Title: AdS/CFT Lecture (230414)

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Collection: AdS/CFT (2022/2023)

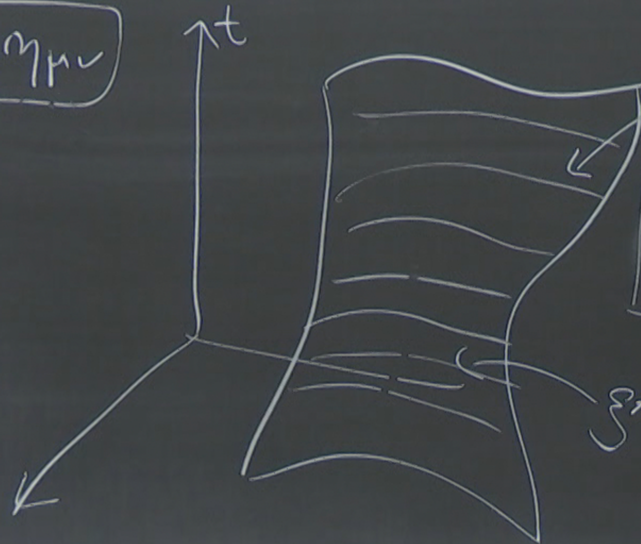
Date: April 14, 2023 - 9:00 AM

URL: https://pirsa.org/23040035

OF RELATIVISTIC STRINGS & OTHER OBJECTS

CARTOON I : RELATIVISTIC STRINGS

$\boxed{X^\mu, \eta_{\mu\nu}}$



INDUCED METRIC

$$\boxed{\gamma_{AB}(\eta) = \frac{\partial x^\mu}{\partial \xi^A} \frac{\partial x^\nu}{\partial \xi^B} \eta_{\mu\nu}}$$

$P^\mu{}_A$

$\xi^A = \{\lambda, \sigma\}$

EORY

• NAMBU-GOTO

$$S_{NG}[X^\mu] = -T \int d^2\xi \sqrt{-\det(\gamma_{AB}(\eta))} \qquad T = \frac{1}{2\pi\alpha'}\ , \ \alpha' = l_s^2$$

• POLYAKOV

$$\boxed{S_{POL}[\underline{X}^\mu, \underline{\underline{h}}^{AB}] = -\frac{T}{2} \int d^2\xi \sqrt{-h}\, h^{AB} \gamma_{AB}} \ \ldots$$

ACTION FOR 2D SCALARS

$$S = \int d^2\xi\, D_A \varphi^\mu D_B \varphi^\nu h^{AB} \sqrt{-h}\, \eta_{\mu\nu}$$

