Title: Lecture - Beautiful Papers

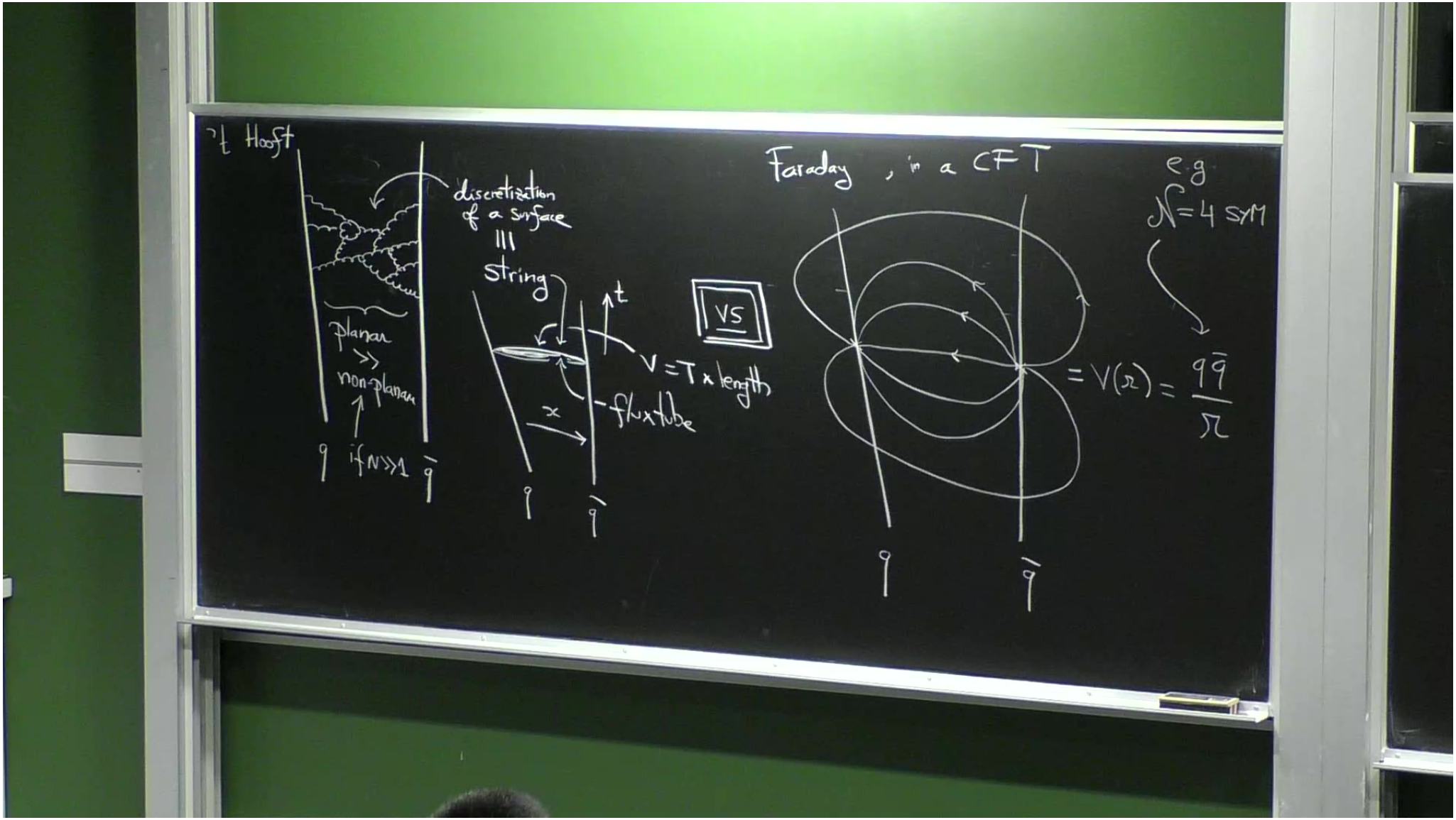
Speakers: Pedro Vieira

