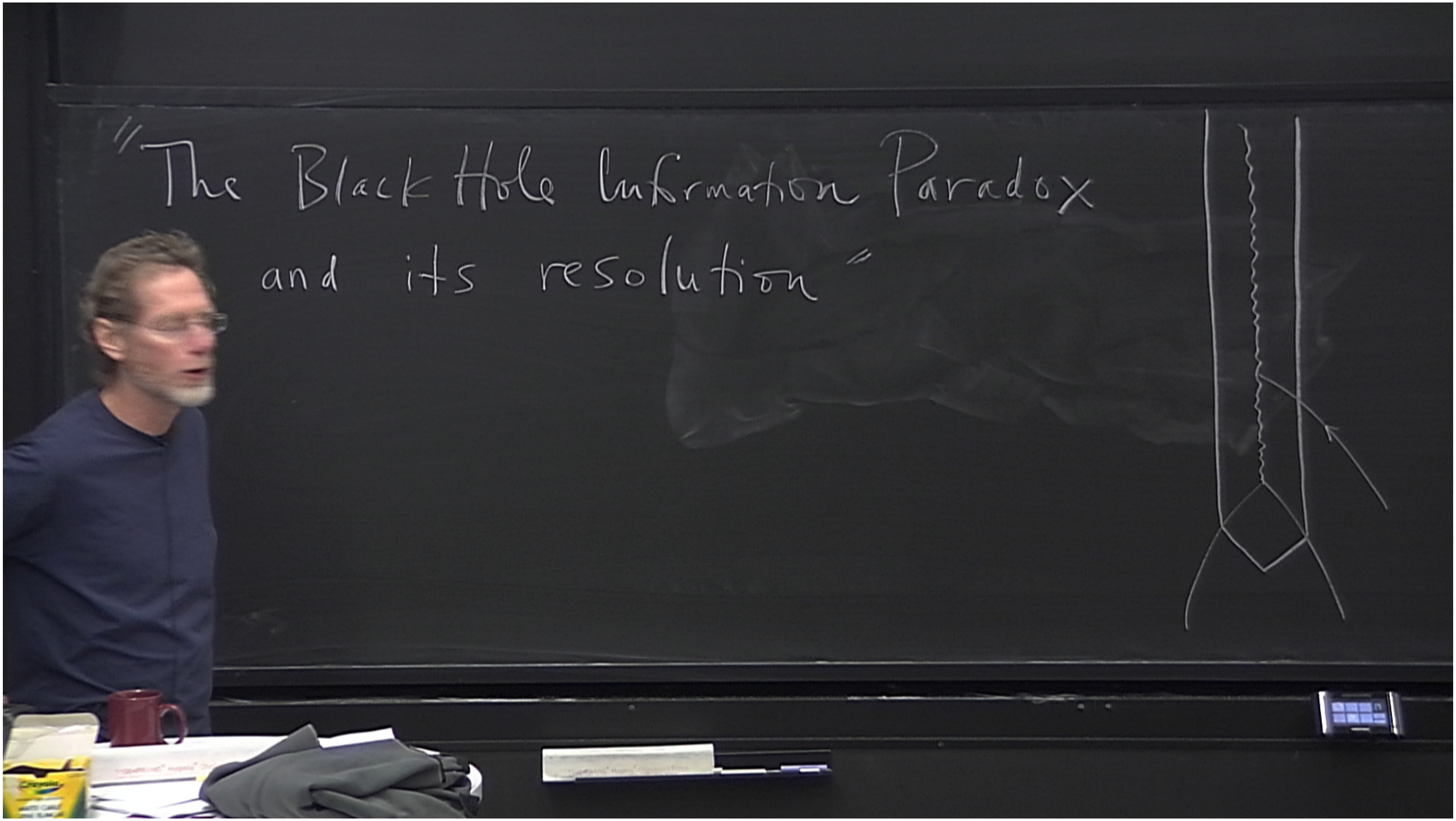
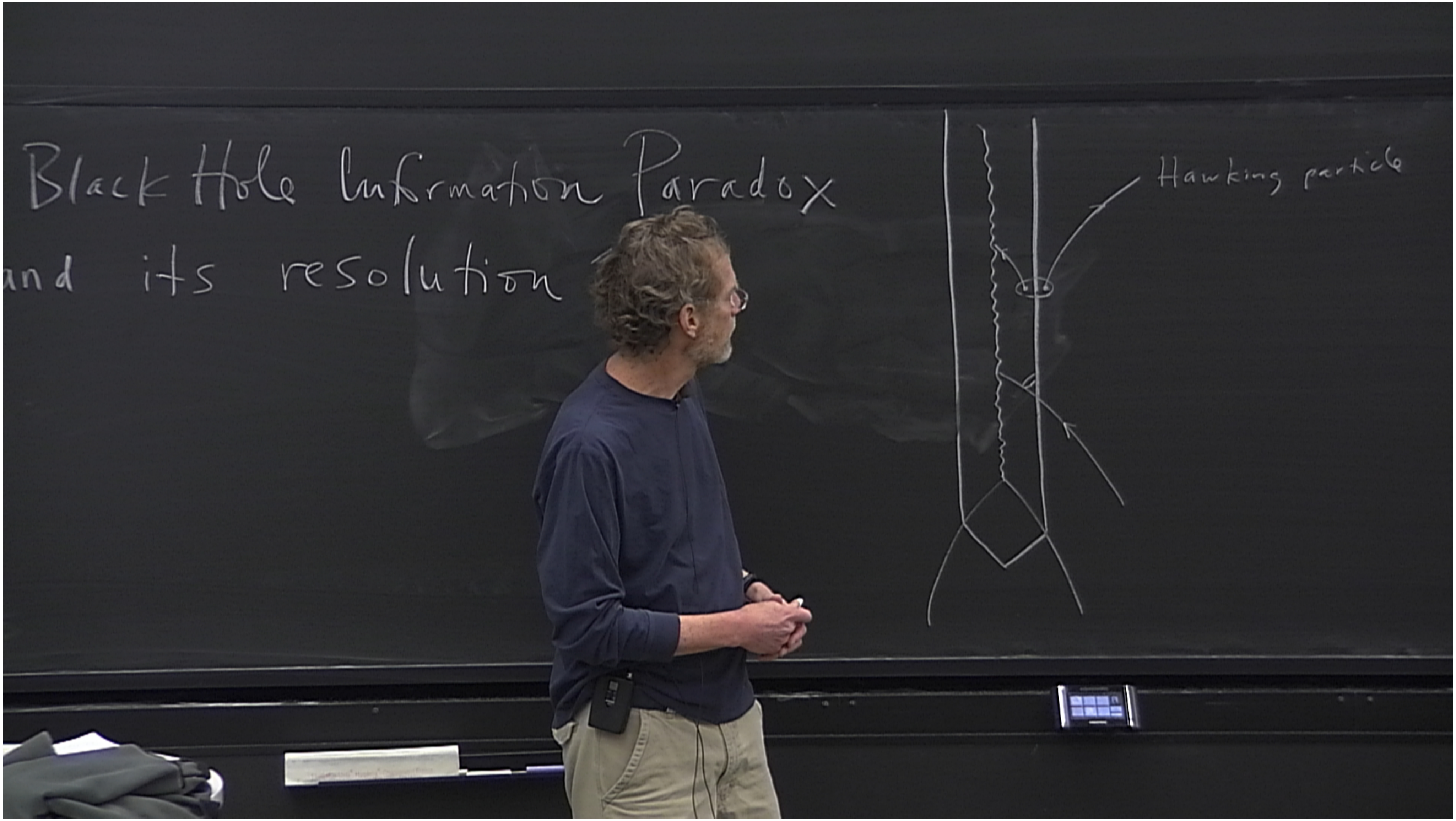
Title: The black hole information paradox and its resolution

