Understanding the Formation and Evolution of Dark Galaxies in a Simulated Universe

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Introduction

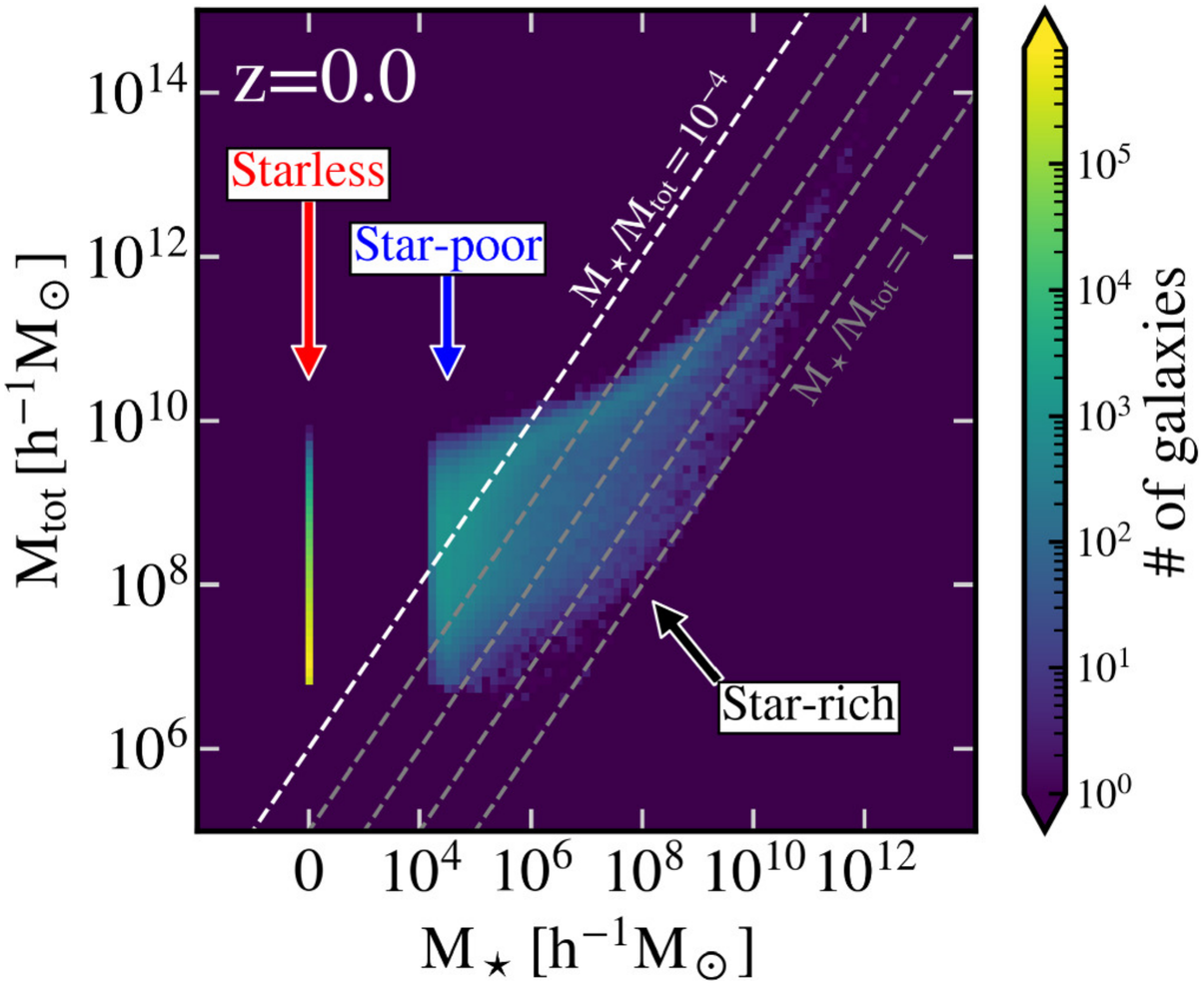
WHAT IS Dark Galaxy?

- Being made up almost entirely of dark matter, with little or no stars.

WHY WE STUDY?

- Test the ΛCDM model
- Missing satellite problem?
- The nature of dark matter

Methodology



IllustrisTNG50

Criterion: $M_\star/M_{tot} = 10^{-4}$

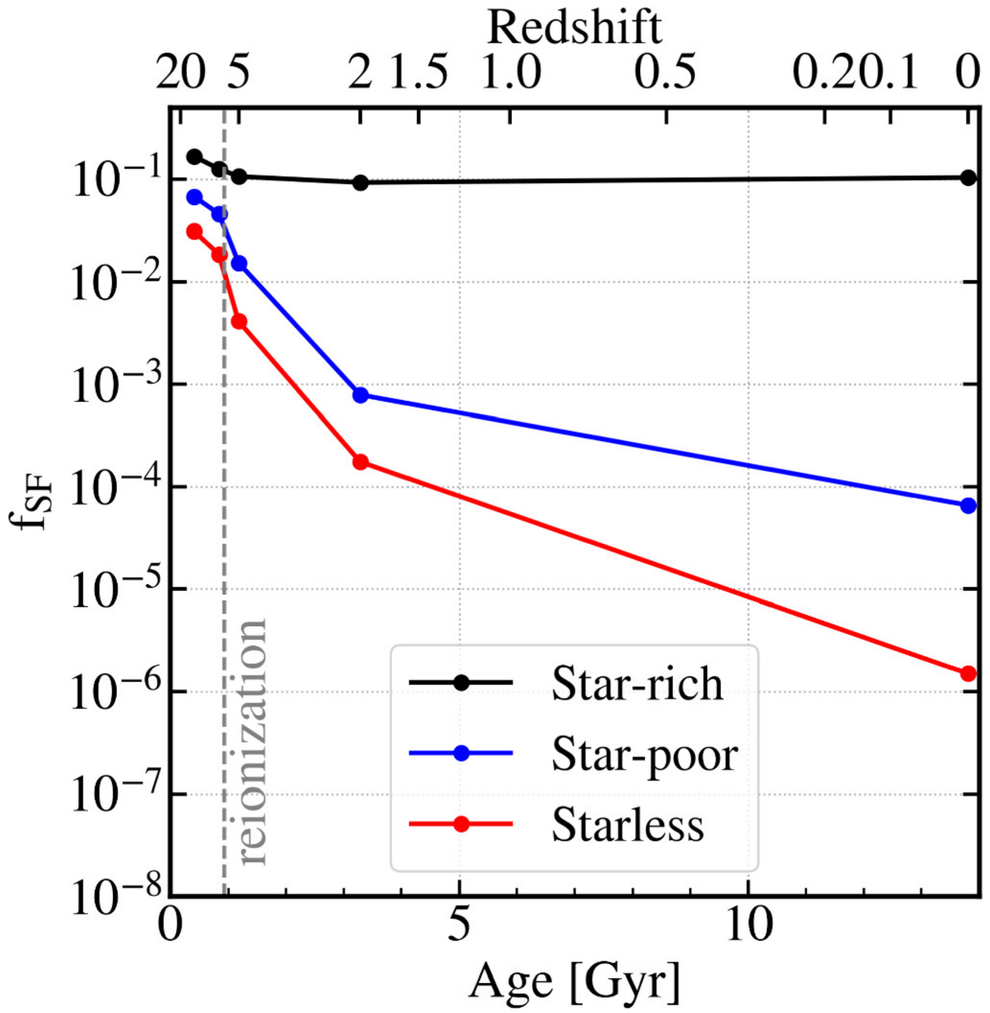
Luminous galaxies:

Star-rich

Dark galaxies:

Star-poor & Starless

Star-forming Gas Fraction



$$f_{SF} = M_{gas,SF}/M_{gas,tot}$$

Cosmic reionization (z=6)

