Title: PSI 2018/2019 - String Theory Review - Lecture 10

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Collection: PSI 2018/2019 - String Theory Review (Gaiotto)

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$$\Sigma \xrightarrow{\;X\;} \text{SPACE-TIME}$$

$$\mu \partial_\mu G_{\nu\rho} = \beta^G_{\nu\rho}[G_{\mu\nu}, B]$$

$$\mu \partial_\mu B_{\nu\rho} = \beta_{\nu\rho}[\ldots]$$

$$\iint \partial_a X^\rho \partial^a X^\nu G_{\nu\rho}(X, \mu_{2d}) + \partial_{[1} X^\nu \partial_{2]} X^\rho B_{\nu\rho} \cdots\cdots$$

$$\mu \partial_\mu B_{\nu\rho} = \beta^B_{\nu\rho}[\ldots]$$

$$\frac{1}{\alpha'}\iint \partial_a X^\rho \partial^a X^\nu G_{\nu\rho}(X, \mu_{2d}) + \partial_{[1} X^\nu \partial_{2]} X^\rho B_{\nu\rho} \ldots\ldots$$

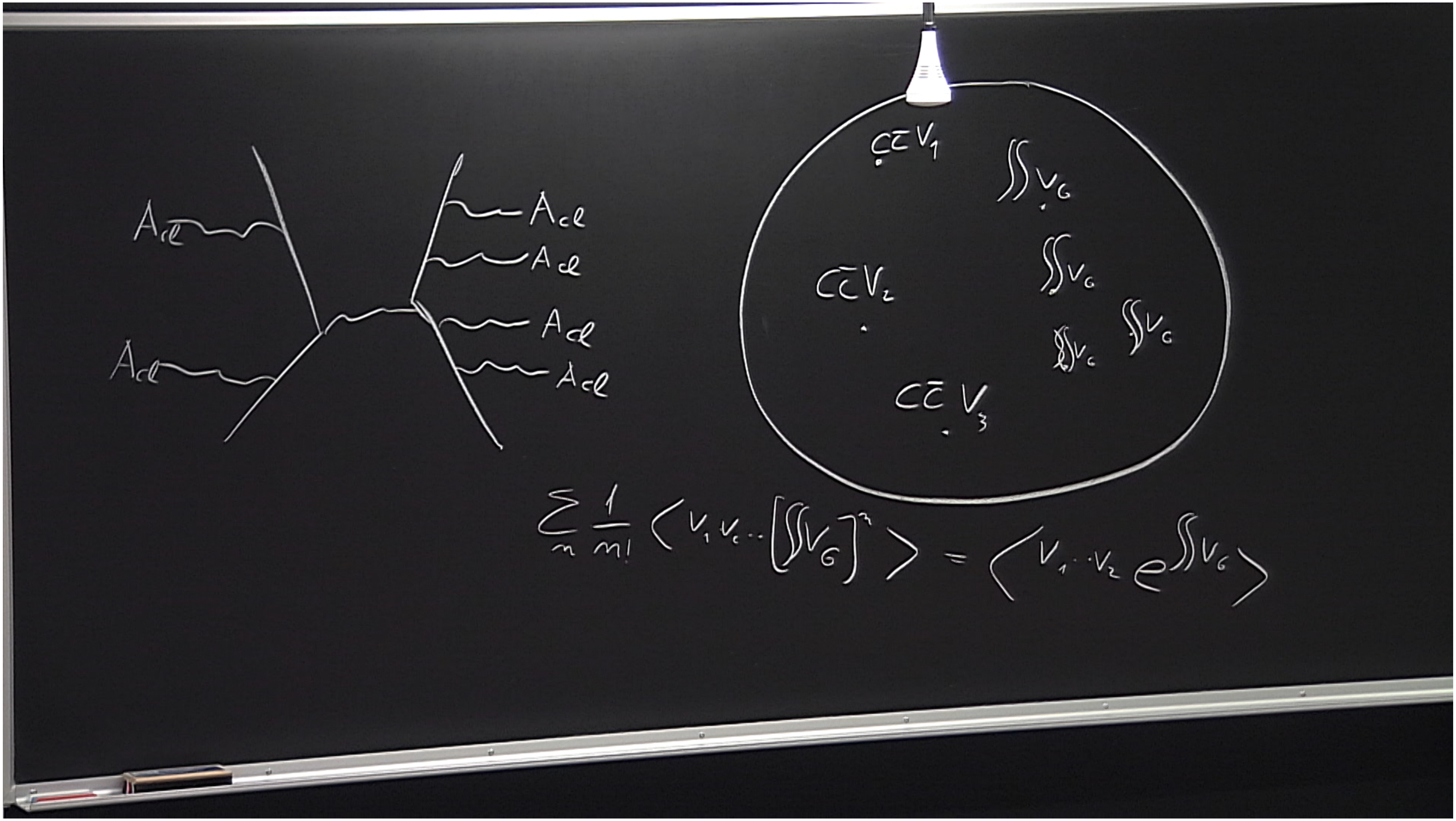
$$\mu \partial_\mu B_{\nu\rho} = \beta^B_{\nu\rho}[\ldots]$$

