Title: AdS/CFT Lecture (230414)

Speakers: David Kubiznak

Collection: AdS/CFT (2022/2023)

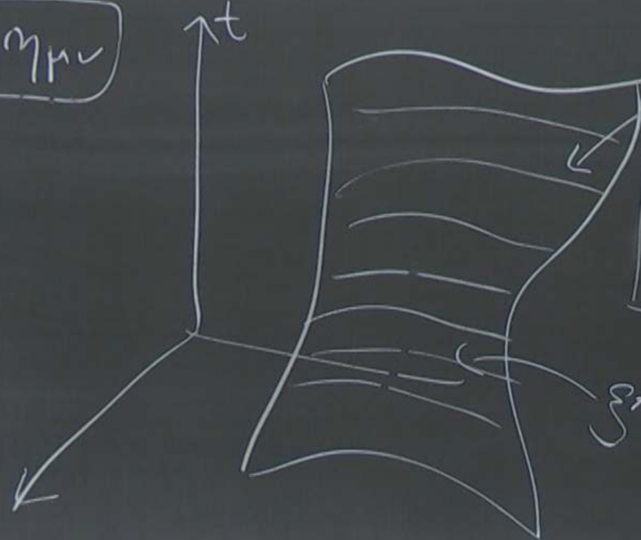
Date: April 14, 2023 - 9:00 AM

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^μ_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 CONFORMAL SYMMETRY

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

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

$\sqrt{h} \to \Omega^2 \sqrt{h}$ $\quad \Omega^2 (\ldots)$

$\int d^2\xi \, \partial_A \varphi \, \partial_B \varphi \, h \; \sqrt{-h} \; \eta_{\mu\nu}$

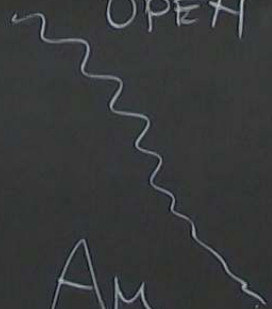
D...SCALAR FIELDS IN 2-DIMEN

QUANTUM SUPERSTRINGS ... QUANTIZE (POL.) SUPPLEMENTED BY

→ A FEW CONSISTENT THEORIES BASED ON WHAT BOOH

CARTOON 2:

OPEN



A_μ

CLOSED

$g_{\mu\nu}$ ... 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

...PEN CLOSED

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

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

ϕ ... DILATON

$\boxed{d=10}$

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

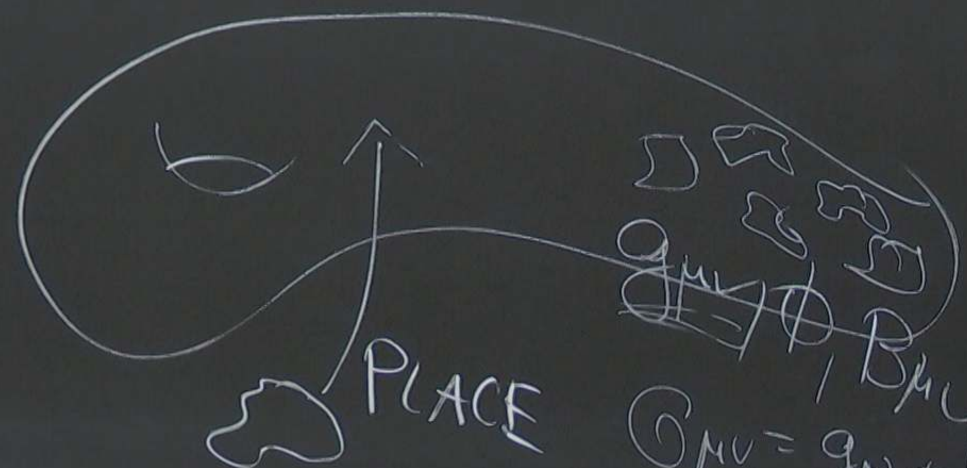
IF $\underbrace{\beta_g = 0} = \underbrace{\beta_B = 0 = \beta_\phi}$ ... YIELD EINSTEIN EQS

IN IIB SUPERSTRING TH: THESE EINSTEIN EQS CAN BE DERIVED FROM IIB SUPERGRAVITY ACTION: $(g_{\mu\nu}, \phi, B_{\mu\nu}, A_0, A_{\mu\nu}, A_{\mu\nu\kappa\lambda})$

$B_{\mu\nu} \to H$, A_0 AXION $\to F_1$, $A_{\mu\nu} \to F_3$, $A_{\mu\nu\kappa\lambda} \to F_5$

