

UV-completing ghost inflation

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in collaboration with Mikhail Ivanov

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d'Avignon
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Inflation is a probe of the highest energies

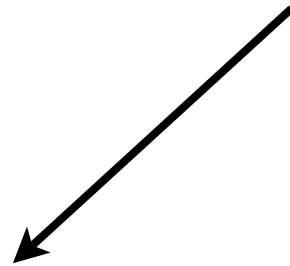
BICEP2

$$M_I \sim 10^{-3} \times M_p$$

Standard paradigm = extrapolation of the known laws over 13 orders of magnitude

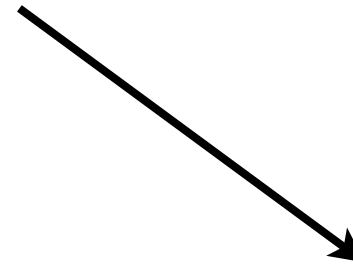
Check: study signatures of alternative scenarios

different space-time symmetries



enhanced

e.g. supersymmetry



reduced

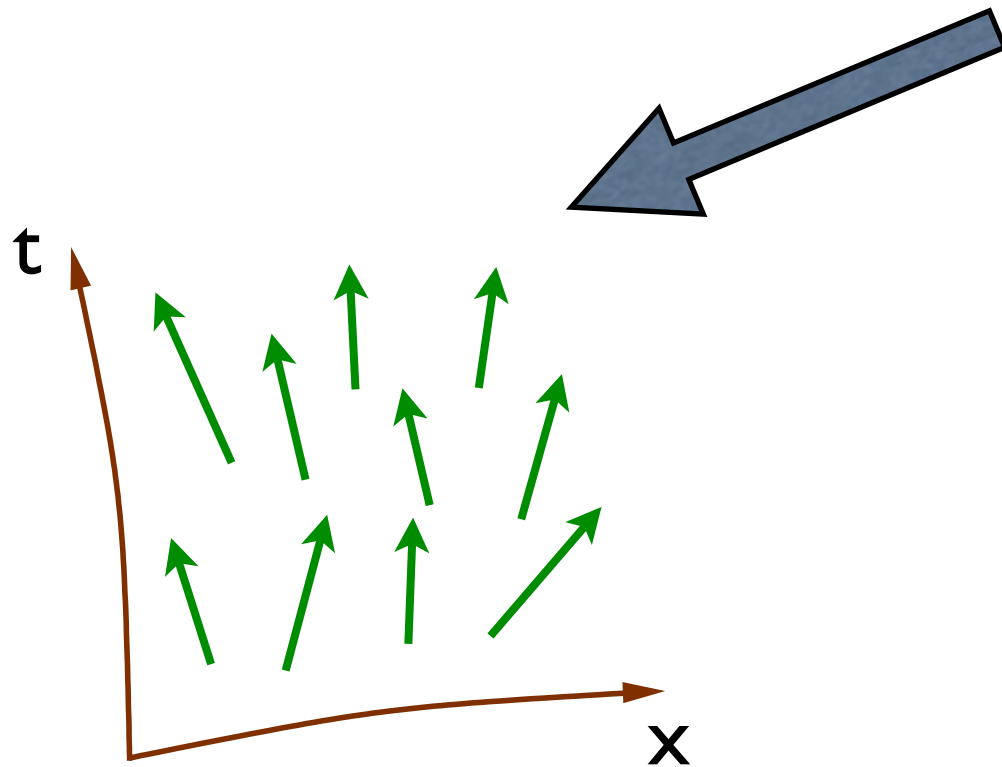
e.g. broken

Lorentz invariance



Coupling inflaton to a **preferred frame**

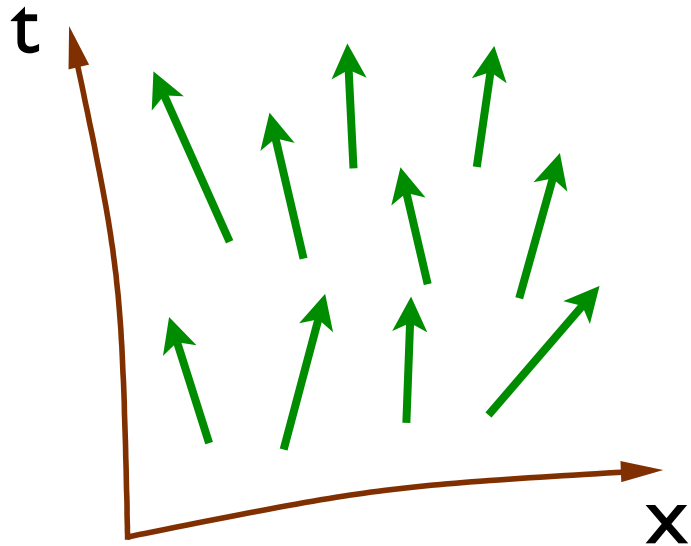
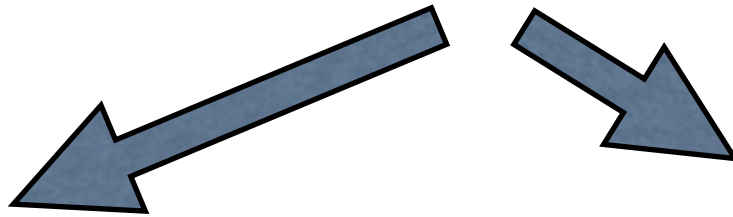
Coupling inflaton to a **preferred frame**



Einstein-aether

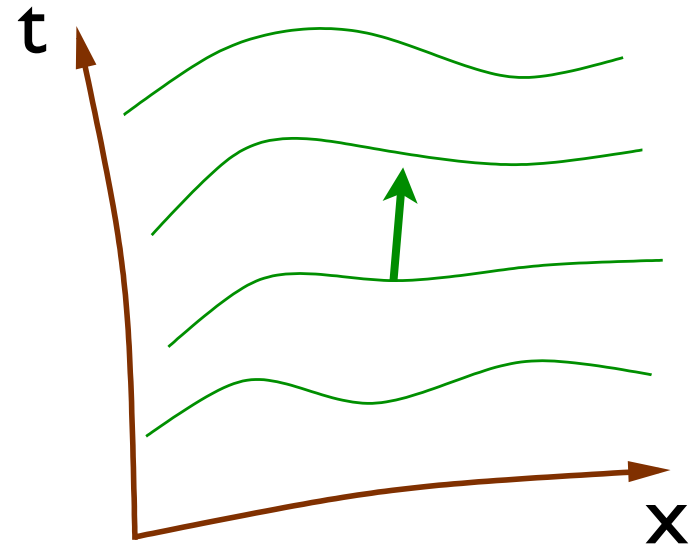
Jacobson & Mattingly

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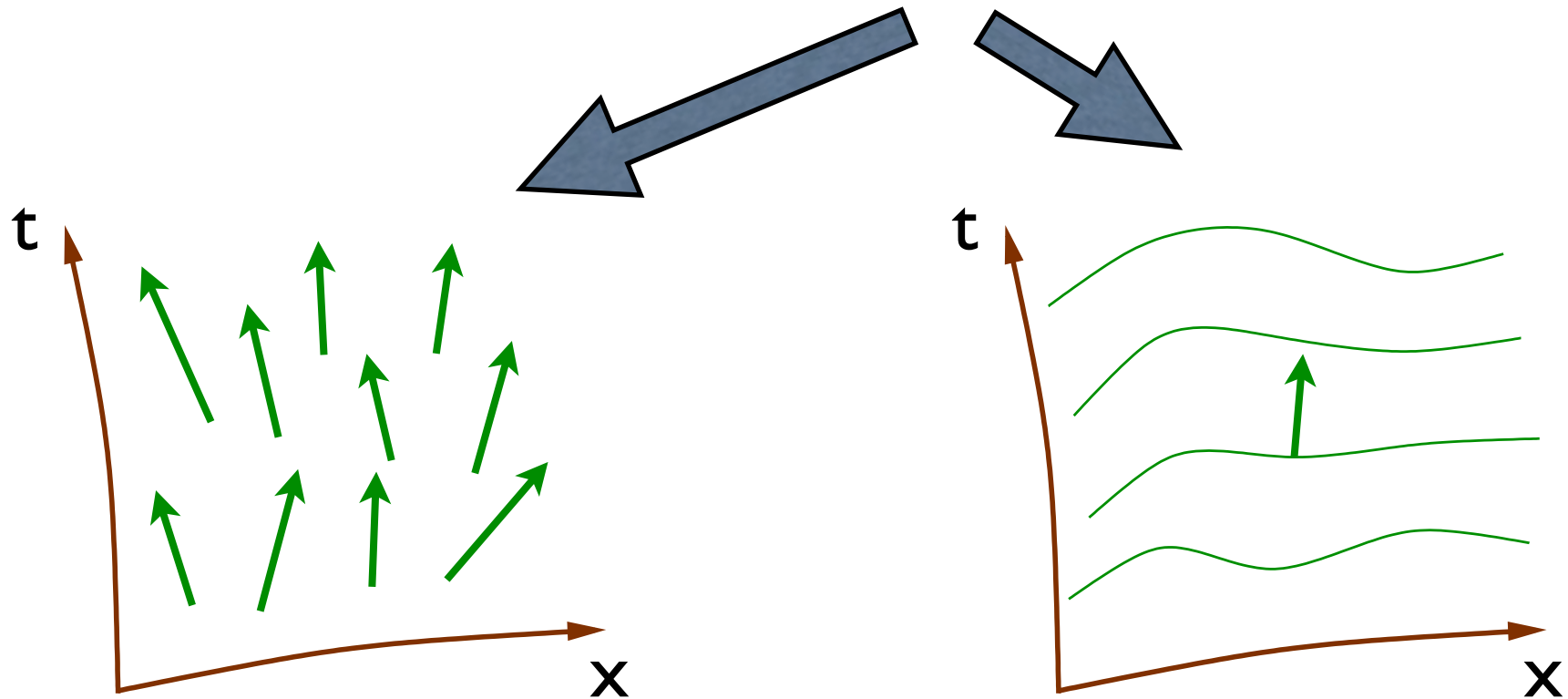
Jacobson & Mattingly



