Generic predictions of plateau inflation

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Based on work with Diederik Roest and Vincent Vennin

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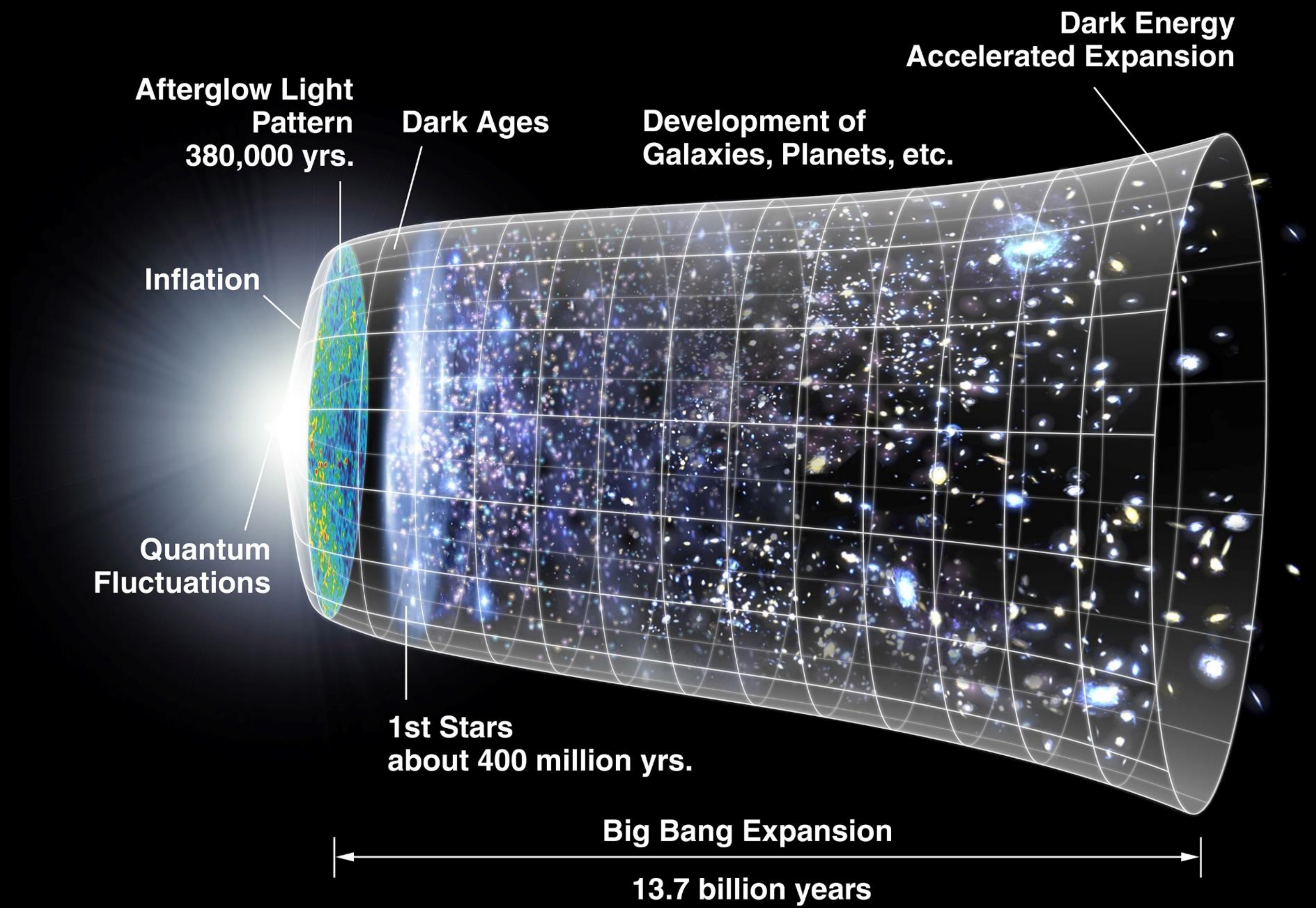
Outline

