Comparing the evolving properties of satellite and isolated dwarf galaxies

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Daniel Ceverino

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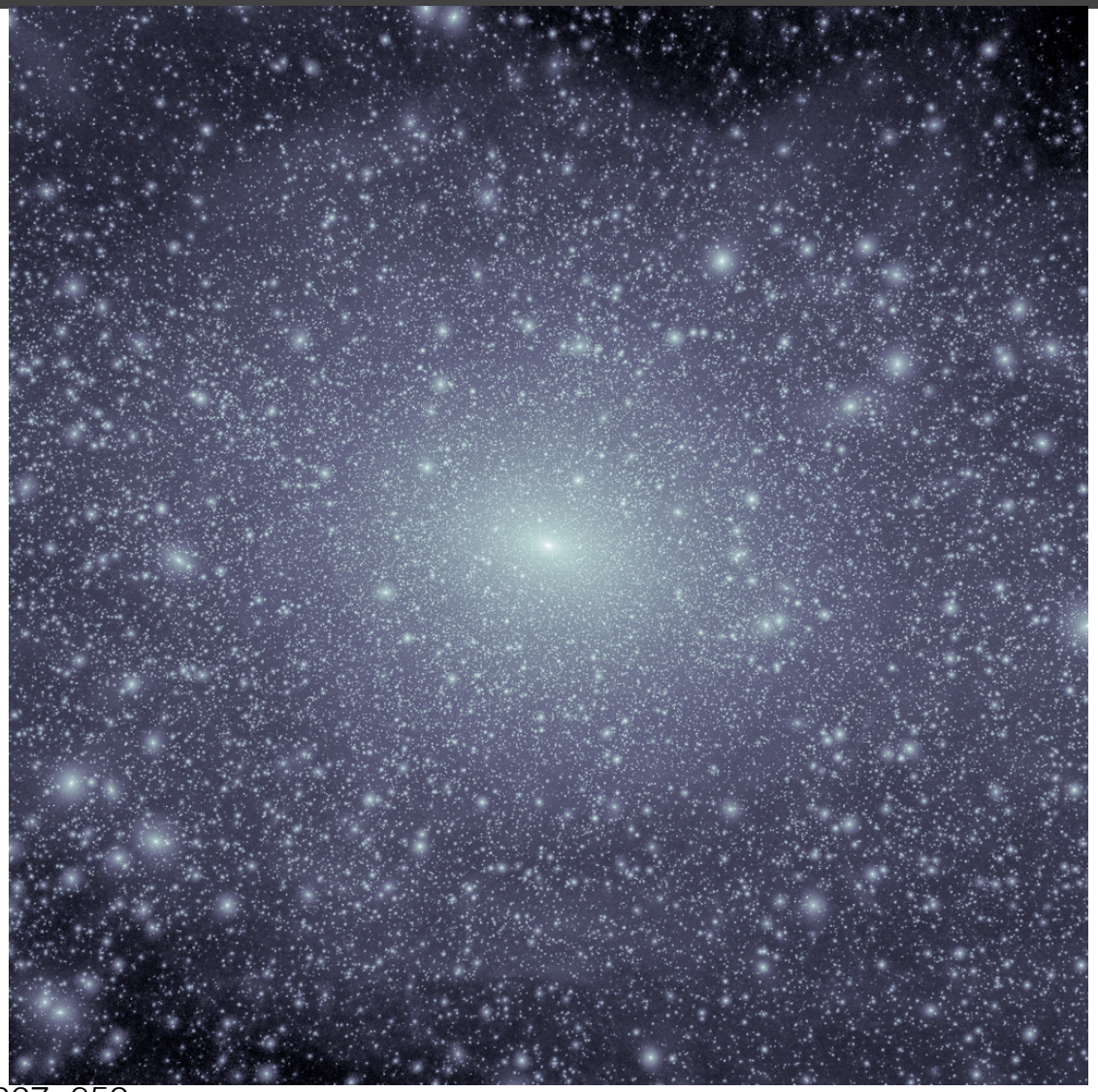
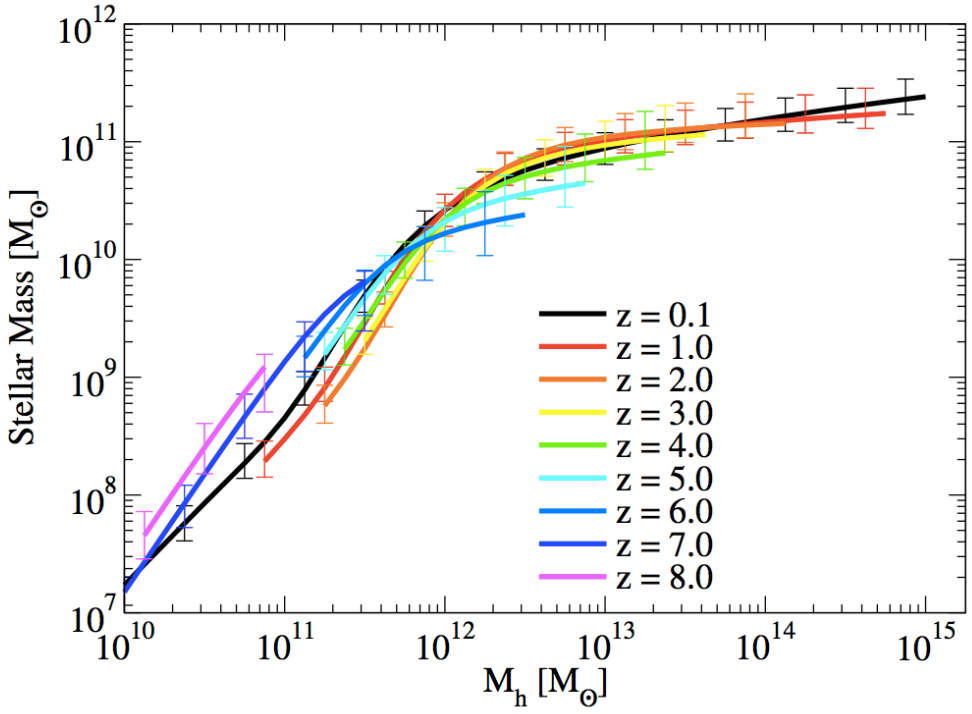
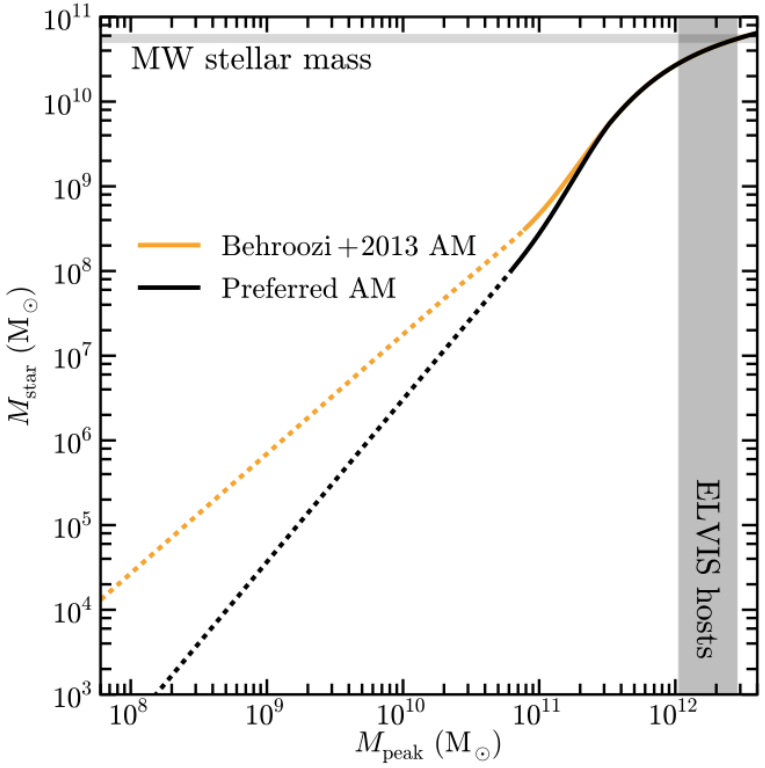
Introduction



