

Title: 13/14 PSI - String Theory Review - Lecture 1

Date: Jan 27, 2014 10:15 AM

URL: <http://pirsa.org/14010070>

Abstract:



$$A(p_1, \dots, p_r) = \sum_r g^{\# \text{Loops}} A_r$$

$$A_{\text{tree}} = \prod_e \frac{1}{p_e^2 + m_e^2} \prod_v T_v(\sum_{e \sim v} p_e)$$

$$A(p_1, \dots, p_i) = \sum_{\Gamma}^{\# \text{ L DOPS}} A_{\Gamma}$$

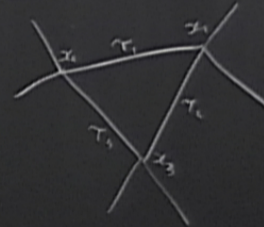
$$A_{\text{X}} = \prod_e \frac{1}{p_e^{d_e + n_e}} \prod_v \delta(\sum_{e \sim v} p_e)$$

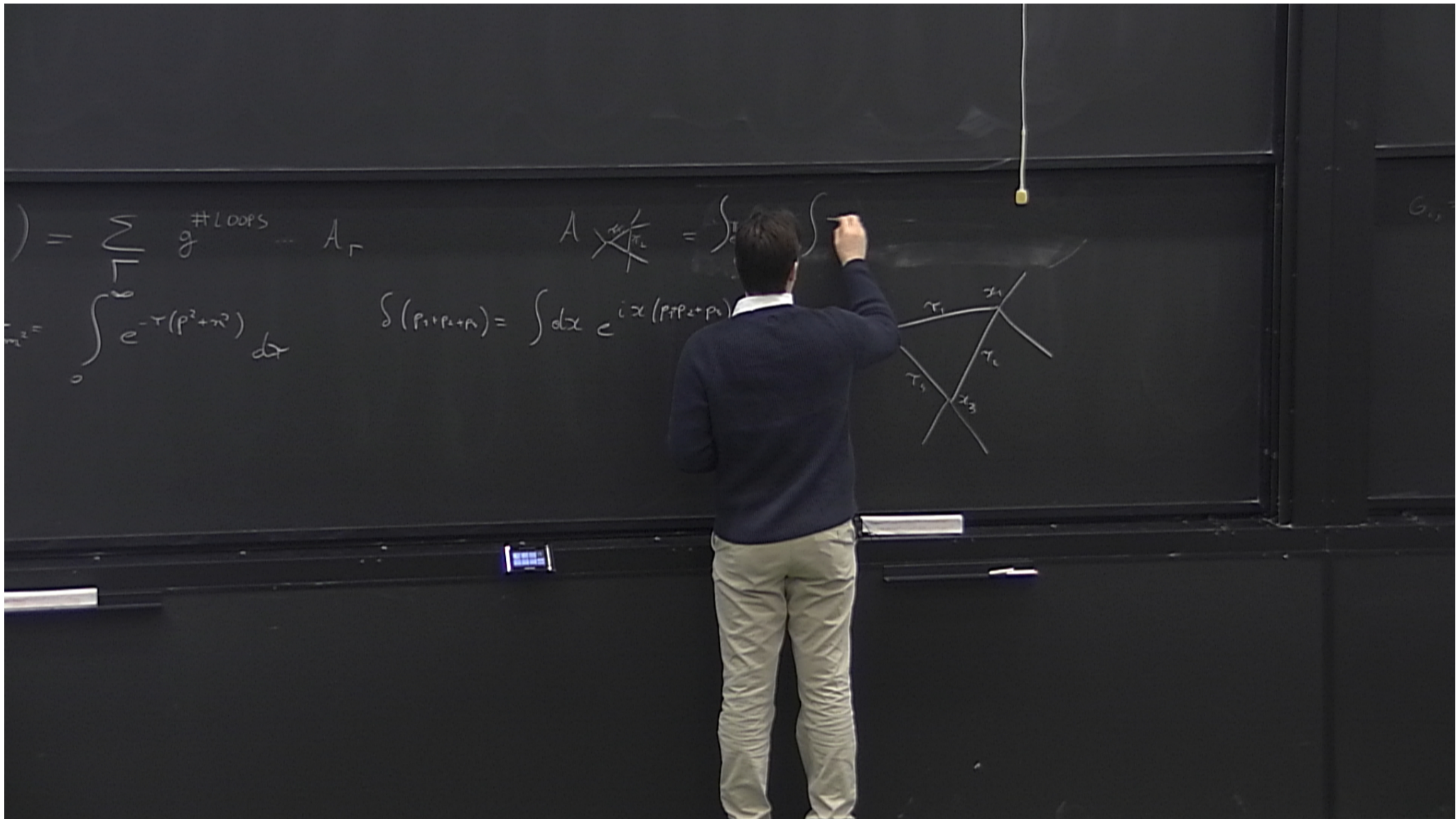
$$A(p_1, \dots, p_i) = \sum_{\Gamma} g^{\# \text{LOOPS}} A_{\Gamma}$$

