Dark Matter Substructure and Dwarf Galactic Satellites

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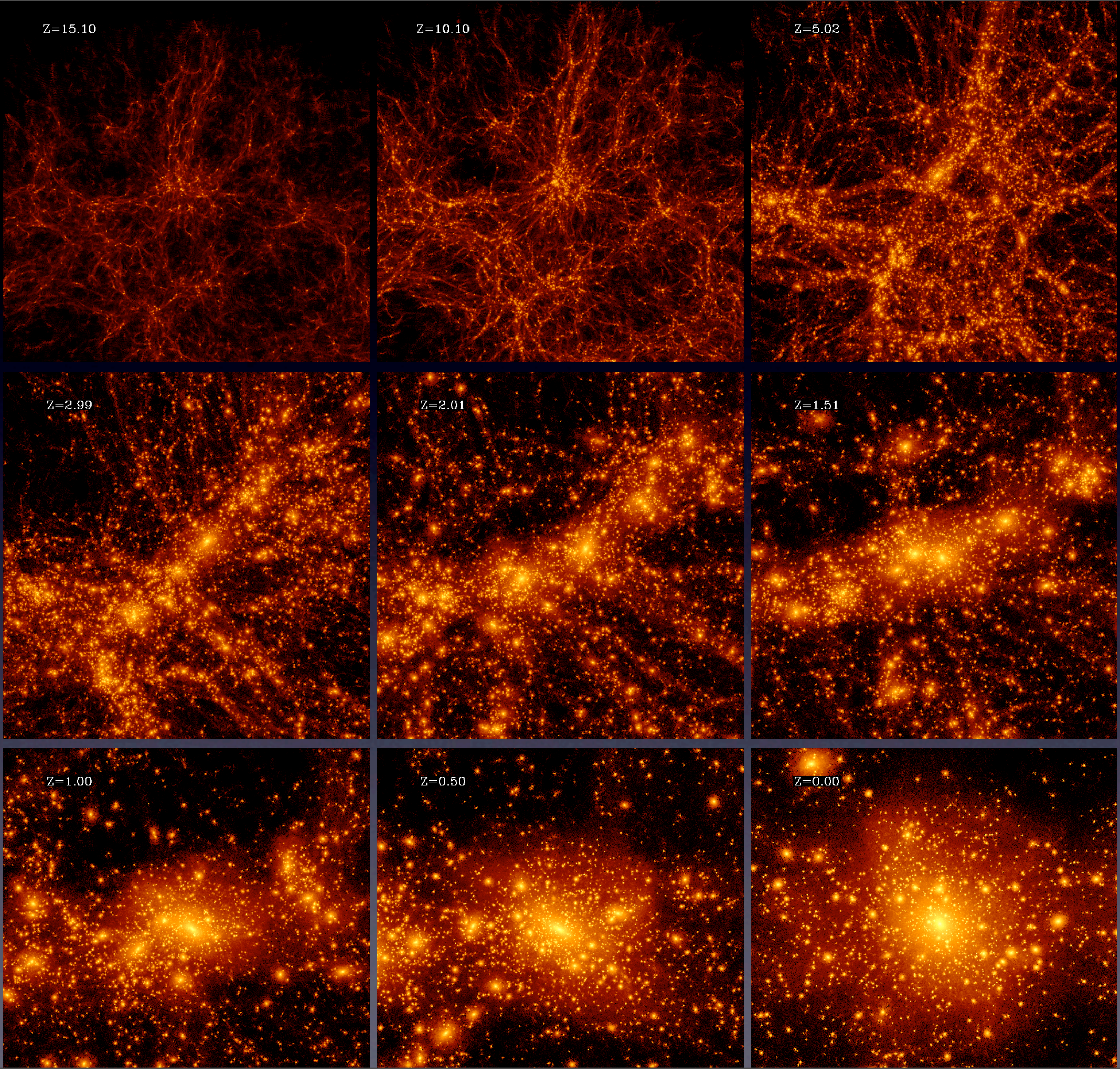
Outline

