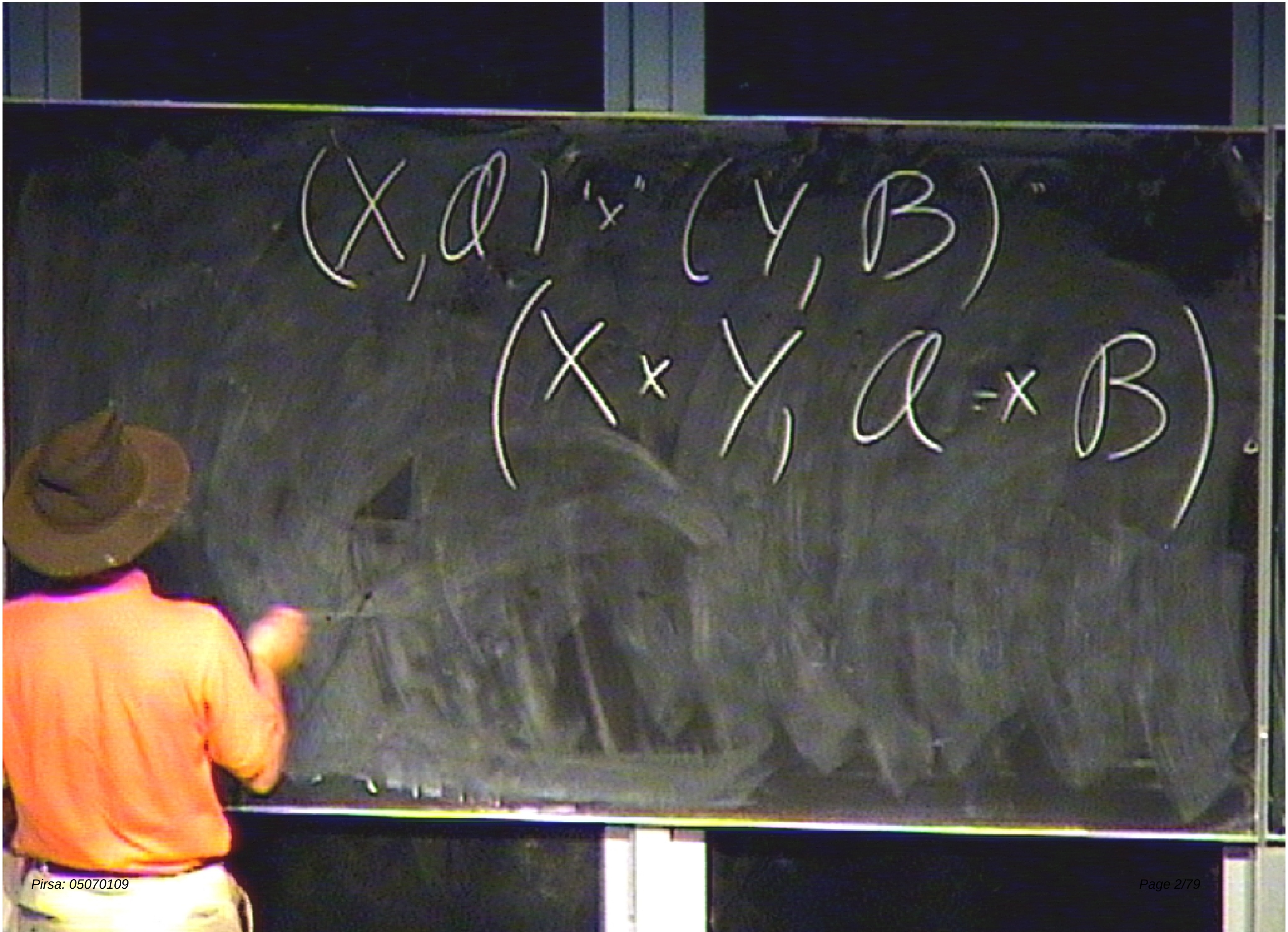
Title: Nonlocal no-signalling correlations that are locally quantum.

Date: Jul 20, 2005 05:00 PM

URL: http://pirsa.org/05070109

Abstract:


(X, 𝒜) "×" (Y, ℬ) "
(X × Y, 𝒜 × ℬ).

$$(X, \mathcal{A}) \text{ ``}\times\text{'' } (Y, \mathcal{B}) \text{ ''}$$

$$[0,1] \quad \underline{\left(X \times Y, \mathcal{A} \times \mathcal{B} \right)}.$$

$(X, \mathcal{A})$ "$\times$" $(Y, \mathcal{B})$

$[0,1]$ $\underline{\left(X \times Y, \mathcal{A} \times \mathcal{B}\right)}$.

$$(X,\mathcal{A}) \text{ “}\times\text{” } (Y,\mathcal{B})$$

$$[0,1] \qquad \left(X\times Y, \mathcal{A}\times\mathcal{B}\right).$$

$$(X, \mathcal{A}) \text{ "}\times\text{" } (Y, \mathcal{B}) \text{ "}$$

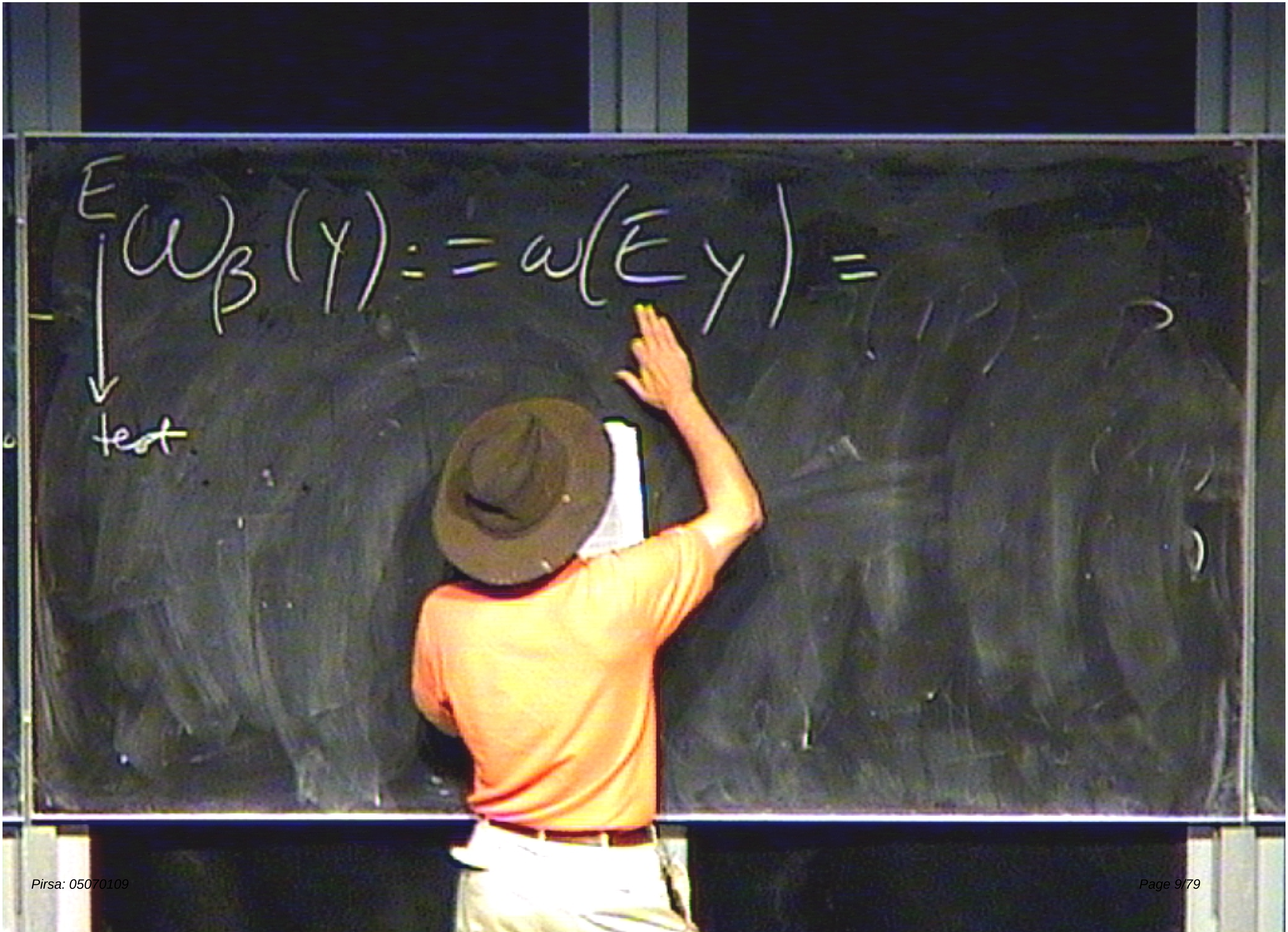
$$[0,1] \qquad \underline{\left(X \times Y, \mathcal{A} \times \mathcal{B}\right)}.$$

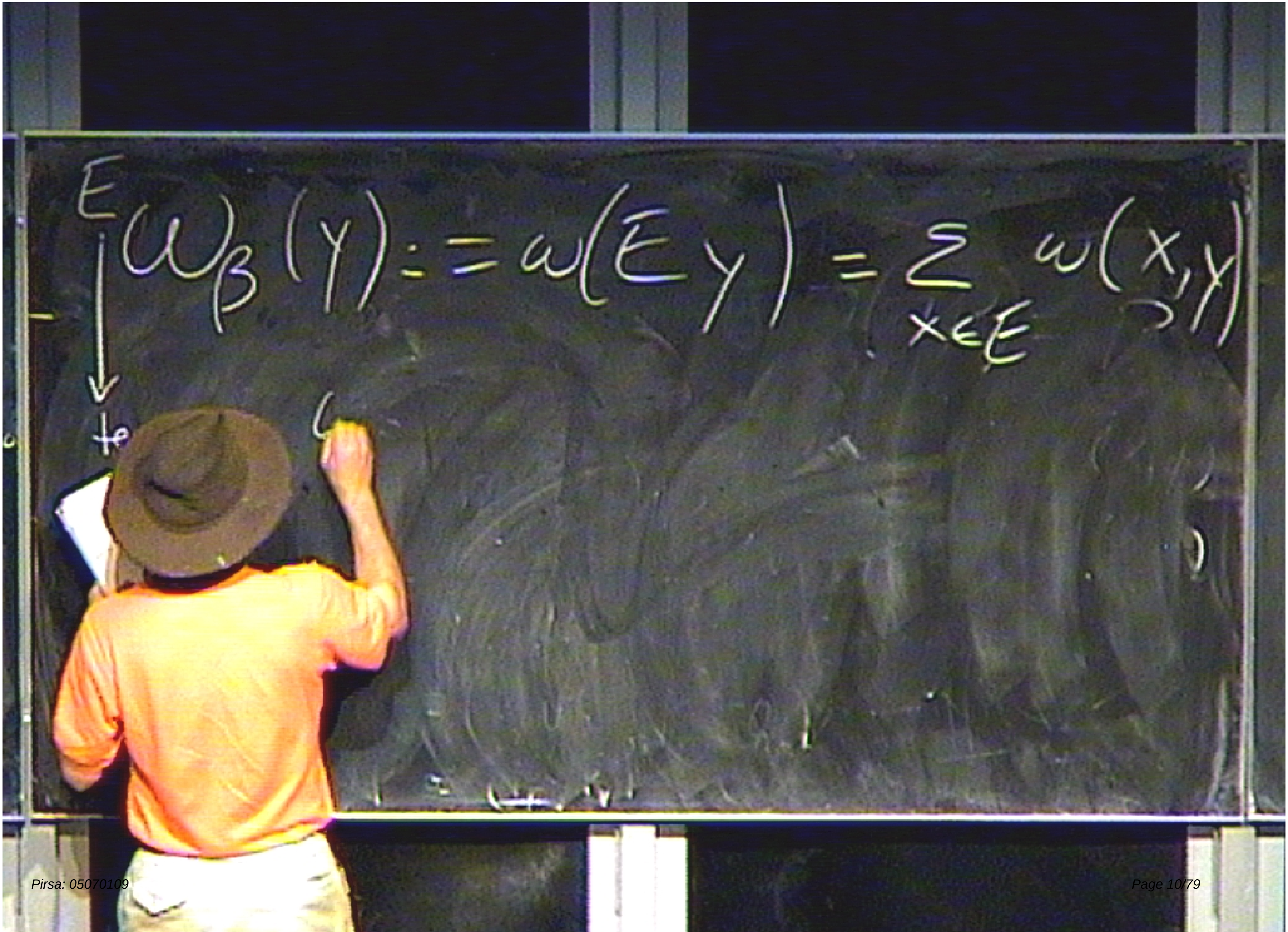
$(X, \mathcal{A})$ "×" $(Y, \mathcal{B})$ "

$[0,1]$ $\underline{\qquad\qquad}$ $(X \times Y, \mathcal{A} \times \mathcal{B})$

$$(X, \mathcal{A}) \text{ "}\times\text{" } (Y, \mathcal{B})$$

$$[0,1] \quad \underline{(X \times Y, \mathcal{A} \times \mathcal{B})}$$


$^{E}\omega_{\beta}(Y) := \omega(EY) =$
test



$^{E}\omega_\beta(y) := \omega(E\,y) = \sum_{x \in E} \omega(x, y)$

$$ {}^{E}\omega_{\beta}(Y) := \omega(E\,Y) = \sum_{x\in E} \omega(x,Y) $$

test

$$ a^{\omega^{F}} $$

$${}^{E}\omega_\beta(y) := \omega(E\,y) = \sum_{x \in E} \omega(x, y)$$

test $\quad a^{\omega^F}$

$$ {}^{E}\omega_\beta(Y) := \omega(E\,Y) = \sum_{x \in E} \omega(x, Y) $$

$$ \downarrow $$

test $\quad \mathfrak{a}^{\omega^F}$

$${}^{E}\omega_\beta(y) := \omega(E\,y) = \sum_{x\in E} \omega(x, y)$$

test $\quad a^{\omega^F}$

$$ {}^{E}\omega_{\beta}(Y) := \omega(EY) = \sum_{x \in E} \omega(x, Y) $$

test $\alpha^{\omega^{F}}$

$${}^{E}\omega_\beta(Y) := \omega(EY) = \sum_{x\in E} \omega(x,y)$$

test $\quad a^{\omega^F}$

$$ {}^{E}\omega_\beta(y) := \omega(E\,y) = \sum_{x\in E} \omega(x,y) $$

test $\quad a^{\omega^F}$

$${}^{E}\omega_\beta(y) := \omega(E\,y) = \sum_{x \in E} \omega(x,y)$$

test $\quad a^{\omega^F}$

$$ {}^{E}\omega_\beta(y) := \omega(E\,y) = \sum_{x\in E} \omega(x, y) $$

$\downarrow$

test $\quad {}^{q}\omega^{F}$

$$ E \xrightarrow{z_1} F_{z_1}, \quad E \xrightarrow{z_2} F_{z_2}, \quad E \xrightarrow{z_3} F_{z_3} $$

$$ {}^{E}\omega_\beta(y) := \omega(Ey) = \sum_{x \in E} \omega(x, y) $$

$\downarrow$

test $\quad a^{\omega^F}$

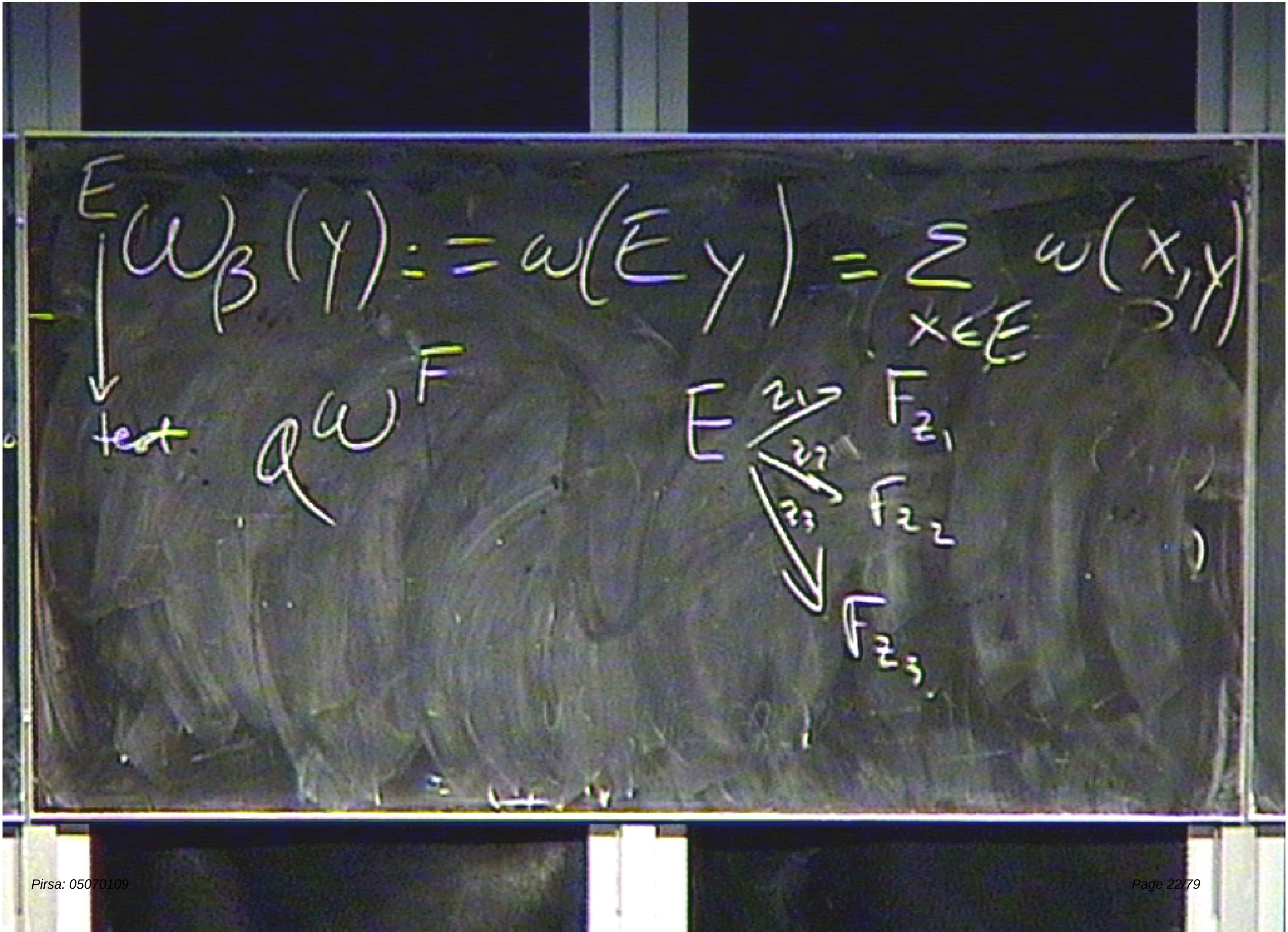
$$
\begin{tikzcd}
 & F_{z_1} \\
E \arrow[ur, "z_1"] \arrow[r, "z_2"] \arrow[dr, "z_3"'] & F_{z_2} \\
 & F_{z_3}
\end{tikzcd}
$$

$$ {}^{E}\omega_\beta(y) := \omega(E\,y) = \sum_{x \in E} \omega(x,y) $$

test

$$ a^{\omega^F} $$

$$ E \xrightarrow{z_1} F_{z_1} $$
$$ E \xrightarrow{z_2} F_{z_2} $$
$$ E \xrightarrow{z_3} F_{z_3} $$