Diemand+ 2007, ApJ, 667, 859

Introduction

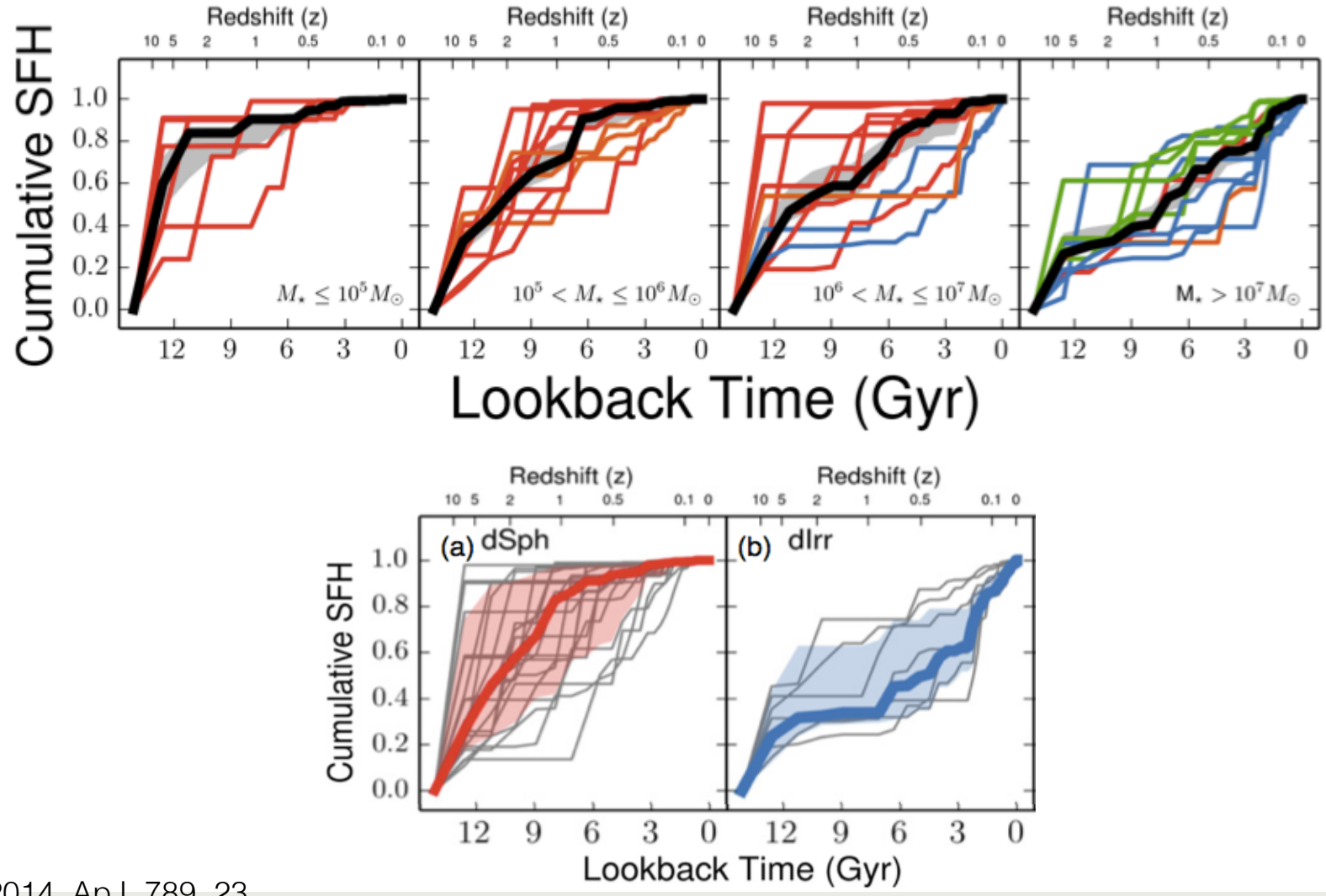




Behroozi+ 2013, ApJ, 770, 33

Garrison-Kimmel+ arxiv:1404.5313

Introduction



Weisz+ 2014, ApJ, 789, 23

Simulation Suite

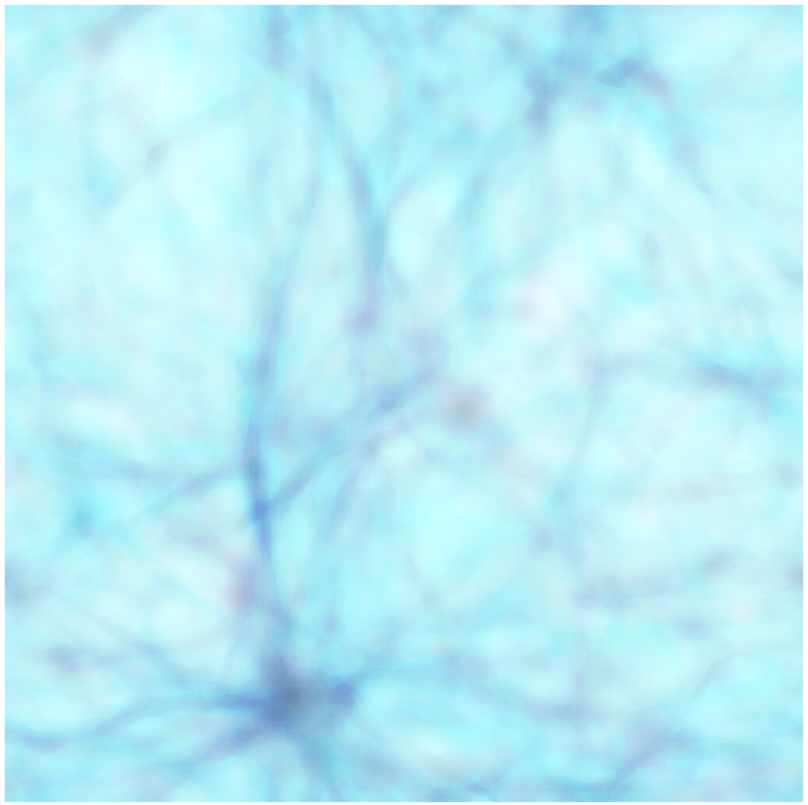
Examining the VELA simulations

Daniel Ceverino

hydrodynamical simulations
ART code (AMR)

Possible MW progenitors
No specific environmental selection

Range of merger histories and M_{vir}



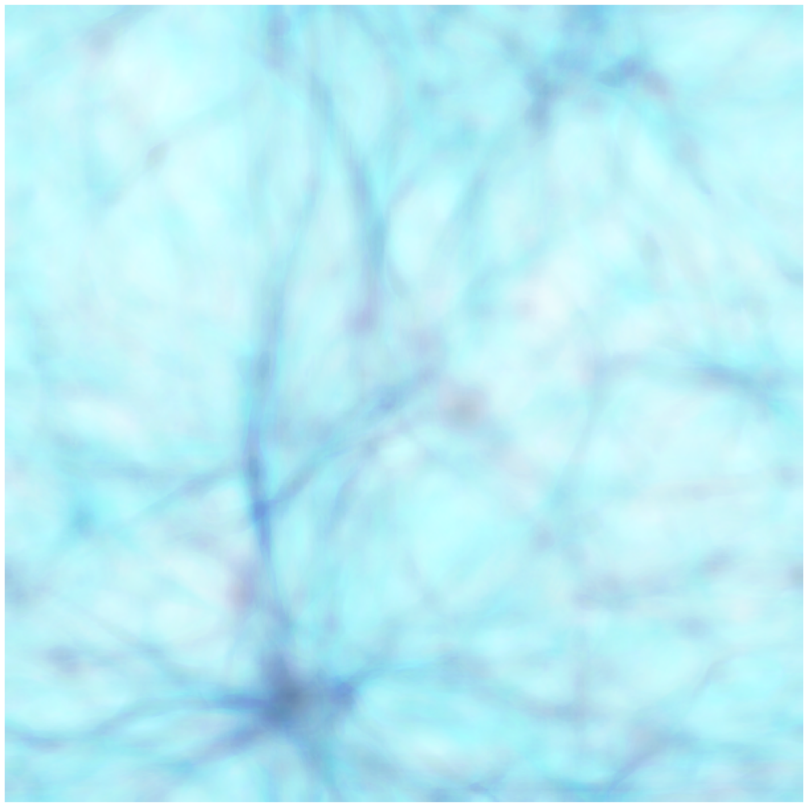
Simulation Suite

10 VELAs

Box length = 20 /h Mpc
DM mass = 8×10^4 M_{sun}
Resolution = 17 pc

cells = 67 million
particles = 30 million
star particles = 7.7 million

Stellar winds
Metal advection
Supernovae feedback
Radiation pressure (τ_{IR}=0)



