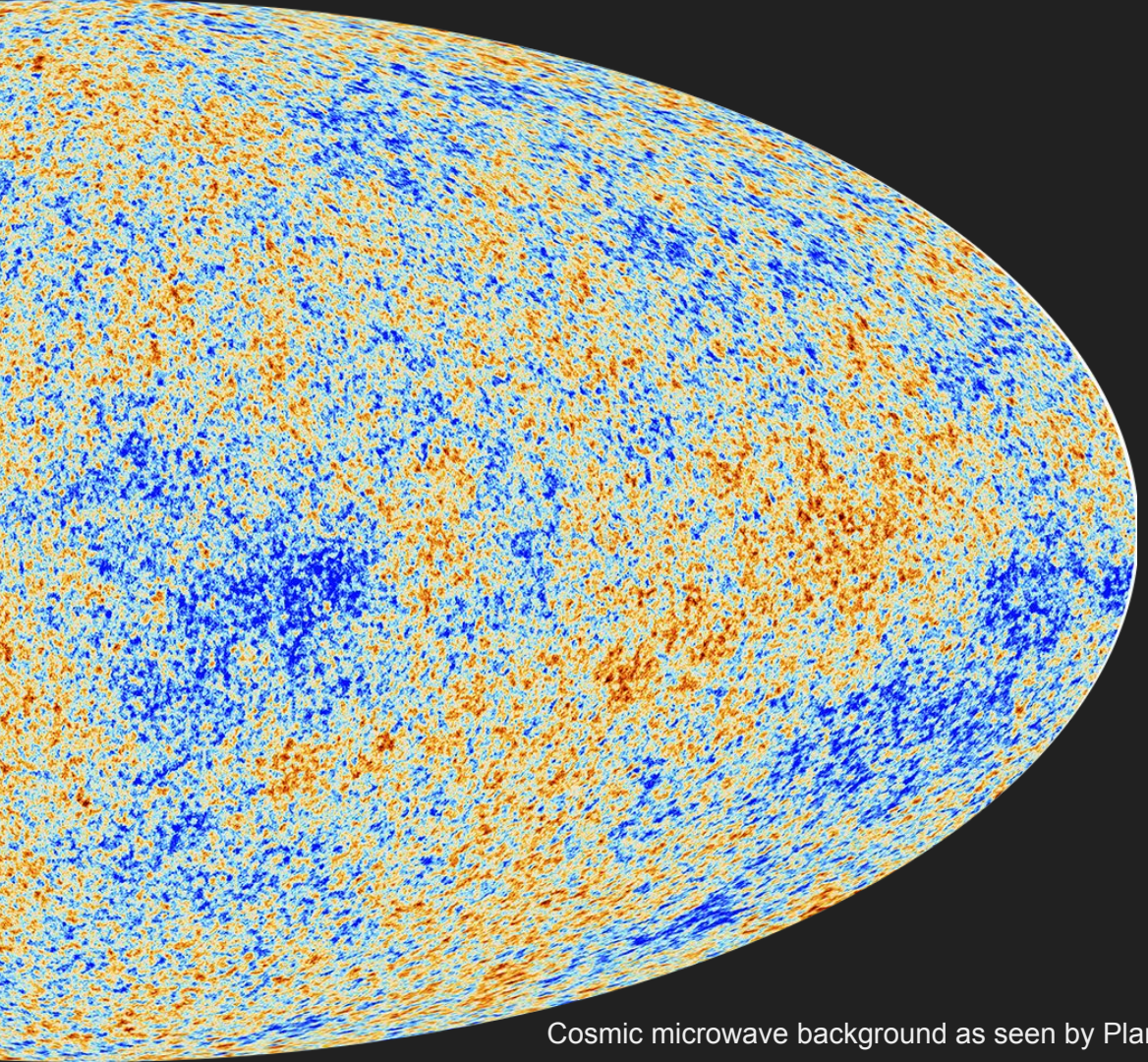
HOW GALAXIES TRACE LARGE SCALE STRUCTURE AT Z~3

Author: Anna Durkalec anna.durkalec@ncbj.gov.pl **Świerk, 10.12.2018**

WE HAVE

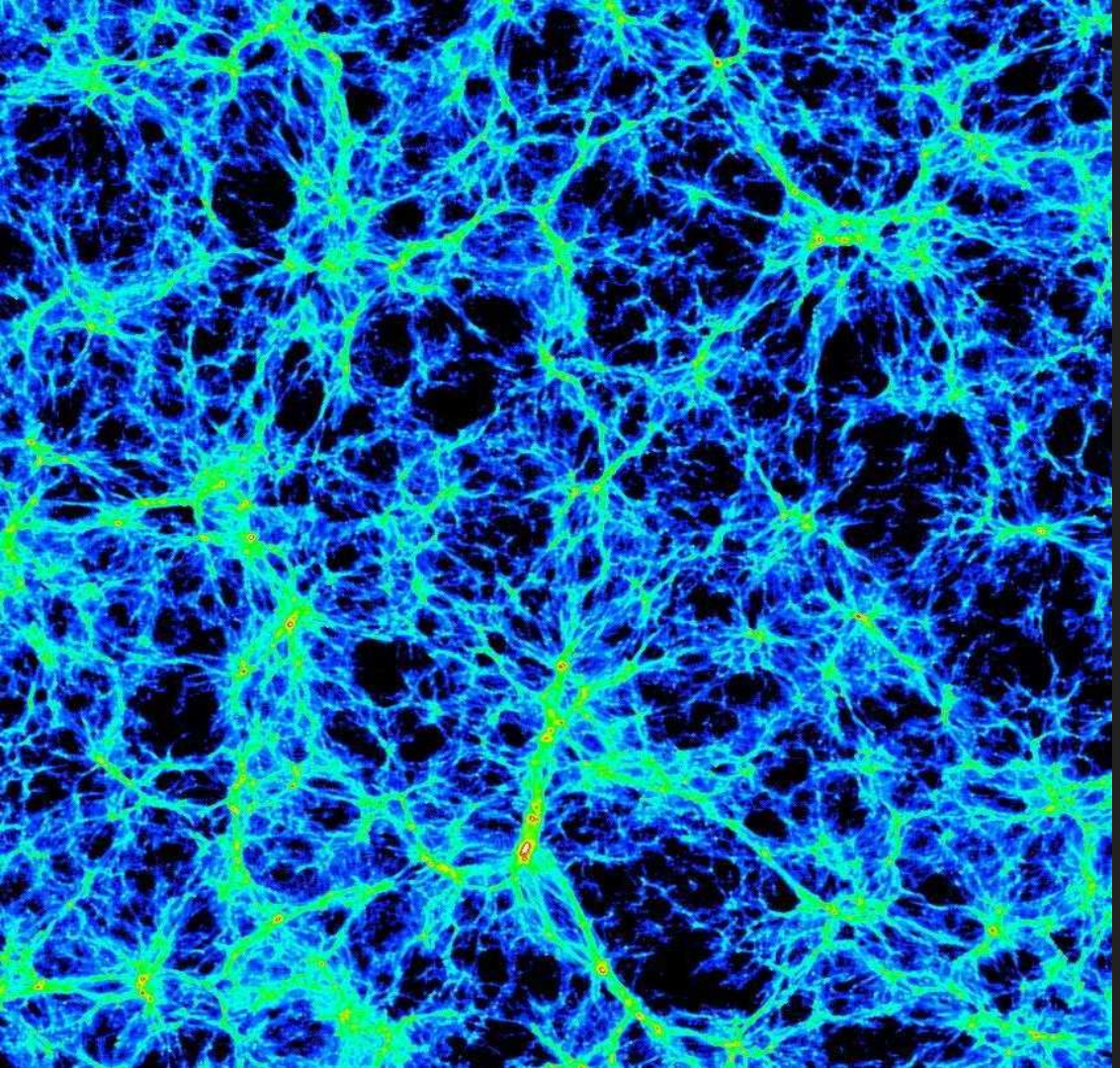
EVEN BIGGER

QUESTIONS



LOOK IT'S ALMOST UNIFORM!

Cosmic microwave background as seen by Planck



AND NOW
LOOK
AT THESE

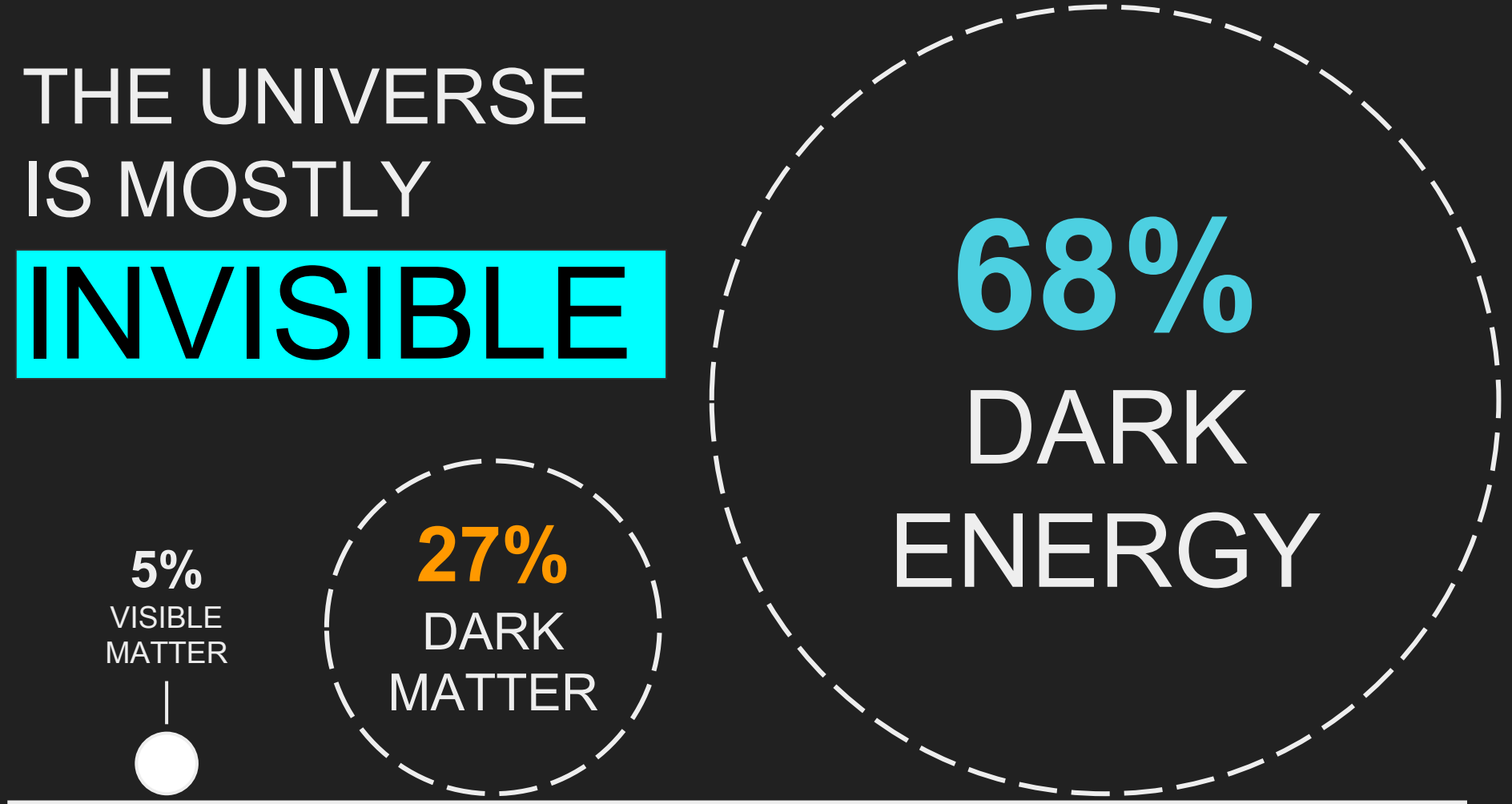
STRUCTURES!