${}^{E}\omega_\beta(Y) := \omega(E\,Y) = \sum_{x\in E} \omega(x, Y)$
test
q^{ω^F}
$E \xrightarrow{z_1} F_{z_1}$
$E \xrightarrow{z_2} F_{z_2}$
$E \xrightarrow{z_3} F_{z_3}$

$$(X,\mathcal{A}) \text{ "}\times\text{" } (Y,\mathcal{B}) \text{ "}$$

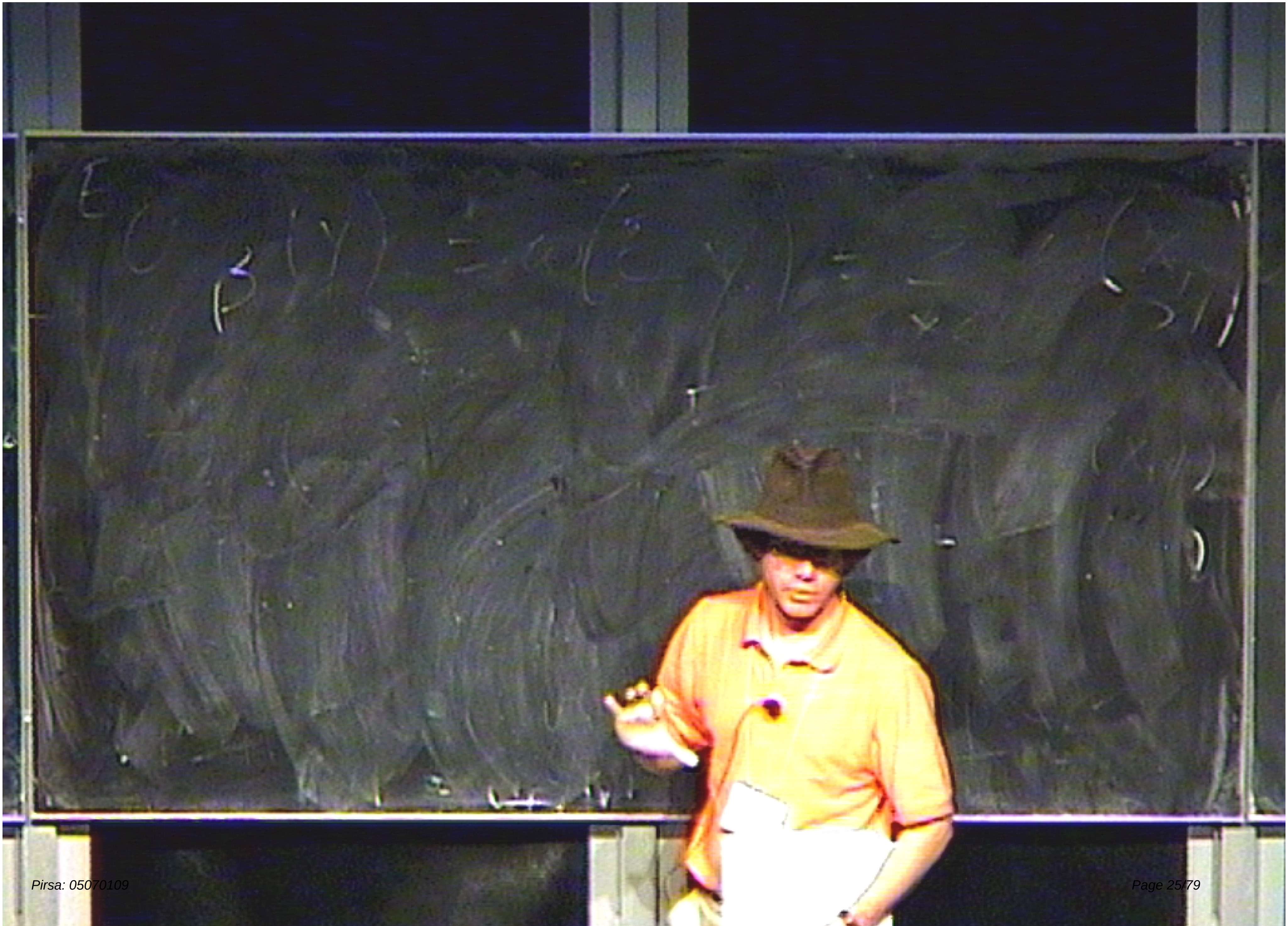
$$[0,1] \qquad (X \times Y, \mathcal{A} \times \mathcal{B})$$

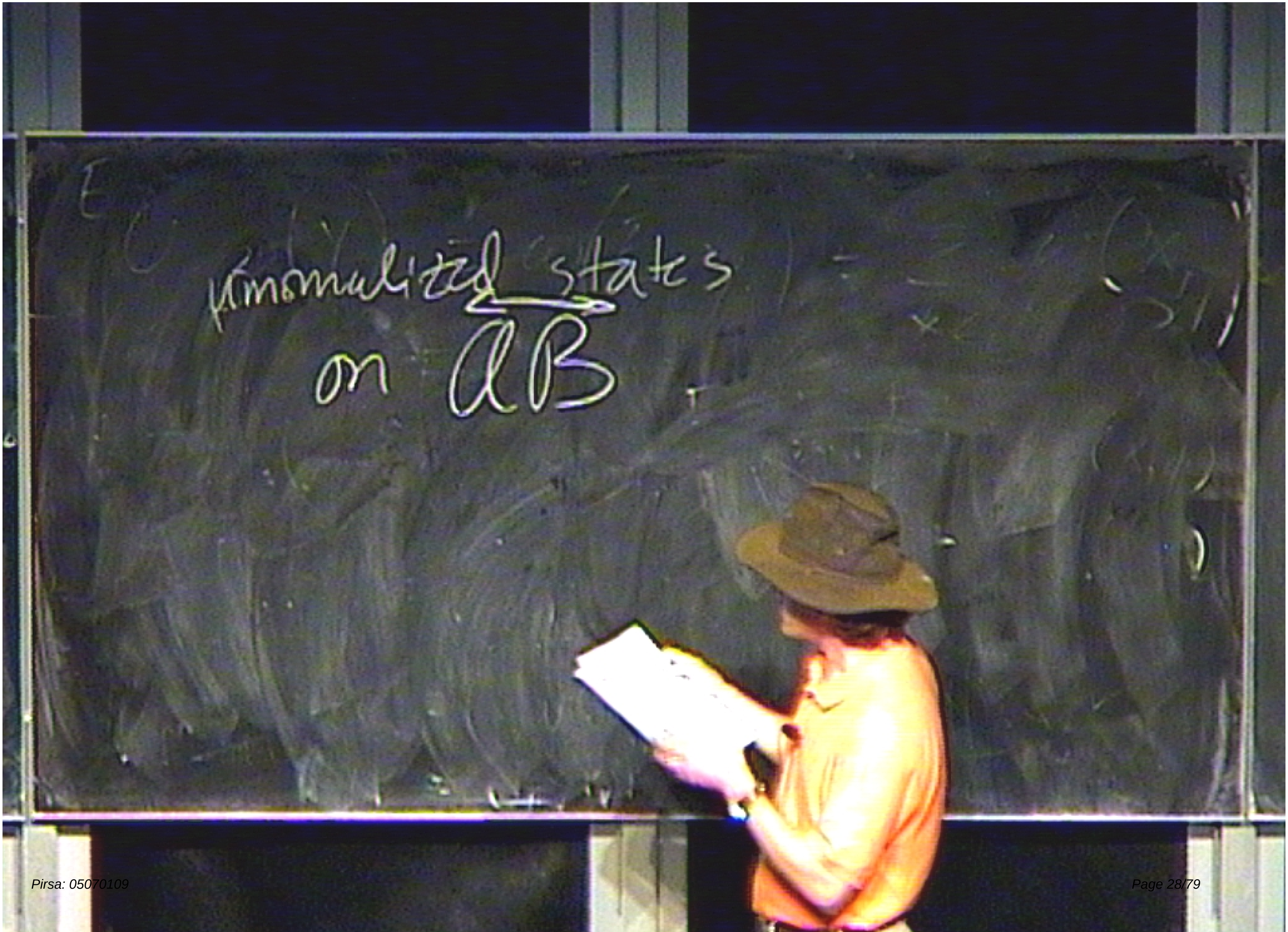
$$\overline{\mathcal{A}\mathcal{B}}$$

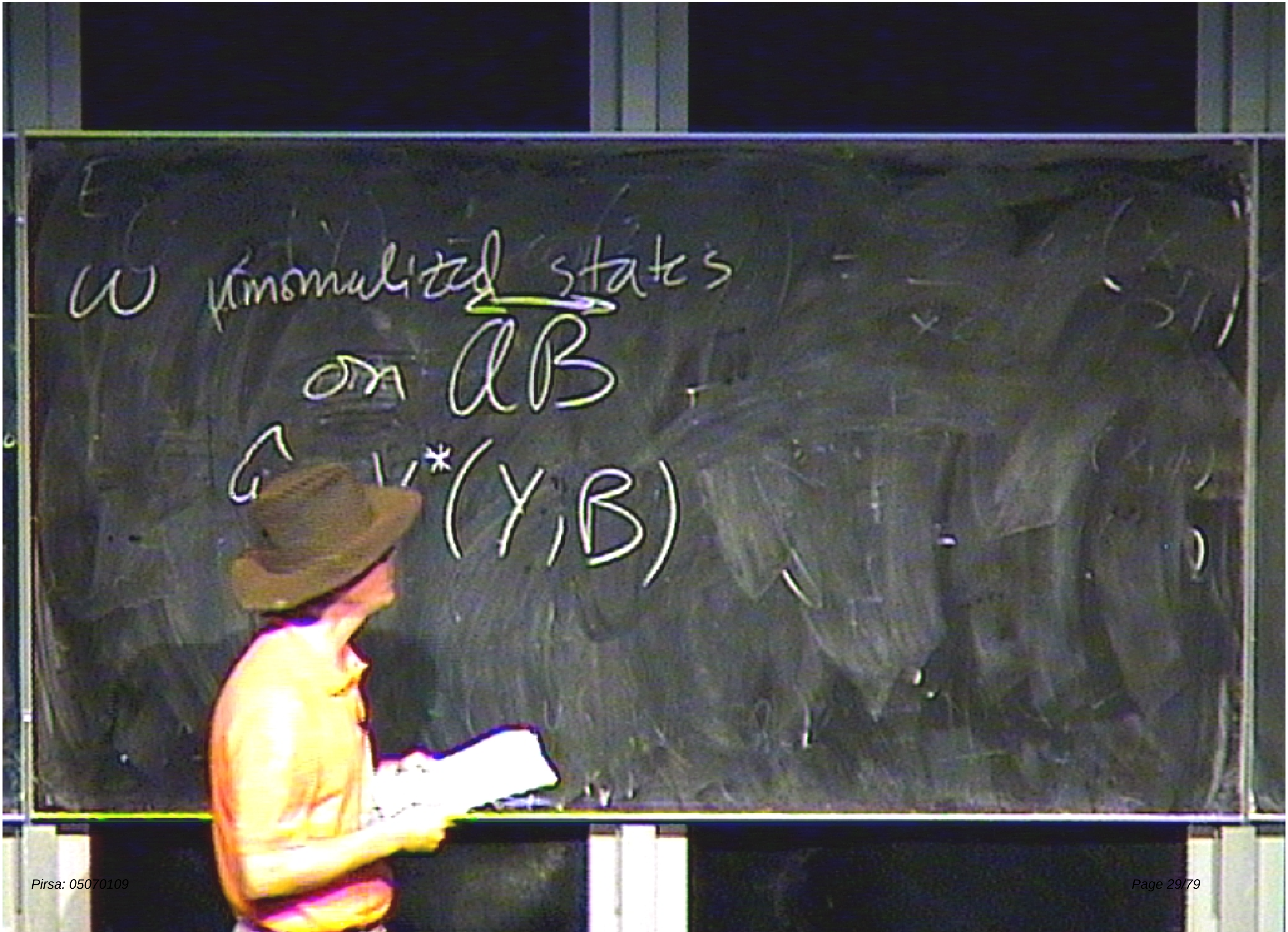
$$(X,\mathcal{A}) \text{ "}\times\text{" } (Y,\mathcal{B})$$

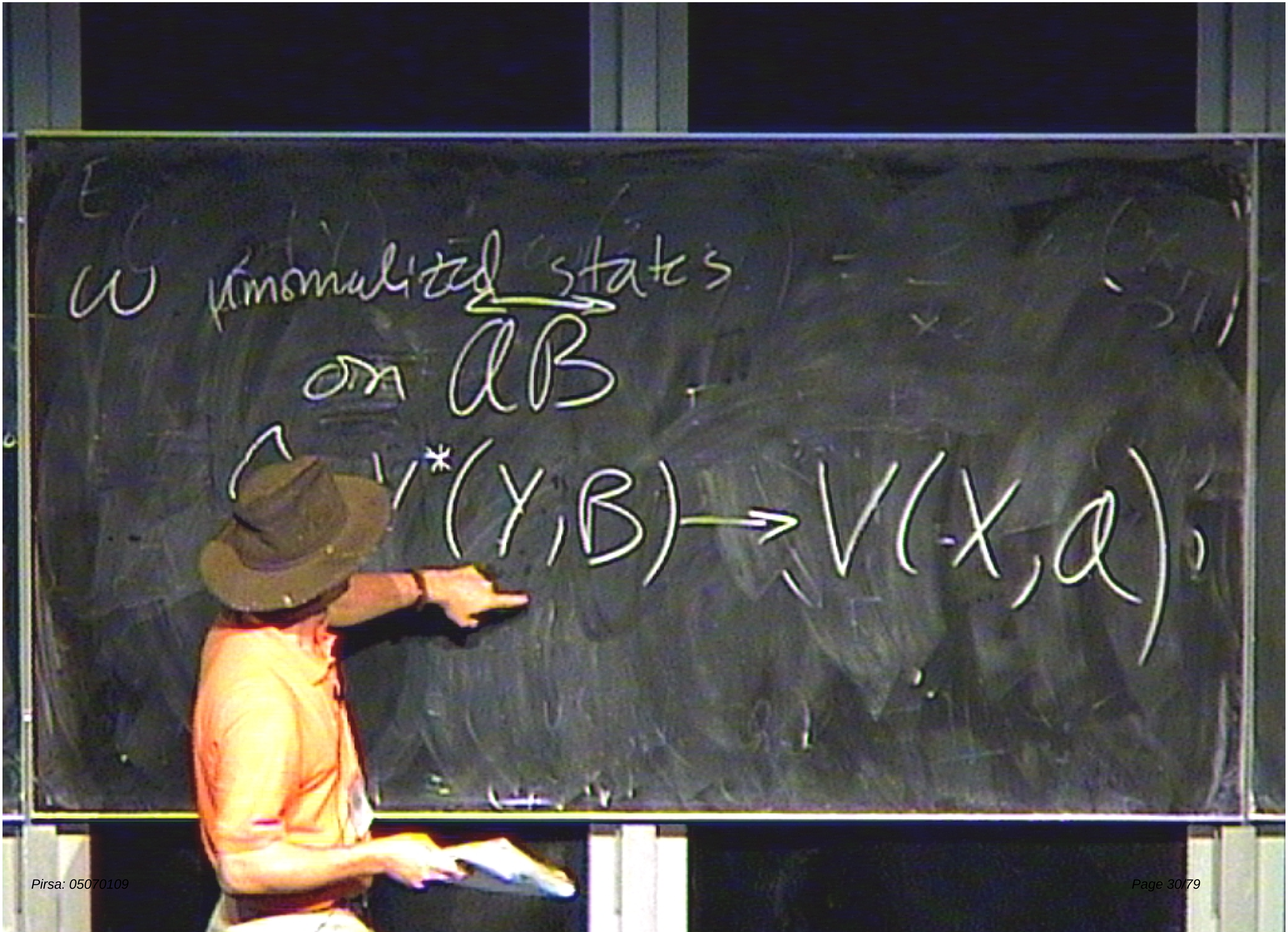
$$[0,1] \qquad \left(X \times Y, \mathcal{A} \times \mathcal{B}\right)$$

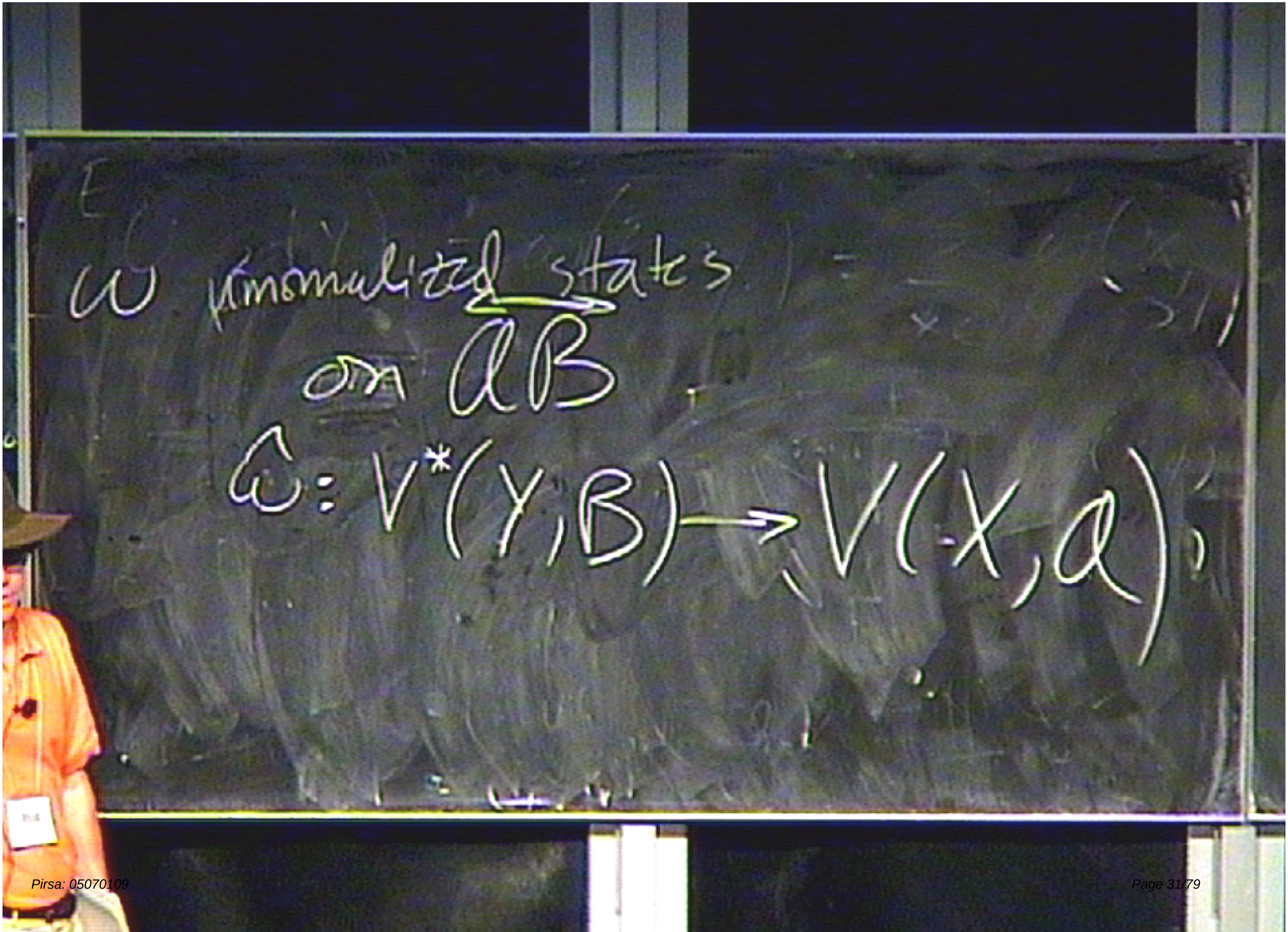
$$\overline{\mathcal{A}\mathcal{B}}$$




renormalized states
on AB


ω renormalized states
on AB
V*(Y,B)


states
on
(Y,B) → V(X,


ω renormalized states
on $\mathcal{A}\mathcal{B}$
$\hat{\omega}: V^*(Y,\mathcal{B}) \longrightarrow V(X,\mathcal{A})$.

