

The Andromeda Effect: Dark Matter Halos in a Local Group Configuration

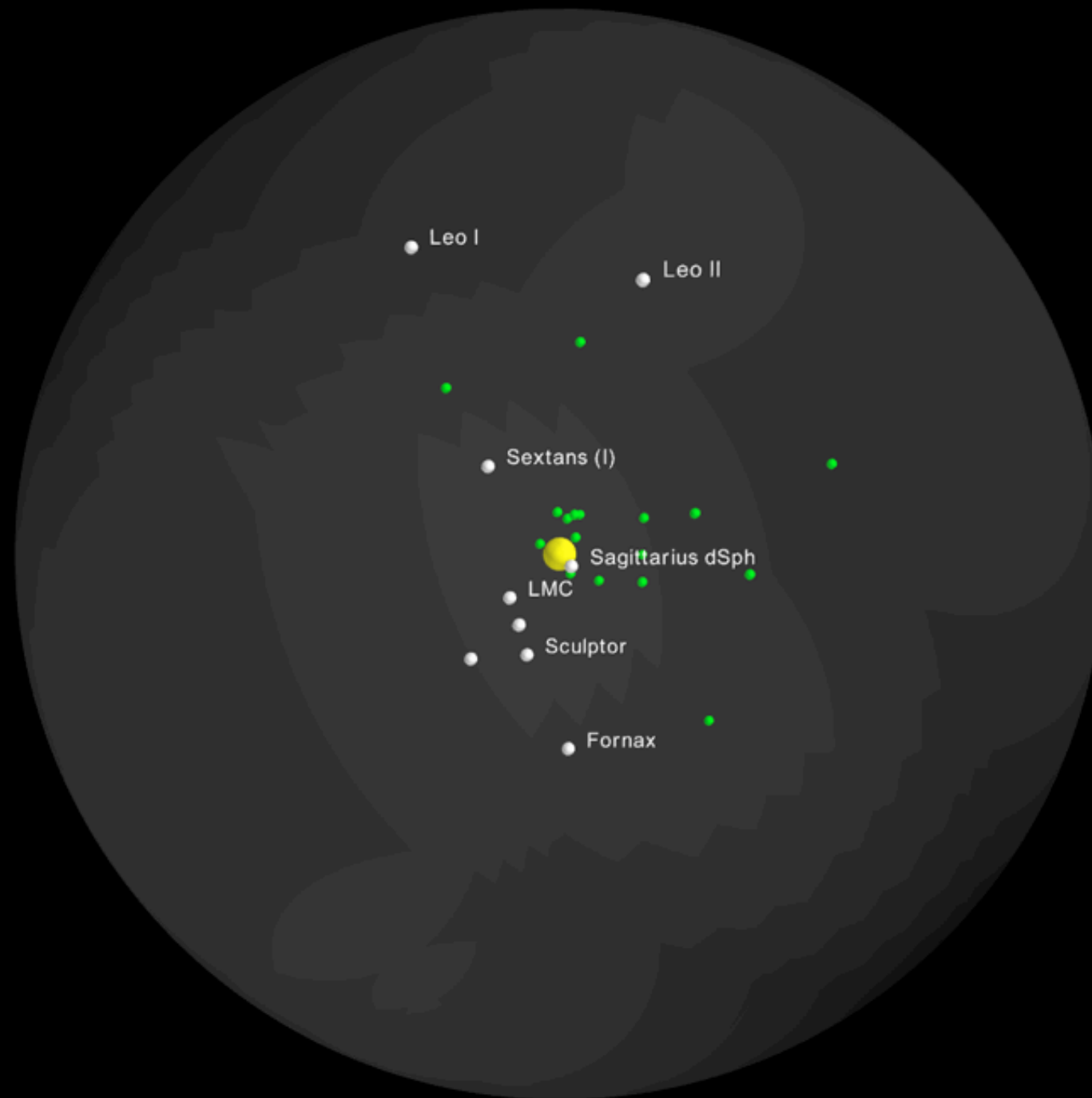
Shea Garrison-Kimmel
UC Irvine

with James Bullock, Jose Oñorbe,
Mike Boylan-Kolchin, and Kyle Lee

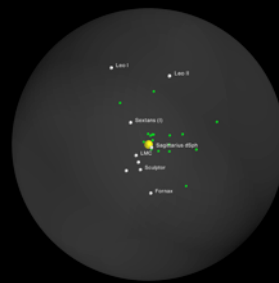
The “Local Volume”