khronometric

Blas, Pujolas & S.S.

Coupling inflaton to a **preferred frame**



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$$\mathcal{L}_u \sim M_*^2 (\partial u_\mu)^2$$

N.B. EFT up to M_* . Above embedded in Horava-Lifshitz gravity.

Coupling inflaton to a preferred frame

$$\mathcal{L}_I = \frac{1}{2}(\partial_\nu\theta)^2 - V(\theta) + \frac{\alpha}{2}(u^\nu\partial_\nu\theta)^2 - \mu^2 u^\nu\partial_\nu\theta$$

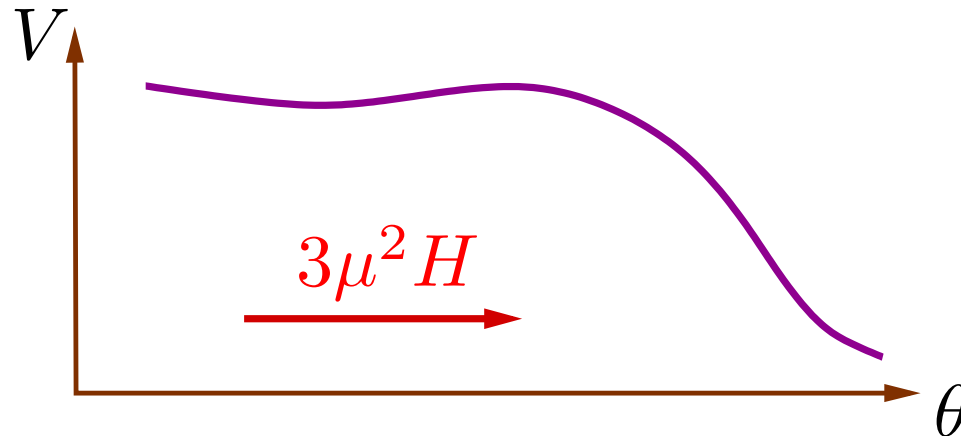
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Coupling inflaton to a preferred frame

