Galaxies in the core of simulated galaxy clusters

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The sample for Galaxy-Galaxy Strong Lensing studies

Hubble Frontier Fields clusters:

- A2744 (z=0.308)
- A370 (z=0.375)
- MACSJ1149 (z=0.542)
- MACSJ0717 (z=0.545)

CLASH clusters:

- RXJ2129 (z=0.234)
- MACSJ193
- MACSJ0329 (z=0.450)
- MACSJ2129 (z=0.5871)

Reference Sample:

- MACSJ1206 (z=0.439)
- MACSJ0416 (z=0.397)
- AS1063 (z=0.348)

(see Caminha+19, Bergamini+19, Meneghetti+20, Granata+22)

Galaxy-Galaxy Strong Lensing

Reference Sample:

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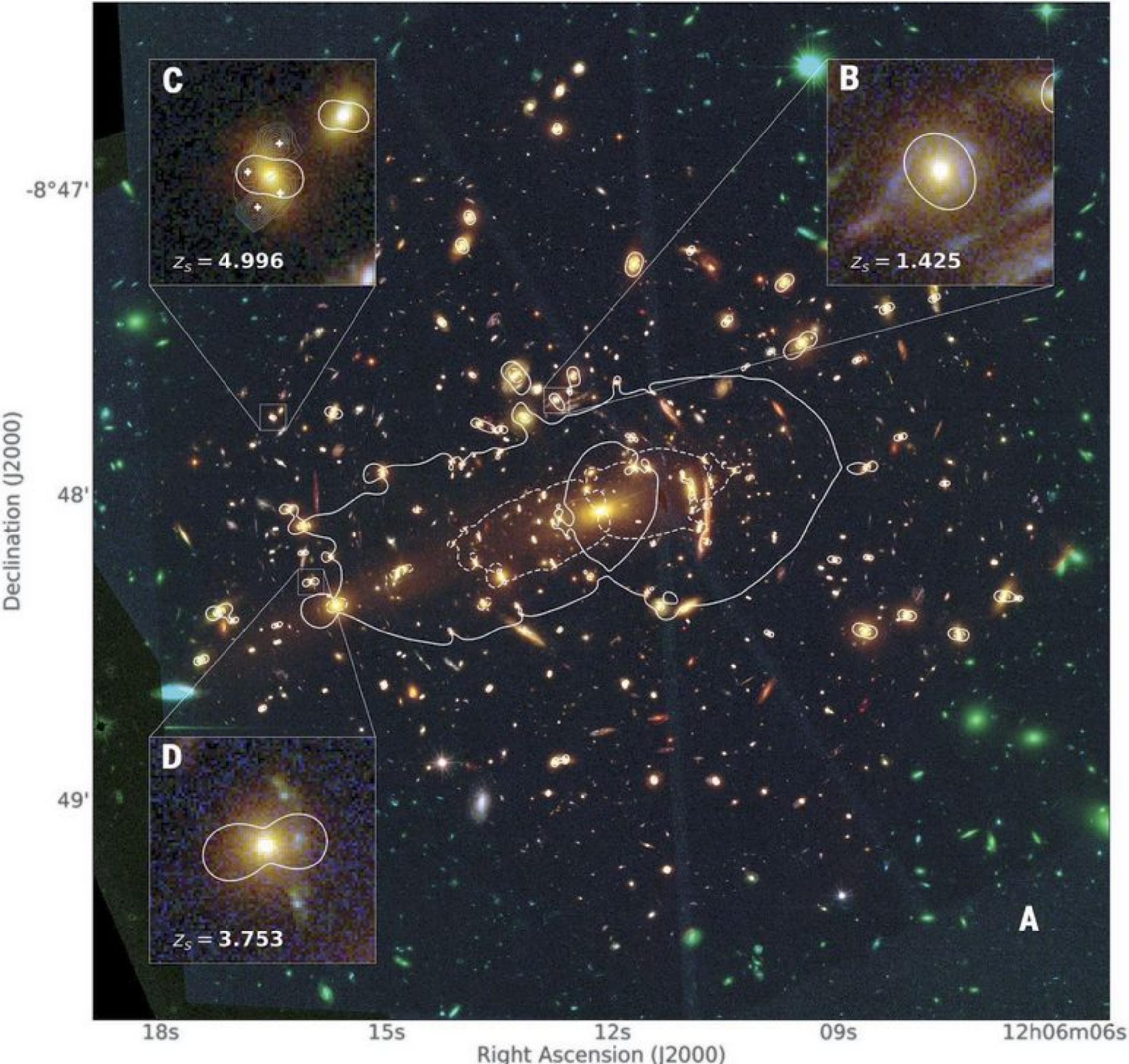
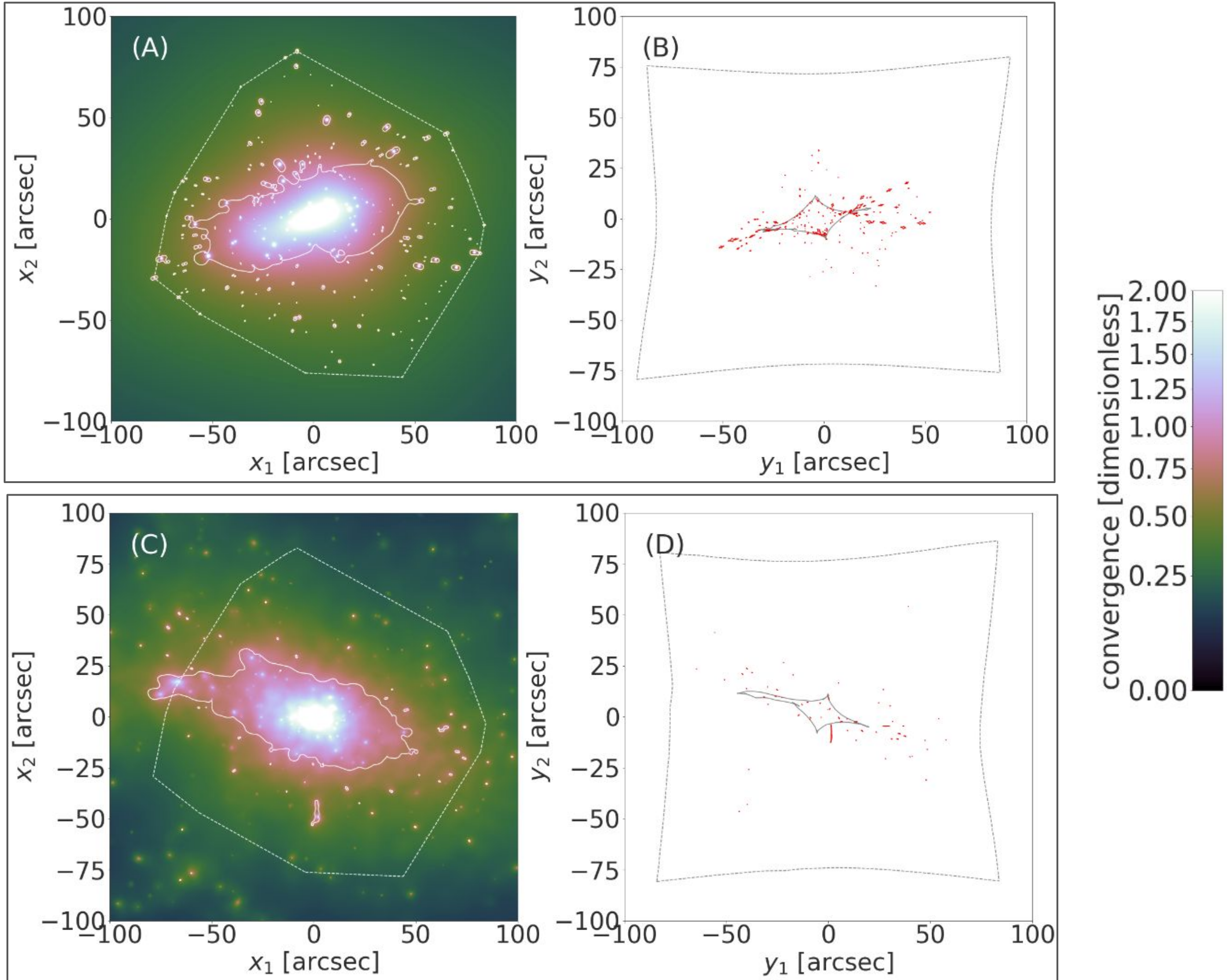
Subhaloes are concentrated enough to act as individual strong lenses

