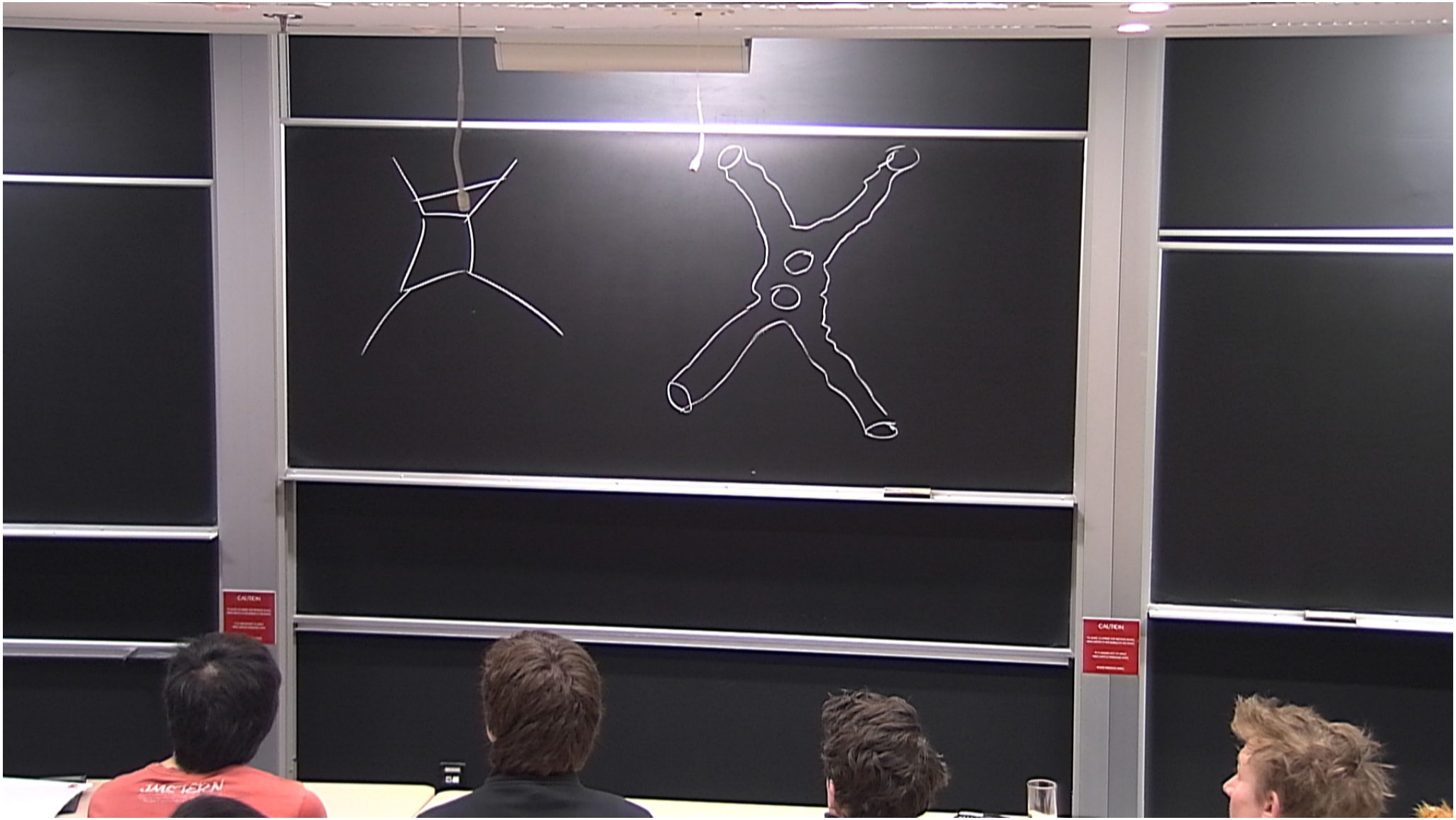
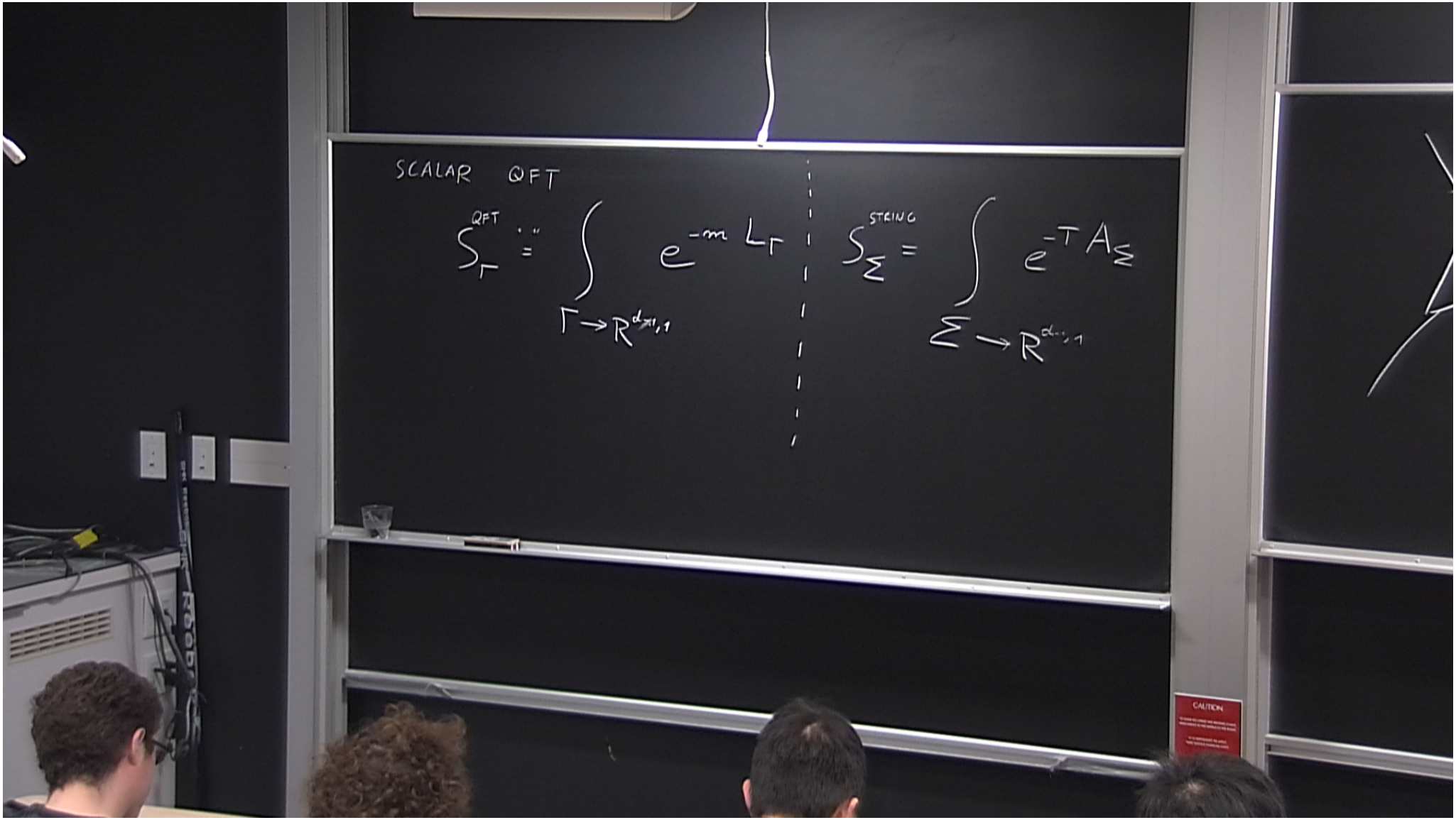
Title: String Theory Review-2

