Title: Why should (and why can) the path integral serve as the basis for quantum theory?

Date: Nov 15, 2017 09:00 AM

URL: http://pirsa.org/17110126

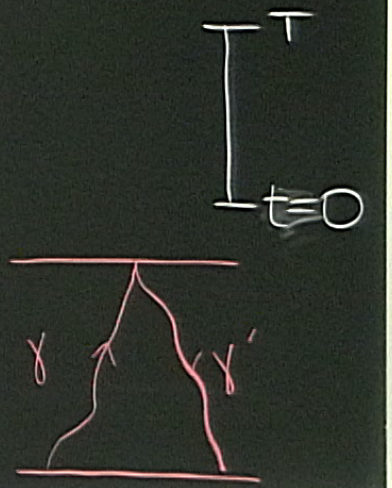
Abstract:

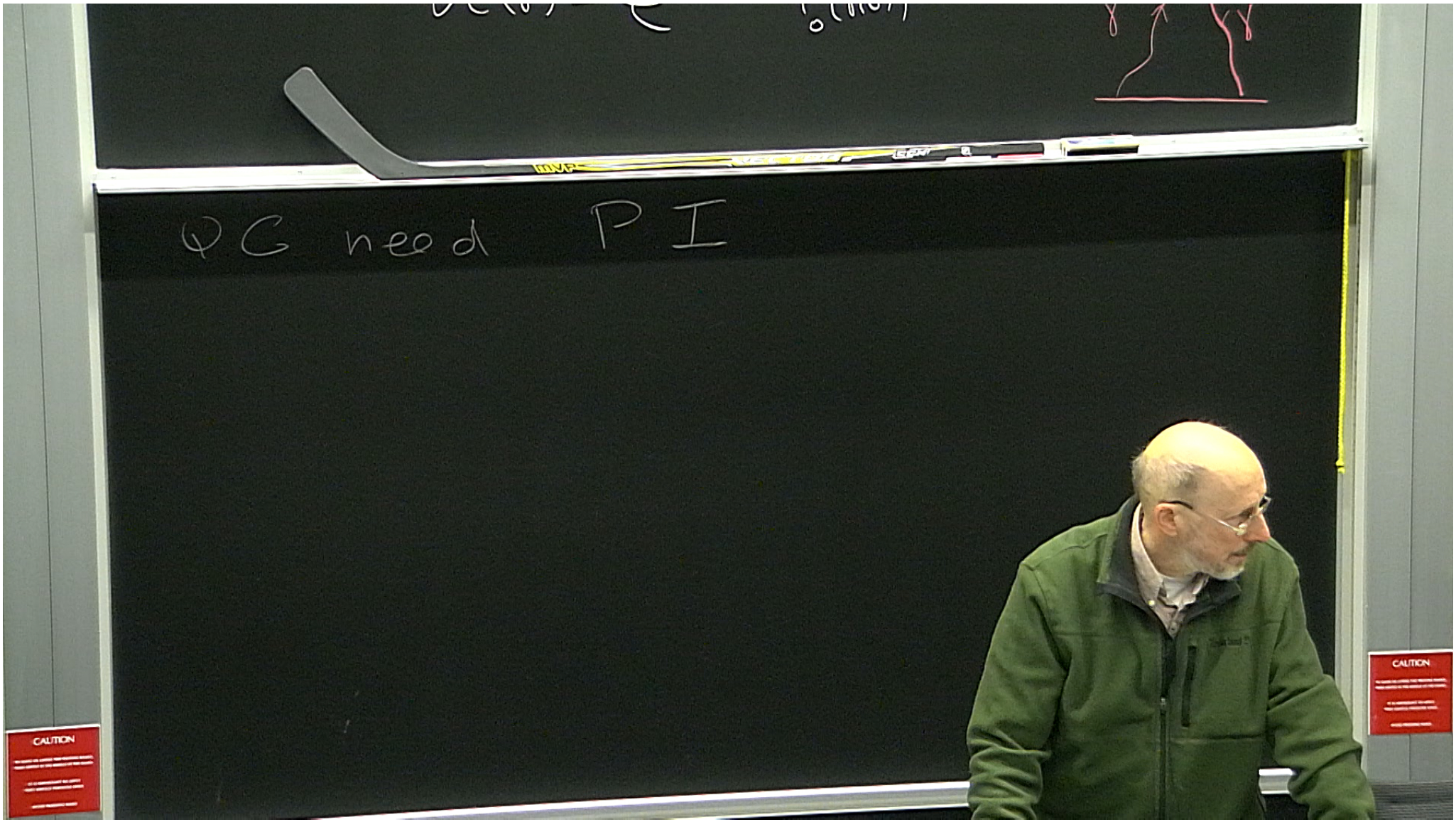
Why Should (and why can) the PI serve as the basis for quantum theory & Q-Gravity?

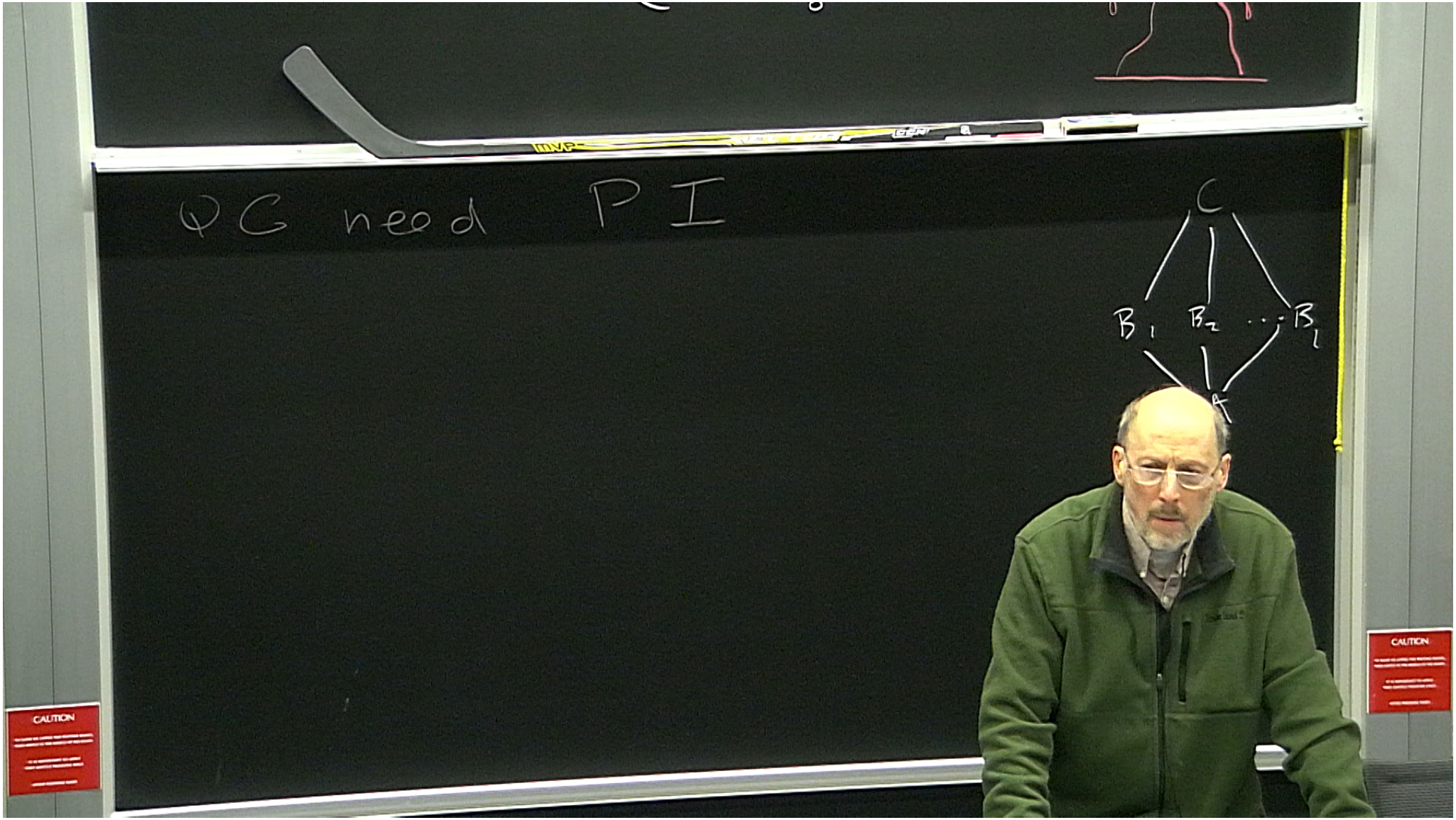
$$\mu(E) = \int_{\gamma \in E} d\gamma \int_{\gamma' \in E} d\gamma' \; D(\gamma, \gamma')$$

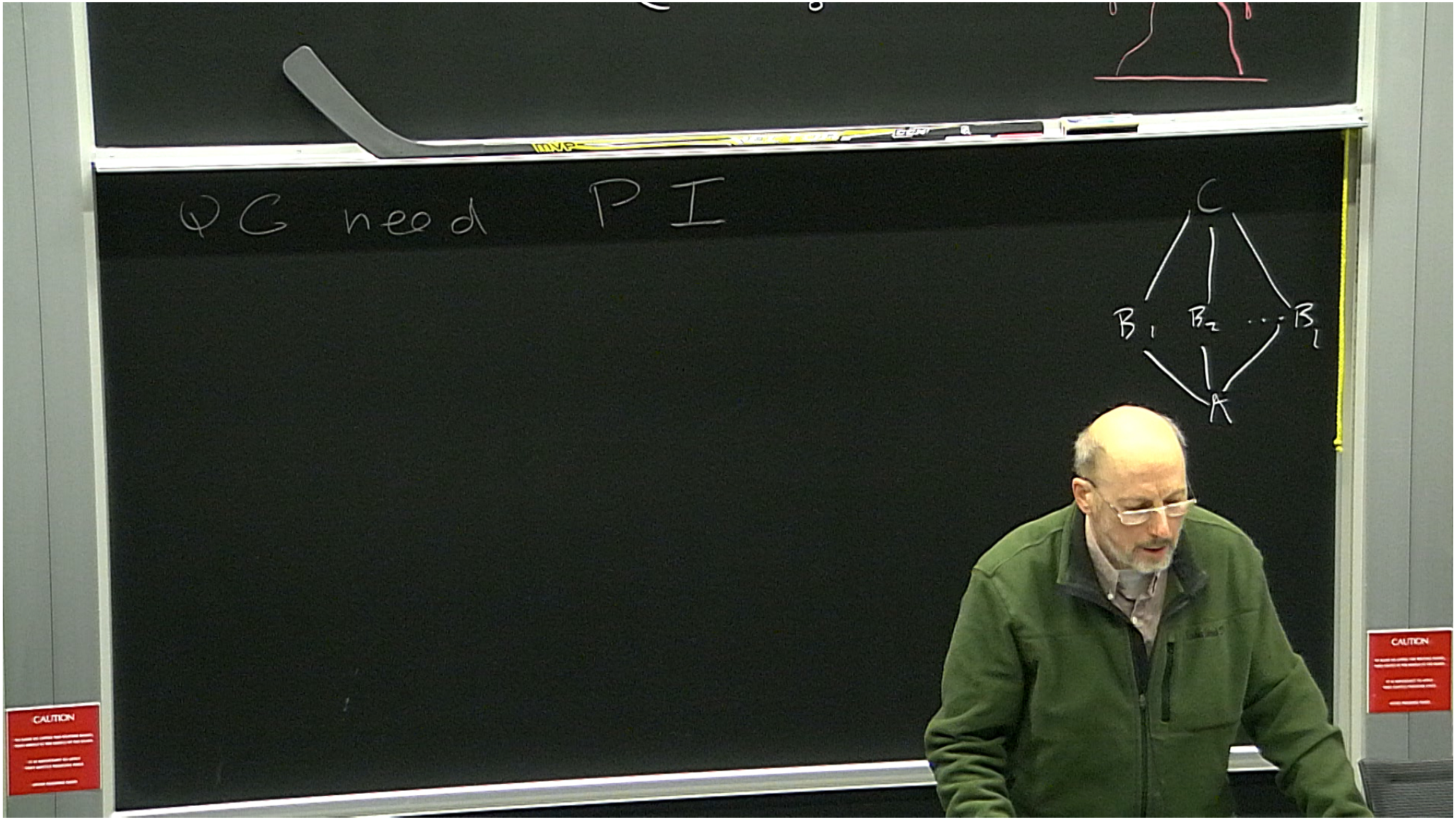
$$D(\gamma, \gamma') = A(\gamma)\, A(\gamma')^{*}\, \delta(\gamma(T) - \gamma'(T))$$

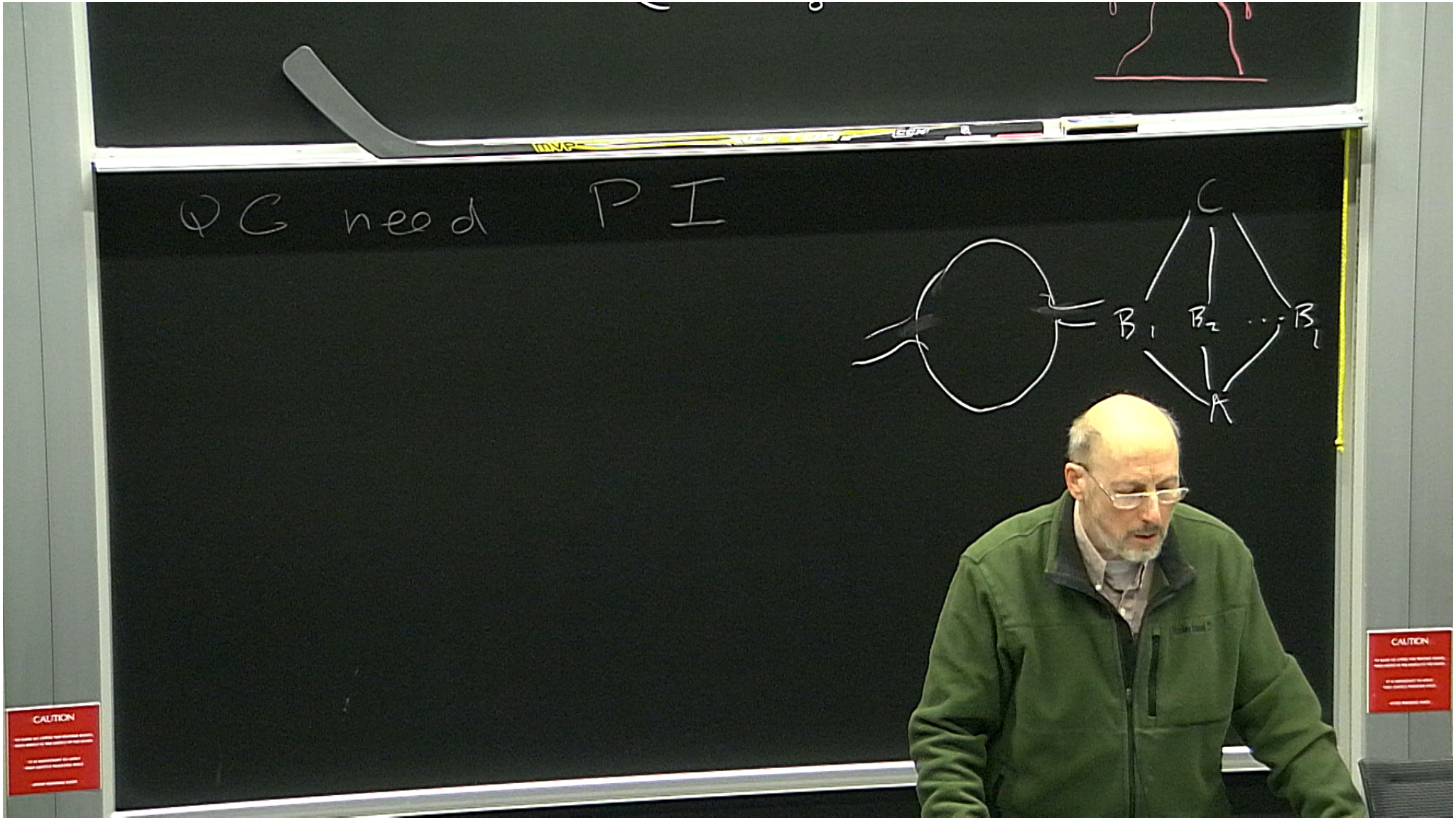
$$A(\gamma) = e^{iS(\gamma)}\, \psi_0(\gamma(0))$$

