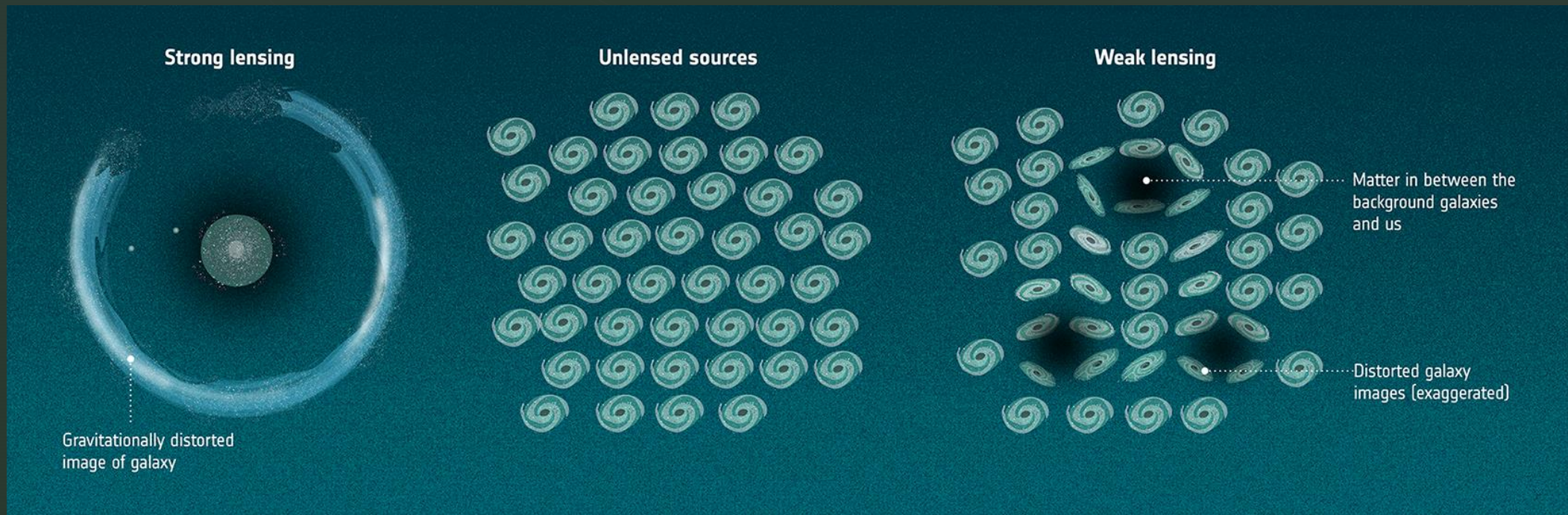


How galaxy properties and evolution shape their intrinsic alignments in hydrodynamical simulations

Weak gravitational lensing

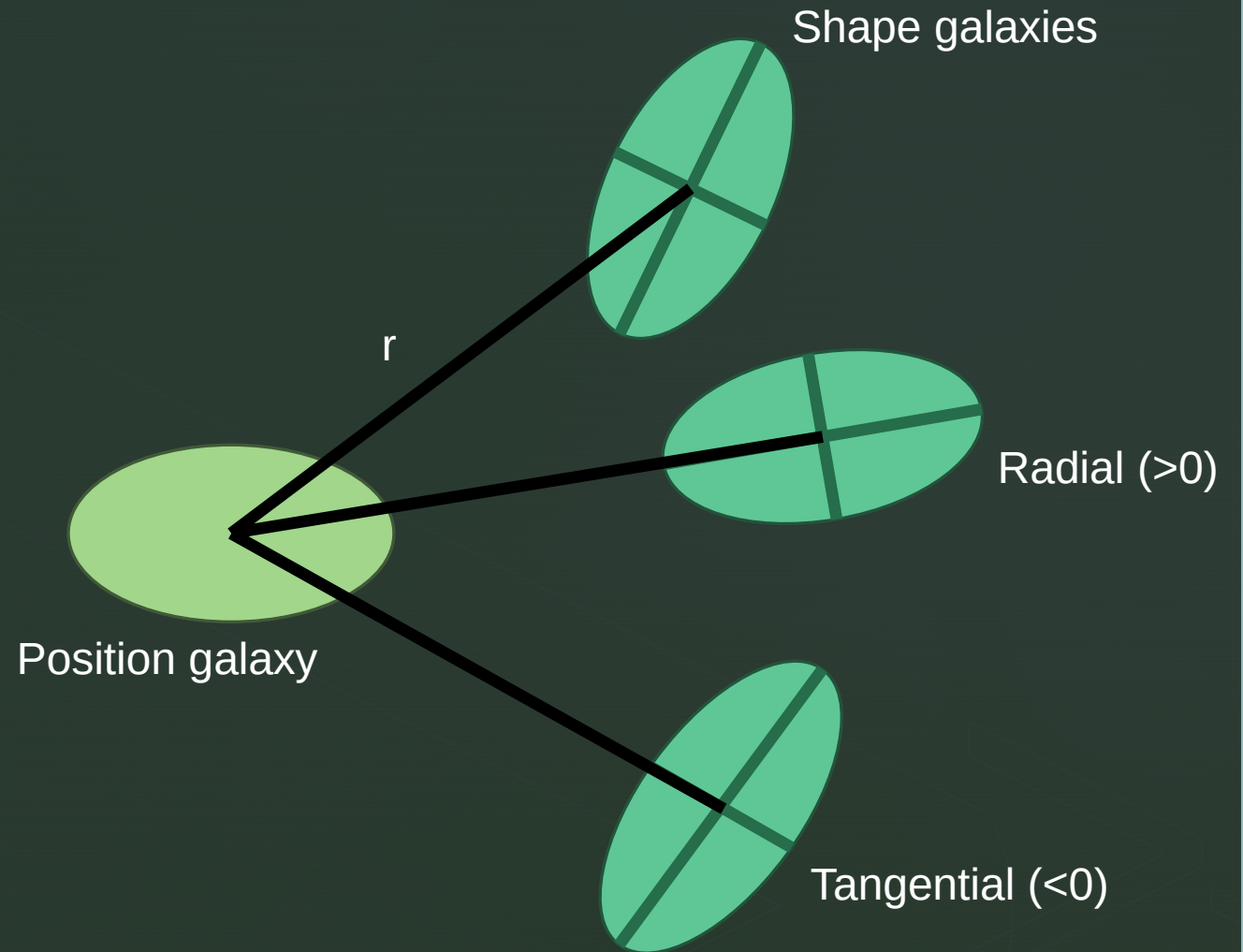
- Measuring cosmological parameters Ω_m and σ_8



