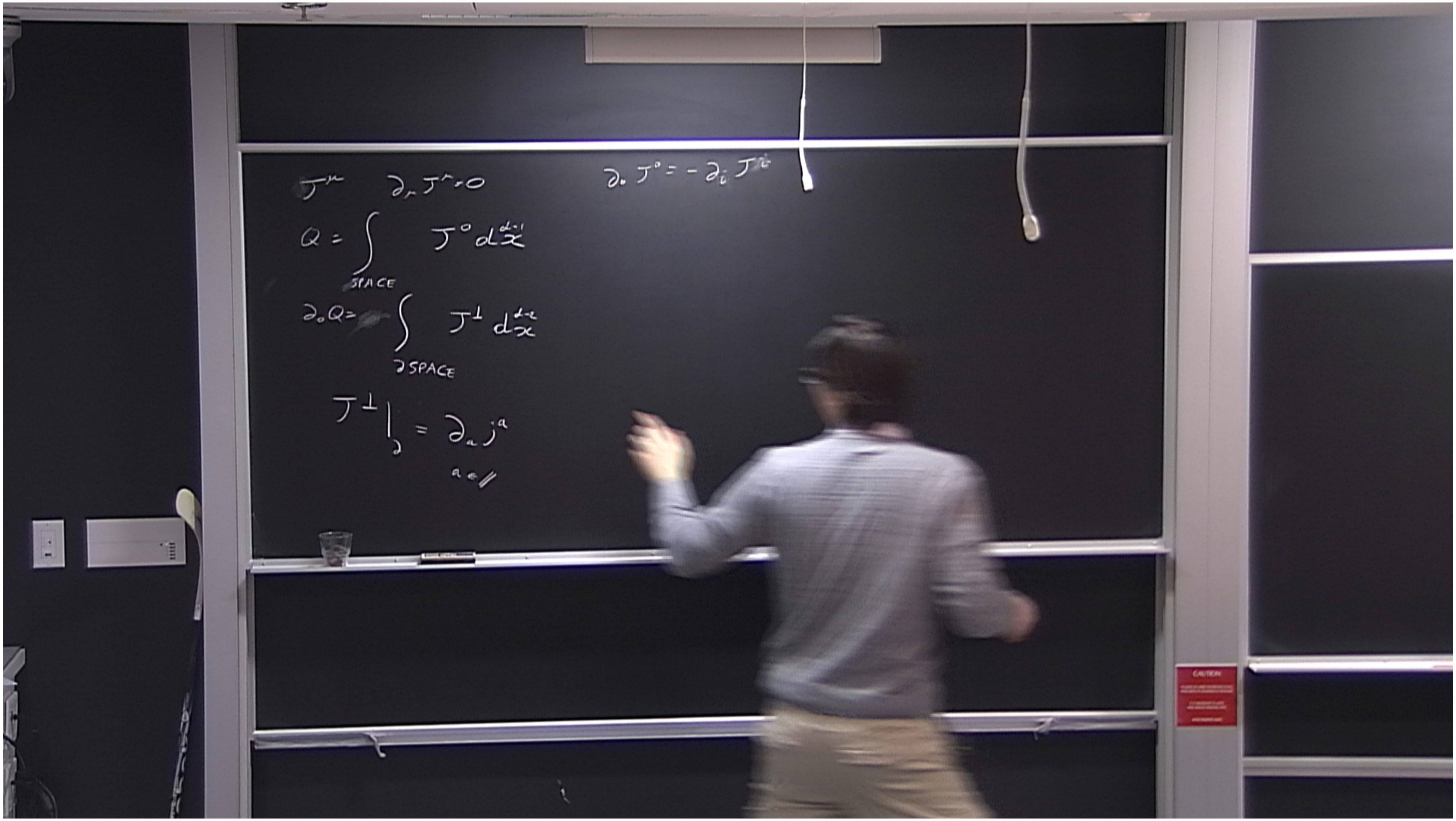
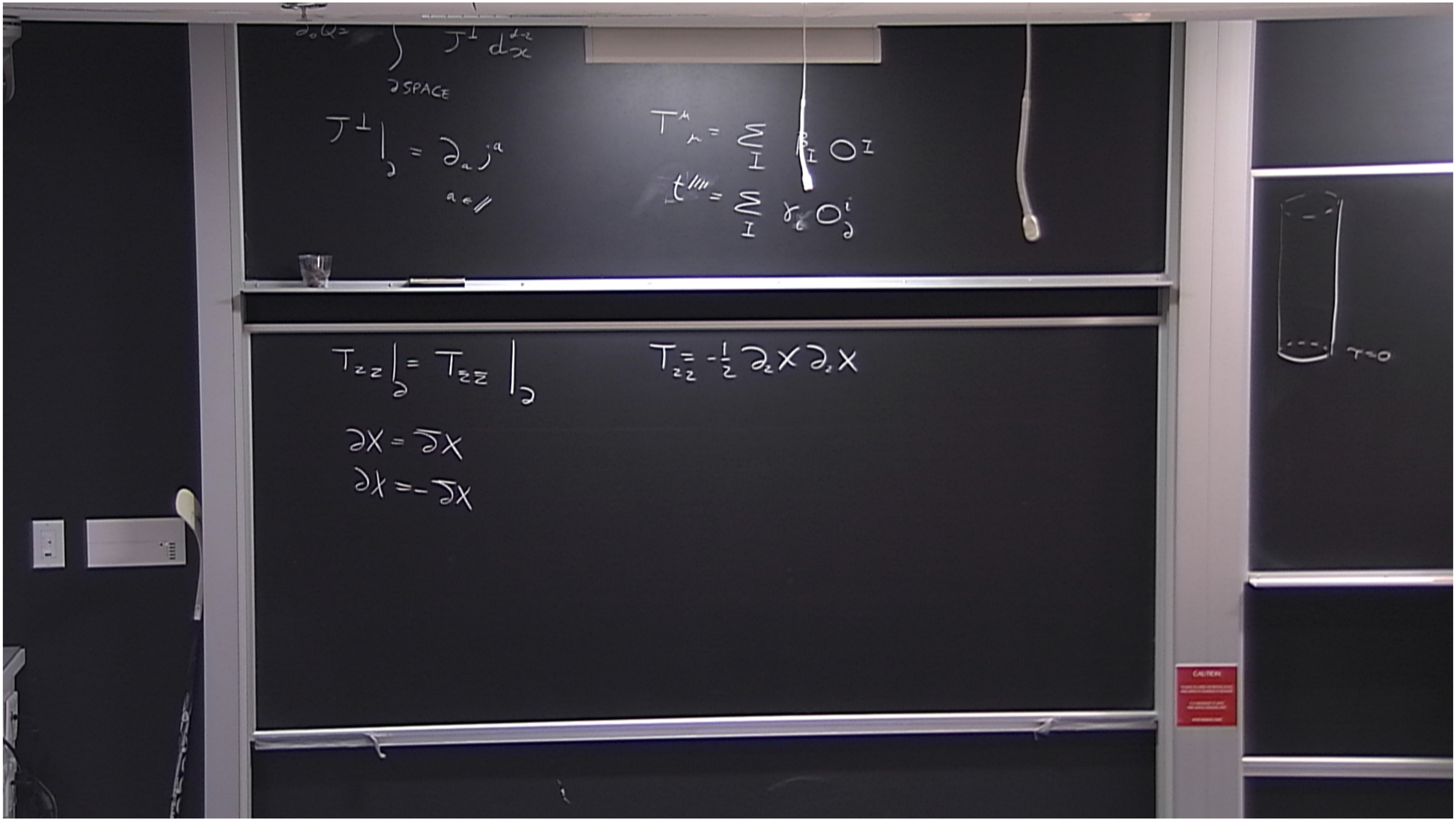
Title: String Theory Review-12

