Constraints on generic non-adiabatic modes

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In this paper we attempt to find the information stored in each mode of the power spectrum using a Fisher information kernel as is described in [1].

I. INTRODUCTION AND SUMMARY

We observe a nearly scale invariant spectrum of fluctuations in the temperature across the sky. Inflation is regarded as the best theory that explains how primordial fluctuations were produced and then set as the initial conditions during the radiation dominated era. The initial conditions set up by most simple inflation models are *adiabatic* which means that the ratio of different particle species abundances would be constant across space. This assumption is usually very good if we take different parts of the universe as having the same history. In general, however, there is no reason to believe that the abundance ratios are the same everywhere. The perturbations caused by varying abundances of species are termed *isocurvature*.

There are two different regimes when it comes to the evolution of the density perturbations:

- When the wavelength of the perturbation mode λ is smaller than the cosmological horizon H^{-1} and were causal physics can effect the mode.
- When $\lambda > H^{-1}$ and the mode is out of the horizon so no causal physics can effect it.

Perturbation modes are inside the horizon at times much later than the matter-radiation equality. These modes correspond to density perturbations that evolve according to Newtonian gravity. The interesting regime is at very early times when the modes have not entered the cosmological horizon. It is in this regime that there are the two orthogonal perturbations; adiabatic and isocurvature.

II. FISHER FORECASTING

The likelihood we are interested in is

$$-\ln L = \frac{f_{sky}}{2} \sum_{l=2}^{l_{max}} (2l+1) \left(tr \left(\frac{\vec{C}_l^{(obs)}}{\vec{C}_l^{(th)} + \vec{N}_l} \right) - \ln\det \left(\frac{\vec{C}_l^{(obs)}}{\vec{C}_l^{(th)} + \vec{N}_l} \right) - 3 \right) \tag{1}$$

where

$$\vec{C}_l = \begin{pmatrix} C_l^{TT} & C_l^{TE} \\ C_l^{ET} & C_l^{EE} \end{pmatrix} \tag{2}$$

and the noise matrix is

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$$\vec{N}_l = \begin{pmatrix} N_l^{TT} & 0 \\ 0 & N_l^{PP} \end{pmatrix} \tag{3}$$

where

$$N_l^{TT/PP} = [(\omega_{T/P} B_l^2)_{100} + (\omega_{T/P} B_l)_{113}^2 + (\omega_{T/P} B_l^2)_{217} + (\omega_{T/P} B_l^2)_{353}]^{-1} \tag{4}$$

where

$$B_l^2 = exp[-l(l+1)\theta_{beam}^2 / 8\ln 2] \tag{5}$$

$$w = (\theta_{beam}\sigma)^{-2} \tag{6}$$

III. DISCUSSION

[1] C. Gauthier and M. Bucher, Journal of Cosmology and Astroparticle Physics **2012**, 050 (2012).