Main Halos

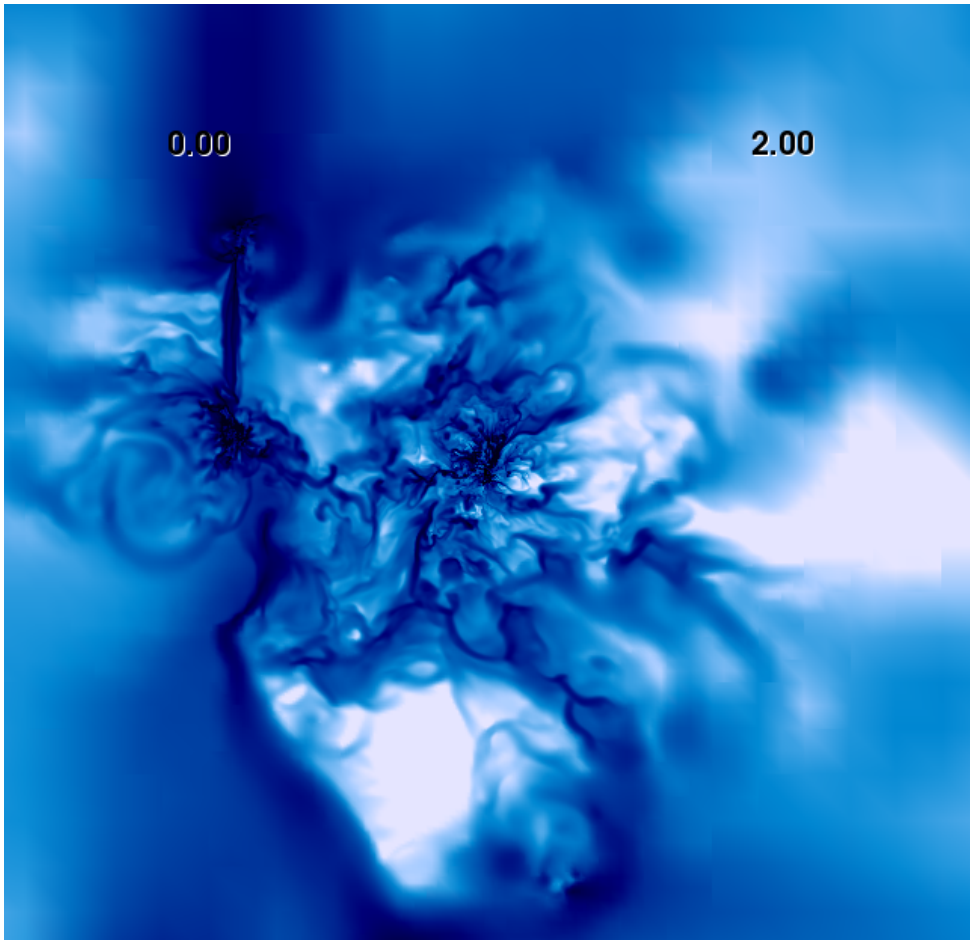
Results at z=1

$M_{vir} = 2x10^{11} - 1.2x10^{12}\ M_{sun}$

$M_{*} = 6x10^{9} - 8x10^{10}\ M_{sun}$

$R_{vir} = 92 - 147$ kpc

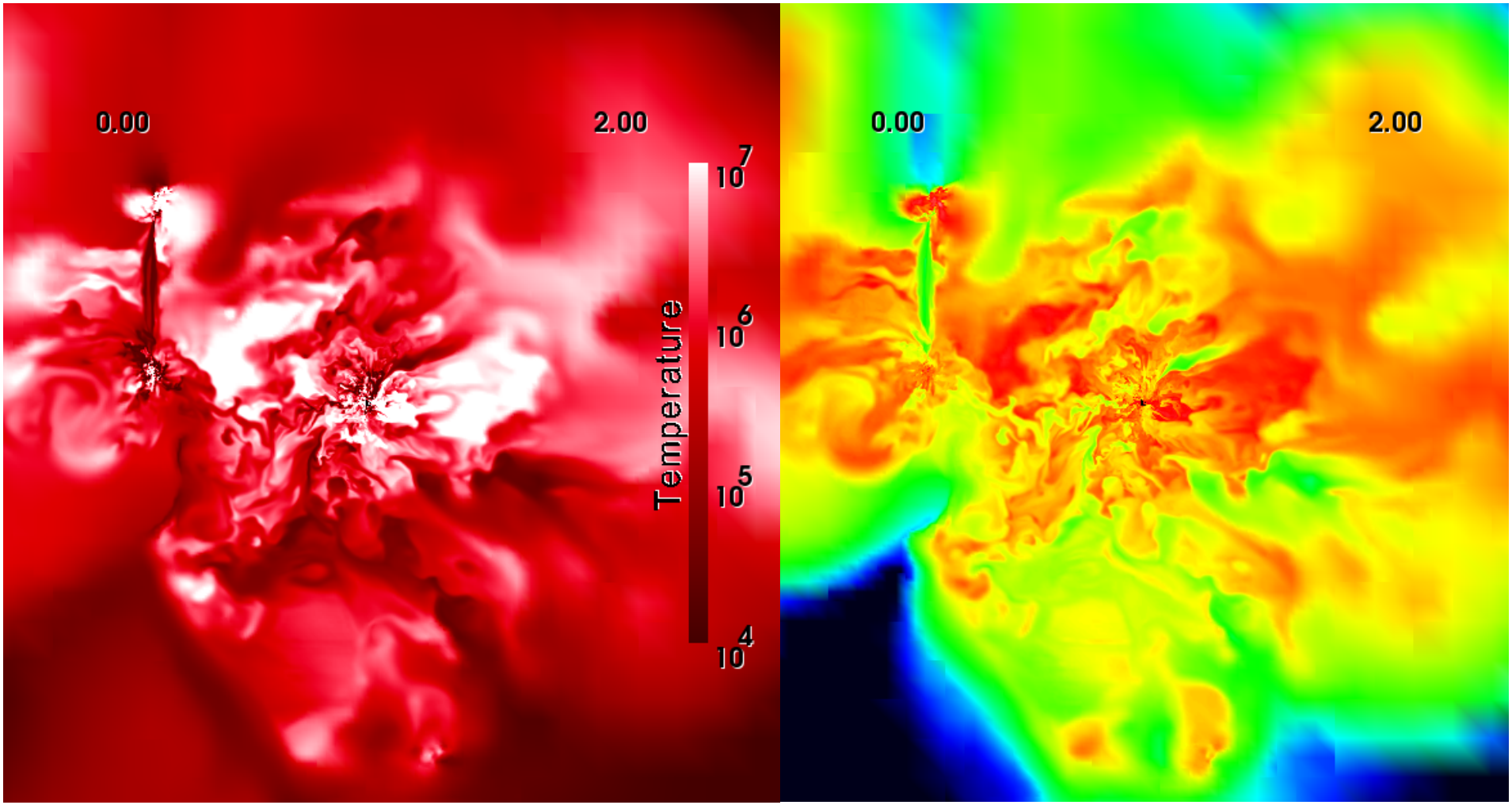
Density



Main Halos

Temperature

Metallicity

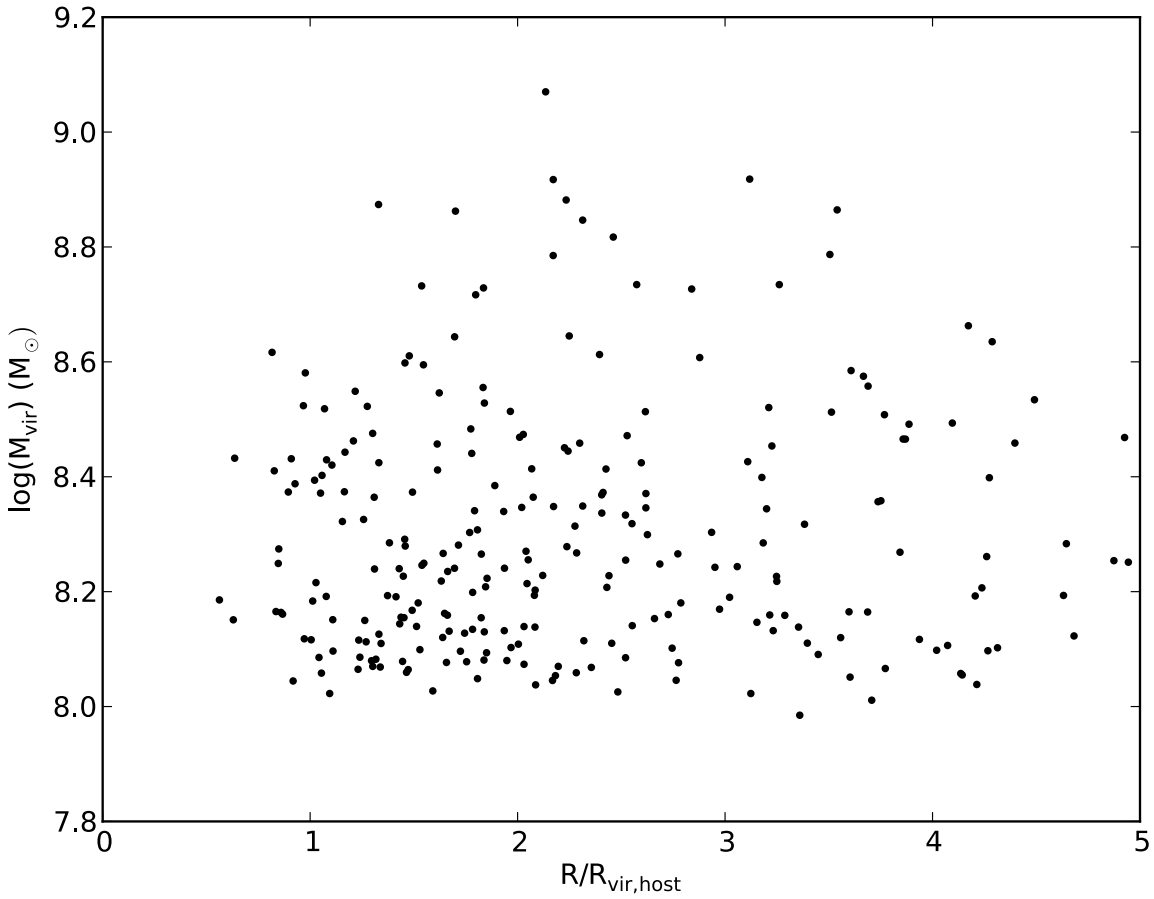


Dark dwarf galaxies

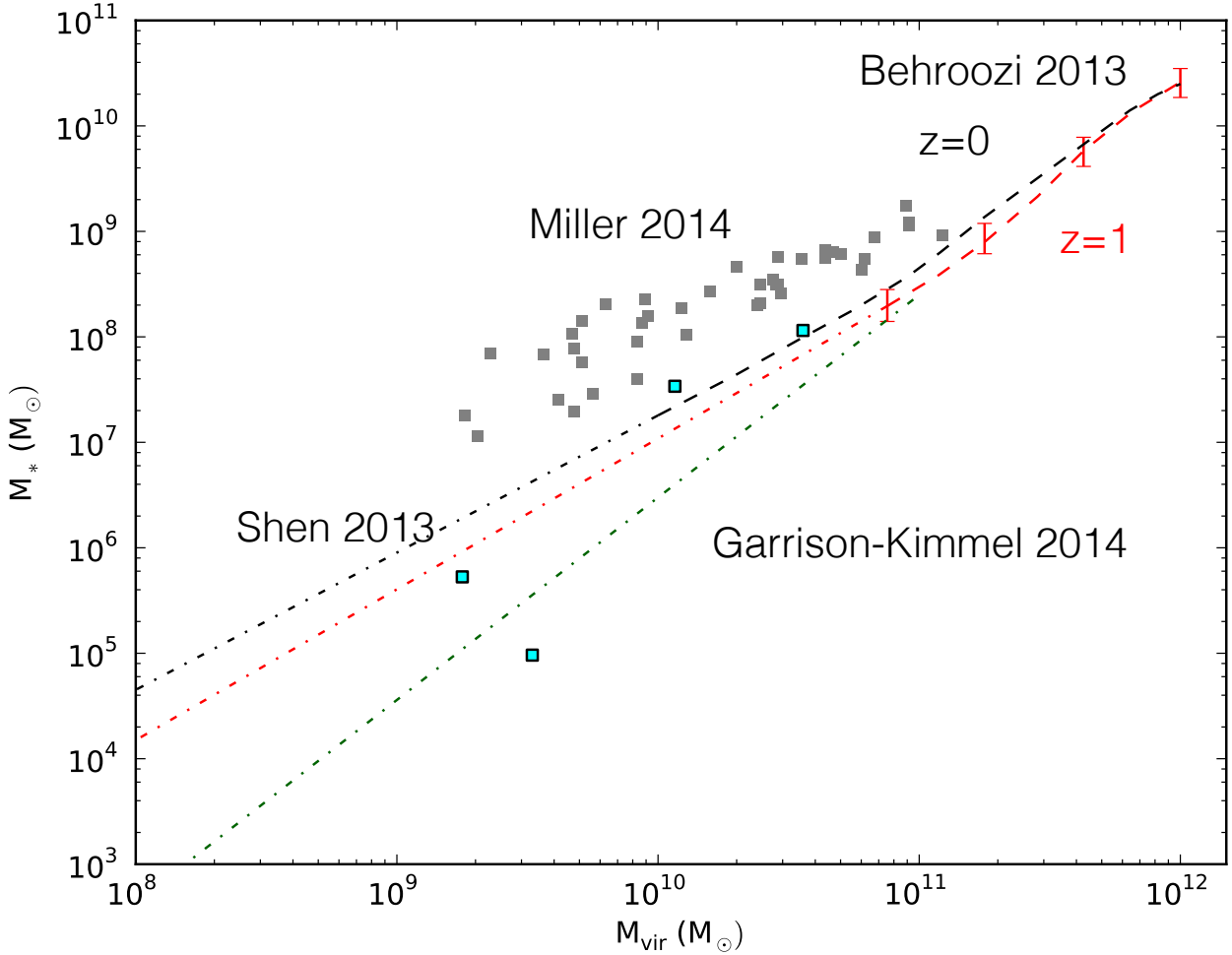
These objects have $M_{vir} \leq 10^9 M_{sun}$

