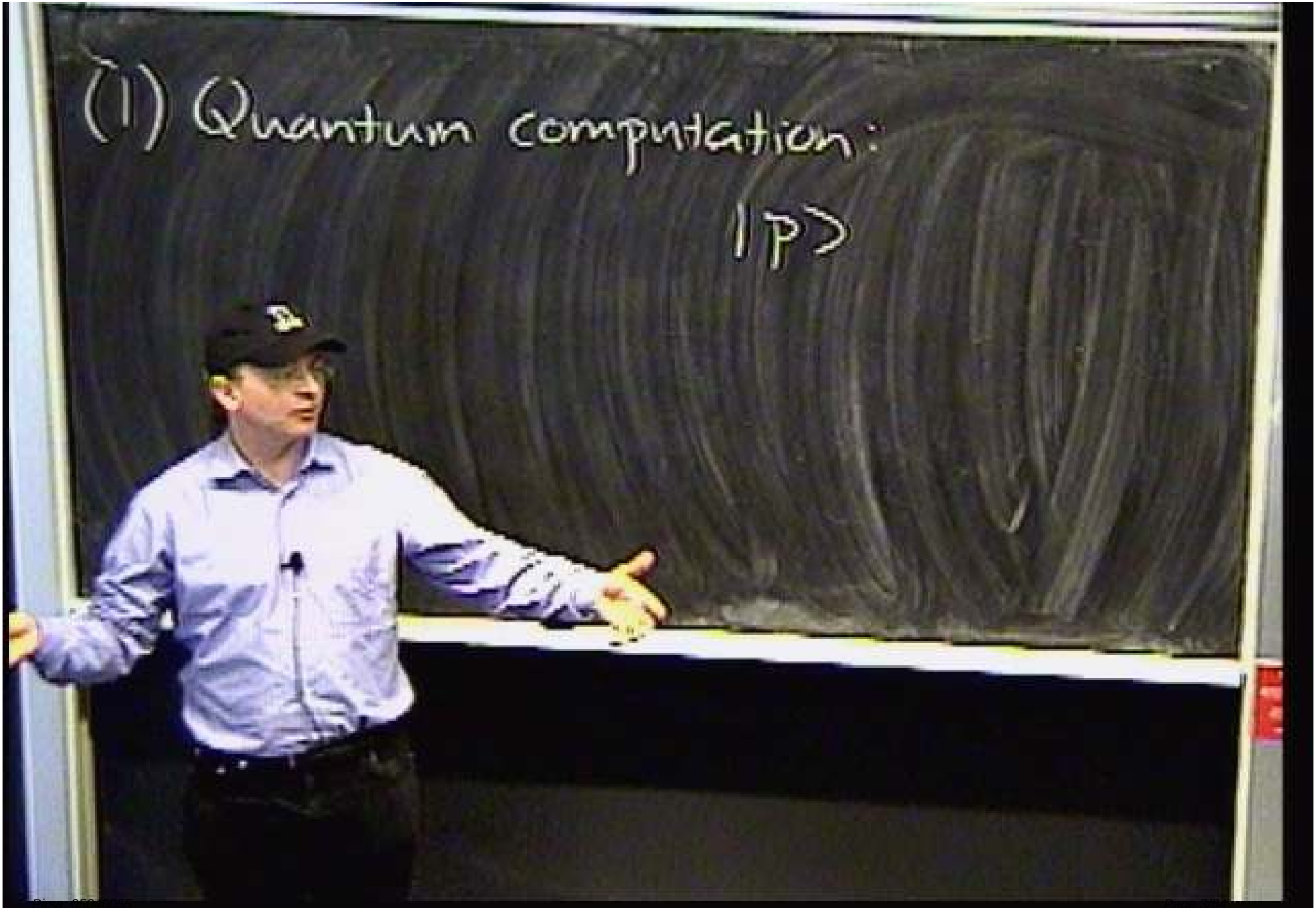
Title: Interpretation of Quantum Theory: Lecture 26 (Bonus)

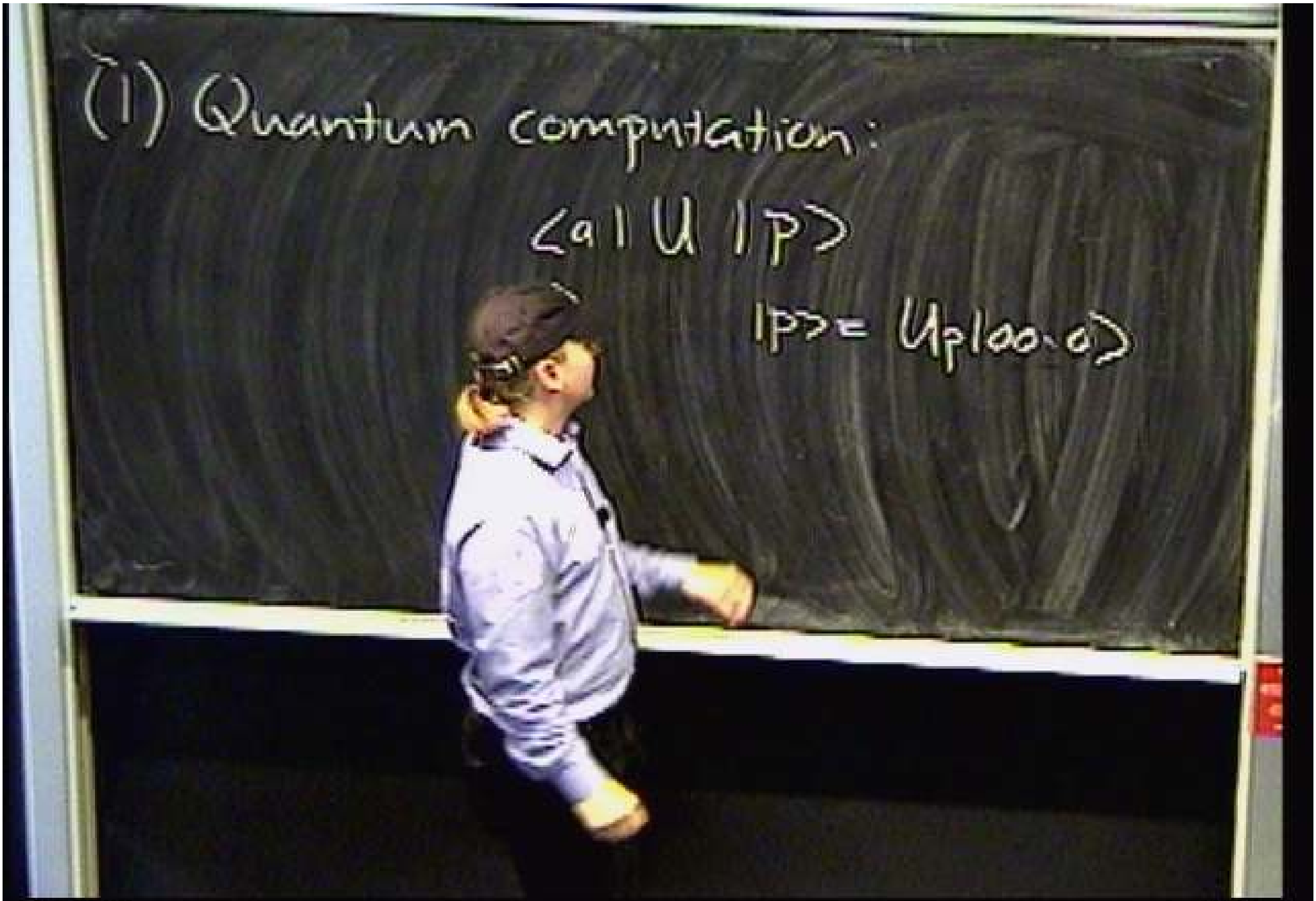
Date: Apr 12, 2005 04:00 PM

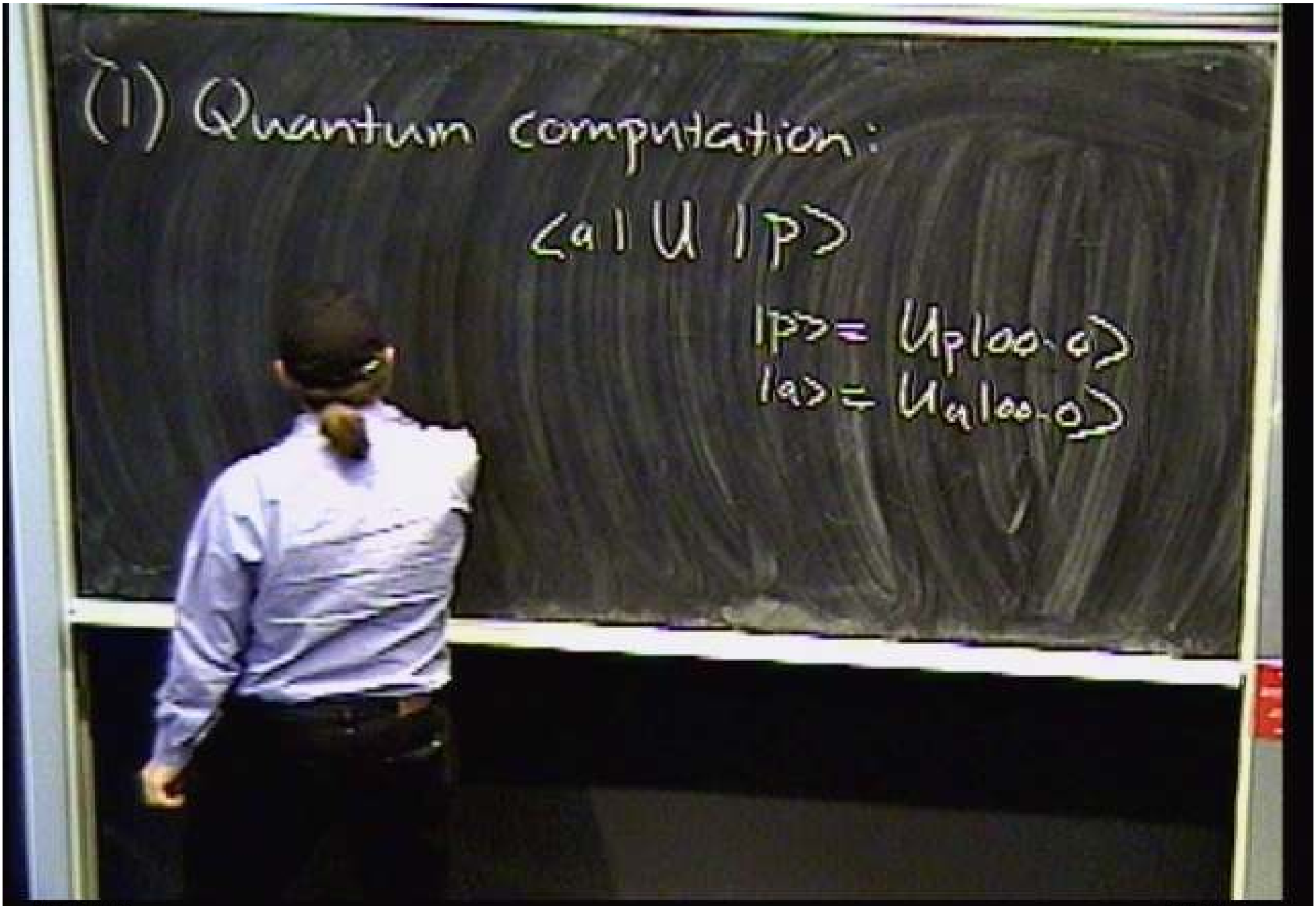
URL: http://pirsa.org/05040055

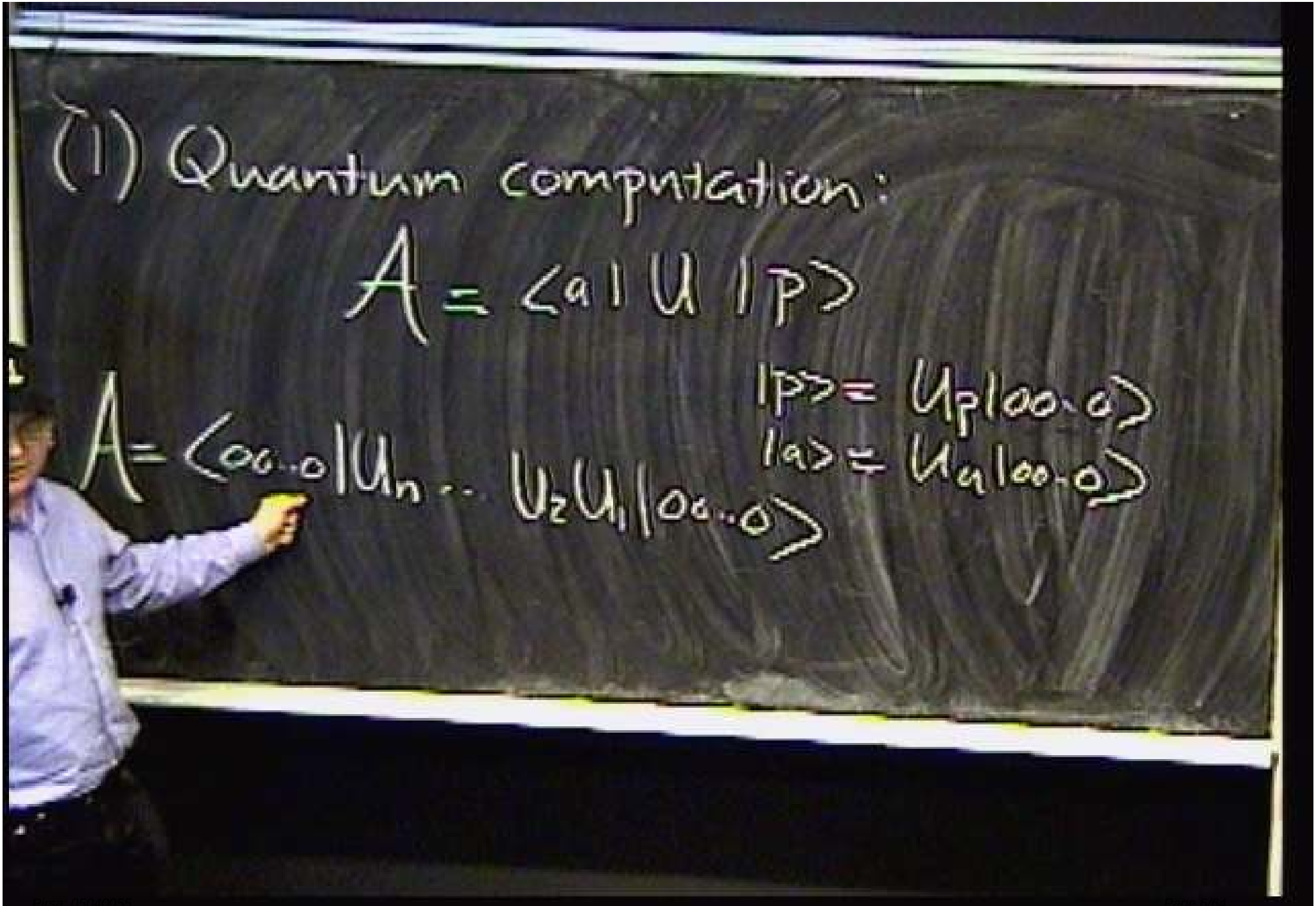
Abstract:

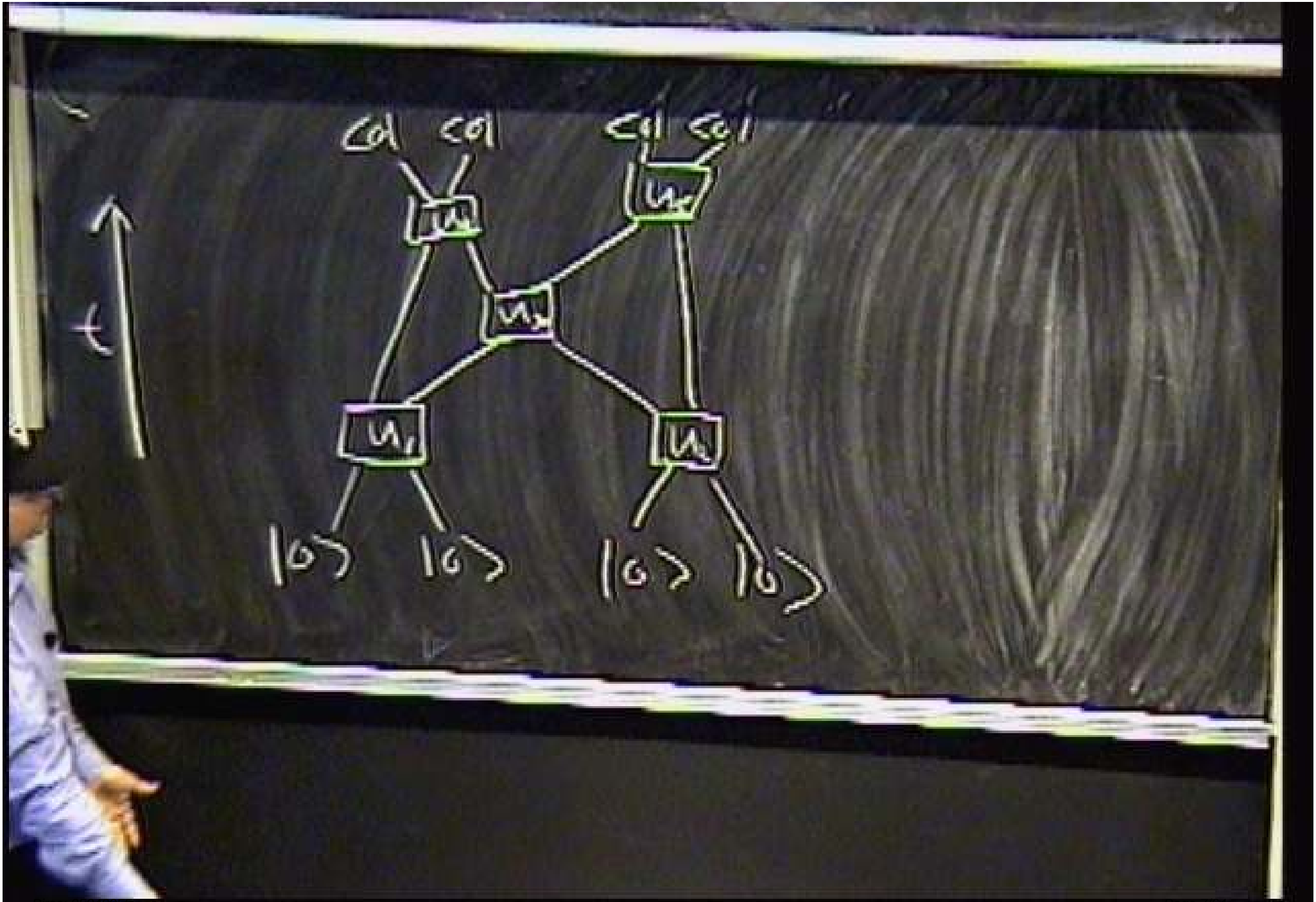
(1) Quantum computation:

