

Life Beyond the Gaussian



Simon DeDeo

8 June 2007

— Day One —

— Day One —

subtle, delicate signals

- whence —
What profundities do they come from?
- wither —
How do they appear on the sky?

— Day One —

The Elohim (אֱלֹהִים)



subtle, delicate signals

- whence —
What profundities do they come from?
- wither —
How do they appear on the sky?

whence Xingang Chen, Sarah Shandera,
Eugene Lim, Daniel Baumann

wither James Fergusson, Chris Byrnes

non-Gaussianities require strange physics

“standard” Q.F.T. + single field slow roll
+ some pretty standard reheating (?) \equiv Gaussianity in ϕ
{ but not necessarily in ζ — gravitational evolution! }

non-Gaussianities require strange physics

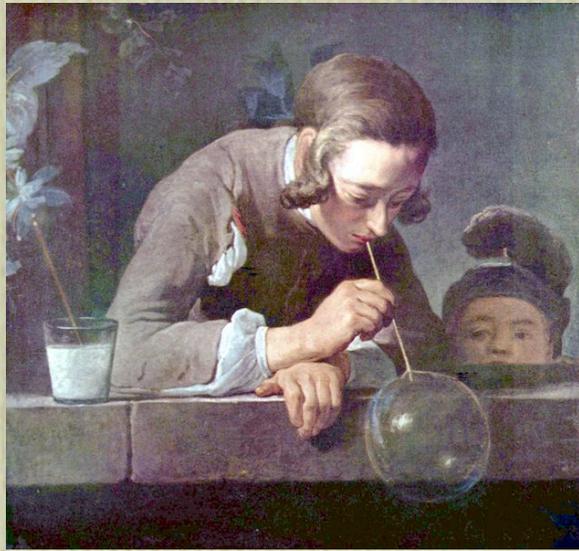
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multifield inflation? } strong non-linearities in messenger

DBI?
 p -adic inflation? } strange kinetic terms —
new propagators,
new E.O.M. allow for strongly
non-linear Lagrangians
while getting acceleration
with single field

D.B.I.

for those who dropped out
of string-theory class



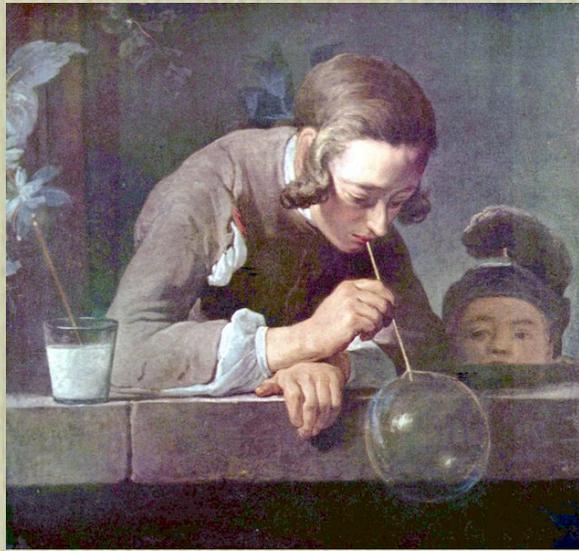
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branes are like string world-sheets
(or soap bubbles) :
they like to minimize their area
natural way to form Lagrangian

$$\int d\tau \sqrt{g_{ab}}$$

↑
induced metric on brane



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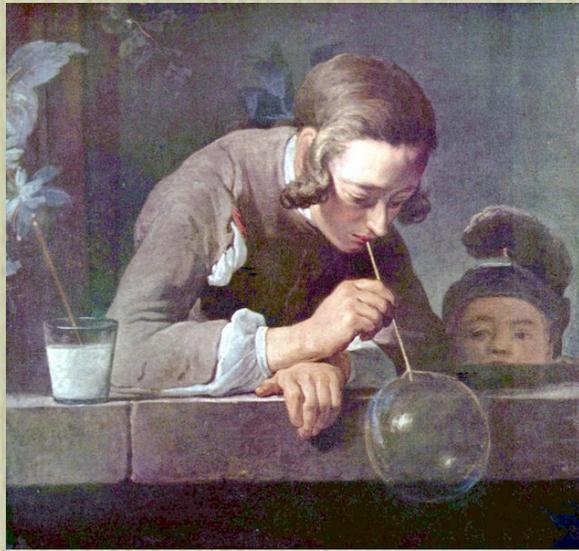
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they warp space with conical singularities
(just classical 2+1 gravity!)

