

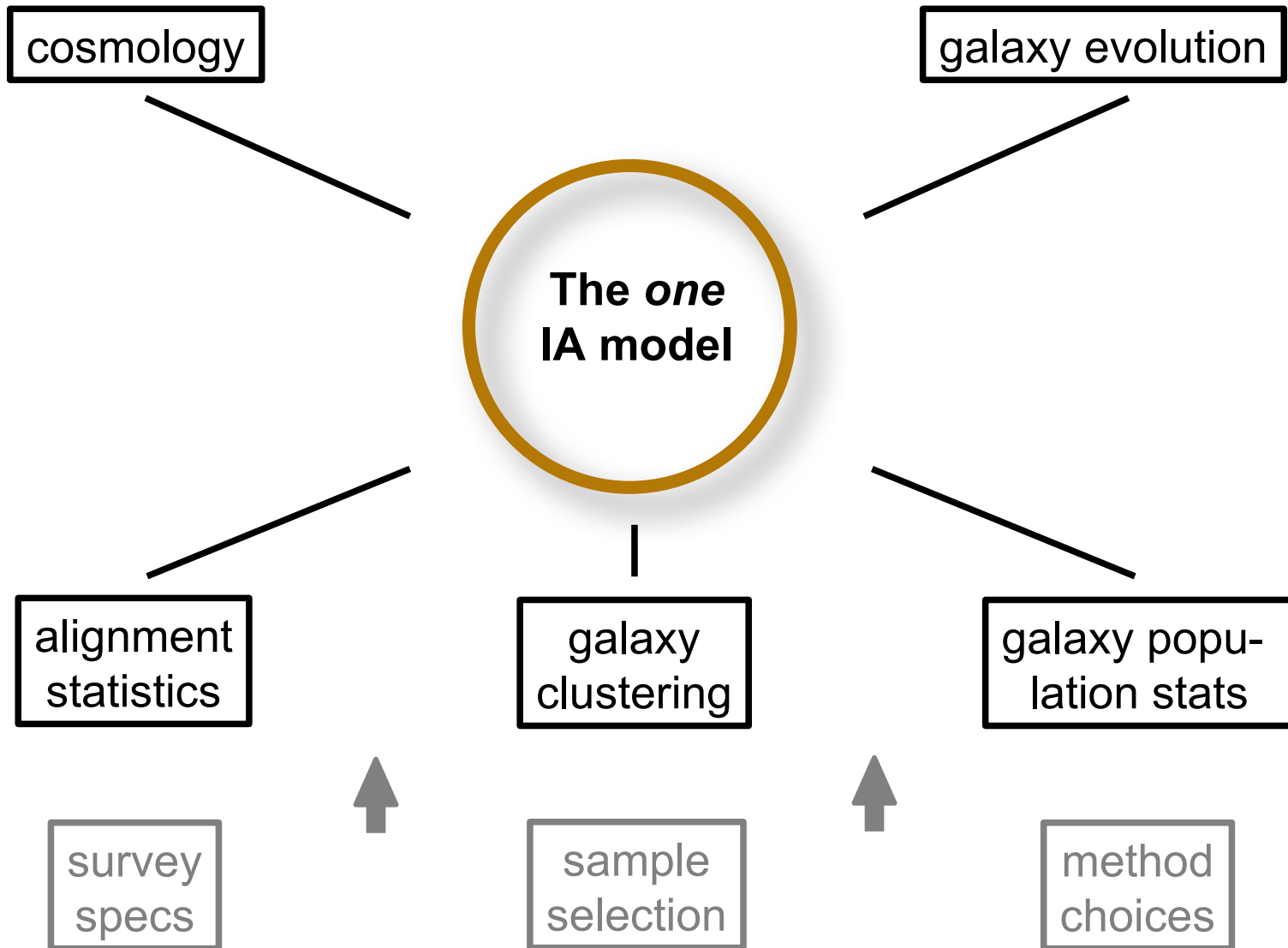
One alignment model to fit them all?

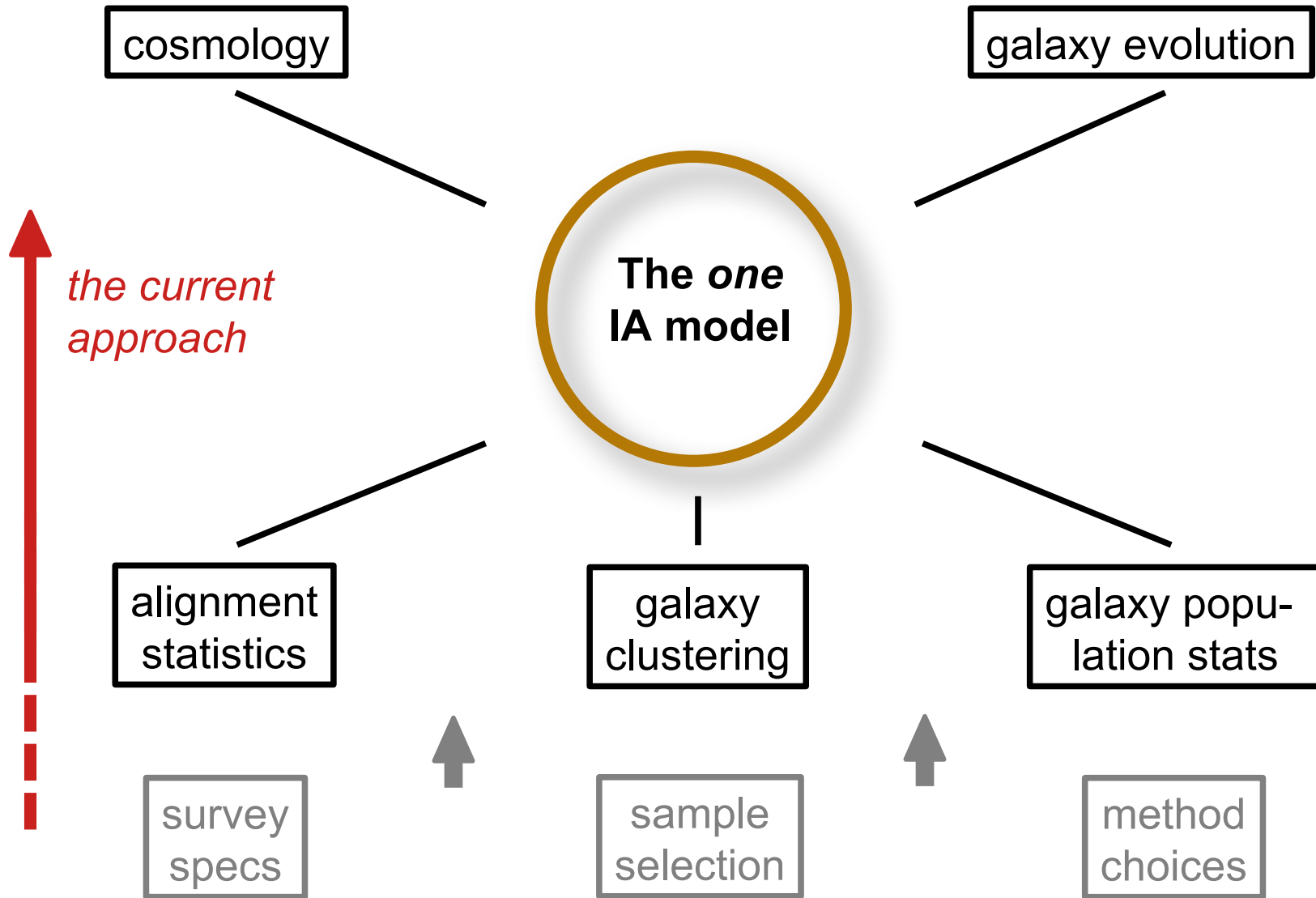
Benjamin Joachimi

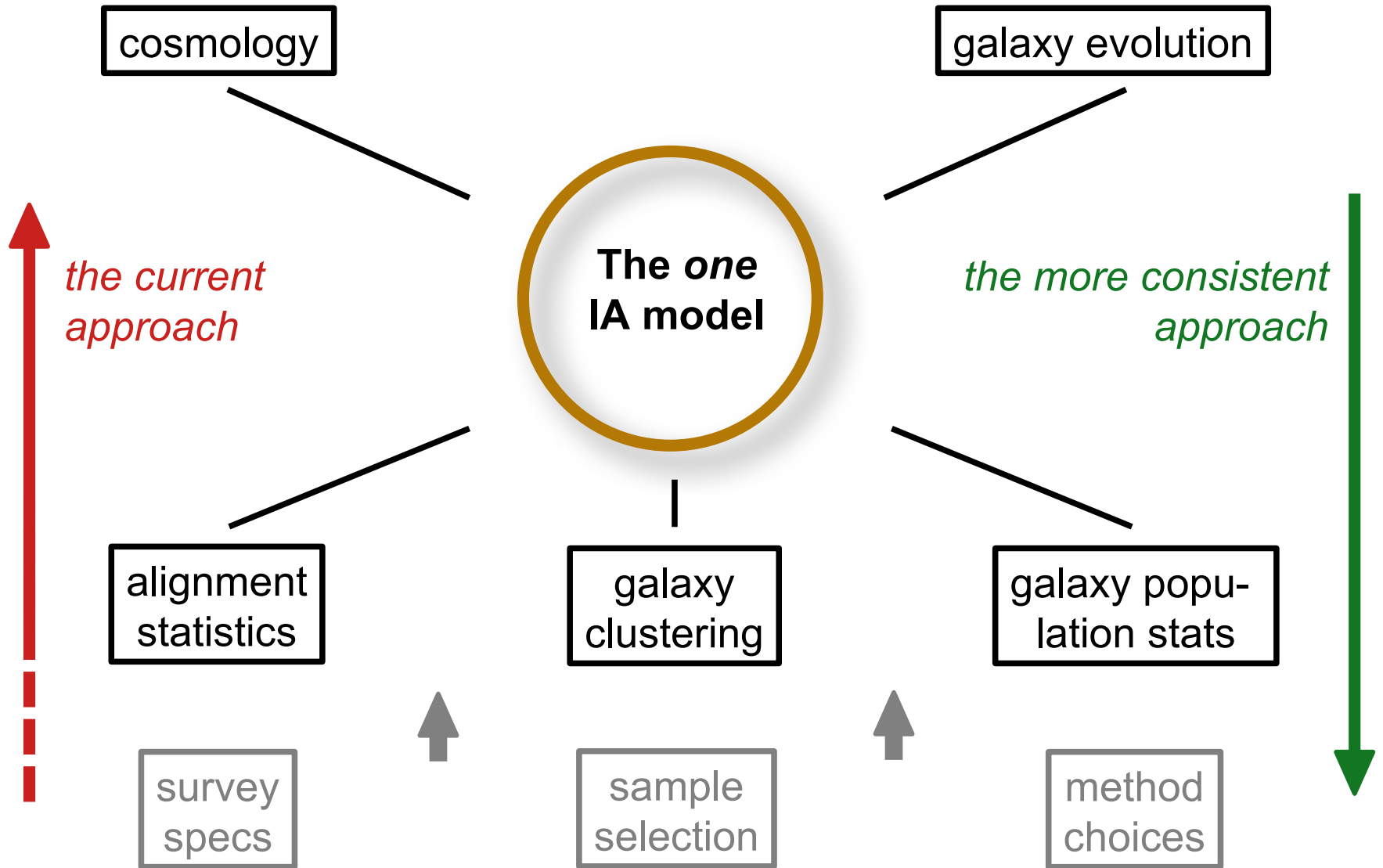
Department of Physics & Astronomy

University College London

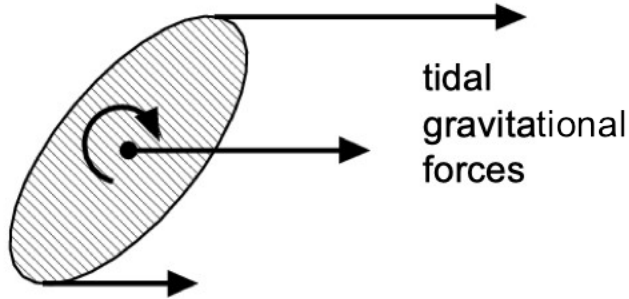
b.joachimi@ucl.ac.uk





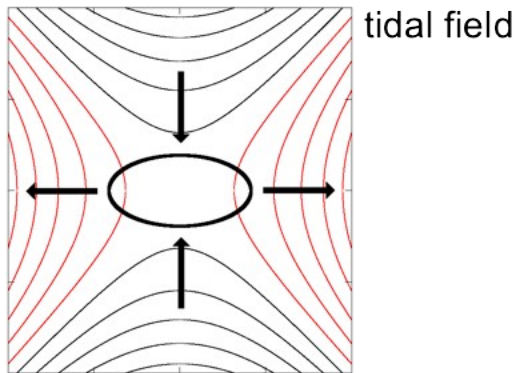


tidal torquing



- Induced ellipticity is quadratic in the tidal field
- Should be applicable to rotationally supported galaxies
- Appears to create small(-scale) alignments only

tidal stretching

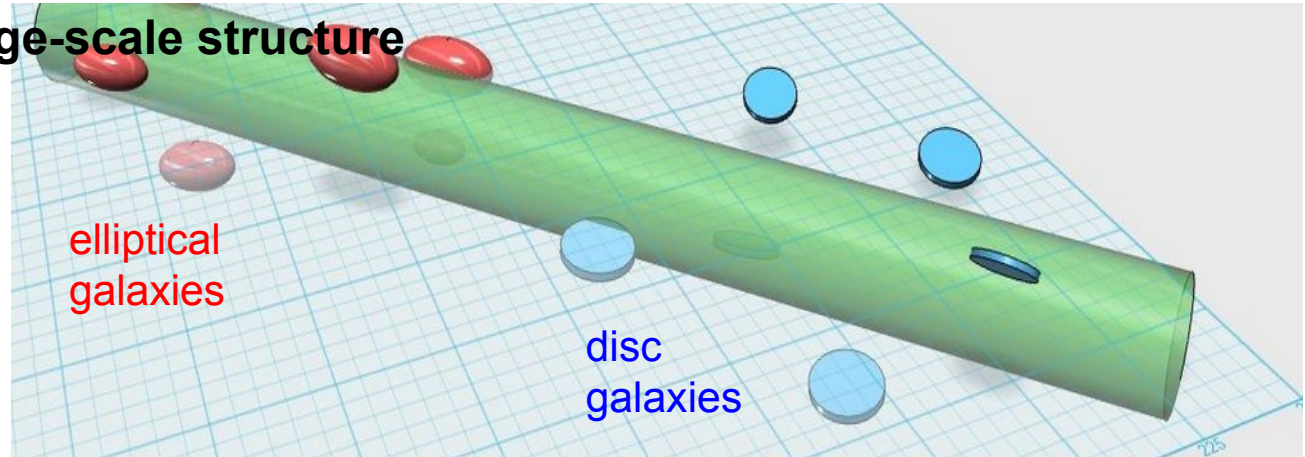


- Induced ellipticity is linear in the tidal field
- Applicable to pressure-supported galaxies
- Creates strong alignments for massive objects