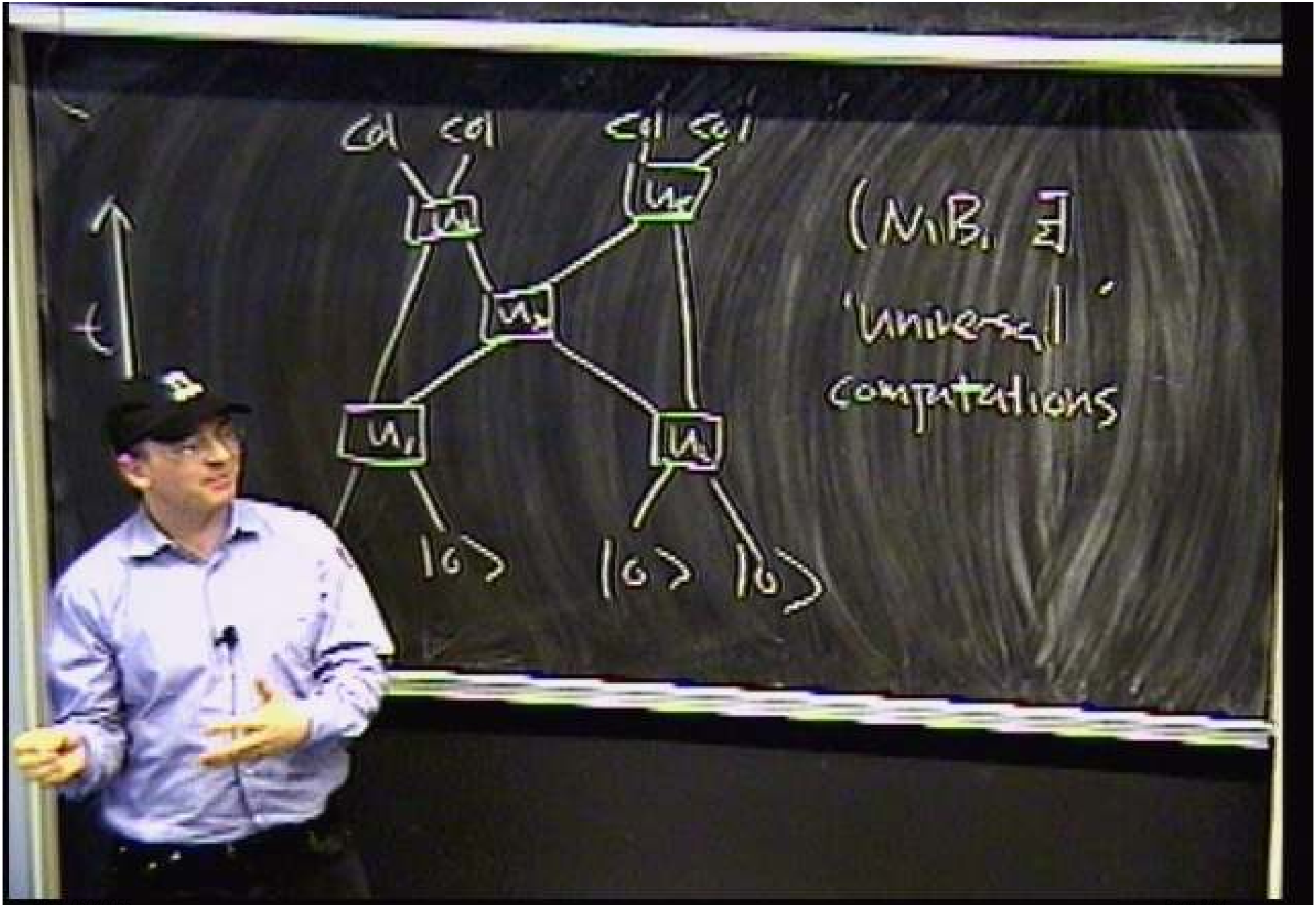

(1) Quantum computation:
|p>

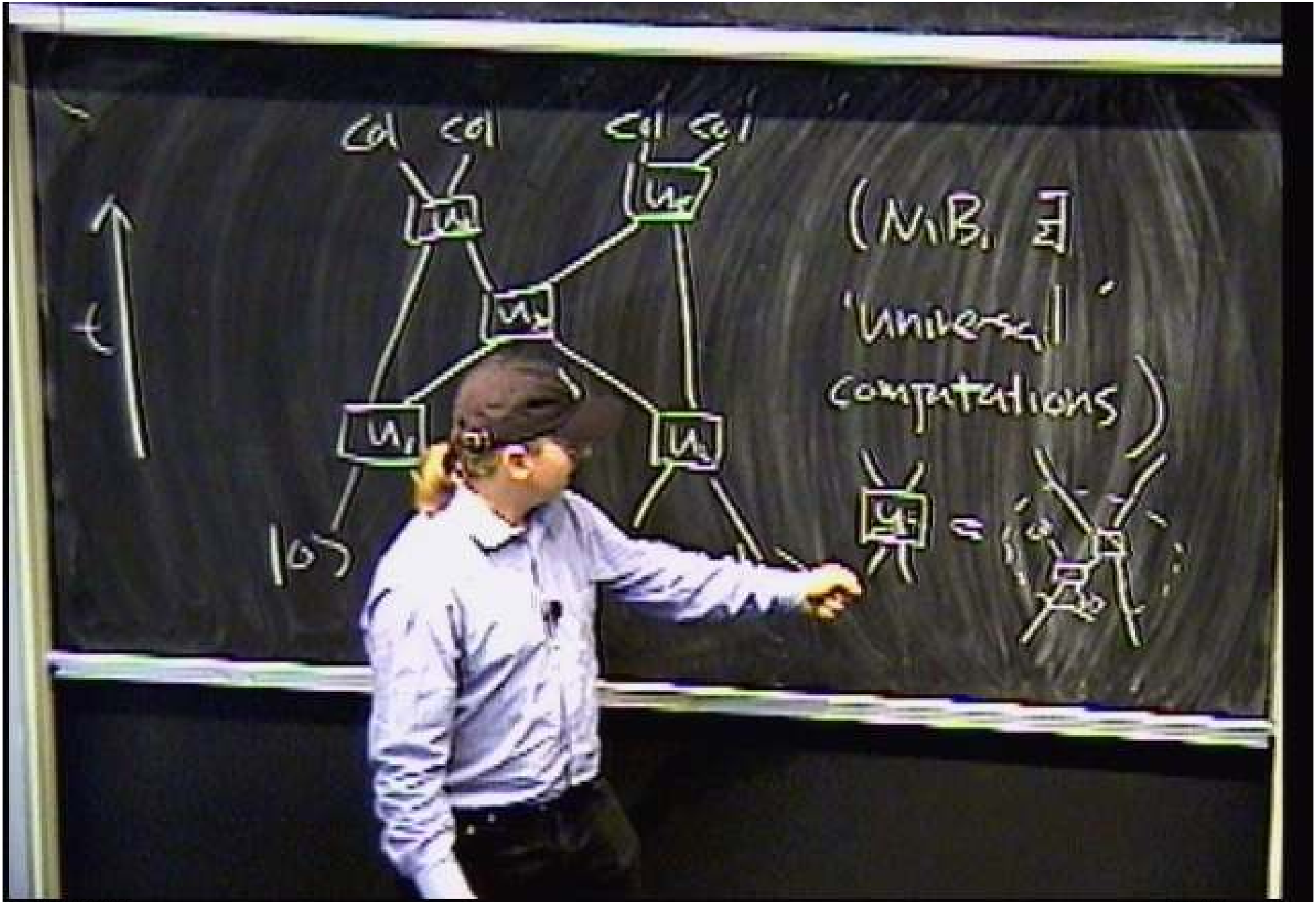

(1) Quantum computation:
<a | U | p>
|p> = U|00...0>


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

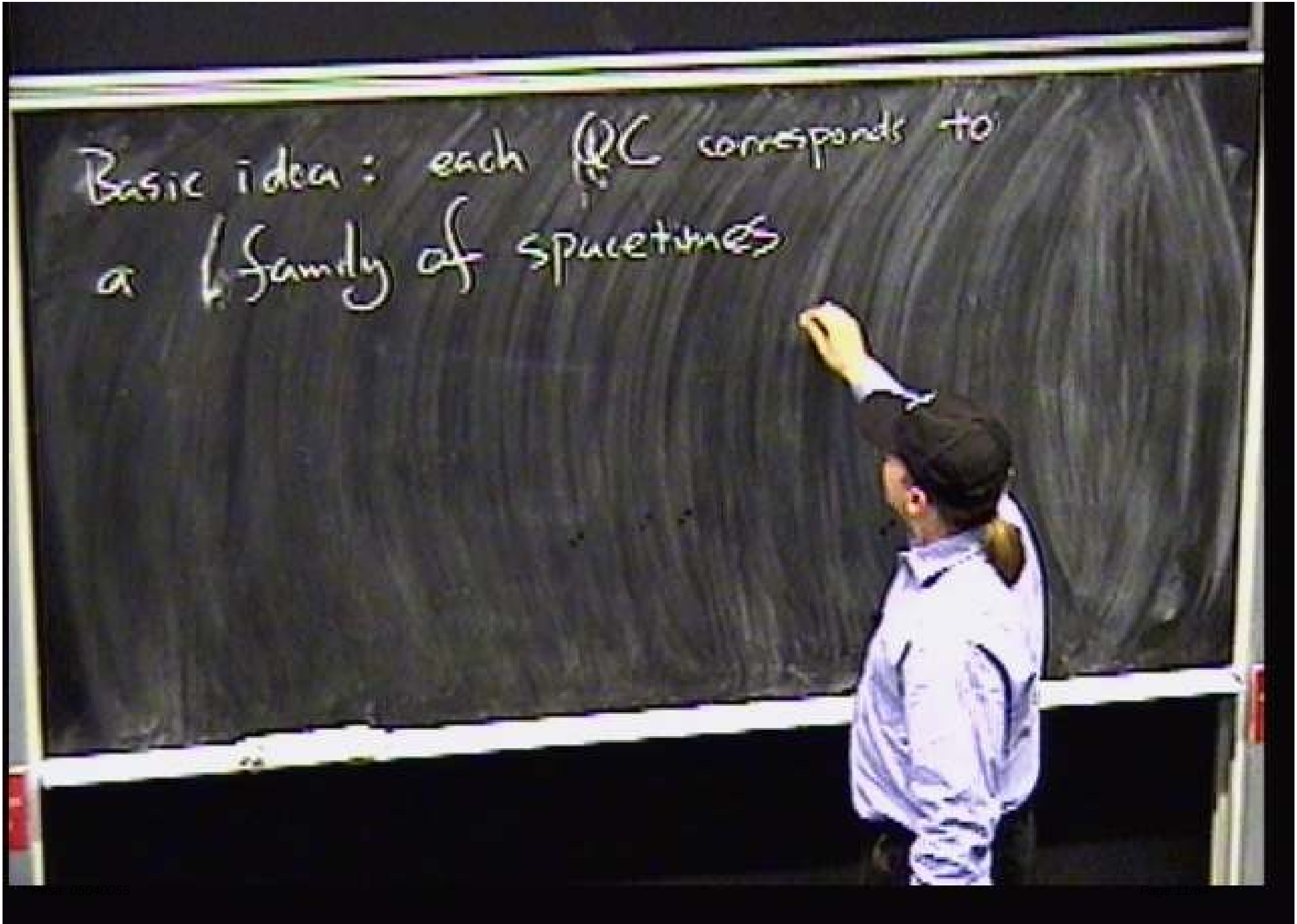

(1) Quantum computation:
$A = \langle a | U | p \rangle$
$|p\rangle = U_p |00\ldots0\rangle$
$|a\rangle = U_a |00\ldots0\rangle$
$A = \langle 00\ldots0 | U_n \ldots U_2 U_1 | 00\ldots0 \rangle$


|0⟩
|0⟩
|0⟩
|0⟩


'universal'
computations


'Universal'
computations

Basic idea: each $\mathbb{Q}C$ corresponds to
a


Basic idea: each QC corresponds to
a 1-family of spacetimes

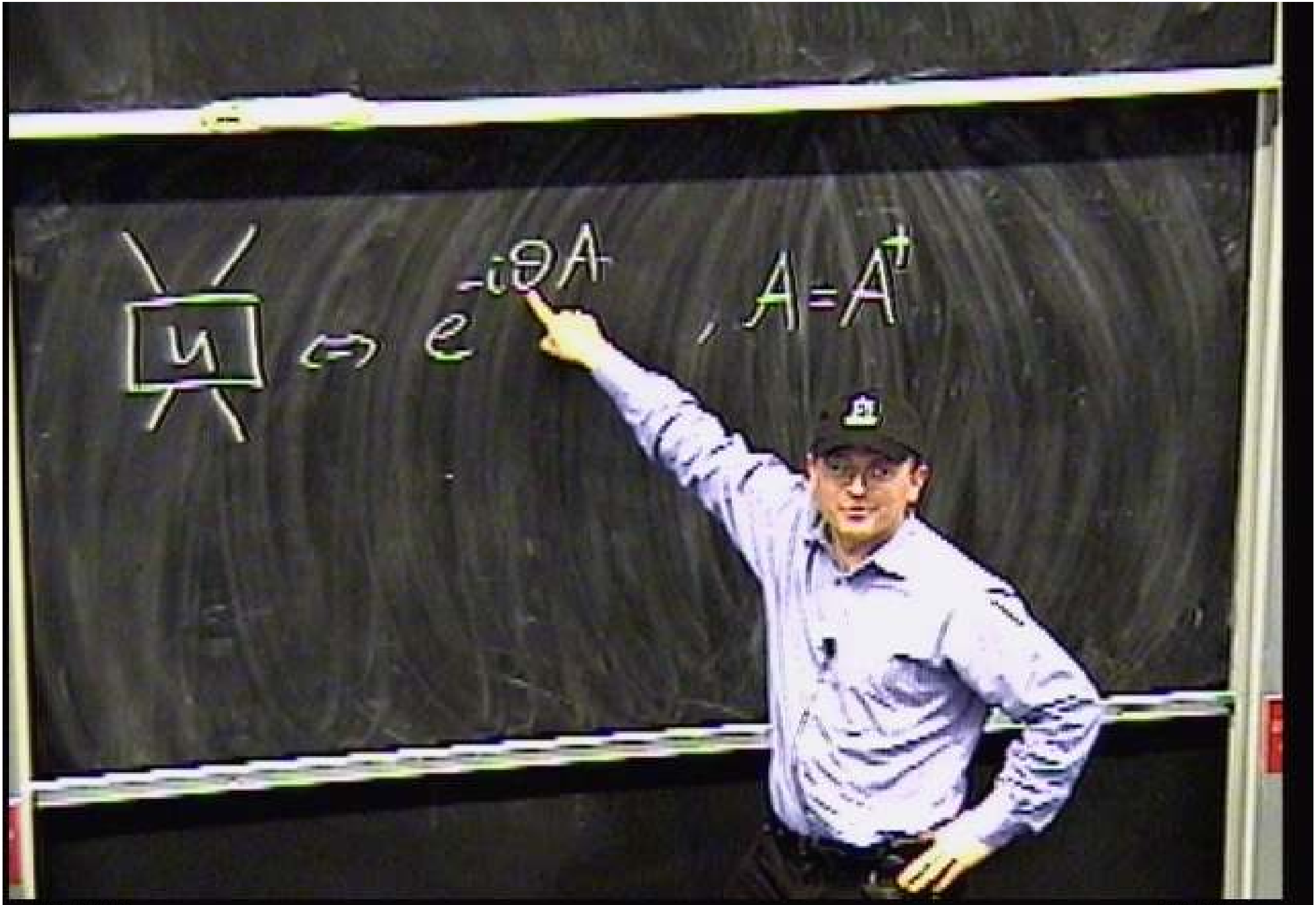
Basic idea: each QC corresponds to
a 1-family of spacetimes, whose geometries
are derived from the underlying QC.

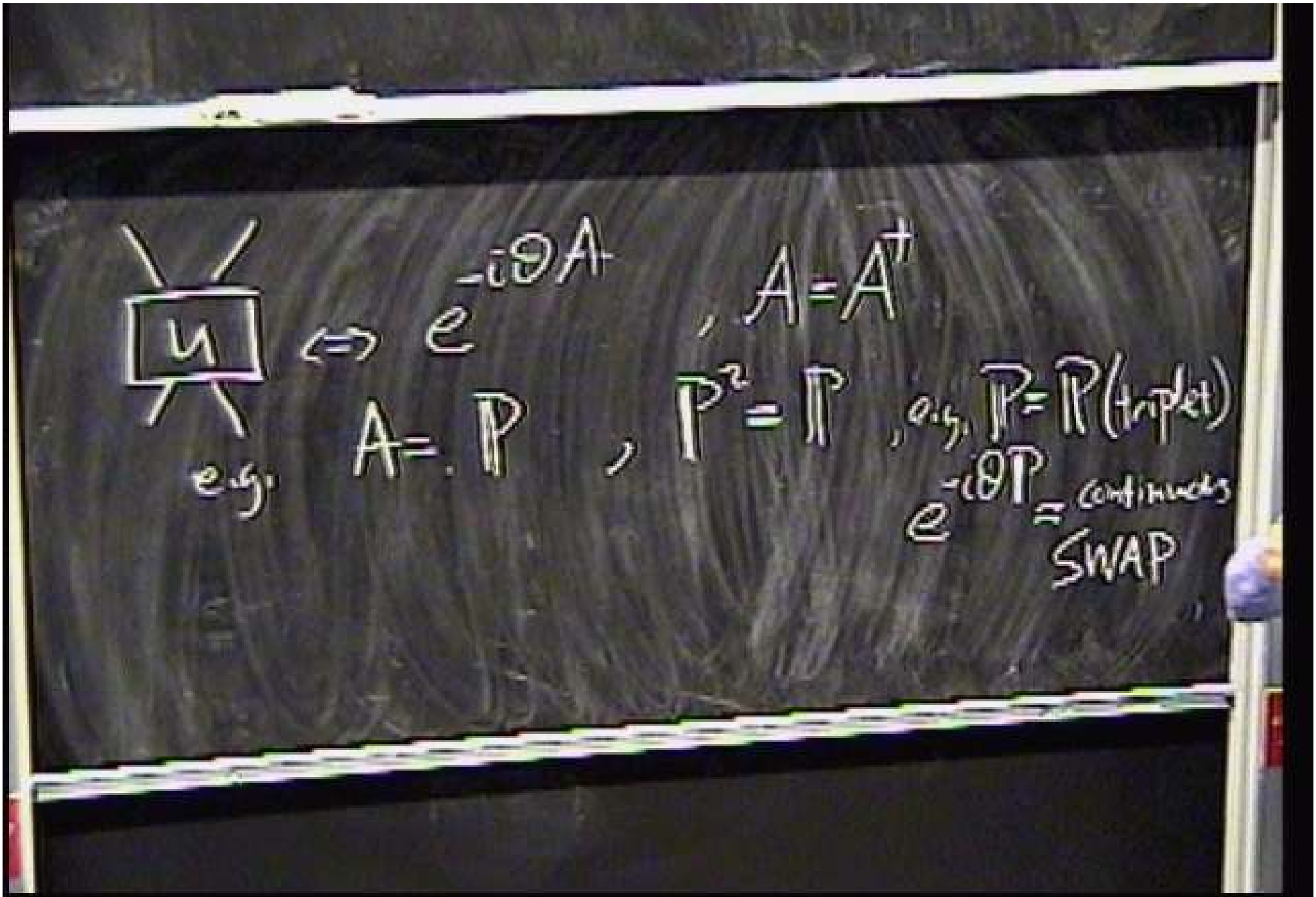
Basic idea: each QC corresponds to a family of spacetimes whose geometries are derived from the underlying QC.

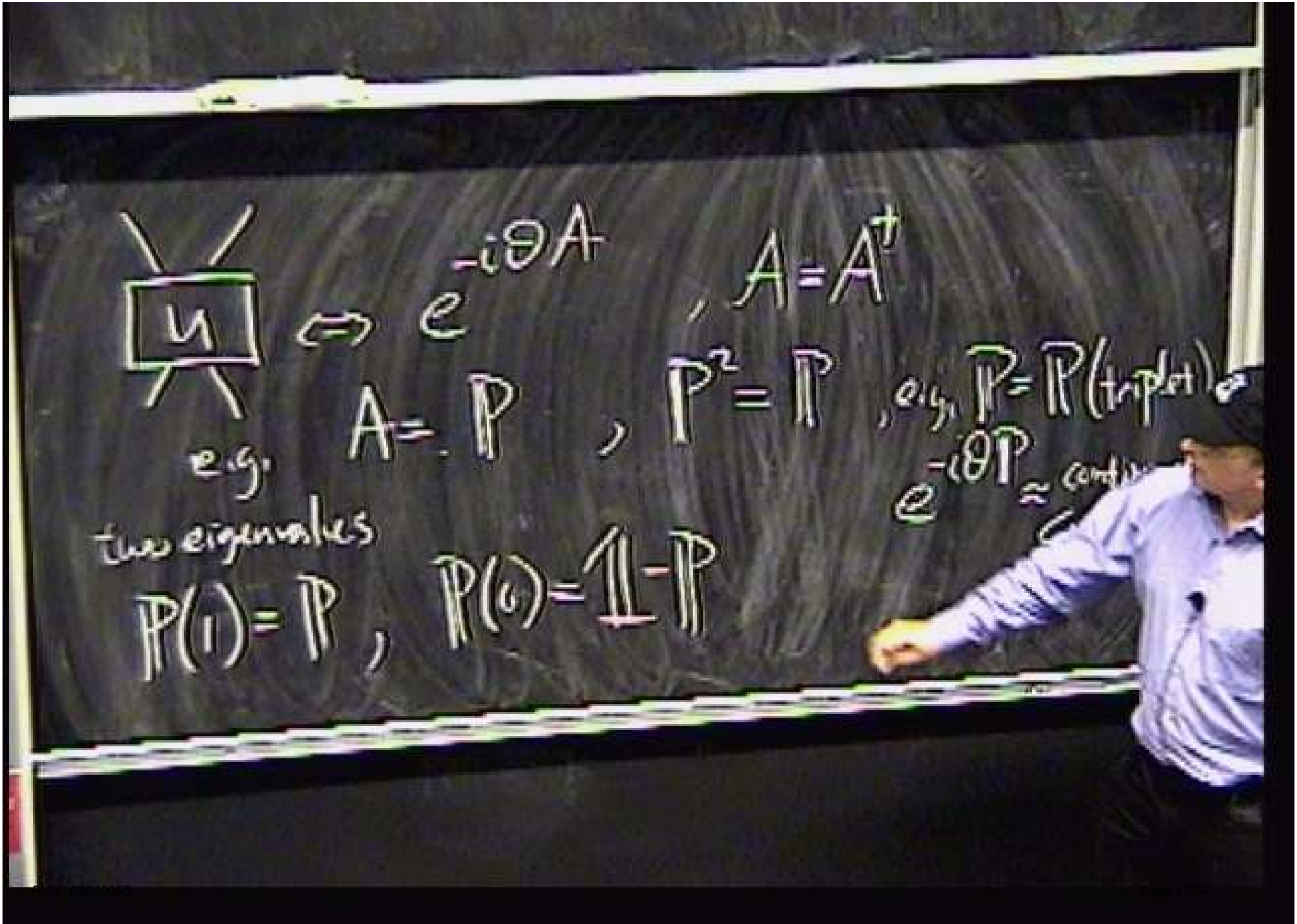
N.B. QC has a causal structure (a set of related causal structure)

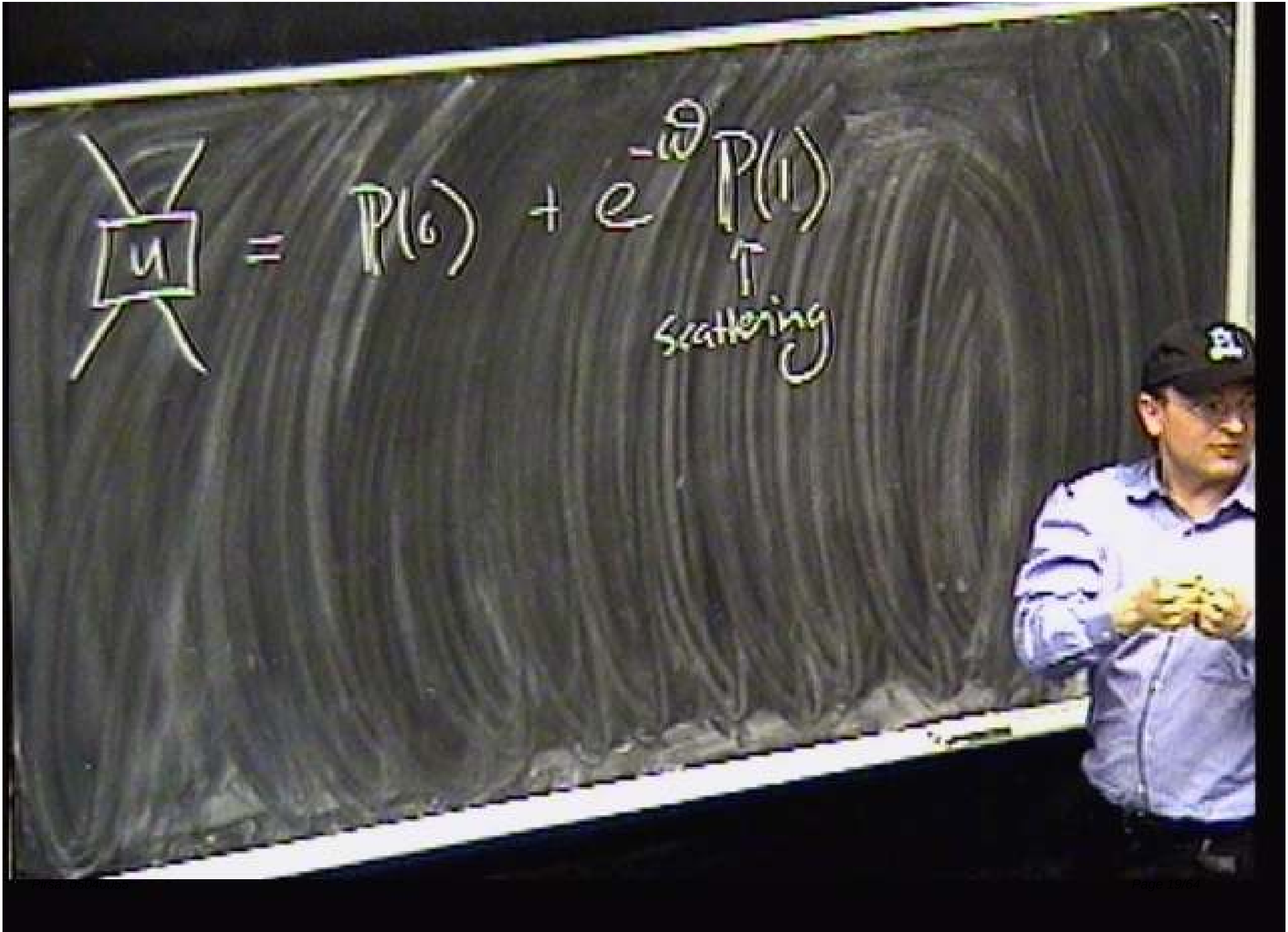
Basic idea: each QC corresponds to a {family of spacetimes, whose geometries are derived from the underlying QC.

