

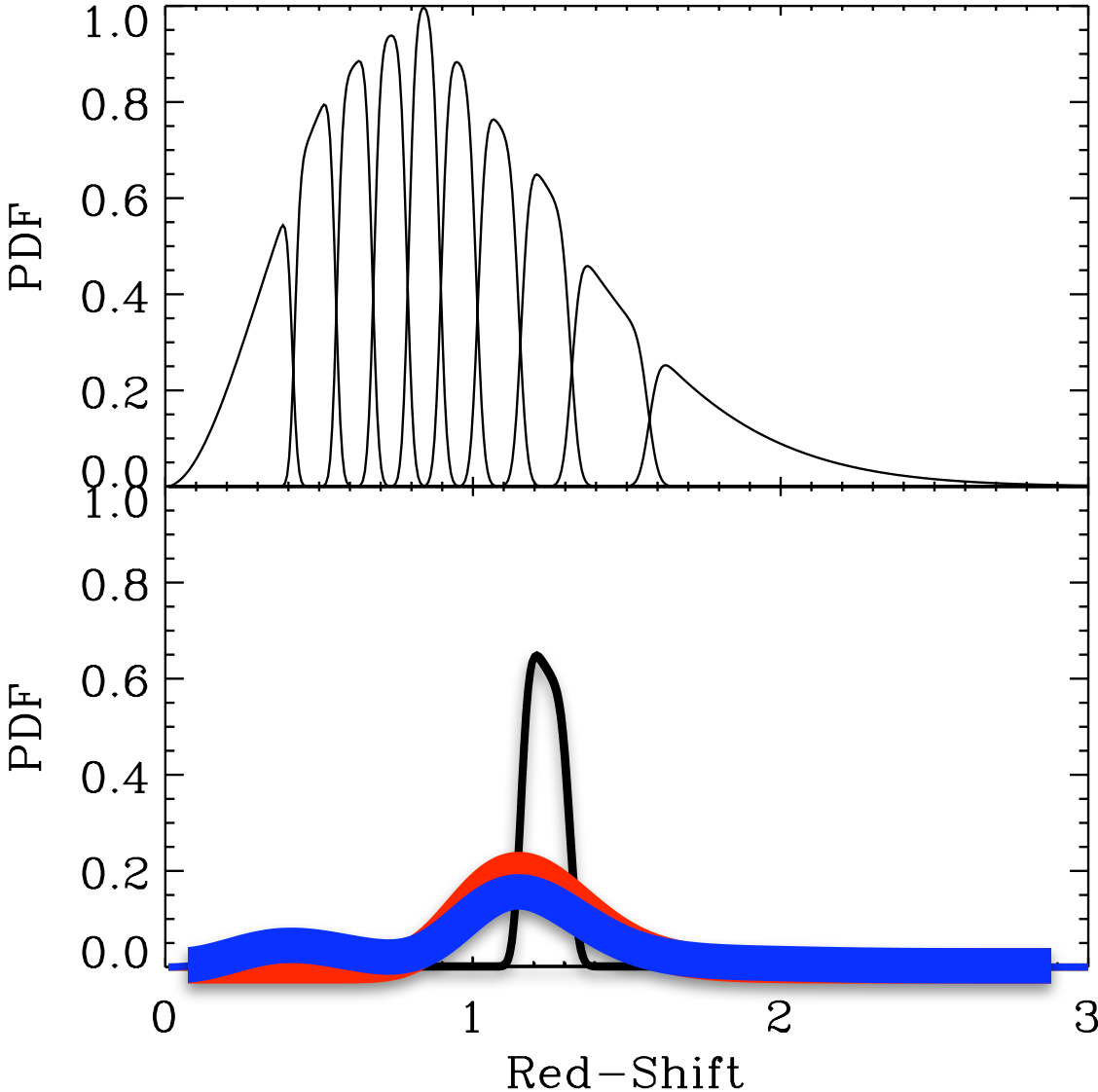
Requirements for Dark Energy Measurements

Adam Amara
(ETH, Zurich)

Types of Systematics

- Measurement: e.g. shapes and redshift
- Theory: e.g. non-linear correction
- Astrophysical: e.g. intrinsic alignment

