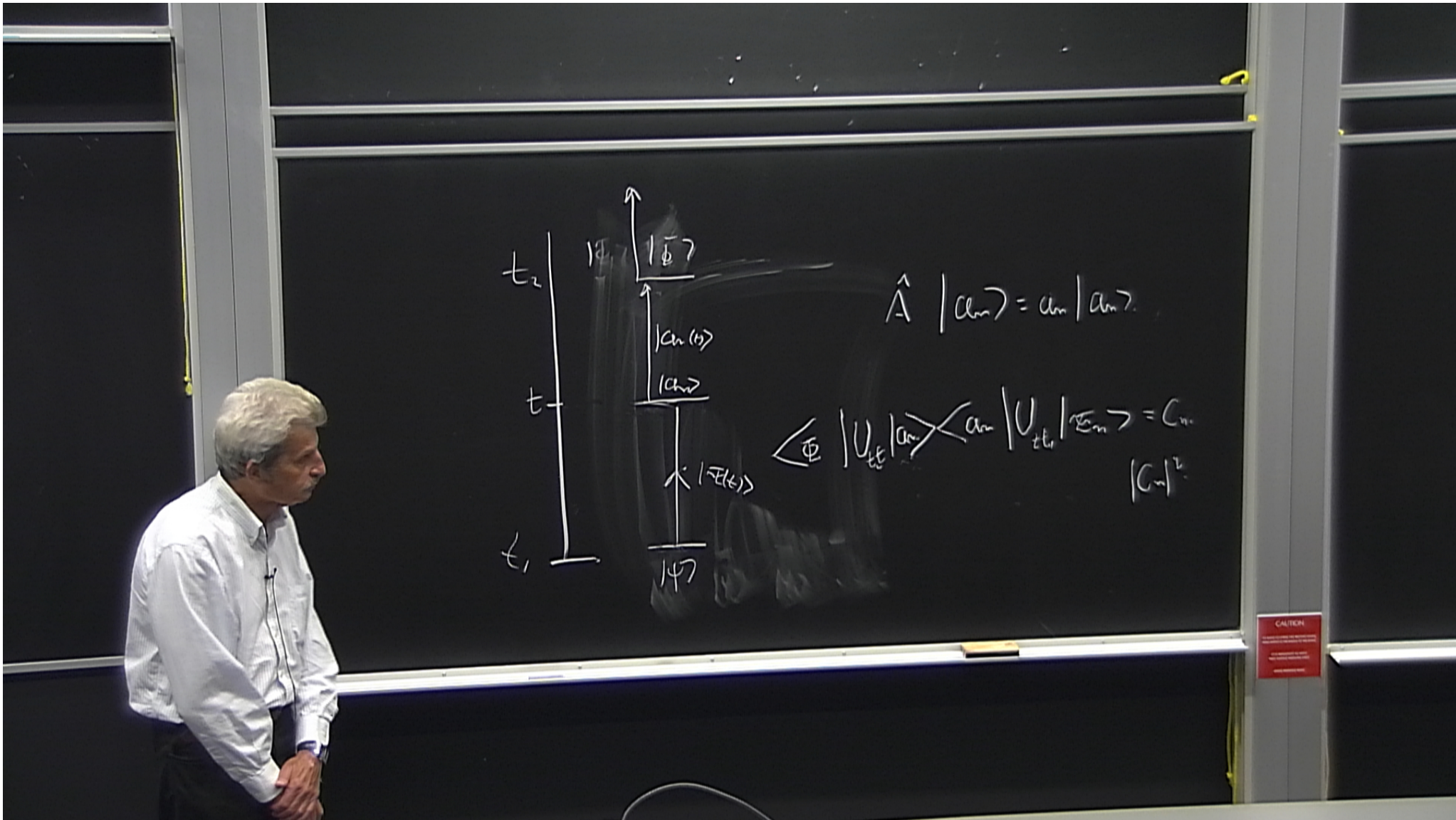


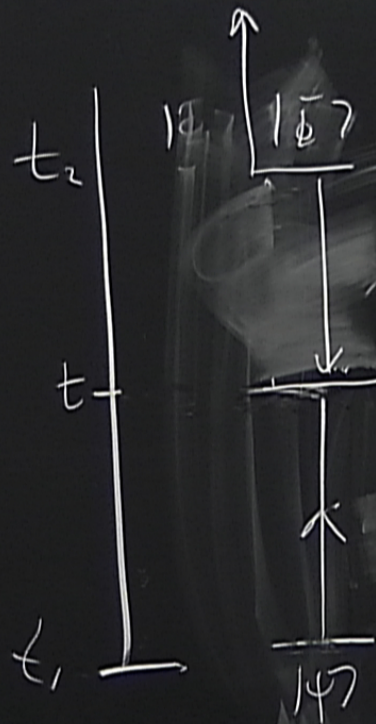
Title: 14/15 PSI - Yakir Aharonov

Date: Aug 19, 2014 02:00 PM

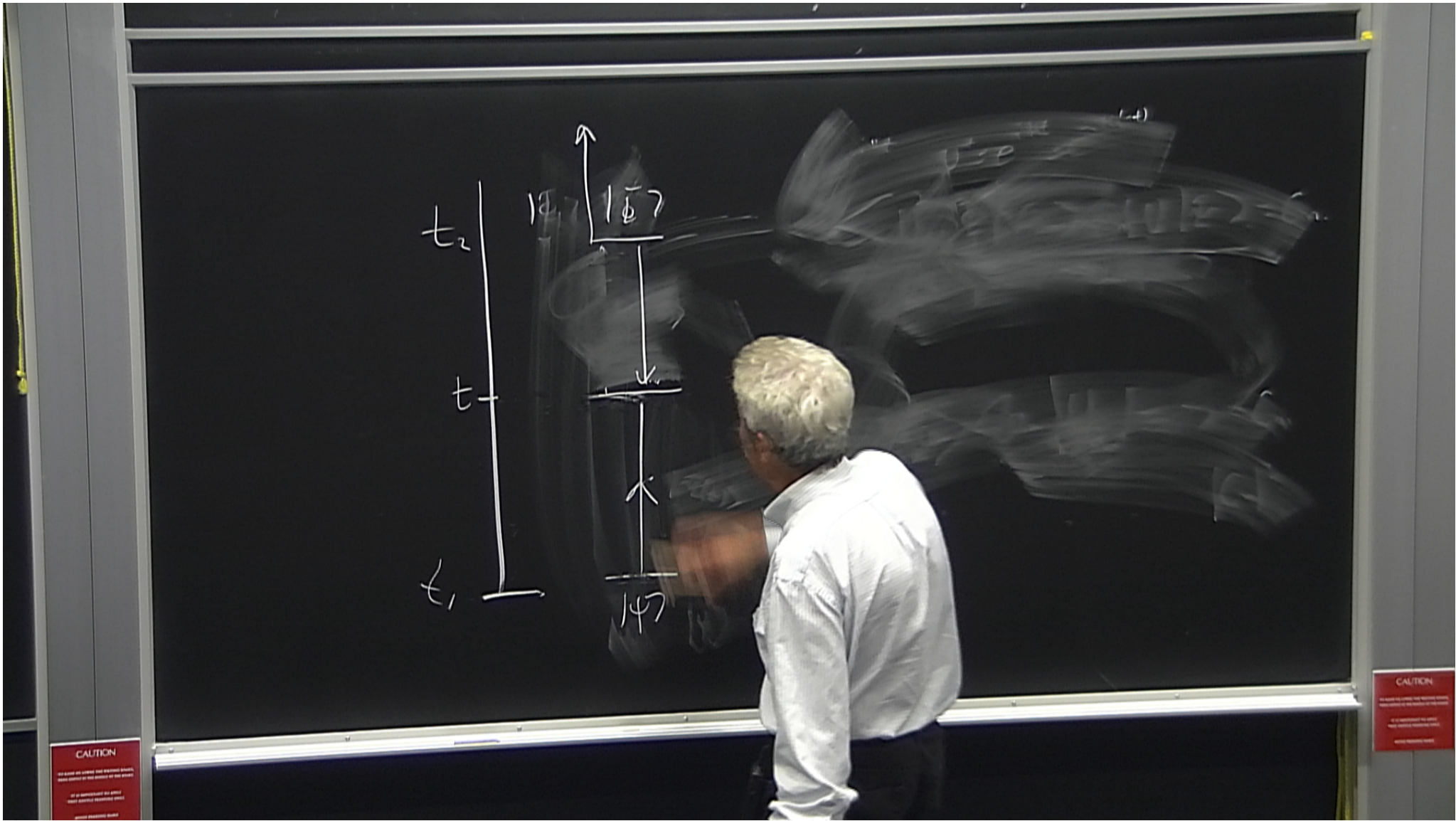
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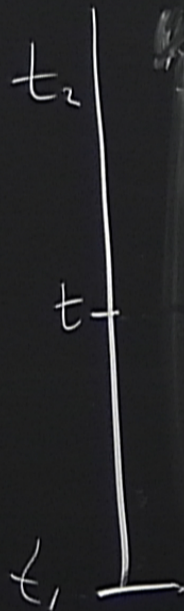
Abstract:





CAUTION
 Do not touch the screen or the board, they are hot to the touch.
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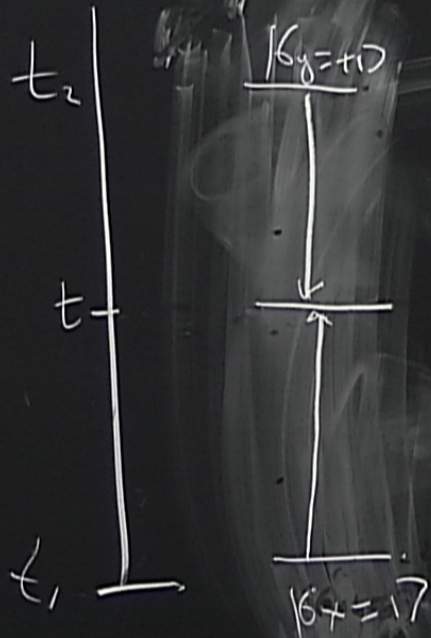


$$|6y = t_1|$$

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CAUTION
Do not touch the board or the board eraser.
If you are not authorized to use the board, please contact the instructor.

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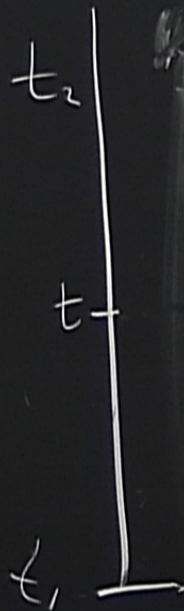
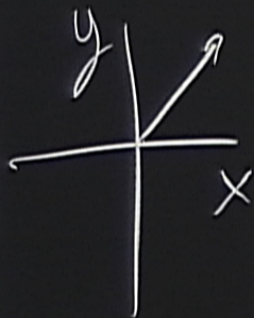


CAUTION

DO NOT TOUCH THE BOARD SURFACE.
HANDS WILL BE CLEANED BY THE BOARD AT THE END OF THE HOUR.

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HANDS WILL BE CLEANED BY THE BOARD AT THE END OF THE HOUR.



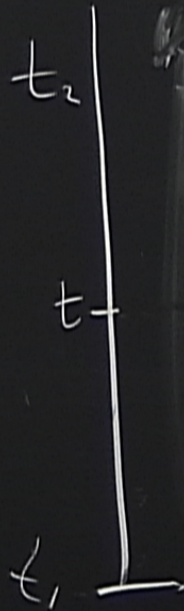
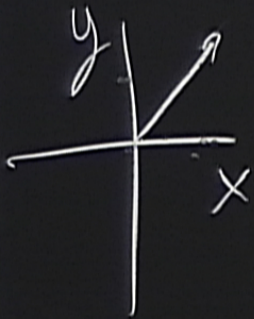
$$6y = +10$$

$$6x = -17$$

$$\frac{6x + 6y}{\sqrt{2}} \stackrel{?}{=} \sqrt{2}$$

CAUTION
DO NOT TOUCH THE BOARD SURFACE
OR THE BOARD FRAME

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OR THE BOARD FRAME



$$|G_y = +D$$

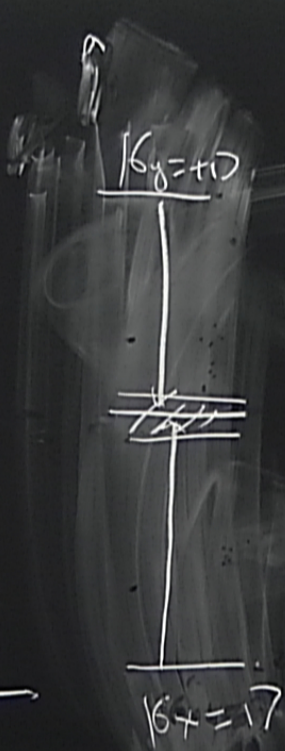
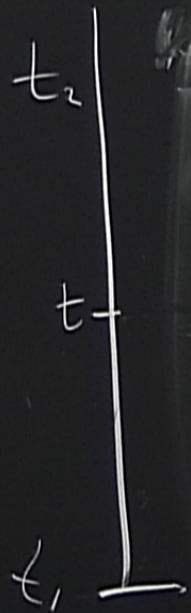
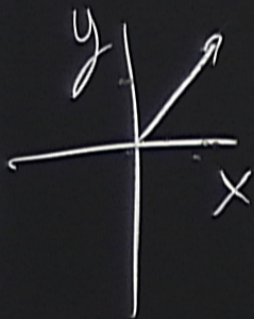
$$|G_y = 0$$

$$|G_y = -D$$

Weak-Means

CAUTION
DO NOT TOUCH THE BOARD SURFACE.
HANDS SHOULD BE KEPT AWAY FROM THE BOARD.
IT IS PROHIBITED TO SMOKING
OR DRINKING BEVERAGES NEAR THE BOARD.