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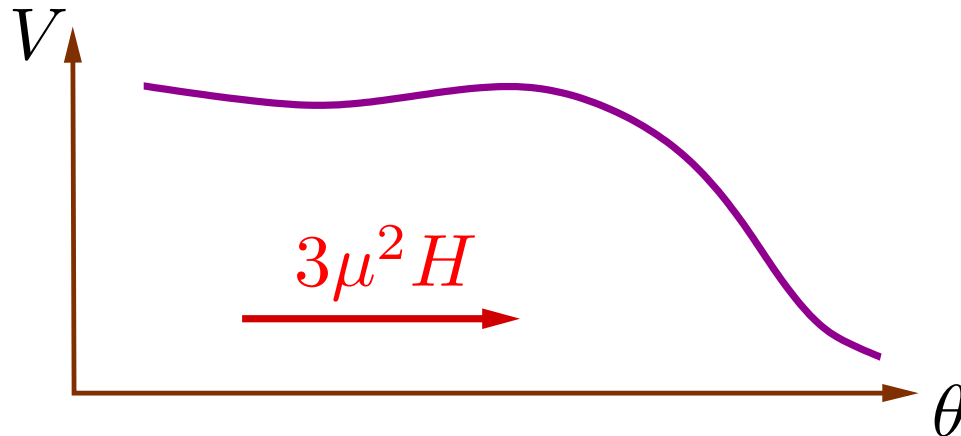
If $\varkappa = 0$  $\ddot{\theta} + 3H\dot{\theta} - 3H\mu^2 + V'(\theta) = 0$



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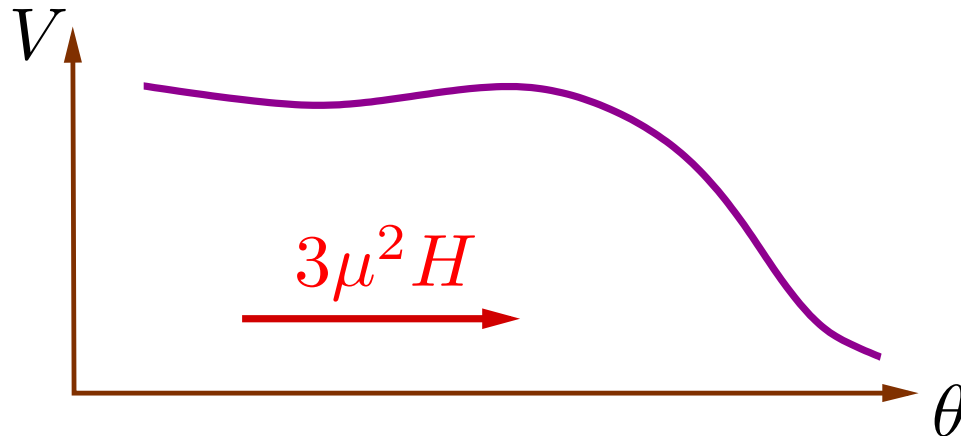
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Donnelly & Jacobson; Solomon & Barrow

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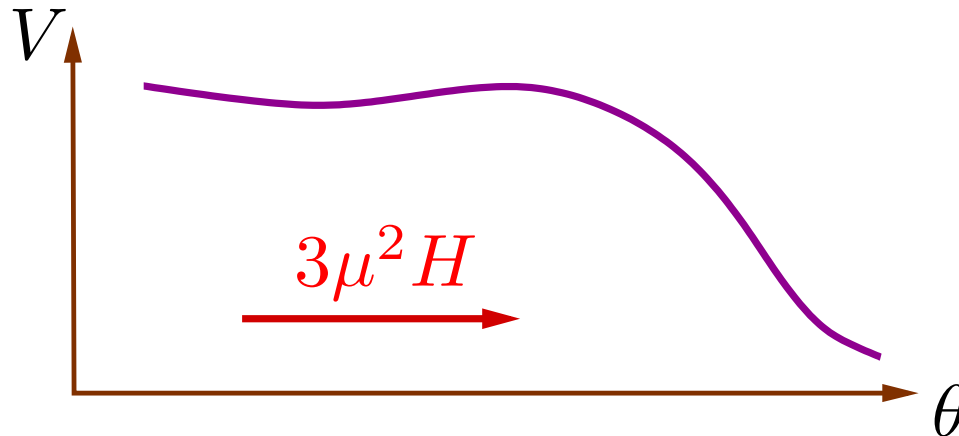
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$H^2 = \frac{1}{3M_p^2} \left(\frac{\dot{\theta}^2}{2} + V \right)$ \Rightarrow inflation occurs even for $V = 0$

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Arkani-Hamed et.al.; Senatore

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However $k_c \ll \mu \sim \sqrt{\dot{\theta}}$

