Anne Warren acrylic

https://www.annewarren.art/

Corde: French for string

QCD - DSSYK$_\infty$ parallel

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QCD

't Hooft coupling: $\alpha = g_{YM}^2 N_{ym}$

't Hooft limit

$N_{YM} \longrightarrow \infty$, α fixed

AdS(5) x S(5) / CFT

$$\frac{l_{string}}{l_{AdS}} = \frac{1}{g^2 N} = \frac{1}{\alpha^{1/4}}$$

$\boxed{\text{Ratio of string to AdS scale fixed!}}$

Fixed g limit

$N \to \infty$, g fixed $(\alpha \to \infty)$

1. AdS/CFT (Flat space limit)

$\frac{l_{string}}{l_{AdS}} \to 0$ Sub AdS Locality

2. BFSS

't Hooft limit 10D D0-Brane black holes

Fixed g limit 11D M-theory

3. DSSYK$_\infty$ $\quad H \sim \sum J^{\cdots} \overbrace{\psi\psi\cdots\psi}^{p}$

't Hooft limit $\quad N \to \infty$

p fixed

$$\frac{l_{string}}{l_{dS}} = \frac{1}{p}$$

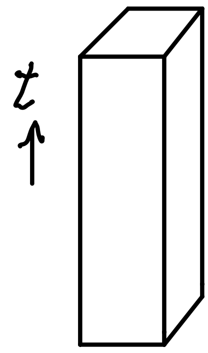
$\boxed{\text{Ratio of string to dS scale fixed!}}$

Double-Scaled limit

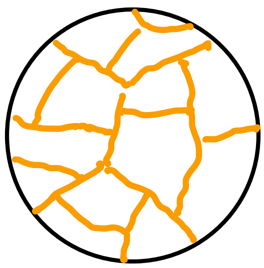
$N \to \infty \quad \lambda \equiv \frac{p^2}{N}$ fixed

$$\frac{l_{string}}{l_{dS}} = \frac{1}{p}$$ Sub dS locality

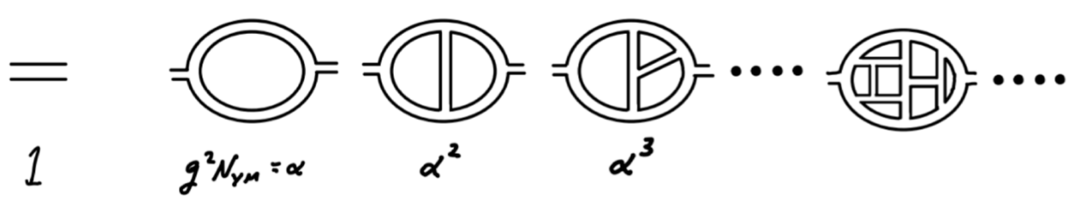
QCD (in a spatial box)

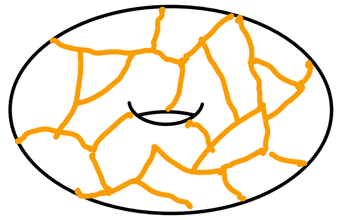


Every diagram has a genus

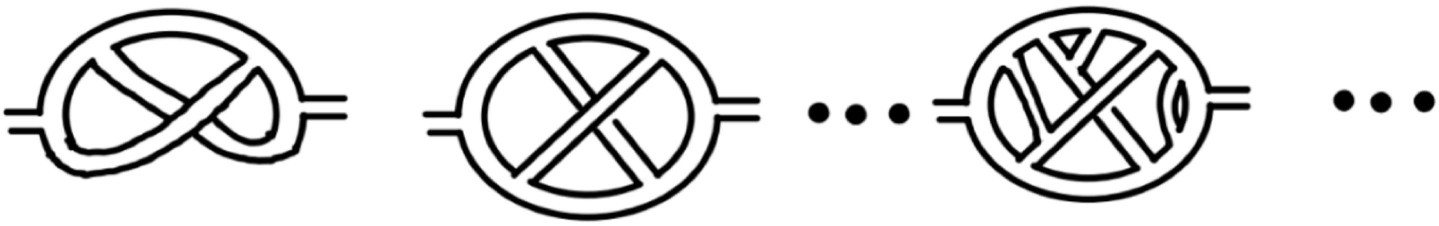


genus $h = 0$





$h = 1$



$g^4 = \frac{\alpha^2}{N_{YM}^2}$ $\qquad$ $g^6 N_{YM} = \frac{\alpha^3}{N_{YM}^2}$ $\qquad \cdots\cdots \qquad$ $\frac{\alpha^6}{N_{YM}^2}$ $\qquad \cdots\cdots$

