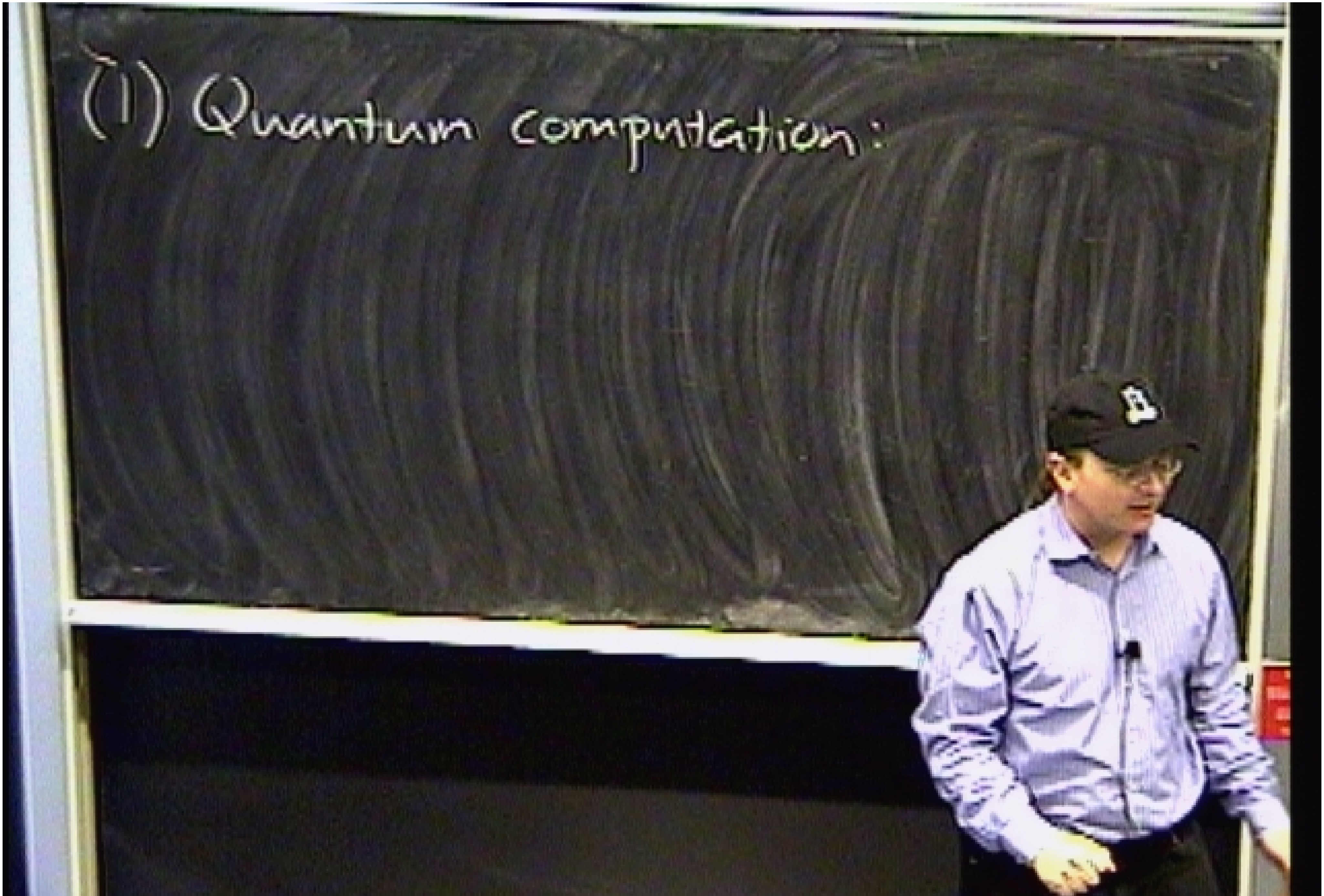
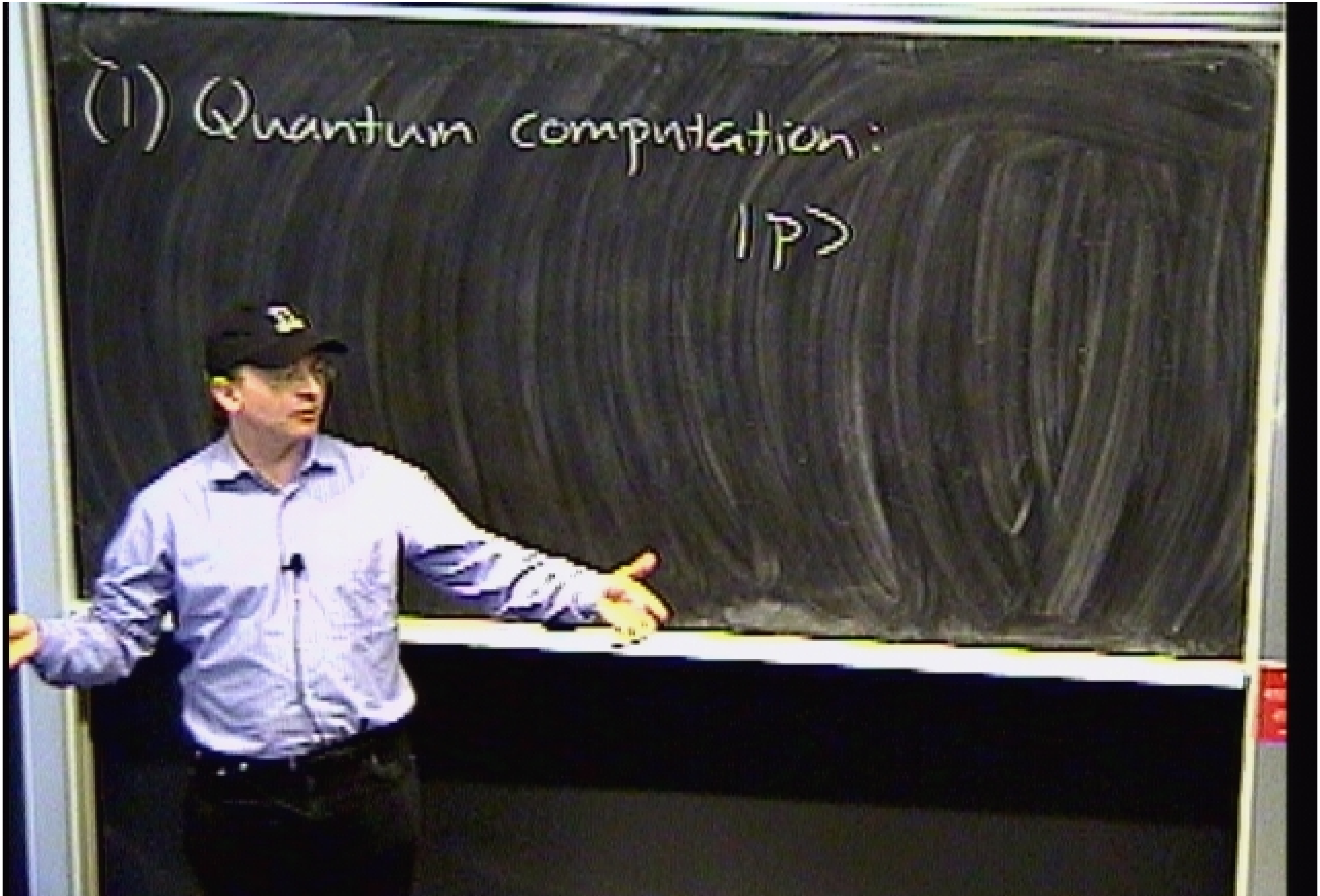
Title: Interpretation of Quantum Theory: Lecture 26 (Bonus)

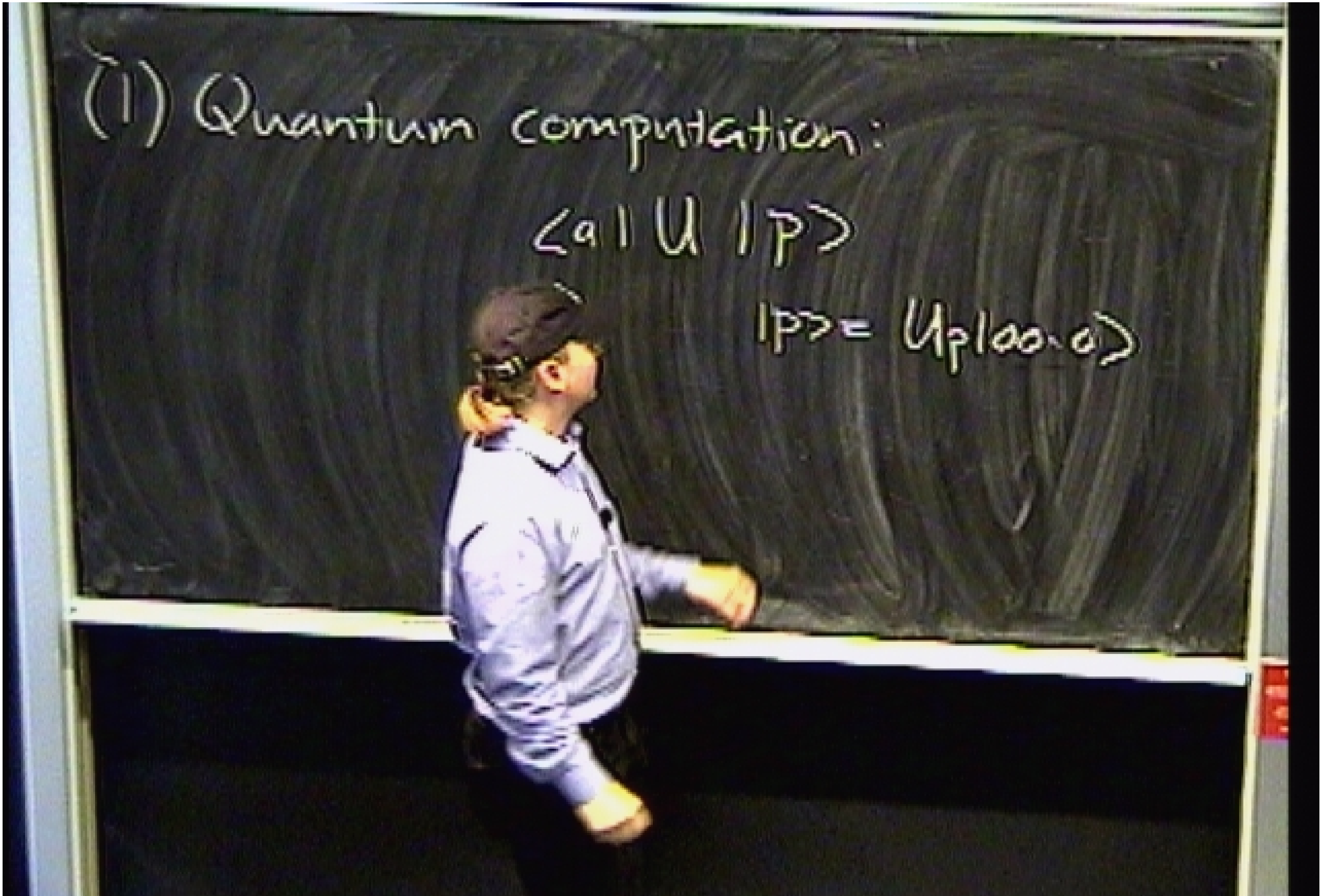
Date: Apr 12, 2005 04:00 PM

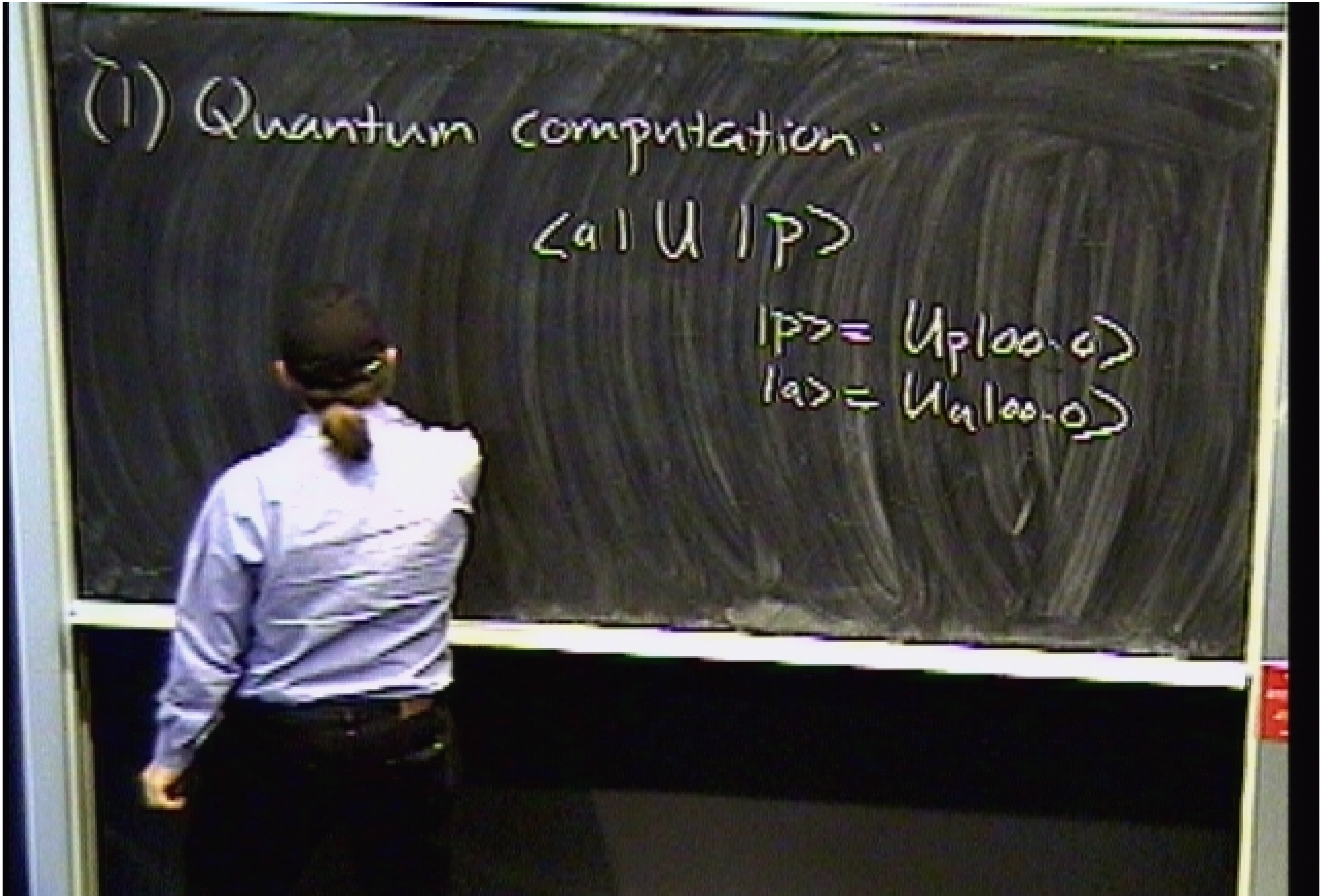
URL: http://pirsa.org/05040055

Abstract:


(1) Quantum computation:


(1) Quantum computation:
|ψ⟩


(1) Quantum computation:
⟨a| U |p⟩
|p⟩ = U_p|00...0⟩


(1) Quantum computation:
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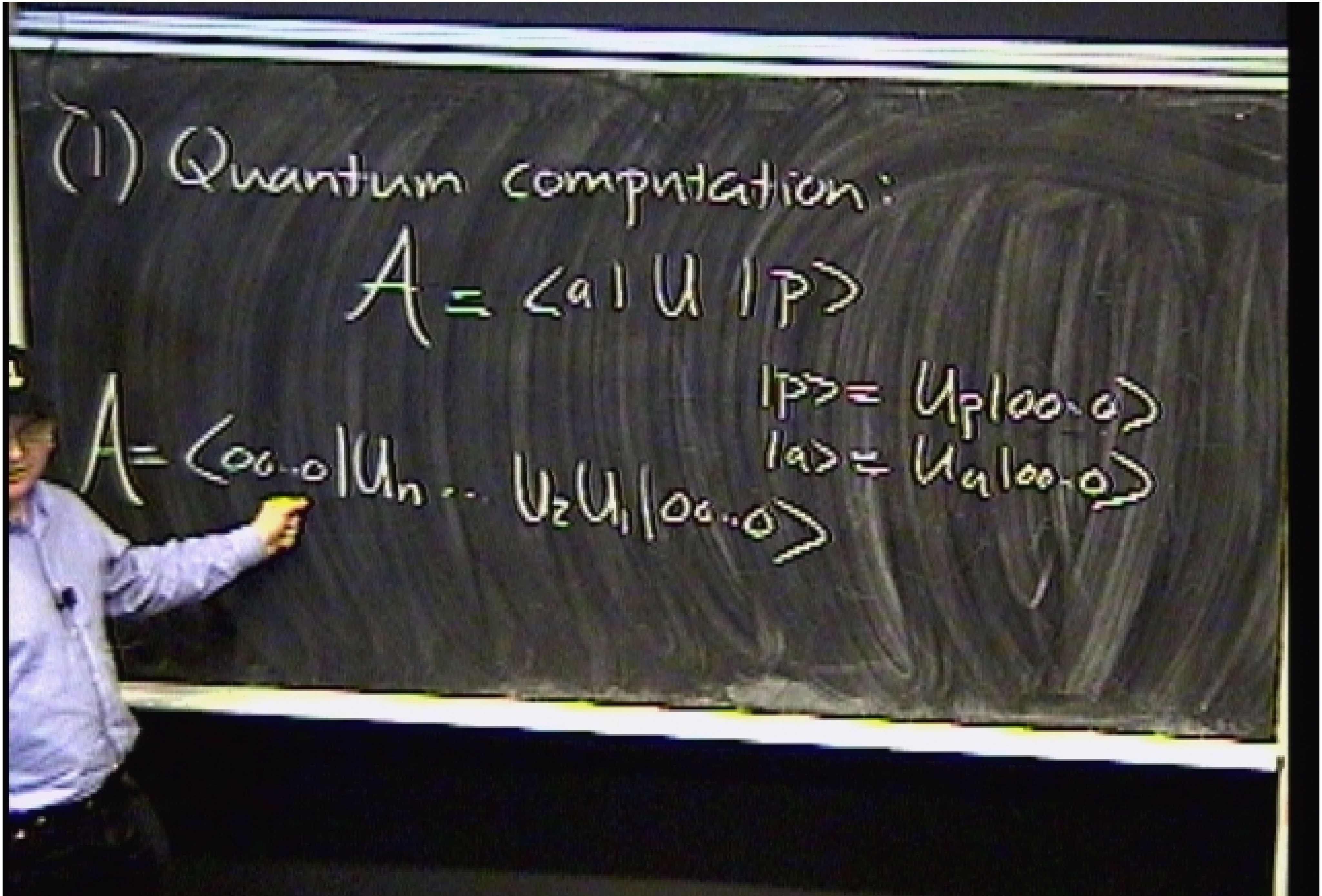
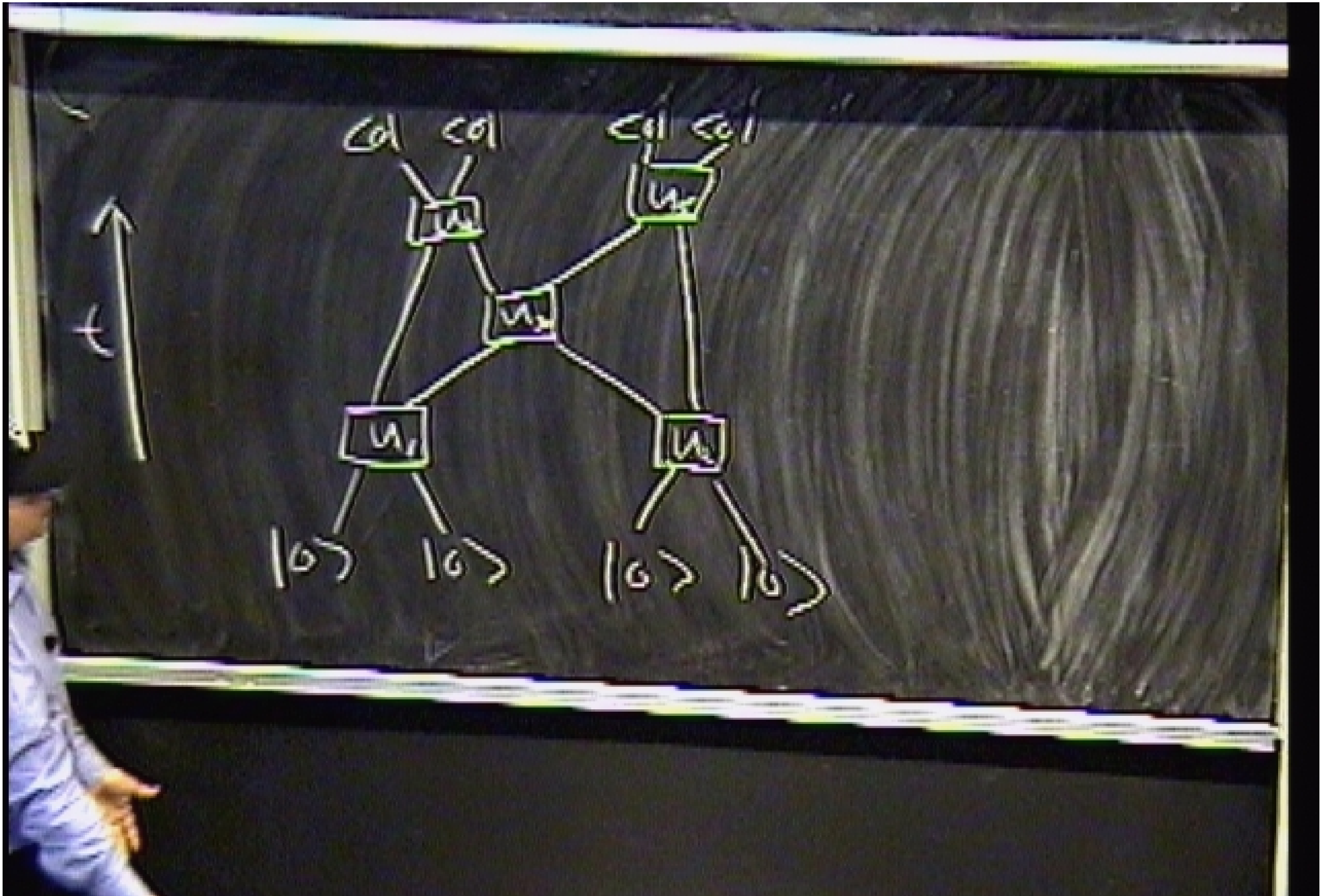
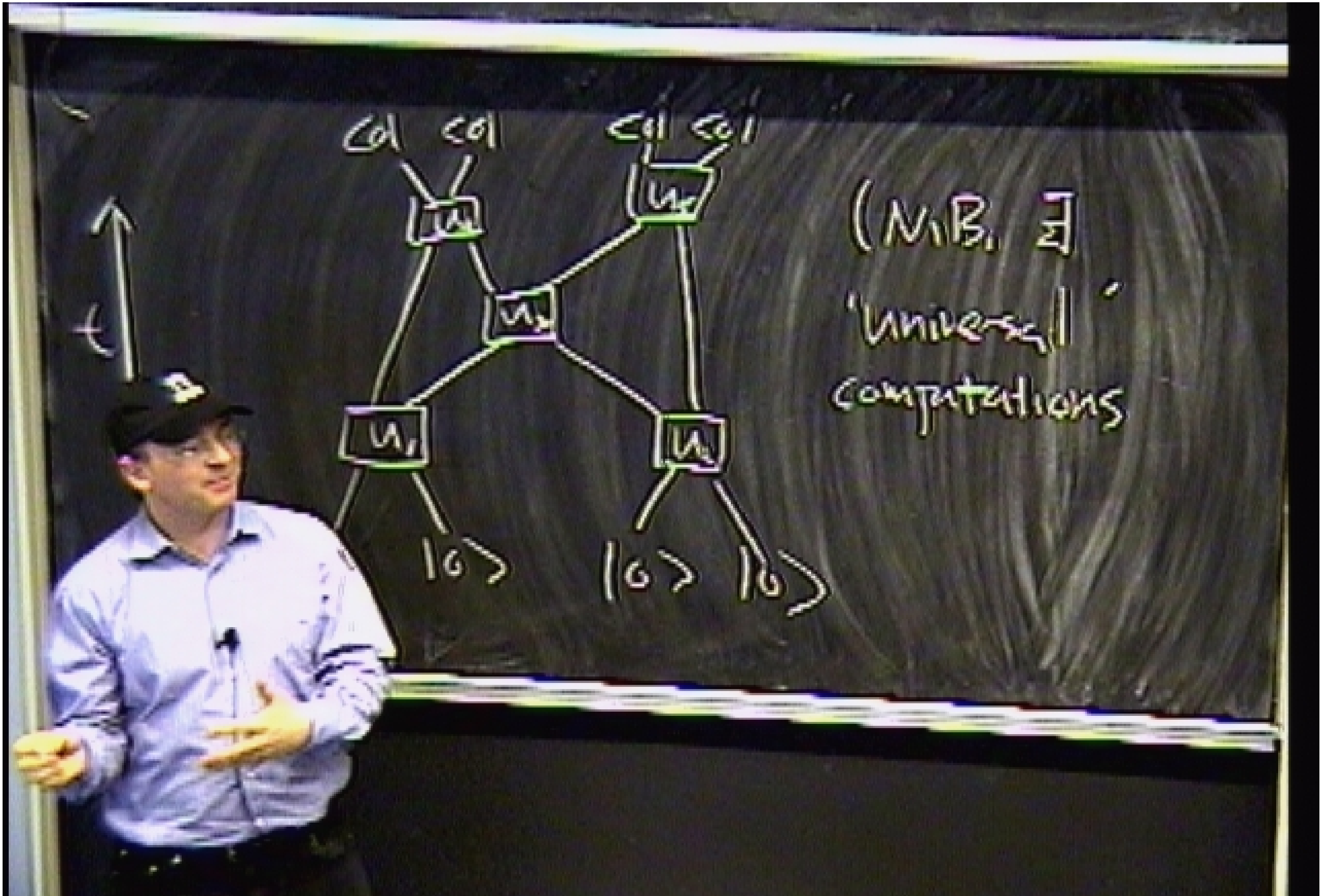
|a⟩ = U_a |00…0⟩


(1) Quantum computation:
$A = \langle a | U | p \rangle$
$|p\rangle = U_p |00..0\rangle$
$|a\rangle = U_a |00..0\rangle$
$A = \langle 00..0 | U_n \dots U_2 U_1 | 00..0 \rangle$


⟨0| ⟨0| ⟨0| ⟨0|
t
|0⟩ |0⟩ |0⟩ |0⟩



<0| <0| <0| <0|
U
(N.B. ∃
'universal'
computations
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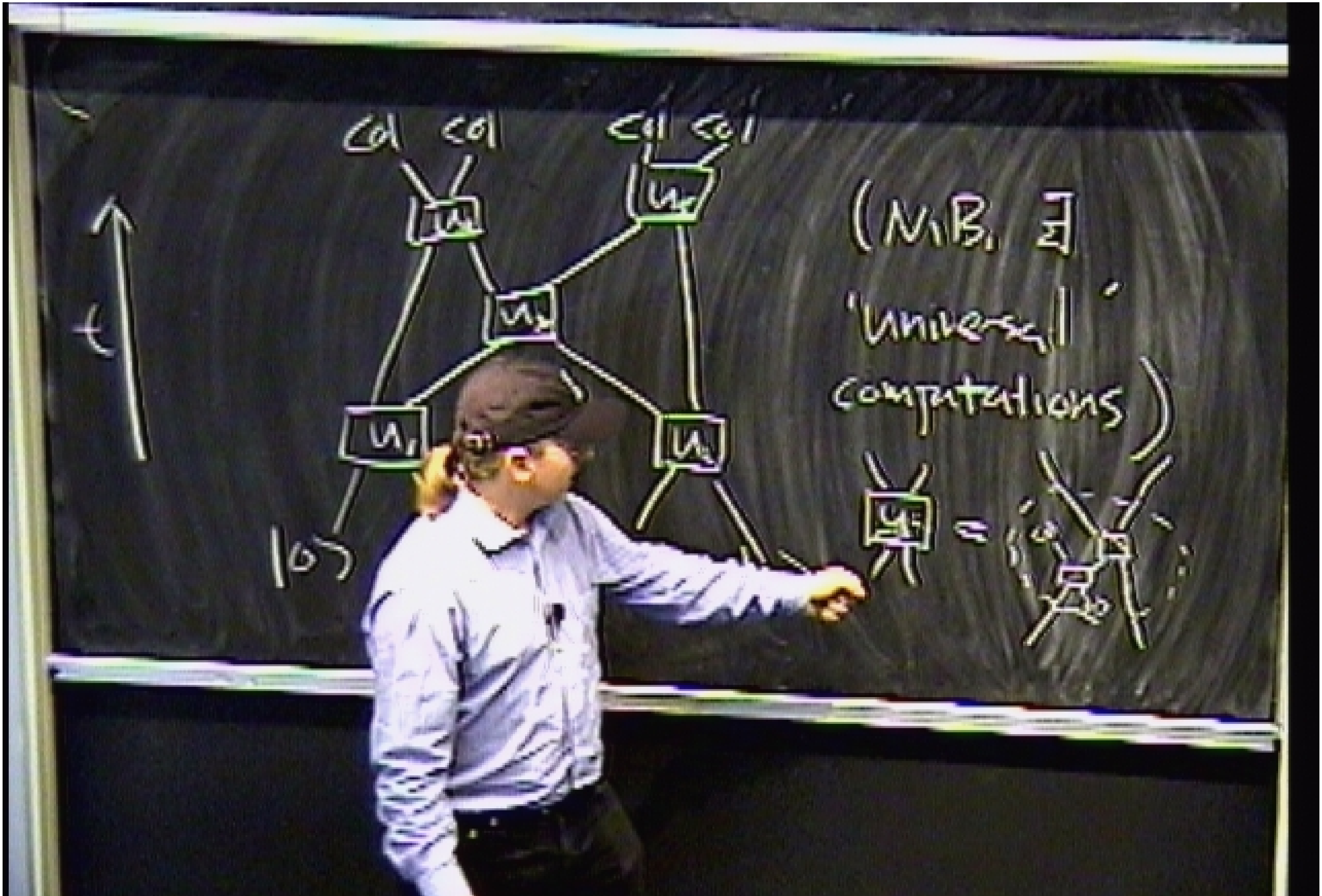
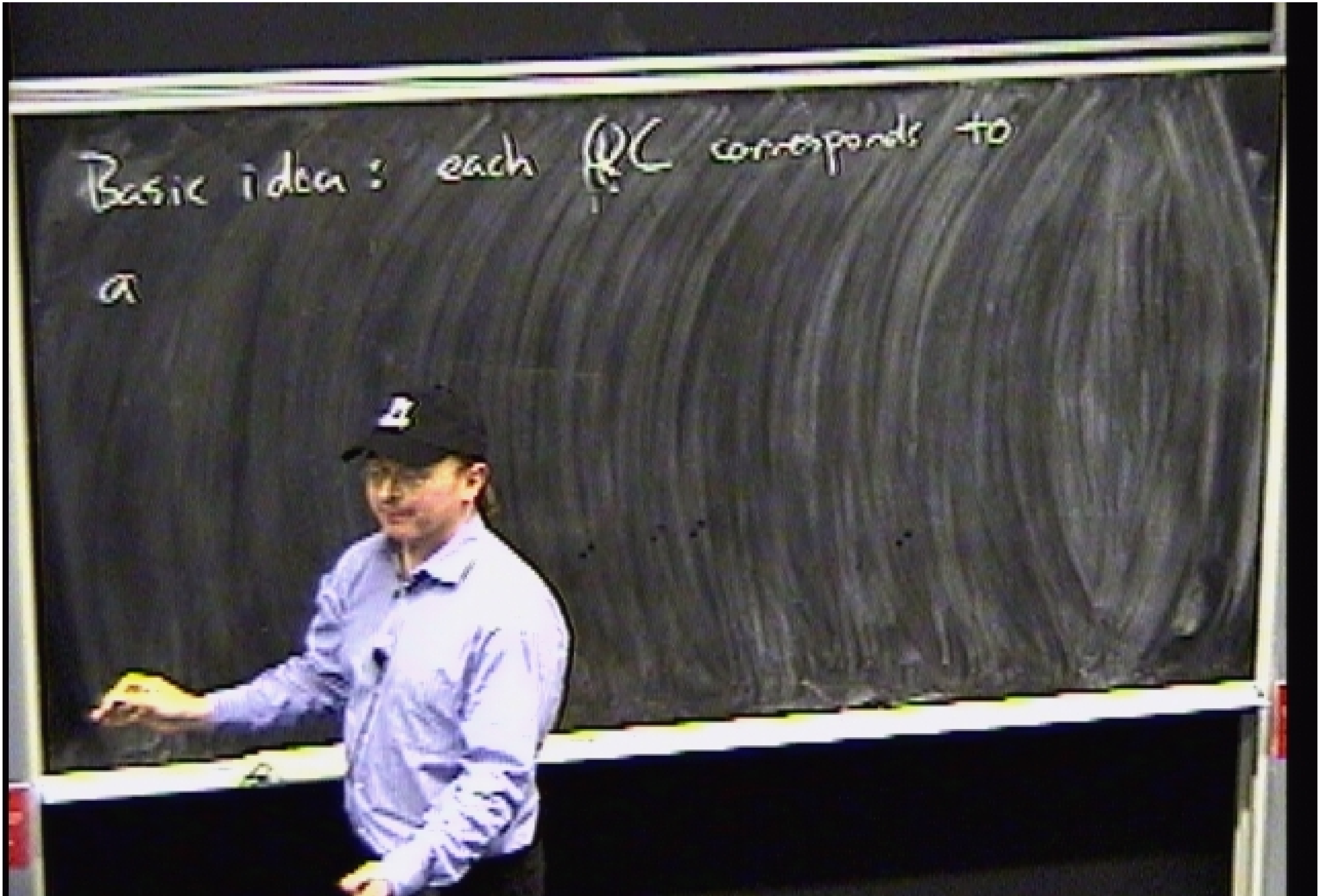
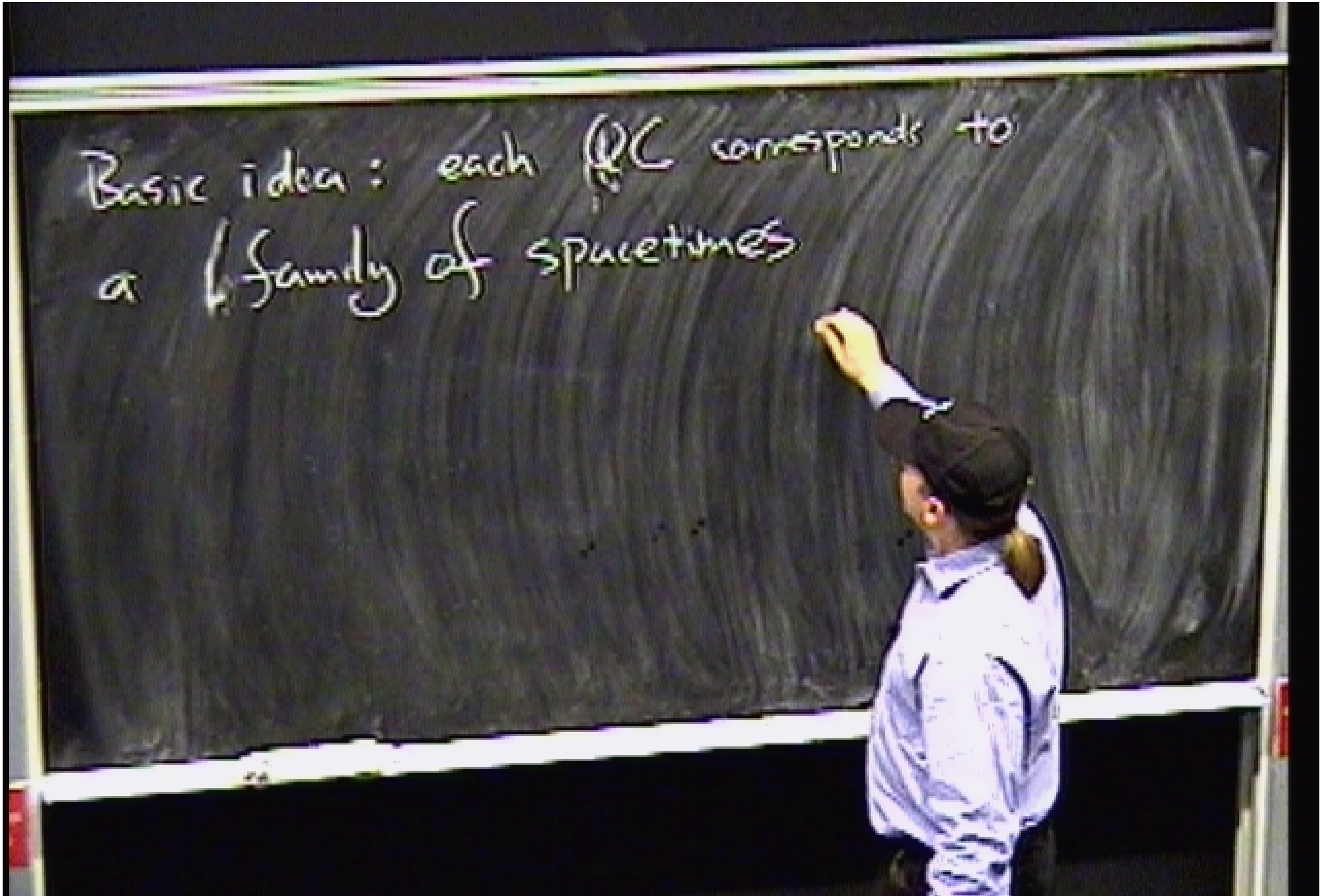
|0> |0> |0>


(M.B. ∃
'universal'
computations)


Basic idea: each QEC corresponds to
a


Basic idea: each QC corresponds to
a family of spacetimes

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N.B. QC has a causal structure (a set of related causal structure)

