dark + luminous satellites of the Milky Way + LMC

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FIRE collaboration
Feedback In Realistic Environments

FIRE-2 model for star formation + feedback

Feedback In Realistic Environments

Hopkins, Wetzel et al 2018

goals

- model dense multi-phase ISM in cosmological setting
- model single stellar populations: star (sub)clusters

high resolution

- MW/M31-mass simulations: 3500-7100 M_{sun}
- LMC-mass simulations: 900-7100 M_{sun}

gas cooling via atoms, molecules, and 9 metals down to 10 K

star formation in dense self-gravitating molecular clouds

$n_{SF} > 1000$ atoms / cm^3

FIRE-2 model for stellar evolution + feedback

Feedback In Realistic Environments

Hopkins, Wetzel et al 2018

explicitly model 3 feedback channels

supernovae

- core-collapse (prompt)
- type Ia (delayed)

stellar radiation

- radiation pressure
- photoionization heating (HII regions)
- photoelectric heating (via dust)

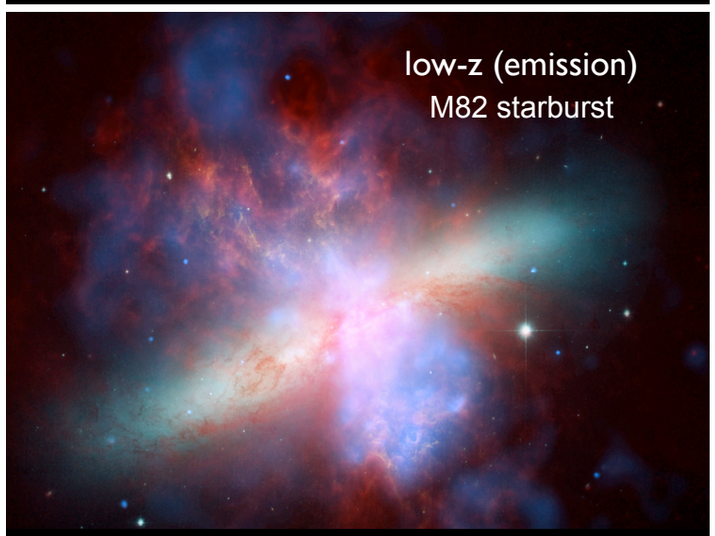
stellar winds

- massive O & B stars (prompt)
- AGB stars (delayed)

redshift-dependent spatially uniform metagalactic UV background

Faucher-Giguere et al 2009

stellar scale



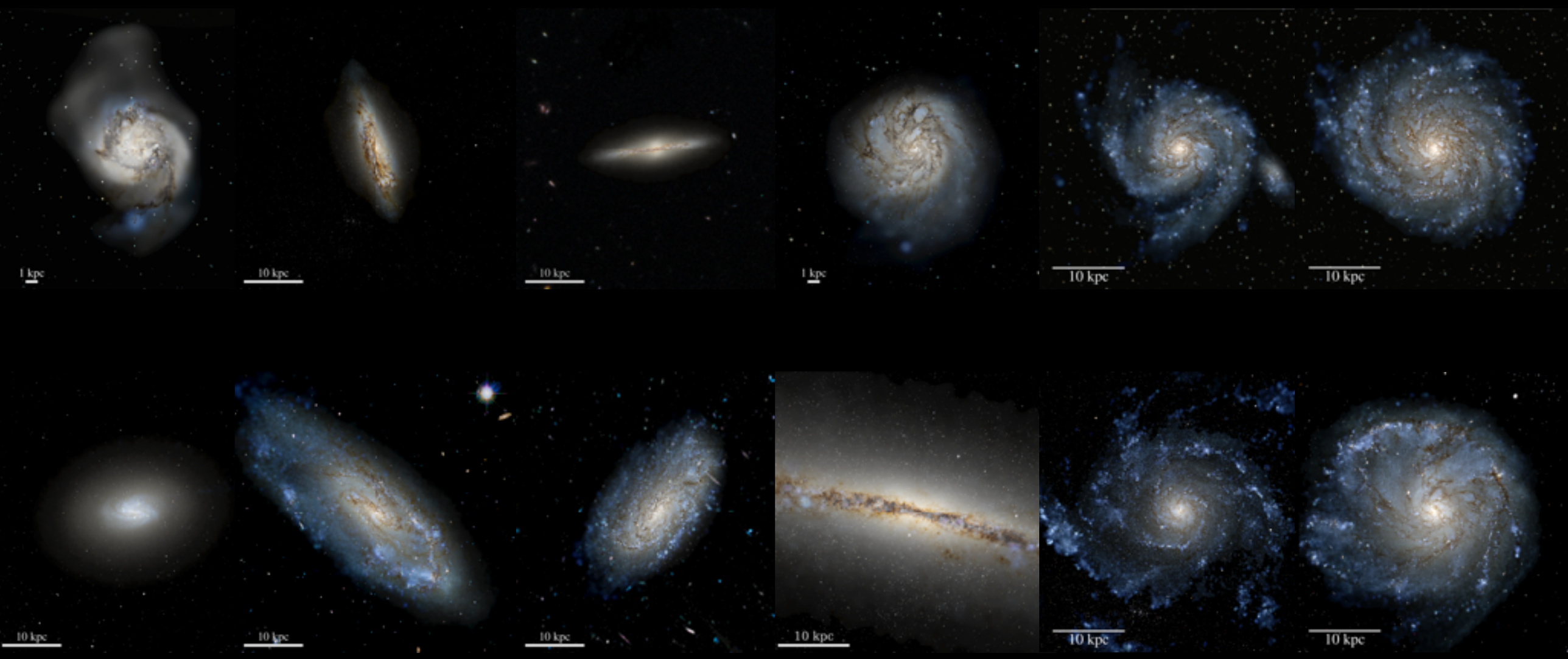
galaxy scale

FIRE-2 simulation suite of MW-mass systems

Feedback In Realistic Environments

Latte suite: 8 isolated MW-mass systems

ELVIS suite: 3 LG-like pairs (6 halos)



GALAXY SIMULATION GROUP @ UC DAVIS

Postdocs

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UC Davis Chancellor Fellow

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Graduate Students

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Undergraduates

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Preet Patel

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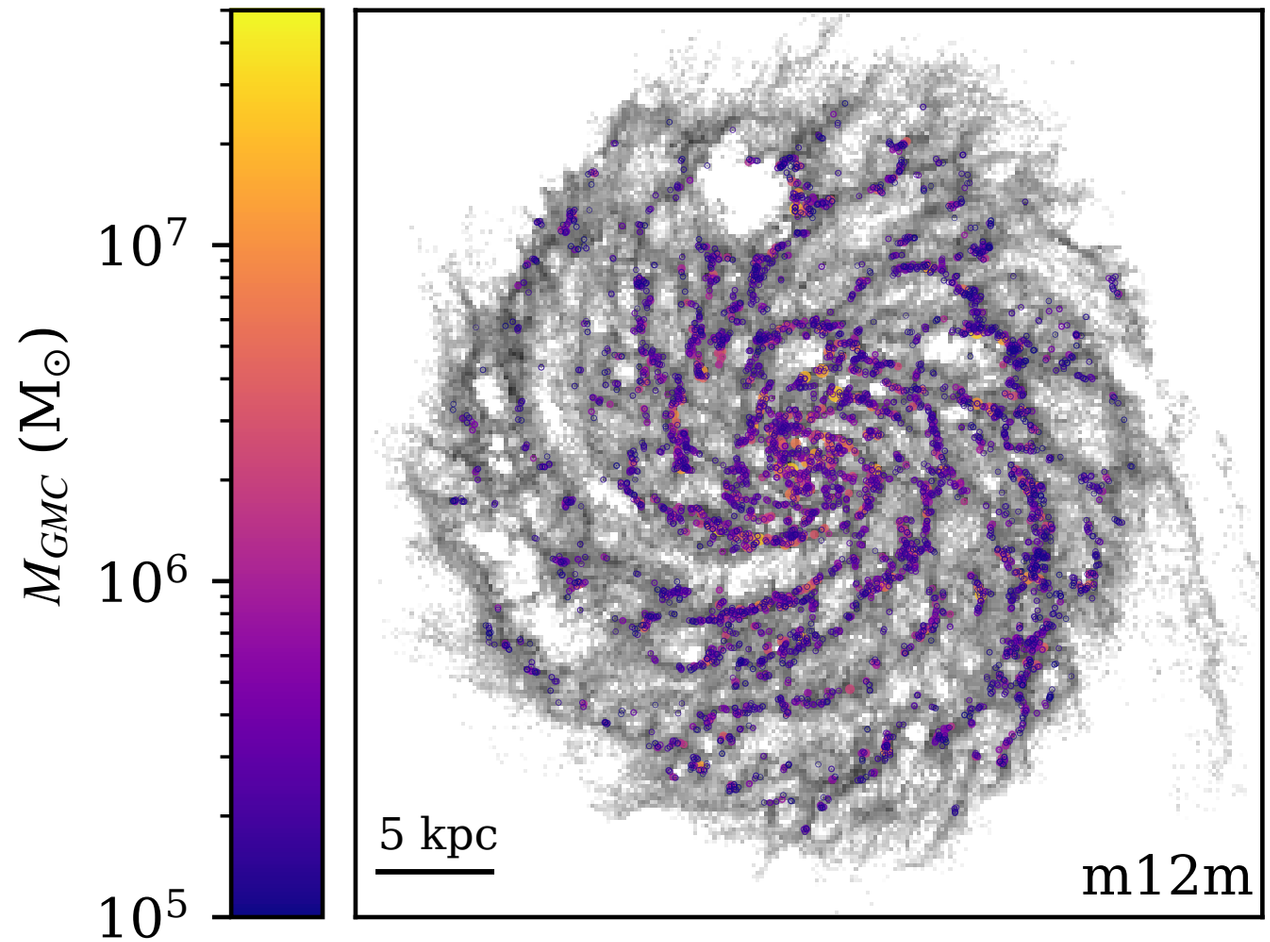
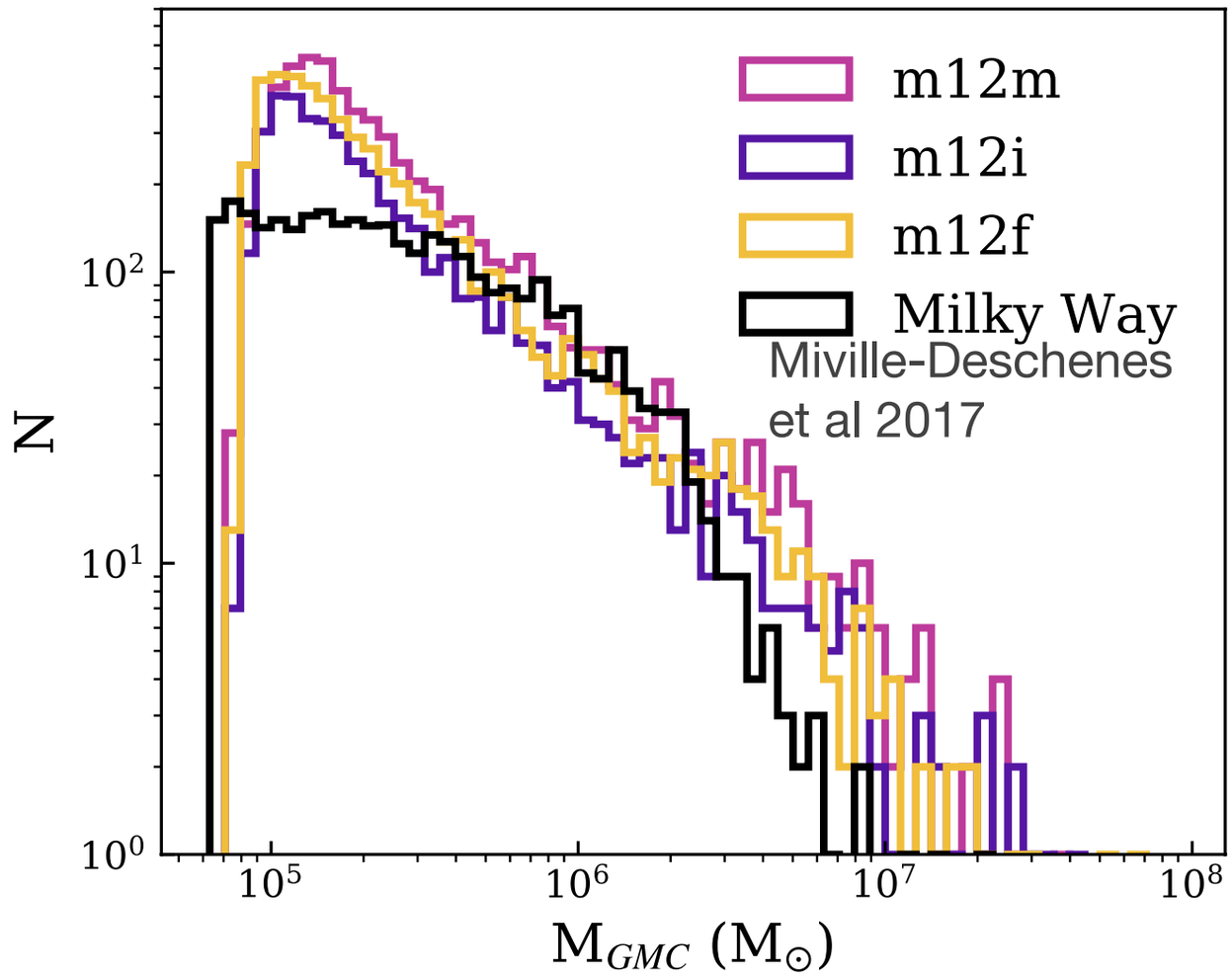
UCDAVIS