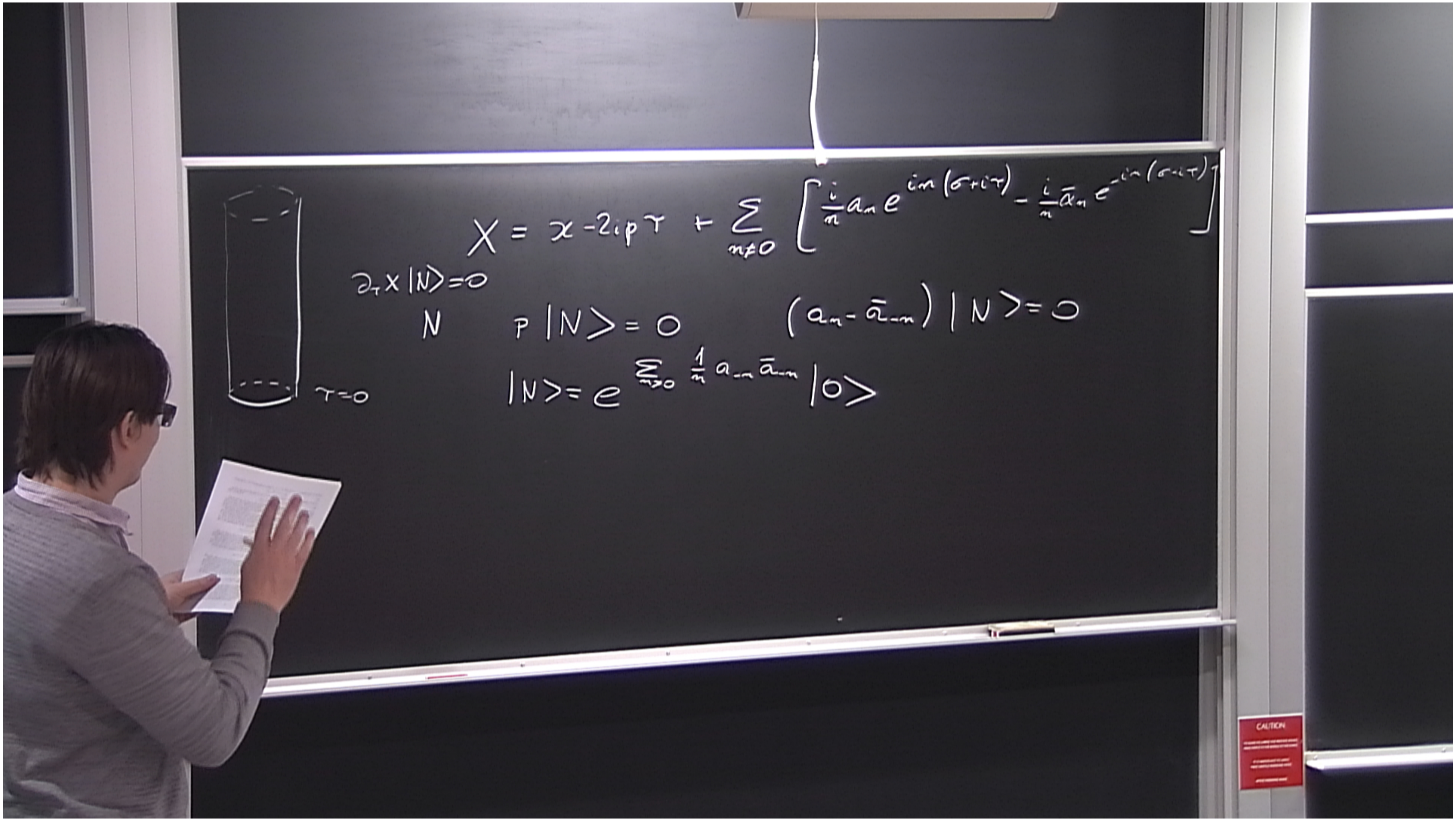
Date: Feb 10, 2015 10:15 AM

URL: http://pirsa.org/15020022

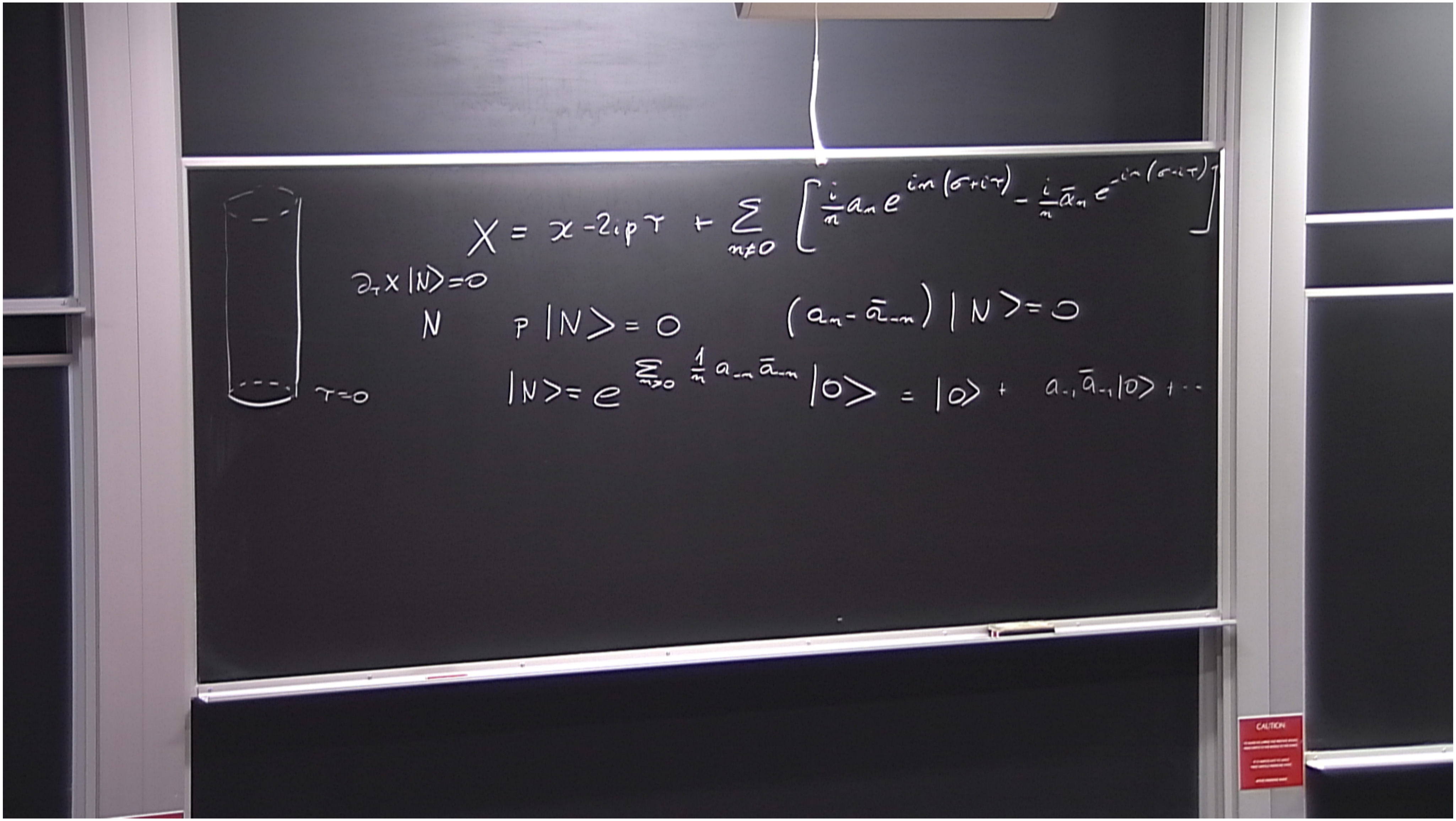
Abstract:


$J^\mu \quad \partial_\mu J^\mu = 0$
$\partial_0 J^0 = -\partial_i J^i$
$Q = \int_{SPACE} J^0 d^{d-1}x$
$\partial_0 Q = \int_{\partial SPACE} J^\perp d^{d-2}x$
$J^\perp |_\partial = \partial_a j^a$
$a \in \parallel$


