

Title: Rethinking Cosmology

Date: Mar 06, 2013 02:00 PM

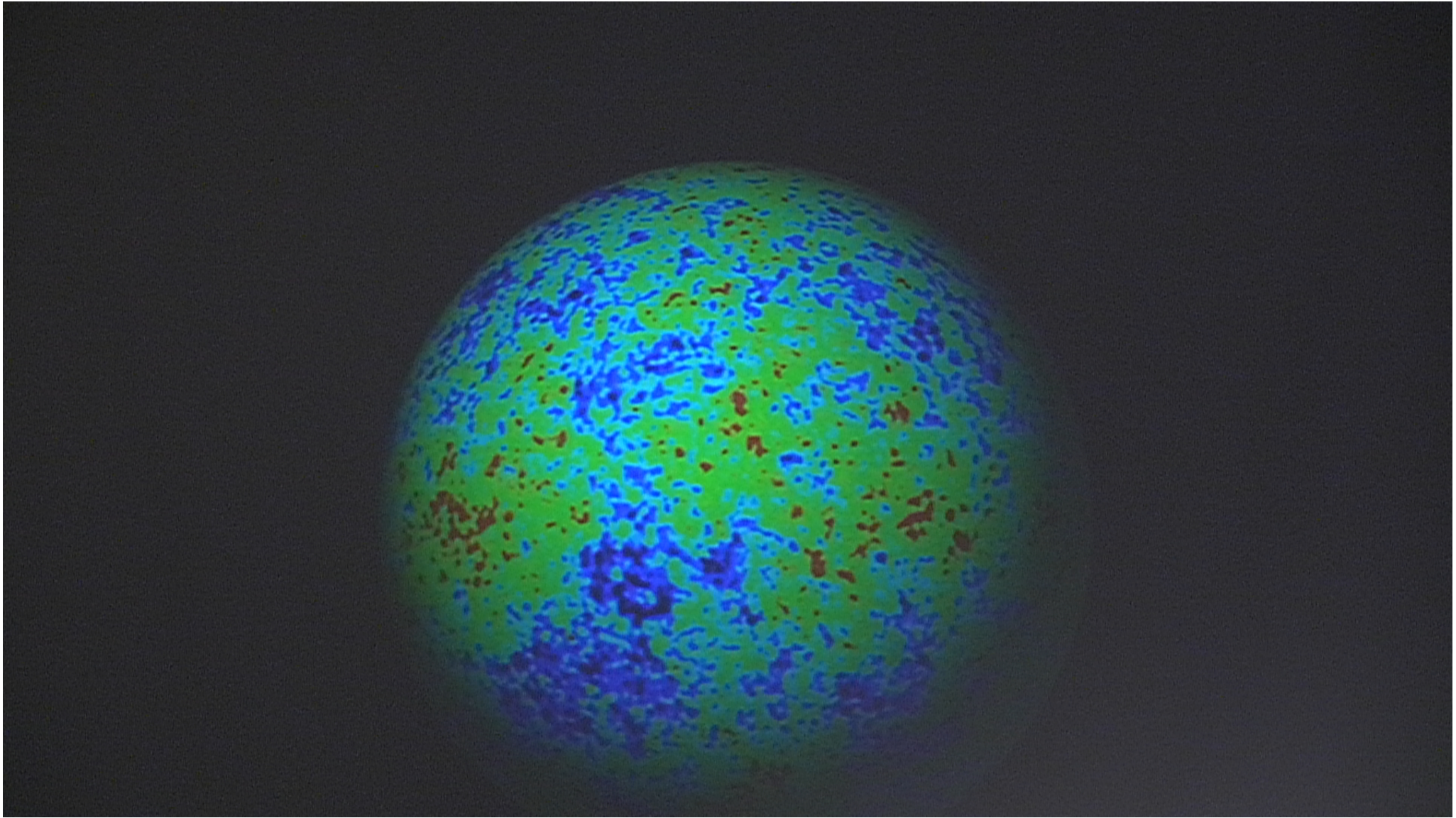
URL: <http://pirsa.org/13030079>

Abstract: This talk will begin by discussing one by one the various reasons why cosmologists today consider the big bang inflationary cosmology to be the leading, if not proven, theory of the universe and

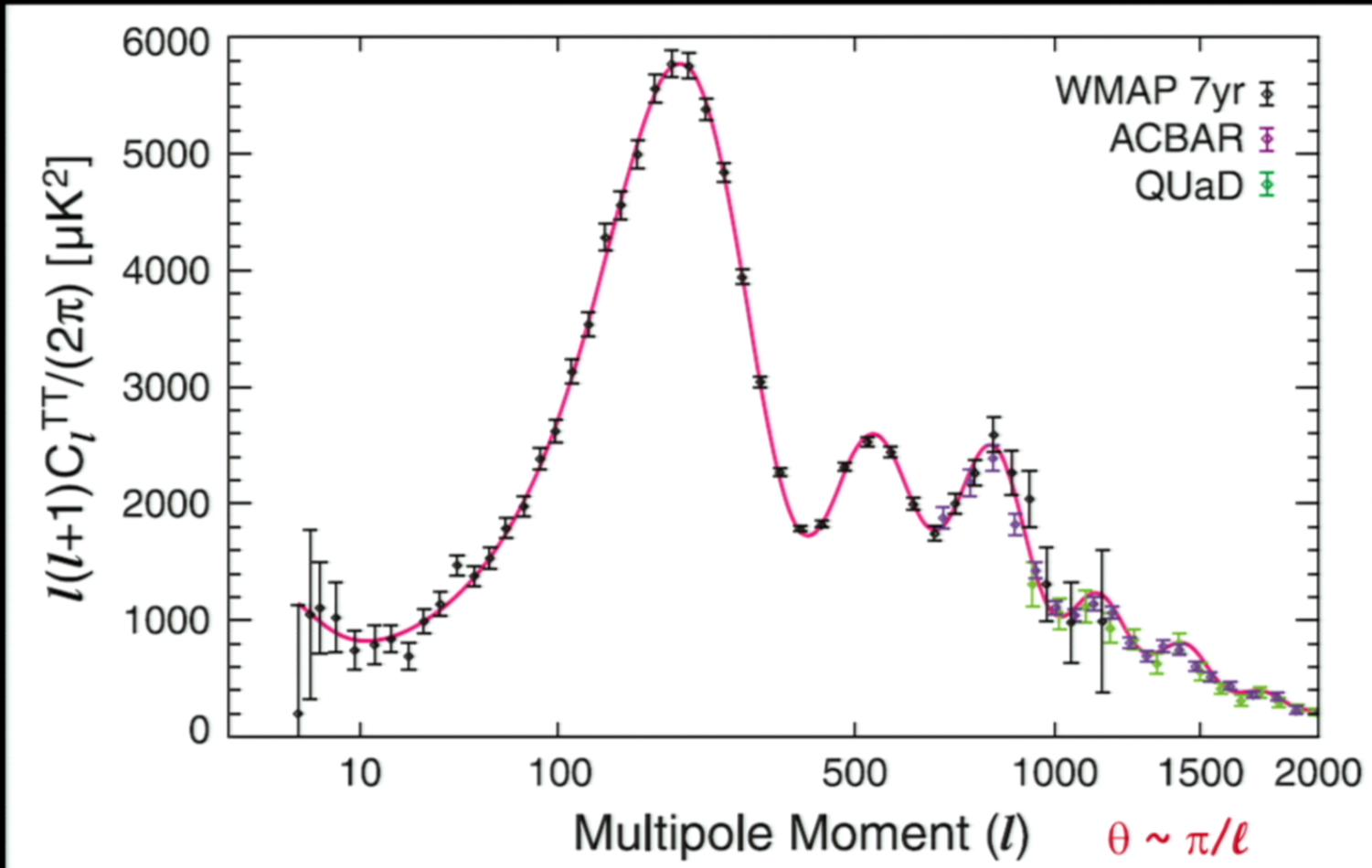
then explaining
why each of these reasons is flawed. This leads

naturally to the question: what is the alternative? Understanding the flaws helps point the way.

