Title: String Theory Lecture

Speakers: Davide Gaiotto

Collection: String Theory 2023/24

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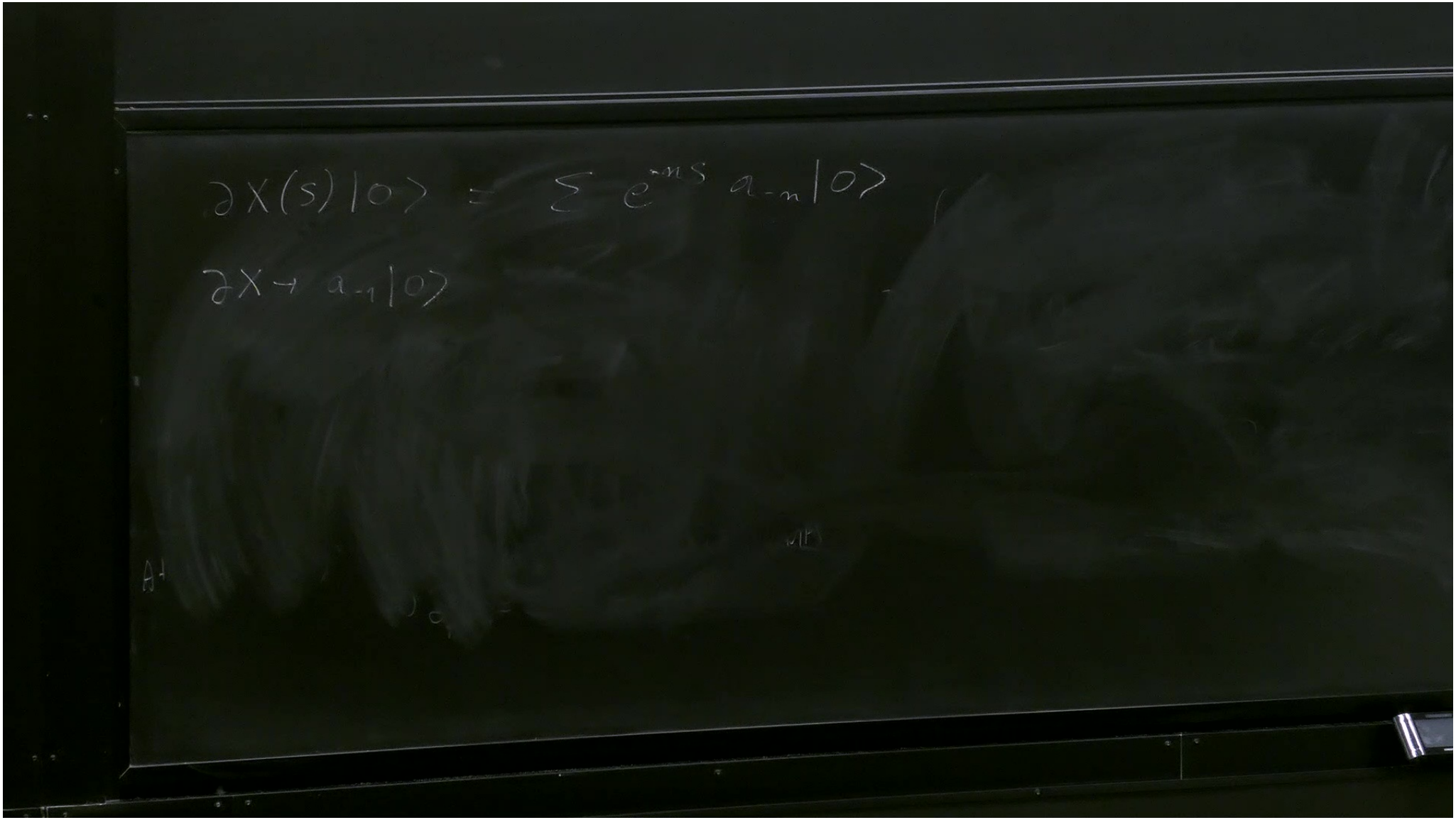