Luminous: maintain constant
Dark galaxies: decrease

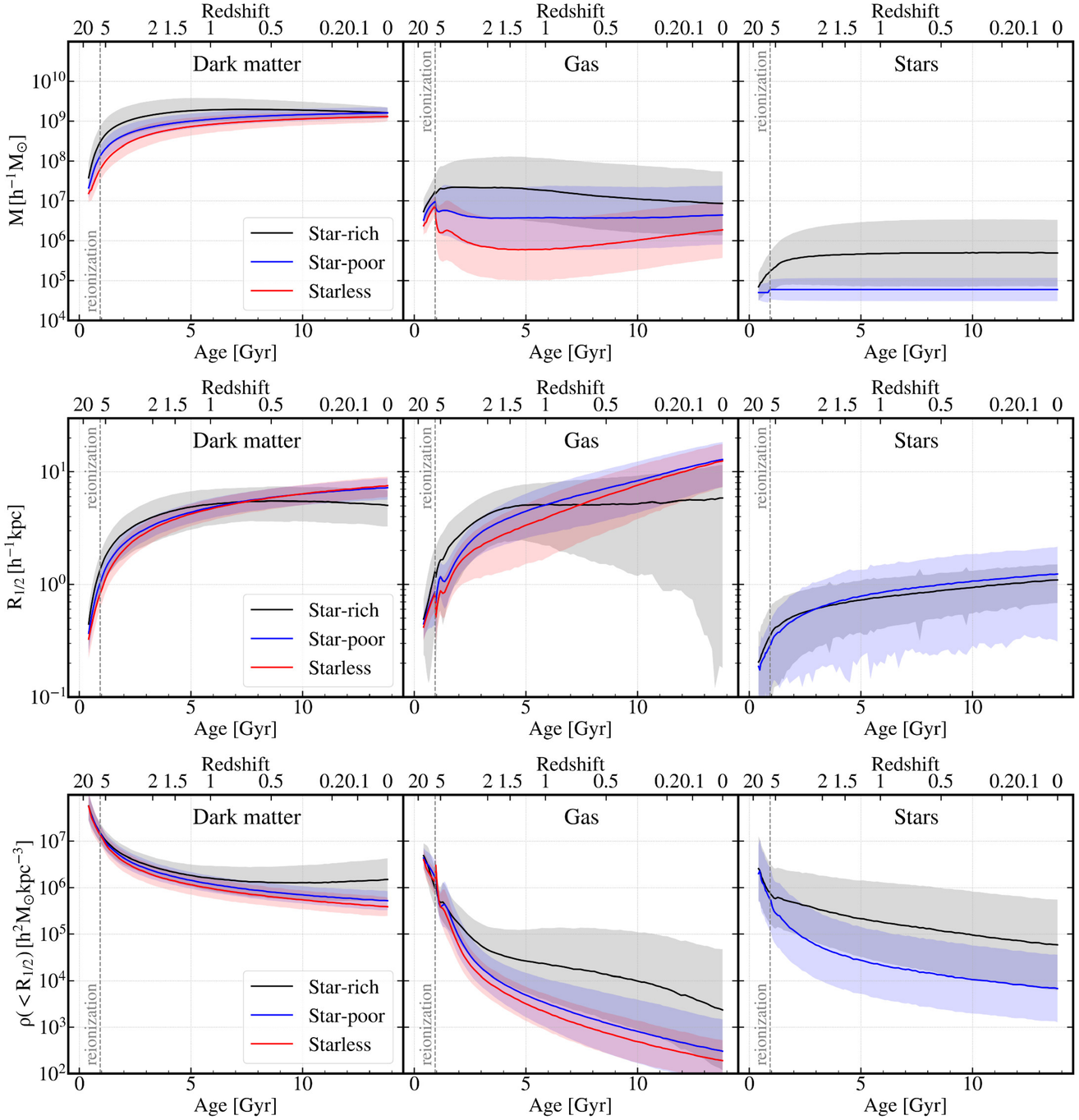
- Low amount of available SF gas
- Low density environment