Source: EUCLID consortium

Intrinsic alignments

- Local alignment of objects
- Weak Lensing contaminant
- 2pt correlation between positions and shapes

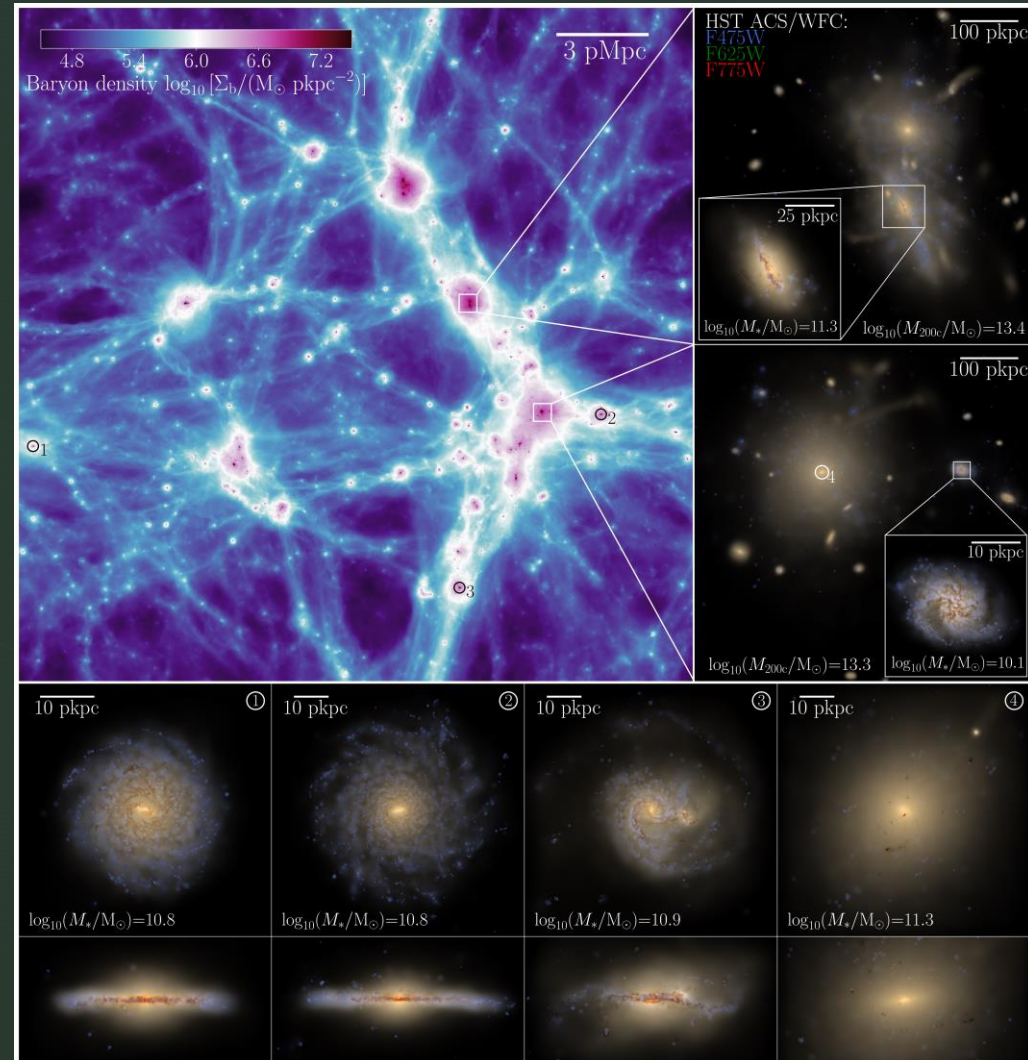


■ Intrinsic alignment and galaxy properties

- **More massive** galaxies are more aligned
- **Brighter** galaxies are more aligned
- **Red** galaxies are more aligned than blue
- **Mergers** influence alignment
- **Galaxies** are aligned with their host **haloes**
- **Satellite galaxies** trace their host halo shape

