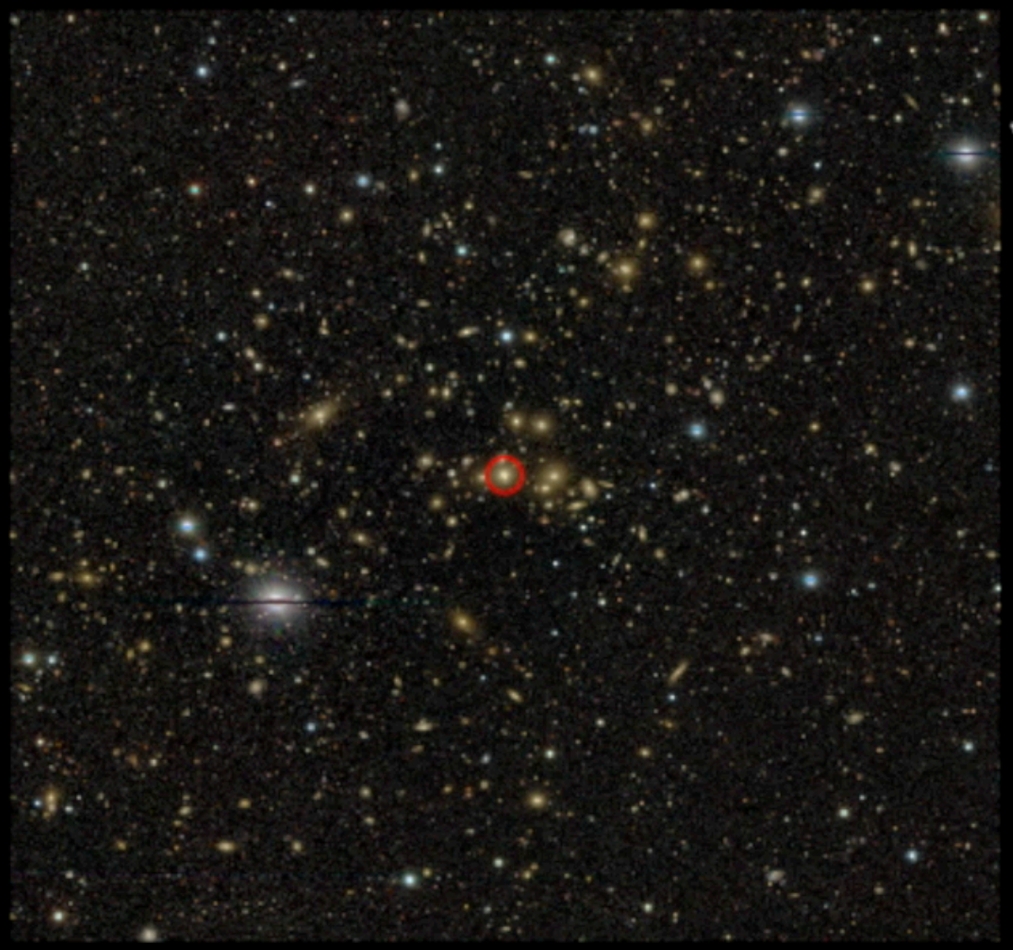
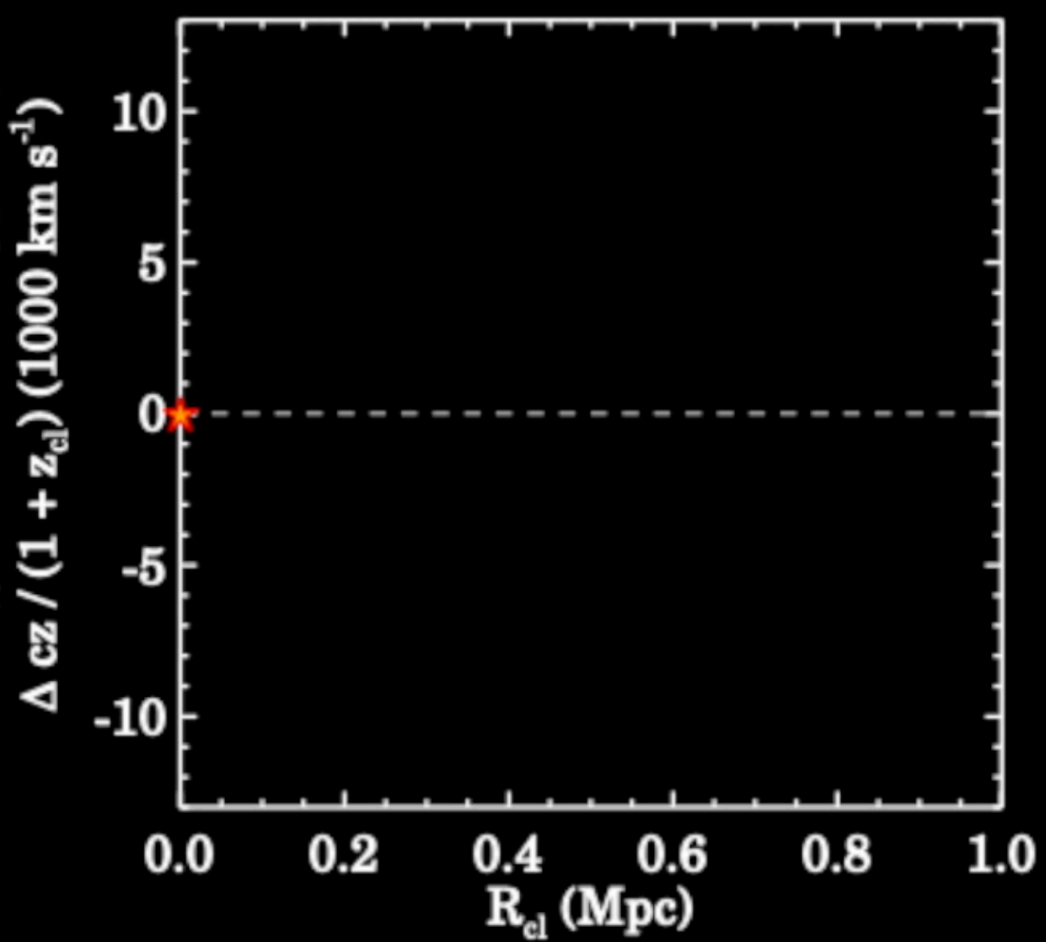
Dynamical Properties of Cluster Galaxies in Dense Spectroscopy and Cosmological Simulations

Jubee Sohn (Seoul National University)

In collaboration with Margaret Geller (CfA), Mark Vogelsberger (MIT), Josh Borrow (MIT)