Mass, Size, Density

$$M[h^{-1}M_{\odot}]$$

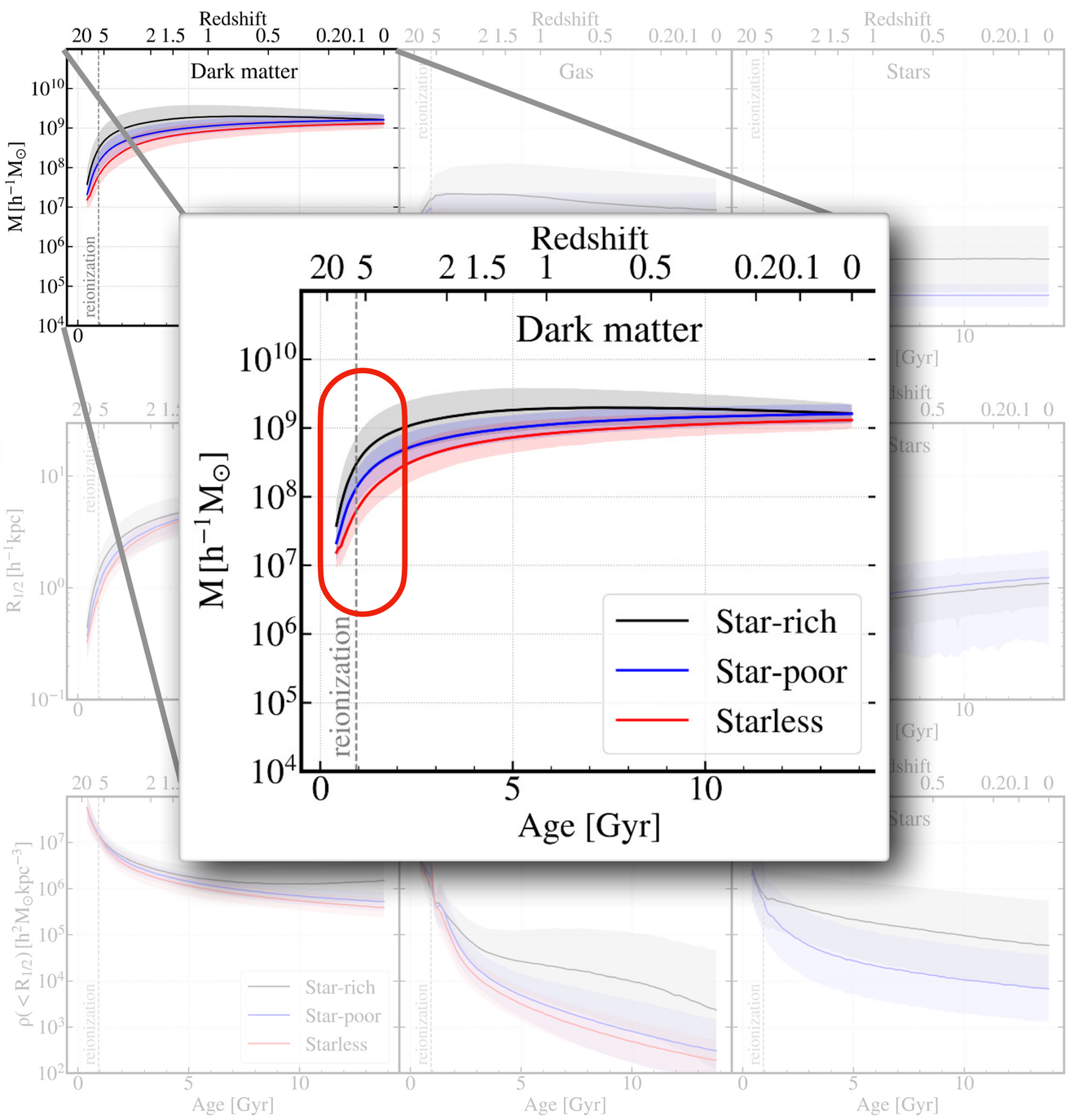
$$R_{1/2}[h^{-1}kpc]$$

$$\rho(<R_{1/2})[h^{2}M_{\odot}kpc^{-3}]$$



Mass, Size, Density

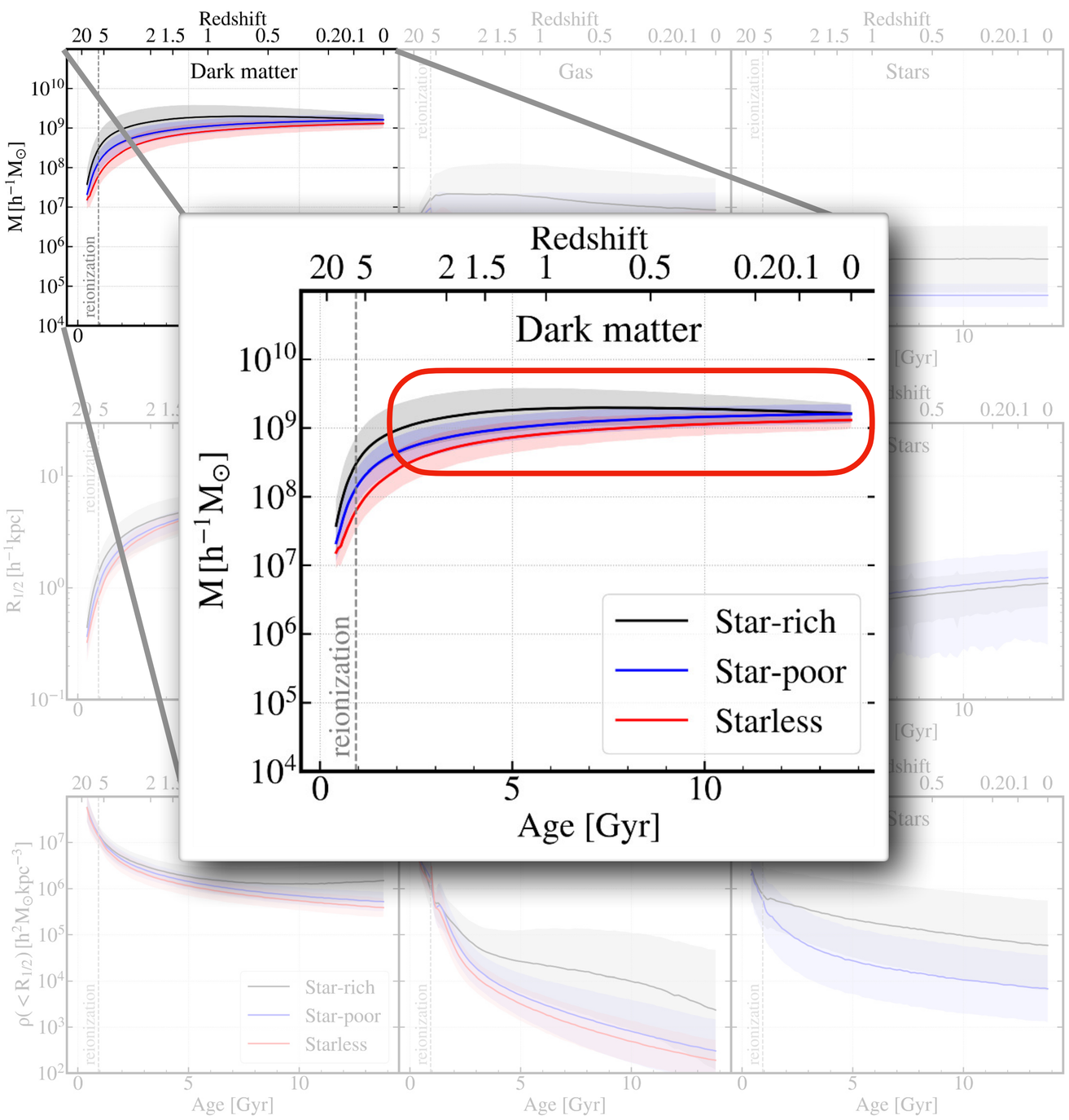
More efficient accretion and merging events in earlier cosmic epochs



Mass, Size, Density

Stripping

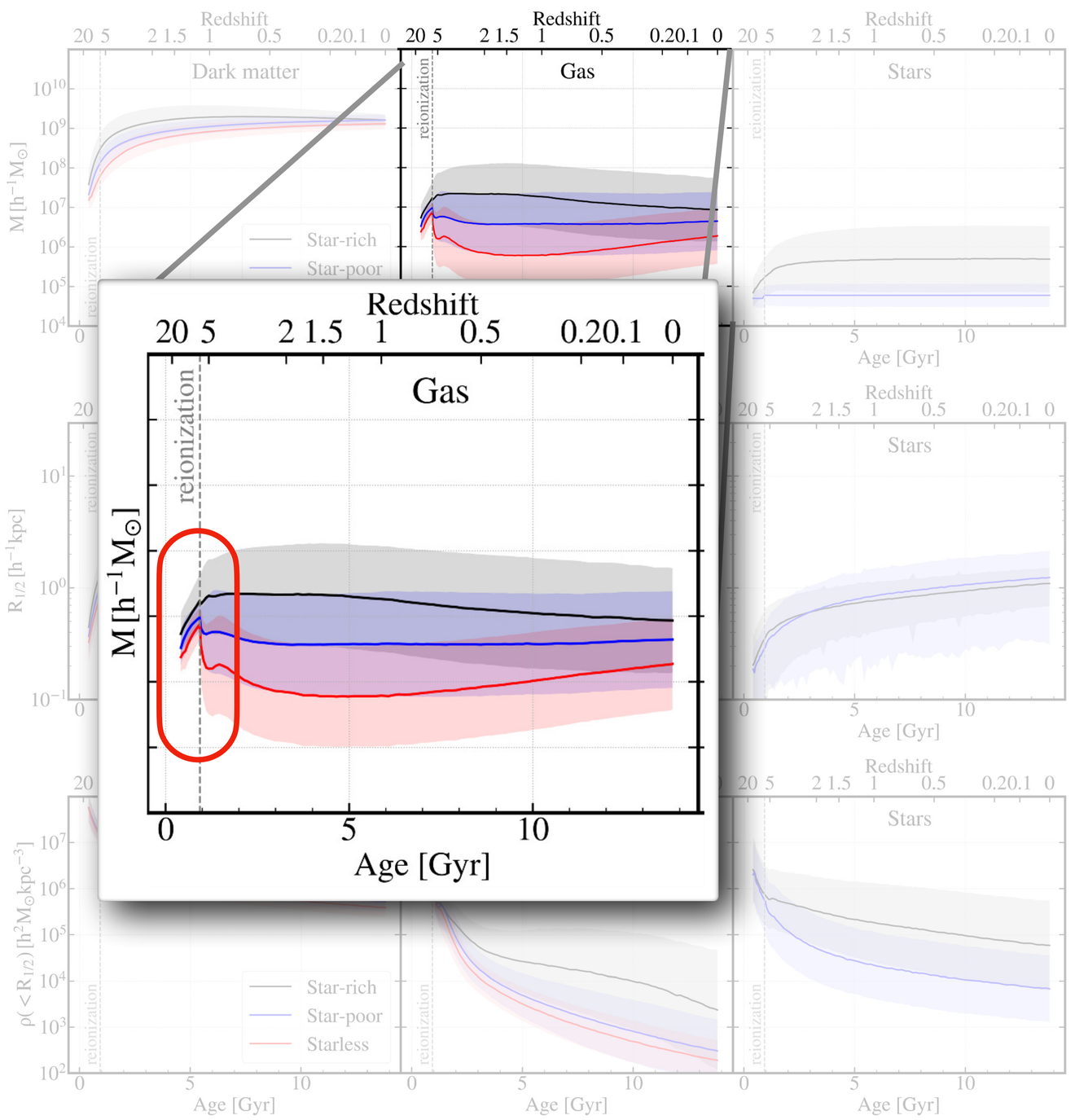
Dark matter is gradually pulled in to larger neighbouring halos