Hydrodynamical simulations

- e.g. COLIBRE
- Calibration + subgrid-models
- Box size vs resolution

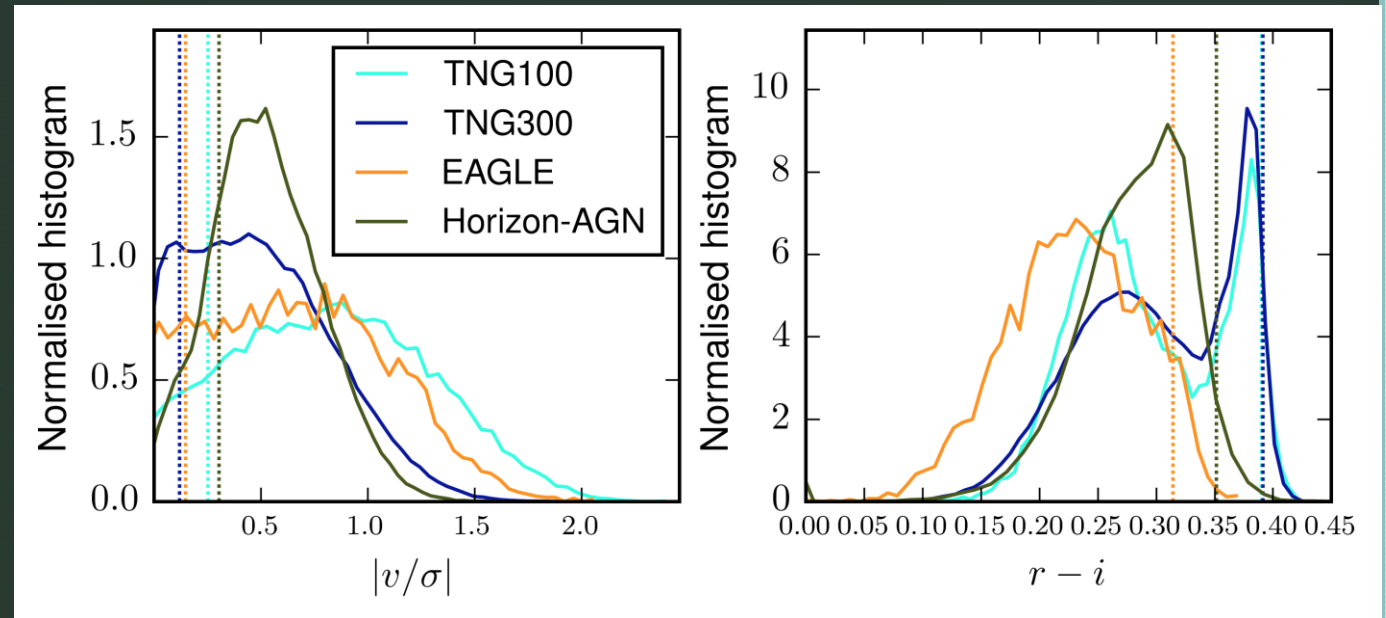


■ Intrinsic alignment of disks and ellipticals across hydrodynamical simulations

- TNG300, EAGLE, Horizon-AGN
- Simple & reduced inertia tensors
- $z=0$ and $z=1$
- Multiple disk/elliptical definitions
- <https://arxiv.org/abs/2510.11118> (MvH & N.E. Chisari 2026)

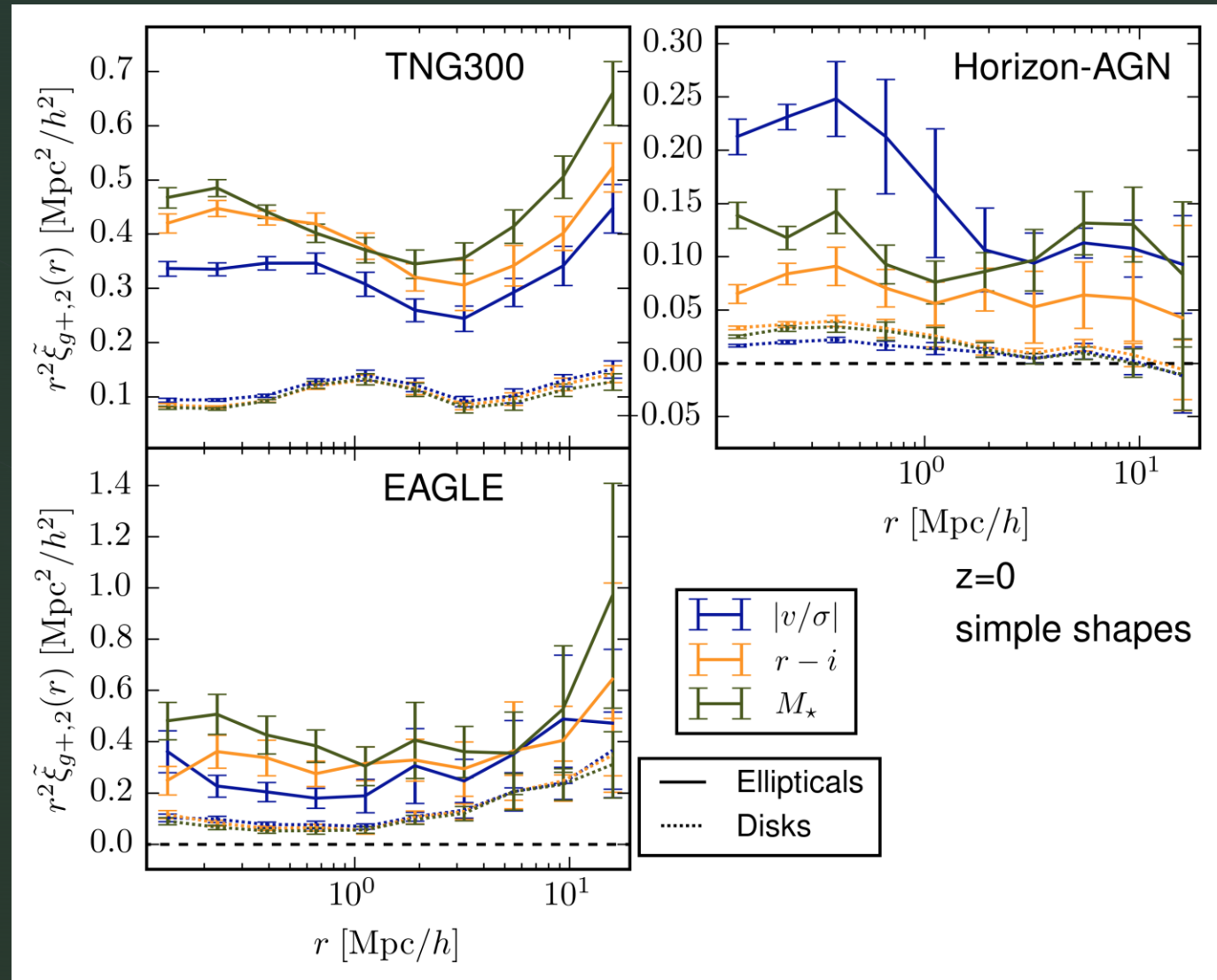
Defining disks and ellipticals

- Distributions of disk and elliptical defining variables at $z=0$
- 3 simulation suites: TNG, EAGLE, Horizon-AGN
- $|v/\sigma|$ = rotational velocity / dispersion
- D:E = 90:10