$$\underbrace{g^4 \qquad\qquad g^4\alpha \qquad\qquad g^4\alpha^4}_{g^4 F(\alpha)}$$

$$\boxed{A = \sum_h \frac{A_h(\alpha)}{(N_{ym}^2)^h}}$$

$$\boxed{A = \sum_h g^{4h} F_h(\alpha)}$$

Fixed g_{YM} limit

$$\lambda = g_{YM}^2 N \longrightarrow \infty$$

$$\mathcal{F}^{(h)} = \lim_{\lambda \to \infty} F_h(\lambda)$$

$$A = \sum_h g_{YM}^{4h} \mathcal{F}^{(h)}$$

$$g_{YM}^4 = g_{string}^2$$

$$\boxed{A = \sum_h g_{string}^{2h} \mathcal{F}^{(h)}}$$

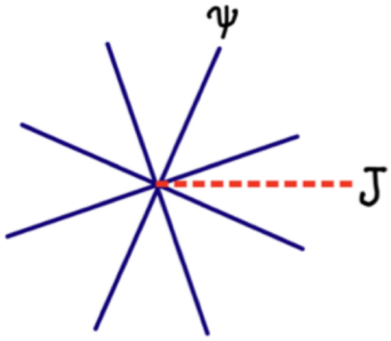
DSSYK$_\infty$

$$H = i^{p/2} \sum_{i_1 < i_2 \cdots < i_p} J^{i_1, \cdots i_p} \psi_{i_1} \cdots \psi_{i_p}$$

$$\langle J^2 \rangle = \mathcal{J}^2 \frac{p!}{N^{p-1}}$$ (cosmic units)

$$\lambda = \frac{p^2}{N} \text{ fixed}$$

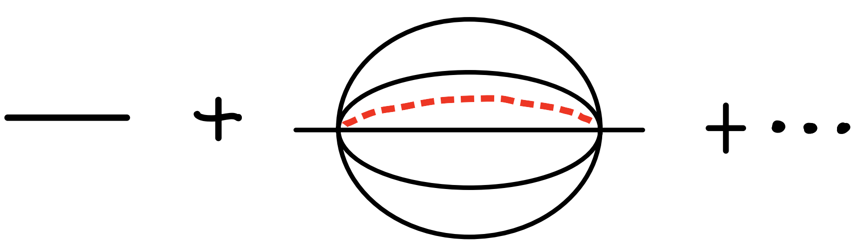
$$T = \infty \quad (\rho \sim 1)$$



$\epsilon(t_2 - t_1)$

$\frac{p!}{N^{p-1}}$

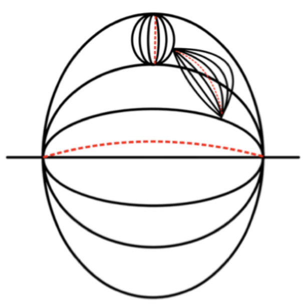
$$\mathcal{F}(T) = \langle \psi(0)\ \psi(\tau) \rangle_{irred}$$



$$\mathcal{J}^2 \frac{p!}{N^{p-1}} \frac{N^{p-1}}{(p-1)!} \tau^2 = \mathcal{J}^2 p\ \tau_- \cdot \tau_+ \qquad (h=0)$$