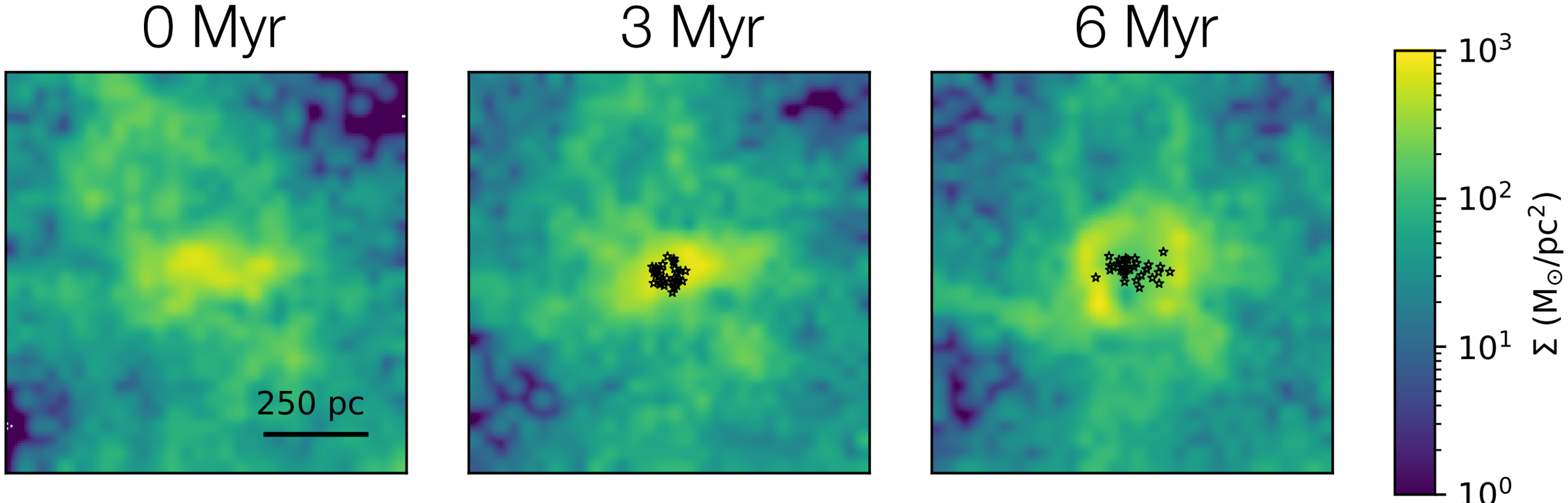
resolving (massive) GMCs

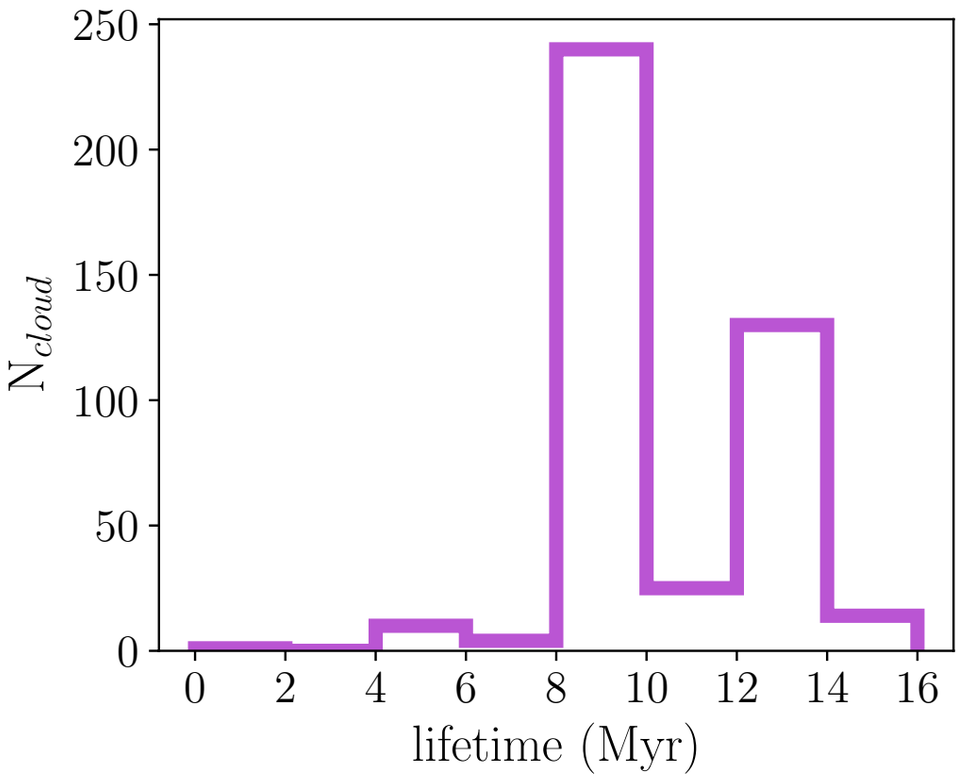
Benincasa, Loebman, Wetzel et al in prep