ω unnormalized states on $\mathfrak{A}\mathfrak{B}$

$$\hat{\omega} : V^*(Y, \mathfrak{B}) \longrightarrow V(X, \mathfrak{A});$$

ω renormalized states on $\mathcal{A}\mathcal{B}$

$$\hat{\omega} : V^*(Y,\mathcal{B}) \longrightarrow V(X,\mathcal{A});$$

ω renormalized states on $\mathcal{A}\mathcal{B}$

$$\hat{\omega} : V^*(Y,\mathcal{B}) \to V(X,\mathcal{A}).$$

ω renormalized states on $\mathcal{A}\mathcal{B}$

$$\hat{\omega}: V^*(Y,\mathcal{B}) \longrightarrow V(X,\mathcal{A}).$$

ω renormalized states on $\mathcal{A}\mathcal{B}$

$$\hat{\omega} : V^*(Y, \mathcal{B}) \longrightarrow V(X, \mathcal{A});$$

ω renormalized states

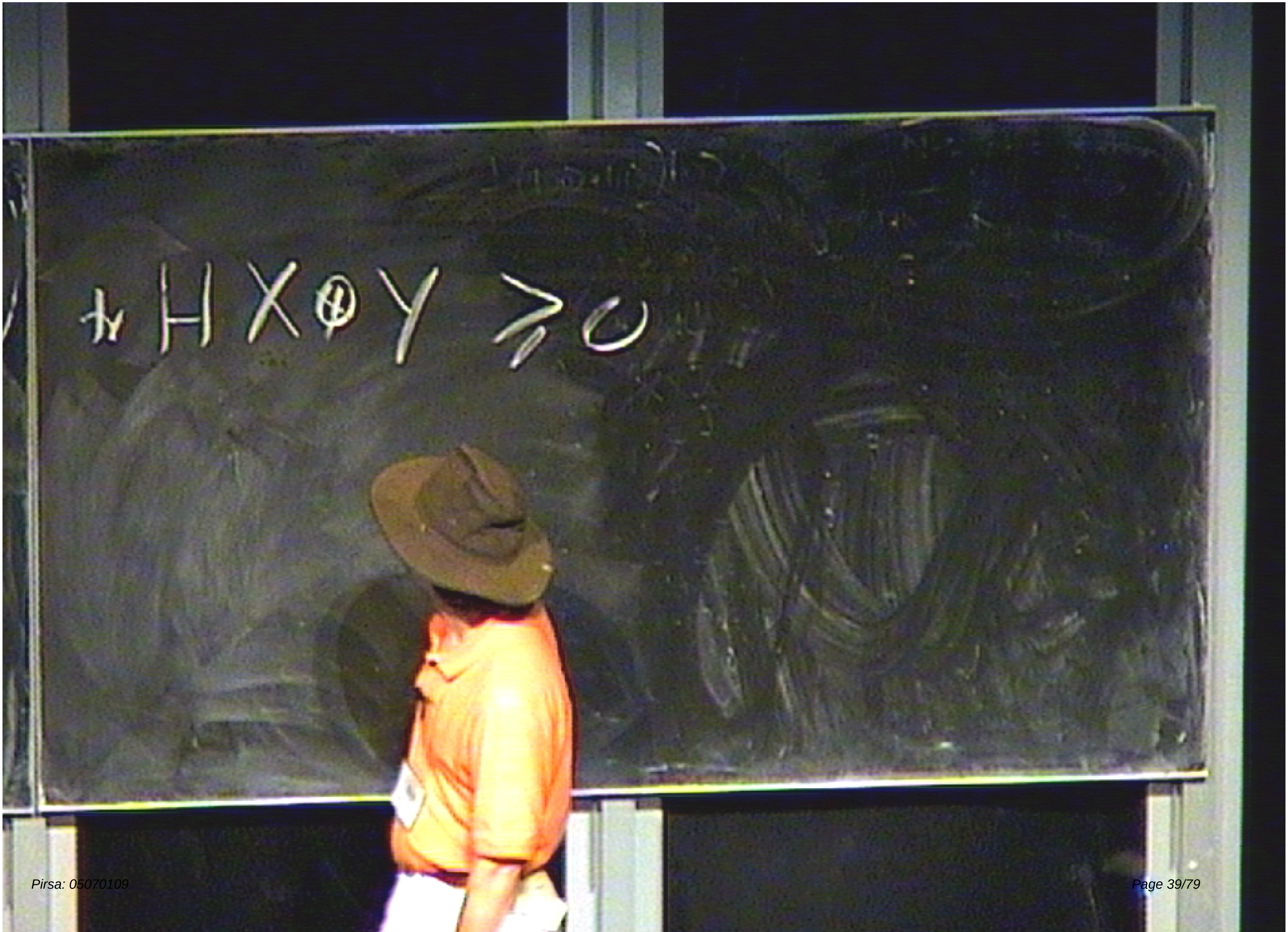
on $\mathcal{A}\mathcal{B}$

$$\hat{\omega} : V^*(Y,\mathcal{B}) \longrightarrow V(X,\mathcal{A})$$

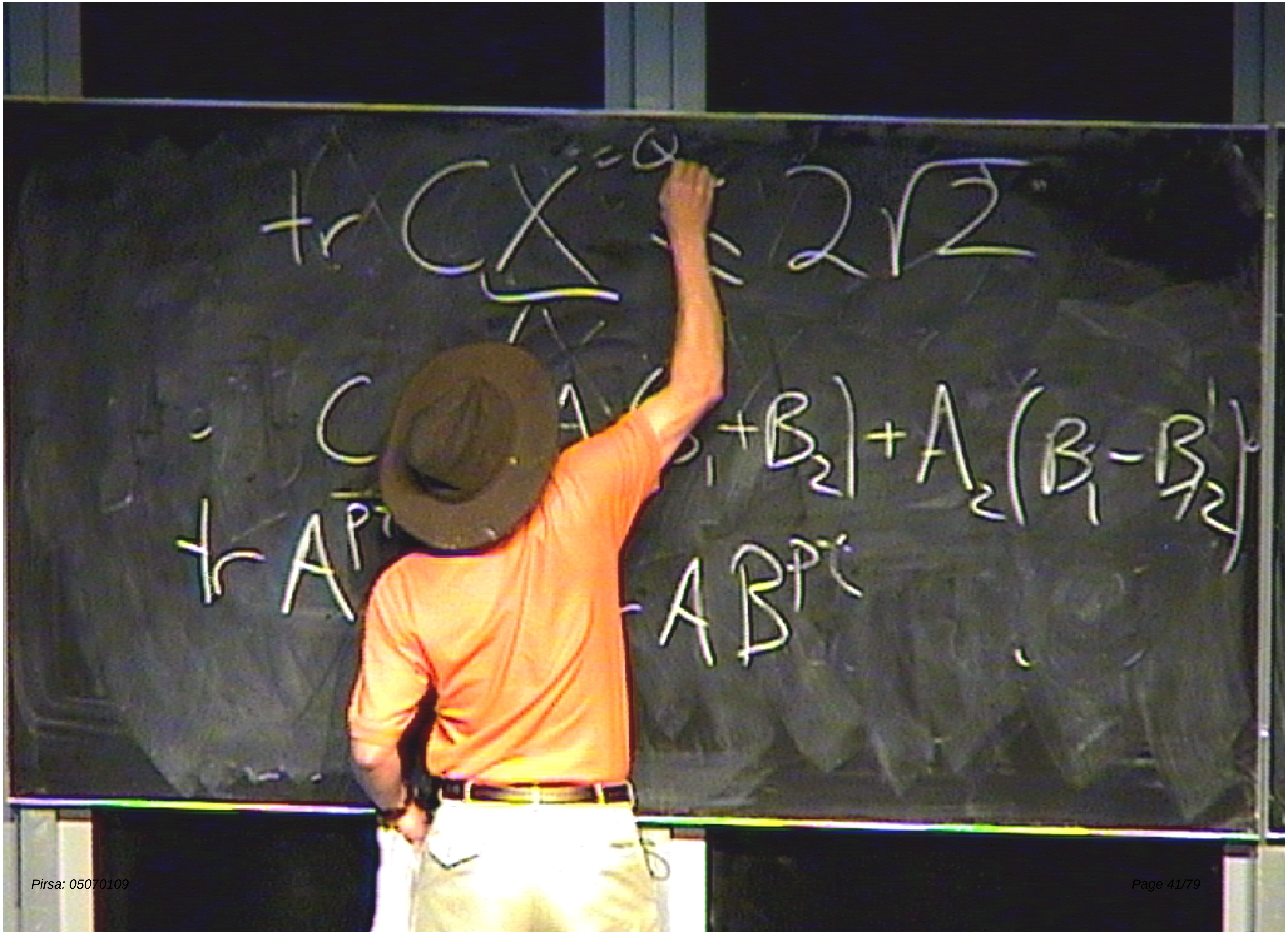
ω renormalized states

on $\mathcal{A}\mathcal{B}$

$$\hat{\omega} : V^*(Y, \mathcal{B}) \longrightarrow V(X, \mathcal{A})$$


tr H X⊗Y ≥ 0

$$\mathrm{tr}\, H\, X \otimes Y \geq 0$$



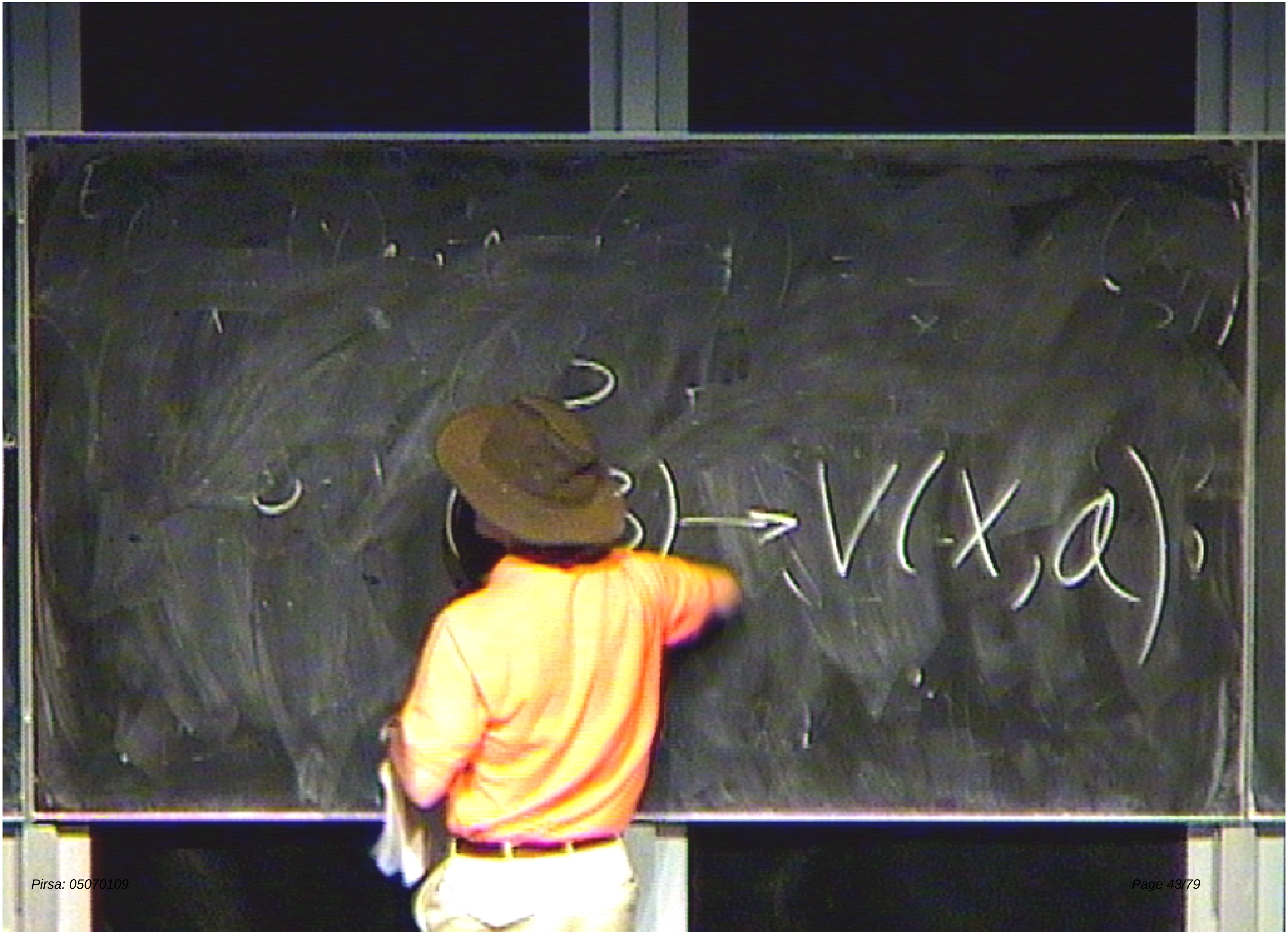
$$\mathrm{tr}\, C X \le 2\sqrt{2}$$

$$X = Q^{pt}$$

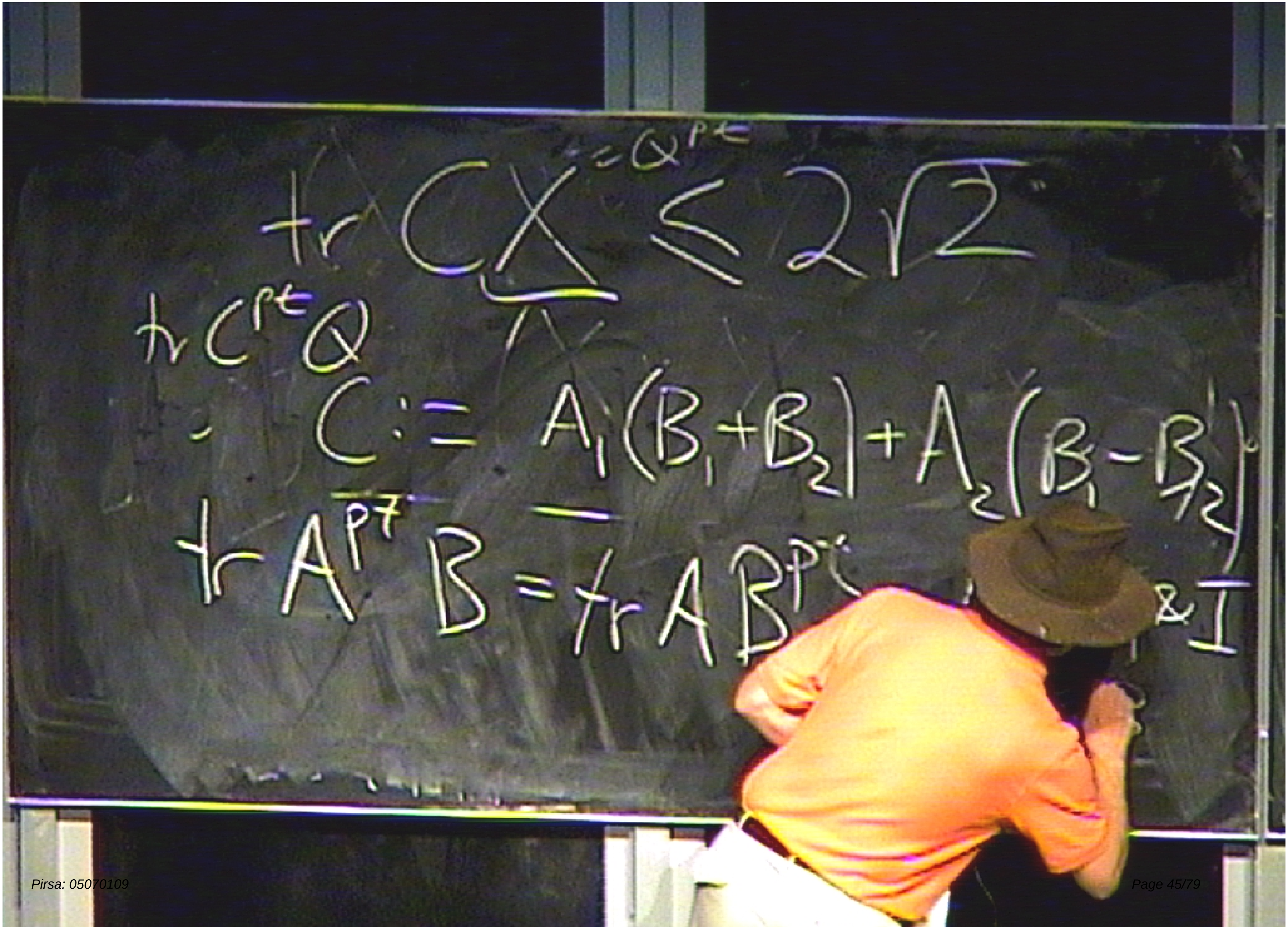
$$\mathrm{tr}\, C^{pt} Q$$

$$C := A_1(B_1 + B_2) + A_2(B_1 - B_2)$$

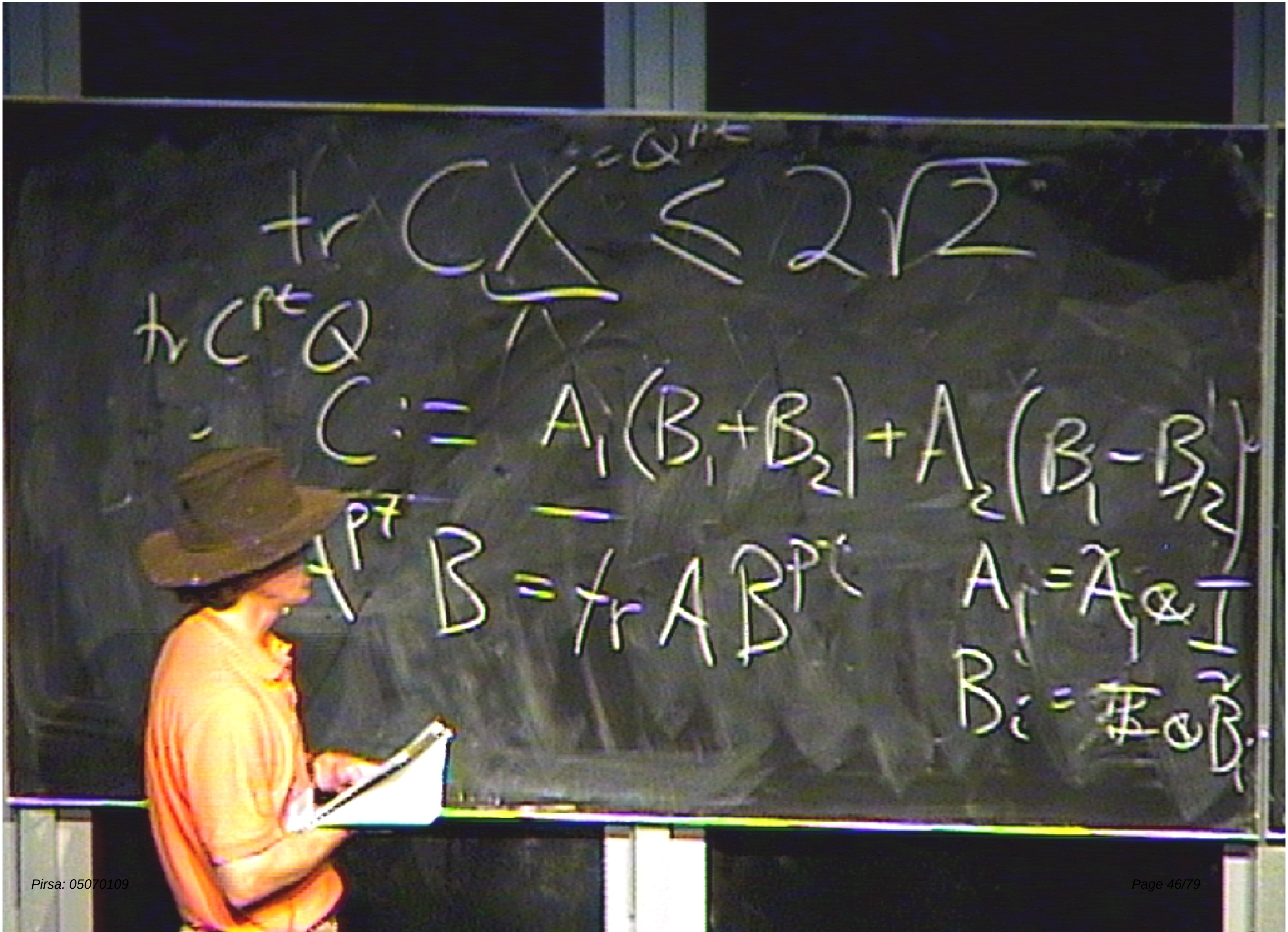
$$\mathrm{tr}\, A^{pt} B = \mathrm{tr}\, A B^{pt}$$


