Dark matter halos density inner slope from weak gravitational lensing

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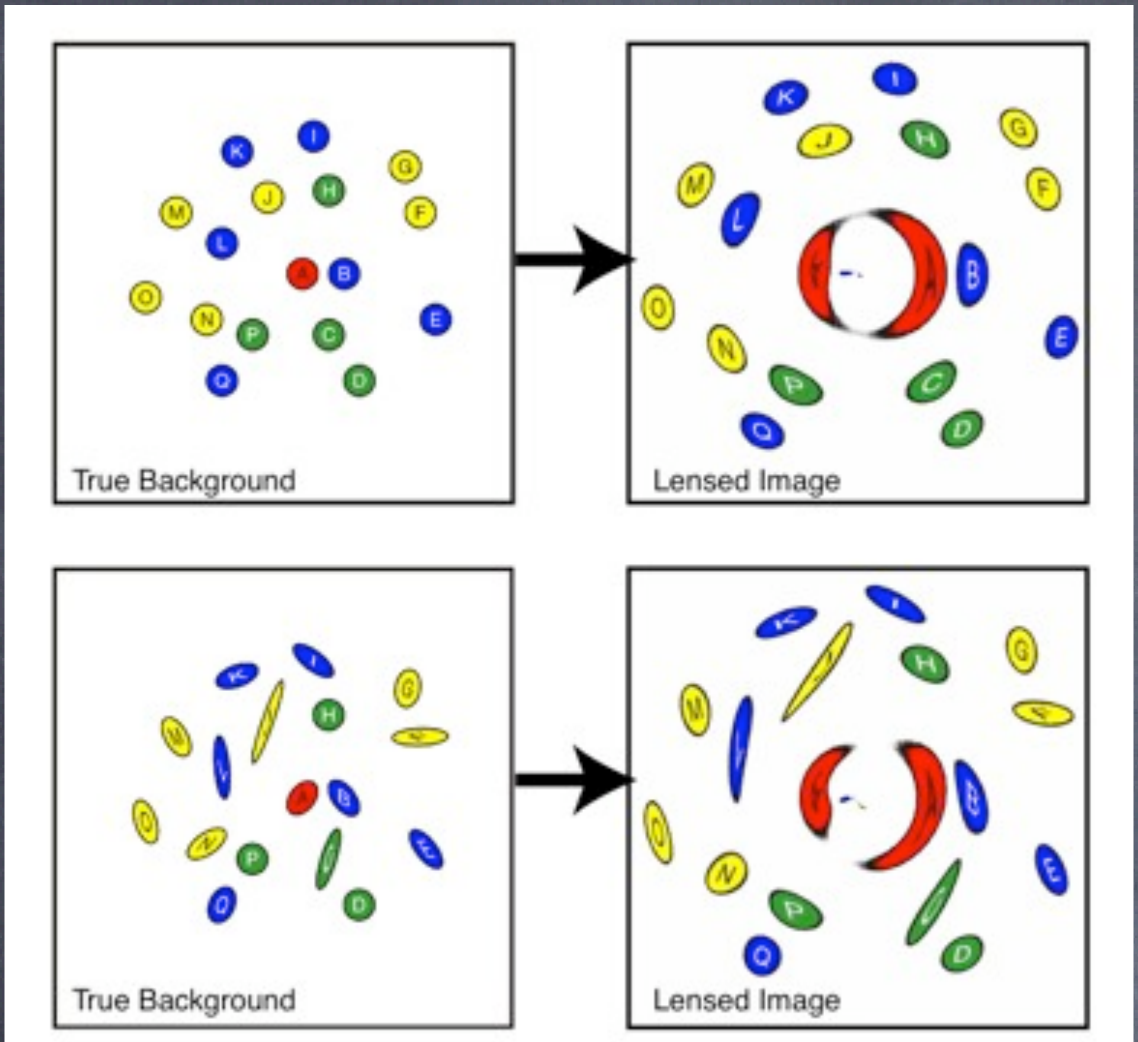
Aim: constraining halo inner slope from weak lensing