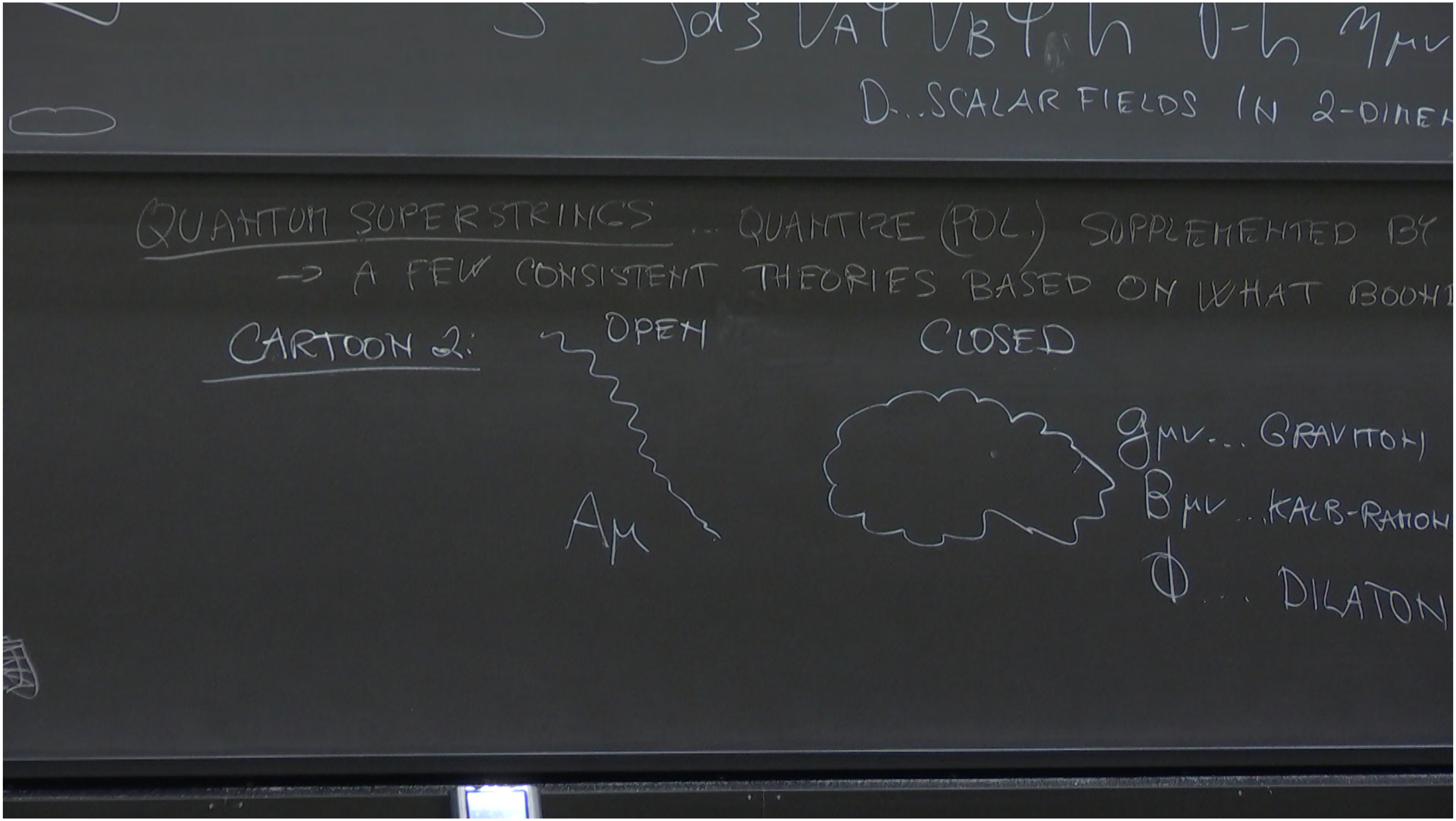
D...SCALAR FIELDS IN 2-DIMENSIONS

$\boxed{2D}$ SCALAR THEORY HAS <u>CONFORMAL SYMMETRY</u>

$h_{AB} \to \Omega^2 h_{AB}$. LEAVES ACTION INVARIANT.

$h^{AB} \to \Omega^{-2} h^{AB}$

$\sqrt{h} \to \Omega^2 \sqrt{h}$ $\quad \Omega^2 \left(\cdots \right)$


D...SCALAR FIELDS IN 2-DIMEN
QUANTUM SUPERSTRINGS ... QUANTIZE (POL.) SUPPLEMENTED BY
→ A FEW CONSISTENT THEORIES BASED ON WHAT
CARTOON 2:
OPEN
CLOSED
A_μ
$g_{\mu\nu}$ ... GRAVITON
$B_{\mu\nu}$ ... KALB-RAMON
ϕ ... DILATON