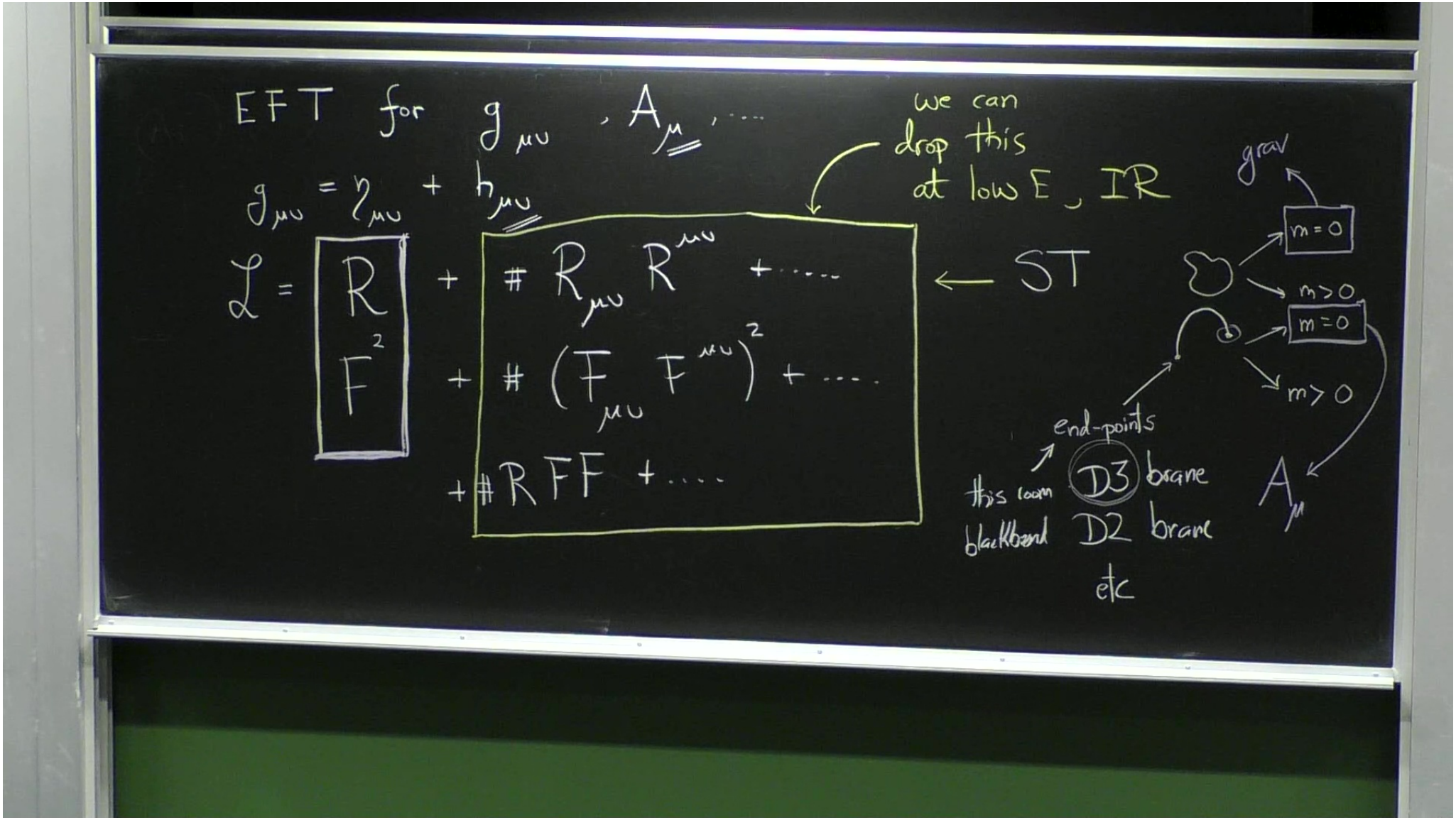
Collection/Series: Beautiful Papers - October 7, 2024 - January 31, 2025