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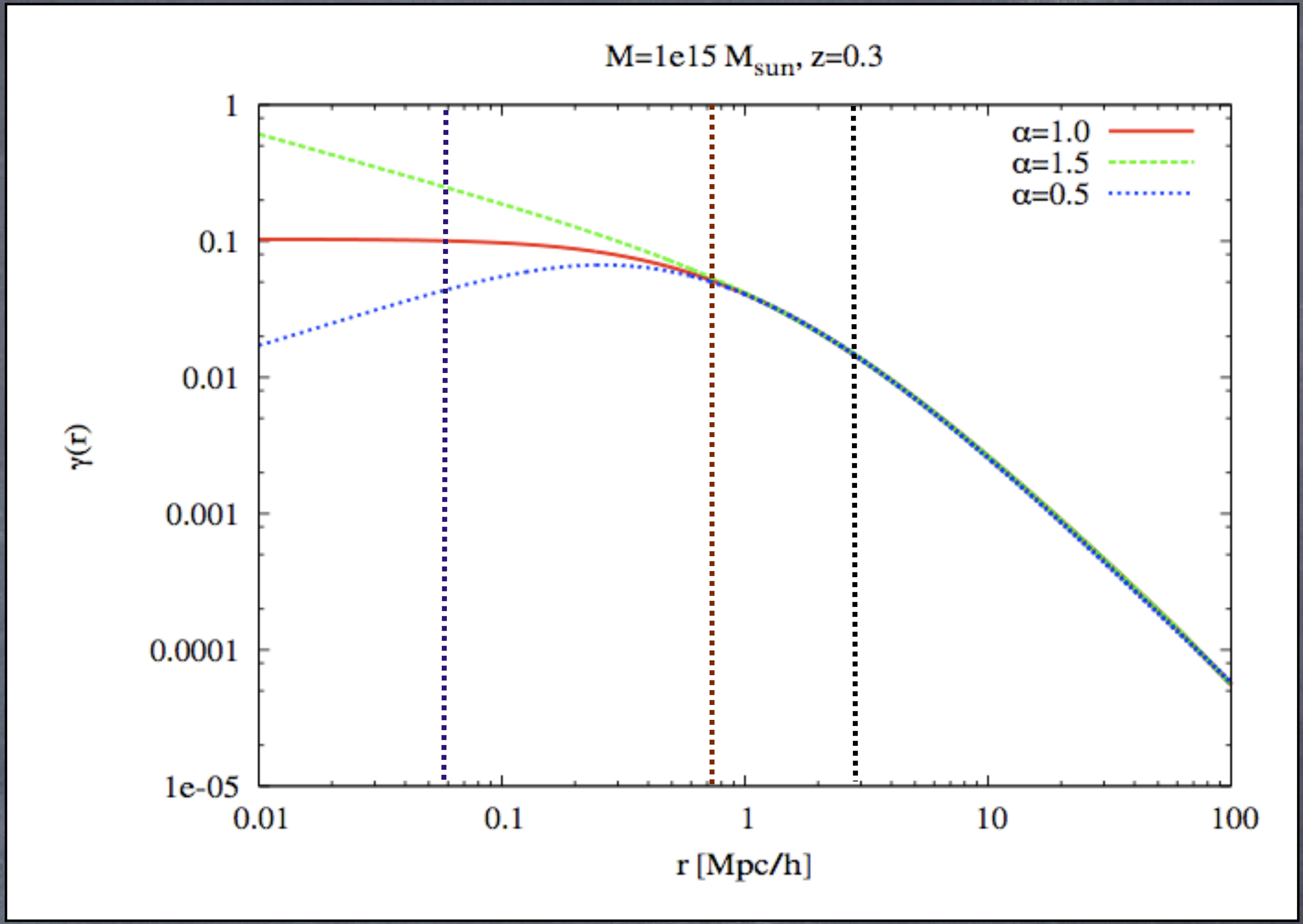

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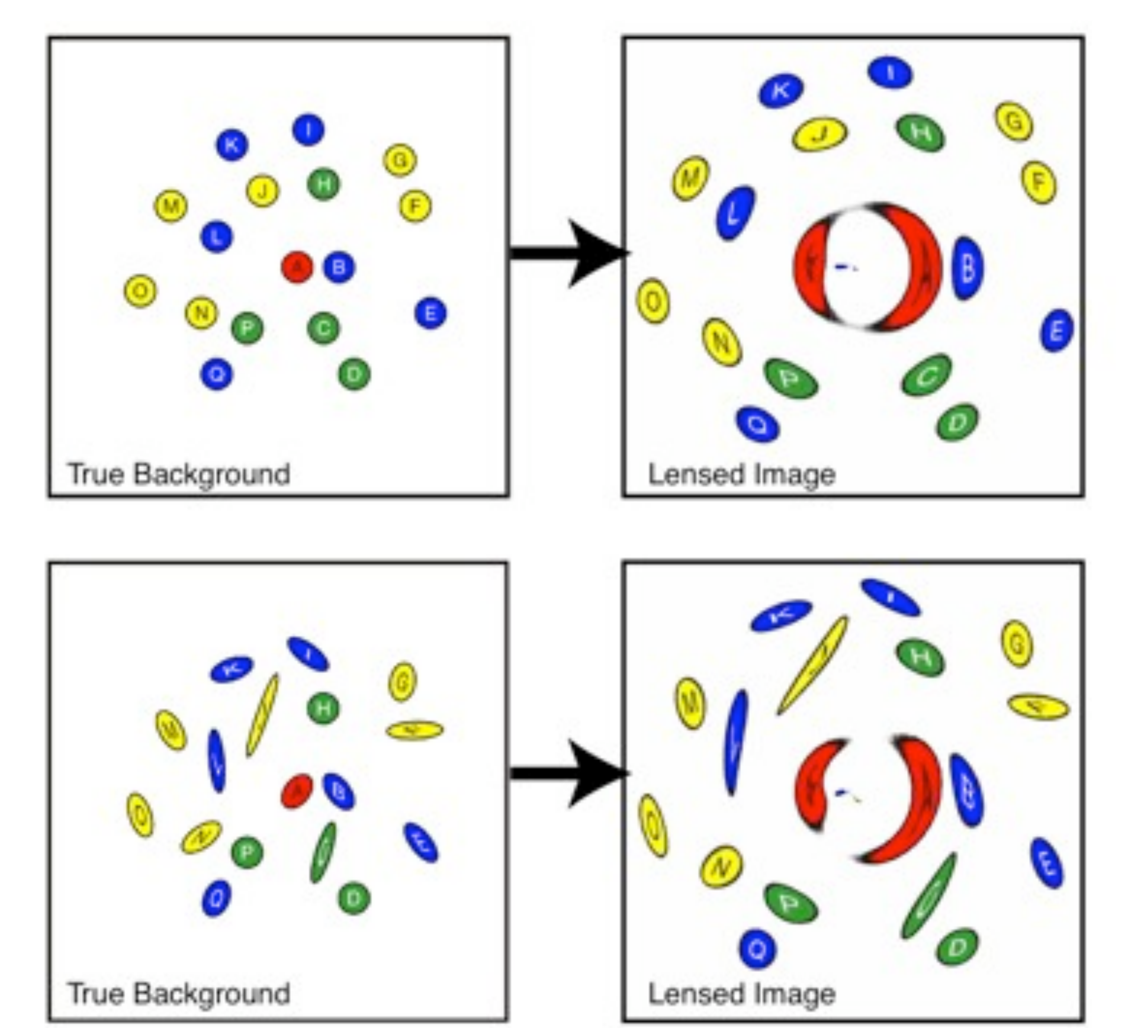
Aim: constraining halo inner slope from weak lensing