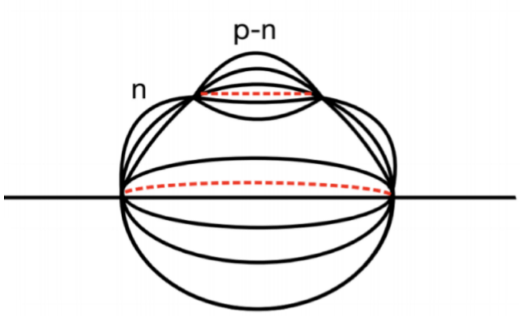
$$J^4 \left(\frac{p!}{N^{p-1}}\right)^2 \frac{N^{p-1}}{(p-1)!} \frac{N^{p-2}}{(p-2)!} \frac{p(p-1)}{2} \tau^4$$

$$\frac{J^4 p^5}{N} \tau_-^3 \cdot \tau_+ \quad (h=1)$$



$$(h=2)$$

$$\frac{J^6 p^9}{N^2} \tau_-^5 \cdot \tau_+$$



$$J^4 \frac{p^{2n+1}}{N^{n-1}} \tau_-^3 \cdot \tau_+ \quad (h = n-1)$$

$$\boxed{F = \sum_h \frac{F_h(p)}{N^h}}$$

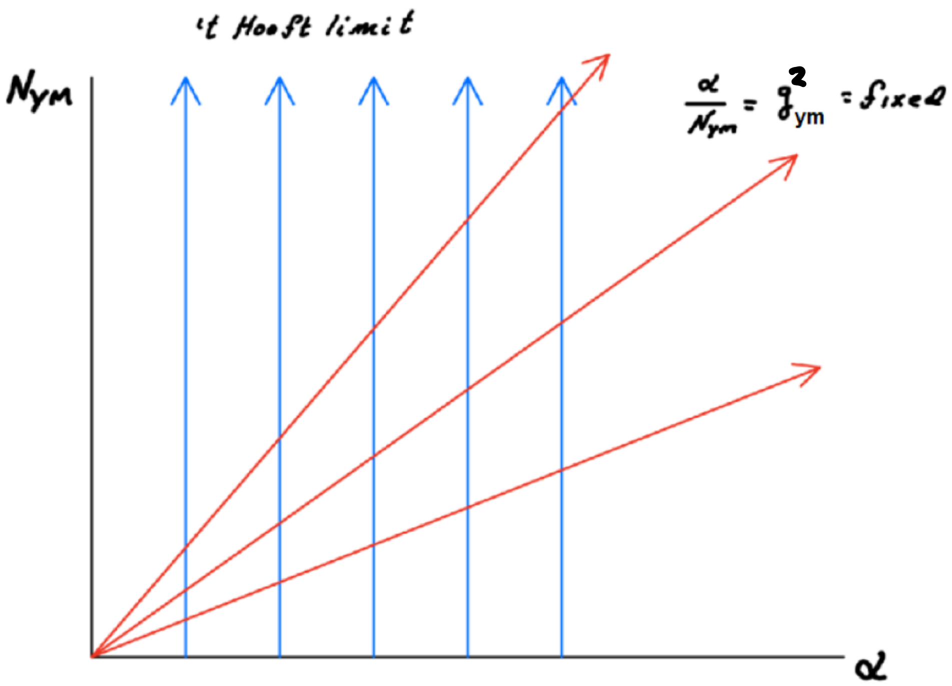
Recall $$A = \sum_h \frac{A_h(\alpha)}{(N_{ym}^2)^h}$$

