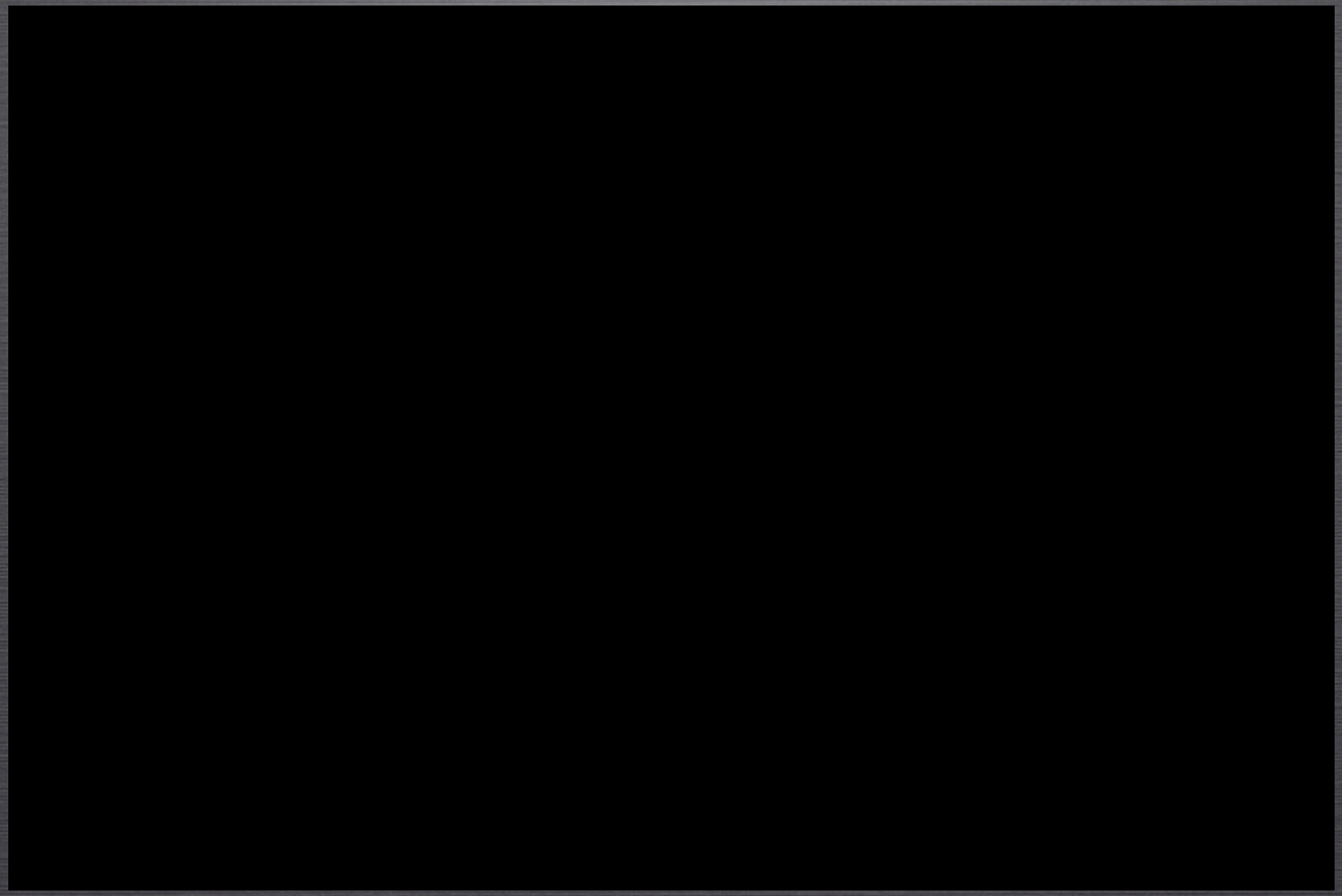
Toward the formation of realistic Satellite Galaxies

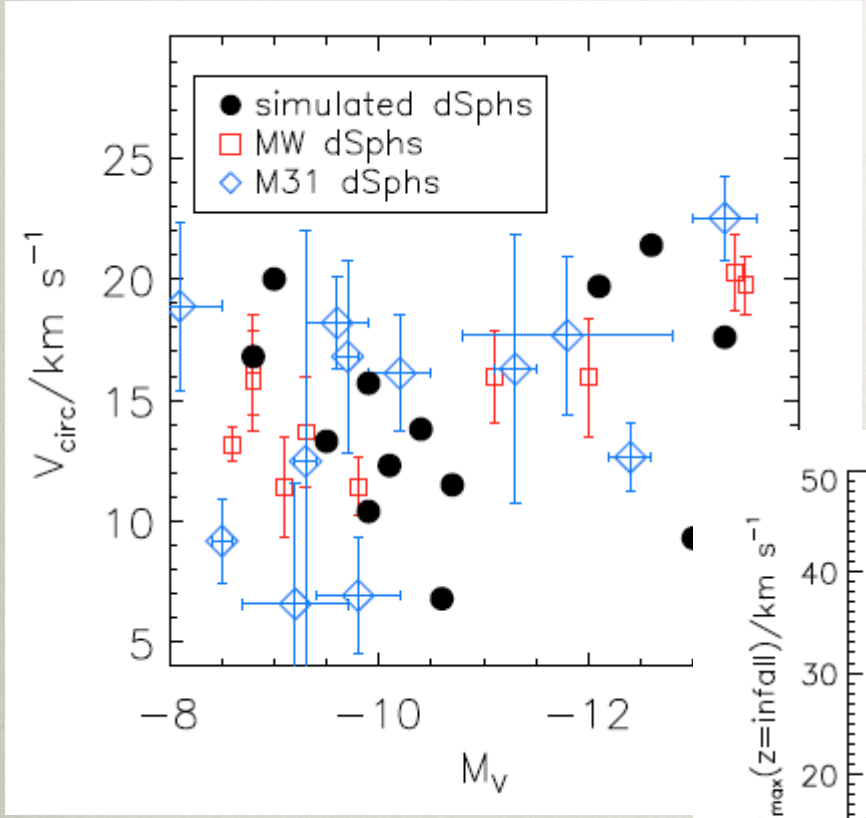


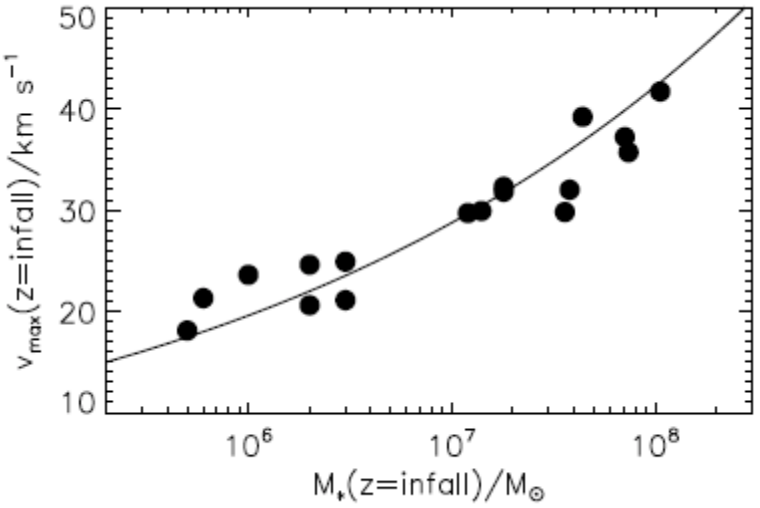
Alyson Brooks
Grainger Postdoctoral Fellow

