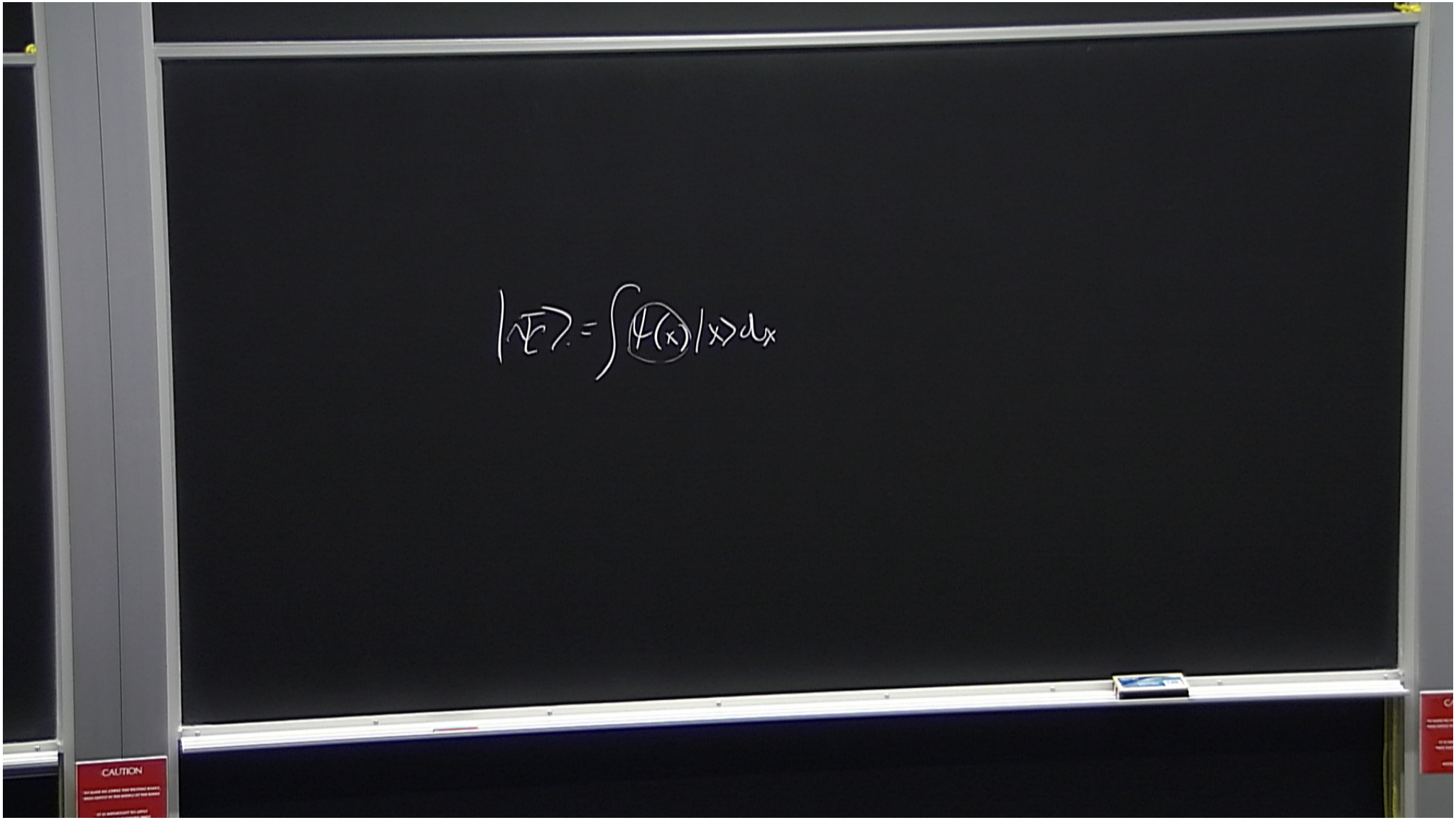
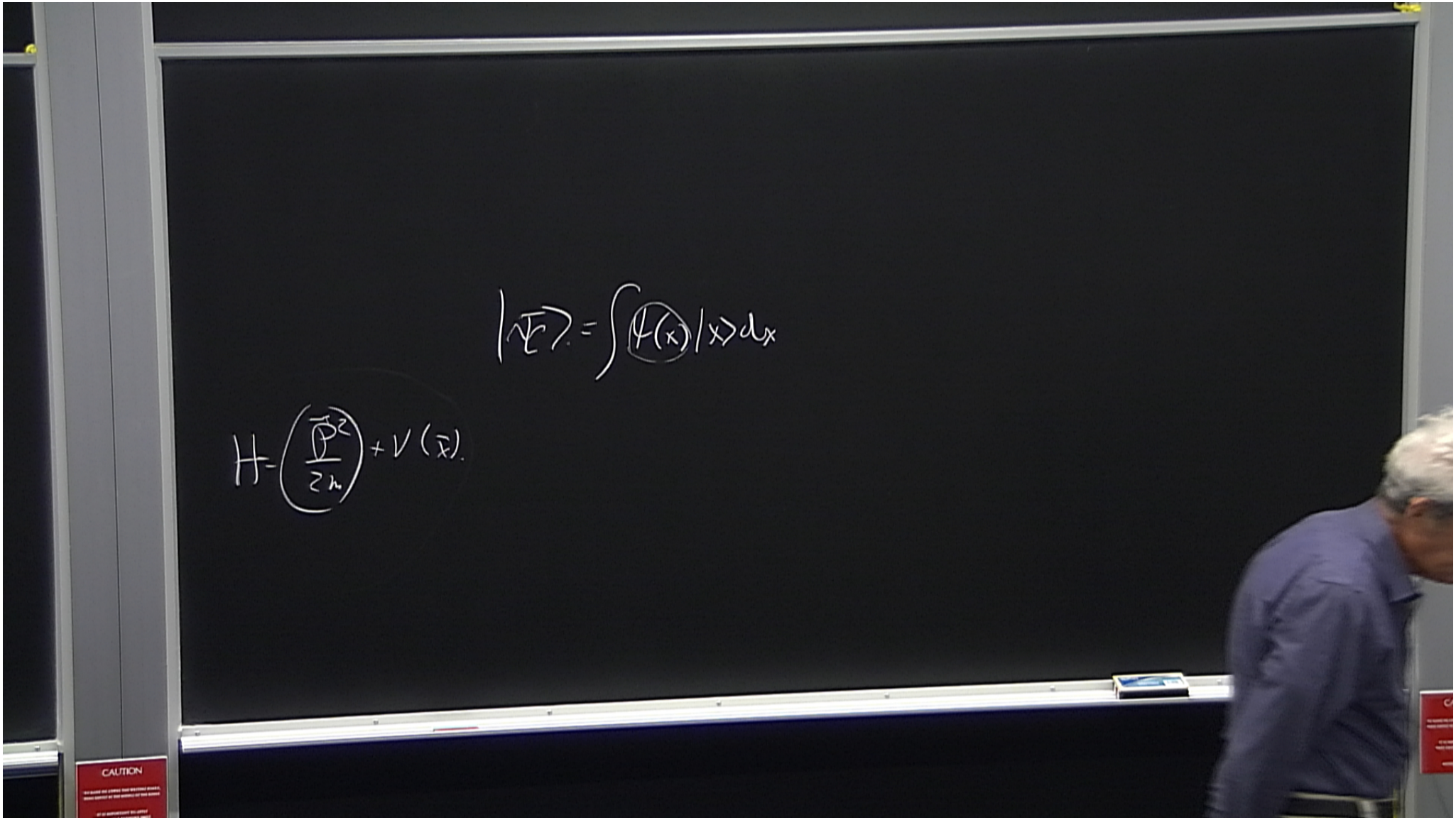
Title: Finally making sense of Quantum Mechanics, part 2

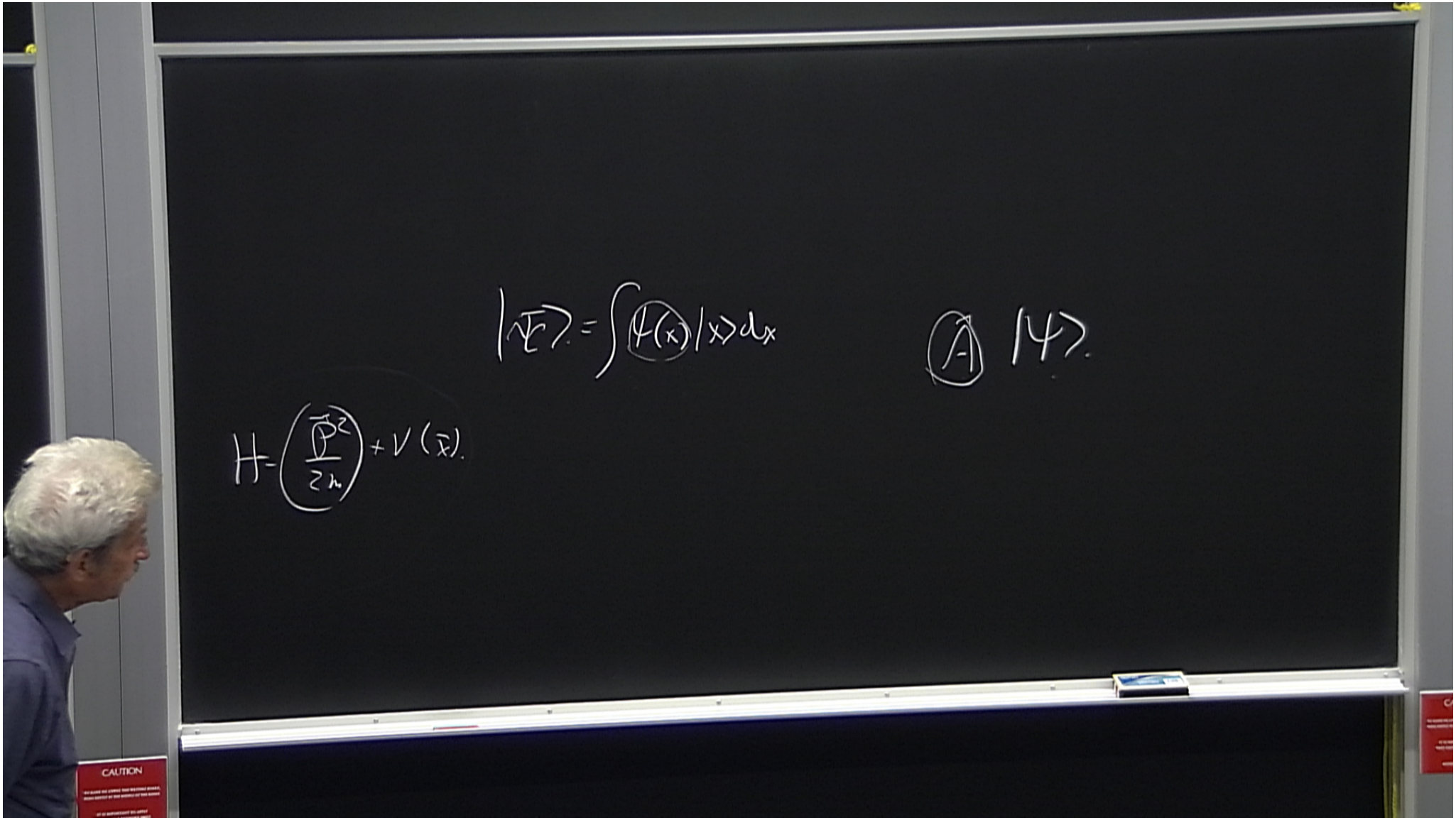
Date: Jun 21, 2016 09:00 AM

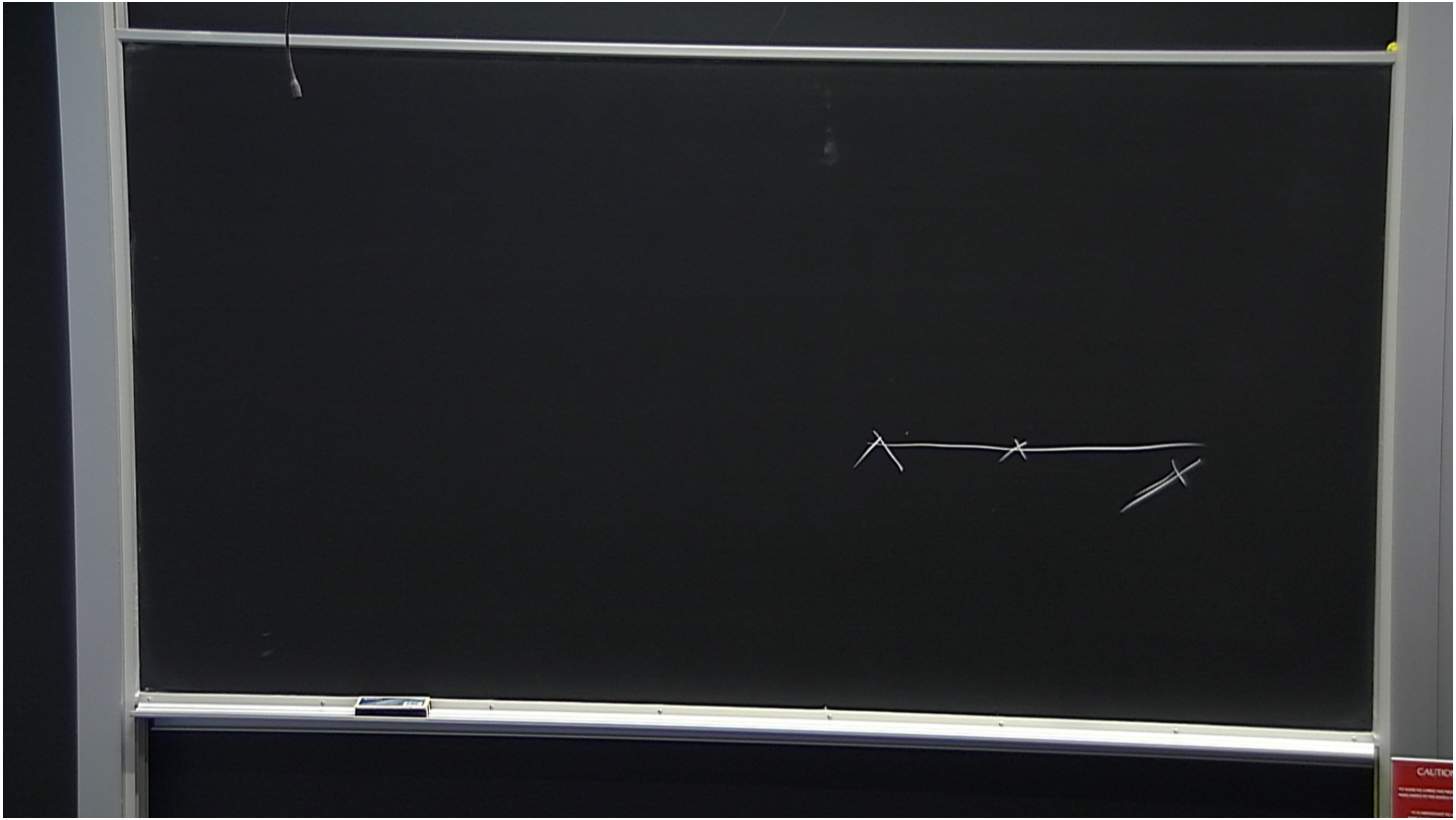
URL: http://pirsa.org/16060042

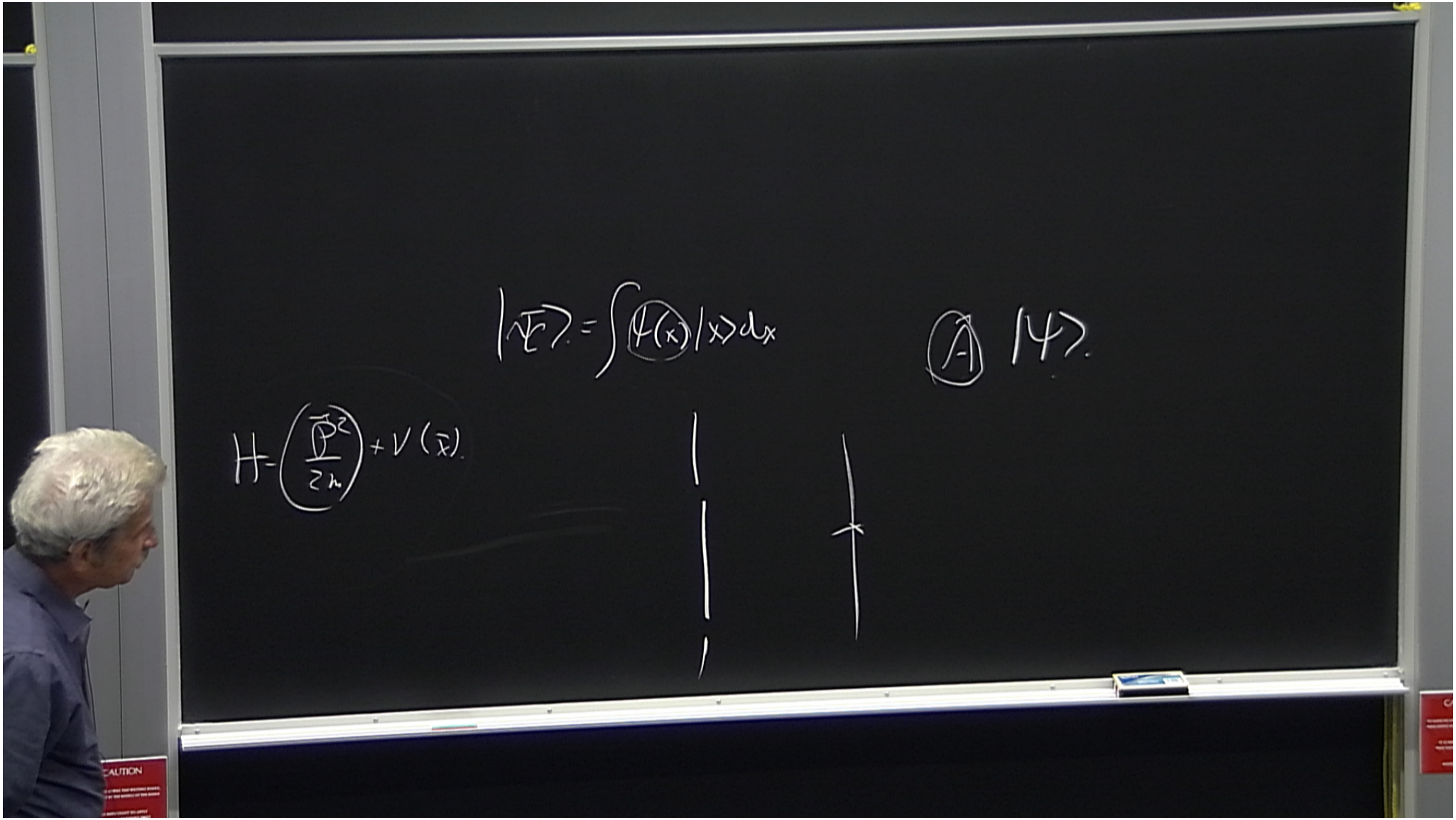
Abstract:


$|\psi\rangle = \int \psi(x)|x\rangle dx$
CAUTION


$|\psi\rangle = \int \psi(x)|x\rangle dx$
$H = \left(\frac{\hat{p}^2}{2m}\right) + V(\hat{x})$
CAUTION

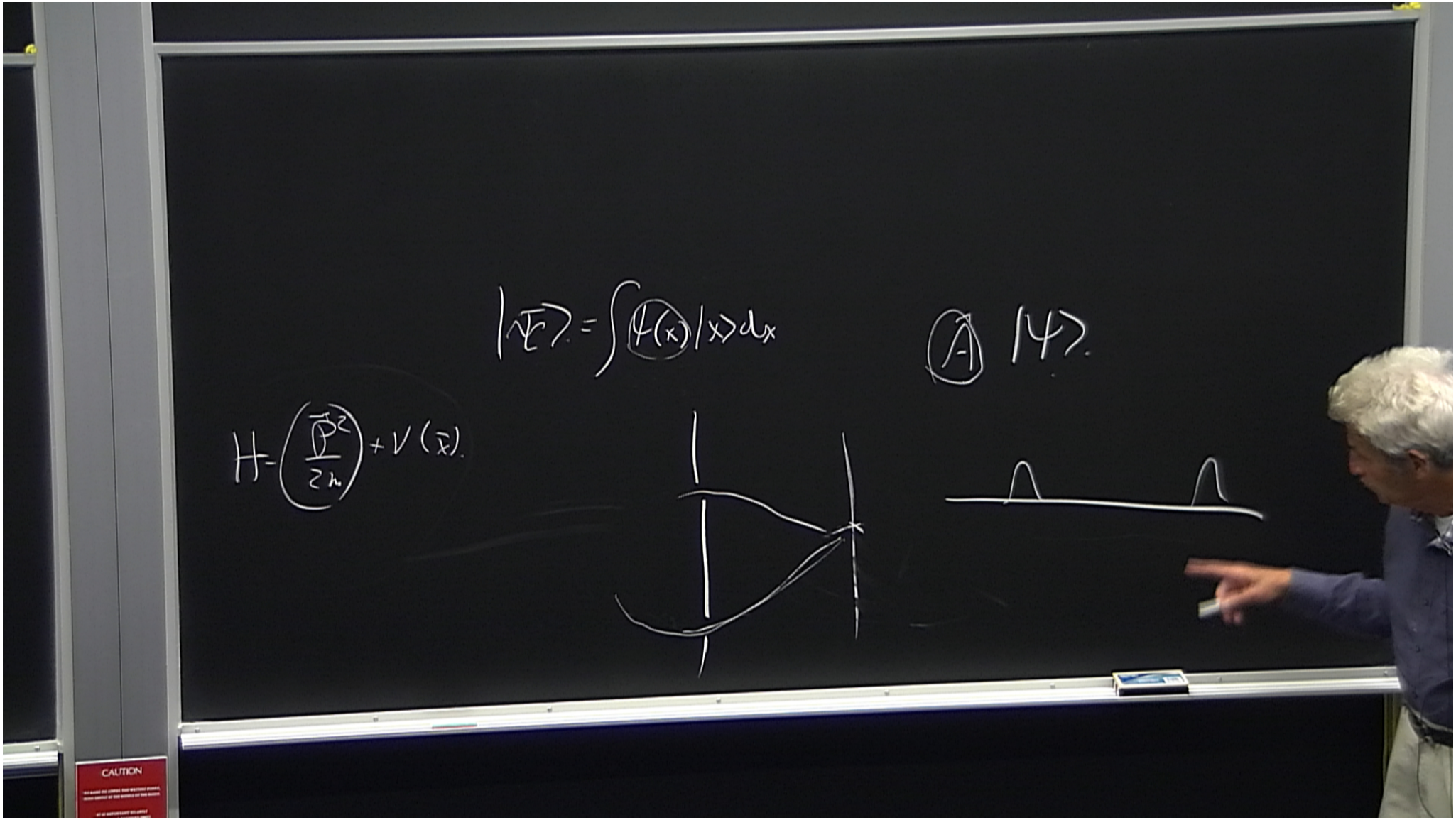

$|\psi\rangle = \int \psi(x)|x\rangle dx$
$\hat{A}|\psi\rangle$
$H = \left(\frac{\hat{p}^2}{2m}\right) + V(\hat{x})$
CAUTION




