Satellites around the Milky Way

Semi-analytic models of galaxy formation

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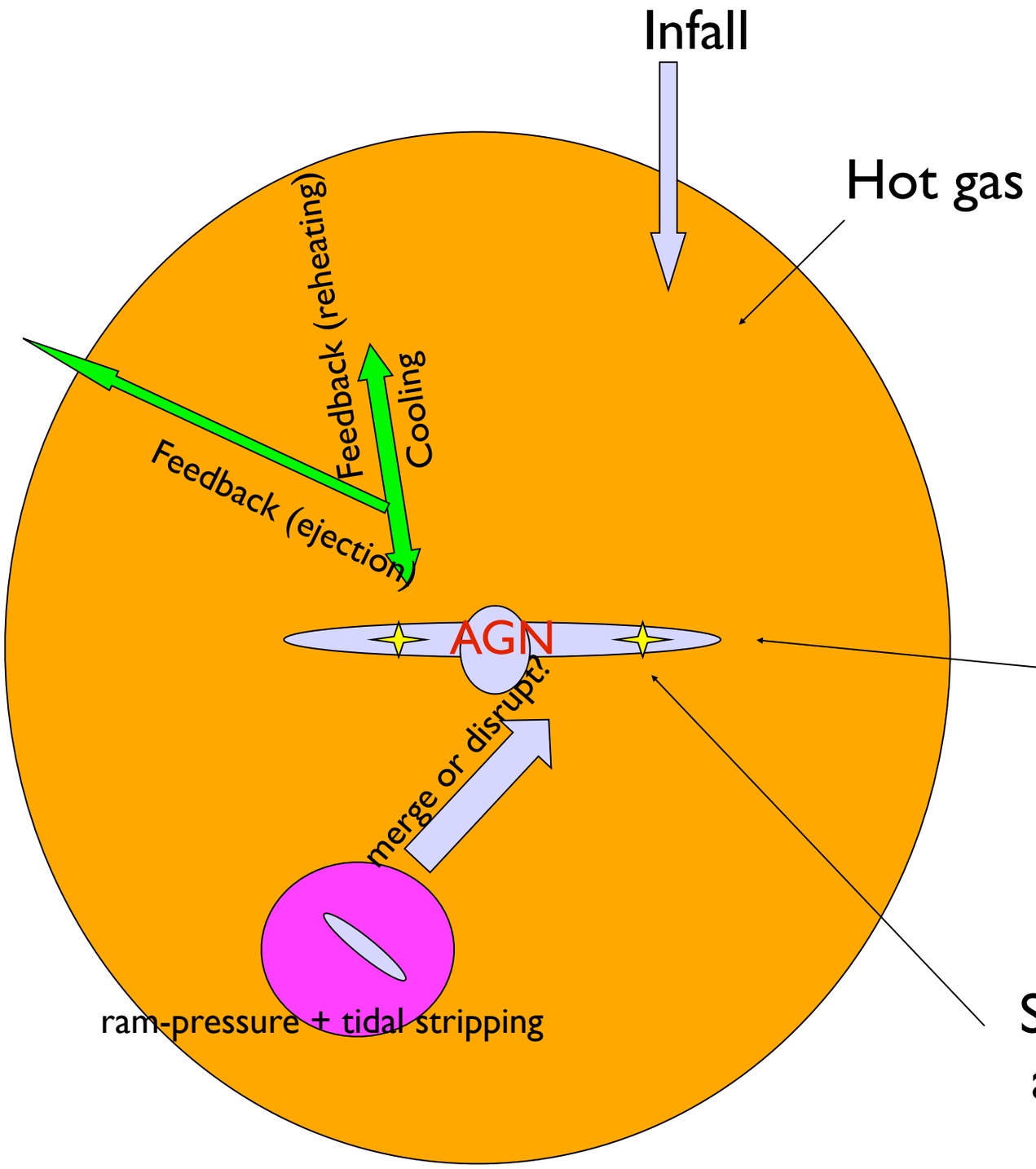
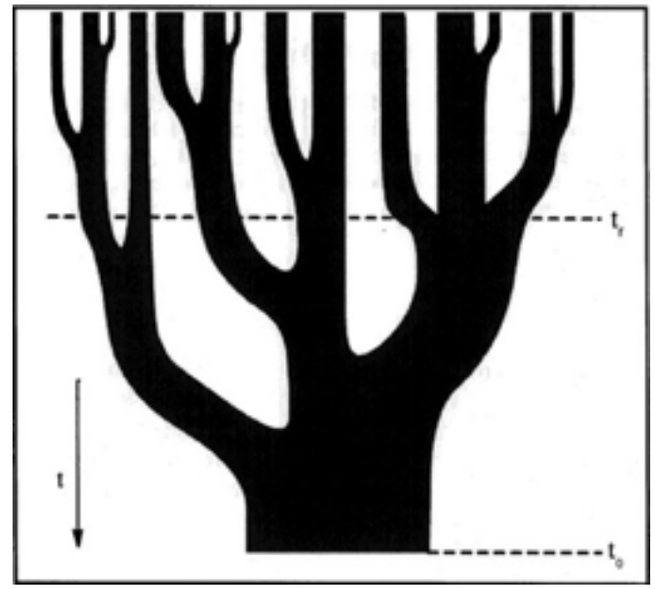
Semi-analytic models of galaxy formation

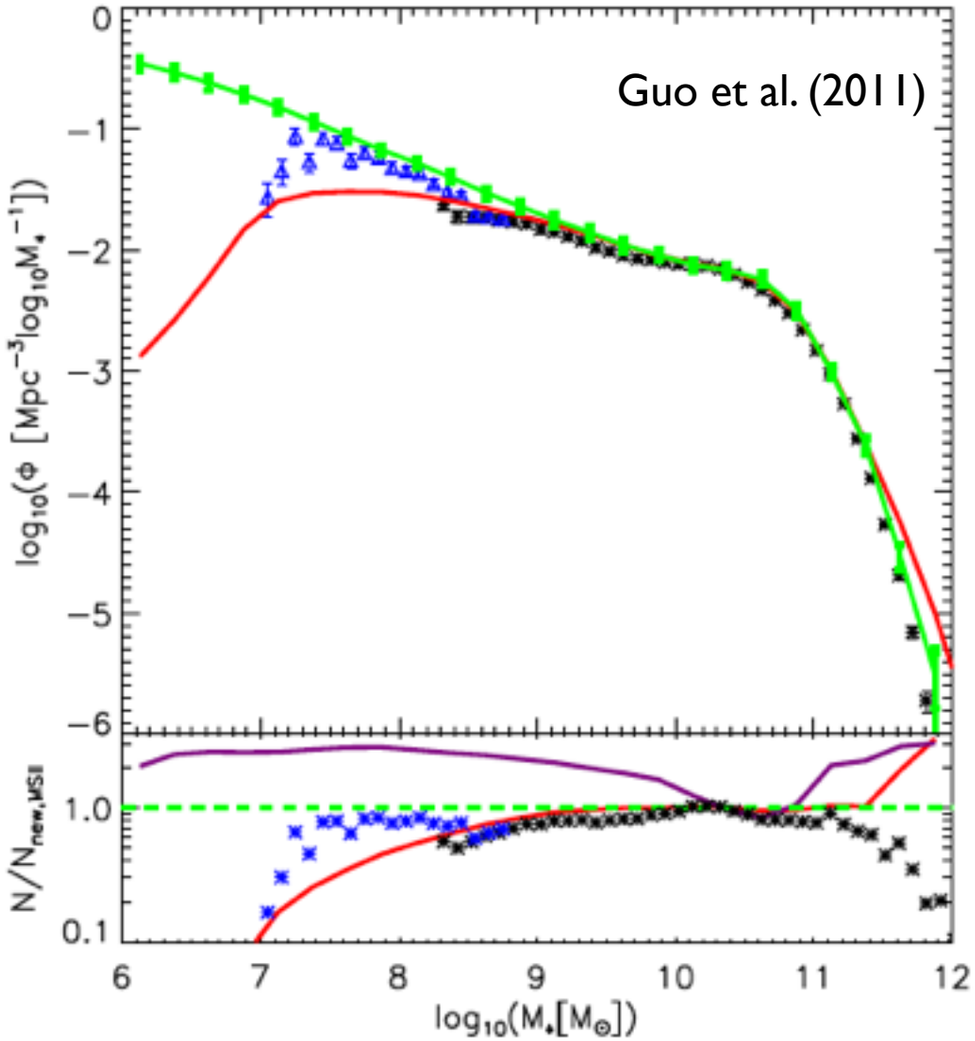




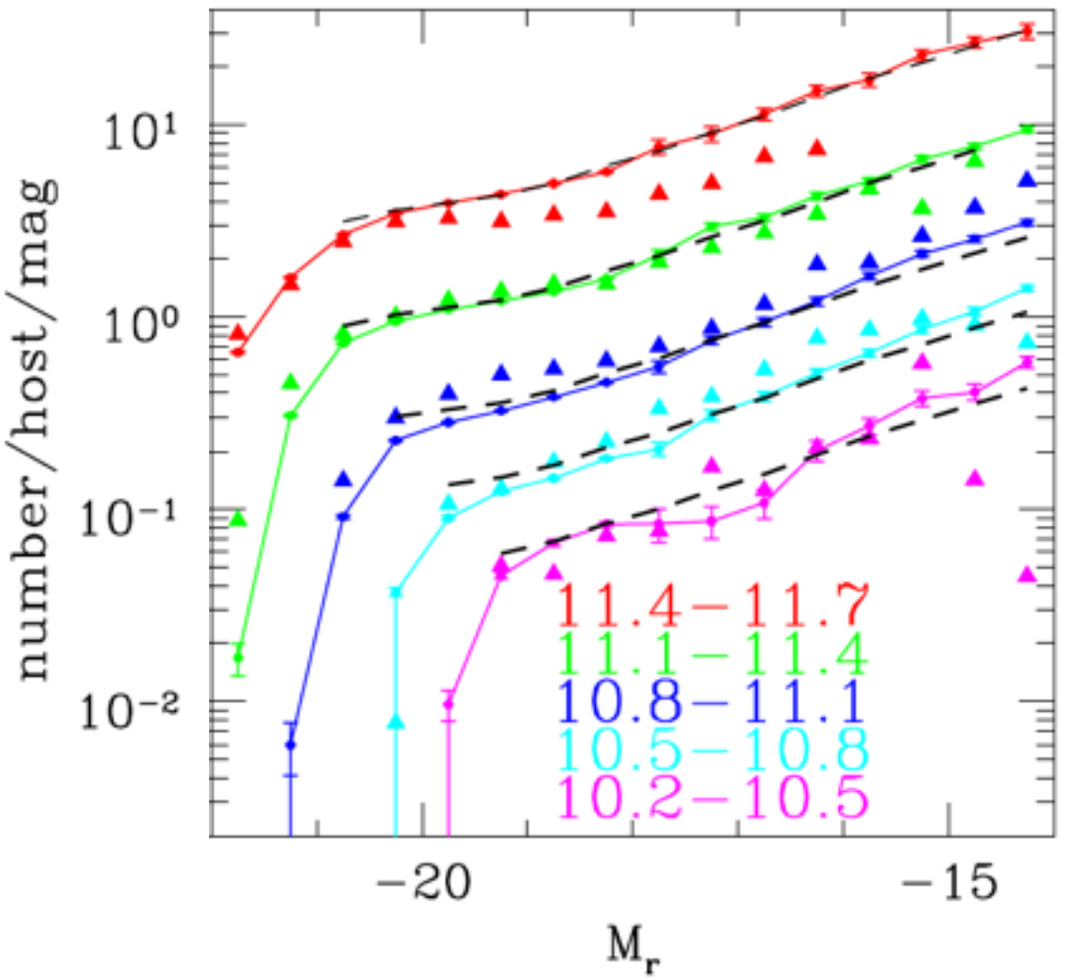
disk formation

Star formation
and evolution

Global stellar mass functions



Satellite abundance around bright galaxies

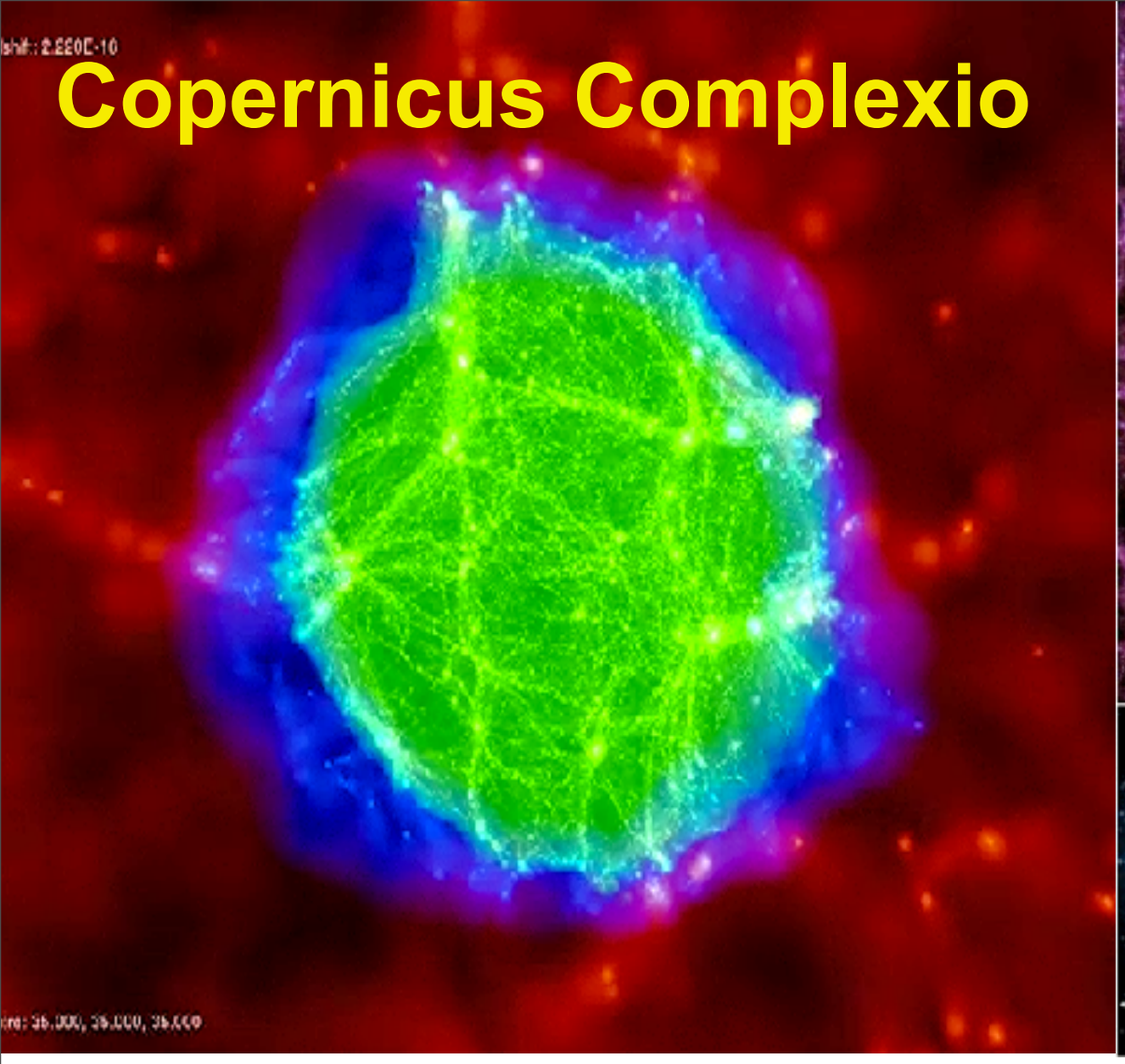


Wang et al. (2012)

