Title: QCD Confinement at Finite Chemical Potential and the Gravity Dual

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Abstract: TBA

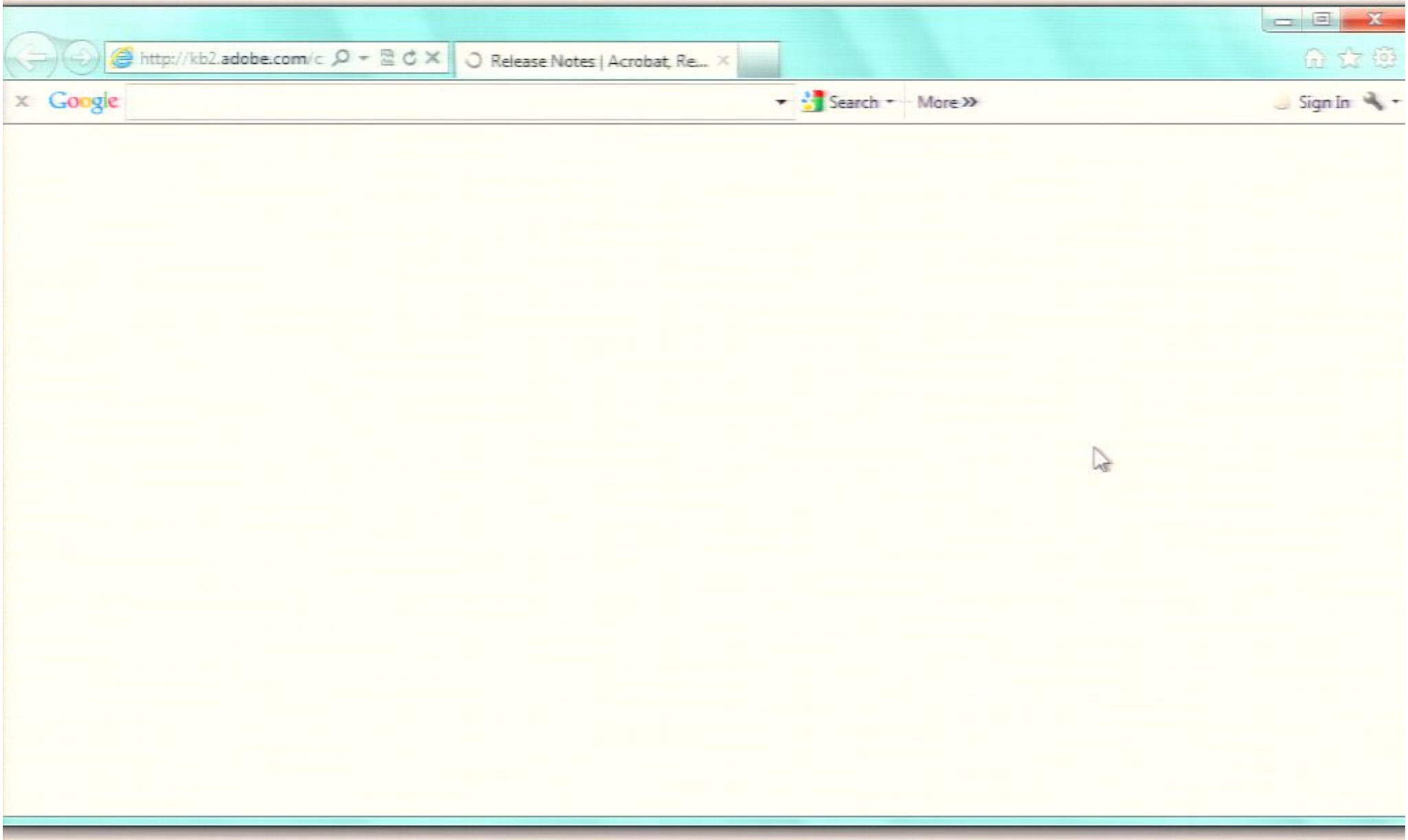
QCD Confinement/deconfinement at Finite Chemical Potential and the Gravity Dual

(work in progress)

Fang Chen, McGill University
with Keshav Dasgupta, Paul Franche, Mohammed Mia, Sachindeo Vaidya

Perimeter Institute

July 21, 2011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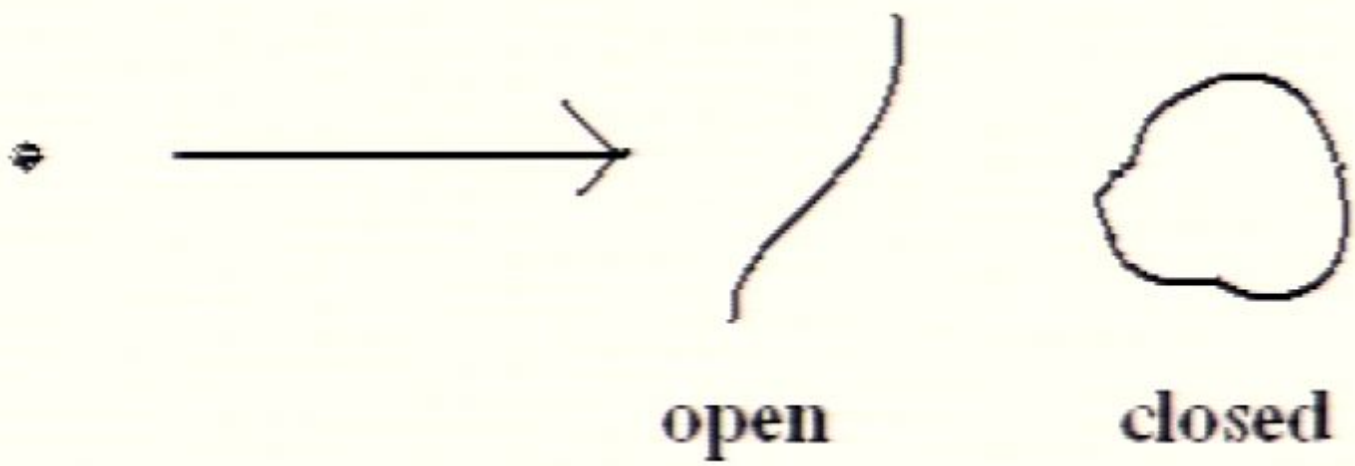
Basic concepts

- What is string theory? String theory is a consistent quantum gravity theory, has space-time dimension 10.
- How to write down the string theory?