Mass, Size, Density

Sharply Decrease

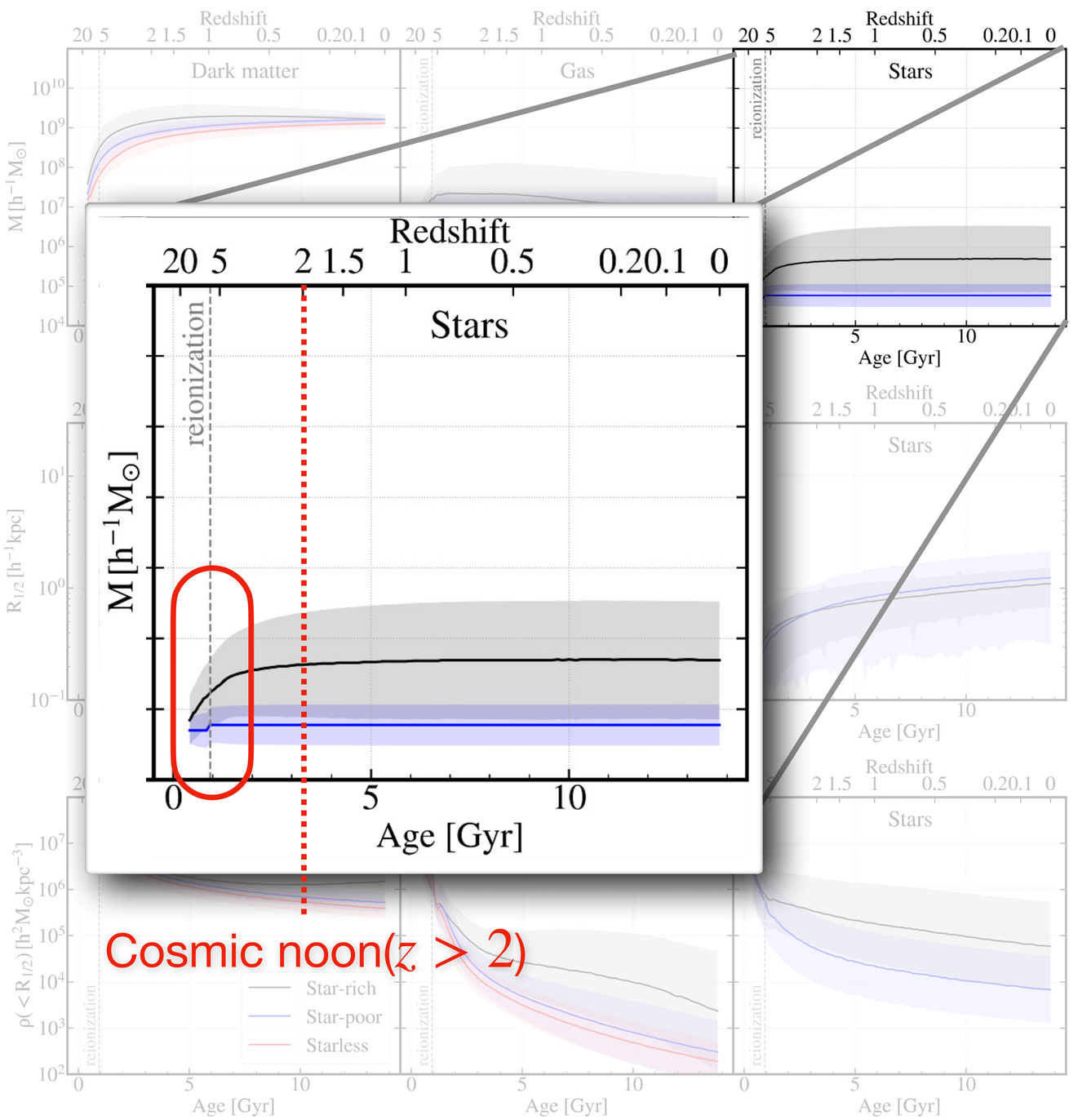
Cosmic Reionization



Mass, Size, Density

Initially posses small number of star particles

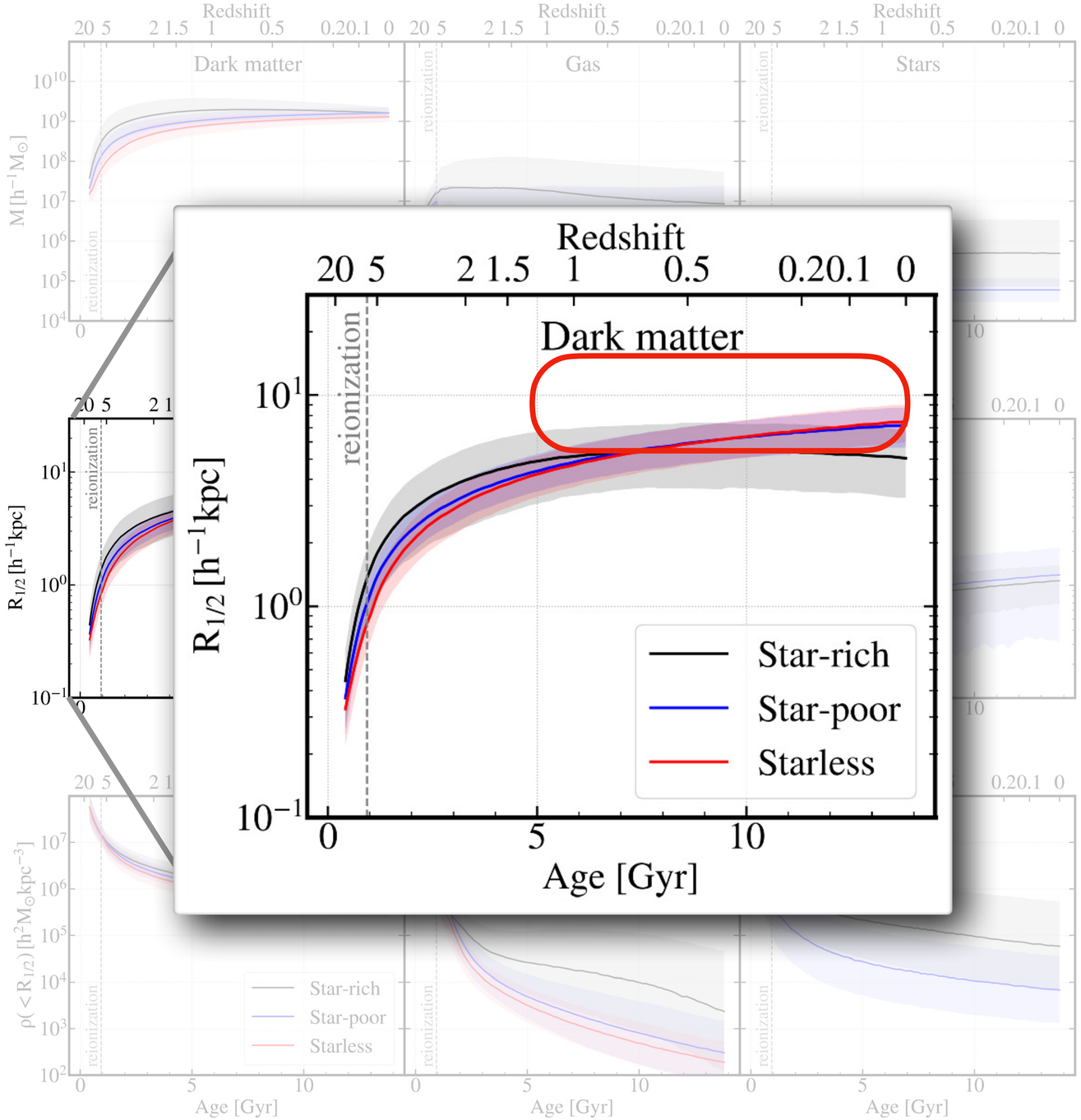
Fail to form new ones



Mass, Size, Density

Expand

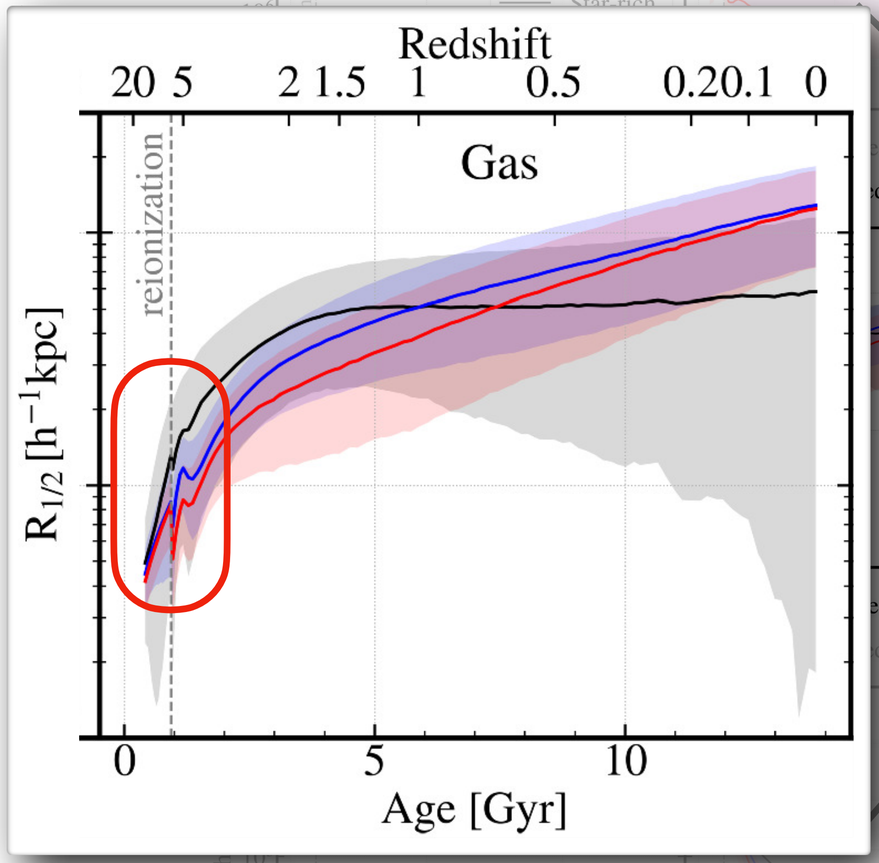
Contraction



Mass, Size, Density