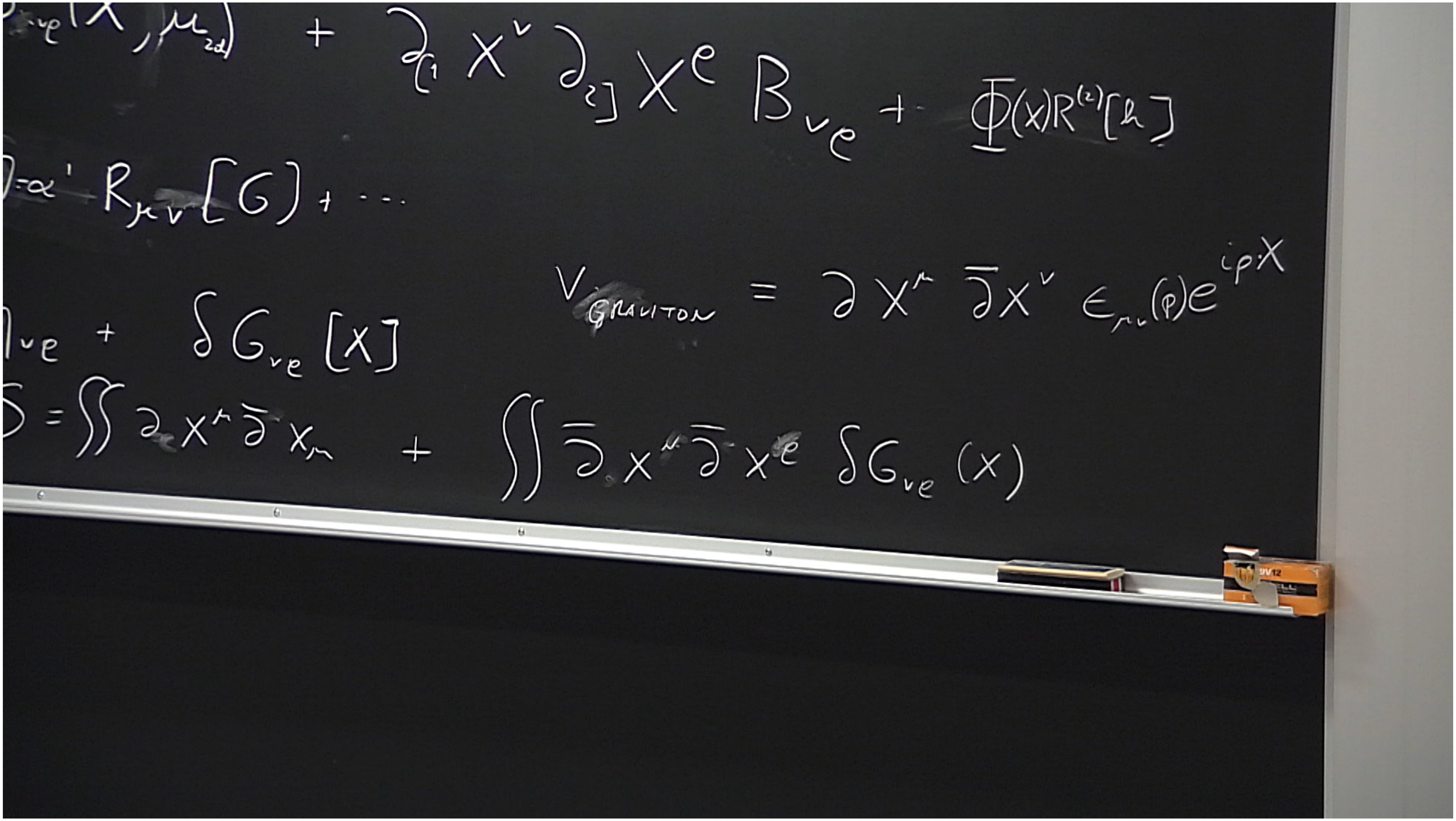
$$\frac{1}{\alpha'}\iint \partial_a X^\rho \partial^a X^\nu G_{\nu\rho}(X, \mu_{2d}) + \partial_{[1} X^\nu \partial_{2]} X^\rho B_{\nu\rho} \ldots$$

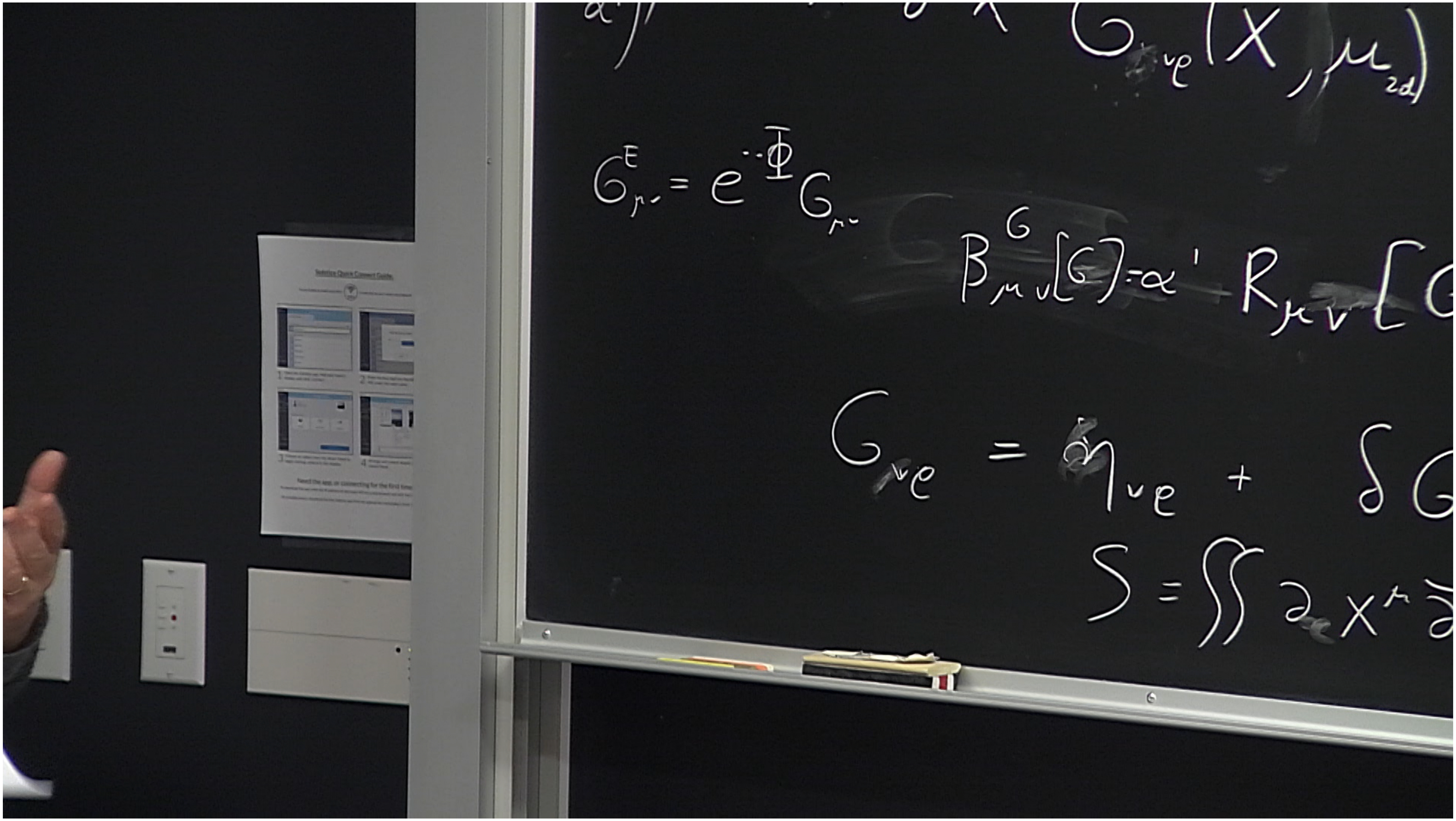
$$\beta^G_{\mu\nu}[G] = \alpha' R_{\mu\nu}[G] + \cdots$$

