

Do we live on the End of the World?

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Based on [2411.05912] w/ Tony Padilla and Paul Saffin

Nothing

~~Nothing~~
Something

~~Nothing~~

~~Something~~

sike...

Nothing

“You only realise the importance of someone when they are gone.”

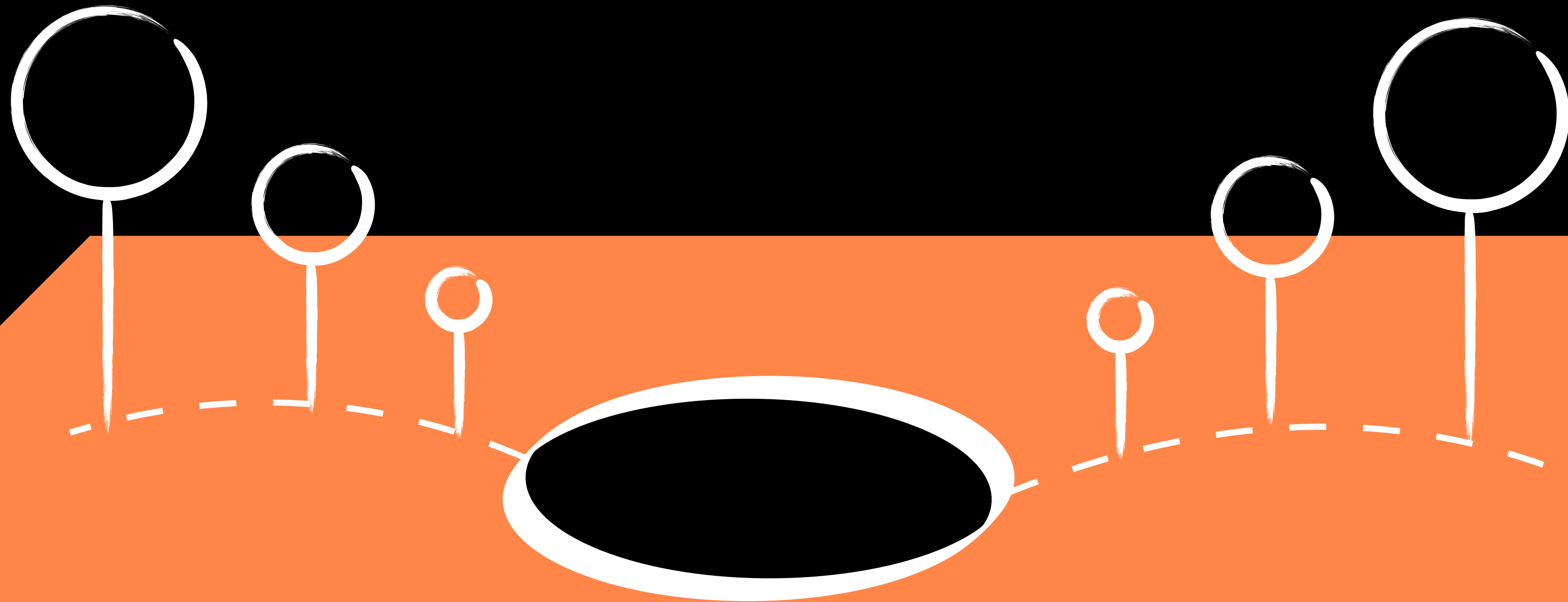
This talk

1. What is Nothing?
2. How to get a dS_4 universe from Nothing

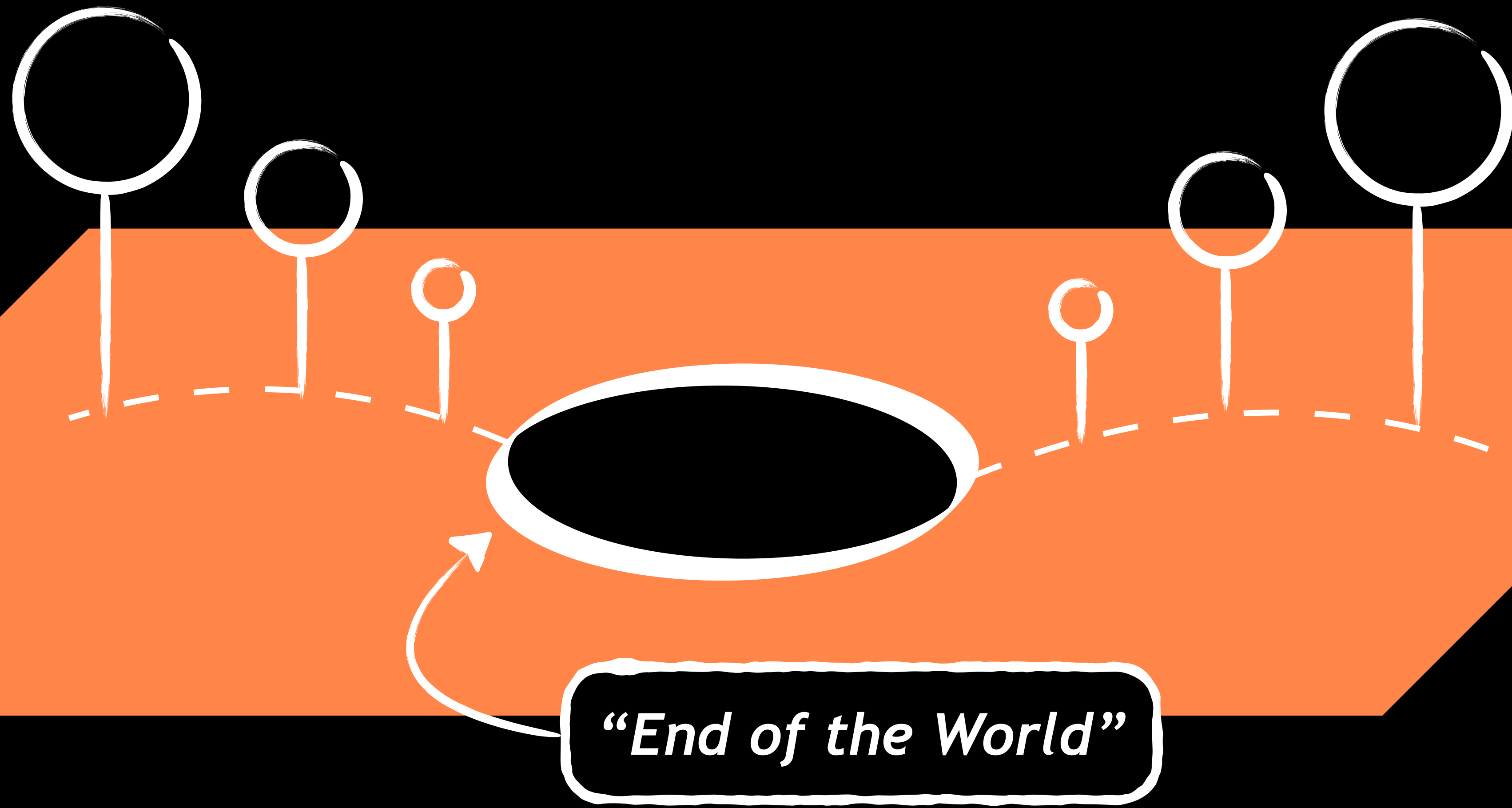
Witten's Bubble of Nothing



Witten's Bubble of Nothing



Witten's Bubble of Nothing