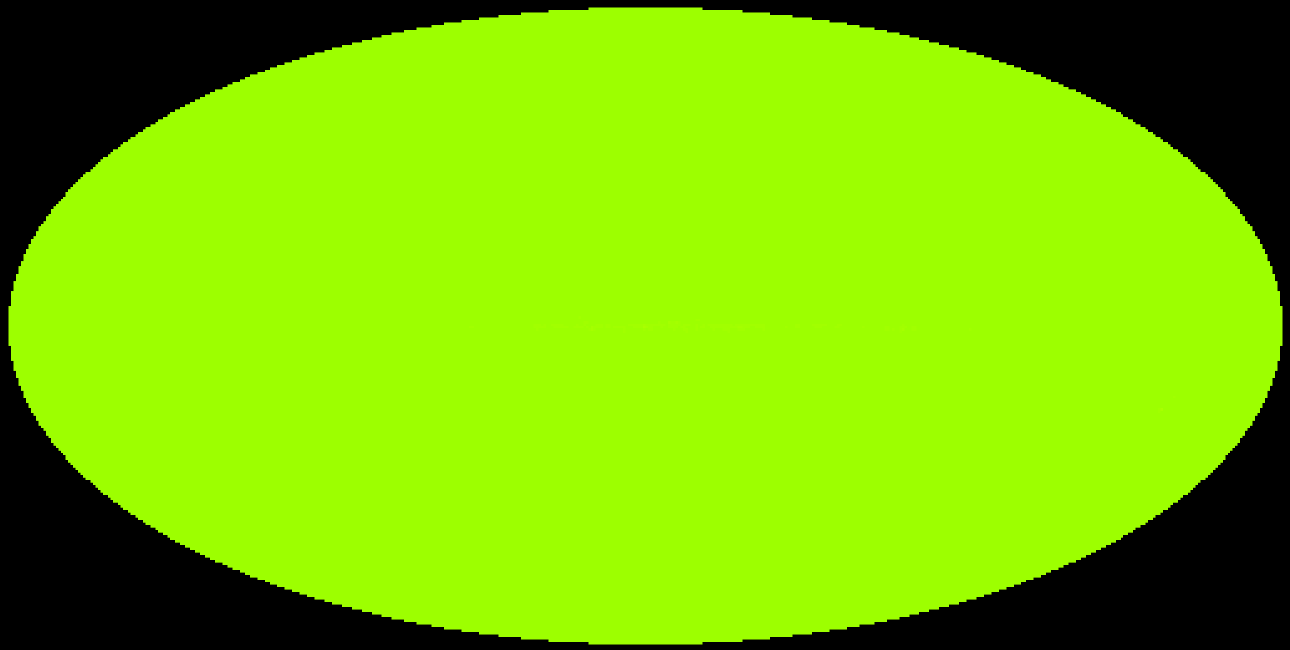
- Introduction to inflation
- Inflation as a Taylor expansion
- Inflation as a Padé approximant
- Conclusions

