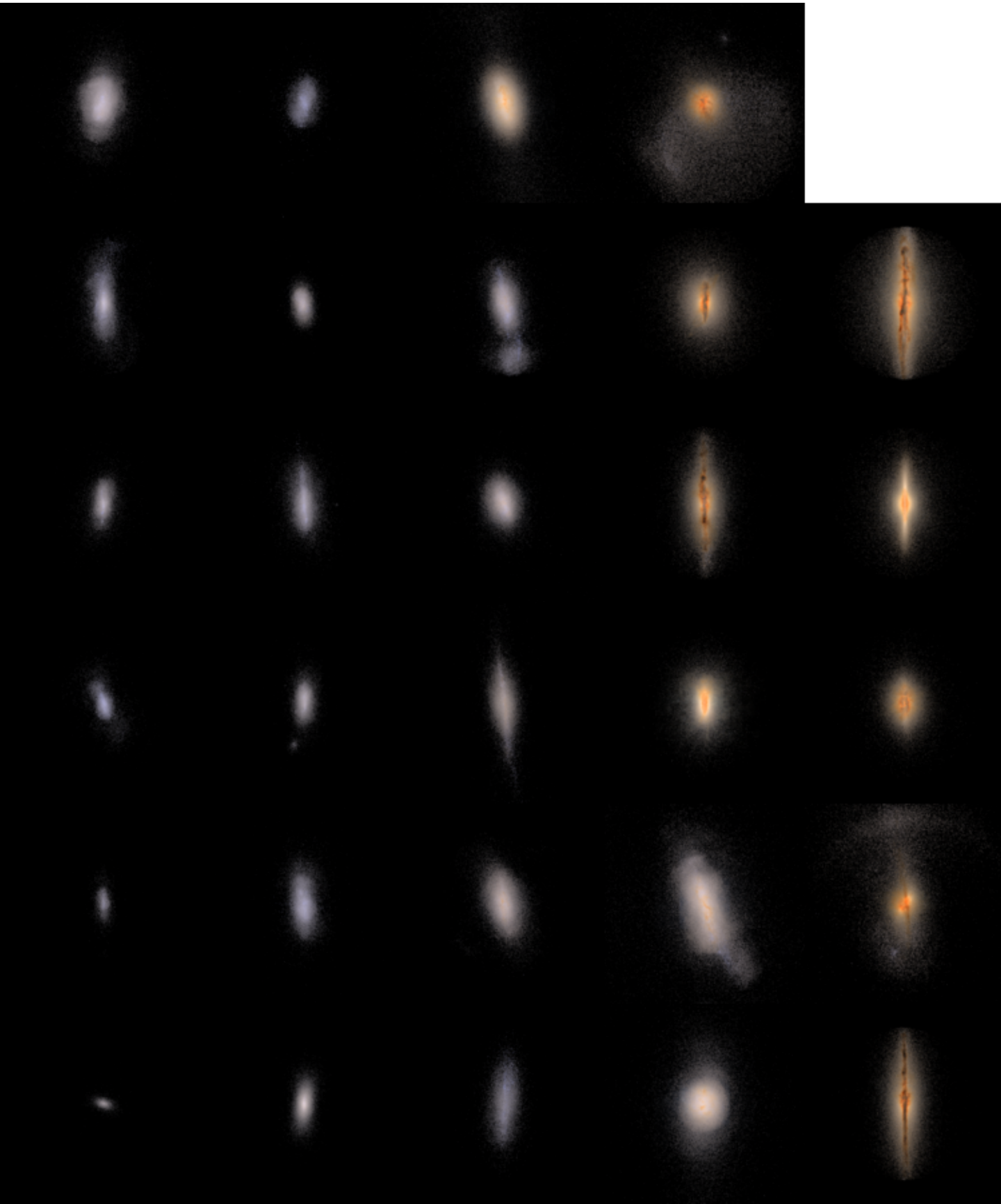
Making Galaxies in a Cosmological Context MaGICC



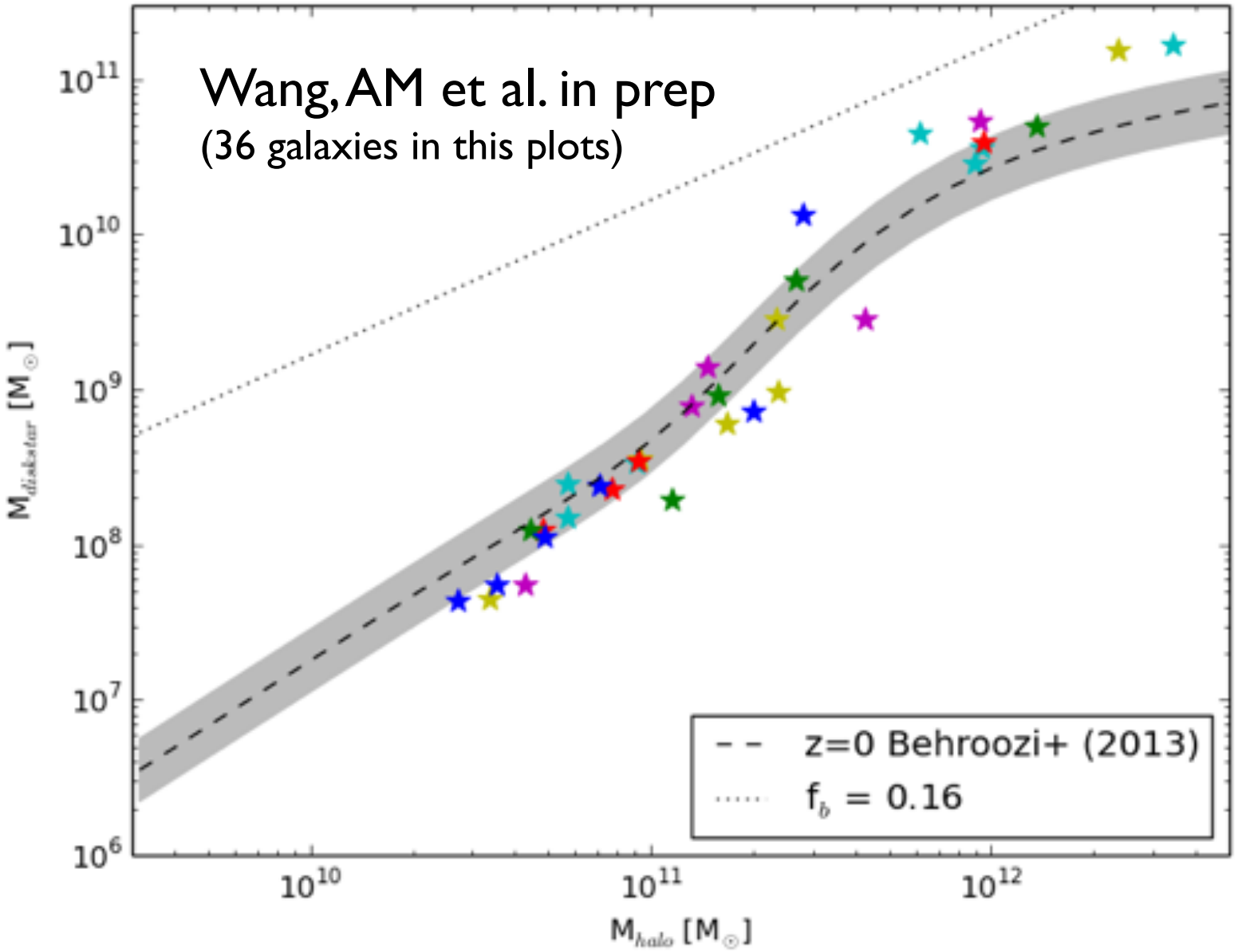
The *Nihao* project

- Same physics as MaGICC
- Gasoline 2.0 (with SPH fix)
- Planck Cosmology
- ***100 high resolution (zoomed) galaxies***
- 10^6 gas particle in each halo
- 10^{10} – 10^{12} $M_\odot$ halo mass range
- 10 to 100 times better than ILLUSTRIS/EAGLE
- 40 galaxies done – 30 running (on Hydra)
- L. Wang, A. Dutton, G. Stinson, X. Kang (PMO)

The *Nihao* galaxies

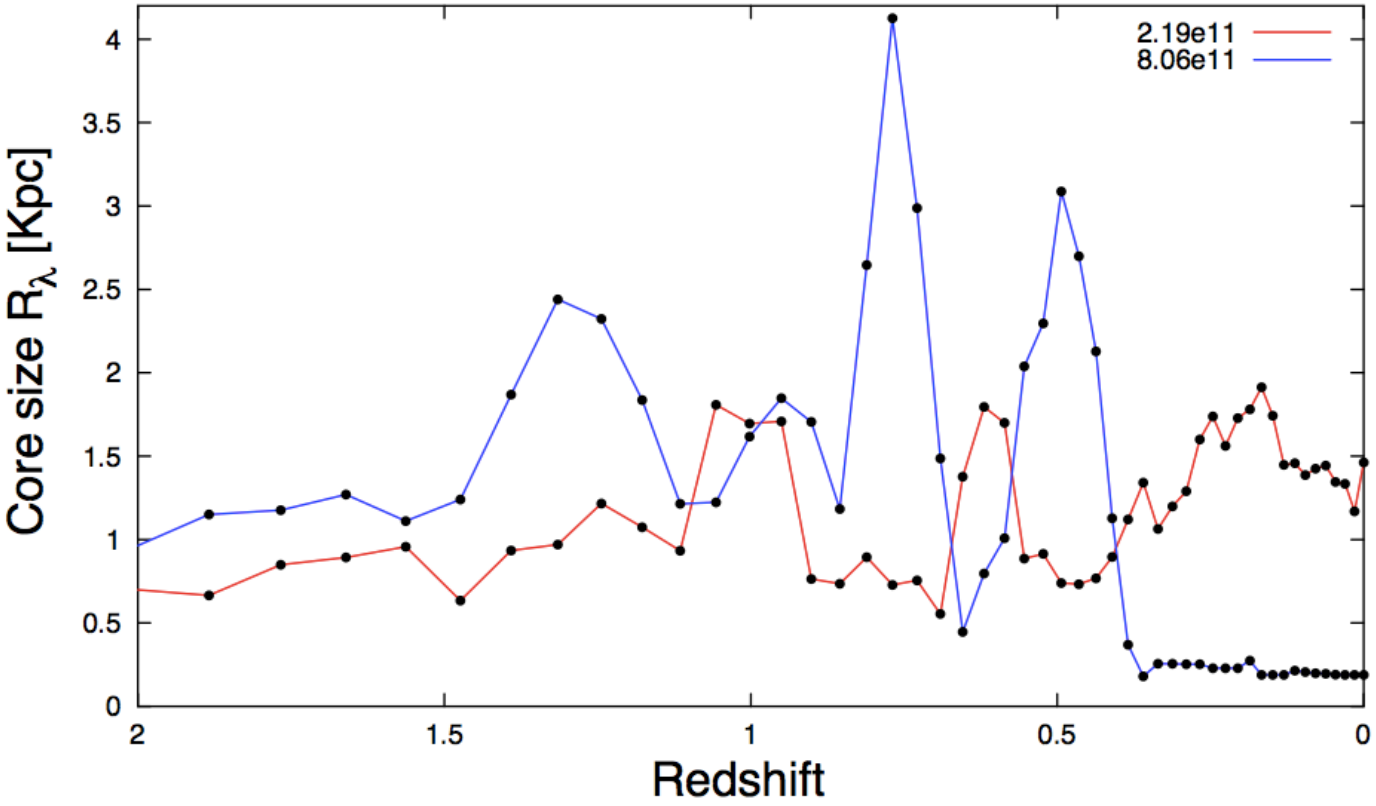


The *Nihao* project



The *Nihao* project

- Core creation and destruction
- Core size evolution with time and Mass
- Central density slope