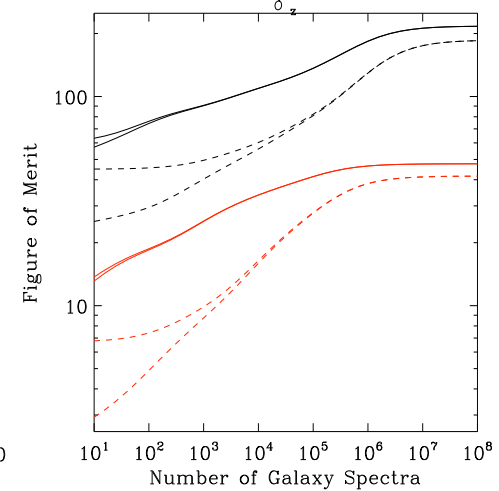
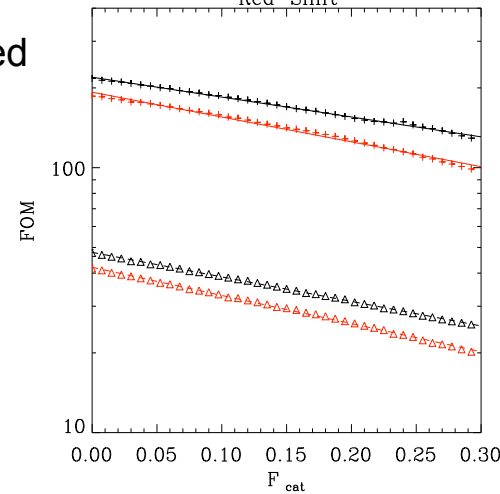
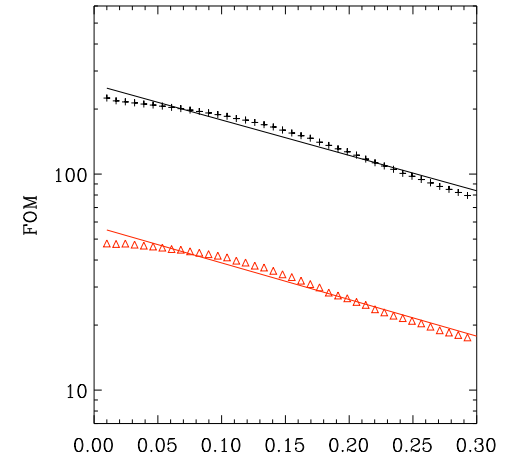
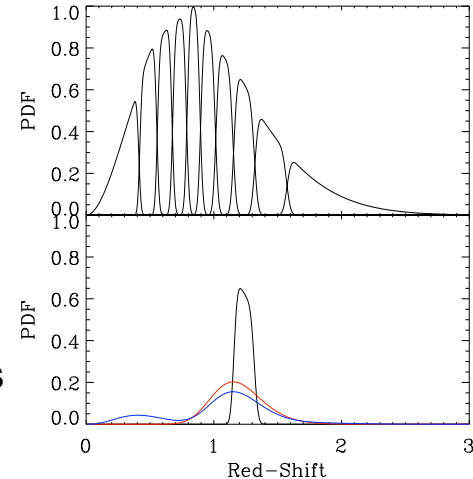
Photometric Red-Shifts



