Comparing the evolving properties of satellite and isolated dwarf galaxies

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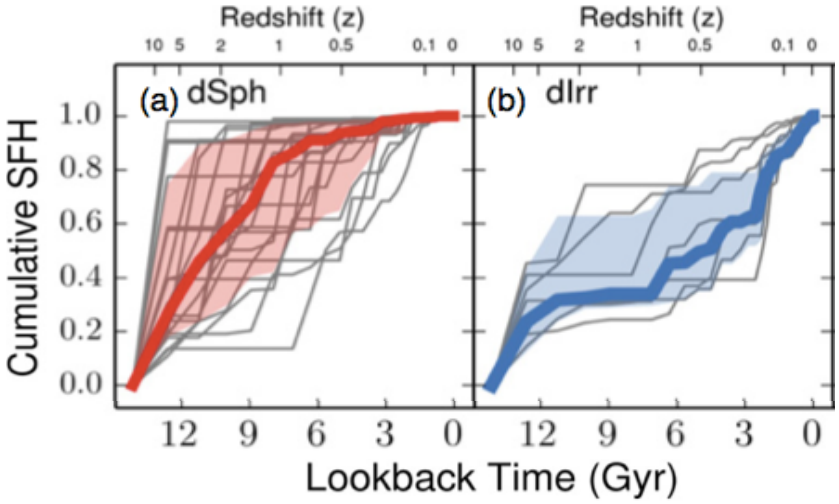
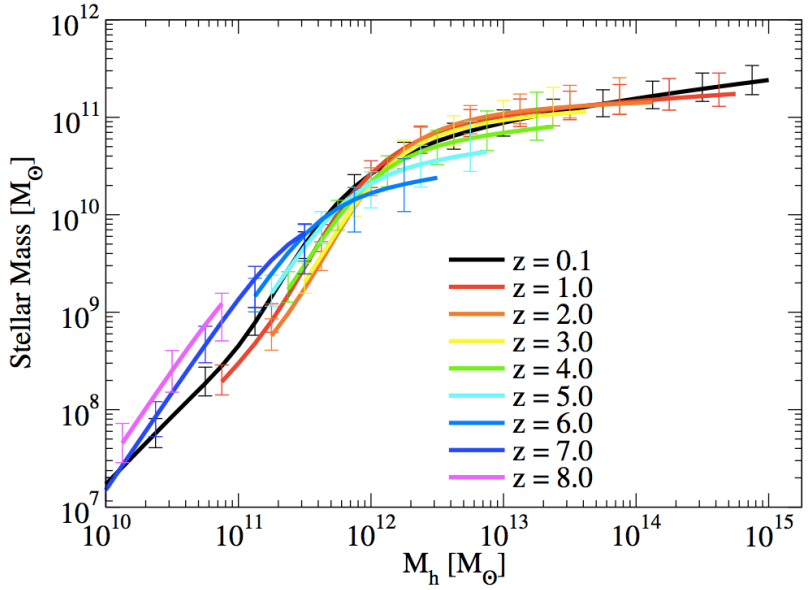
Goals:

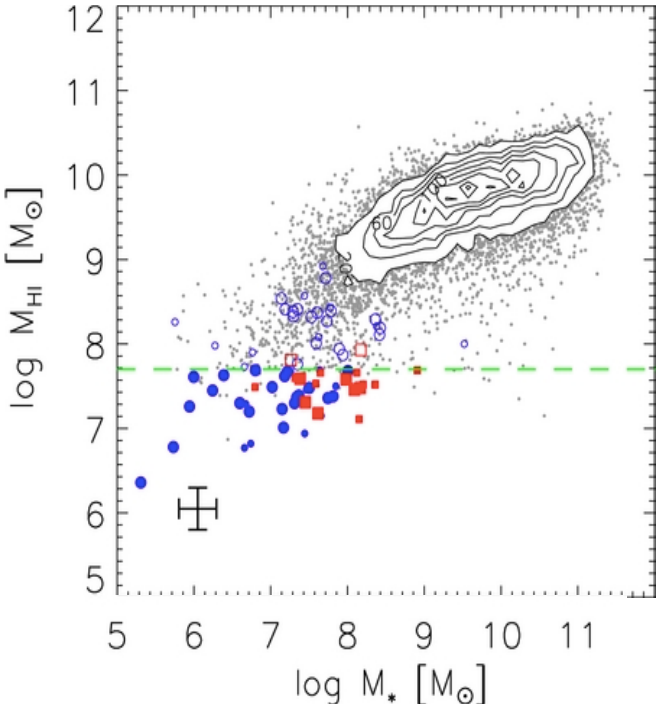
understand why satellite and isolated dwarf galaxies have their abundances and structures

by examining high-resolution hydro simulations of MW-like galaxies and their satellites and surrounding dwarf galaxies

Introduction







Behroozi+ 2013, ApJ, 770, 33
Huang+ 2012, AJ, 143, 133
Weisz+ 2014, ApJ, 789, 23

Simulation Suite

Run by Daniel Ceverino with the hydroART code (AMR)

Box length = 20 /h Mpc

DM mass = 8×10^4 M_{sun}

Resolution = 9 /h pc (z=3)

cells = 67 million

particles = 30 million

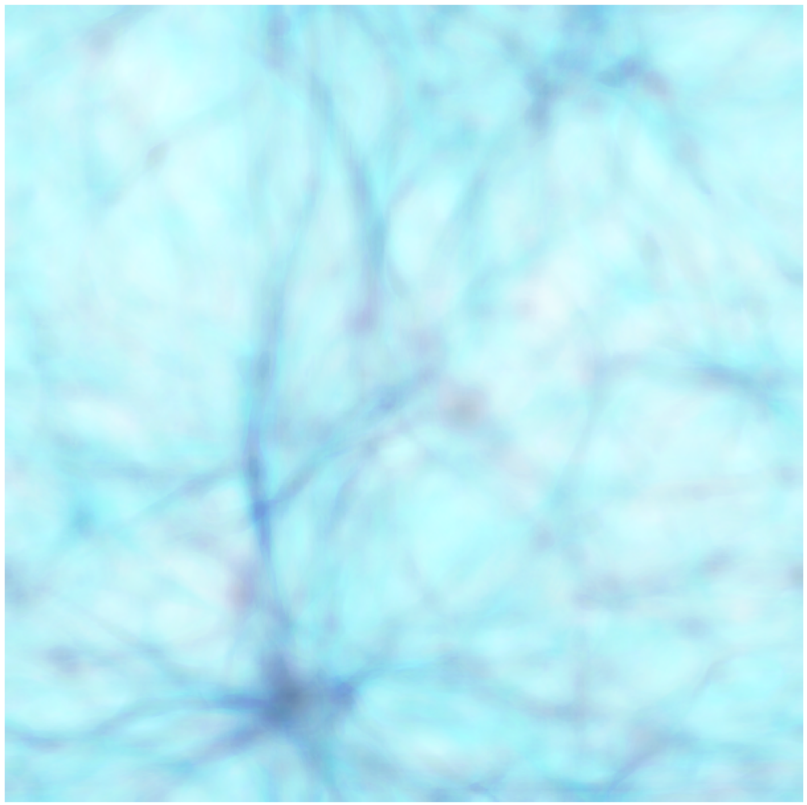
star particles = 7.7 million

Stellar winds

Metal advection

Supernovae feedback

Radiation pressure (τ_{IR}=0)



