

# Limitations on local QFT descriptions of de Sitter space

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more discussion:

[hep-th/0703116](#) (Quant in BH backgrounds)

[arXiv:0705.1178](#), w/ Marolf

Don's presentations

Recall BH story:

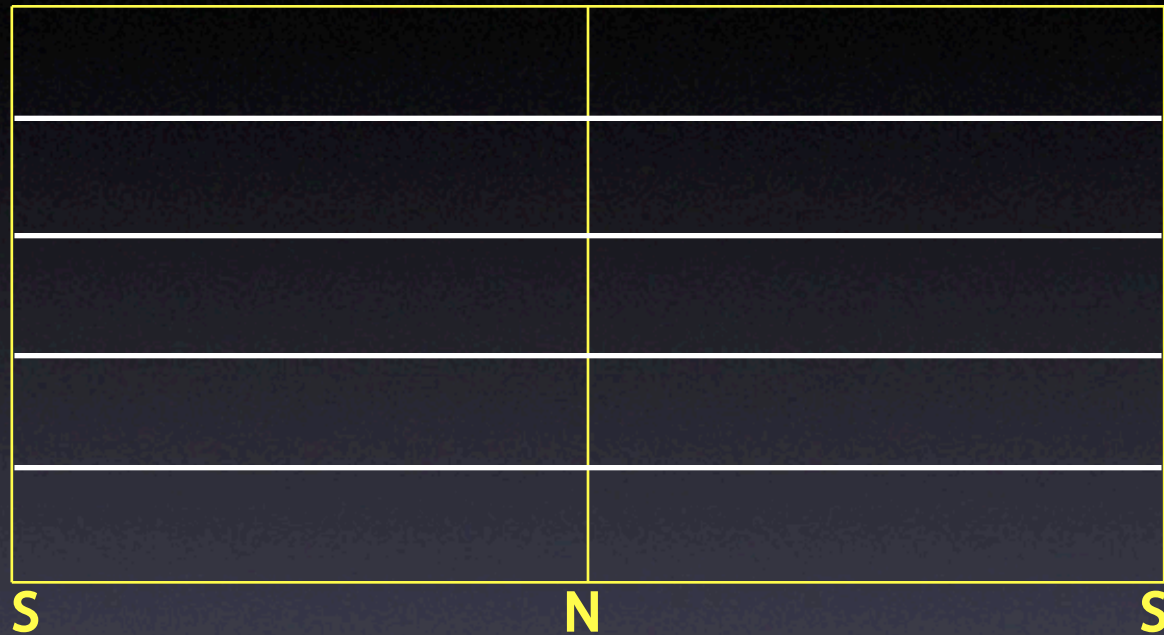
Significant couplings between fluctuations in “nice slice”  
description at time scales  $t \sim M^3$

Corresponding story here?

