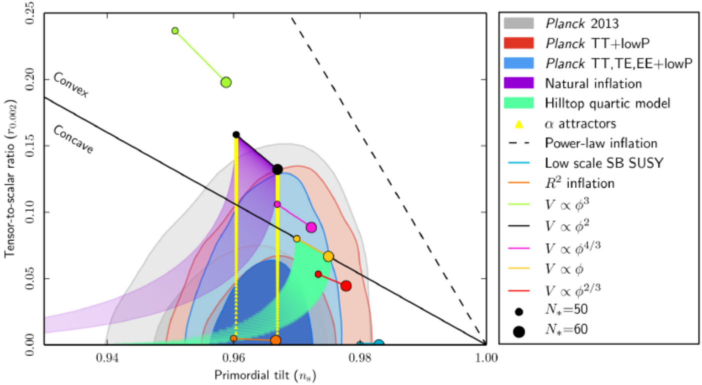
Spiral Embeddings of Inflation

Vicente Atal

with Ana Achúcarro and Yvette Welling
arXiv:1503.07486, accepted for publication in JCAP.

and Cespedes, Gong, Hu, Ortiz, Palma, Patil, Torrado

Planck 2015



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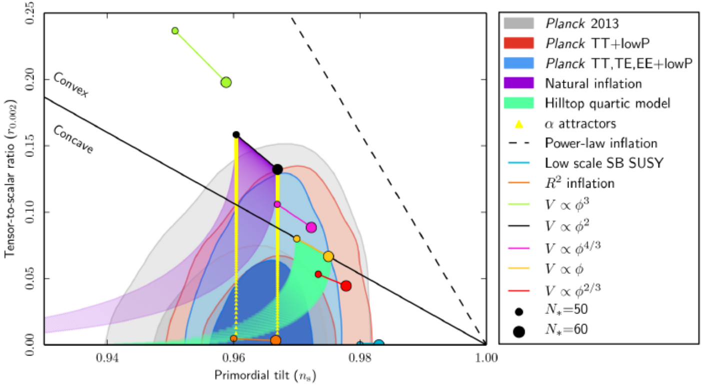

Fig. 12. Marginalized joint 68 % and 95 % CL regions for n_s and $r_{0.002}$ from *Planck* in combination with other data sets, compared to the theoretical predictions of selected inflationary models.

Are these results robust to the presence of heavy fields ?

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Changes in the background: a heavy field may change $H(t)$
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Changes in the perturbations: the heavy isocurvature modes can effectively create a reduced speed of sound for the adiabatic mode

$$\mathcal{L}_2 \propto \dot{\mathcal{R}}^2 + c_s^2 (\nabla \mathcal{R})^2$$

$$\mathcal{L}_3 \propto 2\dot{c}_s c_s^{-3} \mathcal{R}\dot{\mathcal{R}}^2 + (1 - c_s^{-2})\dot{\mathcal{R}}[\dot{\mathcal{R}}^2 - \frac{1}{a^2}(\nabla \mathcal{R})^2]$$

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big angular velocities $\Leftrightarrow$ heavy field displaced from the minimum.

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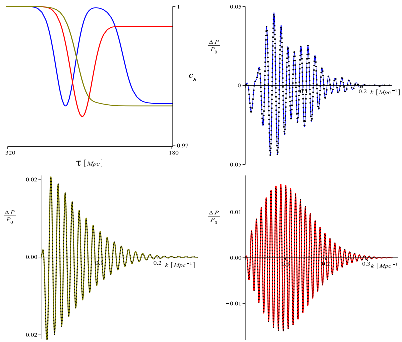

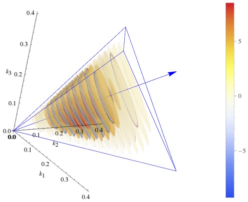

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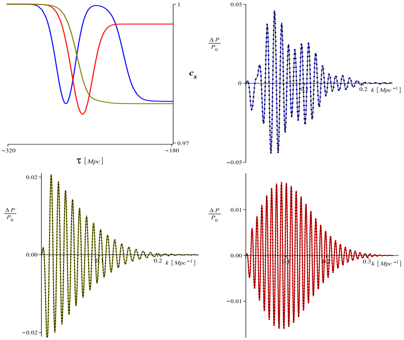
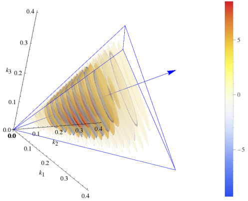


← Today we will talk about this case



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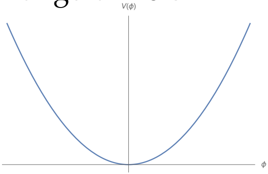

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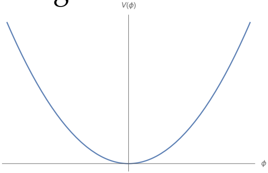

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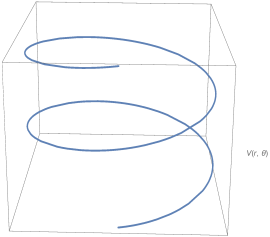

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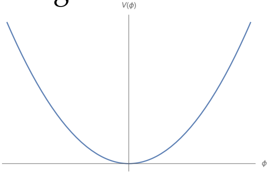

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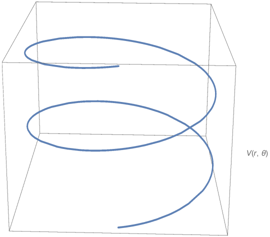