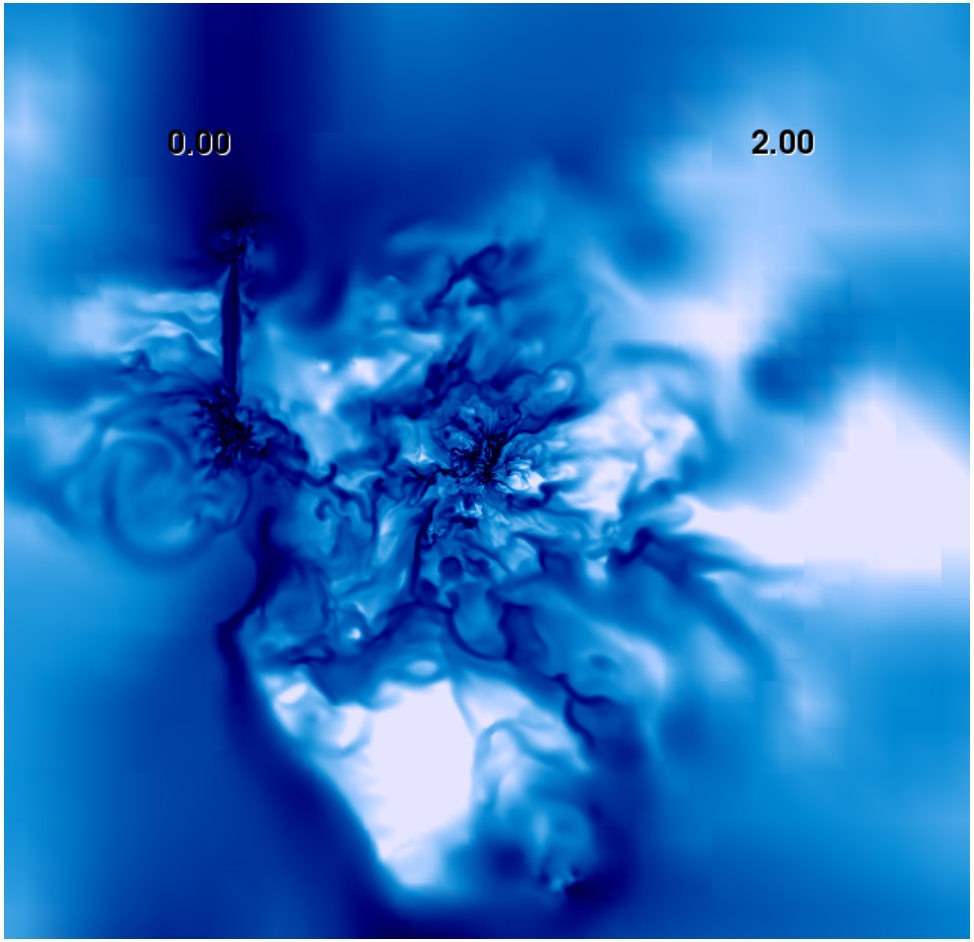
Main Halo

M_{vir} (z=1) = 7.2×10^{11}

Select a volume of 250 kpc around main halo

Examine properties of dwarfs within this region

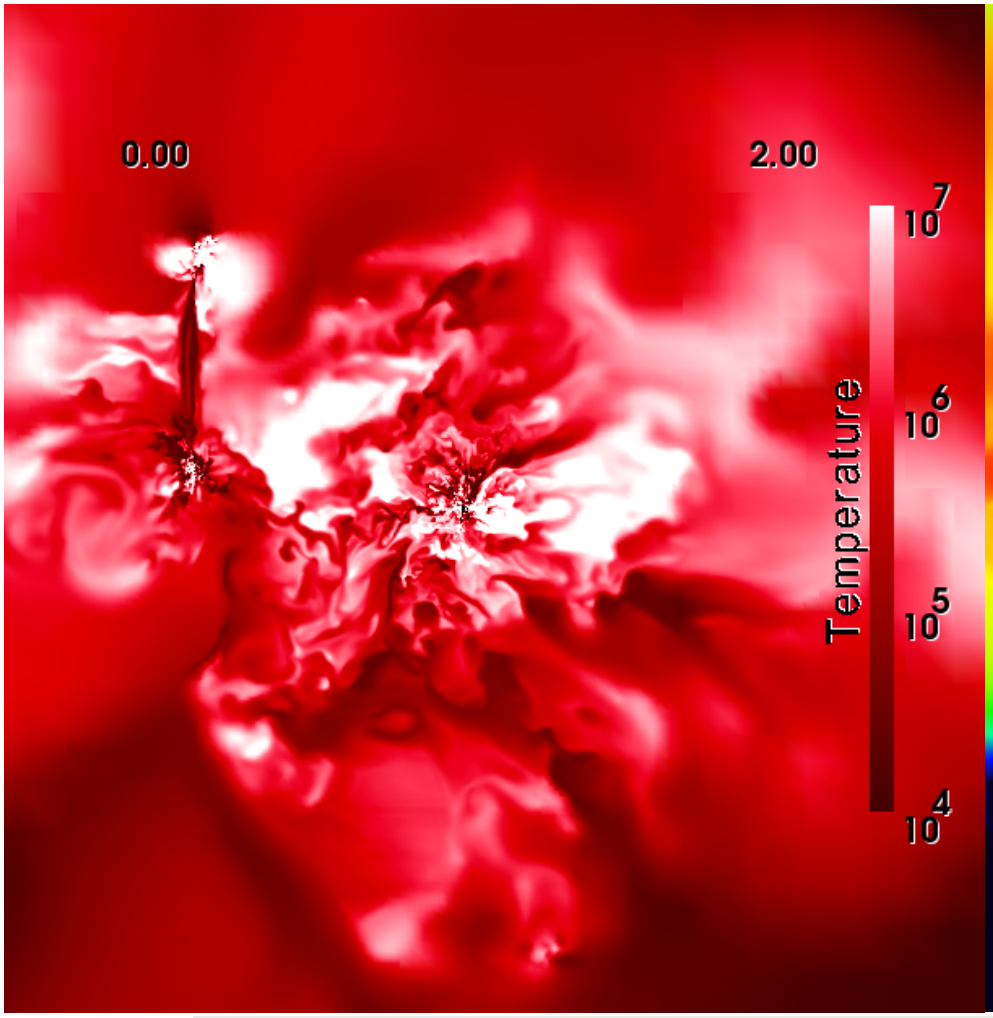