Pic credit: Suvendra Dutta

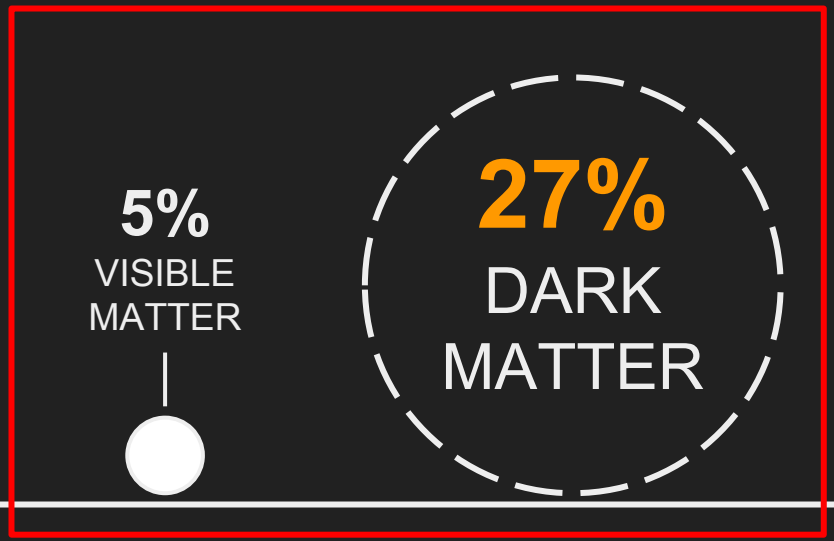
THE UNIVERSE IS MOSTLY INVISIBLE

THE UNIVERSE IS MOSTLY INVISIBLE

THE UNIVERSE IS MOSTLY INVISIBLE



THE UNIVERSE IS MOSTLY INVISIBLE



68%
DARK ENERGY

BIAS

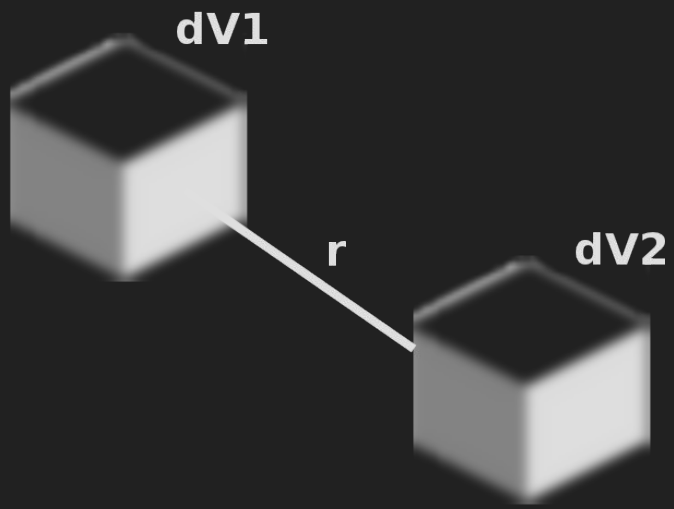
UNDERSTAND THE RELATIONSHIP BETWEEN GALAXIES AND THE UNDERLYING DARK MATTER

AT HIGH REDSHIFT!

AT HIGH REDSHIFT!

(z~3)

GALAXY CORRELATION FUNCTION



Excess number of pairs separated by r over the random distribution

BUT IT HAS REQUIREMENTS

GALAXY SAMPLE VIMOS ULTRA DEEP SURVEY (VUDS)

VIMOS ULTRA DEEP SURVEY (VUDS)

NUMBER OF GALAXIES:

10 000

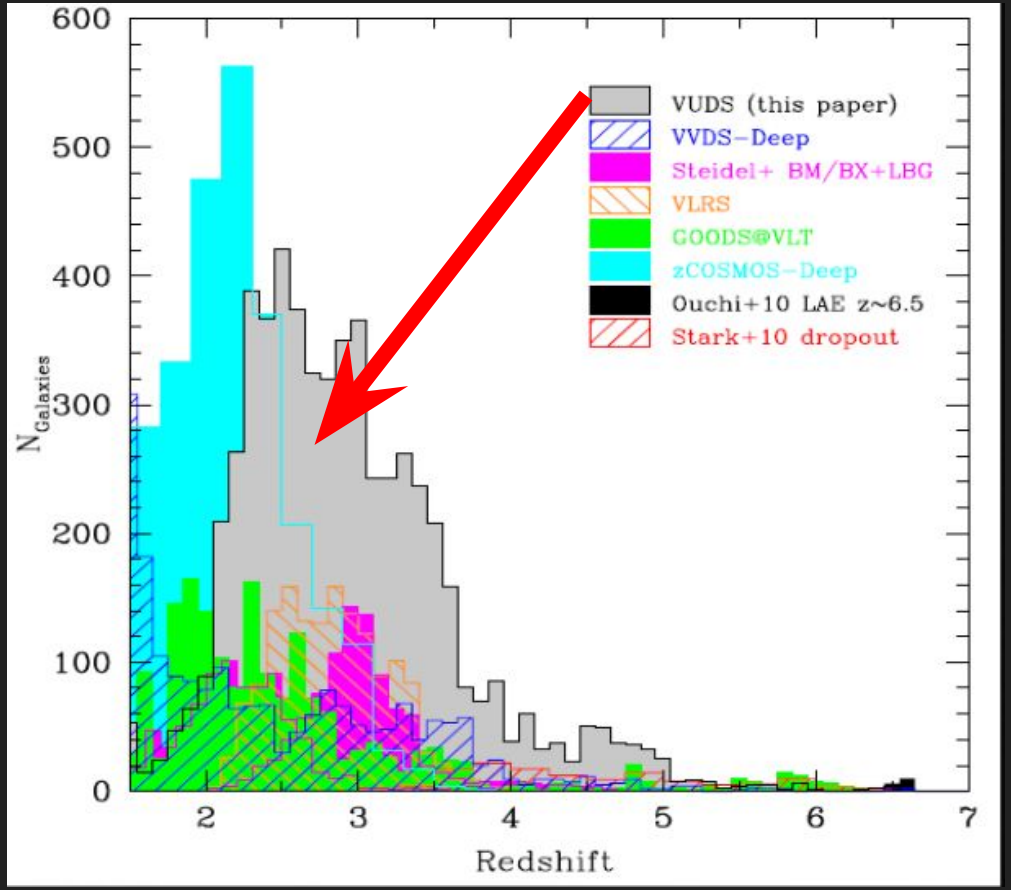
REDSHIFT RANGE:

2.0 - 6.0

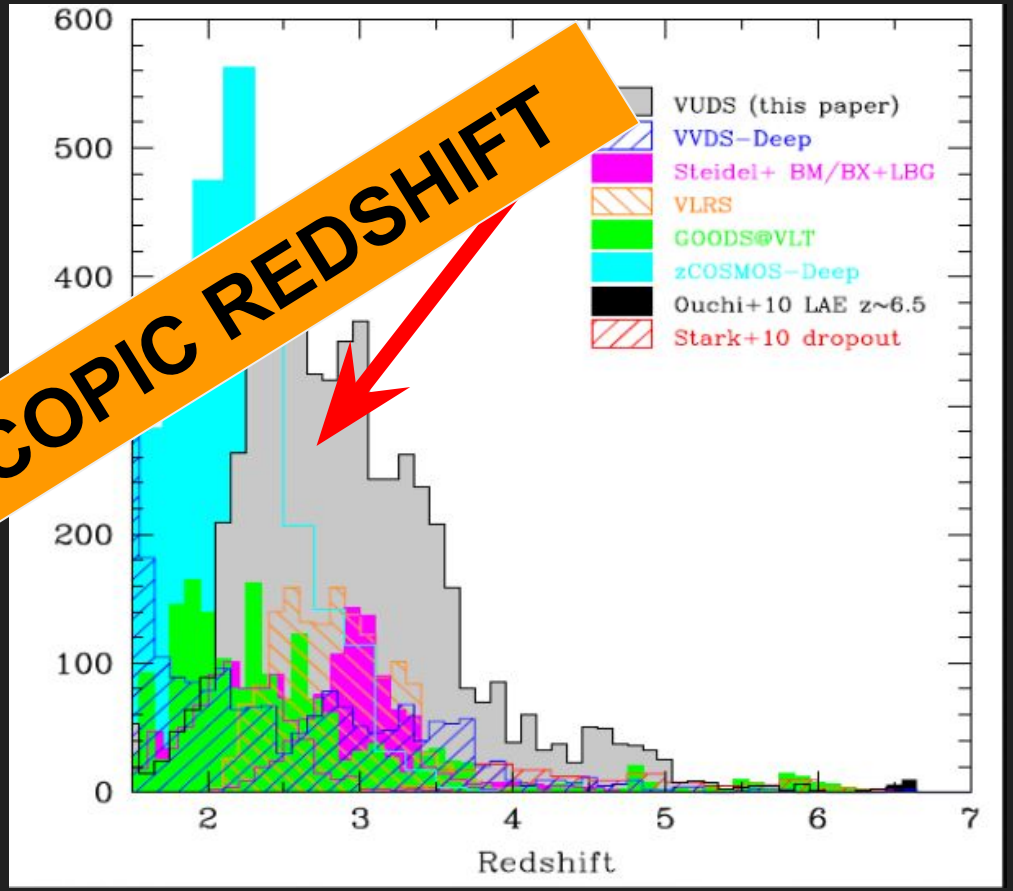
TOTAL AREA:

1 deg^2

VIMOS ULTRA DEEP SURVEY (VUDS)



VIMOS ULTRA DEEP SURVEY (VUDS)

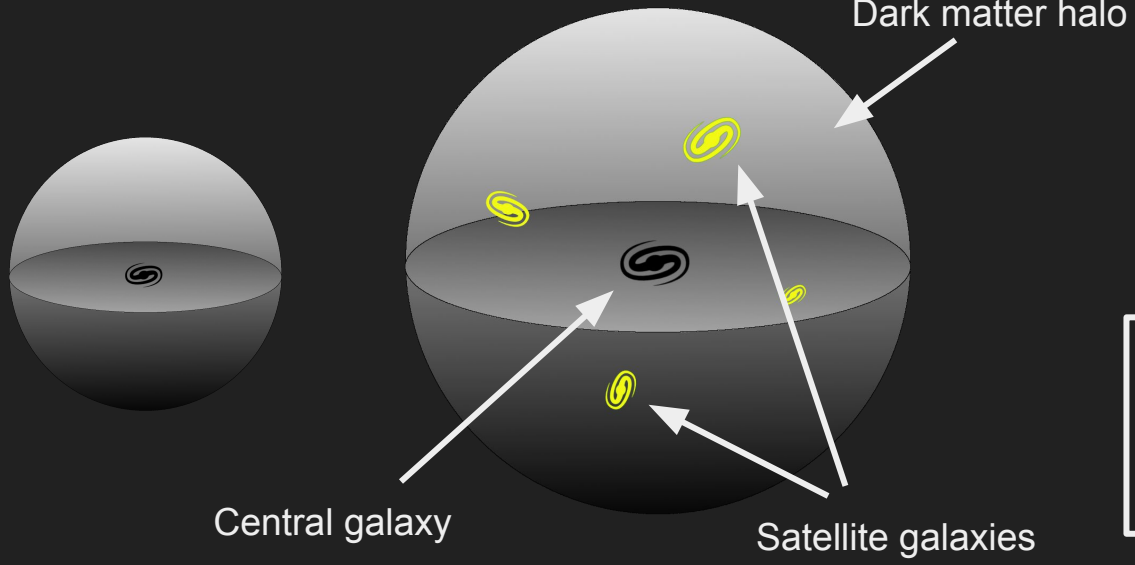


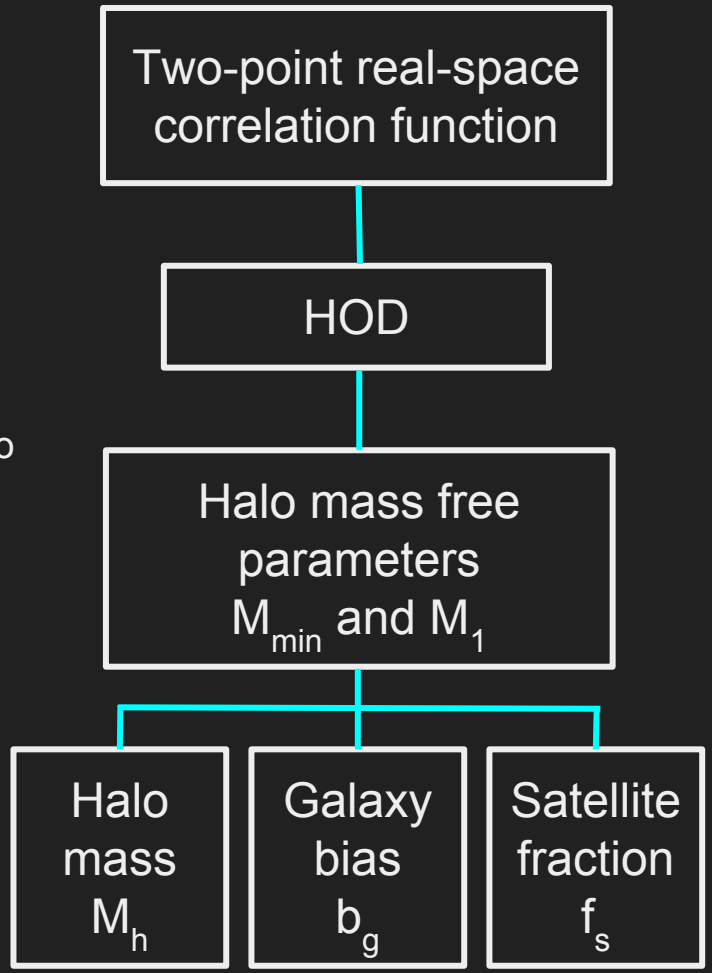
HALO OCCUPATION DISTRIBUTION MODELLING (HOD)

THE HOD FRAMEWORK

Assumptions:

1. Galaxies reside in dark matter halos.
2. Number of galaxies inside the halo is the function of the mass of the halo.

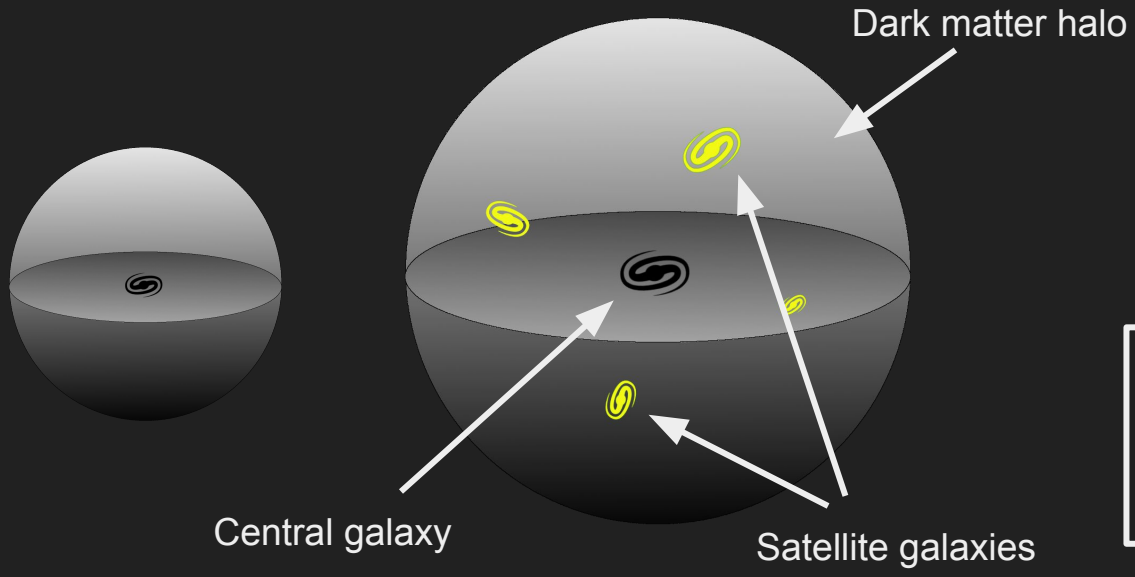


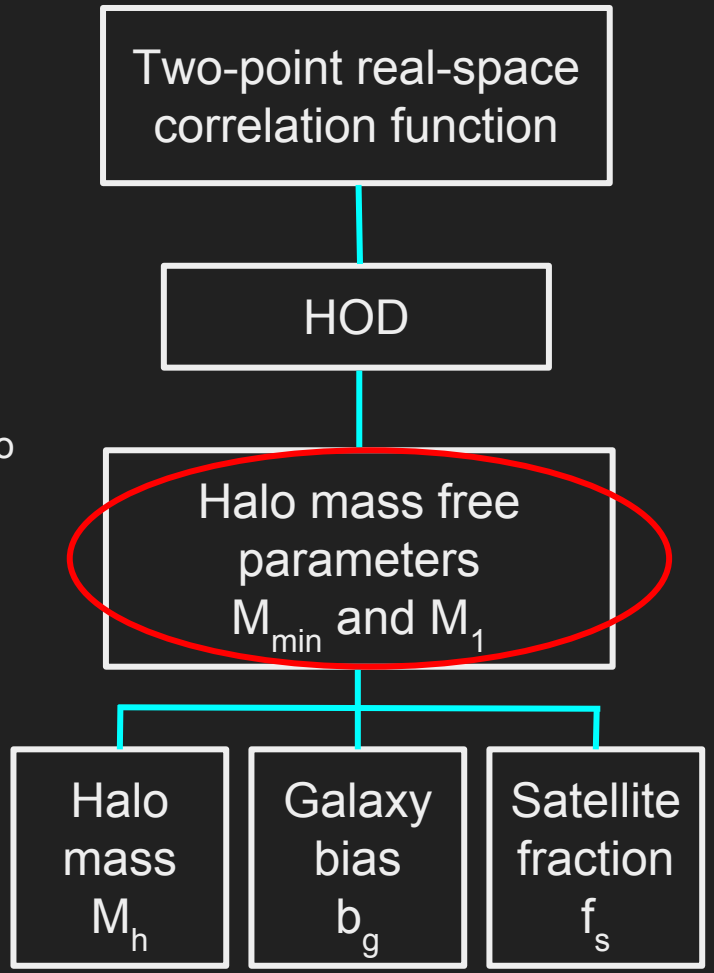


THE HOD FRAMEWORK

Assumptions:

1. Galaxies reside in dark matter halos.
2. Number of galaxies inside the halo is the function of the mass of the halo.

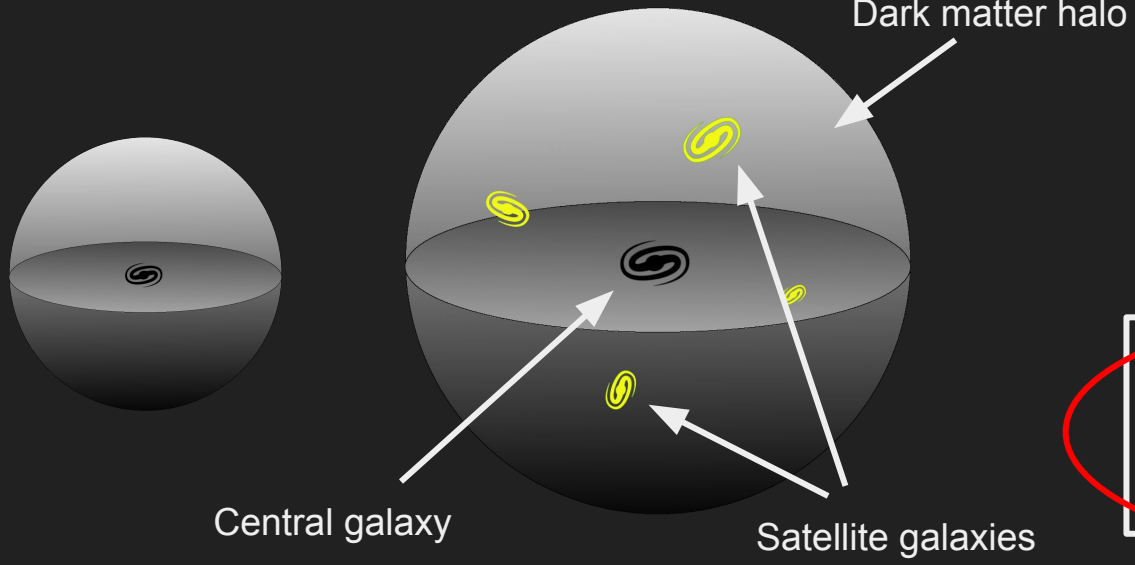


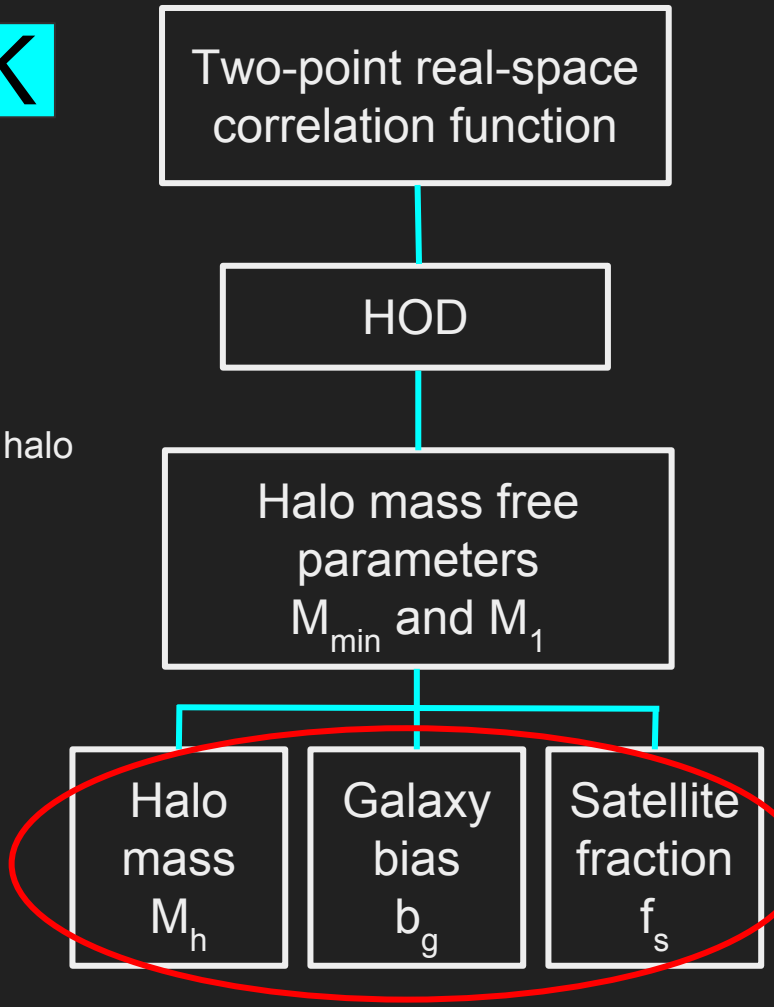


THE HOD FRAMEWORK

Assumptions:

1. Galaxies reside in dark matter halos.
2. Number of galaxies inside the halo is the function of the mass of the halo.





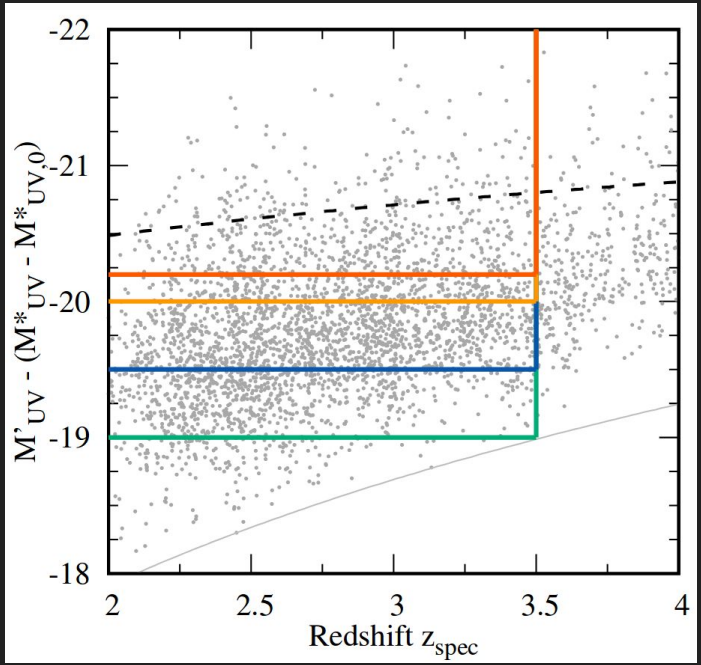
GALAXY SAMPLE SELECTION

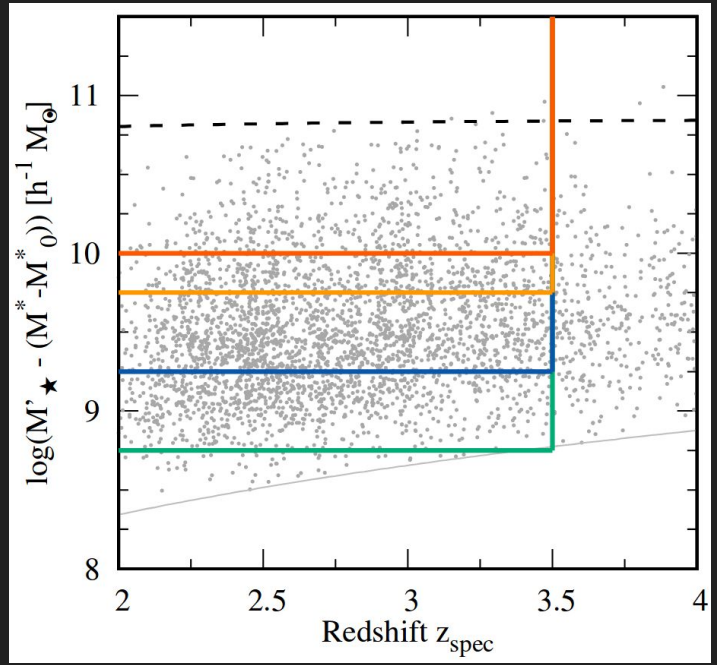
3236

GALAXY SAMPLE SELECTION

3236

Luminosity (UV)



