The role of galactic feedback in regulating angular momentum and intrinsic alignments of galaxies

Jolanta Zjupa

In collaboration with: Volker Springel, Ruediger Pakmor, Rob Grand, Oliver Hahn, Bjoern Malte Schaefer

Shanghai 04.11.2019

Weak gravitational lensing

high redshift z

average galaxy shape *assumed* to be spherical

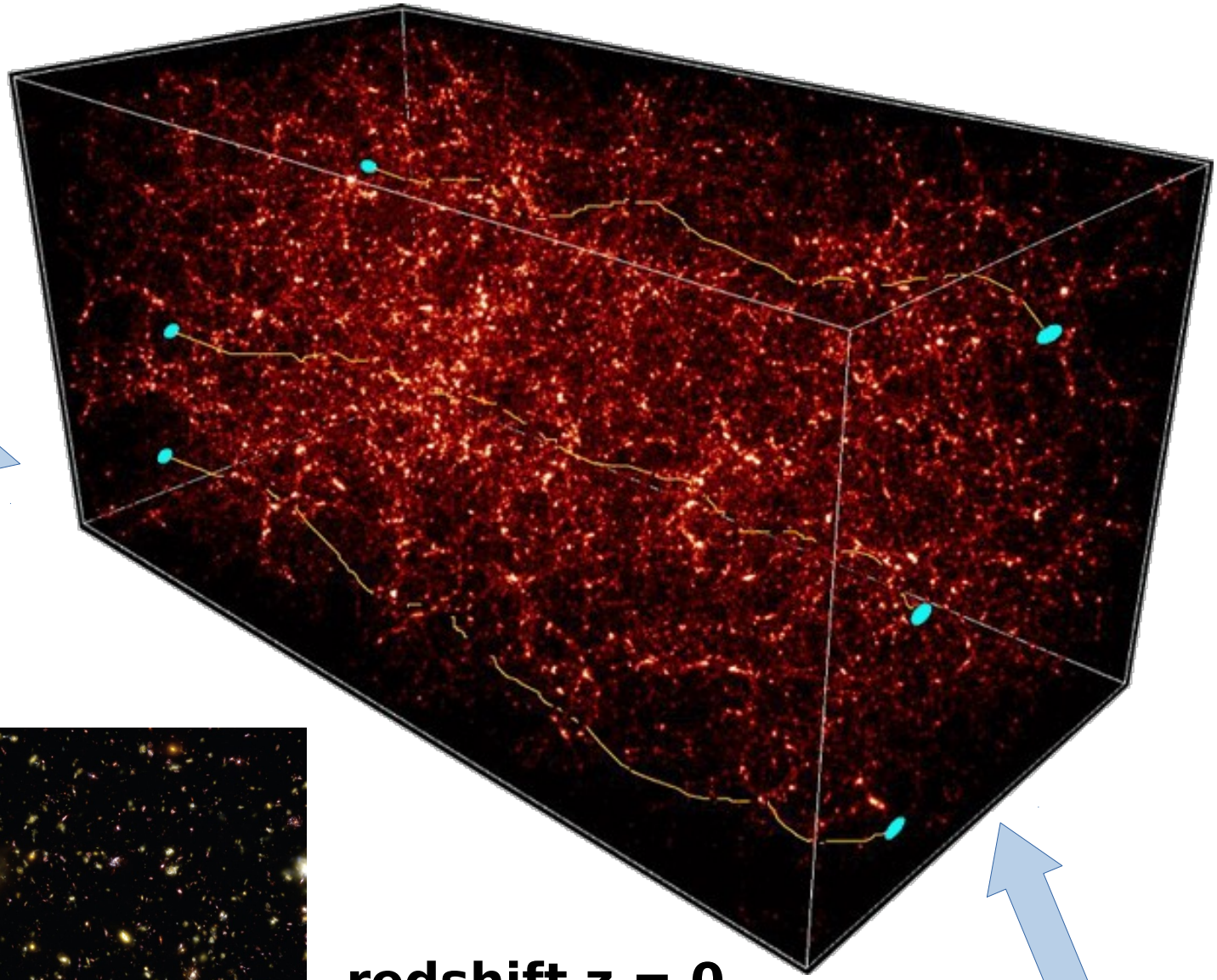
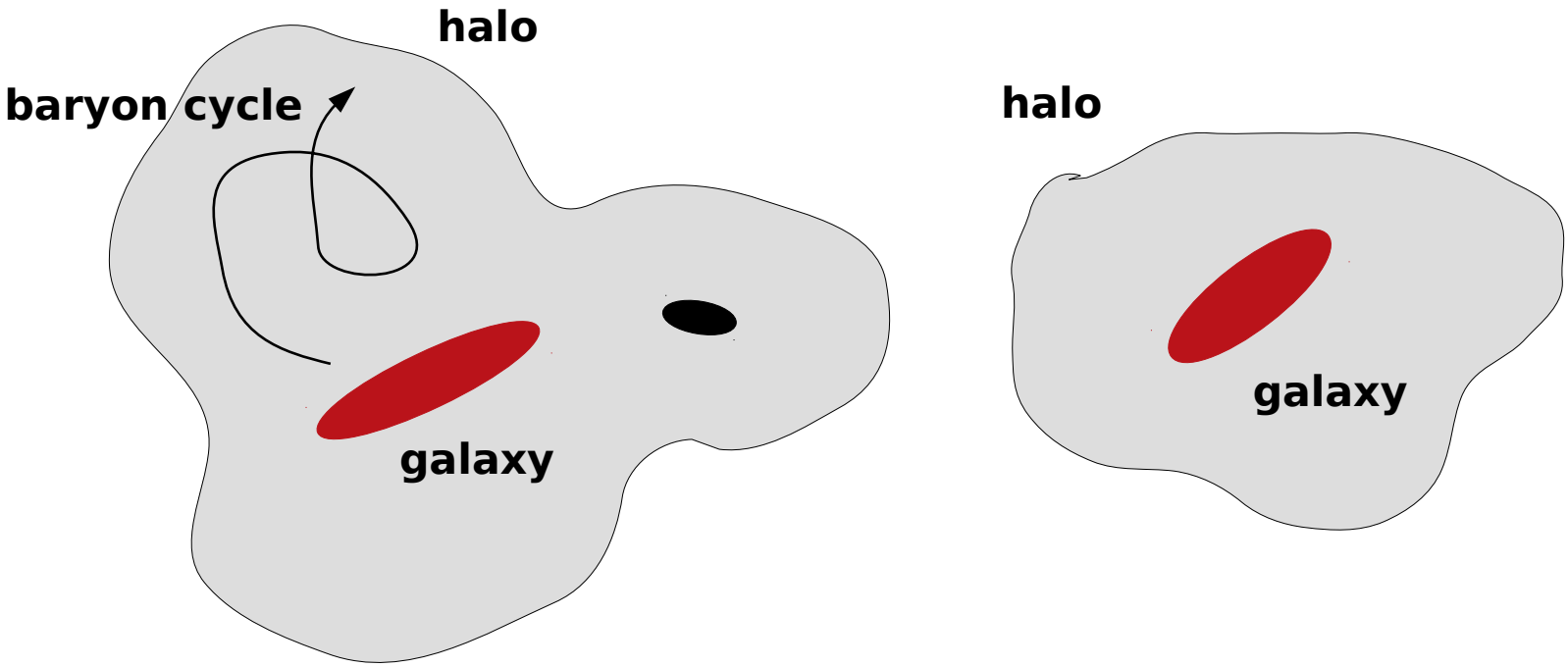


