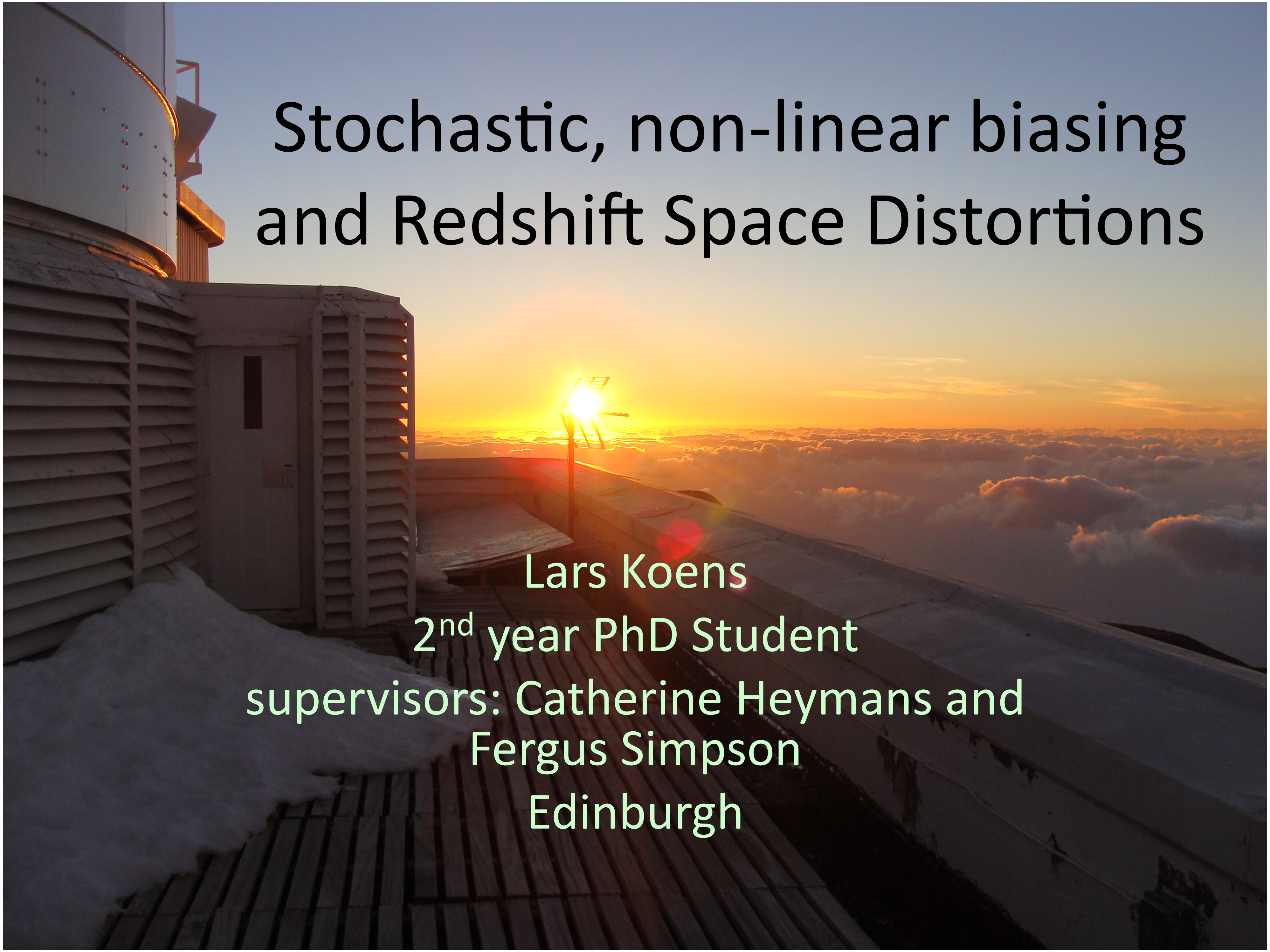
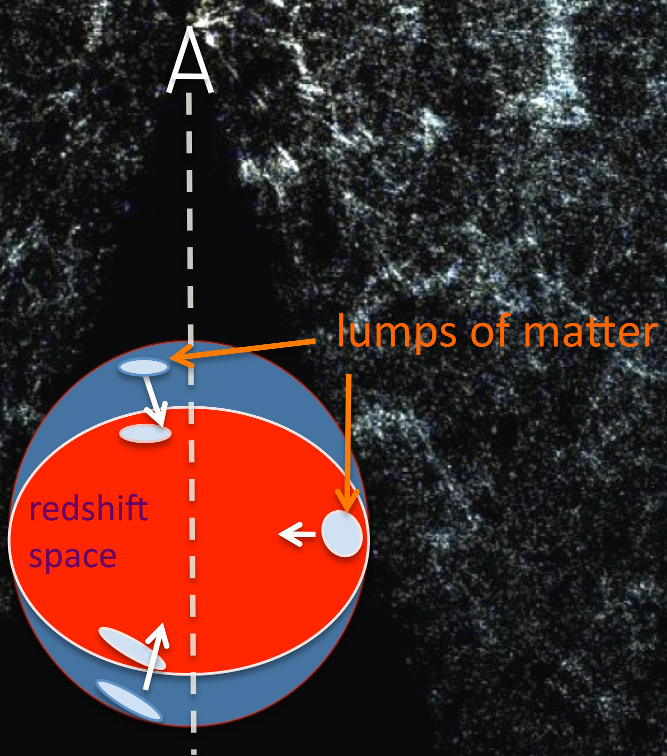


Stochastic, non-linear biasing and Redshift Space Distortions

Lars Koens
2nd year PhD Student
supervisors: Catherine Heymans and Fergus Simpson
Edinburgh

RSD and Lensing

- Redshift Space Distortions probe $\nabla\,\delta$
- Weak Gravitational Lensing probes δ