V(x,a)

$\to V(X, a)$



tr C X ≤ 2√2
=Q^pt
tr C^pt Q
C := A1(B1+B2) + A2(B1−B2)
tr A^pT B = tr A B^pT



$\mathrm{tr}\, C X \leq 2\sqrt{2}$
$= Q^{pt}$
$\mathrm{tr}\, C^{pt} Q$
$C := A_1(B_1 + B_2) + A_2(B_1 - B_2)$
$B = \mathrm{tr}\, A B^{pt}$
$A_1 = A_1 \otimes I$
$B_i = I \otimes B_i$

$$\mathrm{tr}\, C \underbrace{X}_{} \leq 2\sqrt{2} \qquad X = Q^{pt}$$

$$\mathrm{tr}\, C^{pt} Q$$

$$C := A_1(B_1 + B_2) + A_2(B_1 - B_2)$$

$$\mathrm{tr}\, A^{pT} B = \mathrm{tr}\, A B^{pT}$$

$$A_i = \tilde{A}_i \otimes I$$

$$B_i = I \otimes \tilde{B}_i$$

$$\operatorname{tr} C X \leq 2\sqrt{2} \qquad X = Q^{pt}$$

$$\operatorname{tr} C^{pt} Q$$

$$C := A_1(B_1 + B_2) + A_2(B_1 - B_2)$$

$$\operatorname{tr} A^{pt} B = \operatorname{tr} A B^{pt}$$

$$A_i = \tilde{A}_i \otimes I$$

$$B_i = I \otimes \tilde{B}_i$$

$$\operatorname{tr} C \underbrace{X}_{} \leq 2\sqrt{2} \qquad X = Q^{pt}$$

$$\operatorname{tr} C^{pt} Q$$

$$C := A_1(B_1 + B_2) + A_2(B_1 - B_2)$$

$$\operatorname{tr} A^{pT} B = \operatorname{tr} A B^{pT}$$

$$A_i = \tilde{A}_i \otimes I$$

$$B_i = I \otimes \tilde{B}_i$$

$$\operatorname{tr} C X^{=Q^{pt}} \leq 2\sqrt{2}$$

$$\operatorname{tr} C^{pt} Q$$

$$C := A_1(B_1 + B_2) + A_2(B_1 - B_2)$$

$$\operatorname{tr} A^{pT} B = \operatorname{tr} A B^{pT}$$

$$A_i = \tilde{A}_i \otimes I$$

$$B_i = I \otimes \tilde{B}_i$$

$$\operatorname{tr} C X \leq 2\sqrt{2} \qquad X = Q^{pt}$$

$$\operatorname{tr} C^{pt} Q$$

$$C := A_1(B_1 + B_2) + A_2(B_1 - B_2)$$

$$\operatorname{tr} A^{pT} B = \operatorname{tr} A B^{pT}$$

$$A_i = \tilde{A}_i \otimes I$$

$$B_i = I \otimes \tilde{B}_i$$

$$\operatorname{tr} C X \leq 2\sqrt{2}$$

$X = Q^{pt}$

$$\operatorname{tr} C^{pt} Q$$

$$C := A_1(B_1 + B_2) + A_2(B_1 - B_2)$$

$$\operatorname{tr} A^{pt} B = \operatorname{tr} A B^{pt}$$

$$A_i = \tilde{A}_i \otimes I$$

$$B_i = I \otimes \tilde{B}_i$$

$\mathrm{tr}\, H\, X \otimes Y \geq 0$

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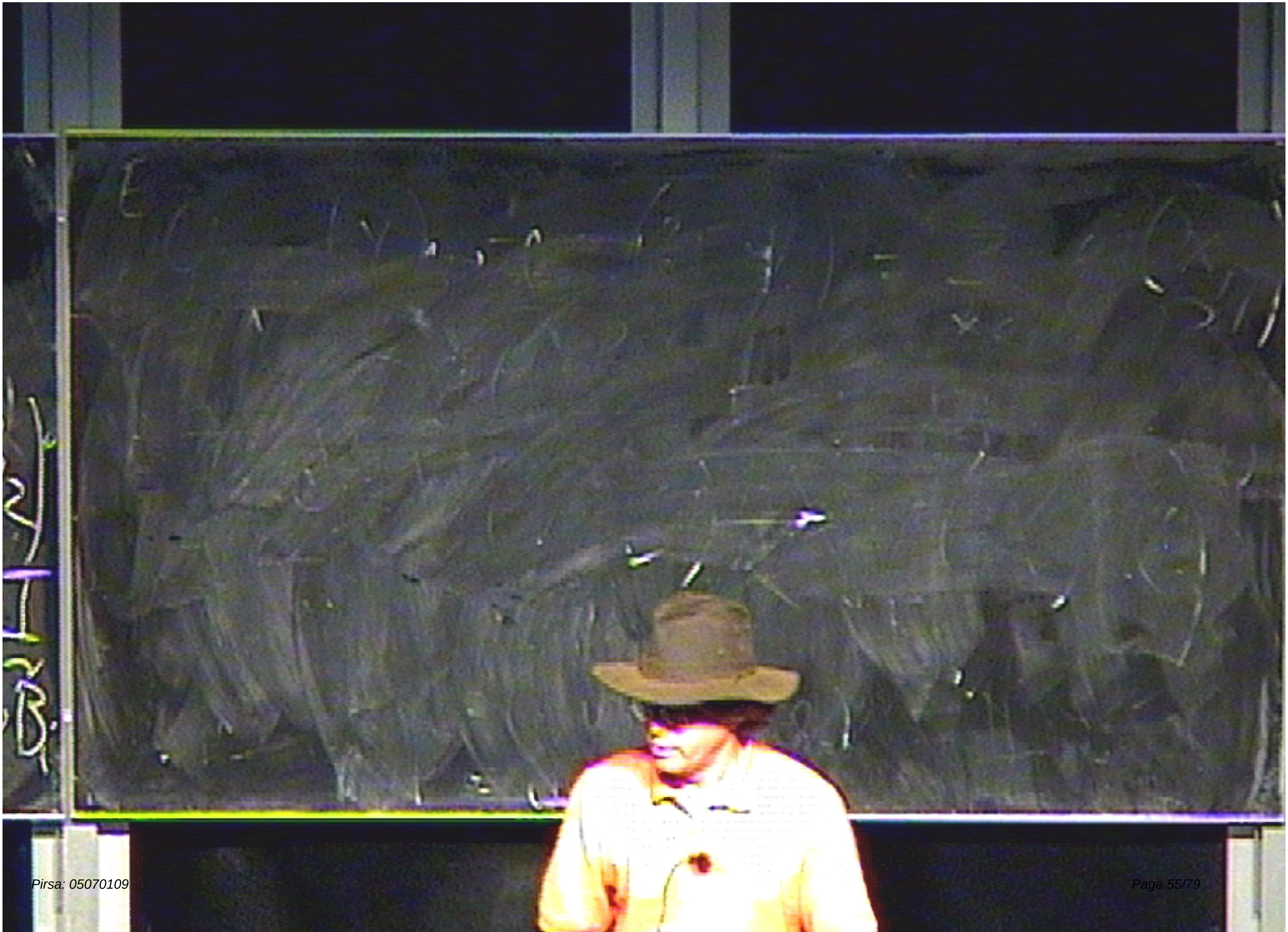
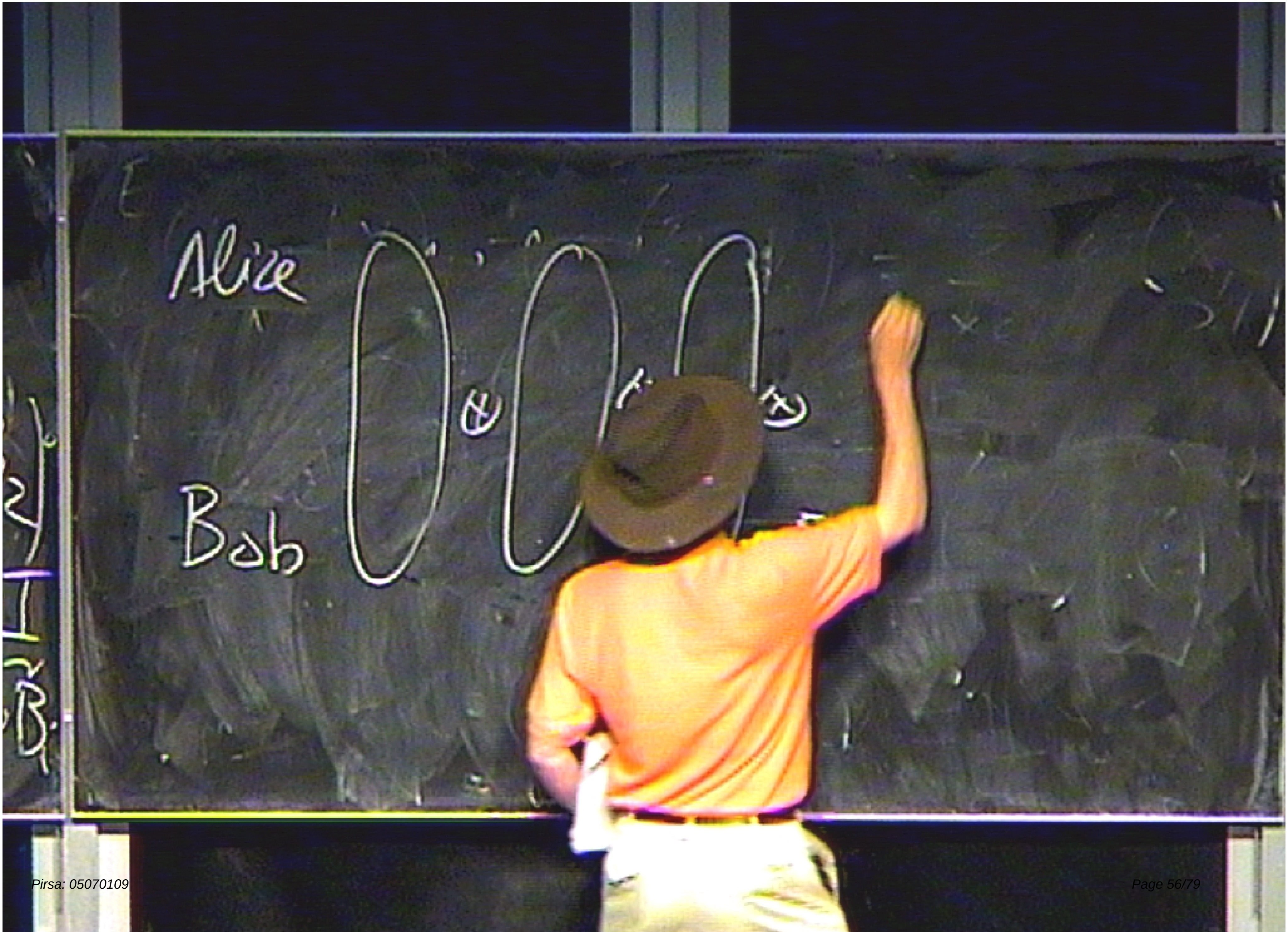
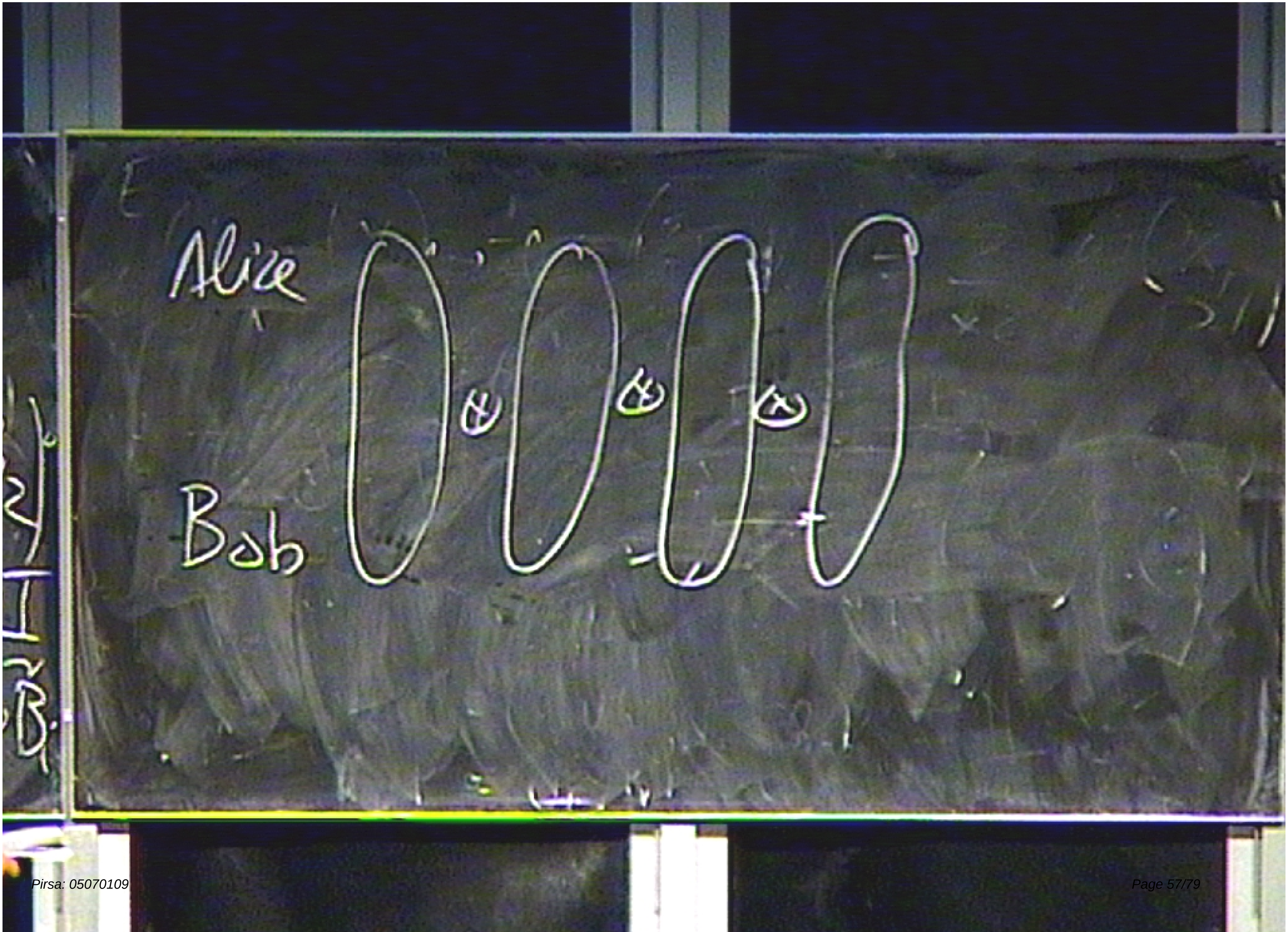
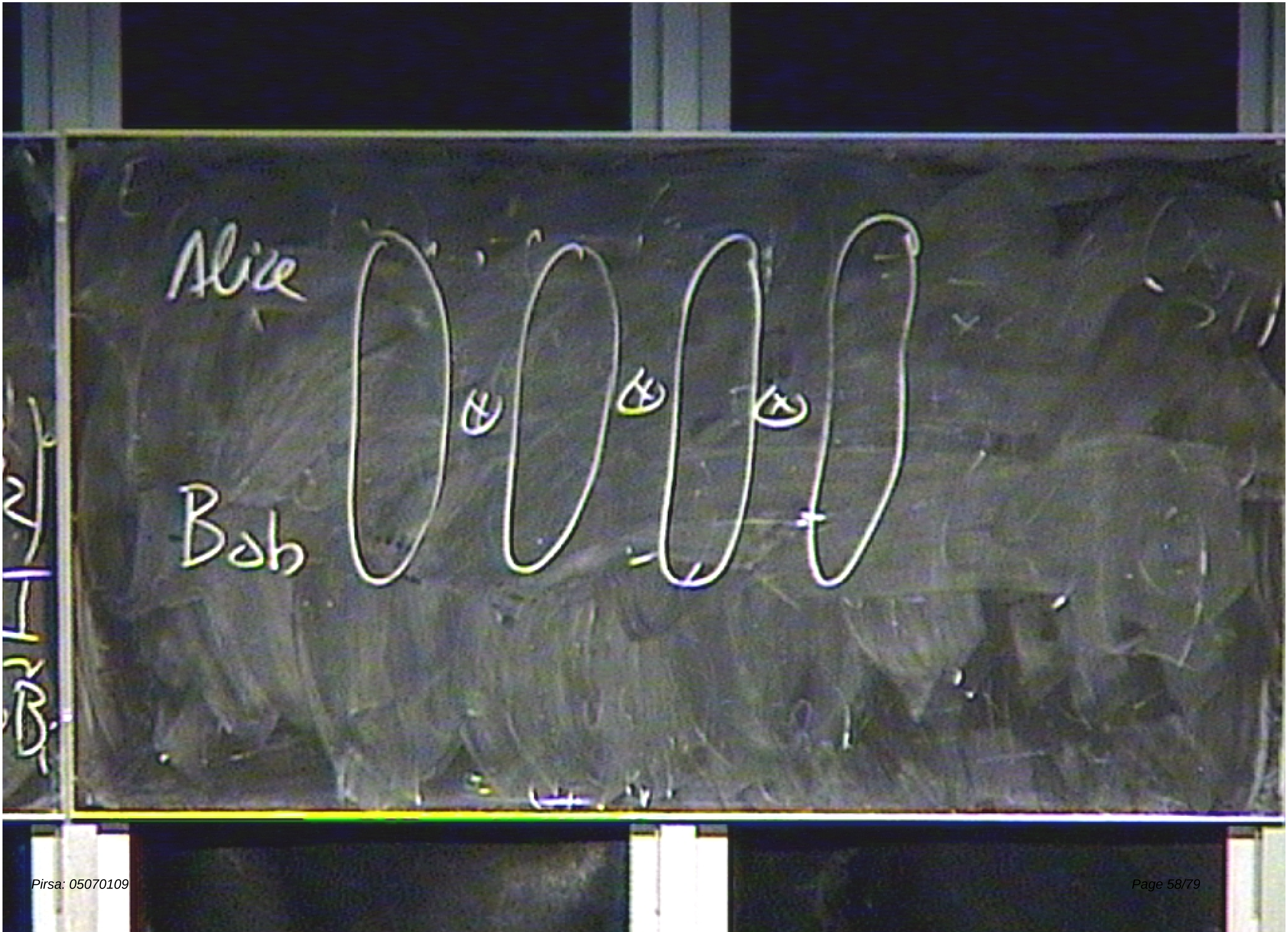
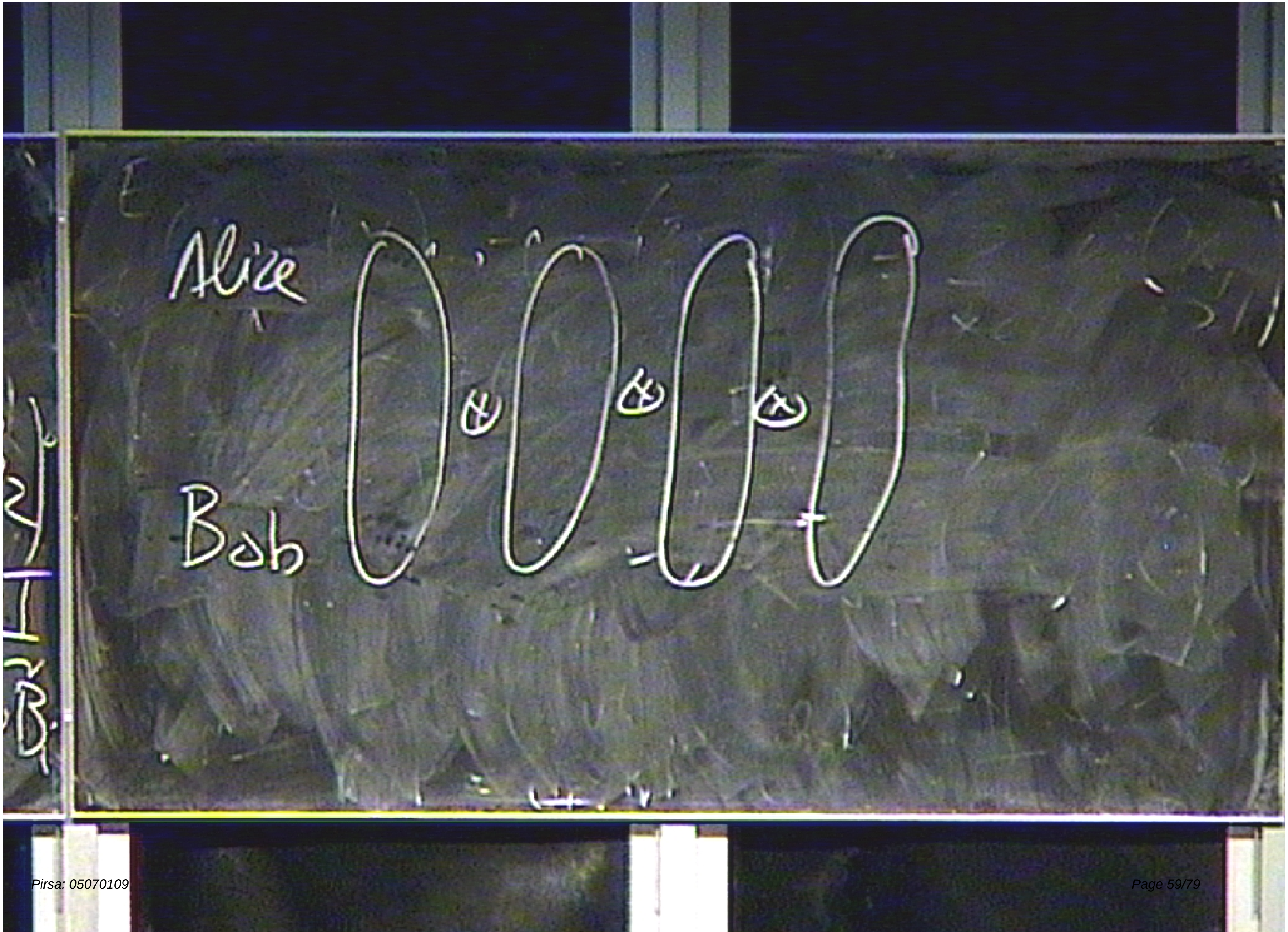
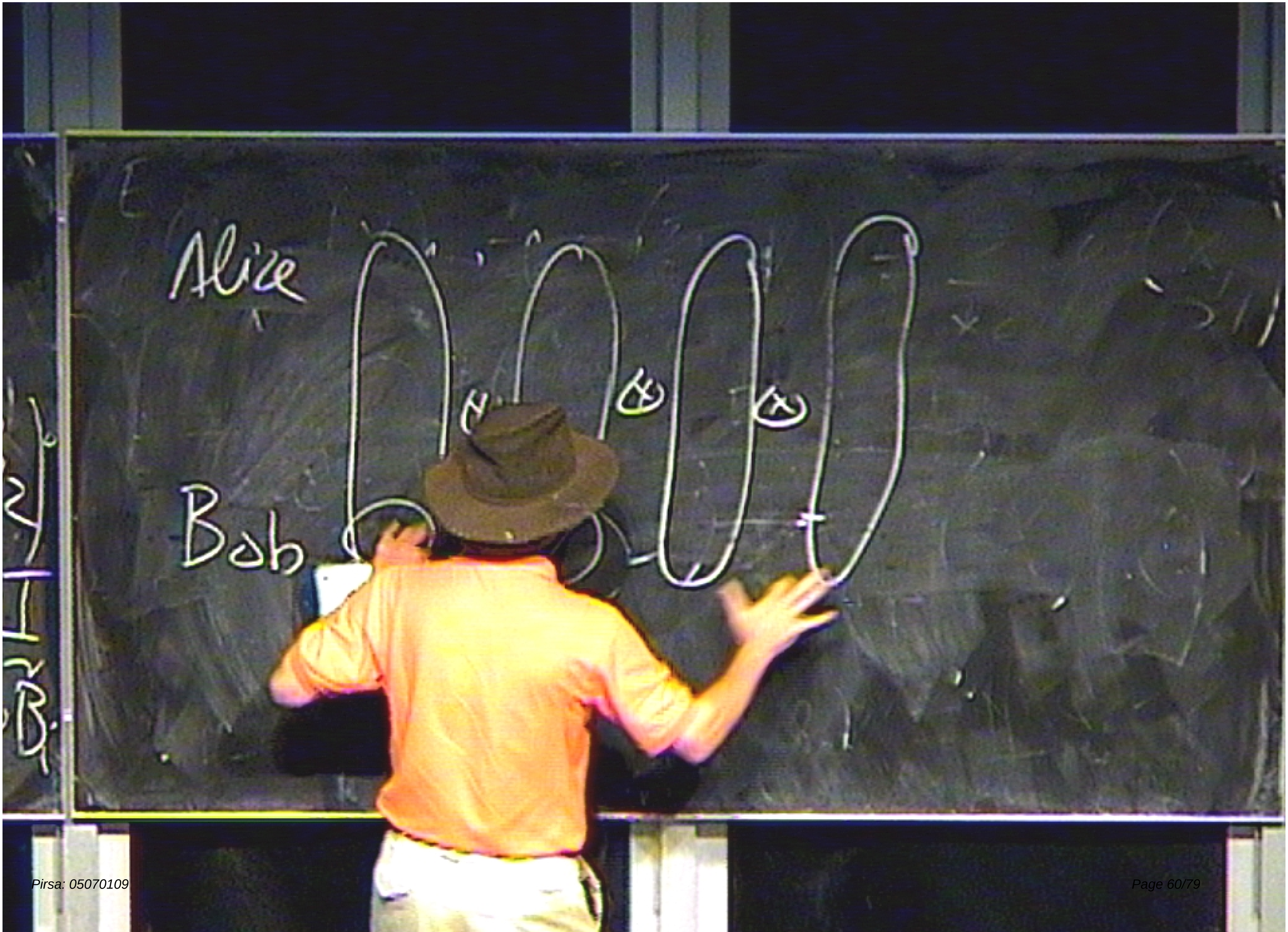