$\partial_0 Q = \int_{\partial \text{SPACE}} J^{\perp} d^{d-2}x$
$J^{\perp}\big|_{\partial} = \partial_a j^a$
$a \in //$
$T^{\mu}{}_{\mu} = \sum_I \beta_I O^I$
$t^{////} = \sum_I \gamma_i O^i_{\partial}$
$T_{zz}\big|_{\partial} = T_{\bar{z}\bar{z}}\big|_{\partial}$
$T_{zz} = -\frac{1}{2} \partial_z X \partial_z X$
$\partial X = \bar{\partial} X$
$\partial X = -\bar{\partial} X$
$\tau = 0$



$X = x - 2ip\tau + \sum_{n\neq 0}\left[\frac{i}{n} a_n e^{in(\sigma+i\tau)} - \frac{i}{n}\bar{a}_n e^{-in(\sigma-i\tau)}\right]$
$\partial_\tau X |N\rangle = 0$
N
$p|N\rangle = 0$
$(a_n - \bar{a}_{-n})|N\rangle = 0$
$|N\rangle = e^{\sum_{n>0}\frac{1}{n} a_{-n}\bar{a}_{-n}}|0\rangle$
$\tau = 0$



$X = x - 2ip\tau + \sum_{n\neq 0}\left[\frac{i}{n} a_n e^{in(\sigma + i\tau)} - \frac{i}{n}\bar{a}_n e^{-in(\sigma - i\tau)}\right]$
$\partial_\tau X |N\rangle = 0$
N
$p|N\rangle = 0$
$(a_n - \bar{a}_{-n})|N\rangle = 0$
$\tau = 0$
$|N\rangle = e^{\sum_{n>0} \frac{1}{n} a_{-n}\bar{a}_{-n}}|0\rangle = |0\rangle + a_{-1}\bar{a}_{-1}|0\rangle + \cdots$

D_p

N $X^0, X^1 \cdots X^p$

D $X^{p+1} \cdots X^{25}$

$$|D_p\rangle = \int dp_\perp^{25-p}\, e^{i x_0 \cdot p_\perp}\, e^{\sum \frac{1}{m}\left(a_{-m}^{\parallel}\cdot \bar{a}_{-m}^{\parallel} - a_{-m}^{\perp}\cdot \bar{a}_{-m}^{\perp}\right)} |0, p_\perp\rangle$$

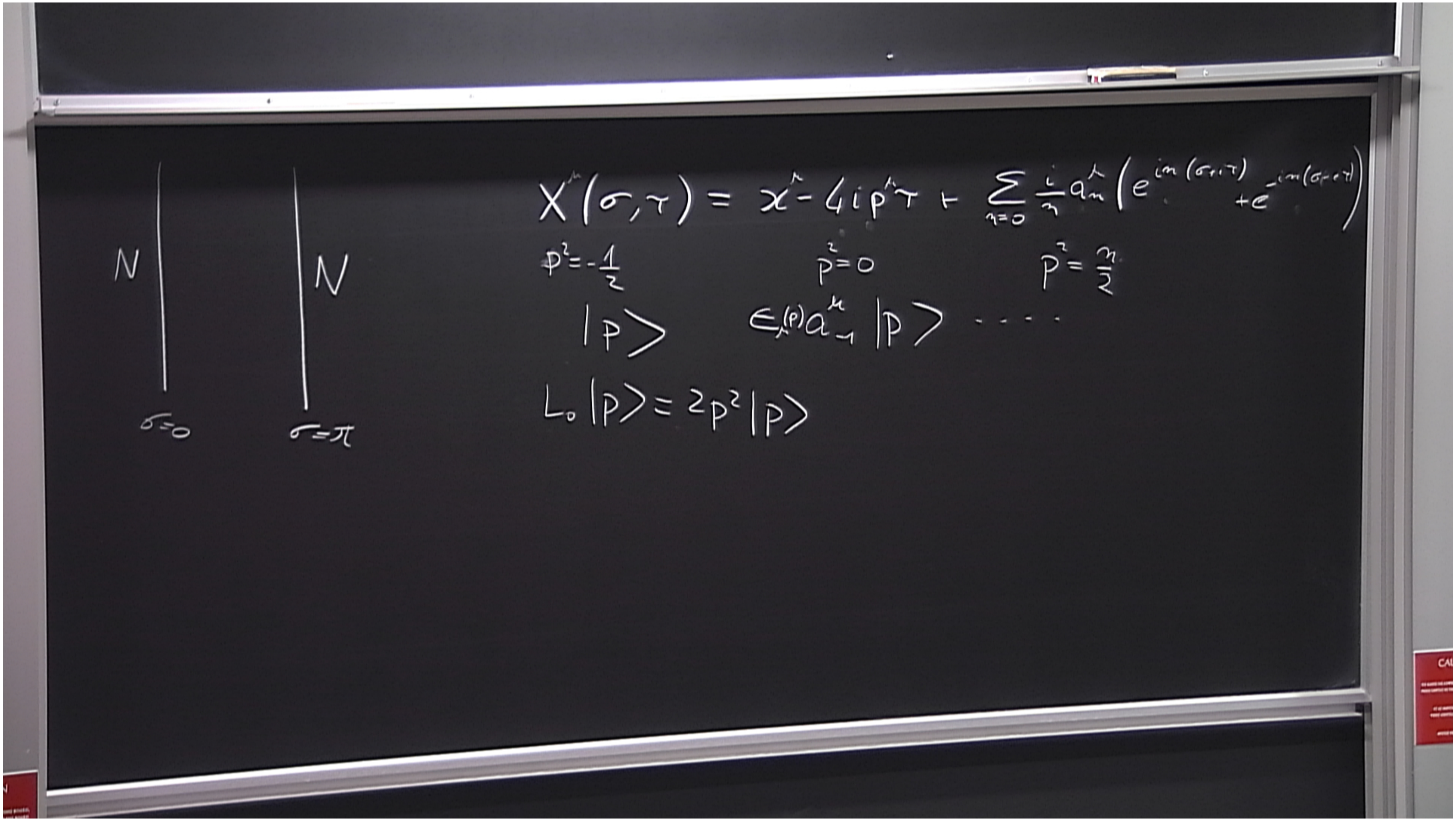
$$= \int e^{i x_0 \cdot p_\perp} |0, p_\perp\rangle + \int e^{i x_0 \cdot p_\perp} \left(a_{-1}^{\parallel}\cdot \bar{a}_{-1}^{\parallel} - a_{-1}^{\perp}\cdot \bar{a}_{-1}^{\perp}\right)|0,p_\perp\rangle$$

