

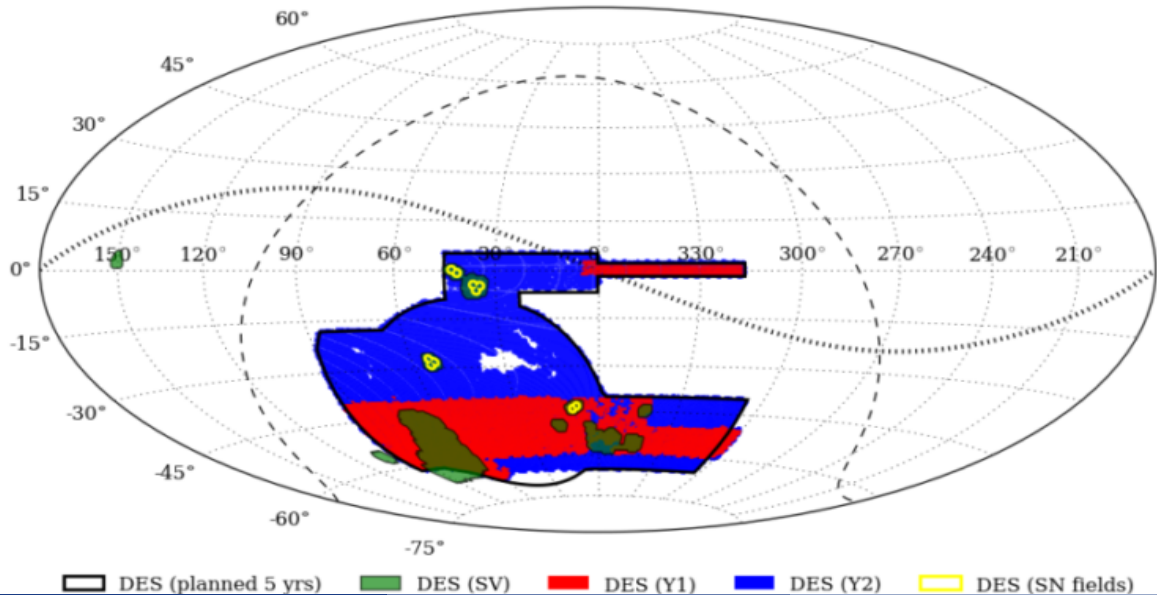
Cosmological constrain from cosmic shear with Dark Energy Survey (DES)

Wang Zheng-Yi¹
z1wang@mail.bnu.edu.cn

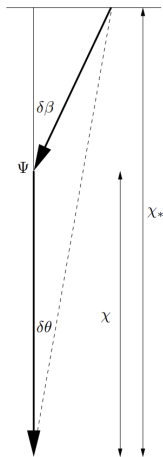
¹ Department of Astronomy, Beijing Normal University

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DES OBSERVING STRATEGY



Gravitational lens



Coforming Newtonian Gauge:

$$ds^2 = a^2(t)[(1 + 2\Psi_N)dt^2 - (1 + 2\Phi_N)d\vec{x}^2]$$

Deflection angle:

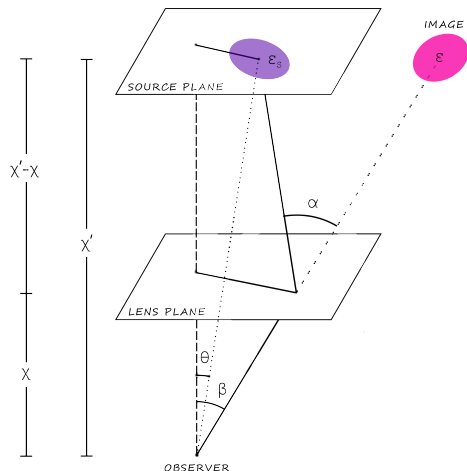
$$\alpha = -\frac{2}{c^2} \int_0^{z_*} \frac{cdz}{H(z)} \frac{\chi_* - \chi}{\chi_* \chi} \nabla_{\theta} \Psi(\theta, z)$$