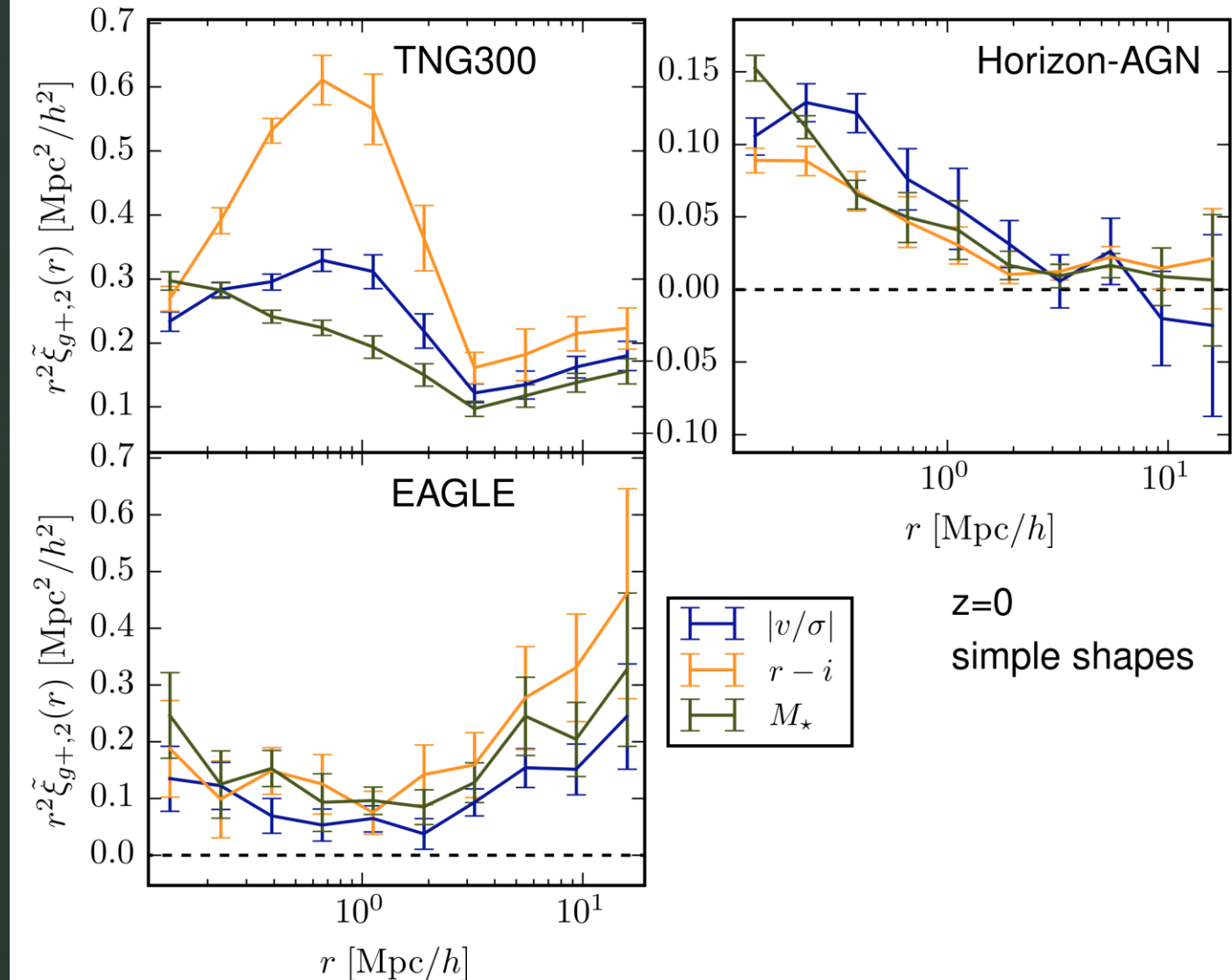
Disks and ellipticals around galaxies

- Similar but not the same
- Disk signal > 0
- Influenced heavily by underlying mass distribution



