Separating Weak Gravitational Lensing and Galaxy Intrinsic Alignments in DES Y1

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In Collaboration with

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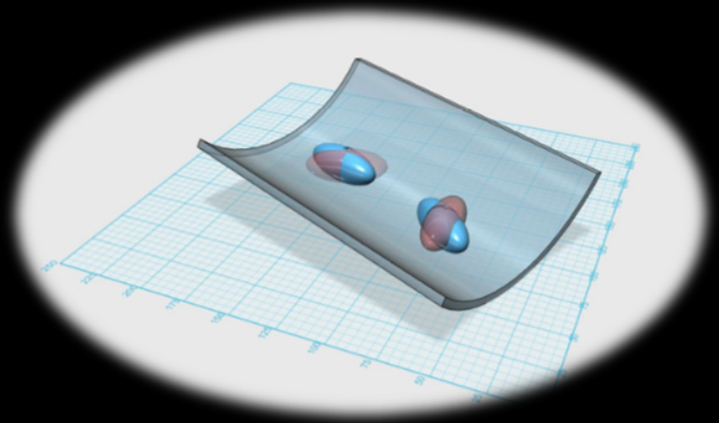
Galaxy-Galaxy Lensing

- Correlation between the position of the foreground galaxies and the shapes of the background galaxies

$$\tilde{\epsilon} = \epsilon + \gamma \Rightarrow \langle \tilde{\epsilon} n \rangle = \langle \epsilon n \rangle + \langle \gamma n \rangle$$

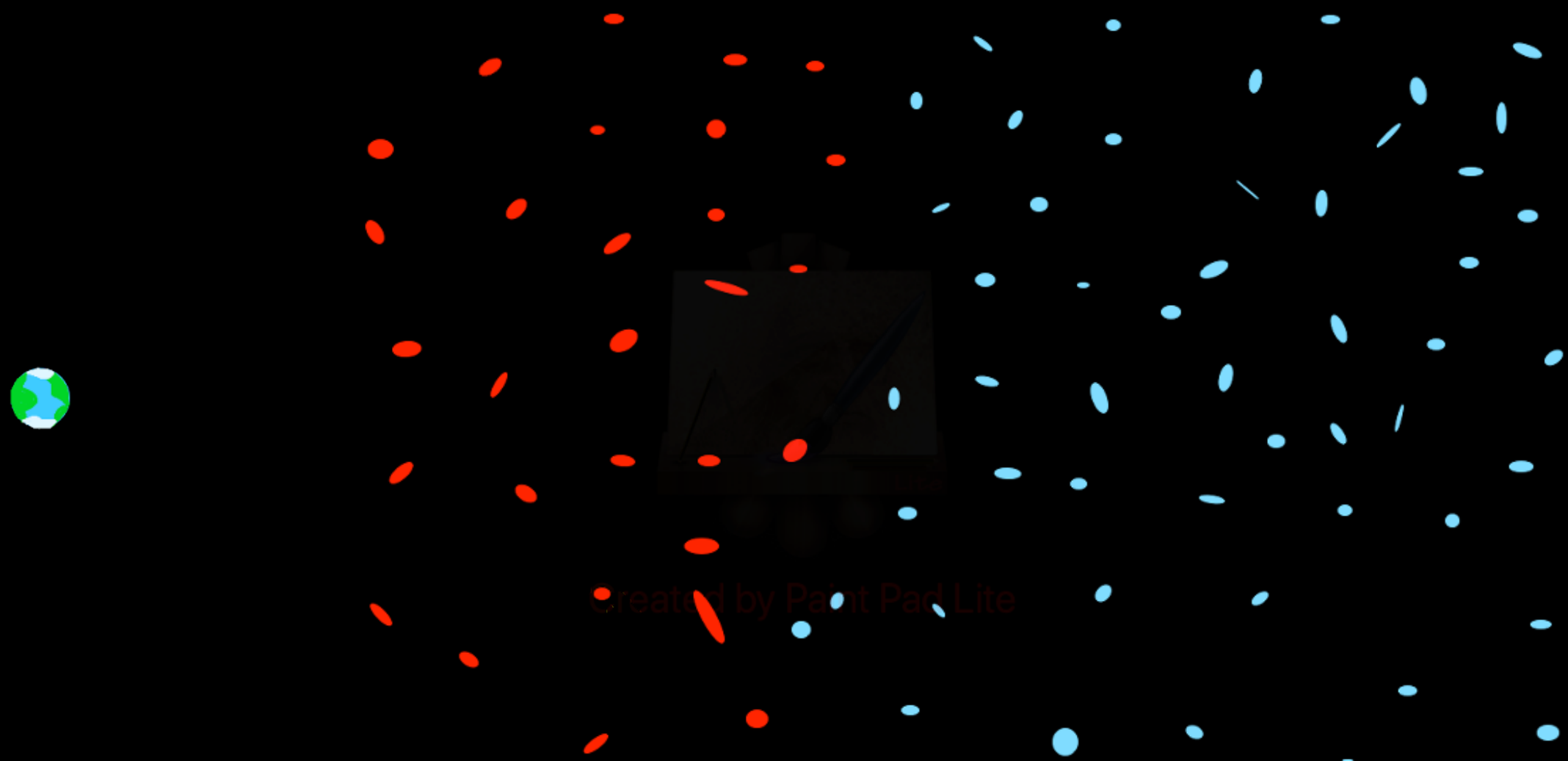
($\langle \epsilon n \rangle$ → 0)

- In the time of galaxy formation galaxies are influenced by the tidal fields in their environment which can potentially affect their alignments.