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

CARTOON 3: LET'S IMAGINE WE ALREADY HAVE MANY STRINGS (CURVE SPACE) & WANT TO PLACE 1 MORE



PLACE $G_{\mu\nu} = g_{\mu\nu} + h_{\mu\nu}$

$h^{AB}\gamma_{AB}(\eta)$

· CONFORMAL SY

IF $\beta_g =$

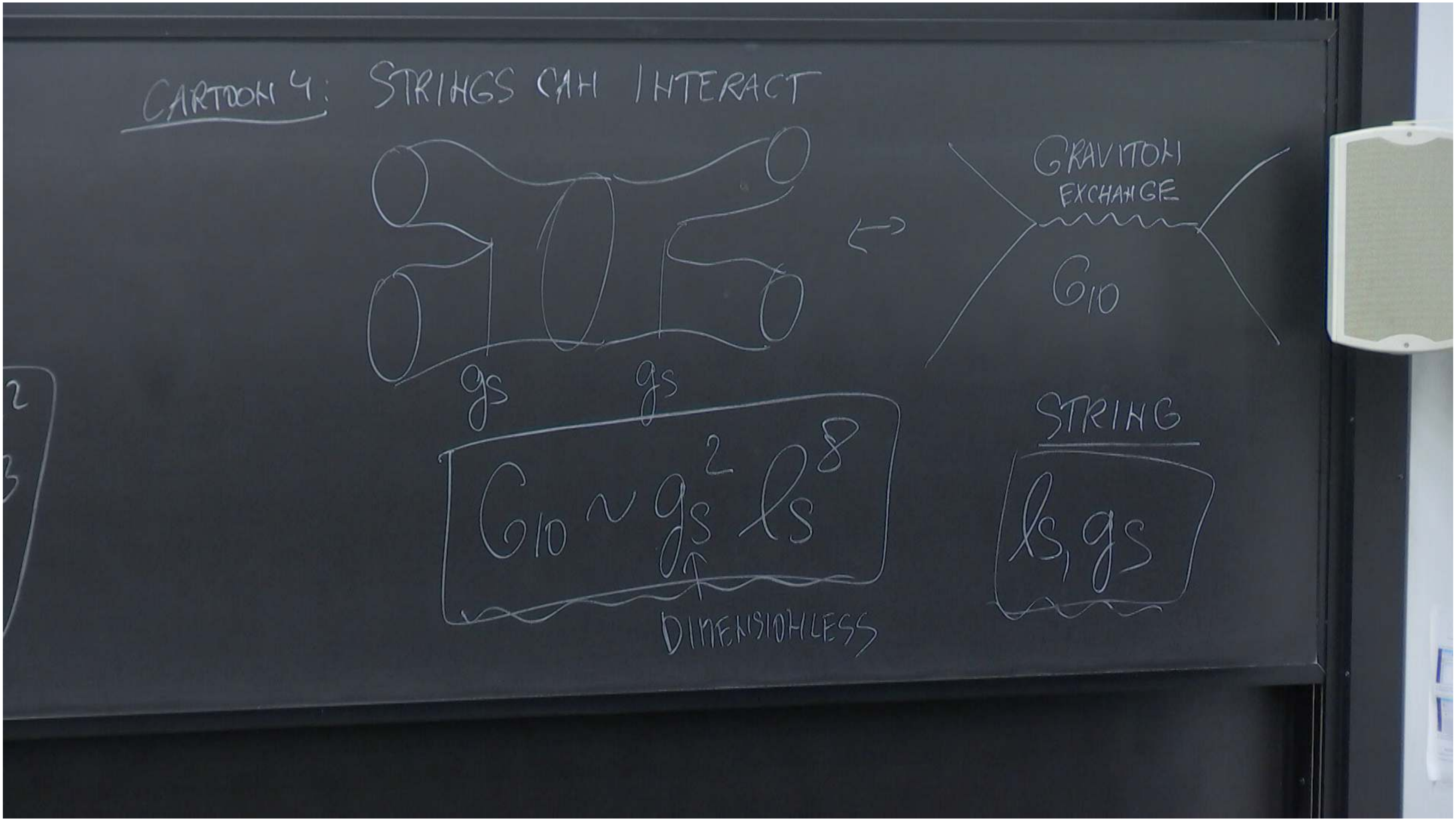
POLYAKOV ACTION CHANGES

$$\frac{1}{G_d}\int \frac{d^dx}{L^d}\, R\, \frac{1}{L^2}\; L^{d-2}$$

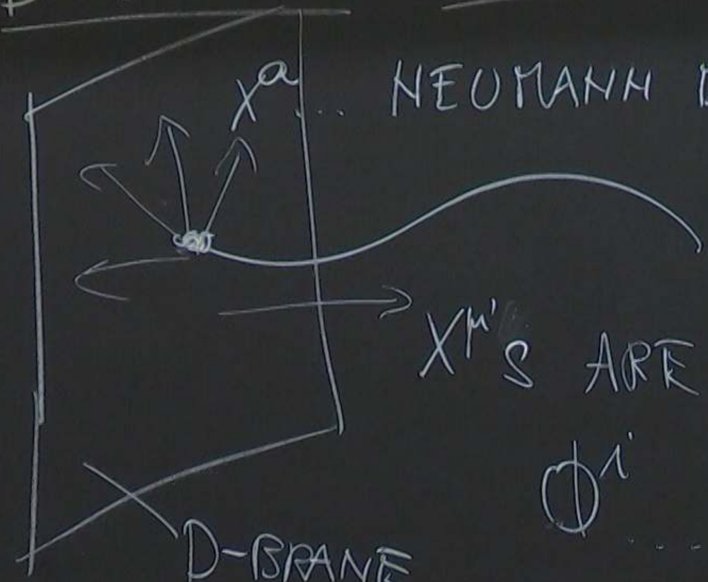
$$\rightarrow h^{AB}\gamma_{AB}(g) + \varepsilon^{AB}\gamma_{AB}(B) + \alpha' R_h \phi$$

SYMMETRY IS PRESERVED AT 1 LOOP

$$= 0 = \beta_B = 0 = \beta_\phi \ \ldots$$ 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



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

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

... D 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

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