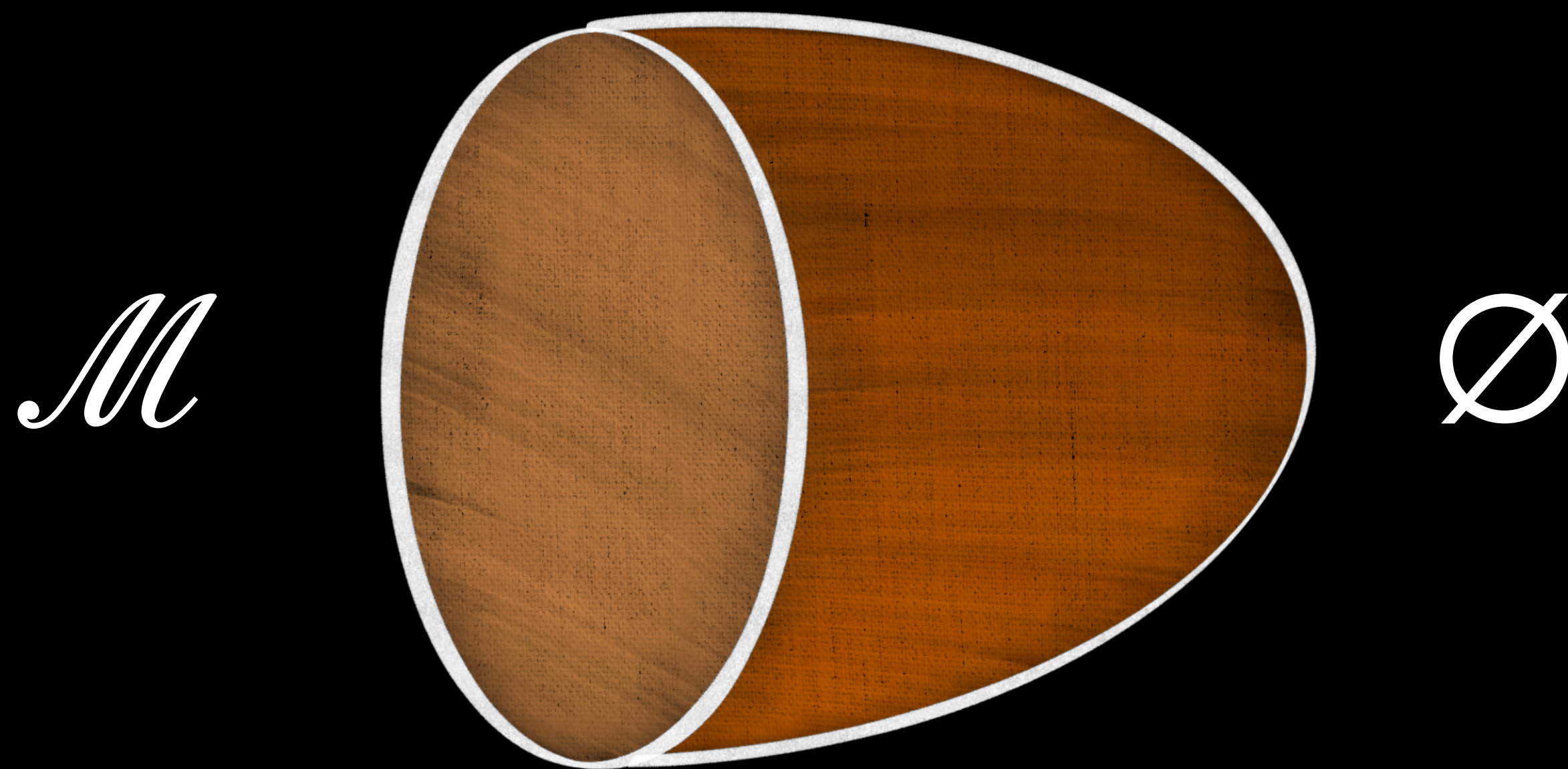


Nothing as a Cobordism



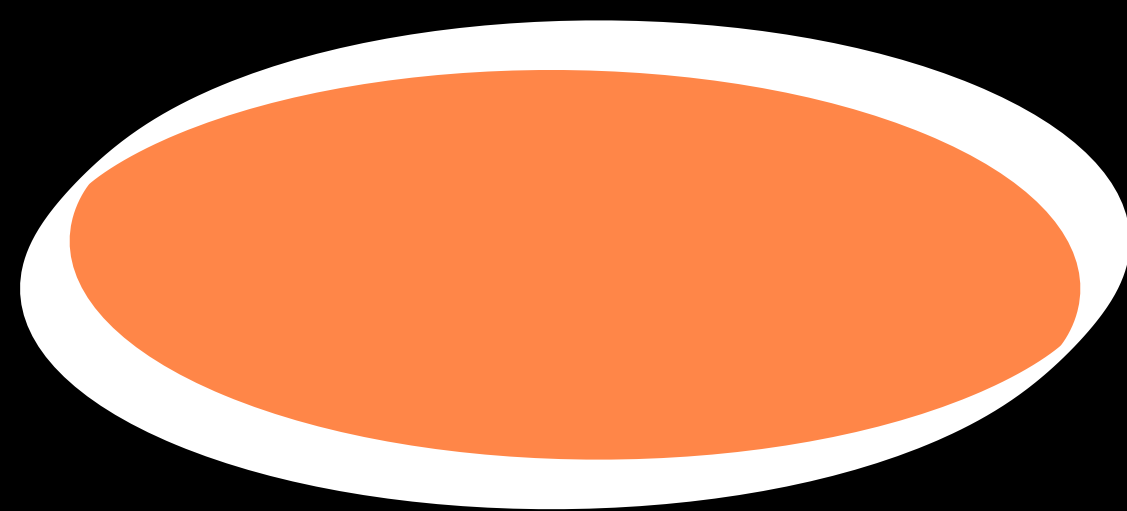
$$\partial W = M \sqcup N$$

Nothing as a Cobordism

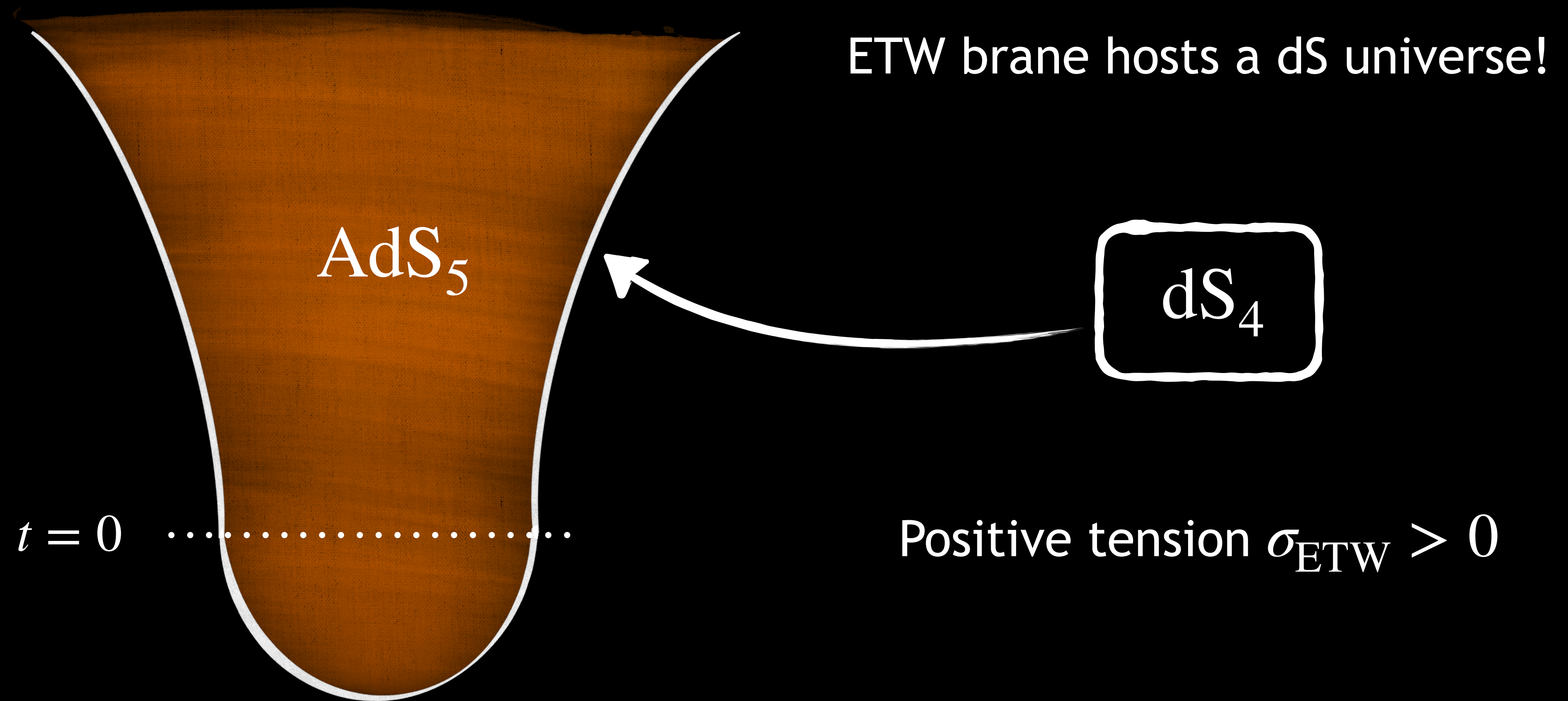


$$\Omega_k^{\text{QG}} = [\emptyset]$$

Bubbles of Something

