How diverse are ultra-faint dwarf galaxies?

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With Andrew Pontzen, Oscar Agertz, Matthew Orkney, Justin Read

Rey et al 2019, 1810.09473
Agertz et al 2019, 1904.02723
Rey at al 2019 (this talk, see me for advanced draft)

Credit: Evgeni Ivanov

Rey at al. in prep

V-band magnitude

−16
−14
−12
−10
−8
−6
−4
−2
0

10^{-2}
10^{-1}
10^{0}

Half-light radius (kpc)

2005
1930
Discovery Year

Fainter

Larger

Rey at al. in prep

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Half-light radius (kpc)

$\mu_{0,V} = 31$ mag arcsec^{-2}

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2015
2010
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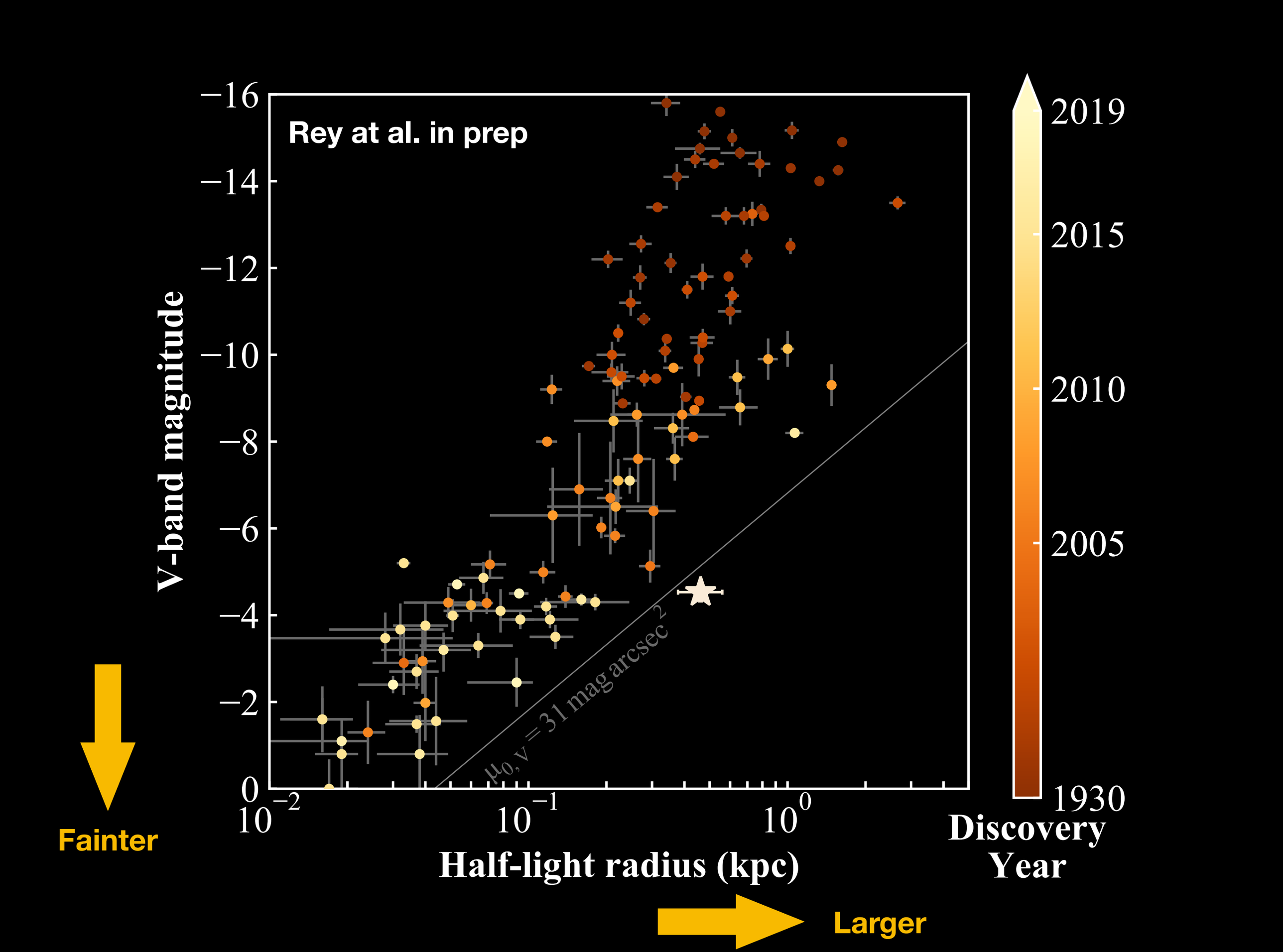
1930

Discovery Year

Fainter

Larger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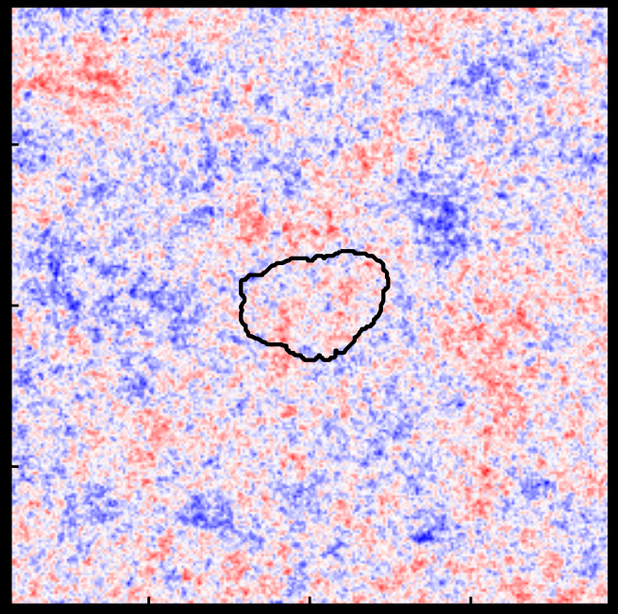
Larger

