Beyond the (Cosmological) Standard Model?

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CERN Theory retreat, Les Houches, November 6 – 8 2013

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- ∃ a *single* effectively light degree of freedom at $\sim \epsilon^{1/4} 10^{16} GeV$.
  - whose field modes began in the relevant vacuum state (BD)
  - whose self interactions and interactions with other fields are sufficiently weak or irrelevant *throughout* inflation
  - which at the same time couples strongly enough to some sector that contains the standard model so that efficient (pre)heating occurs...

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- But what if all we ever get to see are the correlators of the adiabatic mode? What could we still meaningfully hope to know? Could we ever learn about *what* the inflaton is/ how it embeds itself in a UV completion *that includes Gravity*?

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- w/ 3d (i.e. uncompressed) info from LSS (up to $k_{NL} \sim 0.1 Mpc^{-1}$), 21 cm and Spectral distortion (up to $k \sim \mathcal{O}(10^2) Mpc^{-1}$), if present, features can be detected much more cleanly. **We stand to see much more of inflation at work.**

Relaxation to the attractor– for fundamental physics motivation see

Dudas, Kitazawa, Patil, Sagnotti, arXiv:1202.6630

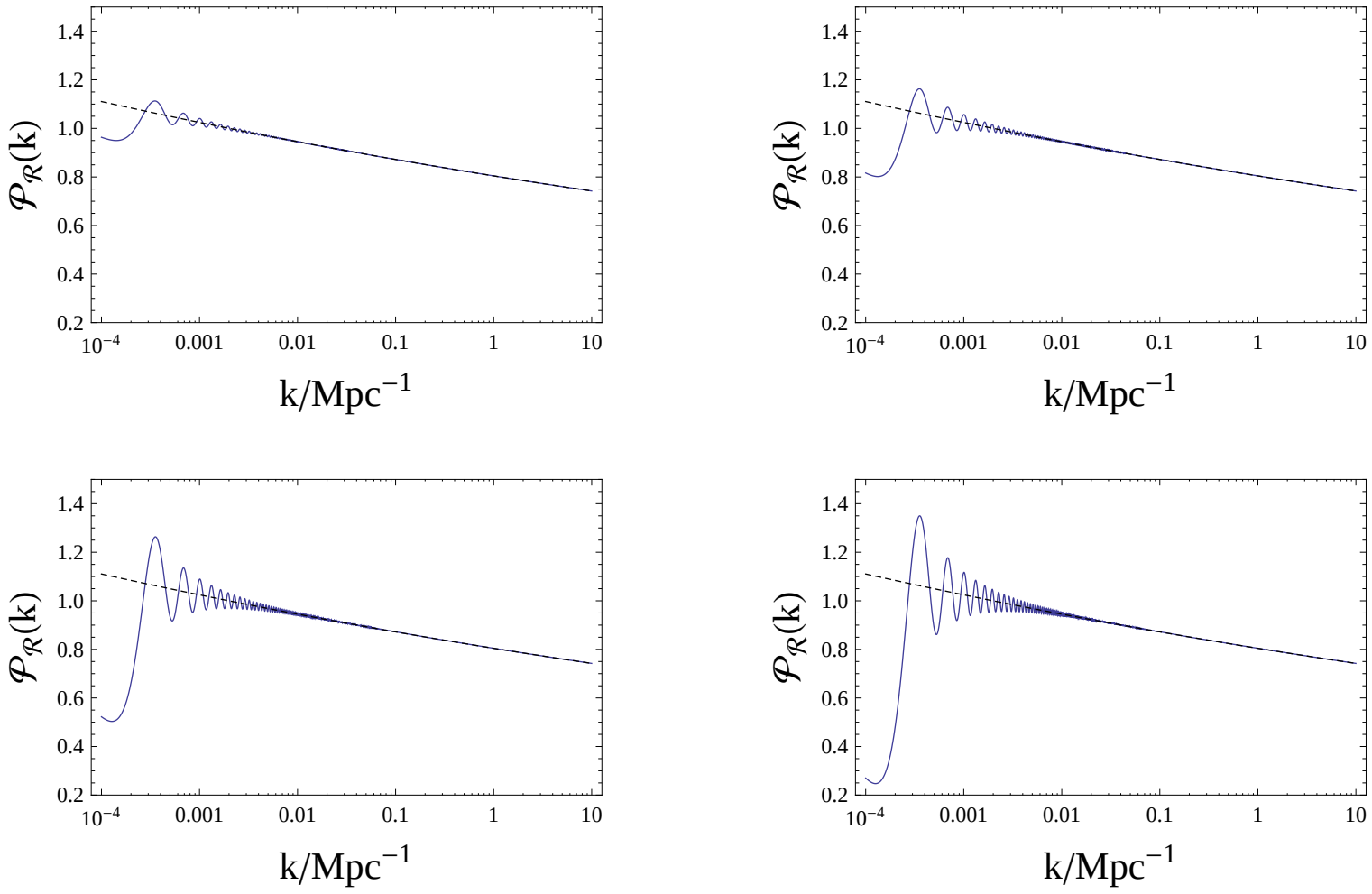

Figure : $\frac{z''}{z} - \frac{z_0''}{z_0} = \lambda e^{-(\tau-\tau_0)\mu}$; $z := \frac{a\phi_0'}{c_s \mathcal{H}}$, with $\lambda = 5 \times 10^{-5}/(4\pi^4)$, $\tau_0 = -10^4$ and with μ running from 2, 1, 0.5 and 0.35 in the upper left, upper right, lower left and lower right panels, respectively.