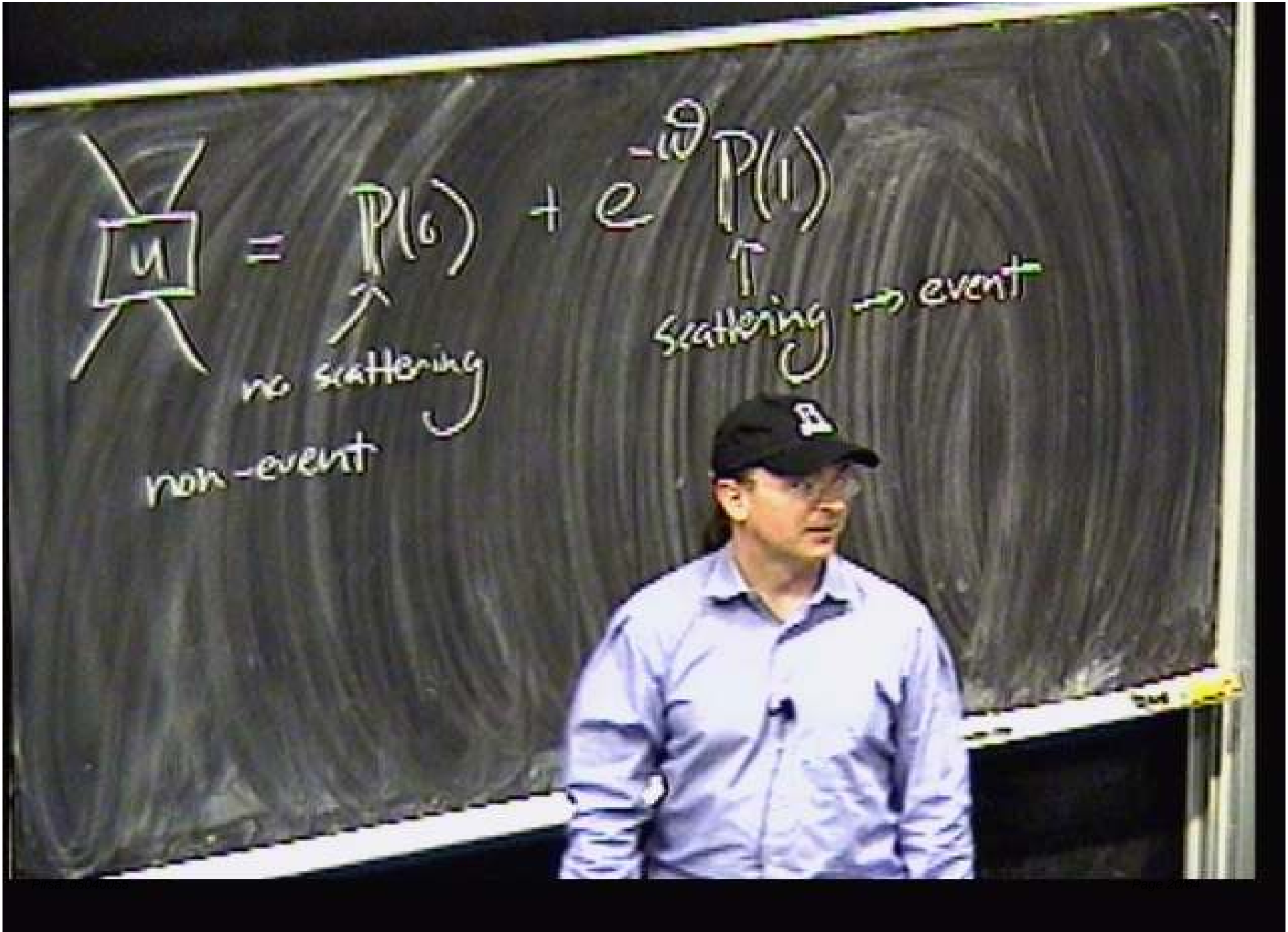
N.B. QC has a causal structure (a set of {2nd related causal structure})

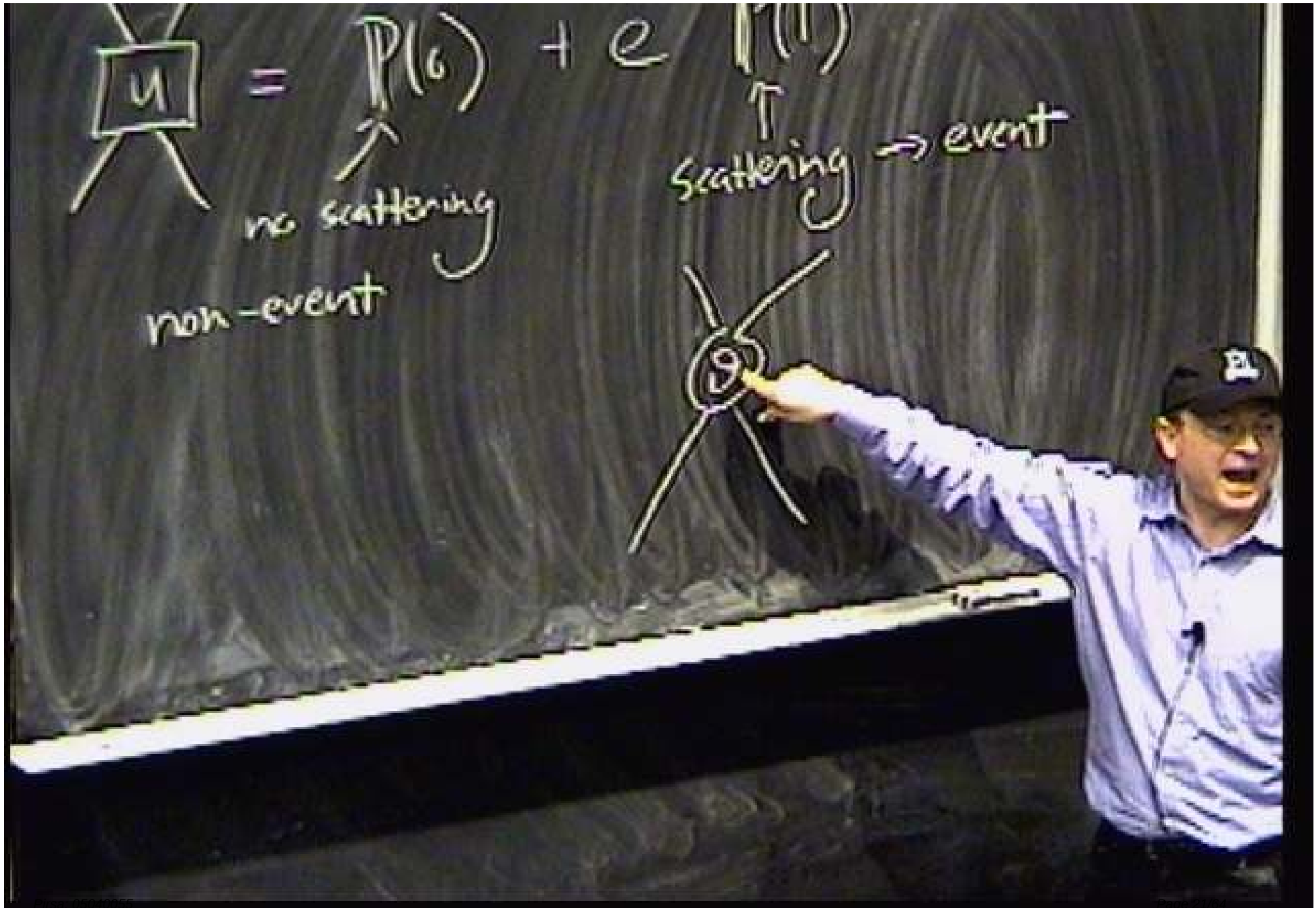

$\Psi \hookrightarrow e^{-i\Theta A}$
$, A = A^{+}$

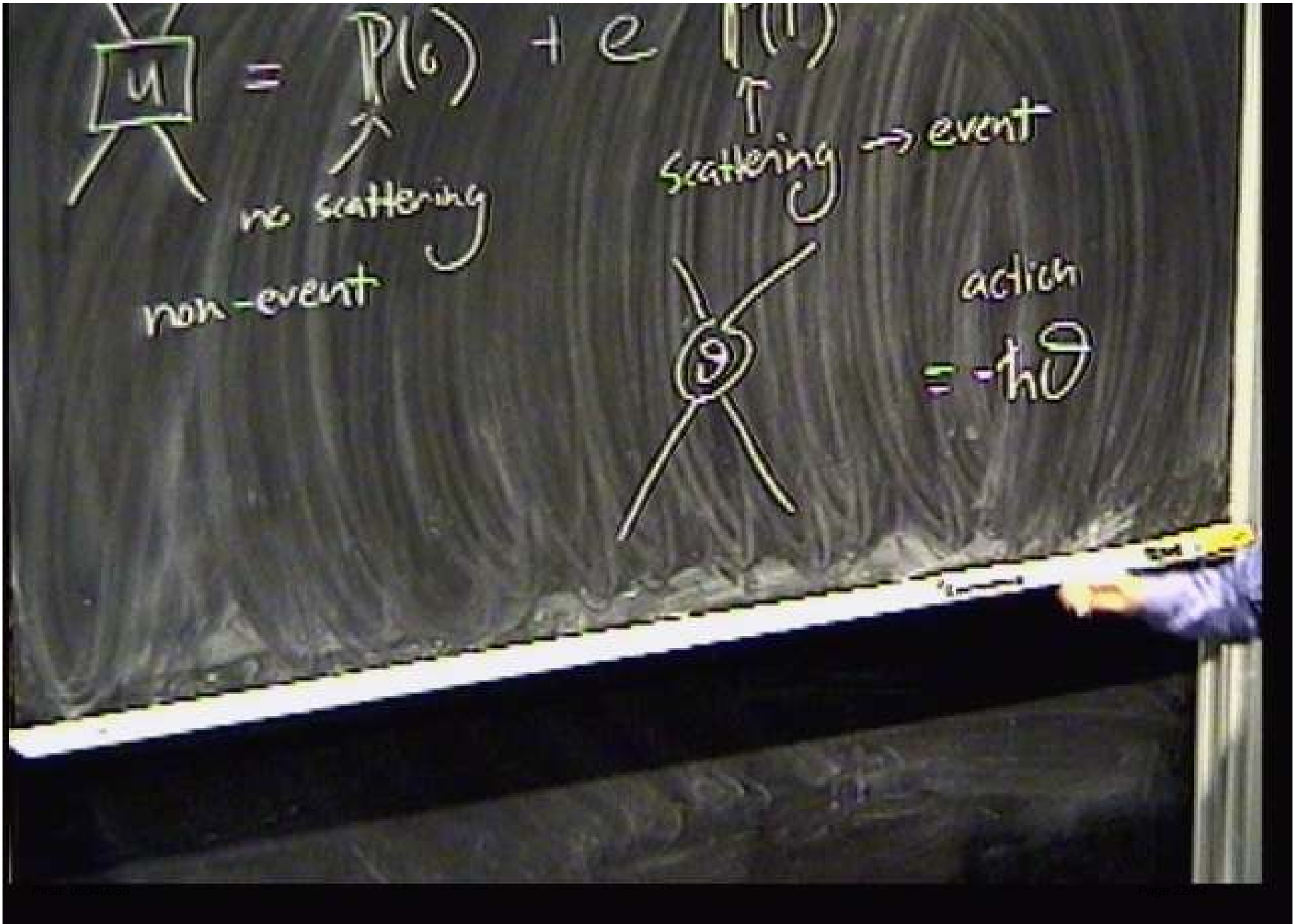

U
$\leftrightarrow e^{-i\theta A}$, $A = A^\dagger$
e.g. $A = \Pi$, $\Pi^2 = \Pi$, e.g. $\Pi = \Pi(\text{singlet})$
$e^{-i\theta\Pi}$ = controlled SWAP

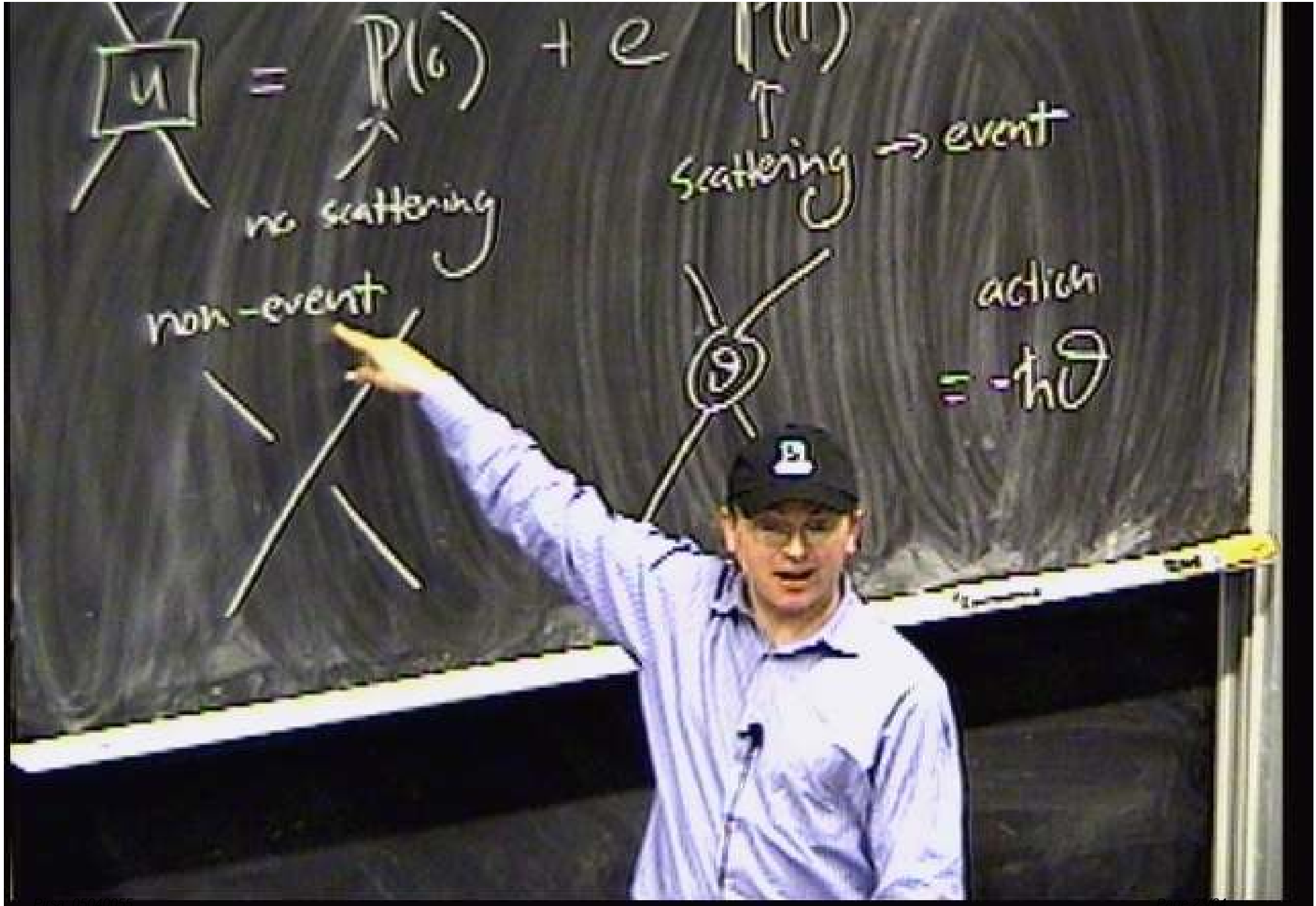

$U \Leftrightarrow e^{-i\theta A}$, $A = A^\dagger$
e.g. $A = \mathbb{P}$, $\mathbb{P}^2 = \mathbb{P}$, e.g. $\mathbb{P} = \mathbb{P}(t_1, t_2, t_3, t_4)$
$e^{-i\theta\mathbb{P}} \approx$ cont
two eigenvalues
$\mathbb{P}(1) = \mathbb{P}$, $\mathbb{P}(0) = \mathbb{1} - \mathbb{P}$

