CEA - IAP Euclid meeting

Nov 13, 2015, IAP

Agenda:

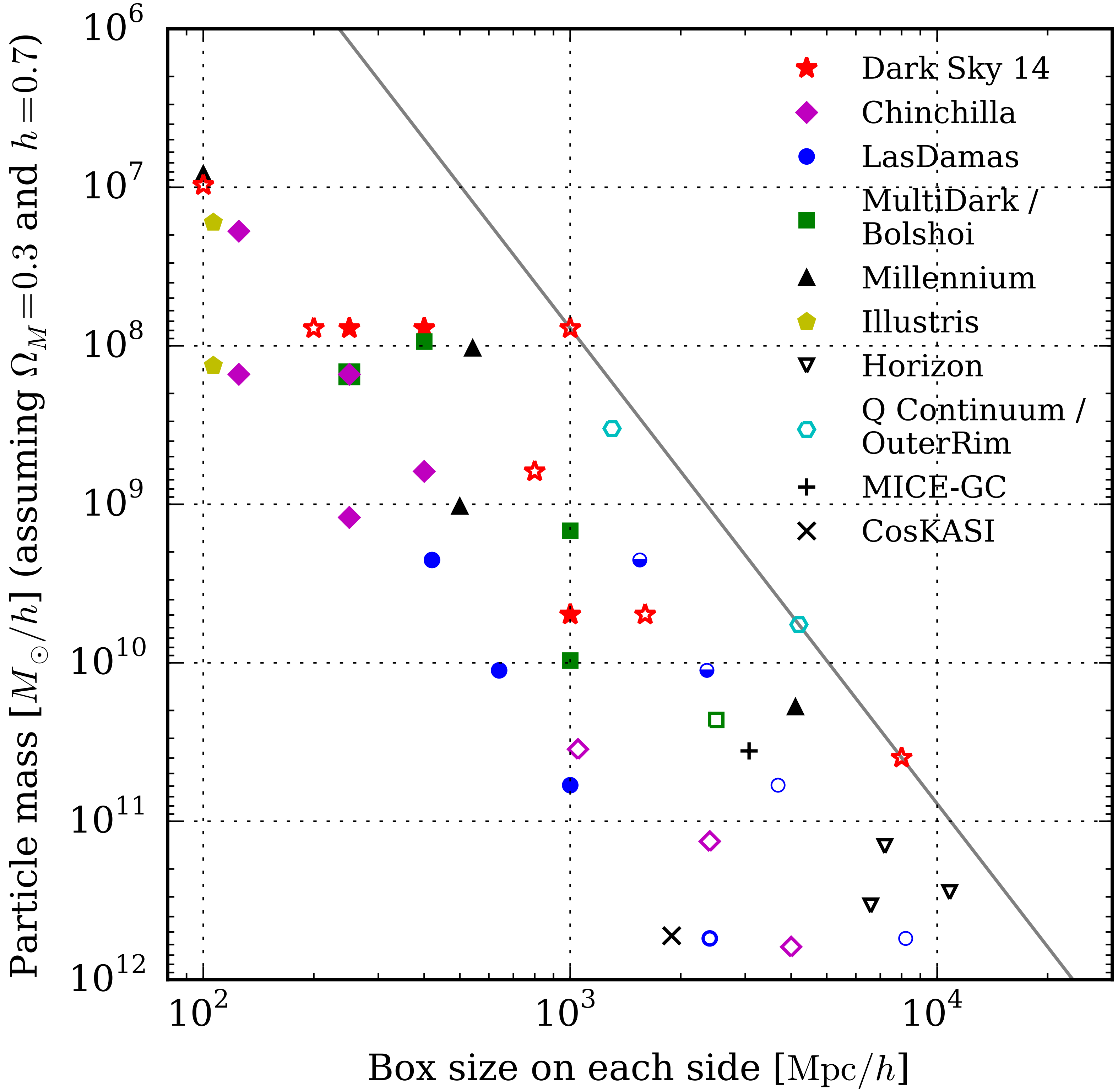
Intrinsic alignment:

- in HORIZON-AGN simulations
- modeling for WL peak counts
- nulling

Higher-order statistics

…

network : winf
identifiant : nov15
code accès : Pol76re?