$$+ \cdots$$

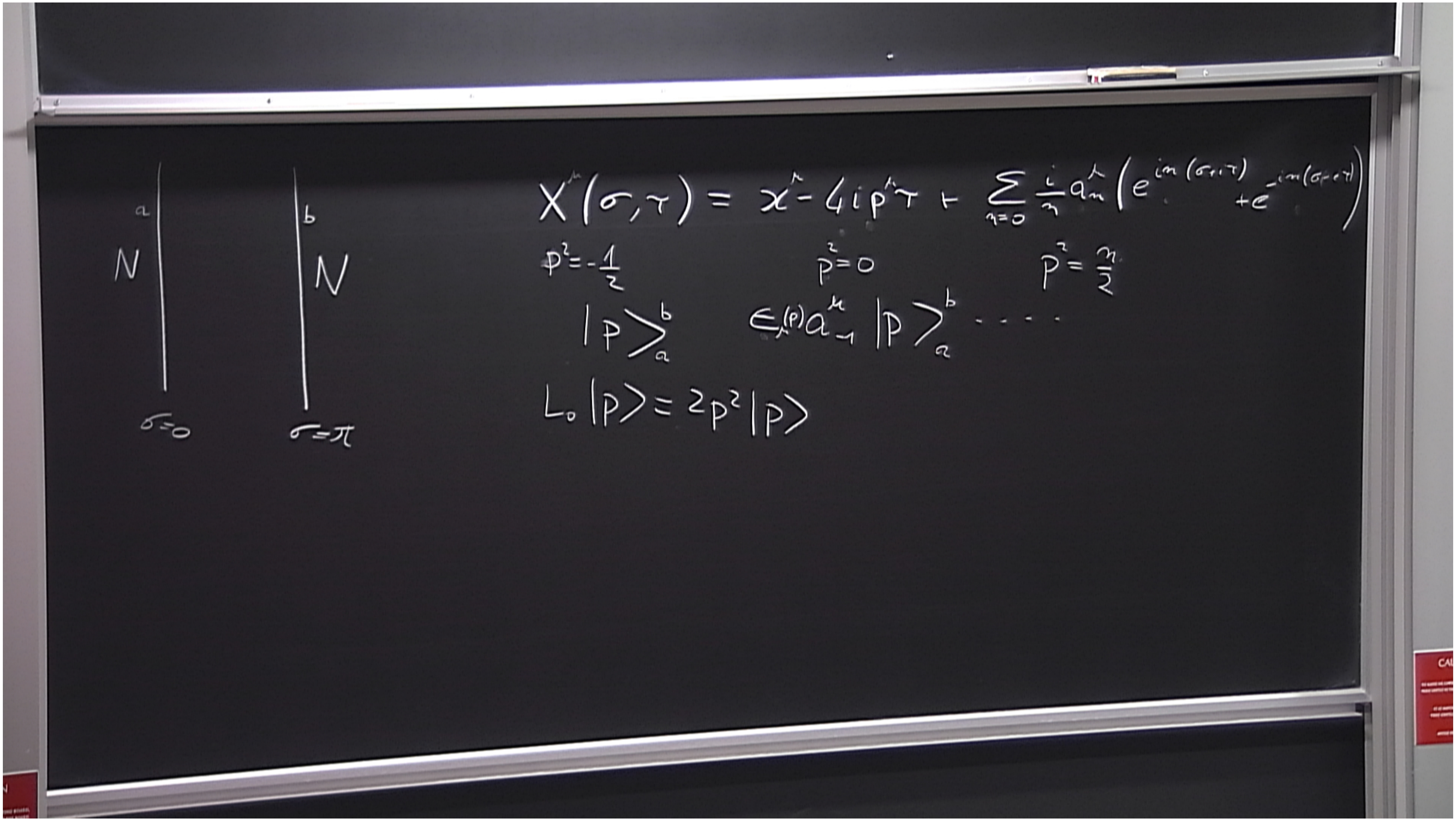
$$\begin{pmatrix} 1 & & & & & & & \\ & 1 & & & & & & \\ & & 1 & & & & & \\ & & & 1 & & & & \\ & & & & -1 & & & \\ & & & & & -1 & & \\ & & & & & & -1 & \\ & & & & & & & -1 \end{pmatrix} = T^{\mu\nu}$$

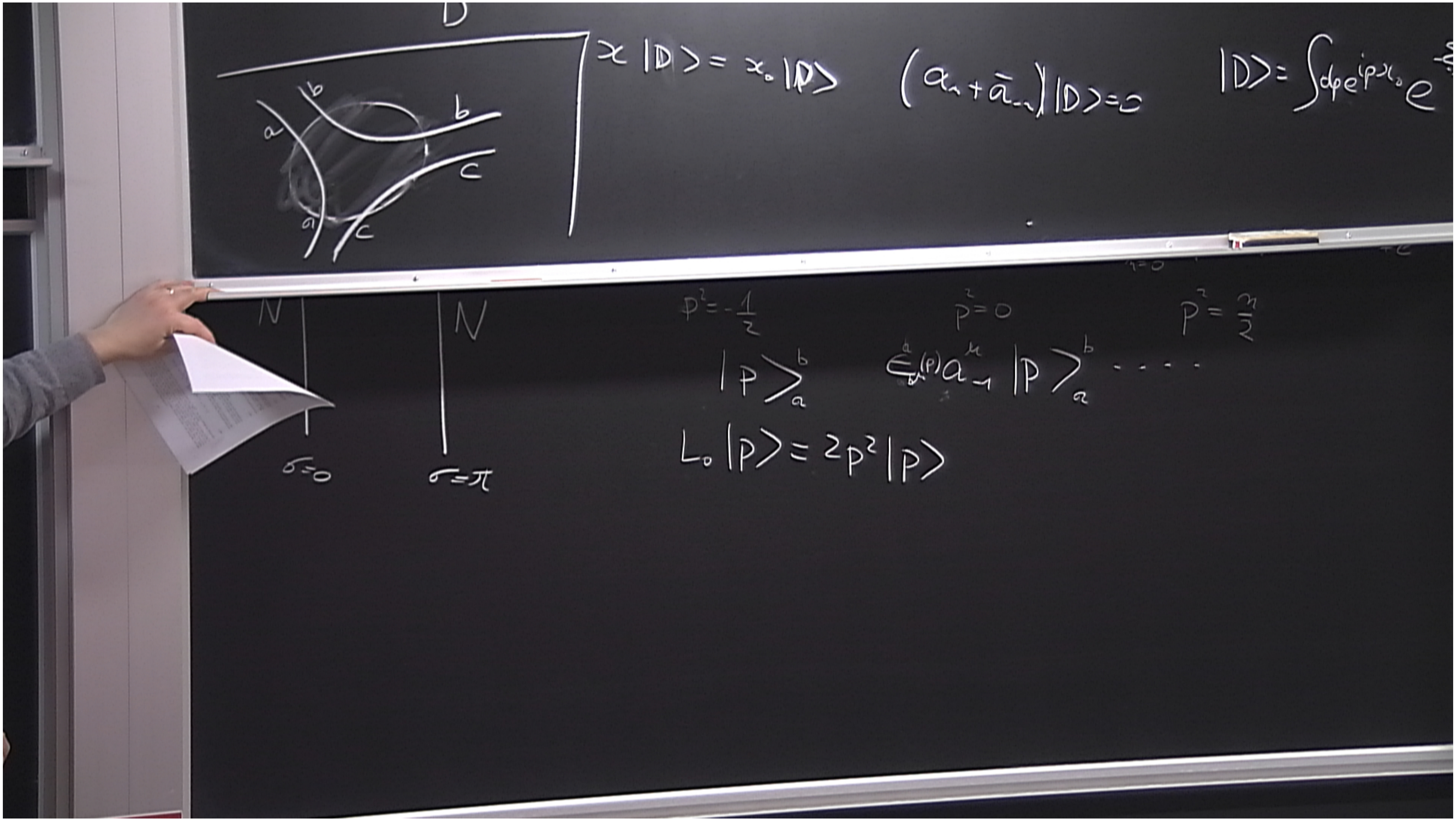
$$T = -\frac{1}{2}\partial X^{\mu}\cdot\partial X_{\mu} \qquad \bar{T} = -\frac{1}{2}\bar{\partial} X^{\mu}\bar{\partial} X_{\mu}$$