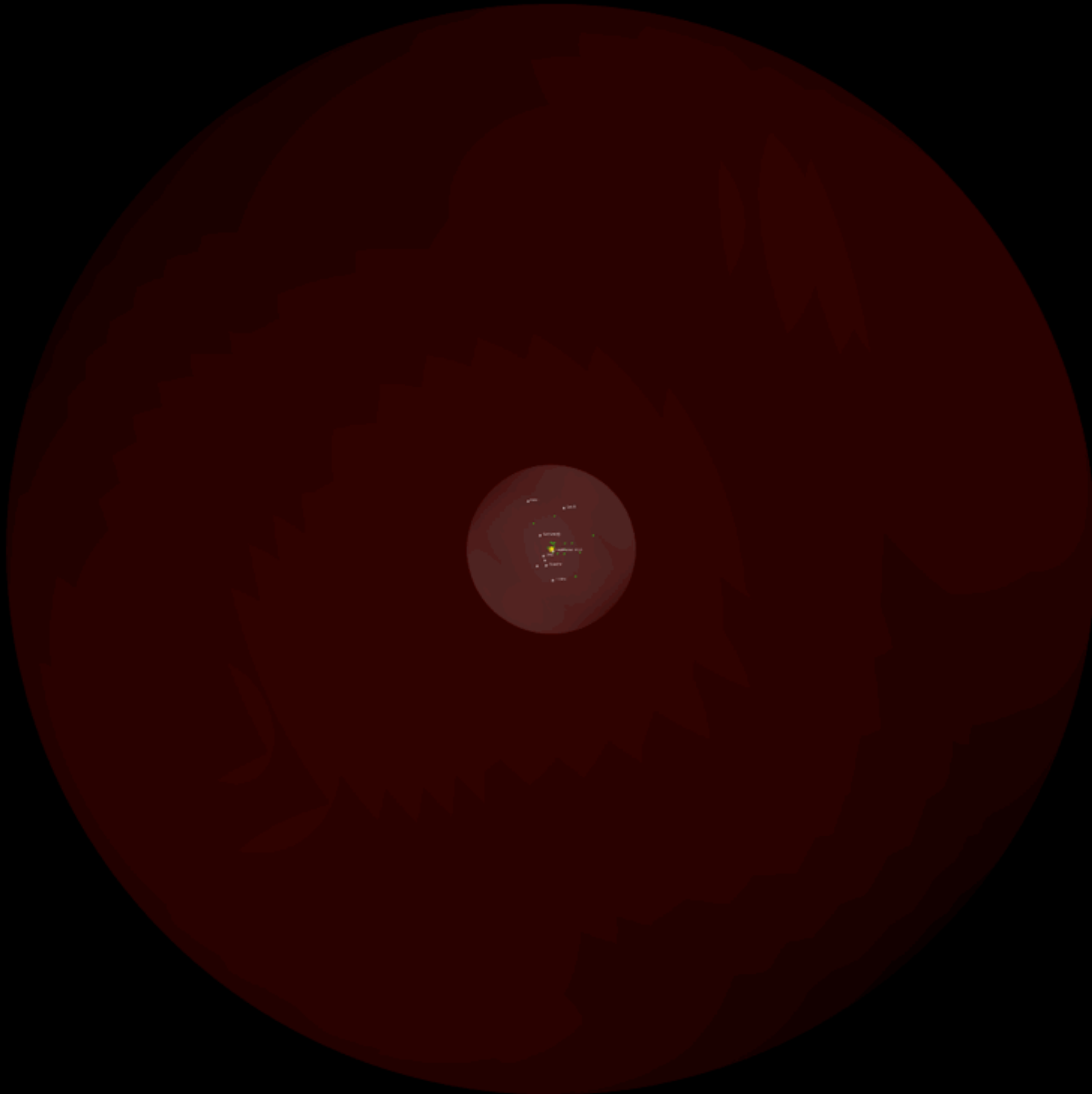
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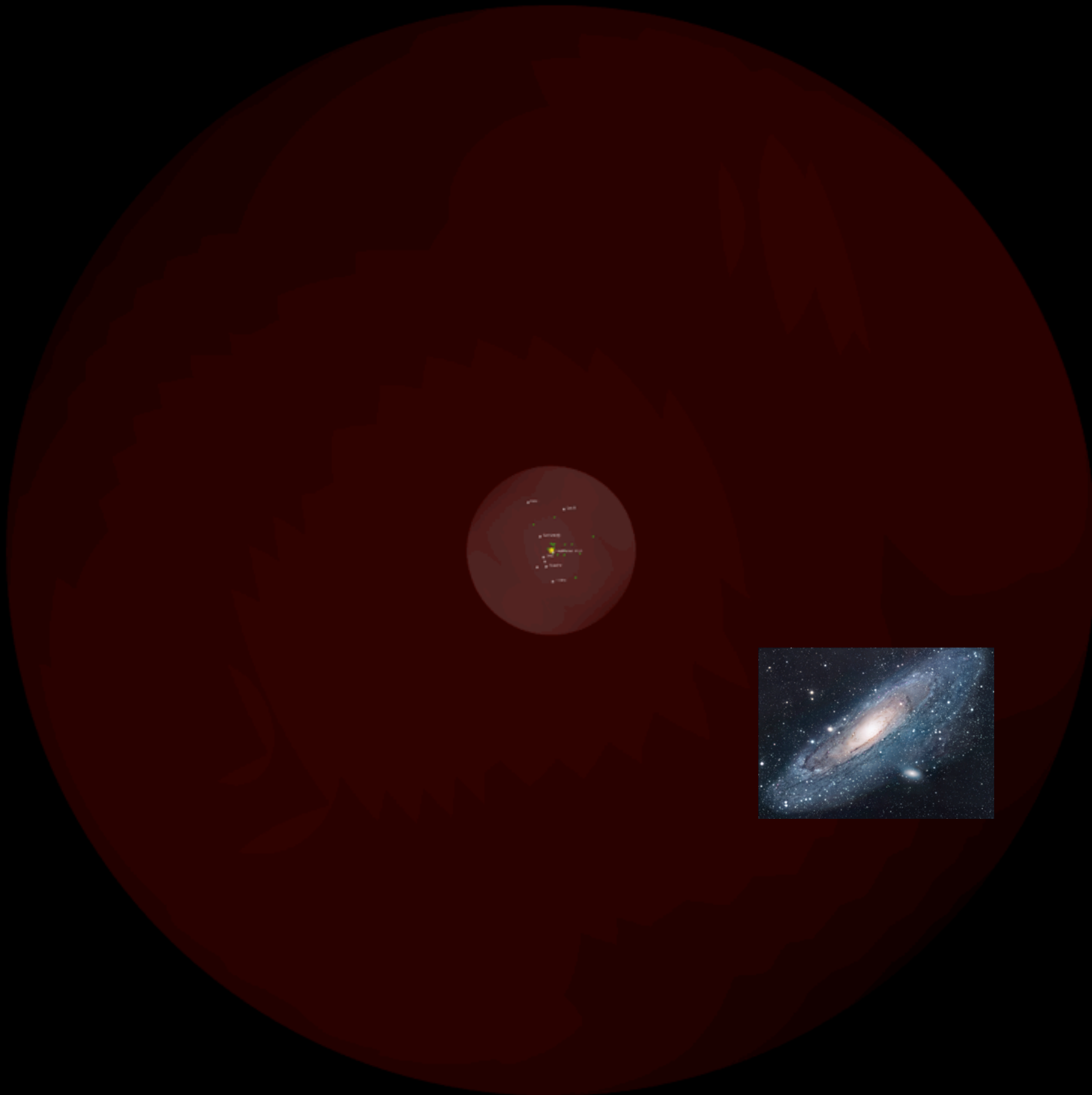
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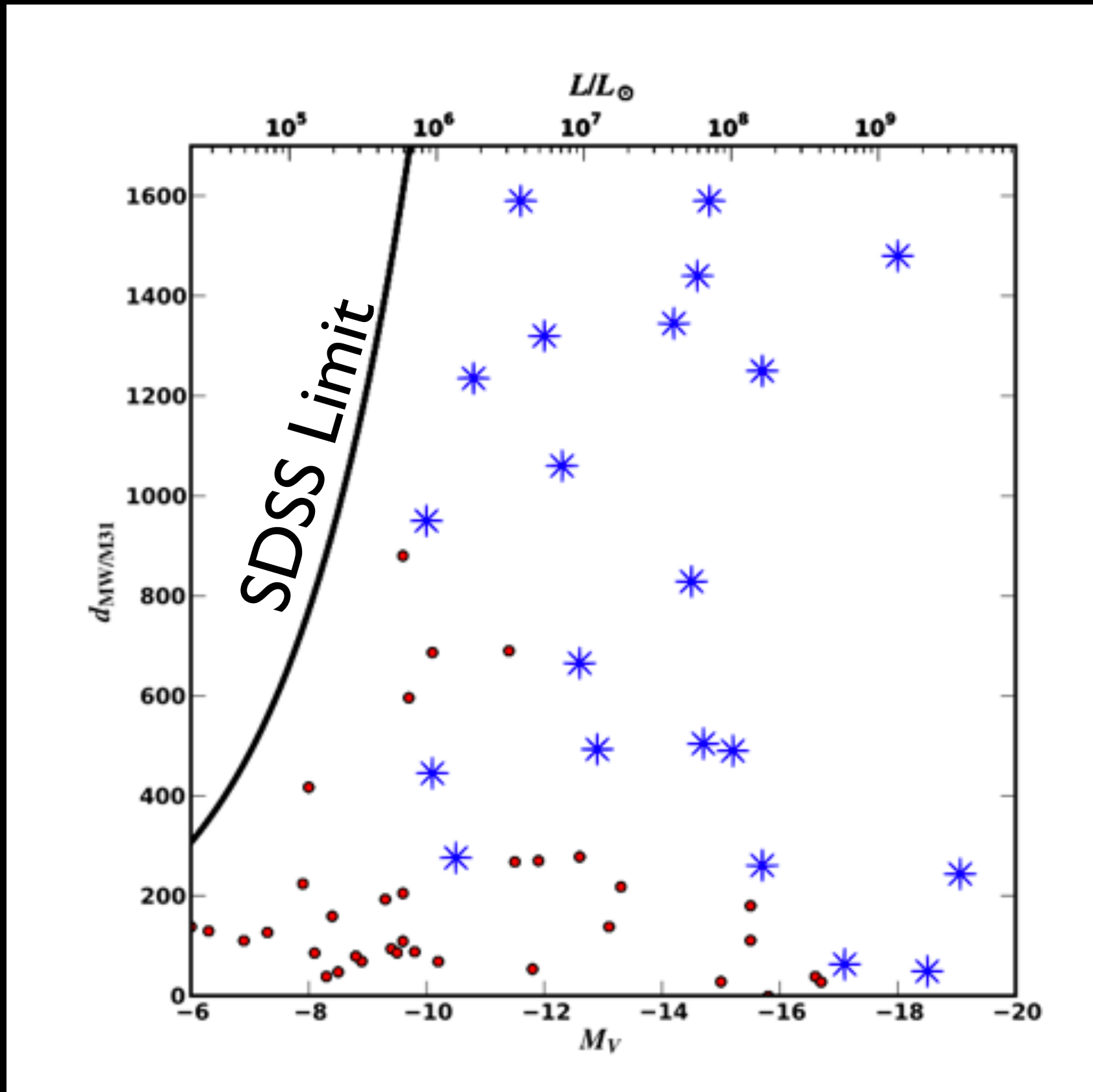
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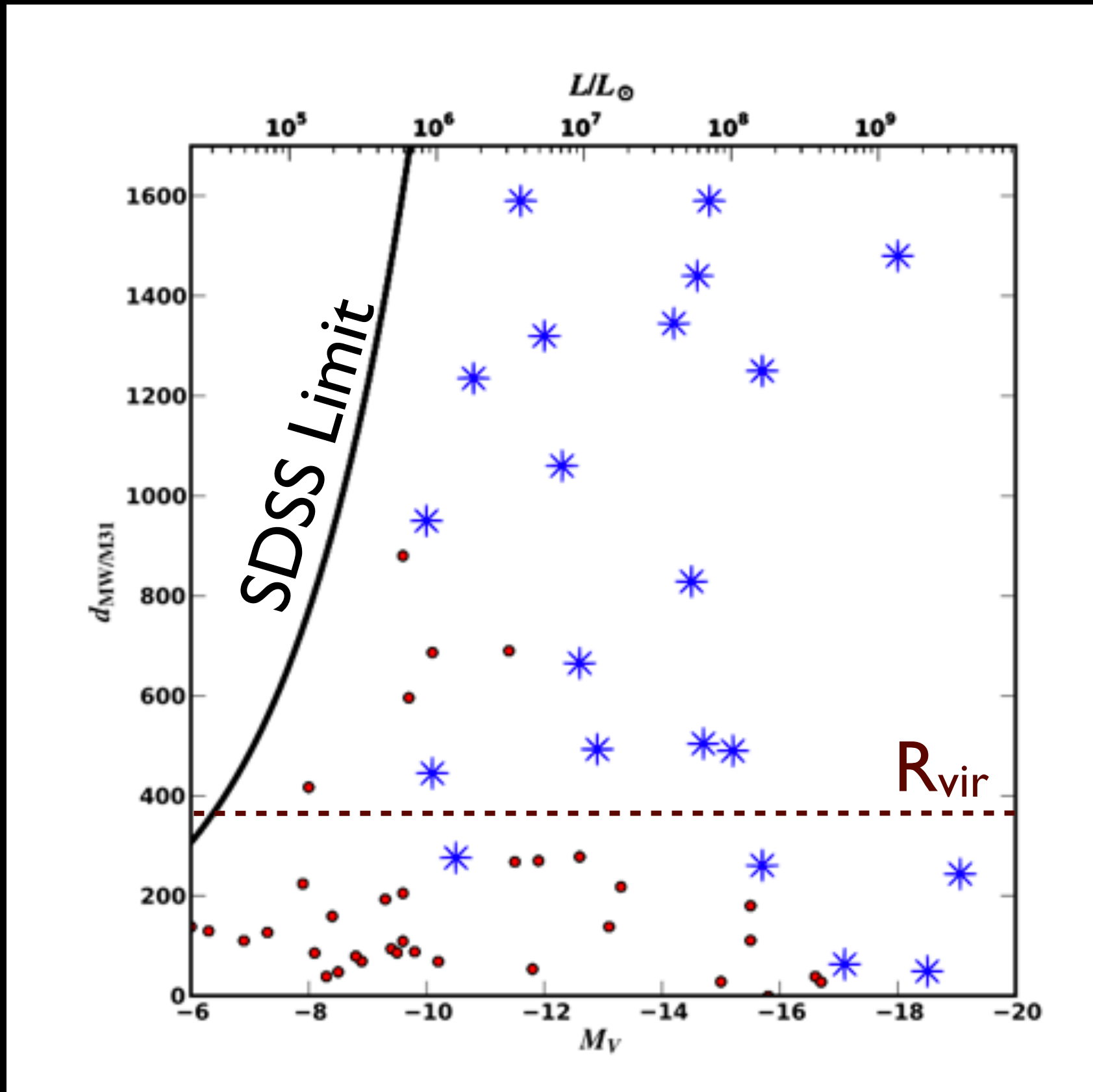
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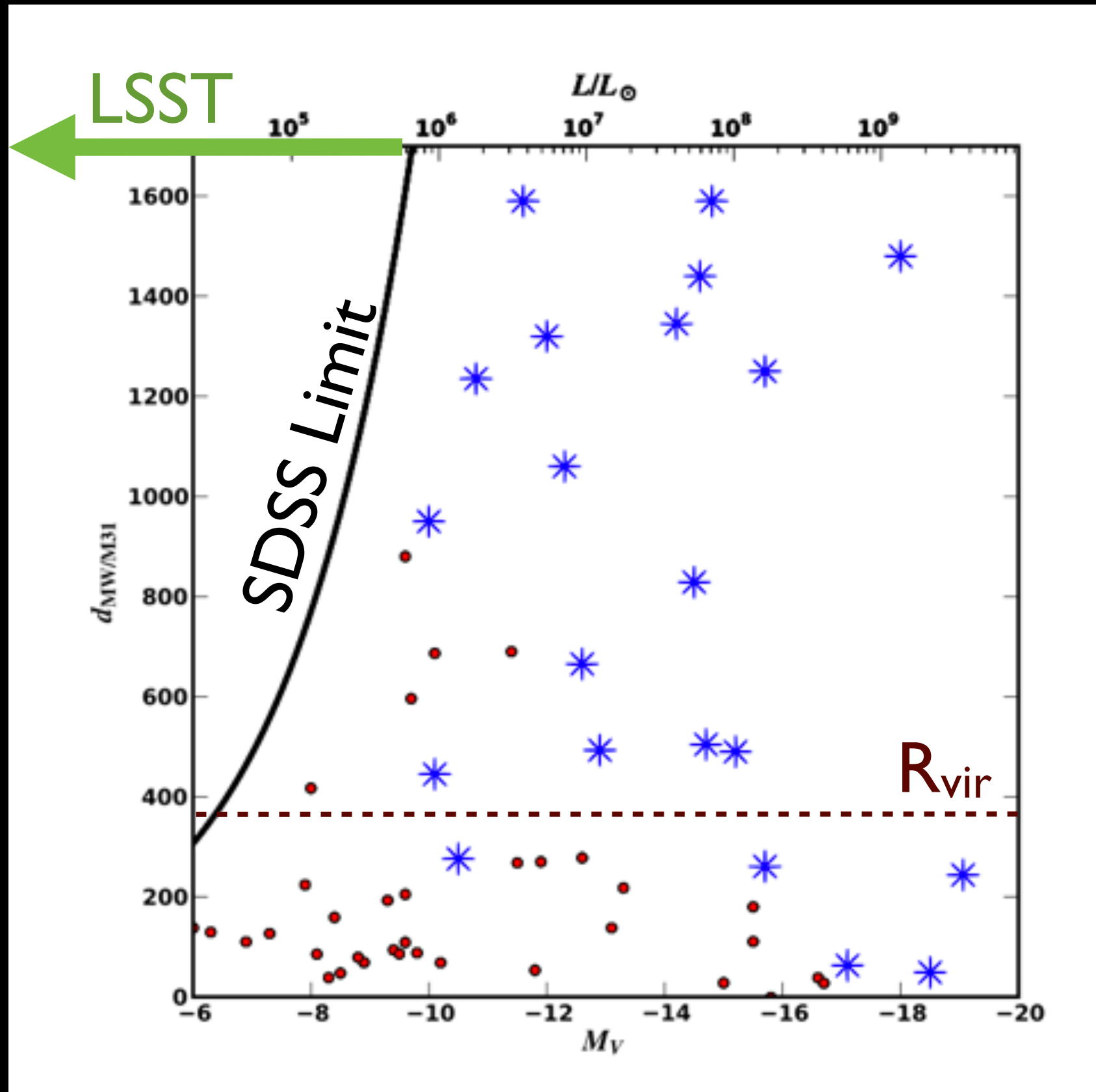
Redefining “Near-Field” Astronomy



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Looking for Local Groups in Simulations

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Selected otherwise isolated pairs of halos in thirty-four 70 Mpc Gadget2 runs with:

- $10^{12}M_{\odot} \leq M_{\text{vir, halo}} \leq 3 \times 10^{12}M_{\odot}$
- $2 \times 10^{12}M_{\odot} \leq M_{\text{vir, sum}} \leq 5 \times 10^{12}M_{\odot}$
- $0.6 \text{ Mpc} \leq \Delta r \leq 1 \text{ Mpc}$