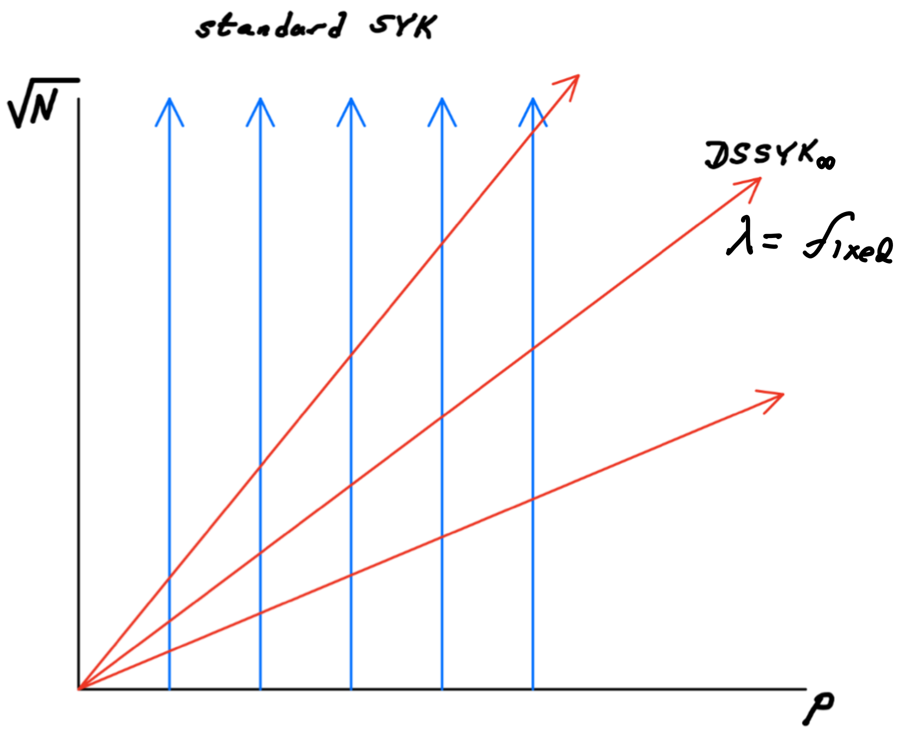
$$\boxed{\begin{array}{ccc} N_{ym}^2 & \longleftrightarrow & N \\ \alpha & \longleftrightarrow & p \\ g_{ym}^4 & \longleftrightarrow & \lambda \end{array}}$$

$$g_{ym}^2 N_{ym} = \alpha, \qquad g^4 = \frac{\alpha^2}{N_{ym}^2} \longleftrightarrow \frac{p^2}{N}$$

$$g_{ym}^4 \longleftrightarrow \frac{p^2}{N} = \lambda$$

Fixed g_{ym} Limit $\longleftrightarrow$ DSSYK - fixed λ Limit

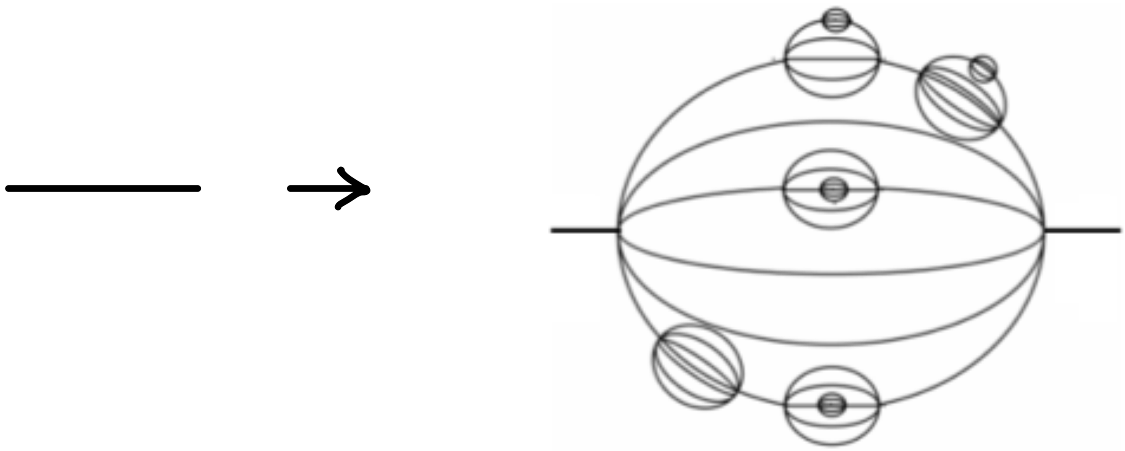




Summing Melons

Maldacena Stanford

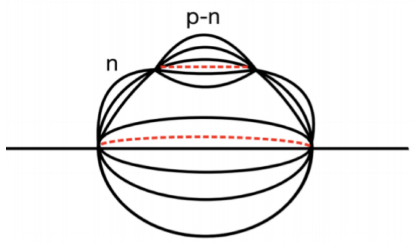
Roberts Streicher Stanford



$$\epsilon(t) \to \epsilon(t)\, e^{-2Jt} \qquad \text{(cosmic)}$$

$$\left(\epsilon(t)\, e^{-2Jt}\right)^{p-1} \approx \epsilon(t)\, e^{-2J(p-1)t}$$

