$N_{\mathbf{eff}}$ priors

(Dated: June 20, 2015)

Abstract

Try to understand the effect of priors on different parameters on the $N_{\rm eff}$ errors with a Fisher matrix approach. Where should you invest time and money if you really care about the value of $N_{\rm eff}$?

- We are now using a simplistic lensing noise but I have lensing noise with the usual Hu Okamoto formula. Iterative Seljack not there yet.
- We are varying $\tau,\ n_s,\ A_s,\ N_{\rm eff},\ H_0, w,\ \Omega_\nu h^2,\ \Omega_c h^2,\ \Omega_b h^2$. The neutrino sector consists of one massive neutrino of $m_\nu = 0.083$ eV, $\Omega_\nu h^2 = 0.0009$
- Next TODO: Check for bugs and errors code in its early stages. PCA? what prior is more important? Full MCMC should not be extremely hard with cosmosis.

INTRODUCTION

THEORY

Fisher Matrix formalism

Copied from paper change it for pubblication:

To avoid any possible numerical instability in the marginalising procedure, we calculate the the Fisher matrix marginalised over the standard LCDM parameters following (Albrecht et al. 2009)

$$G = F^{\phi\phi} - F^{\phi\psi} U \Lambda^{-1} U^T F^{\phi\psi}, \tag{1}$$

where we define $\phi = \{N_{eff}, ...\}$ and $\psi = \{\Omega_m ... marginal\}$; therefore, $F^{\phi\phi}$ is the block of the total Fisher matrix containing the parameters we want to constrain, whilst $F^{\psi\psi}$ is the nuisance-parameter Fisher sub-matrix. Here, Λ is the diagonal matrix whose elements are the eigenvalues of $F^{\psi\psi}$, whilst U is the orthogonal matrix diagonalising $F^{\psi\psi}$. By using Eq., our marginalising procedure is more stable, since degeneracies in $F^{\phi\phi}$ are properly propagated to G with no instabilities, and we do not even worry about a possibly ill-conditioned $F^{\phi\phi}$ sub-matrix, since we check its stability on the fly by the diagonalisation.

$$s\ [\ \mu\mathrm{K.arcmin}\ ] \equiv \frac{\mathrm{NET}\ [\ \mu\mathrm{K.}\sqrt{s}\ ] \times \sqrt{f_{sky}\ [\ \mathrm{arcmin}^2\ ]}}{\sqrt{N_{\mathrm{det}} \times Y \times \Delta T\ [\ \mathrm{s}\ ]}}. \tag{2}$$

$$F_{ij} \equiv -\left\langle \left. \frac{\partial^2 \log \mathcal{L}}{\partial\theta_i \partial\theta_j} \right|_{\boldsymbol{\theta}=\boldsymbol{\theta_0}} \right\rangle \tag{3}$$

$$\mathbf{C}_\ell \equiv \begin{pmatrix} C_\ell^{TT} + N_\ell^{TT} & C_\ell^{TE} & C_\ell^{Td} \\ C_\ell^{TE} & C_\ell^{EE} + N_\ell^{EE} & 0 \\ C_\ell^{Td} & 0 & C_\ell^{dd} + N_\ell^{dd} \end{pmatrix}. \tag{4}$$

