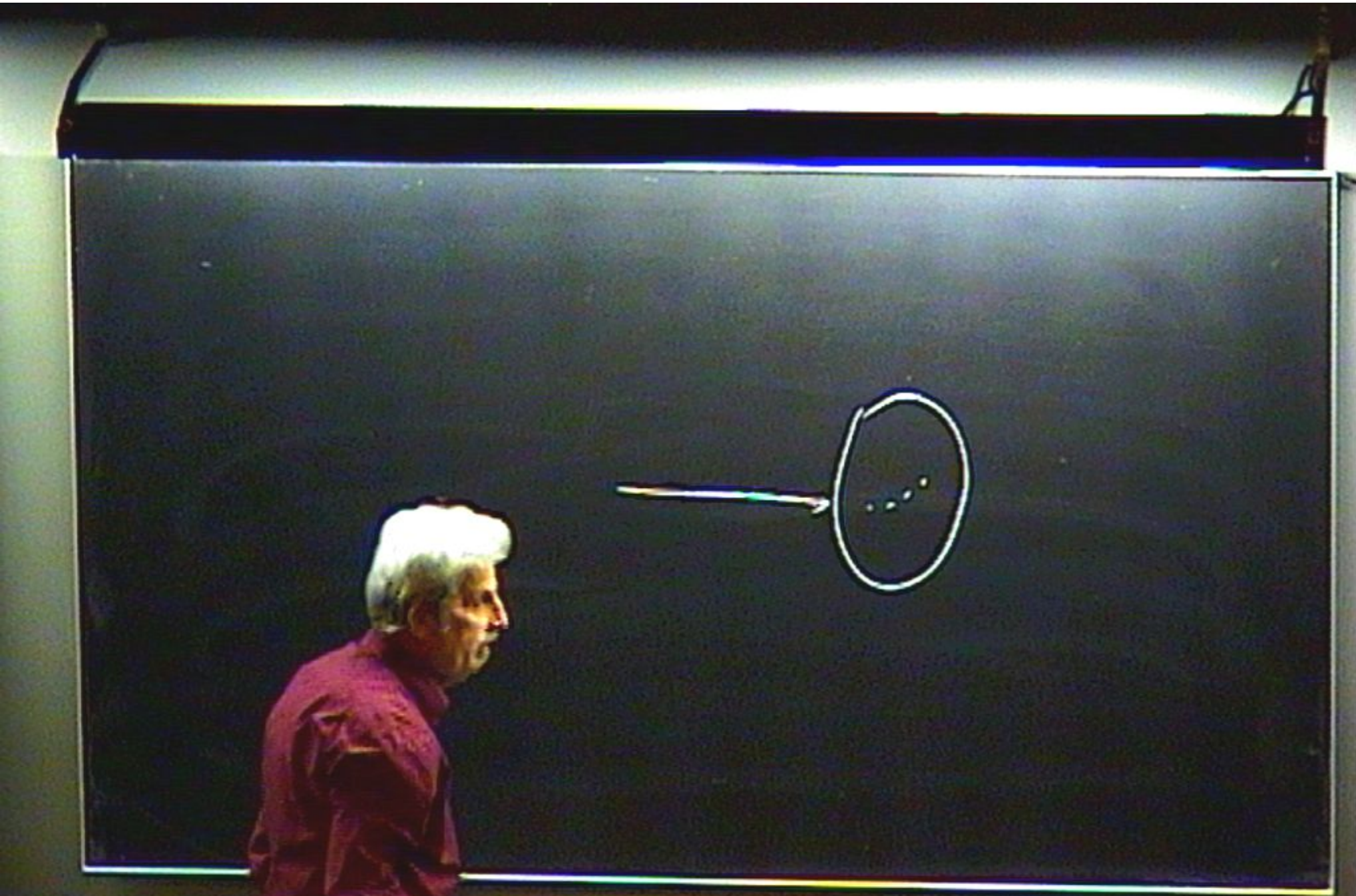


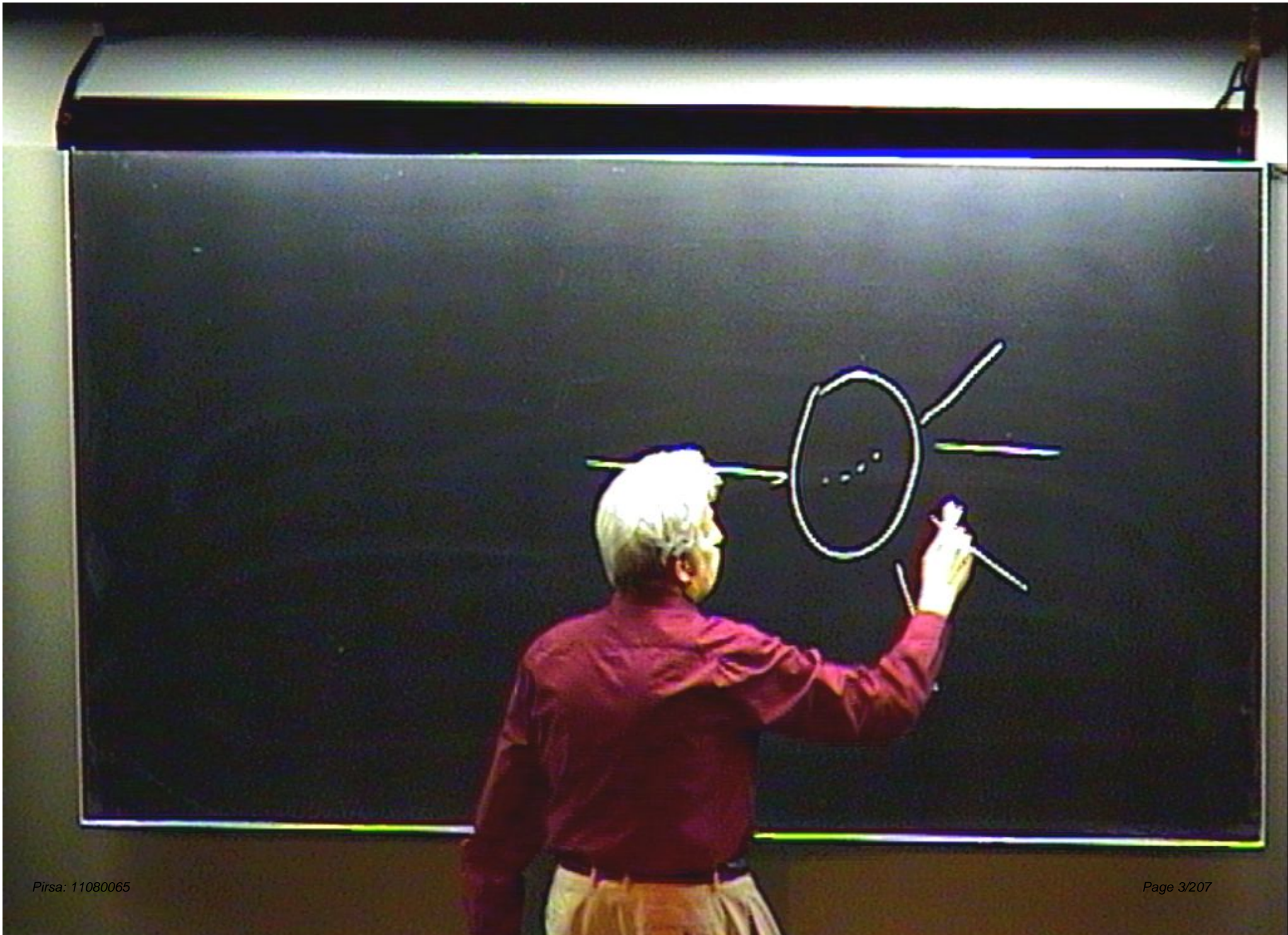
Title: A New Approach to Quantum Mechanics

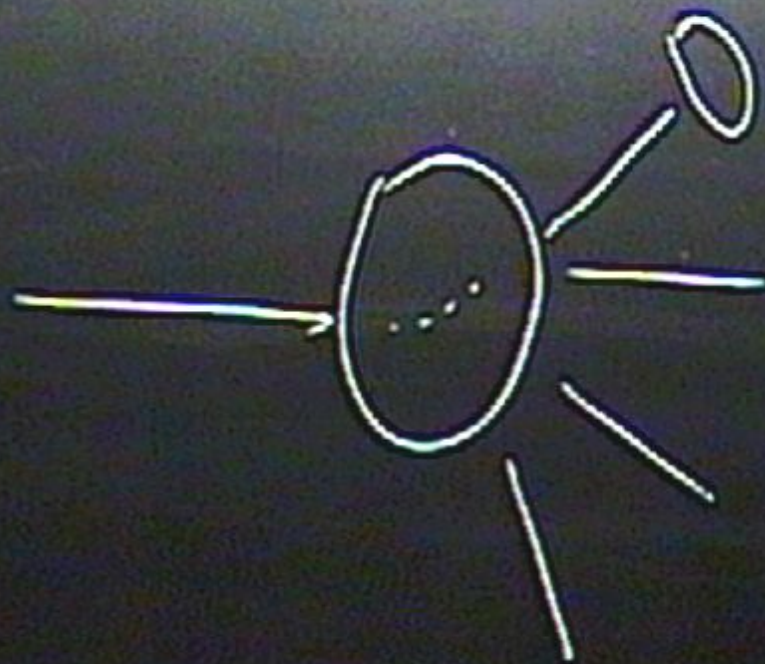
Date: Aug 23, 2011 11:00 AM

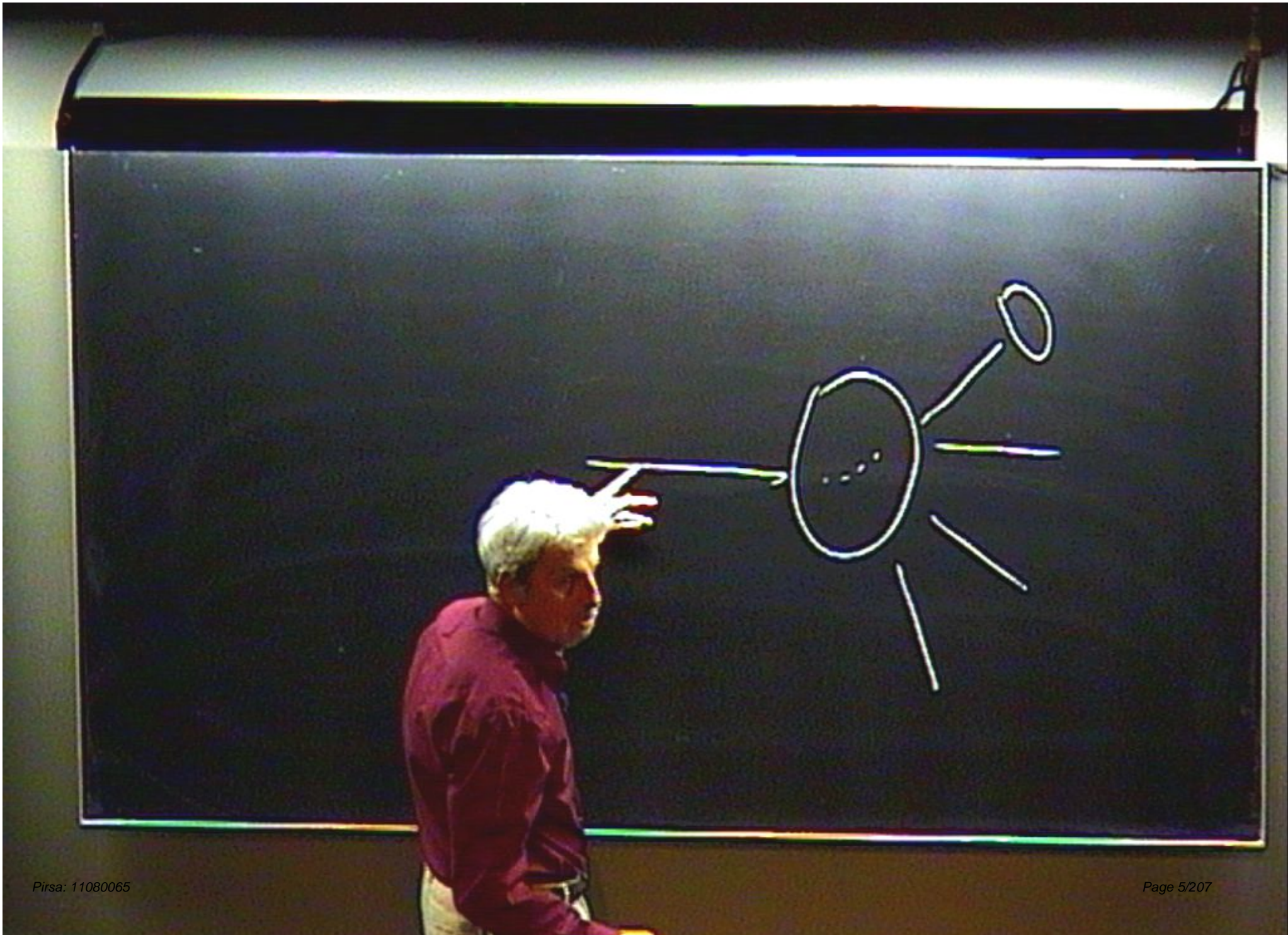
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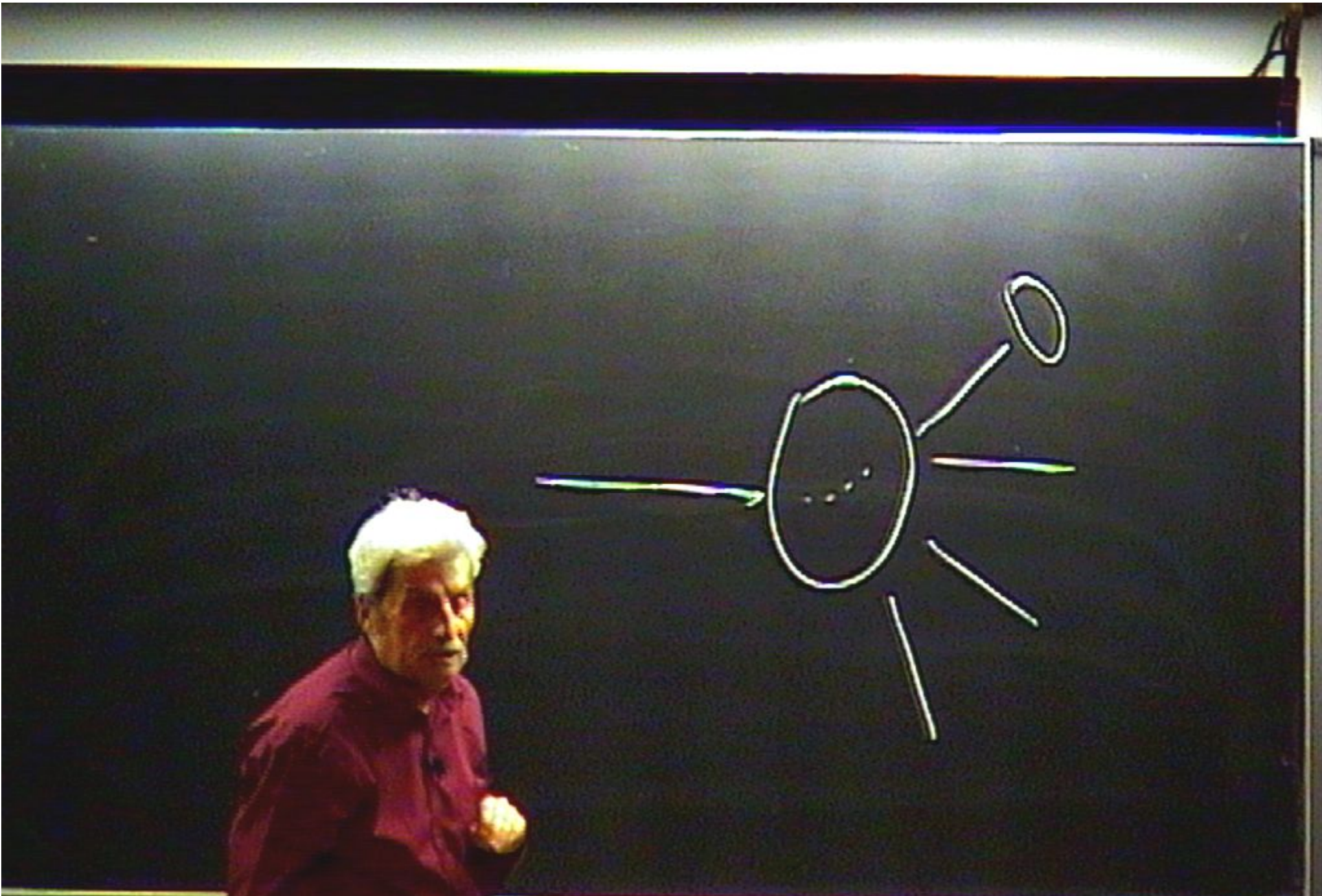
Abstract:

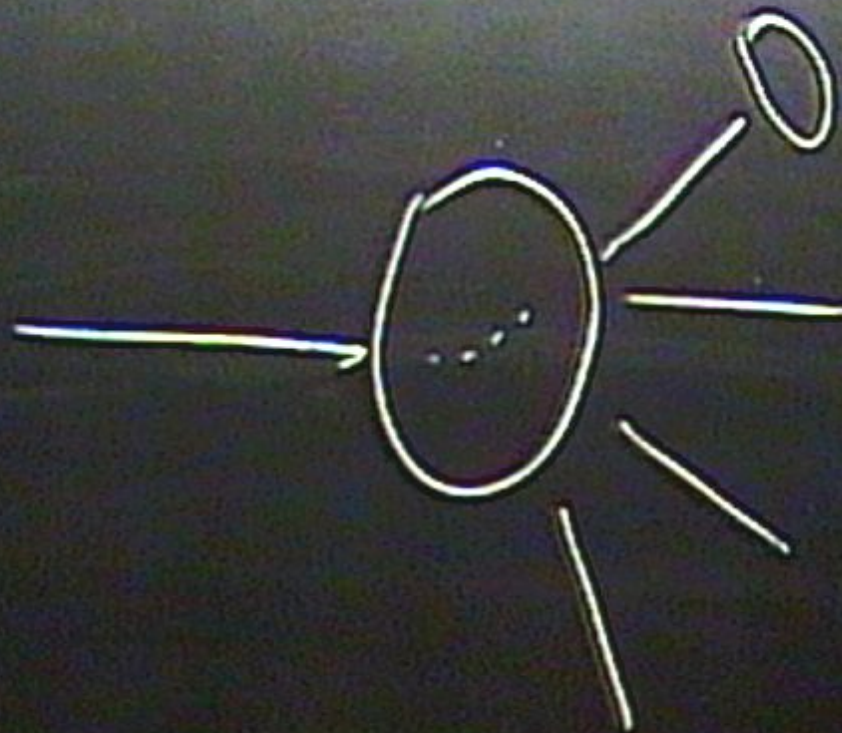


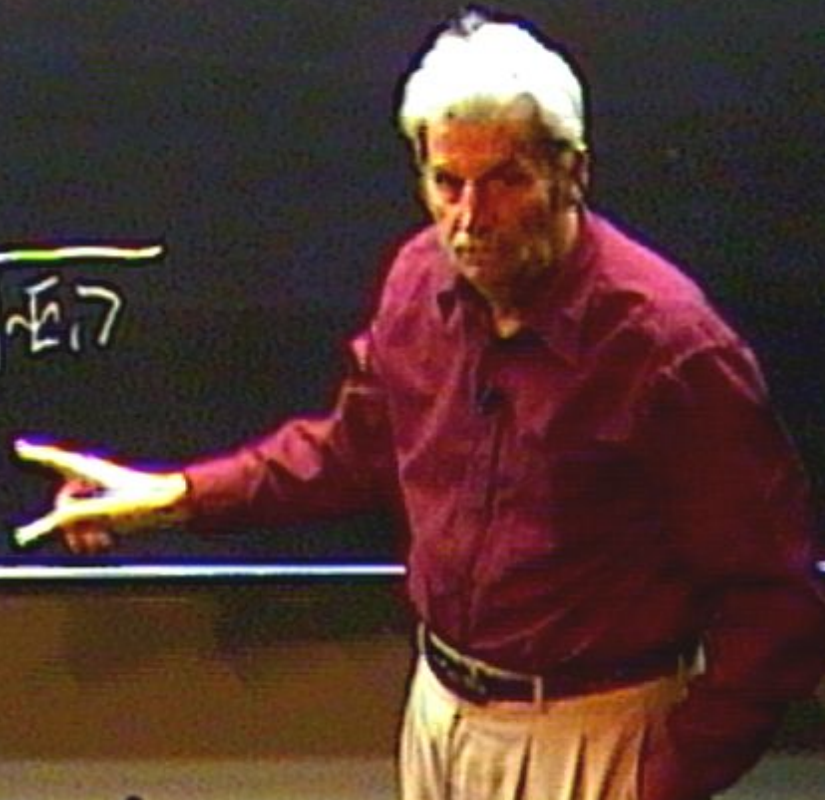
















$$\hat{A}|\psi_2\rangle =$$





$$\hat{A} |d_n\rangle = d_n |d_n\rangle.$$



$$\hat{A} |d_n\rangle = d_n |d_n\rangle.$$



$$\hat{A} |\alpha_n\rangle = \alpha_n |\alpha_n\rangle.$$

$$U |4\rangle$$



$U = e^{-iHt}$

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

$$U_{t_1}|\psi_1\rangle$$



$$U = e^{-iHt}$$

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

$$U_{t_1} |E_1\rangle$$

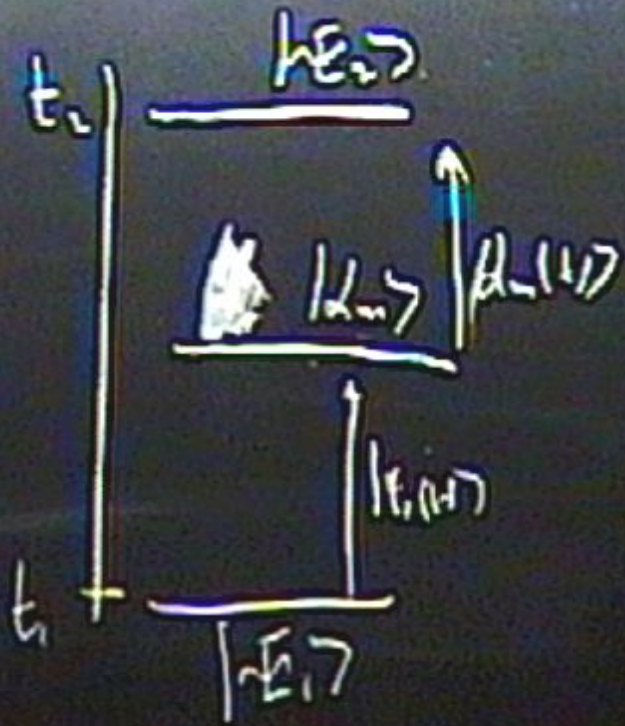


$U = e^{-iHt}$

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

$$\alpha_n |U_{t_1}^{t_2}| \psi \rangle$$





$U = e^{-\beta H}$

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

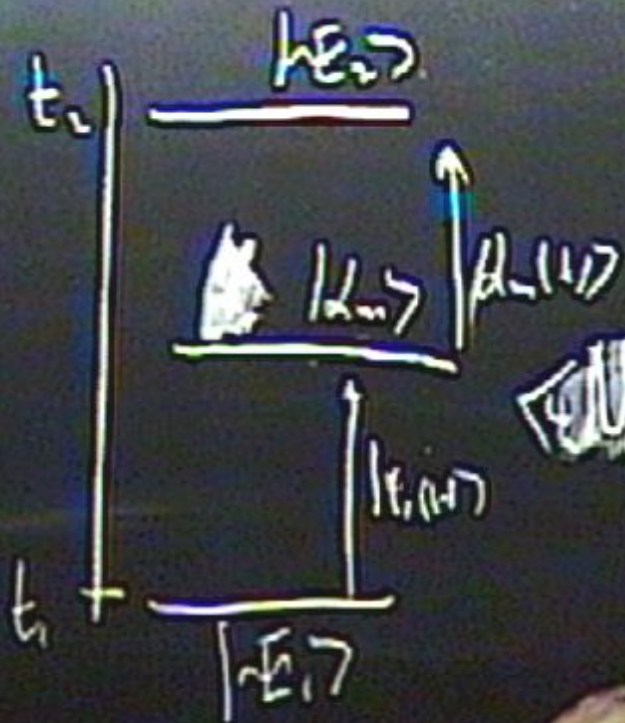
$$|d_1\rangle \langle d_1| + |d_2\rangle \langle d_2| + \dots + |d_n\rangle \langle d_n| = \mathbb{1}$$



$$U = e^{-iHt}$$

$$\hat{A} |d_1\rangle = d_2 |d_2\rangle$$

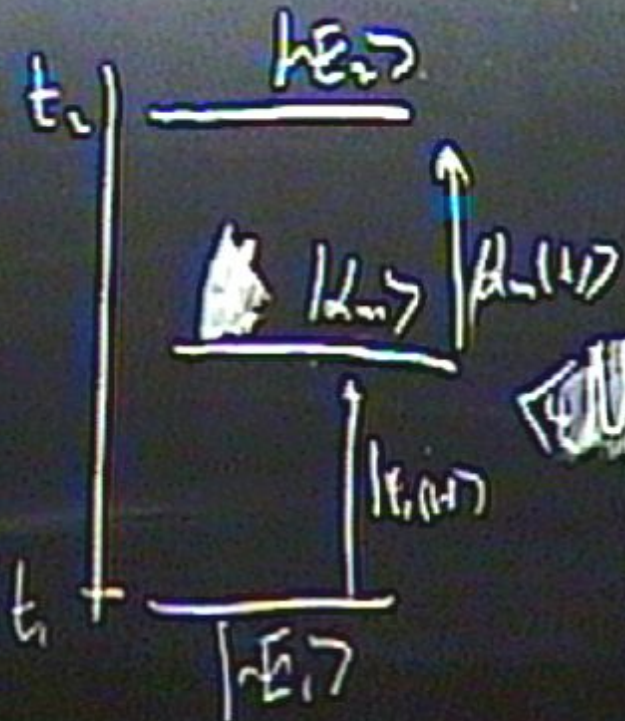
$$\langle \psi_1 | d_1 \rangle \langle d_2 | U_{t_1} | \psi_1 \rangle$$



$U = e^{-iHt}$

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

$$\langle \alpha_n | \alpha_m \rangle = \delta_{nm} \quad |U_{t_1}| \psi_1 \rangle = c_n$$



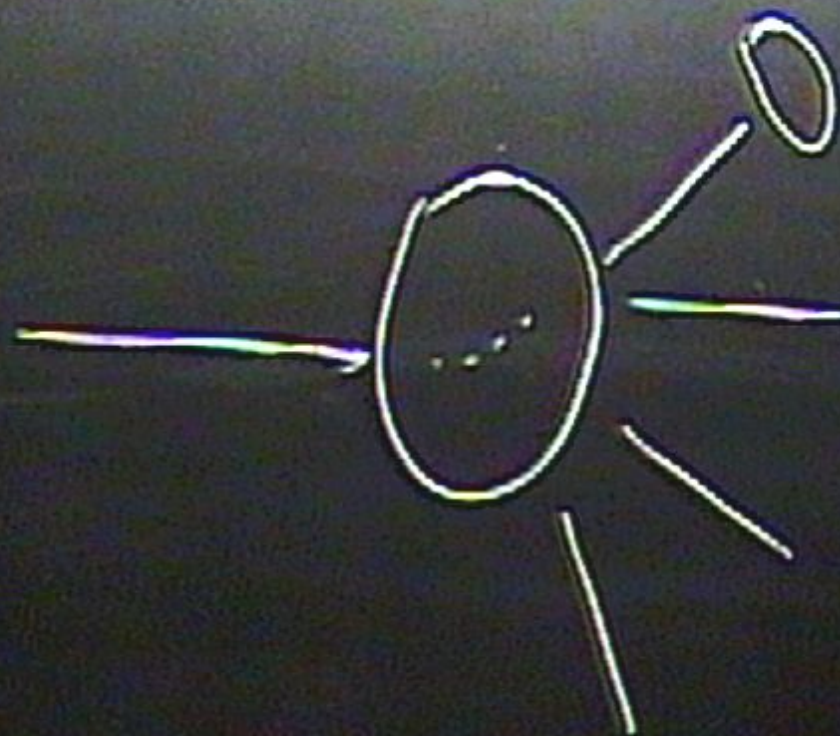
$$U = e^{-iHt}$$

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

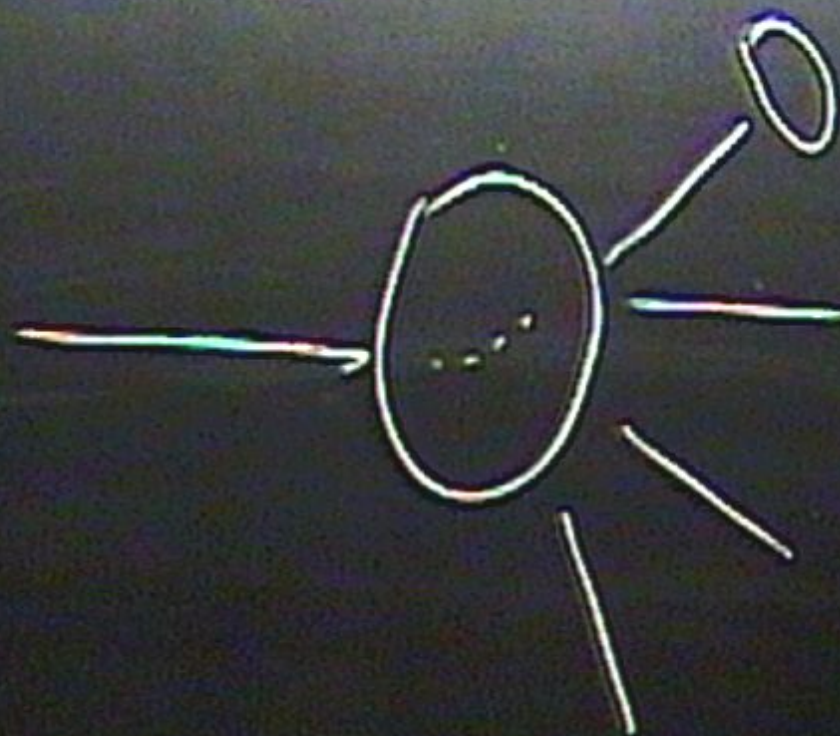
$$\langle U_{t_1} | d_1 \rangle \langle d_2 | U_{t_1} | \psi_1 \rangle = C_1$$

$$|C_1|^2 = P_1(t_1)$$

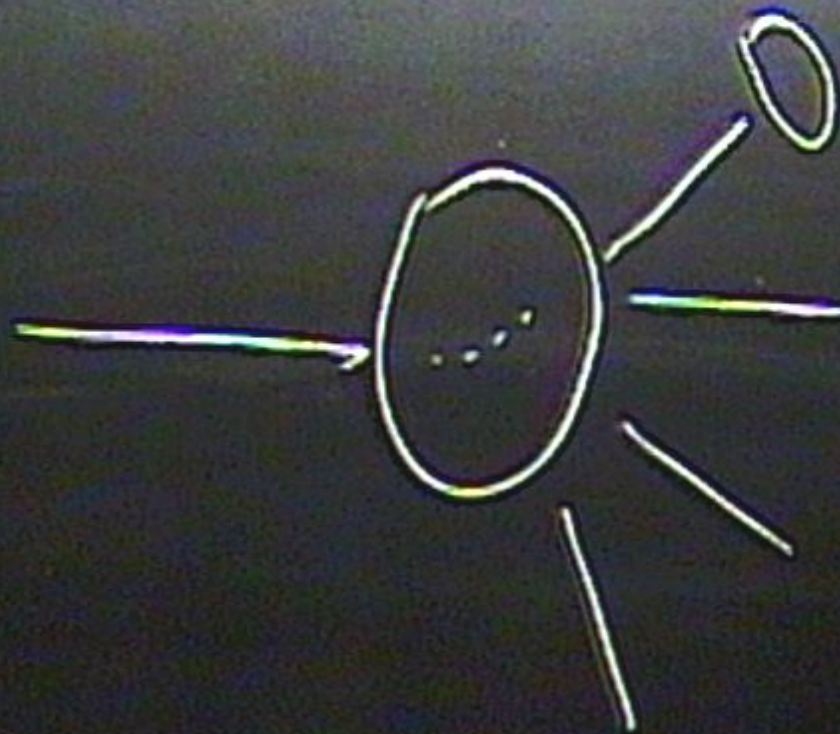
$$\frac{K_{m1}}{S_{m1}} = \theta_1$$

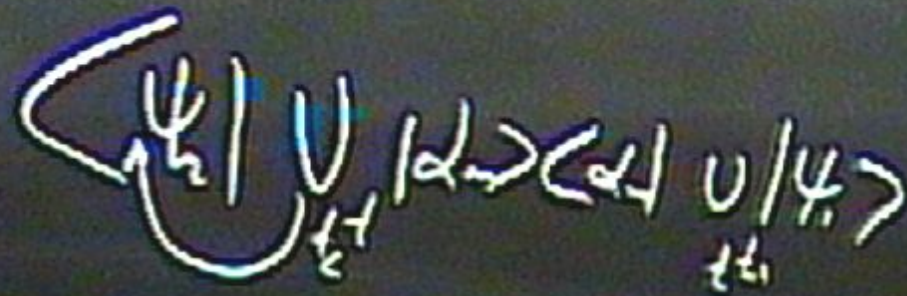


$$\frac{|K_m|^2}{\sum_n |G_n|^2} = P(d_n)$$



$$\frac{|K_m|^2}{\sum_n |G_n|^2} = P(d_n)$$





\wedge

$$\langle \psi_{\frac{1}{2}} | U_{\frac{1}{2}} | \alpha \rangle \langle \alpha | U_{\frac{1}{2}} | \psi_{\frac{1}{2}} \rangle$$

$$\langle U_{\frac{1}{2}}^+ \psi_{\frac{1}{2}} | \alpha \rangle \langle \alpha | U_{\frac{1}{2}} | \psi_{\frac{1}{2}} \rangle$$

$$\langle \psi_2 | U_{t_2} | \alpha \rangle \langle \alpha | U_{t_1} | \psi_1 \rangle$$

$$\langle U_{t_2}^+ \psi_2 | \alpha \rangle \langle \alpha | U_{t_1} | \psi_1 \rangle$$

$$U = e^{-iHt}$$

$$\langle \psi_2 | U | \psi_1 \rangle$$

$$\langle \psi_2^+ | U | \psi_1 \rangle$$

$$\langle \psi_2 | U_{\frac{t}{2}} | \alpha \rangle \langle \alpha | U_{\frac{t}{2}} | \psi_1 \rangle$$

$$U = e^{-iHt}$$

$$U^\dagger = e^{iHt} = e^{-iH(-t)}$$

$$\langle U^\dagger \psi_2 | \alpha \rangle \langle \alpha | U_{\frac{t}{2}} | \psi_1 \rangle$$

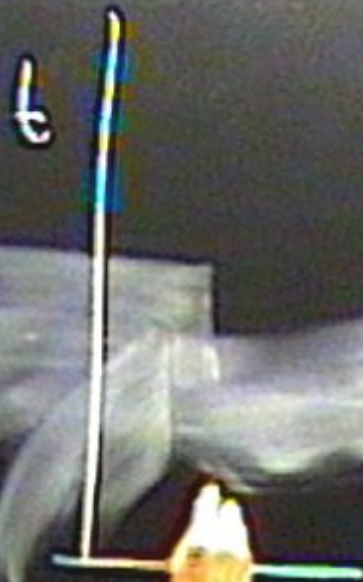
$$\langle \psi_2 | U_{\frac{t}{2}} | \alpha \rangle \langle \alpha | U_{\frac{t}{2}} | \psi_1 \rangle$$