- Introduction
  - CDM Simulations vs Observations
- Quantifying the Substructure Problem
  - Dark Satellites
  - Luminous Satellites
- Possible Solutions
  - New Cosmological Model
  - Galaxy Formation Suppression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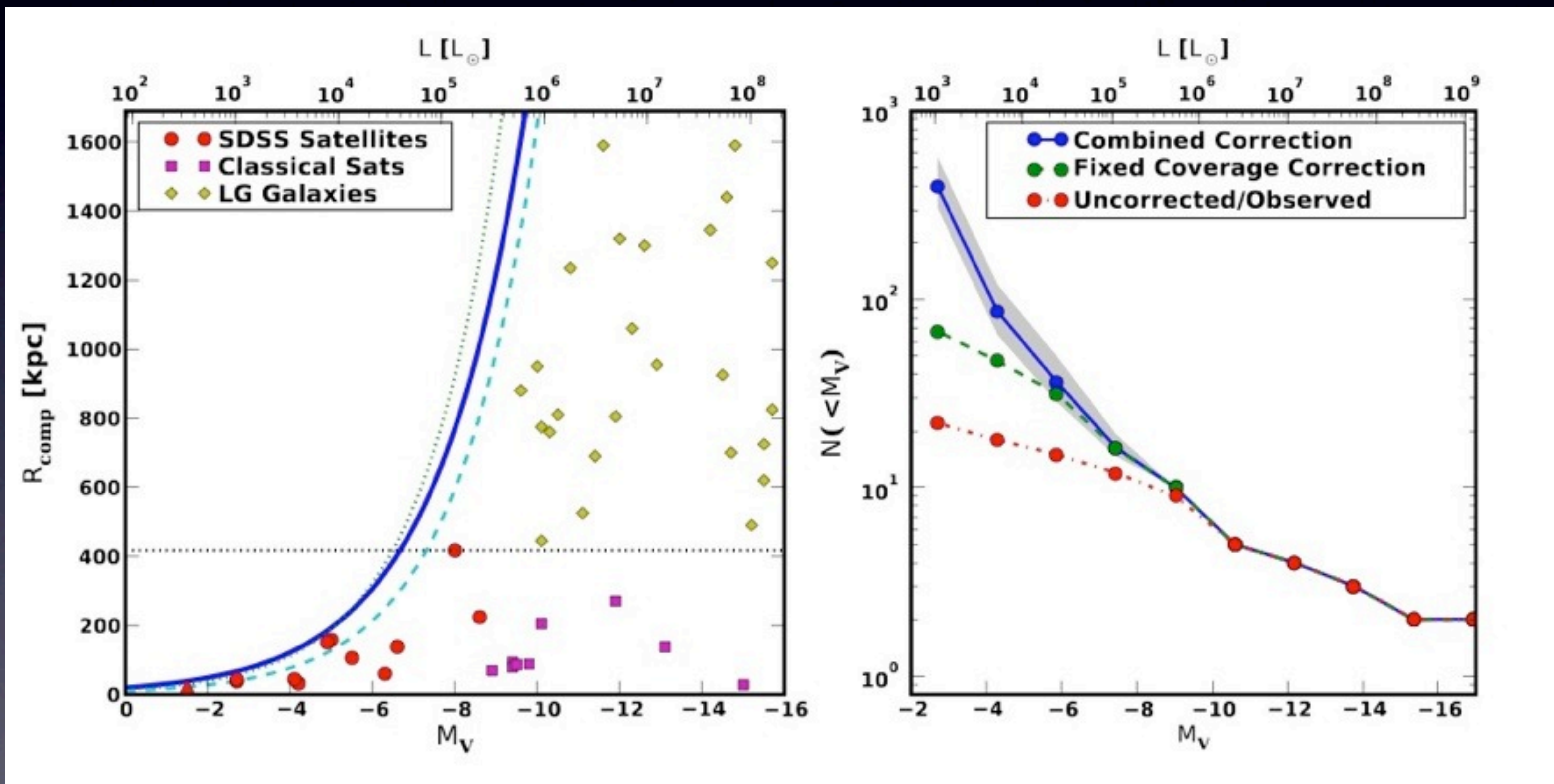
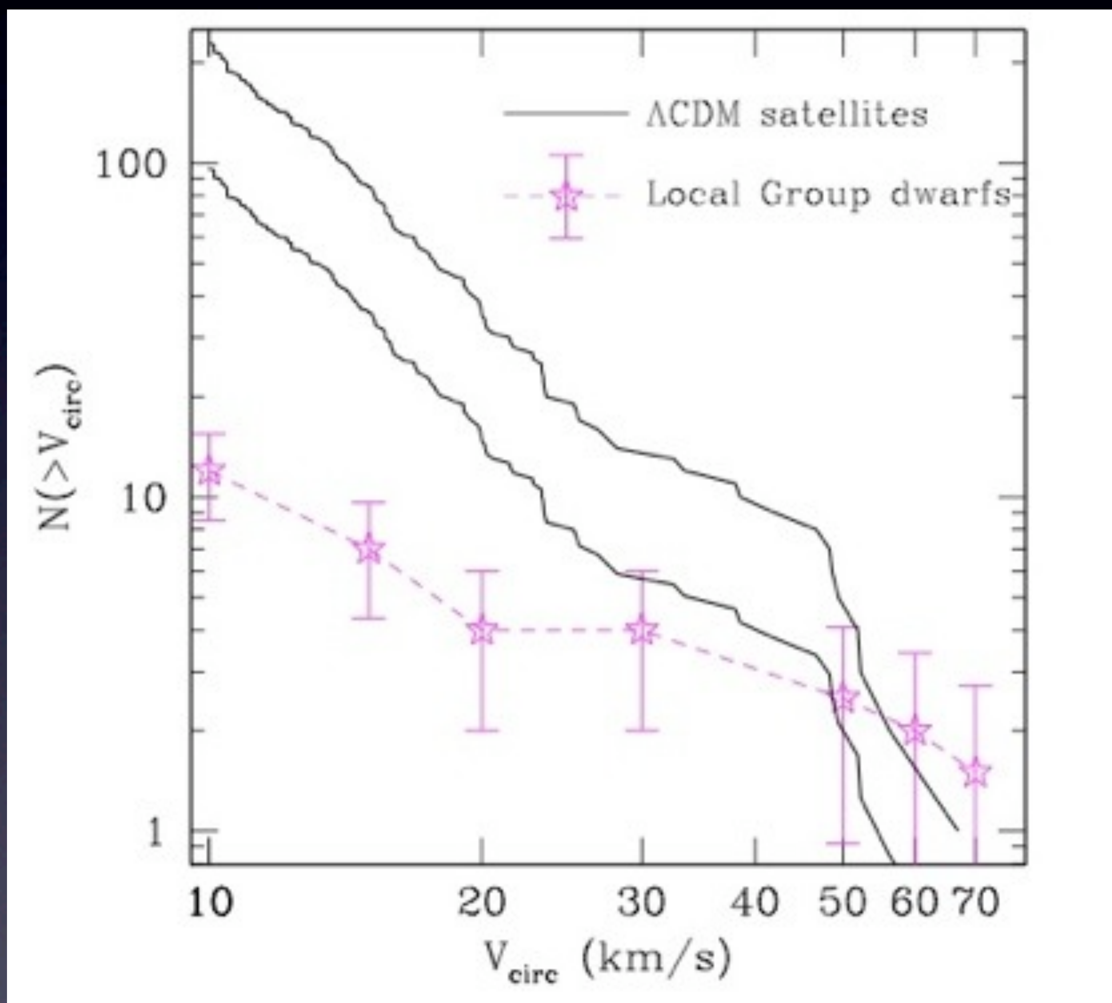
Via Lactea Movies can be found at the following url