in collaboration with C. Christensen, F. Governato, A. Pontzen, T. Quinn, S. Sloebman, J. Wadsley, B. Willman, A. Zolotov

But...

How Does the Model Compare to Data?

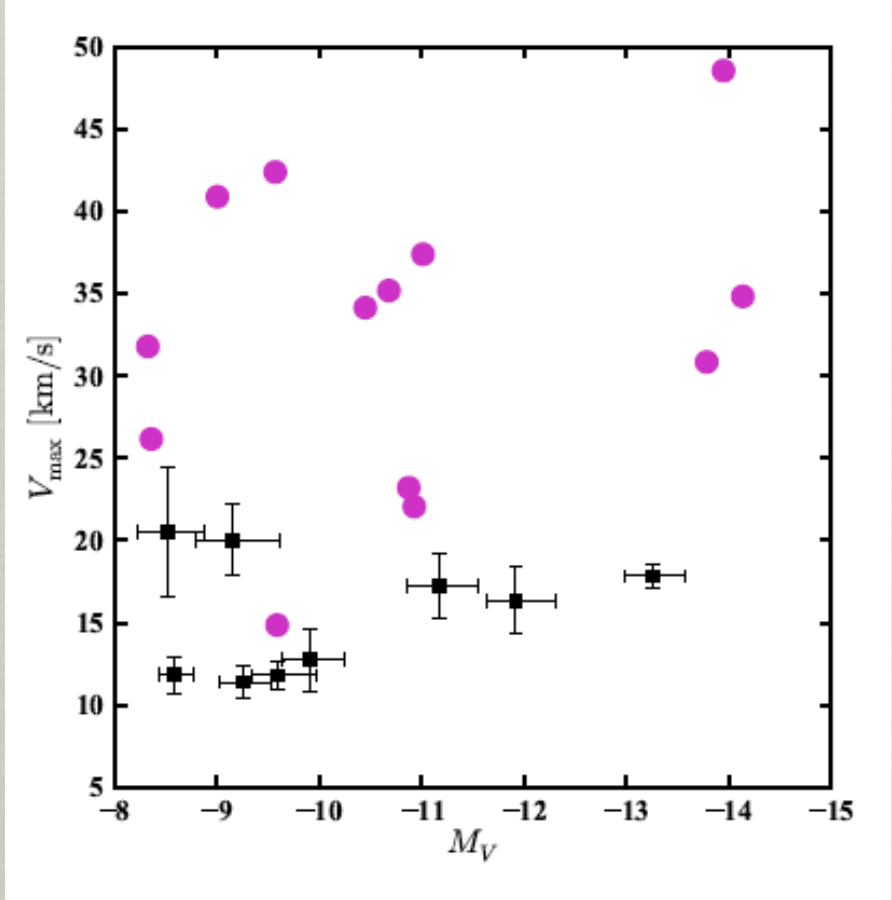


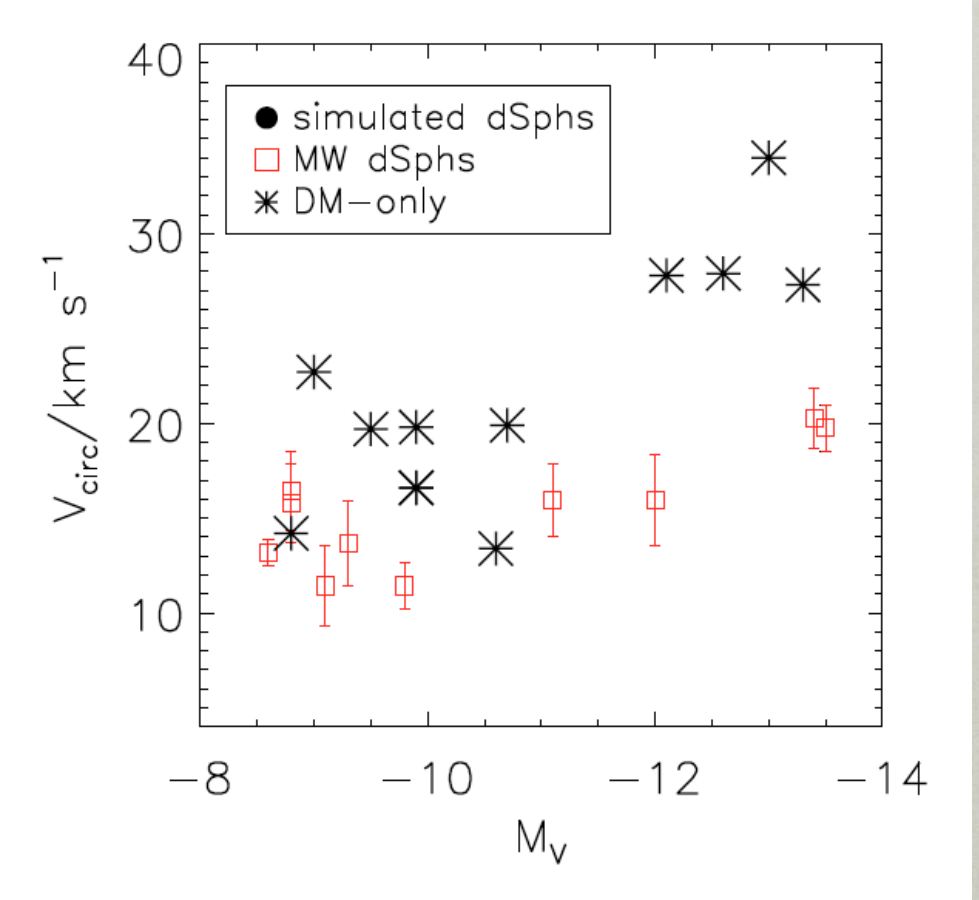


- satellites show no trend across luminosity
- scatter fainter than M_V=-12 after infall
- =-12 have stripping

Brooks & Zolotov (2012)

Predicted Satellites are still too Dense... unless there's a disk!