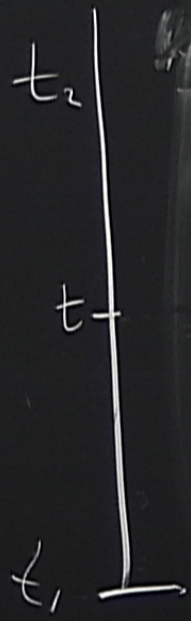
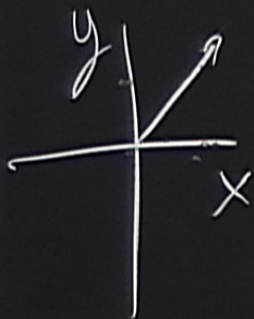
CAUTION
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$$|\Psi_{tot}\rangle = \prod_{m=1}^N |\psi_m\rangle$$

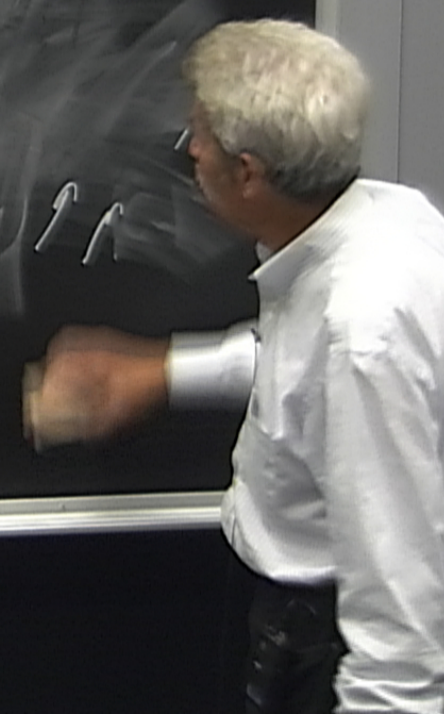
CAUTION
DO NOT TOUCH THE BOARD SURFACE.
IT IS PROHIBITED TO WRITE
ON THE BOARD SURFACE.

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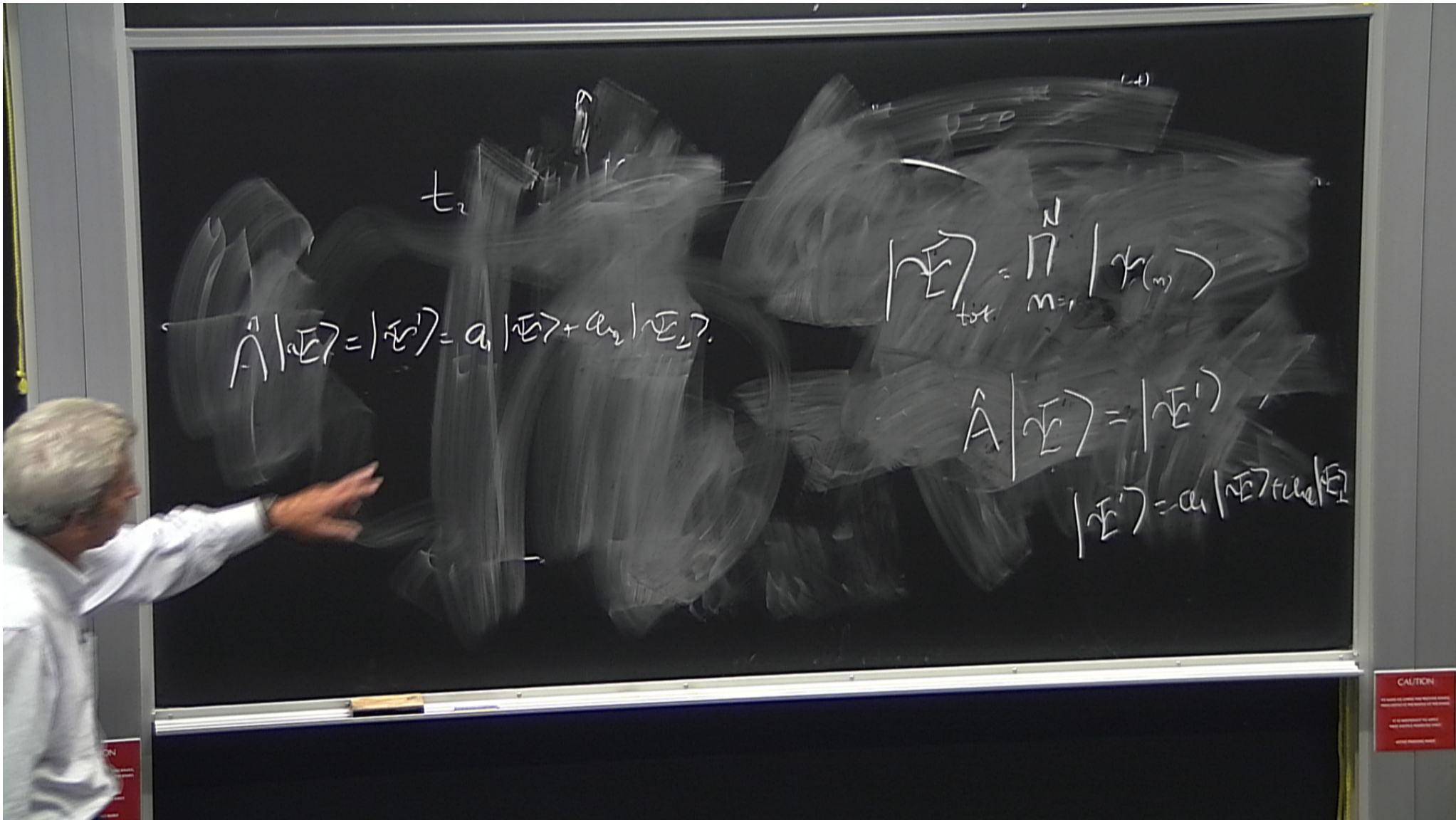


$$|E|_{tot} = \prod_{m=1}^N |r(m)|$$

(4)



CAUTION
DO NOT TOUCH THE BOARD
IF IS NECESSARY TO Wipe
PLEASE CONTACT THE STAFF



$$\hat{A}|\Psi\rangle = |\Psi'\rangle = a_1|\Psi_1\rangle + a_2|\Psi_2\rangle.$$

t_2

$$|\Psi\rangle_{tot} = \prod_{m=1}^N |\psi_m\rangle$$

$$\hat{A}|\Psi\rangle = |\Psi'\rangle$$

$$|\Psi'\rangle = a_1|\Psi_1\rangle + a_2|\Psi_2\rangle$$

$$a_1 = \langle \Psi | \hat{A} | \Psi \rangle = \bar{A}$$

$$\hat{A} | \Psi \rangle = | \Psi' \rangle = a_1 | \Psi \rangle + a_2 | \Psi_2 \rangle$$

$$\langle \Psi | \hat{A} | \Psi \rangle = a_1$$

$$| \Psi \rangle_{\text{tot}} = \prod_{m=1}^N | \psi_{(m)} \rangle$$

$$\hat{A} | \Psi \rangle = | \Psi' \rangle$$

$$| \Psi' \rangle = a_1 | \Psi \rangle + a_2 | \Psi_2 \rangle$$

$$a_1 = \langle \Psi | \hat{A} | \Psi \rangle = \bar{A}$$

$$\hat{A} | \Psi \rangle = | \Psi' \rangle = a_1 | \Psi \rangle + a_2 | \Psi_2 \rangle$$

$$\langle \hat{A} \Psi | \hat{A} \Psi \rangle = \langle \Psi' | \Psi' \rangle = a_1^2 + a_2^2$$

$$\langle \Psi | \hat{A}^2 | \Psi \rangle = \bar{A}^2$$

$$| \Psi \rangle_{\text{tot}} = \prod_{m=1}^N | \psi_m \rangle$$

$$\hat{A} | \Psi \rangle = | \Psi' \rangle$$

$$| \Psi' \rangle = a_1 | \Psi \rangle + a_2 | \Psi_2 \rangle$$

$$a_1 = \langle \psi | \hat{A} | \psi \rangle = \overline{A}$$

$$\hat{A} | \psi \rangle = | \psi' \rangle = a_1 | \psi \rangle + a_2 | \psi_2 \rangle$$