The universe



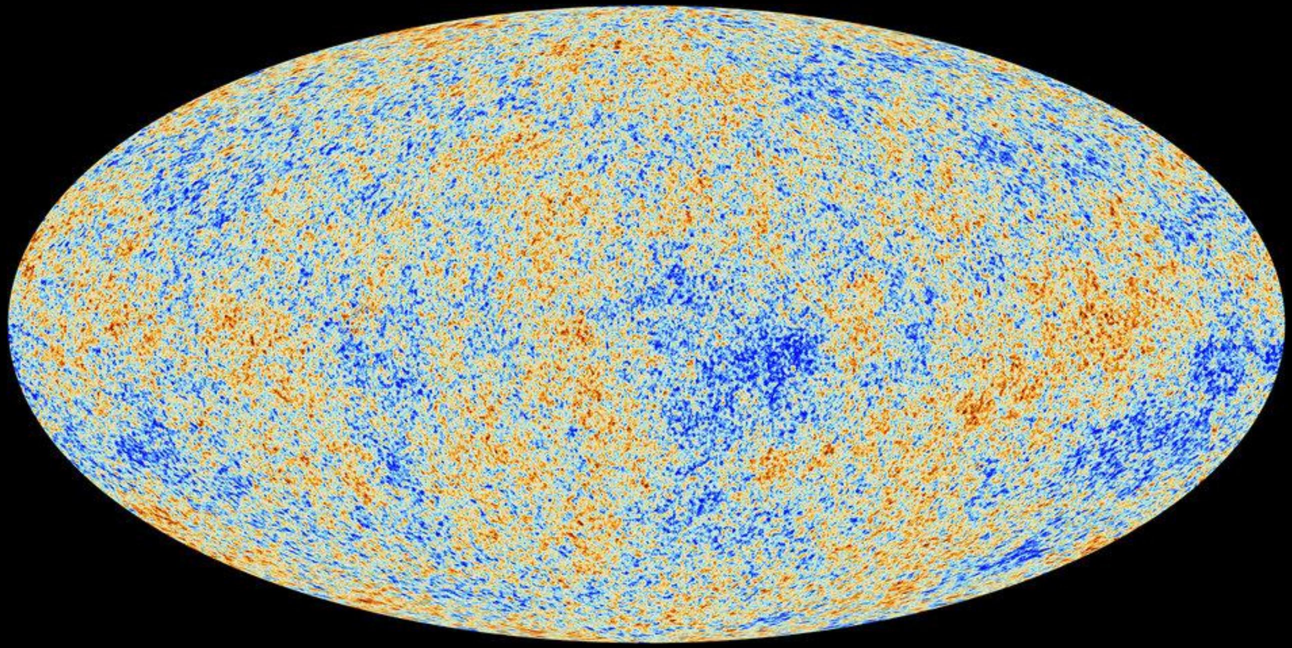
Source: wikipedia
original: WMAP

The CMB universe



T=2.7K

The CMB universe



$\delta T \approx 10^{-4}$

Description inflation

- Ìsotropy and homogeneity gives FLRW metric:

$$ds^2 = dt^2 + a(t)^2(dx^2 + dy^2 + dz^2)$$

where a is the scale factor, parameterizing the size of the universe

- Equations of motion lead to Hamilton-Jacobi equations

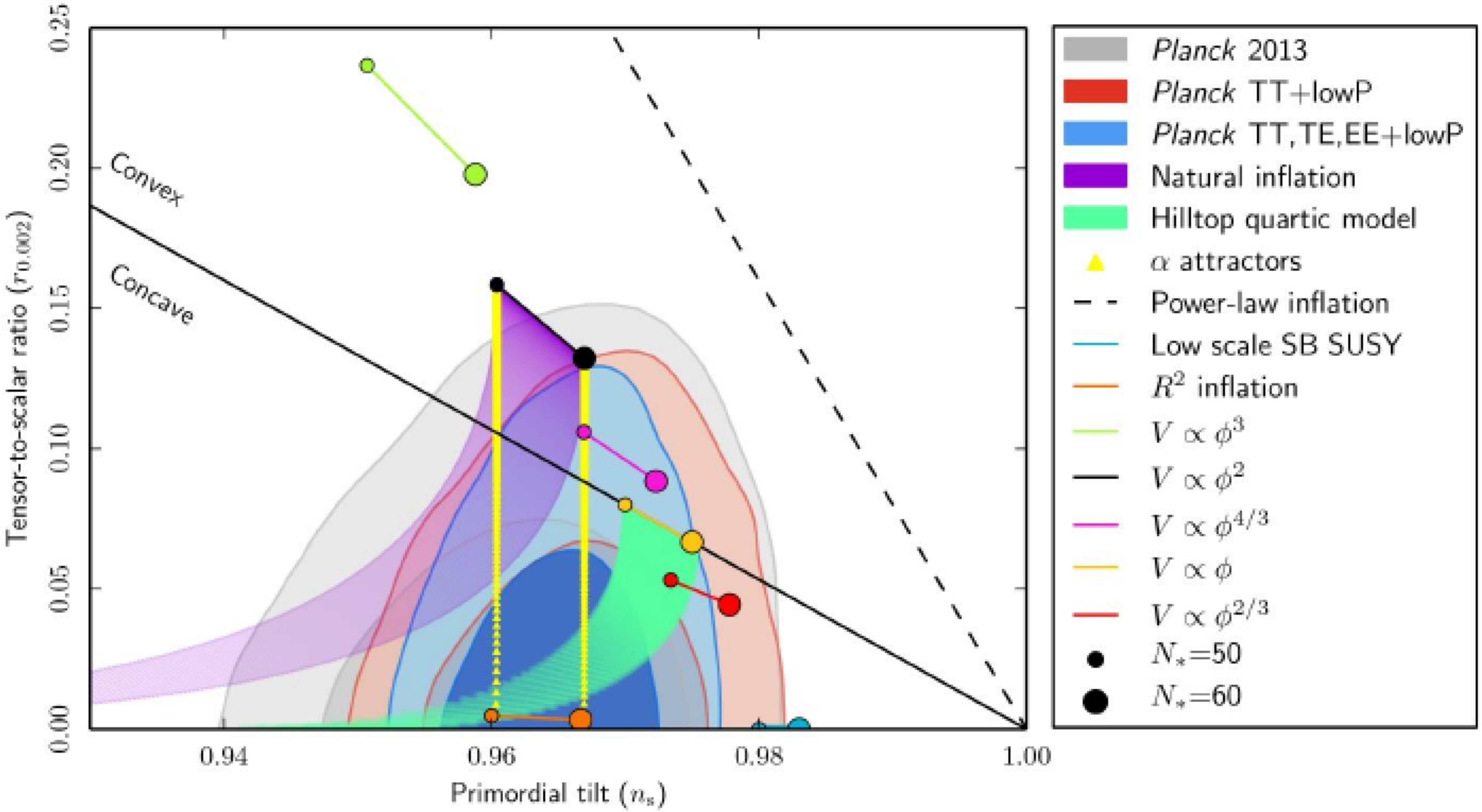
where $H = \frac{\dot{a}}{a}$

$$V(\phi) = 3H(\phi)^2 - 2H'(\phi)^2$$
$$\dot{\phi} = -2H'(\phi)$$

- Inflation is excellerated expansion, which means $\ddot{a} > 0$.