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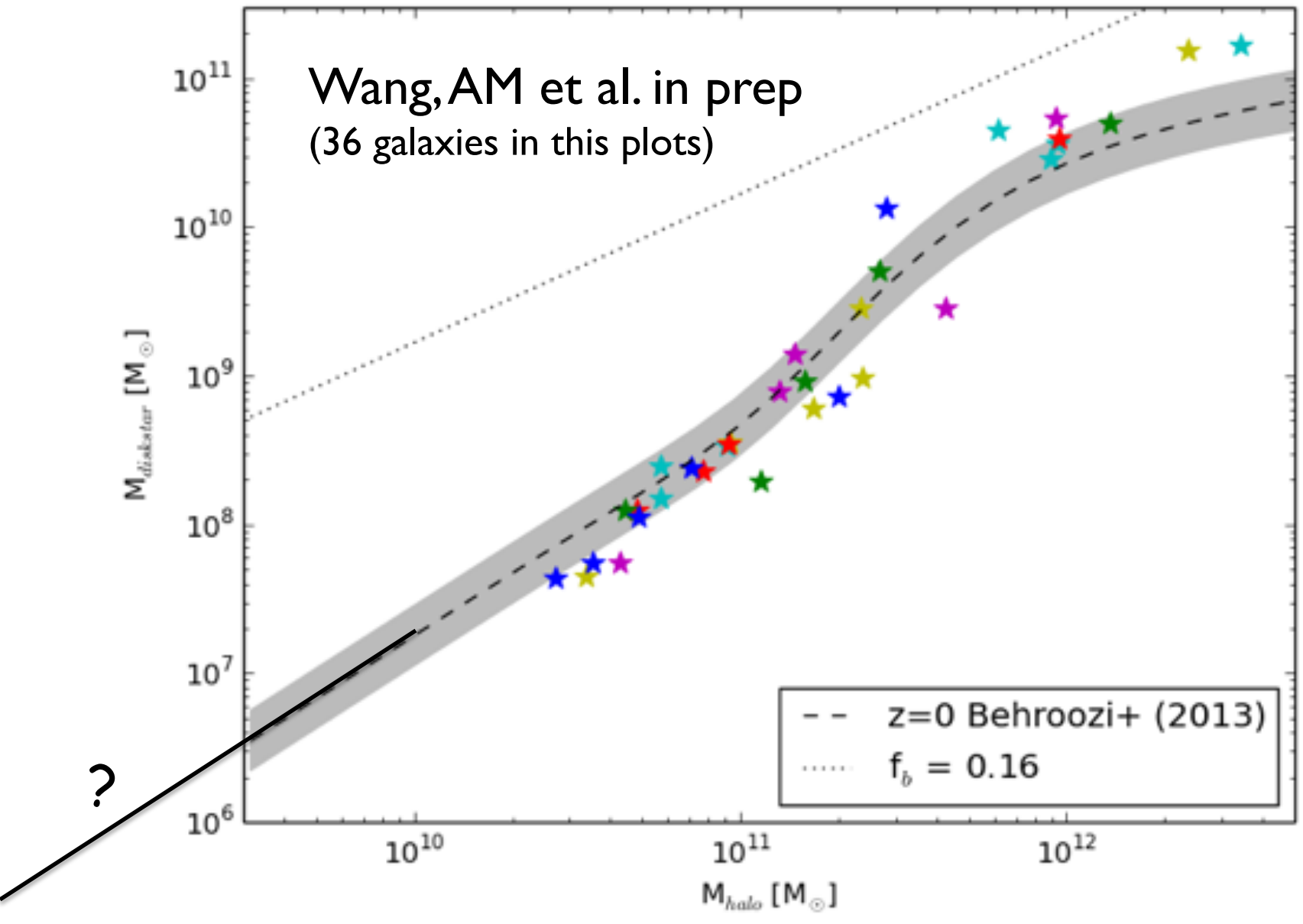
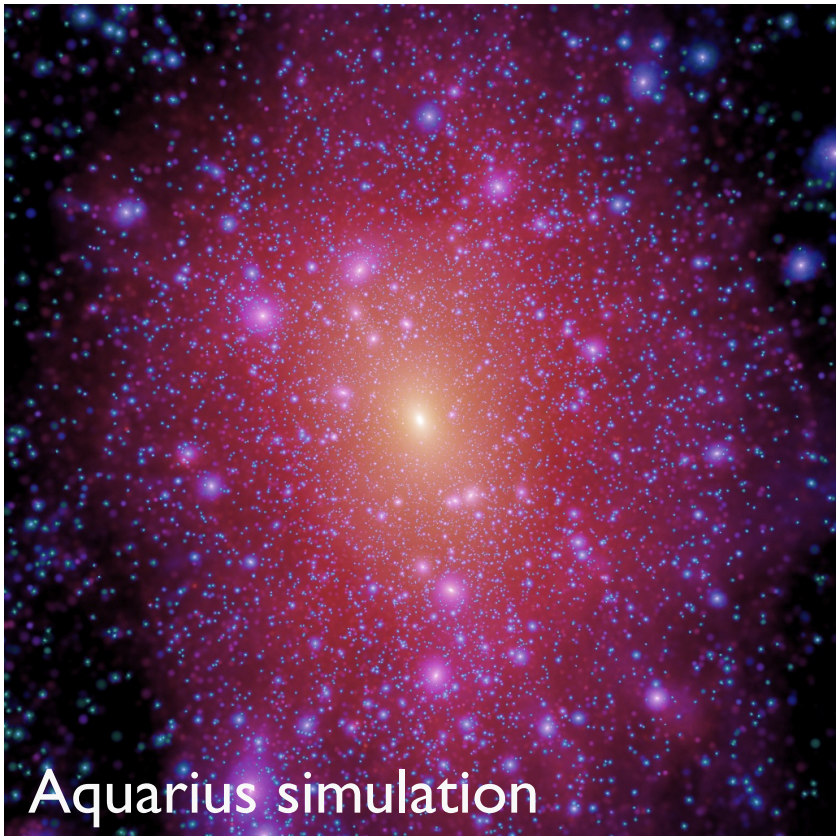
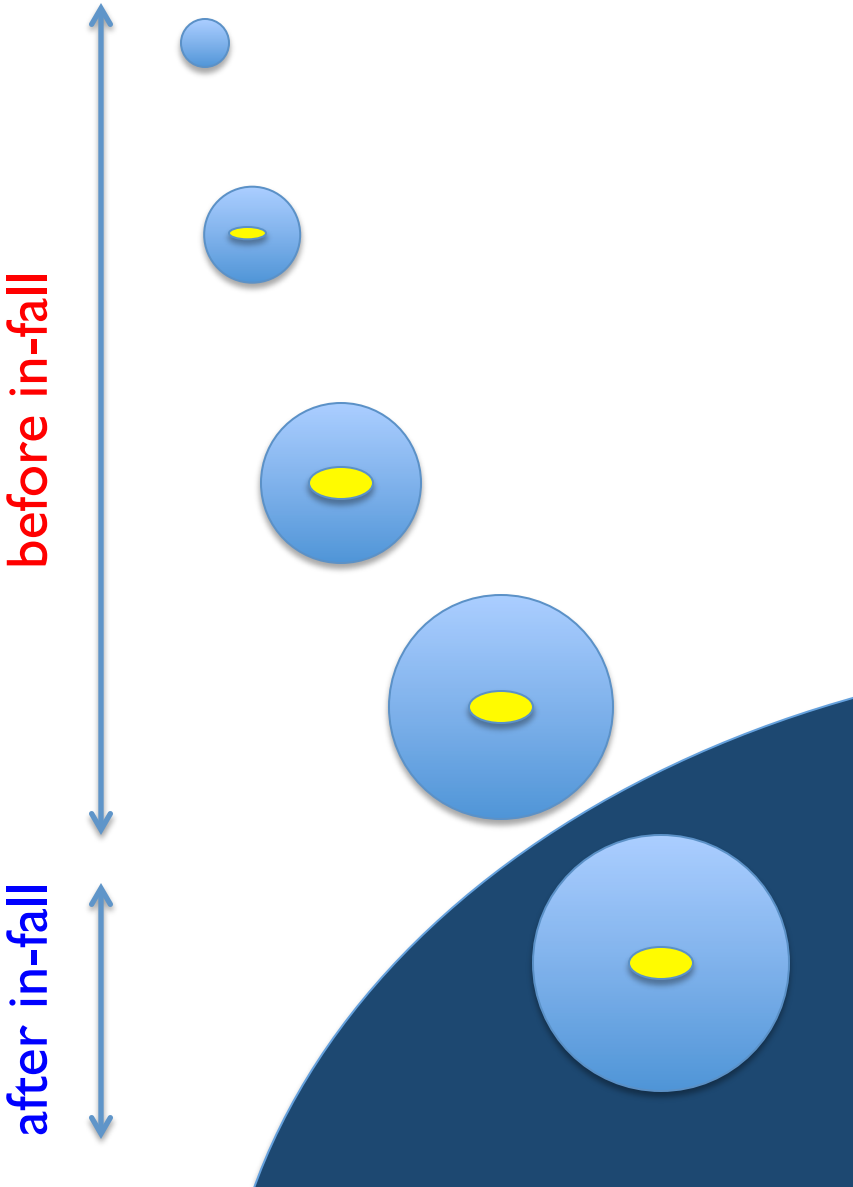


Simulating MW/M31 satellites





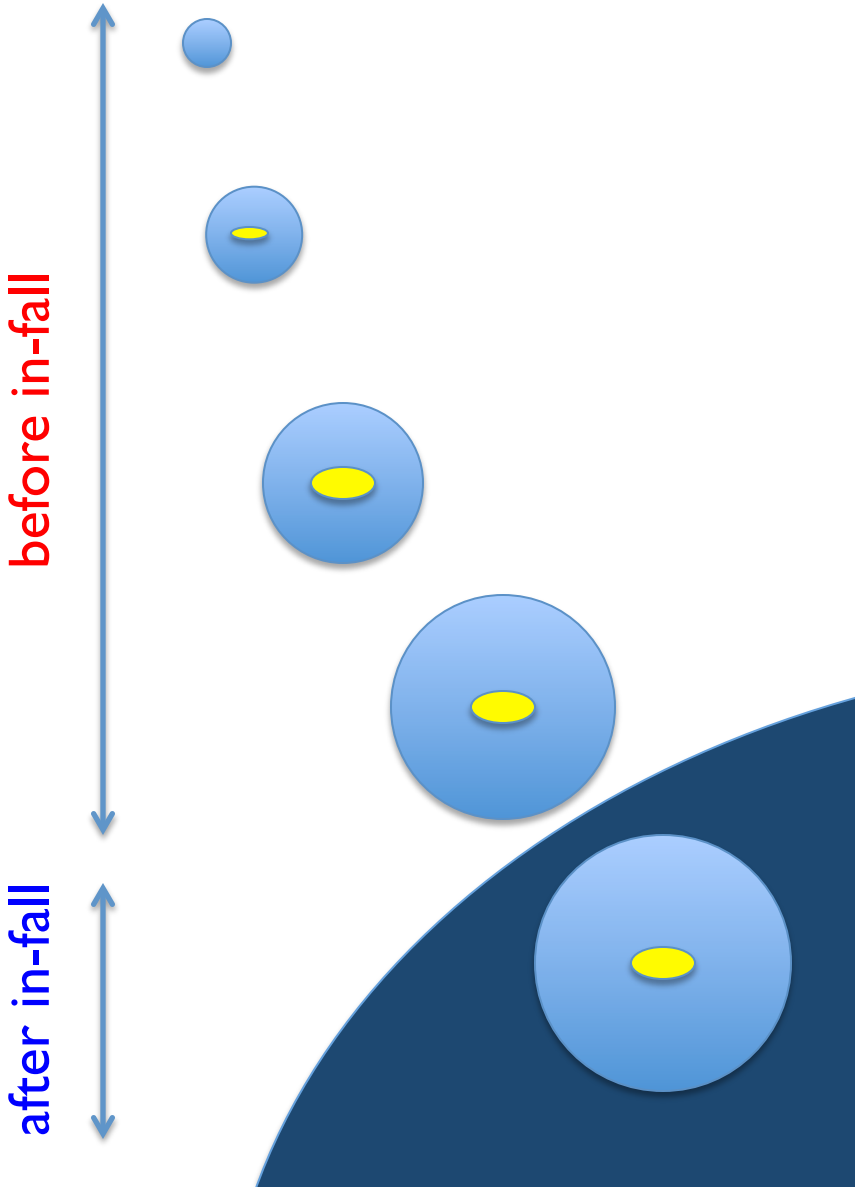
Simulating MW/M31 satellites

Cosmological hydro simulation
MaGICC-like feedback and SF
Stop the simulation at z_{infall} (~1)

Effect of baryons
on DM distribution

Immerge the cosmo-sim into
a pre-cooked MW (halo+disc)

Effect of tidal-interaction



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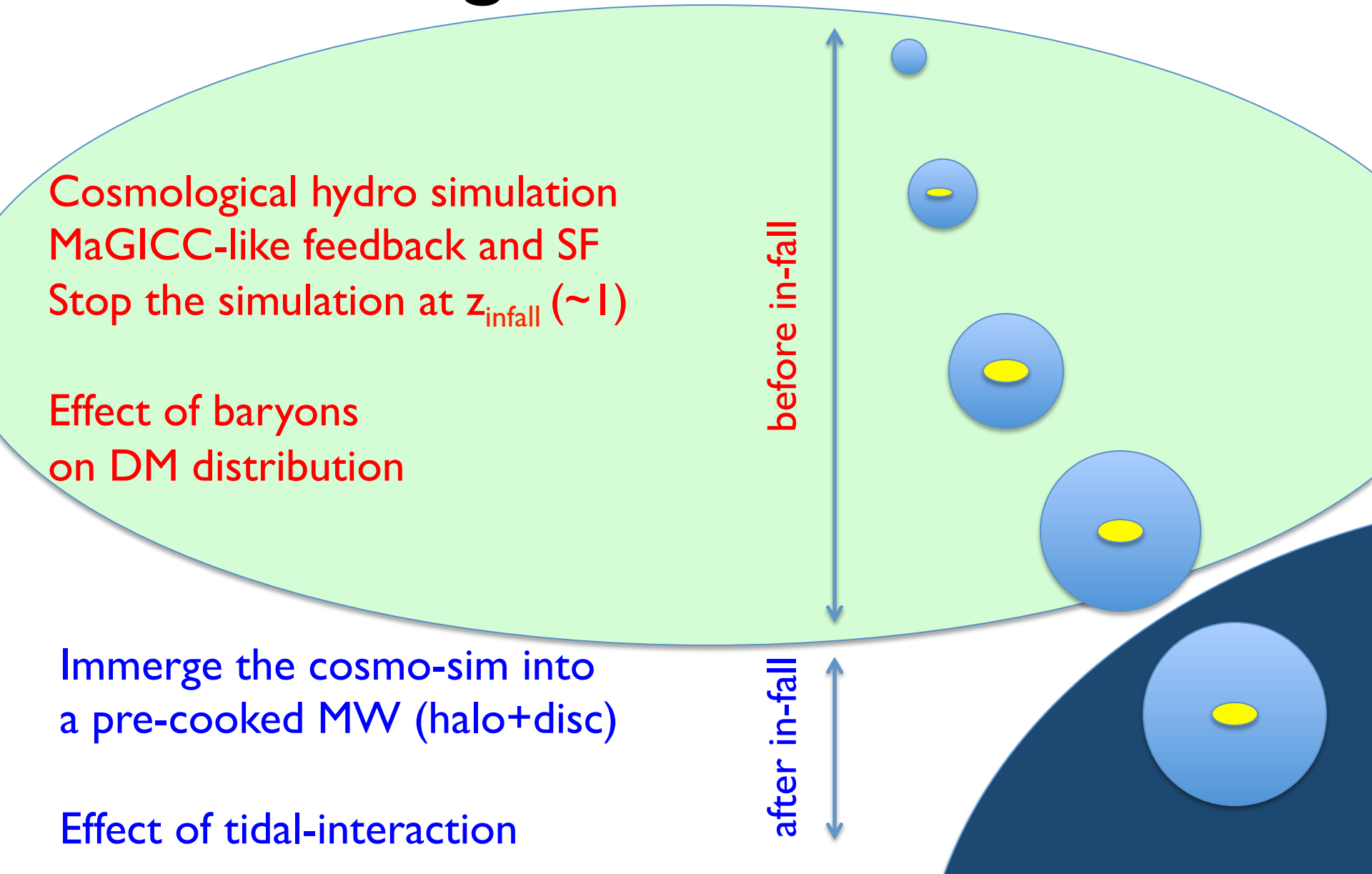