The EDGE project

1 Mpc

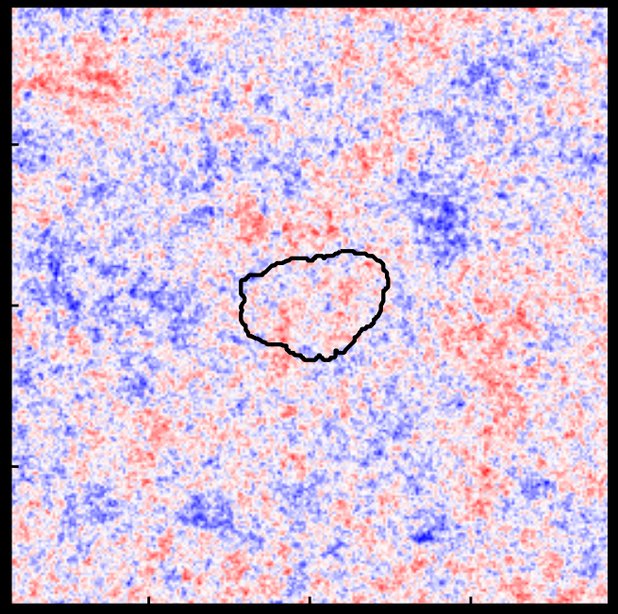


Sampling histories

Dynamic range with
cosmological zooms

The EDGE project

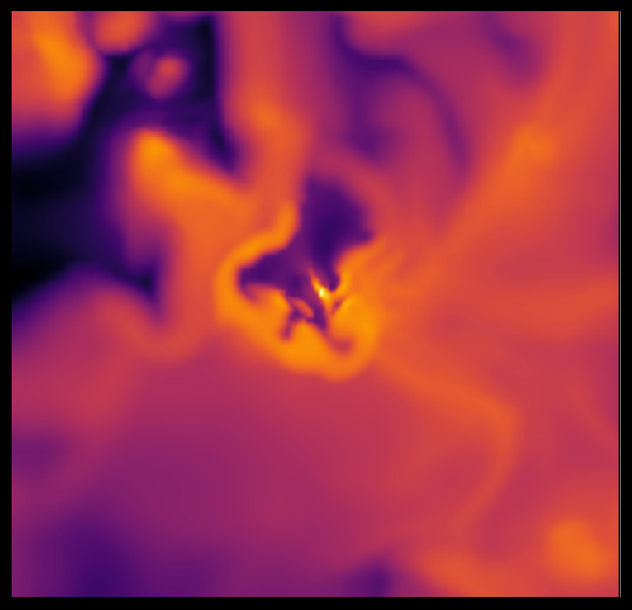
1 Mpc



Sampling histories

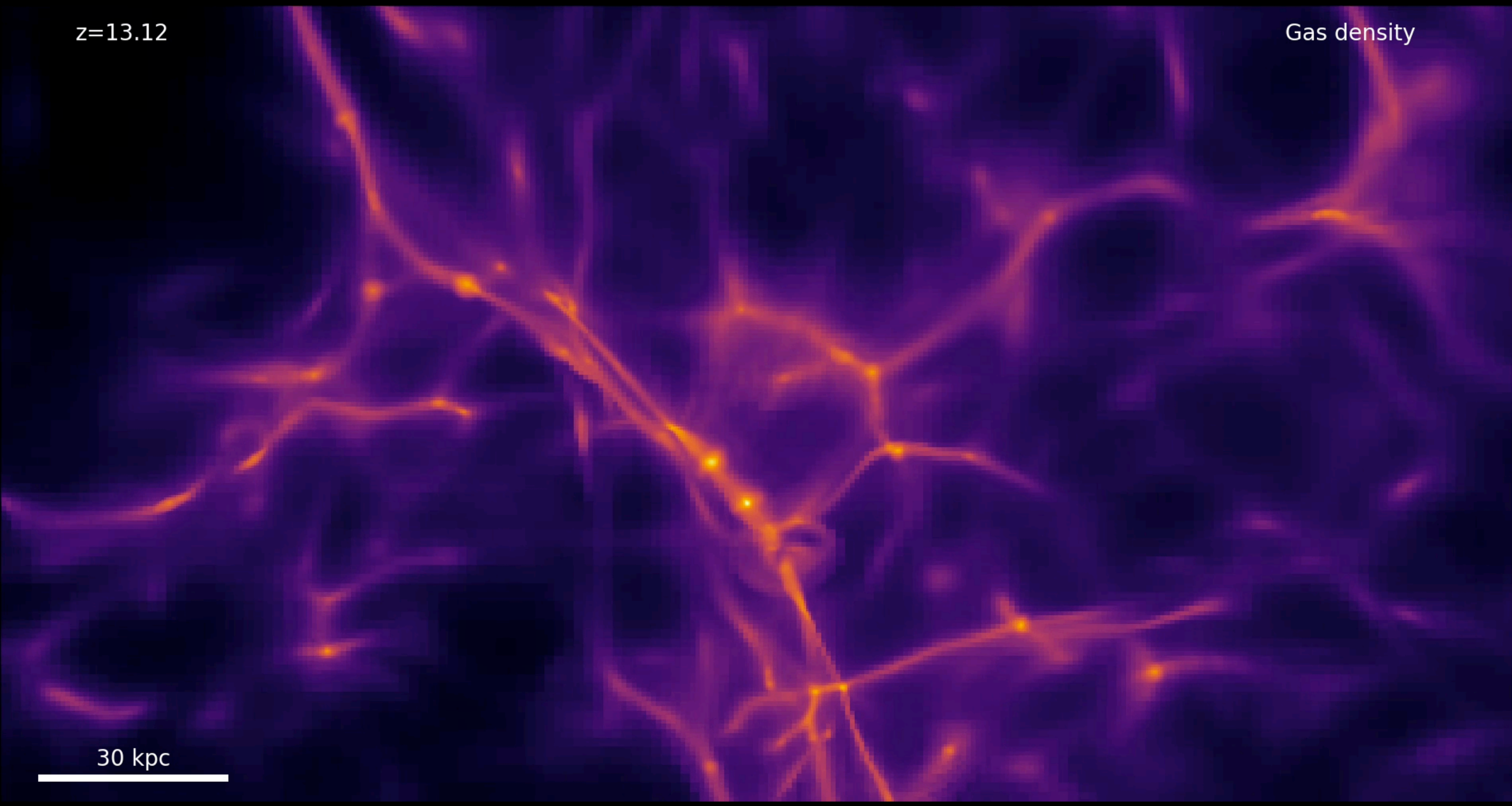
Dynamic range with
cosmological zooms

5 kpc

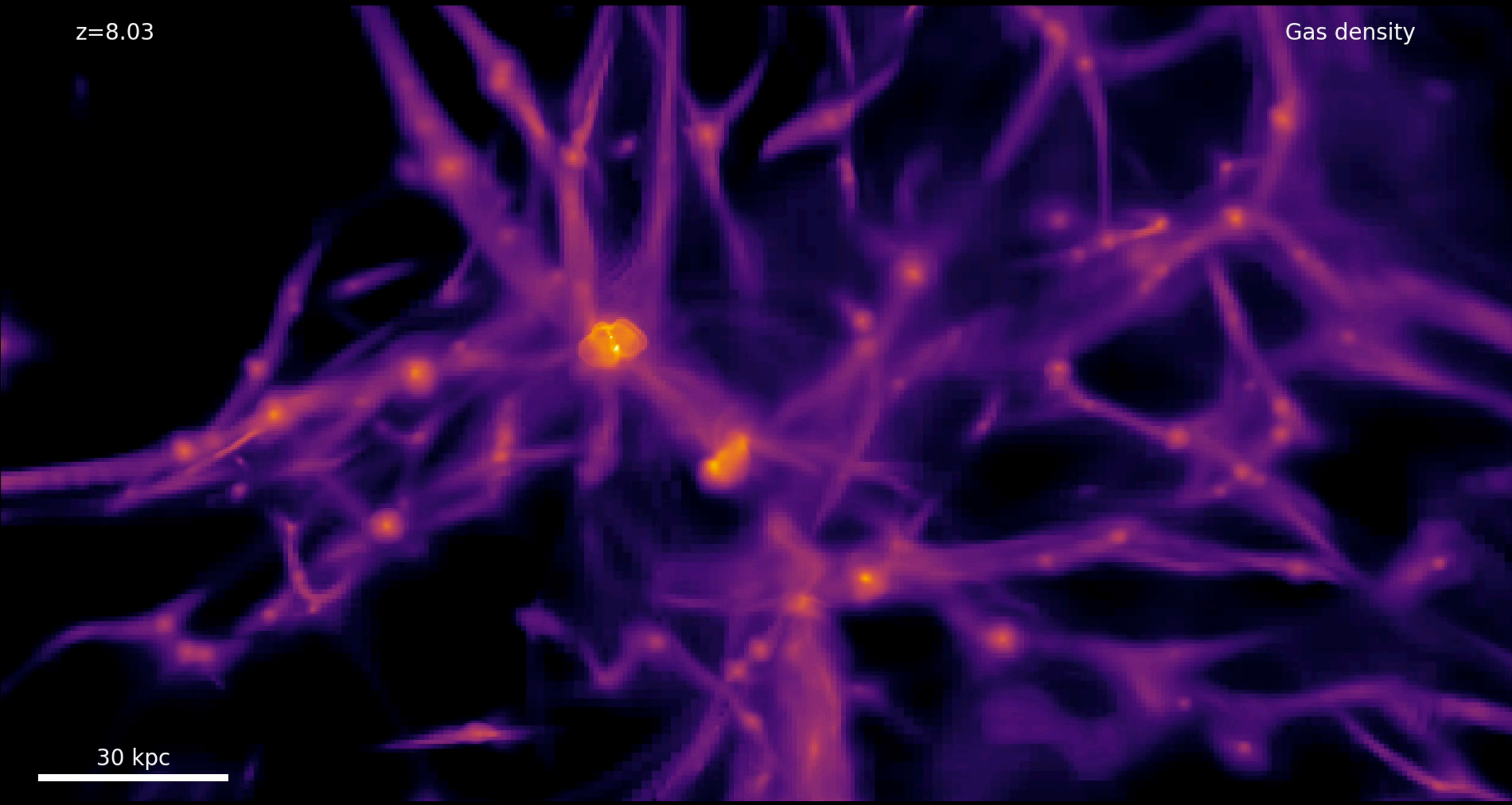


~1000 $M_\odot$ DM particles
3 pc maximum cell size
Resolve explosions of individual supernovae
Agertz et al. 2019