$$\frac{1}{p^2 + m^2} = \int_0^{\infty} e^{-\tau(p^2 + m^2)} d\tau$$

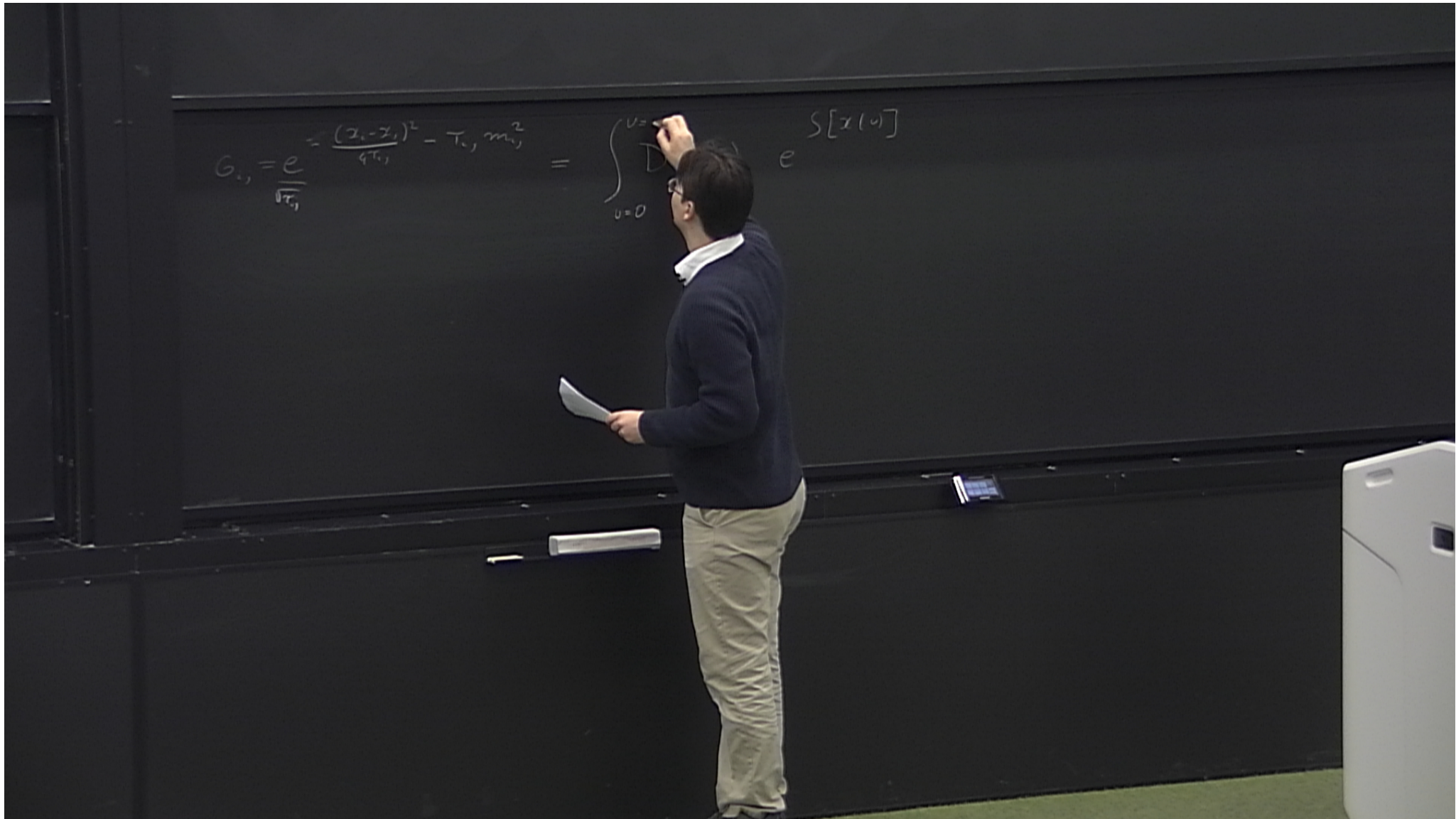
$$\delta(p_1 + p_2 + p_3) = \int dx e^{ix(p_1 + p_2 + p_3)}$$

$$A \times \frac{1}{p_i} = \int d\mu \prod_e \frac{1}{p_e^2 + m_e^2} \prod_v \delta(\sum_{e \sim v} p_e)$$