No distance dependence

Many more objects with smaller M_{vir}



Stellar Mass – Halo Mass Relation



Shen+ 2013, arXiv:1308.4131
Miller+ 2014, ApJ, 782, 10

Behroozi+ 2013, ApJ, 770, 57
Garrison-Kimmel+ arxiv:1404.5313

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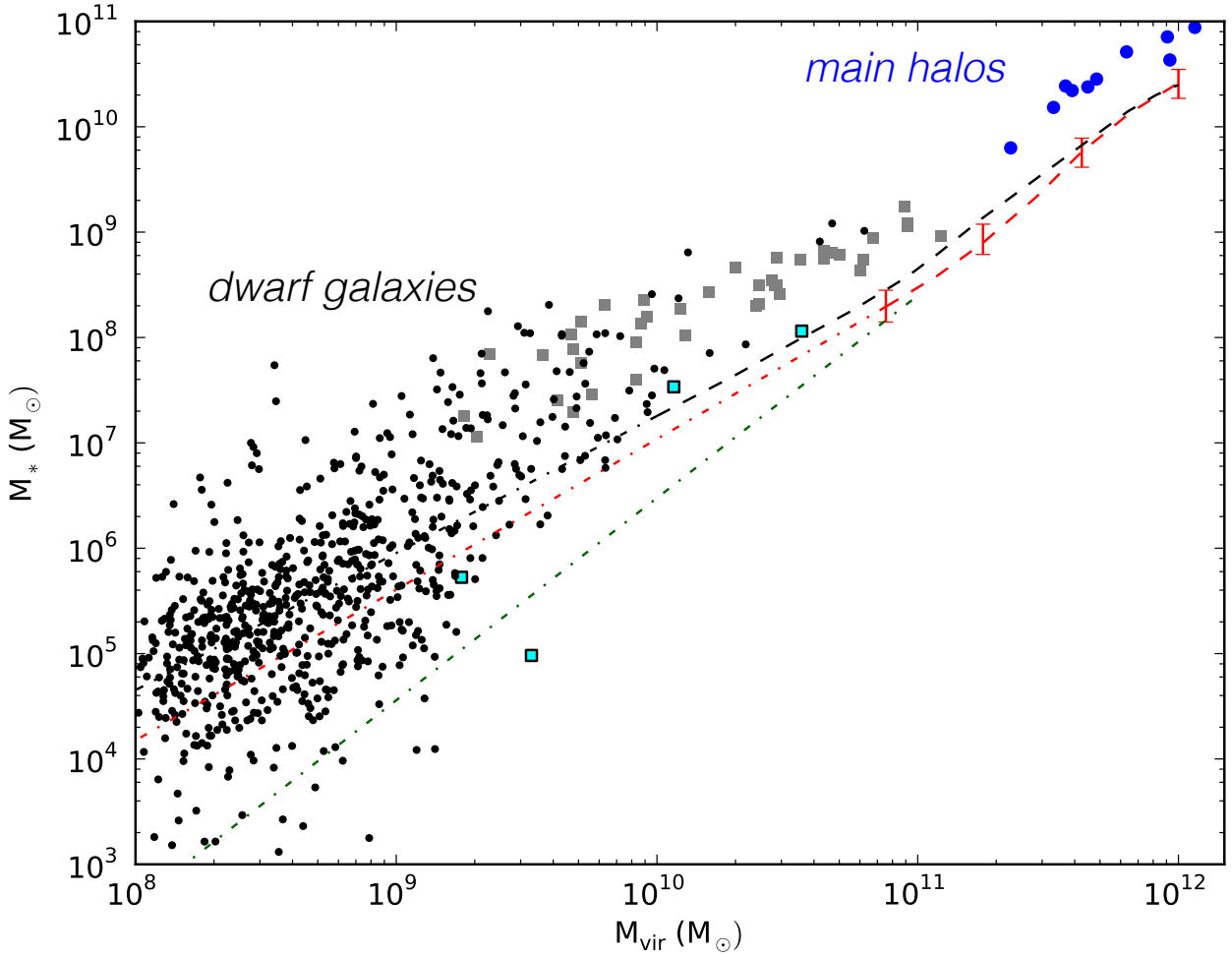
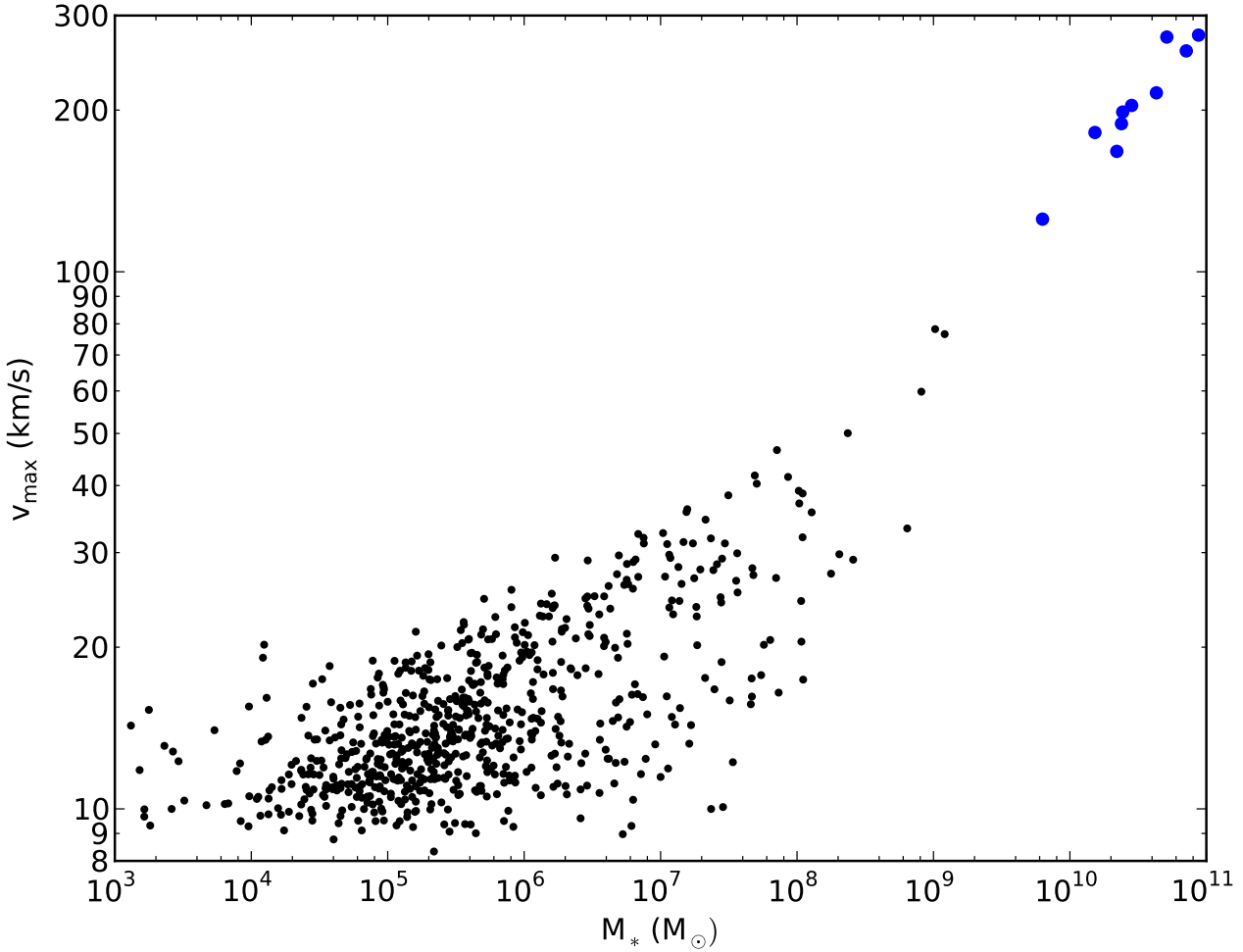