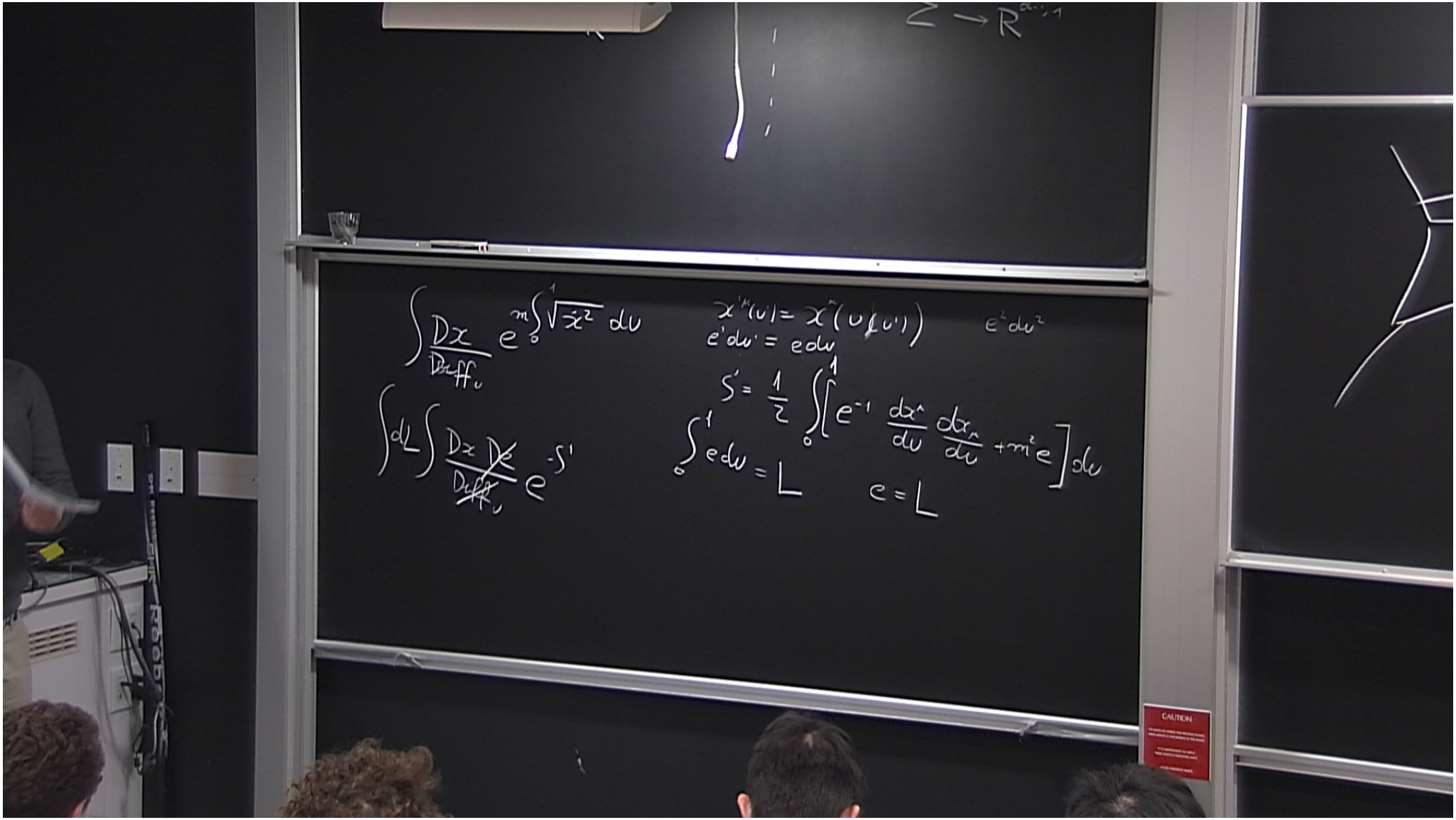
Date: Jan 27, 2015 10:15 AM

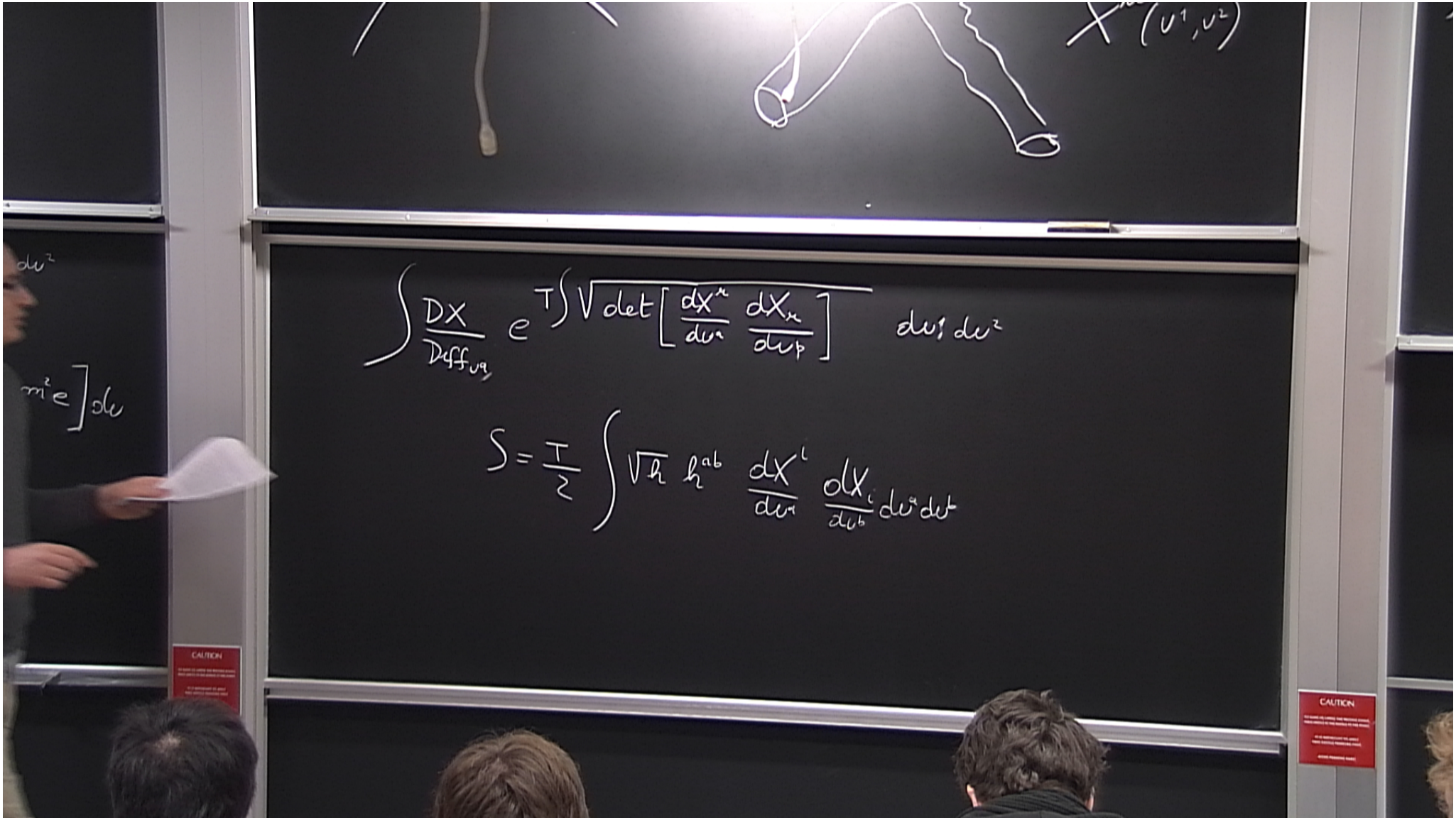
URL: http://pirsa.org/15010081

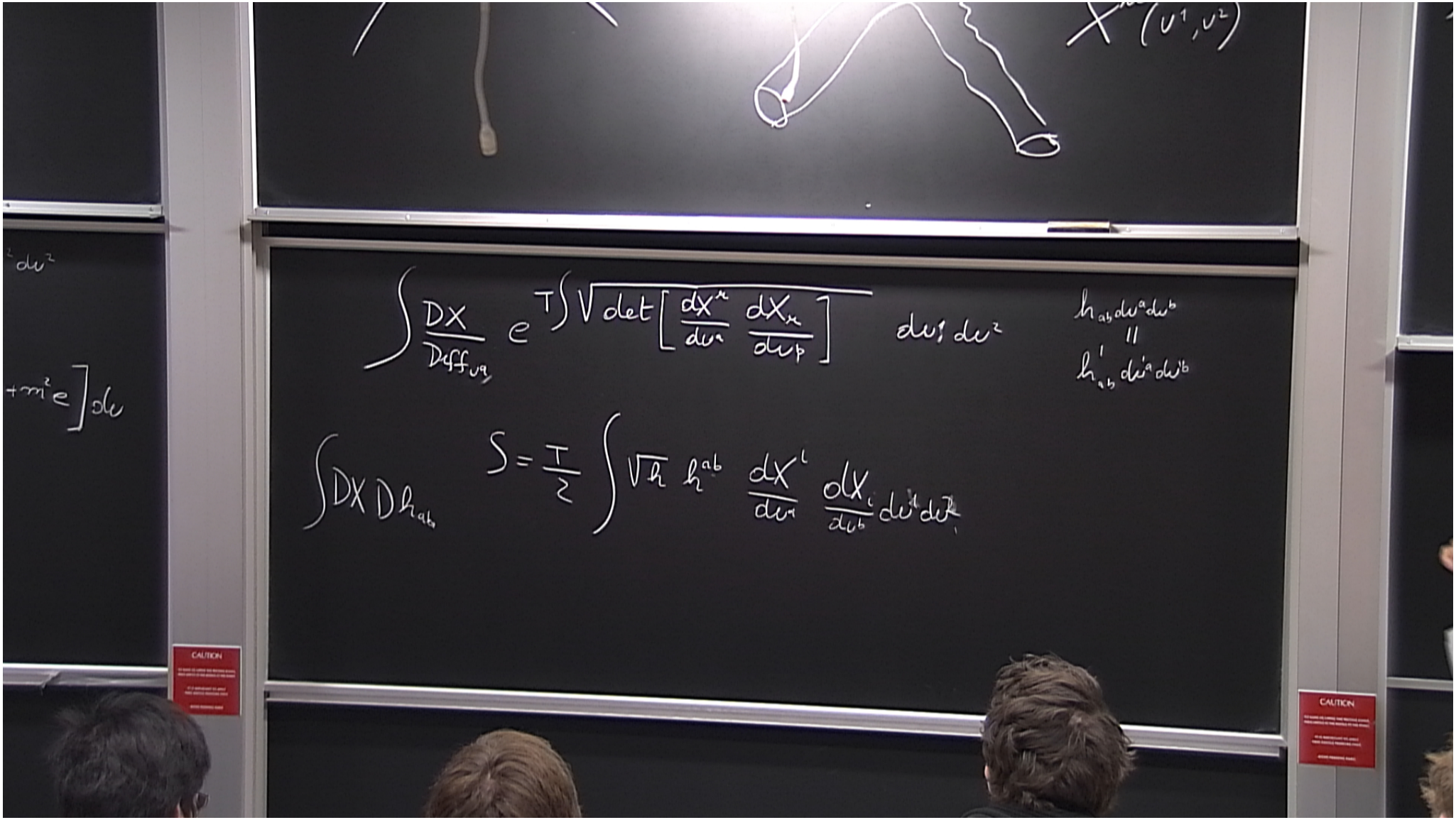
Abstract:

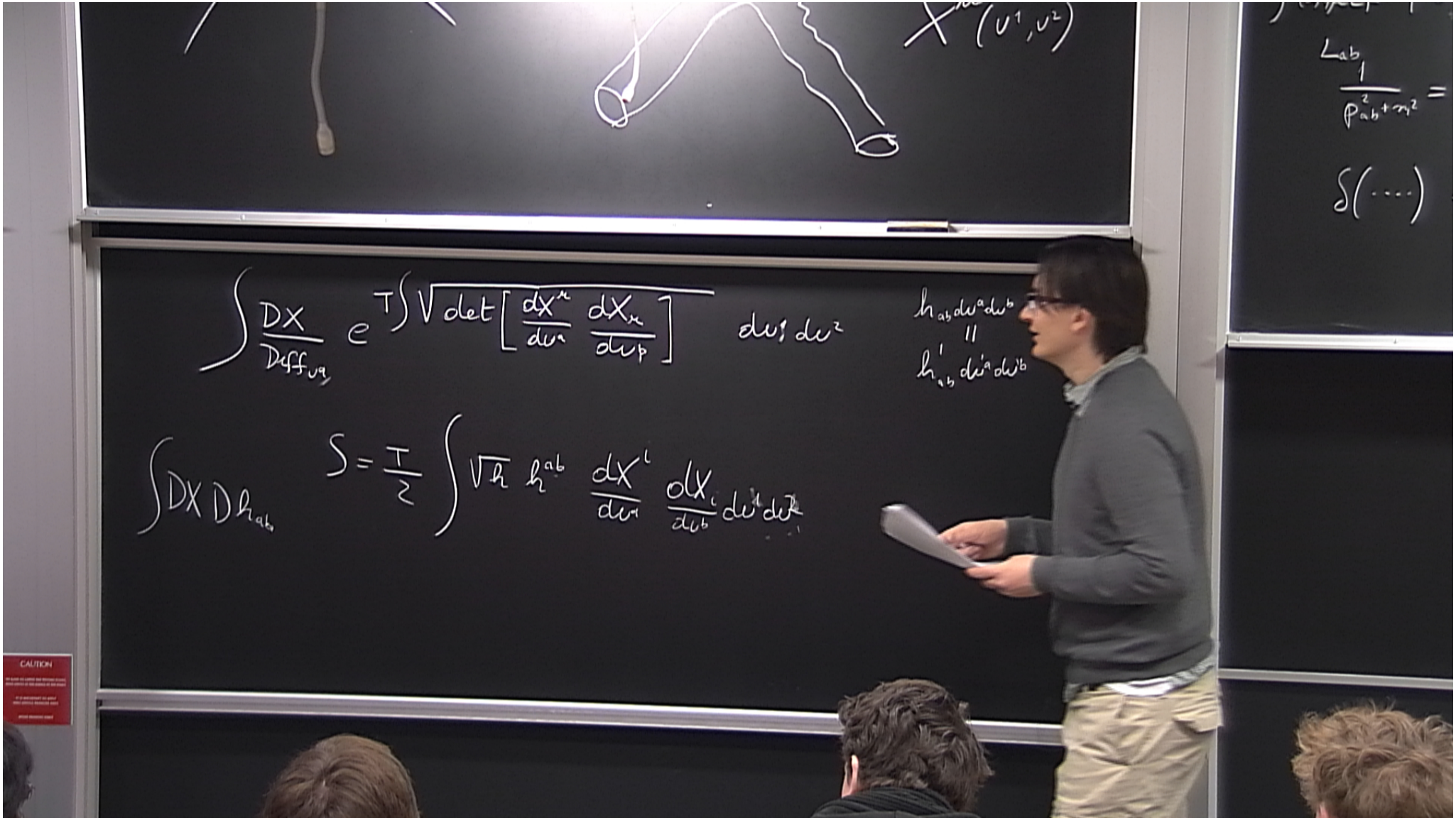

CAUTION
CAUTION

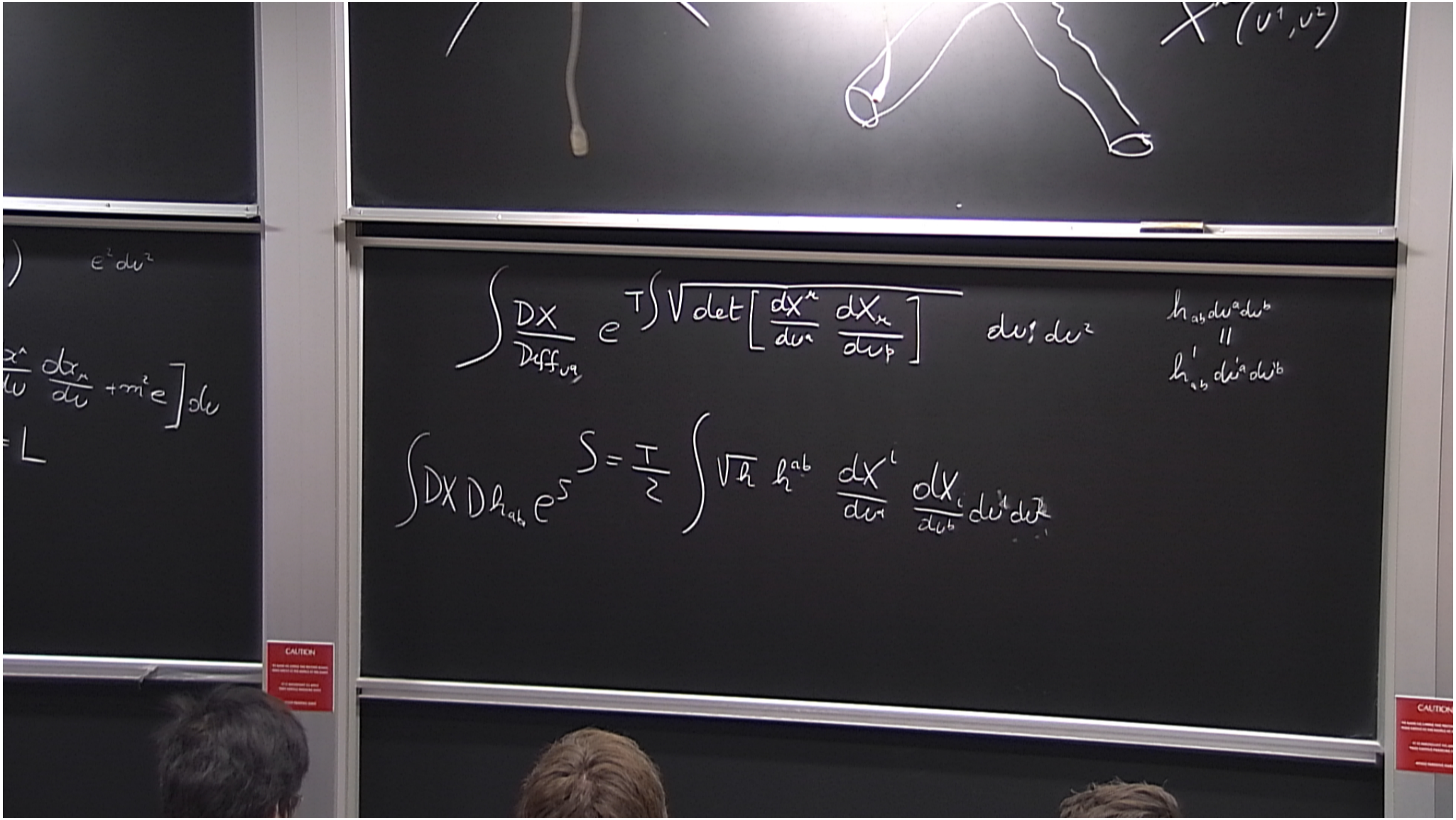

SCALAR QFT
$S_\Gamma^{QFT} := \int_{\Gamma \to R^{d-1,1}} e^{-m L_\Gamma}$
$S_\Sigma^{STRING} = \int_{\Sigma \to R^{d-1,1}} e^{-T A_\Sigma}$
CAUTION