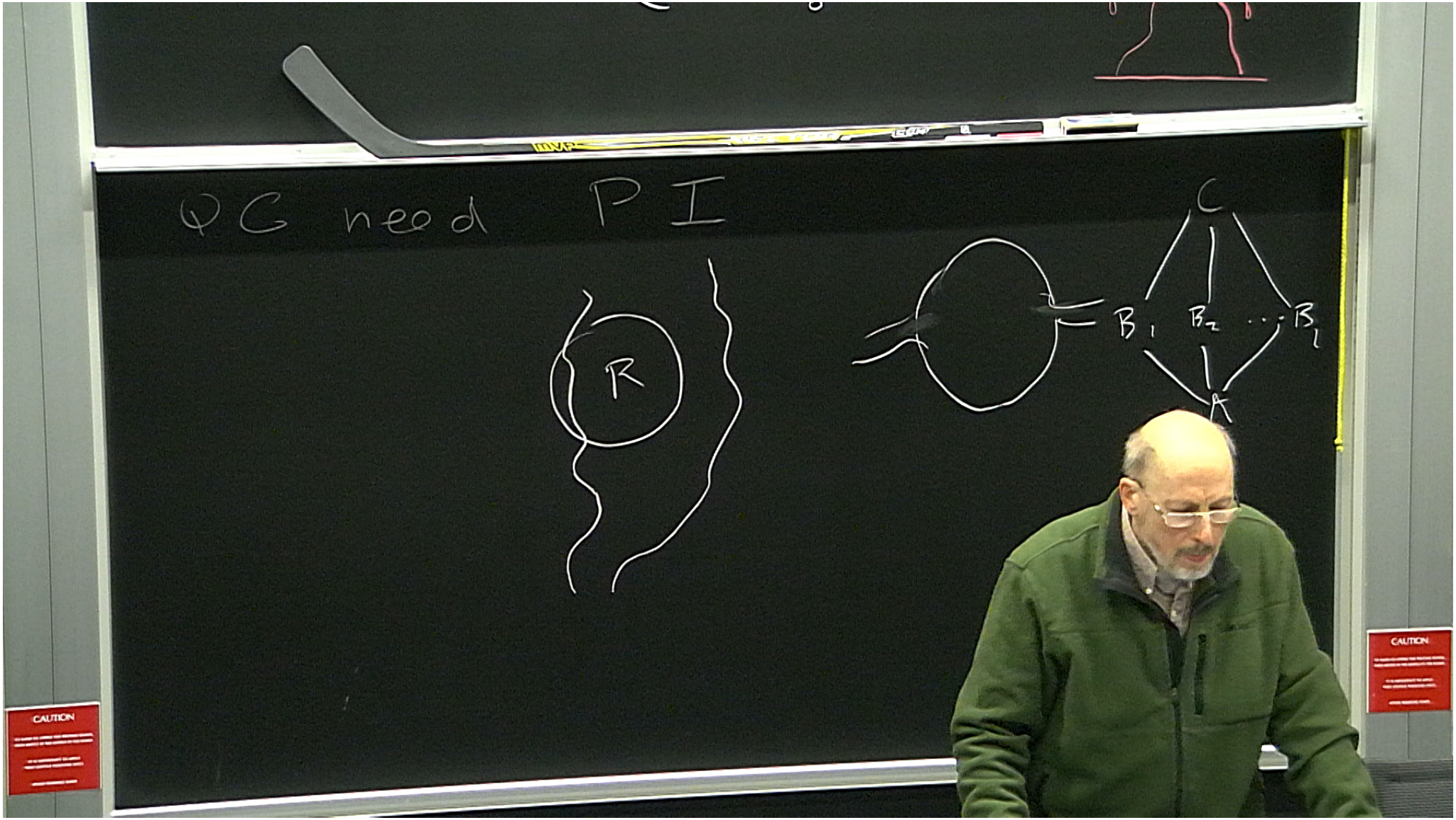


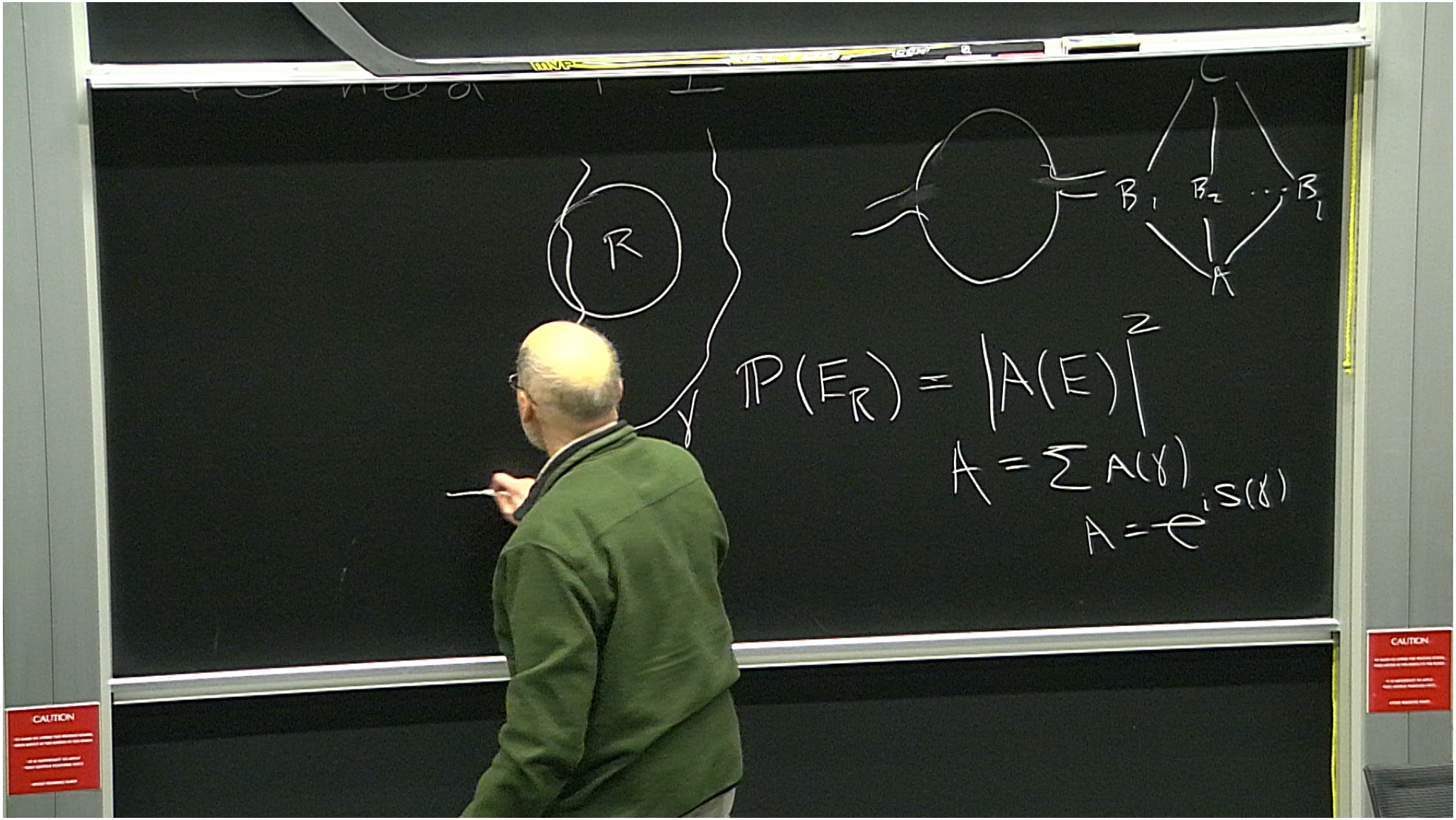

φG need PI
CAUTION
CAUTION

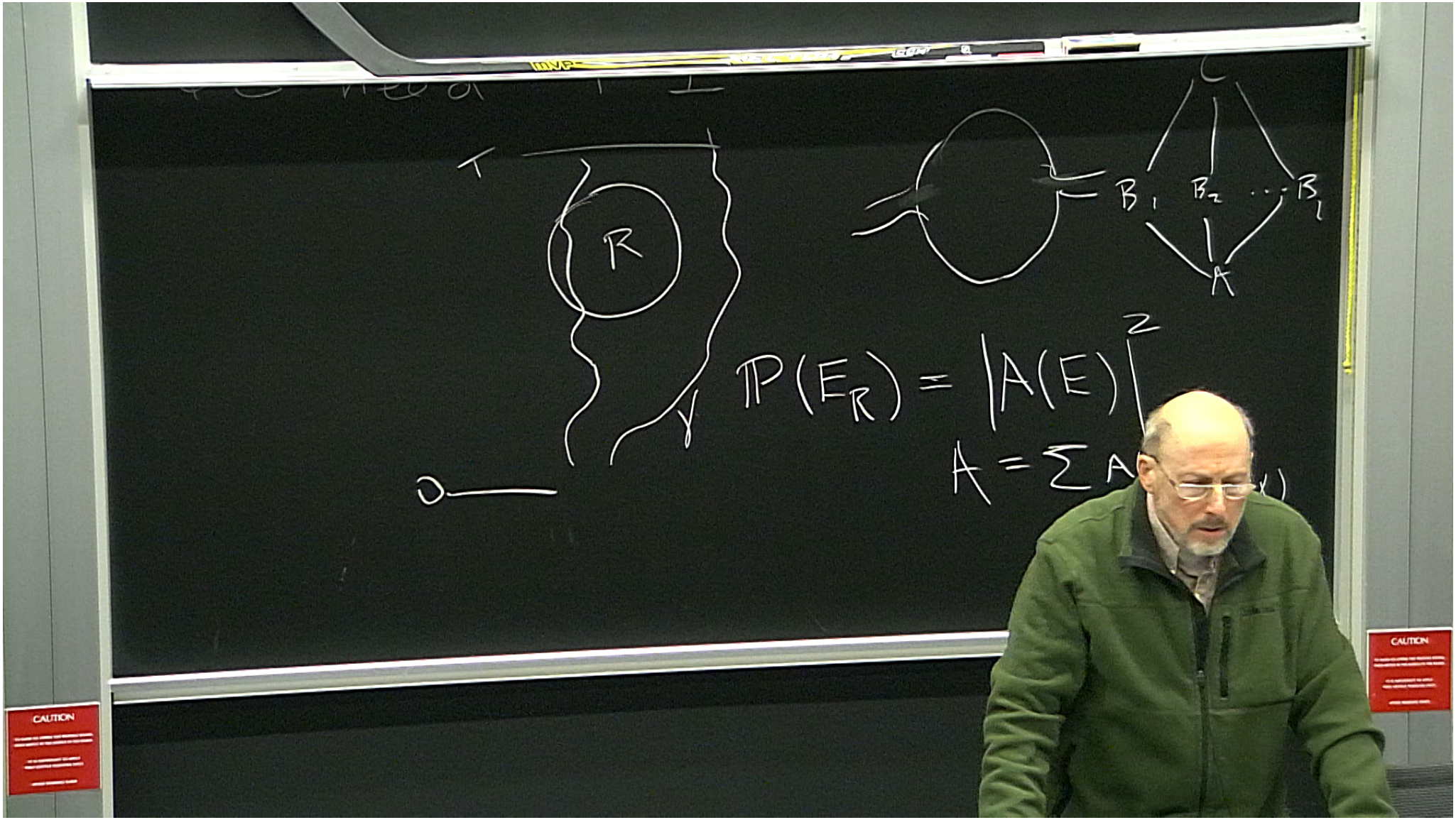

QC need PI
C
B_1 B_2 ... B_l
CAUTION
CAUTION

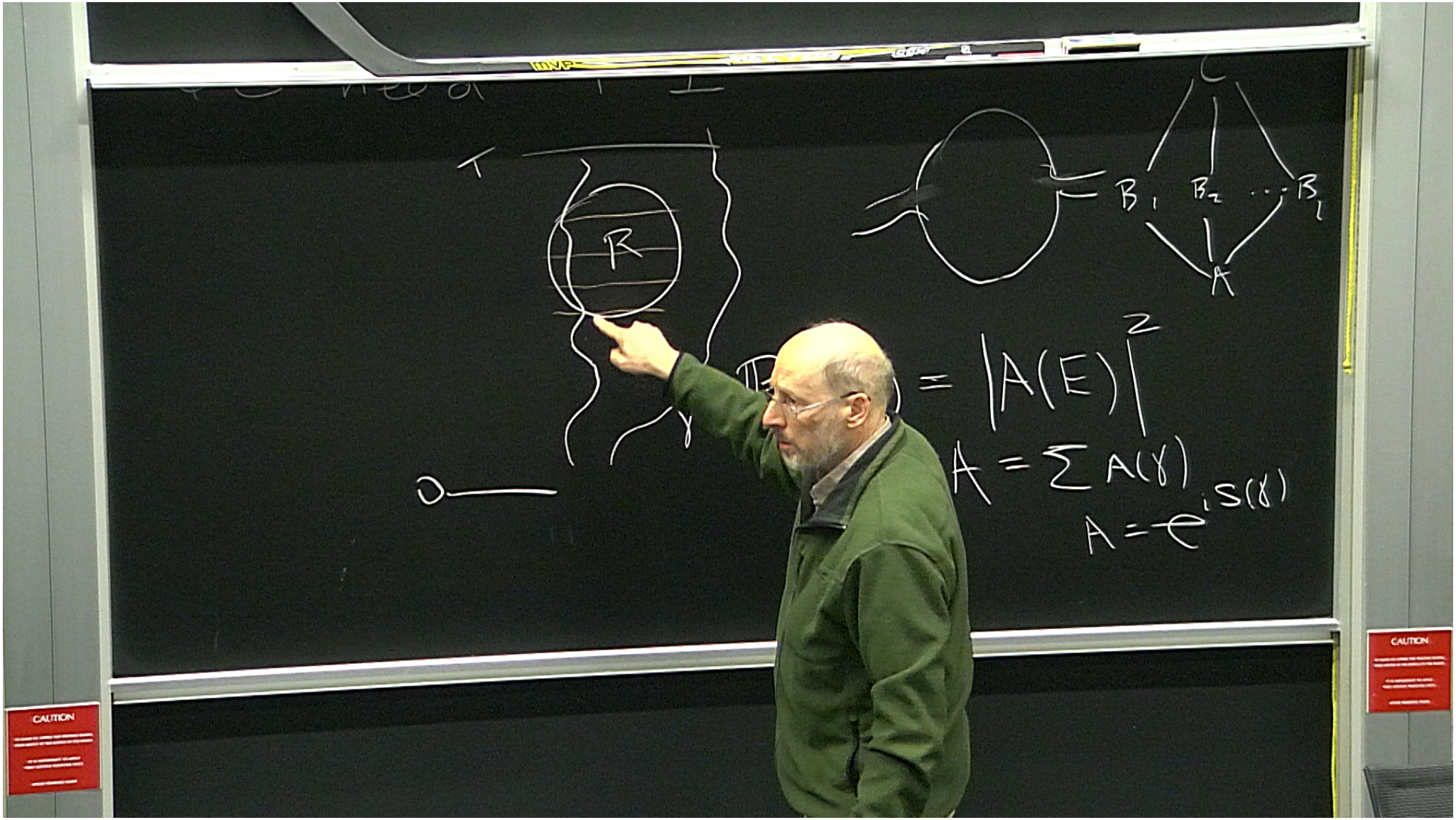

QC need PI
C
B1 B2 ... Bl
A
CAUTION
CAUTION

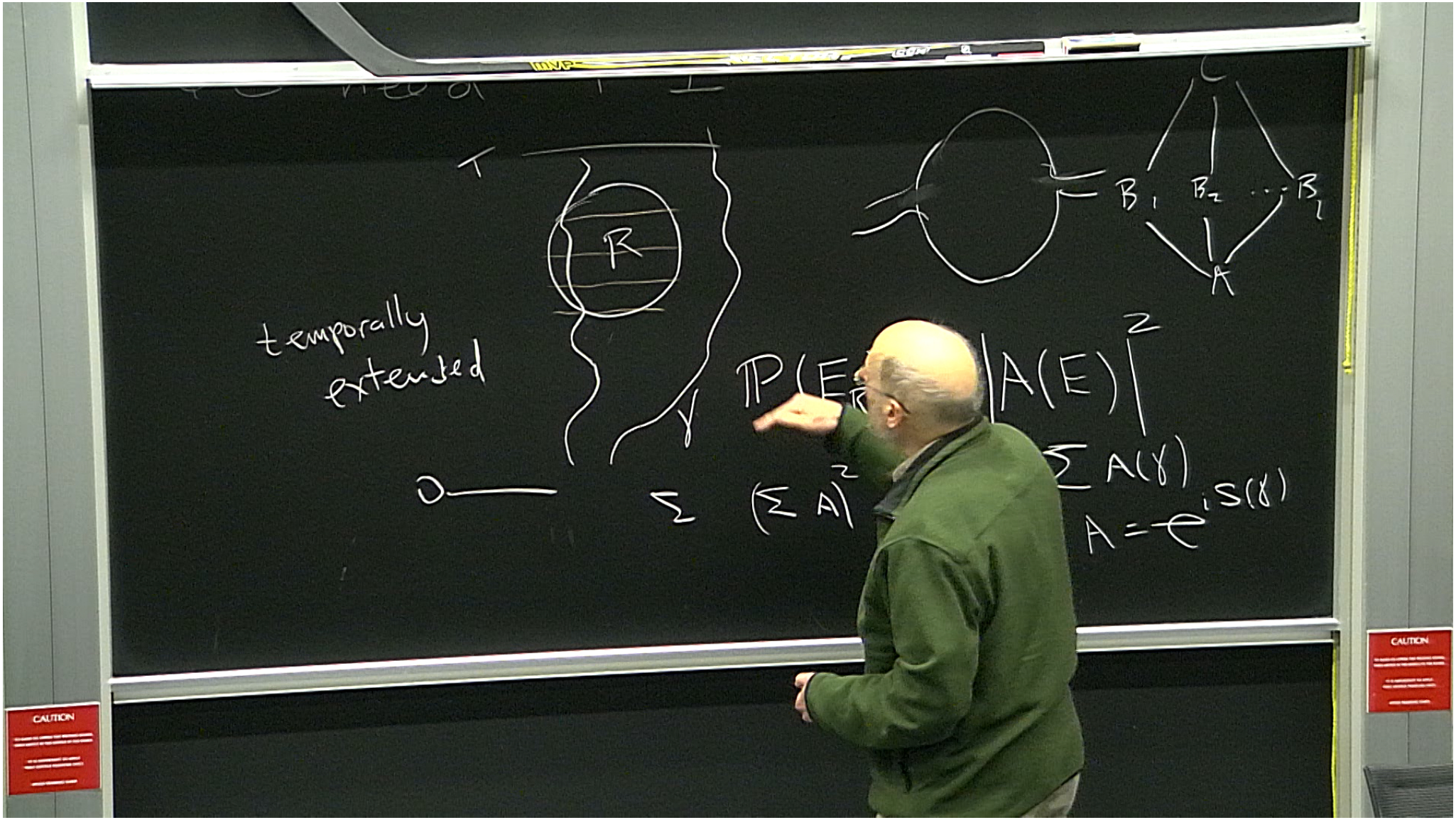

QC need PI
C
B1 B2 ... Bl
A
CAUTION
CAUTION

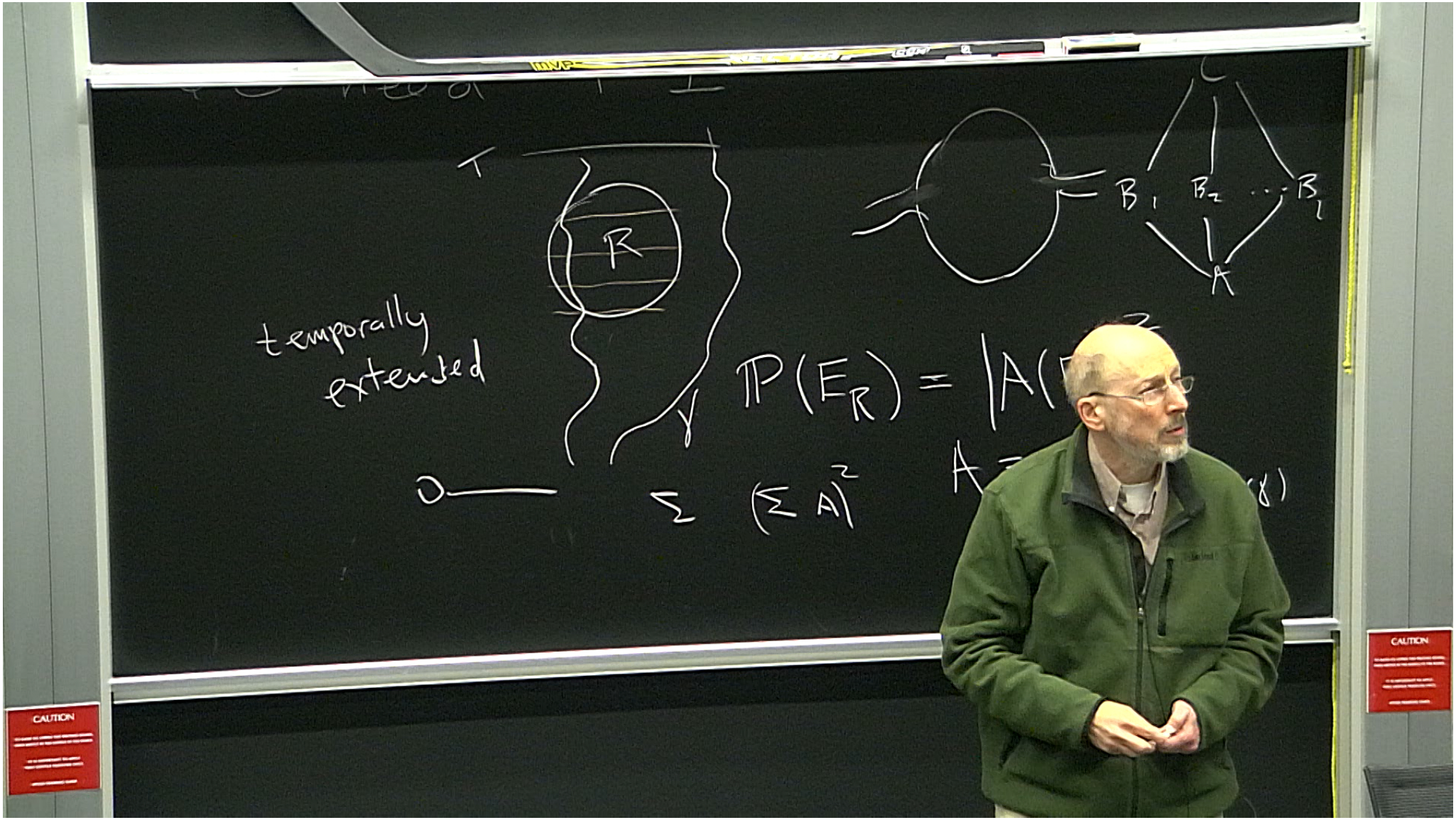

QC need PI
R
C
B_1 B_2 ... B_l
A
CAUTION
CAUTION

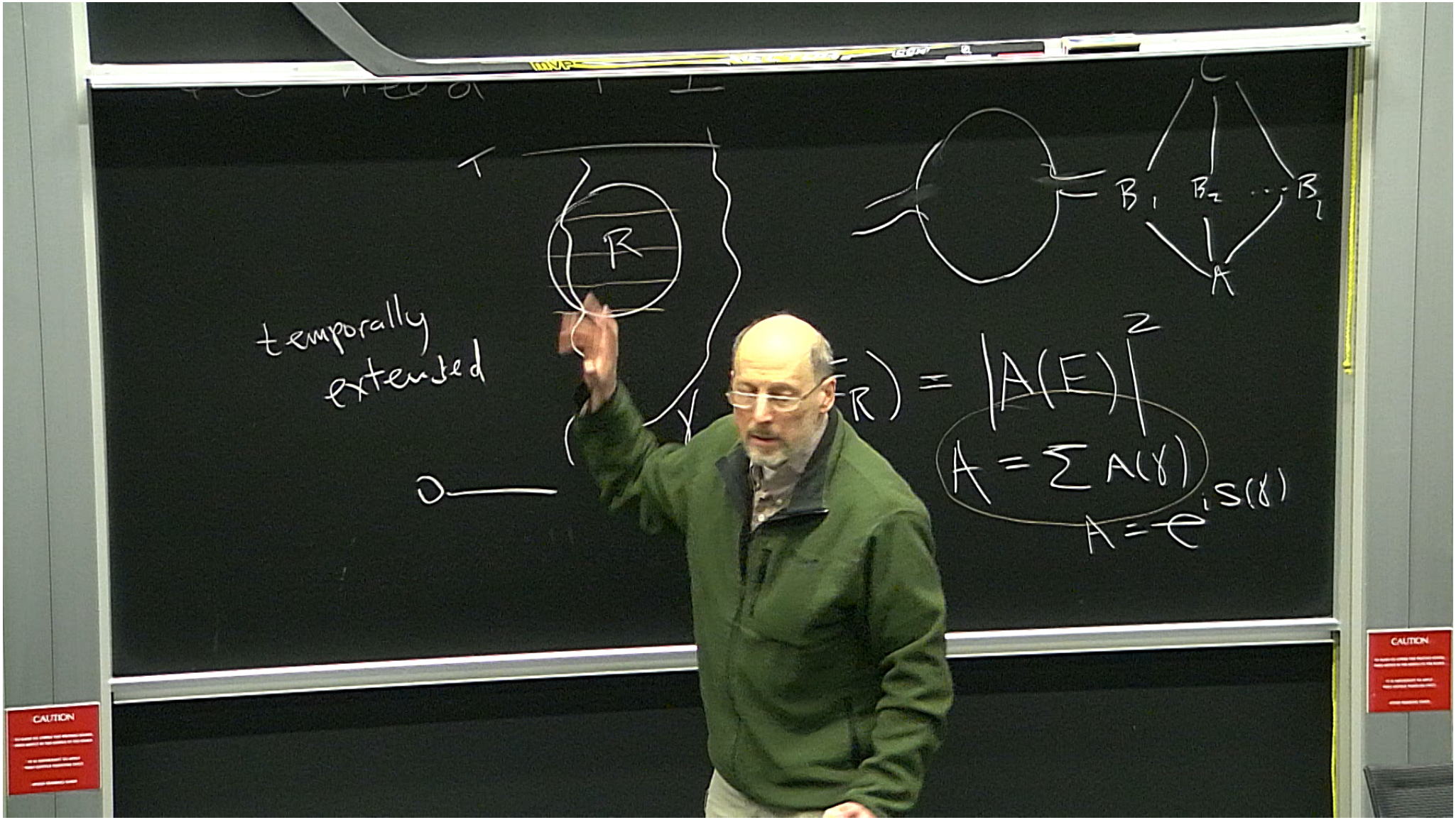

R
γ
B1 B2 ... Bl
A
$\mathbb{P}(E_R) = |A(E)|^2$
$A = \sum A(\gamma)$
$A = e^{iS(\gamma)}$
CAUTION
CAUTION

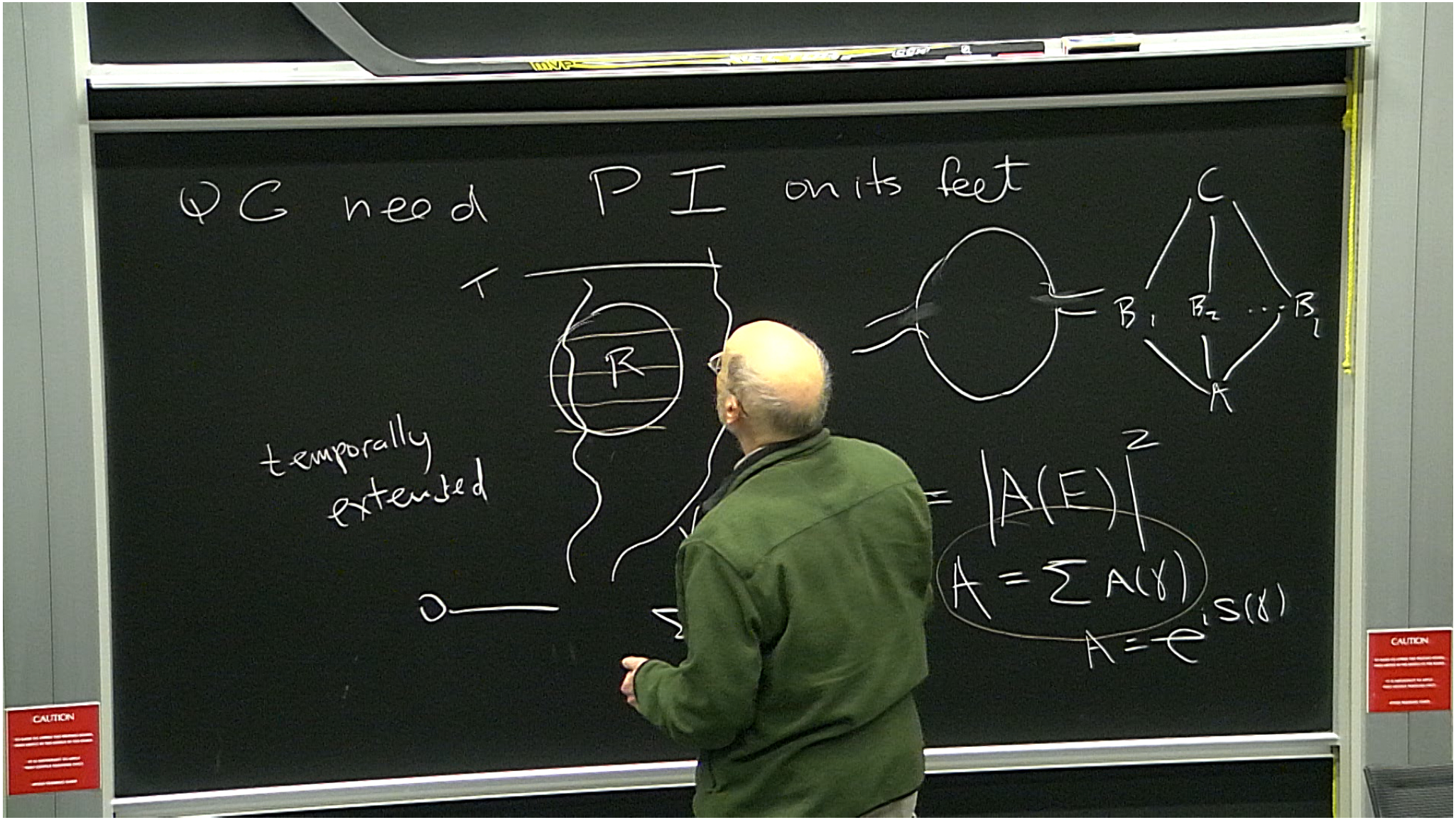

T
R
B_1 B_2 ... B_l
A
$\mathbb{P}(E_R) = |A(E)|^2$
$A = \sum A$

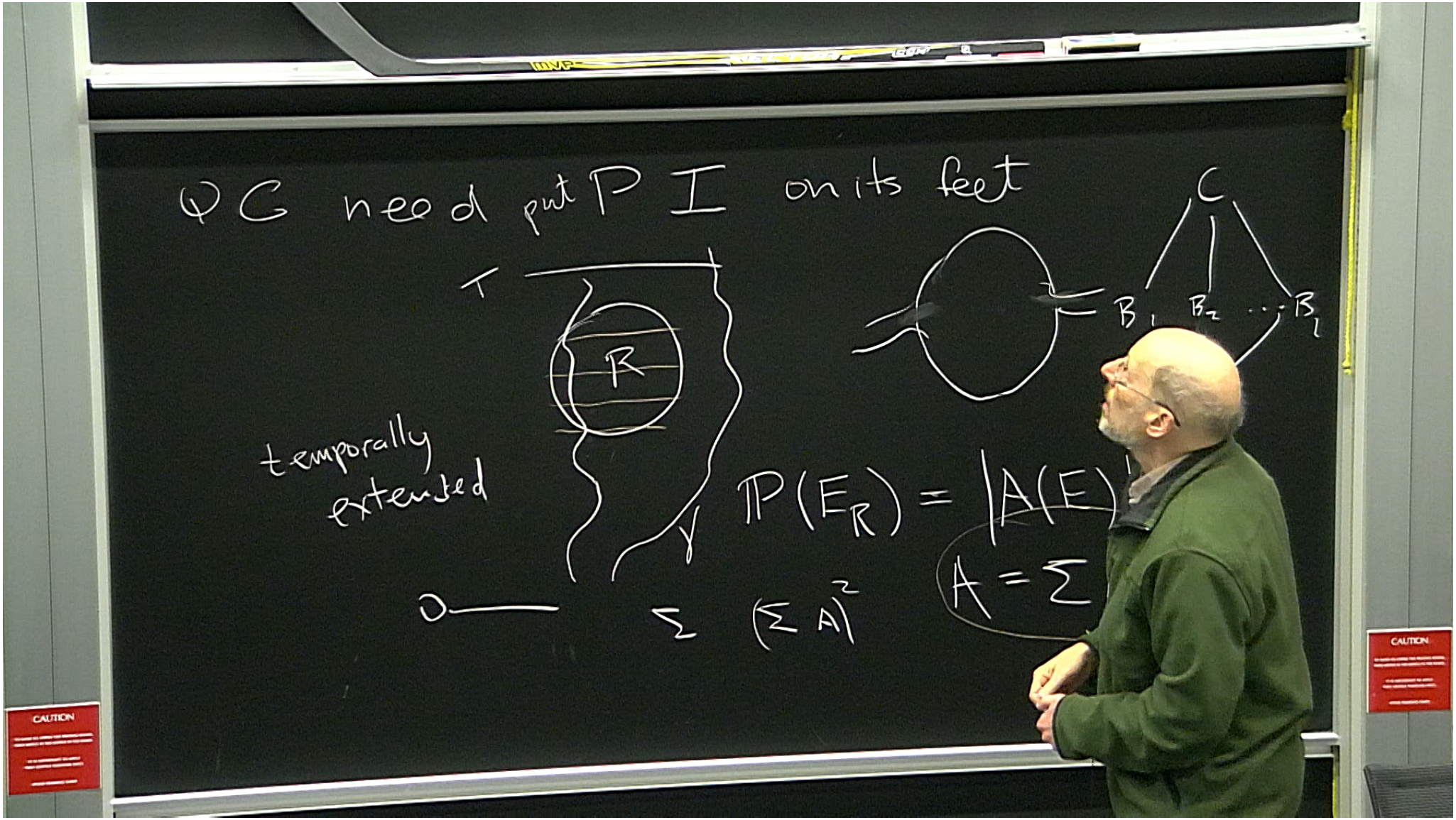

T
R
B_1 B_2 ... B_l
A
$= |A(E)|^2$
$A = \sum A(\gamma)$
$A = e^{iS(\gamma)}$
CAUTION
CAUTION