Immerge the cosmo-sim into
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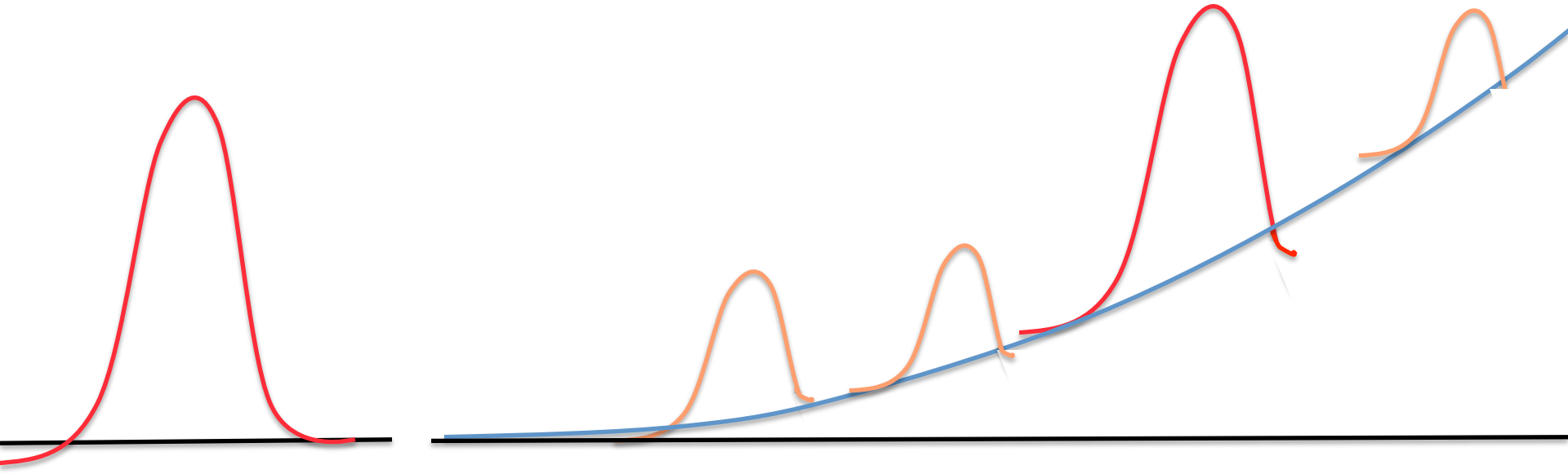
Effect of tidal-interaction

The Initial Conditions



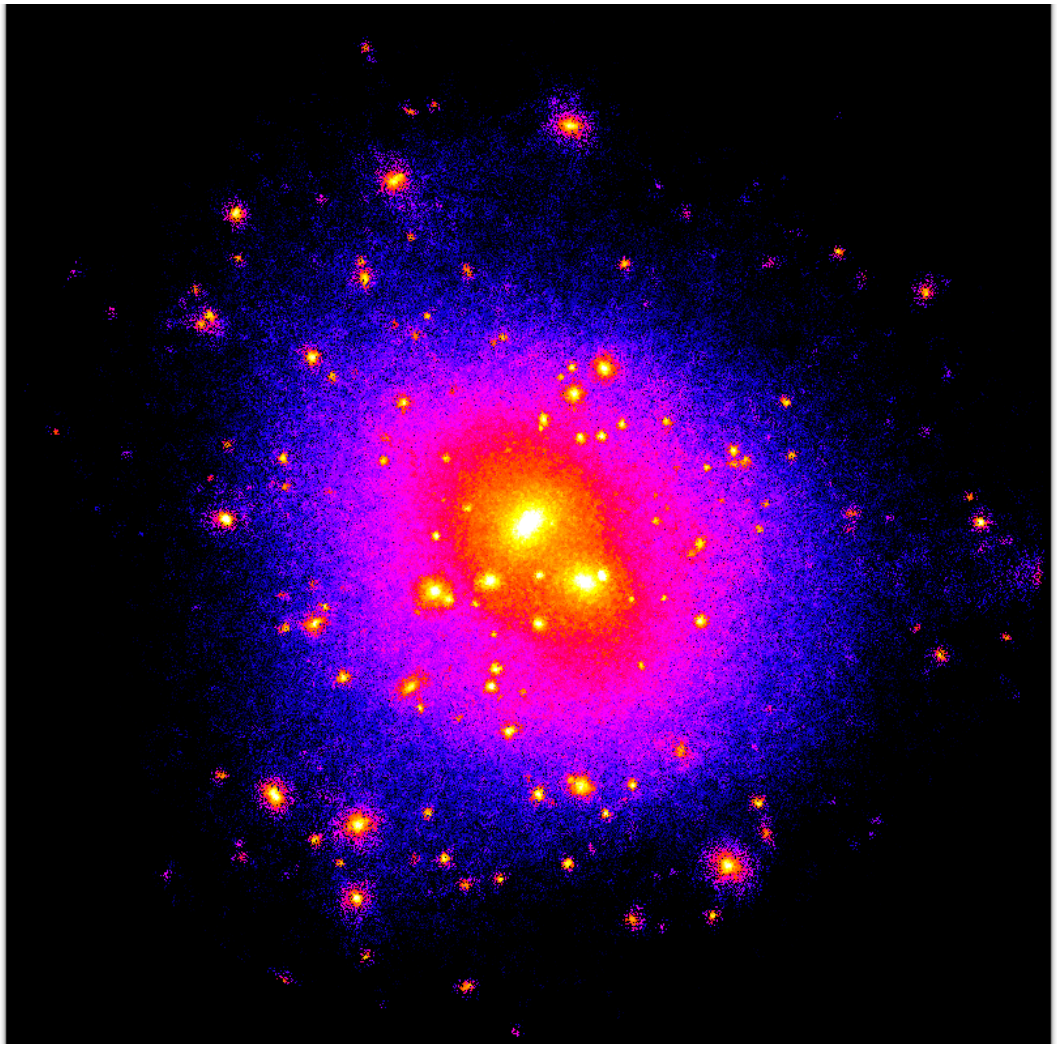
- All haloes end up as satellites of a larger halo (min 50x) by z=1.
- All haloes are in active environments
- No isolated/field haloes

MaGICC satellites

m_{dm}= 700 $M_\odot$
m_{gas} = 200 $M_\odot$
ε = 40 pc

Macciò+14 in prep.

M_{DM}= 5x10^9 $M_\odot$
R_{DM} = 35 kpc
redshift =1



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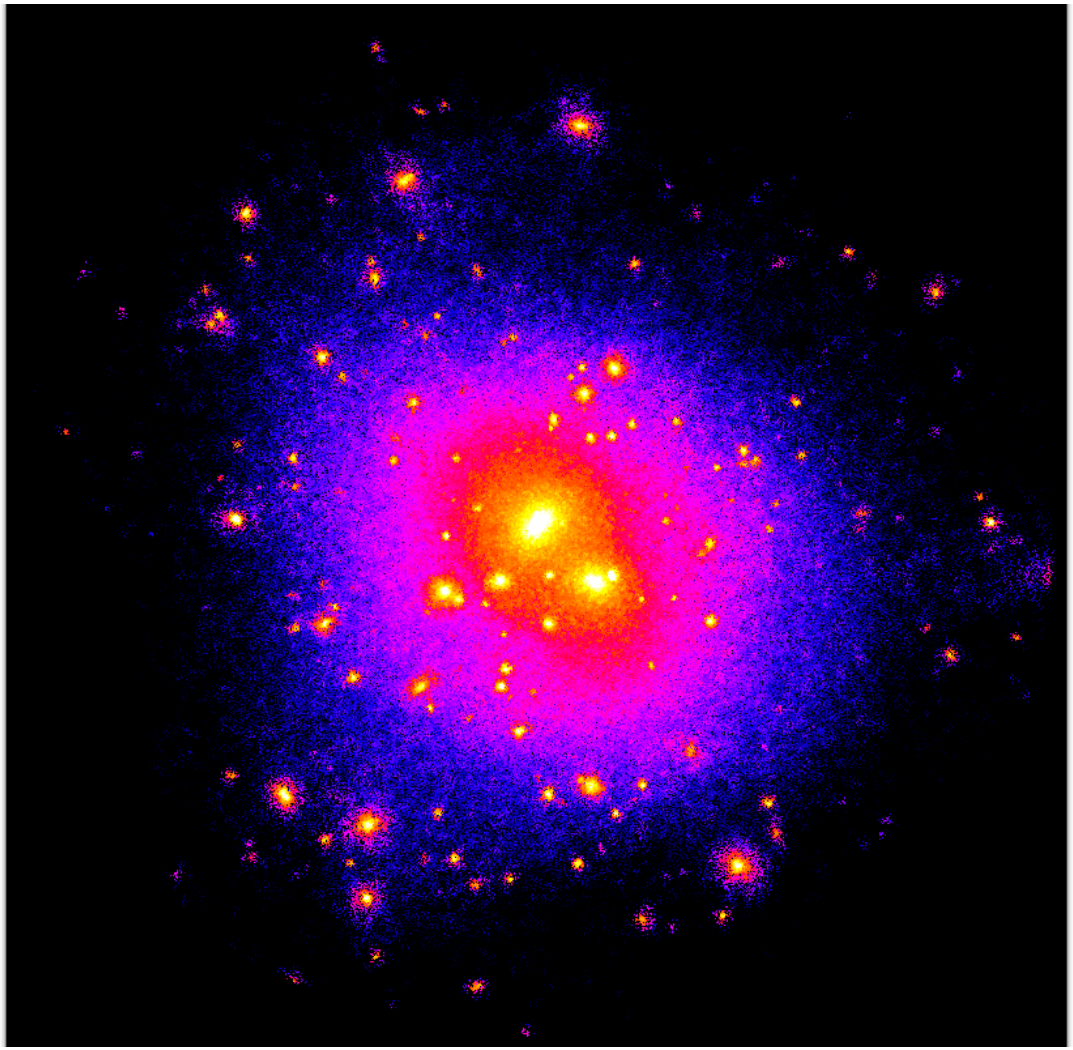
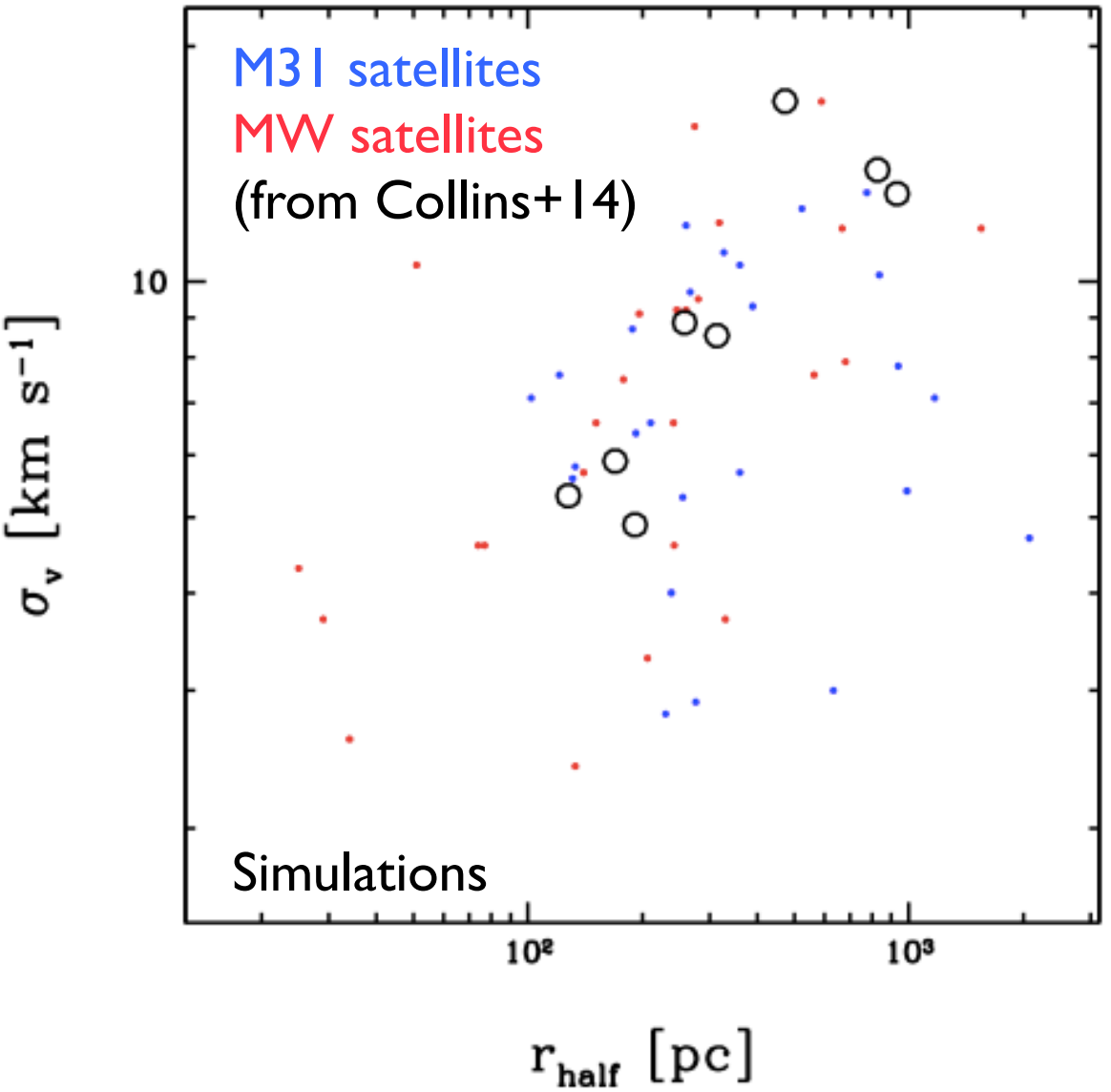
M_{DM}= 5x10^9 $M_\odot$
R_{DM} = 35 kpc
redshift =1
M_*/M_{DM} = 10^{-5}
R_*/R_{DM} < 0.01