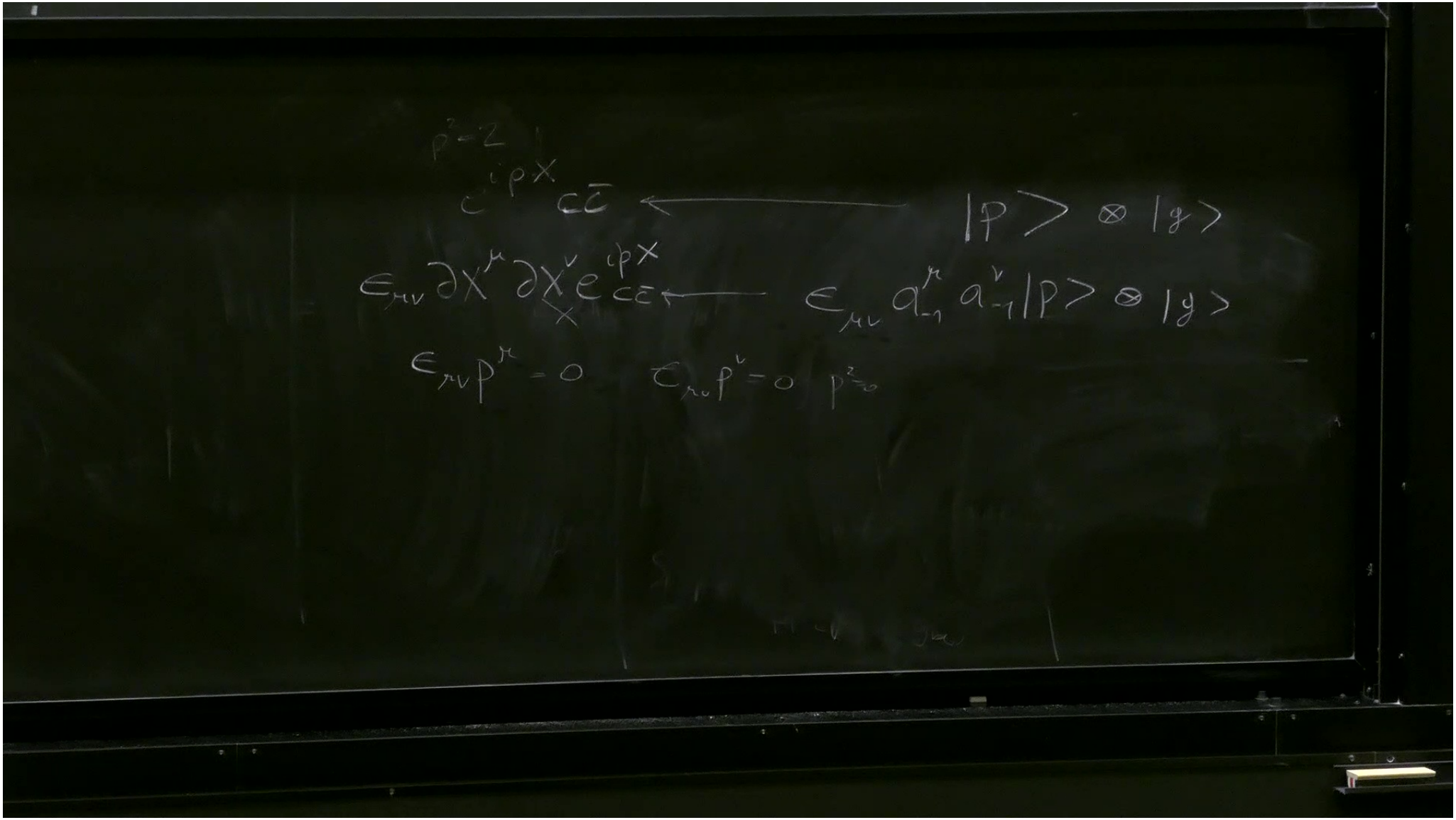
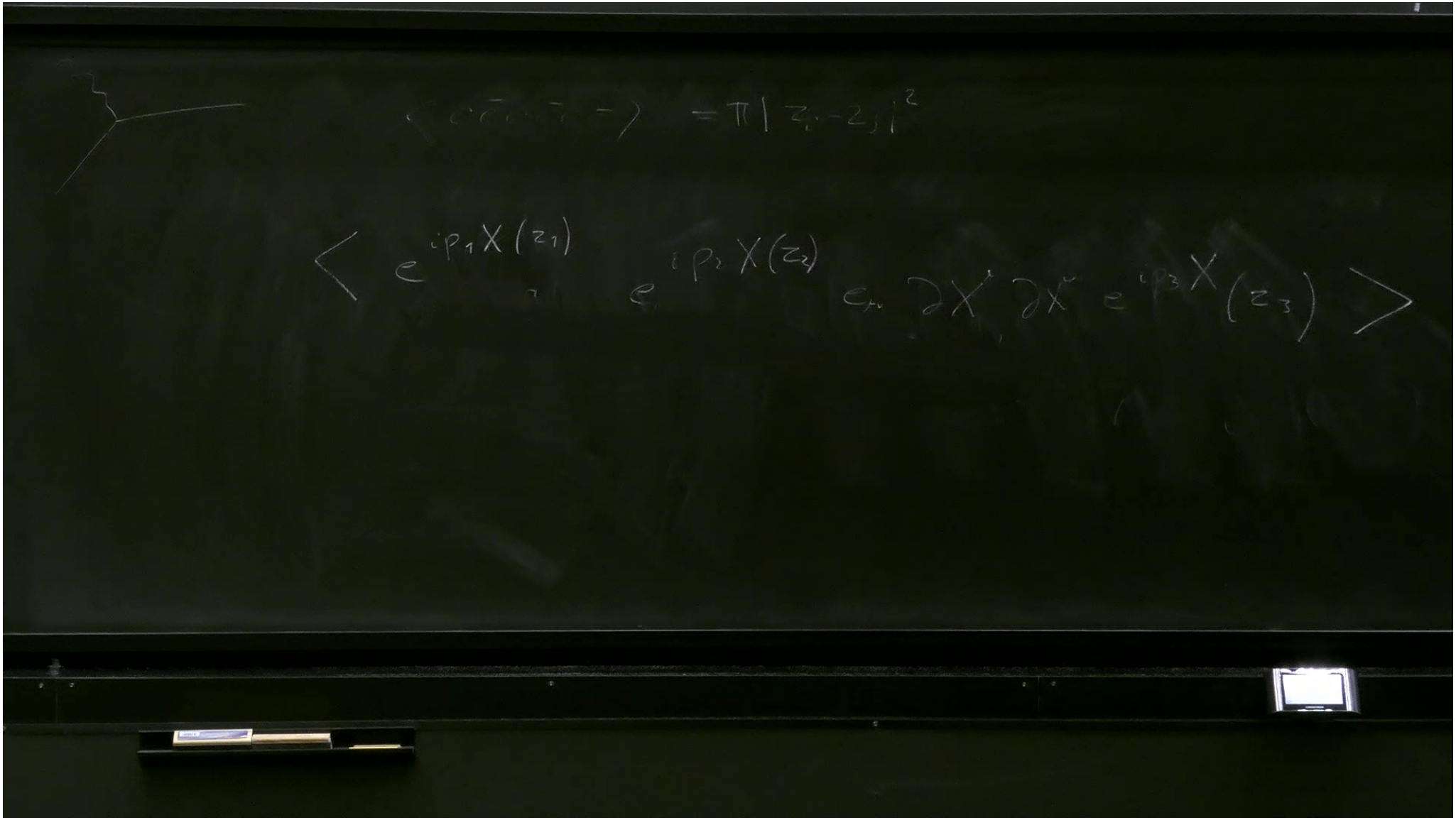
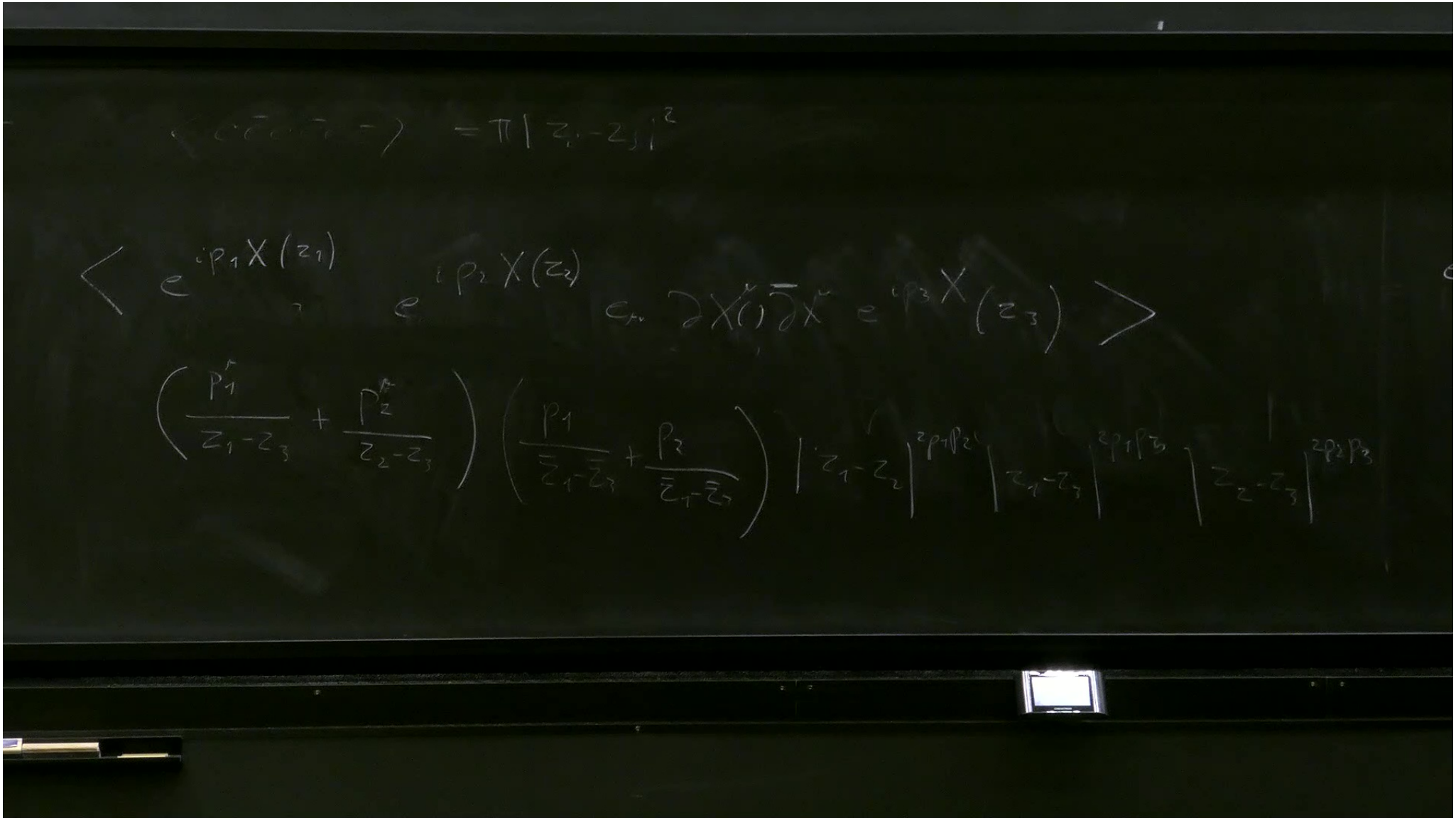
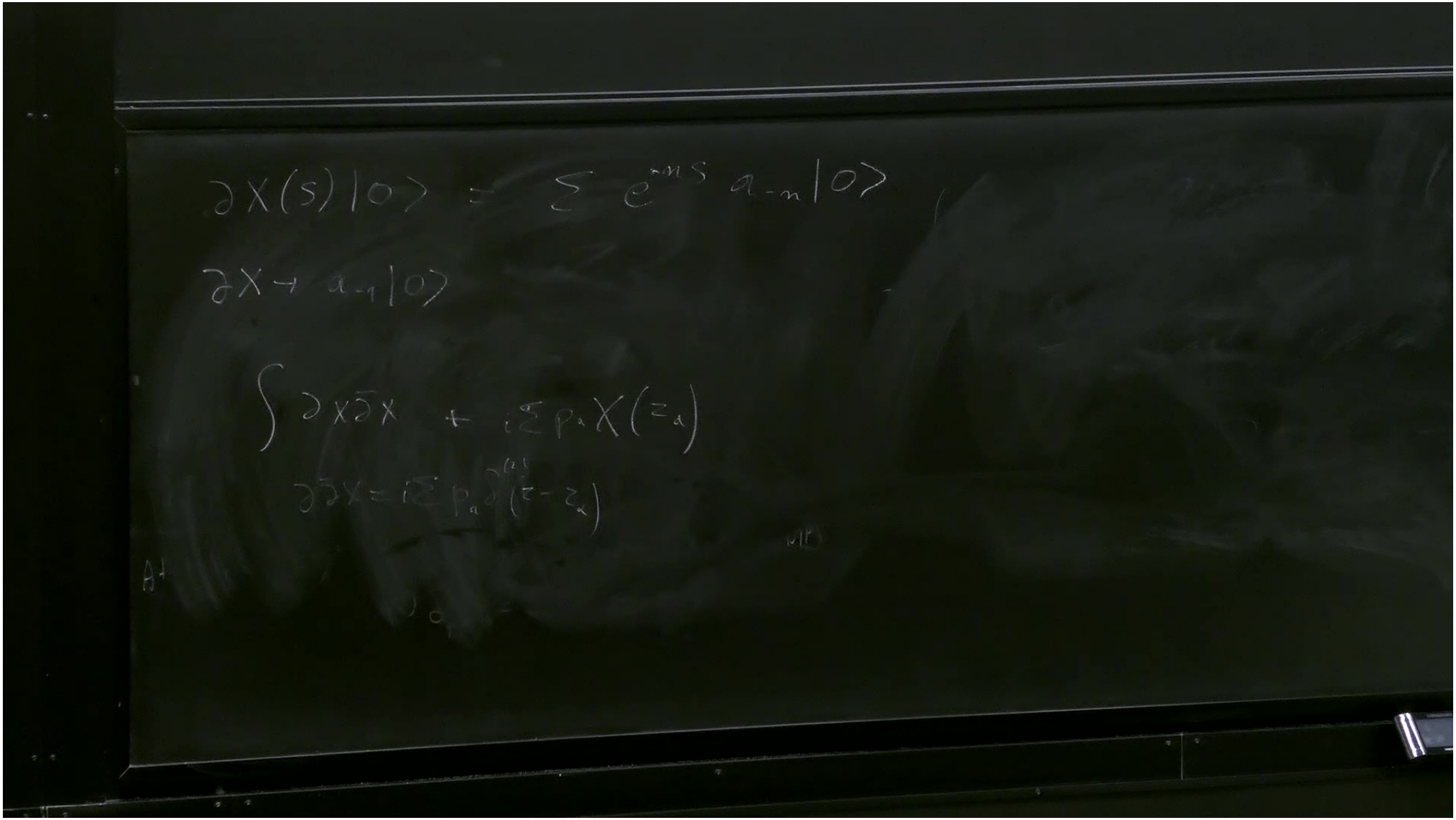
URL: https://pirsa.org/24040041