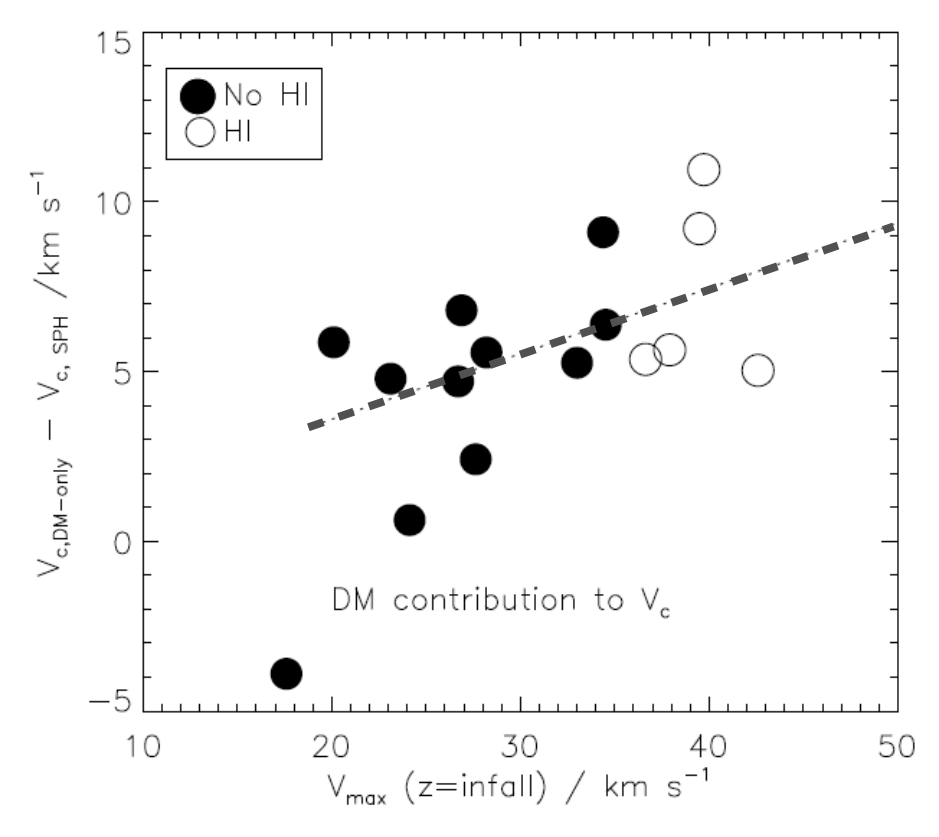




Boylan-Kolchin et al. (2012); Brooks & Zolotov (2012)

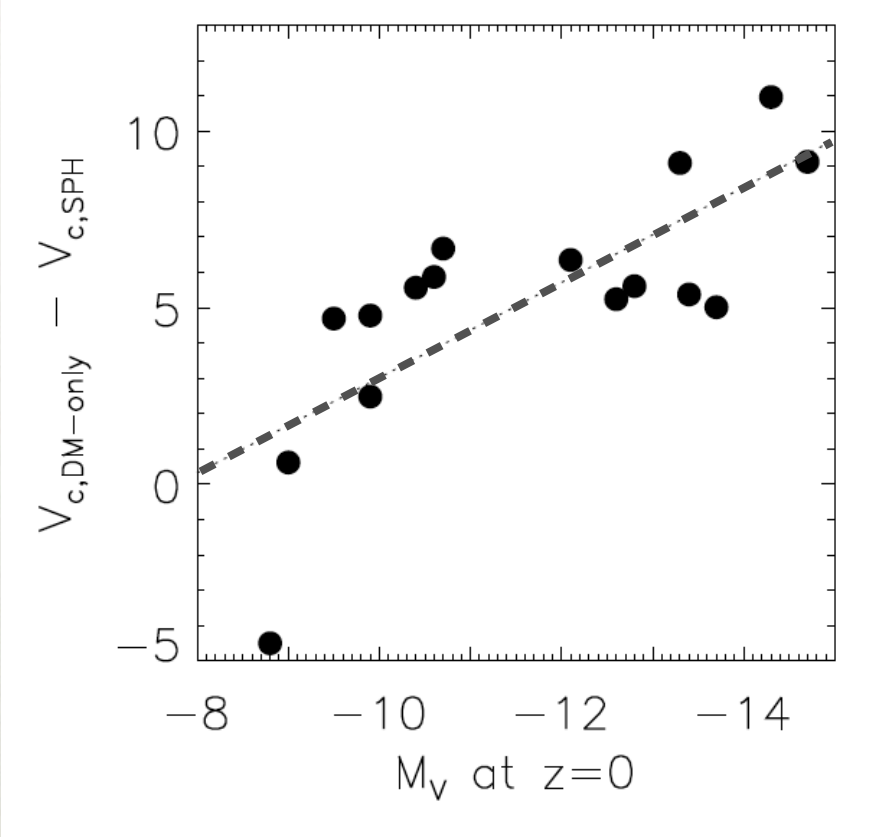
Corrections to DM-only DATA

Theory space:



$$\Delta(v_c, 1kpc) = 0.2v_{peak,DM-only} - 0.26$$

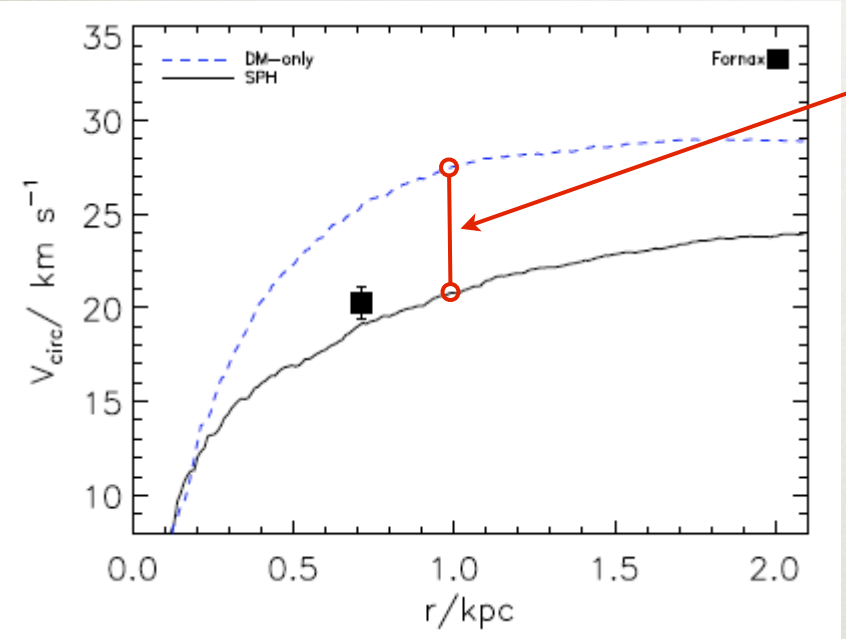
Observer space:



$$\Delta(v_{c,1kpc}) = -10.47 - 1.35 \times M_V$$

Zolotov et al. (2012); Brooks & Zolotov (2012)