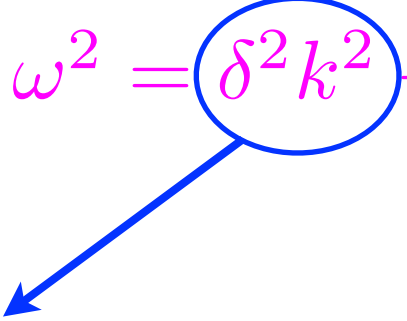
UV-completion from k_c to M_*

- allows higher energy scale of inflation
- suppresses non-Gaussianity

Signatures depend on disp. rel. at horizon crossing

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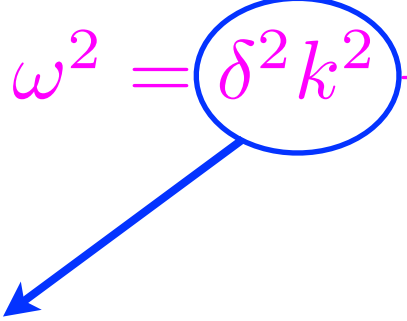
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$$\delta^2 \gg H/k_c \sim M_*/M_p$$

$$n_s - 1 = -6\delta^2 - \frac{3\dot{\delta}}{H\delta}$$

$$r = 48\delta^3$$

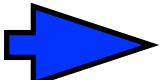
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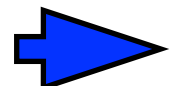
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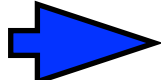
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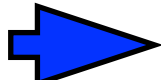
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$$r \sim 0.1$$