$$ds^2 = -h^{-1/2} dt^2 + h^{1/2} (dr^2 + r^2 d\Omega)$$



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... Lagrangian left as an exercise to the reader

— many sources of non-Gaussianity!
did we get them all? **perfection is not yet here.**

— **computationally difficult**: pointy triangles are hard!
“template” forms needed.

one open question :

$B(l_1, l_2, l_3)$ to f_{NL}

— what does our signal look like?

how can we cram the signal into one or two numbers?

“local”, “equilateral”, factorizable : all pragmatic choices, but
will theory give us unique primordial signatures?



the telephone tree

Sarah & Sav & Daniel & Neil argue about DBI, KKLMMT, p , &c.
... call ...

Xingang & Eugene who parametrize as E.F.T.s and get us to Exit
... and call ...

Chris who takes us from Exit to CMB, adding in new sources
...

where James makes templates & Hiranya rules out models!

... supposedly how science is meant to work ...

— Day Two —

Modern Times



the engineers Roman Scoccimarro, Martin Croce

the psychiatrists Olivier Doré, Marilena LoVerde

the ad-man Asantha Cooray

— Day Two —

Modern Times



plenty of machinery!

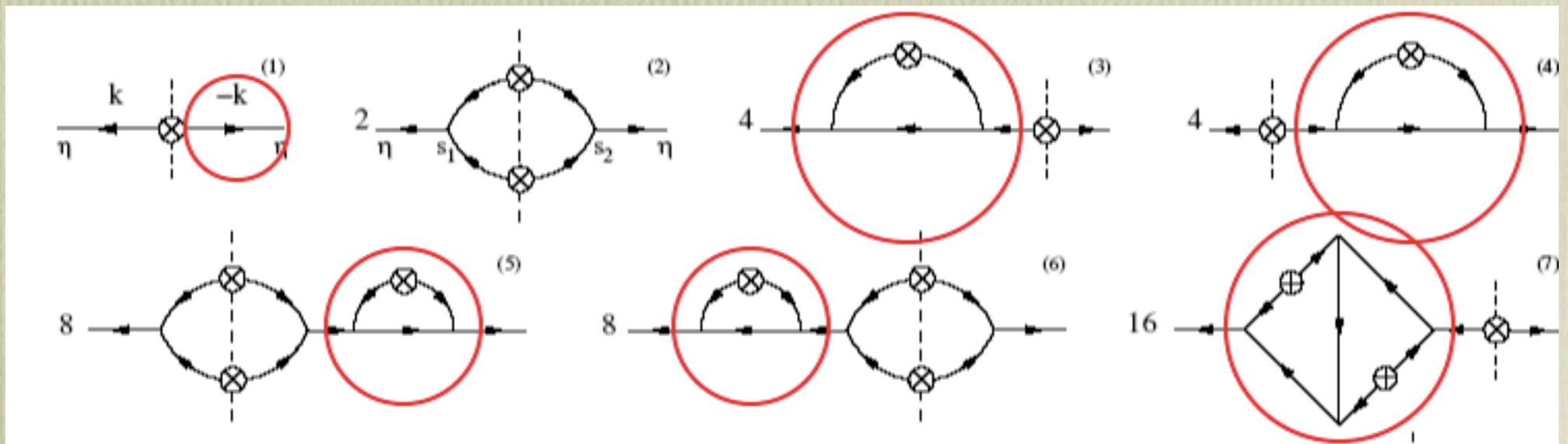
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gravitational amnesia . . .

perturbation theory: the disappearance of initial conditions,
death of the growth function