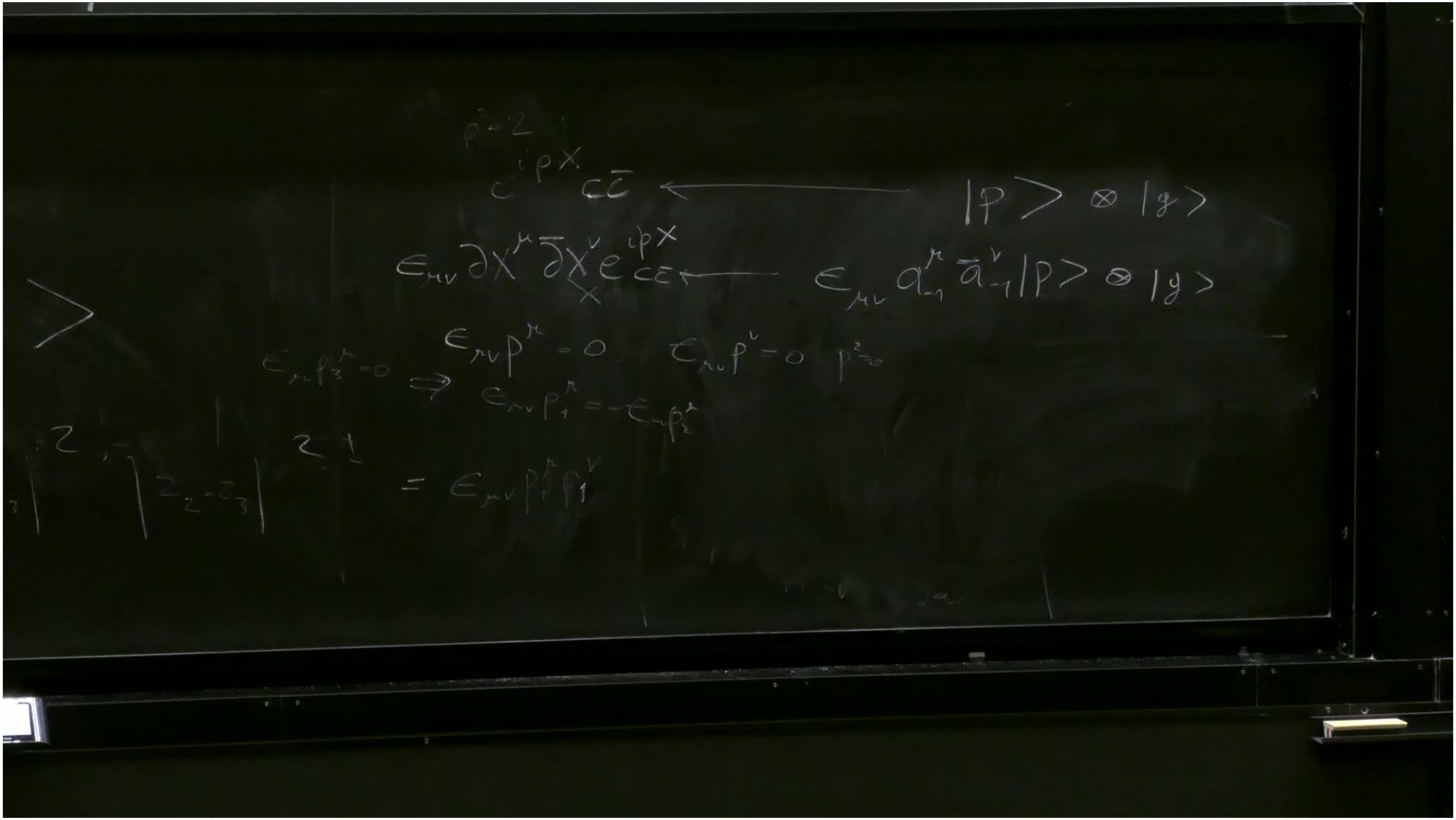

$\partial X(s)|0\rangle = \sum e^{-ns} a_{-n}|0\rangle$
$\partial X \to a_{-1}|0\rangle$

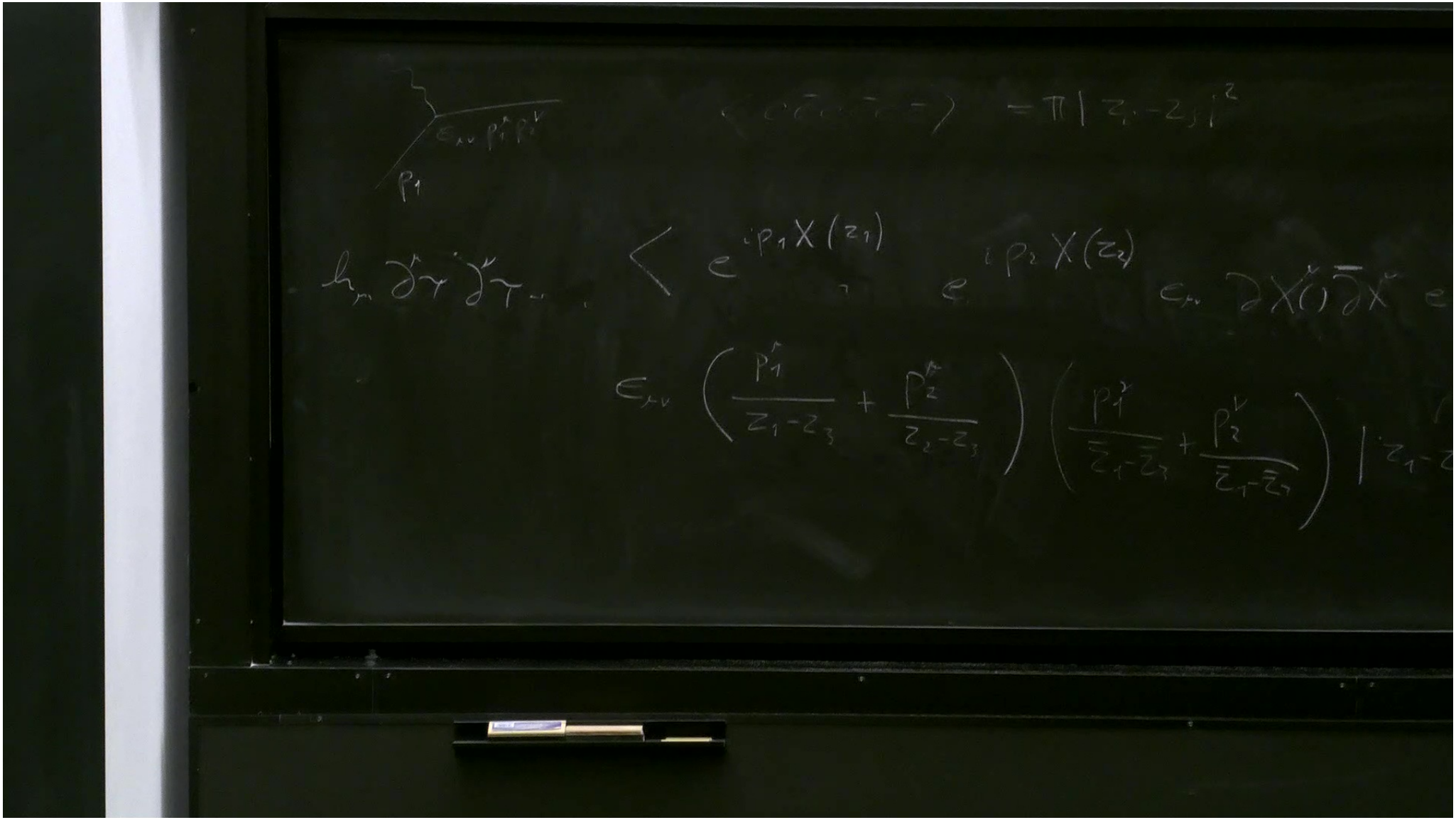

$p^2 = 2$
$c\,e^{ipx}\,c\bar{c}$
$|p\rangle \otimes |g\rangle$
$\epsilon_{\mu\nu}\,\partial X^\mu\,\partial X^\nu\,e^{ipx}\,c\bar{c}$
$\epsilon_{\mu\nu}\,a^\mu_{-1}\,a^\nu_{-1}|p\rangle \otimes |g\rangle$
$\epsilon_{\mu\nu}p^\mu = 0$
$\epsilon_{\mu\nu}p^\nu = 0$
$p^2 = 0$