Date: Jan 17, 2013 02:30 PM

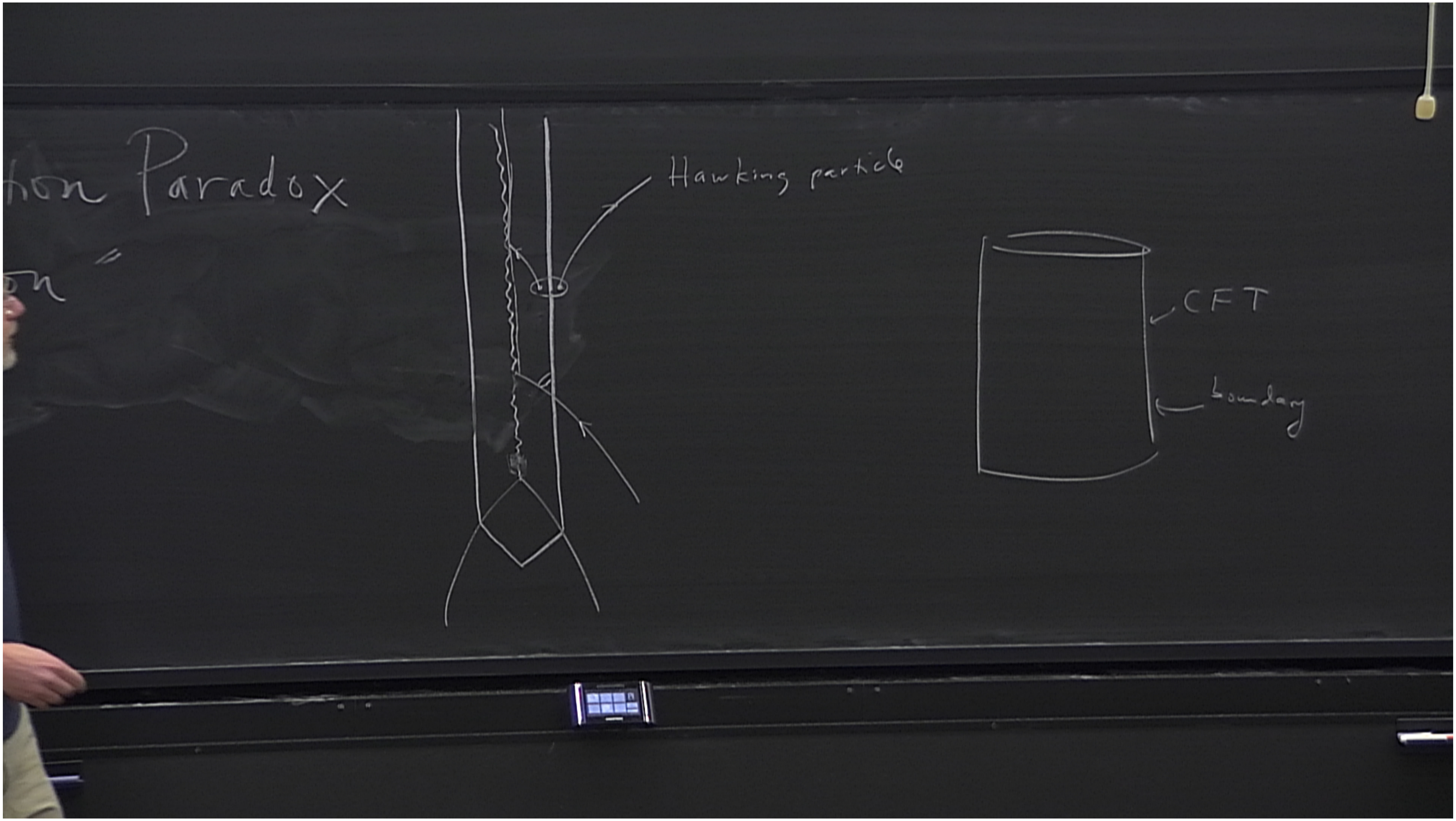
URL: http://pirsa.org/13010021

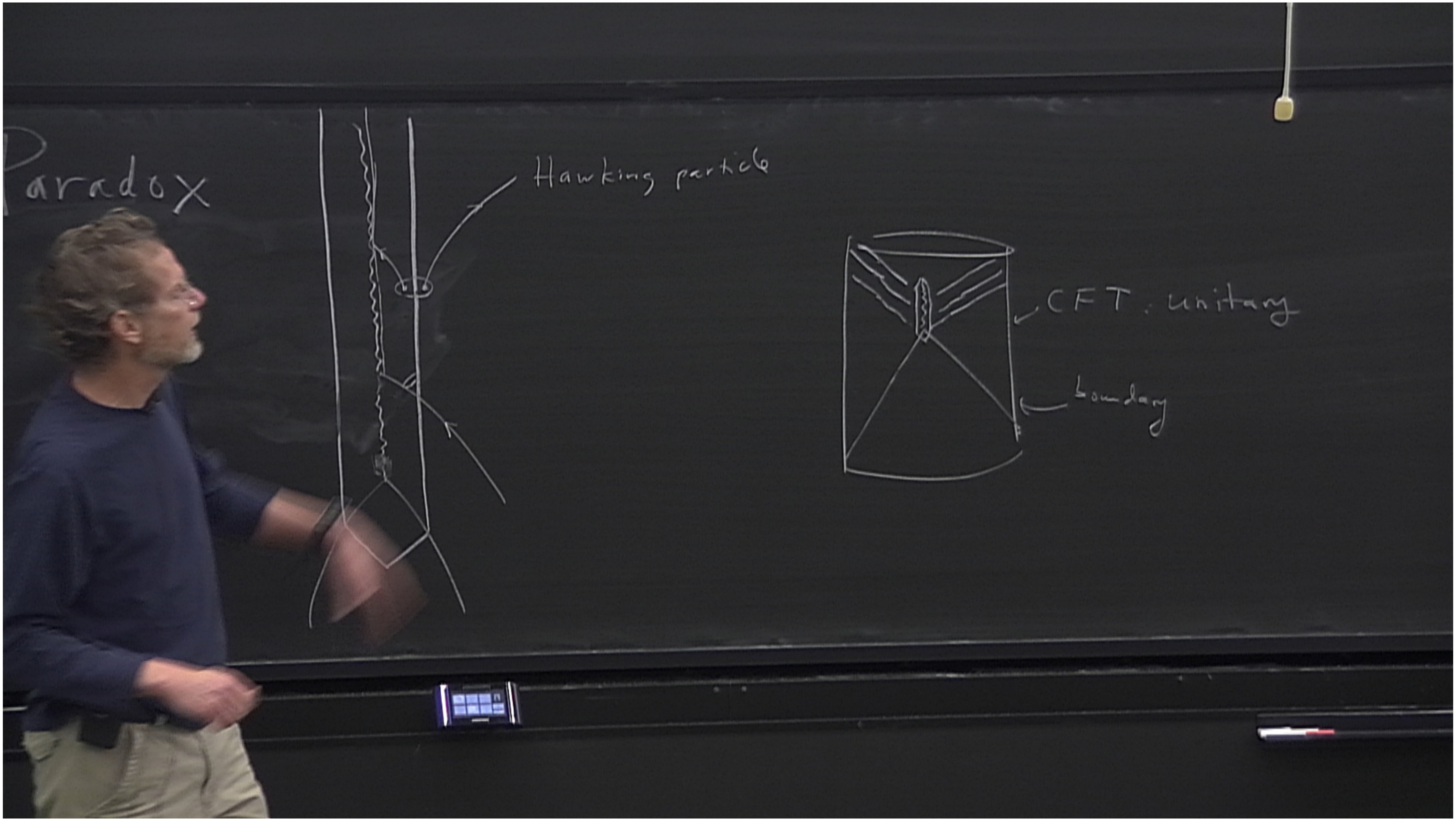
Abstract:

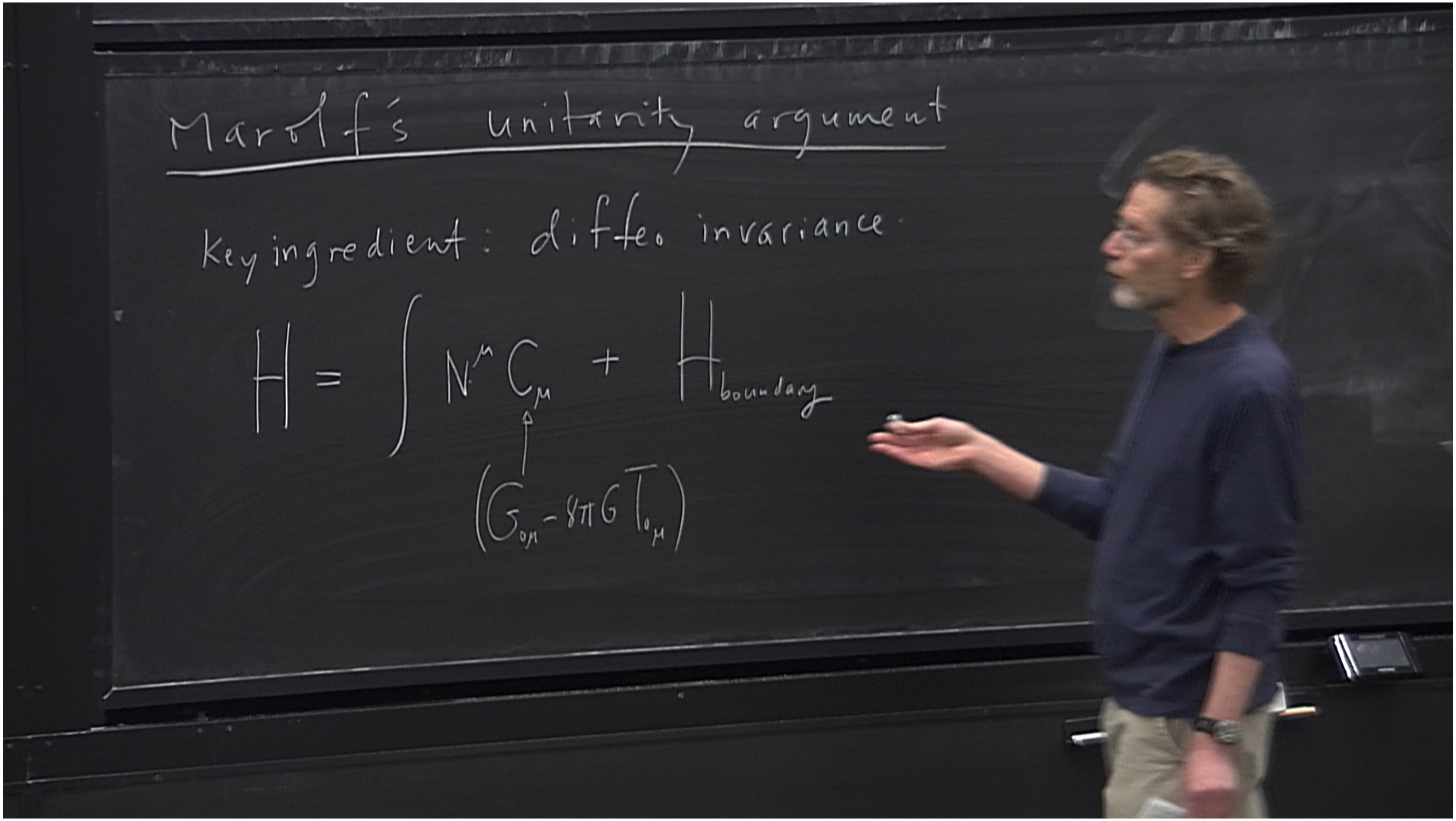

"The Black Hole Information Paradox
and its resolution"