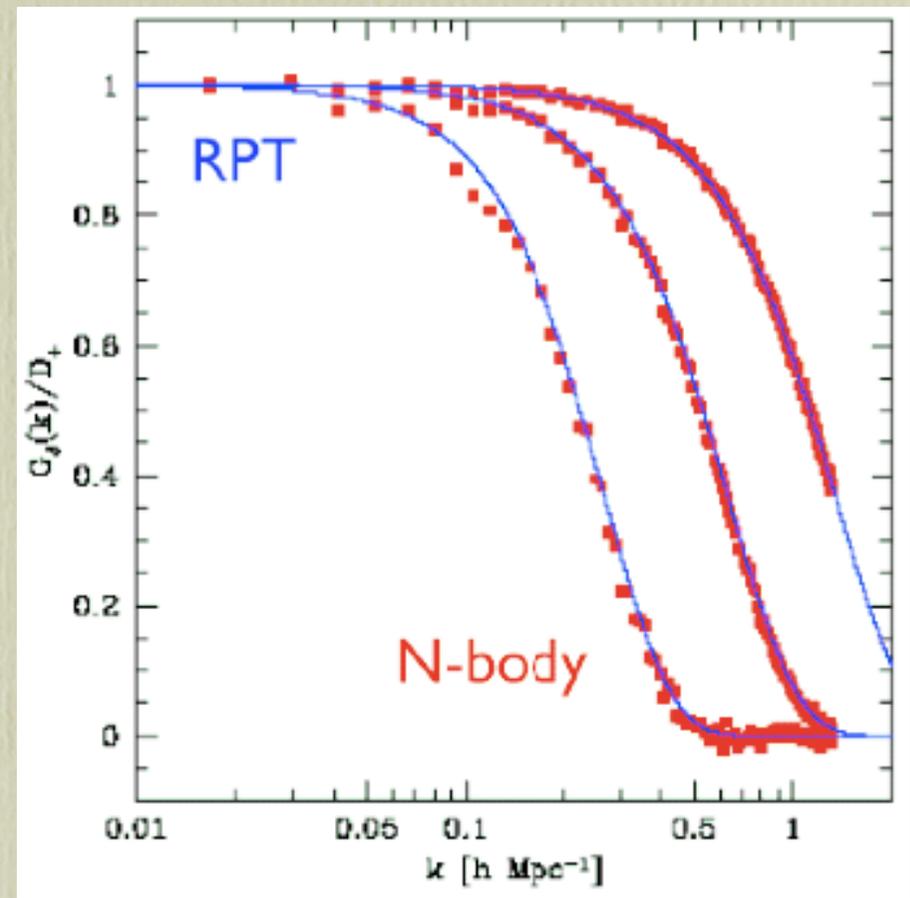
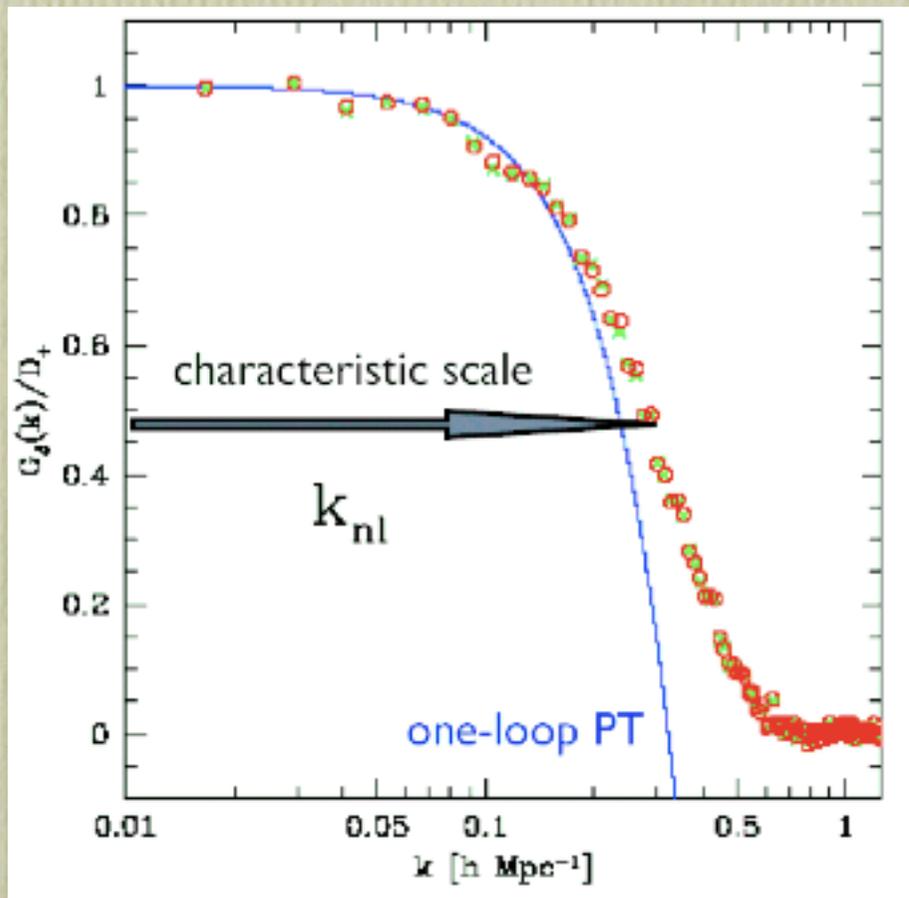