$$\tau_- \to \frac{1}{(p-1)\,J} \approx \frac{1}{pJ}$$



$$\mathcal{J}^4 \frac{p^{2n+1}}{N^{n-1}} \mathcal{T}_-^3 \cdot \mathcal{T}_+ \qquad (h = n-1)$$

$$\mathcal{J}^4 \frac{p^{2n+1}}{N^{n-1}} \frac{1}{\mathcal{J}^3 p^3} \mathcal{T}_+$$

$$\left(\frac{p^2}{N}\right)^{n-1} \mathcal{J} \mathcal{T}_+$$

$$= \boxed{\mathcal{J} \mathcal{T}_+ \lambda^h}$$

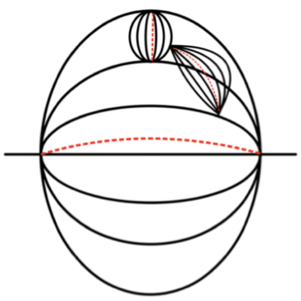
$(h=1)$

$$\frac{J^4 p^5}{N}\, \tau_-^3 \cdot \tau_+$$

$$\rightarrow \quad \frac{J^4 p^5}{N}\, \frac{1}{(Jp)^3} \cdot \tau_+$$

$$= J \tau_+ \frac{p^2}{N}$$

$$= J \tau_+ \lambda$$



$(h=2)$

$$\frac{J^6 p^9}{N^2}\, \tau^5 \cdot \tau_+$$

$$\frac{J^6 p^9}{N^2}\, \frac{1}{(Jp)^5} \cdot \tau_+$$

$$= J \tau_+ \lambda^2$$

General $\quad J \tau_+ \lambda^h$

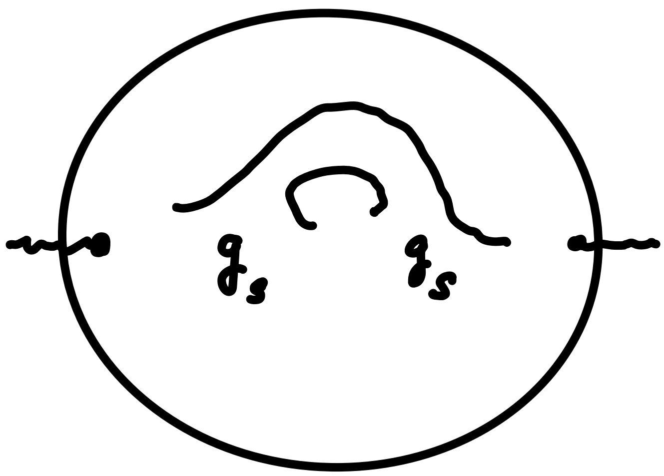
fixed λ limit ✓

What is the Yang Mills analog of λ^h ?

