Connecting halo properties and cosmological statistics

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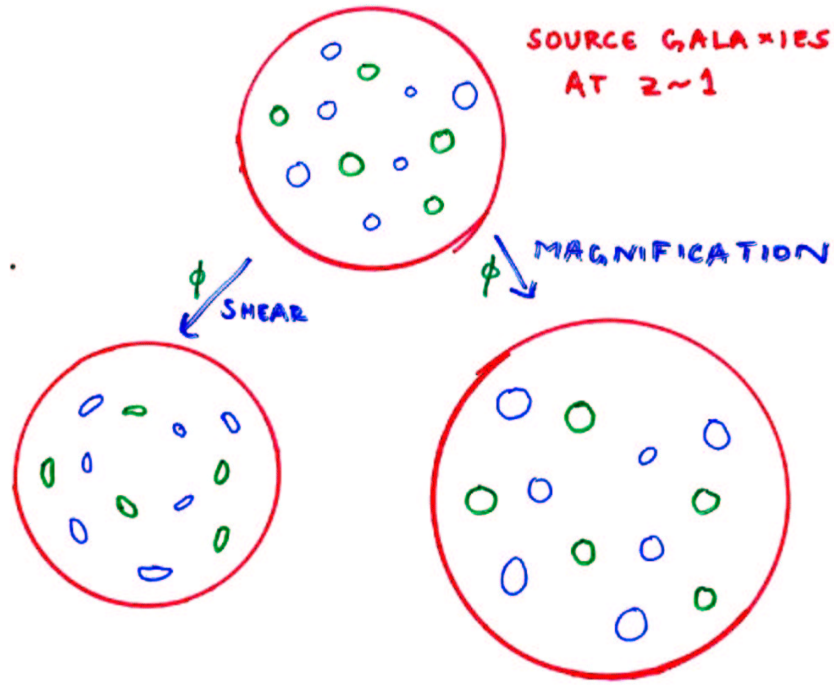
1. Magnification effects: an alternative way of doing lensing from space
2. Higher order correlations: model predictions & how they probe halo properties of 10^{13} - $10^{15} M_\odot$ halos.

— with Masahiro Takada

LENSING: SHEAR AND CONVERGENCE



Area: $A \rightarrow A\mu = \frac{A}{(1-\kappa)^2 - \gamma^2} \simeq A(1+2\kappa)$

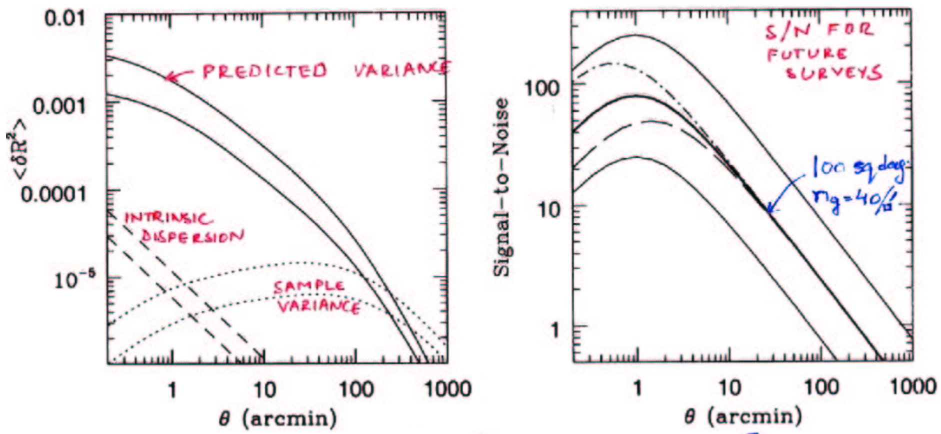
Convergence $= \int dz\, \delta(z) W(z)$

Ellipticity: $\epsilon \simeq e^{2i\theta}(1 - b/a) \longleftrightarrow \gamma = \gamma_1 + i\gamma_2$ (shear)

κ & γ are related to the projected gravitational potential.