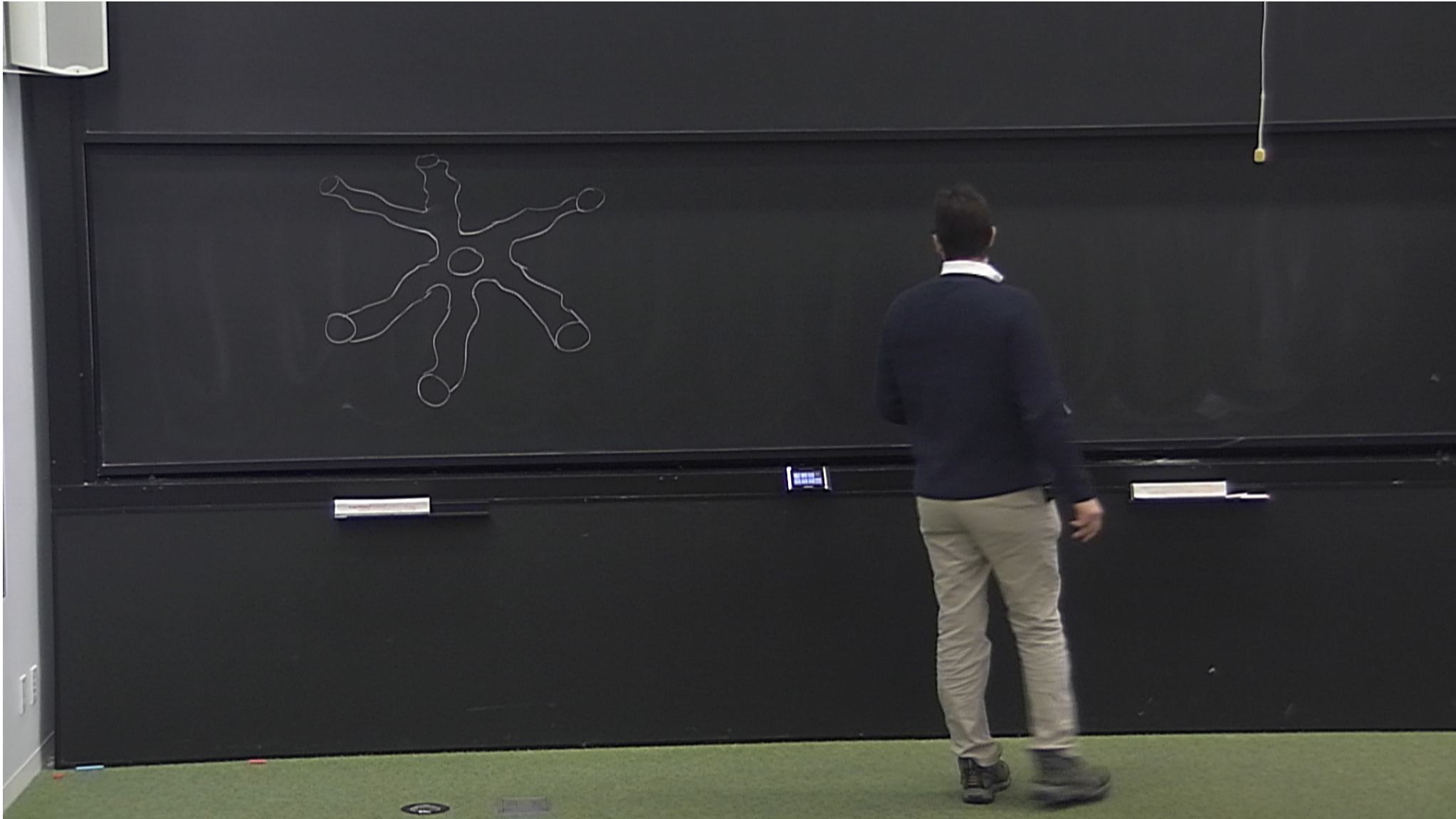


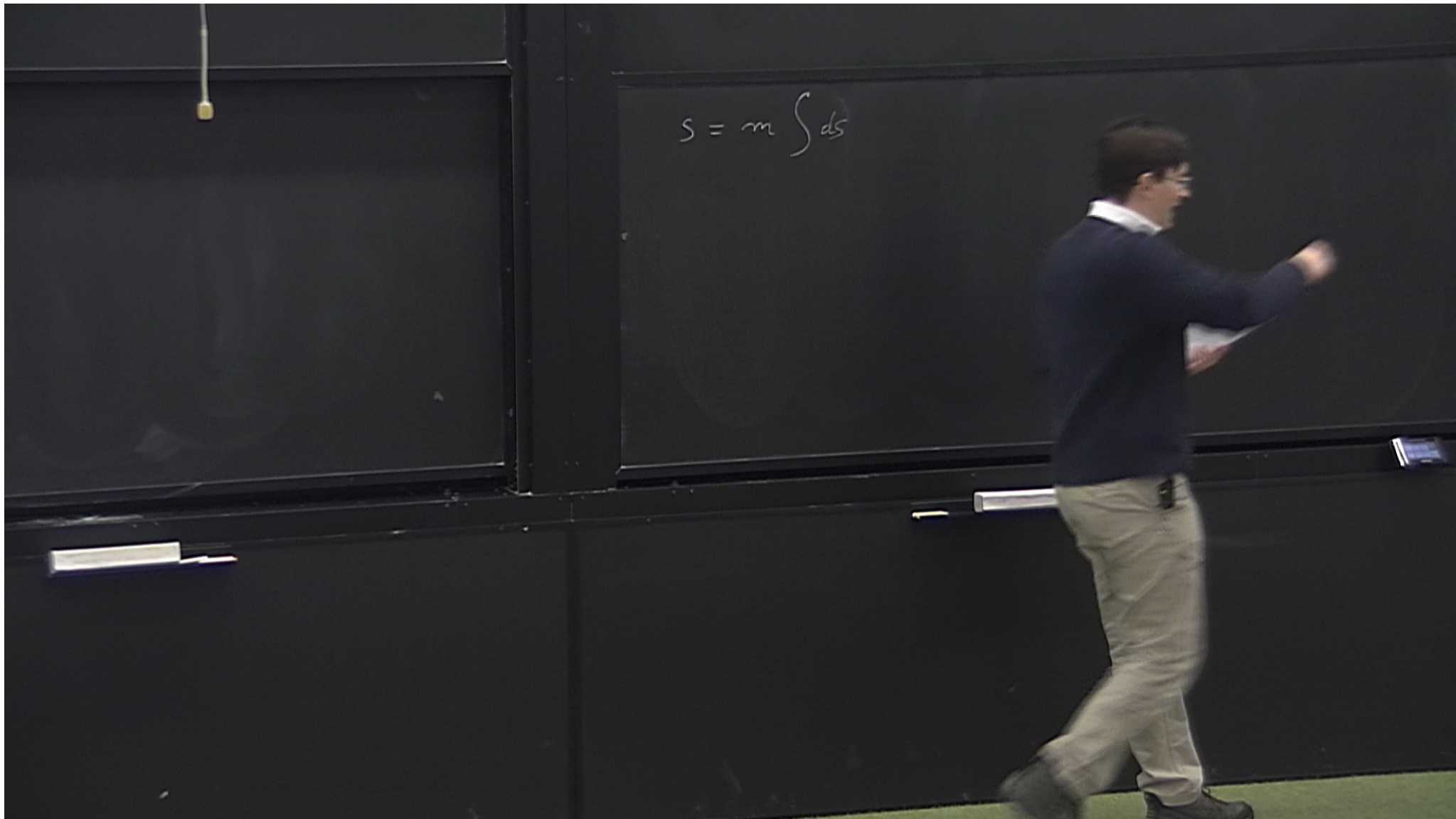


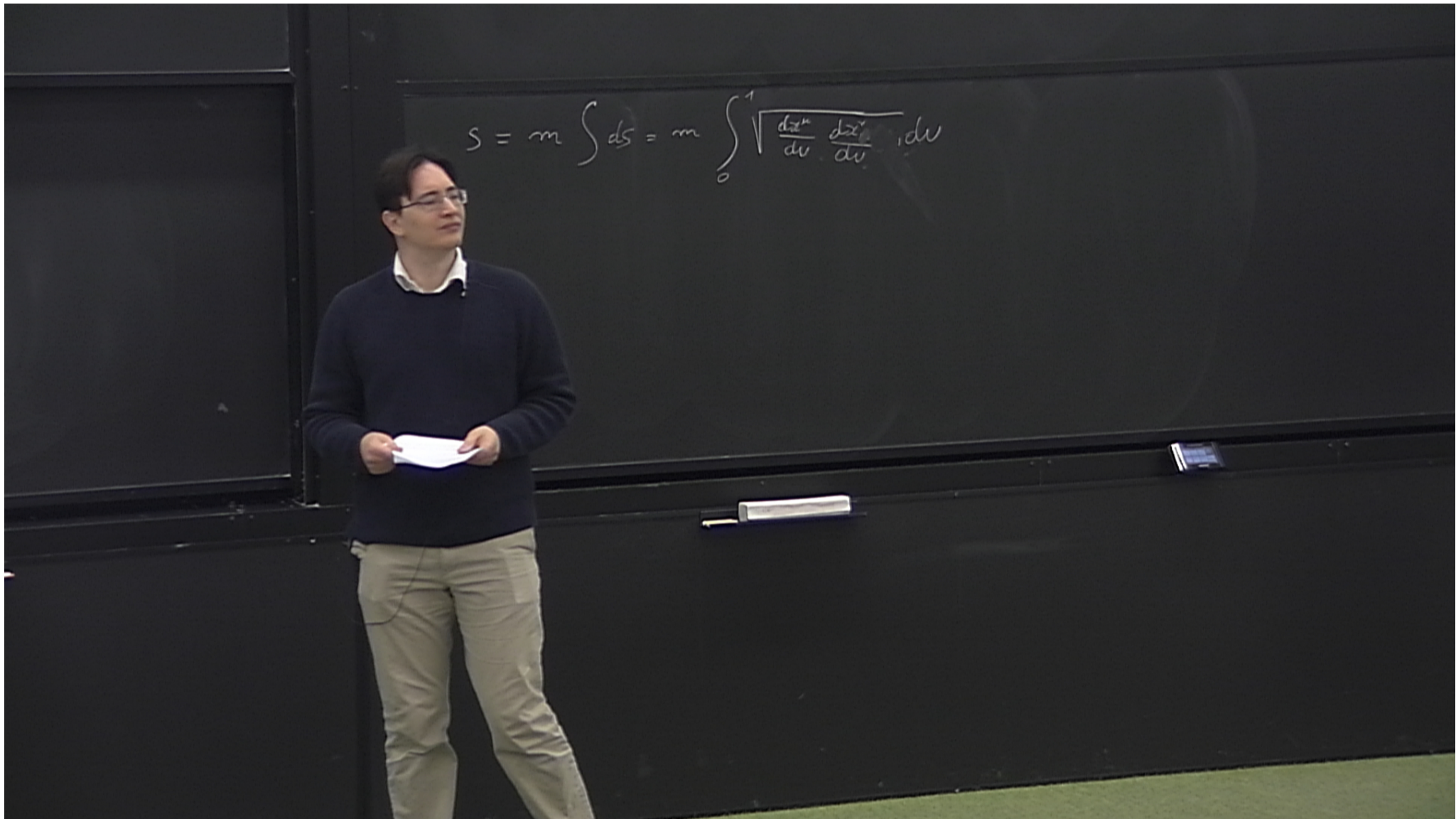
$$G_{i,j} = e^{-\frac{(x_i - x_j)^2}{4\tau_{i,j}} - \tau_{i,j} m_{i,j}^2} = \int D$$