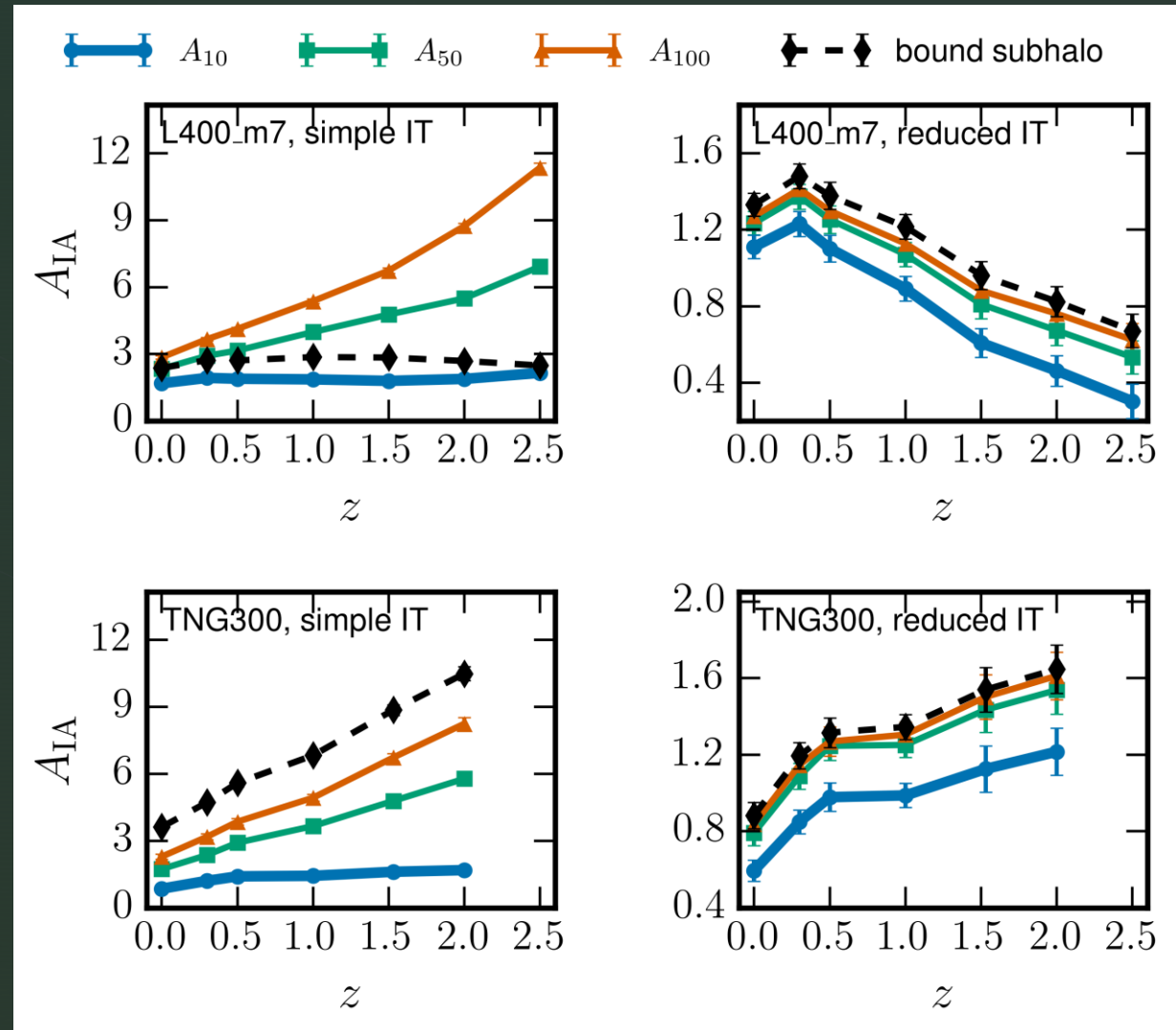
Disks around ellipticals

- Scale dependence differs
- Hints of < 0 signal (Horizon-AGN)



Redshift evolution

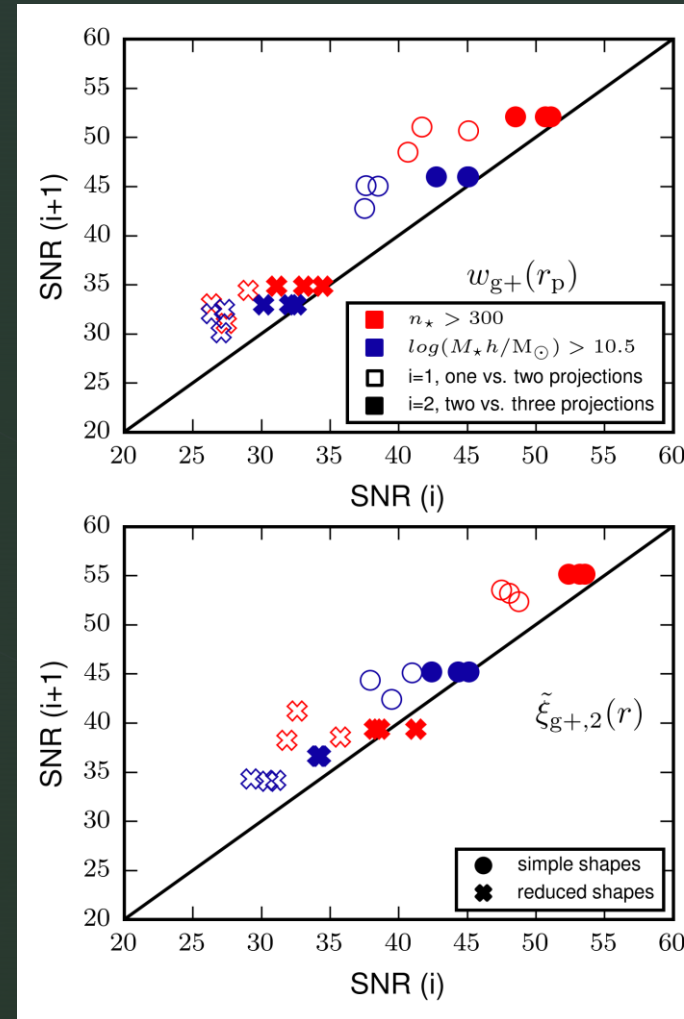
- Alignment amplitude, A_{IA}
- Shape and subhalo definition



PRELIMINARY

Combining multiple projections increases SNR!

- Robust gains across samples, estimators, shape type (and more)
- Includes cross-covariance
- SNR Gain 1->2 > SNR Gain 2->3
- Also SNR gain in NLA fitting amplitude
- <https://arxiv.org/abs/2509.07734> (MvH, D. Neumann, M.G. Escobar, N.E. Chisari & H. Hoekstra 2026)