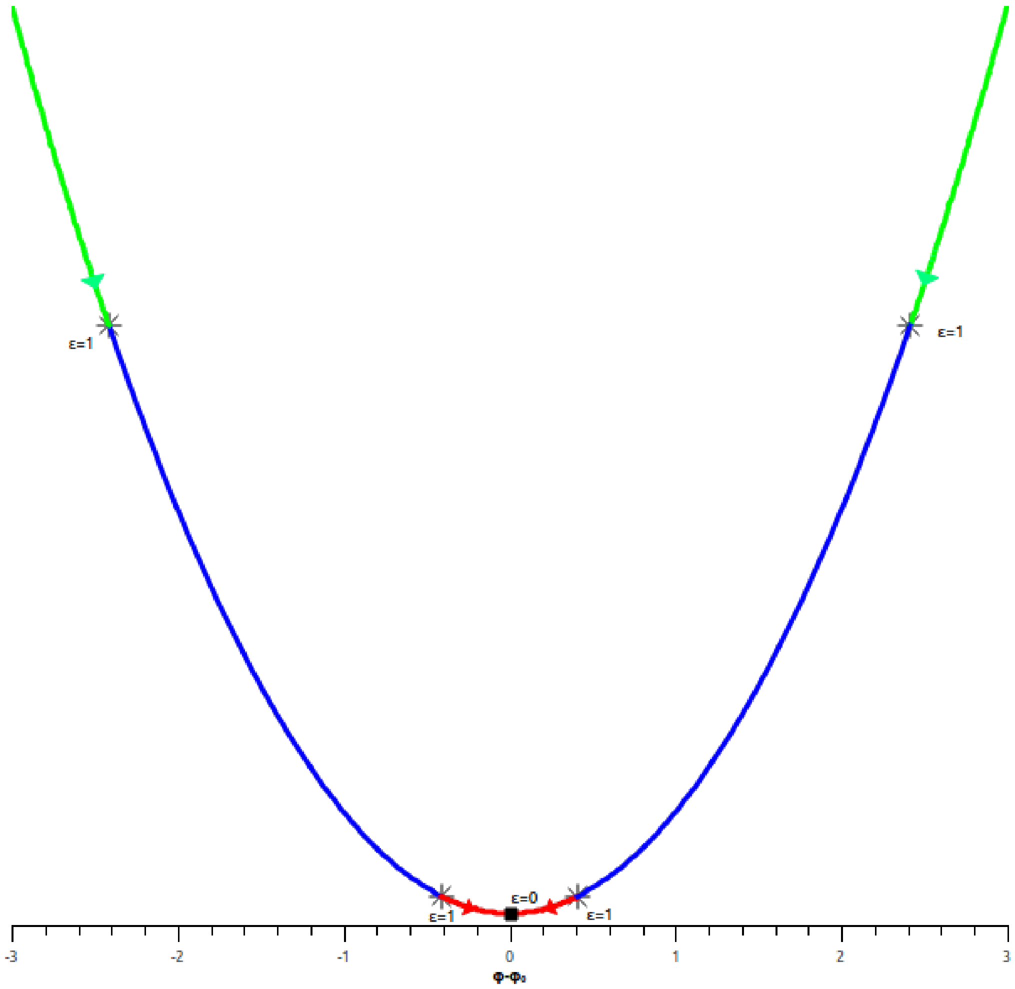
  Then $\epsilon \equiv 2\left(\frac{H'(\phi)}{H(\phi)}\right)^2 < 1$