Jacobian matrix:

$$A_{ij} = \frac{\partial \beta}{\partial \theta} = \delta_{ij} + \frac{\partial \alpha_j}{\partial \theta_i} = \begin{bmatrix} 1 - \kappa - \gamma_1 & -\gamma_2 \\ -\gamma_2 & 1 - \kappa + \gamma_1 \end{bmatrix}$$

convergence: κ ; shear: $\gamma = \gamma_1 + i\gamma_2$

Weak lensing effect on galaxies



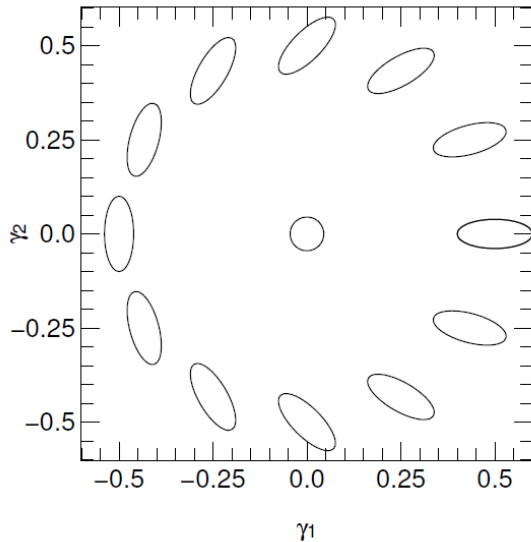
$$Q_{ij} = \frac{\int d^2\theta I(\boldsymbol{\theta})(\theta_i - \bar{\theta}_i)(\theta_j - \bar{\theta}_j)}{\int d^2\theta I(\boldsymbol{\theta})}$$

$$\tilde{Q}_{ij} = \frac{\int d^2\beta I_s(\boldsymbol{\beta})(\beta_i - \bar{\beta}_i)(\beta_j - \bar{\beta}_j)}{\int d^2\beta I_s(\boldsymbol{\beta})}$$

$$Q = A^{-1} \tilde{Q} A^{-1}$$

$$\Rightarrow \varepsilon = \varepsilon_s + \gamma + \mathcal{O} \left[\left(\frac{\gamma}{1 - \kappa} \right)^2 \right]$$

Weak lensing effect



Ellipticity noise ε_s

$$\varepsilon = \varepsilon_s + \gamma$$

Distribution of intrinsic ellipticity (Bartelmann & Narayan, 1995):

$$p(\varepsilon_s) = \frac{\exp(-|\varepsilon_s|^2/\sigma_\varepsilon^2)}{\pi\sigma_\varepsilon^2[1 - \exp(-1/\sigma_\varepsilon^2)]}$$

$\sigma_\varepsilon \approx 0.2$ (e.g. Miralda-Escudé 1991b; Tyson & Seitzer 1988)

$$\langle \varepsilon \rangle \approx \gamma, \quad \langle \varepsilon \varepsilon \rangle(\vartheta) = \langle \gamma \gamma \rangle(\vartheta), \quad \langle \varepsilon \varepsilon^* \rangle(\vartheta) = \langle \gamma \gamma^* \rangle(\vartheta)$$

In harmonic space:

$$\langle \gamma(\ell') \gamma^*(\ell) \rangle = (2\pi)^2 \delta_D(\ell' - \ell) (C_\ell^{\gamma\gamma} + N_\ell)$$

Where:

$$N_\ell = \frac{4\pi f_{\text{sky}}}{N_g} \sigma_\varepsilon^2$$

C_ℓ (Harmonic Space)

E/B mode of cosmic shear:

$$\gamma_E(\ell) = \kappa(\ell); \quad \gamma_B(\ell) = 0$$

C_ℓ 's:

$$C_\ell^{E_i, E_j} = \int_0^{z_*} \frac{cdz}{H(z)} \frac{q_i(z) q_j(z)}{\chi^2} P_\delta(k = \frac{\ell + 1/2}{\chi}, z)$$

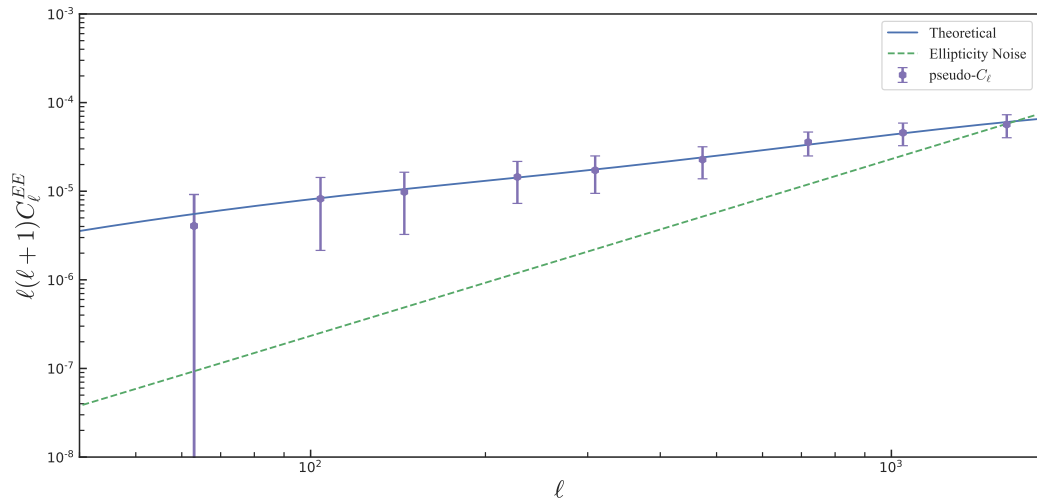
Lensing efficiency:

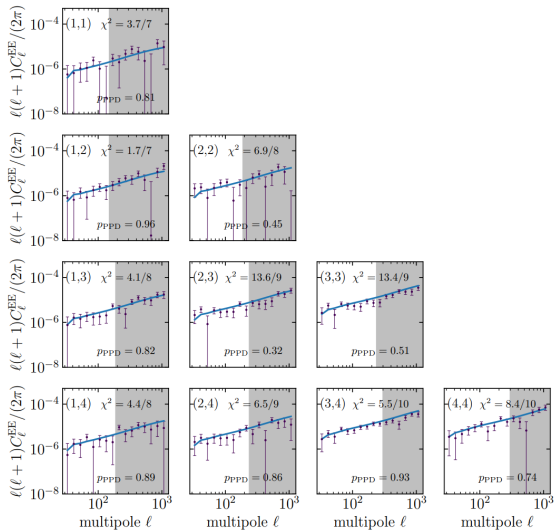
$$q_i(z) = \frac{3\Omega_{m0}}{2} \frac{H_0^2}{c^2} (1+z)\chi(z) \int_z^{z_*} n_i(z') \frac{\chi(z') - \chi(z)}{\chi(z')} dz'$$

Cosmic variance:

$$(\delta C_\ell^{E_i, E_j})^2 = \frac{2}{(2\ell + 1)f_{\text{sky}}} [(C_\ell^{E_i, E_j})^2 + (C_\ell^{E_i, E_i} + N_\ell^i)(C_\ell^{E_j, E_j} + N_\ell^j)]$$

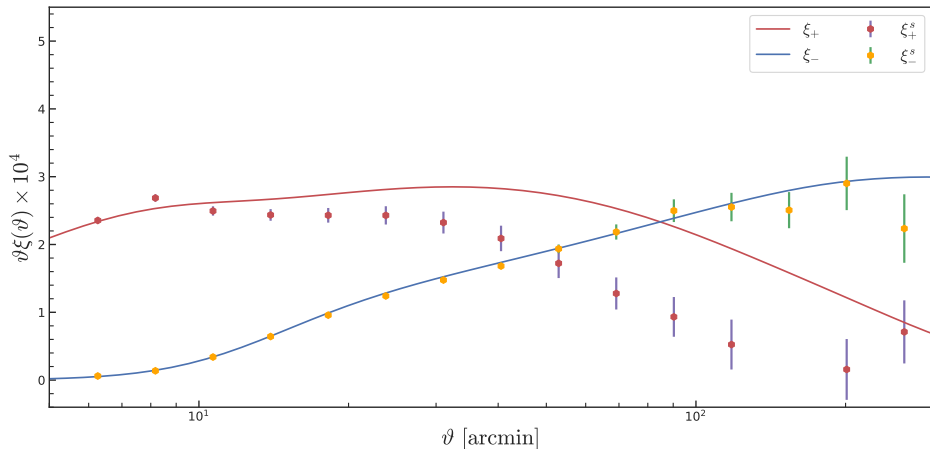
C_ℓ (Harmonic Space)