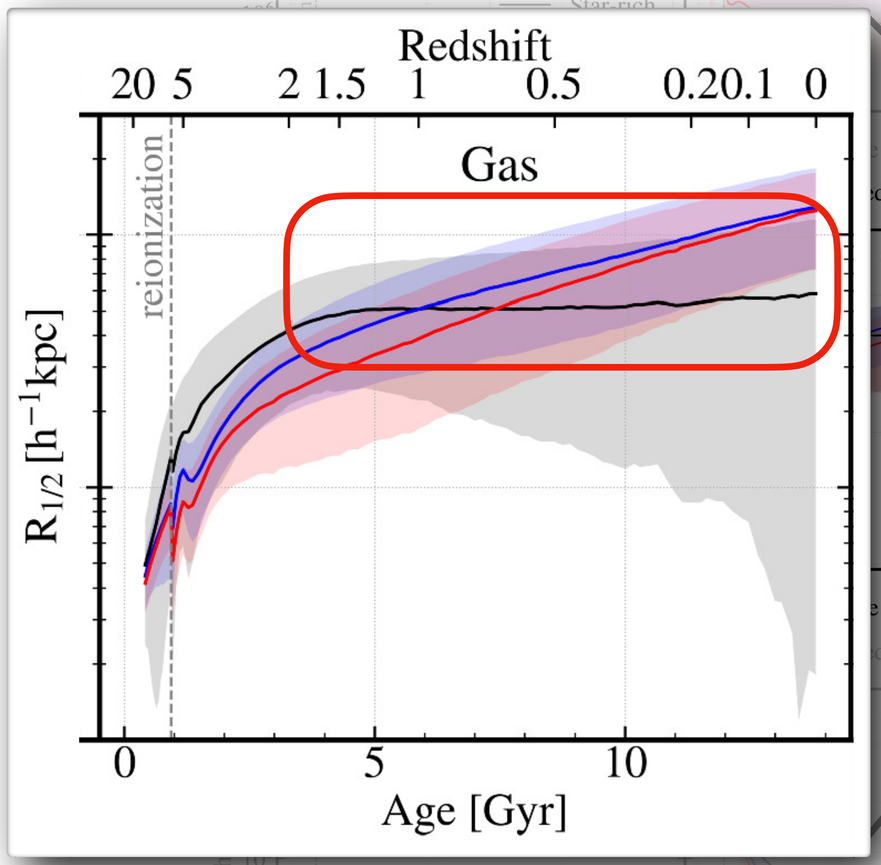
Subtantial reduction

Cosmic reionization

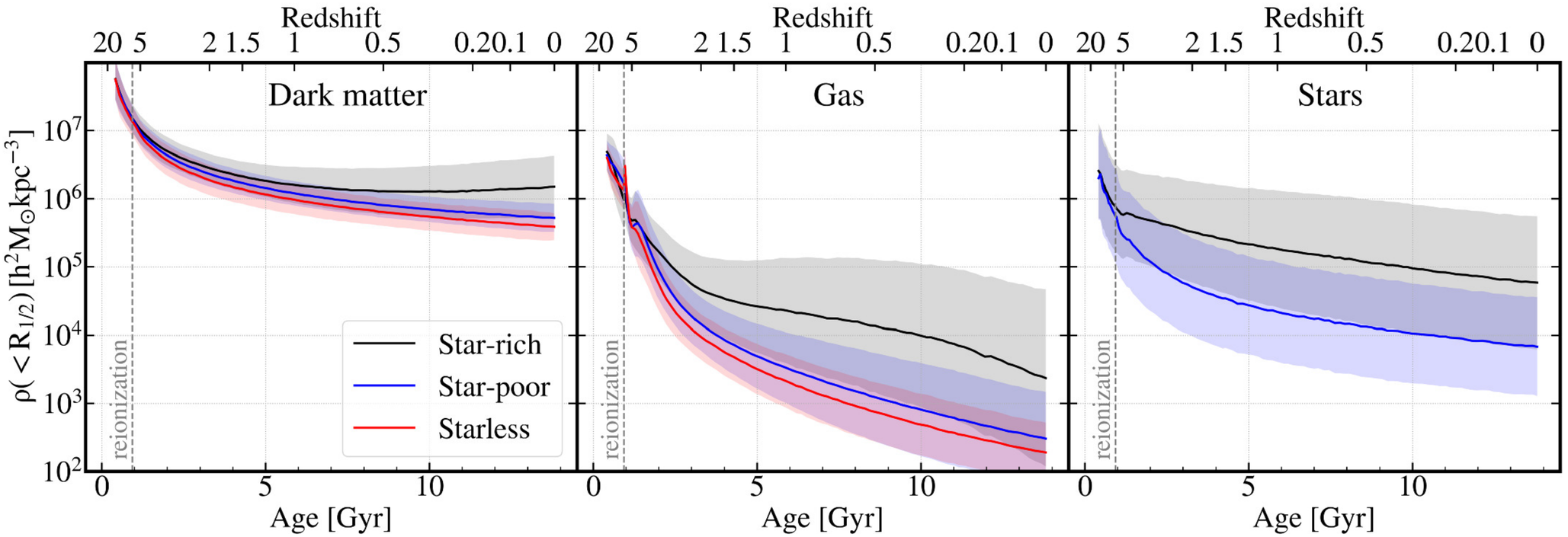


Mass, Size, Density

Transfer angular momentum through interactions with other galaxies

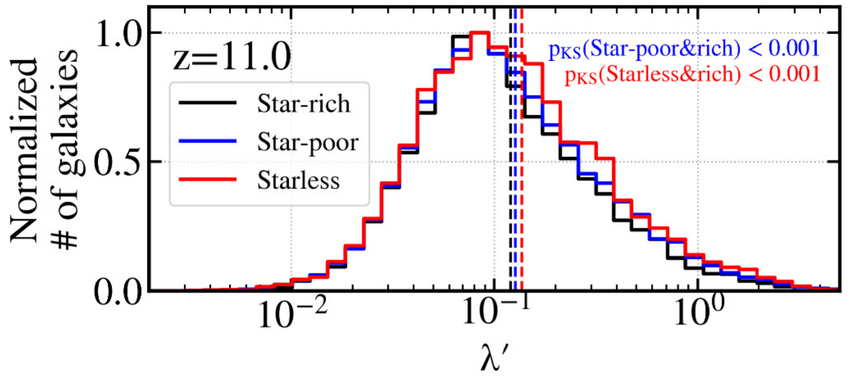


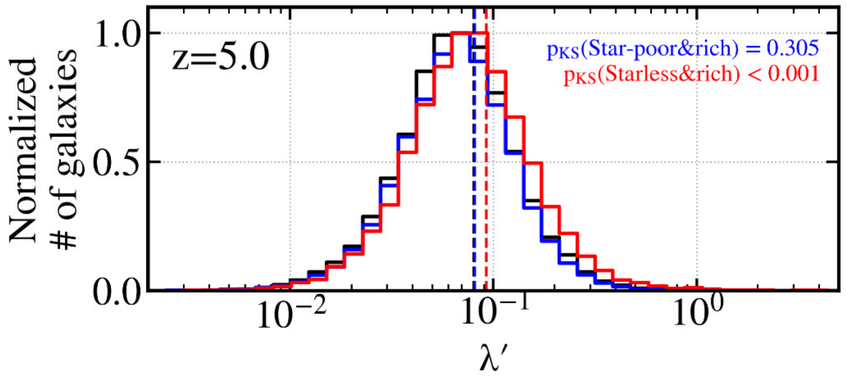
Mass, Size, Density

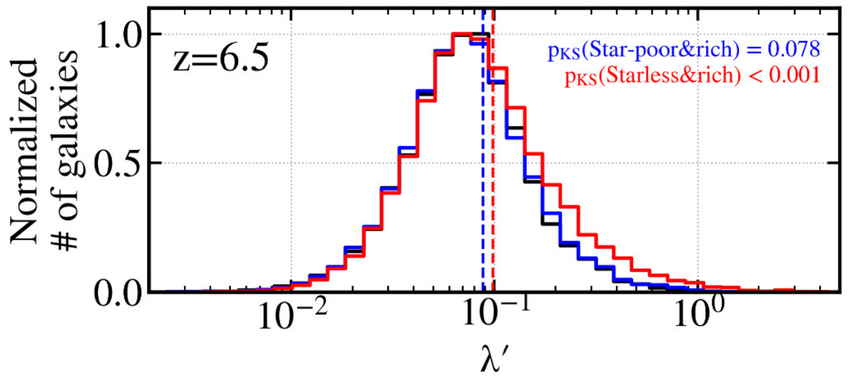