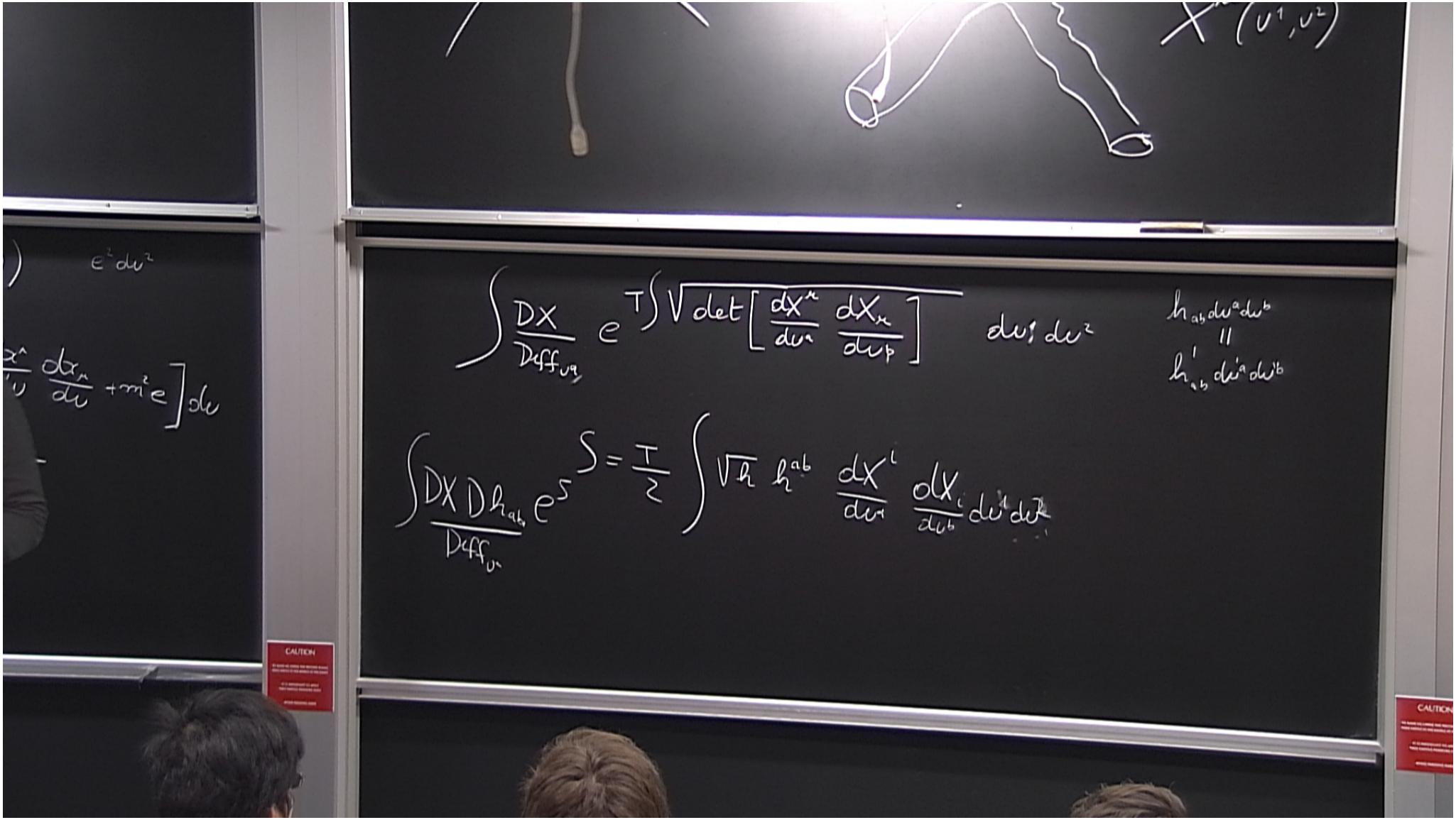

$\int \frac{Dx}{Diff_v} e^{m\int_0^1 \sqrt{\dot{x}^2}\, dv}$
$x'^{\mu}(v') = x^{\mu}(v(v'))$
$e'dv' = e\,dv$
$e^2 dv^2$
$S' = \frac{1}{2}\int_0^1 \left[e^{-1}\frac{dx^{\mu}}{dv}\frac{dx_{\mu}}{dv} + m^2 e\right] dv$
$\int dL \int \frac{Dx\,De}{Diff_v} e^{-S'}$
$\int_0^1 e\,dv = L \qquad e = L$
CAUTION

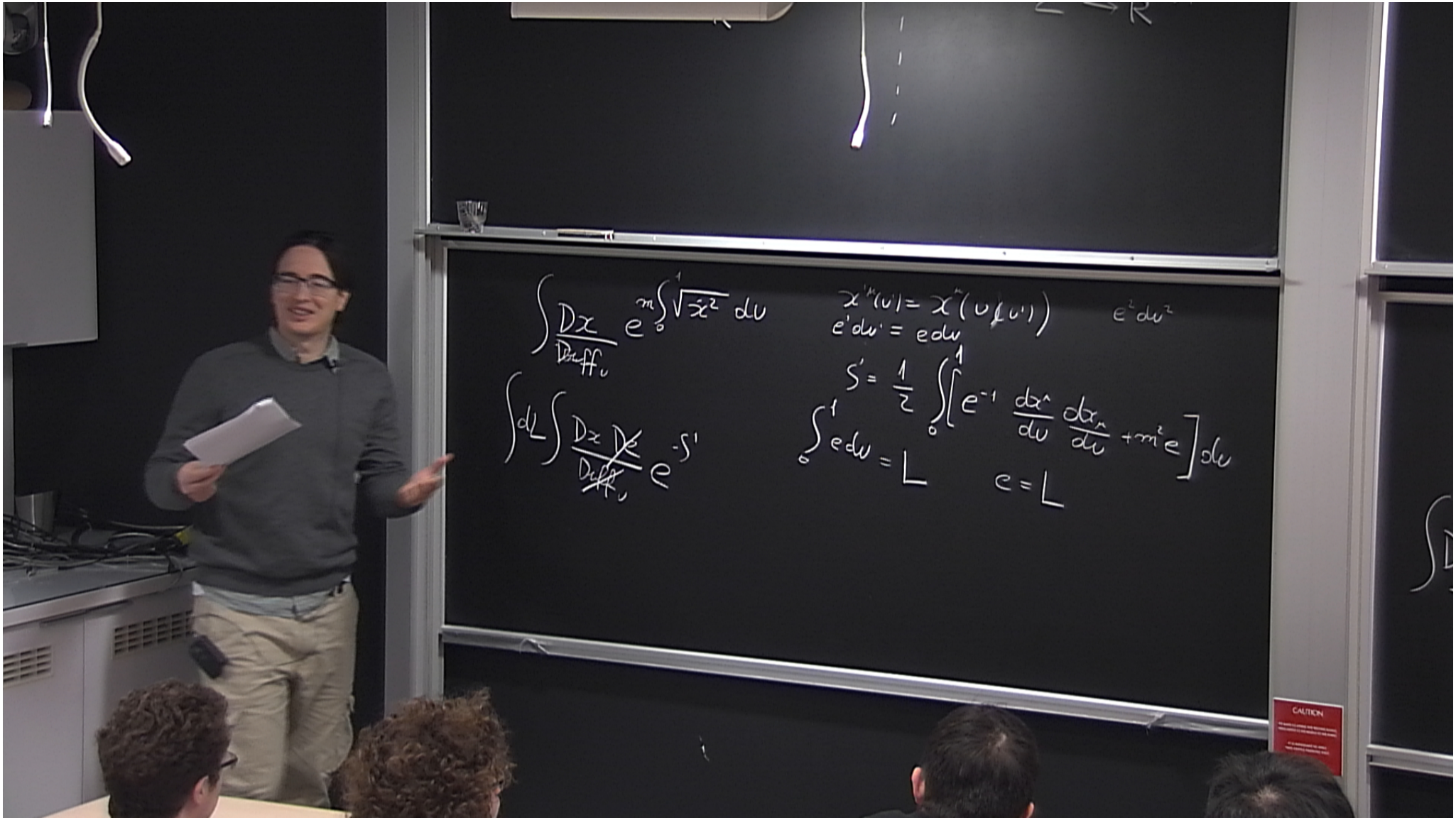

$\int \frac{DX}{Diff_{v_9}} e^{T} \sqrt{\det\left[\frac{dX^a}{dv^a}\frac{dX_a}{dv^b}\right]}\, dv^1 dv^2$
$S = \frac{T}{2} \int \sqrt{h}\, h^{ab} \frac{dX^i}{dv^a} \frac{dX_i}{dv^b} dv^a dv^b$
CAUTION
CAUTION

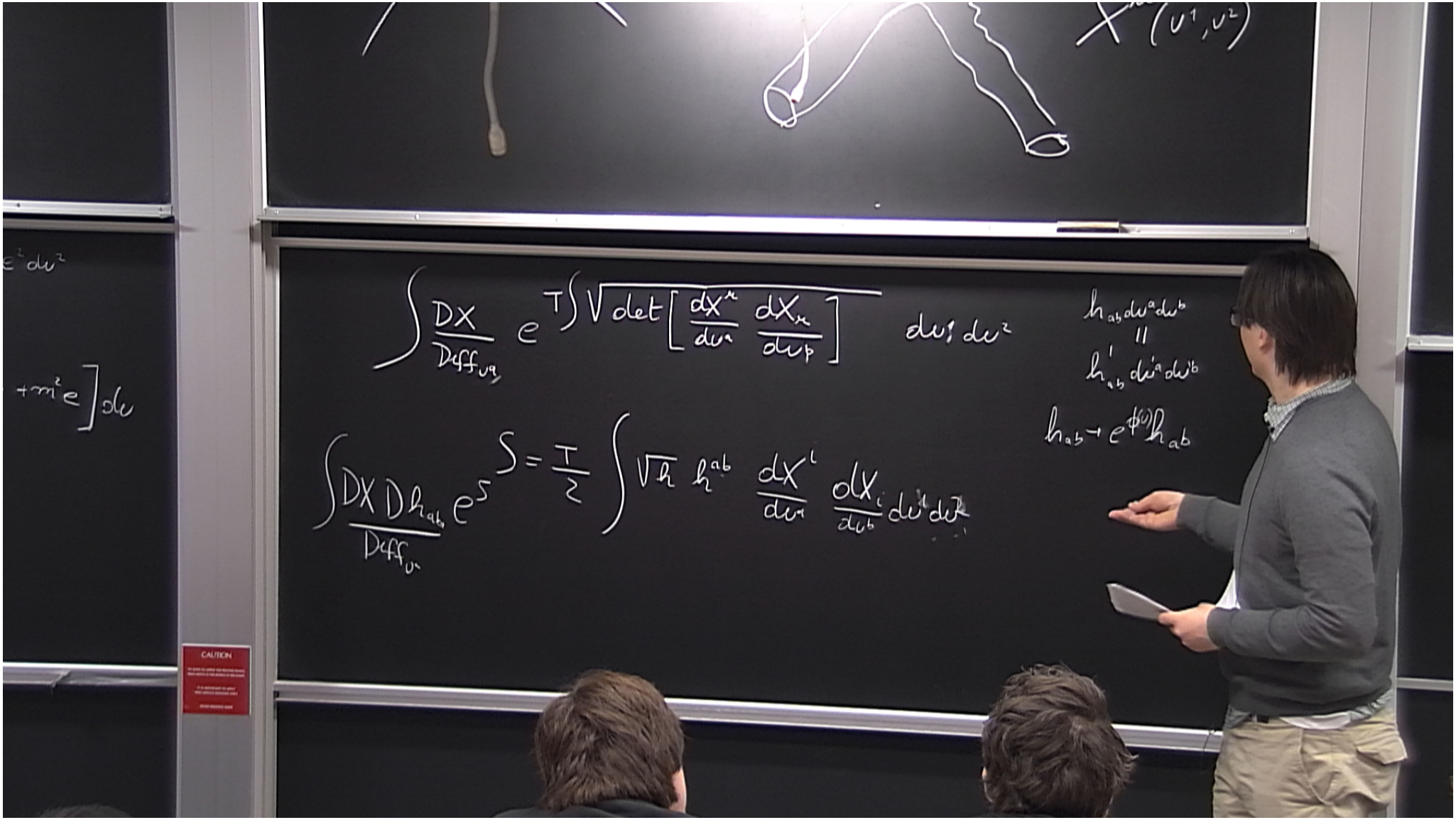

$\int \frac{DX}{Diff_{vol}} e^{-T\int \sqrt{\det\left[\frac{dX^\mu}{d\omega^a}\frac{dX_\mu}{d\omega^b}\right]}\, d\omega^1 d\omega^2}$
$h_{ab}\, d\omega^a d\omega^b$
$=$
$h'_{ab}\, d\omega'^a d\omega'^b$
$\int DX\, Dh_{ab}$
$S = \frac{T}{2}\int \sqrt{h}\, h^{ab}\, \frac{dX^i}{d\omega^a}\frac{dX_i}{d\omega^b}\, d\omega^1 d\omega^2$
CAUTION
CAUTION

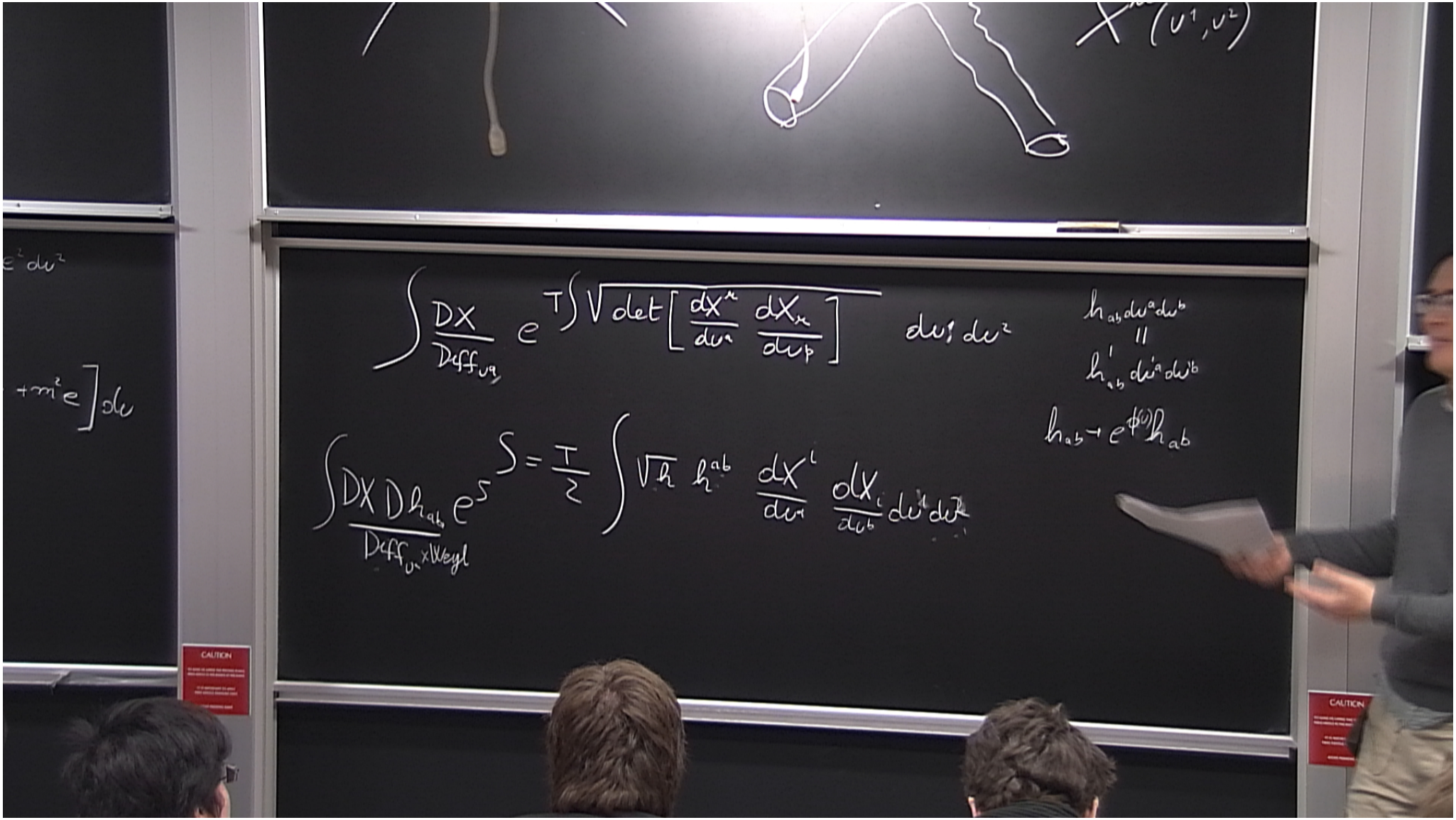

$\int \frac{DX}{Diff_{vol}} e^{T \int \sqrt{\det\left[\frac{dX^\mu}{d\sigma^a} \frac{dX_\mu}{d\sigma^b}\right]}\, d\sigma^1 d\sigma^2}$
$h_{ab} d\sigma^a d\sigma^b$
$=$
$h'_{ab} d\sigma'^a d\sigma'^b$
$\int DX\, Dh_{ab}$
$S = \frac{T}{2} \int \sqrt{h}\, h^{ab} \frac{dX^\mu}{d\sigma^a} \frac{dX_\mu}{d\sigma^b} d\sigma^1 d\sigma^2$
L_{ab}
$\frac{1}{p^2_{ab} + m^2} =$
$\delta(\cdots)$
CAUTION