$|\psi\rangle = \int \psi(x)|x\rangle dx$
$\hat{A}\,|\psi\rangle$
$H = \left(\frac{\hat{p}^2}{2m}\right) + V(\hat{x})$

$$|\psi\rangle = \int \psi(x)|x\rangle dx \qquad \hat{A}|\psi\rangle$$

$$H = \left(\frac{\hat{p}^2}{2m}\right) + V(\hat{x})$$


$|\psi\rangle = \int \psi(x)|x\rangle dx$
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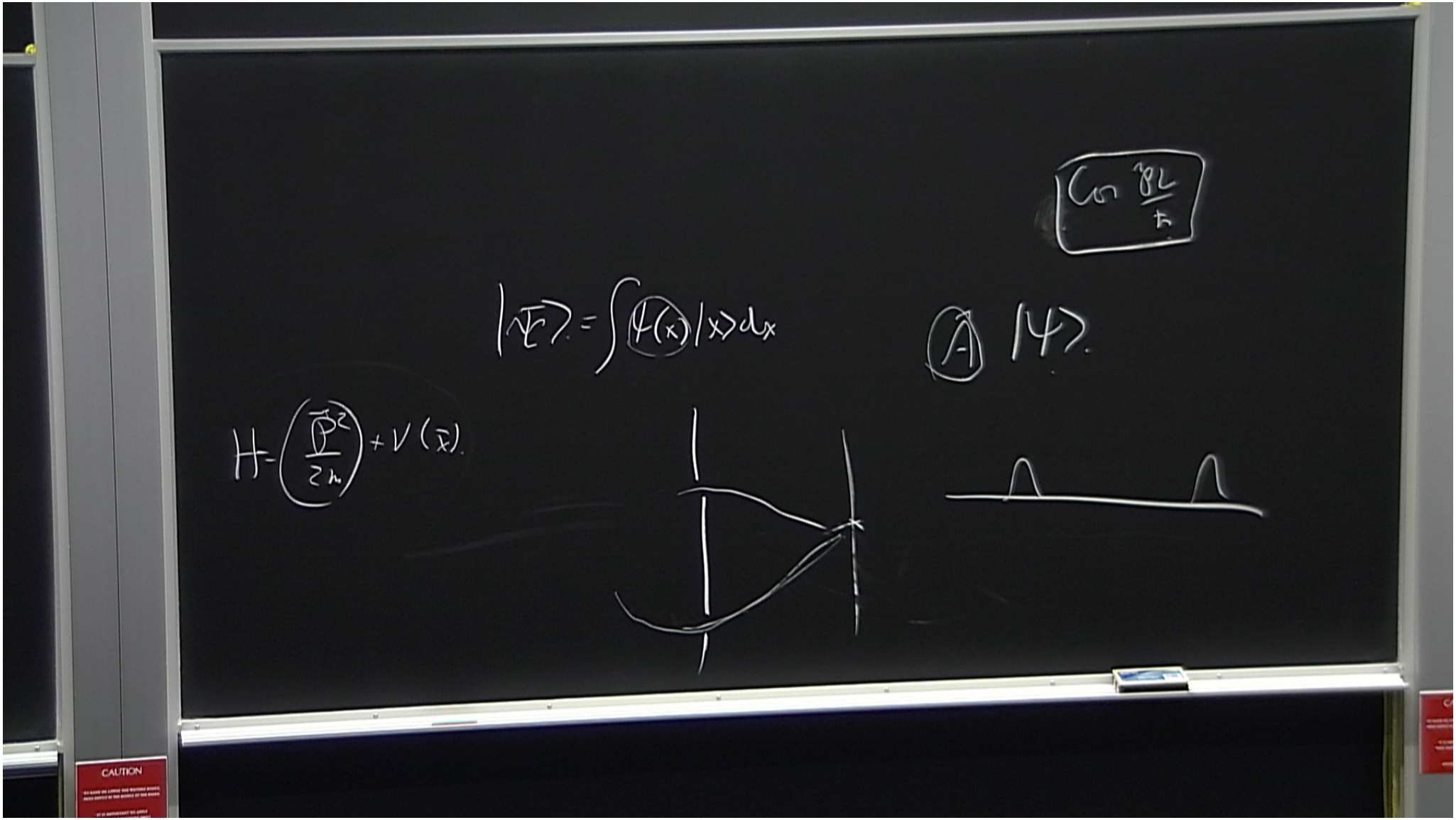
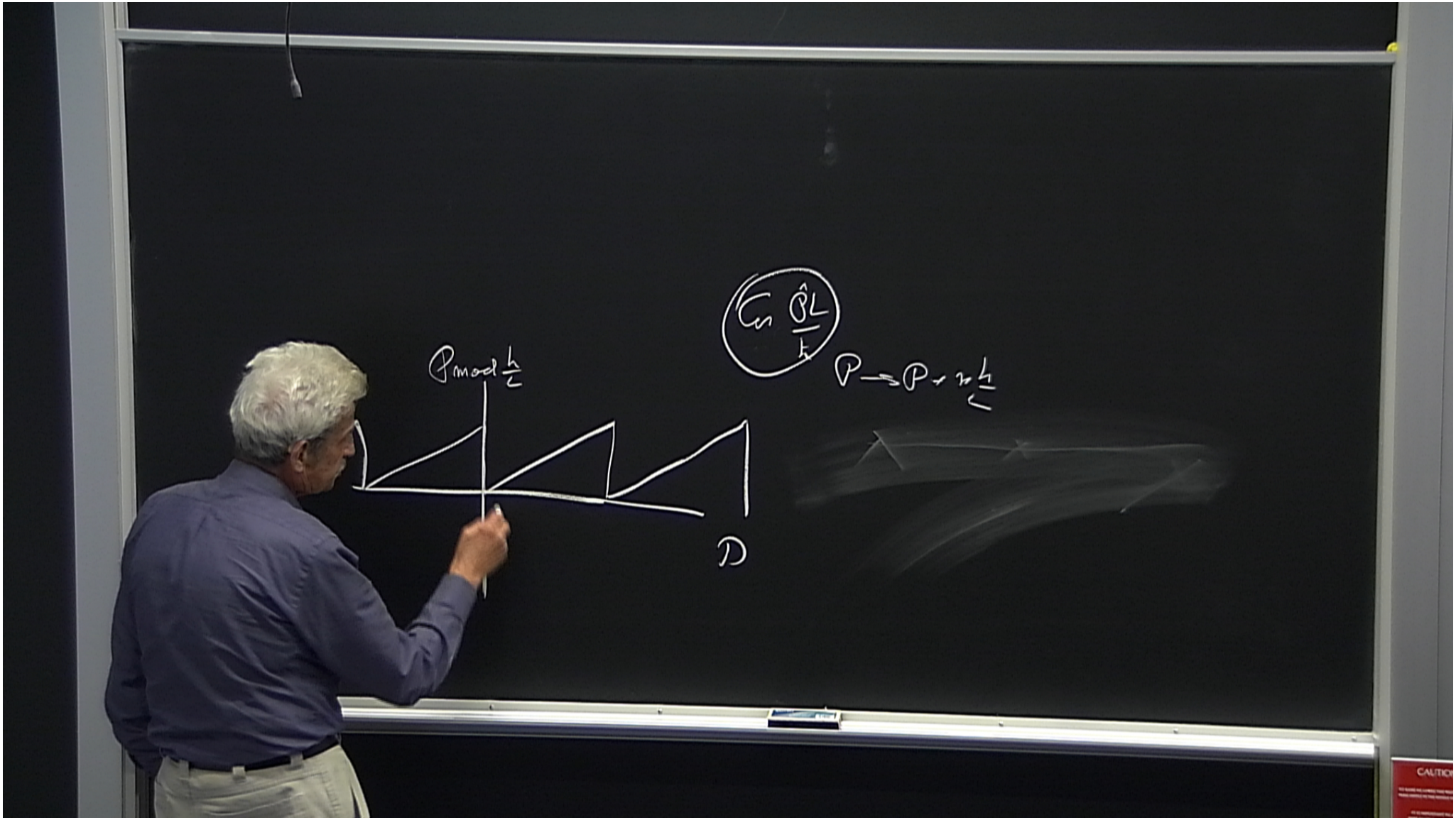
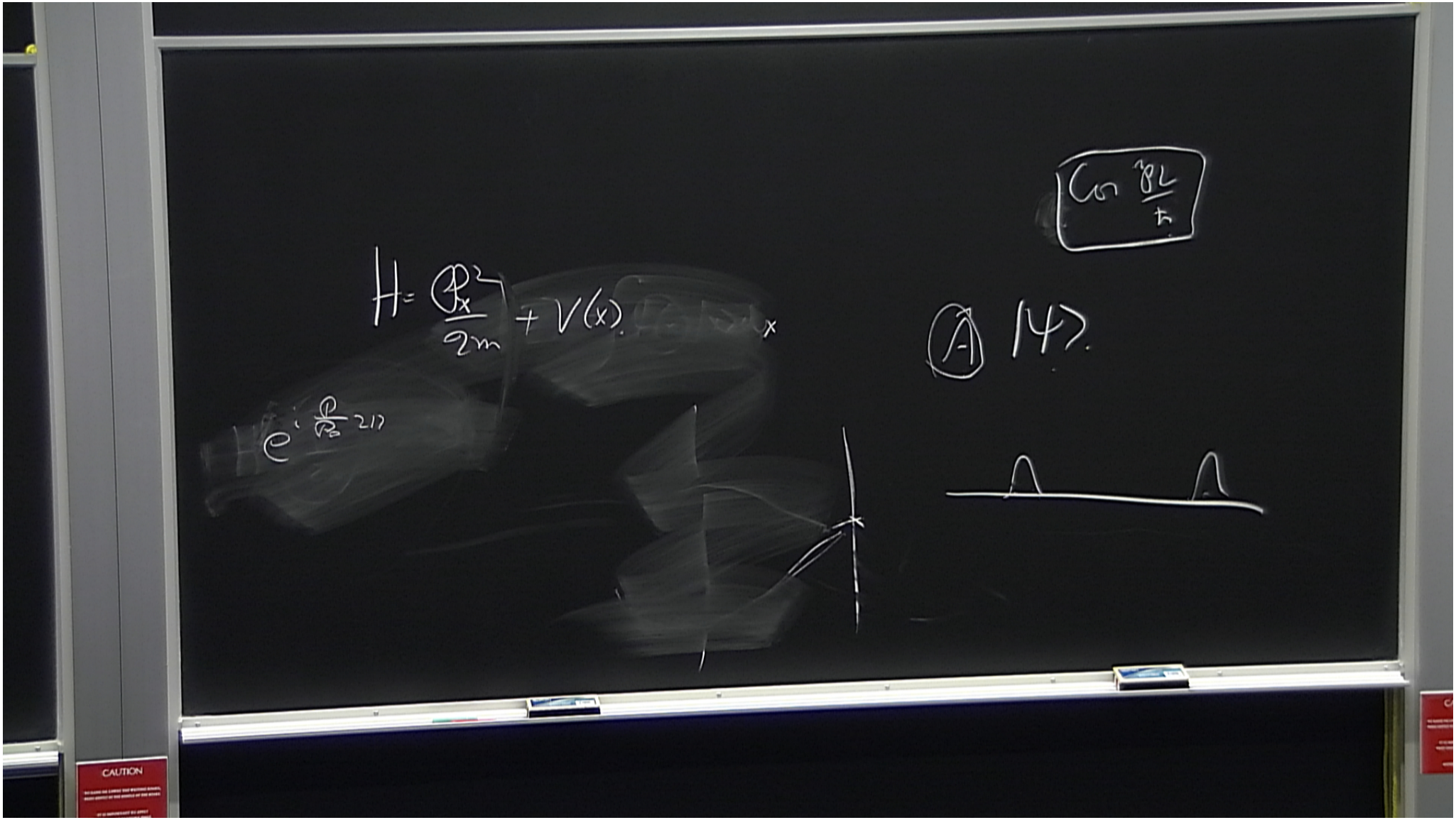
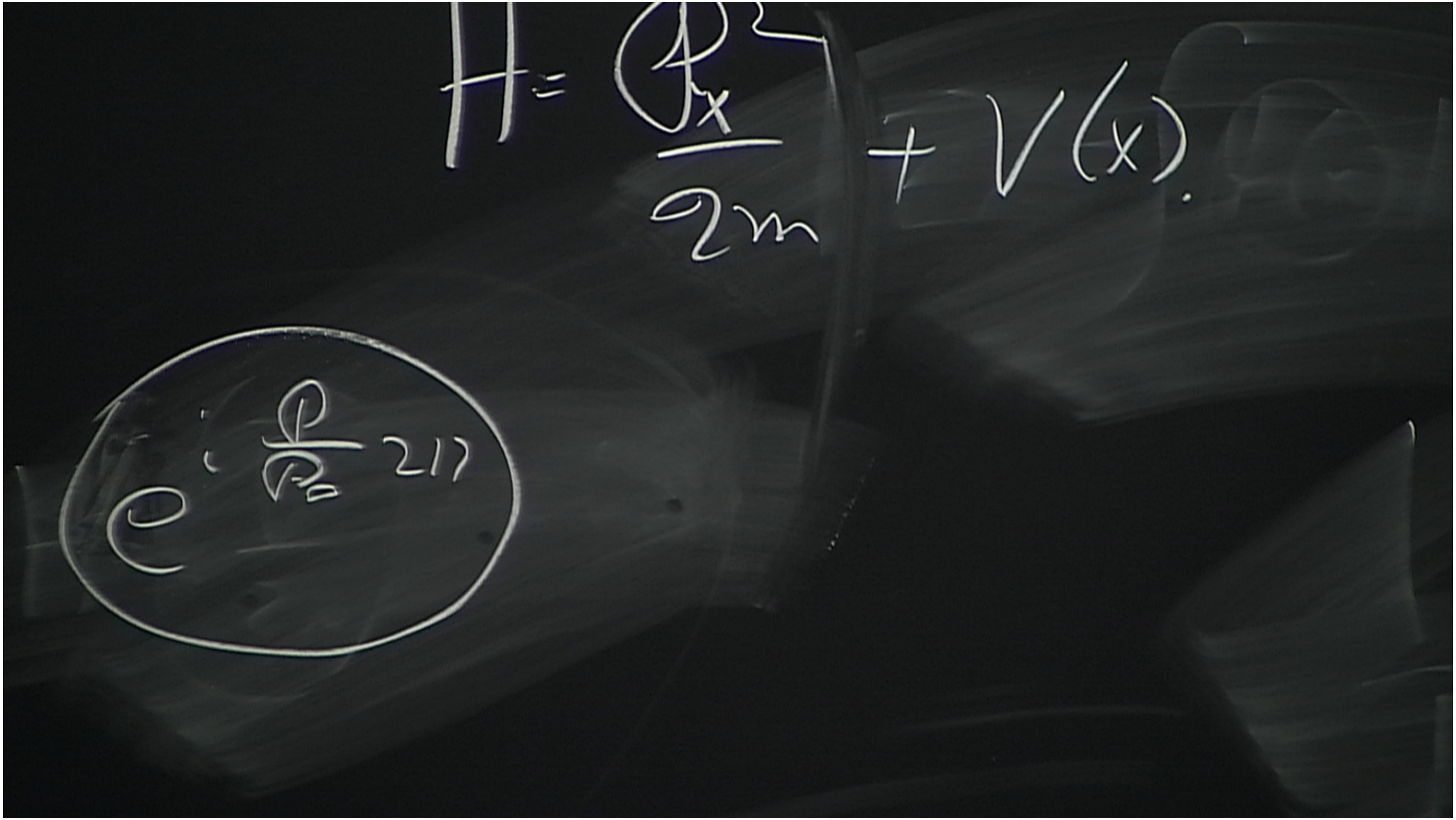
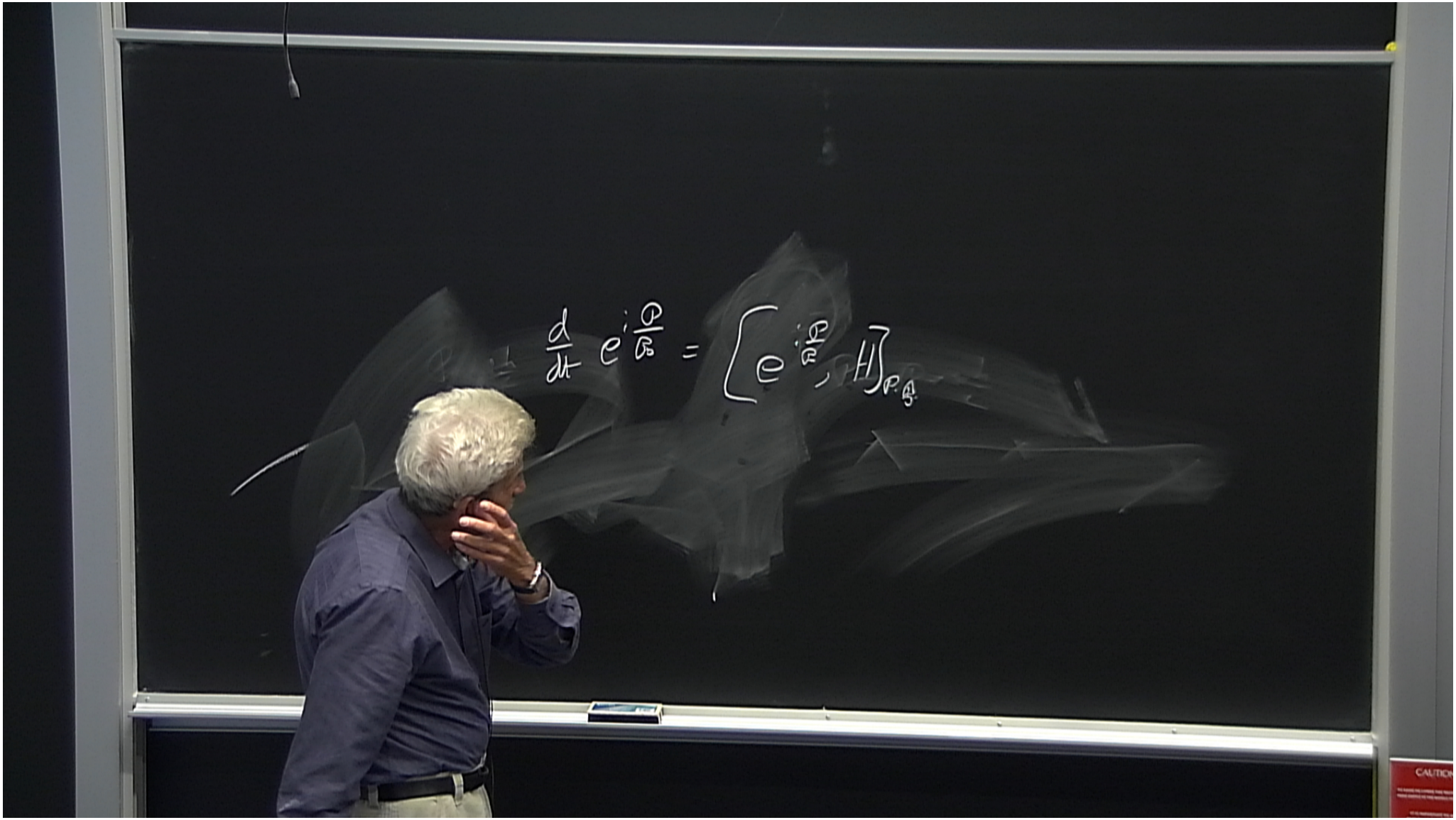
$H = \left(\frac{\hat{p}^2}{2m}\right) + V(\hat{x})$
CAUTION

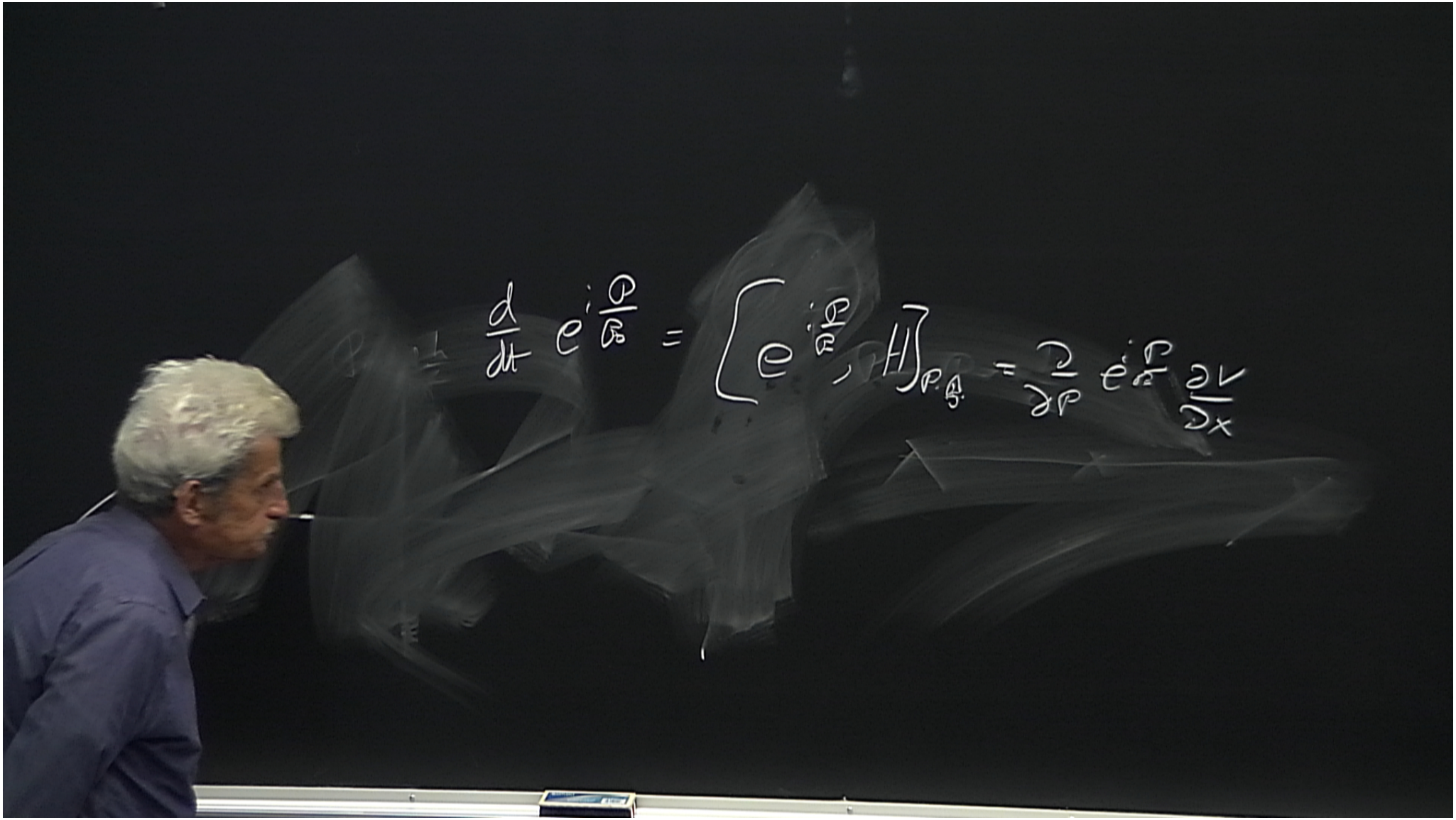

$|\psi\rangle = \int \psi(x)|x\rangle dx$
$\hat{A}|\psi\rangle$
$H = \left(\frac{\hat{p}^2}{2m}\right) + V(\hat{x})$

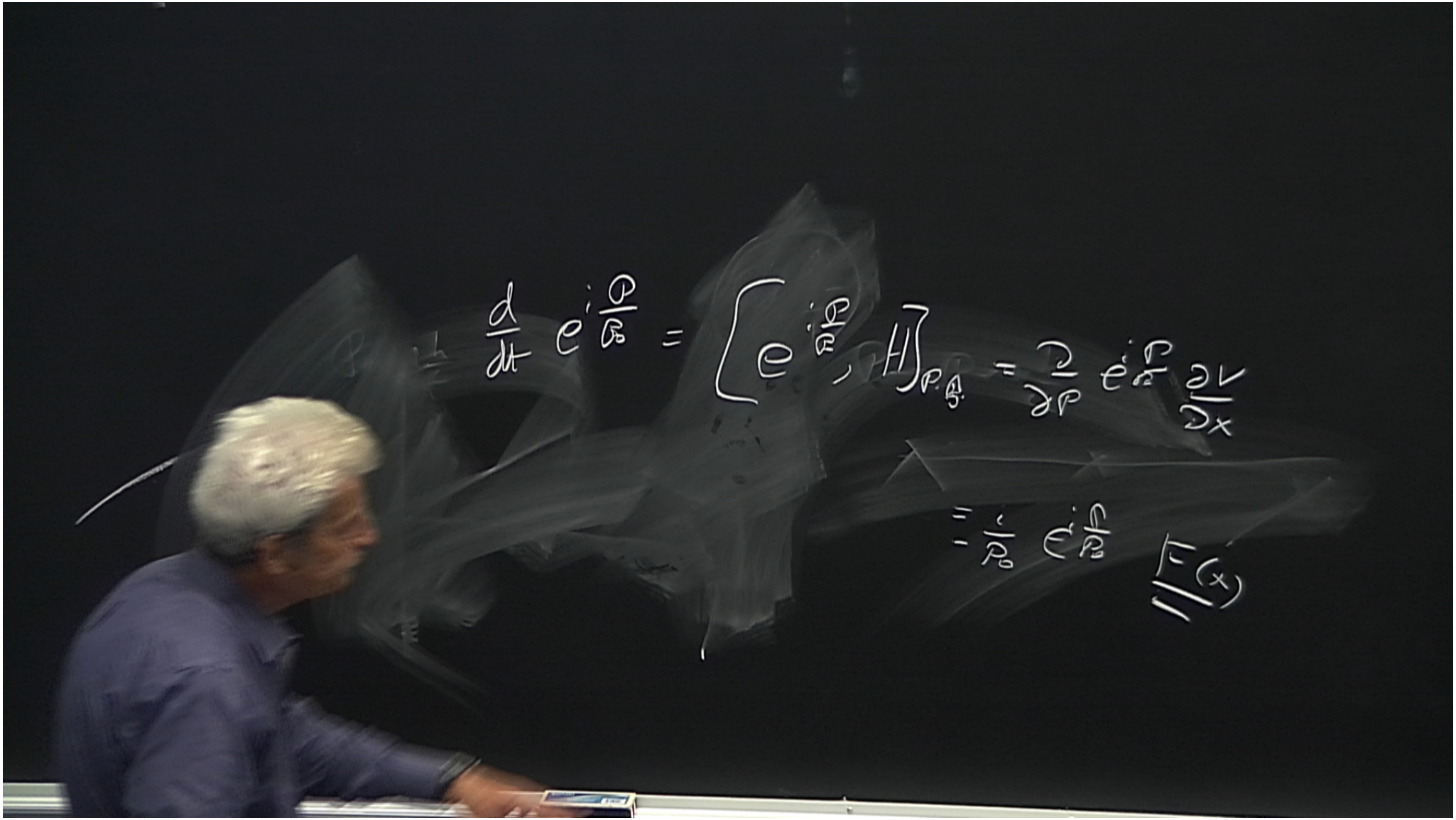

$\rho_{mod} \frac{h}{2}$
$\frac{\hat{\rho} L}{h}$
$P \to P + n \frac{h}{L}$
D

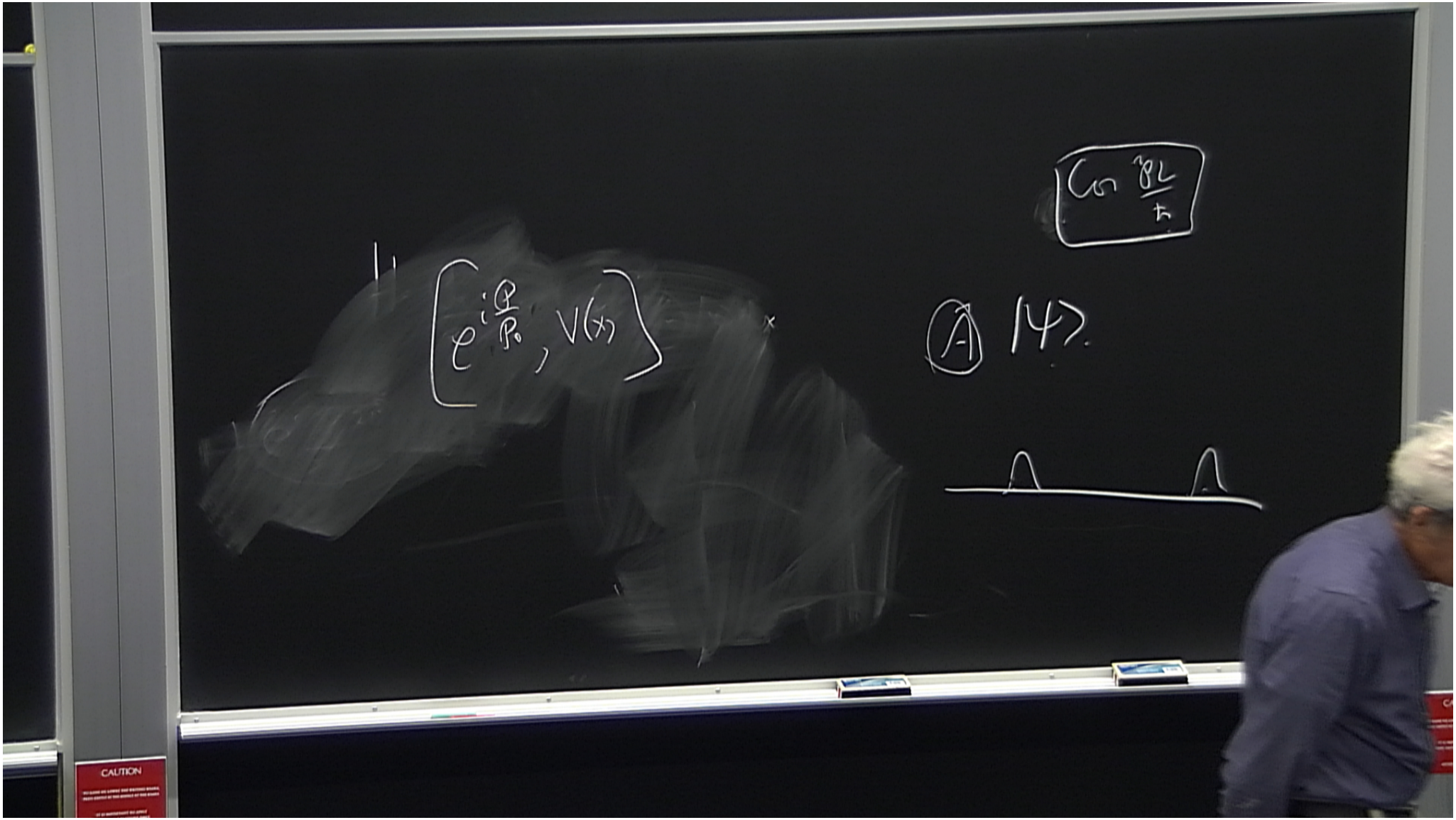

$H = \frac{p_x^2}{2m} + V(x)$
$e^{i\frac{p}{\hbar}2\pi}$
$|A\rangle$
$|4\rangle$
$\frac{2\pi L}{\hbar}$
CAUTION