How galaxies trace dark matter

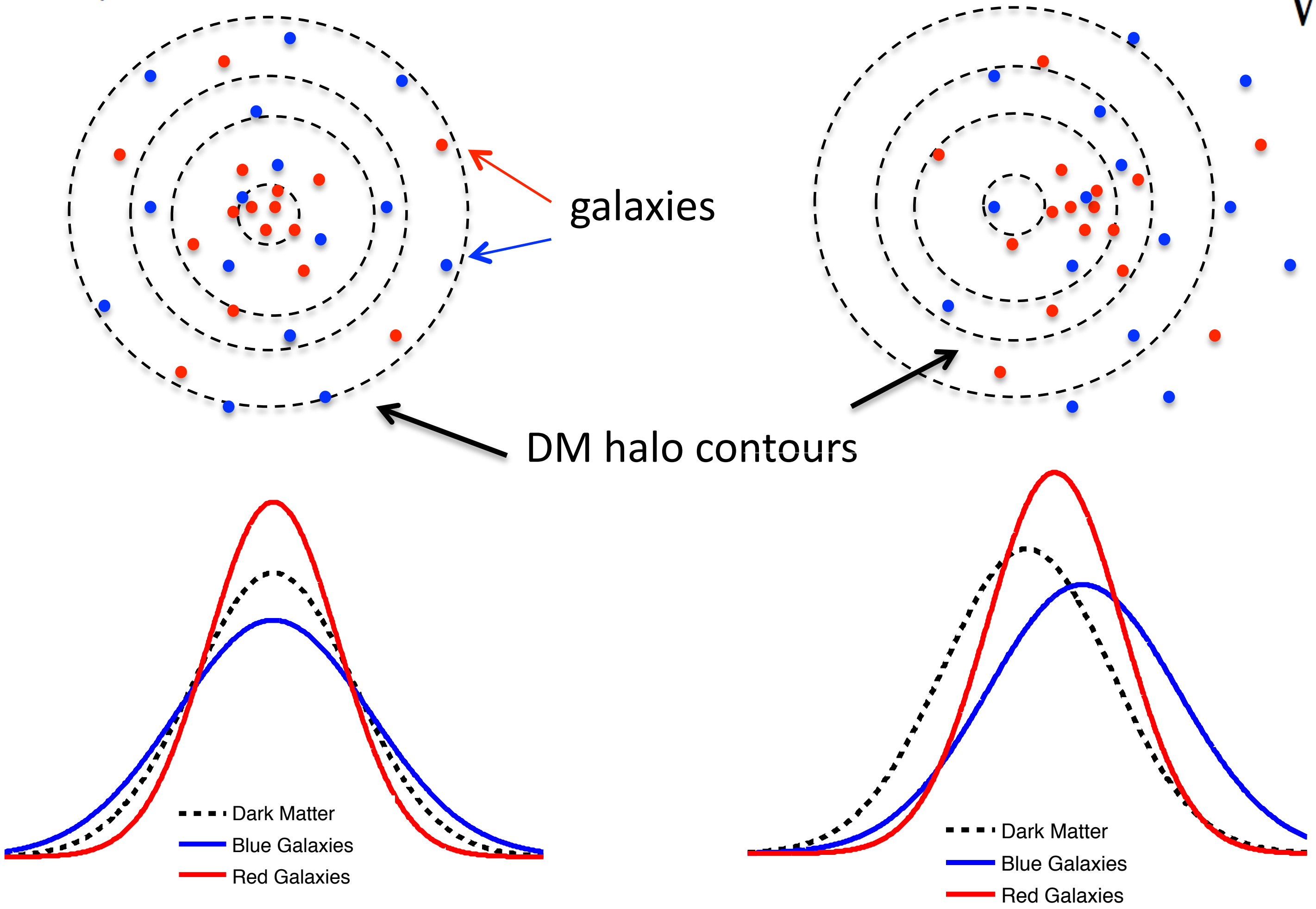
$$b = \sqrt{\frac{\langle \delta_g^2 \rangle}{\langle \delta_m^2 \rangle}}$$

← Galaxy clustering

← shape shape correlation

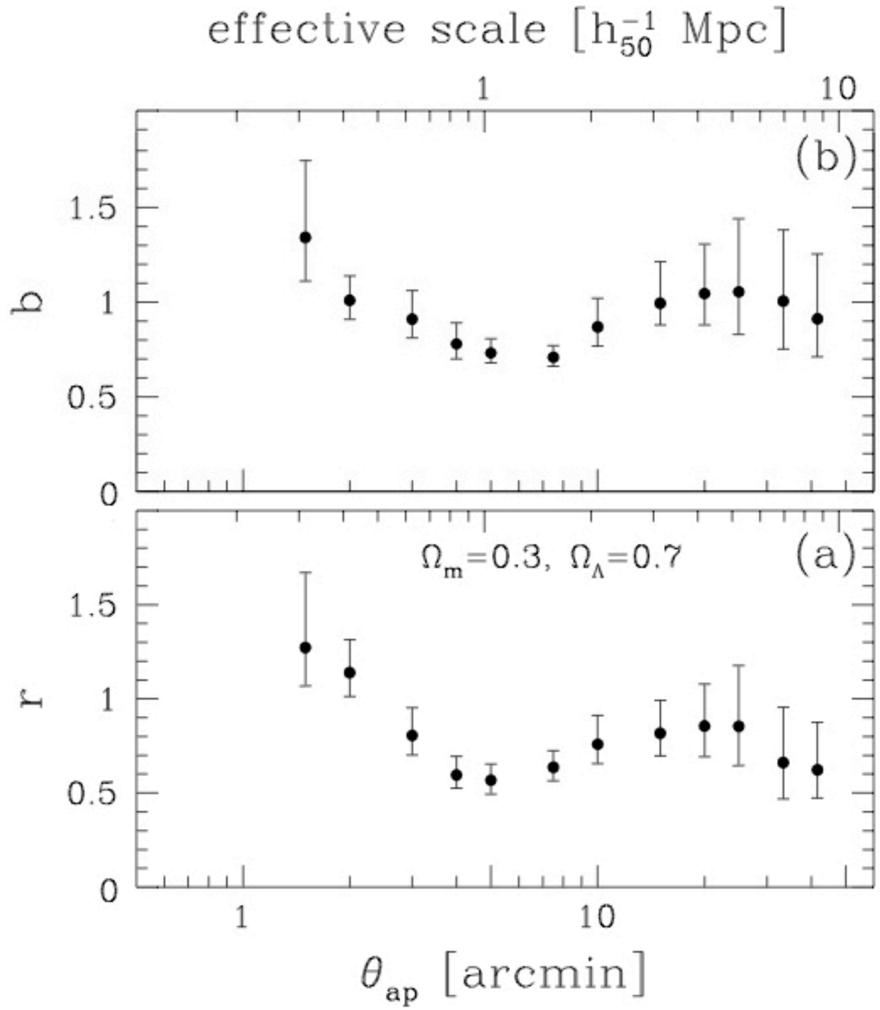
Galaxy-shape correlation →

$$r = \frac{\langle \delta_g \delta_m \rangle}{\sqrt{\langle \delta_g^2 \rangle \langle \delta_m^2 \rangle}}$$