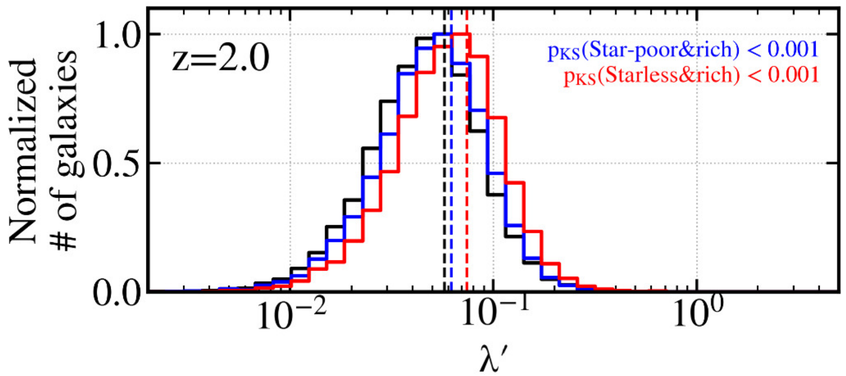
Luminous galaxies are denser in three components

Spin Parameters





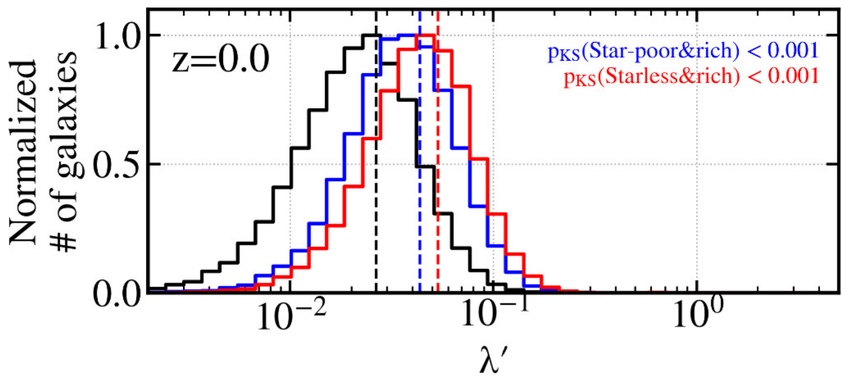




$$\lambda' = \frac{|J|}{\sqrt{2}MRV}$$

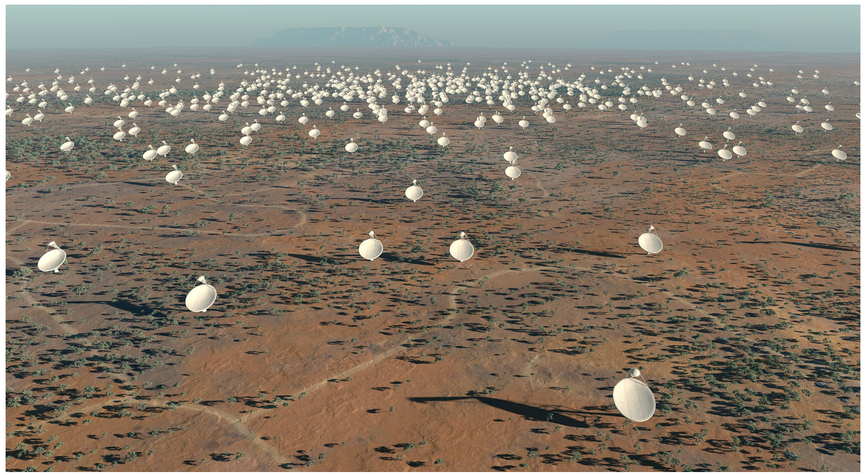
Angular momentum of Galaxy halo

Virial mass, radius, circular velocity

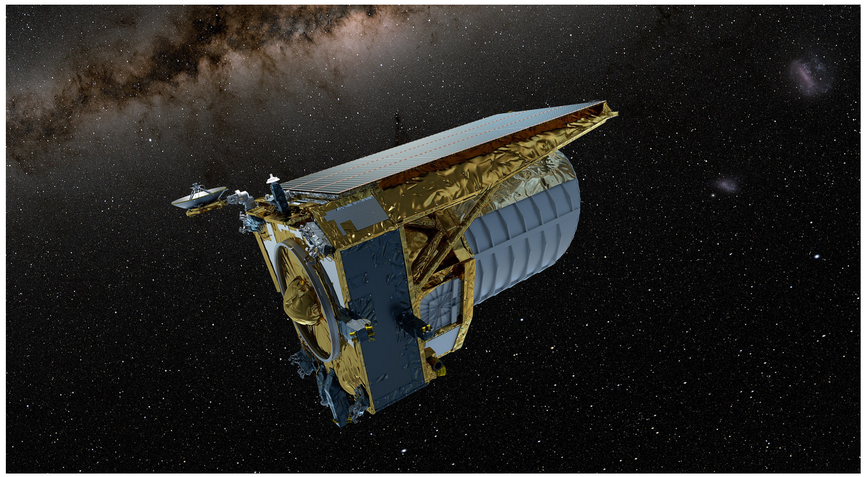


More spin!