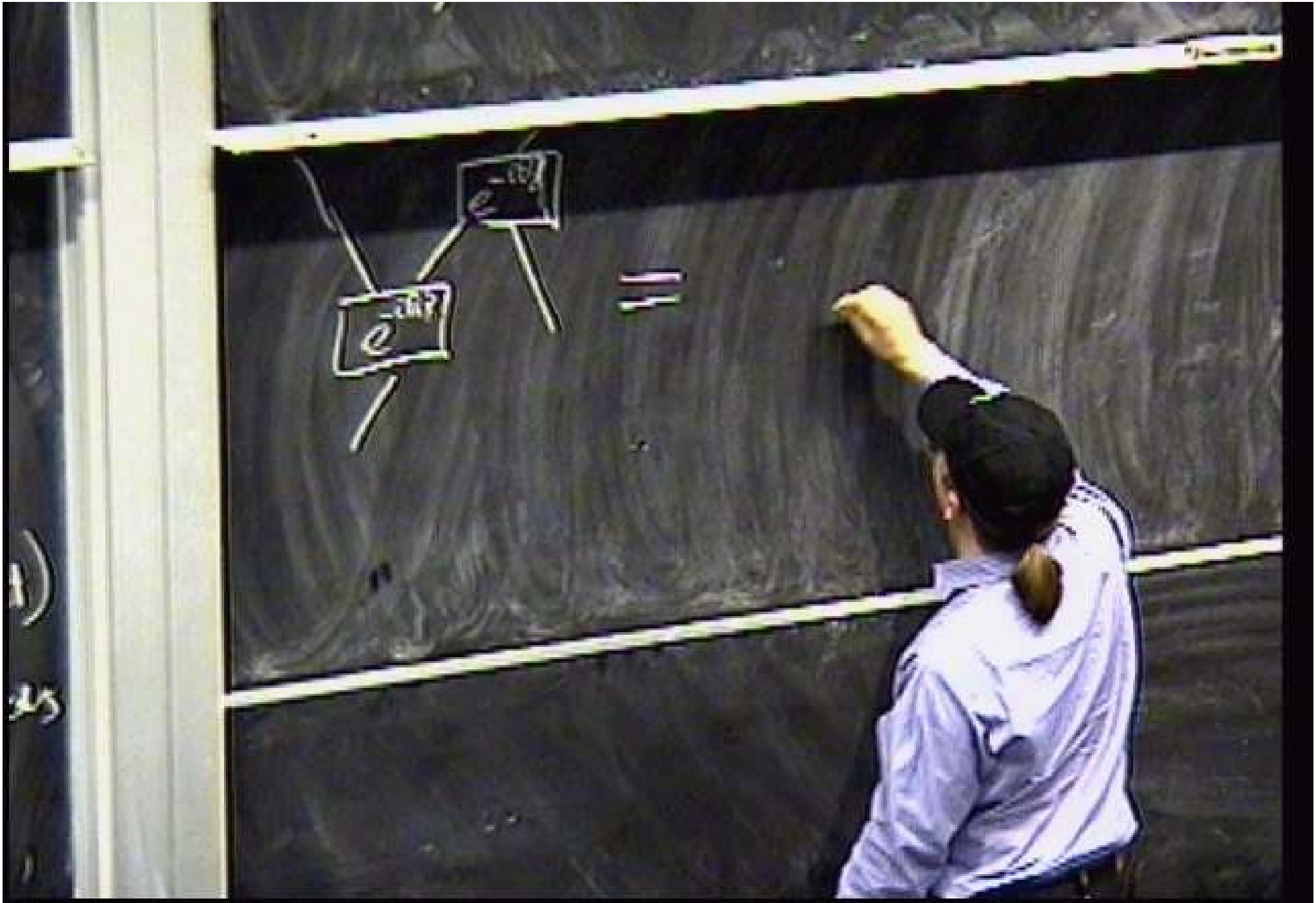

$\mathbb{P}(6) + e^{-\omega} \mathbb{P}(11)$
scattering

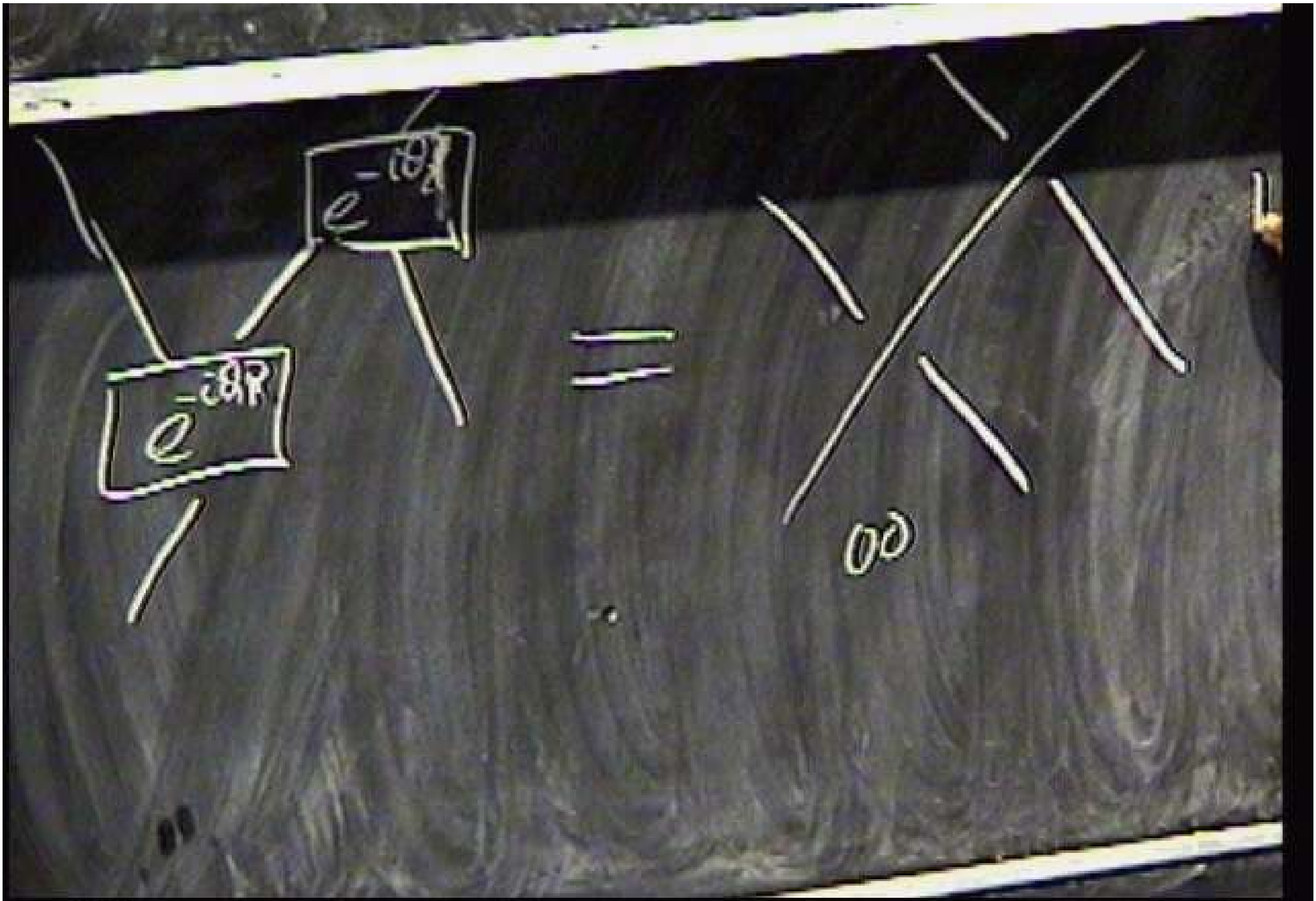

$\mathbb{P}(0)$ + $e^{-\sigma}$ $\mathbb{P}(1)$
no scattering
non-event
scattering → event

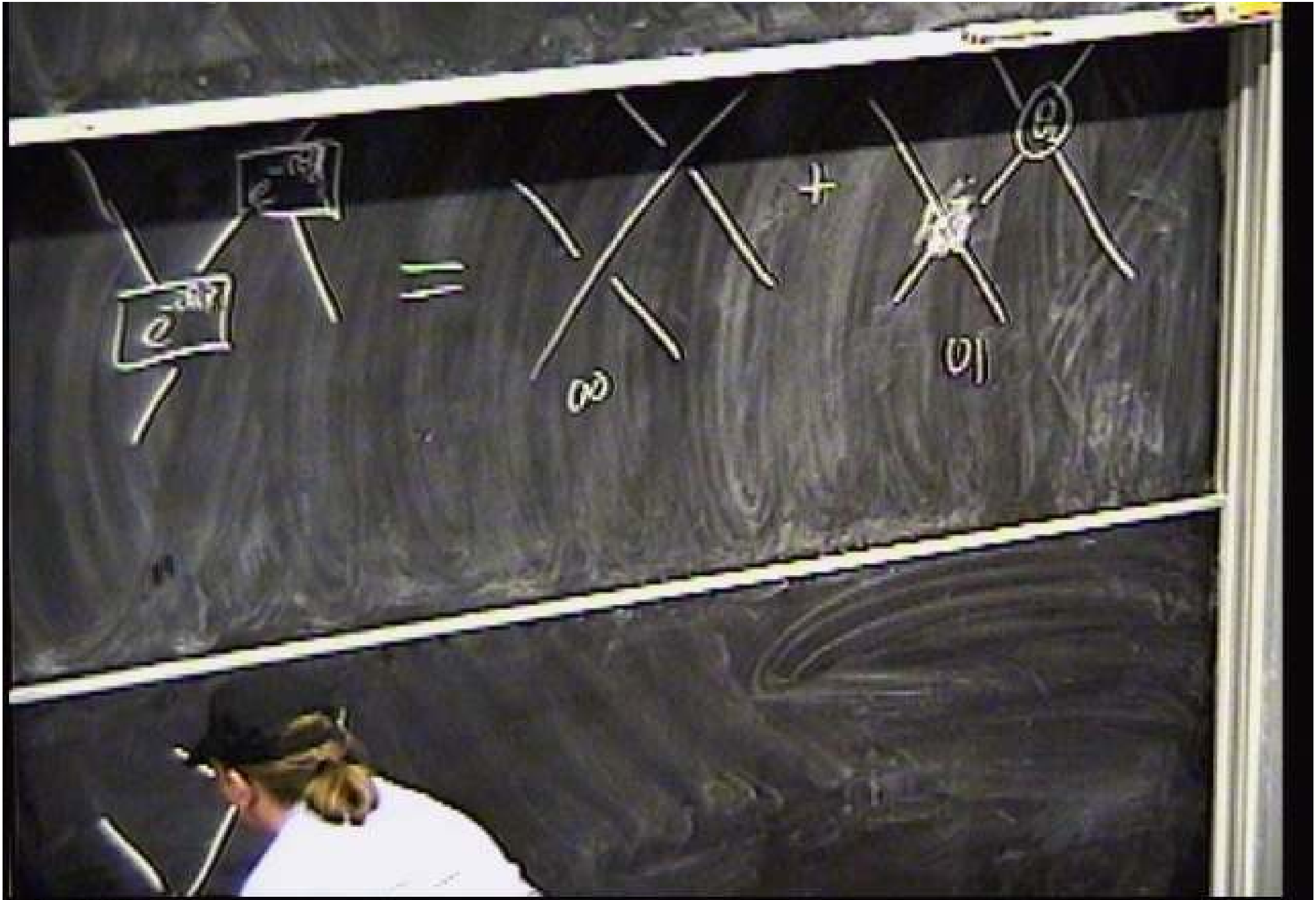

U
= P(0) + e P(1)
no scattering
non-event
scattering → event

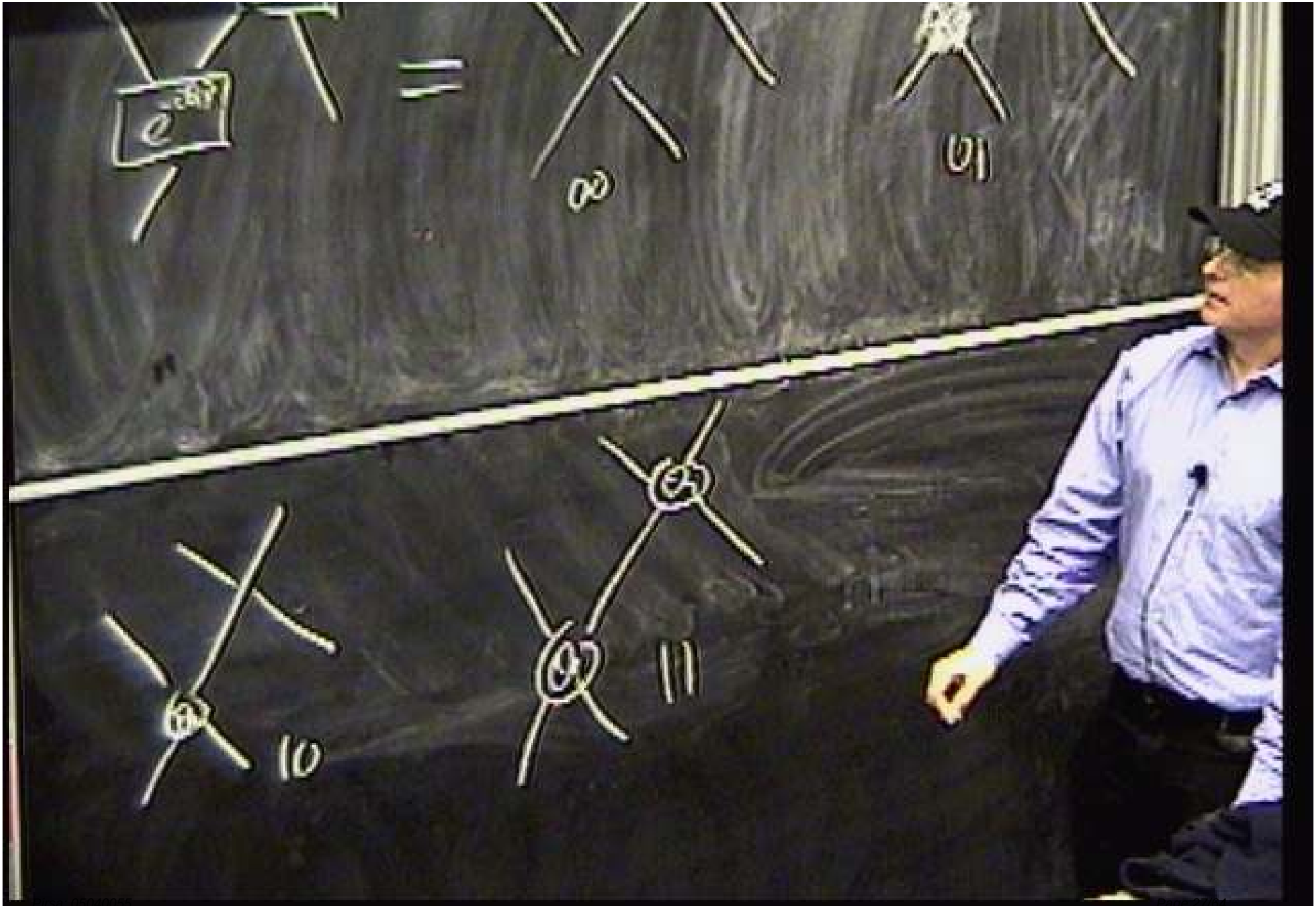

M = P(0) + e P(1)
no scattering
non-event
scattering → event
action
= -hθ

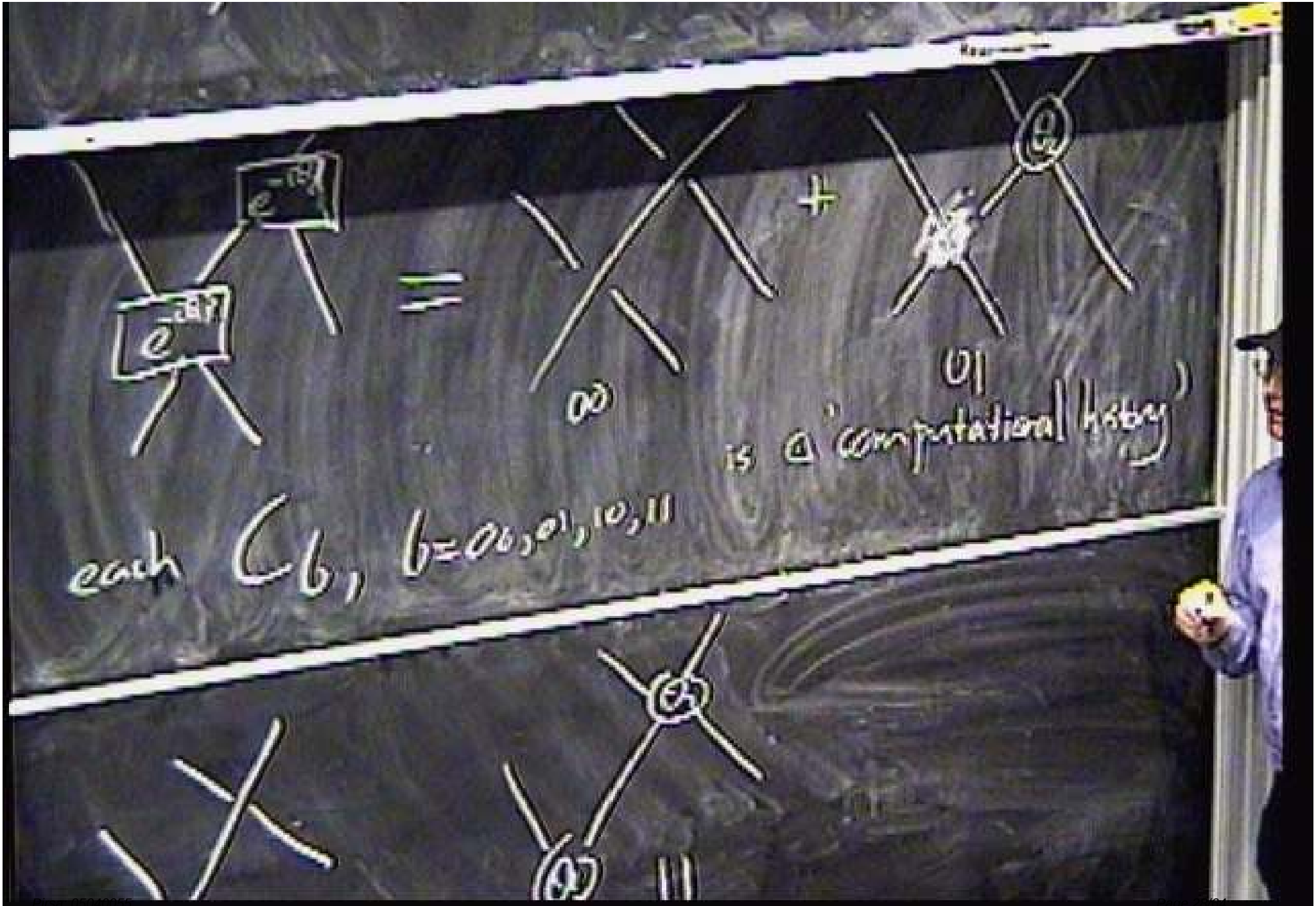

P(0)
+ e
P(1)
scattering → event
no scattering
non-event
action
= -th θ

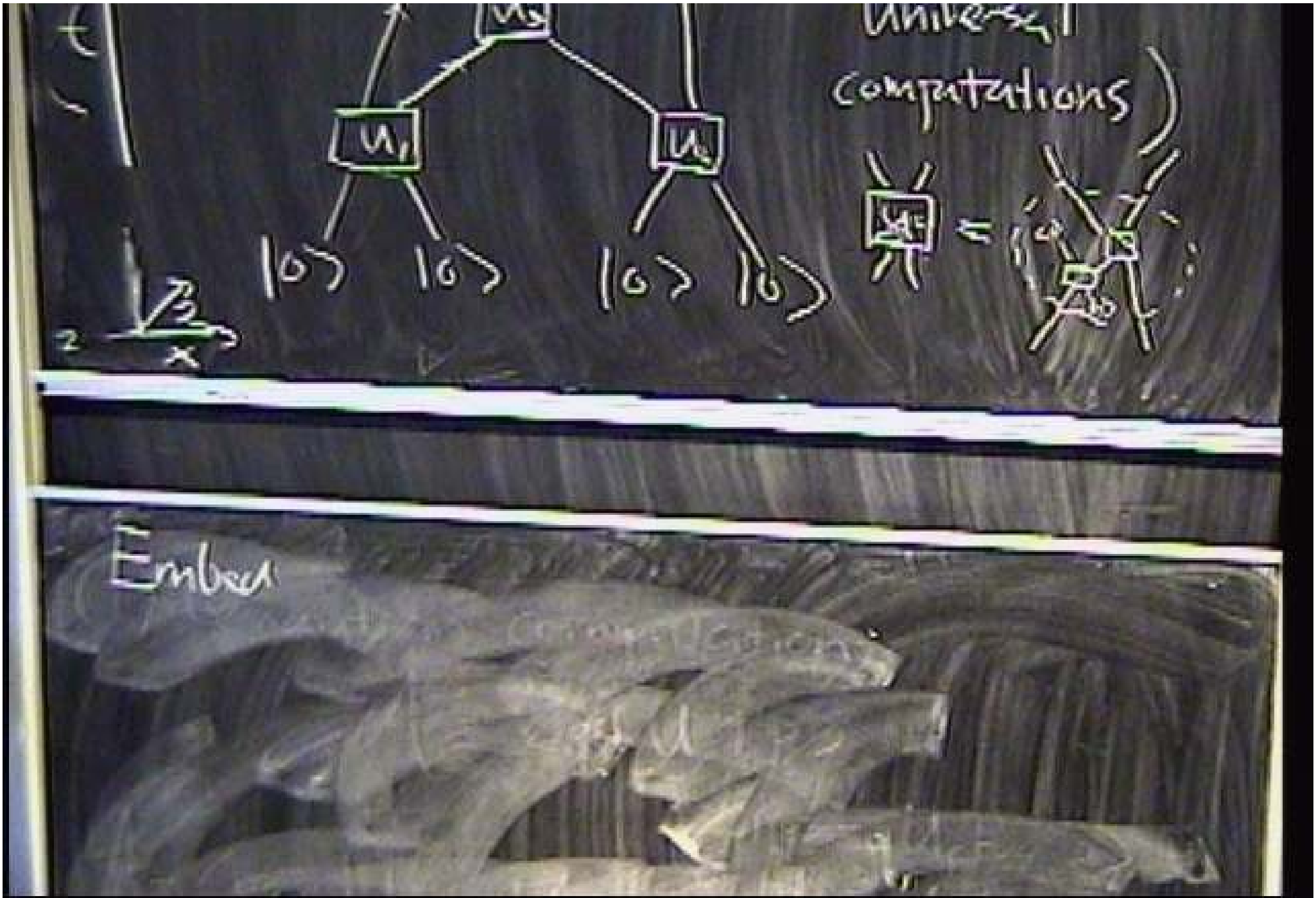



$e^{-(\theta_1}$
$e^{-(\theta_2 R}$
θ_1
θ_2

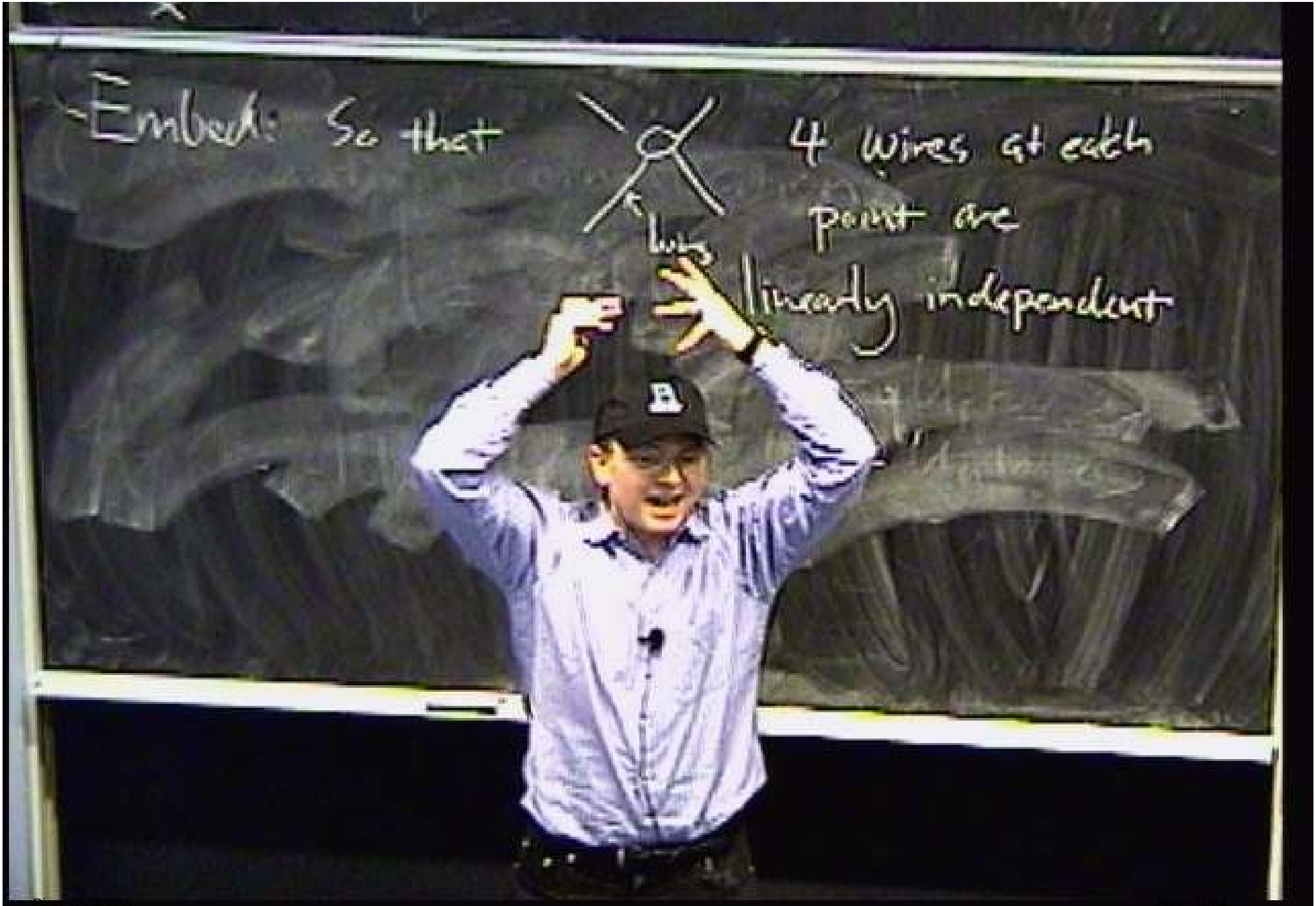

=
+
(a)
(b)