- INTEGRATE OVER INTRINSIC GEOMETRY OF Γ
- INTEGRATE OVER MAPS $\Gamma \rightarrow \text{SPACETIME}$







$$S = m \int ds = m \int_0^1 \sqrt{\frac{dx^\mu}{du} \frac{dx^\mu}{du}} du$$

$$S = \frac{1}{2} \int_0^1 \left[e^{-1} \frac{dx^\mu}{du} \frac{dx^\mu}{du} \right]$$

$$S = m \int ds = m \int_0^1 \sqrt{\frac{dx^\mu}{du} \frac{dx_\mu}{du}} du$$

$$S = \frac{1}{2} \int_0^1 \left[e^{-1} \frac{dx^\mu}{du} \frac{dx_\mu}{du} + m^2 e \right] du$$

$$S = m \int ds = m \int_0^1 \sqrt{\frac{dx^\mu}{du} \frac{dx_\mu}{du}} du \quad u^1(u)$$

$$S = \frac{1}{2} \int_0^1 \left[e^{-1} \frac{dx^\mu}{du} \frac{dx_\mu}{du} + m^2 e \right] du$$

$$S = m \int ds = m \int_0^1 \sqrt{\frac{dx^\mu}{du} \frac{dx_\mu}{du}} du \quad u^1(u)$$

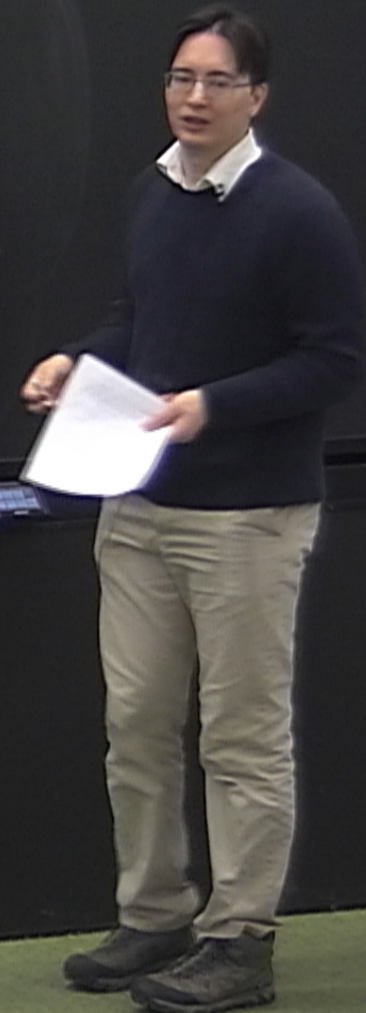
$$S = \frac{1}{2} \int_0^1 \left[e^{-1} \frac{dx^\mu}{du} \frac{dx_\mu}{du} + m^2 e \right] du \quad u \rightarrow$$

$$S = m \int ds = m \int_0^1 \sqrt{\frac{dx^\mu}{dv} \frac{dx_\mu}{dv}} dv \quad v^1(v)$$

$$S = \frac{1}{2} \int_0^1 \left[e^{-1} \frac{dx^\mu}{dv} \frac{dx_\mu}{dv} + m^2 e \right] dv \quad \begin{array}{l} v \rightarrow v(v) \\ e \rightarrow e^1 \frac{dv^1}{dv} \end{array}$$

$$S = m \int ds = m \int_0^1 \sqrt{\frac{dx^\mu}{du} \frac{dx_\mu}{du}} du \quad u'(u)$$

$$S = \frac{1}{2} \int_0^1 \left[e^{-1} \frac{dx^\mu}{du} \frac{dx_\mu}{du} + m^2 e \right] du \quad \begin{matrix} u \rightarrow u'(u) \\ e \rightarrow e' \frac{du'}{du} \end{matrix}$$