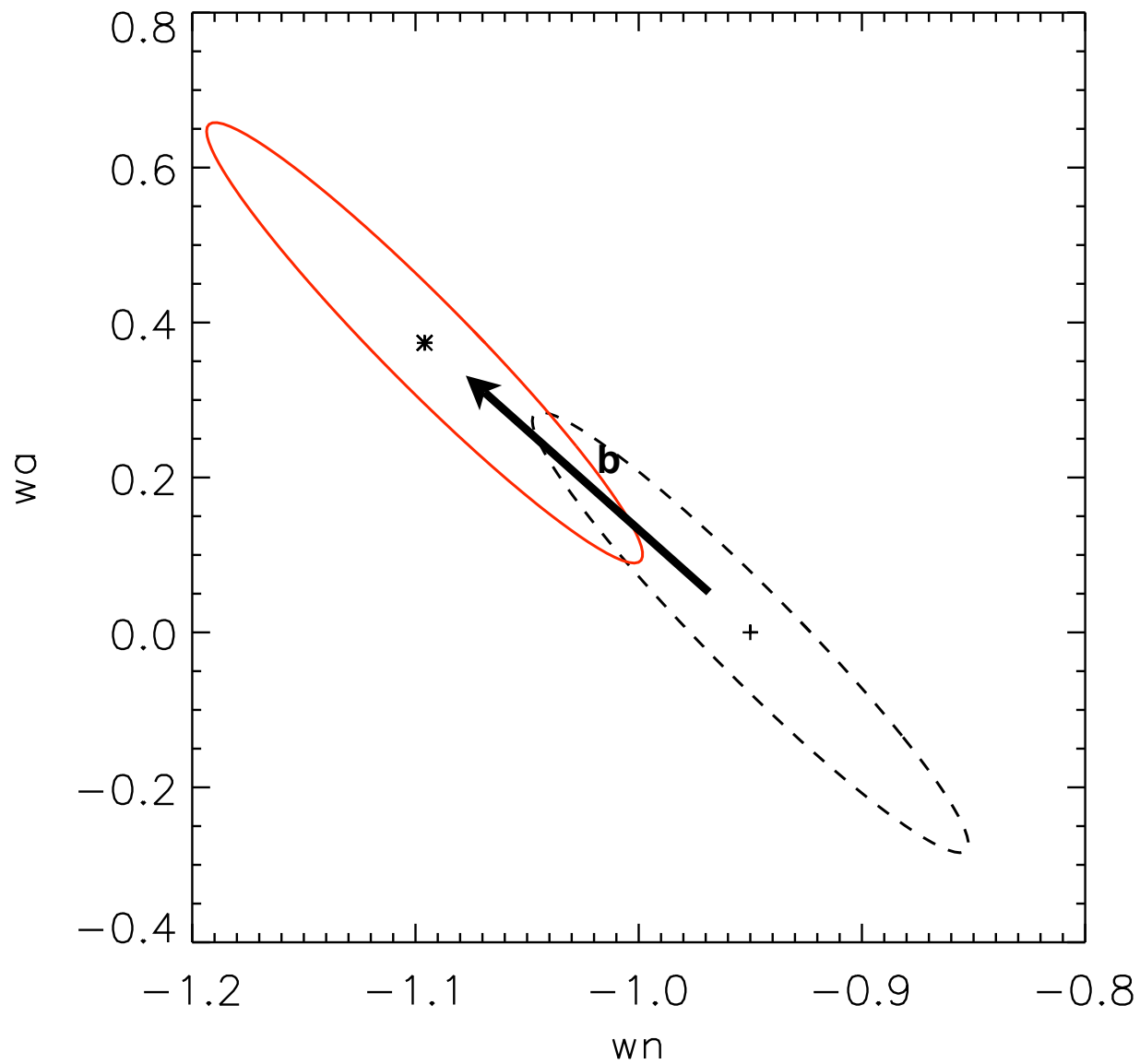
Redshift Information

- Important to have redshift information for the galaxies
- We create a simple model for the redshift errors:
 - ▶ spread (δ_z)
 - ▶ Catastrophic failures (F_{cat})
 - ▶ Spectral calibration (n_s)
- Provide a scaling relation which we have found to be in good agreement with results using PDF from a photo-z code
- Redshift errors are not dominant **BUT** intrinsic alignment has not been considered

Survey	Amara et al	Abdalla et al
DES	84	72
DES + NIR	124	120
Panstarrs	87	80
Panstarrs + NIR	131	132
LSST	112	116
LSST + NIR	148	156



Also, Ma et al (2006), Mandelbaum (2007) ...



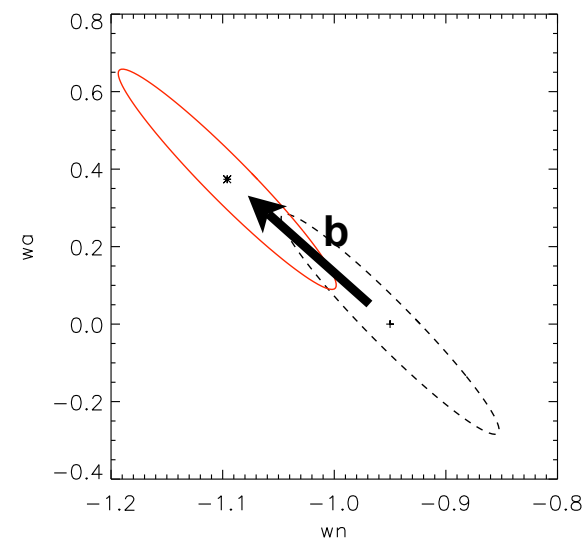
$$C_l^{\text{obs}} = C_l^{\text{lens}} + C_l^{\text{sys}} + C_l^{\text{noise}}$$