T =
00
01
10
11


each C_b, $b = 0_{b_0}, 0_1, 10, 11$
is a "computational history"


Universal
computations
Embed

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


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

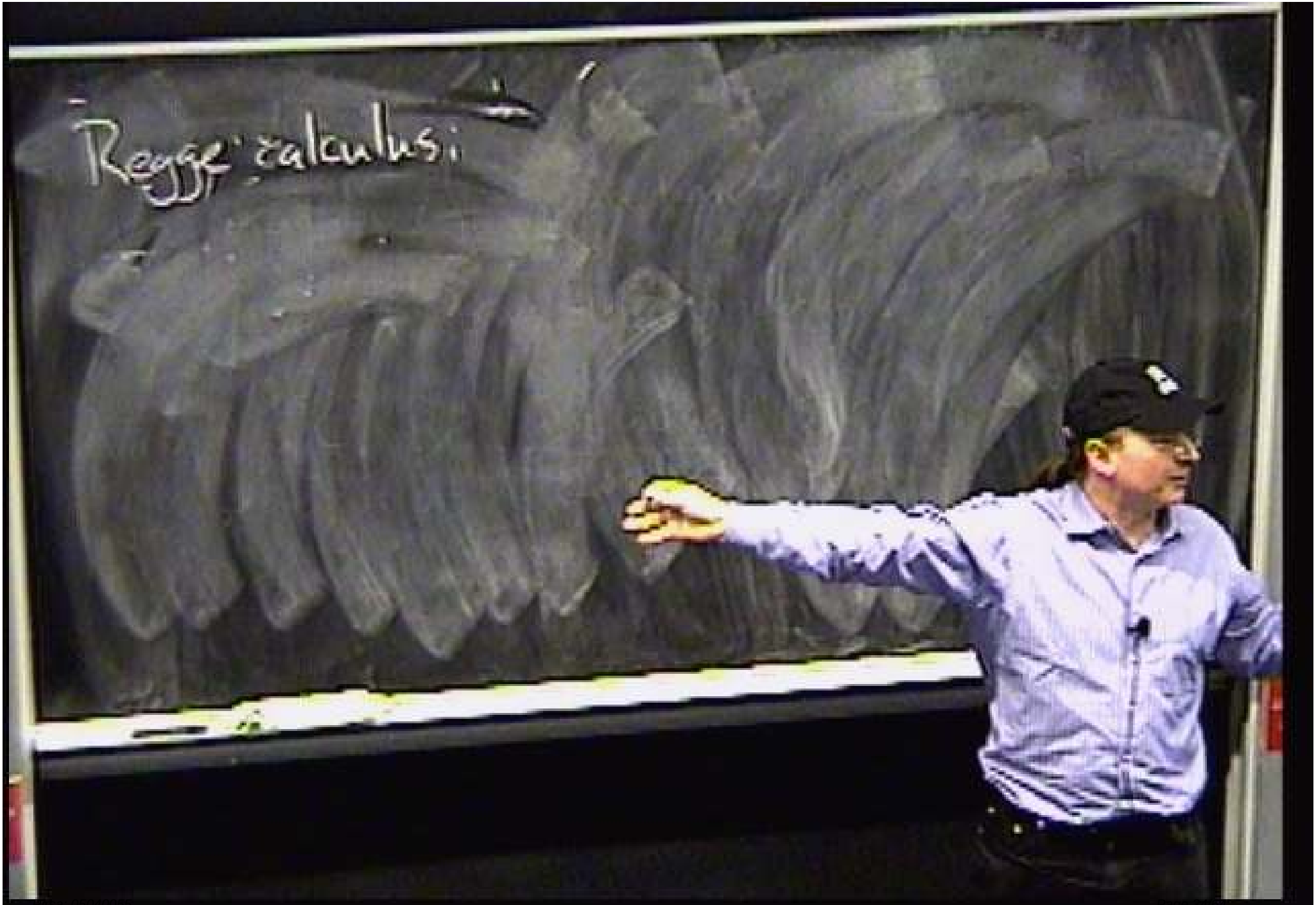
Embed: So that 4 wires at each point are linearly independent

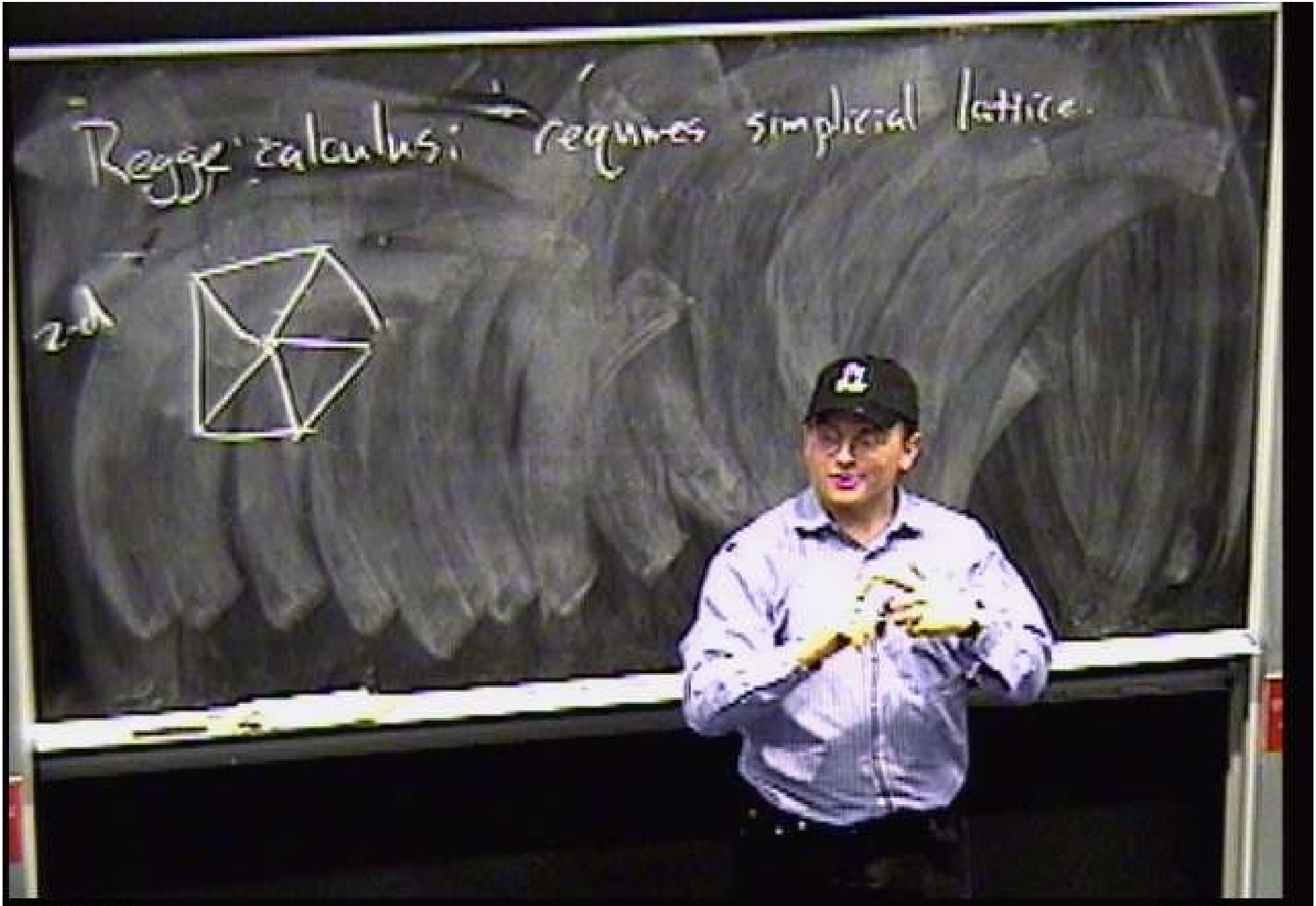
Fact: d null lines determine $g_{\mu\nu}$ up to $g_{\mu\nu} \to \Omega^2 g_{\mu\nu}$ in d dimensions.

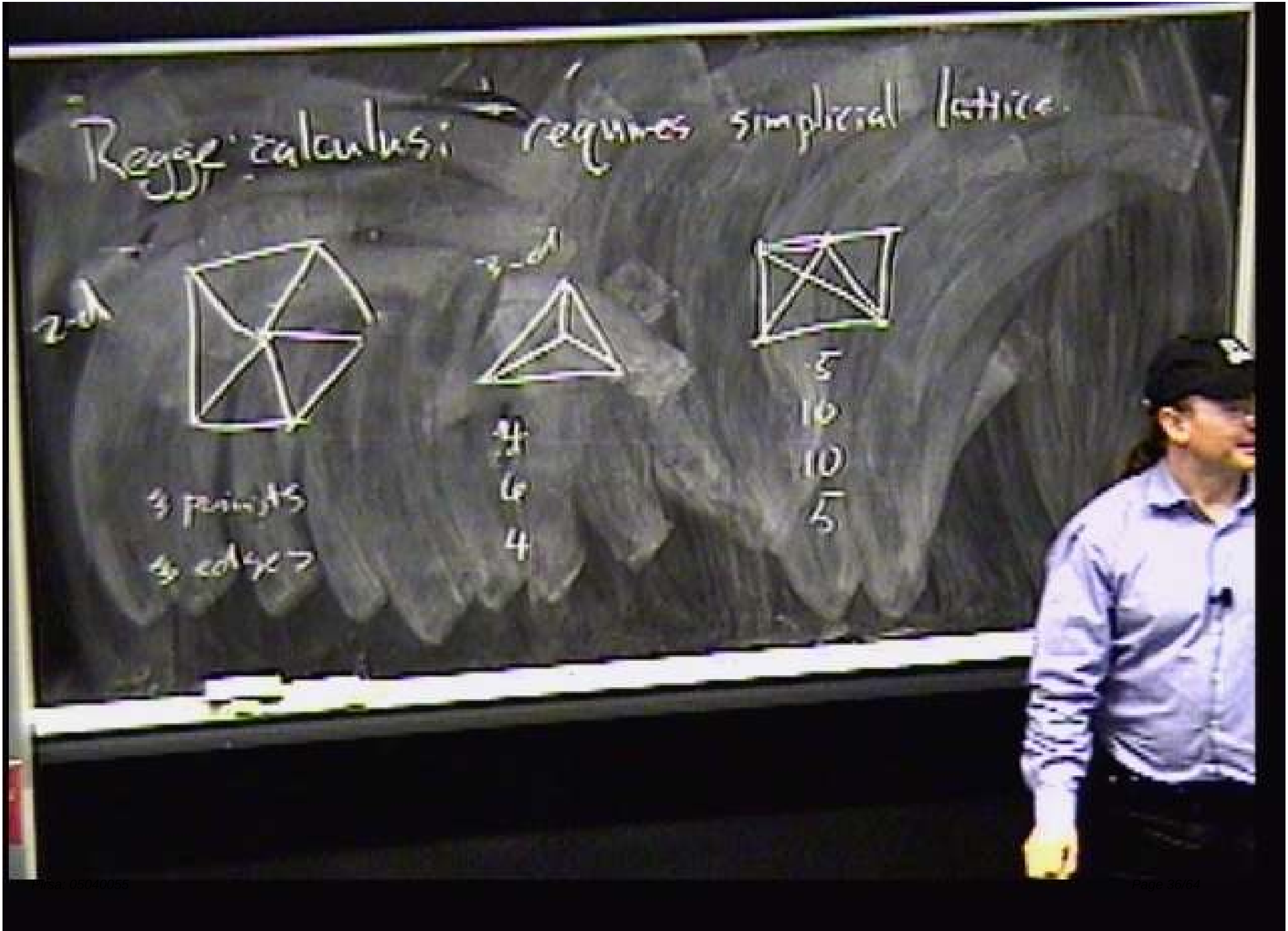
Embed: So that 4 wires at each point are linearly independent

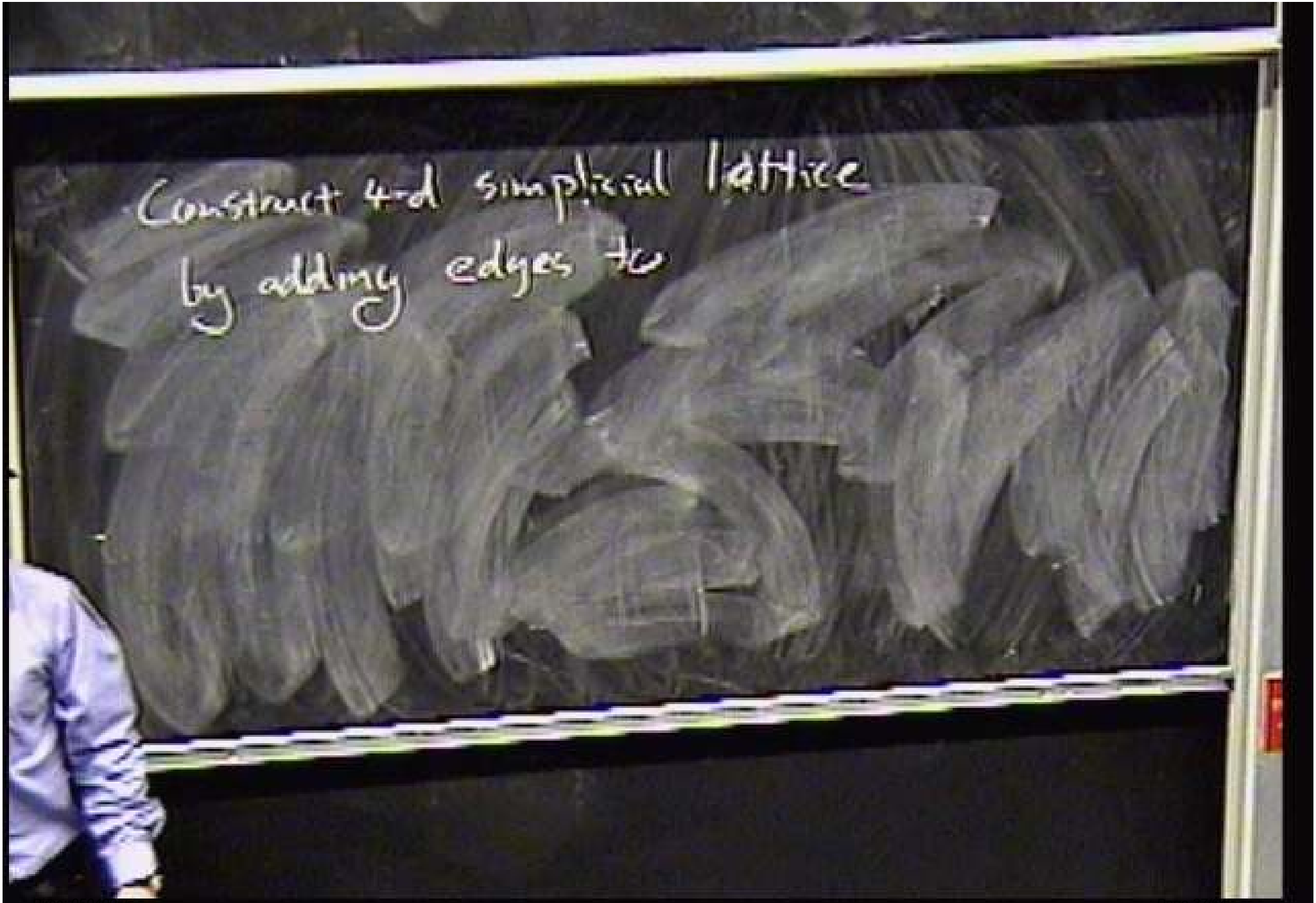
Fact: d null lines determine $g_{\mu\nu}$ up to $g_{\mu\nu} \to \Omega^2 g_{\mu\nu}$ in d dimensions.