MaGICC satellites

12 haloes

9 galaxies
3 dark satellites



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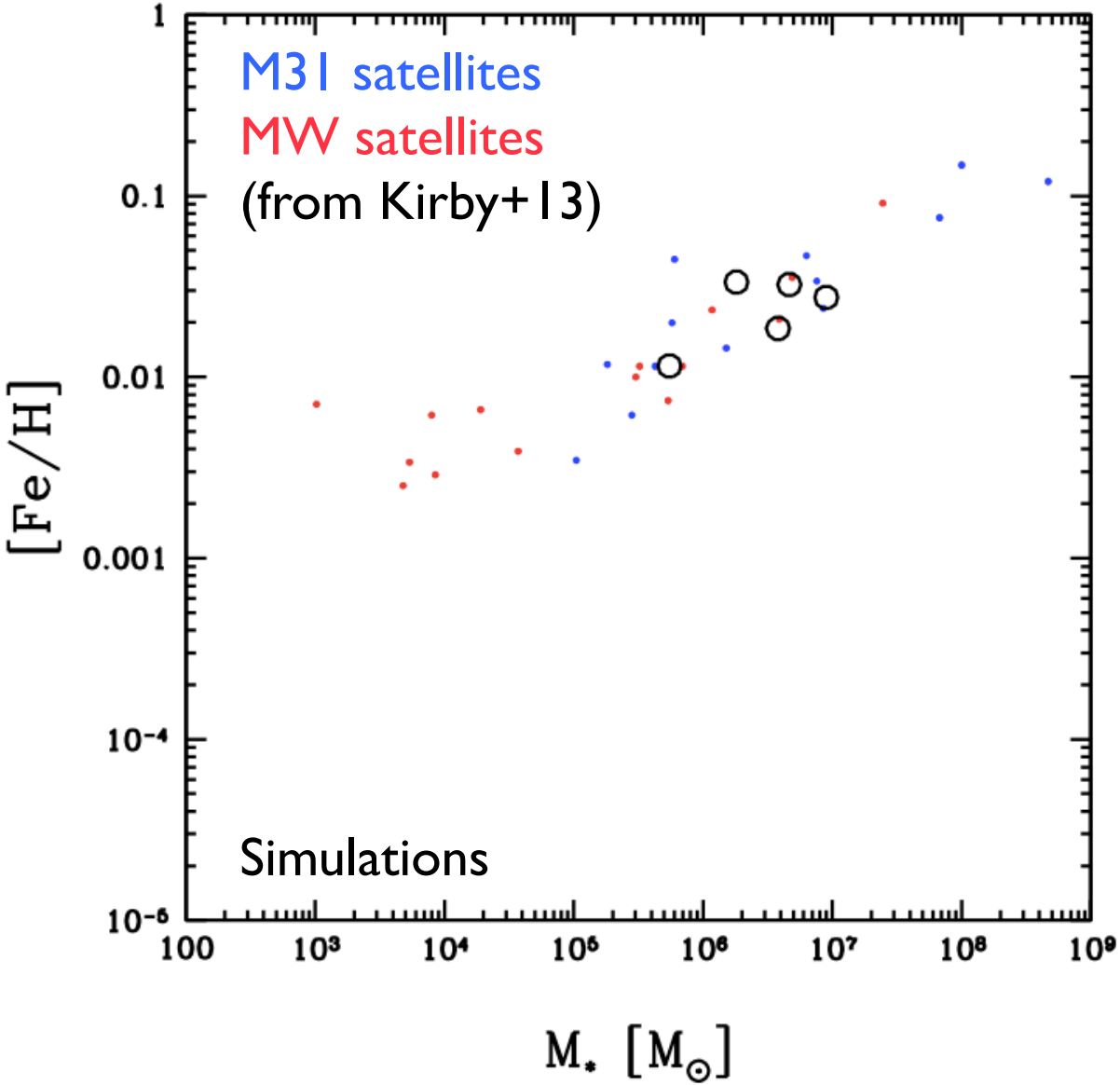
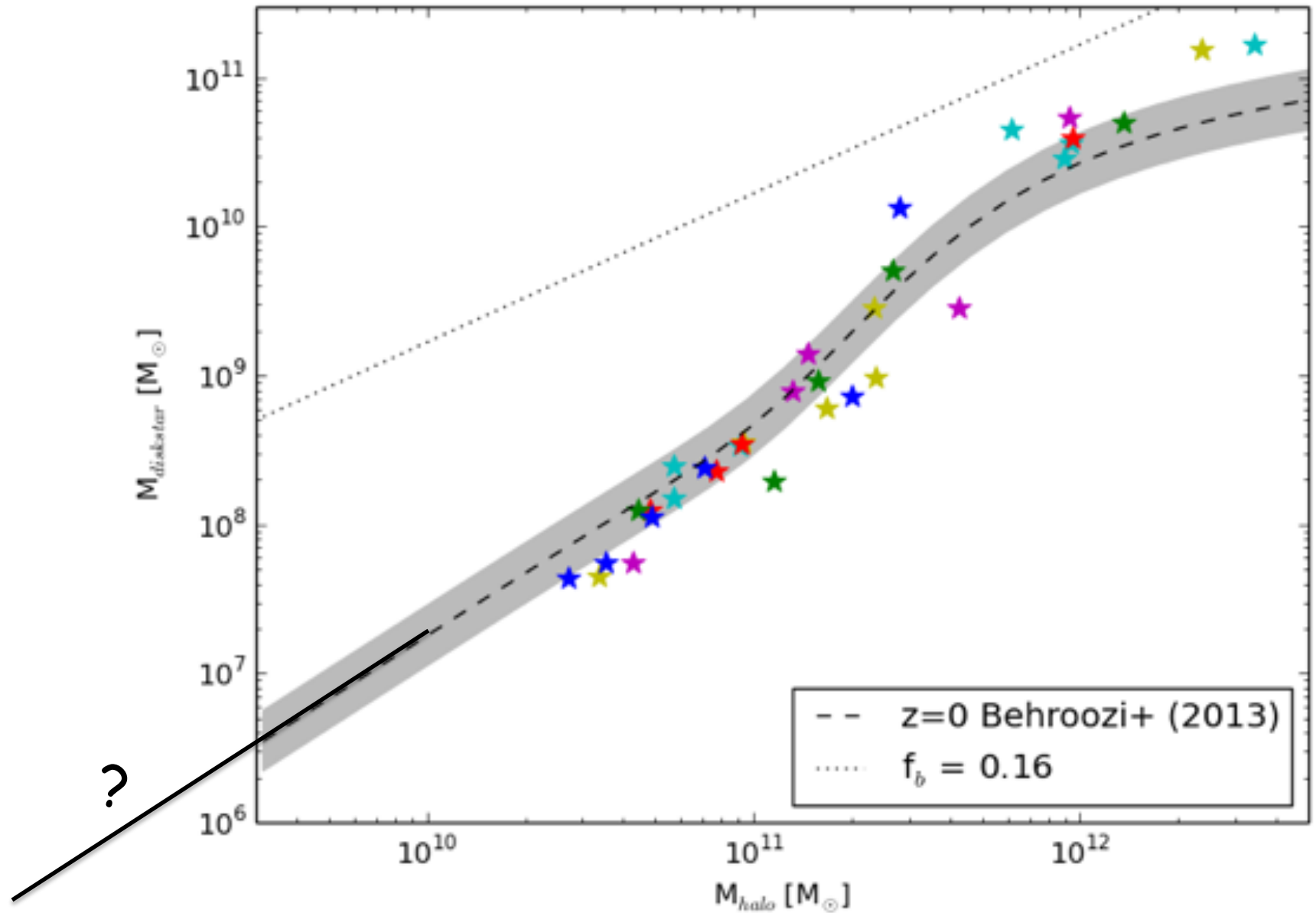
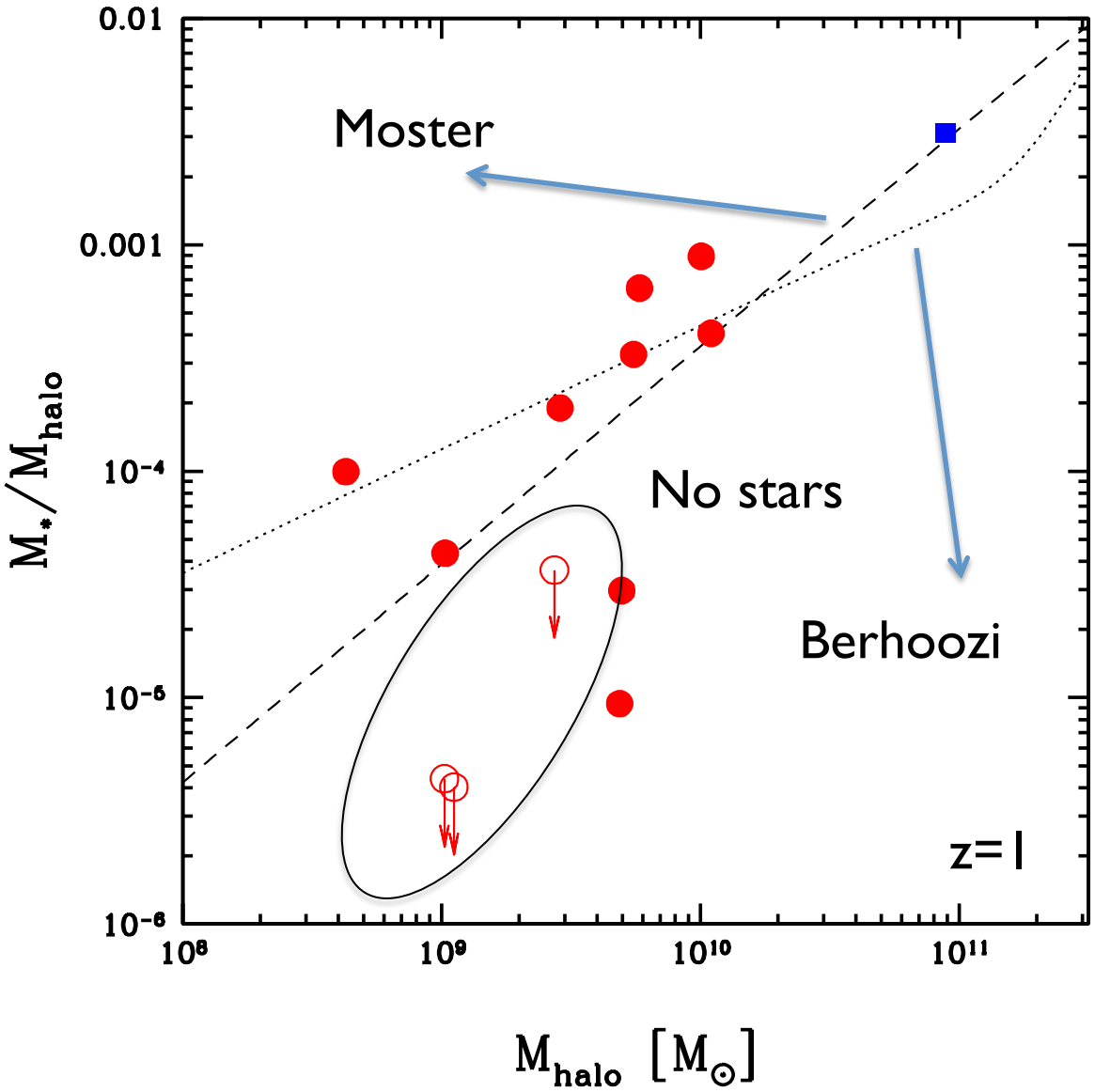



10^{11}
10^{10}
10^{9}
10^{8}
10^{7}
10^{6}
$M_{diskstar}$ [$M_\odot$]
10^{10}
10^{11}
10^{12}
M_{halo} [$M_\odot$]
z=0 Behroozi+ (2013)
f_b = 0.16
?

Abundance matching ?

12 haloes

9 galaxies
3 dark satellites



Abundance matching ?

