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Disk Galaxies in Cosmological Simulations:
First results on the dynamics of extended gas disks

Rhea-Silvia Remus

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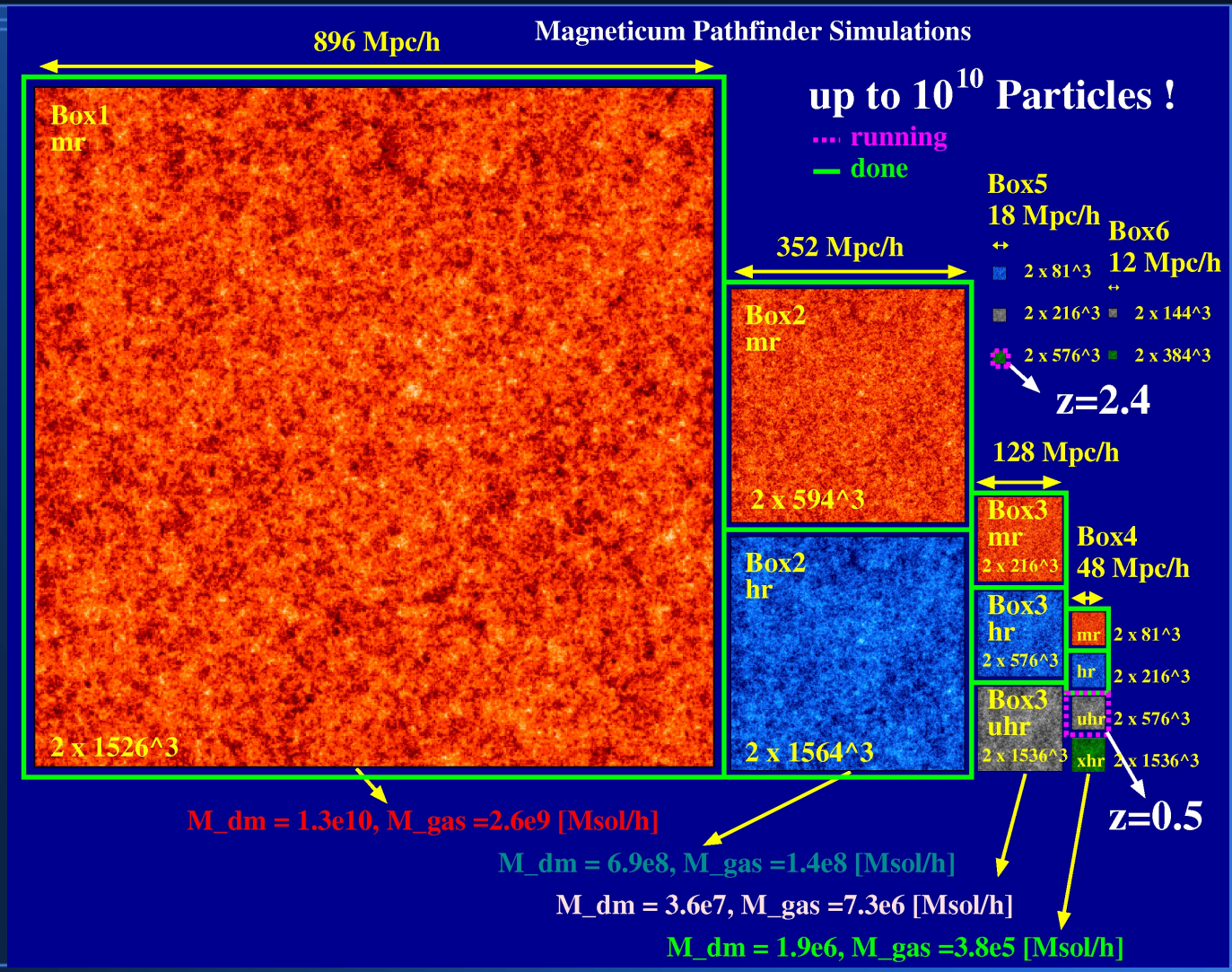
PHISCC 2014