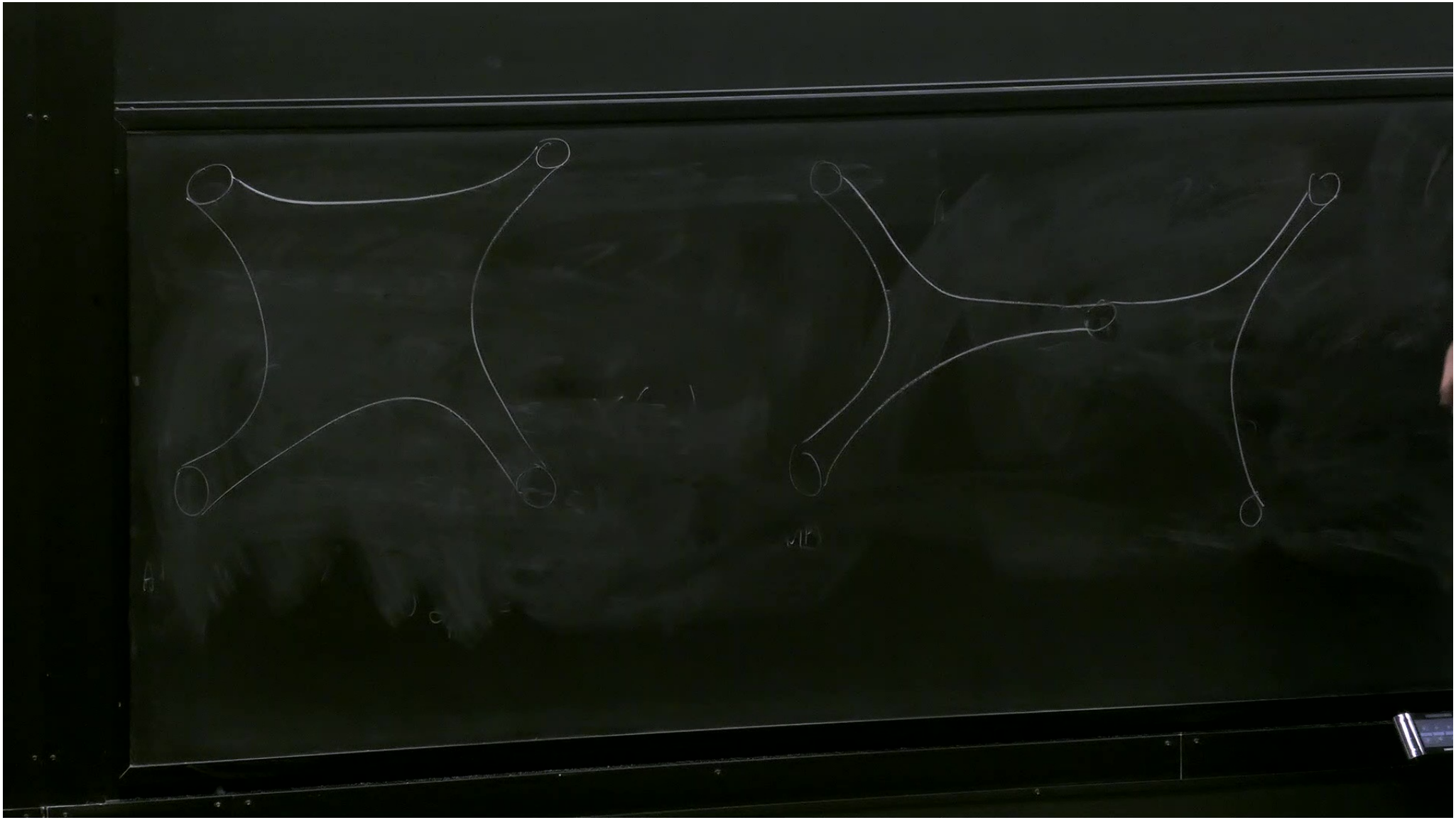

$\langle \quad = \pi |z_1 - z_2|^2$
$\langle e^{ip_1 X(z_1)} \quad e^{ip_2 X(z_2)} \quad \partial X, \partial X \; e^{ip_3 X(z_3)} \rangle$

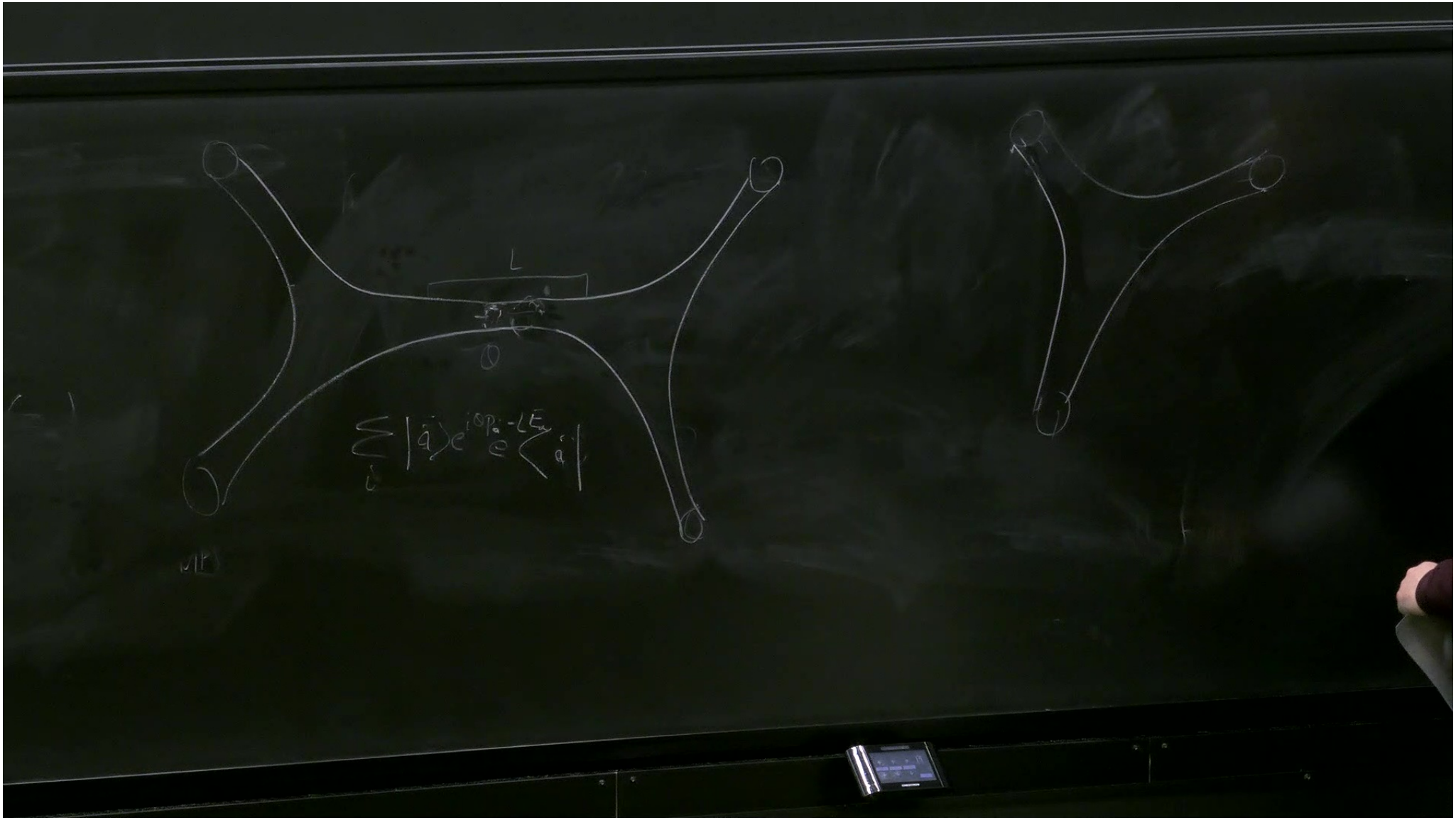

$\langle c\bar{c}\cdots\rangle = \pi |z_i - z_j|^2$
$\langle e^{ip_1 X(z_1)} e^{ip_2 X(z_2)} \partial X \bar{\partial} X e^{ip_3 X(z_3)} \rangle$
$\left(\frac{p_1}{z_1 - z_3} + \frac{p_2}{z_2 - z_3}\right)\left(\frac{p_1}{\bar{z}_1 - \bar{z}_3} + \frac{p_2}{\bar{z}_1 - \bar{z}_3}\right) |z_1 - z_2|^{2p_1 p_2} |z_1 - z_3|^{2p_1 p_3} |z_2 - z_3|^{2p_2 p_3}$

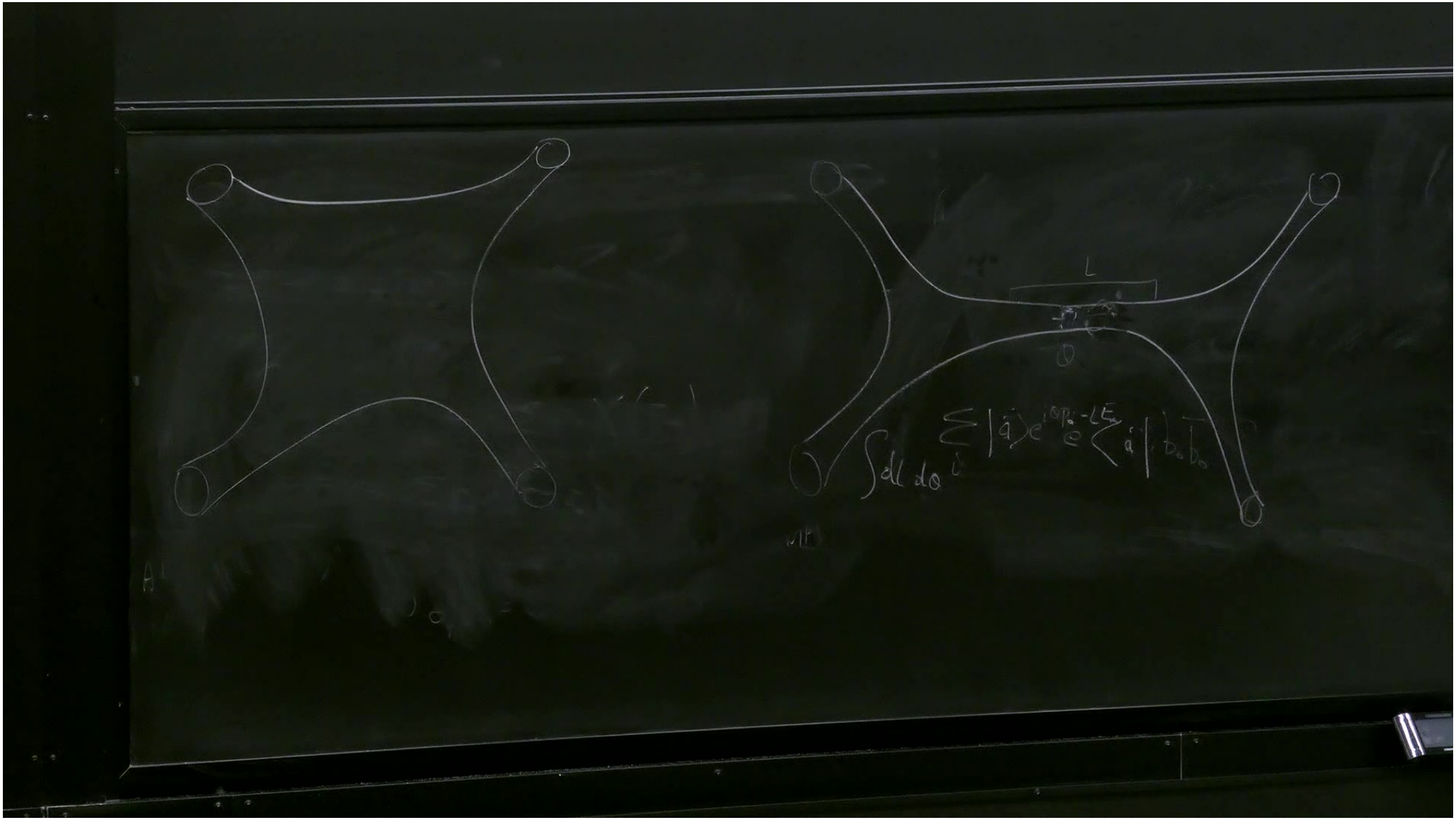

$\partial X(s)|0\rangle = \sum e^{-ns} a_{-n}|0\rangle$
$\partial X \to a_{-1}|0\rangle$
$\int \partial X \bar{\partial} X + i\sum p_\alpha X(z_\alpha)$
$\bar{\partial}\partial X = i\sum p_\alpha \partial^{(1)}(z - z_\alpha)$

