Starobinsky-like inflation and SUSY at the LHC

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Outline

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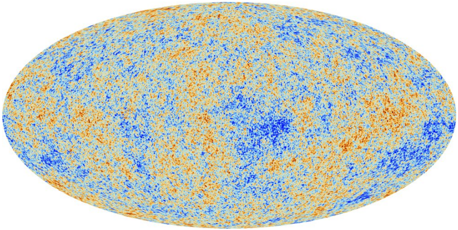
Introduction and Motivation



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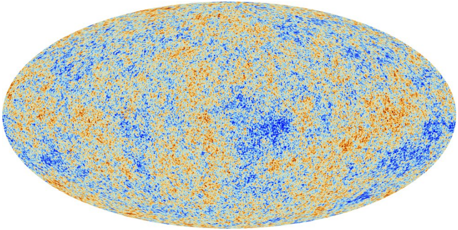

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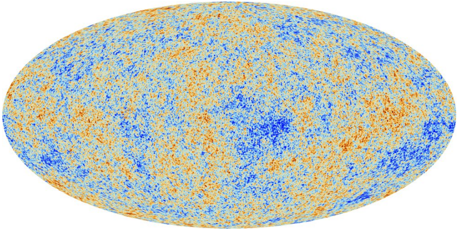

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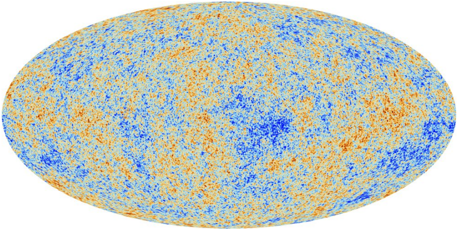

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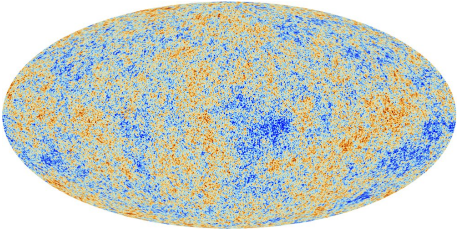

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  - Why is the CMB so homogeneous?
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- An elegant, solid, and comprehensive solution to these problems is **inflation**, defined as a period of exponentially large expansion

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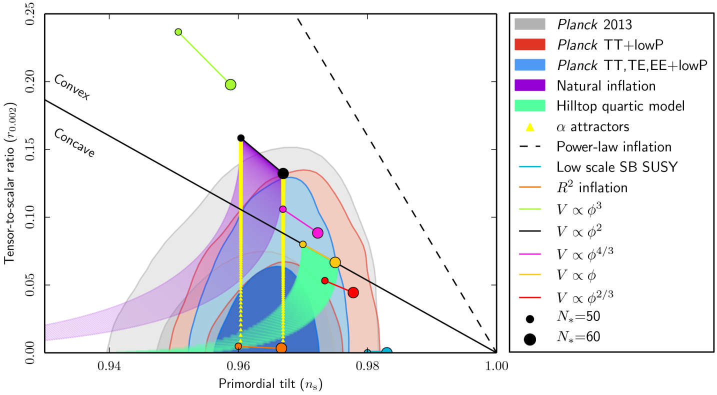
$$n_s \simeq 1 - 6\epsilon + 2\eta$$



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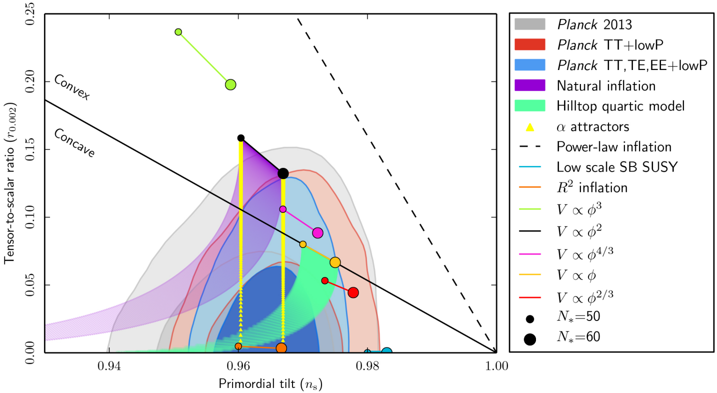