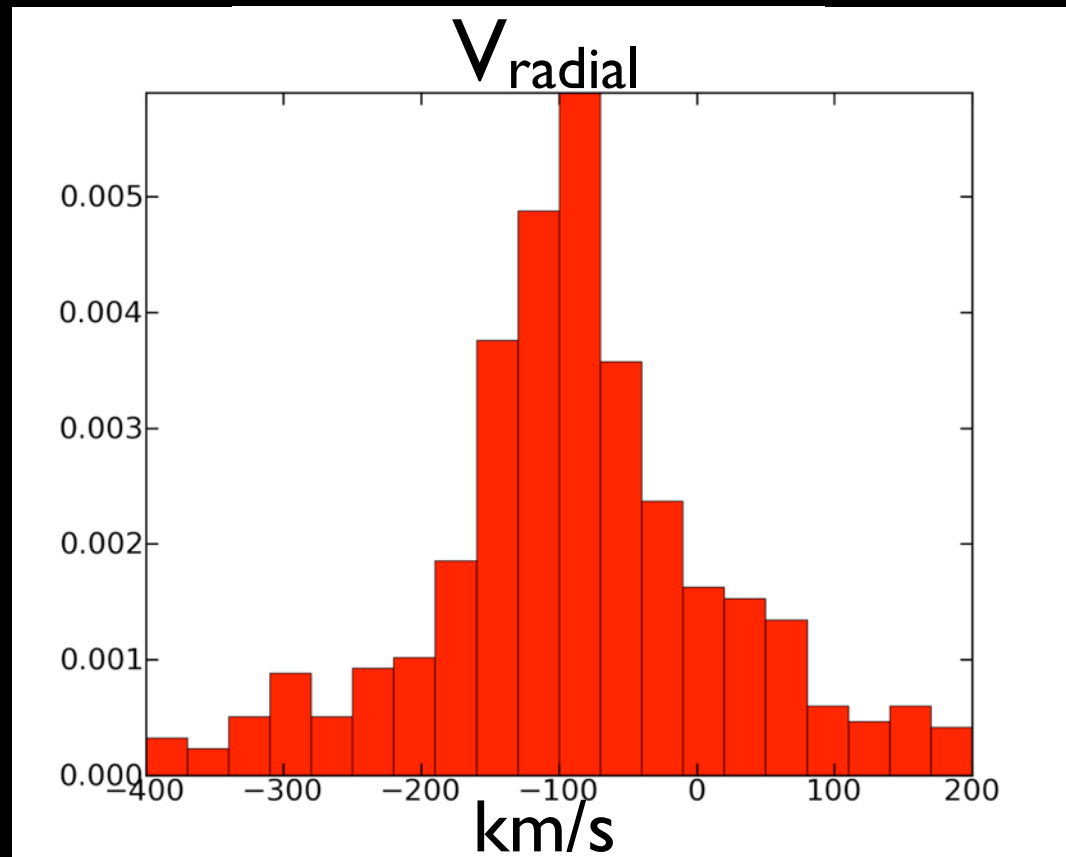
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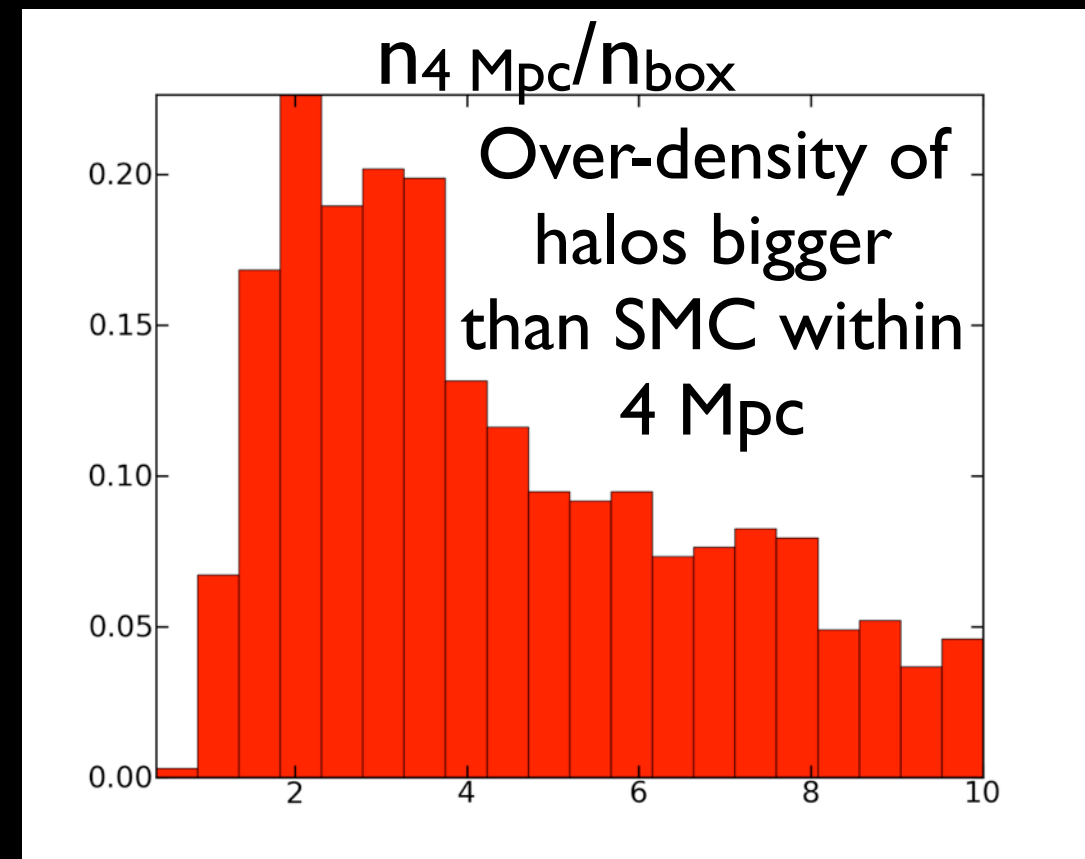
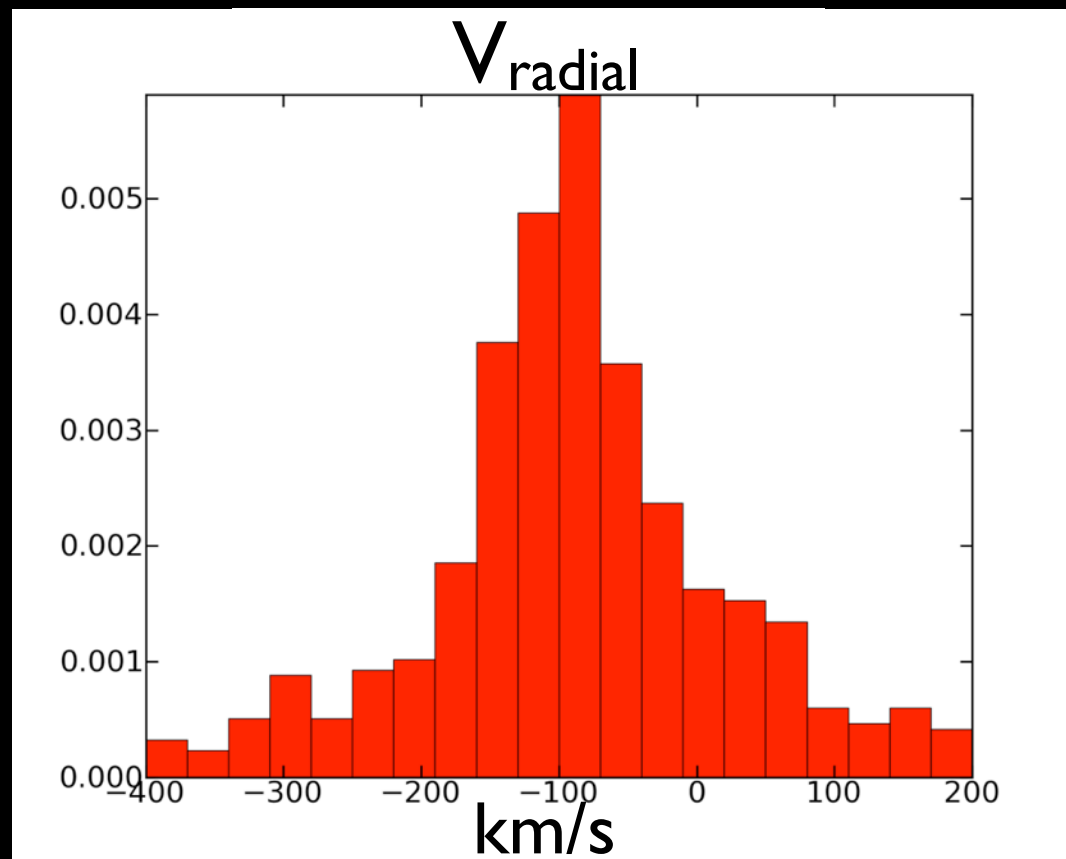
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Identified 880 pairs
(find one pair per $\sim(24 \text{ Mpc})^3$)

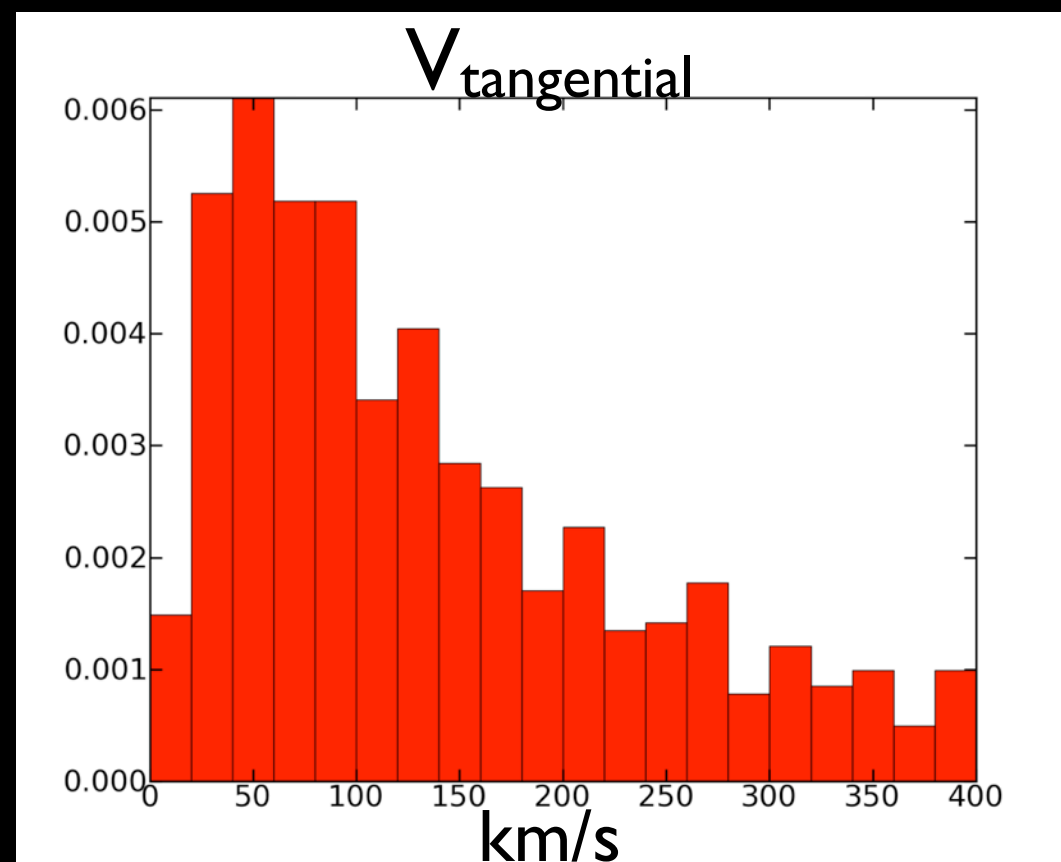
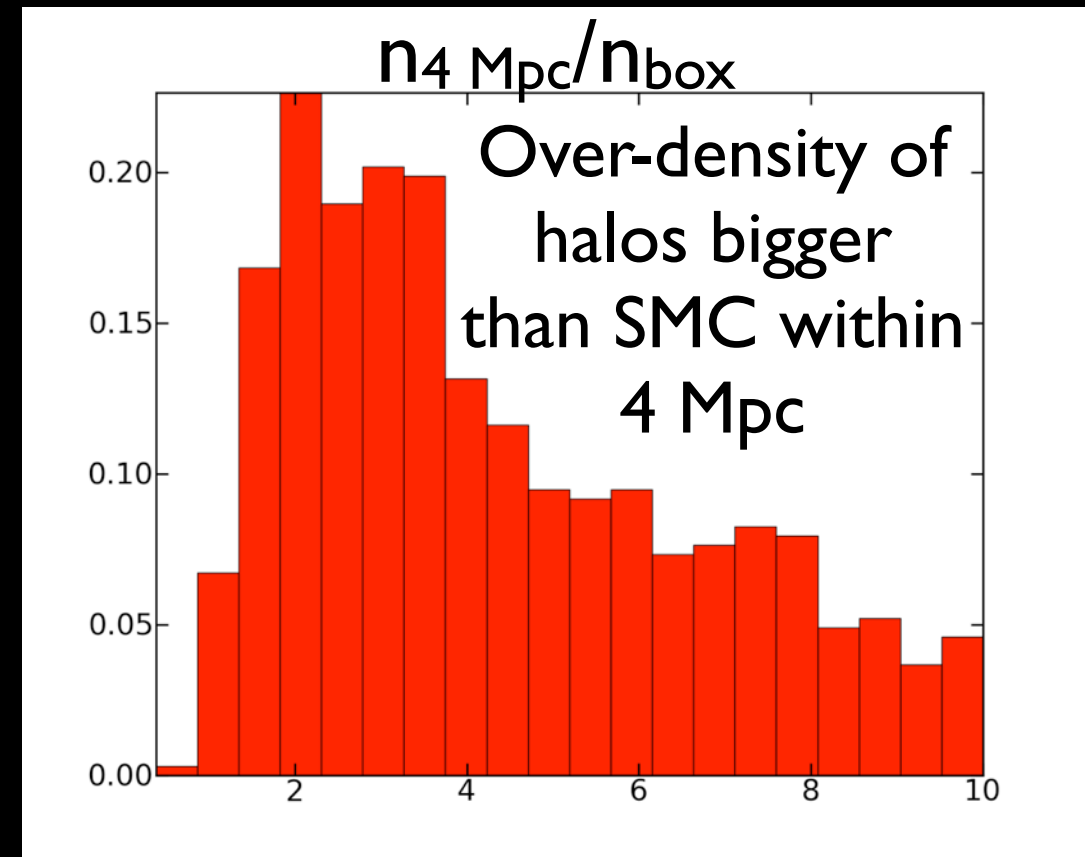
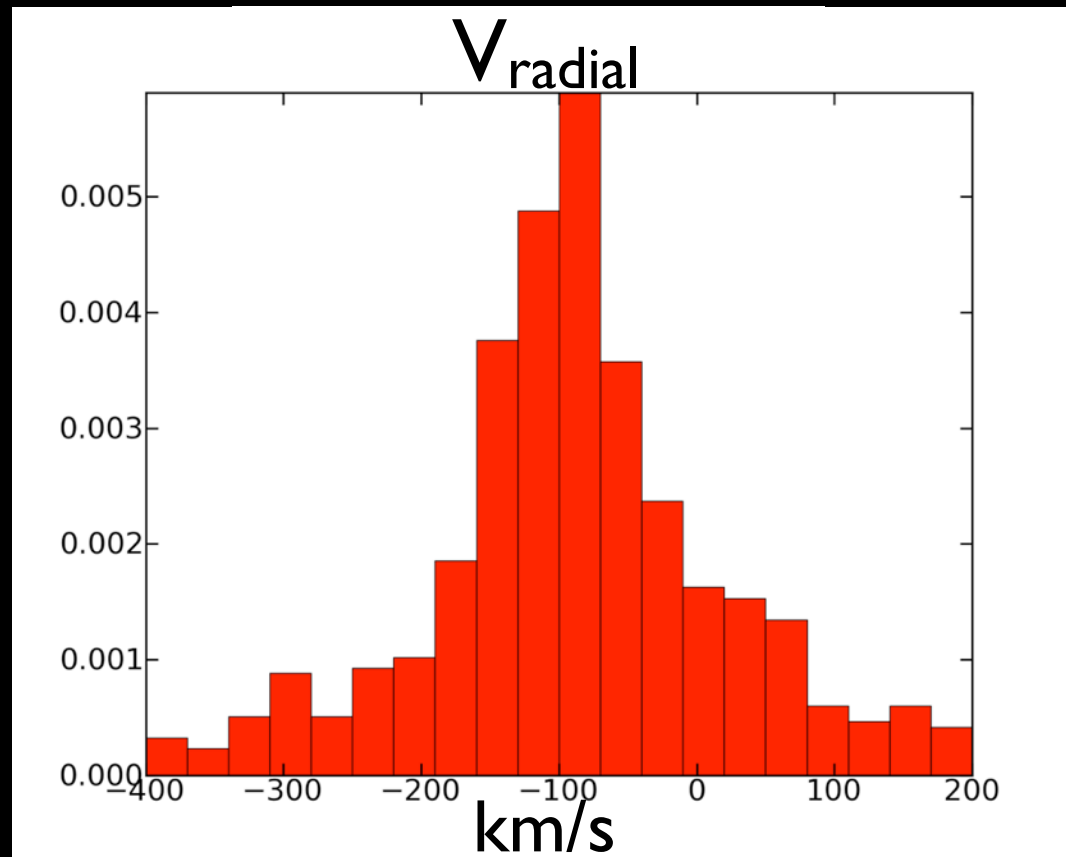
Paired Halos: LG Analogues?



