

Title: String Theory Lecture

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Collection: String Theory 2023/24

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URL: <https://pirsa.org/24050002>

T BOUNDARY

$\beta_1$

$\beta_2$

$\beta_3$

$\vdots$

$H \circ B$

$\int M \times O_3$   
 $\partial \pi$

T

$$T_{\mu\nu} \quad \partial_\mu T^{\mu\nu} = 0$$

$$T_{\perp\parallel} = \partial_\parallel t_{\parallel\parallel}^2$$

$$T_{\mu\mu} = 0$$

$$t_{\parallel\parallel} = 0 \Rightarrow T_{\perp\parallel} = 0 \Rightarrow T = \bar{T}$$

$$\partial x^\mu \partial x_\mu = \bar{\partial} x^\mu \bar{\partial} x_\mu$$

BOUNDARIES FOR  $X$   $2d$  FREE MASSLESS SCALAR

NEUMANN  $\partial_{\perp} X|_2 = 0$

DIRICHLET  $X|_2 = x$

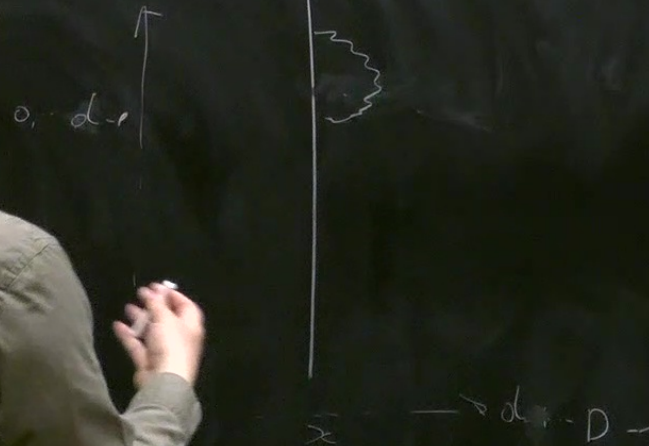
$$\partial_+ X^{0 \dots d-1}$$

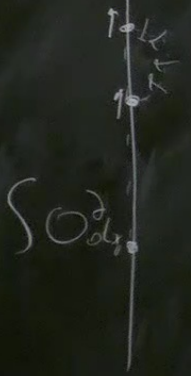
$$X^{d \dots D-1} = x^{d \dots D-1}$$

$$\partial X^\mu = M^\mu_\nu \bar{\partial} X^\nu$$

$\uparrow$   
 $O(D, 1, 1)$

SPACE - TIME





2d QFT



• G

T BOUNDARY

$B_1$   
 $B_2$   
 $B_3$

$\int_M$   
 $\partial M$

$$T_{\mu\nu} \quad \partial_\mu T^{\mu\nu} = 0$$

$$T_{\perp\parallel} = \partial_\parallel t_{\parallel\parallel}$$

$$T_{\mu\nu} = 0$$

$$t_{\parallel\parallel} = 0 \Rightarrow T_{\perp\parallel} = 0 \Rightarrow T = \bar{T}$$

$$\partial x^\mu \partial x^\nu =$$

$$e^{-\frac{pX}{\alpha'}}$$

TACHYON

$$E_{\alpha\beta} \partial X^\alpha \partial X^\beta e^{-\frac{pX}{\alpha'}}$$

$$\partial X^\alpha \partial X^\beta e^{-\frac{pX}{\alpha'}}$$

GAUGE FIELDS  
ON BRANE

CHARGED  
ENDPOINTS

TRANSVERSE  
FLUCTUATIONS

$$e^{i p X_{\alpha-d,1}}$$

TACHION

$$\epsilon_{\alpha-d,1} \partial X_{\alpha-d,1} e^{i p X_{\alpha-d,1}}$$

GAUGE FIELDS  
ON BRANE

CHARGED  
ENDPOINTS

$$\partial X_{\alpha-d,1} e^{i p X_{\alpha-d,1}}$$

TRANSVERSE  
FLUCTUATIONS

$$\sqrt{-g} \frac{d^4 x}{d^4 \sigma} \frac{d^4 y}{d^4 \tau} (G_{\mu\nu} + F_{\mu\nu})$$