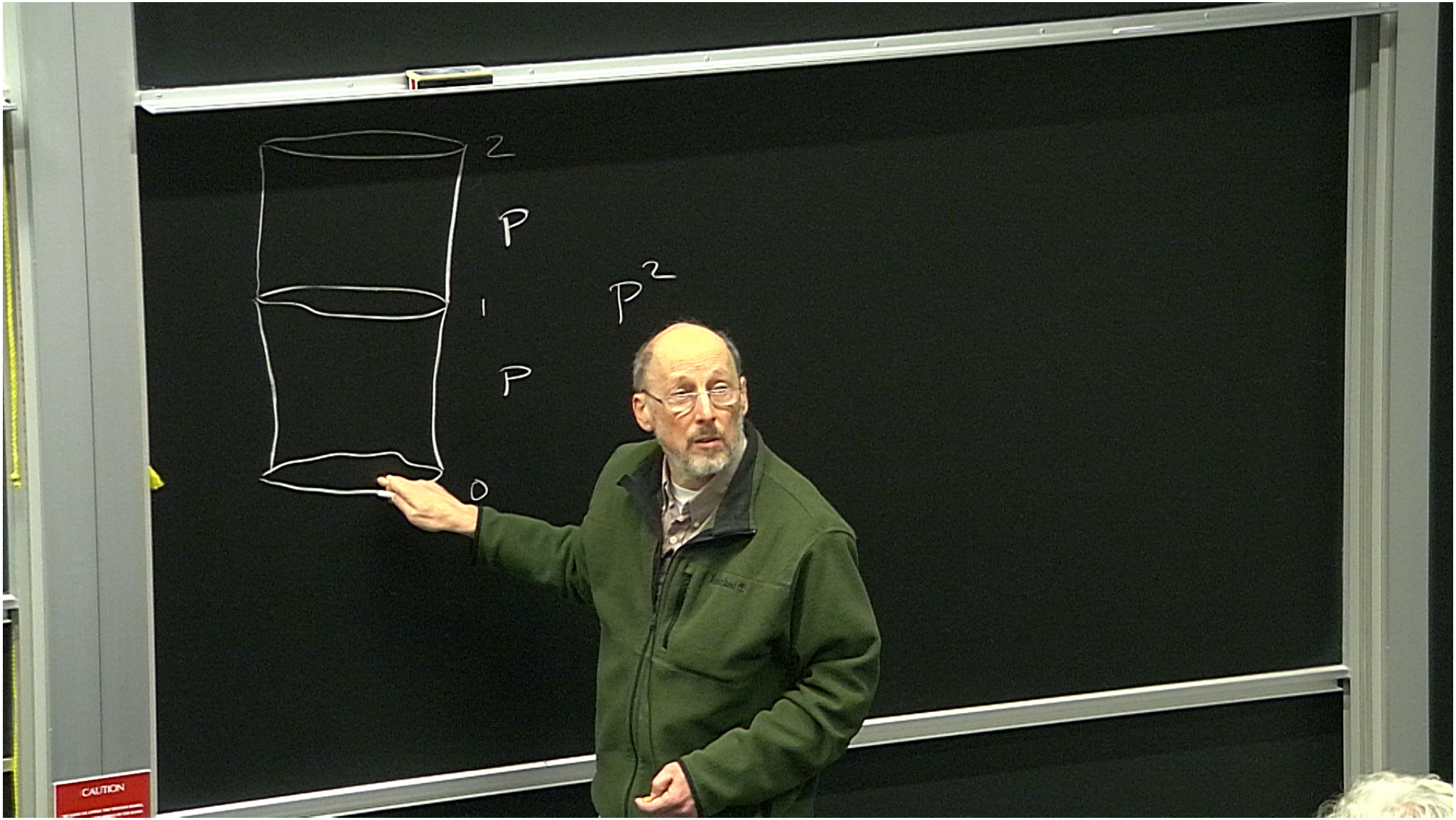

T
R
γ
temporally extended
B_1 B_2 ⋯ B_k
A
$\mathbb{P}(E_R) = |A(E)|^2$
$\sum A(\gamma)$
$A = e^{iS(\gamma)}$
$\sum (\sum A)^2$
CAUTION
CAUTION

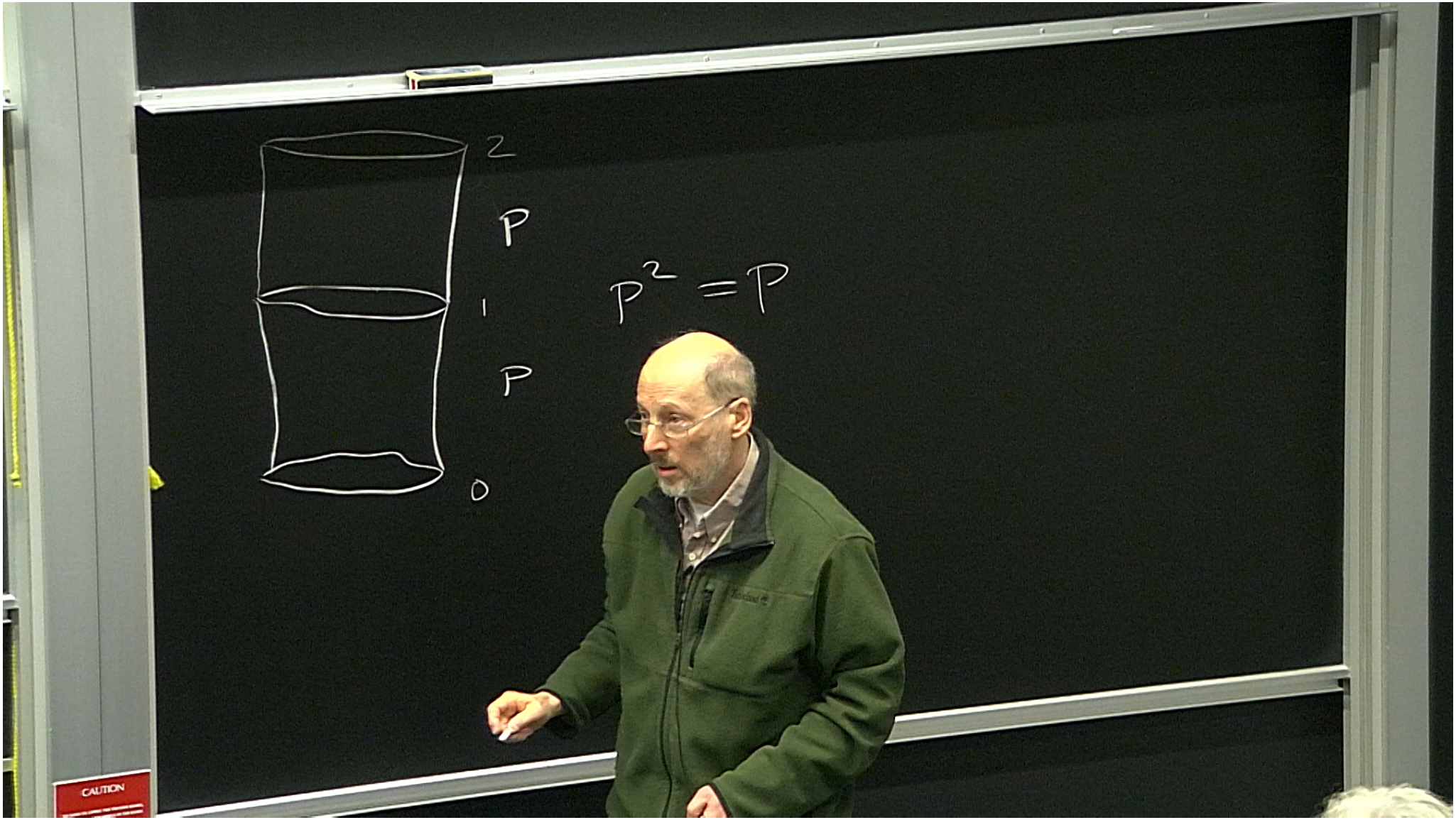

T
R
temporally extended
$\mathbb{P}(E_R) = |A($
$\Sigma (\Sigma A)^2$
B_1 B_2 B_l
A

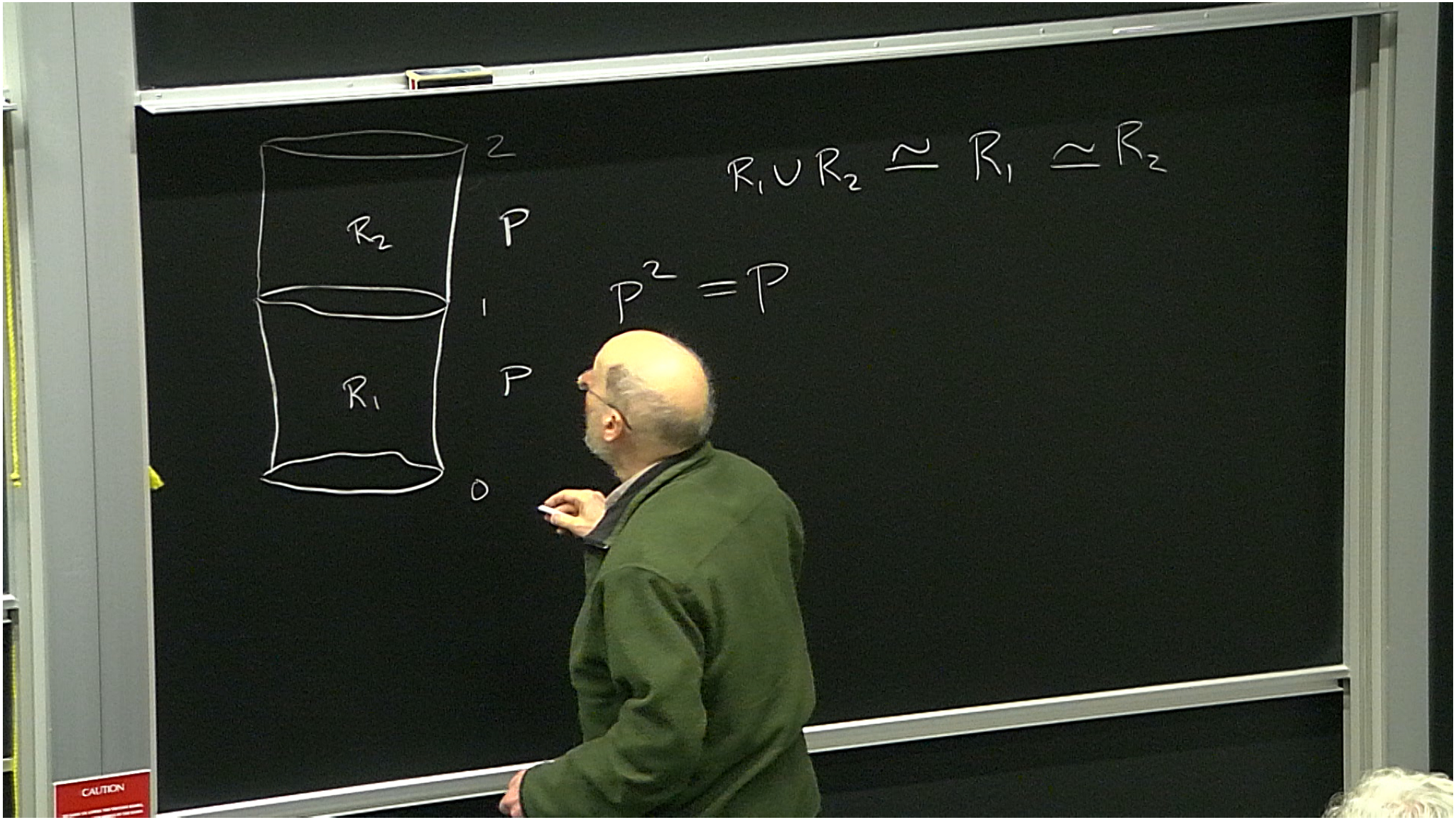

T
R
temporally
extended
B_1 B_2 B_l
A
$= |A(E)|^2$
$A = \sum A(\gamma)$
$A = e^{iS(\gamma)}$
CAUTION

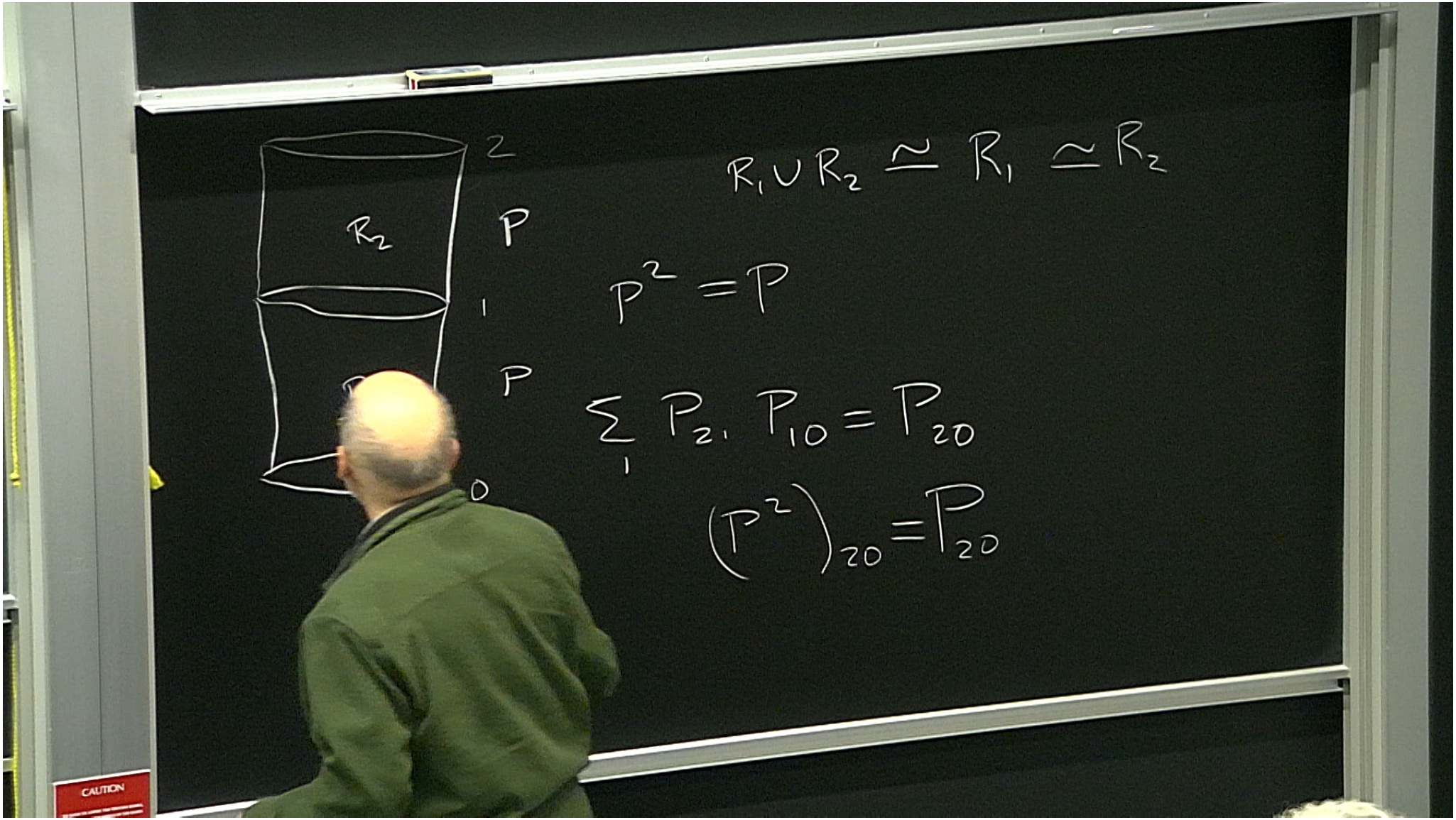

QC need PI on its feet
T
R
temporally extended
C
B_1 B_2 ... B_n
A
$= |A(E)|^2$
$A = \sum A(\gamma)$
$A = e^{iS(\gamma)}$
CAUTION
CAUTION

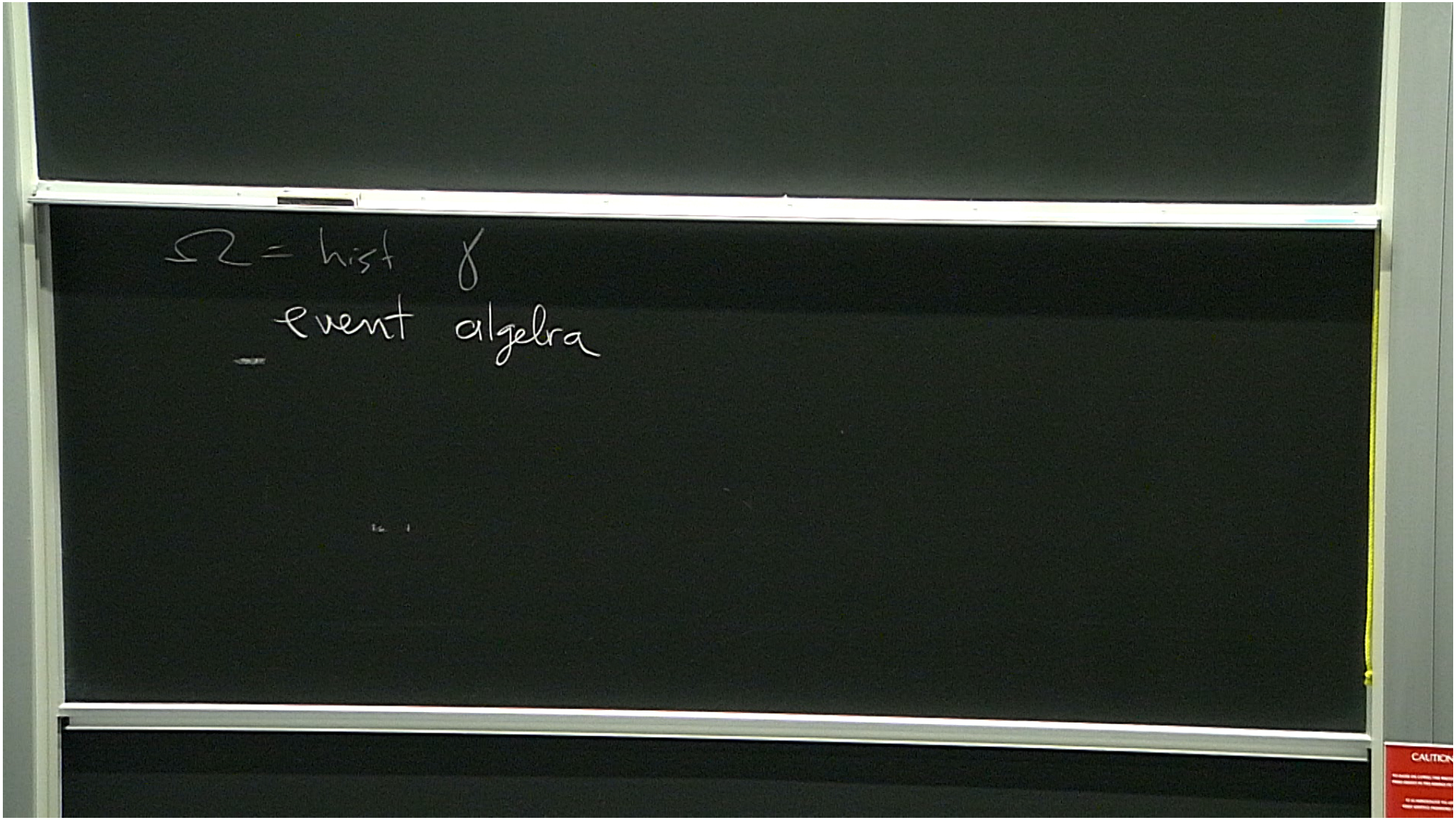

QG need put PI on its feet
T
R
temporally extended
C
B_1 B_2 ... B_n
$\mathbb{P}(E_R) = |A(E)$
$A = \Sigma$
$\Sigma (\Sigma A)^2$
CAUTION
CAUTION