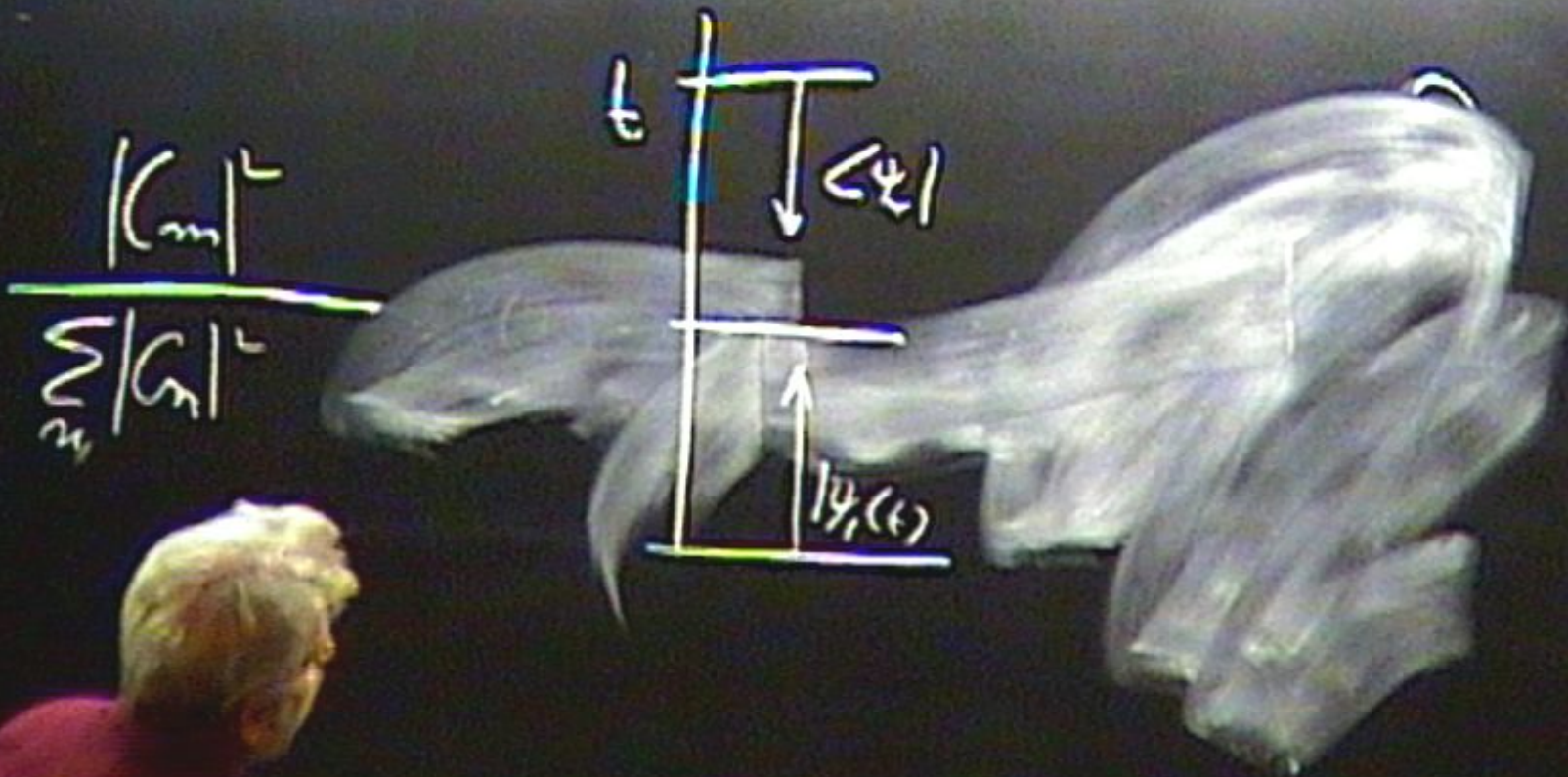
$$U = e^{-iHt}$$

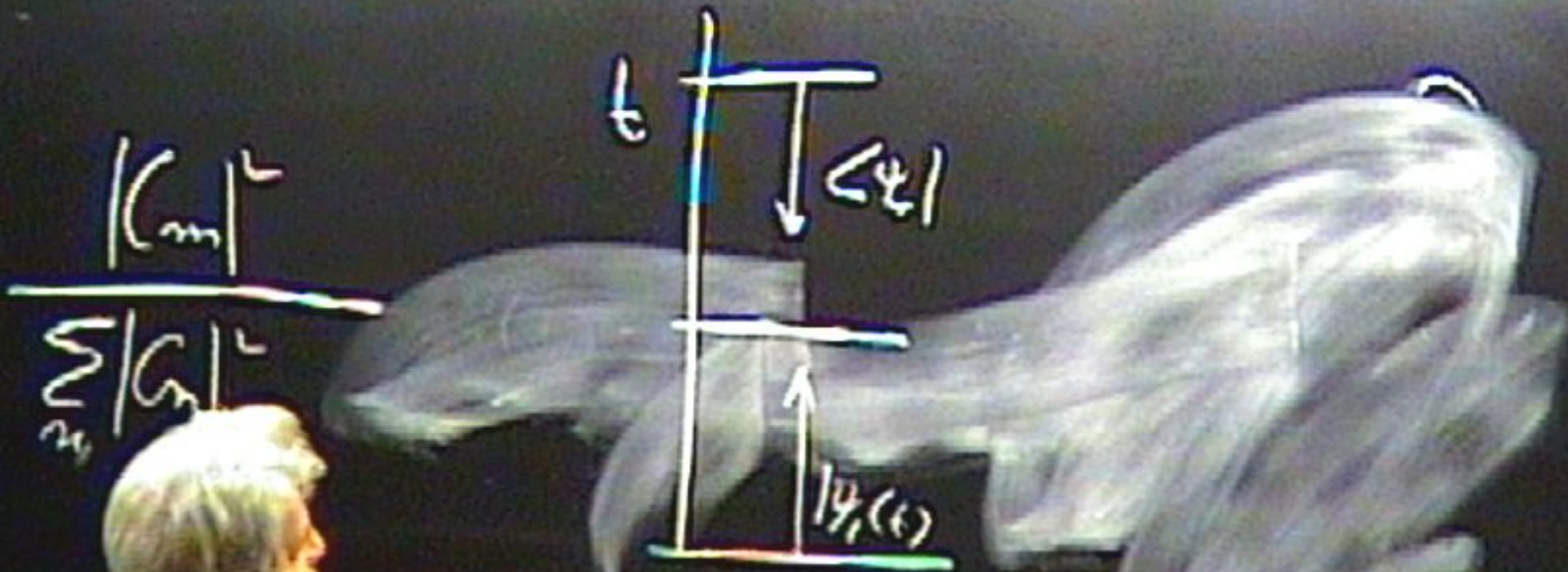
$$U^\dagger = e^{iHt} = e^{-iH(-t)}$$

$$\langle U_{\frac{t}{2}}^\dagger \psi_2 | \alpha \rangle \langle \alpha | U_{\frac{t}{2}} | \psi_1 \rangle$$