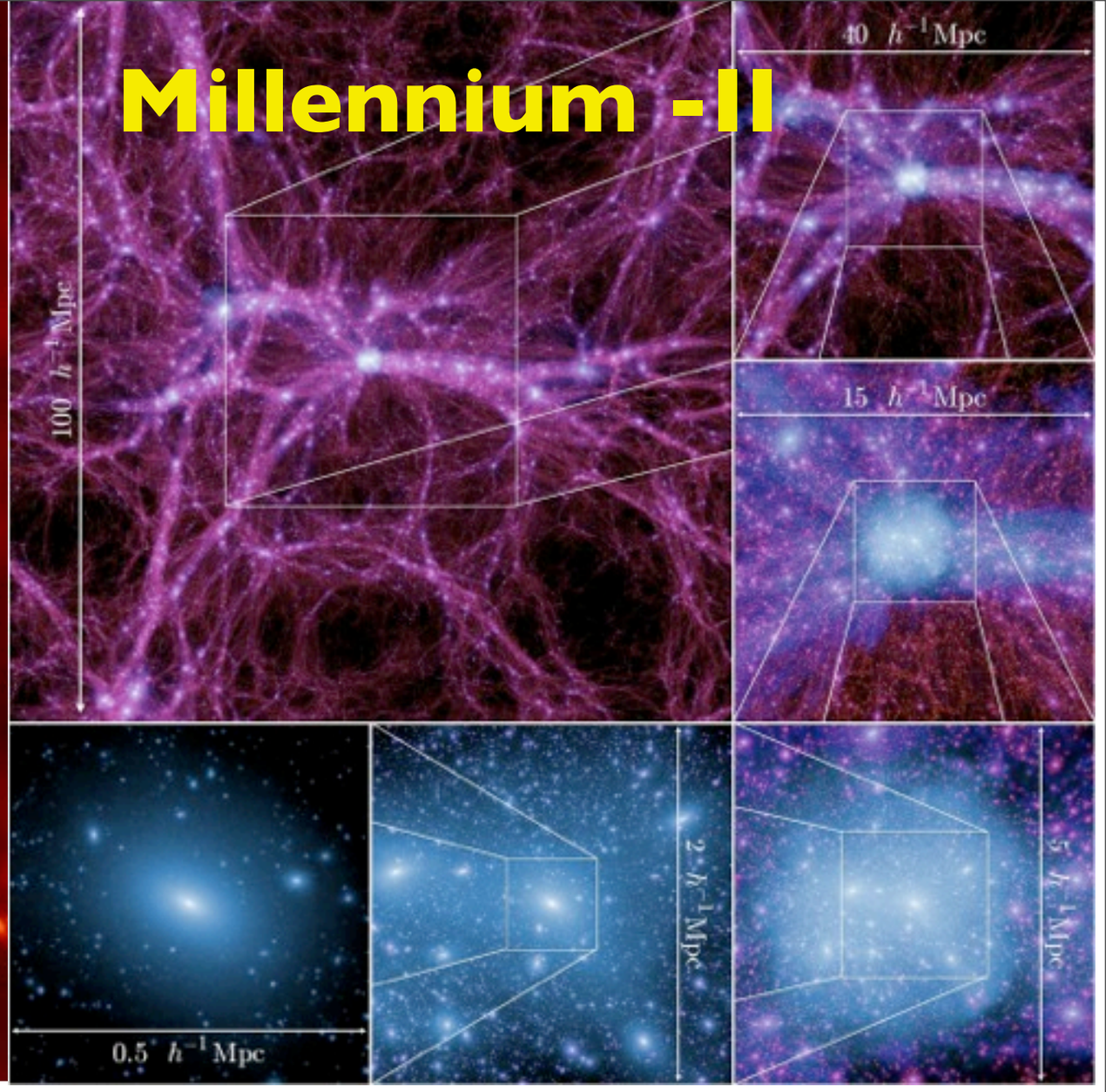
The semi-analytic models of galaxy formation has been proven successful in reproducing many galaxy properties.

Milky Way systems

Copernicus Complexio

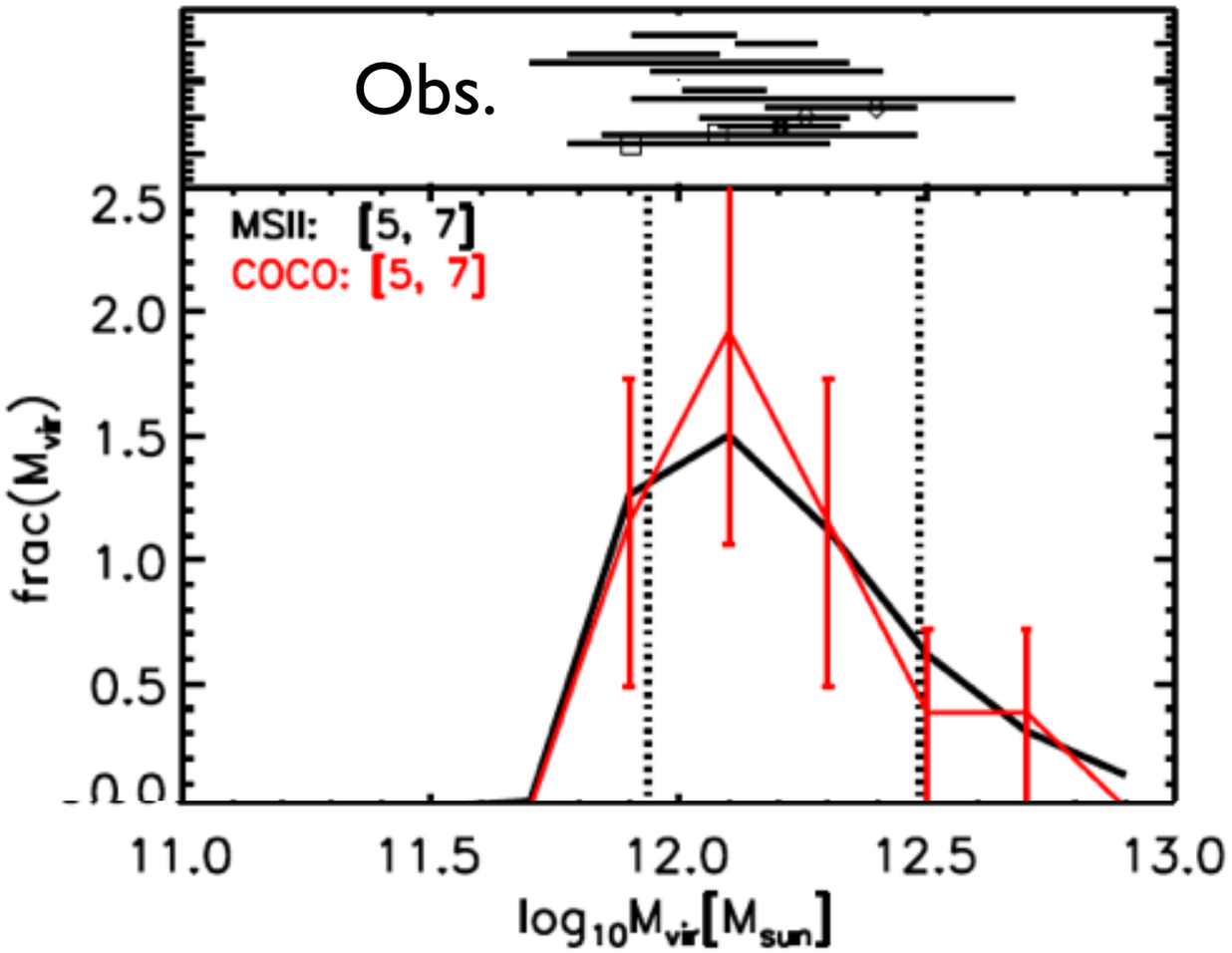


Millennium -II



	Ω_m	$\Omega\Lambda$	σ_8	V[Mpc^3 /h^3]	mp[Msun/h]	ε[pc/h]
COCO	0.272	0.728	0.81	2.25E+04	1.14E+05	230
MS-II	0.25	0.75	0.9	1.00E+06	6.90E+06	1000

Halo mass of the Milky Way



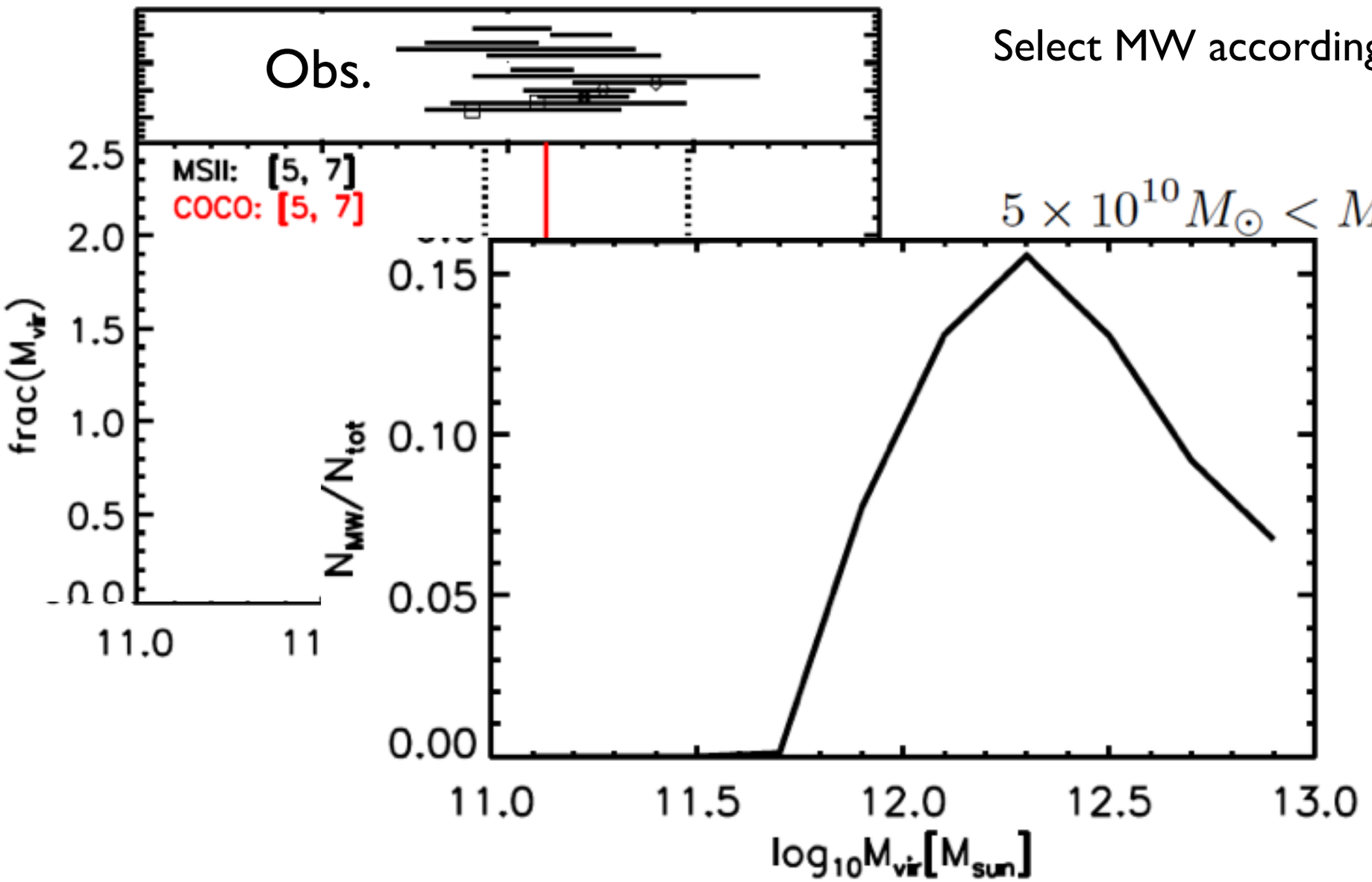
Select MW according to observables:

$$5 \times 10^{10} M_\odot < M_* < 7 \times 10^{10} M_\odot$$

$$0.03 < \frac{M_{bulge}}{M_*} < 0.4$$

The predicted halo mass is consistent with the measurements in the literature.