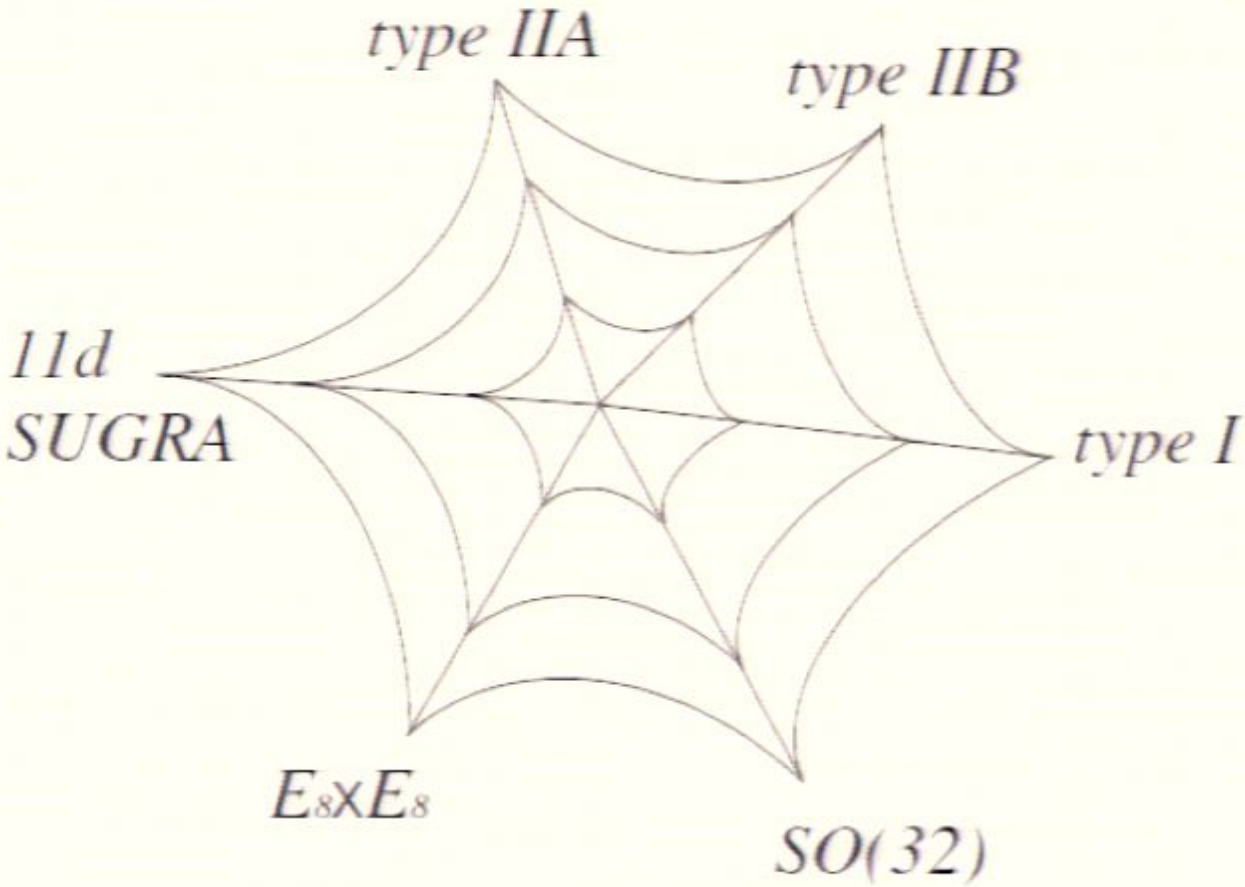


ntroduction

- Goal: to analyze the confinement/deconfinement phase transition in quantum chromodynamics (QCD).
- However QCD is confined in the low energy, meaning the coupling is very large, can not take usual perturbative approach.
- At strong coupling, certain gauge theories can be described using classical supergravity.
- What we actually do: find the supergravity description for a non-conformal thermal gauge theory with non-zero chemical potential, which resembles large N QCD and study the confinement/deconfinement mechanism.