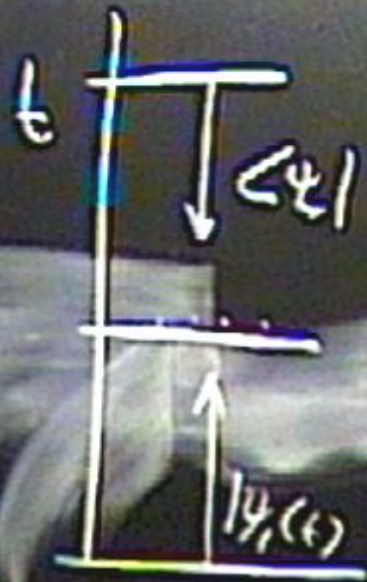
$$\frac{|K_m|^2}{\sum_n |G_n|^2}$$

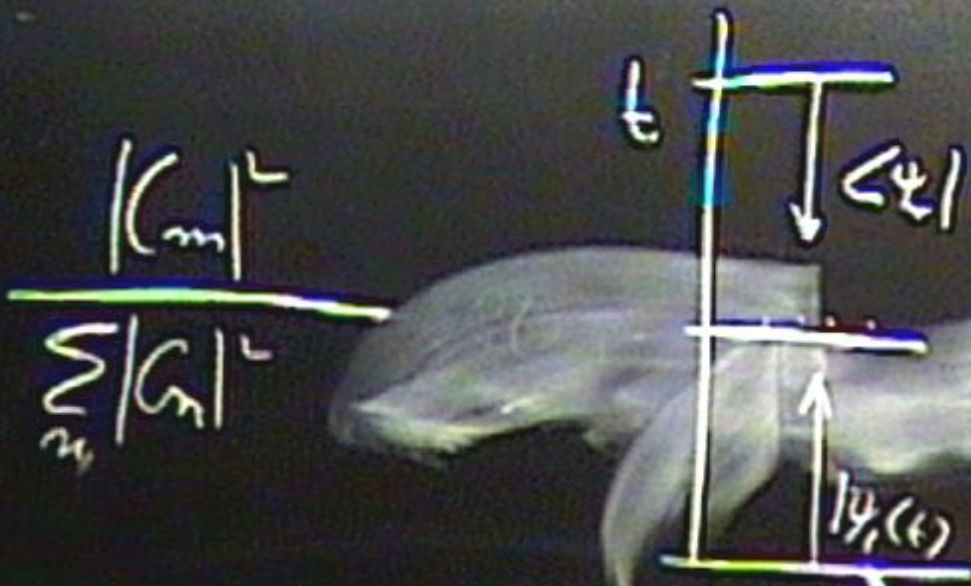






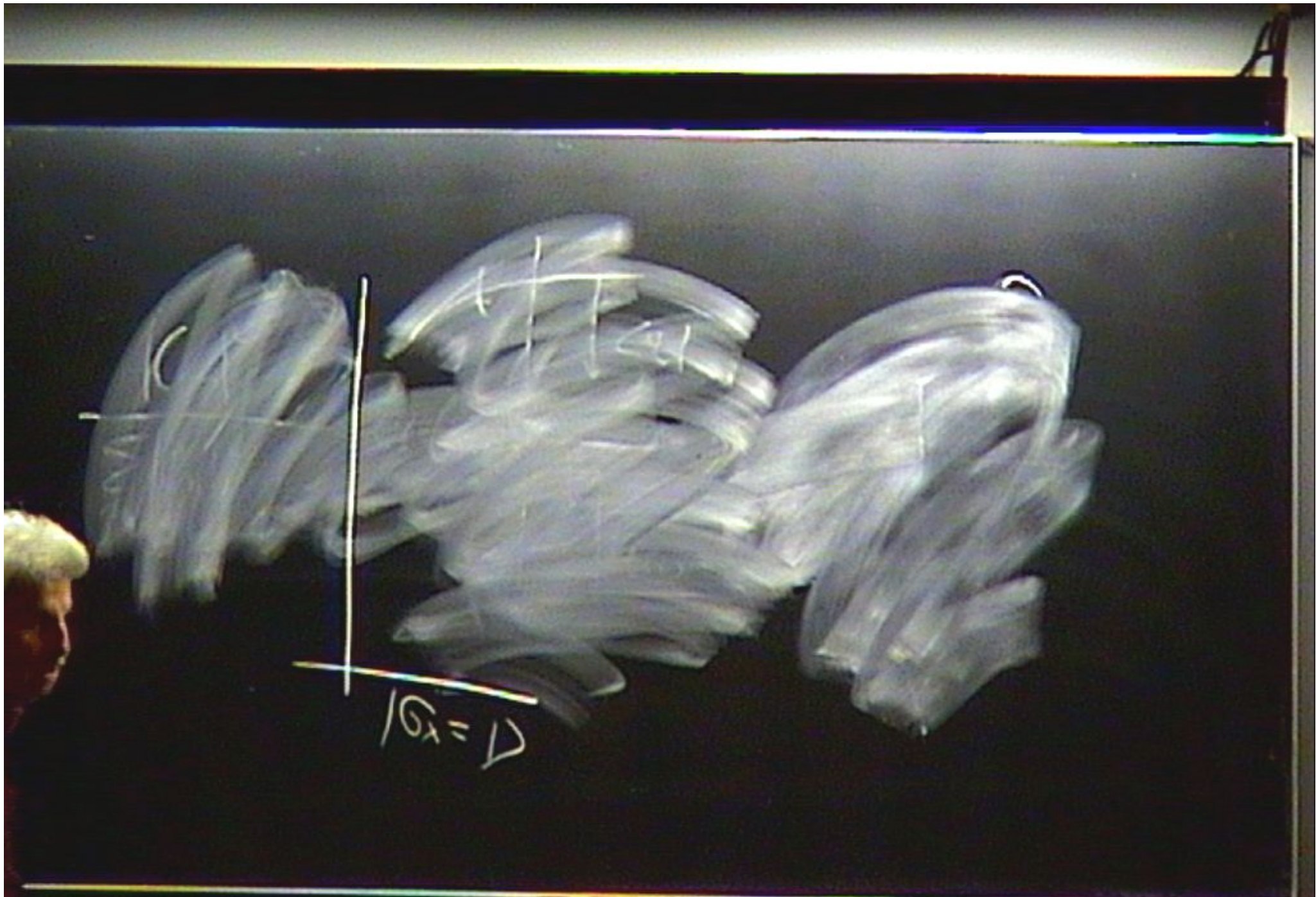
$$\frac{|K_m|^2}{\sum_n |G_n|^2}$$



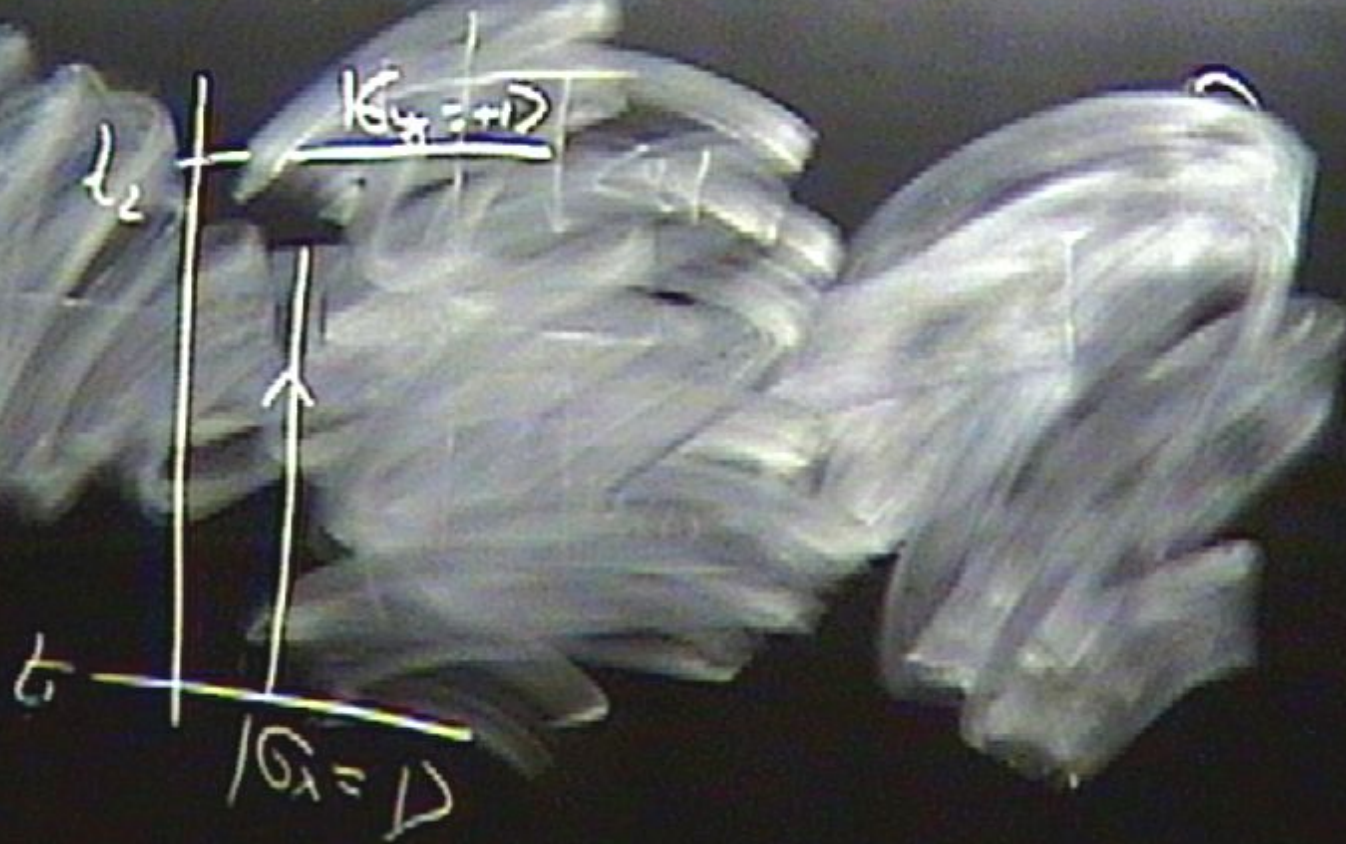


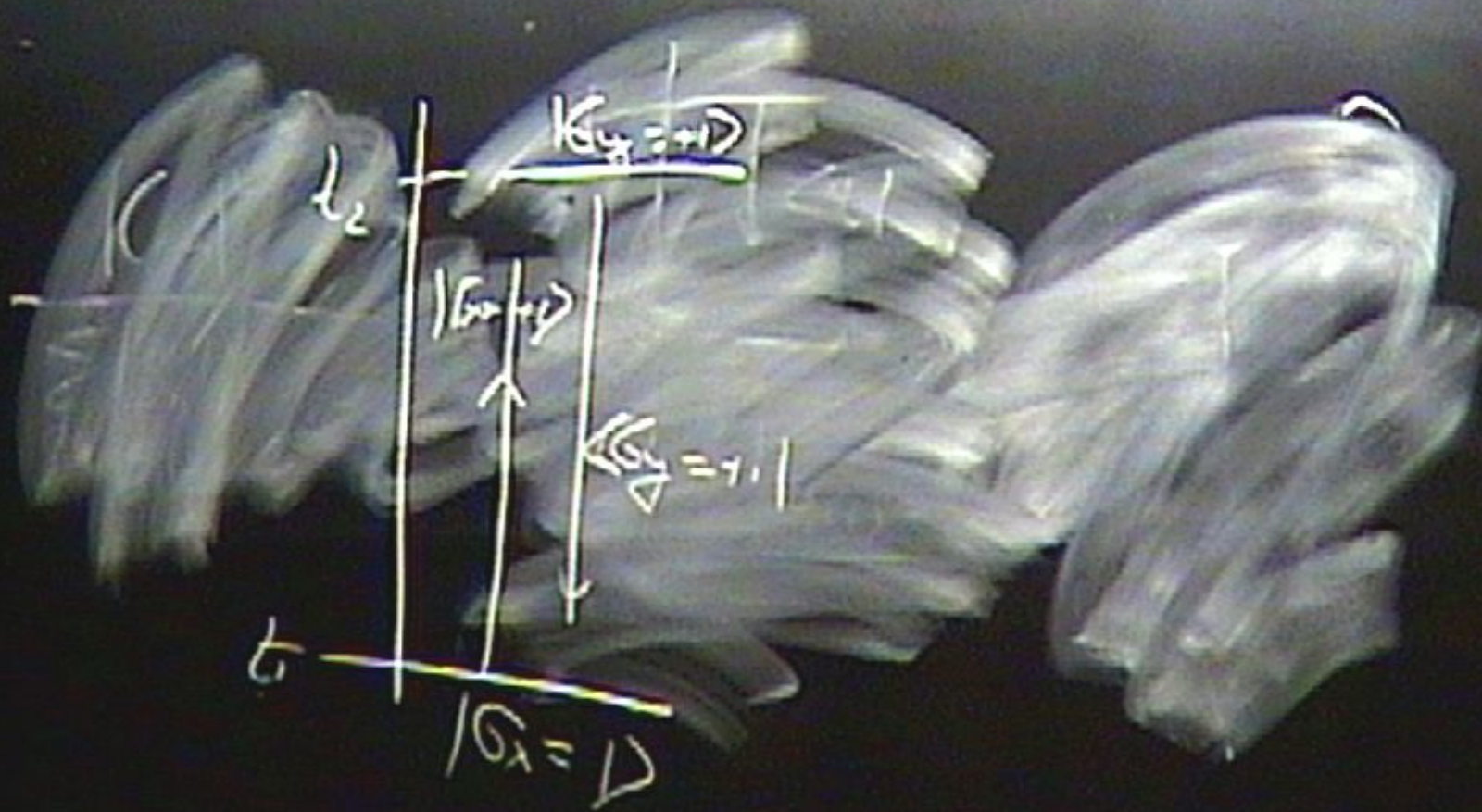
$$\frac{|K_m|^2}{\sum_n |G_n|^2}$$

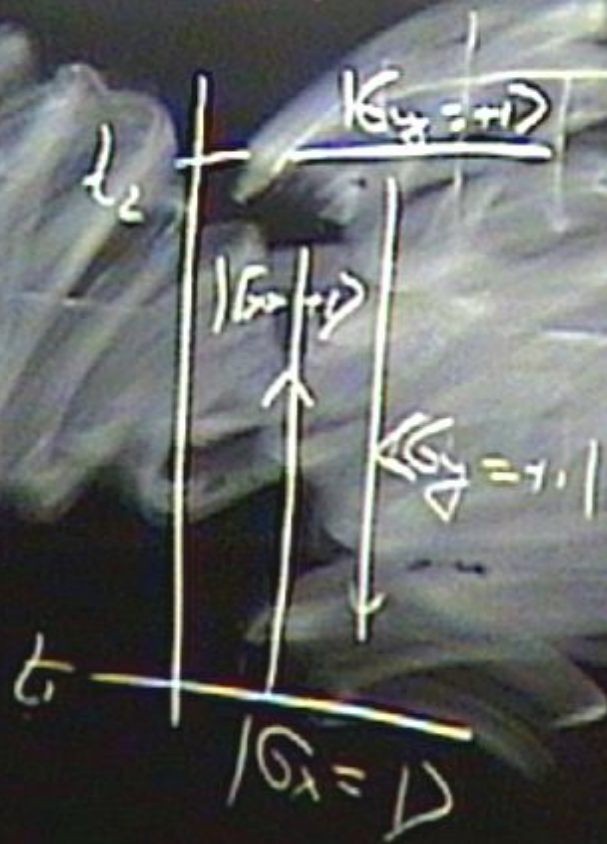


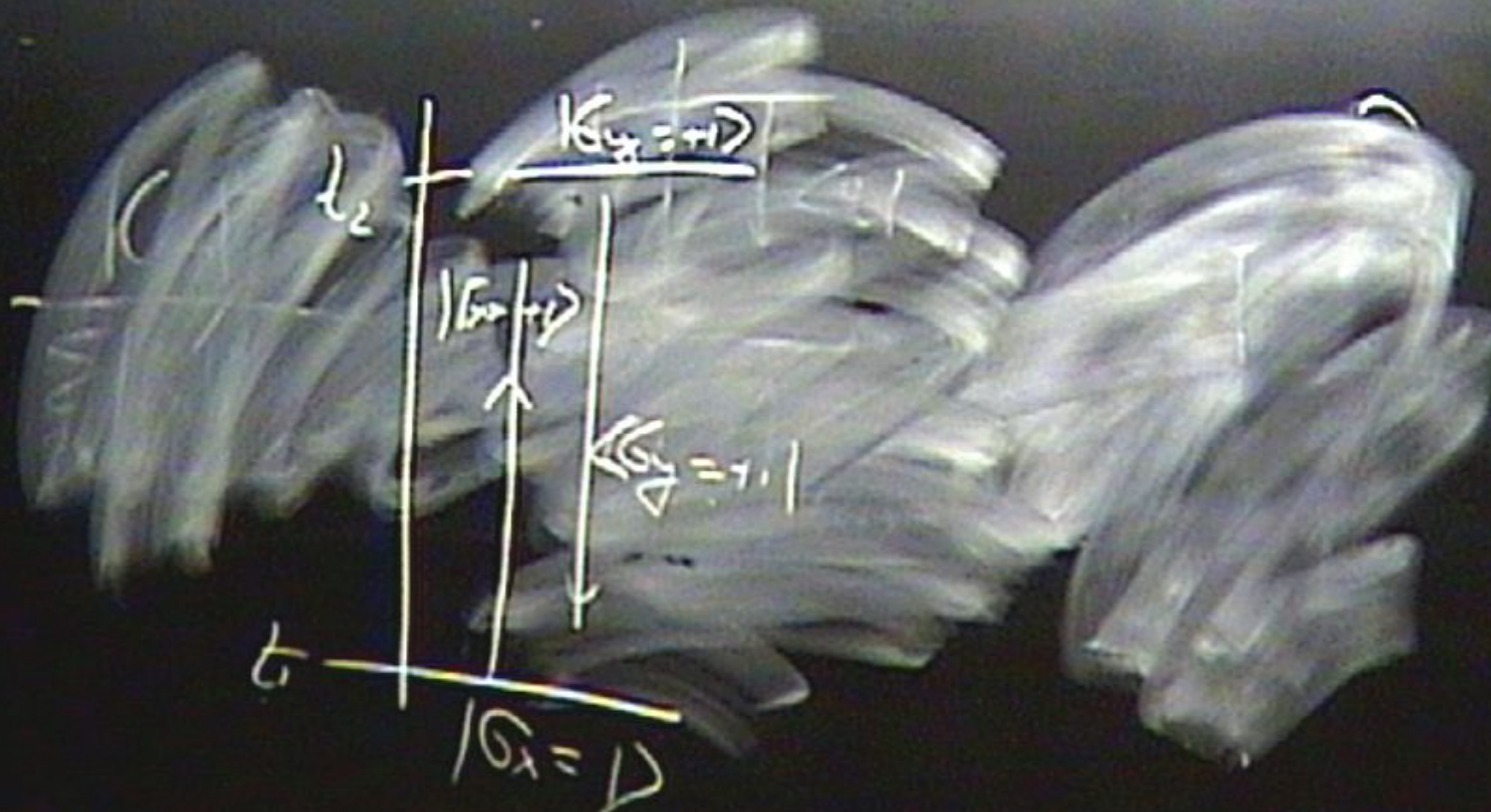


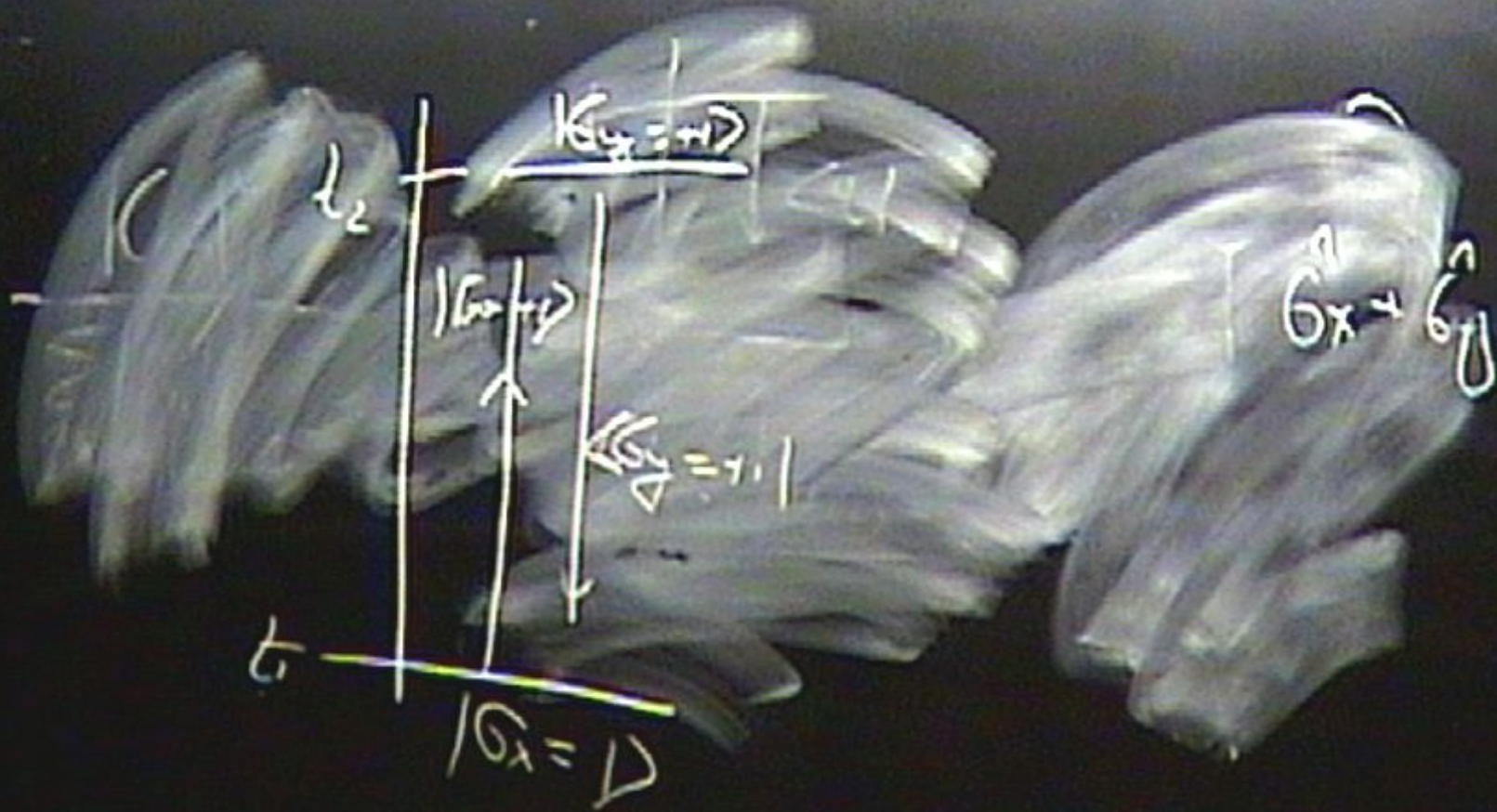
$$10x = 1$$

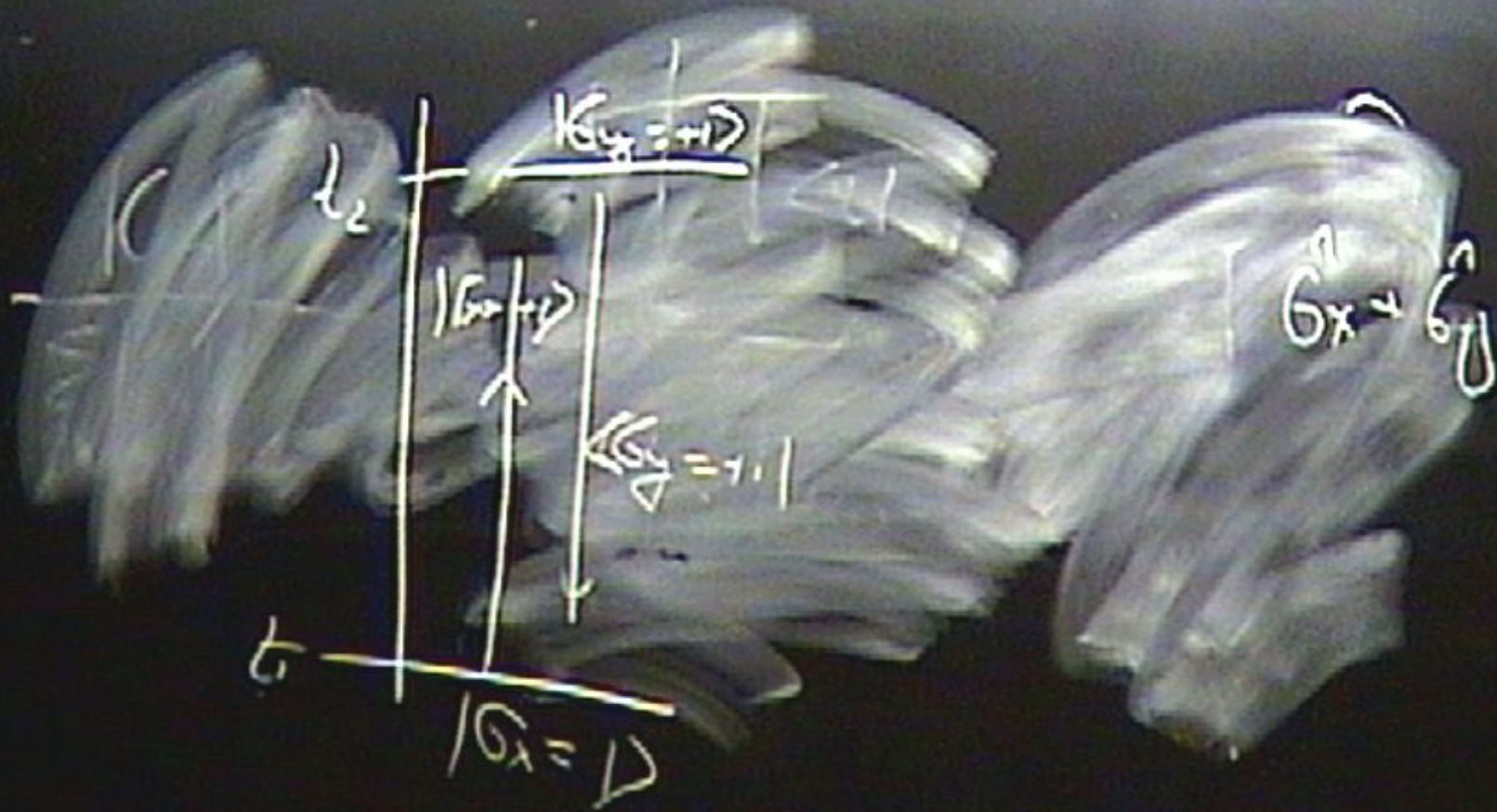


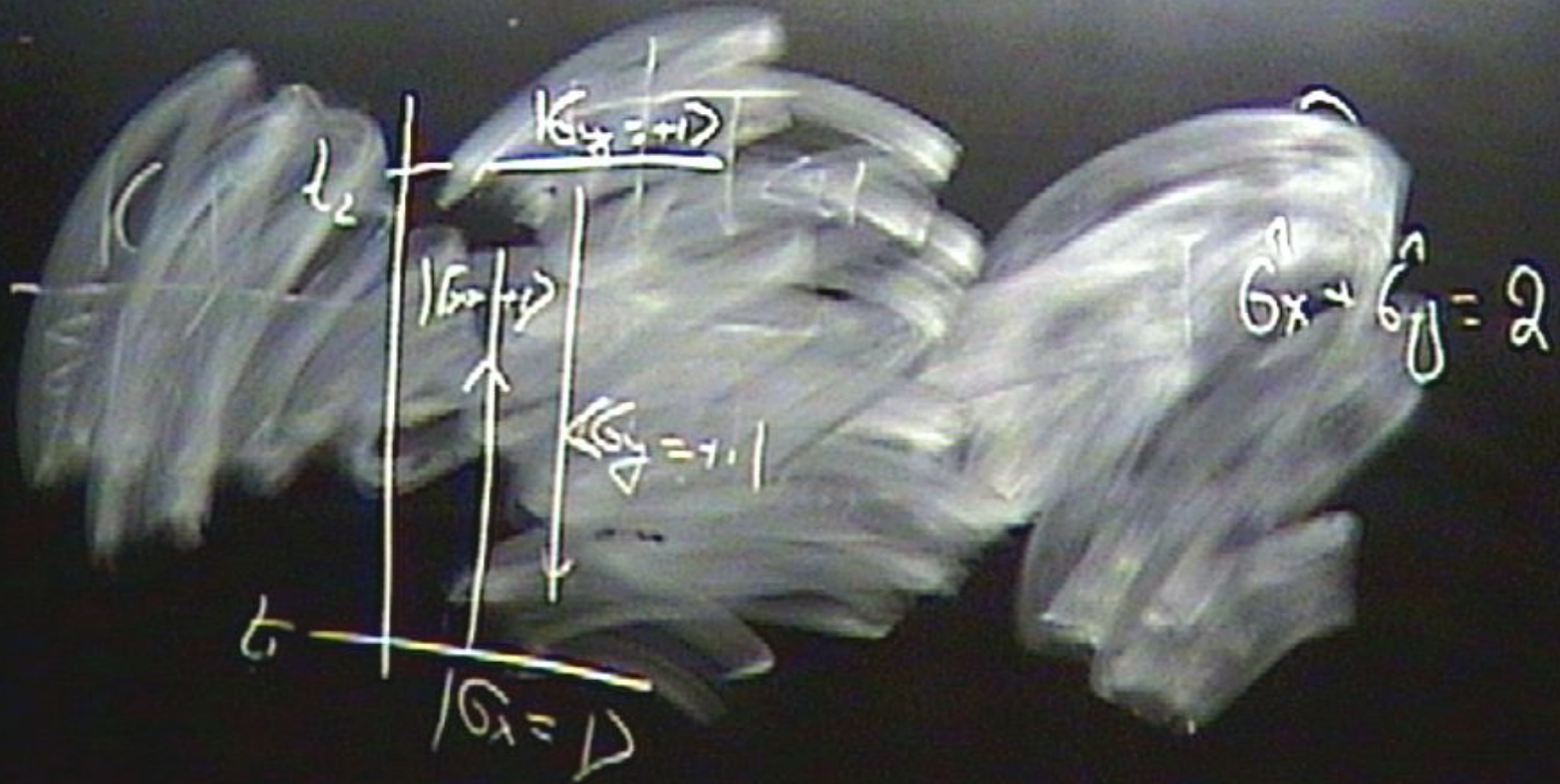


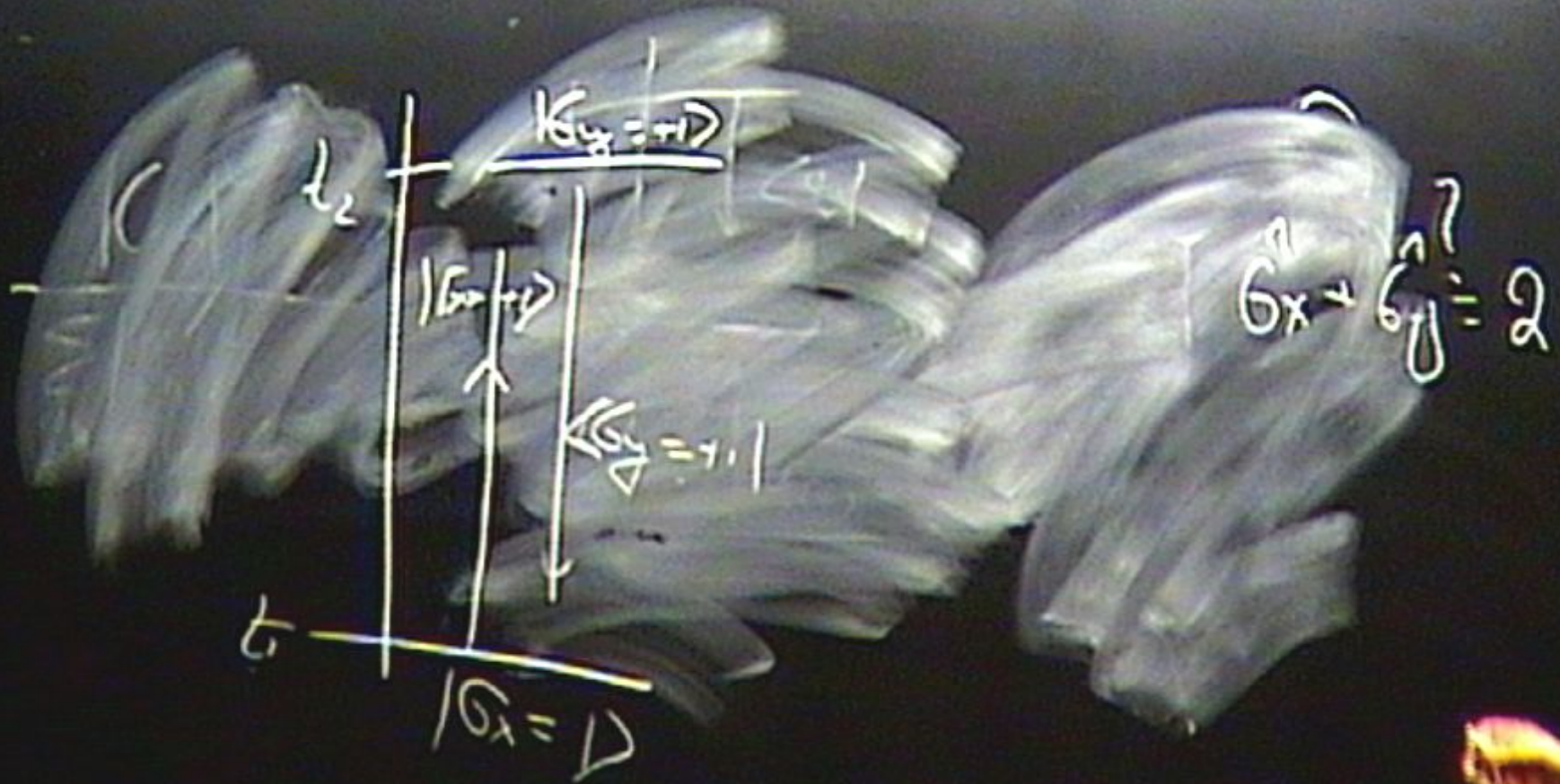


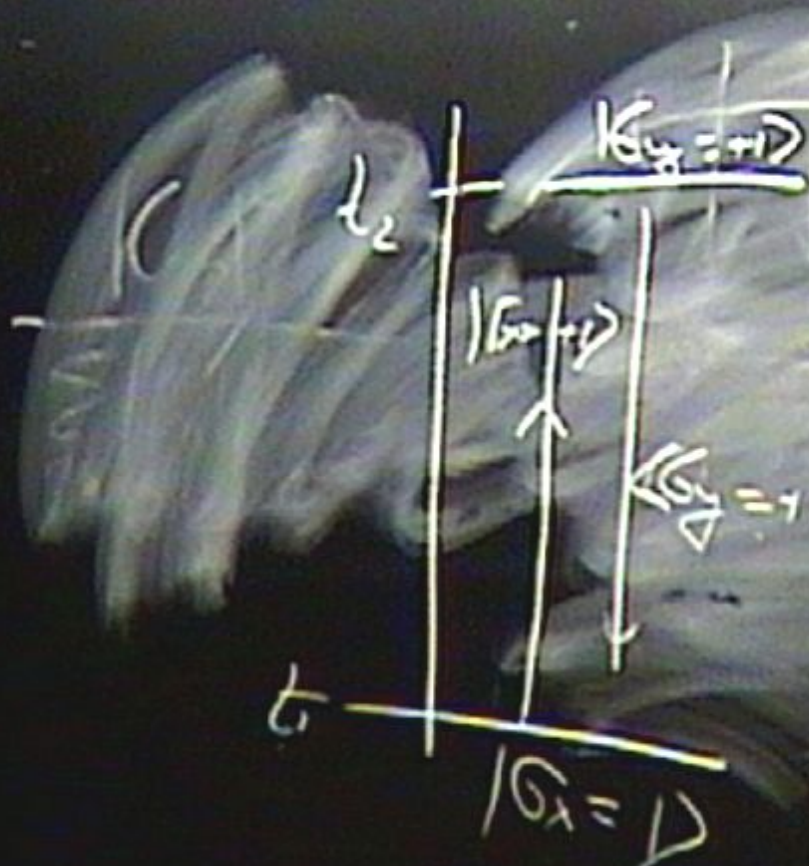




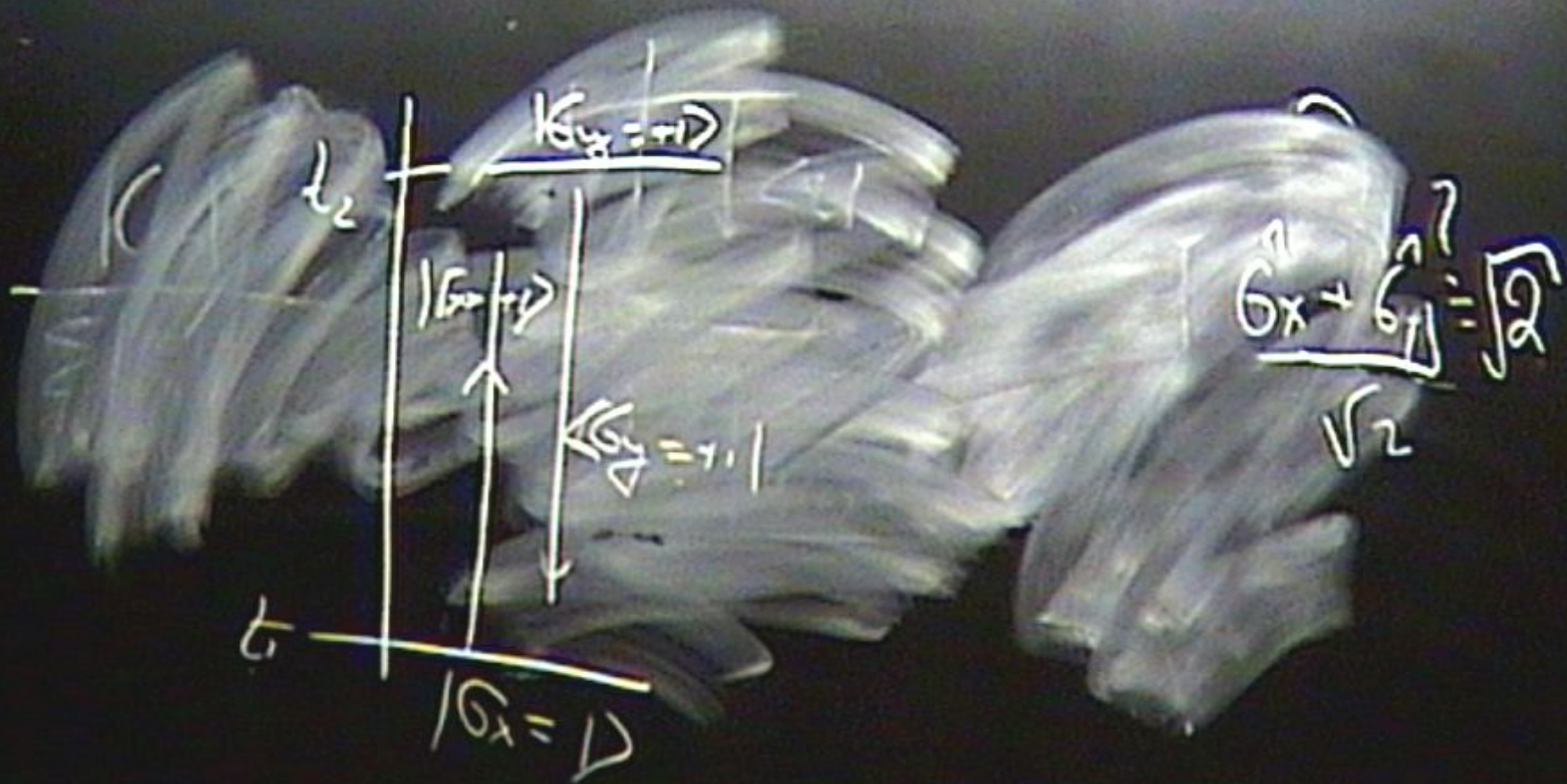


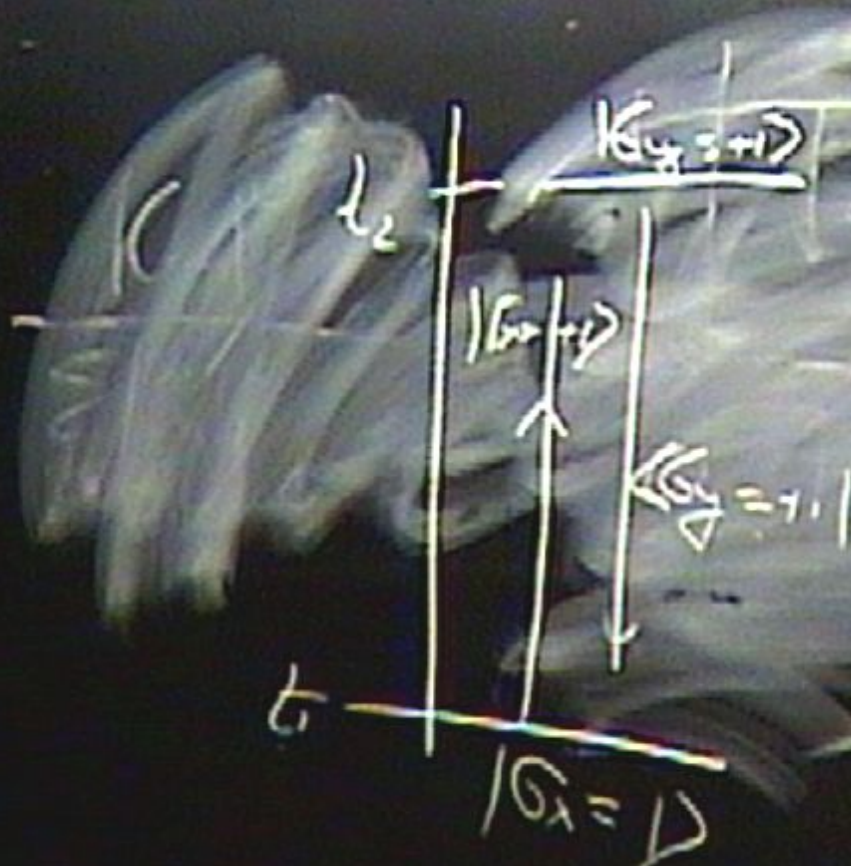




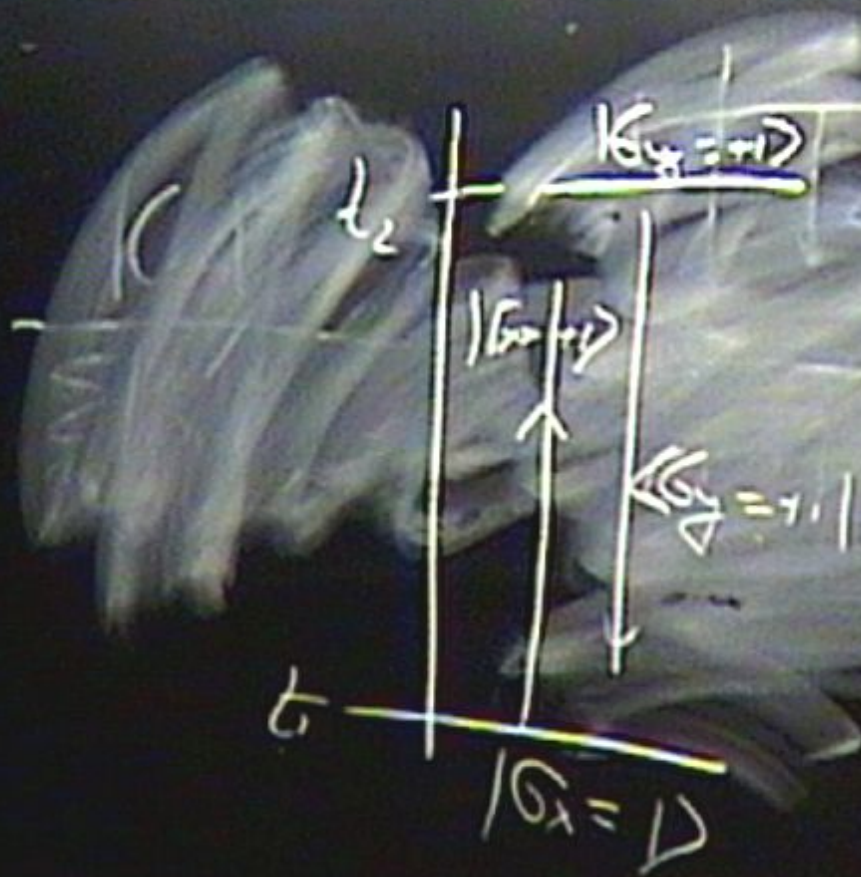


$$\frac{\sigma_x + \sigma_y}{\sqrt{2}} = \sqrt{2}$$



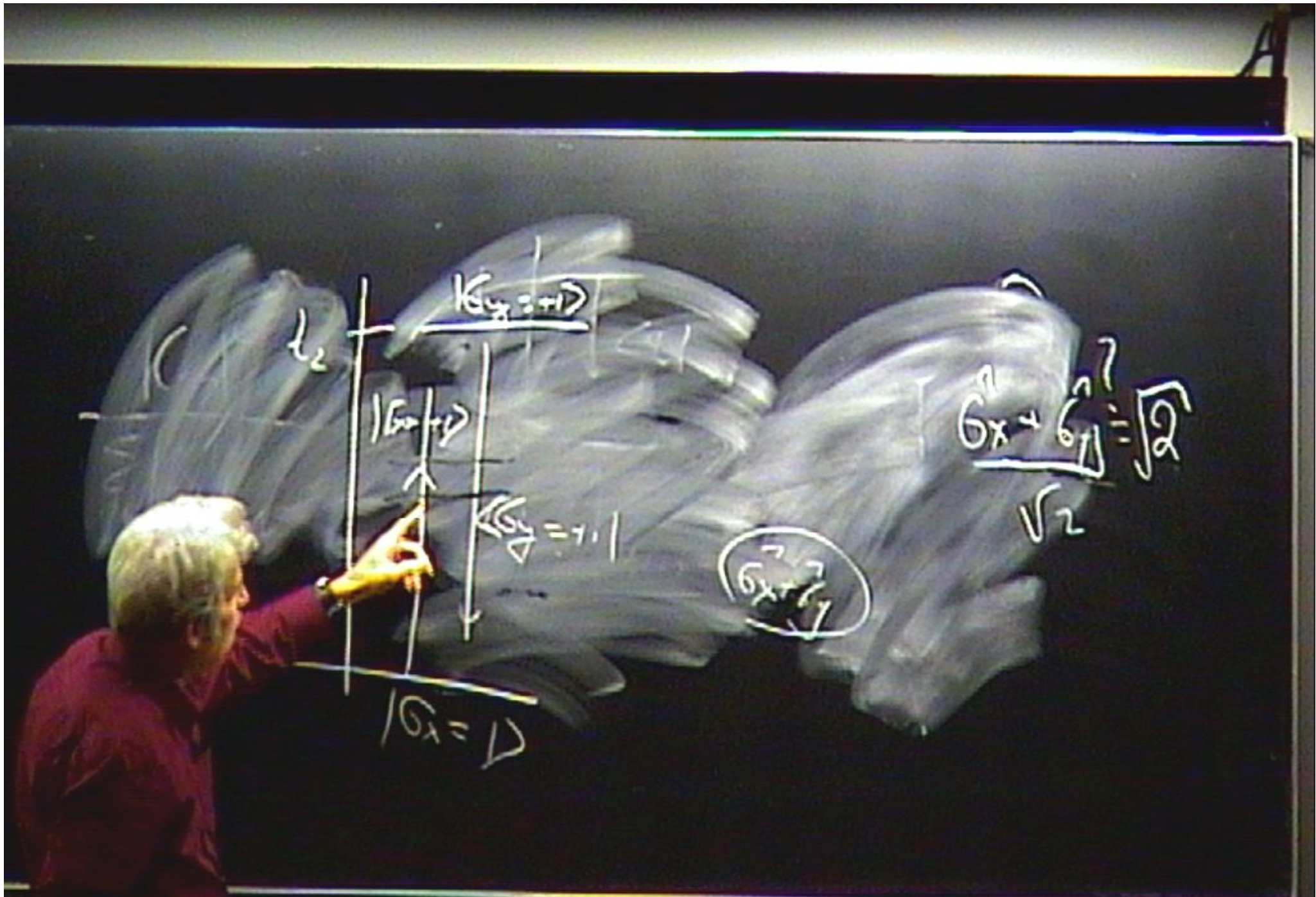


$$\frac{G_x + G_y}{\sqrt{2}} = \sqrt{2}$$



$$\frac{G_x + G_y}{\sqrt{2}}$$

$$\frac{G_x + G_y}{\sqrt{2}} = \sqrt{2}$$



t_2

$$|G_y = +1\rangle$$

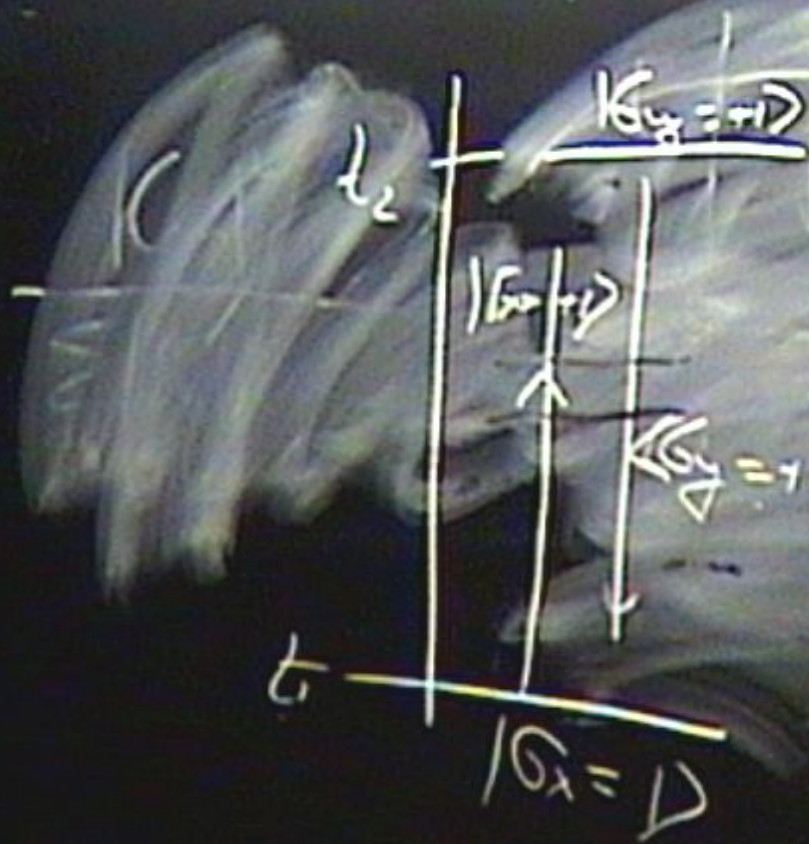
$$|G_x = +1\rangle$$

$$|G_y = -1\rangle$$

$$|G_x = -1\rangle$$

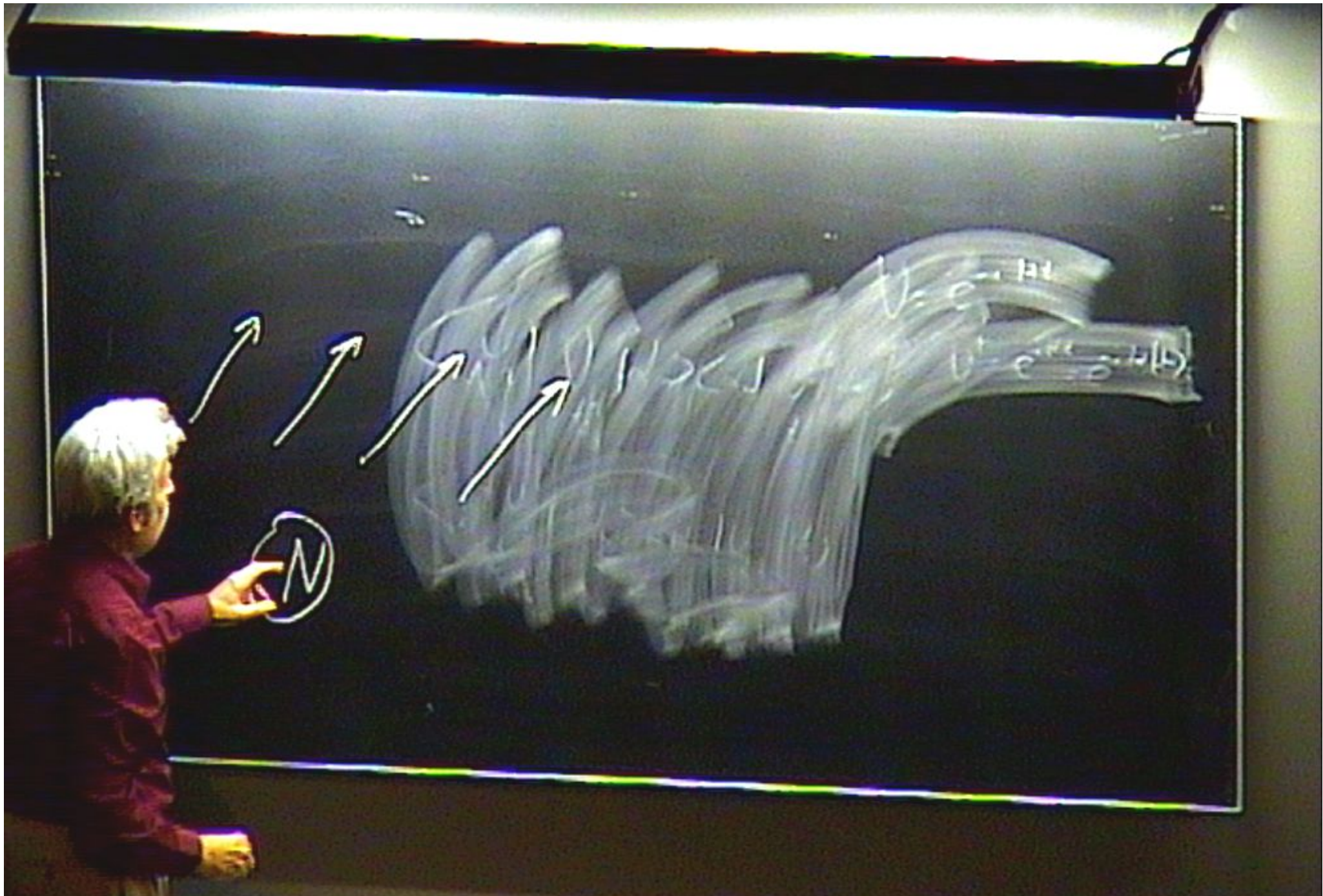
$$\frac{G_x + G_y}{\sqrt{2}} = \sqrt{2}$$

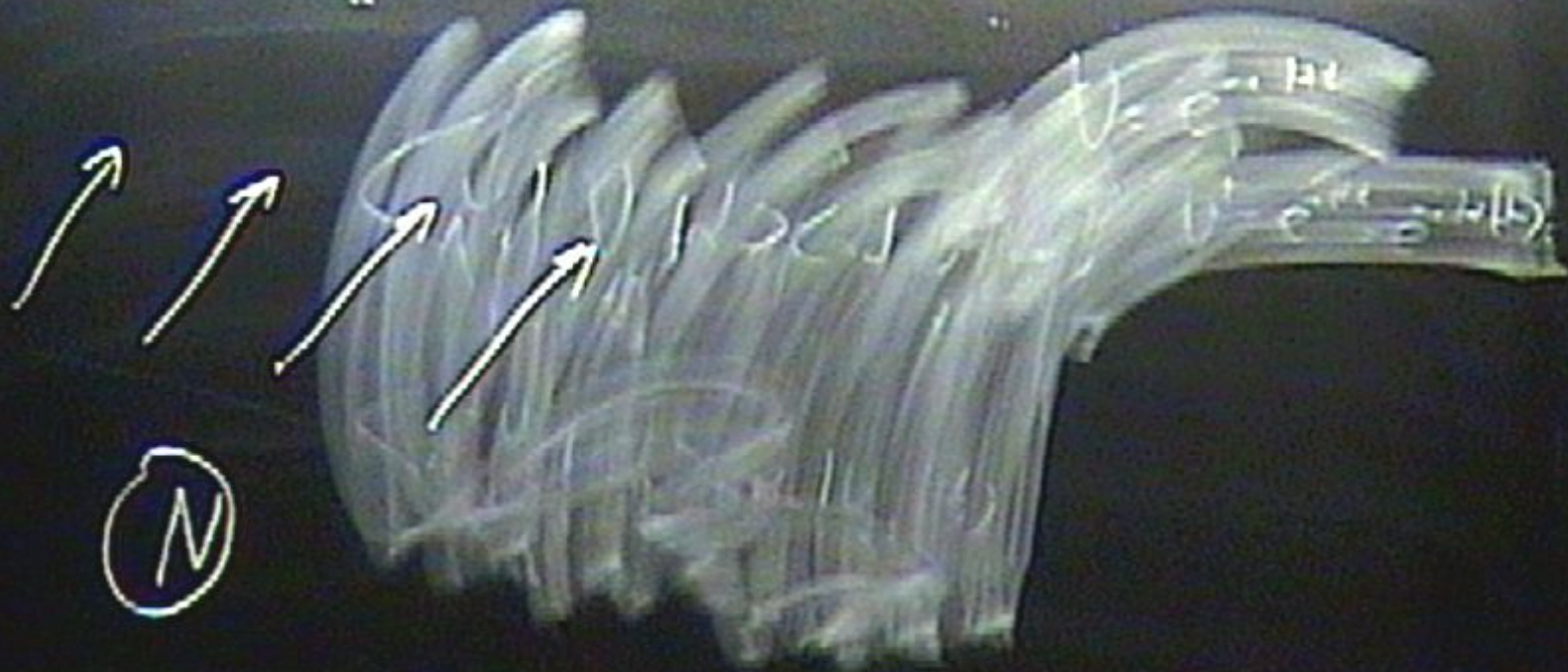
$$G_x + G_y = 1$$

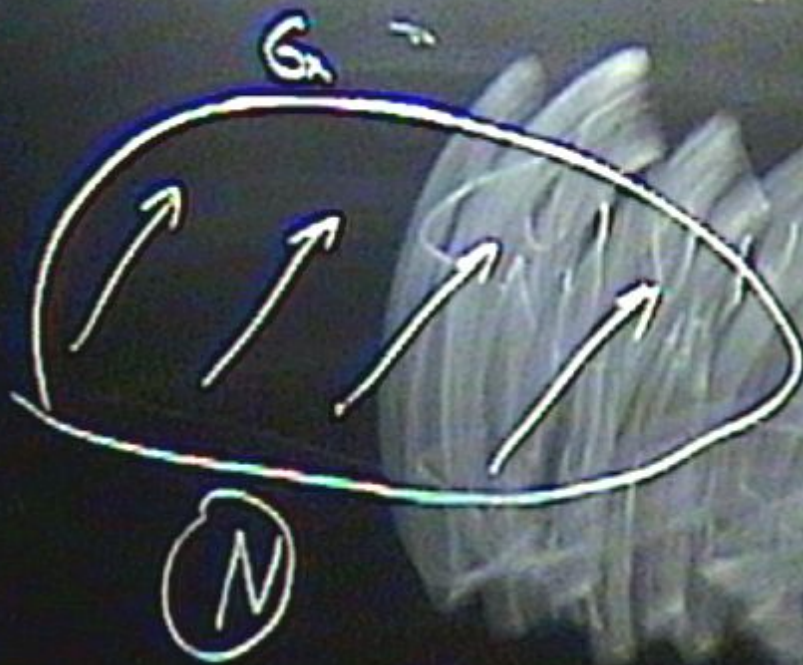


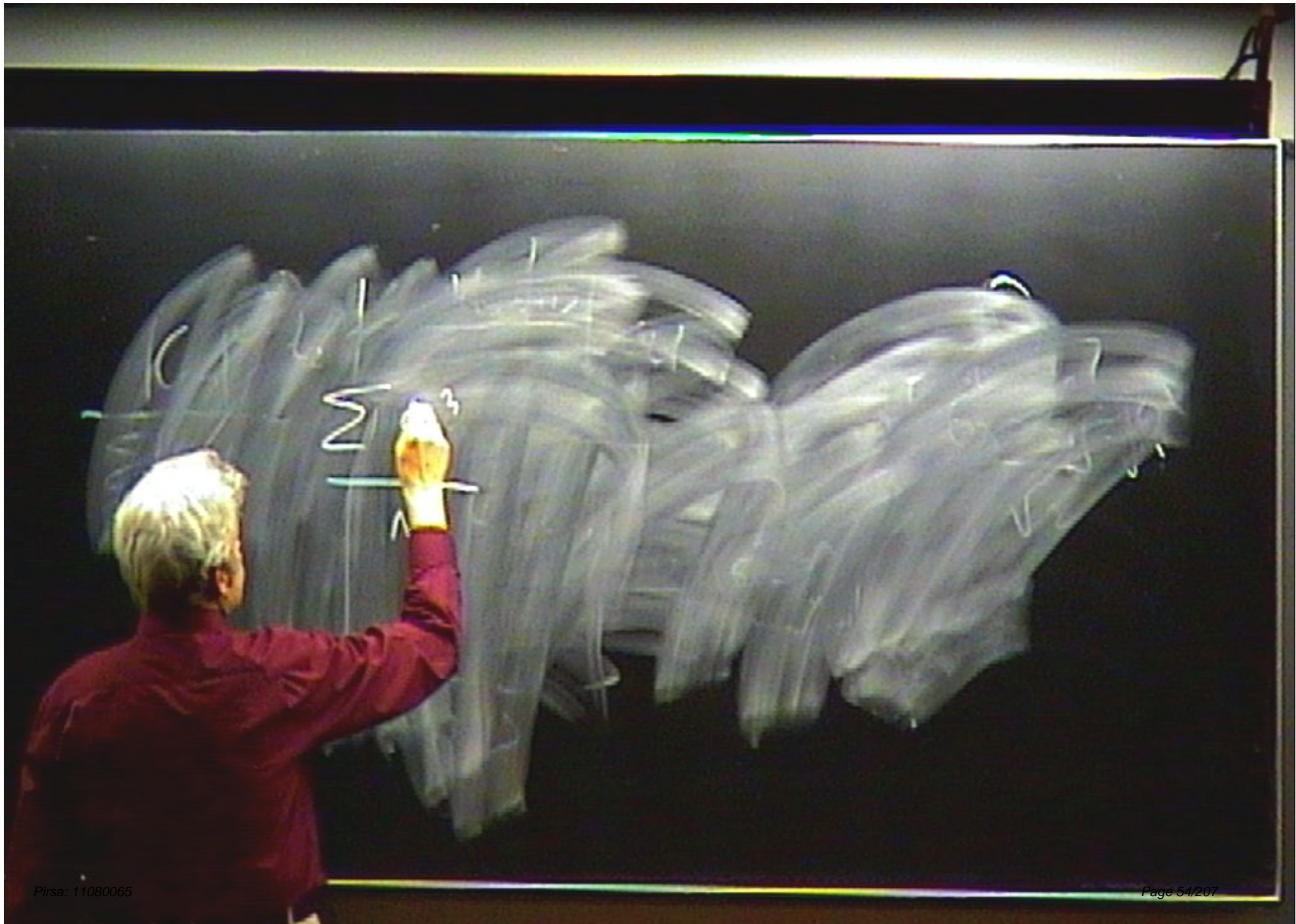
$$\begin{pmatrix} \uparrow \\ \downarrow \\ \uparrow \\ \downarrow \end{pmatrix}$$

$$\frac{\sigma_x + \sigma_y}{\sqrt{2}}$$

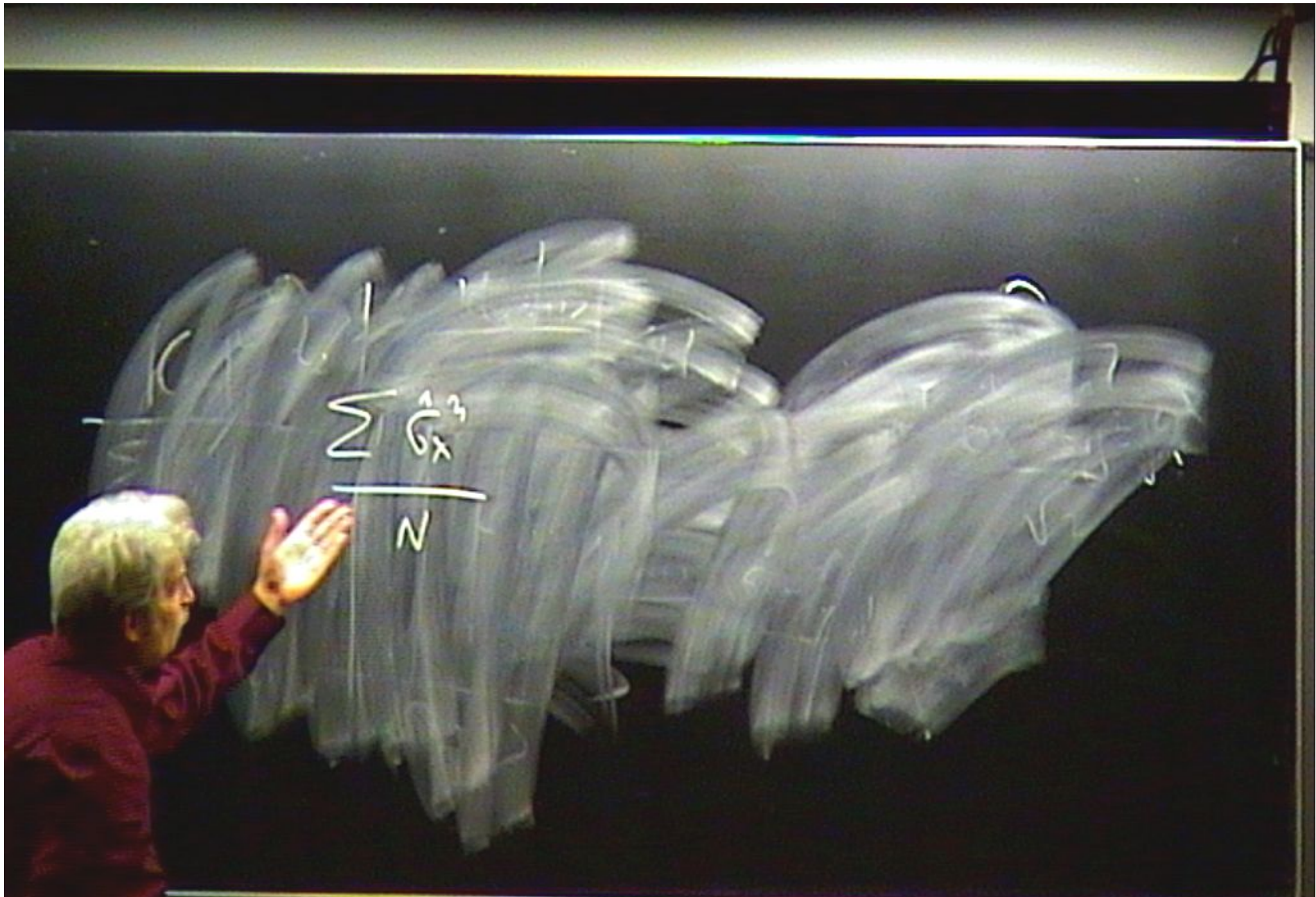








$$\sum_{i=1}^3$$



$$\frac{\sum G_x^3}{N}$$

$$\frac{\sum G_x^3}{N}$$

$$\frac{\sum G_x^3}{N}$$

$$\frac{\sum G_y^3}{N}$$

$$\frac{\sum G_z^3}{N}$$

$$\frac{\sum G_x^3}{N}$$

$$\frac{\sum G_y^3}{N}$$

$$\frac{\sum G_z^3}{N}$$

Use-fit.