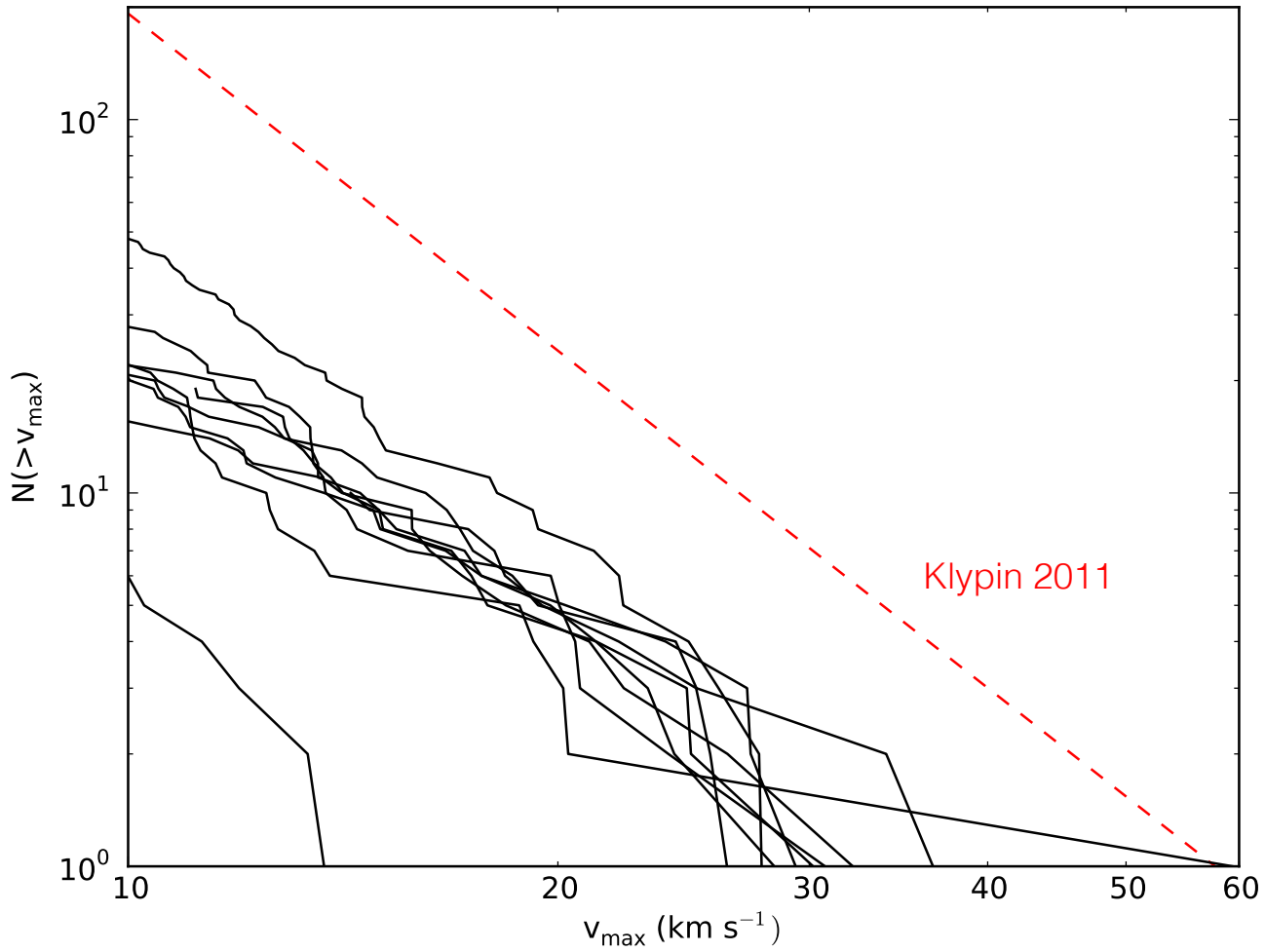
Shen+ 2013, arXiv:1308.4131
Miller+ 2014, ApJ, 782, 10