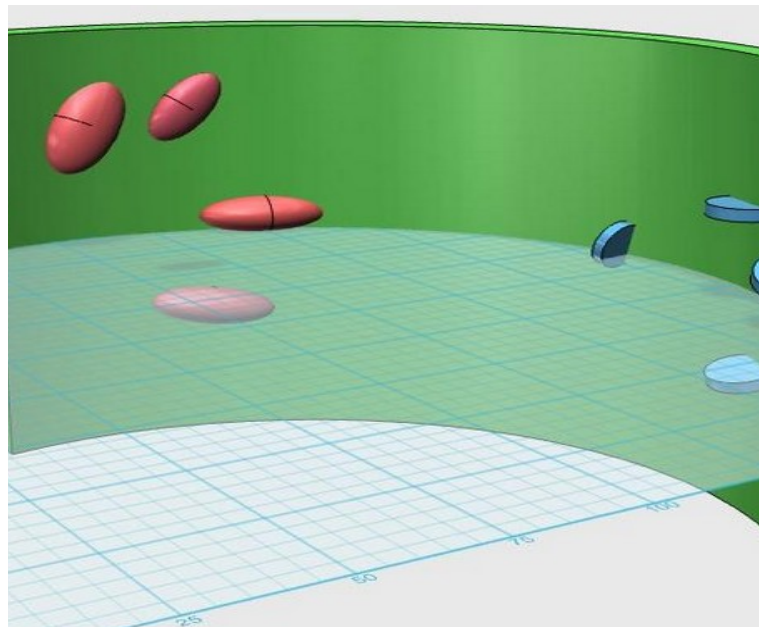
Alignments with the large-scale structure

BJ+ (2015), graphics by Schäfer

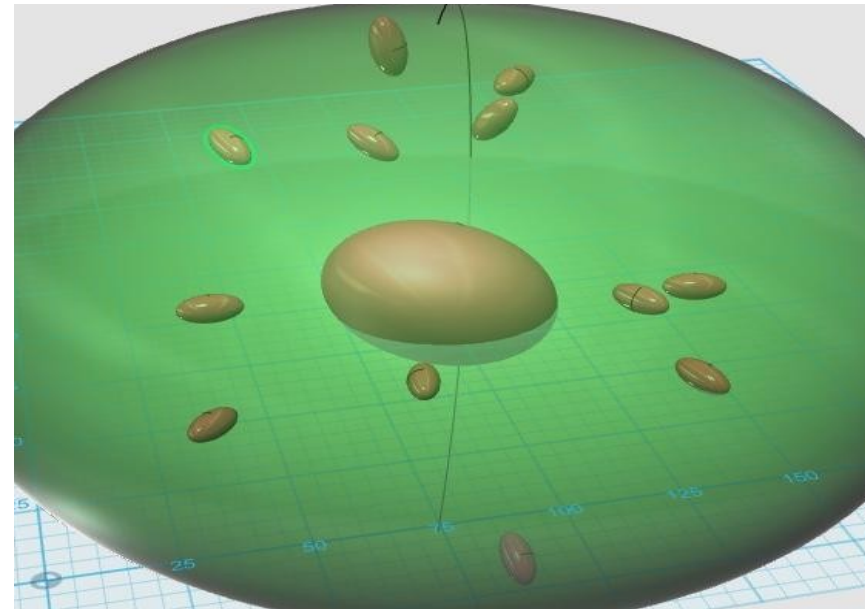
Alignments with the large-scale structure



around voids

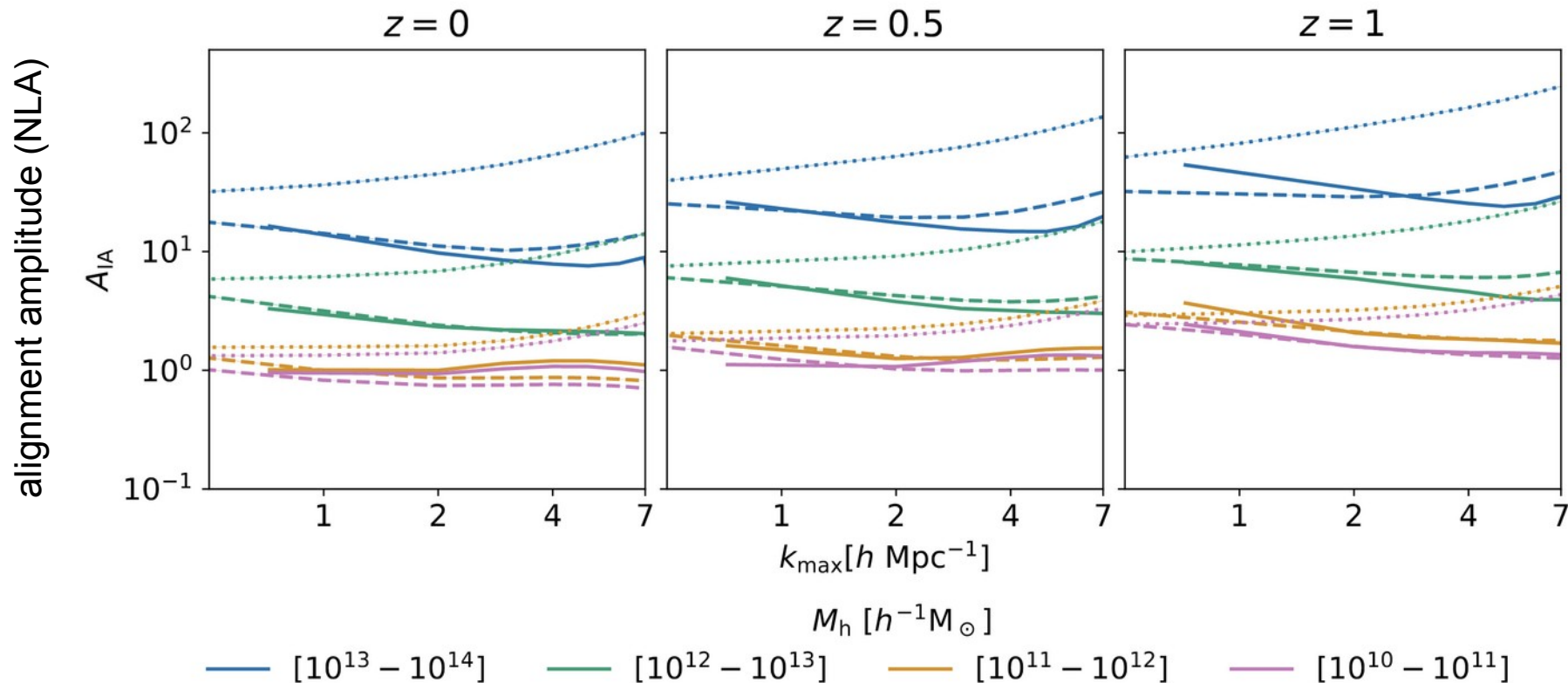


inside haloes



One alignment model to fit them all?

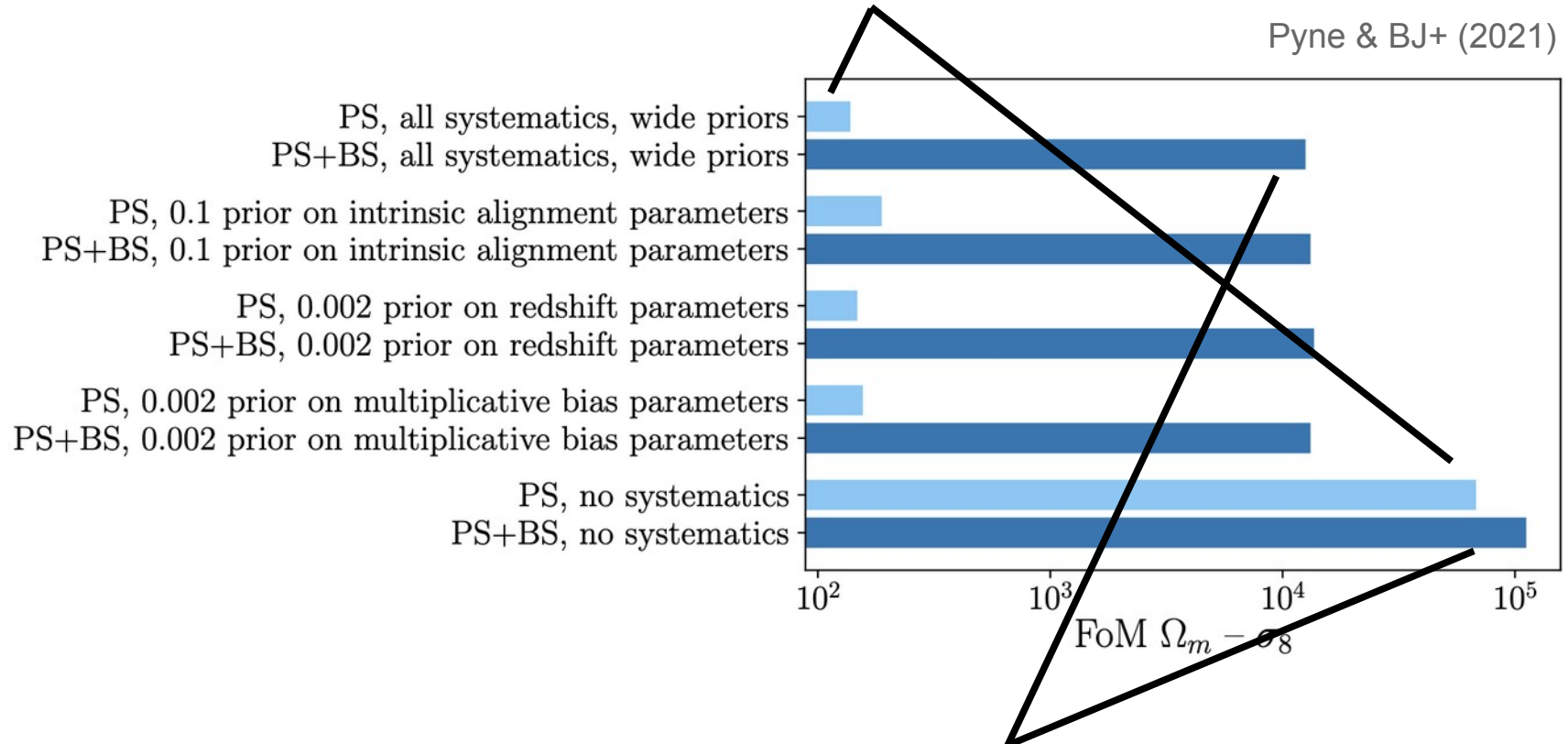
Alignment 3pt statistics



- matter-matter-shape bispectrum
- - - matter-shape power spectrum
- shape-shape power spectrum