$U = e^{-iHt}$

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

$$\sum_{\alpha} A_{\alpha}$$

$U = e^{-\beta H}$

$$\langle H_{\text{tot}} \rangle = \frac{1}{Z} \sum_{m=1}^M \langle H(m) \rangle$$

$$\frac{\sum A_i}{Z}$$

$$U = e^{-iHt}$$

$$|\Psi_{\text{tot}}\rangle = \prod_{m=1}^N |\psi(m)\rangle$$

$$\frac{\sum A_m}{N} |\Psi_{\text{tot}}\rangle = \bar{A} |\Psi_{\text{tot}}\rangle + |\delta A\rangle$$

$$U = e^{-iHt}$$

$$|\Psi_{\text{tot}}\rangle = \prod_{m=1}^N |\psi(m)\rangle$$

$$\frac{\sum A_n}{N} |\Psi_{\text{tot}}\rangle = \bar{A} |\Psi_{\text{tot}}\rangle + |\delta A\rangle$$

$$U = e^{-iHt}$$

$$\Psi(x)$$

$$|\Psi_{\text{tot}}\rangle = \prod_{m=1}^N |\psi(m)\rangle$$

$$\frac{\sum A_n}{N} |\Psi_{\text{tot}}\rangle = \bar{A} |\Psi_{\text{tot}}\rangle + |\delta \bar{A}\rangle$$

$$U = e^{-iHt}$$

$$\Psi(x)$$

$$|\Psi_{\text{tot}}\rangle = \prod_{m=1}^N |\psi(m)\rangle$$

$$\frac{\sum A_n}{N} |\Psi_{\text{tot}}\rangle = \bar{A} |\Psi_{\text{tot}}\rangle + |\delta A\rangle$$

$$\hat{A}|\psi\rangle = a_1|\psi_1\rangle + a_2|\psi_2\rangle$$

$$\hat{A}|\psi\rangle = a_1|\psi_1\rangle + a_2|\psi_2\rangle$$

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

$$\hat{A}(N) = a_1(N) + a_2(N)$$

$$a_1 = \bar{A}$$

$$a_2 = \sigma_A$$

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

$$a_1 = \overline{A}$$

$$a_2 = 0\hat{A}$$

$\langle \hat{A} | \hat{A} \rangle$

$$\hat{A} | \psi \rangle = a_1 | \psi \rangle + a_2 | \psi_{\perp} \rangle$$

$$a_1 = \overline{\hat{A}}$$

$$a_2 = \sigma \hat{A}$$

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

$$\hat{A} | \psi \rangle = a_1 | \psi \rangle + a_2 | \psi_{\perp} \rangle$$

$$a_1 = \bar{A}$$

$$a_2 = 0 \hat{A}$$

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

$$\hat{A} | \psi \rangle = a_1 | \psi \rangle + a_2 | \psi_{\perp} \rangle$$

$$a_1 = \bar{A}$$

$$a_2 = \sigma \hat{A}$$

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

$$\hat{A} | \psi \rangle = a_1 | \psi \rangle + a_2 | \psi_{\perp} \rangle$$

$$a_1 = \bar{A}$$

$$a_2 = 0 \hat{A}$$

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

$$\langle \Psi | \hat{A} | \Psi \rangle = \bar{A} = \alpha_1$$

$$\alpha_2 = \bar{A}^2 = \bar{A}^2 = (\bar{A})^2$$

$$\hat{A} | \Psi \rangle = \alpha_1 | \Psi \rangle + \alpha_2 | \Psi_2 \rangle$$

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

$$= \alpha_1 \hat{A} | \Psi \rangle$$

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

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

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

$$\bar{A}^2 = \bar{A}^2 = \alpha_2$$

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

$$a_2 = \bar{A}^2 = \bar{A}^2 - \langle \hat{A} \rangle^2$$

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

$$a_1 = \bar{A}$$

$$a_2 = \hat{A}^2 - \bar{A}^2$$

$$\langle \hat{A}^2 | \hat{A} | \psi \rangle$$

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

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

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

$$a_2 = \bar{A}^2 = \bar{A}^2 - \langle \hat{A} \rangle^2$$

$$\hat{A} | \psi \rangle = a_1 | \psi \rangle + a_2 | \psi_{\perp} \rangle$$

$$a_1 = \bar{A}$$

$$a_2 = 0 \hat{A}$$

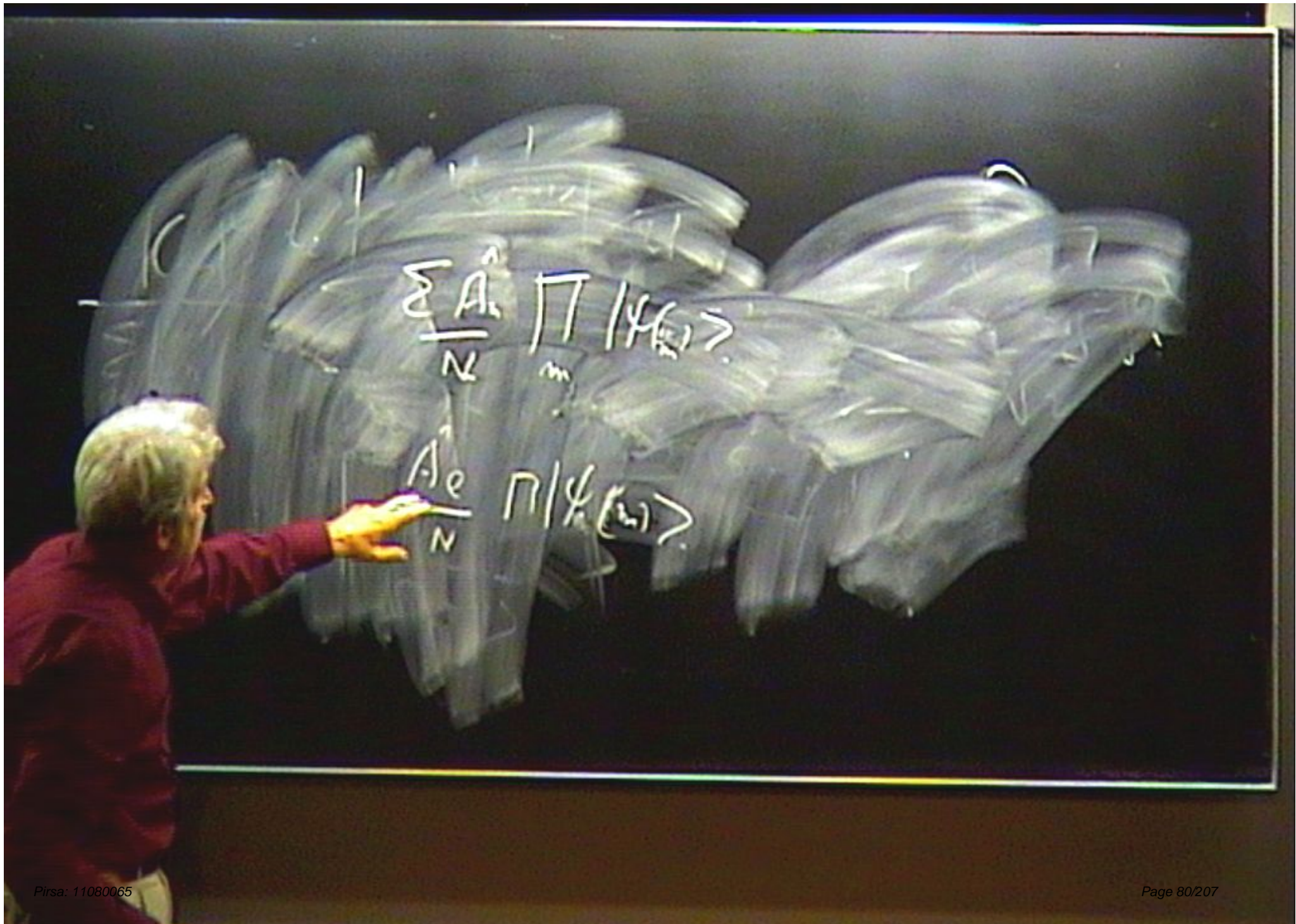
$$\langle \hat{A} | \hat{A} | \psi \rangle$$

$$\hat{A} | \psi \rangle = \bar{A} | \psi \rangle + 0 \hat{A} | \psi \rangle$$

$$\langle \psi | \hat{A} | \psi \rangle = \bar{A} = \bar{A}^2 - a_2$$

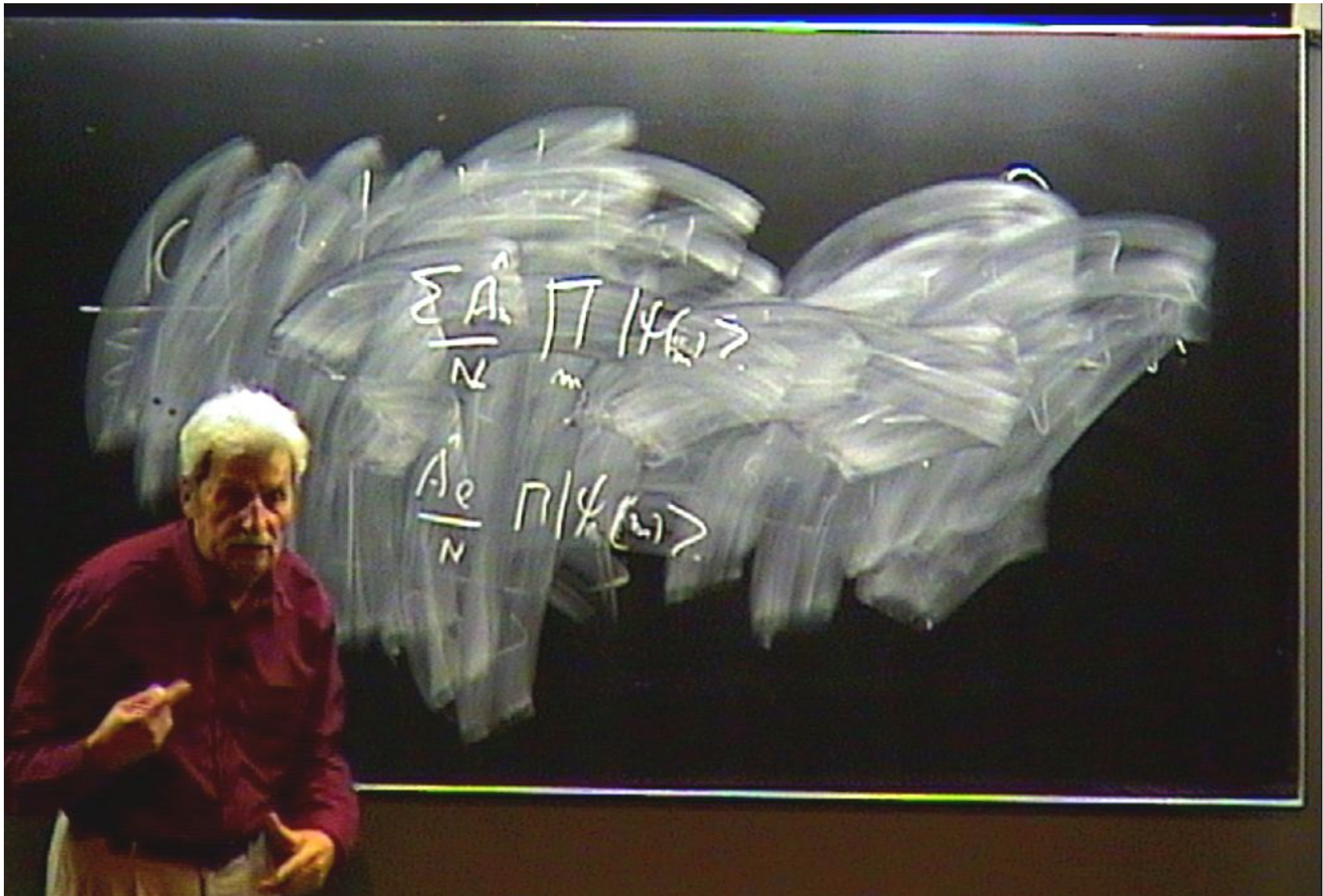
$$\frac{\sum \hat{A}_i}{N} \prod_{i=1}^n |H_i| \rightarrow$$

$$\frac{\sum A_i}{N} \prod_{m=1}^M |H_m|$$



$$\frac{\sum A_i}{N} \prod_m |\psi_m\rangle$$

$$\frac{A_e}{N} \prod |\psi_m\rangle$$



$$\frac{\sum A_i}{N} \prod_m |f_m\rangle$$

$$\frac{A_e}{N} \prod |f_m\rangle$$

$$\frac{\sum A_i}{N} \prod_m |\psi_{i,m}\rangle$$

$$\frac{A_e}{N} \prod |\psi_{i,m}\rangle$$

$$\frac{\sum \hat{A}_i}{N} \prod_m |\psi_m\rangle$$

$$\frac{A_e}{N} \prod |\psi_m\rangle = \bar{A} |\psi_{\text{tot}}\rangle$$

$$\frac{\sum A_i}{N} \prod_m |\psi_{i,m}\rangle$$

$$\frac{A_e}{N} \prod |\psi_{i,m}\rangle = \frac{\bar{A} N}{N} |\psi_{\text{tot}}\rangle = \frac{\bar{A}}{1} |\psi_{\text{tot}}\rangle$$

$$\frac{\sum A_m}{N} \prod_m |\psi_m\rangle$$

$$\frac{\sum A_e}{N} \prod_e |\psi_e\rangle = \frac{\bar{A} N}{N} \prod_{tot} |\psi_e\rangle = \frac{\bar{A}}{N} \prod_{tot} |\psi_e\rangle$$



$$\sum \frac{A_i}{N} \prod_m |\psi_{i,m}\rangle$$

$\langle \delta E | \delta E \rangle \rightarrow \left(\frac{1}{2}\right)$

$$\sum \frac{A_e}{N} \prod |\psi_{e,m}\rangle = \bar{A} N \langle \delta E \rangle \rightarrow \frac{\langle \delta A \rangle}{N} \langle \psi_e \rangle$$

$$\frac{\sum \hat{A}_i}{N} \prod_{m=1}^M |\psi_m\rangle \quad \text{(\text{SREISRE})} \rightarrow \left(\frac{1}{N}\right)$$

$$\left(\frac{\sum \hat{A}_i}{N}\right) |\psi_{tot}\rangle = \frac{\sum \hat{A}_i}{N} \prod_{m=1}^M |\psi_m\rangle = \bar{A} |\psi_{tot}\rangle \rightarrow \frac{\partial \hat{A}_i}{\partial \psi_m} |\psi_{tot}\rangle$$

$U = e^{-\beta H}$

$\Psi(x)$

A

Use $e^{-\lambda t}$.

$Y(x)$

e^{-9A}

$$U = e^{-\beta H}$$

$$\Psi(x)$$

$$e^{-\beta \hat{A}}$$

$U = e^{-\beta H}$

$\Psi(x)$

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

$$U = e^{-iHt}$$

$$\psi(x)$$

$$e^{-i\hat{A}|\psi\rangle\langle\psi}$$

$$U = e^{-\beta H}$$

$$\Psi(x)$$

$$e^{-\beta \hat{A}} |\psi\rangle |\phi\rangle$$

$$U = e^{-iHt}$$

$$\psi(x)$$

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

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

$$U = e^{-i\hat{H}t}$$

$$\psi(x)$$



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

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

$$U = e^{-i\hat{H}t}$$

$$\psi(x)$$



$$e^{-i\hat{A}t} |\psi\rangle | \phi \rangle$$

$$|\psi\rangle e^{i\lambda t} |\phi\rangle$$

$U = e^{-iHt}$

$\psi(x)$



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

$$|\psi\rangle e^{i\lambda g} |\phi\rangle$$

$$U = e^{-i\hat{H}t}$$

$$\psi(x)$$



$$e^{-i\hat{A}} |\psi\rangle |E\rangle$$

$$|\psi\rangle e^{i\lambda\alpha} |E\rangle$$

$U = e^{-\beta H}$

$\Psi(x)$



$\hat{A} = \lambda \hat{A}$

$$\lambda = \frac{\sum_i \lambda_i}{N}$$

$$U = e^{-\beta H}$$

$$\psi(x)$$



$$e^{-\beta H}$$

$$\lambda = \frac{\lambda'}{N}$$

$$\lambda' > 1$$

$U \cdot e^{-\lambda t}$

$Y(x)$



$$\lambda = \frac{\Delta}{N}$$

$$\lambda' > 1$$

$$0 \leq \lambda \leq \lambda' = \frac{\Delta}{N}$$

$U = e^{-\beta H}$

$\psi(x)$



$$\lambda = \frac{\hbar}{N}$$

$$\lambda' > 1$$

$$e^{i\lambda \rho A} = 1 + i\lambda \rho A$$

$$\left(1 + i\lambda \rho A\right)$$

$$U = e^{-iHt}$$

$$\Psi(x)$$



$$\lambda = \frac{\Delta x}{N}$$

$$\lambda' > 1$$

$$e^{i\lambda q A} = 1 + i\lambda q A$$

$$\left(1 + i\lambda q A\right) |\psi\rangle |\bar{e}\rangle$$

$$U = e^{-i\hat{A}t}$$

$$\psi(x)$$



$$\lambda = \frac{\lambda'}{N}$$

$$\lambda' > 1$$

$$e^{i\lambda g \hat{A}} = 1 + i\lambda g \frac{\hat{A}}{N}$$

$$\left(1 + i\lambda g \frac{\hat{A}}{N}\right) |\psi\rangle |\bar{e}\rangle$$

$$\hat{A} \psi$$

$$U = e^{-iHt}$$

$\Psi(x)$



$$\lambda = \frac{\lambda'}{N}$$

$$\lambda' > 1$$

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

$\tau \circ A(\tau \psi)$

$$e^{i\lambda g \hat{A}} = 1 + i \frac{\lambda g \hat{A}}{N}$$

$$\left(1 + i \frac{\lambda'}{N} g \bar{A}\right) |\psi\rangle |\bar{e}\rangle +$$

$$\left(i \frac{\lambda' g \bar{A}}{N}\right) |\psi\rangle |\bar{e}\rangle$$

$$U = e^{-iHt}$$

$\Psi(x)$



$$\lambda = \frac{\lambda'}{N}$$

$$\lambda' > 1$$

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

$$\tau \hat{A}|\psi\rangle$$

$$0 = \lambda \hat{A} = \left(1 + \frac{\lambda' \hat{A}}{N}\right)$$

$$\left(1 + \frac{\lambda' \hat{A}}{N}\right) |\psi\rangle = |\psi\rangle$$

$$-\hat{A}|\psi\rangle = \frac{\lambda'}{N} \hat{A}|\psi\rangle$$

$$\left(1 + \frac{\lambda' \hat{A}}{N}\right) |\psi\rangle = |\psi\rangle$$

$$U = e^{-i\hat{H}t}$$

$\Psi(x)$



$$\lambda = \frac{\lambda'}{N}$$

$$\lambda' > 1$$

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

$\tau \hat{A} / \tau \hat{A}$

$$e^{i\lambda \hat{A}} = 1 + i\frac{\lambda \hat{A}}{N}$$

$$\left(\frac{\lambda'}{N} \hat{A} \right) |\psi\rangle |e\rangle + \left(1 + i\frac{\lambda \hat{A}}{N} \right) |\psi\rangle |e\rangle$$

$$U = e^{-i\hat{H}t}$$

$\Psi(x)$



$$\lambda = \frac{\lambda'}{N}$$

$$\lambda' > 1$$

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

$\tau \hat{A}|\psi\rangle$

$$e^{i\lambda \hat{A}} = 1 + i\frac{\lambda \hat{A}}{N}$$

$$\left(1 + i\frac{\lambda \hat{A}}{N}\right) |\psi\rangle |\bar{e}\rangle$$

$$\left[\left(1 + i\frac{\lambda'}{N} \hat{A}\right) |\psi\rangle |\bar{e}\rangle + i\frac{\lambda'}{N} \hat{A} |\psi\rangle |\bar{e}\rangle \right]$$

$U = e^{-i\hat{H}t}$

$\Psi(x)$



$$\lambda = \frac{\lambda'}{N}$$

$$\lambda' > 1$$

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

$\tau \circ A / \tau \circ \bar{A}$

$$e^{i\lambda g \hat{A}} = 1 + i\frac{\lambda g \hat{A}}{N}$$

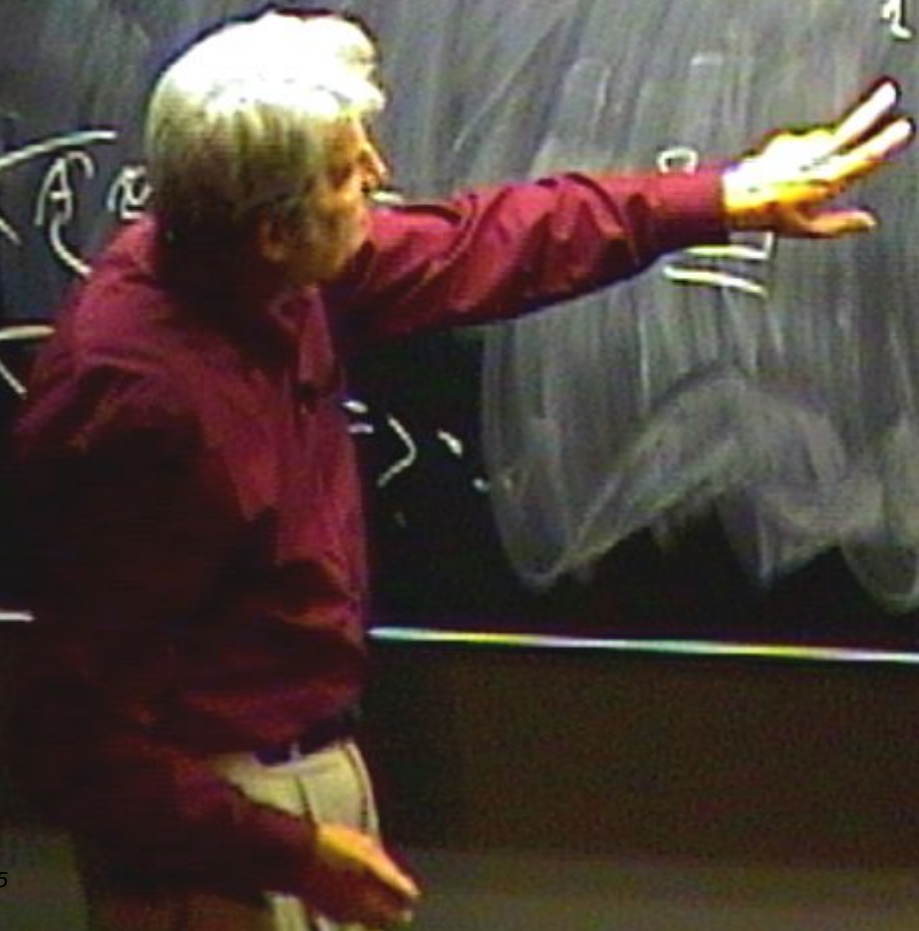
$$\left(1 + i\frac{\lambda g \hat{A}}{N}\right) |\psi\rangle |\bar{\psi}\rangle$$

$$\left(1 + i\frac{\lambda'}{N} g \bar{A}\right) |\psi\rangle |\bar{\psi}\rangle + i\frac{\lambda' g}{N} g \bar{A} |\psi\rangle |\bar{\psi}\rangle$$

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

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

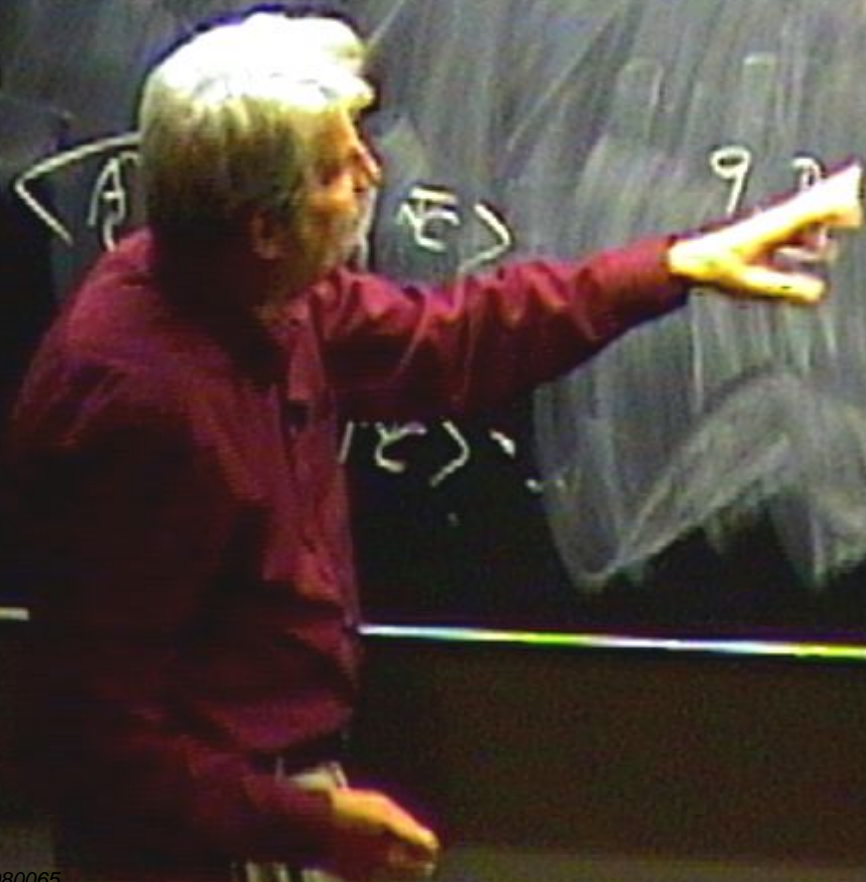
- 1
- 2
- 3
- 4
- 5



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

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

- 1
- 2
- 3
- 4
- 5



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

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

- 1
- 2
- 3
- 4
- 5

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

$$\underline{\underline{9, 2}}$$

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

$$\langle \hat{A} | \hat{A} | \hat{A} \rangle = \hat{A} = Q,$$

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

$$\langle \hat{A} | \hat{A} | \hat{A} \rangle$$

$$\underline{\underline{9, 3}}$$

$$\langle \hat{A} | \hat{A} | \hat{A} \rangle$$



$$\bar{A} = \langle \gamma | \bar{A} | \gamma \rangle$$

$$\langle \delta | \delta \rangle \rightarrow \left(\frac{1}{2} \right)$$

$$\bar{A} = \langle 4 | \hat{A} | 4 \rangle$$

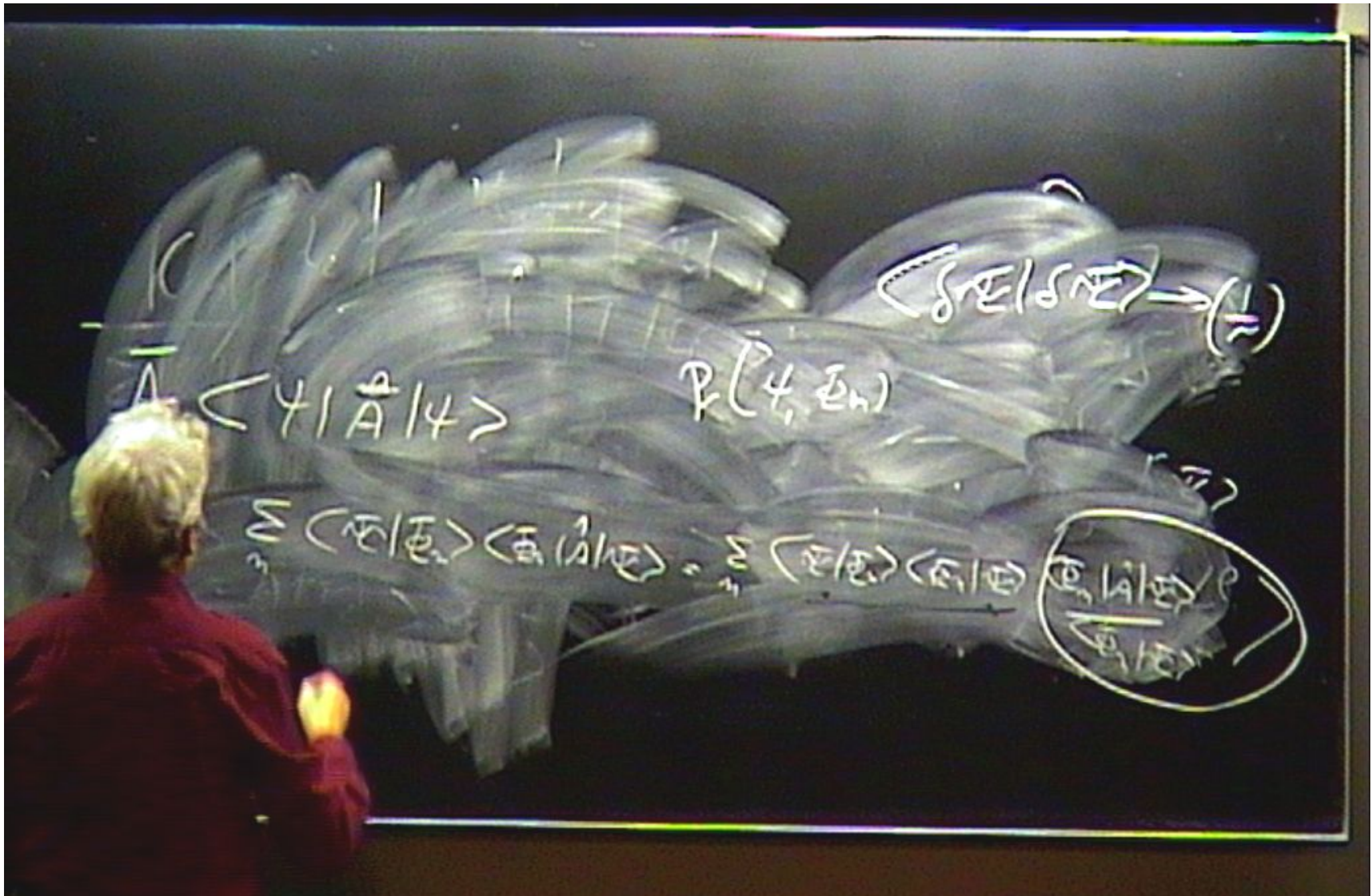
$$\sum_{\alpha} \langle \alpha | \hat{E} \rangle \langle \alpha | \hat{A} \rangle$$

$$\langle \hat{E} | \hat{A} \rangle \rightarrow \langle \hat{E} |$$

$$\langle \delta_{\alpha\beta} | \delta_{\alpha\beta} \rangle \rightarrow \left(\frac{1}{2} \right)$$

$$\bar{A} = \langle 4 | \hat{A} | 4 \rangle$$

$$= \sum_3 \langle \delta_{\alpha\beta} | \delta_{\alpha\beta} \rangle \langle \delta_{\alpha\beta} | \delta_{\alpha\beta} \rangle = \sum_4 \langle \delta_{\alpha\beta} | \delta_{\alpha\beta} \rangle \langle \delta_{\alpha\beta} | \delta_{\alpha\beta} \rangle$$



$A \equiv$

$\langle \delta_{ij} \rangle \rightarrow (1)$

$\bar{A} = \langle 4 | \hat{A} | 4 \rangle$

$P(4, \hat{A})$

$\sum_3 \langle \delta_{ij} \rangle \langle \delta_{ij} \rangle = \sum_4 \langle \delta_{ij} \rangle \langle \delta_{ij} \rangle$

$\langle \delta_{ij} \rangle$
 $\langle \delta_{ij} \rangle$

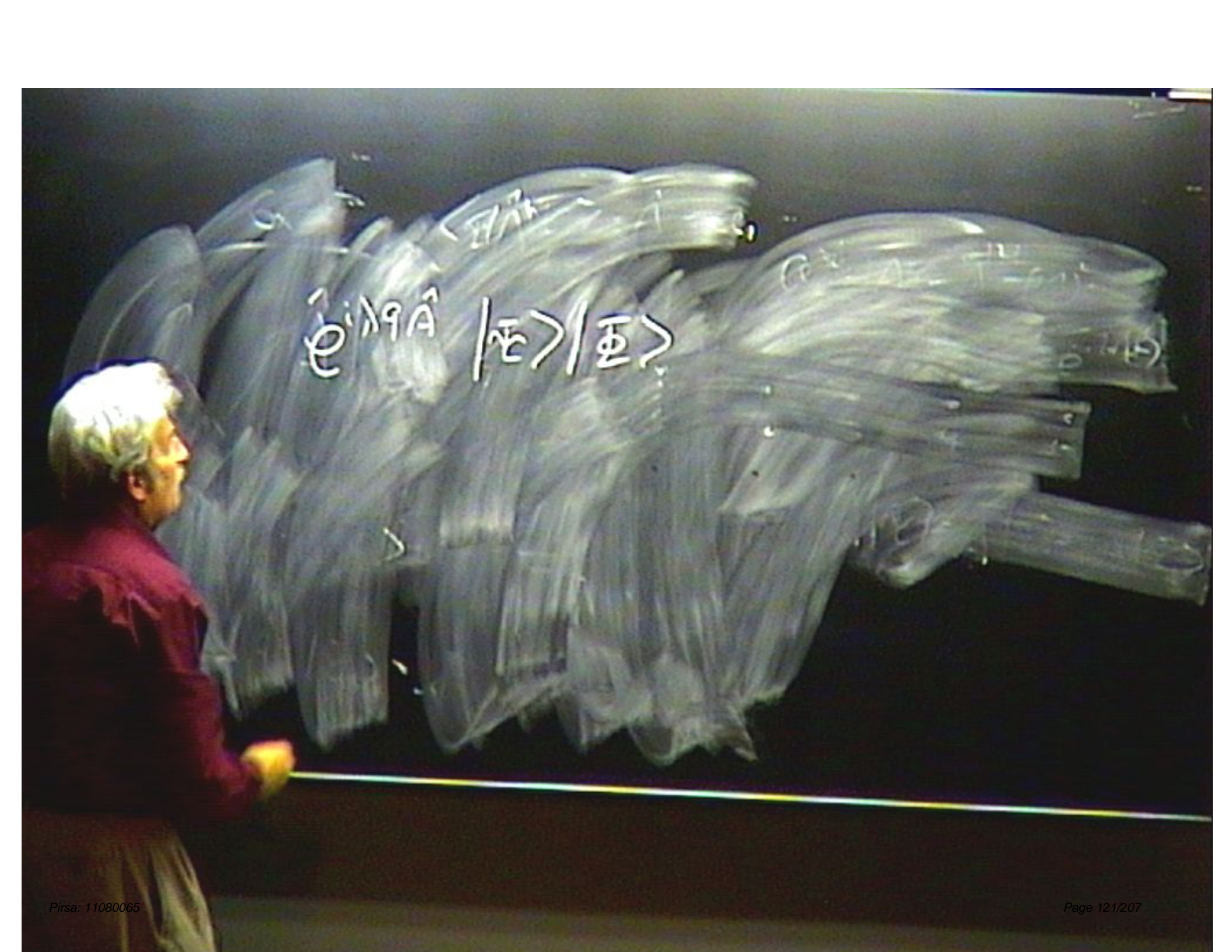
$$A_{ij} = \frac{\langle \psi_m | A | \psi_j \rangle}{\langle \psi_m | \psi_j \rangle}$$

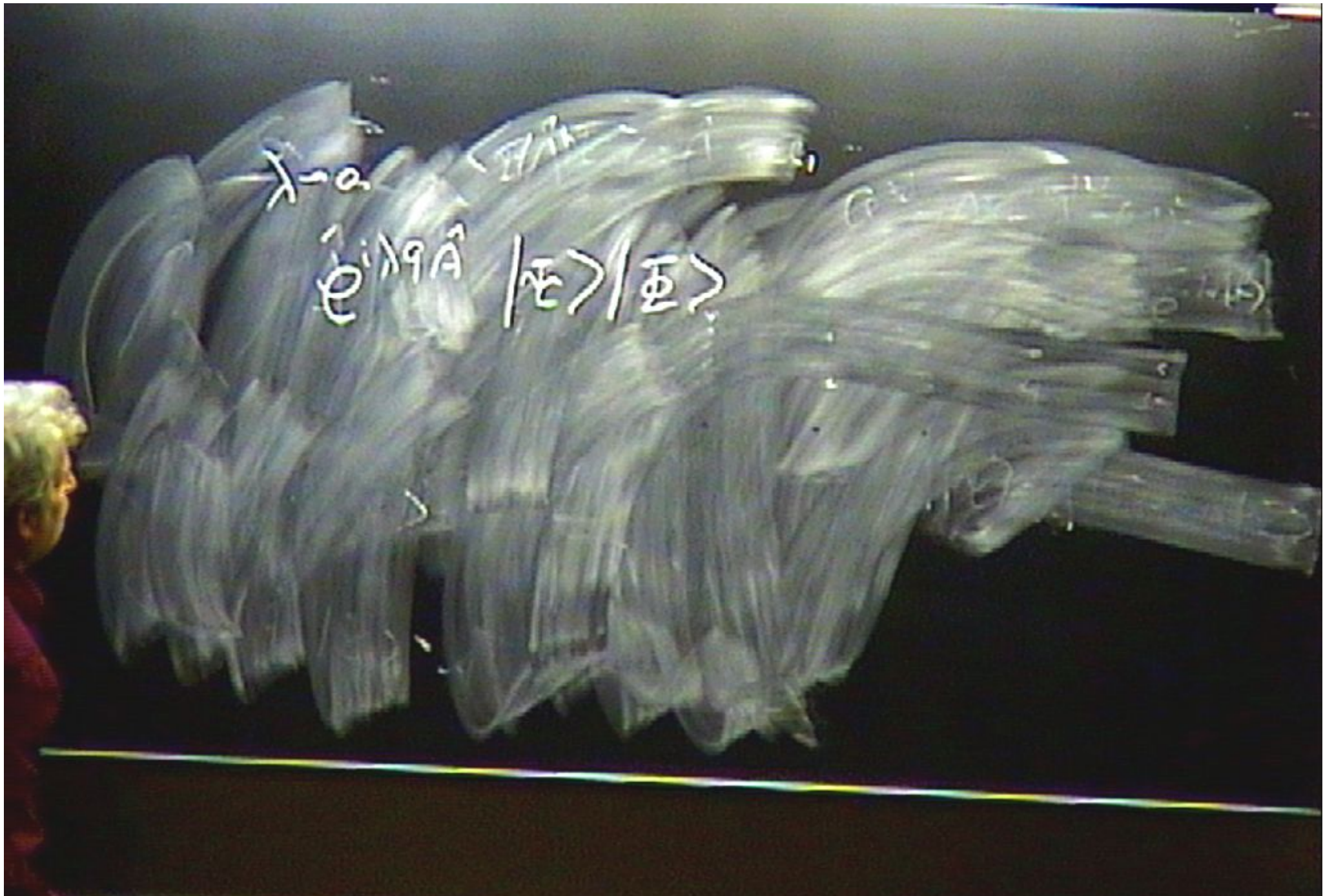
$$\langle \psi_m | \psi_m \rangle = 1$$

$$\bar{A} = \langle \psi | A | \psi \rangle$$

$$P(\psi, \psi_m)$$

$$\sum_j \langle \psi | \psi_j \rangle \langle \psi_j | A | \psi \rangle = \sum_j \langle \psi | \psi_j \rangle \langle \psi_j | \psi \rangle \frac{\langle \psi_j | A | \psi_j \rangle}{\langle \psi_j | \psi_j \rangle}$$

A person with short grey hair, wearing a red long-sleeved shirt, stands on the left side of the frame, pointing with their right hand towards a chalkboard. The chalkboard is filled with white chalk markings. The most prominent text is the equation $\hat{e}^{i\lambda q \hat{A}} |\mathbb{E}\rangle |\mathbb{E}\rangle$ written in the center. The board is also covered with numerous horizontal, overlapping white strokes that appear to be erasing or scribbling over other content. Some faint, illegible markings are visible through the strokes.
$$\hat{e}^{i\lambda q \hat{A}} |\mathbb{E}\rangle |\mathbb{E}\rangle$$



$\lambda = a$
 $(\hat{E}_1) \hat{E}_1 \hat{A}^\dagger |E_1\rangle |E_2\rangle$

$$\langle \xi, \lambda | \hat{A} | \xi, \lambda \rangle$$

$\lambda = a$

$$\langle \mathcal{E}_1 | e^{i\lambda \hat{q}} | \mathcal{E}_1 \rangle | \mathcal{E} \rangle$$

$$\langle \mathcal{E}_1 | 1 + i\lambda \hat{q} | \mathcal{E}_1 \rangle | \mathcal{E} \rangle$$

$$\lambda = a$$

$$\langle \psi_1 | e^{i\lambda \hat{A}} | \psi_1 \rangle | \psi_1 \rangle$$

$$\langle \psi_1 | 1 + i\lambda \hat{A} | \psi_1 \rangle | \psi_1 \rangle$$

$$\lambda = a$$

$$\langle \mathcal{E}_1 | e^{i\lambda \hat{q}} \hat{A} | \mathcal{E}_2 \rangle | \mathcal{E} \rangle$$

$$\langle \mathcal{E}_1 | 1 + i\lambda \hat{q} \hat{A} | \mathcal{E}_2 \rangle$$

$$\langle \mathcal{E}_1 | \mathcal{E}_2 \rangle (1 + i)$$

$$\lambda = a$$

$$\langle \mathcal{E}_1 | e^{i\lambda \hat{A}} | \mathcal{E}_1 \rangle | \mathcal{E}_1 \rangle$$

$$\langle \mathcal{E}_1 | 1 + i\lambda \hat{A} | \mathcal{E}_1 \rangle$$

$$\langle \mathcal{E}_1 | \mathcal{E}_1 \rangle (1 + i\lambda \langle \mathcal{E}_1 | \hat{A} | \mathcal{E}_1 \rangle)$$

$$\lambda = a$$

$$\langle E_1 | e^{i\lambda q \hat{A}} | E_2 \rangle | E \rangle$$

$$\langle E_1 | 1 + i\lambda q \hat{A} | E_2 \rangle$$

$$\langle E_1 | E_2 \rangle (1 + i\lambda \langle E_1 | \hat{A} | E_2 \rangle)$$

$$\lambda = a$$

$$\langle \mathcal{E}_1 | e^{i\lambda \hat{A}} | \mathcal{E}_1 \rangle | \mathcal{E} \rangle$$

$$\langle \mathcal{E}_1 | e^{i\lambda \hat{A}} | \mathcal{E}_1 \rangle | \mathcal{E} \rangle$$

$$\langle \mathcal{E}_1 | \mathcal{E}_1 \rangle \left(1 + i \lambda \frac{\langle \mathcal{E}_1 | \hat{A} | \mathcal{E}_1 \rangle}{\langle \mathcal{E}_1 | \mathcal{E}_1 \rangle} \right)$$

$$\lambda = a$$

$$\langle \mathbb{E}_1 | e^{i\lambda \hat{A}} | \mathbb{E}_1 \rangle | \mathbb{E}_1 \rangle | \mathbb{E}_1 \rangle$$

$$\langle \mathbb{E}_1 | 1 + i\lambda \hat{A} | \mathbb{E}_1 \rangle | \mathbb{E}_1 \rangle | \mathbb{E}_1 \rangle$$

$$\langle \mathbb{E}_1 | \mathbb{E}_1 \rangle (1 + i\lambda \langle \mathbb{E}_1 | \hat{A} | \mathbb{E}_1 \rangle) \langle \mathbb{E}_1 | \mathbb{E}_1 \rangle$$

$$\lambda = 0$$

$$\langle \psi_1 | e^{i\lambda \hat{A}} | \psi_1 \rangle / \langle \psi_1 | \psi_1 \rangle$$

$$\langle \psi_1 | 1 + i\lambda \hat{A} | \psi_1 \rangle / \langle \psi_1 | \psi_1 \rangle$$

$$\langle \psi_1 | \psi_1 \rangle (1 + i\lambda \frac{\langle \psi_1 | \hat{A} | \psi_1 \rangle}{\langle \psi_1 | \psi_1 \rangle})$$

$$e^{i\lambda \hat{A}}$$

$$\lambda = 0$$

$$\langle \psi_1 | e^{i\lambda \hat{A}} | \psi_1 \rangle | \psi_1 \rangle$$

$$\langle \psi_1 | 1 + i\lambda \hat{A} | \psi_1 \rangle | \psi_1 \rangle$$

$$\langle \psi_1 | \psi_1 \rangle (1 + i\lambda \langle \psi_1 | \hat{A} | \psi_1 \rangle) \langle \psi_1 | \psi_1 \rangle$$