Conclusion & Prospects



SKA



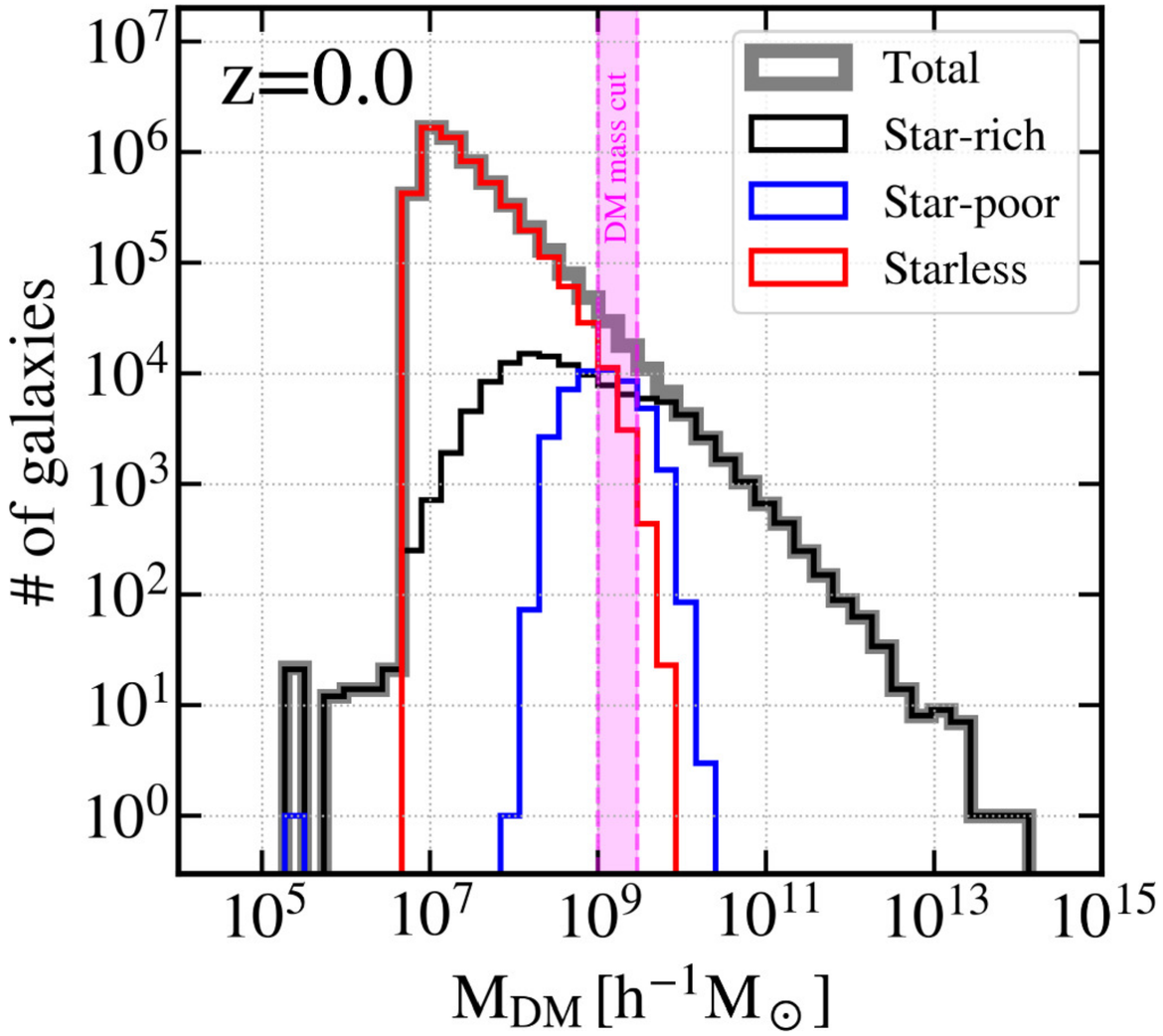
EUCLID survey

FAST (HI survey)

Thanks !