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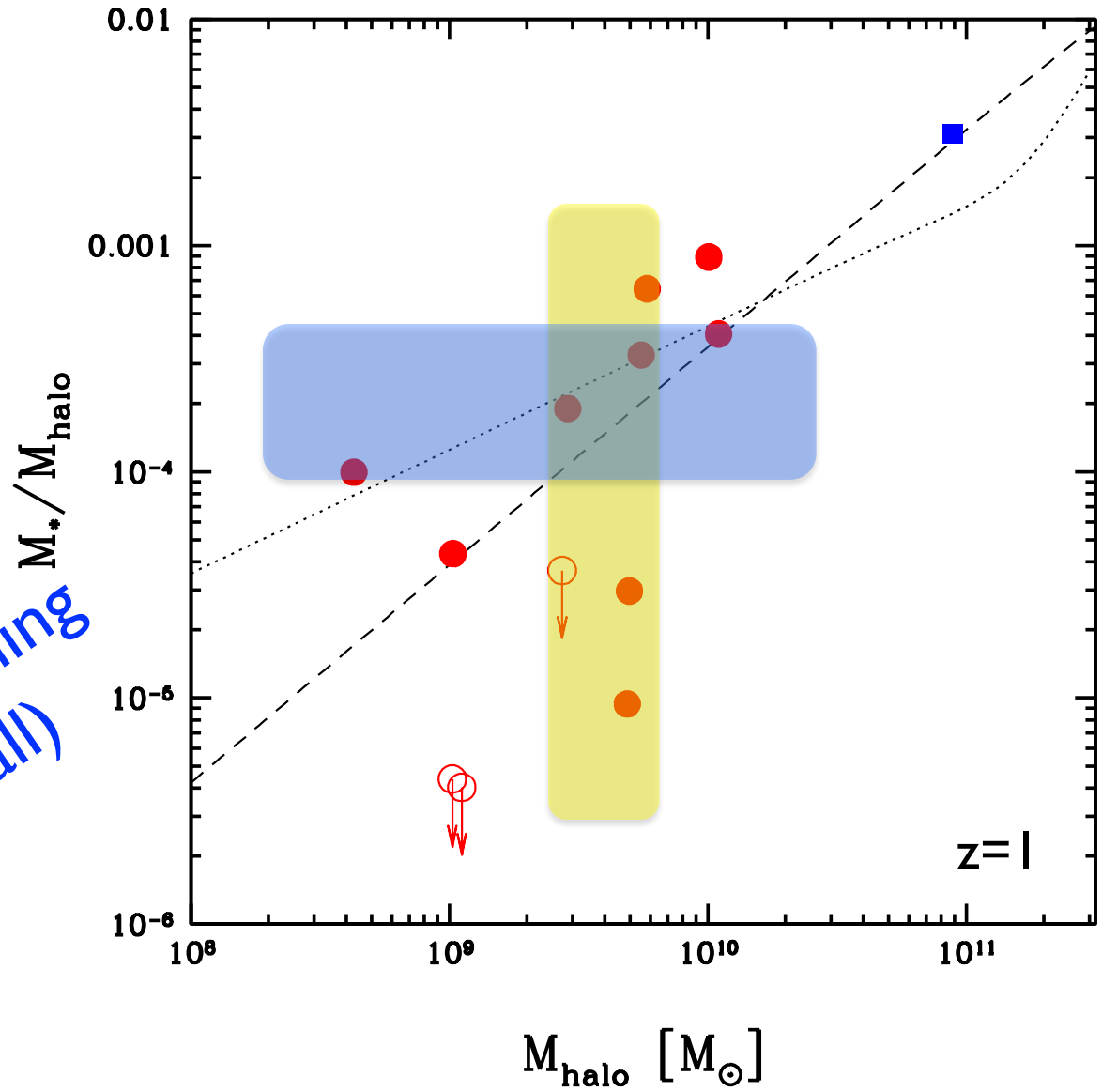
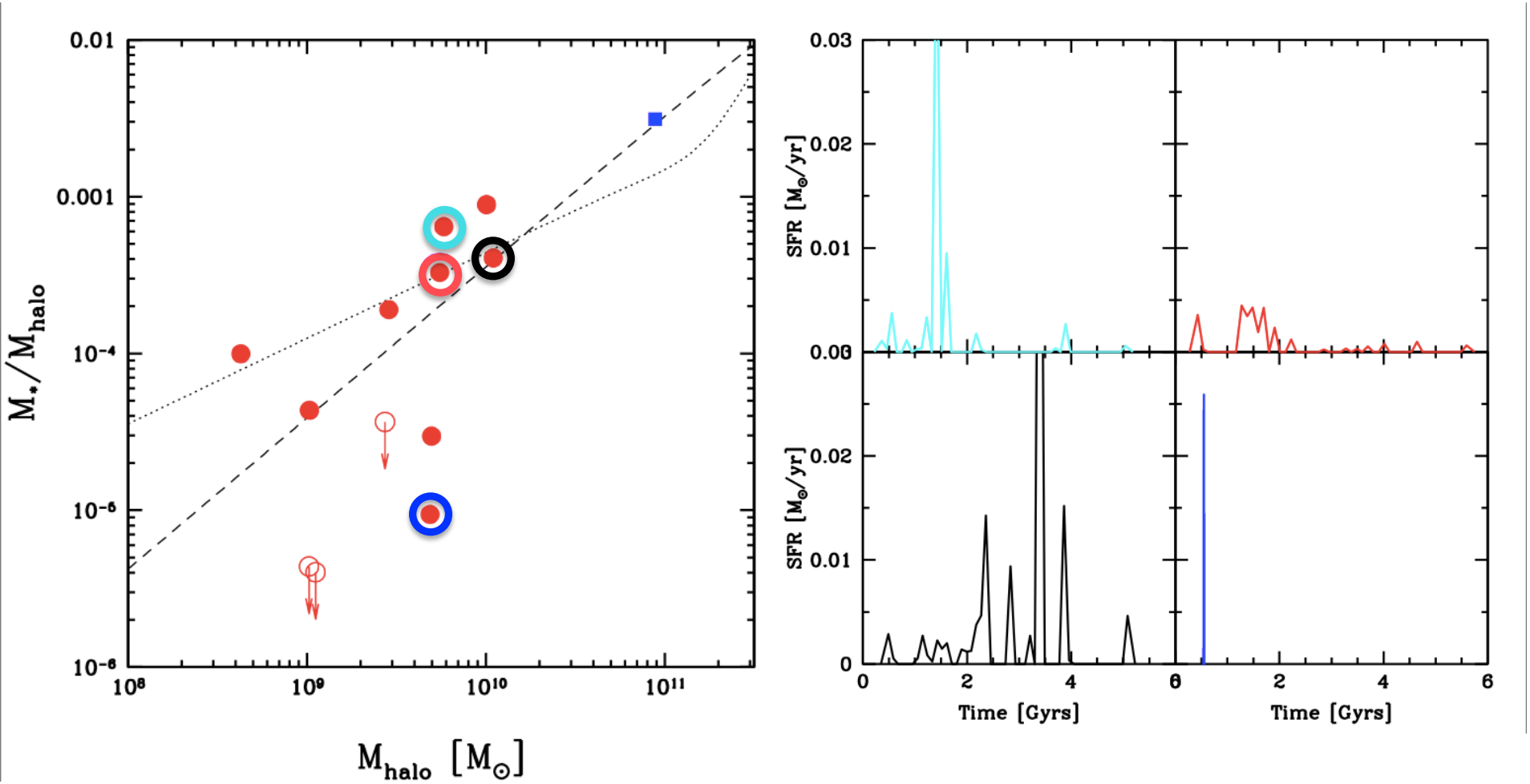


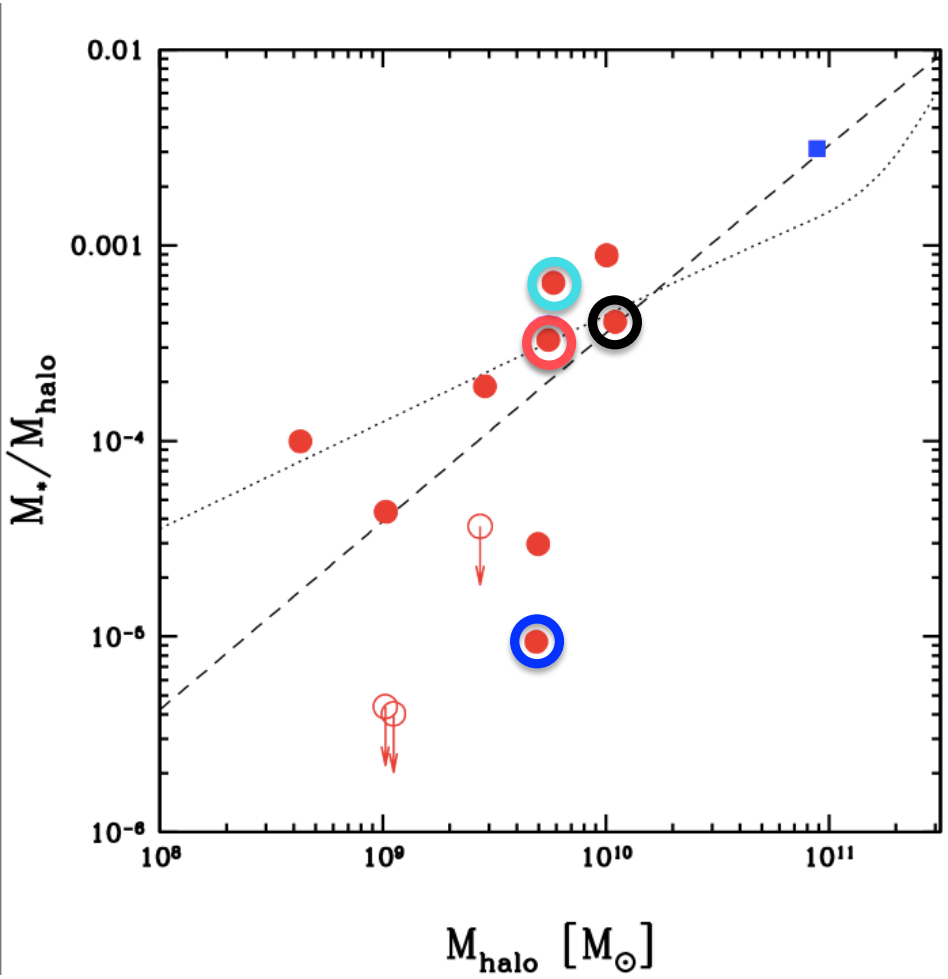
No abundance matching
(even before infall)