The EDGE project



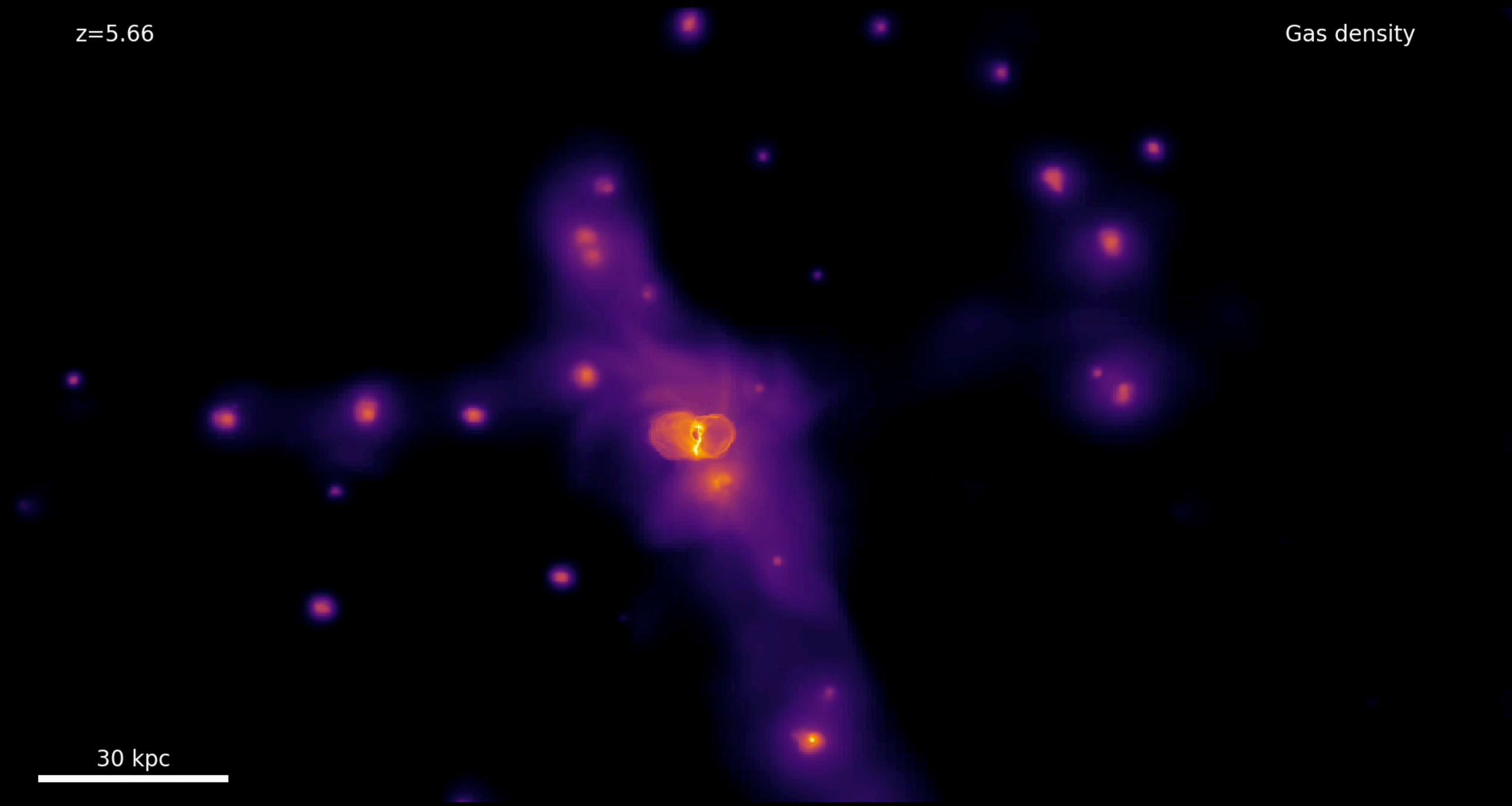
The EDGE project



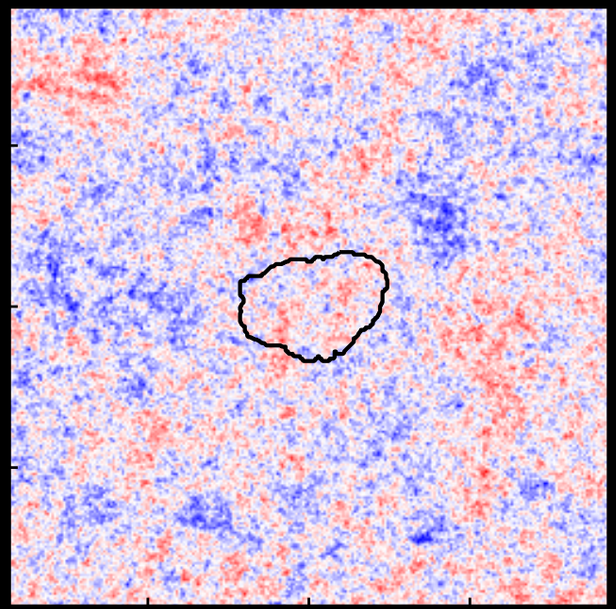
The EDGE project

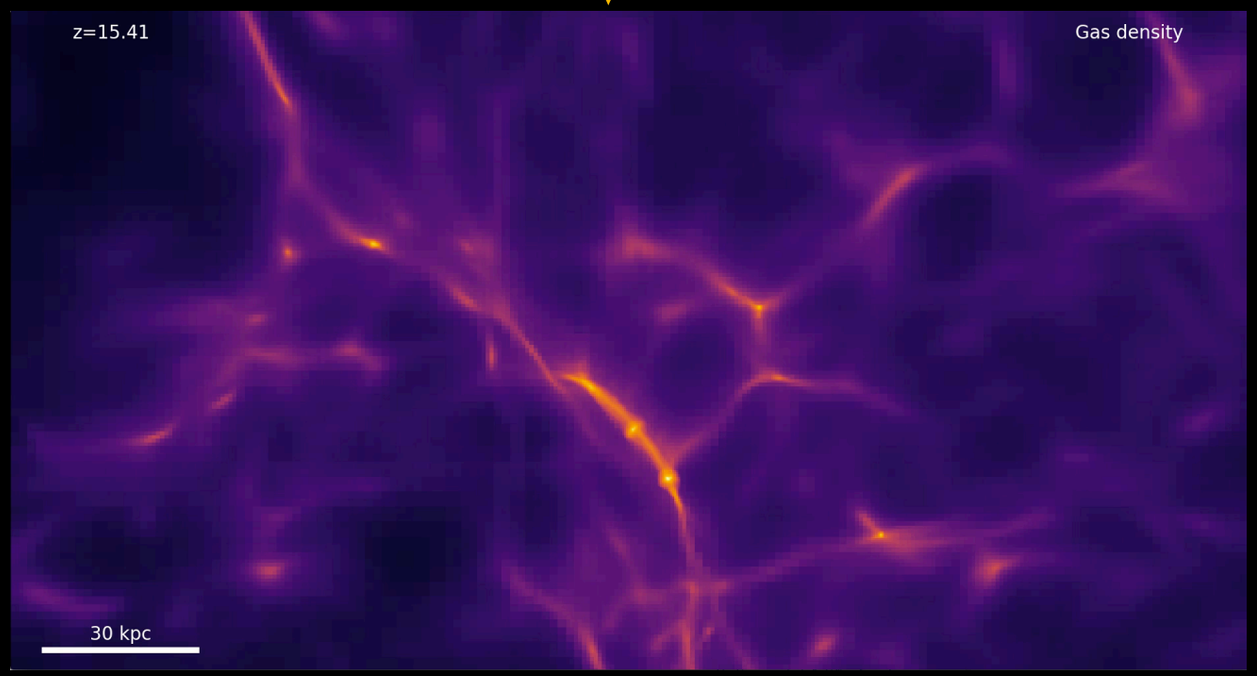
z=5.66

Gas density



The EDGE project





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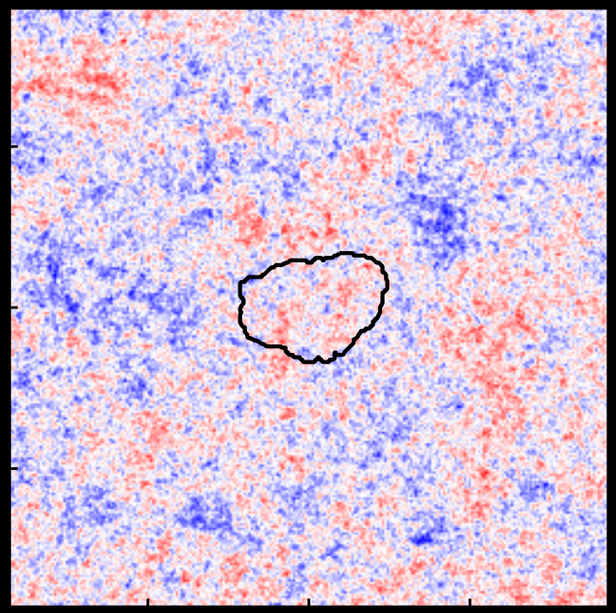
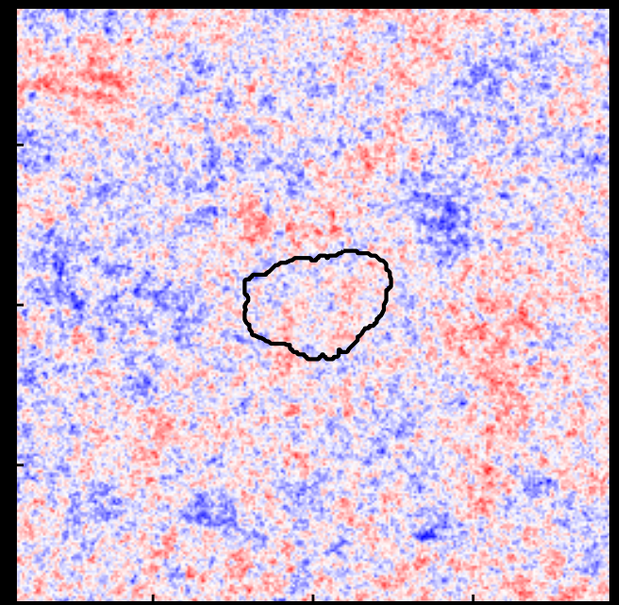
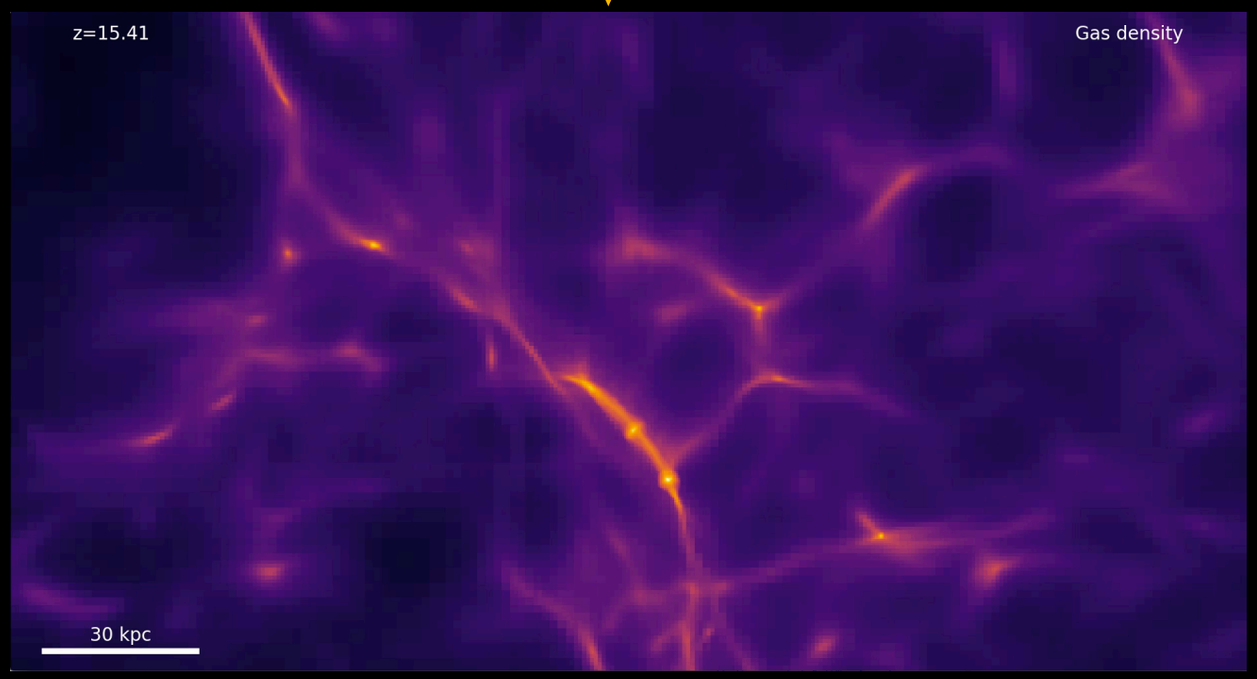


Genetic modifications

Roth et al. 2016
Rey and Pontzen 2018





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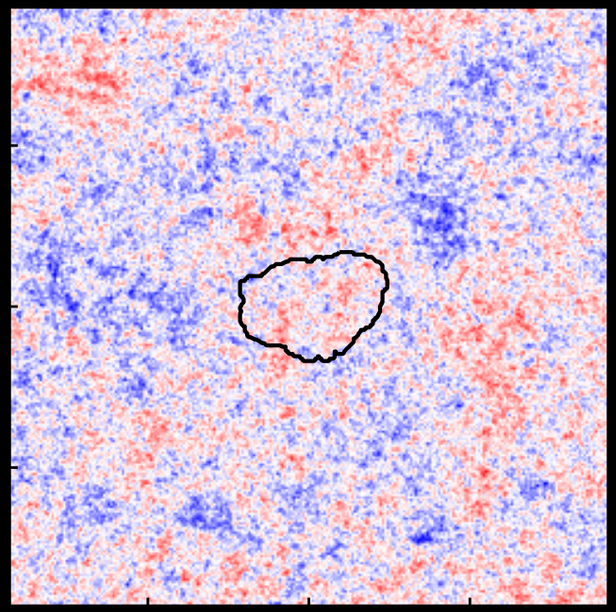