Observables



Inflation as a Taylor expansion

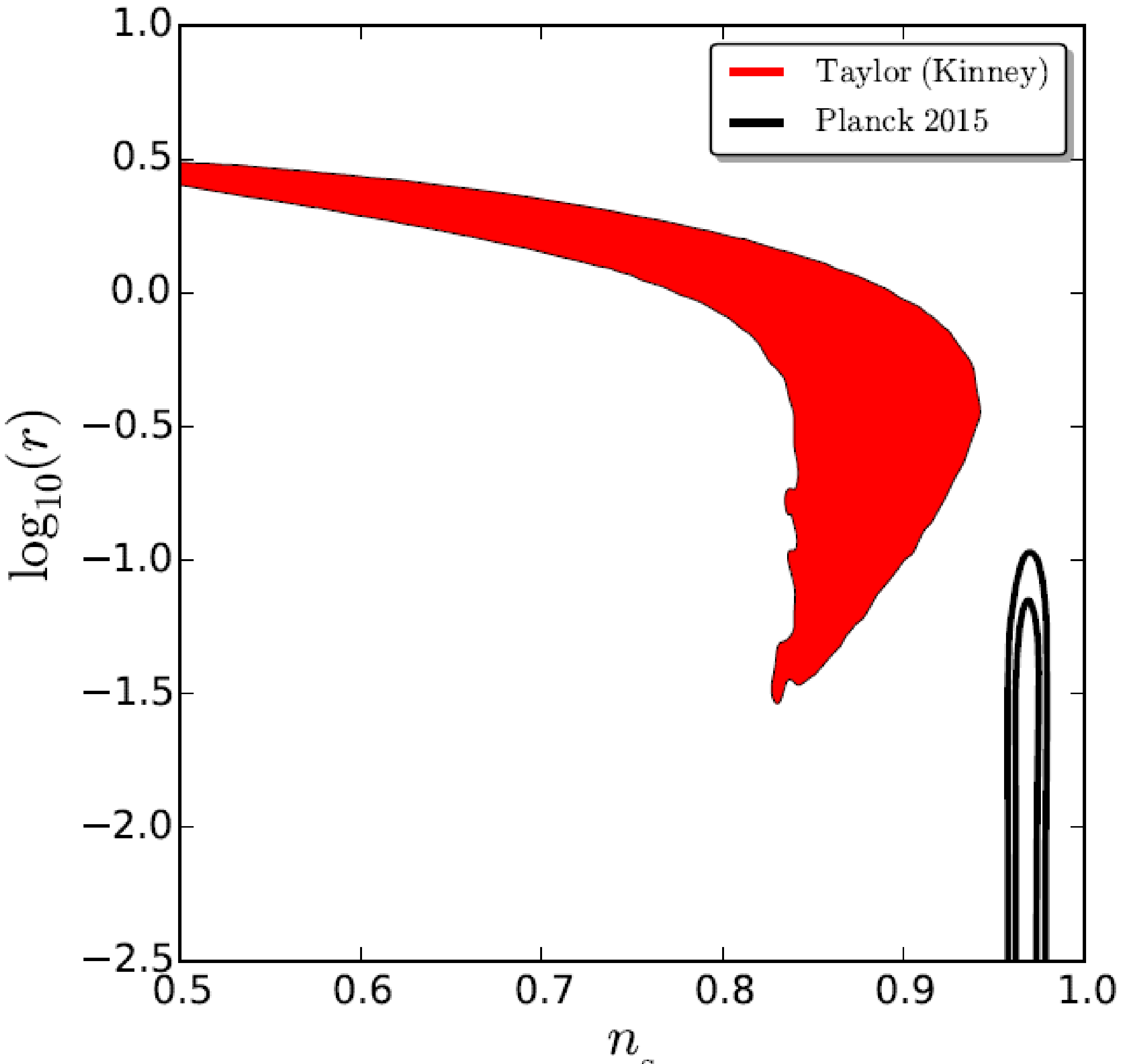
- Parameterize $H(\phi) = H_0(1 + \sum_{k=1}^{M} \frac{a_k}{k!} \phi^k)$
- How to proceed:
  1. Take random a_k
     such that $H(0) > 0$ and $0 < \epsilon(0) < 1$
  2. Search where $\epsilon = 1$ (end inflation)
  3. Search where $\epsilon = 0$ (eternal inflation)
  4. If flow to $\epsilon = 0$, discard model
  5. At point where $\Delta N = 50$, calculate n_s, r