$$\langle \psi | \hat{A} | \psi \rangle = \langle \psi' | \psi' \rangle = a_1^2 + a_2^2$$

$$\langle \psi | \hat{A} | \psi \rangle = \overline{A}$$

$$| \psi \rangle_{\text{tot}} = \prod_{m=1}^N | \psi_m \rangle$$

$$\hat{A} | \psi \rangle = | \psi' \rangle$$

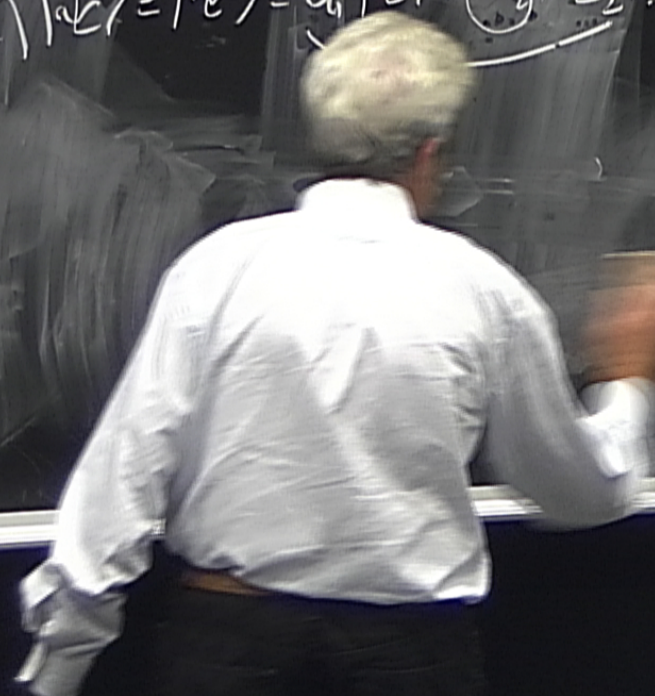
$$| \psi' \rangle = a_1 | \psi \rangle + a_2 | \psi_2 \rangle$$

$$a_1 = \langle \hat{A} | \psi \rangle = \overline{A}$$

$$\hat{A} | \psi \rangle = | \psi' \rangle = a_1 | \psi \rangle + a_2 | \psi_2 \rangle$$

$$\hat{A} | \psi \rangle = \overline{A} | \psi \rangle + a_2 | \psi_2 \rangle$$

$$E_k = \overline{A^2} - (\overline{A})^2$$



CAUTION
 Do not touch the board. The board is hot. Please do not touch the board.

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$$\frac{\sum \hat{A}_m}{N}$$

$$\prod_{m=1}^N |\psi_m\rangle$$

$$\hat{A}_m \prod_m |\psi_m\rangle$$

$$\hat{A} |\psi\rangle = \bar{A} |\psi\rangle + \Delta A |\psi\rangle$$

$$\hat{A}_m |\psi_m\rangle$$

$$= \bar{A} |\psi_m\rangle$$

$$+ \Delta A |\psi_m\rangle$$

$$\frac{\sum \hat{A}_m}{N} \prod_{m=1}^N |\psi_m\rangle$$

$$\frac{\sum \hat{A}_m}{N} \prod_{m=1}^N |\psi_m\rangle = \frac{N\bar{A}}{N} \prod_{m=1}^N |\Psi_m\rangle$$

$\times \sqrt{\Psi}$

$$\frac{\sum \hat{A}_m}{N} \prod_{m=1}^N |\psi_m\rangle$$

$$\frac{\sum \hat{A}_m}{N} \prod_{m=1}^N |\psi_m\rangle = \frac{N\bar{A}}{N} \prod_{m=1}^N |\bar{\psi}_m\rangle$$

$\times \sqrt{N}$

$$\hat{A}_m \prod_{m=1}^N |\psi_m\rangle = \hat{A}_{tot} \prod_{m=1}^N |\psi_m\rangle$$

$$= \Delta A \prod_{m \neq m'} |\psi_m\rangle |\bar{\psi}_{m'}\rangle$$

$$\frac{\Delta A}{N} \sum$$

$$\frac{\sum \hat{A}_m}{N} \prod_{n=1}^N |\psi(n)\rangle$$

$$\frac{\sum \hat{A}_m}{N} \prod |\psi(n)\rangle = \frac{N\bar{A}}{N} \prod |\Psi(n)\rangle$$

$\times \sqrt{N}$

$$\hat{A}_m \prod |\psi(n)\rangle \cdot \frac{1}{\sqrt{N}} |\Psi(n)\rangle$$

$$= \Delta A \prod_{n \neq m} |\psi(n)\rangle |\Psi(n)\rangle$$

$$\frac{\Delta A}{N} \sum_{n=1}^N |\Psi(n)\rangle$$

\hat{A}
 $\langle \delta \hat{A} | \delta \hat{A} \rangle = \frac{(\Delta A)^2}{N^2} N \rightarrow \frac{(\Delta A)^2}{N} \rightarrow 0$
 $\hat{A} = \bar{\hat{A}}$
 $\hat{A}_{(m)} \prod_{n \neq m} |\psi_{(n)}\rangle \langle \bar{\psi}_{(n)}|$
 $= \Delta A \prod_{n \neq m} |\psi_{(n)}\rangle \langle \bar{\psi}_{(n)}|$
 $\langle \delta \hat{A} \rangle = \frac{\Delta A}{N} \sum_{n=1}^N |\psi_{(n)}\rangle \langle \bar{\psi}_{(n)}|$

$\hat{A} = \bar{A}$
 $\langle \delta E | \delta \bar{A} \rangle = \frac{(\delta A)^2}{N^2} N \rightarrow \frac{(\delta A)^2}{N} \rightarrow 0$
 $\overline{P(x)} = \psi^*(x) \psi(x)$
 $A^{(m)} | \psi^{(m)} \rangle = \bar{A} | \psi^{(m)} \rangle + \Delta A | \psi^{(m)} \rangle$
 $A^{(m)} \prod_m | \psi^{(m)} \rangle$
 $\bar{A} \prod_m | \psi^{(m)} \rangle$
 $+ \Delta A \prod_m | \psi^{(m)} \rangle | \psi^{(m)} \rangle$

CAUTION
 DO NOT TOUCH THE BOARD SURFACE
 IT IS COVERED BY A PROTECTIVE FILM
 WHICH MAY BE DAMAGED BY TOUCHING

$\hat{A} = \bar{A}$
 $\langle \delta \hat{A} | \delta \hat{A} \rangle = \frac{(\Delta A)^2}{N^2} N \rightarrow \frac{(\Delta A)^2}{N} \rightarrow 0$
 $\overline{P(x)} = \psi^*(x) \psi(x)$
 $(\psi_1 + \psi_2)^2 = |\psi_1|^2 + |\psi_2|^2$
 $\hat{A}^{(m)} |\psi^{(m)}\rangle = \bar{A} |\psi^{(m)}\rangle + \Delta A |\psi^{(m)}\rangle$
 $\hat{A}^{(m)} \prod_m |\psi^{(m)}\rangle$
 $\bar{A} \prod_m |\psi^{(m)}\rangle$
 $+\frac{\Delta A}{N} \sum_{m=1}^N |\psi^{(m)}\rangle |\psi^{(m)}\rangle$

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 Do not touch the screen when it is on. It is dangerous to touch the screen when it is on.