(Figure from Kiessling et al. 2015)

Intrinsic Alignments (IA)



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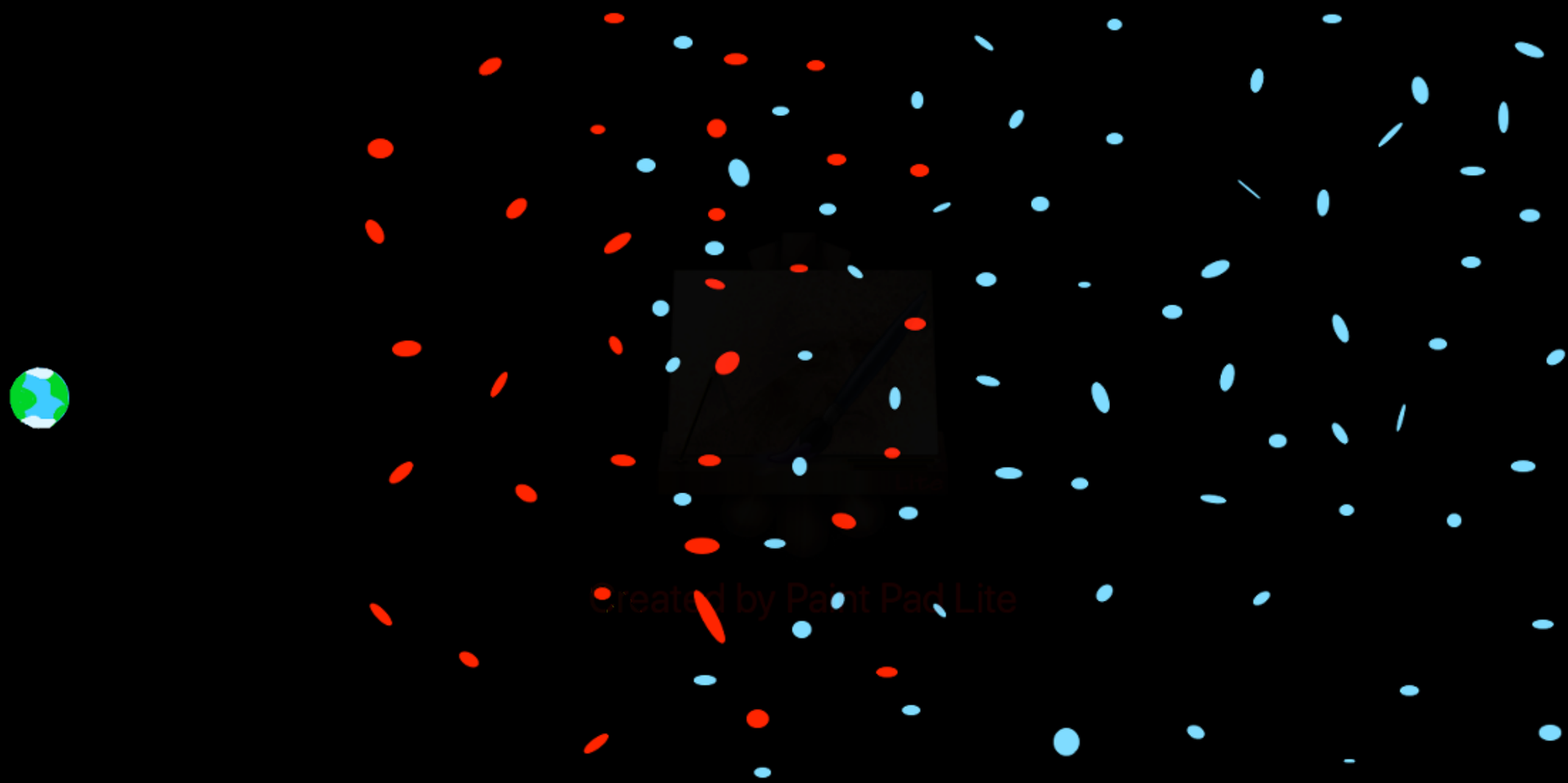
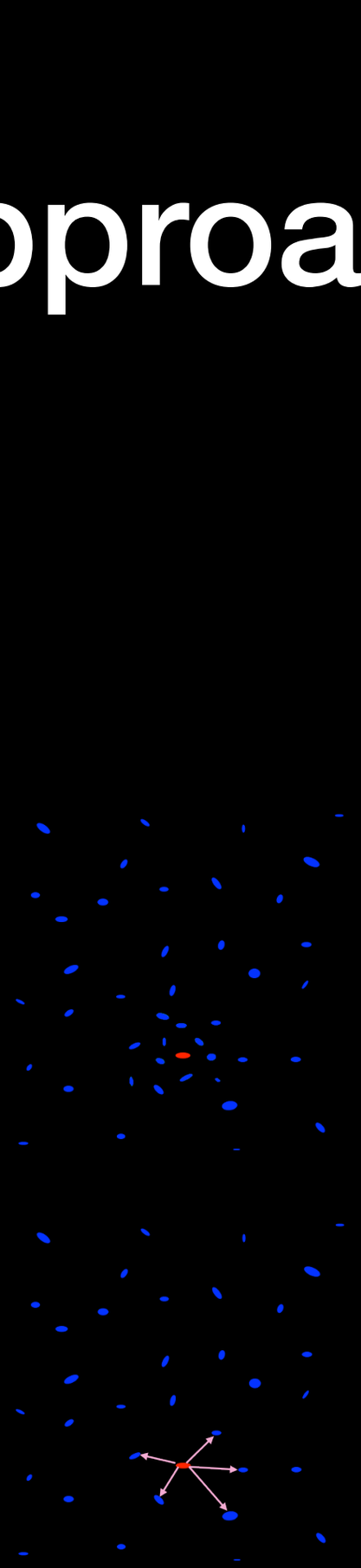