$\kappa = \frac{1}{2}(\nabla_1^2 + \nabla_2^2)\phi$, $\gamma_1 = \nabla_1\nabla_2\phi$, $\gamma_2 = \frac{1}{2}(\nabla_1^2 - \nabla_2^2)\phi$

SIZE FLUCTUATIONS : MAGNIFICATION BY LSS



$$\langle \delta R^2 \rangle_\theta = \frac{1}{N_{patches}} \sum_i \left(\frac{\bar{R}_i - \bar{R}}{\bar{R}} \right)^2_\theta$$

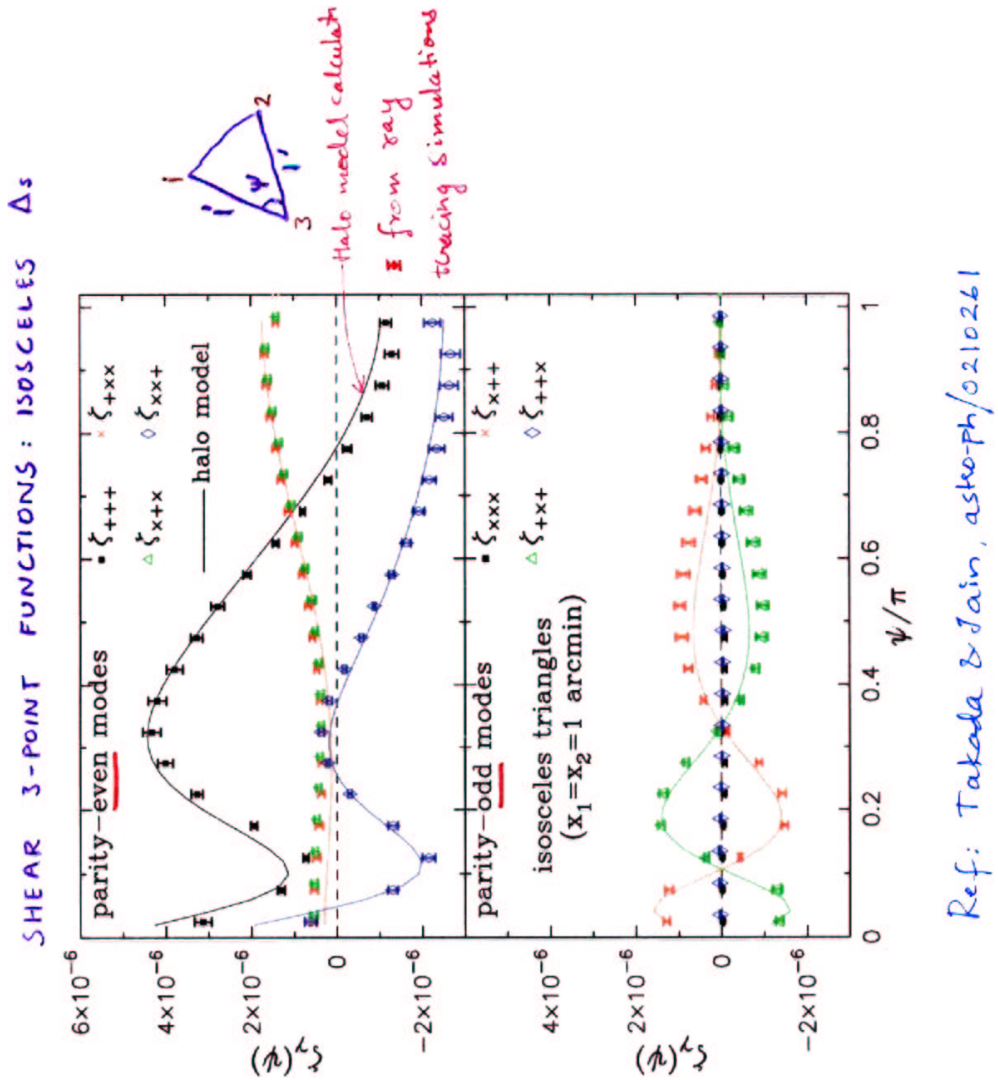
gives $\langle \kappa^2 \rangle_\theta$

Sizes are affected at 1st order by psf, so seeing variations are very bad news.