Black Hole Information Paradox
and its resolution
Hawking particle


Paradox
Hawking particle
CFT
boundary


Paradox
Hawking particle
CFT : unitary
boundary

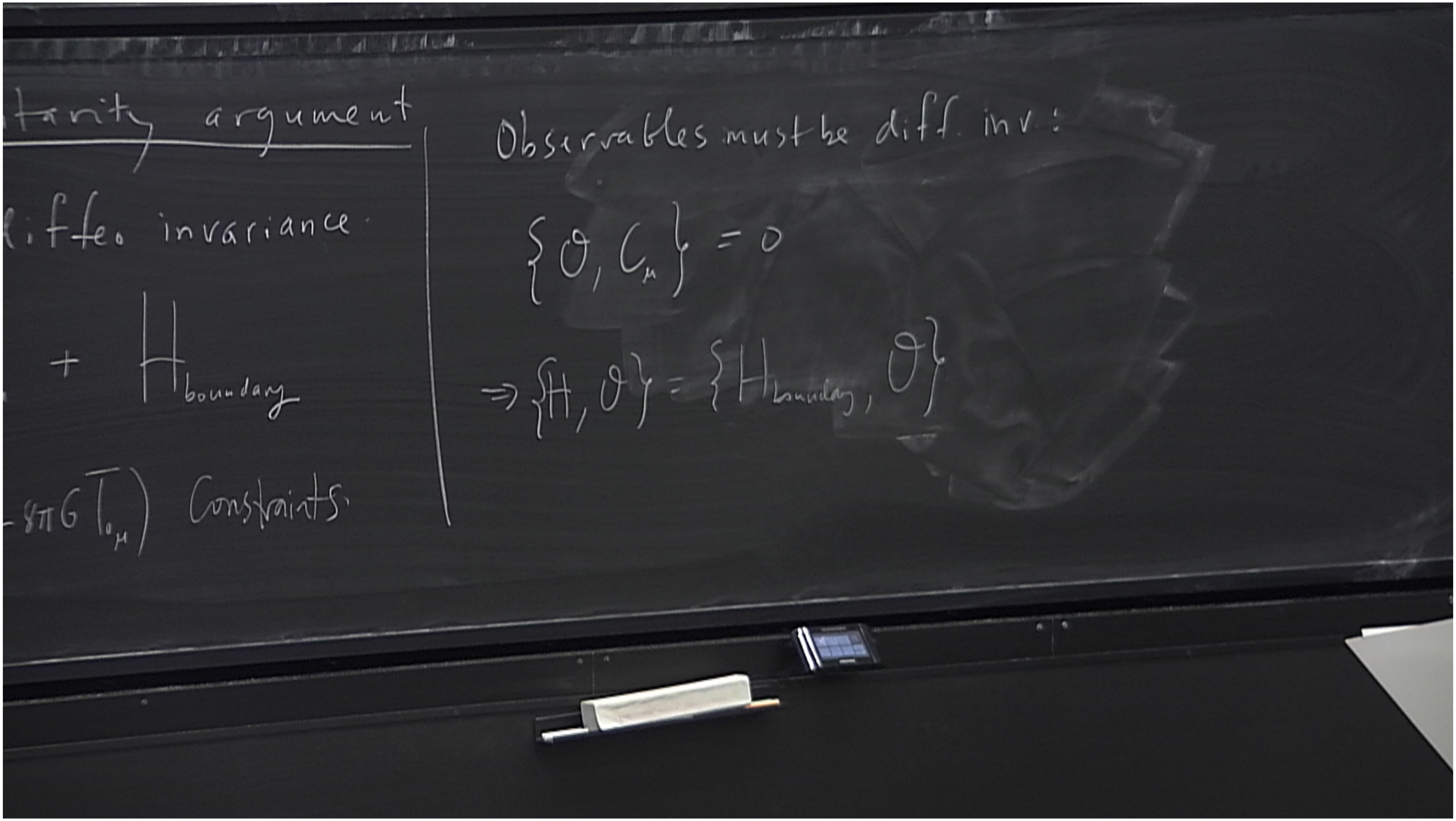

Marolf's unitarity argument
Key ingredient: diffeo invariance.
$H = \int N^\mu C_\mu + H_{boundary}$
$(G_{0\mu} - 8\pi G T_{0\mu})$

Marolf's unitarity argument

Key ingredient: diffeo invariance.

$$H = \int N^\mu C_\mu + H_{\text{boundary}}$$

$$\left(G_{0\mu} - 8\pi G\, T_{0\mu}\right)$$

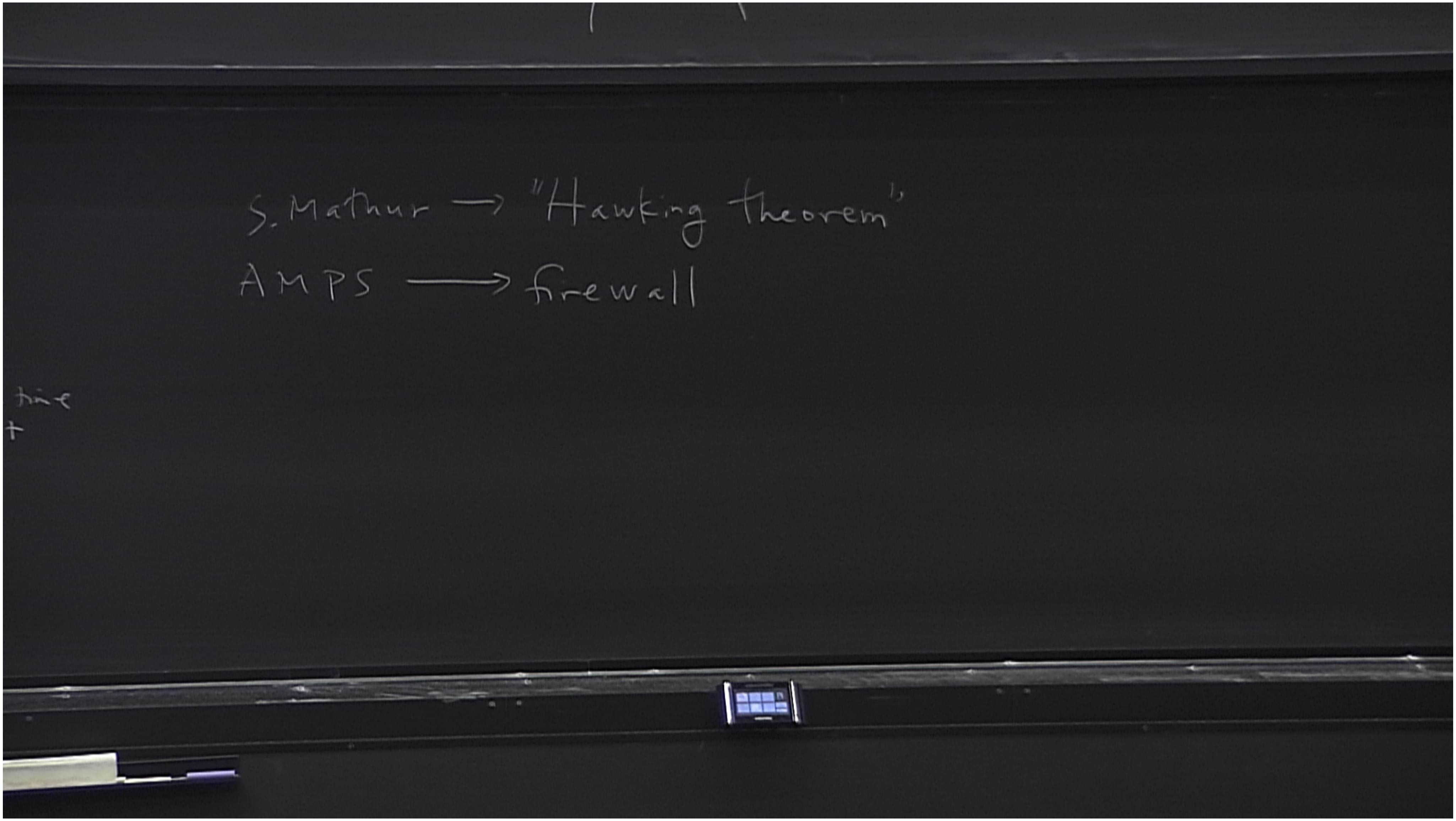

tarity argument
iffeo invariance
$+ H_{boundary}$
$8\pi G T_{0\mu})$ Constraints.
Observables must be diff. inv.:
$\{\mathcal{O}, C_\mu\} = 0$
$\Rightarrow \{H, \mathcal{O}\} = \{H_{boundary}, \mathcal{O}\}$