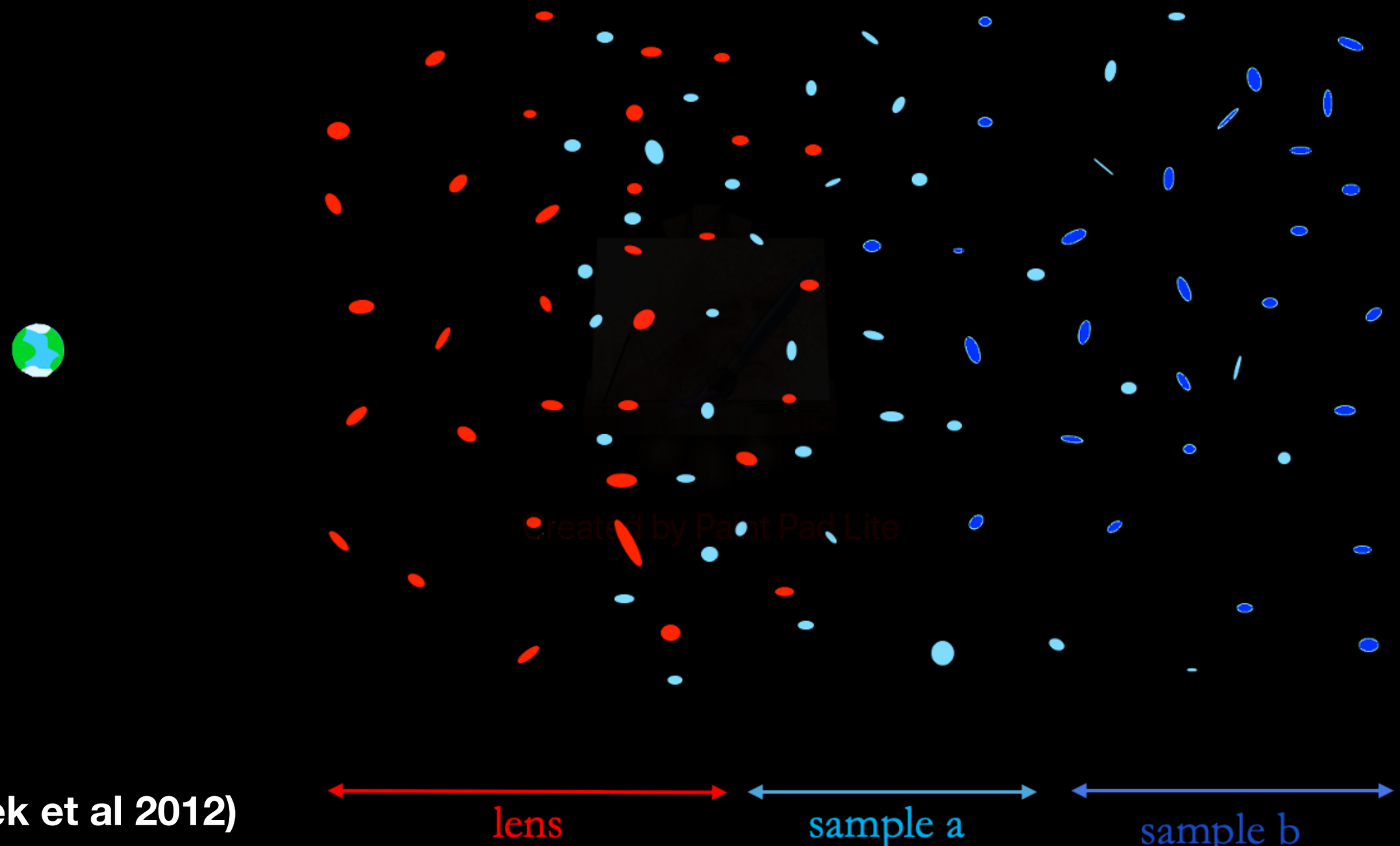
Non-parametric Approach

- There are two different approaches to IA
    - Parametric modelling
    - Non-parametric
        - $$B = \frac{\sum_i^{source-lens} \tilde{w}_i}{\sum_i^{source-random} \tilde{w}_i}$$
        - $$F = \frac{\sum_i^{close-random} \tilde{w}_i}{\sum_i^{source-random} \tilde{w}_i}$$