D. .. SCALAR FIELDS IN 2-DIMENSIONS

...S ... QUANTIZE (POL.) SUPPLEMENTED BY FERMIONS

...STENT THEORIES BASED ON WHAT BOUNDARY CONDITIONS

...OPEN CLOSED

$g_{\mu\nu}$ ... GRAVITON $\Rightarrow$ A QT OF GRAVITY

$B_{\mu\nu}$ ... KALB-RAMOND

ϕ ... DILATON

$d = 10$

AVE MANY

WANT TO

POLYAKOV ACTION CHANGES

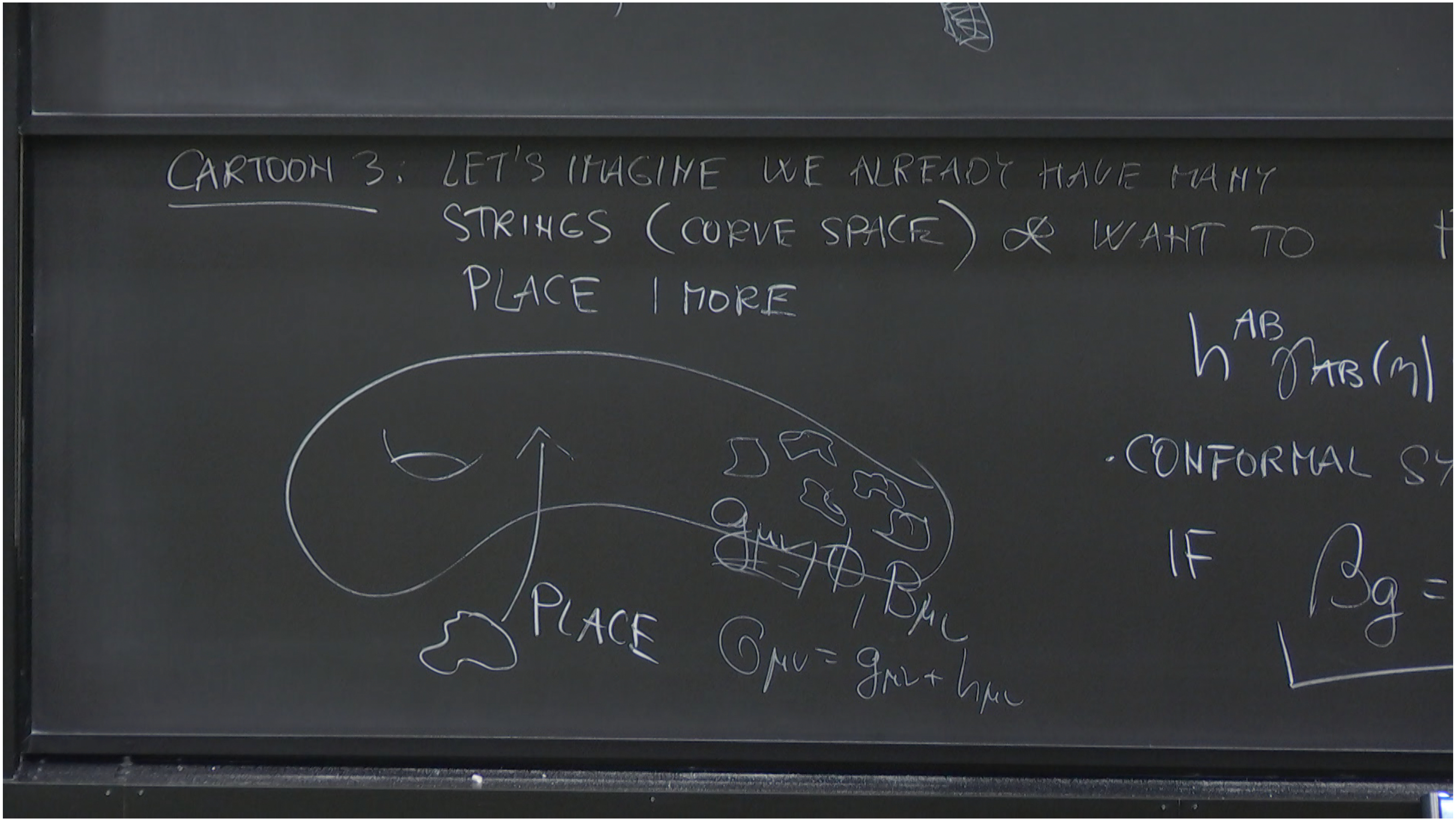
$$h^{AB}\gamma_{AB}(\eta) \to h^{AB}\gamma_{AB}(g) + \varepsilon^{AB}\gamma_{AB}(B) + \alpha' R_h \phi$$

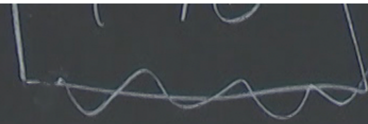
· CONFORMAL SYMMETRY IS PRESERVED AT 1 LOOP

IF $\underbrace{\beta_g = 0} = \underbrace{\beta_B = 0 = \beta_\phi}$ ... YIELD EINSTEIN EQS