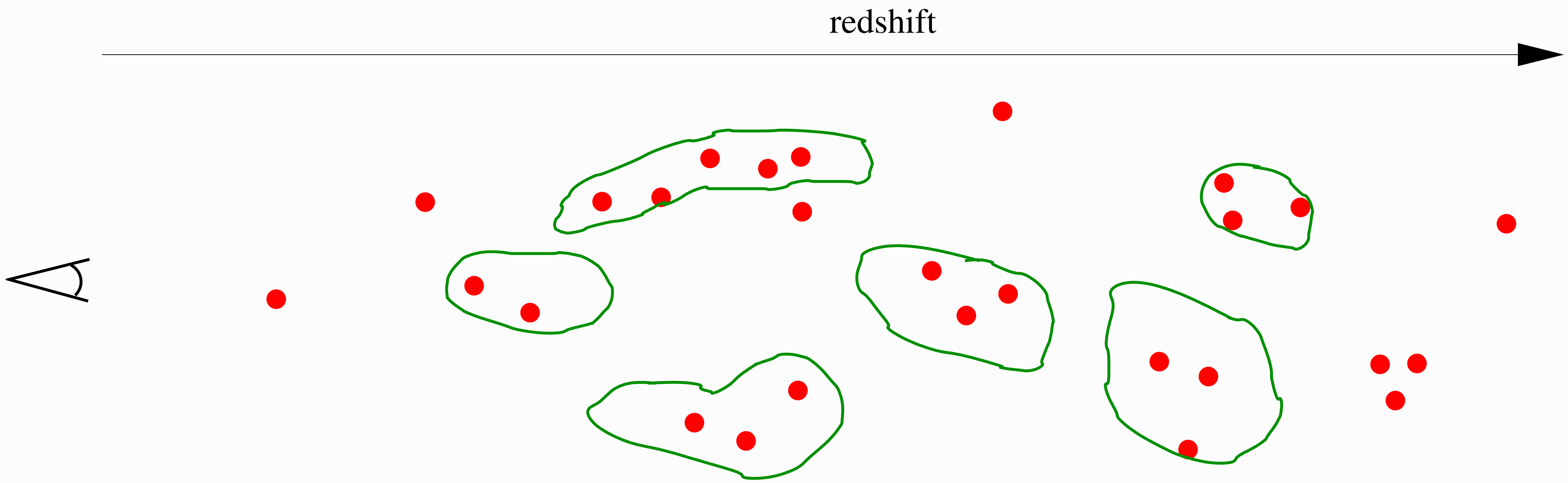


Mao & Wechsler

IA slides for
CEA-IAP Euclid meeting

Nov 2015

Peak counts and IA

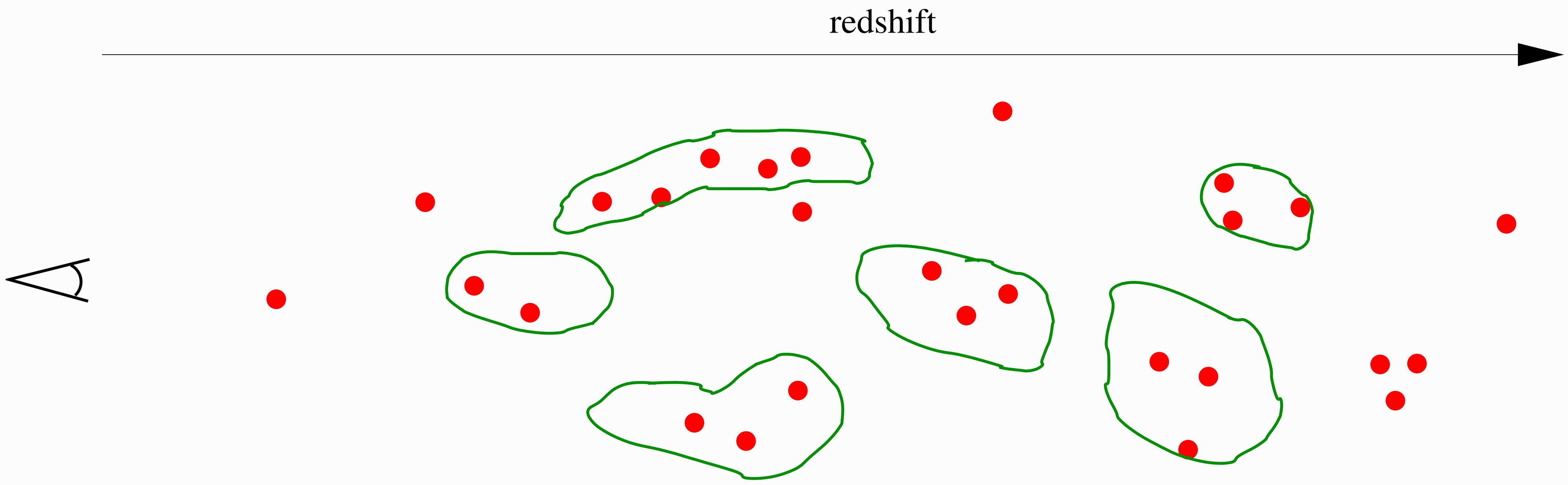


II (intrinsic - intrinsic): 2 (or more) galaxies in same (bg) halo

- Reduce close physical pairs, use only one galaxy per redshift, or galaxies at opposite side of aperture centre.
  Removal of large number of galaxies.

- Difficult to do for globally created convergence maps, would need local (e.g. aperture-based) peak counts.