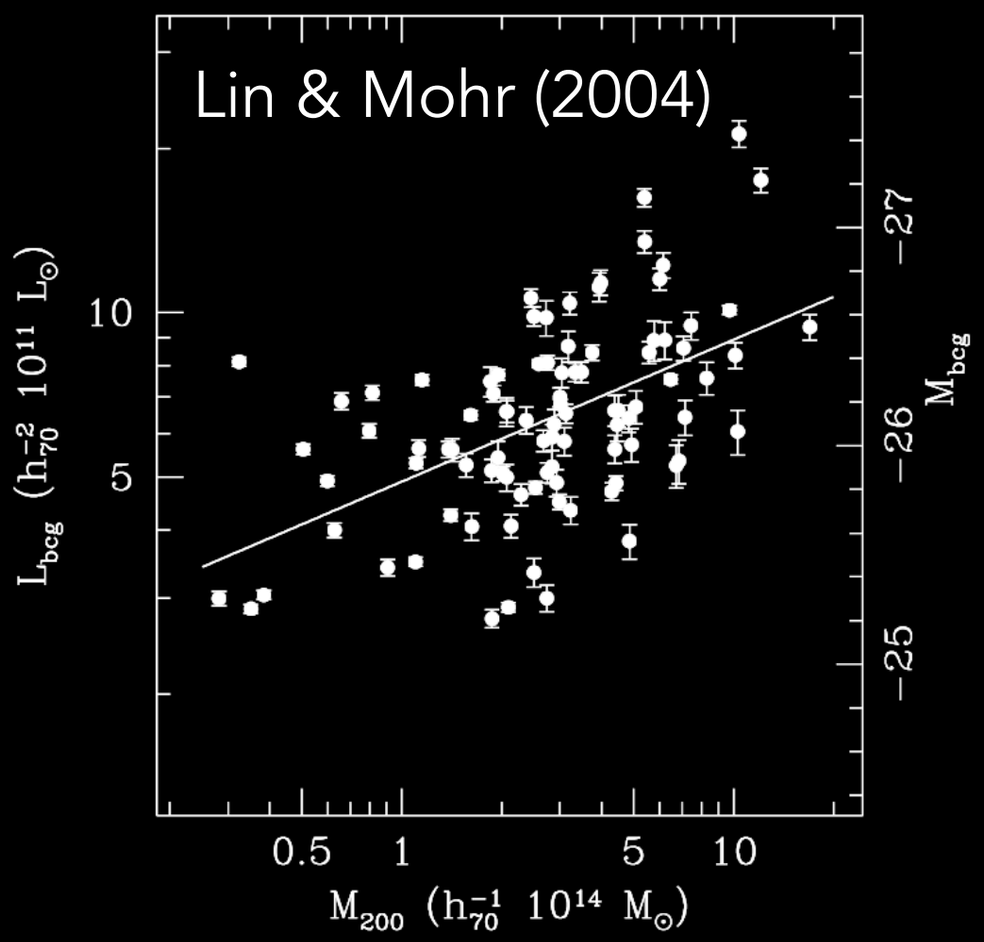
Connecting observables to DM

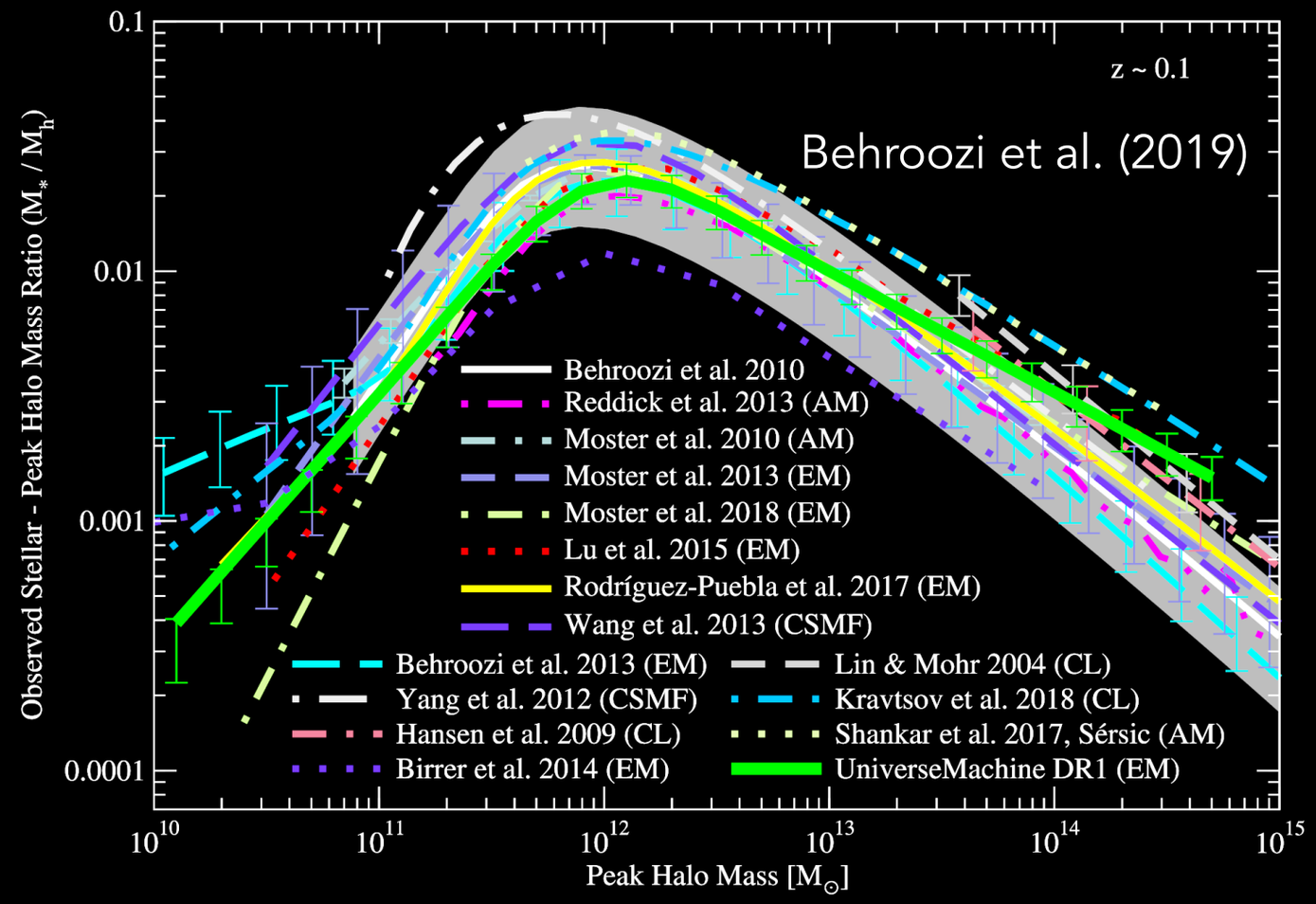
- Galaxy observables and their dark matter (sub)halos
  - Can simulation help?





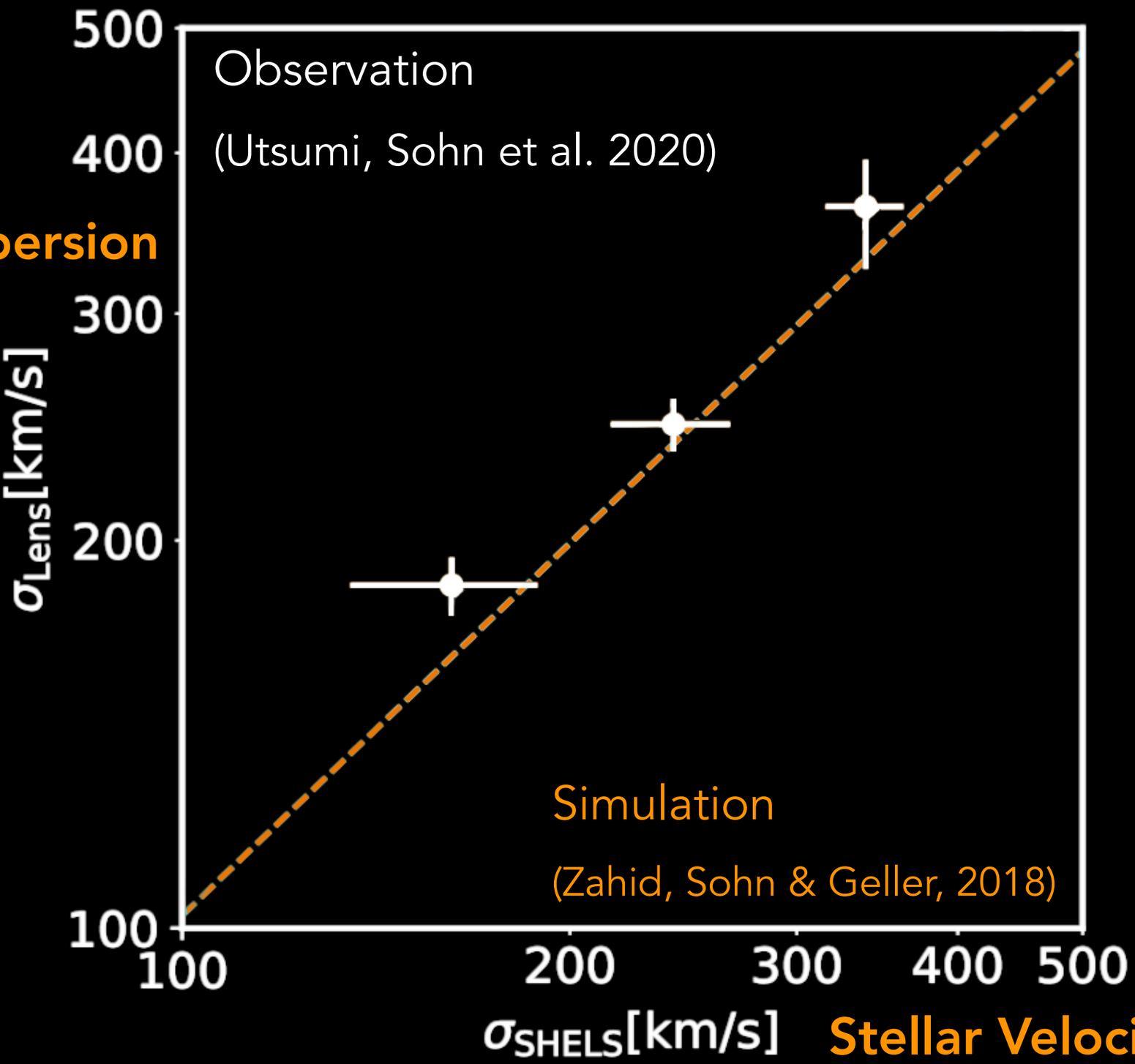
- Photometric proxies for DM : Luminosity, stellar mass
  - **Cautions :**
    - Derivation : Photometry, Crowding
    - Physics : Complexity in baryonic physics / Feedbacks
- Any observable relatively insensitive to these?