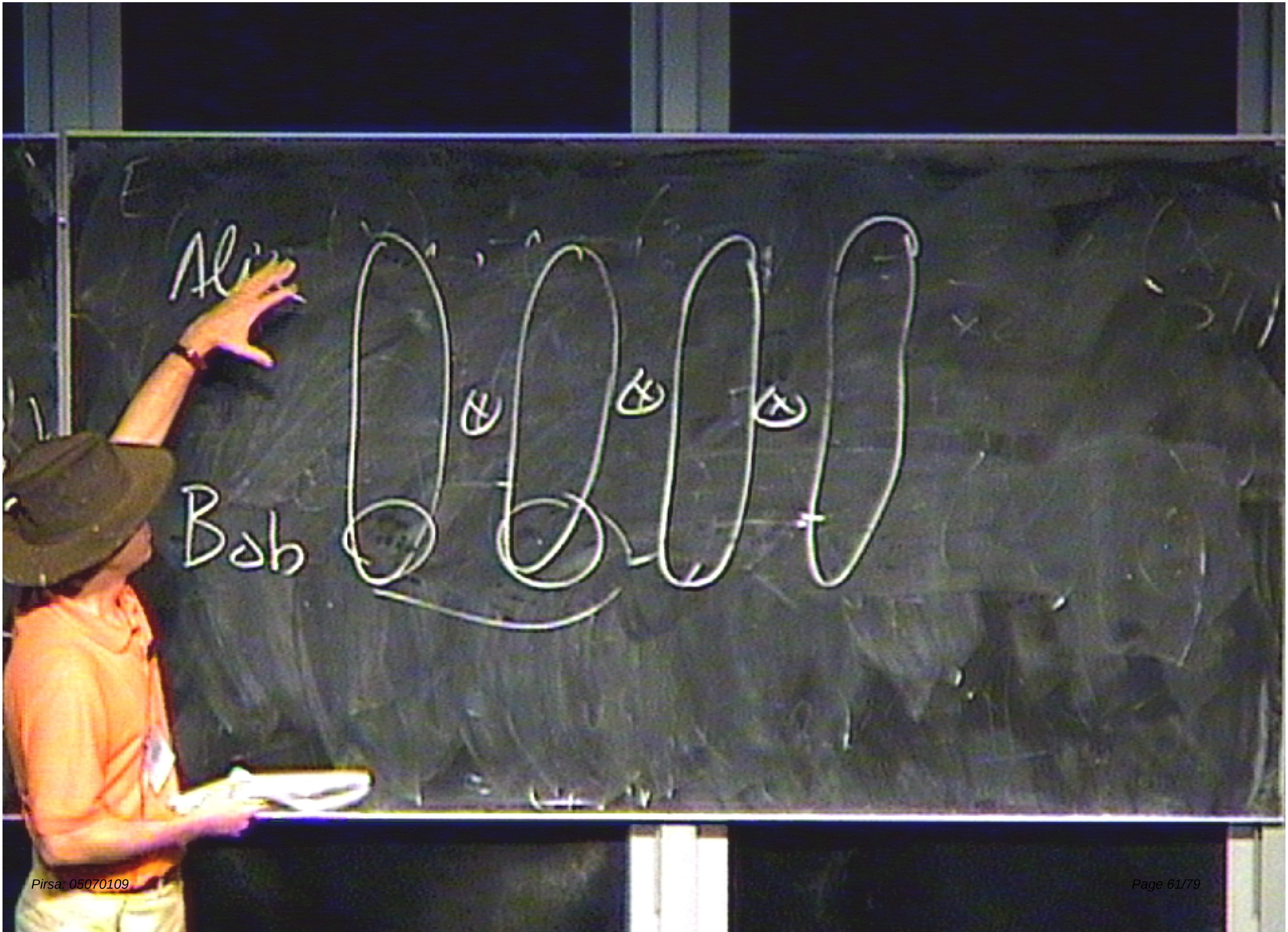

Alice
Bob

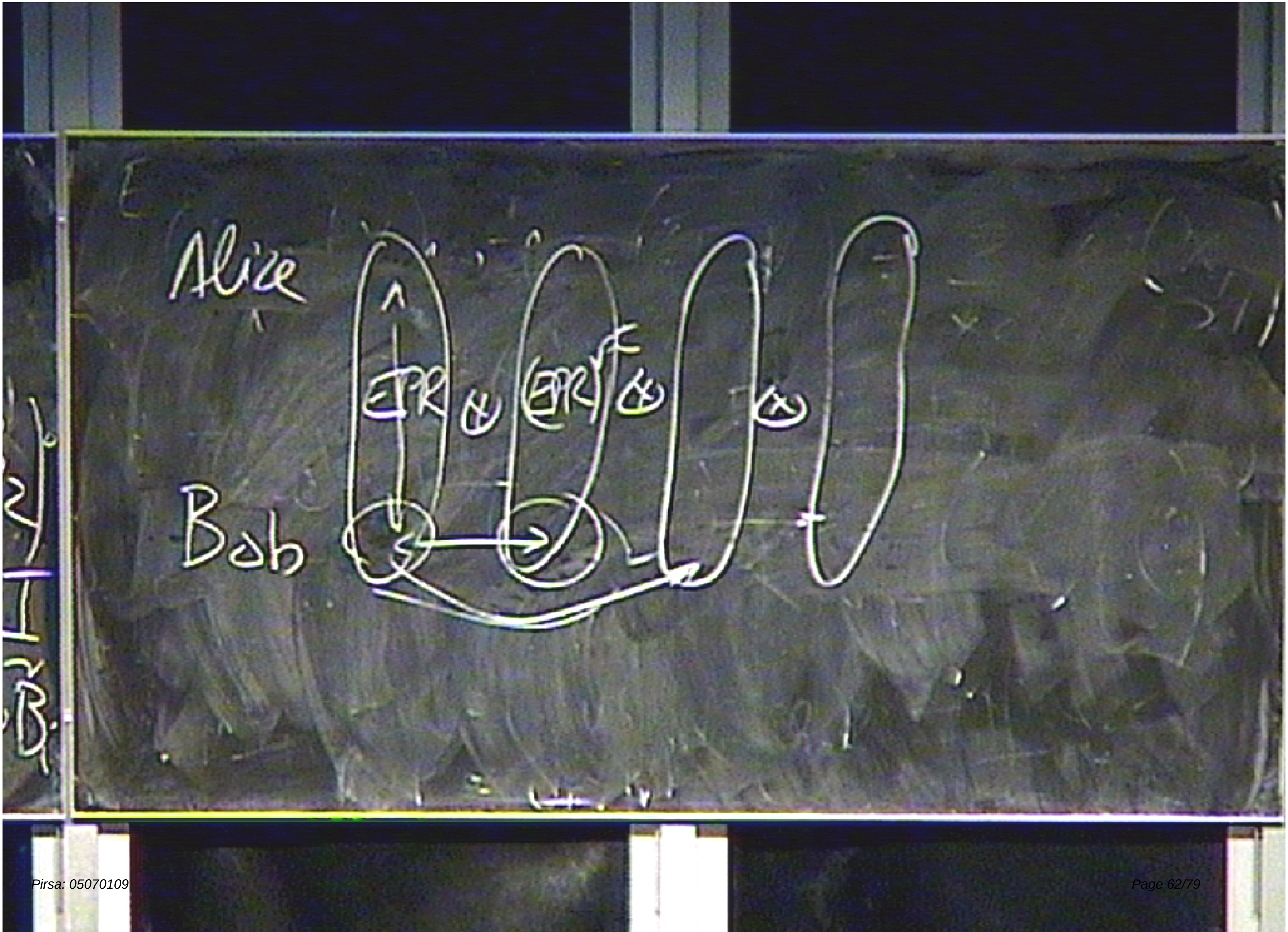

Alice
Bob

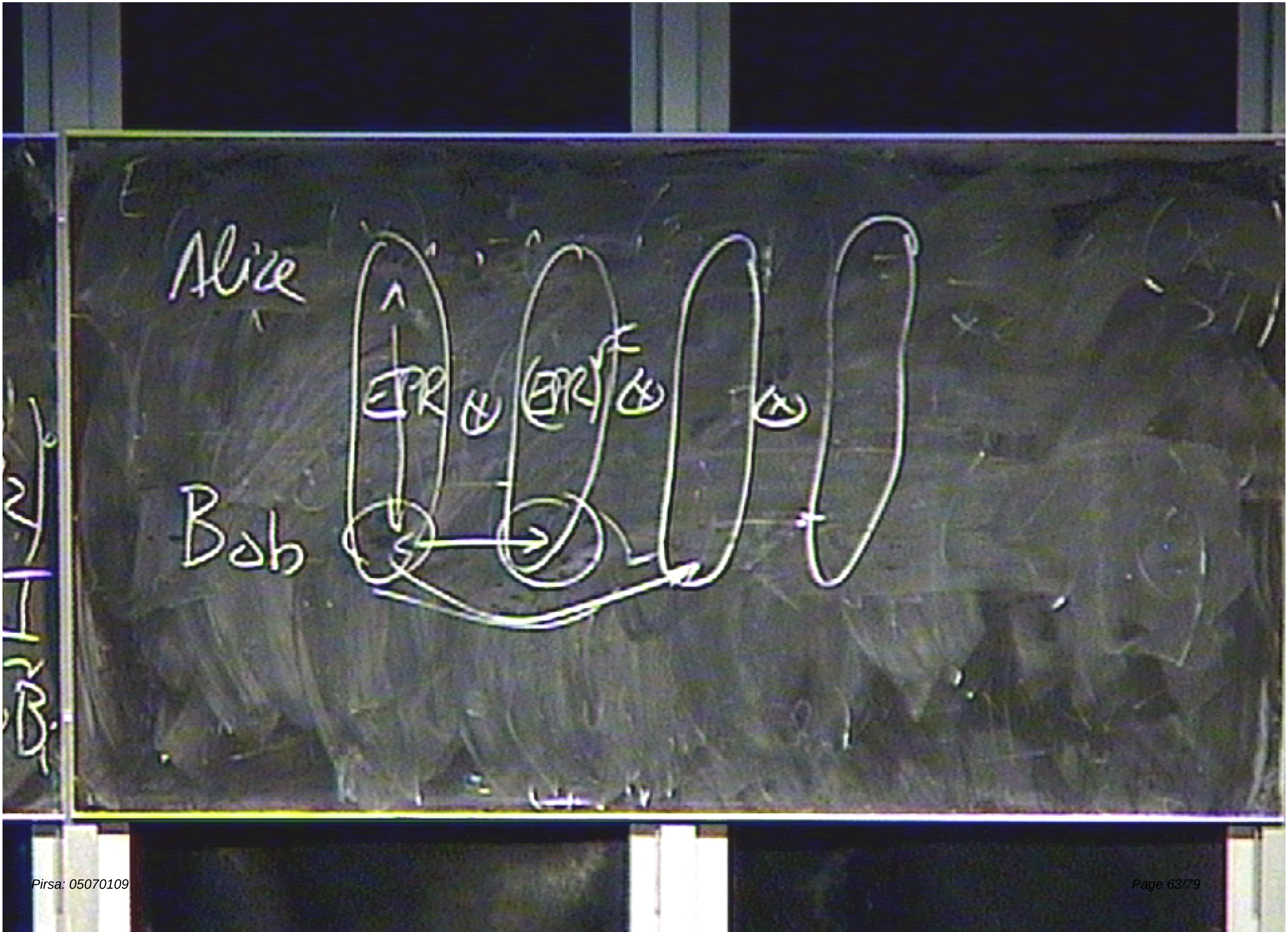

Alice
Bob

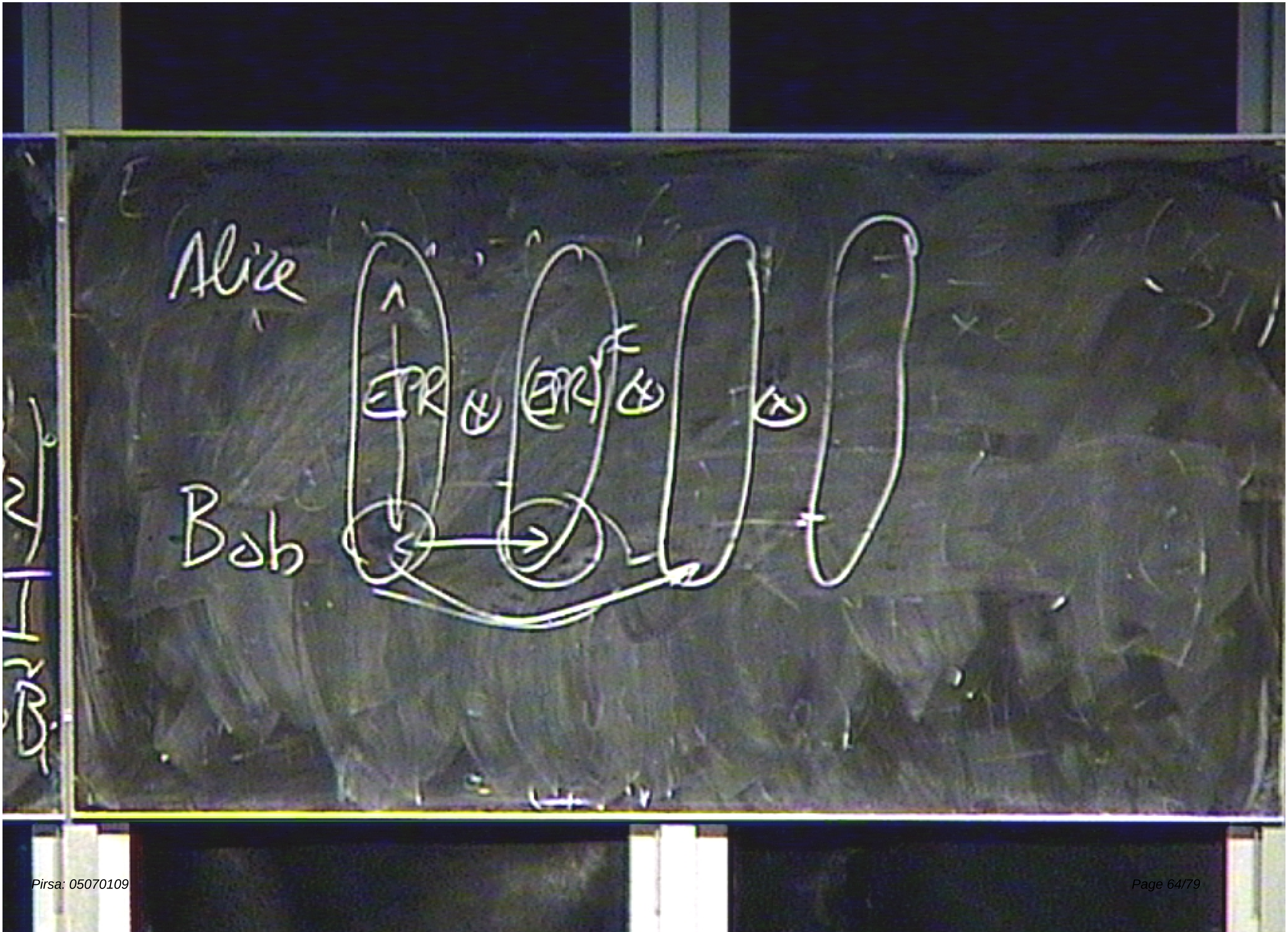

Alice
Bob

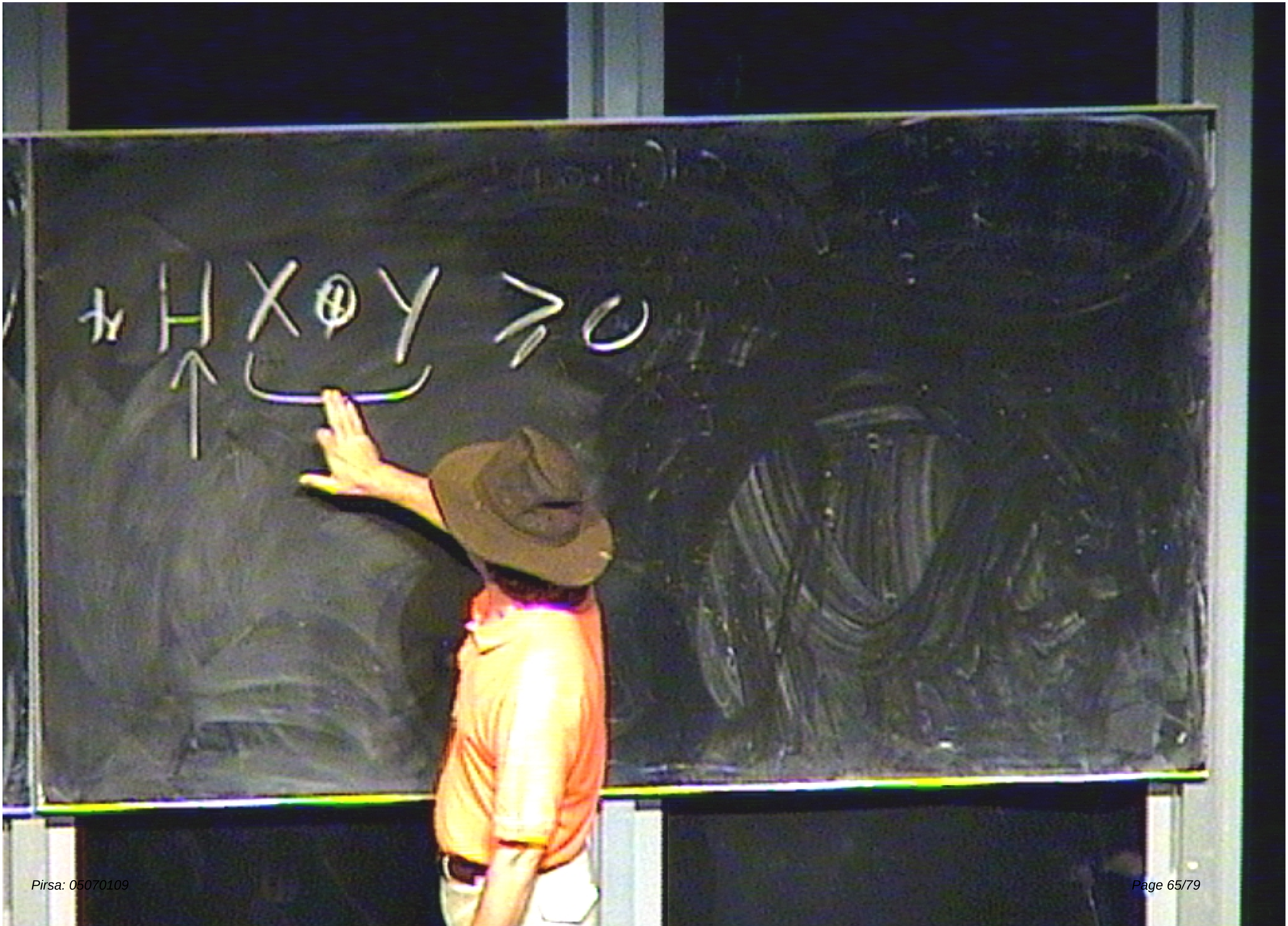

Alice
Bob


Alice