GMC lifetimes in FIRE simulations

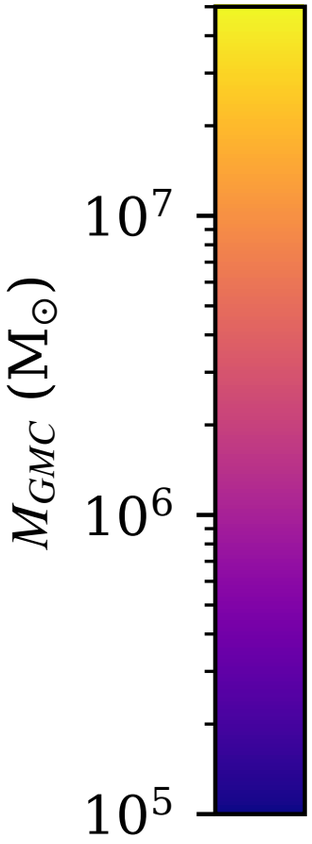


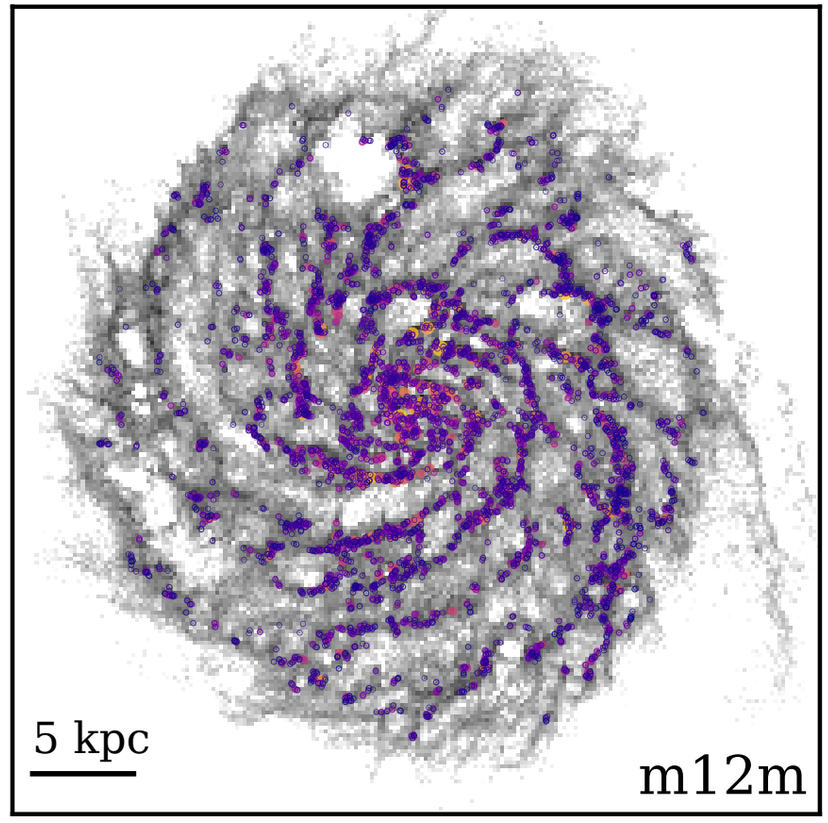


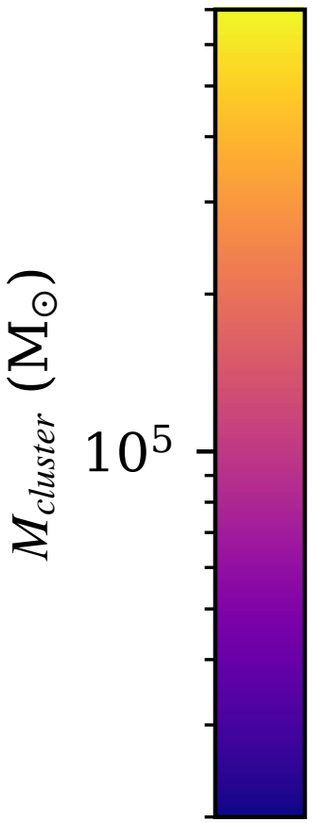
Benincasa, Loebman, Wetzel et al in prep