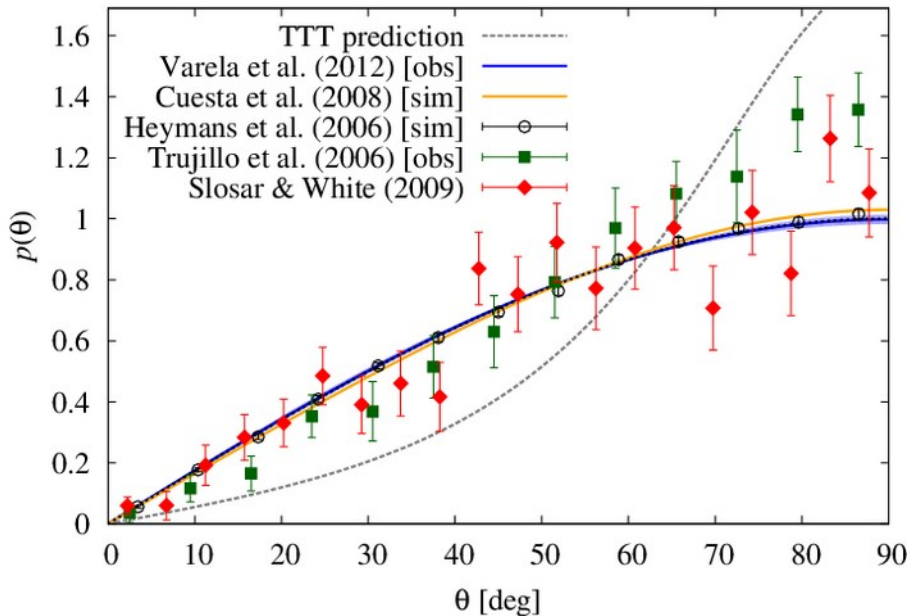
Pyne & BJ+ (2022)

power spectrum alone loses most cosmological information

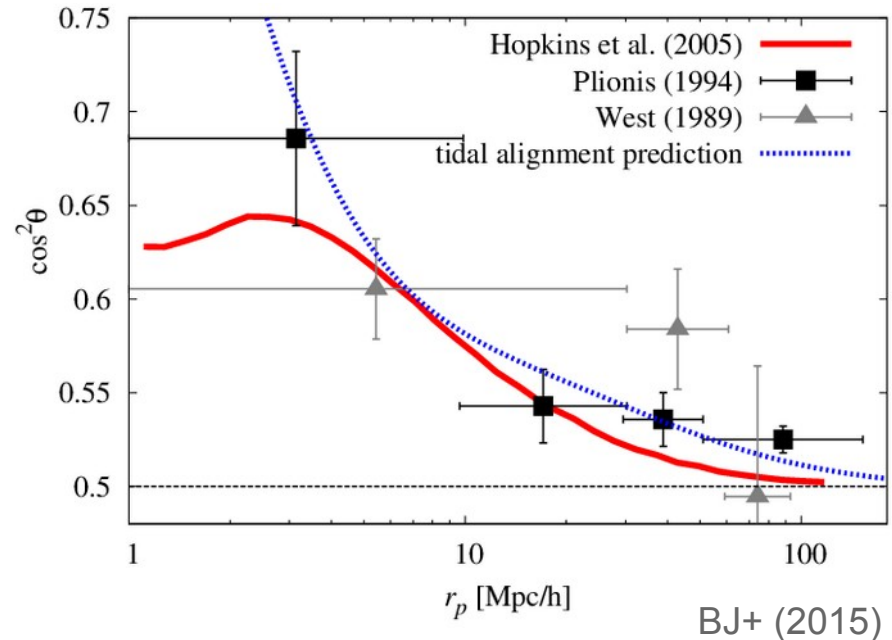


power spectrum + bispectrum recovers most of the information

Alignment of spin with void surfaces



Alignment of cluster haloes with the LSS



alignment of void radius and galaxy spin

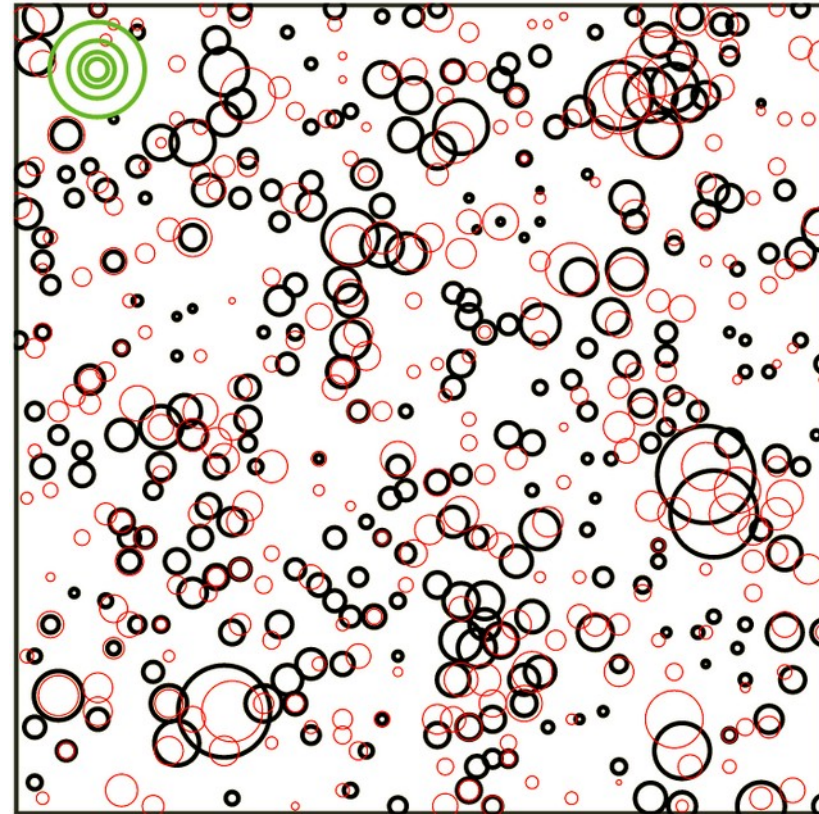
→ tidal torque picture unclear

galaxy cluster shape-position alignment

→ tidal alignment applicable

- IA affects all galaxy weak lensing statistics, e.g. peaks
- IA contaminates redshift-space distortions through selection effects
Hirata (2009), Lamman+ (2022), Zweetslot & Chisari (2022)
- Intrinsic size correlations contaminate magnification and peculiar velocity measurements
BJ+ (2016), Johnston+ (2022)

Harnois-Deraps+ (2022)

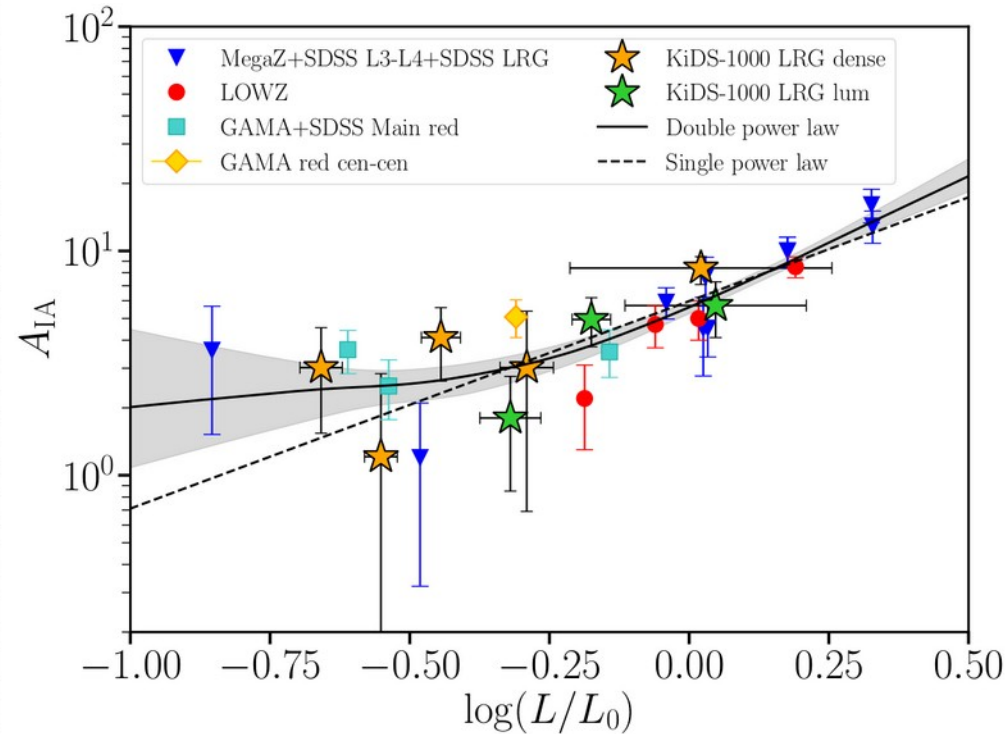
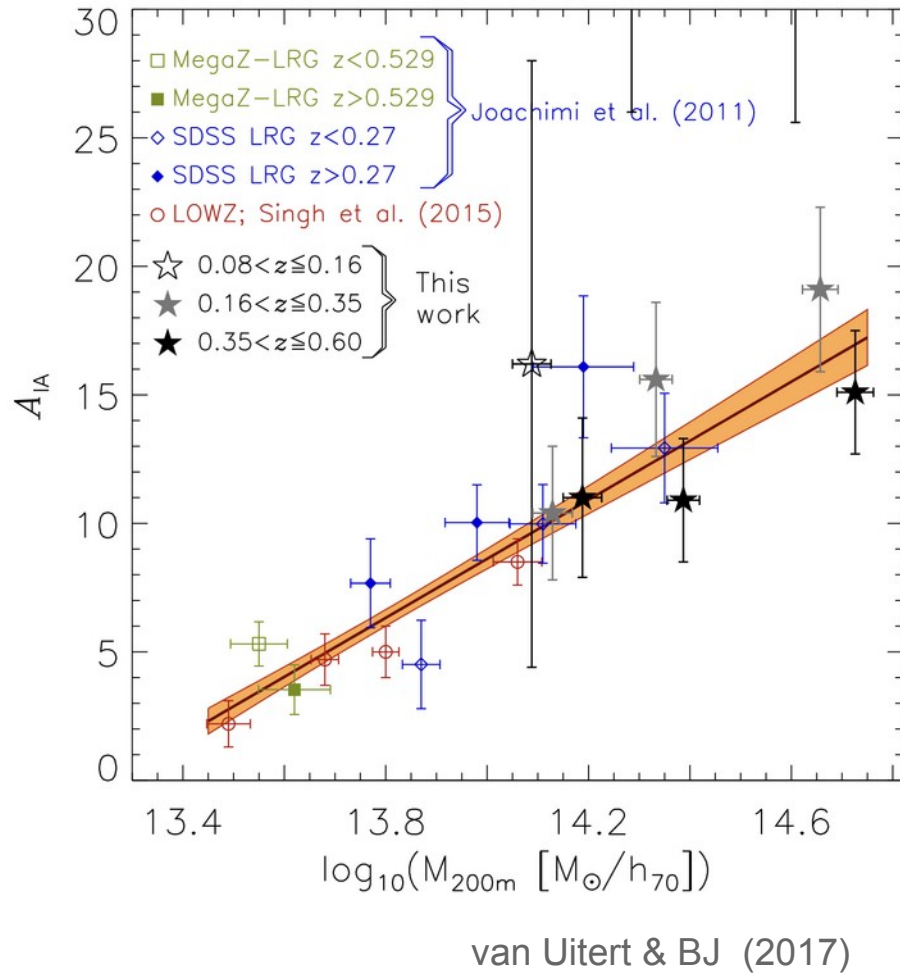