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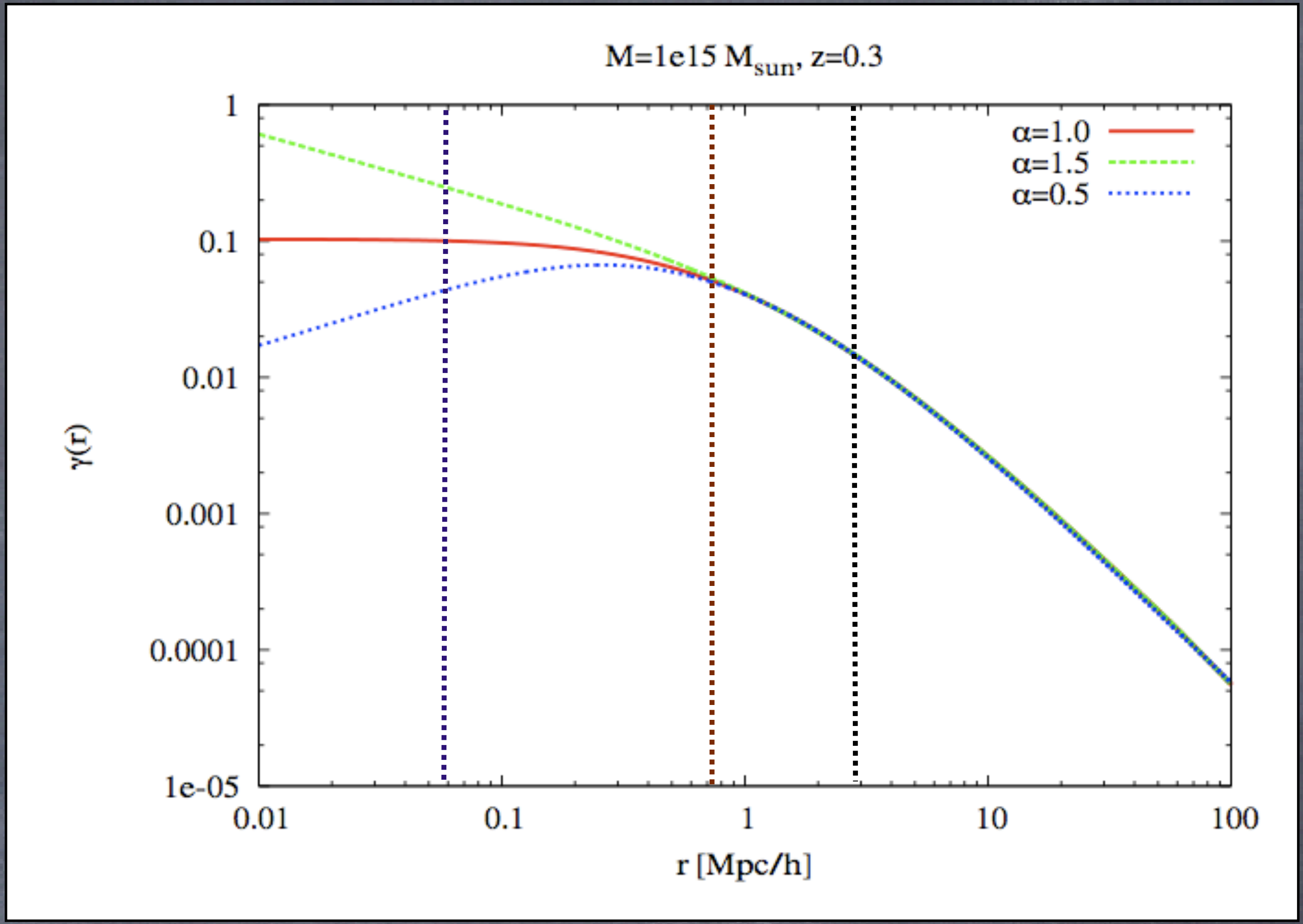

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Image distortion:

$$A(\theta) = \frac{\partial \beta}{\partial \theta} = \left(\delta_{ij} - \frac{\partial^2 \Psi(\theta)}{\partial \theta_i \partial \theta_j} \right) = \begin{pmatrix} 1 - \kappa - \gamma_1 & -\gamma_2 \\ -\gamma_2 & 1 - \kappa + \gamma_1 \end{pmatrix},$$