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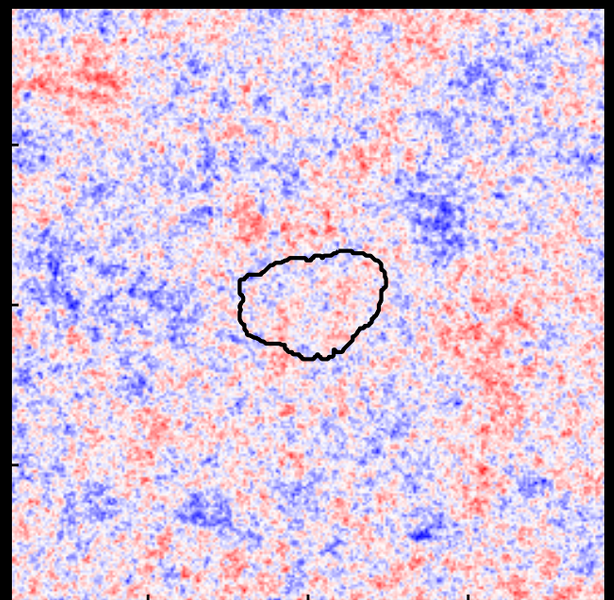
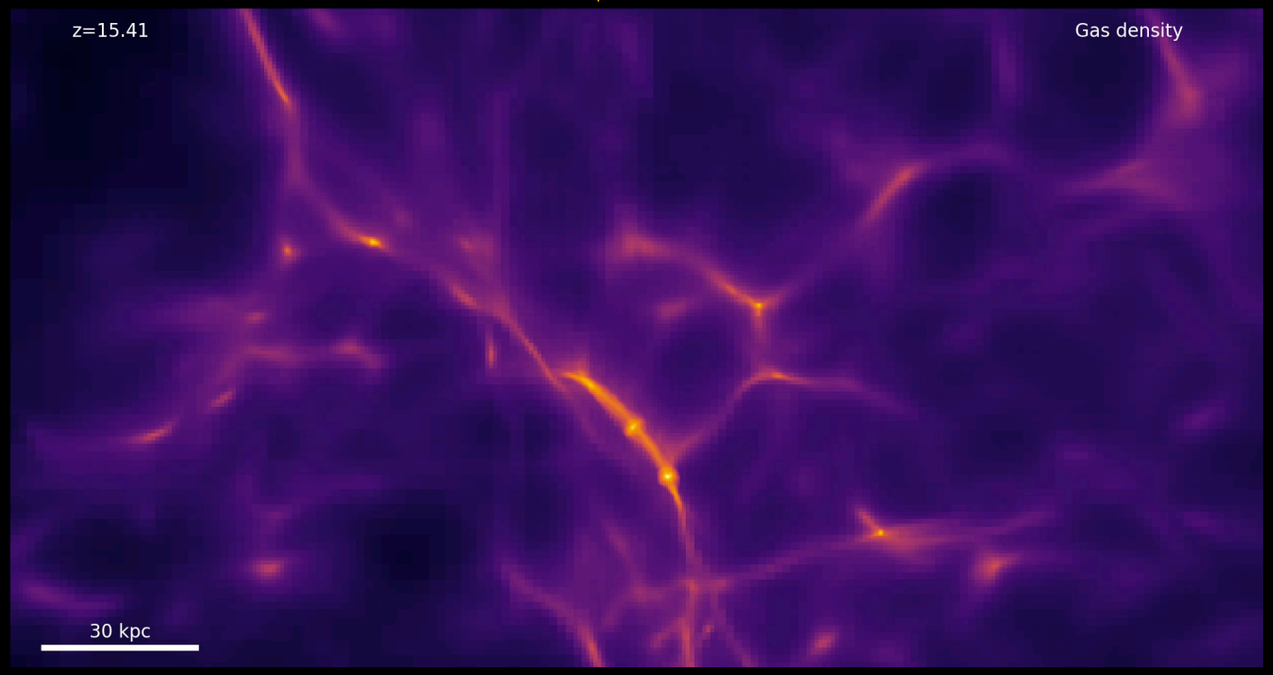
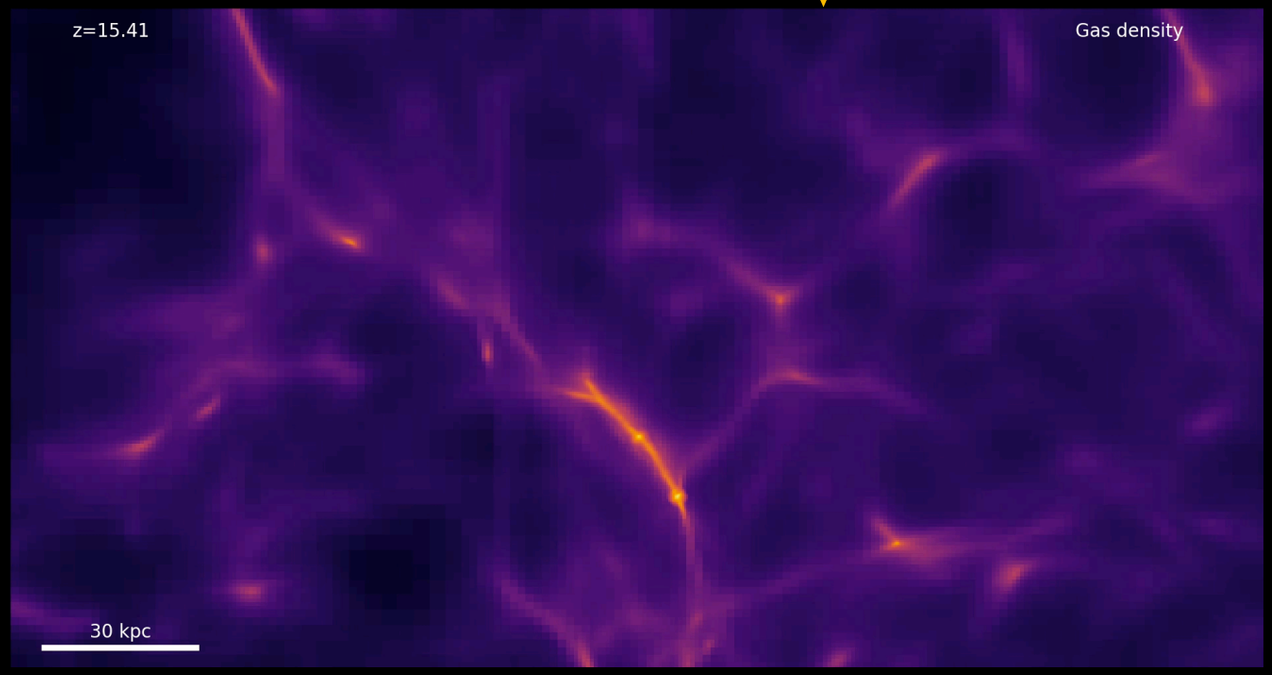
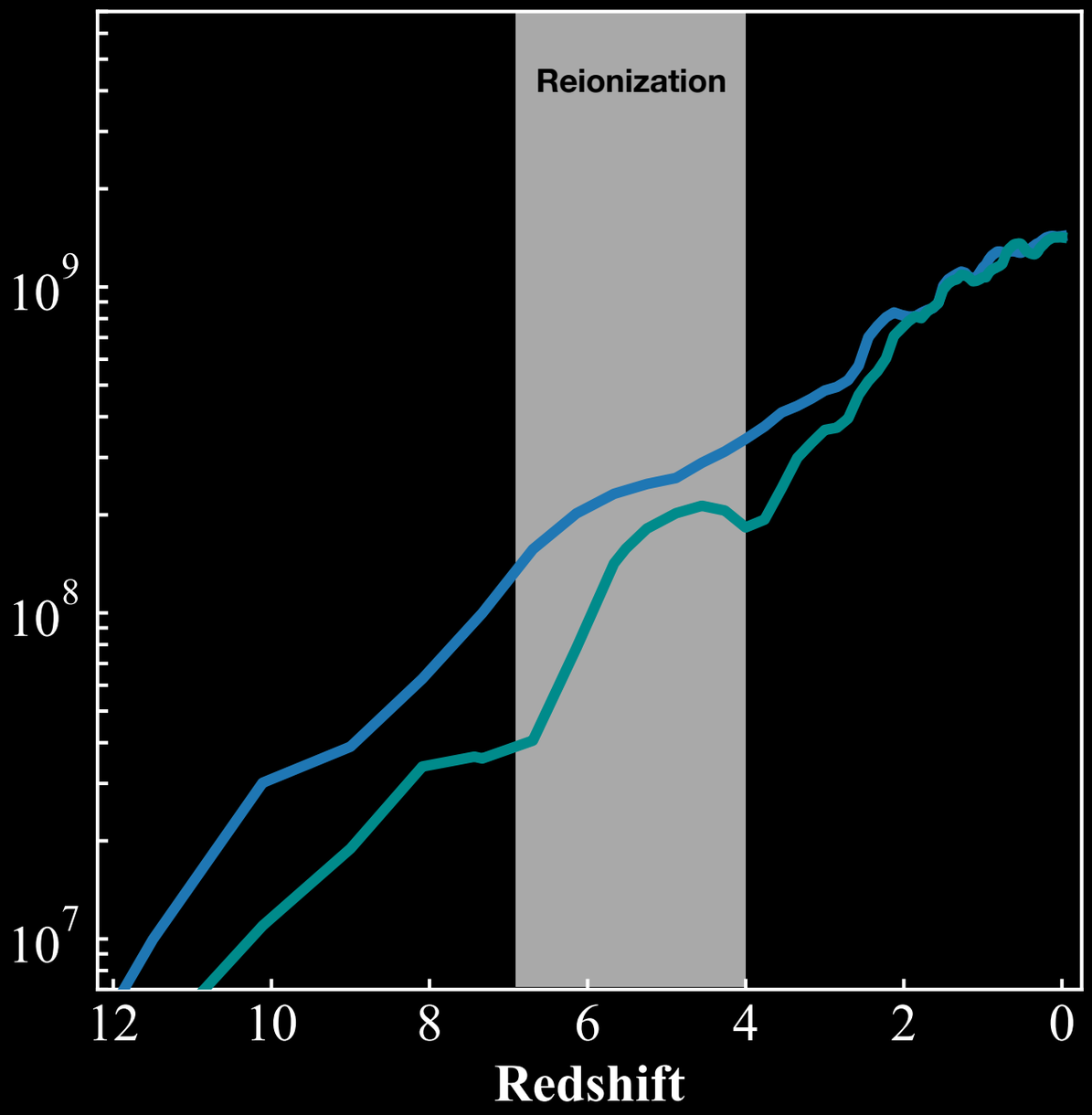