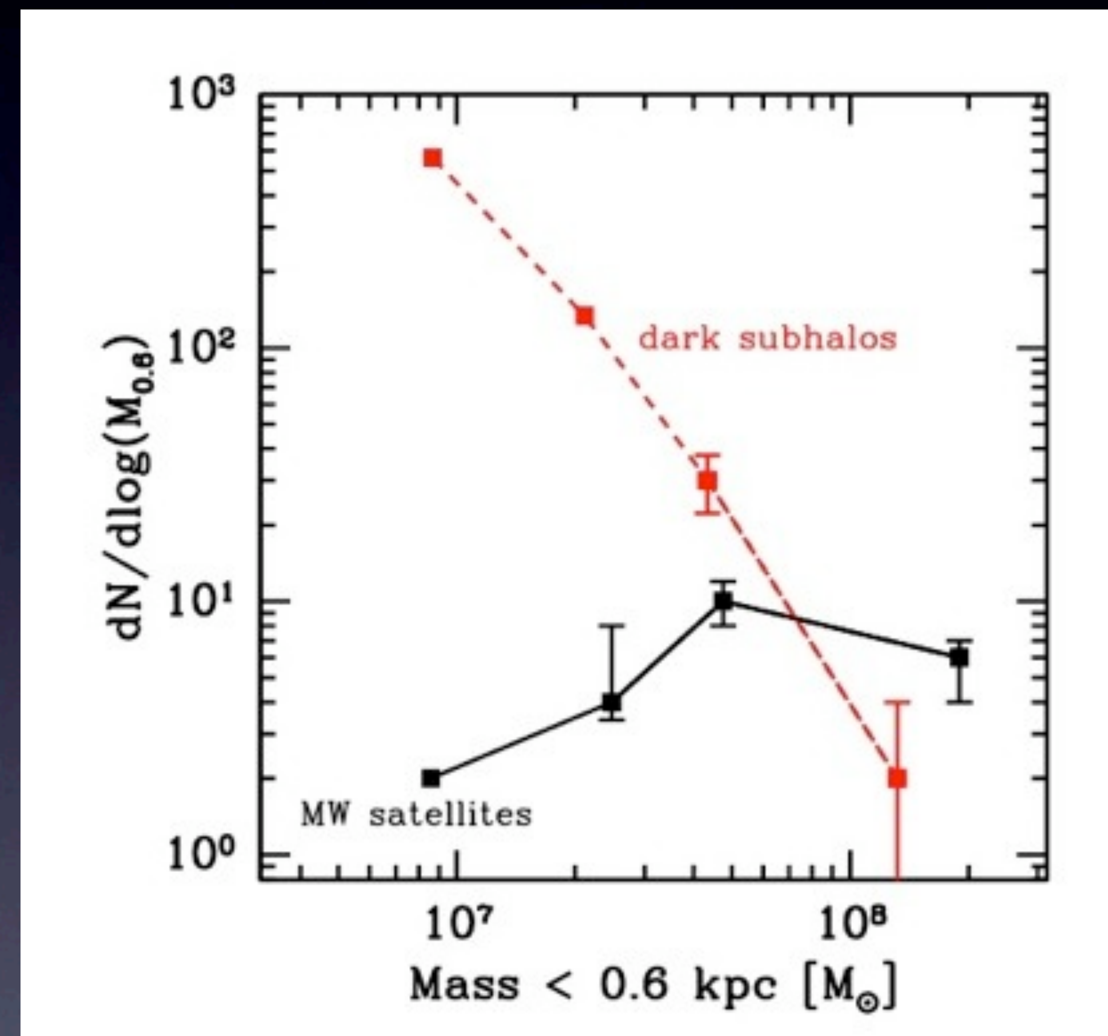
- http://www.ucolick.org/%7Ediemand/vl/movies.html