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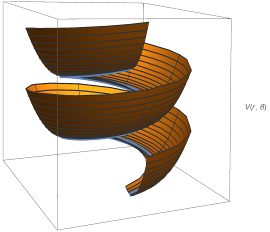

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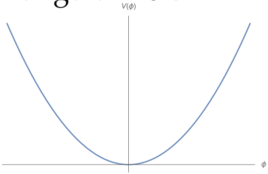

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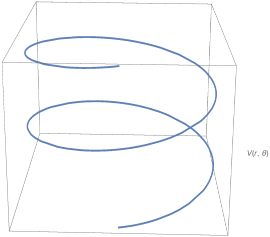

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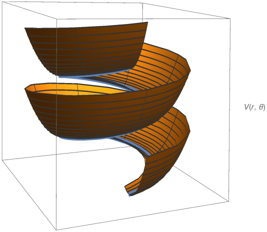

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challenge for string theory Alhqvist et al '13

Simplest Toy Model

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- $\epsilon \sim \rho^2\theta'^2$ then $\rho \ll 1$
- $\Delta\phi \sim \rho\Delta\theta \sim M_{pl}$ large field inflation $\rightarrow$ monodromy
- $\Delta\mathcal{L} \sim \frac{|\Phi|^n}{M_{pl}^n}$ are under control. McDonald, Barenboim et al.

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3- Calculate (n_s, r)

$$\begin{aligned} n_s &= 1 - \epsilon - \eta - \dot{c}_s/Hc_s \\ r &= 16\epsilon c_s \end{aligned}$$

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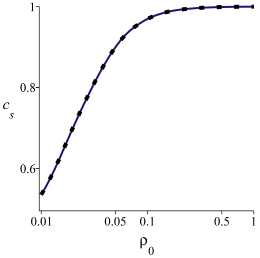

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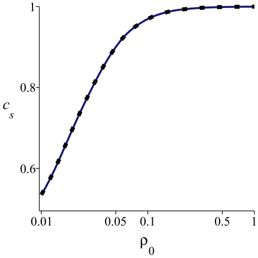

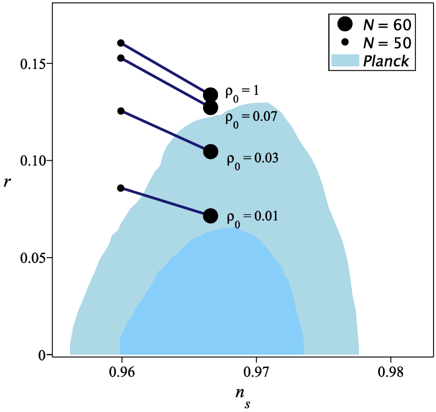

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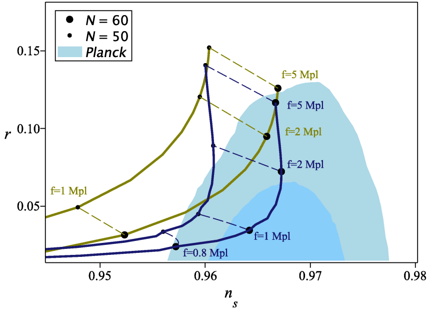

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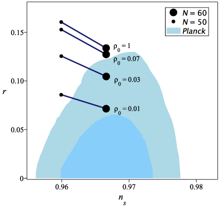

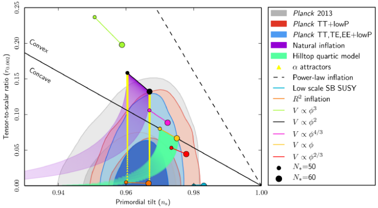

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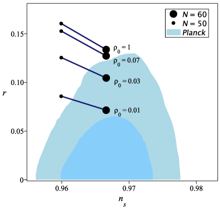

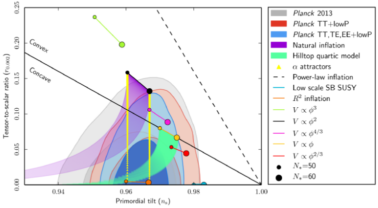

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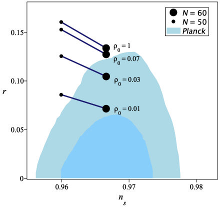

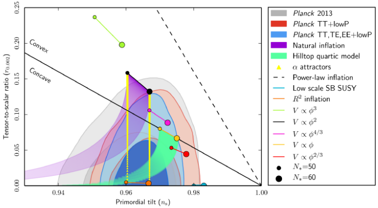

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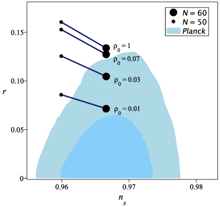

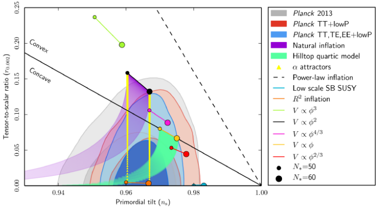

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For slowly varying c_s $\qquad f_{NL}^{eq} \propto \dfrac{1}{c_s^2 - 1} \sim 1$

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- Chaotic and the natural inflationary potential are brought into more consistency with the data.
- Non Gaussianity can help us to detect the presence of additional heavy field.
- Is this an effect we expect to see in string theory ?