$$\sigma_i \equiv \sigma(\theta_i) = \sqrt{(\mathbf{F^{-1}})_{ii}} \tag{5}$$

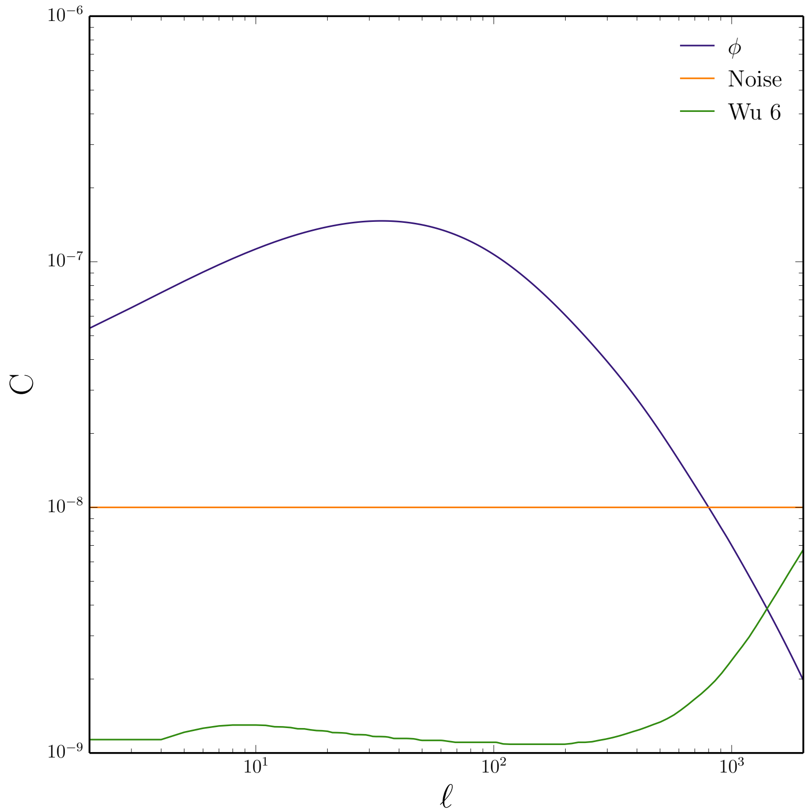


FIG. 1. Lensing potential power spectrum for our fiducial cosmology together with the lensing reconstruction noise N^{ϕ} used in this work.

$$F_{H_0H_0} \rightarrow F_{H_0H_0} + \frac{1}{(1\% \times H_{0,fid})^2}, \tag{6}$$

$$T_{\nu} = \left(\frac{4}{11}\right)^{1/3} T_{\gamma} \tag{7}$$

DATA

RESULTS

CONCLUSIONS

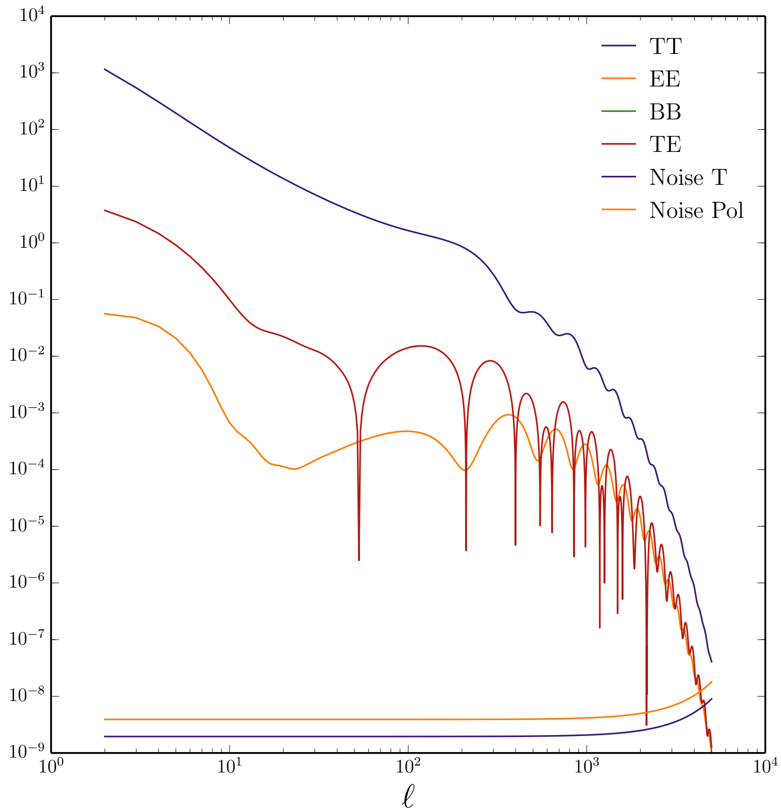


FIG. 2. CMB power spectrum for our fiducial cosmology together with the instrumental noise used in this work. They are basically equivalent to a cosmic variance limited experiment with $l_{max} \sim 3000$

TABLE I. Fiducial values used.

H_0	
τ	
A_s	
n_s	
N_{eff}	

TABLE II. How well we do constrain separate parameters with this data without any external prior?