Image: NASA/ESA, Illustris collaboration

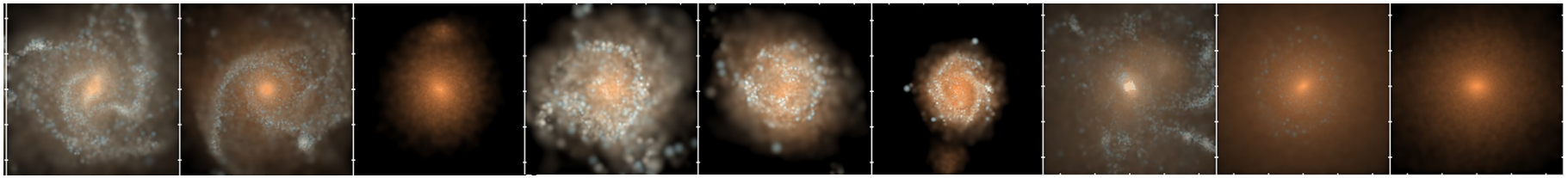
redshift z = 0

all correlations *assumed* to be caused by LSS properties

Intrinsic alignments of galaxies: spiral galaxies



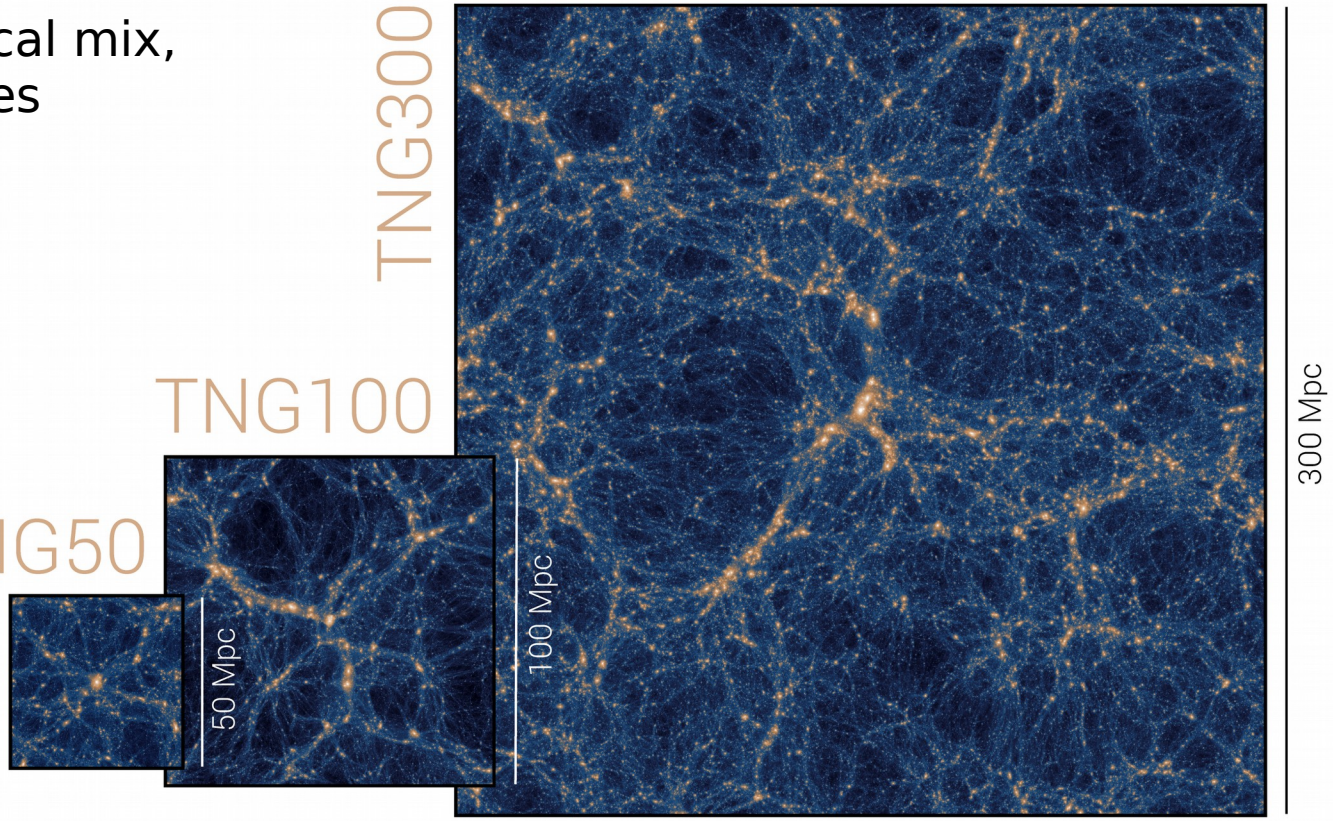
IllustrisTNG: realistic galaxy population