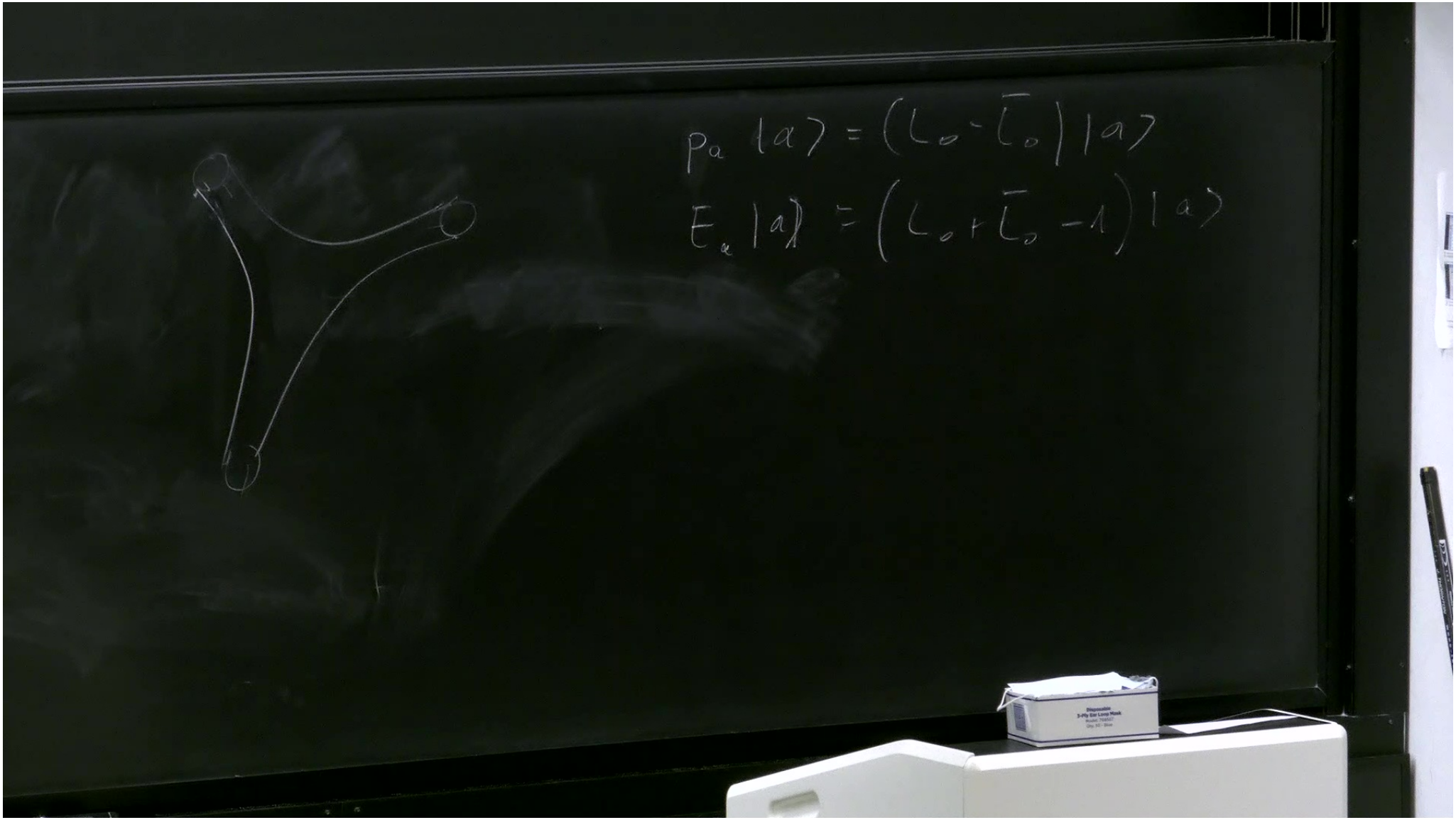

$p^2=2$
$c\,e^{ipx}\,c\bar{c}$
$|p\rangle \otimes |g\rangle$
$\epsilon_{\mu\nu}\partial X^\mu \bar{\partial} X^\nu e^{ipx}\, c\bar{c}$
$\epsilon_{\mu\nu}\, a_{-1}^\mu \bar{a}_{-1}^\nu |p\rangle \otimes |g\rangle$
$\epsilon_{\mu\nu} p^\mu = 0 \quad \epsilon_{\mu\nu} p^\nu = 0 \quad p^2 = 0$
$\epsilon_{\mu\nu} p_3^\mu = 0 \Rightarrow \epsilon_{\mu\nu} p_1^\mu = -\epsilon_{\mu\nu} p_2^\mu$
$= \epsilon_{\mu\nu} p_1^\mu p_1^\nu$

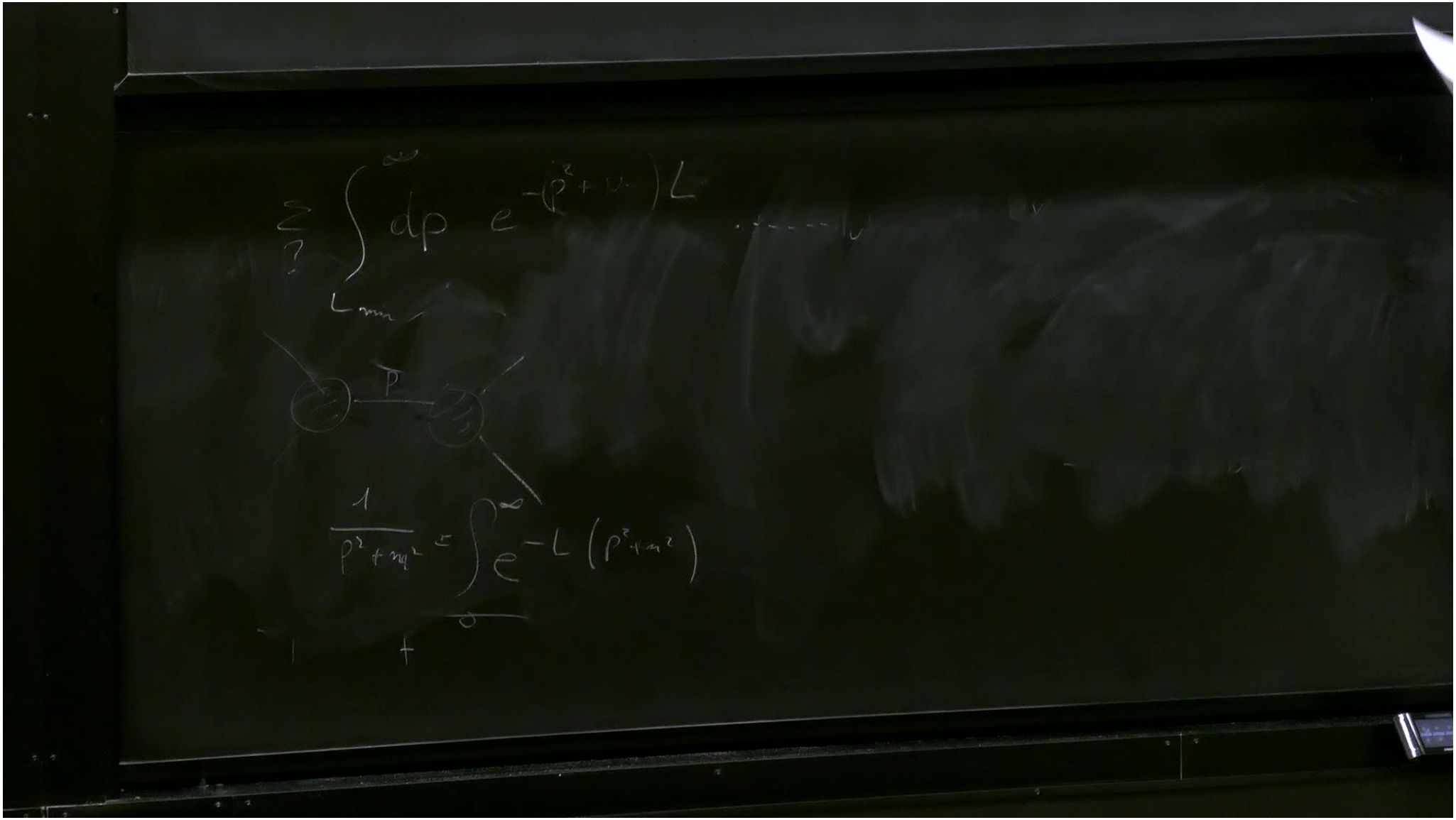

$\epsilon_{\mu\nu} p_1^\mu p_2^\nu$
p_1
$= \pi |z_i - z_j|^2$
$h_{\mu\nu} \partial X^\mu \bar{\partial} X^\nu \ldots \langle e^{ip_1 X(z_1)} \ldots e^{ip_2 X(z_2)} \epsilon_{\mu\nu} \partial X^\mu \bar{\partial} X^\nu$
$\epsilon_{\mu\nu} \left(\frac{p_1^\mu}{z_1 - z_3} + \frac{p_2^\mu}{z_2 - z_3} \right) \left(\frac{p_1^\nu}{\bar{z}_1 - \bar{z}_3} + \frac{p_2^\nu}{\bar{z}_1 - \bar{z}_3} \right)$