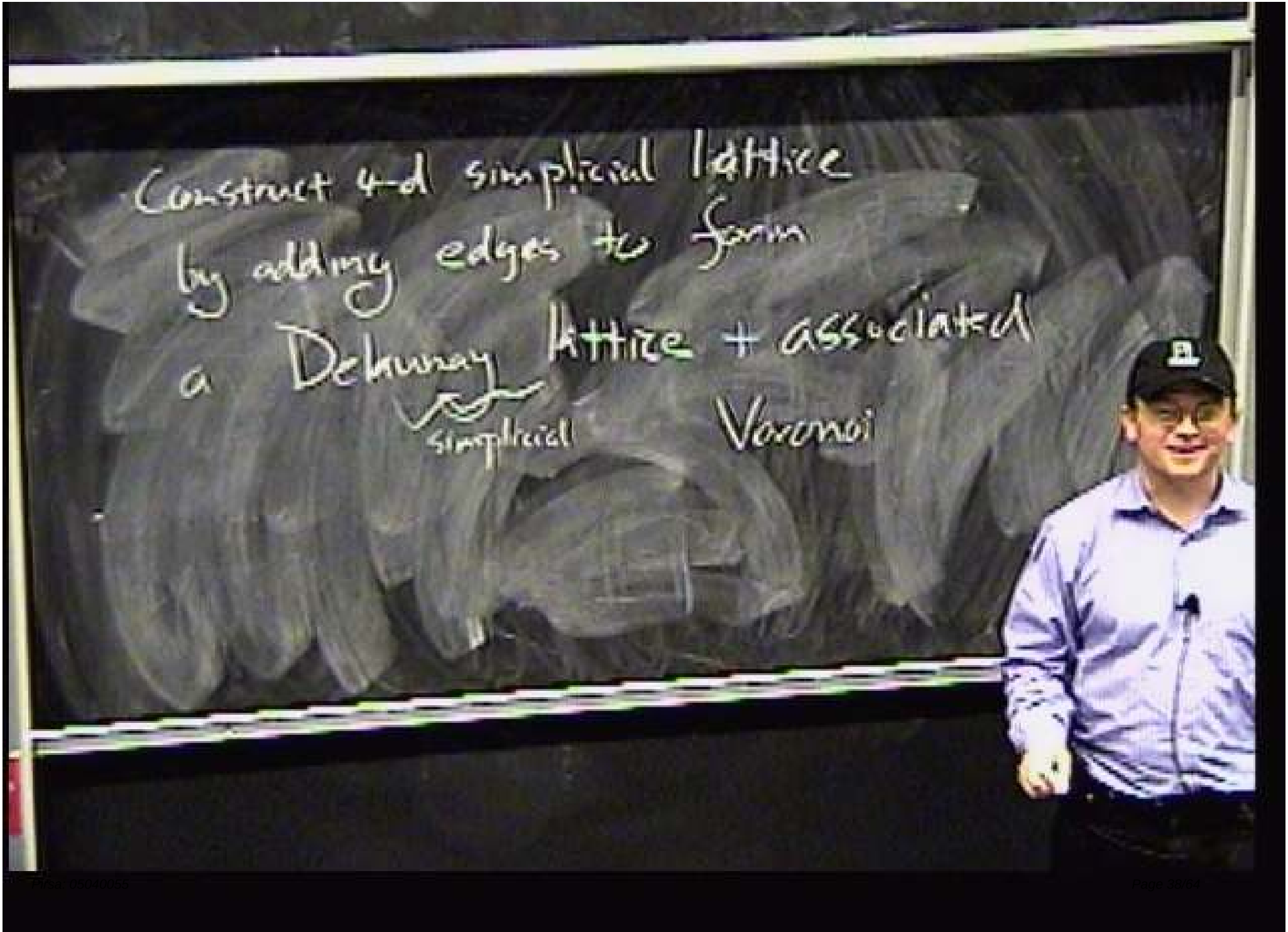
Henceforth take $d=4$

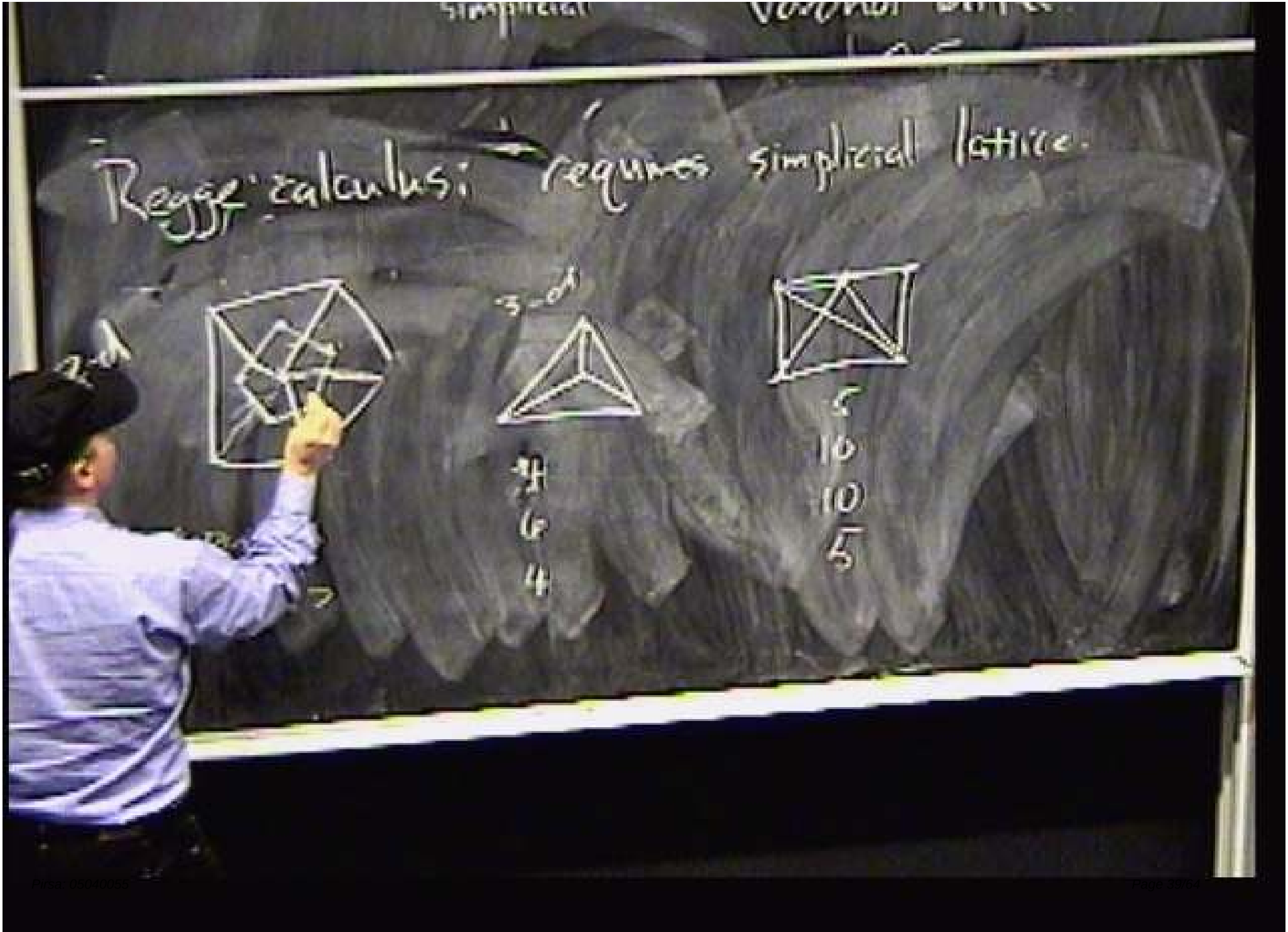

Reggae calculus


Regge calculus: requires simplicial lattice.

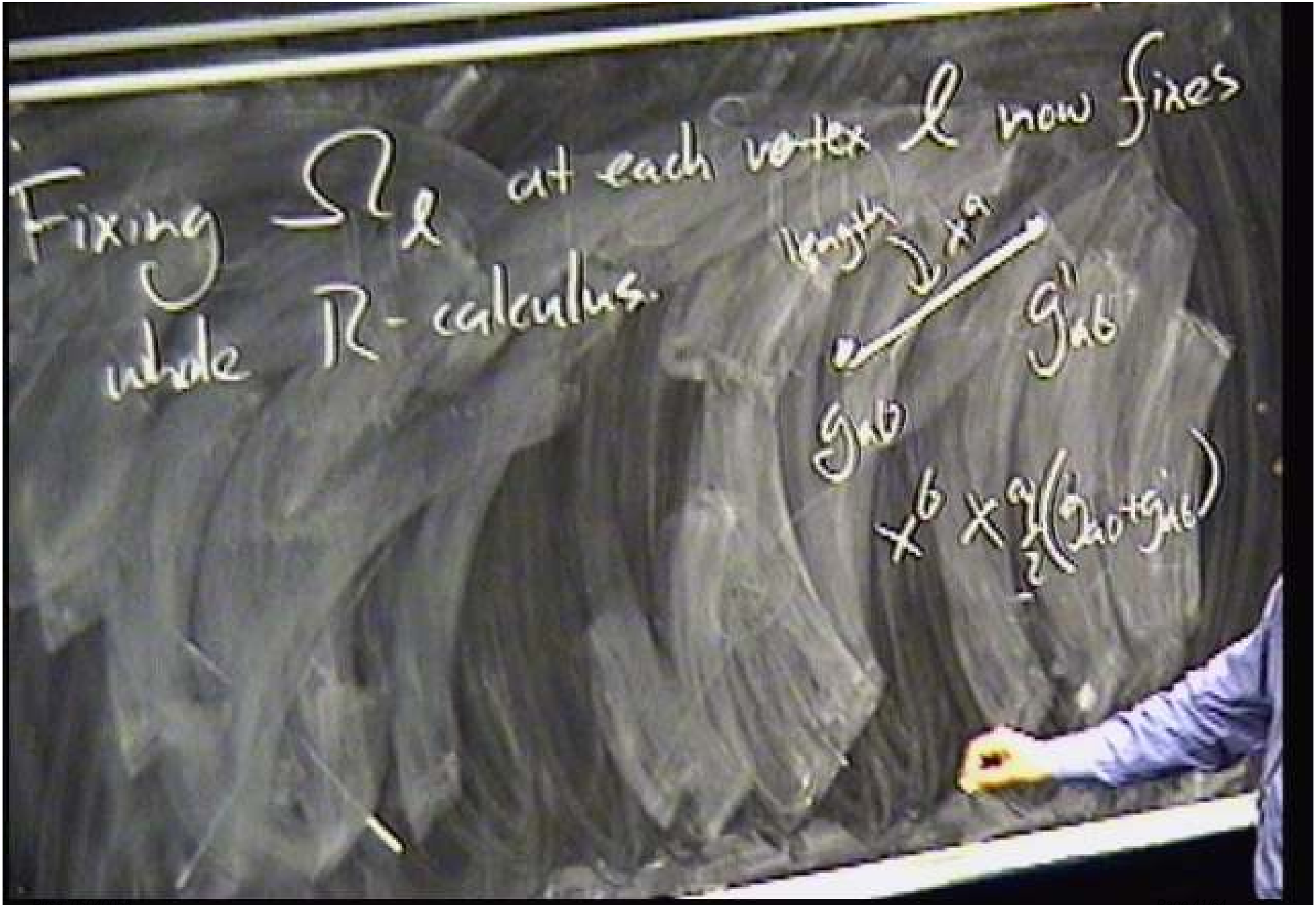

Regge calculus: requires simplicial lattice.
3 points
3 edges
4
6
4
5
10
10
5


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
5
16
10
5
7
12
6
4

3 pentagons
6
4
5


Fixing Ω_ℓ at each vertex ℓ now fixes
under $\mathbb{R}$-calculus.
length
x^a
g'_{ab}
g_{ab}
$x^b \times \frac{1}{2}(g_{ab} + g'_{ab})$

Fixing Ω_ℓ at each vertex ℓ now fixes

whole $\mathbb{R}$-calculus.

length $\to x^a$

g'_{ab}

g_{ab}

$\ell^a = x^b \times \frac{\partial}{\partial x^b}(x^a \to g'_{ab})$

Fixing Ω_ℓ at each

whole $\mathbb{R}$-calculus.

length $\Rightarrow \Delta x^a = y^a - y^i$ fixes

g_{ab}

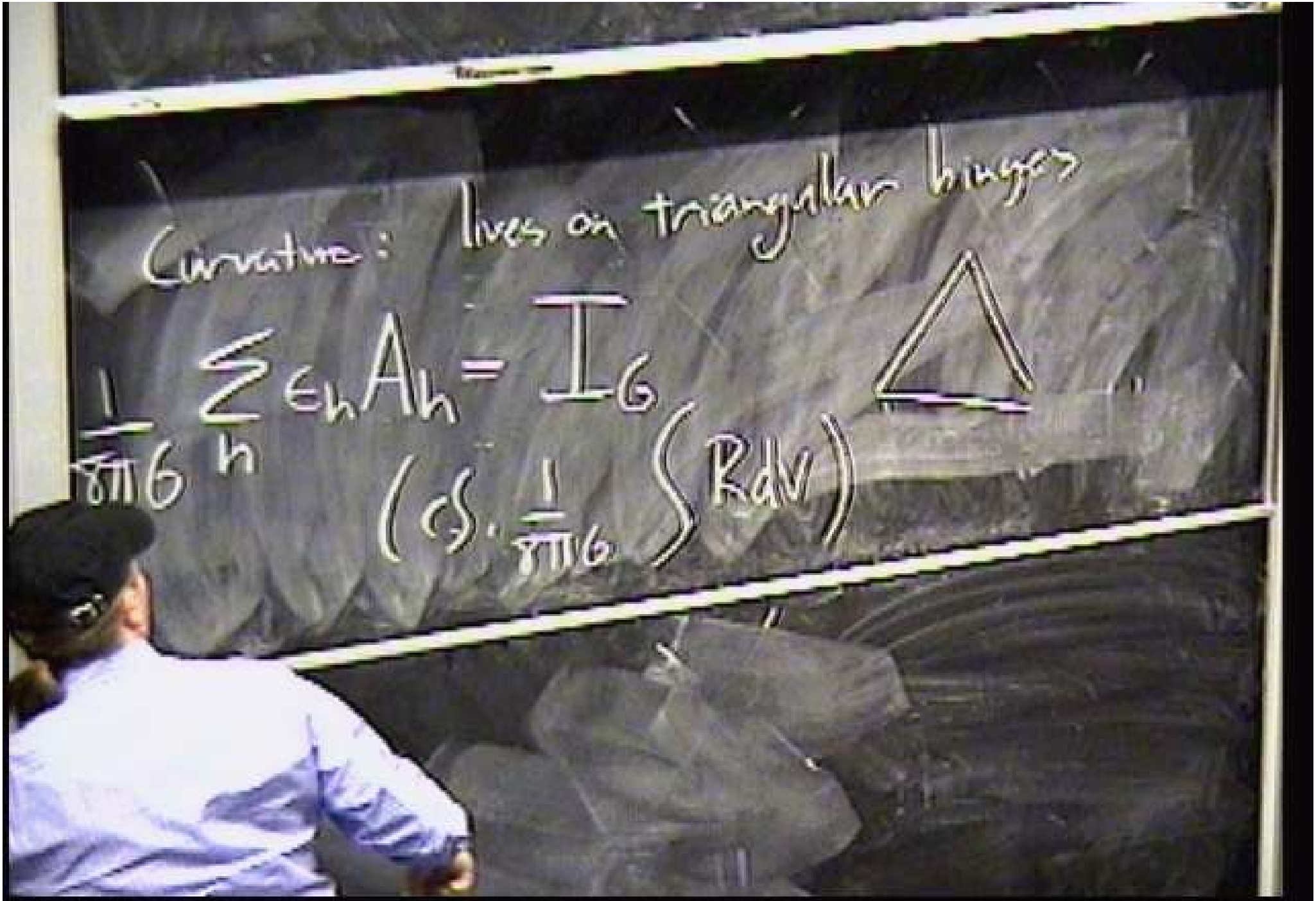
g'_{ab}

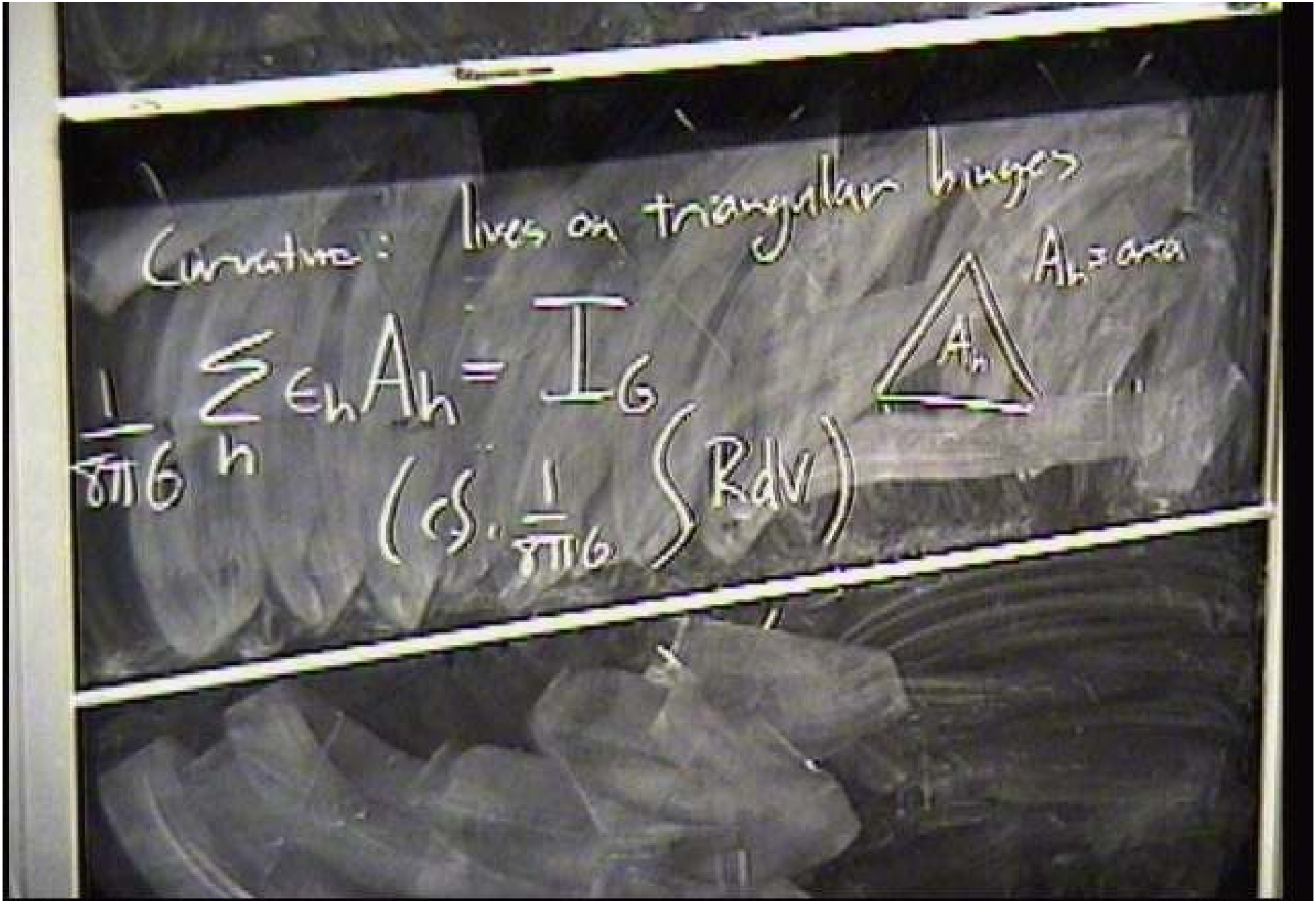
$\Rightarrow$ curvature

is fixed

$$\ell^2 = x^b \times \frac{1}{2}(g_{ab} + g_{ab})$$

Curvature: lives on triangular hinges


Curvature: lives on triangular hinges
$\frac{1}{2\pi} \sum_h \epsilon_h A_h = \mathbb{I}_G$
Δ
$(S, \frac{1}{2\pi} \int R dV)$


Curvature: lives on triangular hinges
A_h = area
$\frac{1}{2\pi} \sum_h \epsilon_h A_h = \int_G K$
$\left(\int_S \frac{1}{2\pi} \int K dV \right)$