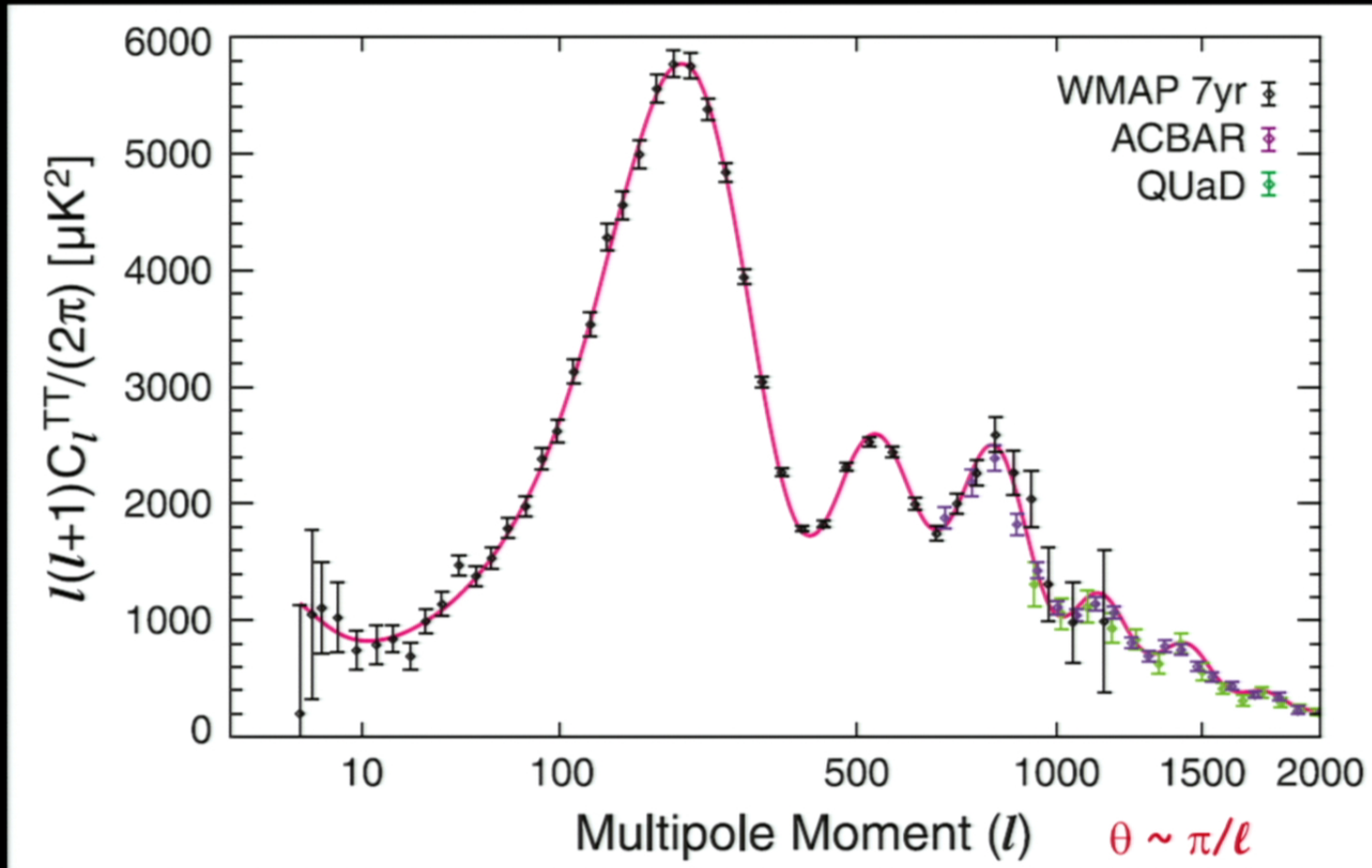




the age of precision cosmology



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the big bang inflationary paradigm
has failed

The inflationary myth:

- inflation transforms an arbitrary chaotic initial state into an ordered (flat, smooth) final state
- inflation explains: homogeneity, isotropy, flatness & absence of monopoles
- inflation predicts: near scale invariance, tilt, gaussianity, adiabaticity, cosmic gravitational waves, consistency relations

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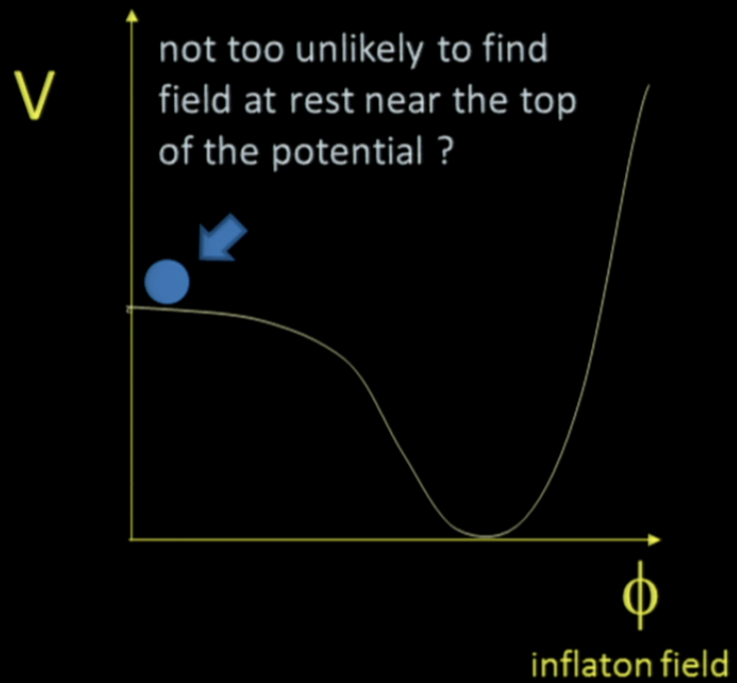
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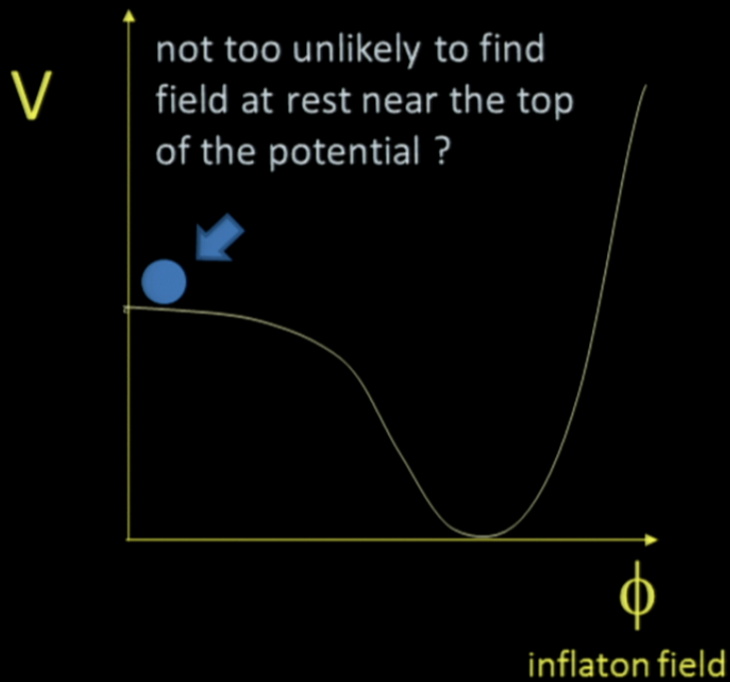

$$S_{max} \sim 1/V > 10^{120} \quad S_{today} = 10^{100} \quad S_{inflation} < 10^{20}$$

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Chaotic initial conditions?



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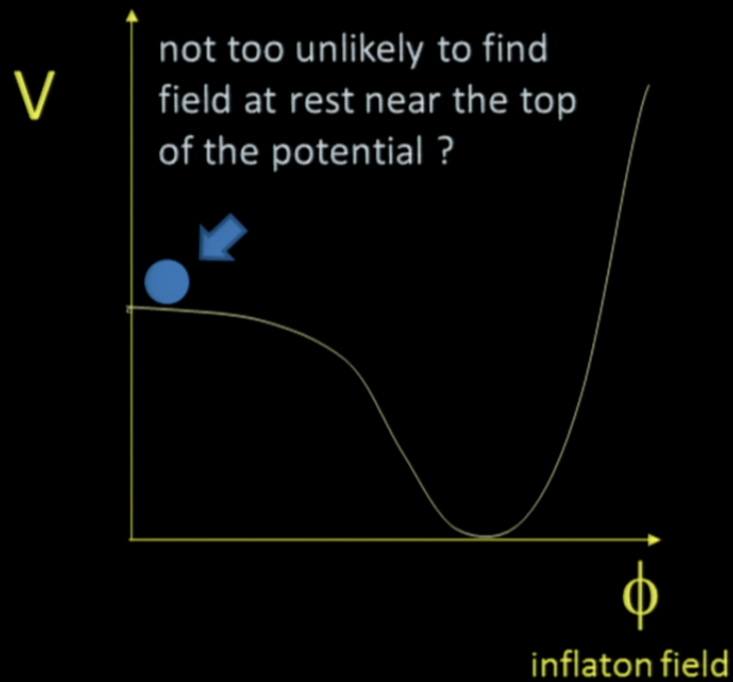


very unlikely to find the field at rest anywhere!!

$$KE \sim 1/a^6 \text{ as } a \rightarrow 0$$

PE \rightarrow constant

Chaotic initial conditions?