(see Caminha+19,
Bergamini+19,
Meneghetti+20,
Granata+22)



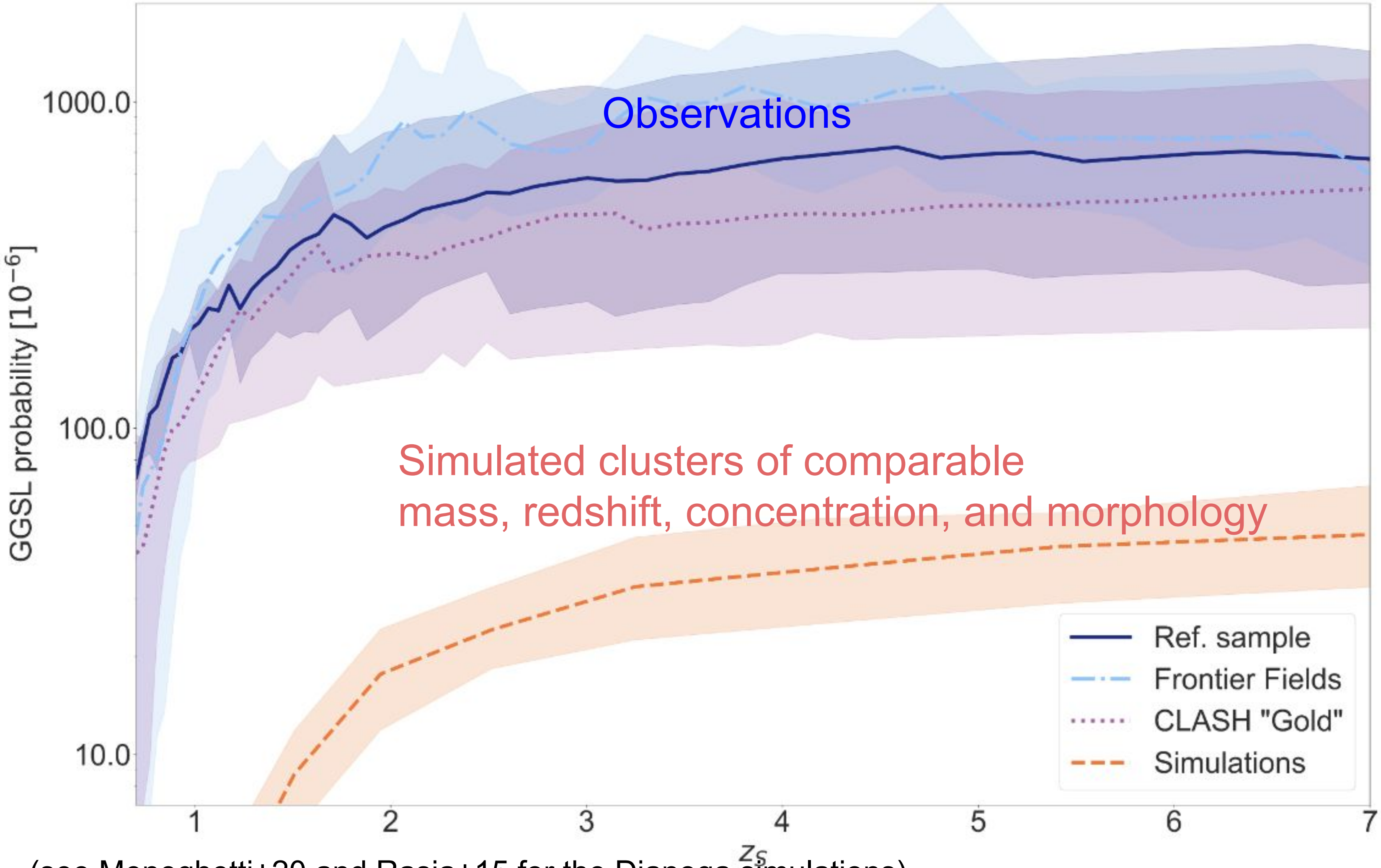
Observations:



GSSL probability:
area covered by
secondary caustic
divided by FoV
mapped back
in the source plane

Simulations:

(see Meneghetti+20,
and Kneib+11 for LENSTOOL)

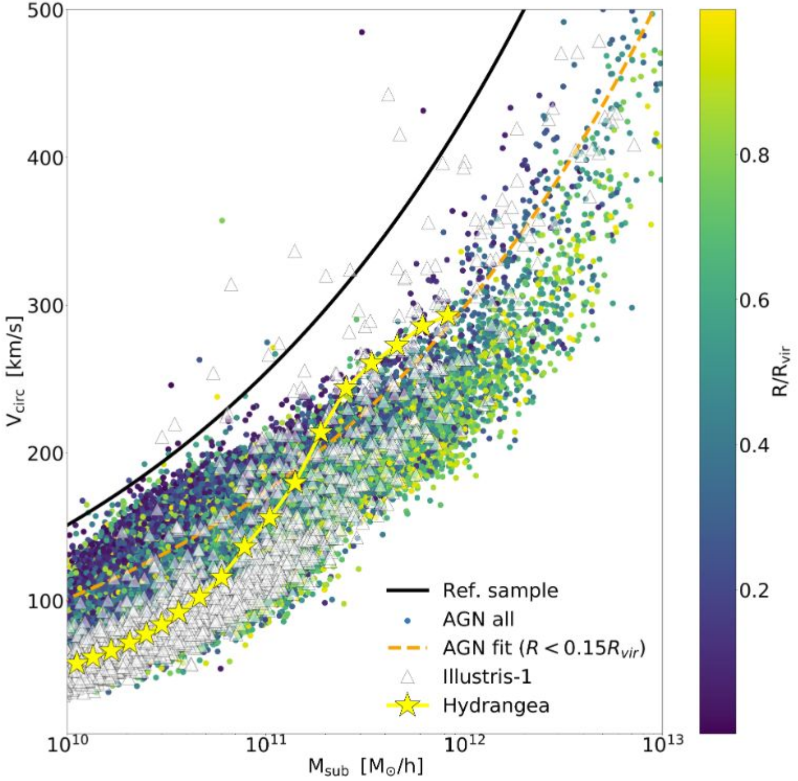


Observations

Simulated clusters of comparable mass, redshift, concentration, and morphology

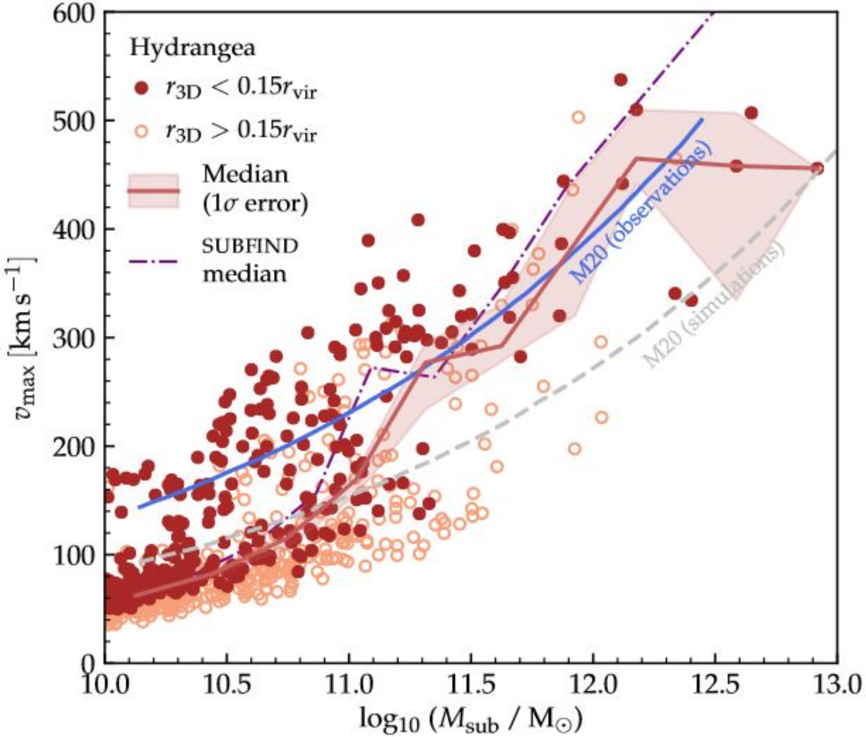
(see Meneghetti+20 and Rasia+15 for the Dianoga simulations)

Subhalo compactness as proxy for GGSL



(see Menghetti+20)