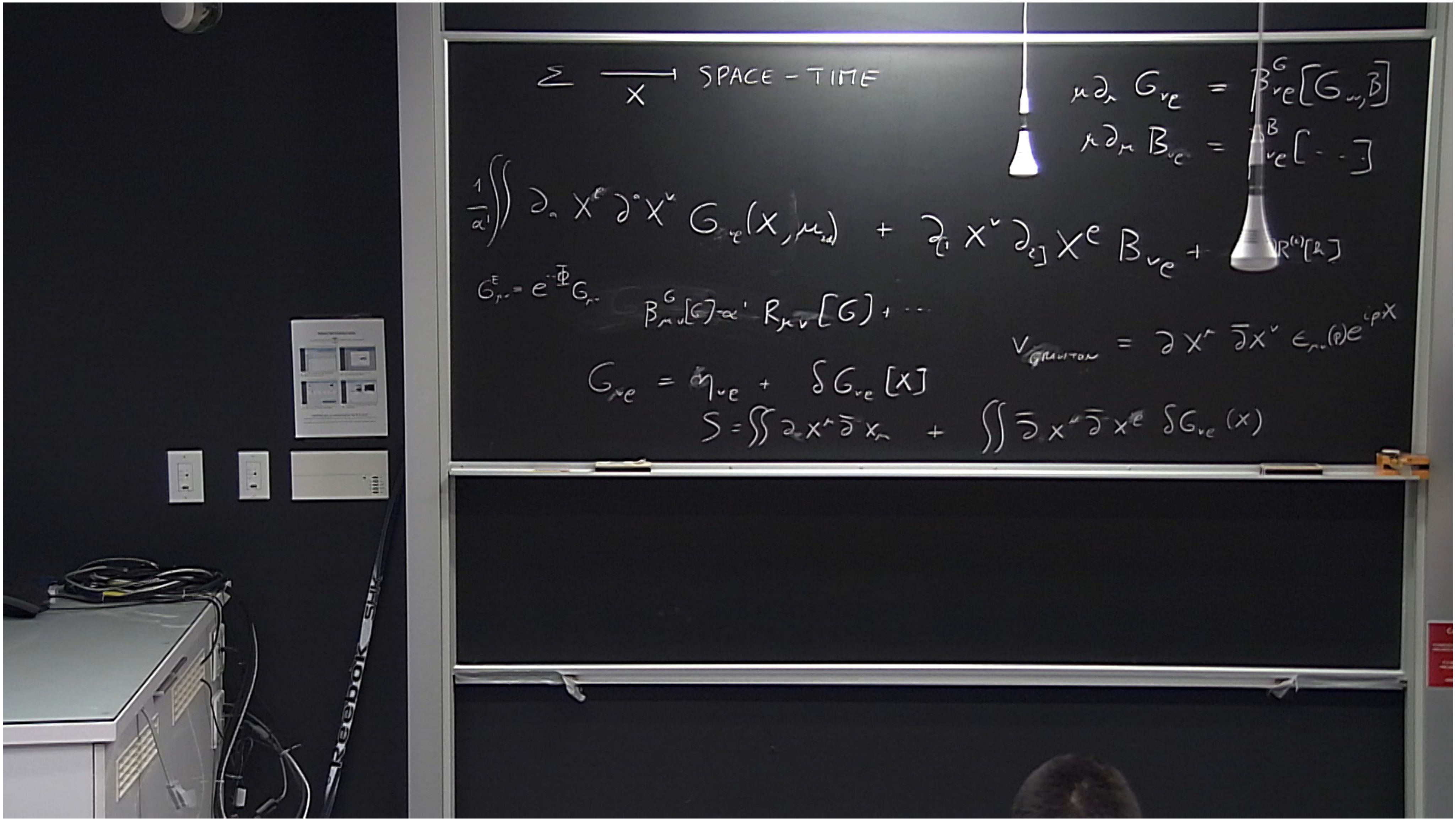
classical solution

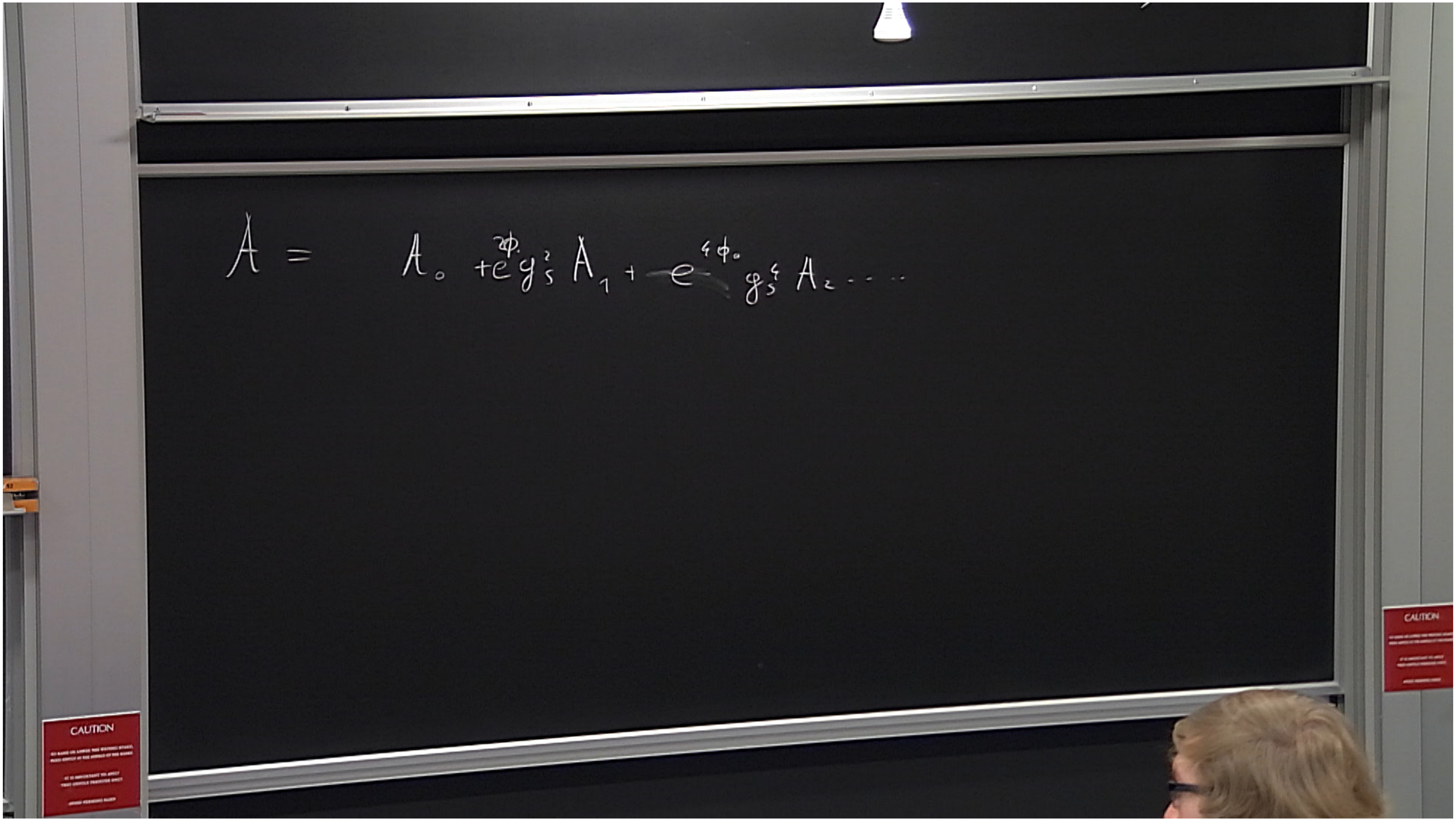
X_{cl}

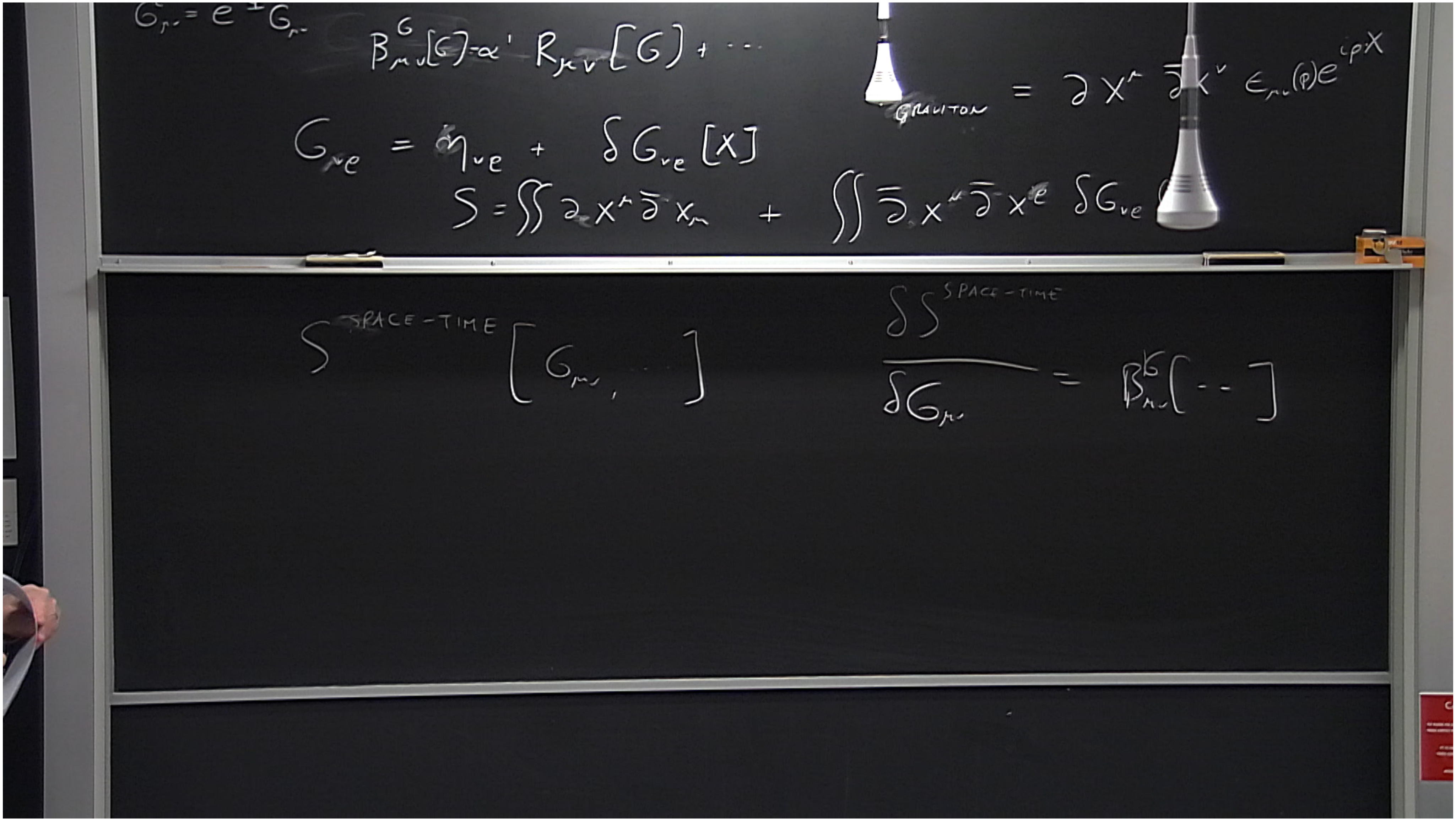

A_cl
A_cl
A_cl
A_cl
A_cl
A_cl
cc̄ V_1
cc̄ V_2
cc̄ V_3
∫∫V_G
∫∫V_G
∫∫V_G
∫∫V_G
Σ_n 1/n! ⟨V_1 V_2 .. [∫∫V_G]^n⟩ = ⟨V_1 .. V_2 e^{∫∫V_G}⟩