IllustrisTNG simulation
cosmological hydrodynamical

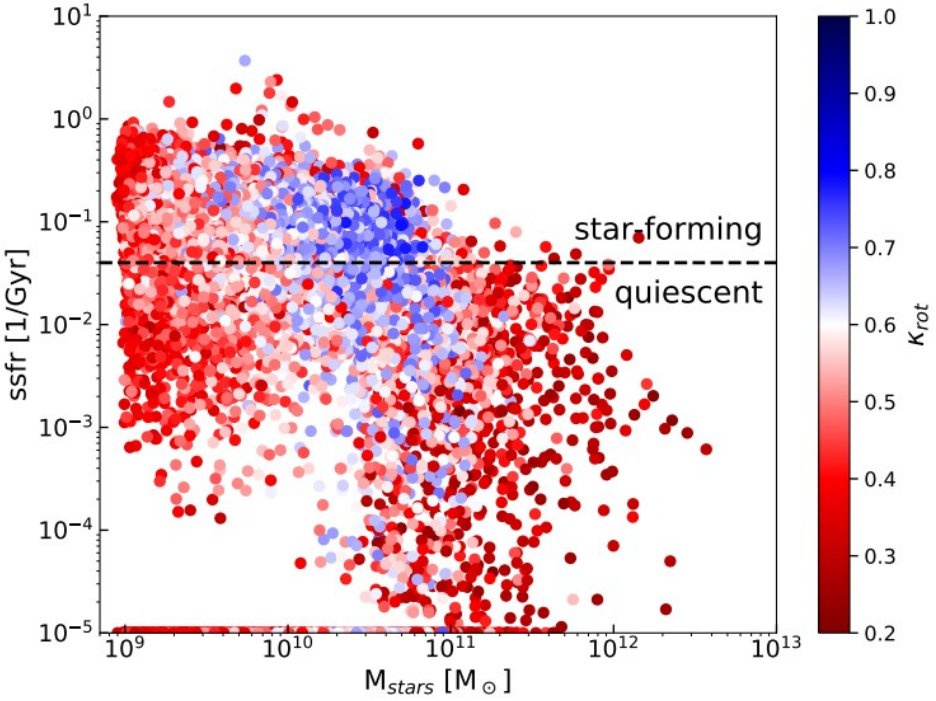
successes: morphological mix,
colours, sizes of galaxies