Ref. Hoffman & Turner, astro-ph/0006321
Kinney, astro-ph/0206032

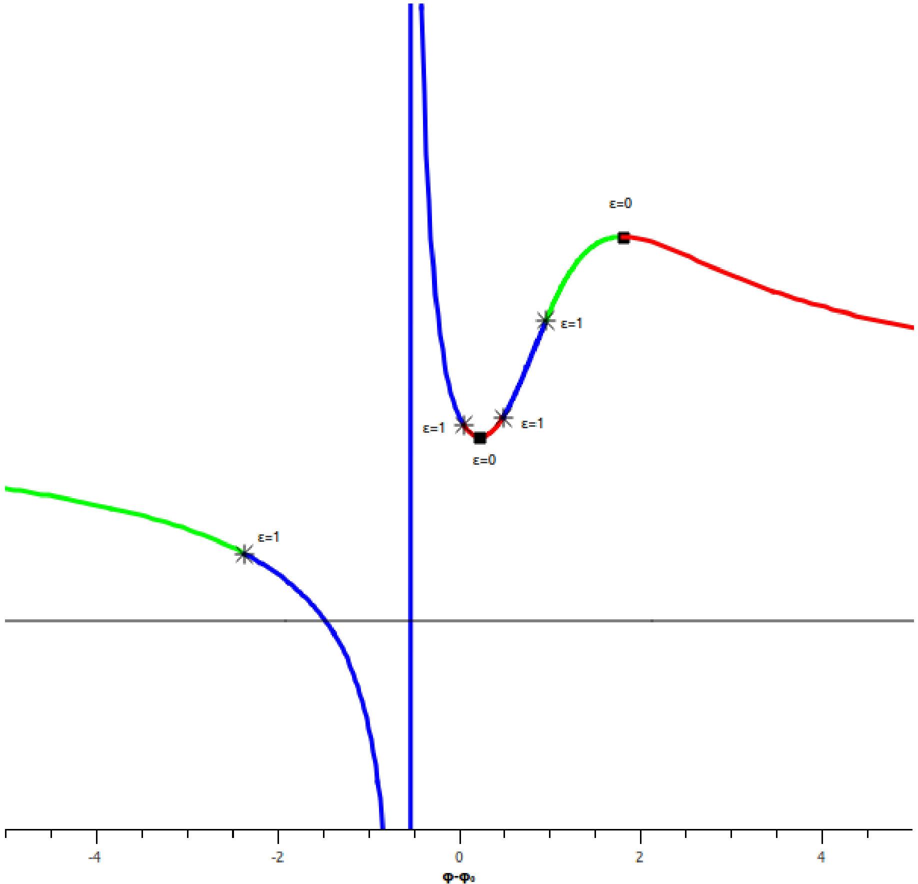
Inflation as a Taylor expansion

- Parameterize
  $H(\phi) = 1 + \frac{a_1}{1!}\phi + \frac{a_2}{2!}\phi^2 + \ldots$
  With a_i random
- Data far from Planck contours
  (0.2% in Planck 2σ contour)