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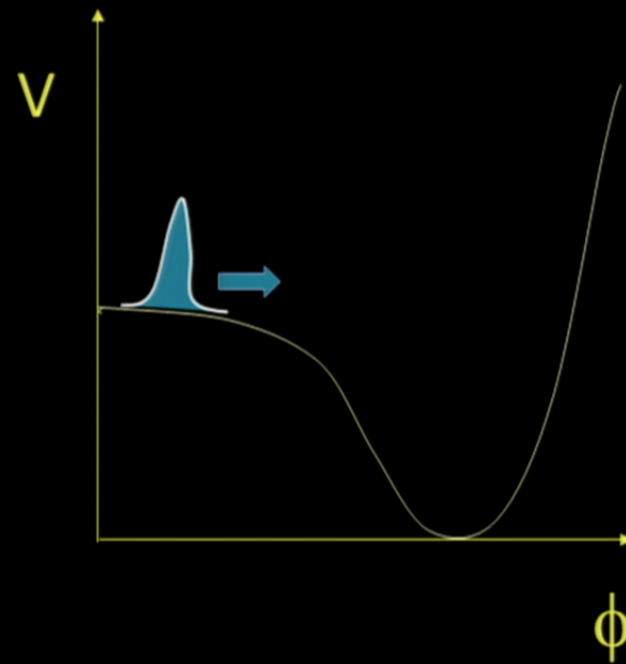
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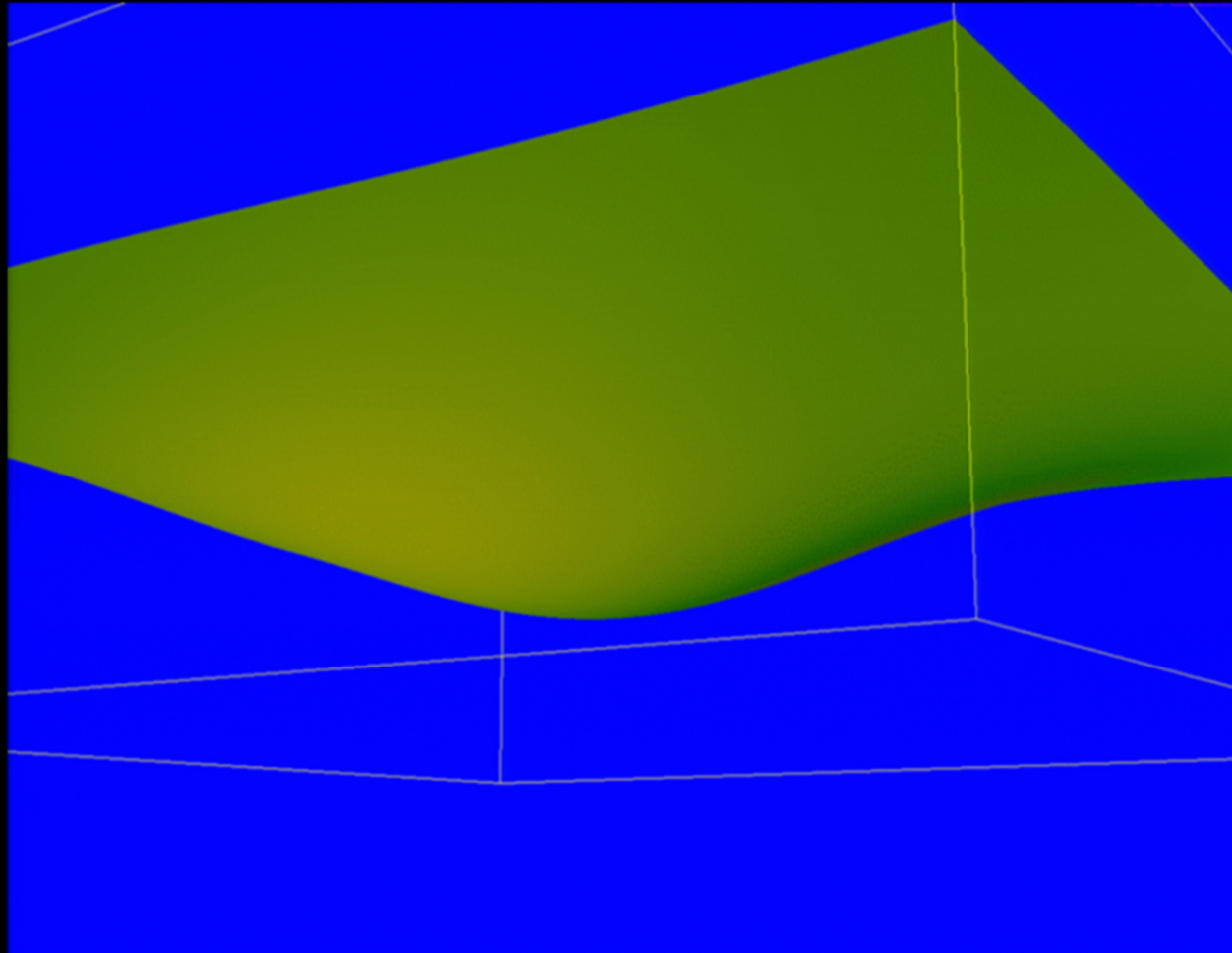
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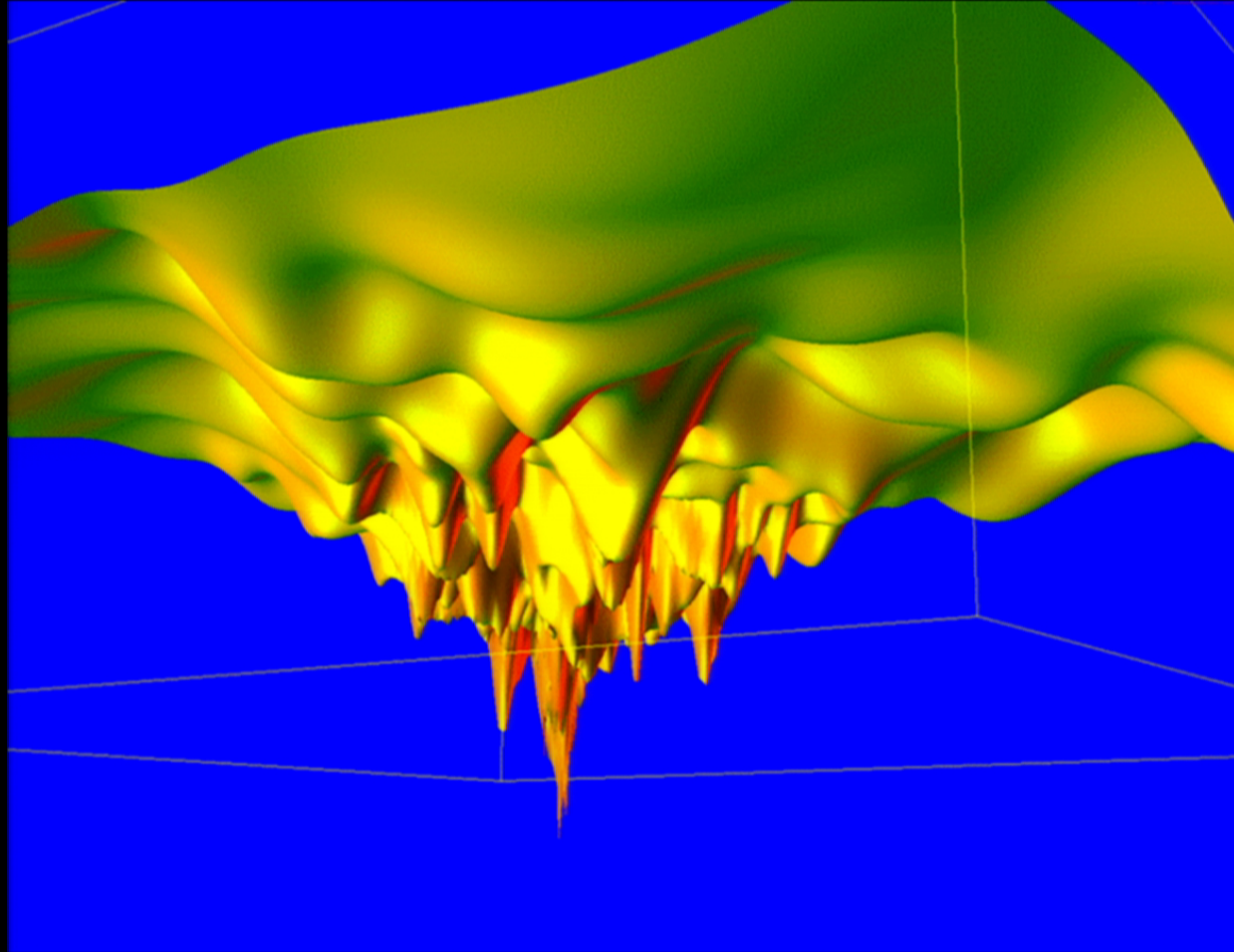
Eternal inflation