$$\lambda \longleftrightarrow g_{YM}^4 = g_{string}^2$$

$$\boxed{\lambda^h \longleftrightarrow g_{string}^{2h}}$$

$(\lambda \longleftrightarrow g_{YM}^4 = g_s^2)$

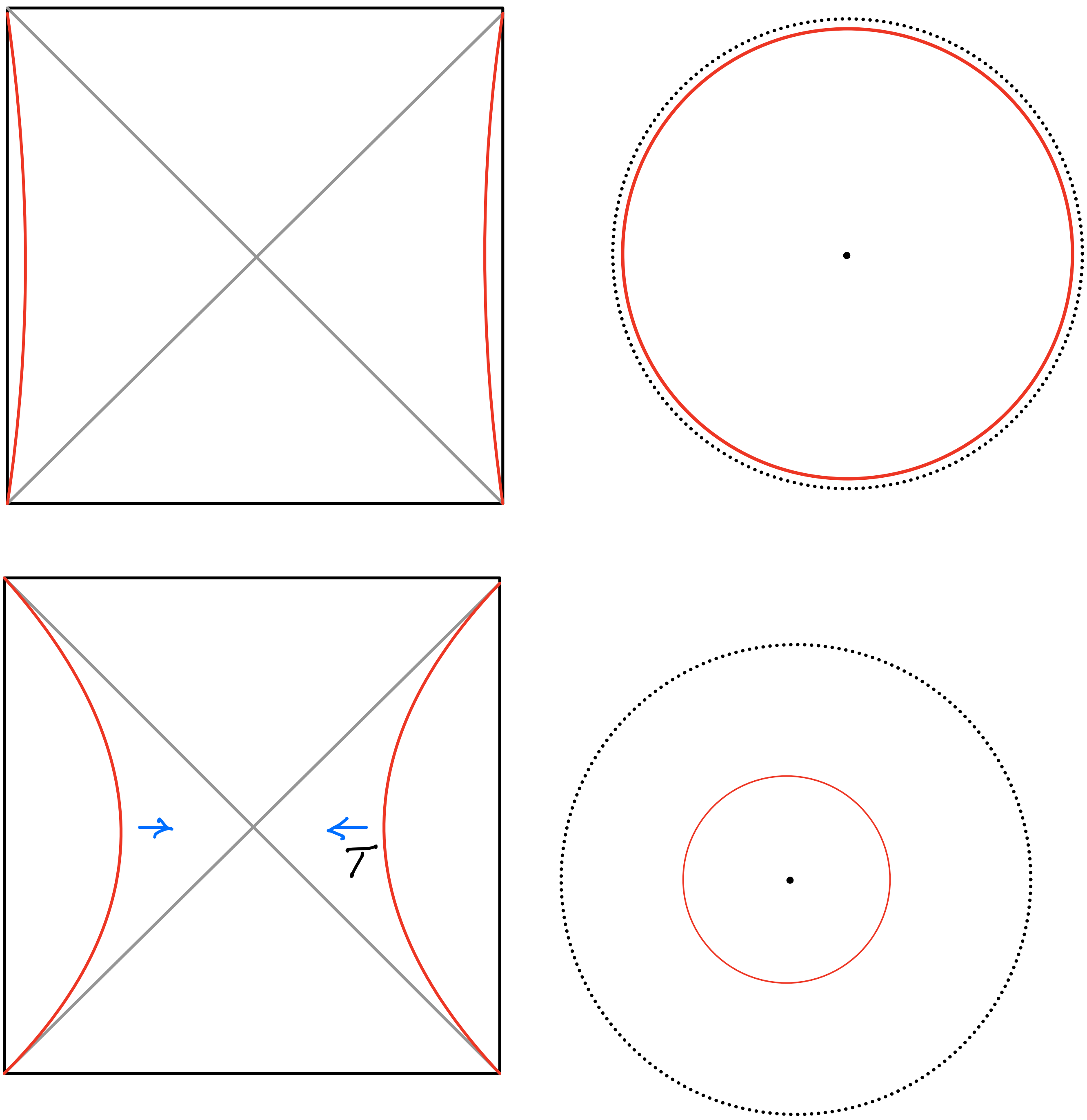


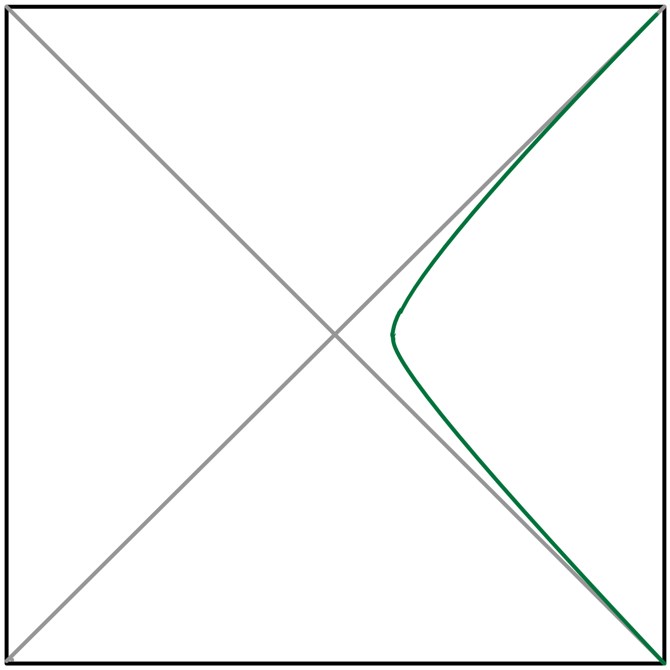
Is DSSYK$_\infty$ a string theory in JT-dS ?

If not then what is it, and what is the meaning of the parallel?