Bob

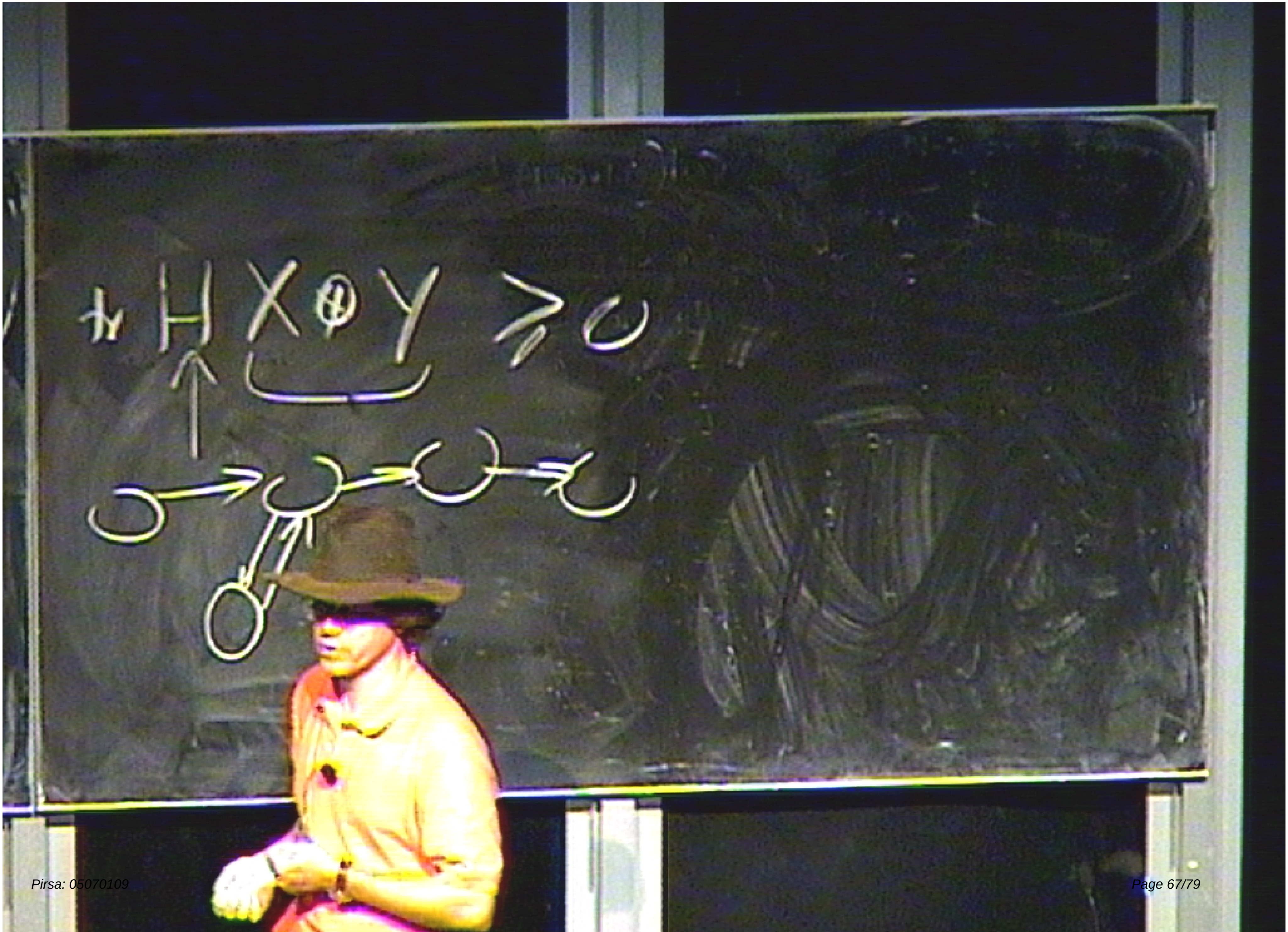

Alice
EPR ⊗ EPR ⊗ ⊗
Bob

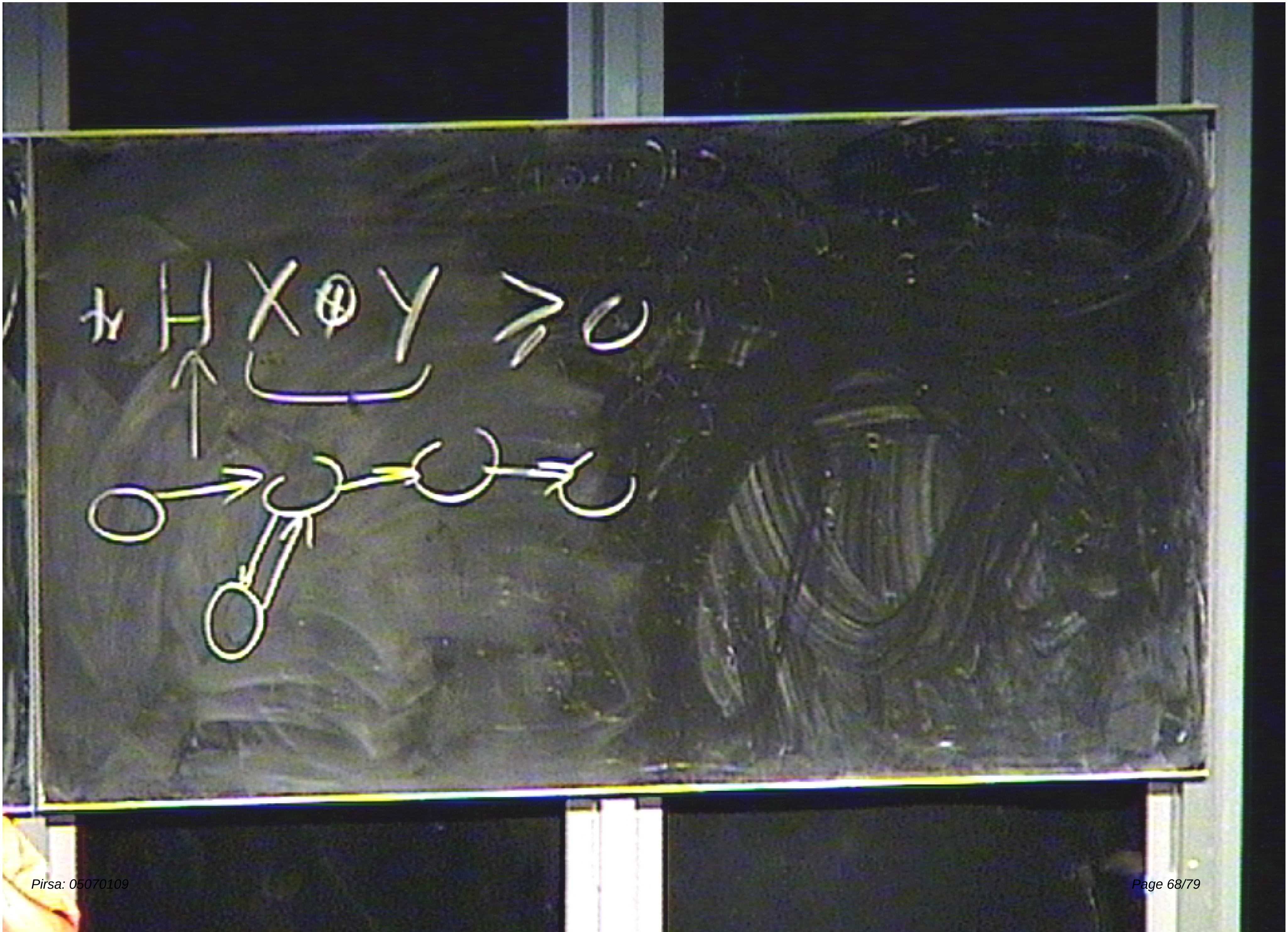

Alice
EPR
EPR
Bob


Alice
EPR ⊗ EPR ⊗
Bob


H X ⊗ Y ≥ 0

$$\mathrm{tr}\, H \underbrace{X \otimes Y} \geq 0$$


tr H X⊗Y ≥ 