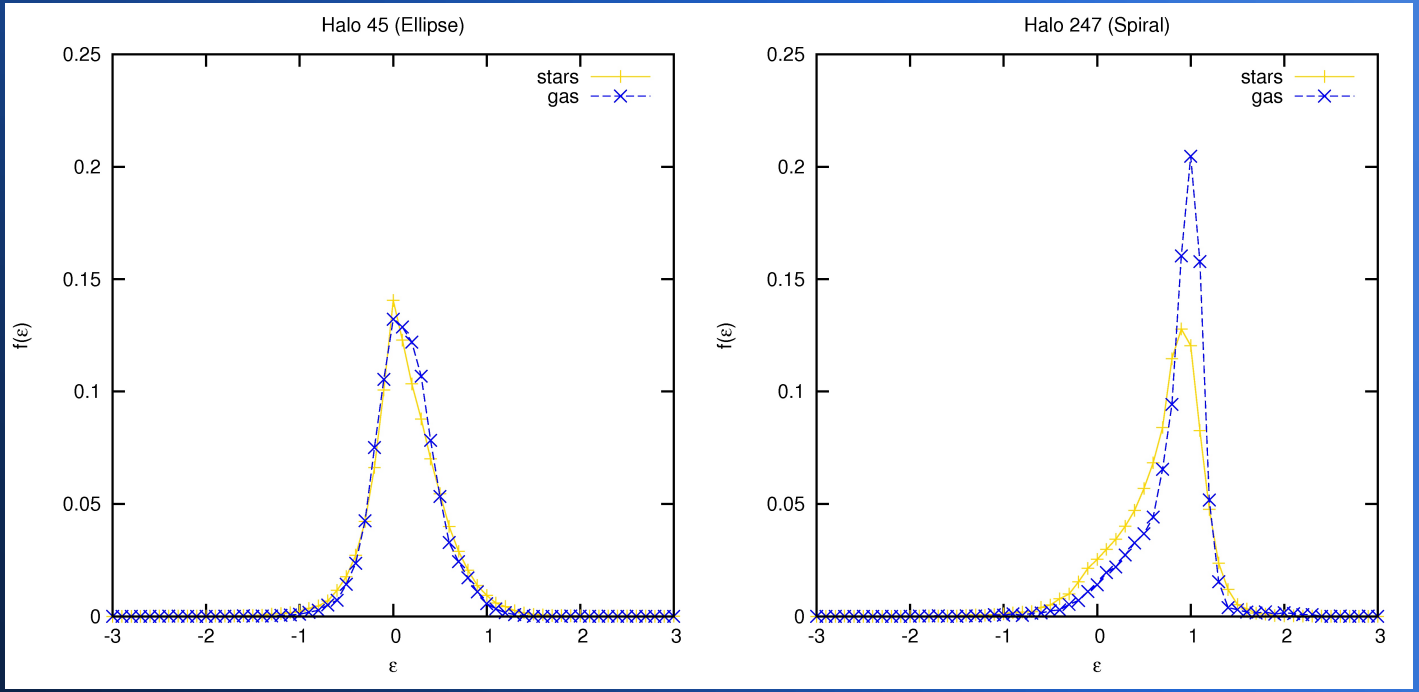
Magneticum

Biffi et al 2013,
Hirschmann et al 2013,
Remus et al 2013,
Planck IR V 2013



Identifying Spirals
- the circularity -

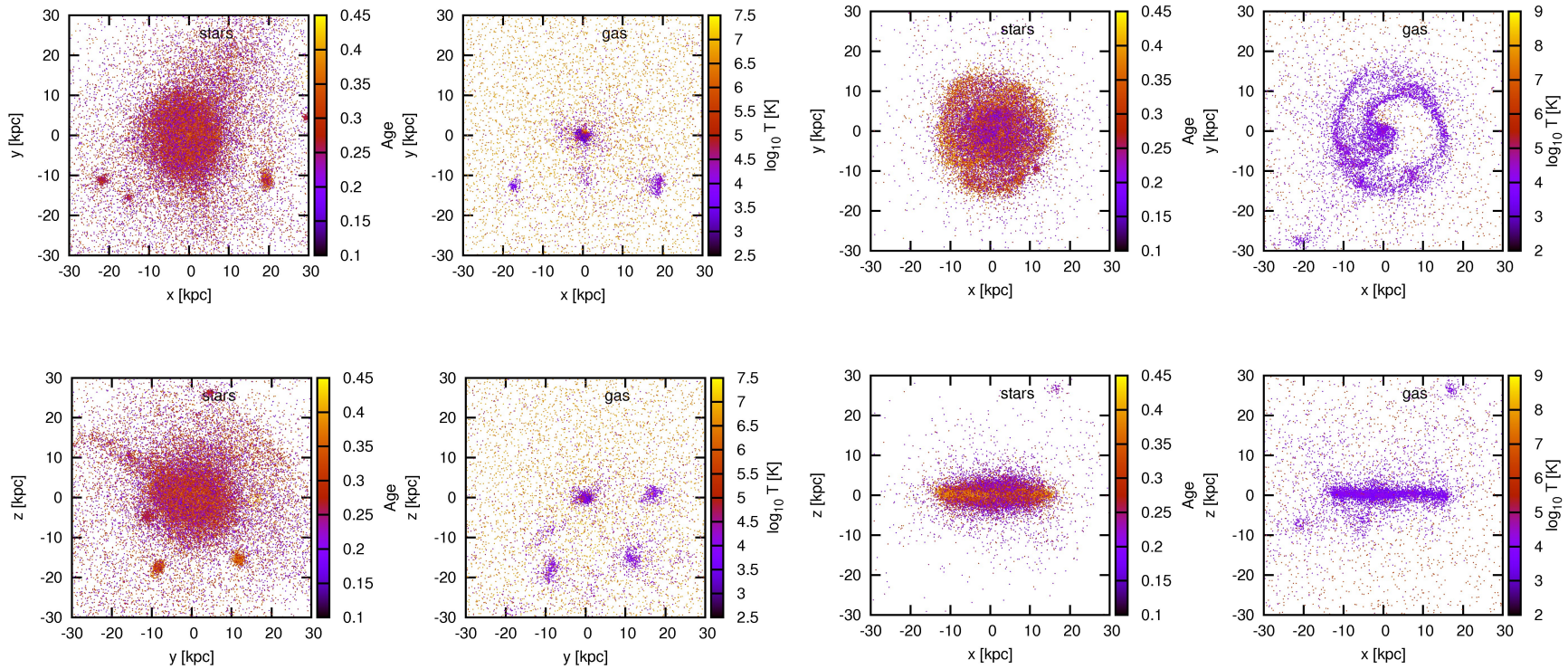
$$\epsilon = \frac{j_z}{j_{circ}}$$



$$\epsilon = 1 \Rightarrow Circular\ Orbits$$
$$\epsilon = 0 \Rightarrow Random\ Orbits$$

Adelheid Teklu
Lisa Bachmann

Identifying Spirals
- the circularity -



$\epsilon = 1 \Rightarrow$ *Circular Orbits*

$\epsilon = 0 \Rightarrow$ *Random Orbits*

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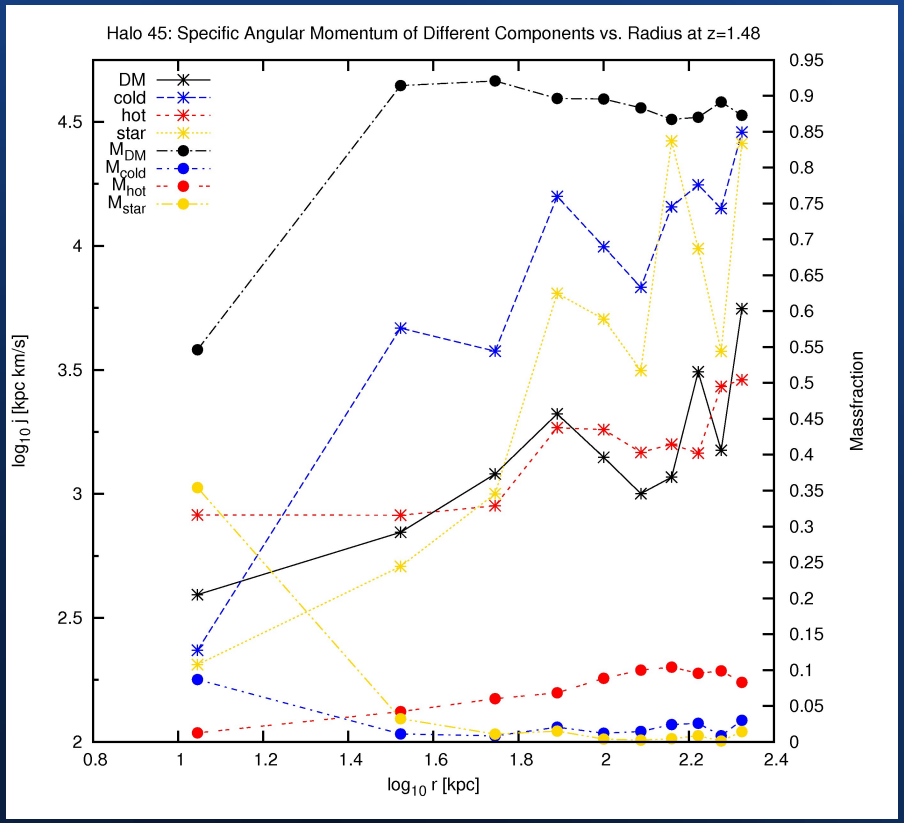
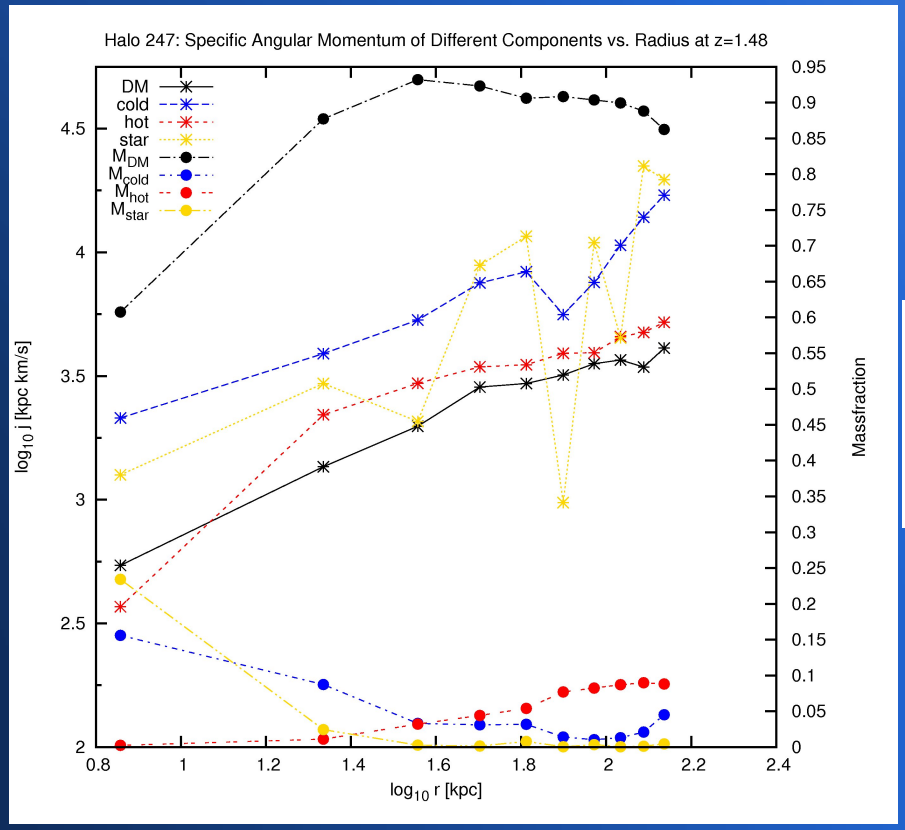
Lisa Bachmann