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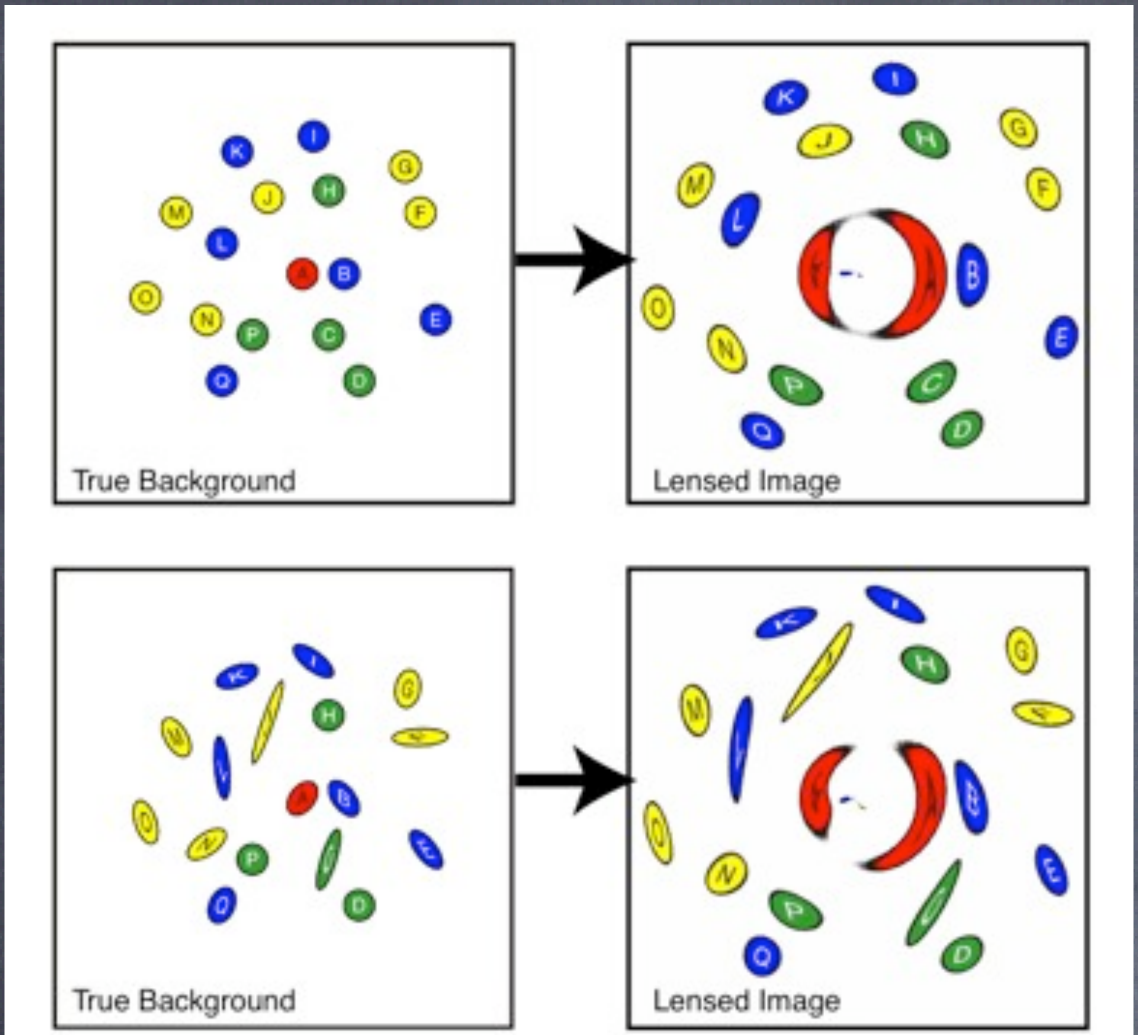