0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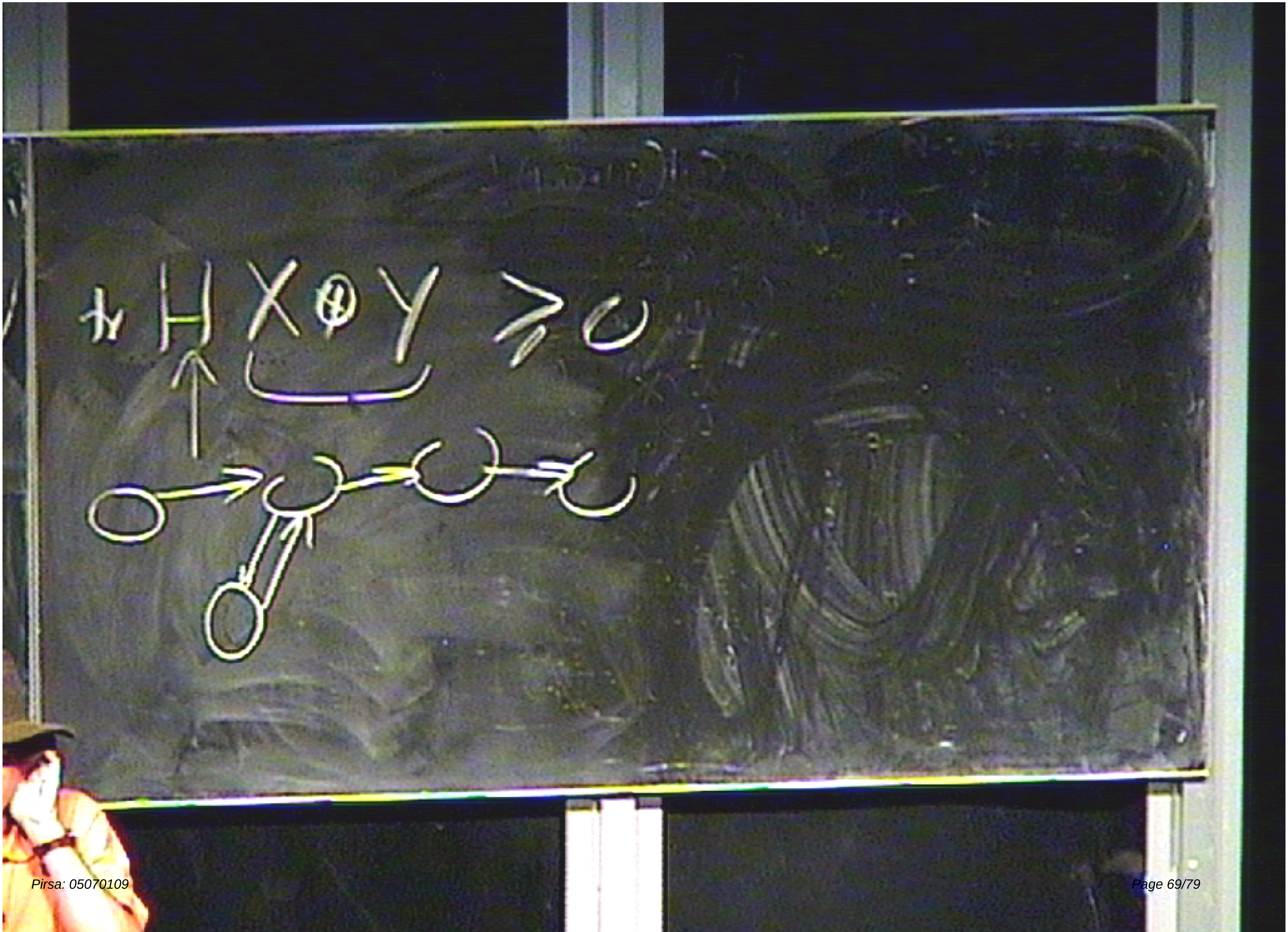
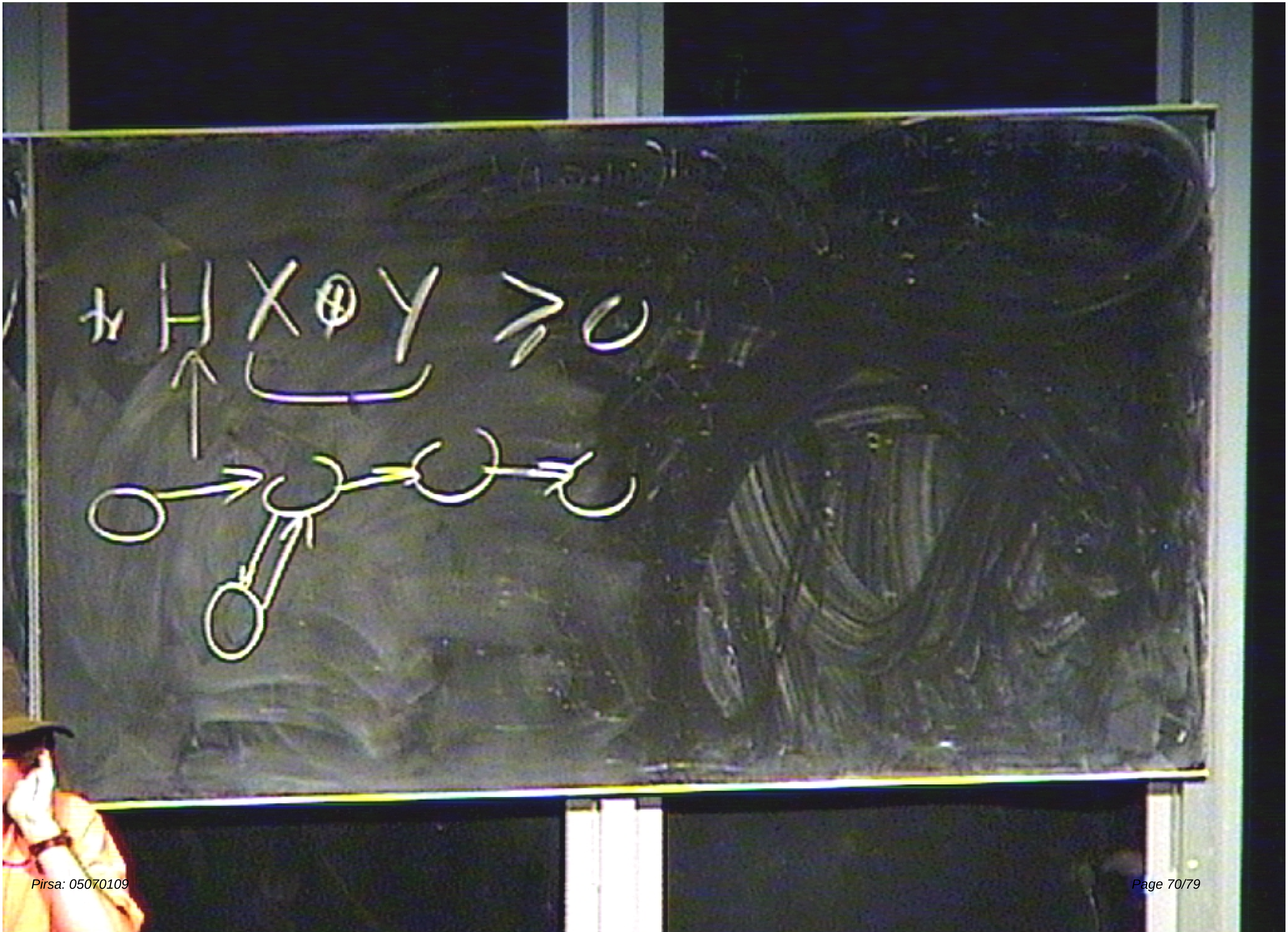
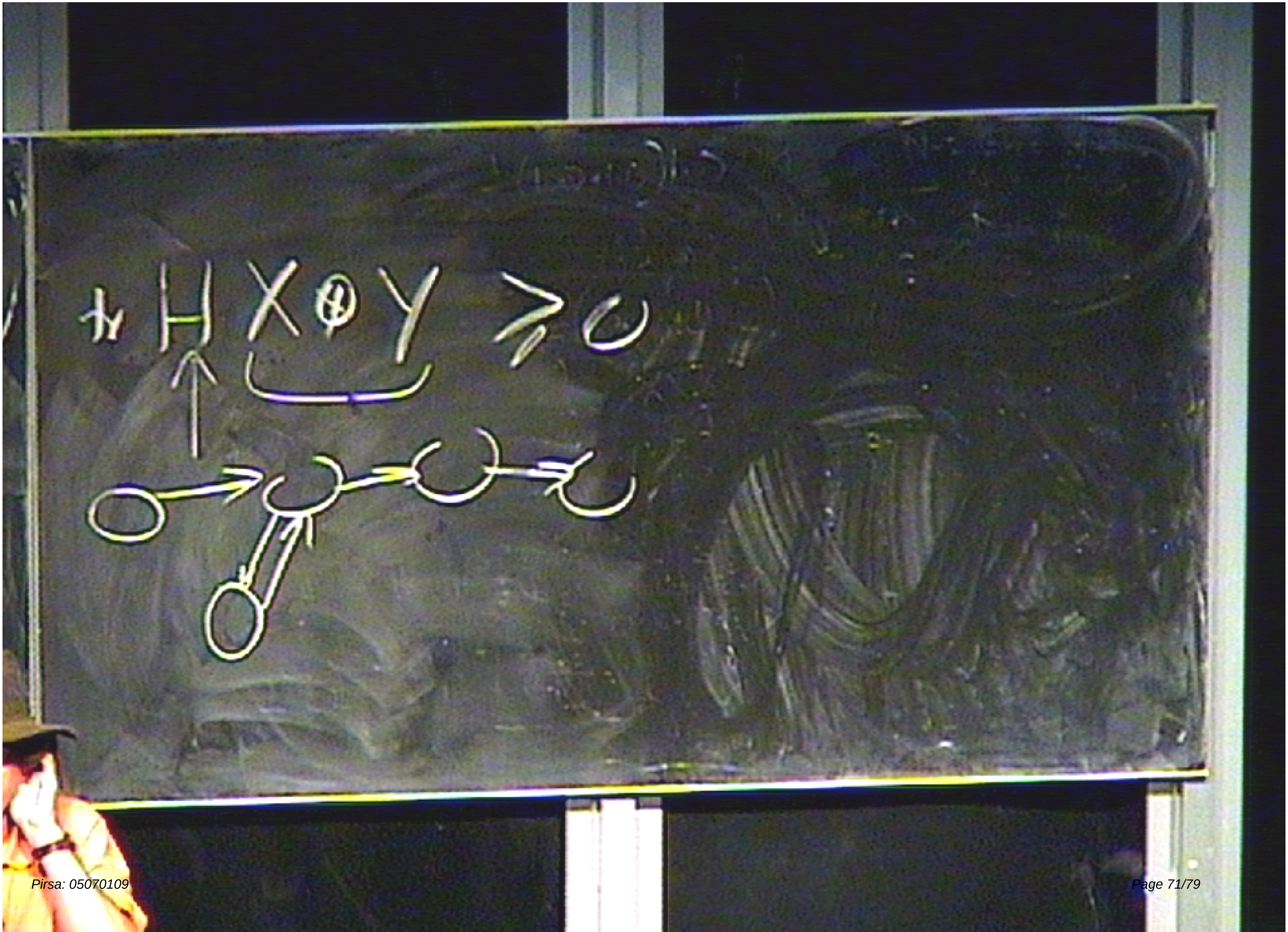
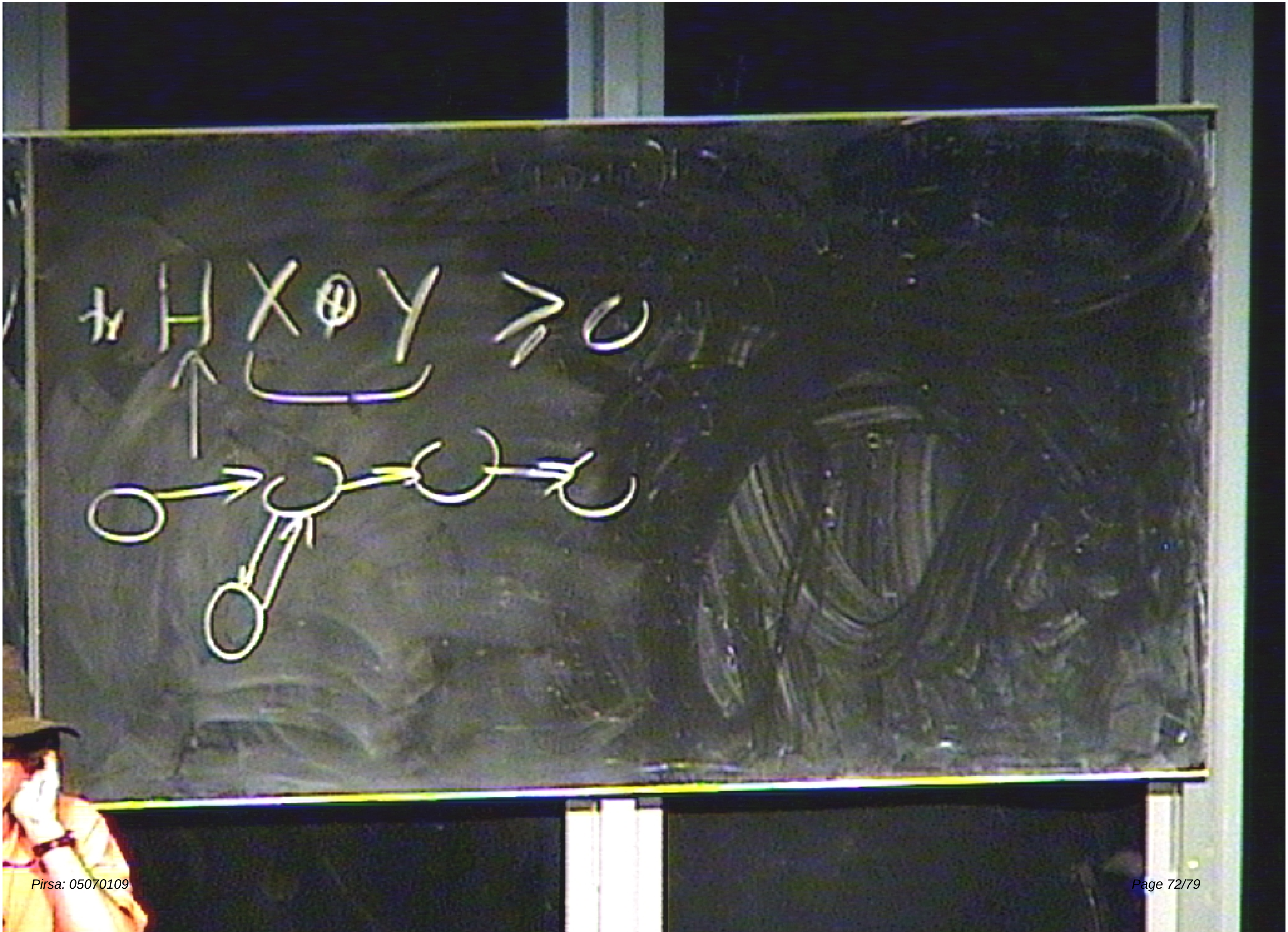
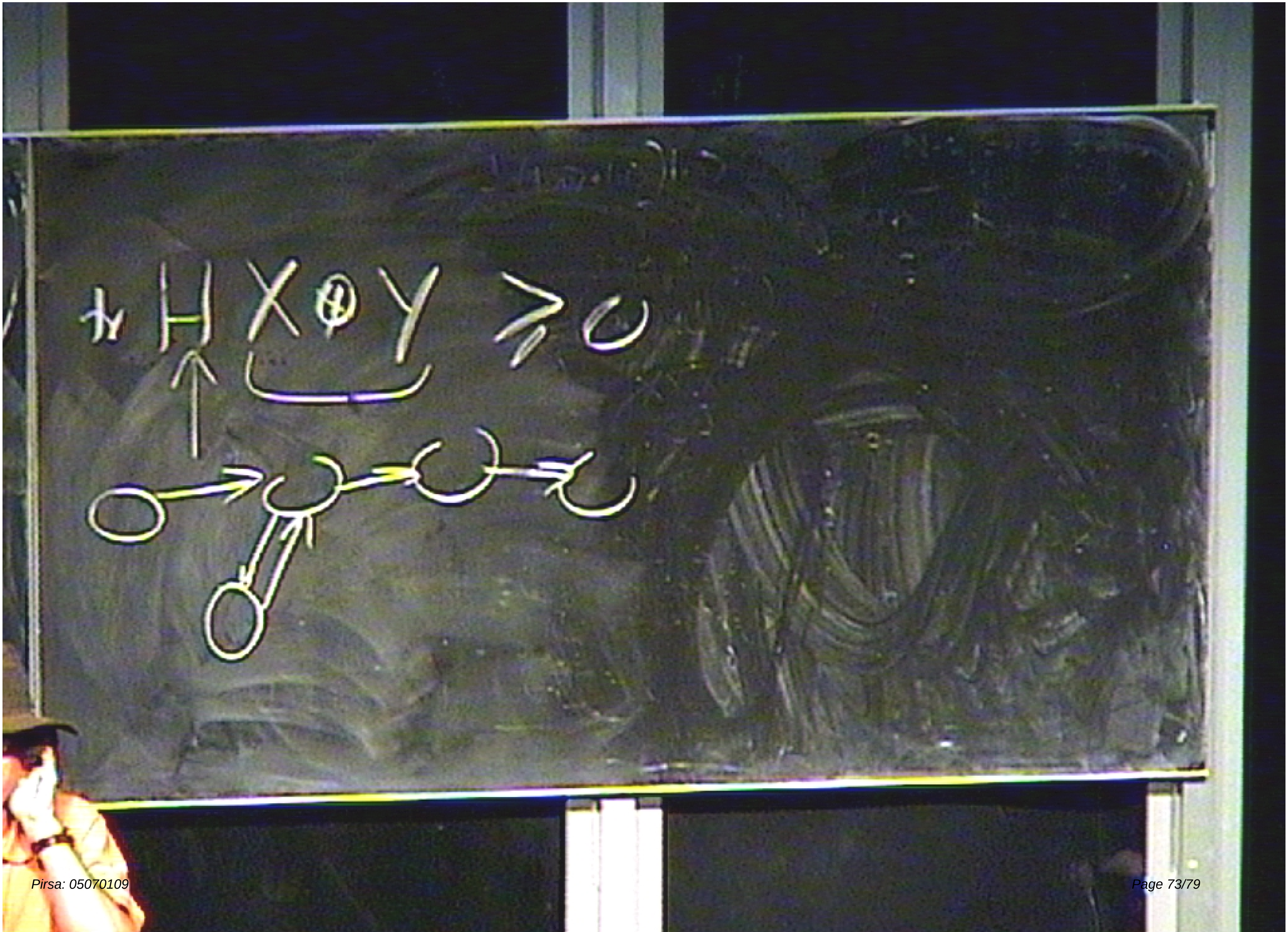
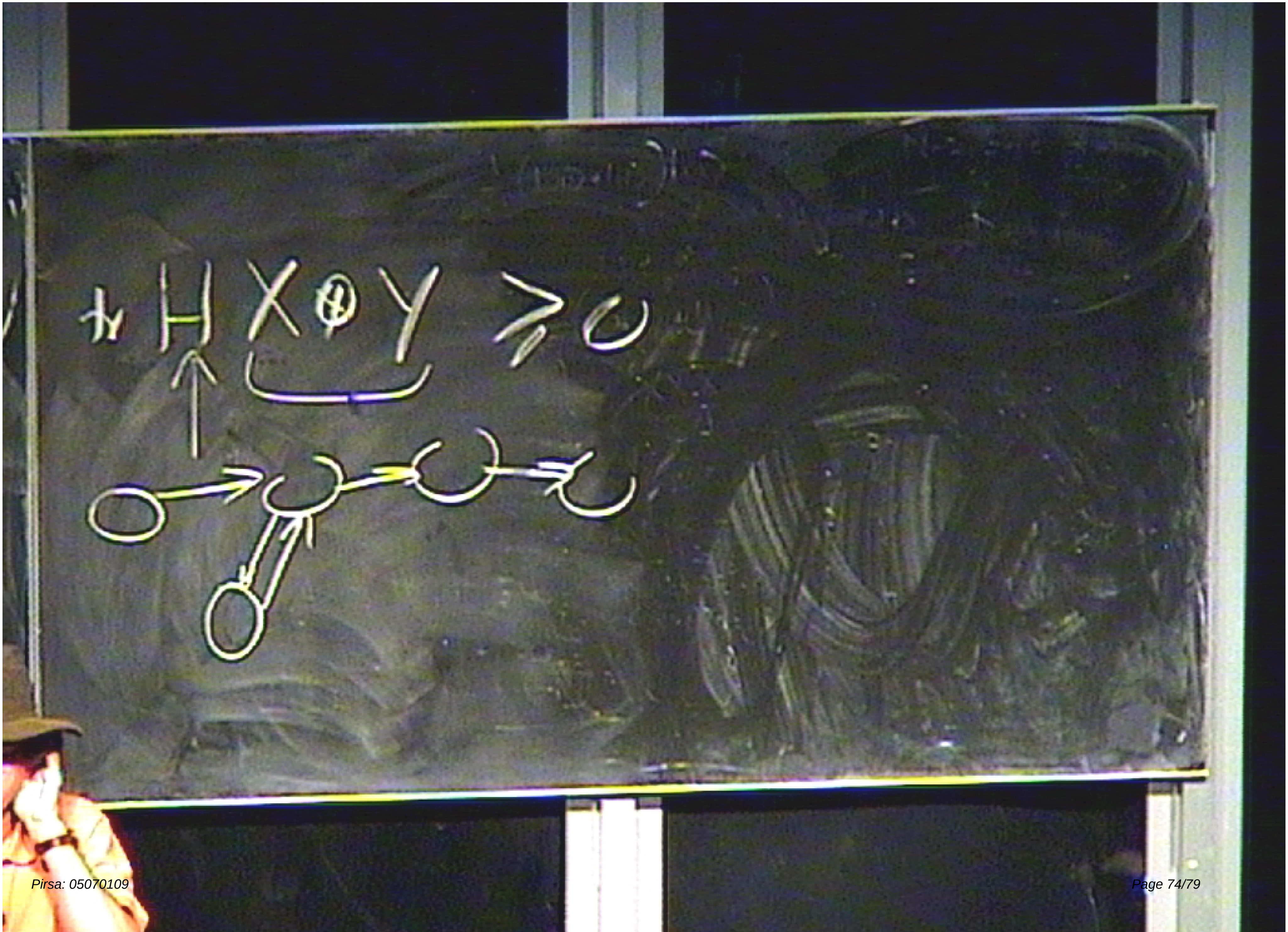