Circle size \leftrightarrow peak signal-to-noise

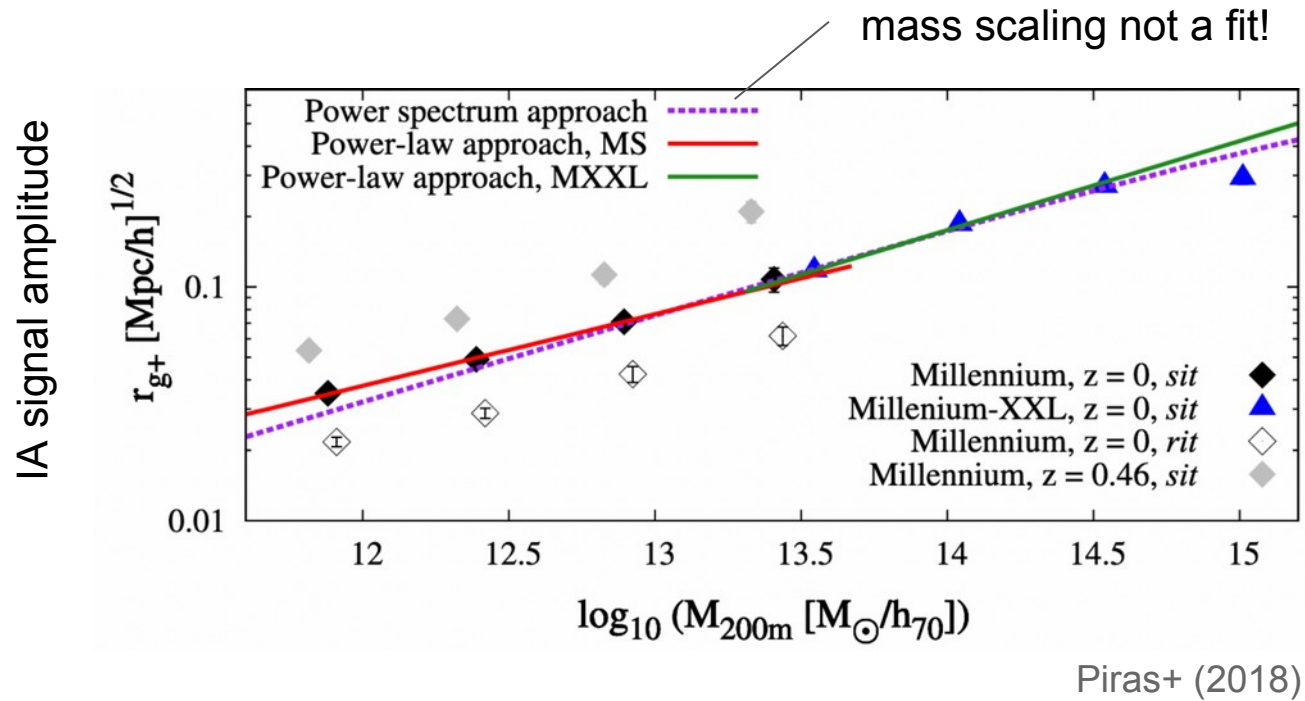
without IA

with IA

Mass dependence

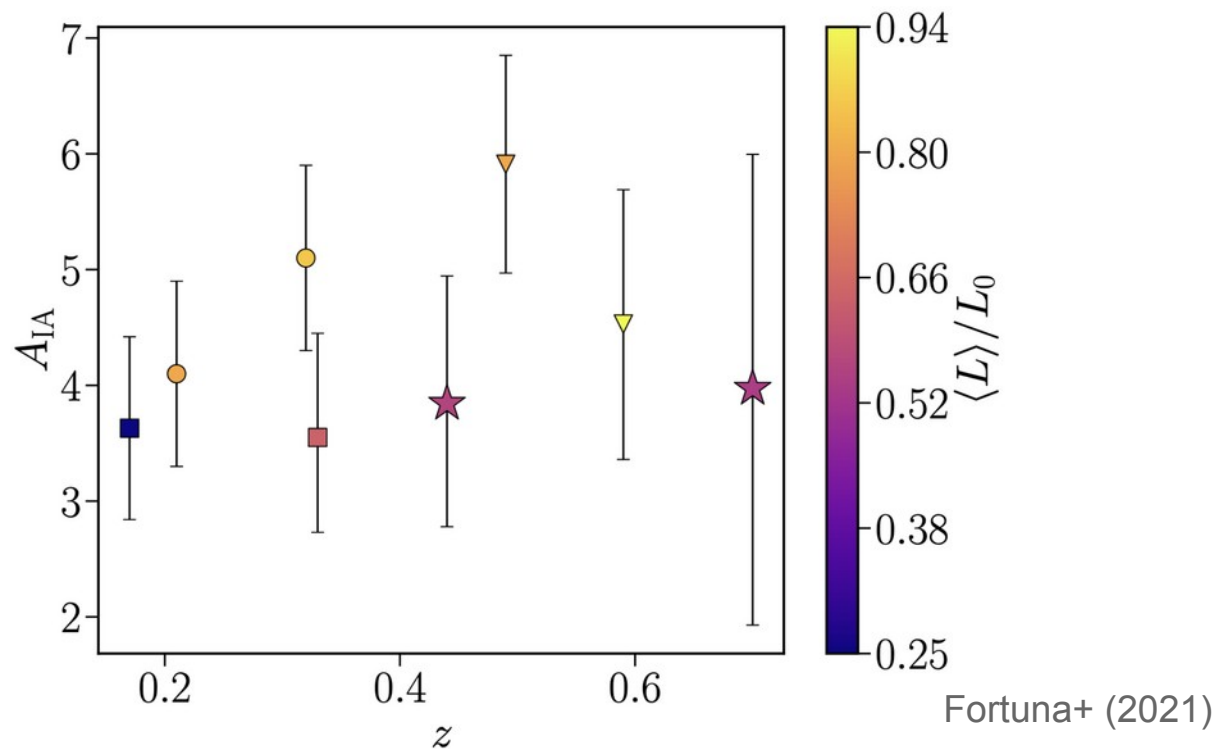


cluster shapes as traced by satellites

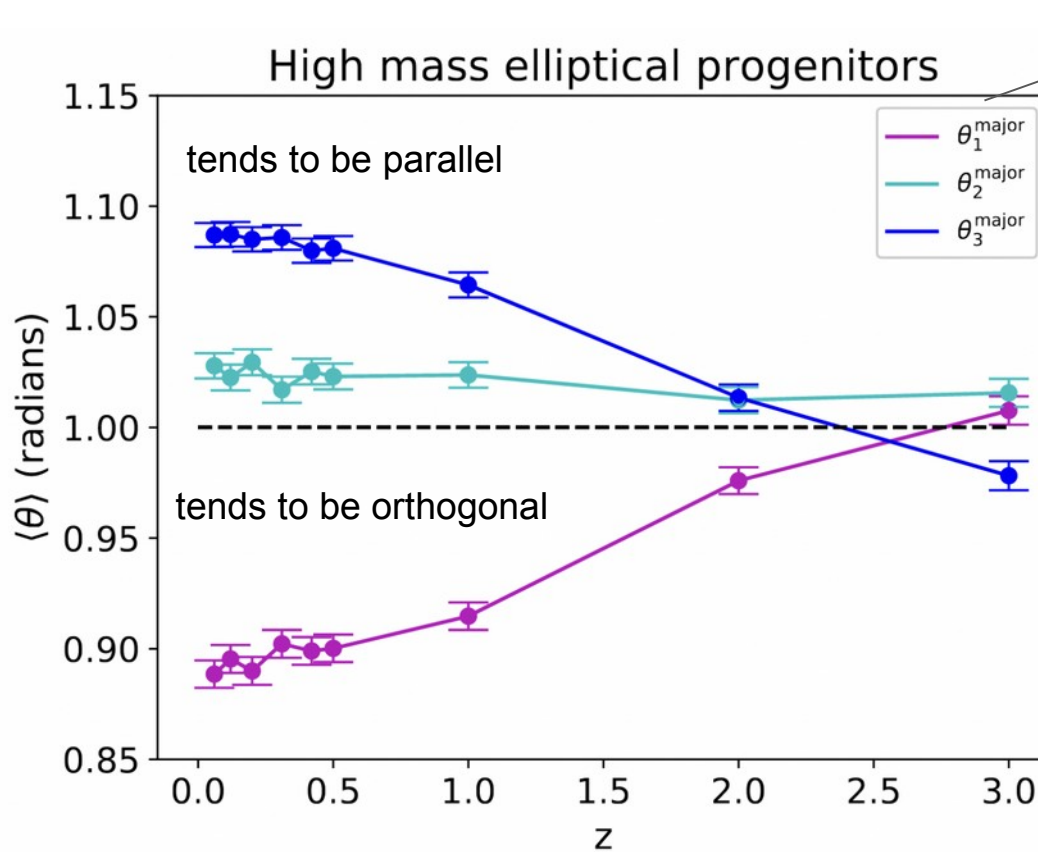


can be understood through the scale dependence of the tidal field

Redshift dependence



includes MegaZ, LOWZ, GAMA, and KiDS LRGs



alignment between galaxy major axis and tidal field eigenvector

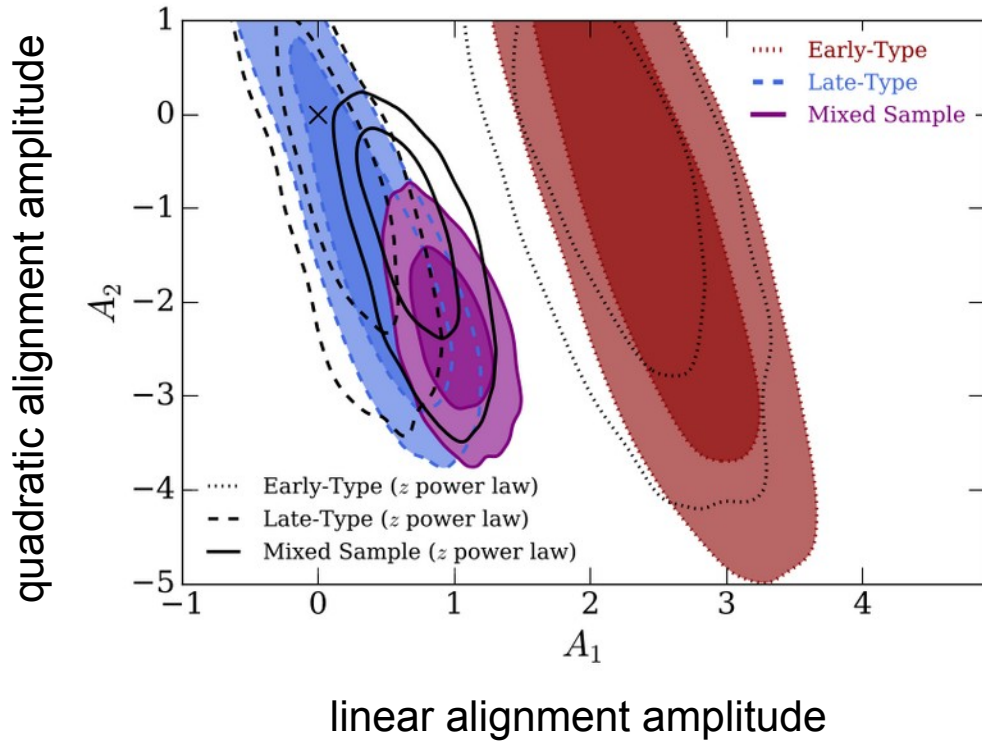
larger eigenvalue

- Halo-density field alignments decrease with time
- Galaxy-halo alignments increase with time
- Galaxy-tidal field alignments increase with time

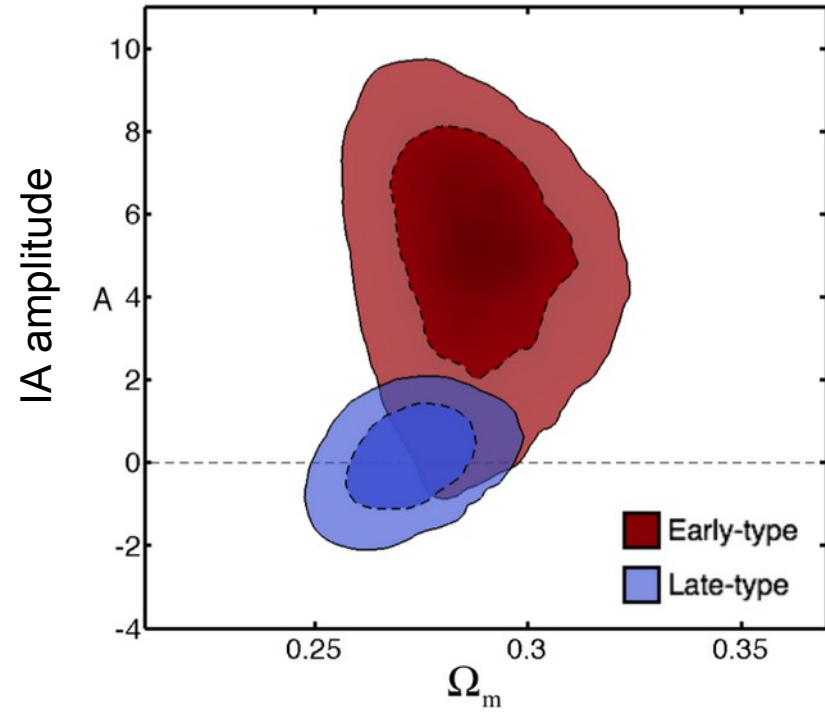
Bhowmick+ (2020), Chisari+ (2017)

Bate+ (2020)

The galaxy type dichotomy



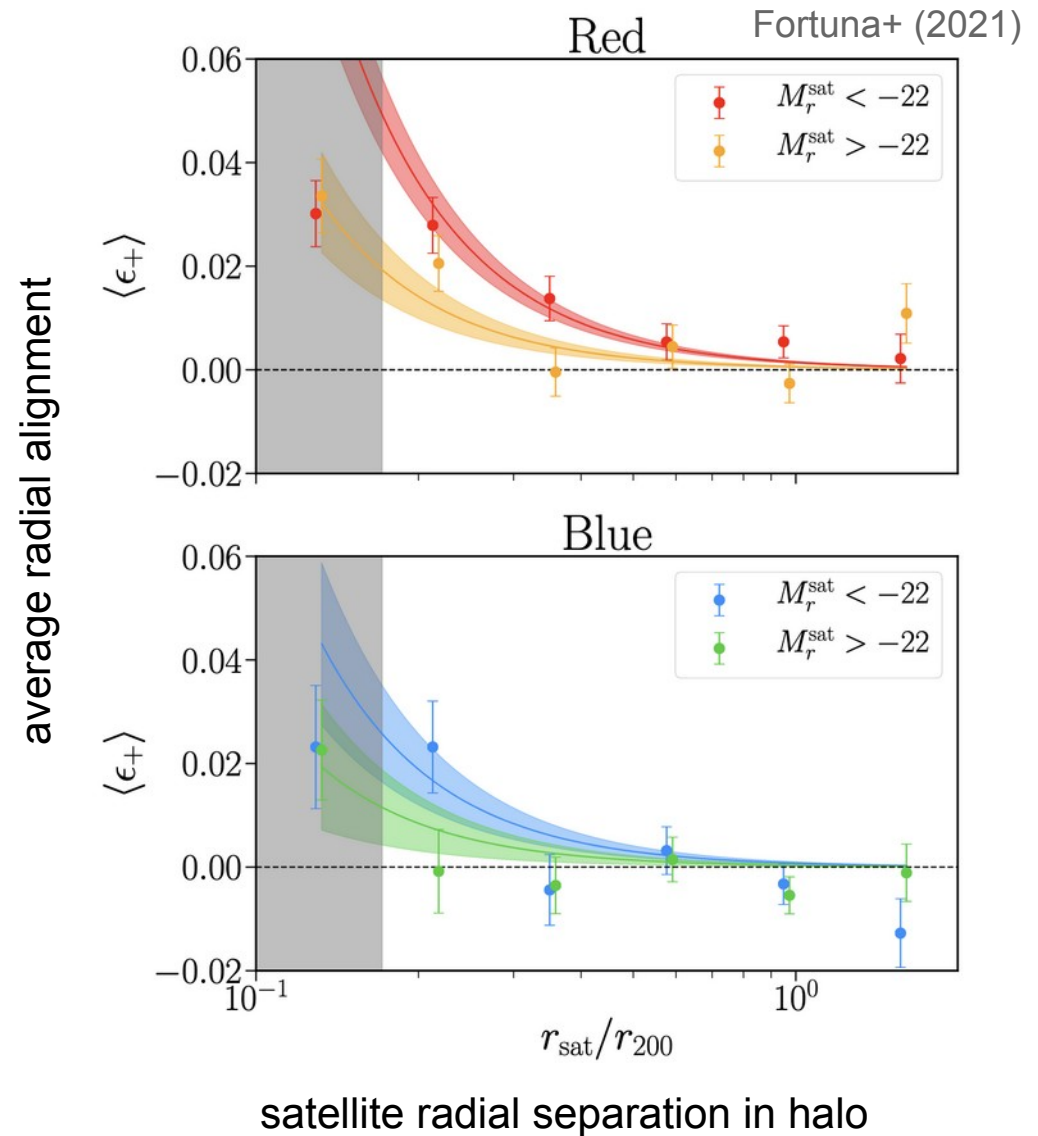
Samuroff+ (2020)