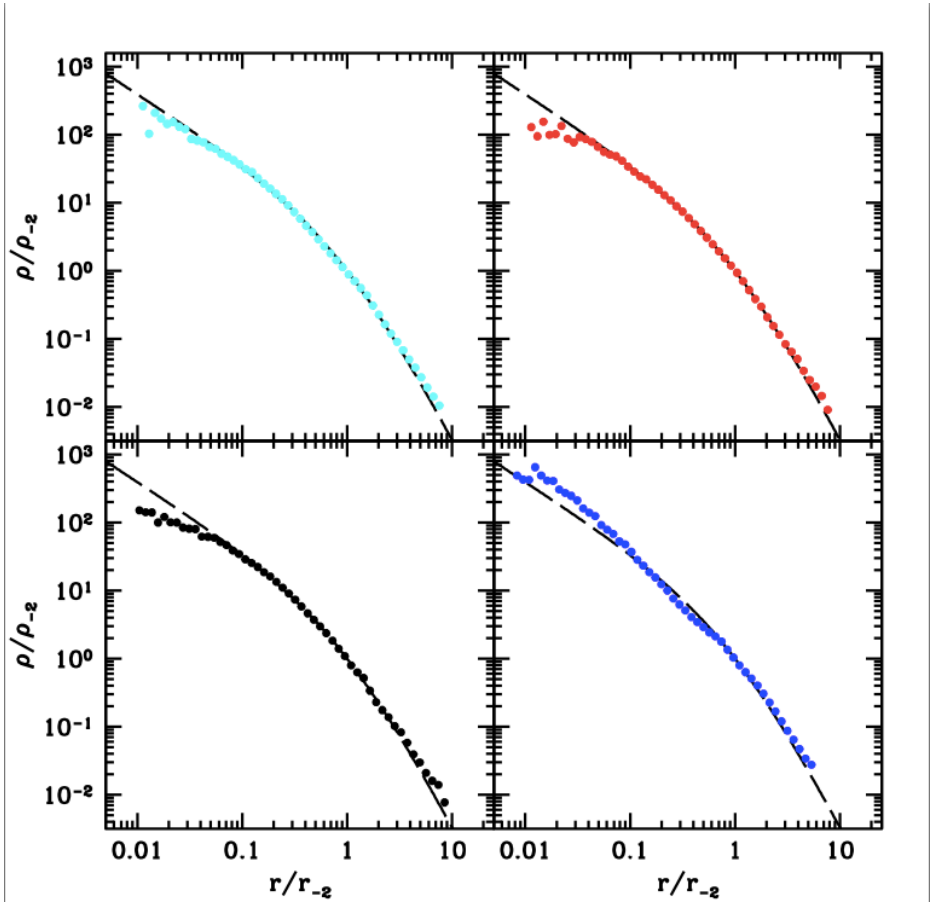
Halo to Halo scatter



Variety of SFH at a ***fixed*** halo mass

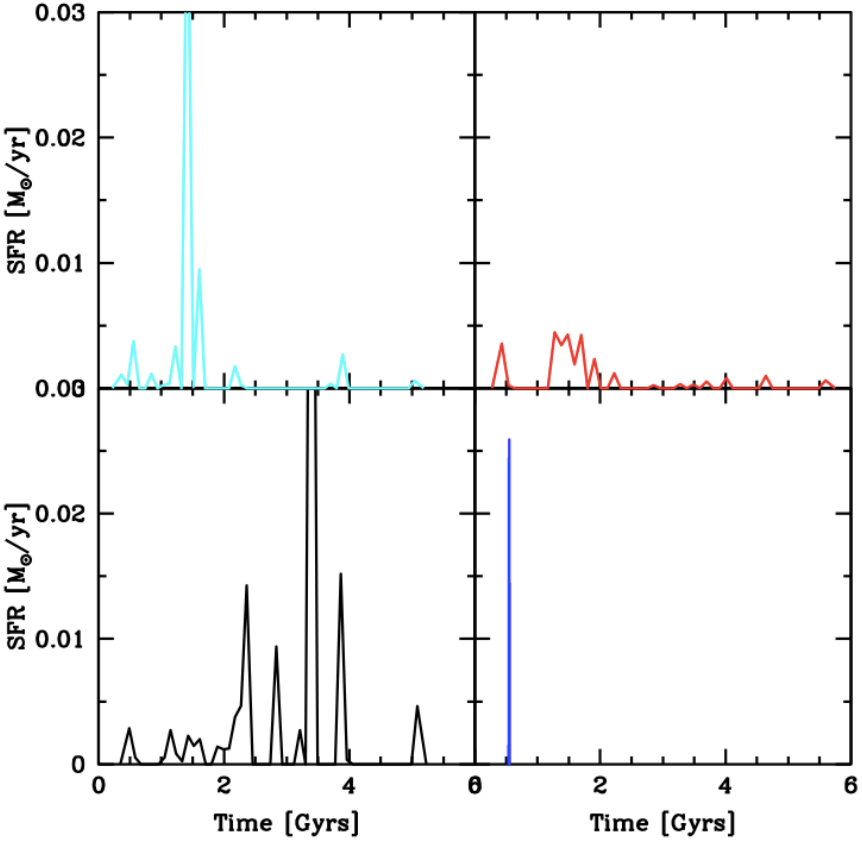
Halo to Halo scatter

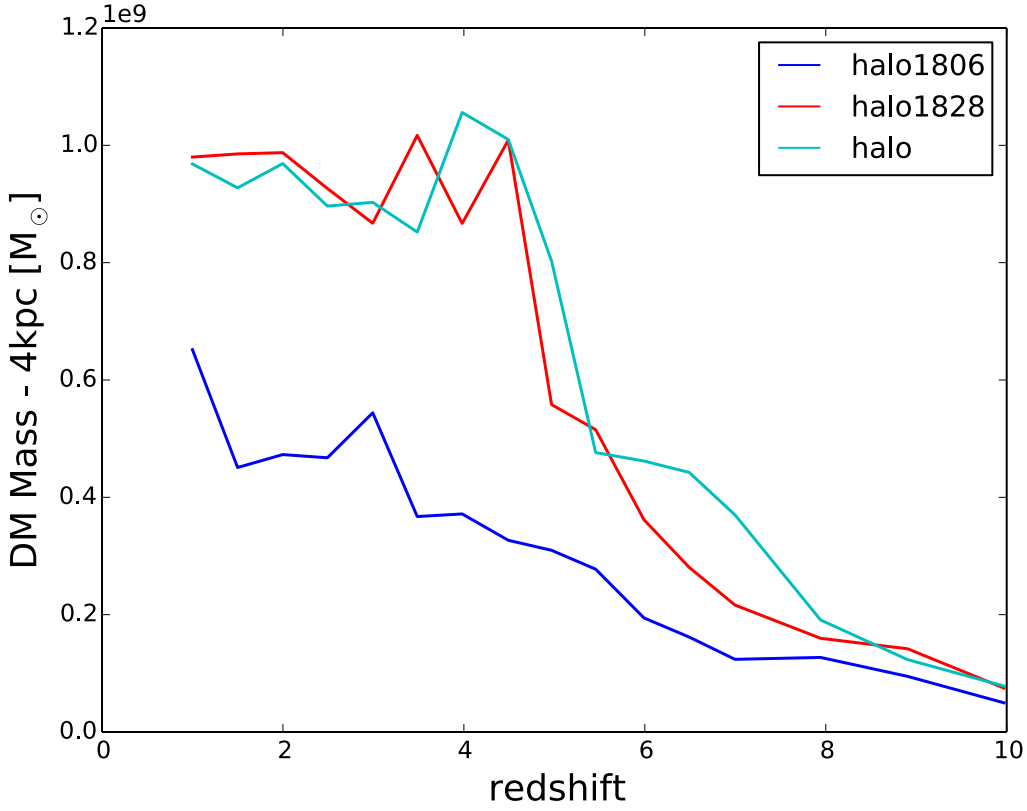




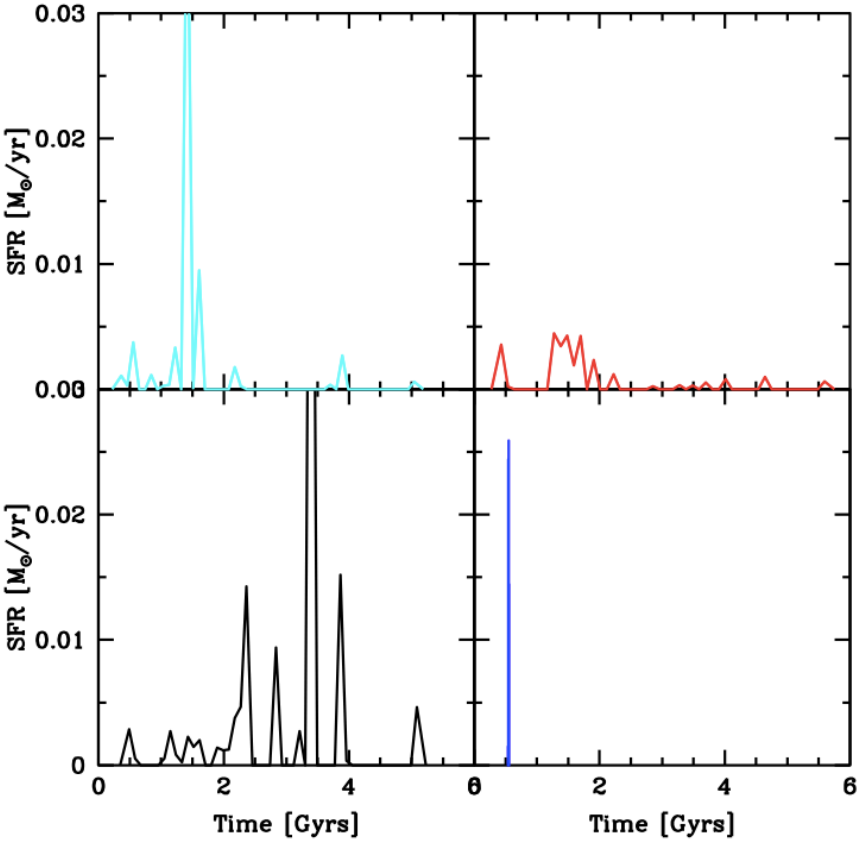
Cored and cusped haloes before accretion

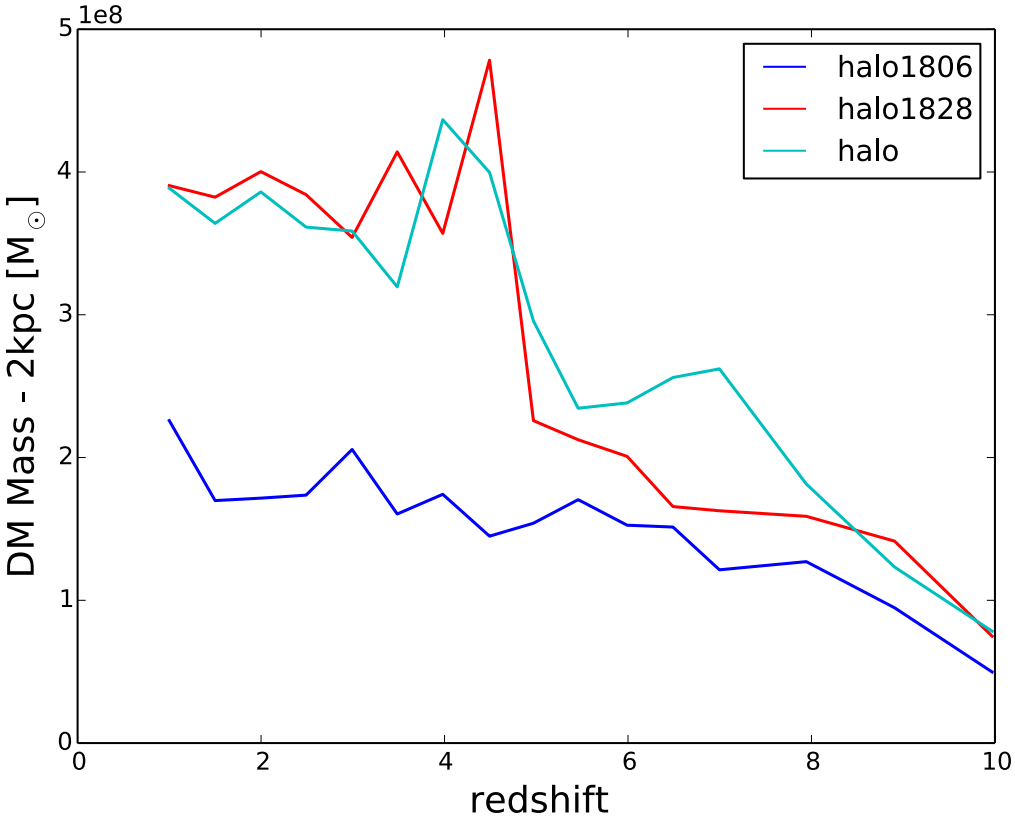
SF and merging history



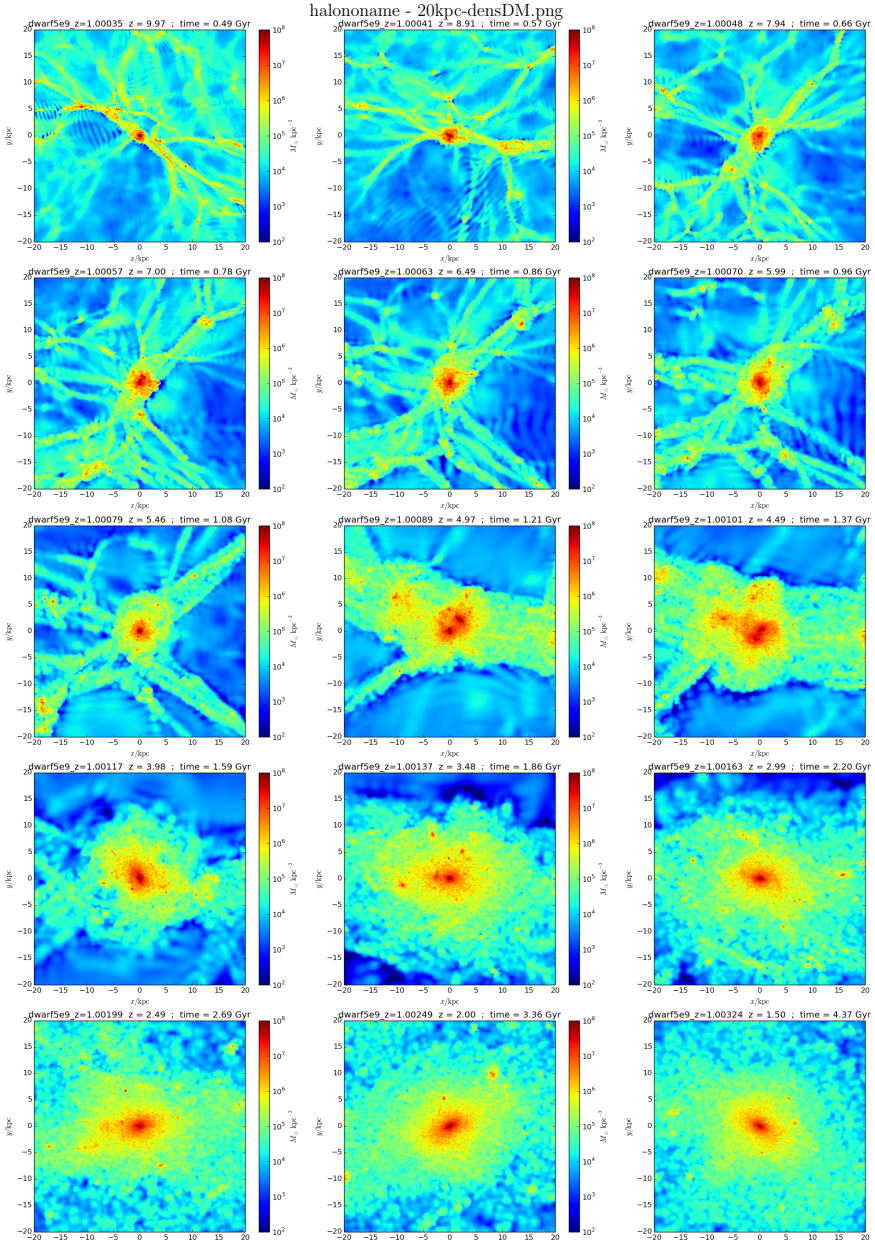


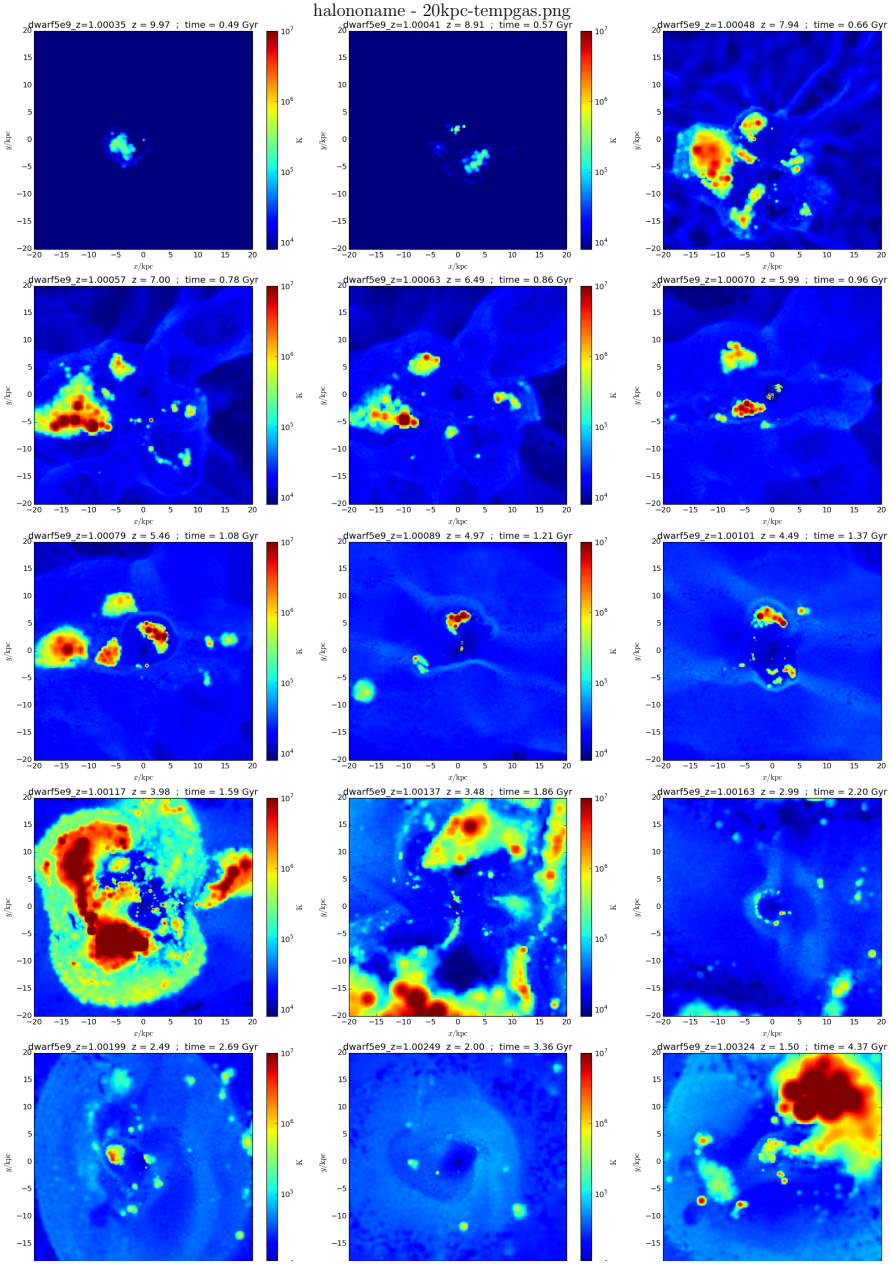
SF and merging history



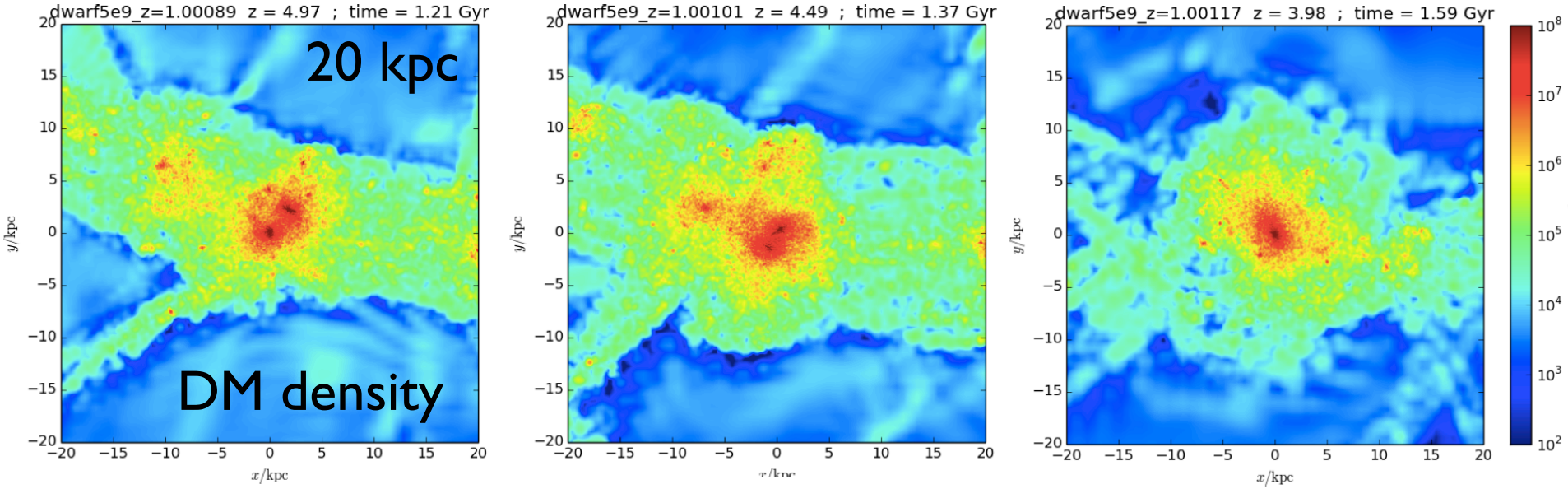


Major Mergers are very important at this mass scales.