Basic concepts

5 different superstring theories, M theory and dualities between each other



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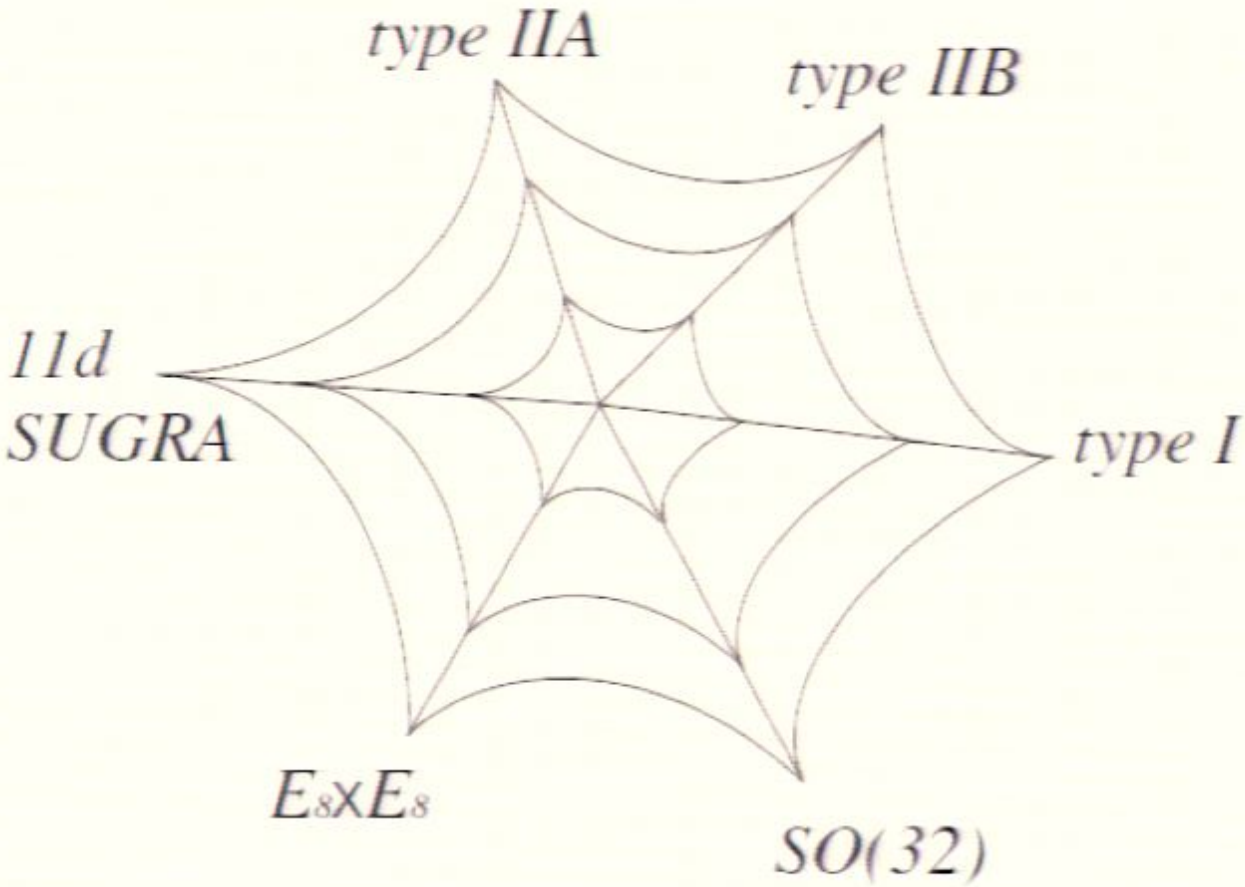
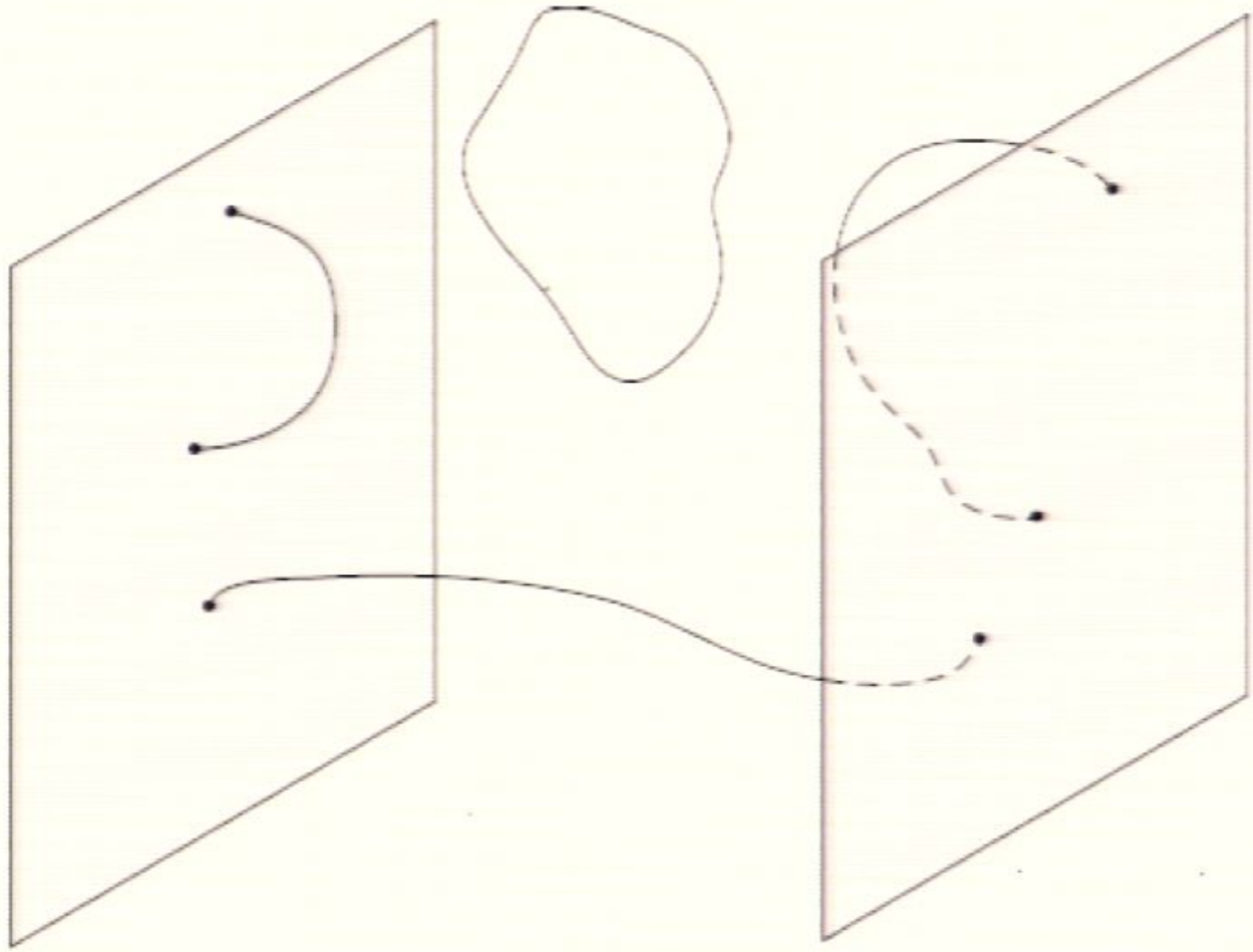