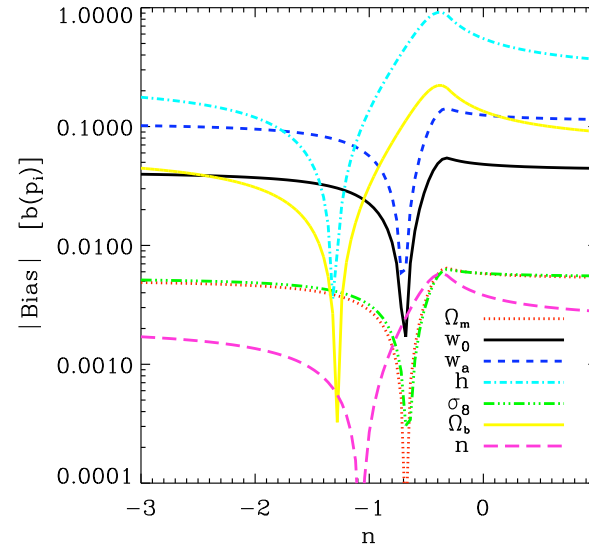
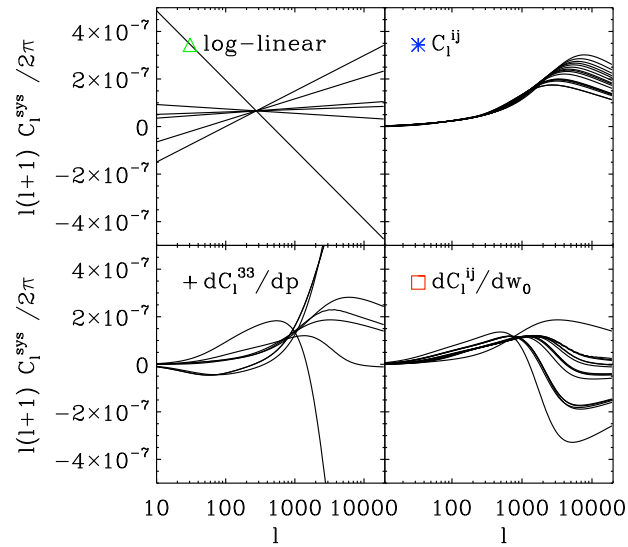
$$\chi^2(p) = \sum_l \Delta C_l^{-2} \left[[\widehat{C}_l^{\text{lens}} - C_l^{\text{lens}}(p)]^2 \right]$$

$$d\chi^2(\hat{p}_i)/dp_i = 0.$$

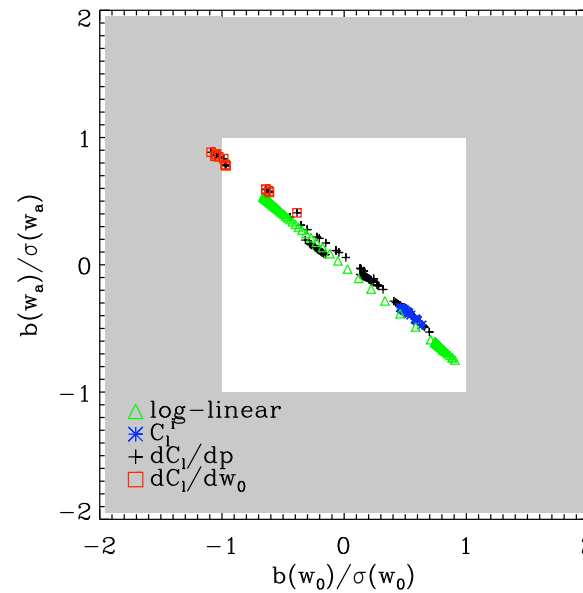
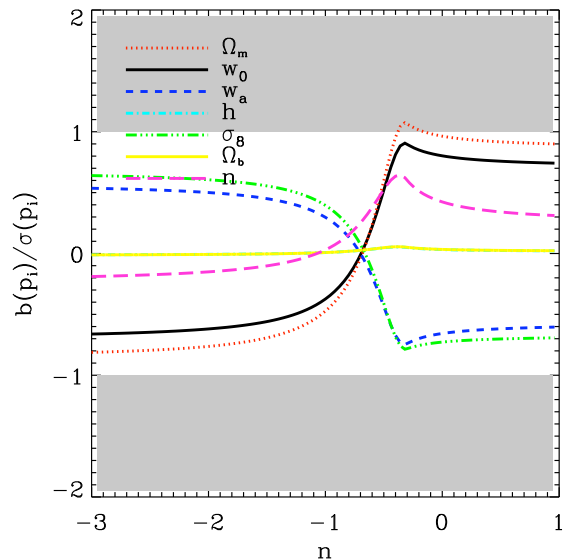
$$F_{ij} = \sum_l \Delta C_l^{-2} \frac{dC_l^{\text{lens}}}{dp_i} \frac{dC_l^{\text{lens}}}{dp_j}.$$

$$\sigma^2[\hat{p}_i] = (F^{-1})_{ii}.$$





$$C_\ell^{\text{obs}} = C_\ell^{\text{lens}} + C_\ell^{\text{sys}} + C_\ell^{\text{noise}}$$