Halo mass of the Milky Way



Select MW according to observables:

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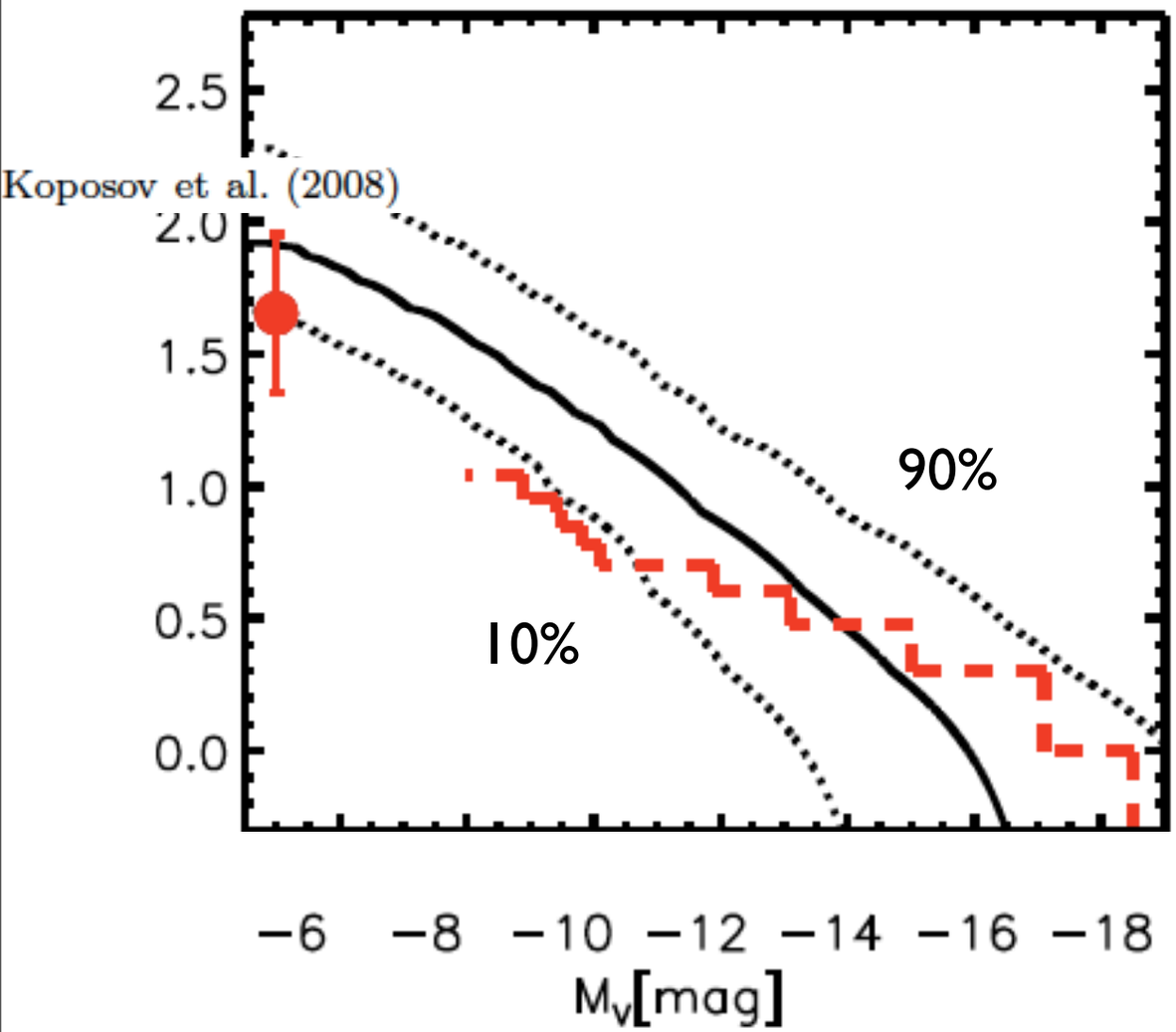
4

s consistent with literature.

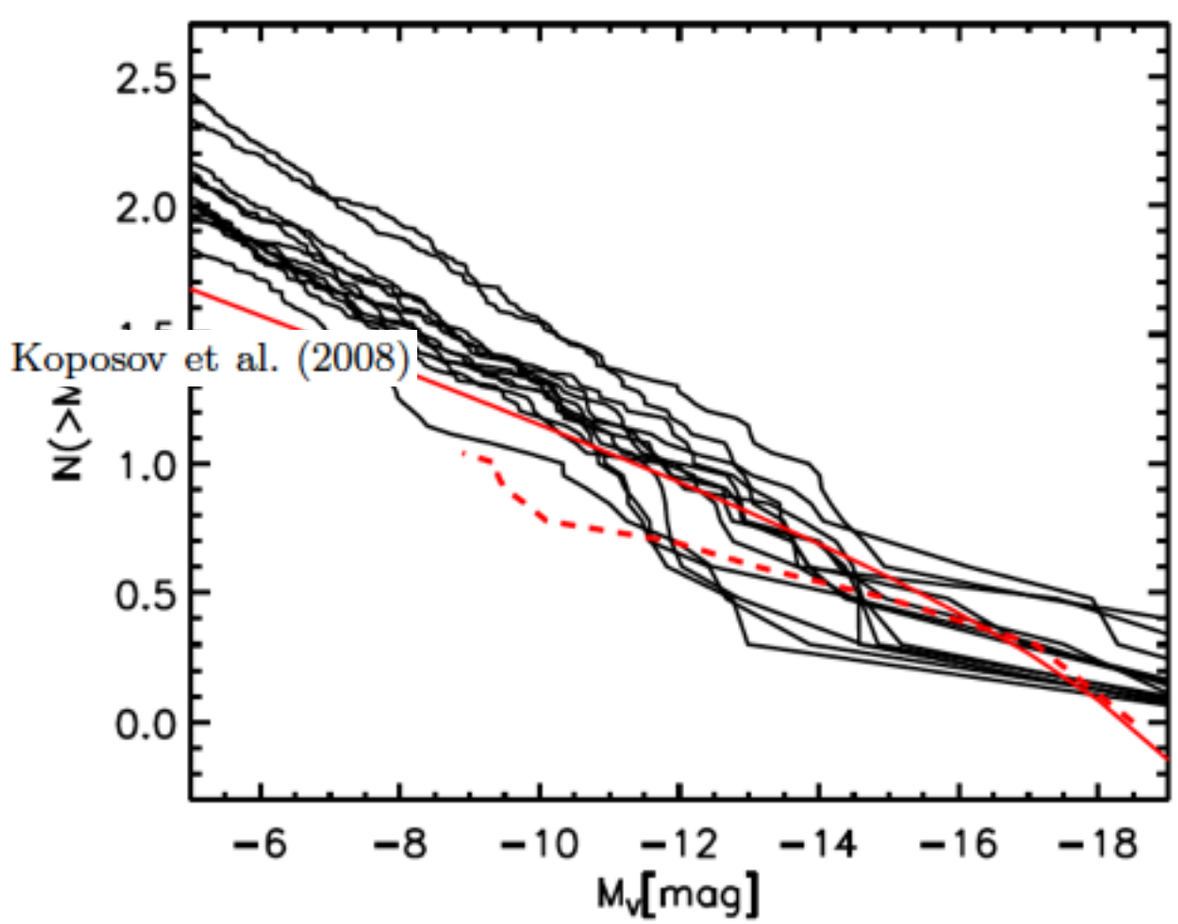
The probability for any halo to host a Milky Way analogue is remarkably low in our model.

Abundance as a function of luminosity

MSII



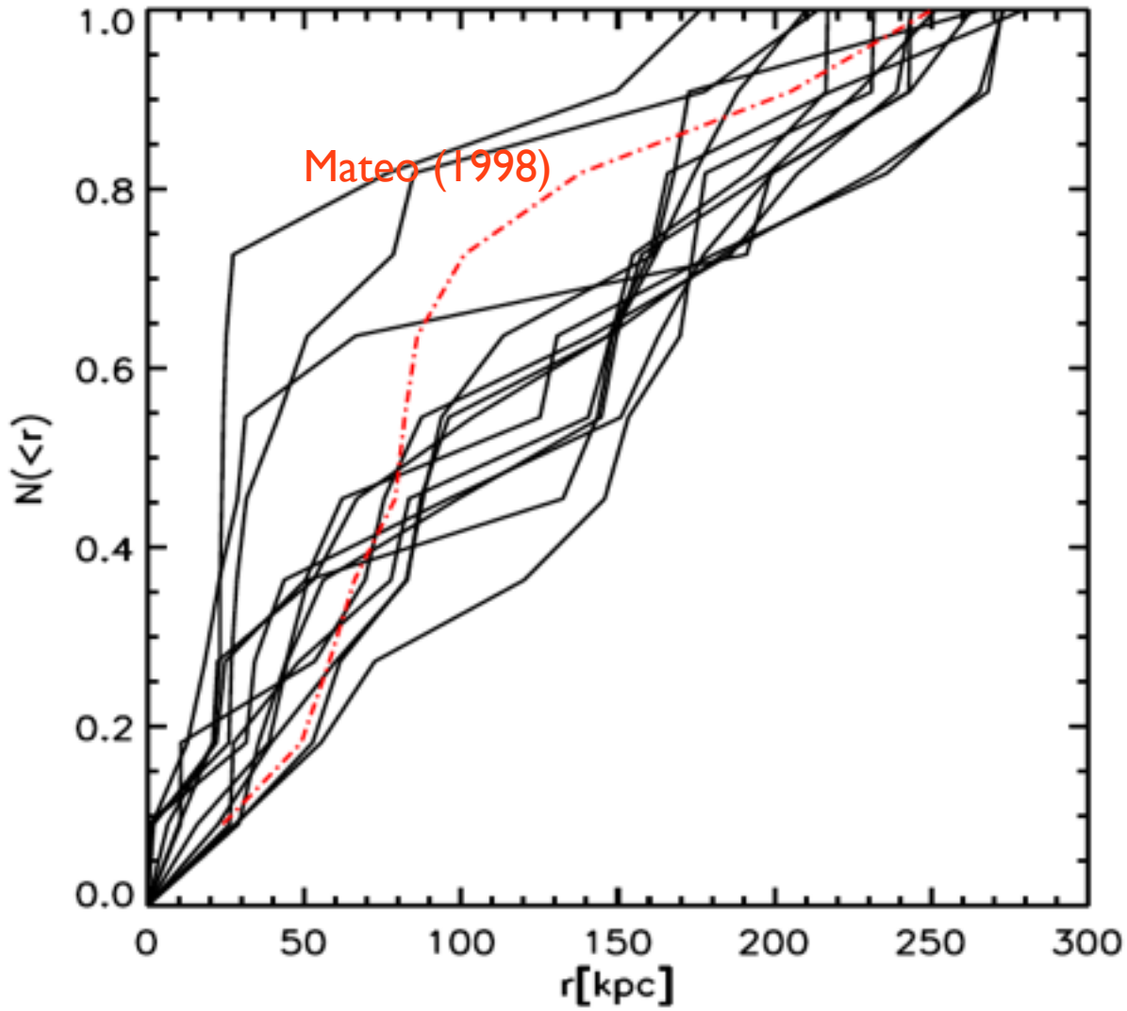
COCO



Both in the MSII and in the COCO, we reproduce galaxy abundance as a function of V-band luminosity function

Spatial distribution of the satellites

COCO: Mv<-9



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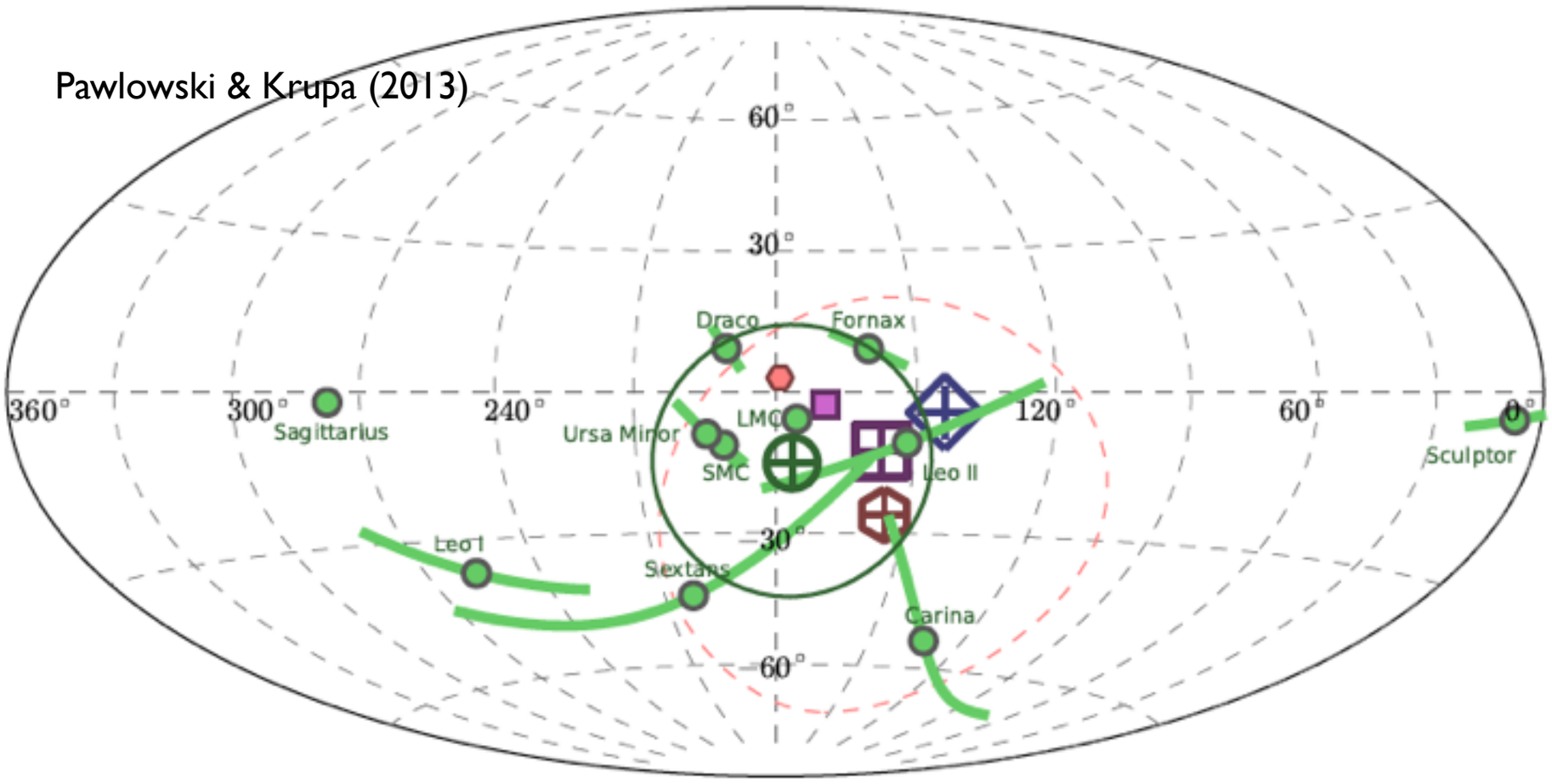
Spatial distribution of the satellites