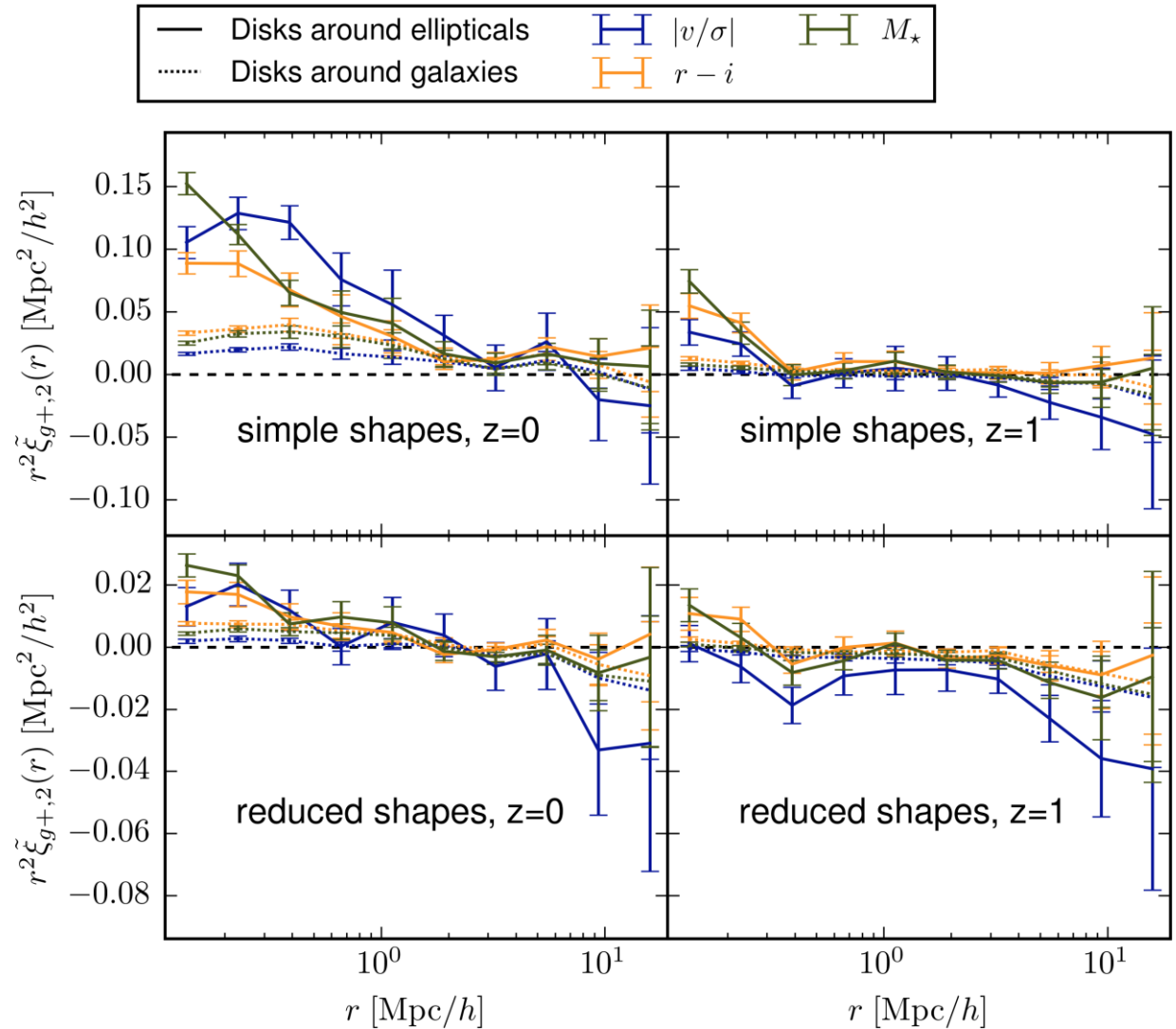


Key takeaways

- Simulations (EAGLE, TNG300 and Horizon-AGN) **agree** that IA of **ellipticals** $>$ **disks**; **ellipticals** $>$ 0, **disks** $\geq$ 0
- Simulations **disagree** on **morphological** details and the **scale dependence** of disks around ellipticals
- The **redshift evolution** of the IA **amplitude** is dependent on **simulation, shape – and subhalo definition**
- Combining **multiple projections increases SNR** of IA correlations in simulations

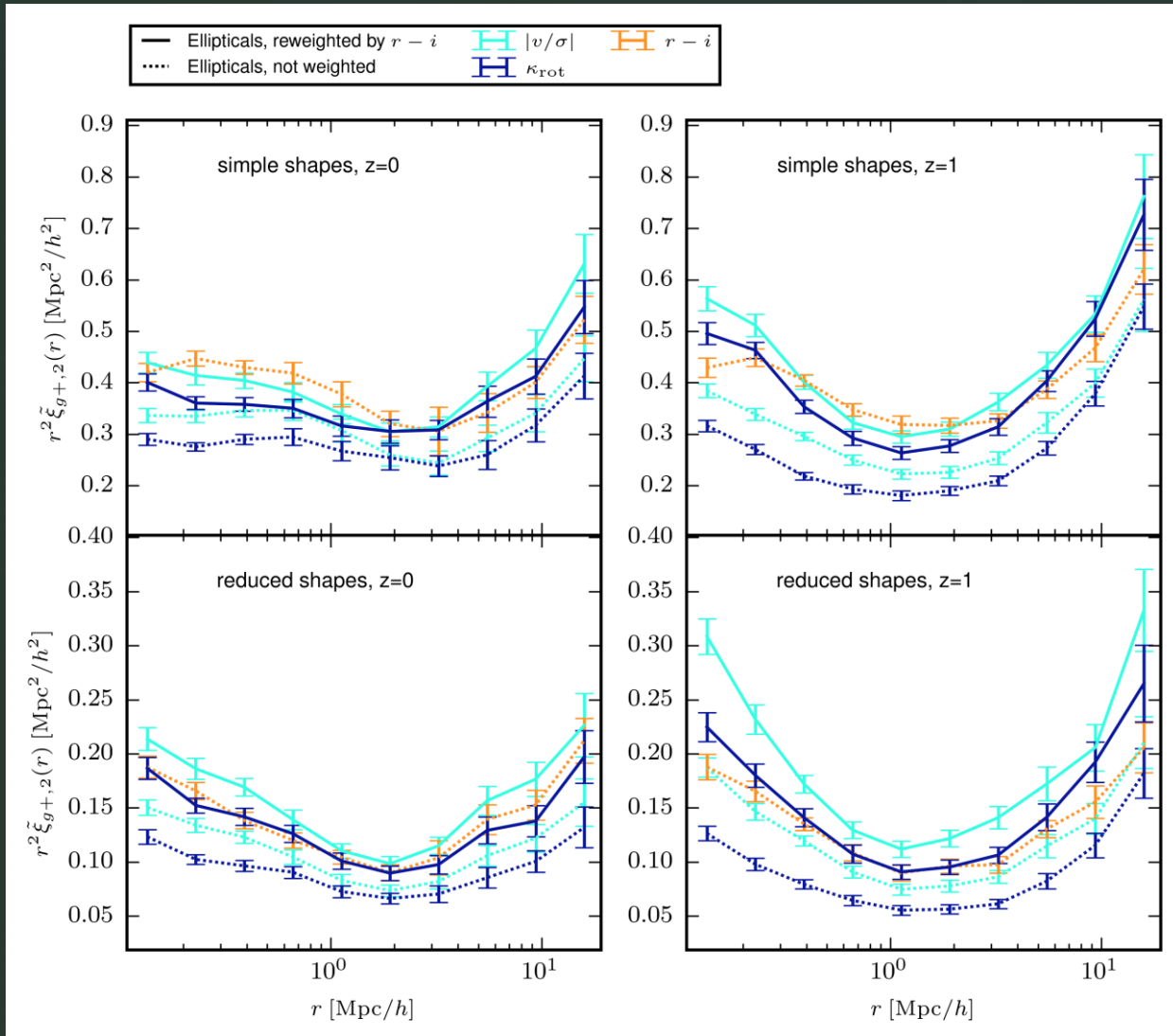
Disk signal in Horizon-AGN

- Disks around galaxies and disks around ellipticals
- < 0 disk signal depends on measurement choices