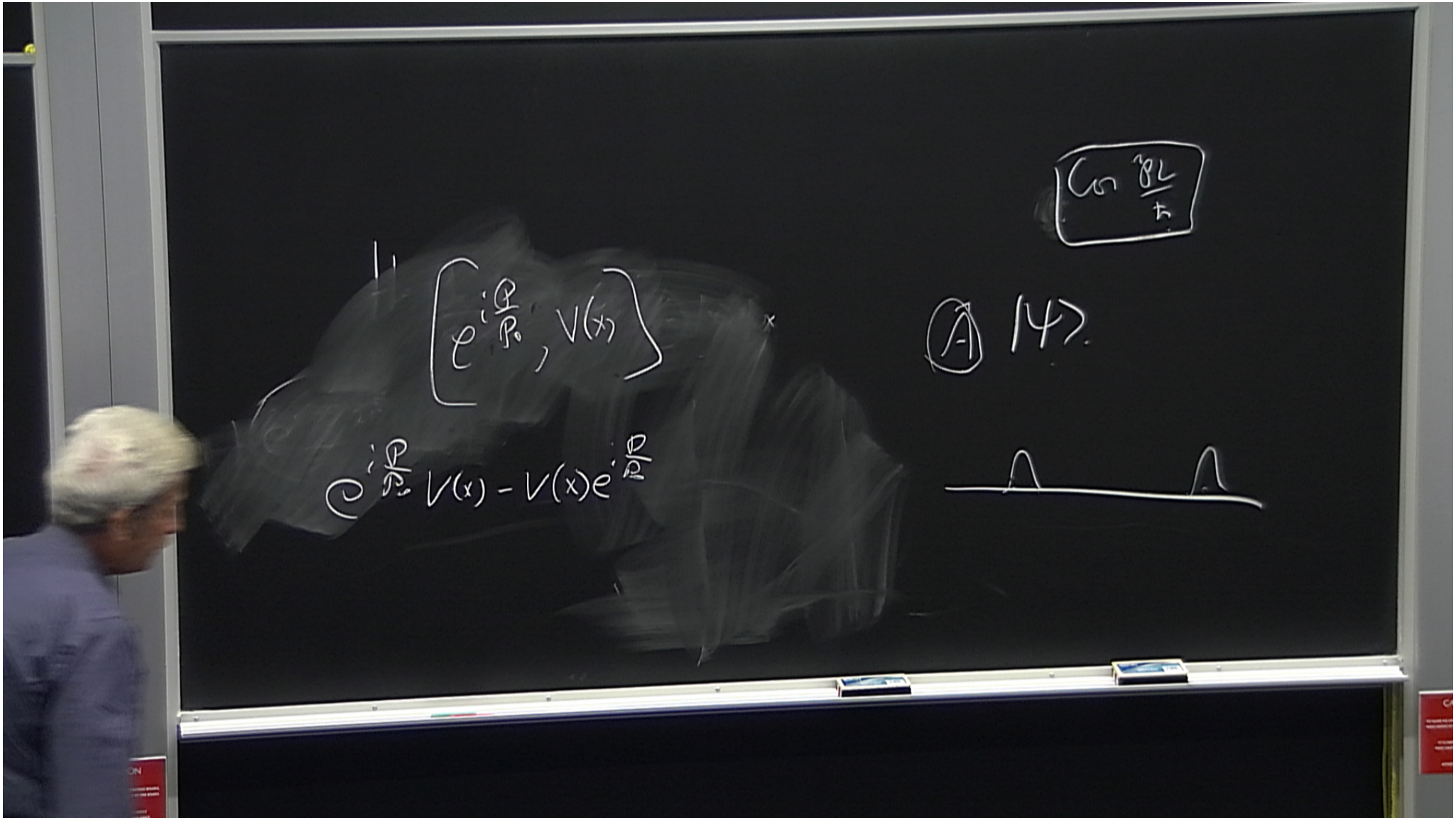

$H = \frac{p_x^2}{2m} + V(x)$.
$e^{i\frac{p}{\hbar}2\pi}$

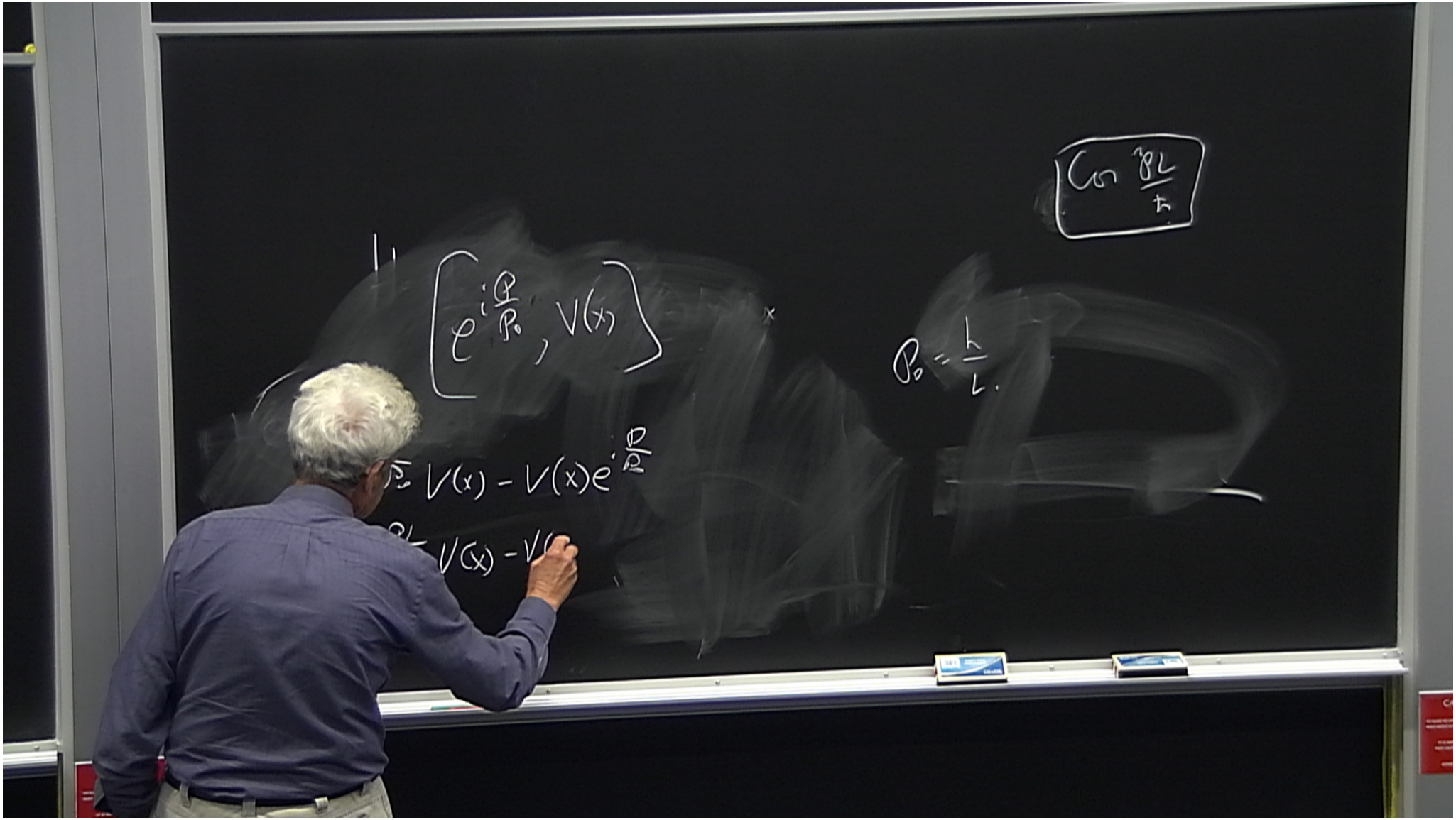

$\frac{d}{dt} e^{i\frac{P}{\hbar}} = \left[e^{i\frac{P}{\hbar}}, H \right]_{P,Q}$

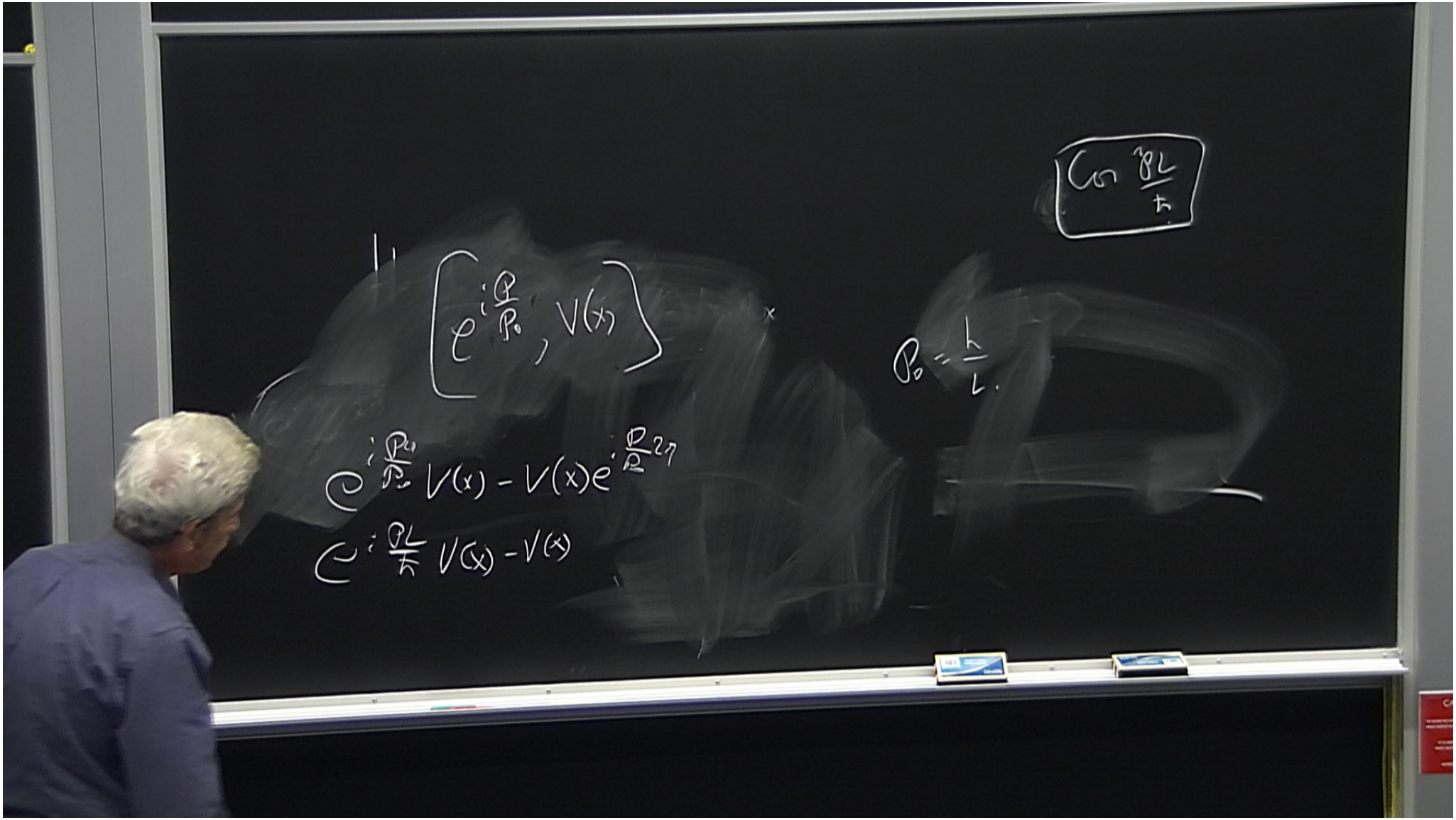

$\frac{d}{dt} e^{i\frac{P}{\hbar}a} = \left[e^{i\frac{P}{\hbar}a}, H \right]_{P,\beta} = \frac{\partial}{\partial P} e^{i\frac{P}{\hbar}a} \frac{\partial V}{\partial x}$

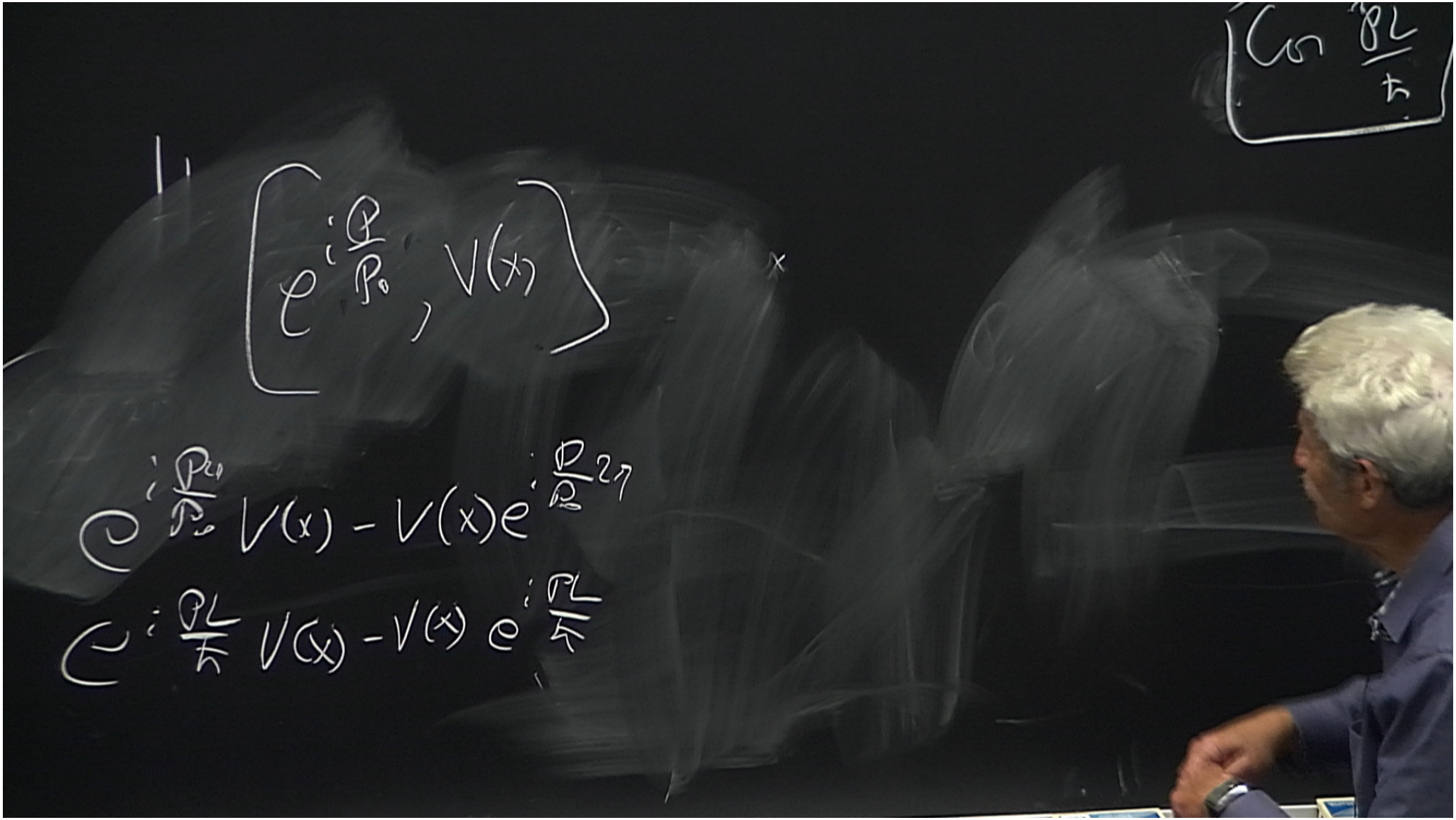

$\frac{d}{dt} e^{i\frac{P}{\hbar}} = \left[e^{i\frac{P}{\hbar}}, H \right]_{P,\beta} = \frac{\partial}{\partial P} e^{i\frac{P}{\hbar}} \frac{\partial V}{\partial x}$
$= \frac{i}{\hbar} e^{i\frac{P}{\hbar}} F(x)$

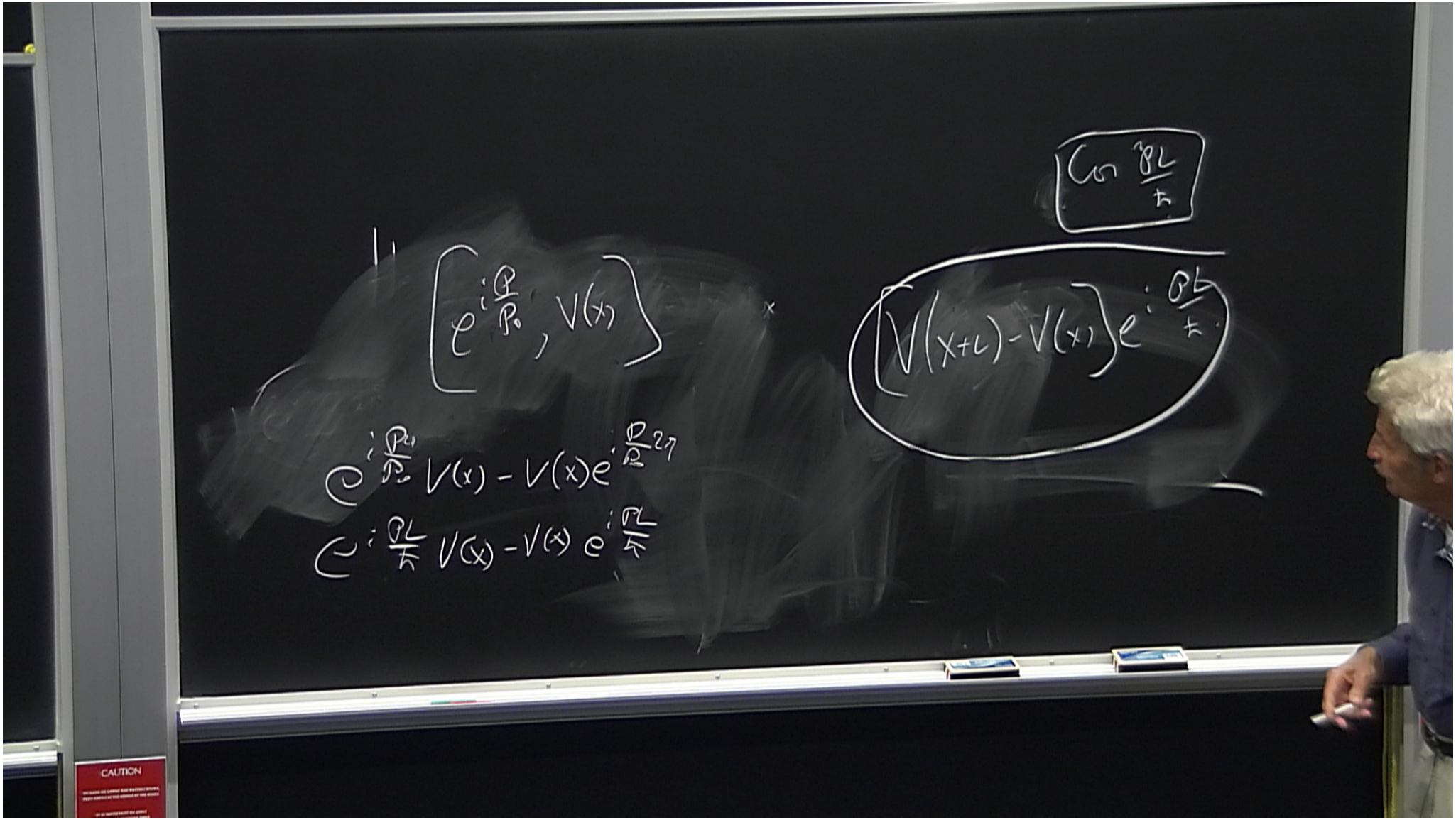

CAUTION

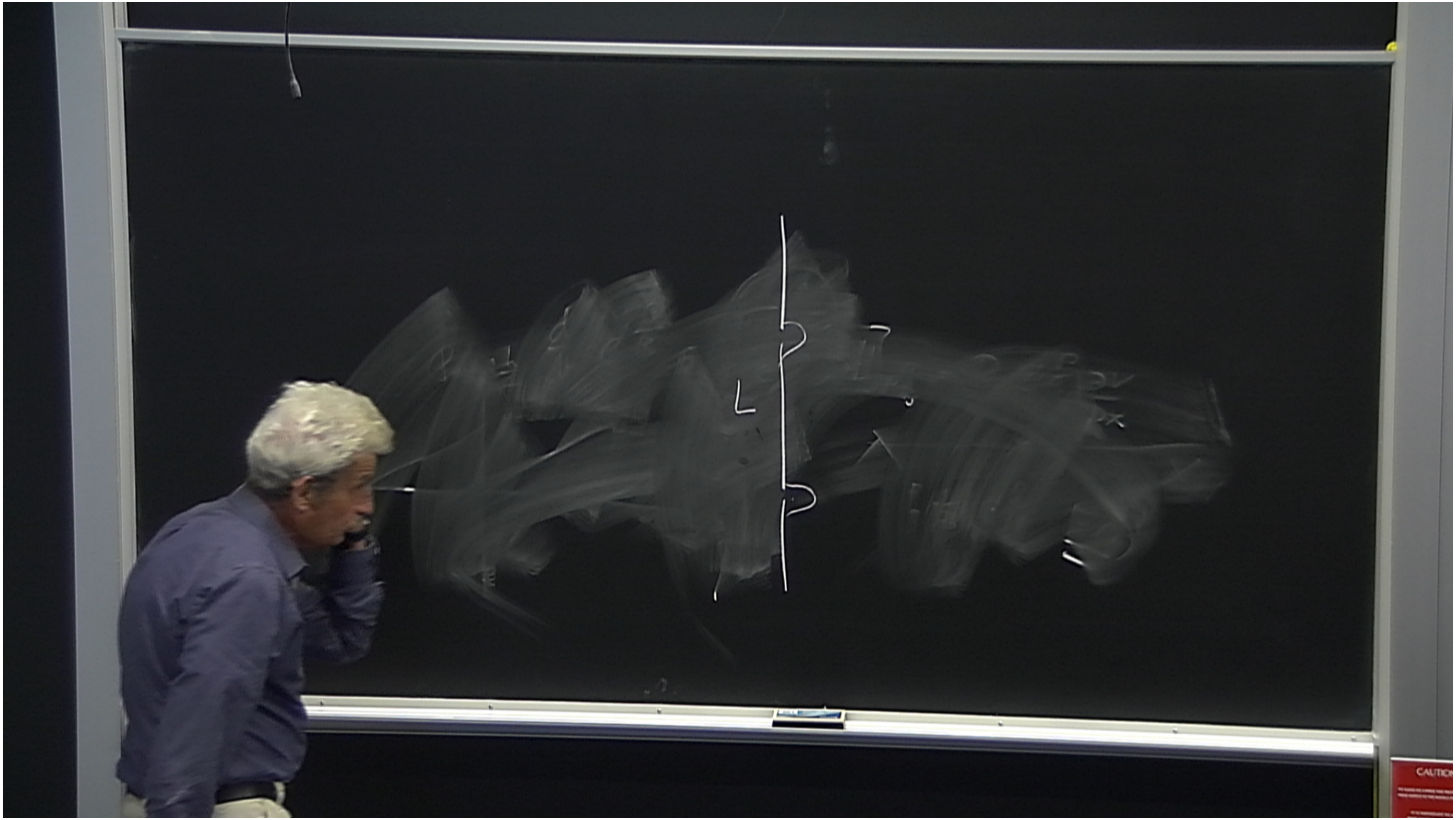

$\left[e^{i\frac{p^2}{2m}}, V(x)\right]$
$e^{i\frac{p^2}{2m}}V(x) - V(x)e^{i\frac{p^2}{2m}}$
$|\psi\rangle$