Specific Angular Momentum

Elliptical



Spiral



$$j = \frac{\vec{J}}{M}$$

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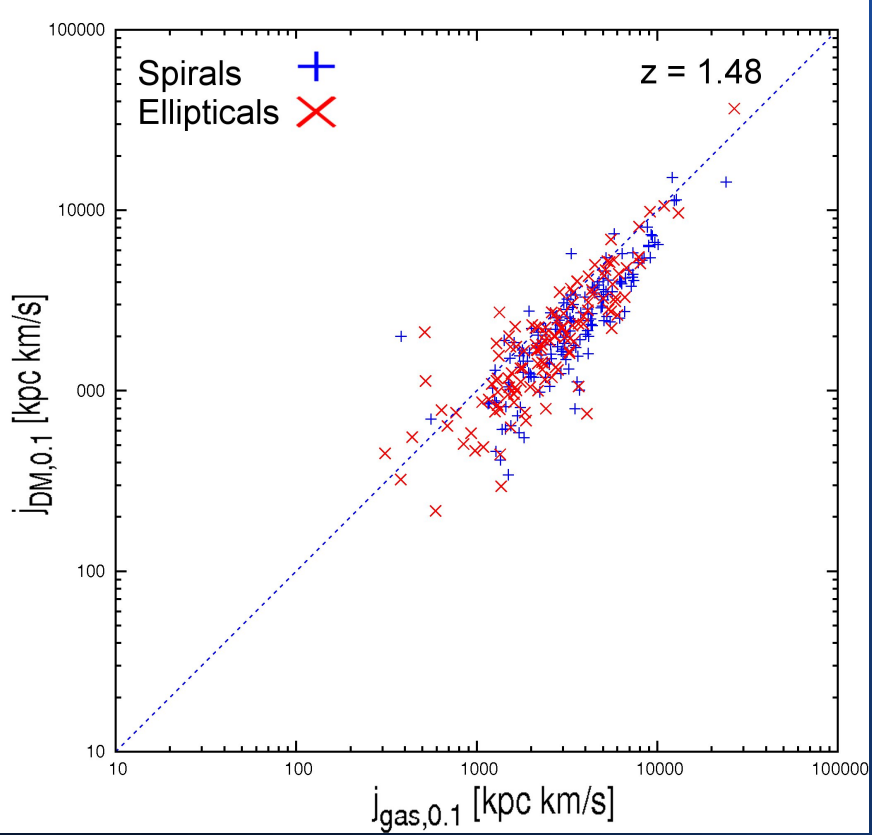
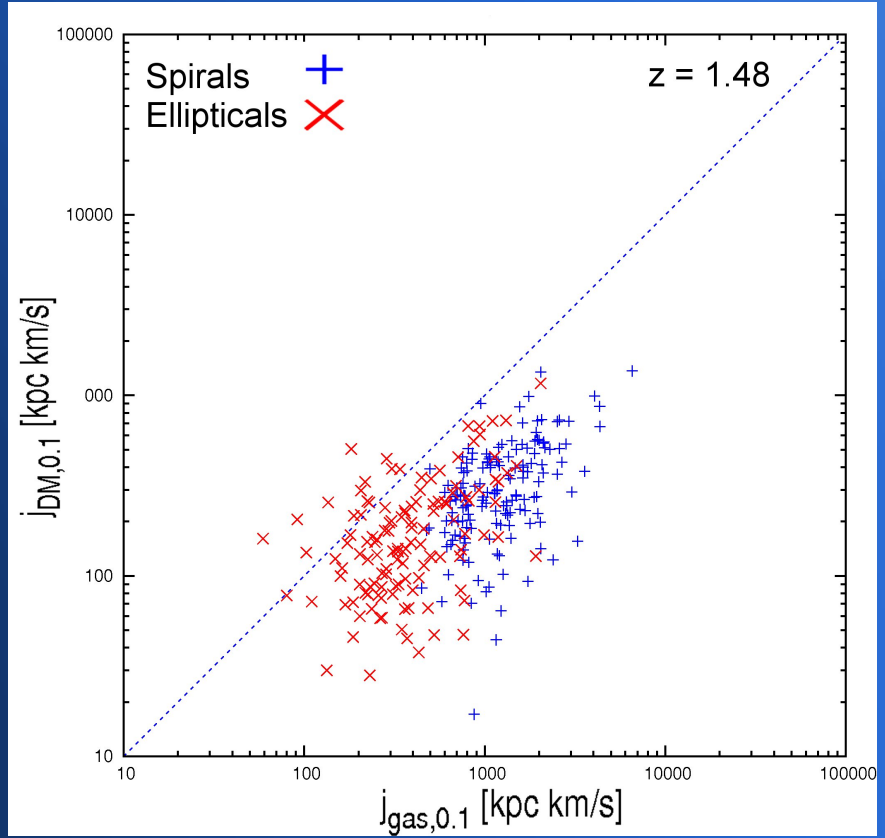
Specific Angular Momentum

Within the virial radius



Within 10% of the virial radius



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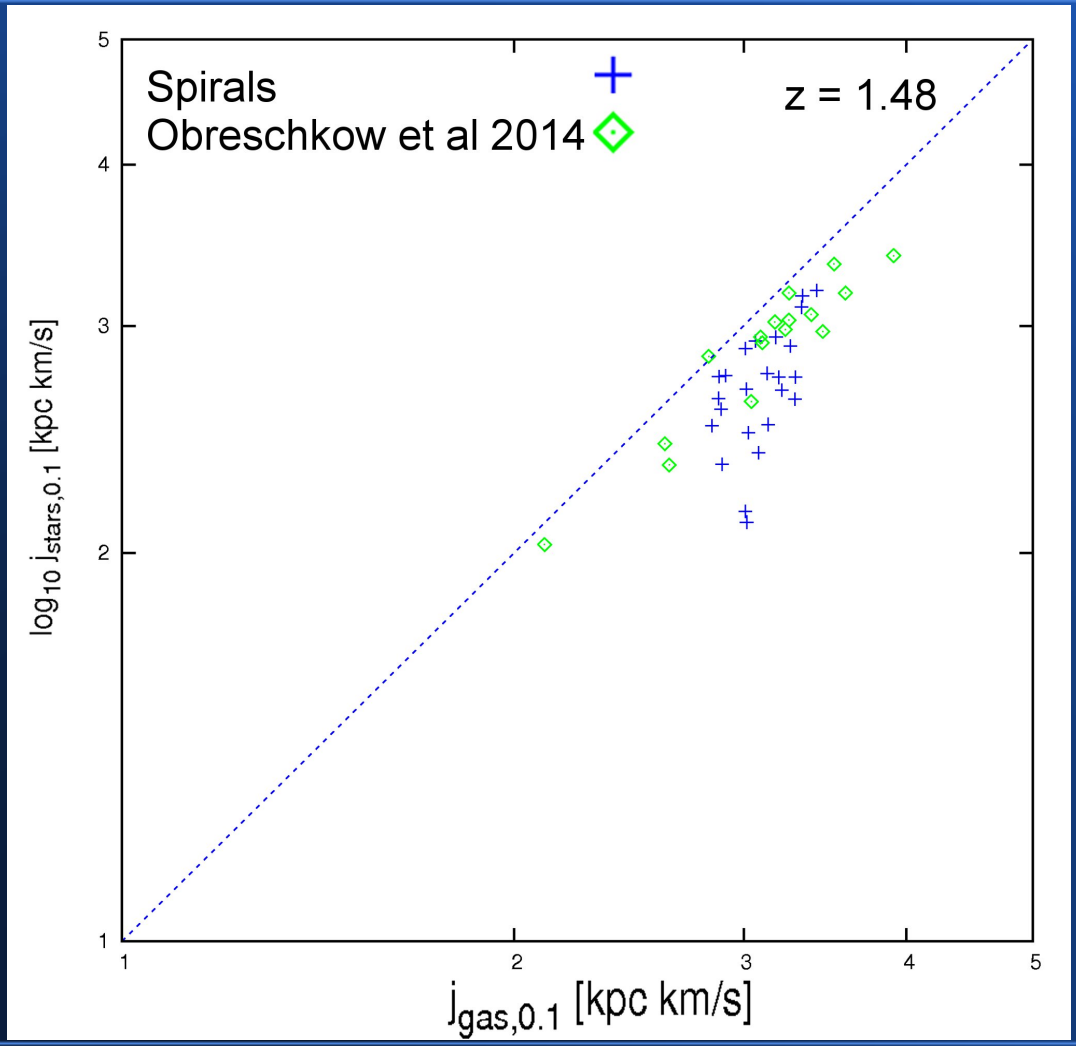
Specific Angular Momentum