Behroozi+ 2013, ApJ, 770, 57
Garrison-Kimmel+ arxiv:1404.5313

v_{max} - Stellar Mass

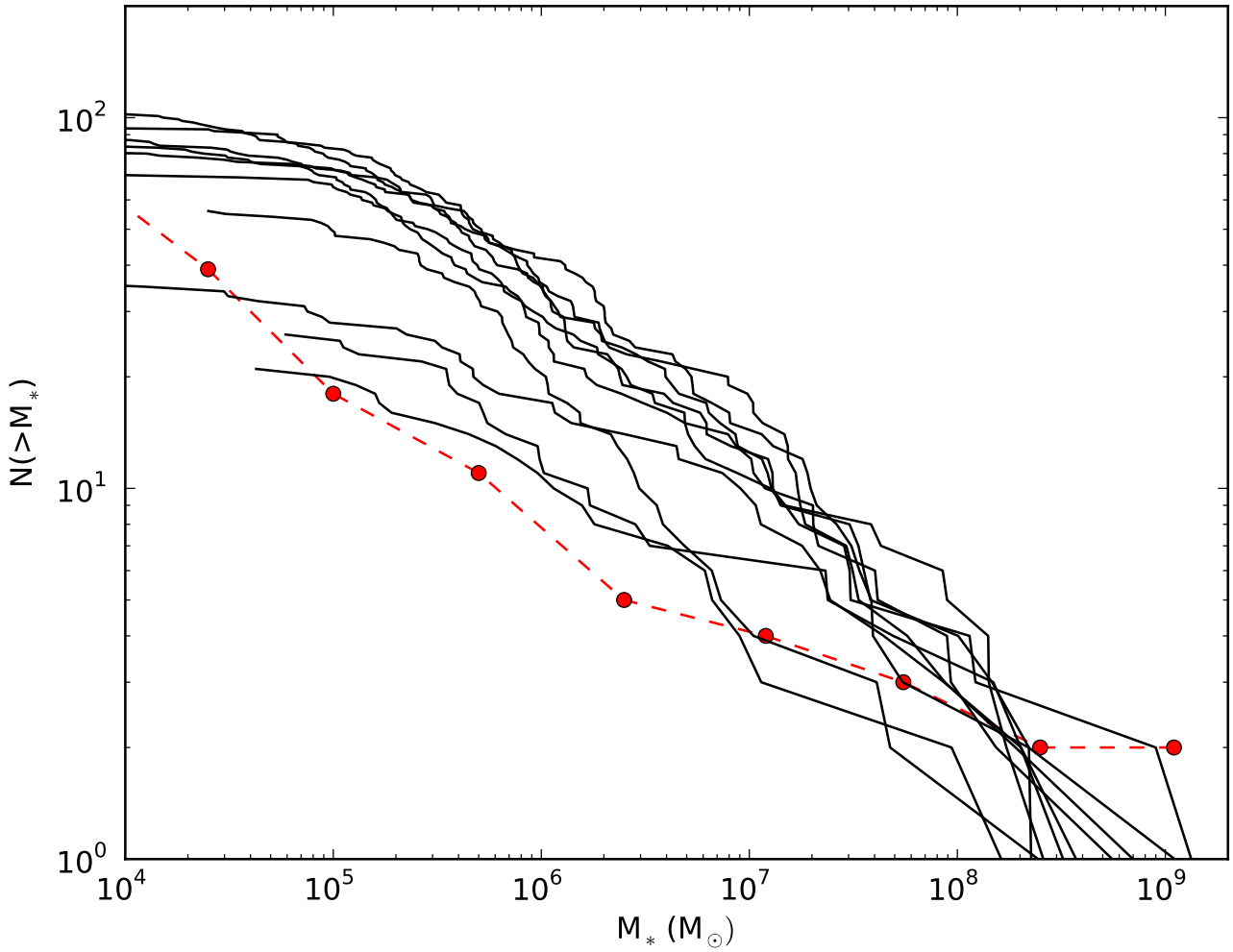


Satellite Velocity Function



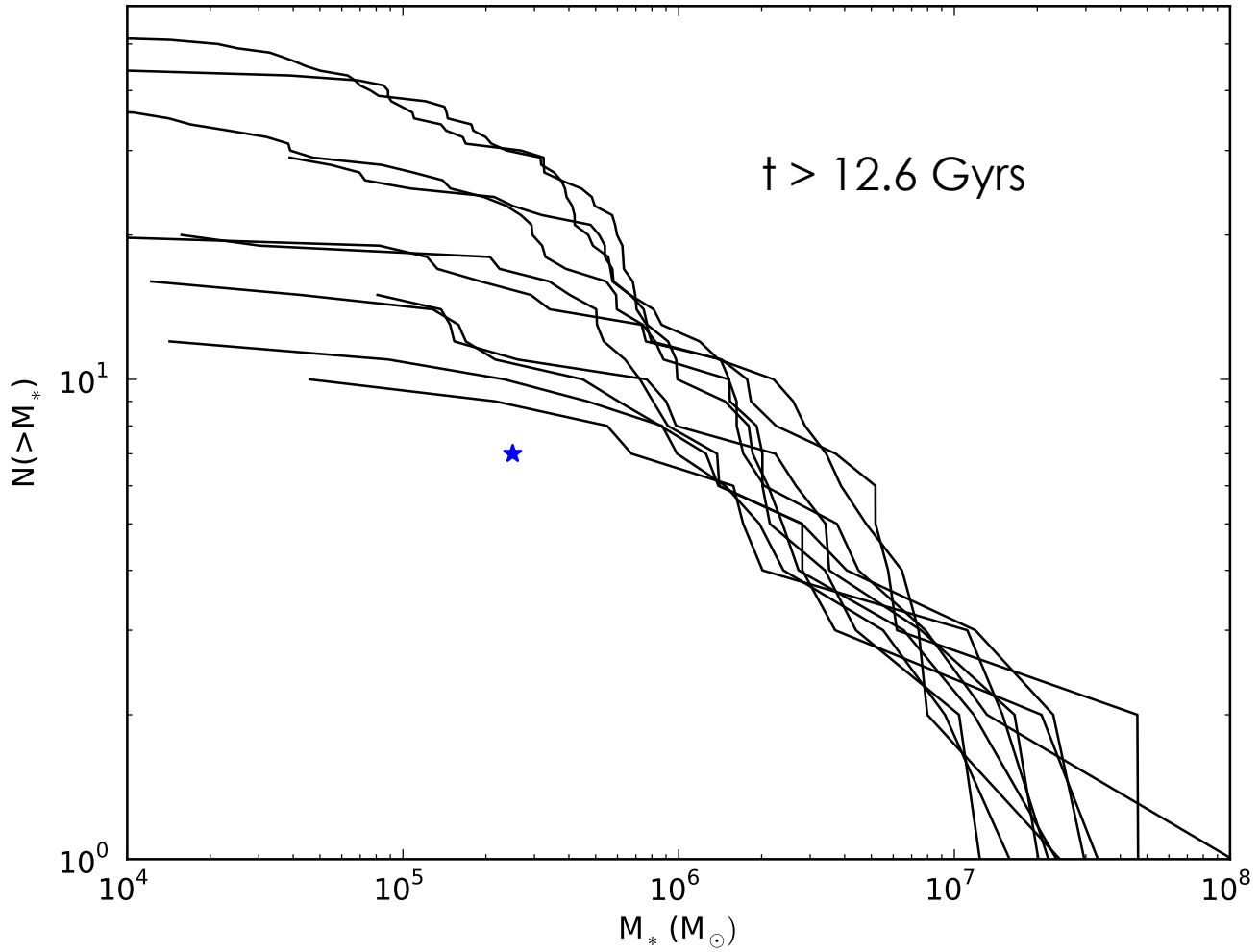
Klypin+ 2011, ApJ, 740, 102

Satellite Mass Function



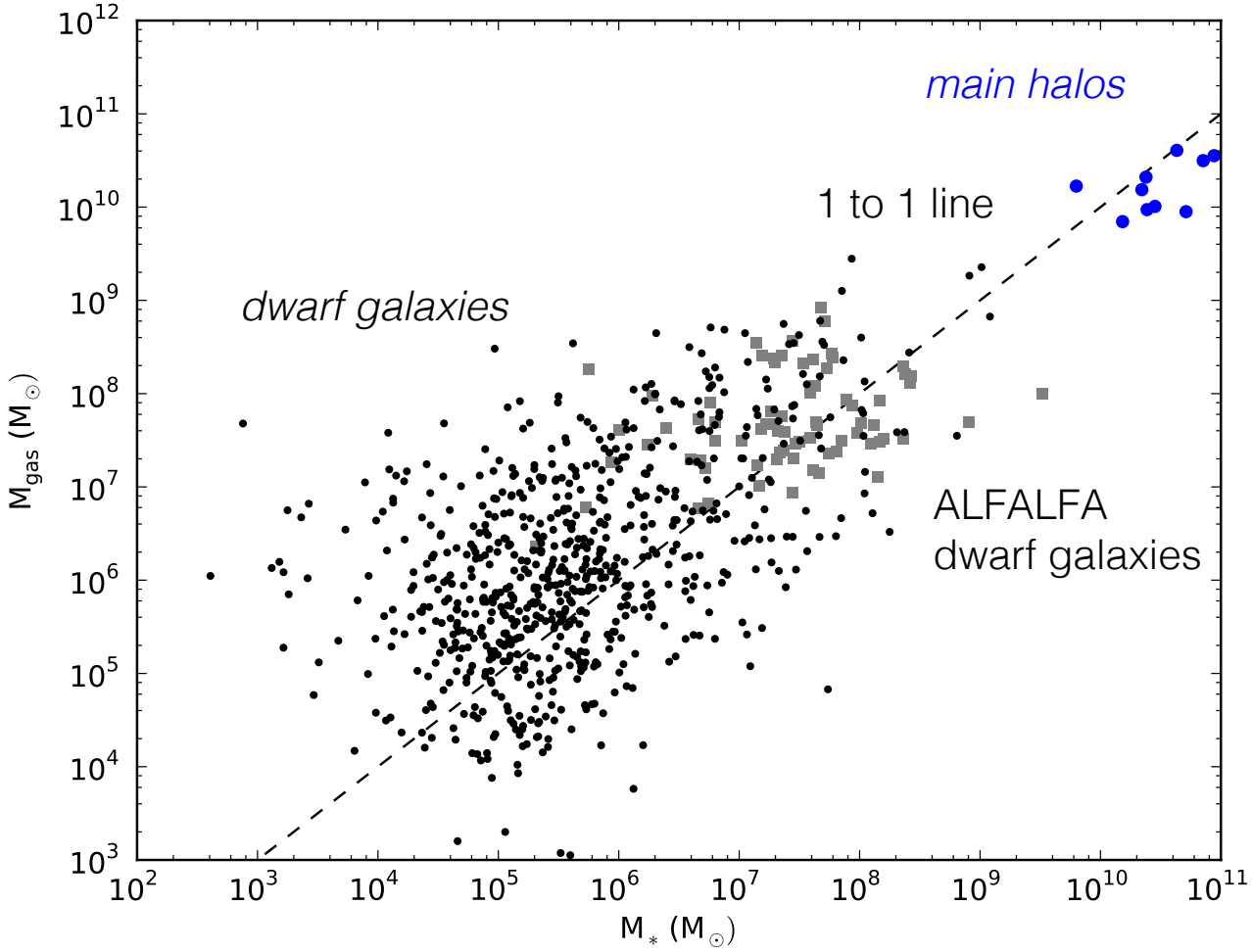
Tollerud+ 2008, ApJ, 688, 277

Satellite Mass Function



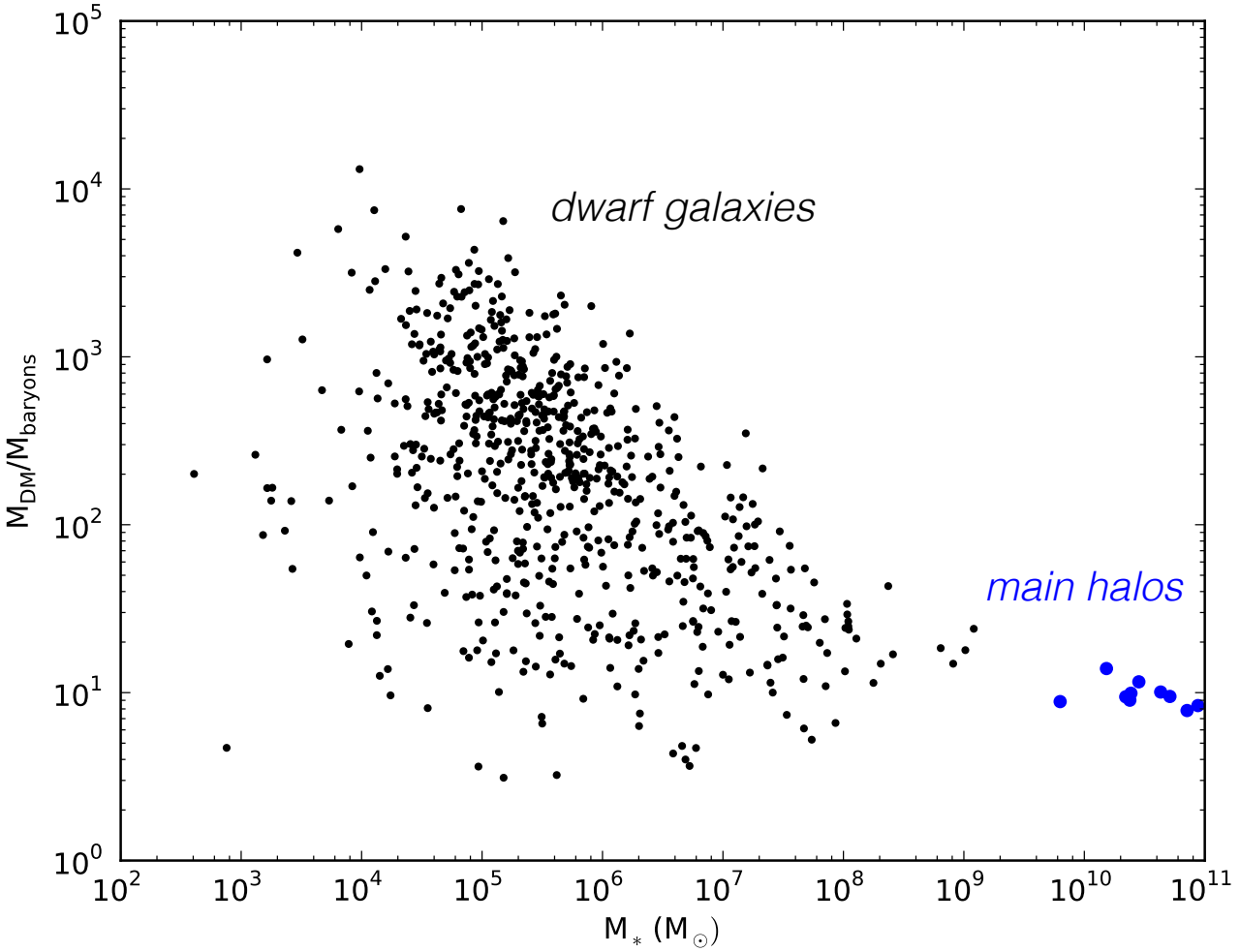
Boylan-Kolchin+ 2014, MNRAS, 443, L44
Wise+ 2014, MNRAS, 442, 2560