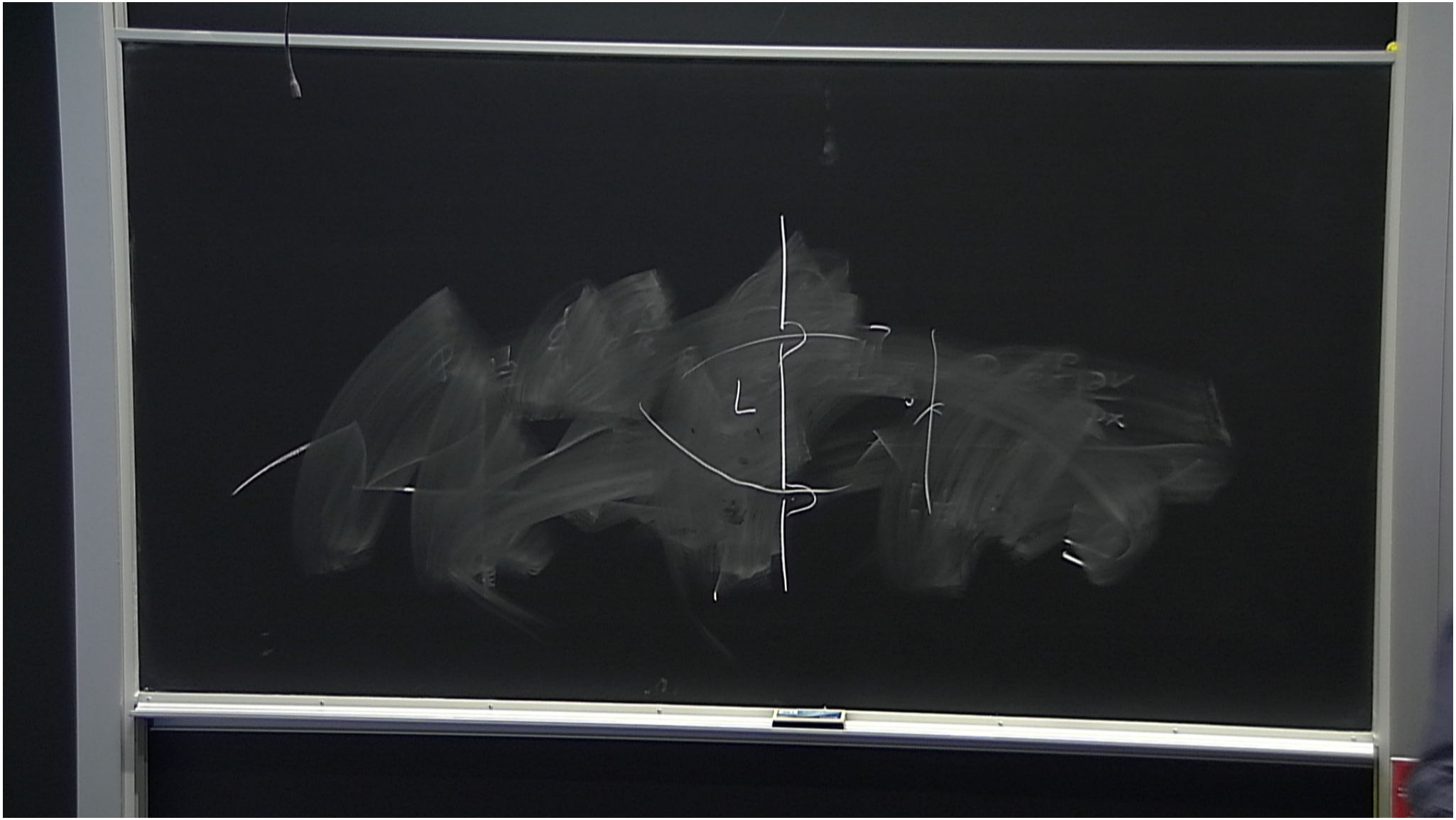

$\left[e^{i\frac{p}{\hbar_0}}, V(x)\right]$
$\hbar_0 = \frac{\hbar}{L_0}$
$V(x) - V(x)e^{i\frac{p}{\hbar_0}}$

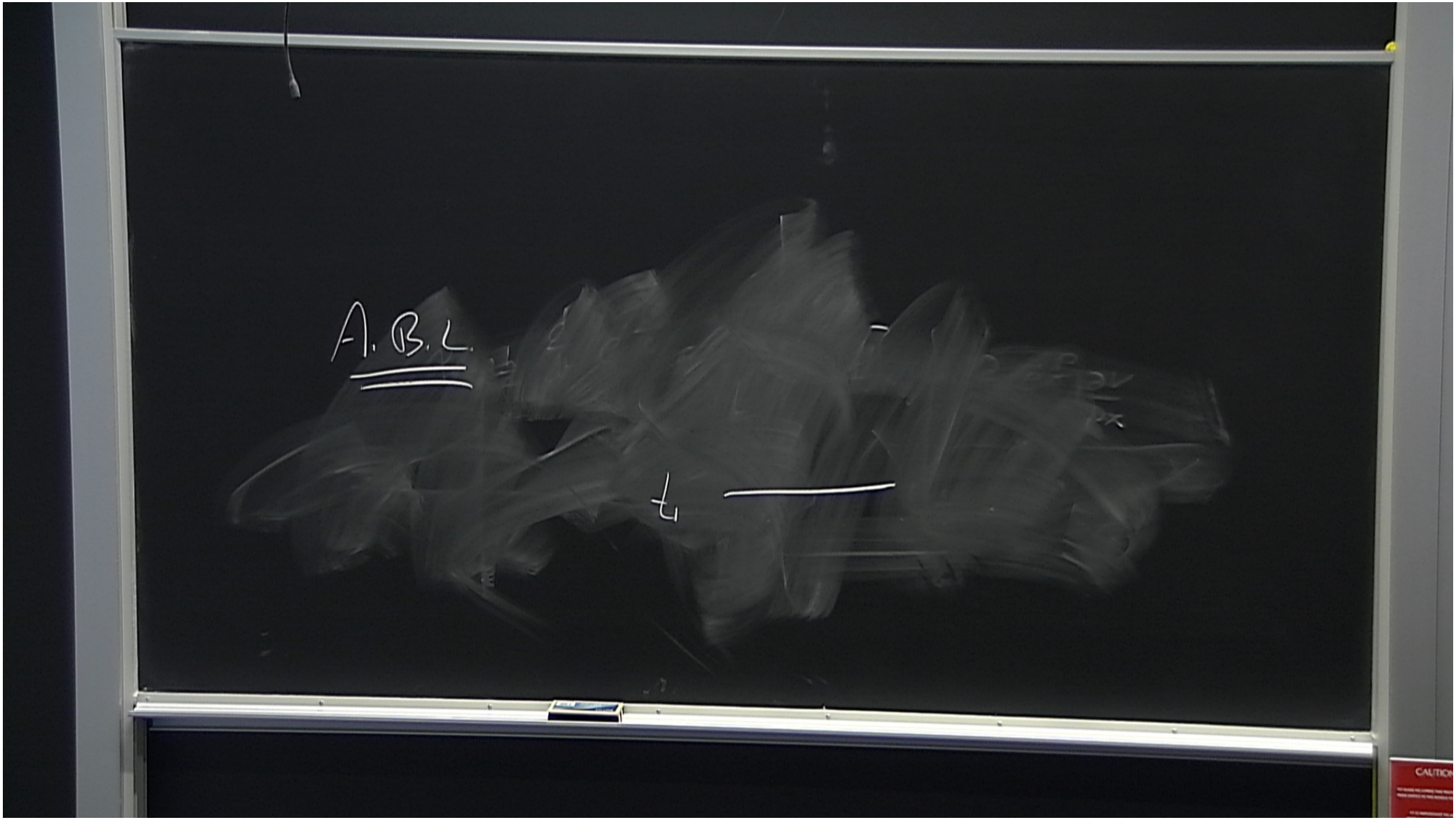

$\left[e^{i\frac{p}{\hbar_0}}, V(x)\right]$
$e^{i\frac{p}{\hbar_0}}V(x) - V(x)e^{i\frac{p}{\hbar_0}}$
$e^{i\frac{p}{\hbar}}V(x) - V(x)$
$\hbar_0 = \frac{\hbar}{L}$
$\hbar_0 \frac{pL}{\hbar}$

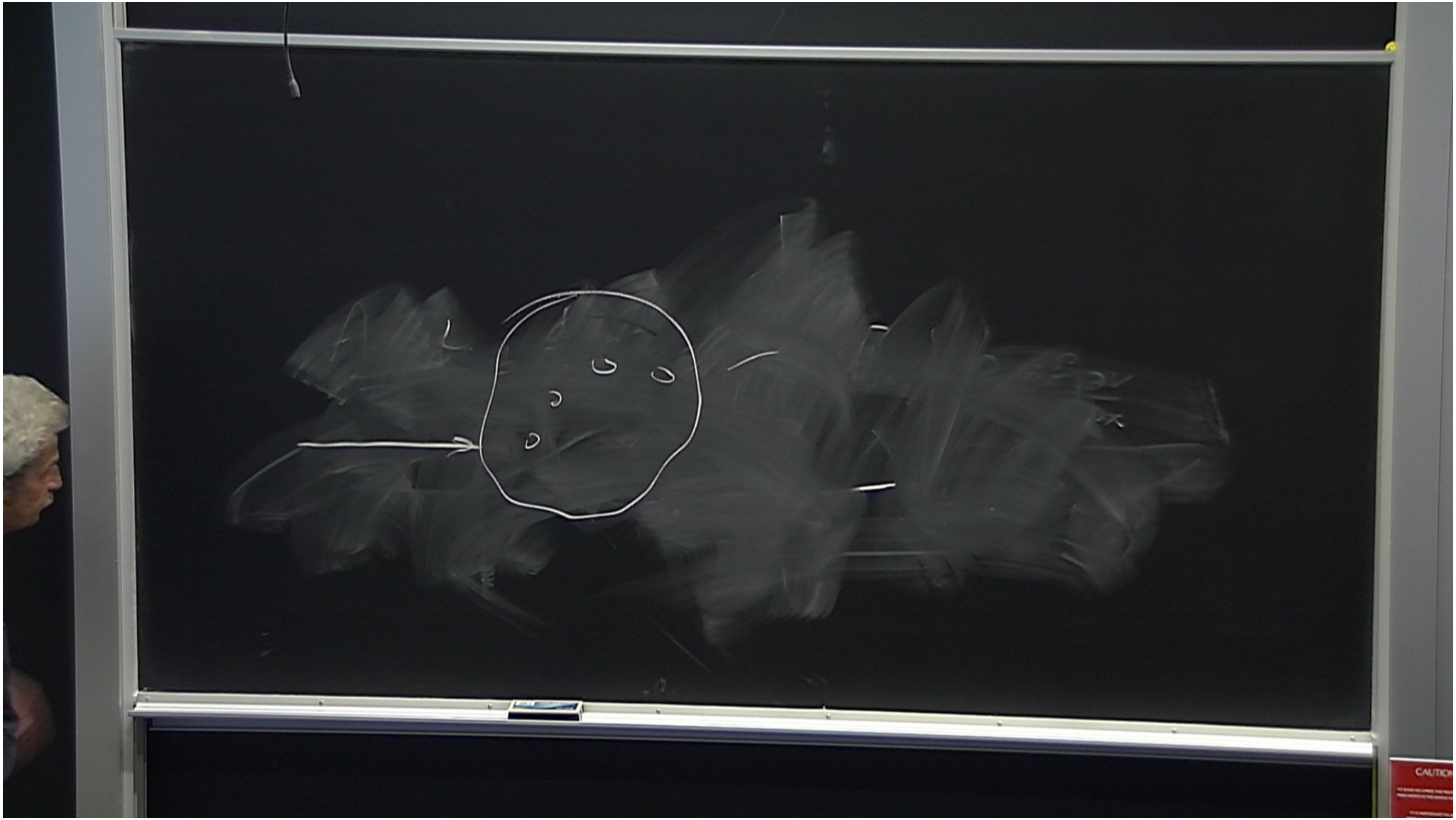

$\left[e^{i\frac{p^2}{2m}}, V(x)\right]$
$e^{i\frac{p^2}{2m}}V(x) - V(x)e^{i\frac{p^2}{2m}}$
$e^{i\frac{p\Delta}{\hbar}}V(x) - V(x)e^{i\frac{p\Delta}{\hbar}}$
$\frac{p\Delta}{\hbar}$

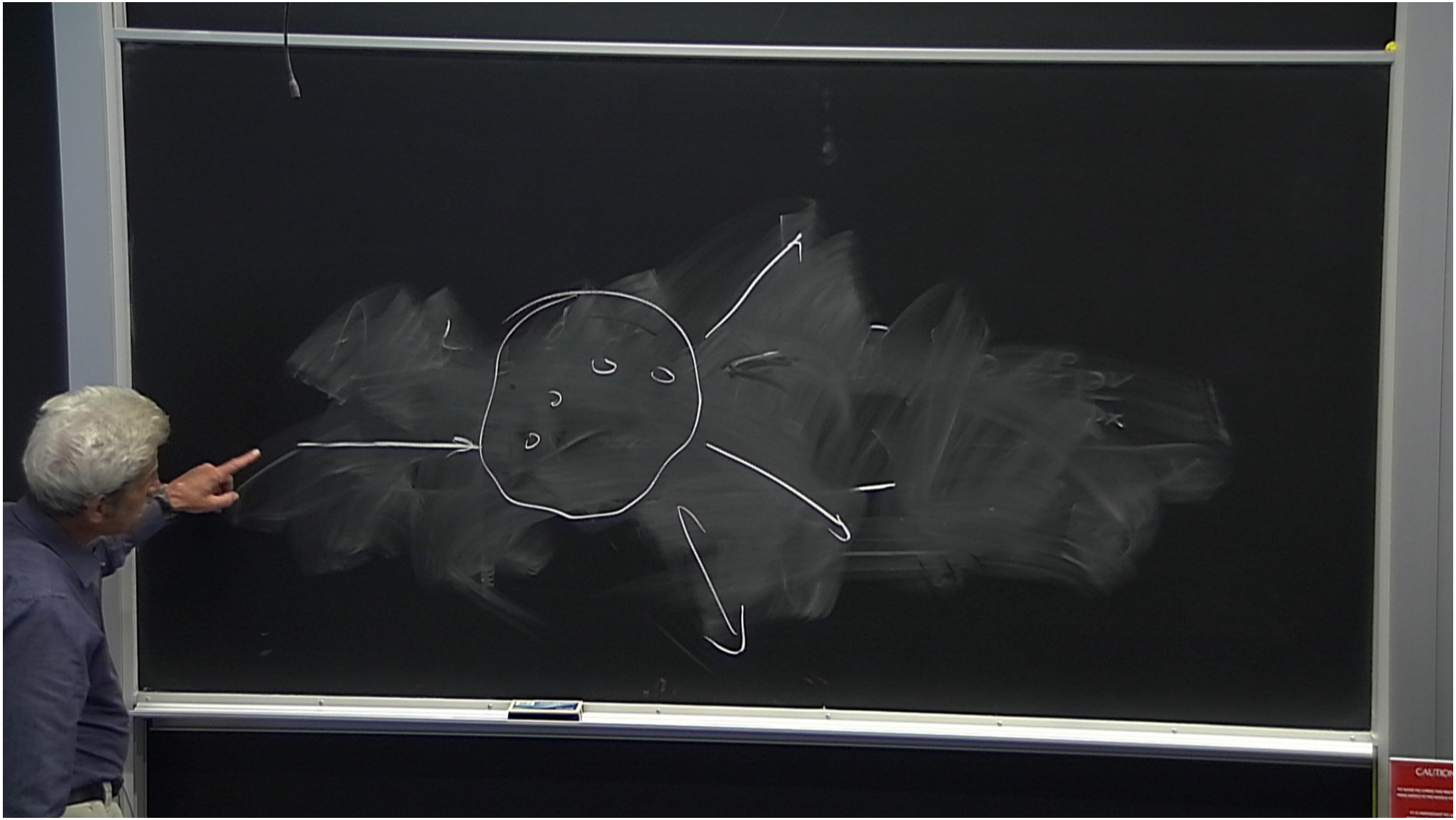

$e^{i\frac{p}{\hbar}\hat{x}}, V(x)$
$e^{i\frac{p}{\hbar}x} V(x) - V(x) e^{i\frac{p}{\hbar}x}$
$e^{i\frac{pL}{\hbar}} V(x) - V(x) e^{i\frac{pL}{\hbar}}$
$[V(x+L) - V(x)] e^{i\frac{pL}{\hbar}}$
$= 0$ if $\frac{pL}{\hbar} = 2\pi n$
CAUTION