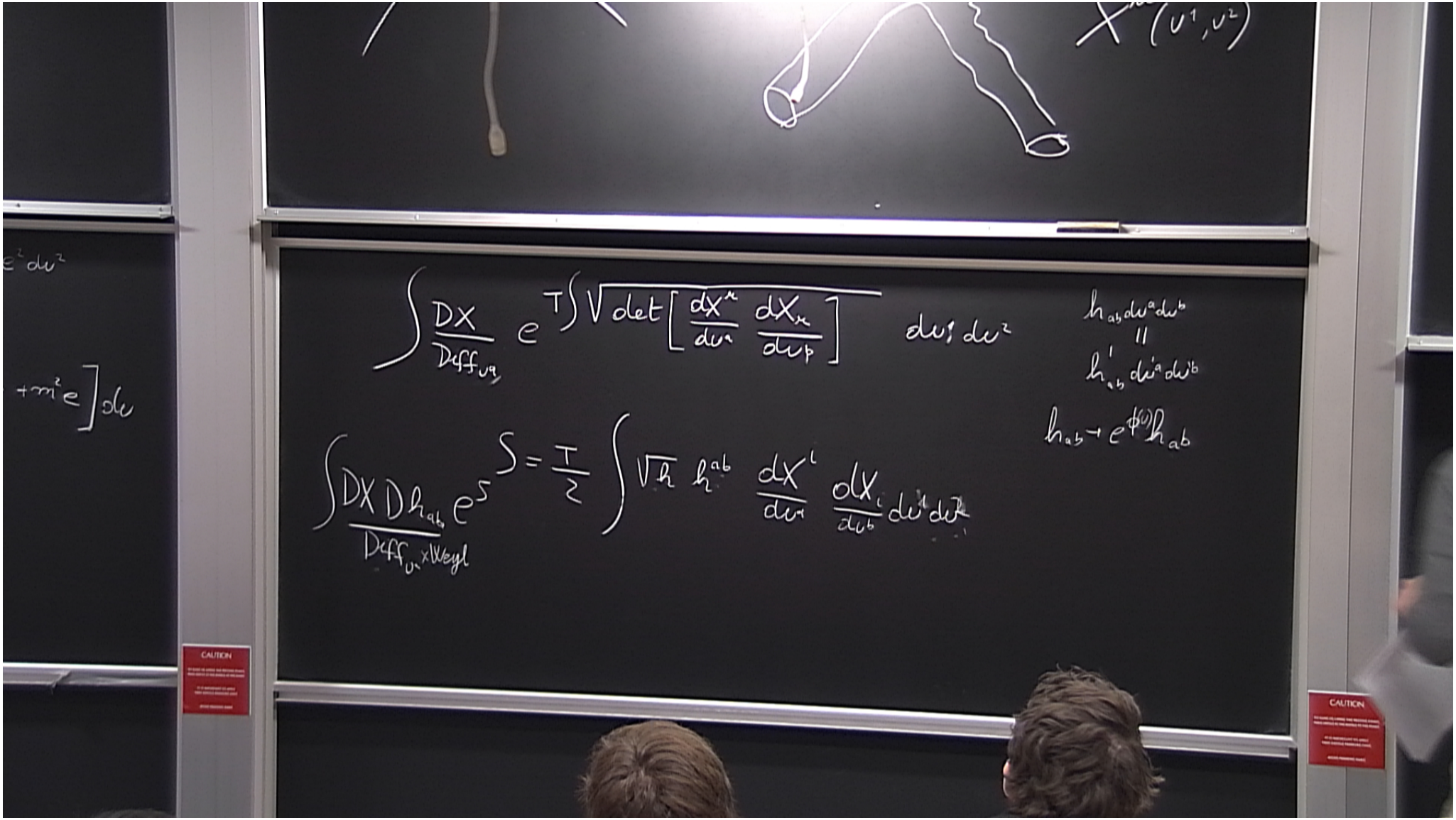

$\int \frac{DX}{Diff_{vol}} e^{T\int} \sqrt{\det\left[\frac{dX^\mu}{du^a}\frac{dX_\mu}{du^b}\right]}\, du^1 du^2$
$h_{ab} du^a du^b$
$=$
$h'_{ab} du'^a du'^b$
$\int DX\, Dh_{ab}\, e^{S} \quad S = \frac{T}{2}\int \sqrt{h}\, h^{ab} \frac{dX^i}{du^a}\frac{dX_i}{du^b} du^1 du^2$
CAUTION


$\int \frac{DX}{Diff_{\sigma_2}} e^{-T \int \sqrt{\det\left[\frac{dX^\mu}{d\sigma^a} \frac{dX_\mu}{d\sigma^b}\right]}\, d\sigma^1 d\sigma^2}$
$h_{ab} d\sigma^a d\sigma^b$
$=$
$h'_{ab} d\sigma'^a d\sigma'^b$
$\int \frac{DX\, Dh_{ab}}{Diff_{\sigma^2}} e^{S} \quad S = \frac{T}{2} \int \sqrt{h}\, h^{ab} \frac{dX^\mu}{d\sigma^a} \frac{dX_\mu}{d\sigma^b} d\sigma^1 d\sigma^2$
CAUTION


$\int \frac{Dx}{Diff_v} e^{m\int_0^1 \sqrt{\dot{x}^2}\, dv}$
$x'^{\mu}(v') = x^{\mu}(v(v'))$
$e'dv' = e\,dv$
$e^2 dv^2$
$S' = \frac{1}{2}\int_0^1 \left[e^{-1}\frac{dx^{\mu}}{dv}\frac{dx_{\mu}}{dv} + m^2 e\right] dv$
$\int dL \int \frac{Dx\,De}{Diff_v} e^{-S'}$
$\int_0^1 e\,dv = L$
$e = L$
CAUTION


$\int \frac{DX}{Diff_{\sigma_g}} e^{-T\int \sqrt{\det\left[\frac{dX^\mu}{d\sigma^a}\frac{dX_\mu}{d\sigma^b}\right]}\, d\sigma^1 d\sigma^2}$
$h_{ab}d\sigma^a d\sigma^b$
$=$
$h'_{ab}d\sigma'^a d\sigma'^b$
$h_{ab} \to e^{\phi(\sigma)} h_{ab}$
$\int \frac{DX\, Dh_{ab}}{Diff_{\sigma}} e^{S} \quad S = \frac{T}{2}\int \sqrt{h}\, h^{ab} \frac{dX^i}{d\sigma^a}\frac{dX_i}{d\sigma^b} d\sigma^1 d\sigma^2$
CAUTION


$\int \frac{DX}{Diff_{U_g}} e^{-T\int \sqrt{\det\left[\frac{dX^\mu}{du^a}\frac{dX_\mu}{du^b}\right]}\, du^1 du^2}$
$h_{ab}\, du^a du^b$
$=$
$h'_{ab}\, du'^a du'^b$
$h_{ab} \to e^{\phi(u)} h_{ab}$
$\int \frac{DX\, Dh_{ab}}{Diff_{U_g} \times Weyl} e^{-S} \quad S = \frac{T}{2} \int \sqrt{h}\, h^{ab} \frac{dX^i}{du^a} \frac{dX_i}{du^b} du^1 du^2$
CAUTION
CAUTION