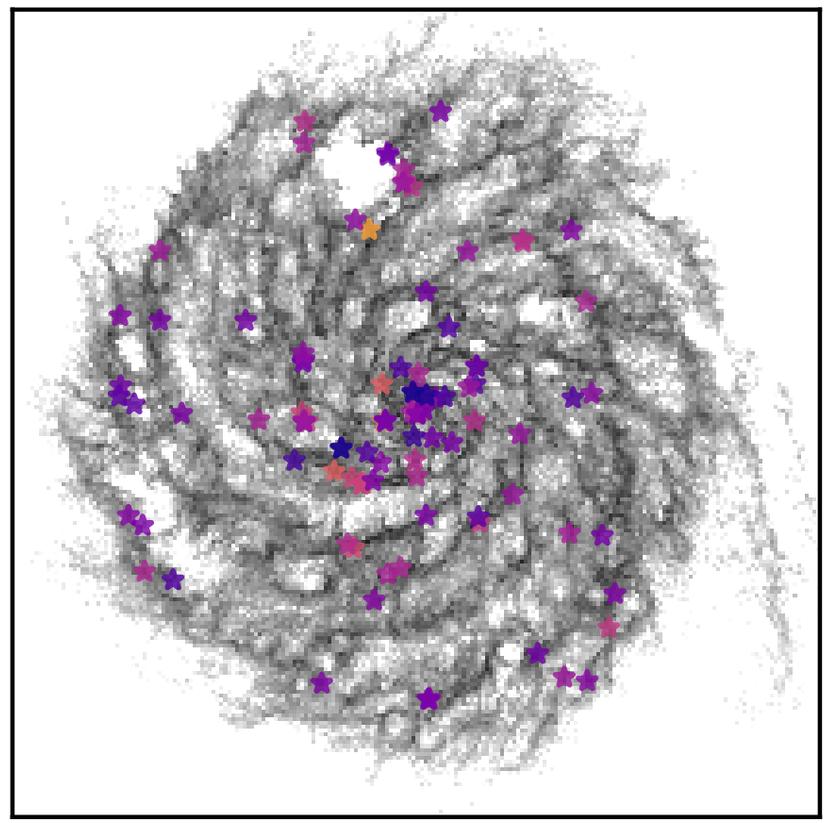
resolving (massive) star clusters

Loebman, Benincasa, Wetzel et al in prep



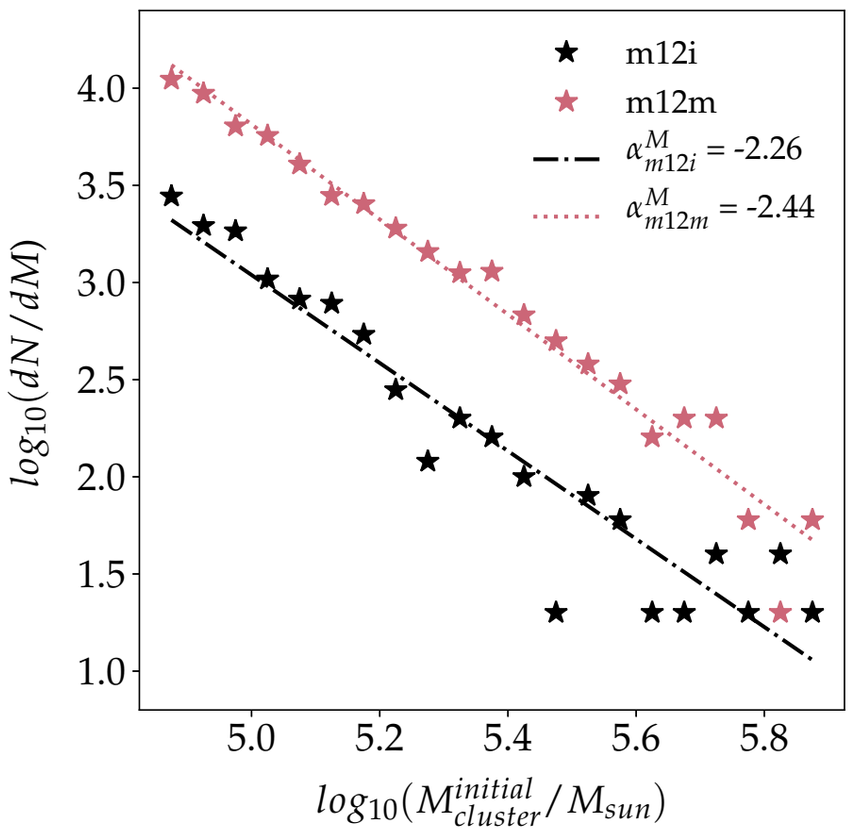


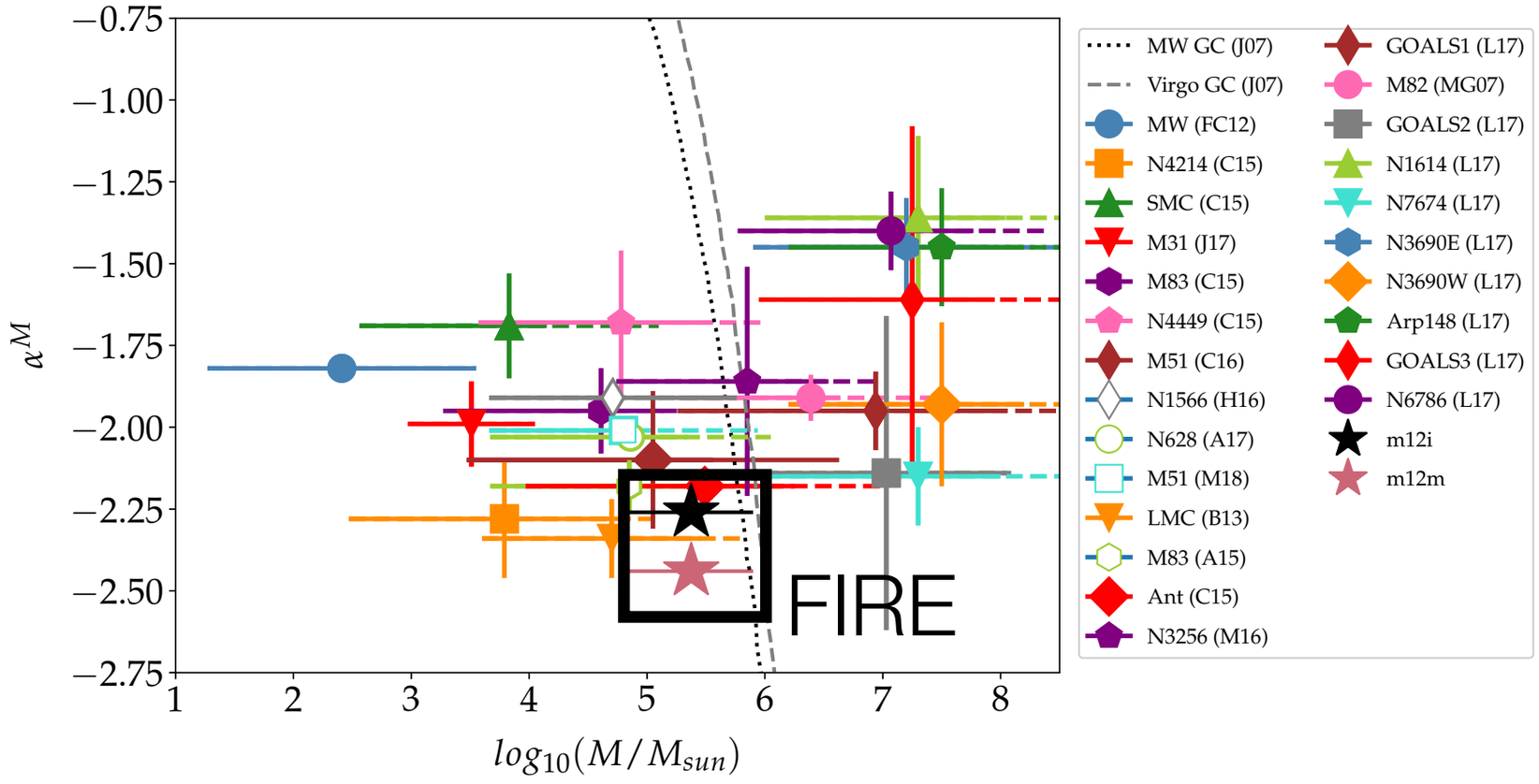




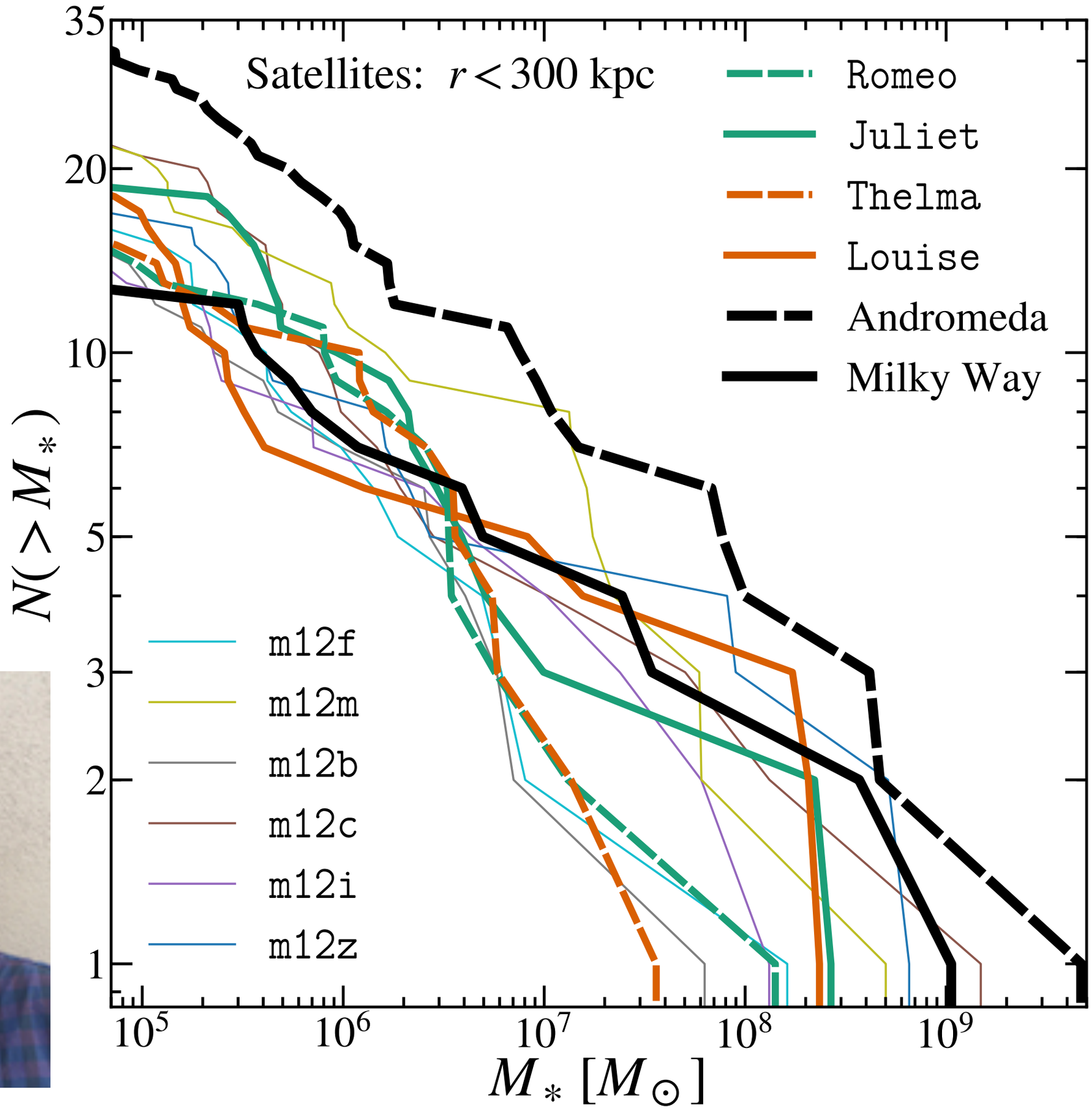
resolving (massive) star clusters

Loebman, Benincasa, Wetzel et al in prep

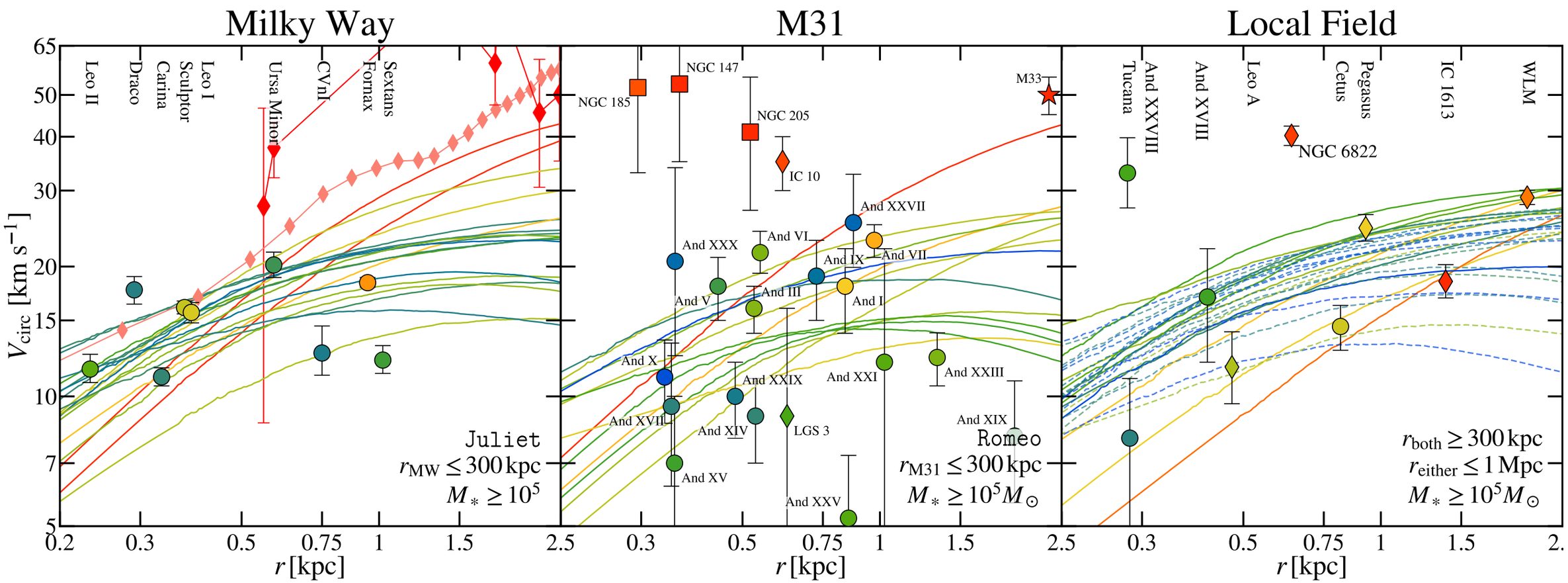




Garrison-Kimmel, Hopkins, Wetzel et al 2019



internal velocity (density) profile of dwarf



Garrison-Kimmel, Hopkins, Wetzel et al 2019

FIRE simulations form too few dense dwarf galaxies

MORE RIGOROUS TEST

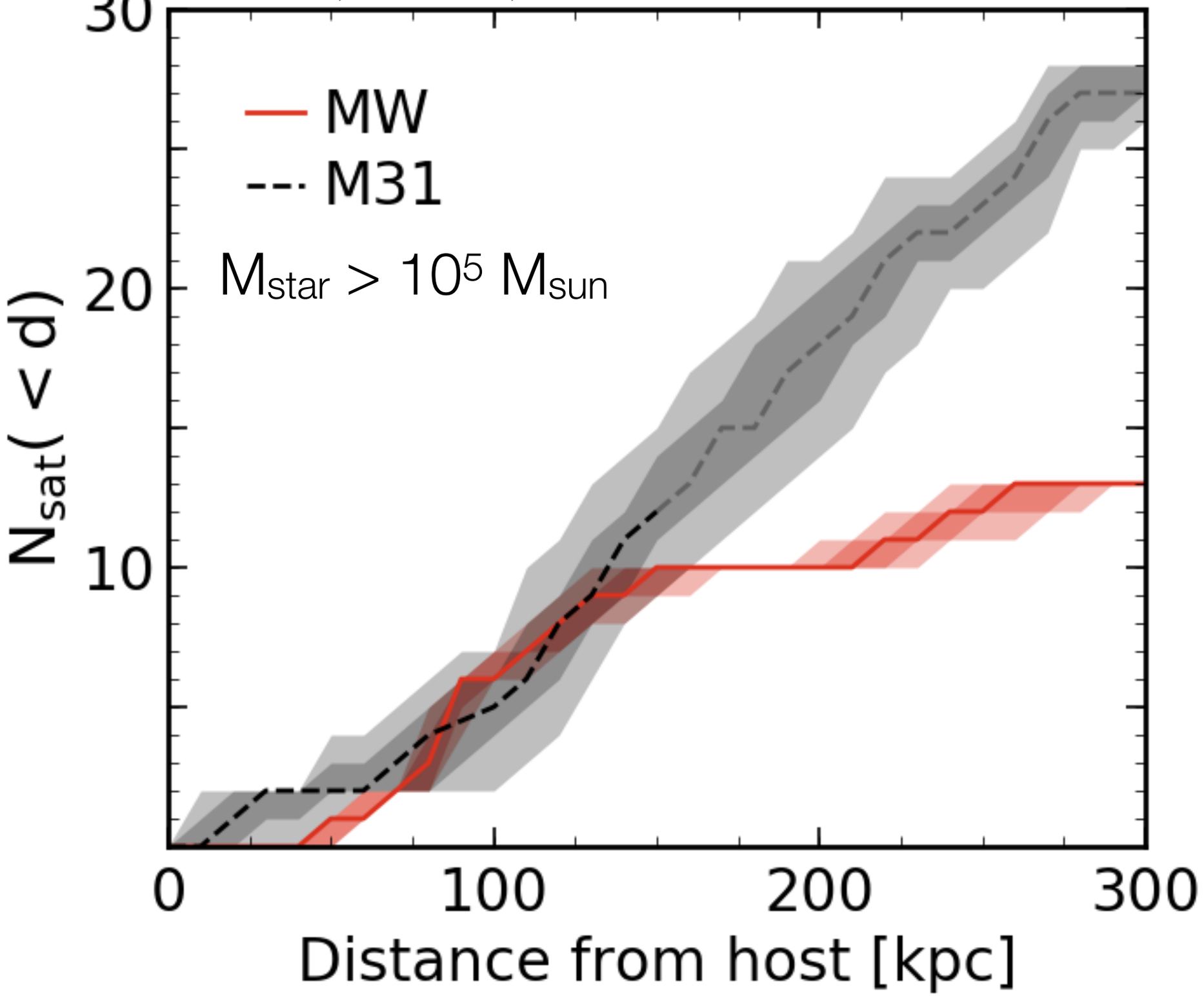
WHAT ABOUT SPATIAL DISTRIBUTION OF SATELLITES?