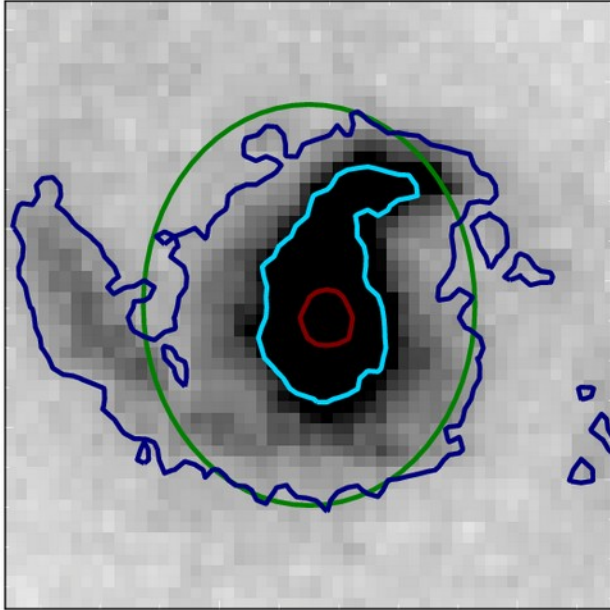
Heymans+ (2013)

Satellites:

- align more strongly close to the centre of a halo
- align more when more luminous
- align more when redder

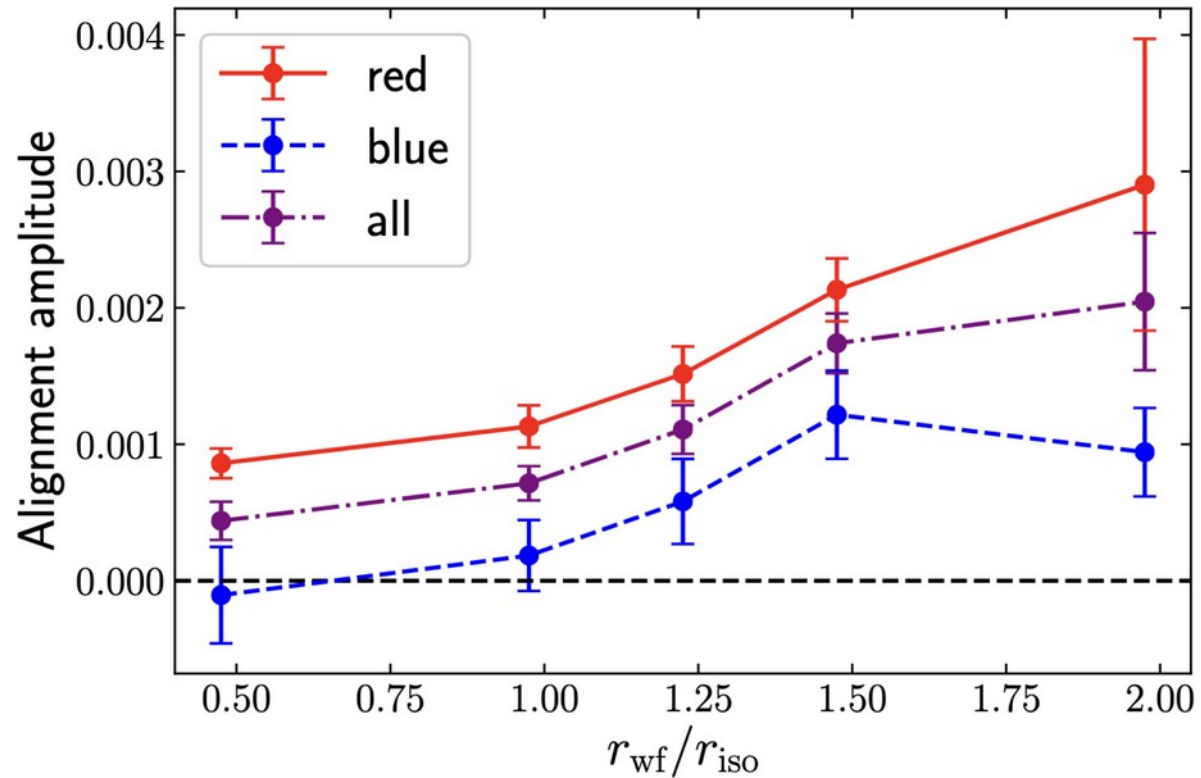


Galaxy scale dependence



R. Mandelbaum

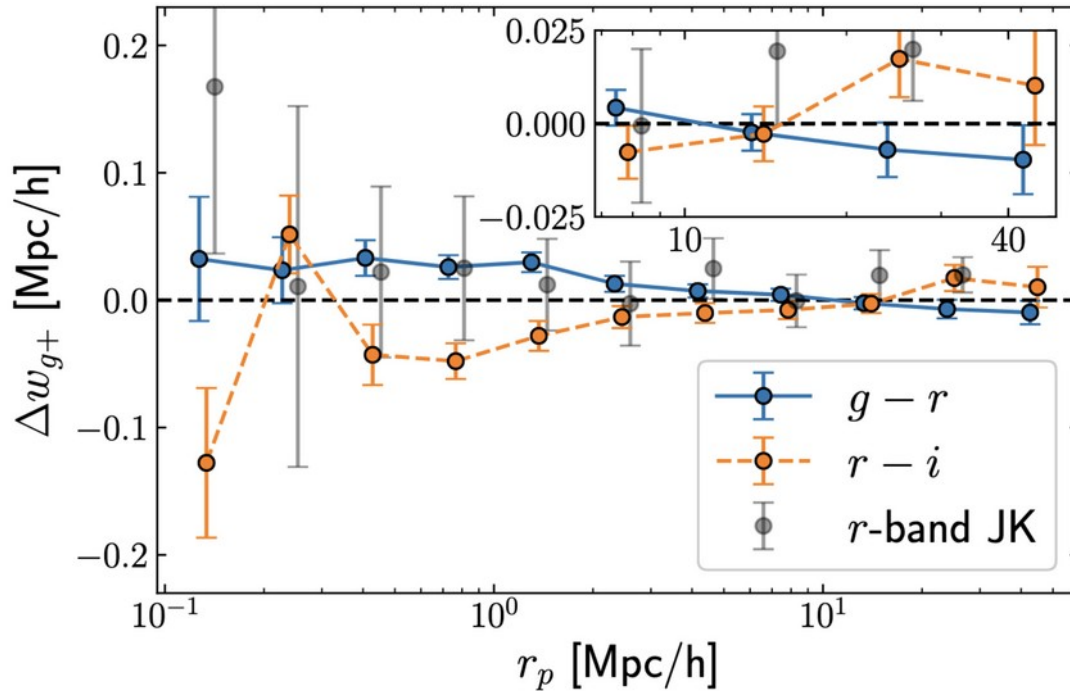
Georgiou+ (2019)



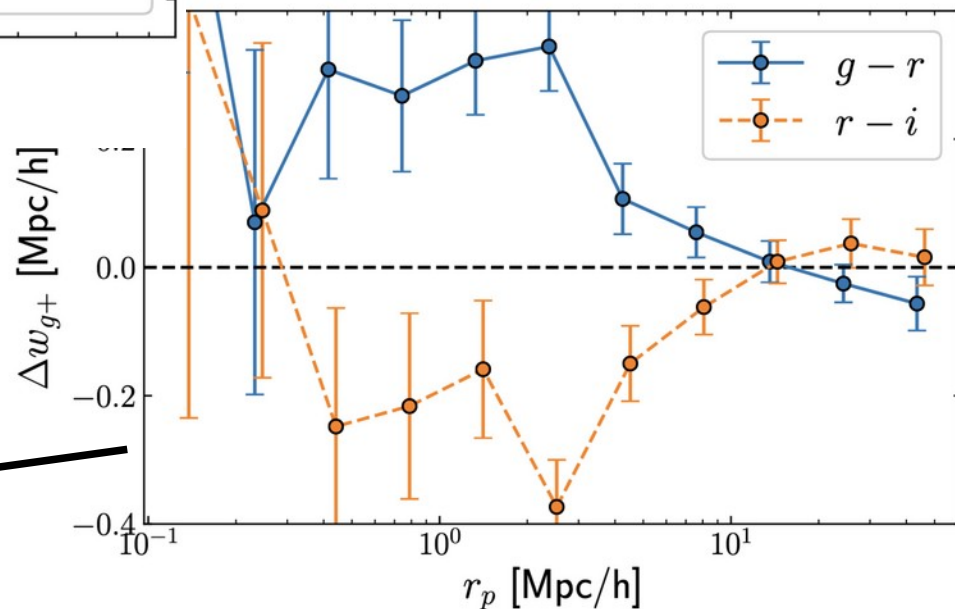
relative size of the shape measurement weight function

the outskirts of a galaxy are more strongly aligned with the large-scale structure