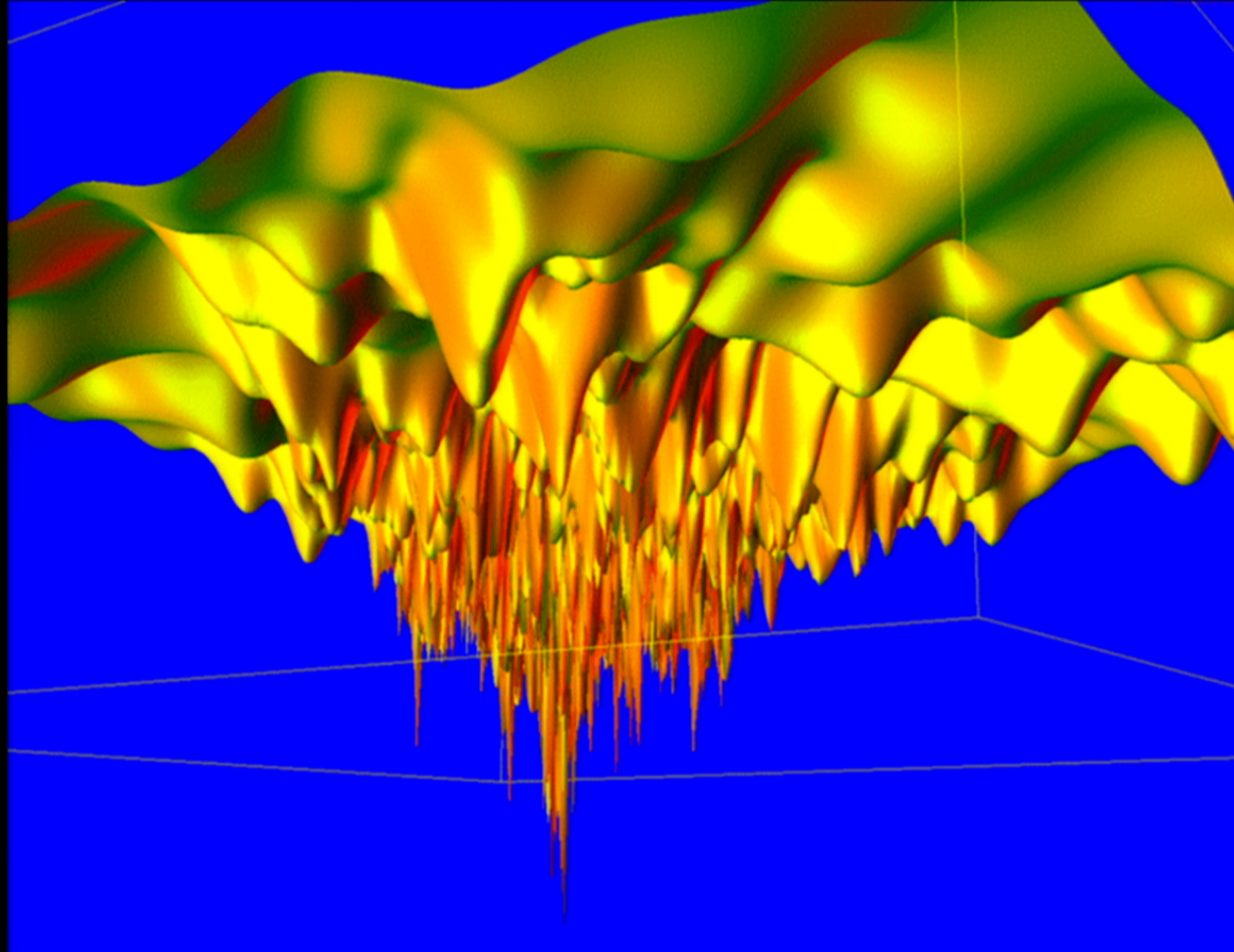
Vilenkin, 1983
PJS, 1983



Linde, Linde, Mezhlumian, PRD 50, 2456 (1994)

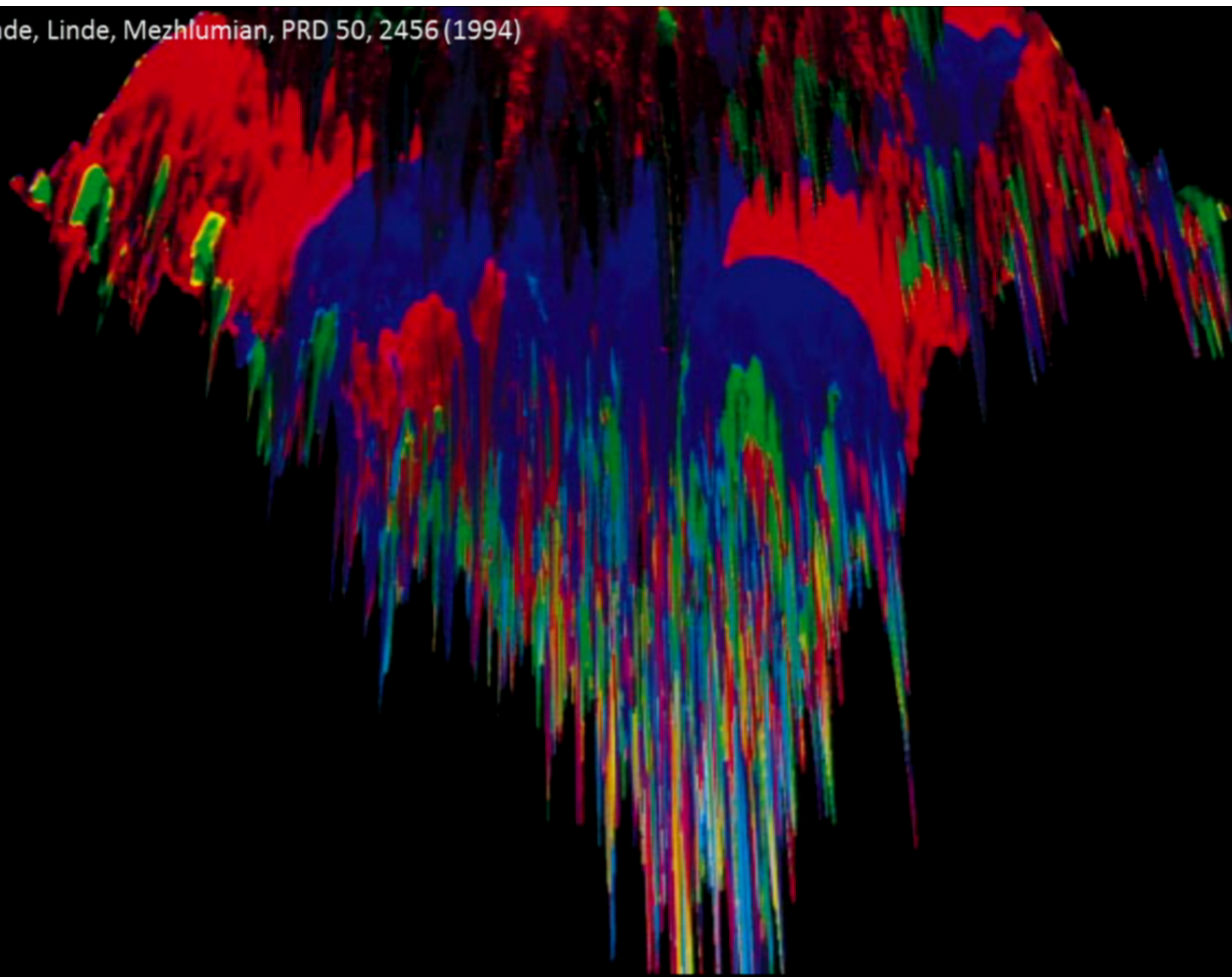


Linde, Linde, Mezhlumian, PRD 50, 2456 (1994)



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“anything that can happen will happen
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- unmitigated disaster:
 maximally unpredictable theory
- any claims that CMB and large scale structure
 data support or prove inflation are misleading
 nor are there any future tests that can prove
 or disprove it

Measure? Anthropics?