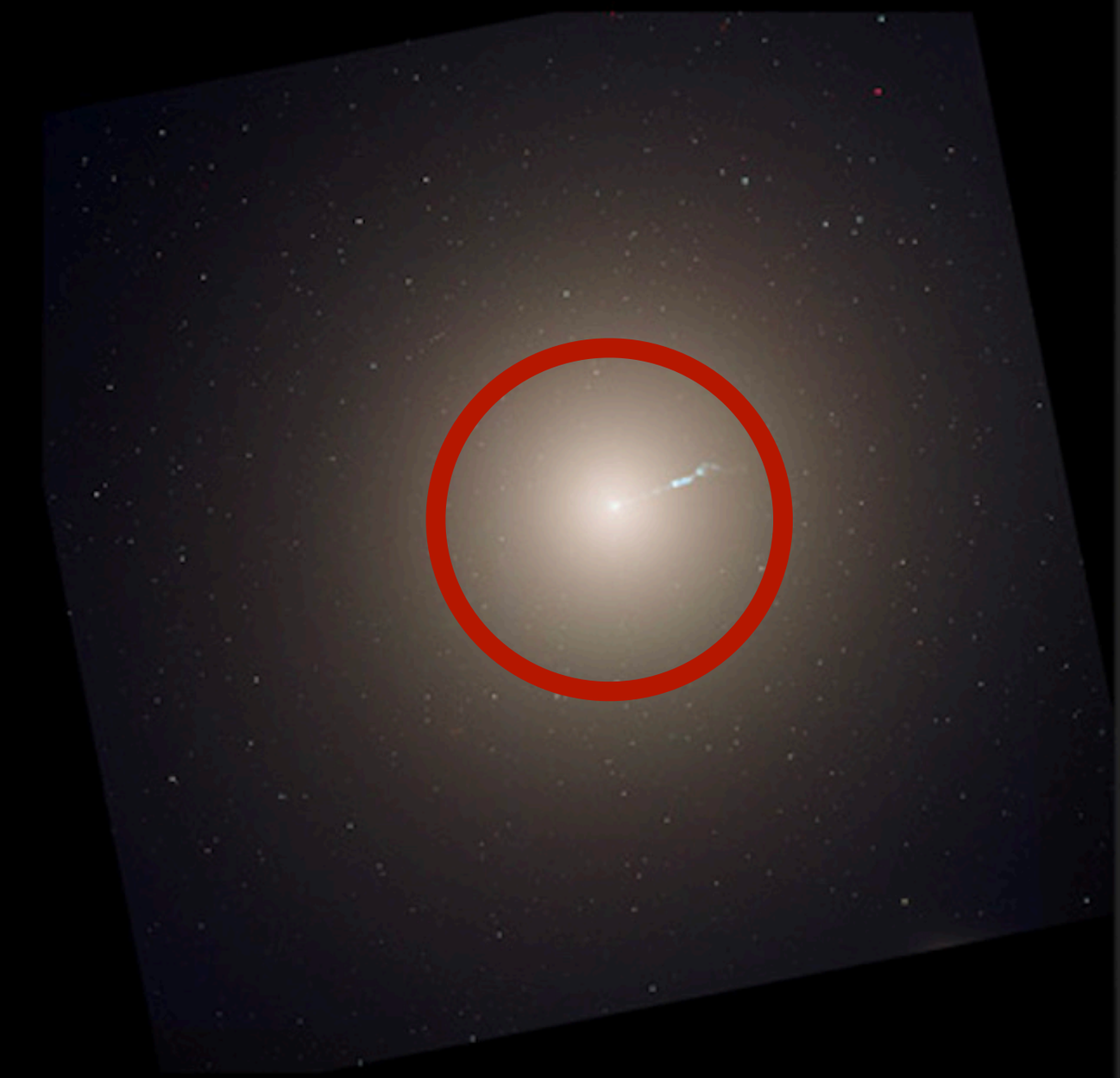
Velocity Dispersions

Dark Matter Velocity Dispersion



Stellar Velocity Dispersion

Measuring σ_*s



HUBBLE PHOTO OF M87

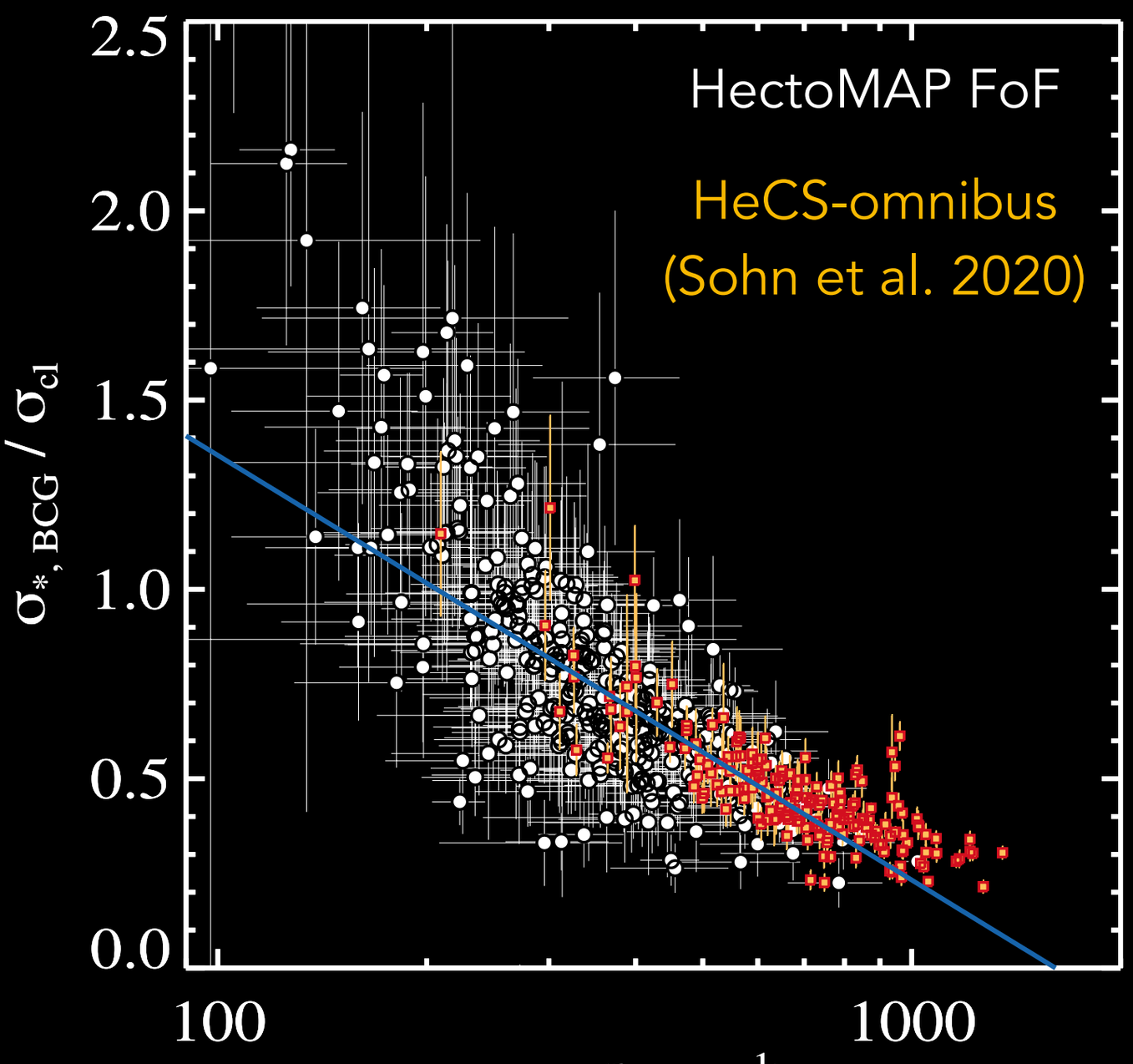


3D ILLUSTRATION OF M87

In 2022 at this workshop…

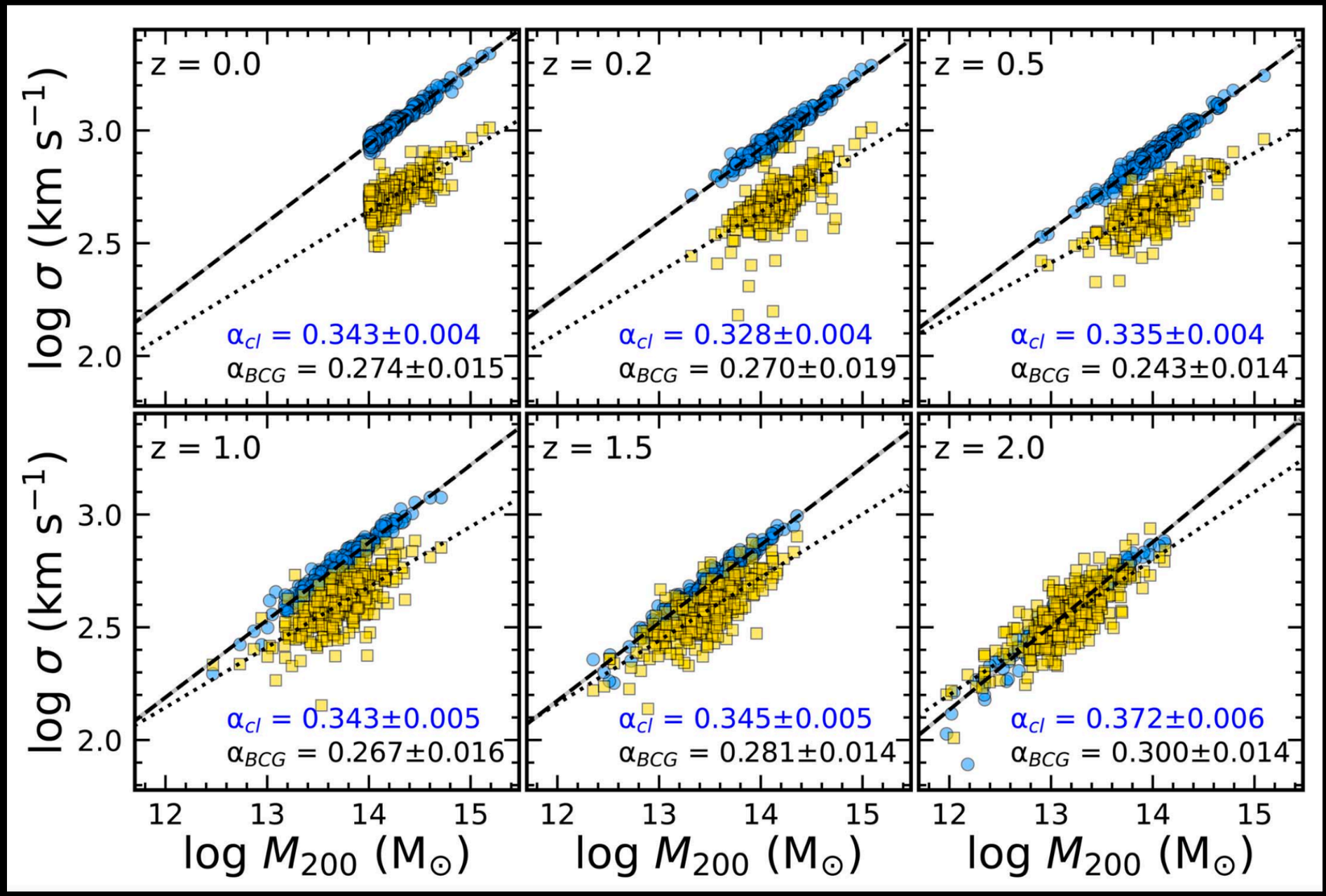
- Tracing co-evolution of clusters and BCGs
- Cluster mass ~ σ_{cl}
- BCG mass ~ $\sigma_{*,\,BCG}$

HeCS-omnibus
(Sohn et al. 2020) :
spec-surveys of
227 clusters at z < 0.27



- Redshift evolution of the $\sigma_{*,BCG}$ and σ_{cl}
- BCGs are much slowly evolving than clusters

IllustrisTNG300, Sohn et al. (2022b)