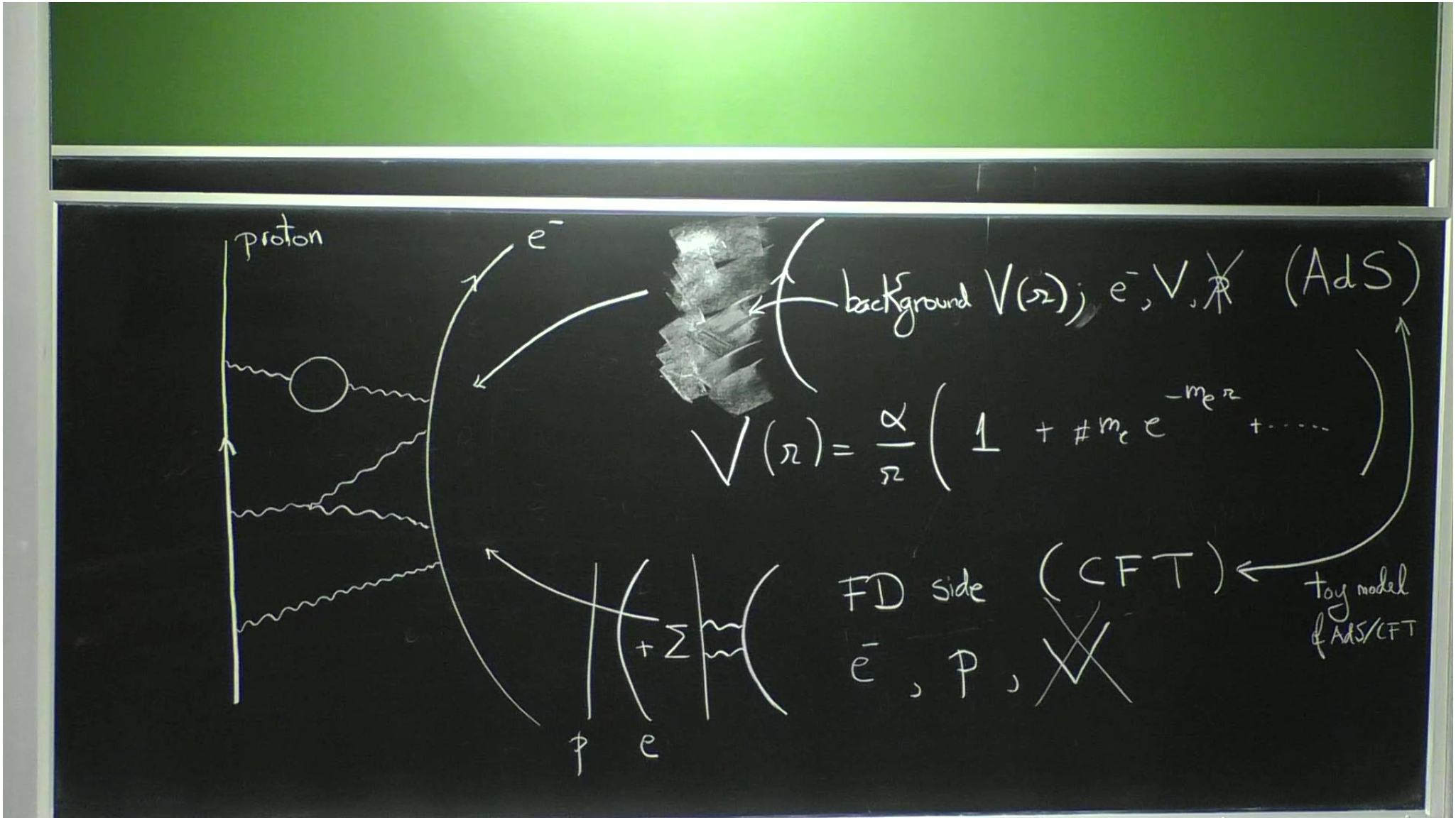
Subject: Other

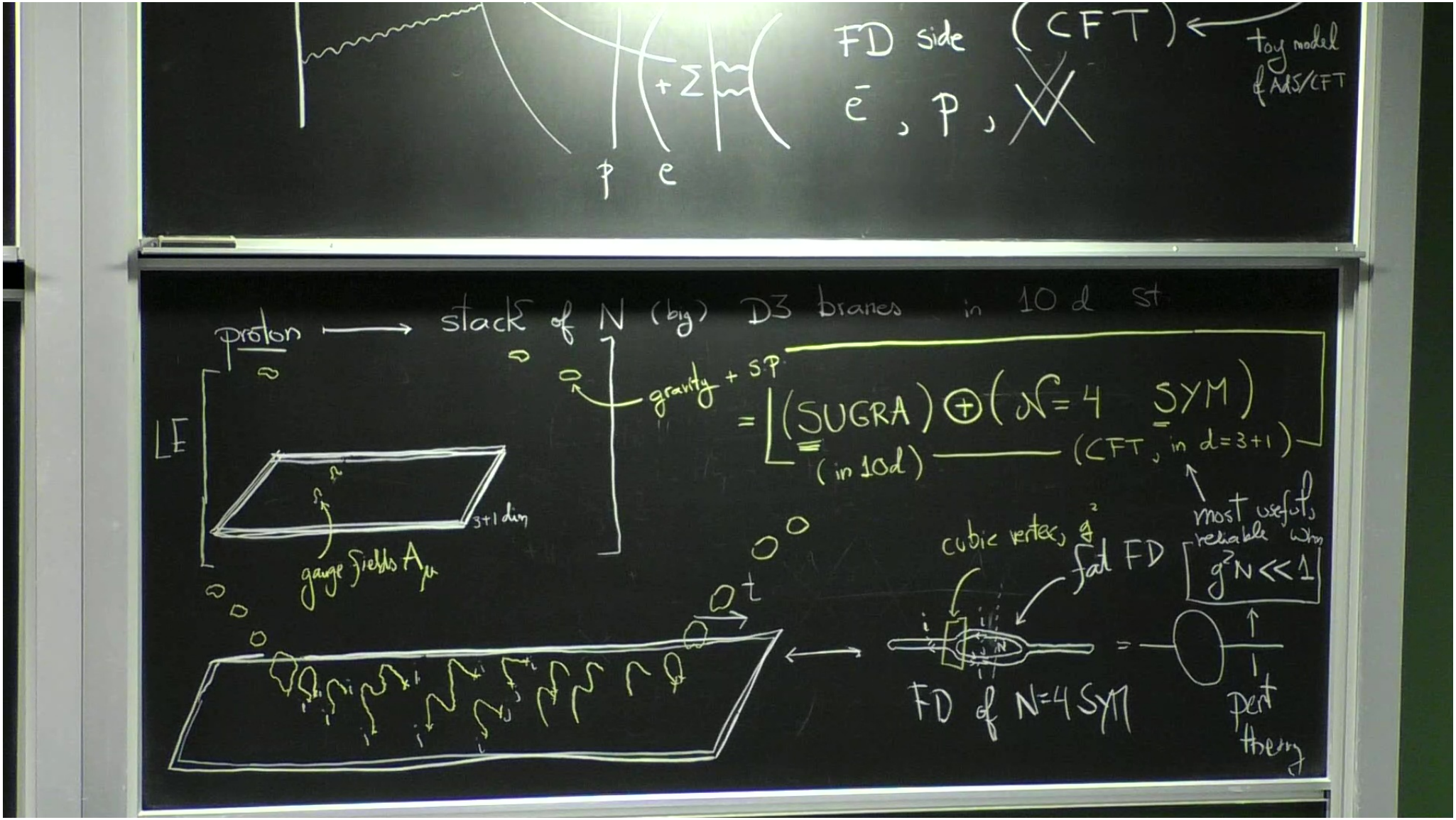