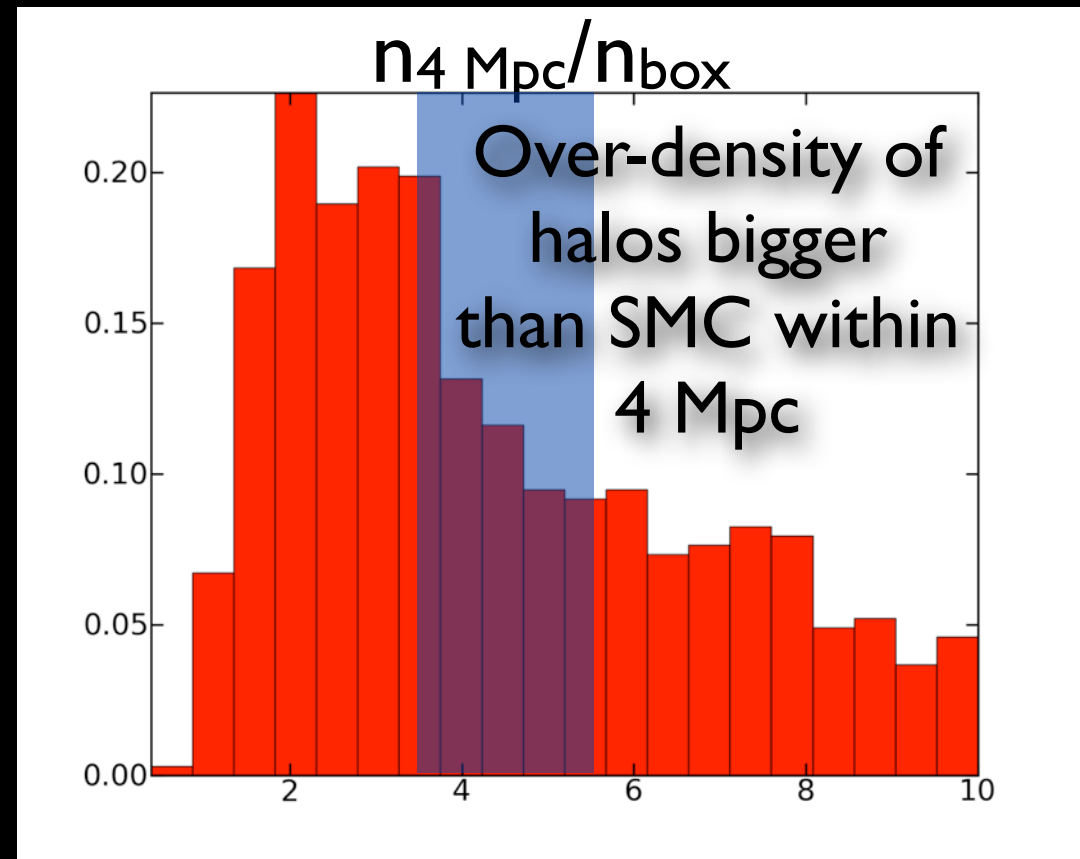
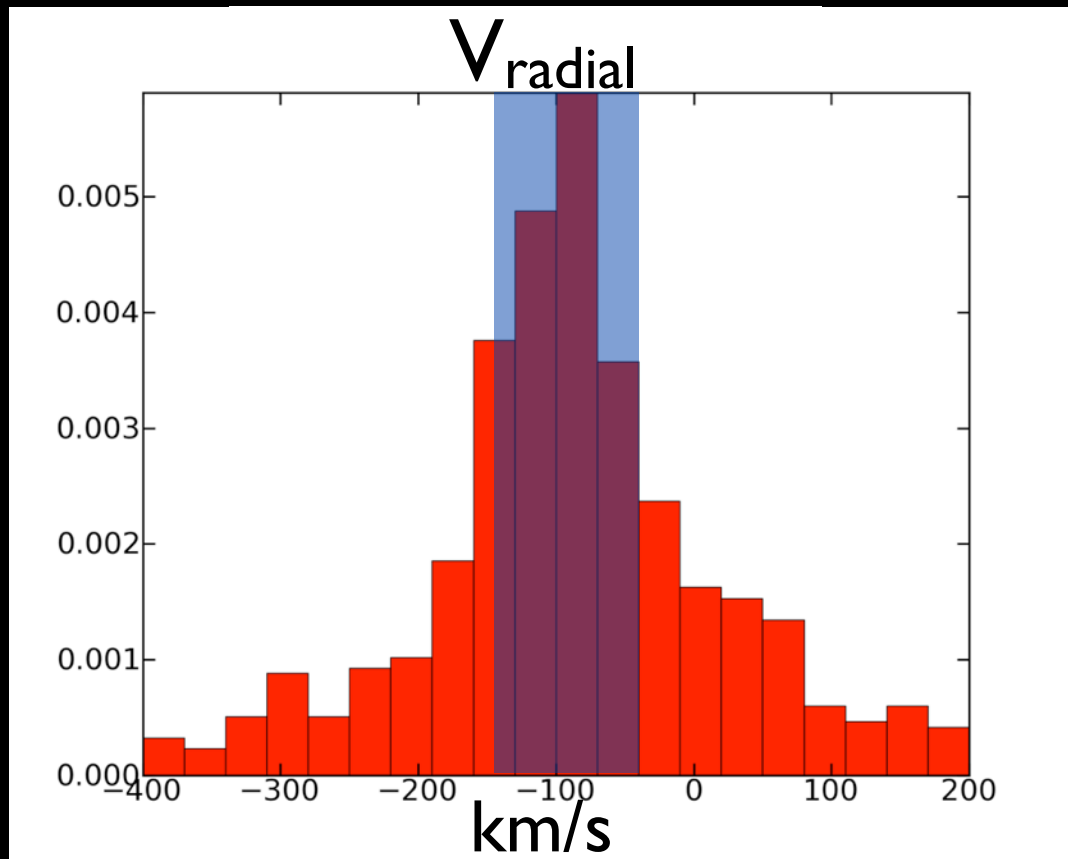
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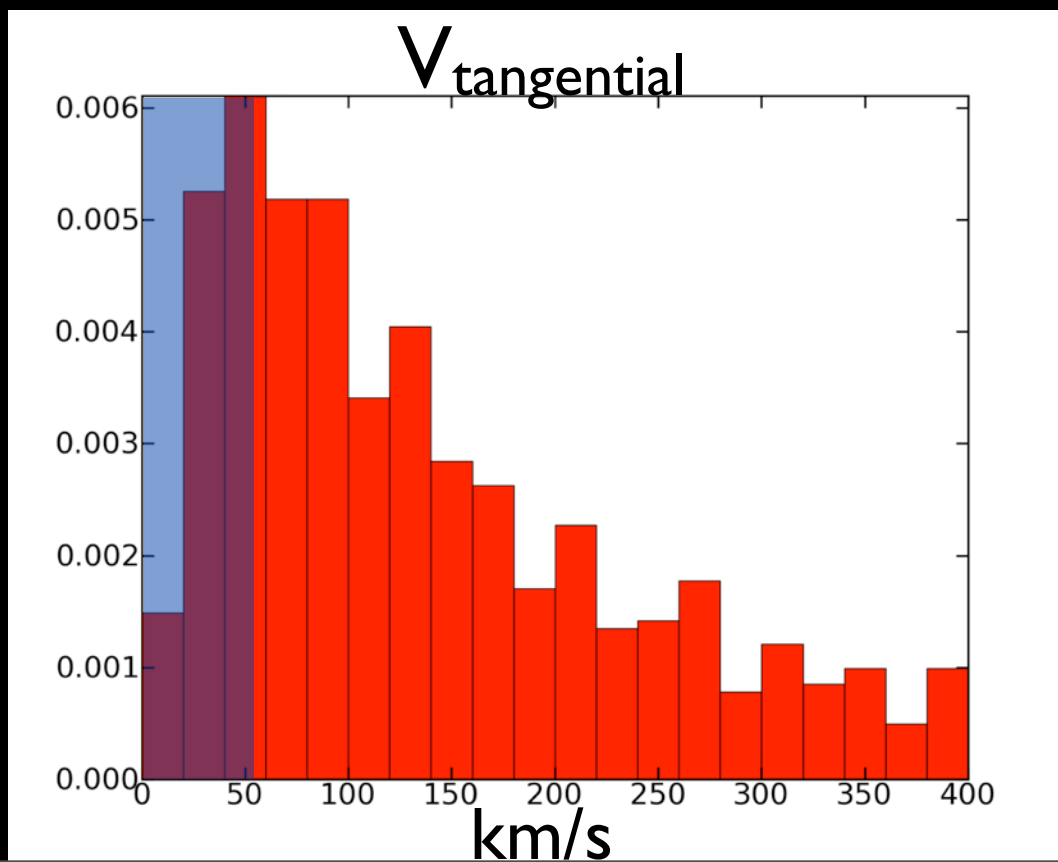