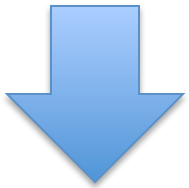


DM density 20 kpc Gas Temperature



More than 85% of M_* produced during the merger

Variety of Halo formation histories
(stochasticity of major mergers)



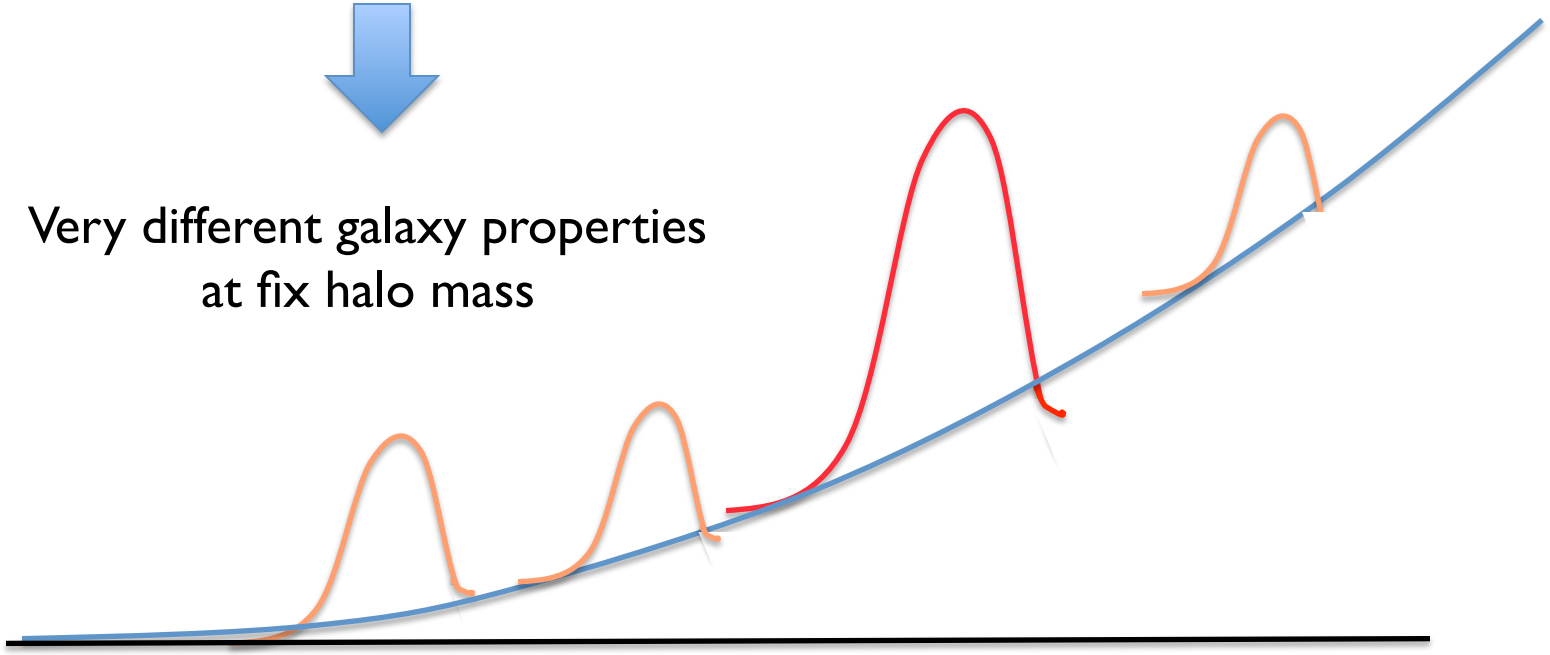
Variety of Star formation histories
(stochasticity of Star formation)

Very different galaxy properties at fix halo mass
(No abundance matching, cusp/core, sizes etc.)
Even before accretion

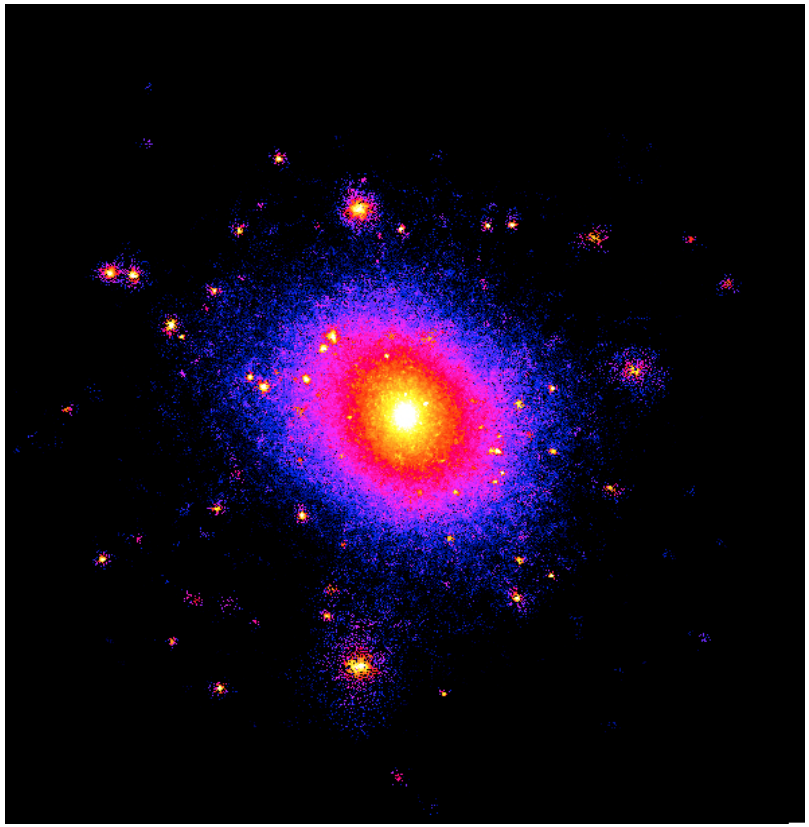
Variety of Halo formation histories
(stochasticity of major mergers)

Variety of Star formation histories
(stochasticity of Star formation)

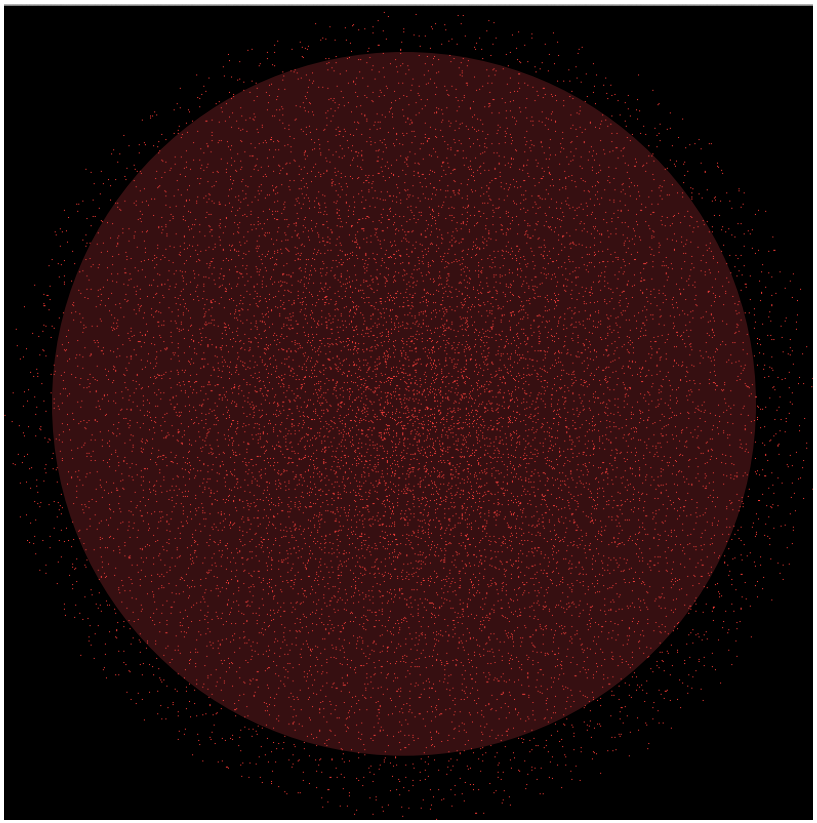
Very different galaxy properties
at fix halo mass