Gauge/Gravity Dual

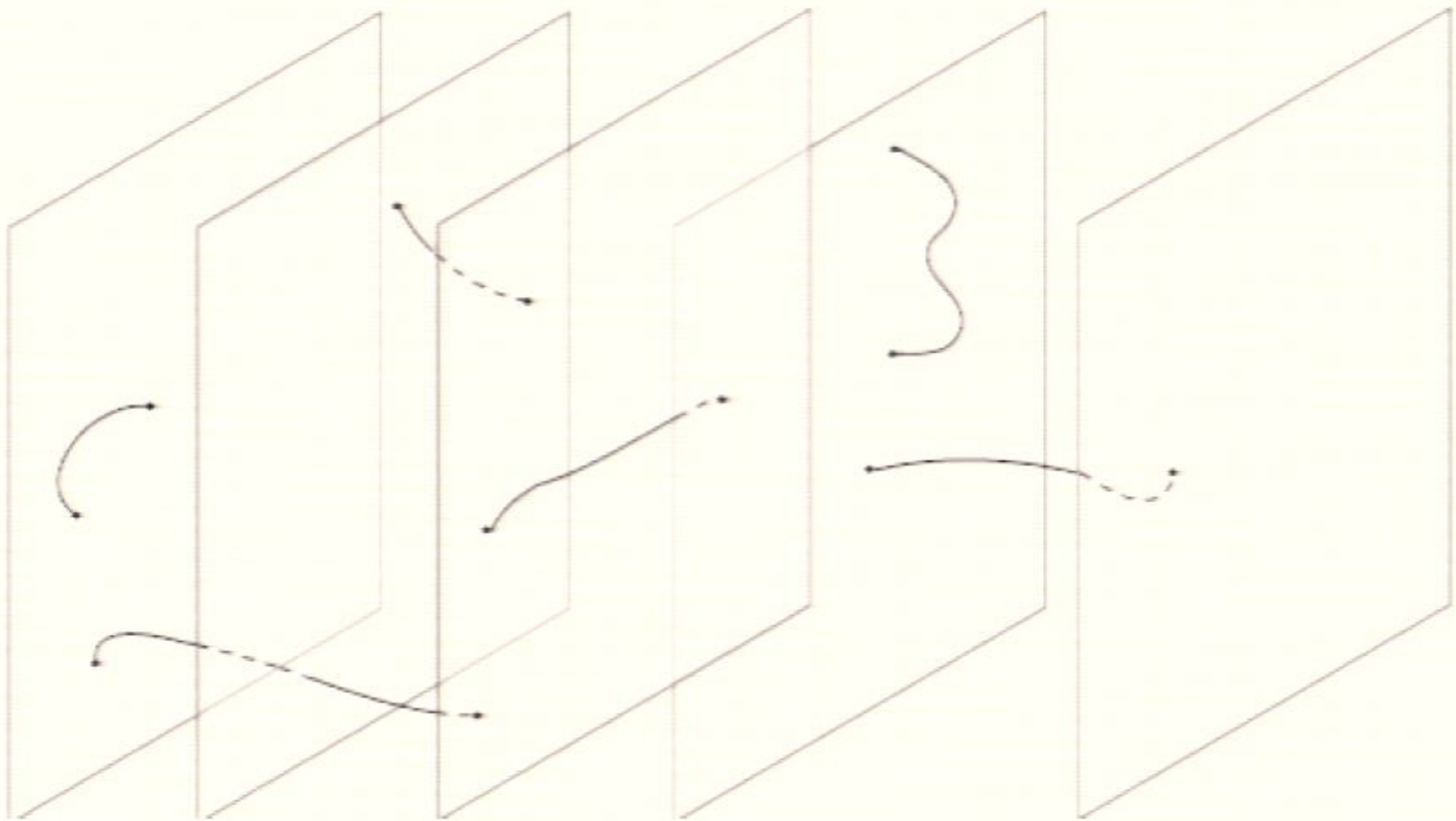
- Brane: an object that open strings can end on.