– the Great Leap Backwards

Measure? Anthopics?

- the Great Leap Backwards
- now any “predictability” rests entirely on measure
- how to distinguish from other unproductive models?

Rethinking Cosmology

the universe emerges from the big bang
with the right conditions

the big bang is a big bounce

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no flatness or causal connectedness problem

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new mechanism for smoothing the universe prior to the bang

$$H^2 = \frac{8\pi G}{3} \frac{\rho_m^0}{a^3} + \frac{8\pi G}{3} \frac{\rho_r^0}{a^4} + \frac{\sigma^2}{a^6} + \dots - \frac{k}{a^2}$$

Khoury, Ovrut, PJS, Turok
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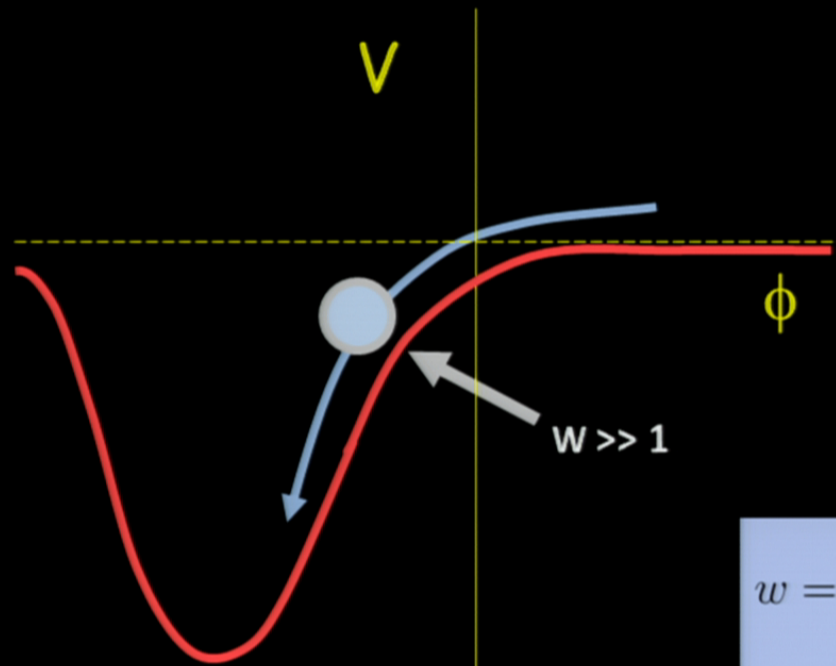
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$$+ \frac{8\pi G}{3} \frac{\rho_\phi^0}{a^{3(1+w)}} \leftarrow w \geq +1$$

Khoury, Ovrut, PJS, Turok
Wesley, Erickson, PJS, Turok

$w > 1 ?$



$$w = \frac{\frac{1}{2}\dot{\phi}^2 - V(\phi)}{\frac{1}{2}\dot{\phi}^2 + V(\phi)}$$

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predictions:

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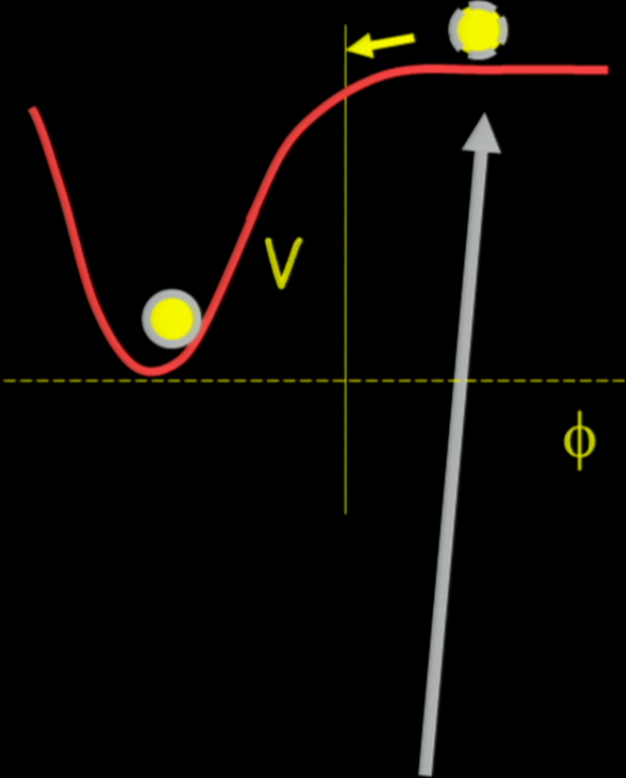
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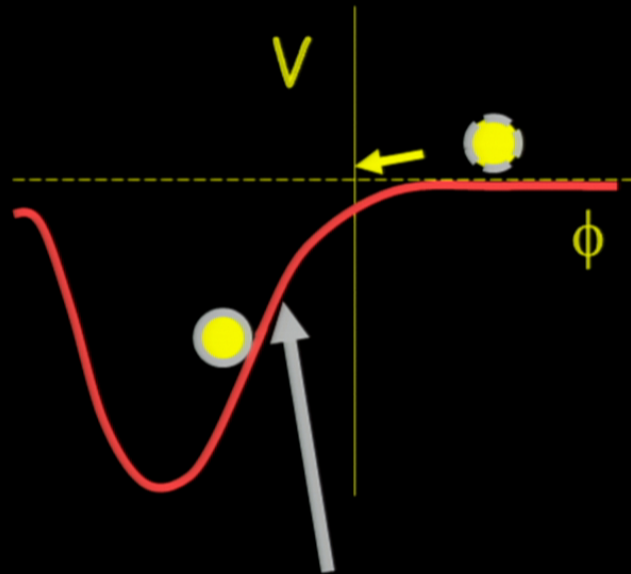
no eternal runaway/multiverse: a predictive theory!

INFLATION



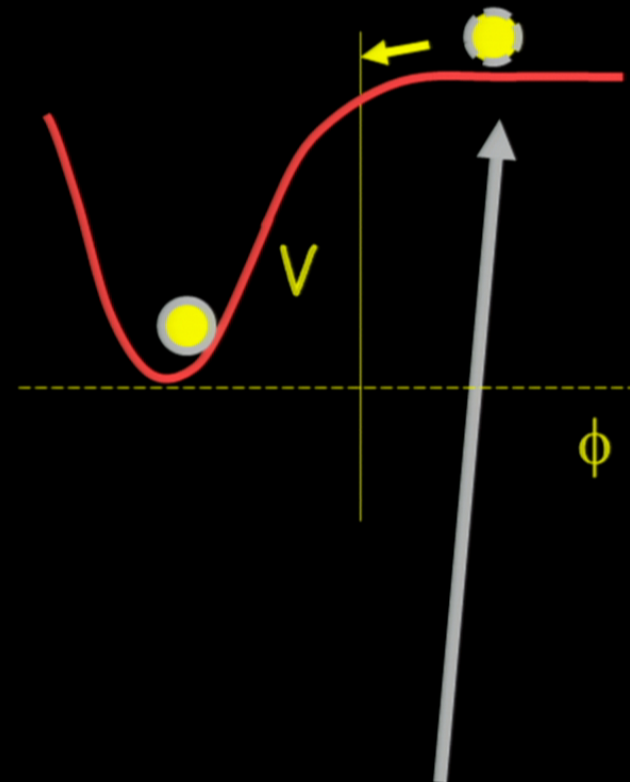
rare fluctuations
that delay reheating
grow exponentially
eternal/multiverse