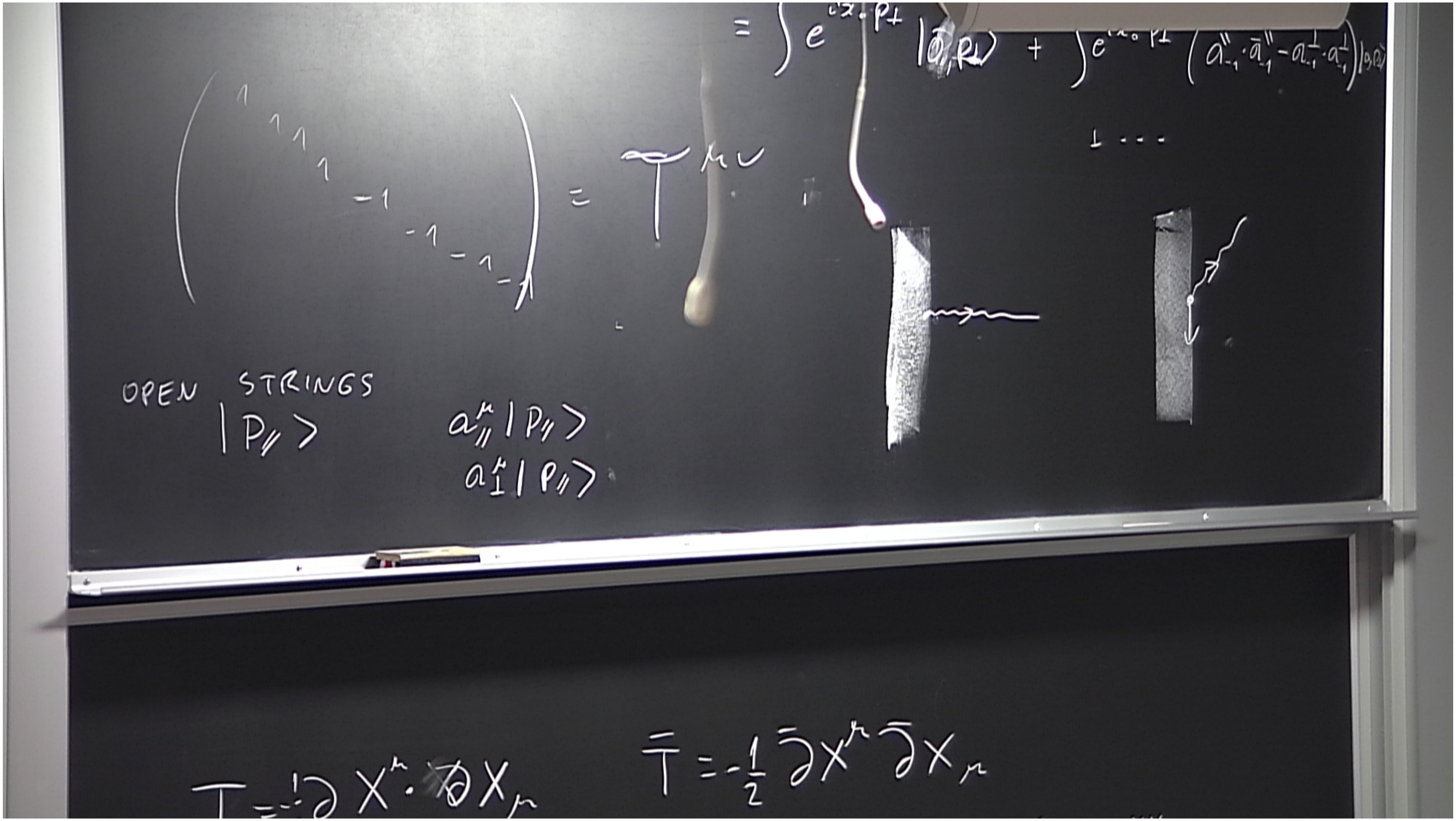
$$\bar{\partial} X^{\mu} = g^{\mu\nu}\partial X \qquad \partial_{\perp} X^{\mu} = \left(\frac{1-g}{1+g}\right)^{\mu\nu}\partial_{\parallel} X^{\nu}$$