- TypeIIB: D1, D3, D5, D7, D9; Type IIA: D0, D2, D4, D4, D8

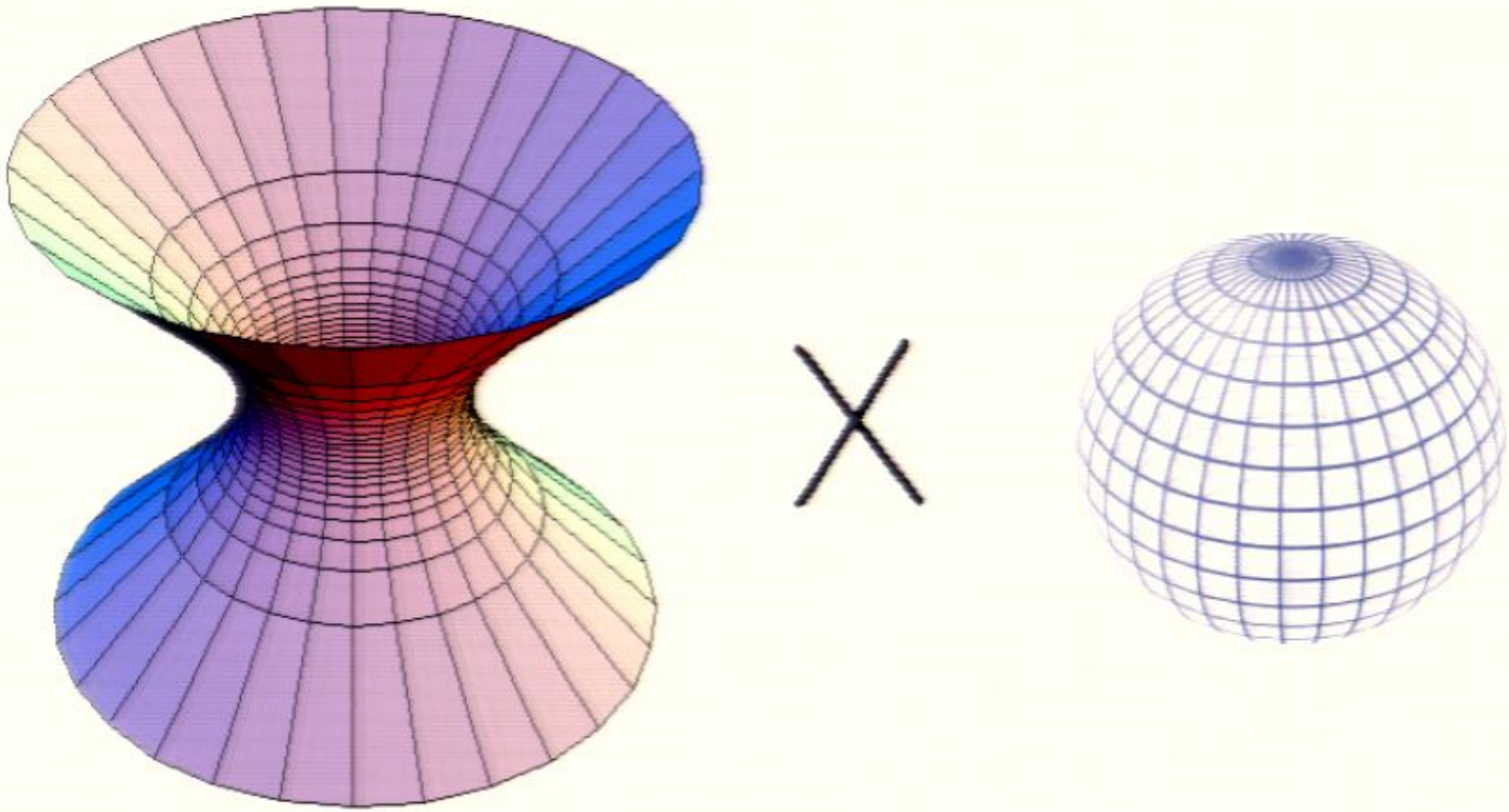
Gauge/Gravity Dual

- N coincident D3 branes in Type IIB, gauge theory SU(N)



Gauge/Gravity Dual

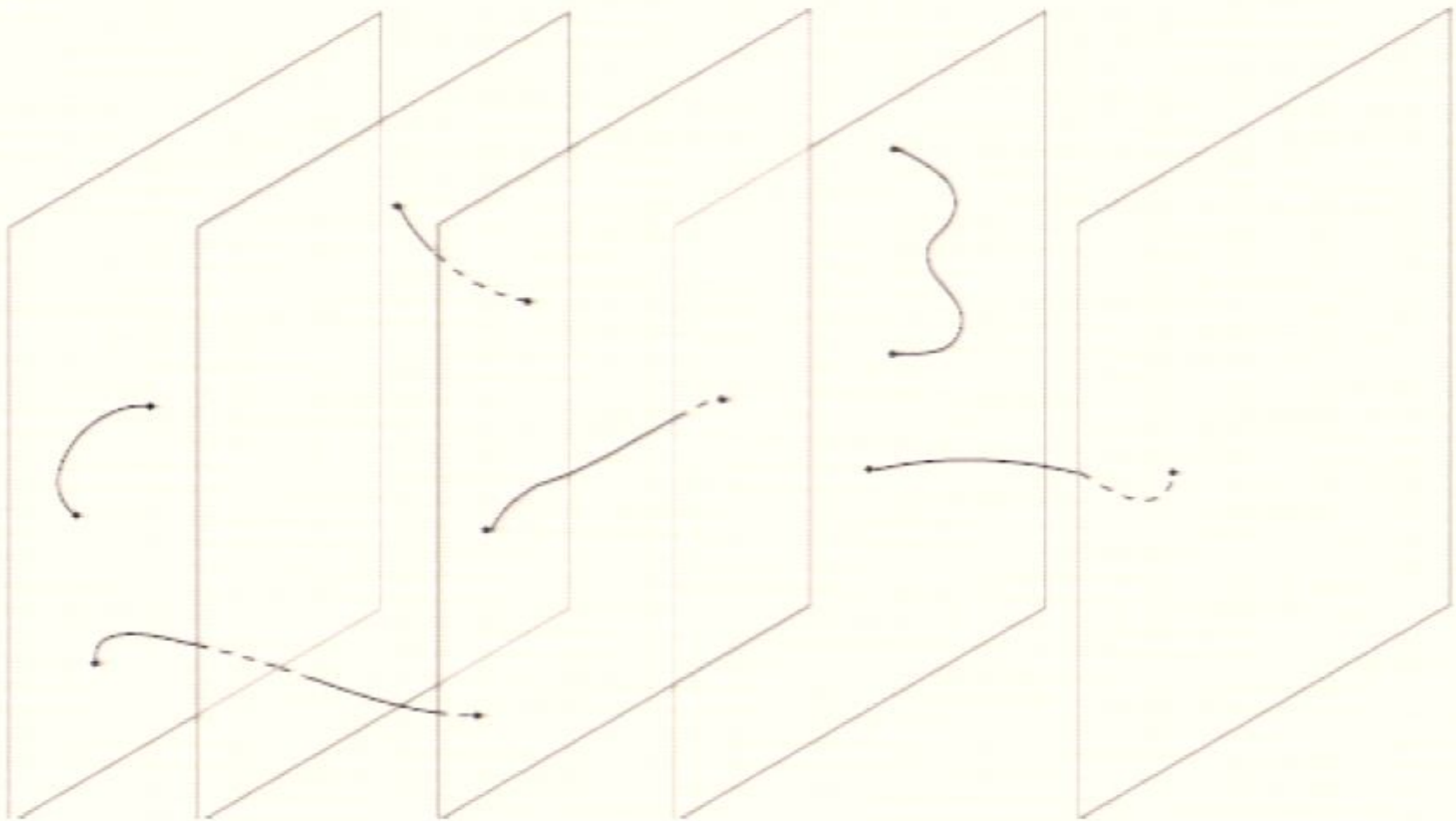
- Geometry near the branes: $Ads_5 \times S_5$