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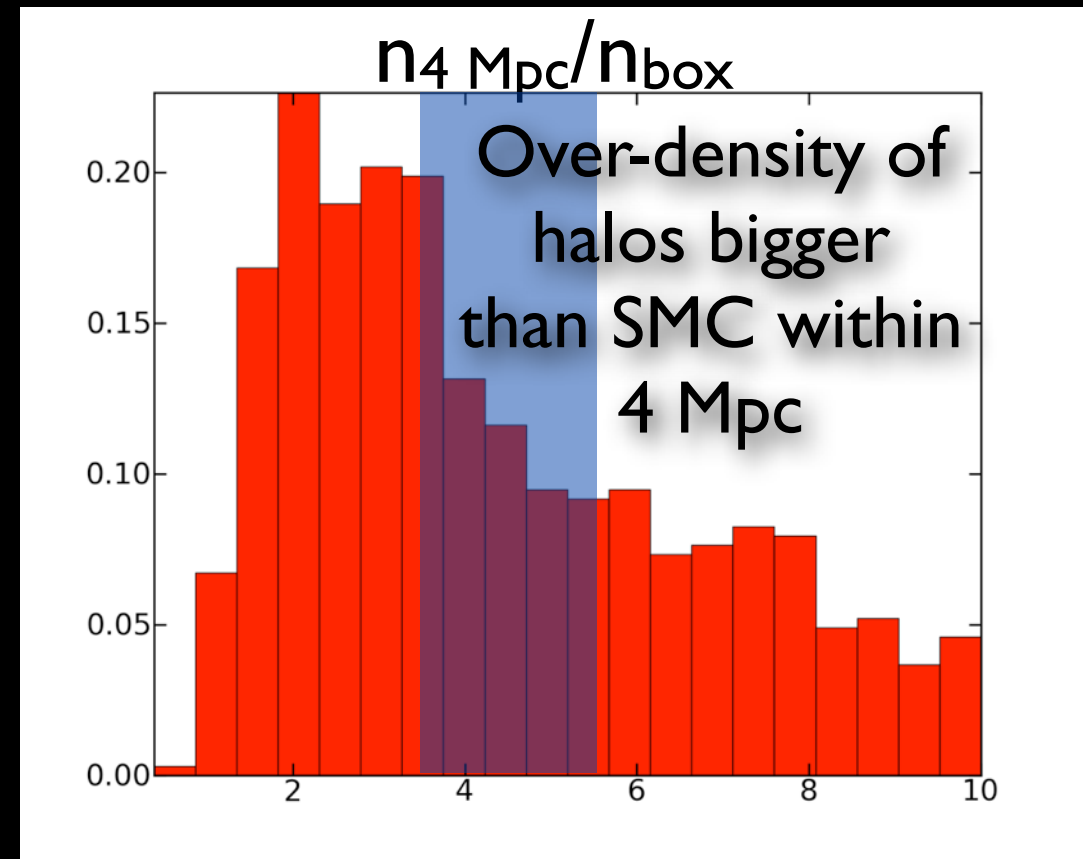
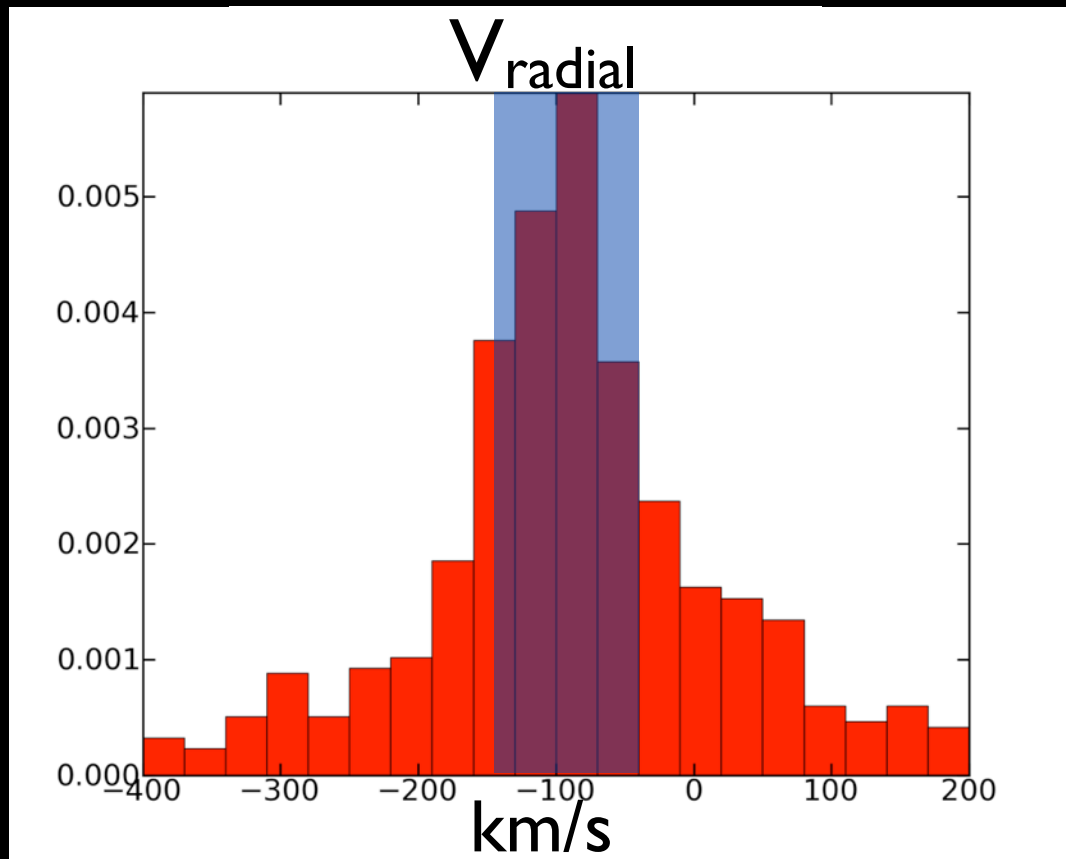
Observed

van der Marel
et al., 2012



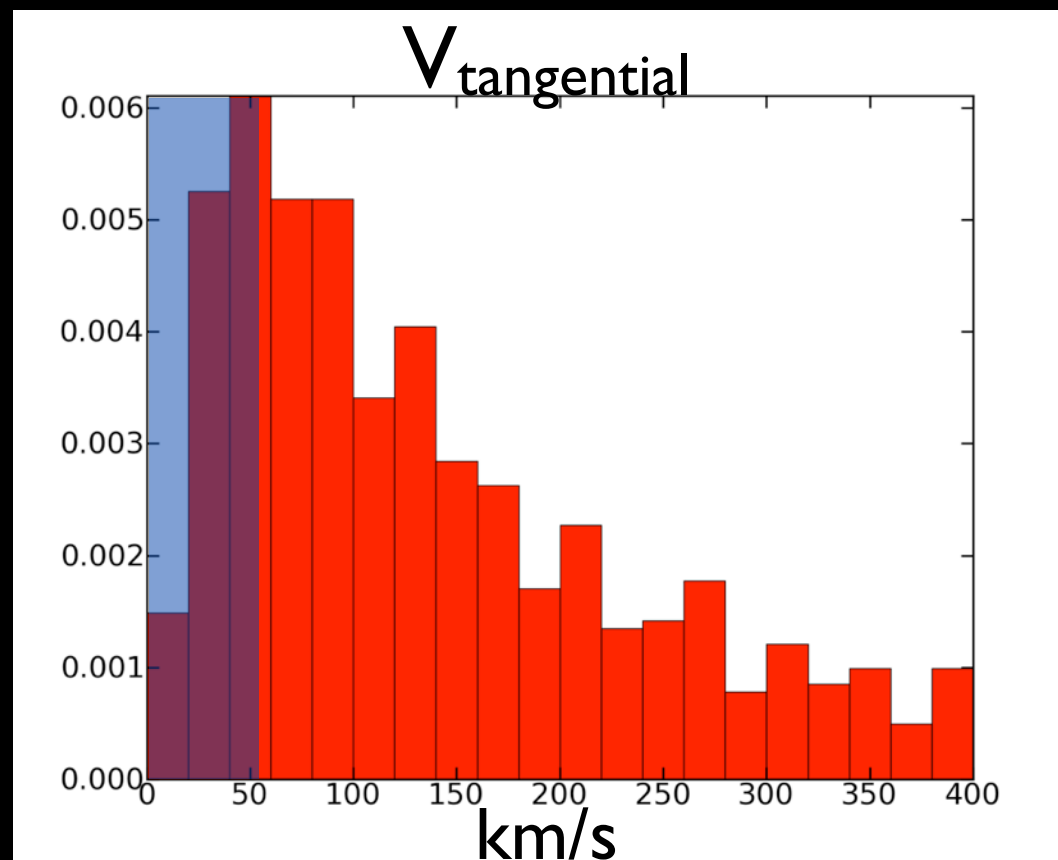
Tikhonov &
Klypin, 2009

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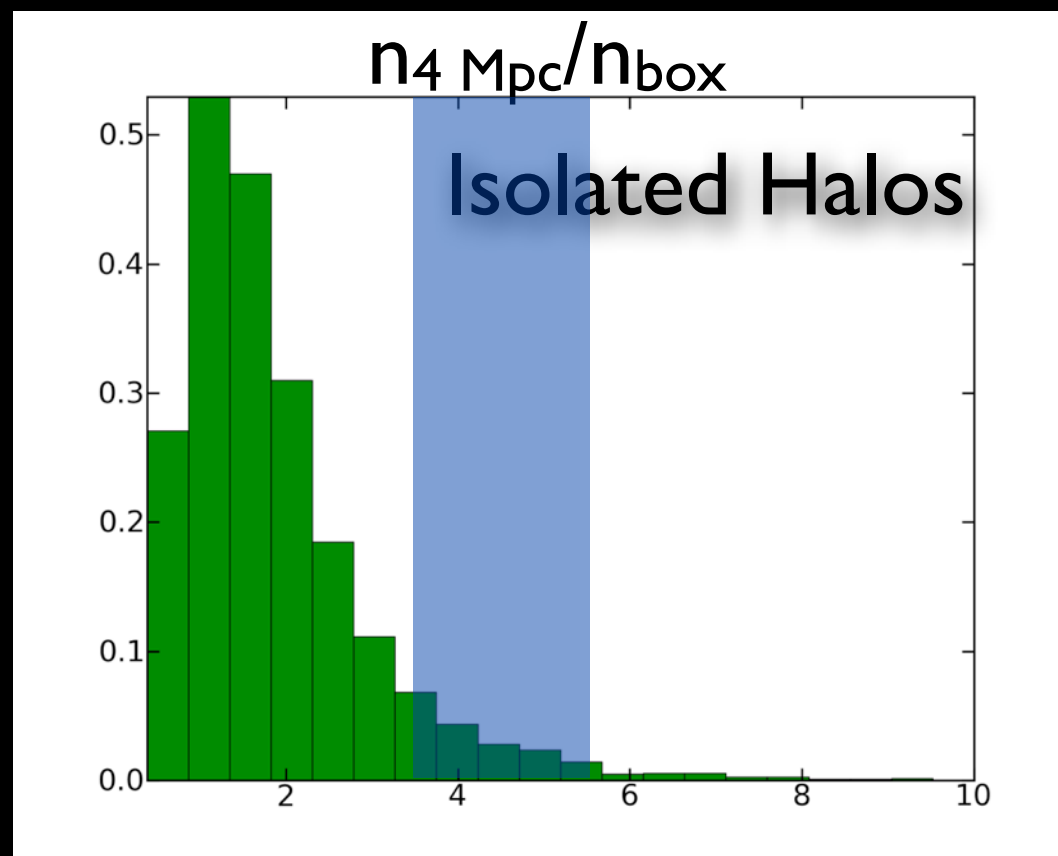
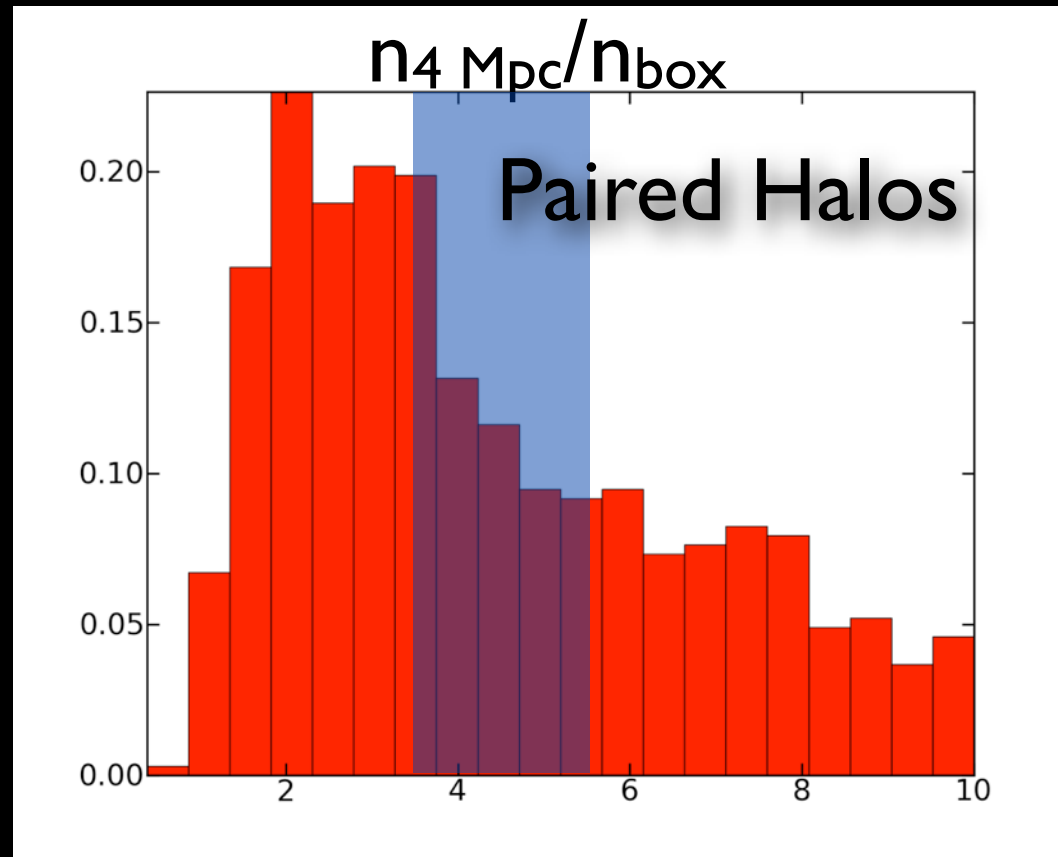
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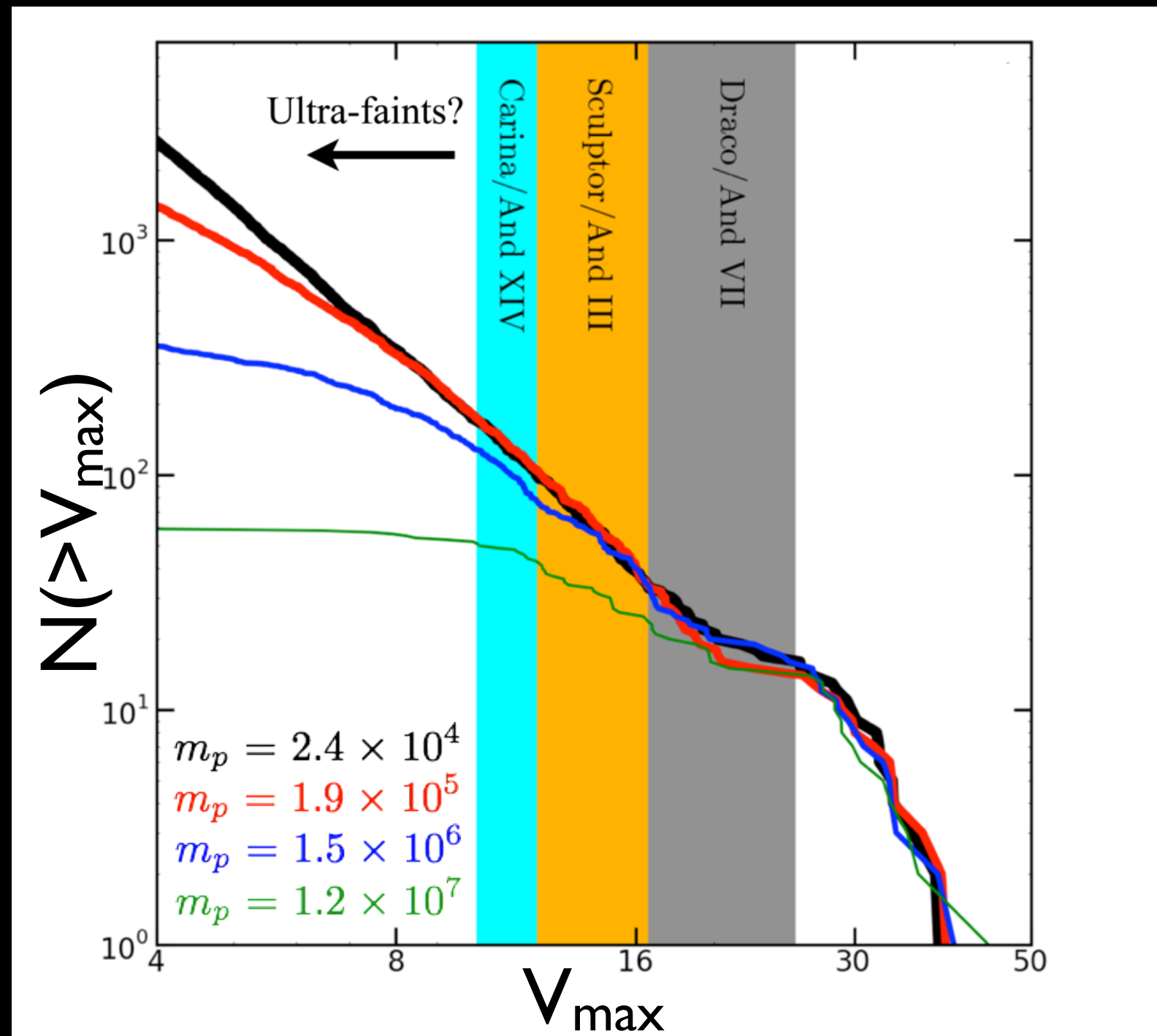
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We find similar
distributions in
Bolshoi (Klypin
et al., 2011)