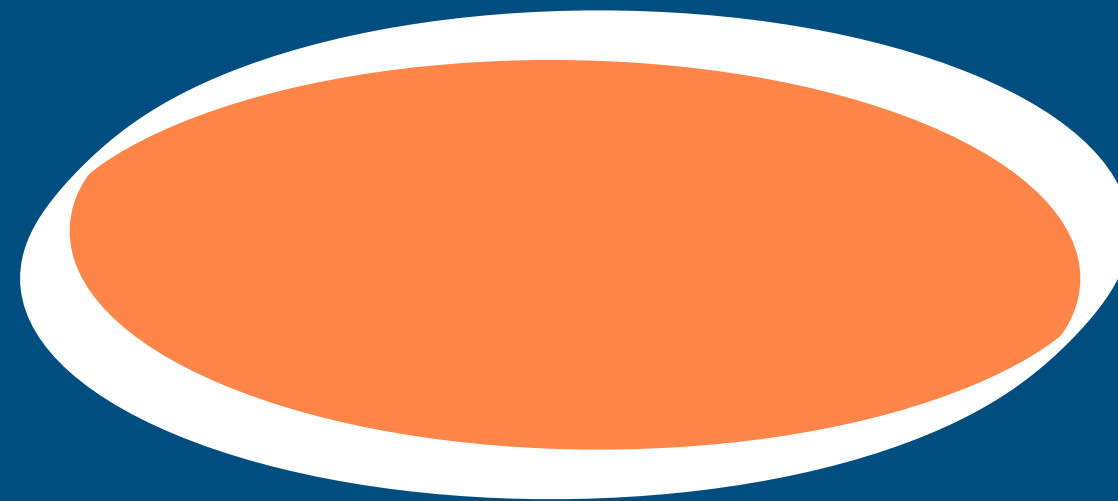


Bubbles of Something



General AdS Bubbles

AdS_5^+ \longrightarrow AdS_5^-

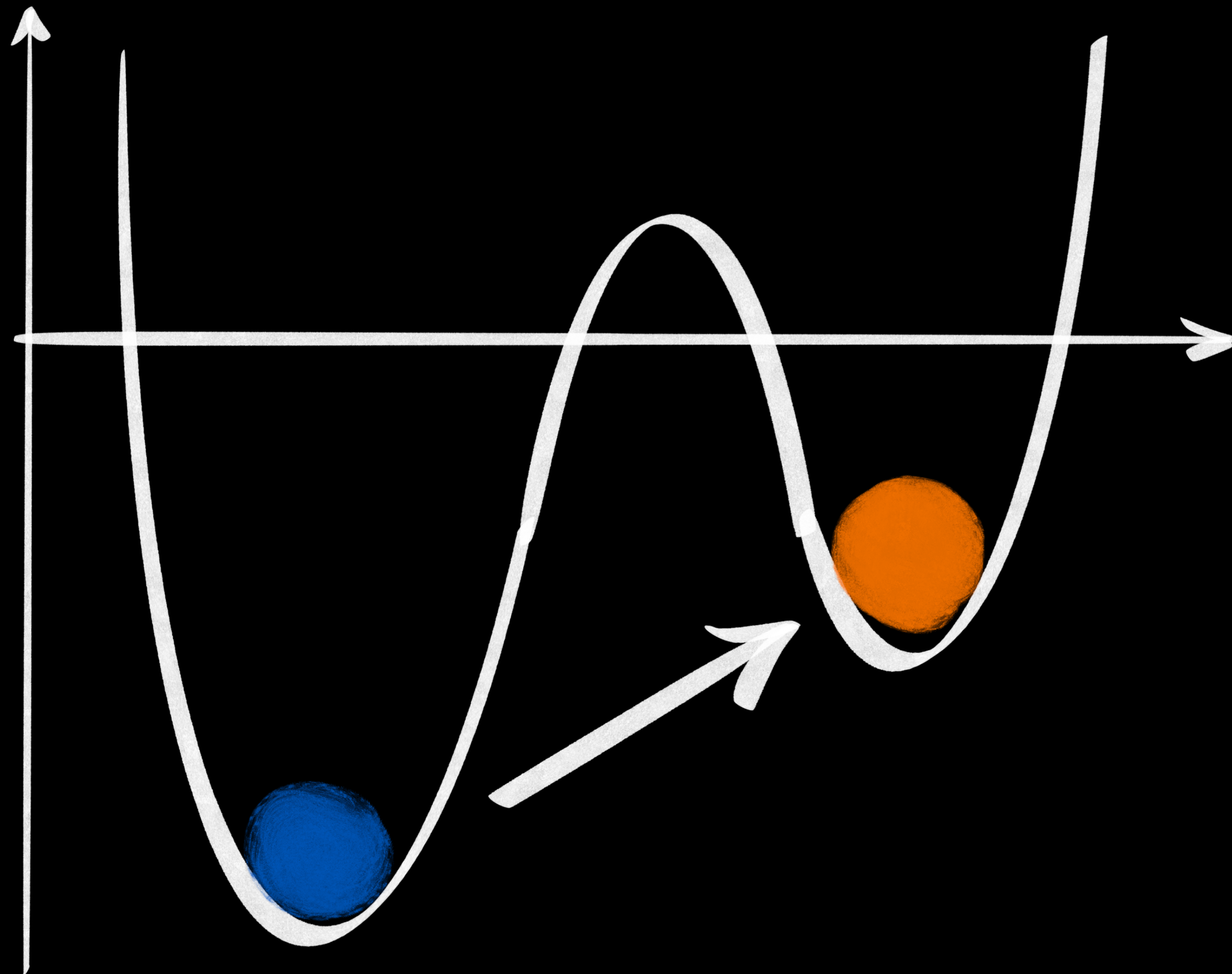


Claim:

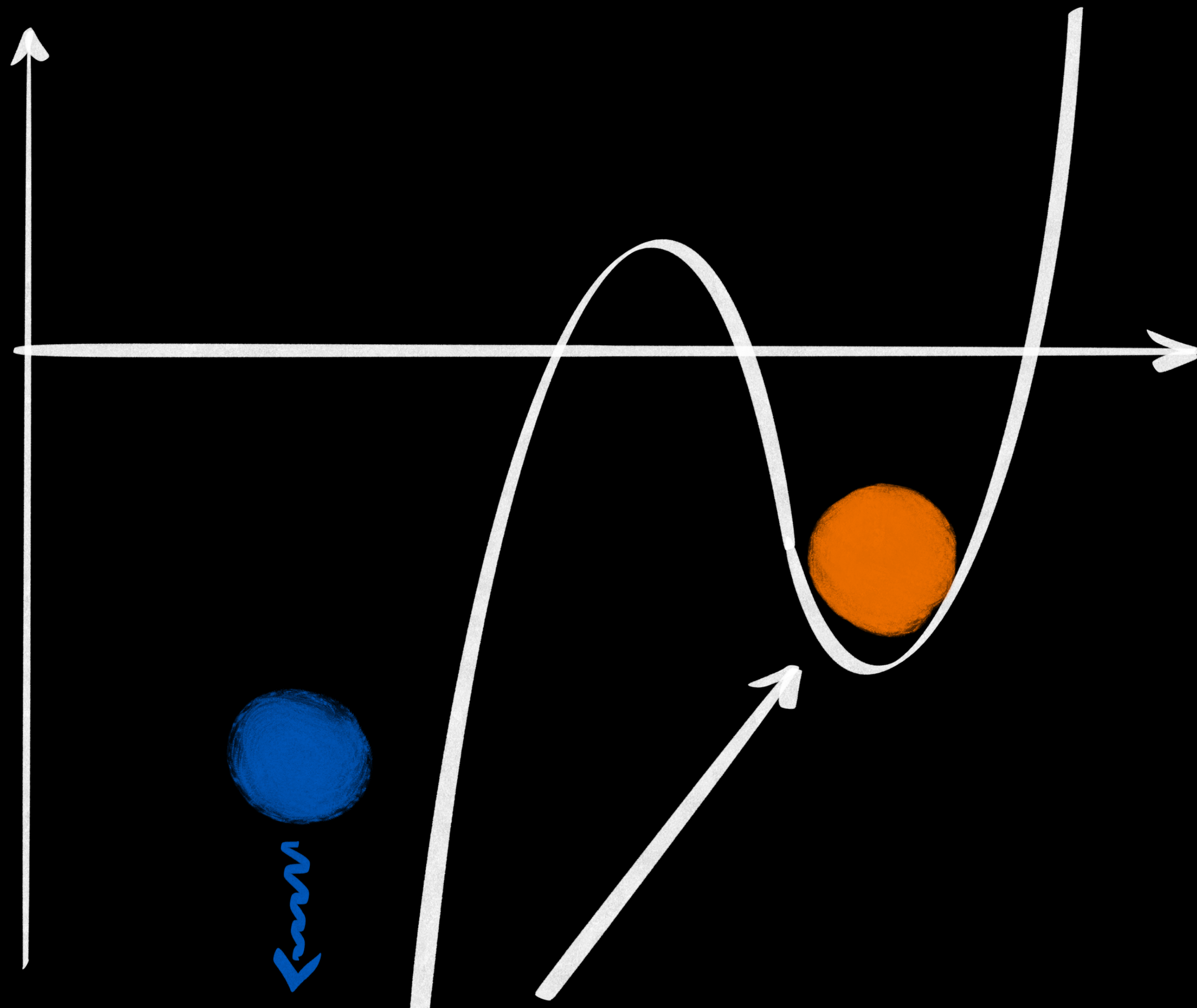
Nothing = AdS_5 with $\ell \rightarrow 0$