resolution
dm ~ 7.5 *10^6
baryonic ~ 1.4 *10^6

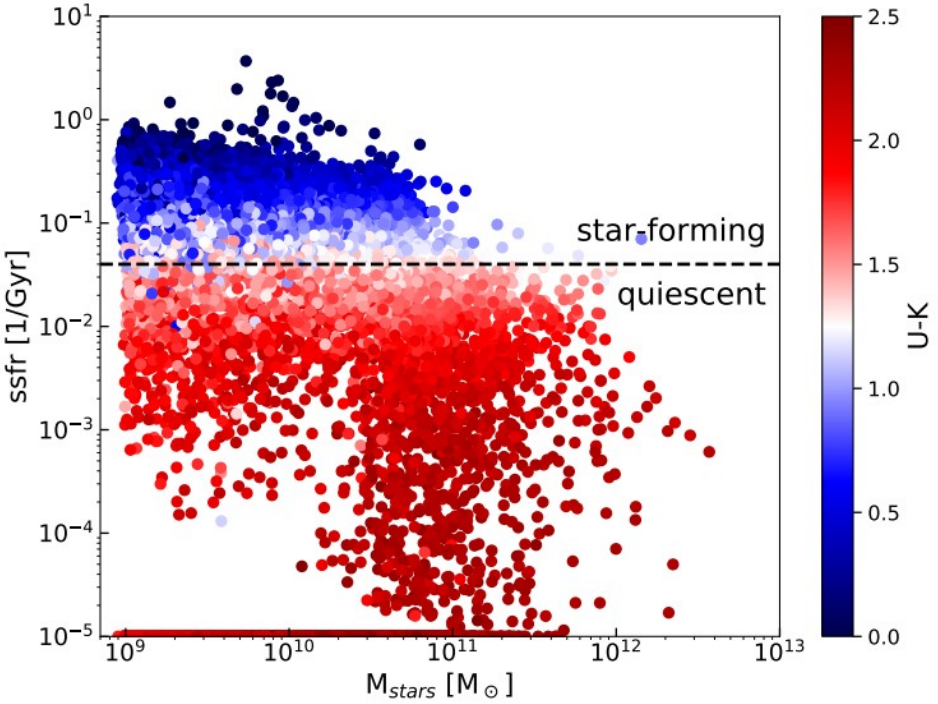


IllustrisTNG: sample selection

rotational support



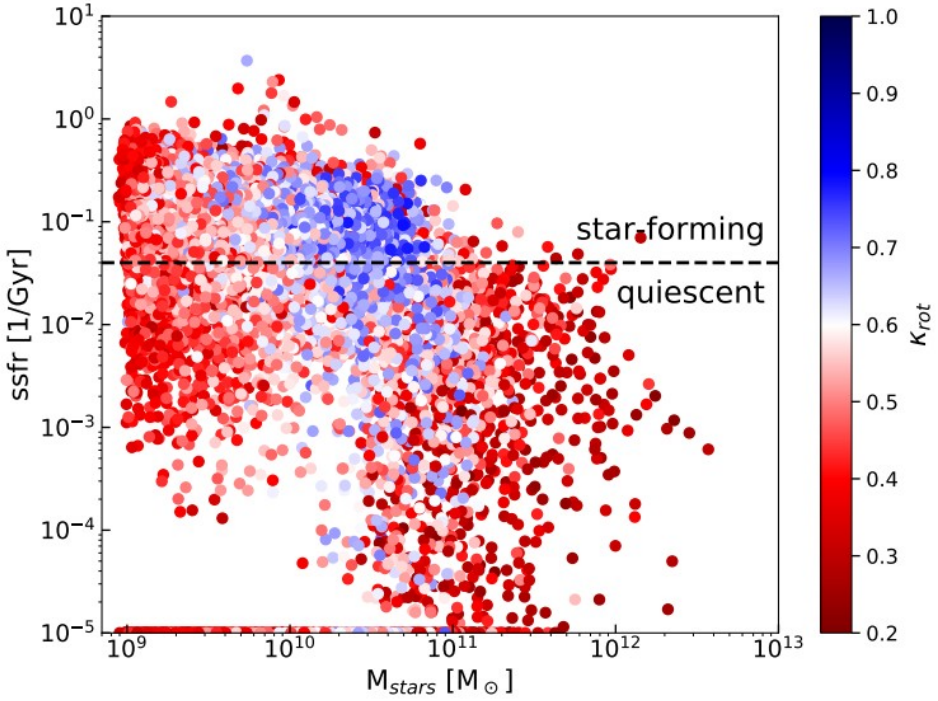
colour selection



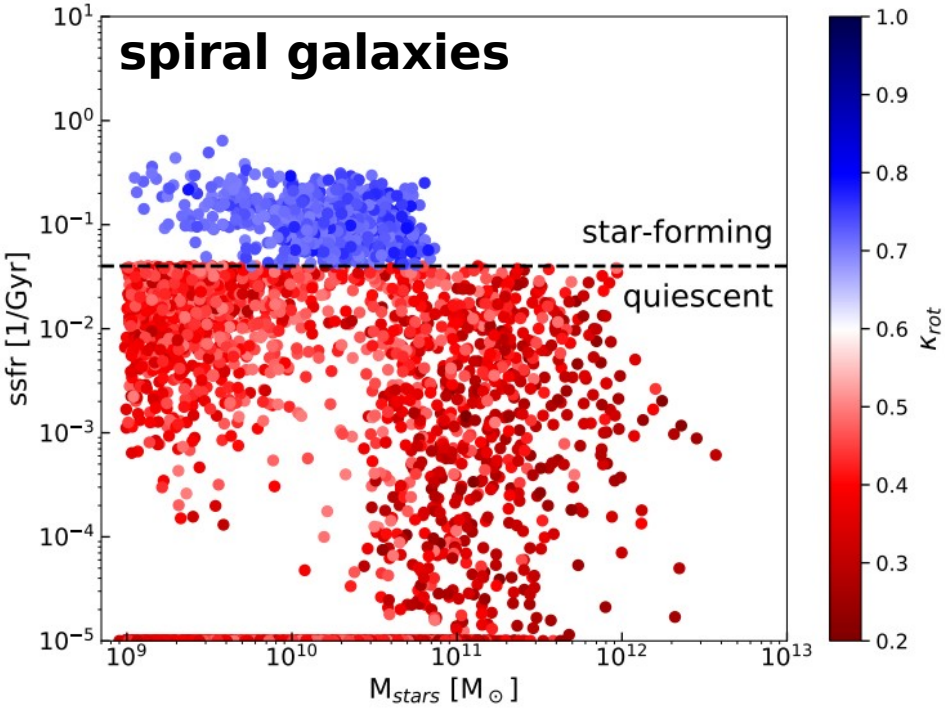
$$\kappa_{rot} = E_{rot}/E_{kin} = \sum_i \frac{1}{2} m_i \left(\frac{j_{z,i}}{r_i}\right)^2 \Big/ \sum_i \frac{1}{2} m_i v_i^2$$

IllustrisTNG: sample selection

rotational support



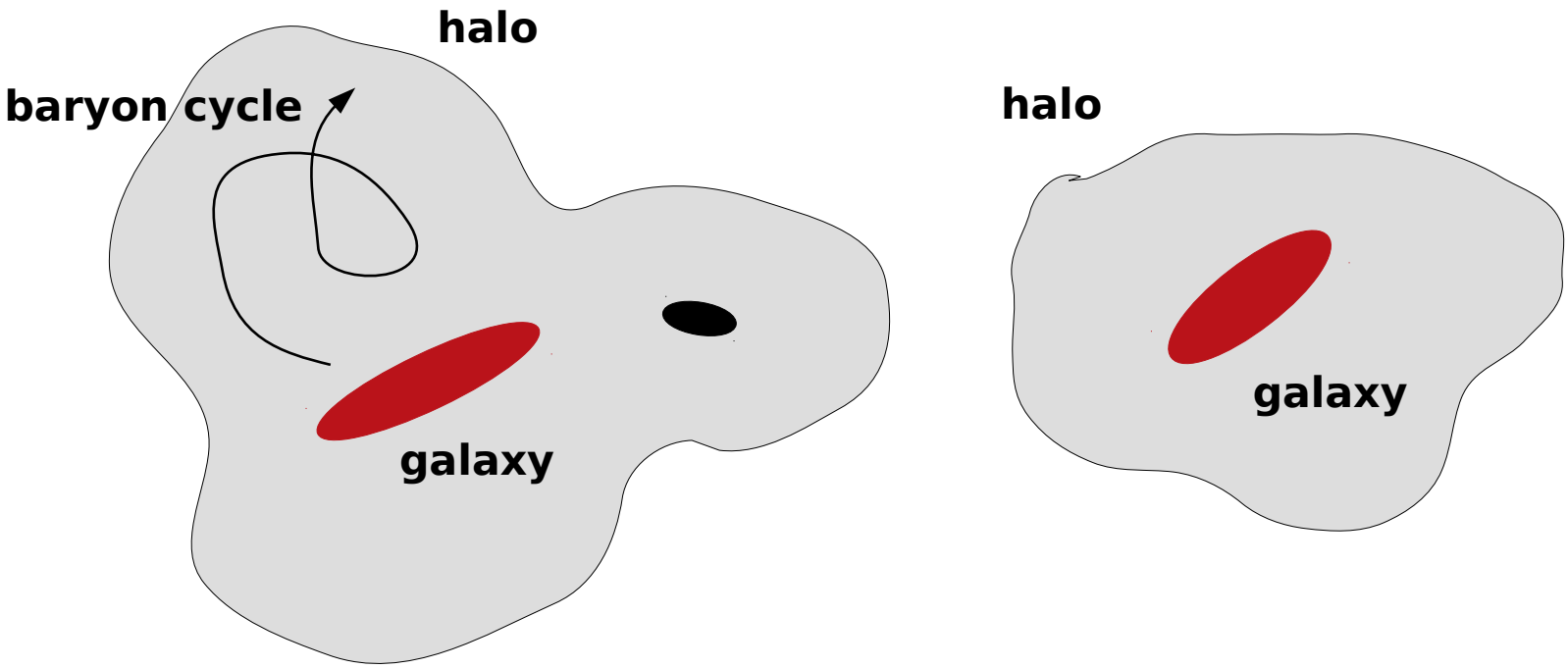
$$\mathrm{sSFR} > 0.04\ Gyr^{-1}$$
$$\kappa_{rot} > 0.7$$



elliptical galaxies

$$\mathrm{sSFR} < 0.04\ Gyr^{-1}$$
$$\kappa_{rot} < 0.5$$

Intrinsic alignments of galaxies: spiral galaxies



$$\langle \hat{L}_\alpha \hat{L}_\beta \rangle = \frac{1+A}{3}\delta_{\alpha\beta} - A\tilde{\Phi}_{\alpha\gamma}\tilde{\Phi}_{\gamma\beta}$$