ALL Satellites have Reduced Central masses



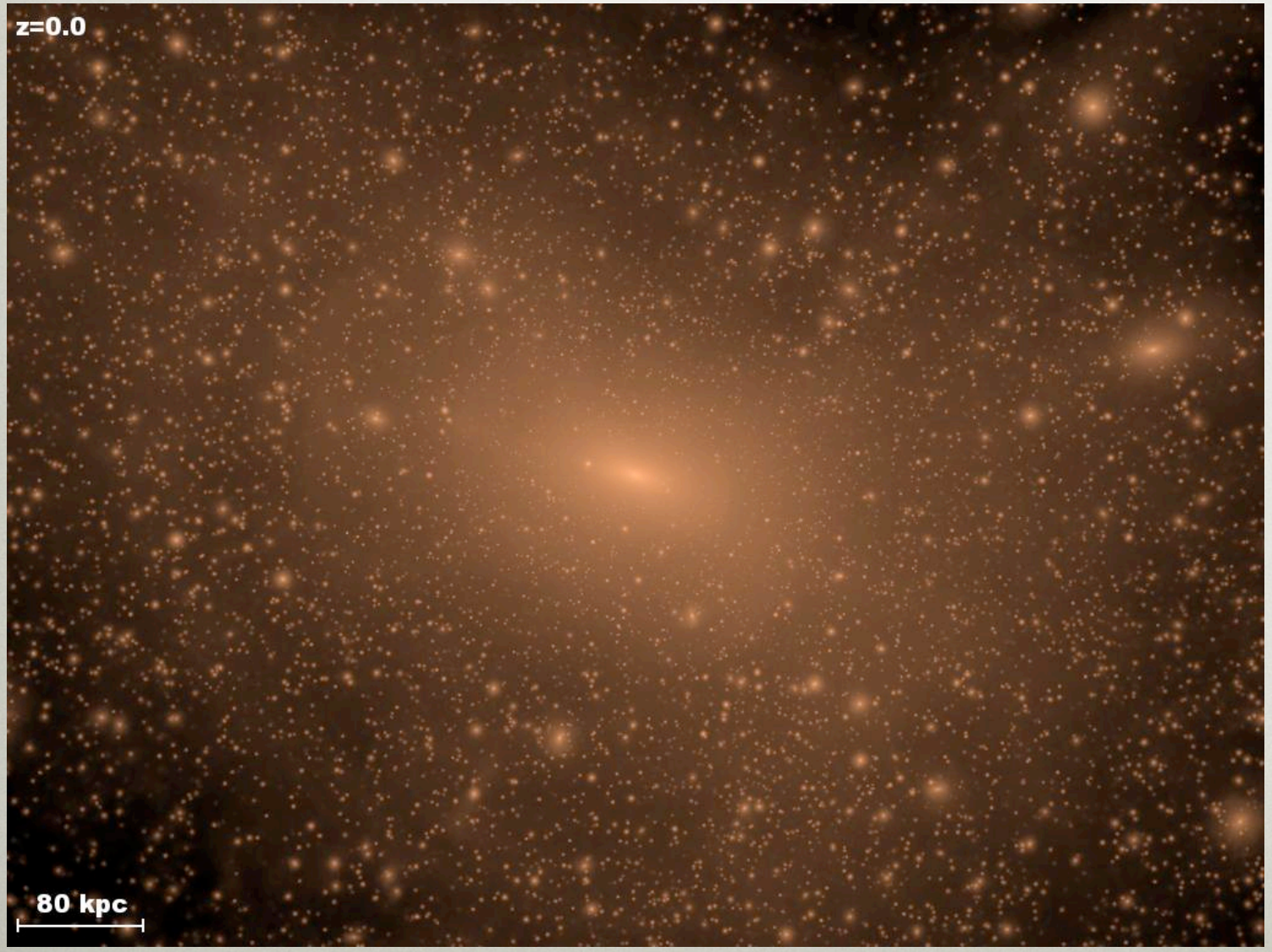
All satellites in our sample have central DM-only masses 2-4x larger than SPH

Corrections account for:

- baryon loss
- tidal presence of the disk
- core creation in satellites brighter than $M_V = -12$

But...

What About the Number of Luminous Satellites?