Rey at al. in prep



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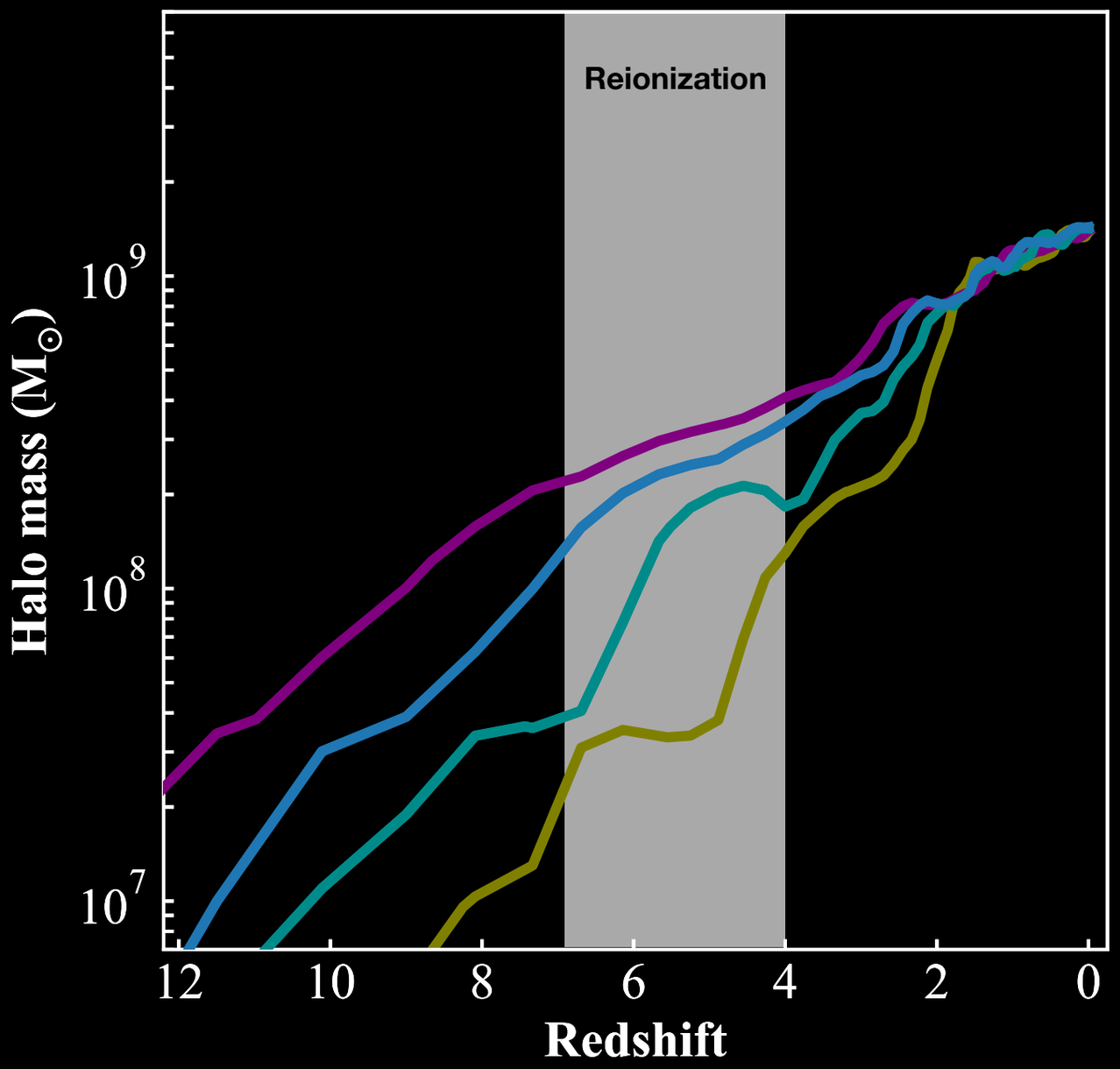

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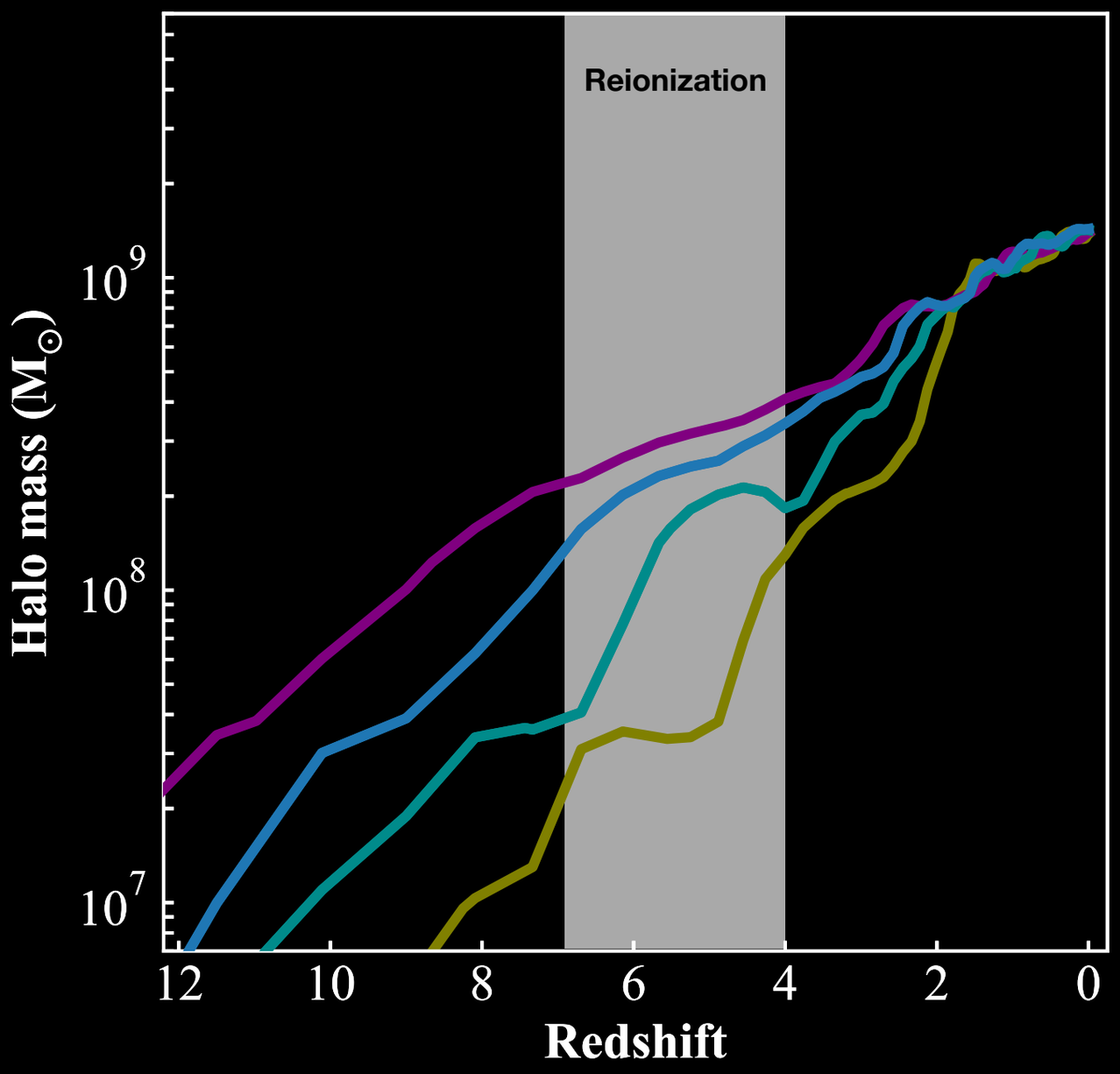