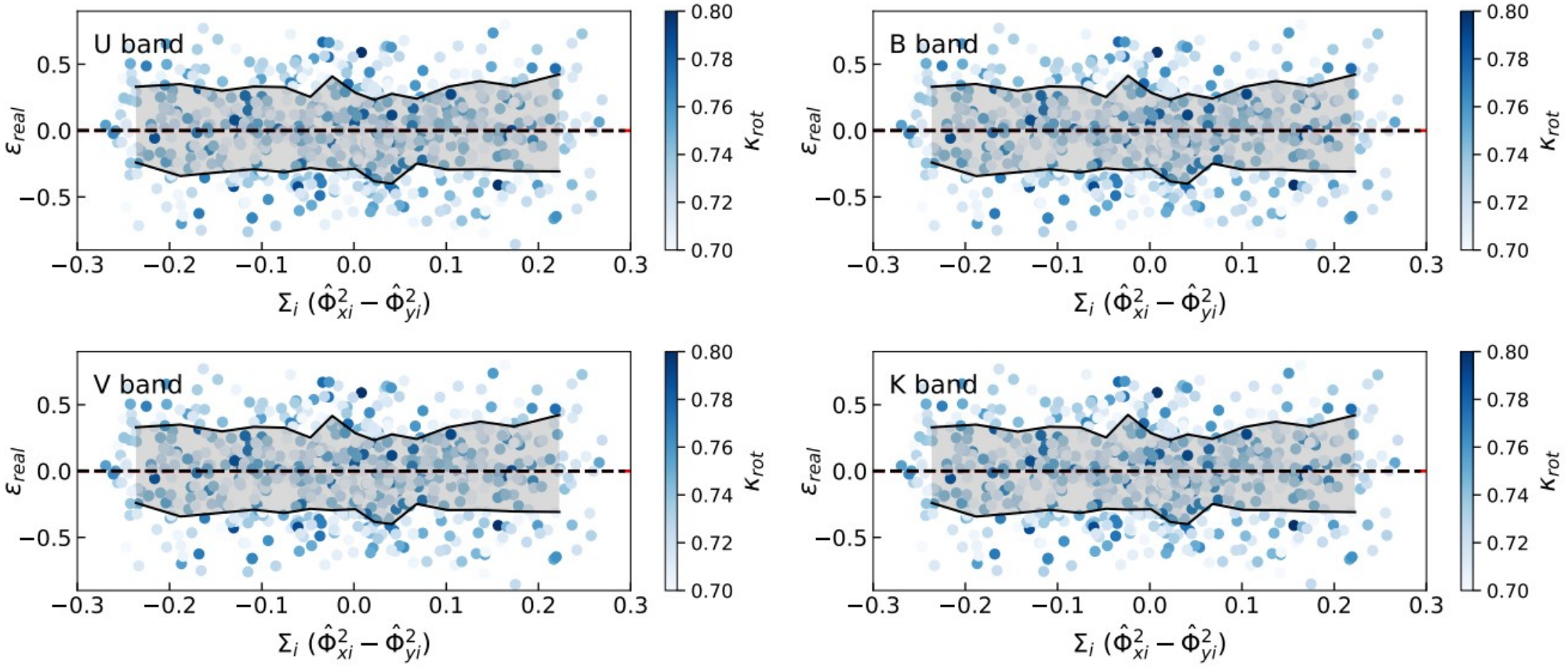
Lee & Pen 2001

$$\epsilon = \alpha\, A/2 \sum_i (\tilde{\Phi}_{xi}\tilde{\Phi}_{ix} - \tilde{\Phi}_{yi}\tilde{\Phi}_{iy} - 2i\,\tilde{\Phi}_{xi}\tilde{\Phi}_{iy})$$