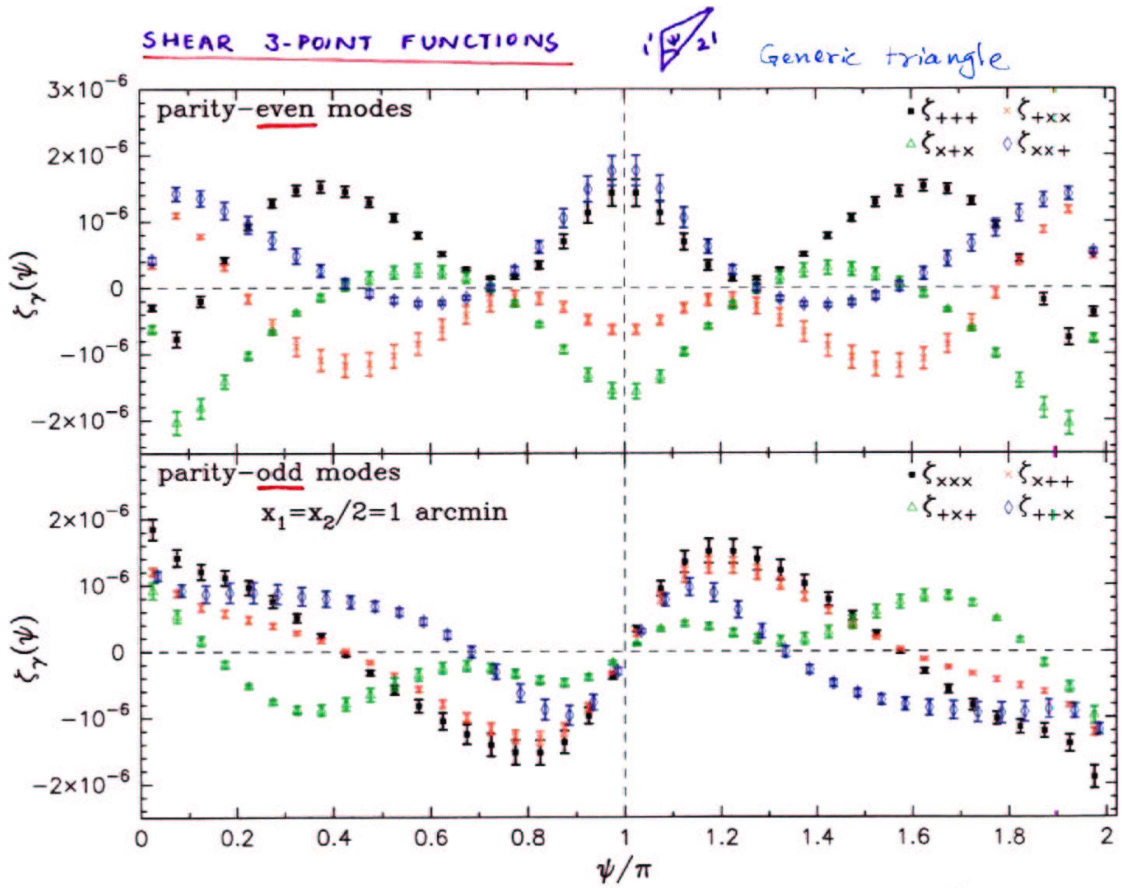
From SNAP type imaging survey with 0.1'' pixels & resolution, should be feasible.

Sample variance ≳ systematics dominate errors ⇒ can afford to discard a large fraction of galaxies.

