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Reheating With an Evolving Equation of State

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Introduction

Reheating is an epoch for the particle production after the inflation, during which the inflaton oscillates around its vacuum. Hence the equation of state (EoS) during reheating may evolve with time rather than be a constant.

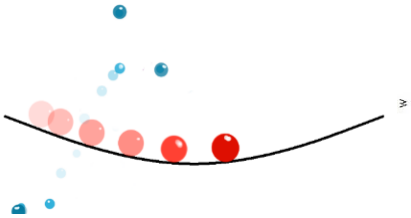

Fig1. Oscillation of the inflaton & the particle production.

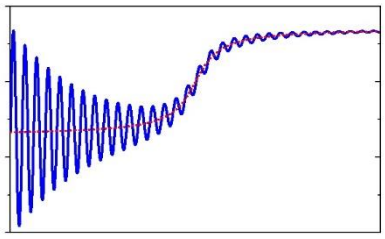

Fig2. Illustration of the EoS in general models.

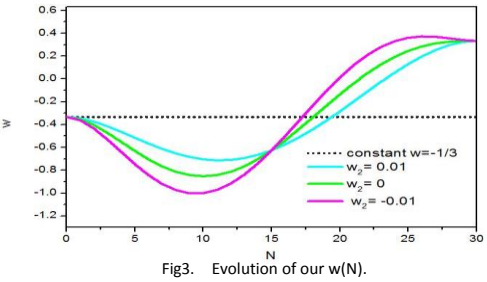

Fig3. Evolution of our w(N).

Cosmography

We use the cosmographic method [1] to give a model independent description of the EoS during reheating with respect to the e-folding number N (w_2 is a parameter here).

$$w(N) = \frac{1}{3} + \sum_{n=1}^{\infty} w_n (N - N_r)^n$$

Transfer Functions

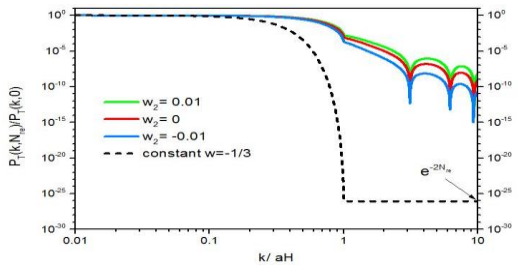

Fig4. Transfer functions of tensor perturbations with various w(N).

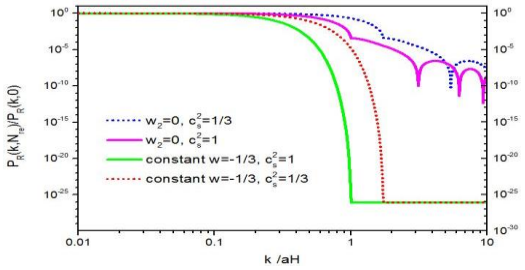

Fig5. Transfer functions of curvature perturbations with various w(N) and various sound speed c_s.

Entropy Perturbations In Reheating

Entropy perturbation provides a larger index n_s and a lower tensor-to-scalar ratio r, hence somehow saves the φ^4 model from the CMB constrains.[2][3]

In the Future

With a joint measurement of both the tensor and scalar perturbation on small scales, we can constrain the evolutions of the sound speed (Gauss beam, PBH).

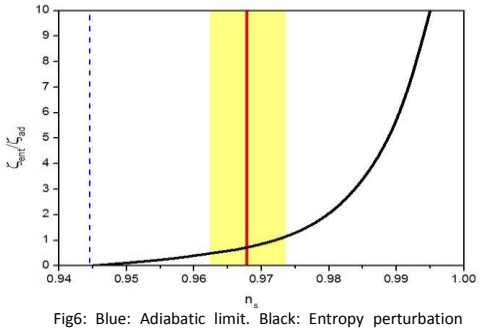

Fig6: Blue: Adiabatic limit. Black: Entropy perturbation involved. Red: $n_s = 0.968$. The entropy perturbation contributions to the curvature perturbations with $w = 1/3$.

[1] Moncy V. John, Astrophys. J. 614 (2004) 1
[2] H. B. Moghaddam, et al Int. J. Mod. Phys. D24 (2015) no.11, 1550082
[3] L. Dai, et al Phys. Rev. Lett. **113**, 041302 (2014).