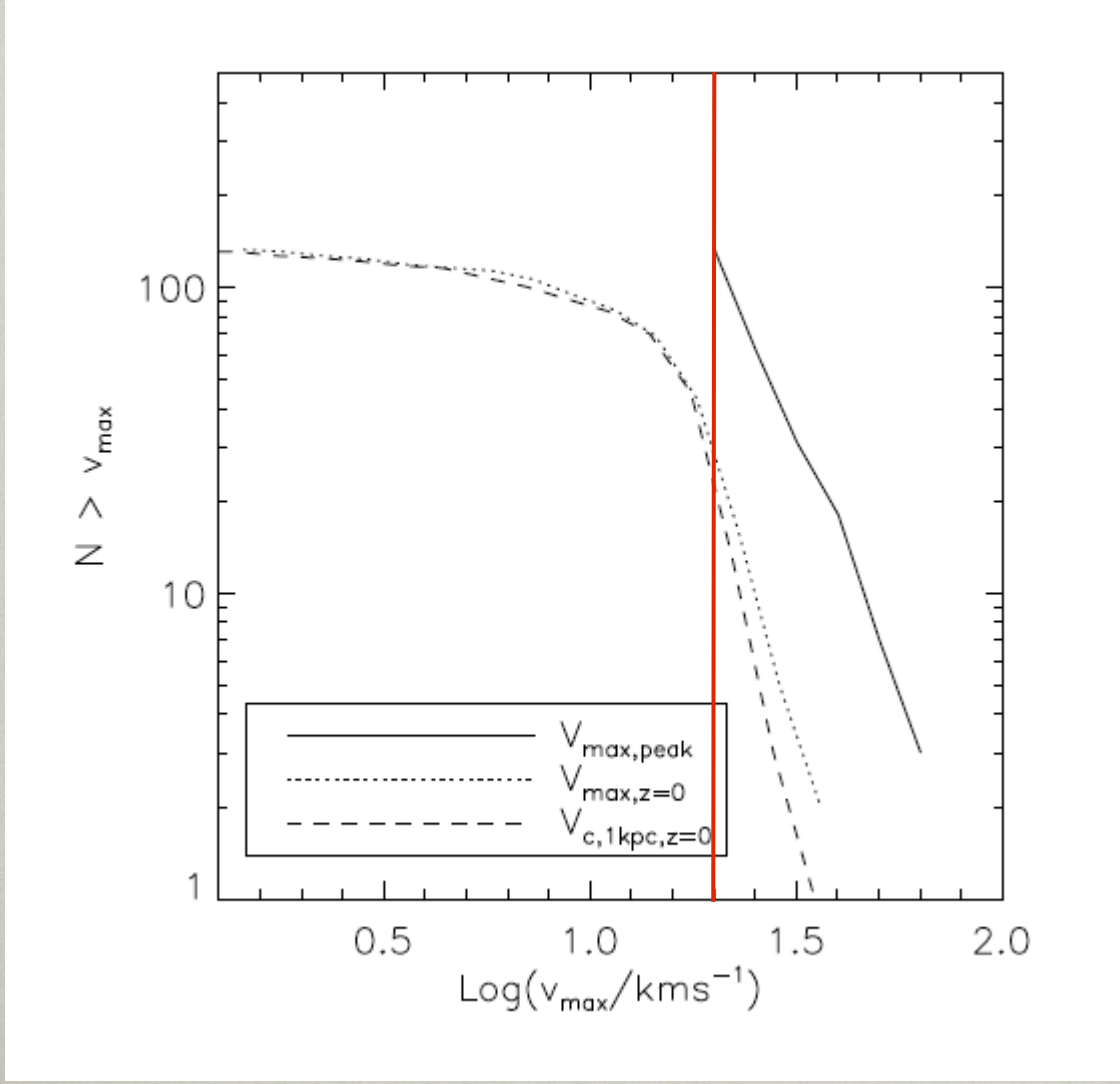
1000's of satellites predicted

dozens seen

"Via Lactea"

But...

What About the Number of Luminous Satellites?



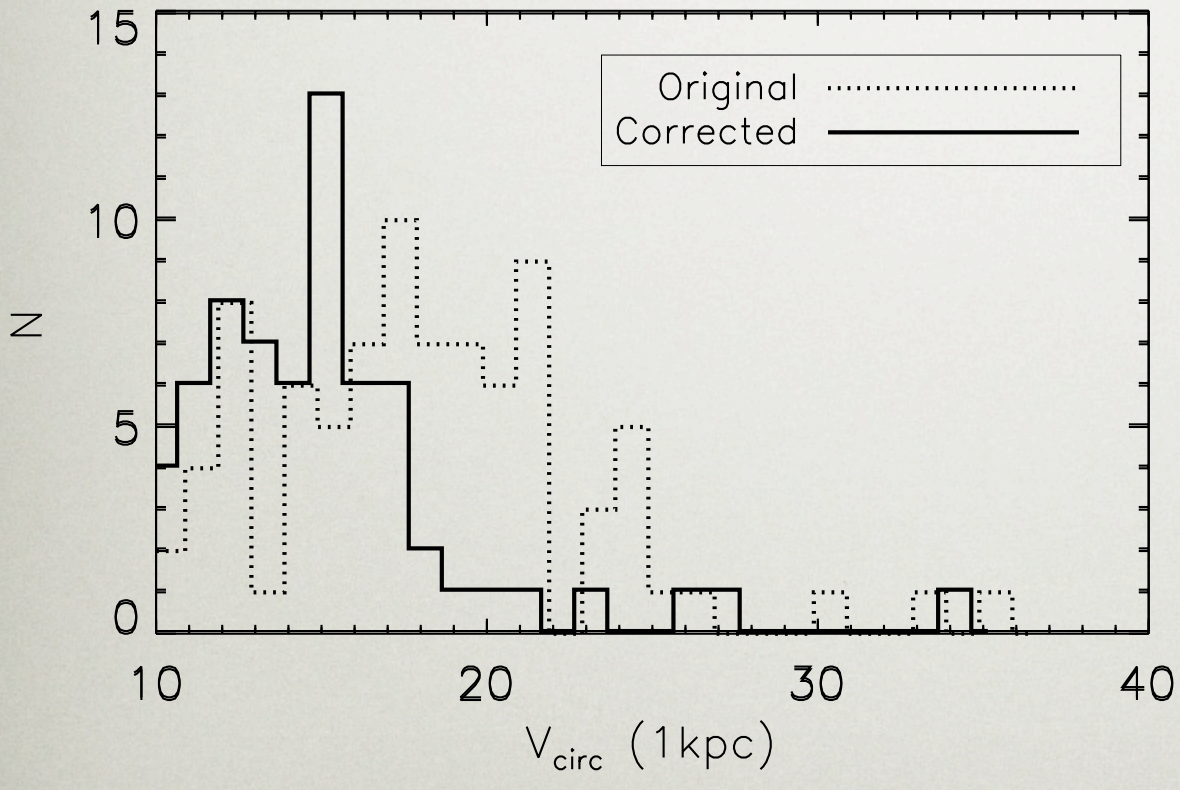
Apply the model to VL2:

VL2 has 28 subhalos with $v_{max} > 20$ km/s

courtesy M. Kuhlen

But...

What About the Number of Luminous Satellites?

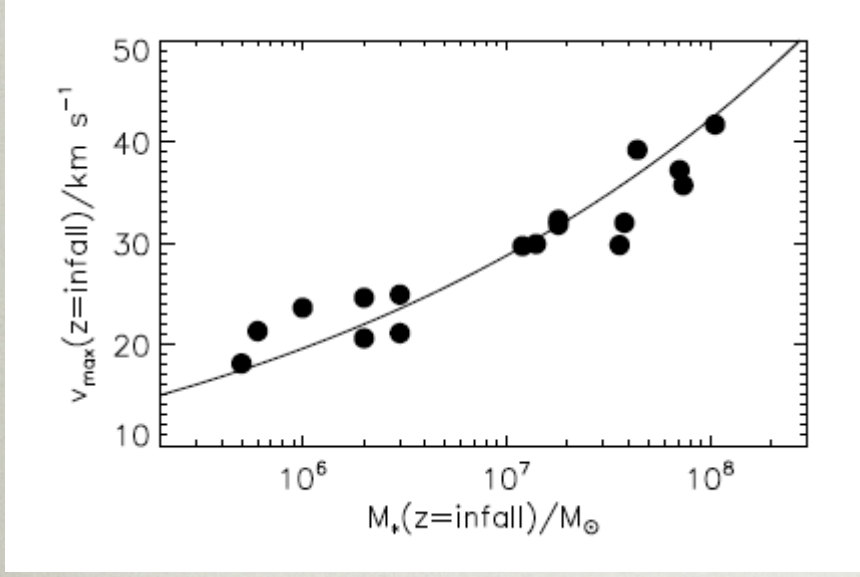


Apply the model to VL2:

VL2 has 28 subhalos with $v_{max} > 20$ km/s

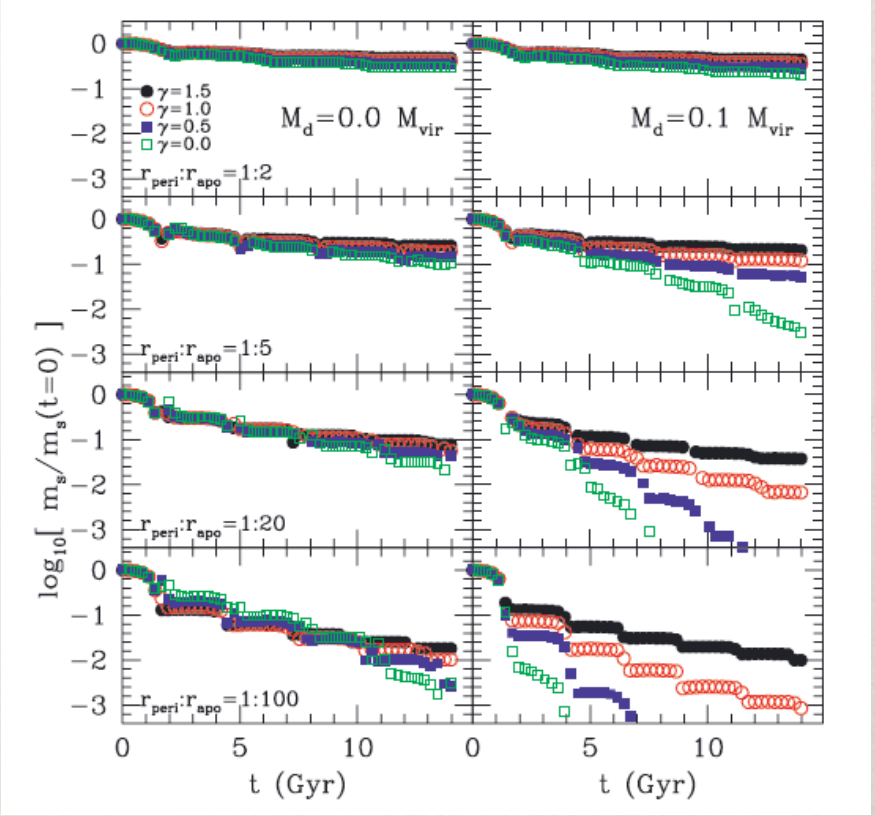
After correction: 6 subhalos with $v_{max} > 20$ km/s

So the Number of Massive Satellites is Reduced...
but what about Luminous Satellites?



Assume

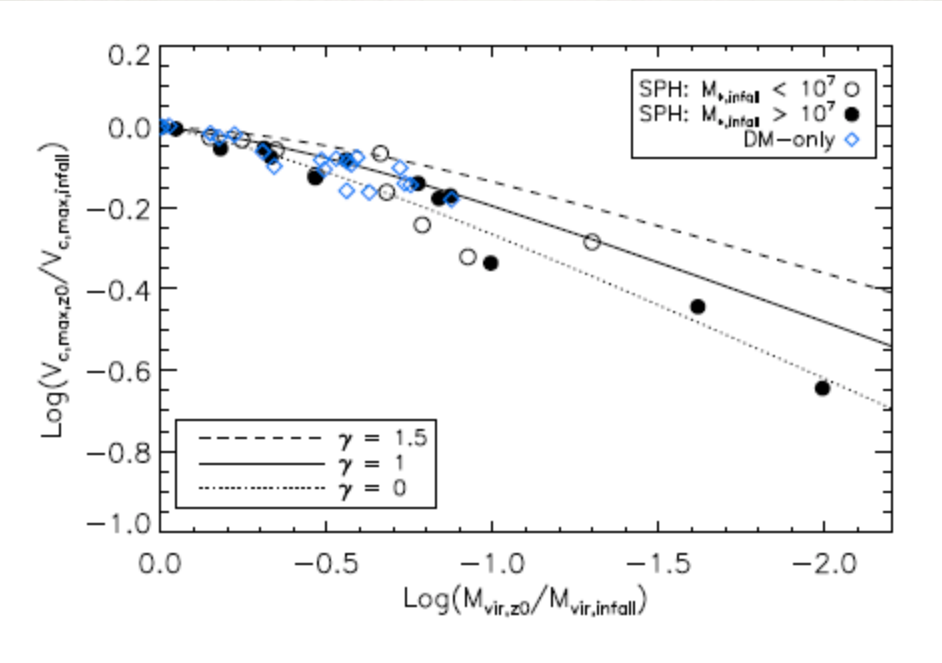
v_{peak} -- M_{star} relation



and destruction

Zolotov et al. (2012); Penarrubia et al. (2010)

So the Number of Massive Satellites is Reduced...
but what about Luminous Satellites?



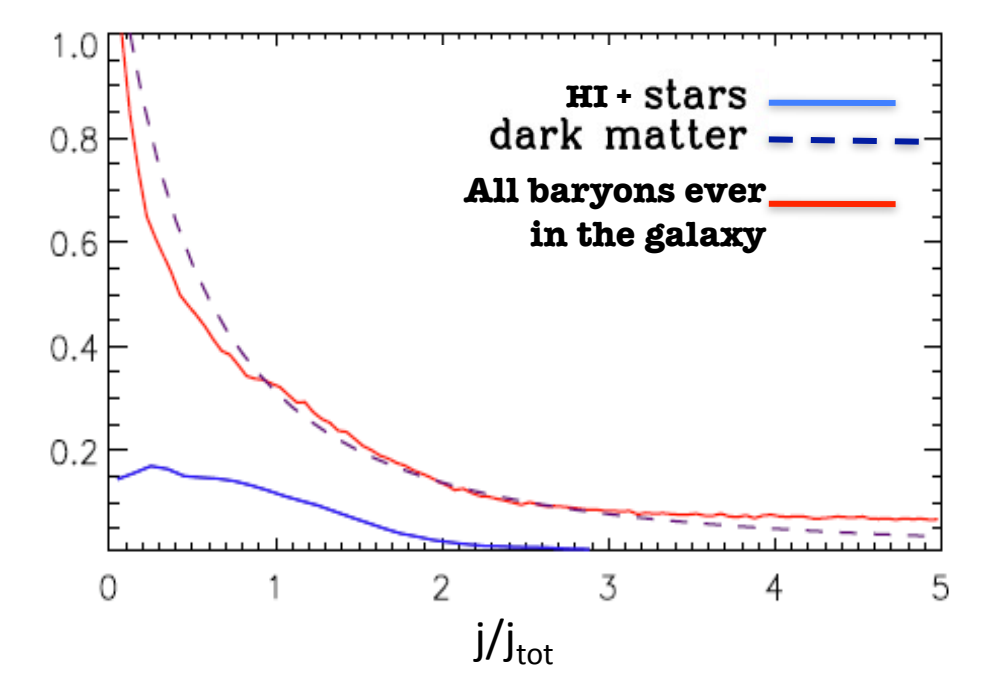
Adopt mass loss associated with destruction