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$$\hat{A} = \overline{\hat{A}}$$

$$\hat{A}(m) |\psi(m)\rangle = \bar{A} |\psi(m)\rangle + \Delta A |\psi_2(m)\rangle$$

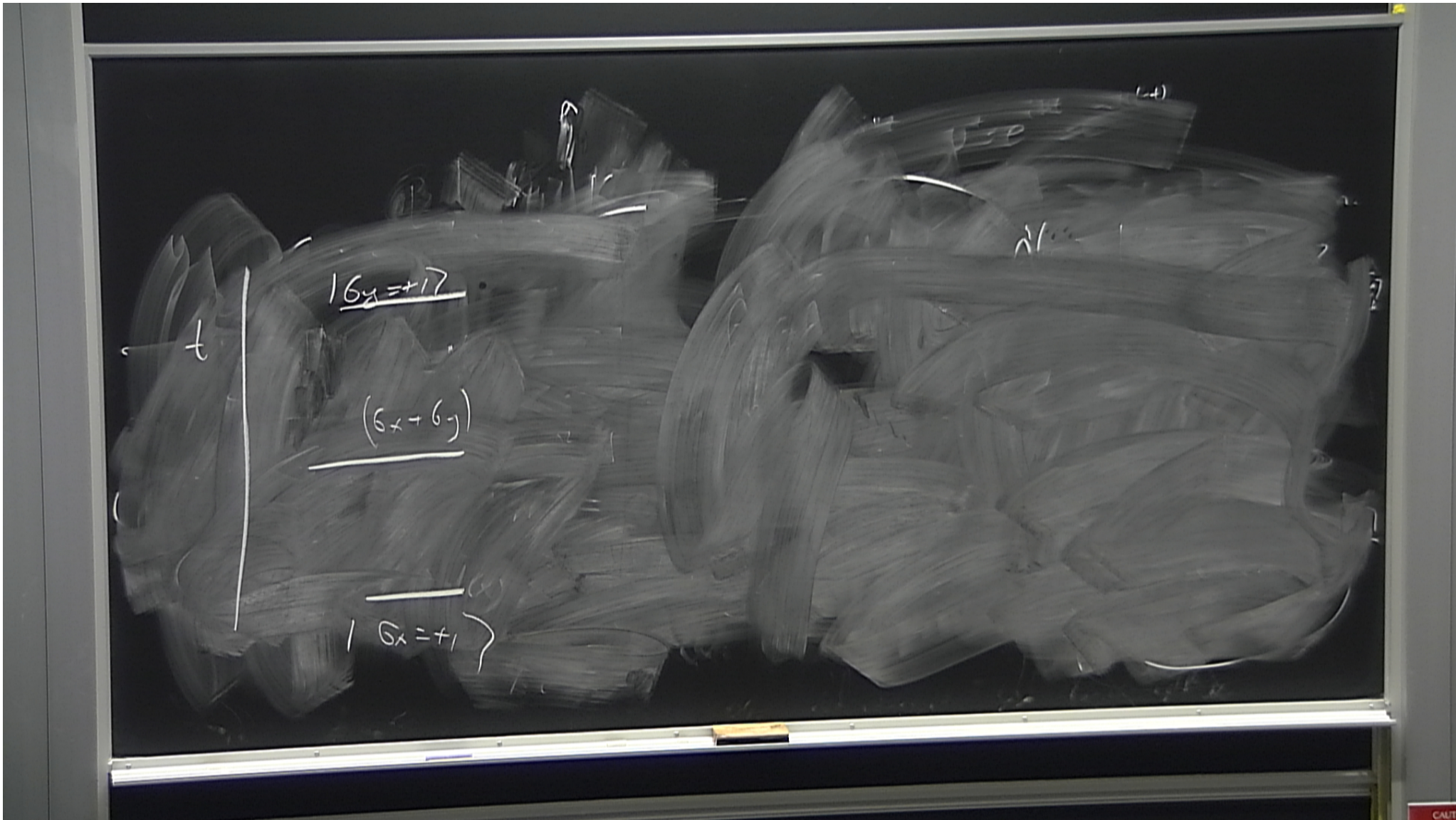
$$\hat{A}(m) \prod_m |\psi(m)\rangle$$

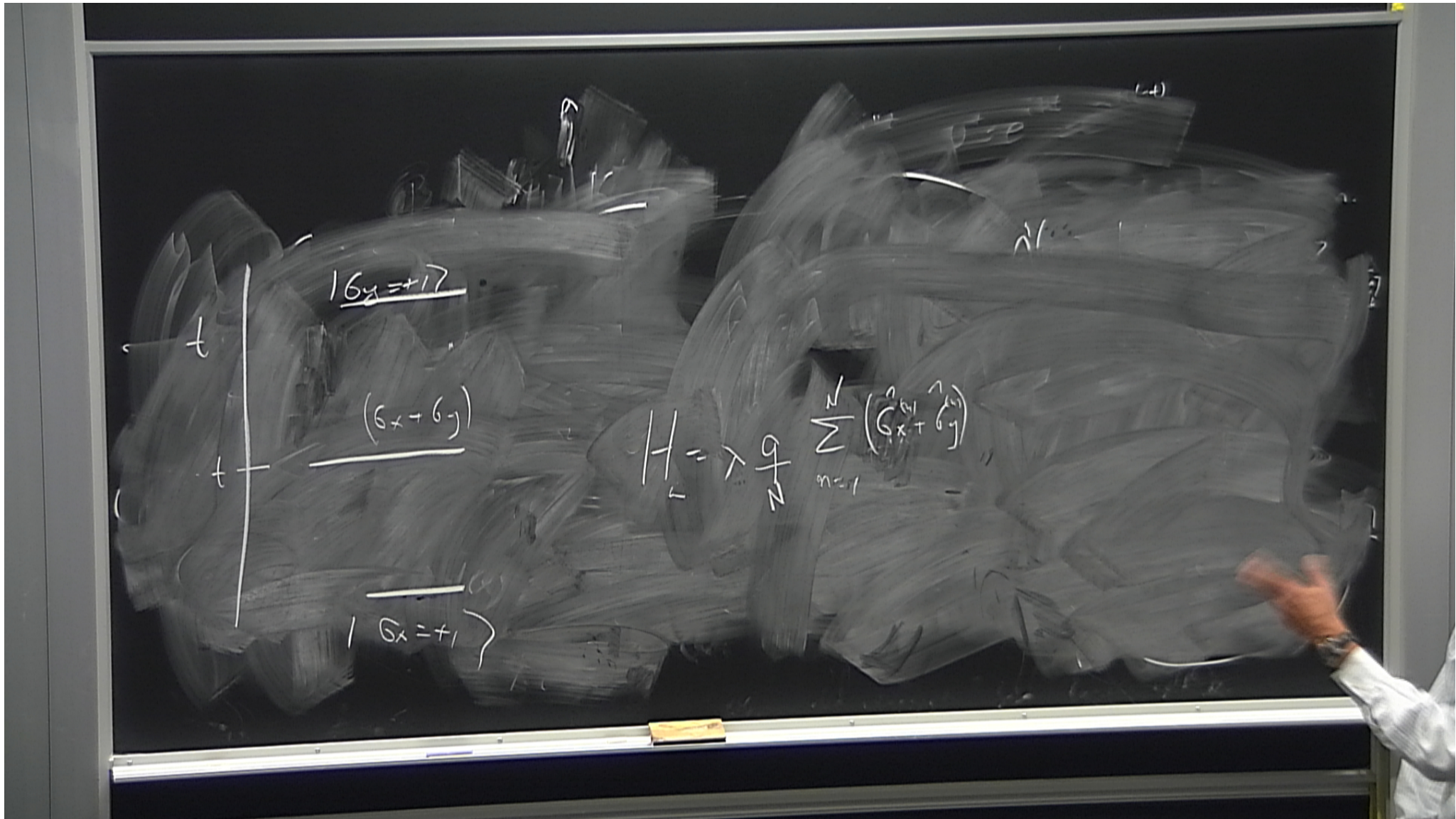
$$\frac{(\Delta A)^2}{N} \rightarrow 0$$

