Punctuated Inflation

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Based on:

R.K. Jain, **P.C**, J.O. Gong, L. Sriramkumar and T. Souradeep, *Punctuated inflation and the low CMB multipoles*, JCAP (2009).

R.K. Jain, **P.C**, and L. Sriramkumar, *Tensor-to-Scalar ratio in punctuated inflation models*, in preparation.

Introduction

$$\text{Inflation: } \ddot{a}(t) > 0.$$

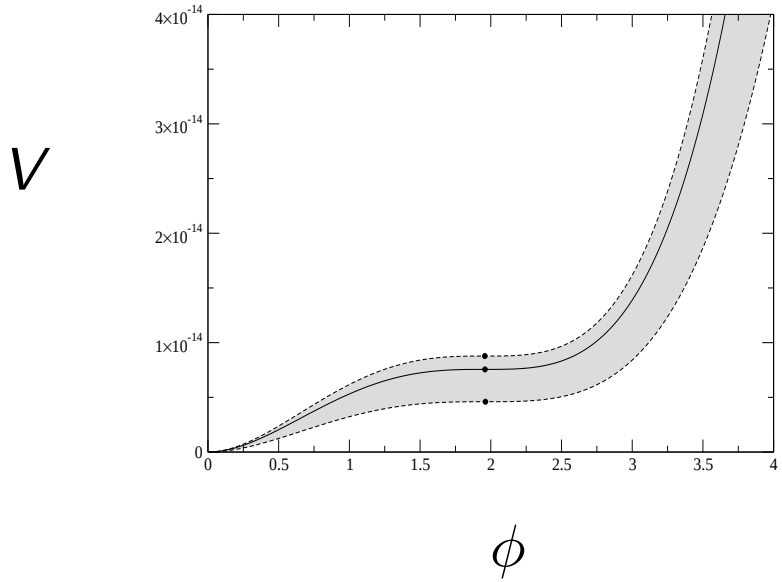
What does inflation have to do with SDSS ?

- In a nutshell: inflation is a very convincing mechanism which provides the initial/primordial tiny fluctuations of matter distribution from which structure grew.

They complement each other in our quest for understanding the origin of the universe.

Punctuated inflation

$$V(\phi) = \frac{m^2}{2}\,\phi^2 - \frac{2}{3}\,m^2\,\frac{\phi^3}{\phi_0} + \frac{m^2}{4}\,\frac{\phi^4}{\phi_0^2}$$



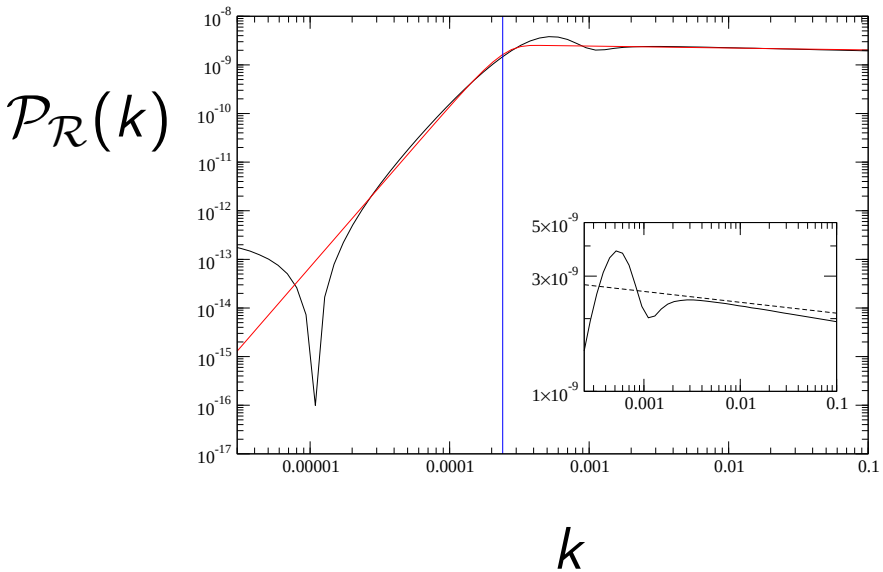
- Two parameters: m, ϕ_0.
- There can be two stages of inflation with a break or punctuation in between.
- We demand that the second stage has about 60 efolds.