Pawlowski & Krupa (2013)



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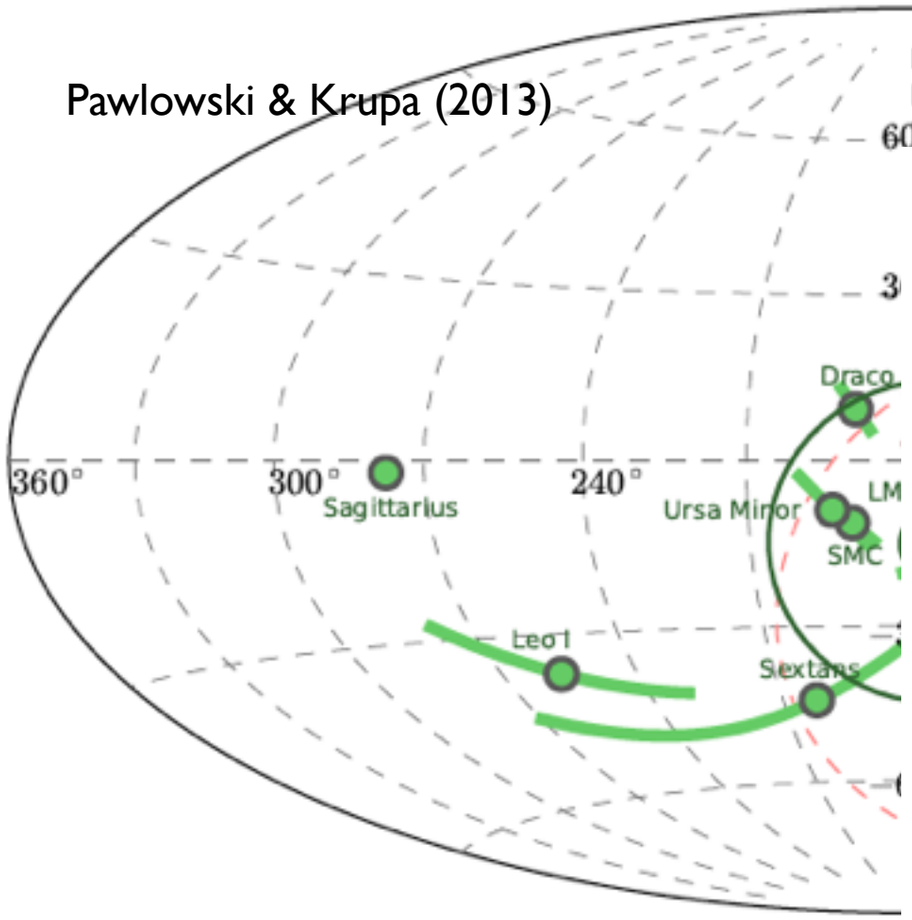
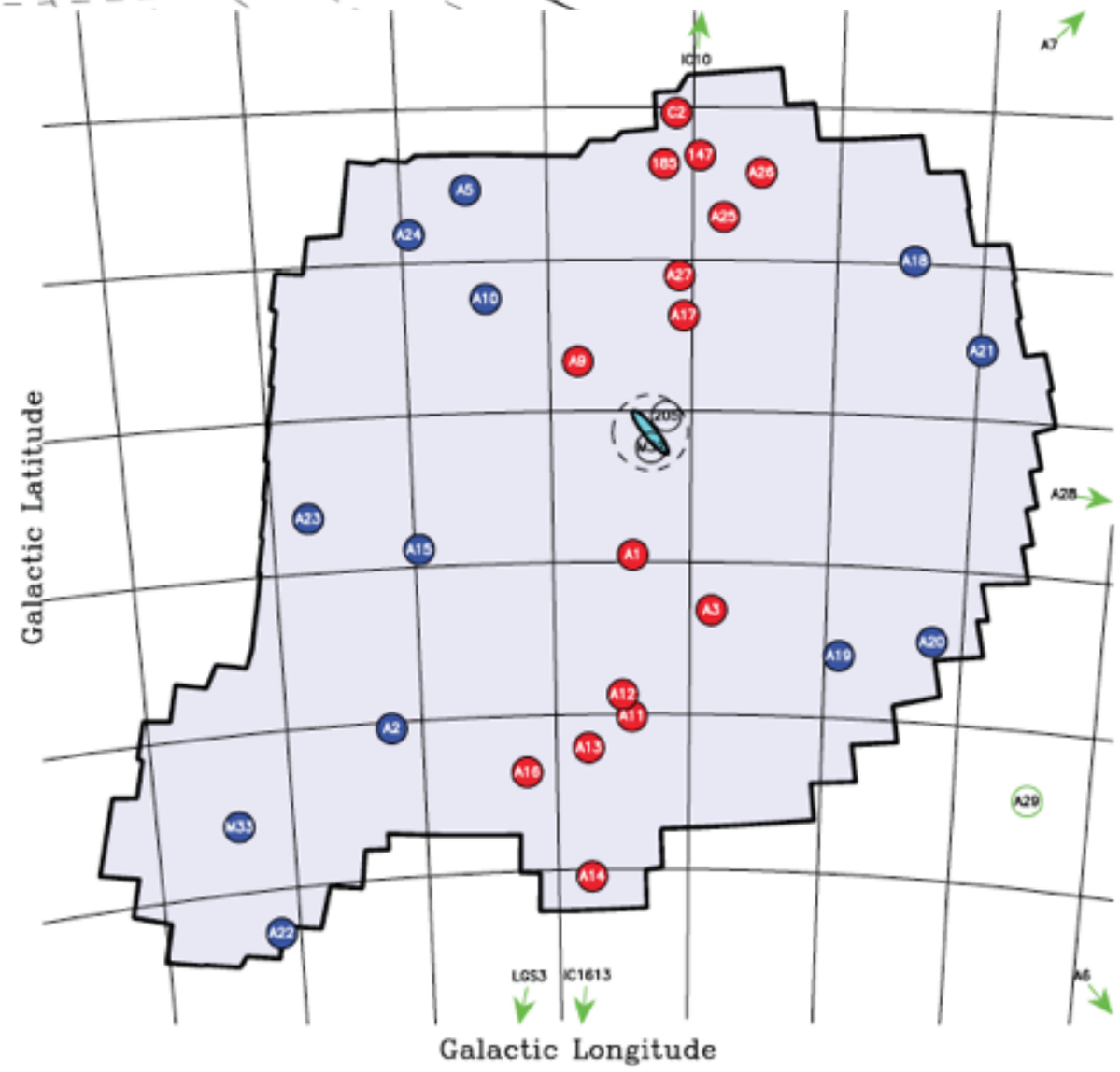
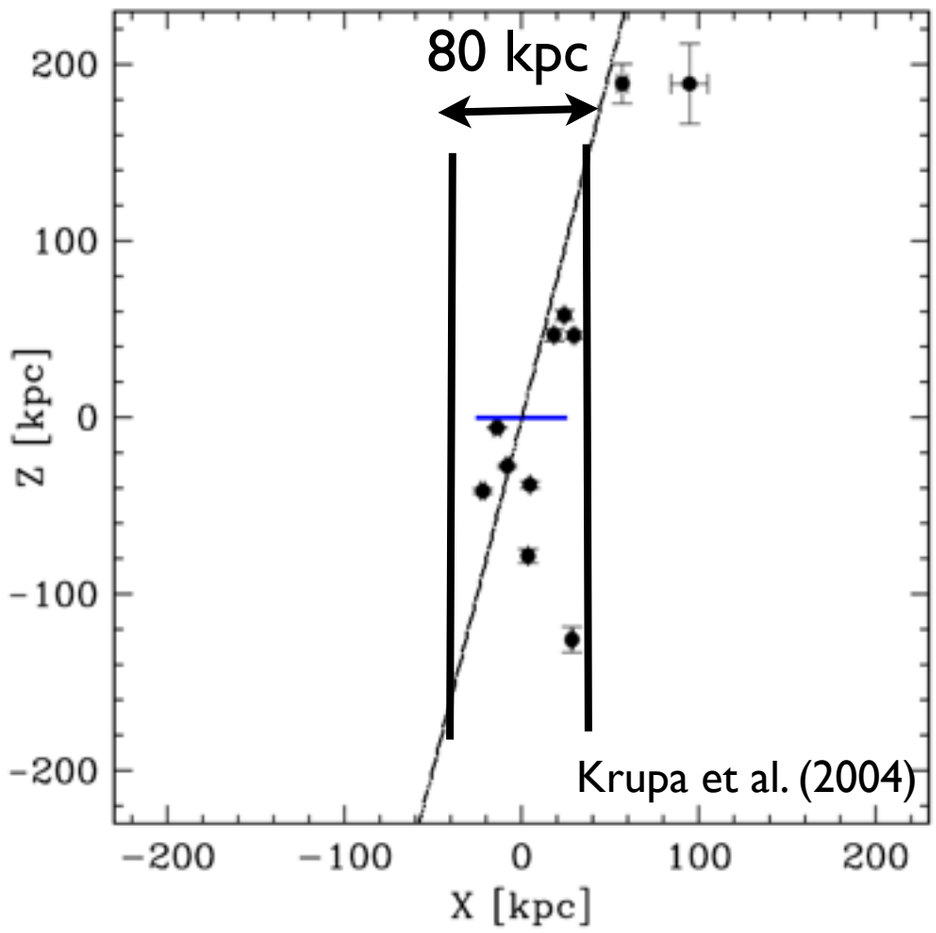




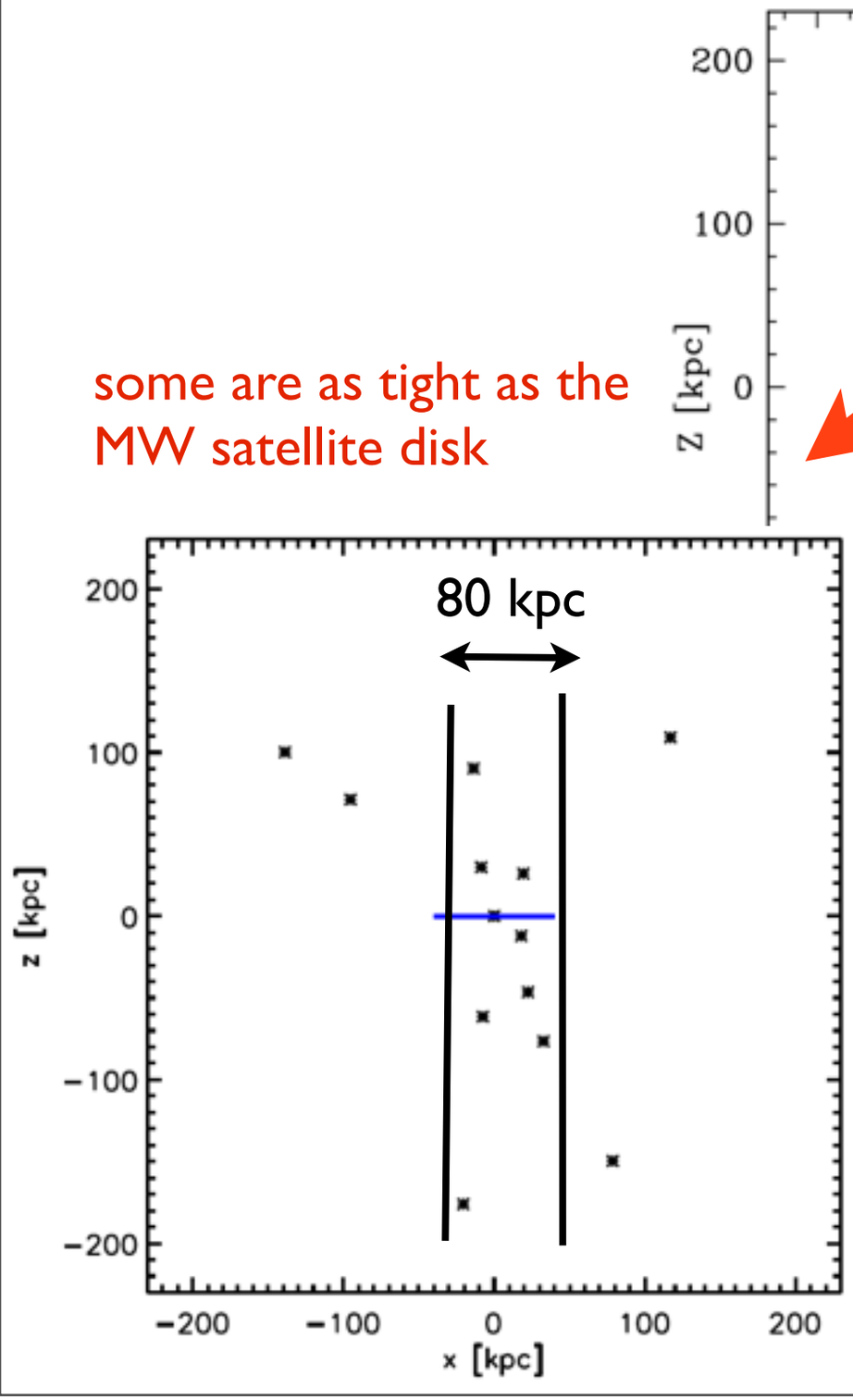
Ibata et al. (2013)