Density



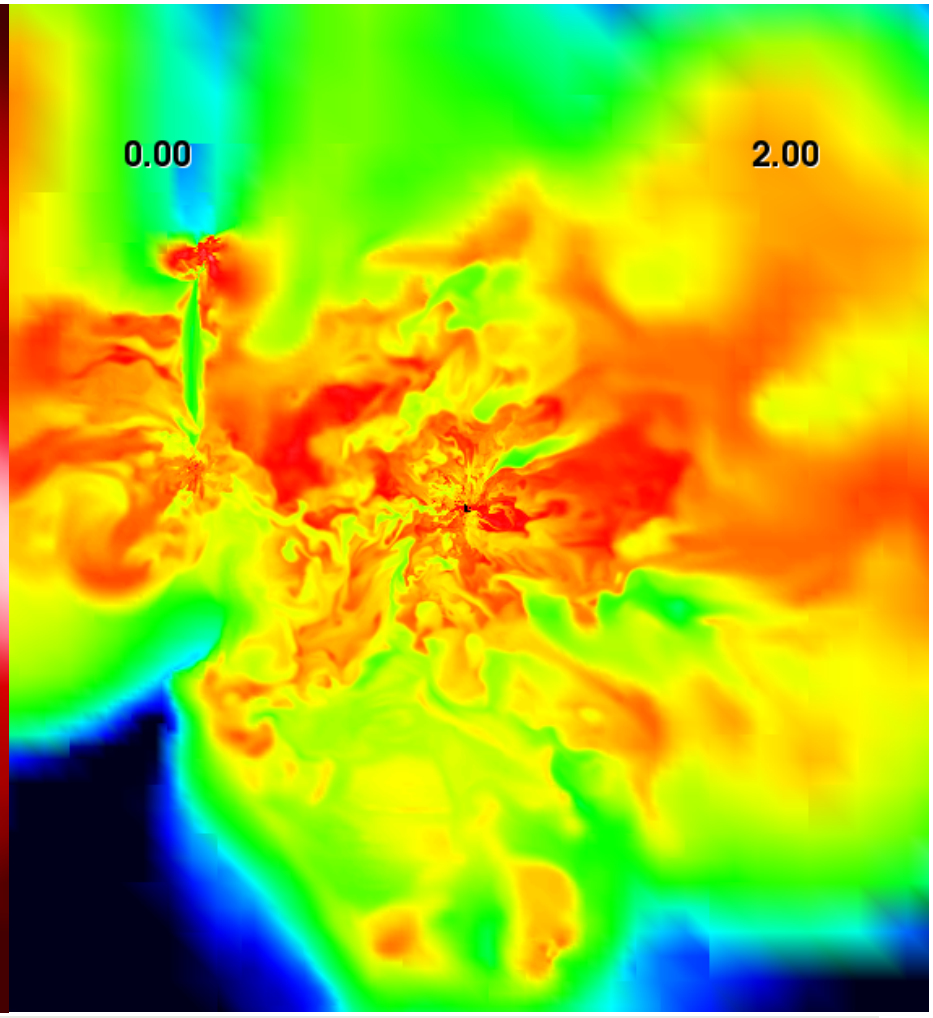
Main Halo

M_{vir} (z=1) = 7.2×10^{11}

Temperature



Metallicity



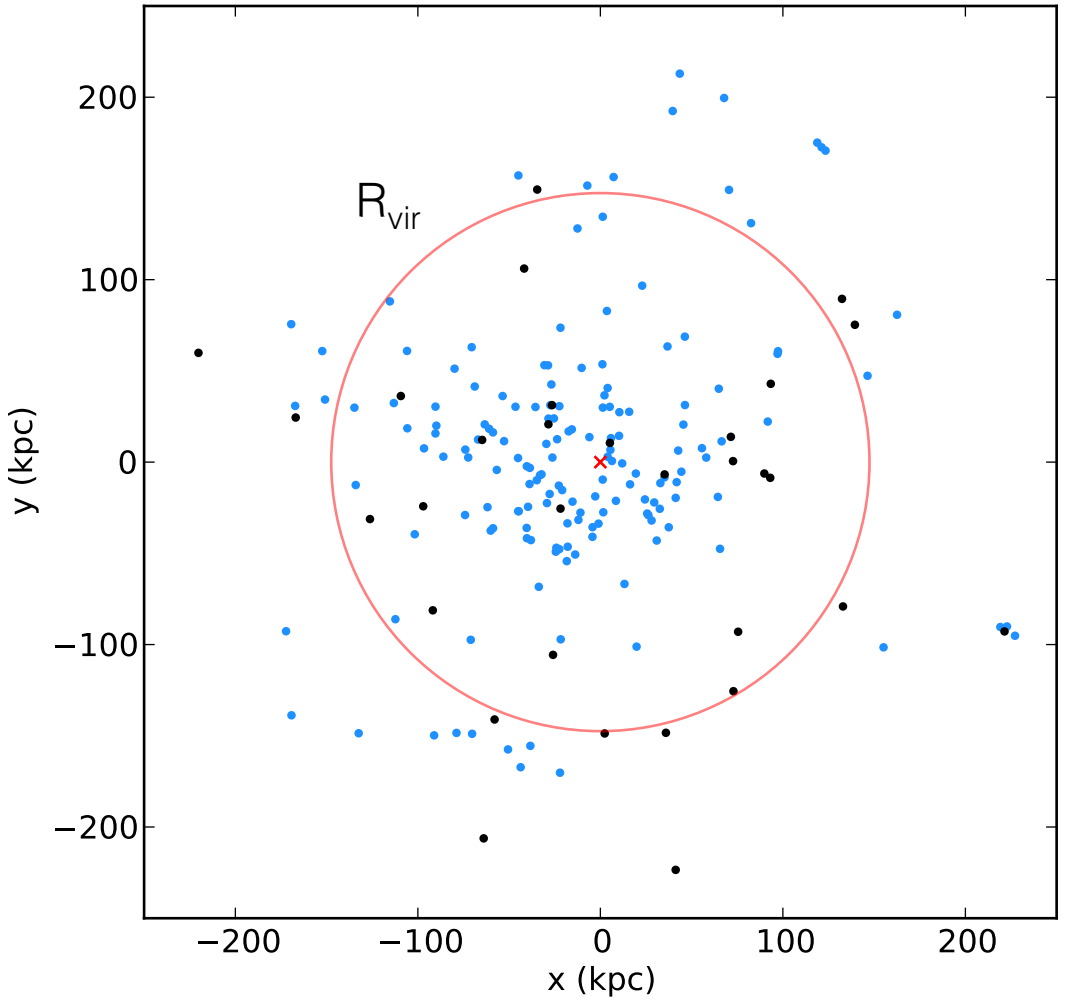
Satellite galaxies