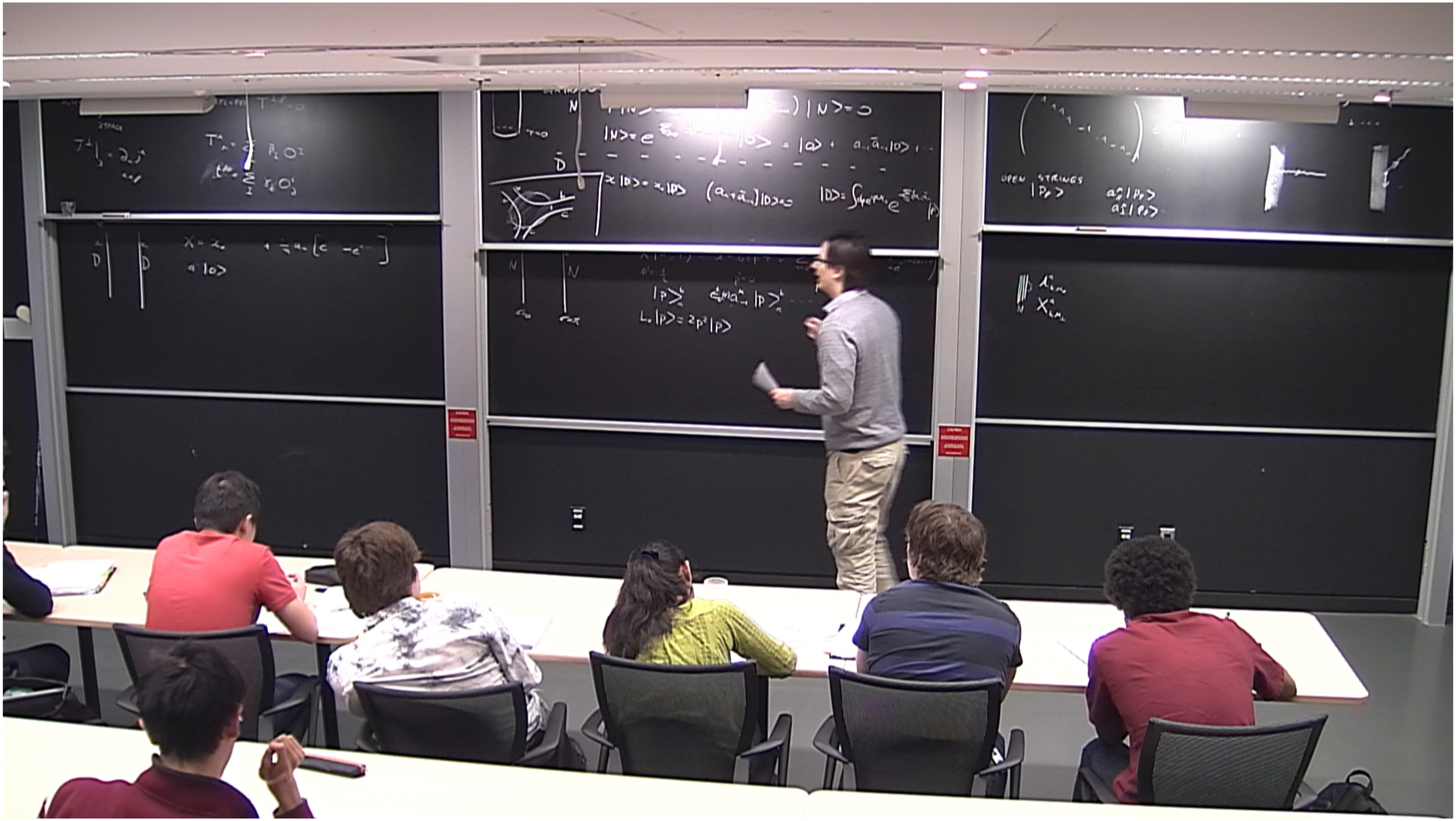


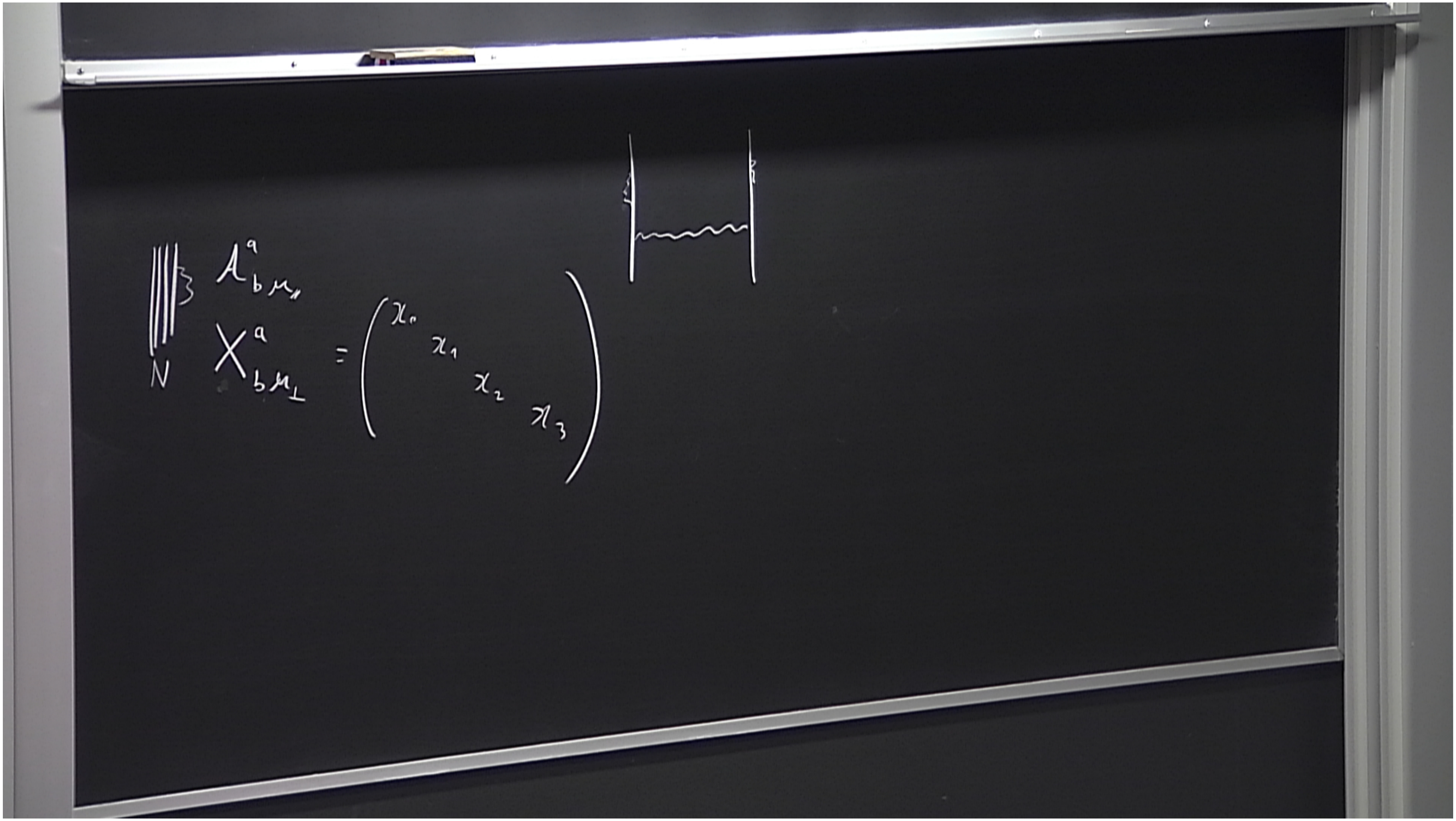
$X^\mu(\sigma,\tau) = x^\mu - 4ip^\mu\tau + \sum_{n=0} \frac{i}{n} a_n^\mu \left(e^{in(\sigma+\tau)} + e^{-in(\sigma-\tau)}\right)$
$p^2 = -\frac{1}{2}$
$p^2 = 0$
$p^2 = \frac{n}{2}$
$|p\rangle$
$\epsilon_\mu(p) a_{-1}^\mu |p\rangle \cdots$
$L_0 |p\rangle = 2p^2 |p\rangle$
N
N
$\sigma=0$
$\sigma=\pi$

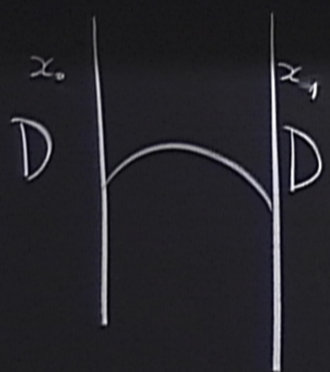

a
N
σ=0
b
N
σ=π
$X^\mu(\sigma,\tau) = x^\mu - 4ip^\mu\tau + \sum_{n=0} \frac{i}{n} a_n^\mu \left(e^{in(\sigma+\tau)} + e^{-in(\sigma-\tau)}\right)$
$p^2 = -\frac{1}{2}$
$p^2 = 0$
$p^2 = \frac{n}{2}$
$|p\rangle_a^b$
$\epsilon_\mu(p) a_{-1}^\mu |p\rangle_a^b$ . . . . .
$L_0 |p\rangle = 2p^2 |p\rangle$


$x |D\rangle = x_0 |D\rangle$
$(a_n + \bar{a}_{-n}) |D\rangle = 0$
$|D\rangle = \int dp\, e^{ip x_0} e$
$p^2 = -\frac{1}{2}$
$p^2 = 0$
$p^2 = \frac{n}{2}$
$|p\rangle_a^b$
$\epsilon(p) a^\mu_{-1} |p\rangle_a^b$ . . . .
$L_0 |p\rangle = 2p^2 |p\rangle$
N
N
$\sigma = 0$
$\sigma = \pi$


OPEN STRINGS
|P∥⟩
a^μ_∥|P∥⟩
a^μ_⊥|P∥⟩
T = -½ ∂X^μ ∂X_μ



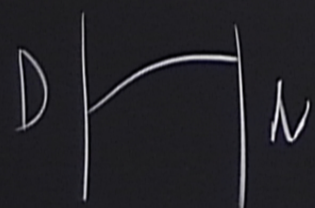

$A^a_{b\mu_\parallel}$
$X^a_{b\mu_\perp} = \begin{pmatrix} x_0 & & & \\ & x_1 & & \\ & & x_2 & \\ & & & x_3 \end{pmatrix}$
N