tr H X⊗Y ≥ 0

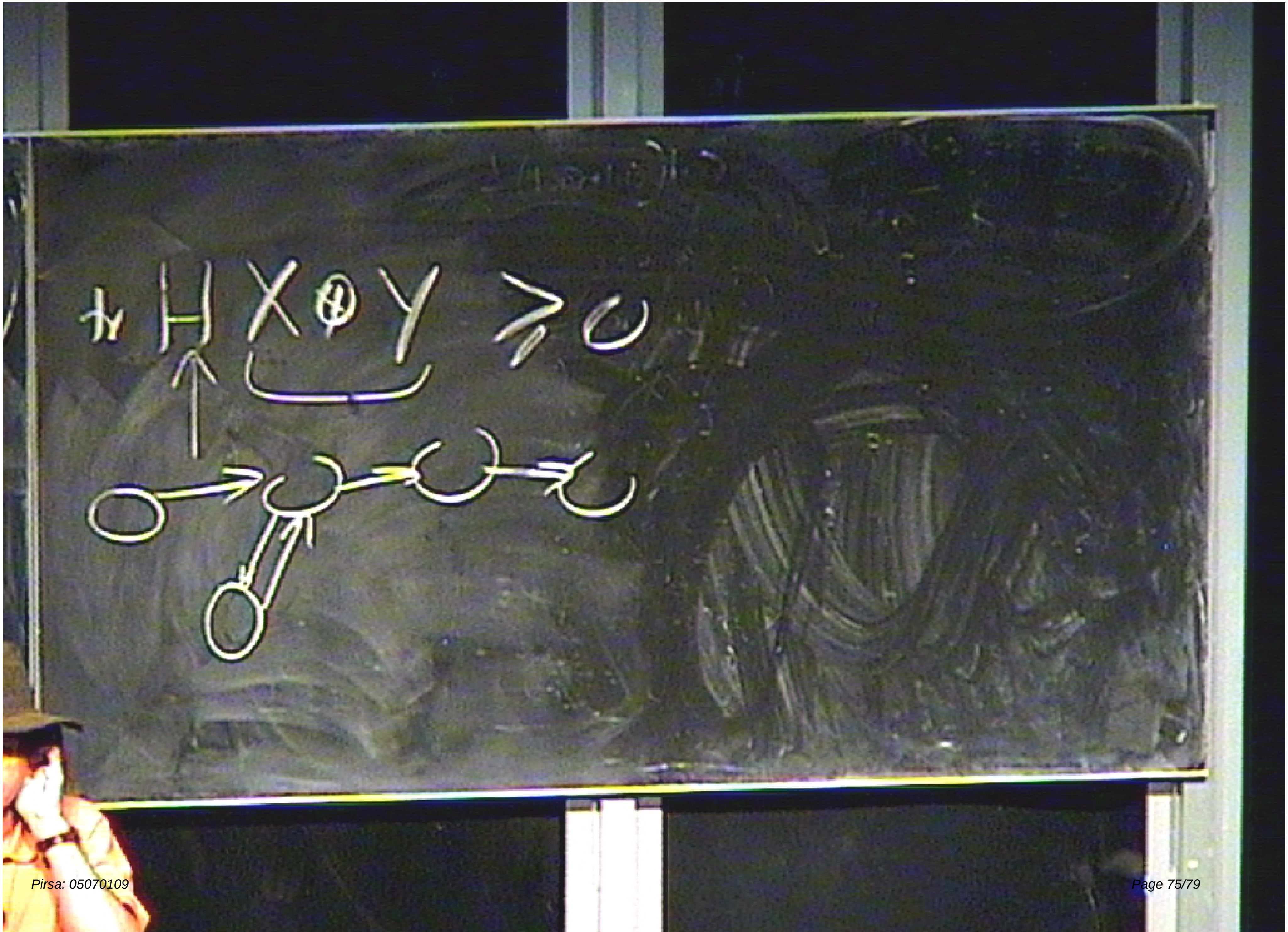

tr H X⊗Y ≥ 0

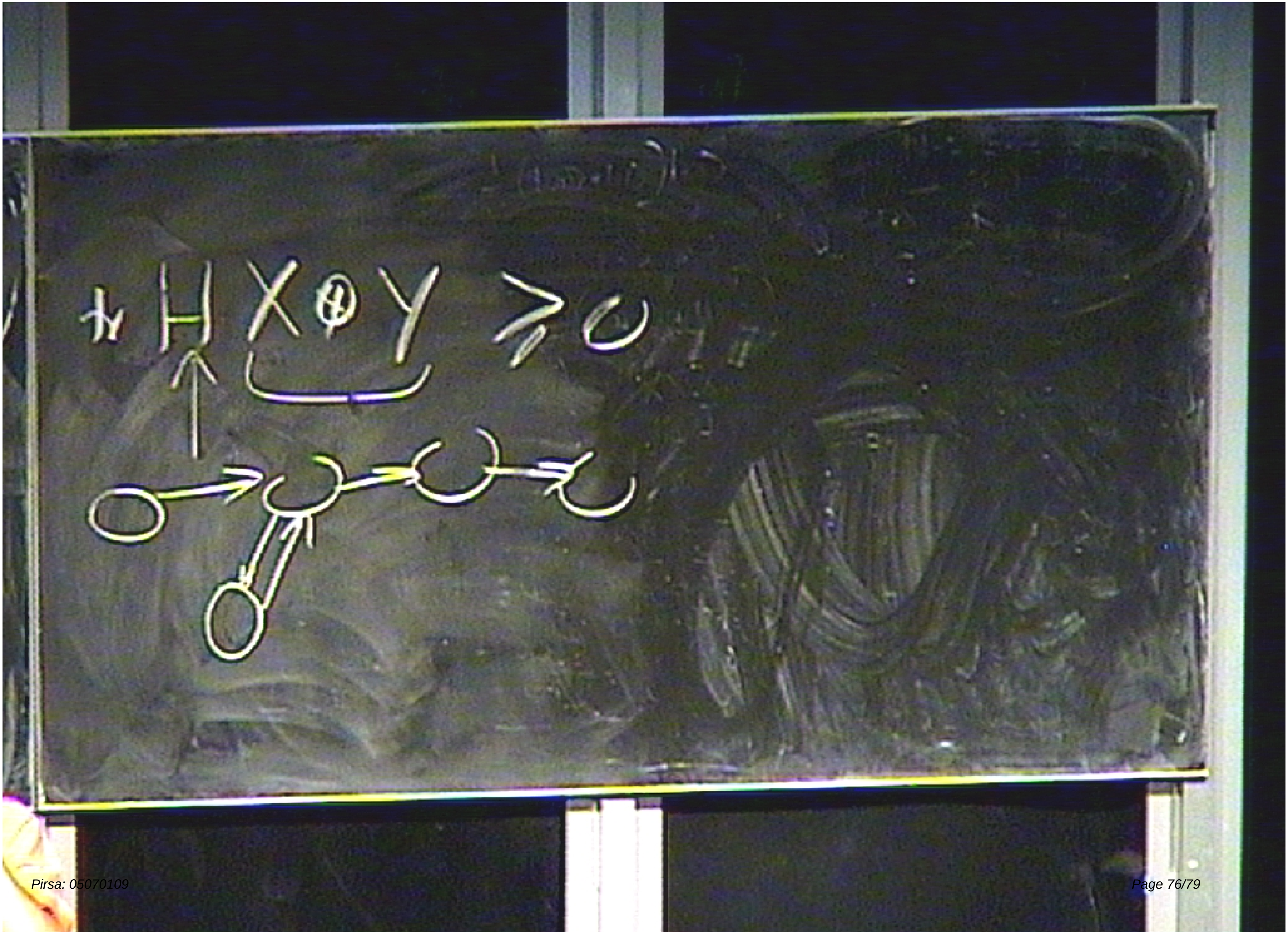

tr H X⊗Y ≥ 0

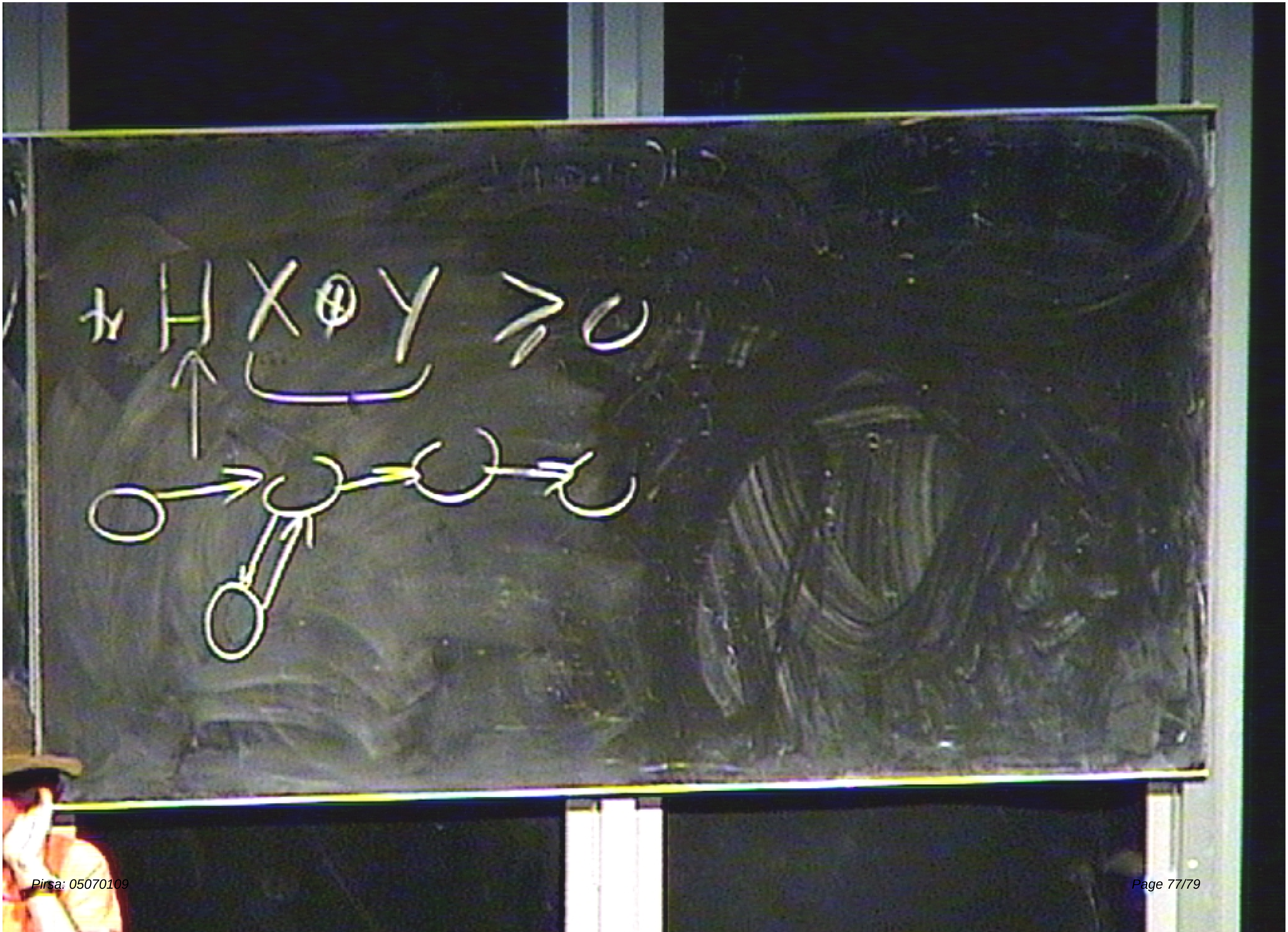

tr H X⊗Y ≥ 0

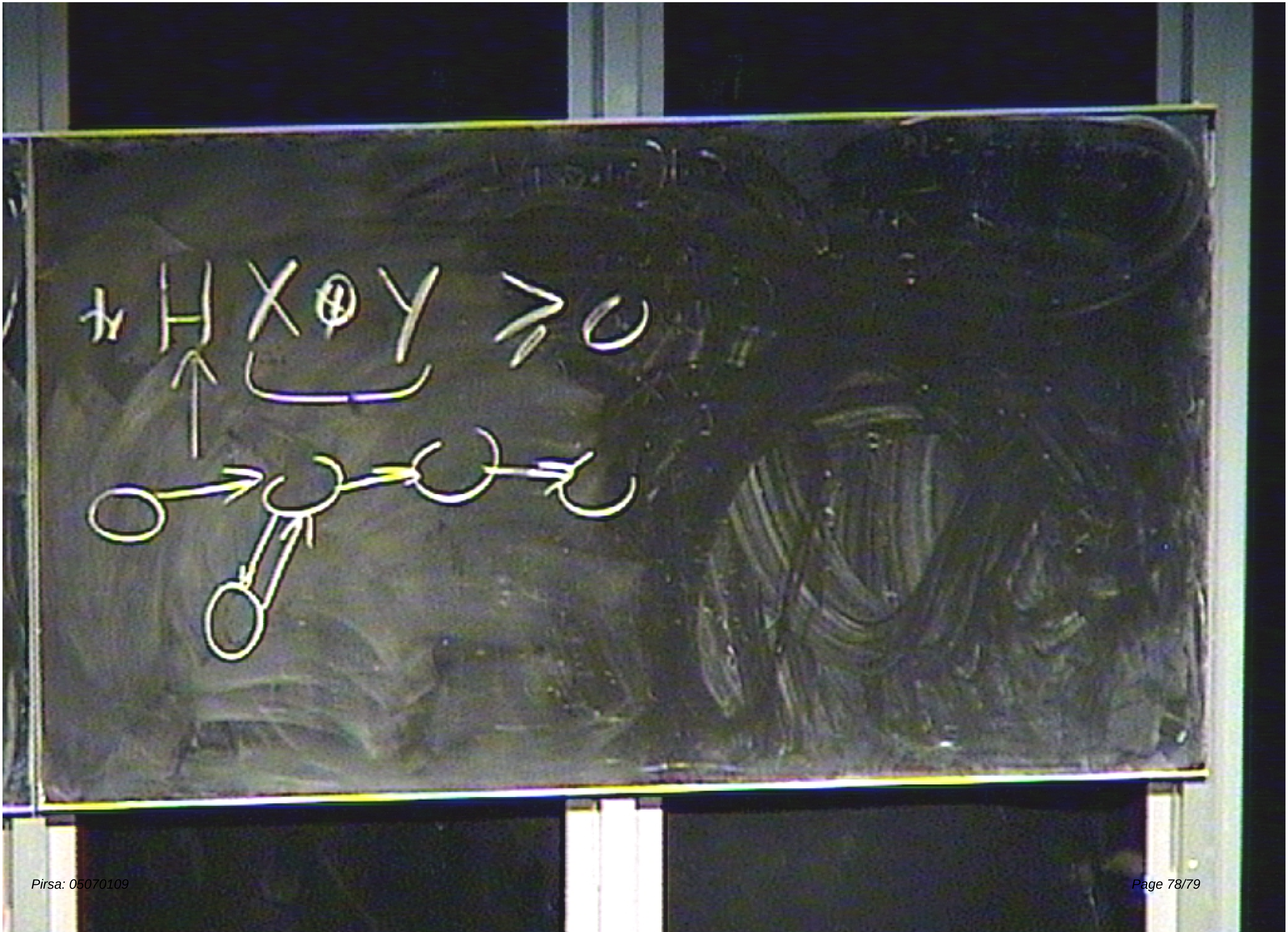

tr H X⊗Y ≥ 0

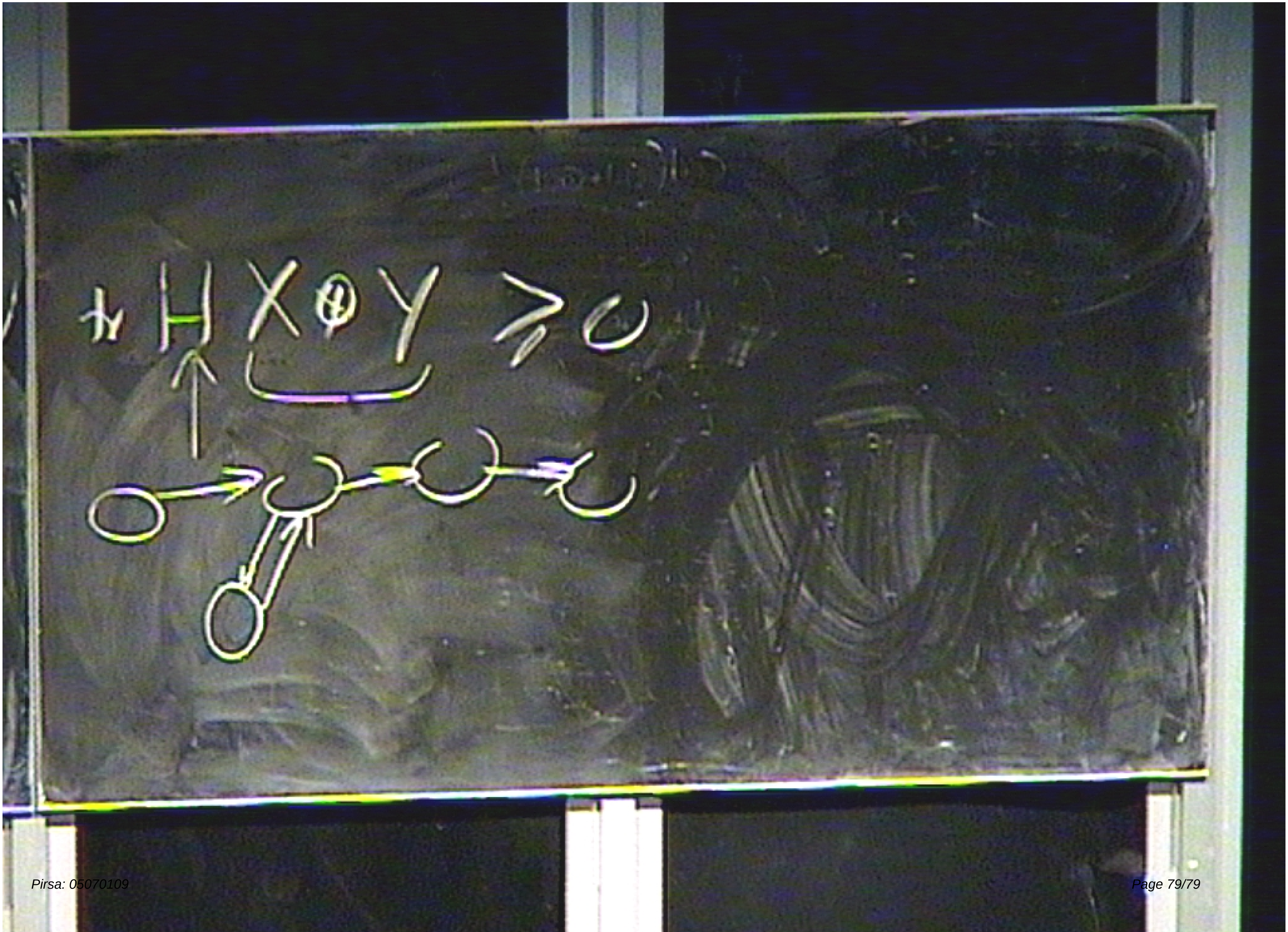

tr H X⊗Y ≥ 0


tr H X⊗Y ≥ 0


tr H X ⊗ Y ≥ 0


H X⊗Y ≥ 0


H X⊗Y ≥ 0


tr H X⊗Y ≥ 0