- Ads/CFT: the field theory on the N D3 branes SU(N) are dual to string theory (supergravity) on $Ads_5 \times S_5$

Gauge/Gravity Dual

- N coincident D3 branes in Type IIB, gauge theory SU(N)



Gauge/Gravity Dual

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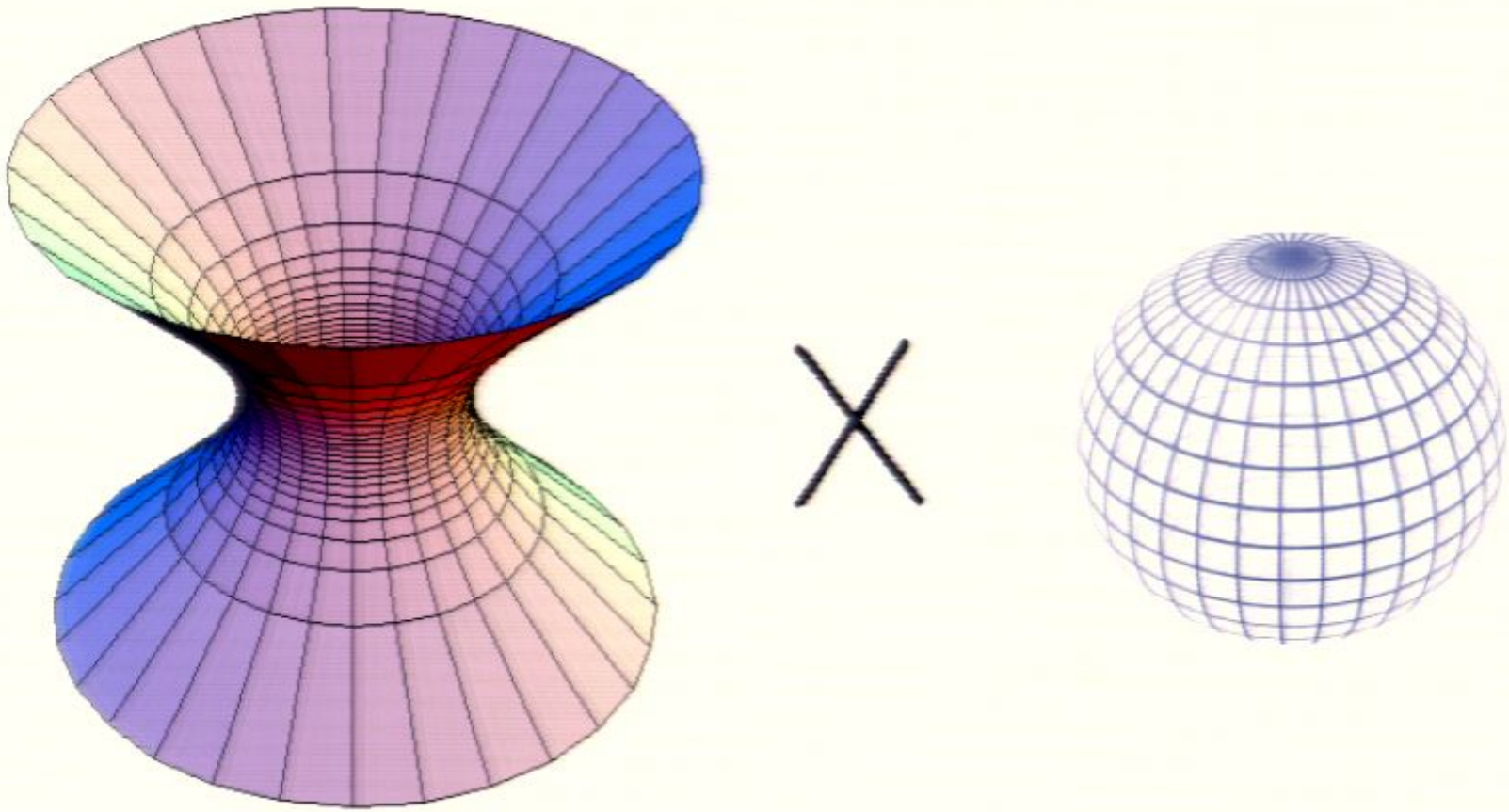