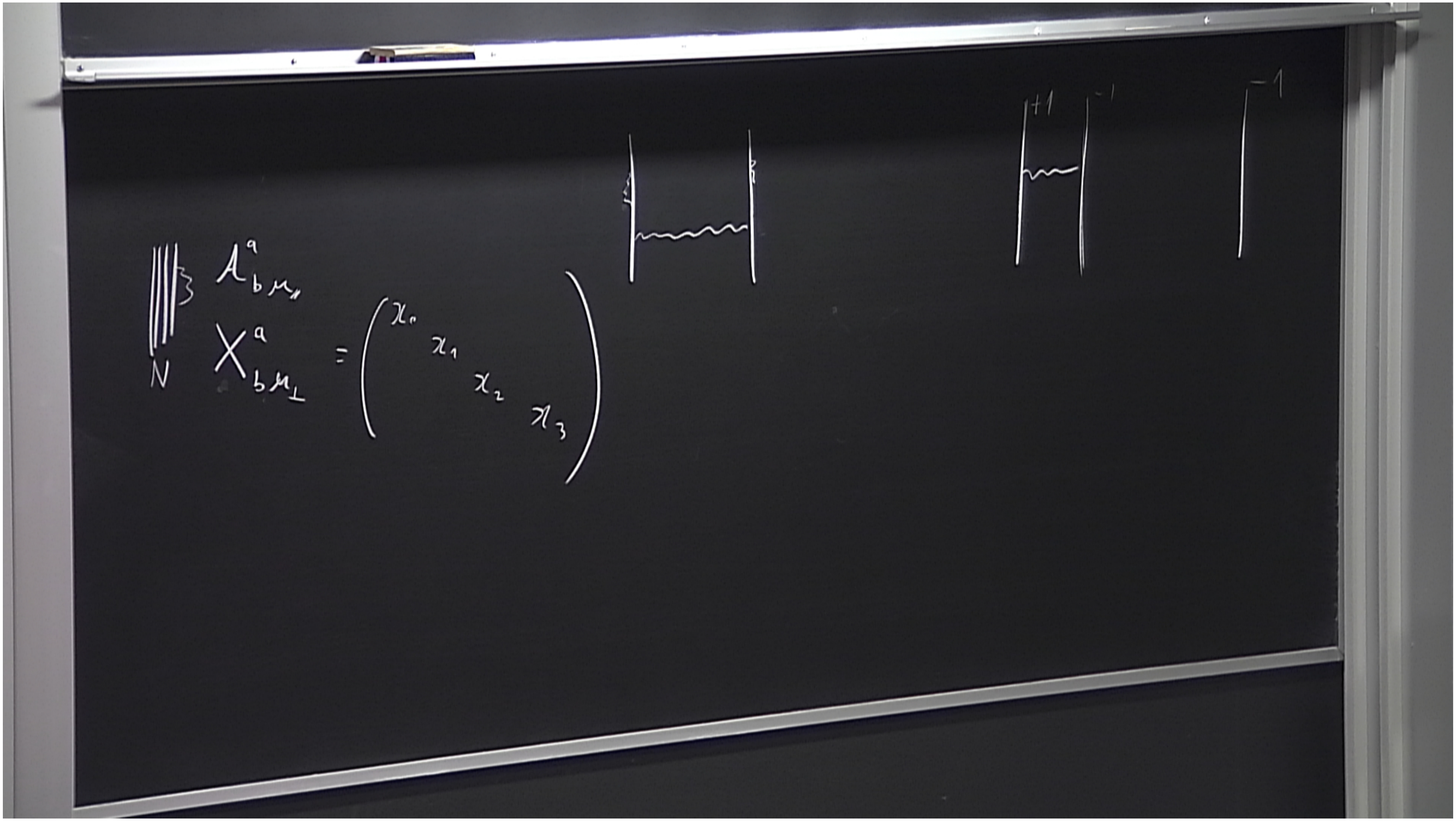


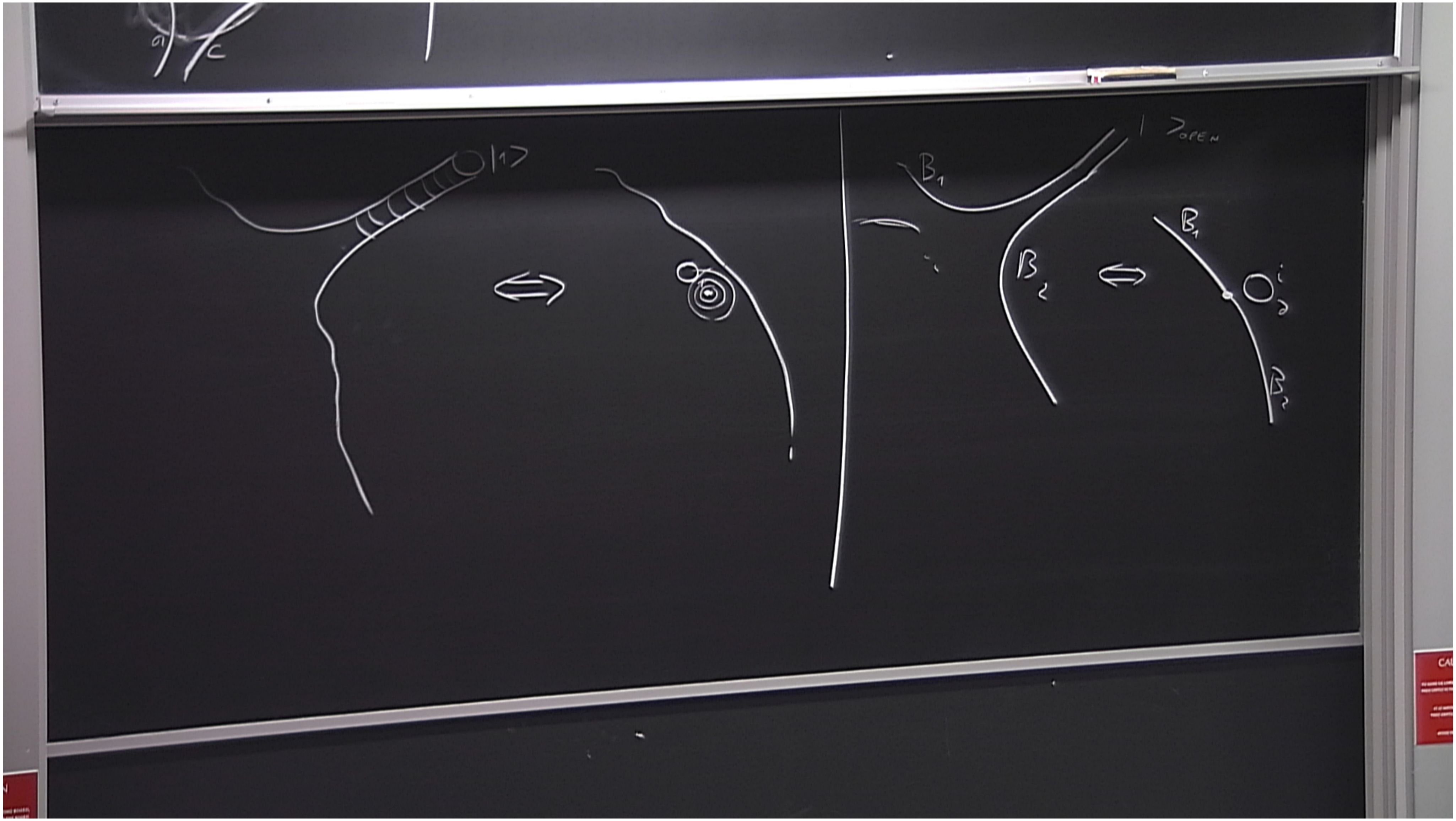
$$X = x_0 + \frac{x_1 - x_0}{\pi}\sigma + \frac{i}{n} a_n \left[e^{i\cdots} - e^{i\cdots} \right]$$