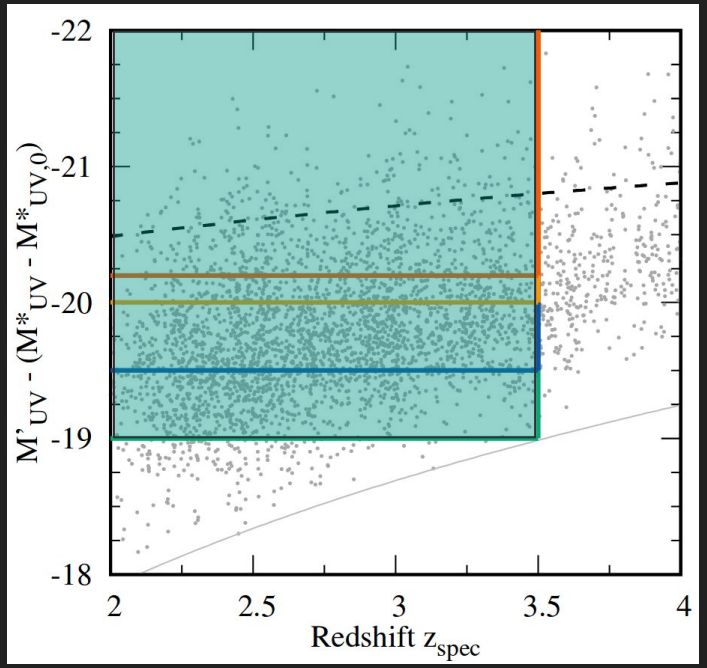


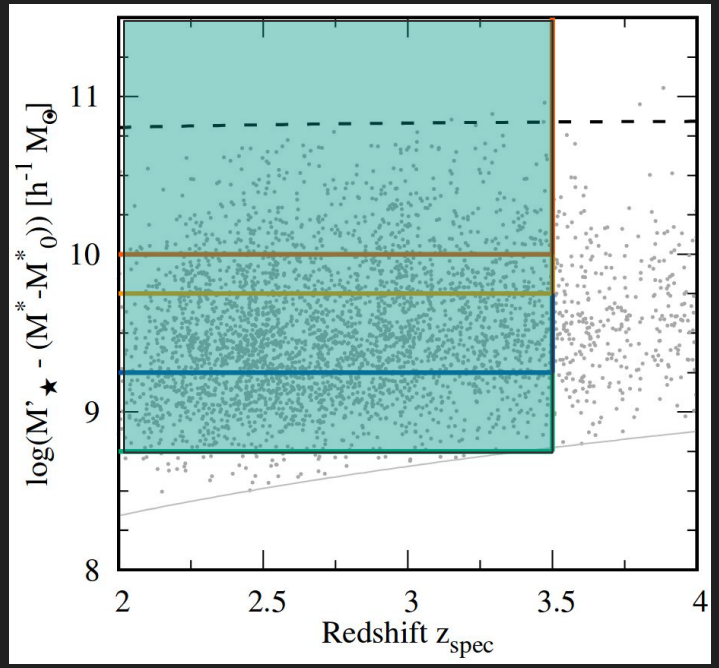
Stellar mass

GALAXY SAMPLE SELECTION

3236

Luminosity (UV)



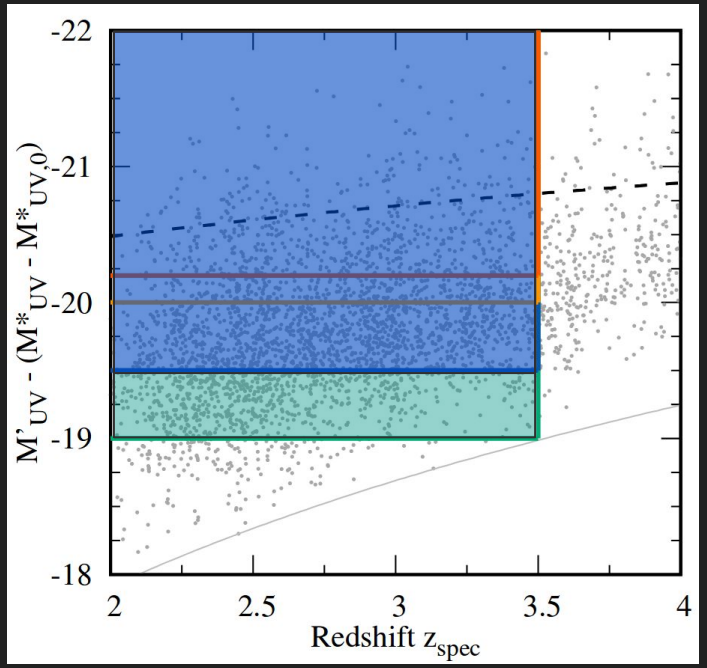


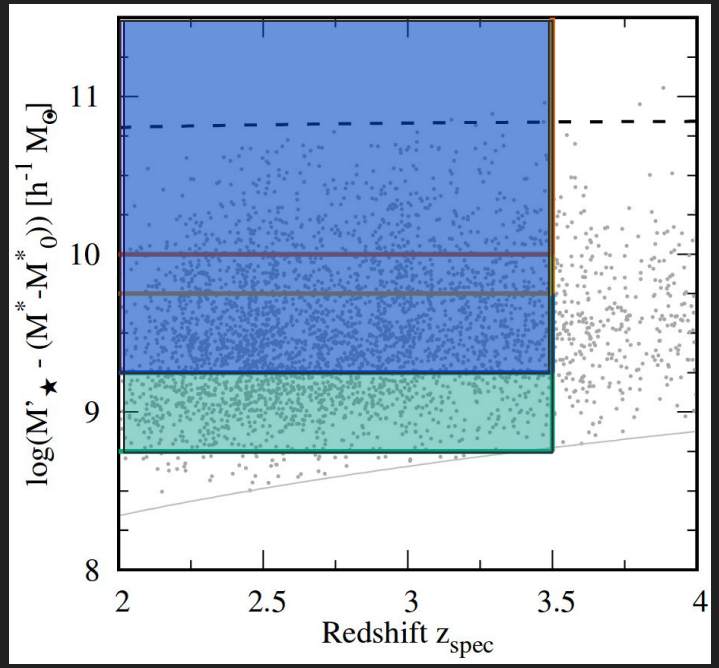
Stellar mass

GALAXY SAMPLE SELECTION

3236

Luminosity (UV)



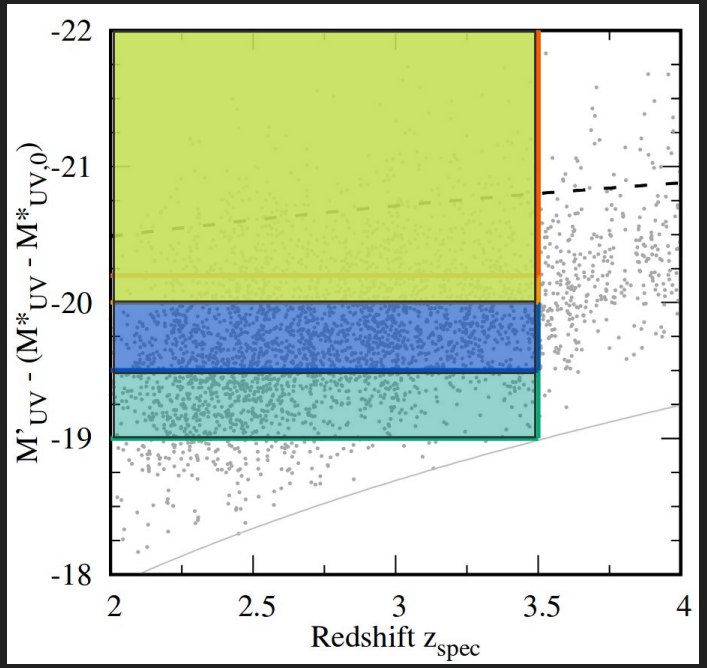


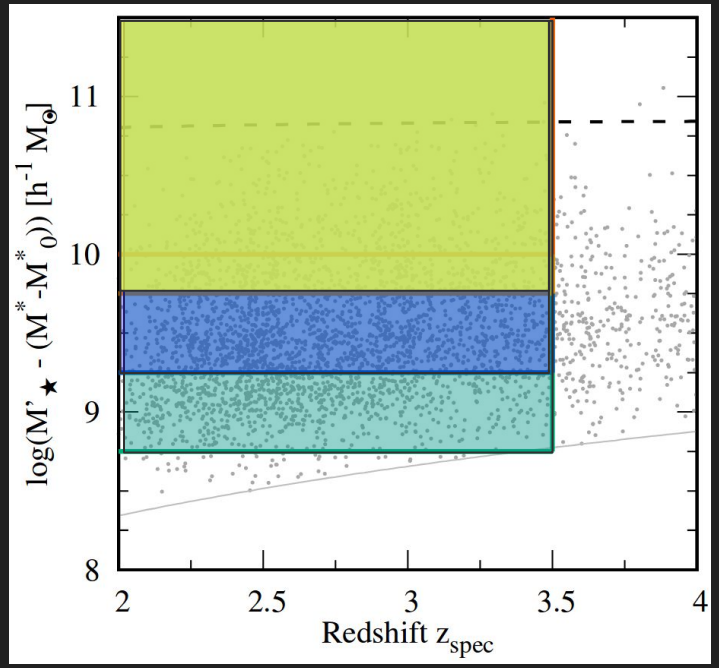
Stellar mass

GALAXY SAMPLE SELECTION

3236

Luminosity (UV)



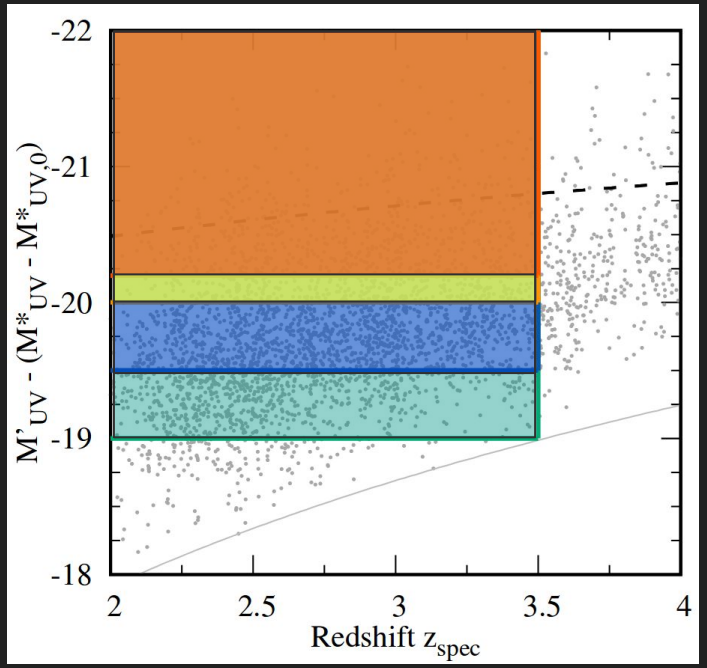


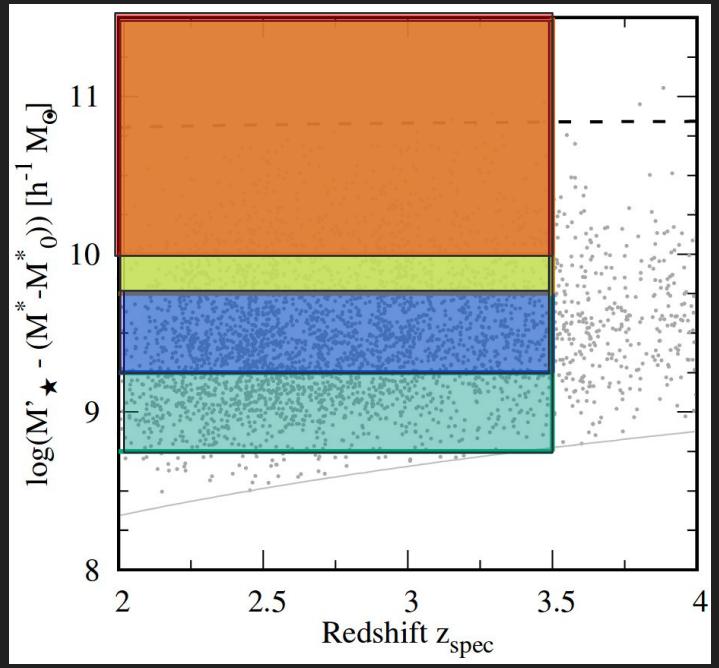
Stellar mass

GALAXY SAMPLE SELECTION

3236

Luminosity (UV)