$e^{i\lambda \hat{A}}$

$$\lambda = a$$

$$\langle \psi_1 | e^{i\lambda \hat{A}} | \psi_1 \rangle | \psi \rangle$$

$$\langle \psi_1 | 1 + i\lambda \hat{A} | \psi_1 \rangle | \psi \rangle$$

$$\langle \psi_1 | \psi_1 \rangle (1 + i\lambda \frac{\langle \psi_1 | \hat{A} | \psi_1 \rangle}{\langle \psi_1 | \psi_1 \rangle})$$

$e^{i\lambda \hat{A}}$

$$\lambda = a$$

$$\langle \mathbb{E}_1 | e^{i\lambda \hat{A}} | \mathbb{E}_1 \rangle | \mathbb{E} \rangle$$

$$\langle \mathbb{E}_1 | 1 + i\lambda \hat{A} | \mathbb{E}_1 \rangle | \mathbb{E} \rangle$$

$$\langle \mathbb{E}_1 | \mathbb{E}_1 \rangle (1 + i\lambda \langle \mathbb{E}_1 | \hat{A} | \mathbb{E}_1 \rangle)$$
$$\langle \mathbb{E}_1 | \mathbb{E}_1 \rangle$$
$$e^{i\lambda \hat{A}}$$

$$A \omega \equiv \frac{\langle \Phi_m | A | \Phi \rangle}{\langle \Phi_m | \Phi \rangle}$$

$$0 - \frac{P^2}{(0,1)}$$

$$P(4, \Phi_m)$$

$$\langle \Phi_m | \Phi \rangle \rightarrow (1)$$

$$\omega = \sum_{m=1}^{\infty} \langle \Phi_m | \Phi \rangle \langle \Phi_m | \Phi \rangle$$

$$\frac{\langle \Phi_m | A | \Phi \rangle}{\langle \Phi_m | \Phi \rangle}$$

$$A_{\omega} \equiv \frac{\langle \Phi_m | A | \Phi \rangle}{\langle \Phi_m | \Phi \rangle}$$

$$\langle \Phi | \Phi \rangle \rightarrow (1)$$

$$e^{-\frac{P_0^2}{4097}}$$

$$P(4, \Phi_m)$$

$$\omega = \sum_n \langle \Phi | \Phi \rangle \langle \Phi_m | \Phi \rangle \frac{\langle \Phi_m | A | \Phi \rangle}{\langle \Phi_m | \Phi \rangle}$$

$$A_{\omega} \equiv \frac{\langle \Phi_m | A | \Phi \rangle}{\langle \Phi_m | \Phi \rangle}$$

$$\langle \Phi | \Phi \rangle \rightarrow \left(\frac{1}{\pi} \right)$$

$$e^{-\frac{P_y^2}{4\alpha\hbar^2}}$$

$$P_y(\alpha, \Phi_m)$$

$$e^{-\frac{(P_y - i\alpha)^2}{2\alpha\hbar^2}}$$

$$\rightarrow \sum_n \langle \Phi | \Phi \rangle \langle \Phi_m | \Phi \rangle \frac{\langle \Phi_m | A | \Phi \rangle}{\langle \Phi_m | \Phi \rangle}$$

$$A_{\omega} \equiv \frac{\langle \Phi_m | A | \Phi \rangle}{\langle \Phi_m | \Phi \rangle}$$

$$\langle \Phi | \Phi \rangle \rightarrow \left(\frac{1}{\pi} \right)$$

$$e^{-\frac{P_0^2}{4097}}$$

$$P(4, \Phi_m)$$

$$e^{-\frac{(P_0 - iP)^2}{2(1097)}}$$

$$\rightarrow \sum_n \langle \Phi | \Phi \rangle \langle \Phi_m | \Phi \rangle \frac{\langle \Phi_m | A | \Phi \rangle}{\langle \Phi_m | \Phi \rangle}$$

$$A_{\omega} \equiv \frac{\langle \Phi_m | A | \Phi \rangle}{\langle \Phi_m | \Phi \rangle}$$

$$\langle \Phi | \Phi \rangle \rightarrow (1)$$

$$e^{-\frac{P_0^2}{40\hbar^2}}$$

$$P(4, \Phi_m)$$

$$e^{-\frac{(P_0 - iP)^2}{2(0\hbar^2)}}$$

$$\rightarrow \sum_n \langle \Phi | \Phi \rangle \langle \Phi_m | \Phi \rangle \frac{\langle \Phi_m | A | \Phi \rangle}{\langle \Phi_m | \Phi \rangle}$$

$$\lambda = a$$

$$\langle \mathcal{E}_1 | e^{i\lambda \hat{q}} \hat{A} | \mathcal{E}_2 \rangle | \mathcal{E} \rangle$$

$$\langle \mathcal{E}_1 | 1 + i\lambda \hat{q} \hat{A} | \mathcal{E}_2 \rangle | \mathcal{E} \rangle$$

$$\langle \mathcal{E}_1 | \mathcal{E}_2 \rangle \left(1 + i\lambda \frac{\langle \mathcal{E}_1 | \hat{A} | \mathcal{E}_2 \rangle}{\langle \mathcal{E}_1 | \mathcal{E}_2 \rangle} \right)$$

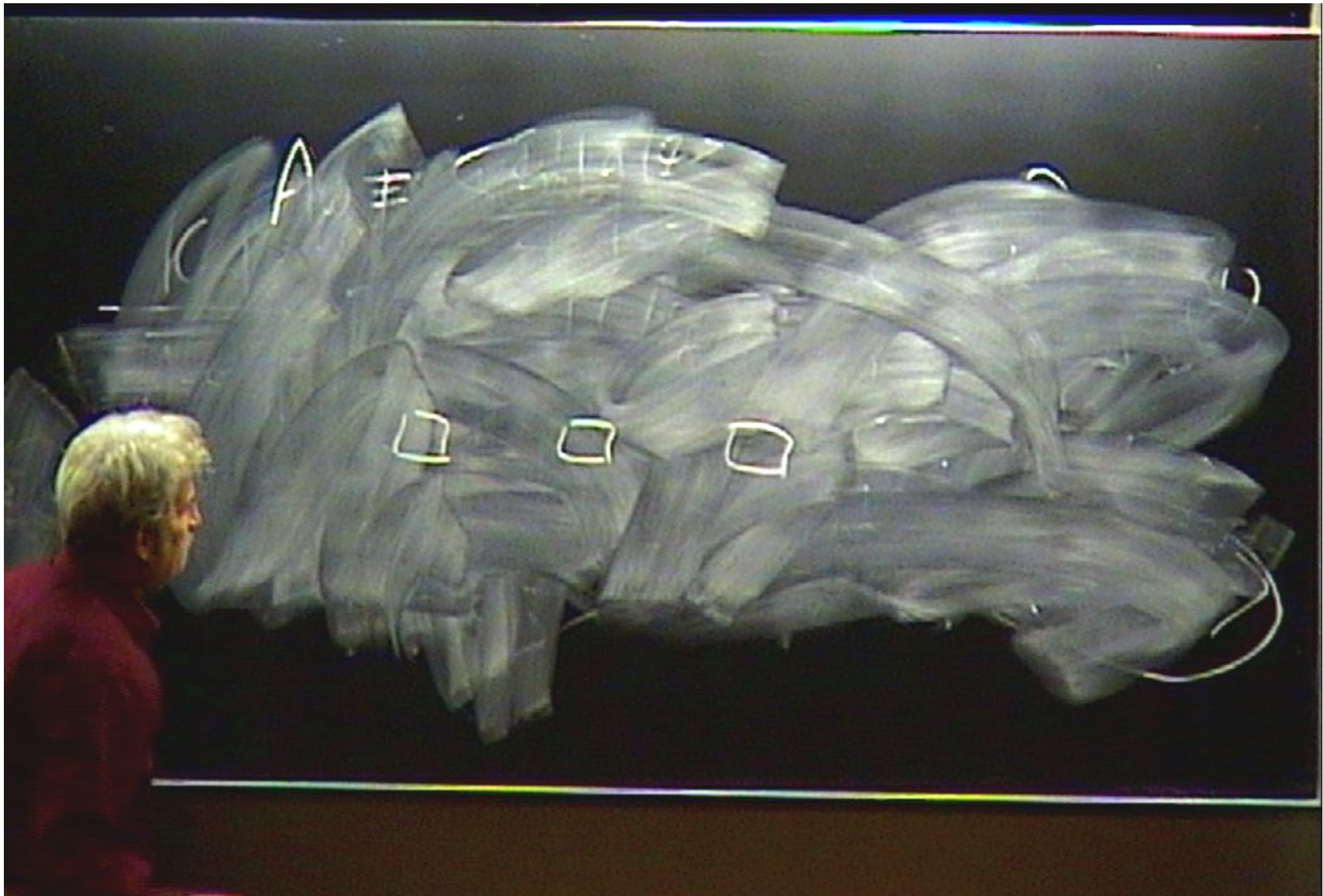
$$\lambda = a$$

$$\langle \mathbb{E}_1 | e^{i\lambda q \hat{A}} | \mathbb{E}_1 \rangle | \mathbb{E} \rangle$$

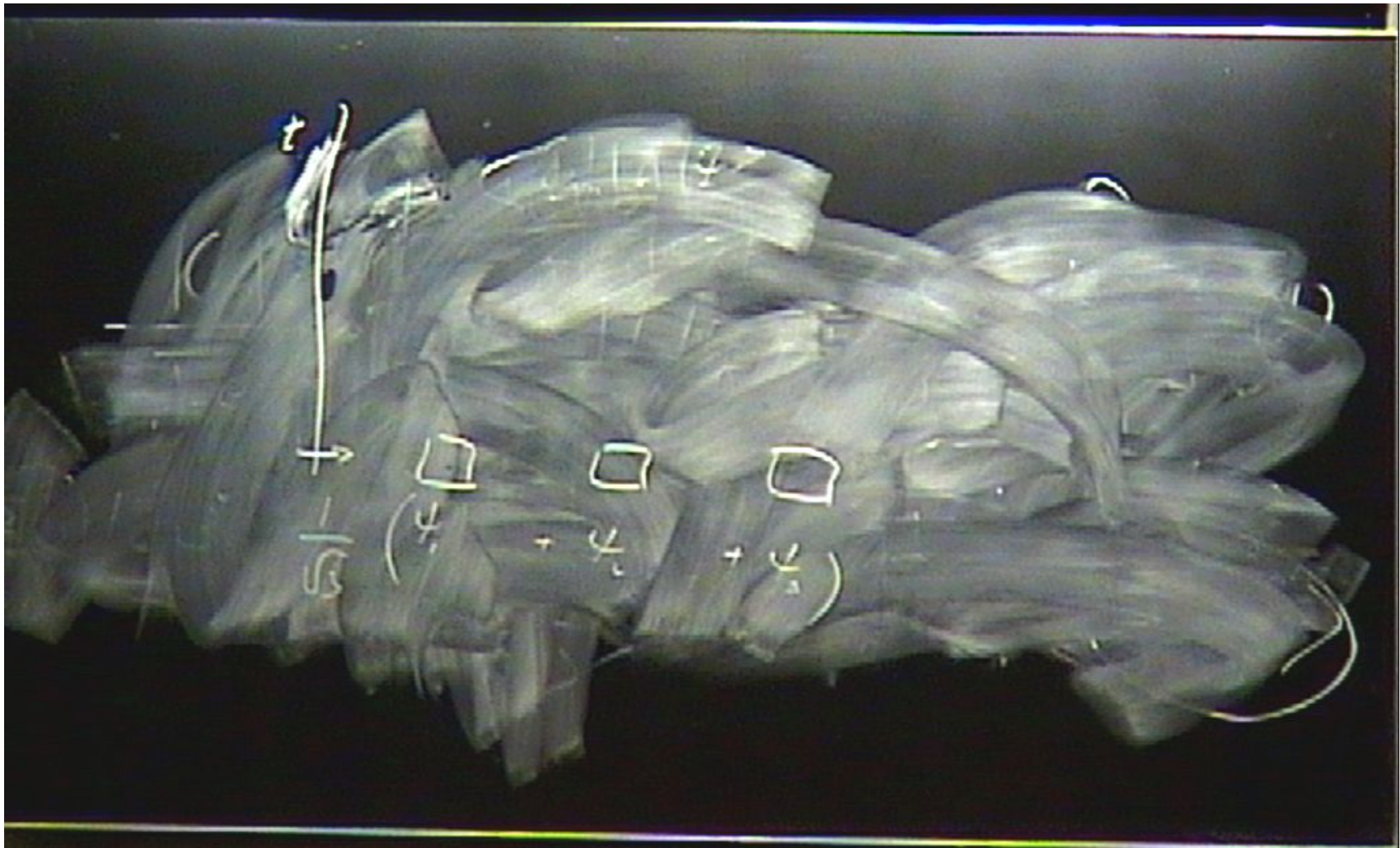
$$\langle \mathbb{E}_1 | 1 + i\lambda q \hat{A} | \mathbb{E}_1 \rangle | \mathbb{E} \rangle$$

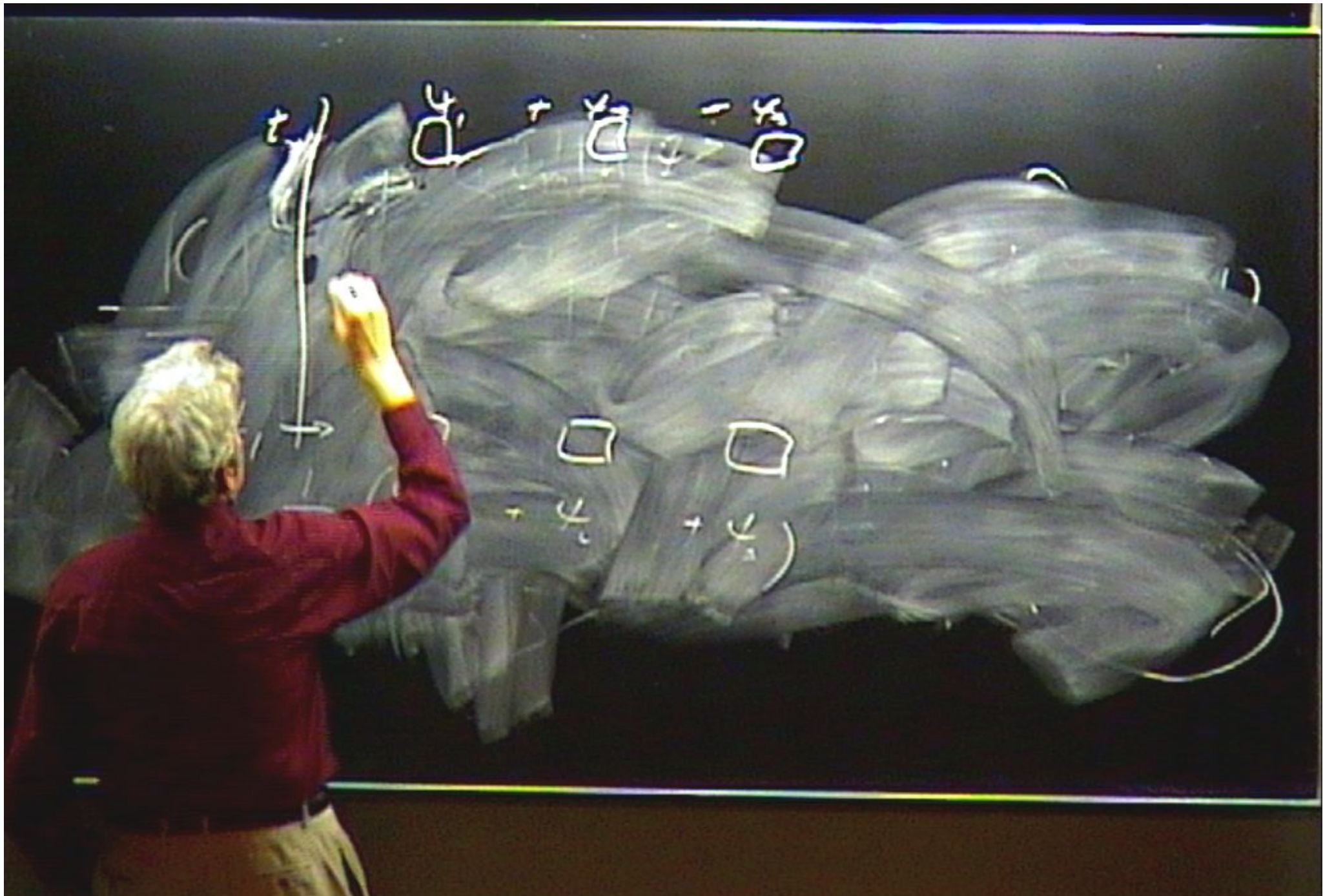
$$\langle \mathbb{E}_1 | \mathbb{E}_1 \rangle (1 + i\lambda q \frac{\langle \mathbb{E}_1 | \hat{A} | \mathbb{E}_1 \rangle}{\langle \mathbb{E}_1 | \mathbb{E}_1 \rangle})$$