Luminous Satellite Galaxies



Circular Velocity and $m_{0.6}$ Slopes





Defining the "Substructure Problem"

"The substructure problem can be stated as the discrepancy in the slopes of the circular velocity and $m_{0.6}$ mass functions inferred for observed satellites of the Milky Way and the slopes of these functions predicted for dark matter subhalos in the MW-sized host halos formed in the concordance ΛCDM cosmology"

Different Cosmology

- Suppressing density fluctuations
- Warm Dark Matter

$$d = 2R = 2\left(\frac{3M}{4\pi\Omega_{m0}\rho_{crit0}}\right)^{1/3} \quad (2)$$

$$= 360.4\,\mathrm{kpc}\left(\frac{M}{10^9\ M_\odot}\frac{0.3}{\Omega_m}\right)^{1/3}\left(\frac{H_0}{70}\right)^{-2/3},$$

where Ω_m is the present-day total matter density in units of the present-day critical density, $\rho_{crit0} \equiv 3H_0^2/8\pi G$ and H_0 is the current Hubble constant in units of km/s/Mpc.

Galaxy Formation Subhalo Suppression

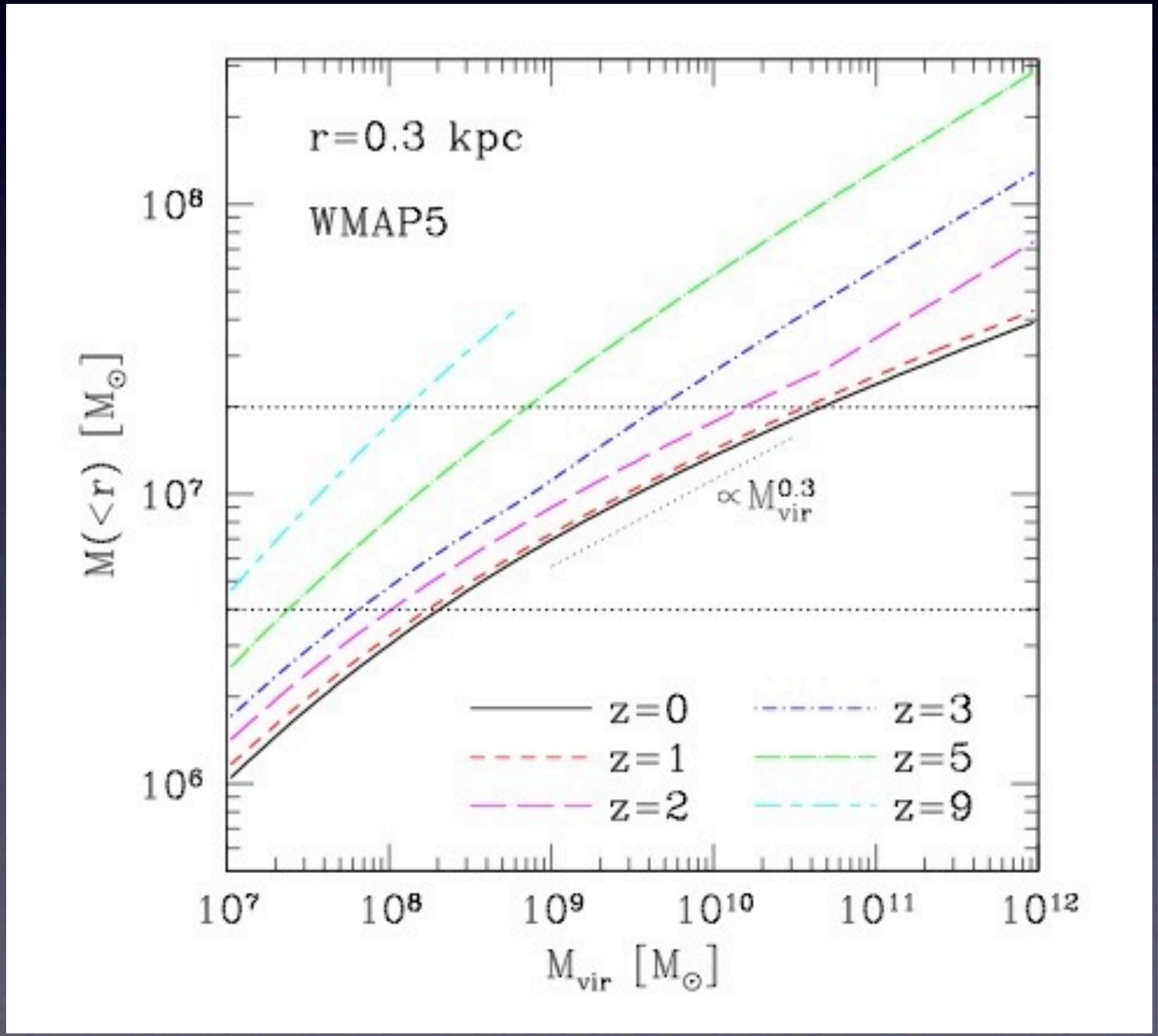
- Gas photoevaporated after reionization
- Supernovae Feedback
- Satellites could be in larger halos