EKPYROSIS



rare fluctuations
that delay reheating
shrink
no multiverse

INFLATION



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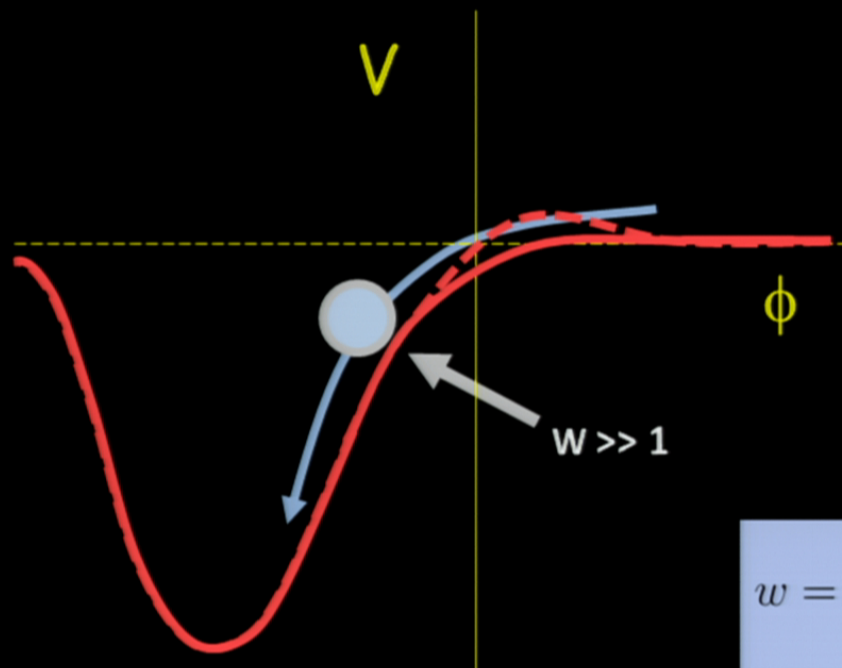
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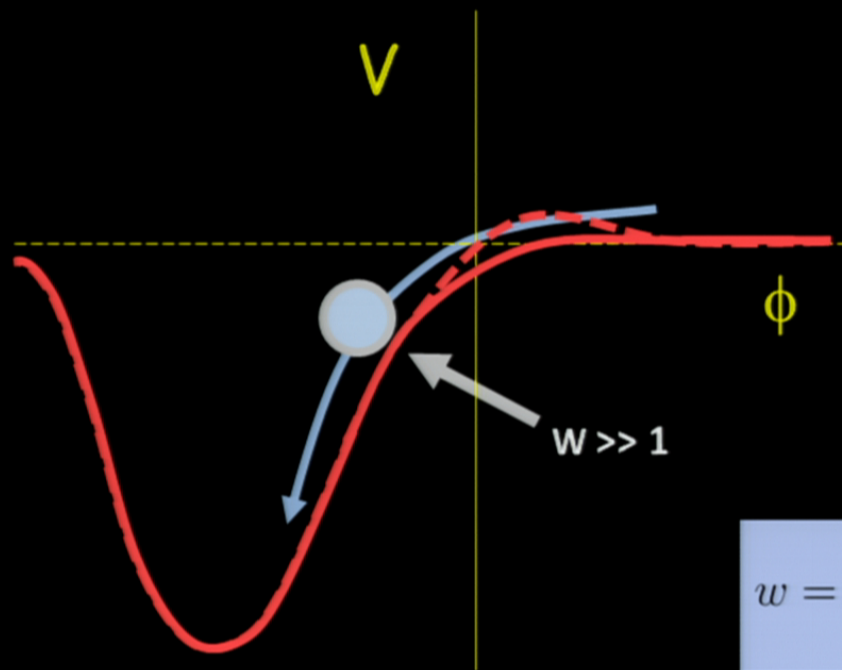
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may compete successfully with inflation (see J-L Lehnars 2012)

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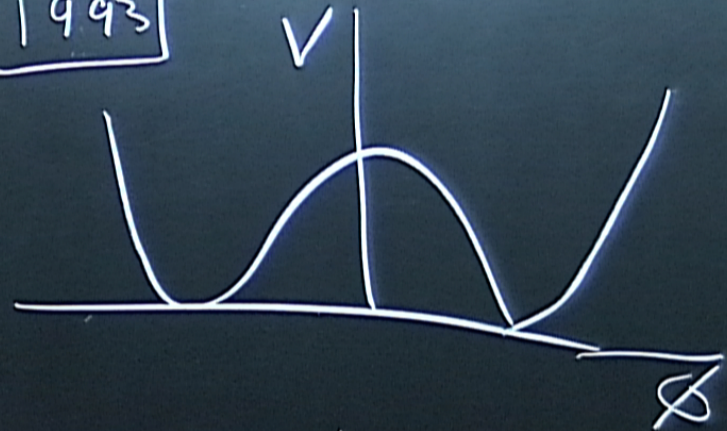
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may explain what we have learned about the state of the vacuum