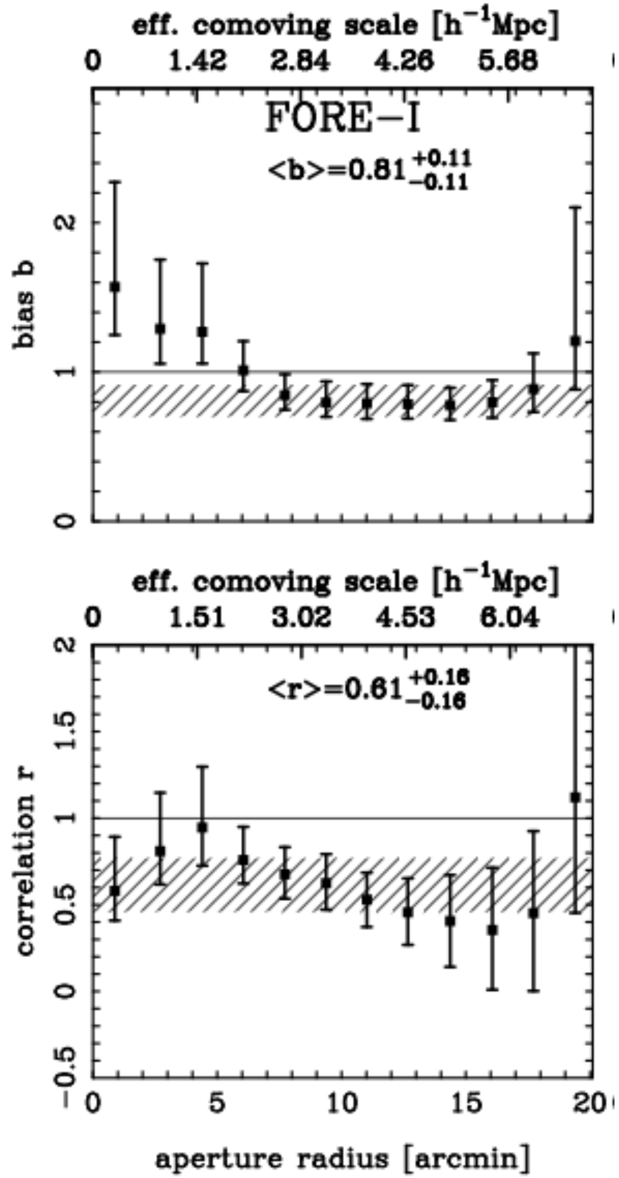


Weak Lensing bias results

Hoekstra et al 2002

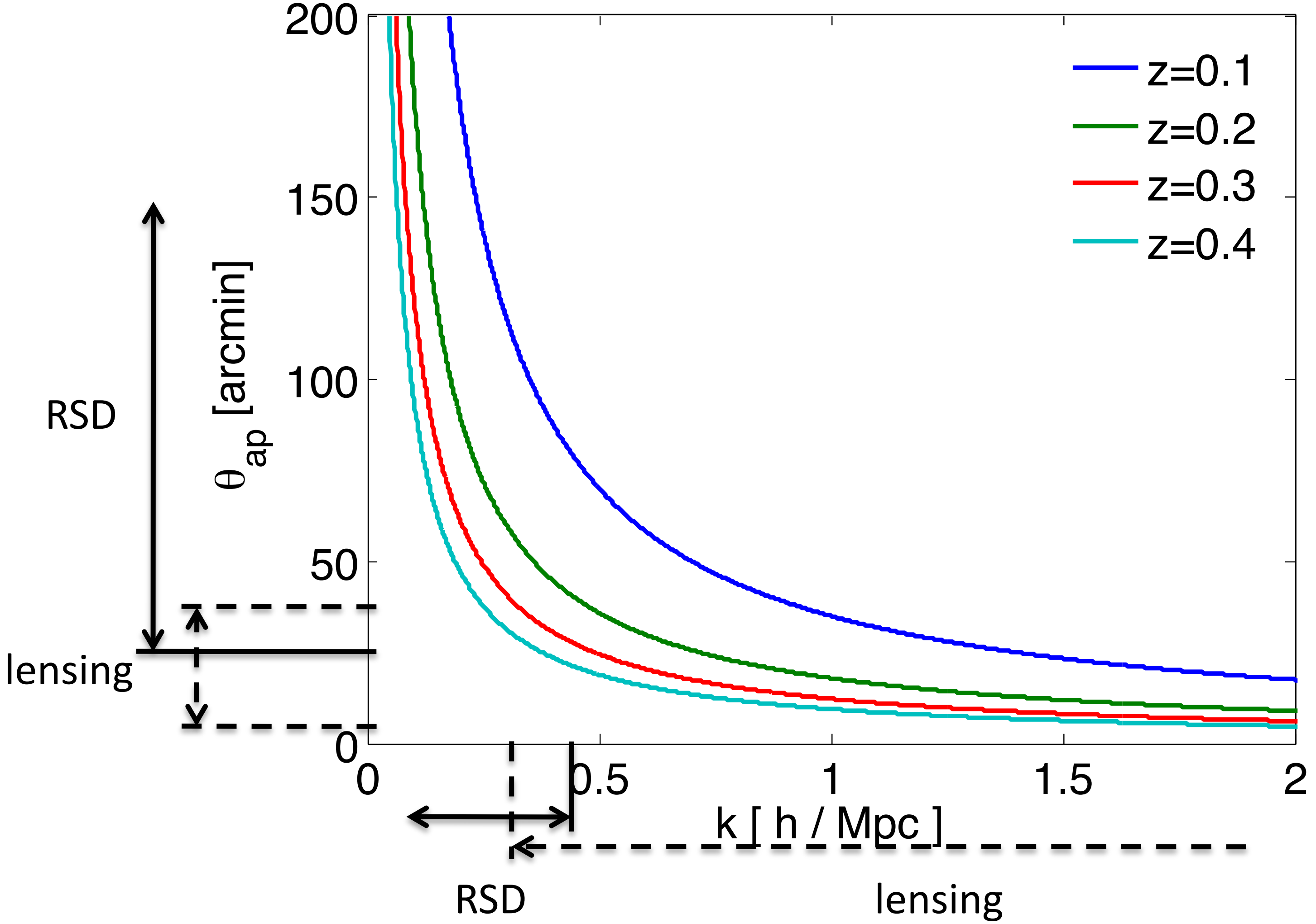


Simon et al 2007