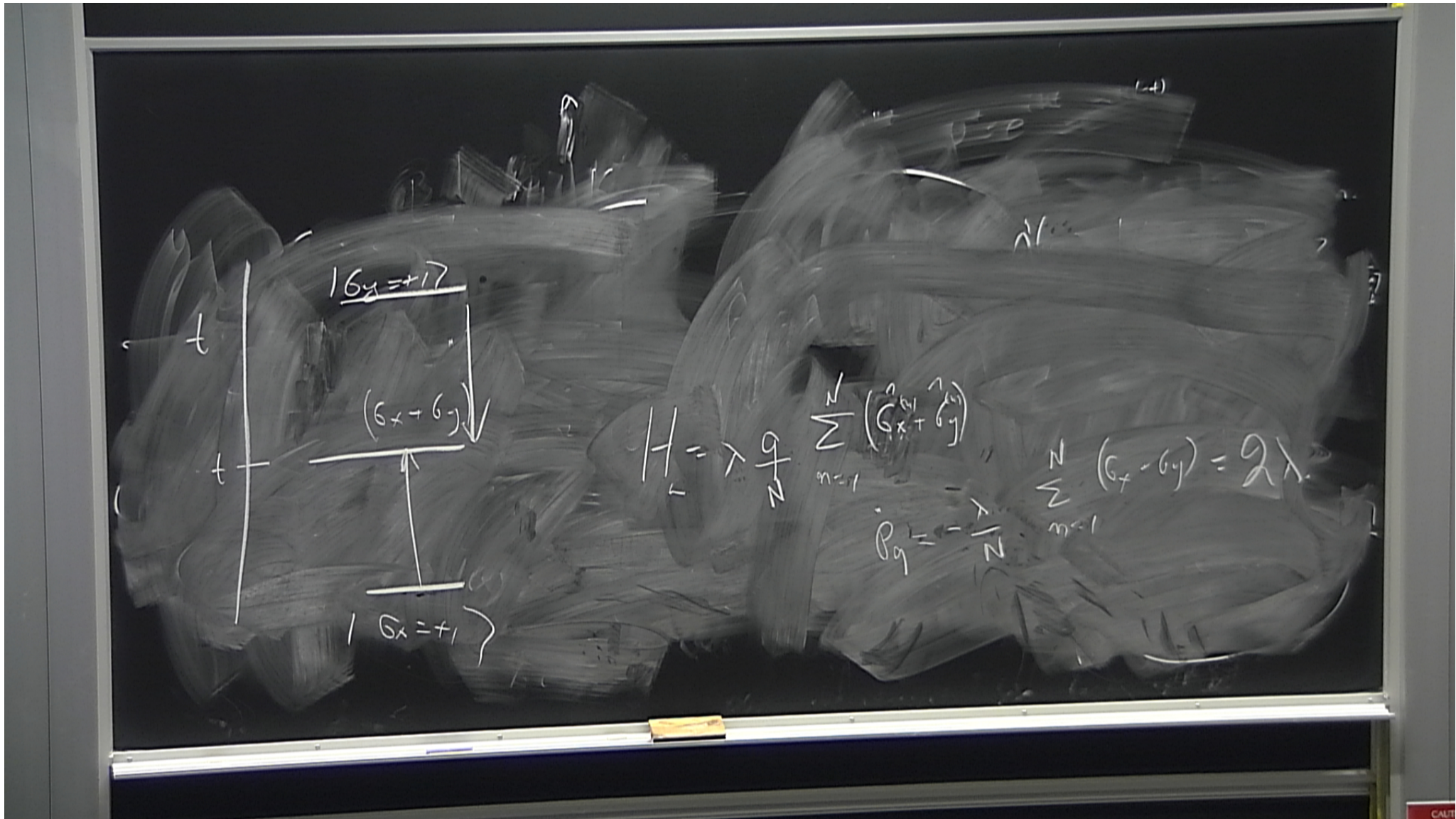
$$(\psi_1 + \psi_2)$$

$$\bar{A} \prod_m |\psi(m)\rangle$$

$$+ \frac{\Delta A}{N} \sum_{n \neq m} |\psi(n)\rangle |\psi_m\rangle$$







Weak-Value.

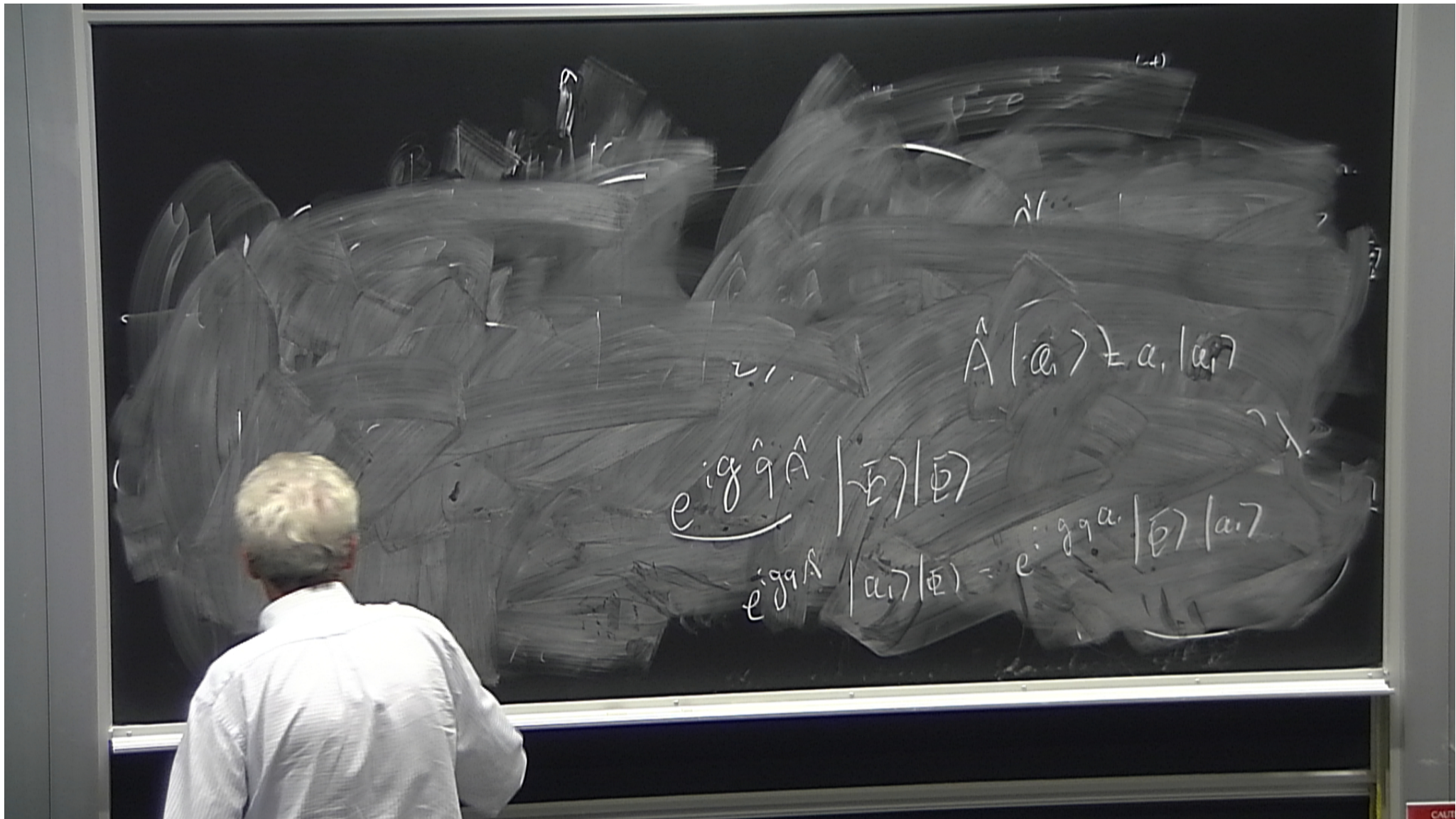
$$\frac{\langle \psi_L | \hat{A} | \psi_R \rangle}{\langle \psi_L | \psi_R \rangle} = A_w$$