Appendices

Methodology

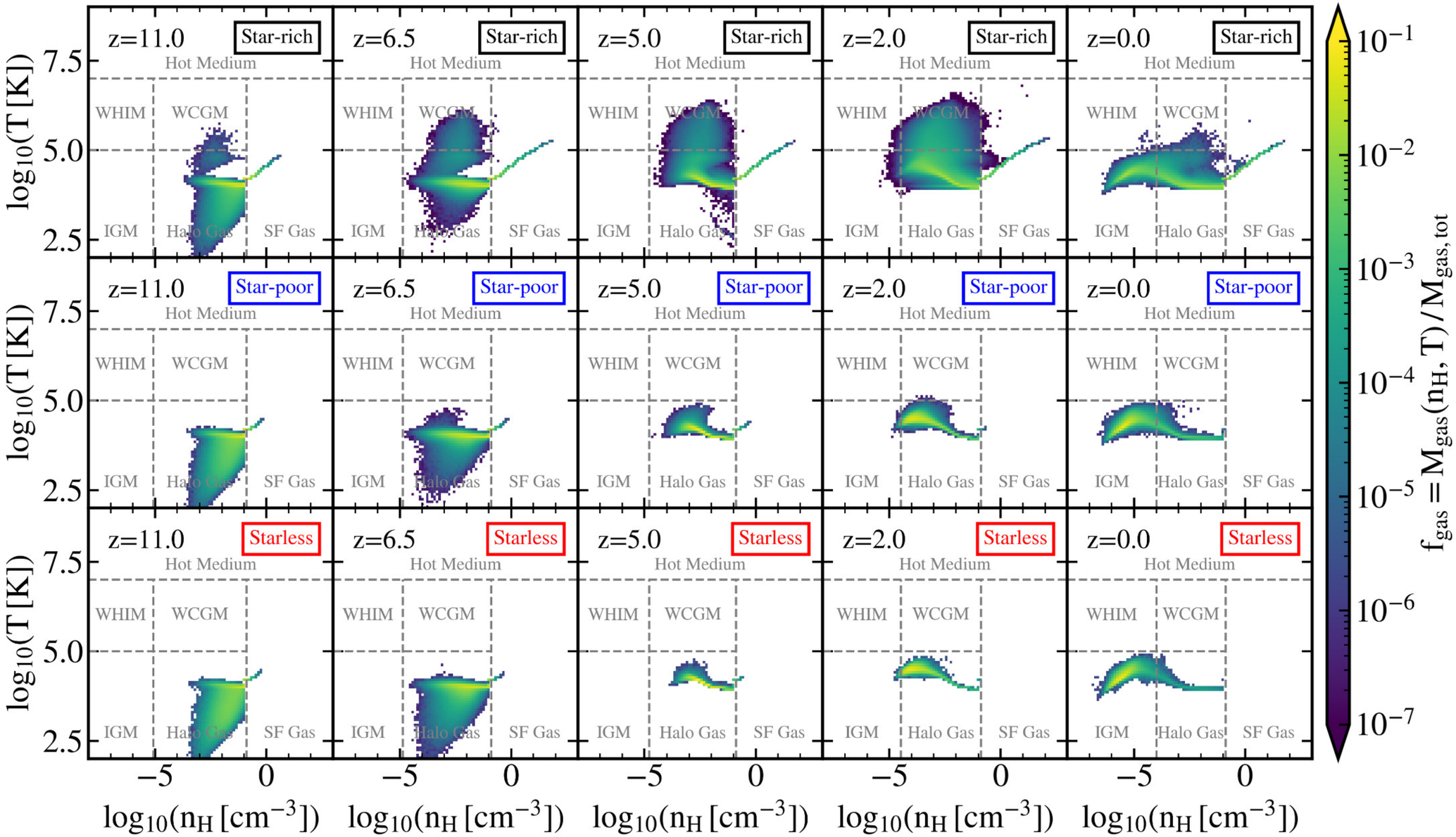


Mass distribution of DM

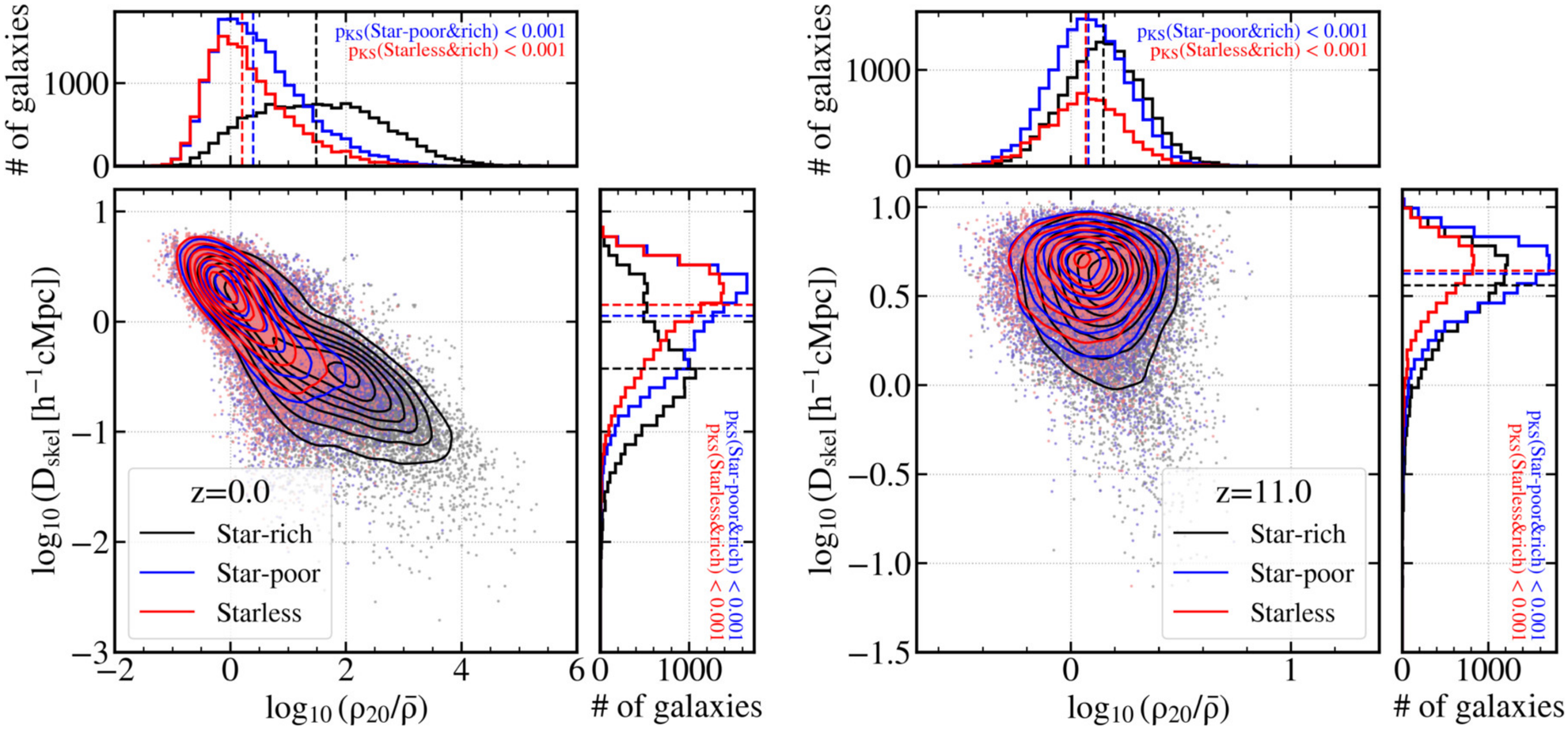
1. Most overlap in frequency, indicating similar sample sizes

2. Variations in baryonic content

Gas Properties

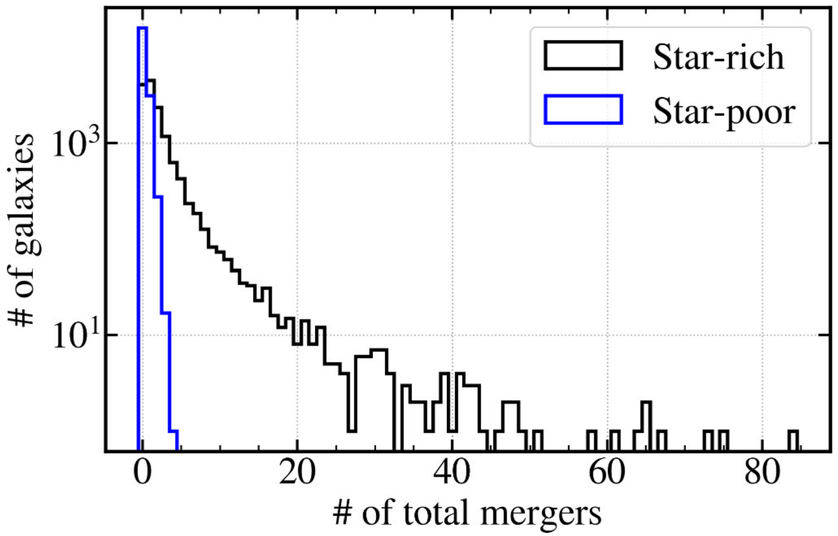
- 

Spatial Distribution

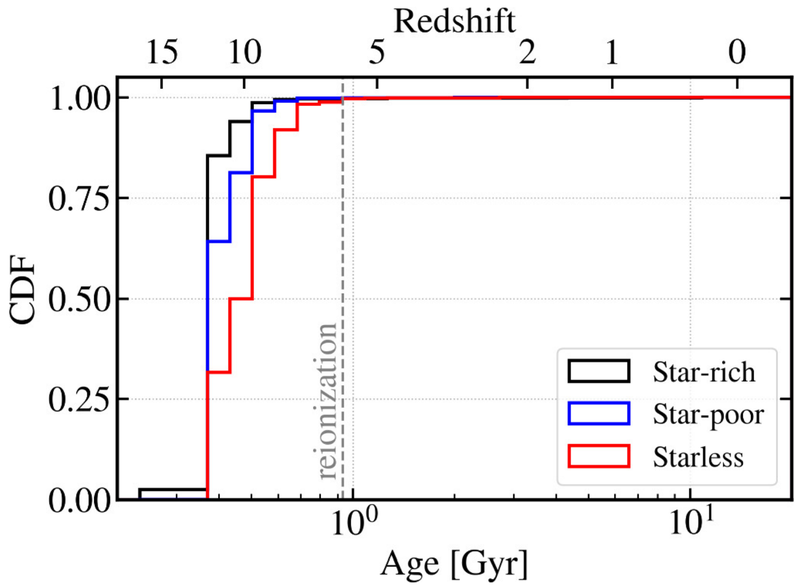


Factors

- Mergers and interactions



- Cumulative Distribution function



- Fraction of satellites