Toward the formation of realistic Satellite Galaxies

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But...

How Does the Model Compare to Data?

- satellites show no trend across luminosity
- scatter fainter than $M_v=-12$ due to stripping after infall
- brighter than $M_v=-12$ have cores, even more 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:

Observer space:

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

\[ \Delta(v_c, 1\text{kpc}) = -10.47 - 1.35 \times M_V \]

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 $v_{\text{max}} > 20$ km/s

courtesy M. Kuhlen
But...

What About the Number of Luminous Satellites?

Apply the model to VL2:

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

After correction: 6 subhalos with $v_{\text{max}} > 20$ km/s
So the number of massive satellites is reduced... but what about luminous satellites?

Assume $v_{\text{peak}} \propto M_{\text{star}}$ 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