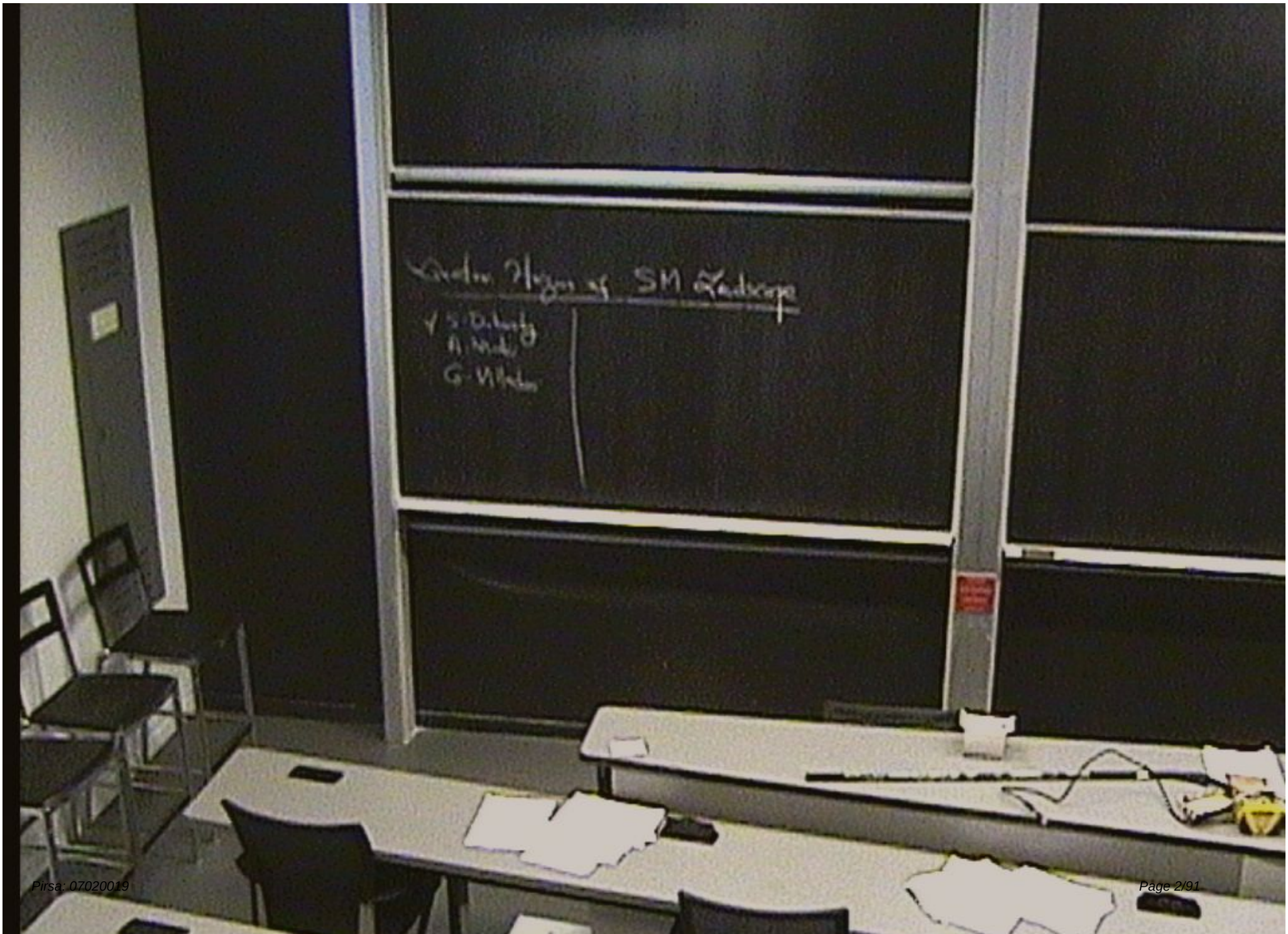
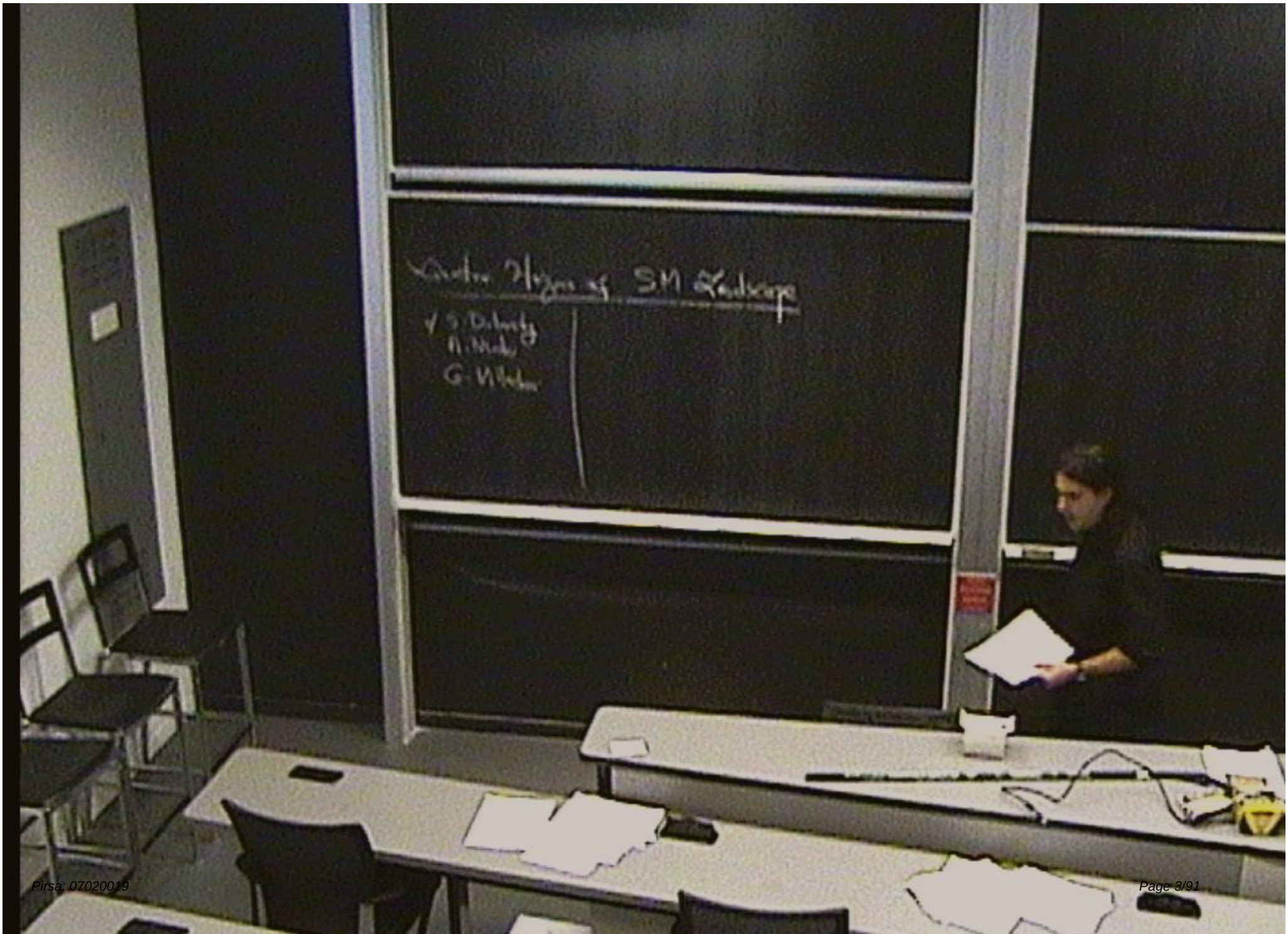
Title: Quantum Horizons of the Standard Model Landscape