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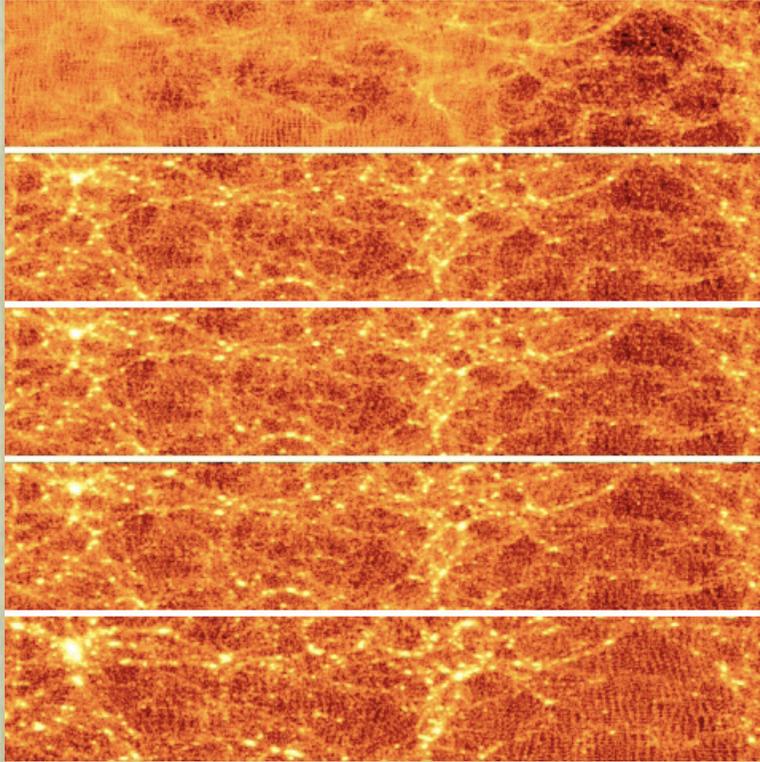
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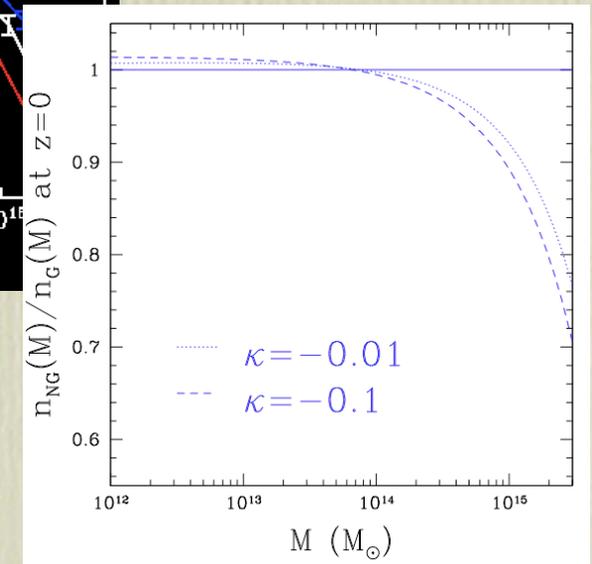
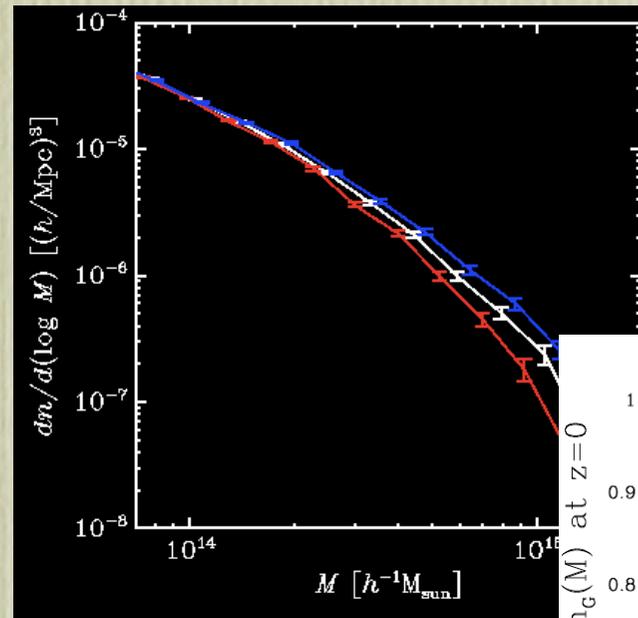
$$P(k, z) = \boxed{G_\delta^2(k, z) \times P_0(k)} + P_{\text{Mode Coupling}}(k, z)$$