What about resolution pt. 1



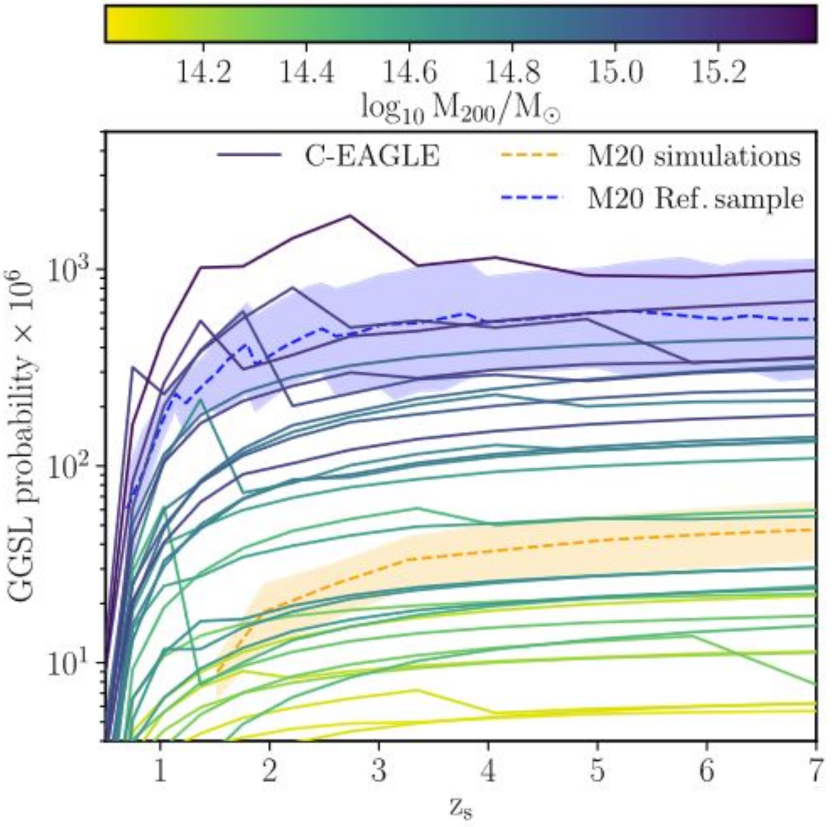
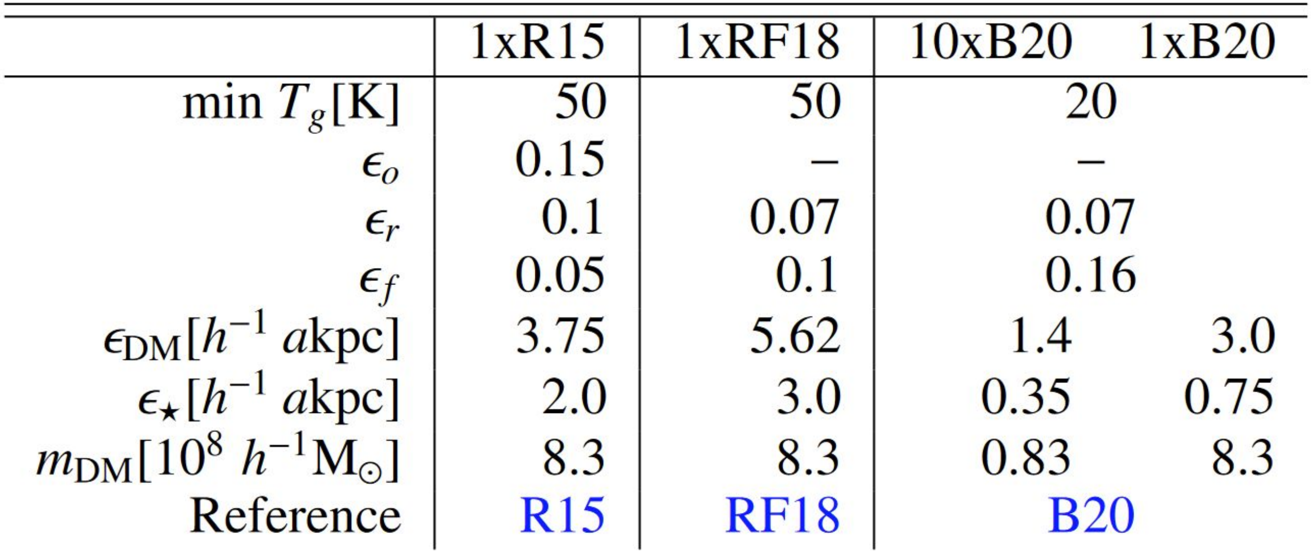


Figure 2. The GGSL probability as a function of source redshift. The dashed lines and associated shaded regions are from M20, while the solid lines are for the C-EAGLE clusters, with the colour indicating the halo mass (see the colour bar at the top).