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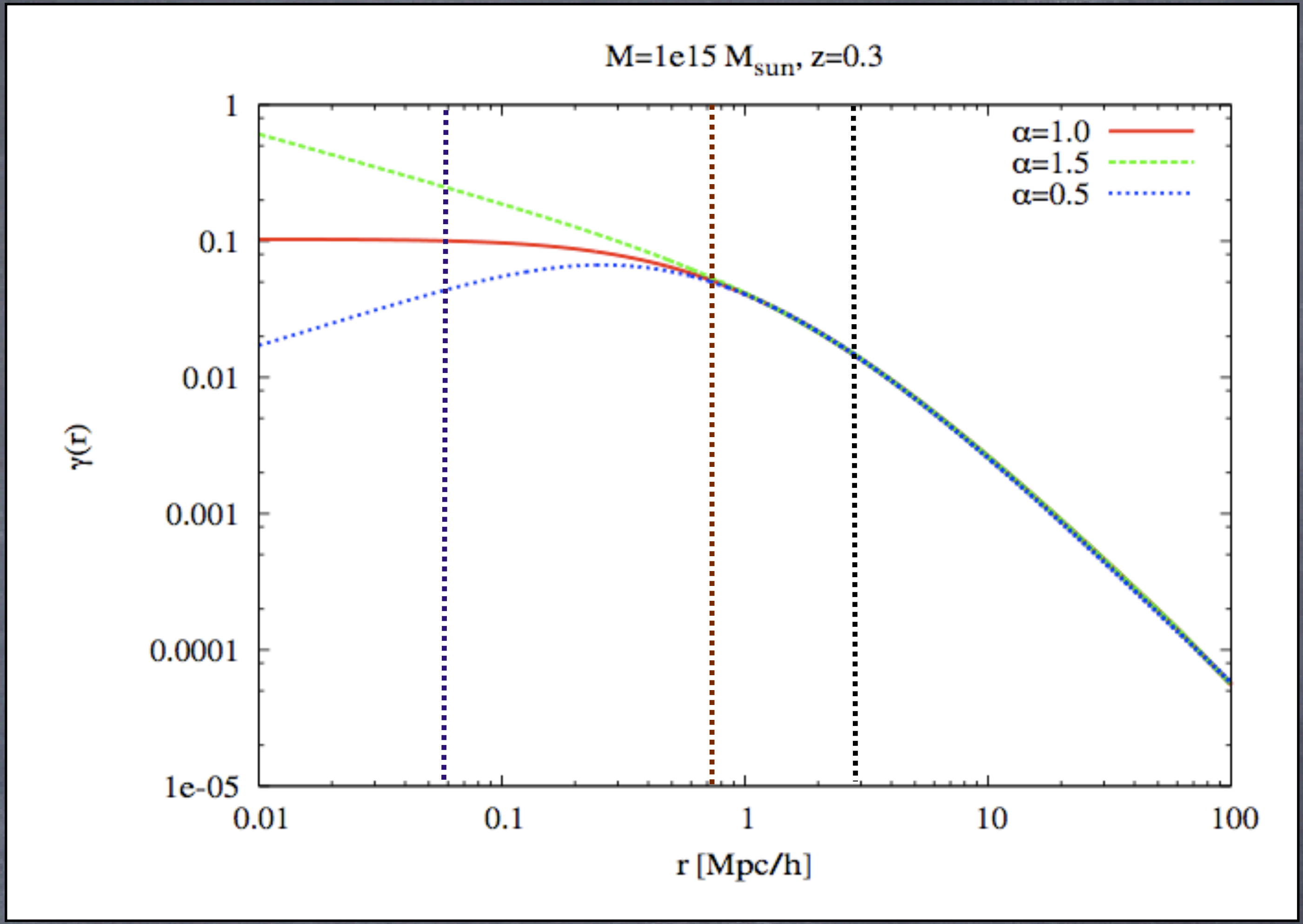

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Measurable quantity: galaxies ellipticity (direct estimator of the shear)

Method: Optimal linear filter

Optimal:
- Minimal variance (noise: intrinsic ellipticities + LSS)
- Unbiased

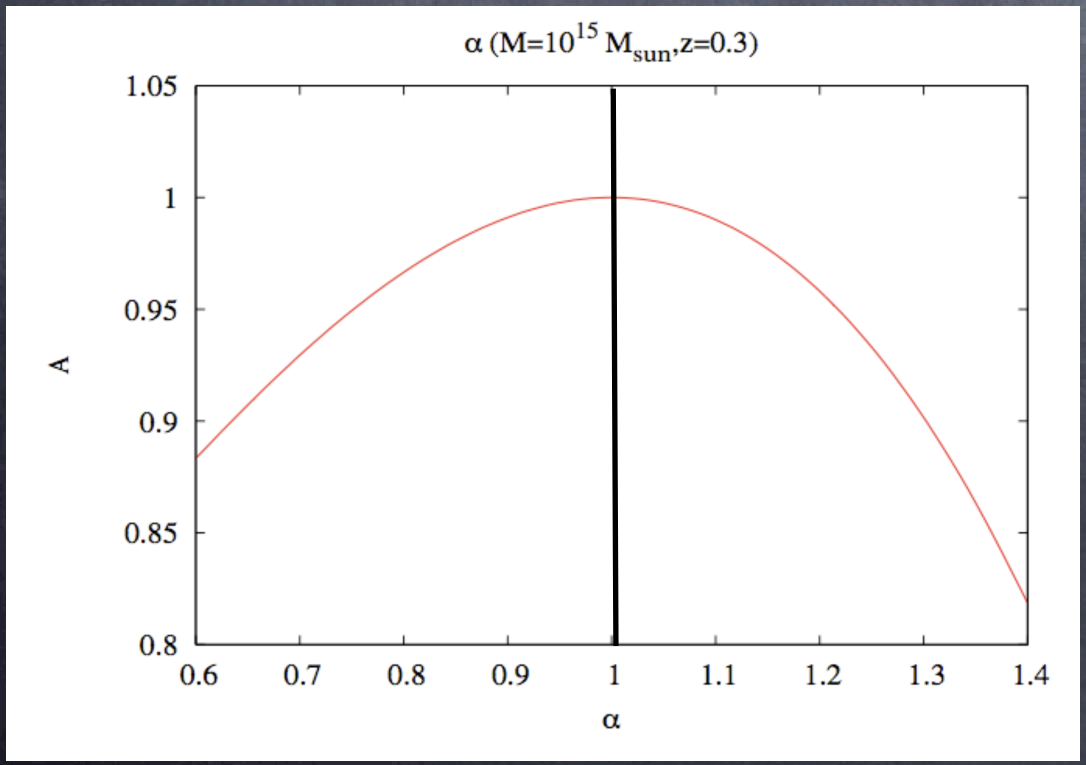
Linear:
- can be used to measure quantities which linearly depend on the signal only

$$D(\theta) = S(\theta) + N(\theta)$$

$$A_{est}(\theta) = \int d^2\theta' D(\theta') \Psi(|\theta - \theta'|)$$

$$\Psi \propto \frac{\tau}{P}$$

$$D(\theta) - \gamma(\theta, \alpha_0) = \left.\frac{\partial \gamma}{\partial \alpha}\right|_{\alpha_0} \Delta\alpha + N(\theta)$$