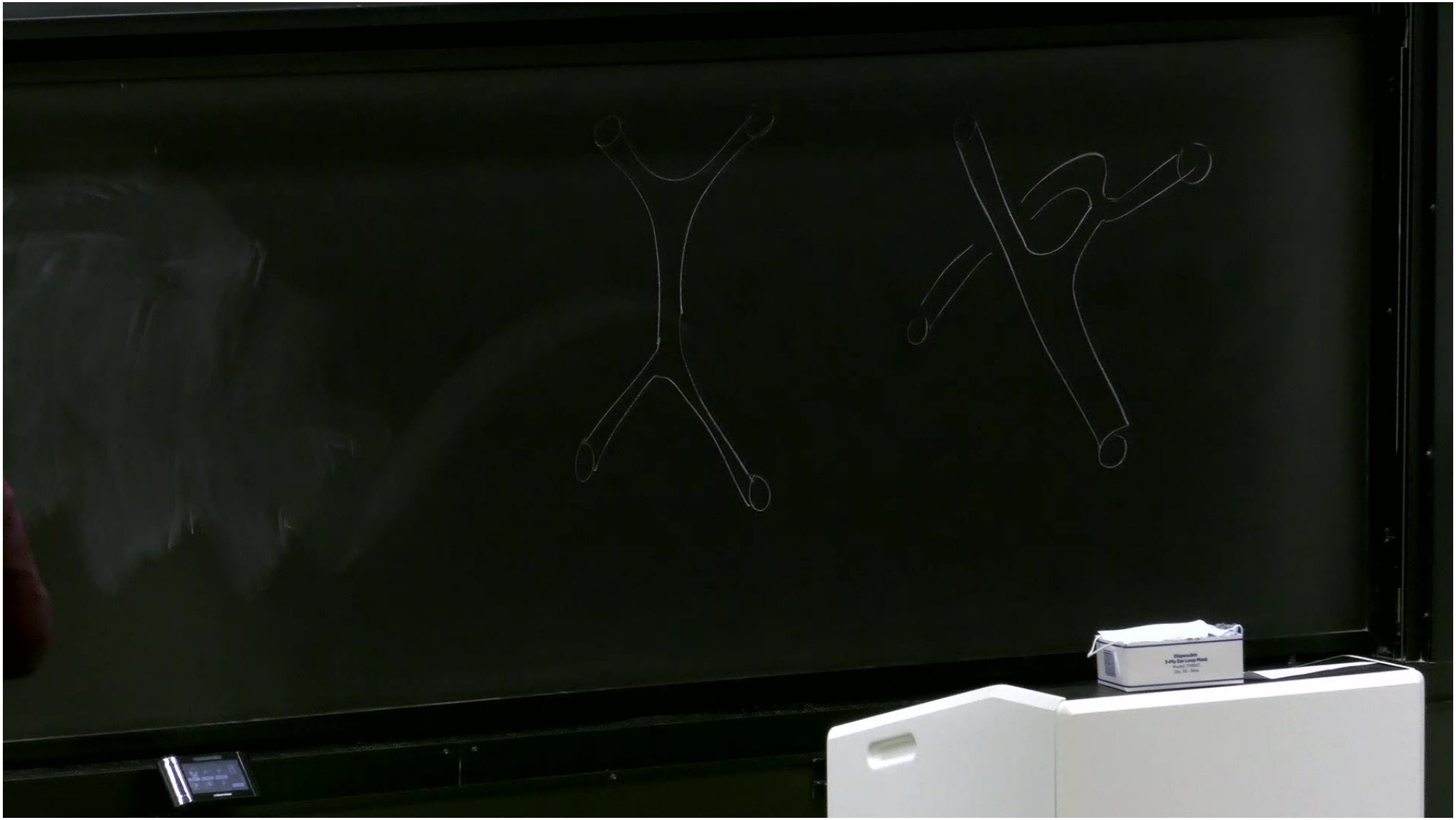


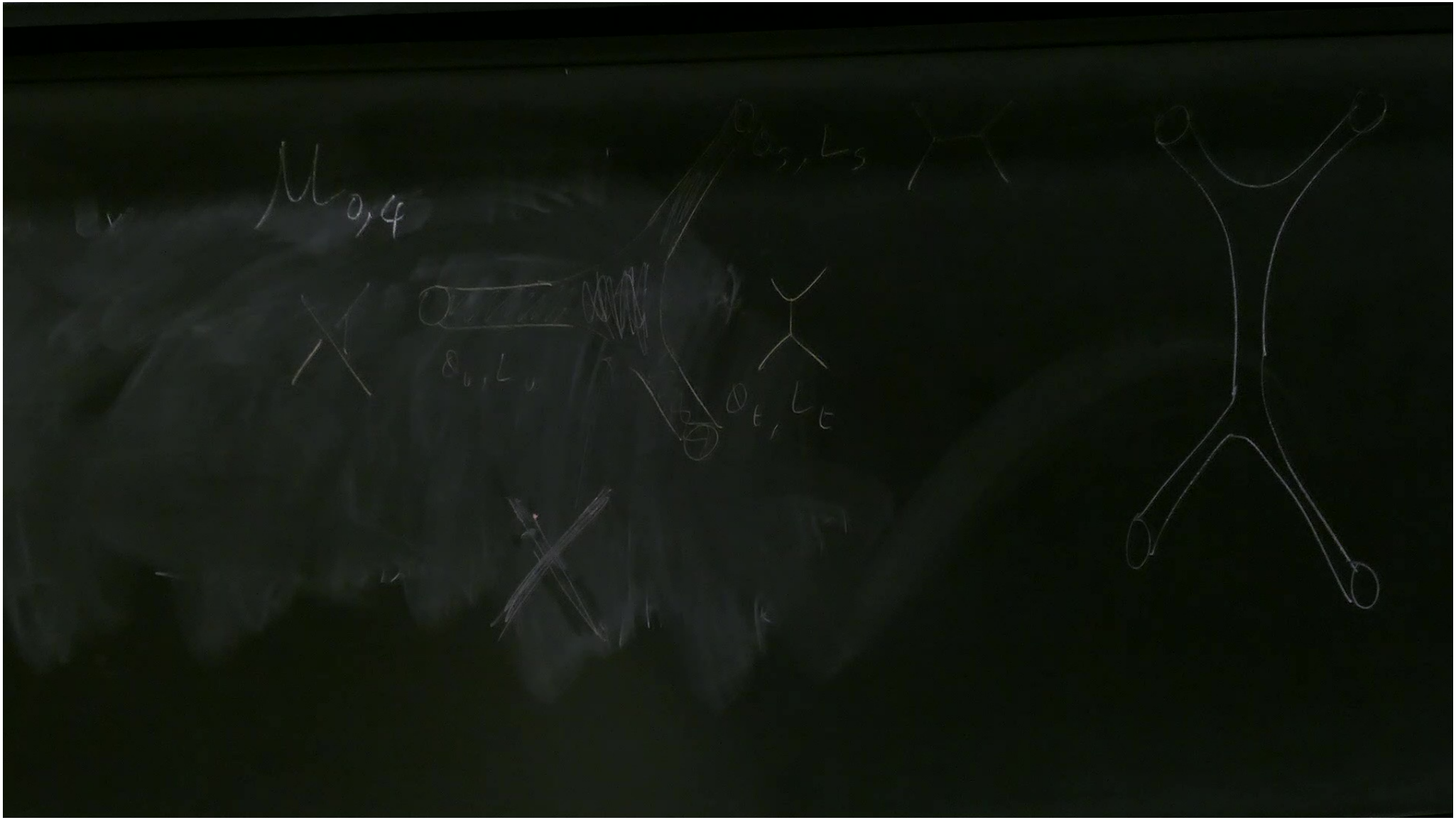

L
0

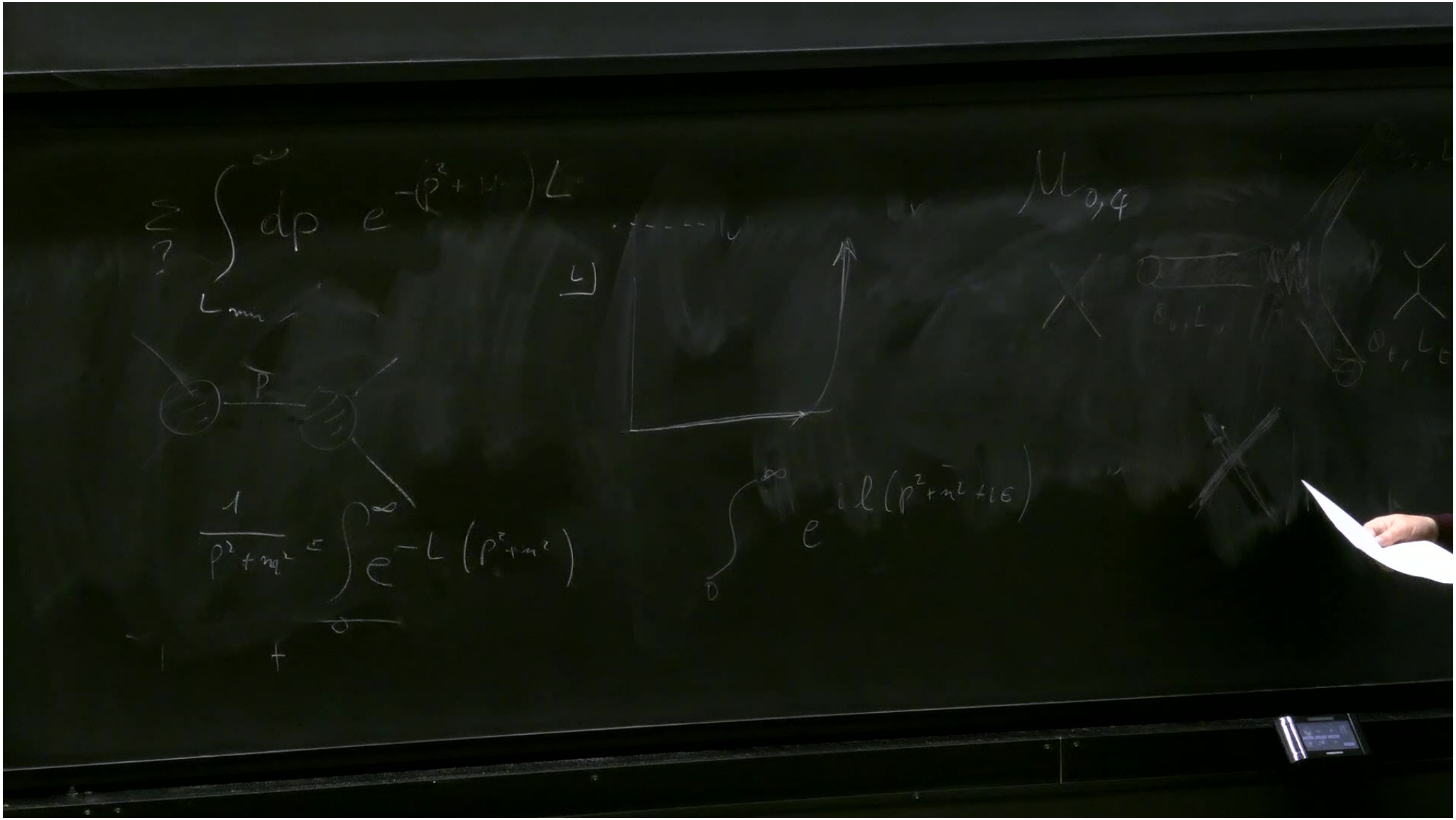

L