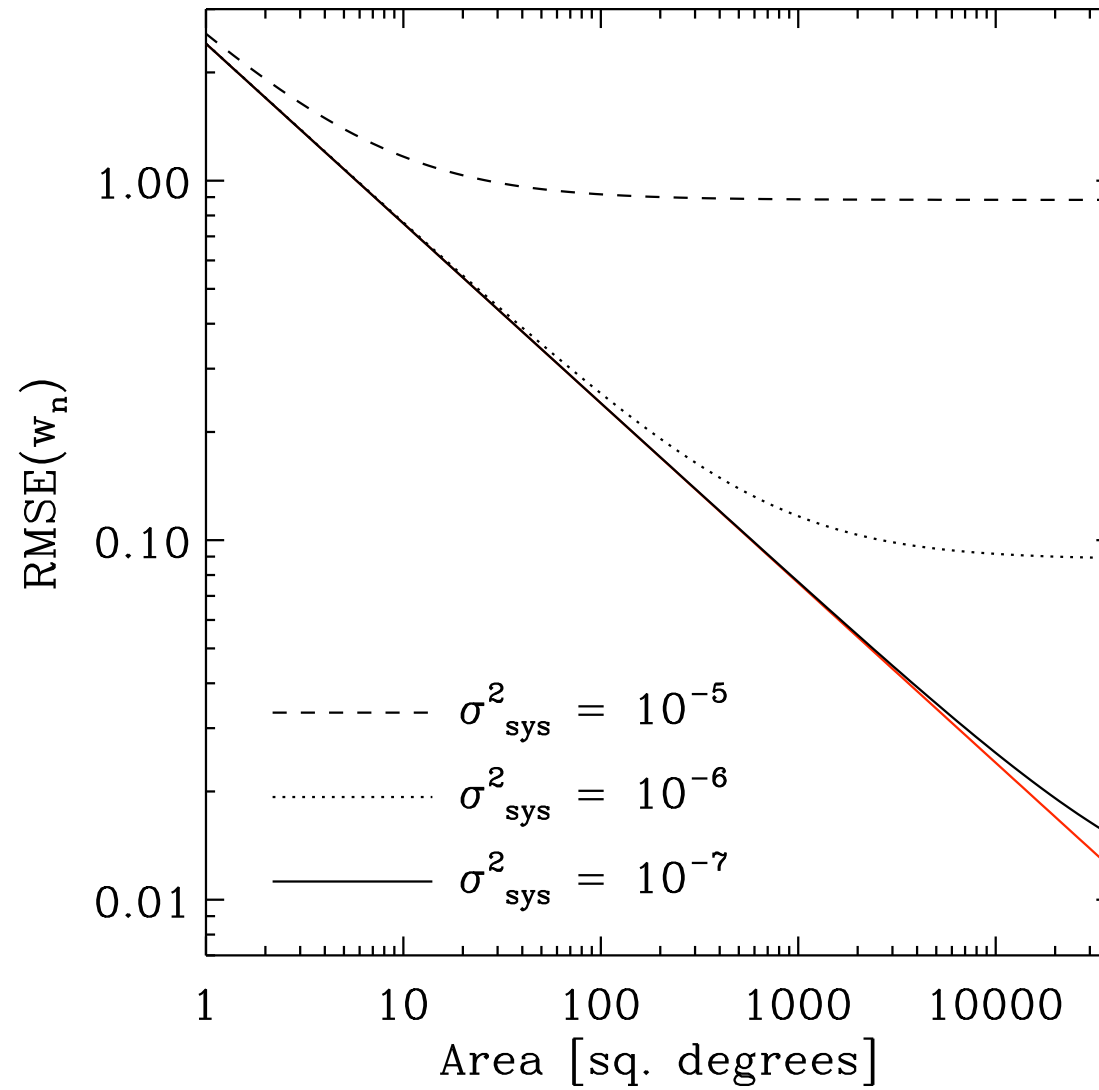


$$\sigma_{\text{sys}}^2 = 4 \times 10^{-7}$$

$$\sigma_{\text{sys}}^2 = \frac{1}{2\pi} \int |C_\ell^{\text{sys}}| \ell(\ell + 1) d \ln \ell,$$