(see Bahé+21, Robertson+21)

Assessing the role of baryon physics in GGSL

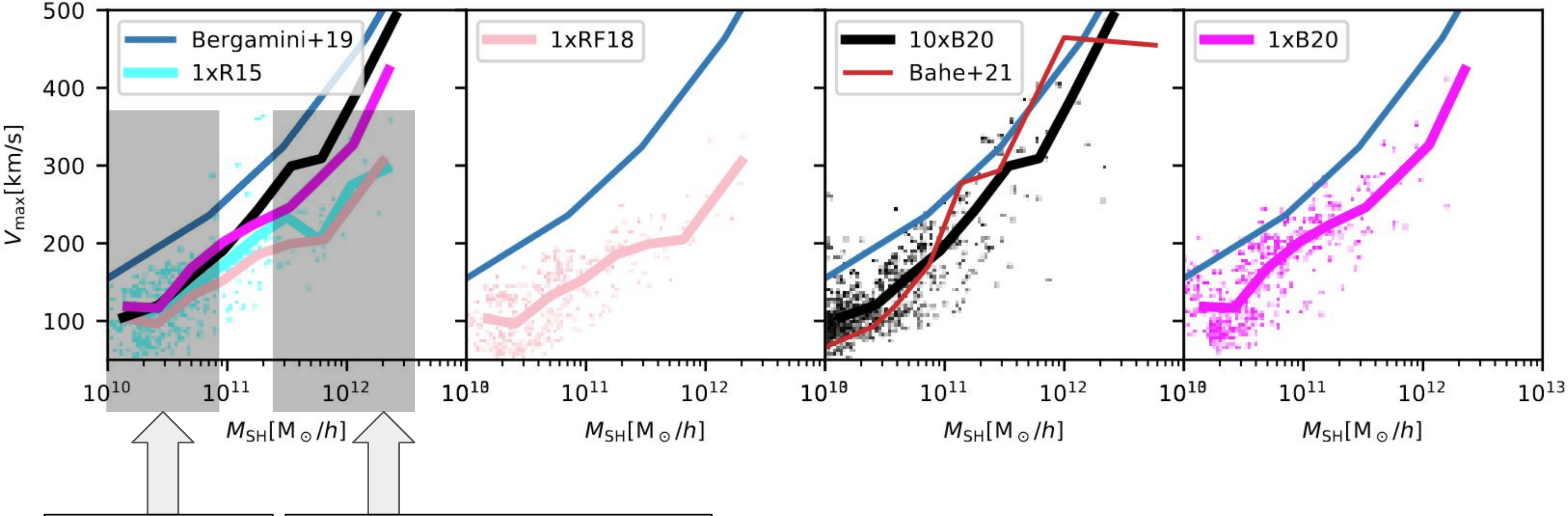
by varying resolution, softening and AGN efficency.



	1xR15	1xRF18	10xB20	1xB20
min T_g[K]	50	50	20	
ϵ_o	0.15	–	–	
ϵ_r	0.1	0.07	0.07	
ϵ_f	0.05	0.1	0.16	
$\epsilon_{\mathrm{DM}}[h^{-1}\ a\mathrm{kpc}]$	3.75	5.62	1.4	3.0
$\epsilon_{\star}[h^{-1}\ a\mathrm{kpc}]$	2.0	3.0	0.35	0.75
$m_{\mathrm{DM}}[10^8\ h^{-1}\mathrm{M}_{\odot}]$	8.3	8.3	0.83	8.3
Reference	R15	RF18	B20	

(see Rasia+15, Ragone-Figueroa+18, Bassini+20, Ragagnin+22)

Subhalo compactenss for different models

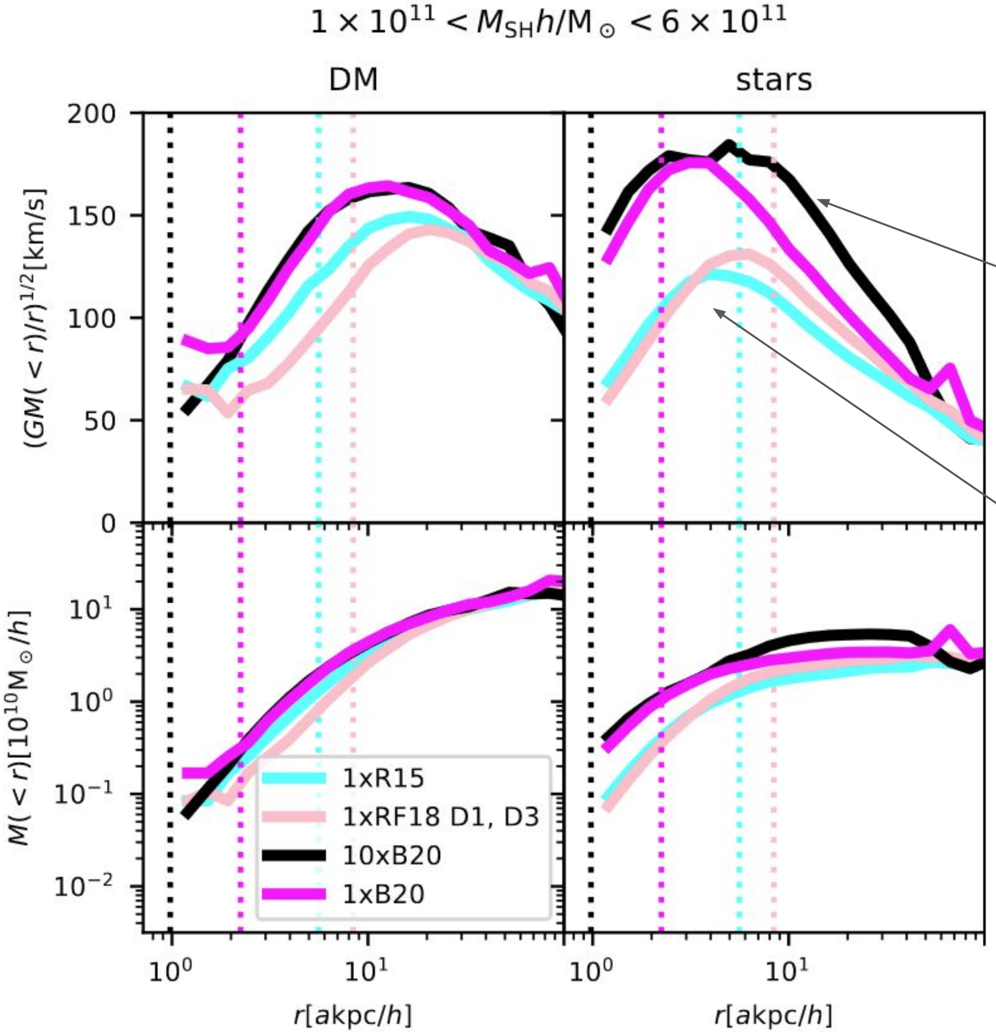


low mass
subhaloes:
below obs!

high mass
subhaloes:
sometimes catch obs

(see Ragagnin+22)

Why some simulations have high compactness?