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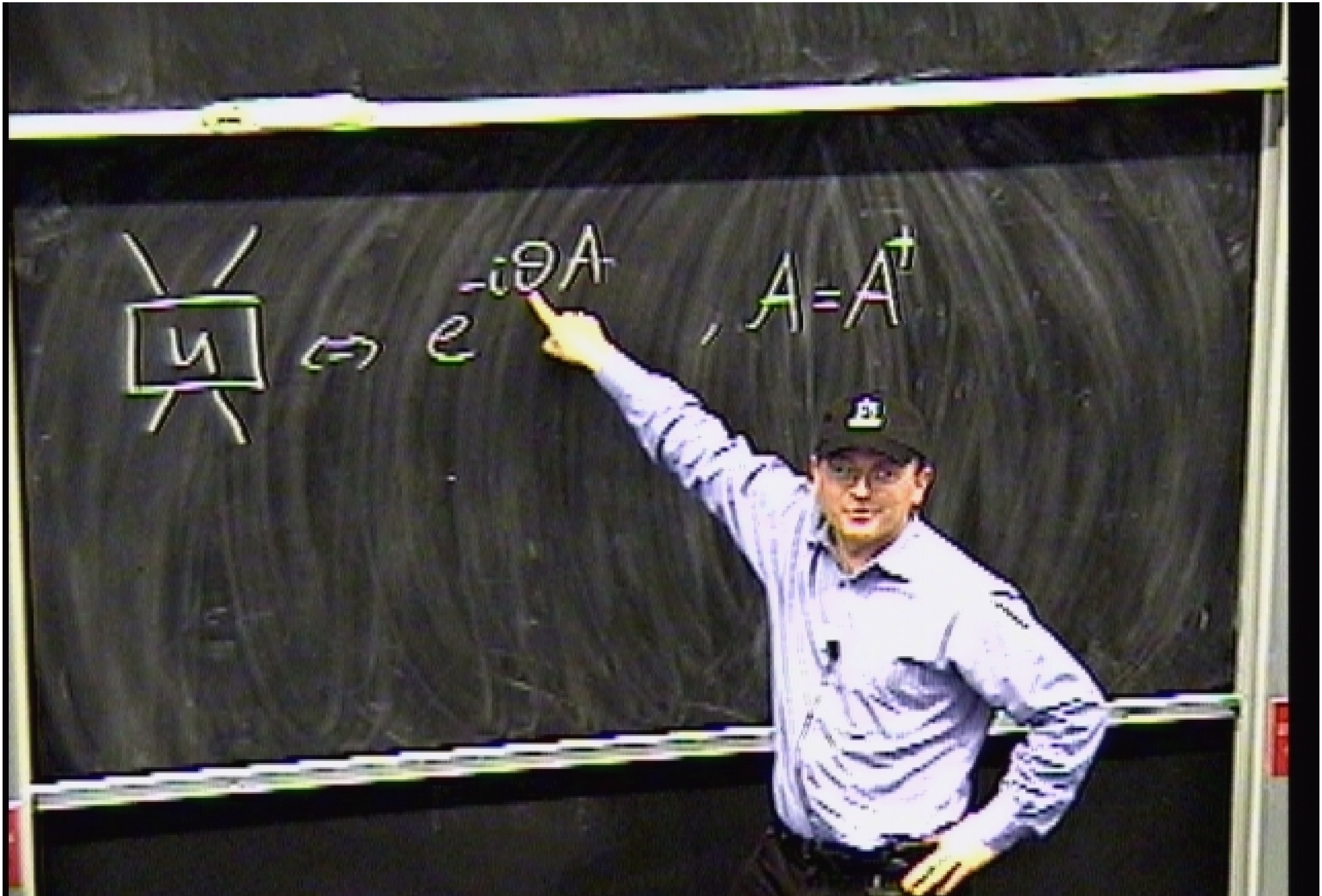
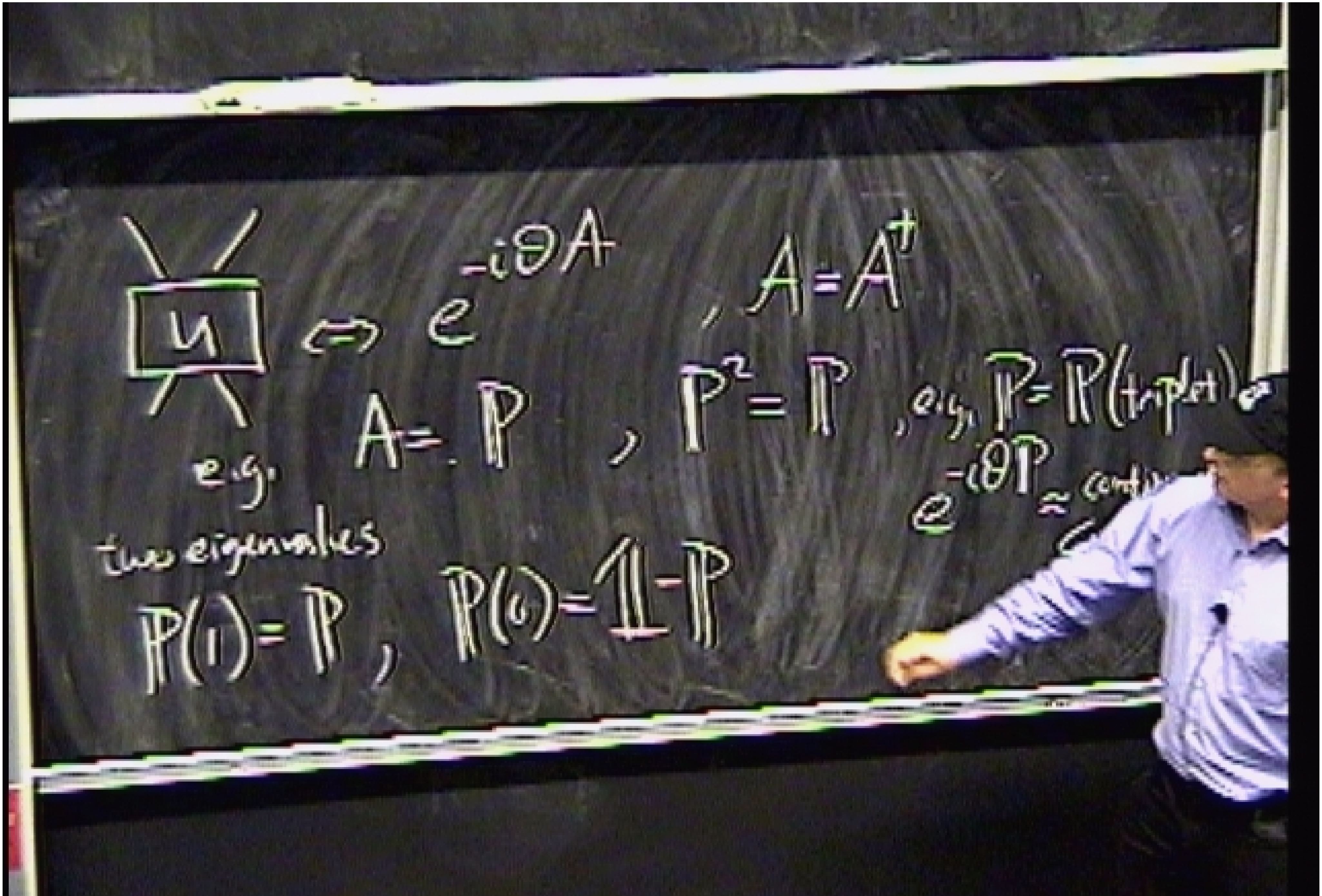
N.B. QC has a causal structure (a set of 2^n related causal structure)


$\boxed{U} \leftrightarrow e^{-i\theta A}$, $A = A^\dagger$

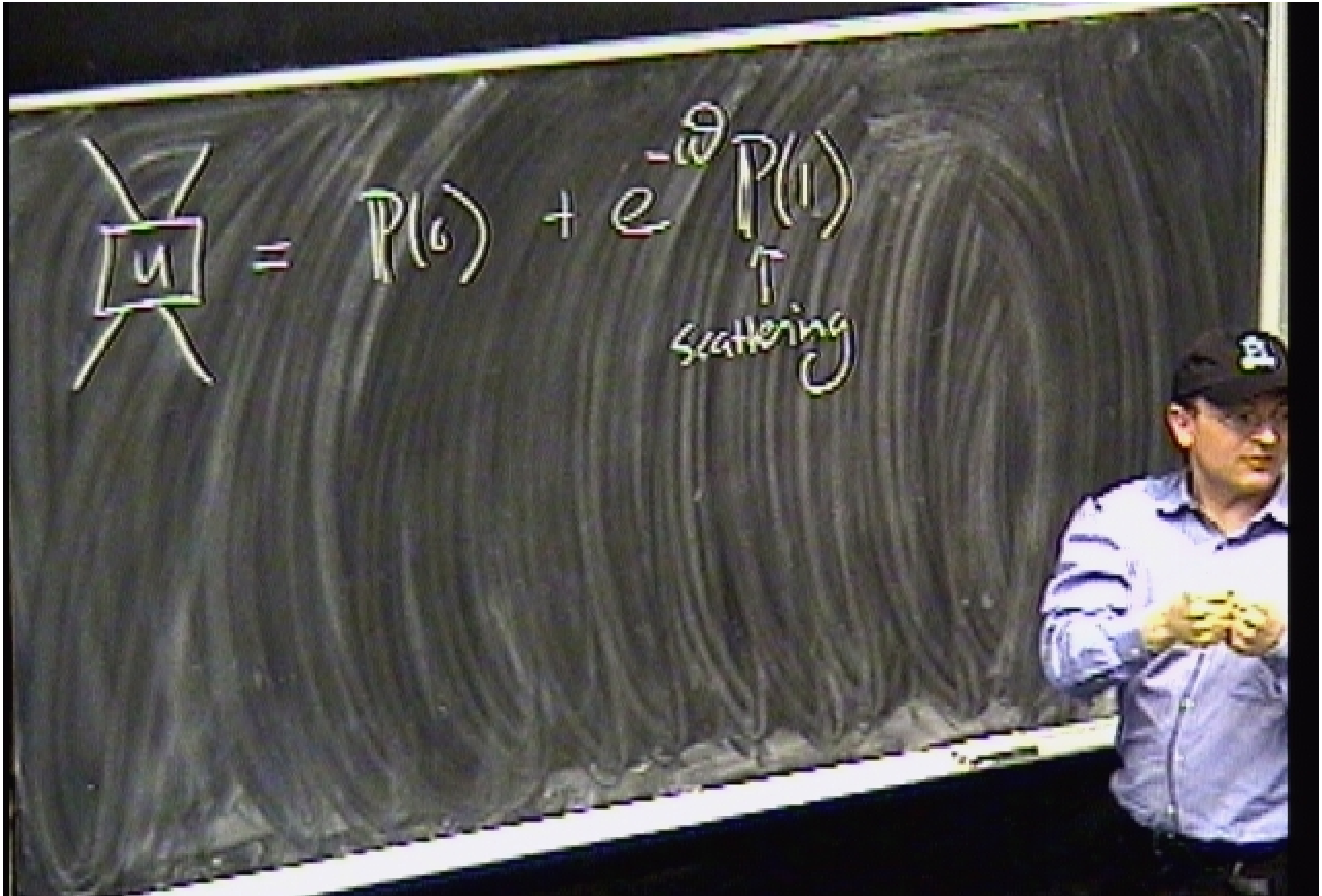
$\Longleftrightarrow e^{-i\theta A}, \quad A = A^\dagger$

e.g. $A = \mathbb{P}$, $\mathbb{P}^2 = \mathbb{P}$, e.g. $\mathbb{P} = \mathbb{P}(\text{triplet})$

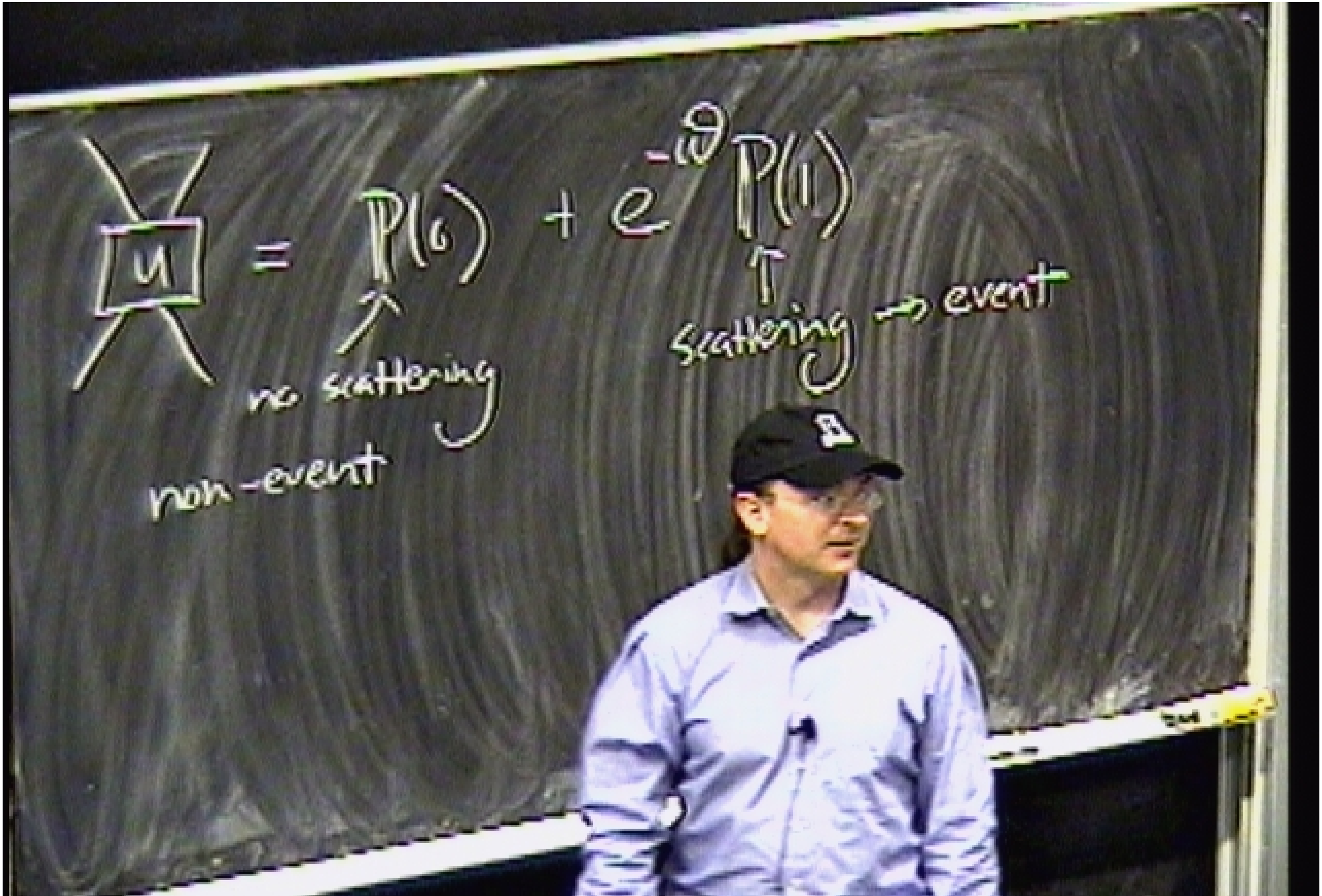
$e^{-i\theta \mathbb{P}}$ = continuous SWAP

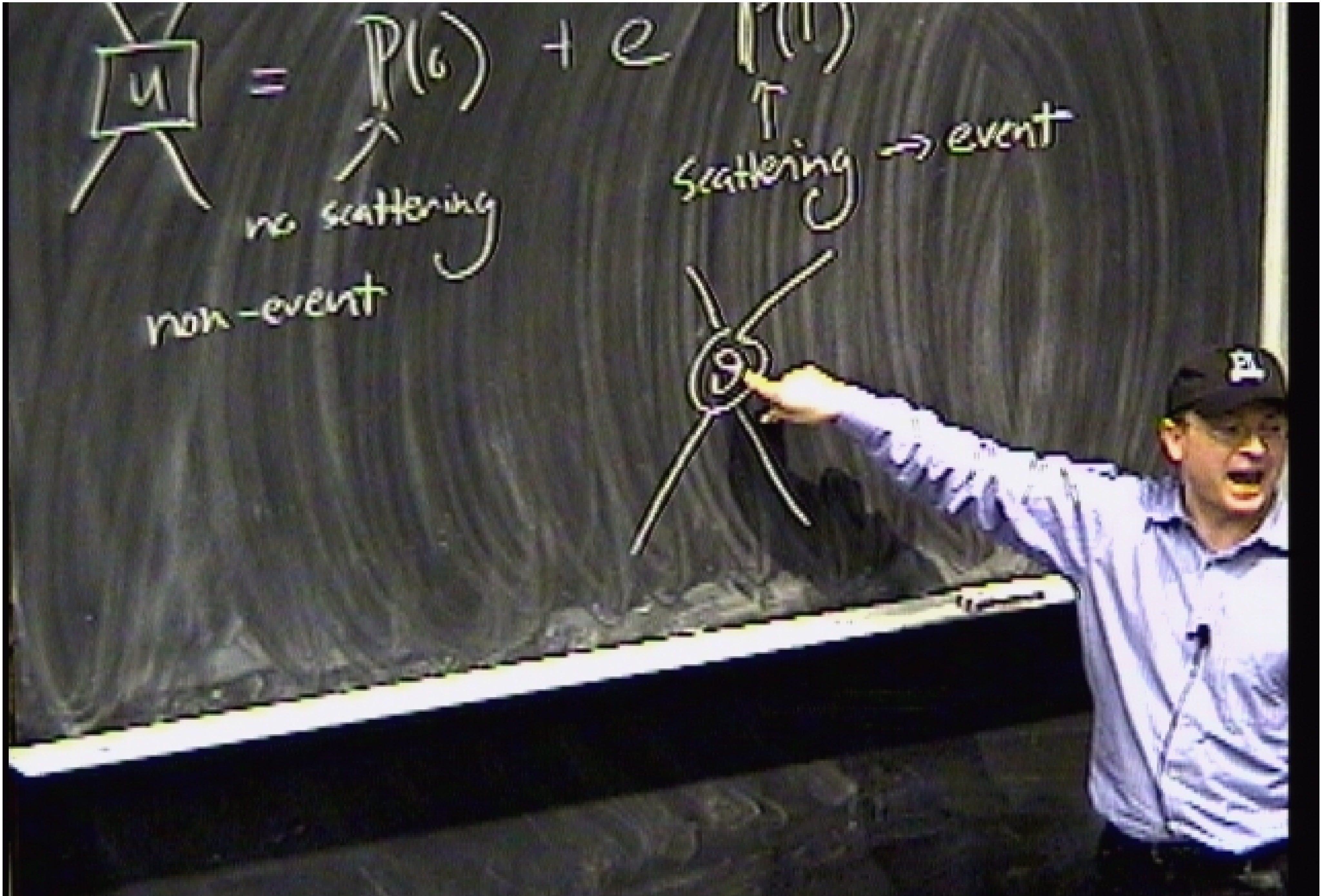

U ⟺ e^{-iθA} , A = A^†
e.g. A = P , P^2 = P , e.g. P = P(triplet)
e^{-iθP} = (cont'd)
two eigenvalues
P(1) = P , P(0) = 1 - P


u



u
= P(0) + e^{-iθ} P(1)
scattering


$\boxed{u} = P(0) + e^{-i\vartheta} P(1)$
no scattering
non-event
scattering → event