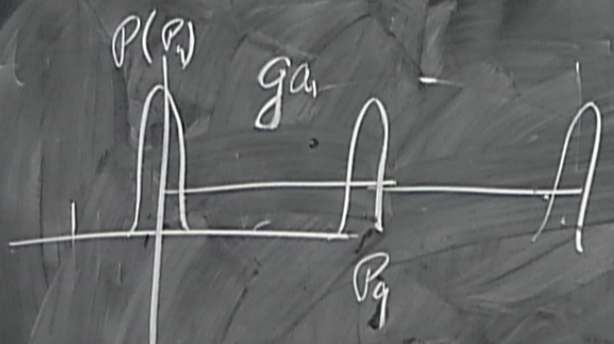
$$H_w = g \hat{q} \hat{A} \cos(\omega t)$$

$$|\Psi\rangle |\Phi\rangle$$

$$e^{i g \hat{q} \hat{A}} |\Psi\rangle |\Phi\rangle$$

$$(q, p_q)$$

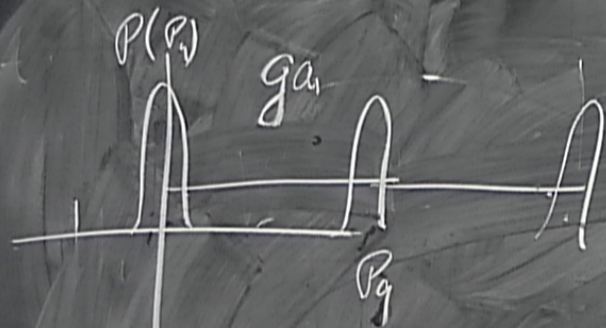




$$e^{i g \hat{q} \hat{A}} |\psi\rangle |\phi\rangle$$

$$e^{i g \hat{A}} |a\rangle |\psi\rangle = e^{i g g a} |\psi\rangle |a\rangle$$

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



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

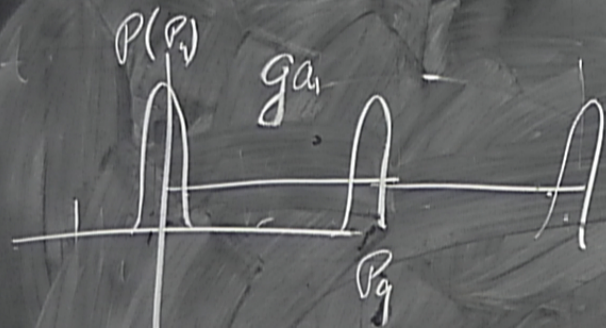
$$|\Psi\rangle$$

$$e^{i g \hat{q} \hat{A}} |\Psi\rangle |\Phi\rangle$$

$$e^{i g q A}$$

$$|a_n\rangle |\Phi\rangle = e^{i g q a_n} |\Phi\rangle |a_n\rangle$$

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



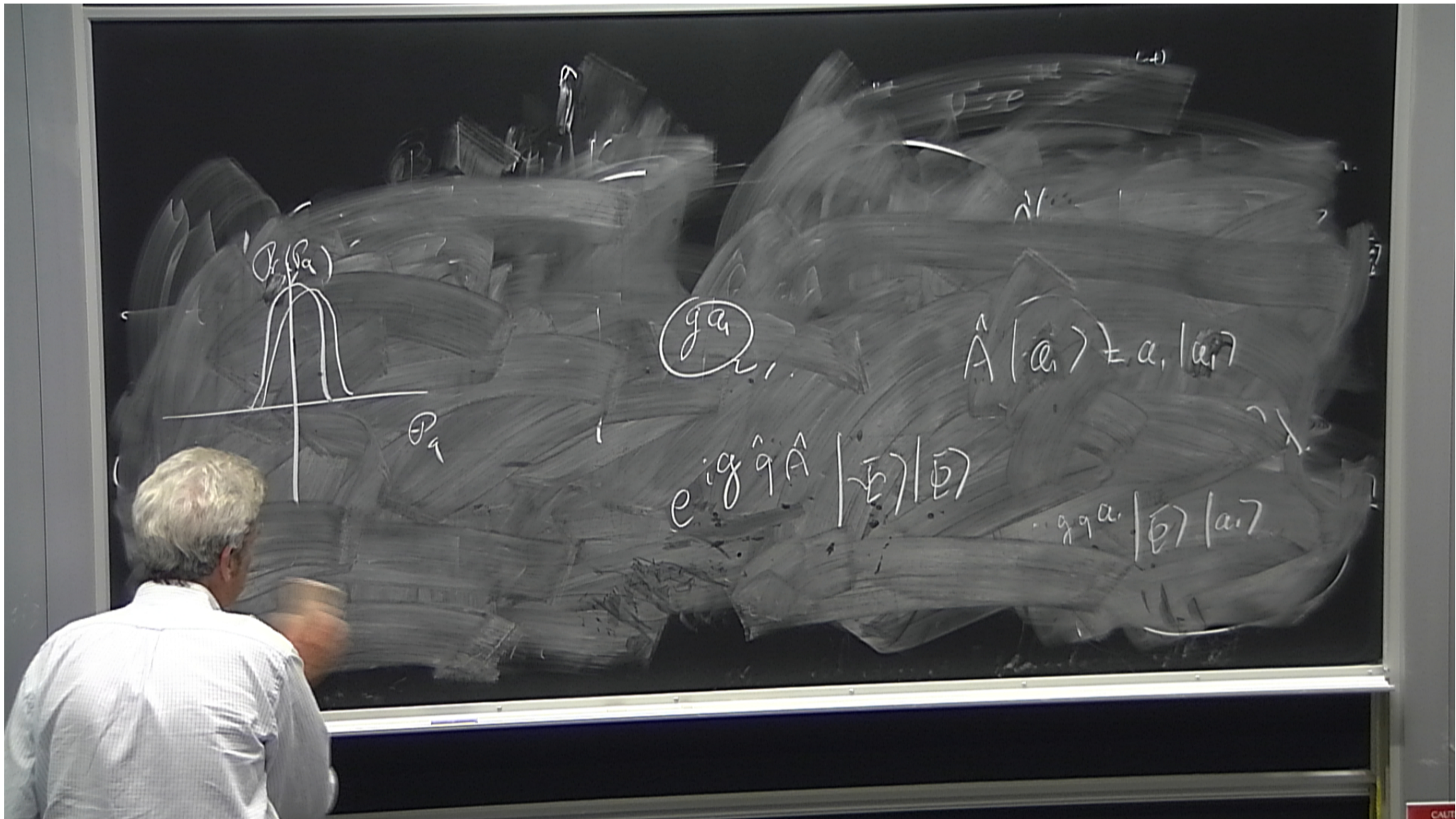
$$\hat{A} |a_n\rangle = a_n |a_n\rangle$$