Jenna Samuel
(grad student @ UC Davis)

Erik Tollerud

observed distances of satellite dwarf galaxies

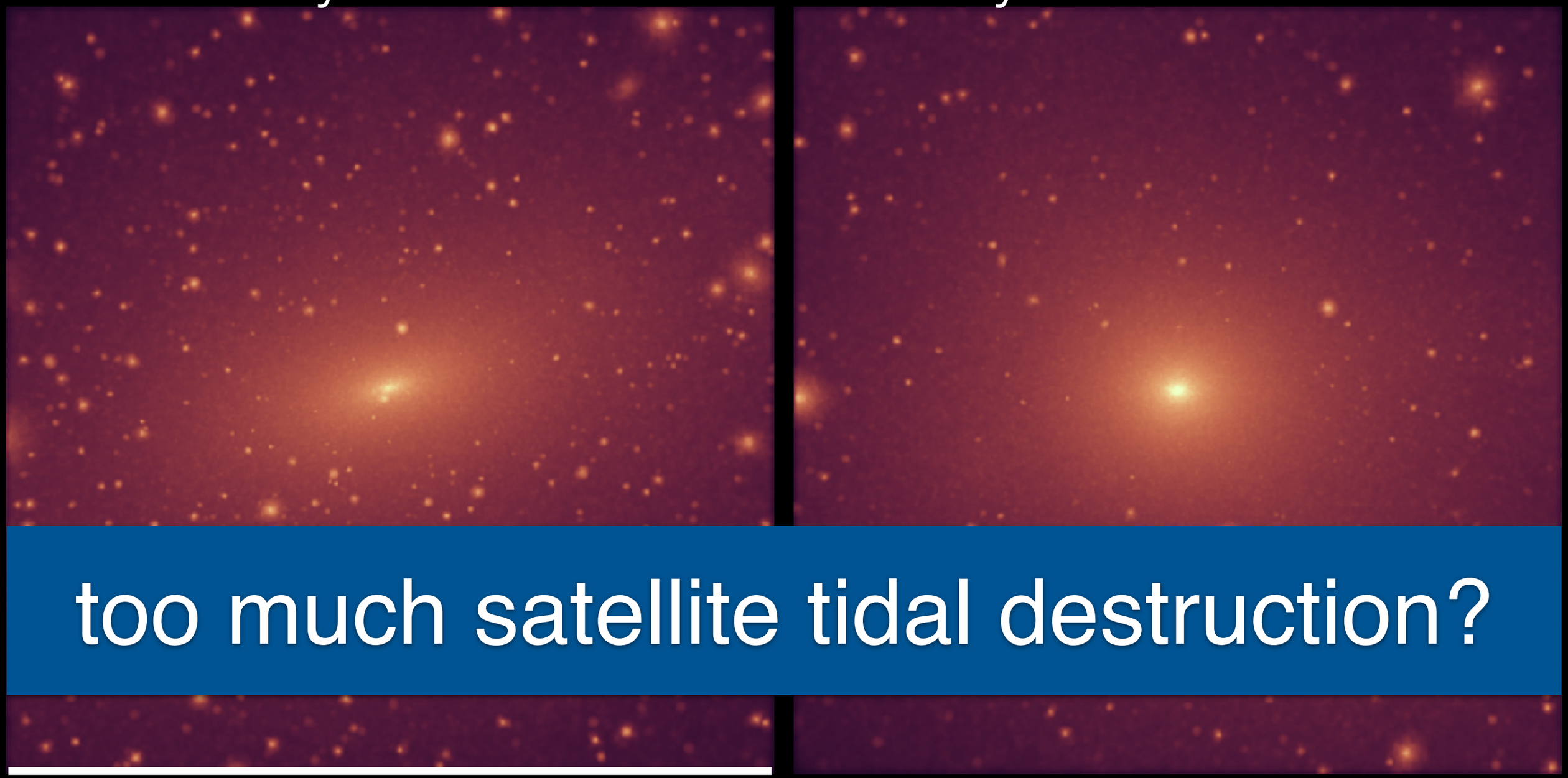
Samuel, Wetzel, Tollerud et al 2019



images of dark matter in

DM-only simulation

baryonic simulation



too much satellite tidal destruction?