Curvature: lives on triangular hinges

A_h = area

$$\frac{1}{2\pi 6} \sum_h \epsilon_h A_h = I_G$$

$$\left(\sigma \cdot \frac{1}{2\pi 6} \int R\,dV\right)$$

Recall $I_G = \star_h \sum_\ell \theta_\ell$

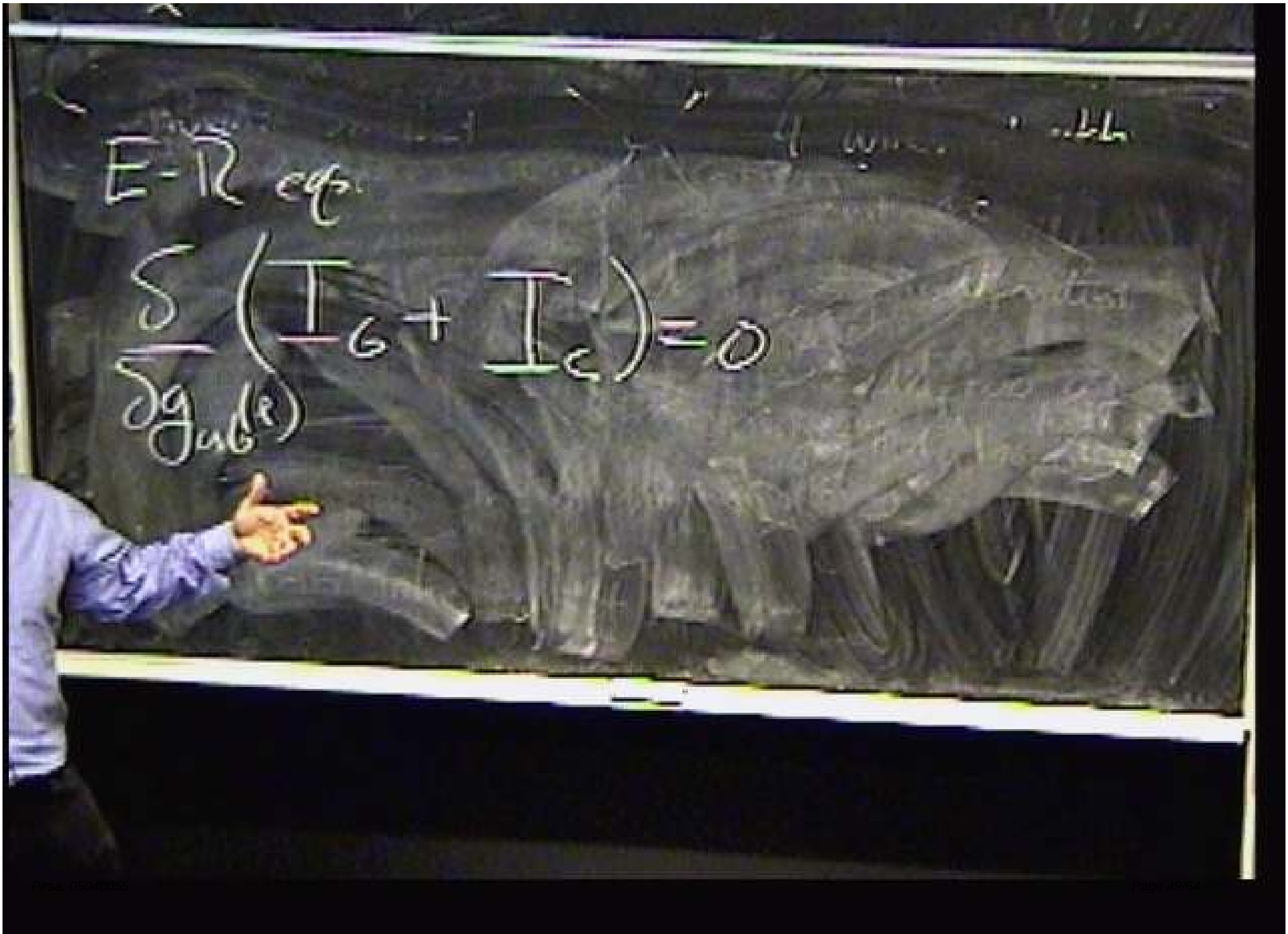
Curvature: lives on triangular hinges

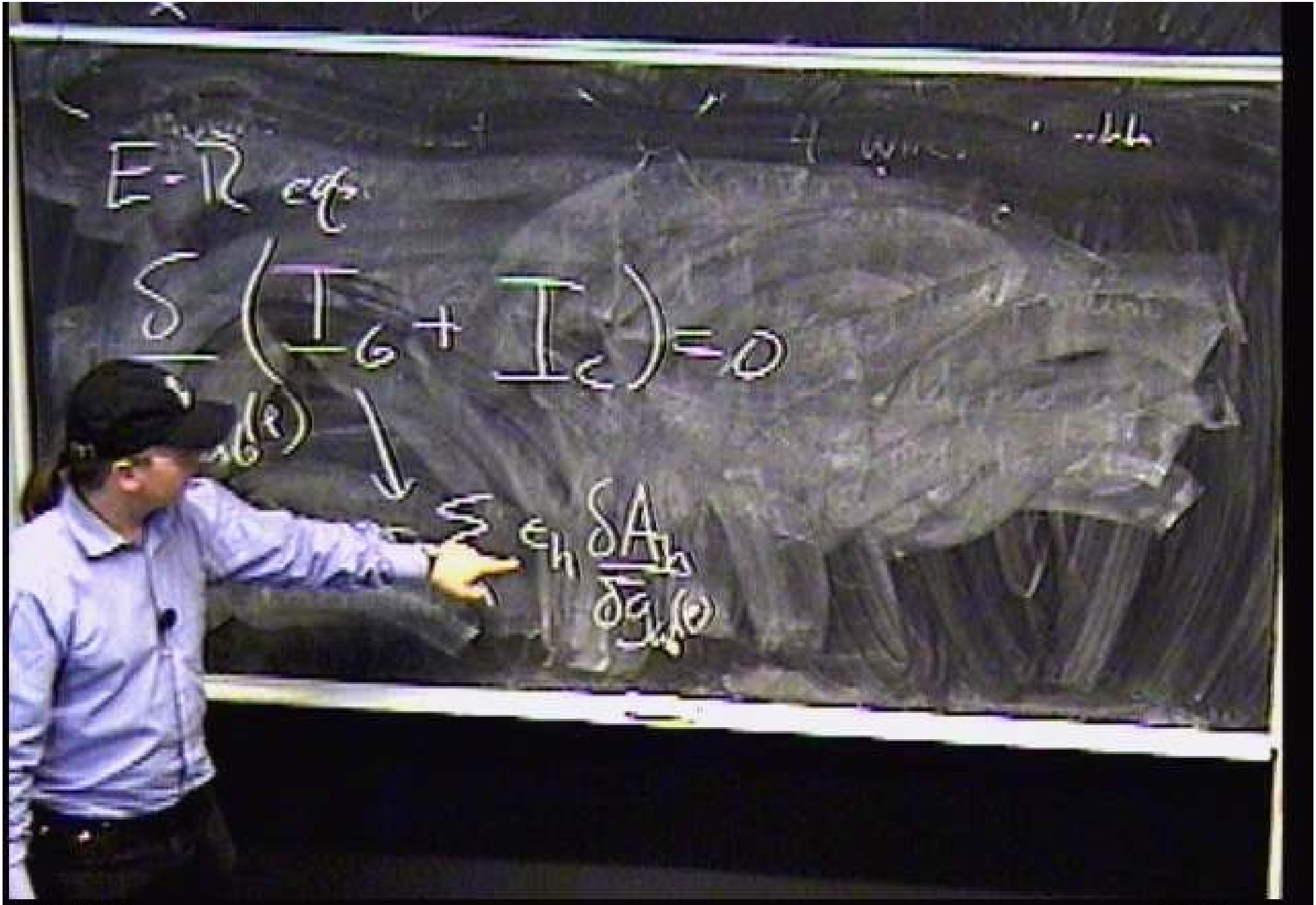
$$\frac{1}{8\pi^2}\sum_h \epsilon_h A_h = \int_G$$

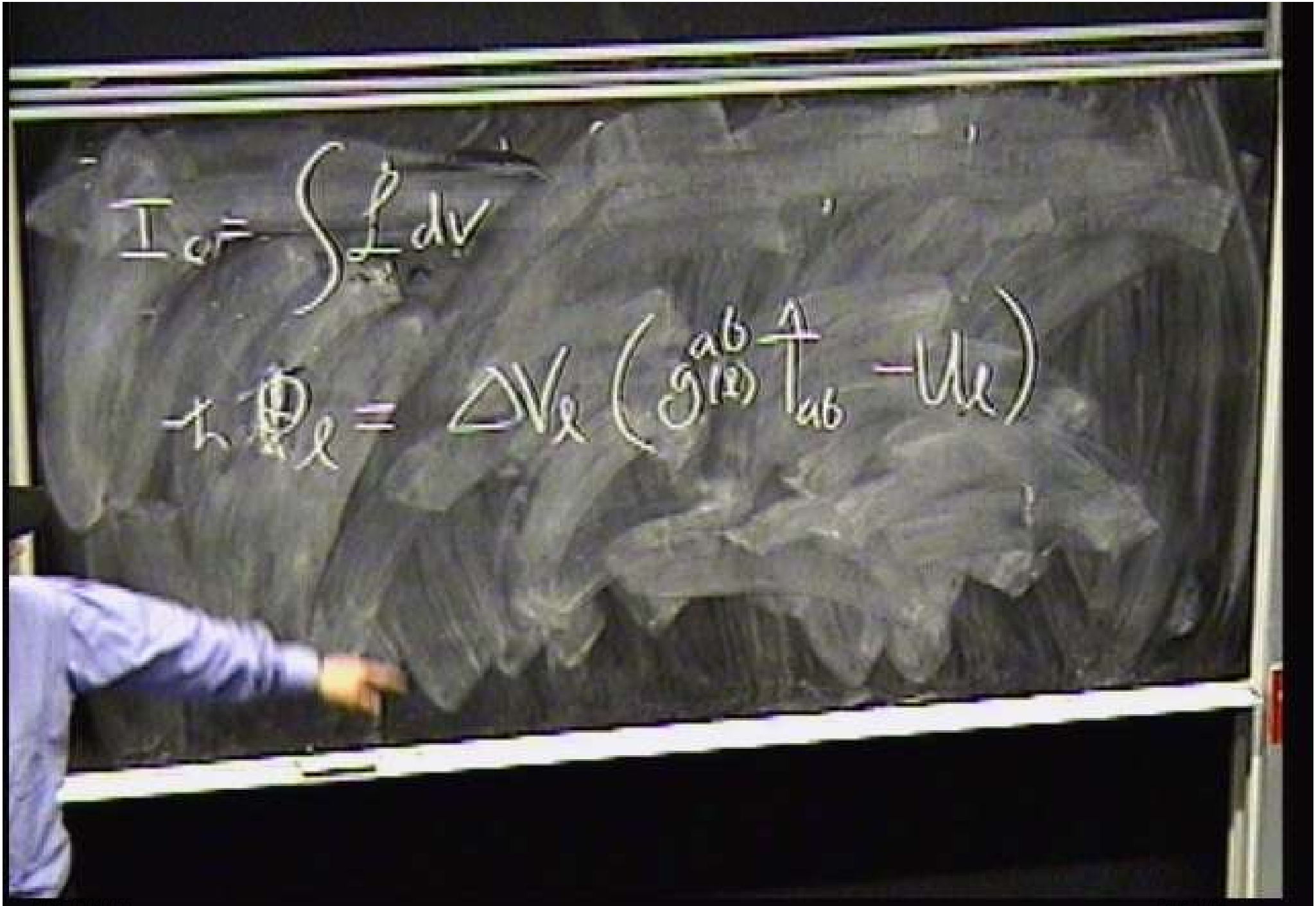
A_h = area

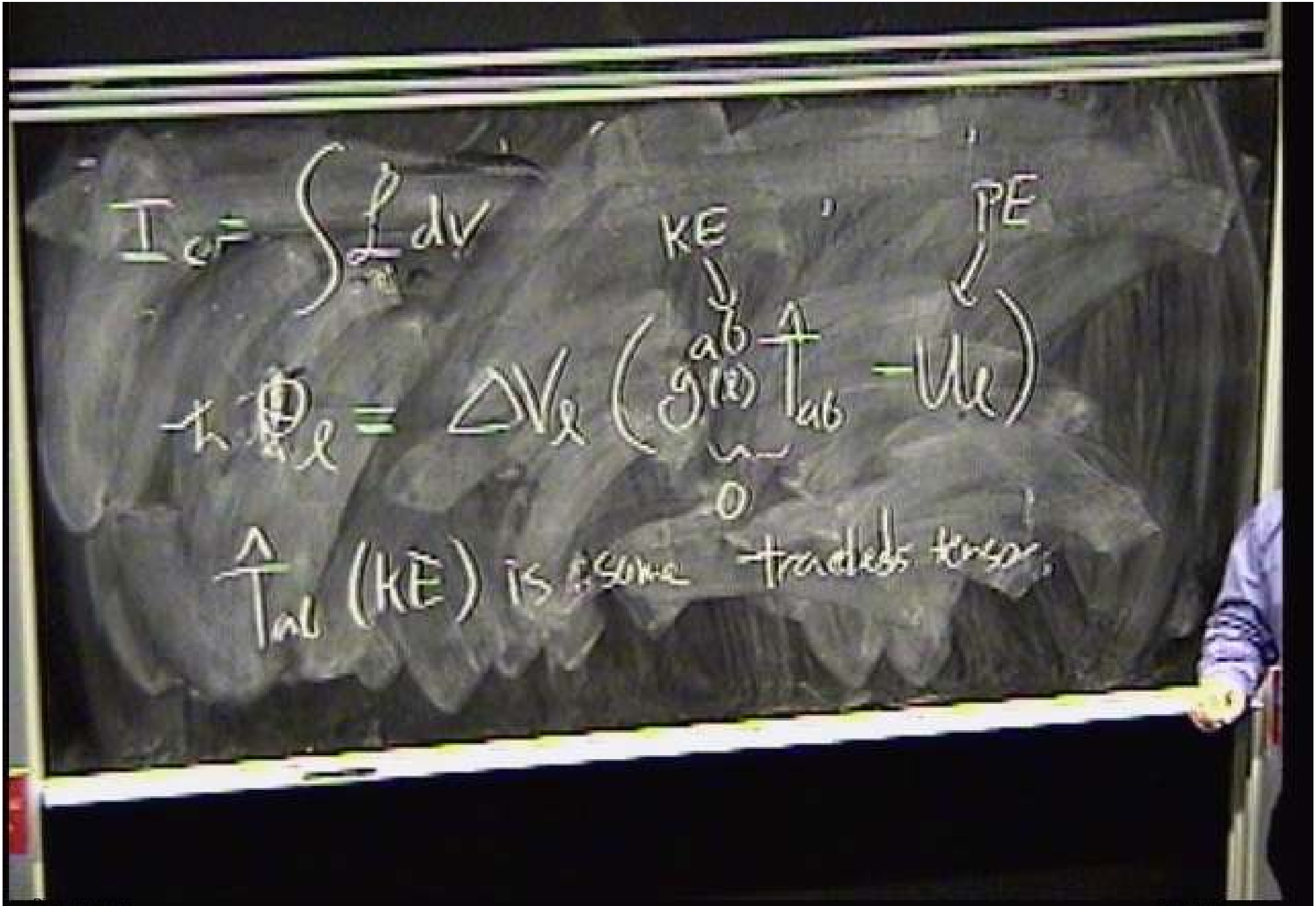
$$\left(\text{c.f. } \frac{1}{8\pi^2}\int R\,dV\right)$$

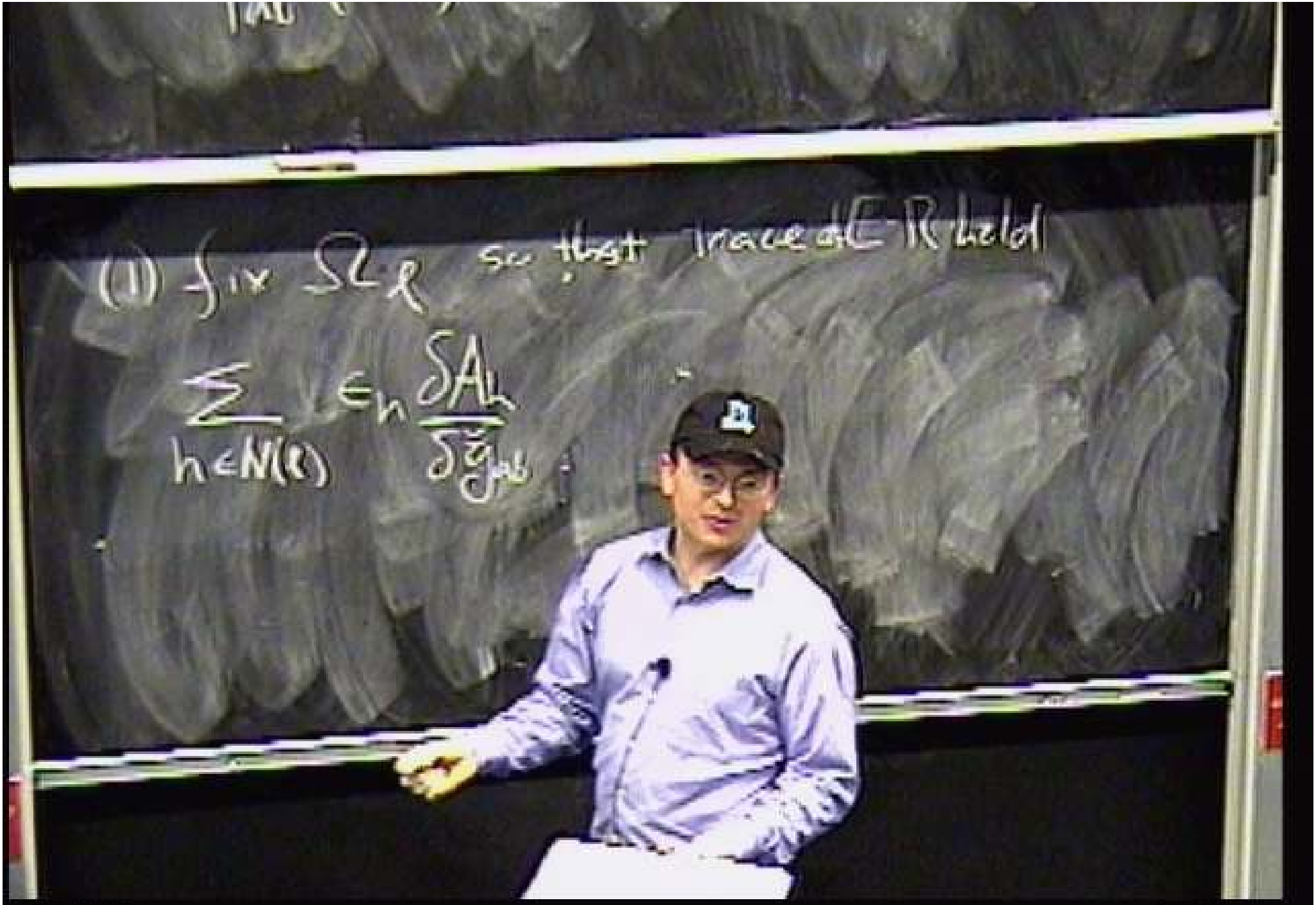
Recall $\int_C = \pm\sum_l \theta_l$ (= "$E_1 t_1$")

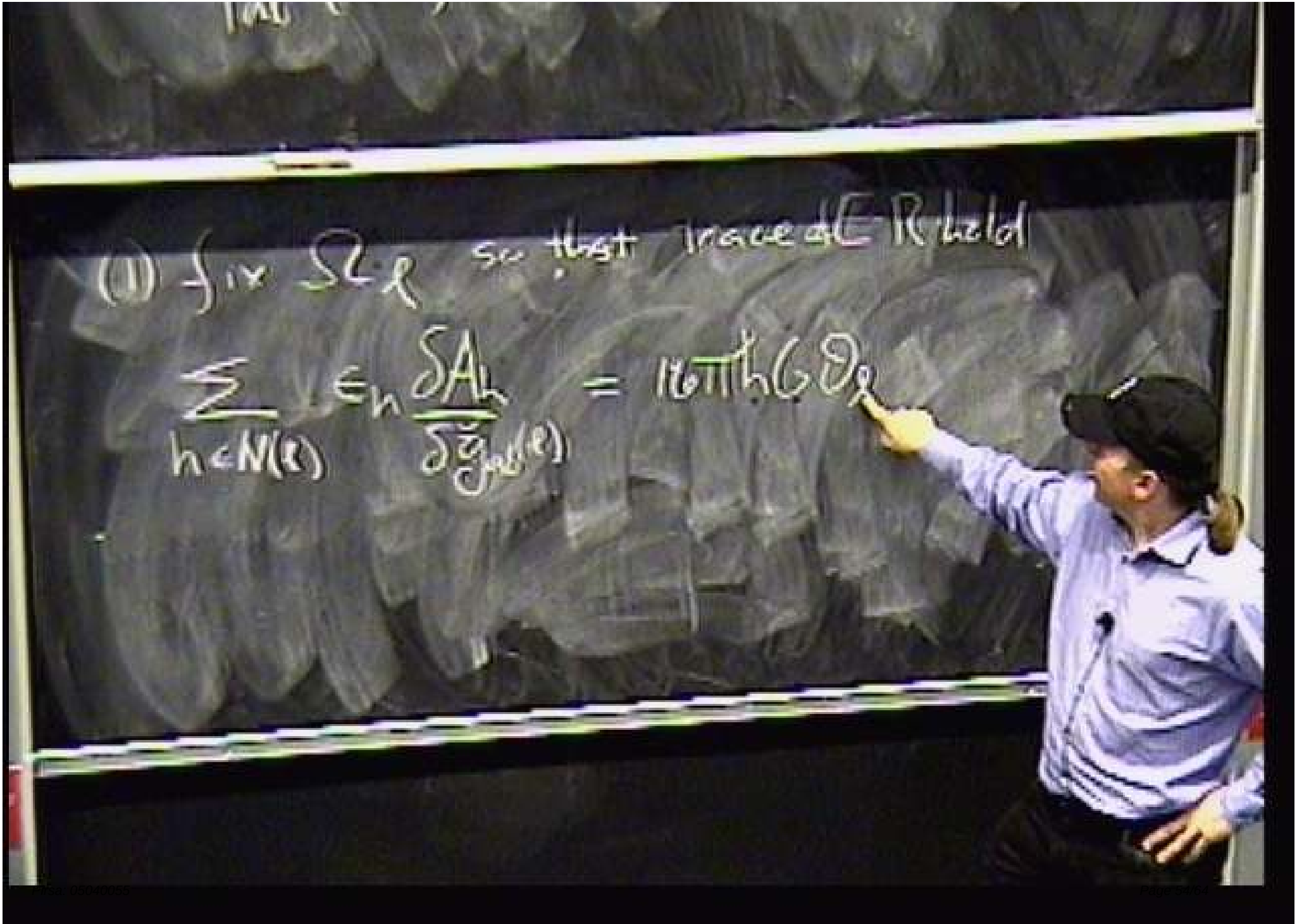

E-R eq.
$\frac{\delta}{\delta g_{\mu\nu}(x)}(I_G + I_c) = 0$

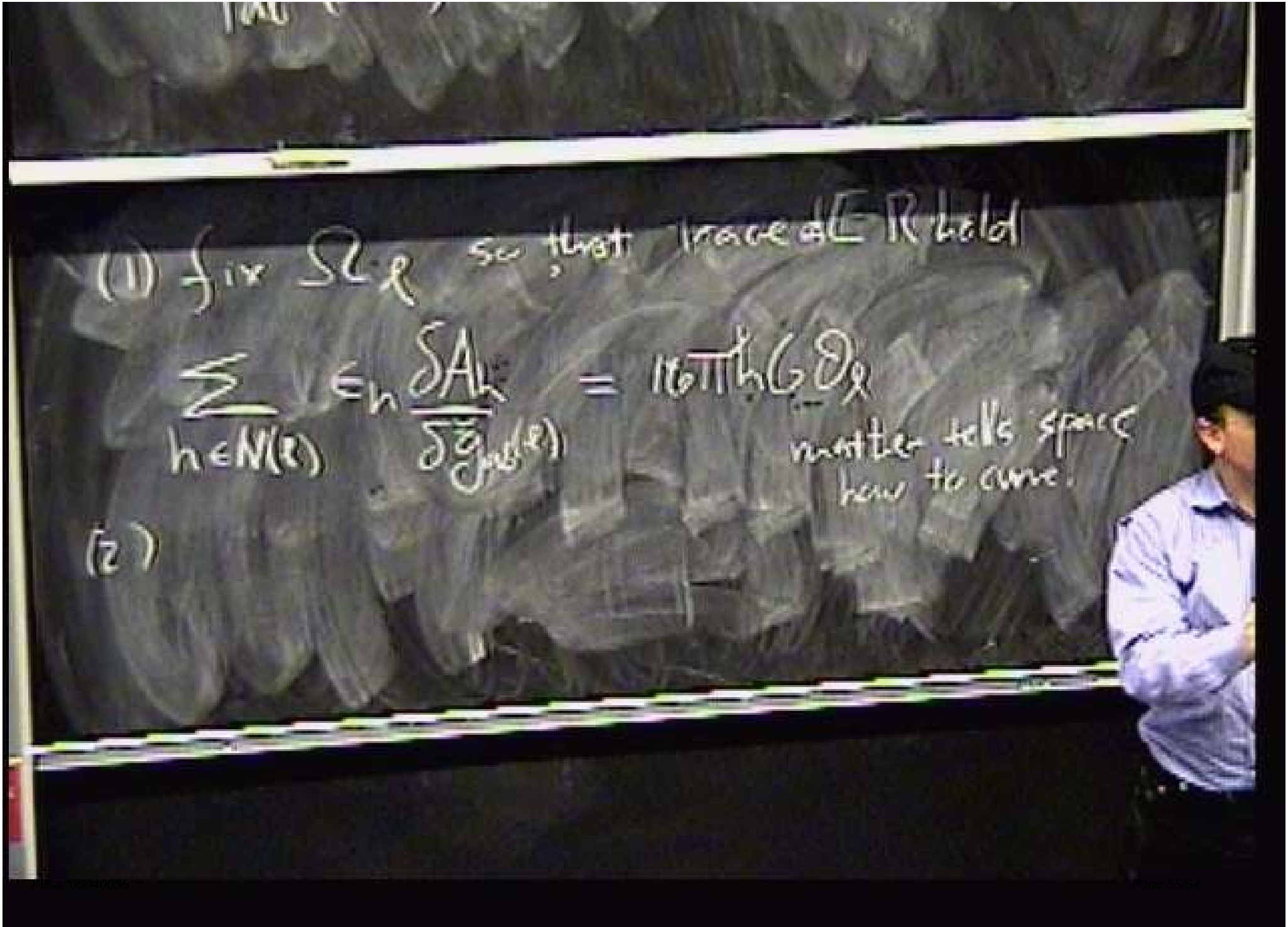

E-R eq.
$\frac{\delta}{\delta(\quad)}\left(\quad + \quad\right) = 0$
$\sum \epsilon_h \frac{\delta A_h}{\delta \quad}$