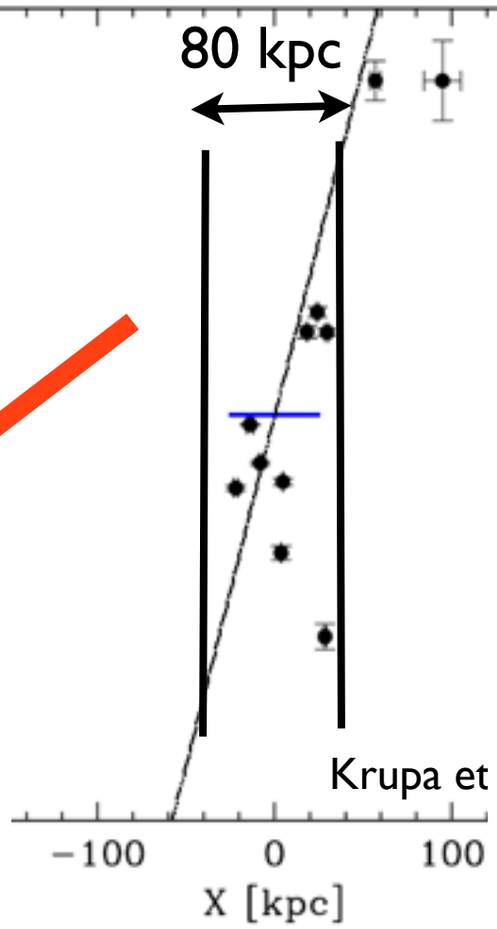
Spatial distribution of the satellites



Spatial distribution of the satellites

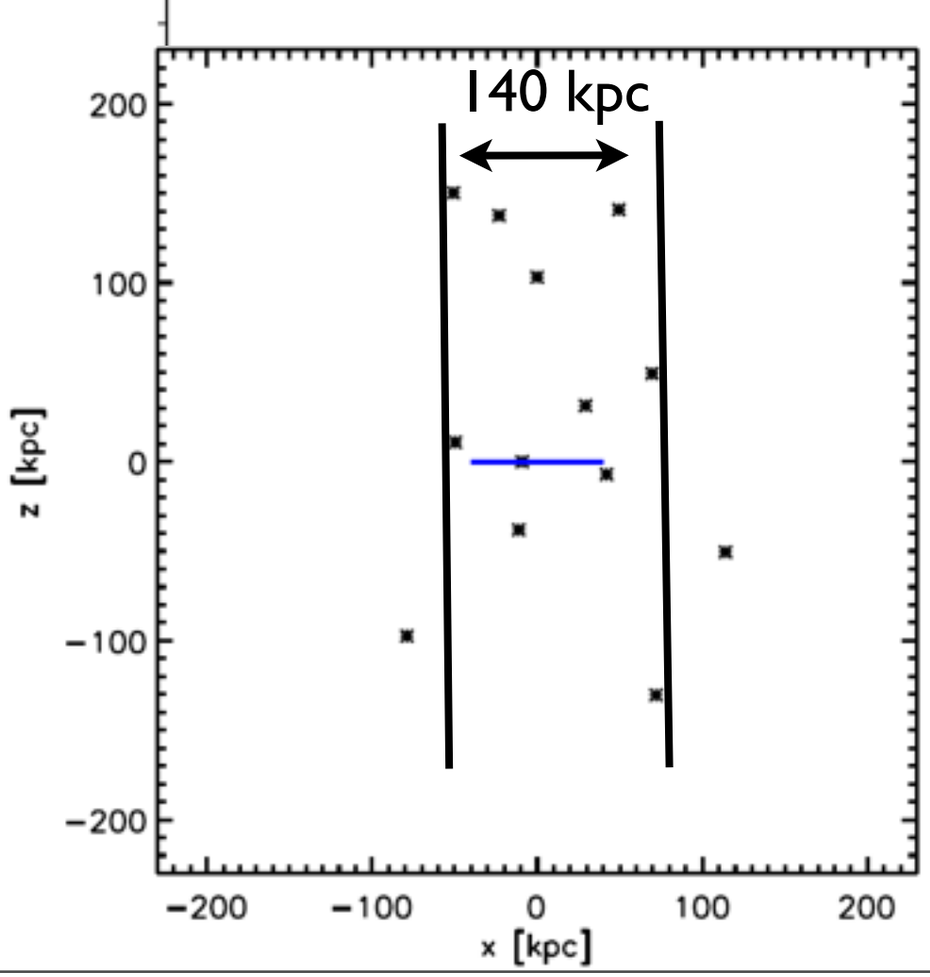
some are as tight as the MW satellite disk





Krupa et

some are wider



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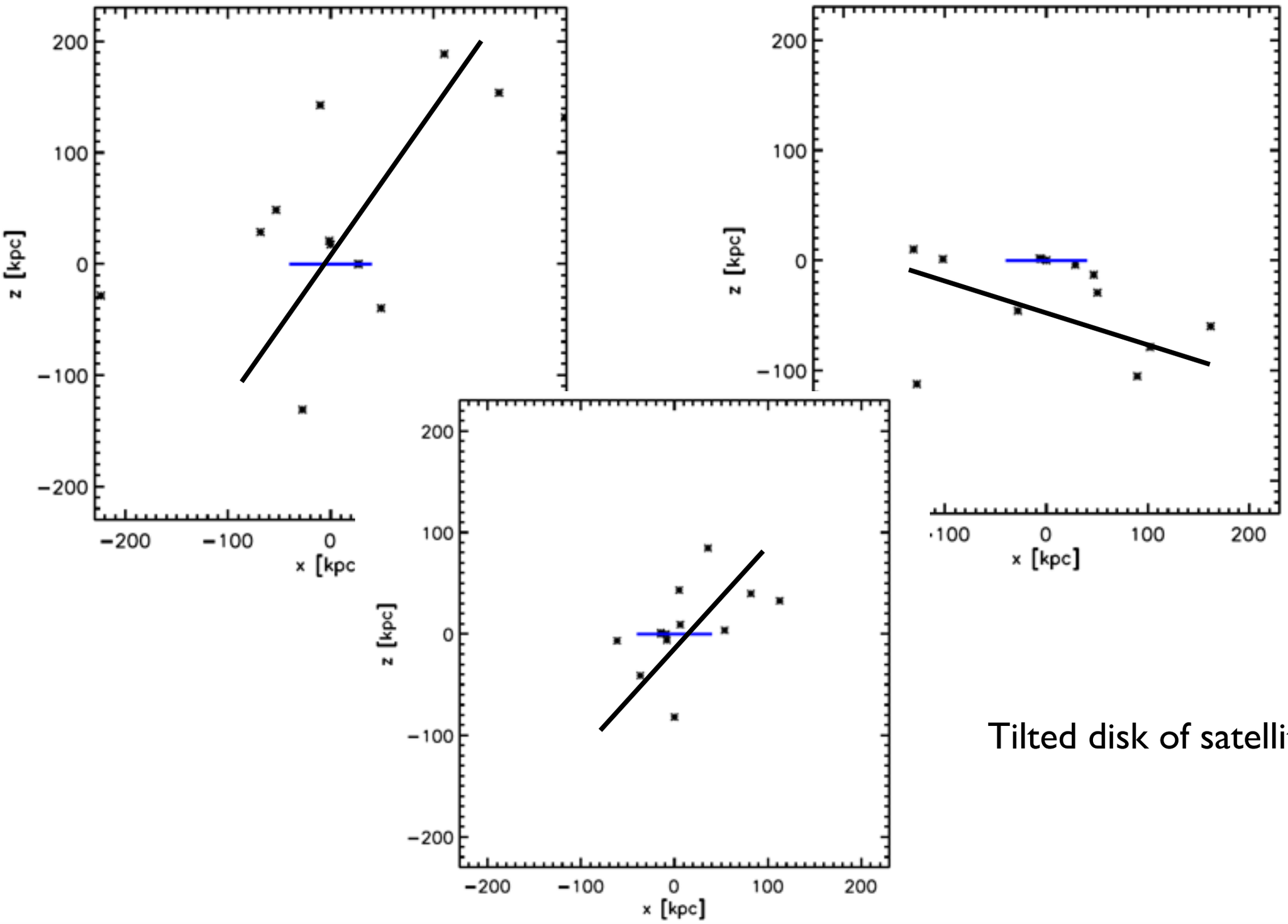
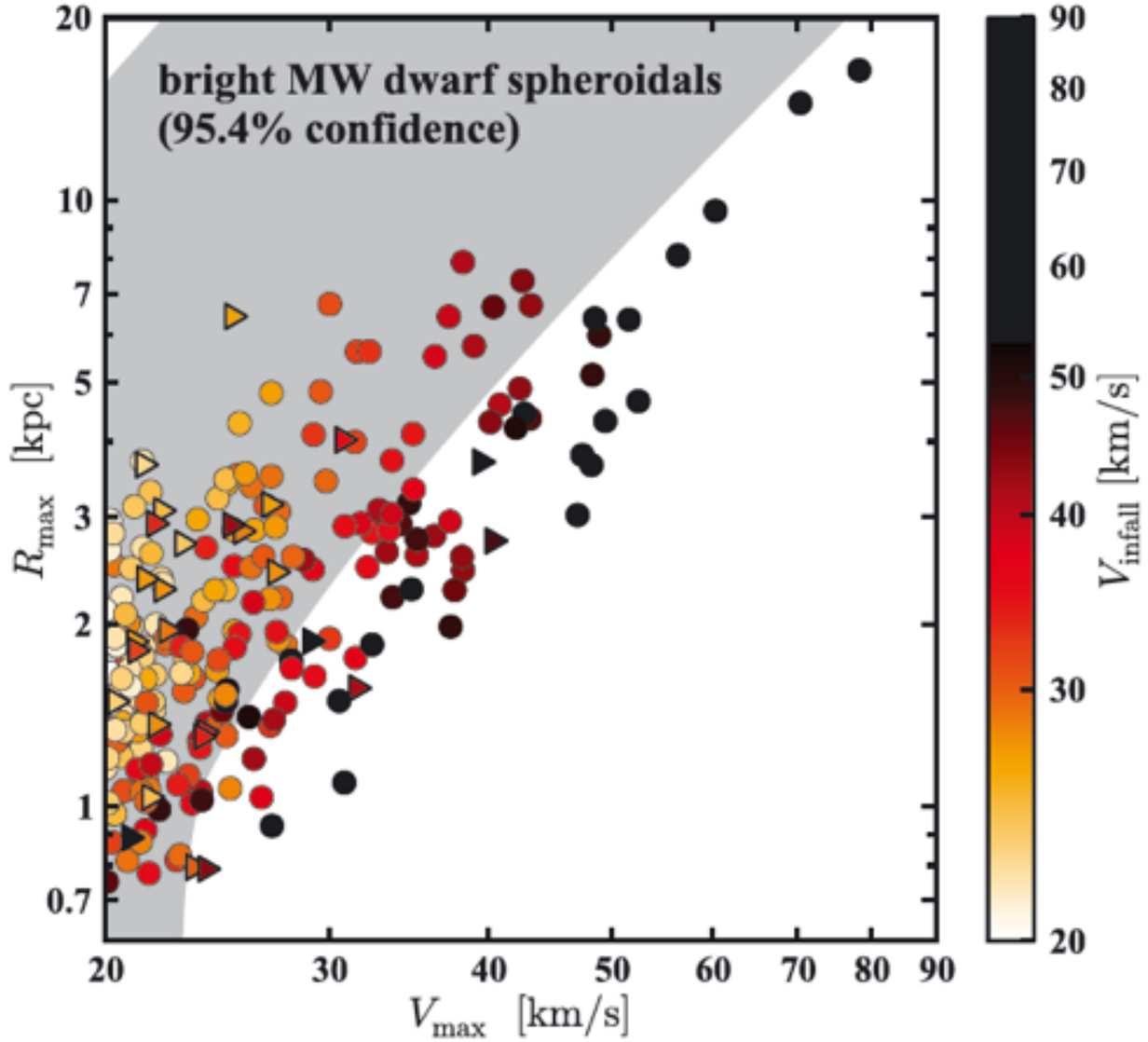