$$\gamma^\mu \Rightarrow \gamma^a$$

$$S = m \int ds = m \int_0^1 \sqrt{\frac{dx^\mu}{du} \frac{dx_\mu}{du}} du$$

$$U^1(u)$$

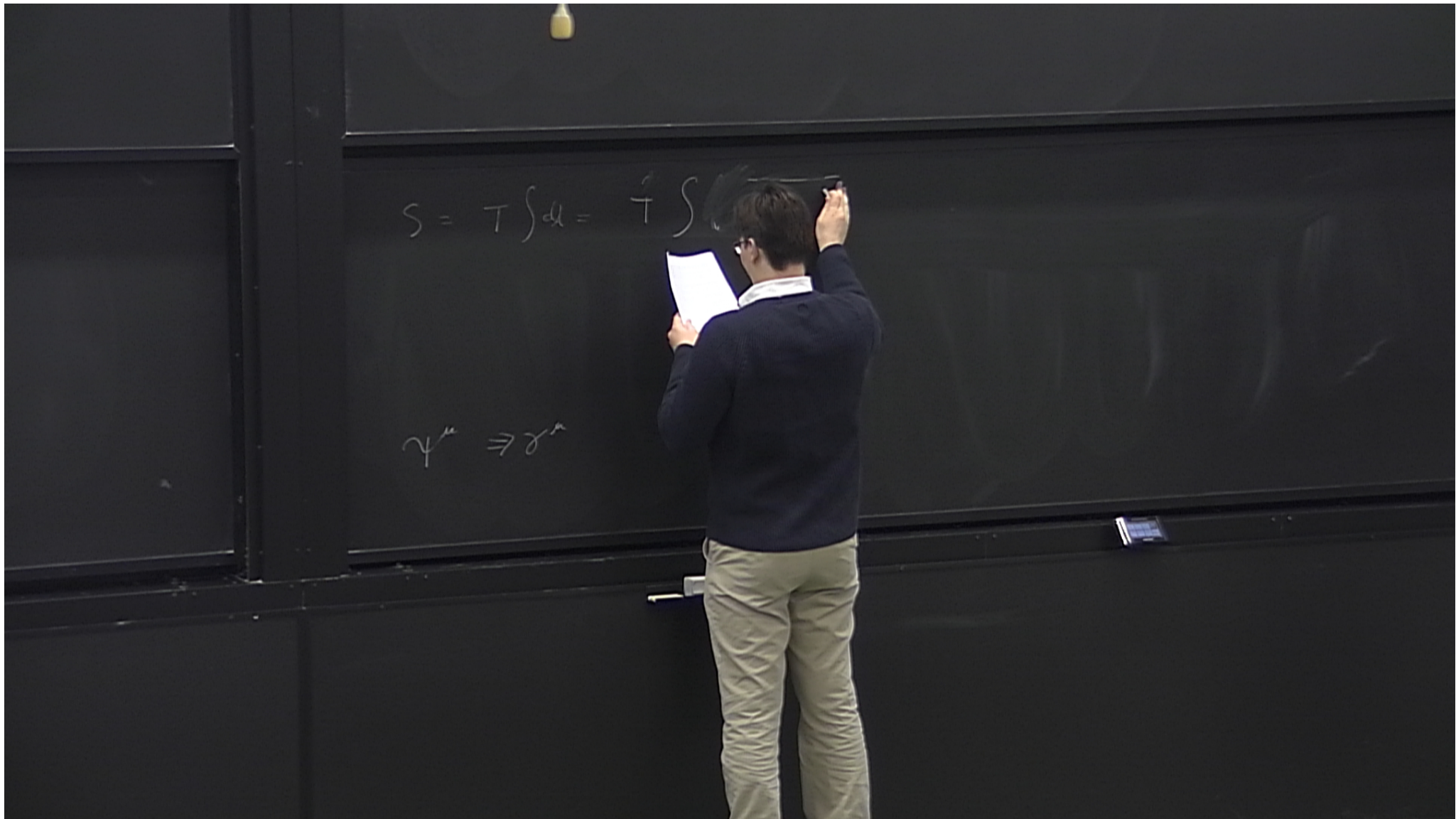
$$S = \frac{1}{2} \int_0^1 \left[e^{-1} \frac{dx^\mu}{du} \frac{dx_\mu}{du} + m^2 e \right] du$$