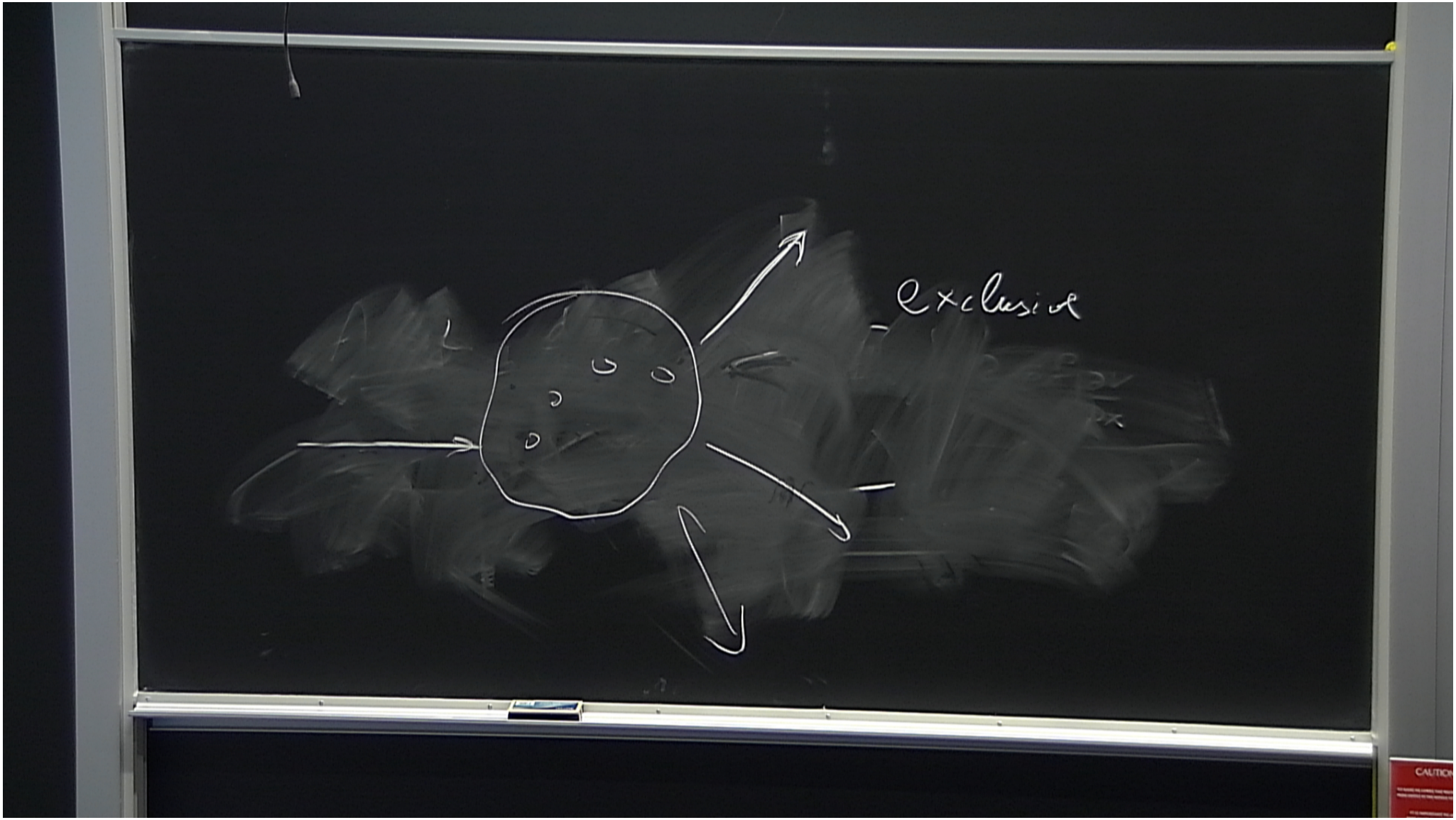


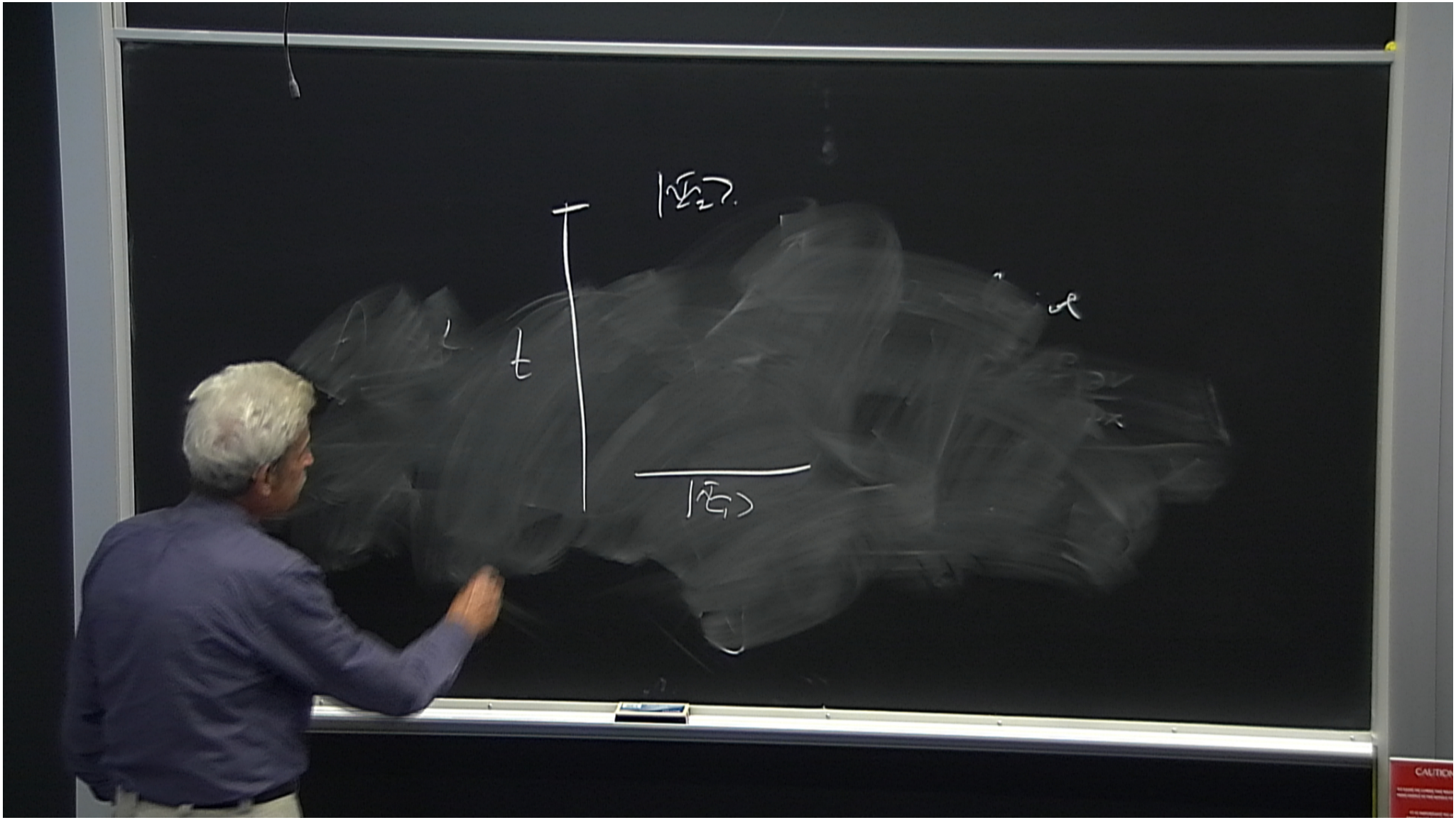

L

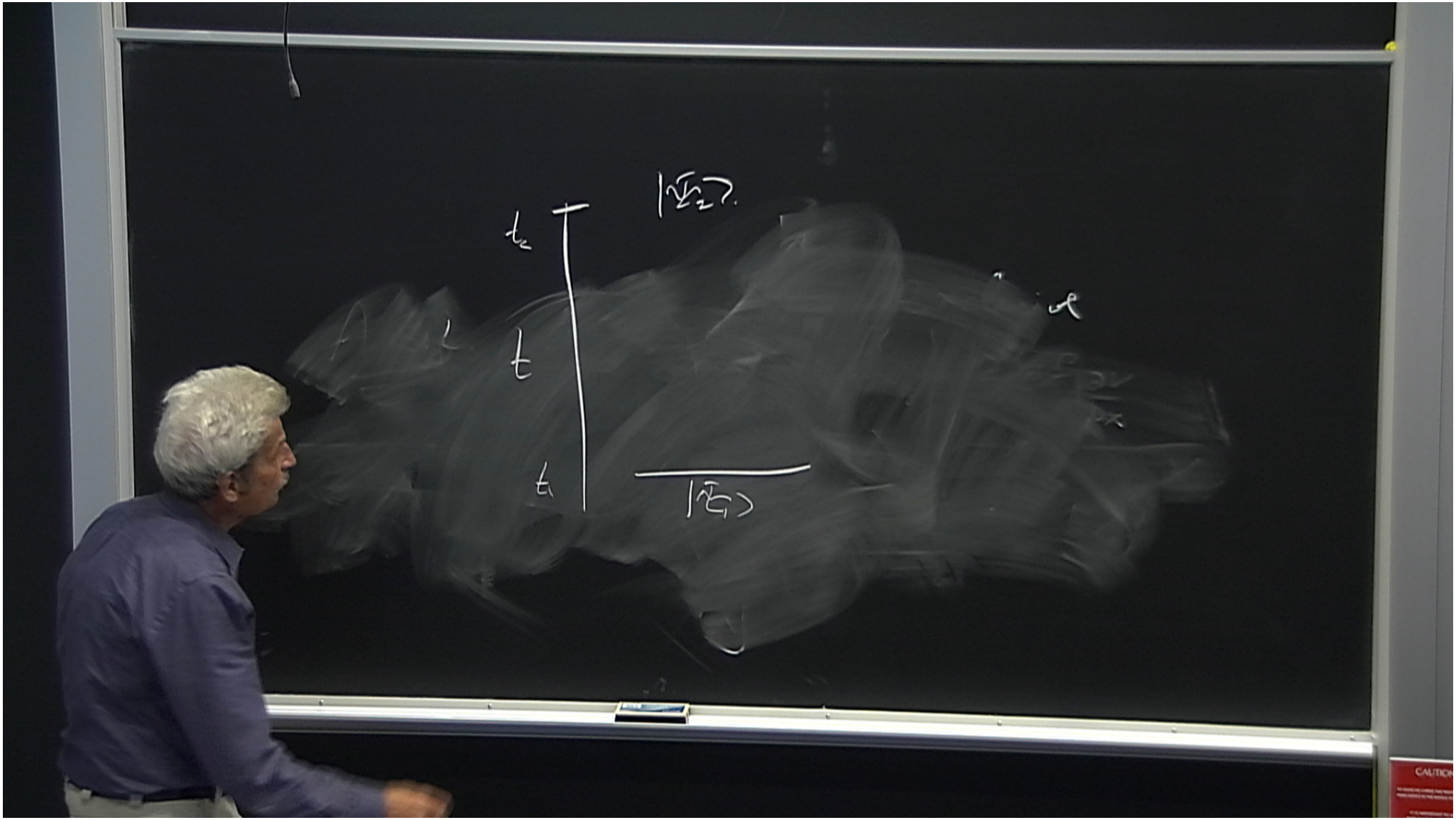

A. B. L.

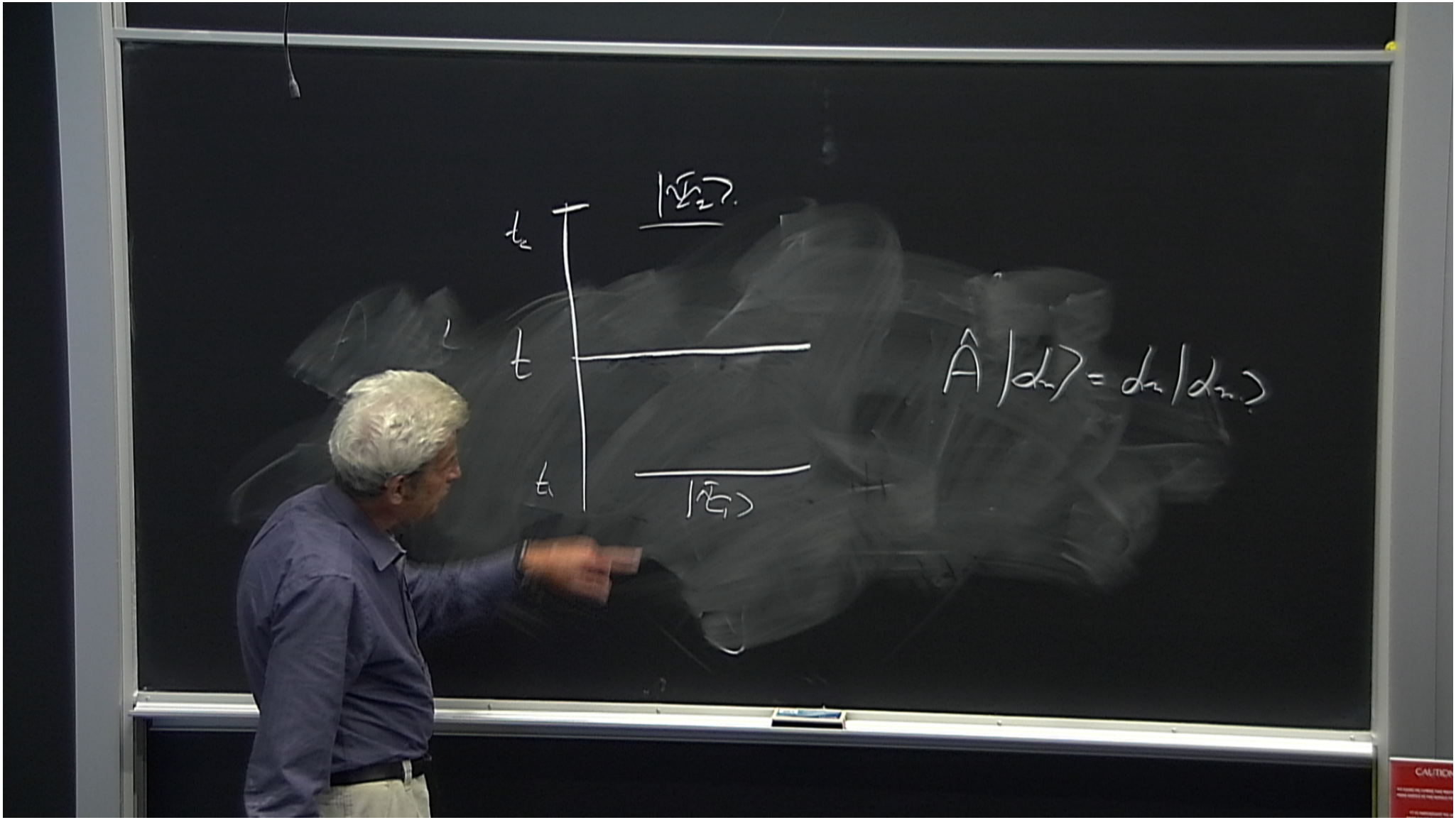


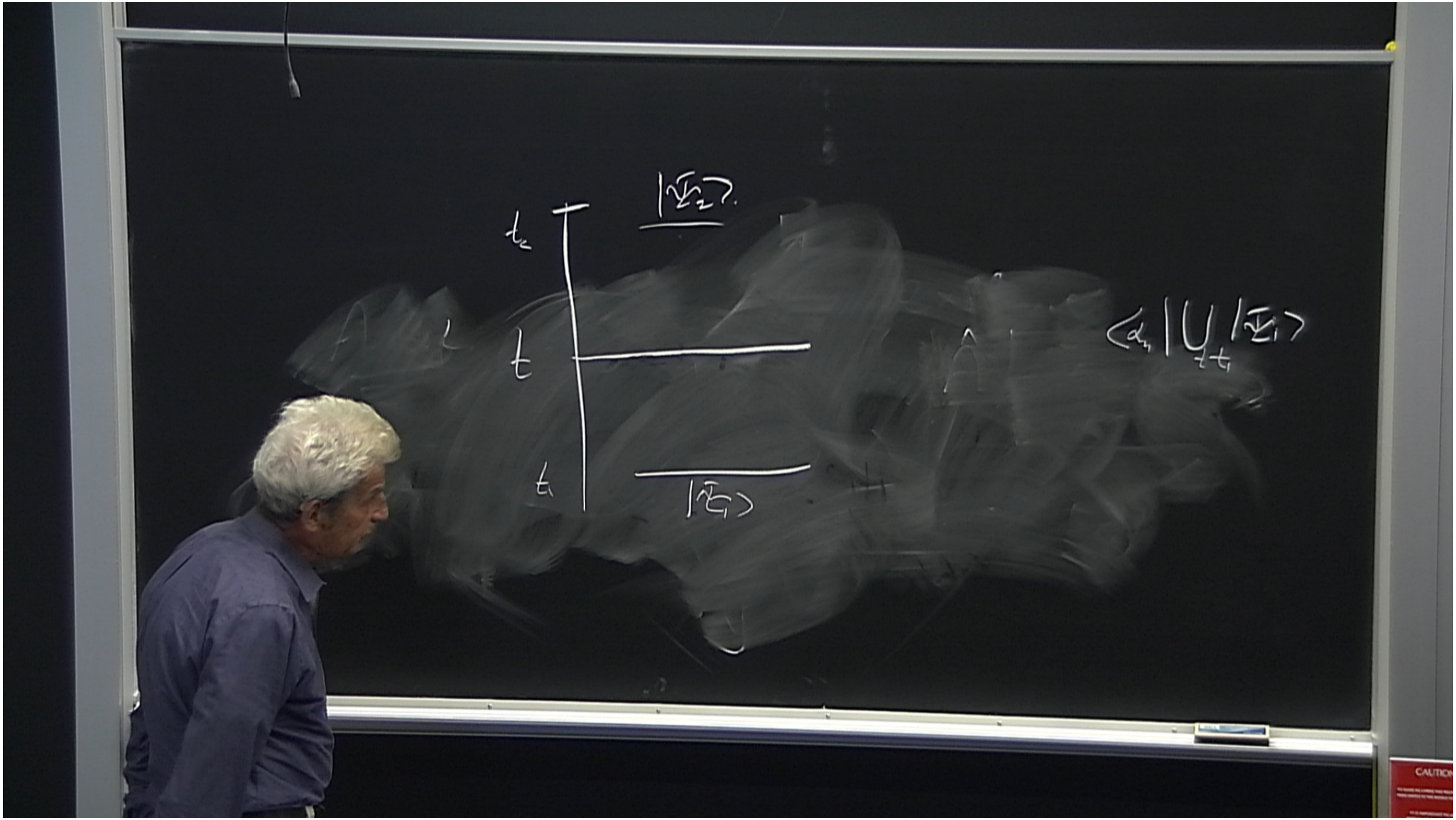


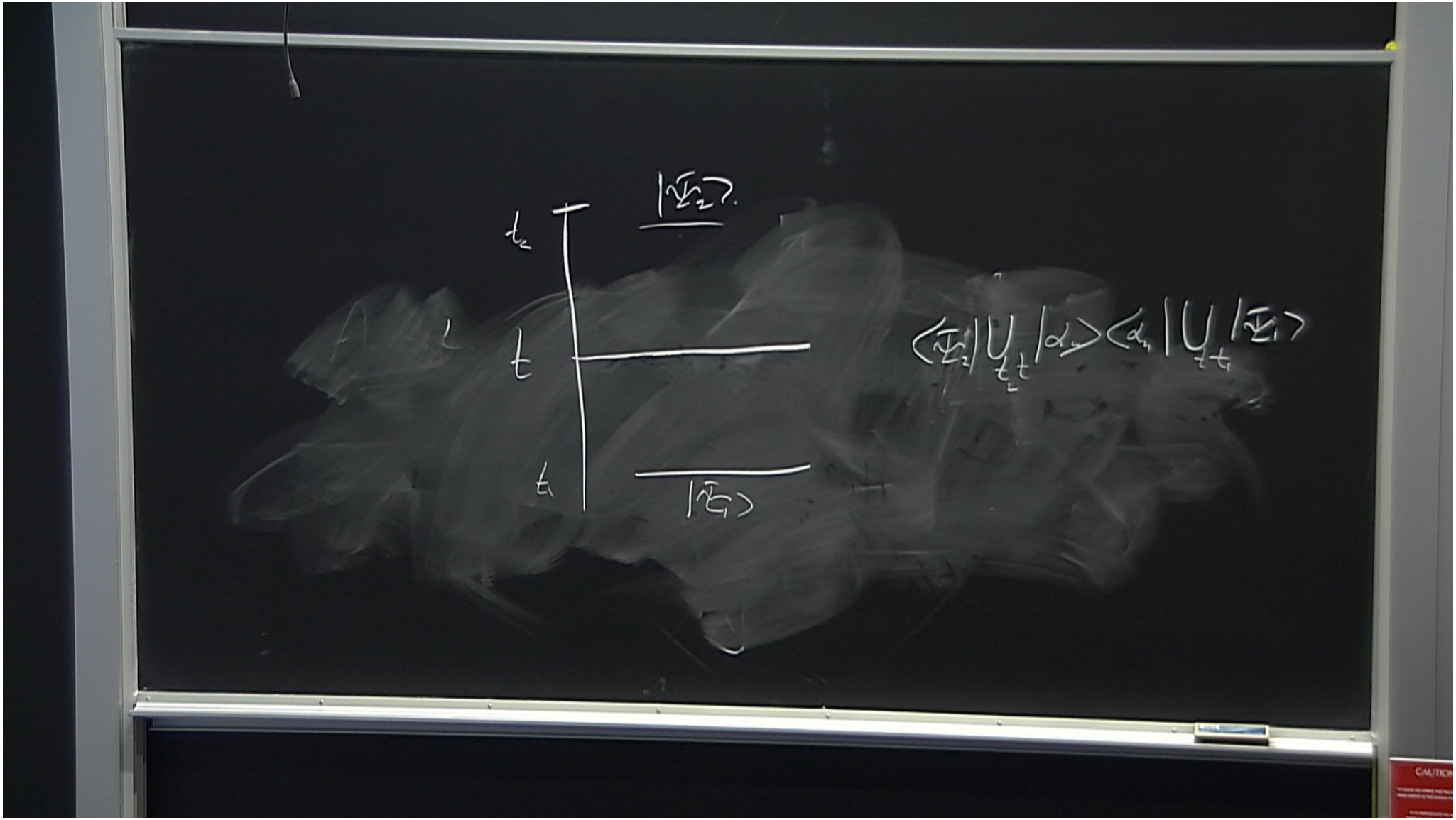

exclusion

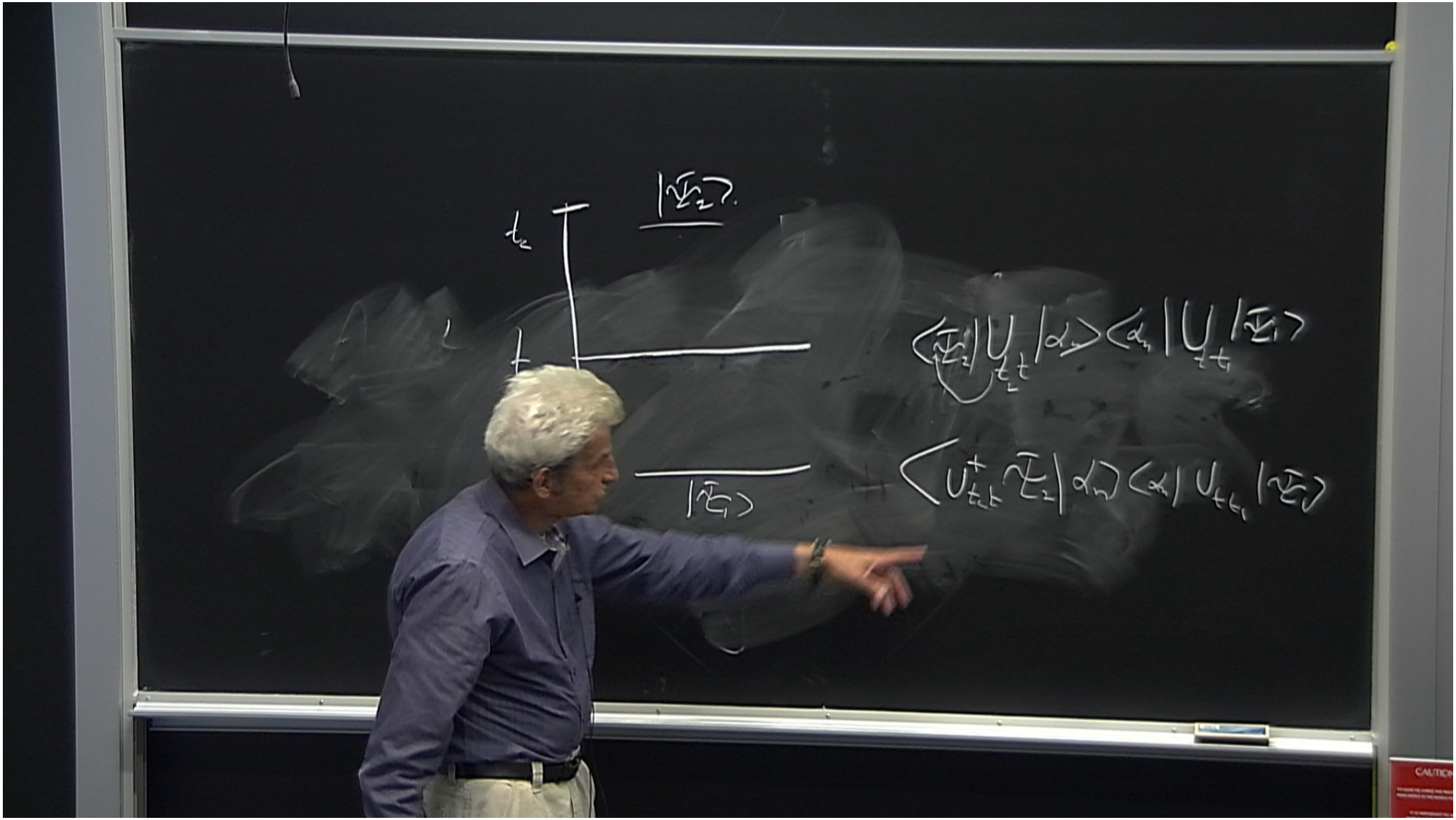

CAUTION

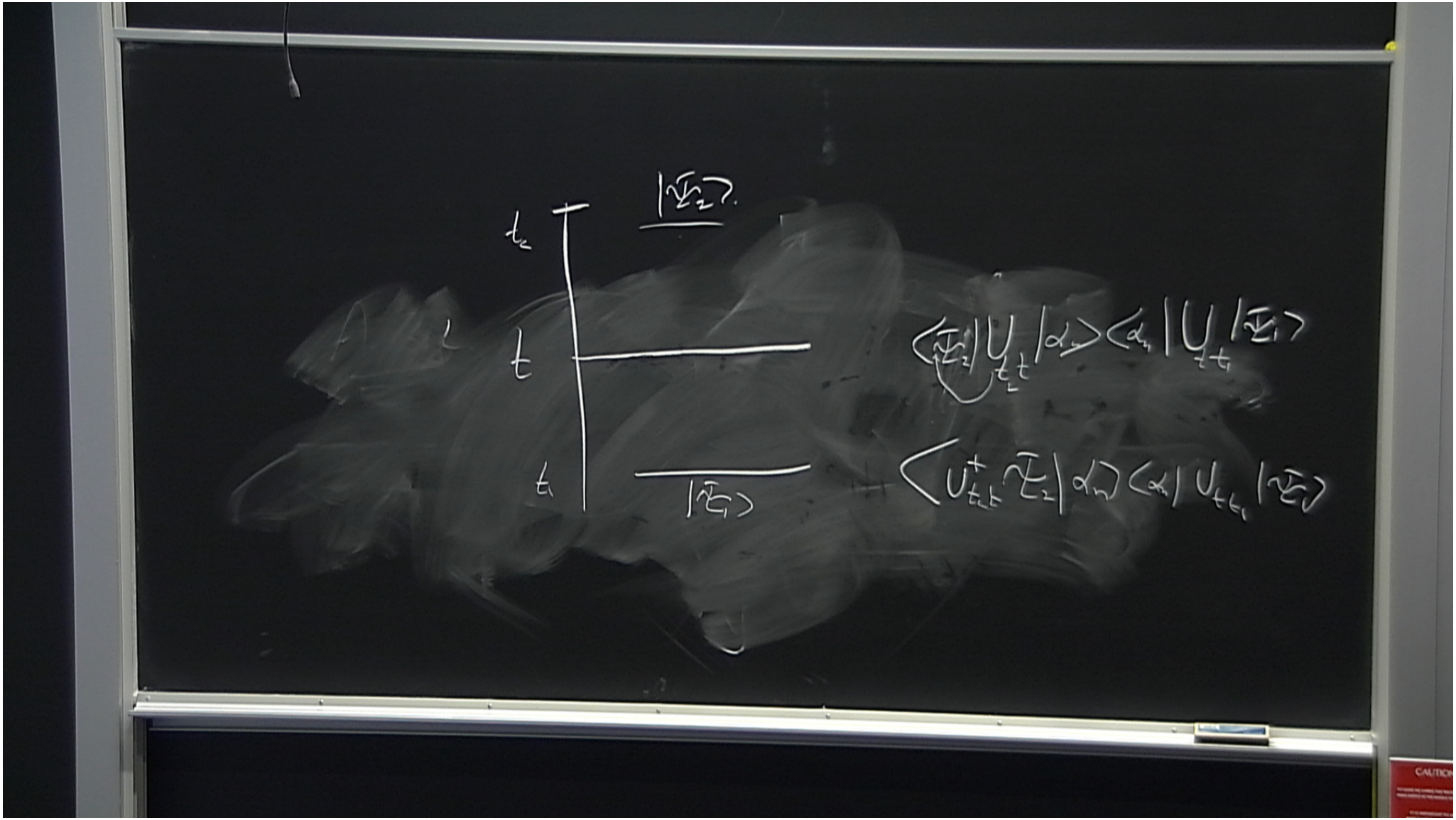


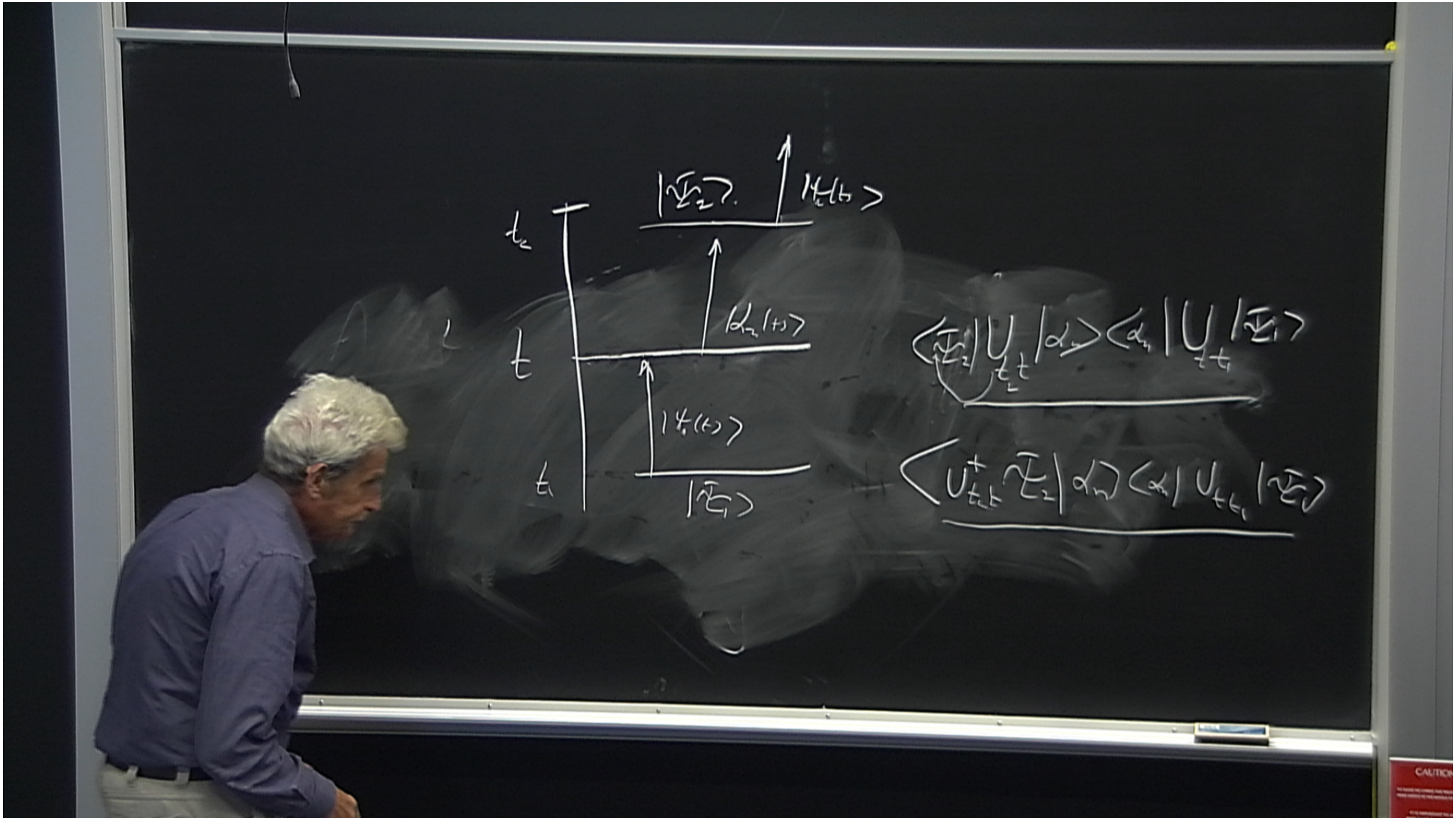

$\hat{A}|a_n\rangle = a_n|a_n\rangle$

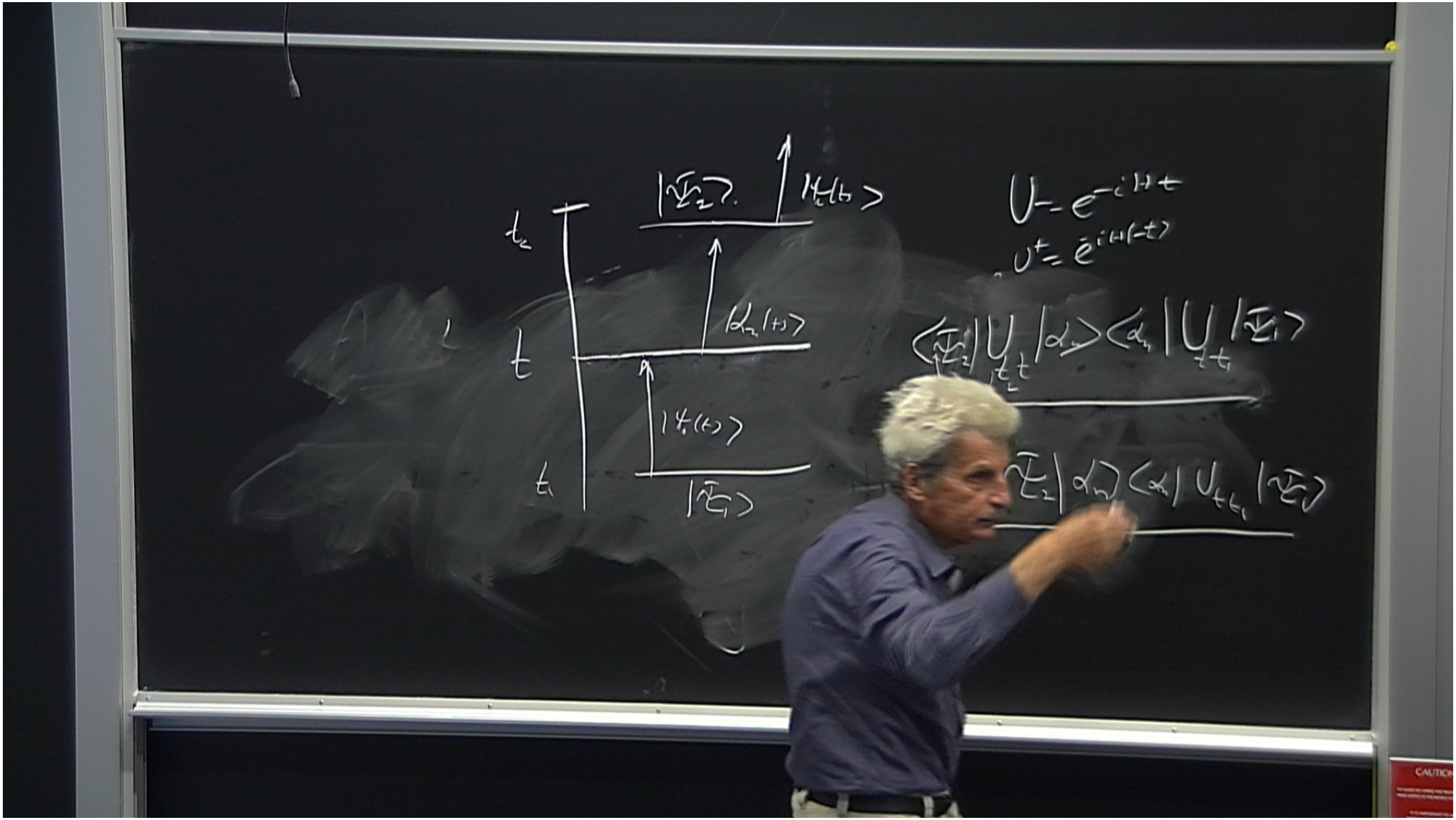

t_2
$|\Sigma_2\rangle$
t
t_1
$|\Sigma_1\rangle$
$\langle a_m | U_{t_1} | \Sigma_1 \rangle$