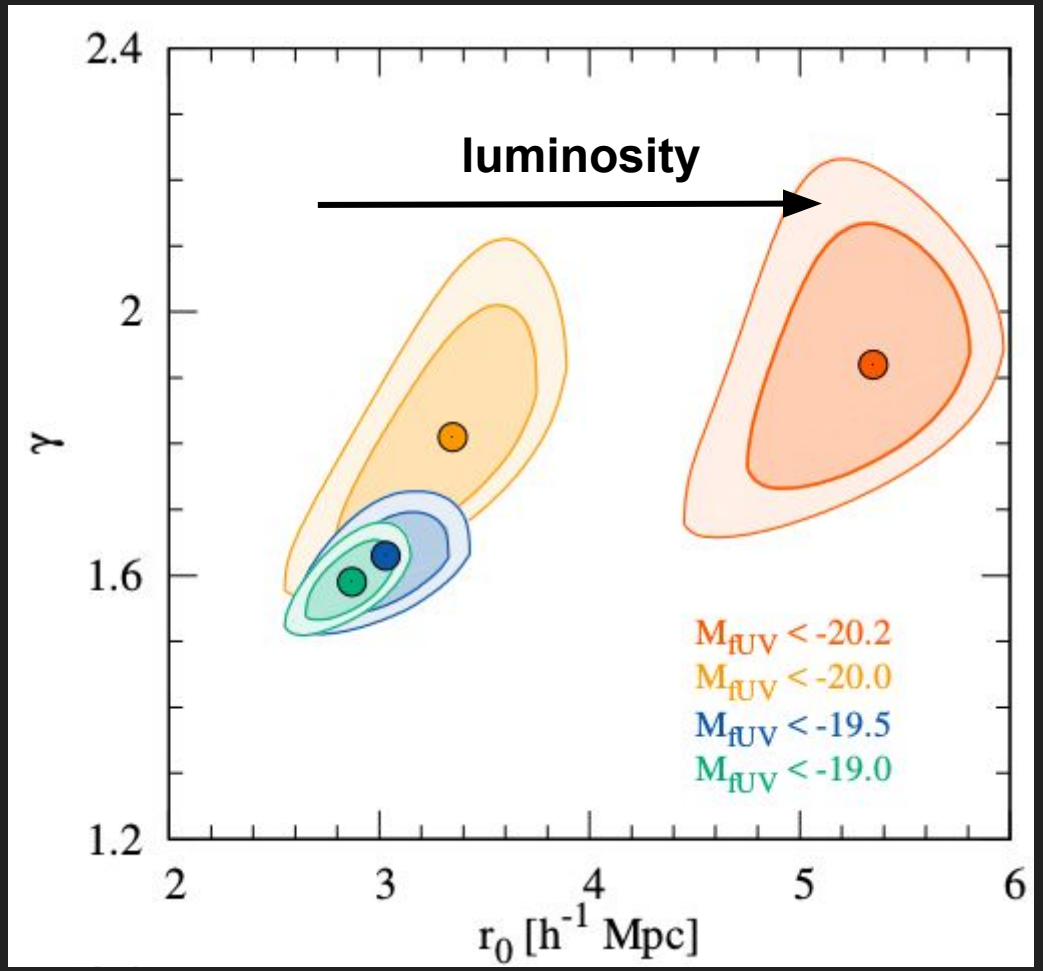




Stellar mass

GALAXY CLUSTERING DEPENDENCIES

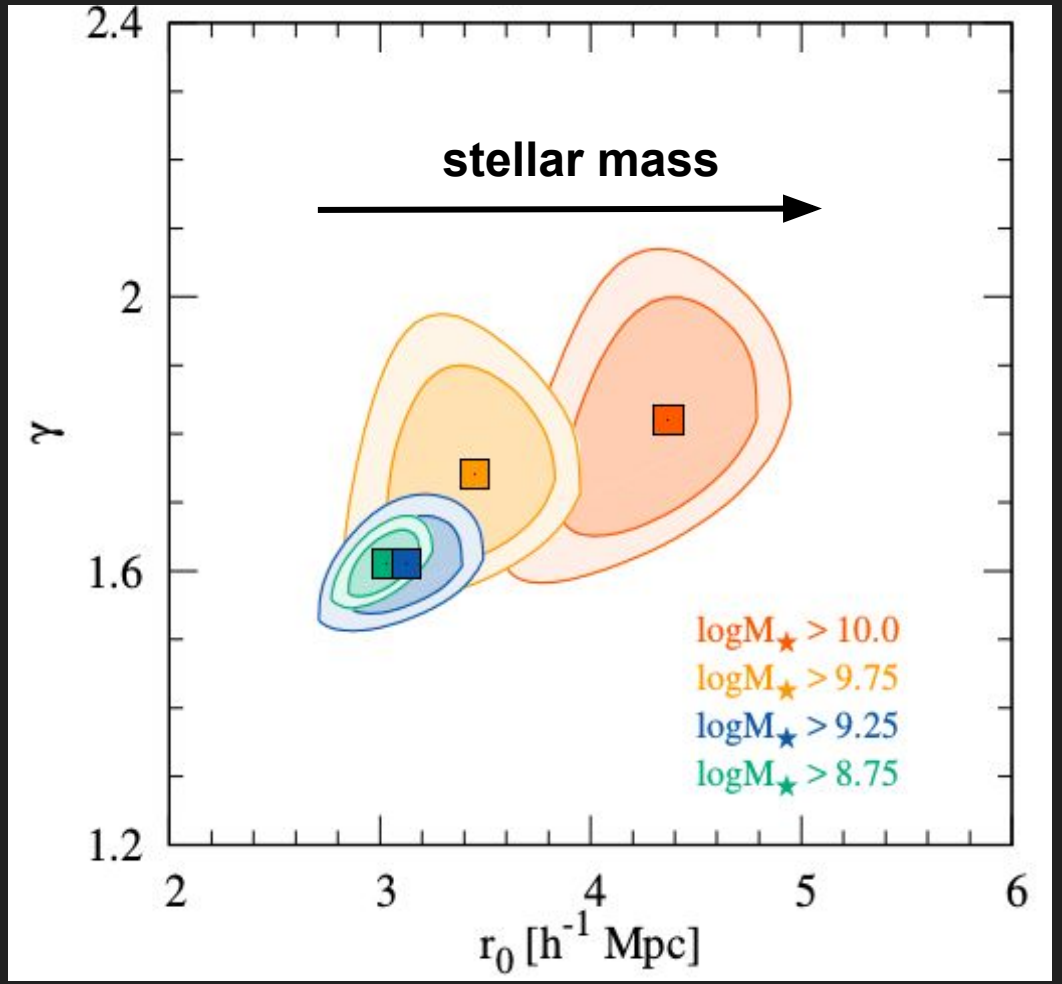
Correlation length r_0 at z~3



Durkalec et al. 2018, A&A 612A, 42D

GALAXY CLUSTERING DEPENDENCIES

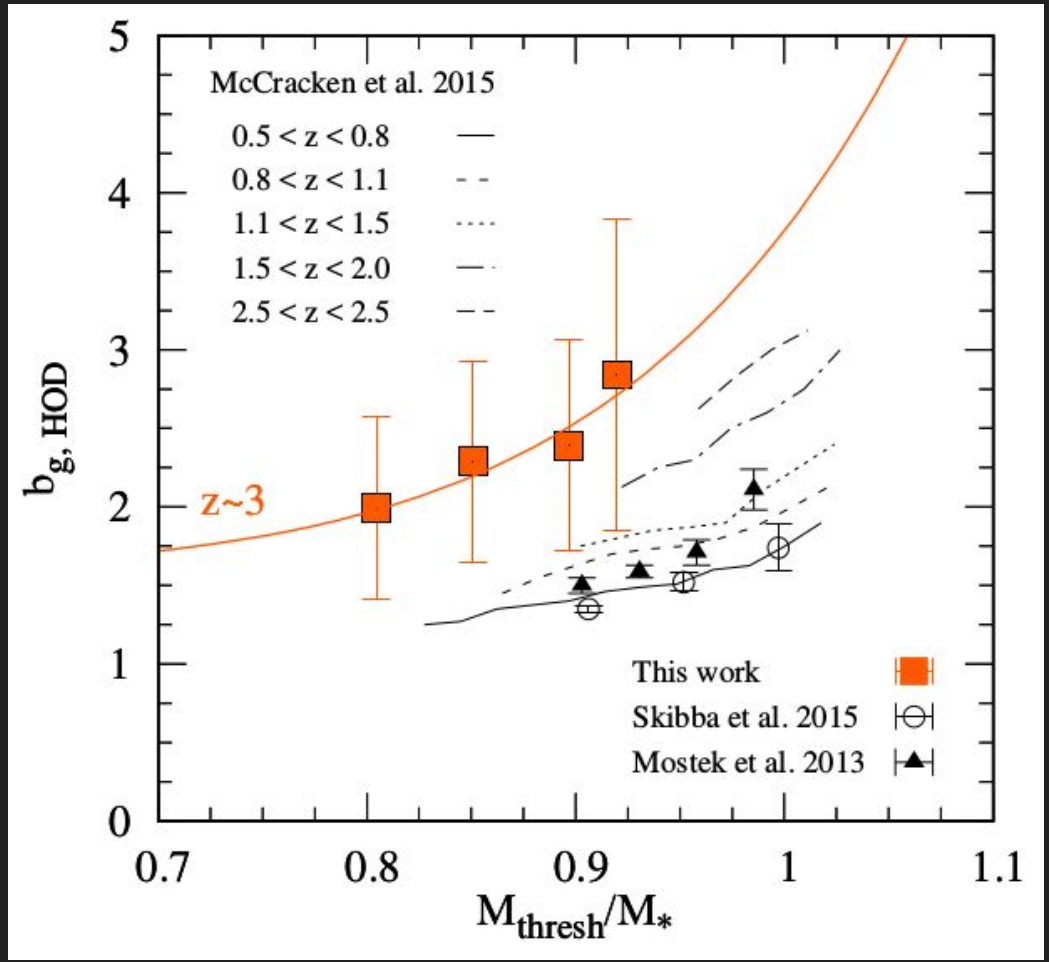
Correlation length r_0 at z~3



Durkalec et al. 2018, A&A 612A, 42D

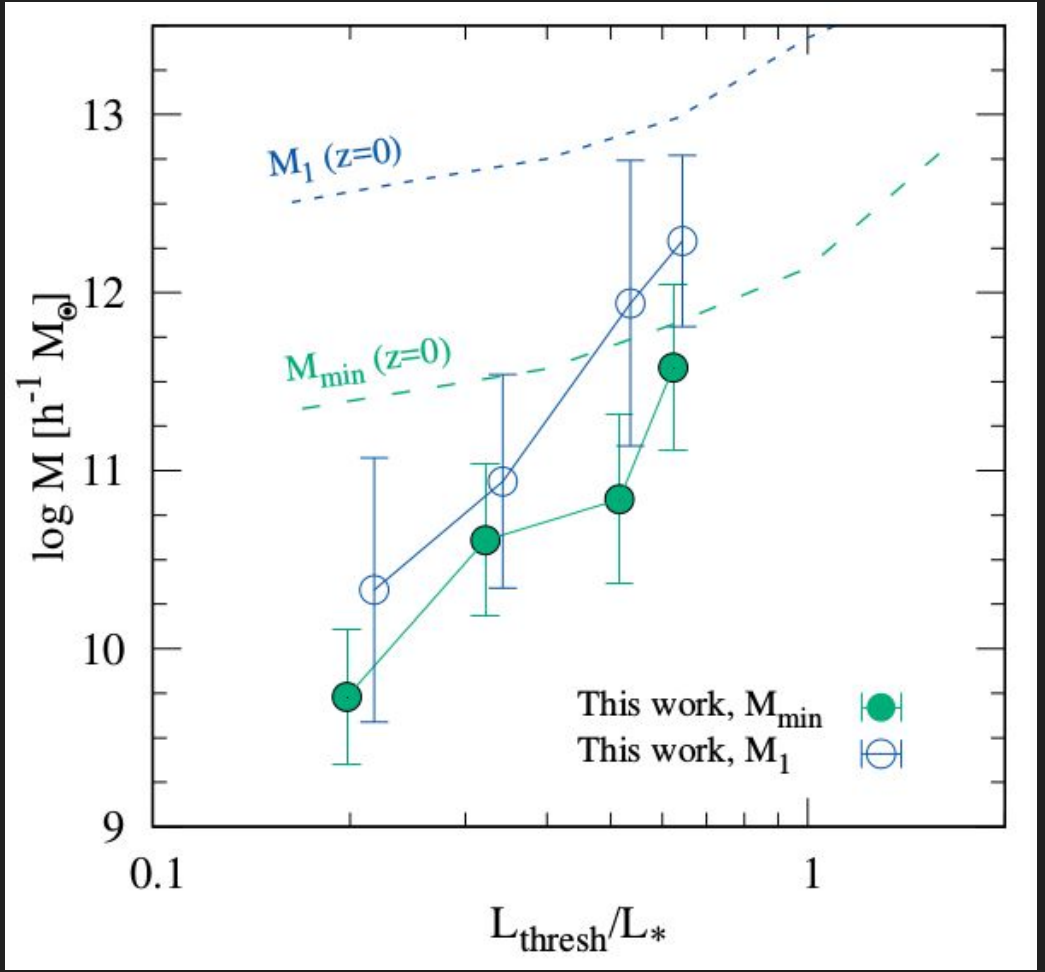
LARGE SCALE GALAXY BIAS

Redshift AND luminosity and stellar mass dependence



Durkalec et al. 2018, A&A 612A, 42D

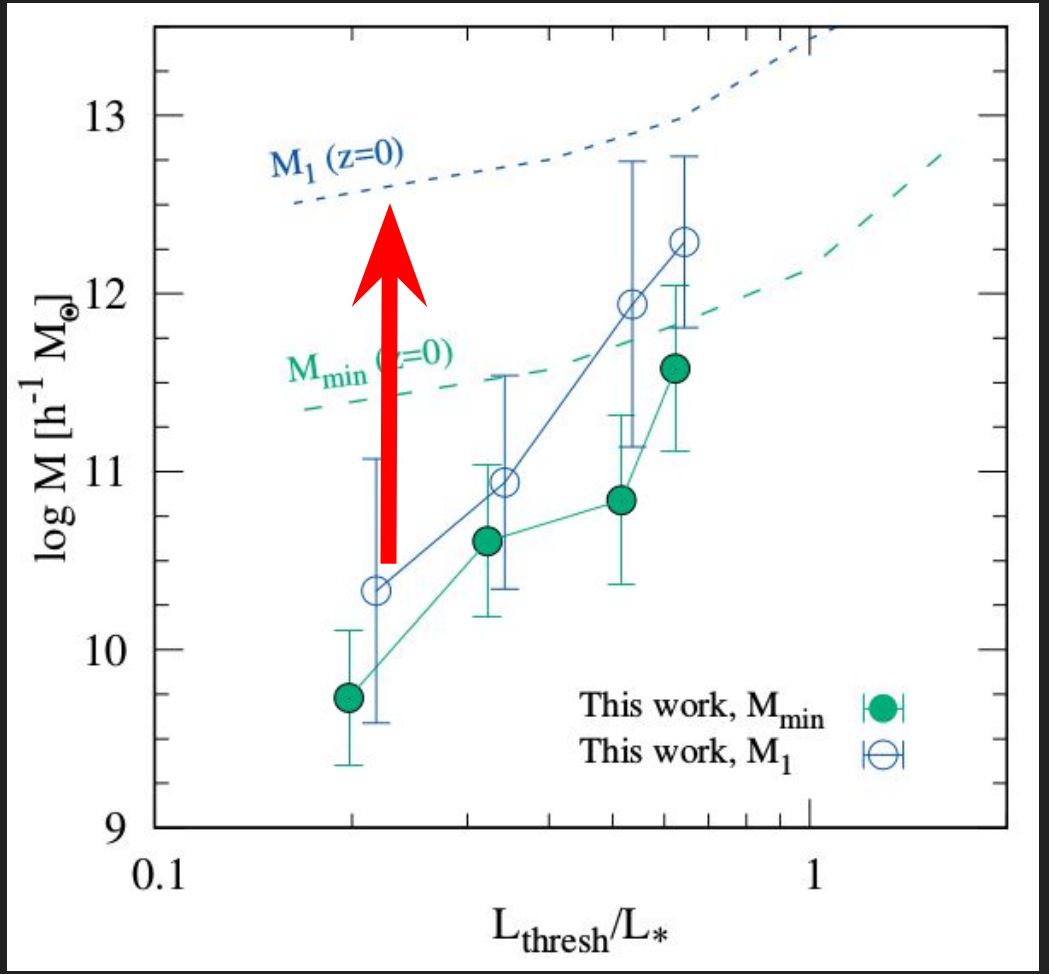
DARK MATTER
HALO MASSES



Durkalec et al. 2018, A&A 612A, 42D

DARK MATTER
HALO MASSES

Build up of dark matter haloes masses with cosmic time