$$U \rightarrow U(u)$$

$$e \rightarrow e^1 \frac{du^1}{du}$$

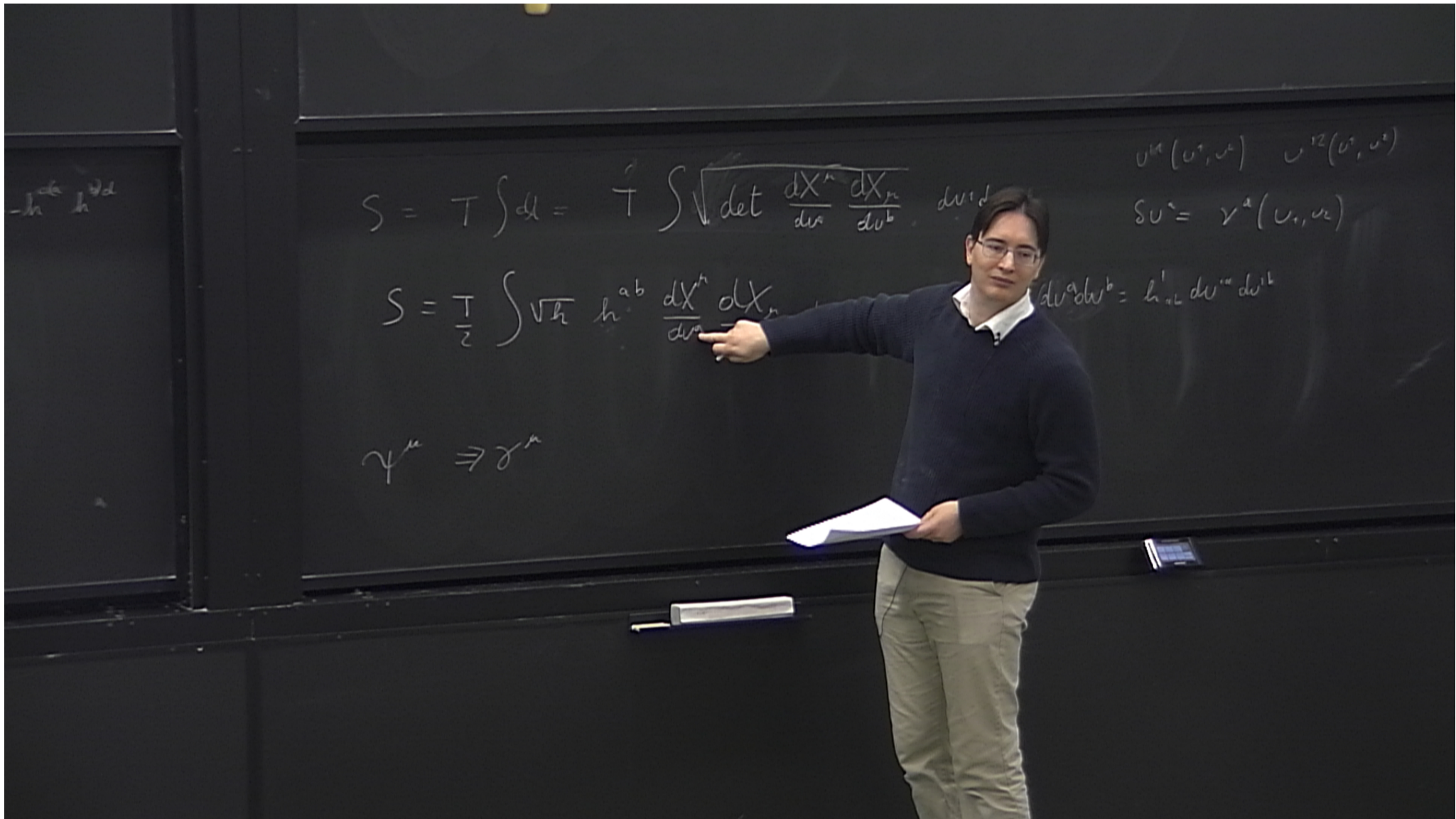
$$\int_0^1 e du = \tau$$

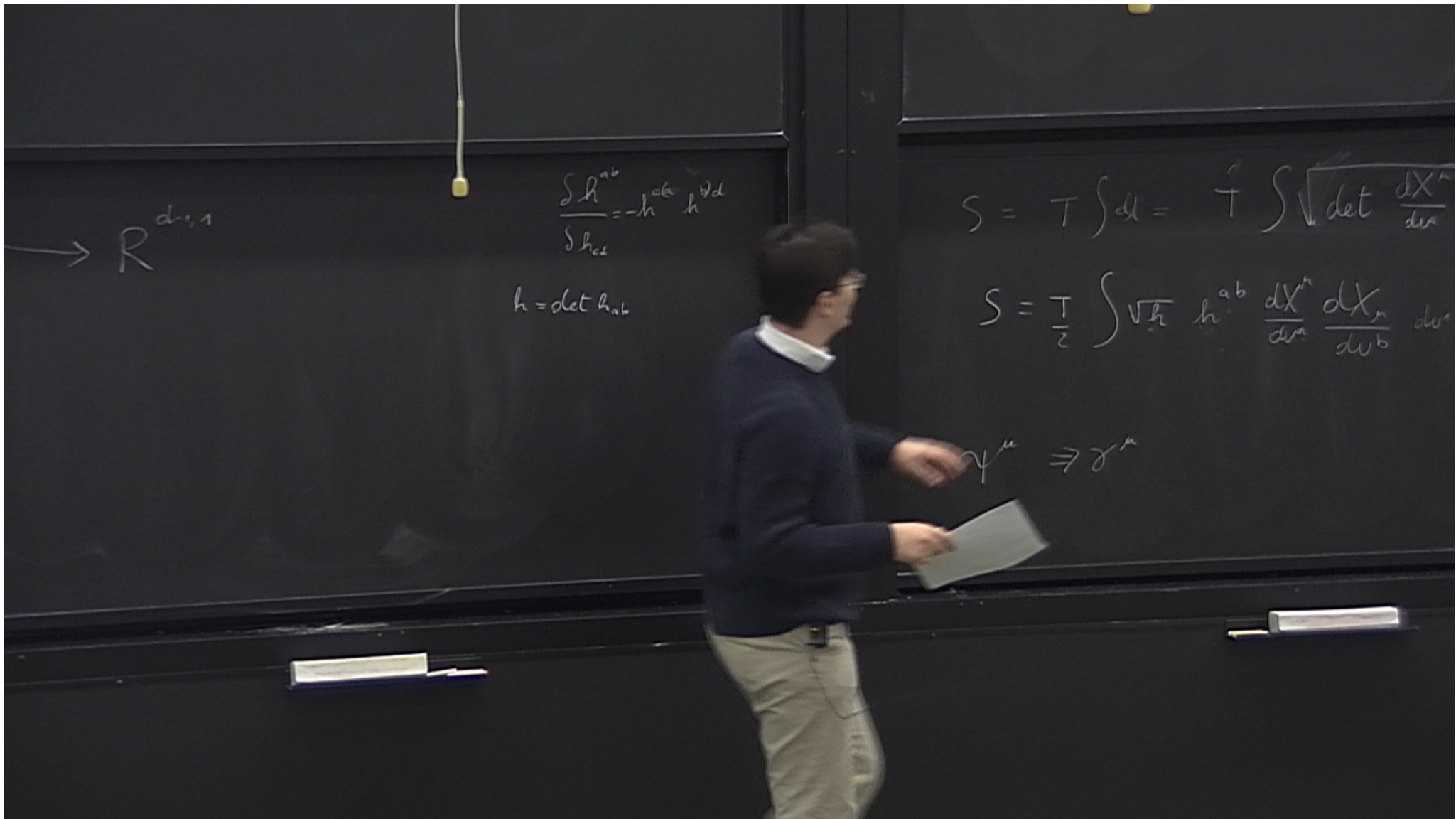
$$\int_0^\tau \frac{dx^\mu}{du} \frac{dx_\mu}{du} + m^2$$



$$S = T \int dl = T \int \sqrt{\det \frac{dX^a}{du^i} \frac{dX_a}{du^j}} du^1 du^2$$

$$\gamma^a \Rightarrow \gamma^a$$





$$S = T \int dl = T \int \sqrt{\det \frac{dX^a}{du^1} \frac{dX_a}{du^2}} du^1 du^2$$

$$S = \frac{T}{2} \int \sqrt{h} h^{ab} \frac{dX^a}{du^1} \frac{dX_b}{du^2} du^1 du^2$$