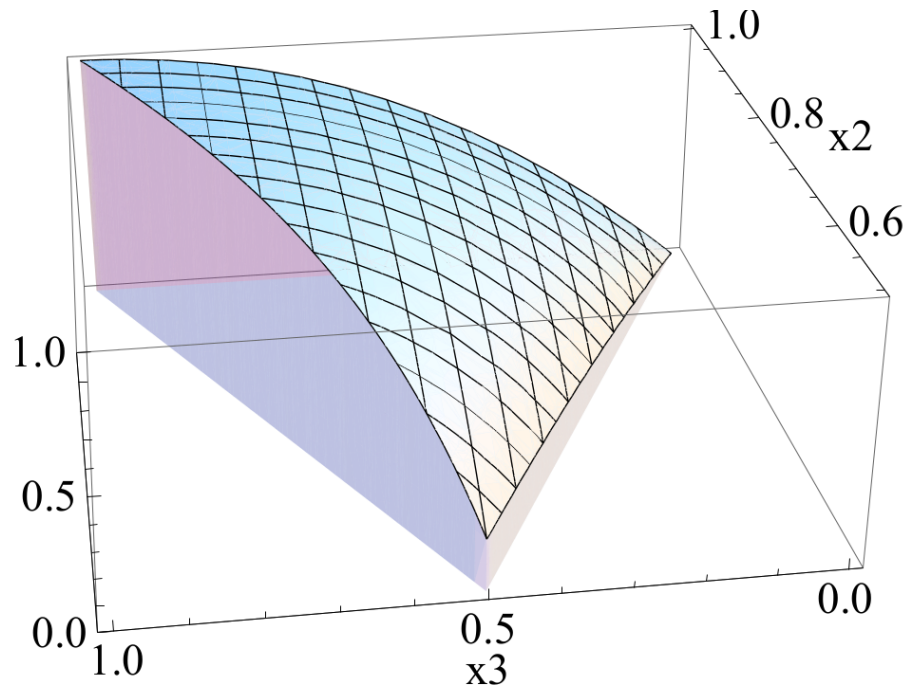
 $M_*/M_p \sim 0.05$

Signatures: non-Gaussianity

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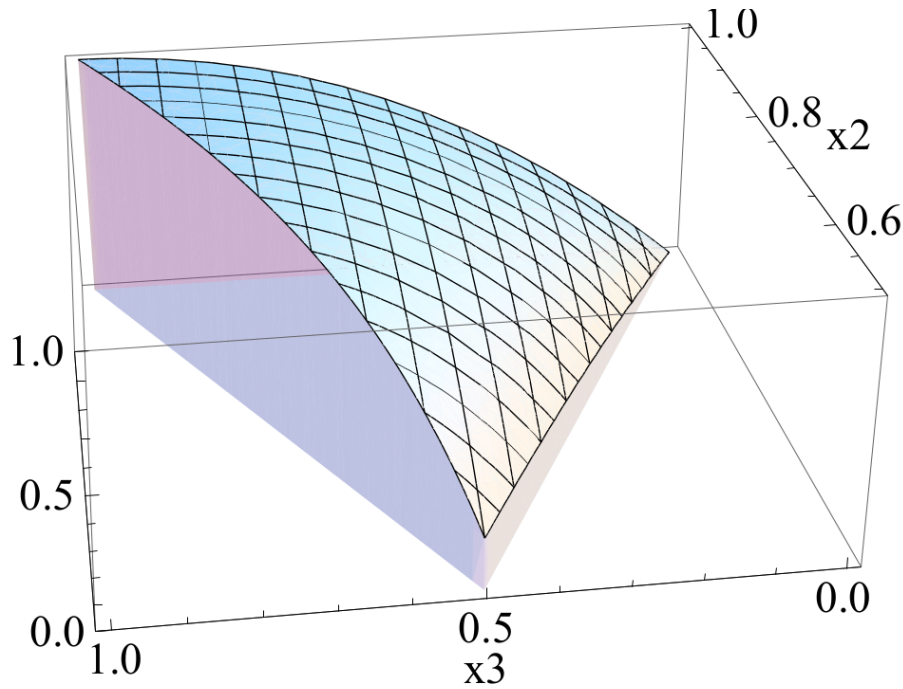


$$f_{NL} \sim -\frac{0.26}{\delta^2} \sim -40$$

cf. $f_{NL} = 8 \pm 73$ *Planck*

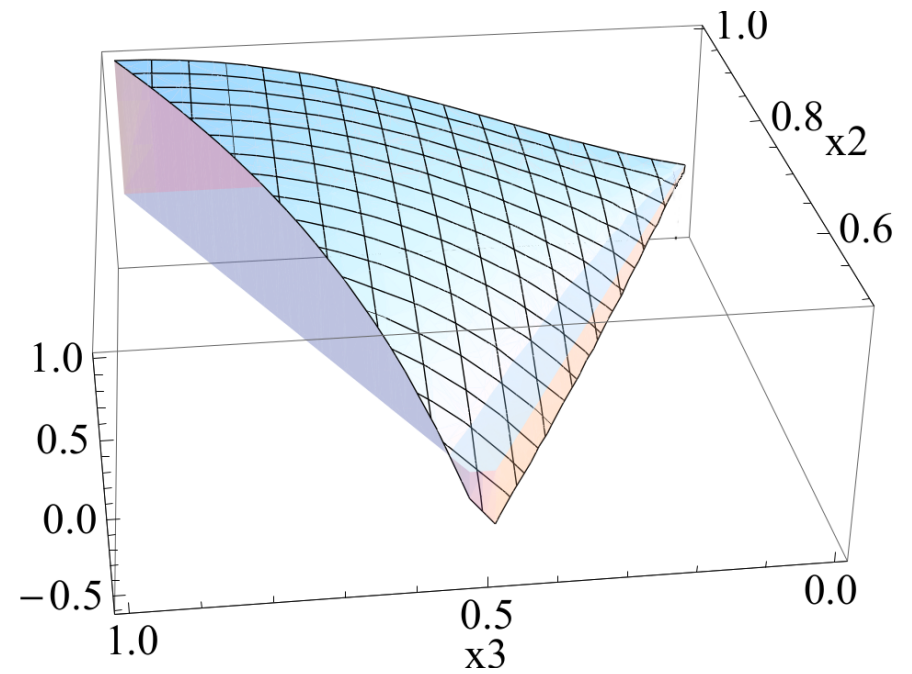
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$$f_{NL} \sim -\frac{0.32 M_p}{M_*} \sim -6.5$$

cf. $f_{NL} = -23 \pm 88$ *Planck*

CONCLUSIONS

- Coupling of inflaton to a preferred frame
 - ➡ *fast-roll* inflation (driven by the kinetic energy of inflaton)
- perturbations \approx ghost inflation, but the scale can be higher; EFT up to $0.1M_p$
- $n_s = 0.96$, $r \sim 0.1$ ➡ $f_{NL}^{ghost} \sim -10$

OUTLOOK

- Higher statistics, related to bispectrum
- UV-completion of LV massive gravity