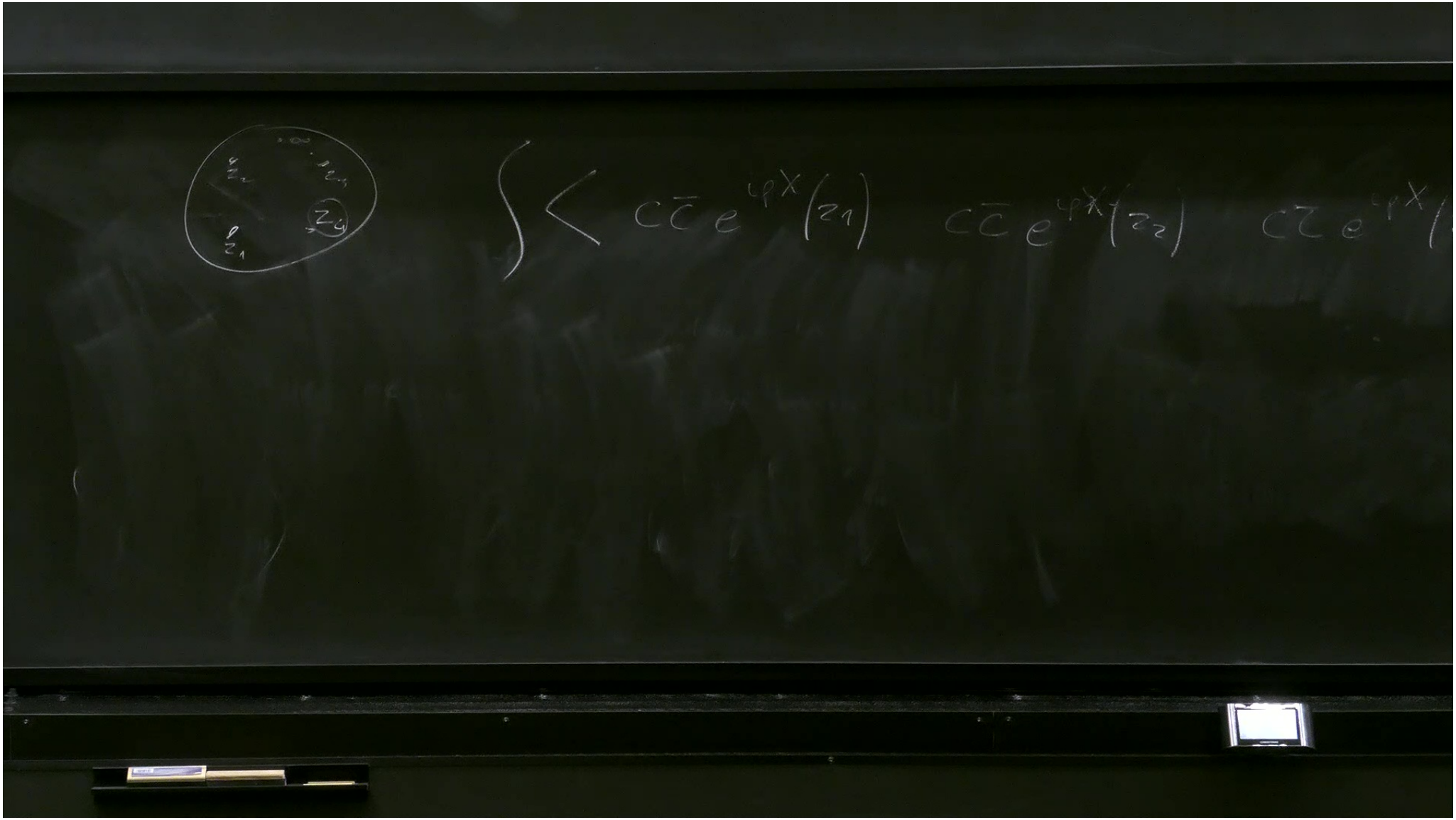

$P_a |a\rangle = (L_0 - \bar{L}_0) |a\rangle$
$E_a |a\rangle = (L_0 + \bar{L}_0 - 1) |a\rangle$