Crittenden et al. 2001

quadratic model

Intrinsic alignments of galaxies: spiral galaxies



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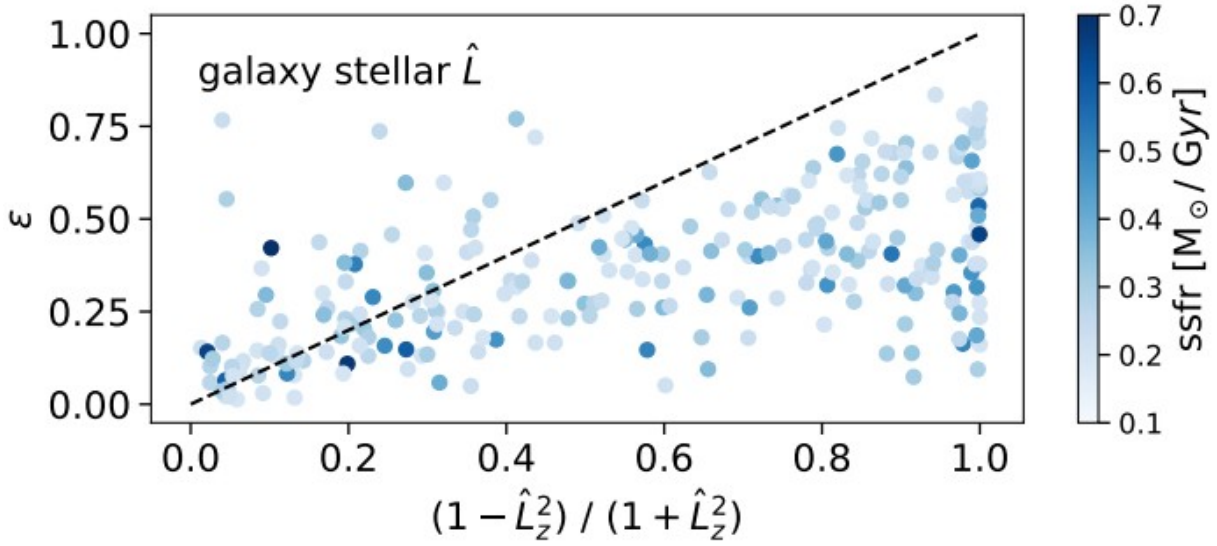
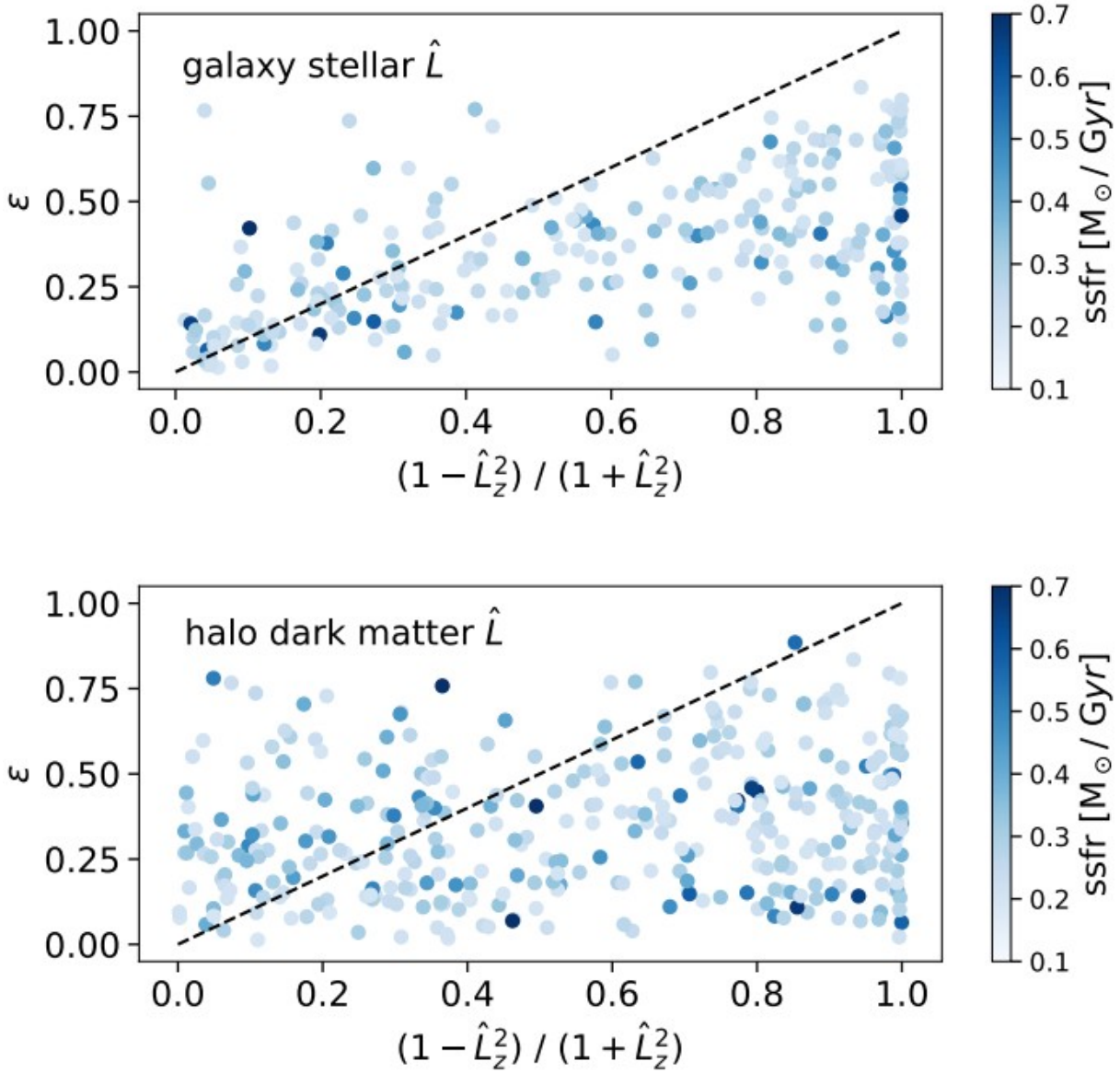
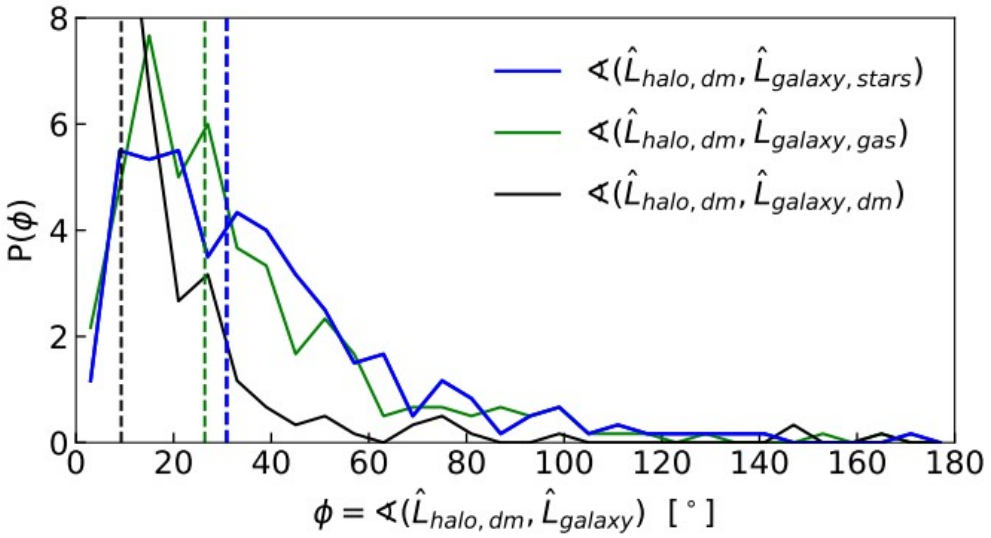
Intrinsic alignments of galaxies: spiral galaxies