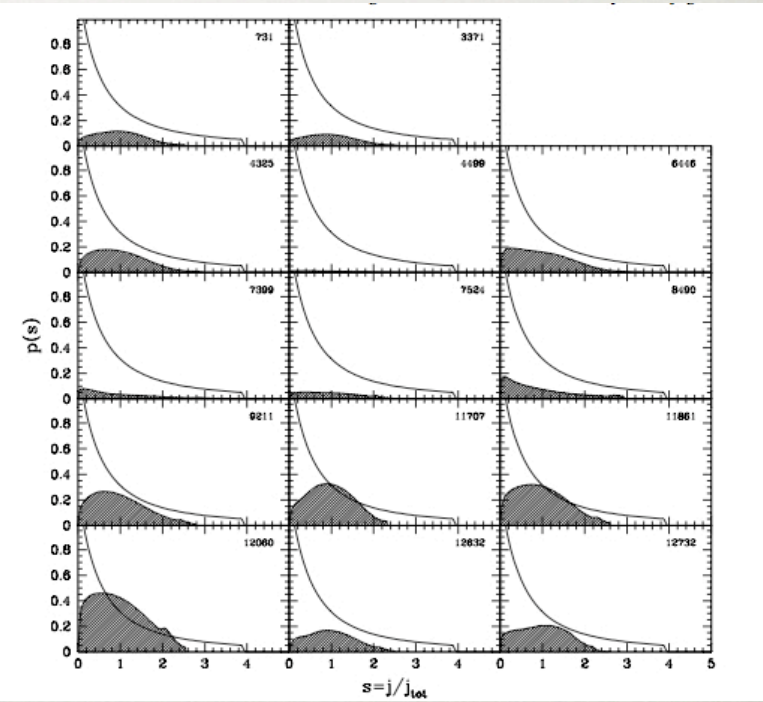
Zolotov et al. (2012)

The Bigger Picture:
The Small Scale "Crisis" of CDM

- Bulge-less disk galaxies
- The cusp/core problem
- The dense satellites problem
- The "Missing Satellites" problem

Supernovae Remove Low Angular Momentum Gas





producing smaller bulges and bulgeless disk galaxies

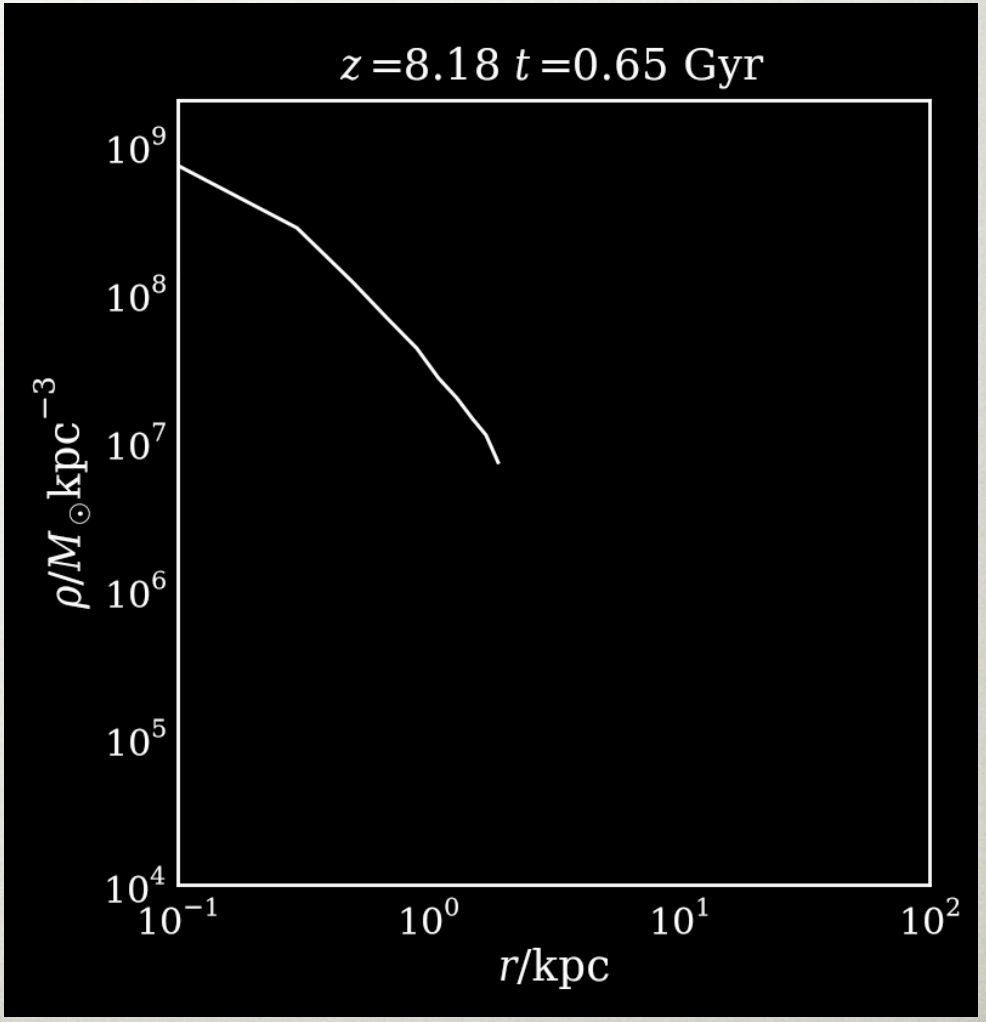
Governato et al. (2010)

The Bigger Picture:
The Small Scale "Crisis" of CDM

- Bulge-less disk galaxies ✓
- The cusp/core problem
- The dense satellites problem
- The "Missing Satellites" problem