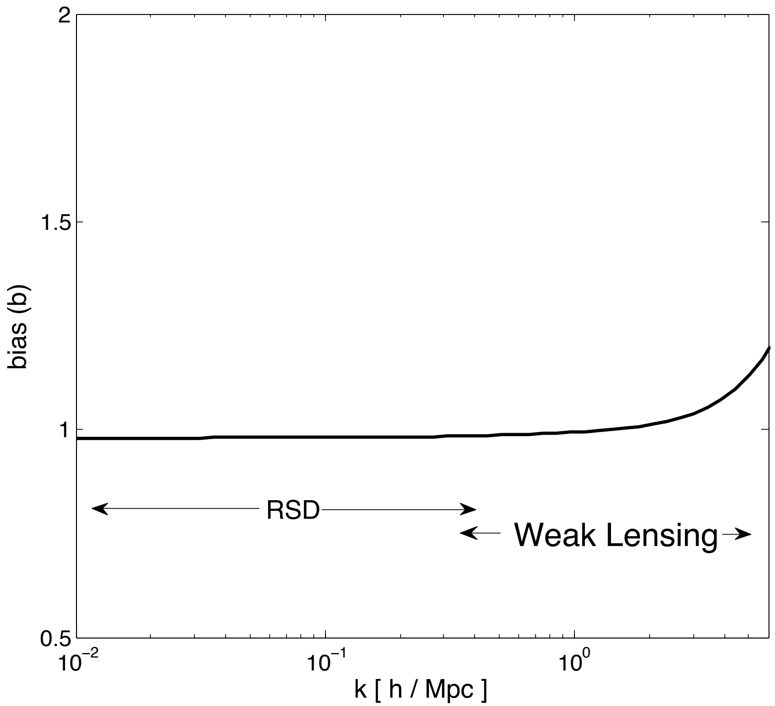
Scale issue

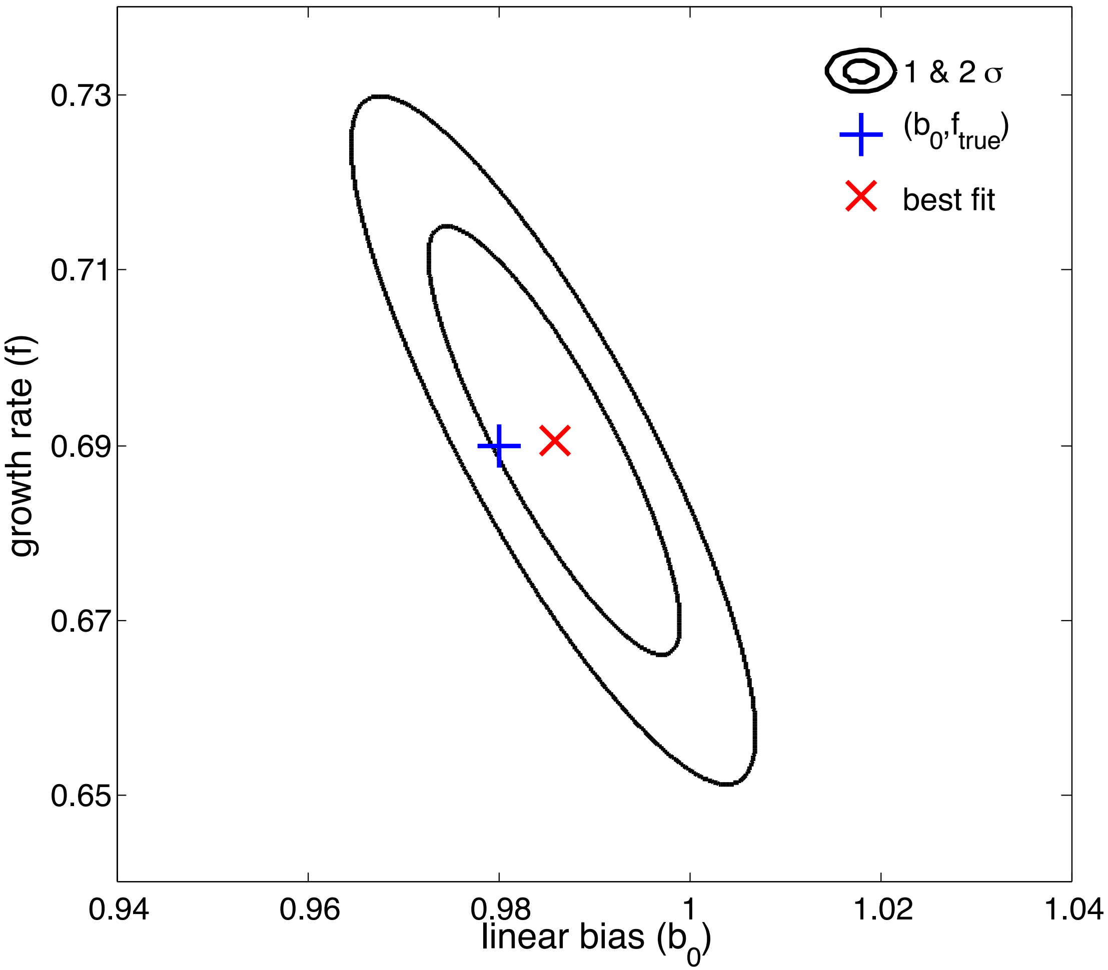
Lensing measurements need to go out to much larger angular scales!