$\int \frac{DX}{Diff_{U_g}} e^{-T\int \sqrt{\det\left[\frac{dX^\mu}{du^\alpha}\frac{dX_\mu}{du^\beta}\right]}\, du^1 du^2}$
$h_{ab}\, du^a du^b$
$=$
$h'_{ab}\, du'^a du'^b$
$h_{ab} \to e^{\phi(u)} h_{ab}$
$\int \frac{DX\, Dh_{ab}}{Diff_{U_g} \times Weyl} e^{-S}$
$S = \frac{T}{2} \int \sqrt{h}\, h^{ab} \frac{dX^i}{du^a} \frac{dX_i}{du^b} du^1 du^2$
CAUTION
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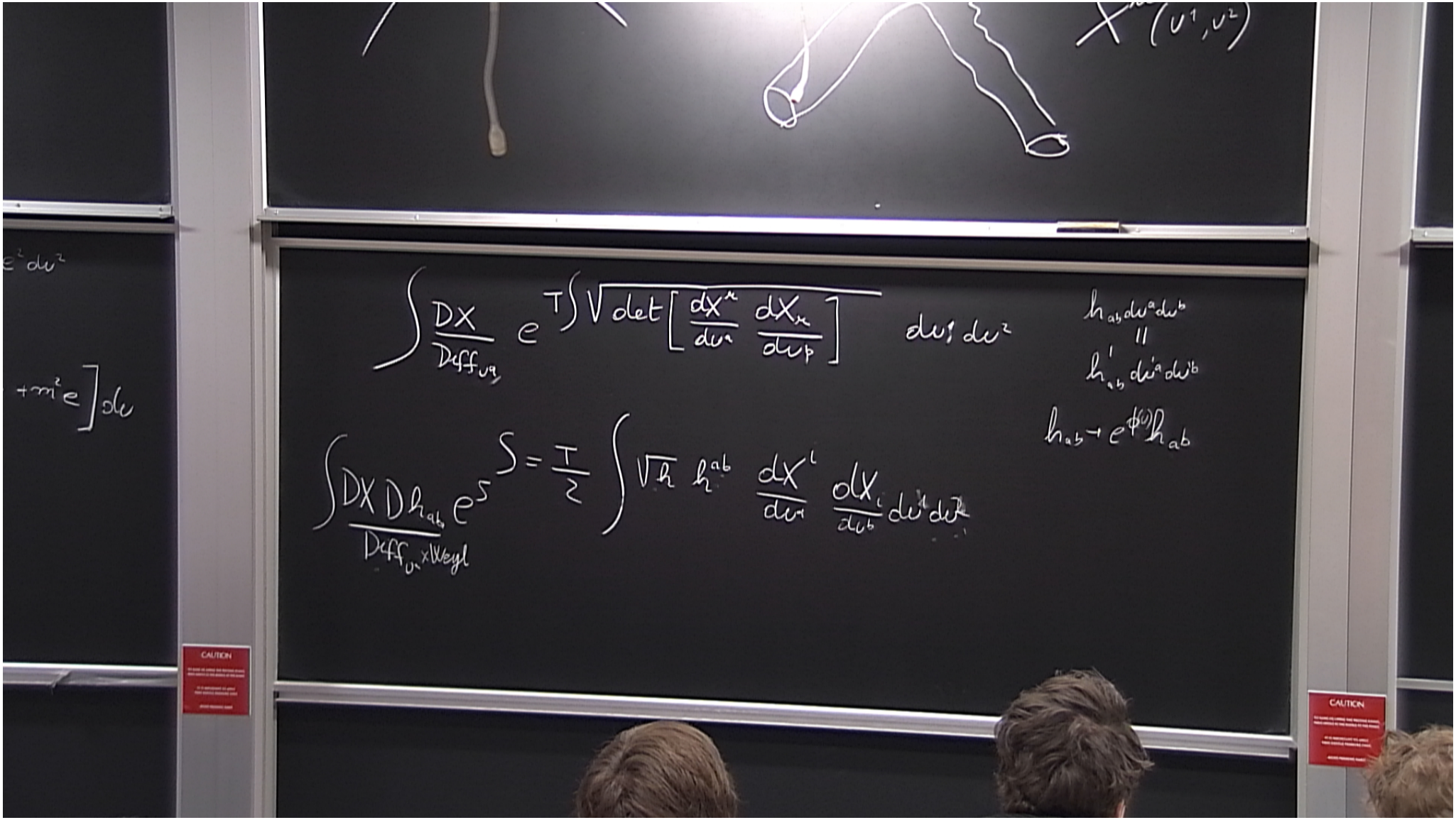
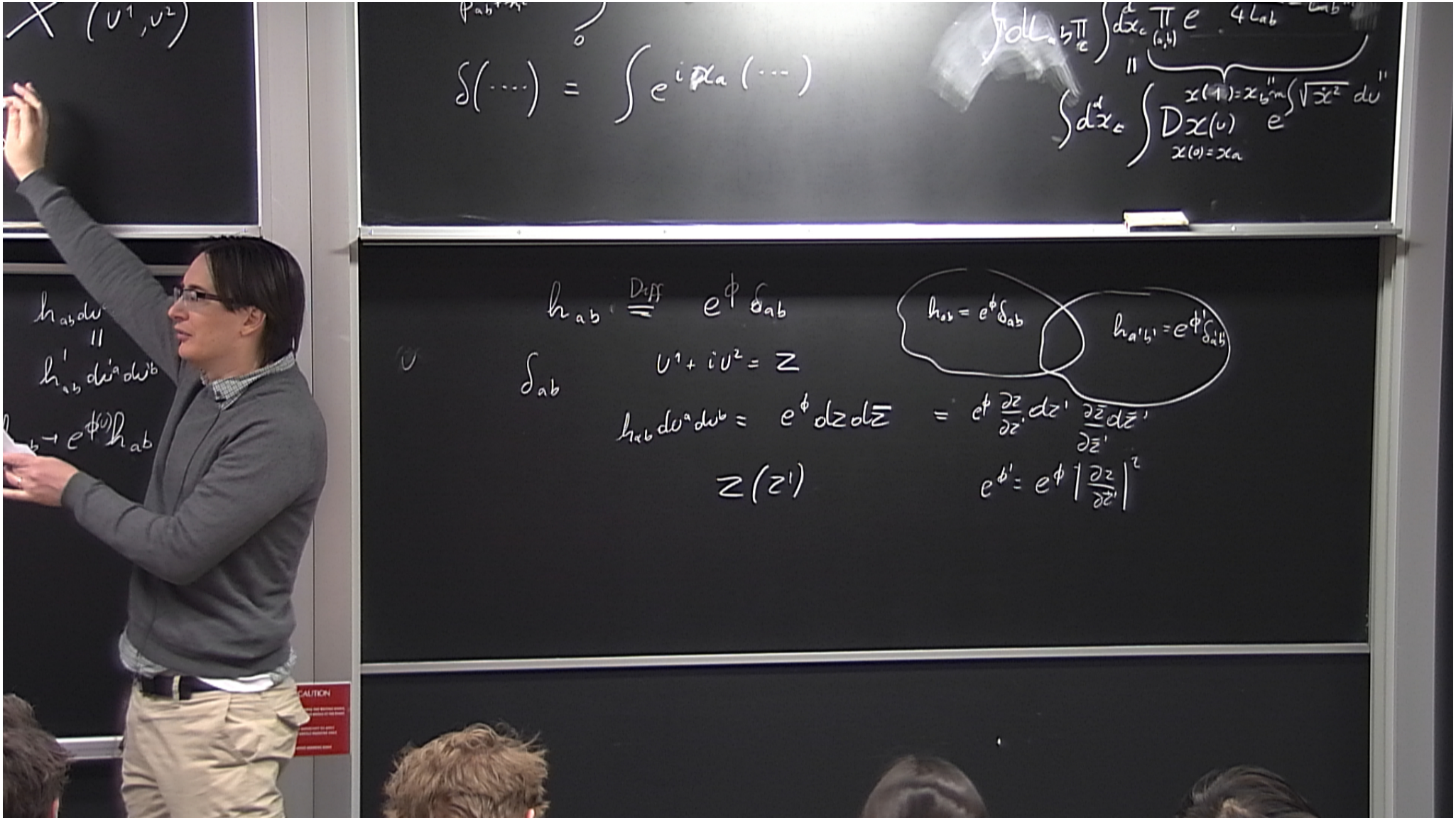
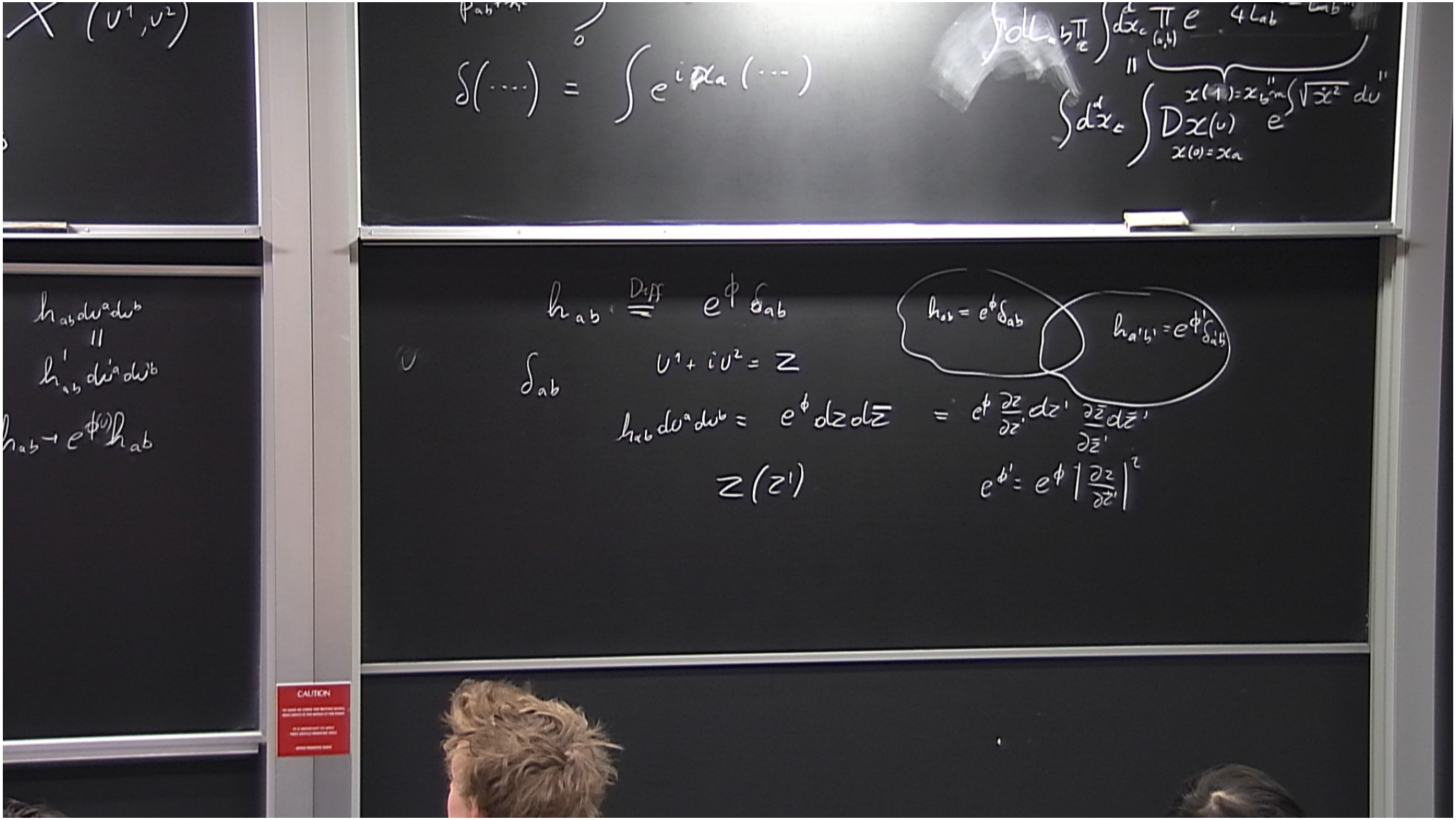
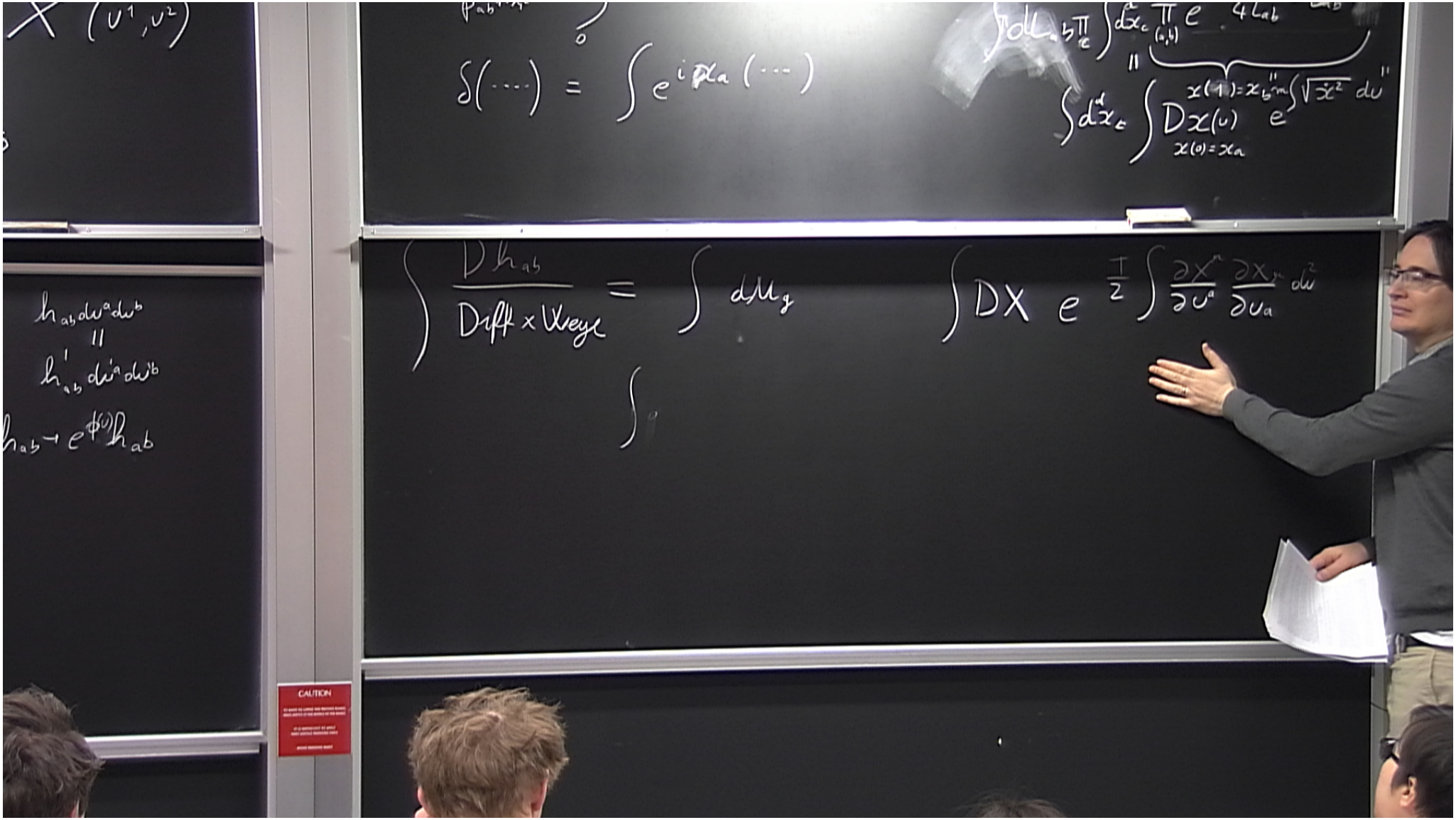
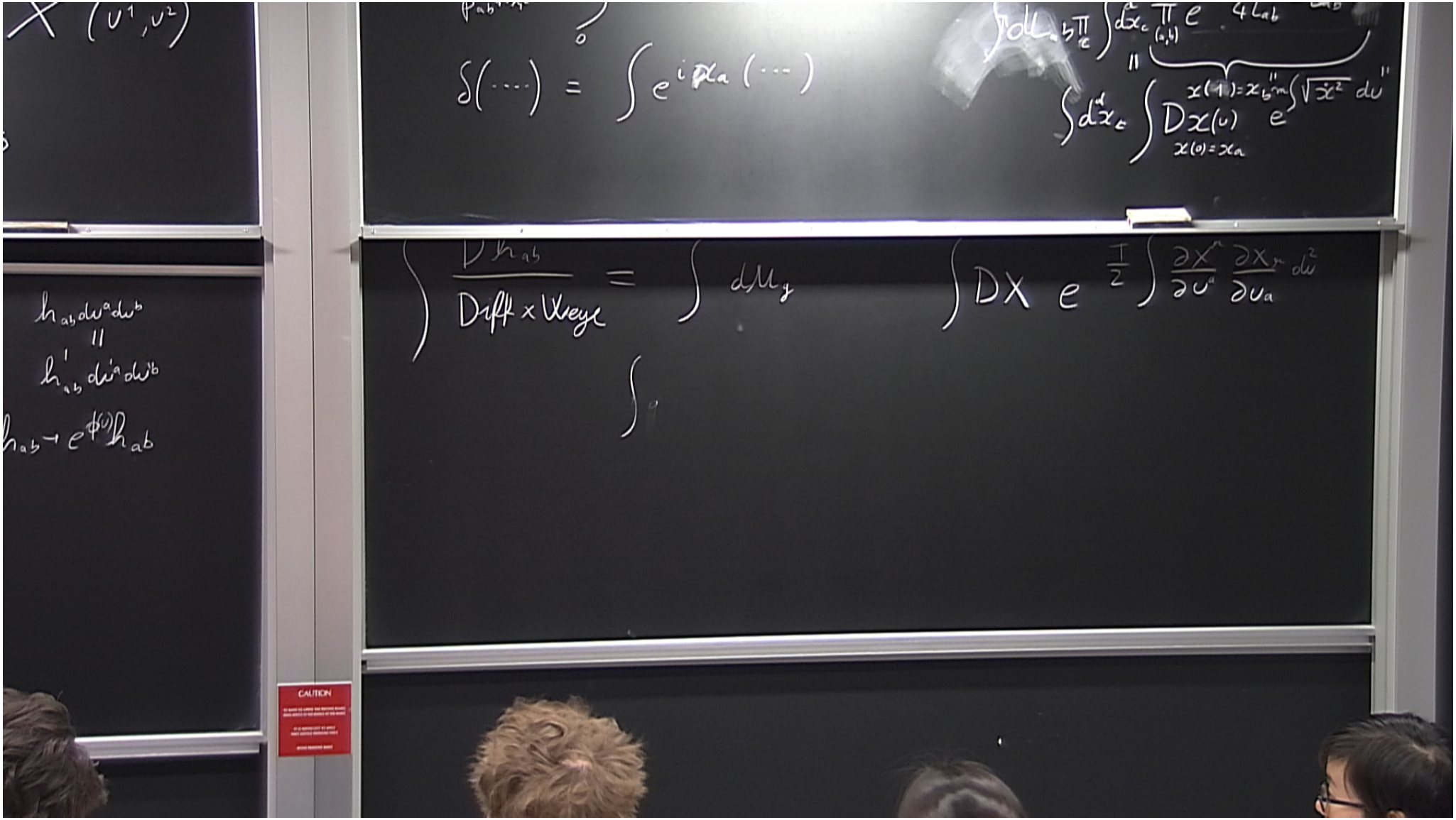
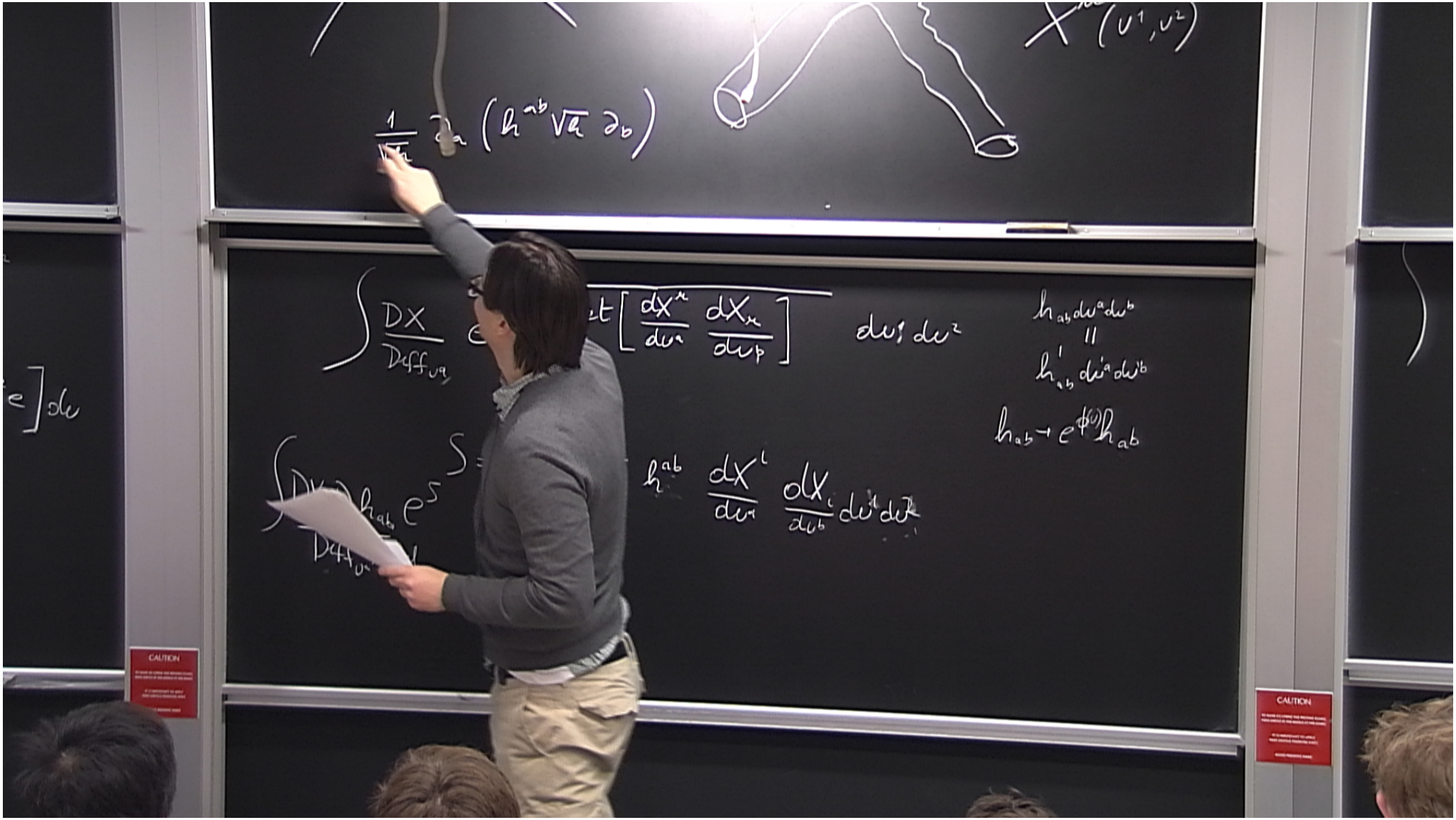