$$\gamma^\mu \Rightarrow \gamma^a$$

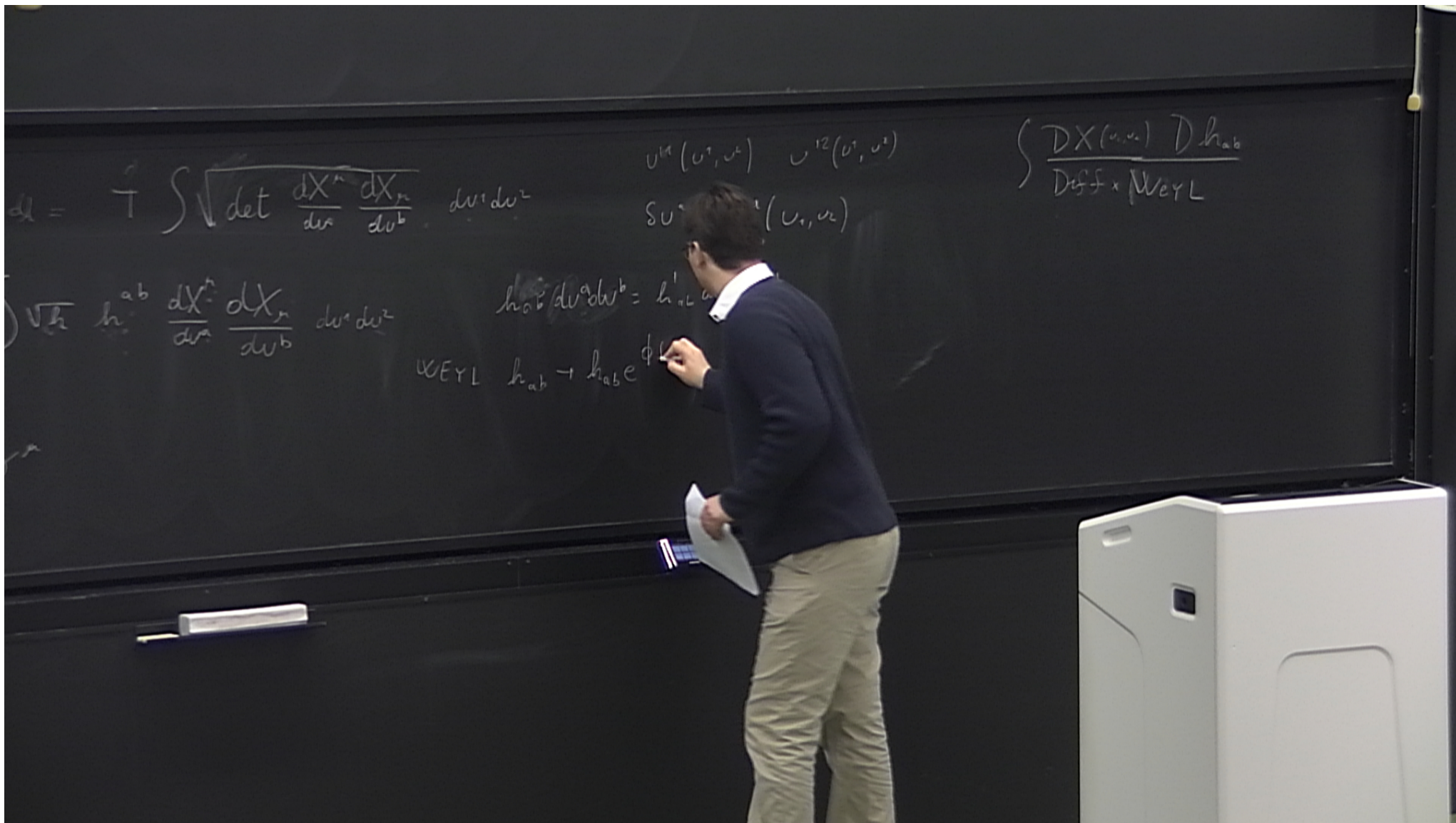
$$u^1(u^1, u^2) \quad u^2(u^1, u^2)$$

$$\gamma^a(u^1, u^2)$$

$$\left(\frac{DX(u, u)}{D\tau} \right)$$

$$h_{ab} du^a du^b = \dots du^a du^b$$

$$h_{ab} \rightarrow h_{ab} e$$



$$X^{\mu}(v_1, v_2)$$

$$\Sigma \rightarrow R^{d-1,1}$$



$$\frac{\delta h^{ab}}{\delta h_{cd}} = -h^{ac} \delta^{bd}$$

$$h = \det h_{ab}$$

$$v^{\mu}(v^1, v^2) \quad v^{12}(v^1, v^2)$$

$$Sv^a = v^a(v^1, v^2)$$

$$v^a dv^b = h^a_b dv^{1a} dv^{1b}$$

$$+ h_{ab} e^{\phi(v^1, v^2)}$$

$$X' = X$$

$$\equiv 0$$

$$\int \frac{DX(v_1, v_2) Dh_{ab}}{\text{Diff}} e^S$$

$$\int DX D\phi e^{\int \partial_a \phi \partial^a \phi + e^{\phi}}$$

$$v^{\mu}(v^1, v^2) \quad v^{12}(v^1, v^2)$$

$$Sv^a = v^a(v^1, v^2)$$

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$$+ h_{ab} e^{\phi(v^1, v^2)}$$

$$X' = X$$

$$\equiv 0$$

$$\int \frac{DX(v_1, v_2) Dh_{ab}}{\text{Diff}} e^{\int \partial \phi \partial \phi + e^{\phi}}$$

$$DX D\phi e$$