Adaptive:
- Maximum signal amplitude for a fixed value of a scalar quantity

$$\Psi(k, \alpha) = \frac{1}{2\pi} \frac{\tau(k, \alpha)}{P_N(k)} \cdot f\left(\frac{d \ln \tau(k, \alpha)}{d \ln \alpha}\right).$$

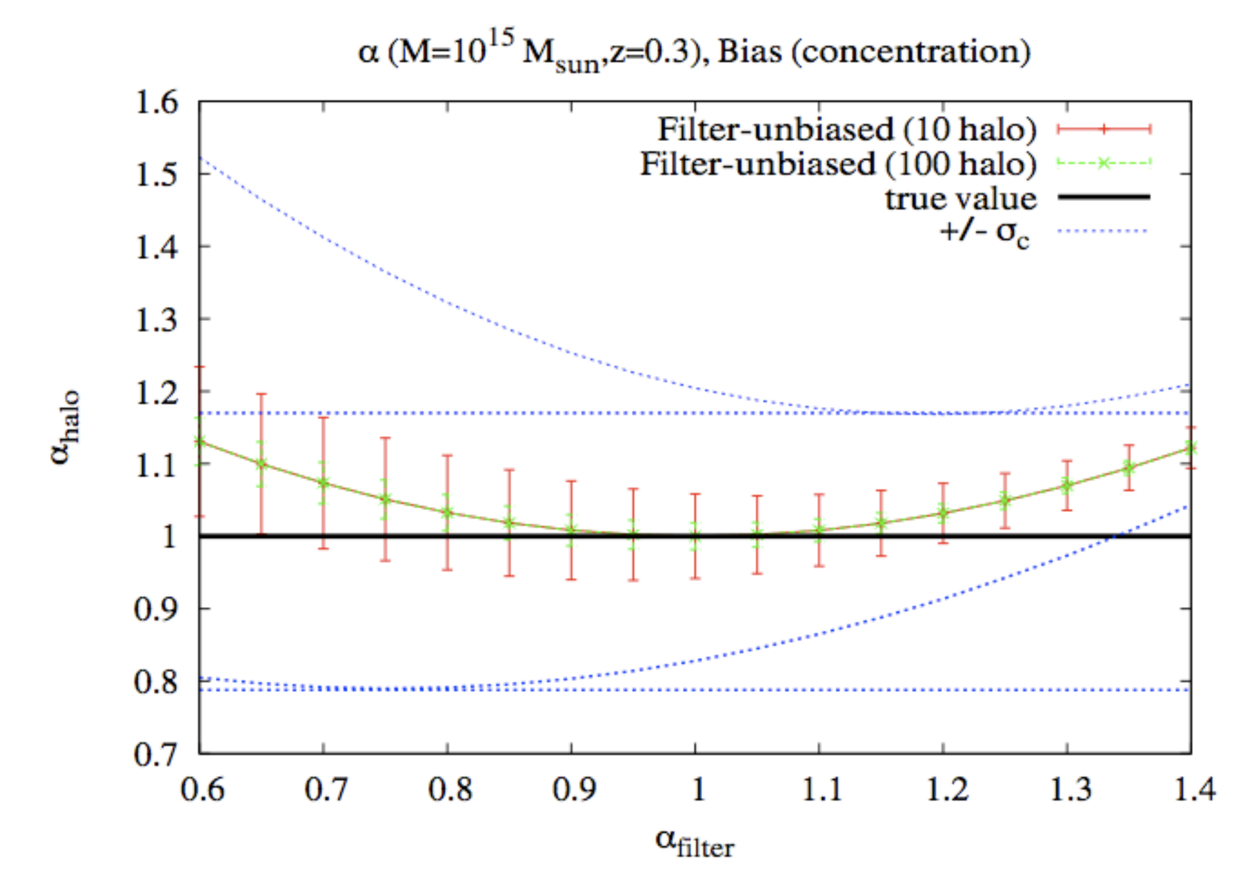
How does it work ?