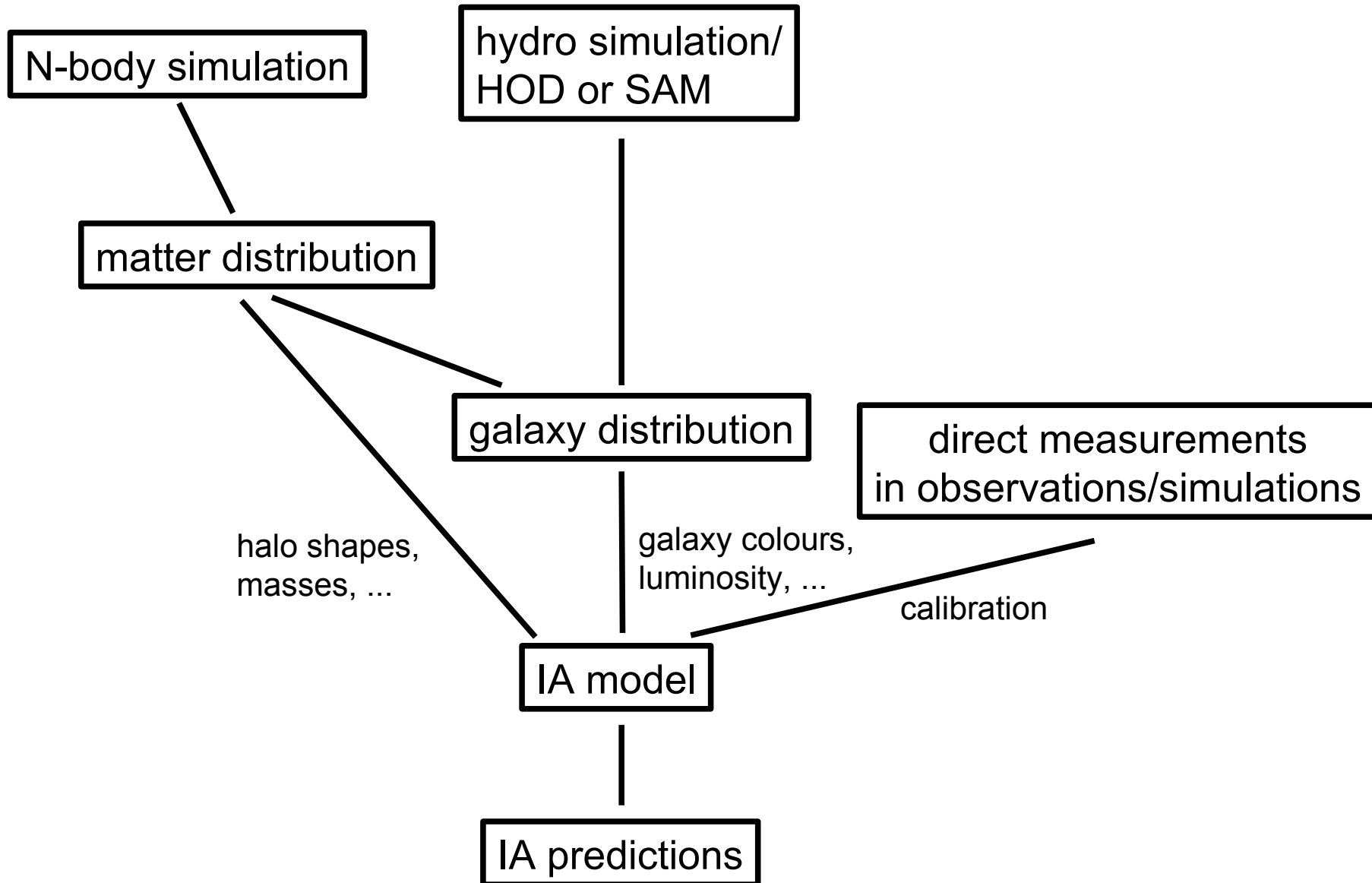
Shape measurement filter dependence



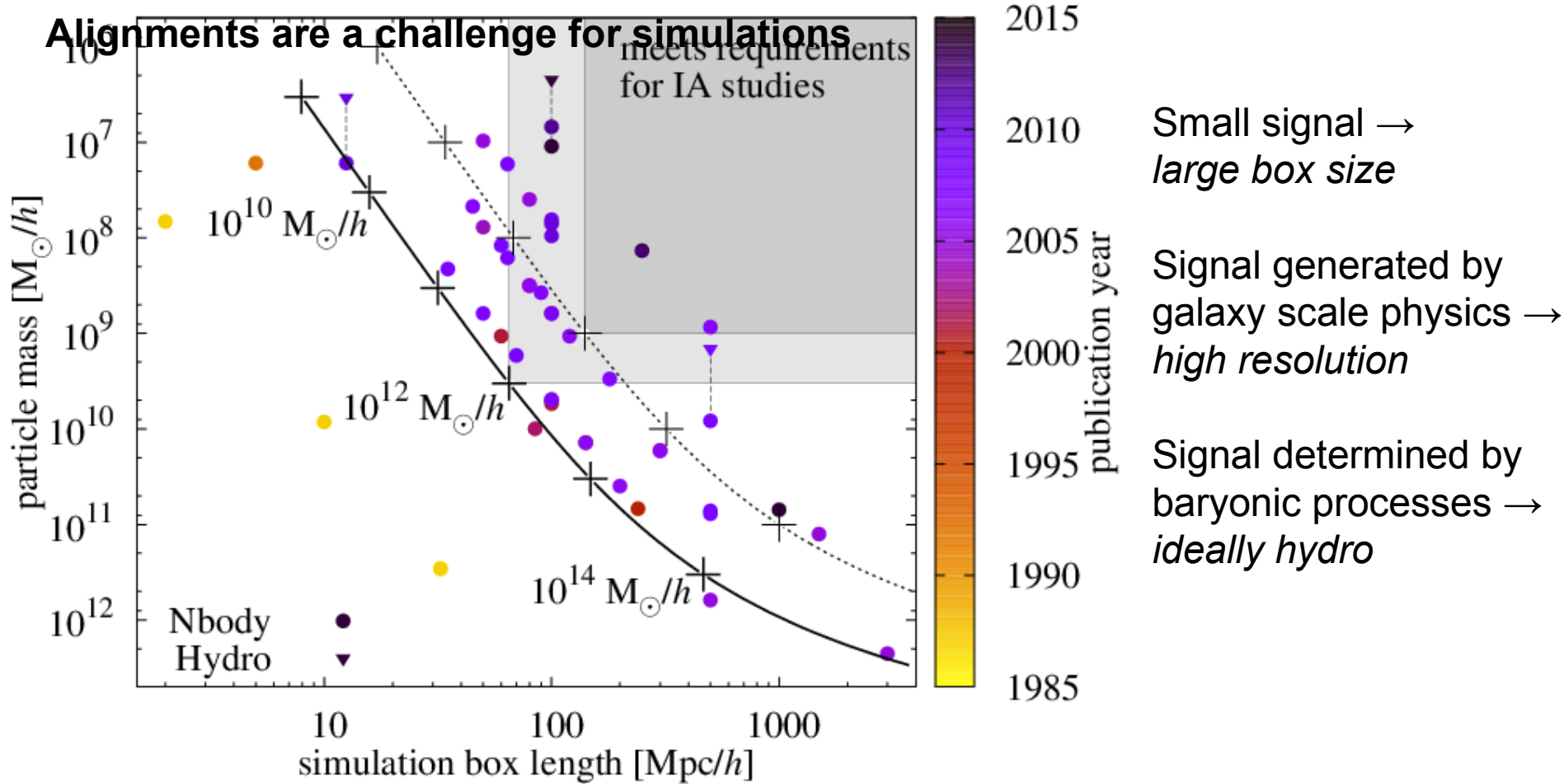
most pronounced for red satellites



Forward-modelling alignments

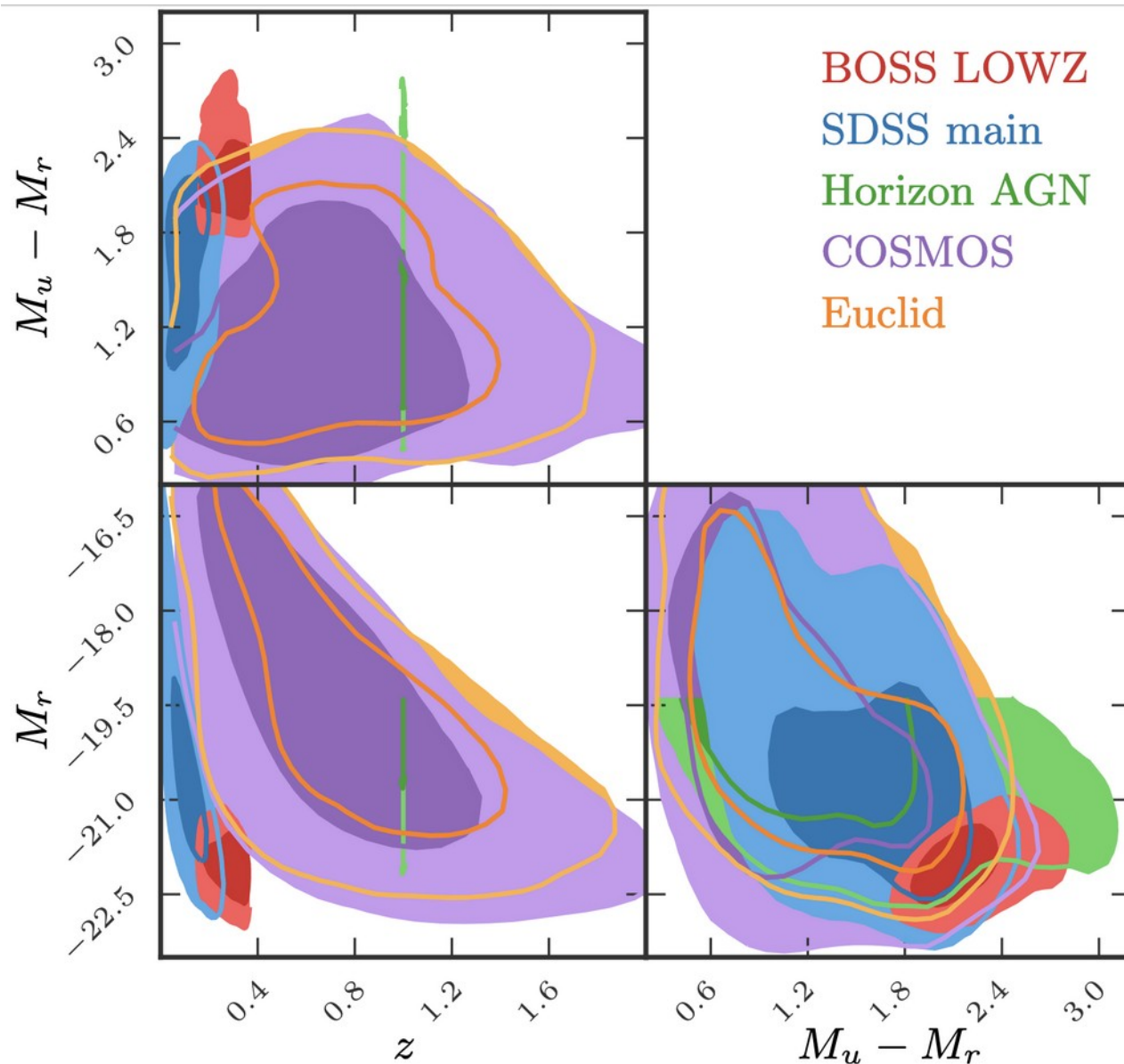


Alignments are a challenge for simulations



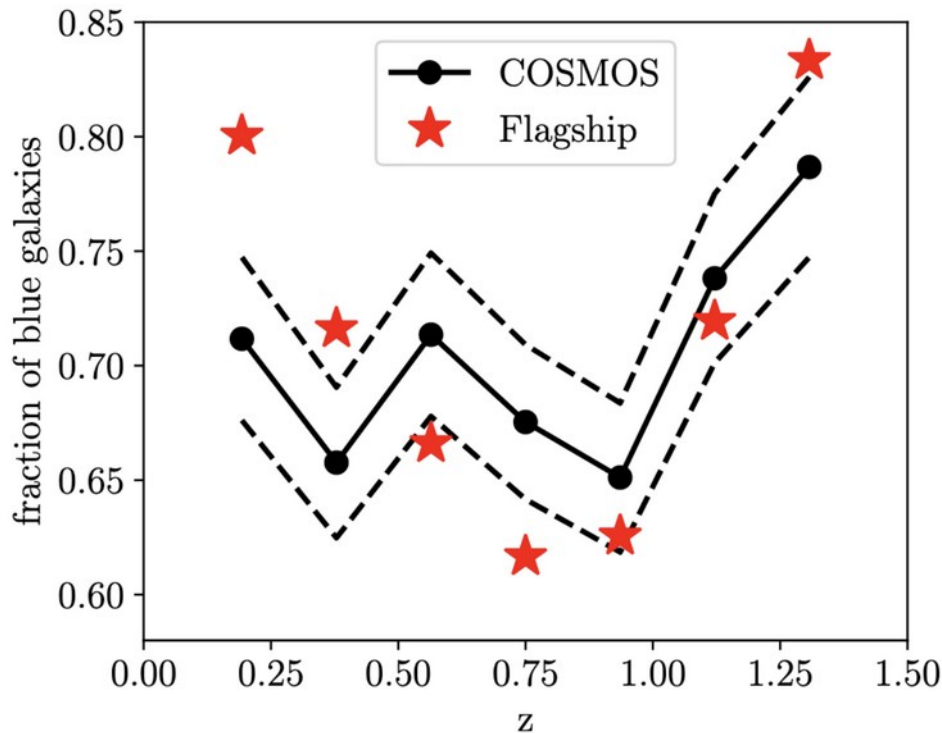
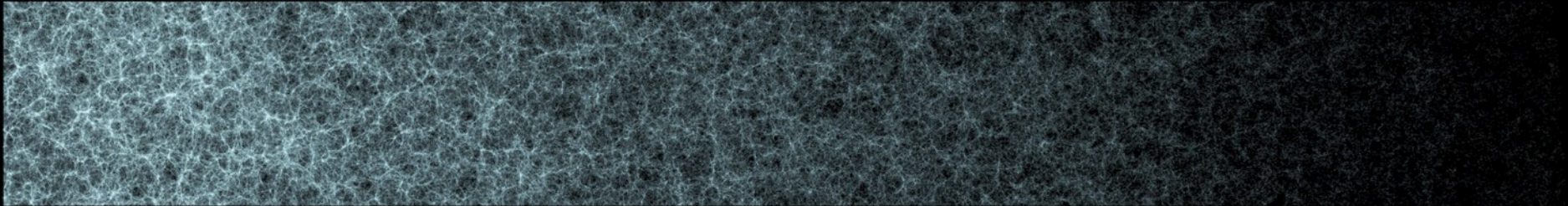
Kiessling+ (2015)

Extrapolation to weak lensing samples



Hoffmann+, in prep.