Scale dependent bias

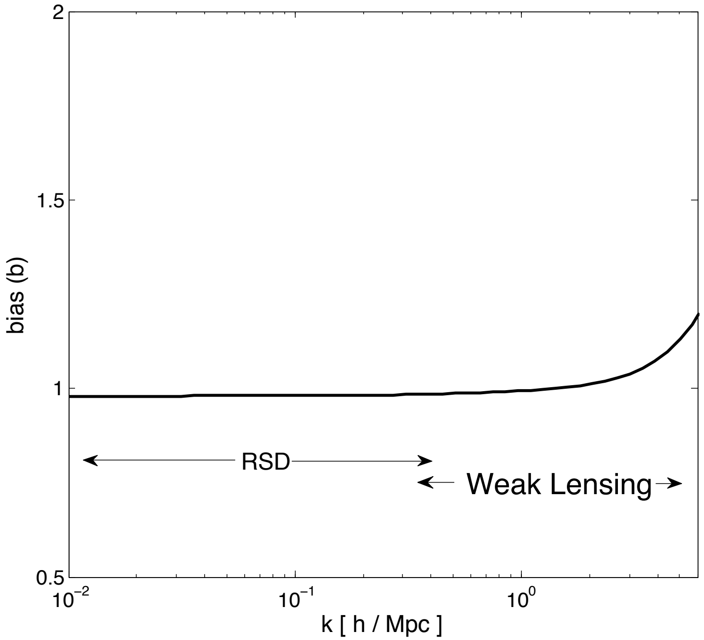
- Schulz & White (2006): $\Delta_g^2 = b^2 \Delta_{\rm lin}^2(k) + \left(\frac{k}{k_1}\right)^3$

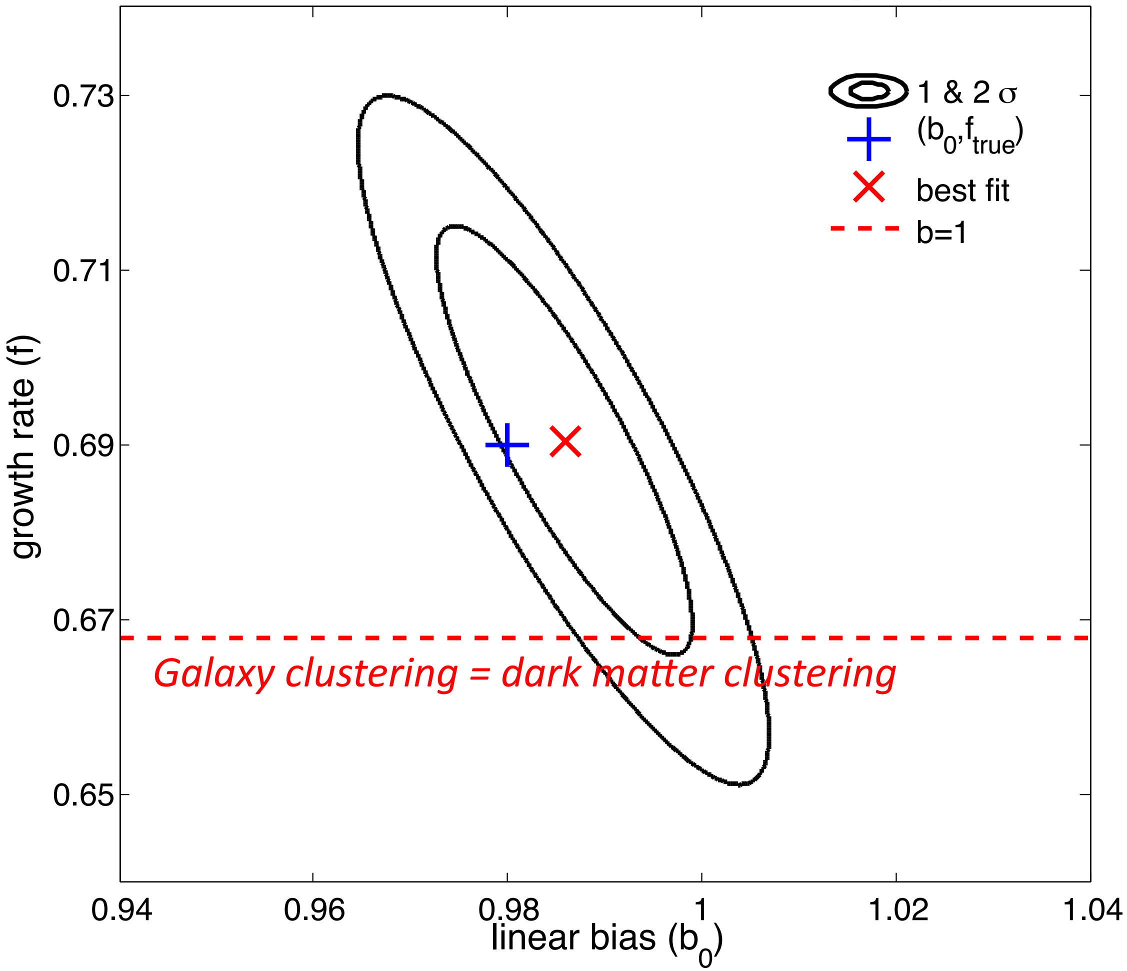




Scale dependent bias

- Schulz & White (2006): $\Delta_g^2 = b^2 \Delta_{\rm lin}^2(k) + \left(\frac{k}{k_1}\right)^3$