Tilted disk of satellites

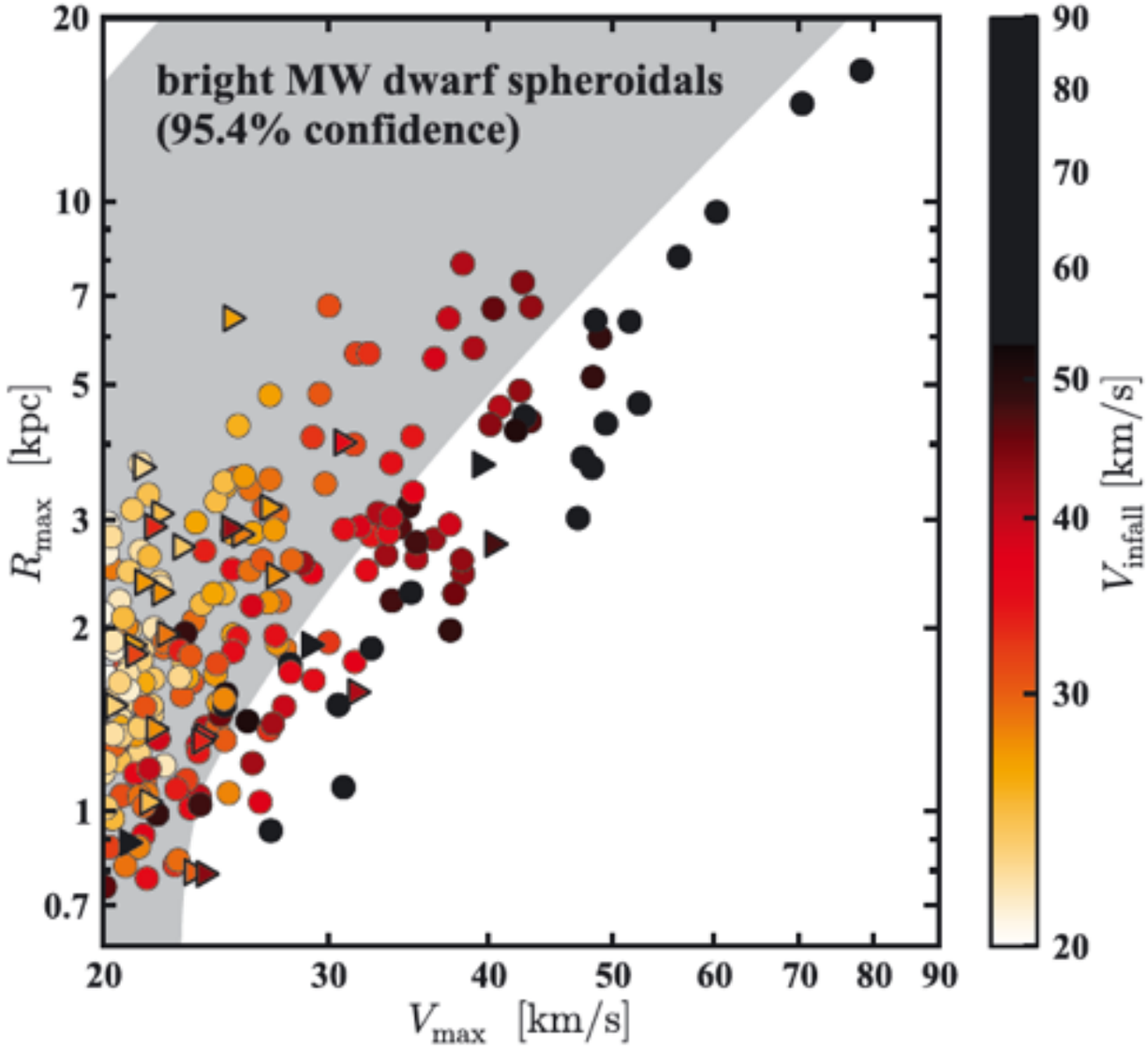
Too big to fail?



Boylan-Kochin et al. (2011)

Too many subhalos with Vmax>30km/s

Too big to fail?



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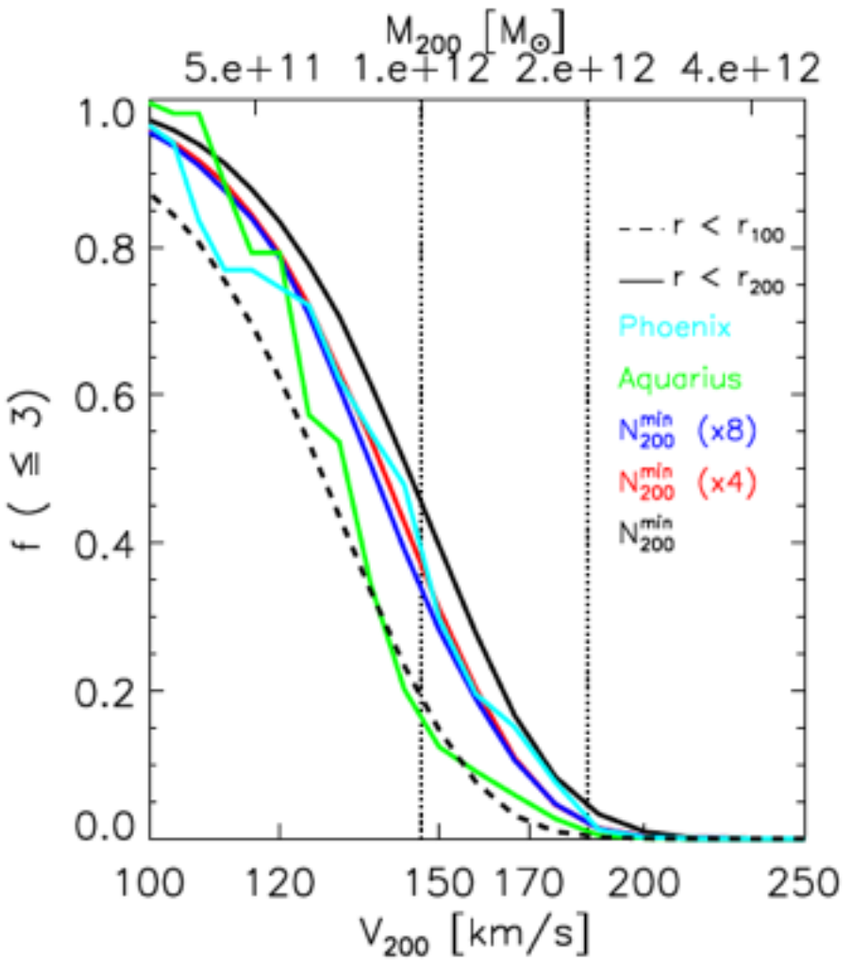

Wang et al. (2012)

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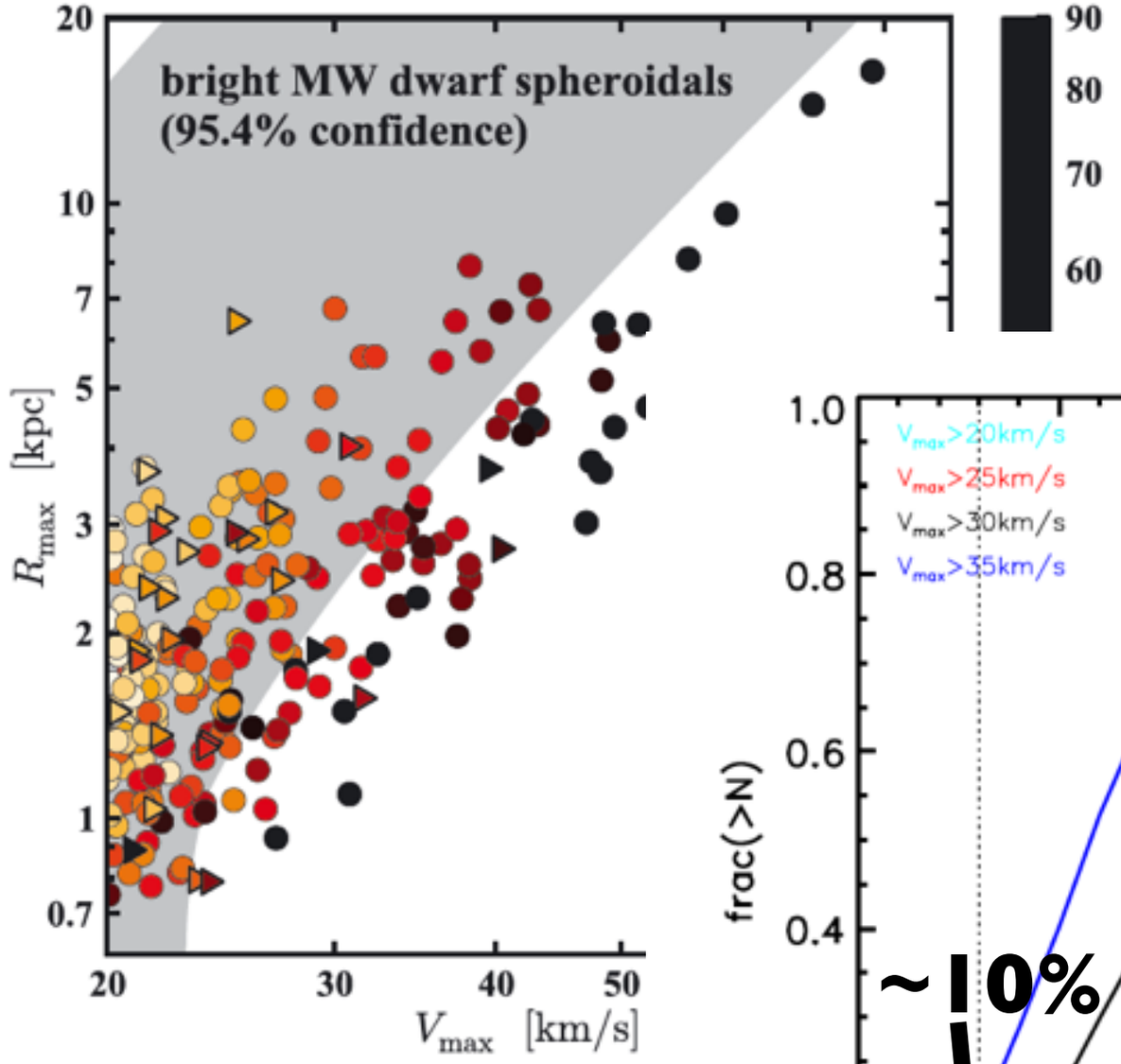
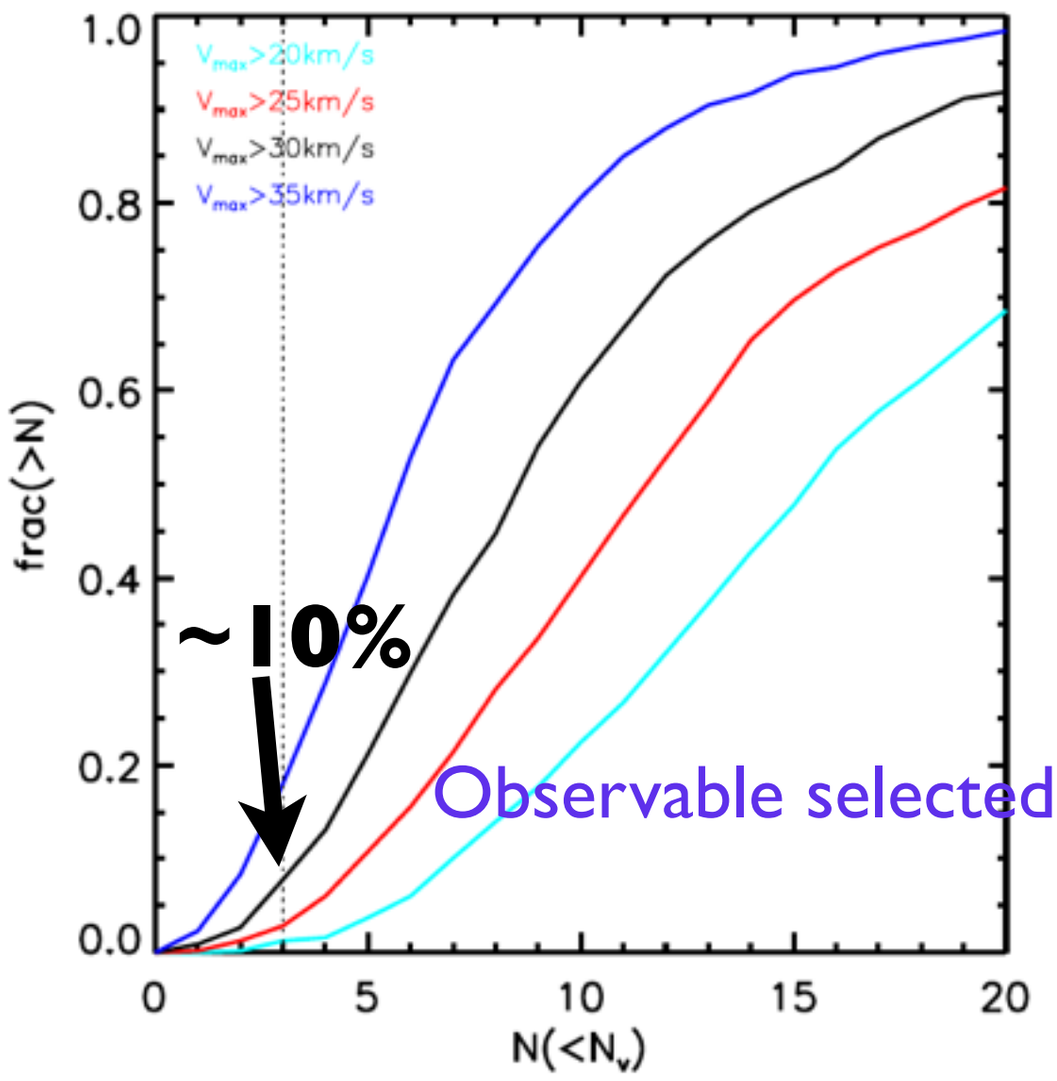
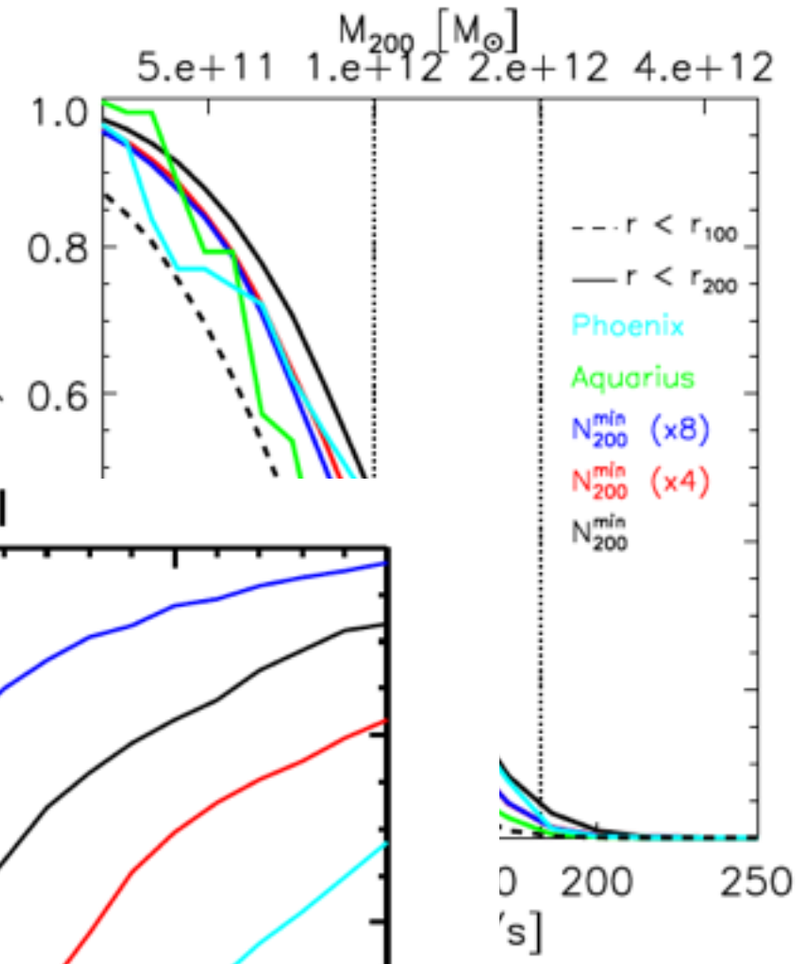