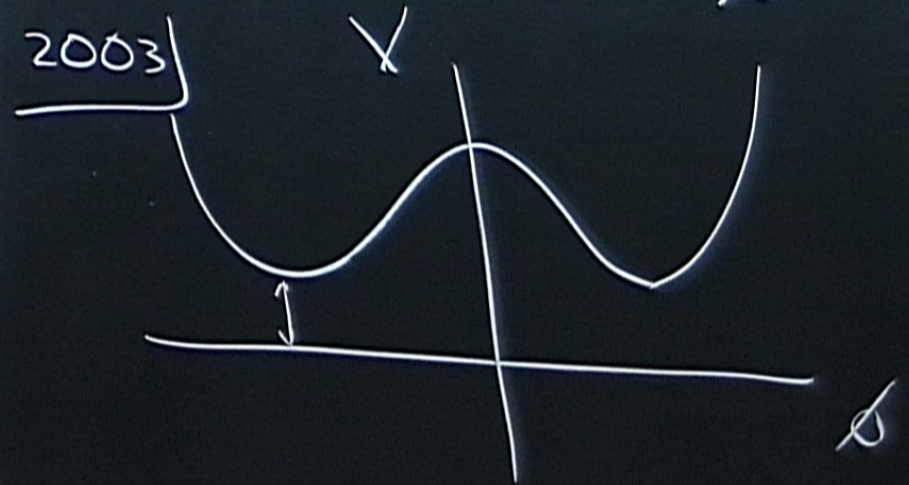
the state of the vacuum

3

1993



2003

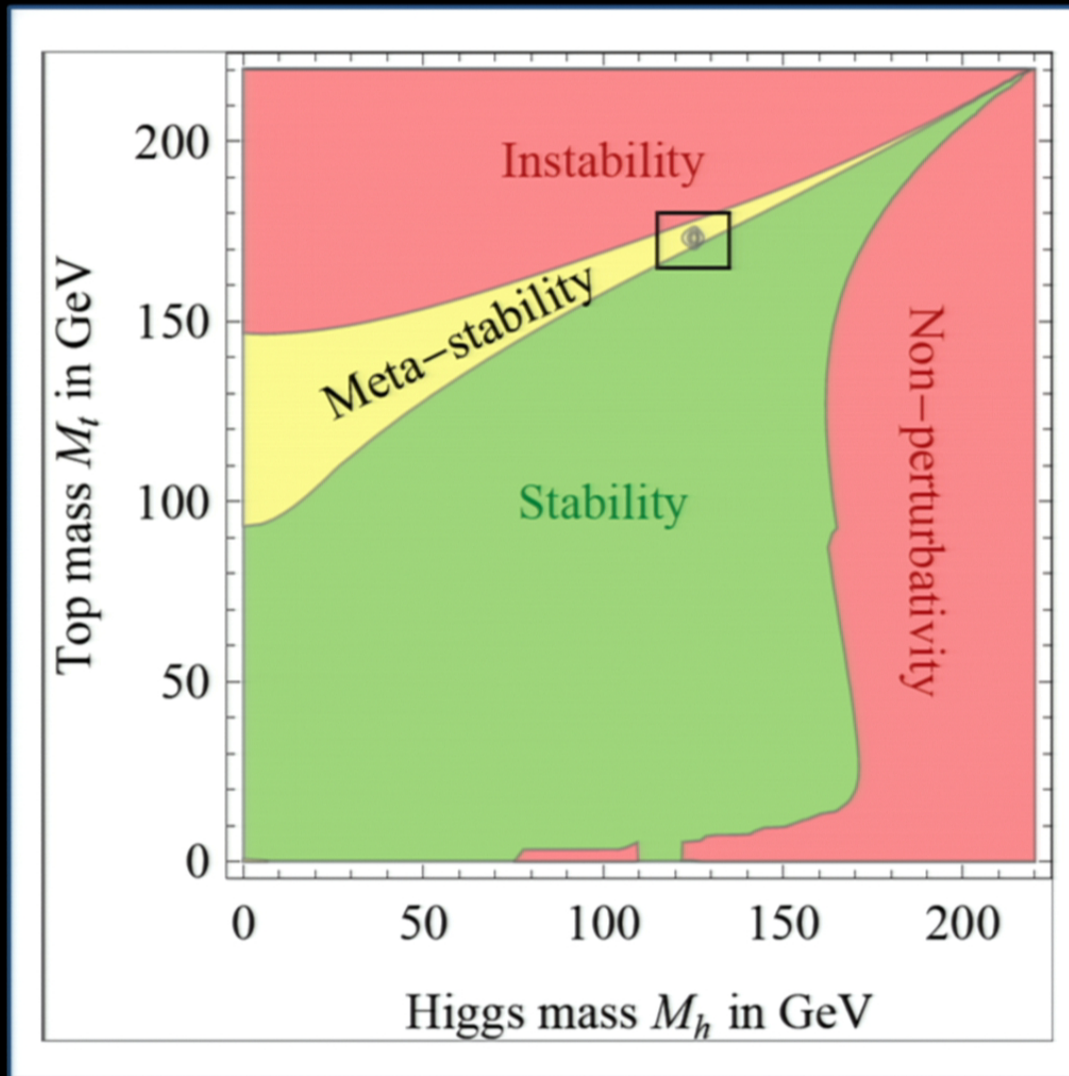


2013

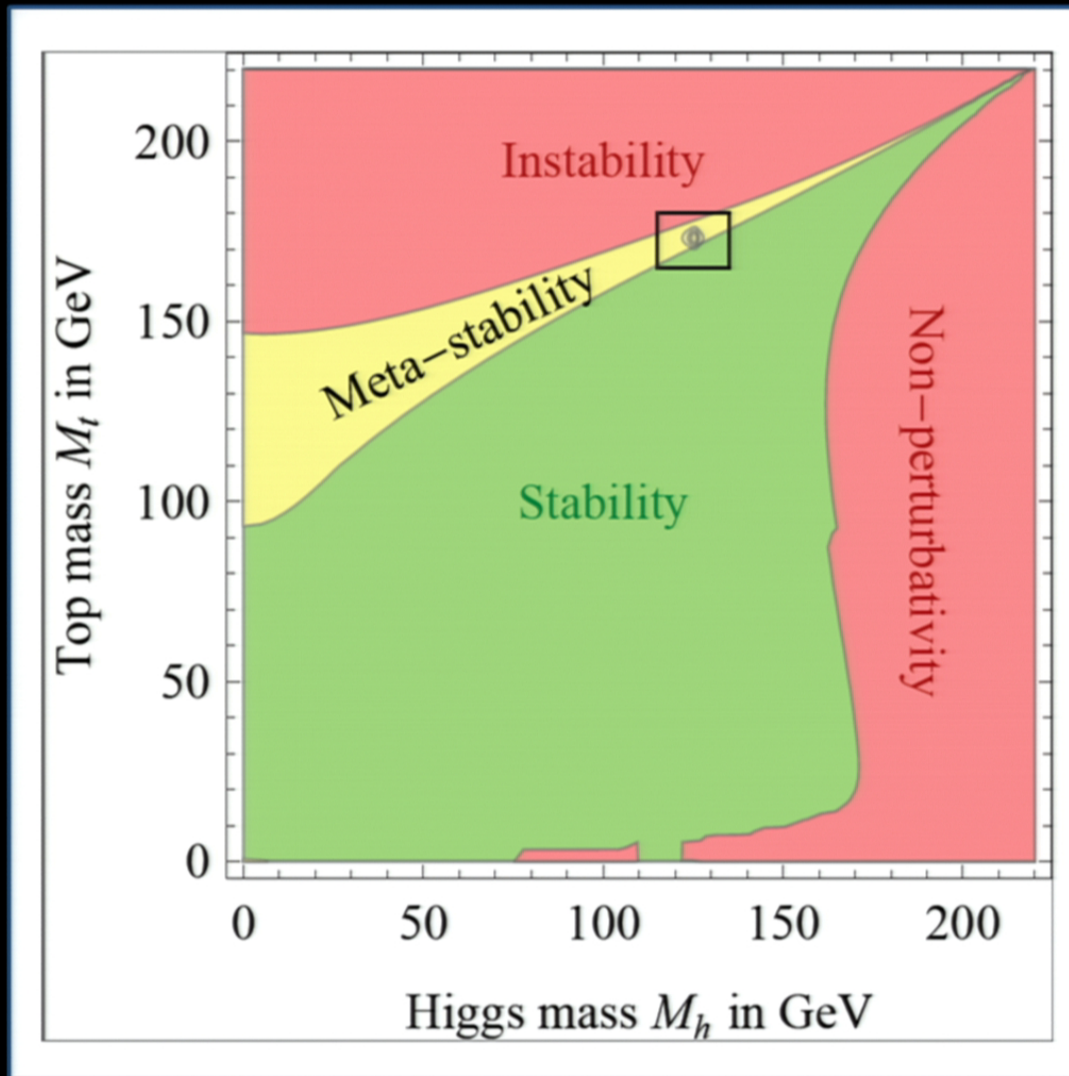


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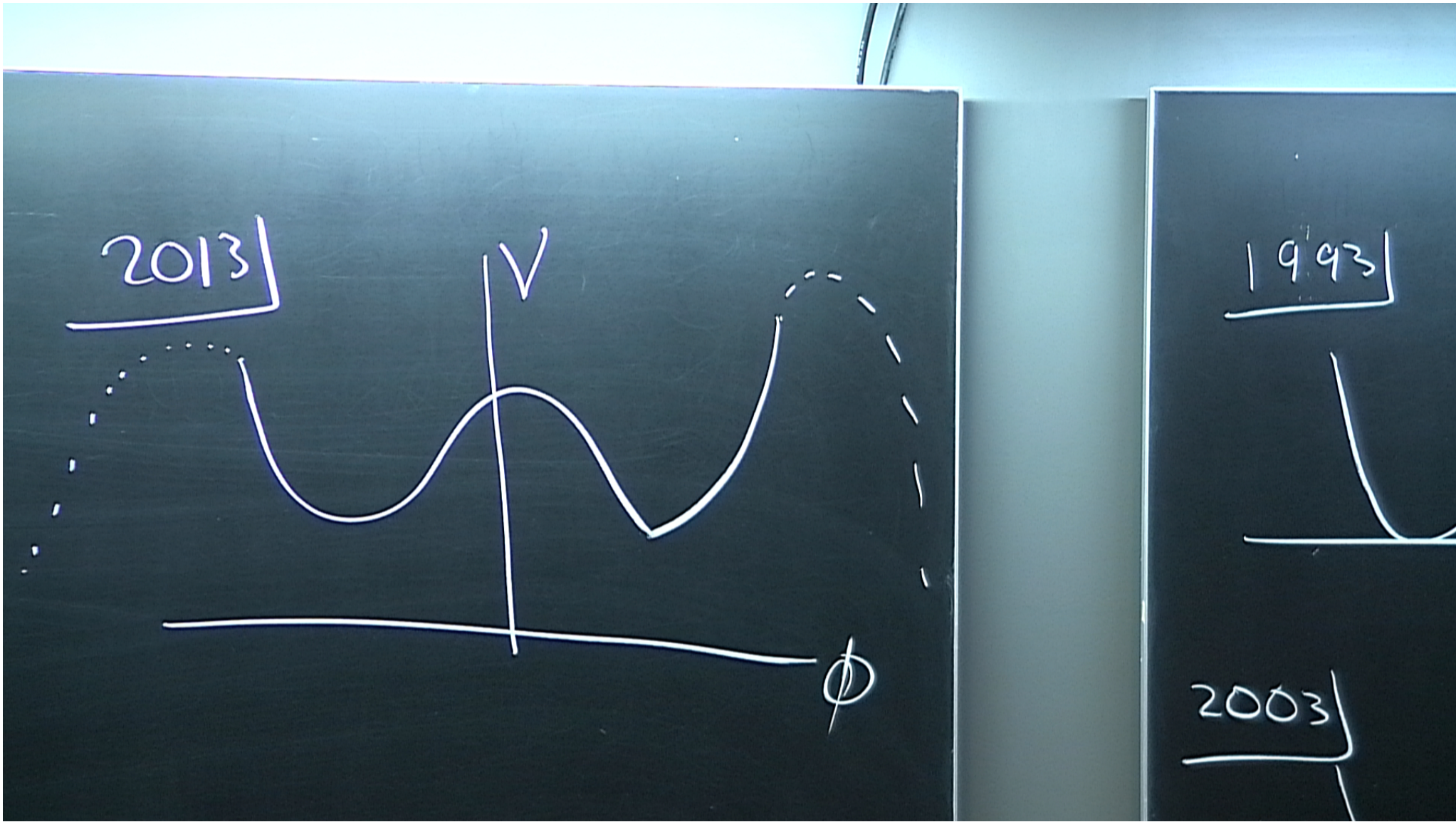
2003