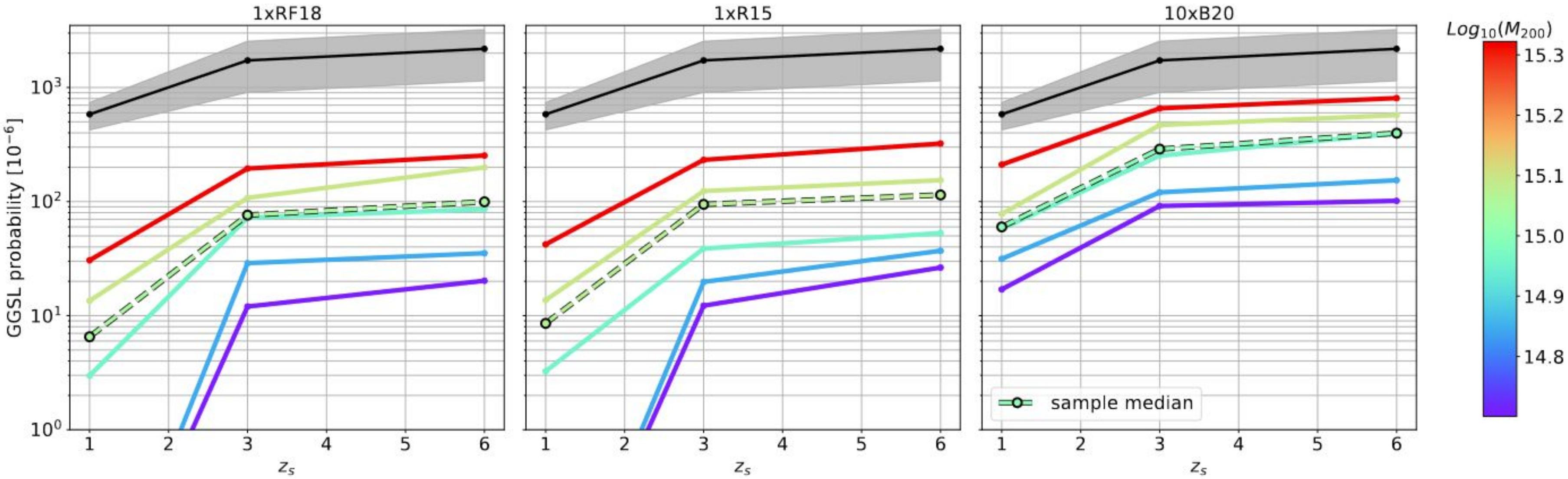


this DO
match GGSL
probability

this DON´t
match GGSL
probability

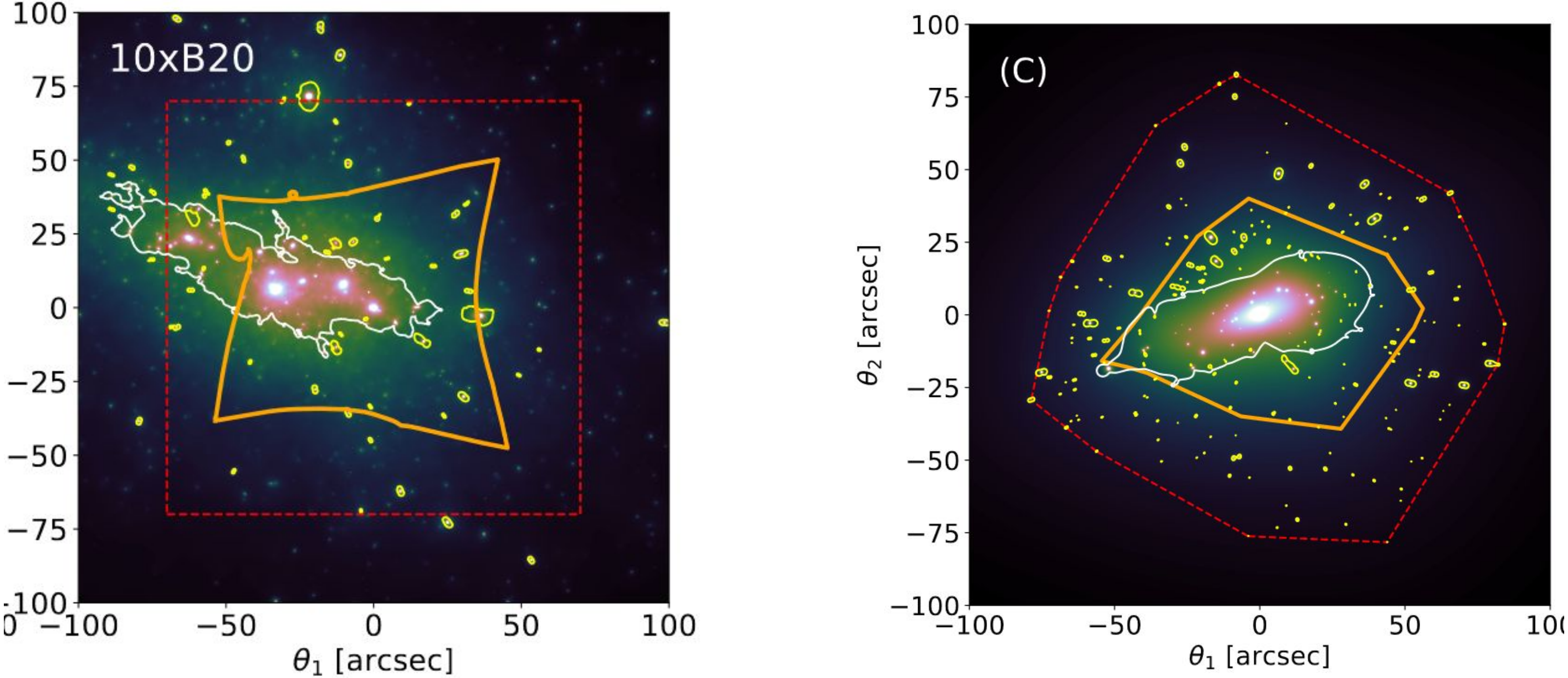
(see Ragagnin+22)