Dark satellites

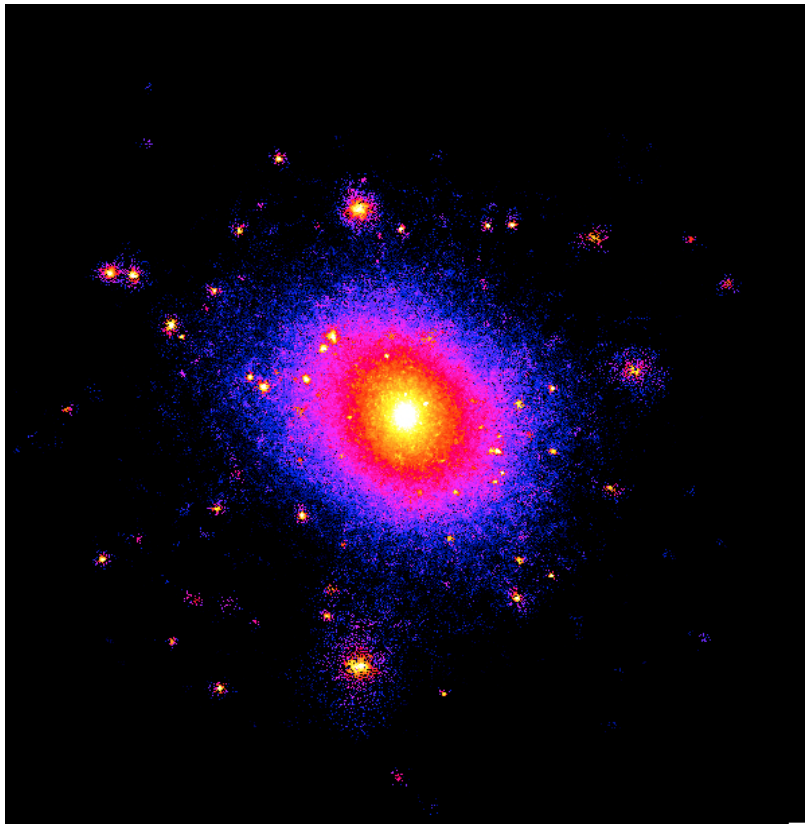


DM density

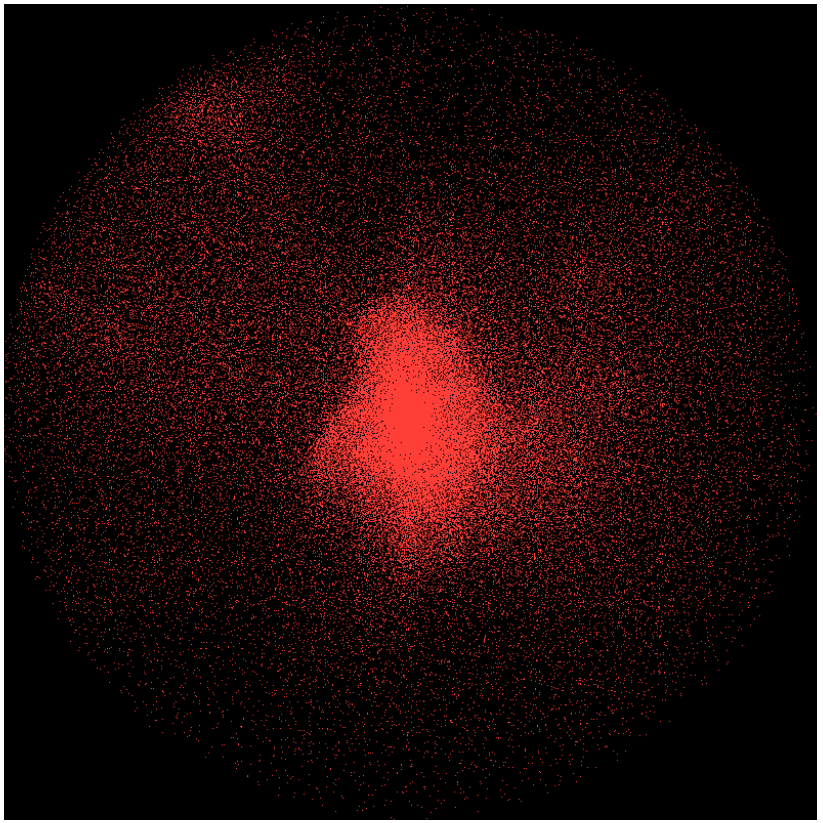


GAS density
with UV background

Dark satellites



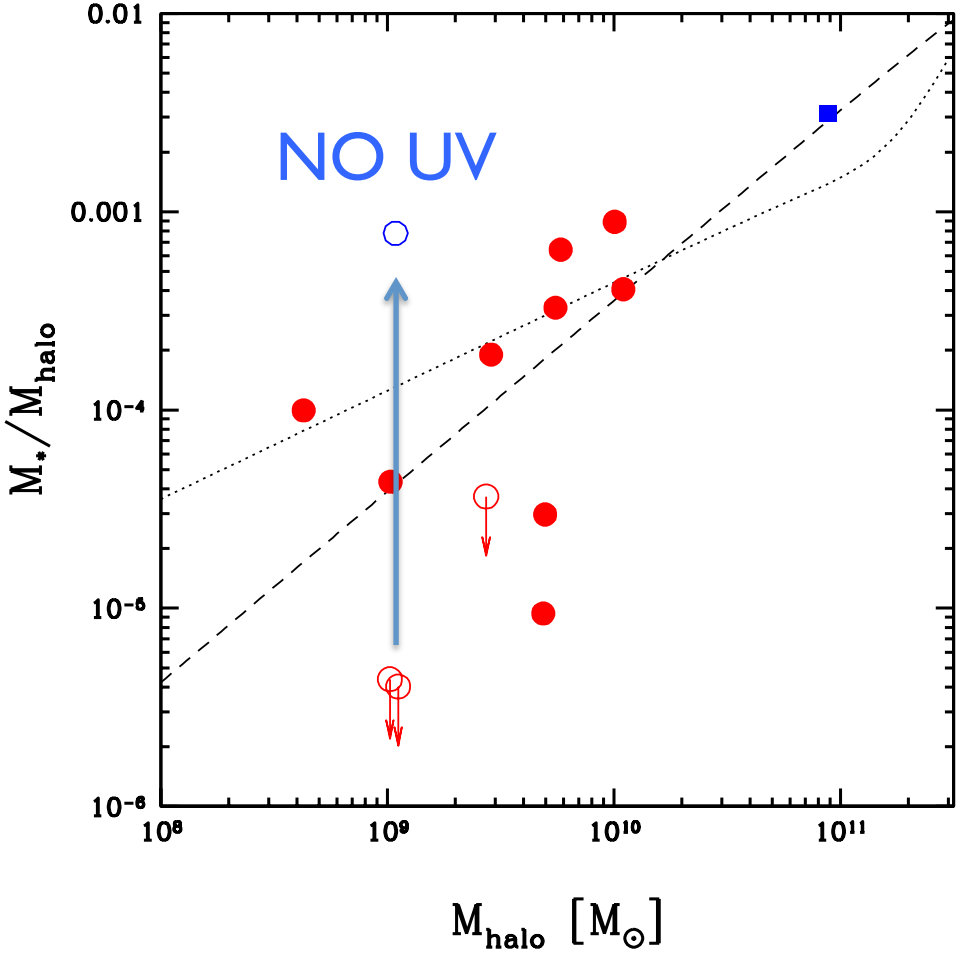
DM density

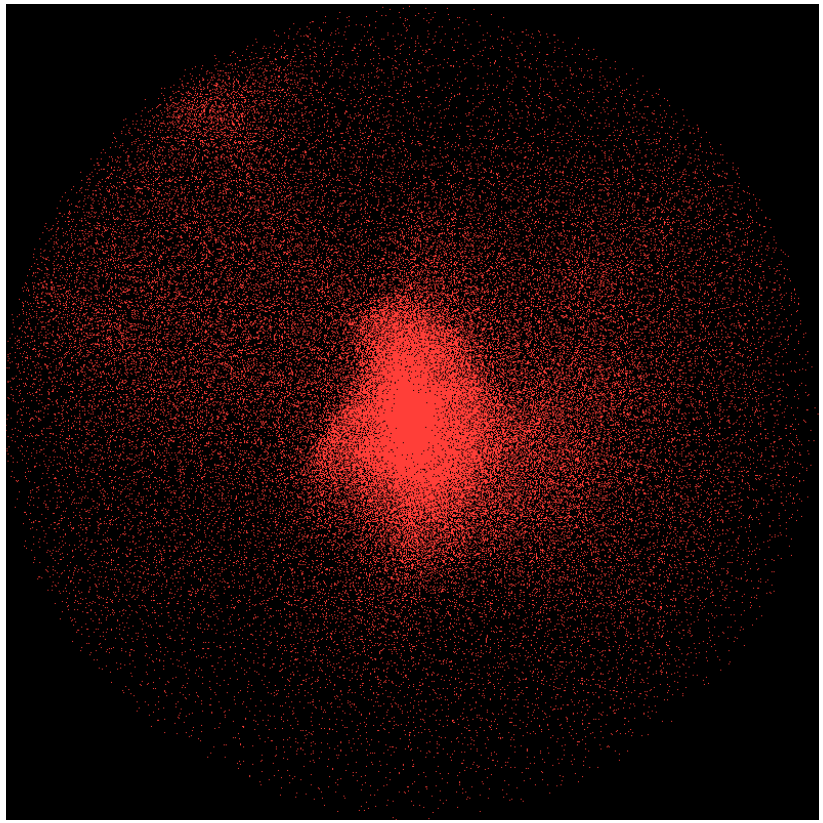


GAS density

NO UV background

Dark satellites





GAS density

NO UV background

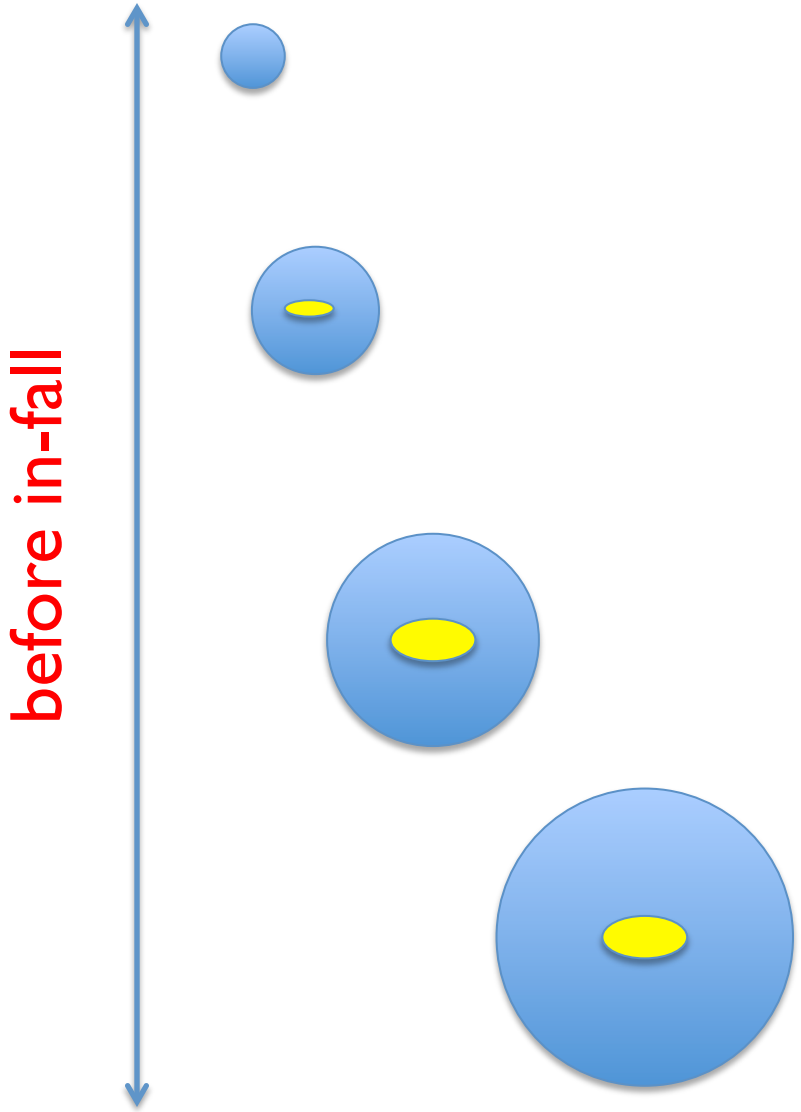
Conclusions: Before In-fall

NO M^*-M_{DM} relation below 10^{10} $M_\odot$

Large variation in Star Formation History

Major Mergers are relevant at these mass scales

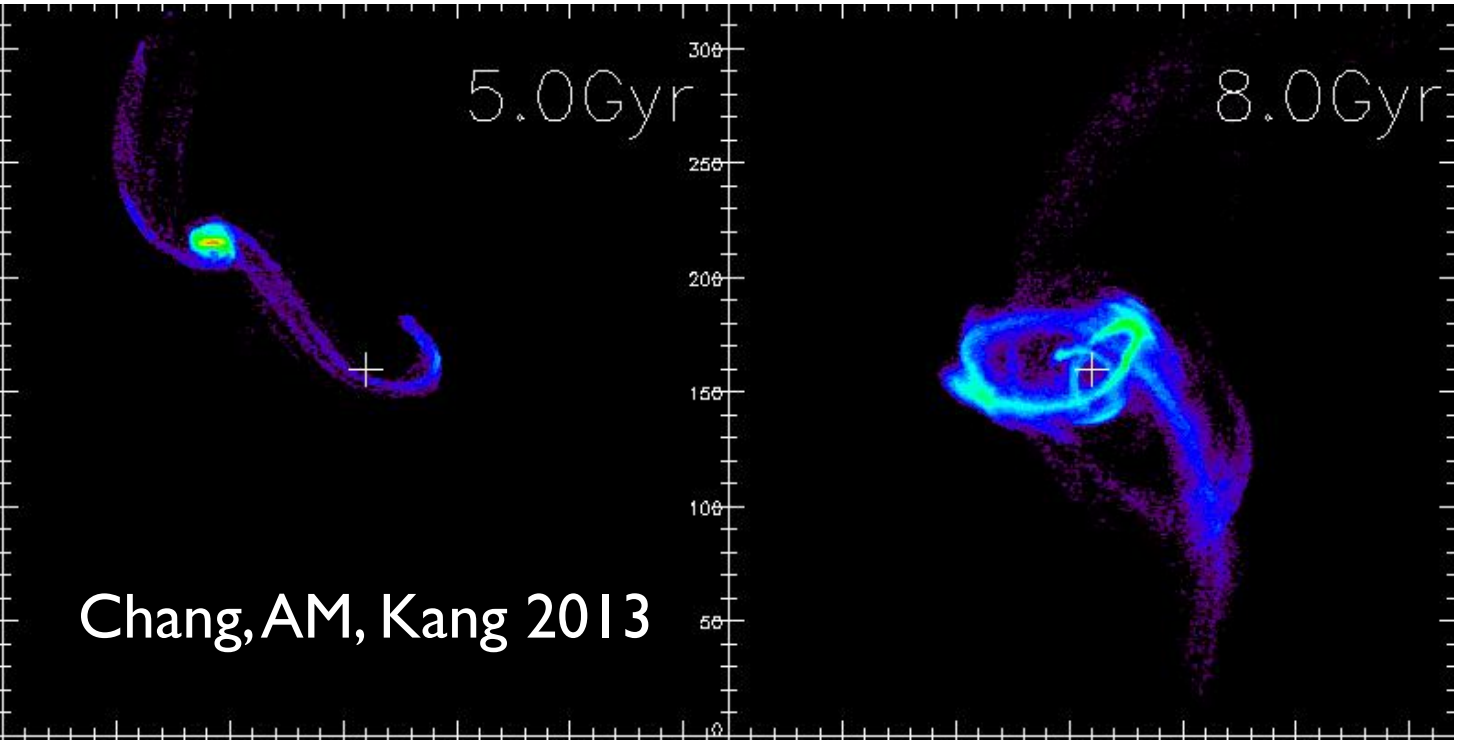
Cored and cuspy profiles before accretion



Macciò et al. in prep

Future Work

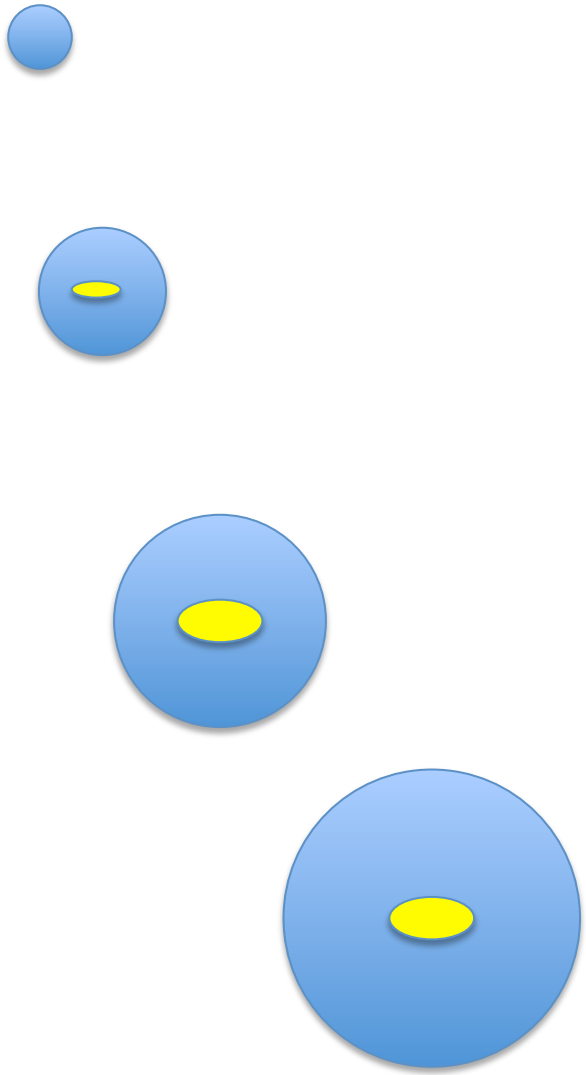
After accretion
effects of tidal interactions



Take home message

Take home message

Satellites are very heterogeneous objects with very different formations paths



Thank you