$\int \frac{DX}{Diff_{U_g}} e^{-T\int \sqrt{\det\left[\frac{dX^\mu}{du^a}\frac{dX_\mu}{du^b}\right]}\, du^1 du^2}$
$h_{ab}\, du^a du^b$
$=$
$h'_{ab}\, du'^a du'^b$
$h_{ab} \to e^{\phi(u)} h_{ab}$
$\int \frac{DX\, Dh_{ab}}{Diff_{U_g} \times Weyl} e^{-S} \quad S = \frac{T}{2} \int \sqrt{h}\, h^{ab} \frac{dX^i}{du^a} \frac{dX_i}{du^b} du^1 du^2$
CAUTION
CAUTION


$\delta(\cdots) = \int e^{i\alpha_a}(\cdots)$
$h_{ab} \overset{\text{Diff}}{=} e^{\phi}\delta_{ab}$
δ_{ab}
$u^1 + iu^2 = z$
$h_{ab}du^a du^b = e^{\phi}dz\,d\bar{z}$
$z(z')$
$h_{ab} = e^{\phi}\delta_{ab}$
$h_{a'b'} = e^{\phi'}\delta_{a'b'}$
$= e^{\phi}\frac{\partial z}{\partial z'}dz'\,\frac{\partial \bar{z}}{\partial \bar{z}'}d\bar{z}'$
$e^{\phi'} = e^{\phi}\left|\frac{\partial z}{\partial z'}\right|^2$
$\int dx_c \prod_{(a,b)} e^{-L_{ab}}$
$= \int dx_c \int_{x(0)=x_a}^{x(1)=x_b} Dx(u)\, e^{-m\int \sqrt{\dot{x}^2}\,du}$


$\delta(\cdots) = \int e^{i p x_a} (\cdots)$
$\int dx_c \prod_{(a,b)} e^{-\frac{1}{4} L_{ab}} = \int d^d x_c \int_{x(0)=x_a}^{x(1)=x_b} Dx(u)\, e^{-m \int \sqrt{\dot{x}^2}\, du}$
$h_{ab} \overset{\text{Diff}}{=} e^{\phi} \delta_{ab}$
δ_{ab}
$u^1 + i u^2 = z$
$h_{ab}\, du^a du^b = e^{\phi}\, dz\, d\bar{z} = e^{\phi} \frac{\partial z}{\partial z'} dz' \frac{\partial \bar{z}}{\partial \bar{z}'} d\bar{z}'$
$z(z')$
$e^{\phi'} = e^{\phi} \left| \frac{\partial z}{\partial z'} \right|^2$
$h_{ab} = e^{\phi} \delta_{ab}$
$h_{a'b'} = e^{\phi'} \delta_{a'b'}$
$h_{ab}\, du^a du^b = h'_{ab}\, du'^a du'^b$
$h_{ab} \to e^{\phi(u)} h_{ab}$
CAUTION


$\delta(\cdots) = \int e^{i\alpha_a(\cdots)}$
$\int \frac{Dh_{ab}}{\text{Diff} \times \text{Weyl}} = \int d\mu_g$
$\int DX\, e^{\frac{T}{2}\int \frac{\partial X^a}{\partial v^a}\frac{\partial X_a}{\partial v_a} dv}$
$h_{ab}\, dv^a dv^b$
$h'_{ab}\, dv'^a dv'^b$
$h_{ab} \to e^{\phi(v)} h_{ab}$
CAUTION


$\delta(\cdots) = \int e^{i\alpha_a(\cdots)}$
$\int \frac{Dh_{ab}}{\text{Diff} \times \text{Weyl}} = \int d\mu_g$
$\int Dx\, e^{\frac{T}{2}\int \frac{\partial x^\mu}{\partial v^a}\frac{\partial x_\mu}{\partial v_a} dv^2}$
$h_{ab} dv^a dv^b$
$h'_{ab} dv'^a dv'^b$
$h_{ab} \to e^{\phi(v)} h_{ab}$
$\int dx_c \prod_{(a,b)} e^{\cdots}$
$\int dx_c \int_{x(0)=x_a}^{x(1)=x_b} Dx(v)\, e^{m\int \sqrt{\dot{x}^2}\, dv}$
CAUTION