Comparison with Observations by Obreschkow & Glazebrook 2014

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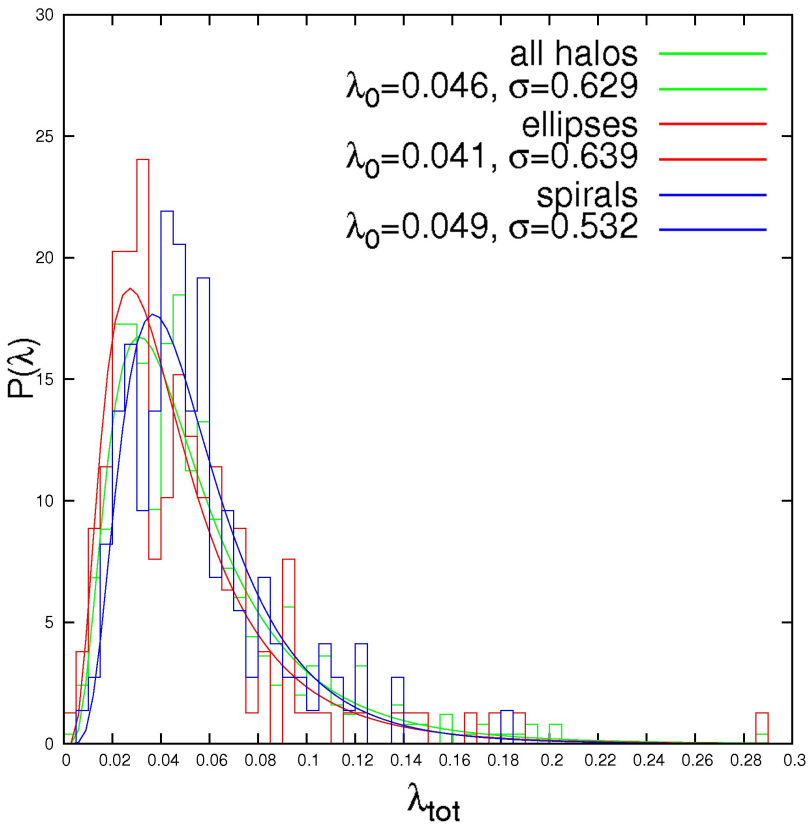
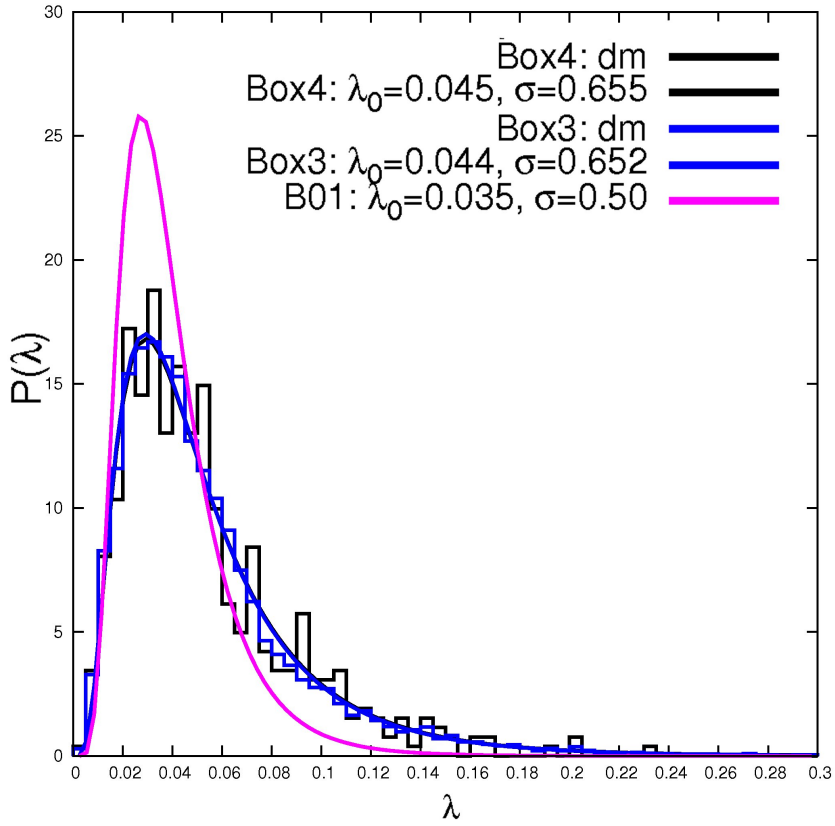
Spin Parameter





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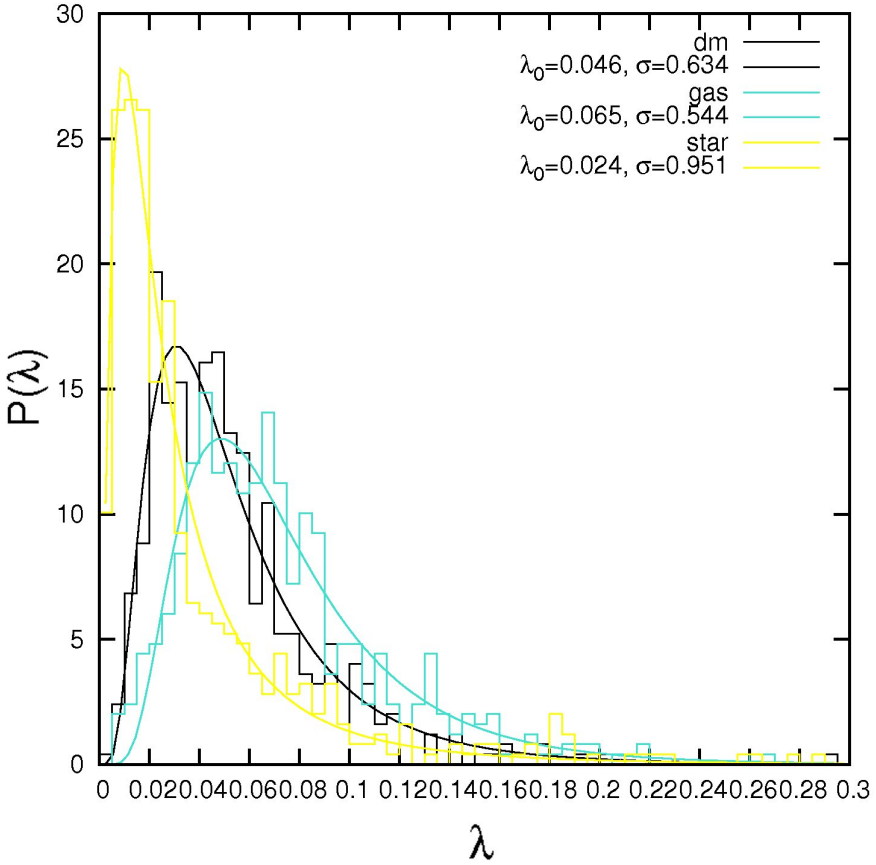
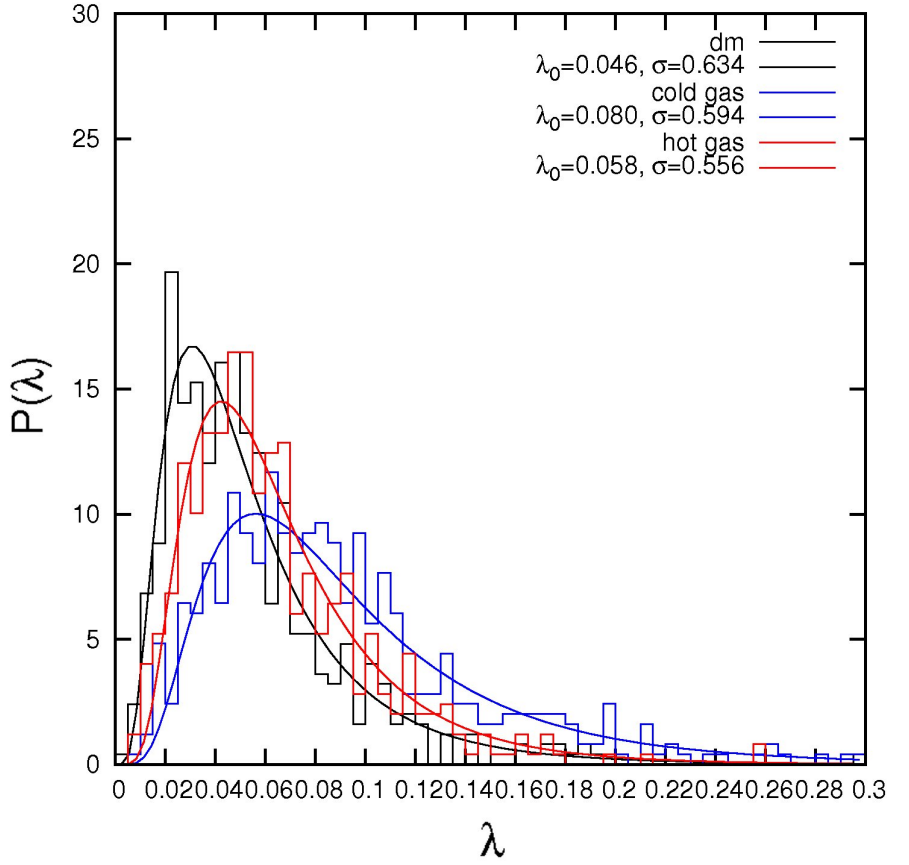
$$\lambda = \frac{J \mid E \mid^{1/2}}{GM^{5/2}}$$