(Leonard et al 2018)



Intrinsic Alignments (IA)



(Blazek et al 2012)

Non-parametric Approach

$$\Delta\Sigma = \gamma_t \Sigma_c$$

$$\Delta\Sigma(r_p) = (\tilde{\gamma}_t^{\,a}(r_p) - \bar{\gamma}_{IA}[B^a(r_p) - 1 + F^a])\frac{1}{\left\langle \Sigma_c^{-1} \right\rangle^a}$$

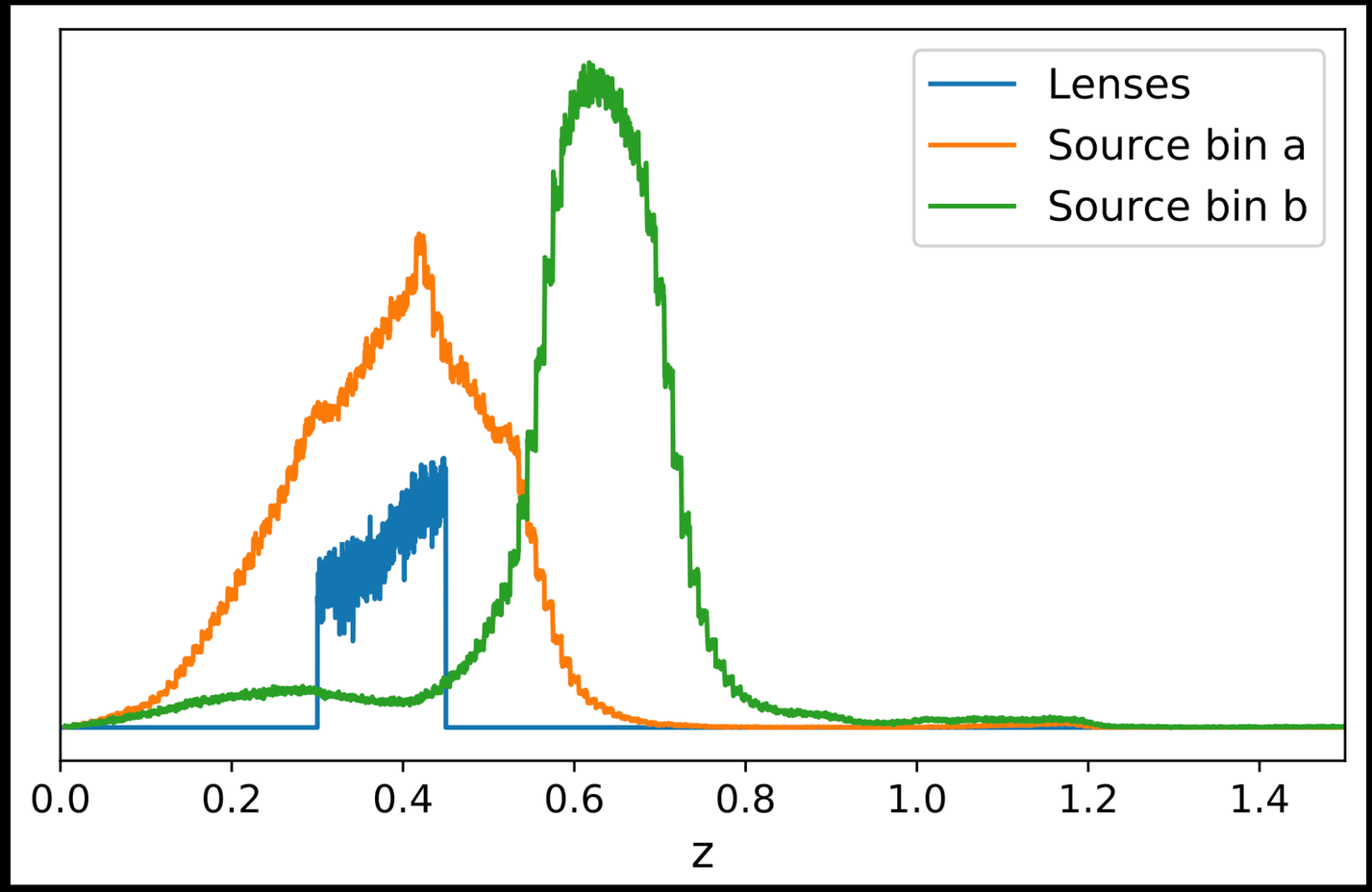
$$\Delta\Sigma(r_p) = (\tilde{\gamma}_t^{\,b}(r_p) - \bar{\gamma}_{IA}[B^b(r_p) - 1 + F^b])\frac{1}{\left\langle \Sigma_c^{-1} \right\rangle^b}$$

$$\bar{\gamma}_{IA}(r_p) = \frac{\tilde{\gamma}_t^{\,b}(r_p)(\left\langle \Sigma_c^{-1} \right\rangle^b)^{-1} - \tilde{\gamma}_t^{\,a}(r_p)(\left\langle \Sigma_c^{-1} \right\rangle^a)^{-1}}{[B^b(r_p) - 1 + F^b](\left\langle \Sigma_c^{-1} \right\rangle^b)^{-1} - [B^a(r_p) - 1 + F^a](\left\langle \Sigma_c^{-1} \right\rangle^a)^{-1}}$$