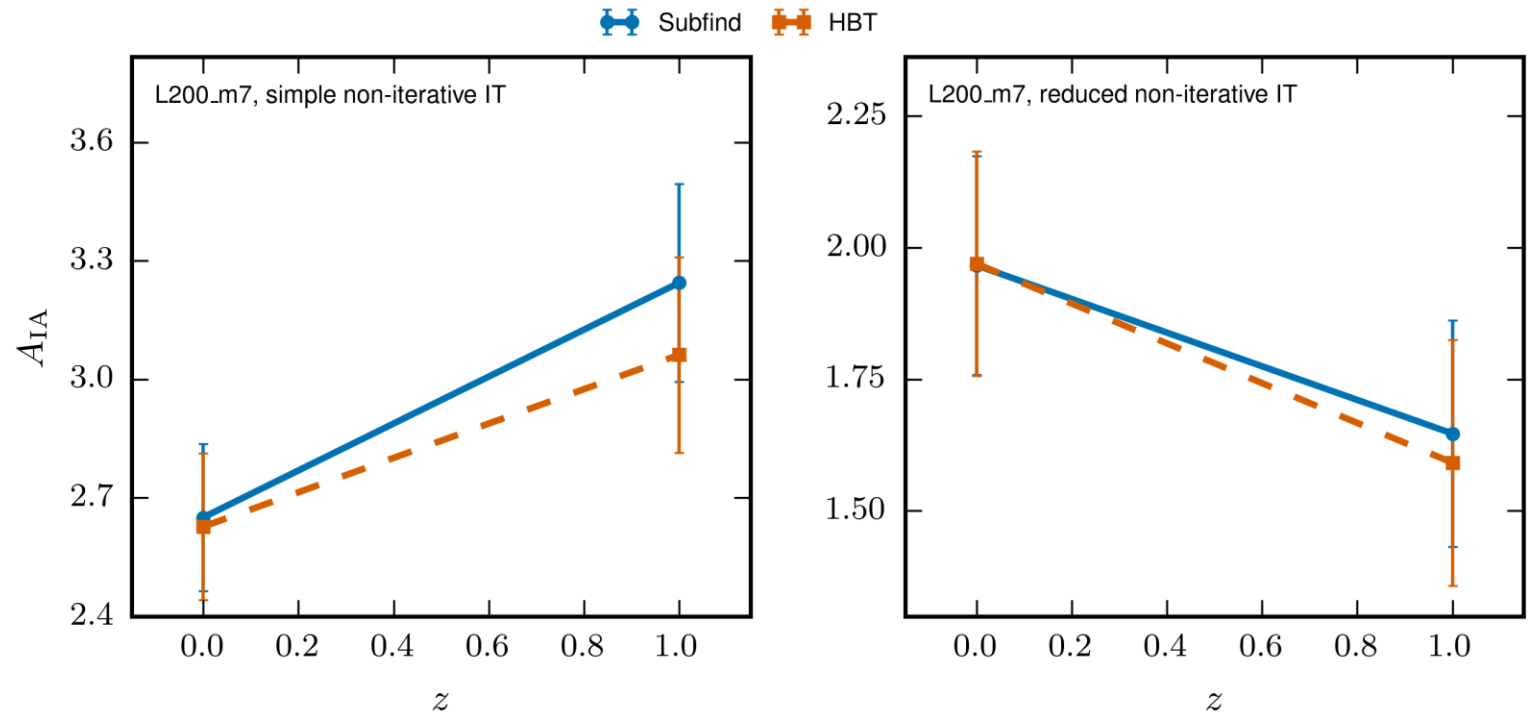
Mass relations

- Reweighted by r-i stellar mass distributions
- $w_j = p_{r-i} / p_e$
- Mostly dominated by mass, not physics