u = P(0) + e P(1)
no scattering
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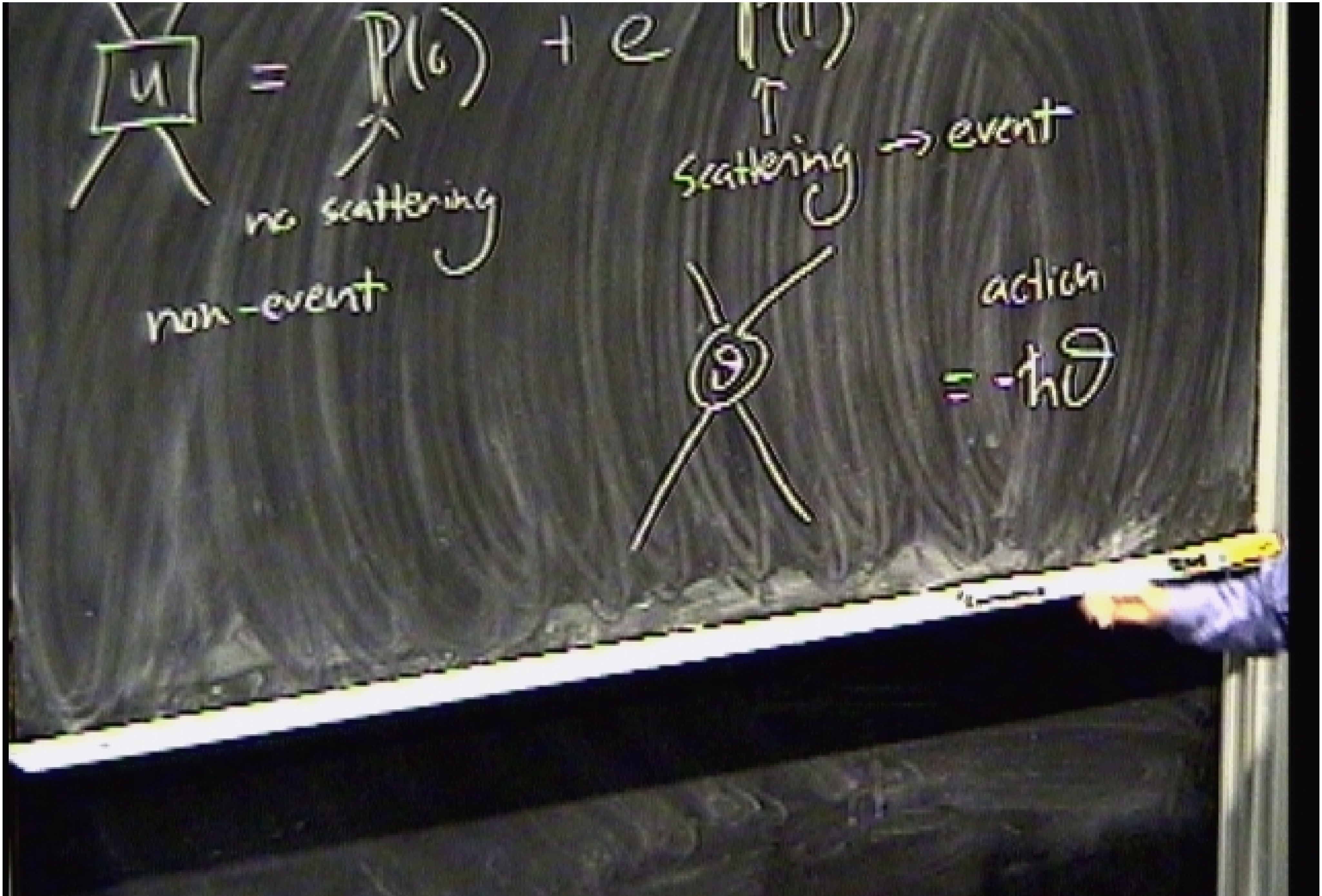
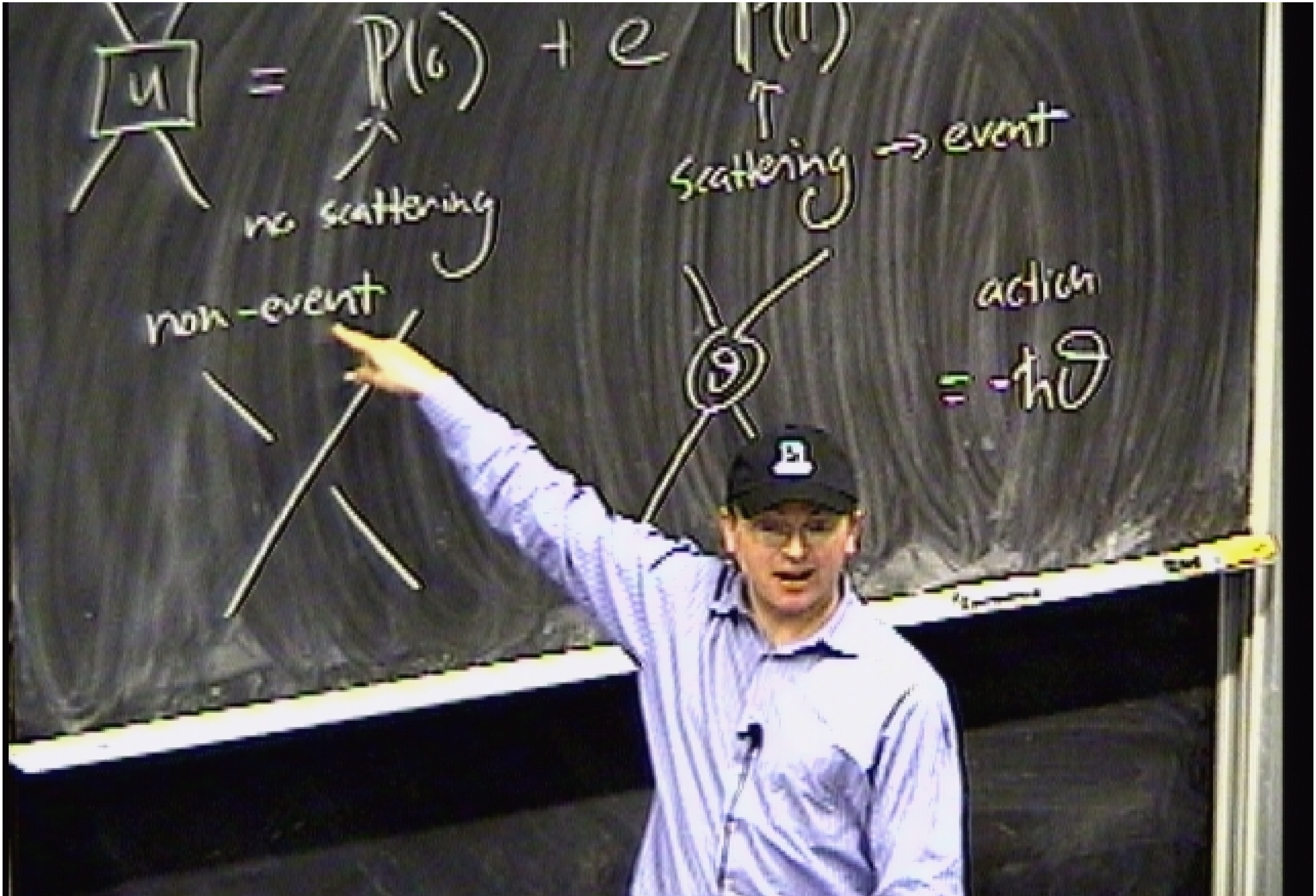
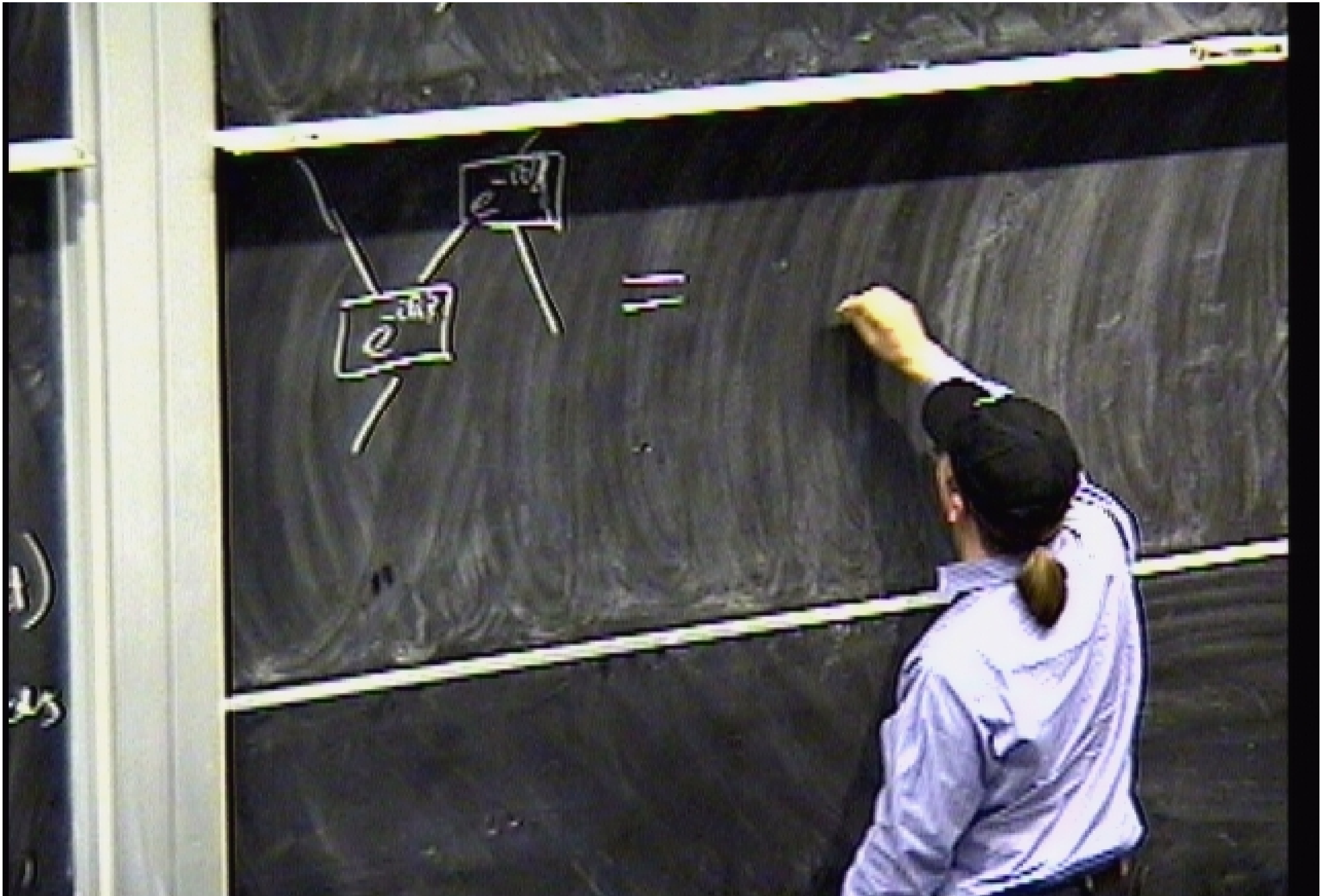
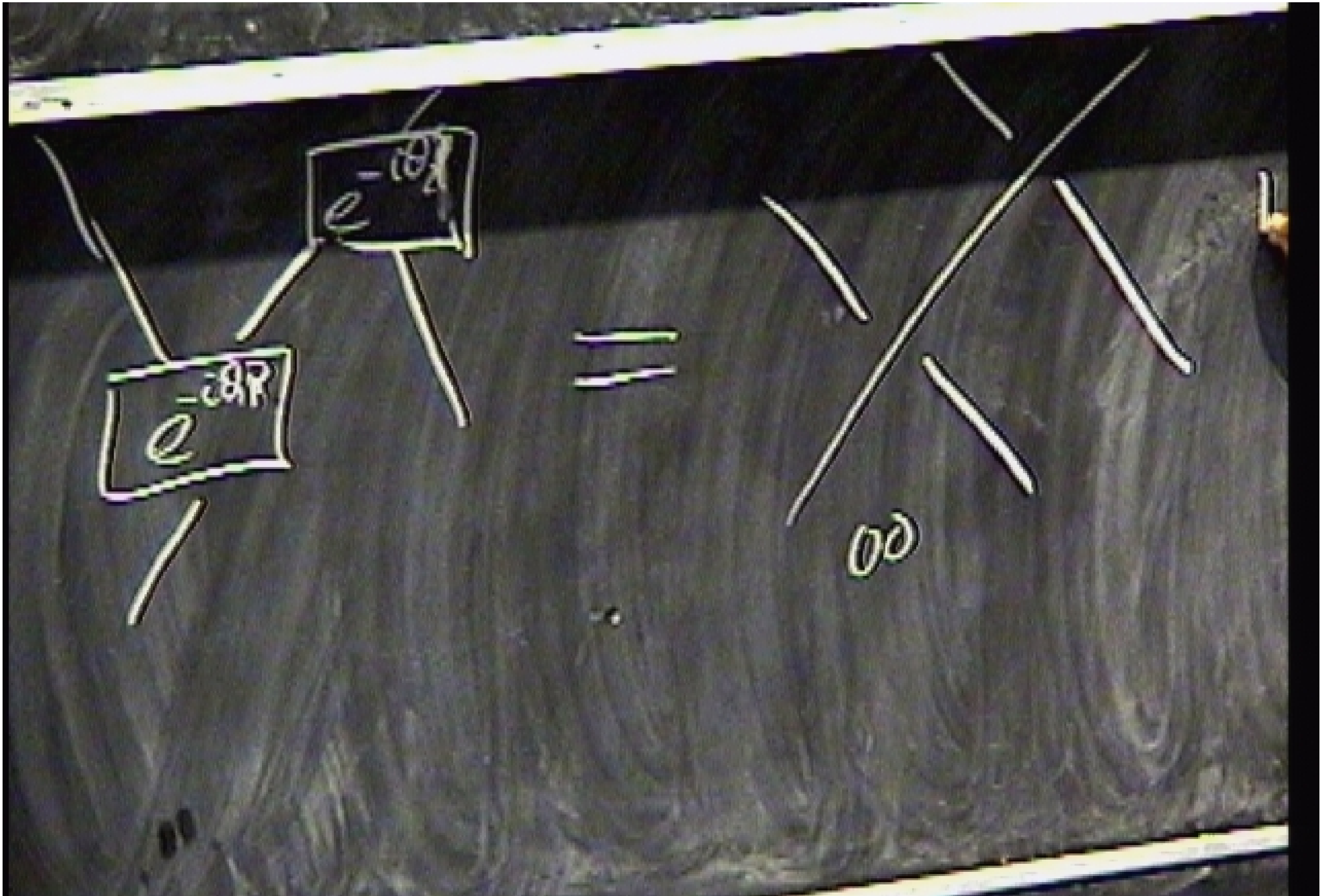
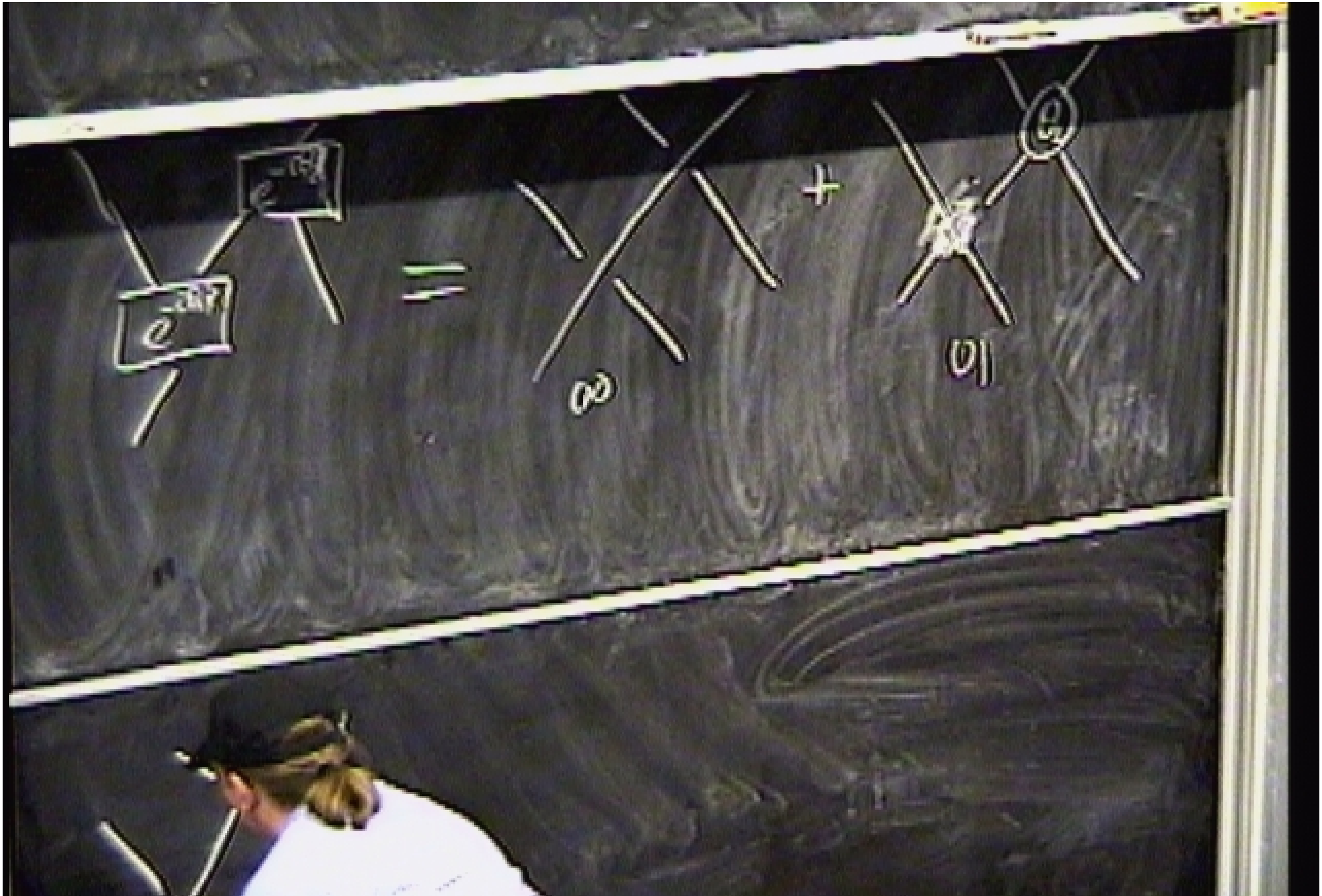
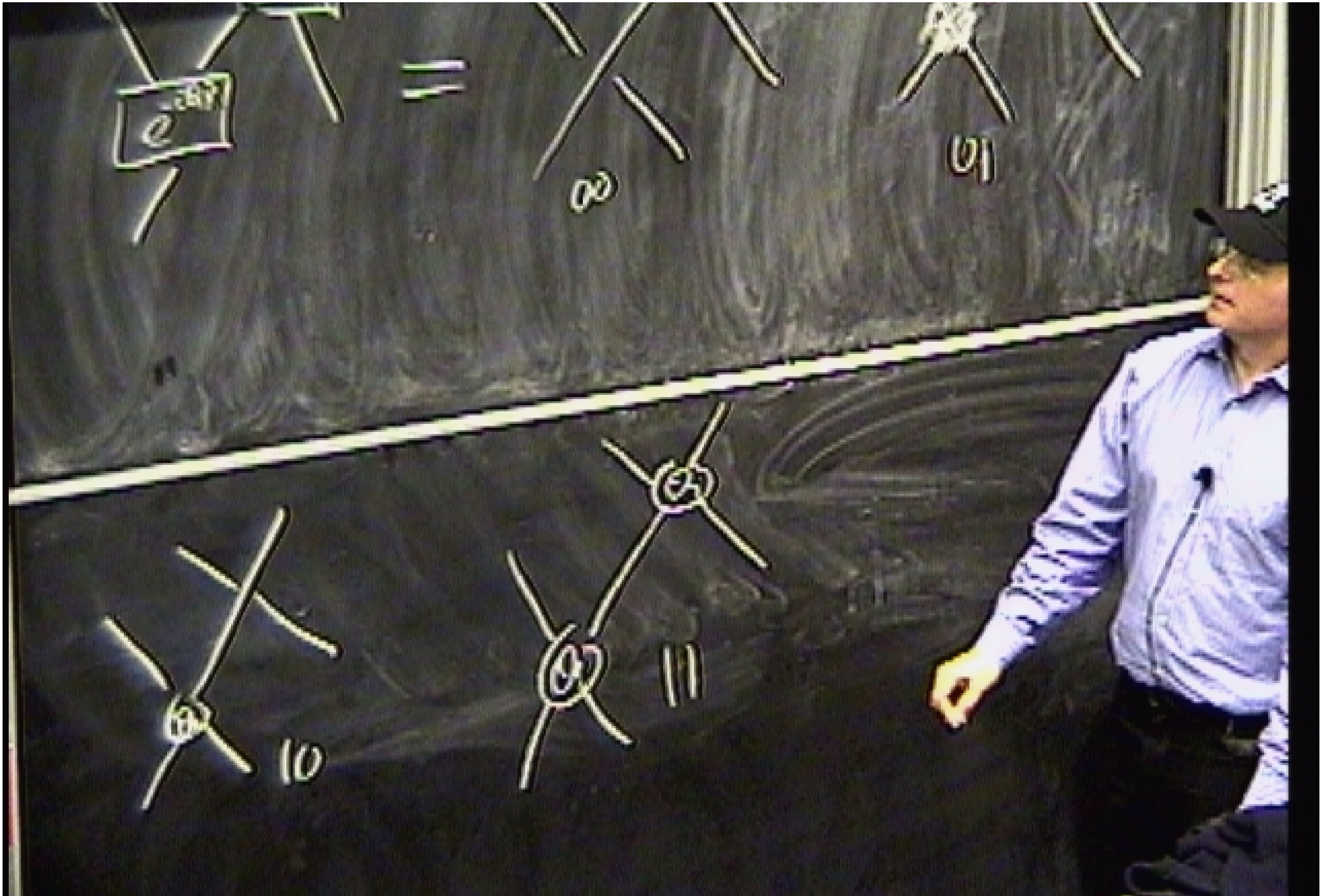