Mo, Mao & White 1998, Bullock et al 2001, Sharma &Steinmetz 2005

Spin parameter





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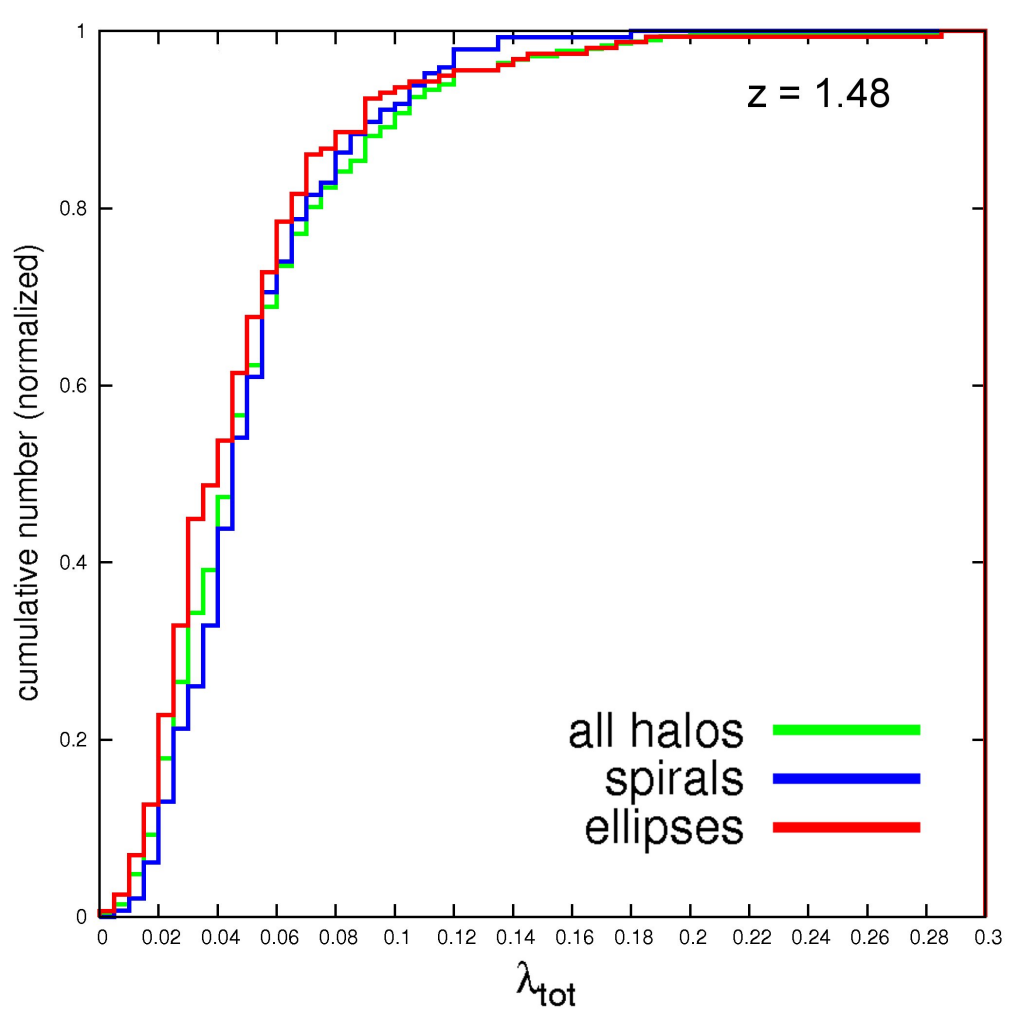
Mo, Mao & White 1998, Bullock et al 2001, Sharma &Steinmetz 2005

Spin parameter



The halos with the highest total angular momentum are actually NOT spirals!

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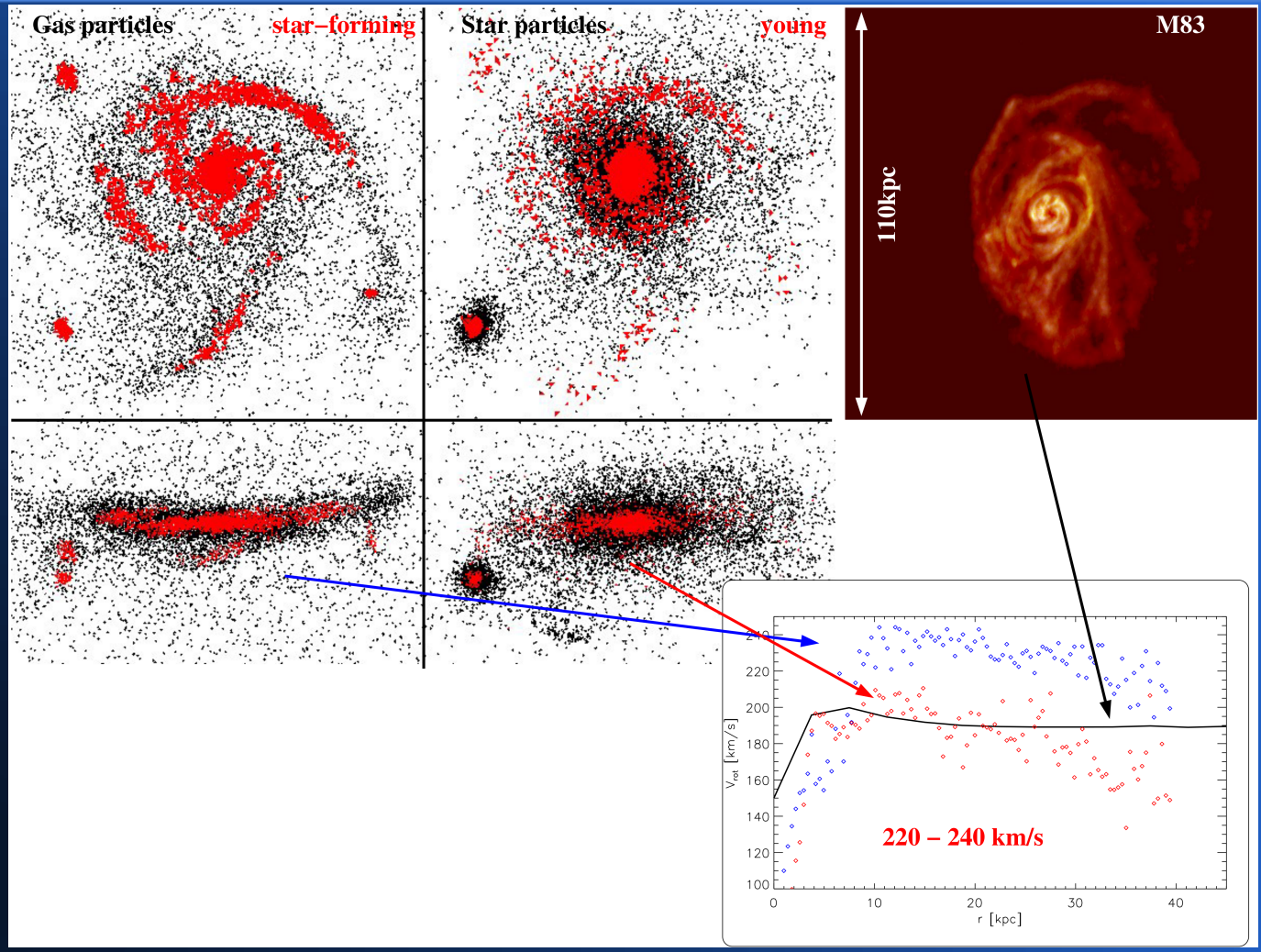
Rotation curves