Date: January 13, 2025 - 9:15 AM

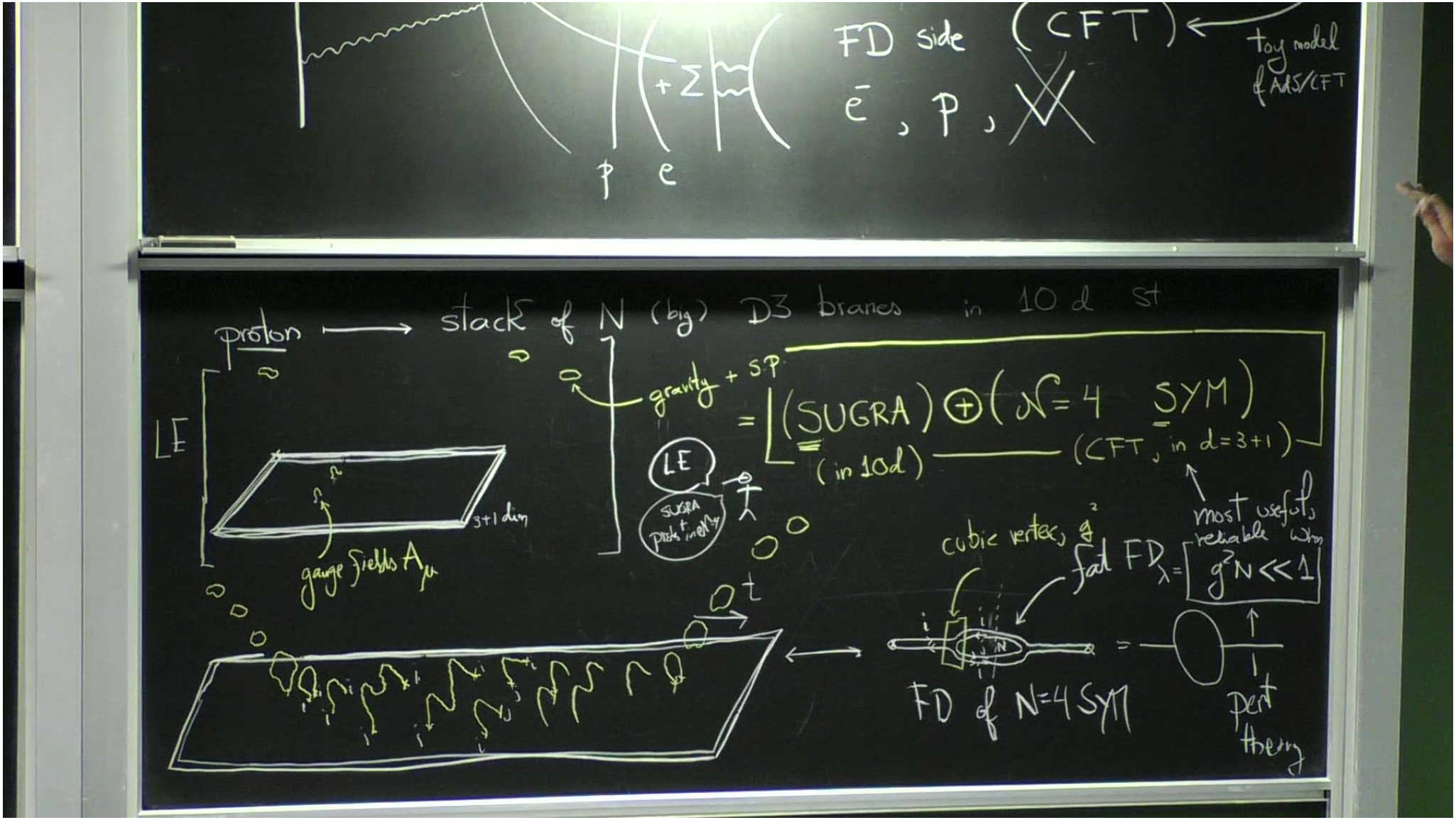
URL: https://pirsa.org/25010049