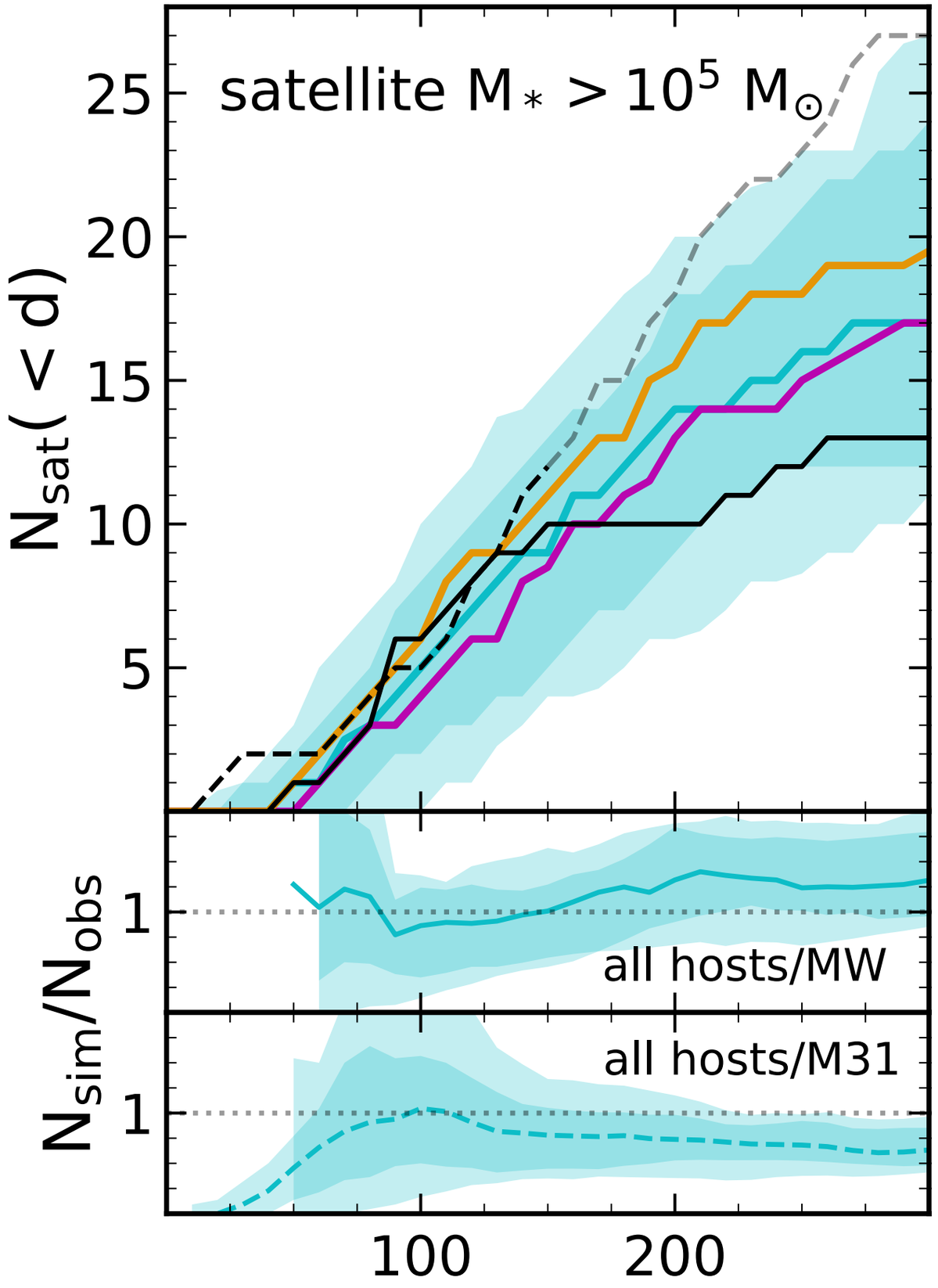
100 kpc

Garrison-Kimmel, Wetzel et al 2017

central galaxy destroys subhalos

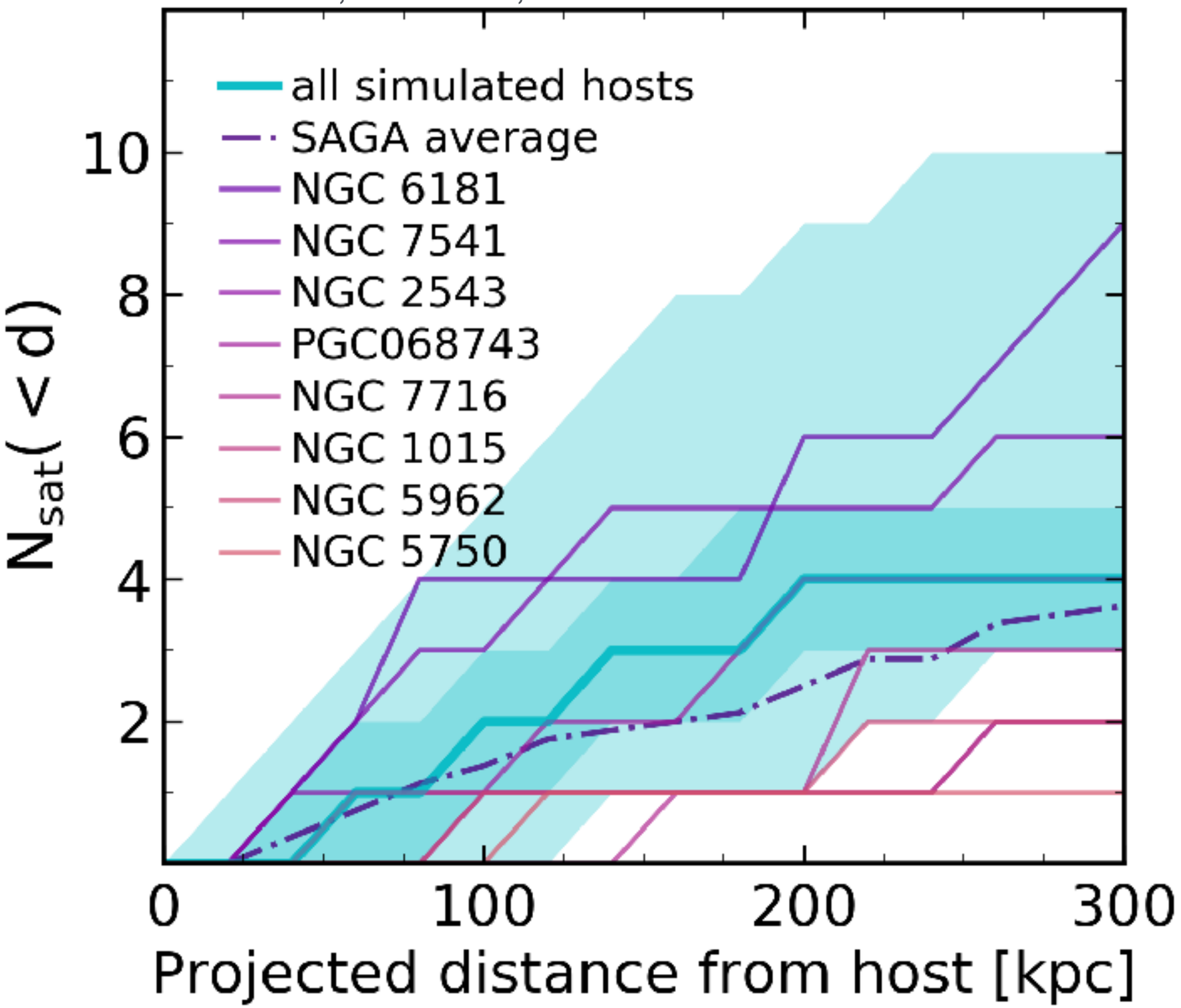
FIRE simulations broadly agree with MW + M31 down to d <~ 50 kpc

Samuel, Wetzel, Tollerud et al 2019



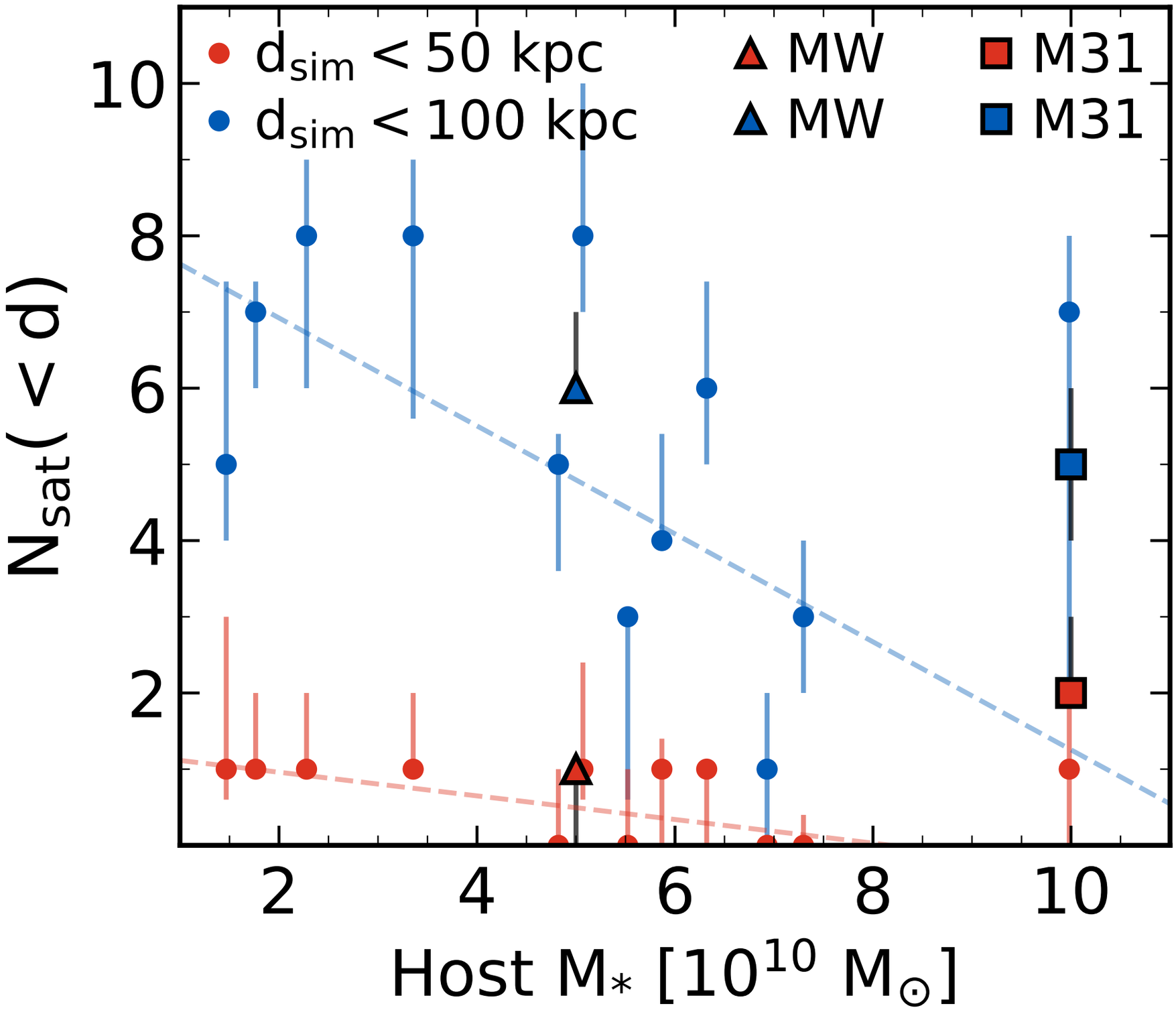
FIRE simulations broadly agree with SAGA survey

Samuel, Wetzel, Tollerud et al 2019



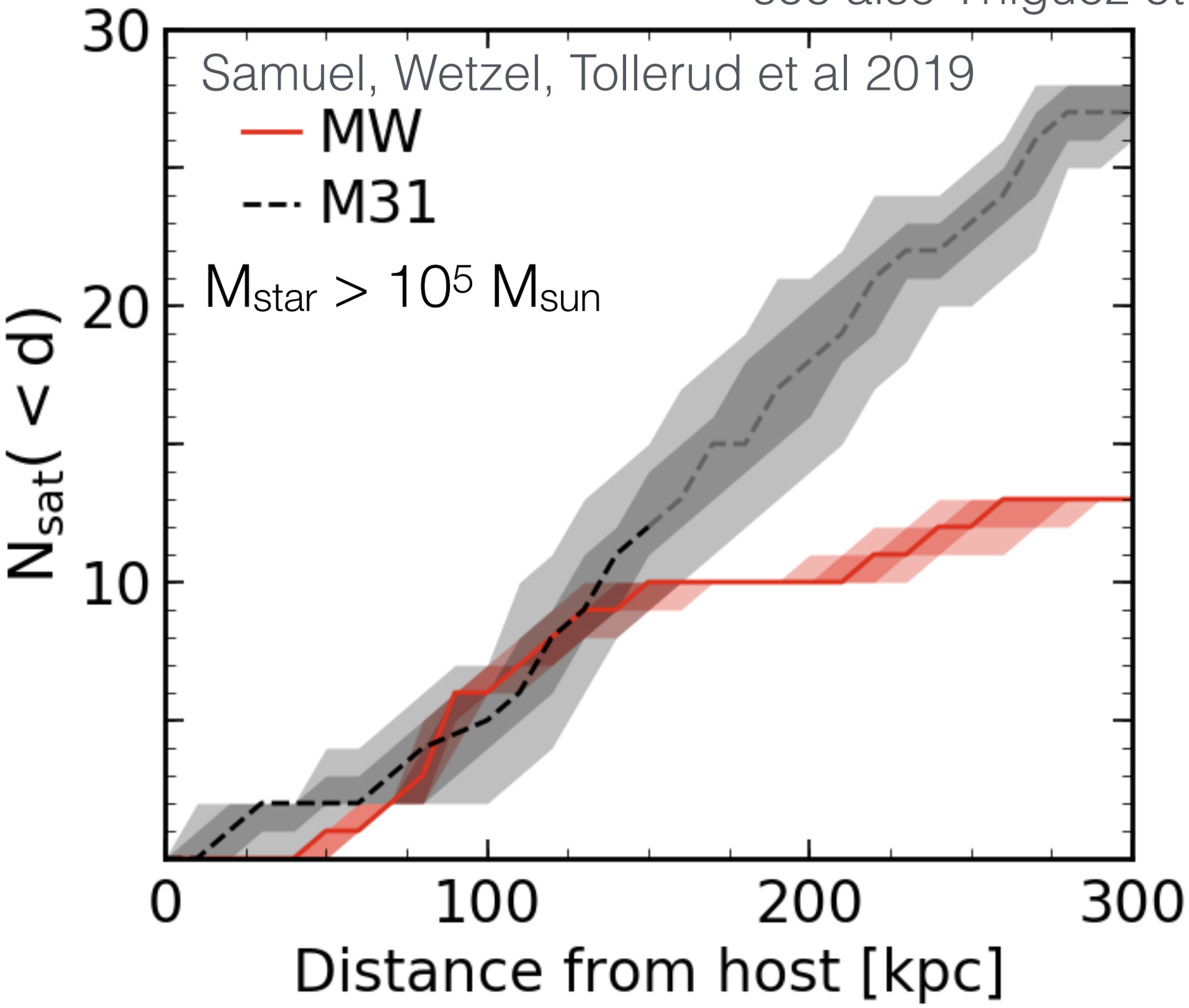
satellite destruction depends on host galaxy mass