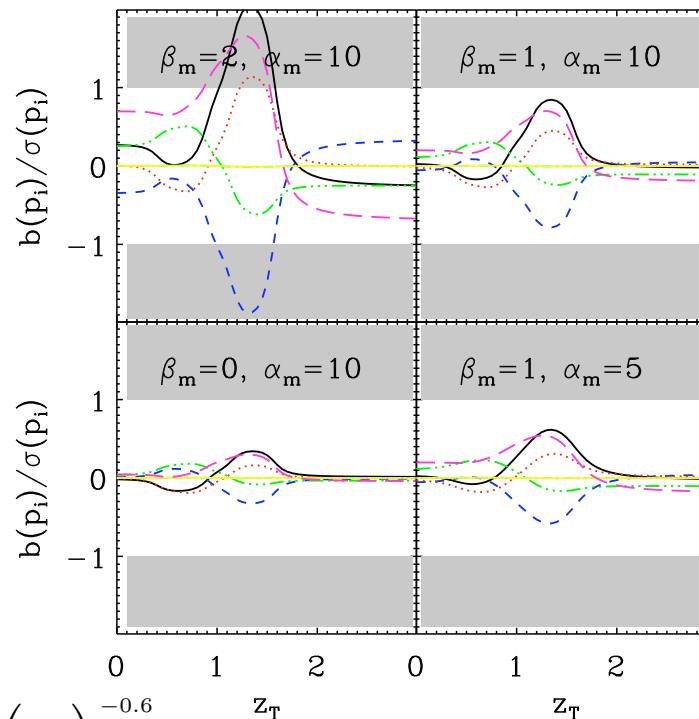
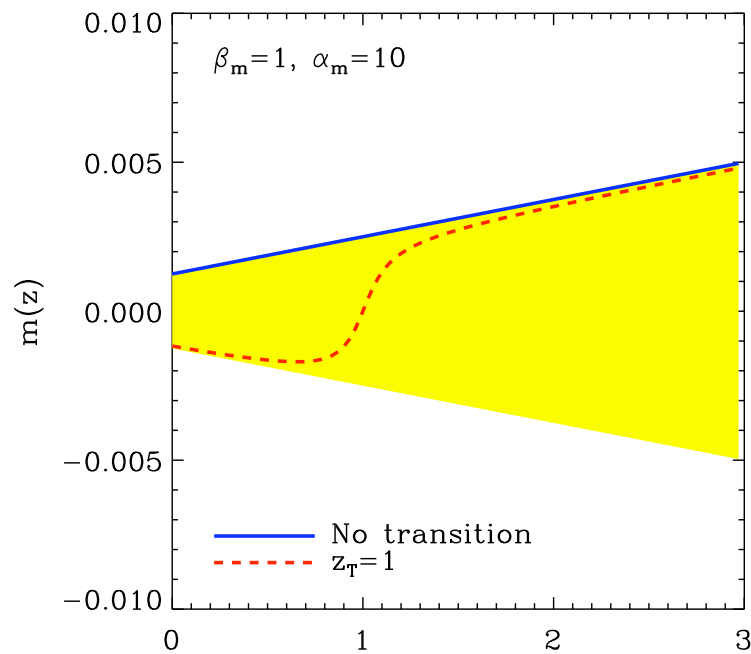
Amara and Refregier 2008

Setting Systematic Limits



$$m_{\text{sys}} = m_0(1+z)^\beta$$

$$\gamma^{\text{obs}} = \gamma^{\text{lens}} + m\gamma^{\text{lens}} + \gamma^{\text{add}}$$



$$\sigma_{\text{sys}}^2 < 10^{-7} \left(\frac{A_s}{2 \times 10^4 \text{ deg}^2} \right)^{-0.5} \left(\frac{n_g}{35 \text{ amin}^{-2}} \right)^{-0.5} \left(\frac{z_m}{0.9} \right)^{-0.6}$$