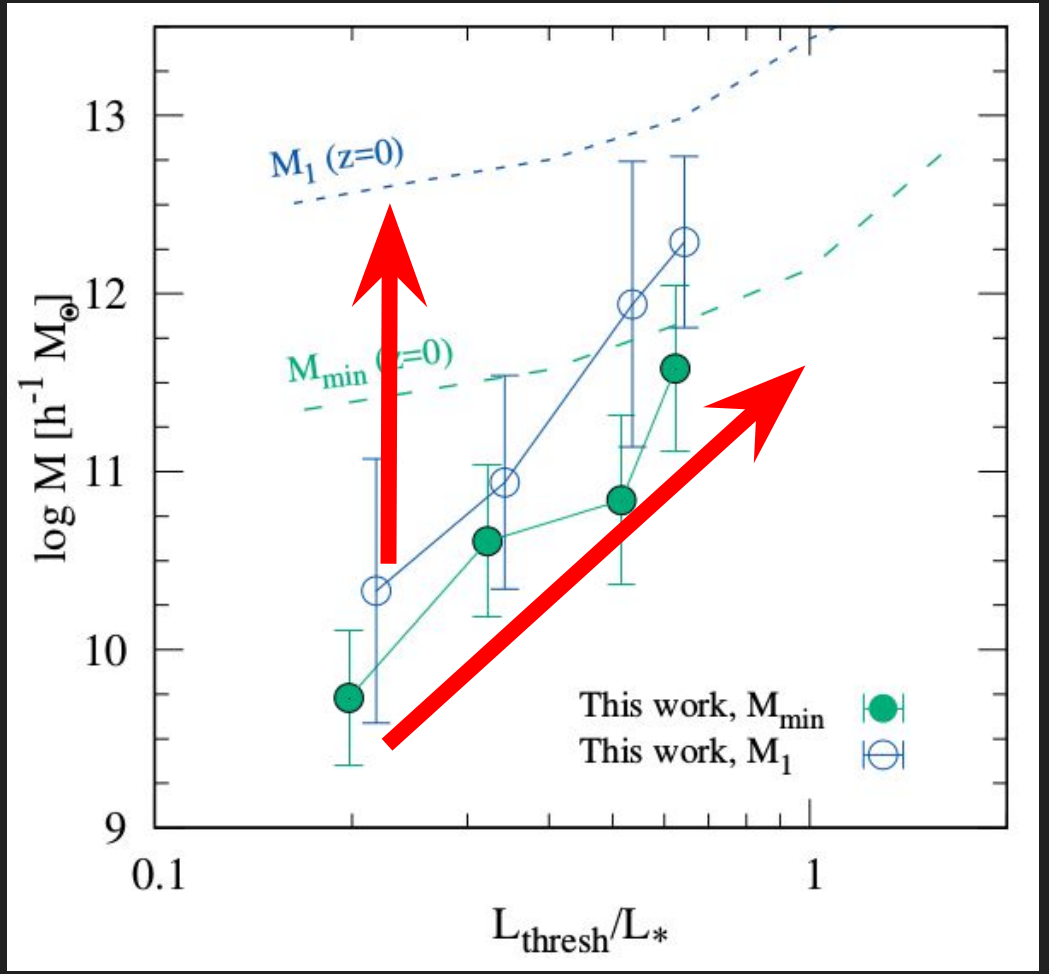


Durkalec et al. 2018, A&A 612A, 42D

DARK MATTER
HALO MASSES

Build up of dark matter haloes masses with cosmic time

Growth with rising luminosity and stellar mass of galaxy population



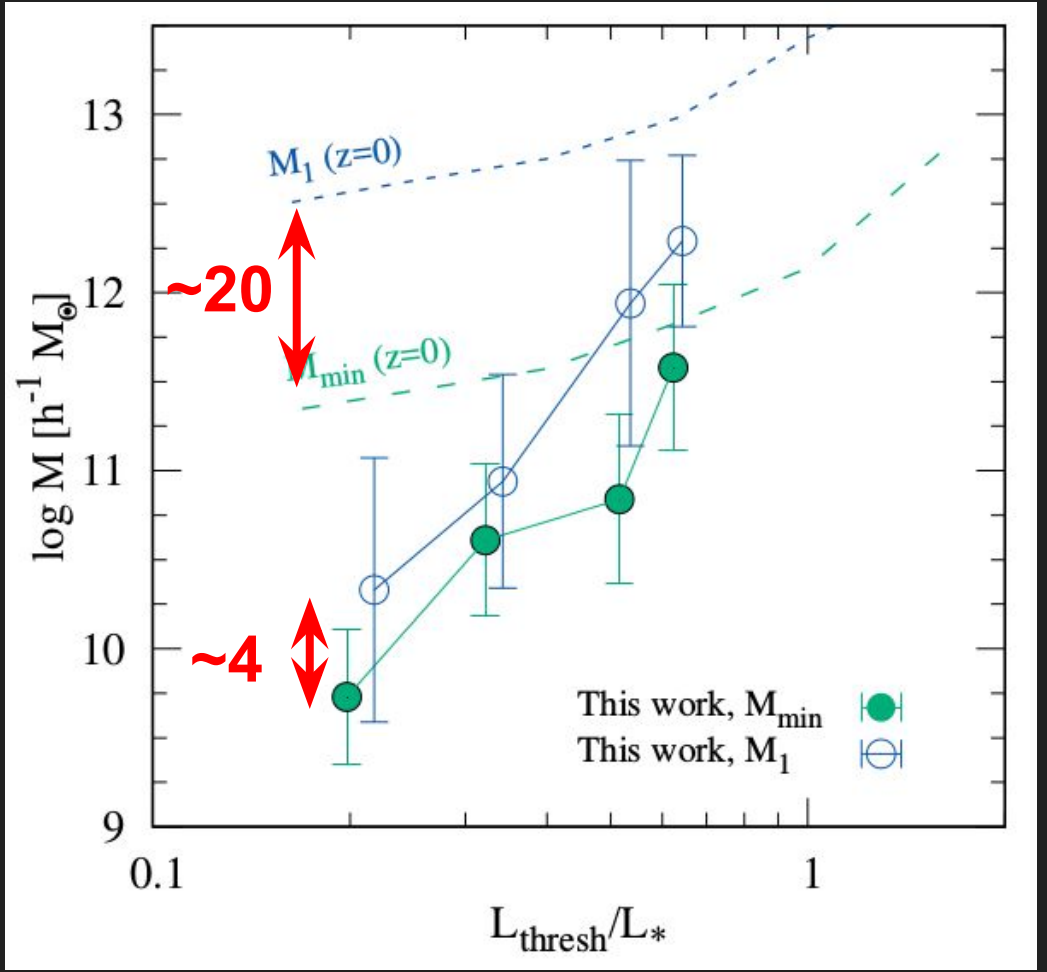
Durkalec et al. 2018, A&A 612A, 42D

DARK MATTER
HALO MASSES

Build up of dark matter haloes masses with cosmic time

Growth with rising luminosity and stellar mass of galaxy population

M_1/M_{min} ratio



Durkalec et al. 2018, A&A 612A, 42D

Halo mergers create satellites, galaxy mergers destroy them

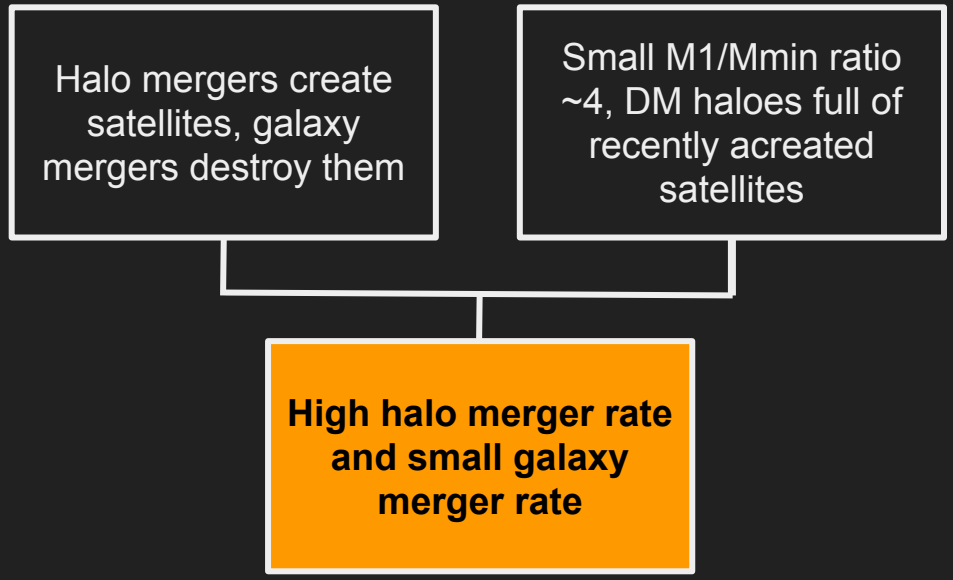
WHAT DOES SMALL M_1/M_{min} RATIO MEAN?

WHAT DOES SMALL M_1/M_{min} RATIO MEAN?