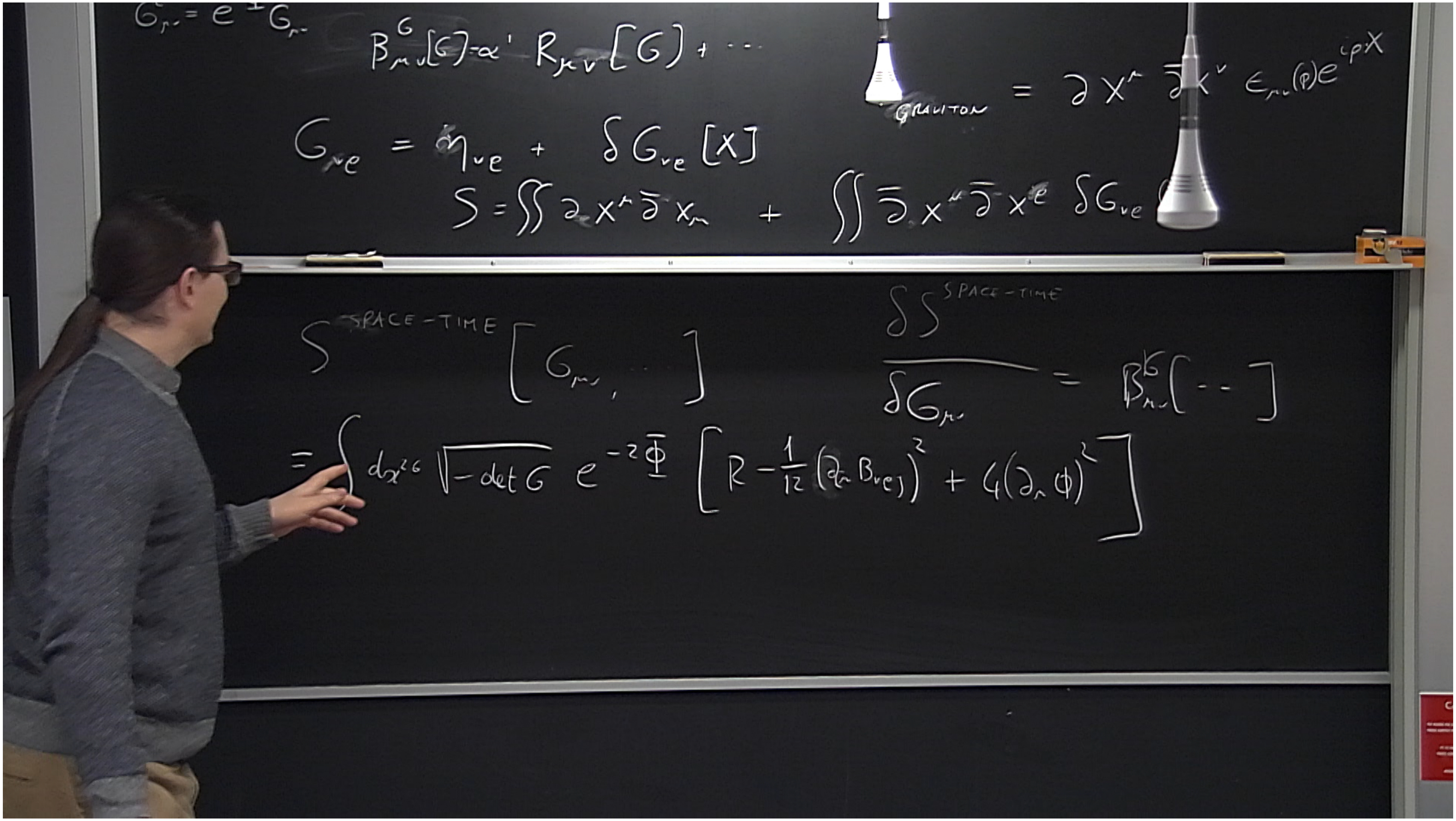

$_{\nu\rho}(X,\mu_{2d}) + \partial_{[1} X^\nu \partial_{2]} X^\rho B_{\nu\rho} + \Phi(X) R^{(2)}[h]$
$= \alpha' R_{\mu\nu}[G] + \dots$
$V_{GRAVITON} = \partial X^\mu \bar{\partial} X^\nu \epsilon_{\mu\nu}(p) e^{ip\cdot X}$
$_{\nu\rho} + \delta G_{\nu\rho}[X]$
$S = \iint \partial X^\mu \bar{\partial} X_\mu + \iint \bar{\partial} X^\mu \bar{\partial} X^\rho \delta G_{\nu\rho}(X)$


$G^E_{\mu\nu} = e^{\cdots\Phi} G_{\mu\nu}$
$\beta^G_{\mu\nu}[G] = \alpha' R_{\mu\nu}[G$
$G_{\nu\rho} = \eta_{\nu\rho} + \delta G$
$S = \iint \partial X^\mu \partial$


SPACE - TIME
GRAVITON


$\check{A} = A_0 + e^{2\phi_0} g_s^2 \check{A}_1 + e^{4\phi_0} g_s^4 A_2 \ldots$


$\beta^G_{\mu\nu}[G] = \alpha' R_{\mu\nu}[G] + \cdots$
GRAVITON
$= \partial X^\mu \bar{\partial} X^\nu \epsilon_{\mu\nu}(p) e^{ip\cdot X}$
$G_{\nu\rho} = \eta_{\nu\rho} + \delta G_{\nu\rho}[X]$
$S = \iint \partial X^\mu \bar{\partial} X_\mu + \iint \bar{\partial} X^\nu \bar{\partial} X^\rho \delta G_{\nu\rho}$
$S^{\text{SPACE-TIME}}[G_{\mu\nu}, \ldots]$
$\frac{\delta S^{\text{SPACE-TIME}}}{\delta G_{\mu\nu}} = \beta^G_{\mu\nu}[\ldots]$


GRAVITON
SPACE-TIME
SPACE-TIME

$G_{\mu\nu} = e^{\Phi} G_{\mu\nu}$

$\beta^G_{\mu\nu}[G] = \alpha' R_{\mu\nu}[G] + \cdots$

$V_{\text{GRAVITON}} = \partial X^\mu \bar{\partial} X^\nu \epsilon_{\mu\nu}(p) e^{ip\cdot X}$

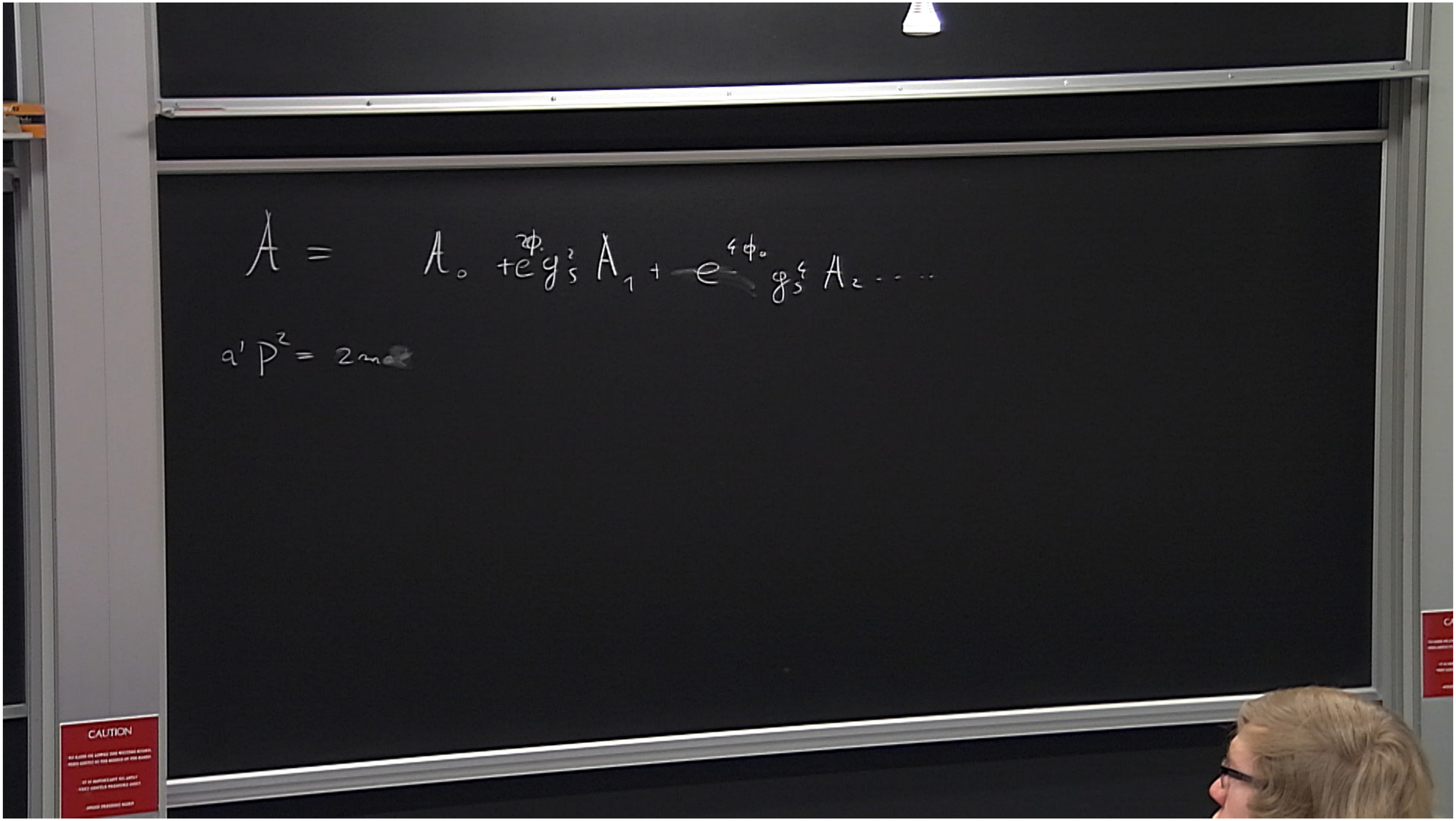
$$G_{\nu\rho} = \eta_{\nu\rho} + \delta G_{\nu\rho}[X]$$