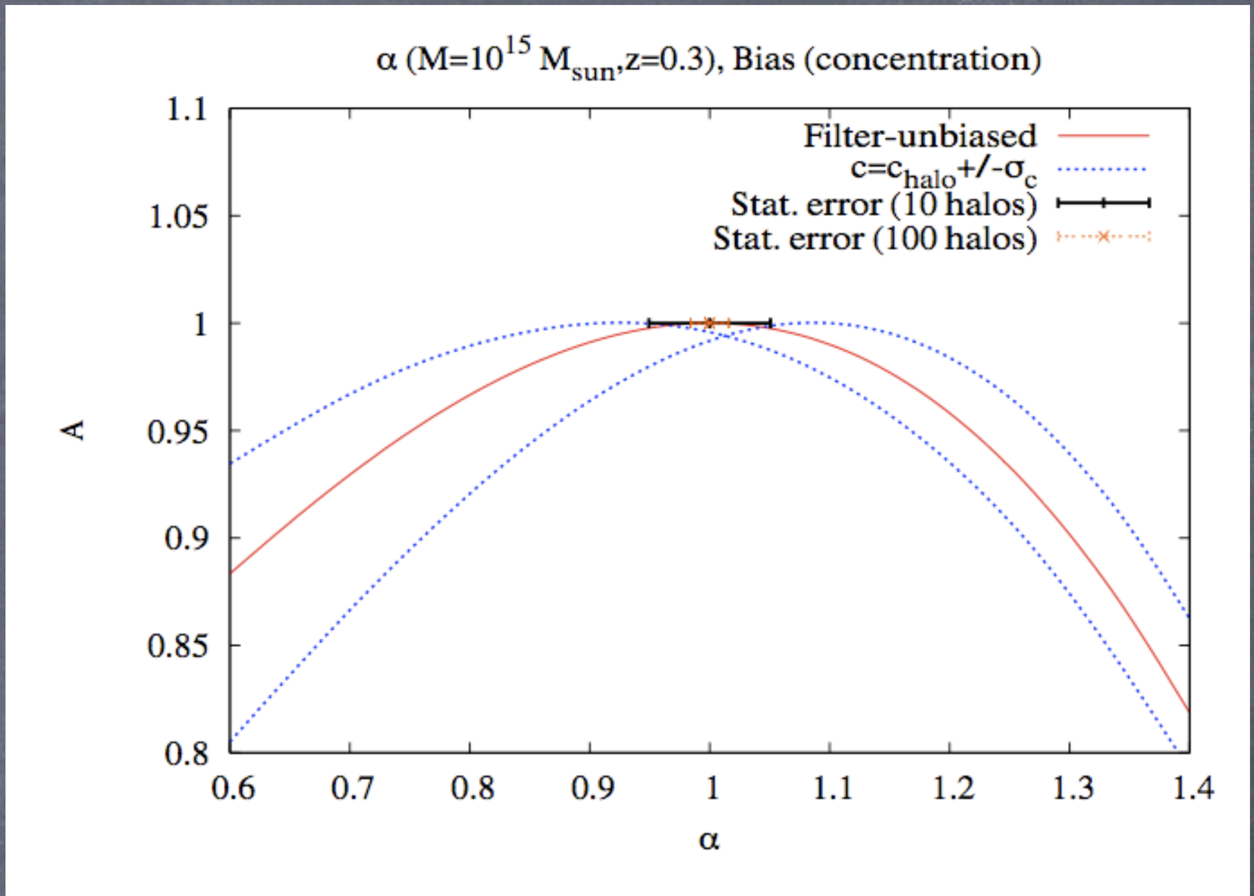
- Choose a model (generalized NFW,...)
- Define the filter
- Convolve the filter with data
- Find a number carrying infos about the inner slope of the profile

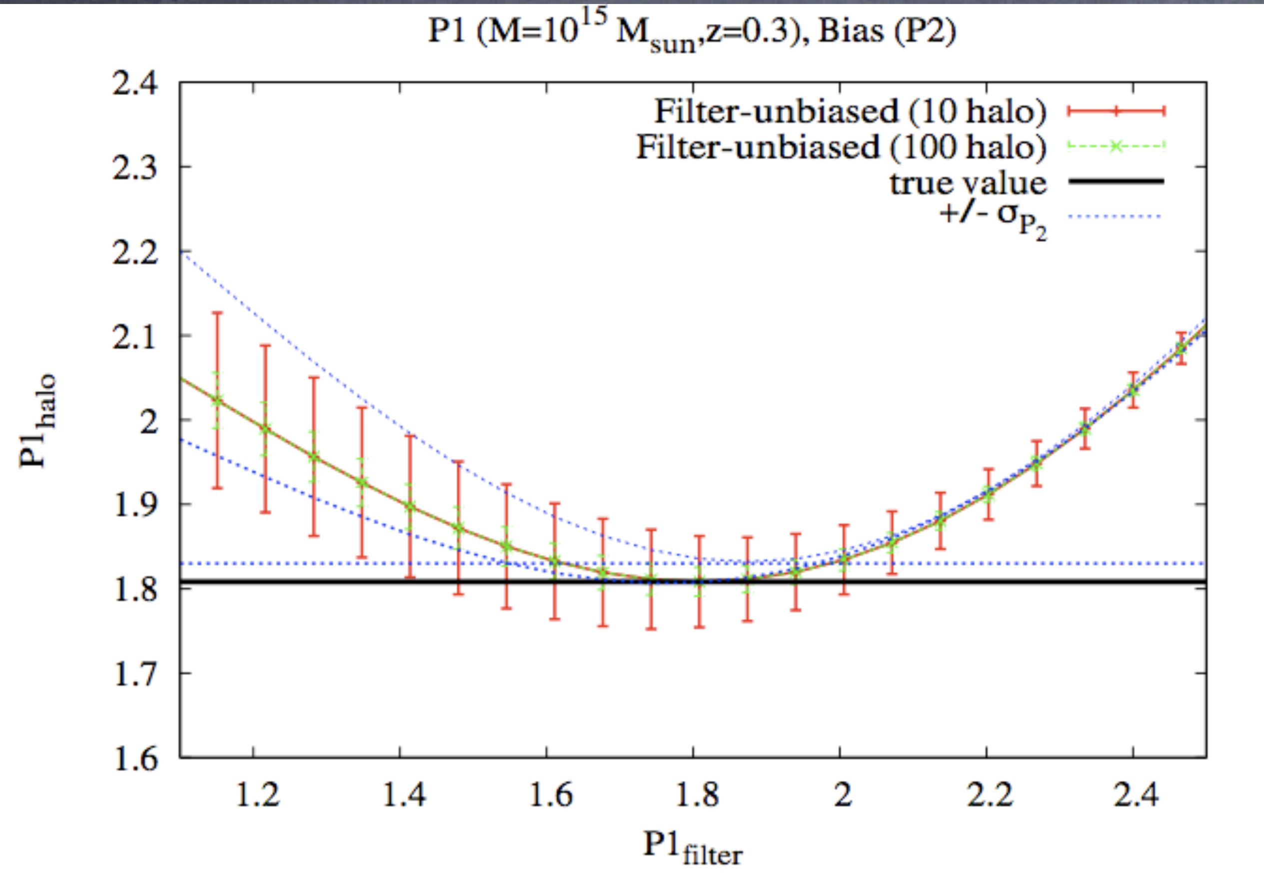
- Model can be wrong
- Degeneracy in the model (inner slope & concentration)
- Measurement is biased