$\frac{1}{\sqrt{h}}\partial_a\left(h^{ab}\sqrt{h}\,\partial_b\right)$
$\int \frac{DX}{Diff_{U^a}}$
$\left[\frac{dX^\mu}{du^a}\frac{dX_\mu}{du^b}\right]$
$du^1 du^2$
$h_{ab}du^a du^b$
$=$
$h'_{ab}du'^a du'^b$
$h_{ab} \to e^{\phi(u)} h_{ab}$
$h^{ab}\frac{dX^i}{du^a}\frac{dX_i}{du^b}du^1 du^2$
CAUTION
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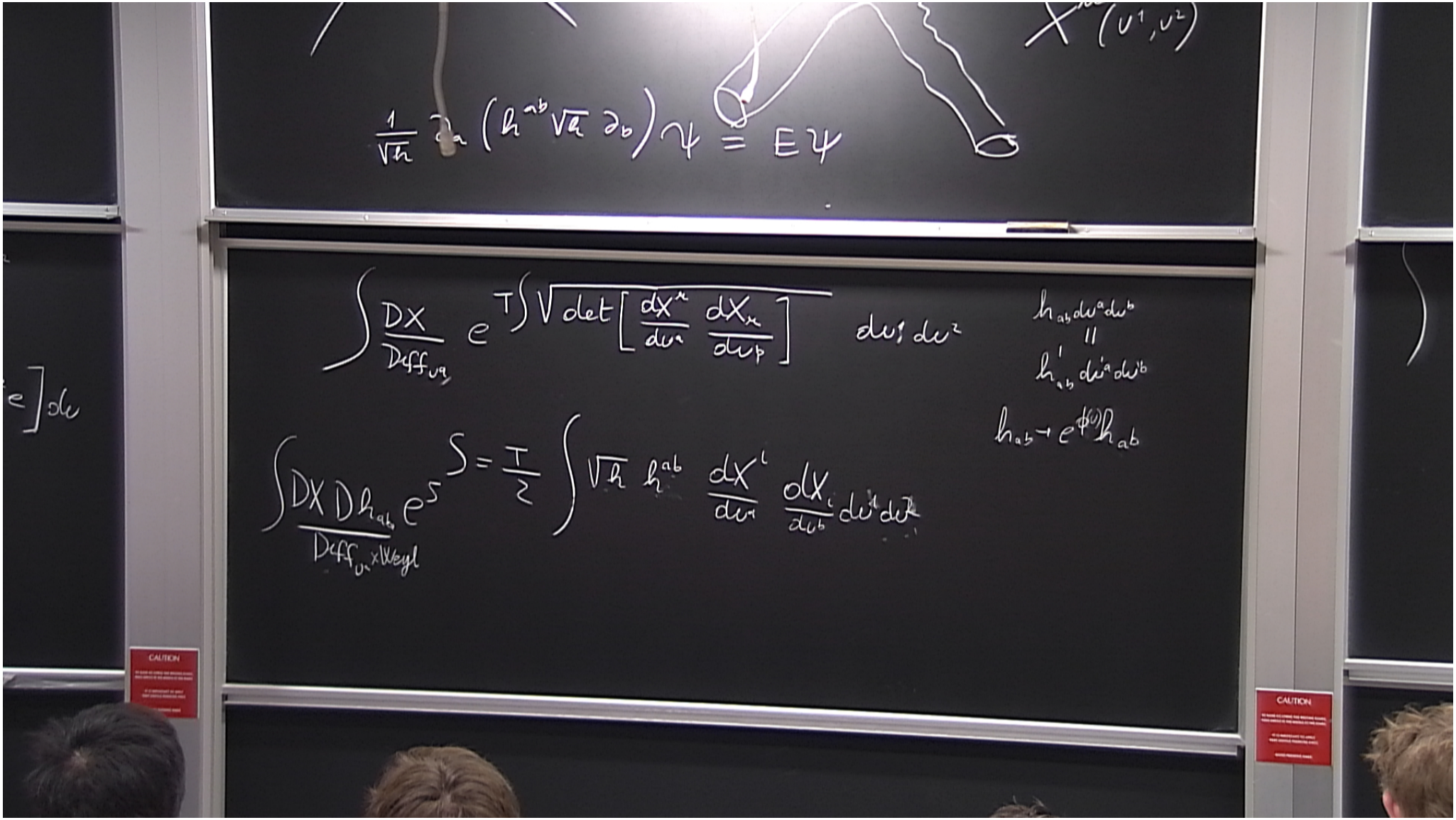
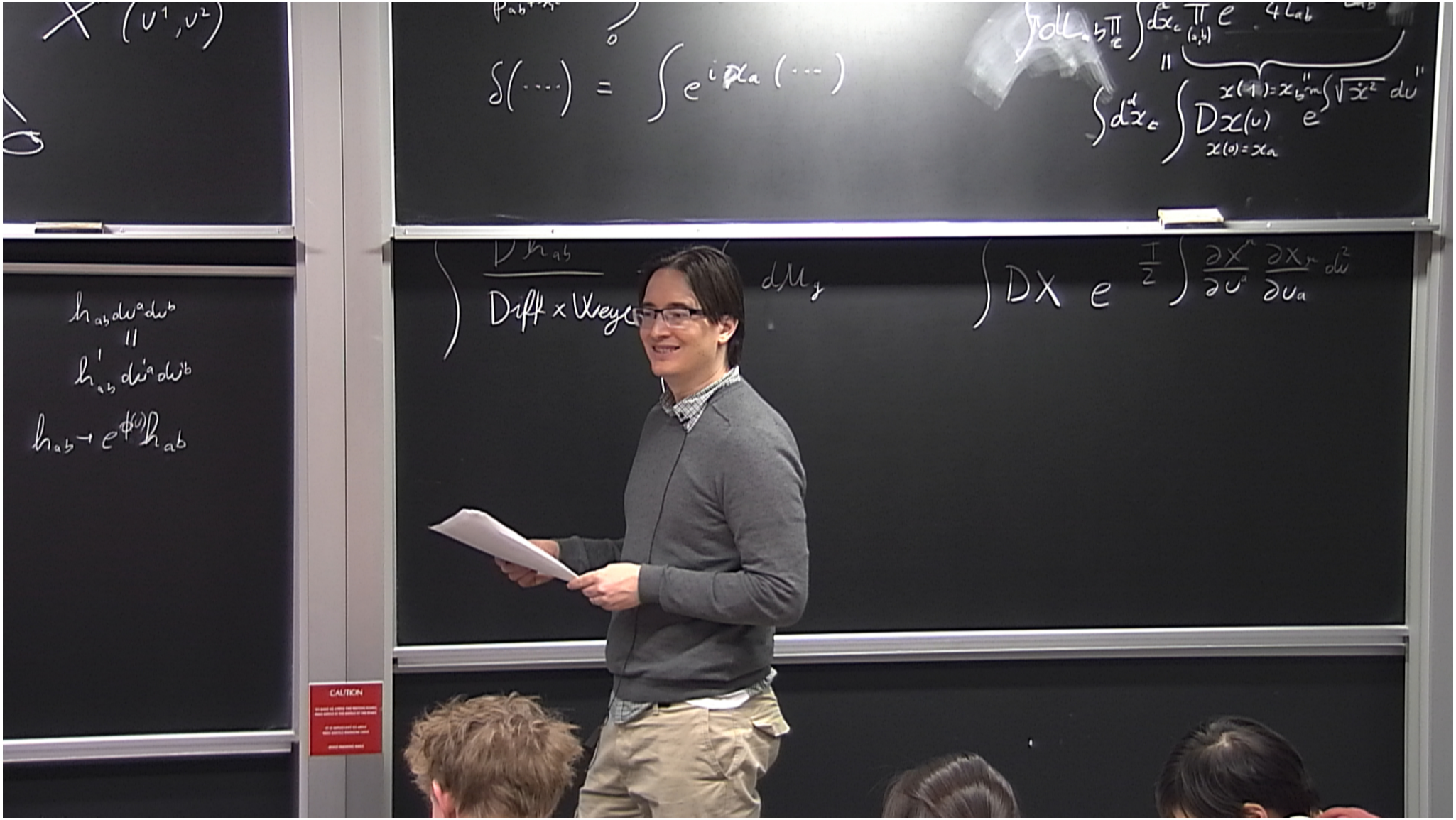
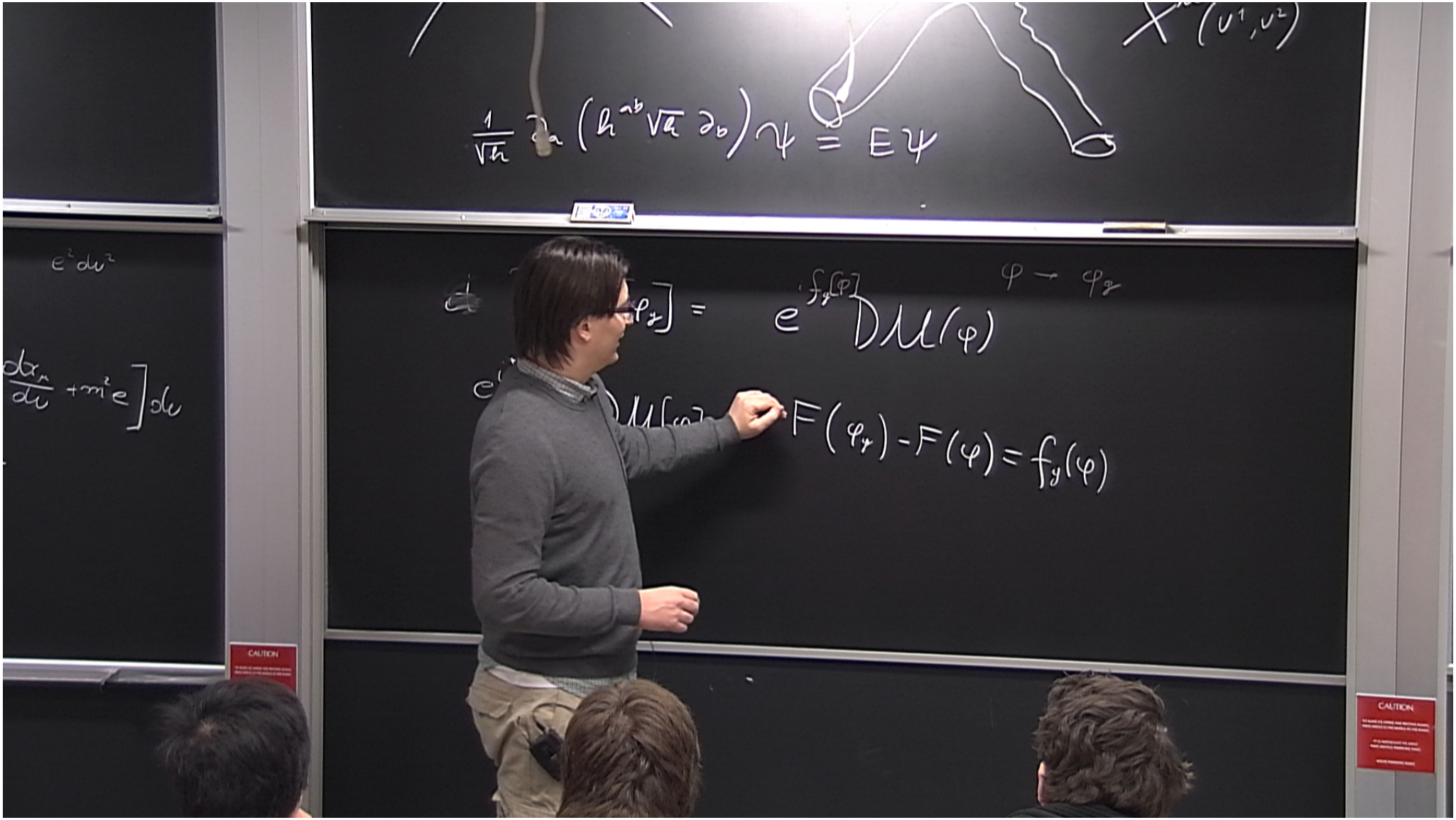
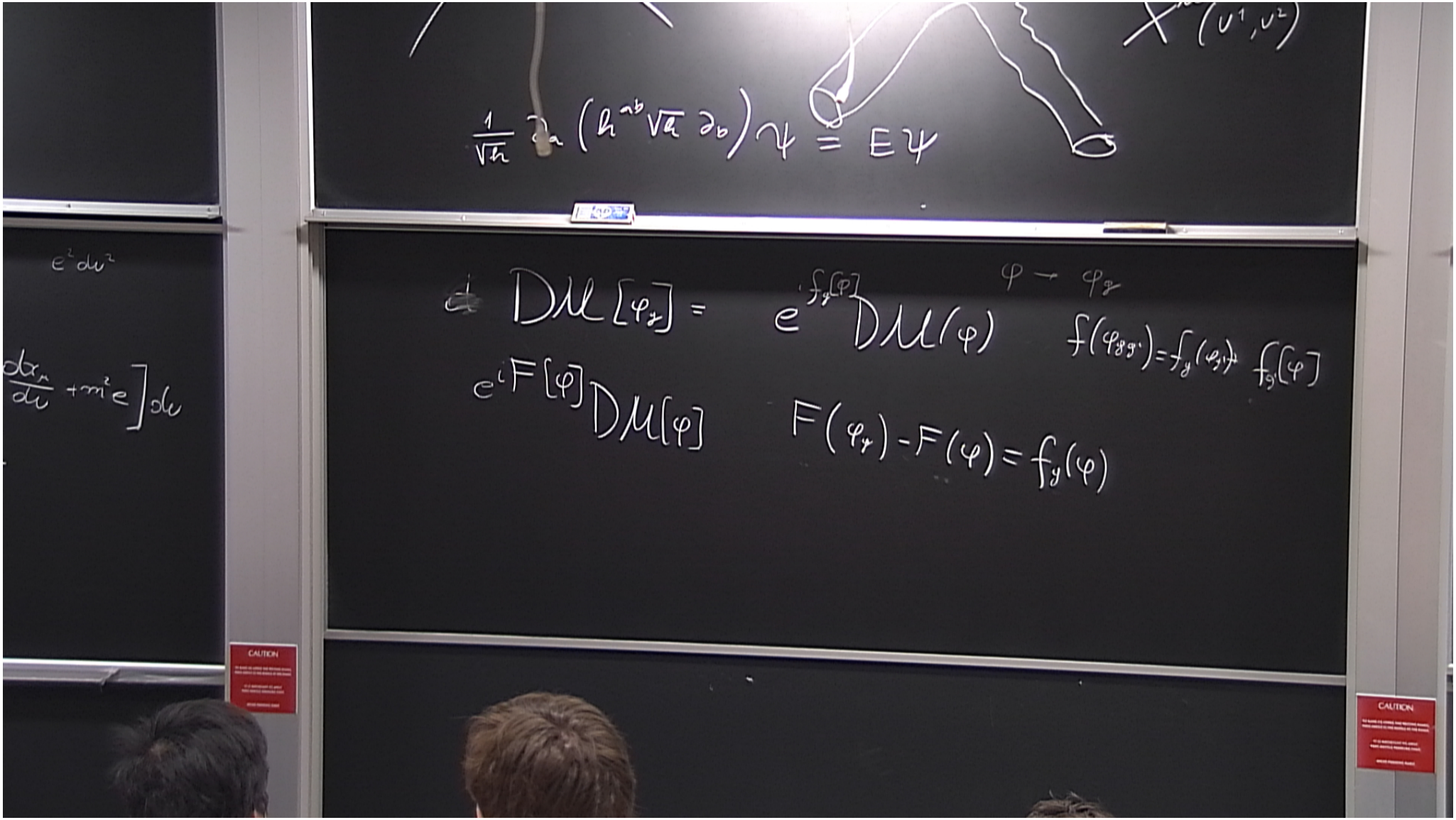
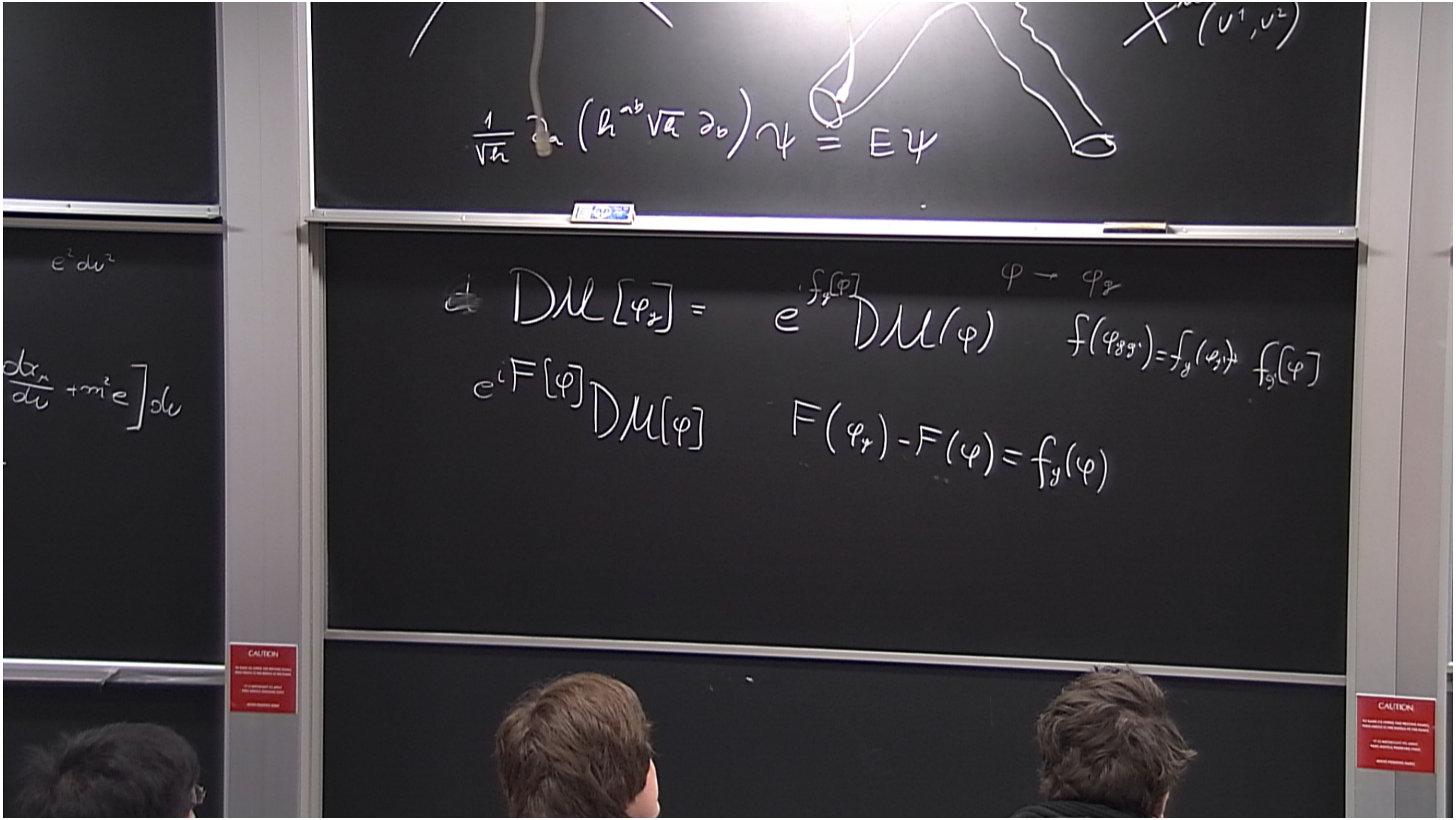

$\frac{1}{\sqrt{h}}\partial_a\left(h^{ab}\sqrt{h}\,\partial_b\right)\psi = E\psi$
$X^{\mu}(u^1,u^2)$
$\int \frac{DX}{Diff_{vol}} e^{T\int\sqrt{\det\left[\frac{dX^\mu}{du^a}\frac{dX_\mu}{du^b}\right]}\,du^1 du^2}$
$h_{ab}du^a du^b$
$=$
$h'_{ab}du'^a du'^b$
$h_{ab}\to e^{\phi(u)}h_{ab}$
$\int \frac{DX\,Dh_{ab}}{Diff_{vol}\times Weyl} e^{S} \quad S=\frac{T}{2}\int\sqrt{h}\,h^{ab}\frac{dX^\mu}{du^a}\frac{dX_\mu}{du^b}du^1 du^2$
CAUTION
CAUTION


$h_{ab}\,du^a du^b$
$=$
$h'_{ab}\,du'^a du'^b$
$h_{ab} \to e^{\phi(x)} h_{ab}$
$\delta(\cdots) = \int e^{i p x_a} (\cdots)$
$\int \mathcal{D}X\, e^{\frac{1}{2}\int \frac{\partial x^\mu}{\partial u^a} \frac{\partial x_\mu}{\partial u_a} du}$
CAUTION


$\frac{1}{\sqrt{h}}\partial_a\left(h^{ab}\sqrt{h}\,\partial_b\right)\psi = E\psi$
$e^{2}du^{2}$
$\frac{dx_n}{du}+m^2e\Big]du$
$\varphi \to \varphi_g$
$e^{f_g[\varphi]}\mathcal{D}\mathcal{U}(\varphi)$
$F(\varphi_g)-F(\varphi)=f_g(\varphi)$
CAUTION
CAUTION


$\frac{1}{\sqrt{h}}\partial_a\left(h^{ab}\sqrt{h}\,\partial_b\right)\psi = E\psi$
$X^{\mu}(u^1,u^2)$
$e^2 du^2$
$\frac{dx_n}{du} + m^2 e\Big] du$
$\mathcal{D}\mathcal{U}[\varphi_g] = e^{i f_g[\varphi]}\mathcal{D}\mathcal{U}(\varphi)$
$\varphi \to \varphi_g$
$f(\varphi_{gg'}) = f_g(\varphi_{g'}) + f_{g'}[\varphi]$
$e^{iF[\varphi]}\mathcal{D}\mathcal{U}[\varphi]$
$F(\varphi_g) - F(\varphi) = f_g(\varphi)$
CAUTION
CAUTION