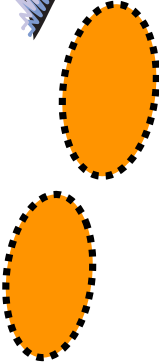
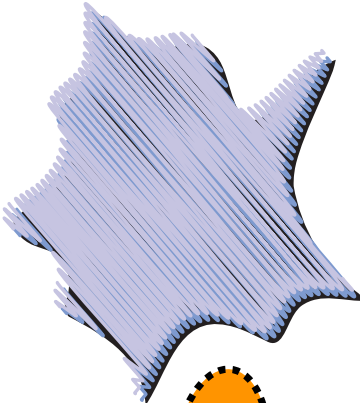
and the requirement on the multiplicative systematic is,

$$m_0 < 10^{-3} \left(\frac{A_s}{2 \times 10^4 \text{ deg}^2} \right)^{-0.5} \left(\frac{n_g}{35 \text{ amin}^{-2}} \right)^{-0.5} \left(\frac{z_m}{0.9} \right)^{-0.6}$$

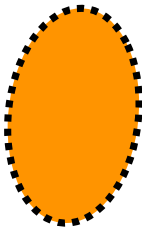
Intrinsic Alignment



Dark Matter

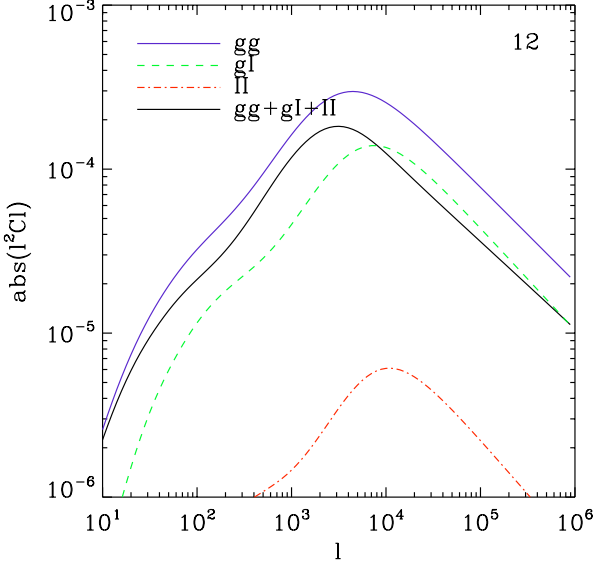
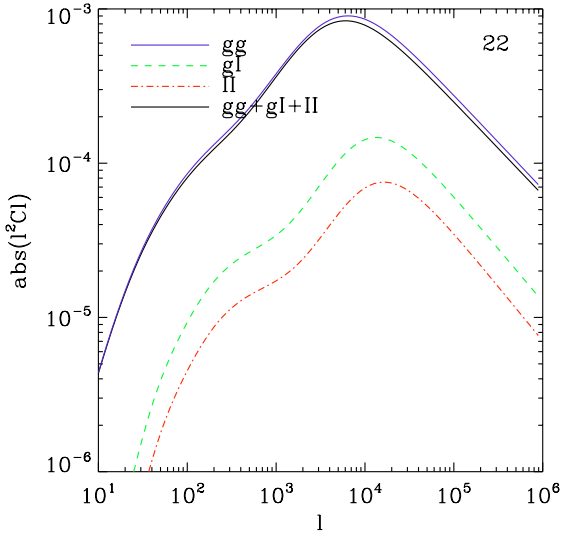
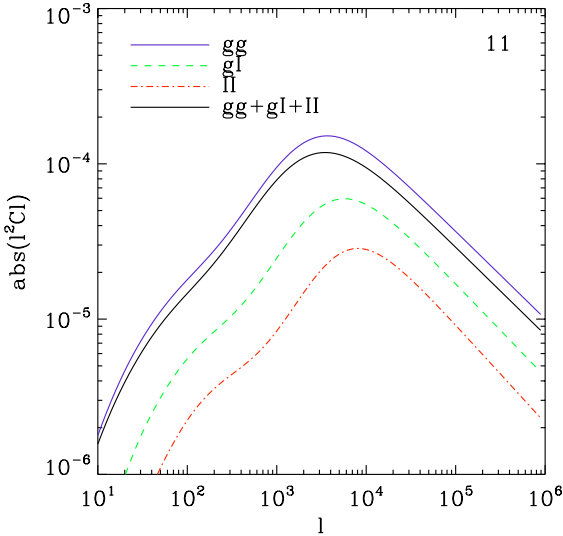