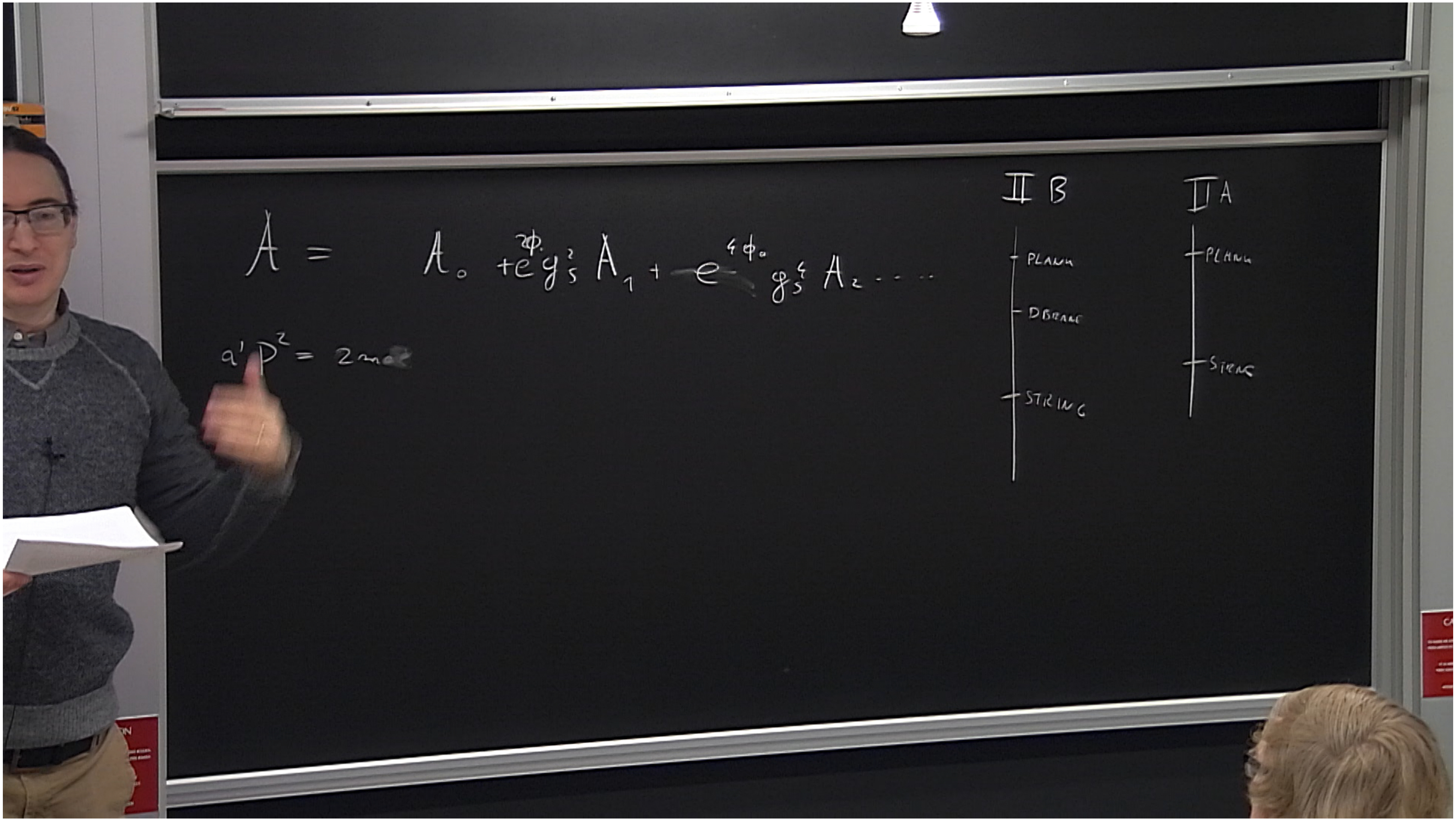
$$S = \iint \partial X^\mu \bar{\partial} X_\mu + \iint \bar{\partial} X^\nu \bar{\partial} X^\rho \, \delta G_{\nu\rho}$$