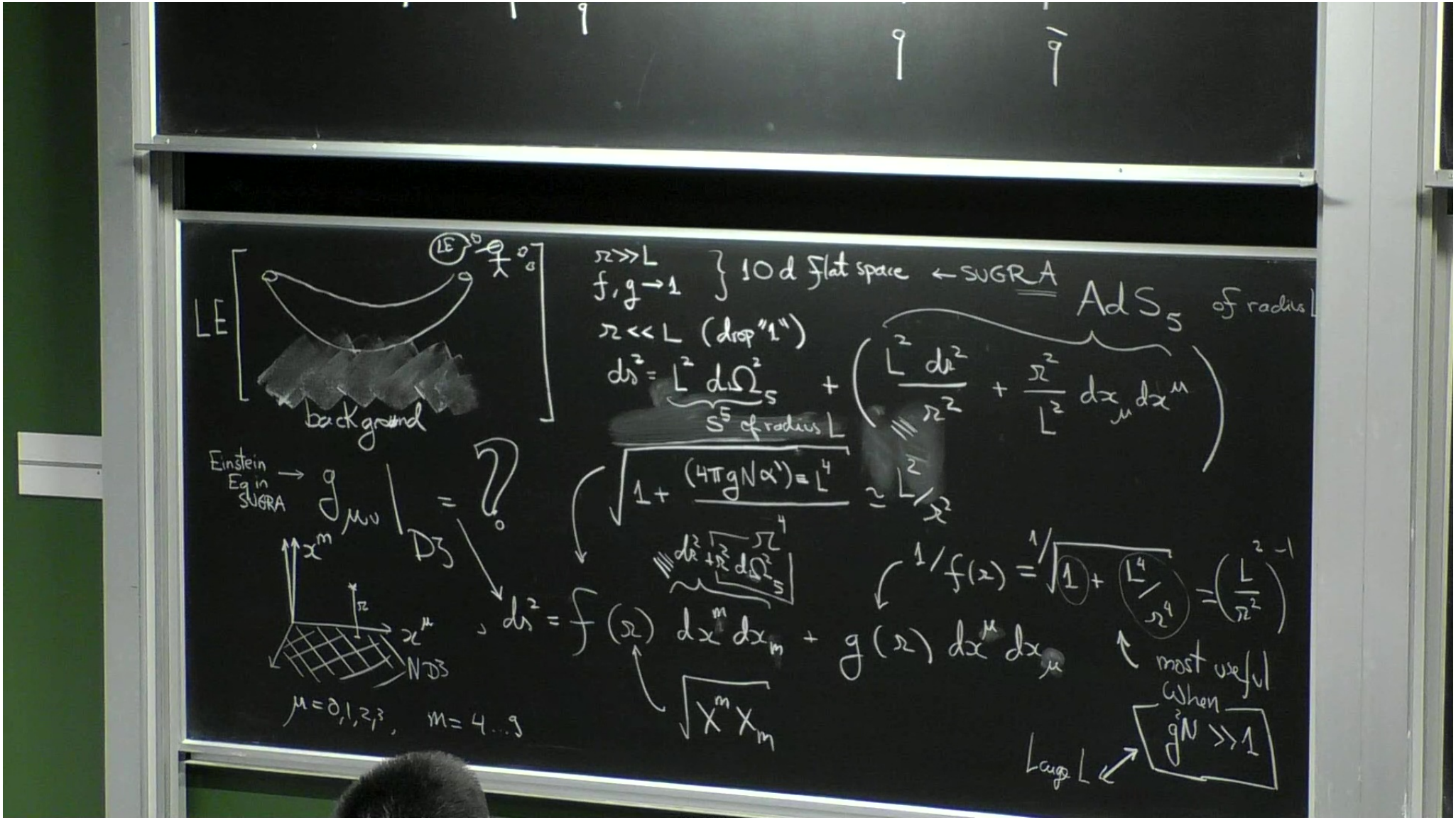

't Hooft
discretization of a surface
=
string
planar
>>
non-planar
if N>>1
q
q̄
t
x
V = T x length
flux tube
VS
Faraday, in a CFT
e.g
N=4 SYM
= V(x) = qq̄/x


