

The Angular Momentum Problem in Λ CDM halos

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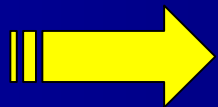
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Understanding the formation of disk galaxies
is linked to understanding the origin of its
angular momentum

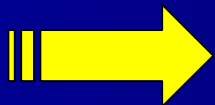
General Theory (Fall & Efsthathiou 1980):



Angular momentum origins from tidal torques



Gas had the same specific **angular momentum** of dark matter halos today



Infalling gas conserves its specific
angular momentum (Mestel 1963)

Galactic disks with correct sizes!!!!

SEMI-ANALYTIC MODELS

General Theory

+

hierarchical structure formation

Tidal torques impart angular momentum to dark matter halos

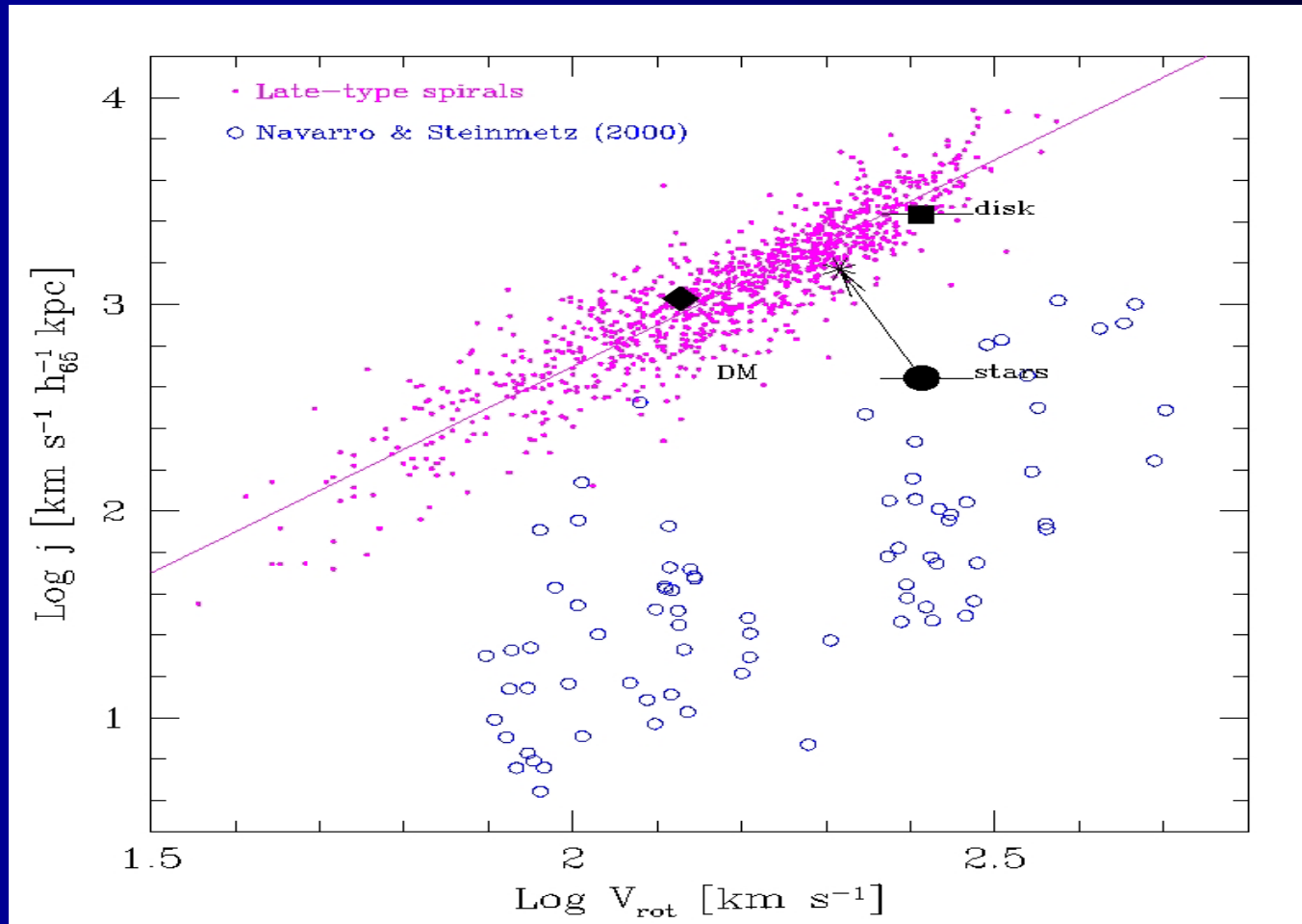
$$\lambda = \frac{|J| |E|^{1/2}}{GM^{5/2}}$$