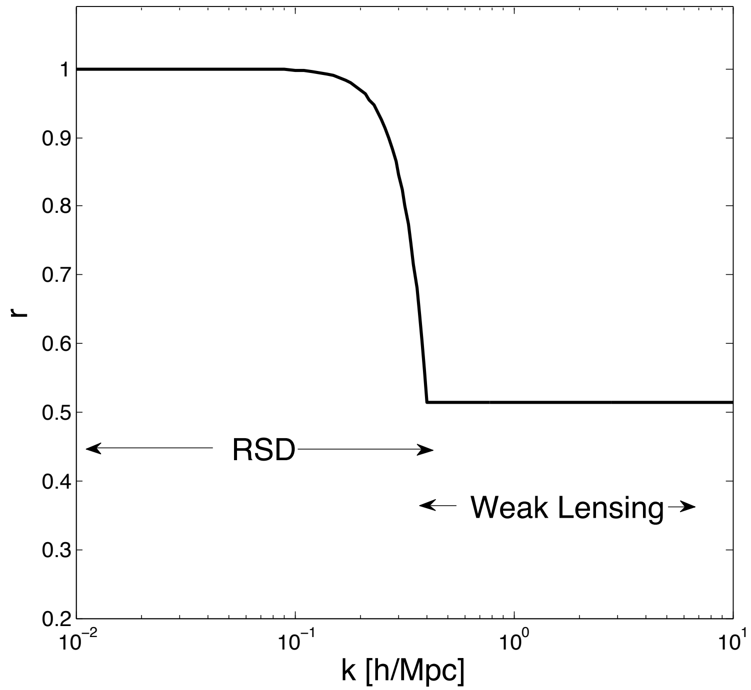


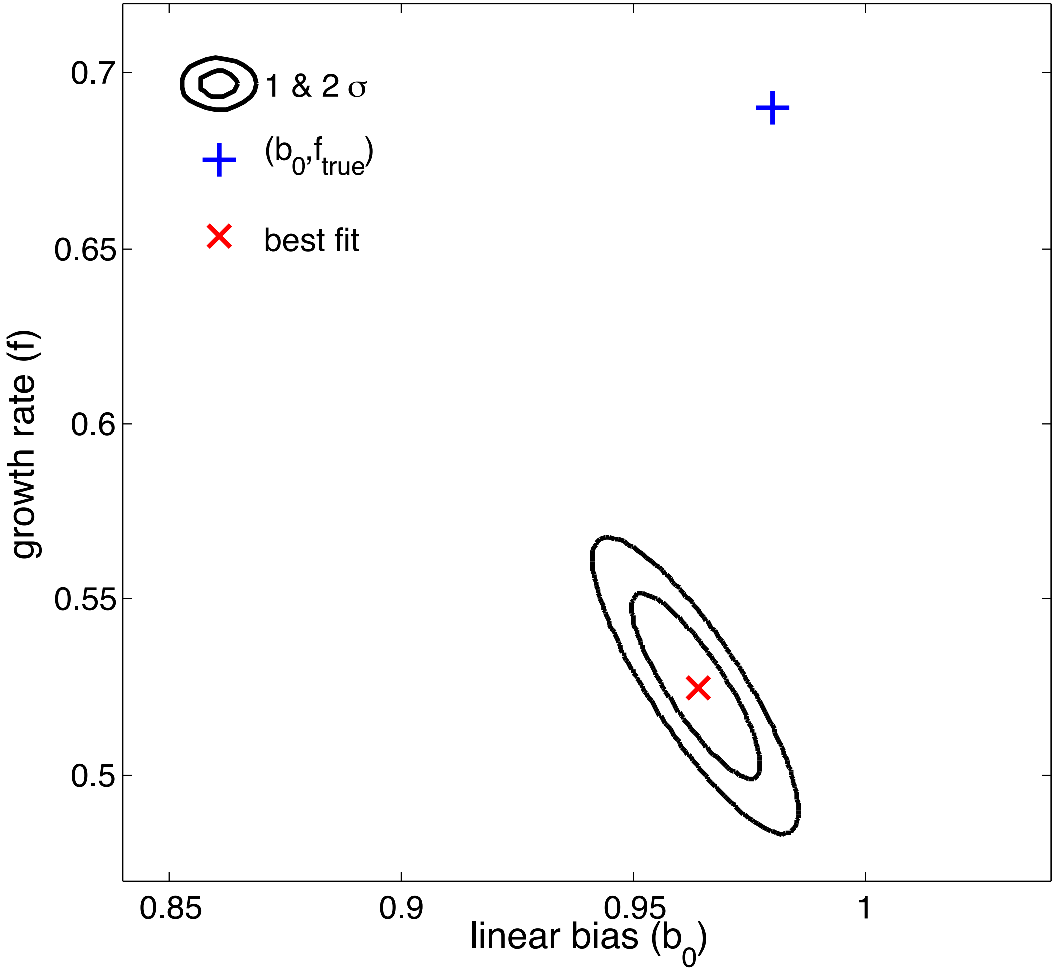


Stochastic bias

Kaiser Formula (Kaiser 1987) with r not necessarily 1

toy model for r(k):