$(\Lambda \rightarrow -\infty)$

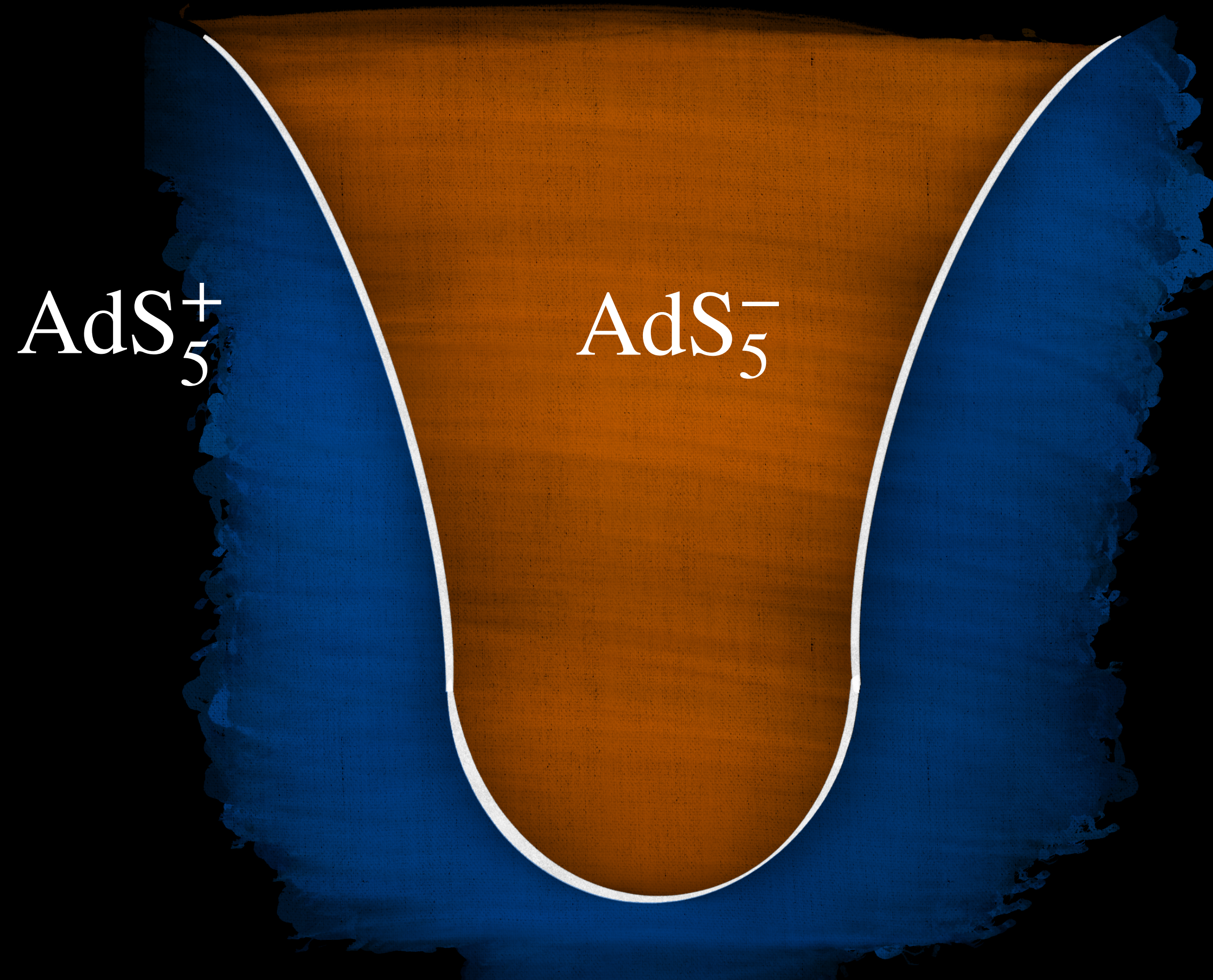
General AdS Bubbles



General AdS Bubbles



General AdS Bubbles



Oh no! Tension diverges!

$$\sigma = \sigma_{\text{ETW}} - \frac{3}{\kappa^2 \ell_+} + \mathcal{O}(\ell_+)$$

ℓ_+ : AdS length scale ($\rightarrow 0$)