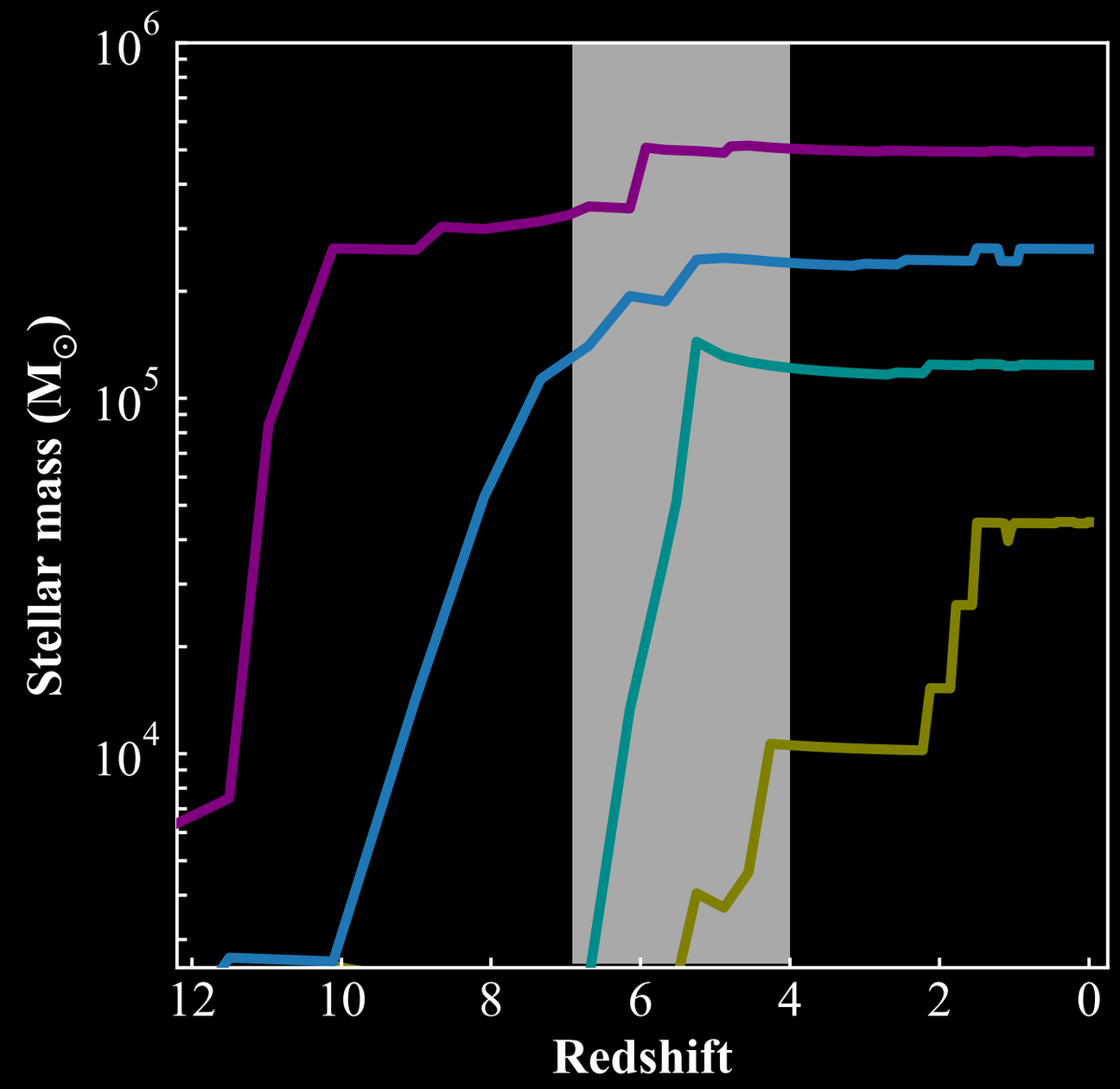

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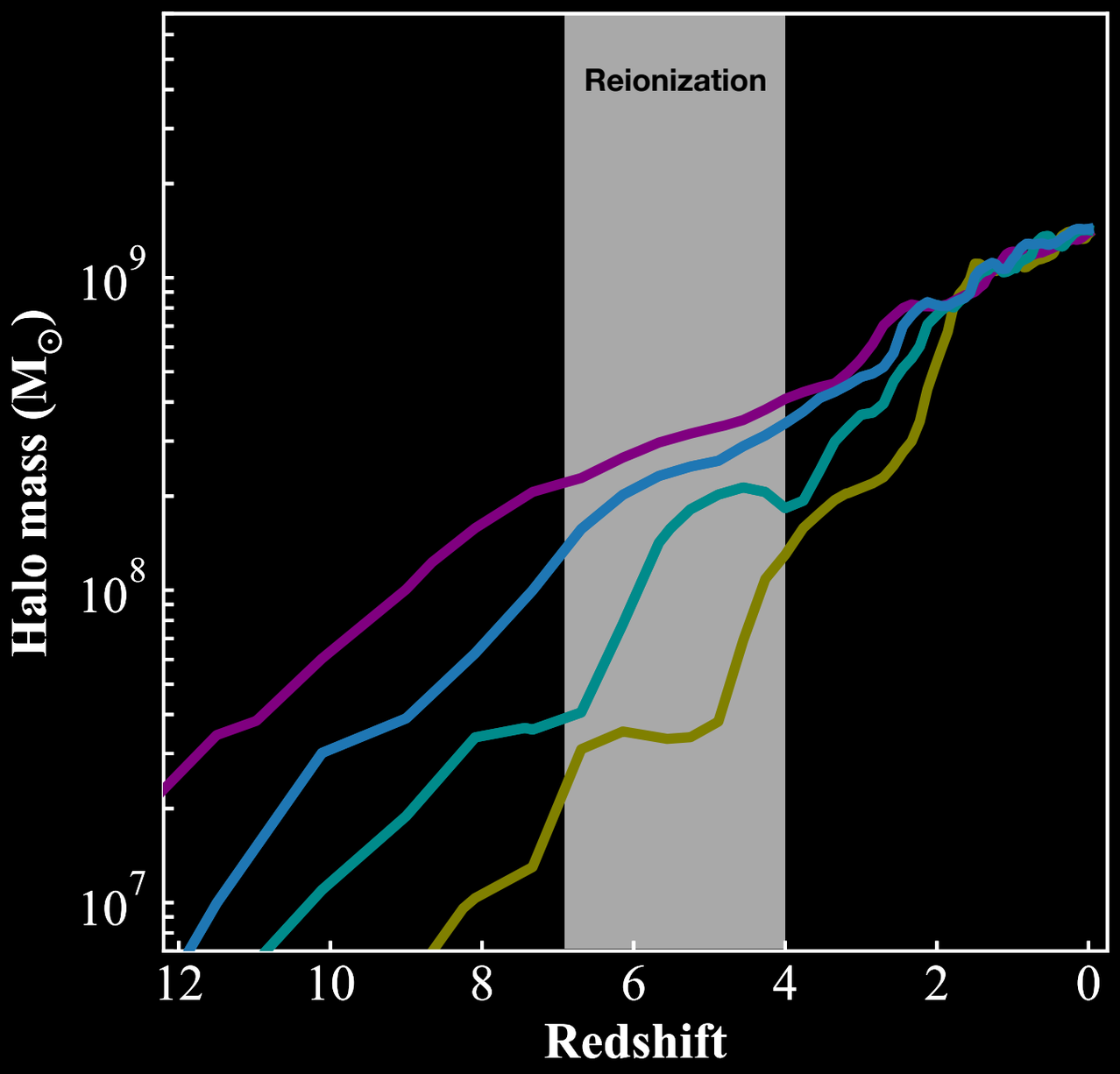