VIS < 24.5

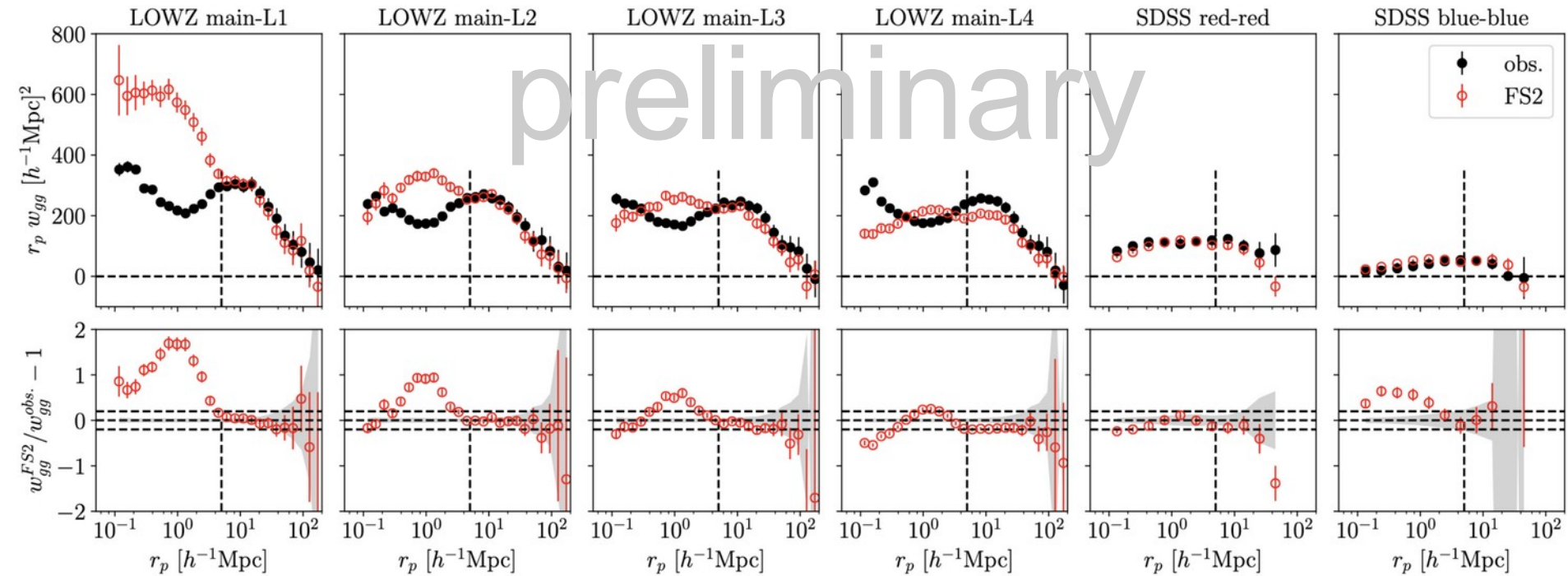


Potter+ (2017)

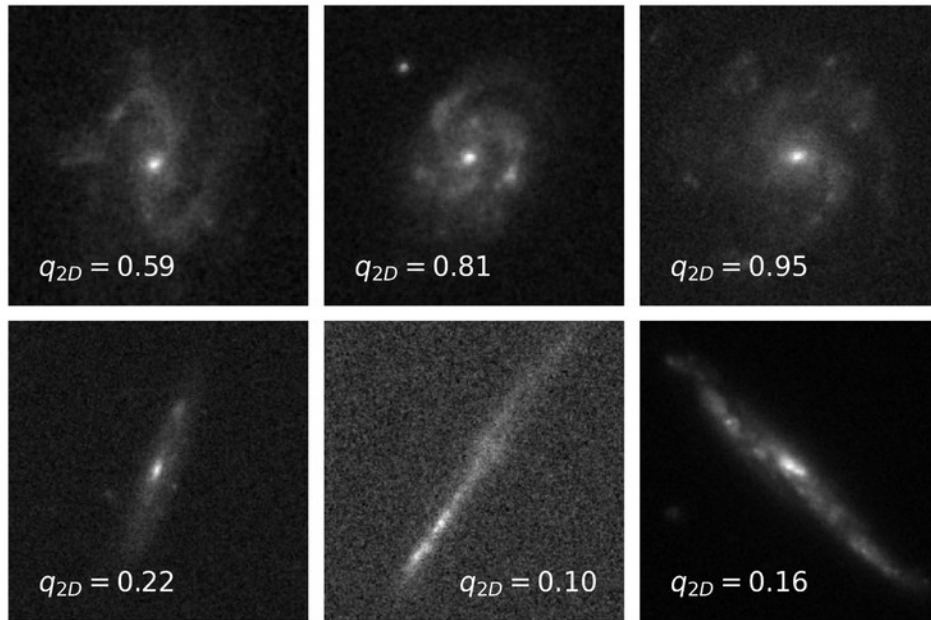
- implemented in Flagship 2
- octant of the sky, i.e. 5000 deg²
- HOD-like galaxy population
- halo shapes etc. measured on the fly
- realistic photometric redshifts

Hoffmann+, in prep.

Euclid IA model: clustering



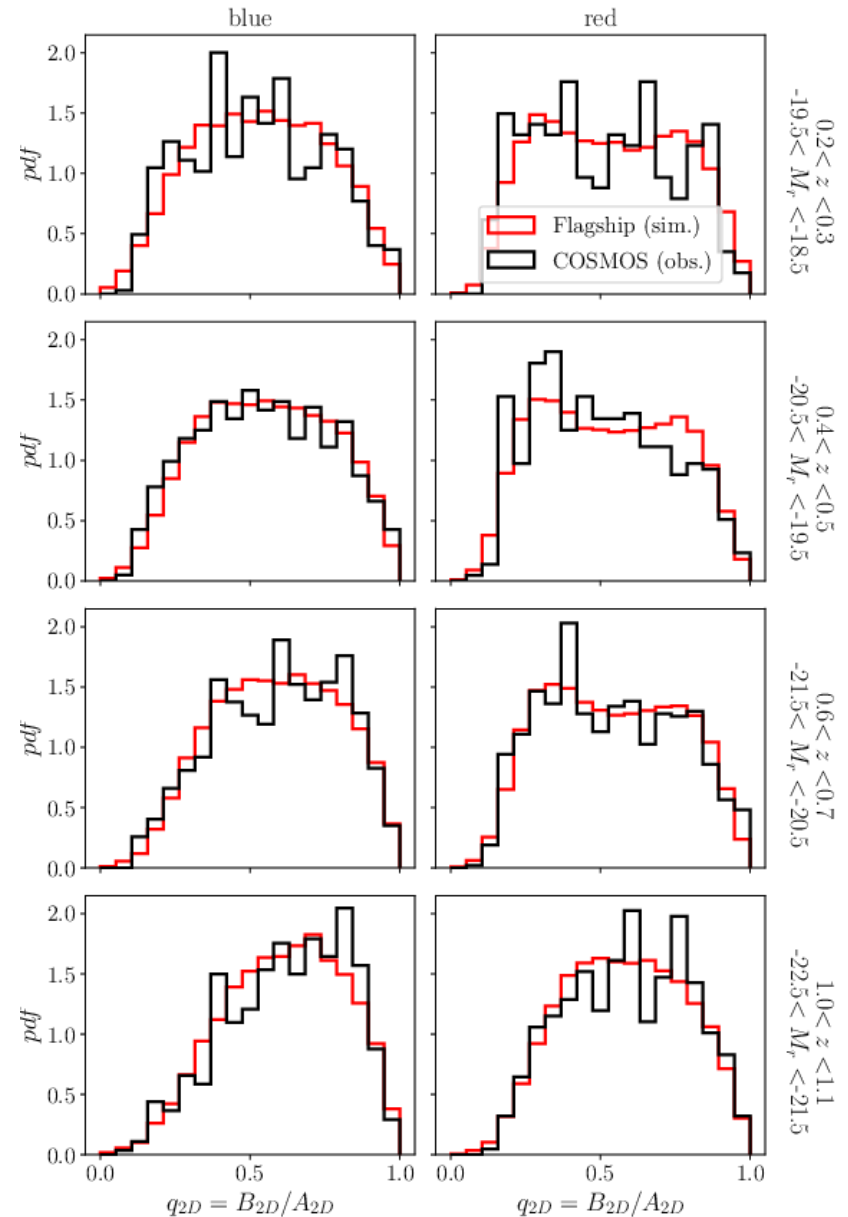
Euclid IA model: galaxy shapes



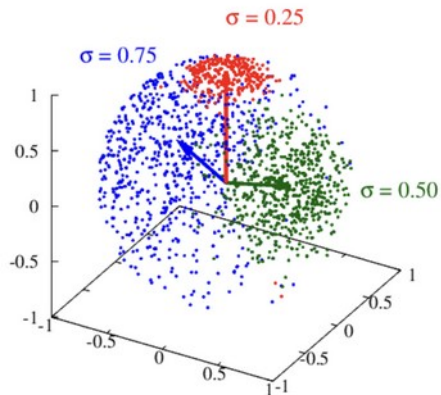
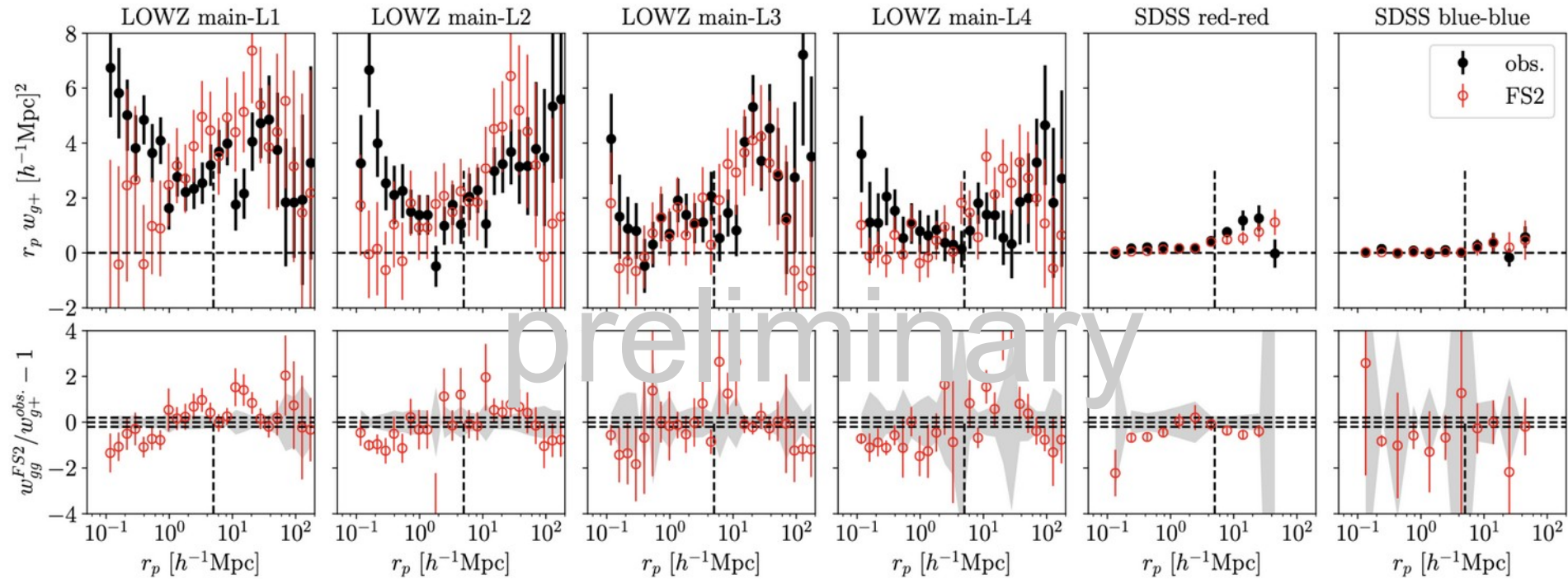
Hoffmann+ (2022)

galaxy shape distributions designed to match COSMOS

Hoffmann+, in prep.