DATA

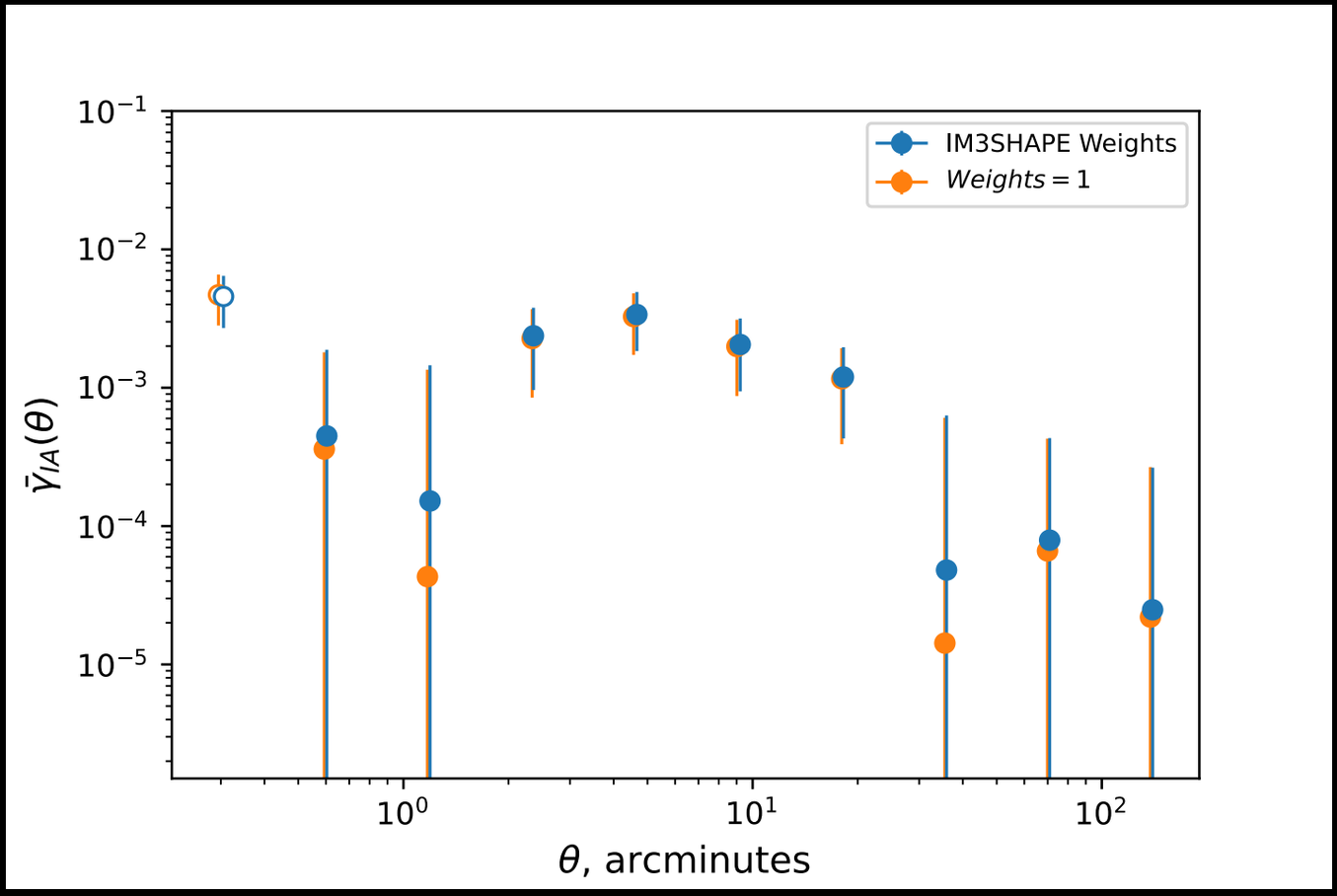
- DES Y1: IM3SHAPE and redMaGiC

(Zuntz et al 2017)