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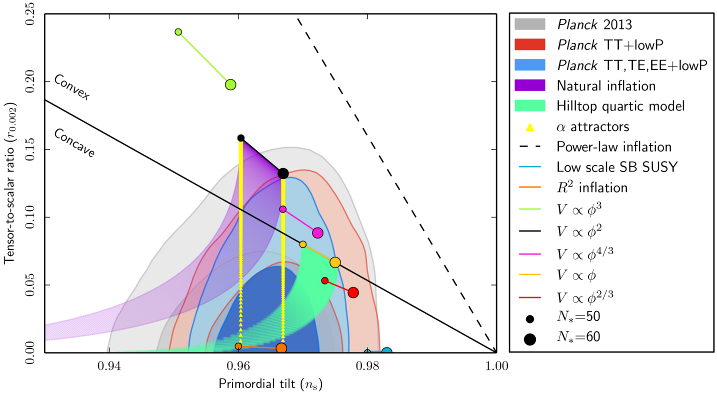

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- **No-Scale SUGRA inflation** offers an elegant solution to this problem

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- In SUGRA, the scalar potential is given by

$$V = e^{K/M_{Pl}} \left(D_i W (K^{-1})^{ij^*} D_{j^*} W^* - 3 \frac{|W|^2}{M_{Pl}^2} \right)$$

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$$K = -3M_{Pl}^2 \left(\frac{T + T^*}{M_{Pl}} - \frac{|Z|^2}{3M_{Pl^2}} \right)$$

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$$W = \frac{\hat{\mu}}{2} Z^2 - \frac{\lambda}{3} Z^3$$

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- In the **limit** $\lambda = \mu/3$ (with $\hat{\mu} = \mu\sqrt{c/3}$) we

$$V = \mu^2 e^{-\sqrt{2/3}x/M_{Pl}} \sinh^2 \left(\frac{x}{M_{Pl}\sqrt{6}} \right)$$

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- At the end of inflation $V \to 0$ as $x \to 0$ (defining feature of No-Scale SUGRA)
- There is an active interest in No-Scale inflation models as the **shape of the Kähler potential prevents** $\mathcal{O}(1)$ **corrections to** η

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Employing the same reparametrisation $Z = \sqrt{3cM_{Pl}} \tanh\left(\frac{x+iy}{M_{Pl}\sqrt{6}}\right)$, and stabilising $y = 0$, the inflaton potential is

$$V = a \left|\cosh\left(\frac{x}{M_{Pl}\sqrt{6}}\right)\right|^4 \left|b + f \tanh\left(\frac{x}{M_{Pl}\sqrt{6}}\right) - \tanh^2\left(\frac{x}{M_{Pl}\sqrt{6}}\right)\right|^2$$

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With

$$a = |3\lambda M_{Pl}^2|^2 f, \quad b = \frac{M^2}{3c\lambda M_{Pl}}, \quad f = \frac{\mu}{\lambda\sqrt{3cM_{Pl}}}$$

- The ENO limit to **Starobinsky-like inflation** is $M \to 0$, $\lambda = \mu/3$ (with $\hat{\mu} = \mu\sqrt{c/3}$), meaning