Measuring κ is good! On large scales ≳10' get skewness. On small scales, galaxy-galaxy lensing probes halo profiles better than shapes alone.

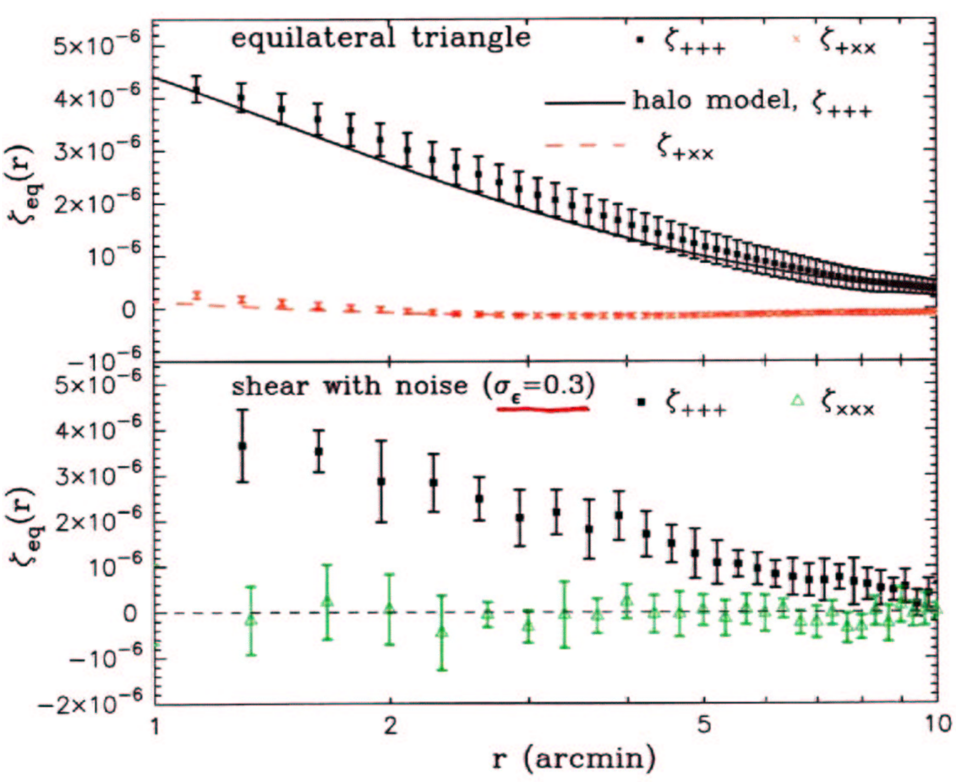


SHEAR 3-POINT FUNCTIONS



Parity properties are flipped for B-modes → allows for test of systematics!

SHEAR 3-POINT FUNCTIONS : EFFECTS OF NOISE



Area = 10 sq. deg , n_g = 38/sq. arcmin

Good S/N measurements (if no systematics) from existing data!

WHAT ARE 3 & 4-POINT FUNCTIONS GOOD FOR?

Given high $\frac{S}{N}$ measurements & model predictions for:
shear correlations galaxy correlations
cross-correlations $\langle g g \gamma \rangle$ $\langle g \gamma \gamma \rangle$

Quasilinear Regime: think bispectra (ℓ_1, ℓ_2, ℓ_3)
with weak & well known covariances over 10–100 MpC.
⇒ Parameters of cosmology (σ_8, Ω_m, dark energy)
and biasing $\langle b_1, b_2 ; b_{gg}, b_{gm} .. \rangle$ obtained
by combining 2 & 3-point information.

Nonlinear Regime: 20 kpc – 2 MpC
Real space correlations tell us about halos of
big galaxies – clusters, because 1-halo term dominates.
Choose parameters for mass function, halo profile,
substructure & fit from the data (for given cosmology).
E.g. lensing 3 & 4-point functions ⇔ concentration
& inner slope of 10^{13}–10^{15} $M_\odot$ halos.