And in terms of GGSL?

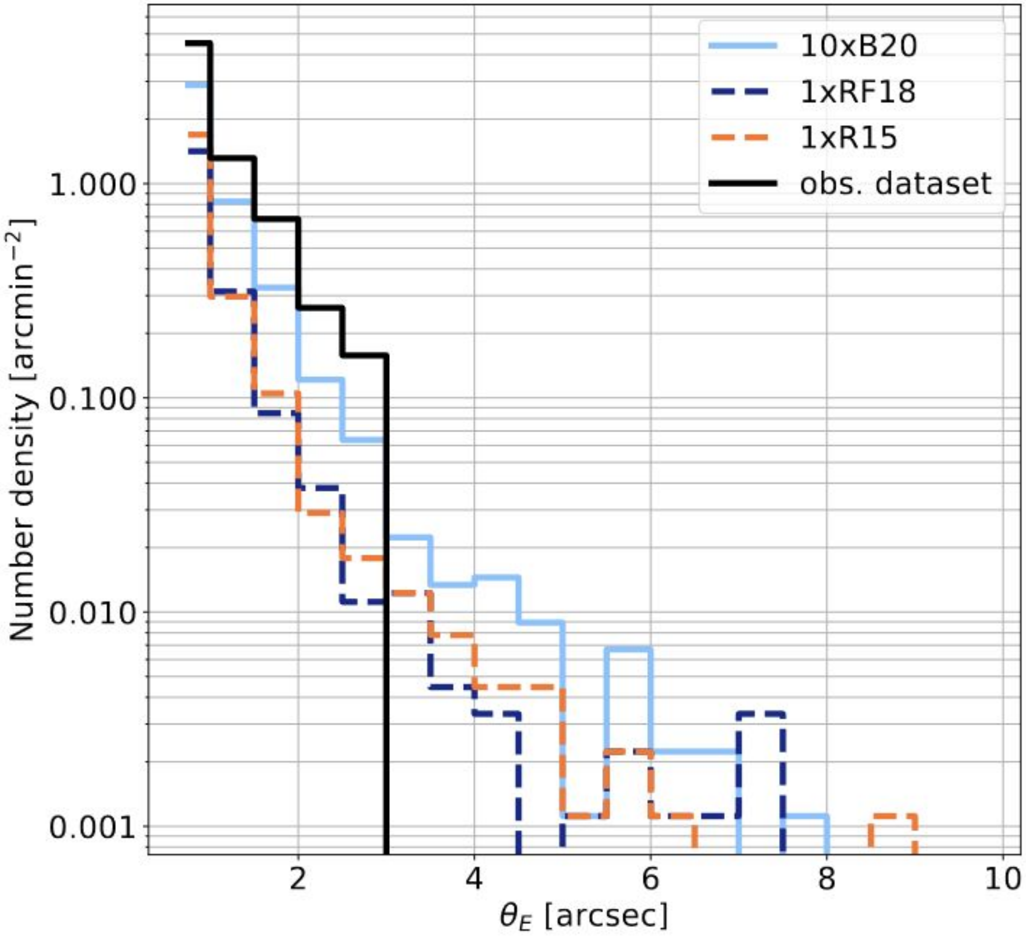


(see Meneghetti+22)

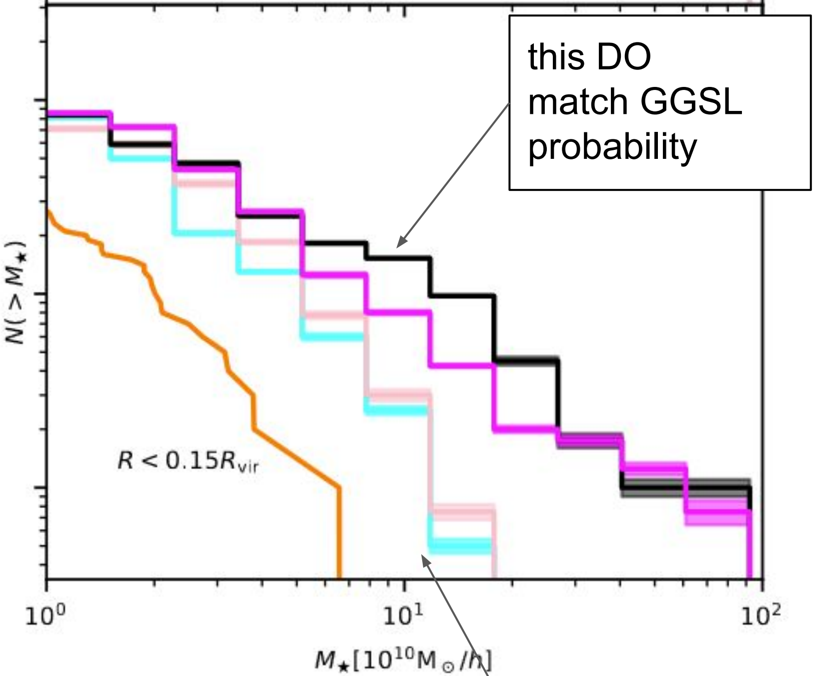
It looks like some simulations can catch observations, however, **critical lines differ qualitatively.**