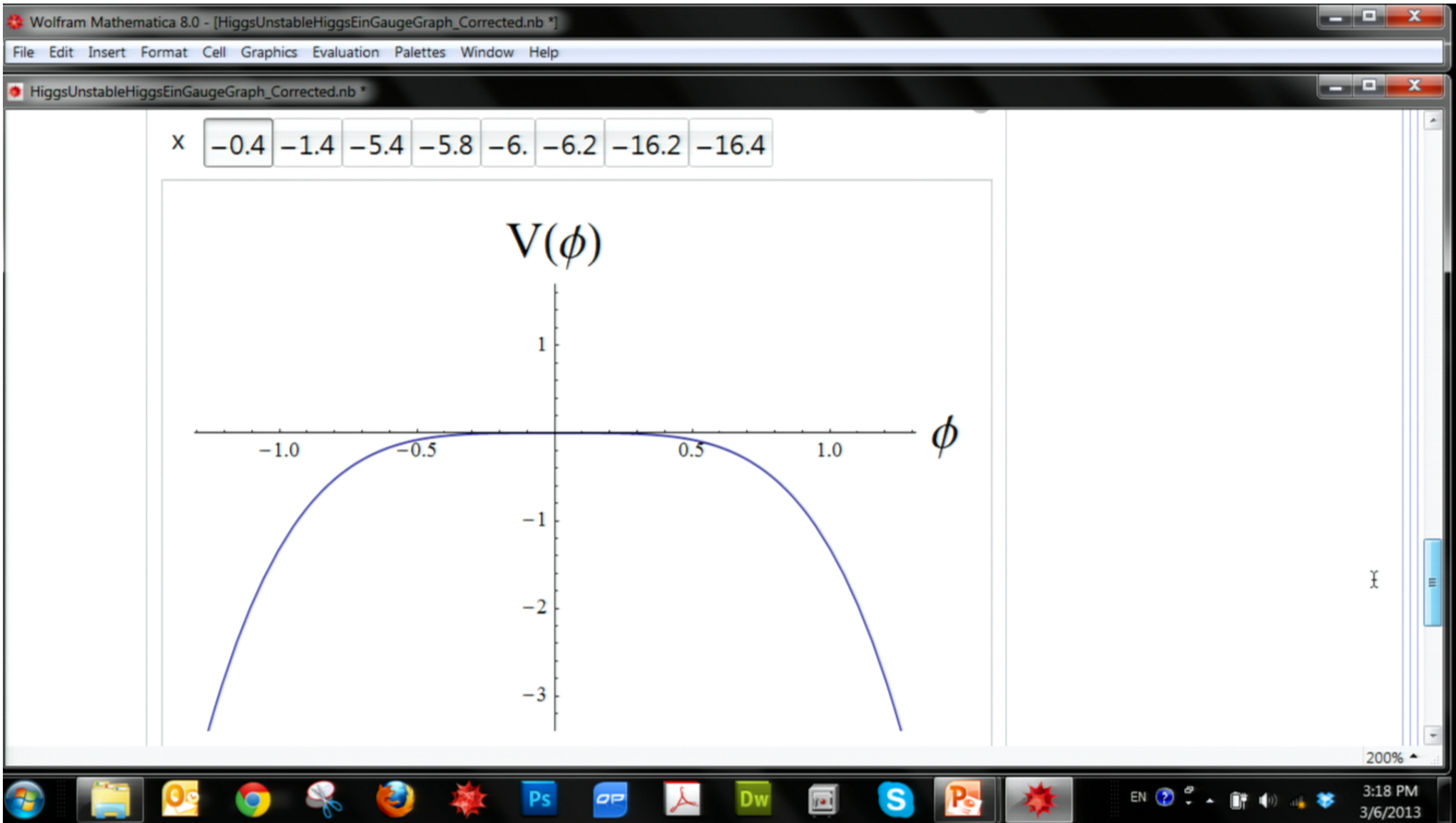


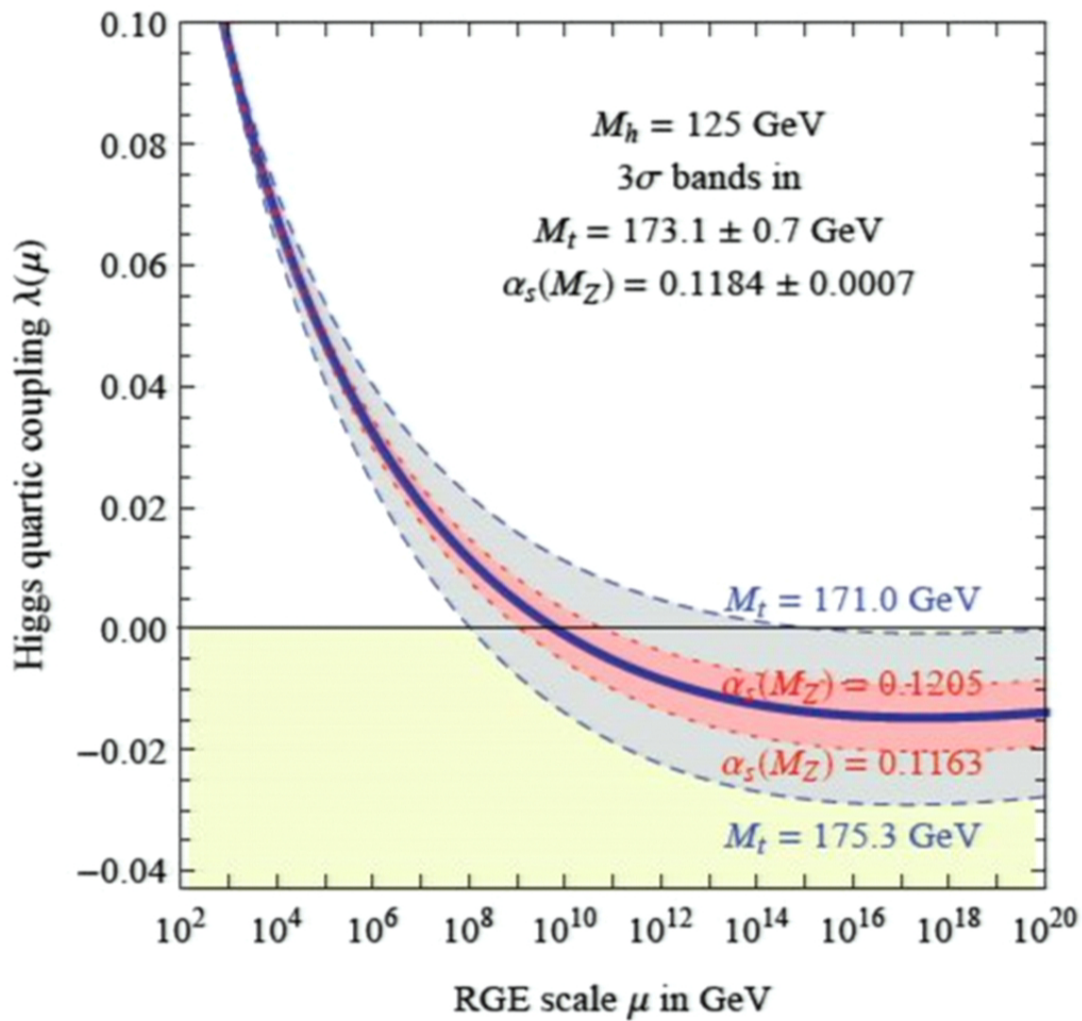
Degrassi, DiVita, Elias-Miro, Espinosa, Giudice, Isidori Strumia (2012)



Degrassi, DiVita, Elias-Miro, Espinosa, Giudice, Isidori Strumia (2012)







Nearly scale-free
at large Higgs

Degrassi, DiVita, Elias-Miro, Espinosa, Giudice, Isidori Strumia (2012)

cyclic solutions & the higgs

w/Itzhak Bars & Neil Turok

a big bounce is *better*
than a big bang