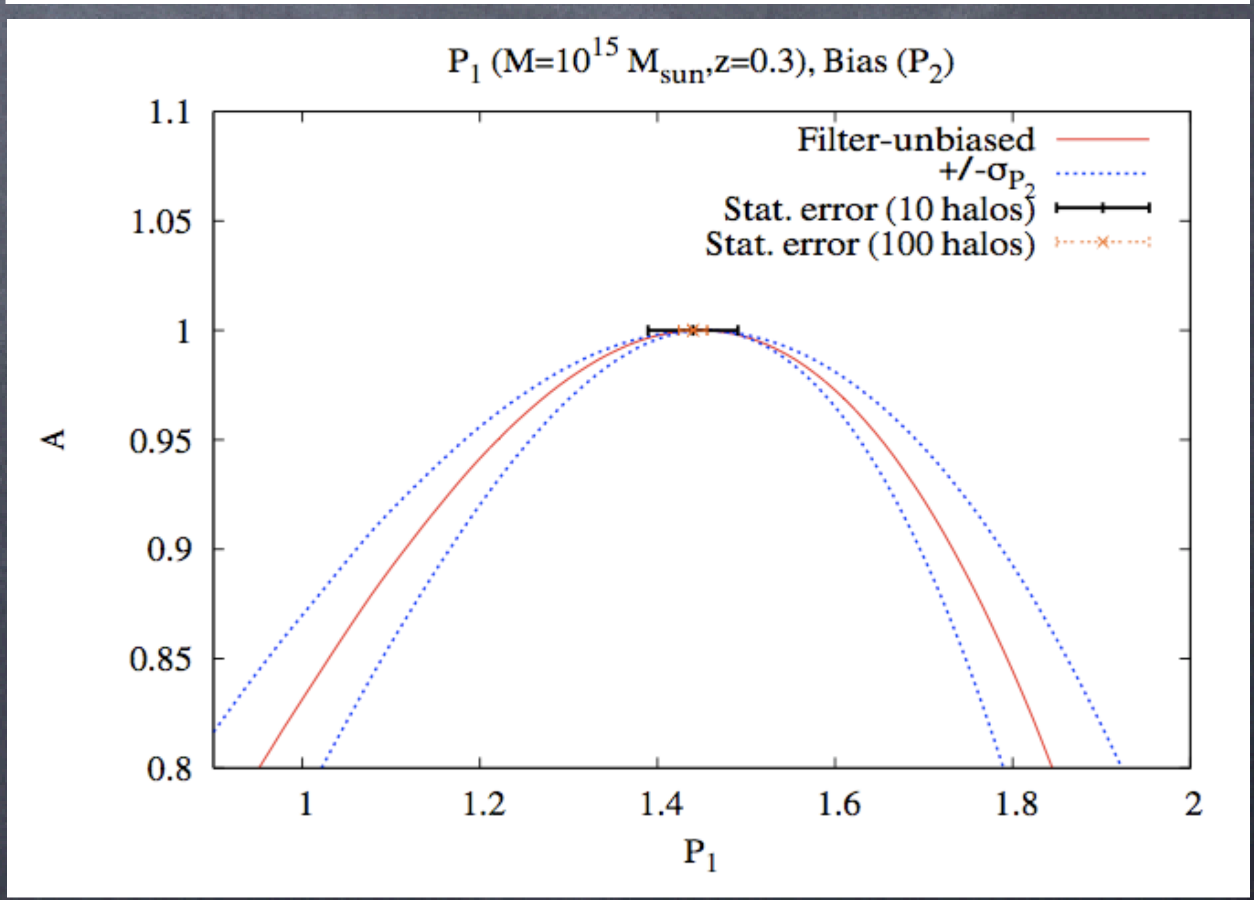
- Define new parameters (P1,P2) linear combination of the inner slope and concentration that are the best and worst constrainable parameter given that model [Fisher matrix]

Inner slope & Halo's model









Methods uncertainties

1. Statistical uncertainties:

- intrinsic ellipticity + finite # background galaxies
- large scale structure

Minimized (filter!)

2. Dark matter halo model used in the filter definition

- inner slope sensitivity to the choice of the halo's model
- propagation of errors of the halo's parameters in the inner slope measurment (Montecarlo)

The two methods allow to estimate statistically the halo inner slope (or some other halo's property) with an accurancy of few percent.