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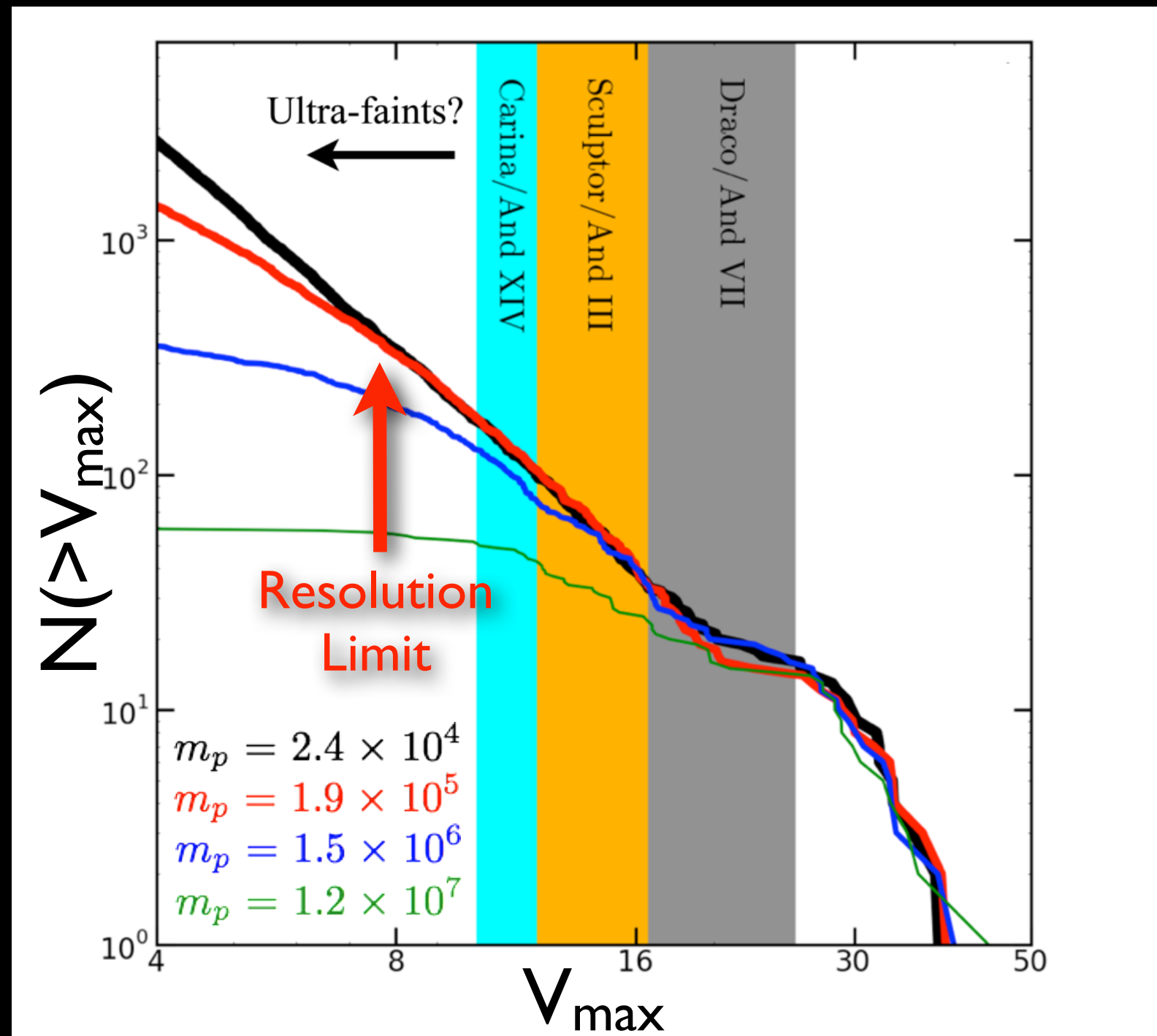


Resolution Requirements



Simulating the same halo at four resolutions

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The ELVIS Suite:

Exploring the Local Volume In Simulations

- Twenty-two halos in LG-like configurations
- Twenty-two mass-matched isolated halos



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- $-203 \text{ km/s} \leq V_{\text{rad}} \leq -39 \text{ km/s}$
- $14 \text{ km/s} \leq |V_{\text{tan}}| \leq 125 \text{ km/s}$
- $1.05 \times 10^{12} M_{\odot} \leq M_{\text{vir}} \leq 2.86 \times 10^{12} M_{\odot}$



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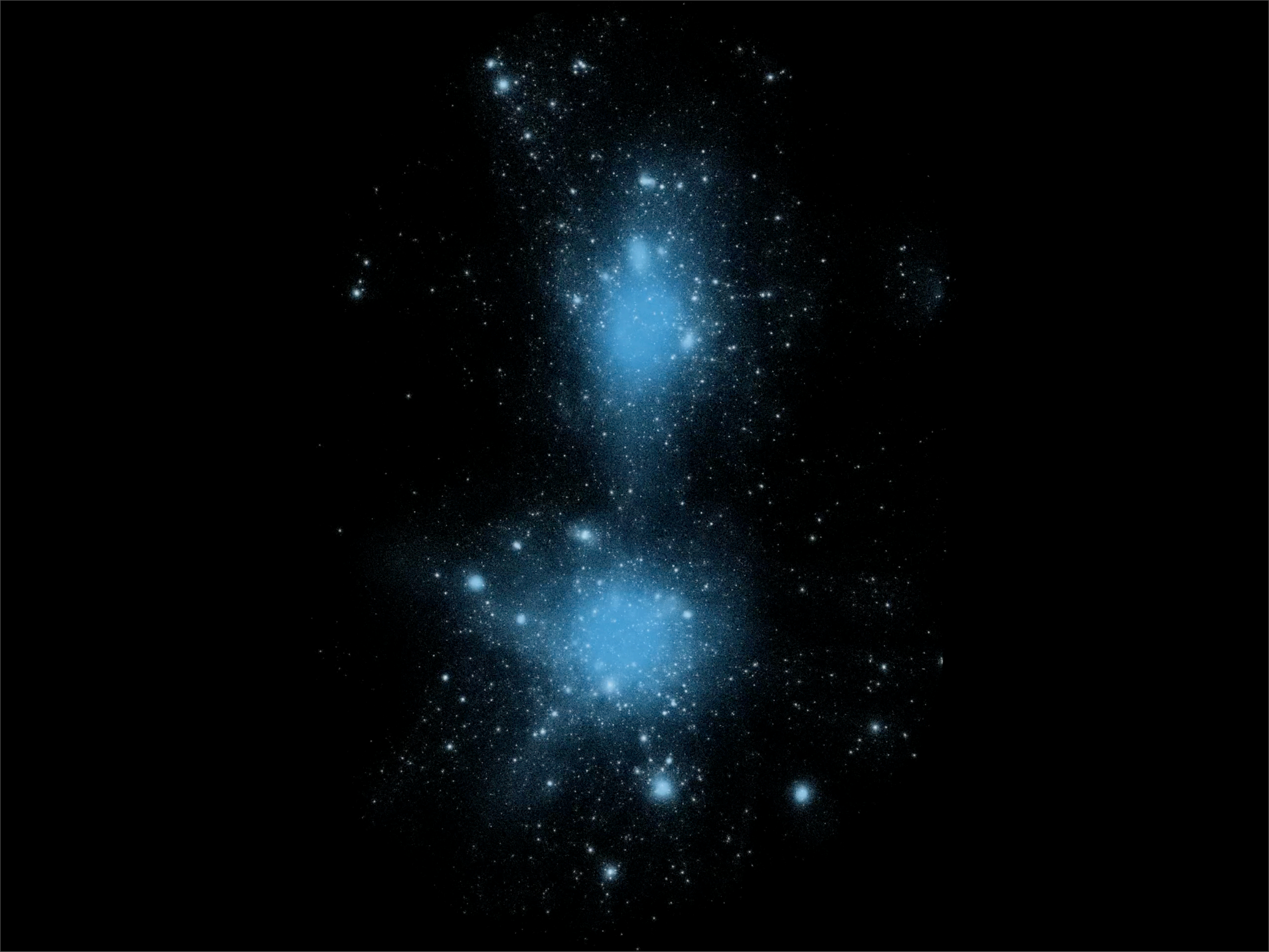
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Up to **15 million** particles in a halo
and up to **42 million** high-res particles
in the uncontaminated region