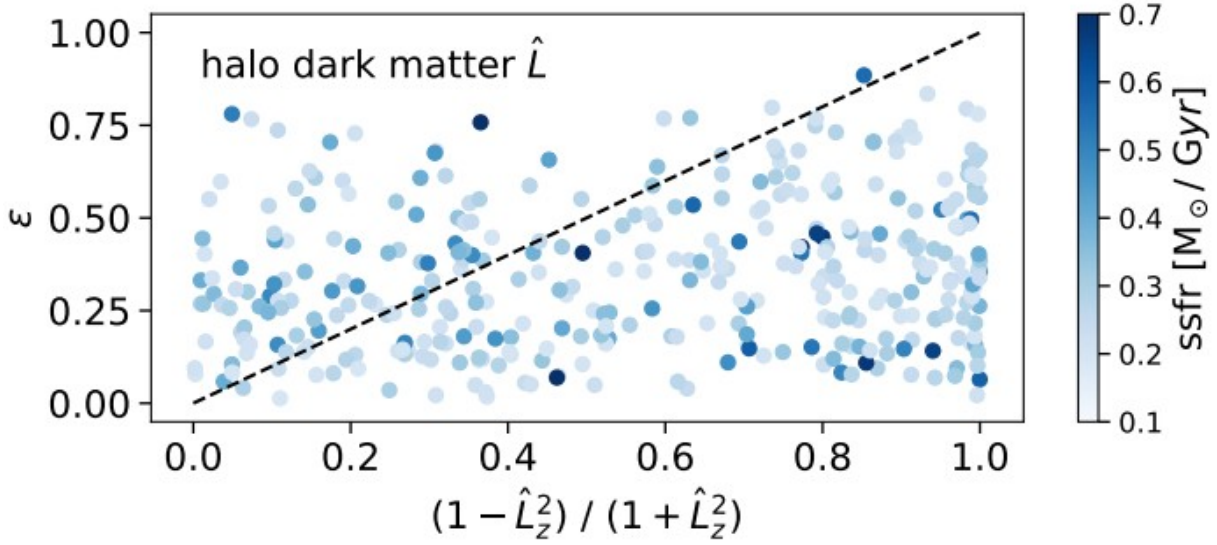


Intrinsic alignments of galaxies: spiral galaxies

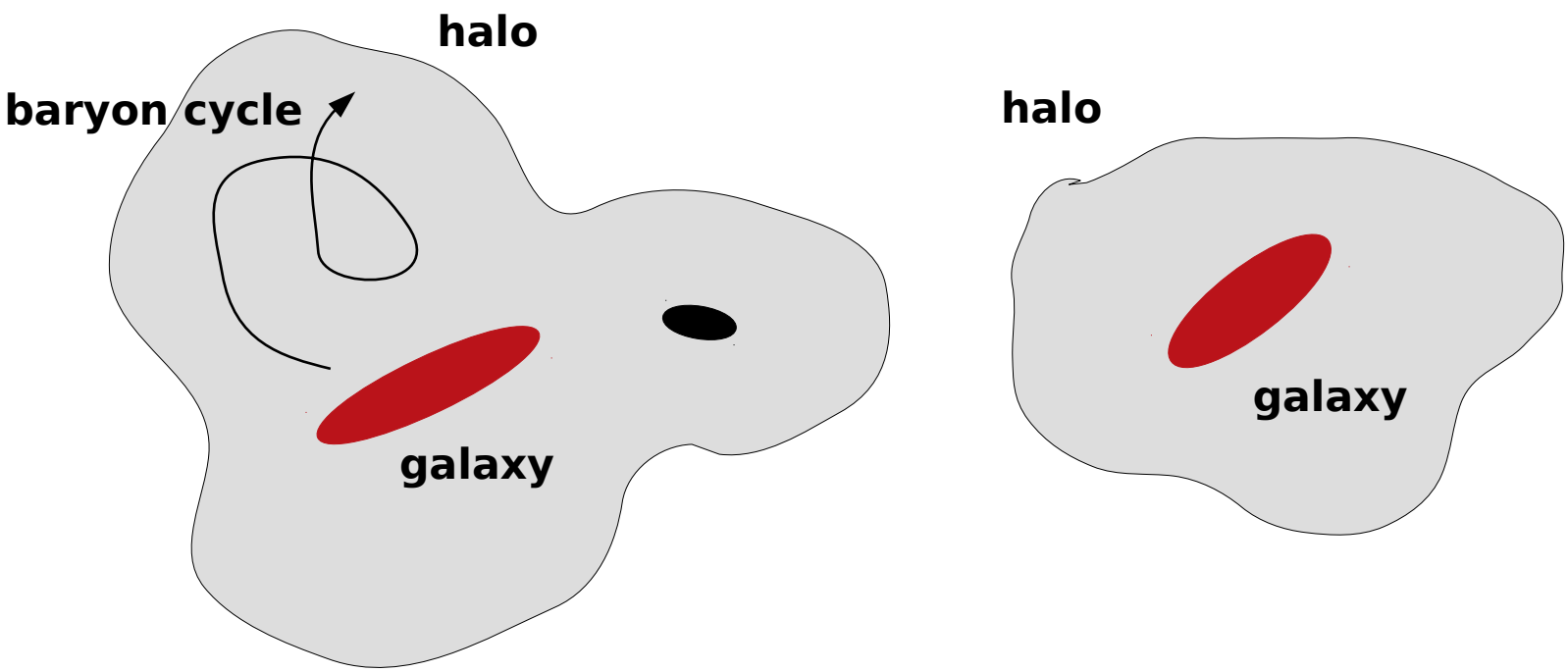


Intrinsic alignments of galaxies: spiral galaxies





Intrinsic alignments of galaxies: elliptical galaxies

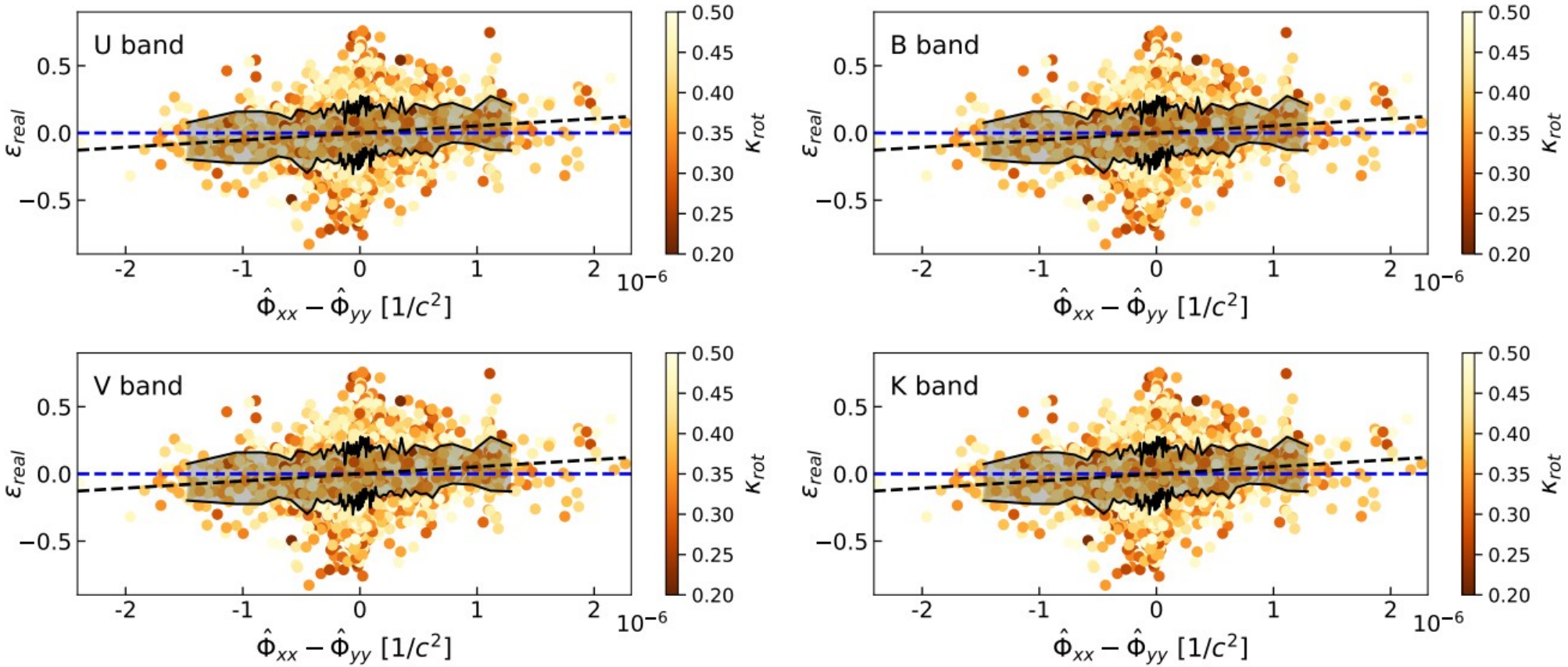


$$\epsilon = D\,(\hat{\Phi}_{xx} - \hat{\Phi}_{yy} + 2i\hat{\Phi}_{xy})$$

Hirata & Seljak 2010