(Meneghetti+22)



(see Meneghetti+22)



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this DON´T
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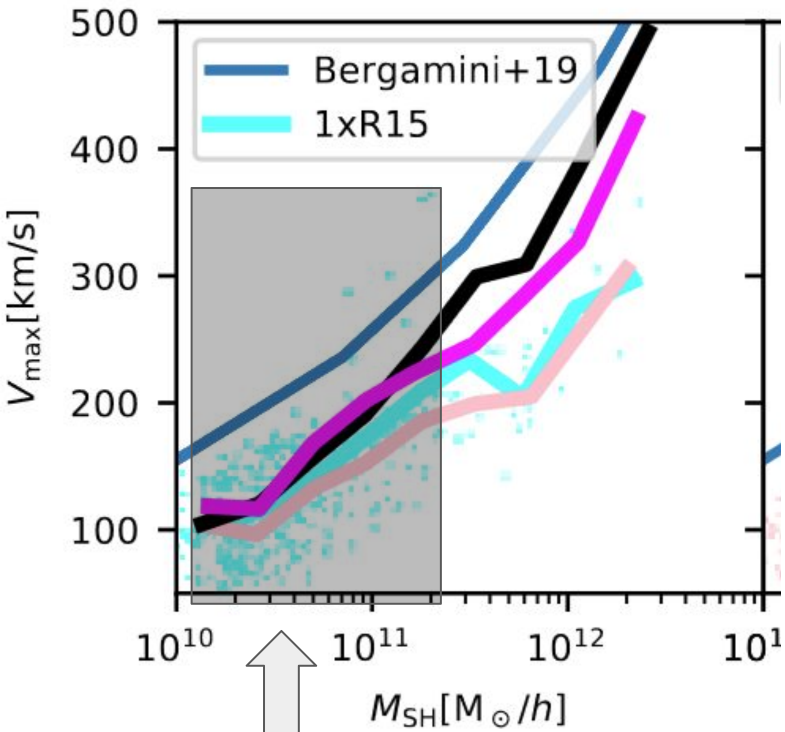
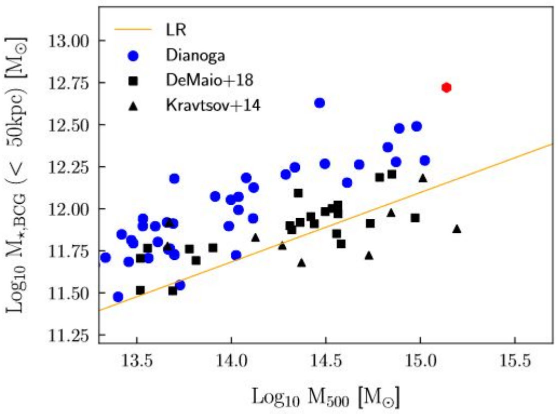
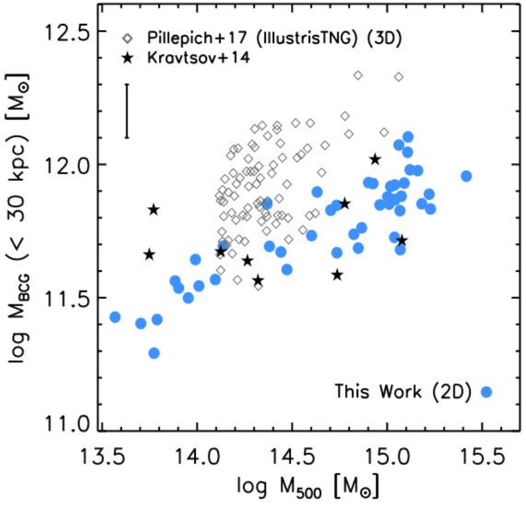
(see Ragagnin+22,
Granata+22,
Bergamni+19)

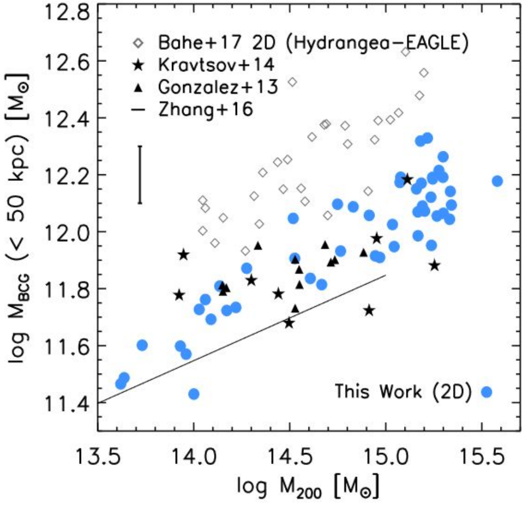


low mass
subhaloes:
below obs!

Lowering stellar masses us already a problem for many sims







(see Bahe+17, Ragone-Figueroa+18, Bassini+20)

Changing dark matter paradigm?

- None of our simulations ca reproduce low-mass subhaloes compactness, which is the mass-regime that affects most observed GGSL

- Some setups can reproduce integrated GGSL probability, however it happens because they overproduce high-mass subhaloes

- In general: increase feedback => lower the number count (good) and lower compactness (not good).

- Can changing DM paradigm improve the situation? SIDM induced core-collapse could increase compactness?