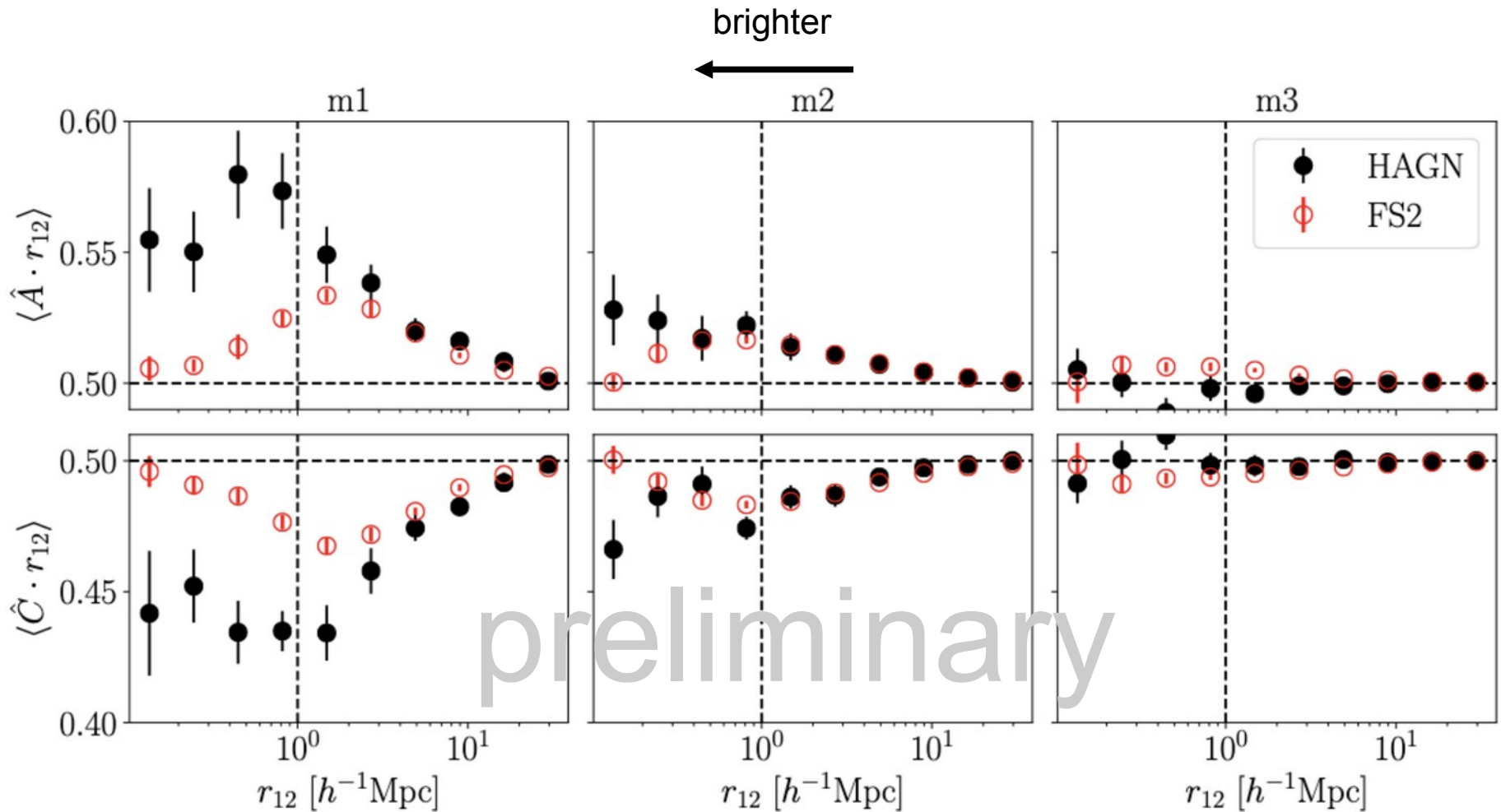


Euclid IA model: alignments



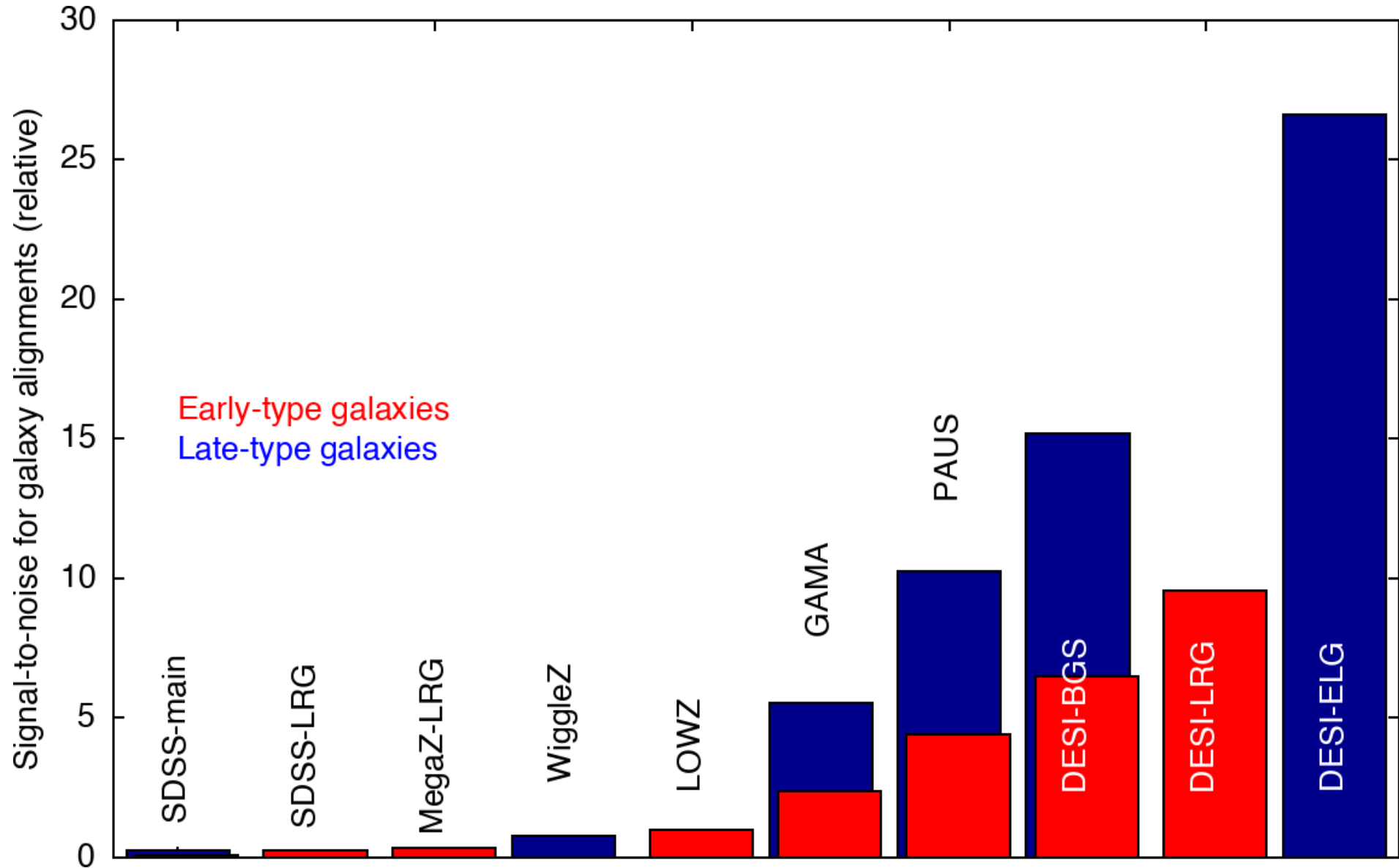
- all central galaxies follow shape of host halo
- satellites are radially aligned
- alignment strength regulated via misalignments

Euclid IA model: alignments

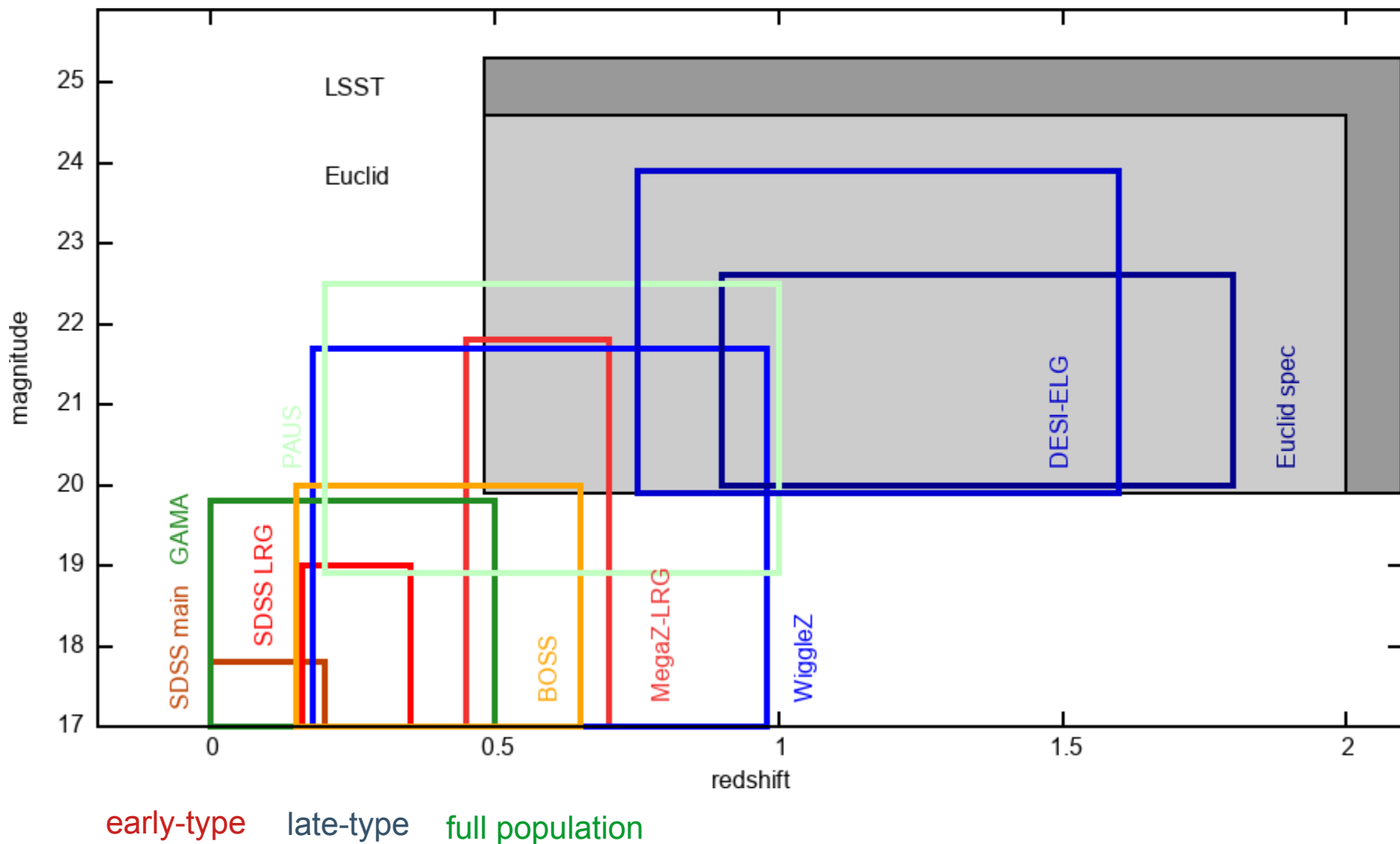


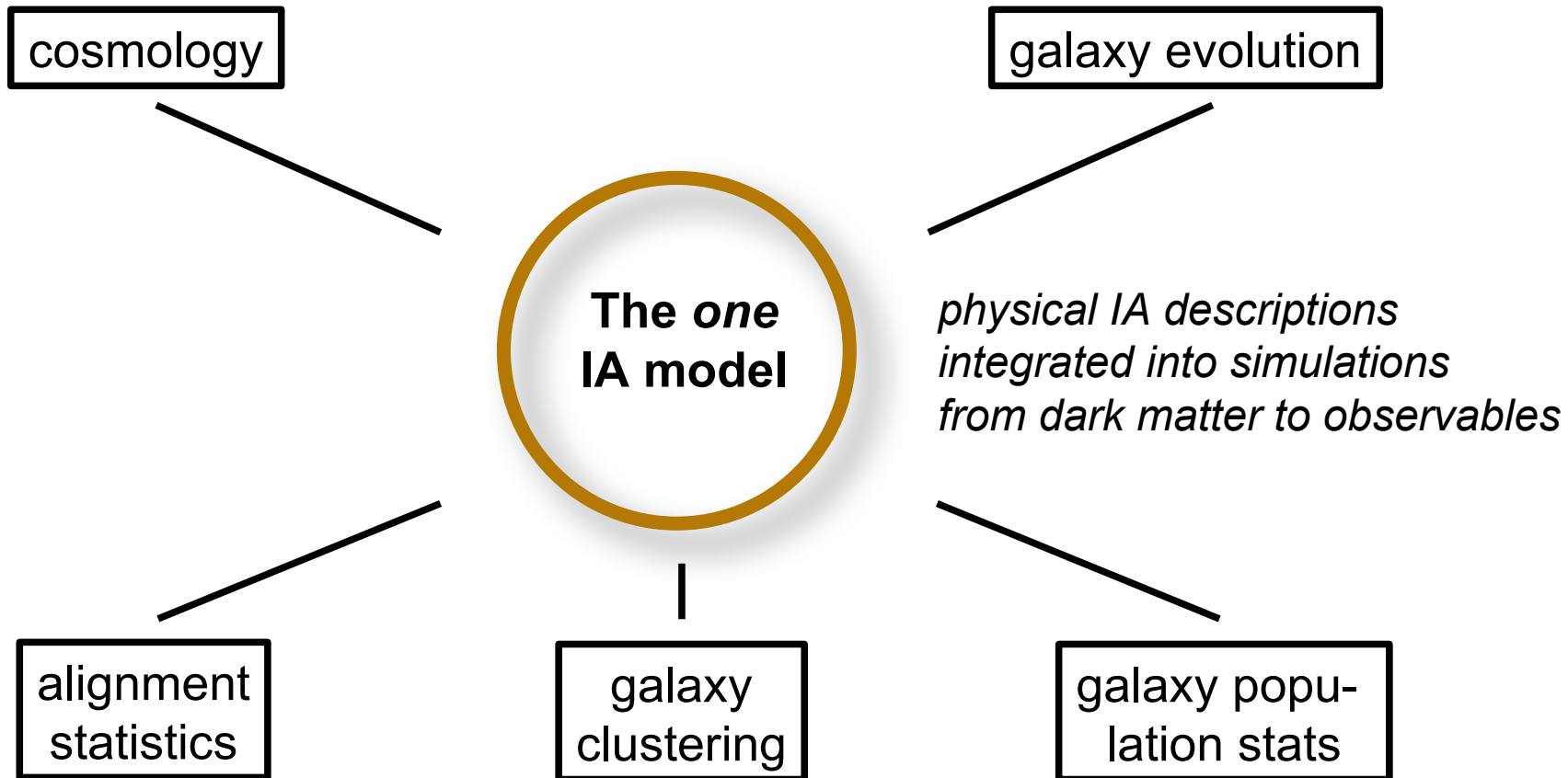
comparison to Horizon-AGN at redshift $z=1$

Outlook: new constraints



Outlook: new constraints





Pan-survey effort and collaboration:

echoIA: Enabling Cosmology with Homogenised Observations of Intrinsic Alignments

<https://github.com/echo-IA>

Ask Jonathan & myself