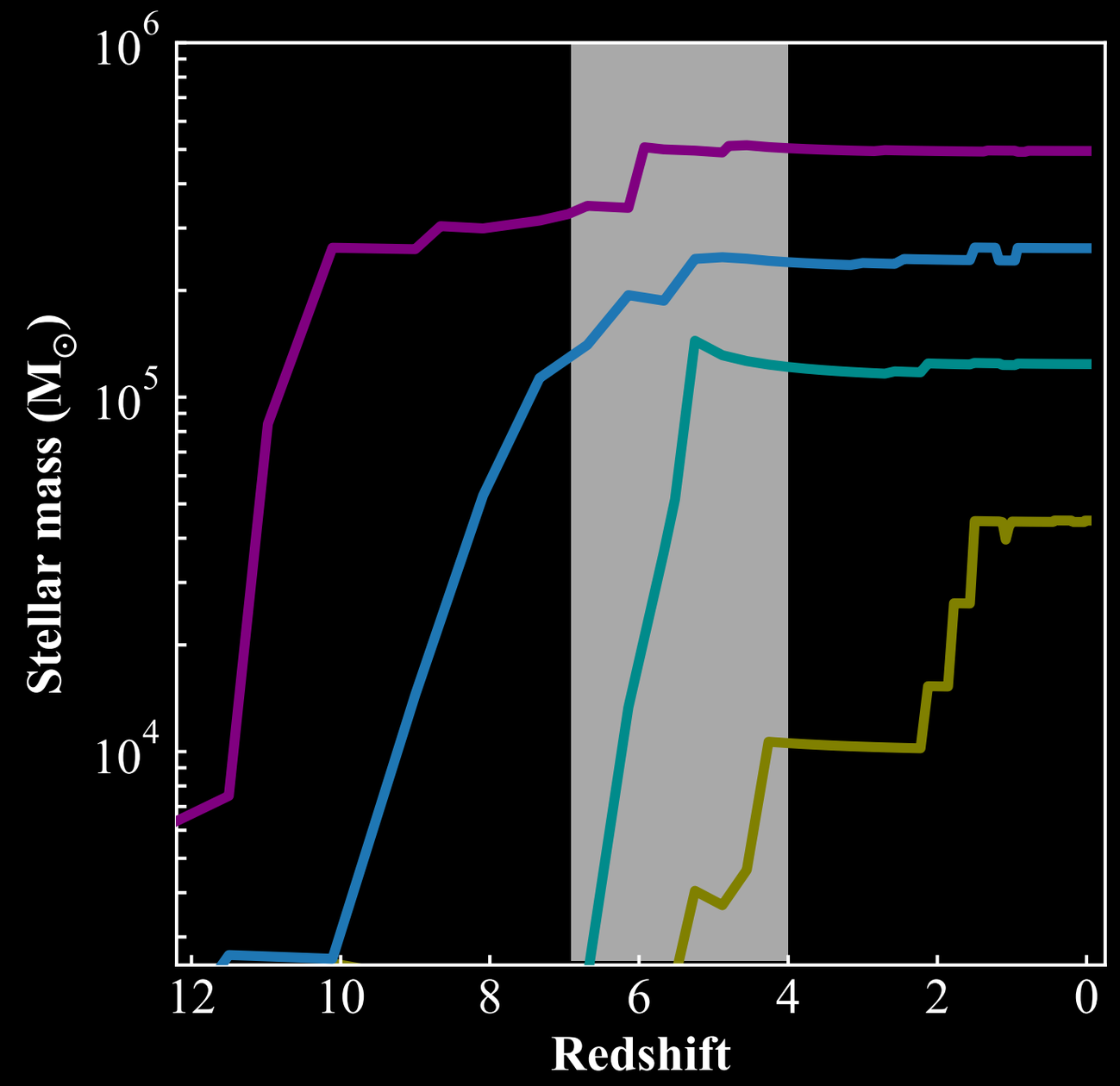
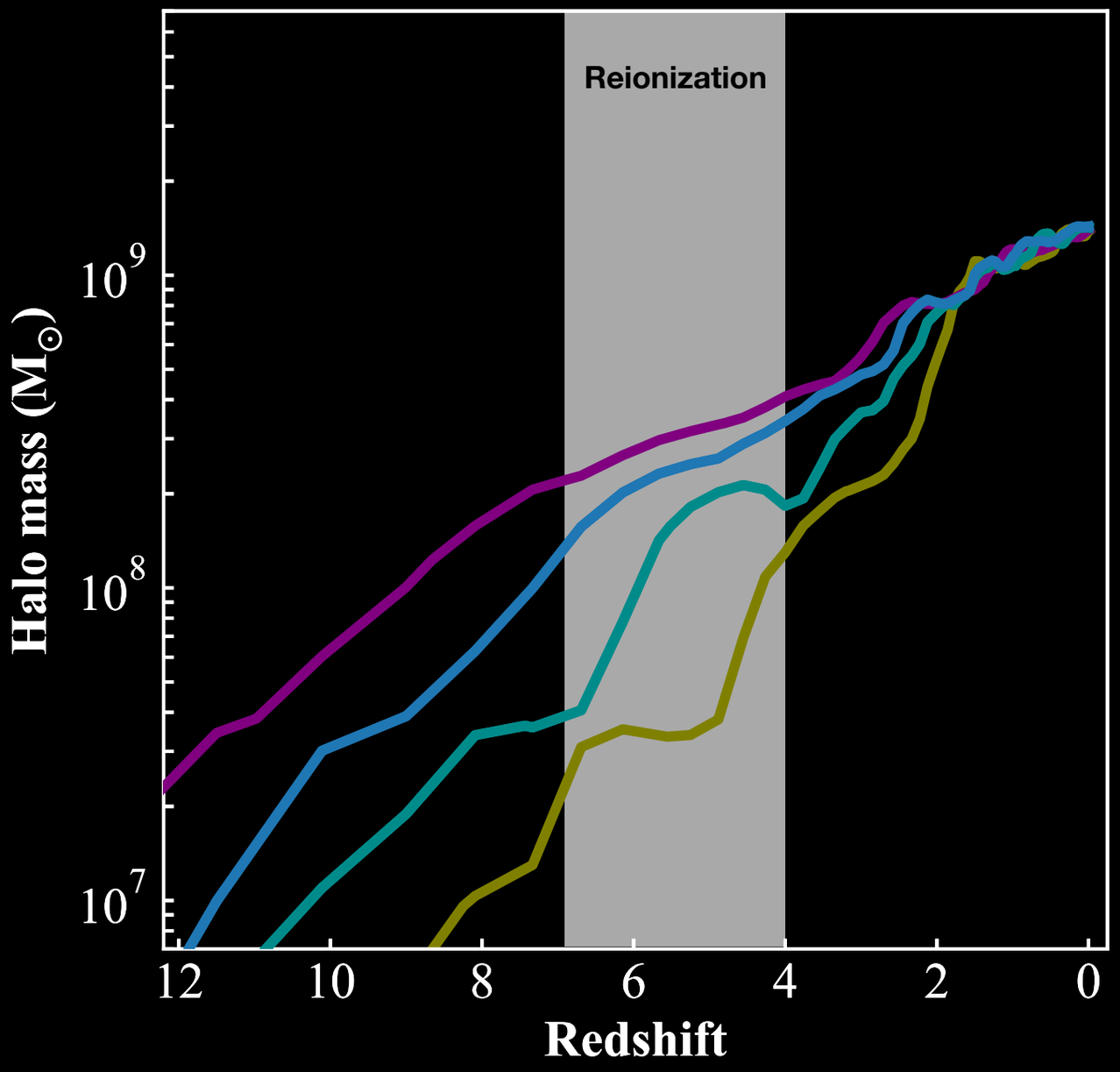
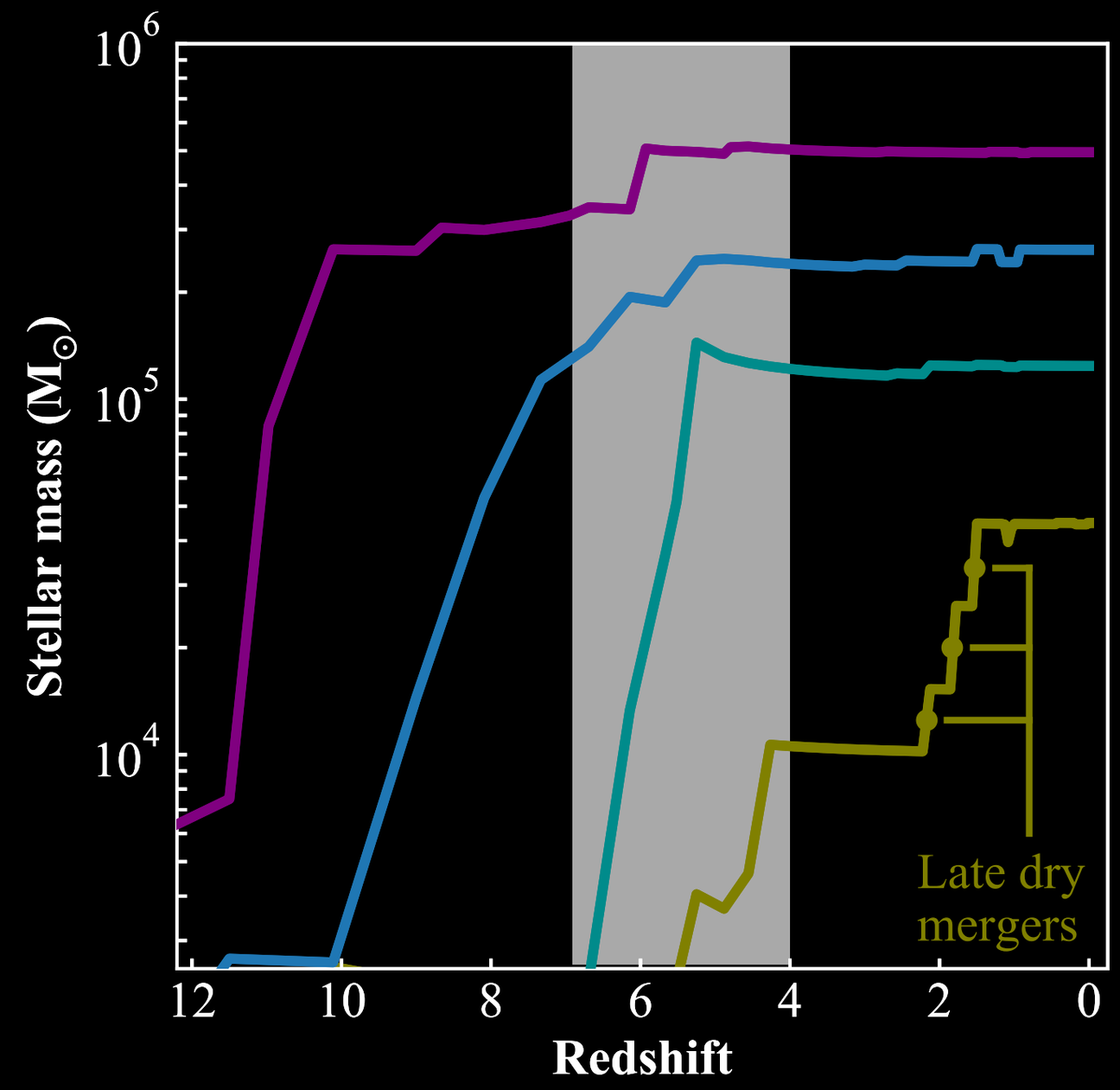