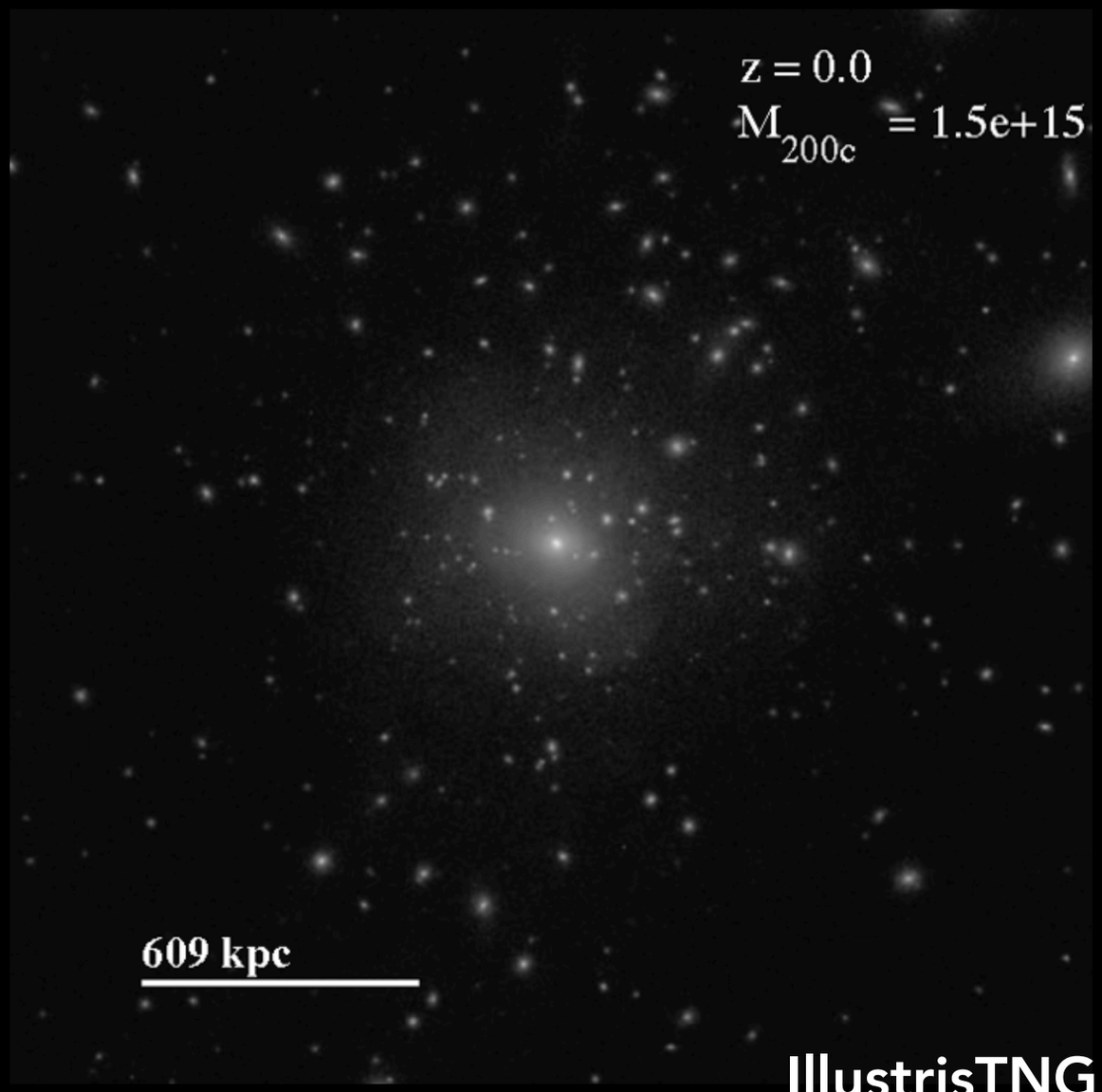


Tracing DM mass distributions



A2029

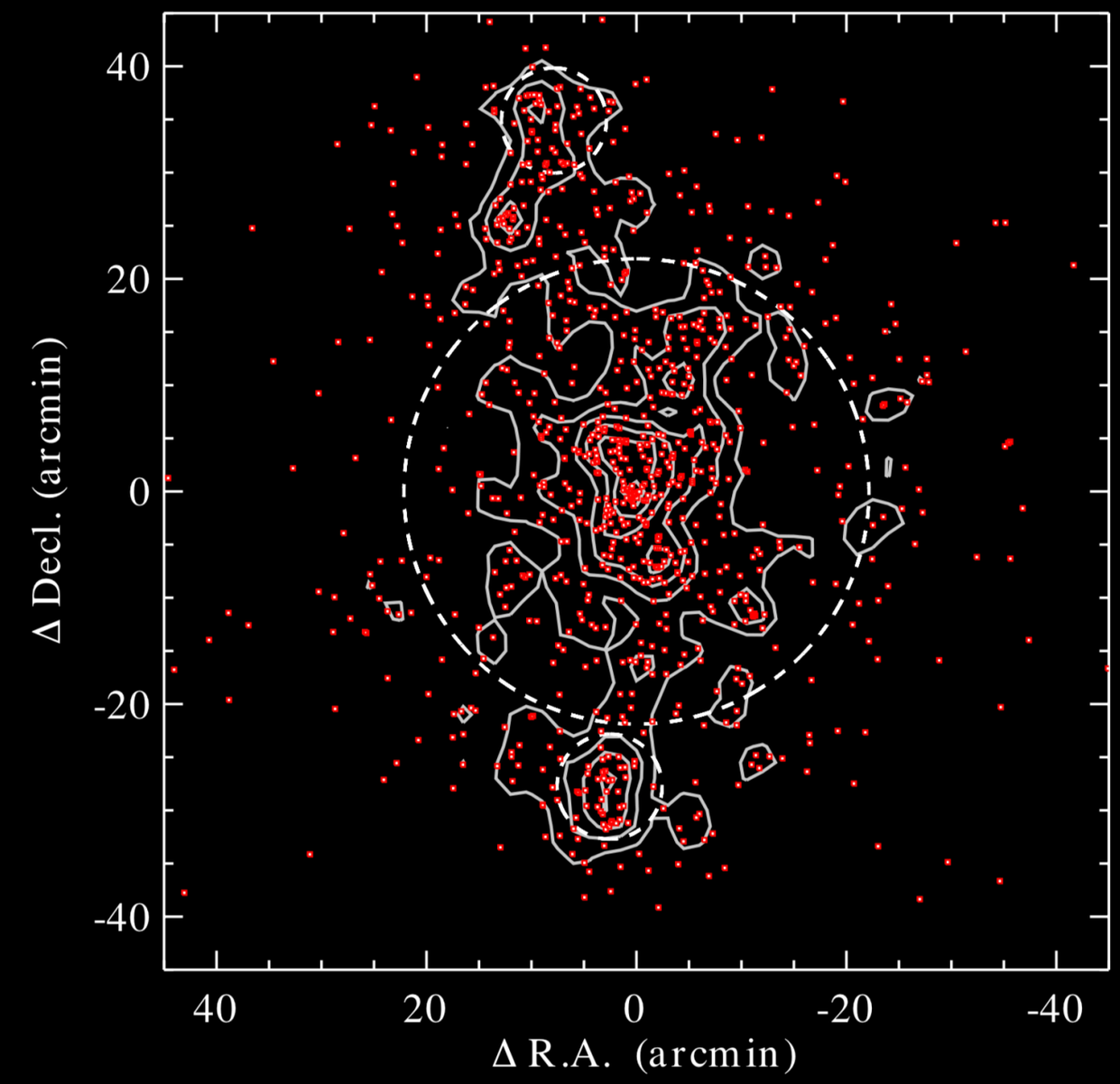
Optical imaging

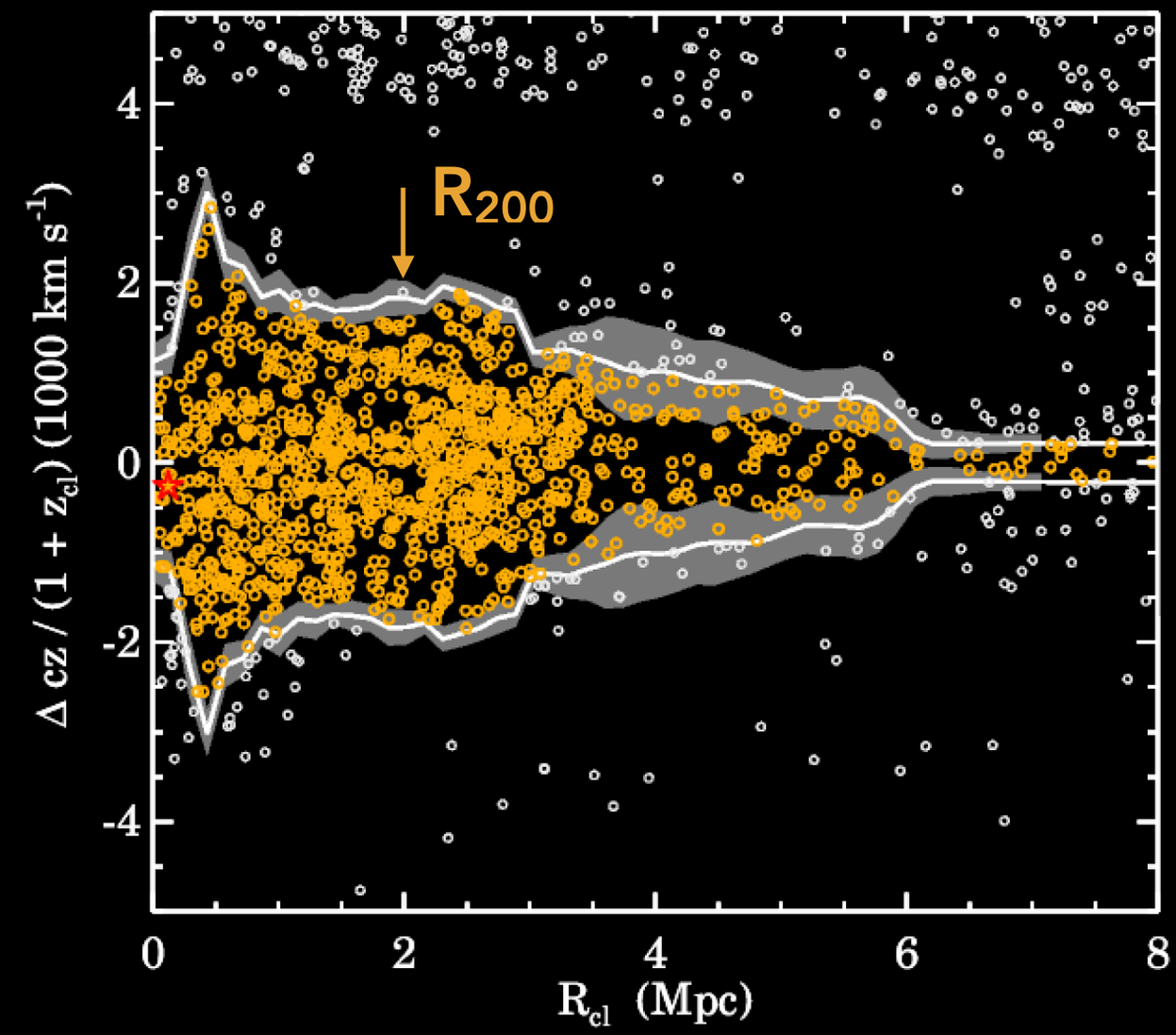


IllustrisTNG

Pillepich et al. 2018

- MACH (MAssive Cluster survey with Hectospec)
  - The densest and complete redshift survey for nearby massive clusters
  - A2029 : the 2nd most populated cluster after Coma
    - ~5000 redshifts (1215 members)