~ 1 Mpc



Structure Formation in LG Pairs

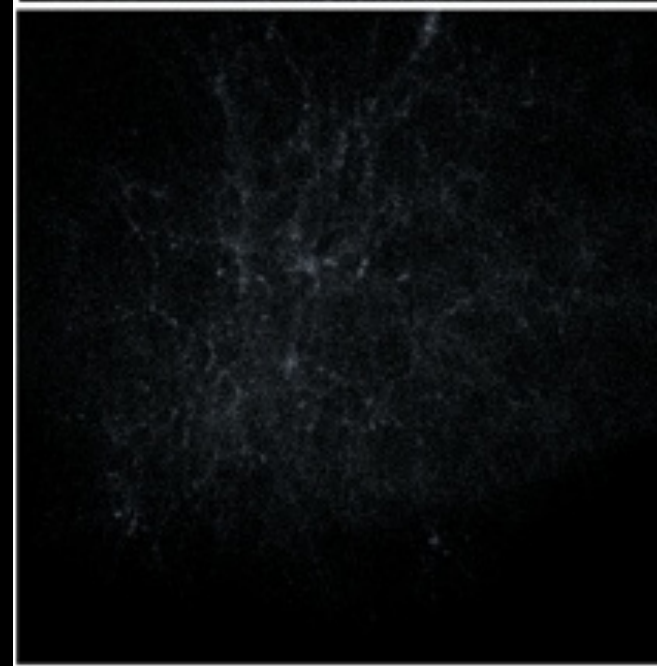
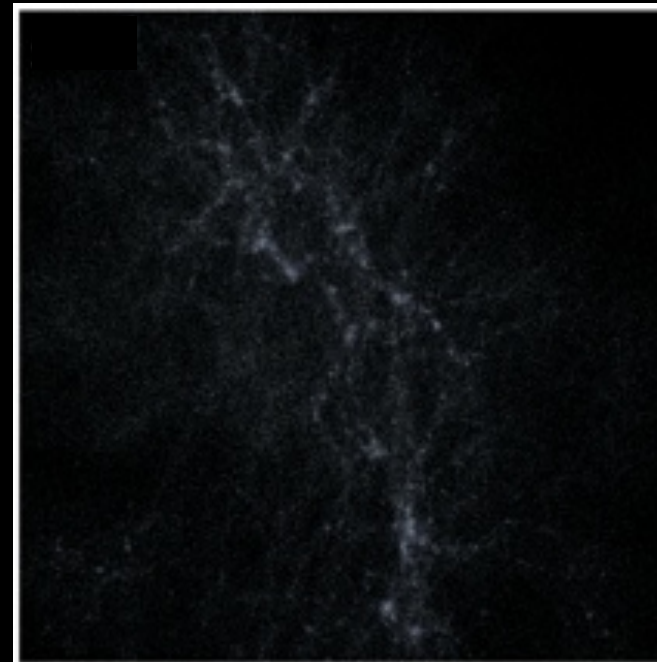