Peak counts and IA



GI: One (or more) galaxy in halo that produces (most of the) peak lensing signal

- GI is proportional to halo redshift distribution $n_{\rm h}(z)$, but GG monotonously increases with z, sensitive to $\int n_{\rm h}(z)\, W(z)\, dz$.
- GI < 0

Modeling IA for peak counts

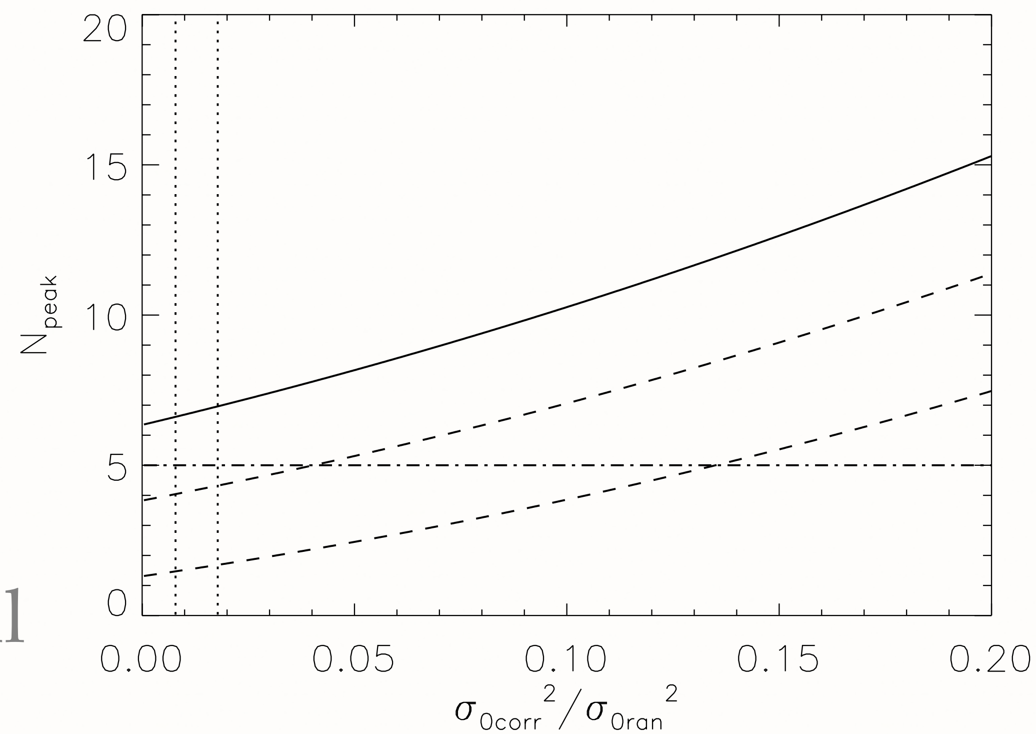
Fan et al. (2007):

- Peaks are maxima in $\nu = S/N$, $S = \kappa$, $N^2 = \sigma^2_{0\mathrm{ran}} + \sigma^2_{0\mathrm{corr}}$. (II)

- Ignoring IA, measured ν over-estimates true ν, leading to `false' peaks.

- CFHTLS Deep, 3.61 deg^2 [Soucail & Gavazzi 2007]: 5 out of 14 WL peaks at $\nu > 3.5$ do not correspond to galaxy over-densities.

- If 5 false peaks and IA model (tidal torque): constraints on IA



Modelling IA for peak counts

Chieh-An Lin, MK, B.M. Schaefer (Uni Heidelberg)

- Peak count model: Draw halos from mass function, source galaxies from n(z), create convergence maps, count peaks

  1410.6955, 1506.01076, cosmostat.org/software/camelus/

- Add correlations between galaxy and halo potential for each galaxy. Need to identify (galaxy, halo) pairs.

- If parametric model: can marginalise over IA parameters.

- Late-type (spiral) galaxies: tidal torque: coupling of angular momentum to tidal shear and inertia (Lee & Pen 2000)

- Early-type (elliptical) galaxies: stretching of galaxy potential in external tidal field

Modelling IA for peak counts

Potential of NFW mass distribution.

$$\phi = -\,G M_{\rm vir} \frac{\log\left(1 + r/r_{\rm s}\right)}{r f_c};$$

$$f_c = \log(1+c) - \frac{c}{1+c}.$$

Tidal shear 3×3 matrix

$$\psi_{ij} = \frac{\partial^2 \phi}{\partial x_i \partial x_j}.$$

Normalized traceless

$$\hat{\psi}_{ij} = \psi_{ij} - \frac{\mathrm{tr}\,\psi}{3}\delta_{ij}.$$

Relation between angular momentum and potential [Lee & Pen(2001)].

$$\langle L_i L_j \rangle = \frac{1}{3}\left(\frac{1+a}{3}\delta_{ij} - a\sum_k \hat{\psi}_{ik}\hat{\psi}_{kj} \right)$$

$a = 0$: perfect correlation between inertia and shear, recover isotropy
$a = 3/5$: no correlation, angular momentum random.
$a \approx 0.24$ from simulations.

Modelling IA for peak counts

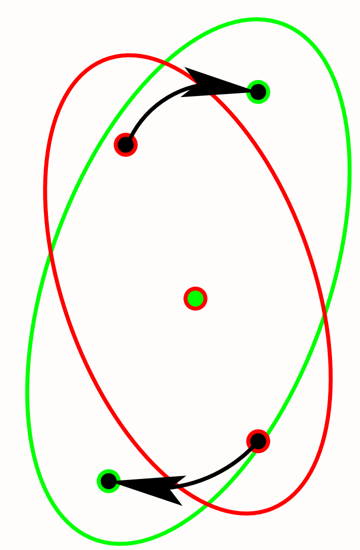
Simulation:
Halo with $M=10^{15}$ M_{sol}, cube of size R=32 Mpc,
10000 galaxies.