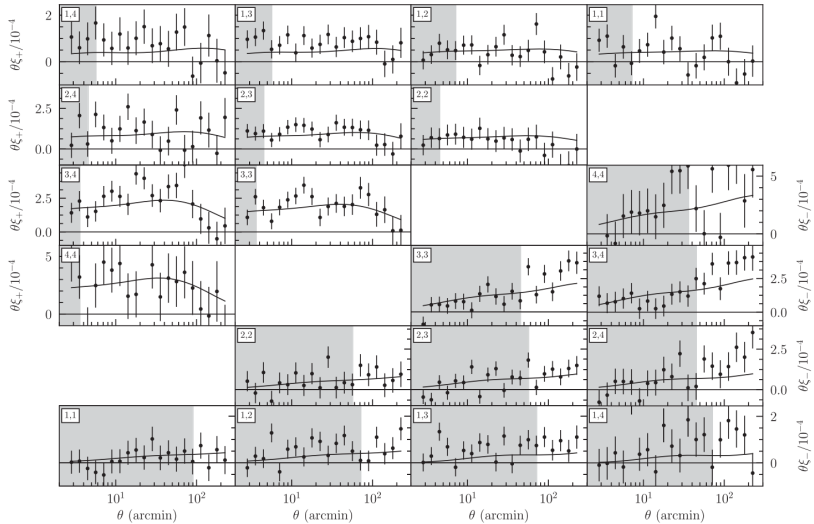


$\xi_{\pm}(\vartheta)$ (Configuration Space)

$$\xi_{\pm}^{ij}(\vartheta) = \int_0^{\infty} \frac{\ell d\ell}{2\pi} J_{0,4}(\ell\vartheta) C_{\ell}^{E_i, E_j}$$



$$\xi_{\pm}(\vartheta)$$



Systematic error

- 1 Galaxy-galaxy lensing effect:

$$q_{g,i}(z) = b_g(k, z)n_i(z)$$

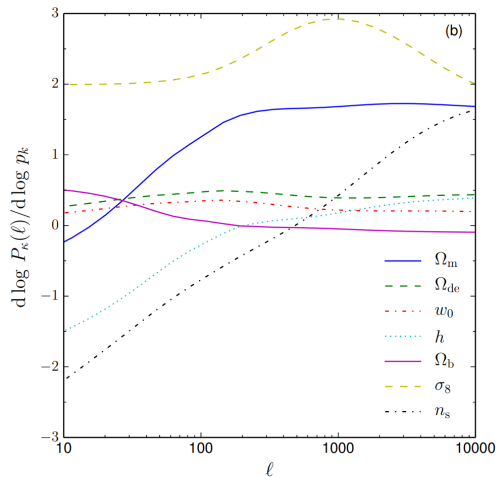
- 2 Intrinsic Alignment (e.g. Hand et al., 2013):

$$q_{IA,i}(z) = -A_0 \left(\frac{L}{L_0}\right)^\beta \left(\frac{1+z}{1+z_0}\right)^\eta \frac{C_1 \rho_{m,0}}{D(z)} n_i(z)$$

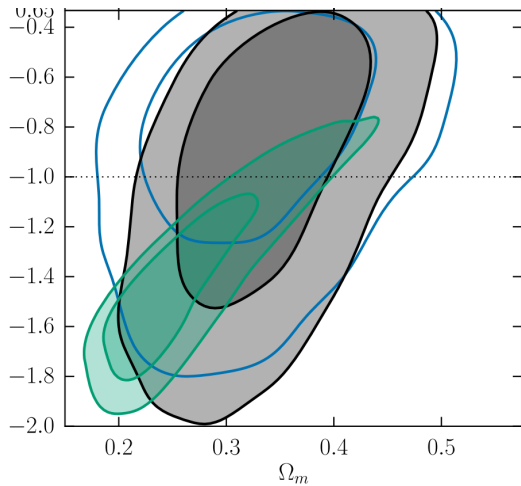
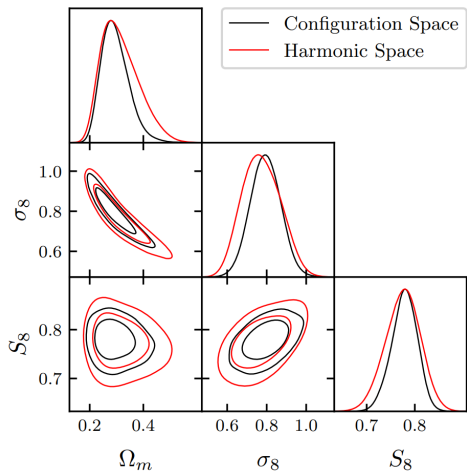
- 3 Photo-z error

$$p(z^P|z) = \frac{1}{\sqrt{2\pi}\sigma_z(1+z)} \exp\left[-\frac{(z - z^P - \Delta_z^i)^2}{2(\sigma_z(1+z))^2}\right]$$

Dark Energy?



Cosmological constrain



Appreciate your Criticism