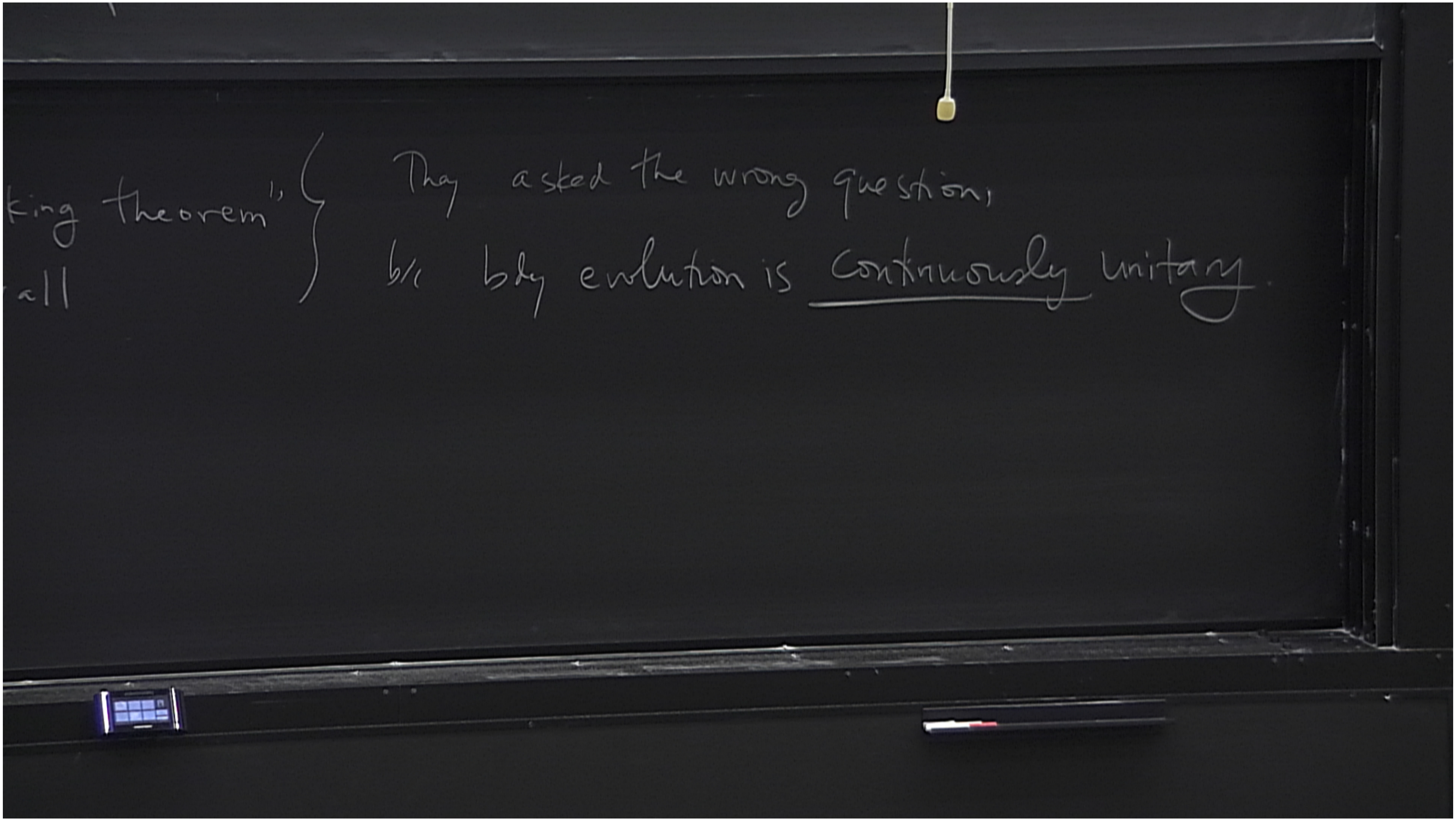
Observables must be diff. inv.:

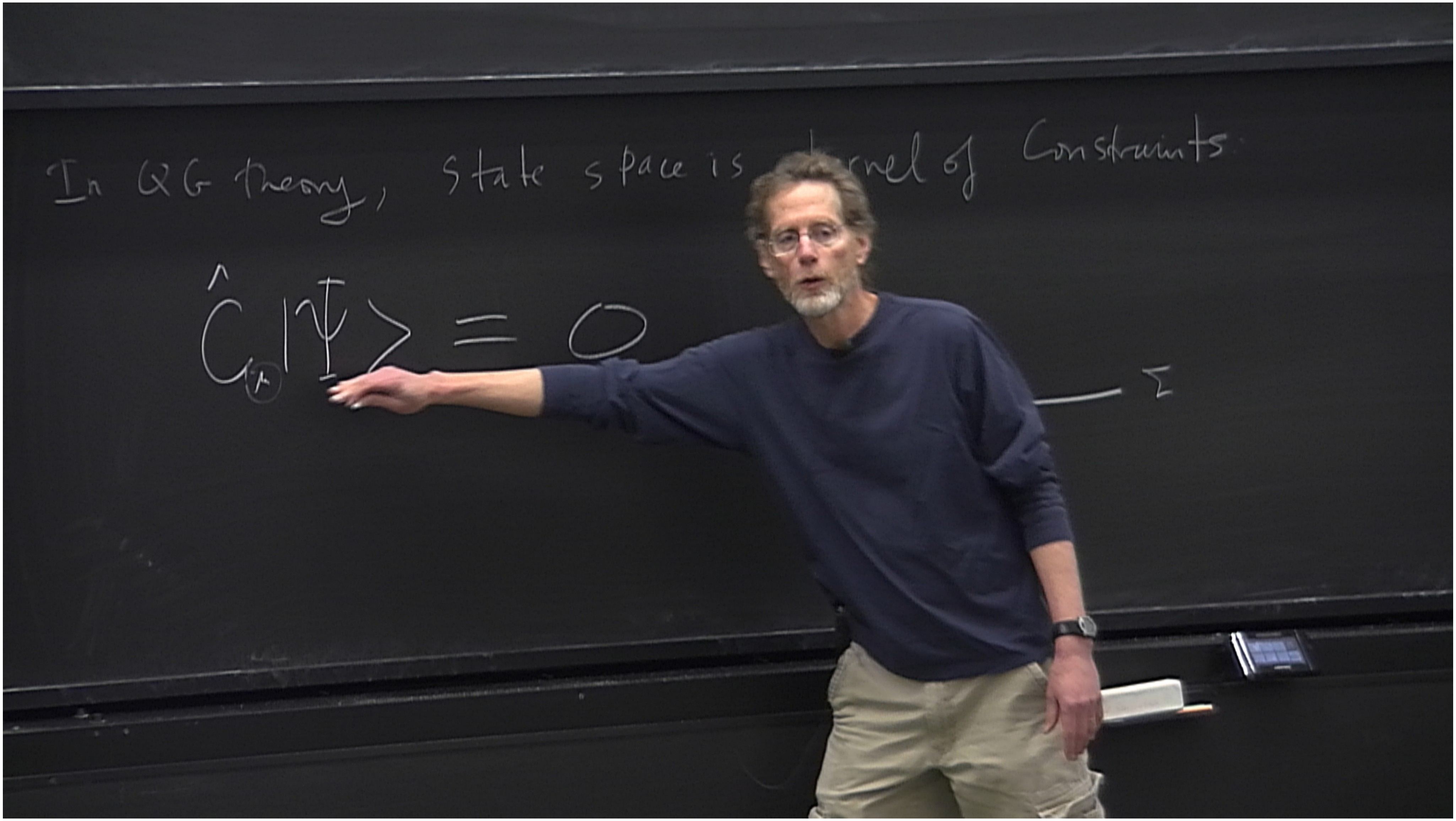
$$\{\mathcal{O}, C_\mu\} = 0$$

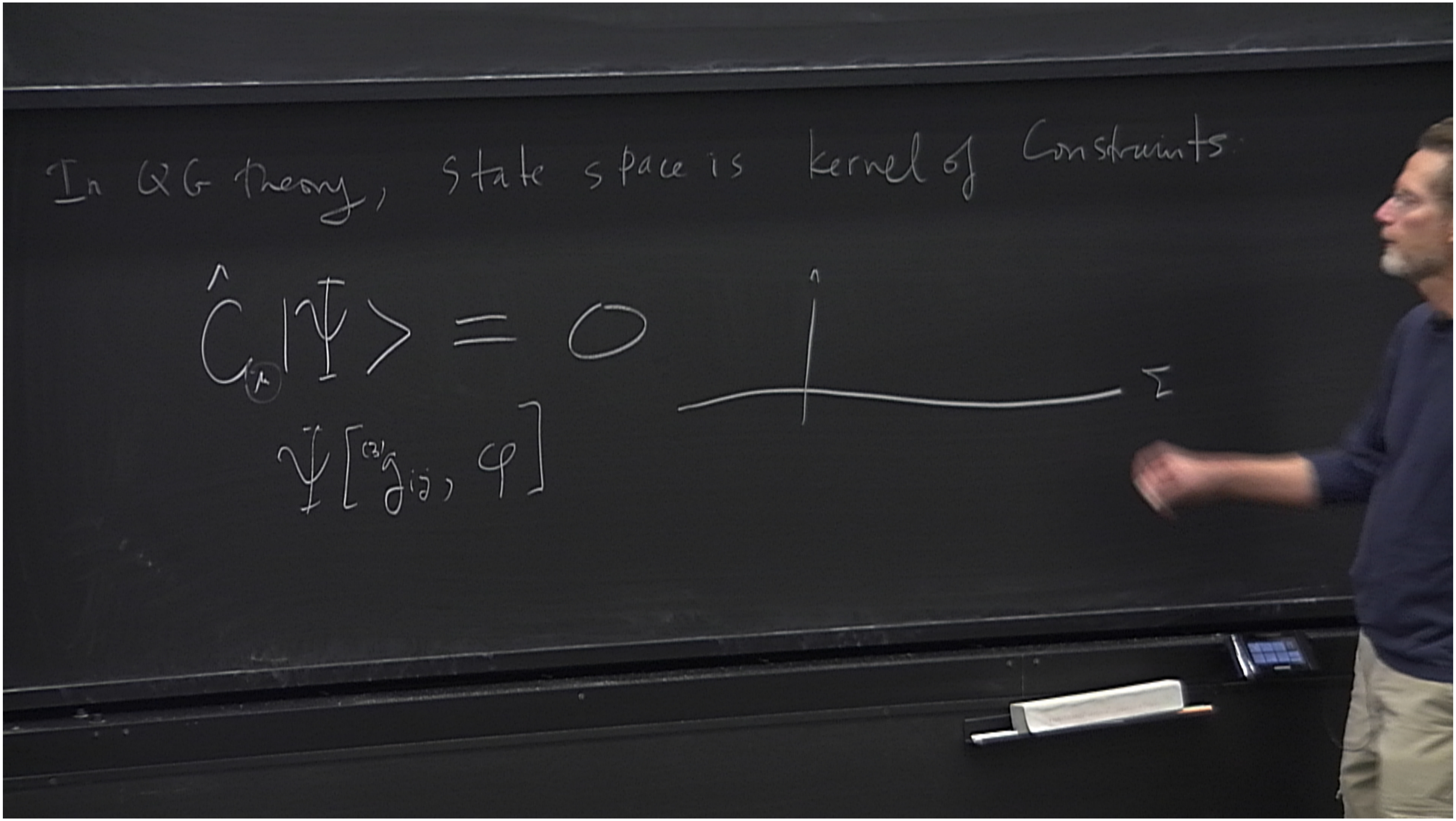
$$\Rightarrow \{H, \mathcal{O}\} = \{H_{\text{boundary}}, \mathcal{O}\}$$

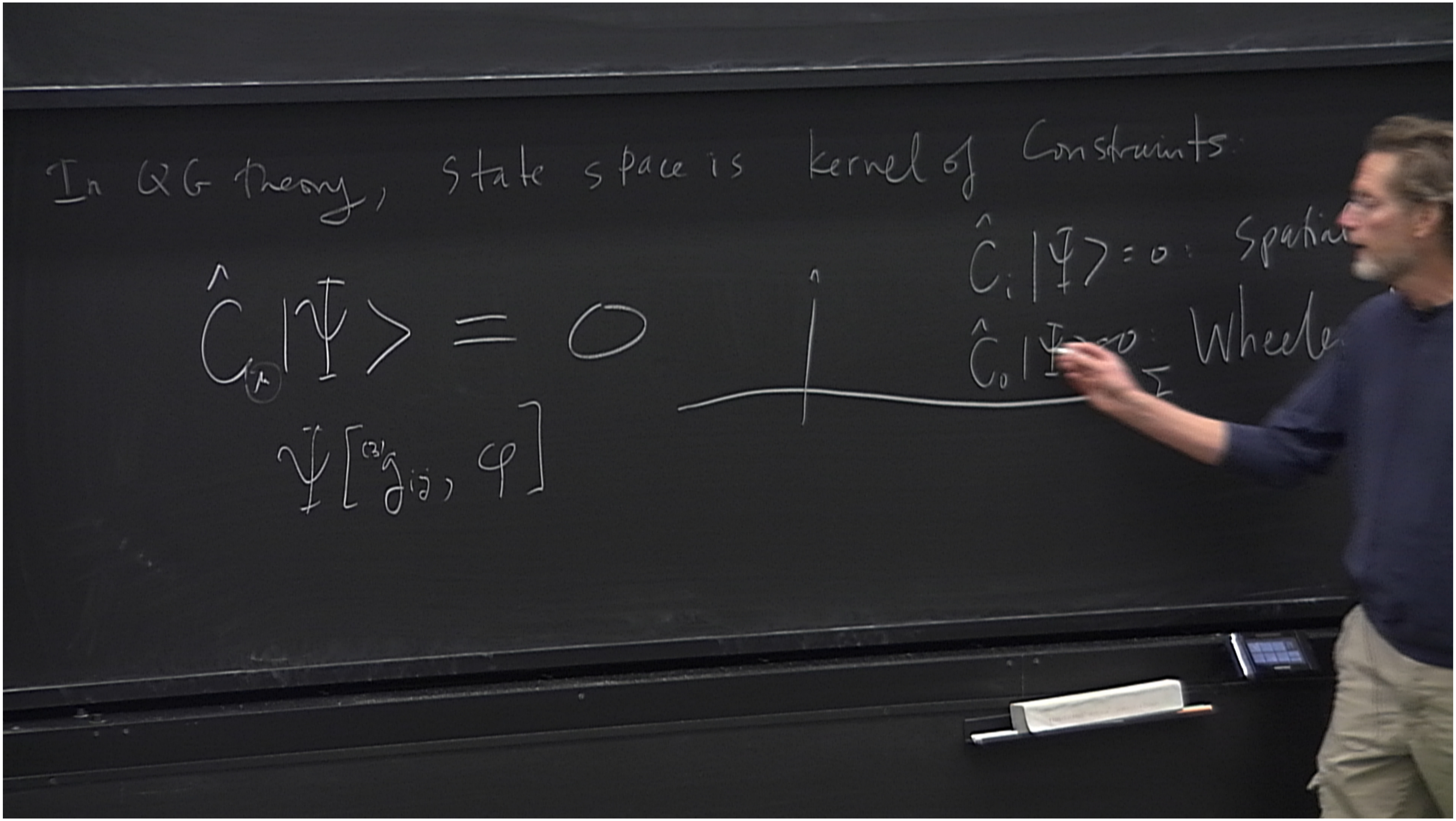
$\Rightarrow$ bdy observables evolve to bdy observables