$z = 0$

Structure Formation in LG Pairs

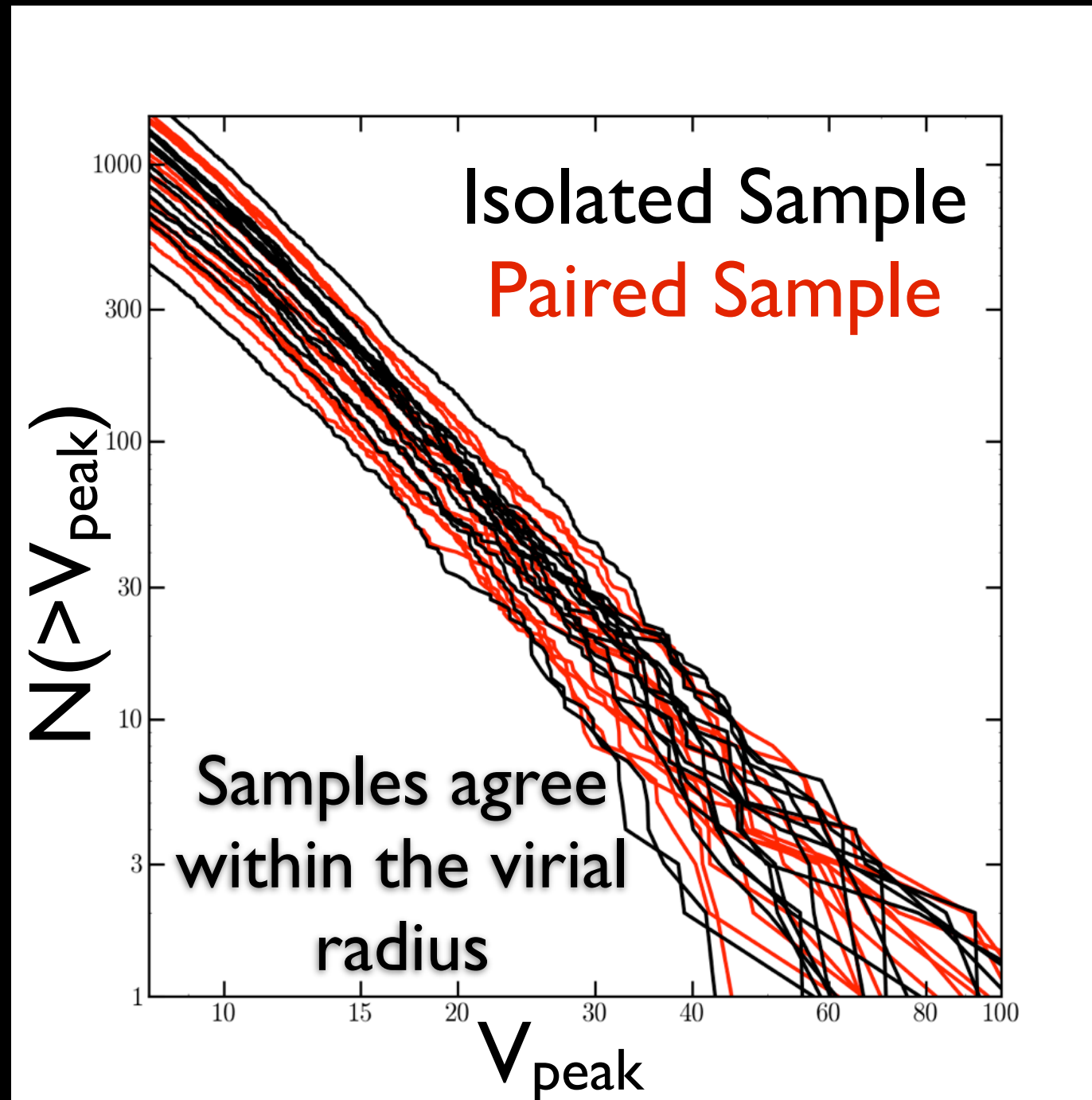


$z = 0$



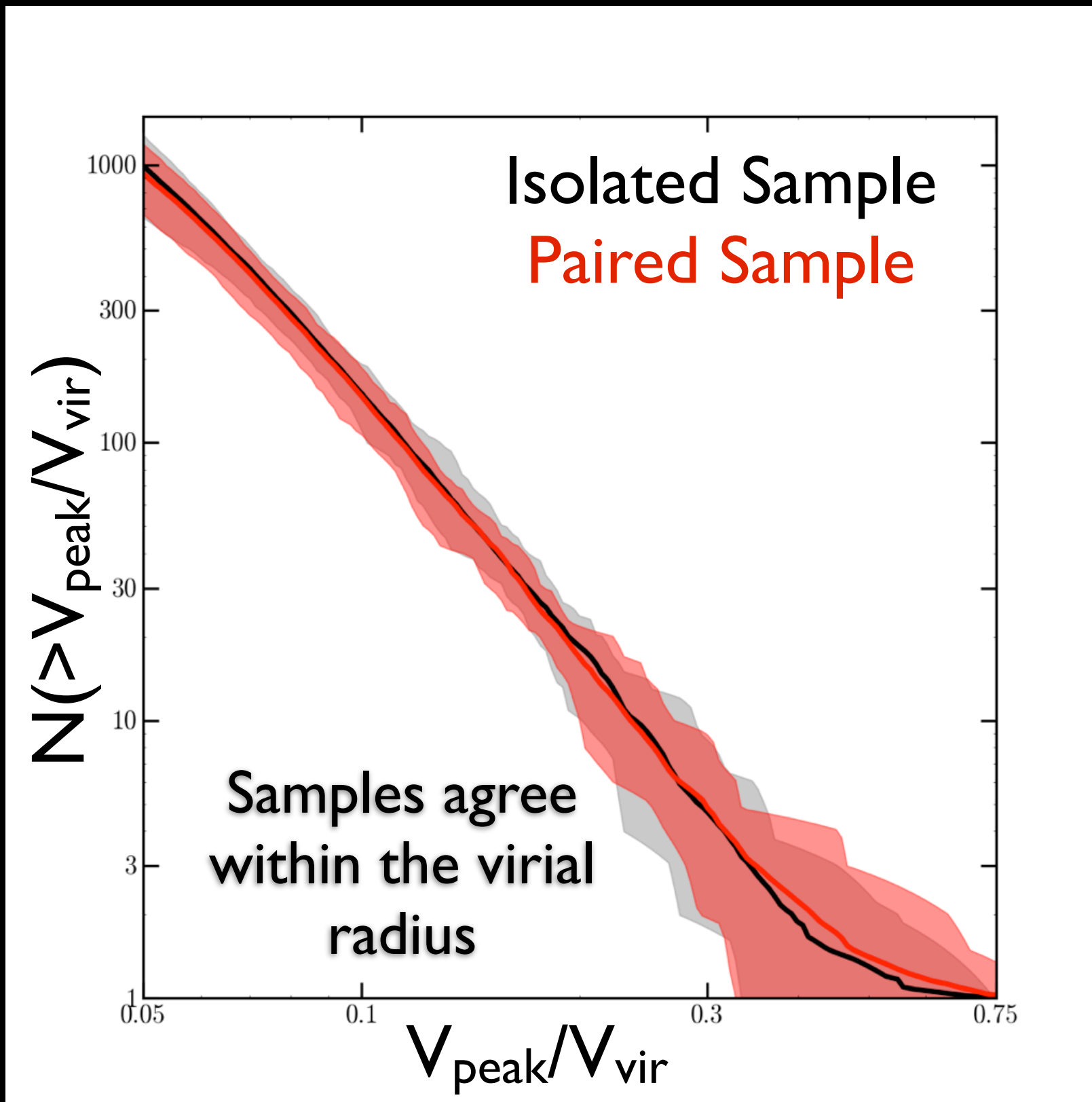
$z = 7$

Halos within R_{vir}

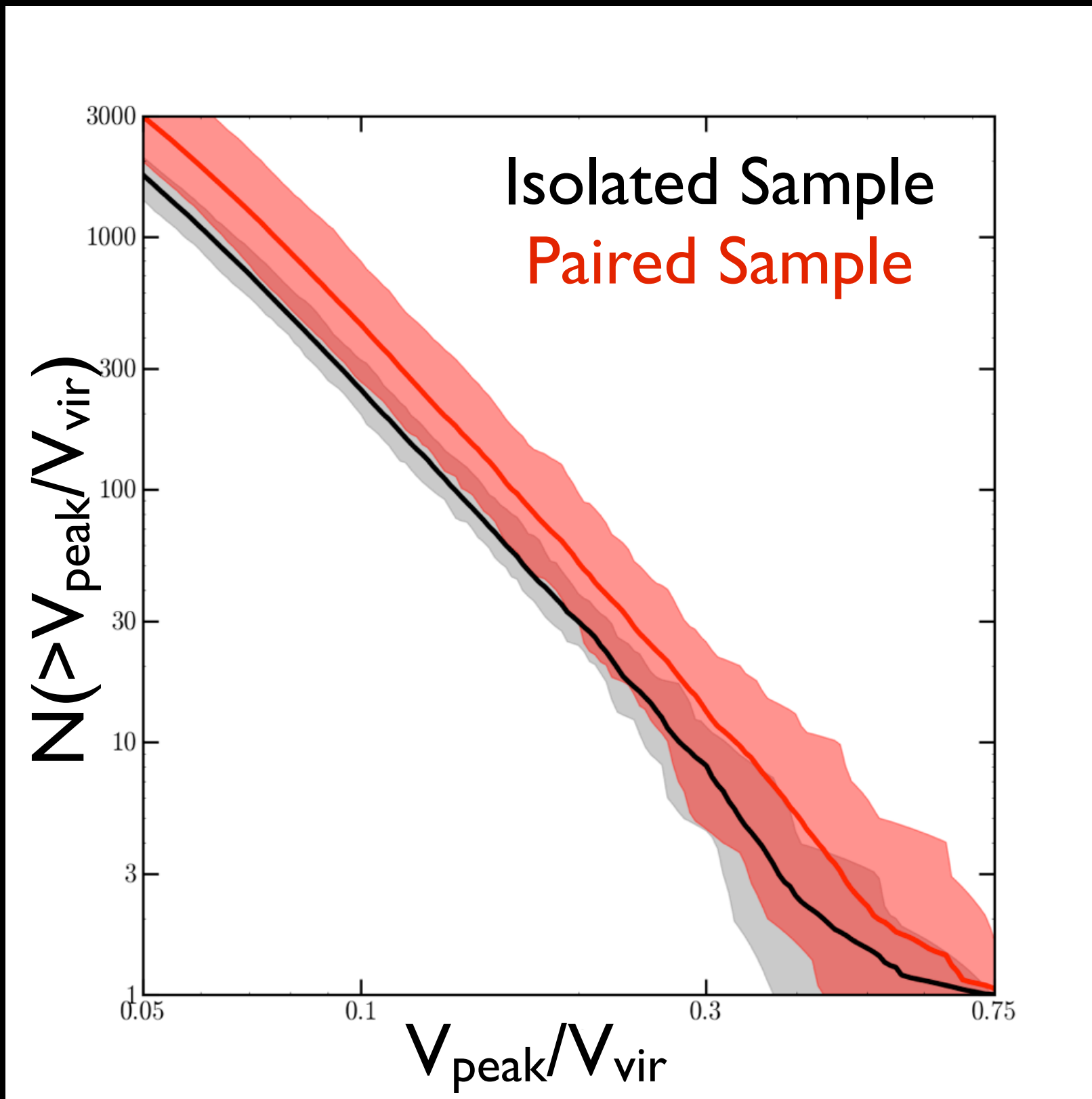


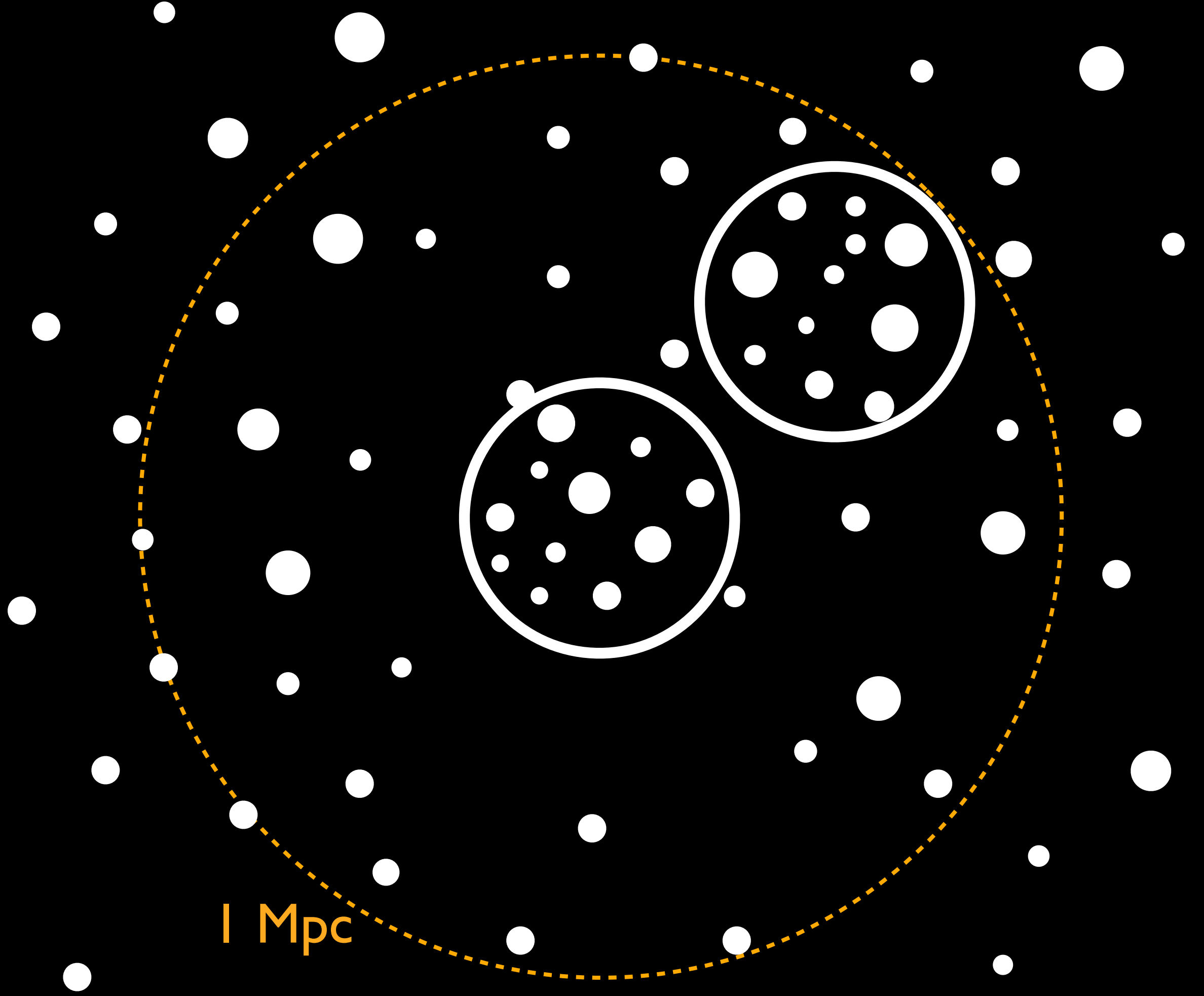
$V_{\text{peak}} \equiv$ maximum circular velocity over all time

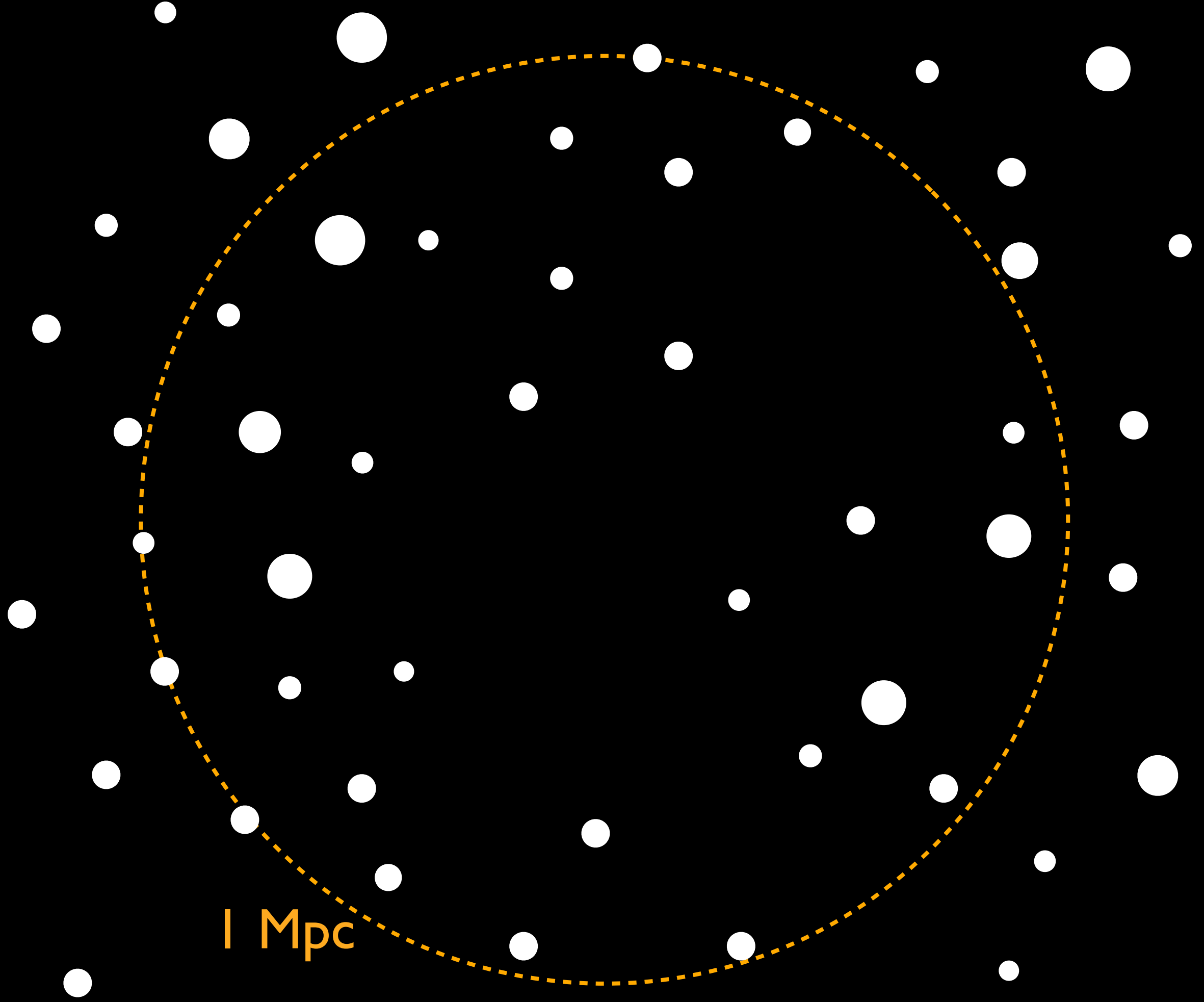
Halos within R_{vir}



Halos within 1 Mpc

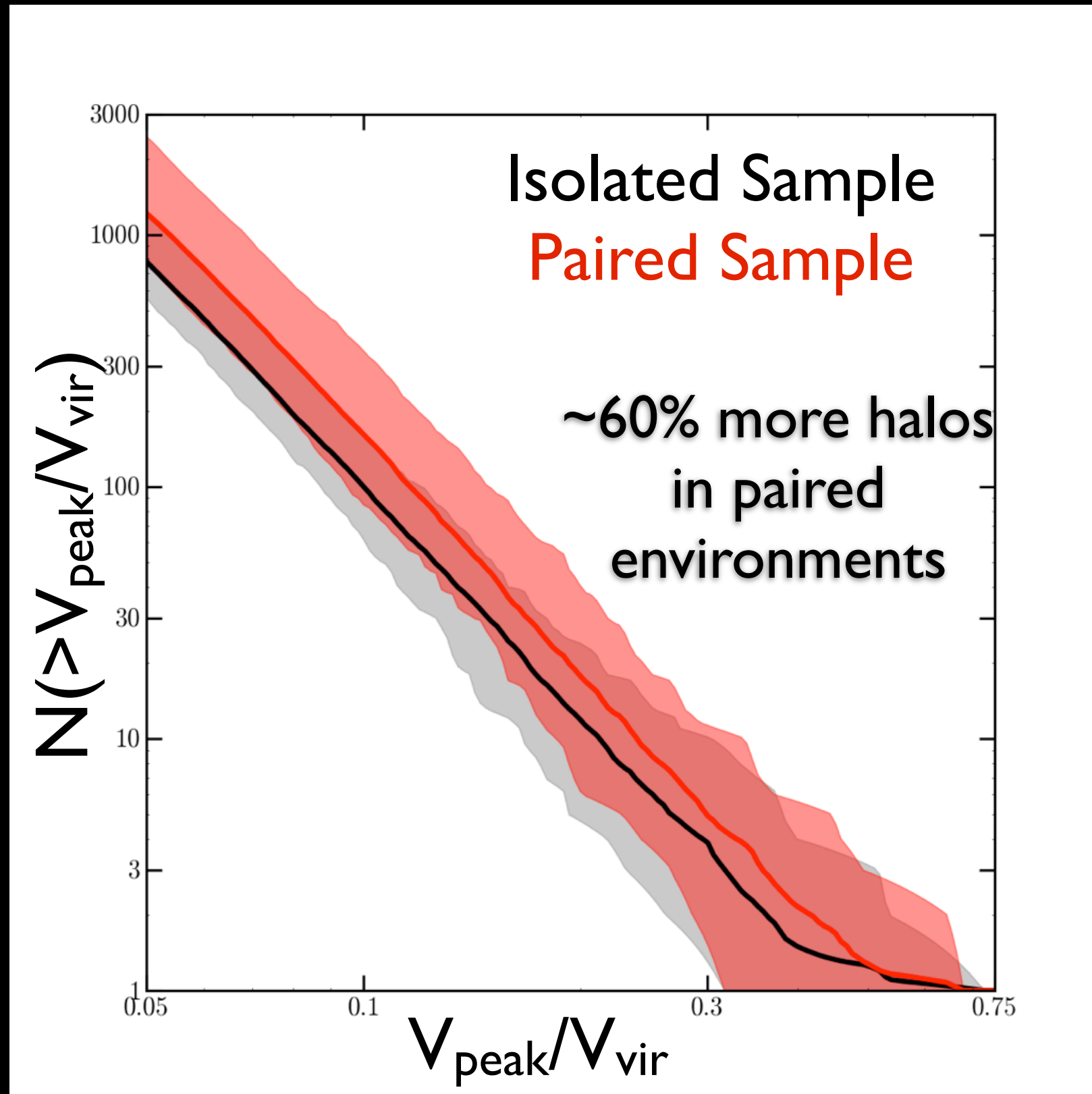






1 Mpc

Halos outside MW and M31



Conclusions

- New surveys (Pan-STARRS, SkyMapper, DES, LSST, etc.) are pushing the boundaries of discovery within the Local Group
- Simulations need to resolve large regions with a comparable mass halo nearby to confront these data
- Overdensity of galaxies brighter than SMC within 4 Mpc isn't unexpected for halos that live in Local Group configurations

Conclusions

- ELVIS Suite:
 - Eleven Local Group pairs selected for zoom simulations from large volume simulations
 - Twenty two mass-matched isolated halos
- Subhalo number counts within R_{vir} agree between isolated and LG zoom simulations
- LG simulations predict about 150 galaxies larger than Carina outside R_{vir} of the MW or M31 but within 1 Mpc, versus only about 90 in isolated simulations