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Gauge/Gravity Dual

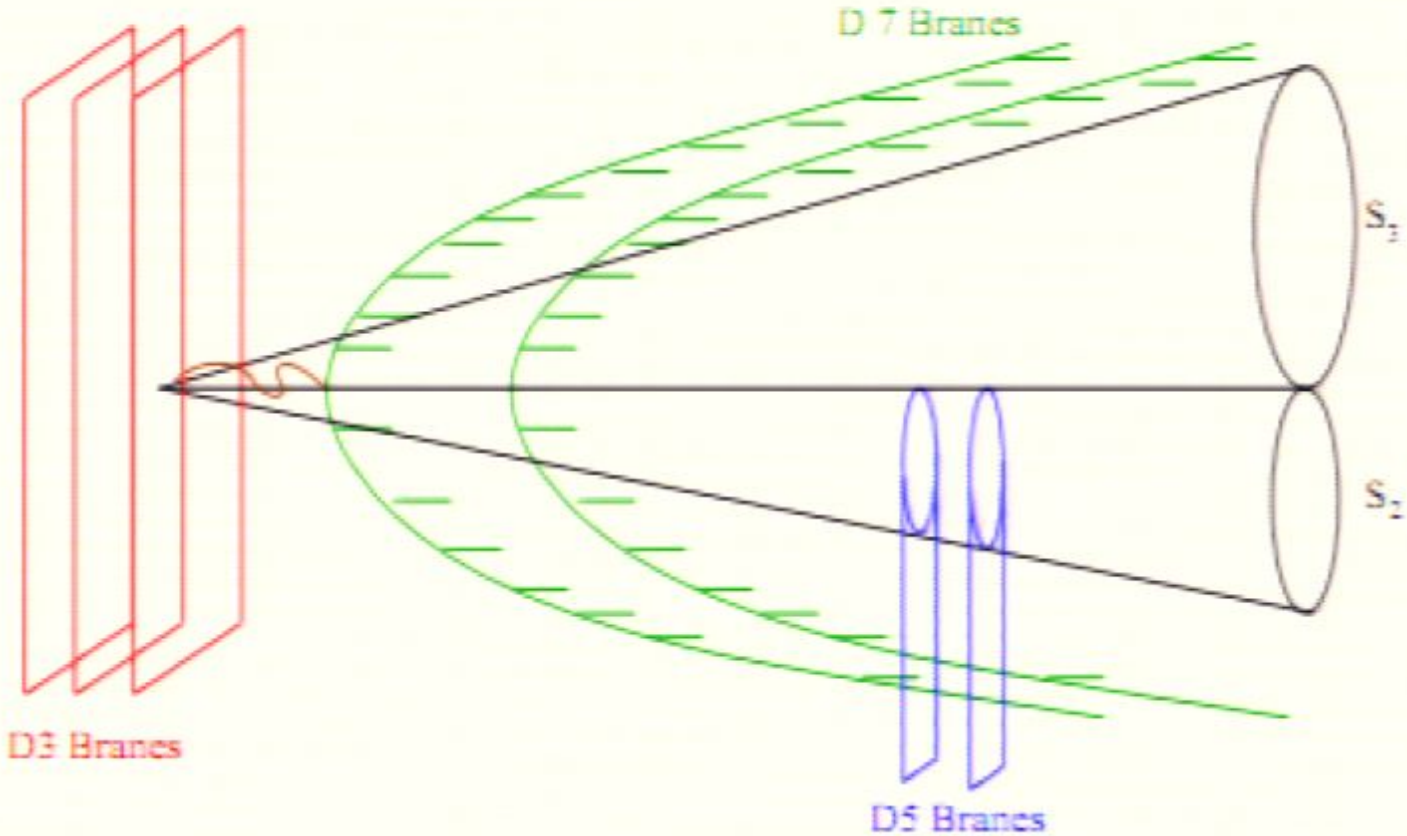
Type IIB background	Gauge theory
$AdS_5 \times S^5$	N D3 branes $\mathcal{N} = 4$ SU(N) SCFT
$AdS_5 \times M^5$ $(T^{1.1})$	N D3 branes $\mathcal{N} = 1$ (SU(N)$\times$ SU(N)) SCFT **(Klebanov-Witten Model)**
$AdS_5 \times T^{1.1}$ NSNS and RR flux near $r \longrightarrow 0$ modified background deformed conifold	N D3 branes and M D5 branes $\mathcal{N} = 1$ SU(N)$\times$SU(N+M) break CF invariance/running far IR gaugino condensation chiral symmetry breaking **(Klebanov-Strassler Model)**

What we do

- Add temperature in the gauge theory $\longleftrightarrow$ Black hole solution (already done by Mohammed Mia and his collaborators)
- Add chemical potential in the gauge theory $\longleftrightarrow$ Special fluxes