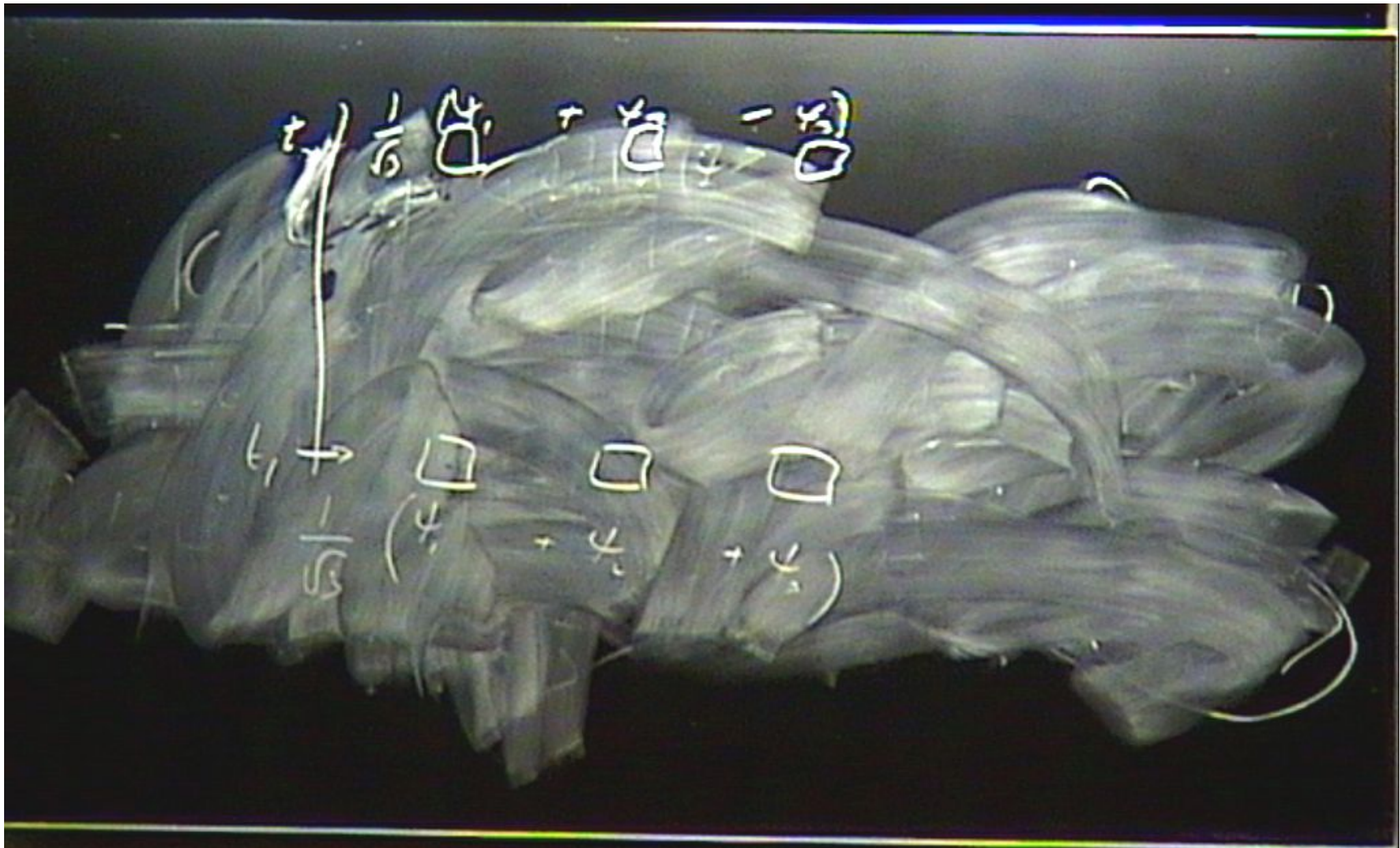
$$e^{i\lambda q \hat{A}_0}$$

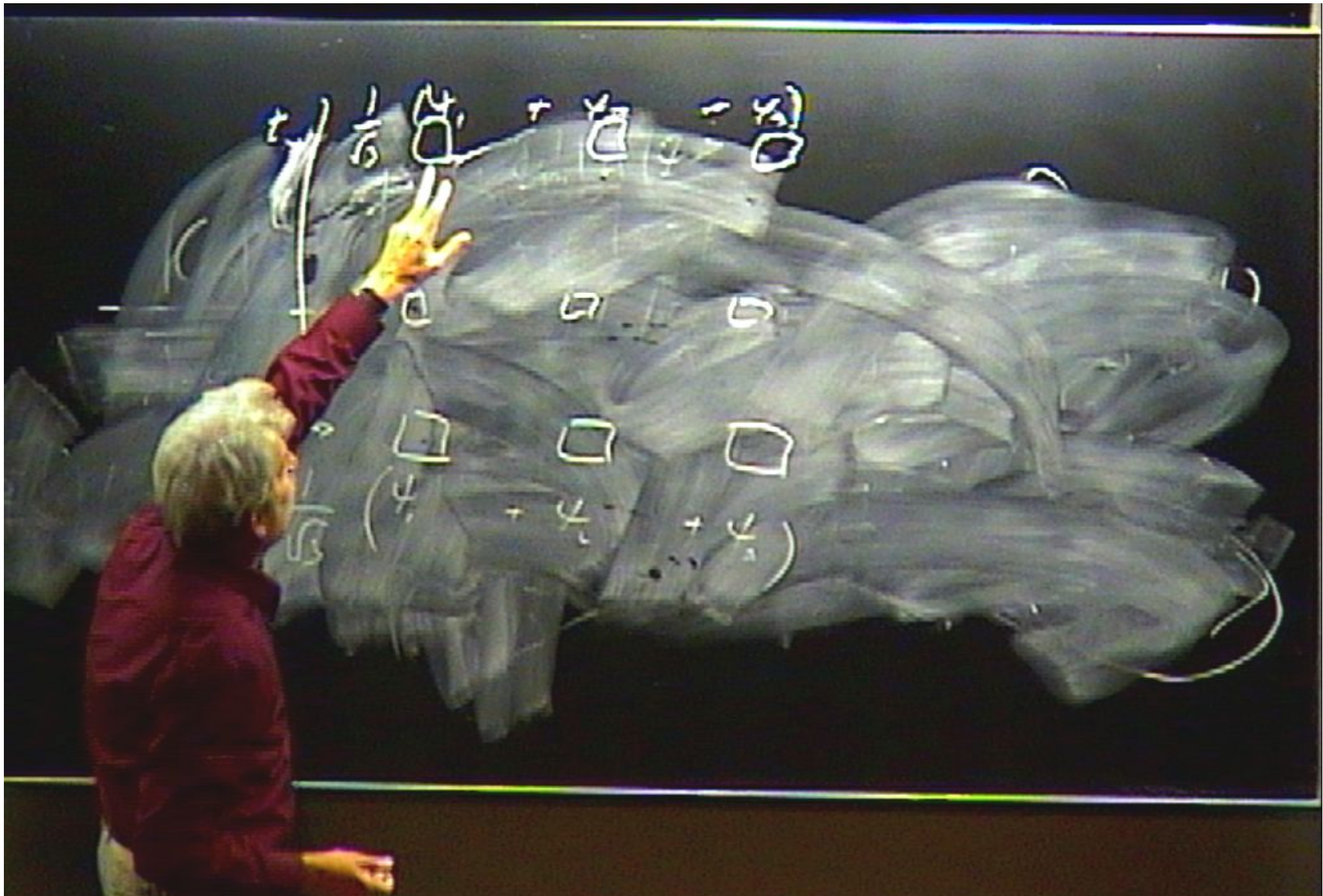


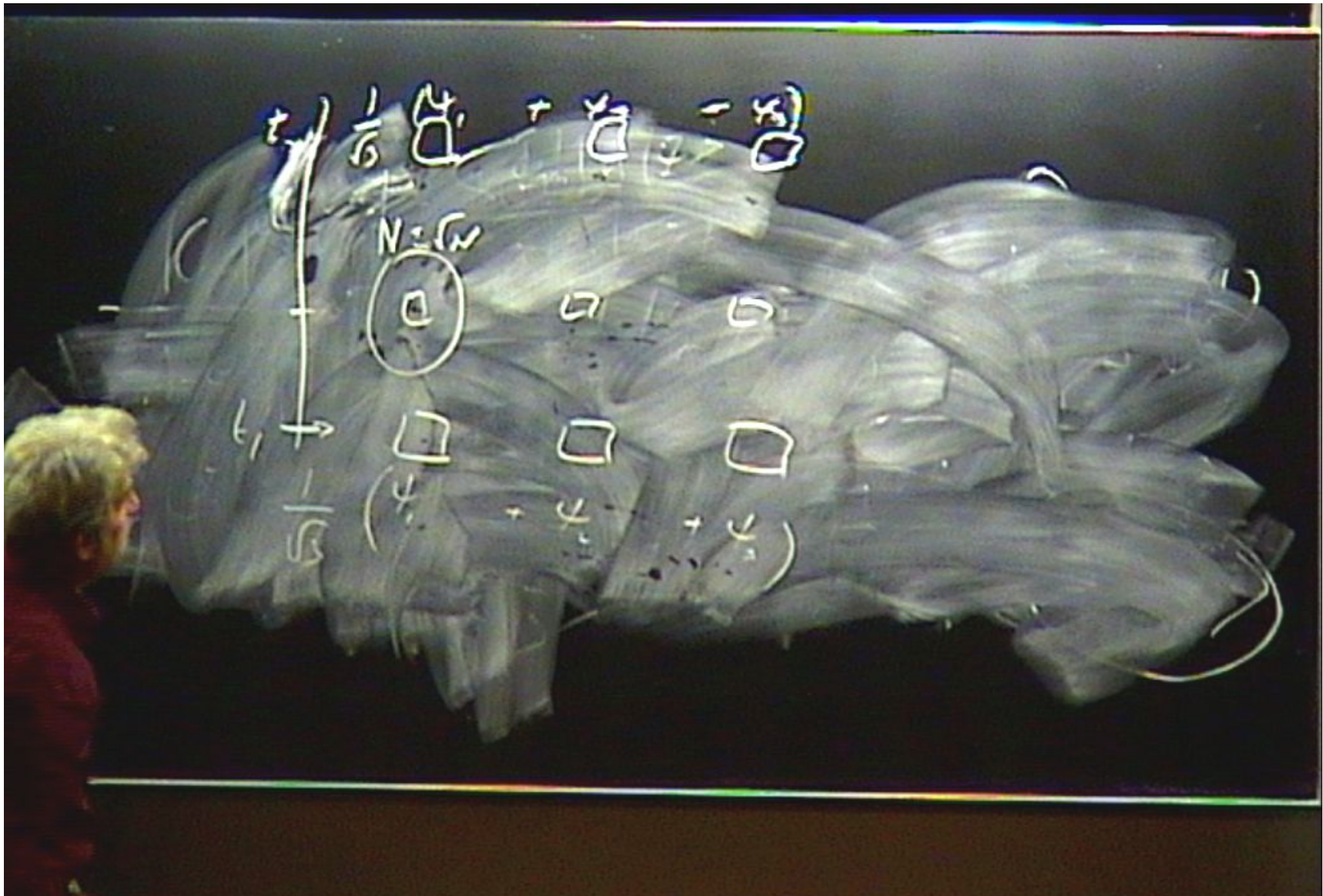




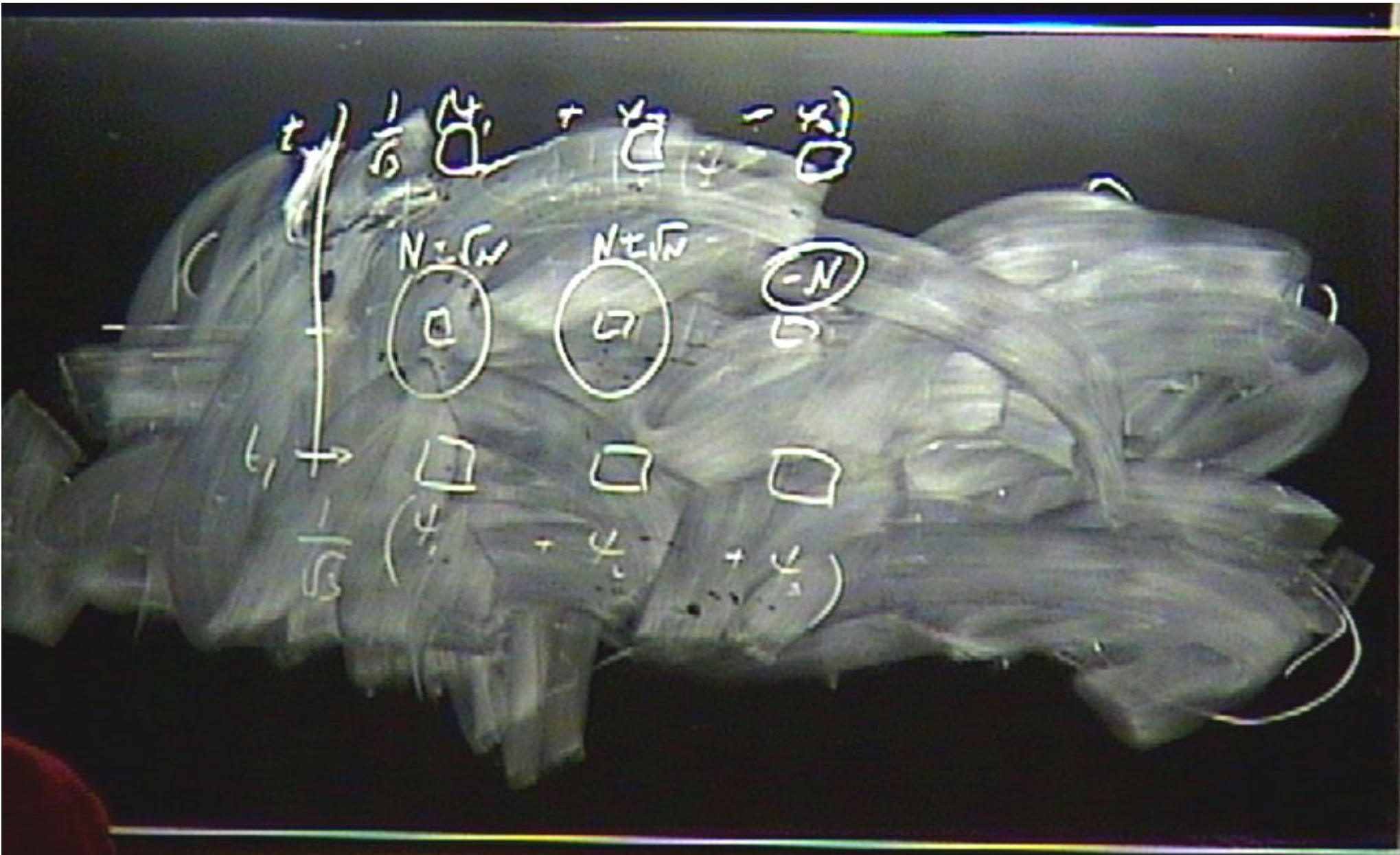


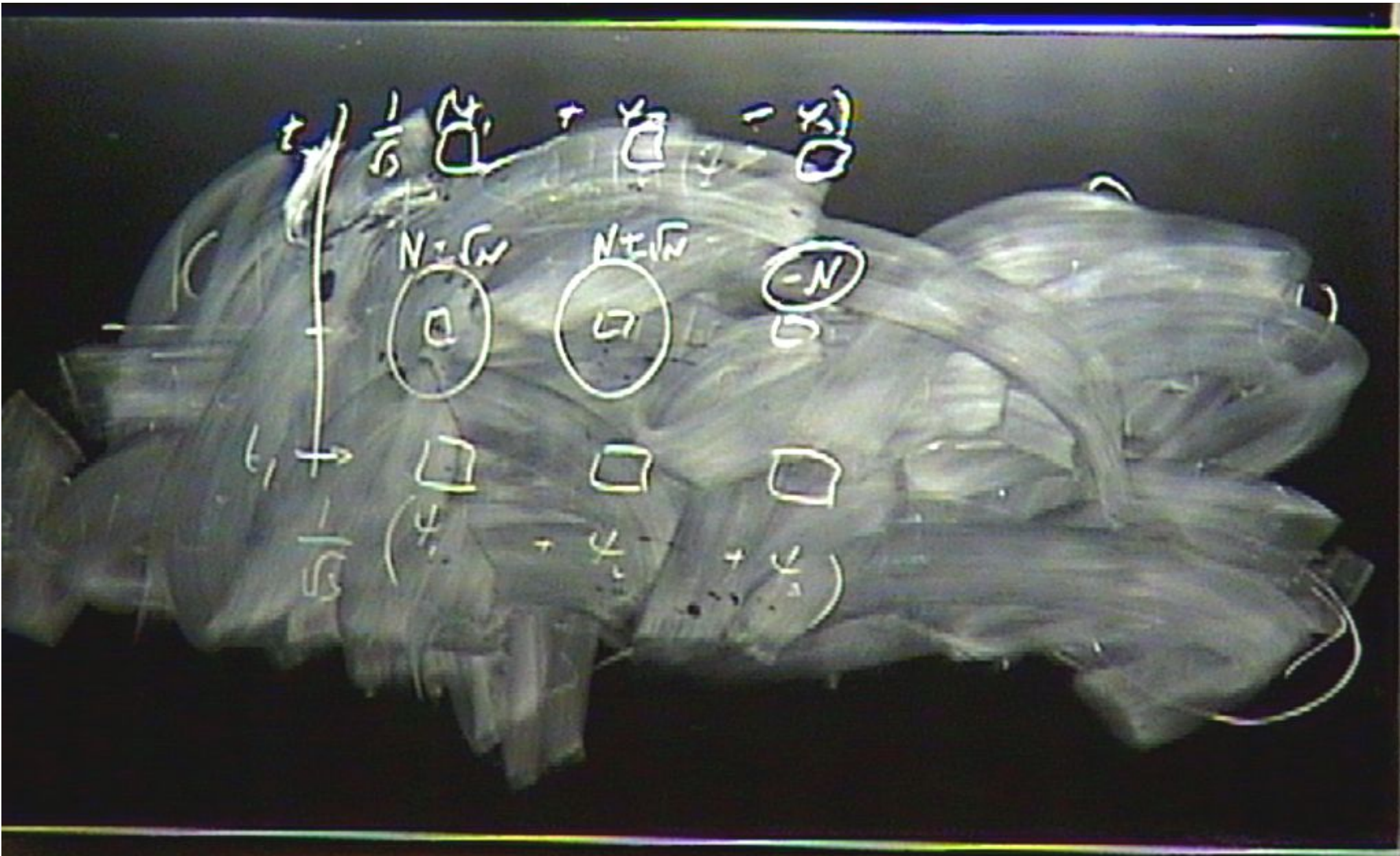


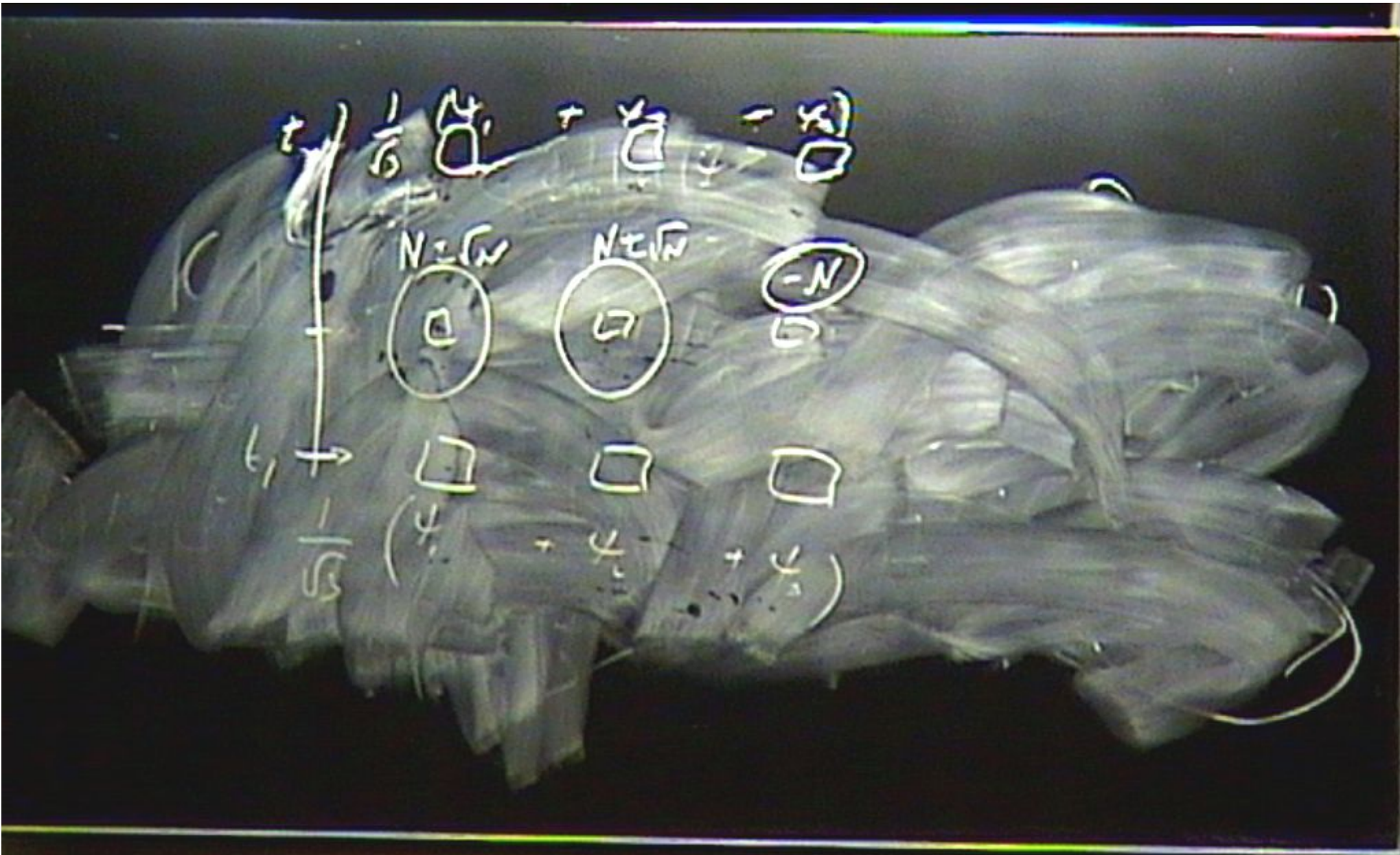




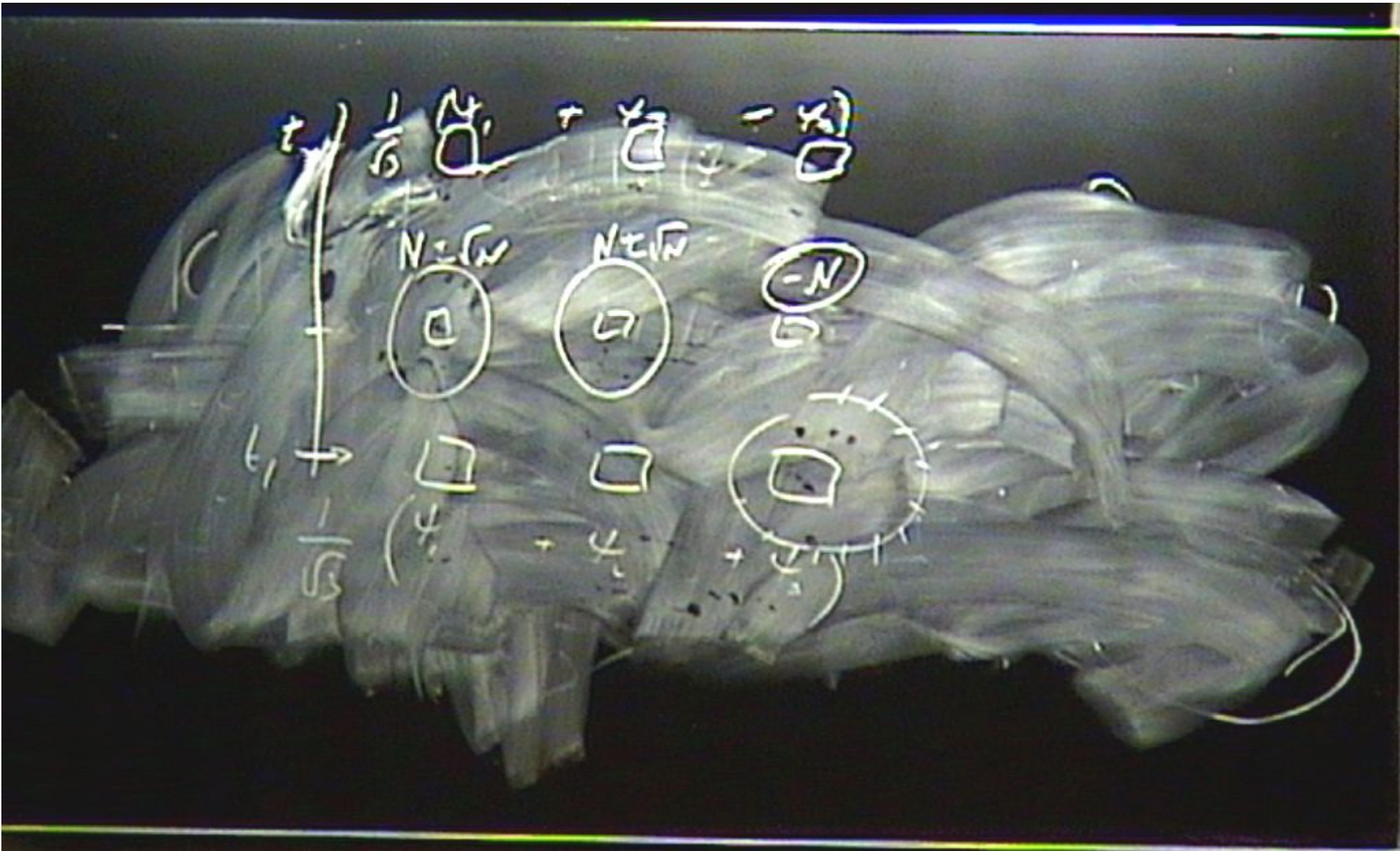


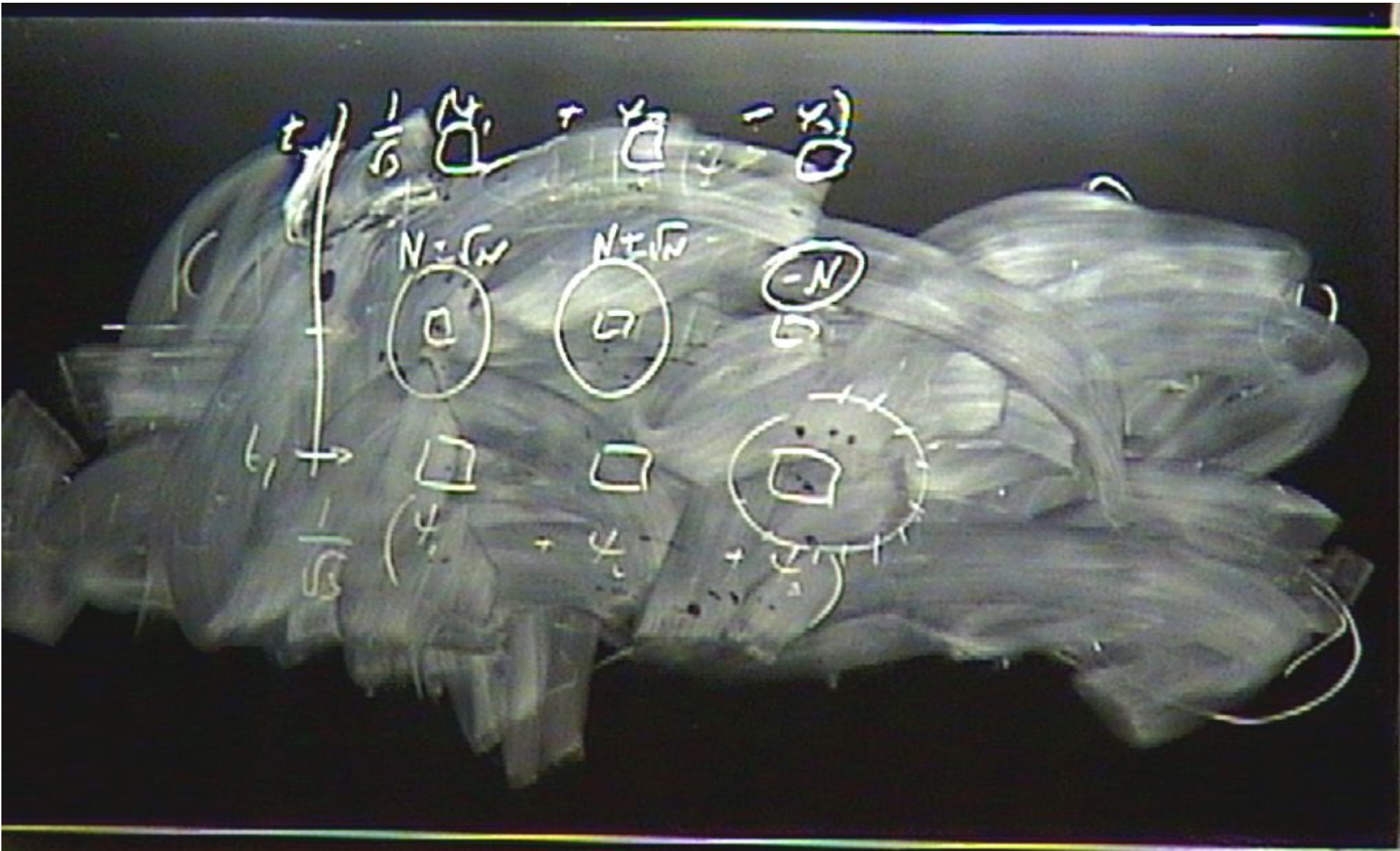


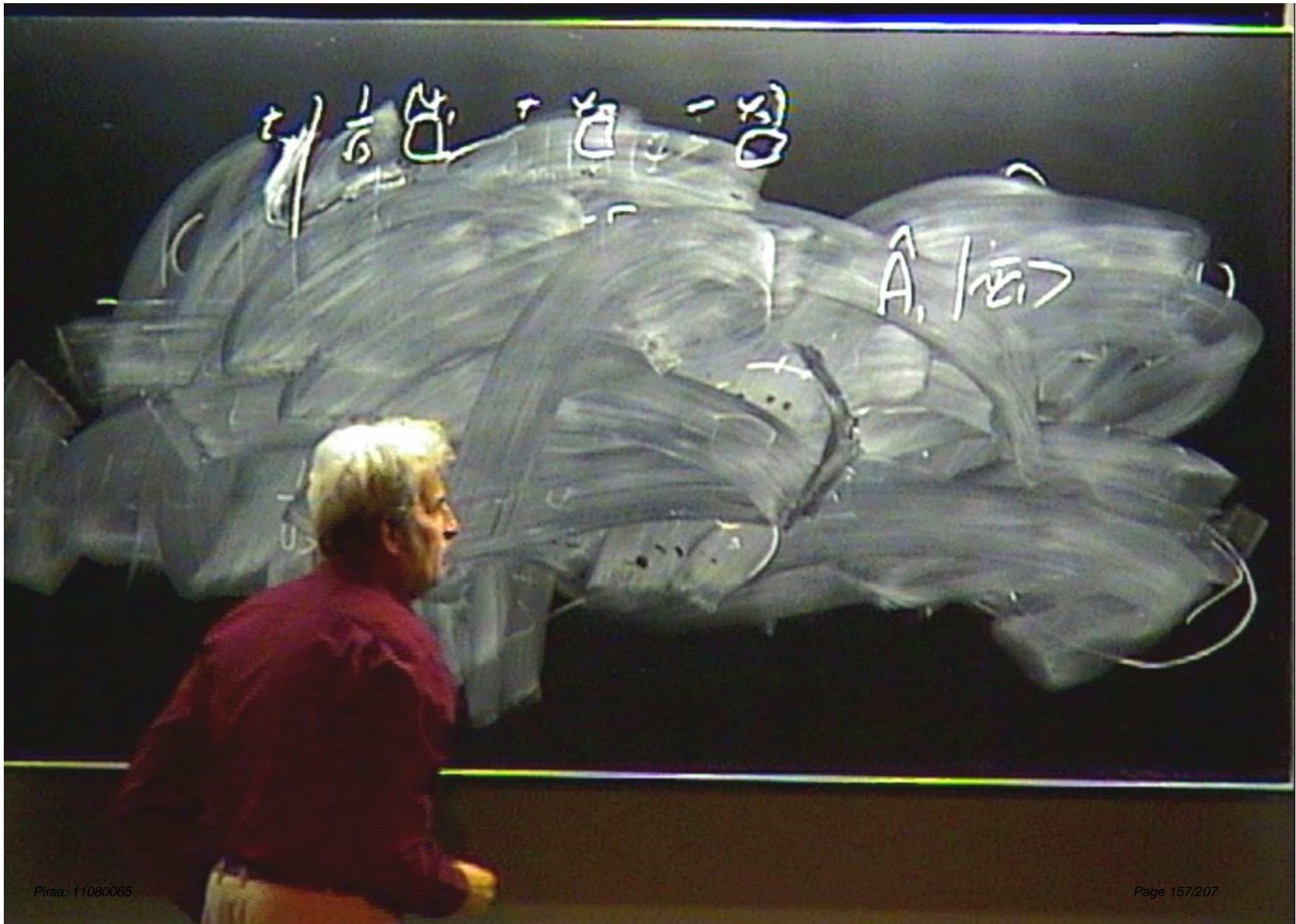












$$\frac{1}{\sqrt{2}}(\hat{a}_1 + \hat{a}_2) = \hat{a}_+$$

$$\hat{A}_+ |n\rangle = \sqrt{n+1} |n+1\rangle$$

$$\hat{A}_- |n\rangle = \sqrt{n} |n-1\rangle$$

$$A_1 + A_2 = A$$

$$\hat{A}_1 |E_1\rangle = \alpha_1 |E_1\rangle$$

$$\hat{A}_2 |E_2\rangle = \alpha_2 |E_2\rangle$$

$$(\hat{A}_1 + \hat{A}_2) |E\rangle = \alpha_1 + \alpha_2$$

$$\frac{1}{\sqrt{2}}(\hat{a}_1 + \hat{a}_2) = \hat{a}_0$$

$$\hat{A}_1 |\psi_1\rangle = \alpha_1 |\psi_1\rangle$$

$$\langle \psi_{j=0} | \psi_{j=1} \rangle$$

$$\hat{A}_2 |\psi_2\rangle = \alpha_2 |\psi_2\rangle$$

$$(\hat{A}_1 + \hat{A}_2) |\psi_0\rangle = \alpha_1 + \alpha_2$$

$$\frac{1}{\hbar} \hat{G}_1 + \hat{G}_2 - \hat{G}_3$$

$$\hat{A}_1 |\psi_1\rangle = \alpha_1 |\psi_1\rangle$$

$$\langle \psi_{j+1} | \hat{G}_x + \hat{G}_y | \psi_{j+1} \rangle$$

$$\hat{A}_2 |\psi_2\rangle = \alpha_2 |\psi_2\rangle$$

$$(\hat{A}_1 + \hat{A}_2) |\psi\rangle = \alpha_1 + \alpha_2$$

$$\frac{1}{\sqrt{2}}(\hat{a}_1 + \hat{a}_2) \rightarrow \hat{a}$$

$$\hat{A}_1 |\psi_1\rangle = \alpha_1 |\psi_1\rangle$$

$$\langle \psi_{j+1} | \hat{G}_x + \hat{G}_y | \psi_{j+1} \rangle$$

$$\hat{A}_2 |\psi_2\rangle = \alpha_2 |\psi_2\rangle$$

$$\hat{G}_x + \hat{G}_y = 2\hat{a}$$

$$(\hat{A}_1 + \hat{A}_2)_{\omega} = \alpha_1 + \alpha_2$$

$$\frac{1}{\sqrt{2}}(\hat{\sigma}_x + \hat{\sigma}_y) = \hat{\sigma}_z$$

$$\hat{A}_1 |E_1\rangle = \alpha_1 |E_1\rangle$$

$$\langle \sigma_{z=1} | \sigma_x + \sigma_y | \sigma_{z=1} \rangle$$

$$\hat{A}_2 |E_2\rangle = \alpha_2 |E_2\rangle$$

$$\sigma_x + \sigma_y = 2!$$

$$(\hat{A}_1 + \hat{A}_2) |E\rangle = \alpha_1 + \alpha_2$$

$$\frac{1}{\sqrt{2}}(\hat{\sigma}_x + \hat{\sigma}_y) = \hat{\sigma}_z$$

$$\hat{A}_1 |\uparrow\uparrow\rangle = \alpha_1 |\uparrow\uparrow\rangle$$

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

$$\hat{A}_2 |\uparrow\uparrow\rangle = \alpha_2 |\uparrow\uparrow\rangle$$

$$\sigma_x + \sigma_y = 2!$$

$$(\hat{A}_1 + \hat{A}_2)_{\uparrow\uparrow} = \alpha_1 + \alpha_2$$

$\frac{1}{2} \hat{A}_1 \rightarrow \hat{A}_2 - \hat{A}_1$

$$\hat{A}_1 |E_1\rangle = \lambda_1 |E_1\rangle$$

$$\hat{A}_2 |E_2\rangle = \lambda_2 |E_2\rangle$$

$\frac{1}{2} \hat{A} \rightarrow \hat{A} - \hat{A}$

$$\hat{A}_1 |\psi_1\rangle = \lambda_1 |\psi_1\rangle$$

$$\hat{A}_2 |\psi_2\rangle = \lambda_2 |\psi_2\rangle$$



$\frac{1}{2} \sigma + \sigma - \sigma$

$$\hat{A}_1 |\psi_1\rangle = \lambda_1 |\psi_1\rangle$$

$$\hat{A}_2 |\psi_2\rangle = \lambda_2 |\psi_2\rangle$$



$\frac{1}{6} \rightarrow \frac{1}{2} - \frac{1}{3}$

$$\hat{A}_1 |\psi_1\rangle = \lambda_1 |\psi_1\rangle$$

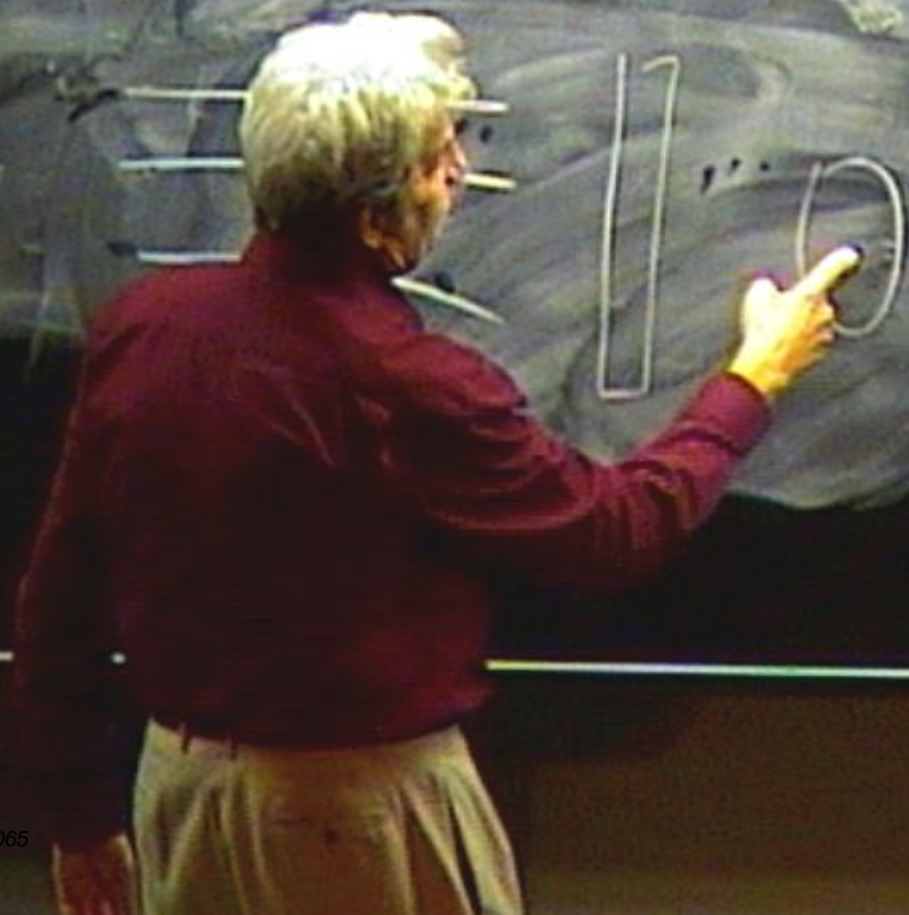
$$\hat{A}_2 |\psi_2\rangle = \lambda_2 |\psi_2\rangle$$



$$\frac{1}{2} \left(\frac{1}{2} \hat{A}_1 + \frac{1}{2} \hat{A}_2 \right)$$

$$\hat{A}_1 |E_1\rangle = \lambda_1 |E_1\rangle$$

$$\hat{A}_2 |E_2\rangle = \lambda_2 |E_2\rangle$$



$$\frac{1}{2} \hat{A} + \hat{B} - \hat{C}$$

$$\hat{A}_1 |\psi_1\rangle = \lambda_1 |\psi_1\rangle$$

$$\hat{A}_2 |\psi_2\rangle = \lambda_2 |\psi_2\rangle$$



$$\frac{1}{2} \hat{A}_1 + \hat{A}_2 - \hat{A}_3$$

$$\hat{A}_1 | \psi_1 \rangle = \lambda_1 | \psi_1 \rangle$$

$$\hat{A}_2 | \psi_2 \rangle = \lambda_2 | \psi_2 \rangle$$

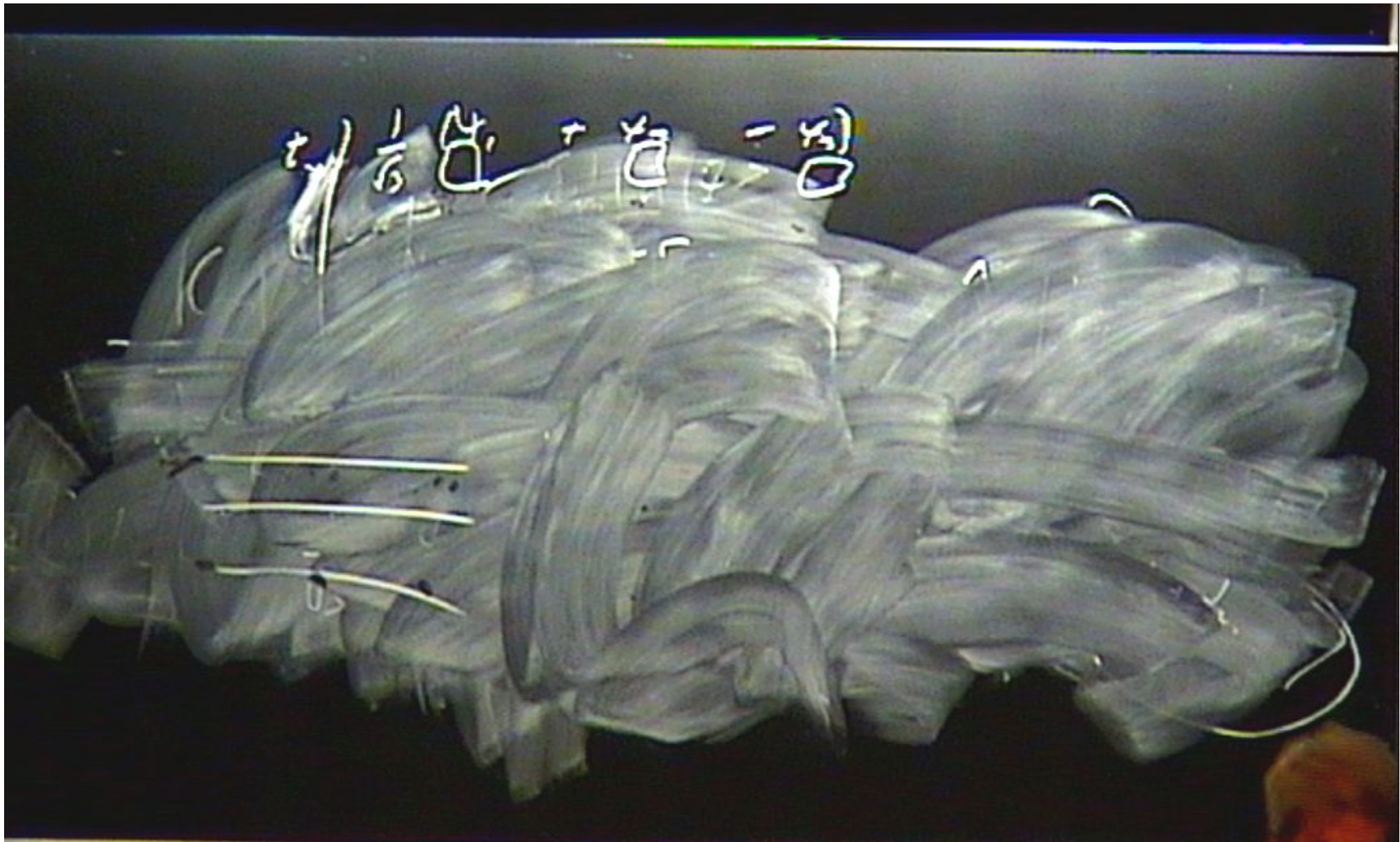


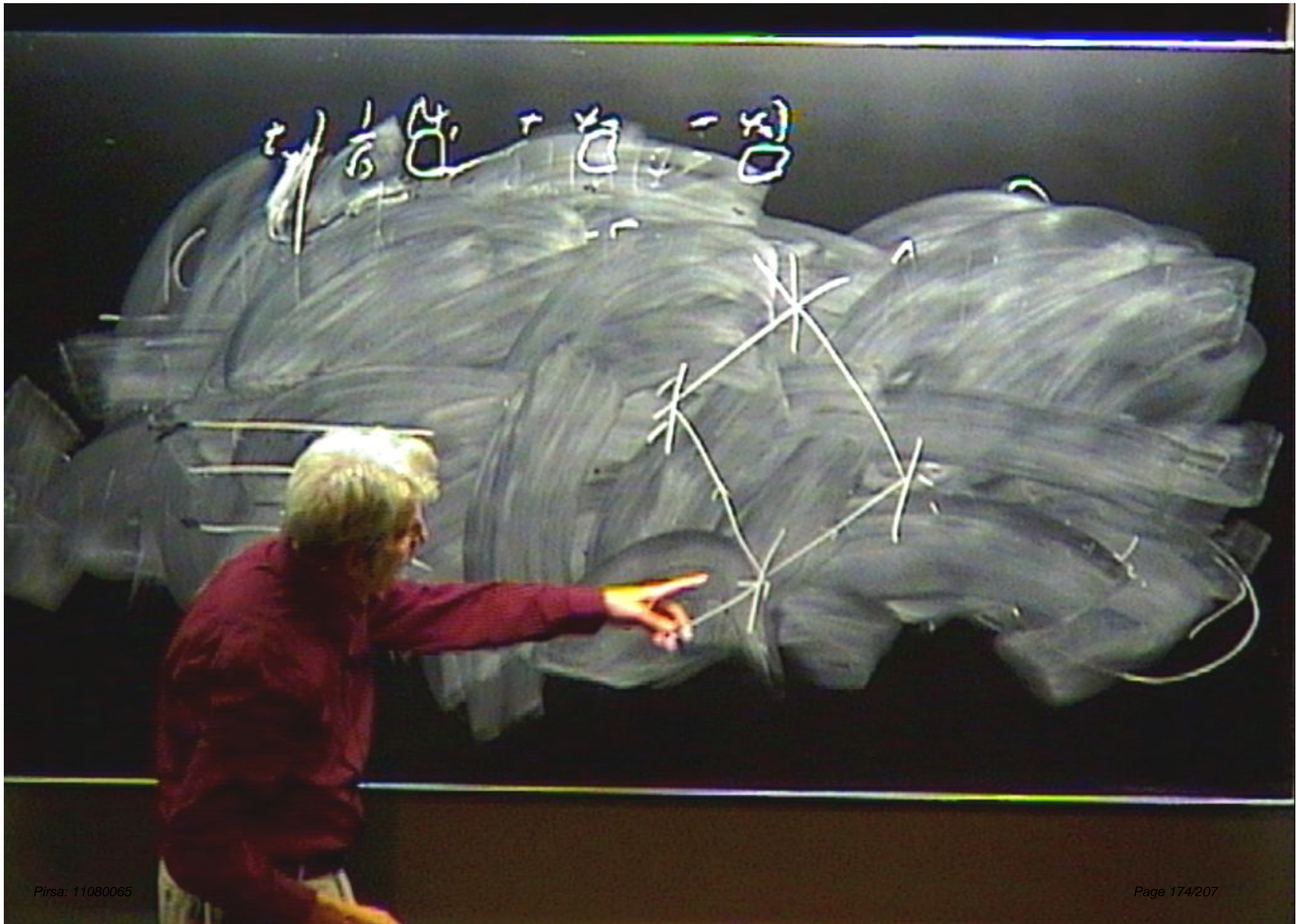
$\frac{1}{2} \hat{A} + \hat{B} - \hat{C}$

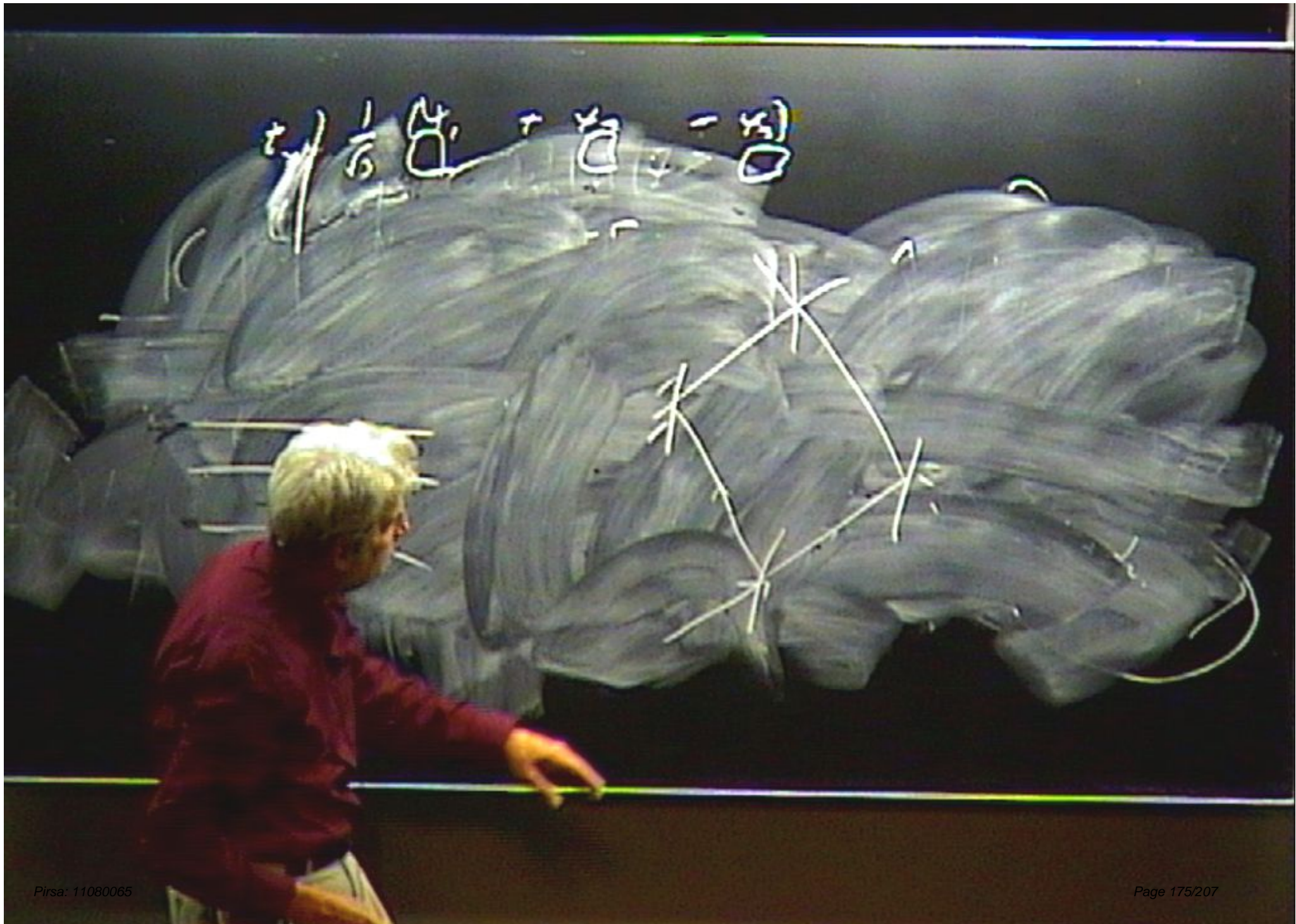
$$\hat{A} | \psi_1 \rangle = \lambda_1 | \psi_1 \rangle$$