Samuel, Wetzel, Tollerud et al 2019



MW satellites are unusually (?) concentrated

see also Yniguez et al 2014



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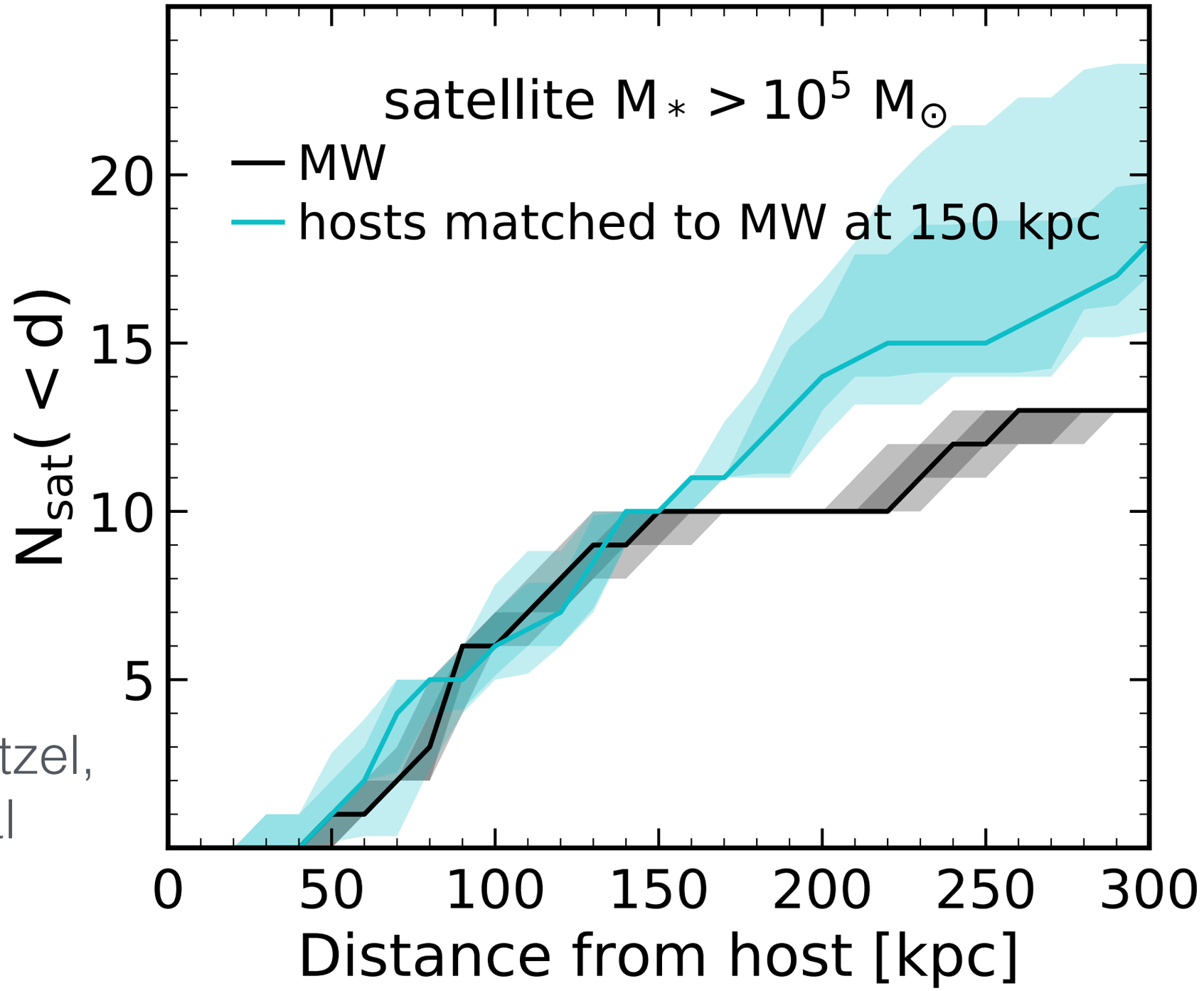


Samuel, Wetzel, Tollerud et al 2019

- no simulated host (even across time) is as concentrated as MW
- predict ~4 more ‘classical’ dwarf galaxies around MW

WHAT ABOUT (ULTRA-FAINT) SATELLITES OF THE LMC?

Ethan Jahn
(grad student @ UC Riverside)