recovered memory syndrome?



if there's a large signal
from primordial physics, easy!

the mass function —
lowest order probes
of “deep physics”



the psychiatrists

characteristic structures in the bispectrum —



can future analyses take advantage?

squeezed triangles (local, gravity) *vs.* equilaterals

(what if f_{NL} from strings is unity?)

P.S. — beware the halo model!

the ad-man

we will have plenty to look at —
especially early epochs —
let's include noise, build some filters,
and see what we can do!

the “non-Gaussian Olympics”

— Day Three —

The Explorers



Leonardo Senatore, Emiliano Sefusatti,
Sabino Matarrese, Eiichiro Komatsu,
Ben Wandelt, Kendrick Smith

— Day Three —

The Explorers



many models, much data!

Leonardo Senatore, Emiliano Sefusatti,
Sabino Matarrese, Eiichiro Komatsu,
Ben Wandelt, Kendrick Smith

fertile plains in the New World

at $k \sim 0.2$ — bispectrum has more information!

ADEPT: can do f_{NL} (local) of order unity, even when being conservative about maximal k



f_{NL} will continue to be the *lingua franca* of Fisher matrices

what estimator to use?

$$\frac{f_{\text{NL}} \Phi^2}{\Phi} \approx 0.1\%$$

editorial point : the rigorous Gaussianity of the CMB
has led people to talk in terms of the bispectrum

the bispectrum is the optimal estimator
for the bispectrum

Minkowski Functionals — alternative,
different systematics

void ellipticities, *e.g.*

Huterer *Ansatz*, $D_{\text{hut}} = \frac{\text{major}}{\text{minor}} - 3$

depending on the properties of the noise,
other non-Gaussian foregrounds,
strange mode coupling from geometry,
or a strange kind of “bias” —

may want to come up with alternative techniques —
something we haven’t discussed much here

(also consider the many non-Gaussian fields in “ordinary” cosmology!
— reionization, *e.g.*)