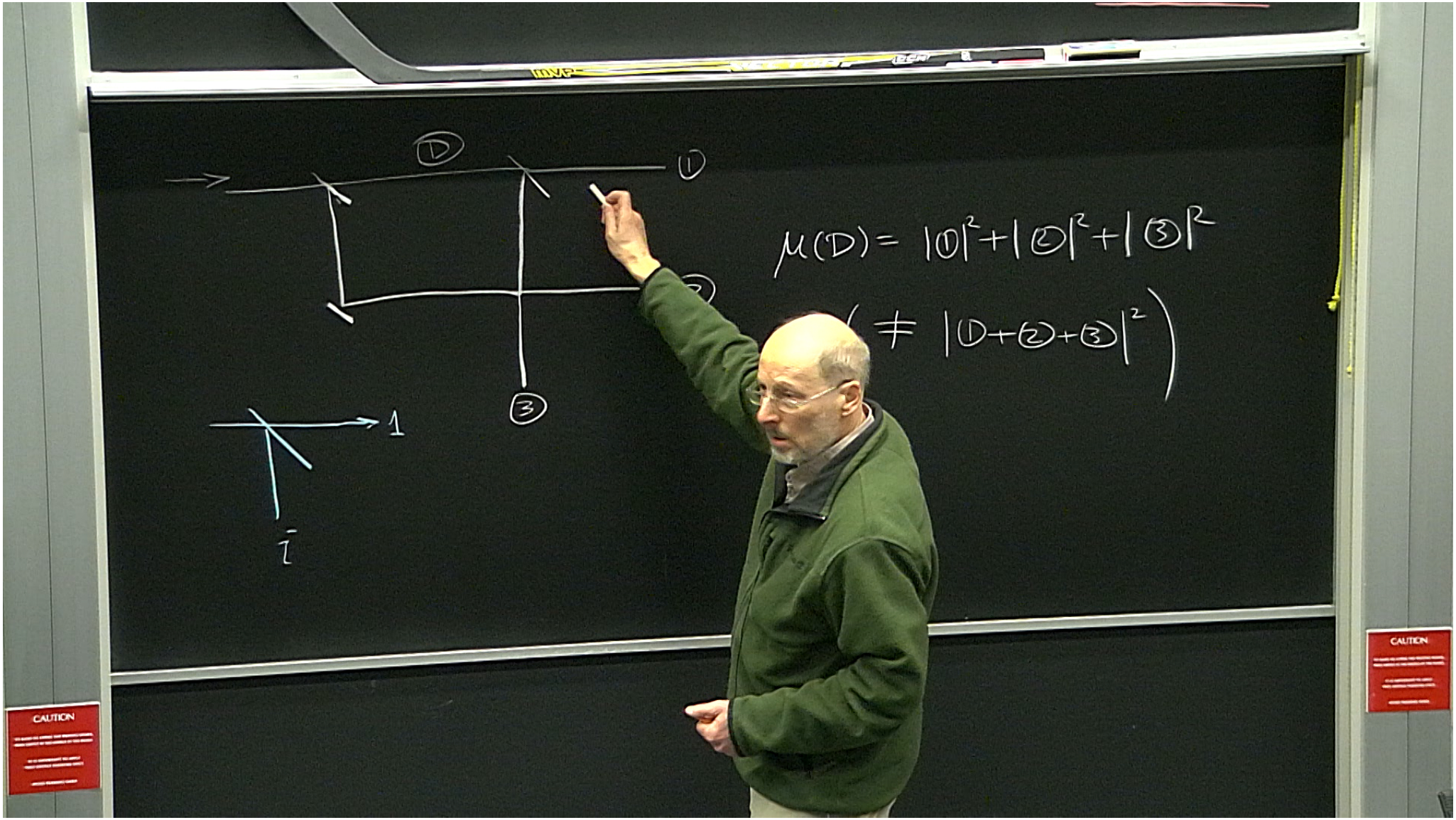

2
P
1
P²
P
0
CAUTION

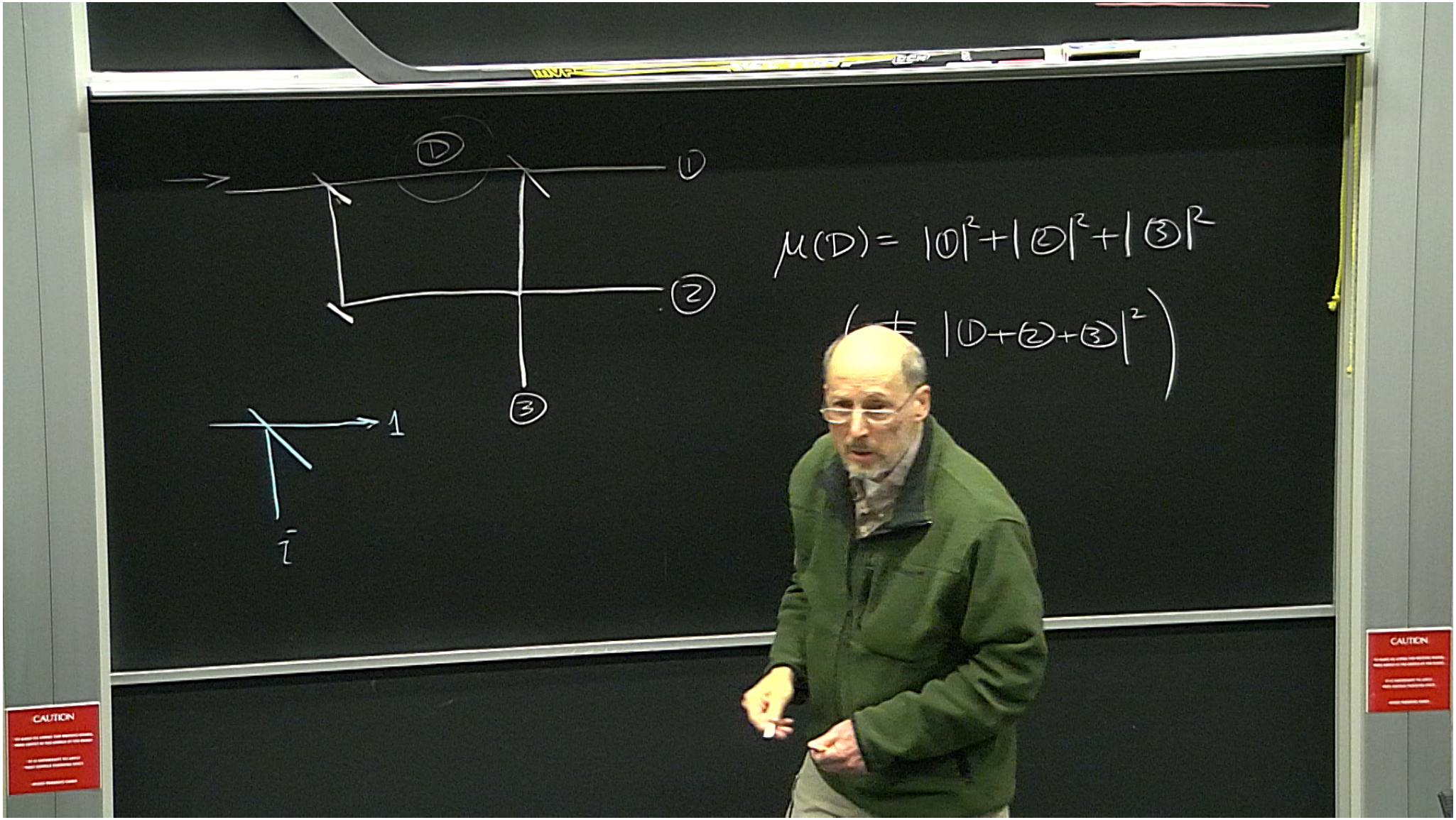

2
P
1
P
0
$P^2 = P$
CAUTION

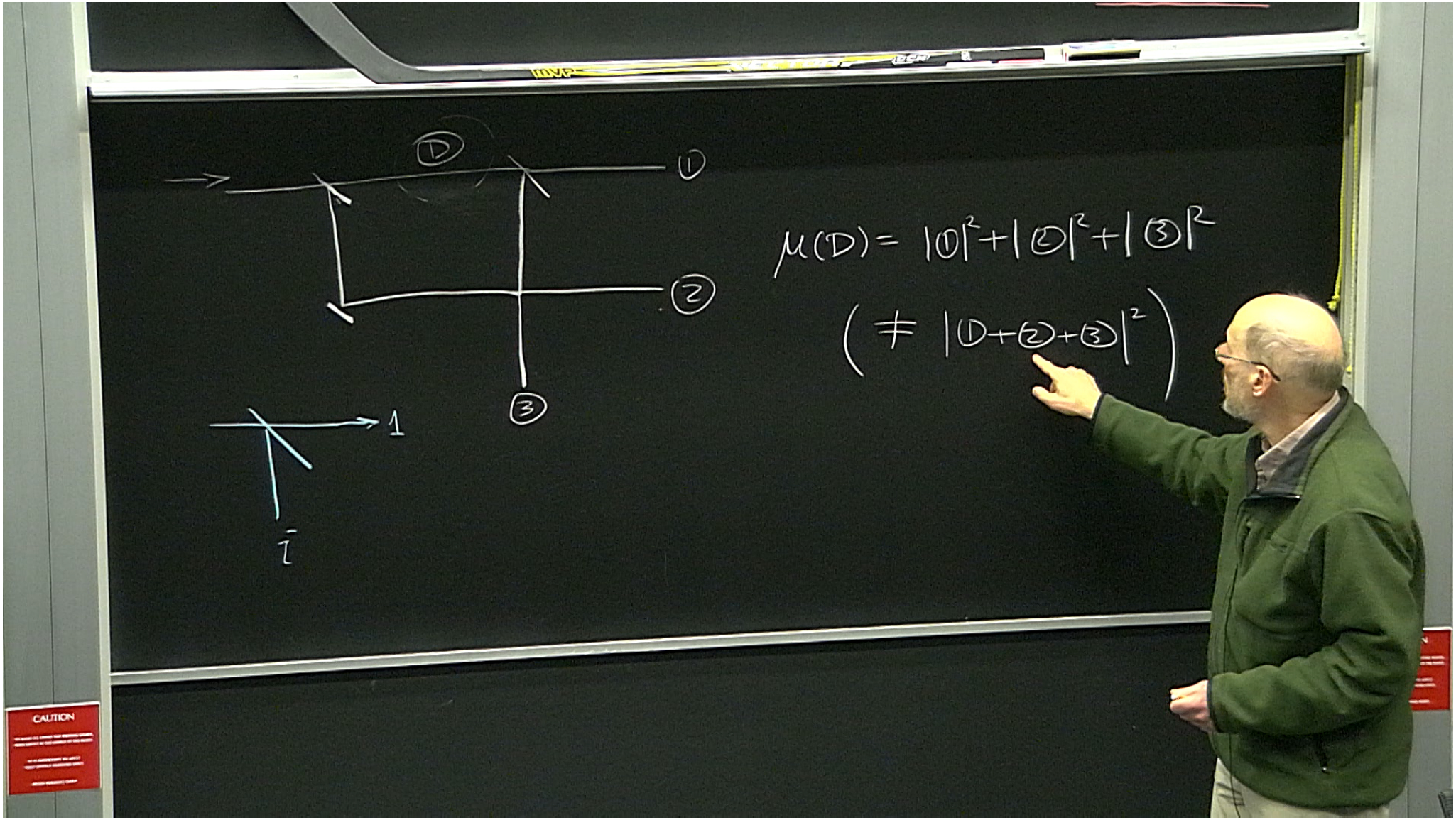

$R_1 \cup R_2 \simeq R_1 \simeq R_2$
$P^2 = P$
2
P
1
P
0
R_2
R_1
CAUTION

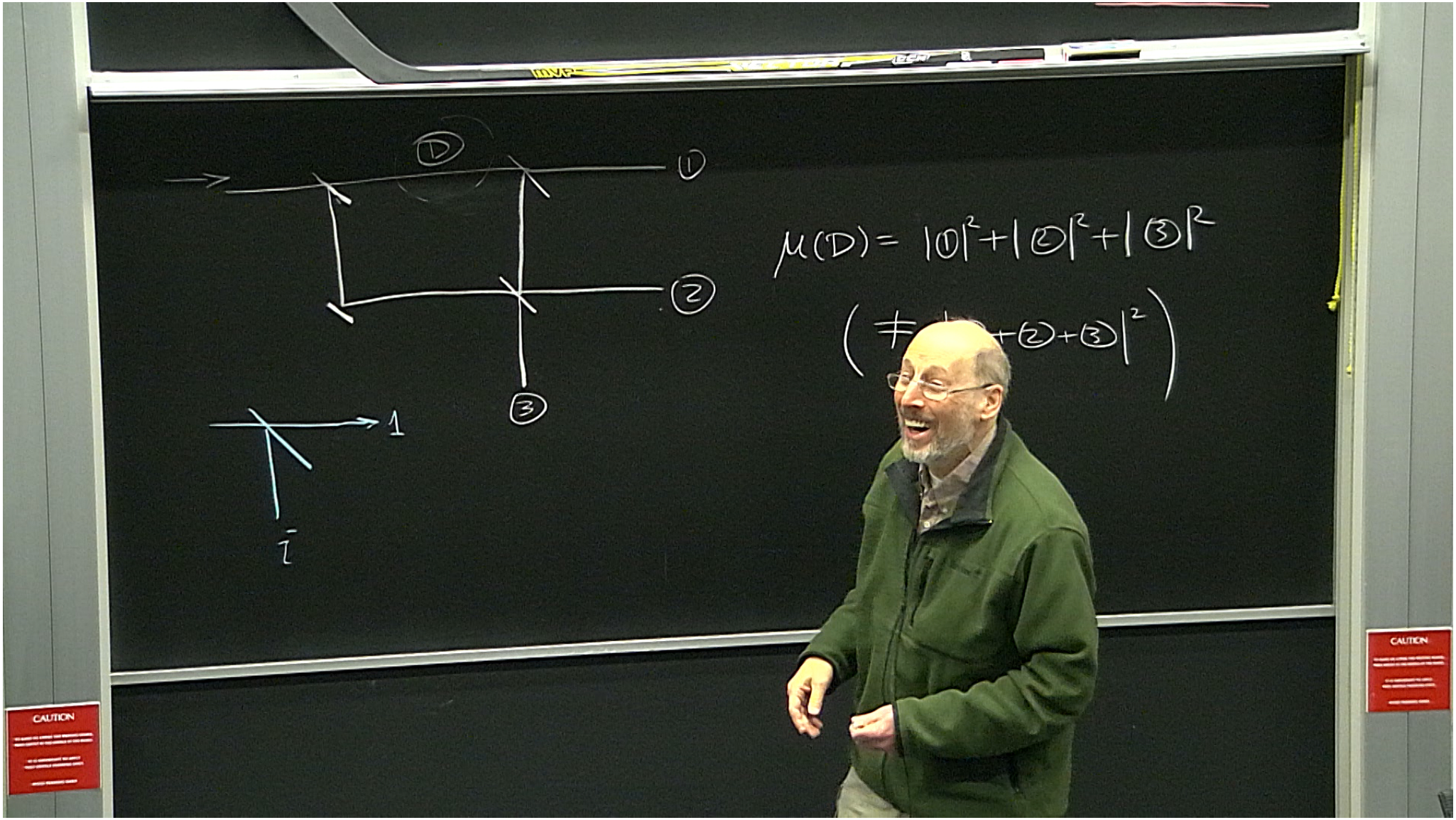

2
R_2
P
1
P
0
$R_1 \cup R_2 \simeq R_1 \simeq R_2$
$P^2 = P$
$\sum_1 P_{21} P_{10} = P_{20}$
$(P^2)_{20} = P_{20}$
CAUTION

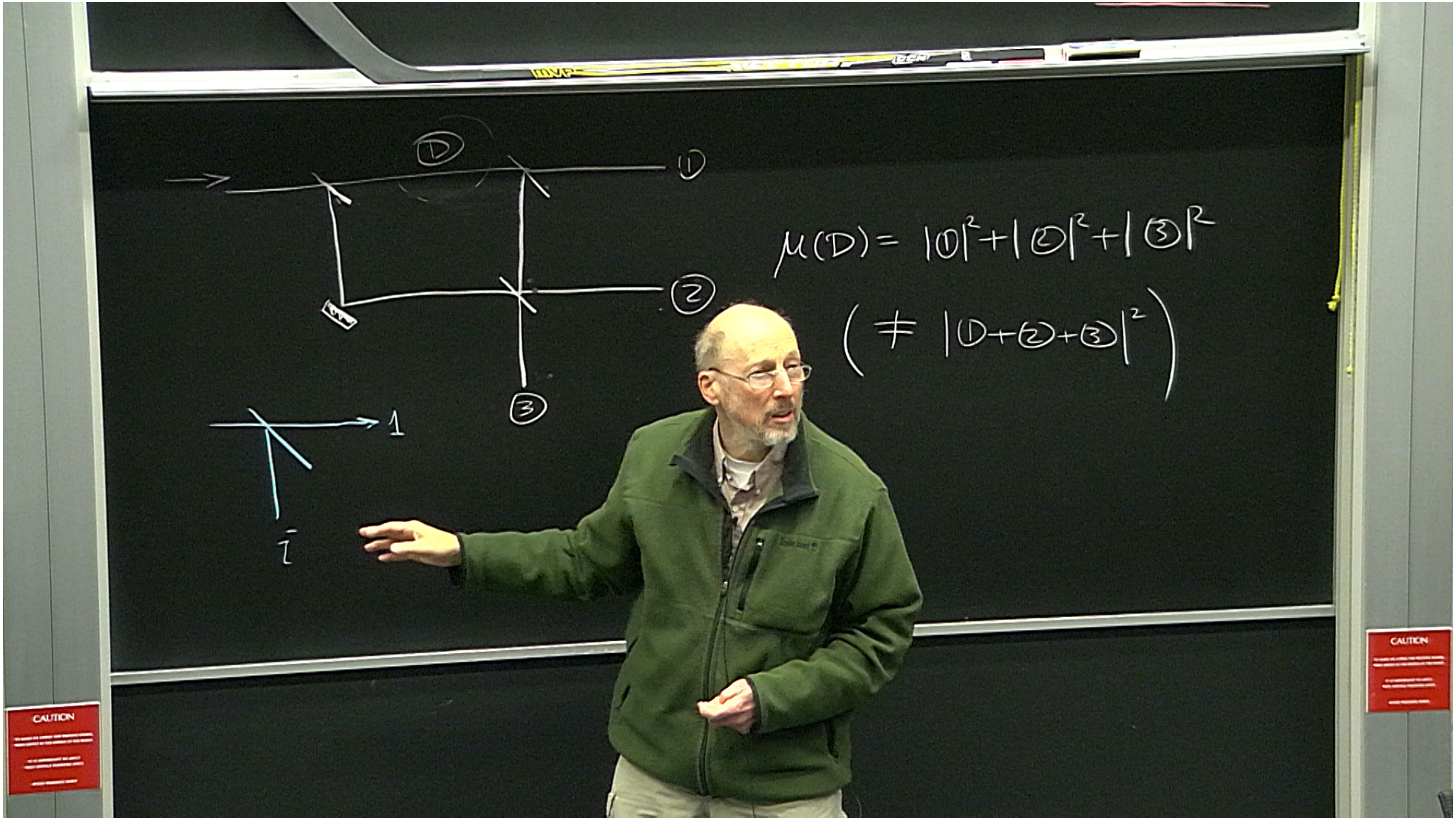

Ω = hist
event algebra

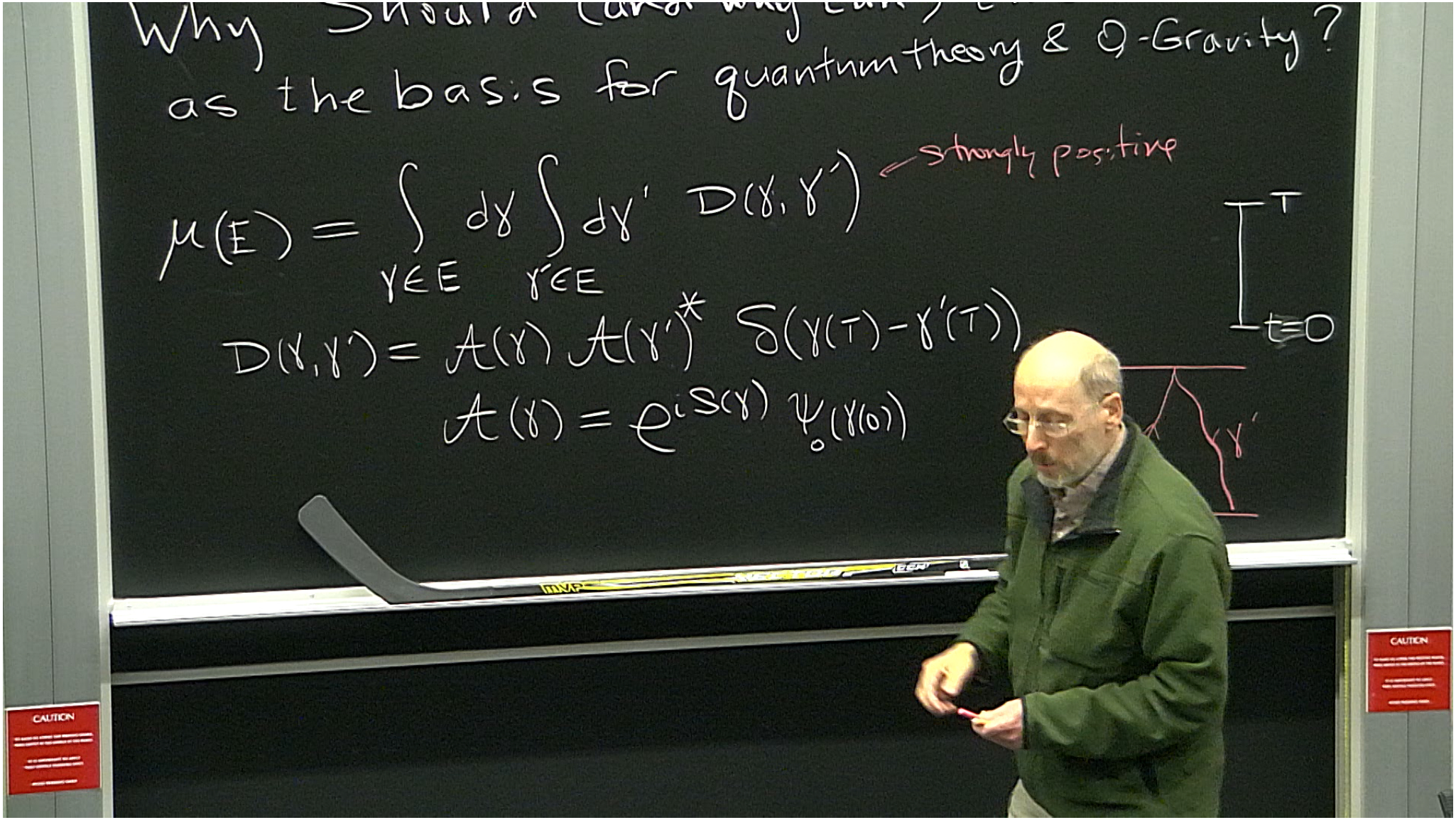

D
1
2
3
1
i
μ(D) = |1|² + |2|² + |3|²
(≠ |1+2+3|²)
CAUTION
CAUTION

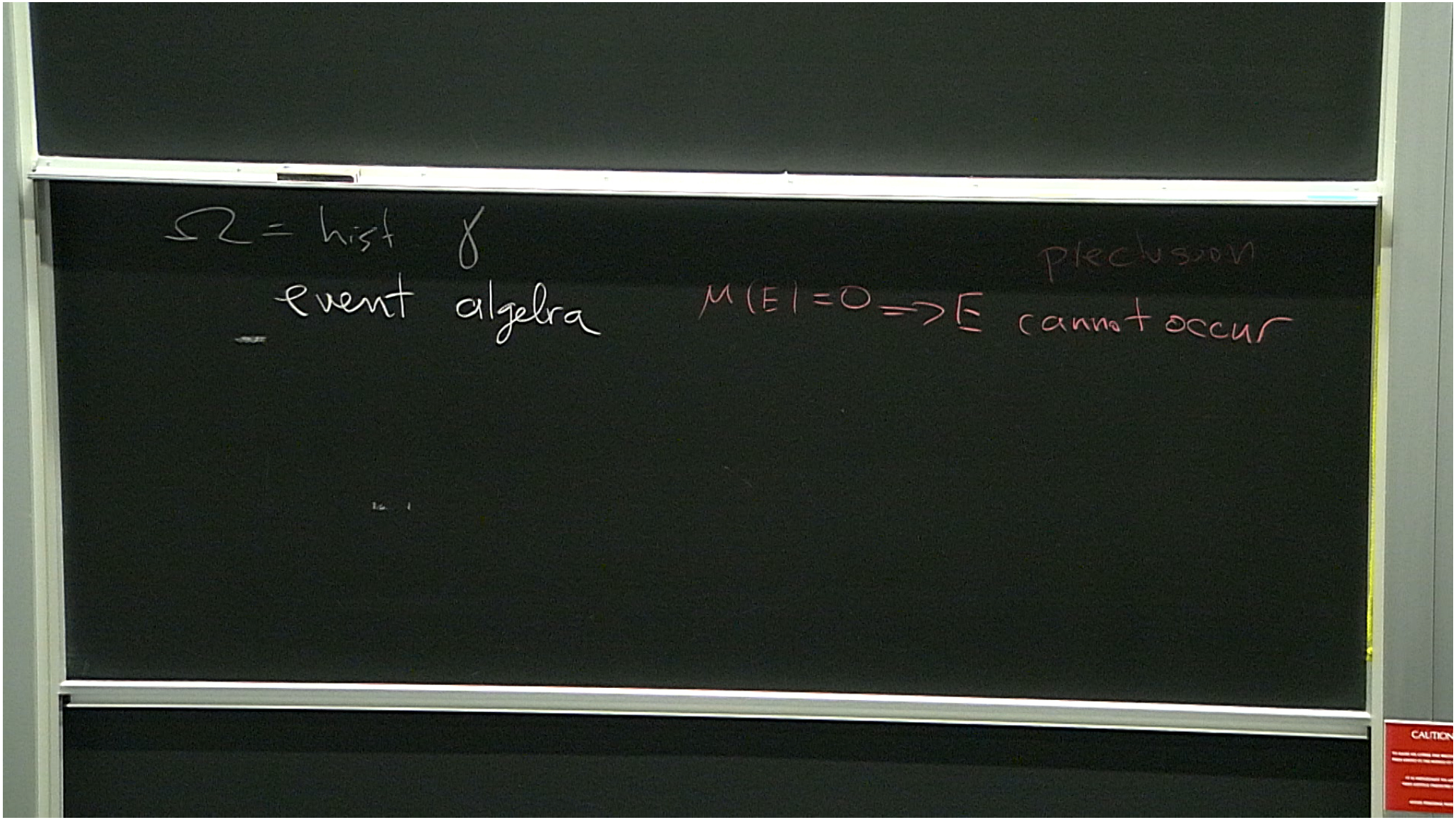

D
1
2
3
1
i
μ(D) = |1|² + |2|² + |3|²
(+ |1+2+3|²)
CAUTION
CAUTION

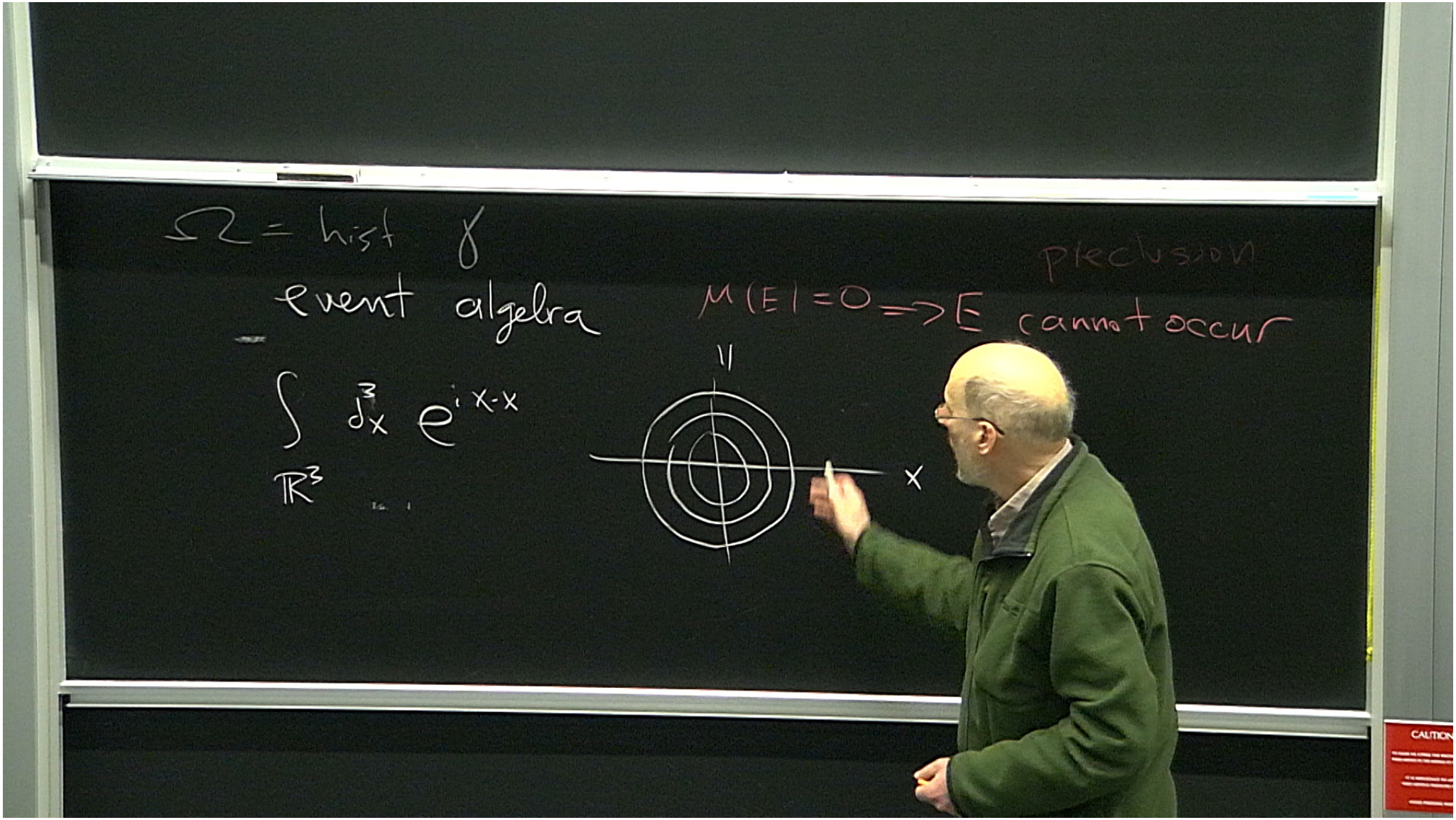

①
①
②
③
1
i
$\mu(D) = |①|^2 + |②|^2 + |③|^2$
$(\neq |①+②+③|^2)$
CAUTION

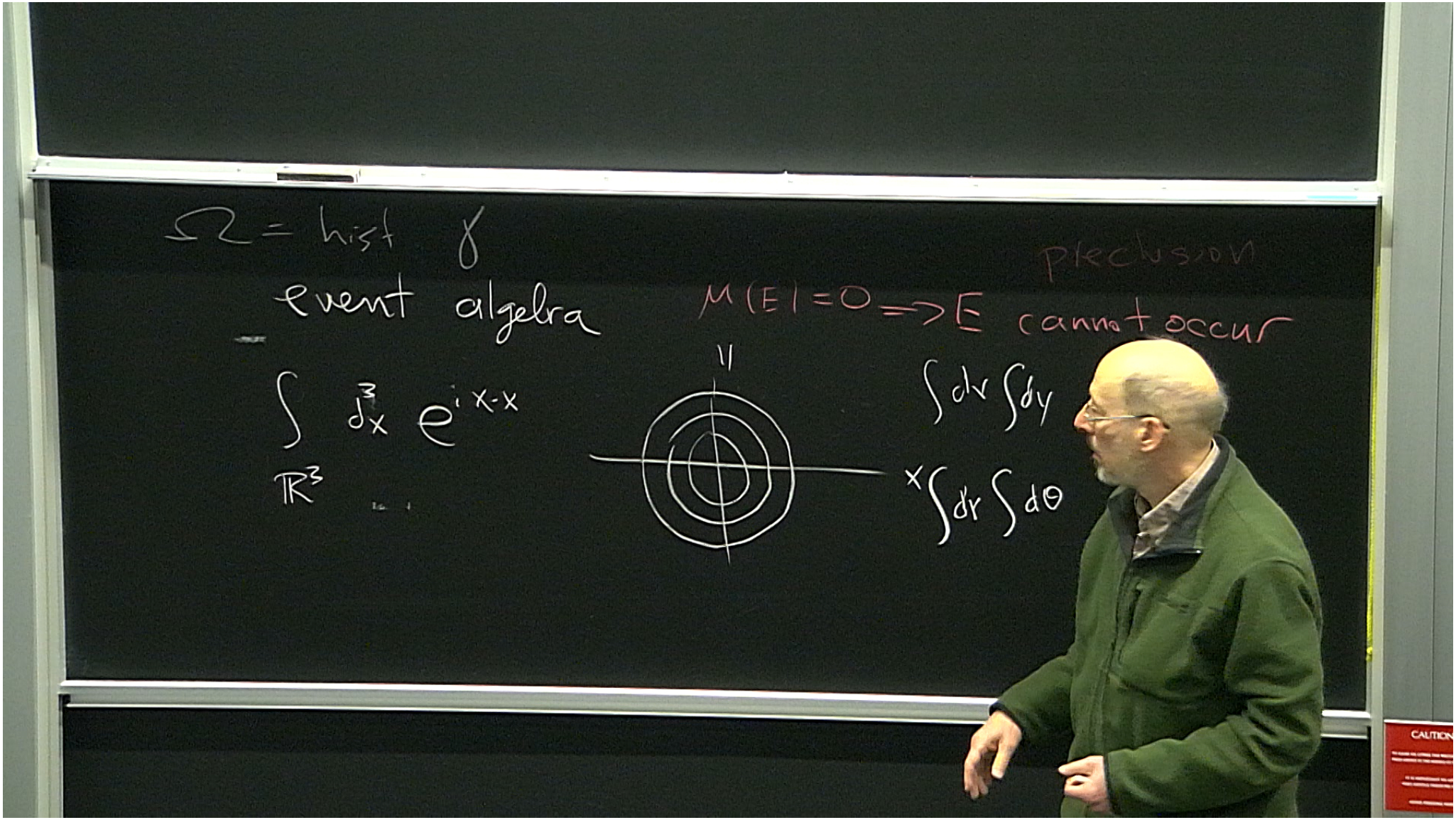

D
1
2
3
1
i
μ(D) = |1|² + |2|² + |3|²
CAUTION
CAUTION


D
1
2
3
1
i
$\mu(D) = |1|^2 + |2|^2 + |3|^2$
$(\neq |1+2+3|^2)$


Why
as the basis for quantum theory & Q-Gravity?
$\mu(E) = \int_{\gamma \in E} d\gamma \int_{\gamma' \in E} d\gamma' \; D(\gamma,\gamma')$
strongly positive
$D(\gamma,\gamma') = A(\gamma)\, A(\gamma')^* \, \delta(\gamma(T) - \gamma'(T))$
$A(\gamma) = e^{iS(\gamma)} \psi_0(\gamma(0))$
T
t=0
γ'
CAUTION
CAUTION