II



GI

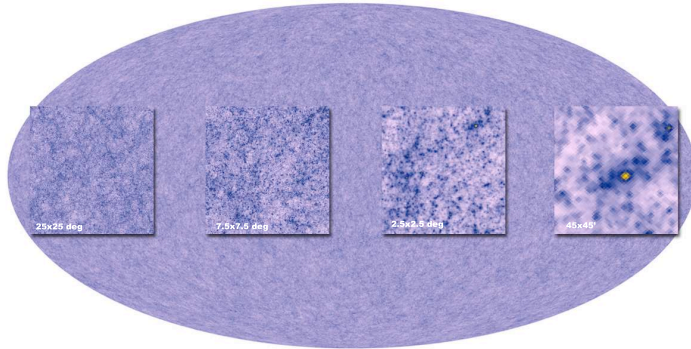
Correlation functions



See Zhang 2008

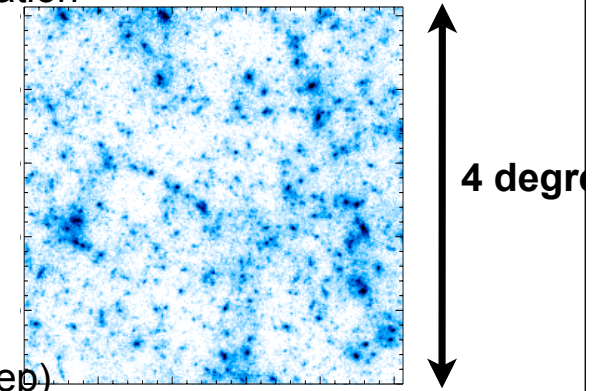
Numerical Simulations

- All Sky Kappa Map
- 1 Ultra-large simulation
- Born approximation



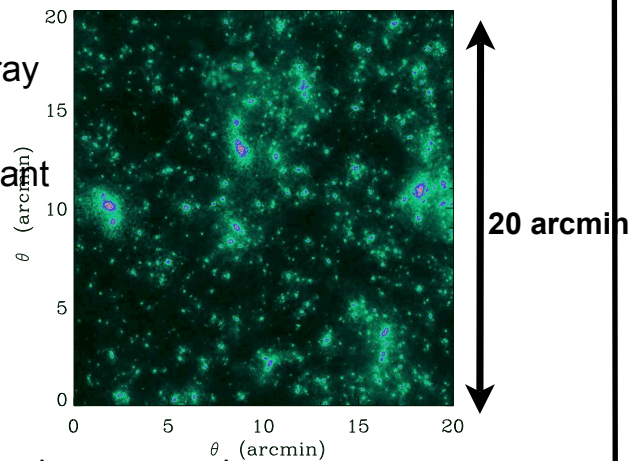
Teyssier et al (in prep)

- Intermediate scale
- Set of simulations (few hundred)
- Born approximation



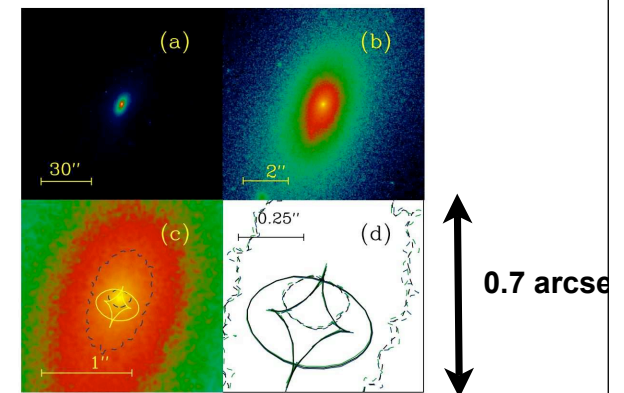
Pires et al (in prep)

- Small scale weak lensing
- Multiple sheet ray shooting
- Baryons important



Amara, Ostriker, Wambsganss and Bode (in prep)

- Very Small Scale - Strong lensing
- Ray shooting
- Image finding
- Baryons crucial



Amara, Metcalf, Cox and Ostriker (2006)

Conclusion

Measurement Systematics

▶ Shape measurement

- Very hard
- High quality (space quality) images needed
- Development of new analysis techniques (see GREAT08)

▶ Photo-z

- Can cause loss of statistical information & systematics bias
- For no IA: statistical loss not huge and systematics controlled with spectral sample
- For IA: photo-z can be improved by adding NIR

Theory

▶ Non-linear corrections

- Large N-body effort and analytic work underway to model this

▶ Baryons

- More work needed ...

Astronomy

▶ Intrinsic alignments

- IA can be limited with good photo-z (Bridle et al)
- Adding galaxy correlation information gets rid of problem (Zhang 2008)