Gas Mass – Stellar Mass



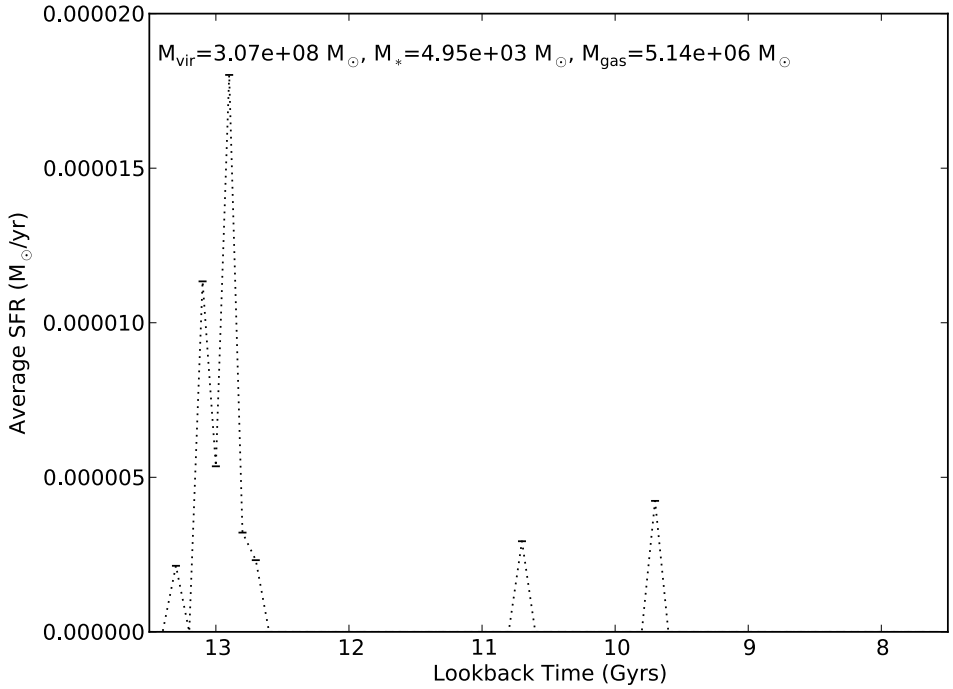
Huang+ 2012, AJ, 143, 133

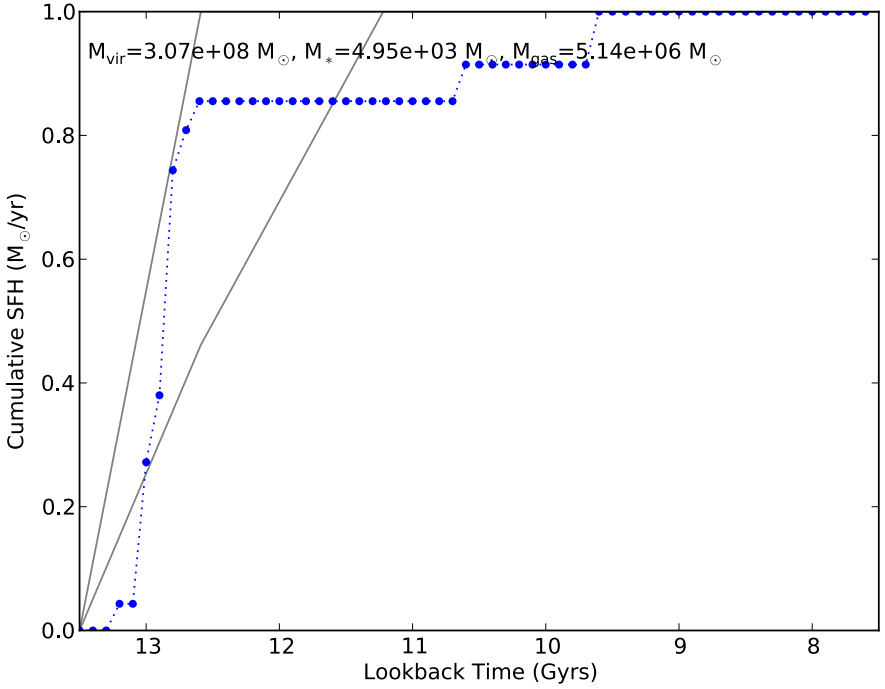
Baryon fraction



Star Formation Histories

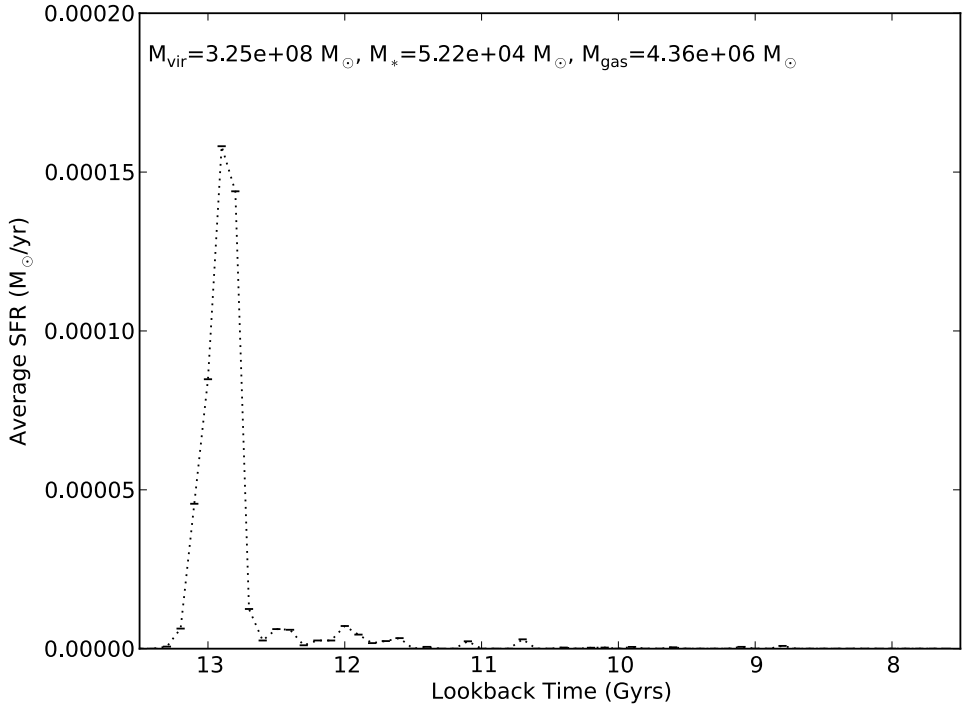
$M_* < 10^4\ M_{sun}$

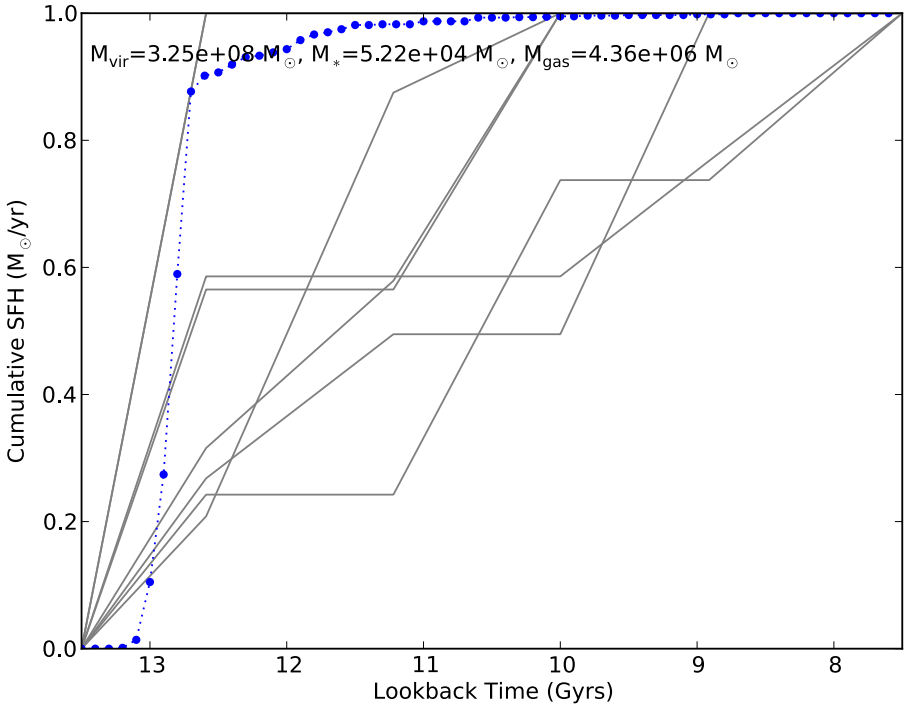




Star Formation Histories

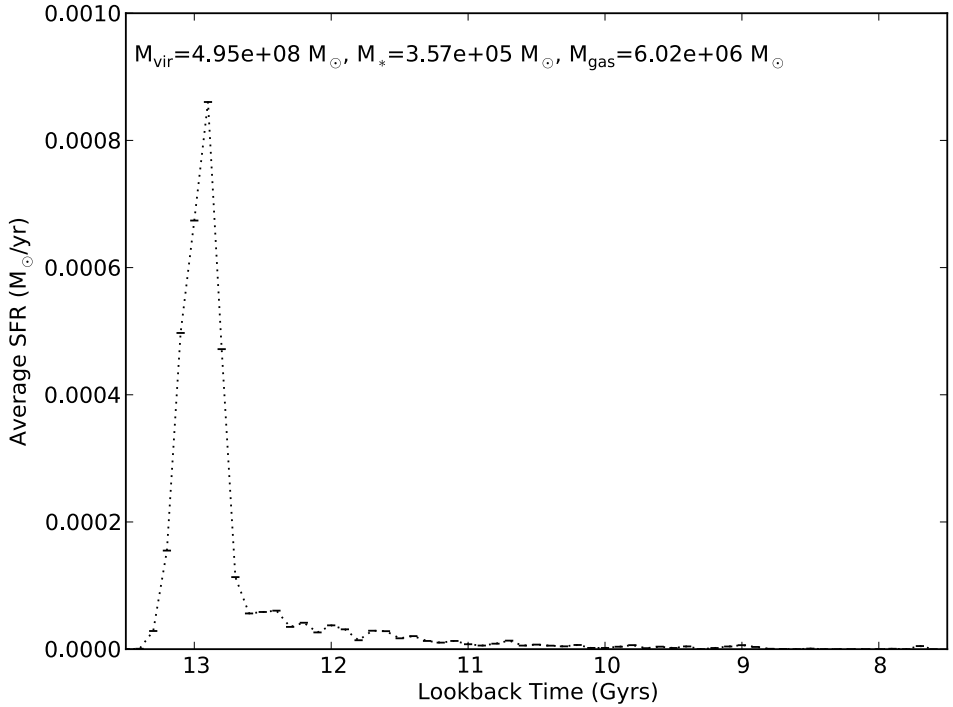
$10^4\ M_{sun} < M_* < 10^5\ M_{sun}$

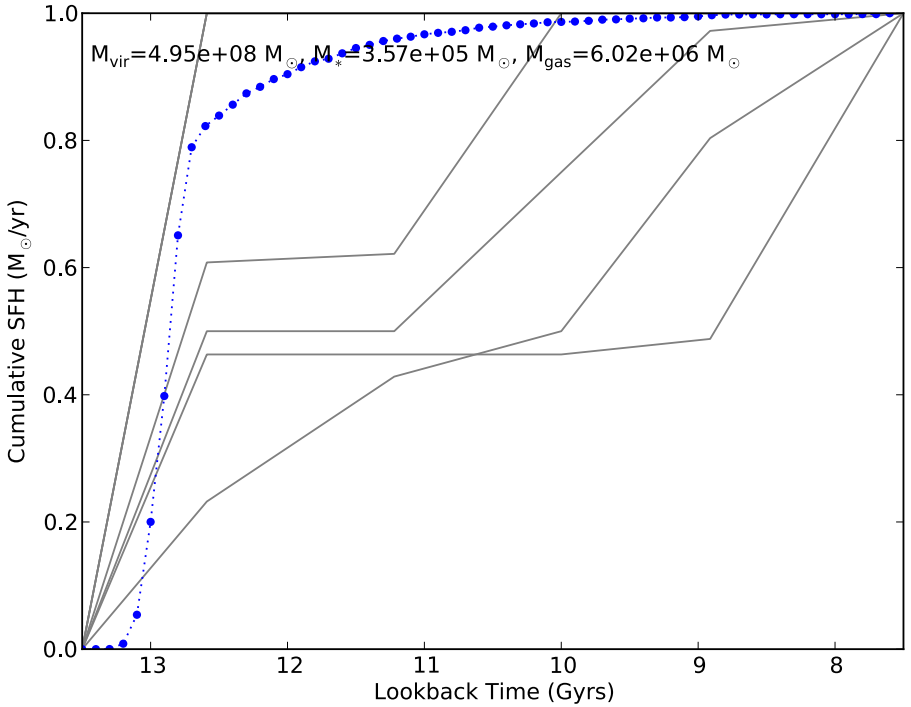




Star Formation Histories

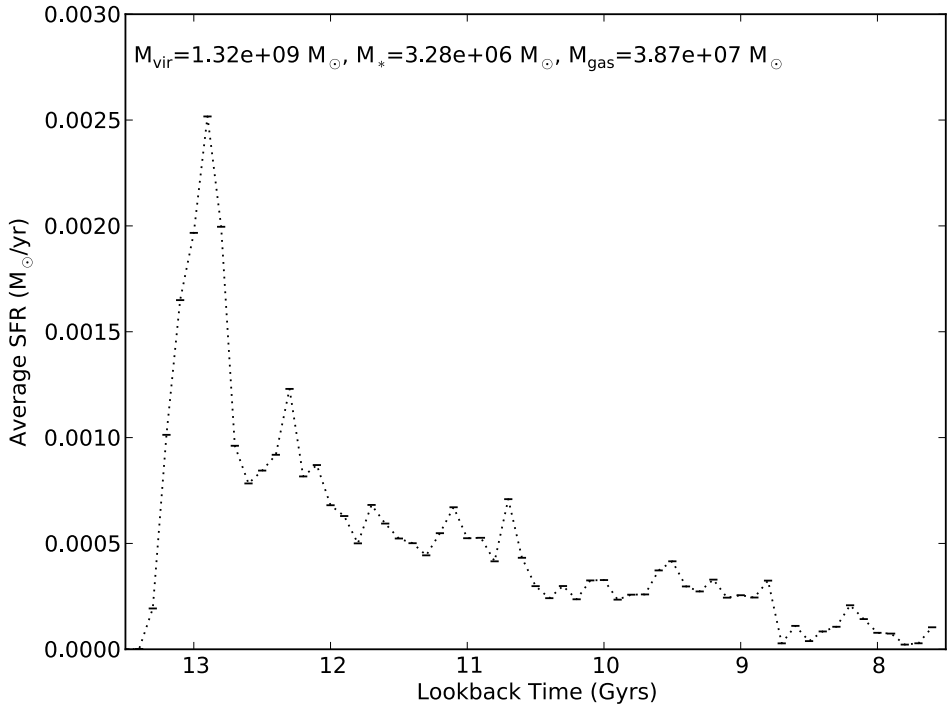
$10^5\ M_{sun} < M_* < 10^6\ M_{sun}$

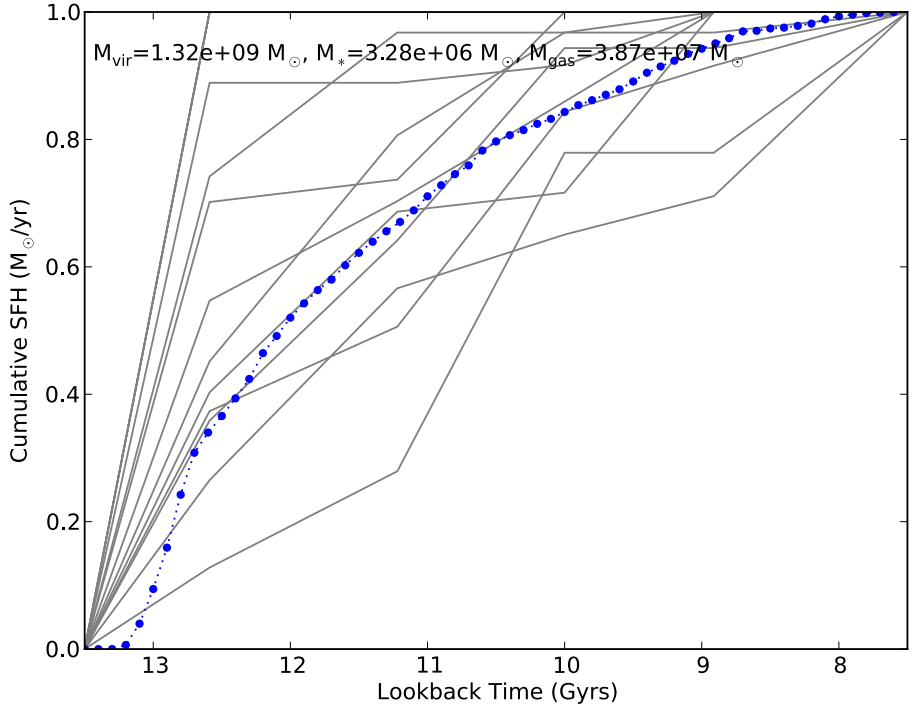




Star Formation Histories