Create, correlated angular momenta according to

$$C_{ij} = \langle L_i L_j \rangle = \frac{1}{3} \left(\frac{1+a}{3} \delta_{ij} - a \sum_k \hat{\psi}_{ik} \hat{\psi}_{kj} \right).$$

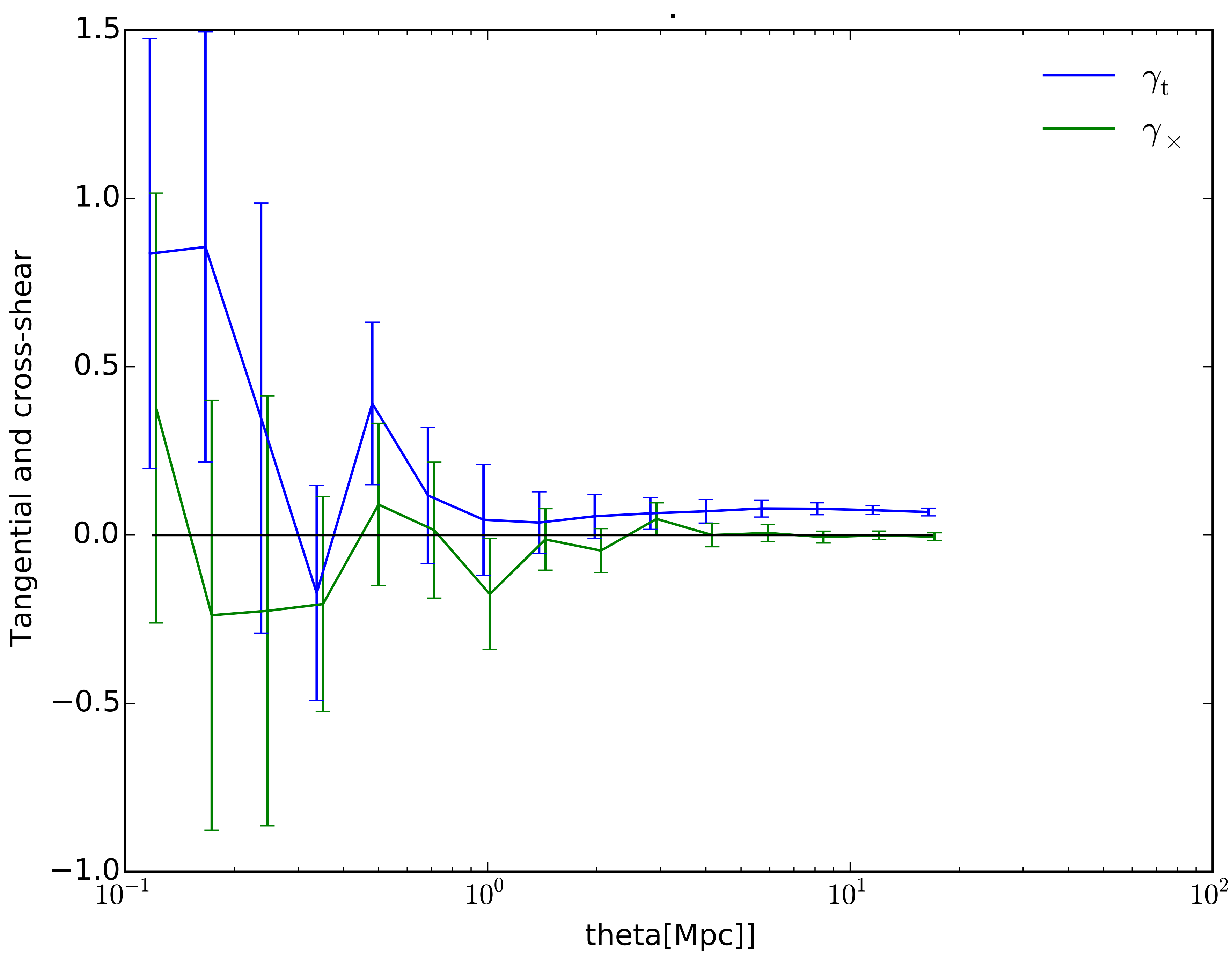
1. Create uncorrelated momenta $L_{r,i} \sim \mathcal{N}(0, 1)$
2. Transform to $L = \mathbf{A} L_r$ with $C = AA^T$

$$\langle L_i L_j \rangle = \langle A_{ik} L_{r,k} A_{jl} L_{r,l} \rangle = \langle L_{r,k} L_{r,l} \rangle = A_{ik} A_{jl} \delta_{kl} = A^T_{ki} A_{jk} = C_{ij}.$$



Ellipticity $$\varepsilon = \frac{L_0^2 - L_1^2 + 2\mathrm{i} L_0 L_1}{1 + L_2^2}$$