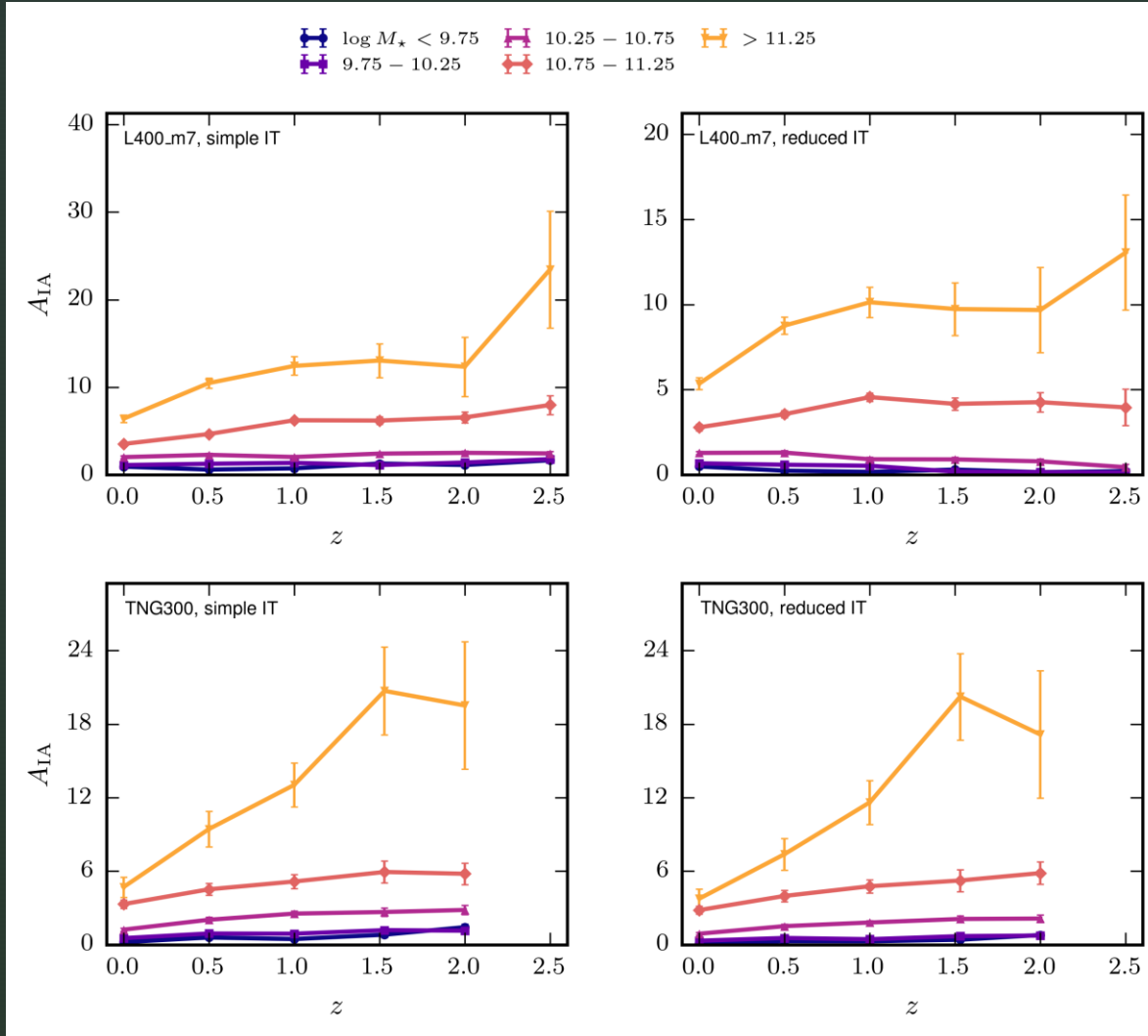
Impact halo finder

- Halo finders agree



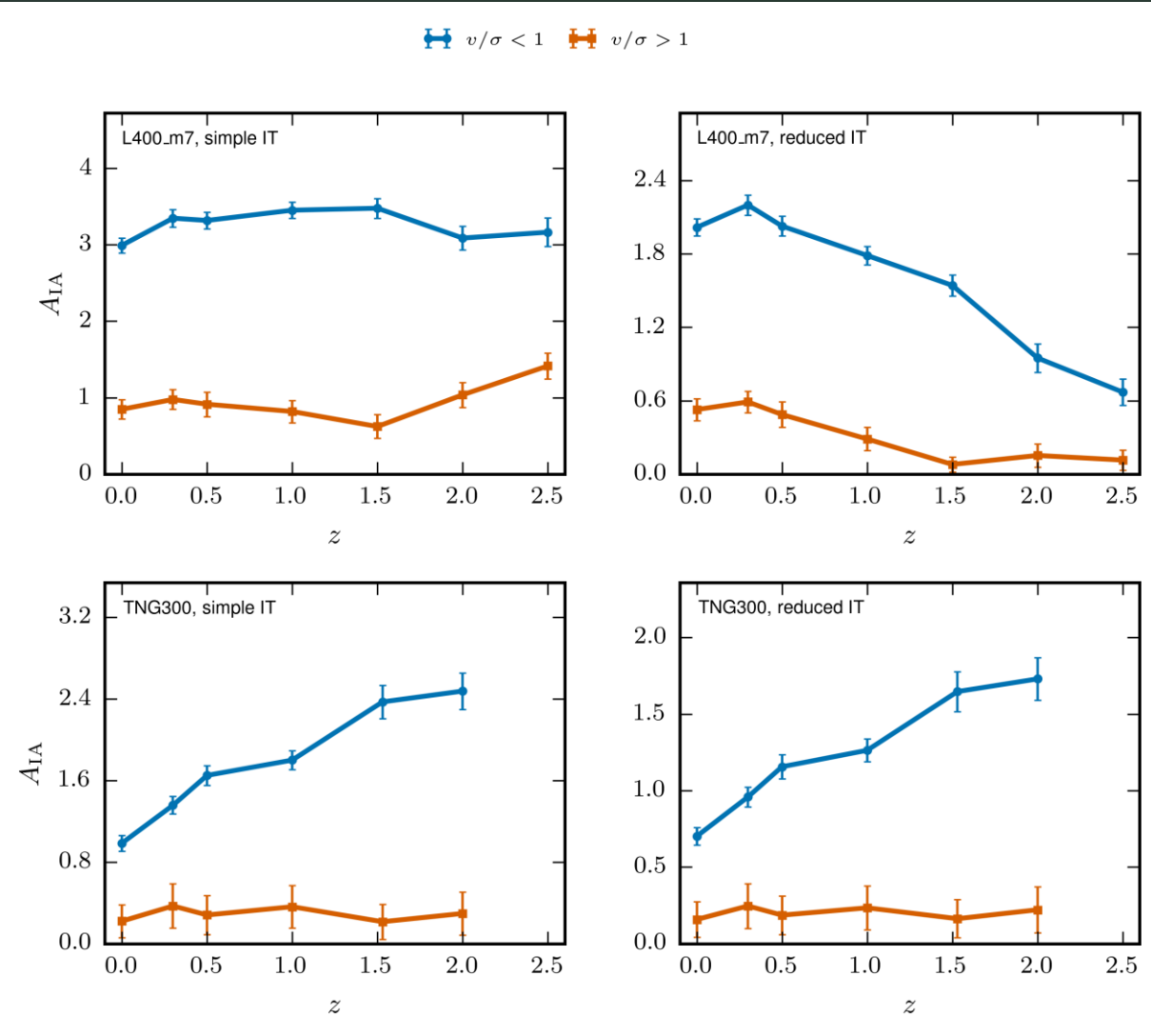
PRELIMINARY

Redshift evolution per mass bin



PRELIMINARY

Disks and ellipticals and redshift evolution



PRELIMINARY