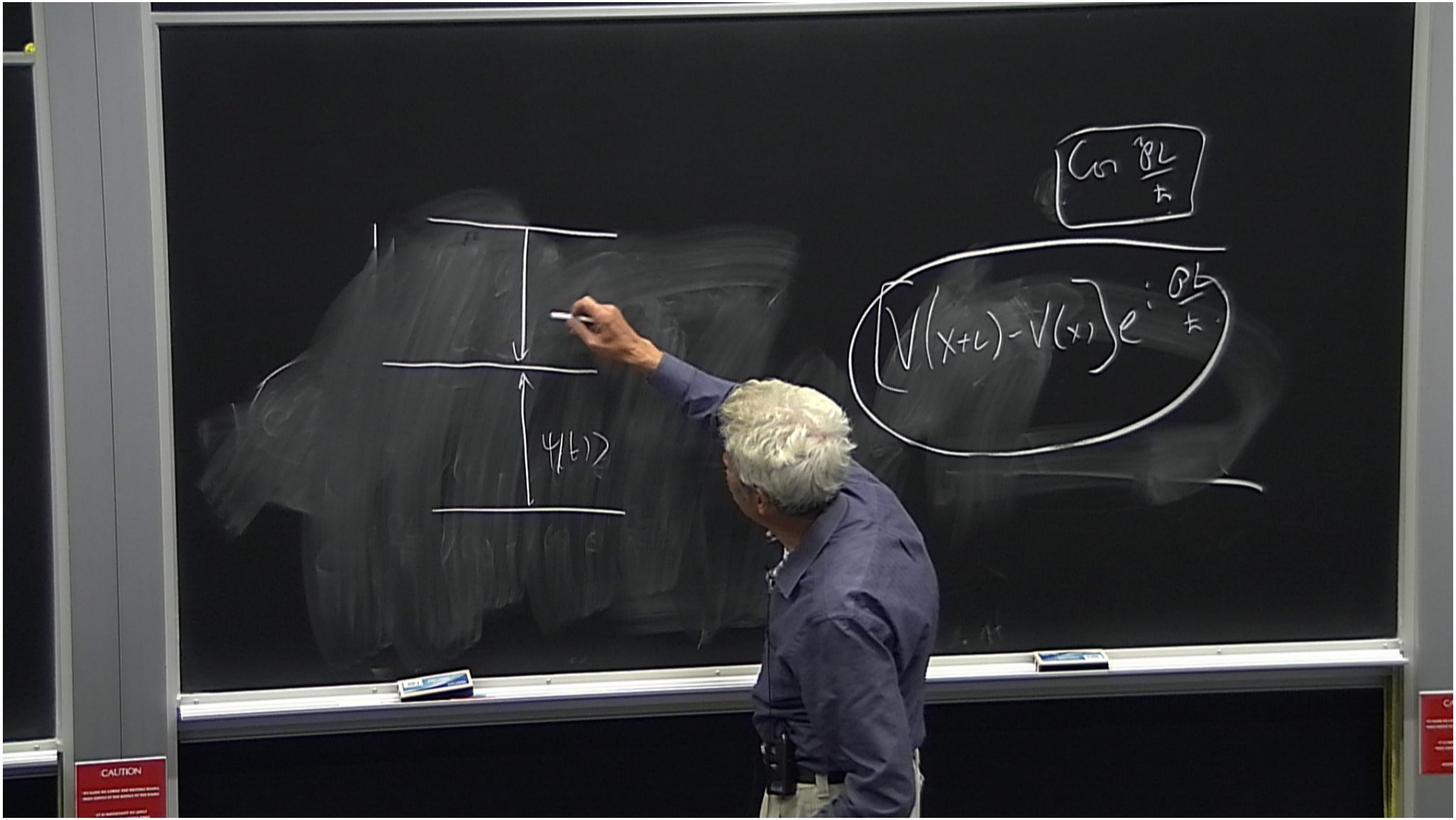

t_2
$|\Sigma_2\rangle$
t
t_1
$|\Sigma_1\rangle$
$\langle\Sigma_2|U_{t_2 t}|\alpha_2\rangle\langle\alpha_1|U_{t t_1}|\Sigma_1\rangle$

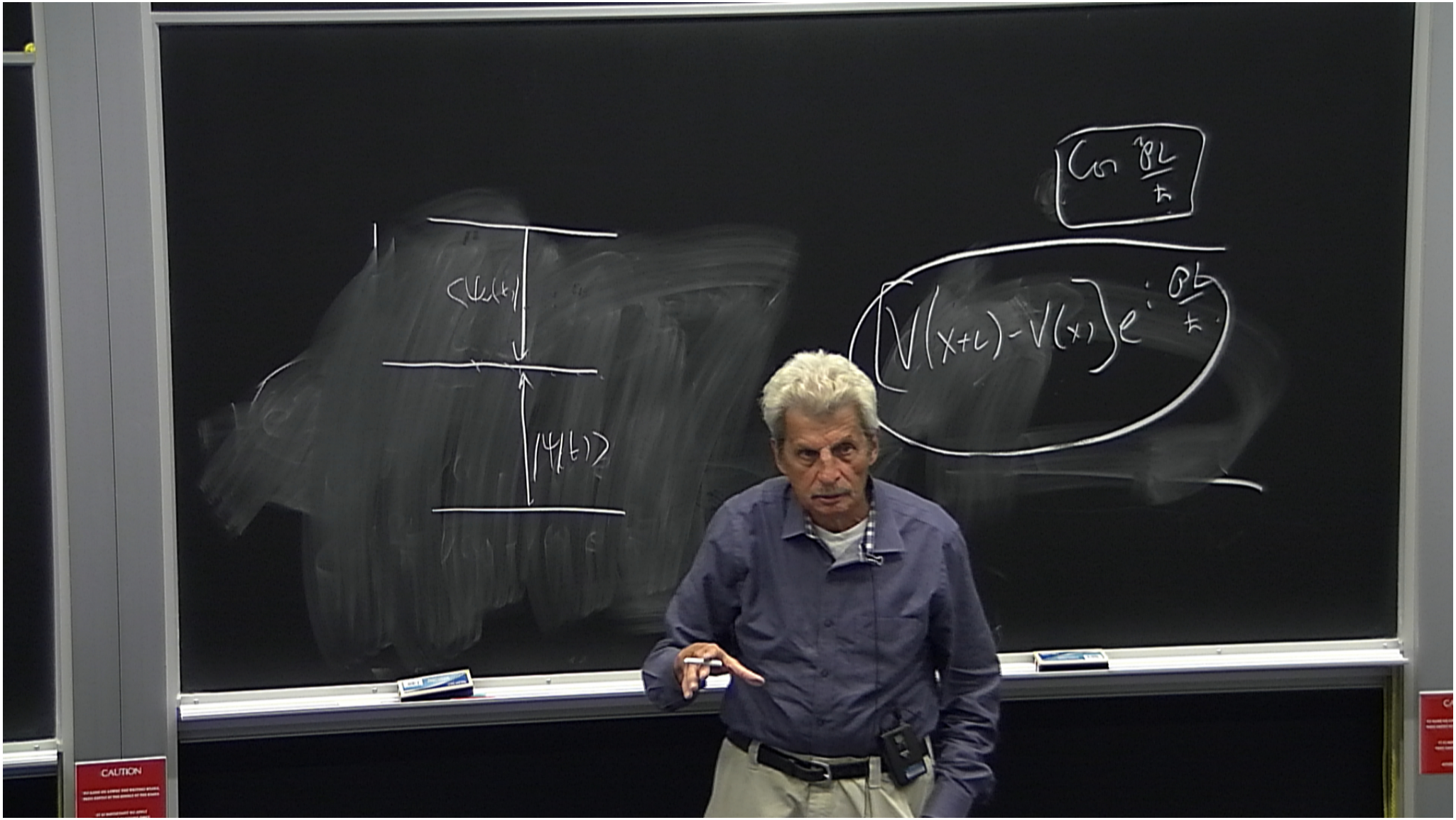

t_2
$|\Sigma_2\rangle$
t_1
$|\Sigma_1\rangle$
$\langle\Sigma_2|U_{t_2t_1}|\alpha_2\rangle\langle\alpha_1|U_{t_1t_1}|\Sigma_1\rangle$
$\langle U^+_{t_2t_1}\Sigma_2|\alpha_2\rangle\langle\alpha_1|U_{t_1t_1}|\Sigma_1\rangle$

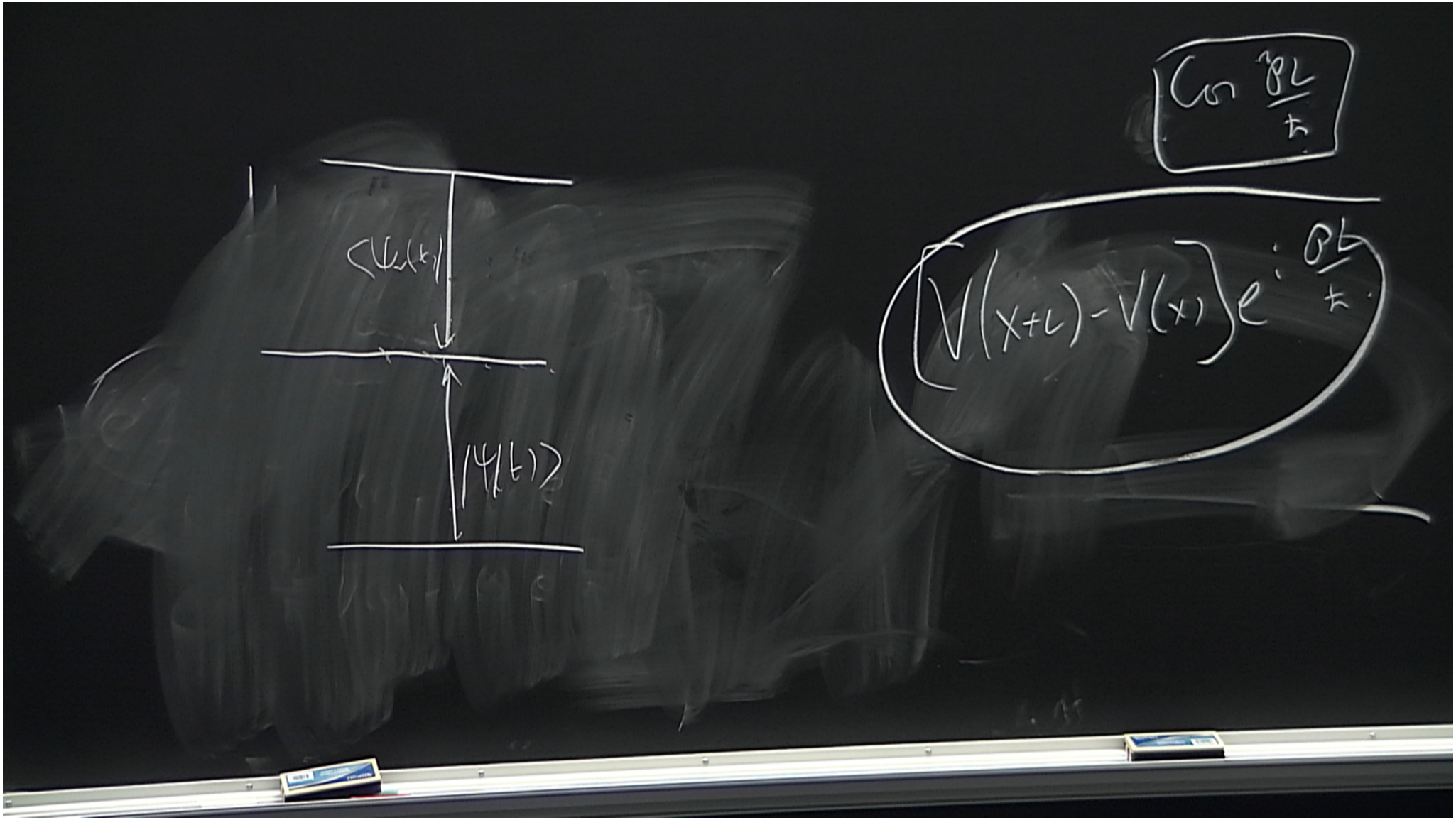

t_2
t
t_1
$|\Sigma_2\rangle$
$|\Sigma_1\rangle$
$\langle\Sigma_2|U_{t_2 t}|\alpha_2\rangle\langle\alpha_1|U_{t t_1}|\Sigma_1\rangle$
$\langle U^+_{t_2 t}\Sigma_2|\alpha_2\rangle\langle\alpha_1|U_{t t_1}|\Sigma_1\rangle$

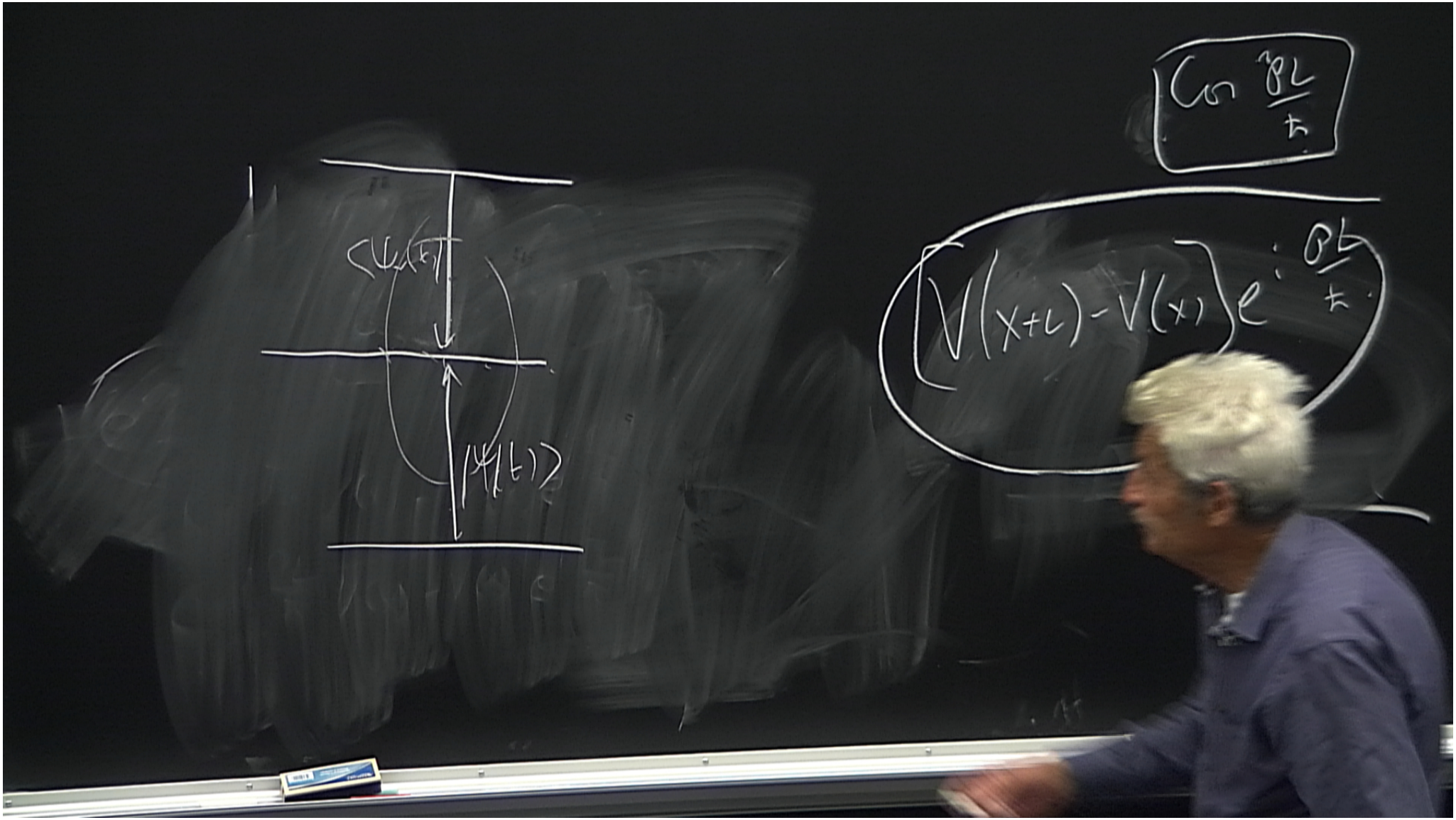

t_2
t
t_1
$|\Psi_2\rangle$
$|\Psi_I(t_2)\rangle$
$|\alpha_m(t)\rangle$
$|\Psi_I(t)\rangle$
$|\Psi_I\rangle$
$\langle\Psi_2|U_{t_2 t}|\alpha_m\rangle\langle\alpha_m|U_{t t_1}|\Psi_1\rangle$
$\langle U^{+}_{t_2 t}\Psi_2|\alpha_m\rangle\langle\alpha_m|U_{t t_1}|\Psi_1\rangle$

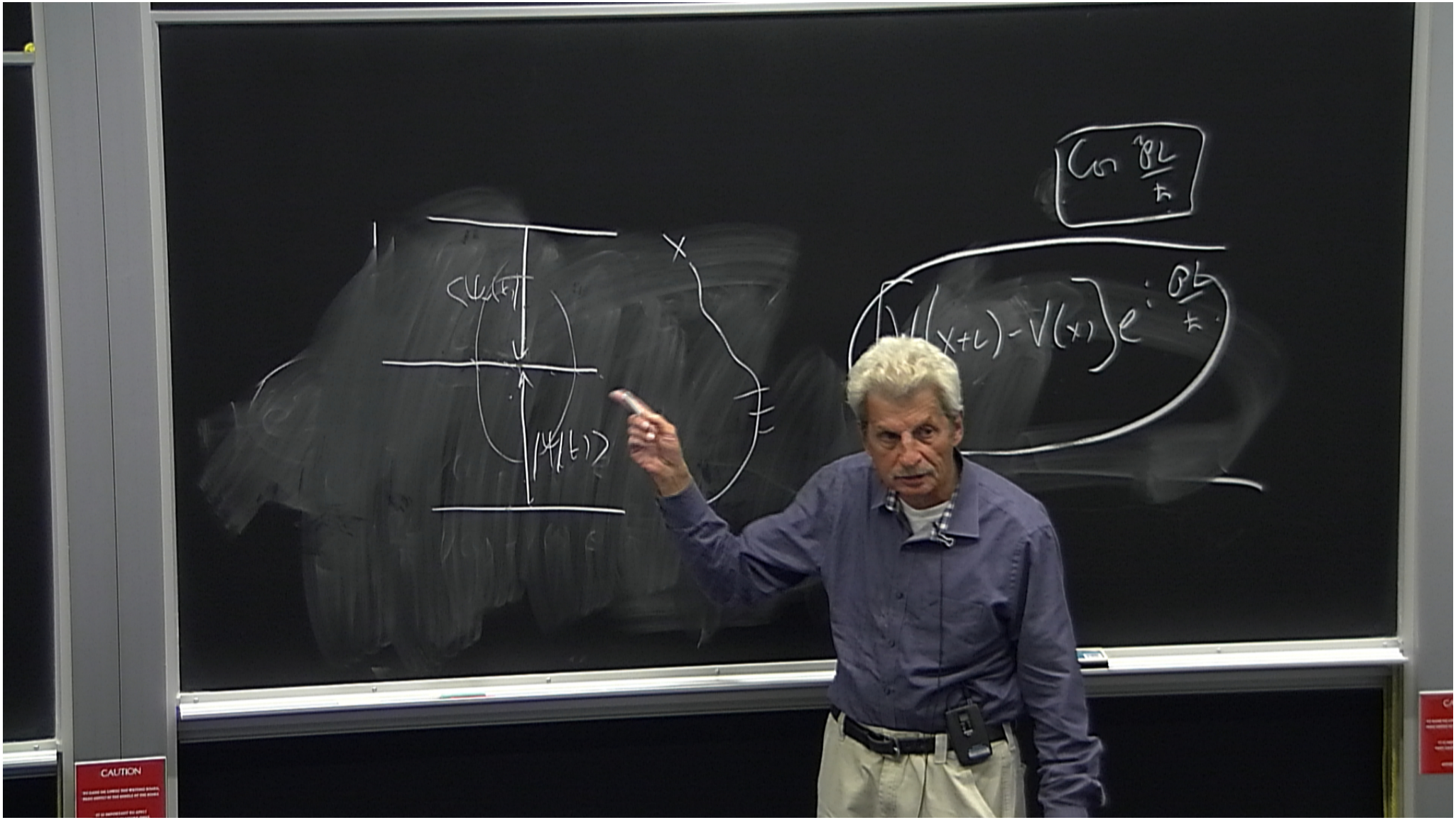

t_2
t
t_1
$|\Psi_2\rangle$
$|\alpha_m(t)\rangle$
$|\psi_i(t)\rangle$
$|\Psi_1\rangle$
$U = e^{-iHt}$
$U^\dagger = e^{iH(-t)}$
$\langle\Psi_2|U_{t_2 t}|\alpha_m\rangle\langle\alpha_m|U_{t t_1}|\Psi_1\rangle$
$|\Psi_2\rangle\langle\alpha_m|\langle\alpha_m|U_{t_2 t_1}|\Psi_1\rangle$