Distribution of galaxies around main halo

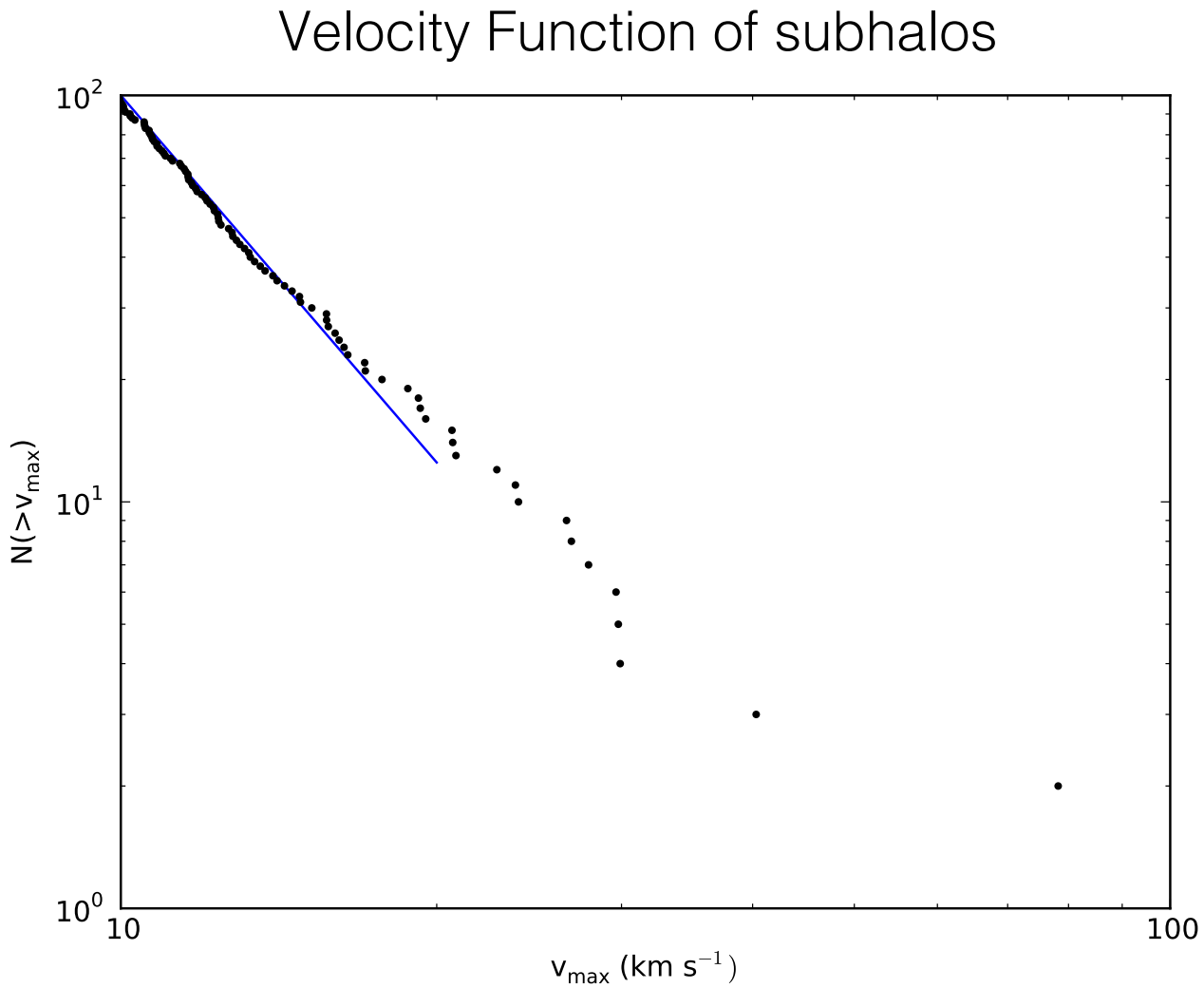
Red “x” marks the center of main halo

Blue dots are luminous dwarfs

Black dots are dark dwarfs