κ^2 : 5d gravitational coupling

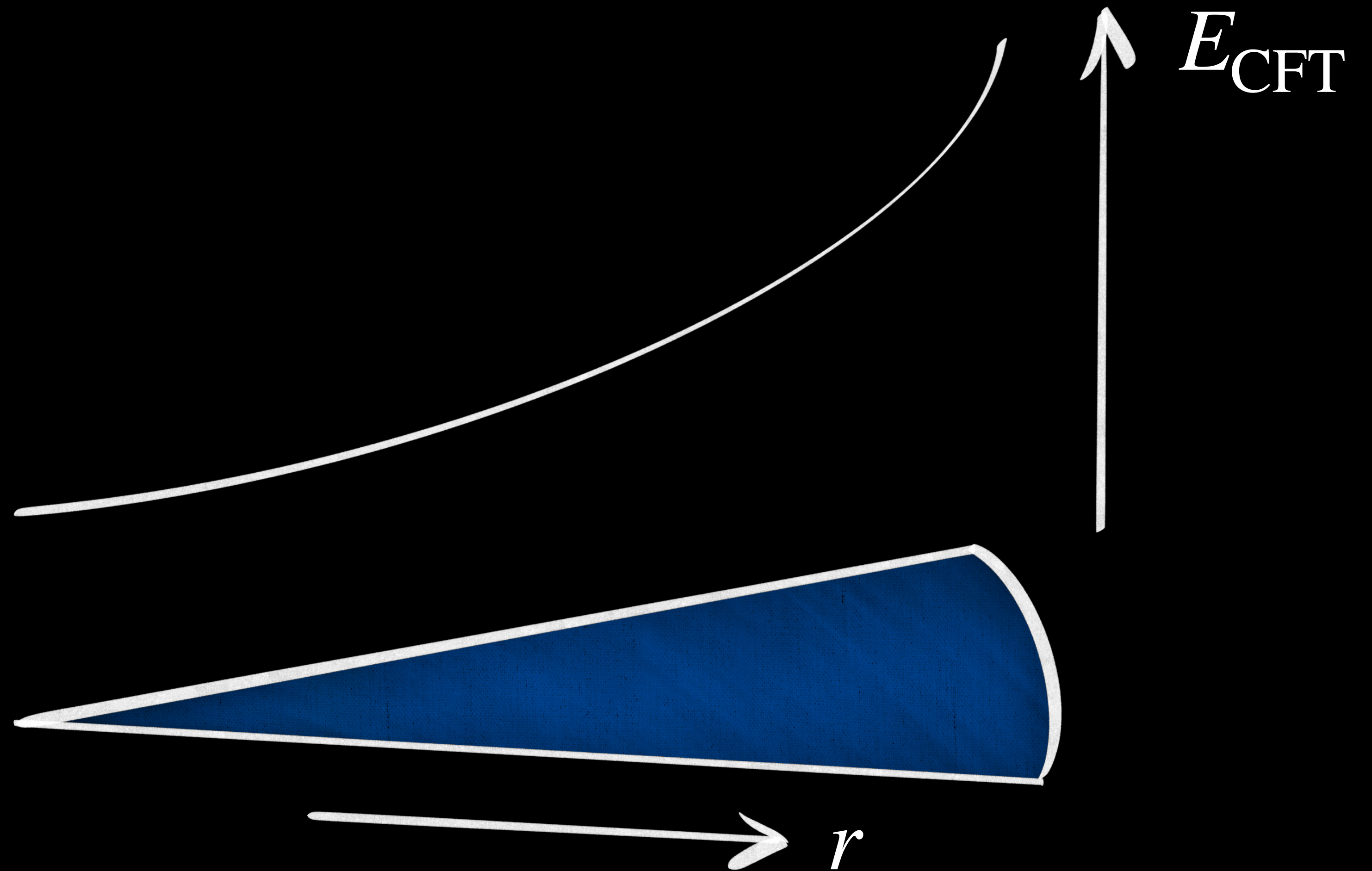
What is going on?

Infinite tension stems from
infinite volume of AdS

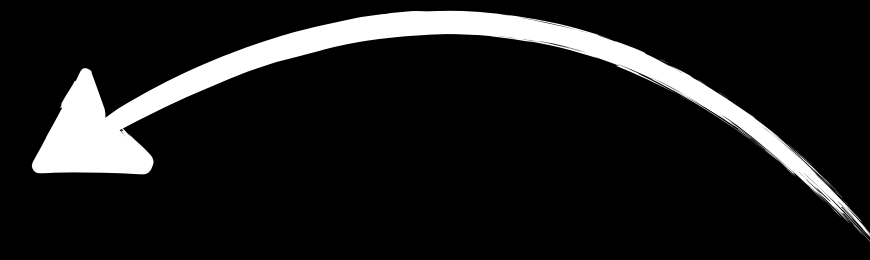
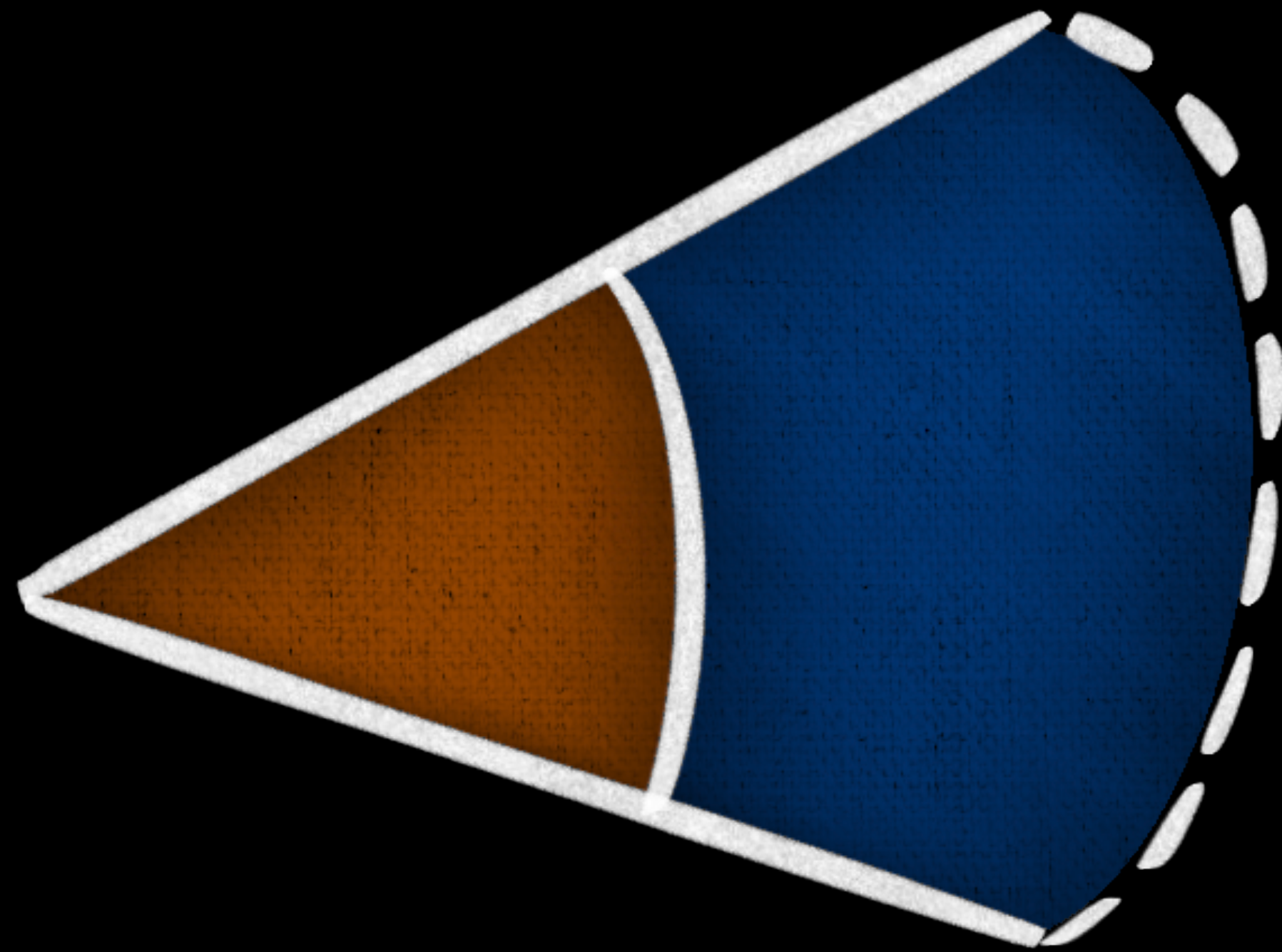
Dual CFT calls for UV
renormalization