Ω = hist
event algebra
M(E) = 0 => E cannot occur
preclusion

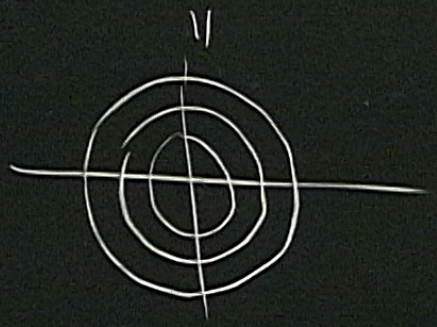

Ω = history
event algebra
preclusion
M(E) = 0 ⇒ E cannot occur
∫ d³x e^{i x·x}
ℝ³
x


Ω = hist of
event algebra
M(E) = 0 => E cannot occur
preclusion
∫ d³x e^{i x·x}
ℝ³
∫dr ∫dy
x ∫dr ∫dθ

Ω = hist of event algebra

$$\int_{\mathbb{R}^3} d^3x\, e^{i\,x\cdot x}$$

$M(E) = 0 \Rightarrow E$ cannot occur — precision



$$\int dr \int dy \times \int dr \int d\theta''$$

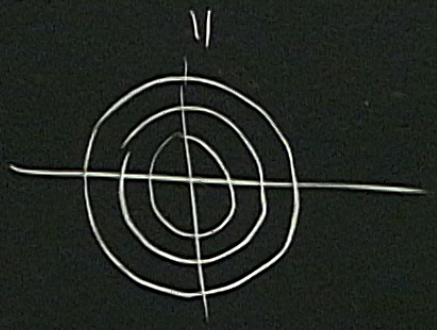
Ω = hist ϕ

event algebra

precision

$M(E) = 0 \Rightarrow E$ cannot occur

$$\int_{\mathbb{R}^3} d^3x \, e^{i\,x\cdot x}$$



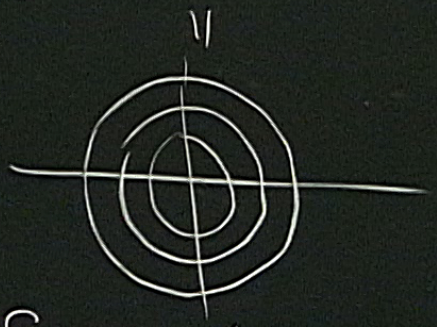
$$\int dr \int dy \int dz$$

$$\times \int dr \int d\Omega^2$$

Ω = history

event algebra

$$\int_{\mathbb{R}^3} d^3x\, e^{i\,x\cdot x}$$

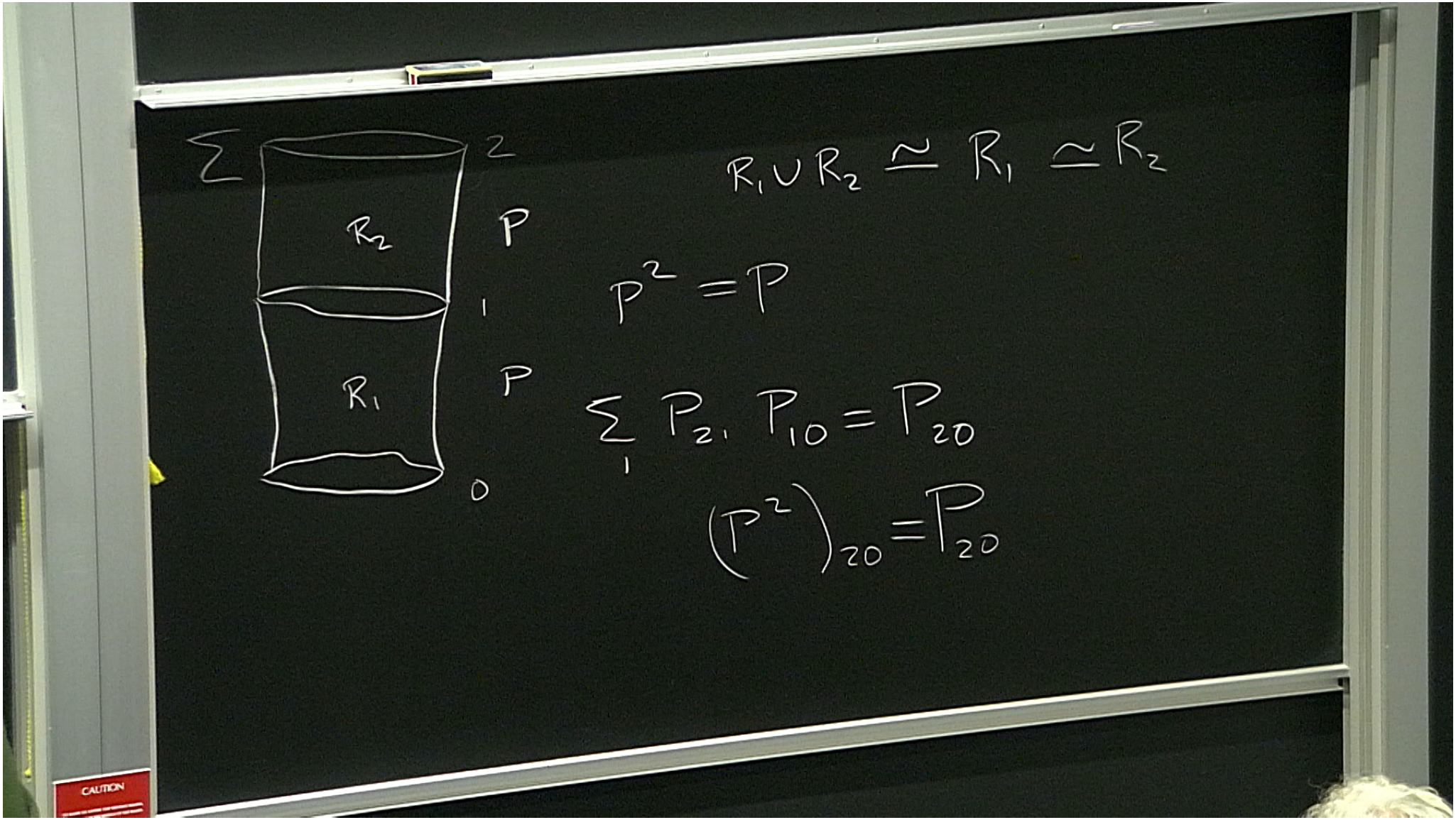


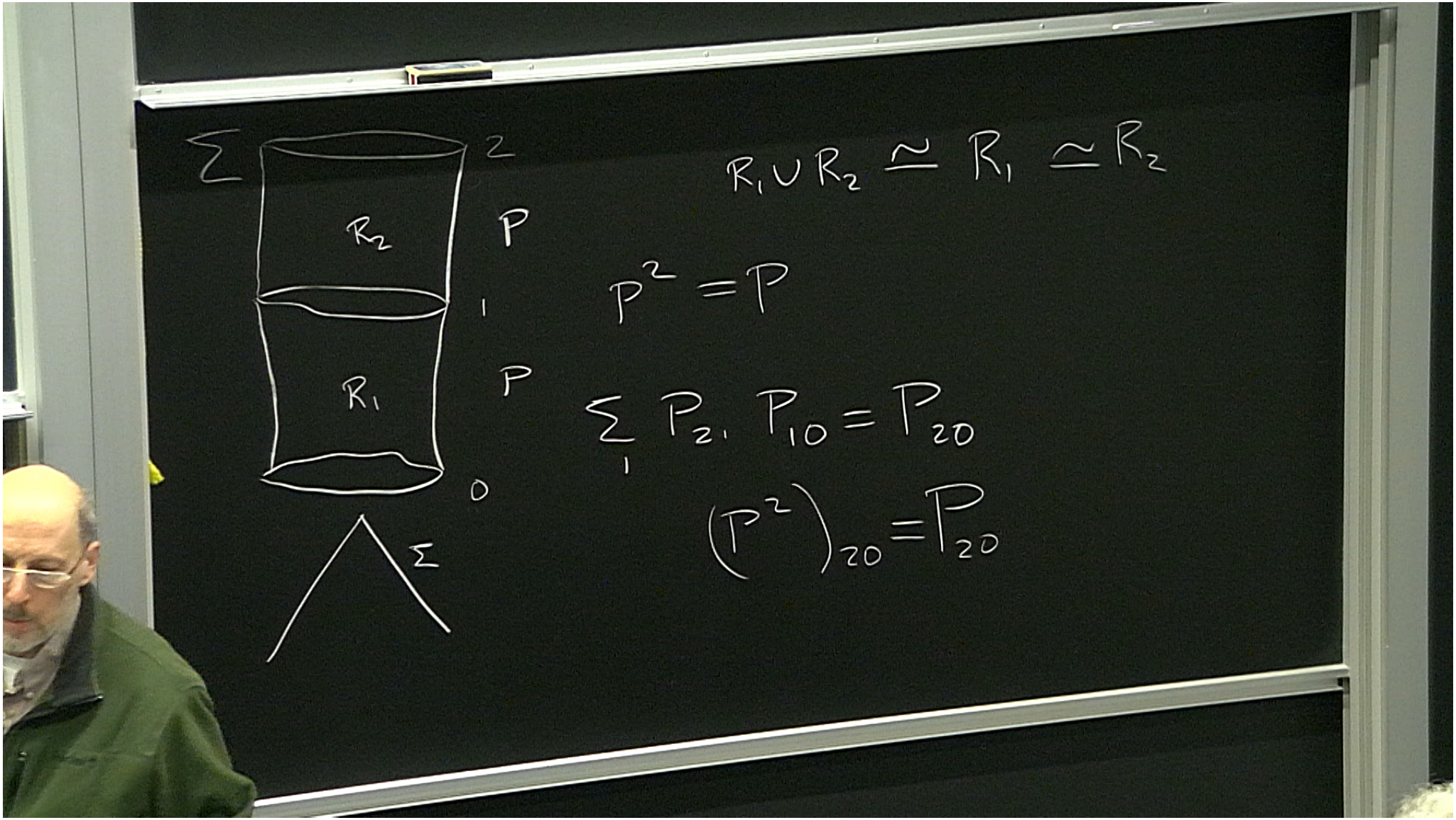
precision

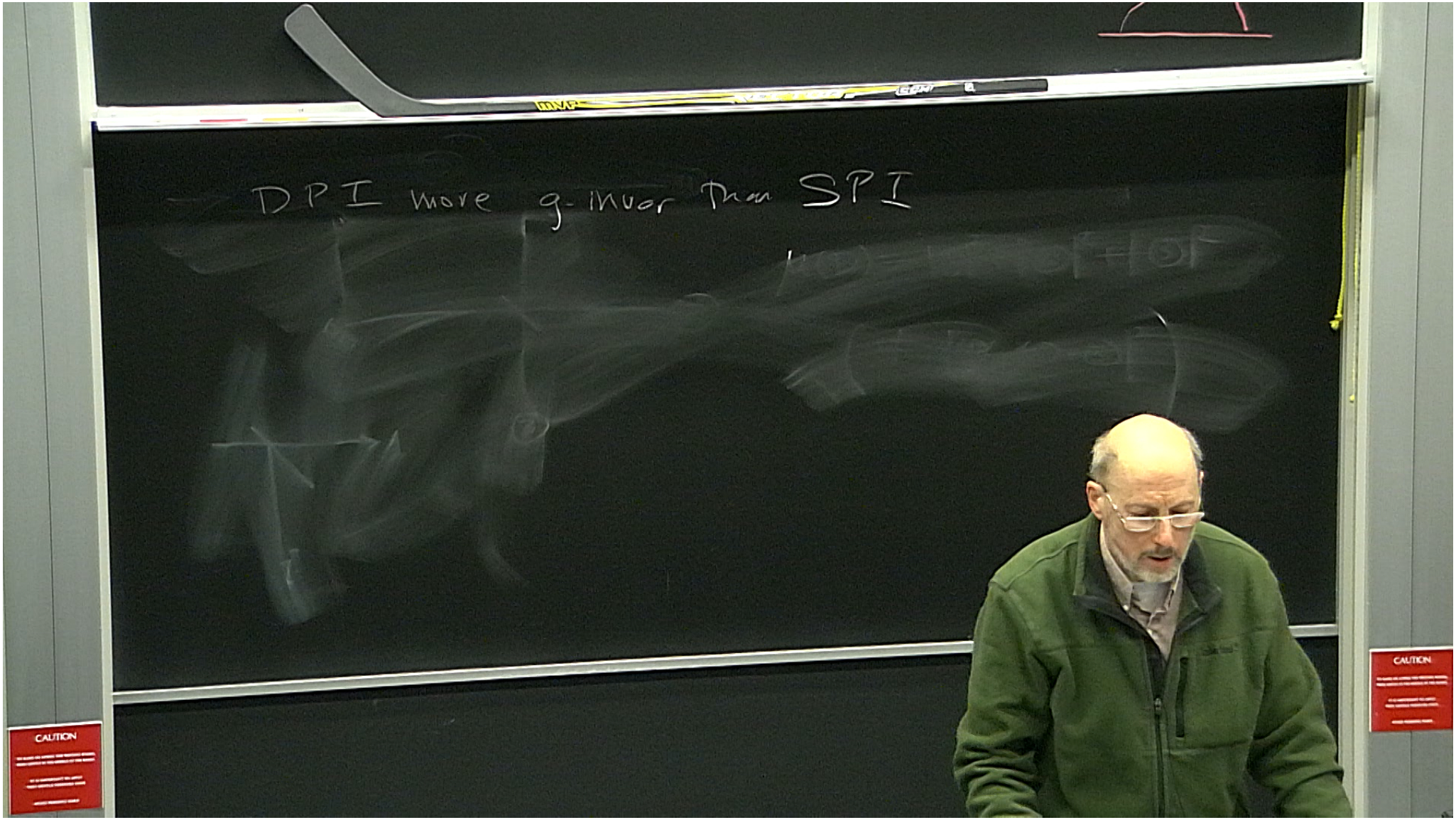
$M(E) = 0 \Rightarrow E$ cannot occur

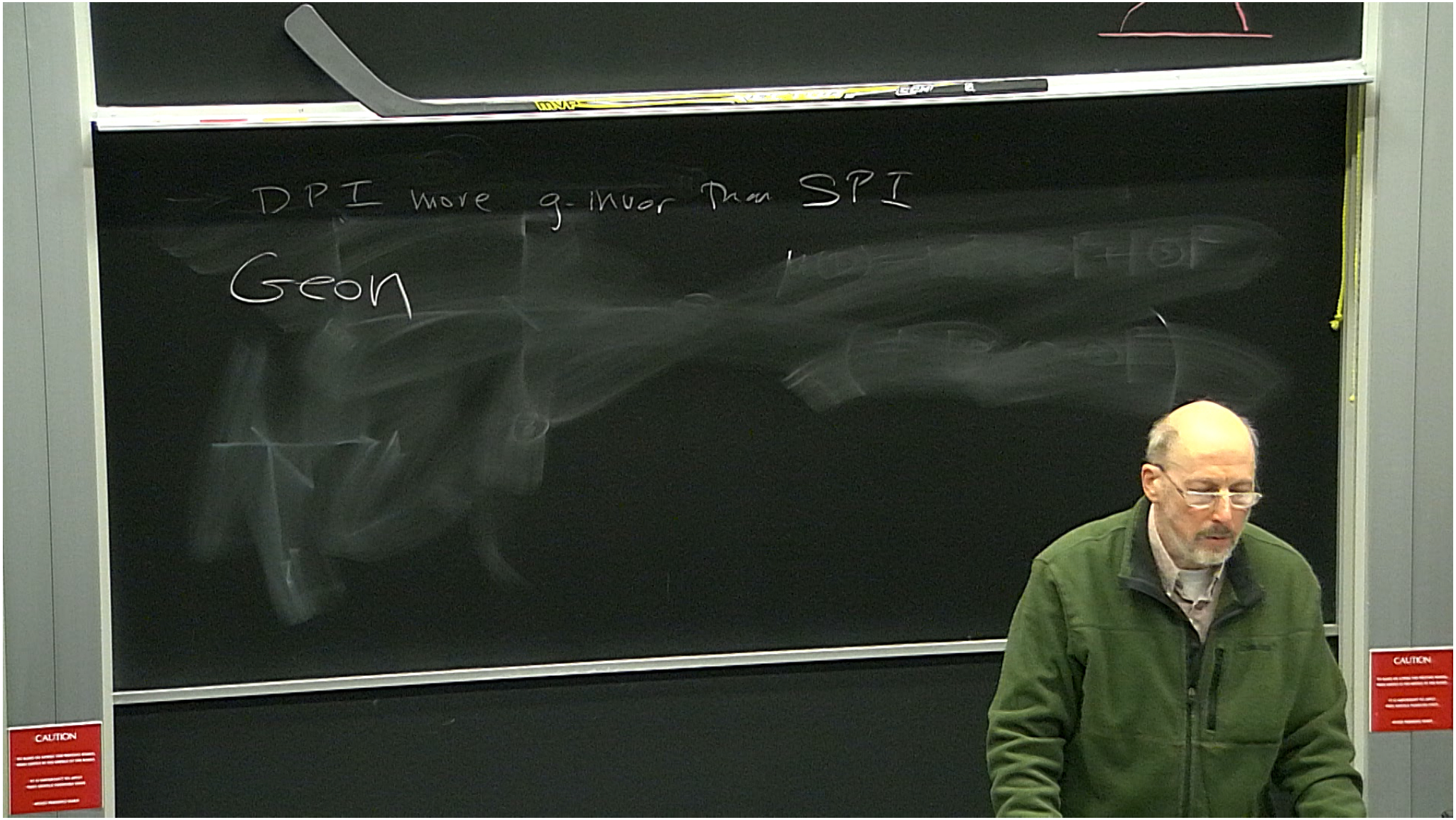
$$\int dx \int dy \int dz \times \int dr \int d\Omega^2$$

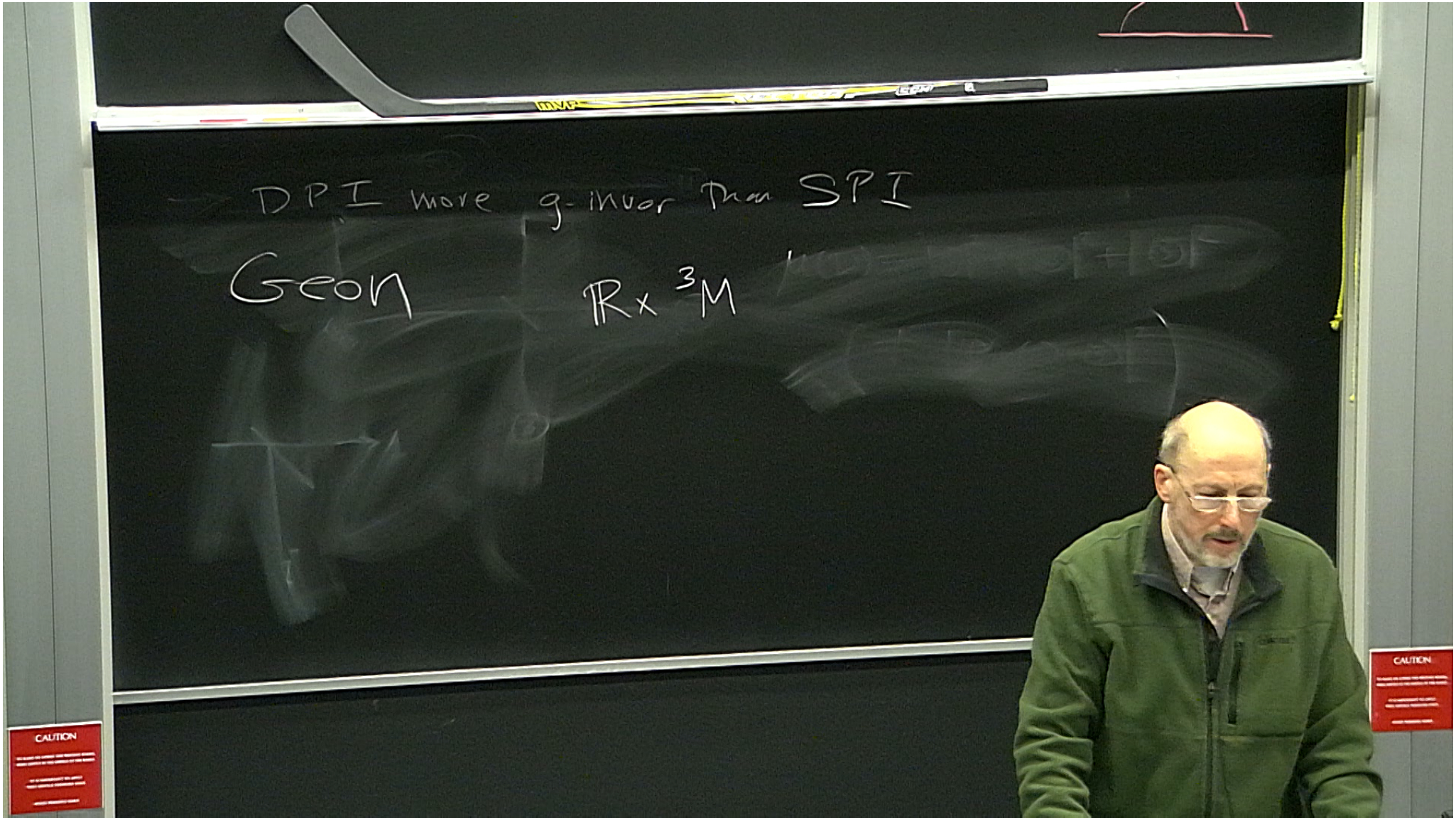
What can PI do for us & vice versa?