Satellite galaxies



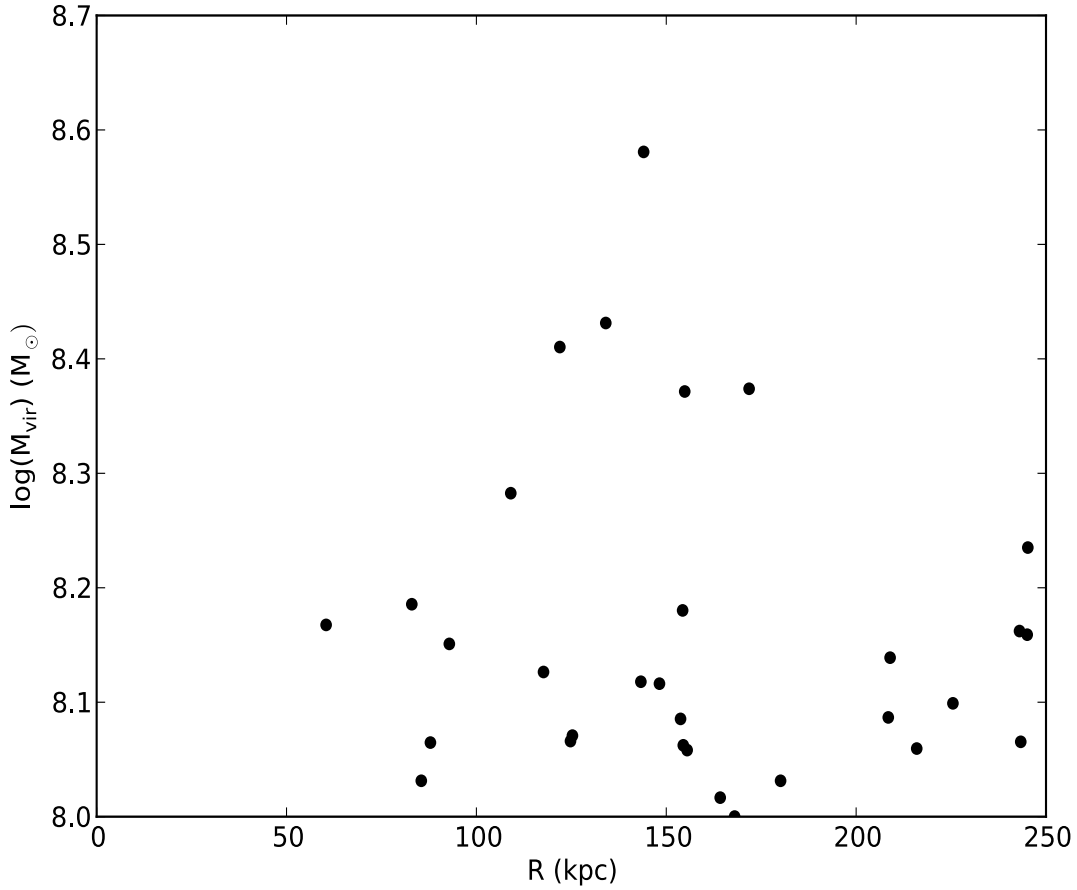
Satellite galaxies

Dark satellite galaxy population

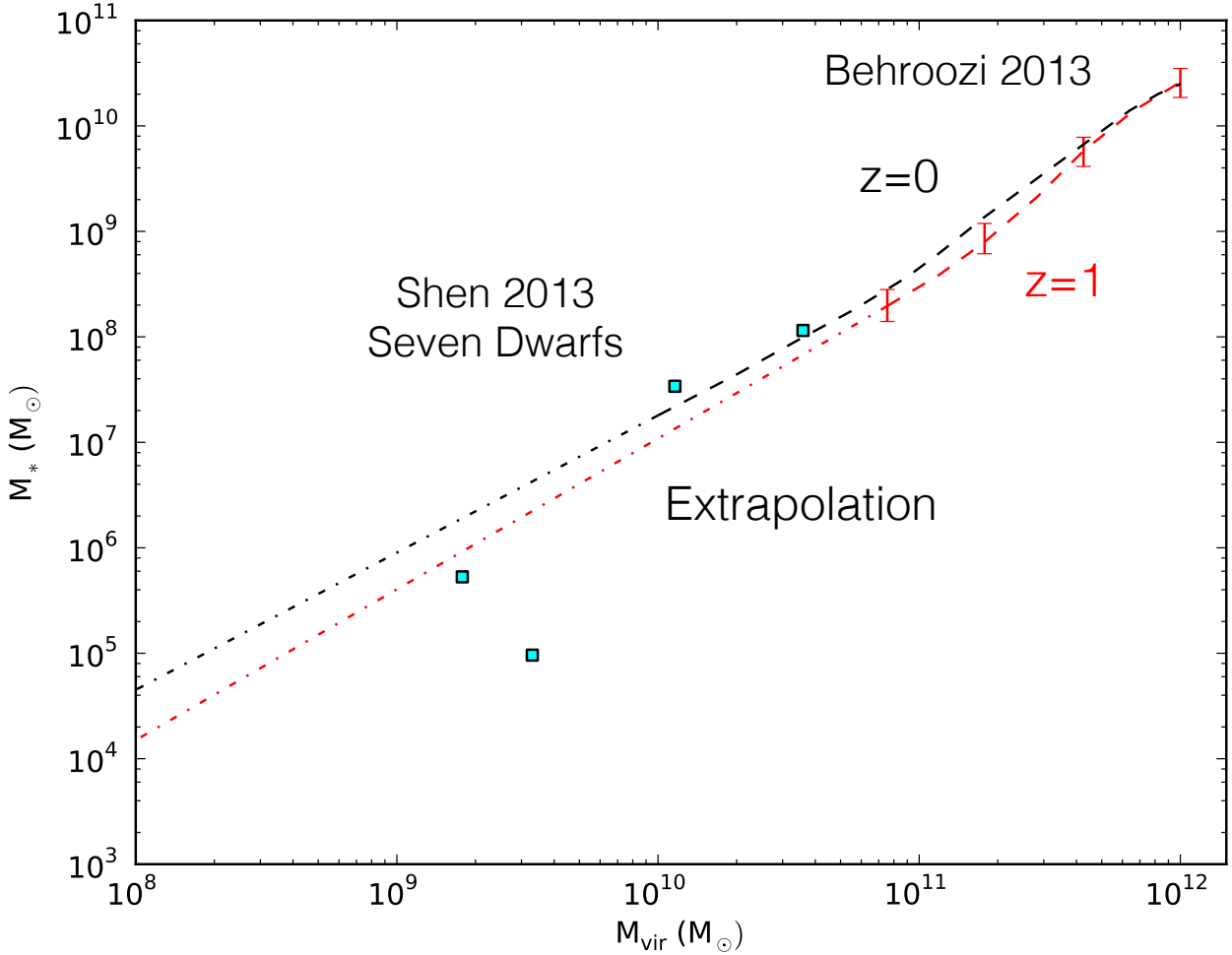
These objects have $M_{vir} < 10^9 M_{sun}$.