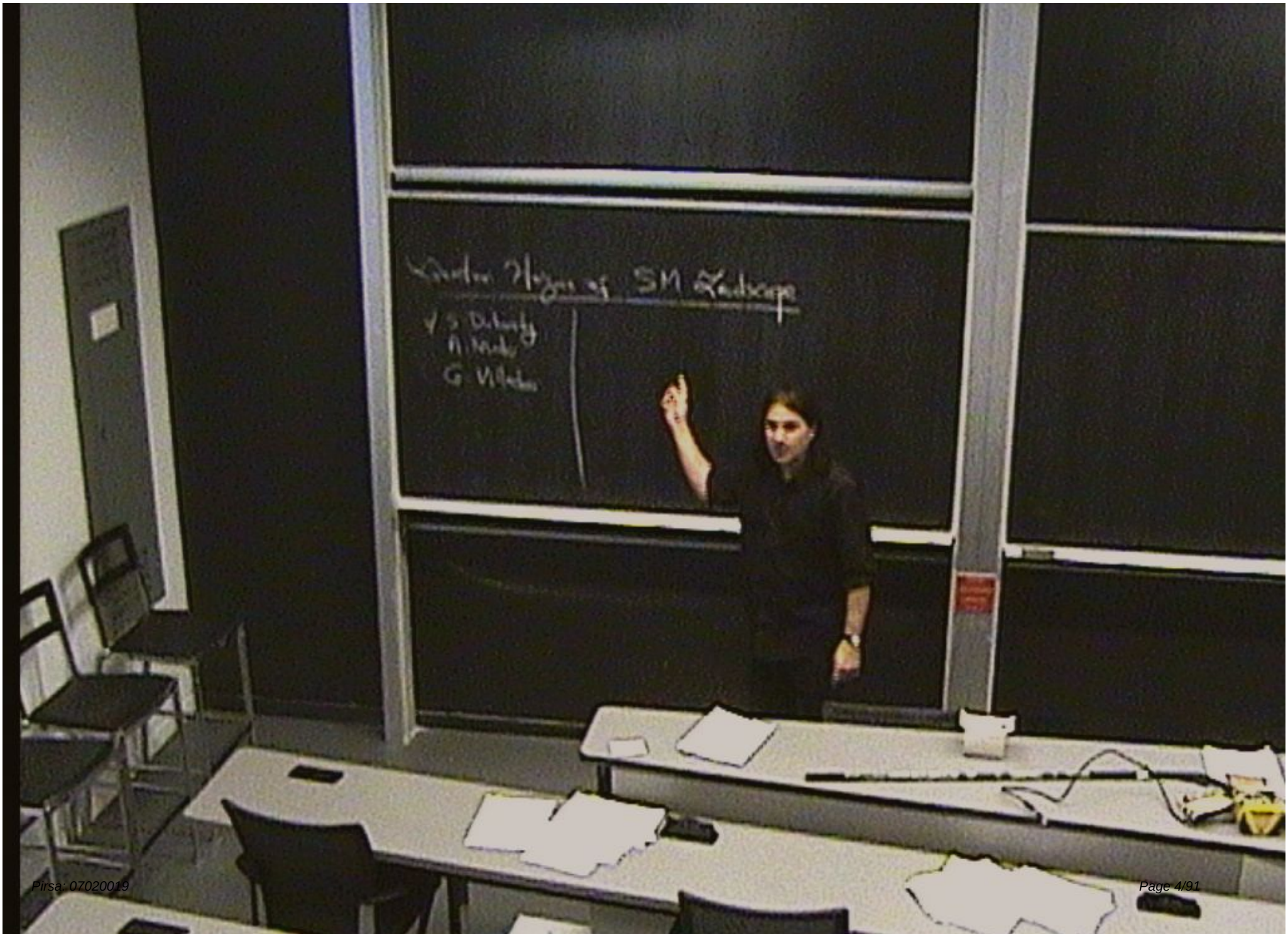
Date: Feb 08, 2007 11:00 AM