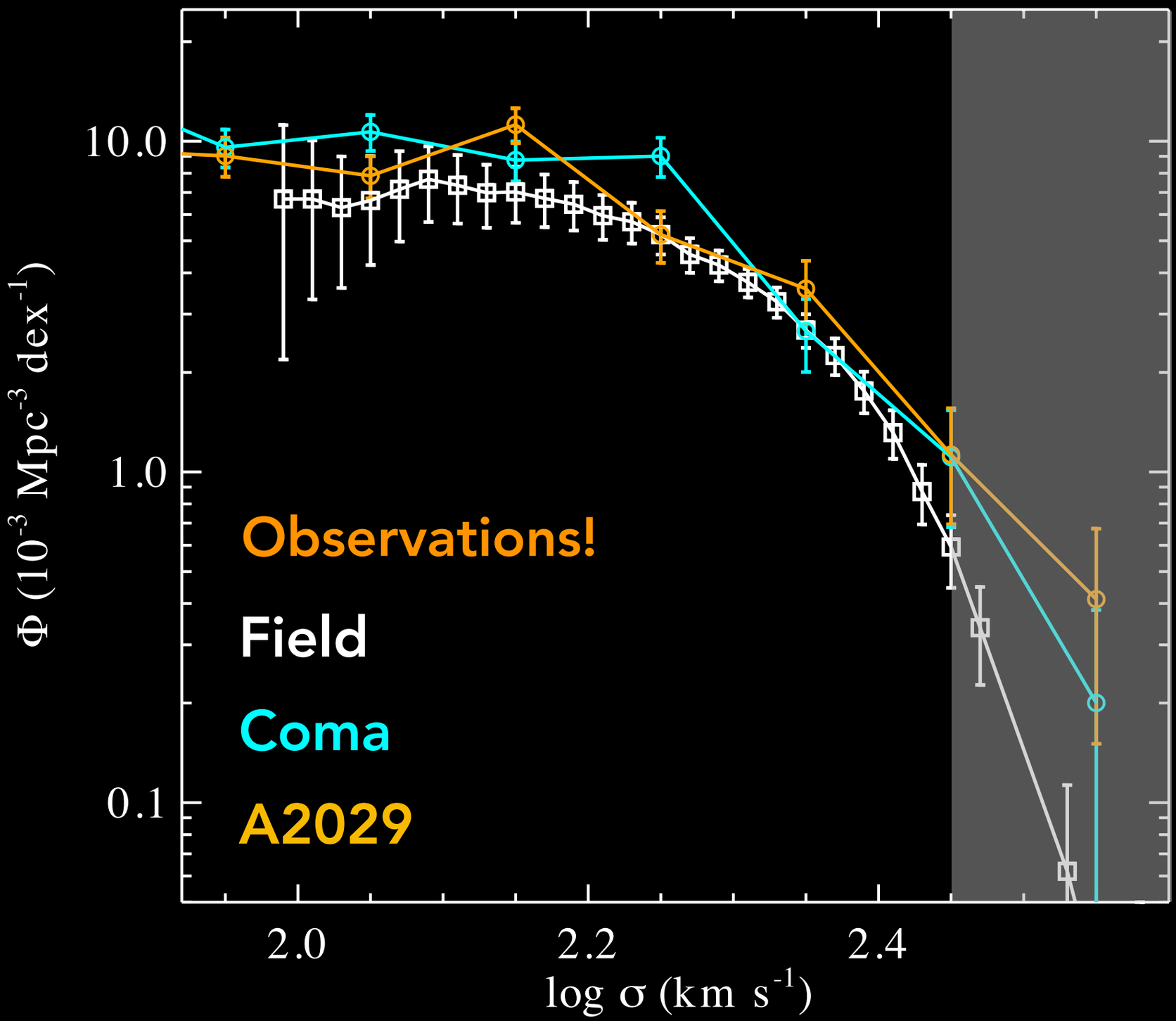




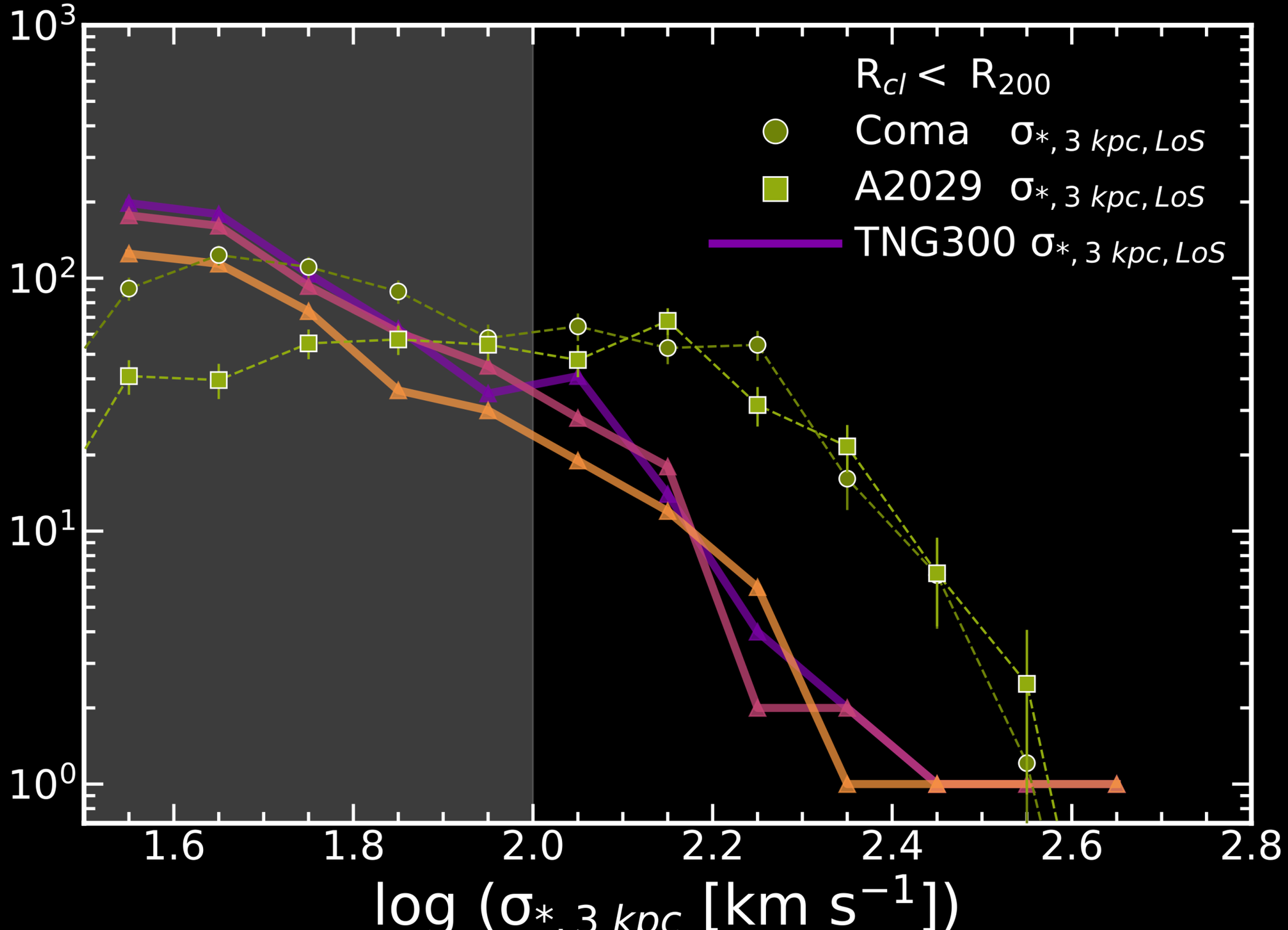
Sohn et al. 2017a, 2019a, b

Velocity Dispersion Functions

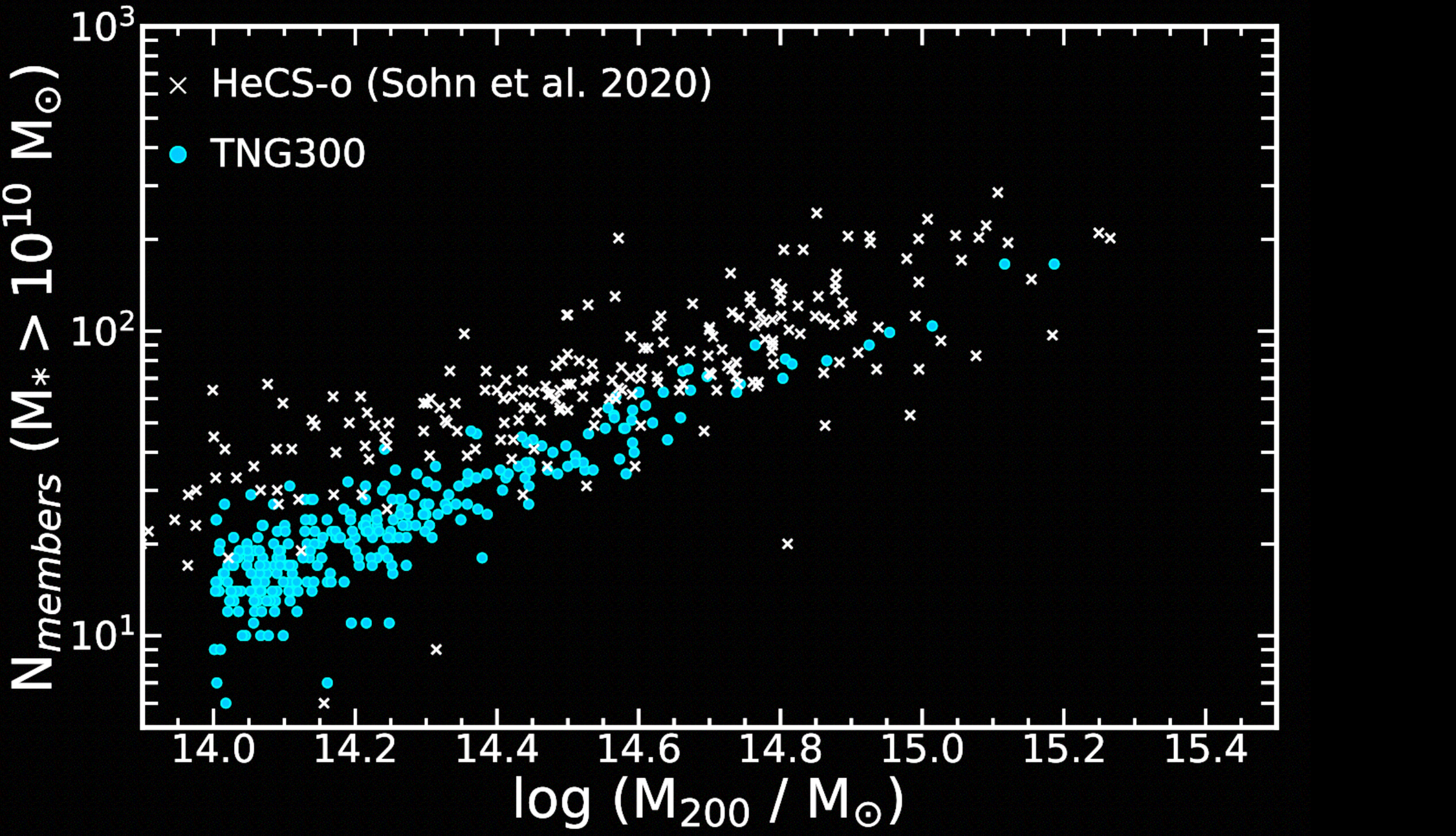
An excess at σ > 250 km/s

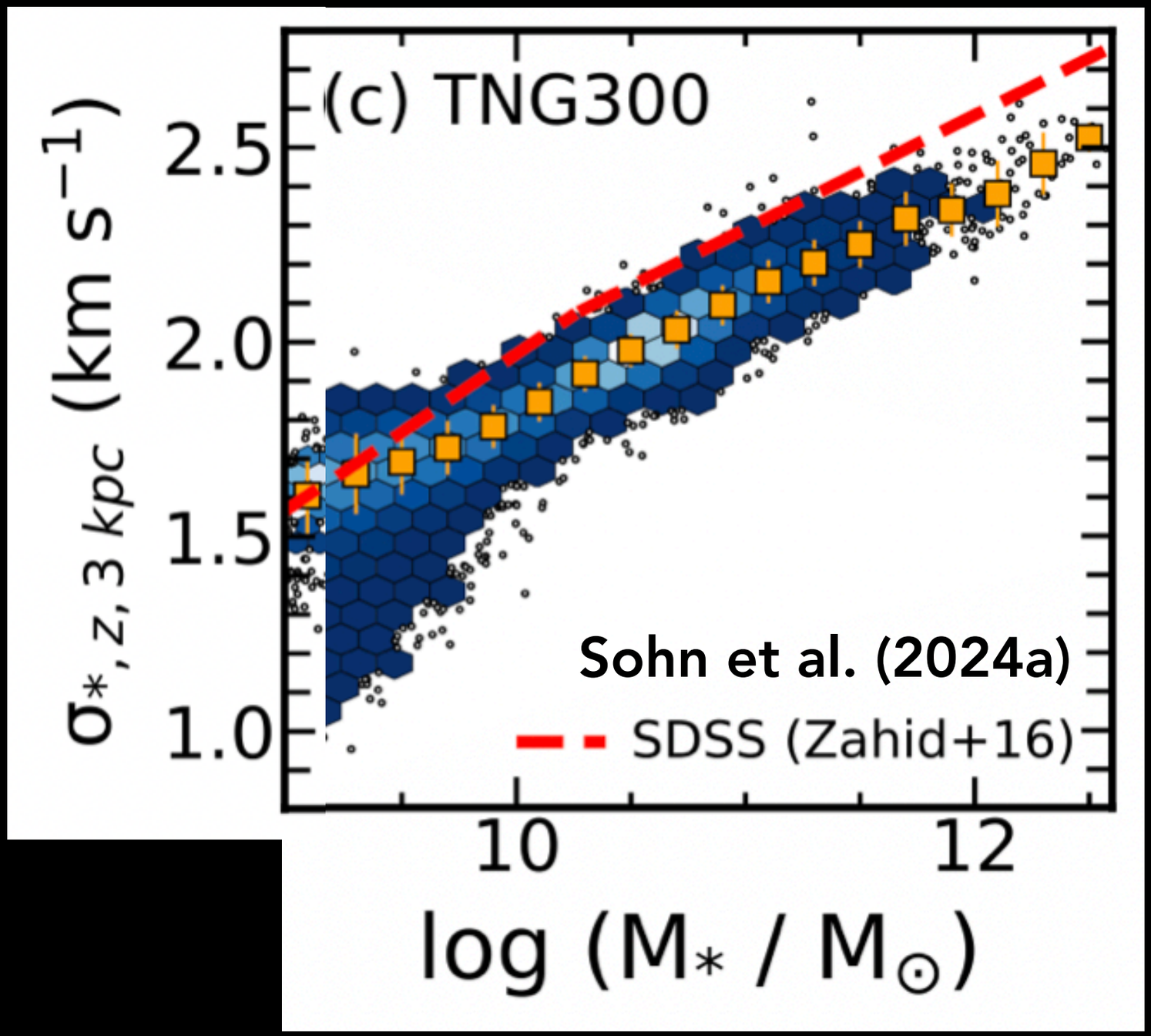


Velocity Dispersion Functions