EFT for $g_{\mu\nu}$, A_μ, ...
$g_{\mu\nu} = \eta_{\mu\nu} + h_{\mu\nu}$
$\mathcal{L} = R + F^2 + \#R_{\mu\nu}R^{\mu\nu} + ... + \#(F_{\mu\nu}F^{\mu\nu})^2 + ... + \#RFF + ...$
we can drop this at low E, IR
← ST
grav
m = 0
m > 0
m = 0
m > 0
A_μ
end-points
this room
blackboard
D3 brane
D2 brane
etc


proton
e^-
background $V(r)$; e^-, V, ~~$\bar{p}$~~ (AdS)
$V(r) = \frac{\alpha}{r}\left(1 + \#\, m_e\, e^{-m_e r} + \cdots\right)$
$+\Sigma$
FD side (CFT)
$\bar{e}$, p, ~~$\bar{p}$~~
toy model of AdS/CFT
p e


FD side (CFT)
toy model of AdS/CFT
p e
proton ⟶ stack of N (big) D3 branes in 10d ST
gravity + S.P
LE
3+1 dim
gauge fields A_μ
= [(SUGRA) ⊕ (N=4 SYM)]
(in 10d) (CFT, in d=3+1)
most useful, reliable when $g^2N \ll 1$
cubic vertex g^2
fat FD
N
FD of N=4 SYM
Pert theory
t


FD side (CFT)
toy model of AdS/CFT
p e
proton ⟶ stack of N (big) D3 branes in 10d ST
LE
3+1 dim
gauge fields A_μ
gravity + s.p
LE
SUGRA picks it implicitly
= [(SUGRA) ⊕ (N=4 SYM)
(in 10d) (CFT, in d=3+1)]
most useful, reliable when
$g^2N \ll 1$
cubic vertex g^2
fat FD, $\lambda = g^2N$
FD of N=4 SYM
Pert theory


LE
background
$r \gg L$
$f, g \to 1$
10d flat space ← SUGRA
AdS_5 of radius L
$r \ll L$ (drop "1")
$ds^2 = L^2 d\Omega_5^2 + \left(\frac{L^2 dr^2}{r^2} + \frac{r^2}{L^2} dx_\mu dx^\mu\right)$
S^5 of radius L
Einstein Eq in SUGRA
$g_{\mu\nu}\big|_{D3} = ?$
$\sqrt{1 + \frac{(4\pi g N \alpha')^2 L^4}{r^4}} \simeq \frac{L^2}{r^2}$
$dr^2 + r^2 d\Omega_5^2$
$1/f(r) = \sqrt{1 + \frac{L^4}{r^4}} = \left(\frac{L}{r^2}\right)^{-1}$
x^m
r
x^μ
$N D3$
$ds^2 = f(r)\, dx^m dx_m + g(r)\, dx^\mu dx_\mu$
most useful when $g^2 N \gg 1$
$\sqrt{X^m X_m}$
$\mu = 0,1,2,3$, $m = 4 \ldots 9$
Large L

susy []

etc

[useful for large g^2N]

AdS/CFT

[most useful for $g^2N \ll 1$]

LE = Type IIB [SST in $AdS_5 \times S^5$] $\oplus$ SUGRA = [$\mathcal{N}=4$ SYM $_{4d}$ $\oplus$ SUGRA] = LE