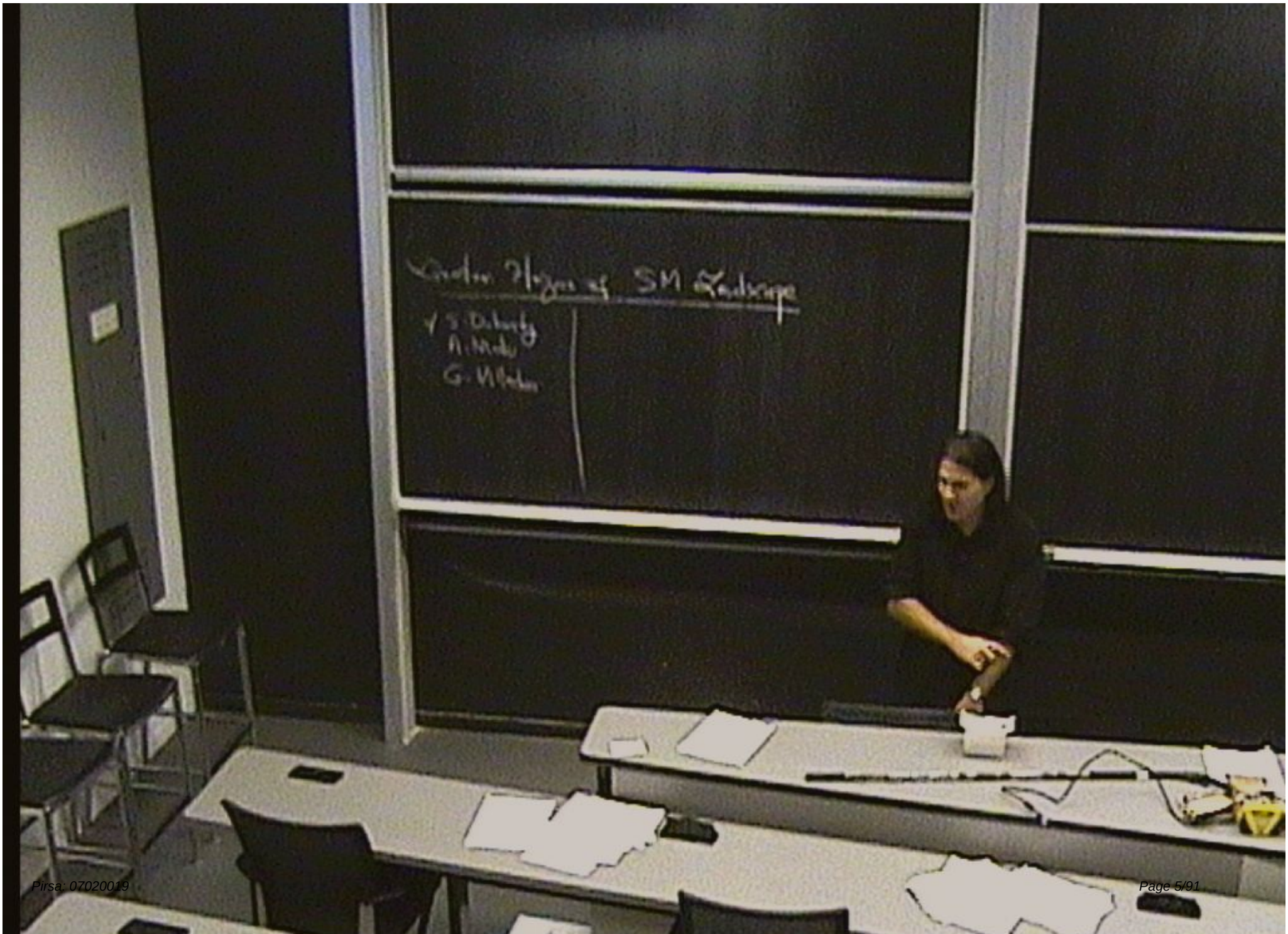
URL: http://pirsa.org