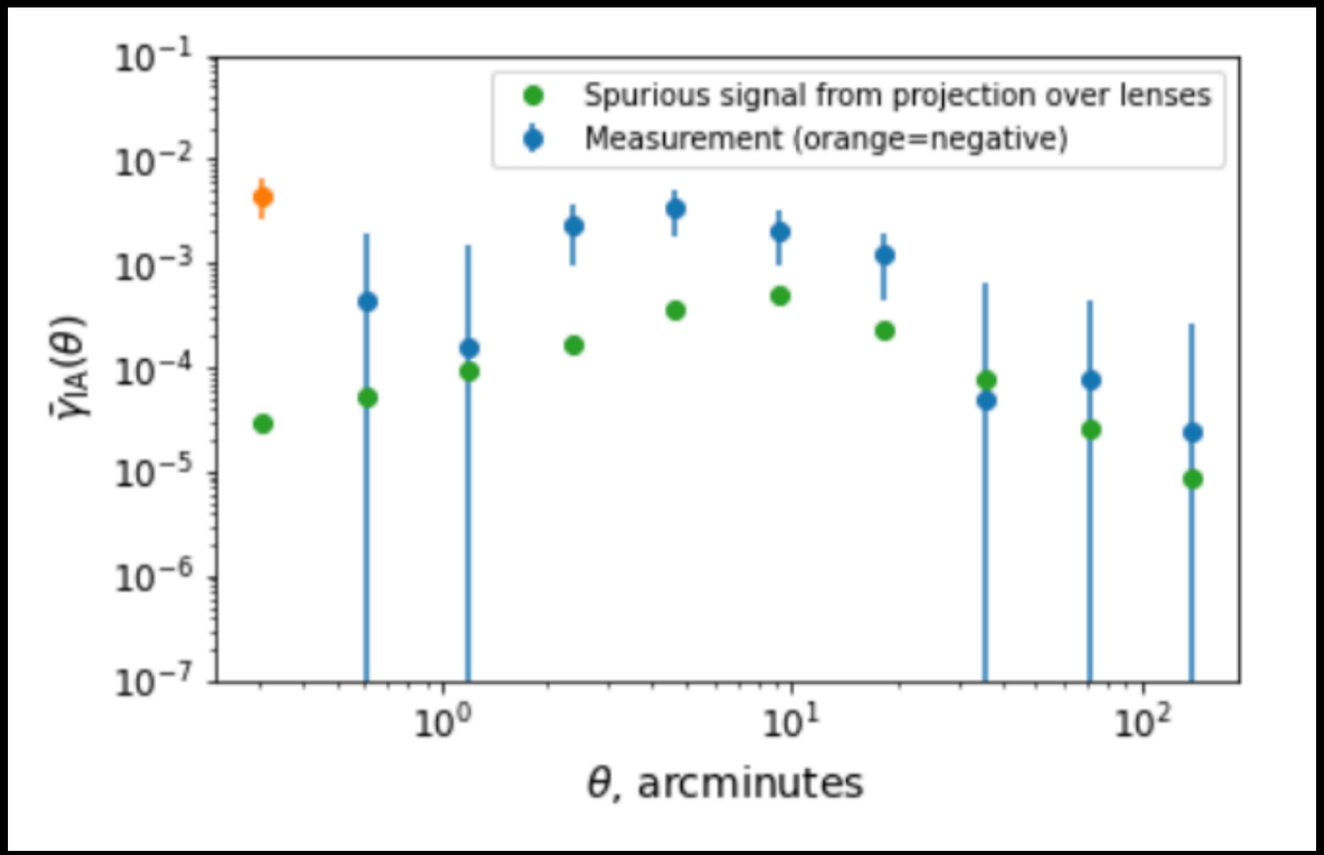
IA Measurement

- Measured IA per pair using the estimator introduced and the selected samples. Error estimation is done via Jackknife covariance. **(Jarvis et al 2004)**