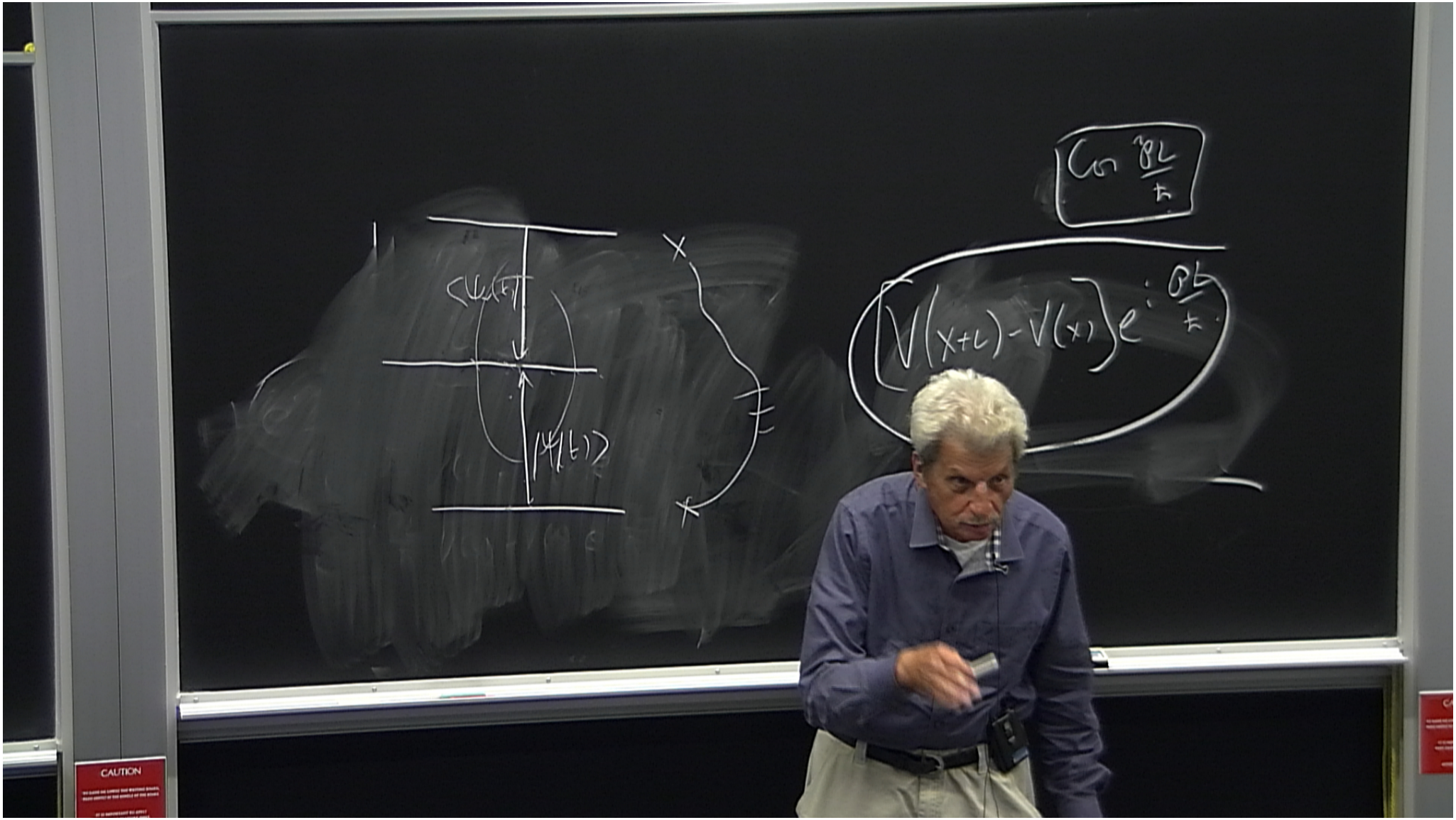

CAUTION

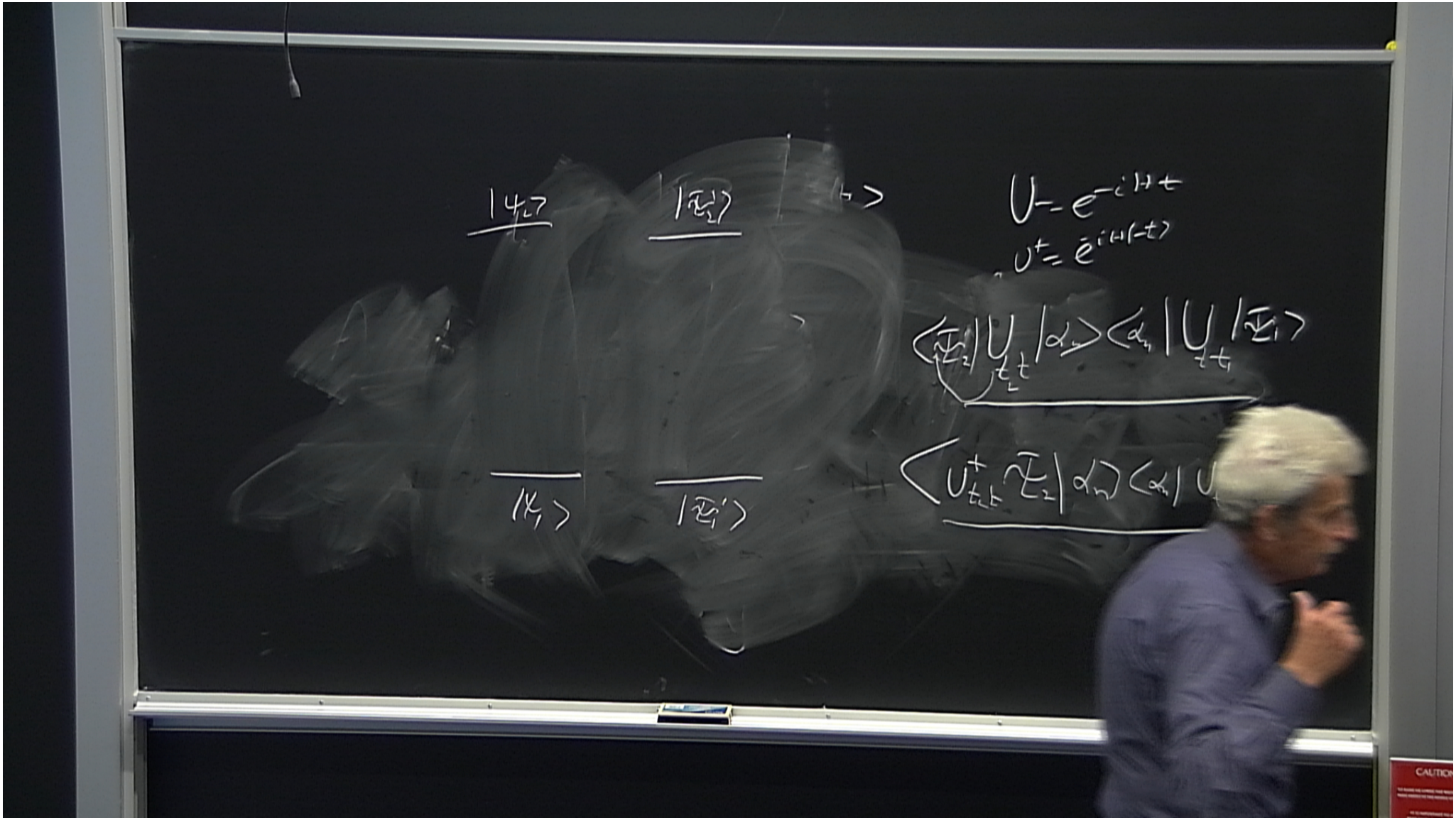

CAUTION

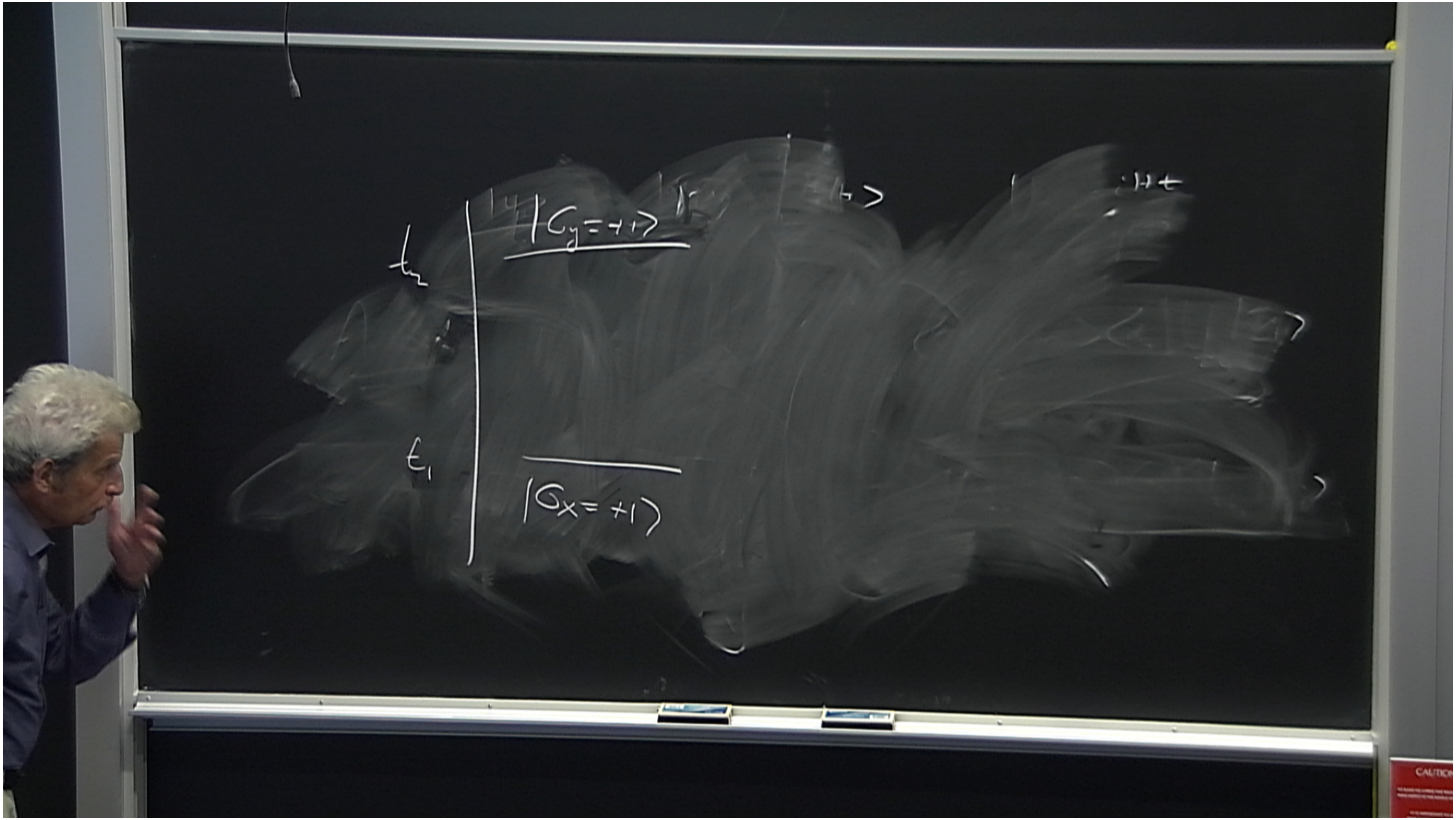

$\frac{2\pi}{L}$
$\hbar$
$\langle \psi_{n-1}(x) |$
$|\psi_n(x)\rangle$
$[V(x+L)-V(x)]e^{i\frac{2\pi}{\hbar}}$

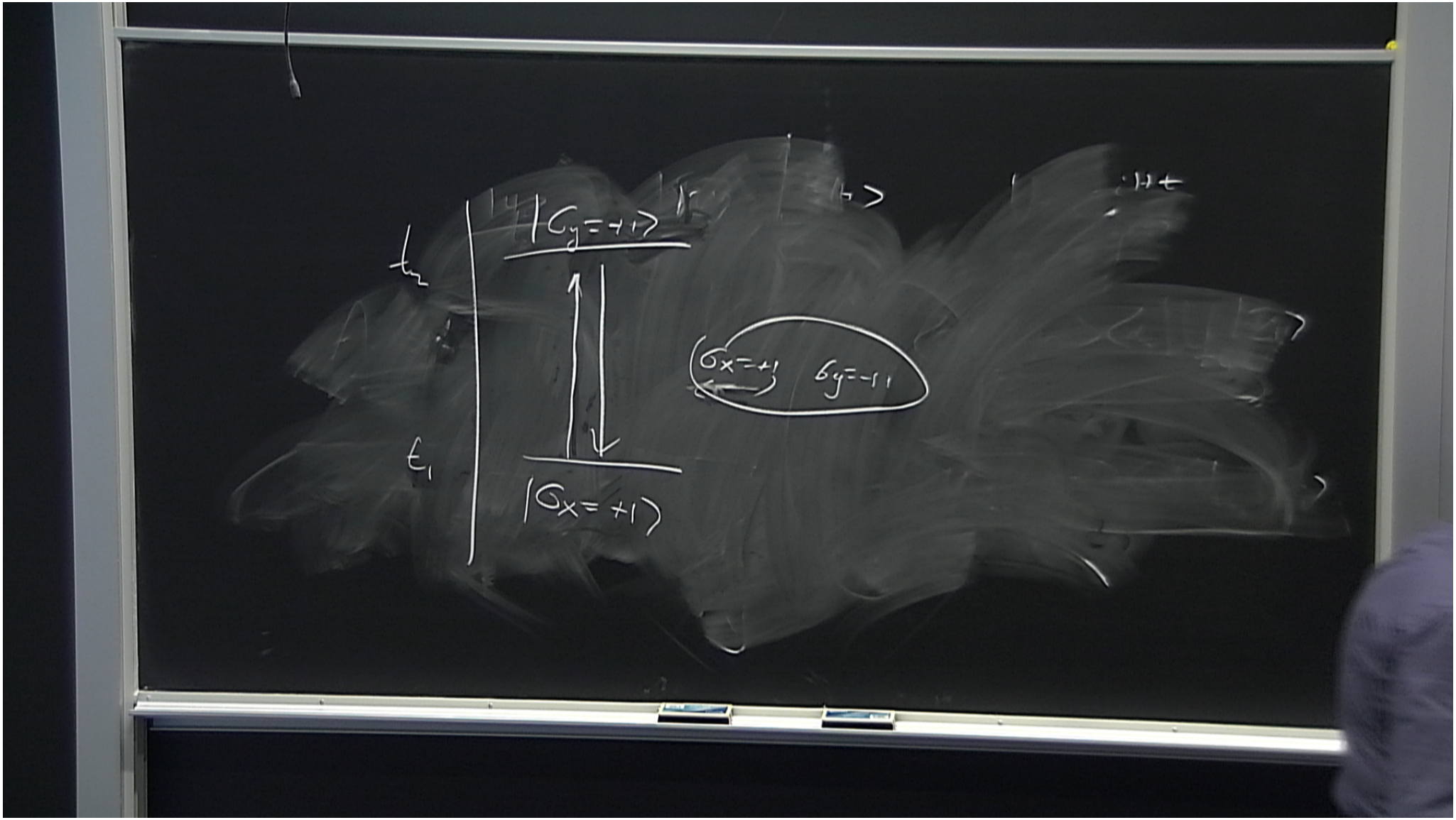

V(x+L)-V(x)

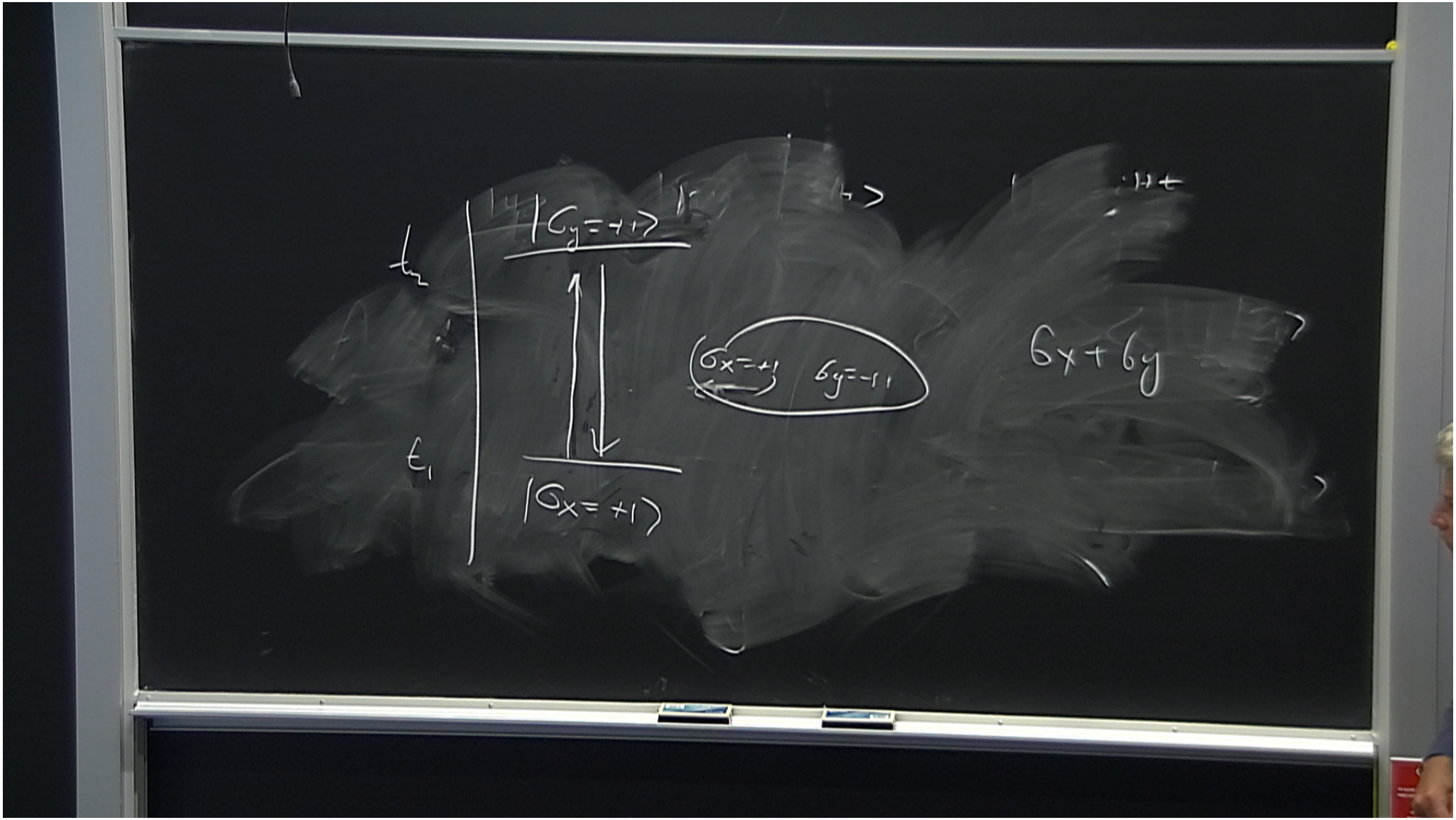

CAUTION

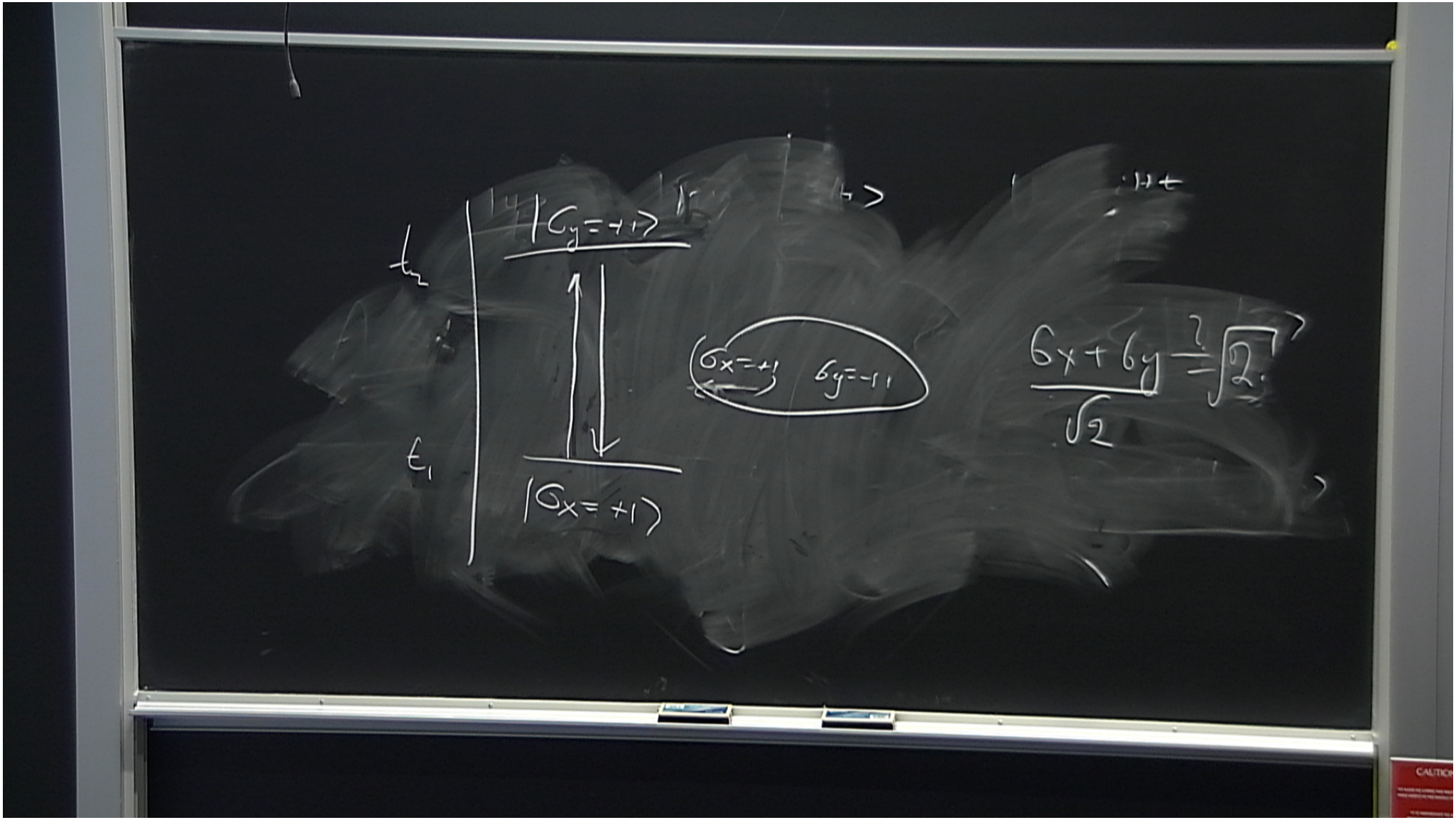

CAUTION

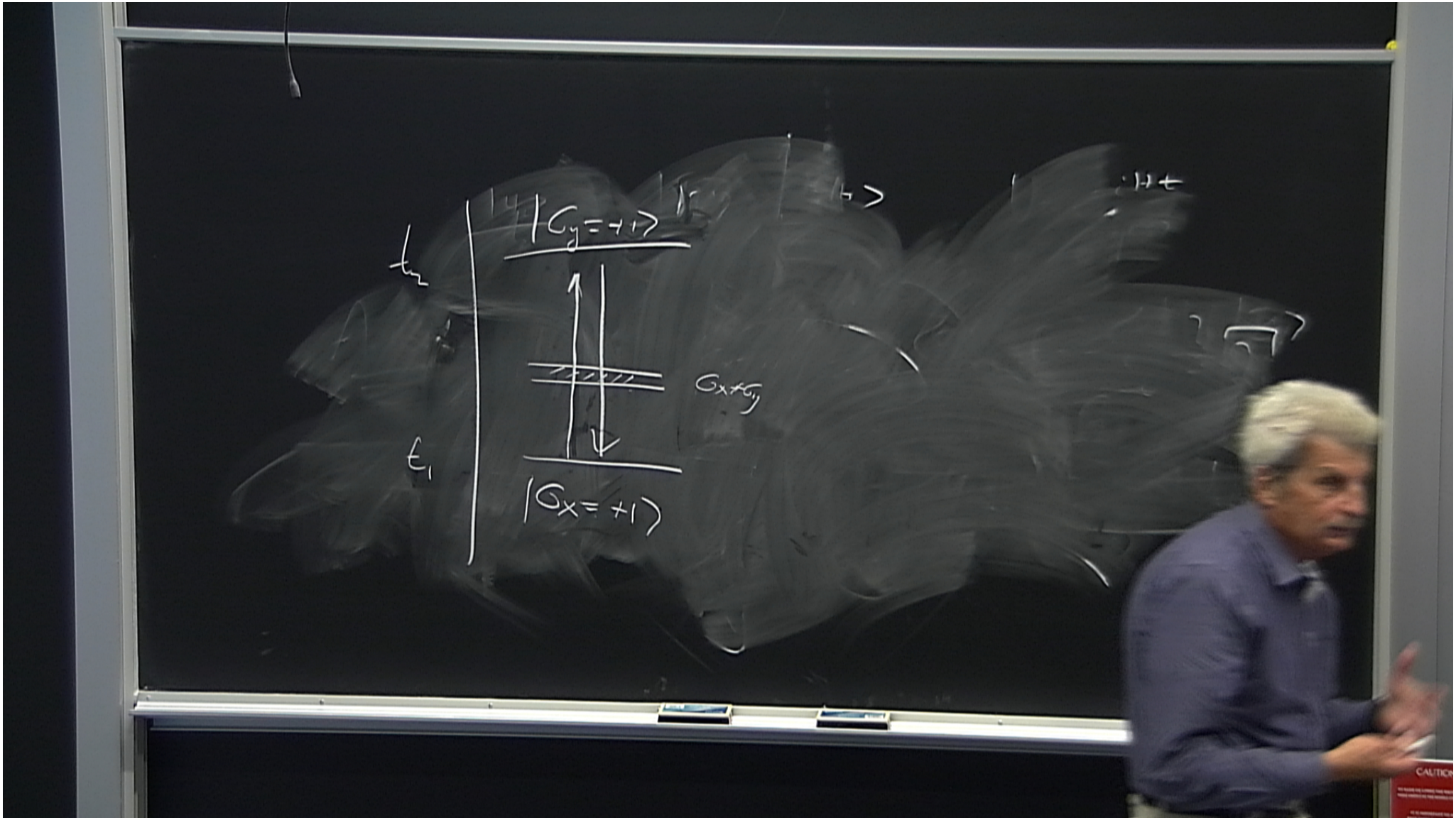

$|\psi_{t_2}\rangle$
$|\vec{x}_2\rangle$
$|\psi_{t_1}\rangle$
$|\vec{x}_1\rangle$
$U = e^{-iHt}$
$U^\dagger = e^{iH(-t)}$
$\langle \vec{x}_2 | U_{t_2 t} | \alpha_2 \rangle \langle \alpha_1 | U_{t t_1} | \vec{x}_1 \rangle$
$\langle U^\dagger_{t_2 t} \vec{x}_2 | \alpha_2 \rangle \langle \alpha_1 | U$