/07020019

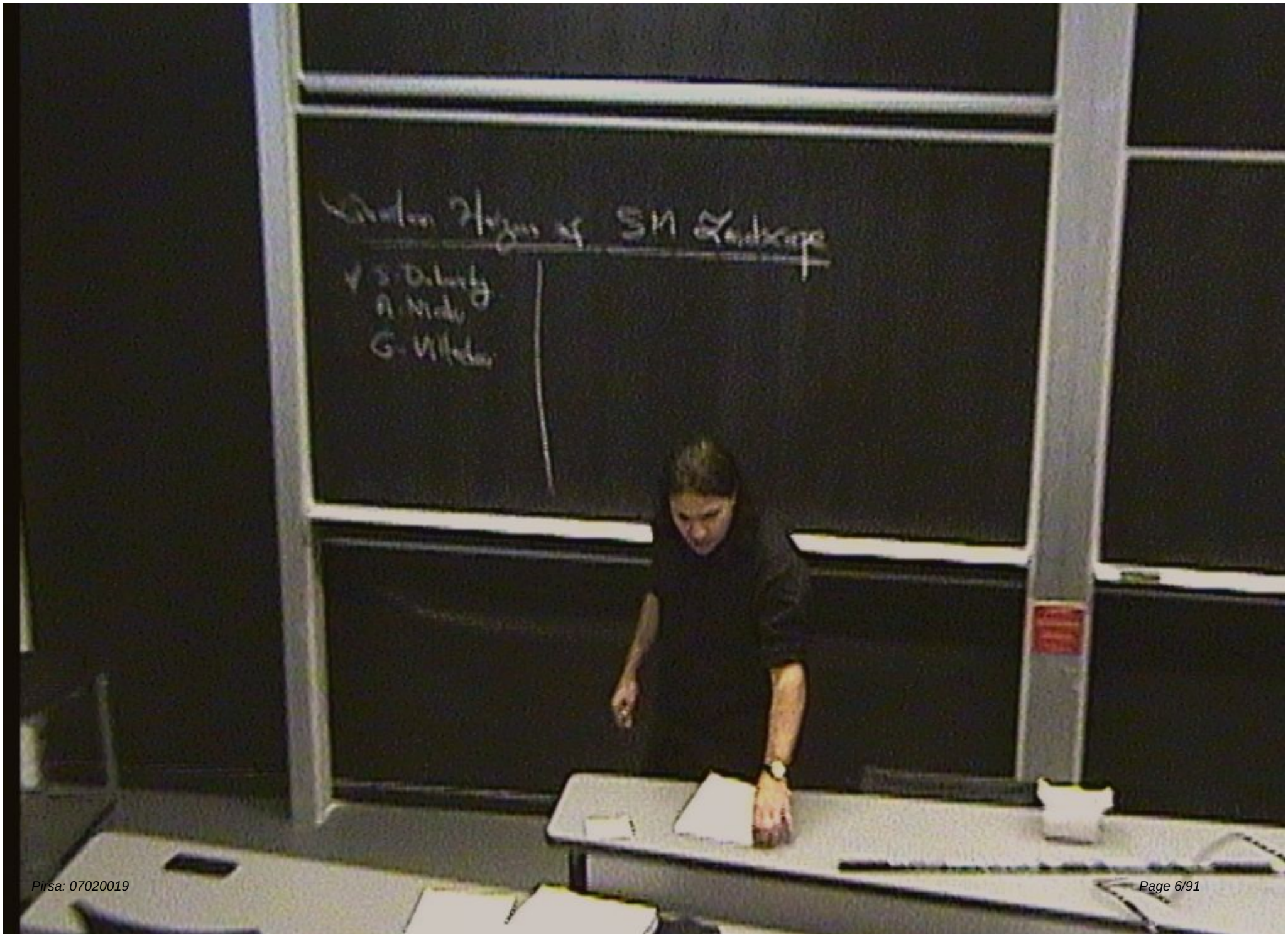
Abstract:


Quantum Higgs as SM Radiation


Quantum Aspects of SM Landscape


SM Landscape


Quantum Phases of SM Landscape


SM Landscape

Quantum Horizons of SM Landscape

S. Dubovsky
A. Nicolis
G. Villadoro

Quantum Horizons of SM Landscape

w/ S. Dubovsky
A. Nicolis
G. Villadoro

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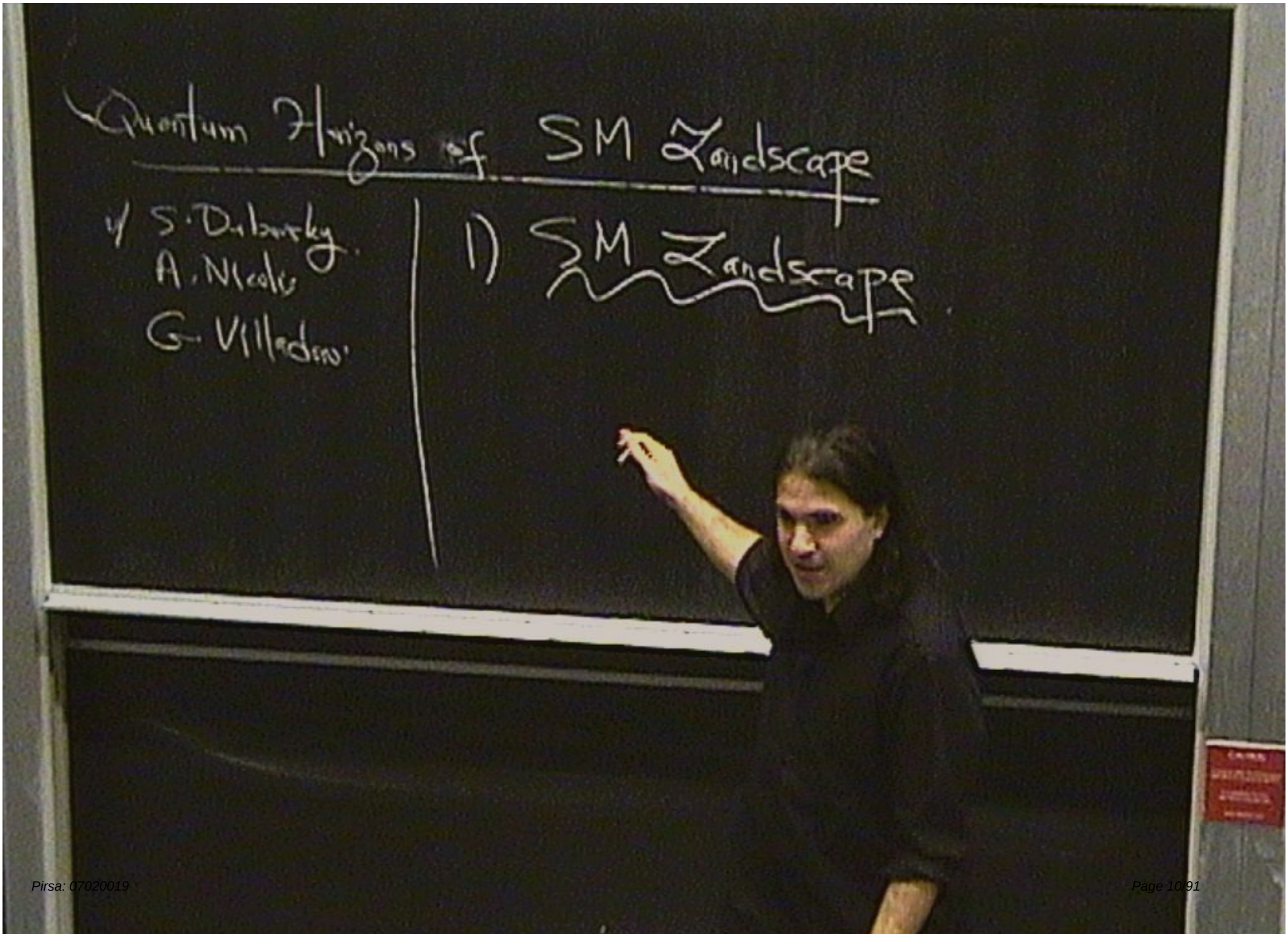
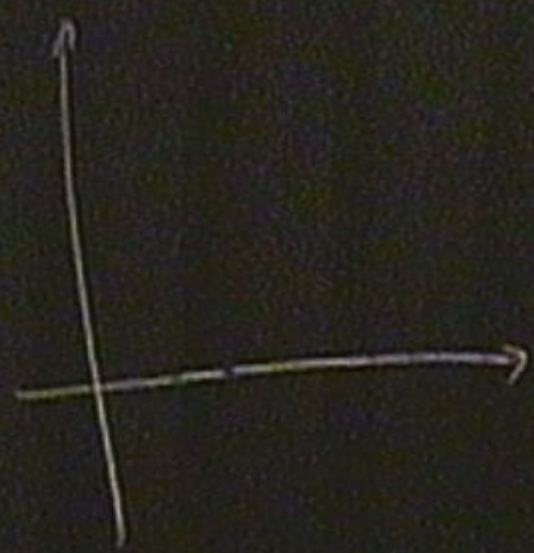
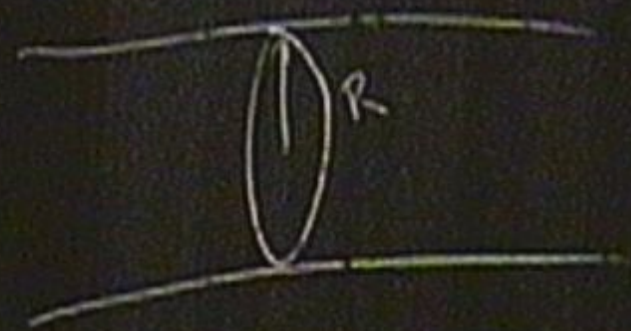
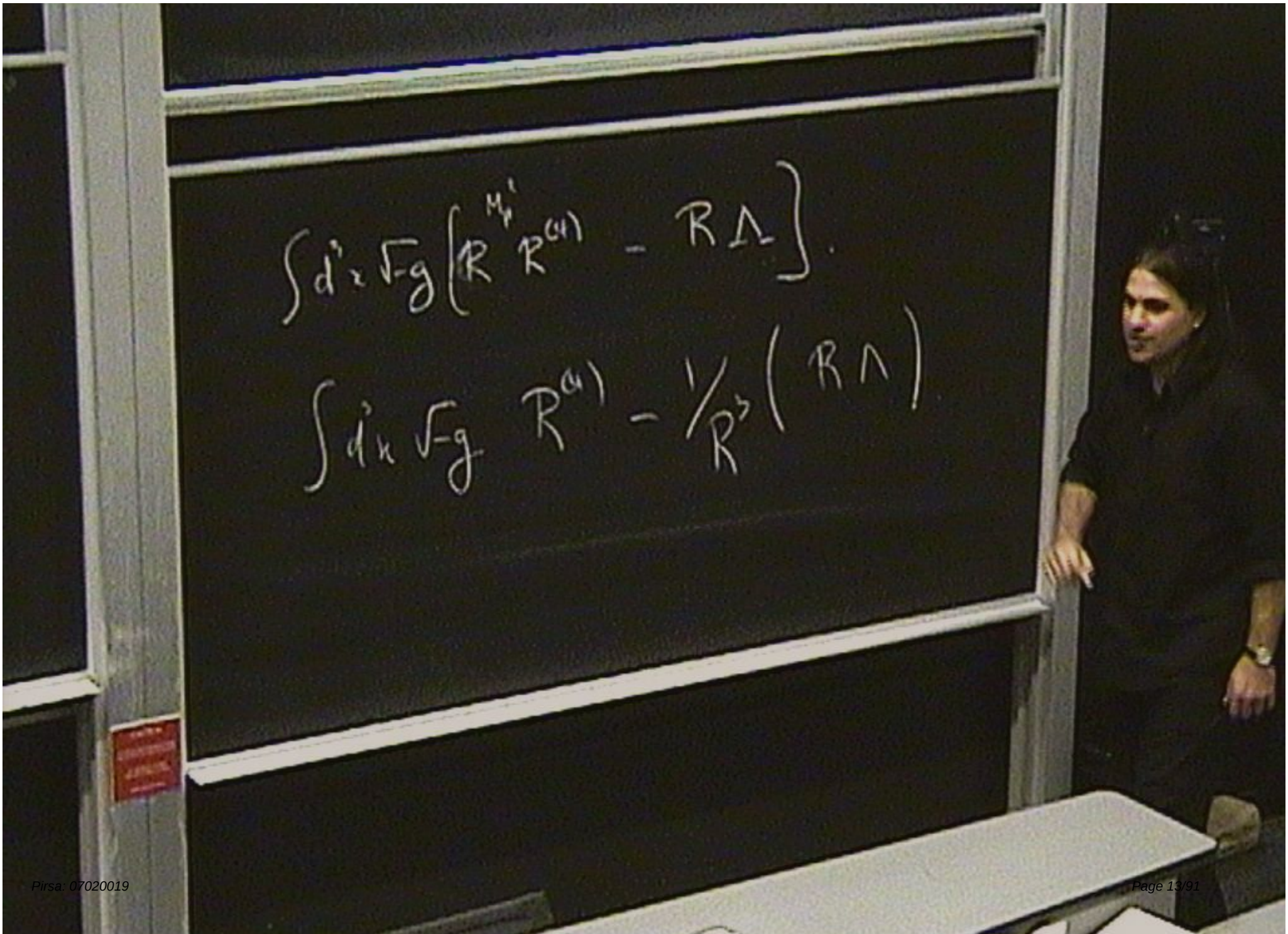