Boylan-Kochin et al. (2011)

Too many subhalos wi

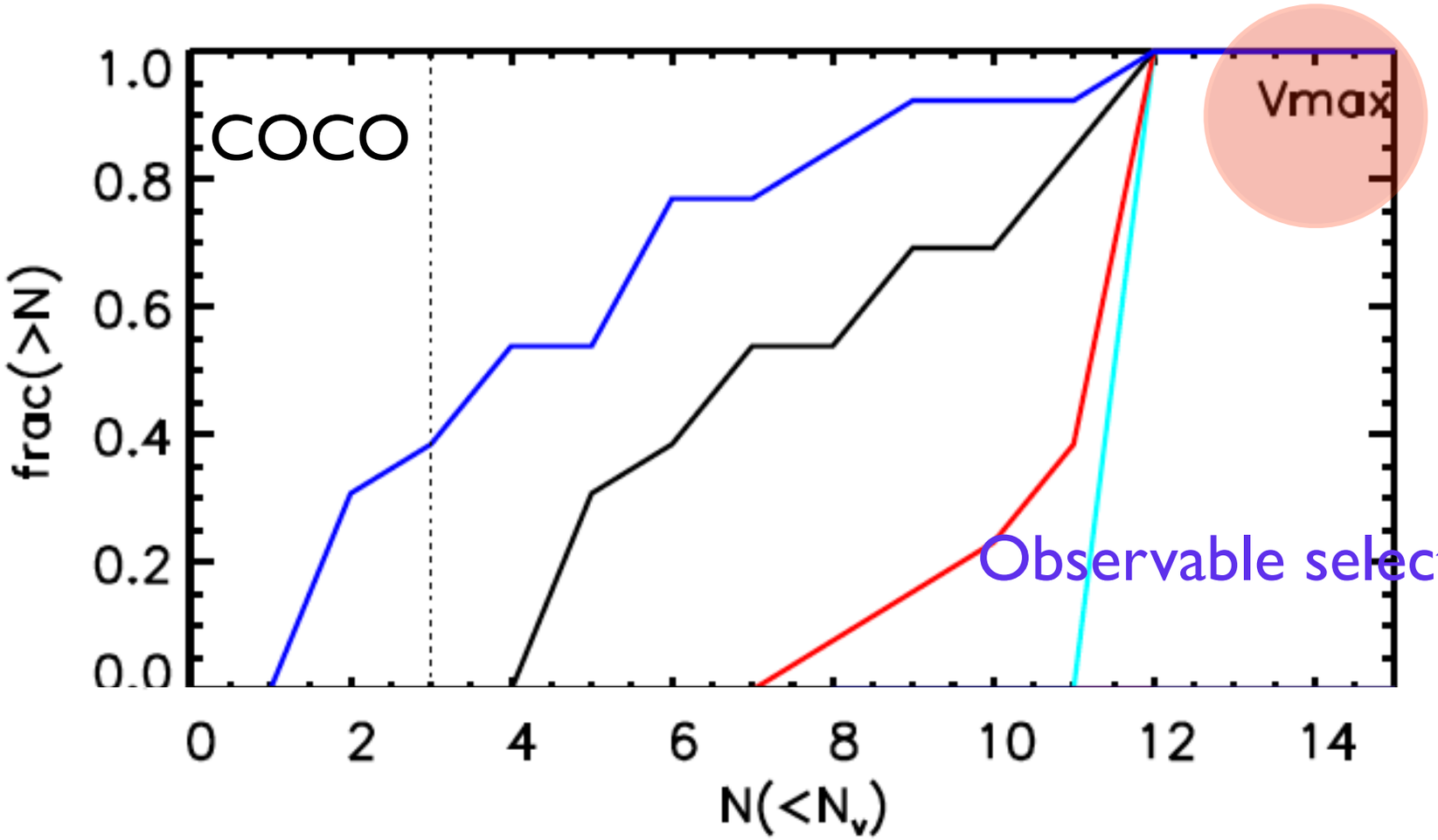




Wang et al. (2012)

Observable selected MW analogues

Too big to fail?



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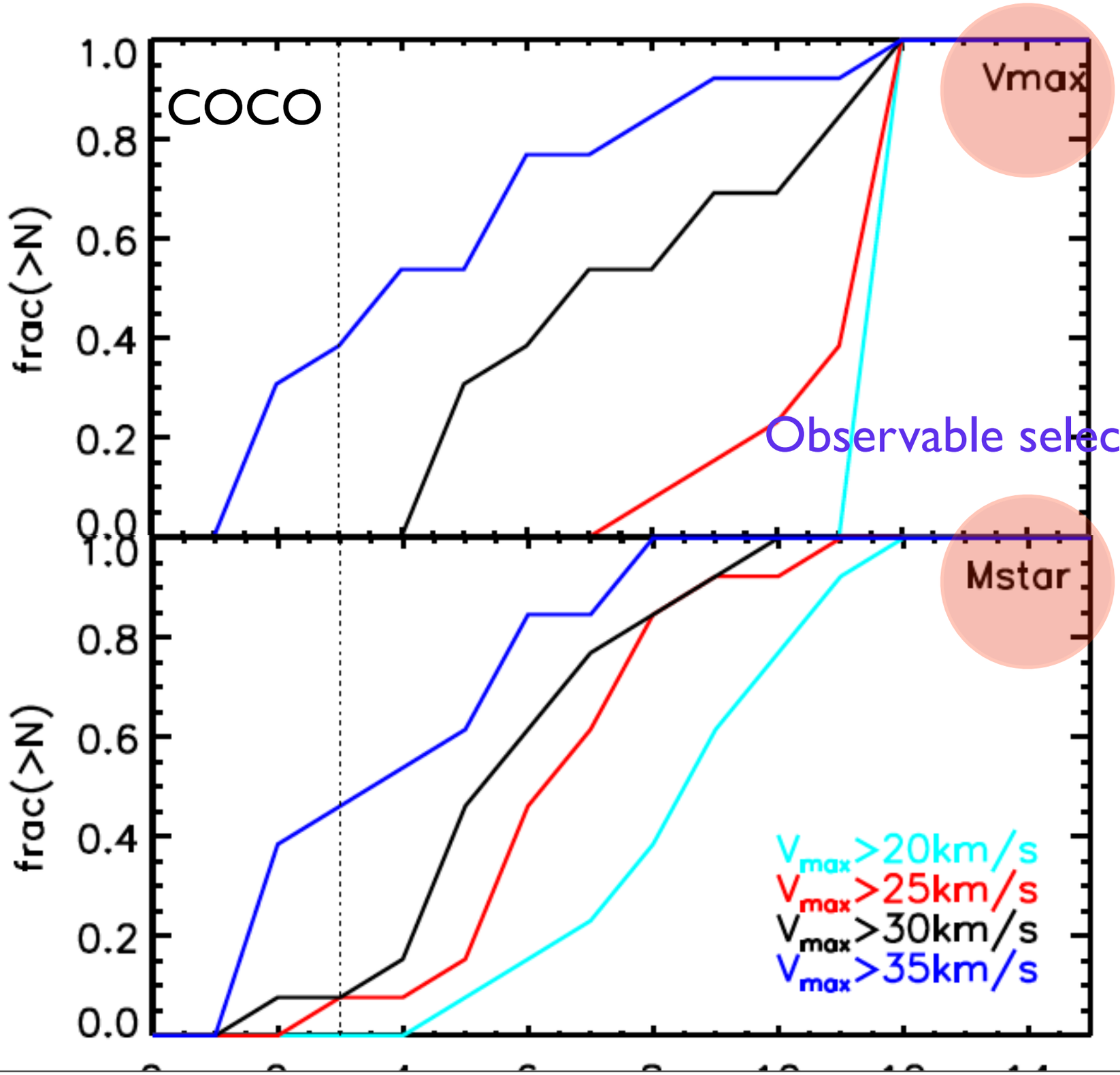
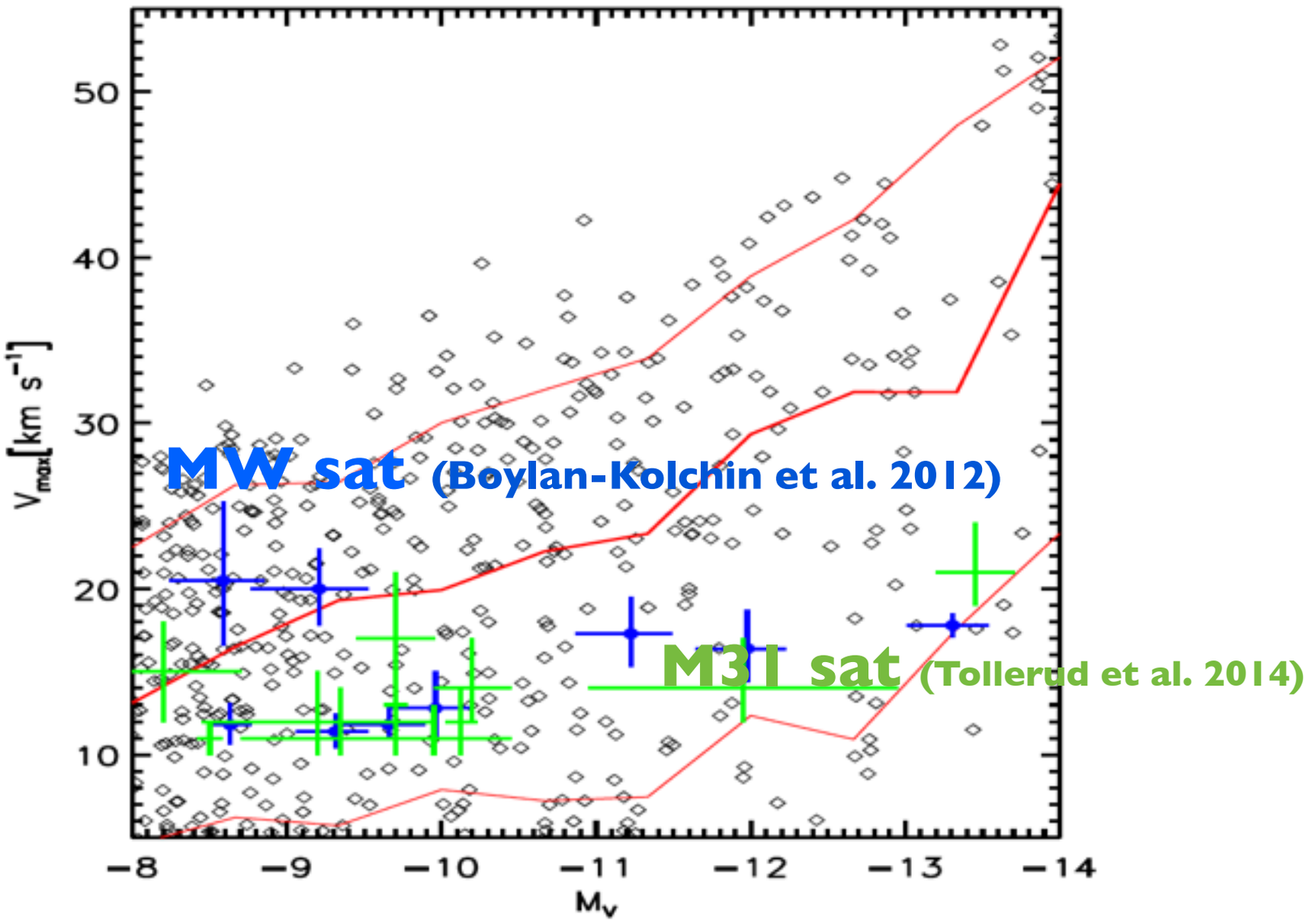