Spin parameter λ is determined by angular momentum J and energy E , and depends on the mass M .

$$R_d = \lambda R_{VIR}$$

Galactic disks with correct sizes!!!!

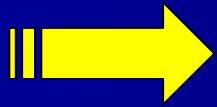
However hydrodynamical N-body simulations of disk
Formation in CDM yield disks too small



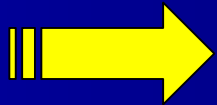
Navarro & Steinmetz 2000
Abadi et al. 2003

The Angular Momentum Catastrophe of the gas !!

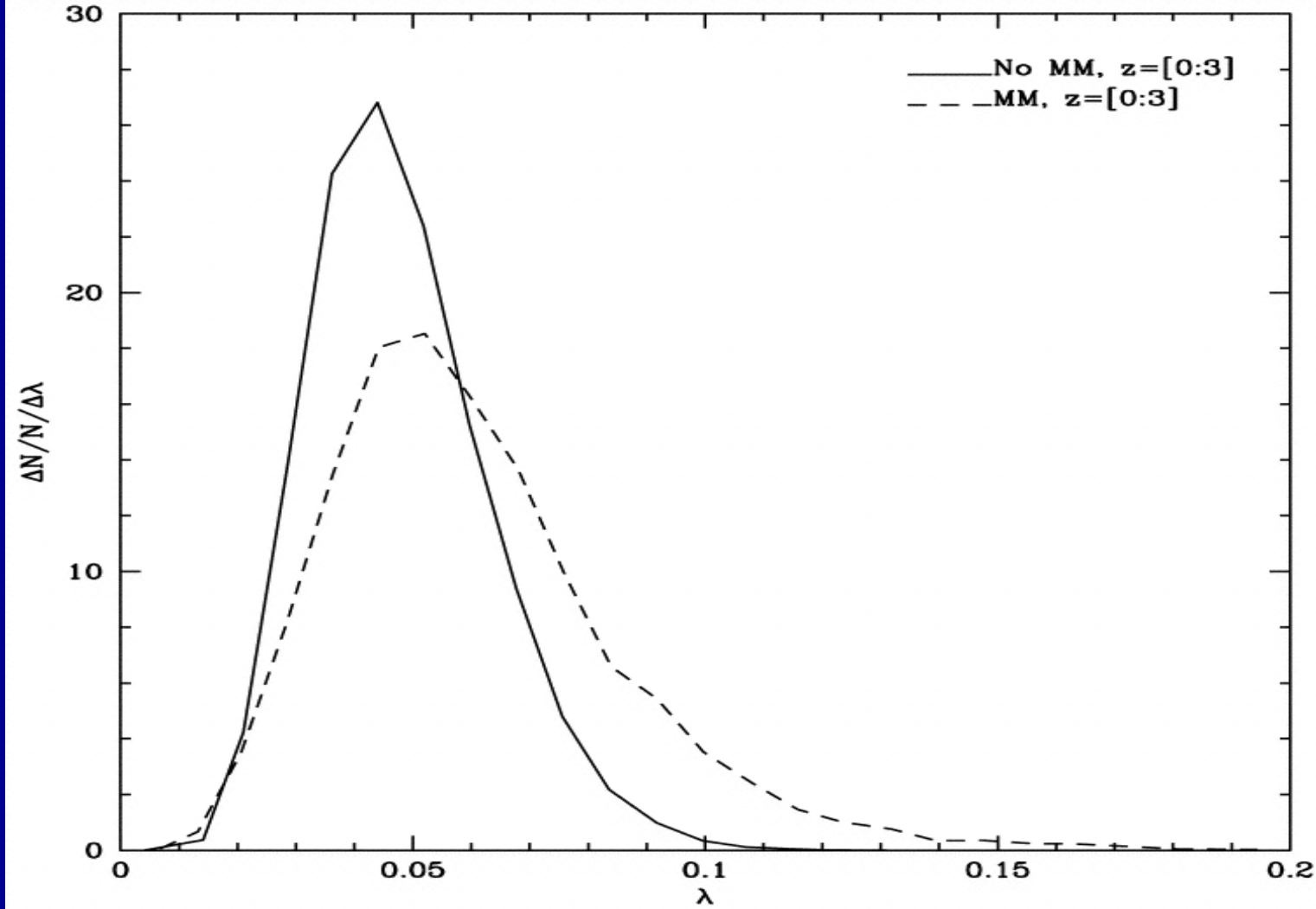
We focus on this question:



Is the halo merging history playing a role in building small disks?



What's the effect of the major merging?



Vitvitska, Klypin et al. 2002, ApJ, 581, 799

Haloes that have had recent major mergers have larger Spin values!

STRATEGY

We build up a set of CDM only simulations exploring the spin parameter of halos formed through various Merging history

For each halo:

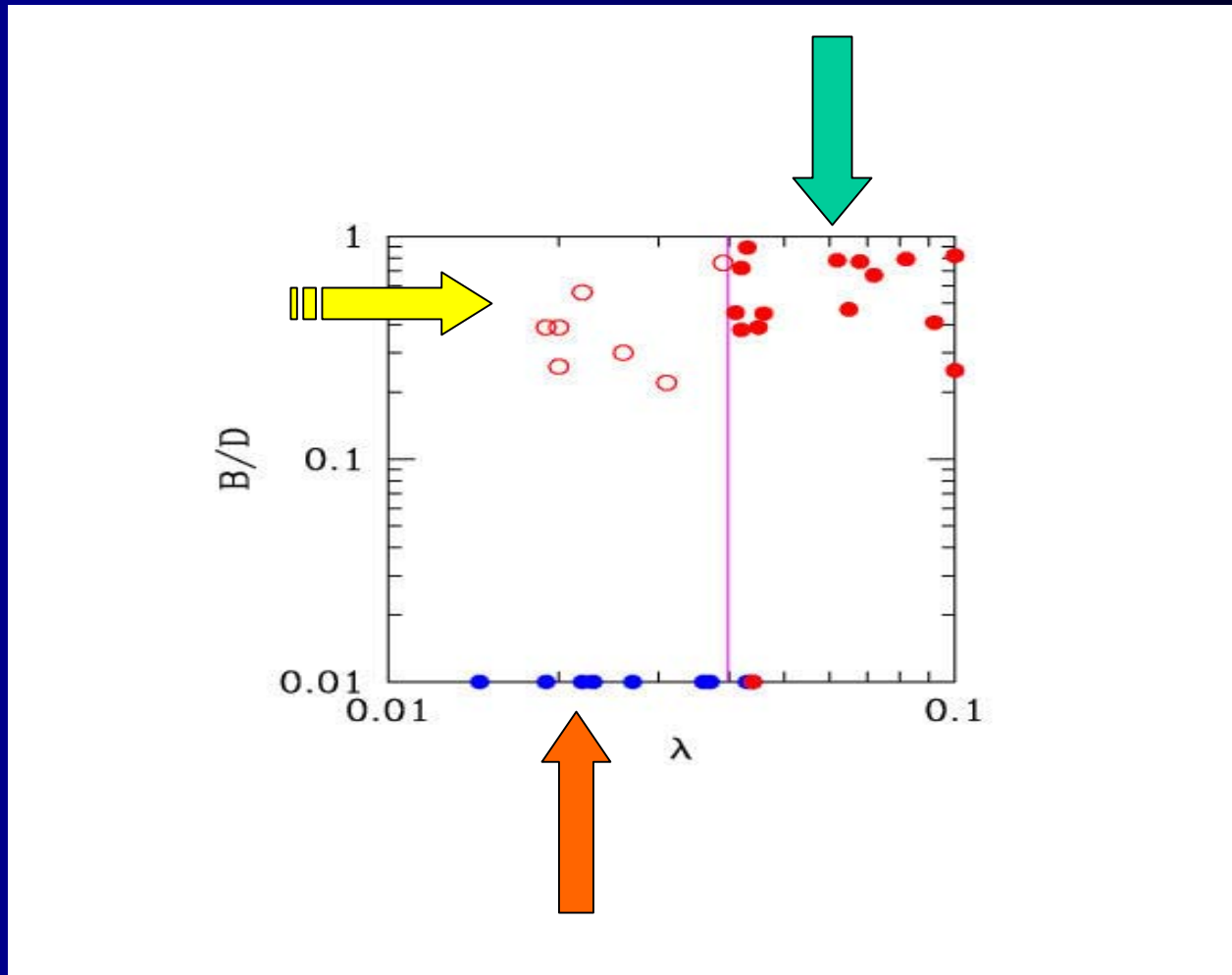
➡ We identify the last major merging

➡ Bulge/Disk

➡ Spin parameter at $z=0$



Preliminary Results



Burkert, D'Onghia, Khochfar 2003, in prep.

The Simulation

A galaxy-sized dark matter halo in low-density flat CDM Universe

$$\Omega_m = 0.3$$

$$\Omega_b = 0.019 h^{-2}$$

$$\Omega_\Lambda = 0.7$$

$$h = 0.7$$

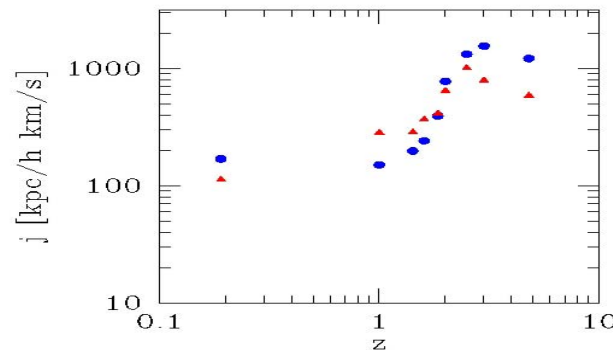
At $z=0$ the halo has:

$$V_{200} \cong 140 \text{ km / s}$$

$$M_{200} = 5.5 \cdot 10^{11} h^{-1} M_\oplus$$

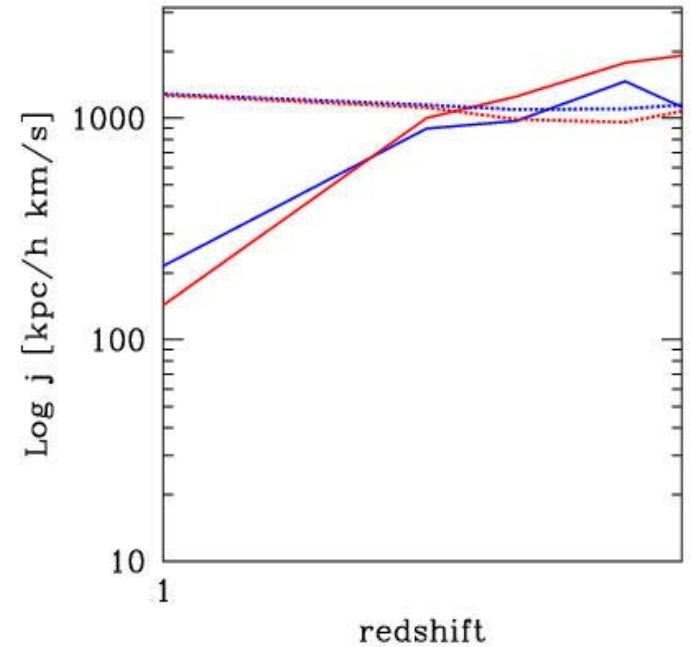
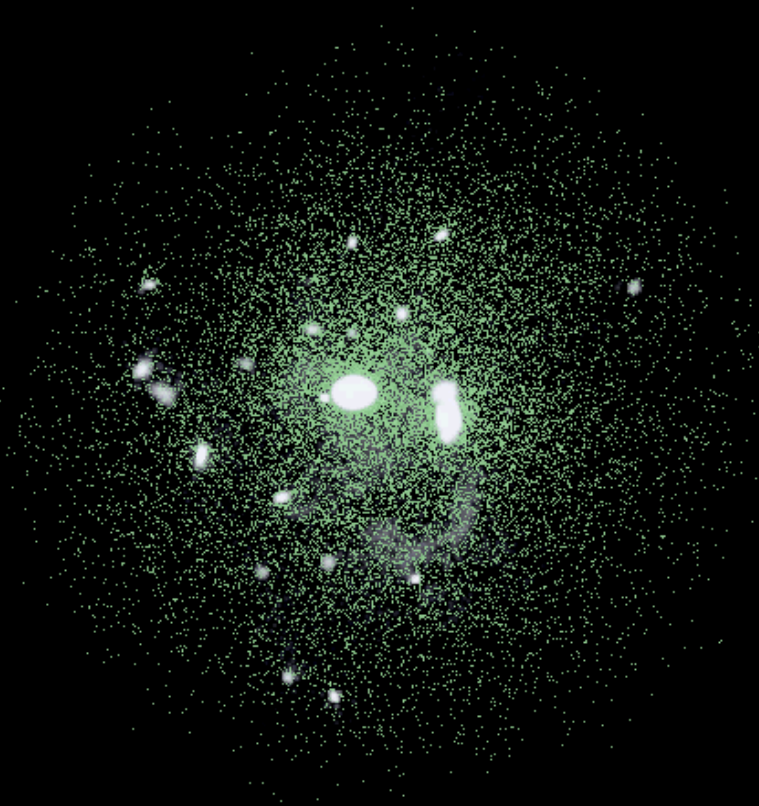
$$R_{200} = 140 h^{-1} \text{ kpc}$$