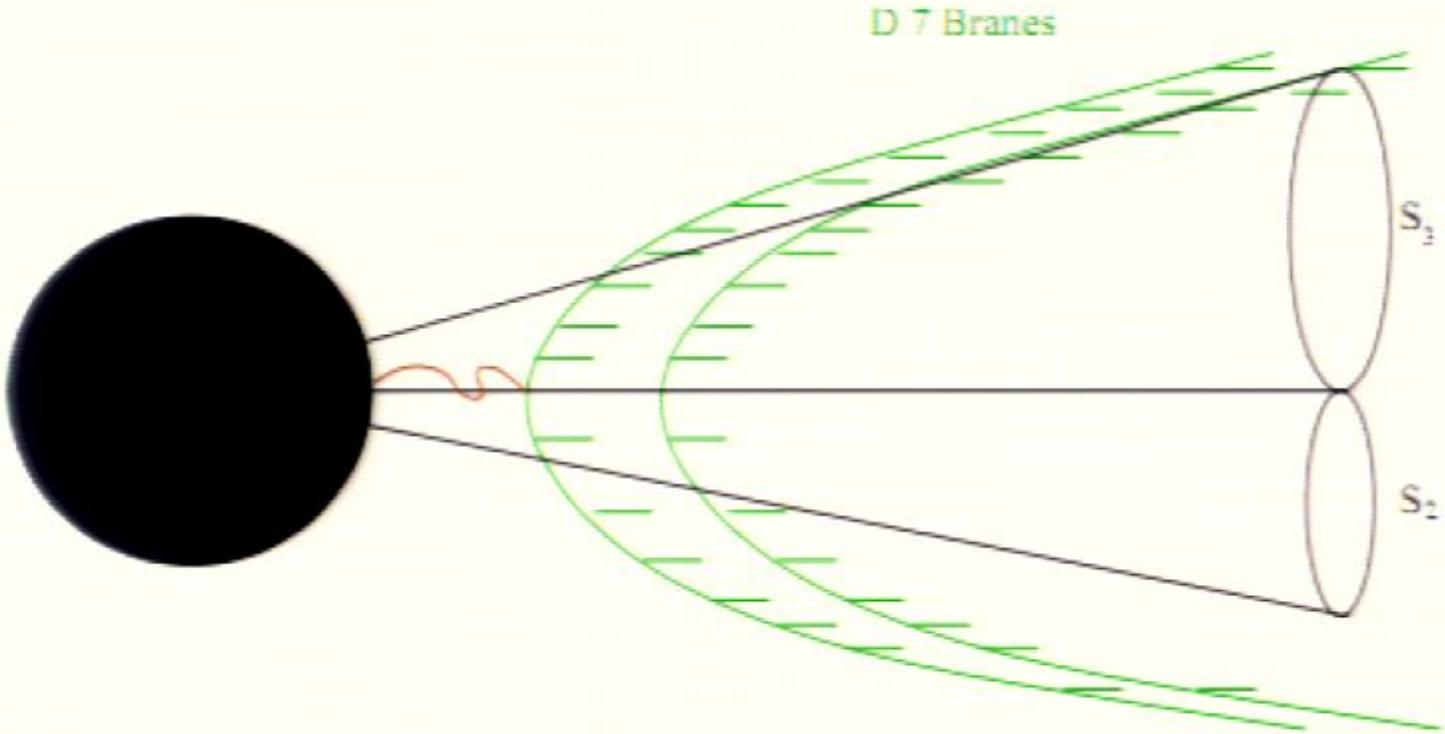
What we do

The brane set up (0902.1540)



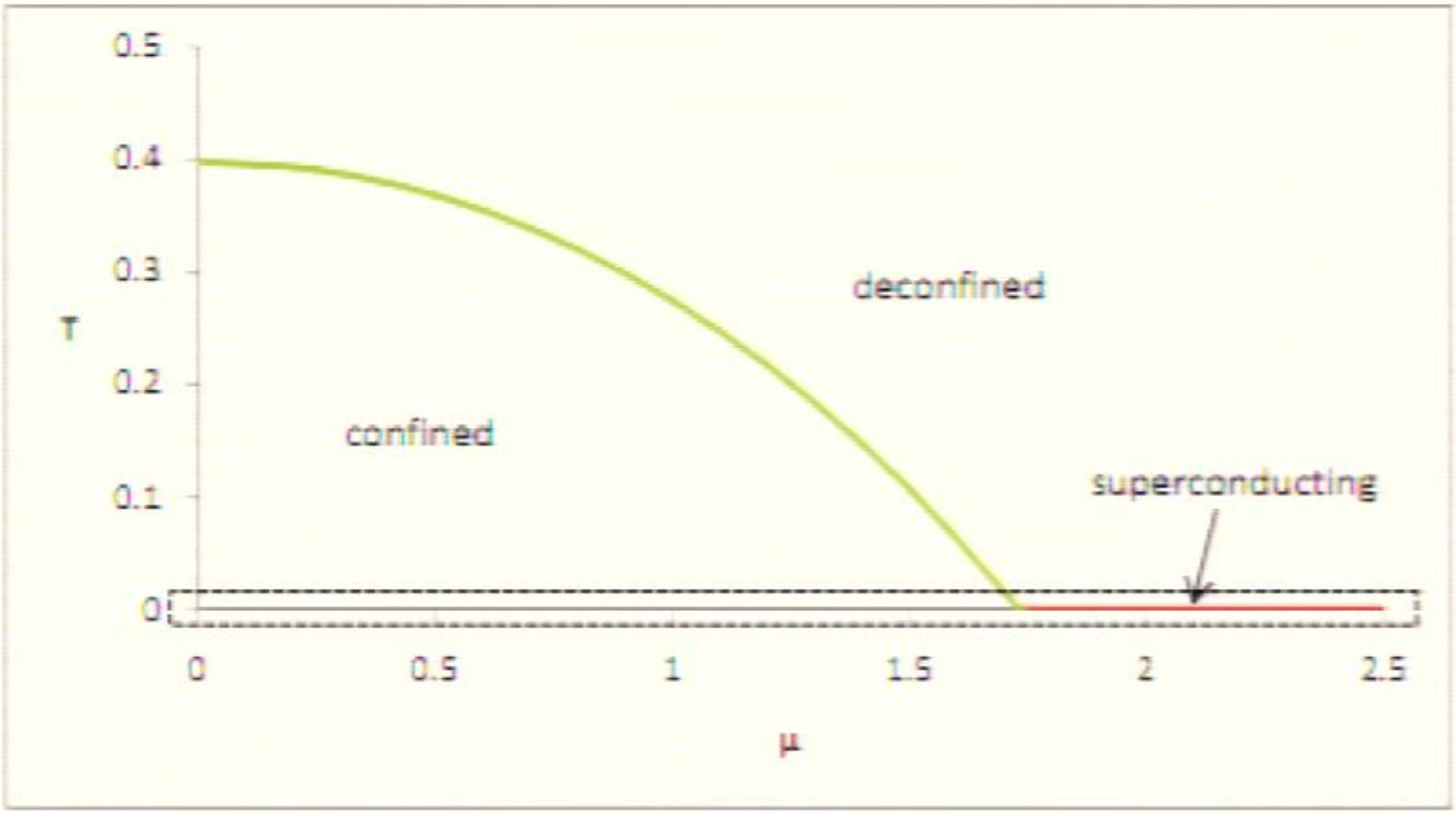
What we do

The dual gravity picture (0902.1540)



What we want to find

Phase diagram we want to find (1101.4042)



Thank you!