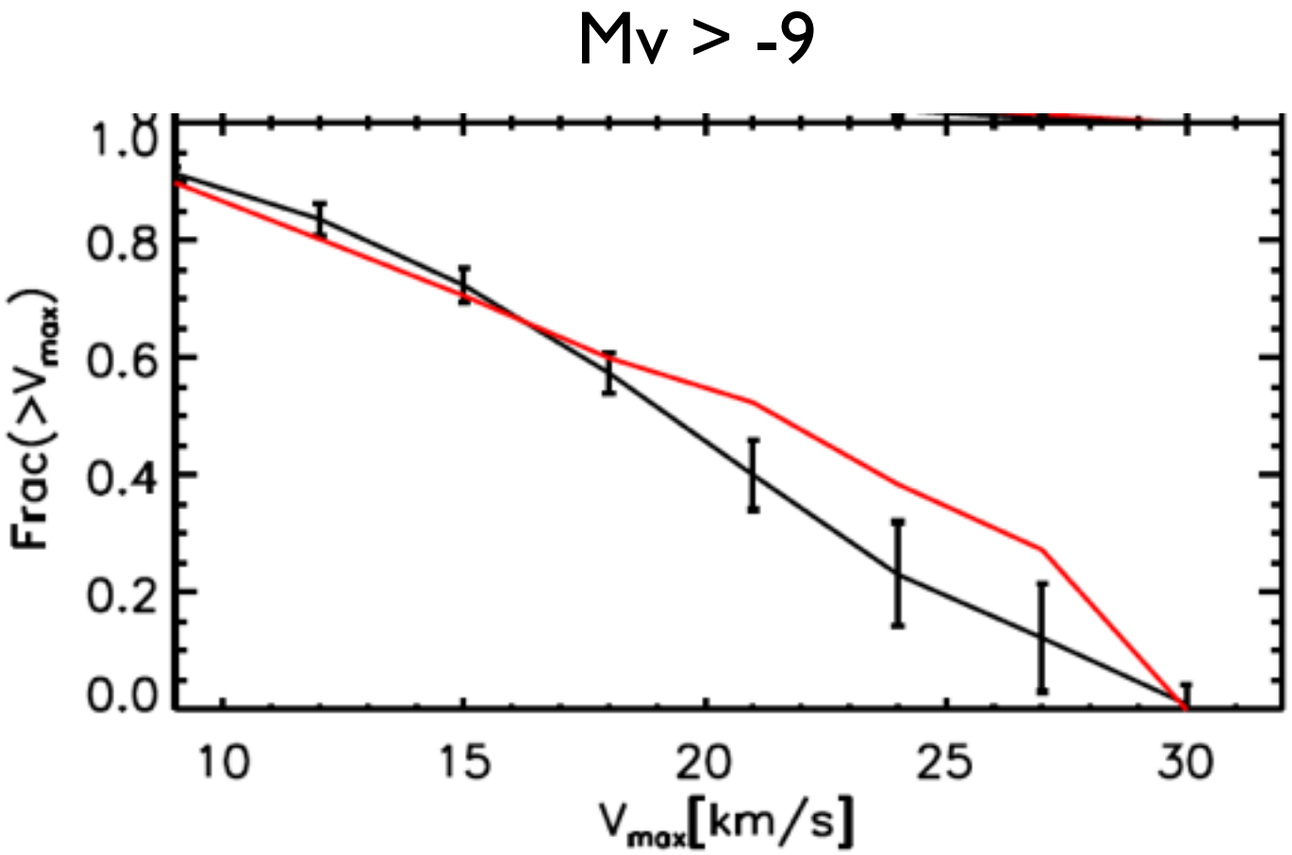
Observable selected MW analogues

Mv vs. Vmax



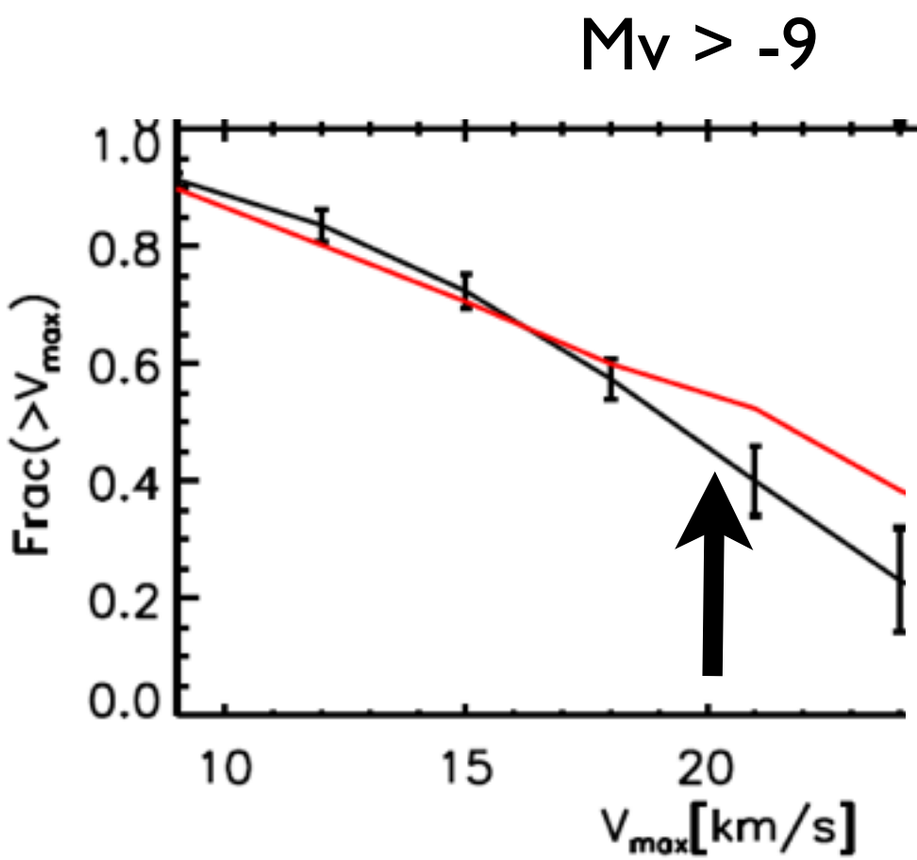
The observed Mv vs. Vmax relations fall well within the one-sigma region predicted by our model.

Where are the dark sub halos?

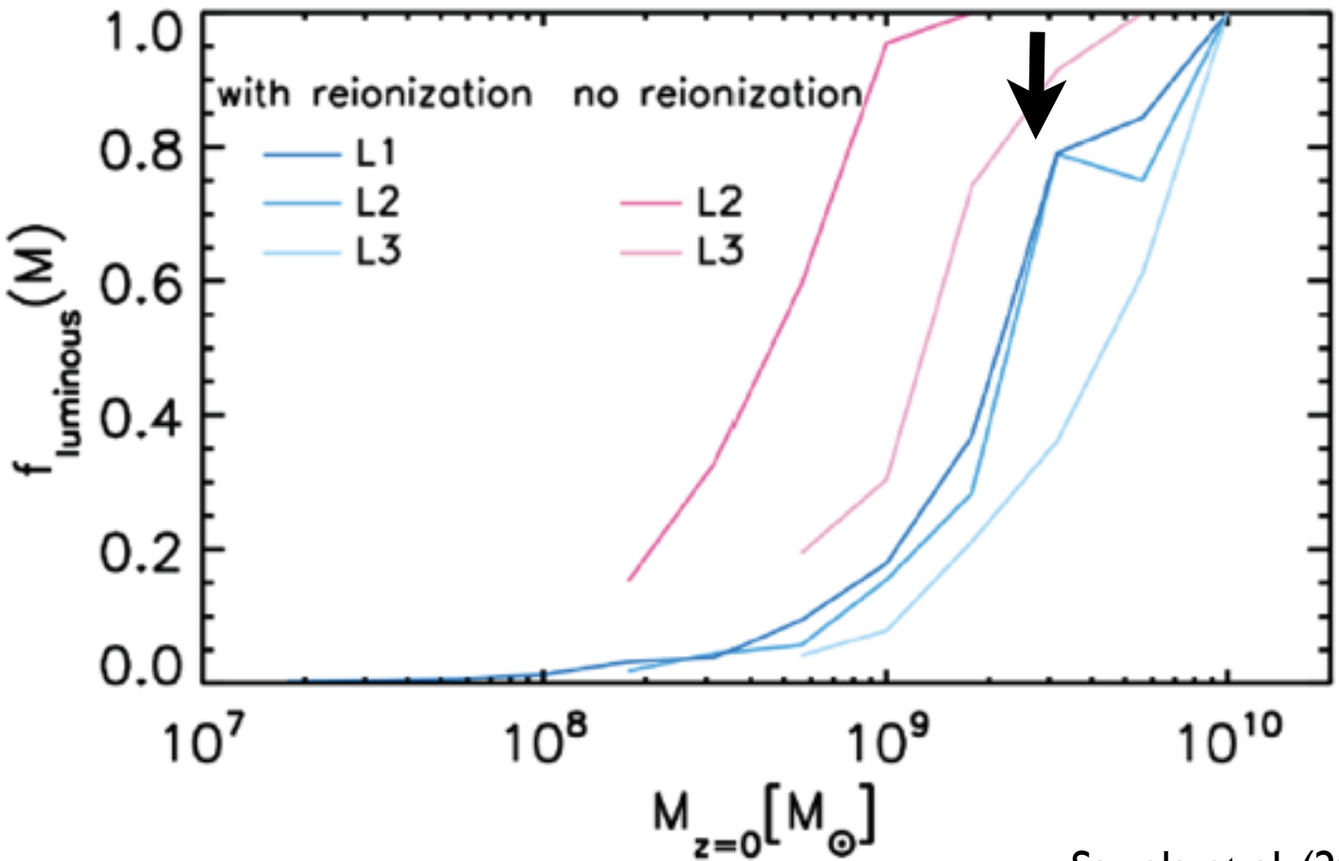


Dark fraction increases rapidly with decreasing Vmax

Where are the dark sub halos?



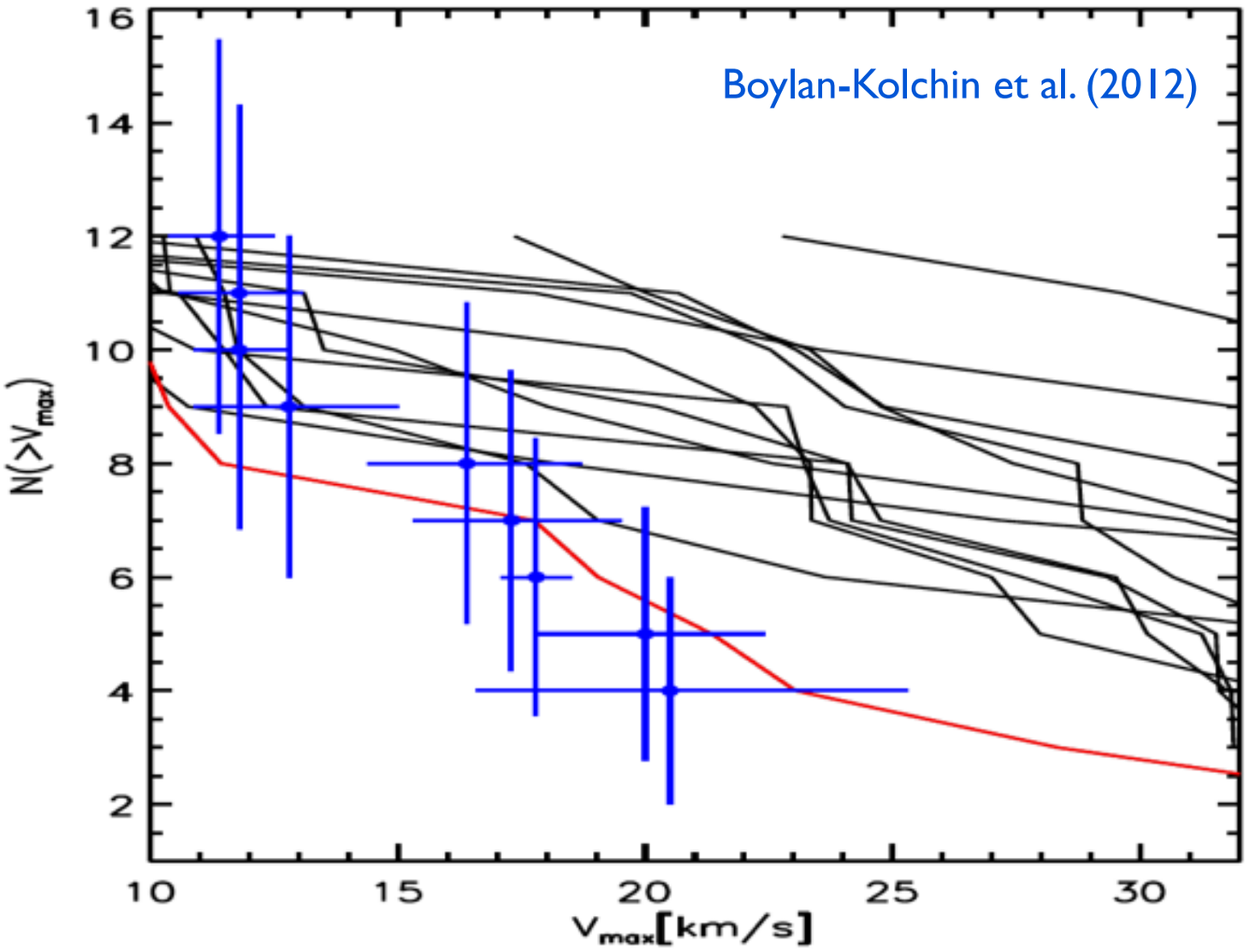
At 20km/s, around half sub halos host galaxies with Mv > -9



Dark fraction increases ra
decreasing Vmax

Sawala et al. (2014)

Abundance as a function of Vmax



One out of 13 MW analogues which have Vmax function consistent with the measurements.

Conclusions

- We select MW analogues according to the observed properties. The predicted halo mass centered at 1E12Msun, with scatters consistent with the measurements in the literature.
- Both the abundance of the MW satellites as a function of luminosity and their profiles are reproduced.
- We find in some MW analogues, their satellites distribute in a disk perpendicular to the MW disk with similar width, some with wider width. There are also some tilted disks of satellites as those observed around the M31.
- Half of subhalos with Vmax = 20km/s are missed from current surveys, and the fraction increases rapidly with decreasing circular velocity.
- One out of 13 MW analogues from COCO have less than 3 satellites with Vmax < 30km/s, when selecting satellites also according to their luminosities.