Earlier forming ultra-faint have higher stellar mass, at fixed halo mass today.

Rey at al. in prep





Earlier forming ultra-faint have higher stellar mass, at fixed halo mass today.

Rey at al. in prep

10^7

10^6

10^5

10^4

Stellar mass ($M_\odot$)

10^7

10^8

10^9

Halo mass ($M_\odot$)

Rey at al. in prep

10^7

10^6

10^5

10^4

Stellar mass ($M_\odot$)

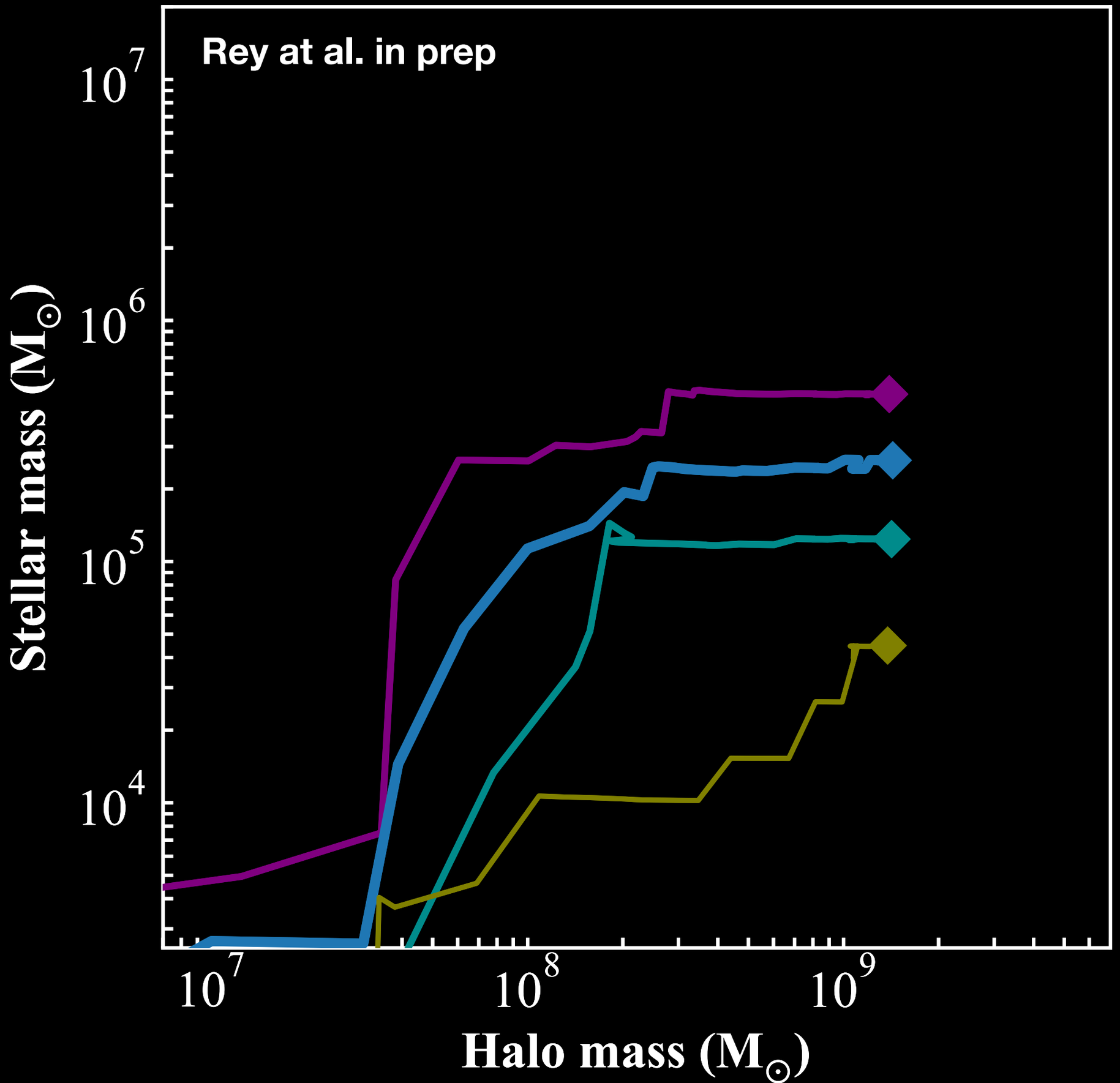
1 dex

10^7

10^8

10^9

Halo mass ($M_\odot$)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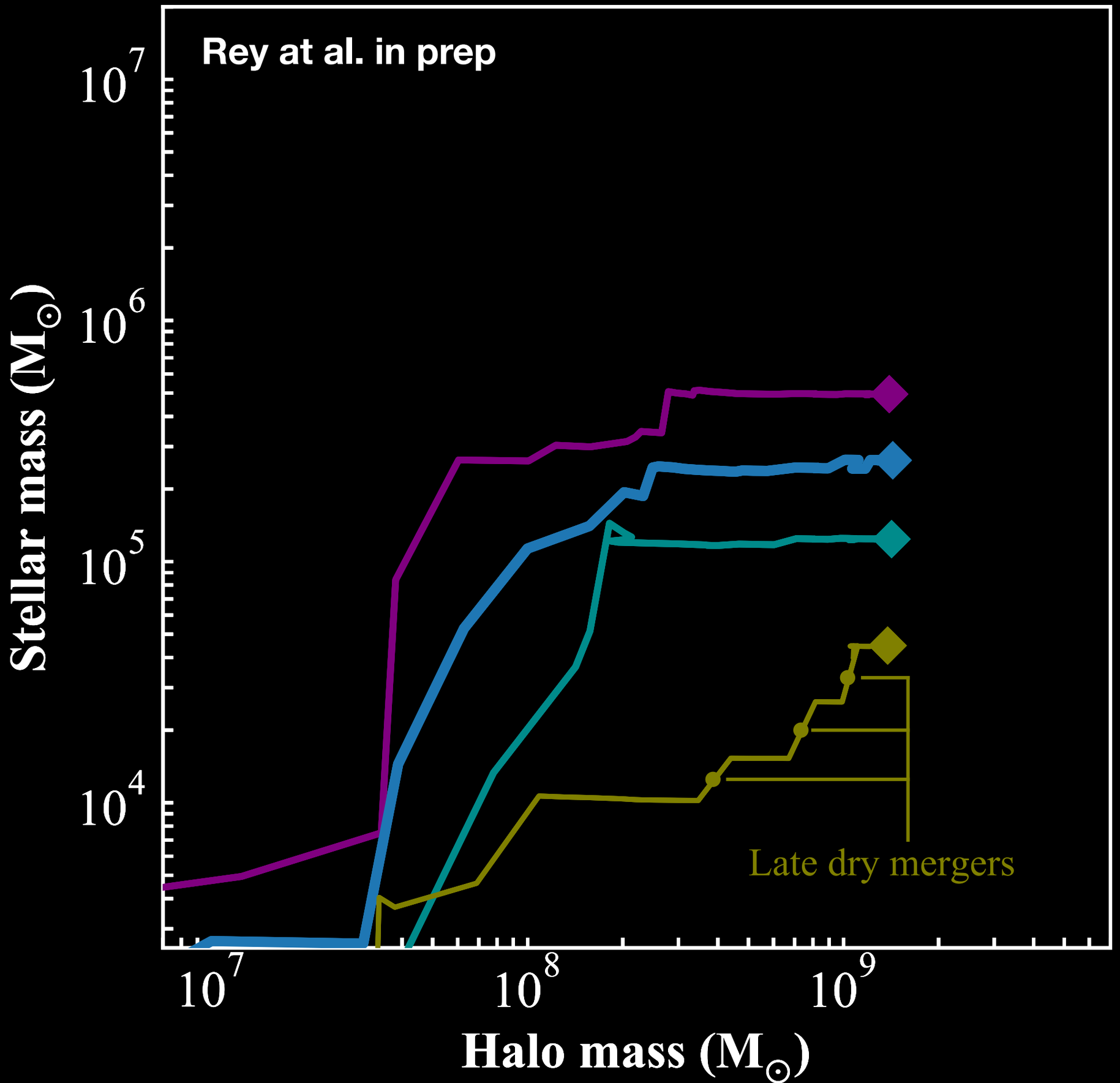
Rey at al. in prep
10^7
10^6
10^5
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Stellar mass ($M_\odot$)
Late dry mergers
10^7
10^8
10^9
Halo mass ($M_\odot$)

Rey at al. in prep

5 kpc
25 mag arcsec^2

Late dry mergers

Stellar mass ($M_\odot$)

10^7
10^6
10^5
10^4

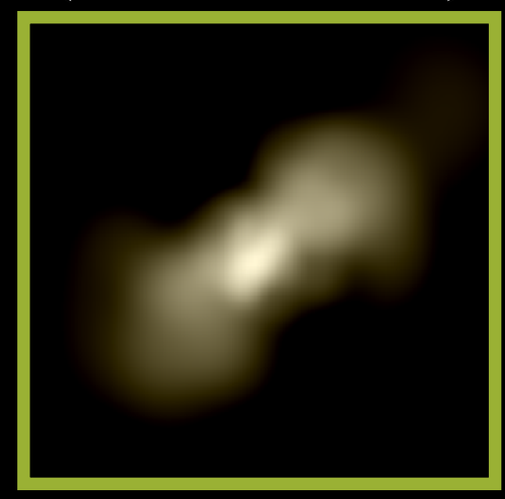
10^7
10^8
10^9

Halo mass ($M_\odot$)

Rey at al. in prep

5 kpc
25 mag arcsec²

5 kpc
32 mag arcsec²



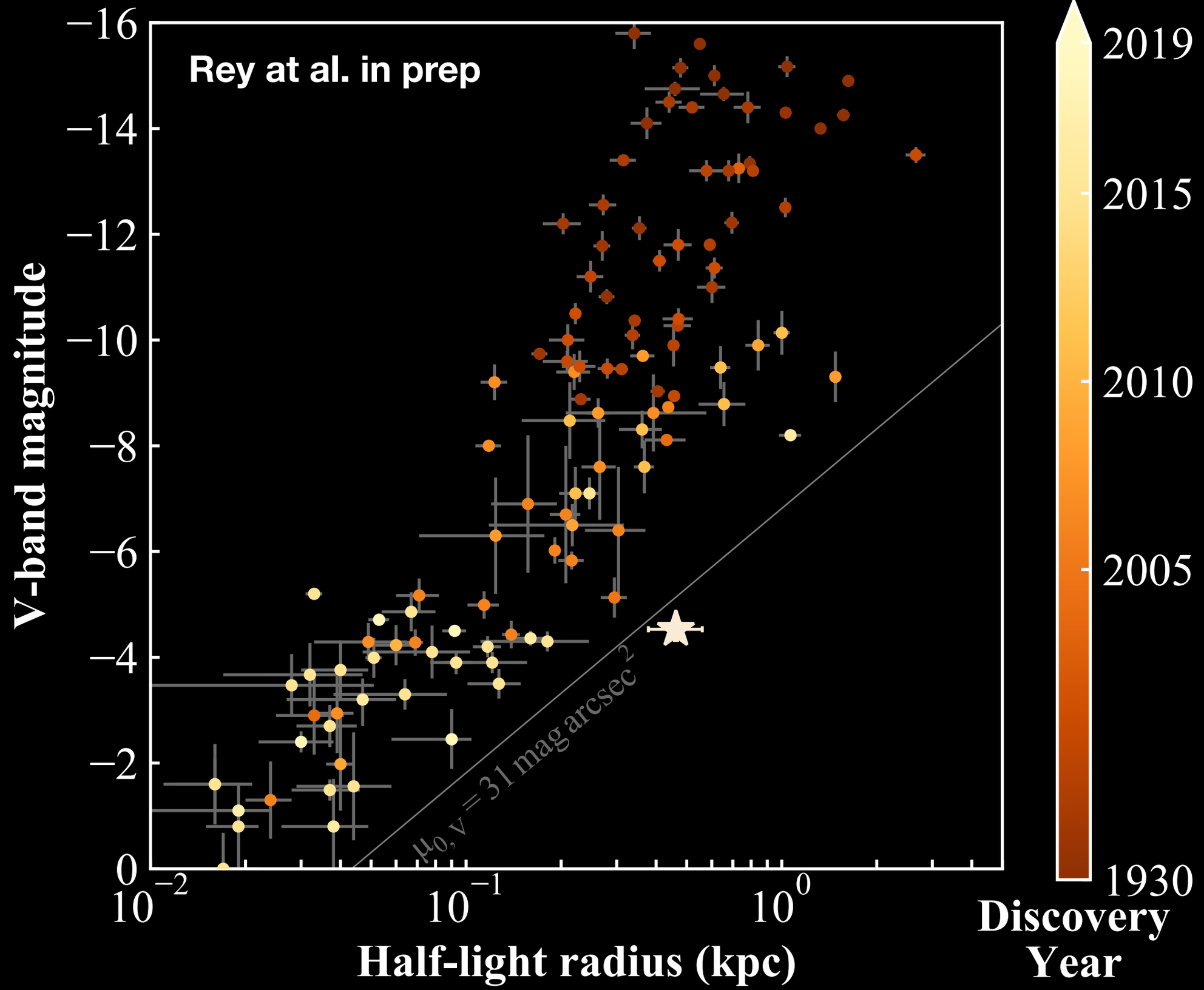
Late dry merger

Stellar mass ($M_\odot$)

10^7
10^6
10^5
10^4

10^7
10^8
10^9

Halo mass ($M_\odot$)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Conclusion

1. Genetic modifications construct controlled studies, of different galaxies in the same dynamical mass today.

2. Earlier forming ultra-faints have higher stellar mass, directly probing the scatter of stellar masses at fixed halo mass.

3. A new formation scenario predicting the existence of highly diffuse, extended ultra-faints to be discovered by future surveys.