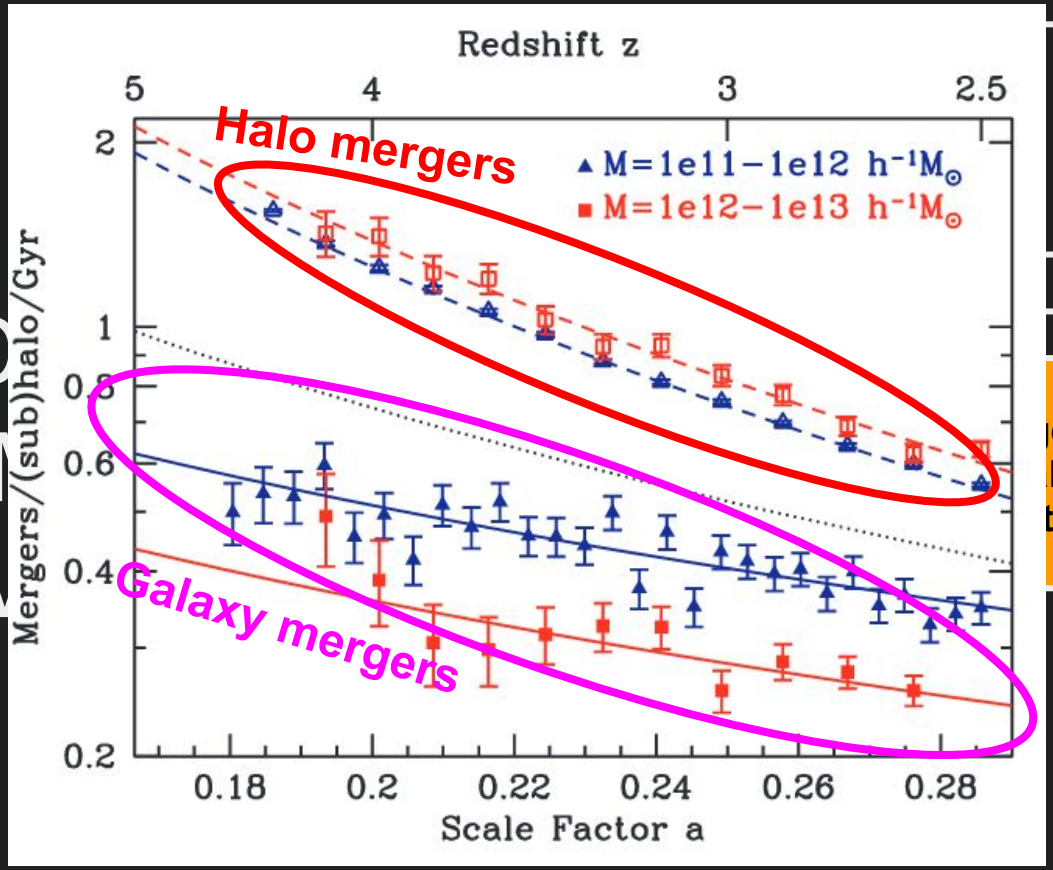
Halo mergers create satellites, galaxy mergers destroy them

Small M1/Mmin ratio ~4, DM haloes full of recently acreated satellites

WHAT DOES SMALL M_1/M_{min} RATIO MEAN?



WHAT D
SMALL M
RATIO M

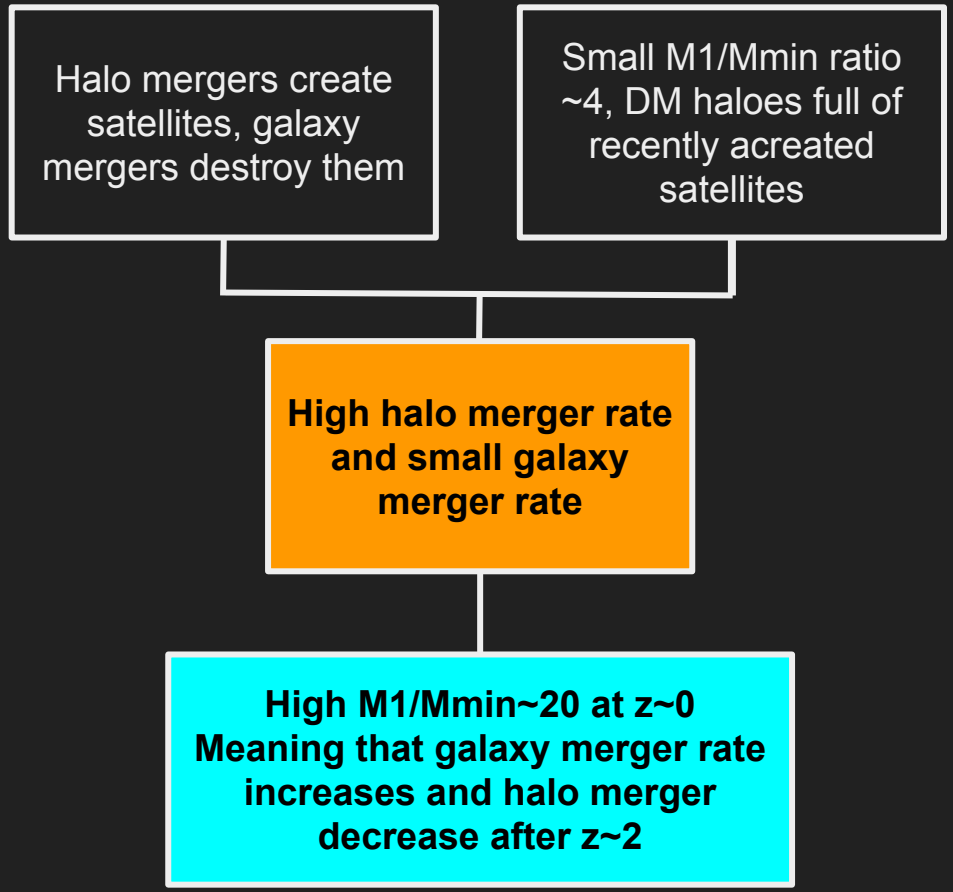


Small M1/Mmin ratio ~4, DM haloes full of recently acreated satellites

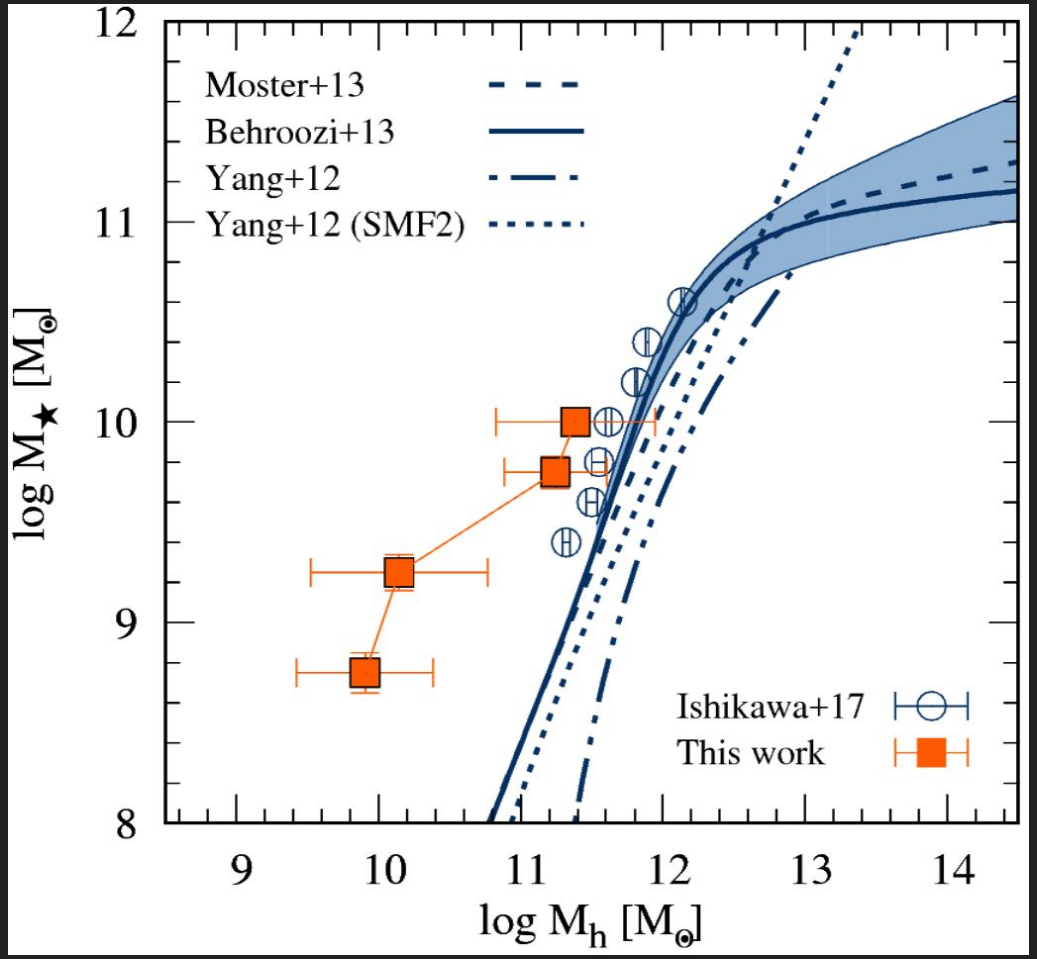
er rate
laxy
te

Fig: Wetzel+2009

WHAT DOES SMALL M_1/M_{min} RATIO MEAN?