Piras et al. 2017

linear model

Intrinsic alignments of galaxies: elliptical galaxies

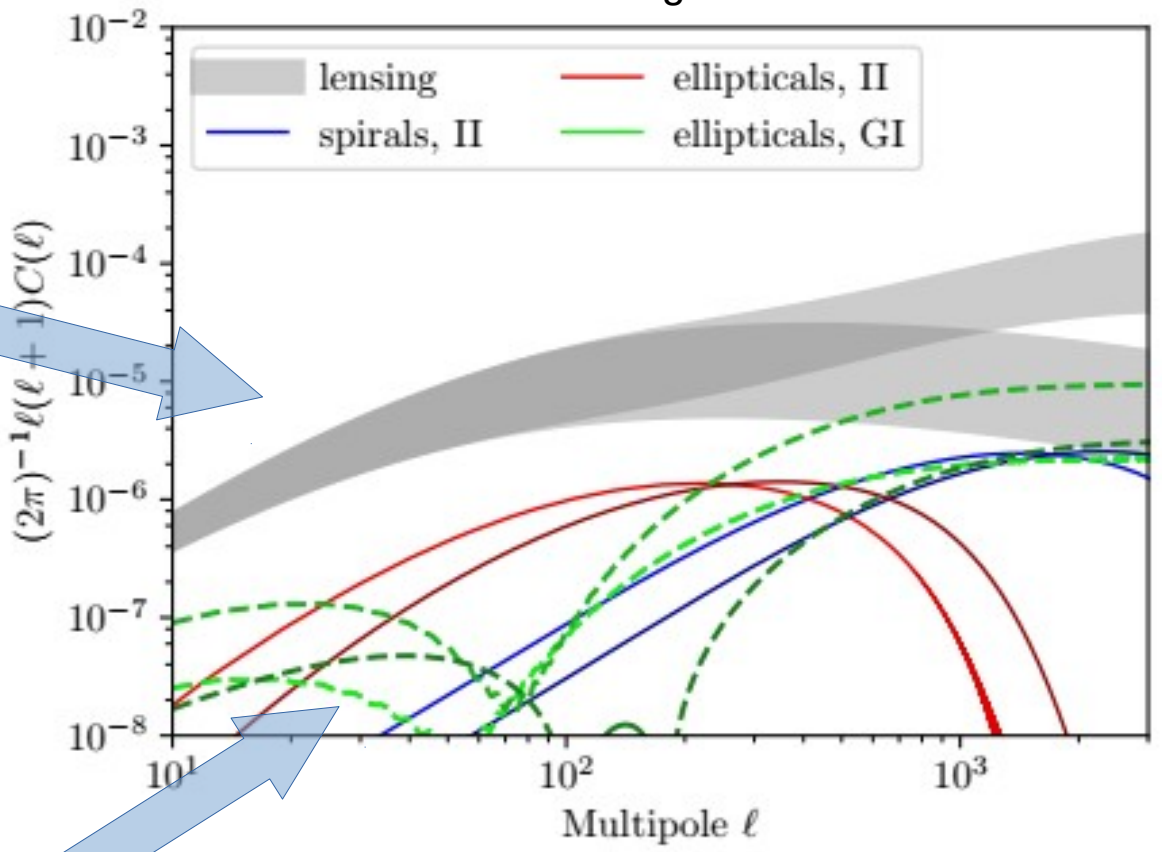


$$\epsilon = D\,(\hat{\Phi}_{xx} - \hat{\Phi}_{yy} + 2i\hat{\Phi}_{xy})$$

Intrinsic alignments of galaxies: lensing predictions

derive cosmological parameters

Tugendhat & Schaefer 2017



remove bias from intrinsic alignments

Thank you!