u
= P(0) + e P(1)
no scattering
non-event
scattering → event
θ
action
= -ħθ

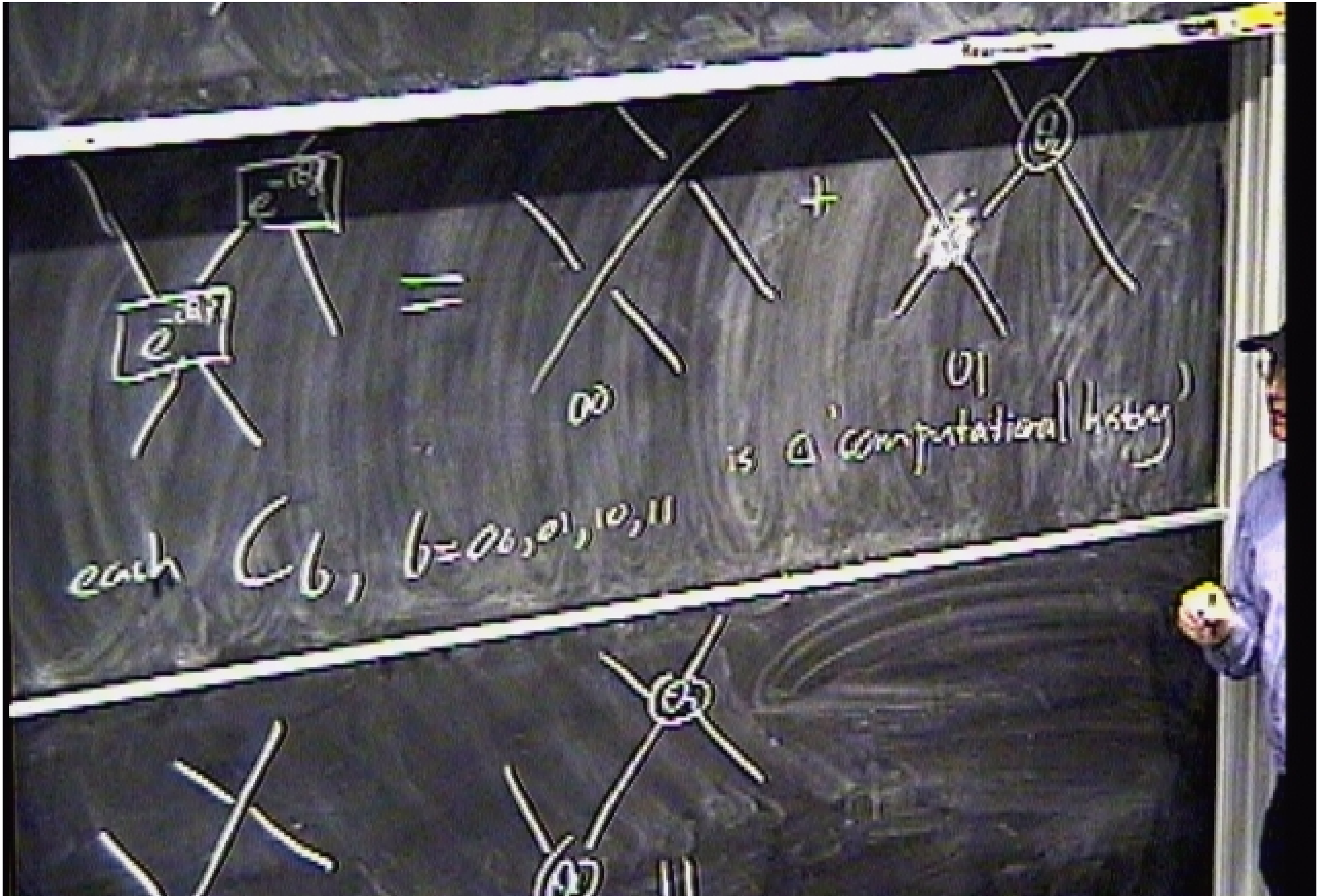

scattering → event
no scattering
non-event
action
= -ħθ

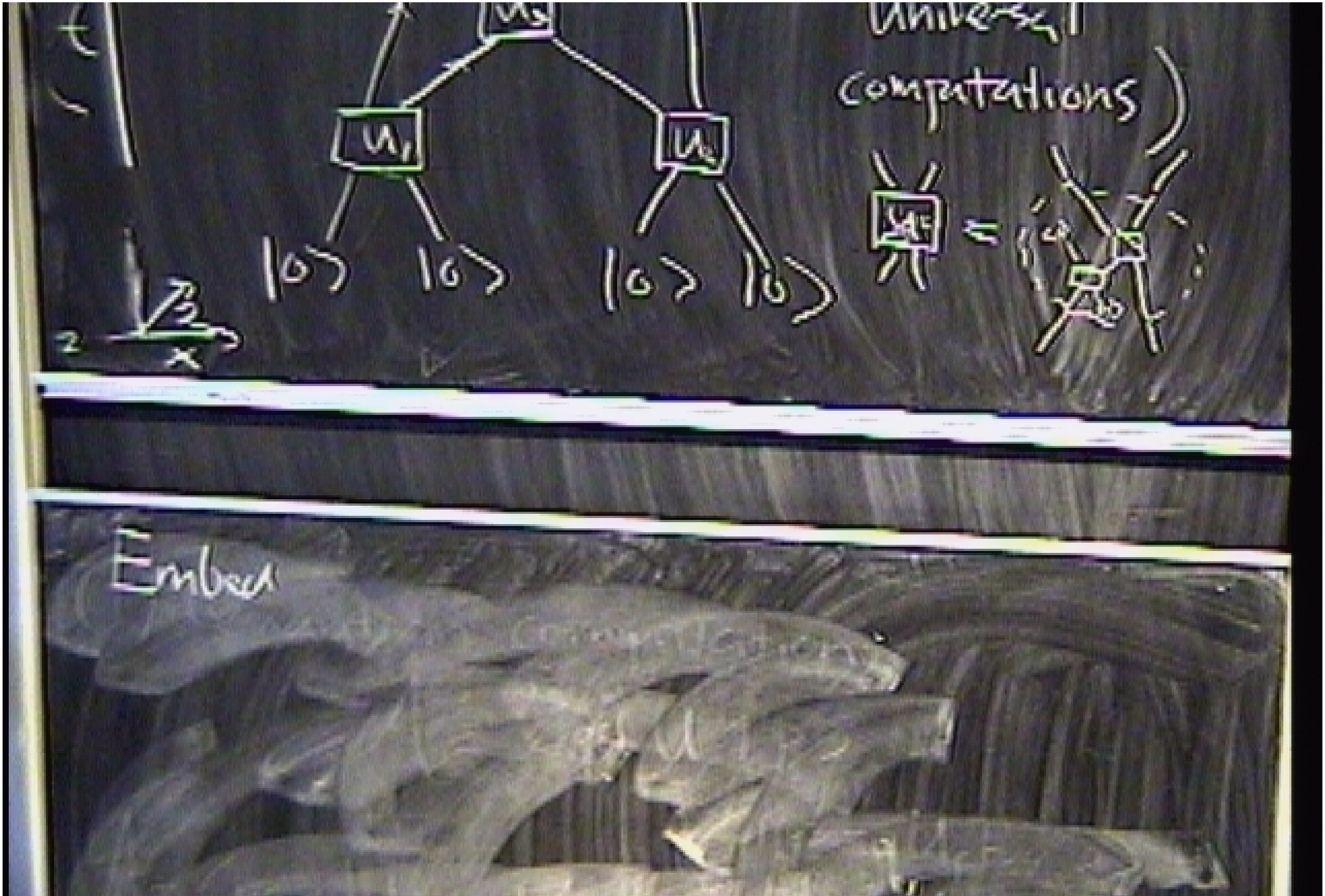


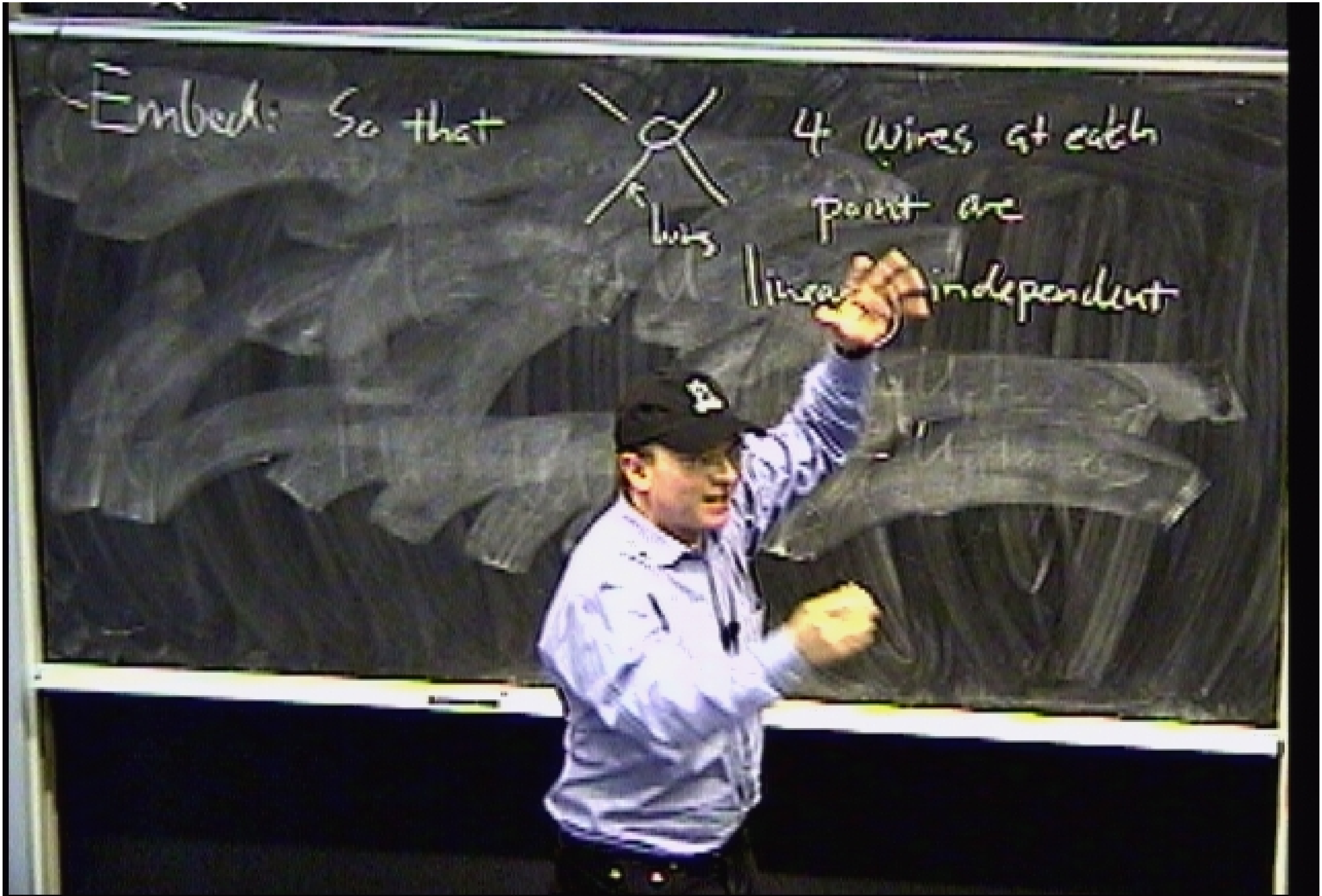




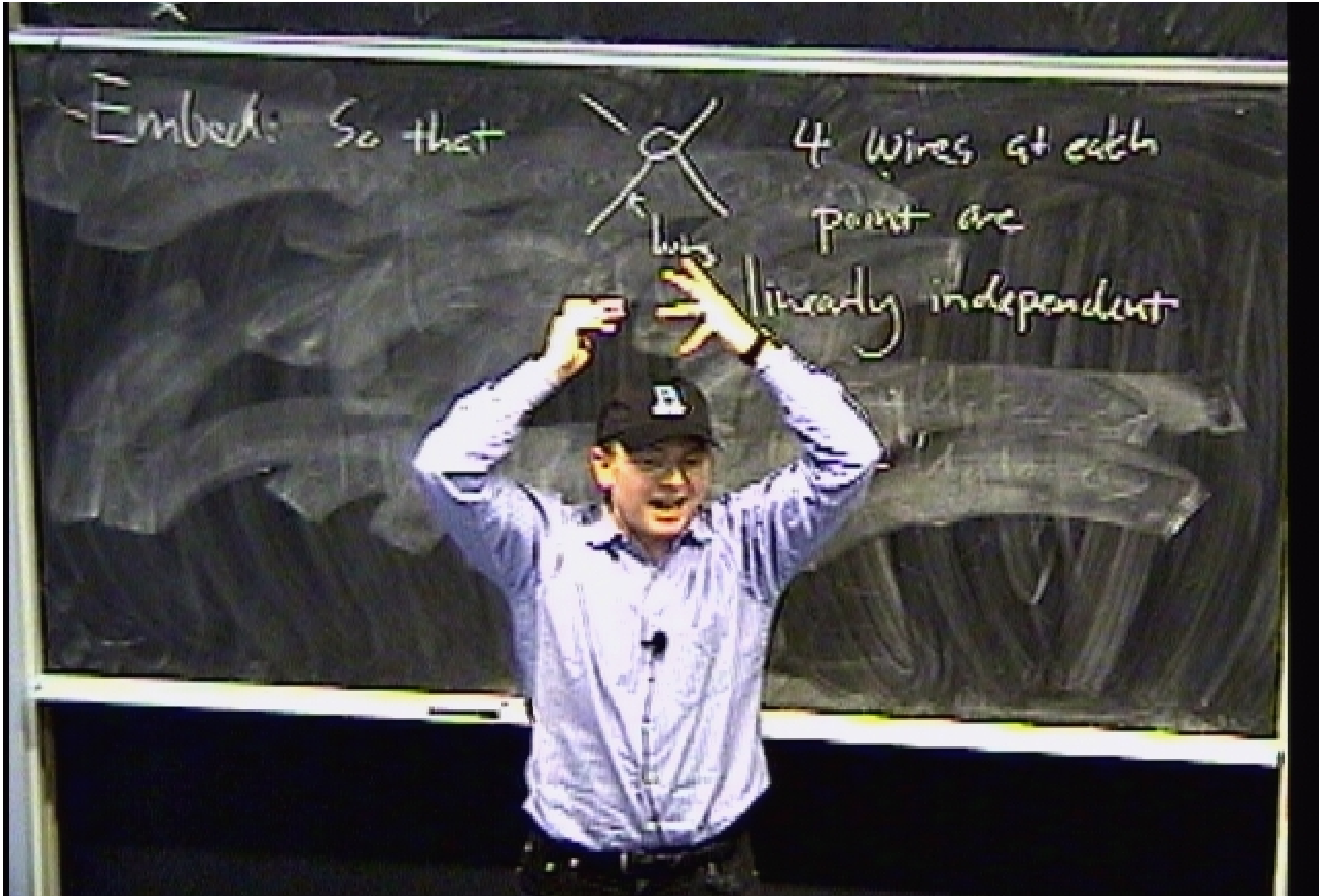

00
01
10
11


00
01
is a 'computational history'
each C_b, b=00,01,10,11


universal
computations)
U_1
U_2
$|0\rangle$ $|0\rangle$ $|0\rangle$ $|0\rangle$
Embed



Embed: So that
4 wires at each
point are
independent


Embed: So that
loop
4 wires at each
point are
linearly independent

Embed: So that

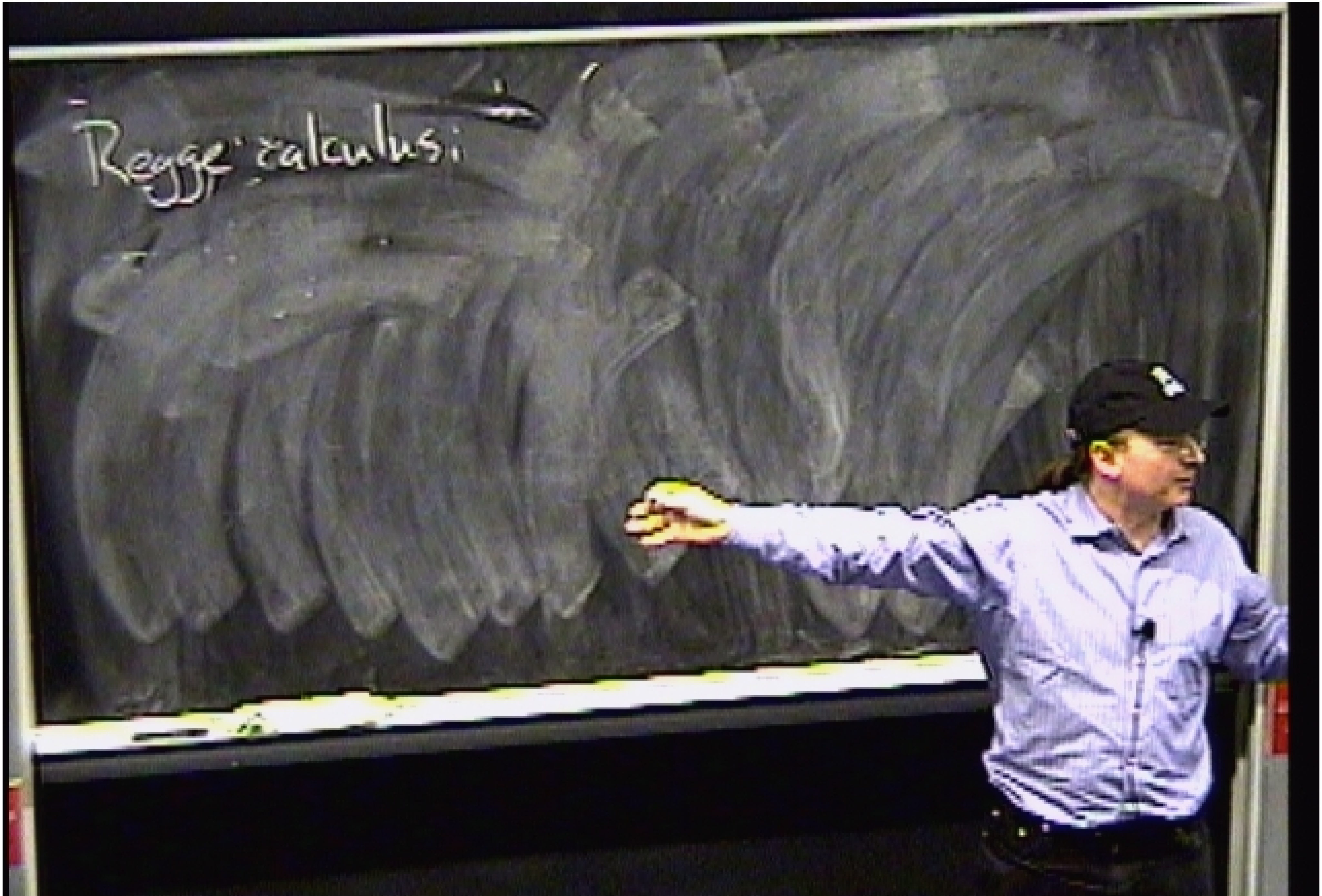
4 wires at each point are linearly independent

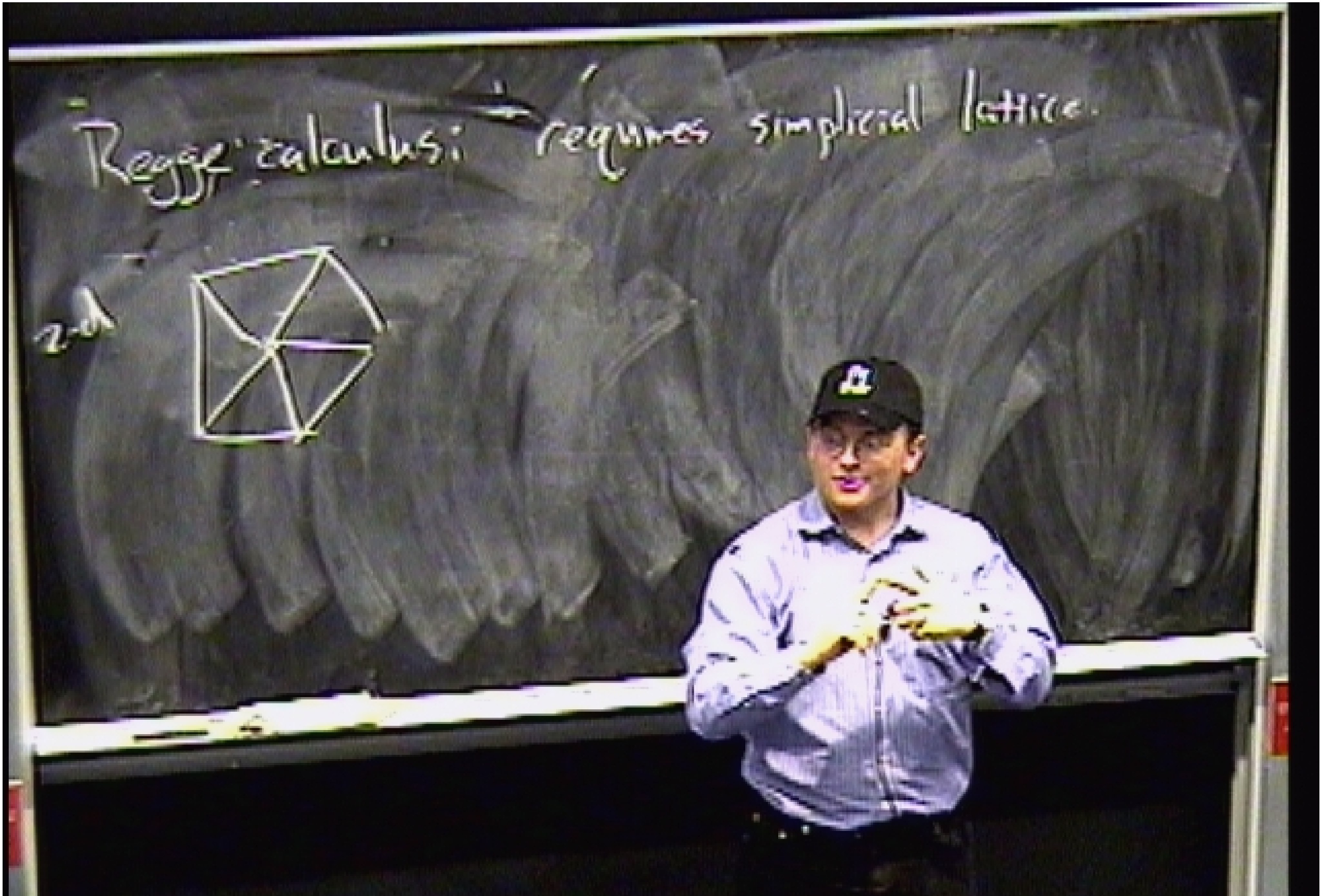
Fact: d null lines determine g_{ab} up to $g_{ab} \to \Omega^2 g_{ab}$ in d dimensions.