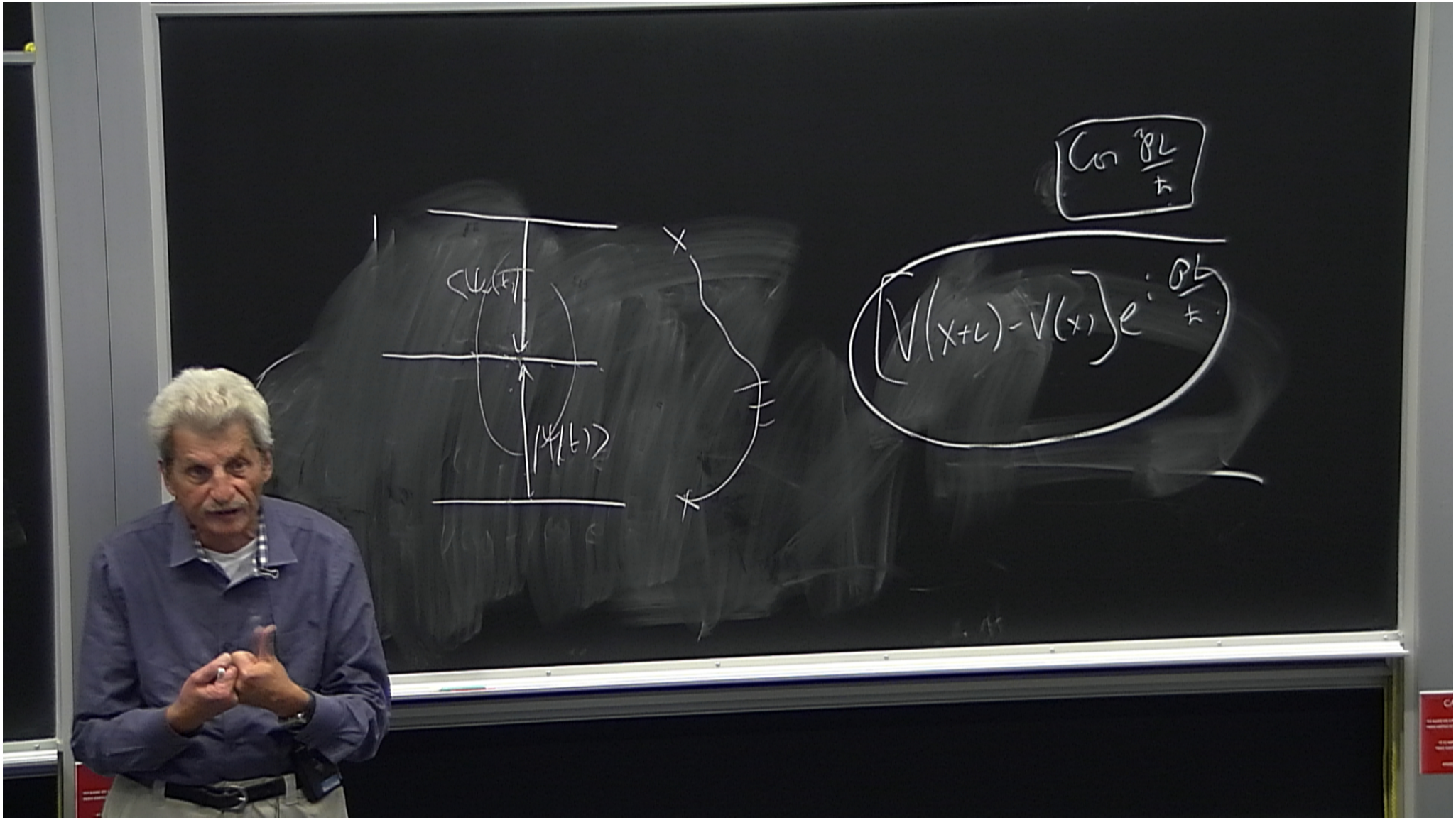

$|\sigma_y = +1\rangle$
$|\sigma_x = +1\rangle$

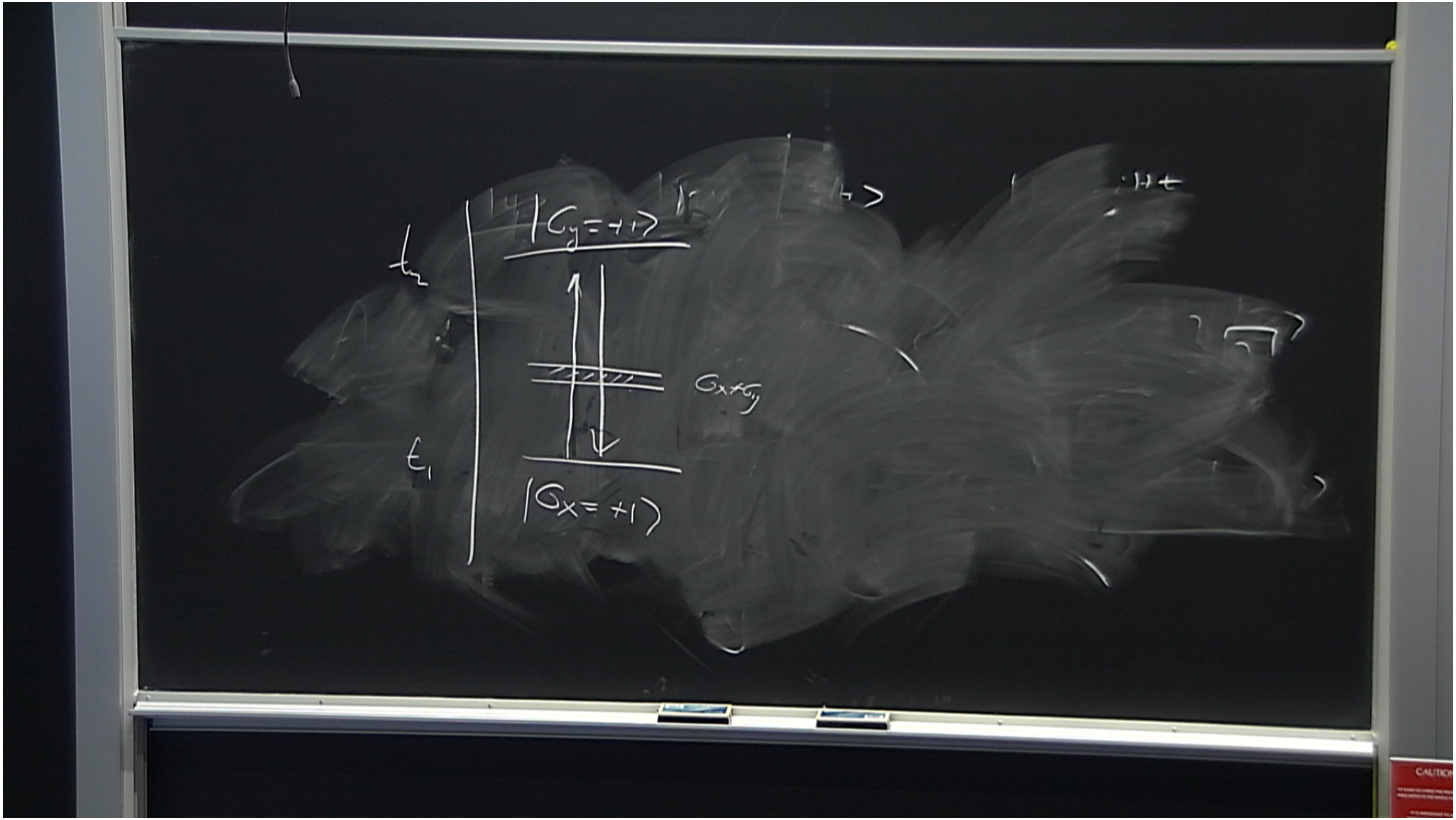

$|\sigma_y=+1\rangle$
$|\sigma_x=+1\rangle$
$\sigma_x=+1$ $\sigma_y=-1$

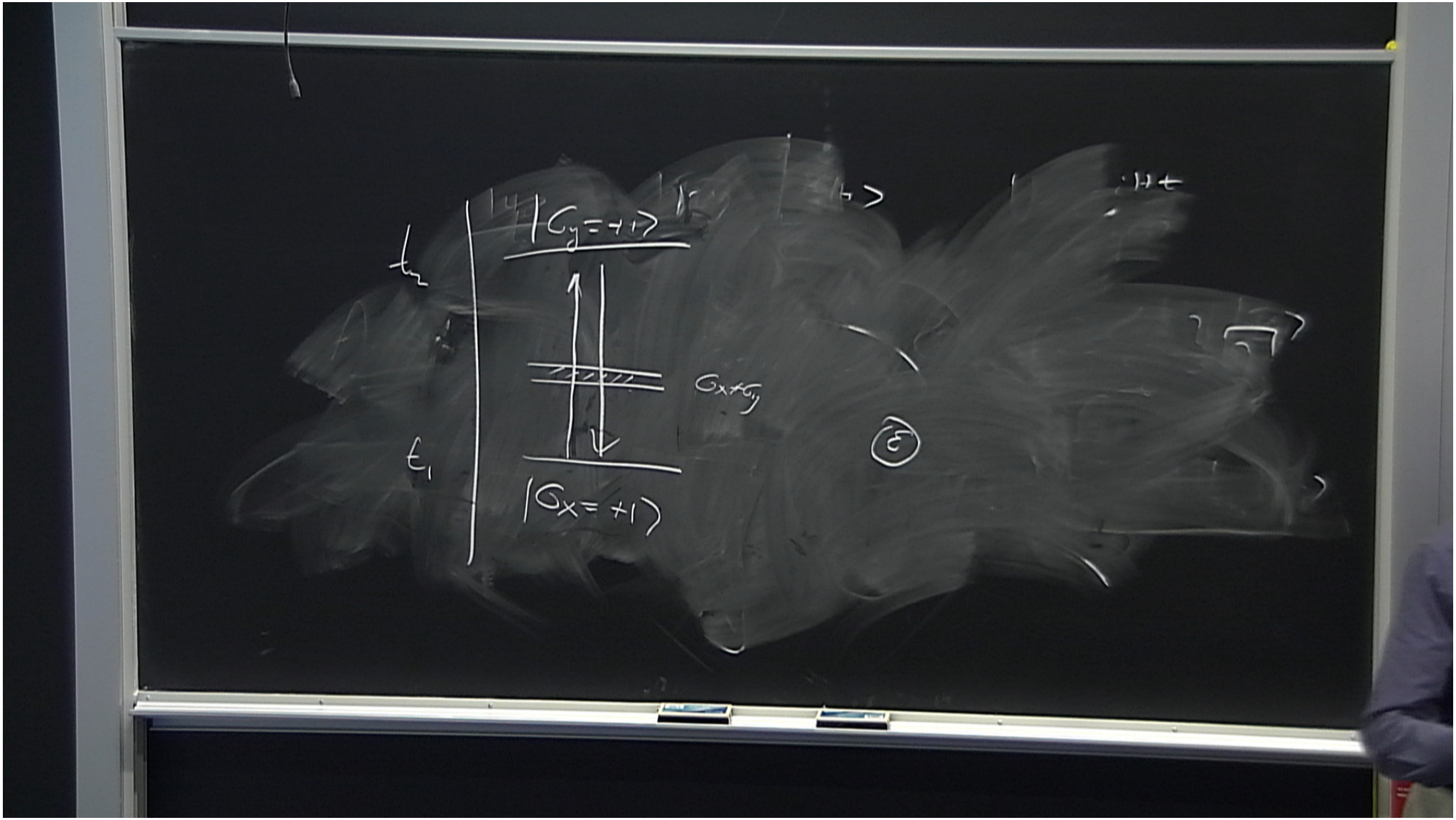

$|\sigma_y=+1\rangle$
$|\sigma_x=+1\rangle$
$\sigma_x=+1$ $\sigma_y=-1$
$\sigma_x+\sigma_y$

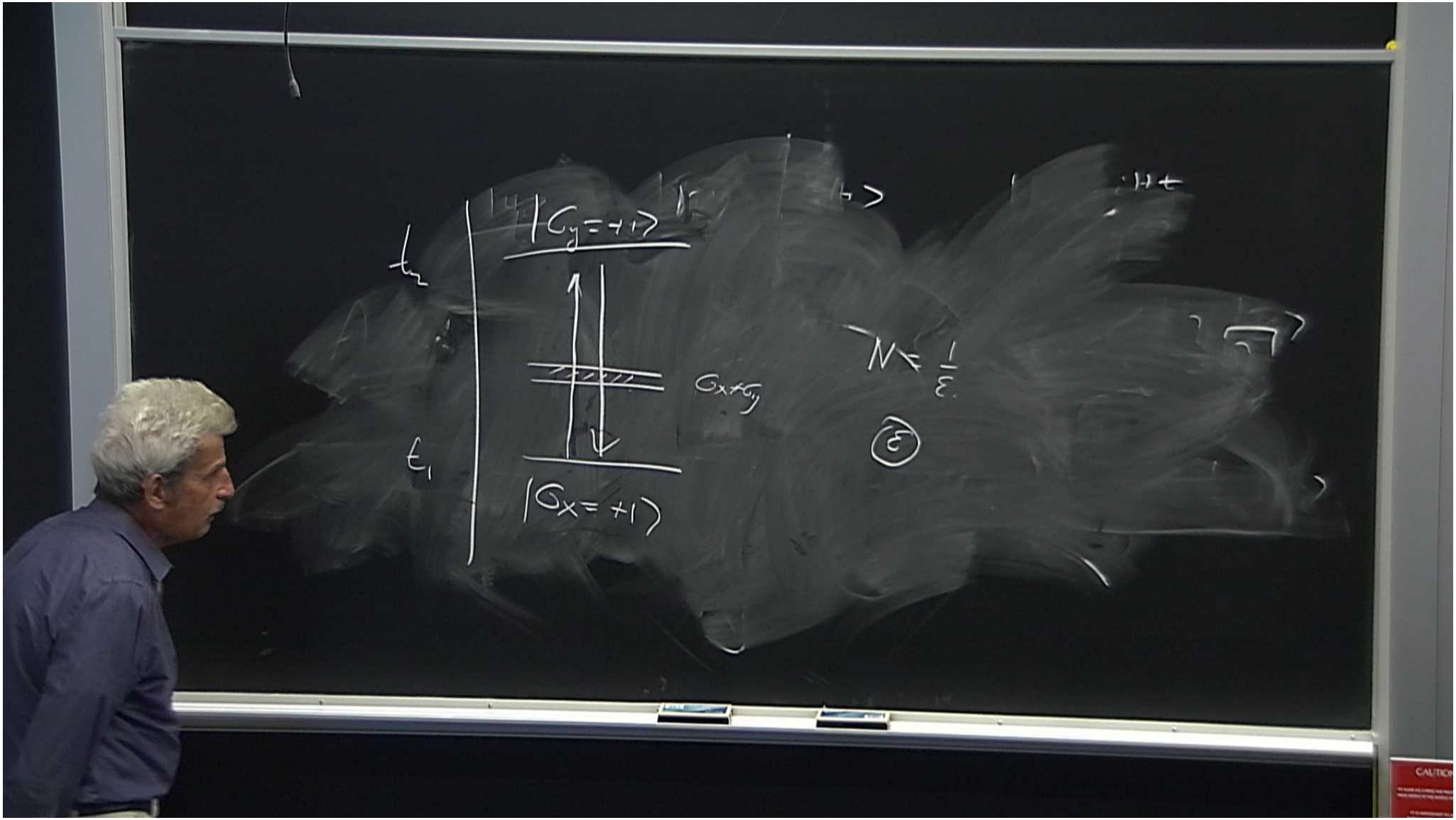

$|G_y=+1\rangle$
$|G_x=+1\rangle$
$G_x=+1$ $G_y=-1$
$\frac{G_x+G_y}{\sqrt{2}} \stackrel{?}{=} \sqrt{2}$

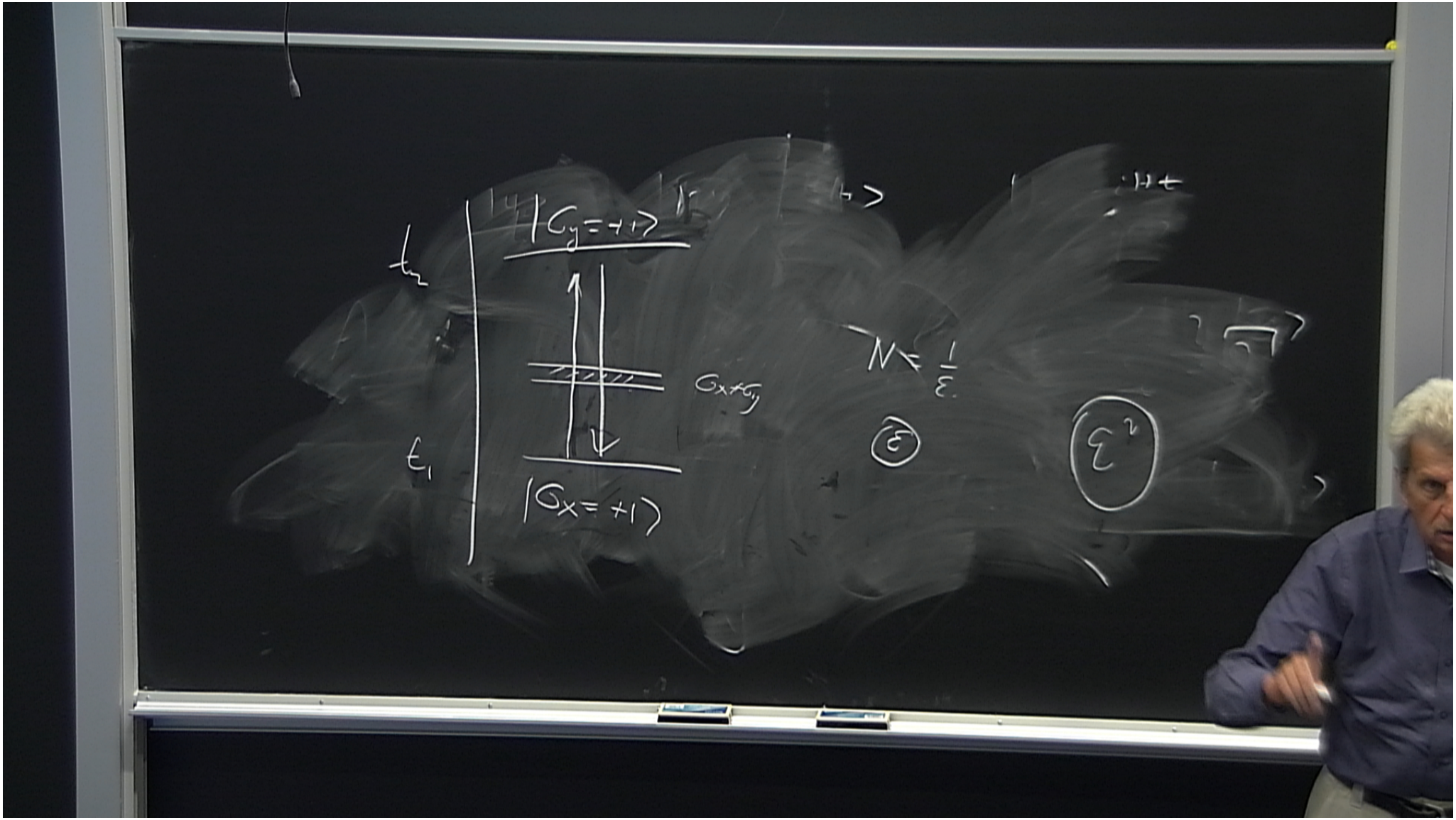

$|G_y=+1\rangle$
G_x+G_y
$|G_x=+1\rangle$

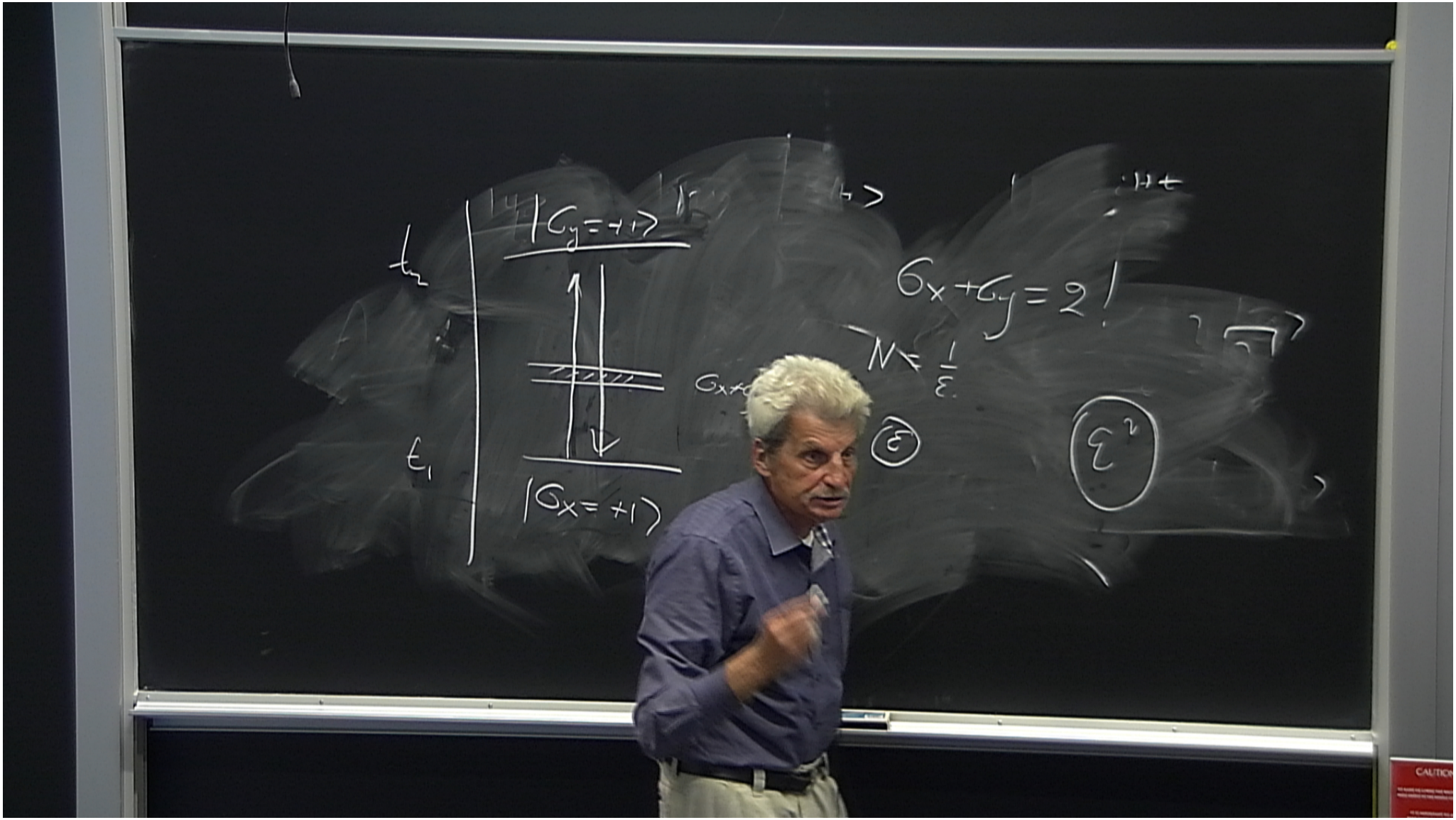

$\langle \psi_k(t) |$
$|\psi(t)\rangle$
$[V(x+L) - V(x)] e^{i \frac{\beta L}{\hbar}}$

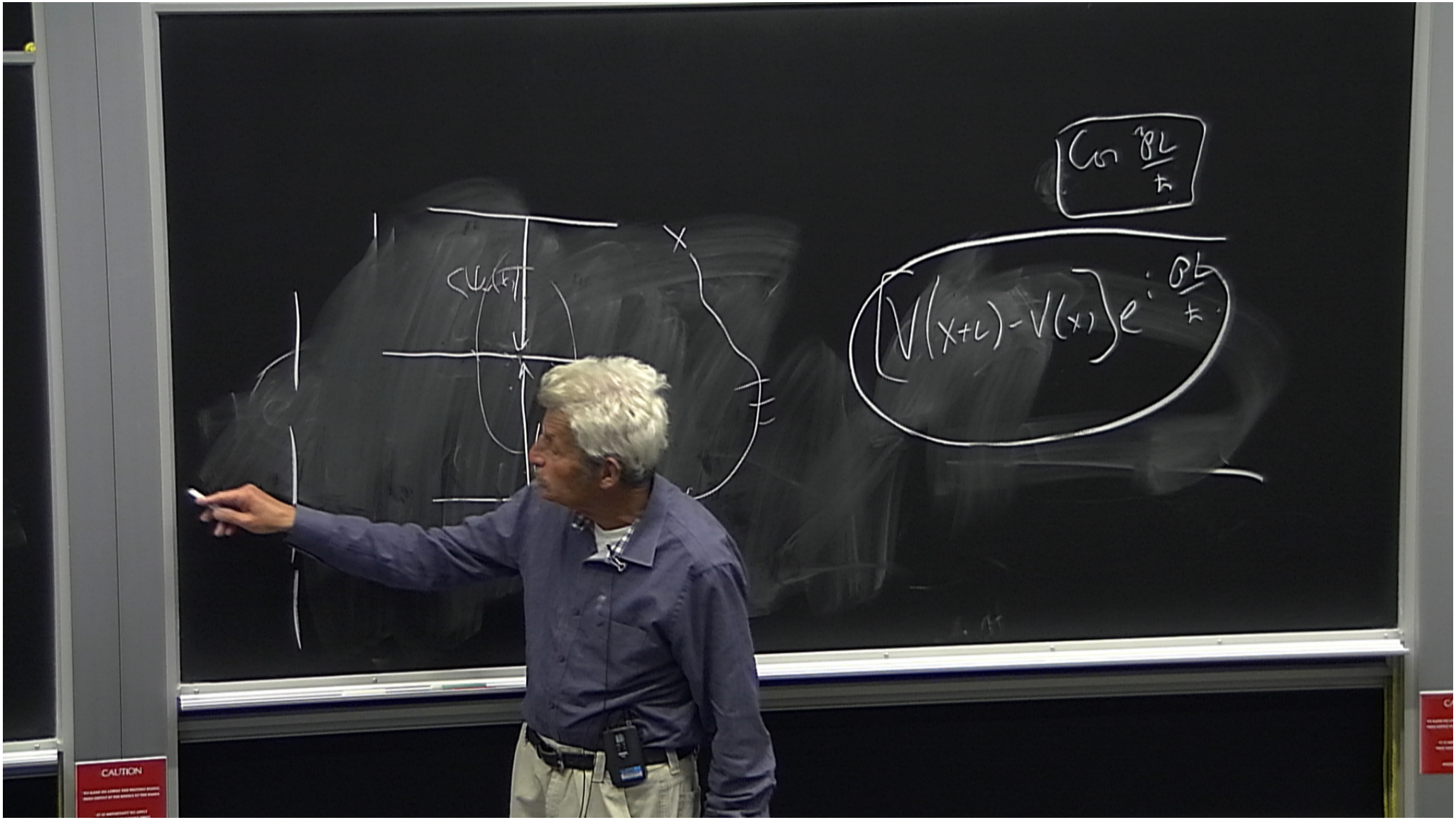

$|G_y=+1\rangle$
G_x+G_y
$|G_x=+1\rangle$

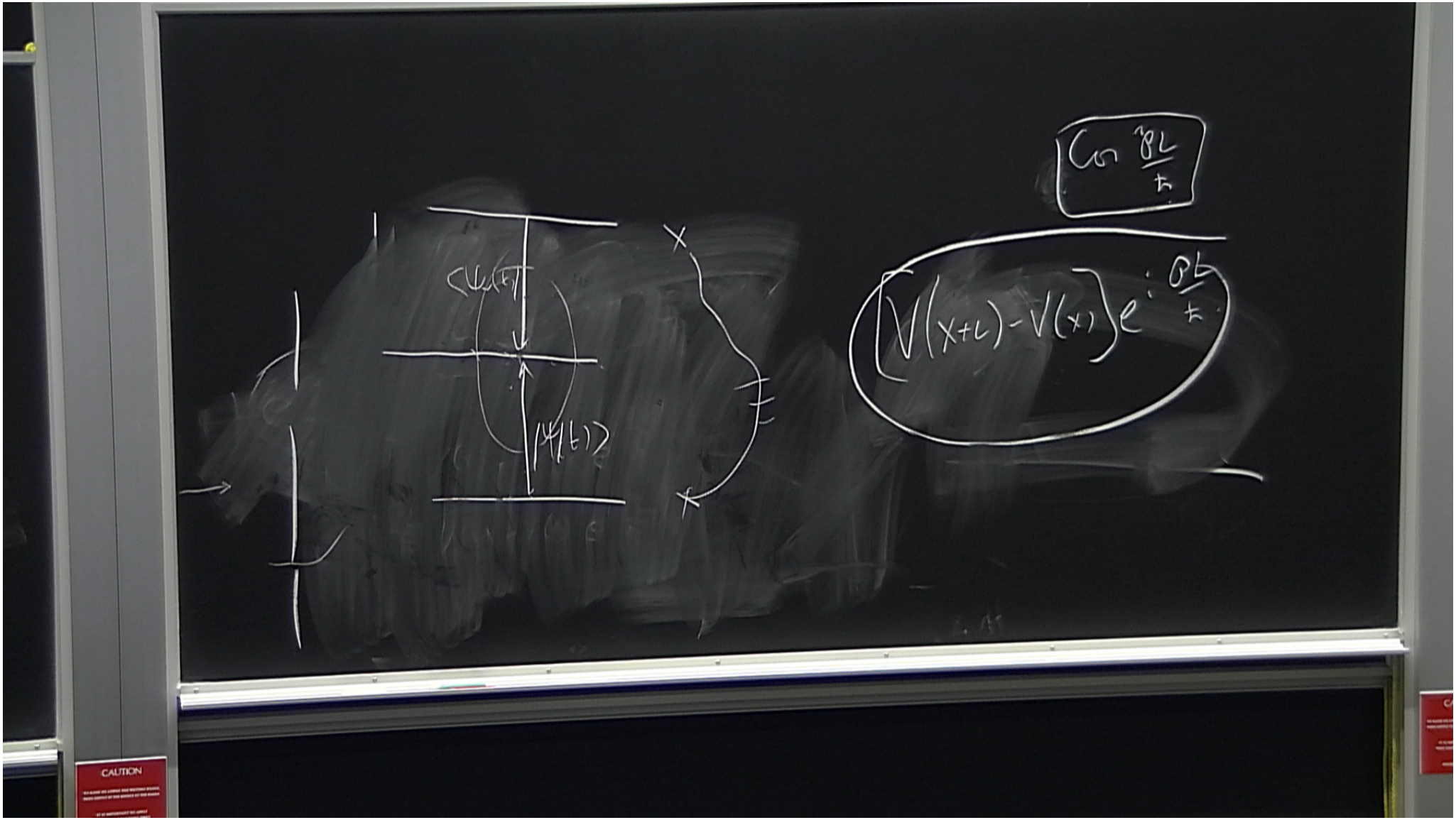

$|G_y=+1\rangle$
$G_x G_y$
$|G_x=+1\rangle$


$|G_y=+1\rangle$
G_x+G_y
$|G_x=+1\rangle$
$N=\frac{1}{\varepsilon}$


$|G_y=+1\rangle$
$G_x \neq G_y$
$|G_x=+1\rangle$
$N=\frac{1}{\varepsilon}$
ε
ε^2


$|G_y=+1\rangle$
$|G_x=+1\rangle$
$G_x+G_y=2$
$N=\frac{1}{\varepsilon}$
ε
ε^2


X
CAUTION


$\frac{2\pi L}{h}$
$[V(x+L)-V(x)]e^{i\frac{2\pi L}{h}}$