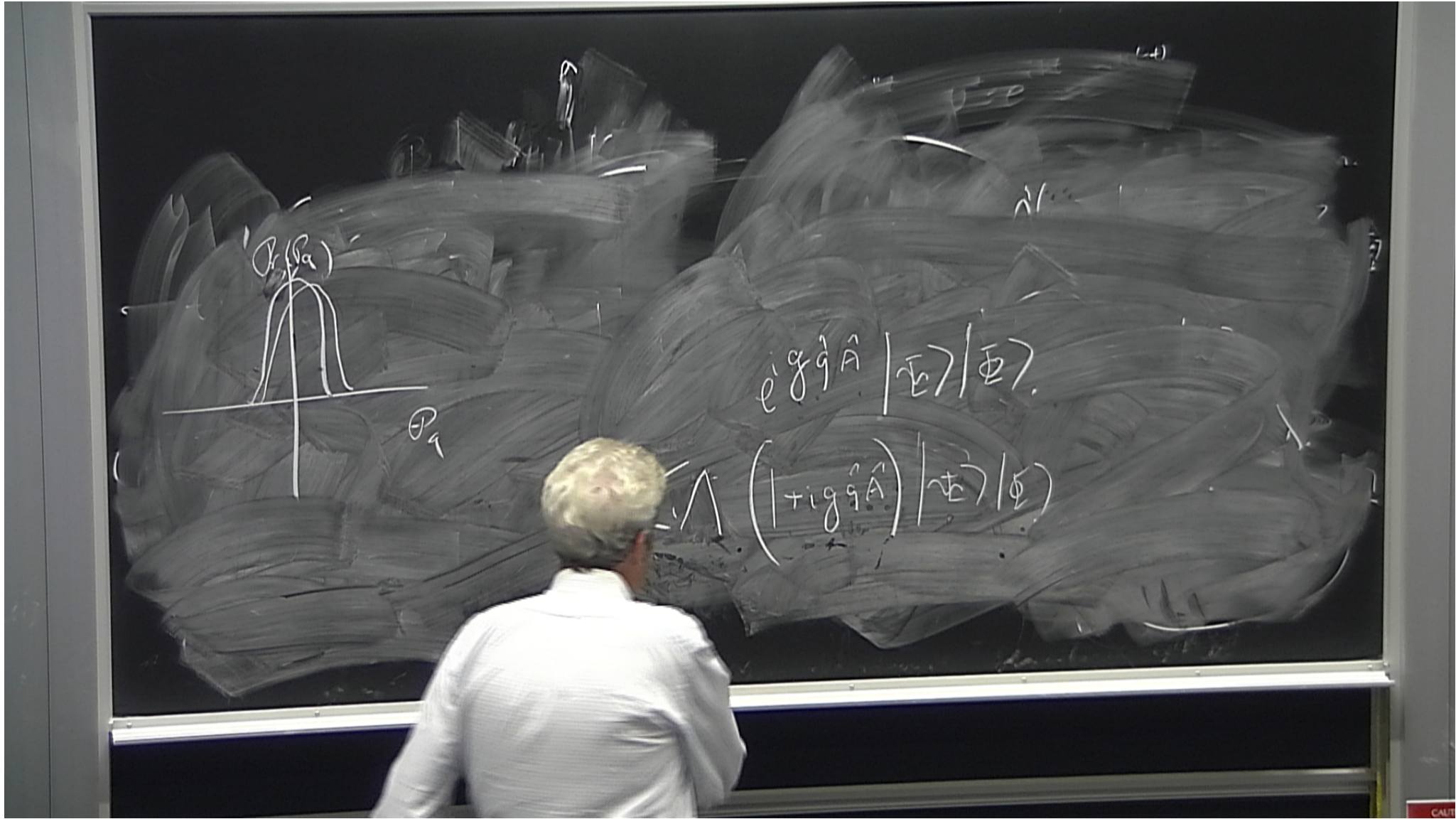
$$|\Psi\rangle = \sum a_n |a_n\rangle$$

$$e^{i g \hat{q} \hat{A}} |\Psi\rangle |\Phi\rangle$$

$$e^{i g q A} |a_n\rangle |\Phi\rangle = e^{i g q a_n} |\Phi\rangle |a_n\rangle$$

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





$$\langle \Lambda | 1 + ig\hat{g}\hat{A} | \Psi \rangle$$

$$\langle \Lambda | \Psi \rangle \left(1 + \frac{ig\langle \Lambda | \hat{A} | \Psi \rangle}{\langle \Lambda | \Psi \rangle} \right)$$

$$e^{ig\hat{g}\hat{A}} | \Psi \rangle | \Phi \rangle$$

$$\langle \Lambda | \left(1 + ig\hat{g}\hat{A} \right) | \Psi \rangle | \Phi \rangle$$

$$\langle \Lambda | 1 + i g g \hat{A} | \Psi \rangle$$

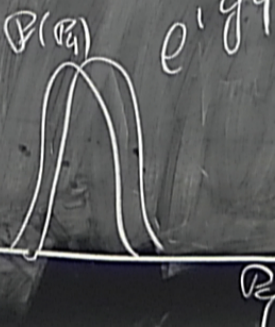
$$\langle \Lambda | \Psi \rangle \left(1 + i g \frac{\langle \Lambda | \hat{A} | \Psi \rangle}{\langle \Lambda | \Psi \rangle} \right)$$

$$|\Psi\rangle / \langle \Psi | \Psi \rangle$$

$$e^{i g g A \omega}$$

$$A_{\omega} \equiv \frac{\langle \Lambda | \hat{A} | \Psi \rangle}{\langle \Lambda | \Psi \rangle}$$

$$P(\omega) e^{i g g A \omega}$$



$$\langle \Lambda | 1 + i g g \tilde{A} | \Psi \rangle$$

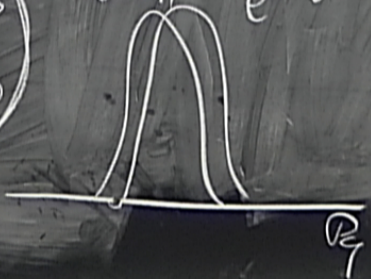
$$\langle \Lambda | \Psi \rangle \left(1 + i g \frac{\langle \Lambda | \tilde{A} | \Psi \rangle}{\langle \Lambda | \Psi \rangle} \right)$$

$|\Psi\rangle|\Psi\rangle$

$e^{i g g A \omega}$

$P(\omega)$

$e^{i g g A \omega}$



$$\frac{\langle G_{j-1} | G_x + G_j | G_{x+1} \rangle}{\langle G_{j-1} | G_x = 1 \rangle} = 2$$