H_0	0.32%
τ	2.26 %
A_s	0.37 %
n_s	0.25 %
N_{eff}	0.9 %

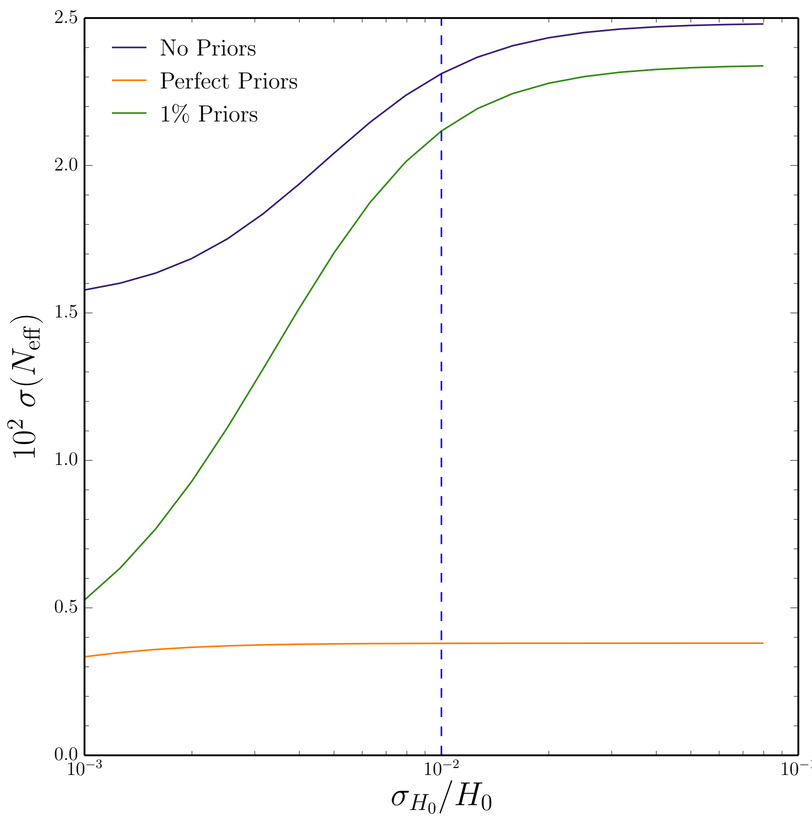
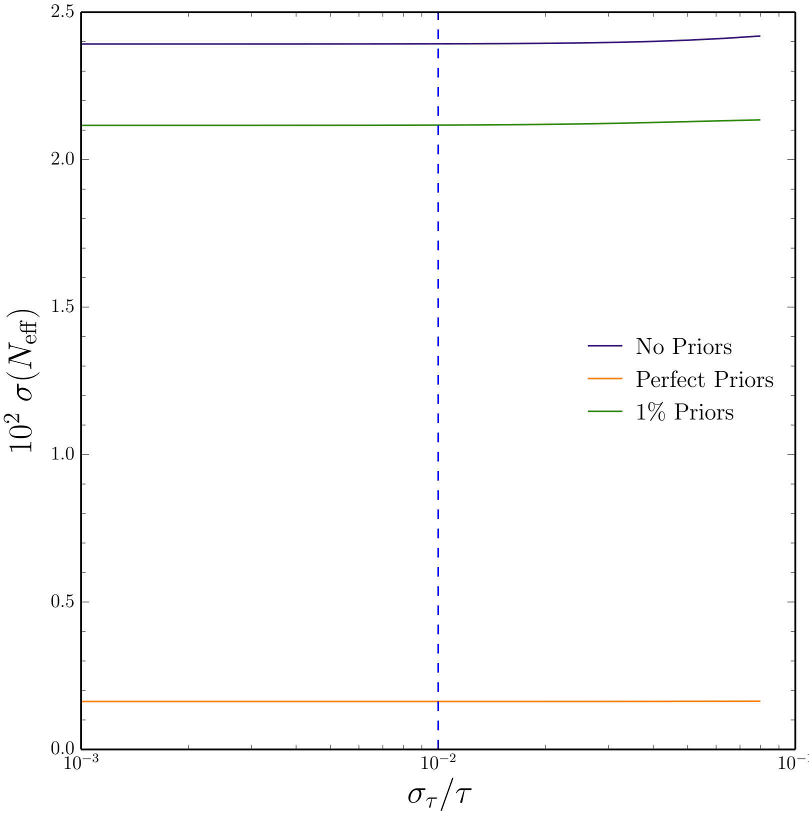


FIG. 3.



2.5
2.0
1.5
1.0
0.5
0.0
10^{-3}
10^{-2}
10^{-1}
$10^2\ \sigma(N_{\rm eff})$
σ_τ/τ
No Priors
Perfect Priors
1% Priors

FIG. 4.