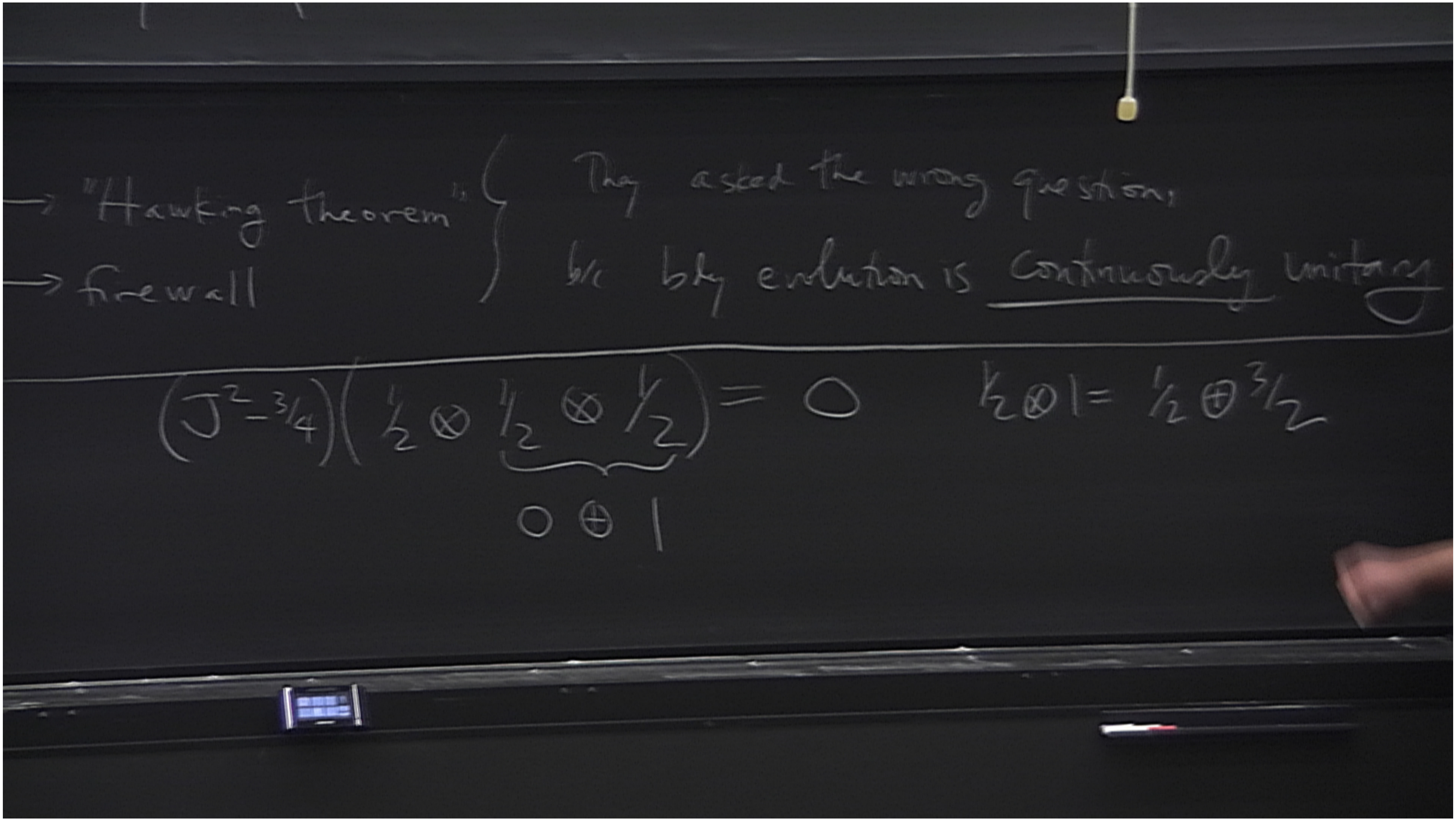

S. Mathur → "Hawking theorem"
AMPS → firewall

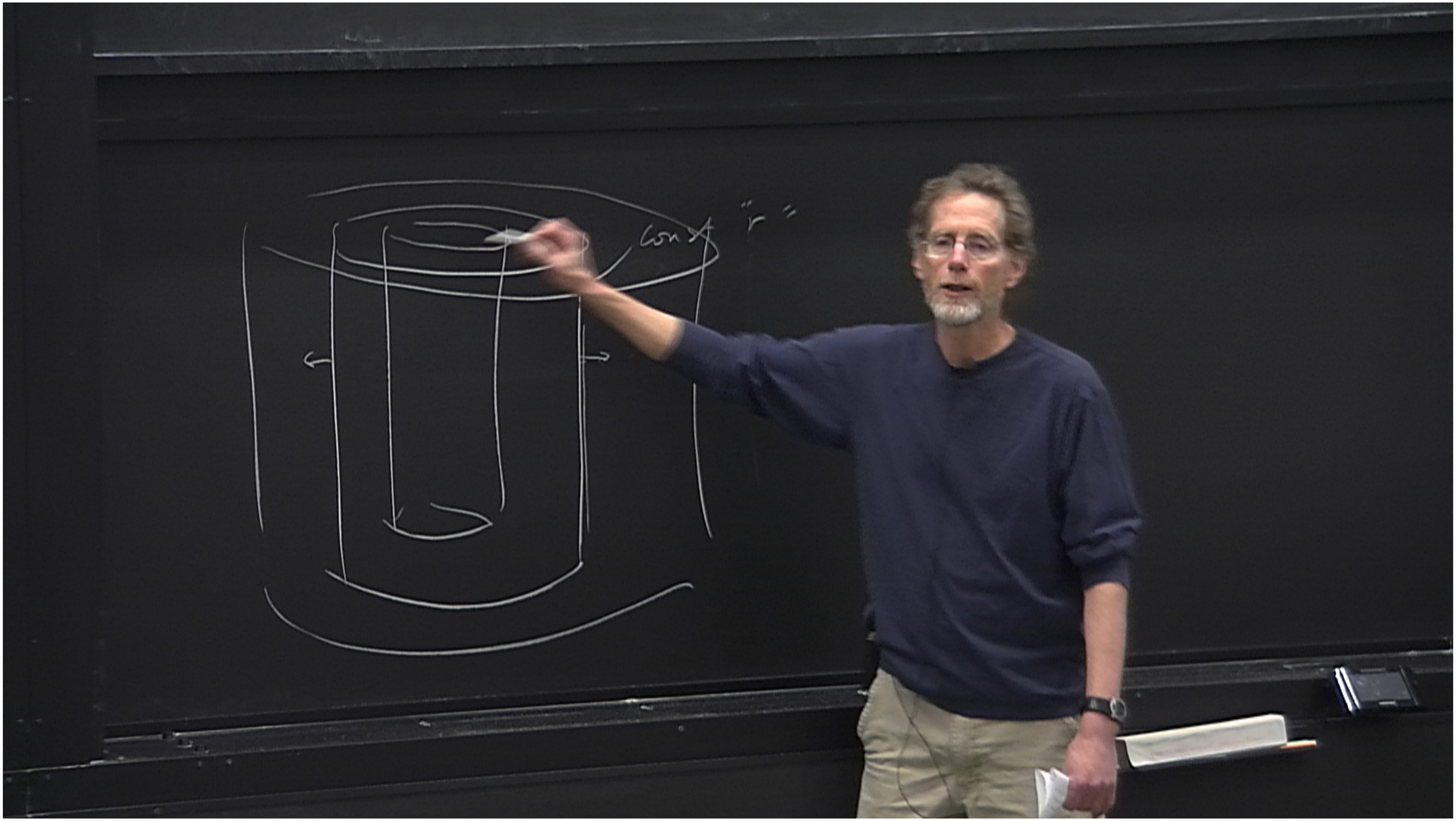

king theorem",
all
They asked the wrong question;
b/c bdy evolution is continuously unitary.

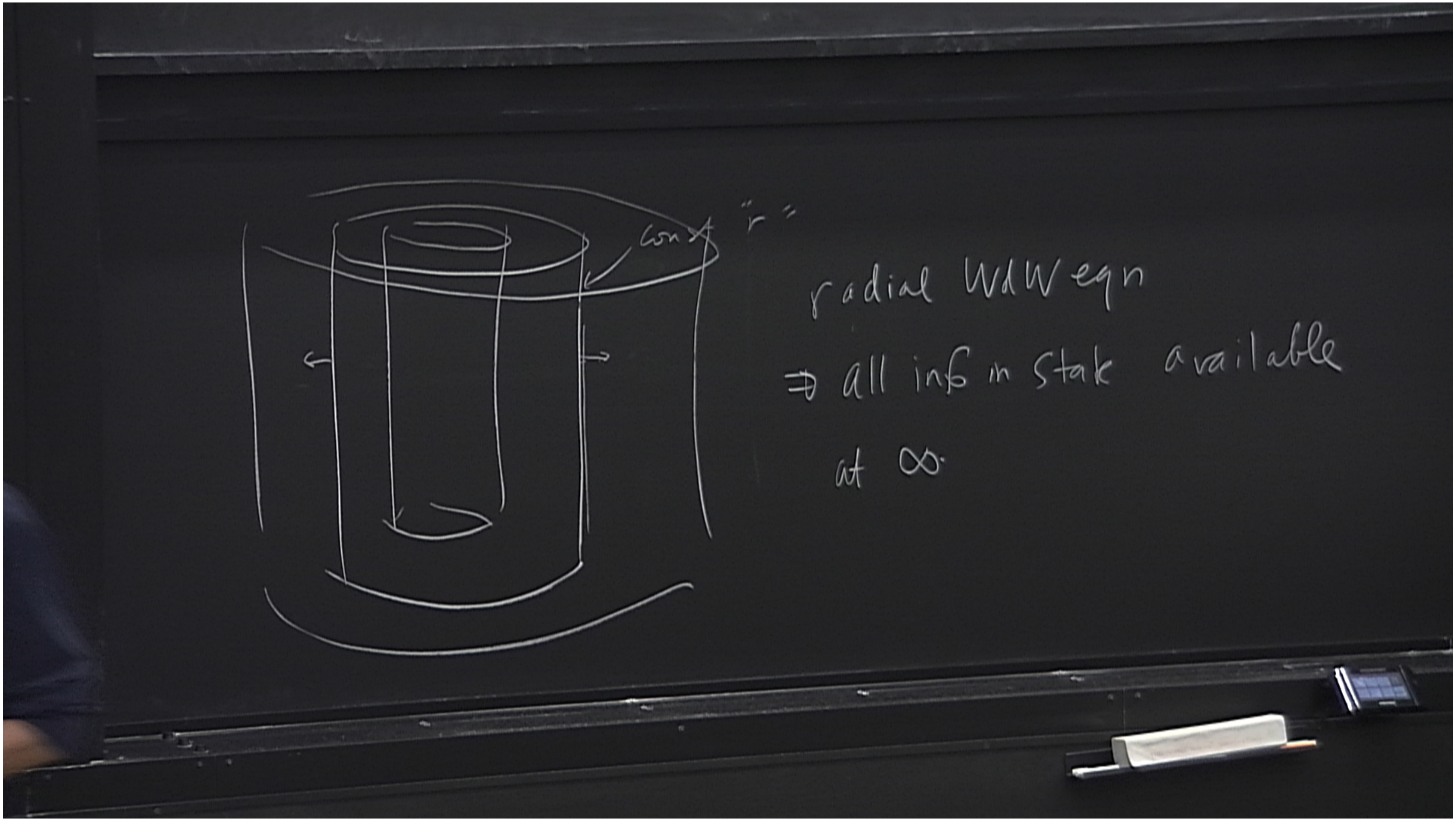

In QG theory, state space is
rnel of Constraints
$\hat{C}_\mu |\Psi\rangle = 0$
Σ