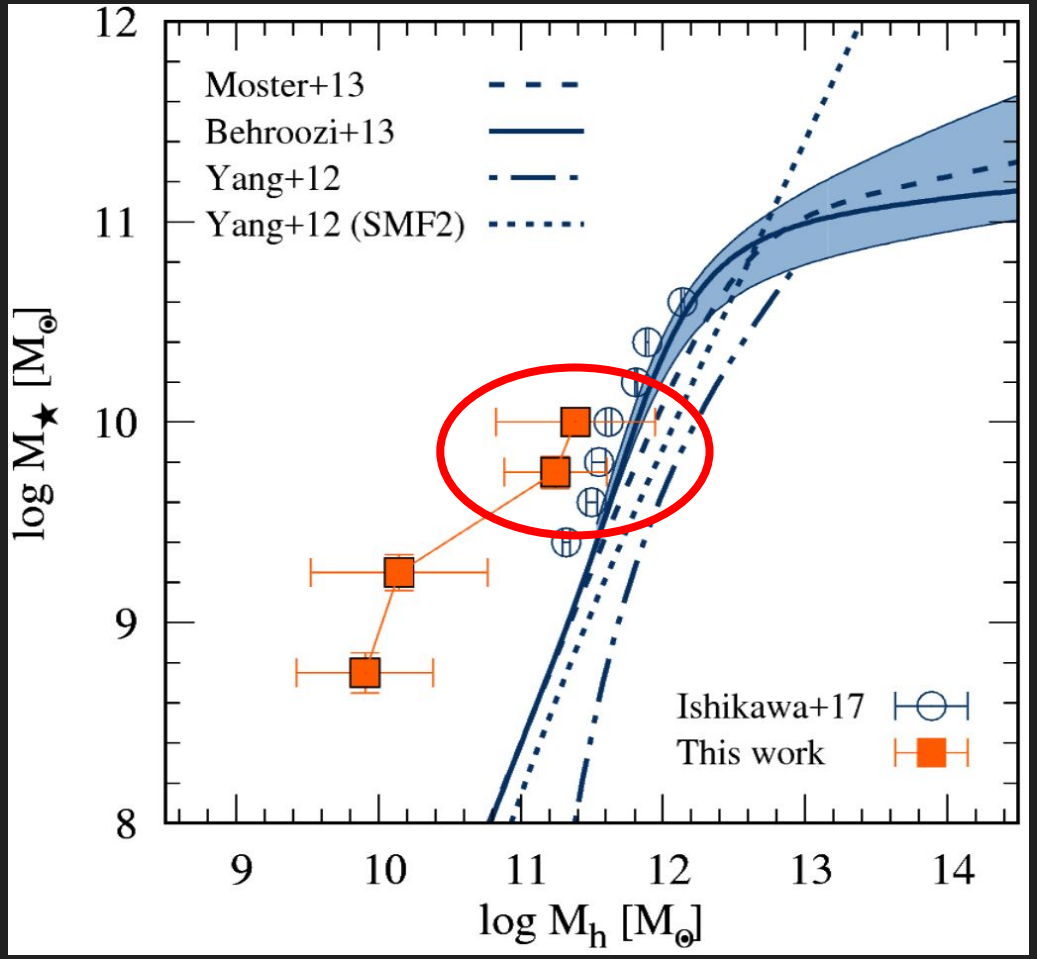


STELLAR TO HALO MASS RATIO



Durkalec et al. 2018, A&A 612A, 42D

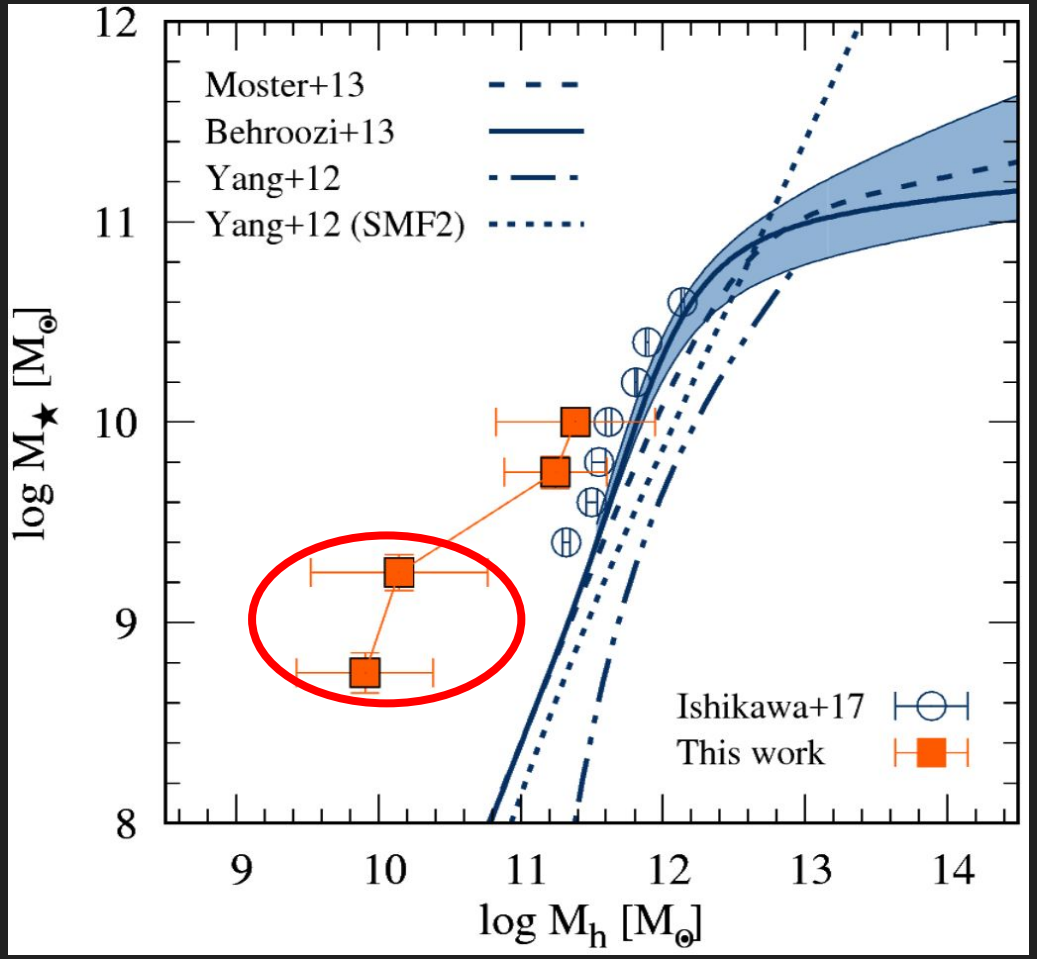
STELLAR TO HALO MASS RATIO



Durkalec et al. 2018, A&A 612A, 42D

STELLAR TO HALO MASS RATIO

Dark matter halos less massive than expected

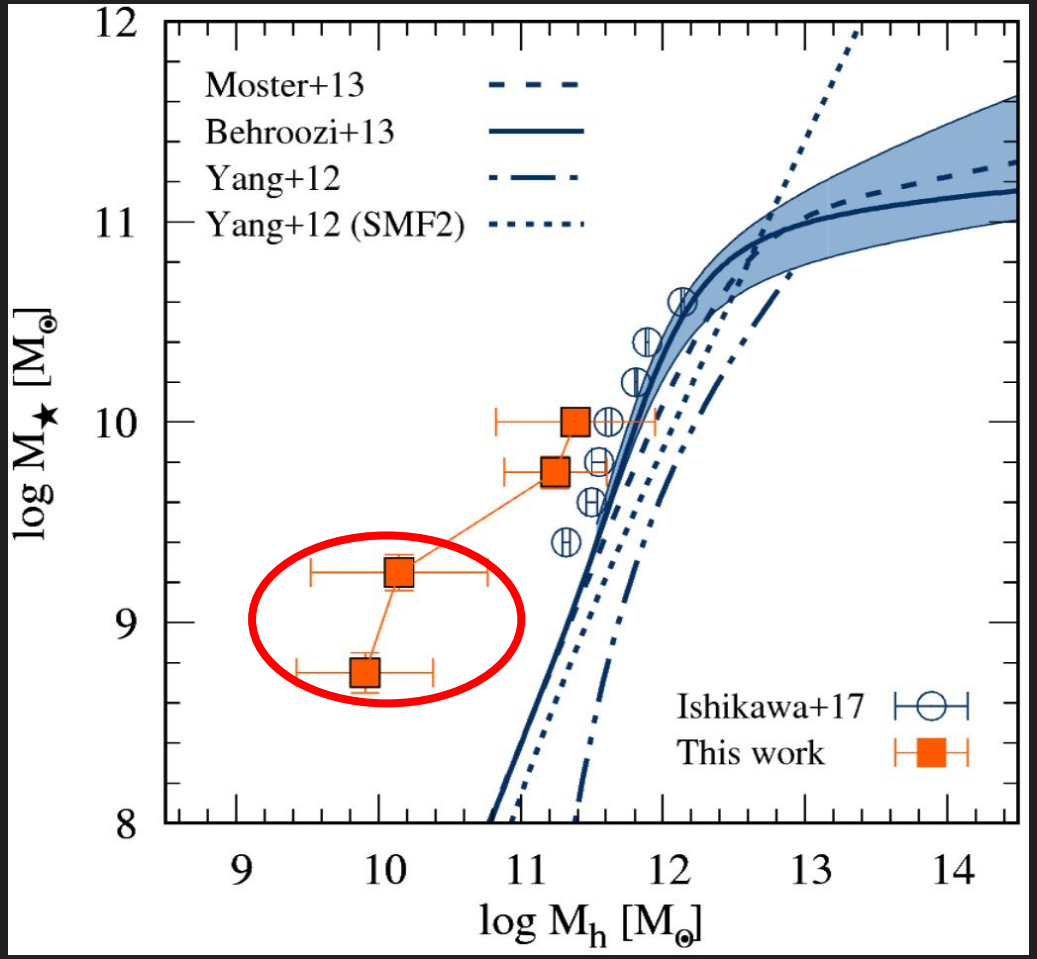


Durkalec et al. 2018, A&A 612A, 42D

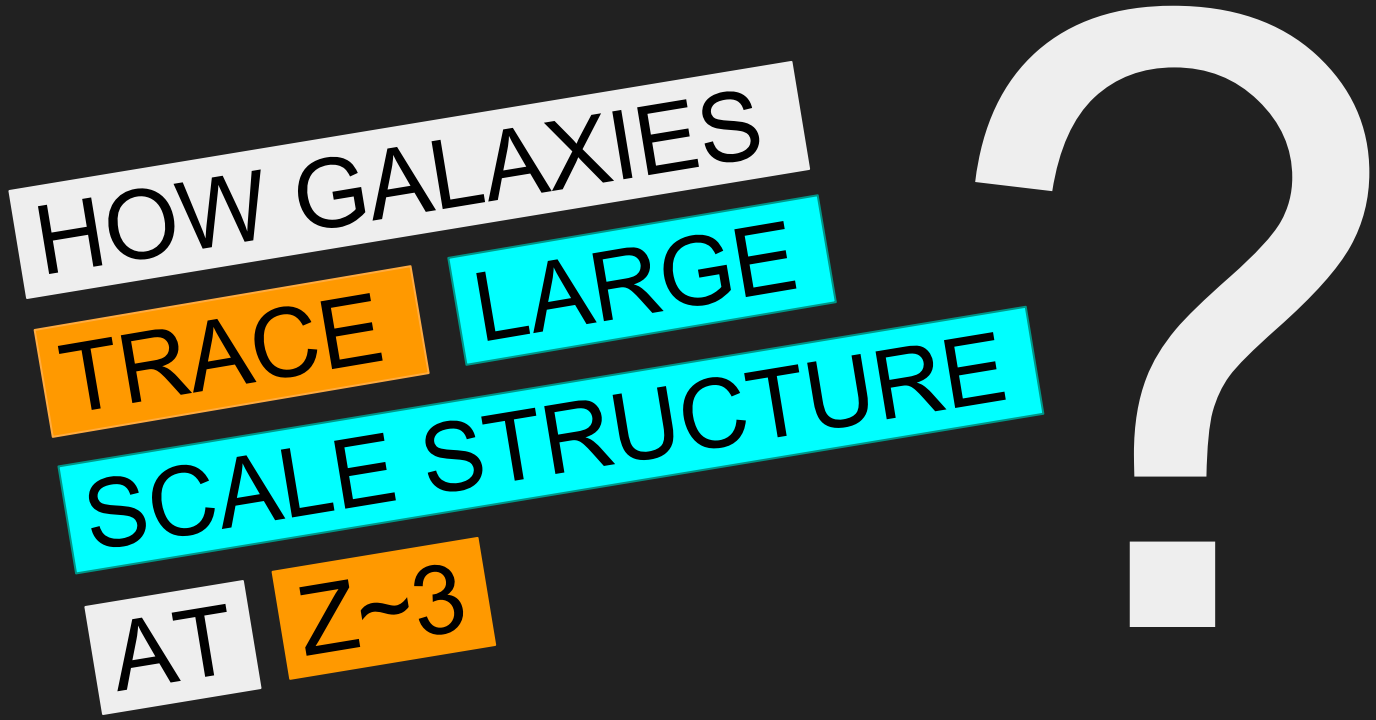
STELLAR TO HALO MASS RATIO

Dark matter halos less massive than expected

Feedback?
Dark (empty) halos?



Durkalec et al. 2018, A&A 612A, 42D


HOW GALAXIES
TRACE LARGE
SCALE STRUCTURE
AT Z~3
?

WELL… IT’S COMPLICATED

TAKE AWAY MESSAGES

We observe luminosity and stellar mass dependence of galaxy clustering at z~3.

Large scale galaxy bias depend on luminosity and stellar mass and redshift.

The same goes for dark matter halo masses.

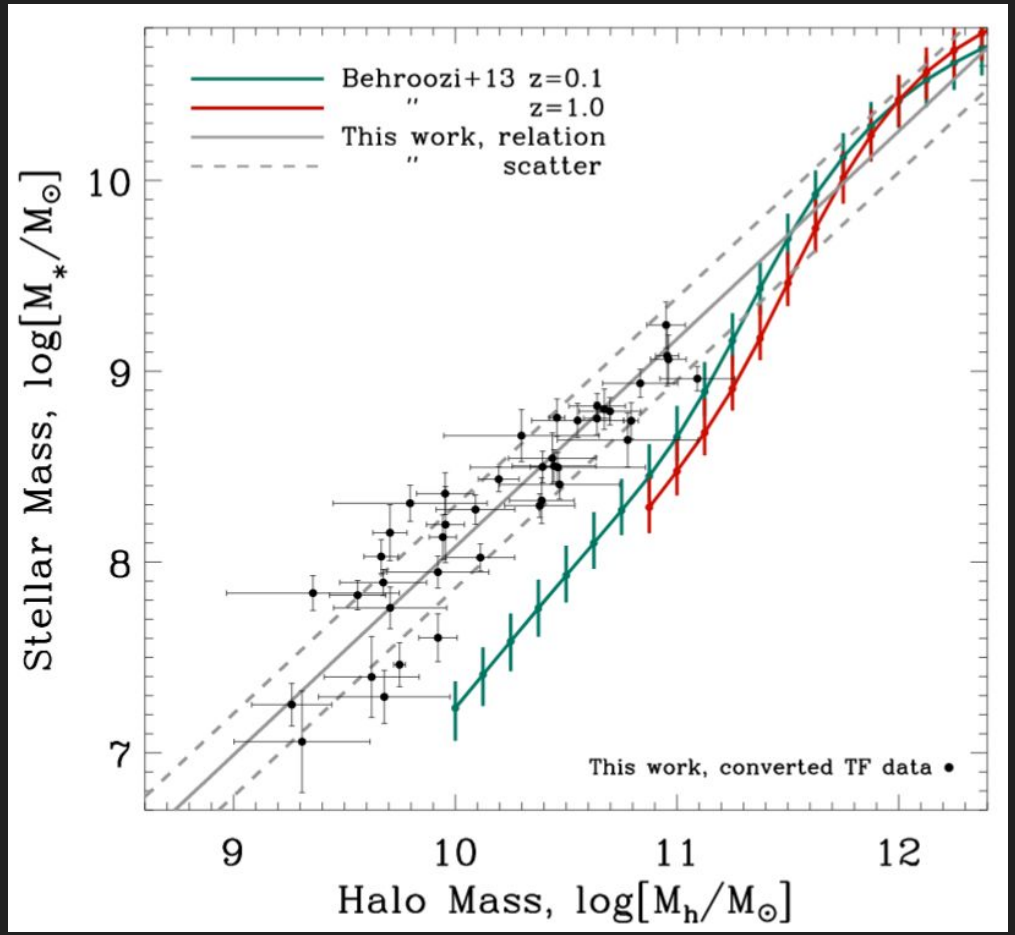
There is a lot of satellite galaxies at z~3.

Stellar to halo mass relation might get complicated at z~3. Low mass galaxies can be found in unexpectedly low mass halos and they forming stars more efficiently.

THANK YOU!

Special thanks to:
Olivier Le Fevre (LAM)
Agnieszka Pollo (NCBJ)
and the VUDS team

Interested? There is more! Check out
Durkalec et al. 2015, A&A, 583A, 128D
Durkalec et al. 2018, A&A, 612A, 42D



Miller et al. 2014, ApJ, 782, 115M