Finite Lens Bin Width Effect

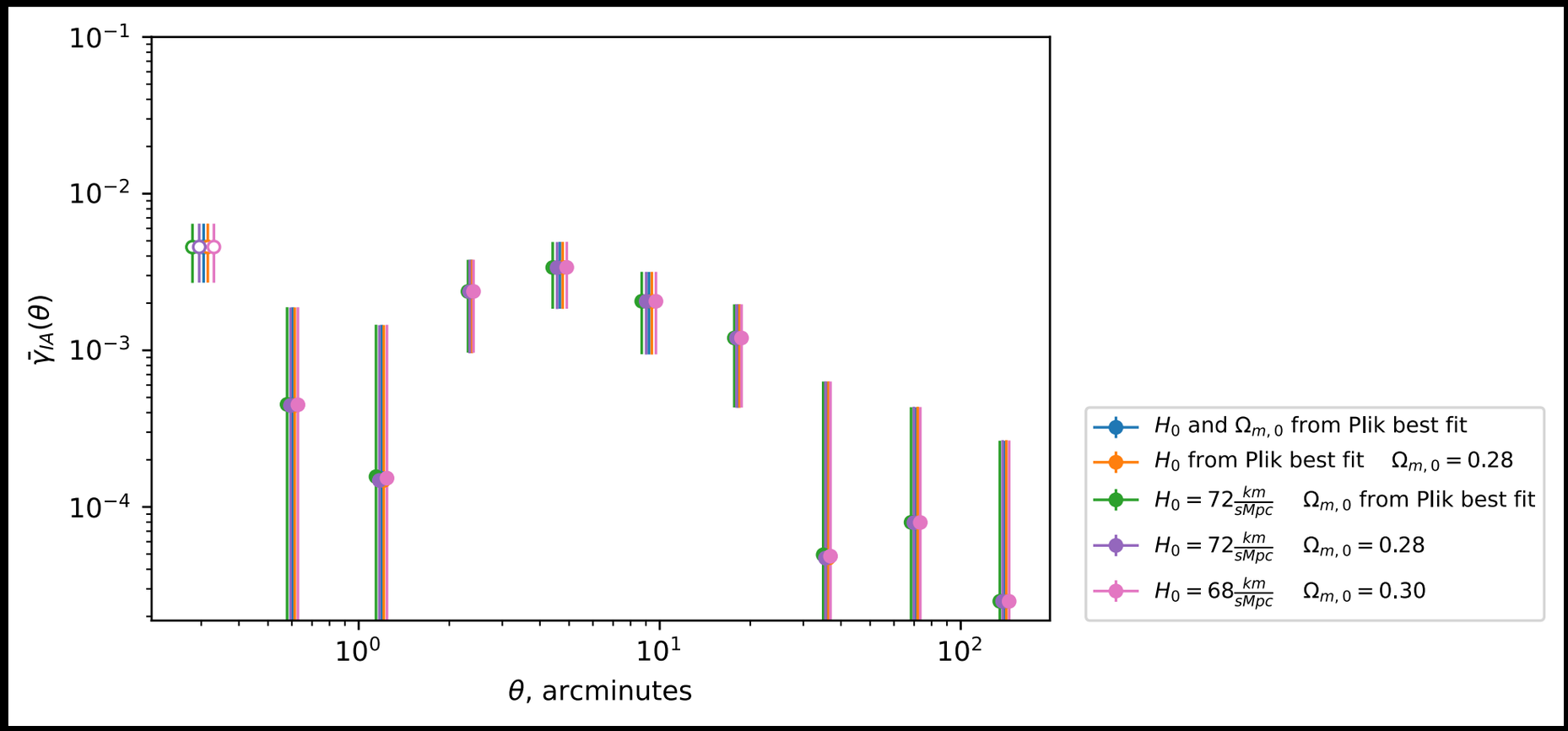
- In the no-IA case, the numerator in the estimator would differ from zero if the lens is not infinitely thin which is not the case in reality.



Cosmological Parameters Uncertainty Effect

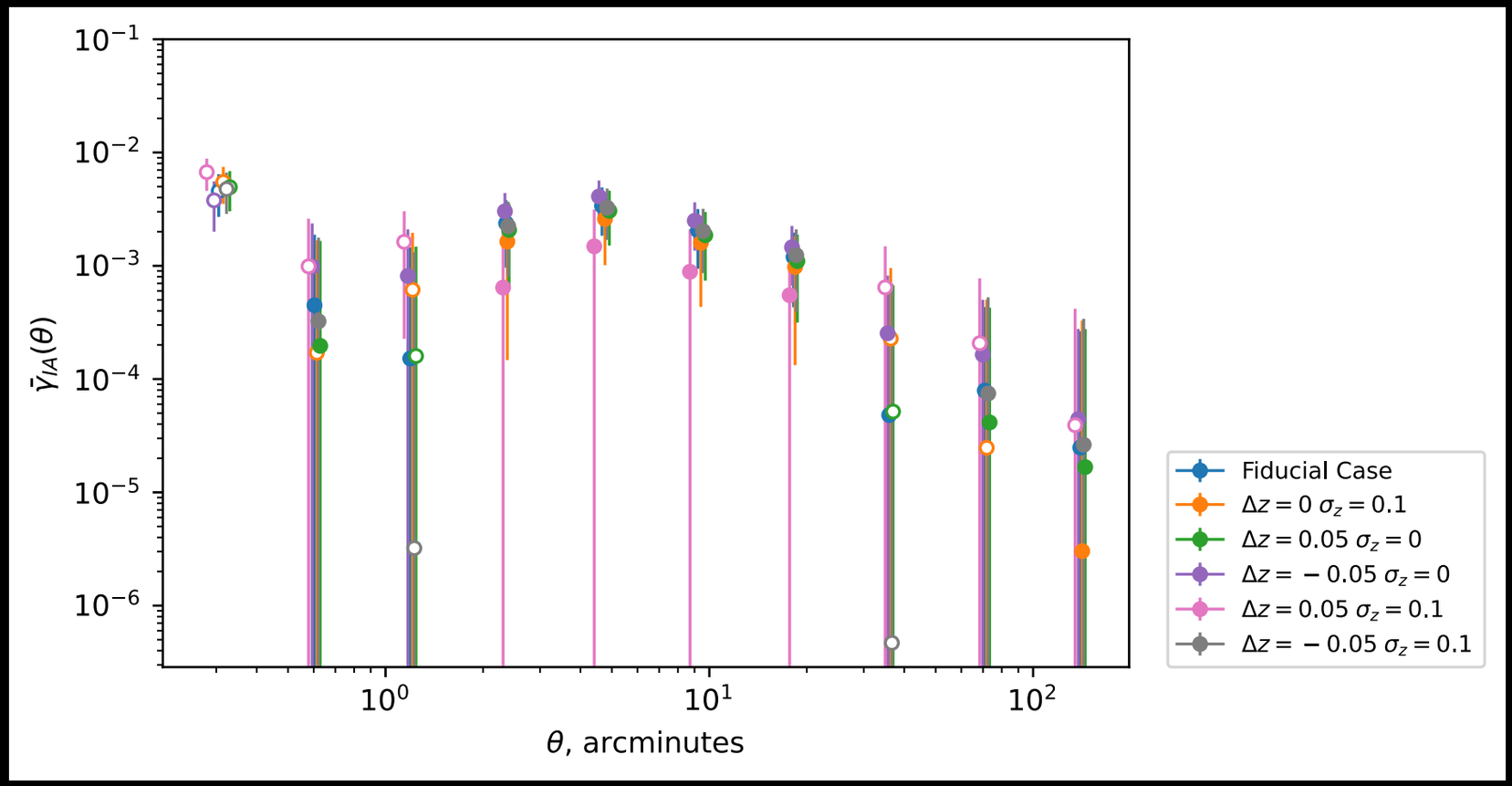
- The underlying Cosmological model can potentially affect the measurement via Σ_c and F.