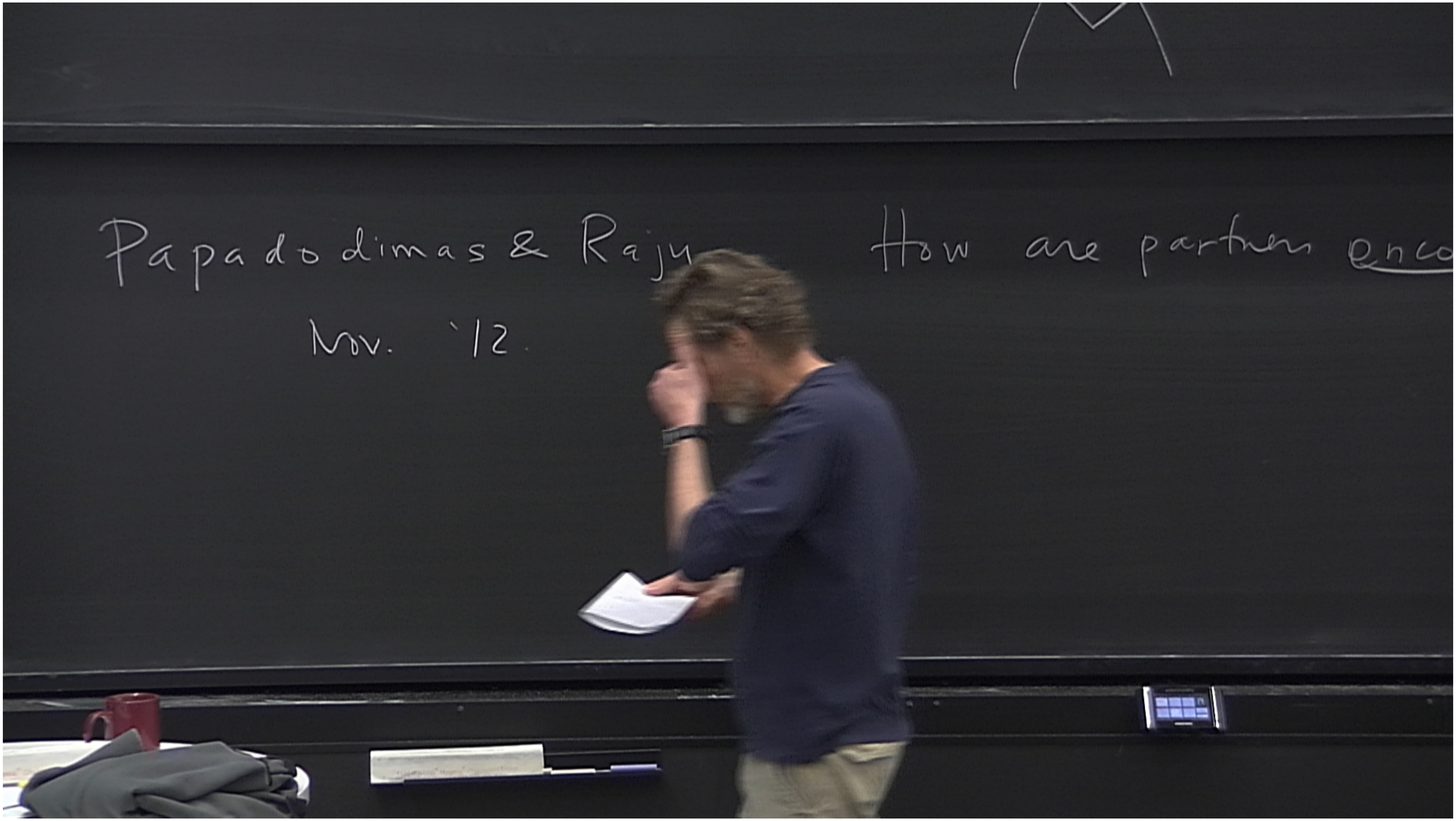

In QG theory, state space is kernel of constraints.
$\hat{C}_\mu |\Psi\rangle = 0$
$\Psi[{}^{(3)}g_{ij}, \varphi]$
Σ

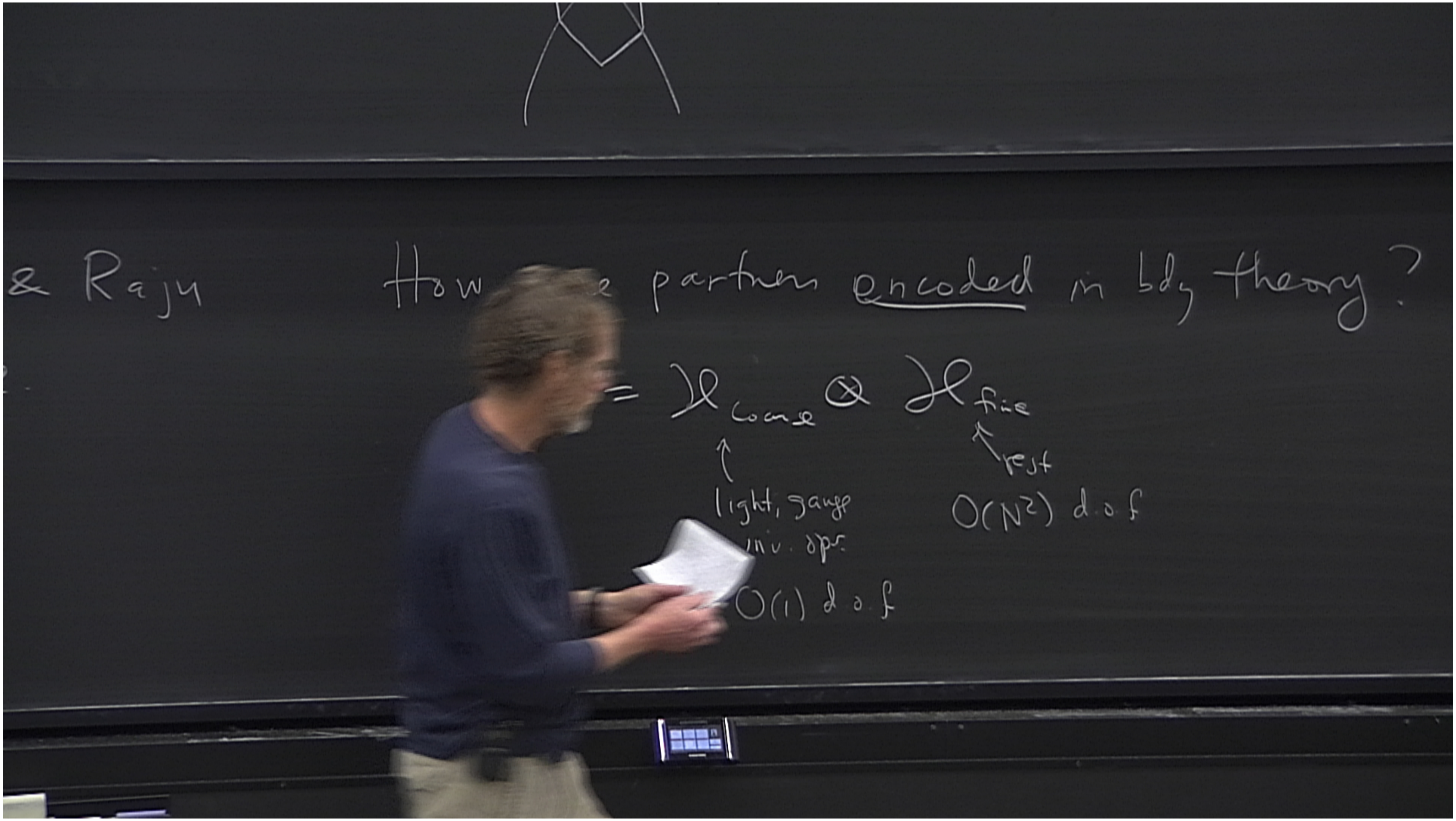

In QG theory, state space is kernel of Constraints:
$\hat{C}_\mu |\Psi\rangle = 0$
$\Psi[{}^{(3)}g_{ij}, \varphi]$
$\hat{C}_i |\Psi\rangle = 0$: Spatia
$\hat{C}_0 |\Psi\rangle = 0$: Wheele
$\hat{t}$
Σ

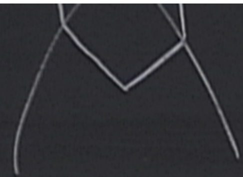

→ "Hawking theorem" is
→ firewall
They asked the wrong question;
b/c bh evolution is continuously unitary
(J² − 3/4)(1/2 ⊗ 1/2 ⊗ 1/2) = 0
0 ⊕ 1
1/2 ⊗ 1 = 1/2 ⊕ 3/2


const "r" =


const "r" =
radial WdW eqn
⇒ all info in state available
at ∞.


Papadodimas & Raju
Nov. '12.
How are partners enco


& Raju
How
partners encoded in bdy theory?
$= \mathcal{H}_{\text{coarse}} \otimes \mathcal{H}_{\text{fine}}$
light, gauge
inv. opr
$O(1)$ d.o.f
rest
$O(N^2)$ d.o.f



How are partners encoded in bdy theory?