Modelling IA for peak counts

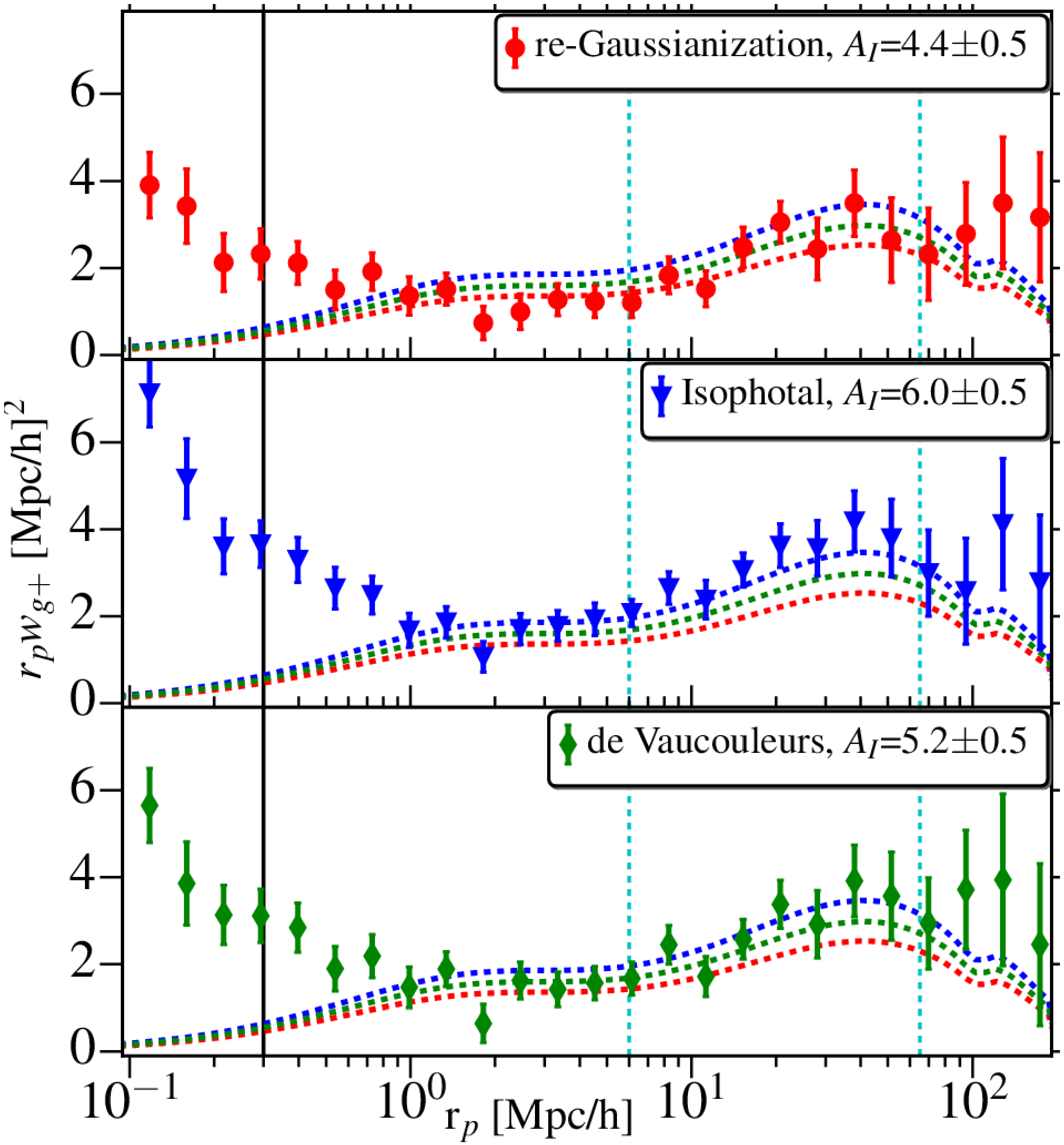


Modelling IA for peak counts

Early-type (elliptical) galaxies (TODO)

- Need physical model that where smaller galaxies are more strongly distorted by external tidal field than more massive ones.
- Idea: Use stellar velocity dispersion $\sigma^2 = 2GM/R$ as indicator of mass or compactness.
- External tidal distorts gravitational potential ϕ, stars would "leak" towards largest $\nabla\phi$.
- Free parameter to describe leakage strength.