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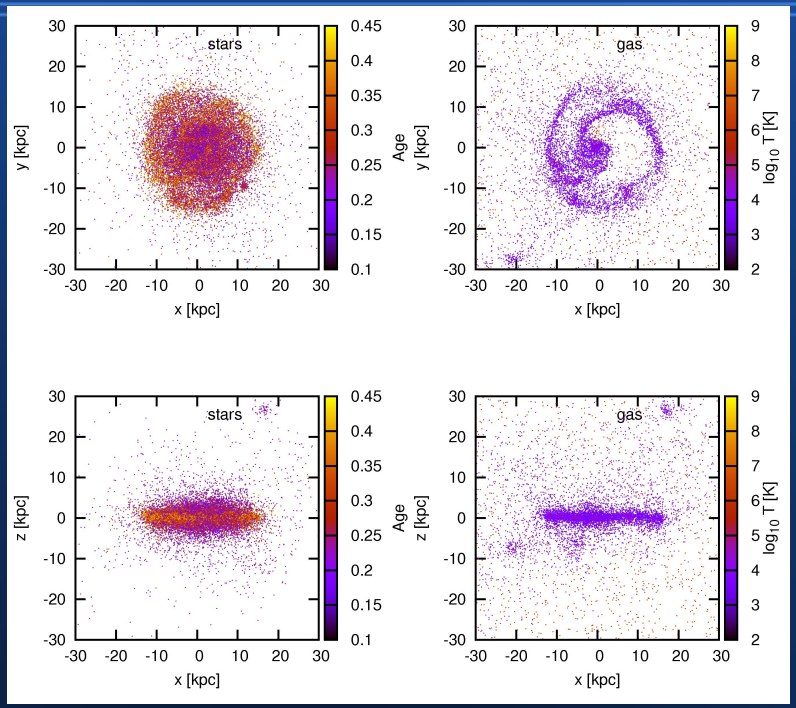
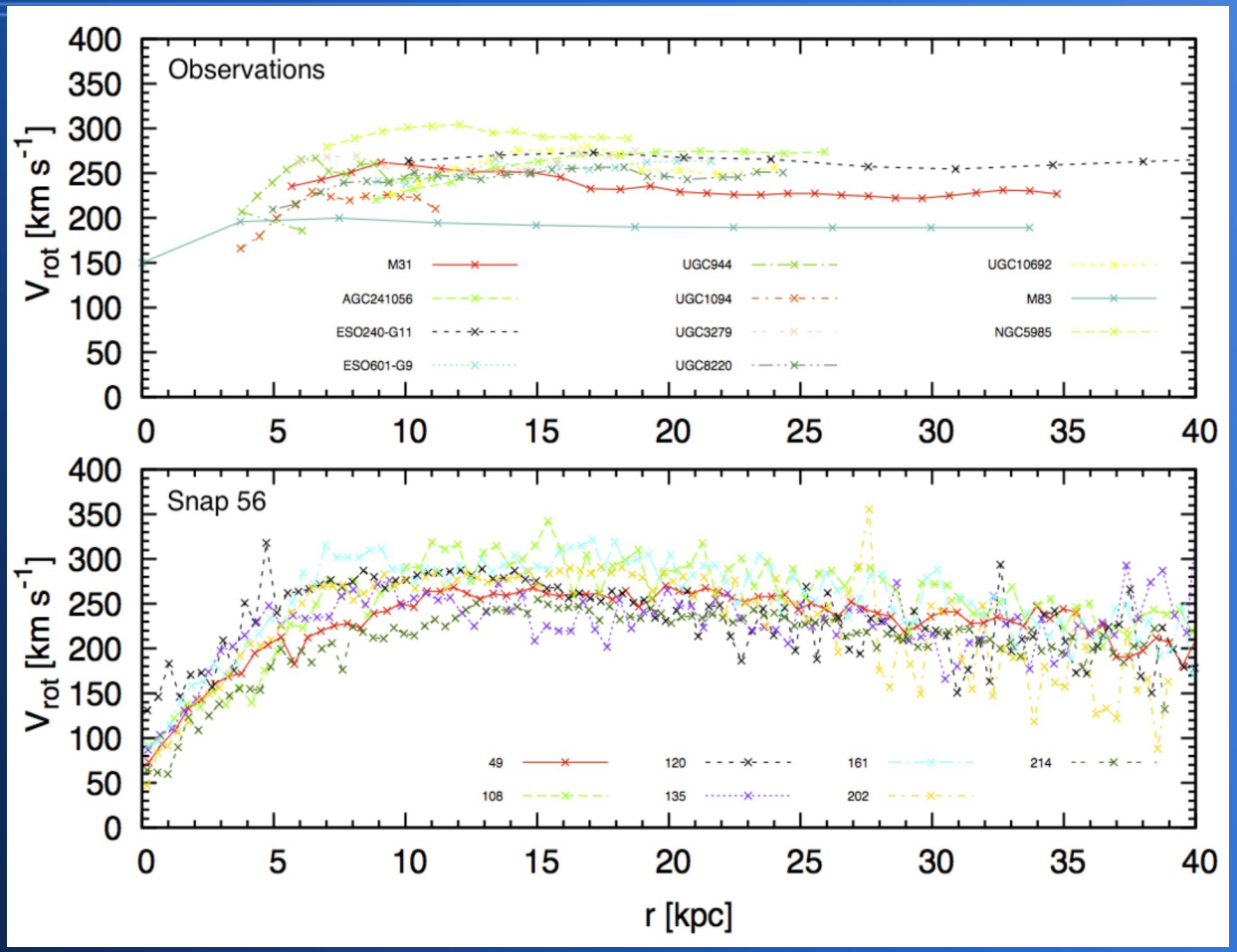
M82 data thanks to Bärbel Koribalski