$$\hat{A} | \psi_2 \rangle = \lambda_2 | \psi_2 \rangle$$



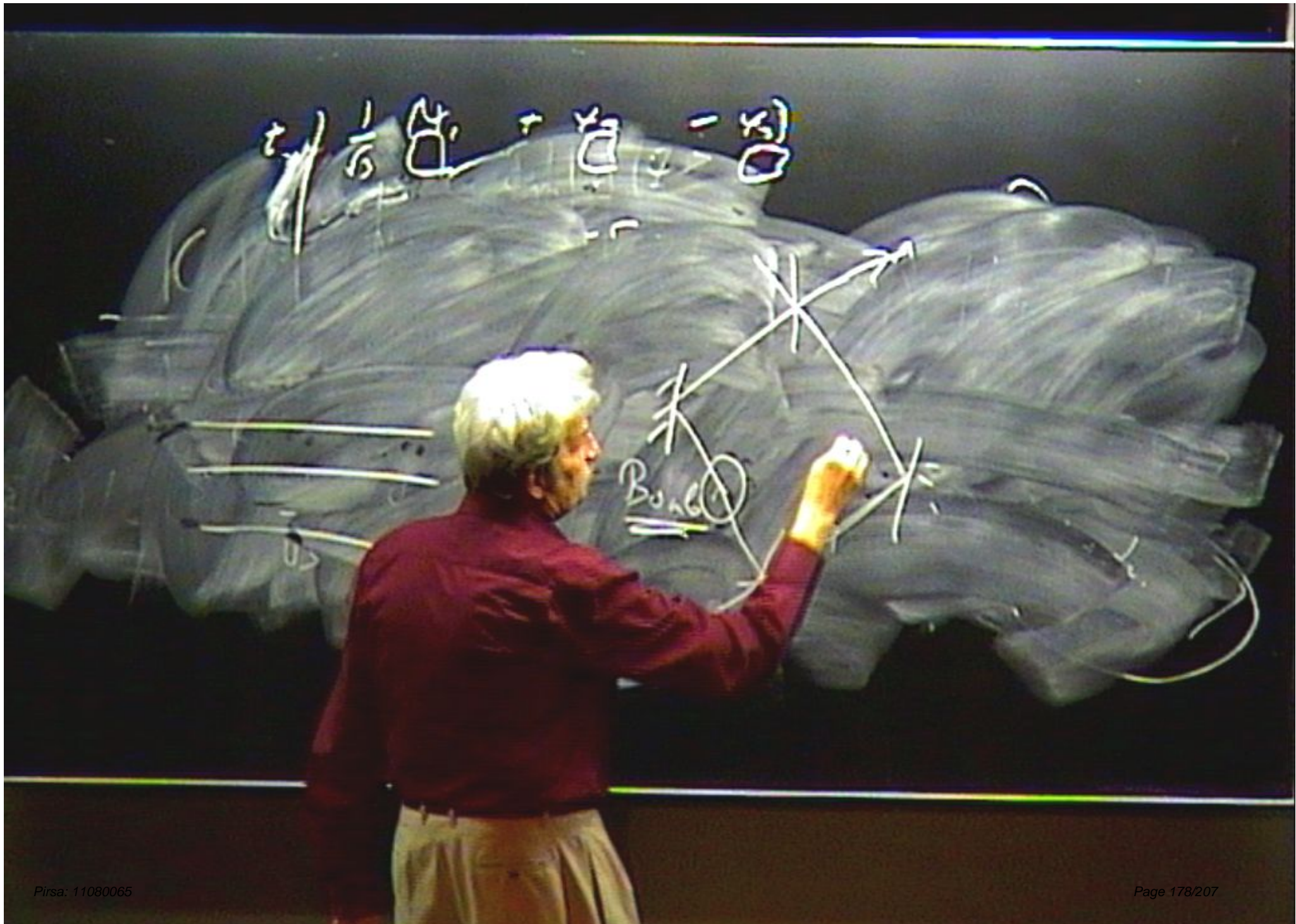


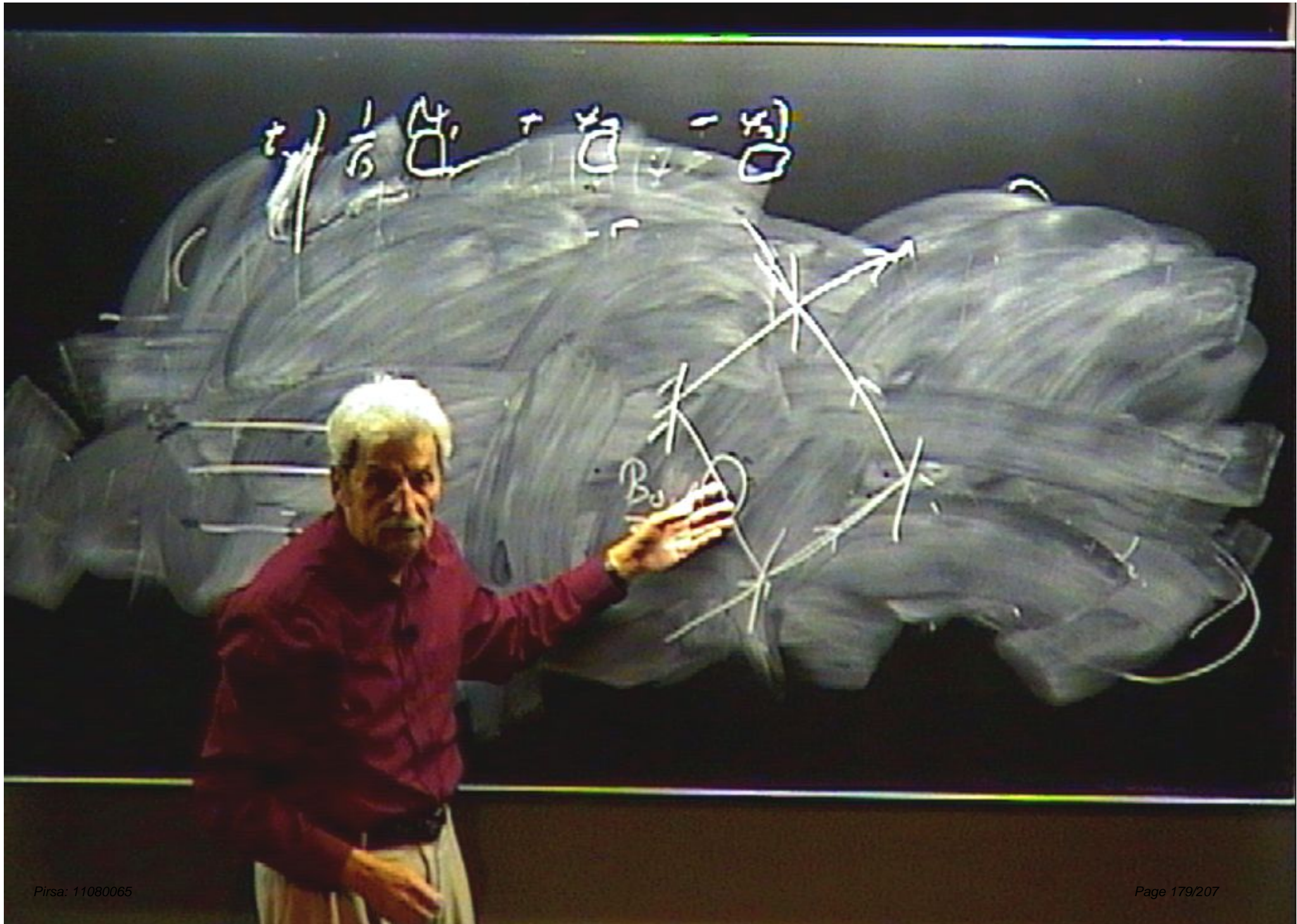


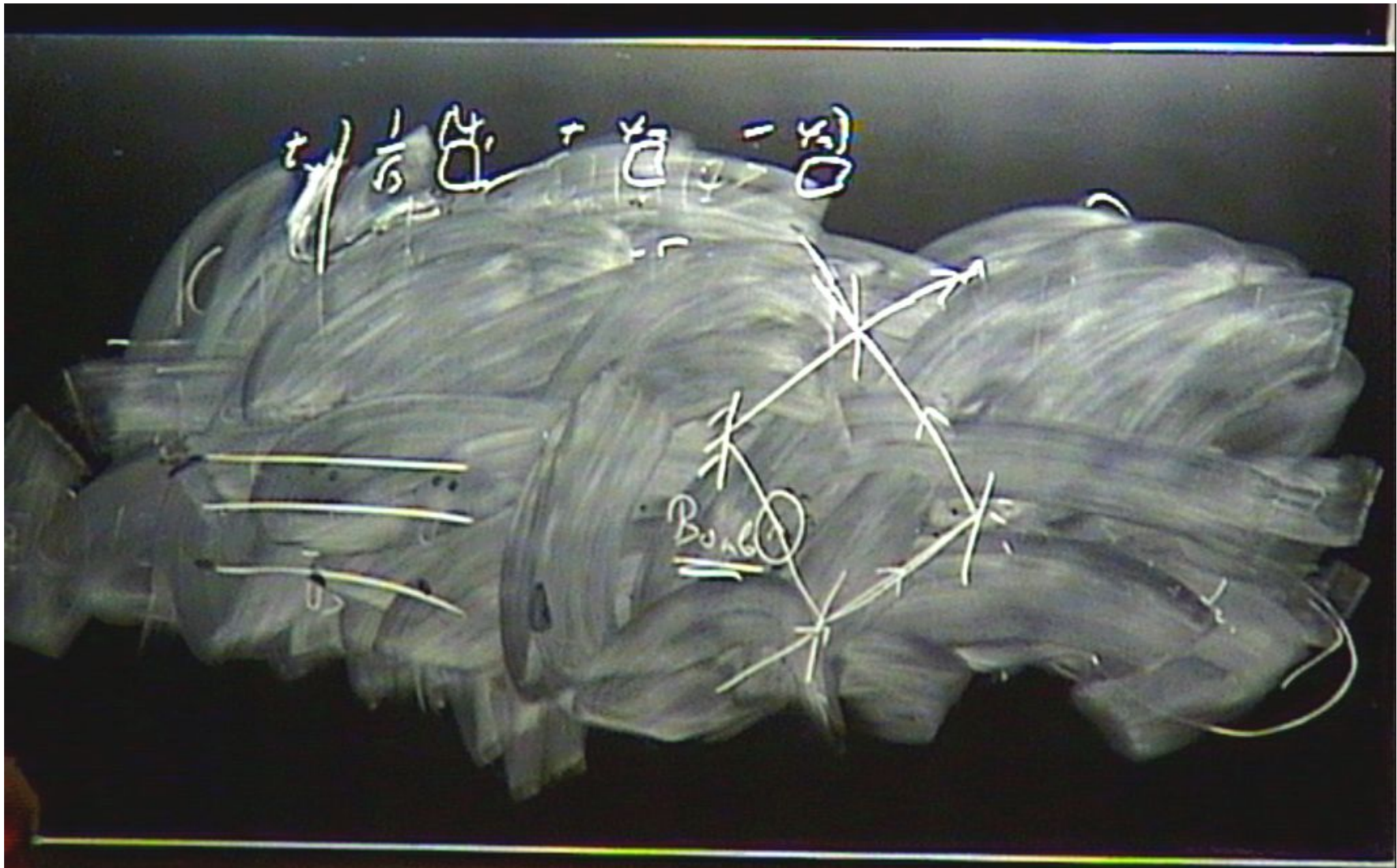


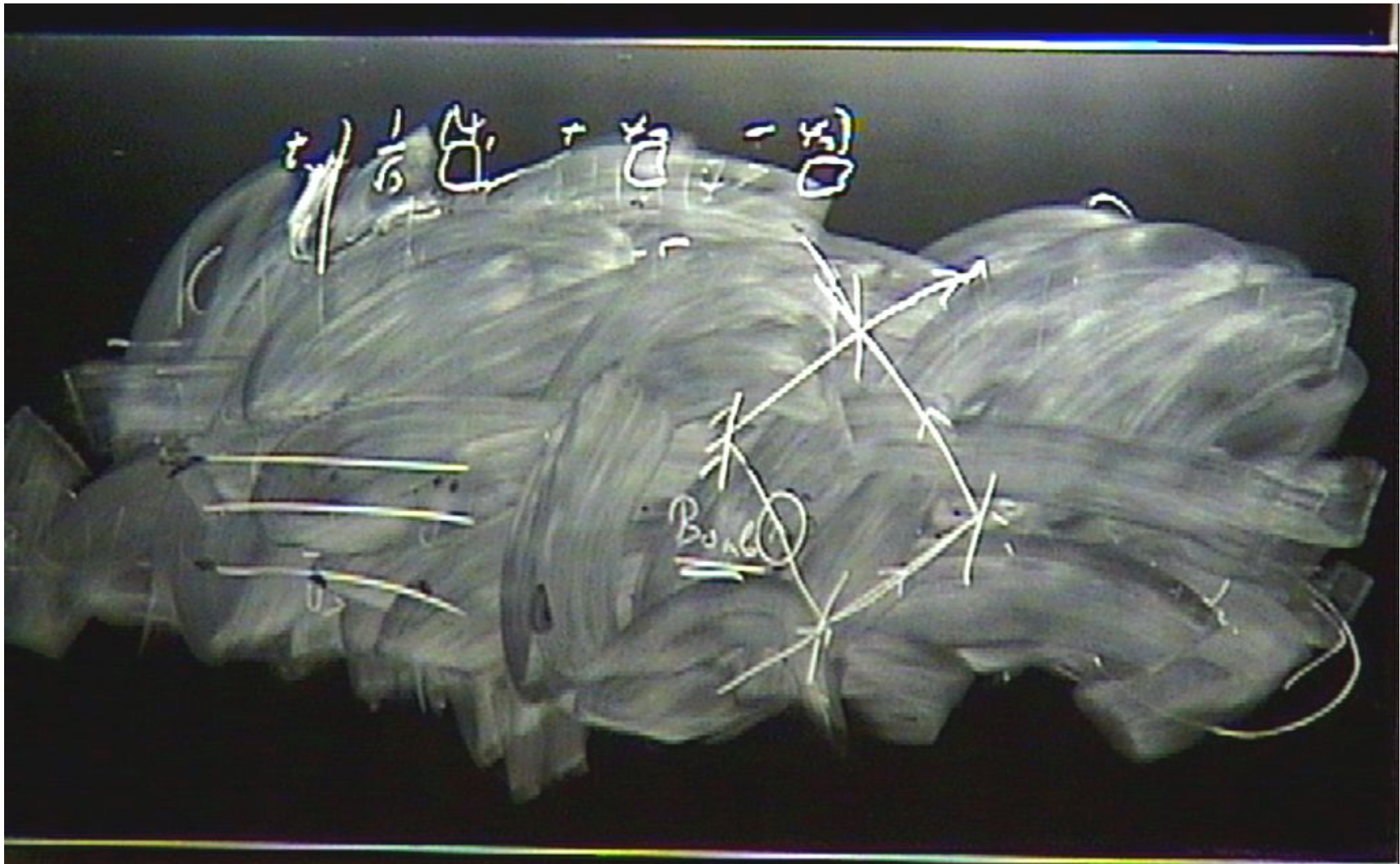


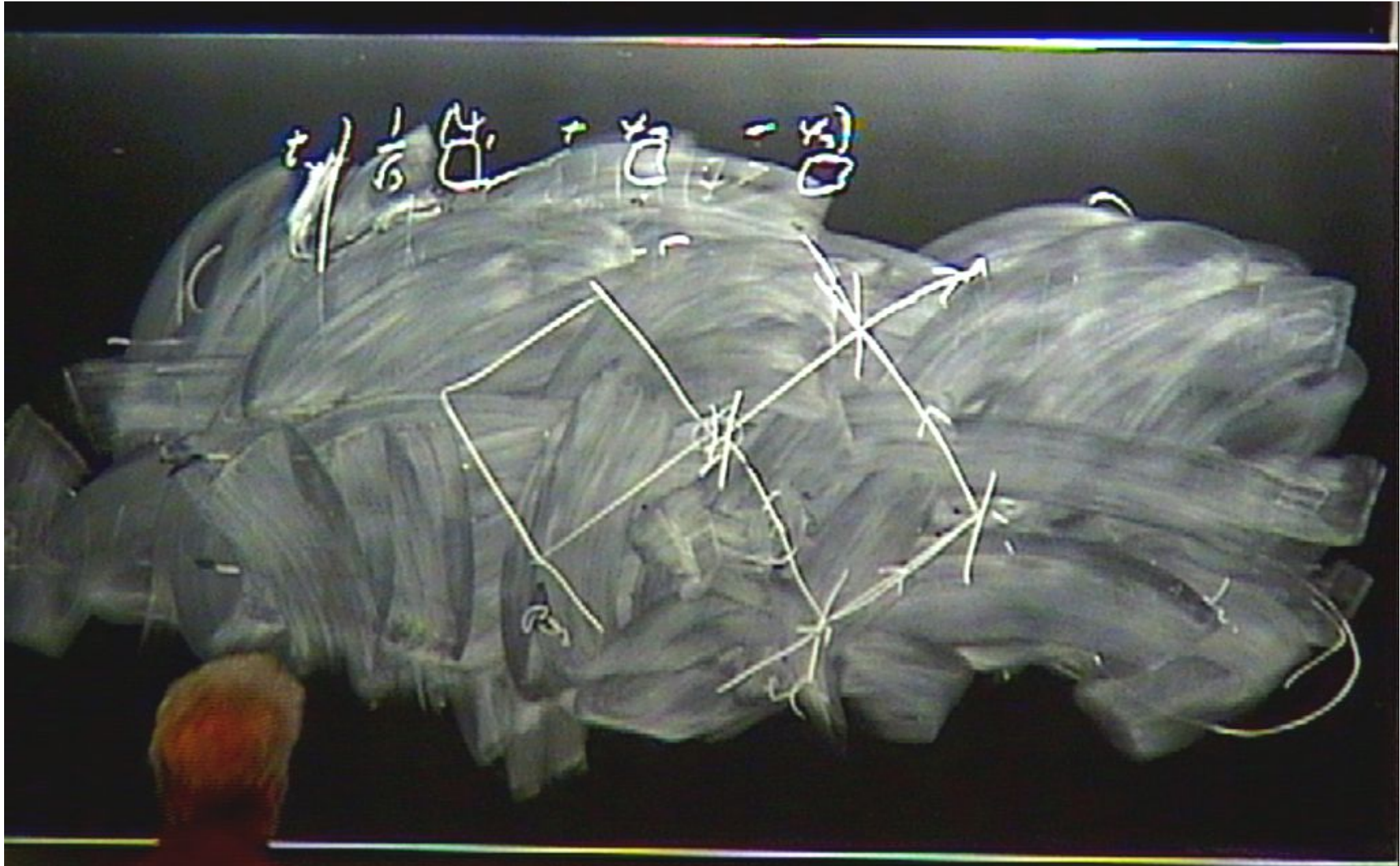


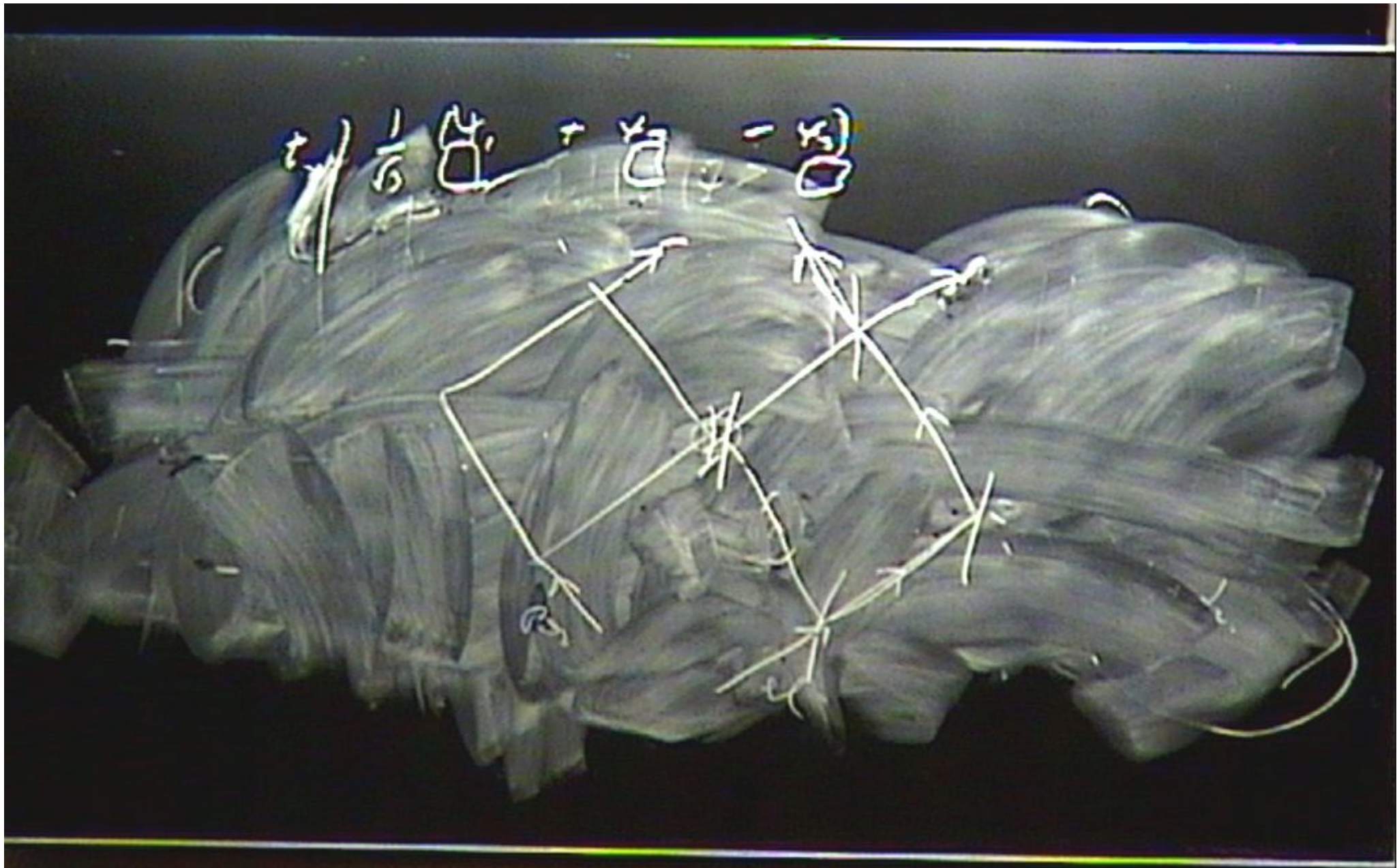




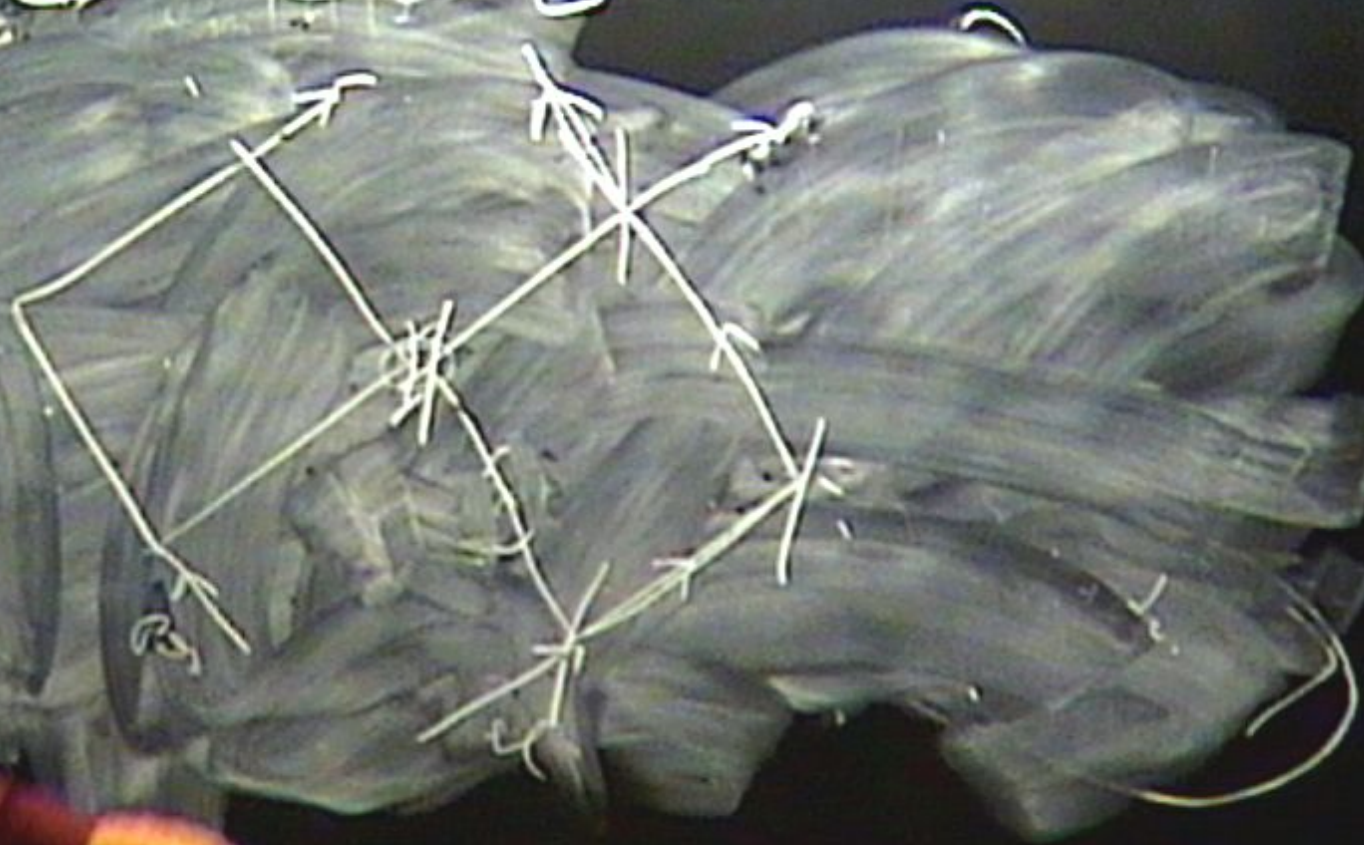


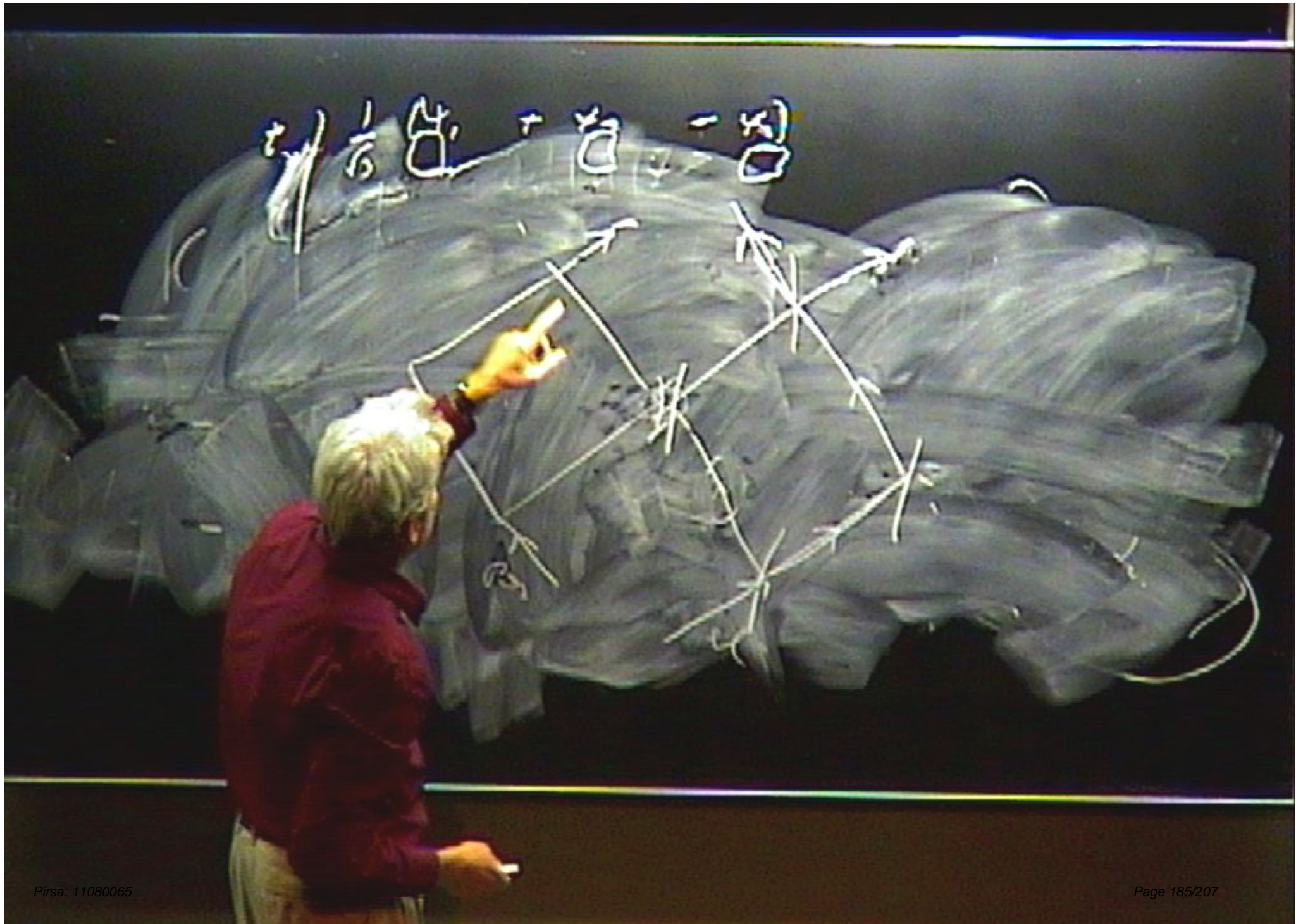


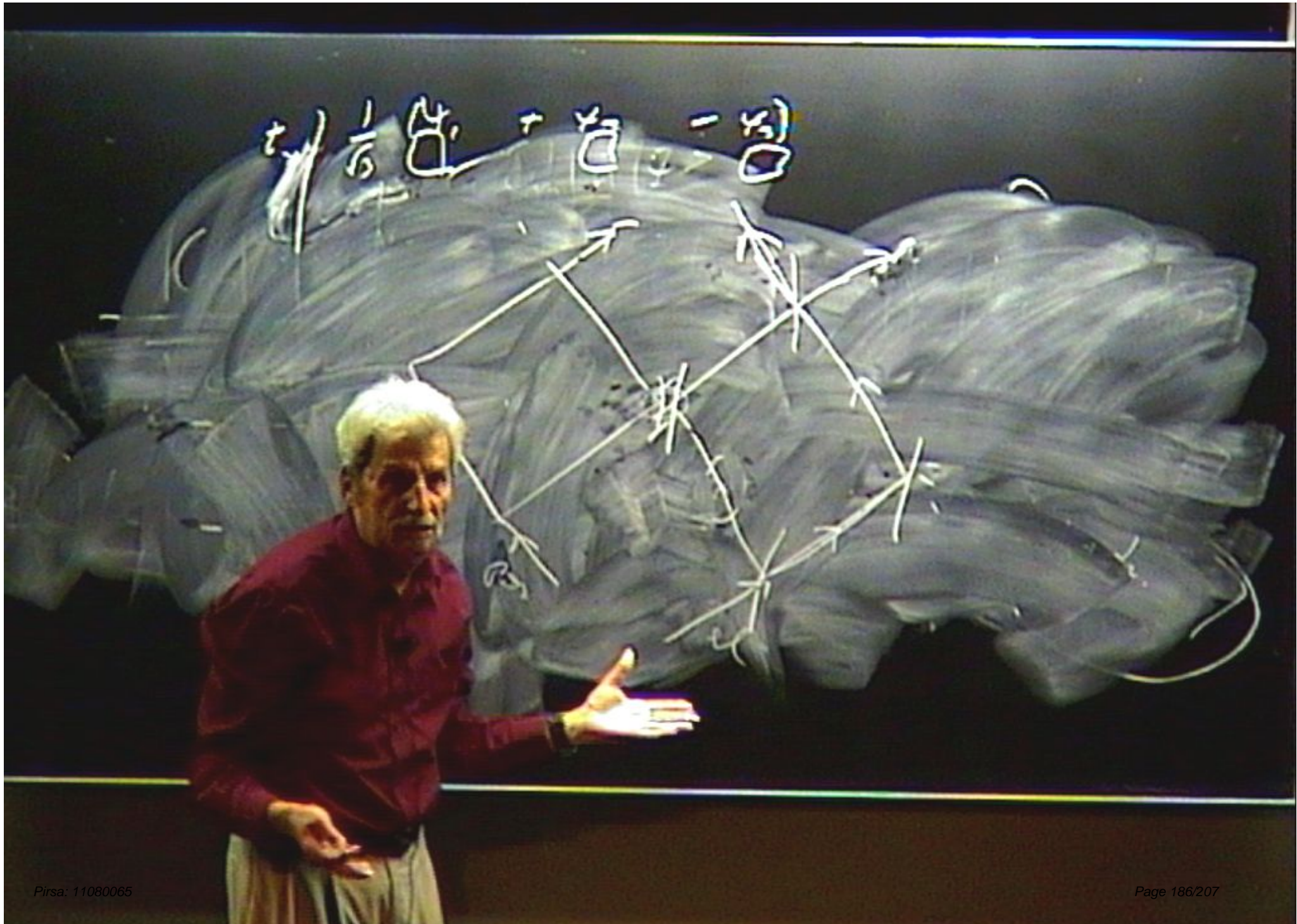


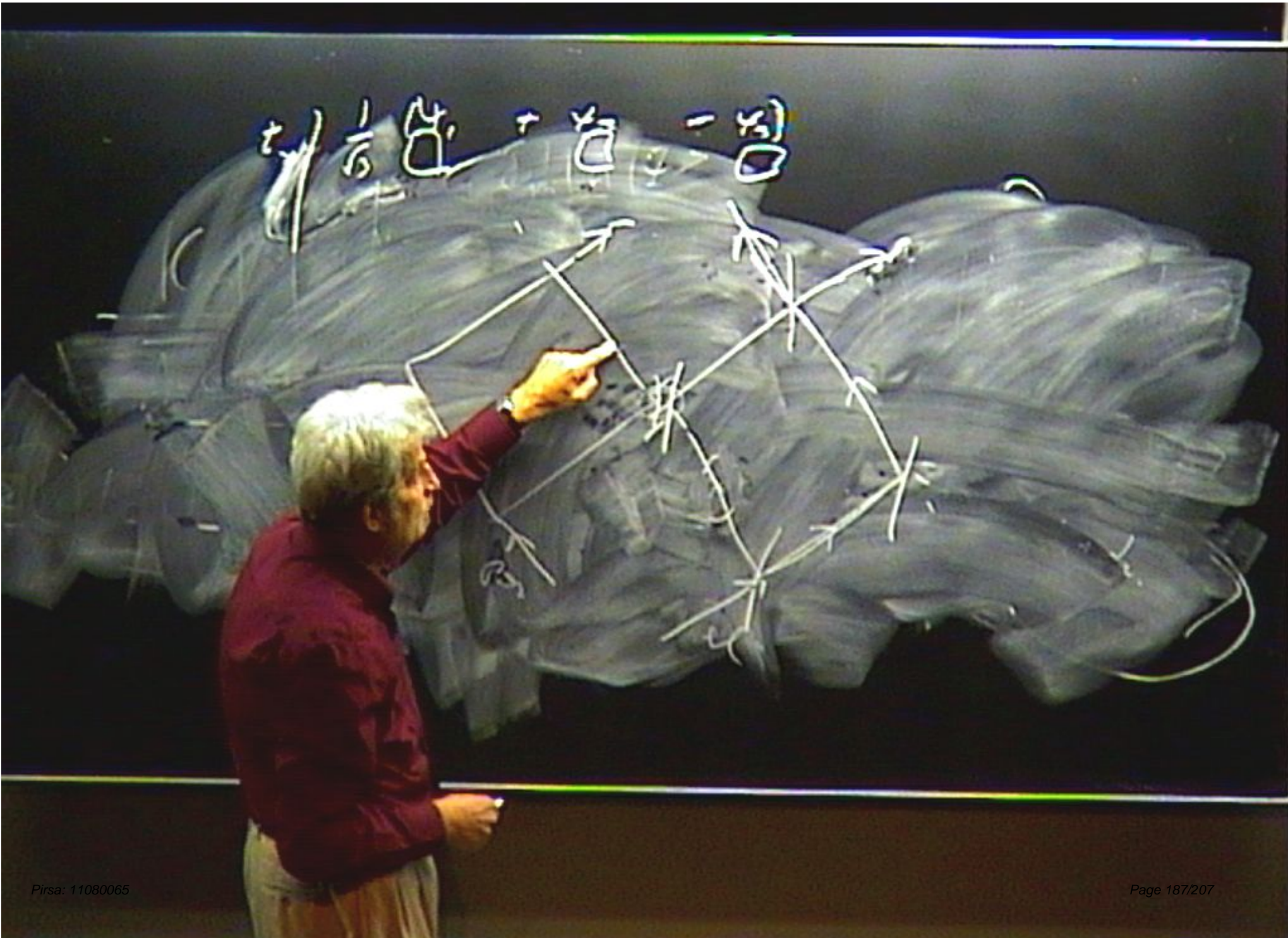


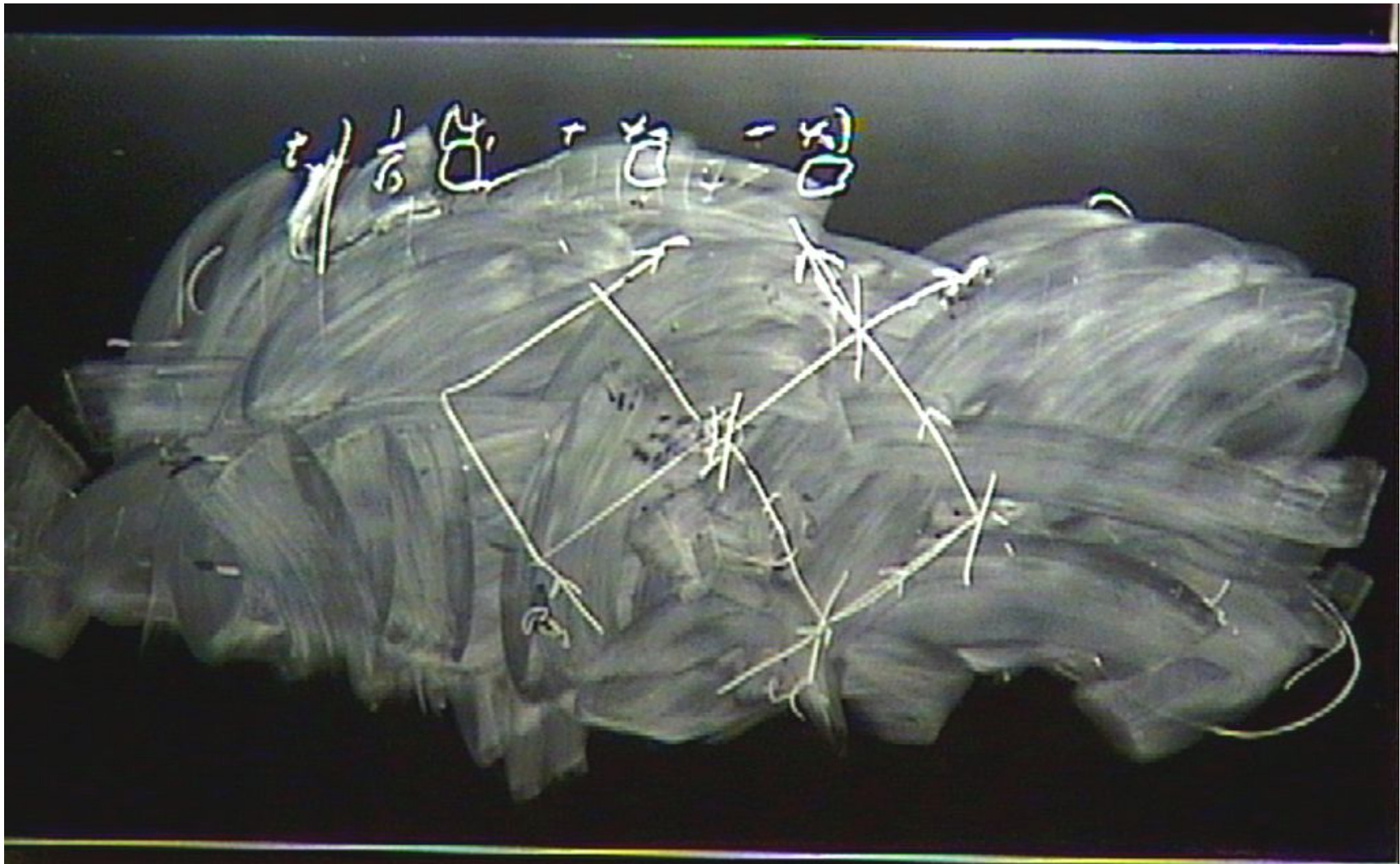
$$t \frac{1}{6} \text{ (unclear)} + \text{ (unclear)} - \text{ (unclear)}$$