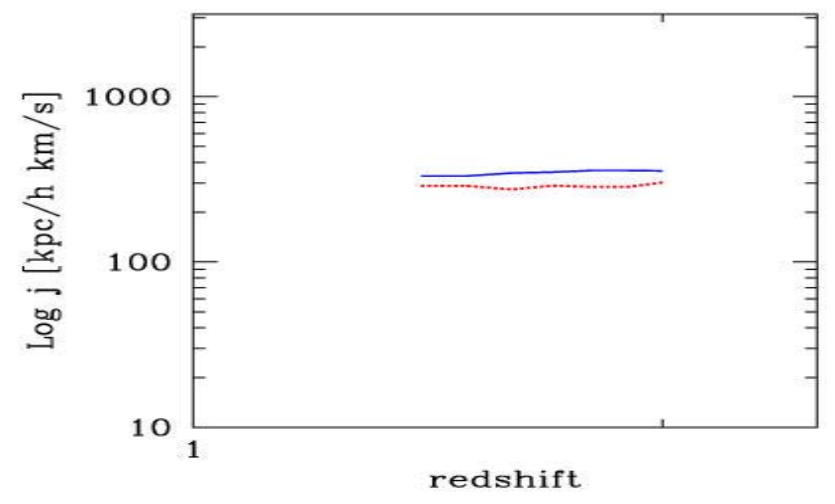
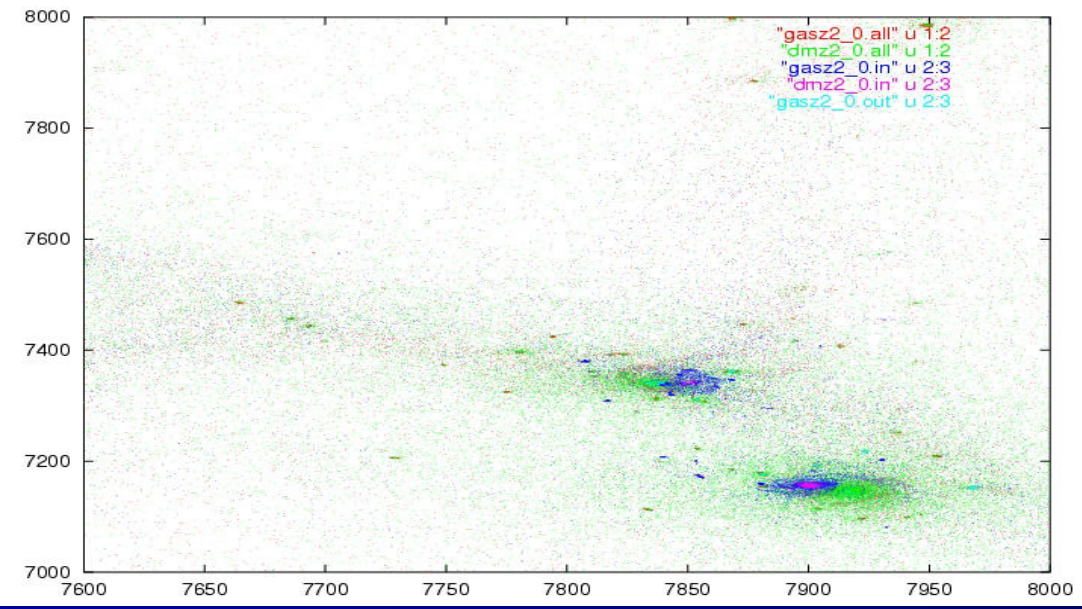
This region is identified in a cosmological simulation of a box and resimulated at higher resolution:

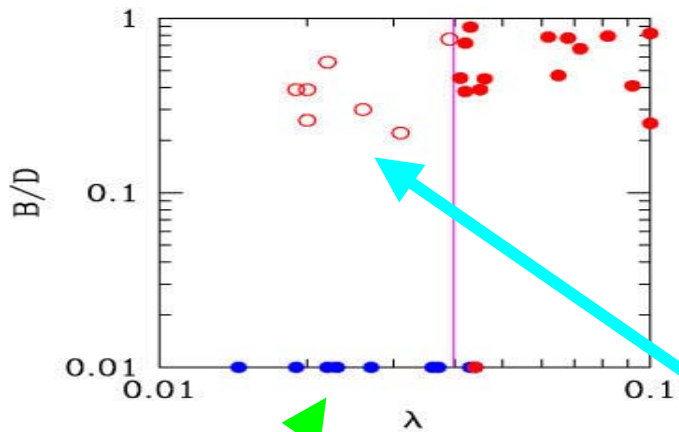


We use Gadget
Code with
Isothermal gas

**We run the isolated halo only during the major merging event
from $z=1.8$ to $z=1$**







Conclusions

High lambda \rightarrow major Mergers \rightarrow difficult to Form disks

Intermediate Objects similar difficulties

No major mergers \rightarrow ok to form disks \rightarrow but lambda too small!