$$a^{\cdot} |0\rangle$$

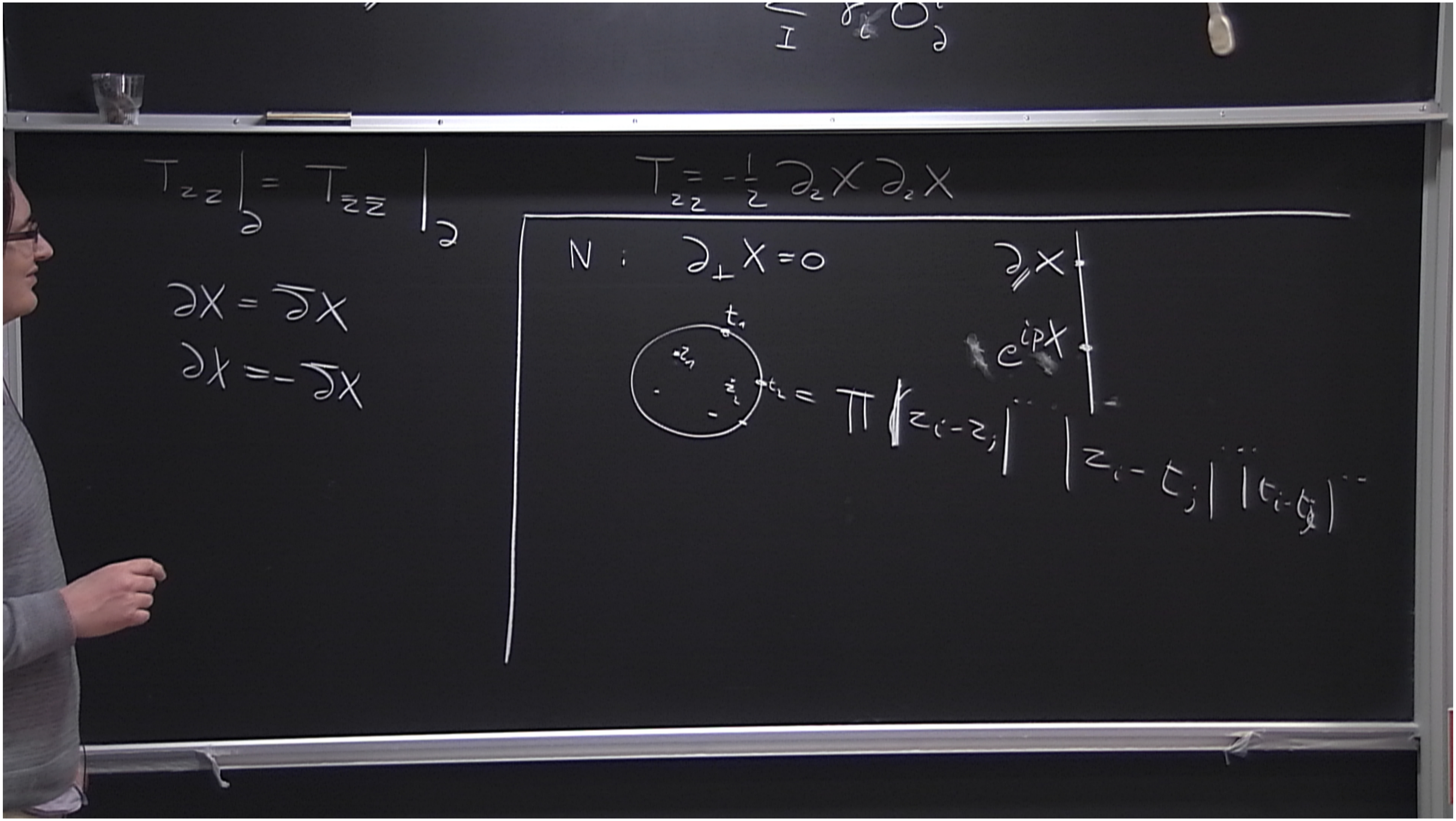
$$L_0 |0\rangle_{x_0}^{x_1} = \frac{(x_1 - x_0)^2}{8\pi'} |0\rangle_{x_2}^{x_1}$$




$A^a_{b\mu_\parallel}$
$X^a_{b\mu_\perp} = \begin{pmatrix} x_0 & & & \\ & x_1 & & \\ & & x_2 & \\ & & & x_3 \end{pmatrix}$
N
+1
−1
−1



|1⟩
|⟩OPEN
B1
B2
B1
B2

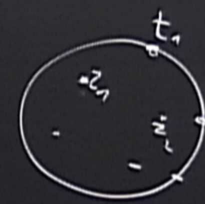

$T_{zz}\big|_\partial = T_{\bar z\bar z}\big|_\partial$
$T_{zz} = -\frac{1}{2}\partial_z X \partial_z X$
$\partial X = \bar\partial X$
$\partial X = -\bar\partial X$
$N: \partial_\perp X = 0$
$\partial_\parallel X$
e^{ipX}
t_1
z_1
z_2
$t_2 = \prod |z_i - z_j|^{\cdots} |z_i - t_j|^{\cdots} |t_i - t_j|^{\cdots}$

$$T_{zz}\big|_\partial = T_{\bar z\bar z}\big|_\partial \qquad T_{zz} = -\frac{1}{2}\partial_z X \partial_z X$$

$$\partial X = \bar\partial X$$

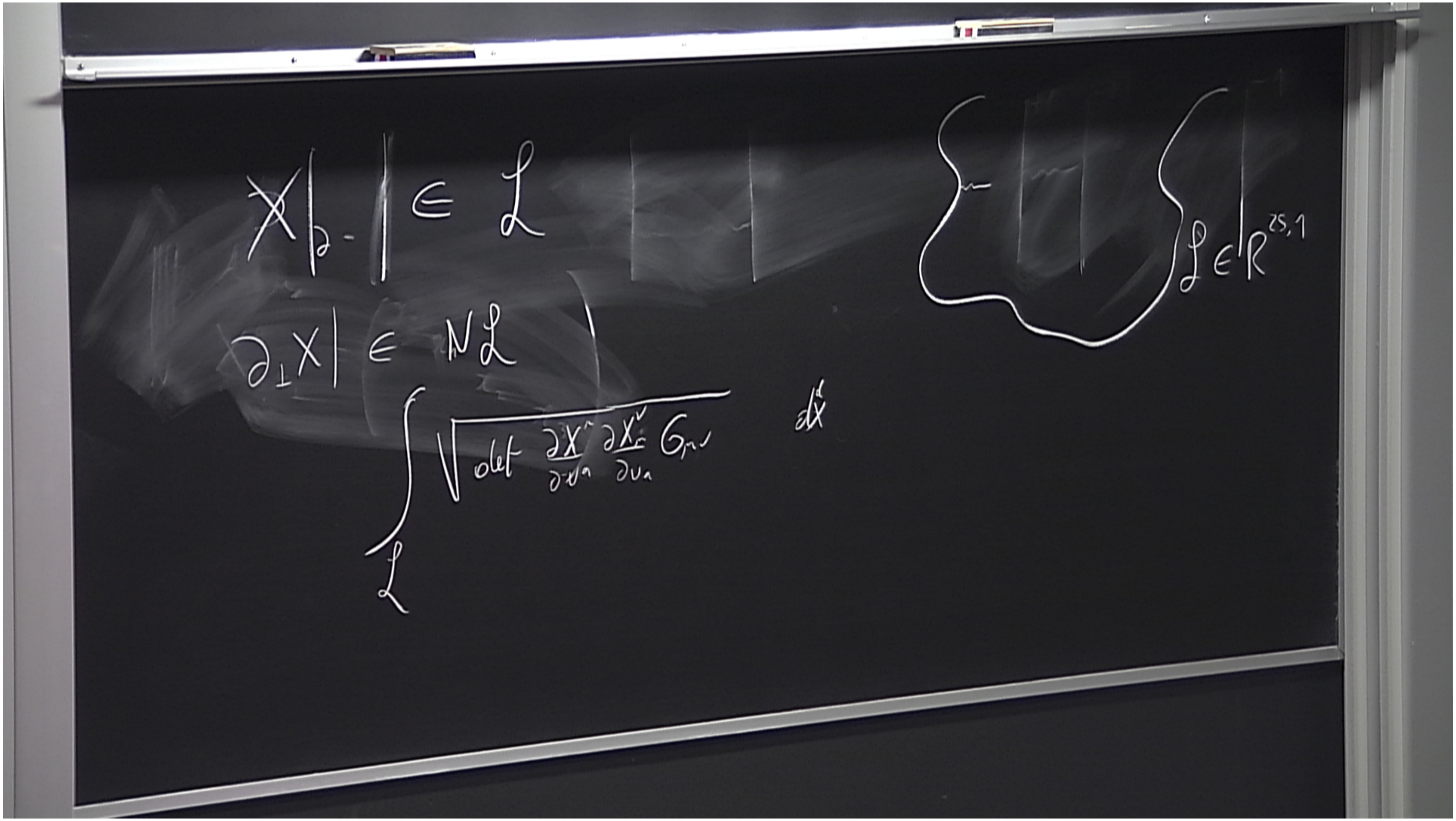
$$\partial X = -\bar\partial X$$

N : $\partial_\perp X = 0$ $\qquad \partial_\parallel X\big|$ $\qquad e^{ipX}\big|$



$$= \prod |z_i - z_j|^{\cdots} \, |z_i - t_j|^{\cdots} \, |t_i - t_j|^{\cdots}$$

D: $\partial_\perp X\big|$


X|∂- ∈ ℒ
∂⊥X| ∈ Nℒ
∫ℒ √det ∂X^μ/∂u^a ∂X^ν/∂u_a G_μν d^dx
ℒ ∈ R^25,1