Not preferentially closer to main halo in this mass range

Many more objects with smaller M_{vir}

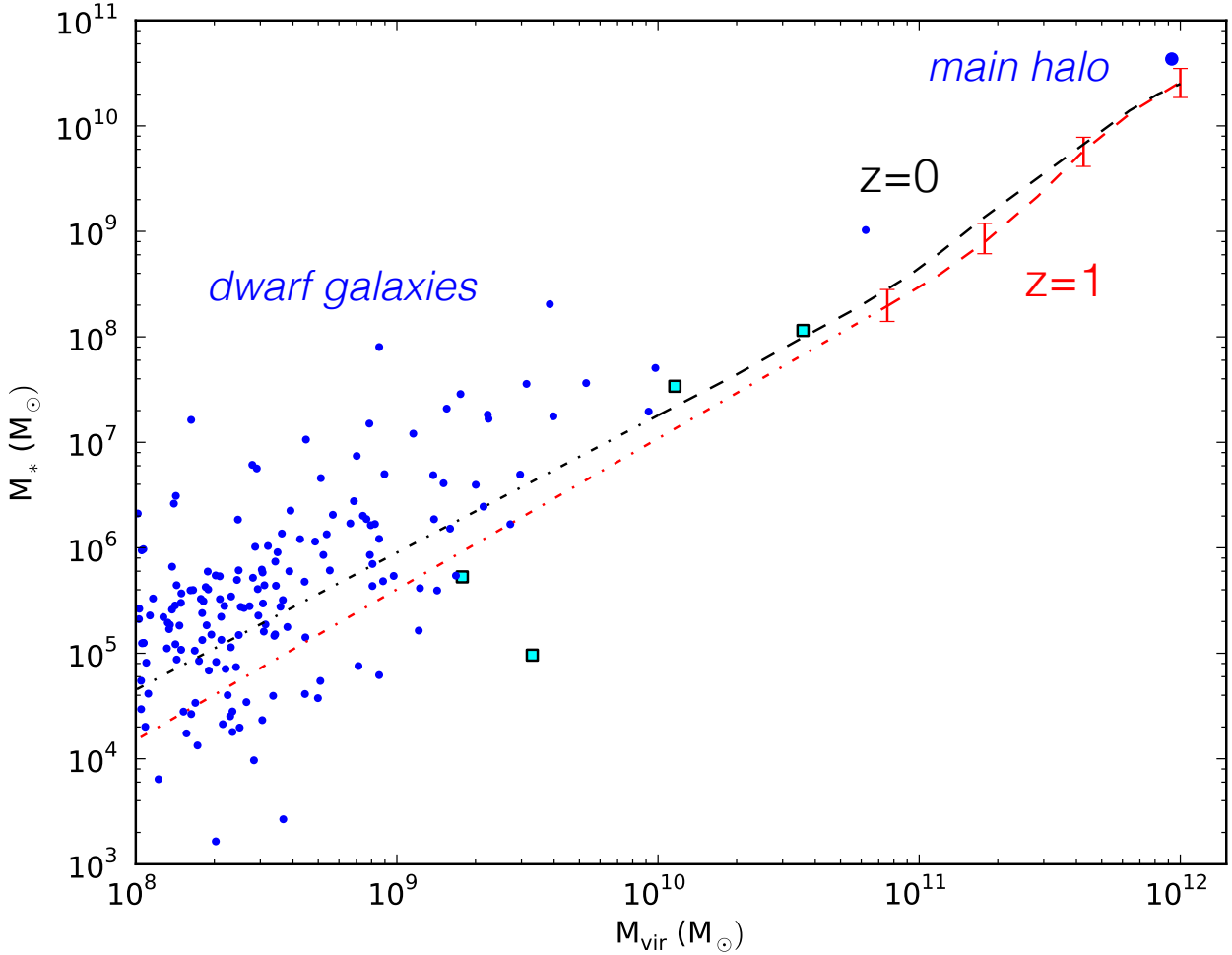


Stellar Mass – Halo Mass Relation



Shen+ 2013, arXiv:1308.4131
Behroozi+ 2013, ApJ, 770, 57

Stellar Mass – Halo Mass Relation



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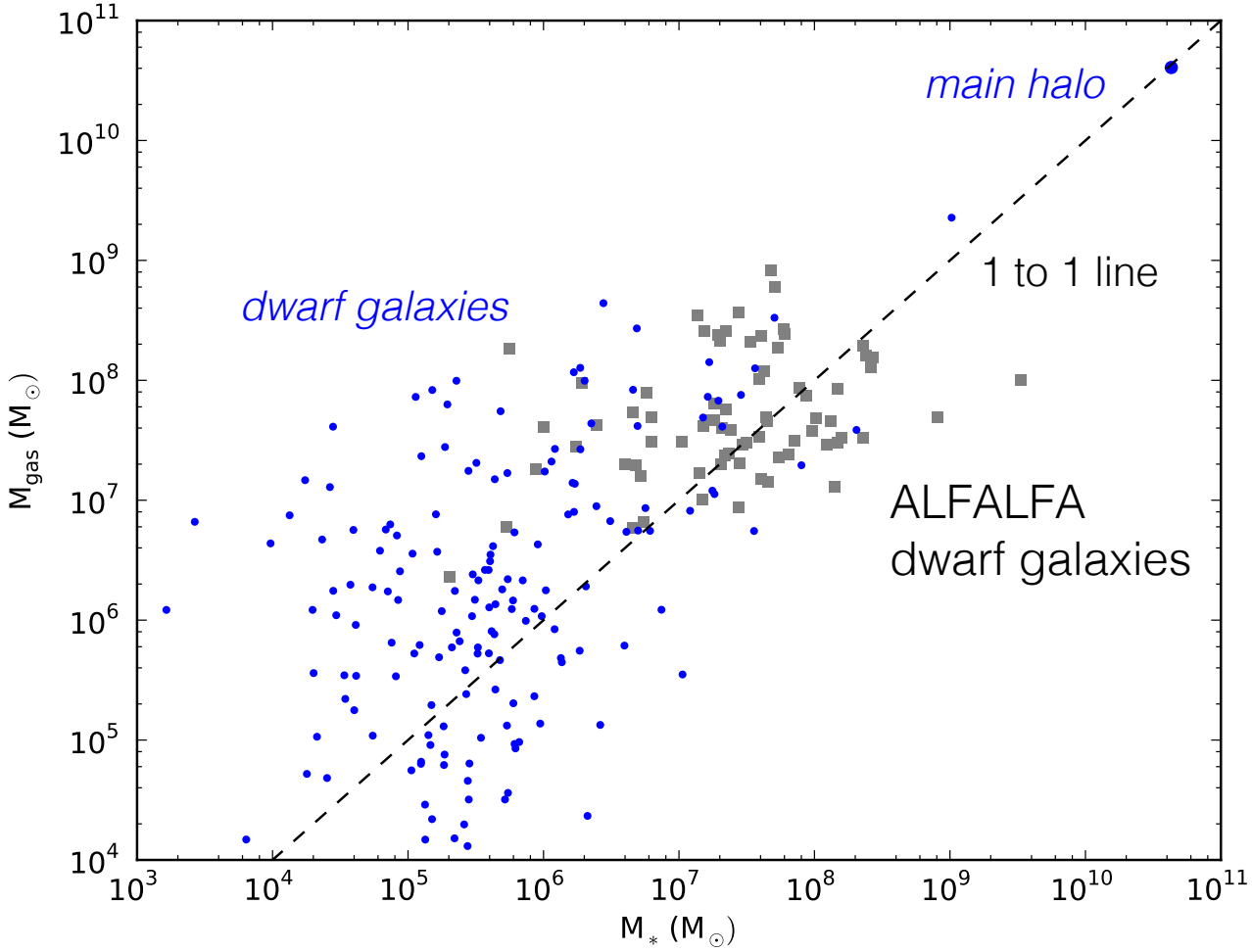
Behroozi+ 2013, ApJ, 770, 57