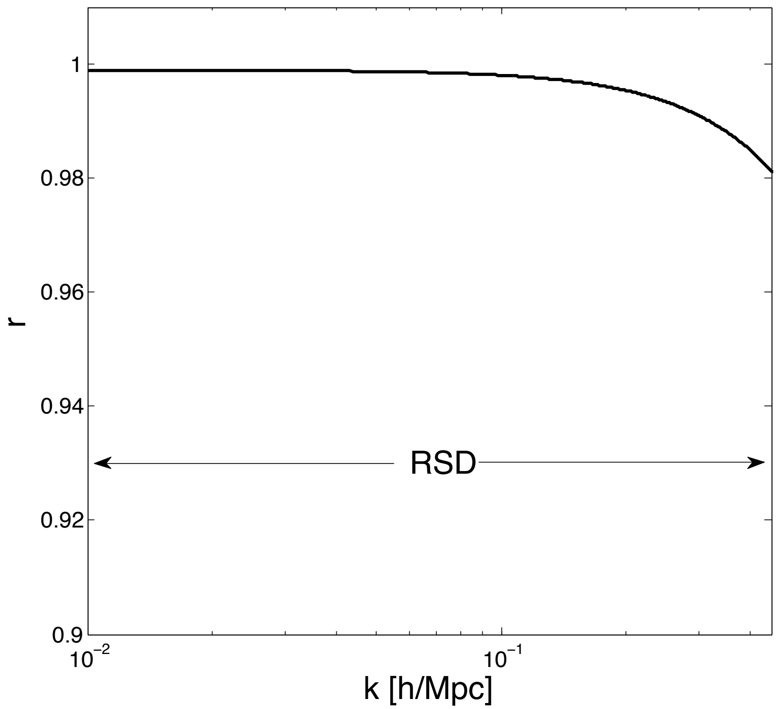


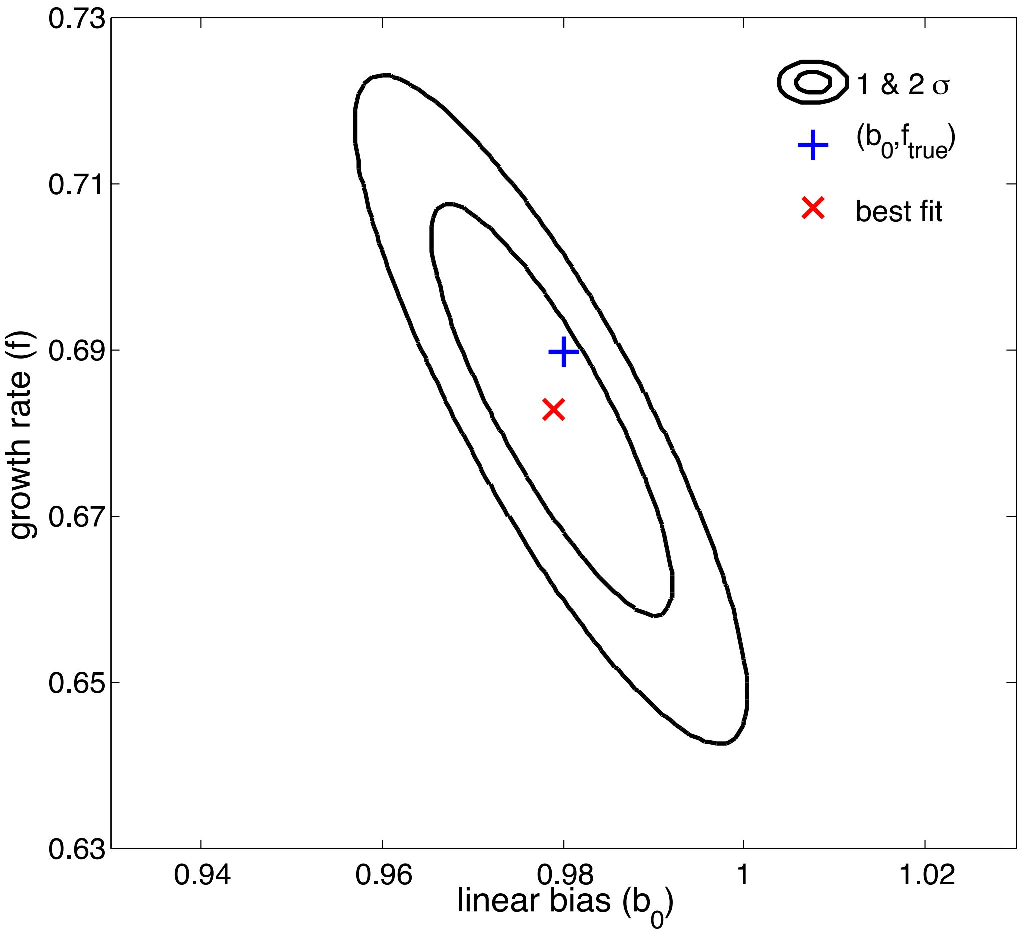


Stochastic bias

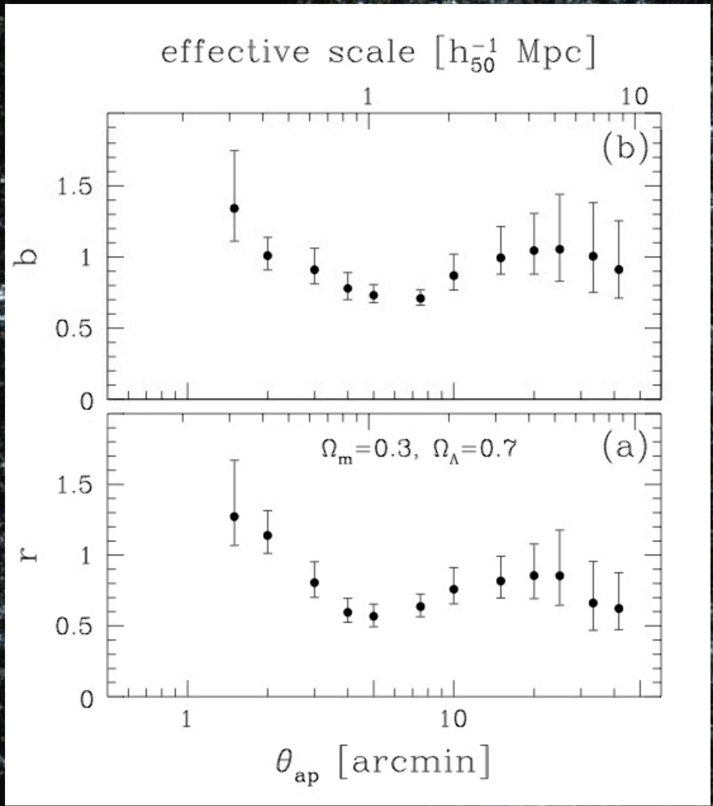
Kaiser Formula (Kaiser 1987) with r not necessarily 1

toy model for r(k):