Boundary counterterms

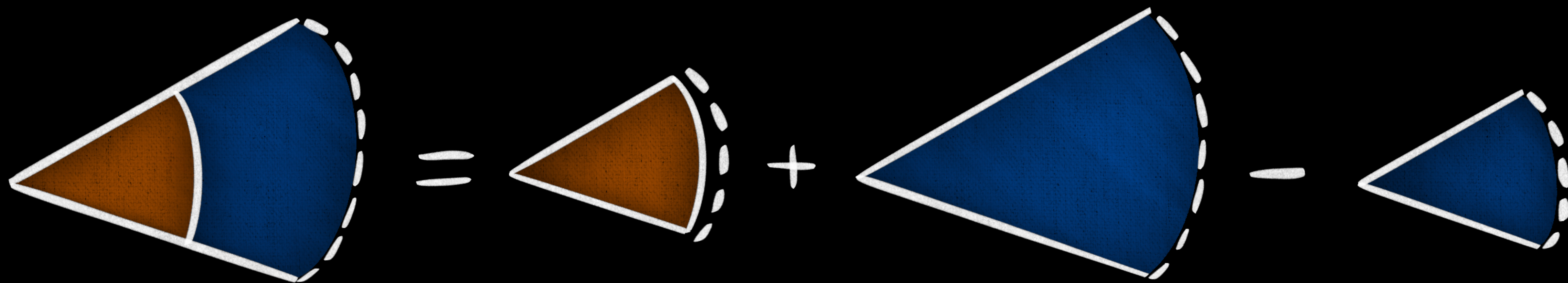


Holographic Renormalization

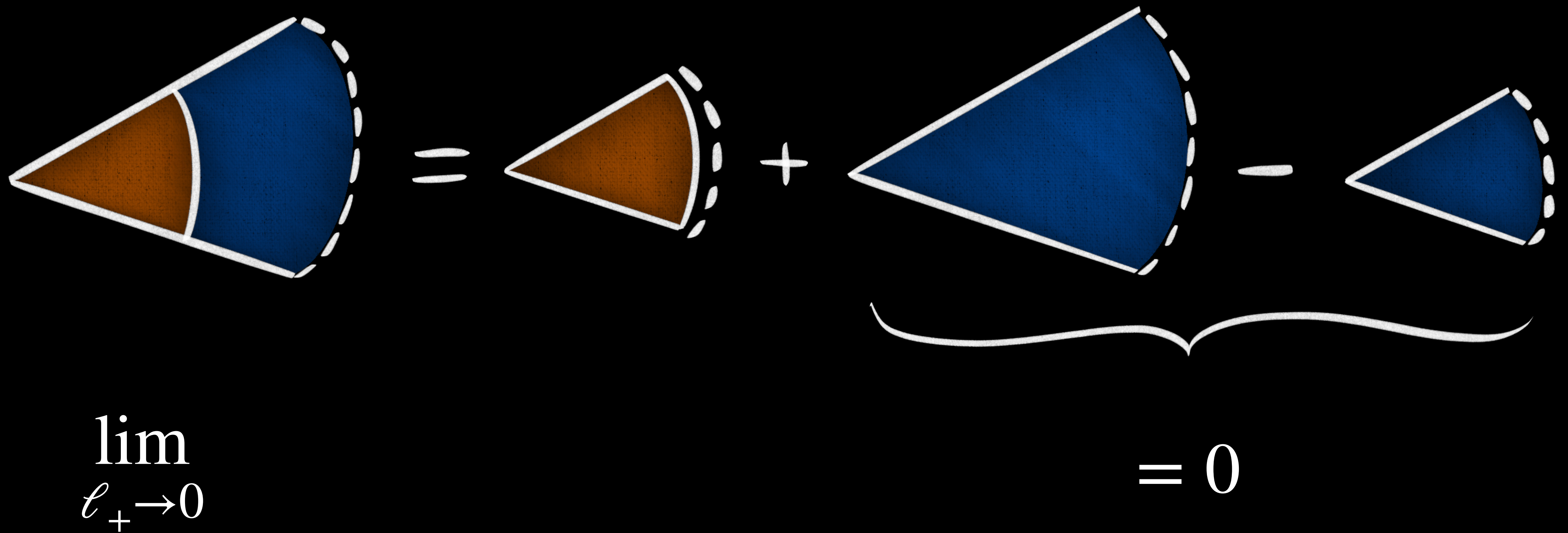


Introduce holographic counterterms
on the conformal boundary

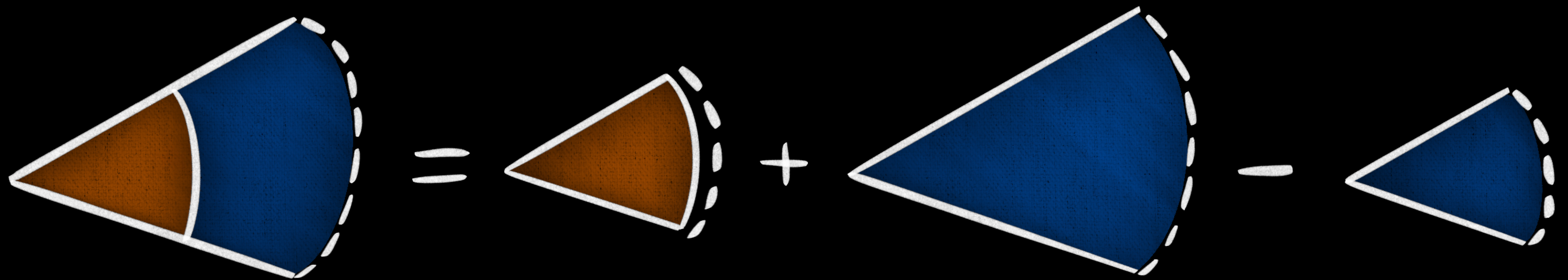
Holographic Renormalization



Holographic Renormalization



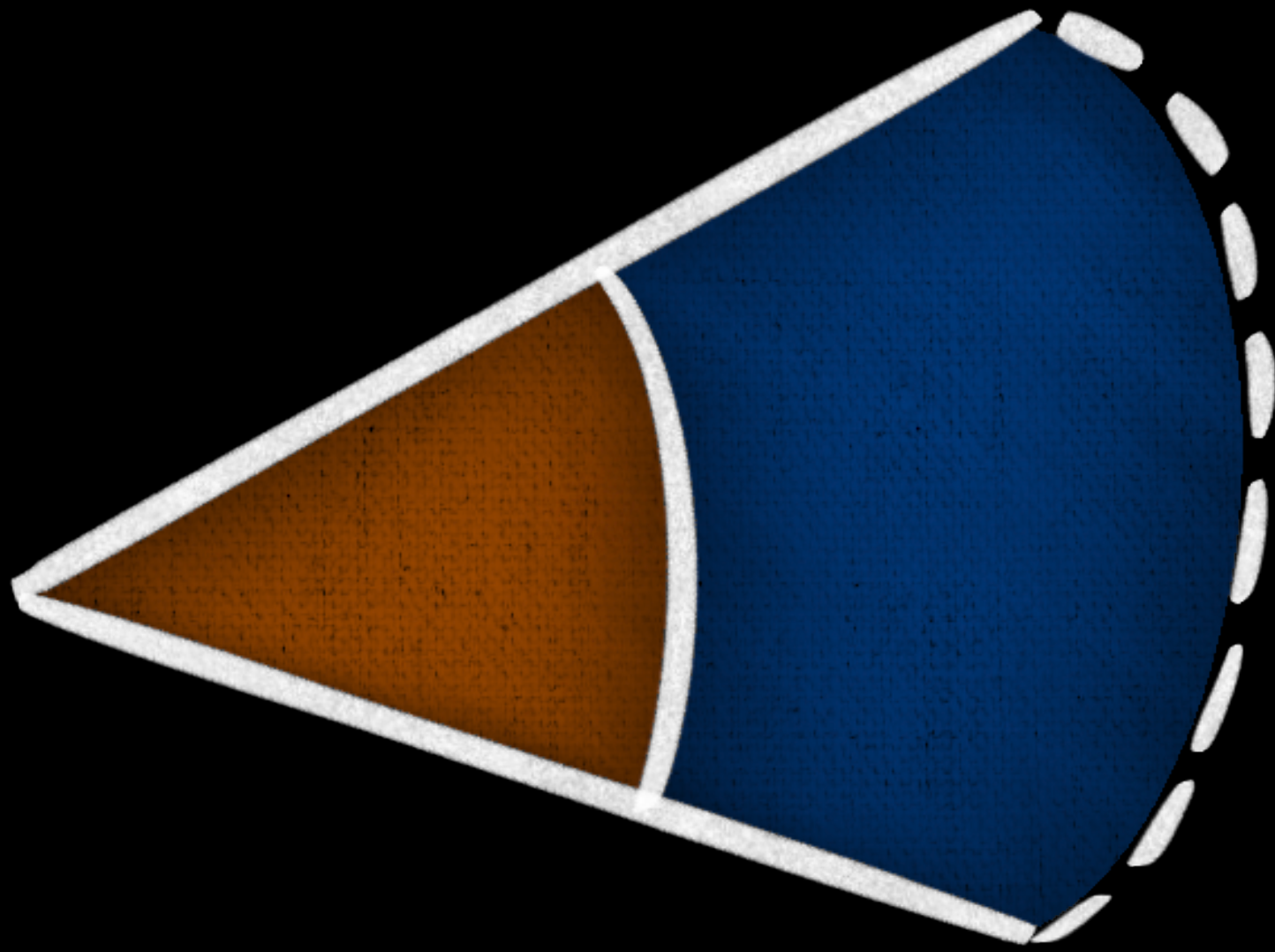
Holographic Renormalization



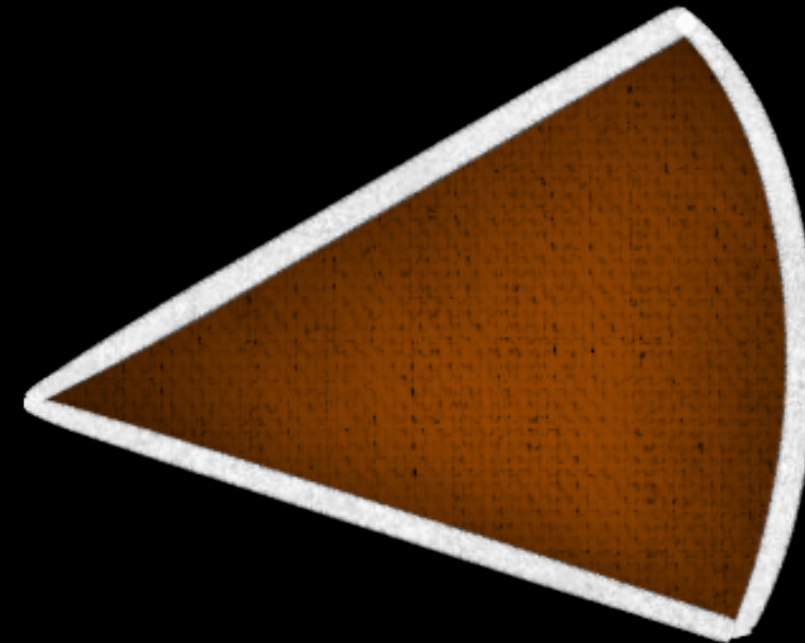
$$\lim_{\ell_+ \rightarrow 0}$$

$$\sigma + \frac{3}{\kappa^2 \ell_+} = \sigma_{\text{ETW}}$$

$\lim_{\ell_+ \rightarrow 0}$



=



σ_{ETW}

Summary

Absence of spacetime is a spacetime

It is of infinite negative curvature.

holographic in nature.

dual “CFT” with $c \rightarrow 0$

able to decay.

dS on ETW branes is straightforward

works in d dimensions and to all orders in perturbations

In progress:

-↔ *string theory embedding*

-↔ *early universe cosmology*

-↔ *more Swampland*

Thank you