Cusps Transform into Cores

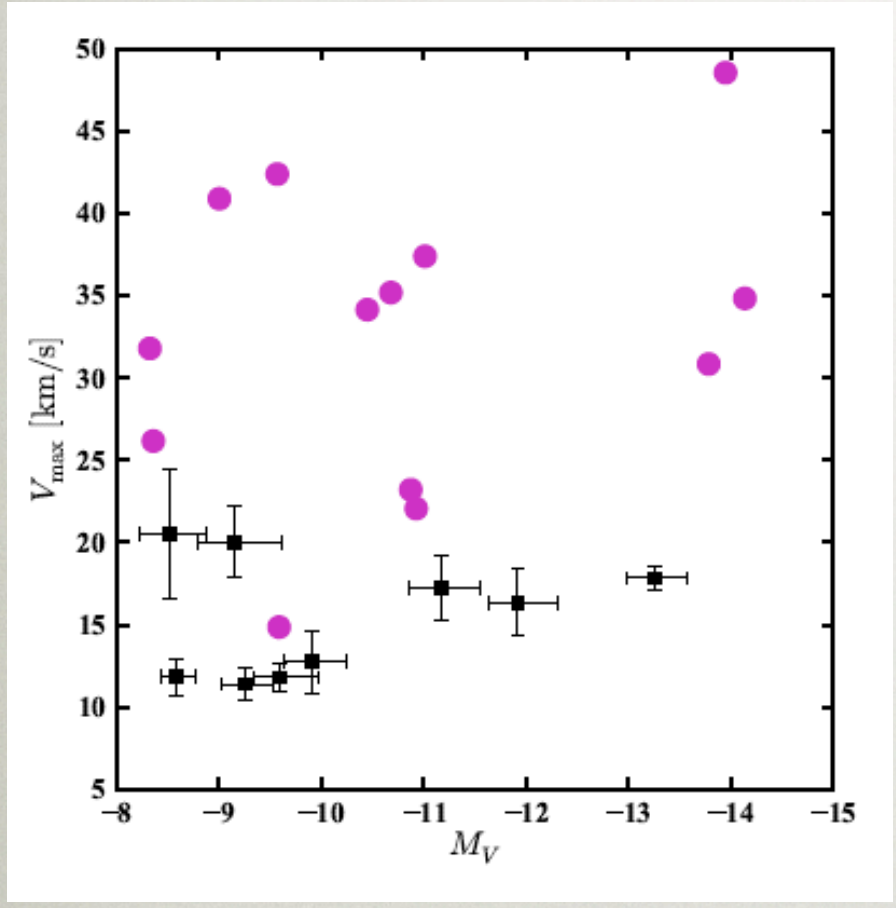
Repeated bursts of star formation flatten the central density slope

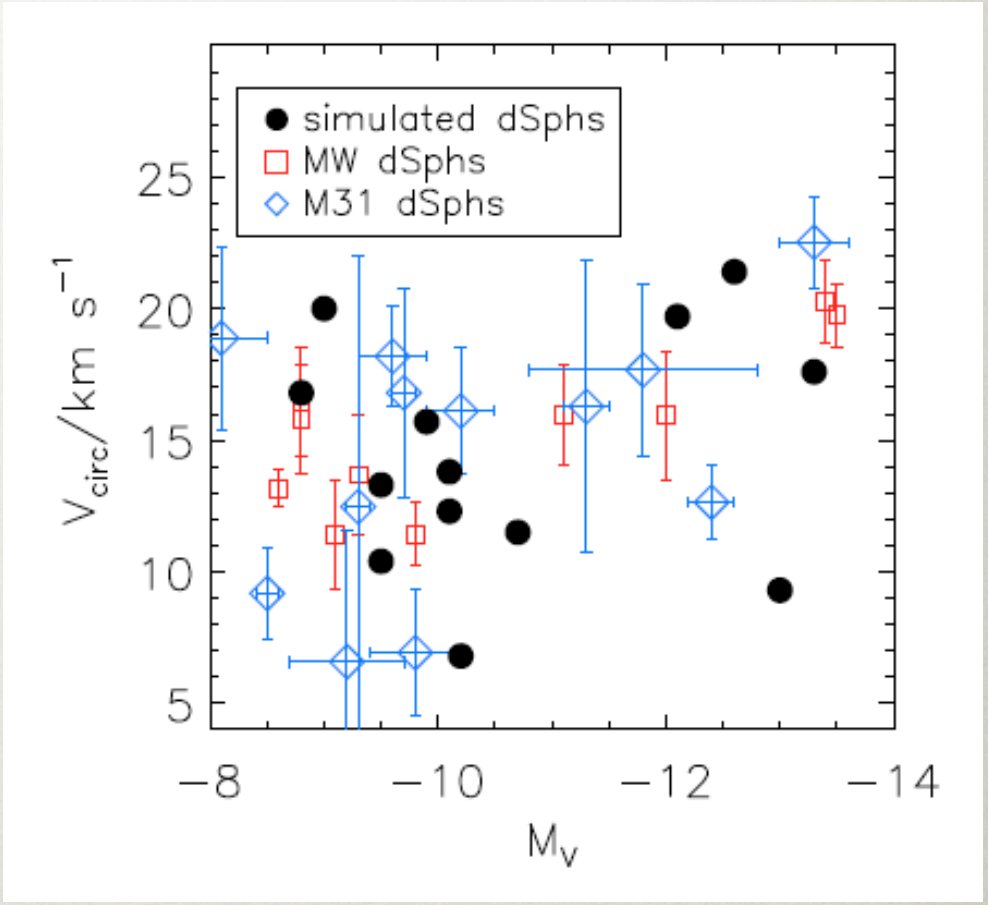


The Bigger Picture:
The Small Scale "Crisis" of CDM

- Bulge-less disk galaxies ✓
- The cusp/core problem ✓
- The dense satellites problem
- The "Missing Satellites" problem

Satellites that are not Too Dense





Boylan-Kolchin et al. (2012); Brooks & Zolotov (2012)

The Bigger Picture:
The Small Scale "Crisis" of CDM

- Bulge-less disk galaxies ✓
- The cusp/core problem ✓
- The dense satellites problem ✓
- The "Missing Satellites" problem

The Bigger Picture:
The Small Scale "Crisis" of CDM

- Bulge-less disk galaxies ✓
- The cusp/core problem ✓
- The dense satellites problem ✓
- The "Missing Satellites" problem maybe

Conclusions

- Baryonic physics is a viable solution to creating a realistic satellite population
- End the small scale crisis! We must first understand the impact of baryons on dark matter to understand galaxy evolution in CDM
- ...But that means we have to first understand star formation