IN IIB SUPERSTRING TH: THESE EINSTEIN EQS CAN BE DERIVED FROM IIB SUPERGRAVITY ACTION: $\left(g_{\mu\nu},\ \phi,\ \underset{\substack{\downarrow \\ H}}{B_{\mu\nu}},\ \underset{\substack{\uparrow \\ \text{AXION}}}{A_0} \underset{\substack{\downarrow \\ F_1}}{},\ \underset{\substack{\downarrow \\ F_3}}{A_{\mu\nu}},\ \underset{\substack{\downarrow \\ F_5}}{A_{\mu\nu\kappa\lambda}}\right)$

$$\boxed{\mathcal{L} = *\left(e^{-2\phi}\left(R+4(\partial_\mu\phi)^2-\frac{1}{2}H_3^2\right)-\frac{1}{2}F_1^2-\frac{1}{2}F_3^2-\frac{1}{4}F_5^2\right)-\frac{1}{2}A_4\wedge H_3\wedge F_3}$$


CARTOON 3: LET'S IMAGINE WE ALREADY HAVE MANY
STRINGS (CURVE SPACE) & WANT TO
PLACE 1 MORE
$h^{AB}\gamma_{AB}(\eta)$
· CONFORMAL SY
IF
$\beta_g =$
$g_{\mu\nu}$, ϕ, $B_{\mu\nu}$
PLACE $G_{\mu\nu} = g_{\mu\nu} + h_{\mu\nu}$