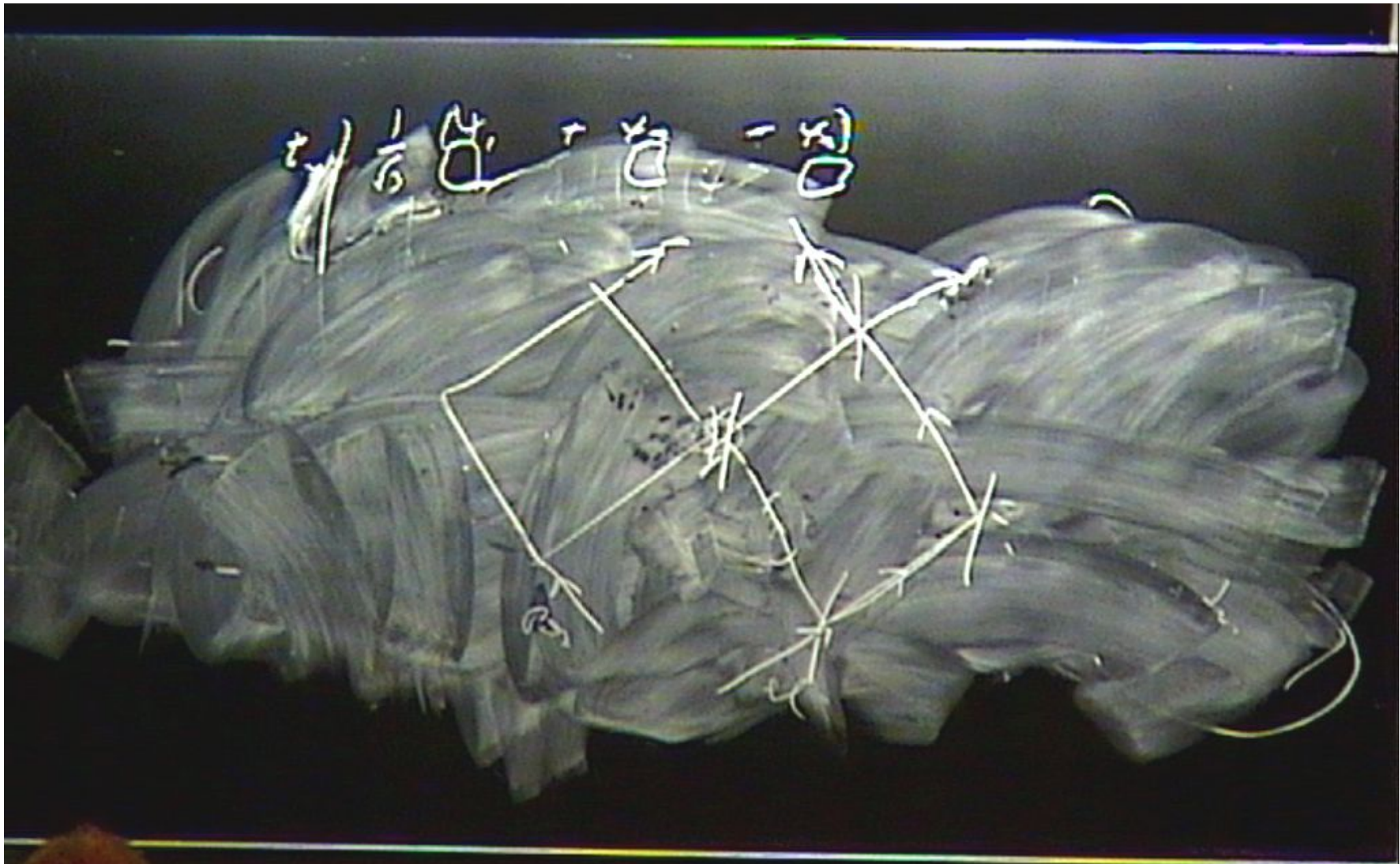






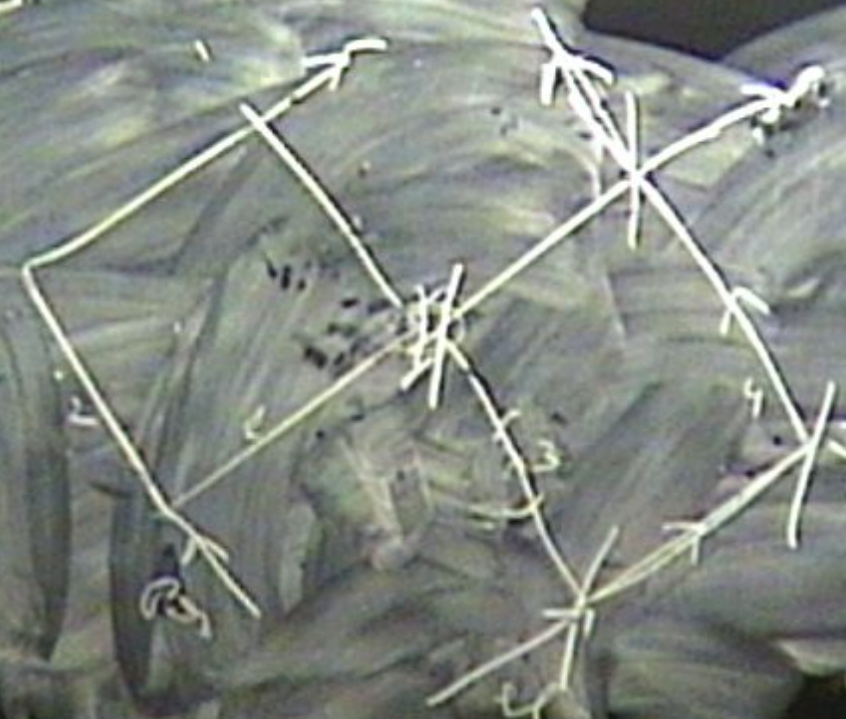


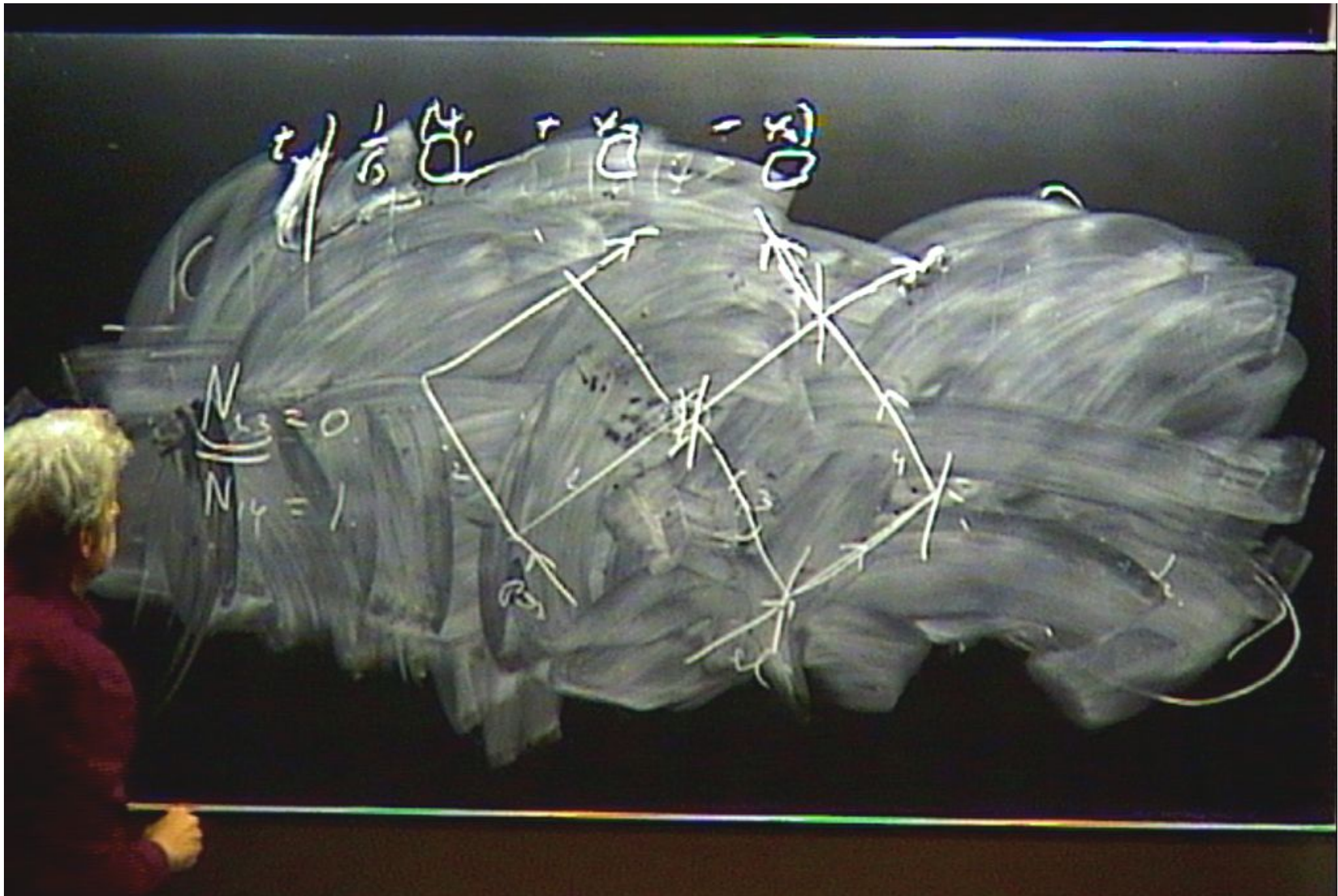




$$t \frac{1}{6} \partial_i \partial_i + \partial_i \partial_i - \partial_i \partial_i$$

$$N_{13} = 0$$

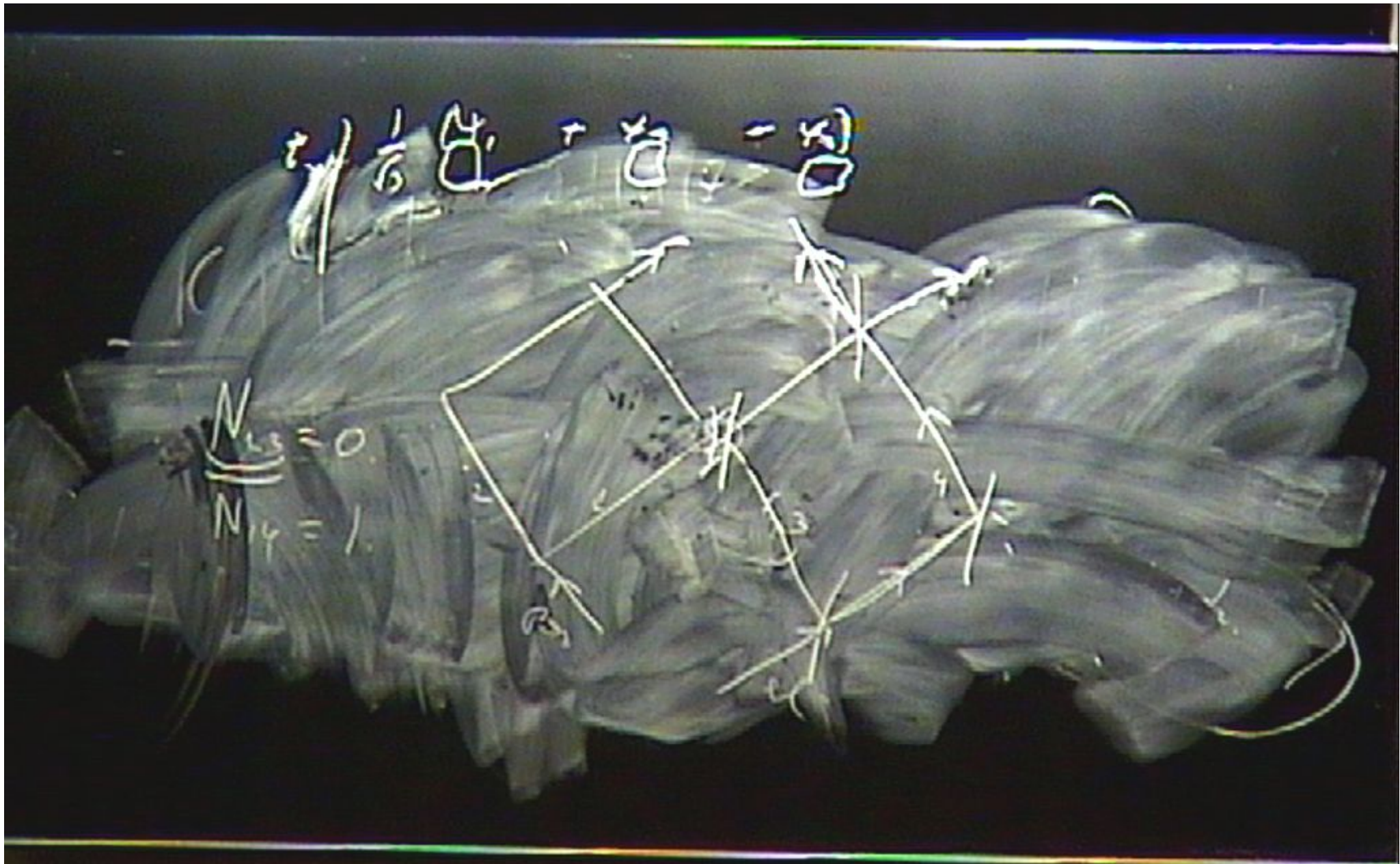




$$\frac{1}{6} \left(\frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} \right)$$

$$N_{L3} = 0$$

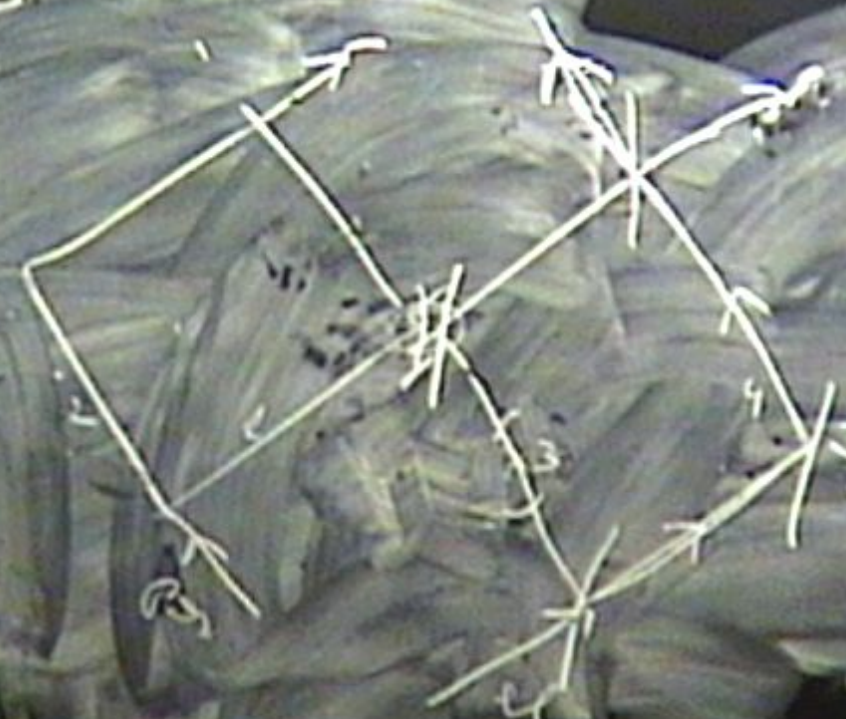
$$N_{L4} = 1$$

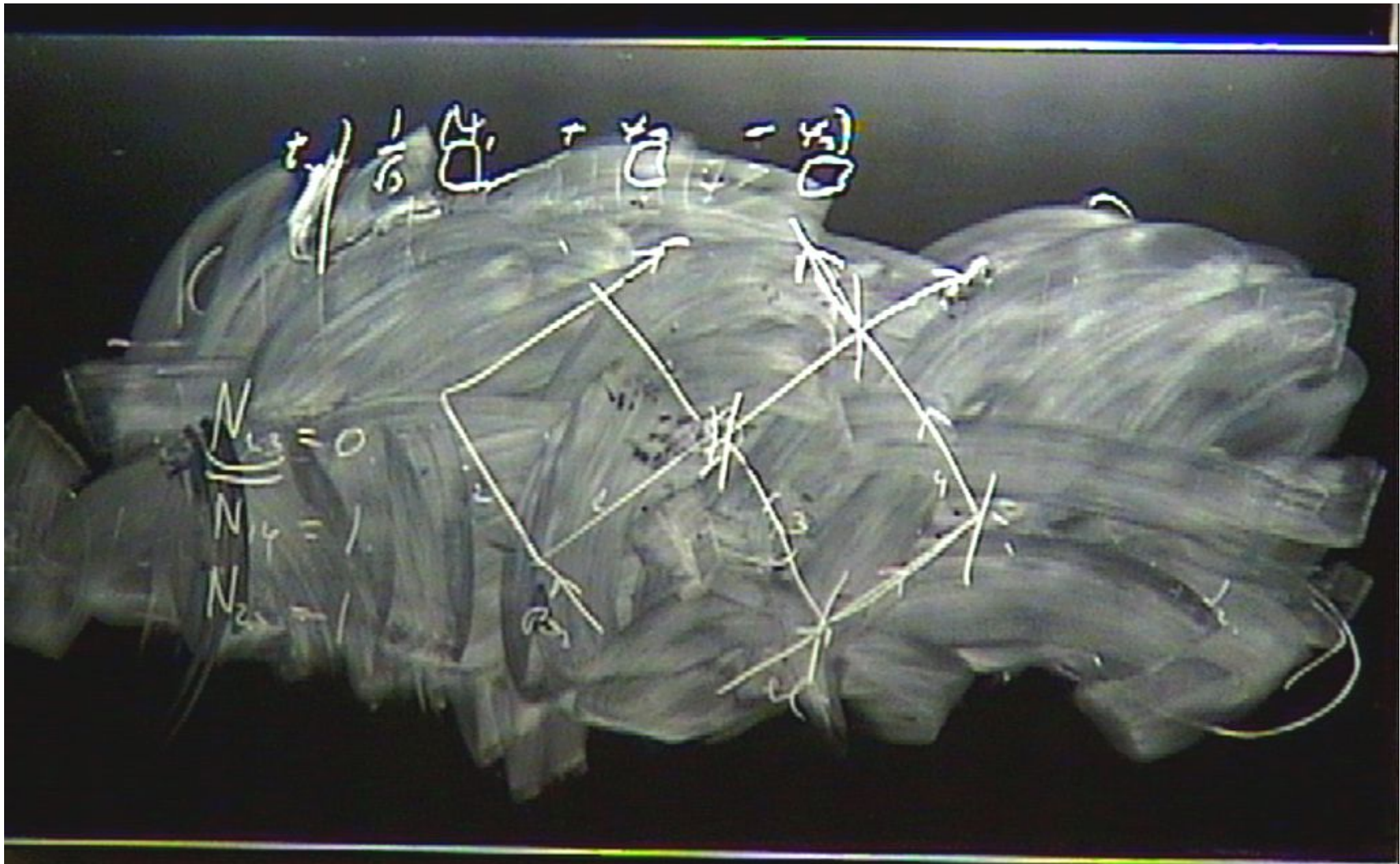


$$t \frac{1}{6} \left(\frac{4}{3} + \frac{2}{3} - \frac{1}{3} \right)$$

$$N_{2,3} = 0$$

$$N_{1,4} = 1$$





$$z = \frac{1}{6} \left(\frac{4}{3} + \frac{1}{3} + \frac{1}{3} - \frac{1}{3} \right)$$

$$\begin{aligned} N_{1,3} &= 0 \\ N_{1,4} &= 1 \\ N_{2,3} &= 1 \end{aligned}$$

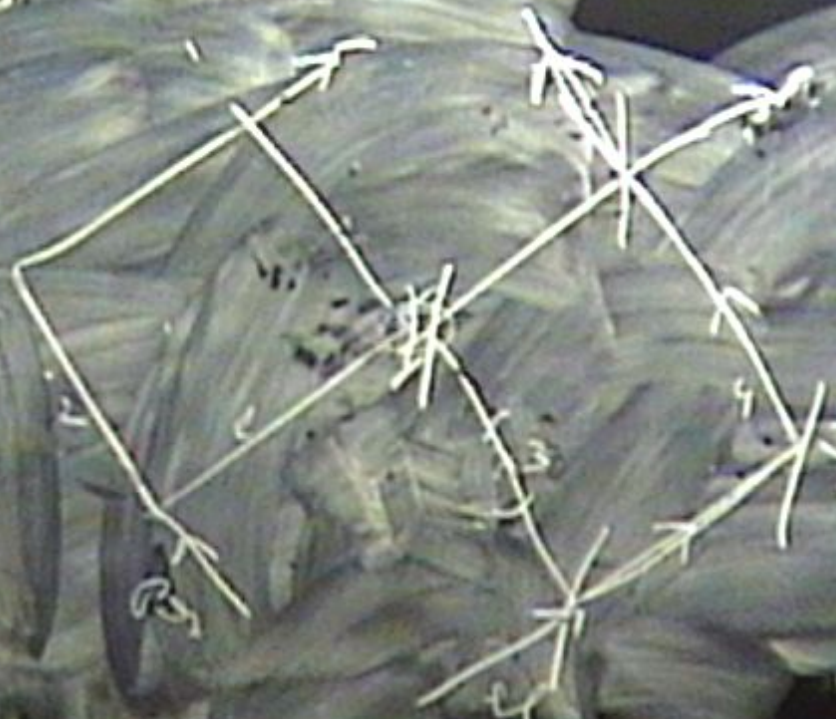


$$t \frac{1}{6} \left(\frac{4}{3} + \frac{2}{3} - \frac{2}{3} \right)$$

$$N_{23} = 0$$

$$N_{14} = 1$$

$$N_{24} = 1$$



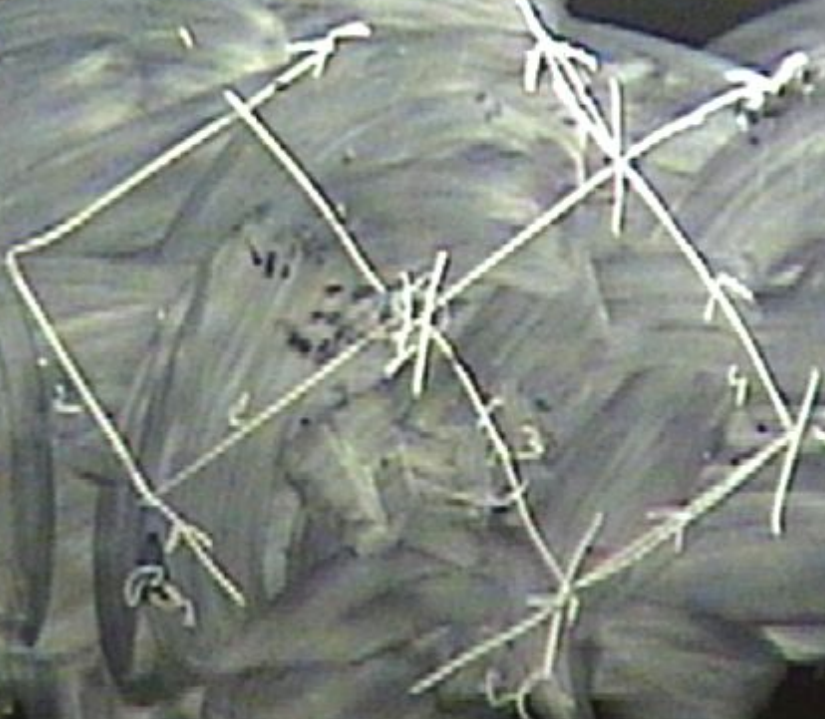
$$\frac{1}{6} \left(\frac{1}{2} + \frac{1}{2} - \frac{1}{2} \right)$$

$$N_{13} = 0$$

$$N_{14} = 1$$

$$N_{23} = 1$$

$$N_{11} = -1$$



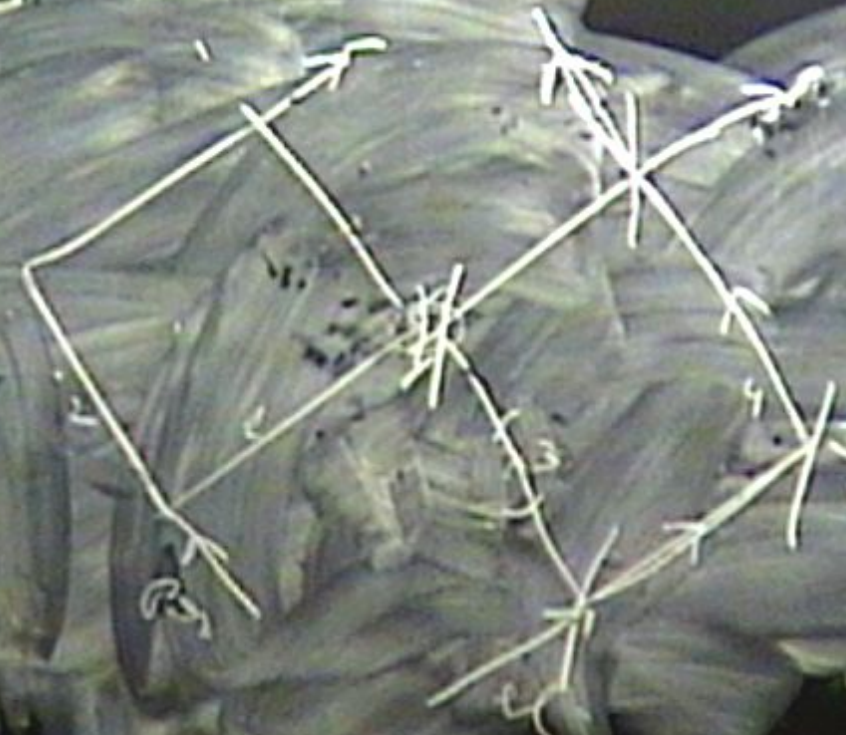
$$\frac{1}{6} \left(\frac{4}{3} + \frac{2}{3} - \frac{2}{3} \right)$$

$$N_{L3} = 0$$

$$N_{L4} = 1$$

$$N_{L2} = 1$$

$$N_{L1} = -1$$



$$t \cdot \frac{1}{6} \left(\frac{4}{3} + \frac{2}{3} - \frac{2}{3} \right)$$

$$N_{L3} = 0$$

$$N_{L4} = 1$$

$$N_{L2} = 1$$

$$N_{L1} = -1$$



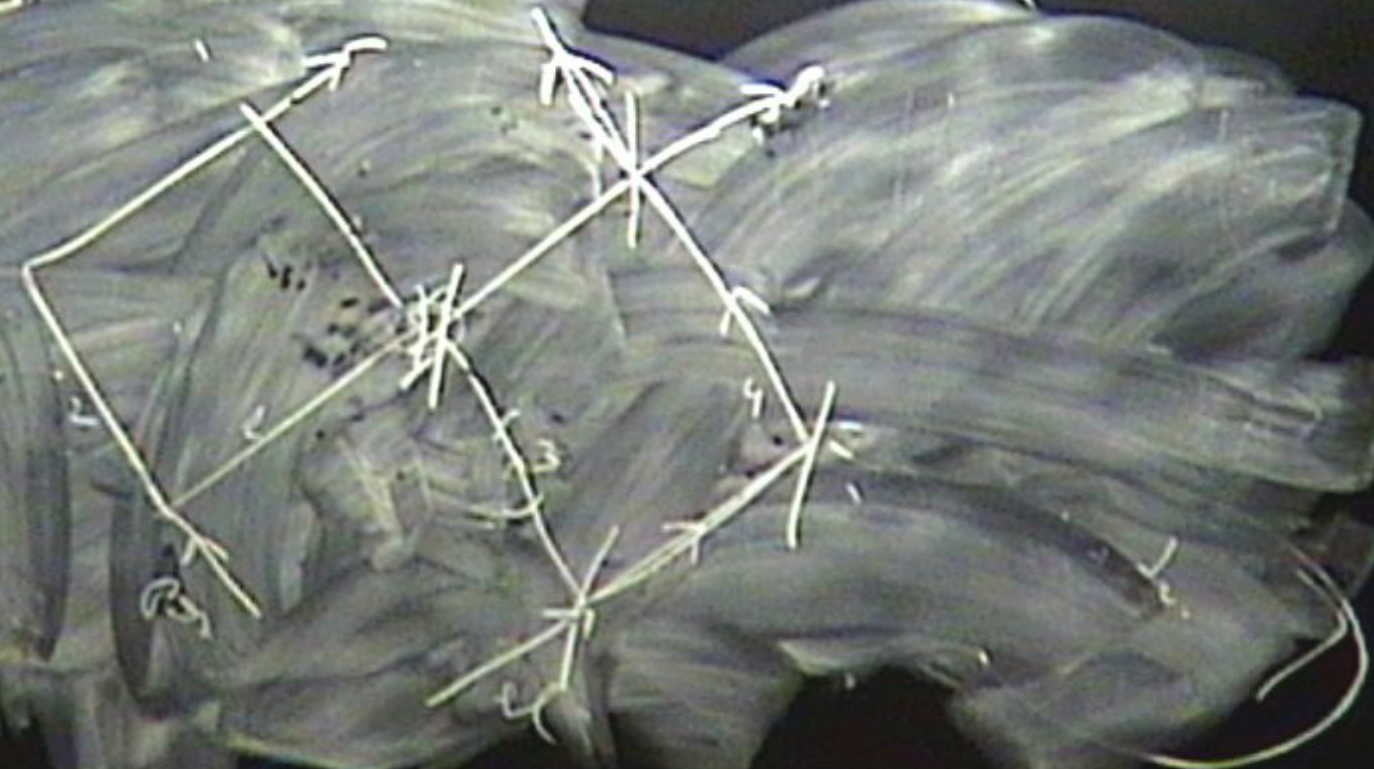
$$t \cdot \frac{1}{6} \left(\frac{4}{3} + \frac{2}{3} - \frac{2}{3} \right)$$

$$N_{L3} = 0$$

$$N_{L4} = 1$$

$$N_{L2} = 1$$

$$N_{L1} = -1$$



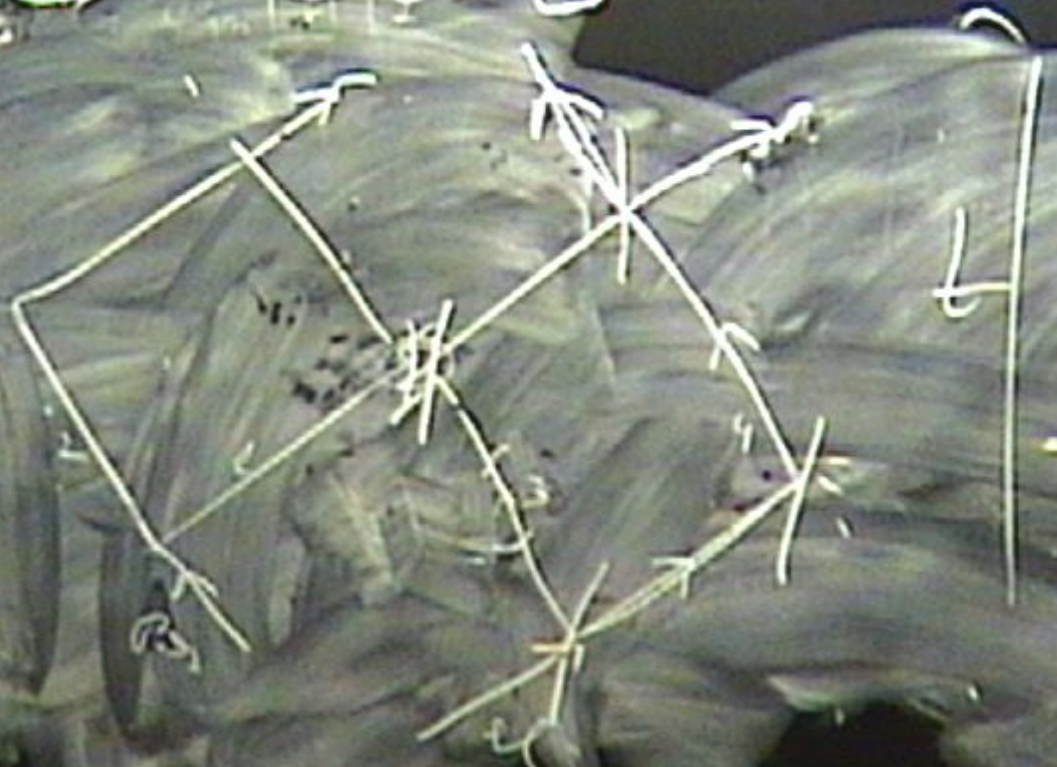
$\frac{1}{5} \rightarrow \frac{1}{4} - \frac{1}{5}$

$N_{23} = 0$

$N_{14} = 1$

$N_{24} = 1$

$N_{12} = -1$



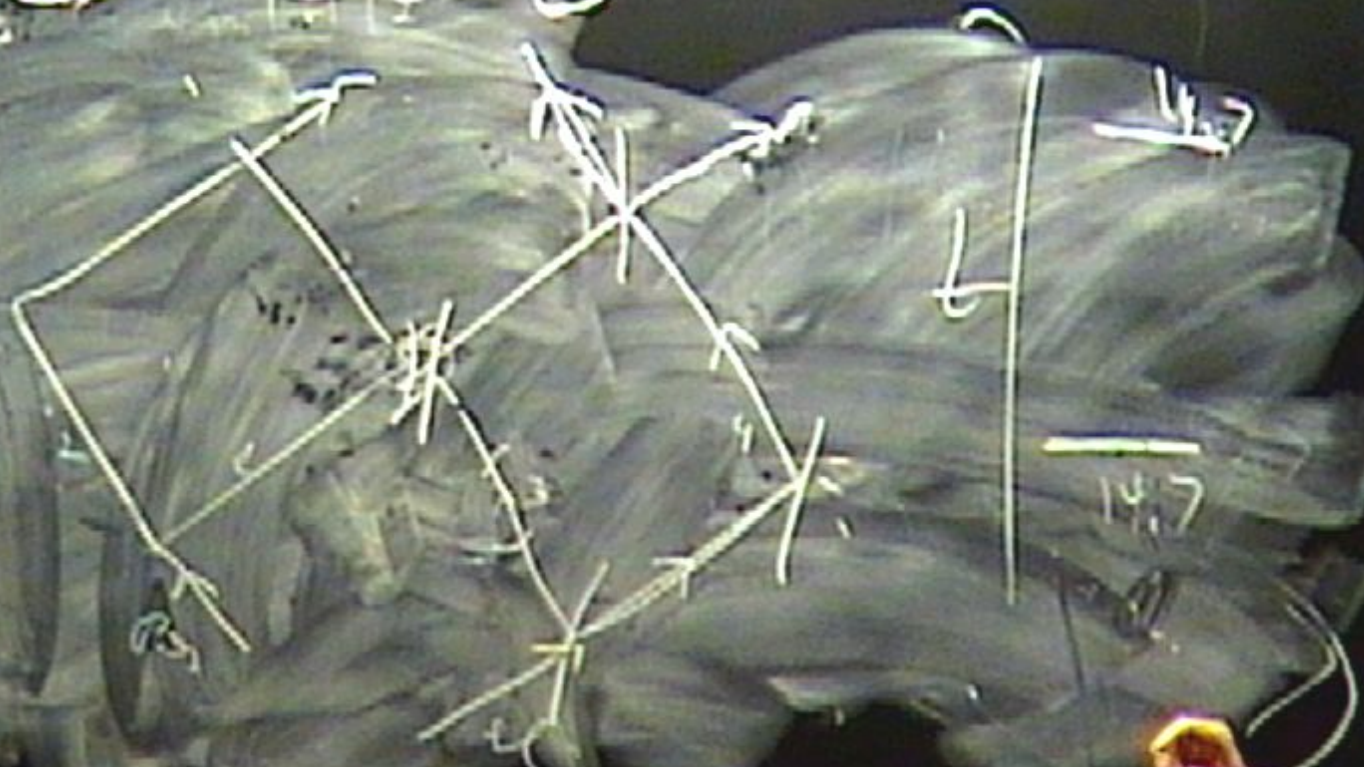
$$t = \frac{1}{5} \left(\frac{4}{5} + \frac{4}{5} - \frac{4}{5} \right)$$

$$N_{23} = 0$$

$$N_{14} = 1$$

$$N_{24} = 1$$

$$N_{12} = -1$$



14.7

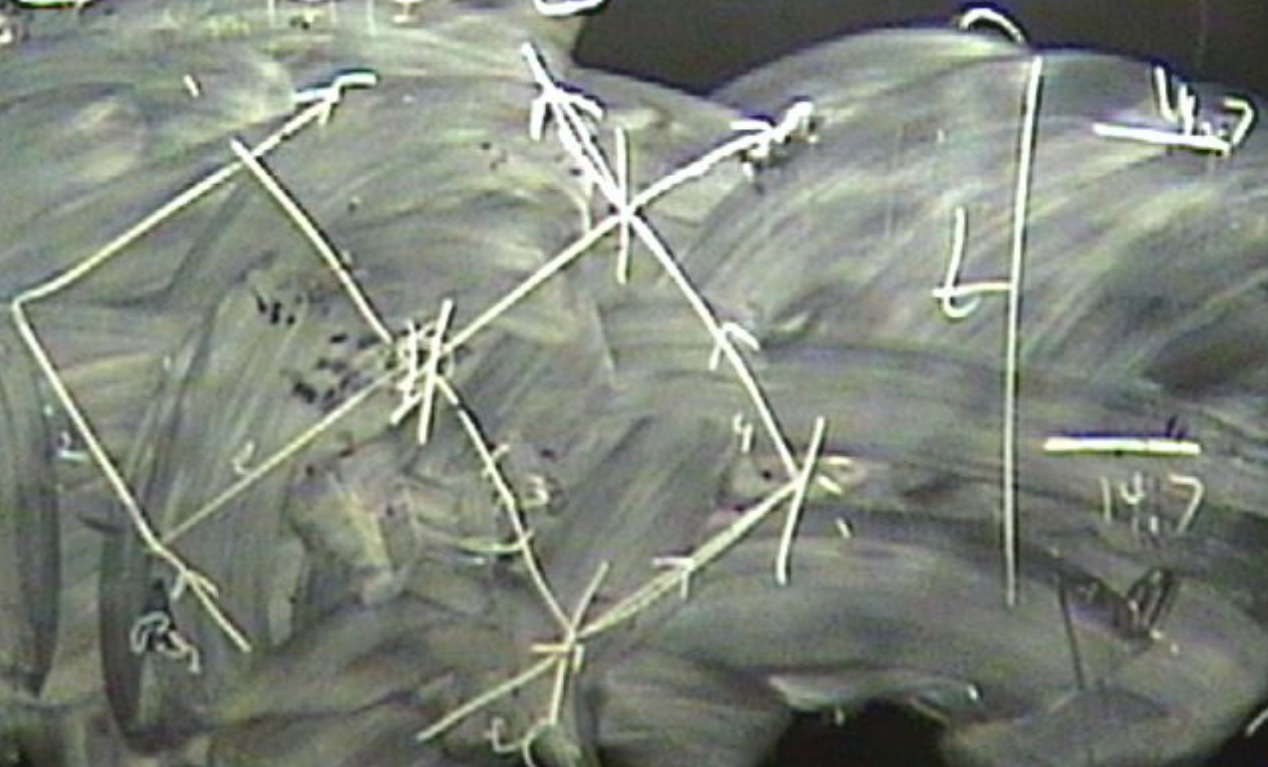
$$z = \frac{1}{6} \left(\frac{4}{3} + \frac{2}{3} - \frac{2}{3} \right)$$

$$N_{23} = 0$$

$$N_{14} = 1$$

$$N_{24} = 1$$

$$N_{12} = -1$$



$$14.7$$

$\frac{1}{6} \begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & 1 & -1 \\ 1 & -1 & -1 & 1 \end{pmatrix} \rightarrow \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$

$N_{23} = 0$

$N_{14} = 1$

$N_{24} = 1$

$N_{13} = -1$



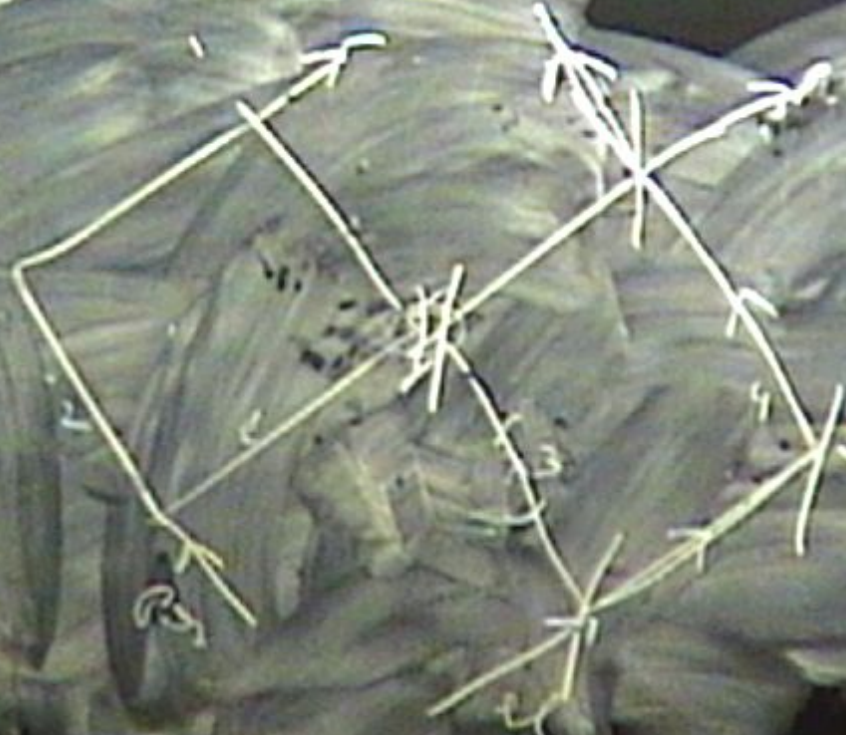
$$x_1 + \frac{1}{6}x_2 + x_3 + x_4 - x_5 = 0$$

$$N_{23} = 0$$

$$N_{14} = 1$$

$$N_{22} = 1$$

$$N_{11} = -1$$



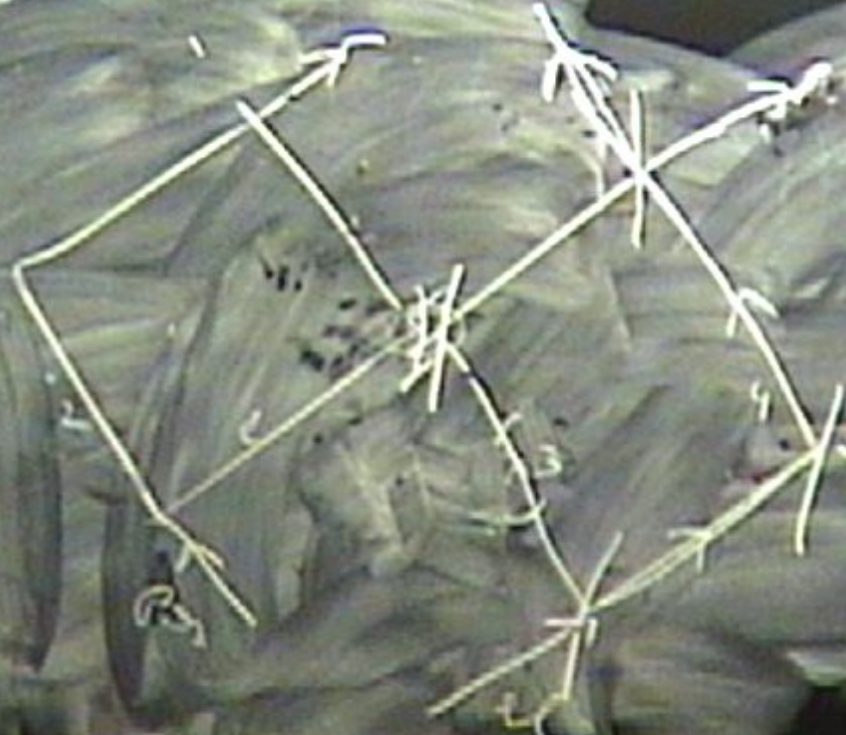
$$\frac{1}{6} \left(\frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} \right) = \frac{1}{6} \times 3 = \frac{1}{2}$$

$$N_{23} = 0$$

$$N_{14} = 1$$

$$N_{22} = 1$$

$$N_{11} = -1$$



$$\frac{1}{6} \left(\frac{1}{2} + \frac{1}{2} - \frac{1}{2} \right)$$

$$N_{23} = 0$$

$$N_{14} = 1$$

$$N_{22} = 1$$

$$N_{11} = -1$$