- What causes the offsets?
  - TNG300 contains less number of subhalos?
  - Not enough…



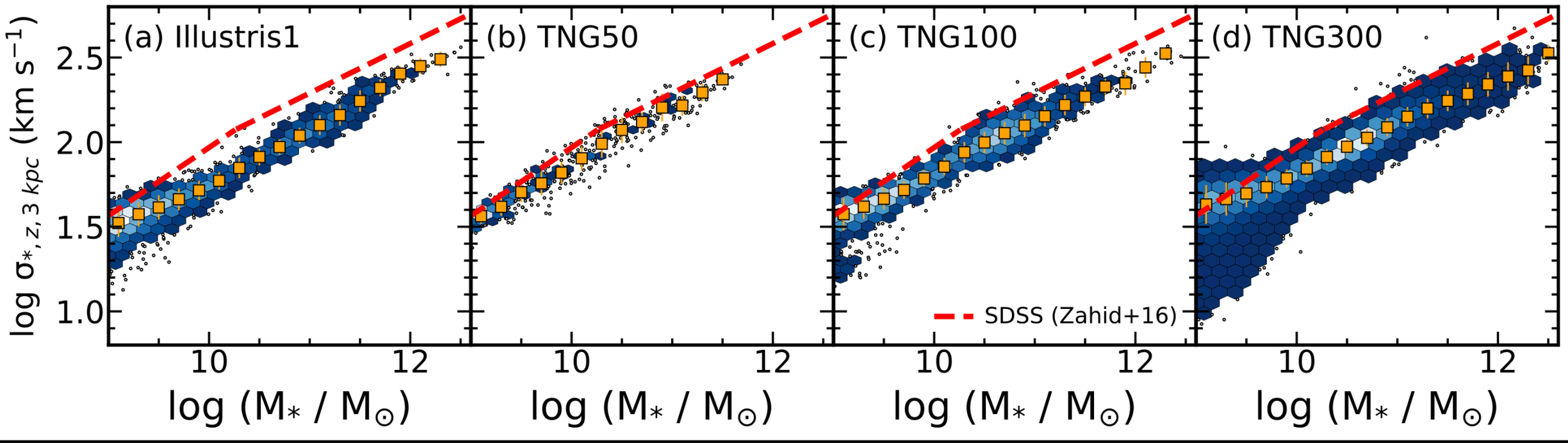


- Line : SDSS quiescent galaxies
- Contour : TNG 300 quiescent galaxies
- Squares : TNG 300 median

- TNG is not fine-tuned to match observed σ_*
- What causes this difference?