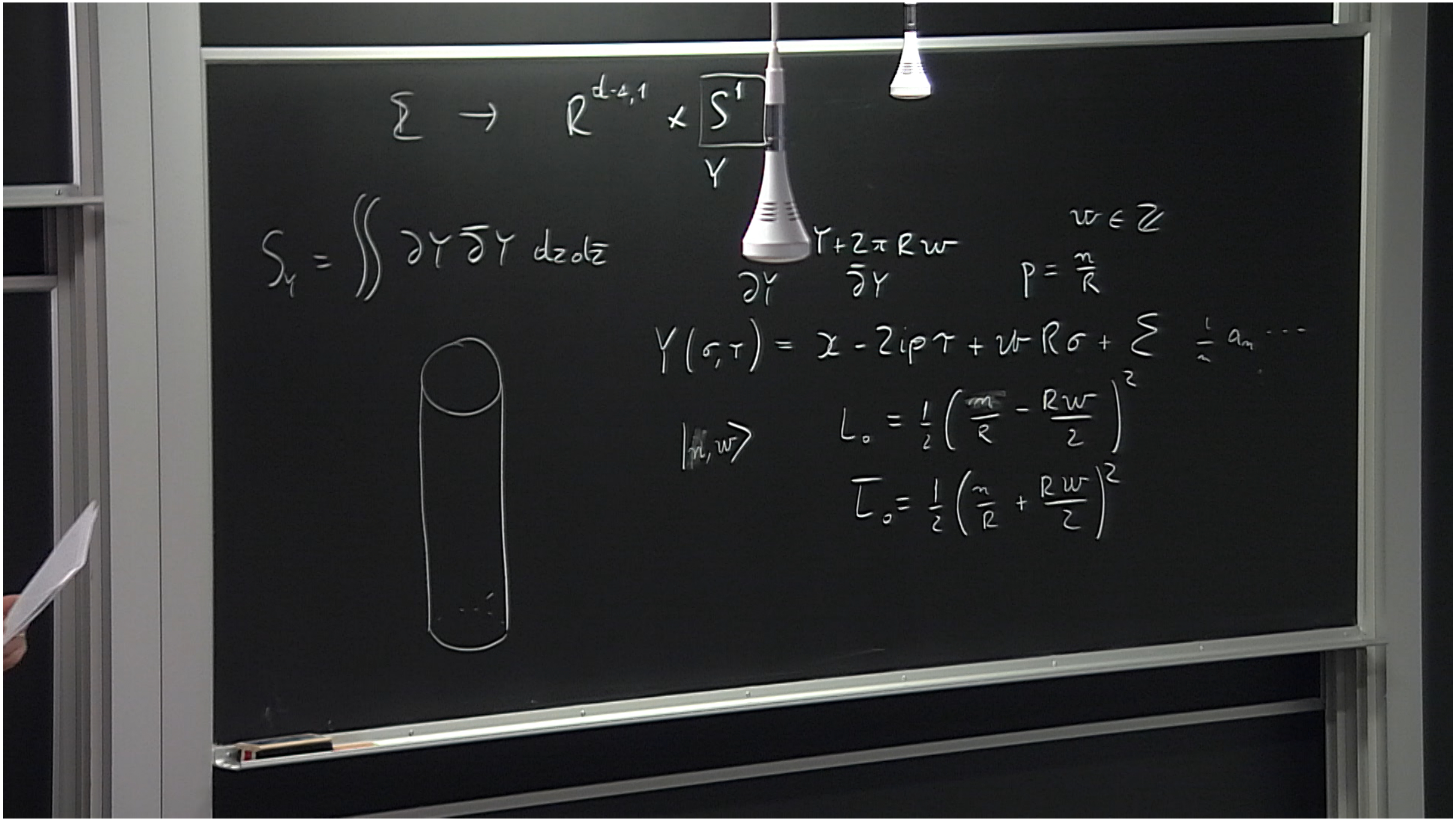
$$S^{\text{SPACE-TIME}}[G_{\mu\nu}, \ldots]$$

$$\frac{\delta S^{\text{SPACE-TIME}}}{\delta G_{\mu\nu}} = \beta^G_{\mu\nu}[\cdots]$$

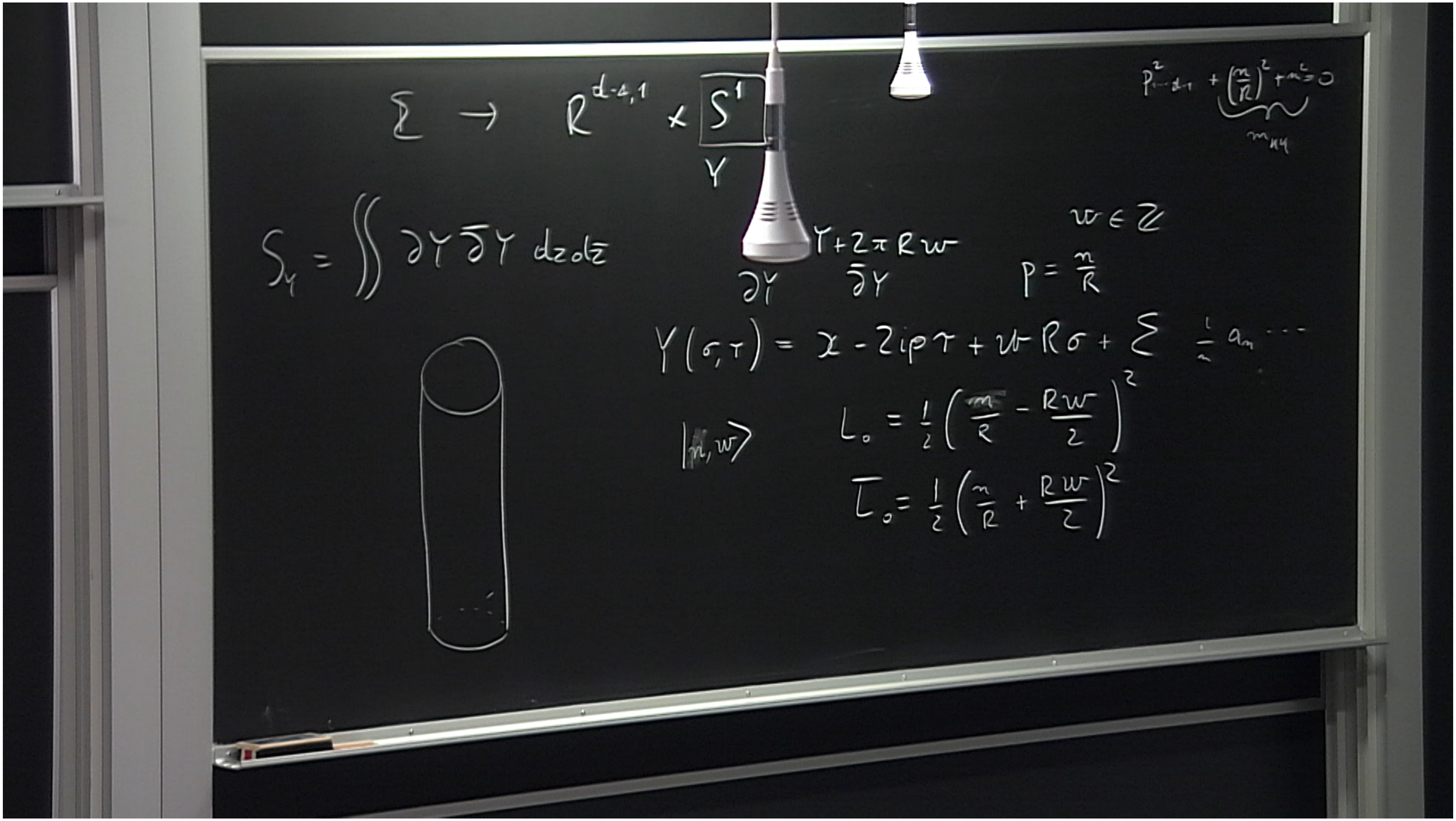
$$= \frac{1}{g_s^2}\int dx^{26} \sqrt{-\det G}\, e^{-2\Phi}\left[R - \frac{1}{12}\left(\partial_{[\mu} B_{\nu\rho]}\right)^2 + 4(\partial_\mu \Phi)^2\right]$$