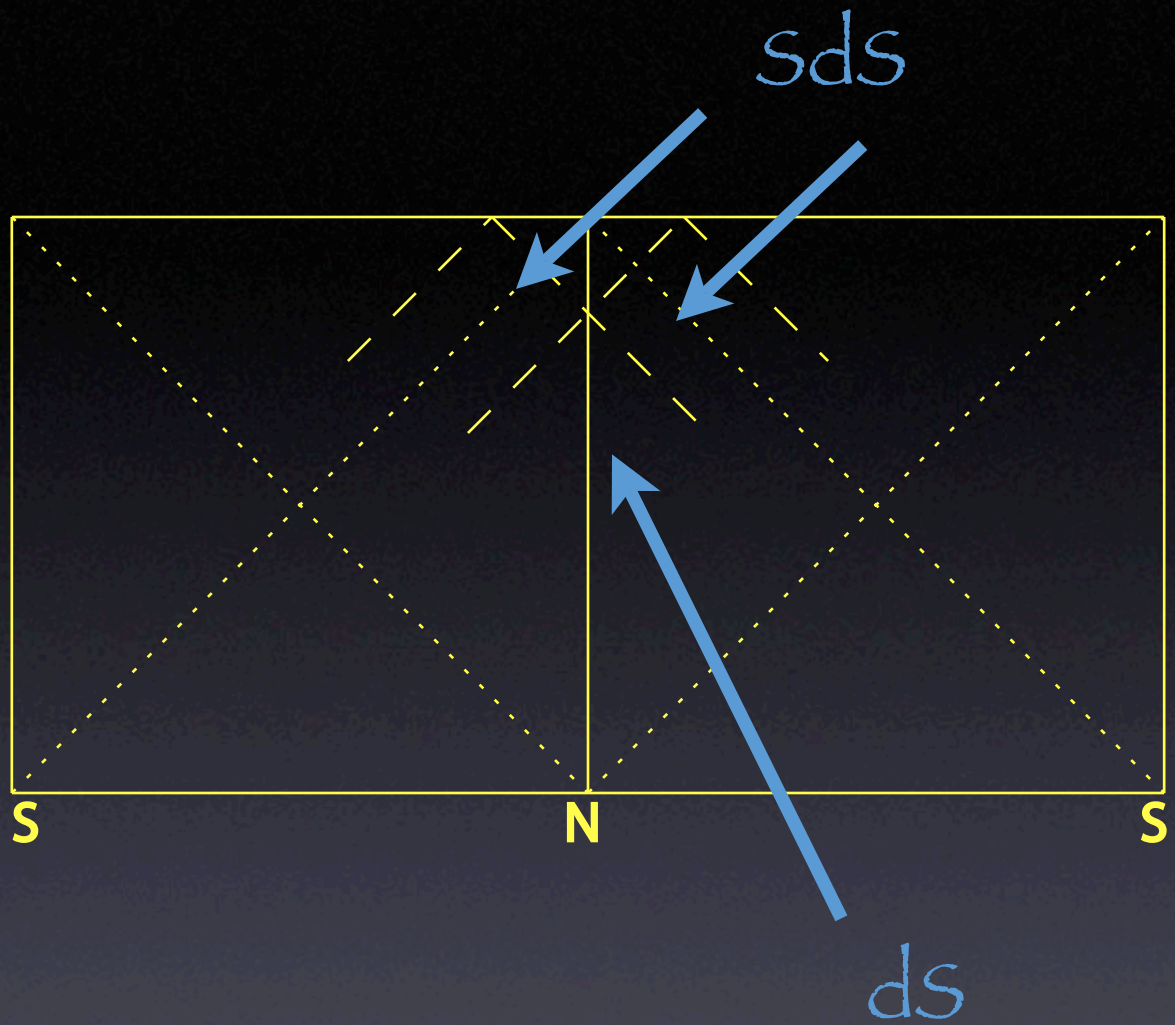
Nima, Sergei, ...: slow roll inflation goes eternal  
at  $t \sim R_{dS}^3$ , etc.

Other indicators?

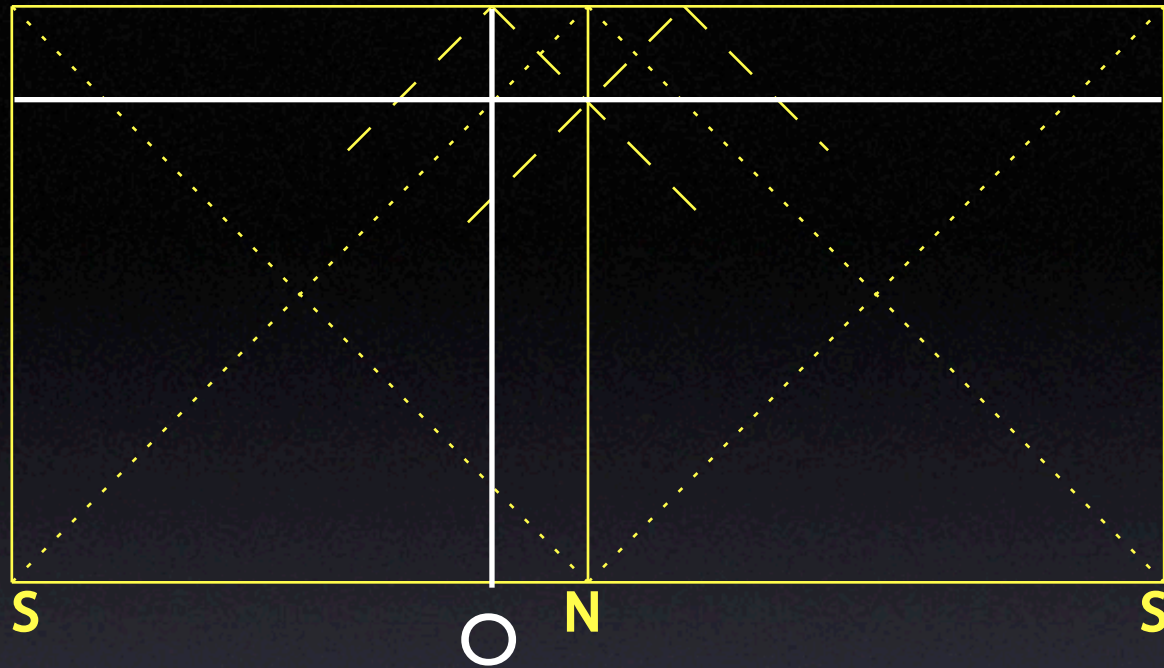
Nice slice evolution for dS:



When do fluctuations become important?



$$\delta m \sim \frac{1}{R_{dS}}$$



1. Observer  $O$  expected to see  $T + \delta T$
2. Deformation of geometry; shift in state (e.g. phase as seen by  $O$ )
3. When?

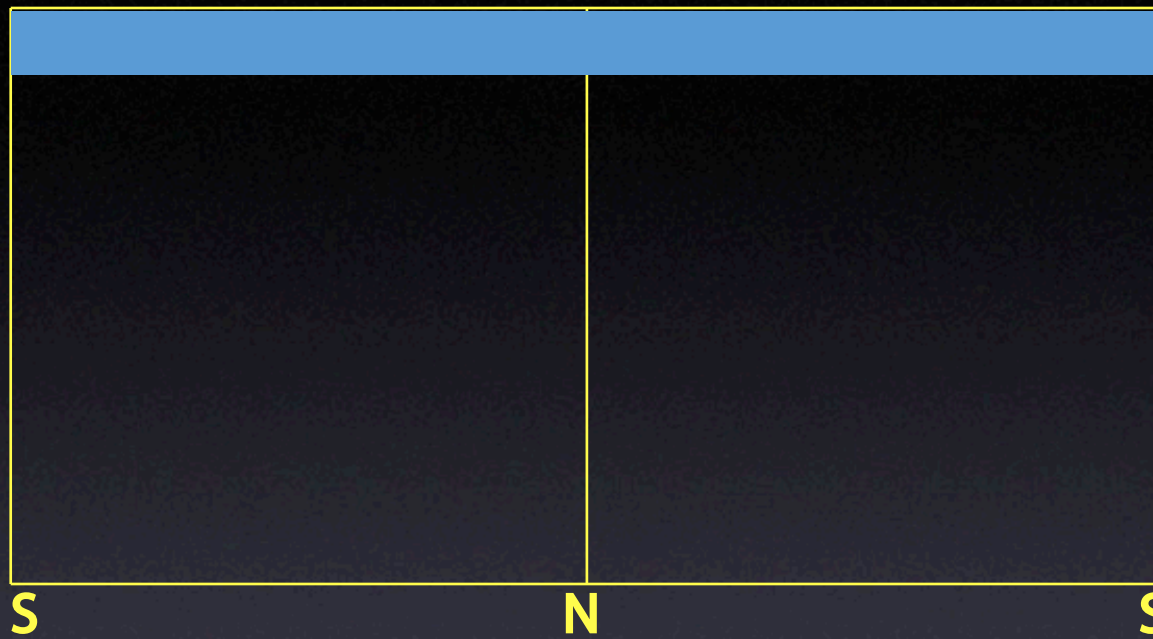
$$\delta s \sim R_{dS} \Leftrightarrow t \sim R_{dS} S_{dS} \sim R_{dS}^3$$

... Analogy to BH argument for significant coupling  
between fluctuations:

Limit of local QFT description?

Another argument pointing to this timescale:

# The Boltzmann brain population explosion:



$$t \sim R_{dS} S_{dS}$$

(~ large thermal fluctuations; see older arguments of Banks et al, Bousso)

Largest observer:  $m \leq R_{dS}$

Number/dS volume:  $\sim \exp\{-S_{dS}\}$

Total number:  $\sim \exp\{N - S_{dS}\}$

Thus for  $t \geq R_{dS} S_{dS}$

the most robust relational  
observables “confounded”

(in practice, earlier)

(How to isolate the observer you want from the  
miasma of Boltzmann brains??)

(Though with appropriate conditionals, may be  
able to focus on “causal patch” for longer? For  
more on some conditionals: Don)



Conclusion:

The effects:

- 1) Inflation going eternal (chaotic)
- 2) Large flucsts of nice slice states  
(NA-H+SD+...  $\leftrightarrow$  SG?)
- 3) Confounding of observables by BBs

All suggest limitations to local QFT  
description of global geom at time scale

$$t \sim R_{dS} S_{dS}$$