Laura Sales

m11q
xy

satellites
subhalos
virial radius

6.32e3
3.36e4
1.43e7
1.23e4
6.4e3
1.56e5
3.3e4
5.67e3

25 kpc

m11q-DM
xy

virial radius

25 kpc

m11c
xy

25 kpc

m11d
yz

25 kpc

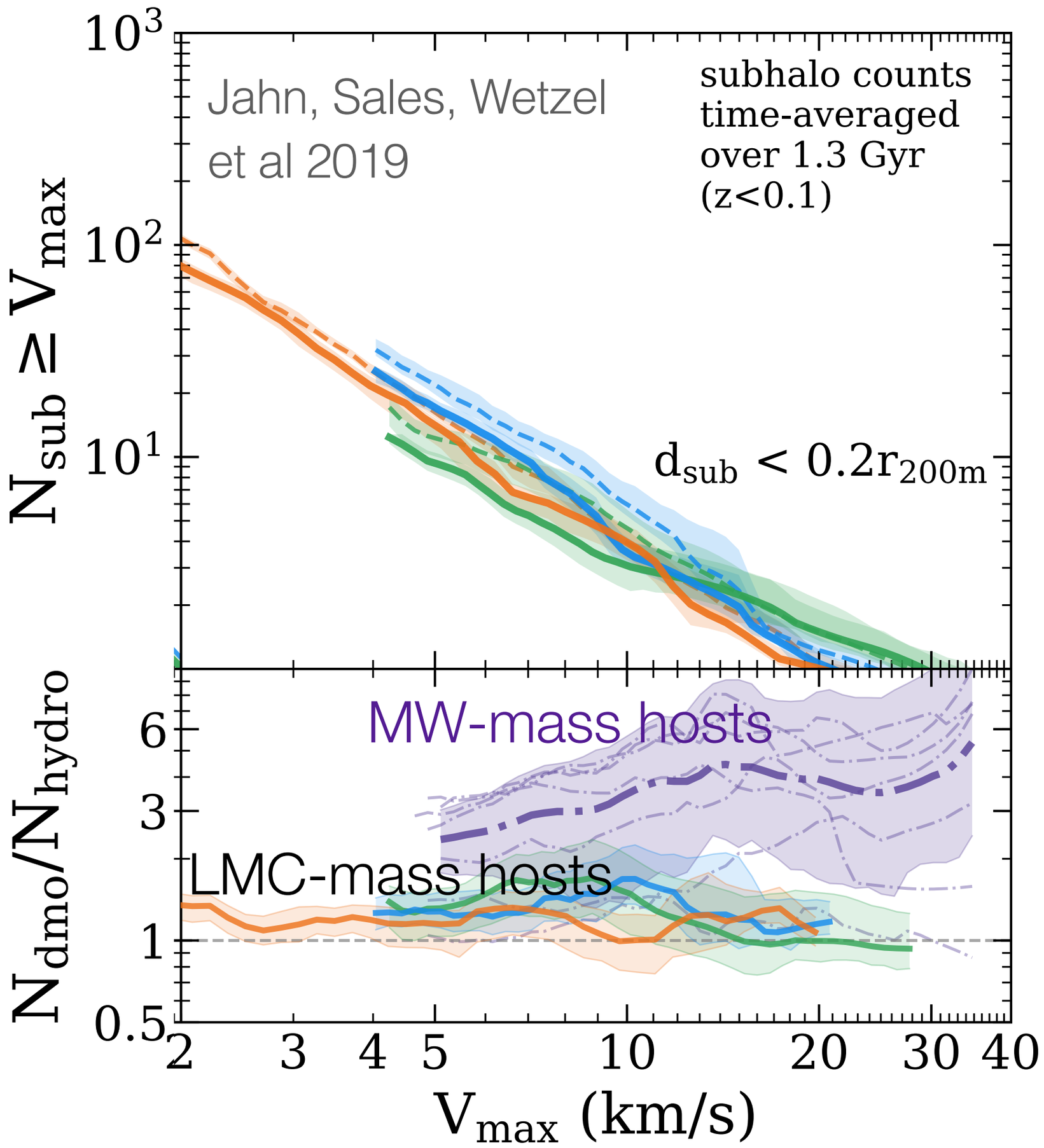
m11e
yz

25 kpc

m11v
xy

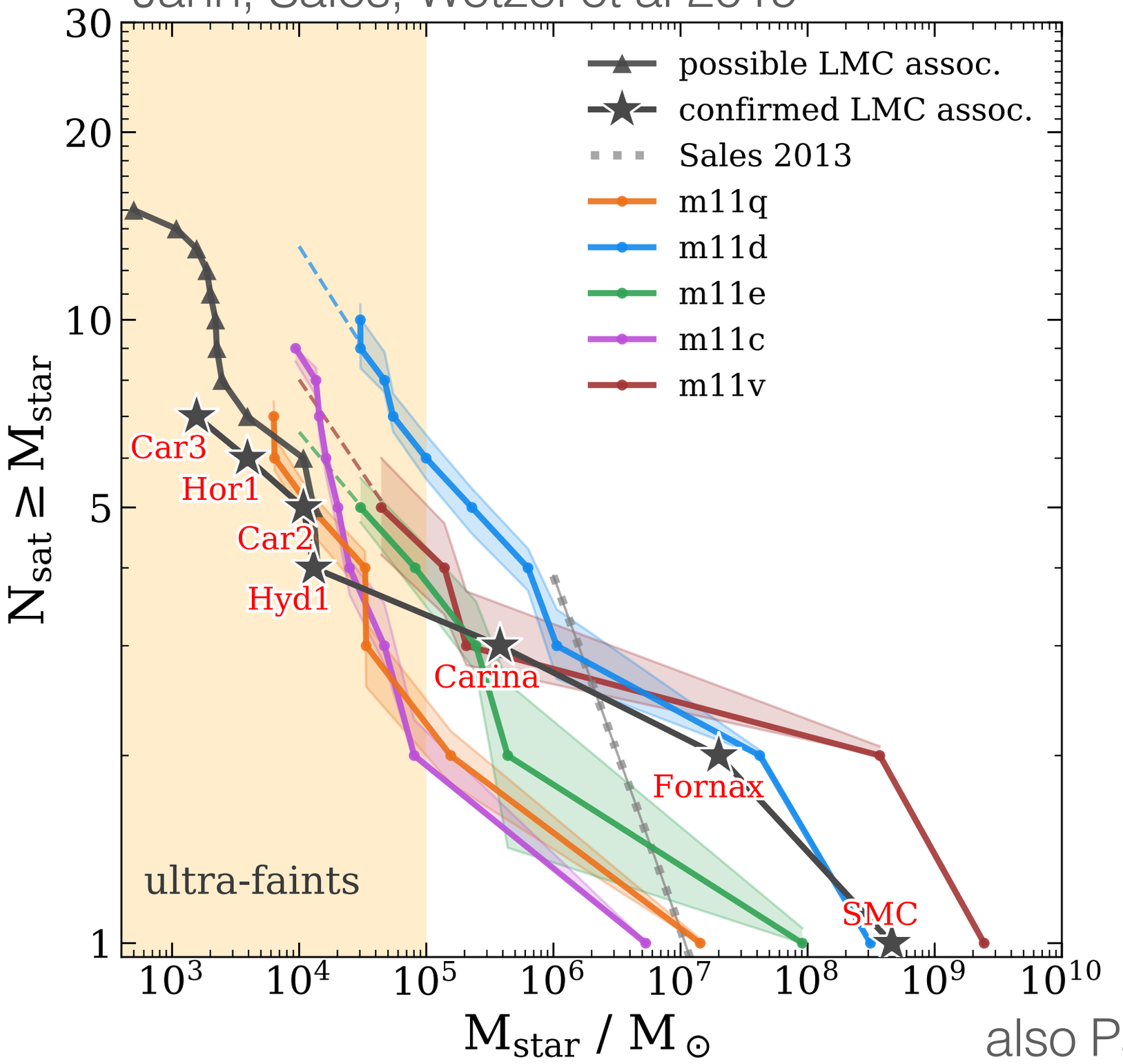
25 kpc

LMC-mass host galaxies: little tidal destruction of satellites



satellites of LMC-mass hosts in FIRE simulations

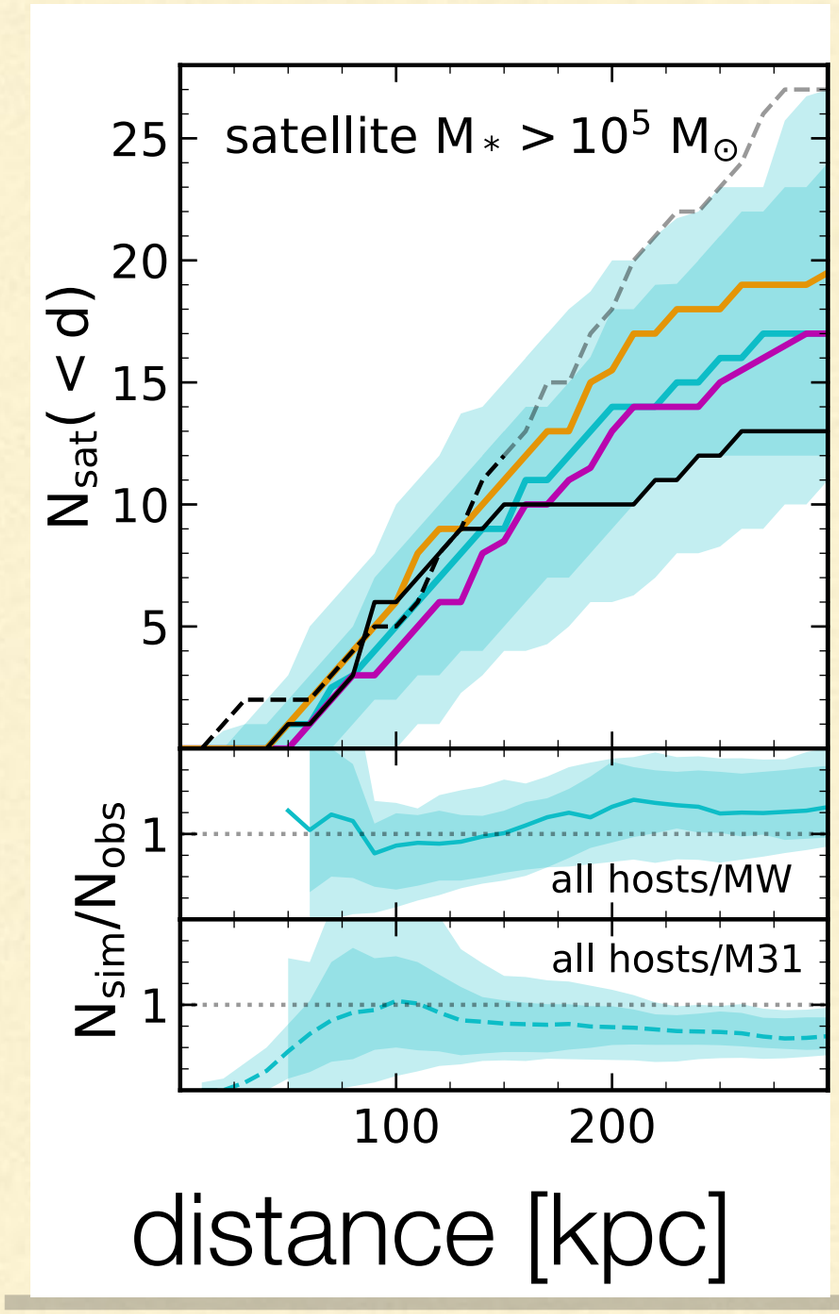
Jahn, Sales, Wetzel et al 2019

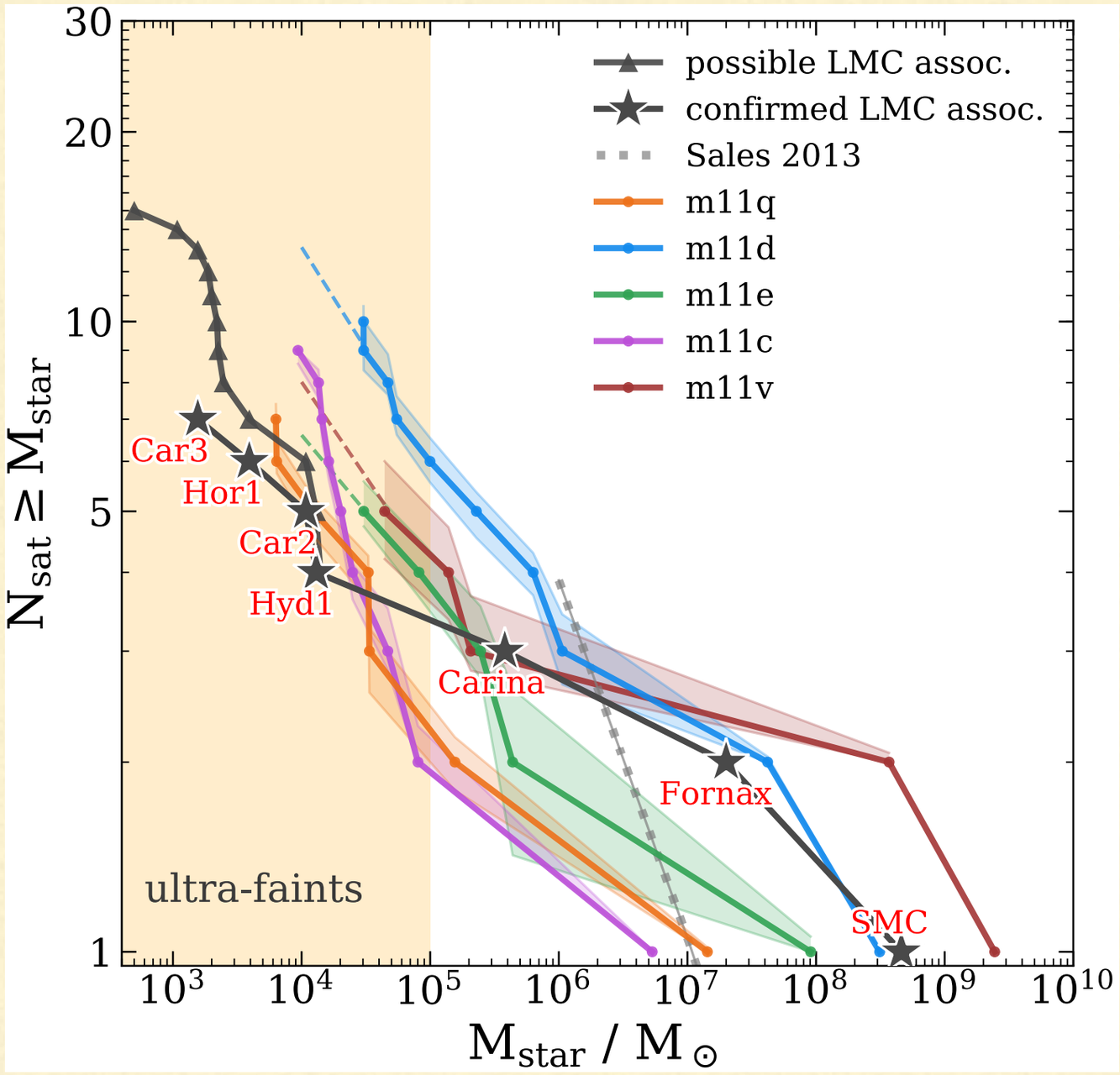


also Pardy et al 2019

THE MILKY WAY + M31 + LMC ON FIRE

Feedback In Realistic Environments





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