Conclusions

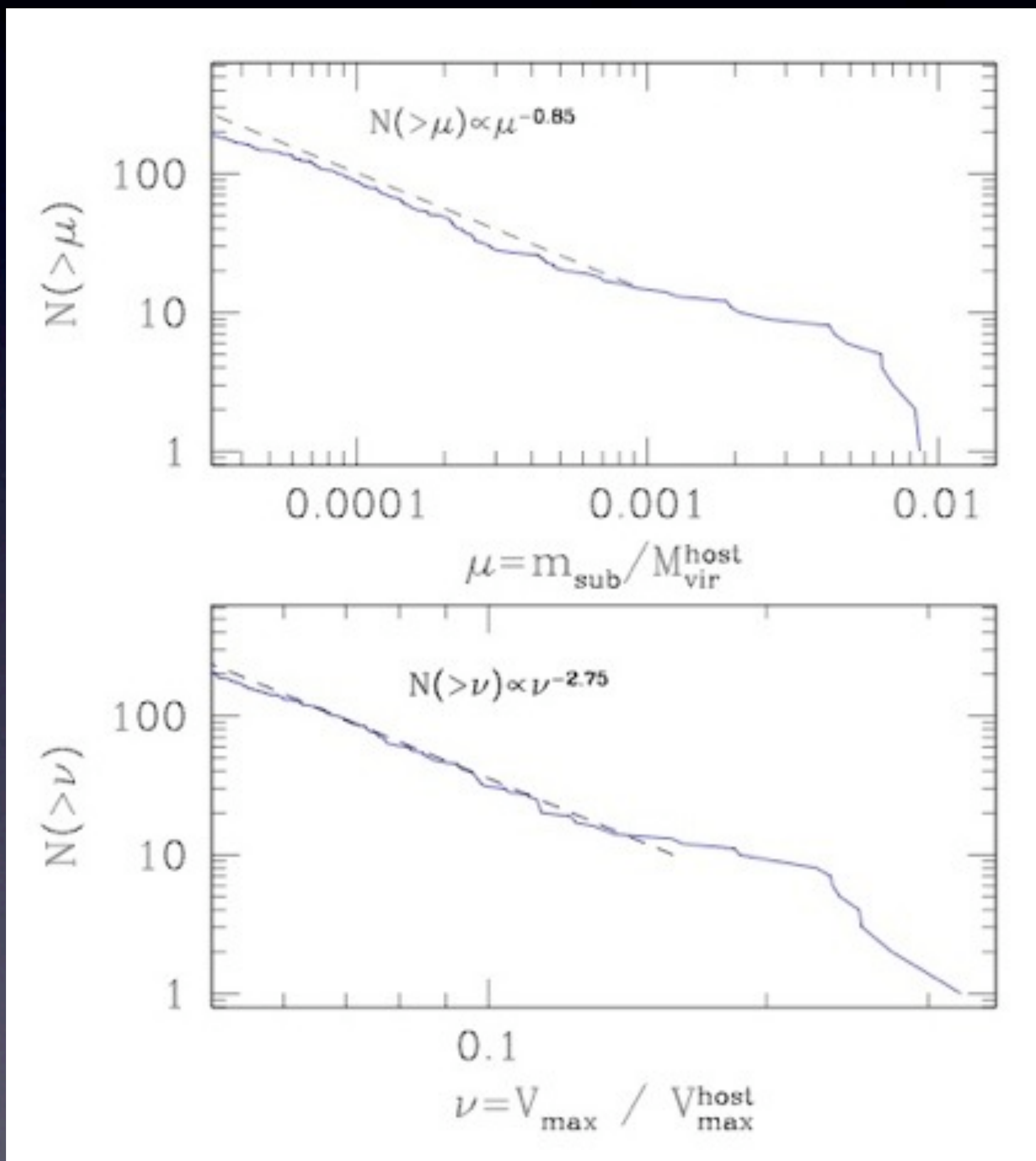
- Models and Observation do not agree
- Satellites could be mostly dark
- If satellites are dark, need low star forming efficiency
- Mass-dependent suppression mechanism

Luminous Satellite Models

- Threshold Galaxy Formation
- Selective Galaxy Formation



Subhalo Populations



$$V_{max} = max\left(\frac{Gm(<r)}{r}\right)^{1/2}$$

$$m(<r) = 4\pi\int\rho(r)r^2dr$$

Luminous Satellites (Cont.)