

Superstring Cosmology?

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- braneworlds
- singularities
- CMB
- $\Lambda > 0$?
- holographic principle
- initial conditions

Braneworlds -

- large extra dimensions \rightarrow
transition from higher-dimensional
cosmology is relatively recent
- inflation from strings?



brane



antibrane

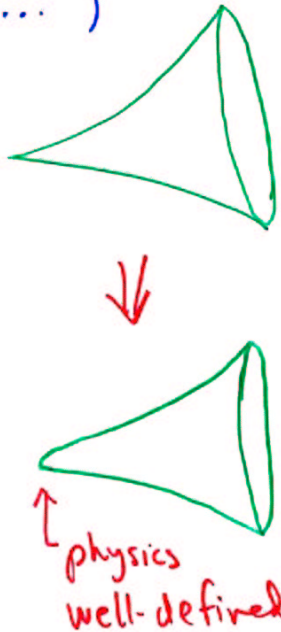
$V(\text{separation})$



- ekpyrotic ...

Singularities -

String theory resolves various kinds of spacetime singularity (conifold, orbifold, flop, D-brane horizon, repulson, ...)



But these are all static geometries

PBB, ekpyrotic \rightarrow Big Bounce

KOSST: ekpyrotic crunch/bounce
 \approx orbifold; allowed in string theory?

or, is a Big Crunch the end of time?

CMB

- blue tilt, tensor perturbations in bouncing cosmologies?
- $\frac{H_{\text{inflation}}}{M_{\text{string}}}$ effect?

$\Lambda > 0$: (1) practical and (2) conceptual problem in string theory

(1):

Old question: are there any string vacua like ours -

- 3+1 dimensional
- no unbroken supersymmetry
- stable (or long-lived)
- no Brans-Dicke-like scalars (moduli)
- zero cosmological constant

?

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(1):

Old question: are there any string vacua like ours -

- 3+1 dimensional
- no unbroken supersymmetry
- stable (or long-lived)
- no Brans-Dicke-like scalars (moduli)
- ~~zero cosmological constant~~
small positive cosmological constant

??

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Answer: very likely (Silverstein)

But if there is one there are probably many. What chooses - random, anthropic, initial conditions?

$\Lambda = 0$ vs. $\Lambda > 0$

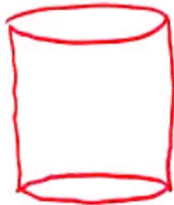
$\Lambda > 0$ vs. quintessence

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Holographic principle -

What is the central defining principle of string theory, analogous to the Equivalence Principle in GR and the Uncertainty Principle in QM?

Holo: Fundamental degrees of freedom are highly nonlocal, live on boundary of any given region. Has precise realization in anti-de Sitter space:



But for $\Lambda \geq 0$ we don't know!

Initial Condition

There should be a precise theory of the initial condition (cf. Hartle-Hawking and competitors). What is it?

Conclusim:

There are many interesting and timely questions, which interpolate between cosmological observation and the most fundamental questions in string theory.