$$\begin{aligned} b &= 0 \\ f &= 1 \end{aligned} \tag{1}$$

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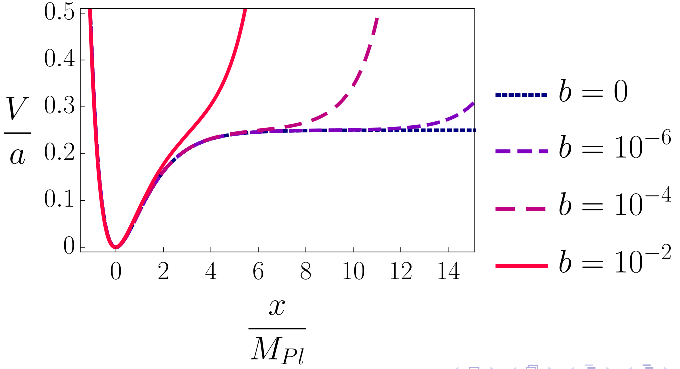
- The Polonyi term $b \neq 0$ will change the shape of the potential while retaining a plateau suitable for inflation



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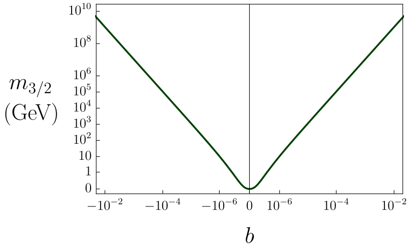
- Furthermore, since the gravitino mass is proportional to W

$$m_{3/2}^2 = \frac{K_i^j F_j F^{*i}}{3M_{Pl}^2} = e^{K/M_{Pl}^2} \frac{|W|^2}{M_{Pl}^4}$$

the Polonyi term will break SUSY and generate a gravitino mass



$$m_{3/2} \lesssim 10^6 \text{ GeV} \Rightarrow |b| \lesssim 10^{-4}$$

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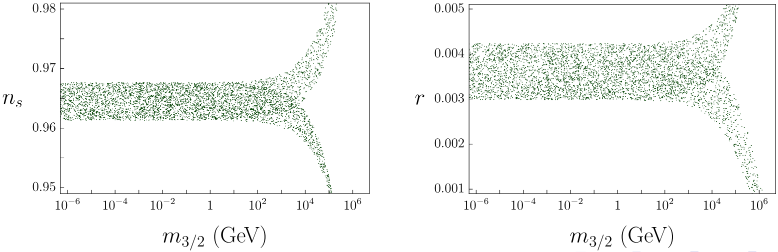
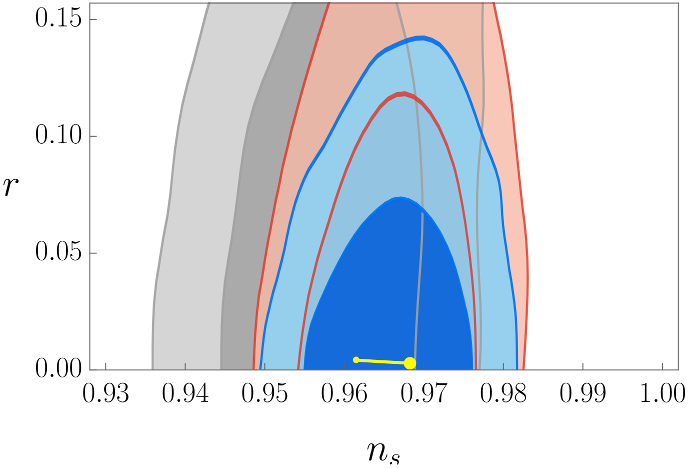
And we find that agreement with current PLANK results severely constrains the allowed gravitino mass



The cosmological predictions are the same as the Wess-Zumino Starobinsky-like without the Polonyi term for

$$m_{3/2} \lesssim \mathcal{O}(10^3)\ \text{GeV}$$



- The overall coefficient of the potential, a can be constrained using the scalar fluctuation amplitude

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- For this region of the parameter space, $|b| \lesssim 10^{-5}$ and $f = 1$, the superpotential parameters are constrained

$$\mu \simeq 10^{-5} M_{Pl}$$
$$M \lesssim 10^{-5} M_{Pl}$$

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- The model proposed not only fits cosmological data but also breaks SUSY
- The gravitino mass is expected to be $m_{3/2} \lesssim 10^3$ GeV, meaning that the LHC should be able to see SUSY partners

Thank you!