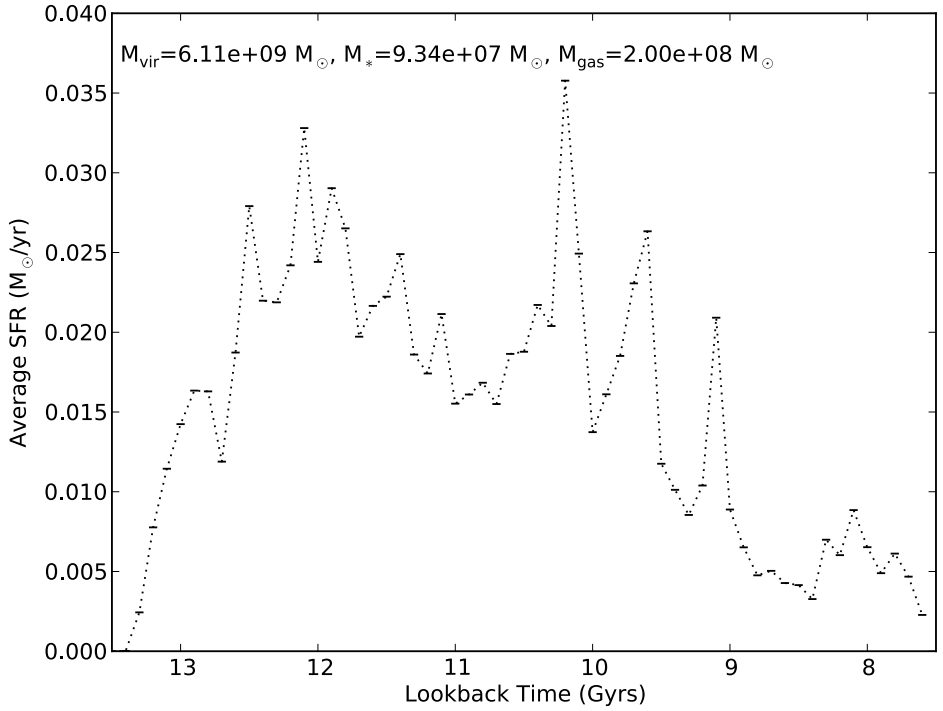
$10^6\ M_{sun} < M_* < 10^7\ M_{sun}$

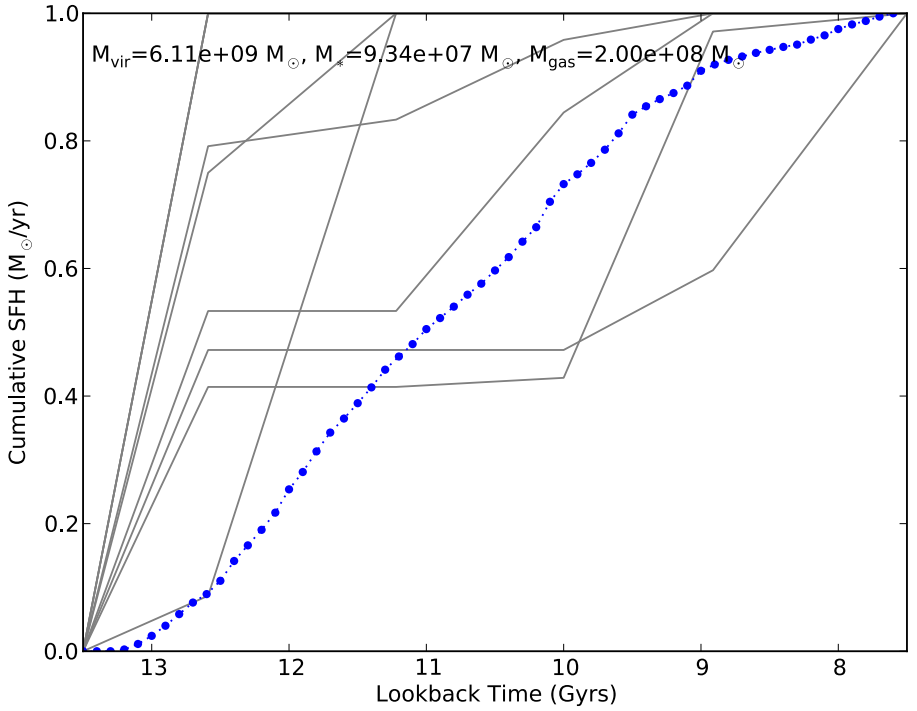




Star Formation Histories

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





Conclusions

- VELAs are high-resolution hydro simulations of MW-like galaxies and their satellites
- Velocity function has steep slope, unlike field observations
- Stellar mass function over produces luminous satellites
- SHM - large spread in M_* for given M_{vir} or v_{max}
- Gas mass to stellar mass and baryon fractions are good
- SF in most satellites has initial burst then is roughly constant. Not completely suppressed by reionization