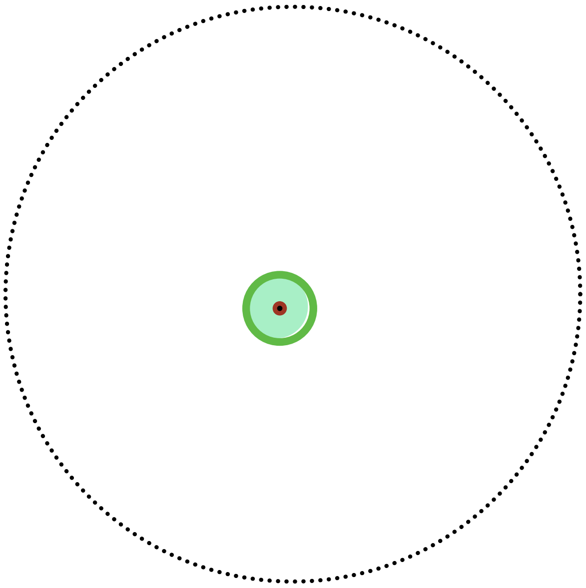
Corde: French for string

The stretched horizon, the fake disc and the phase boundary



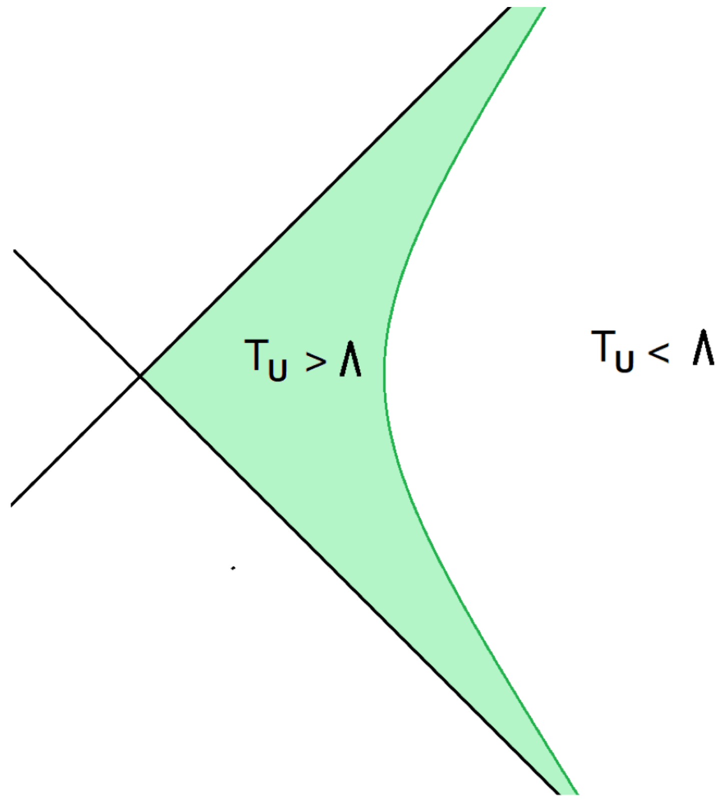


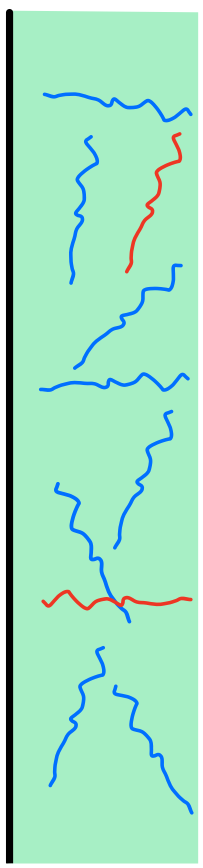
Stretched Horizon



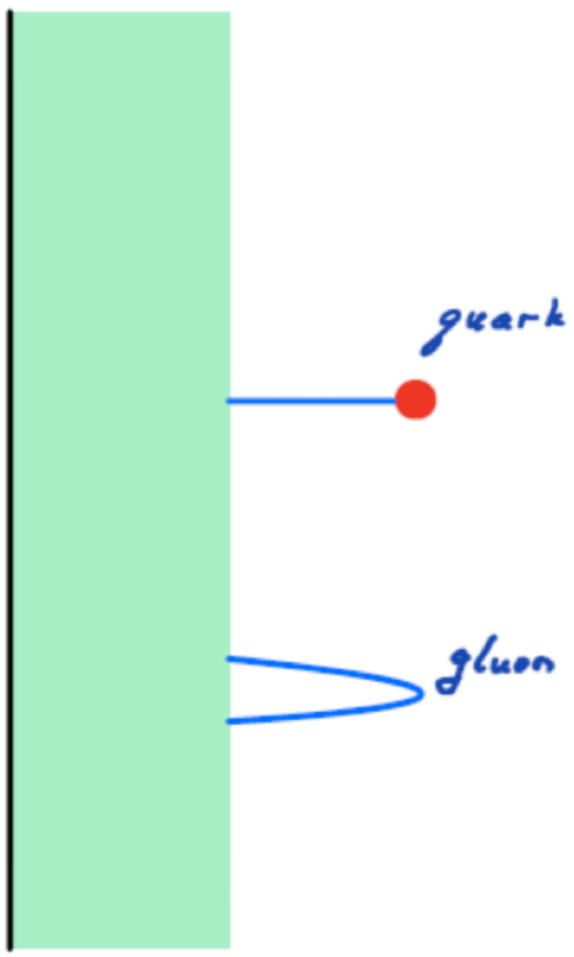
"Fake disc"