(Planck Collaboration et al 2020)



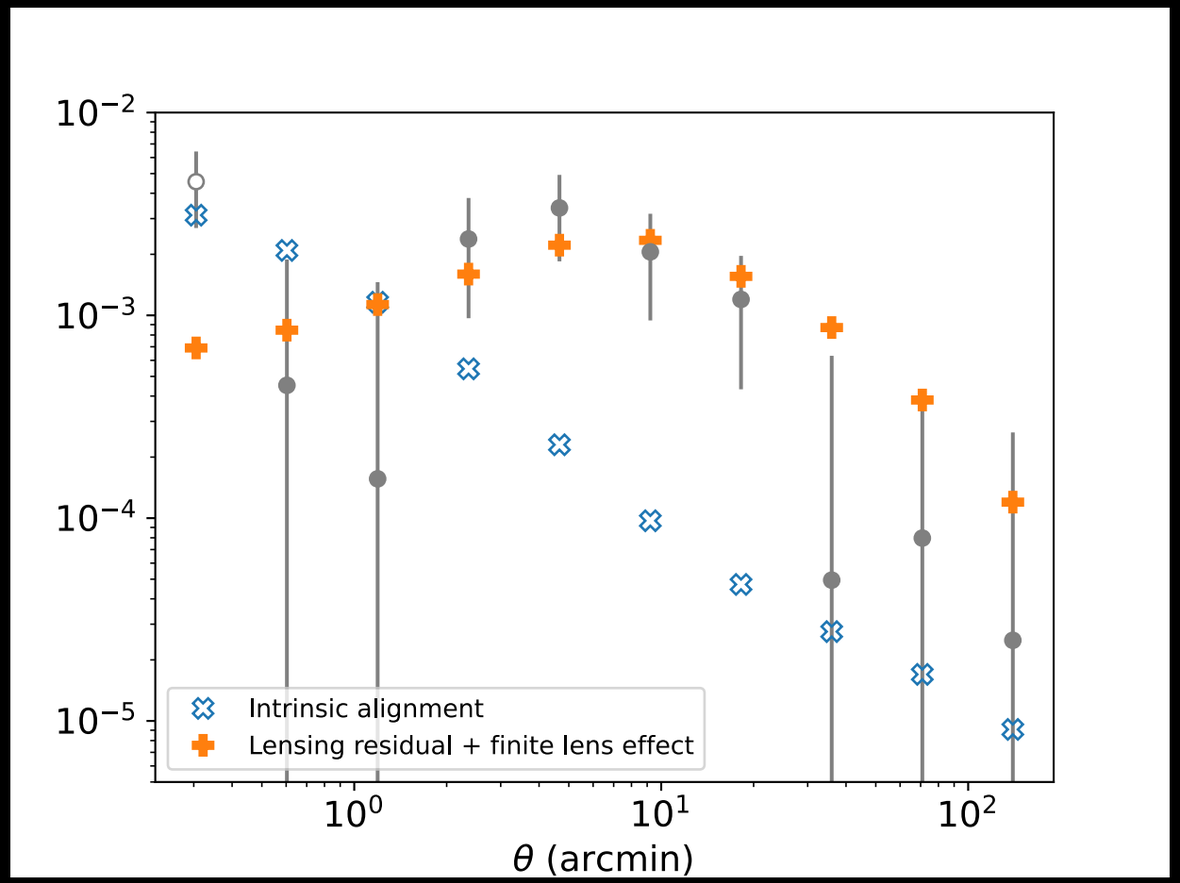
Photometric Redshift Uncertainty Effect

- Any scatter in the redshift estimation would distort the measurement and introduce a spurious signal.



IA and Photo-z Modelling

- According to the verification tests, we need to proceed to interpret the signal via both IA and redshift distribution uncertainty.



(Blazek et al 2015)

References

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