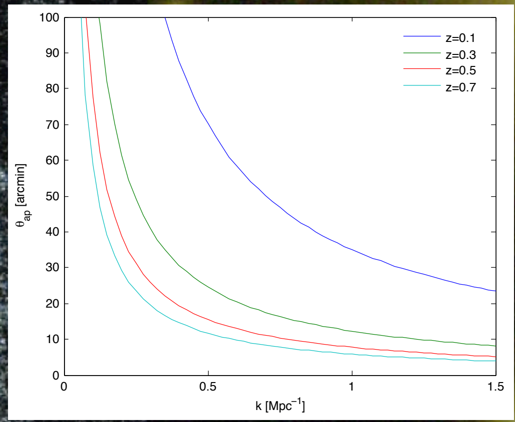




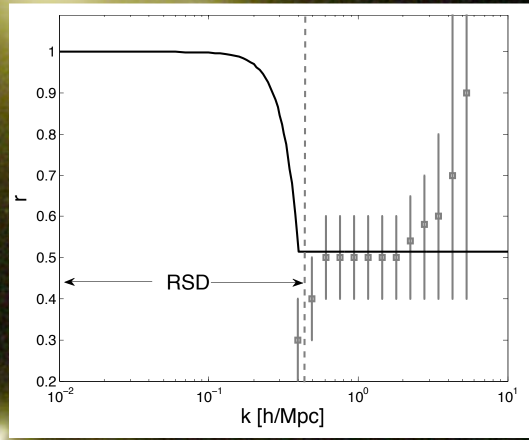
Summary



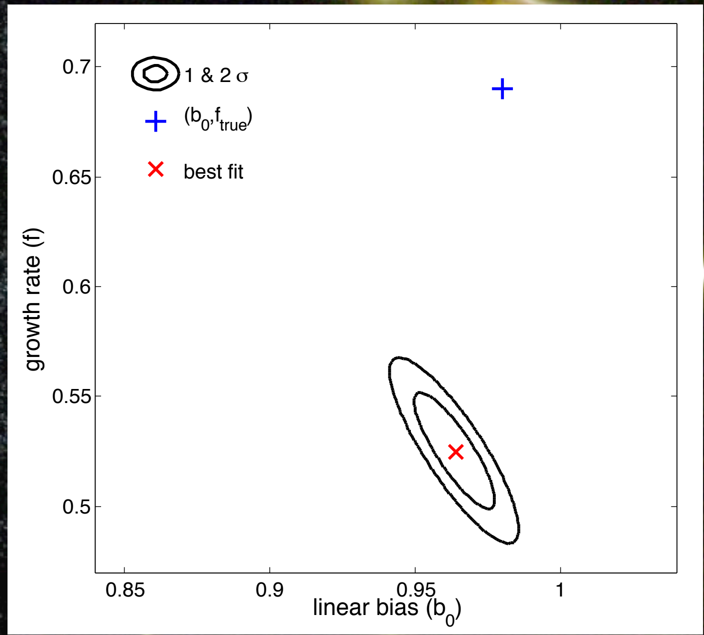
effective scale [h_{50}^{-1} Mpc]
(b)
b
(a)
Ω_m=0.3, Ω_Λ=0.7
r
θ_{ap} [arcmin]



z=0.1
z=0.3
z=0.5
z=0.7
θ_{ap} [arcmin]
k [Mpc^{-1}]



r
RSD
k [h/Mpc]



1 & 2 σ
(b_0,f_{true})
best fit
growth rate (f)
linear bias (b_0)

Extra slide 1

Some RSD equations:

Growth factor as a function of redshift: $$f \simeq \Omega_m(z)^\gamma$$

Relative difference:

$$\frac{\gamma_{\rm true}}{\gamma_{\rm obs}} - 1 = \frac{\log(f_{\rm true})}{\log(f_{\rm obs})} - 1$$

Kaiser with cross correlation coefficient r (see Pen 1998):

$$P^s_{gg}(k,\mu) = b^2 P^r_{\delta\delta}(k)\left(1+\beta\mu^2\right)^2 + b^2 P^r_{\delta\delta}(k) 2\beta\mu^2(r-1)$$

where beta is: $$\beta = f/b$$

Aperture Statistics (Kaiser et al 1994, Schneider et al 1998):

Extra slide 2

$$\mathrm{M}_{ap}(\theta) = \int_0^\theta \mathrm{d}^2\vartheta\, U(|\vartheta|)\kappa(\vartheta)$$

$$\langle M_{\mathrm{ap}}^2(\theta)\rangle = 2\pi \int_0^\infty \mathrm{d}\ell\ \ell\ P_\kappa(\ell)\,[I(\ell\theta)]^2$$

$$P_\kappa(\ell) = \int_0^{w_h} \mathrm{d}w\, \frac{[g(w)]^2}{[f_K(w)]^2} P_m\left(\frac{\ell}{f_K(w)}, w\right)$$

$$N(\theta) = \int_0^\theta \mathrm{d}^2\vartheta\, U(|\vartheta|)\delta_g(\vartheta)$$

$$\langle \mathcal{N}^2(\theta)\rangle = 2\pi \int_0^\infty \mathrm{d}\ell\ \ell\ P_n(\ell)\,[I(\ell\theta)]^2$$

$$P_n(\ell) = \int_0^{w_h} \mathrm{d}w\, \frac{[p_f(w)]^2}{[f_K(w)]^2} b^2 P_m\left(\frac{\ell}{f_K(w)}, w\right)$$

$$\langle \mathcal{N}(\theta) M_{\mathrm{ap}}(\theta)\rangle = 2\pi \int_0^\infty \mathrm{d}\ell\ \ell\ P_{n\kappa}(\ell)\,[I(\ell\theta)]^2$$

$$P_{\kappa n}(\ell) = \int_0^{w_h} \mathrm{d}w\, \frac{g(w) p_f(w)}{[f_K(w)]^2} br P_m\left(\frac{\ell}{f_K(w)}, w\right)$$

$$b(\theta) = f_1(\theta, \Omega_m, \Omega_\Lambda) \times \sqrt{\frac{\langle \mathcal{N}^2(\theta)\rangle}{\langle M_{\mathrm{ap}}^2(\theta)\rangle}} \qquad r(\theta) = f_2(\theta, \Omega_m, \Omega_\Lambda) \times \frac{\langle \mathcal{N}(\theta) M_{\mathrm{ap}}(\theta)\rangle}{\sqrt{\langle \mathcal{N}^2(\theta)\rangle \langle M_{\mathrm{ap}}^2(\theta)\rangle}}$$