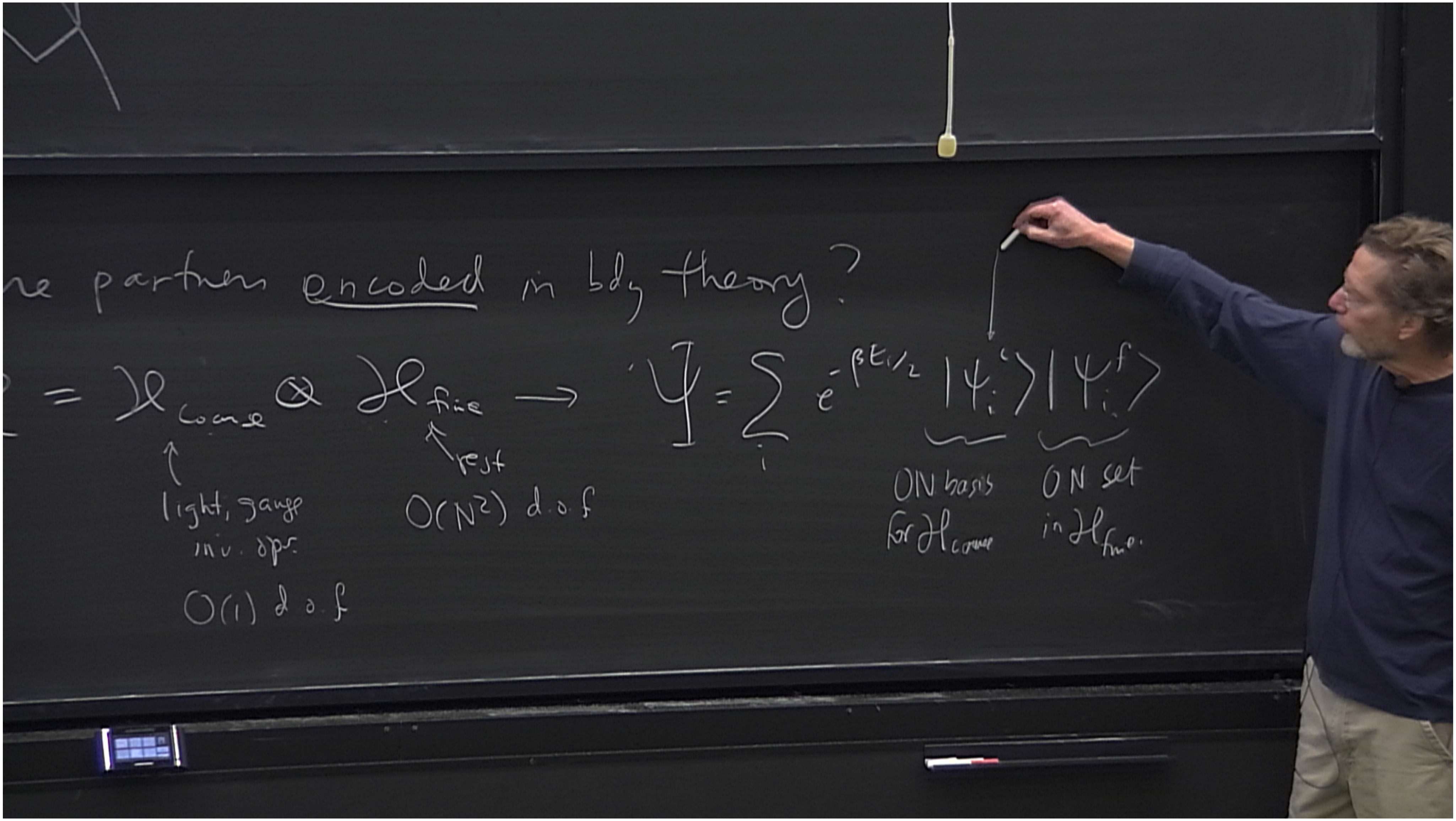
$$\mathcal{H} = \mathcal{H}_{coarse} \otimes \mathcal{H}_{fine} \longrightarrow \Psi = \sum_i e^{-\beta E_i/2} |\psi_i^c\rangle |\psi_i^f\rangle$$

light, gauge inv. ops.

$O(1)$ d.o.f

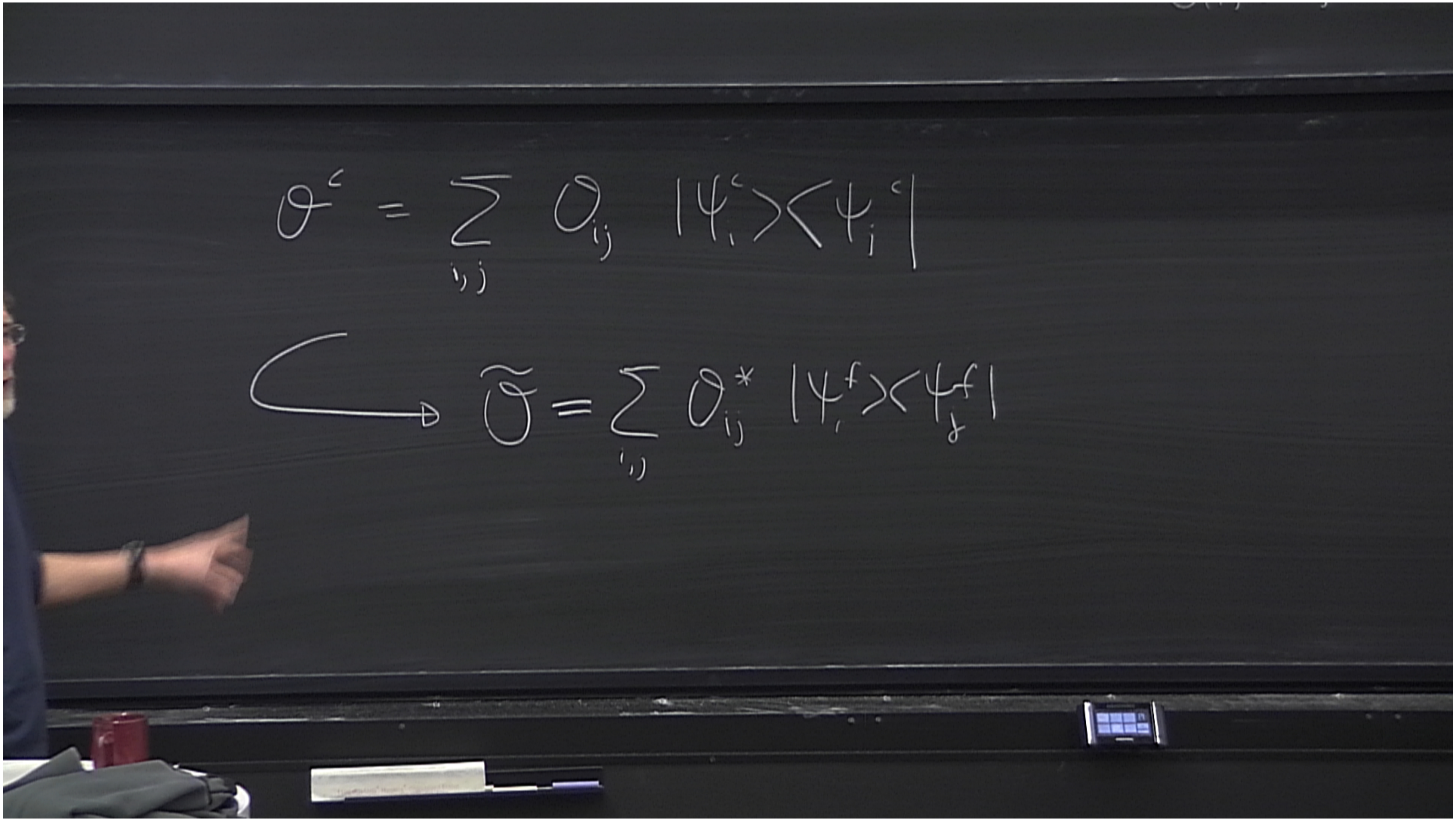
rest

$O(N^2)$ d.o.f


ne partners encoded in bdy theory?
light, gauge inv. ops
O(1) d.o.f
rest
$O(N^2)$ d.o.f
ON basis for $\mathcal{H}_{coarse}$
ON set in $\mathcal{H}_{fine}$

ne partners <u>encoded</u> in bdy theory?

$$\mathcal{H} = \underset{\substack{\uparrow \\ \text{light, gauge} \\ \text{inv. opr.} \\ O(1)\ \text{d.o.f}}}{\mathcal{H}_{\text{coarse}}} \otimes \underset{\substack{\nwarrow \text{rest} \\ O(N^2)\ \text{d.o.f}}}{\mathcal{H}_{\text{fine}}} \longrightarrow |\Psi\rangle = \sum_i e^{-\beta E_i/2} \underbrace{|\psi_i^c\rangle}_{\substack{\text{ON basis} \\ \text{for } \mathcal{H}_{\text{coarse}}}} \underbrace{|\psi_i^f\rangle}_{\substack{\text{ON set} \\ \text{in } \mathcal{H}_{\text{fine}}}}$$



$O^c = \sum_{i,j} O_{ij} |\psi_i^c\rangle\langle\psi_j^c|$
$\tilde{O} = \sum_{i,j} O_{ij}^* |\psi_i^f\rangle\langle\psi_j^f|$