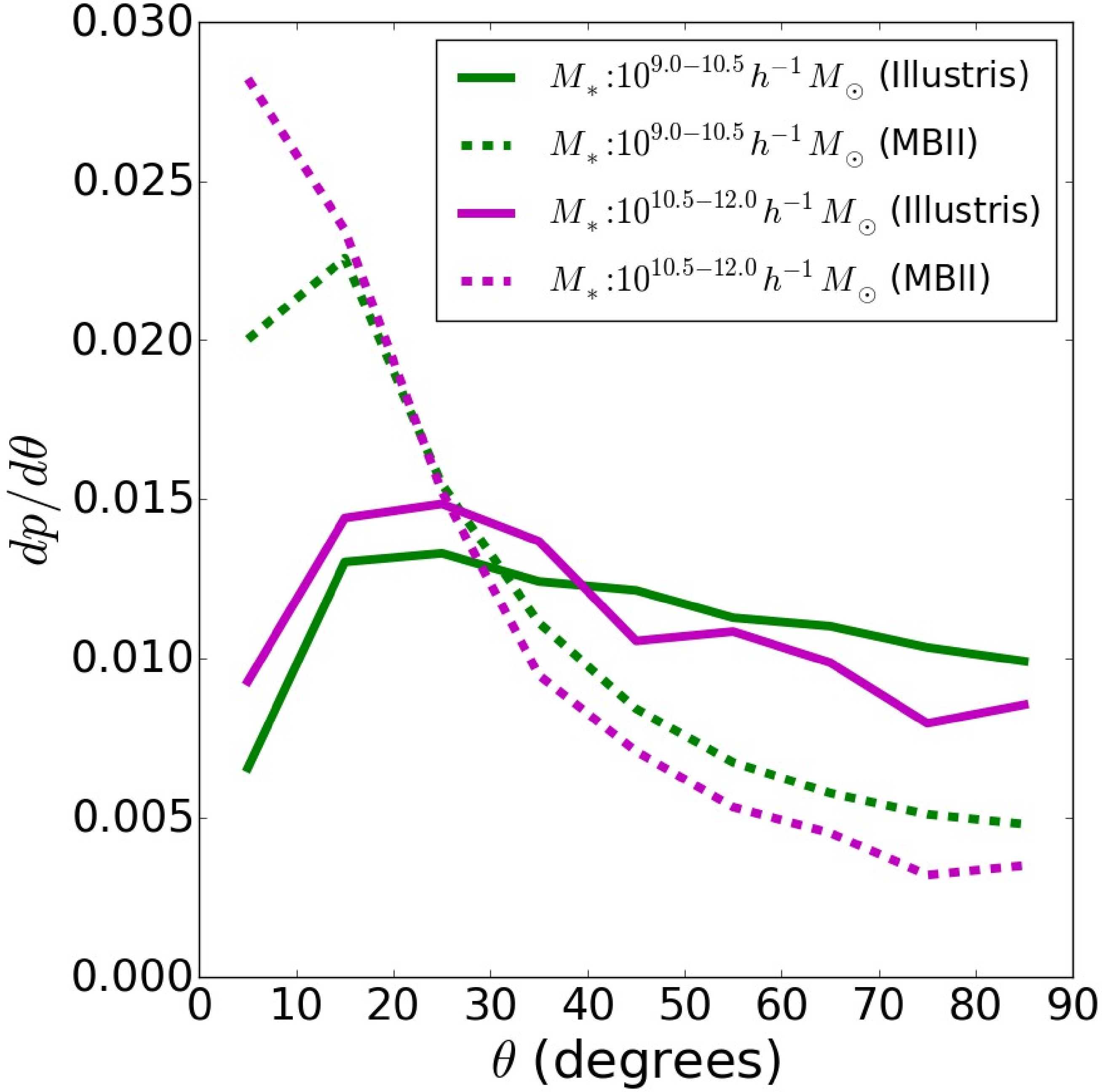
Recent developments



The IA signal amplitude depends on the shape measurement method.

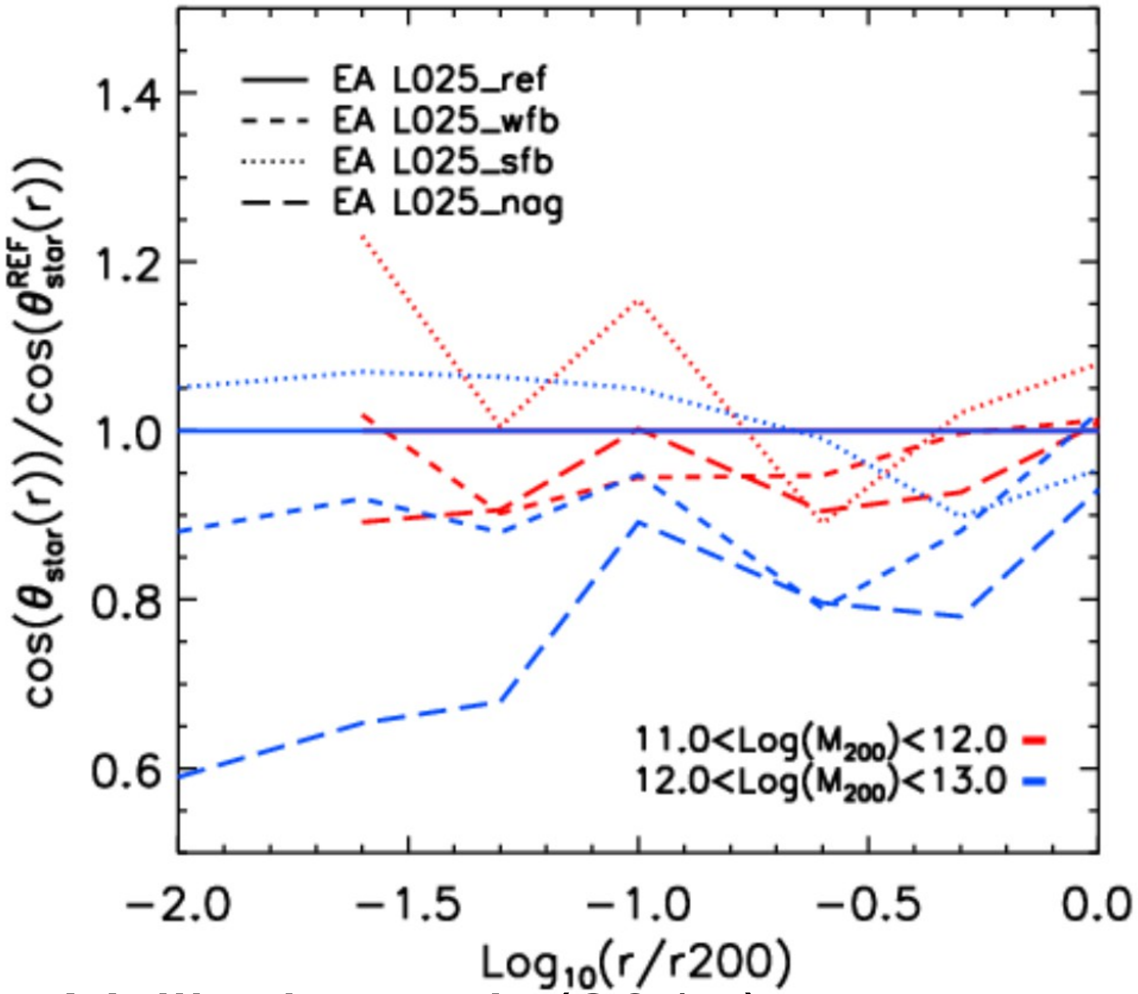
Singh & Mandelbaum (2015), arxiv.org/1510.06752