$I_{eff} = \int \mathcal{L} dV$
$\pm \Phi_k = \Delta V_k \left(g^{ab}_{(k)} T_{ab} - U_k \right)$


KE
PE
0


(1)
such that


(1) $\int_{\Omega} \mathrm{Ric}_g \, dV_g$ so that trace of Ric_g
$\sum_{h \in N(g)} \epsilon_h \frac{\delta A_h}{\delta \vec{g}_{ij}(p)} = 16\pi^2 G \Theta_g$

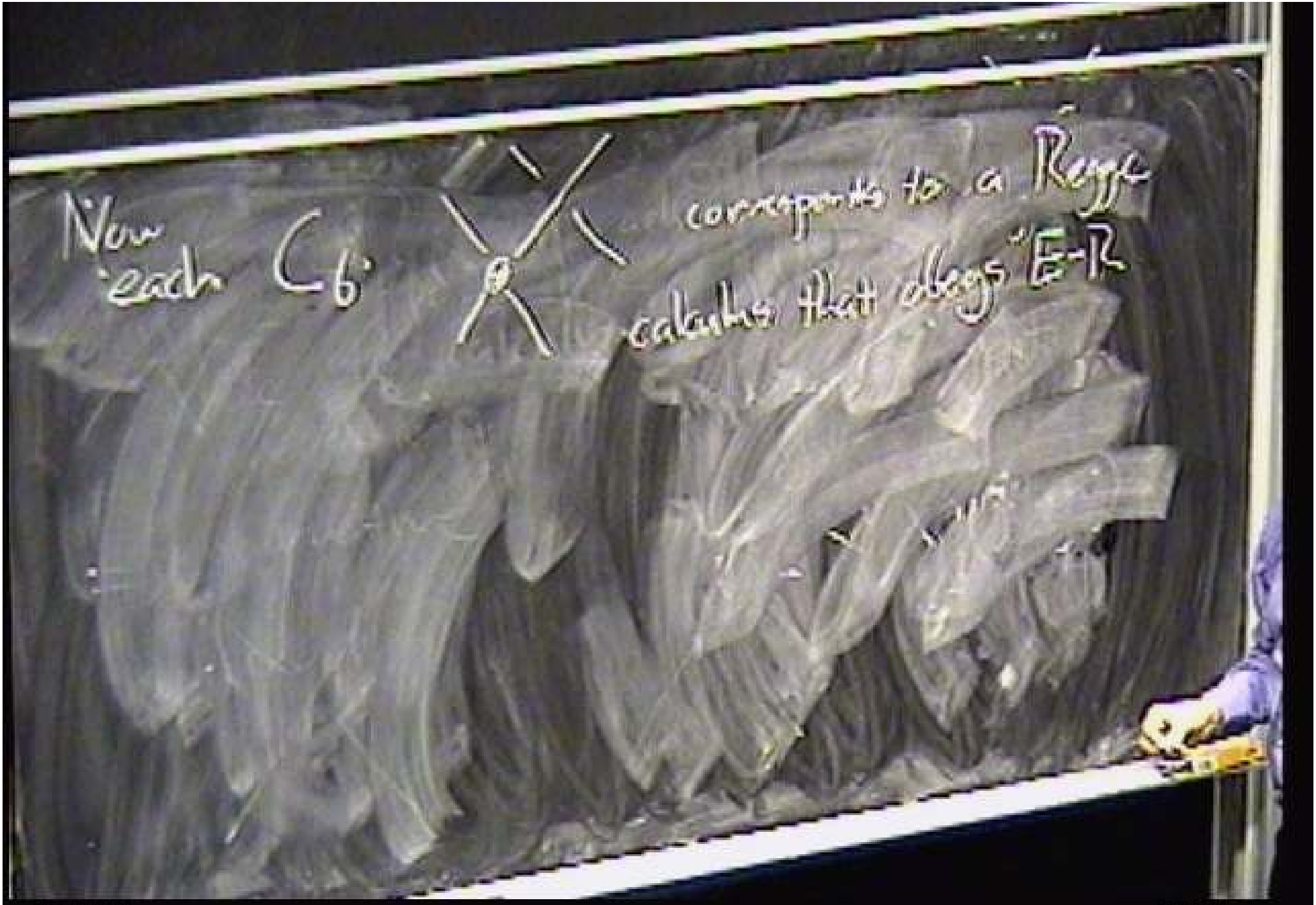

(1)
such that
matter tells space
how to curve.
(2)

(1) $\int_{\mathcal{R}} \mathcal{L}_R$ so that Einstein-Hilbert

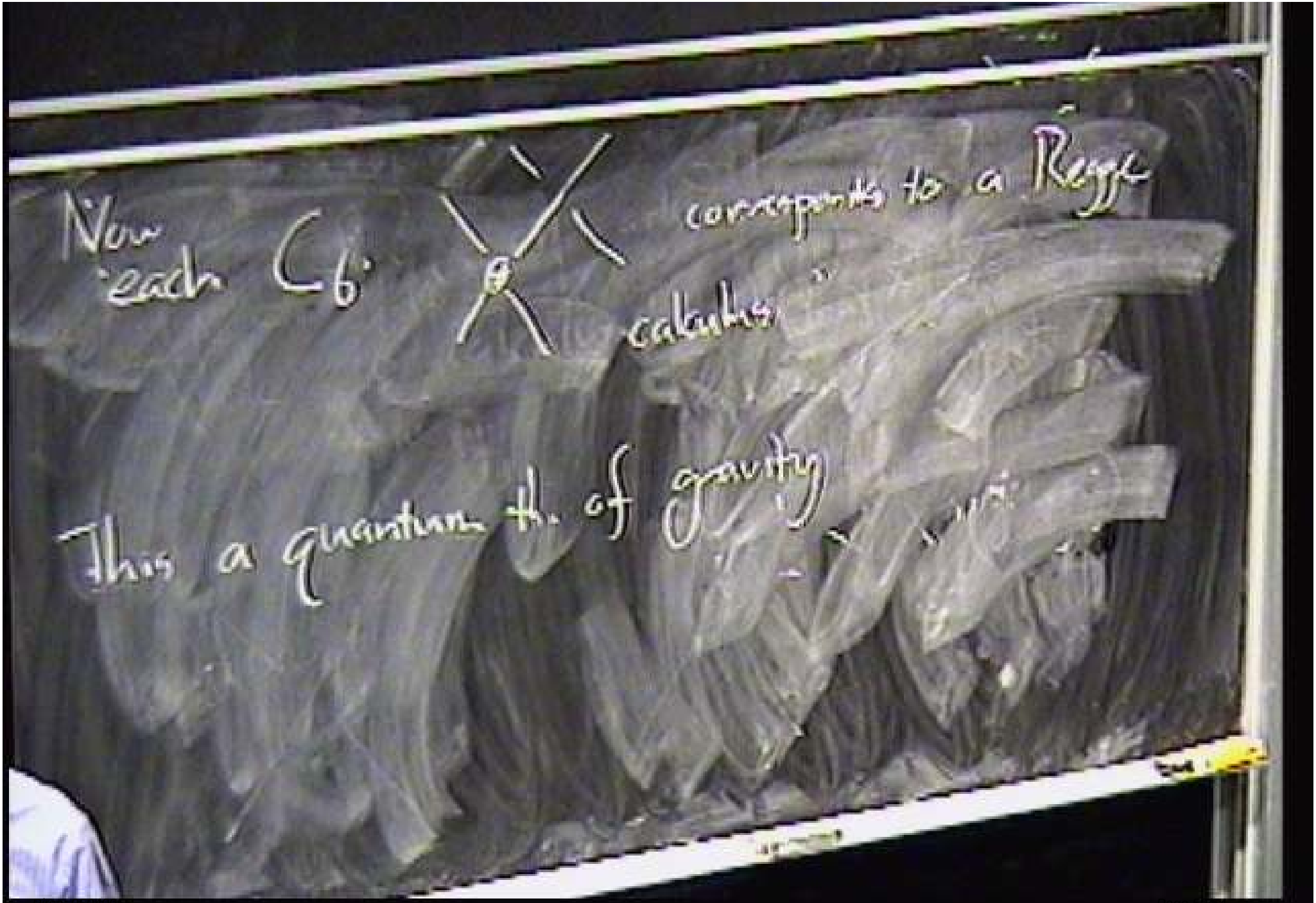
$$\sum_{h \in N(R)} \epsilon_h \frac{\delta A_h}{\delta g_{ab}(R)} = 16\pi h G_R \Theta_R$$

matter tells space how to curve.

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


Now
each
corresponds to a Regu
calculus that obeys "E-R

Now
each
corresponds to a Regge
calculus


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

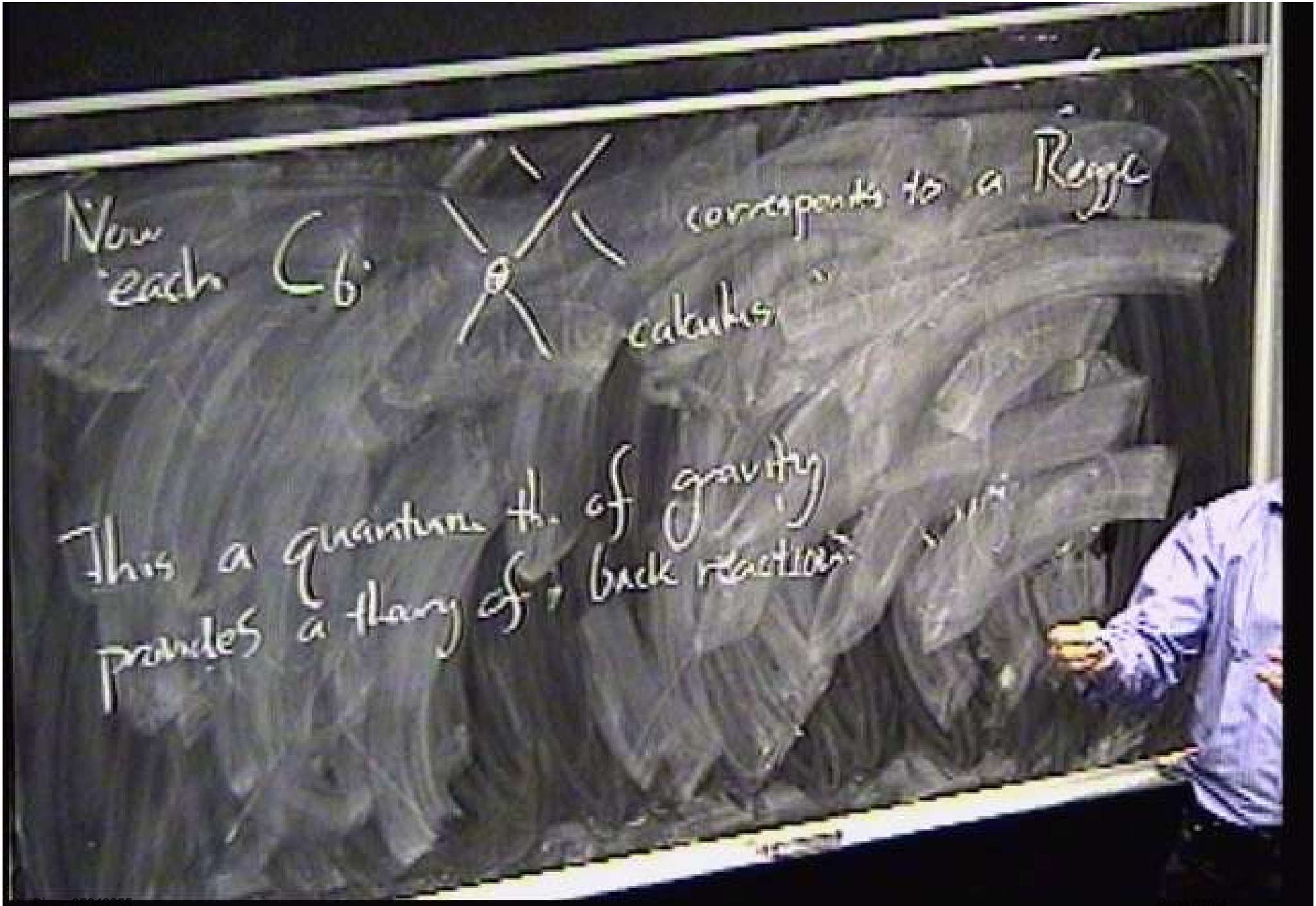
(1) $\int_{\partial\Omega} \Omega_R$ such that trace $\in \mathbb{R}$ holds

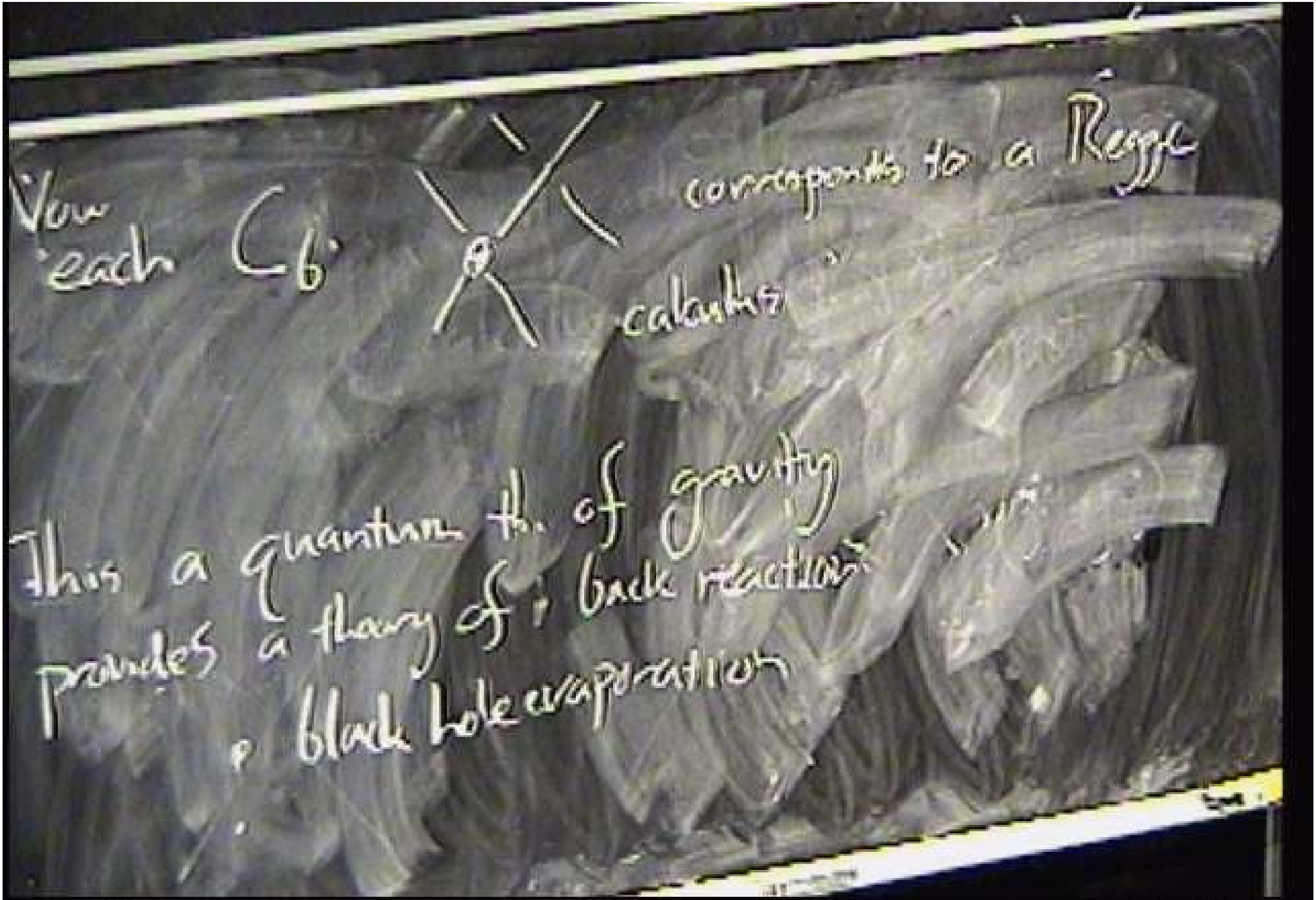
$$\sum_{h \in N(R)} \epsilon_h \frac{\delta A_k}{\delta \bar{\sigma}_{j_h}(R)} = \text{tr}\,\Pi^{\dagger}_{h} G_{\partial\Omega}$$

matrix tells space how to curve.

(2) assign $\top_{ab}$ s.t. that

the rest of $E \to \mathbb{R}$ eqs. holds $\left(\top_{ab} \neq 0 \right)$

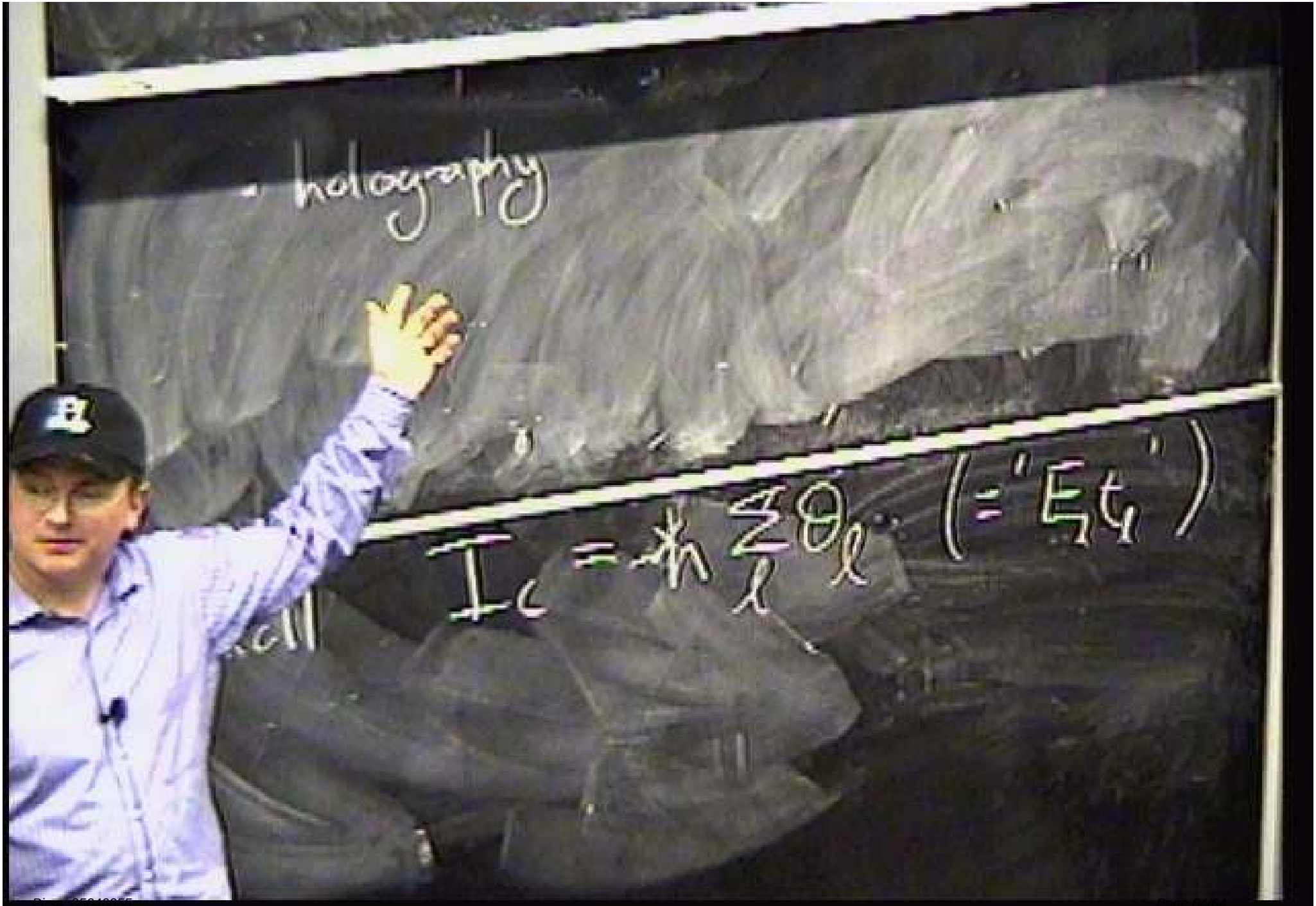

Now
each
corresponds to a Regge
calculus
This a quantum th. of gravity
provides a theory of, back reaction


Now
each
corresponds to a
calculus
This a quantum th. of gravity
provides a theory of
black hole evaporation

Now each C_6 corresponds to a Regge calculus

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

hinges


holography
$I_c = \hbar \sum_l \theta_l$ (= "$E_1 t_1$")