Everything in $AdS_5 \times S^5$

close to $r=0$

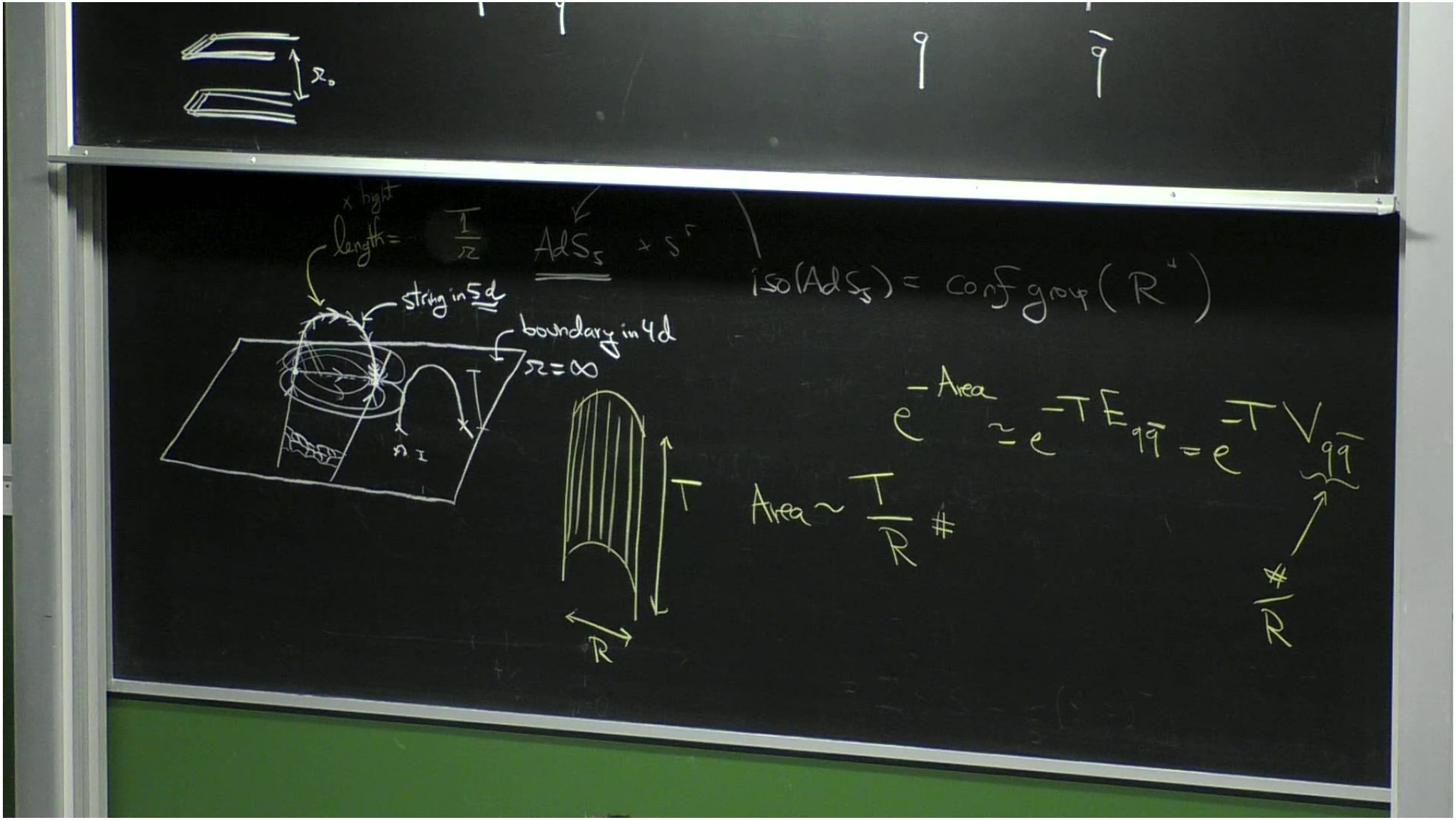
$$ds^2 = \cdots \left(\frac{r^2}{L^2}\right) dt^2 + \cdots$$

$$\sim dz^2_{AdS}$$

$$E_{AdS} = \frac{L}{r} E_{\infty}$$

$$E_{\infty} = \frac{r}{L} E_{AdS} - \text{Low } E^{\nabla}_{0}$$

AdS_5 is a box


z_0
q
$\bar{q}$
length = $\frac{1}{z}$ × light
$AdS_5 \times S^5$
$iso(AdS_5) = conf\,grav(R^4)$
string in 5d
boundary in 4d
$z = \infty$
z_1
T
R
Area $\sim \frac{T}{R}$ #
$e^{-\text{Area}} \simeq e^{-TE_{q\bar{q}}} = e^{-TV_{q\bar{q}}}$
R