A = A₀ + e^{2φ₀} g_s^2 A₁ + e^{4φ₀} g_s^4 A₂ ....
α' p^2 = 2m
CAUTION


IIB
PLANK
DBRANE
STRING
IIA
PLANK
STRNG



$\Sigma \to \mathbb{R}^{d-1,1} \times S^1$
Y
$S_Y = \iint \partial Y \bar{\partial} Y \, dz \, d\bar{z}$
$Y + 2\pi R w$
$w \in \mathbb{Z}$
∂Y
$\bar{\partial} Y$
$p = \frac{n}{R}$
$Y(\sigma, \tau) = x - 2ip\tau + wR\sigma + \sum \frac{1}{n} a_n \ldots$
$|n, w\rangle$
$L_0 = \frac{1}{2}\left(\frac{n}{R} - \frac{Rw}{2}\right)^2$
$\bar{L}_0 = \frac{1}{2}\left(\frac{n}{R} + \frac{Rw}{2}\right)^2$


$\Sigma \to R^{d-1,1} \times S^1$
Y
$S_Y = \iint \partial Y \bar{\partial} Y \, dz \, d\bar{z}$
$Y + 2\pi R w$
$w \in \mathbb{Z}$
$\partial Y \quad \bar{\partial} Y$
$p = \frac{n}{R}$
$Y(\sigma,\tau) = x - 2ip\tau + wR\sigma + \sum \frac{1}{n} a_n \cdots$
$|n, w\rangle$
$L_0 = \frac{1}{2}\left(\frac{n}{R} - \frac{Rw}{2}\right)^2$
$\bar{L}_0 = \frac{1}{2}\left(\frac{n}{R} + \frac{Rw}{2}\right)^2$
$p^2_{1 \cdots d-1} + \left(\frac{n}{R}\right)^2 + m^2 = 0$

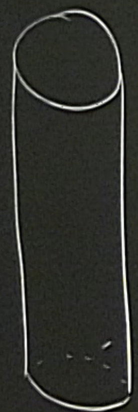
Y

m_{KK}

$$S_Y = \iint \partial Y \bar{\partial} Y \, dz \, d\bar{z}$$

$$Y \to Y + 2\pi R w \qquad w \in \mathbb{Z}$$

$$\partial Y = \partial \tilde{Y} \qquad \bar{\partial} Y = -\bar{\partial} \tilde{Y} \qquad p = \frac{n}{R}$$



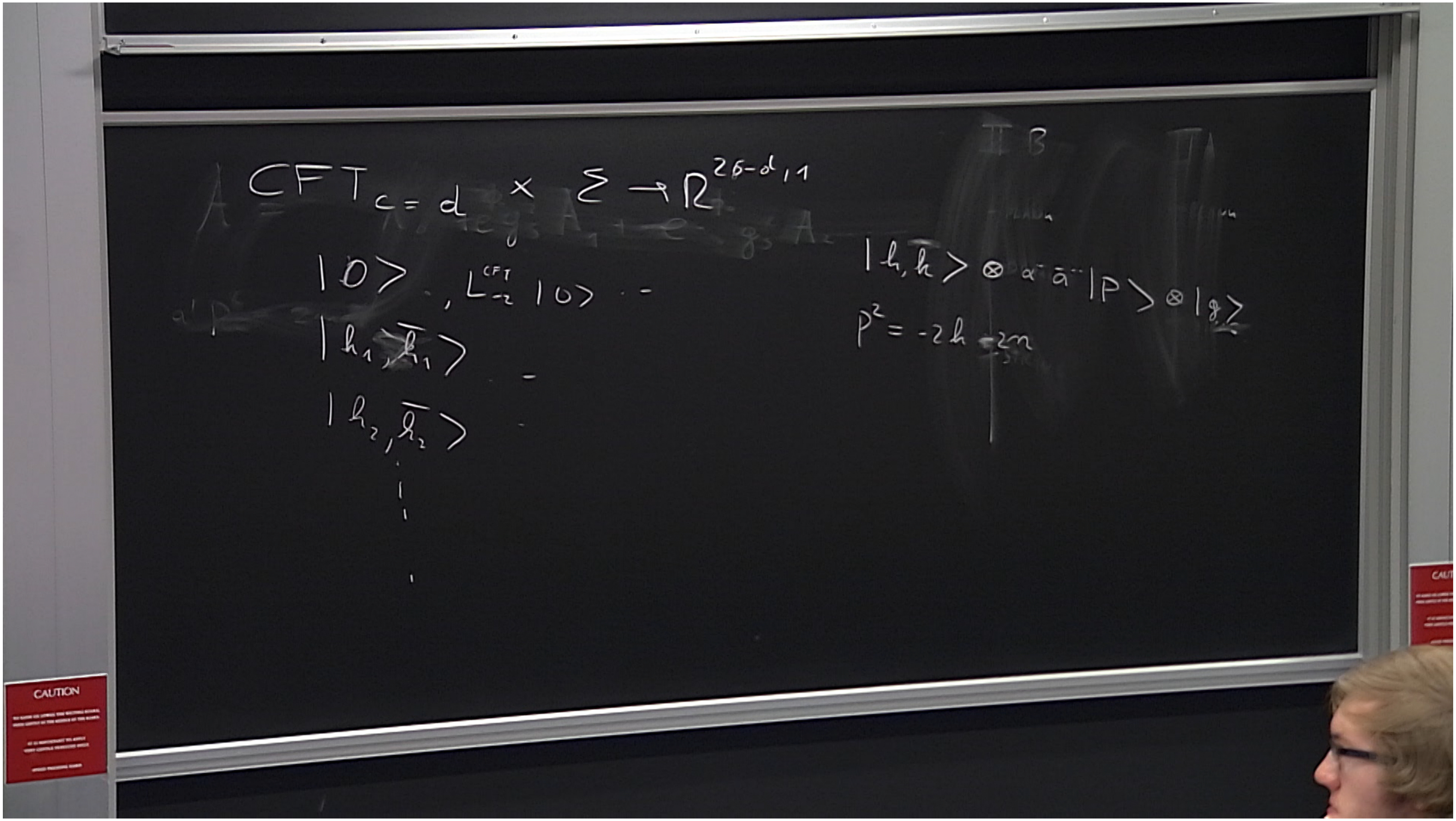
R

$$Y(\sigma, \tau) = x - 2ip\tau + wR\sigma + \sum \frac{i}{n} a_n \cdots - \bar{a}_n$$

$$|n, w\rangle \qquad L_0 = \frac{1}{2}\left(\frac{n}{R} - \frac{Rw}{2}\right)^2$$

$$\bar{L}_0 = \frac{1}{2}\left(\frac{n}{R} + \frac{Rw}{2}\right)^2$$

$$\tilde{R} = \frac{2}{R} \qquad \tilde{Y}(\sigma, \tau) = \tilde{x} - 2p\sigma + iwR\tau + \sum \cdots a_n + \bar{a}_n$$


CFT c=d × Σ → R 26-d,1
|0> , L CFT -2 |0> . . .
|h1, h̄1> . . .
|h2, h̄2> .
|h, h̄> ⊗ α ᾱ |P> ⊗ |g>
P2 = -2h -2n