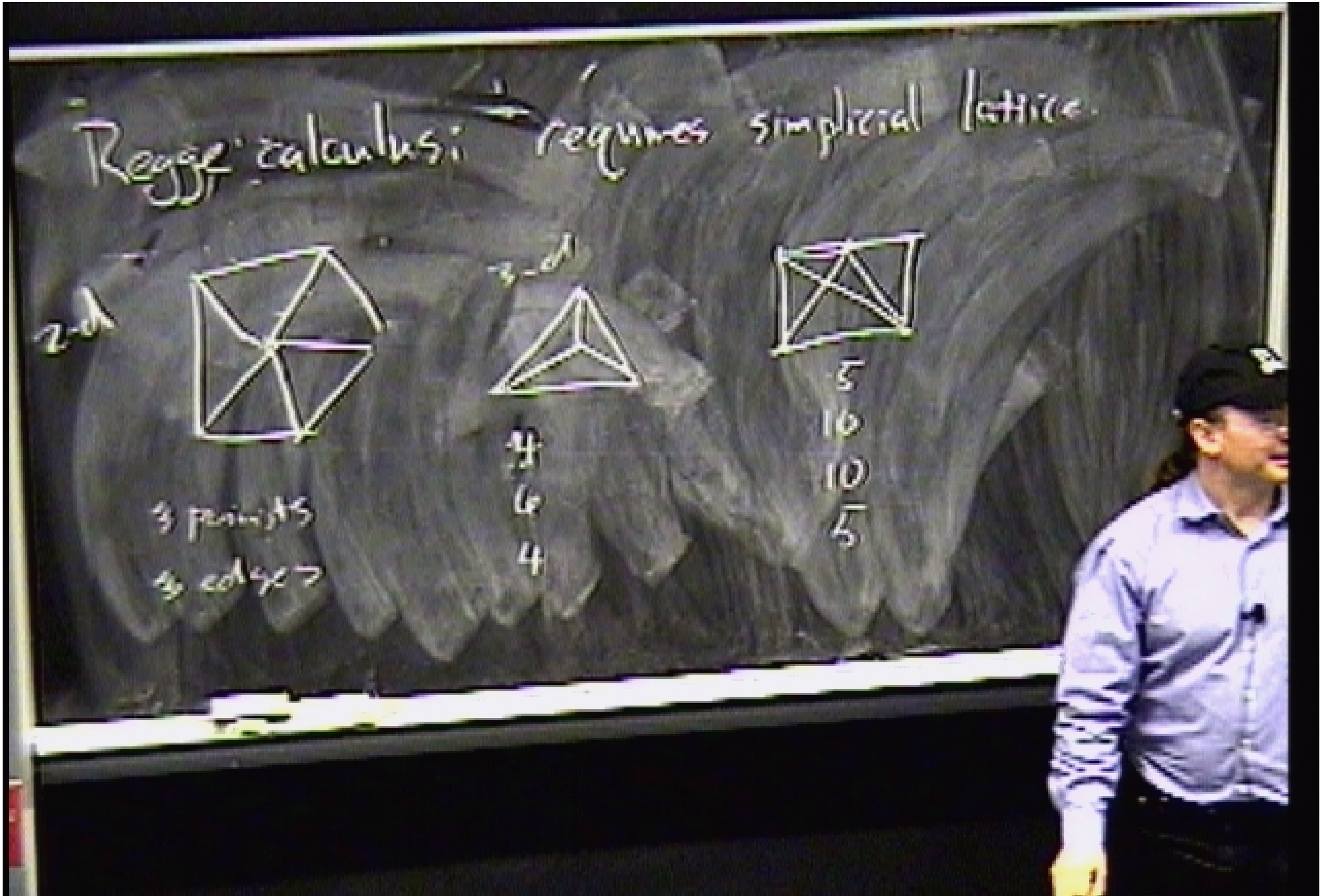
Embed: So that  4 wires at each point are linearly independent

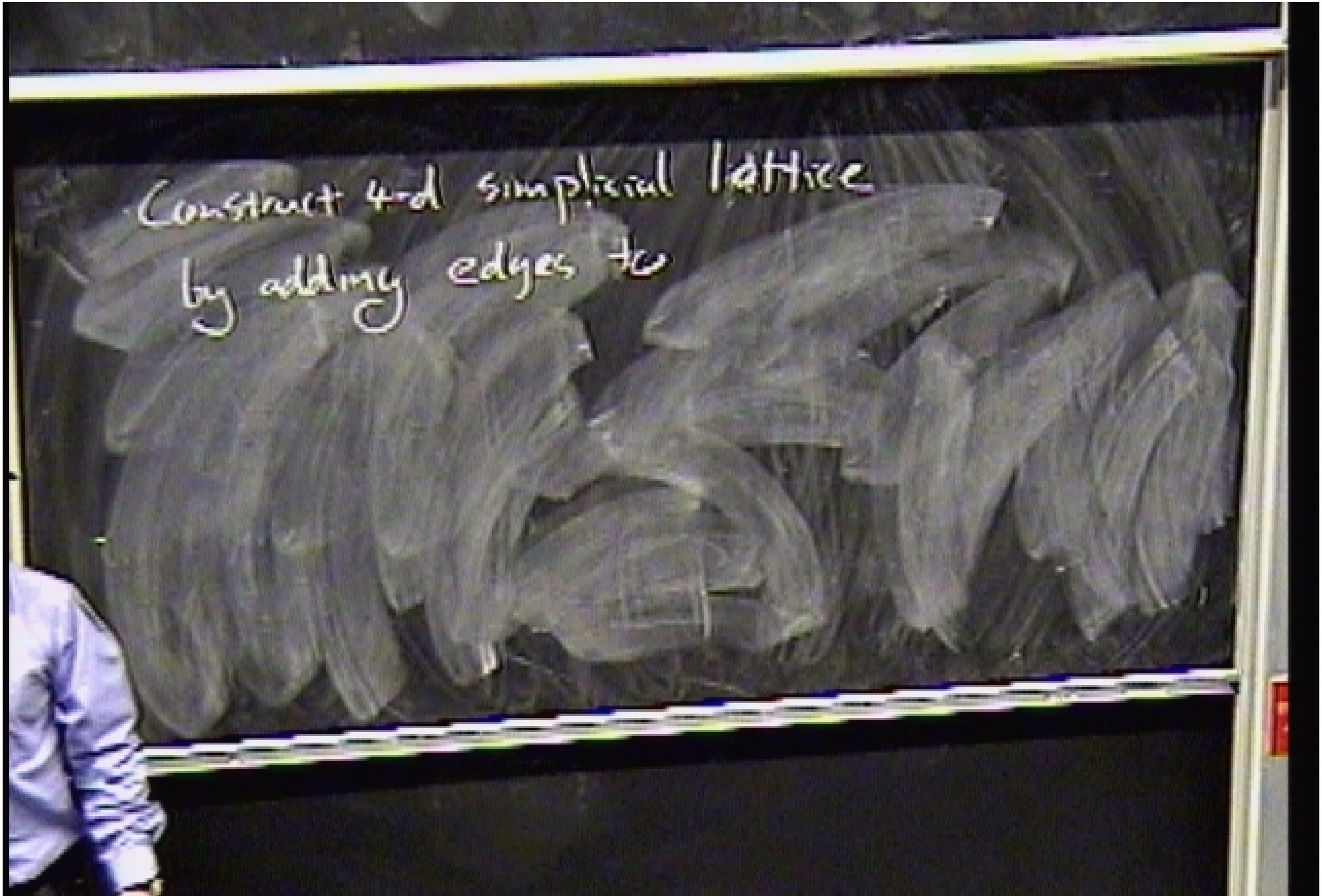
Fact: d null lines determine g_{ab} up to $g_{ab} \to \Omega^2 g_{ab}$ in d dimensions.

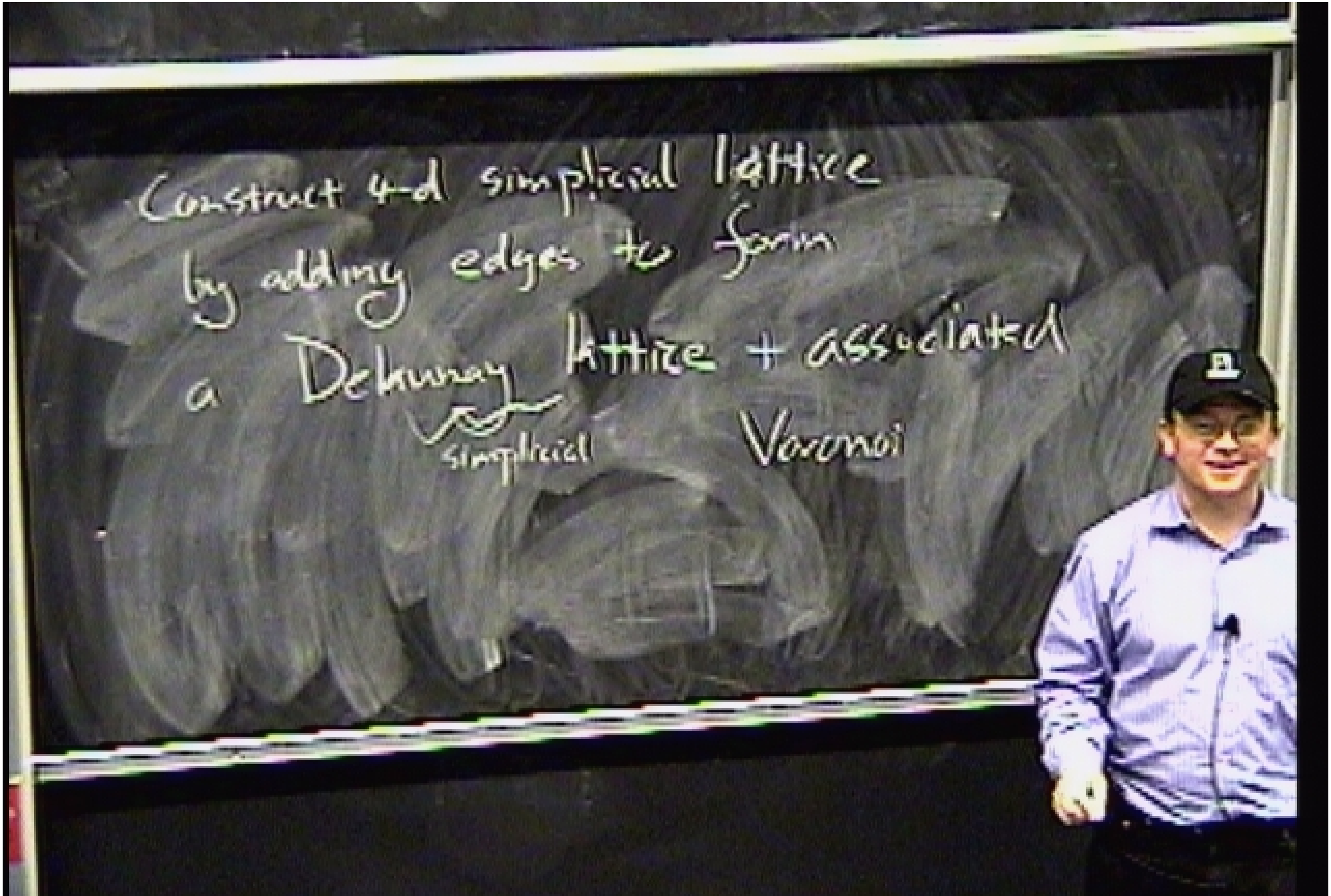
Henceforth take $d = 4$

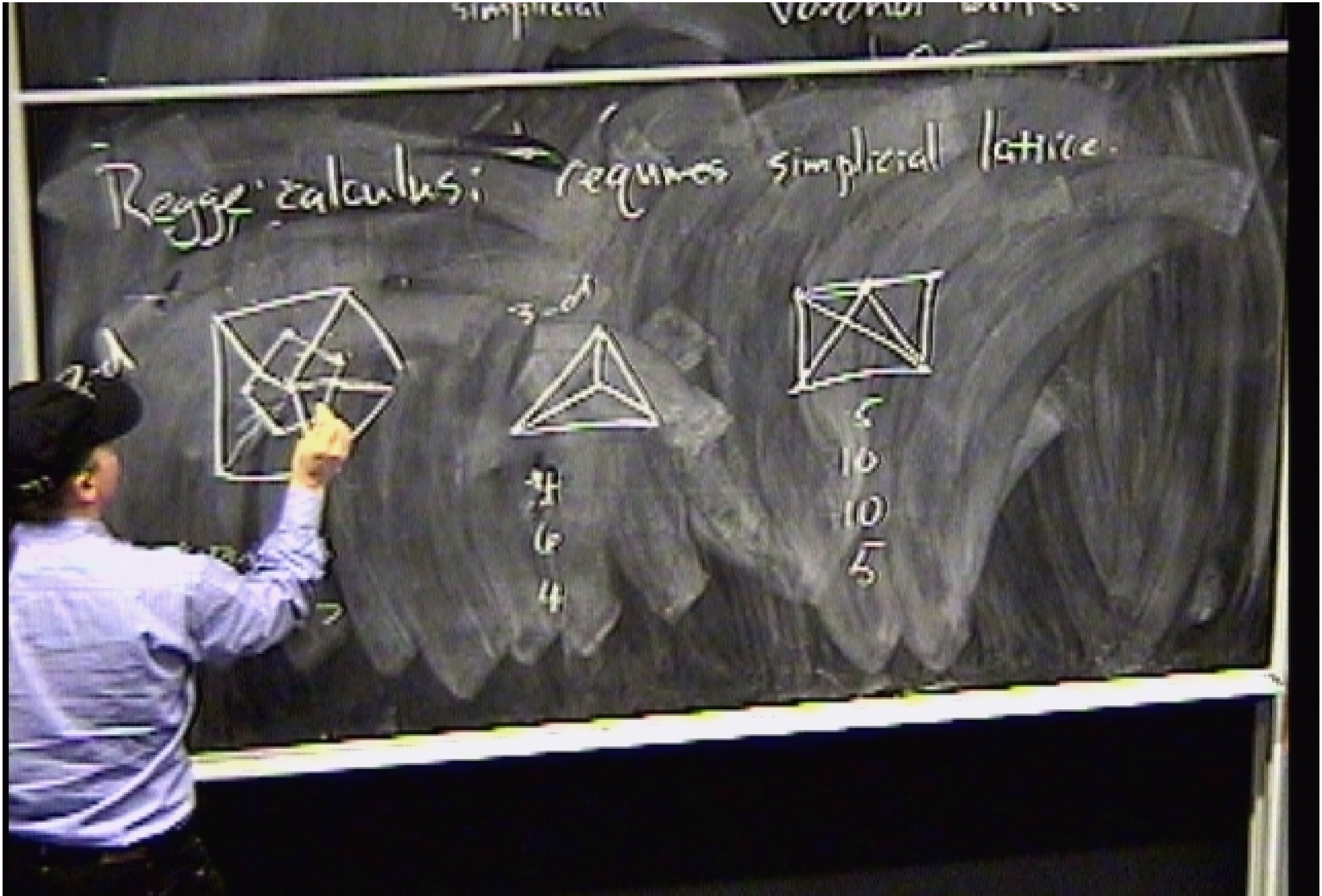

Regge calculus:


Regge calculus: requires simplicial lattice.
2-d


Regge calculus: requires simplicial lattice.
2-d
3-d
3 points
3 edges
4
6
4
5
10
10
5


Construct 4-d simplicial lattice
by adding edges to


Construct 4-d simplicial lattice
by adding edges to form
a Delaunay lattice + associated
simplicial
Voronoi


Regge calculus: requires simplicial lattice.
3-d
4
6
4
5
10
10
5


3 points 6 5
3 edges 4 5

Fixing Ω_ℓ at each vertex ℓ now fixes whole R-calculus.

length $\Downarrow x^a$

g'_{ab}

g_{ab}

$$x^b x^a \tfrac{1}{2}(g_{ab} + g'_{ab})$$

Fixing Ω_ℓ at each vertex ℓ now fixes whole R-calculus.

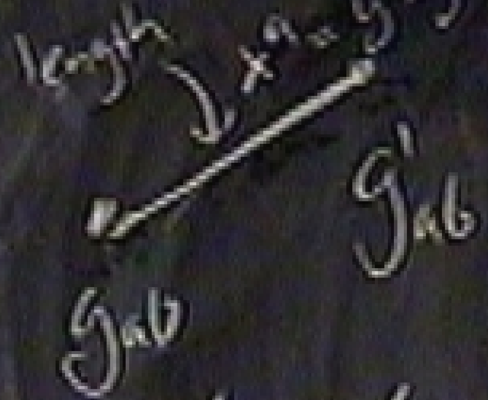
length x^a

g'_{ab}

g_{ab}

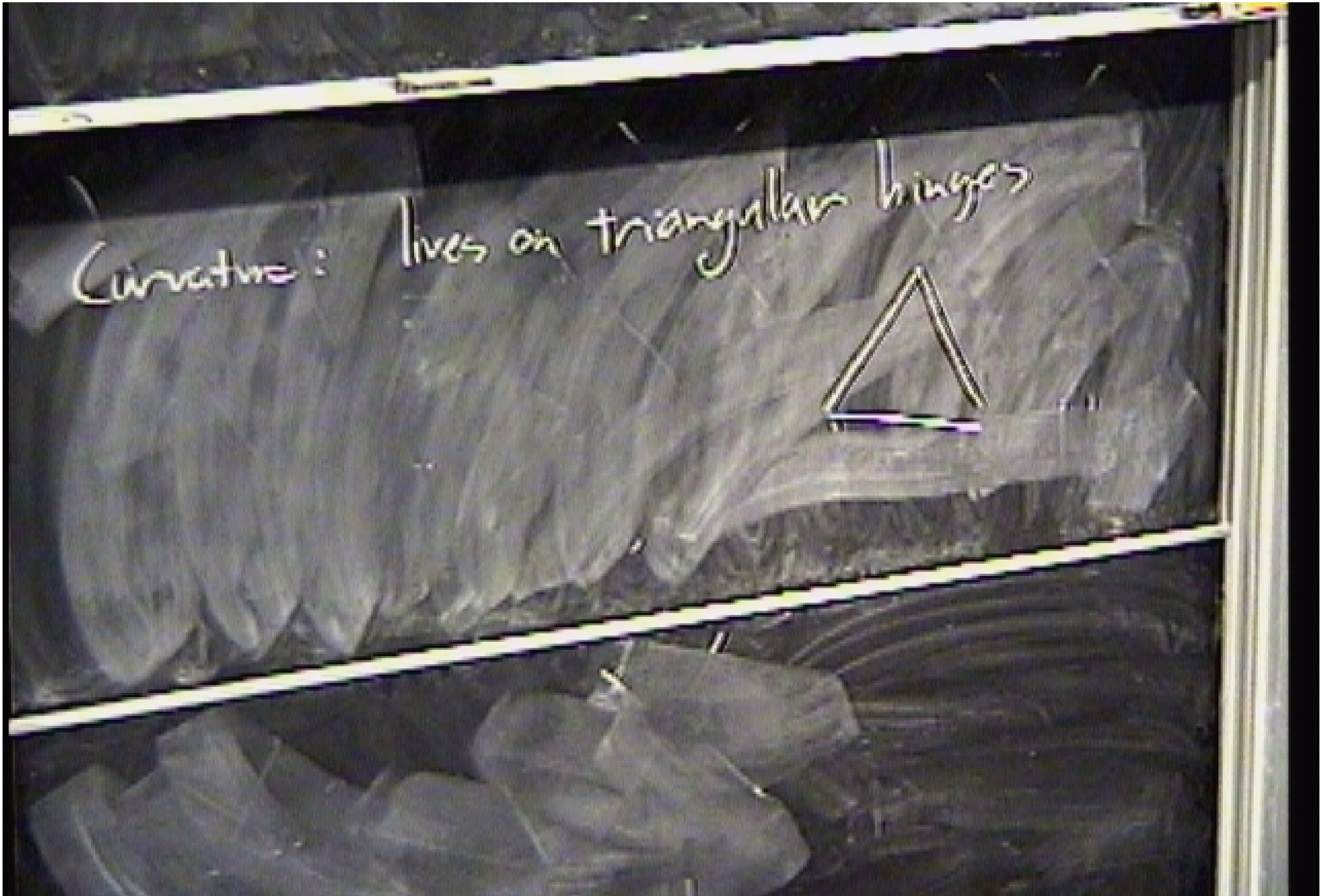
$$\ell^2 = x^b x^a \tfrac{1}{2}\left(g'_{ab} + g_{ab}\right)$$