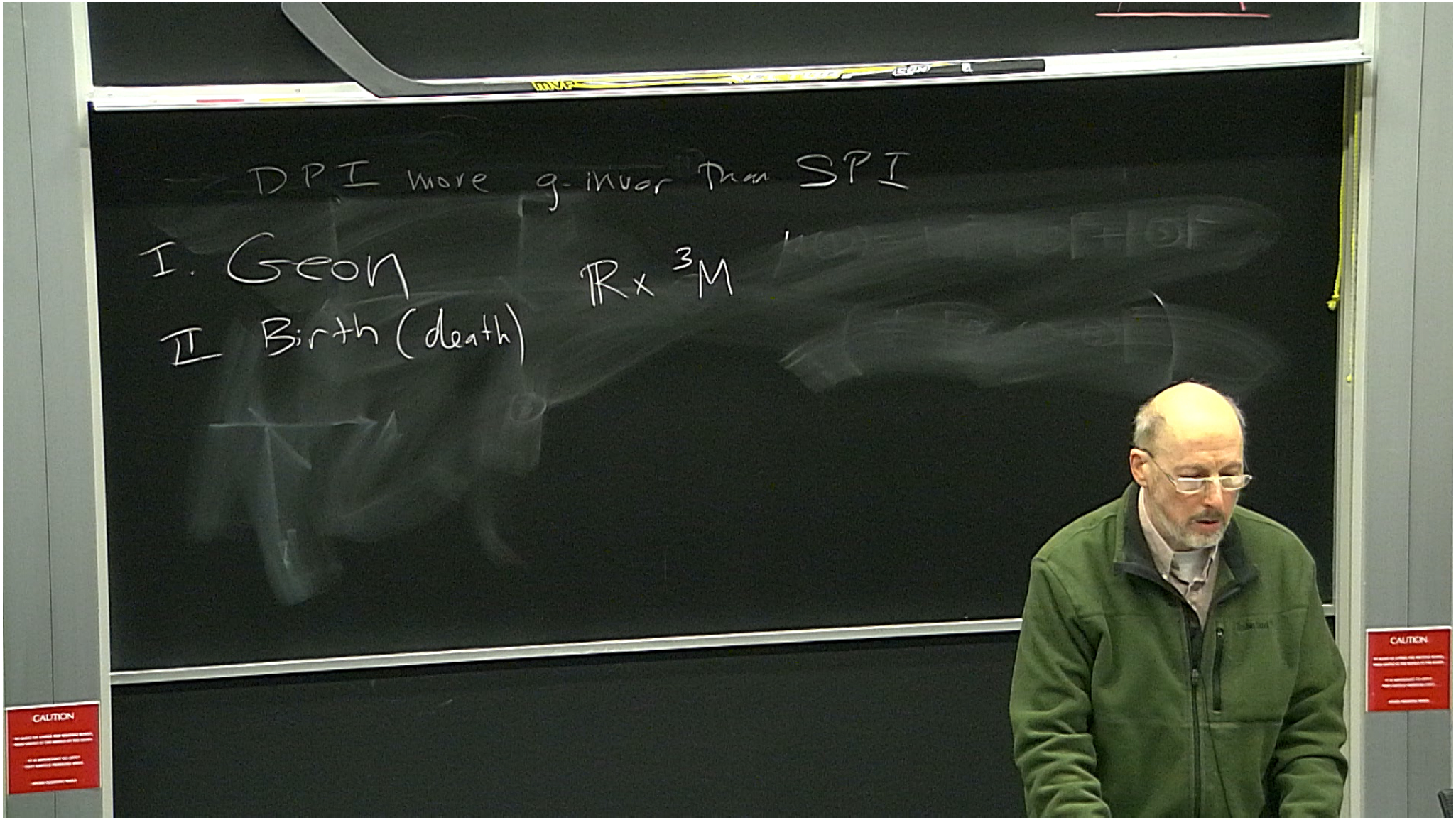

Σ
R_2
R_1
2
1
0
P
P
$R_1 \cup R_2 \simeq R_1 \simeq R_2$
$P^2 = P$
$\sum_1 P_{21} P_{10} = P_{20}$
$(P^2)_{20} = P_{20}$
CAUTION


Σ
2
R_2
P
1
R_1
P
0
Σ
$R_1 \cup R_2 \simeq R_1 \simeq R_2$
$P^2 = P$
$\sum_1 P_{21} P_{10} = P_{20}$
$(P^2)_{20} = P_{20}$


DPI more g-inver than SPI
CAUTION
CAUTION


DPI more g-invar than SPI
Geon
CAUTION
CAUTION

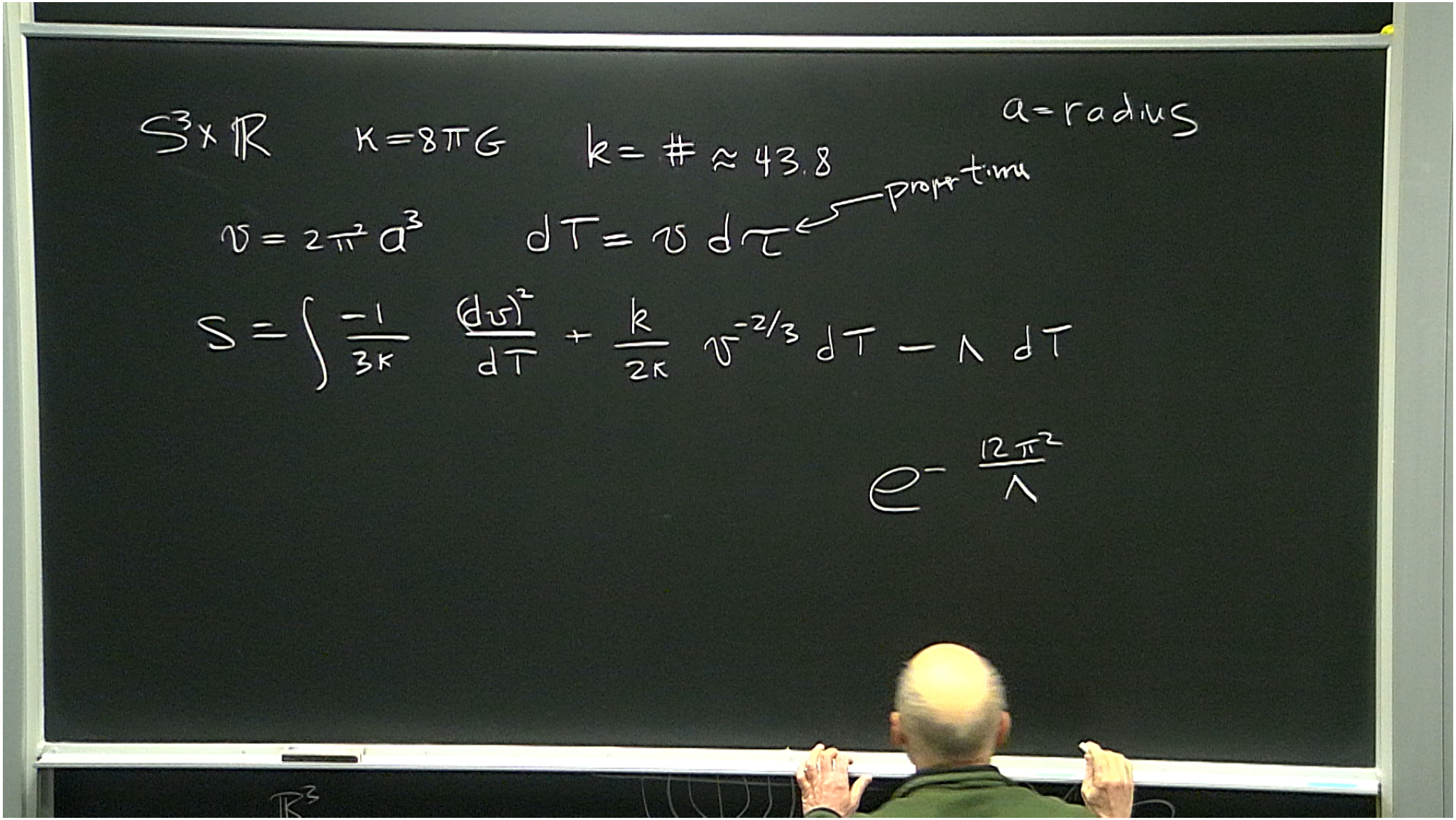

DPI more g-invar than SPI
Geon
$\mathbb{R} \times {}^3M$


DPI more g-invar than SPI
I. Geon
II Birth (death)
$\mathbb{R} \times {}^3M$
CAUTION
CAUTION

$S^3 \times \mathbb{R}$ $\quad \kappa = 8\pi G \quad$ $k = \# \approx 43.8$ $\quad$ a = radius

$v = 2\pi^2 a^3 \qquad dT = v\, d\tau$ ← proper time

$$S = \int \frac{-1}{3\kappa} \frac{(dv)^2}{dT} + \frac{k}{2\kappa} v^{-2/3} dT - \Lambda\, dT$$

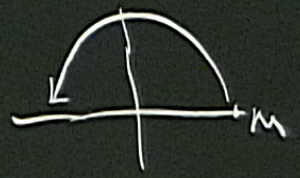

$S^3 \times \mathbb{R}$ $\kappa = 8\pi G$ $k = \# \approx 43.8$
a = radius
$v = 2\pi^2 a^3$ $dT = v\, d\tau$
proper time
$S = \int \frac{-1}{3\kappa} \frac{(dv)^2}{dT} + \frac{k}{2\kappa} v^{-2/3} dT - \Lambda\, dT$
$e^{-\frac{12\pi^2}{\Lambda}}$
$\mathbb{R}^3$

$S^3 \times \mathbb{R}$ $\kappa = 8\pi G$ $k = \# \approx 43.8$ a = radius

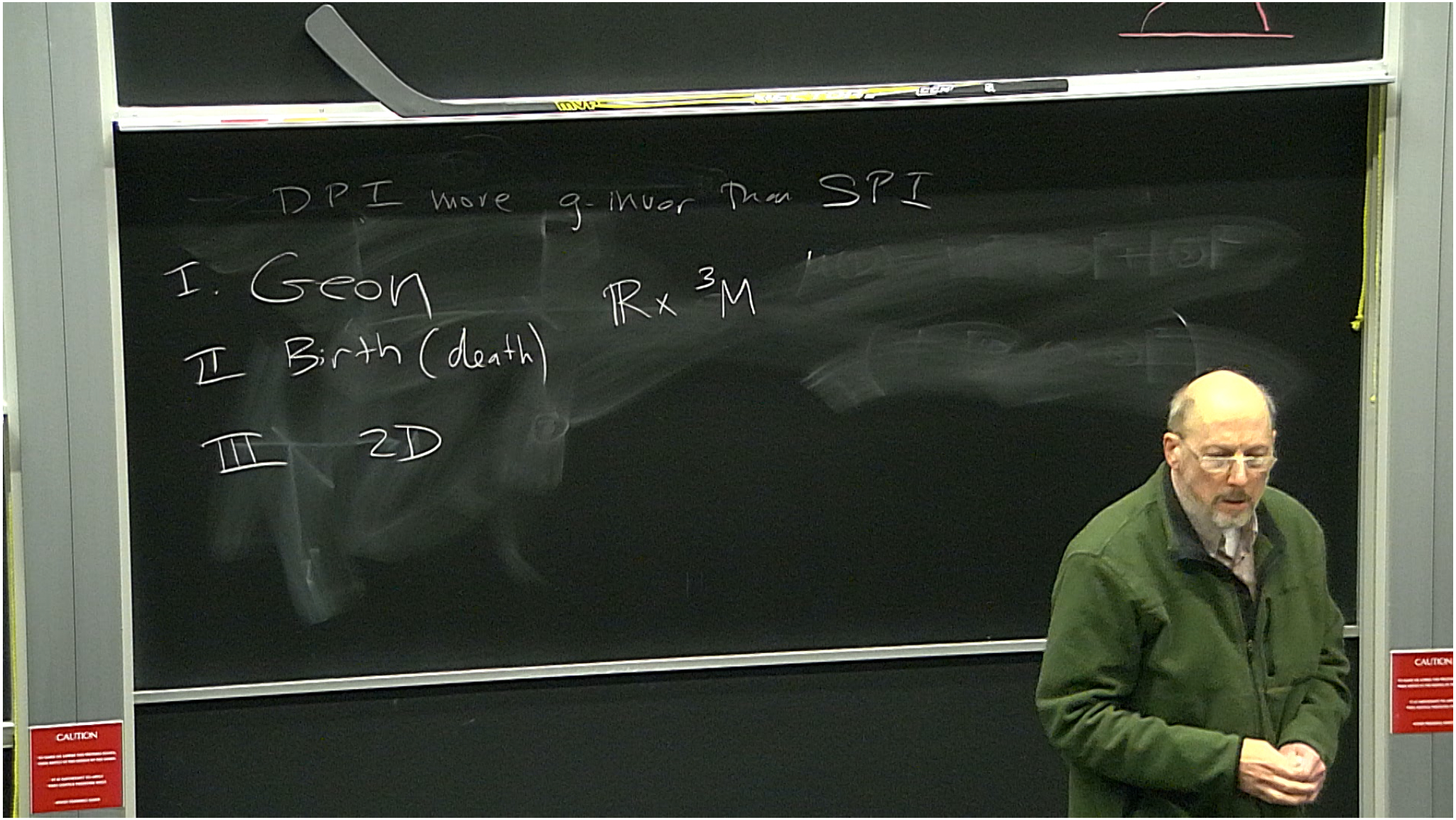
$v = 2\pi^2 a^3$ $dT = v\, d\tau$ ← proper time

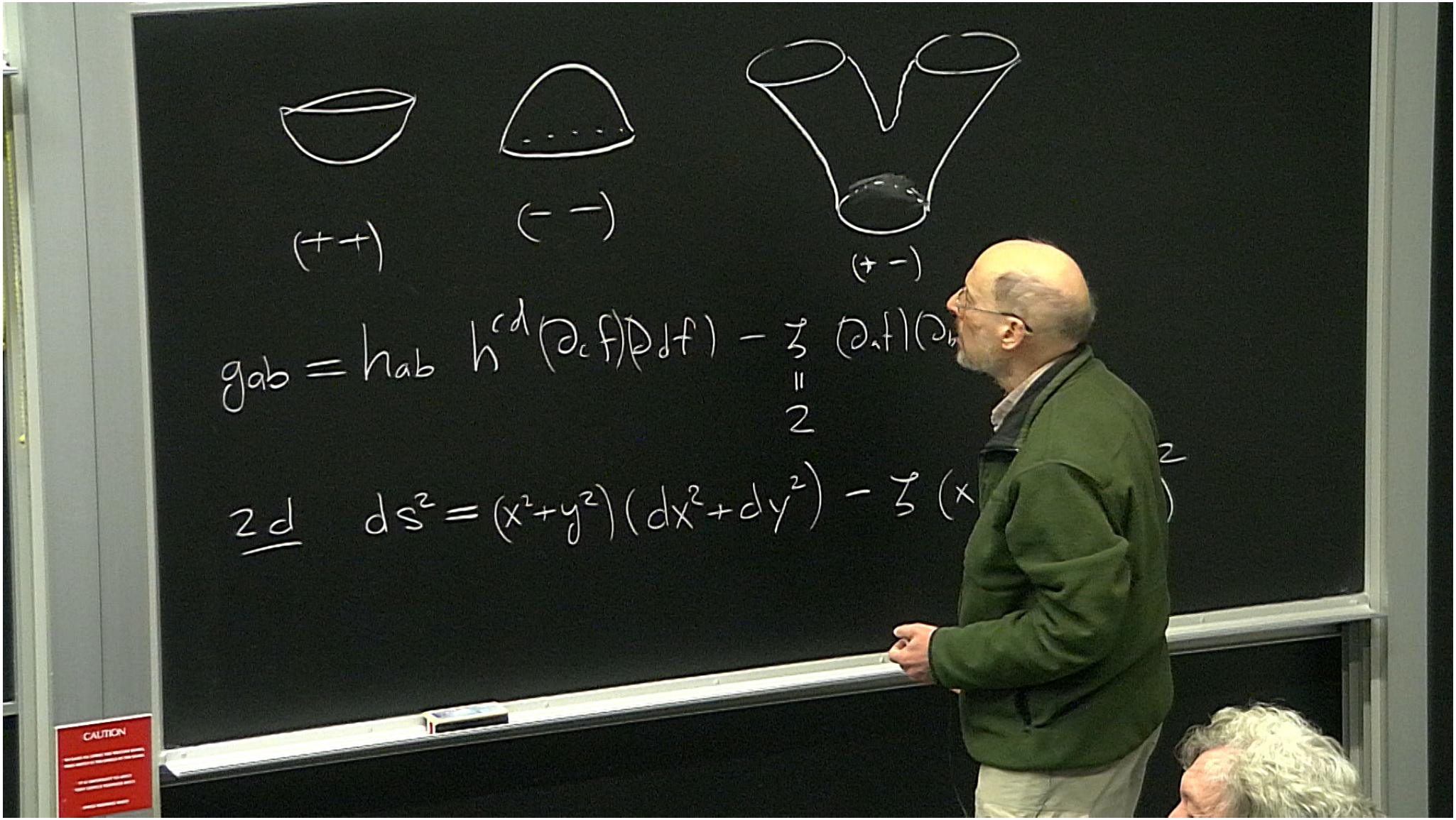
$$S = \int \frac{-1}{3\kappa} \frac{(dv)^2}{dT} + \frac{k}{2\kappa} v^{-2/3} dT - \Lambda\, dT$$

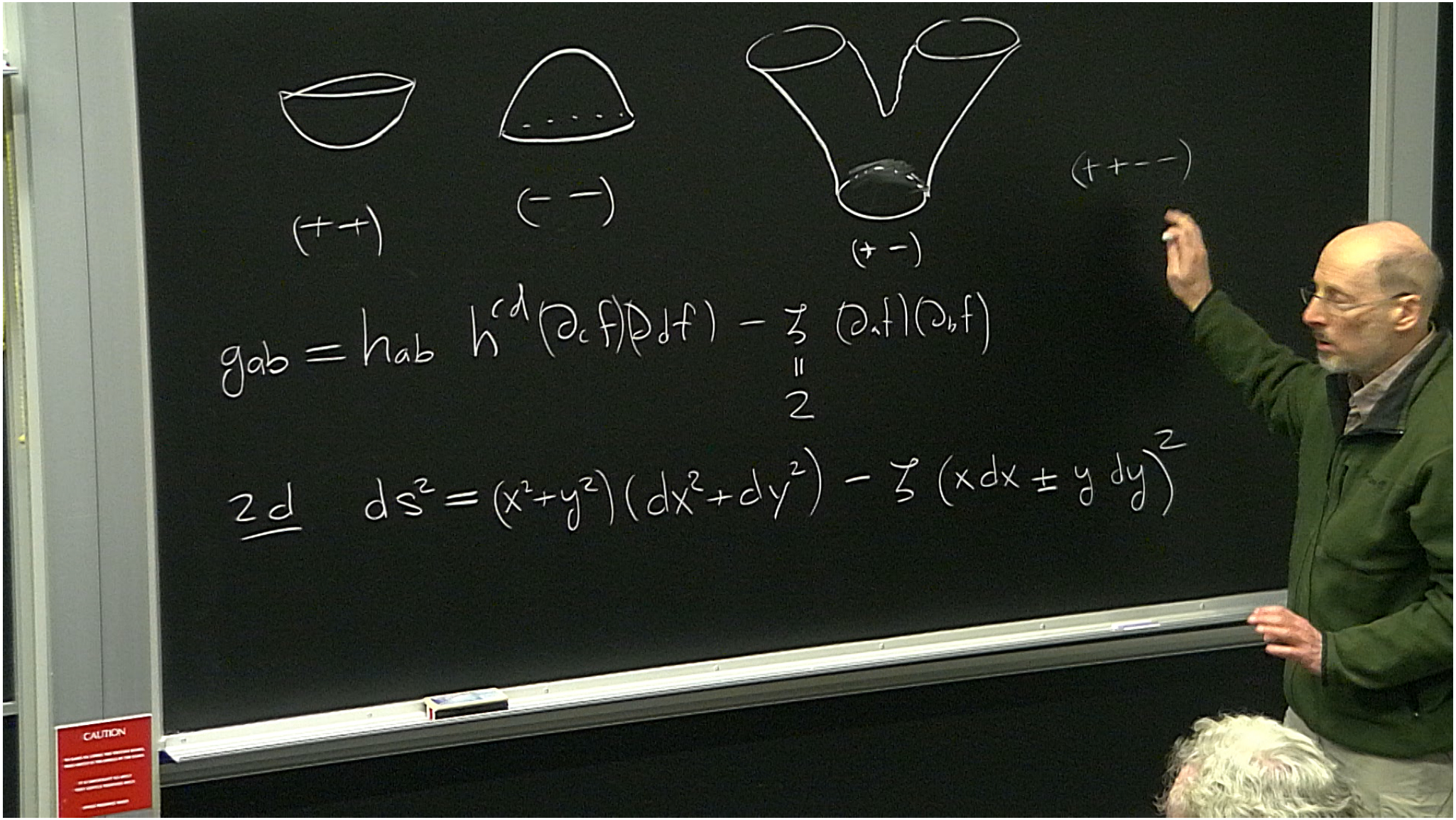
$$e^{-\frac{12\pi^2}{\Lambda}}$$

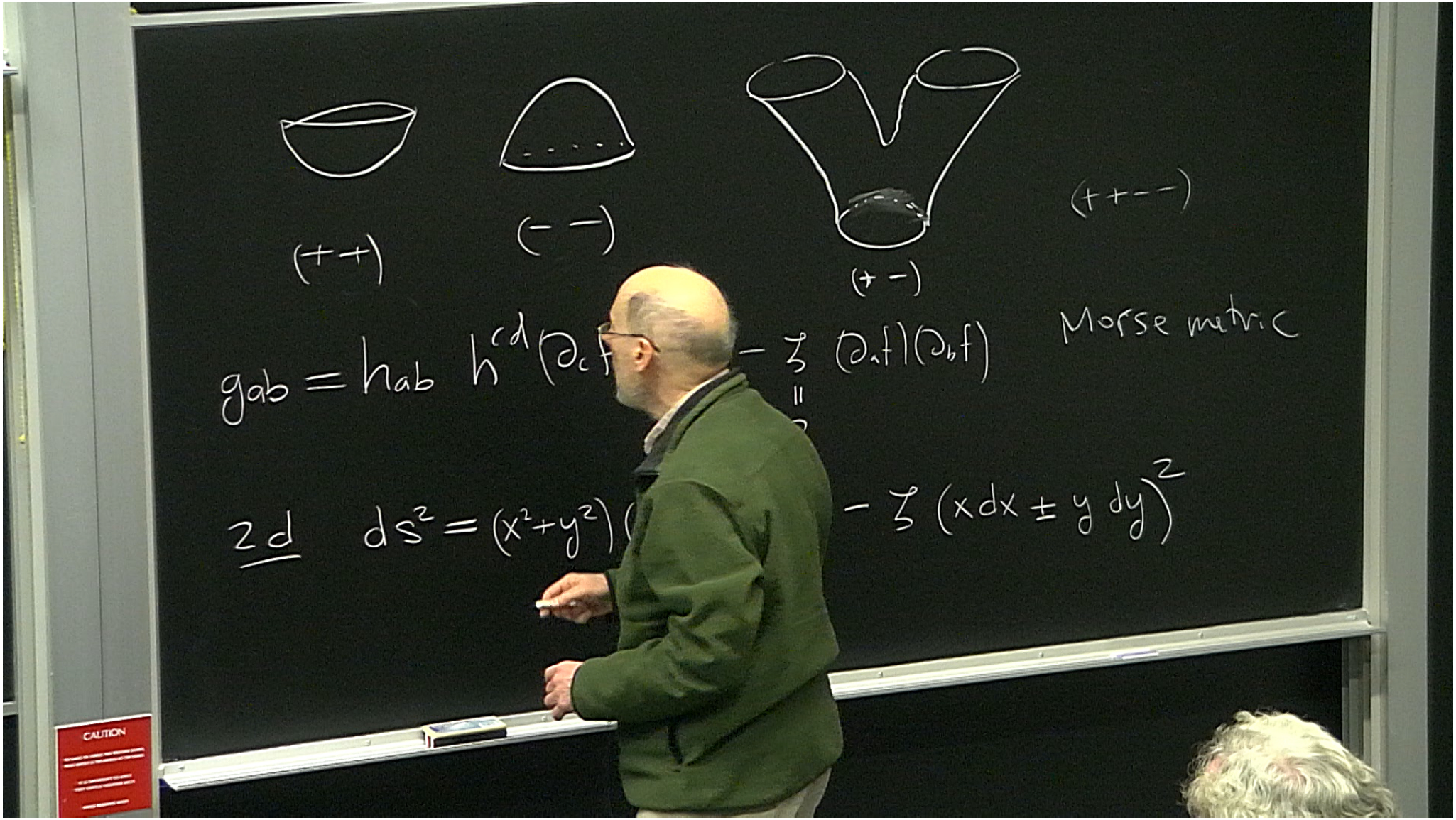


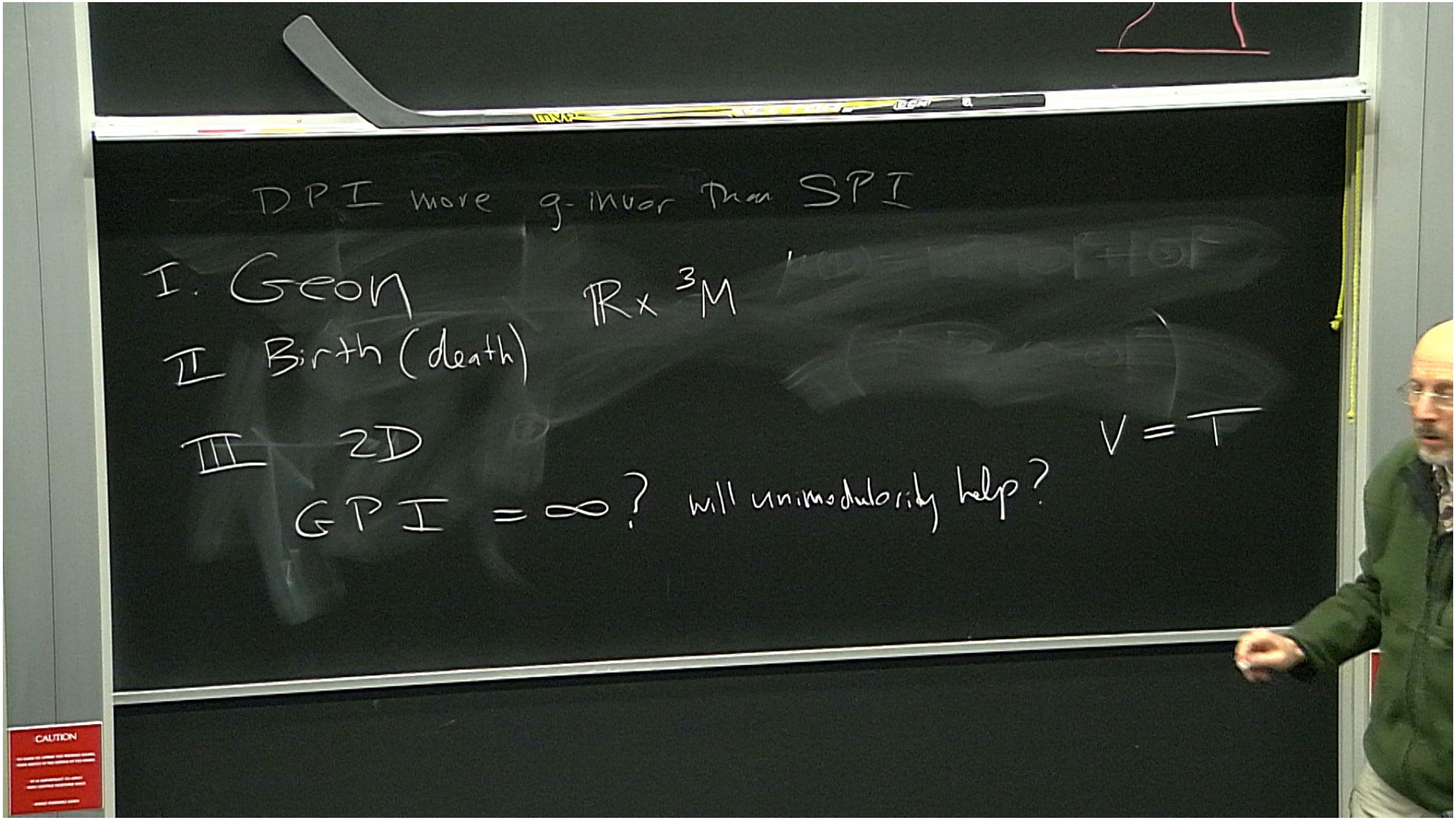
$\int d^3x\, e^{i\,x\cdot x}$

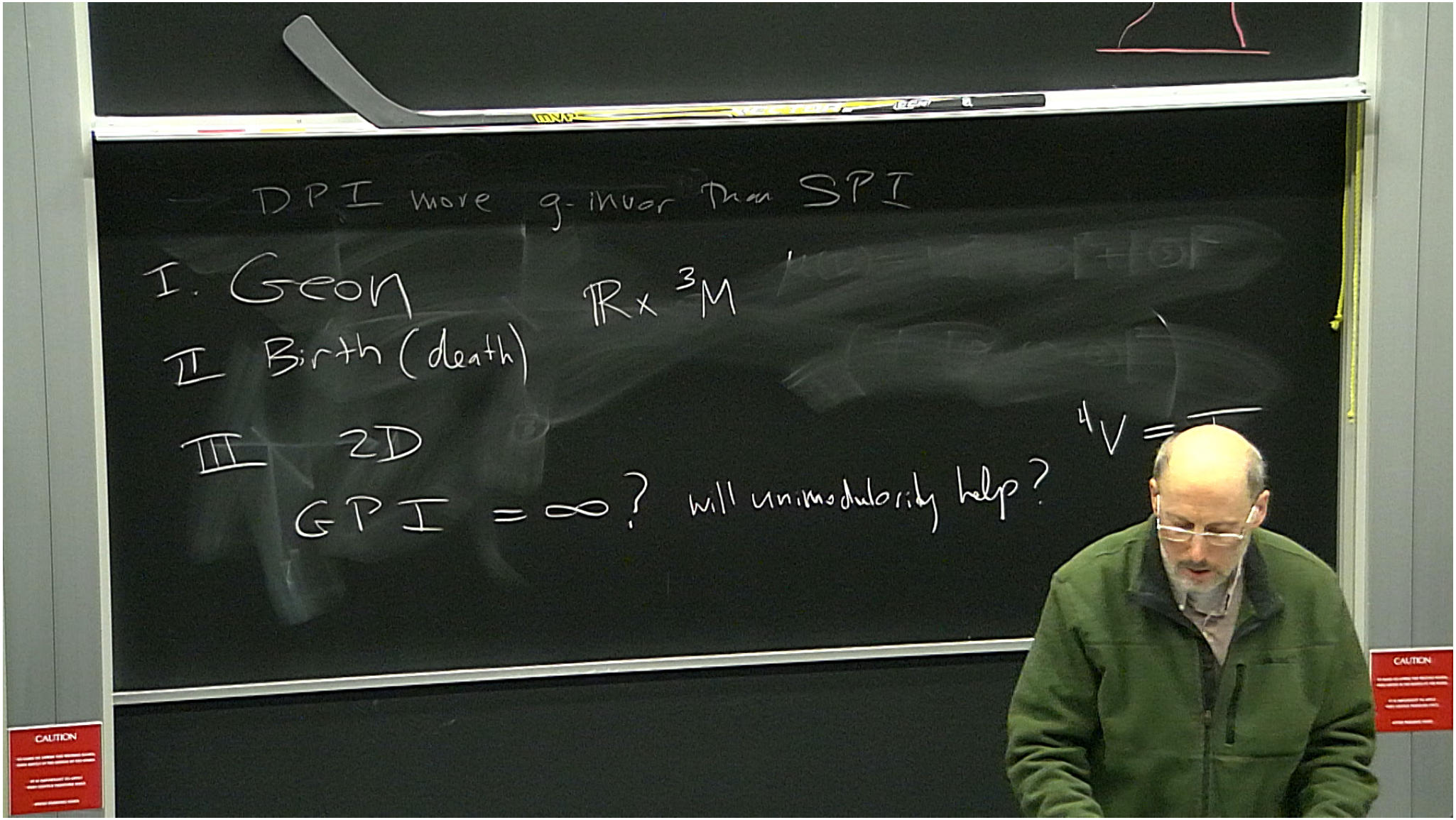

DPI more g-invar than SPI
I. Geon
II Birth (death)
III 2D
$\mathbb{R} \times {}^3M$
CAUTION
CAUTION