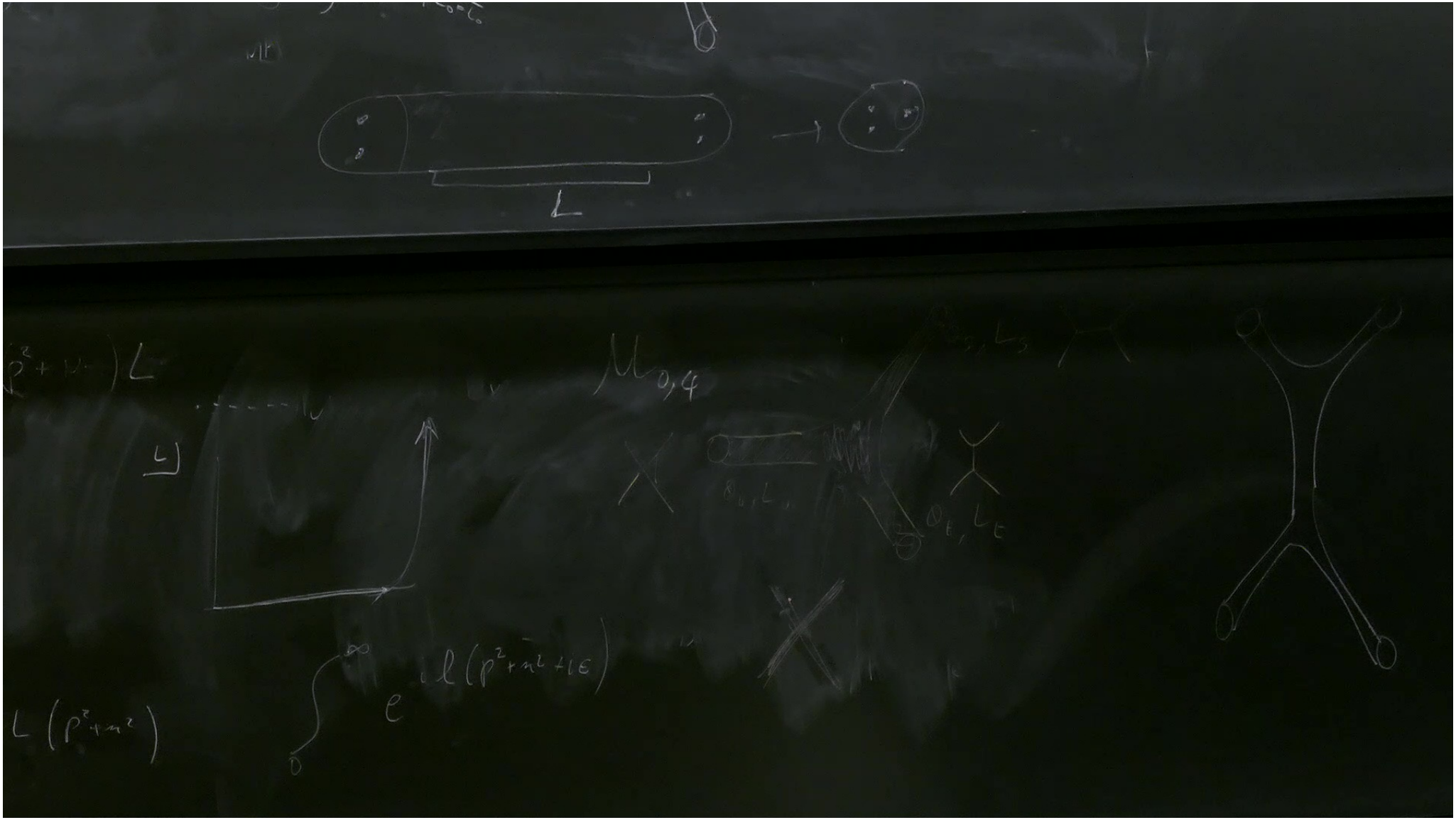

p
$\frac{1}{p^2+m^2} = \int_0^\infty e^{-L(p^2+m^2)}$

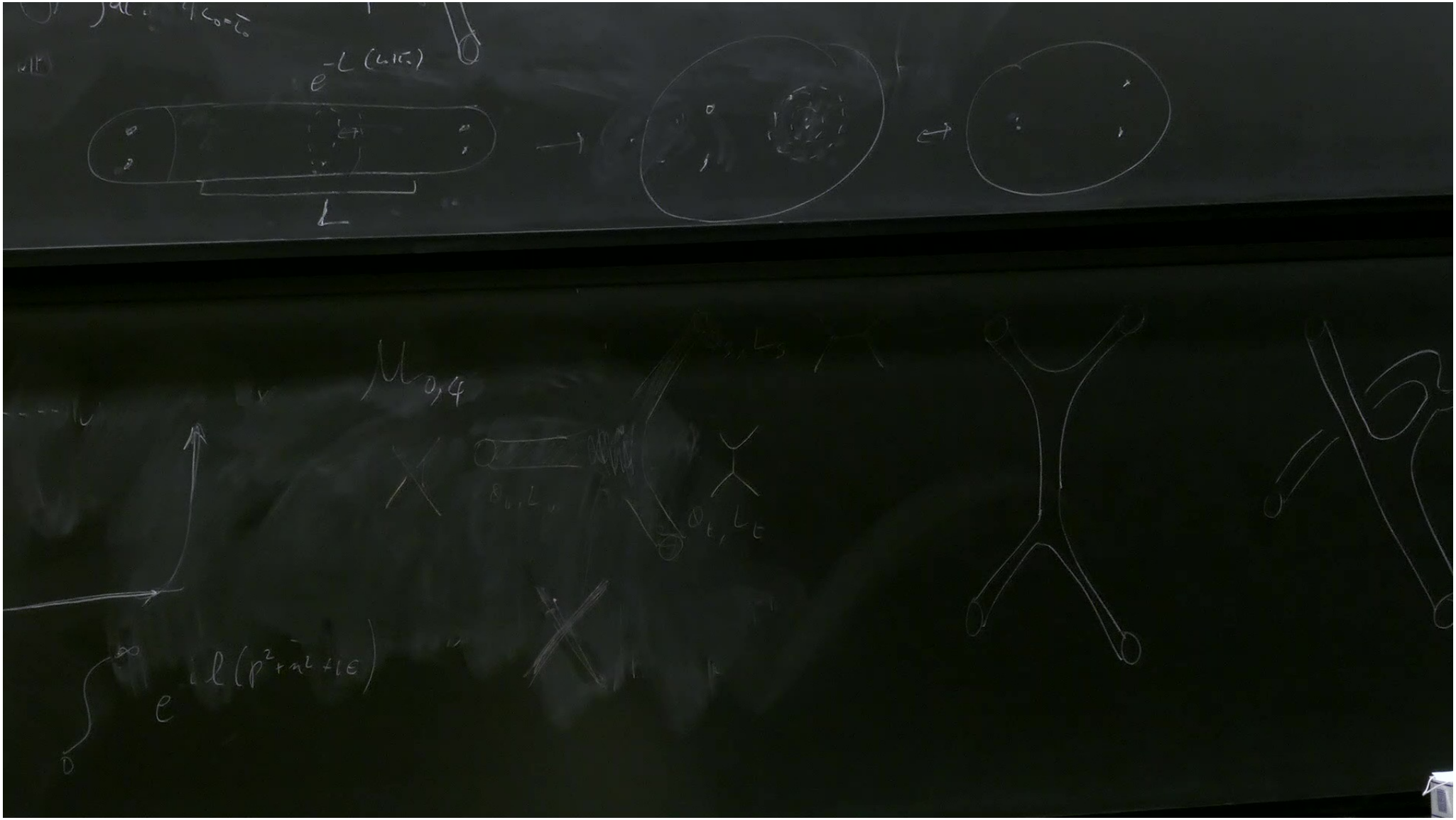



$\mu_{0,4}$
θ_s, L_s
θ_t, L_t
θ_t, L_t

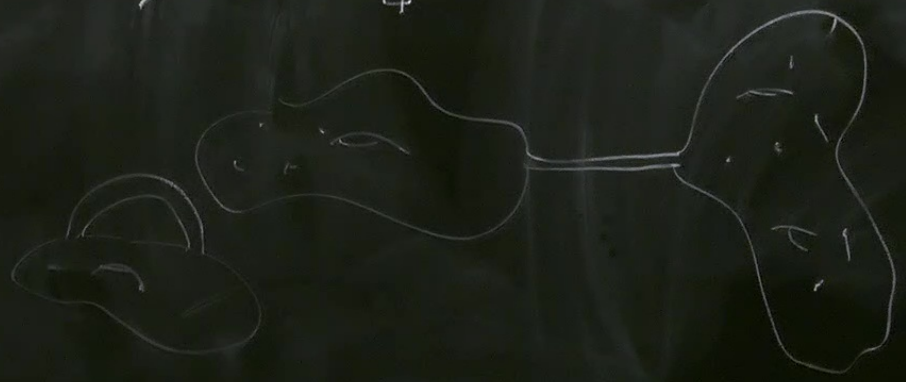

$\int_{L_{min}}^{\infty} dp\, e^{-(p^2+m^2)L}$
$\frac{1}{p^2+m^2} = \int_0^\infty e^{-L(p^2+m^2)}$
$\int_0^\infty e^{il(p^2+m^2+i\epsilon)}$
$M_{0,4}$
P

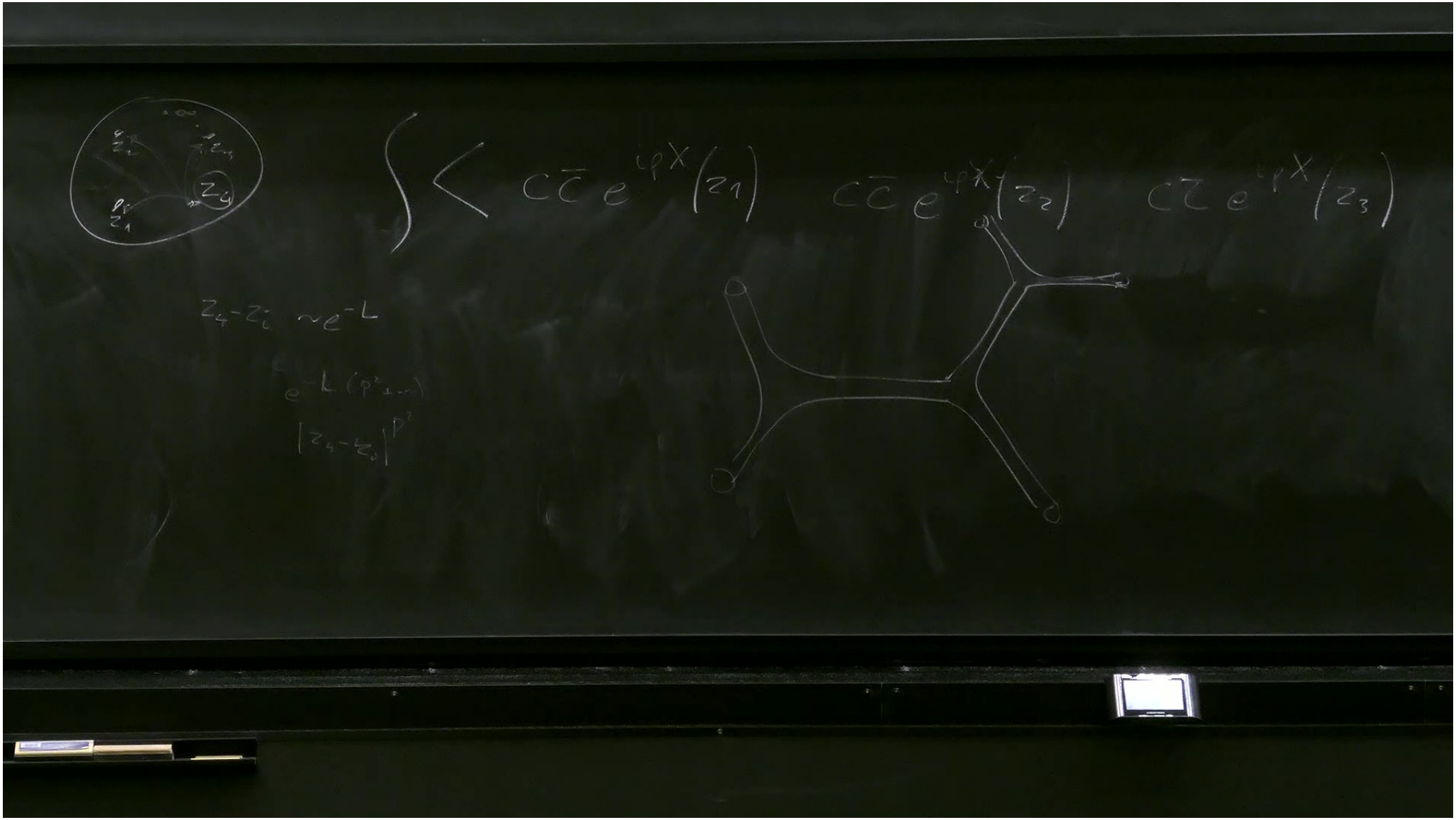

$\int < c\bar{c} e^{\varphi X}(z_1) \quad c\bar{c} e^{\varphi X}(z_2)$


L
$M_{0,4}$
$\int_0^\infty e^{-\ell(p^2+m^2+i\epsilon)}$
$L(p^2+m^2)$


$e^{-L(L+\epsilon)}$
L
$\mathcal{M}_{0,4}$
$\int_0^\infty e^{il(p^2+m^2+i\epsilon)}$

$e^{ipX}(z_2)$ $cc\, e^{ipX}(z_3)$ $e^{ipX(z_4)} > d^2 z_4$




z_4
z_1
$\int <$
$c\bar{c}e^{i\varphi X}(z_1)$
$c\bar{c}e^{i\varphi X}(z_2)$
$c\bar{c}e^{i\varphi X}(z_3)$
$z_4 - z_i \sim e^{-L}$
$e^{-L(p^2_\perp + \ldots)}$
$|z_4 - z_i|^{p^2}$