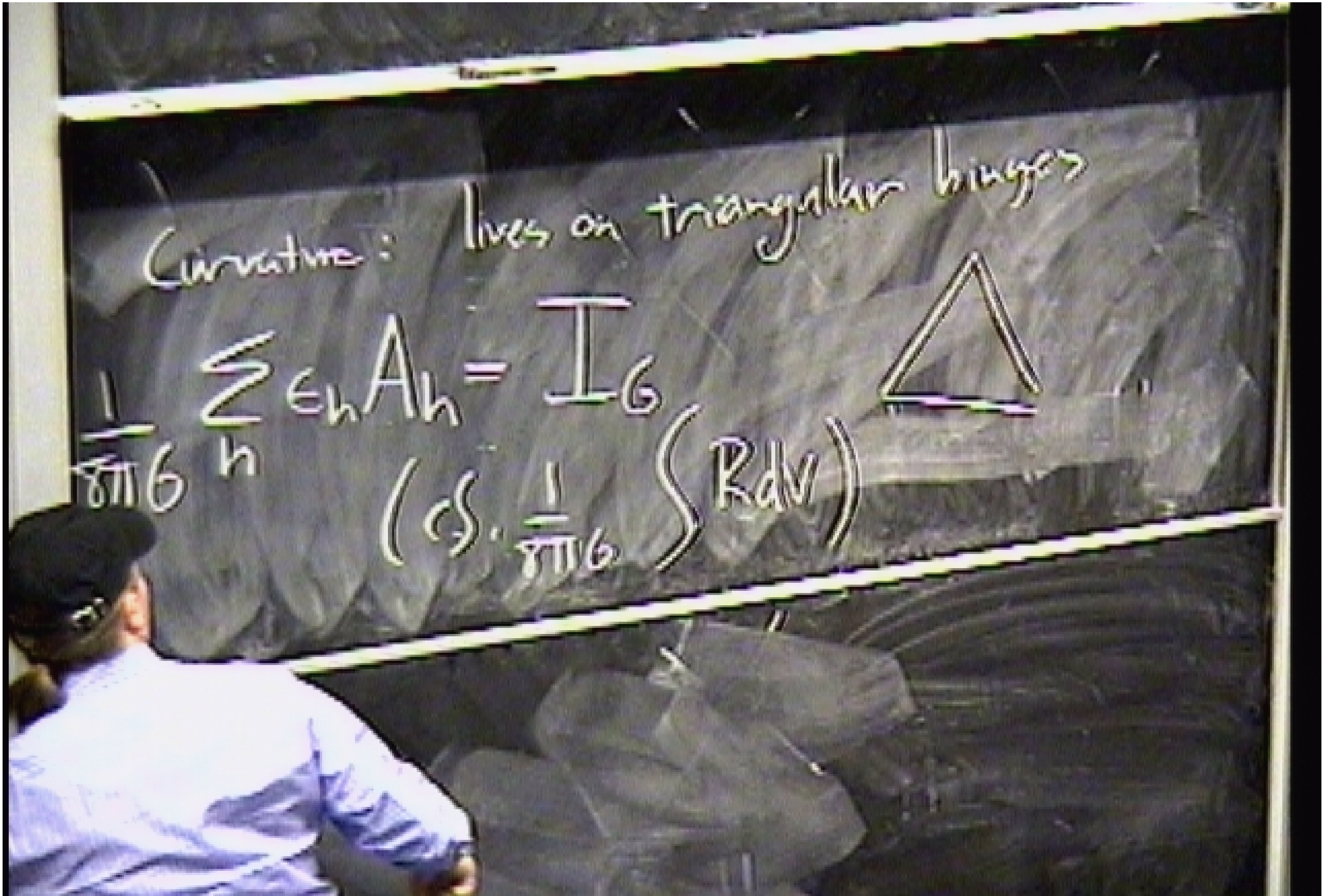
Fixing Ω_ℓ at eac now fixes whole R-calculus.



$\Rightarrow$ curvature is fixed

$$\ell^2 = x^b x^a \tfrac{1}{2}(g_{ab} + g'_{ab})$$


Curvature: lives on triangular hinges


Curvature: lives on triangular hinges
$\frac{1}{8\pi G}\sum_h \epsilon_h A_h = I_G$
$\left(\text{cf. } \frac{1}{8\pi G}\int R\,dV\right)$

Curvature: lives on triangular hinges

A_h = area

$$\frac{1}{8\pi G}\sum_h \epsilon_h A_h = I_G$$

$$\left(\text{c.f. } \frac{1}{8\pi G}\int R\,dv\right)$$

Curvature: lives on triangular hinges

A_h = area

$$\frac{1}{8\pi G}\sum_h \epsilon_h A_h = I_G$$

$$\left(\text{cf. } \frac{1}{8\pi G}\int R\,dV\right)$$

Recall $I_G = \frac{1}{8\pi G}\sum_\ell \theta_\ell$

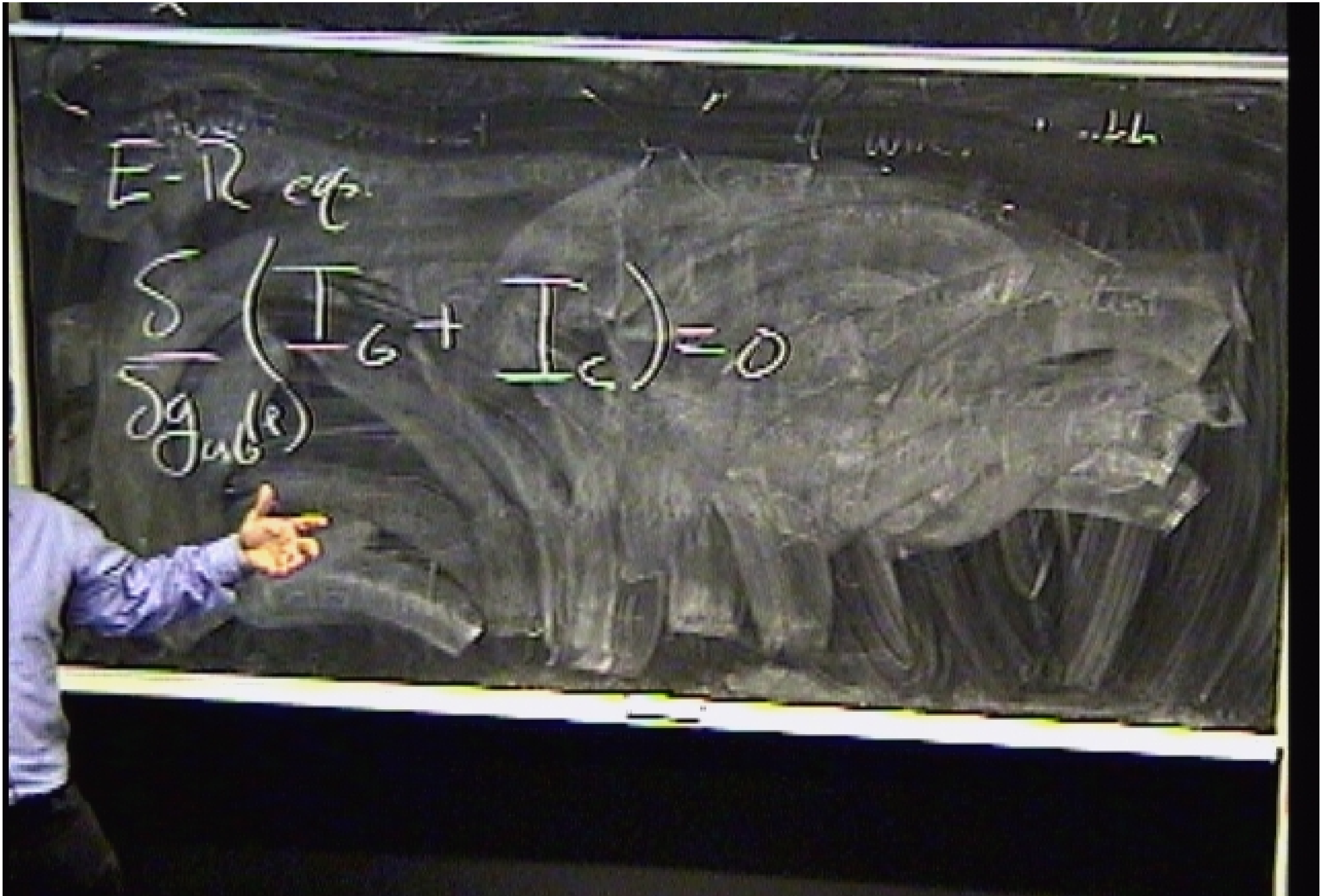
Curvature: lives on triangular hinges

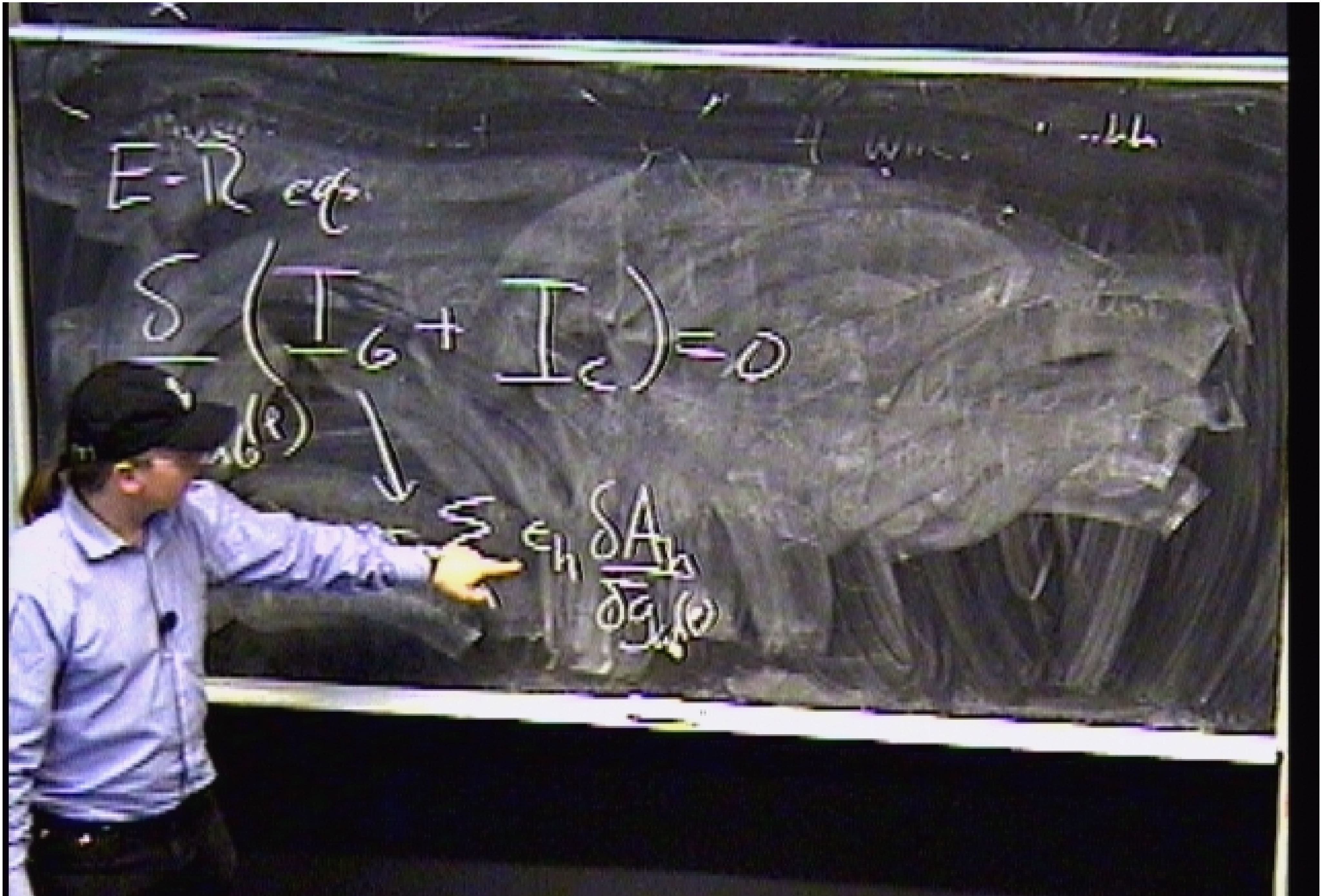
A_h = area

$$\frac{1}{8\pi G}\sum_h \epsilon_h A_h = I_G$$

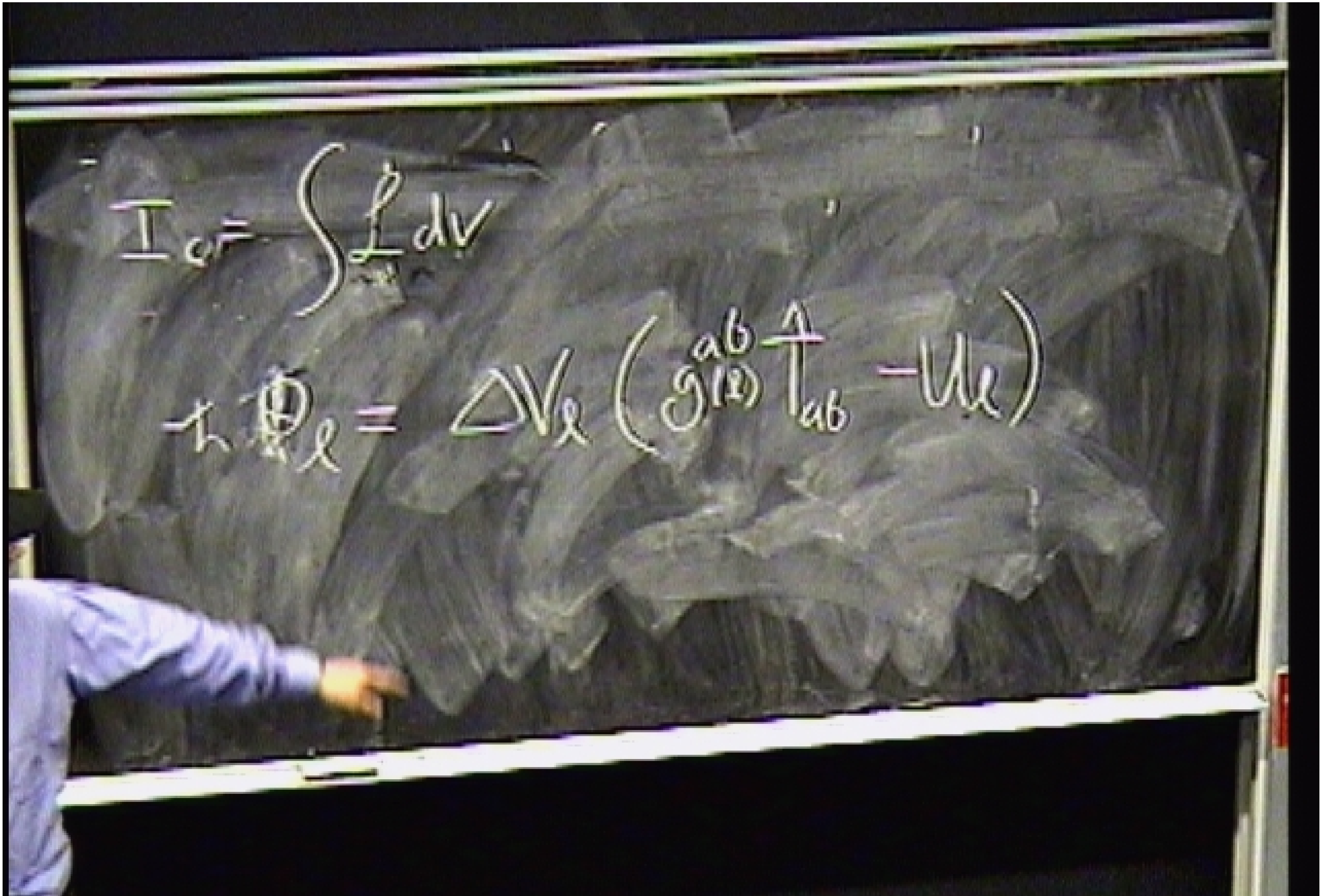
$$\left(\text{cf. } \frac{1}{8\pi G}\int R\,dV\right)$$

Recall $I_c = \cancel{h}\sum_\ell \theta_\ell \quad (= \text{'}E t_\ell\text{'})$


E-R eqn.
$\frac{\delta}{\delta g_{ab}(x)}\left(I_G + I_c\right) = 0$



E-R eq.

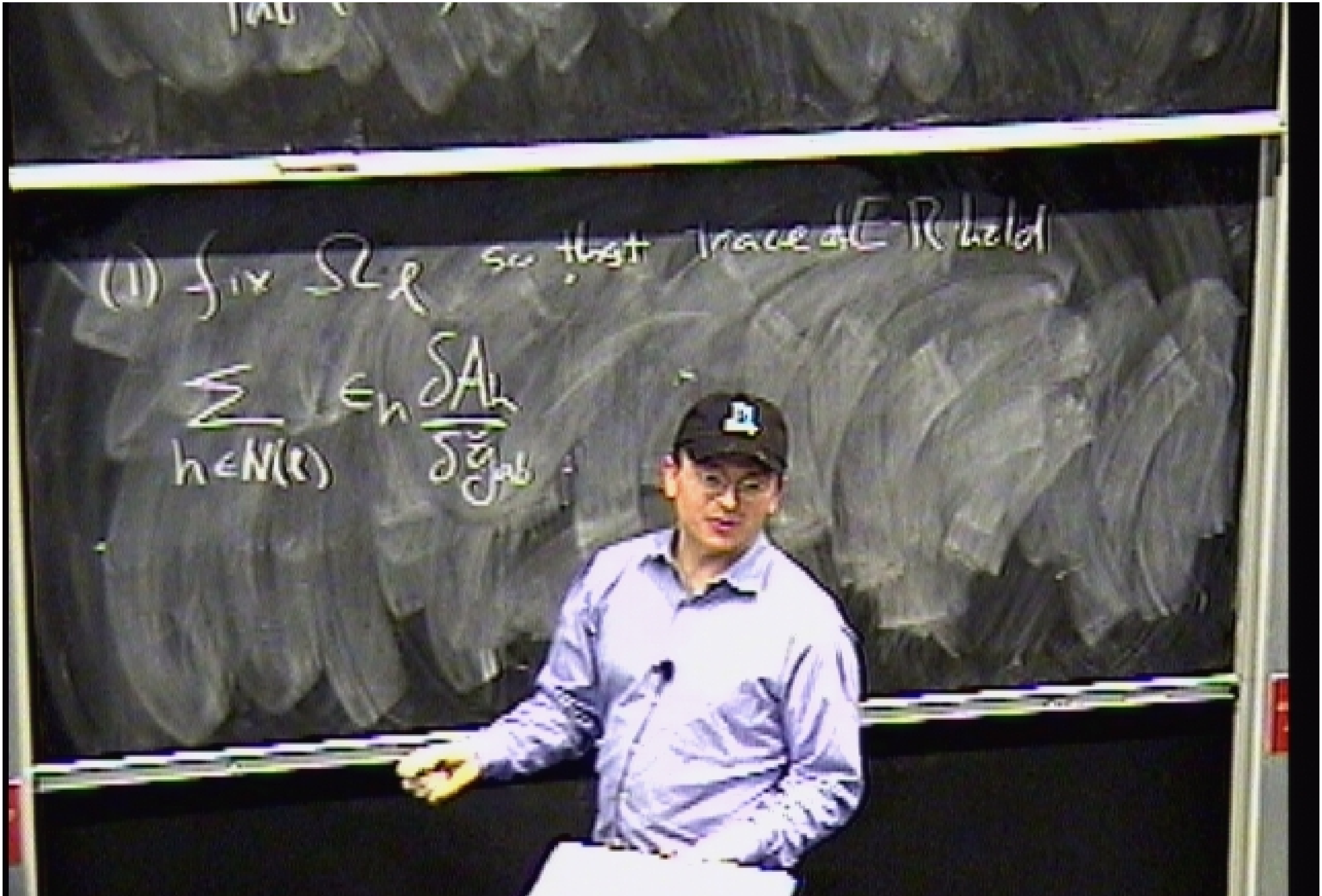

$I_G = \int \mathcal{L}\, dV$
$-t\,\Phi_\ell = \Delta V_\ell \left(g^{ab}_{(1)} \hat{t}_{ab} - U_\ell \right)$