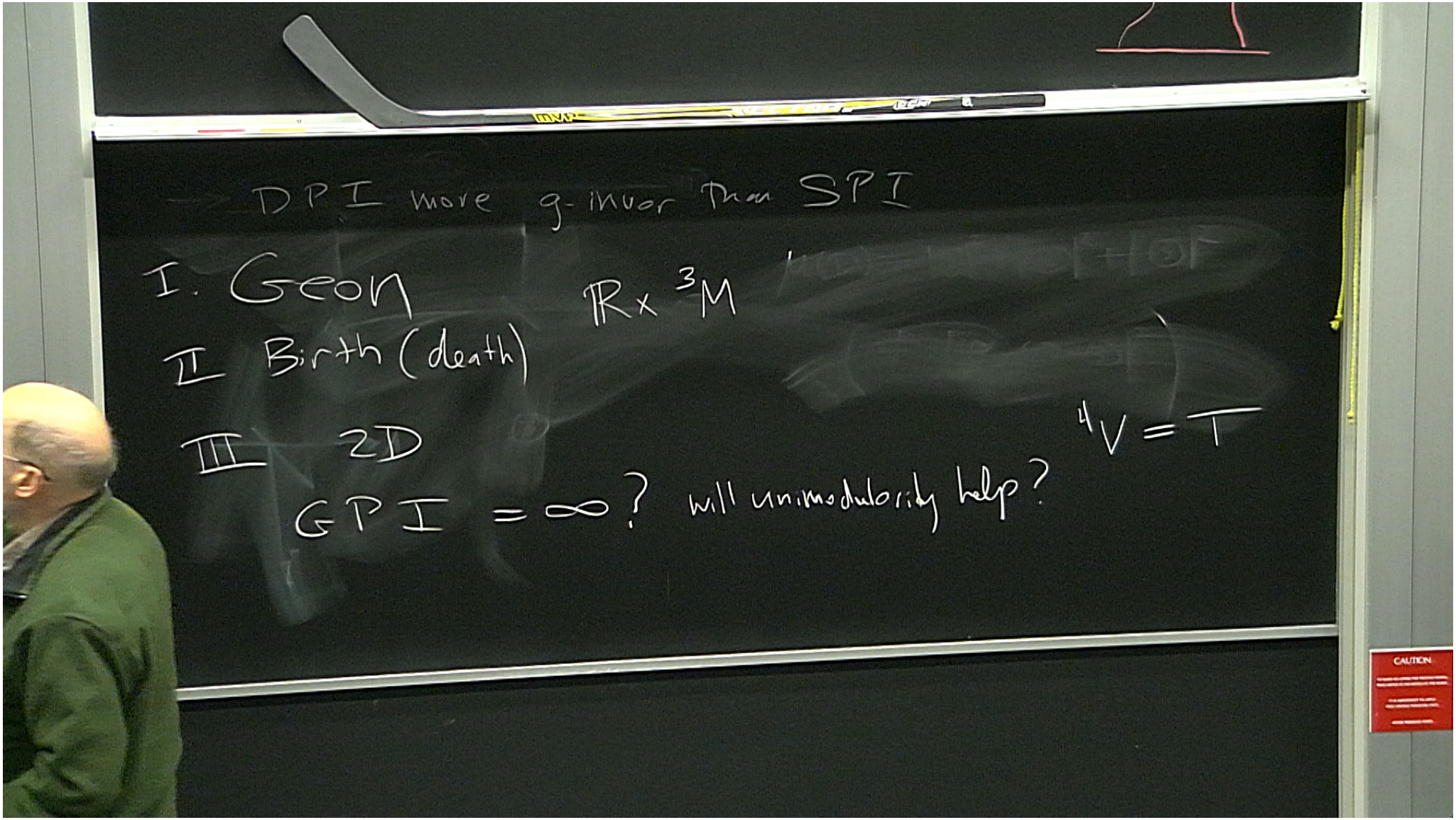

(++)
(--)
(+-)
$g_{ab} = h_{ab} \; h^{cd}(\partial_c f)(\partial_d f) - \frac{1}{2}(\partial_a f)(\partial_b$
2d $ds^2 = (x^2+y^2)(dx^2+dy^2) - \frac{1}{2}(x$
CAUTION

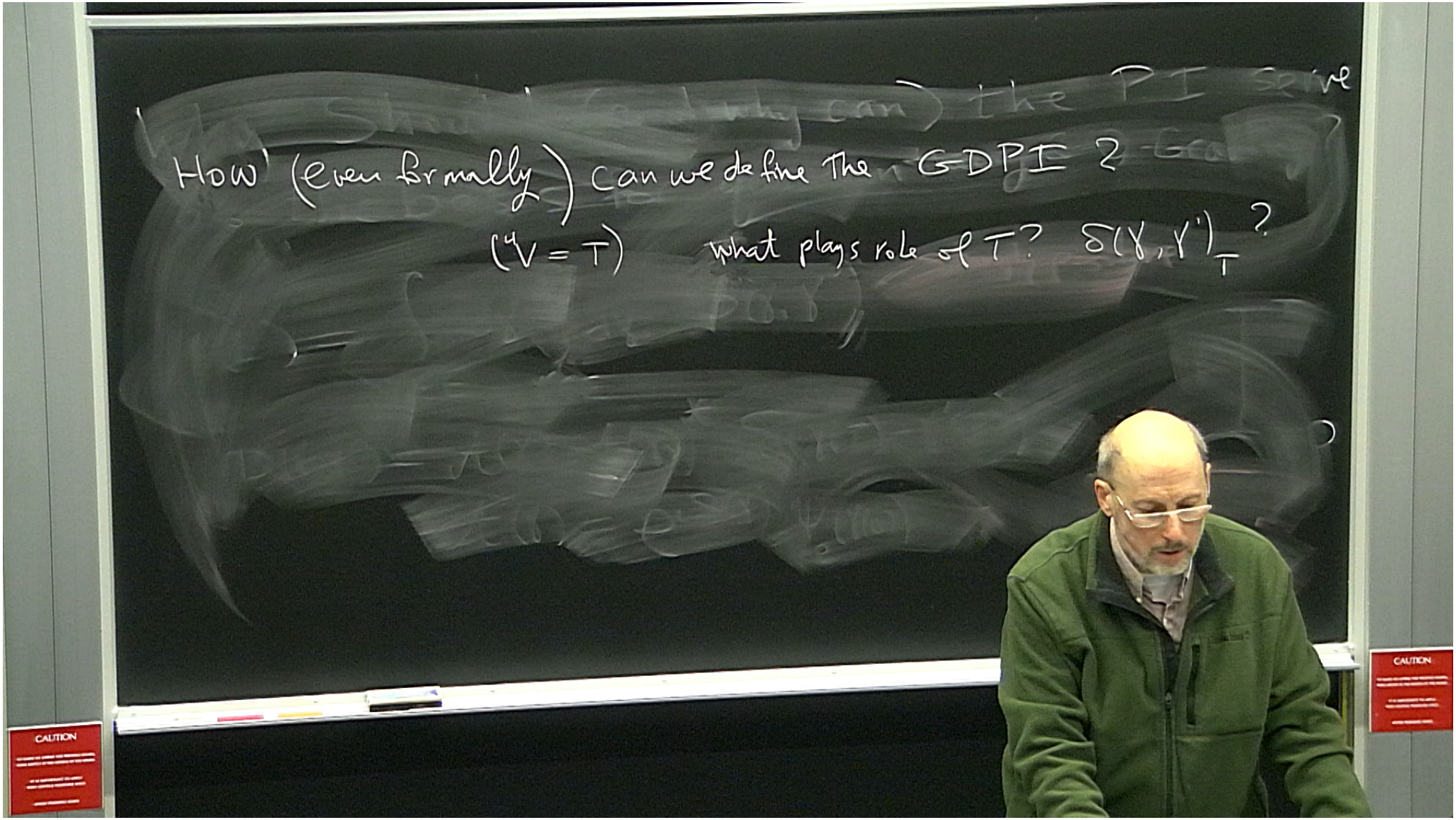

(++)
(--)
(+-)
(++--)
$g_{ab} = h_{ab} \; h^{cd}(\partial_c f)(\partial_d f) - \frac{3}{2}(\partial_a f)(\partial_b f)$
2d $ds^2 = (x^2+y^2)(dx^2+dy^2) - \frac{3}{2}(x\,dx \pm y\,dy)^2$
CAUTION

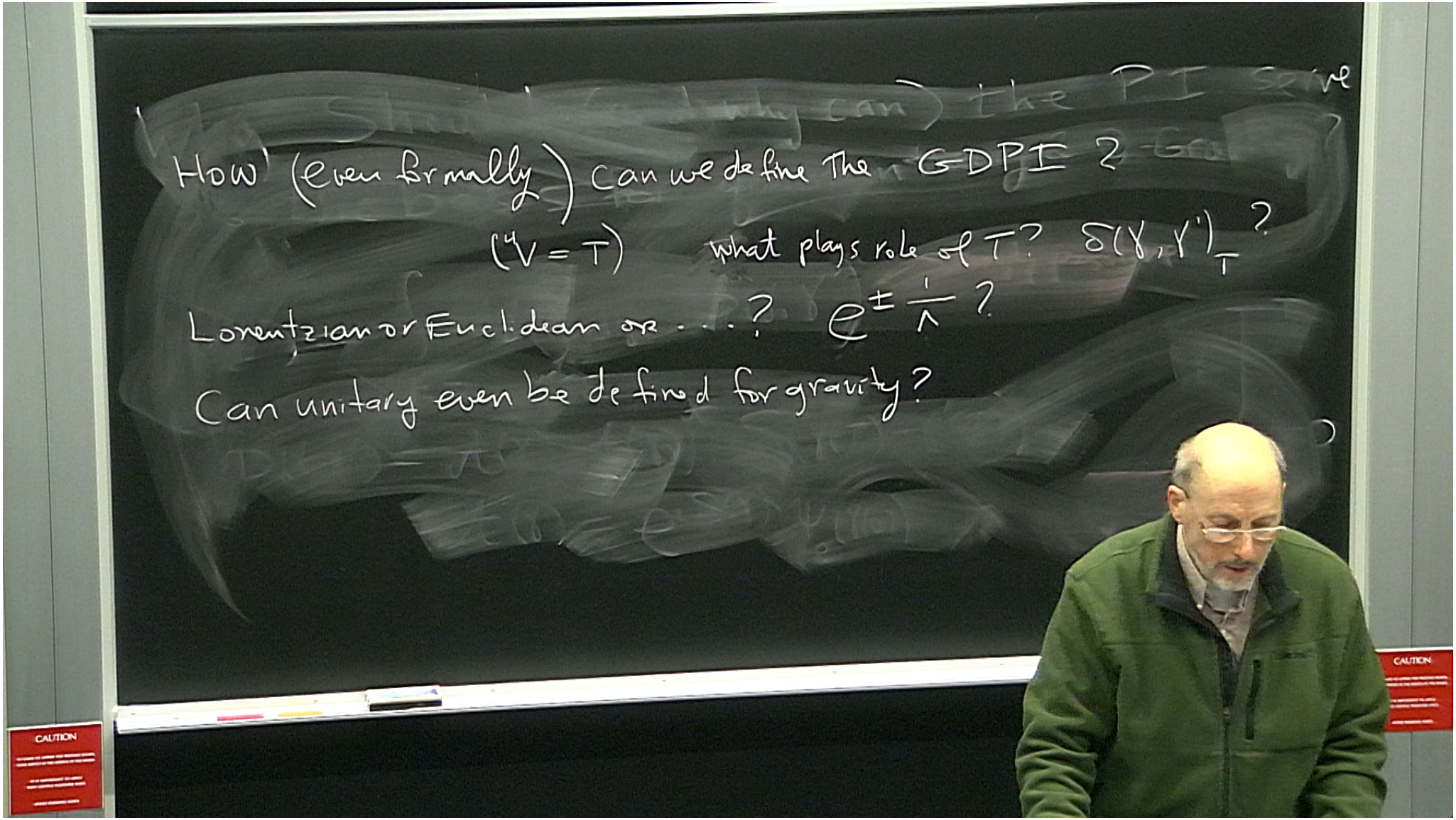

(++)
(--)
(+-)
(++--)
$g_{ab} = h_{ab}\ h^{cd}(\partial_c f$
$(\partial_a f)(\partial_b f)$
Morse metric
2d
$ds^2 = (x^2+y^2)($
$(x\,dx \pm y\,dy)^2$
CAUTION

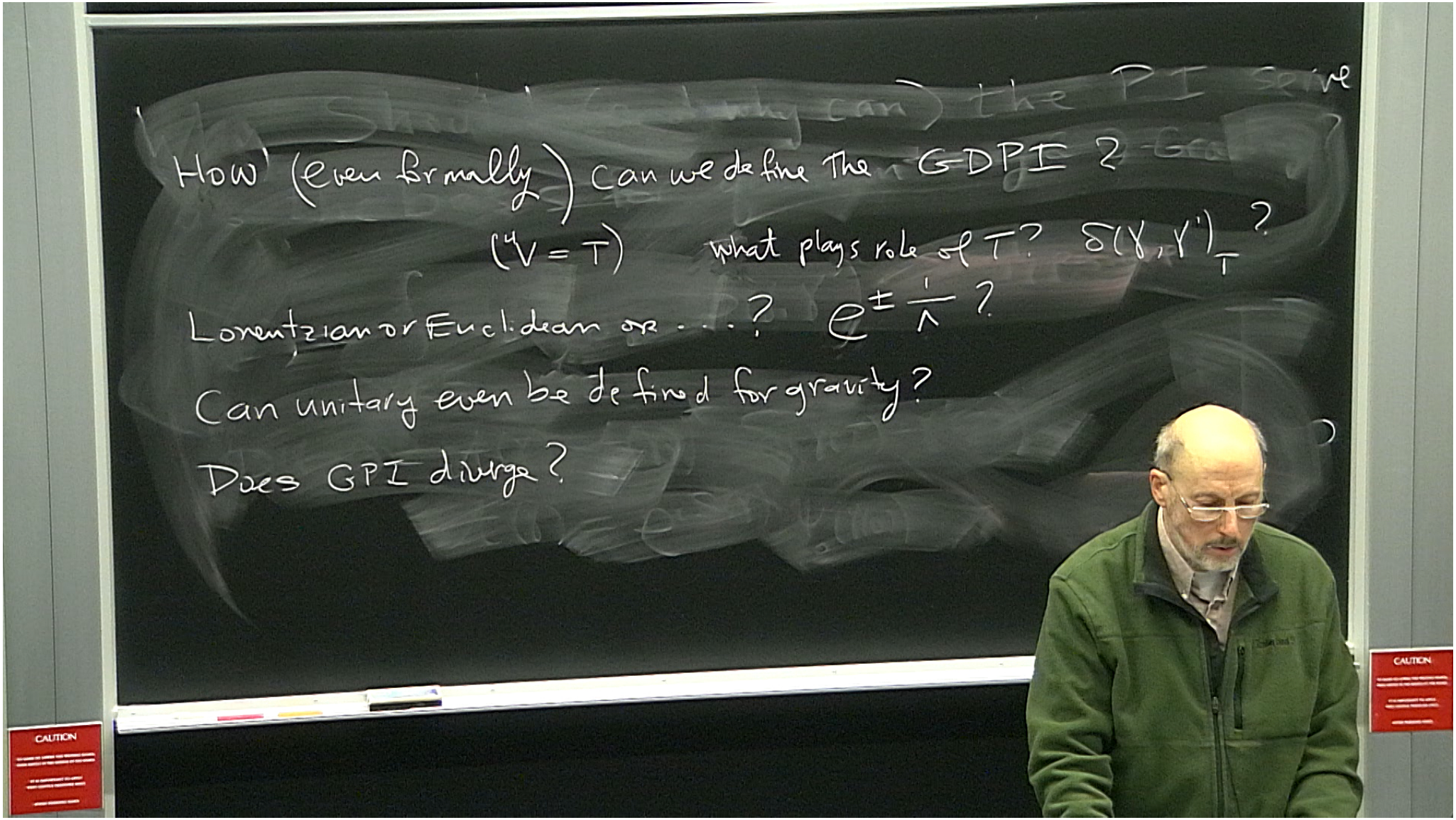

DPI more g-invar than SPI
I. Geon
II Birth (death)
$\mathbb{R} \times {}^3M$
II 2D
GPI $= \infty$? will unimodularity help?
$V = T$
CAUTION

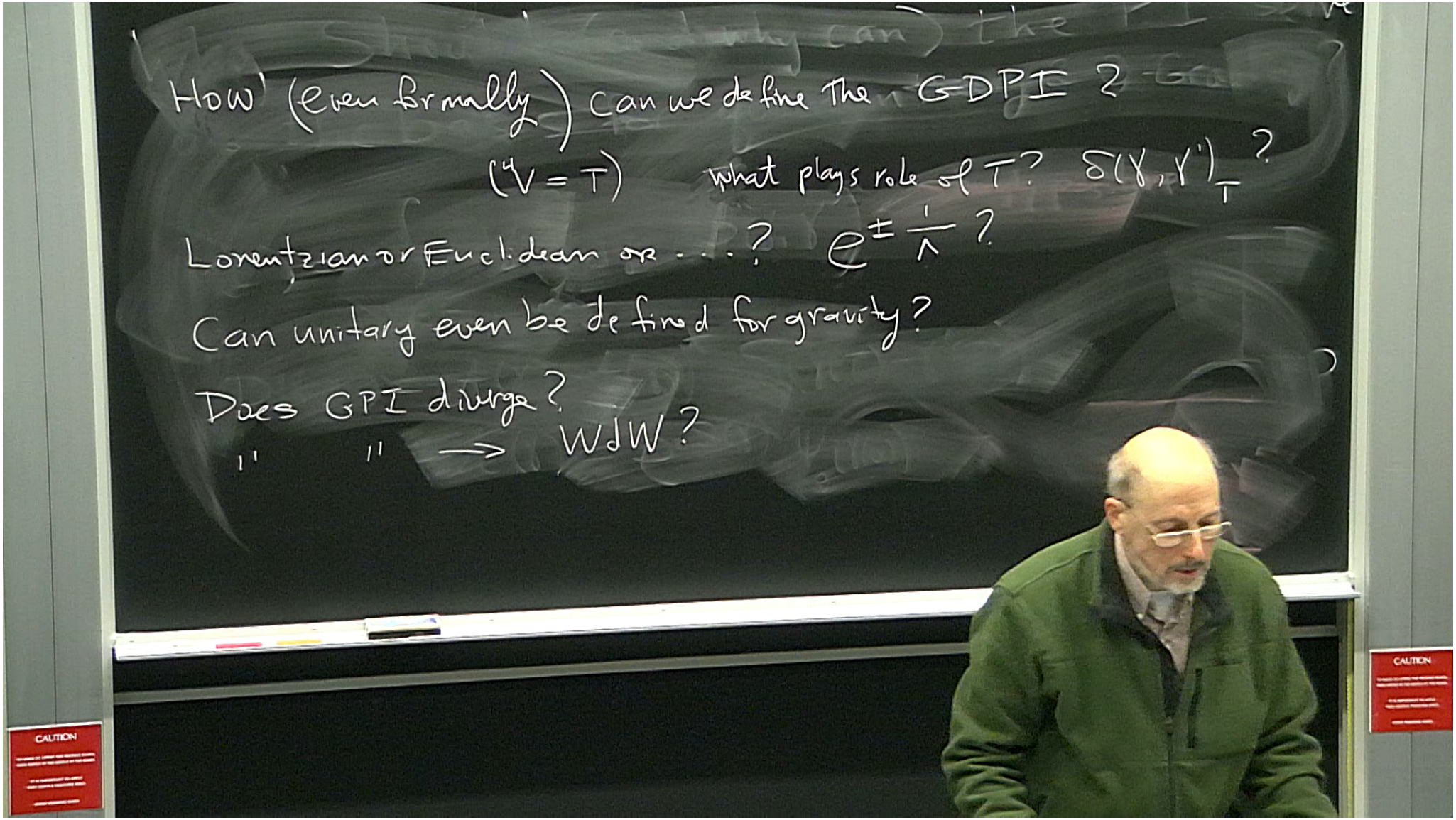

DPI more q-invar than SPI
I. Geon
$\mathbb{R} \times {}^3M$
II Birth (death)
II 2D
GPI $= \infty$? will unimodularity help?
CAUTION
CAUTION

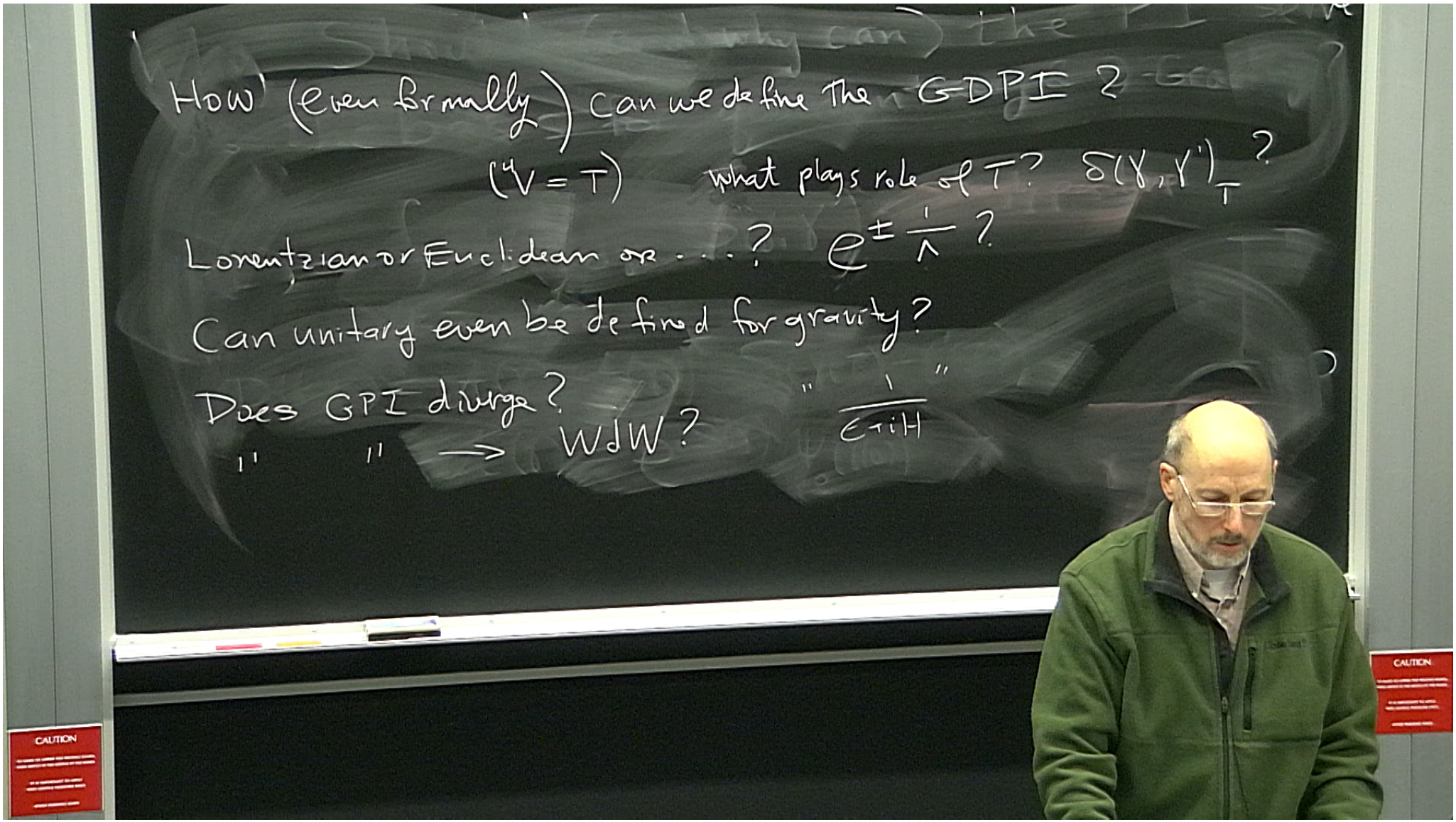

DPI more g-invar than SPI
I. Geon
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GPI = ∞?
will unimodularity help?
CAUTION

