Draft version April 17, 2017
Preprint typeset using LaTeX style emulateapj v. 01/23/15

ISOCURVATURE FORECASTS FOR CMB S4, PIXIE, AND MAYBE CONSTRAINTS FOR ACTPOL

Zack Li and Jo Dunkley
(Dated: April 17, 2017)
Draft version April 17, 2017

ABSTRACT

We provide forecasts of cold dark matter isocurvature (CDI) constraints for combinations of Planck, CMB S4, and PIXIE. Using MCMC methods on fiducial power spectra, we find substantial improvements in the measurement of the large scale isocurvature power.

1. INTRODUCTION

- Planck 2015
- WMAP

2. METHODS

2.1. *Perturbations and Power Spectra*

For a set of the standard cosmological parameters with the additional isocurvature parameters, we compute a theoretical power spectrum with CLASS, a fast Boltzmann code written in C (citation). The adiabatic and isocurvature are contained in three functions, $\mathcal{P}_{\mathcal{RR}}(k)$, $\mathcal{P}_{\mathcal{II}}(k)$, and $\mathcal{P}_{\mathcal{RI}}(k)$, the curvature, isocurvature, and cross-correlation power spectra, respectively (cite Planck 2015 XX). Like Planck, we specify these power spectra through two scales, $k_1 = 0.002$ Mpc^{-1} and $k_2 = 0.100$ Mpc^{-1}. We use the same uniform priors as Planck,

$$\mathcal{P}^{(1)}_{\mathcal{RR}}, \mathcal{P}^{(2)}_{\mathcal{RR}} \in (10^{-9}, 10^{-8}), \tag{1}$$

$$\mathcal{P}^{(1)}_{\mathcal{II}}, \mathcal{P}^{(2)}_{\mathcal{II}} \in (0, 10^{-8}), \tag{2}$$

$$\mathcal{P}^{(1)}_{\mathcal{RI}} \in (-10^{-8}, 10^{-8}). \tag{3}$$

We follow Planck 2015 XX's convention of fixing $\mathcal{P}^{(2)}_{\mathcal{RI}}$ from these parameters. Then we sample over the ΛCDM scenario, but replace A_s and n_s with $\mathcal{P}^{(1)}_{\mathcal{RR}}$, $\mathcal{P}^{(2)}_{\mathcal{RR}}$ and add the three isocurvature parameters $\mathcal{P}^{(1)}_{\mathcal{II}}$, $\mathcal{P}^{(2)}_{\mathcal{II}}$, $\mathcal{P}^{(1)}_{\mathcal{RI}}$.

$$\begin{aligned} \{\Omega_b h^2, \Omega_c h^2, \theta_A, &\tau_{reio}, \mathcal{P}^{(1)}_{\mathcal{RR}}, \mathcal{P}^{(2)}_{\mathcal{RR}} && (4)\\ &\mathcal{P}^{(1)}_{\mathcal{II}}, \mathcal{P}^{(2)}_{\mathcal{II}}, \mathcal{P}^{(1)}_{\mathcal{RI}}\} && (5)\end{aligned}$$

Should I describe the perturbation stuff of how the CLASS isocurvature code works?

2.2. *Forecasting*

2.3. *ACTPol Likelihood*

We use the same methods as in Louis et al. 2016 for the ACT likelihood, marginalizing the ACTPol spectrum from $350 < l < 4000$ to construct a Gaussian likelihood function with an overall calibration parameter. We produce our parameter constraints by summing this with the Planck 2015 log-likelihood. We use the public CMB-marginalized 'plik-lite' Planck 2015 likelihood which uses TT for $30 \leq l \leq 2508$, a likelihood generated from CMB lensing, and a joint TT, EE, BB, and TE likelihood for the range $2 \leq l < 30$.

$$\begin{aligned} -2\ln L = &-2\ln L(\text{ACTPol}) && (6)\\ &-2\ln L(\text{Planck TT}_{30<l<2508}) && (7)\\ &-2\ln L(\text{Planck TEB}_{2\leq l<30}) && (8)\\ &-2\ln L(\text{Planck Lensing}) && (9)\end{aligned}$$

In addition to the ΛCDM and isocurvature parameters, we need two nuisance parameters coming from the normalizations of the two instruments we use data from (Planck and ACT),

$$\{A_{planck}, Y_p\}. \tag{10}$$

3. RESULTS

TABLE 1
Forecasting Parameters

Experiment	l_{min} - l_{max}	f_{sky}	θ FWHM	σ_T (μK arcmin)	σ_P (μK arcmin)
CMB S4	30-3000	0.40	3.0	1.0	1.4
PIXIE	2 - 150	0.8	120	2.9	4.0
Planck 2017 high_l	30 - 2500	0.65	10,7.1,5.0	65.0, 43.0, 66.0	103.0, 81.0, 134.0

Note. — These forecasts are based on blahblahblah.