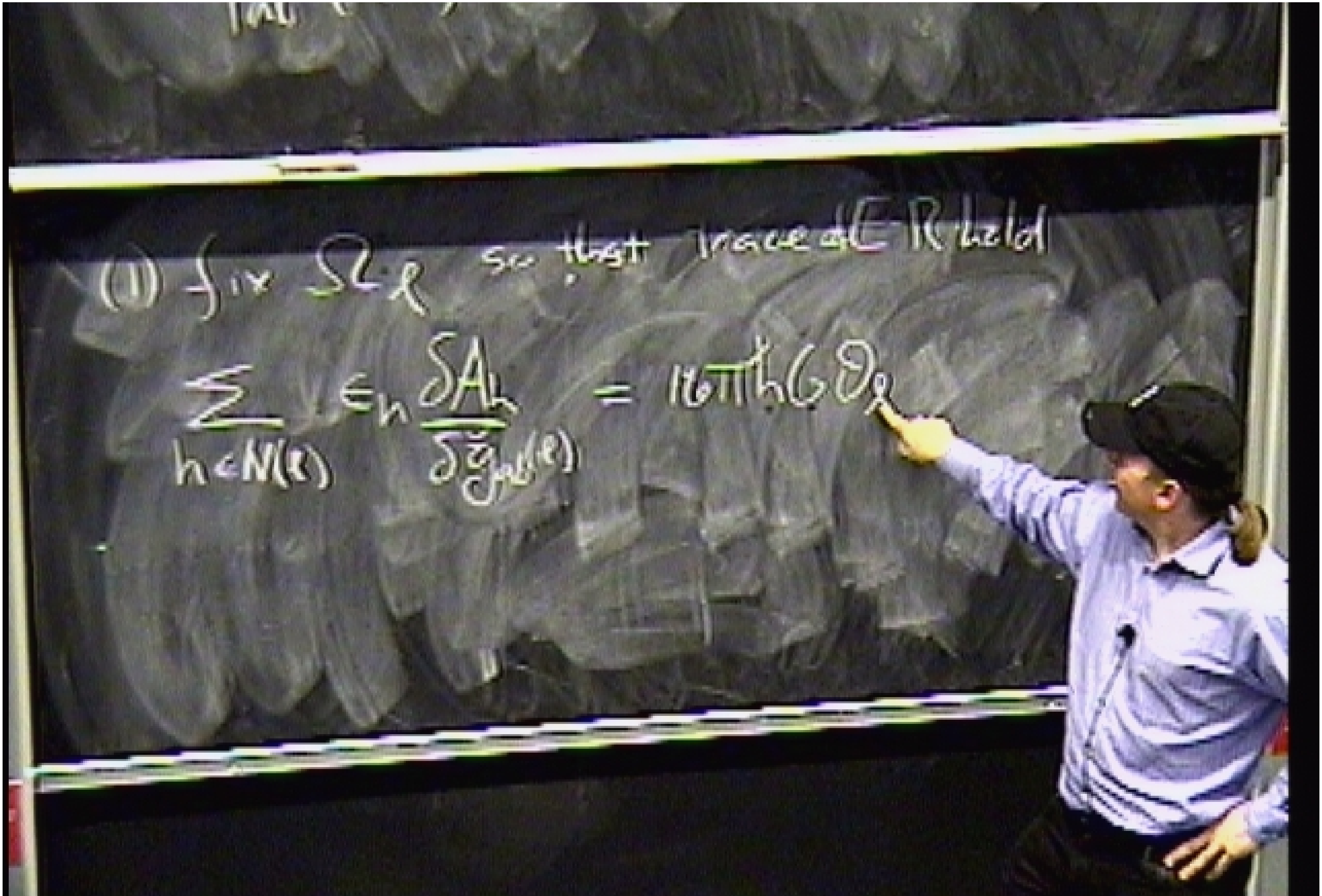
$$I_{cr} = \int \mathcal{L}\, dV$$

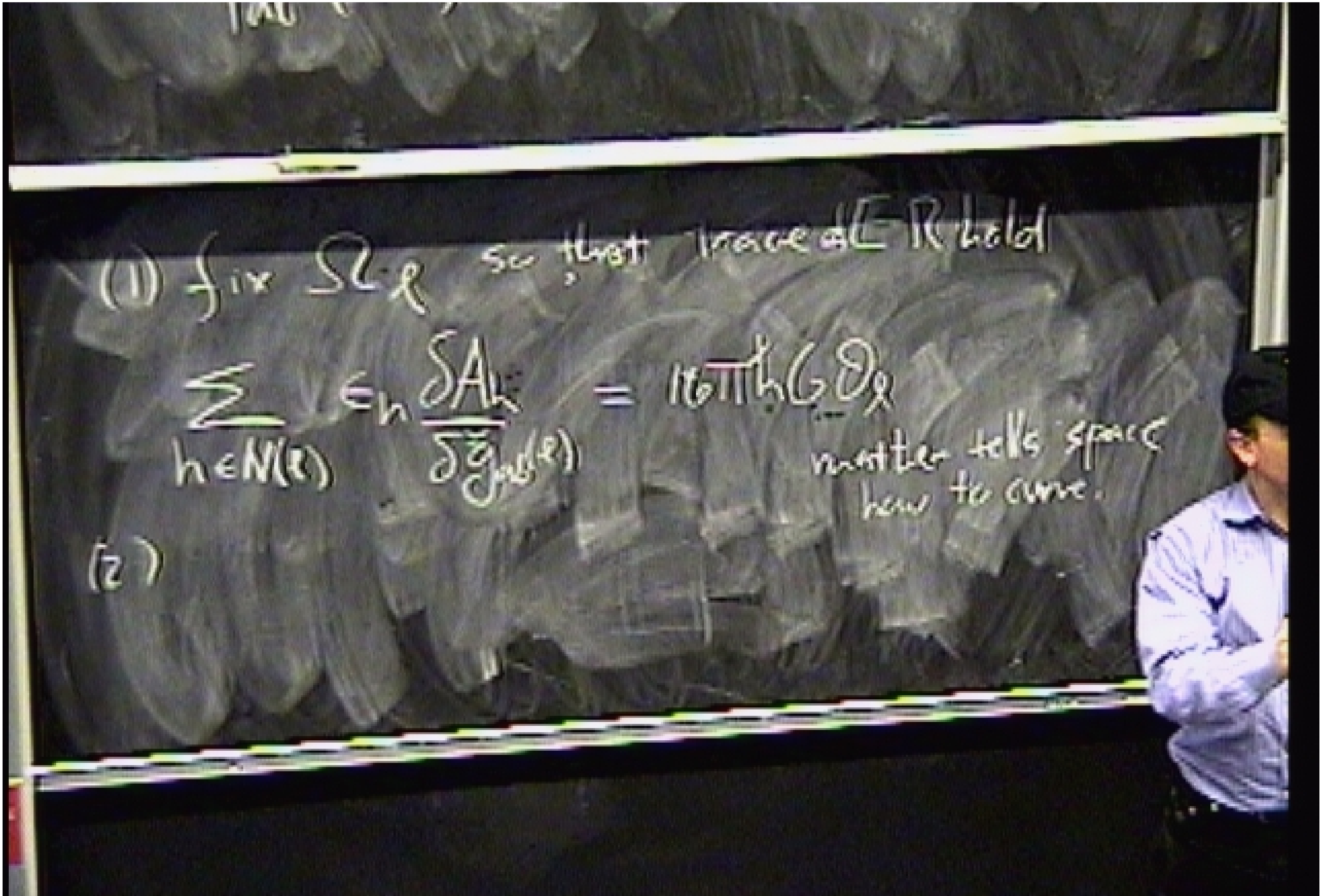
KE   PE

$$-\hbar\, \Phi_\ell = \Delta V_\ell \left(\underbrace{g^{ab}_{(2)}}_{0}\, \hat{t}_{ab} - U_\ell \right)$$

$\hat{t}_{ab}$ (KE) is some traceless tensor.


(1) fix
so that


(1) fix Ωℓ so that trace of E R held
Σ h∈N(ℓ) ϵh δAh / δξ = 16πhG θℓ


(1) fix Ω_ℓ so that
Σ_{h∈N(ℓ)} ε_h δA_h / δξ_ℓ = 16πħG Θ_ℓ
matter tells space how to curve.
(2)

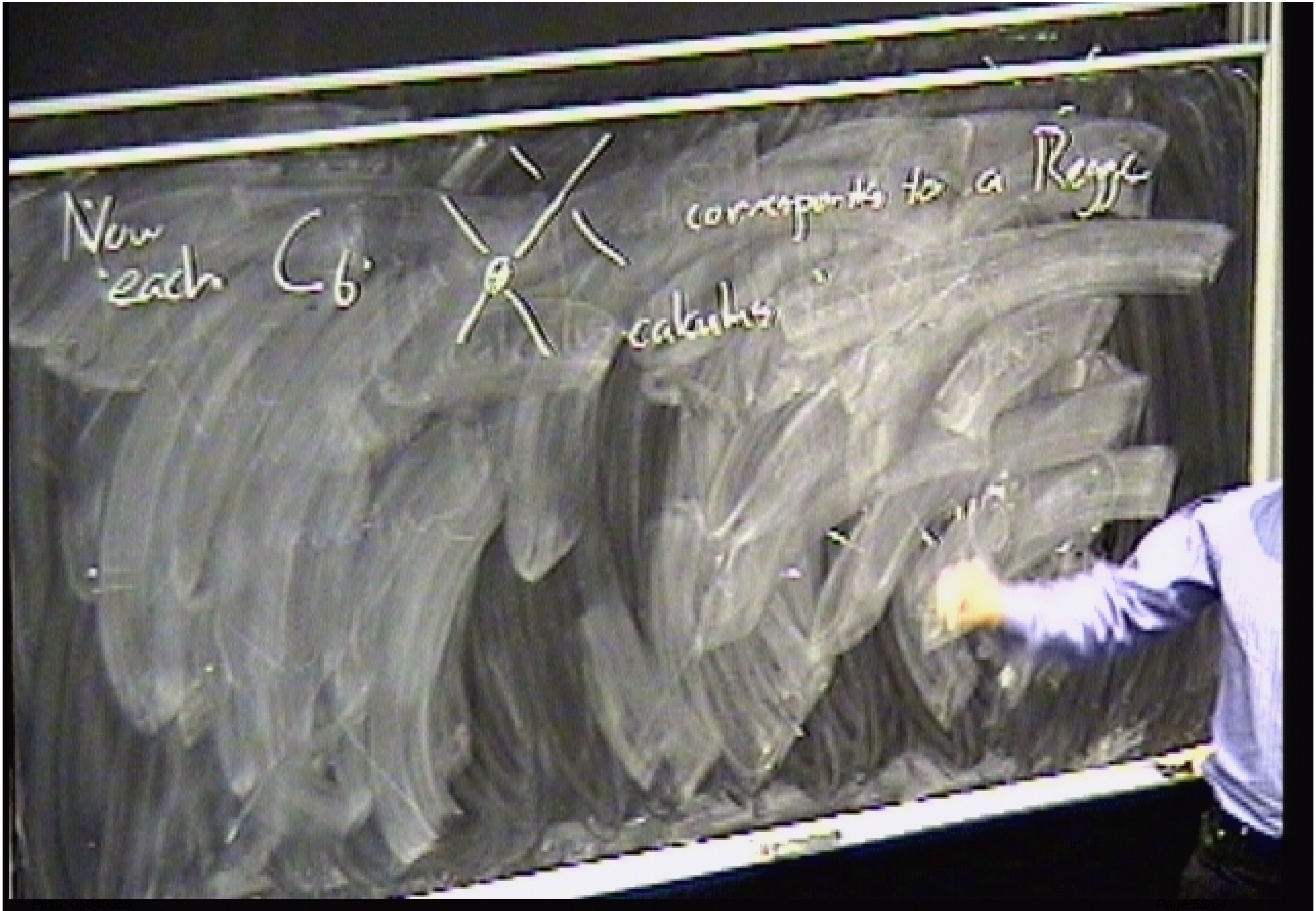
(1) fix Ω_ℓ so that trace of E-R hold

$$\sum_{h \in N(\ell)} \epsilon_h \frac{\delta A_h}{\delta \tilde{g}_{ab}(e)} = 16\pi \hbar G\, \theta_\ell$$

matter tells space how to curve.

(2) assign $\hat{T}_{ab}$ so that the rest of E-R eqs. hold $\left(T^{ab}{}_{;b} = 0 \right)$

Now each C_6:  corresponds to a Regge calculus that obeys "E-R"


Now each C_6:
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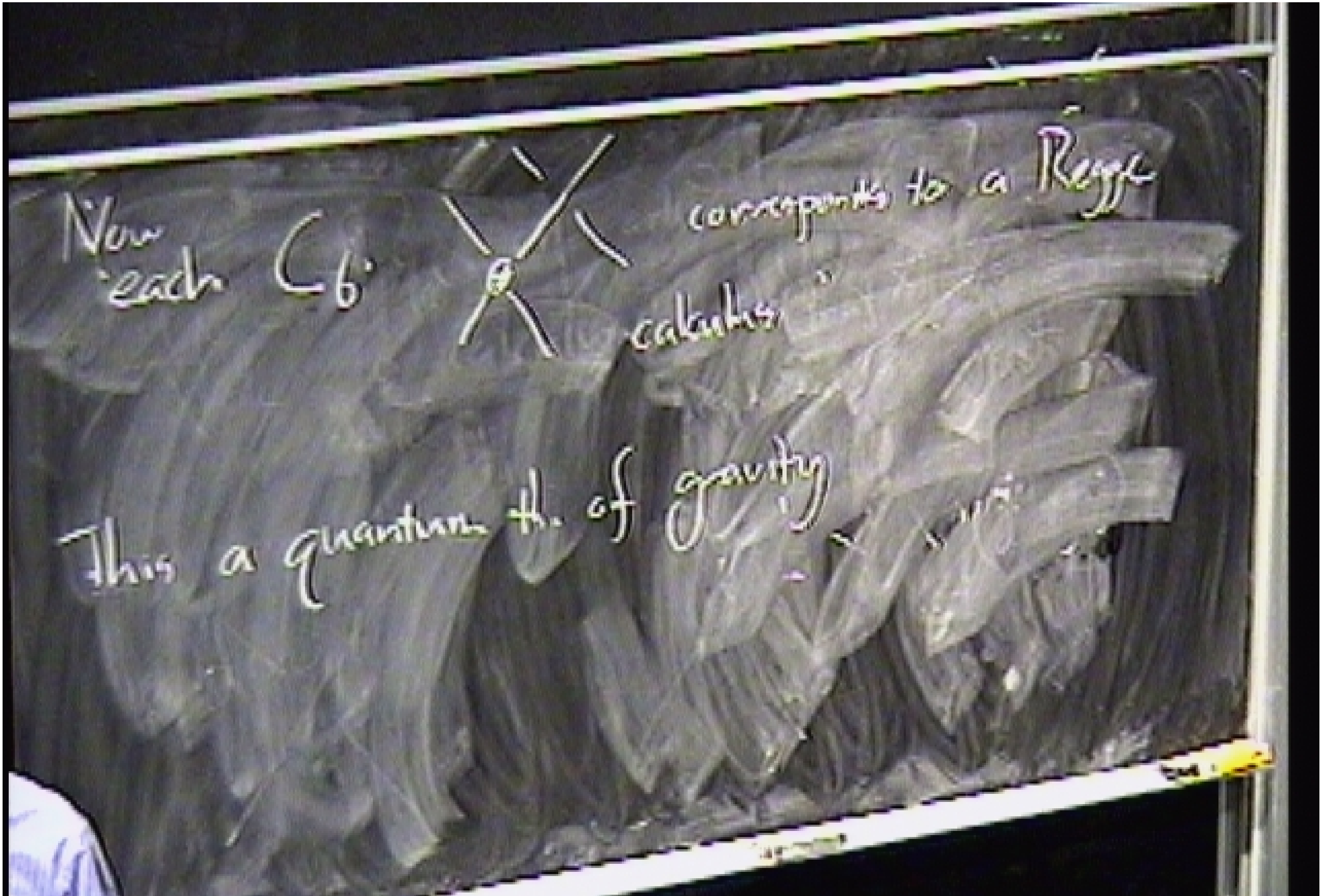

Now each C_6:
corresponds to a Regge calculus
This a quantum th. of gravity

(1) fix Ω_ℓ so that trace of E-R hold

$$\sum_{h \in N(\ell)} \epsilon_h \frac{\delta A_h}{\delta \xi_{h(\ell)}} = 16\pi \hbar G \theta_\ell \quad = 16\pi G \left(\text{"}E\delta t\text{"} \right.$$

matter tells space how to curve.

(2) assign $\hat{T}_{ab}$ so that the rest of E-R eqs. hold $\left(\hat{T}^{ab}{}_{;b} = 0 \right)$

Now each C_6:  corresponds to a Regge calculus

This a quantum th. of gravity
provides a theory of back reaction

Now each C_6:  corresponds to a Regge calculus

This a quantum th. of gravity

provides a theory of: • back reaction

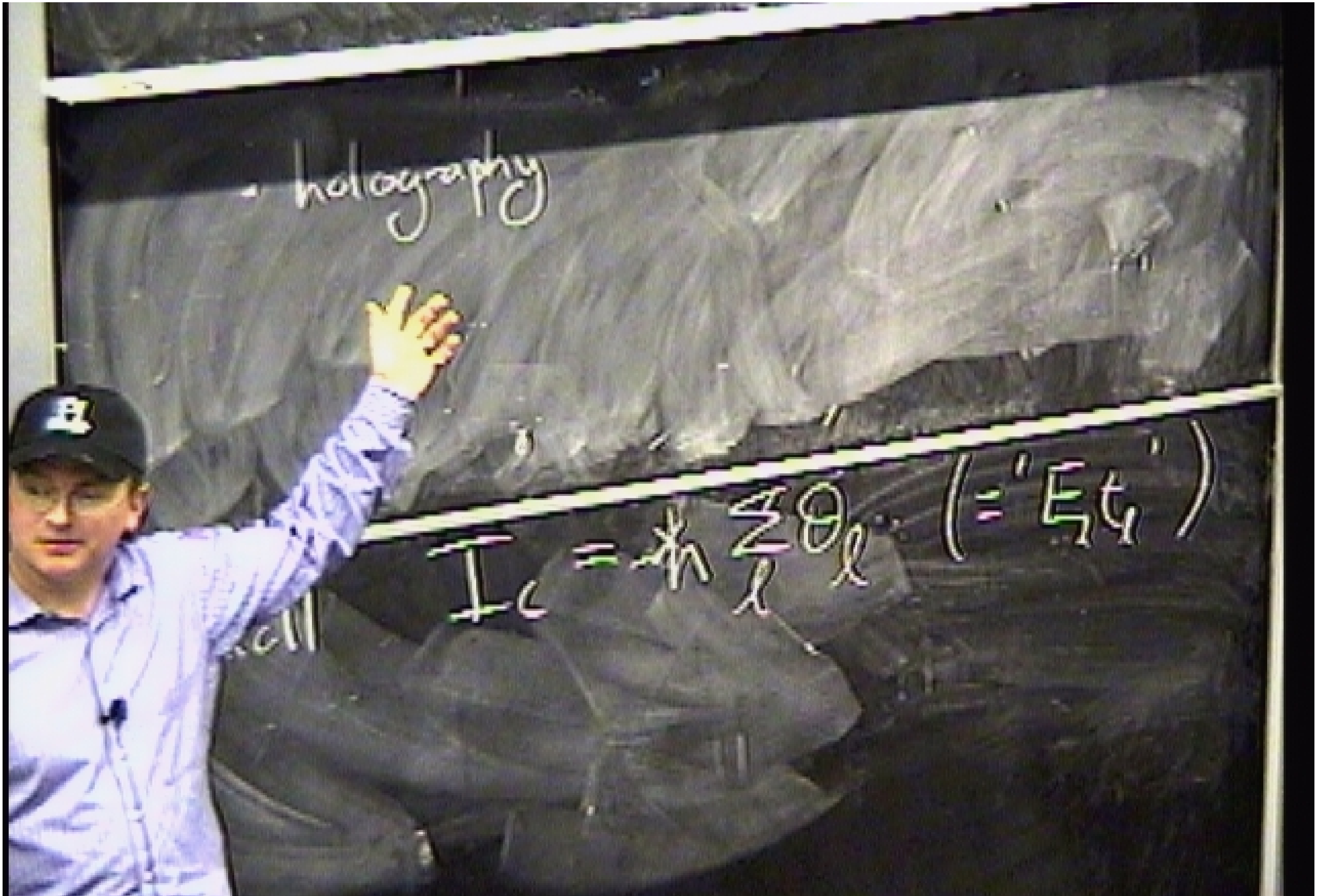
• black hole evaporation

Now each C_6:  corresponds to a Regge calculus

This a quantum th. of gravity provides a theory of : back reaction : black hole evaporation ; primordial curvature fluct.

hinges>

A_ℓ = area


holography
$I_c = \hbar \sum_l \theta_l$ ('= E_4')