Transient drops in the speed of sound– for EFT motivation see

Achucarro, Patil et al: arXiv:1010.3693, 1201.6362, 1205.0710, 1211.5619; Burgess, Horbatsch, Patil 1209.5701

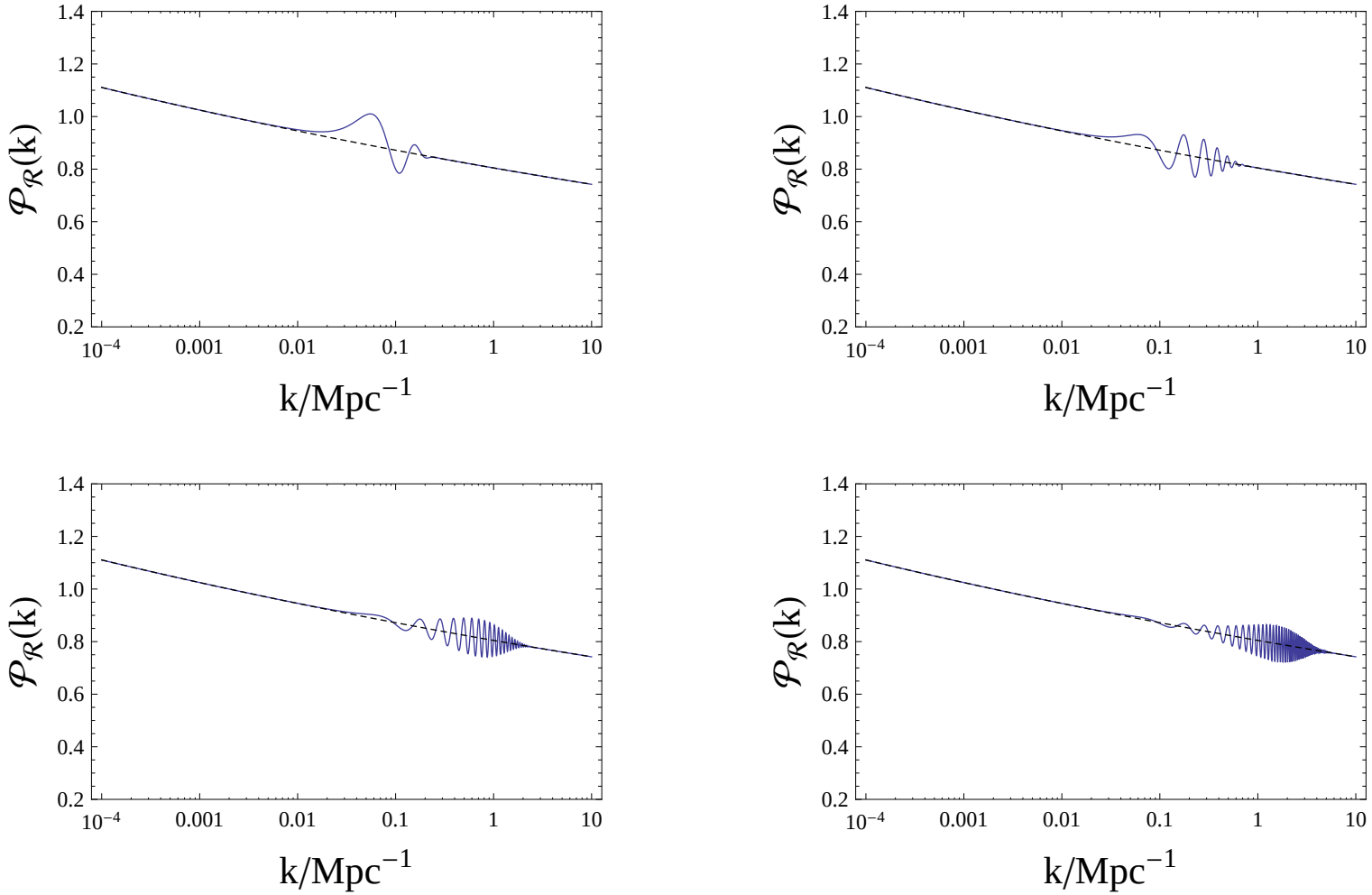

Figure : Transient drop in c_s with $c_s^2 - c_0^2 = \lambda \tau^2 e^{-(\tau-\tau_0)^2 \mu}$, with $\lambda = 2 \times 10^{-4}/(4\pi^4)$, $\tau_0 = -30$ and with μ running from 0.01, 0.1, 1 and 5 in the upper left, upper right, lower left and lower right panels, respectively.

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- Classifying the various possibilities is a work in progress (under certain assumptions for the inverse problem to be tractable)...

Recent work

EFT of inflation:

- arXiv:1209.5701, JHEP **1301**, 133 (2013)

  C.P. Burgess, M.W. Horbatsch, S.P. Patil

- arXiv:1211.5619, Phys. Rev. D **87**, 121301 (2013)

  A. Achúcarro, J-O. Gong, G.A. Palma, S.P. Patil

Features in primordial observables:

- arXiv:1312.xxxx, *in preparation*

  J. Hamann, S.P. Patil

A stringy alternative to generating primordial structure:

- arXiv:1311.xxxx, *to appear*

  R.H.Brandenberger, C.Kounnas, H.Partouche, S.P. Patil, N. Toumbas

Also currently investigating semi-classical stability of de Sitter space using non-equilibrium (2PI) techniques– *in progress*. A. Mukhopadhyay, S.P. Patil