Rotation curves





Observations from Yegorova et al 2011

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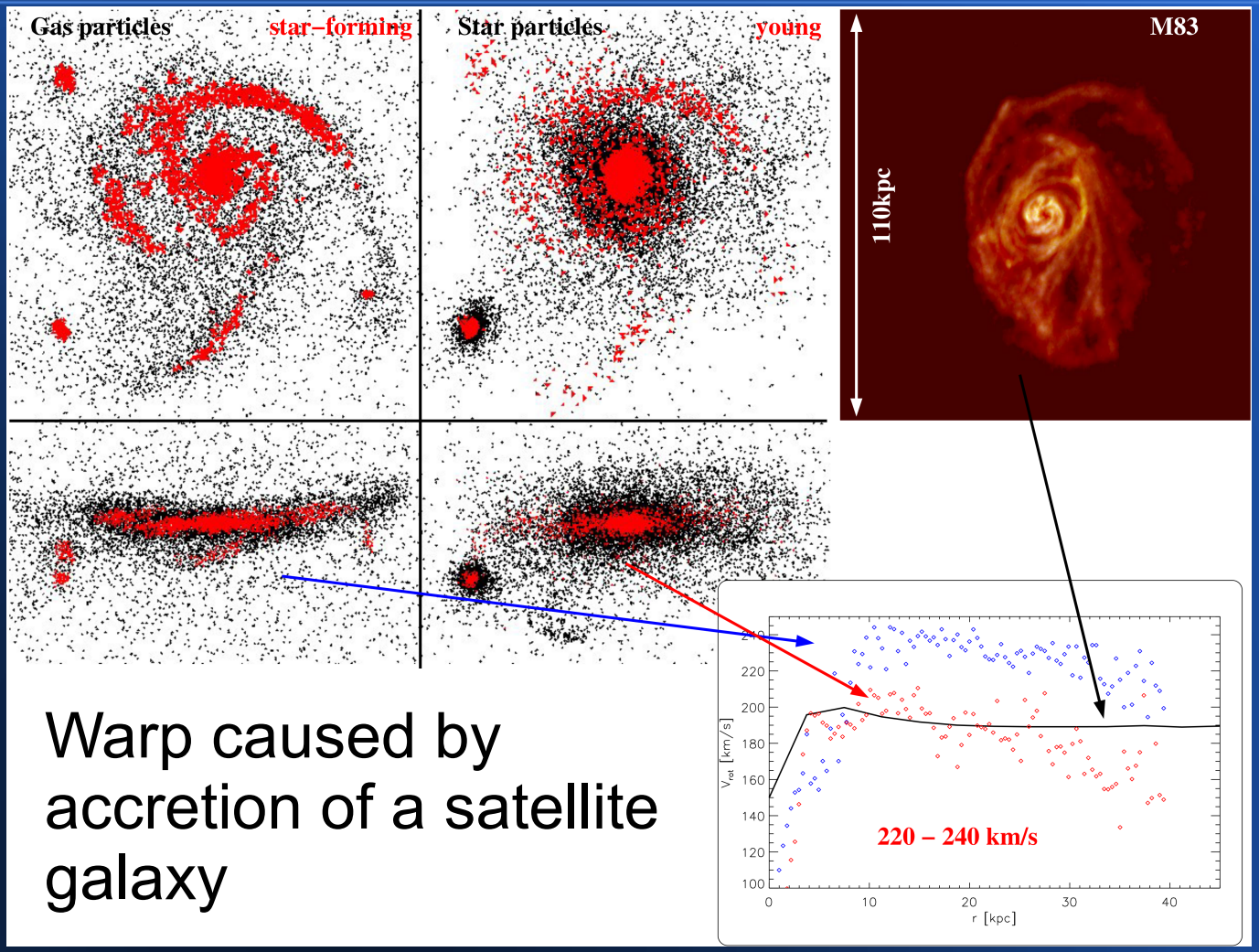
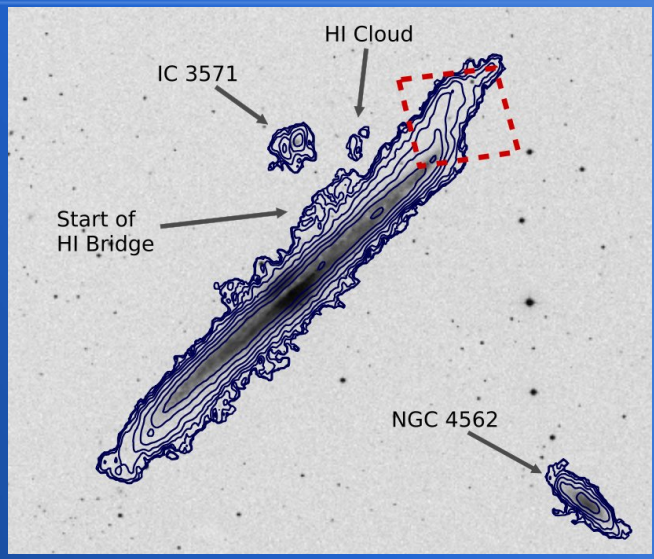
Warped Disks