Features in the primordial power spectrum?

An important statistical measure of fluctuations generated by inflation :

Power Spectrum of Scalar Gravitational Perturbations, $\mathcal{P}_{\mathcal{R}}(k)$.

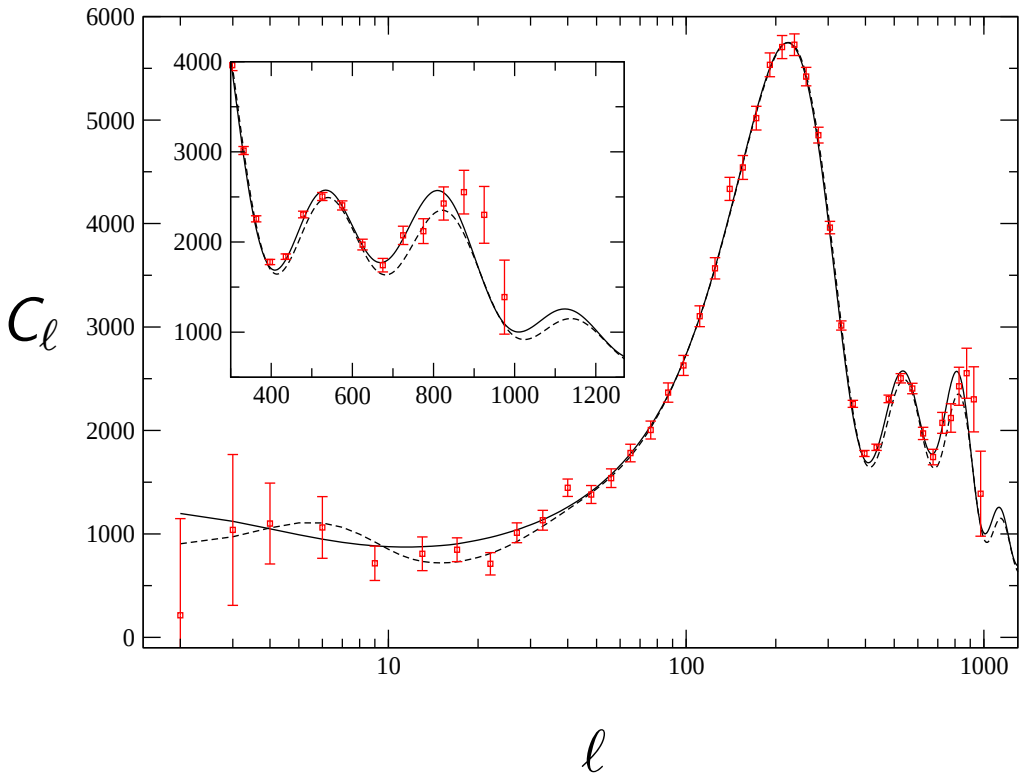
- Standard slow-roll inflation with no break gives:
  $\mathcal{P}_{\mathcal{R}}(k) = A\left(\frac{k}{k_0}\right)^{n_s-1}$, with $A = 2\times10^{-9}$ and $n_s = 0.955$.
- Punctuated inflation gives:



Inset dashed line: standard inflation, solid line: punctuated inflation, red line: approximate cut-off spectrum.

Comparing theory with observation: angular power spectrum of the CMB

$$C_\ell = 4\pi^2 \int dk\, k^2\, |\Delta_{T\ell}(k, \eta = \eta_0)|^2\, \mathcal{P}_\mathcal{R}(k)$$



Red points: WMAP 5-year data, dashed line: punctuated inflation, solid line: standard slow-roll inflation.

How good is the fit compared to standard slow-roll inflation?

- Perform a Markov Chain Monte Carlo analysis to determine values of model parameters that provide best fit to WMAP 5-year data [COSMOMC Package, A. Lewis and S. Bridle, Phys. Rev. D **66**, 103511 (2002)].
- Perform a chi-square fit of the angular power spectrum C_ℓ.
- Compare result with the standard featureless power spectrum.

Punctuated inflation improves the χ^2 fit by about 6.62 compared to standard slow-roll inflation.