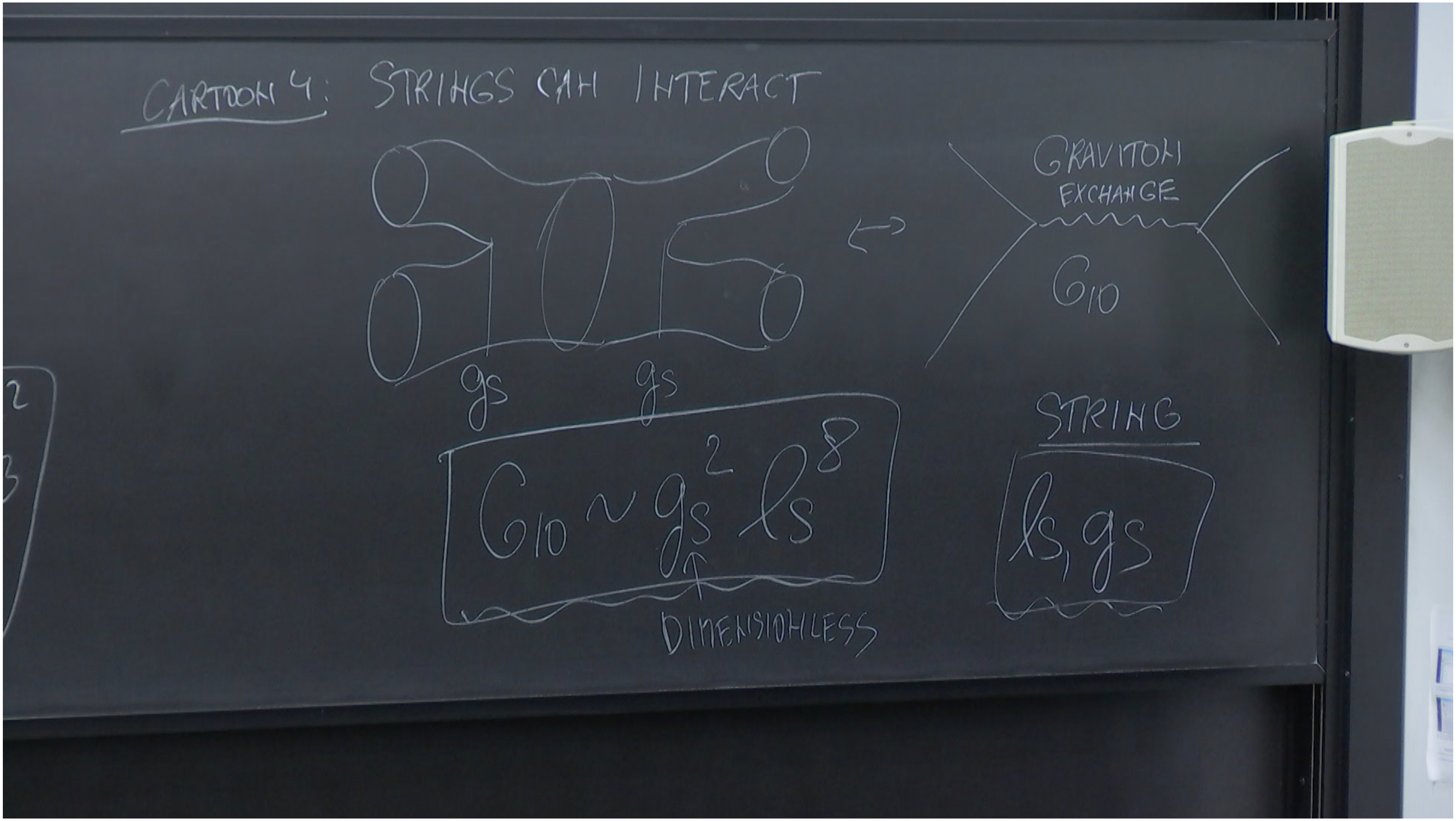


POLYAKOV ACTION CHANGES $\qquad \frac{1}{G_d}\int \frac{d^d x}{L^d} R \frac{1}{L^2} \, L^{d-2}$

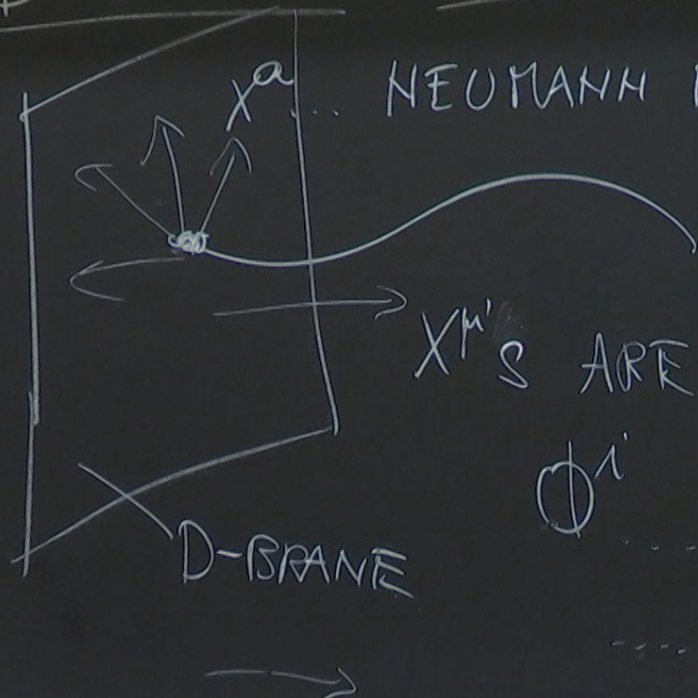
$$\to h^{AB}\gamma_{AB}(g) + \varepsilon^{AB}\gamma_{AB}(B) + \alpha' R_h \phi$$

SYMMETRY IS PRESERVED AT 1 LOOP

$= 0 = \beta_B = 0 = \beta_\phi$ ... YIELD EINSTEIN EQS


CARTOON 4: STRINGS CAN INTERACT
GRAVITON EXCHANGE
G_{10}
g_s
g_s
$G_{10} \sim g_s^2 l_s^8$
DIMENSIONLESS
STRING
l_s, g_s

D-BRANES. CARTOON 5



X^a ... NEUMANN DIRS.

$X^{\mu'}$S ARE FIXED.. RENAMED TO

Φ^i ... SCALARS (FROM BRANE VIEWPOINT)

... D[illegible] DIRS

ENDPOINT LOOKS LIKE A PARTICLE
FROM BRANE VIEPOINT
& CAN MOVE IN X^a
DIRECTIONS
(COULD BE CHARGED)
→ INTERACT WITH
A_a. VECTOR FIELD
ON THE BRANE

S.

ED.. RENAMED TO
ALARS (FROM BRANE
VIEWPOINT)
DIRS

THE MOTION OF A SINGLE D-BRANE GOVERNED BY DIRAC-BORN-INFELD ACTION

$$S_{DBI} = -T_{Dp} \int d\xi^{p+1} \sqrt{-\det\left(\gamma_{AB}(g) + \gamma_{AB}(B)\right)}$$

OF A SINGLE D-BRANE GOVERNED

-BORN-INFELD ACTION

$$T_{Dp}\int d\xi^{p+1}\sqrt{-\det\left(\gamma_{AB}(g)+\gamma_{AB}(B)+2\pi\alpha' F_{AB}\right)}\; e^{-\phi}$$