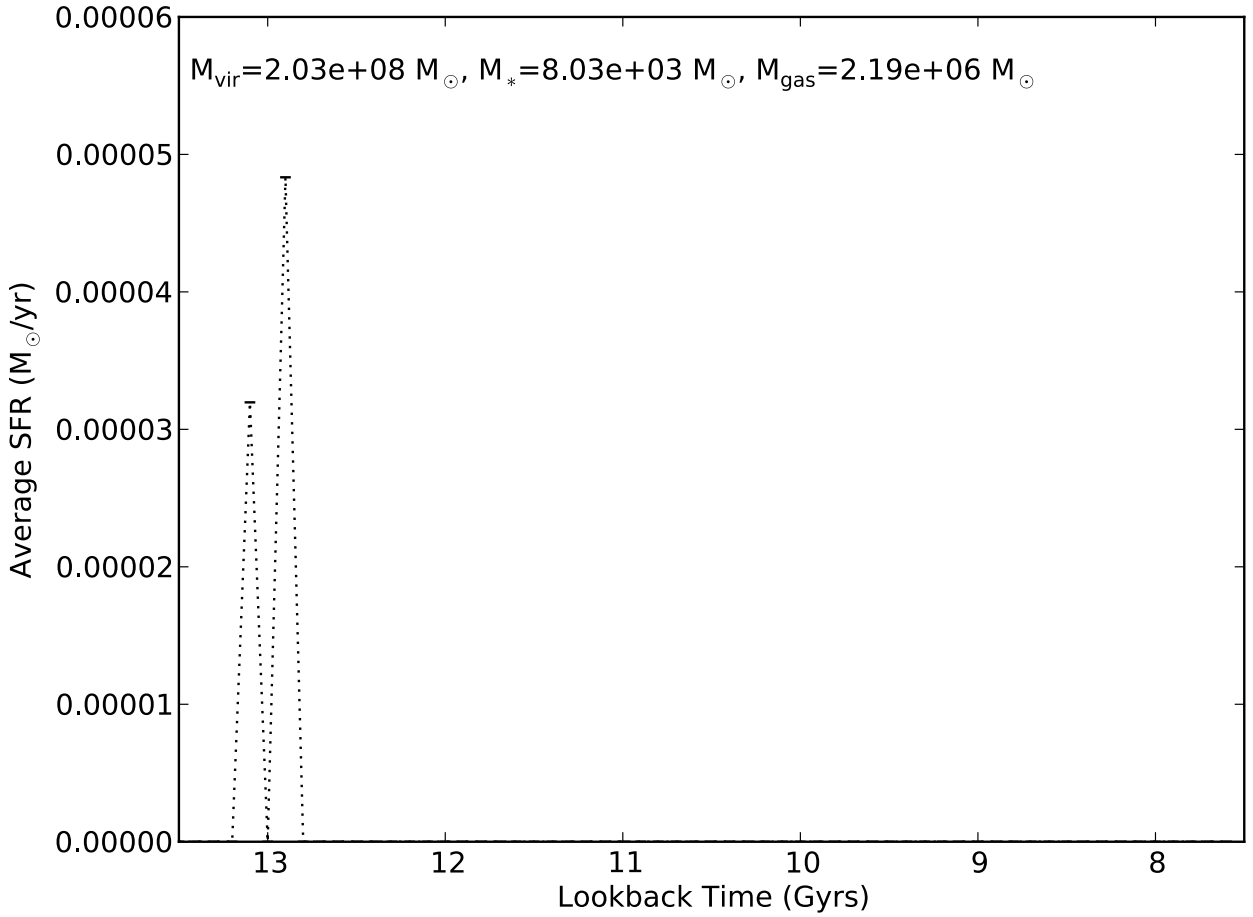
Gas Mass – Stellar Mass



Huang+ 2012, AJ, 143, 133

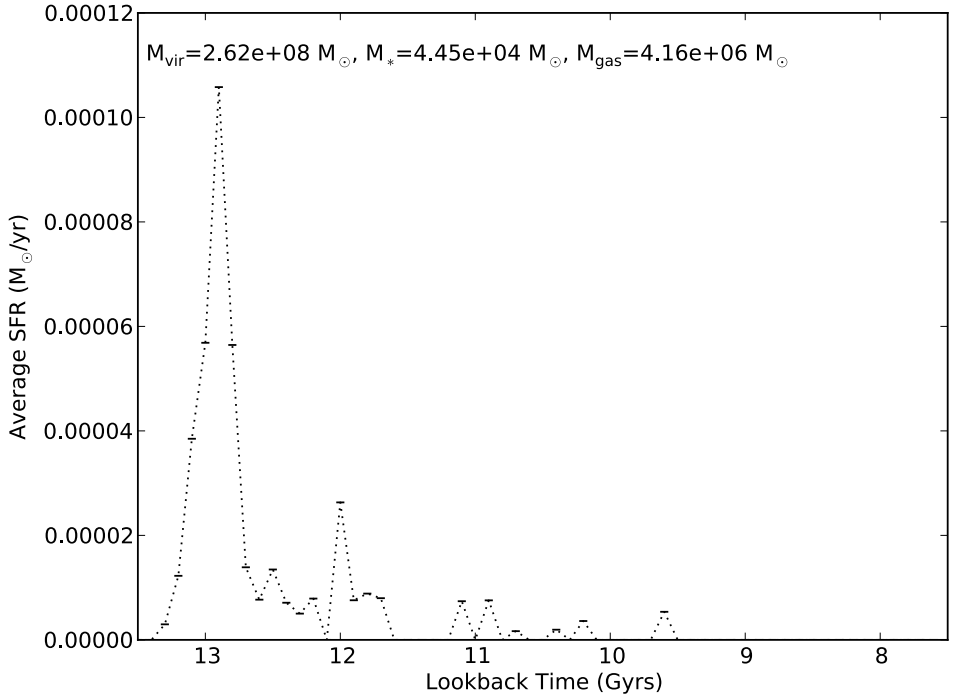
Average Star Formation Rates

$M_* < 10^4\ M_{sun}$

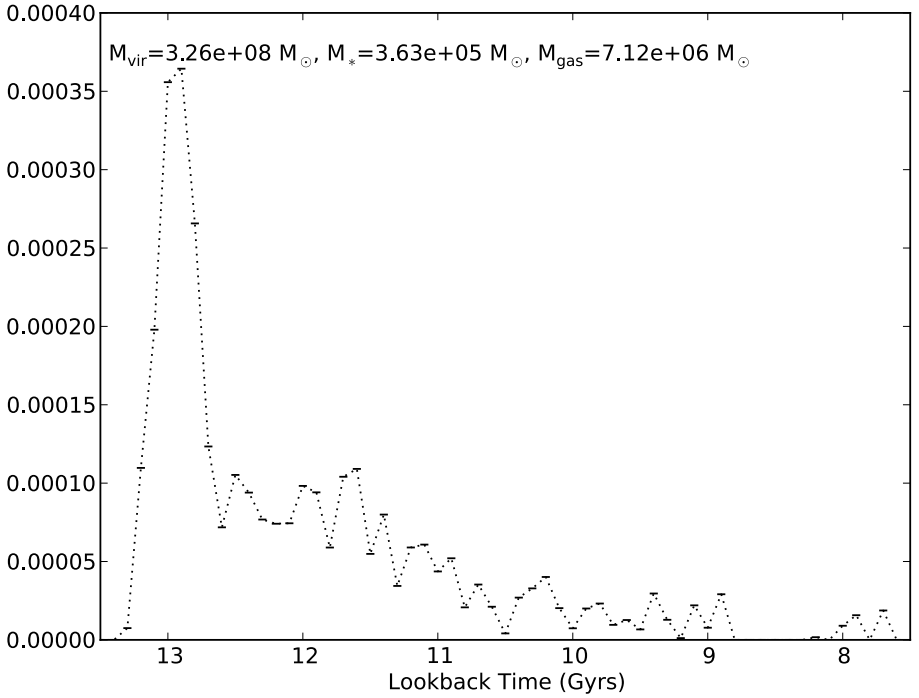


Average Star Formation Rates

$10^4\ M_{sun} < M_* < 10^5\ M_{sun}$

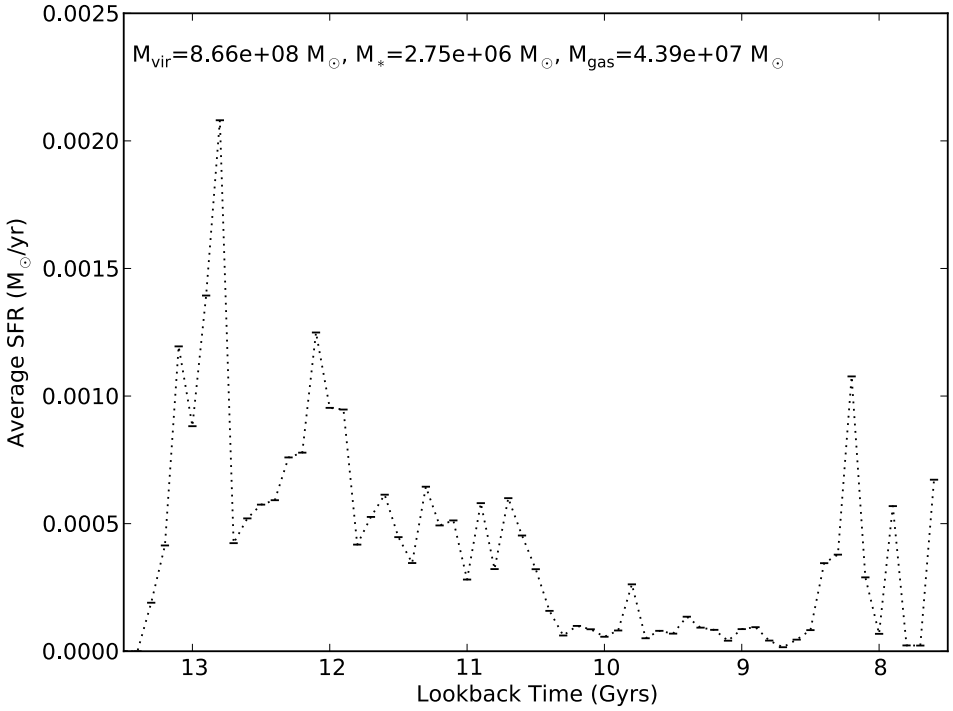


$10^5\ M_{sun} < M_* < 10^6\ M_{sun}$

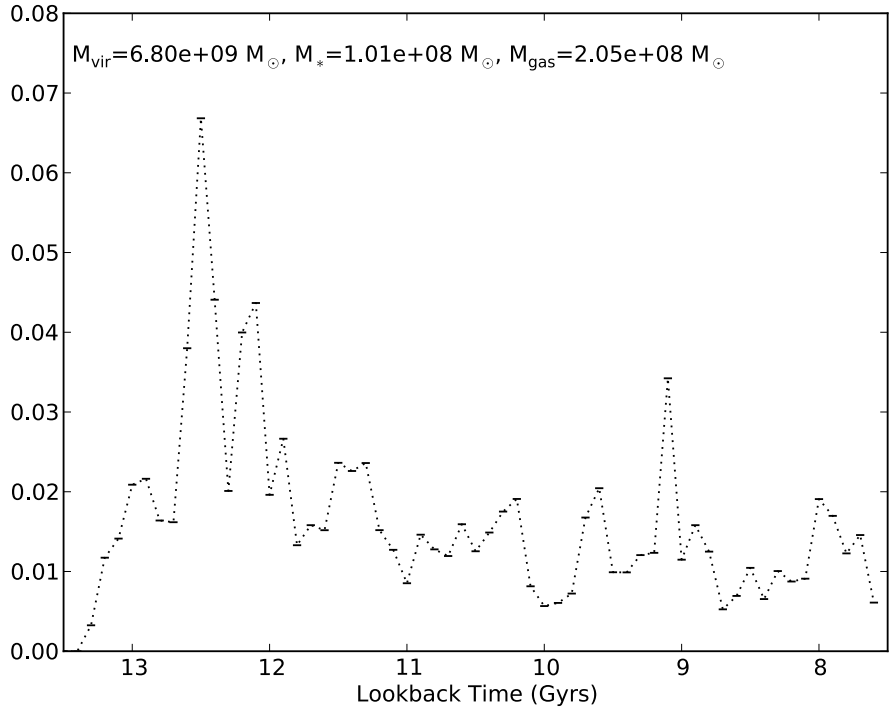


Average Star Formation Rates

$10^6\ M_{sun} < M_* < 10^7\ M_{sun}$



$M_* > 10^7\ M_{sun}$



Conclusions

- High-resolution hydro simulation of MW-like galaxy and its satellites
- Main halo hosts luminous and dark subhalos
- Velocity function has slope of -3
- Main halo and subhalos agree with SHM relationship. Large spread in M_* for given M_{vir}
- Gas mass to stellar mass agrees with HI observations
- SF in most satellites has initial burst then is roughly constant. Not completely suppressed by reionization