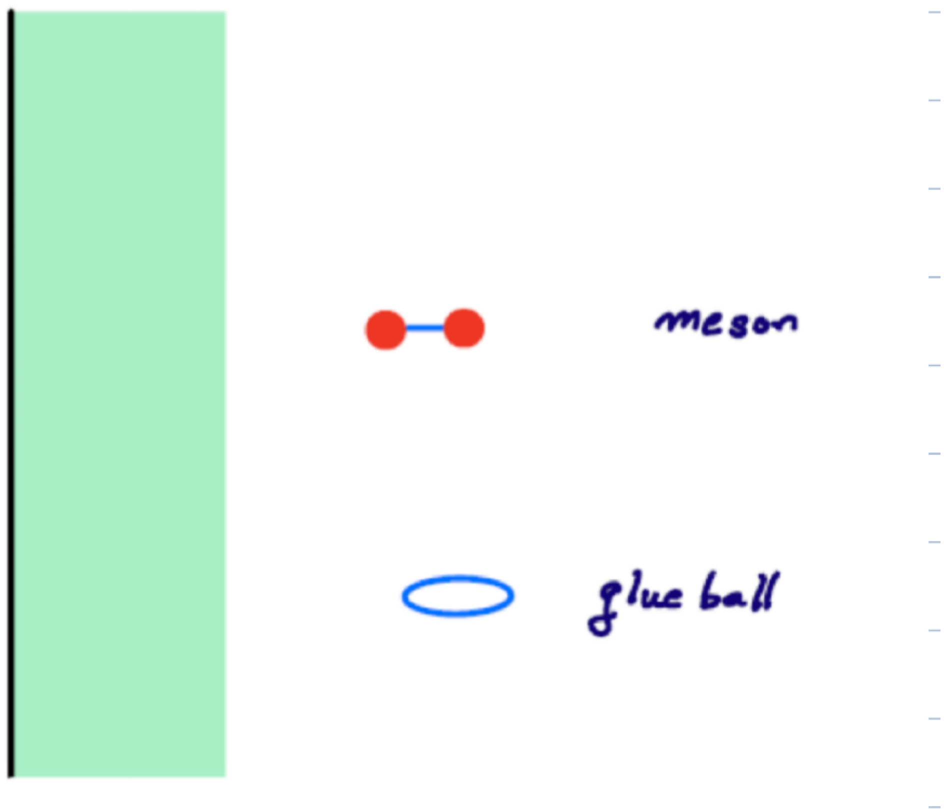
QCD in Rindler Space





Free quarks and gluons


quark
gluon



Number of gluon species $= N^2$

Number of meson-gluon species ~ 1

Confinement in $DSSYK_\infty$?

$O(N)$ symmetry (real ψ)

$SU(N)$ symmetry (complex ψ)

Confinement of $O(N)$ or $SU(N)$ charges