Recent developments



There is large variation in IA signals in simulations (although some trends are shared).

galaxy-dark matter misalignments in hydro-simulations

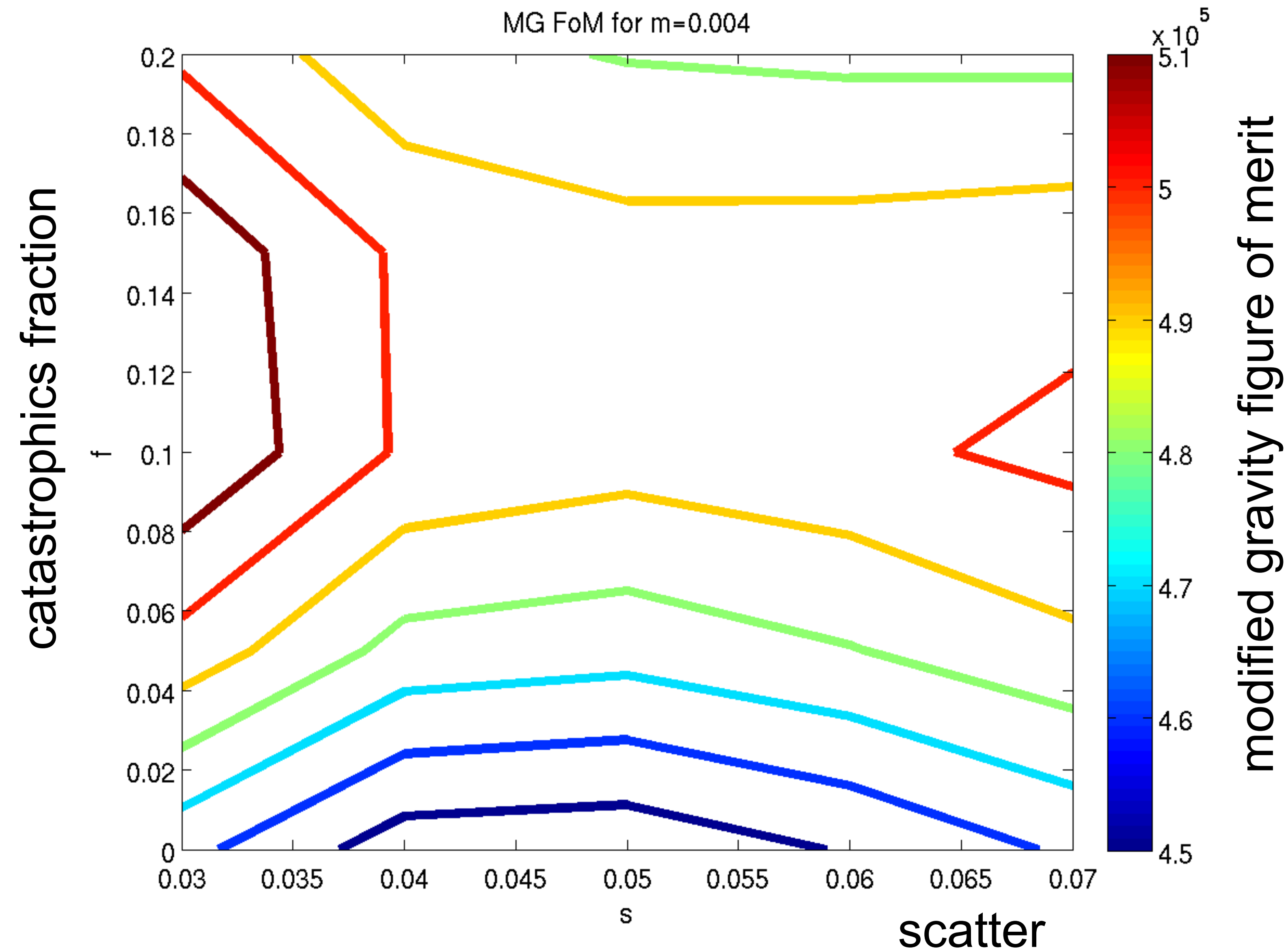


Tenneti, Mandelbaum, & Di Matteo (2015), arxiv.org/1510.07024

Velliscig et al. (2015), arxiv.org/1504.04025

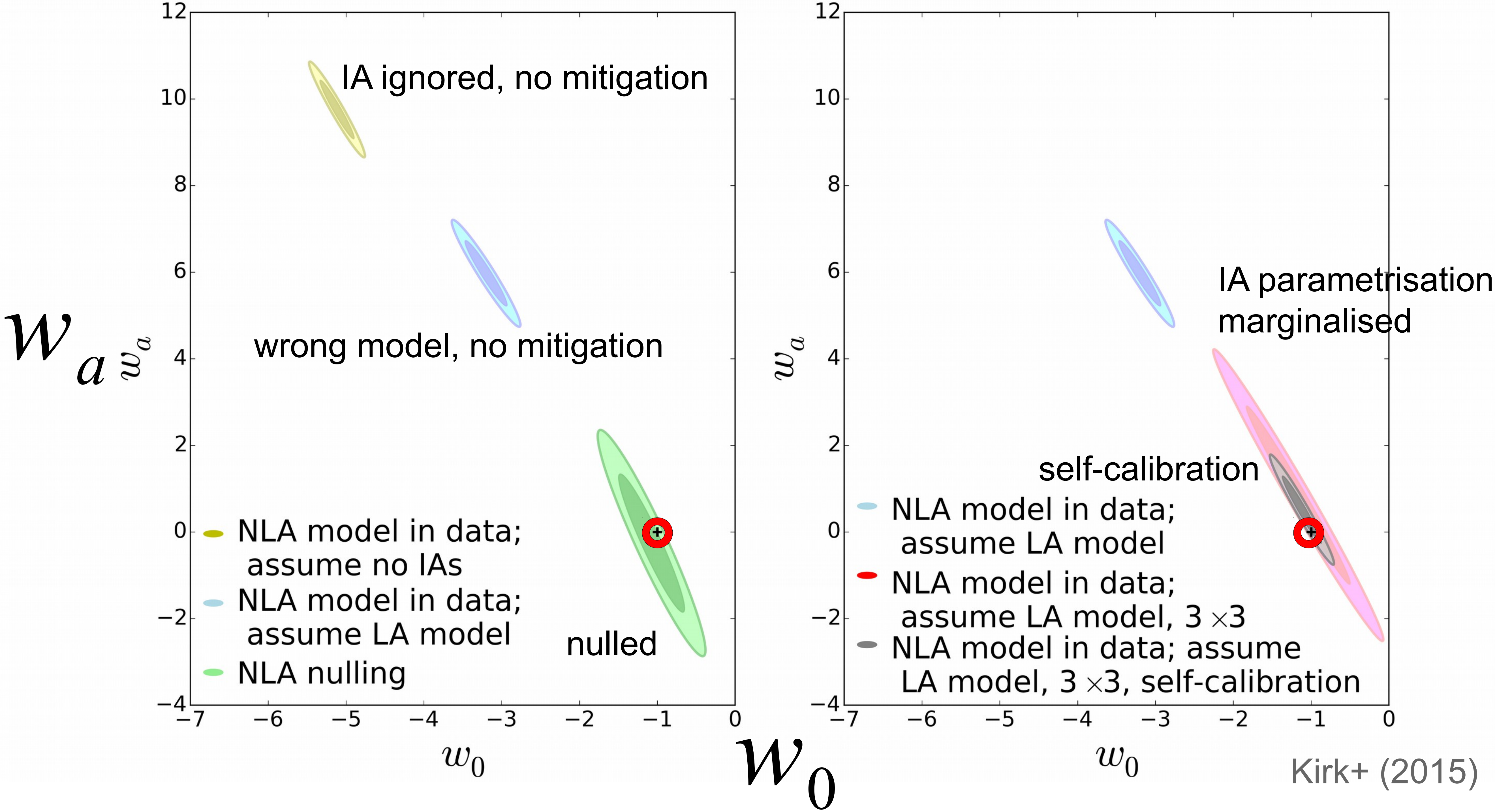
Limitations of the photo-z model

Self-calibration (WL+photometric clustering)



- driven by clustering signals → redshift cross-correlations pick up signal for increased photo-z scatter
- catastrophics fraction and distribution are known → can leverage cosmological information

Performance of mitigation



Kirk+ (2015)

- nulling works, but removes substantial amount of cosmological information
- self-calibration works, and recovers most/all of the constraints