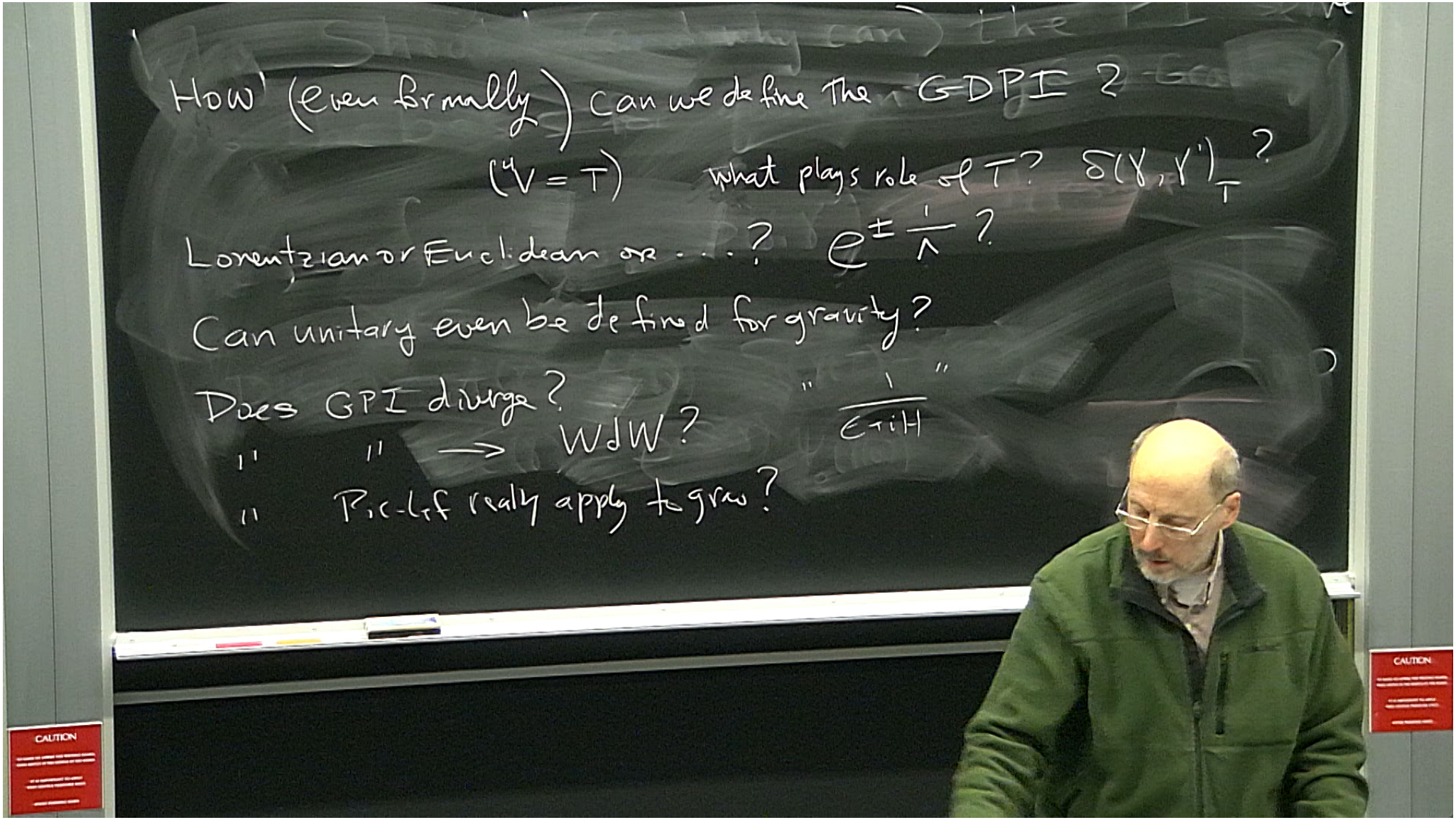

How (even formally) can we define the GDPI ?
(V = T) what plays role of T? δ(γ, γ')_T ?
CAUTION
CAUTION

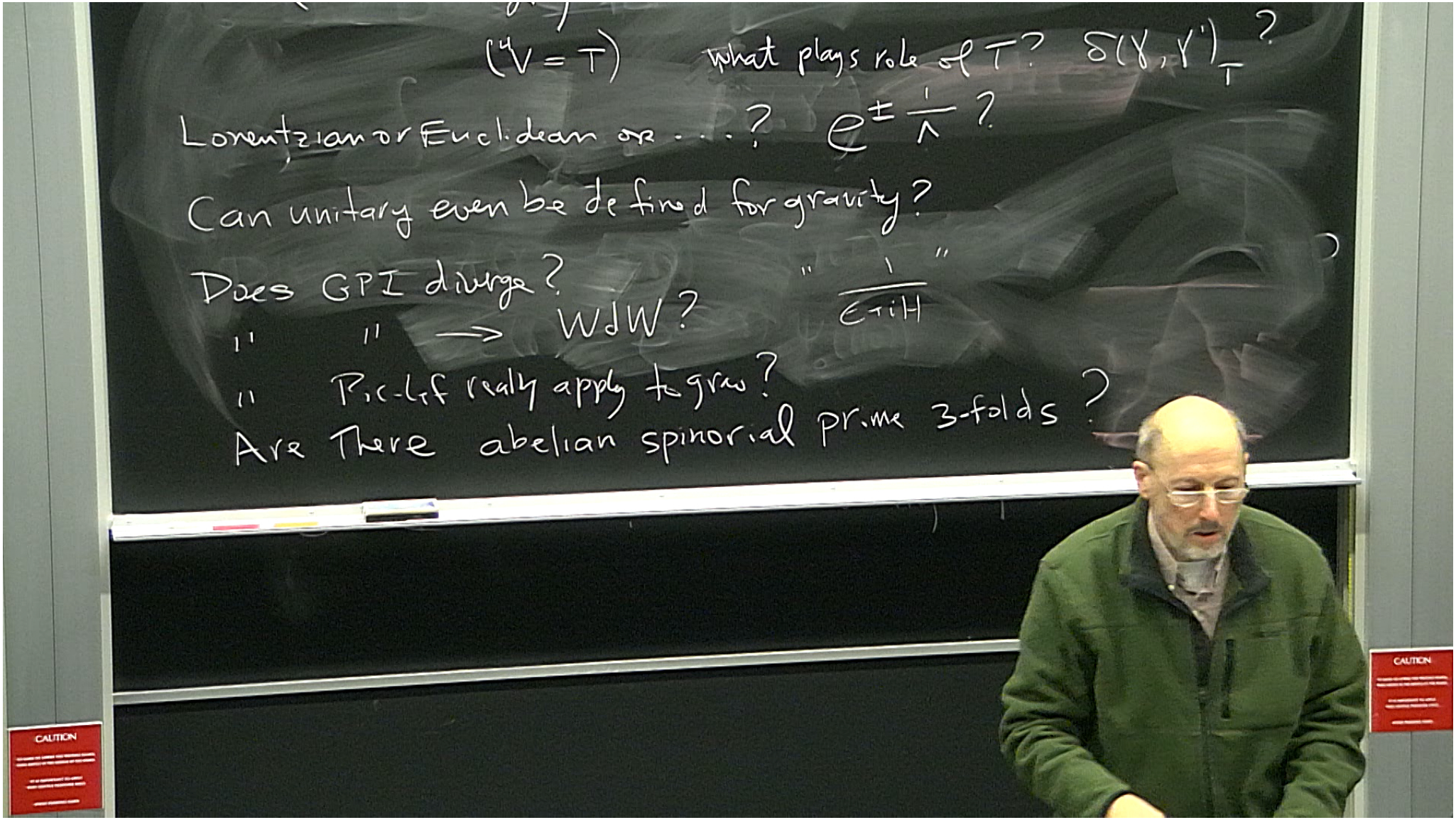

How (even formally) can we define the GDPI ?
(V = T) what plays role of T? δ(γ, γ')_T ?
Lorentzian or Euclidean or ...? e^{± 1/ħ} ?
Can unitary even be defined for gravity?
CAUTION
CAUTION

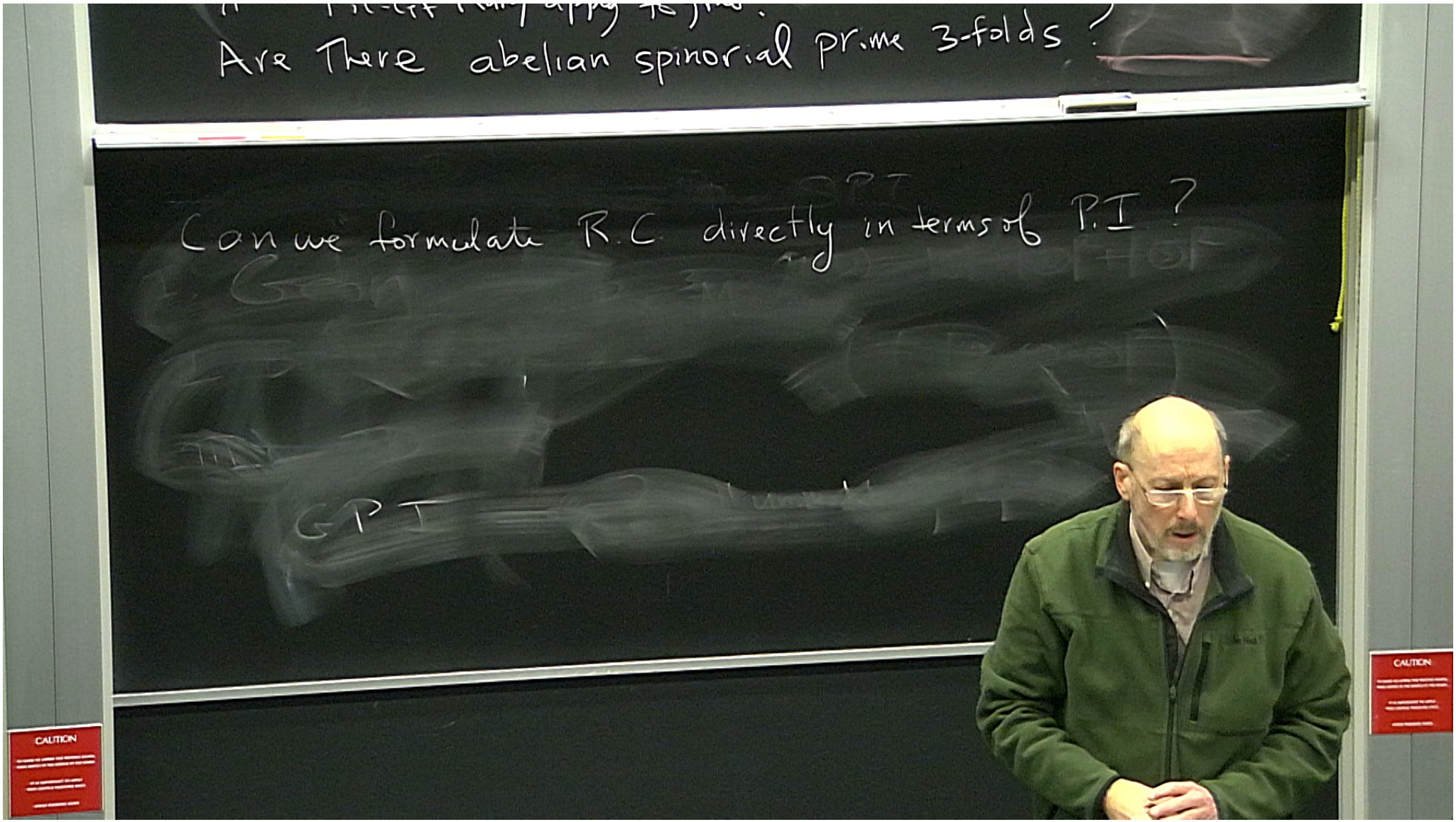

How (even formally) can we define the GDPI ?
(V = T) what plays role of T? $\delta(\gamma,\gamma')_T$?
Lorentzian or Euclidean or ...? $e^{\pm\frac{i}{\hbar}}$?
Can unitary even be defined for gravity?
Does GPI diverge?
CAUTION
CAUTION

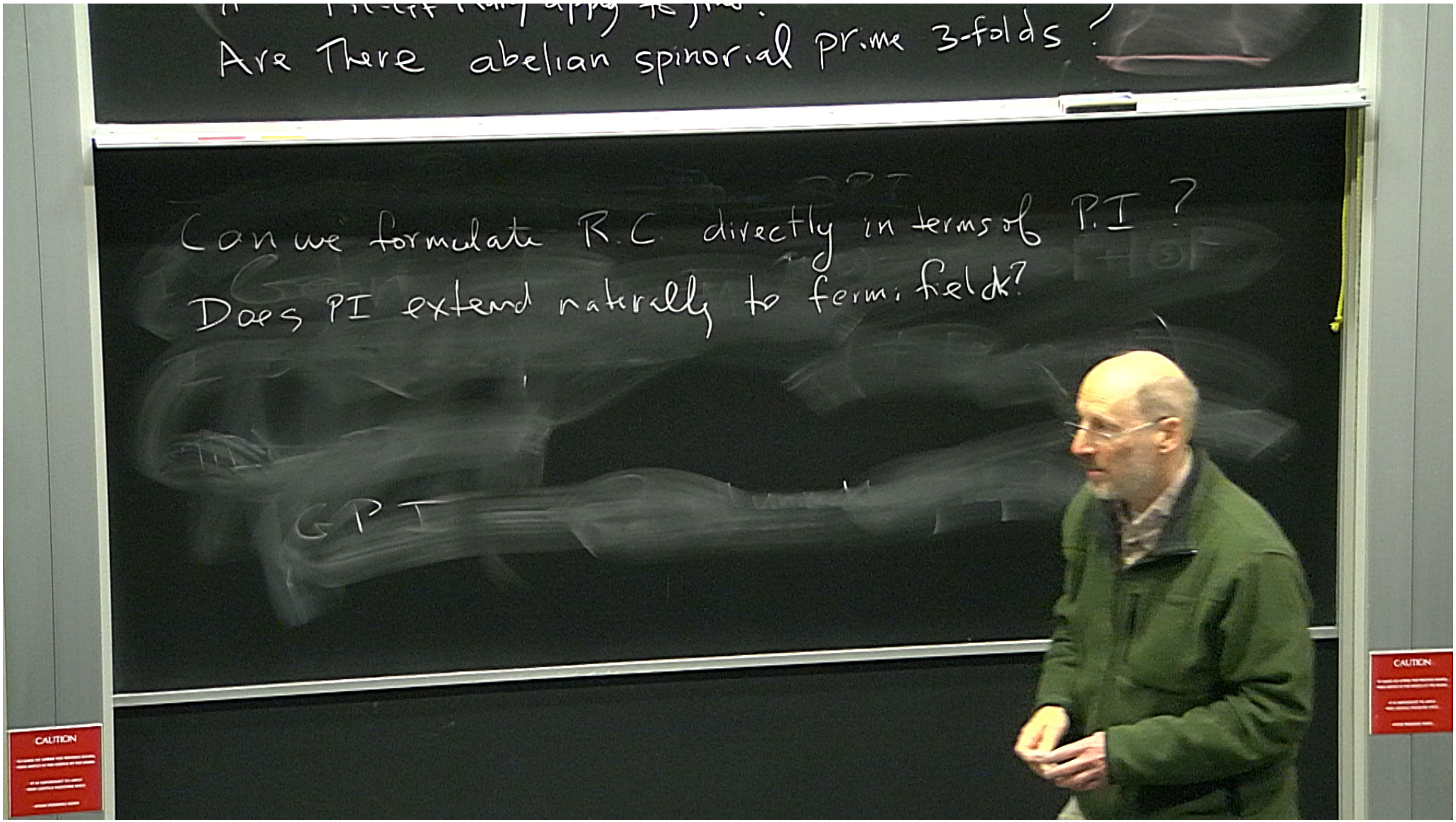

How (even formally) can we define the G-DPI ?
(V = T) what plays role of T? $\delta(\gamma,\gamma')_T$?
Lorentzian or Euclidean or ...? $e^{\pm\frac{1}{\Lambda}}$?
Can unitary even be defined for gravity?
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" " → WdW?
CAUTION
CAUTION

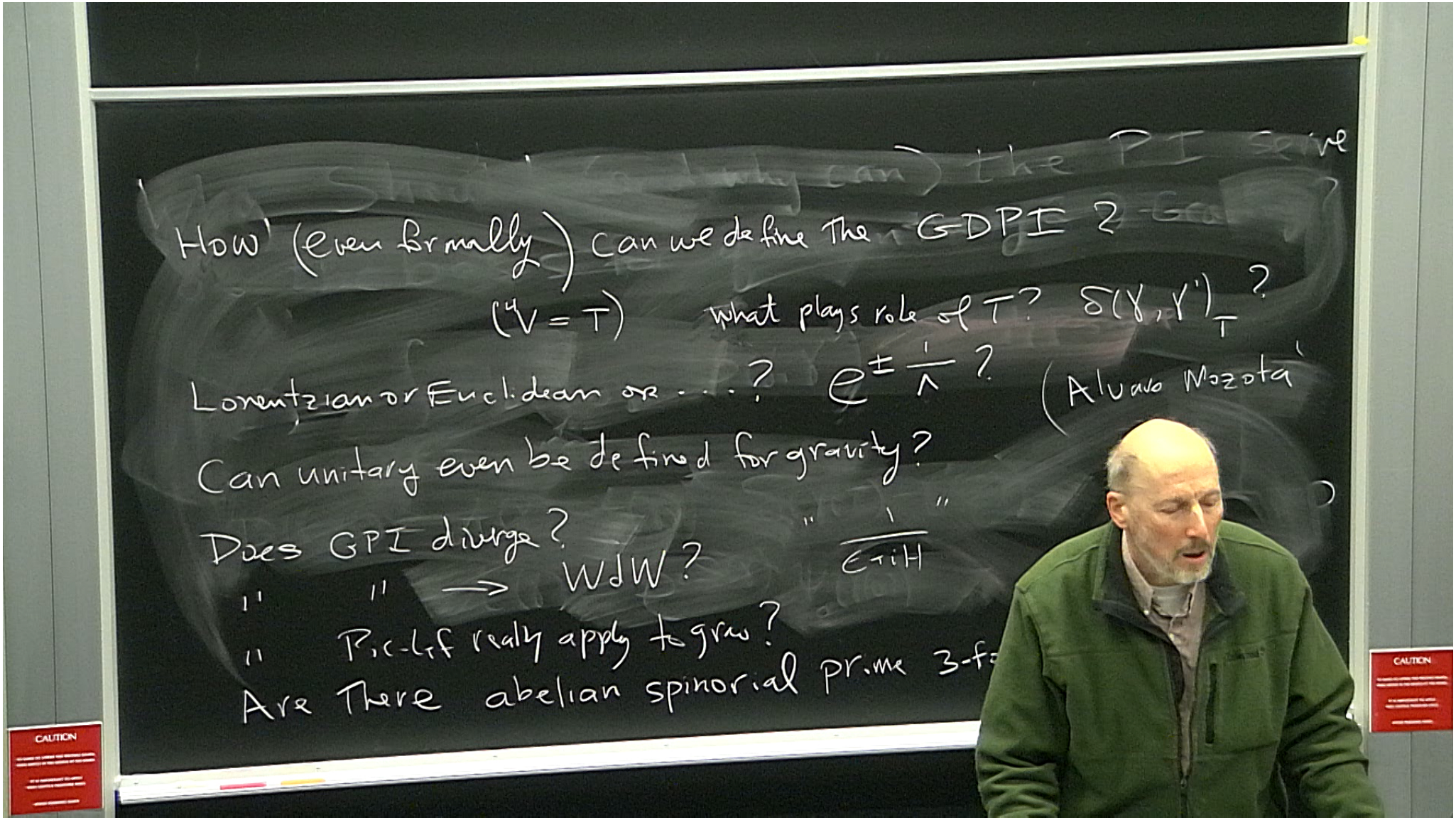

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" " → WdW?
" $\frac{1}{\epsilon+iH}$ "
CAUTION
CAUTION

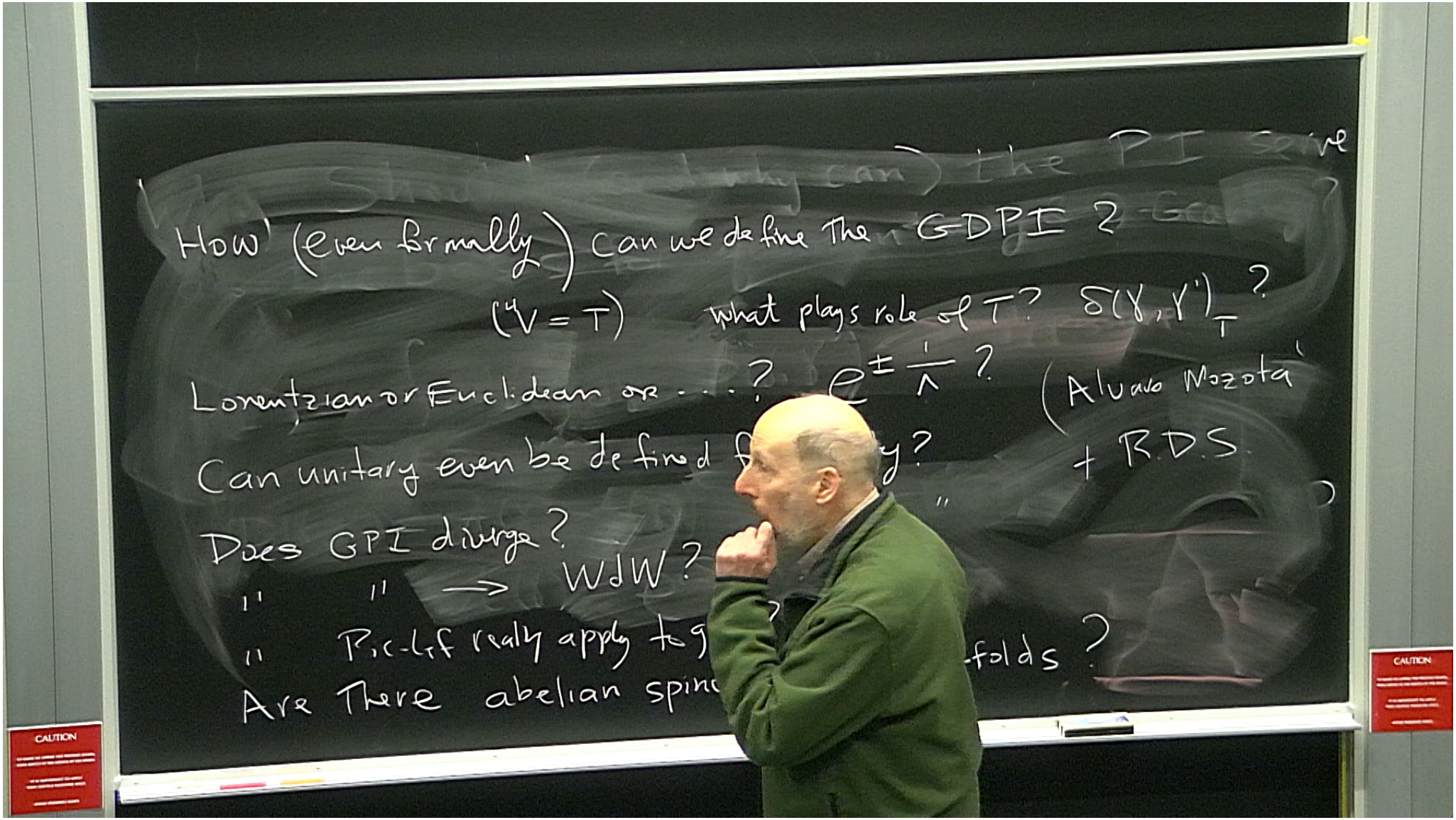

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" " → WdW?
" Pic-Lef really apply to grav?
" $\frac{1}{\epsilon+iH}$ "
CAUTION
CAUTION


$(\hat{V} = T)$ what plays role of T? $\delta(\gamma, \gamma')_T$?
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" " → WdW?
" $\frac{1}{\epsilon + iH}$ "
" Pic-Lef really apply to grav?
Are There abelian spinorial prime 3-folds ?
CAUTION
CAUTION


Are There abelian spinorial prime 3-folds ?
Can we formulate R.C directly in terms of P.I ?
GPT
CAUTION
CAUTION


Are There abelian spinorial prime 3-folds ?
Can we formulate R.C directly in terms of P.I ?
Does PI extend naturally to fermi fields?
GPT
CAUTION
CAUTION


How (even formally) can we define the GDPI ?
(V = T) what plays role of T? δ(γ, γ')_T ?
Lorentzian or Euclidean or ...? e^{± 1/Λ} ?
(Alvaro Mozota
Can unitary even be defined for gravity?
Does GPI diverge?
" " → WdW?
" 1/(ε+iH) "
" Picard-Lef really apply to grav?
Are There abelian spinorial pr.me 3-f
CAUTION
CAUTION


How (even formally) can we define the GDPI ?
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" " → WdW ?
" Picard-Lef really apply to
Are There abelian spin
folds ?
(Alvaro Mozota
+ R.D.S.
CAUTION
CAUTION