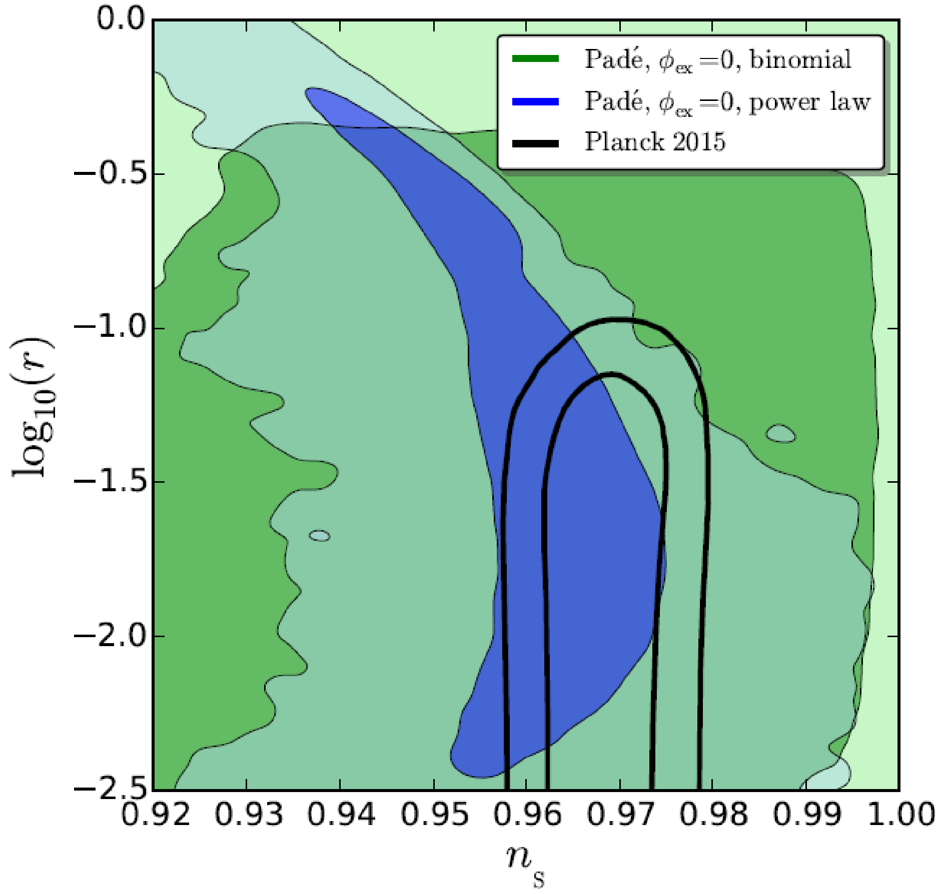
Inflation as a Padé approximant

- Padé approximant natural expansion around $\phi = 0$ and $\phi = \infty$
- $H(\phi) = \frac{\sum_{n=0}^{N} a_n \phi^n}{1+\sum_{m=1}^{M} b_m \phi^m}$.
- For a plateau, choose $N = M$.
- 2 inflation domains:
  a) Around $\phi = 0$, chose a_n, b_n such that derivatives of $H(\phi)$ maximally 1 at $\phi = 0$
  b) Around $\phi = \infty$, chose $\{a_i, b_i\} \in [-1,1]$



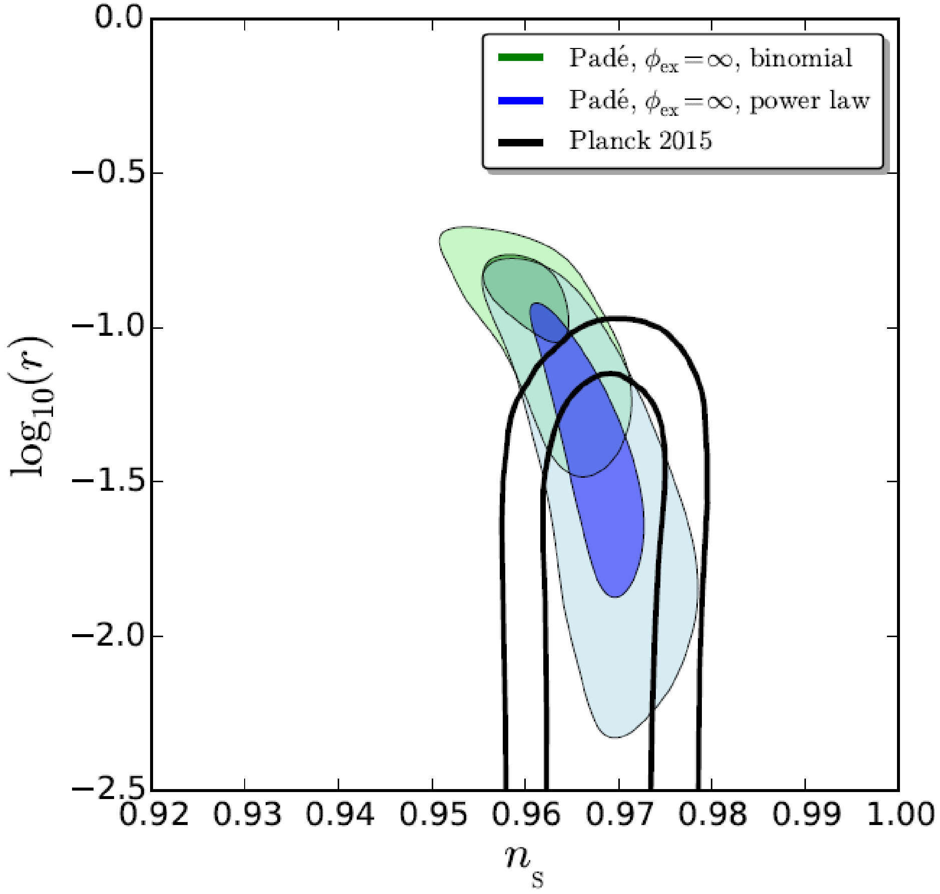
Inflation as a Padé approximant

$\phi \approx 0$



5% and 38% in Planck 2σ contour

$\phi \approx \infty$



18% and 90% in Planck 2σ contour

Conclusions

- Inflation is an appealing model to describe the early universe
- An approach using polynomial approximations is not recommended by the Planck data
- Padé approximants do much better.

- But now other parametrizations has to be studied:
  - Number of efold inflation
  - Generalized α attractors

Number of efold inflation