$B_1$   
 $B_2$   
 $B_3$   
⋮

$$\begin{array}{c} H \circ B \\ \hline \int M \circ O \\ \partial H \end{array}$$

T

$$\begin{array}{c} C^M \circ B \\ \text{MATRIX } O^2 \end{array}$$

$$B \circ C^M =$$

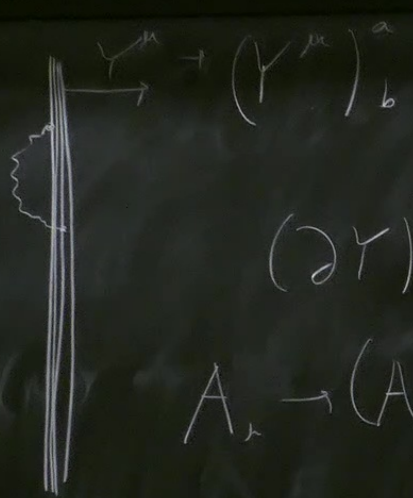
B

B

$$C^M \circ G^M \circ H \circ B$$

$$\partial X^T \partial X_r = \bar{\partial} X^T \bar{\partial} X_r$$





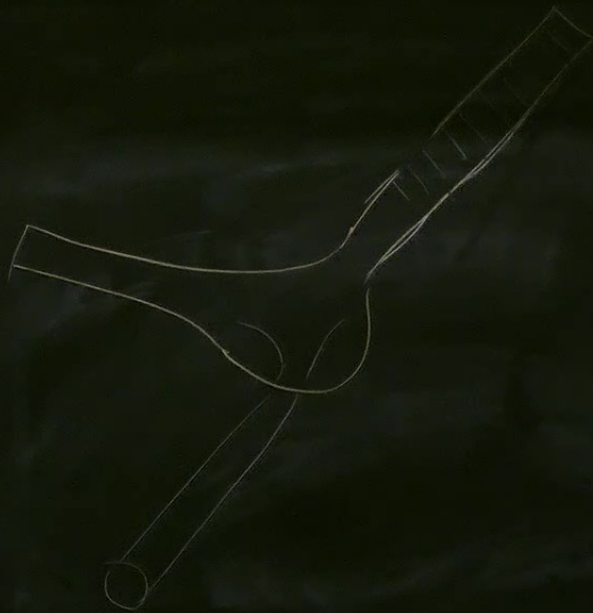
$$P_{\mu\nu} = [Y^\mu, Y^\nu]$$

$$(\partial Y)^2 + \sum_{\mu, \nu} [Y^\mu, Y^\nu]^2$$



$$A_\mu \rightarrow (A_\mu)_b^a$$

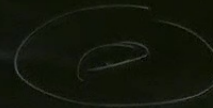
$U(N)$  GAUGE FIELDS



$\frac{N}{g}$



1



$g \rightarrow 0$

SMALL  
BACK-REACTIVE

$\frac{1}{g}$

HEAVY

$$e^{i p X_{\alpha}^{0, d-1}}$$

TACHYON

$Y \cdot \partial X$

$$e_{\alpha-d, \alpha} \partial X_{\alpha}^{0, d-1} e^{i p X_{\alpha}^{0, d-1}}$$

GAUGE FIELDS  
ON BRANE

CHARGED  
ENDPOINTS

$$\partial X_{\alpha}^{d-D, \alpha} e^{i p X_{\alpha}^{0, d-1}}$$

TRANSVERSE  
FLUCTUATIONS

$$\sqrt{-\det \left( \frac{\partial x^{\mu}}{\partial \sigma^{\alpha}} \frac{\partial y^{\nu}}{\partial \sigma^{\beta}} (G_{\mu\nu} + F_{\mu\nu}) \right)}$$

SUPER-STRINGS

10d

HETEROTIC

$SO(32)$   
 $E_8 \times E_8$

$$X^\mu \leftrightarrow \psi^\mu$$

↓ GSO

IIA    IIB

0A    0B

$$\int e^{-|z|^2} dz$$

$$\int dx d\bar{x} e^{-\frac{c}{2} |x|^2}$$