- Resolution of simulations?

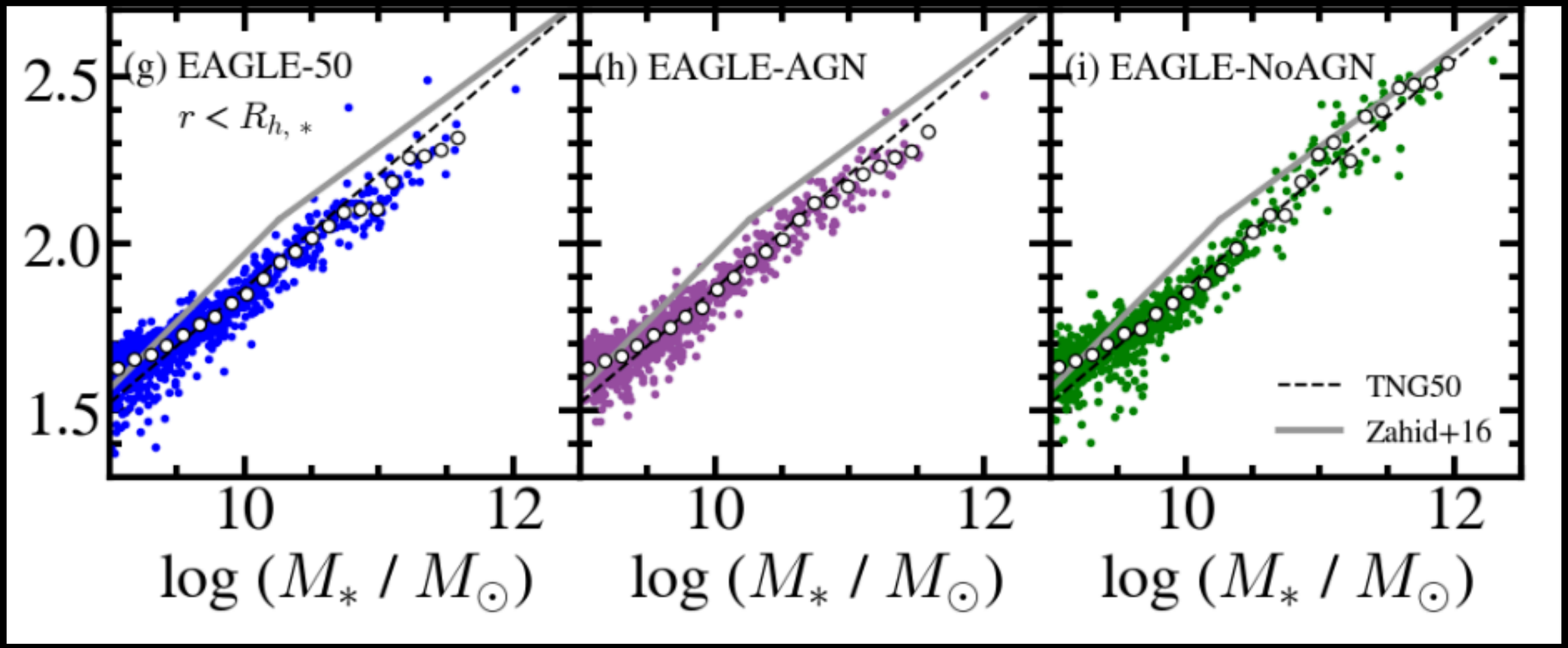
Sohn et al. (2024a)



- The σ* measurements are also insenstive to
  - Quiescent galaxy selection
  - Aperture sizes
  - Velocity dispersion methods
  - Anisotropy

- Comparison with EAGLE

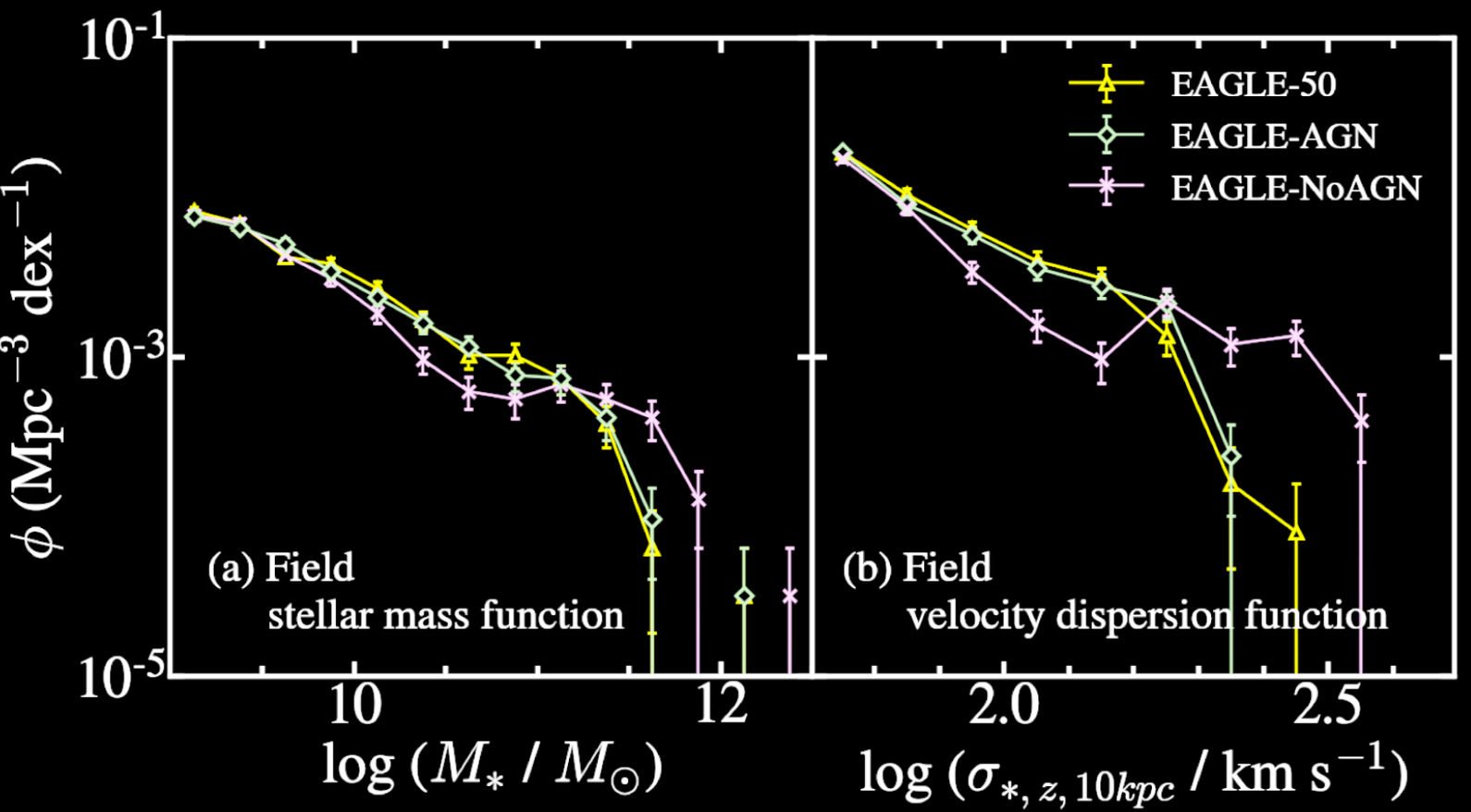
JW Choi, Sohn (in preparation)



- No AGN feedback model reproduces
  - The observed M_* - σ_* relation
  - Not mass function and velocity dispersion functions

- Comparison with EAGLE

JW Choi, Sohn (in preparation)



- No AGN feedback model reproduces
  - The observed M_* - σ_* relation
  - Not mass function and velocity dispersion functions

Summary

- Tracing subhalo mass distributions based on σ_*
- Difference in the observed and simulated M_* - σ_* relations
  - Better calibration for simulations required?