$\frac{1}{\sqrt{h}}\partial_a\left(h^{ab}\sqrt{h}\,\partial_b\right)\psi = E\psi$
$X^{\mu}(u^1,u^2)$
$e^2 du^2$
$\frac{dx_n}{du} + m^2 e\Big] du$
$\mathcal{D}\mathcal{U}[\varphi_f] = e^{i f_f[\varphi]}\mathcal{D}\mathcal{U}(\varphi)$
$\varphi \to \varphi_f$
$f(\varphi_{fg}) = f_f(\varphi_g) + f_g[\varphi]$
$e^{iF[\varphi]}\mathcal{D}\mathcal{U}[\varphi]$
$F(\varphi_f) - F(\varphi) = f_f(\varphi)$
CAUTION
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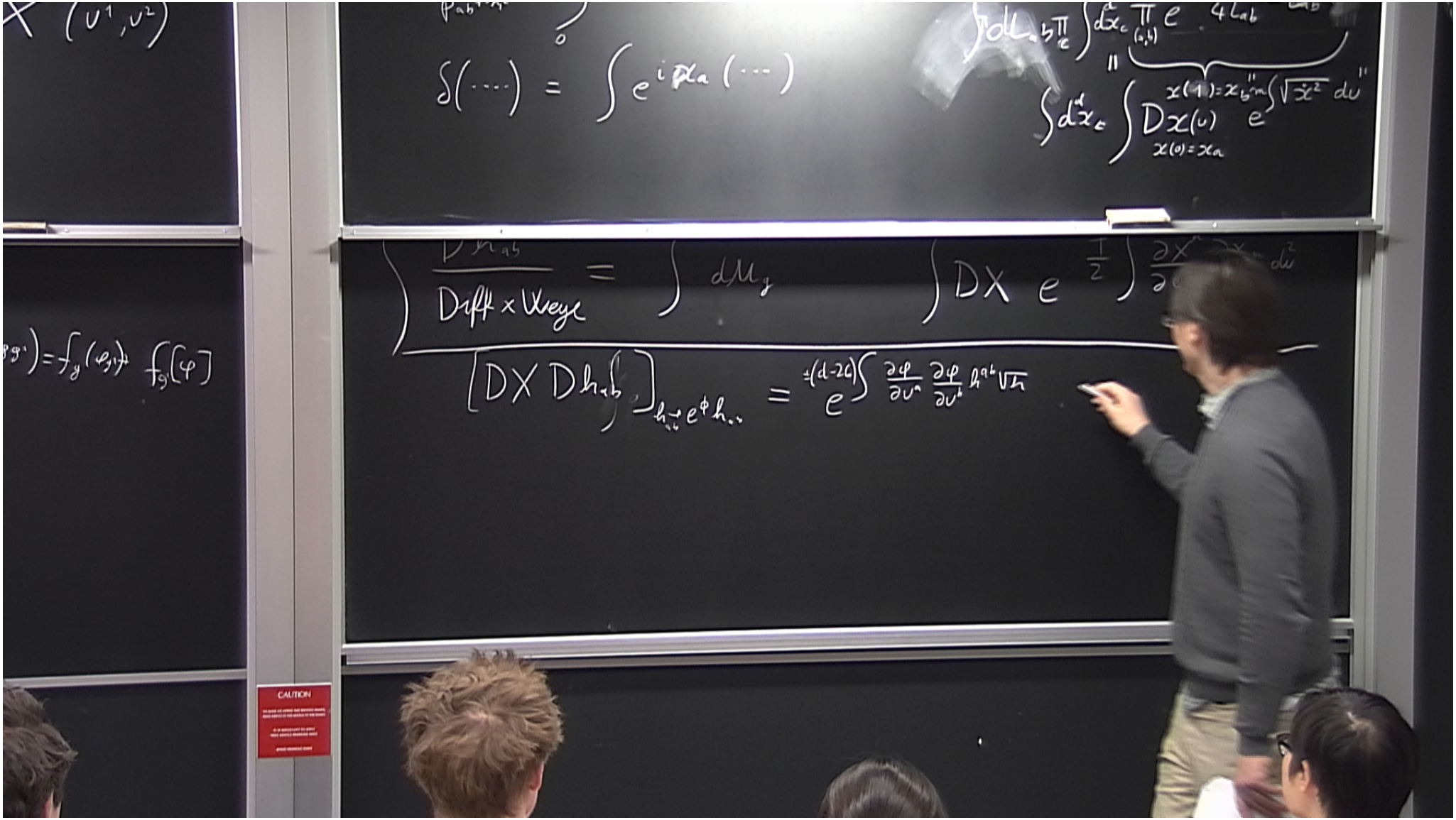
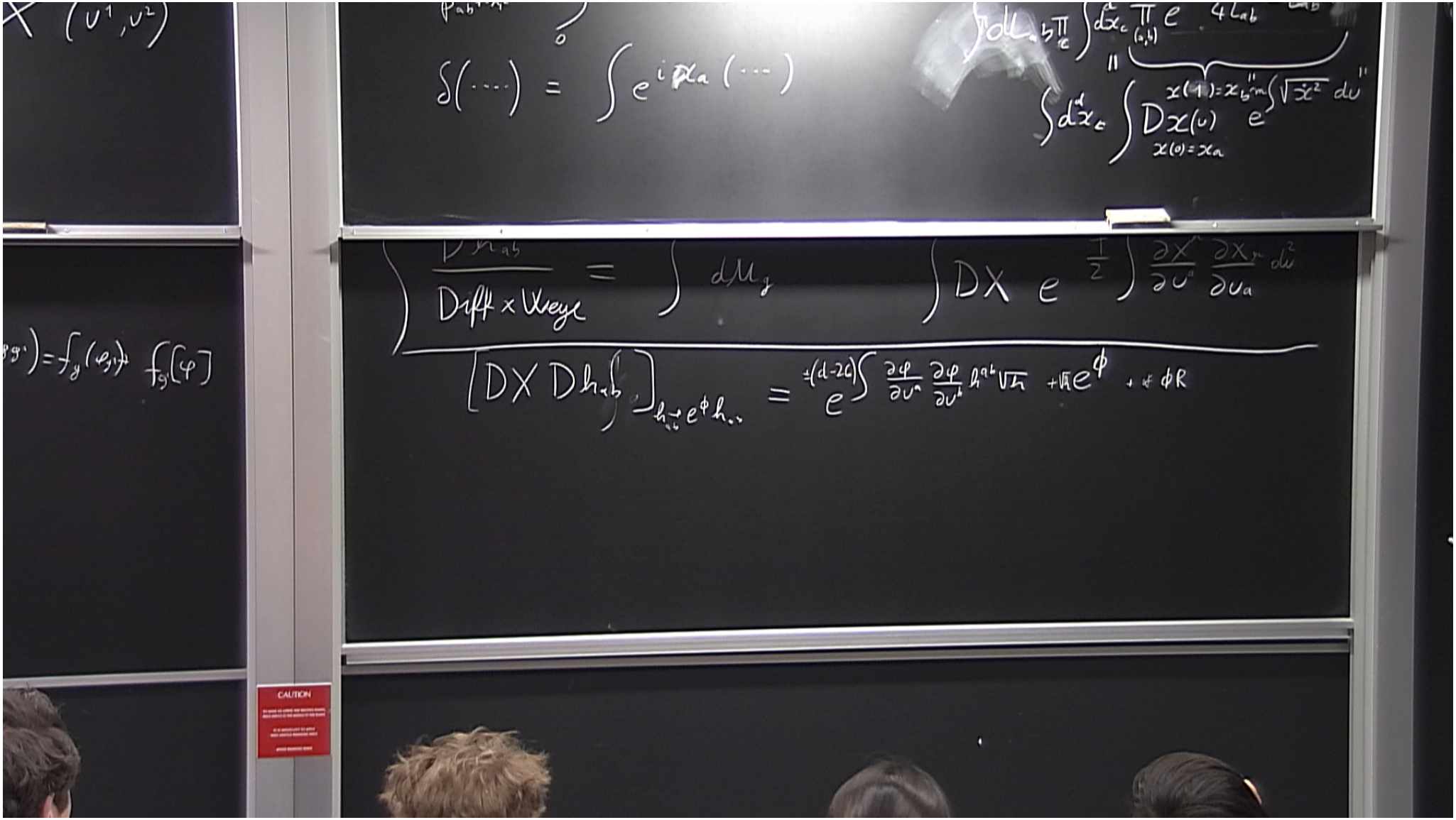
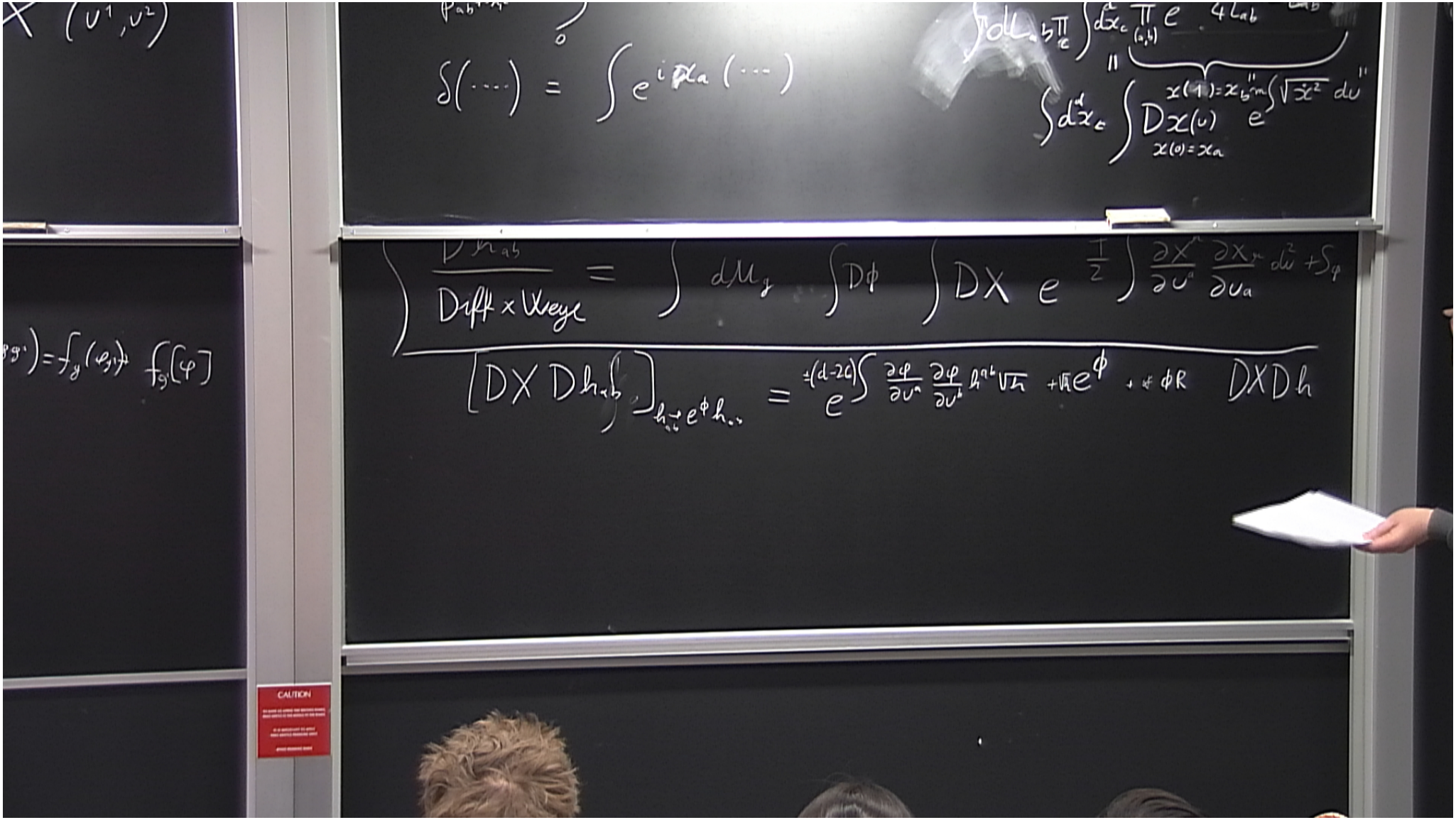

$\delta(\cdots) = \int e^{i p_a x^a} (\cdots)$
$\int dL_{ab} \prod_c \int dx_c \prod_{(a,b)} e^{-L_{ab}}$
$= \int d^d x_c \int_{x(0)=x_a}^{x(1)=x_b} Dx(\nu)\, e^{m \int \sqrt{\dot{x}^2}\, d\nu}$
$\frac{Dh_{ab}}{Diff \times Weyl} = \int dM_g \int DX\, e^{\frac{1}{2}} \int \frac{\partial X}{\partial}$
$[DX\, Dh_{ab}]_{h_{ab}=e^{\phi}\hat{h}_{ab}} = e^{\pm(d-26)\int \frac{\partial\varphi}{\partial\nu}\frac{\partial\varphi}{\partial\nu} h^{ab}\sqrt{h}}$
CAUTION


$\delta(\cdots) = \int e^{i\alpha_a}(\cdots)$
$\int dL_{ab} \prod_c \int dx_c \prod_{(a,b)} e^{\cdots} = \int d^d x_c \int_{x(0)=x_a}^{x(1)=x_b} Dx(u)\, e^{m\int\sqrt{\dot{x}^2}\,du}$
$\frac{Dh_{ab}}{\text{Diff} \times \text{Weyl}} = \int dU_g \int DX\, e^{\frac{1}{2}\int \frac{\partial X^\mu}{\partial u^a}\frac{\partial X_\mu}{\partial u^b}\,du^2}$
$[DX\,Dh_{ab}]_{h_{ab}=e^\phi \hat{h}_{ab}} = e^{\pm(d-26)\int \frac{\partial\varphi}{\partial u^a}\frac{\partial\varphi}{\partial u^b}h^{ab}\sqrt{h}\,+\sqrt{h}e^\phi + \int\phi R}$
CAUTION


$\delta(\cdots) = \int e^{i\alpha_a}(\cdots)$
$\int dL_{ab} \prod_c \int dx_c \prod_{(a,b)} e^{-\frac{1}{4}L_{ab}}$
$= \int d^d x_c \int_{x(0)=x_a}^{x(1)=x_b} Dx(\nu)\, e^{m\int\sqrt{\dot{x}^2}\,d\nu}$
$\frac{Dh_{ab}}{Diff \times Weyl} = \int dM_g \int D\phi \int DX\, e^{\frac{1}{2}\int \frac{\partial X^\mu}{\partial \nu^a}\frac{\partial X_\mu}{\partial \nu_a} d\nu^2 + S_\phi}$
$[DX\, Dh_{ab}]_{h_{ab}=e^{\phi}h_{ab}} = e^{\pm(d-26)\int \frac{\partial\varphi}{\partial\nu^a}\frac{\partial\varphi}{\partial\nu^b}h^{ab}\sqrt{h} + \sqrt{h}e^{\phi}\,\phi R}\, DXDh$
CAUTION