Warp caused by accretion of a satellite galaxy

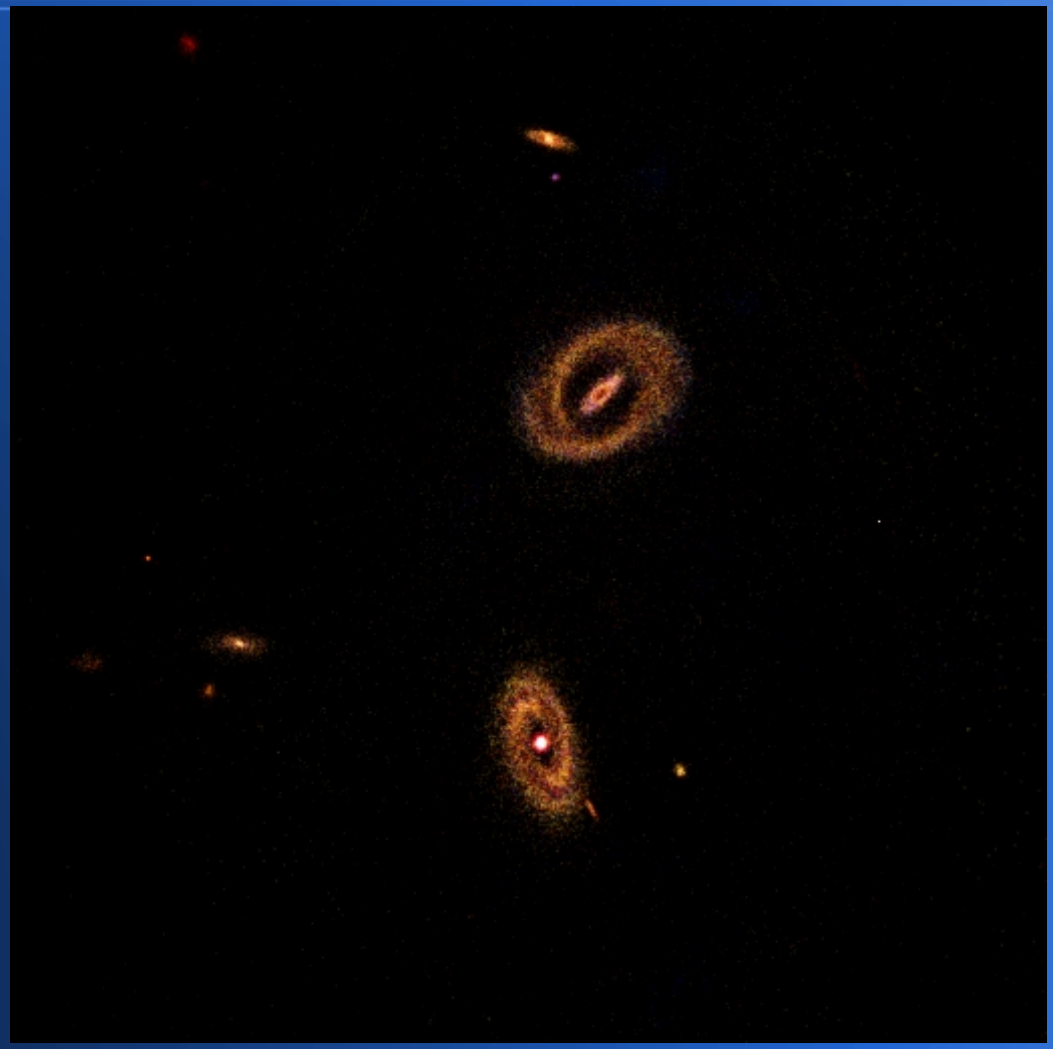


Radburn-Smith et al 2013: NGC 4565 HI-disk warp

But: see Haan & Braun 2014

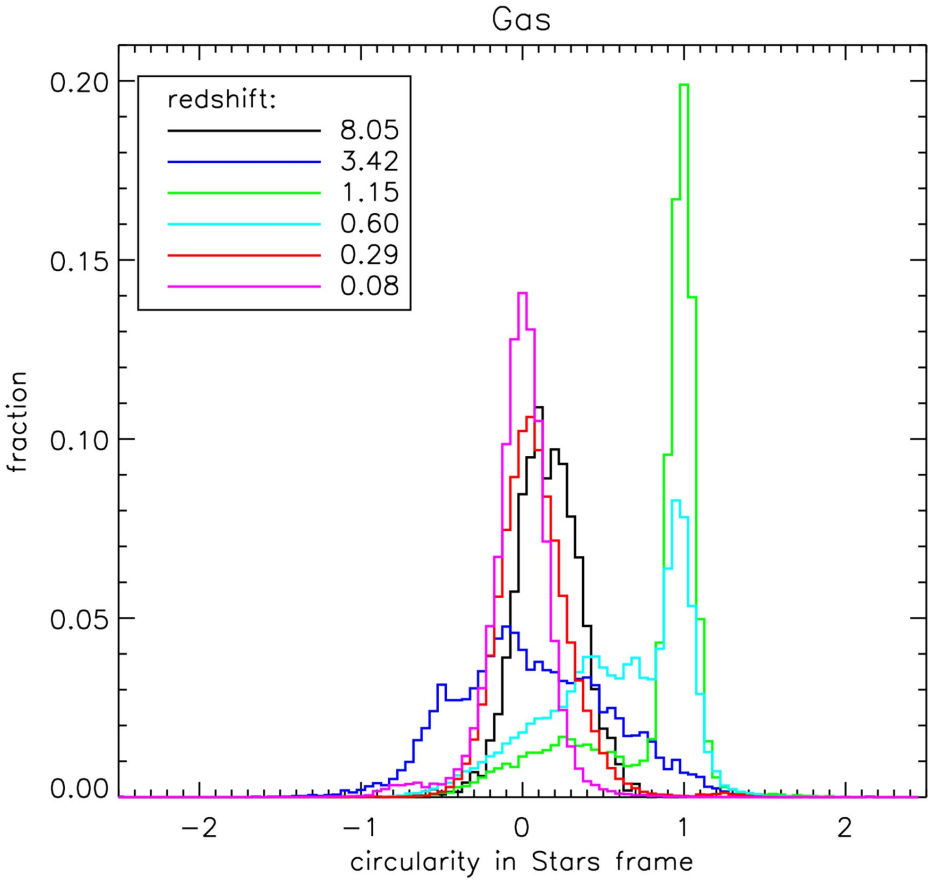
Re-Simulations
- higher resolution -

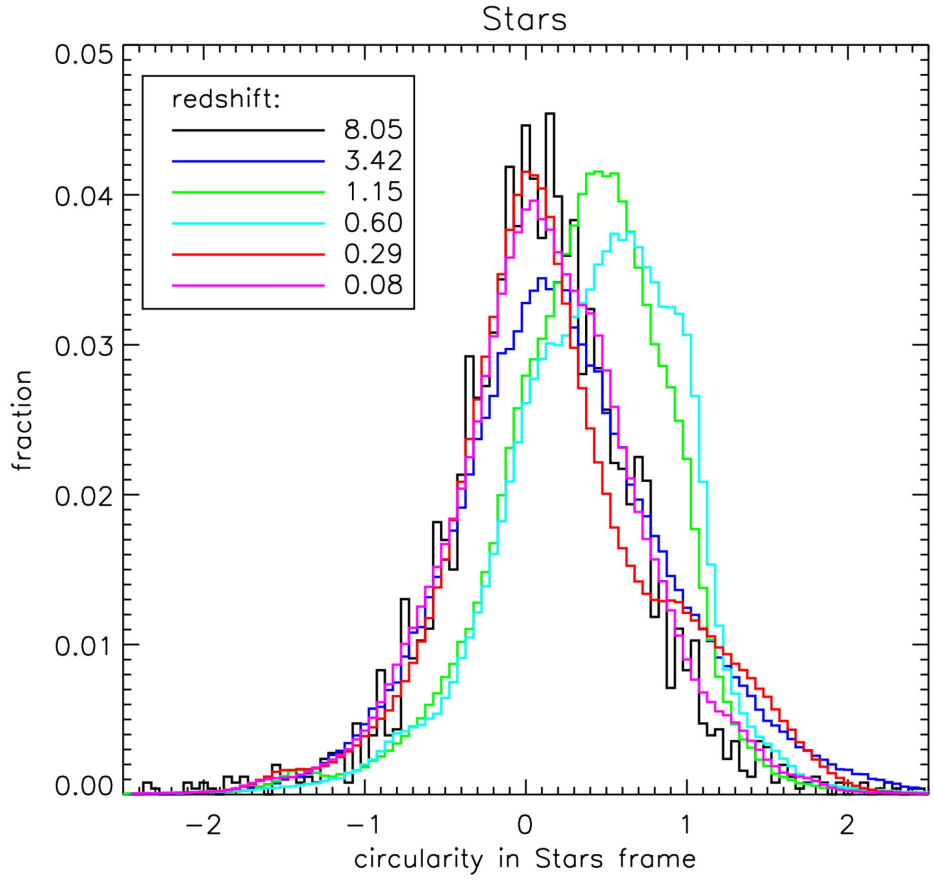
Snapshot at z=0.6;
Shown are stars formed between 1<z<0.6
Colors code the age of the stars, with red stars formed at z=1 and yellow stars formed in this snapshot of the simulation



David Schlachtberger

Re-Simulations
- Epsilon – Parameter -





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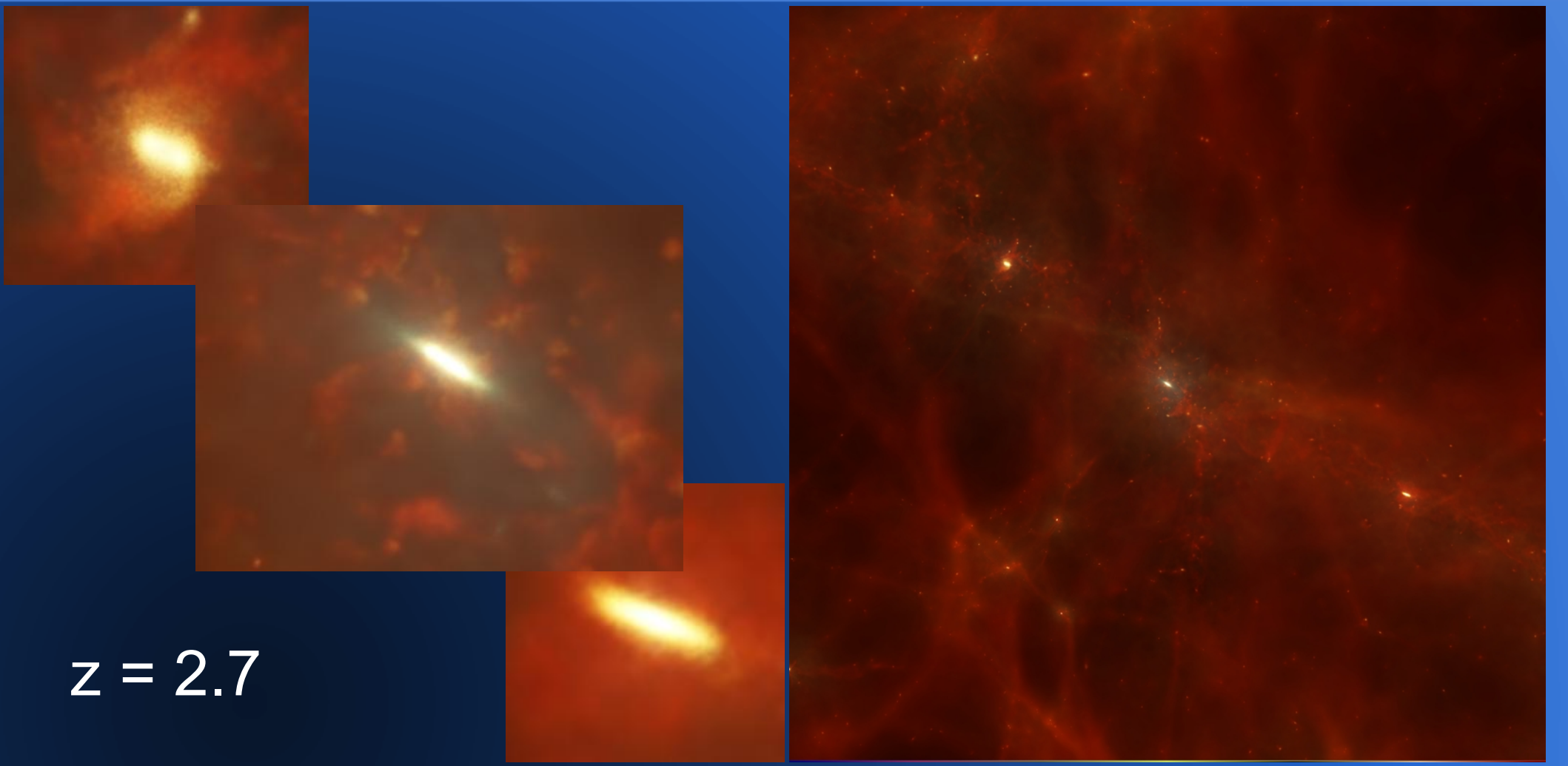
Box 5 xhr
- even higher resolution -



z = 2.7

For the Future...

- Specific angular momentum and angular momentum transport by the gas
- (Statistic) analysis of spiral galaxy parameters: scale height, size, star formation regions
- Origin of warped disks: is minor merger accretion the answer?
- Spiral galaxy evolution: origin of the disk, stability
- Where does the gas come from? Main mechanisms for feeding gas disks