Quantum Horizons of SM Landscape
w/ S. Dubovsky
A. Nicolis
G. Villadoro
1) SM Landscape




R

$$\int d^4x \sqrt{-g} \left[R^{\mu\nu} R^{(4)}_{\mu\nu} - R\Lambda \right].$$


$\int d^3x \sqrt{-g} \left[R^{\mu\nu} R^{(4)} - R\Lambda \right]$
$\int d^3x \sqrt{-g}\, R^{(4)} - \frac{1}{R^3} (R\Lambda)$

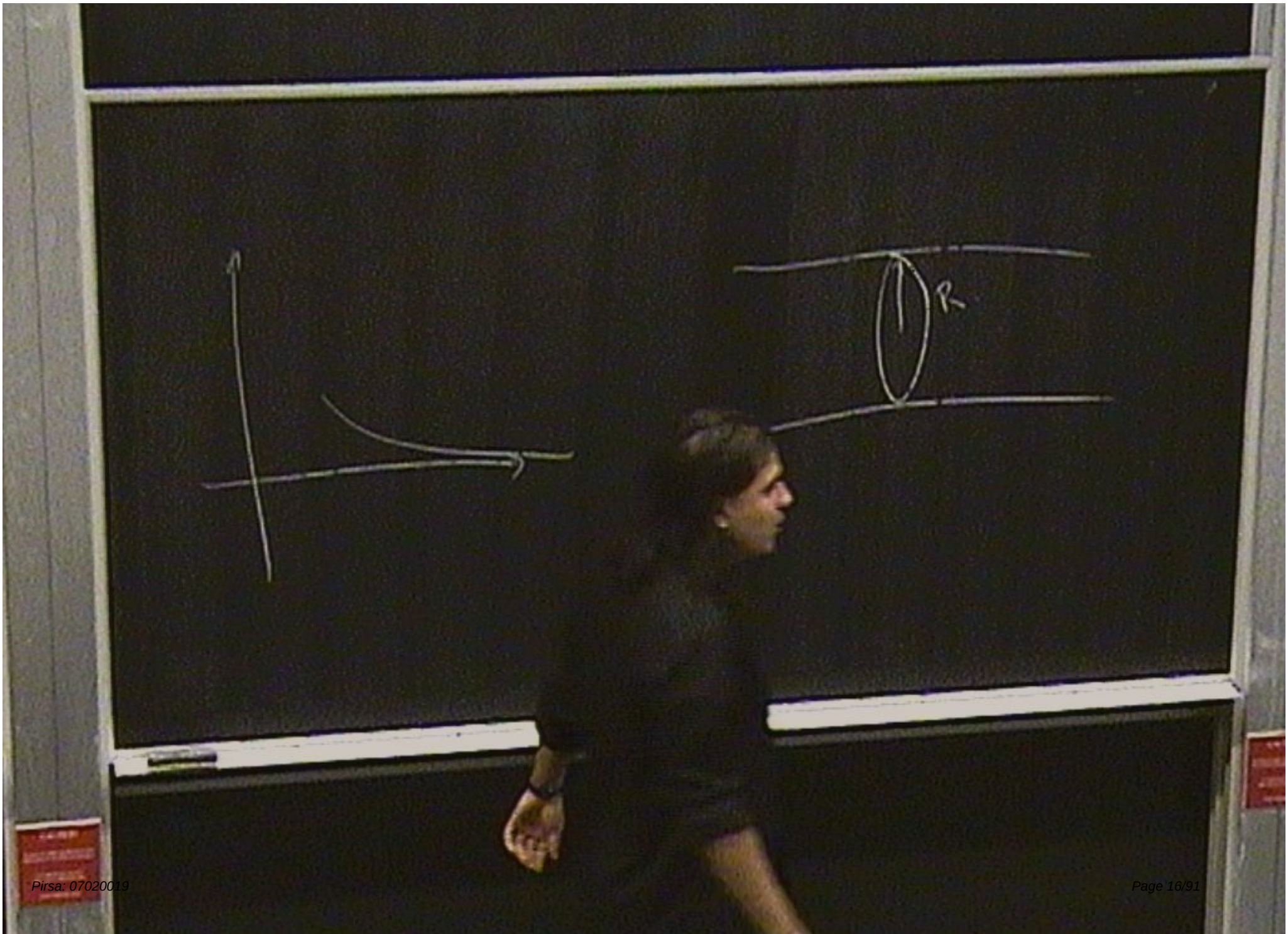
$$\int d^4x \sqrt{-g}\left[R^{\mu\nu} R^{(4)} - R\Lambda\right] . \qquad g = \frac{1}{R}\hat{g}$$

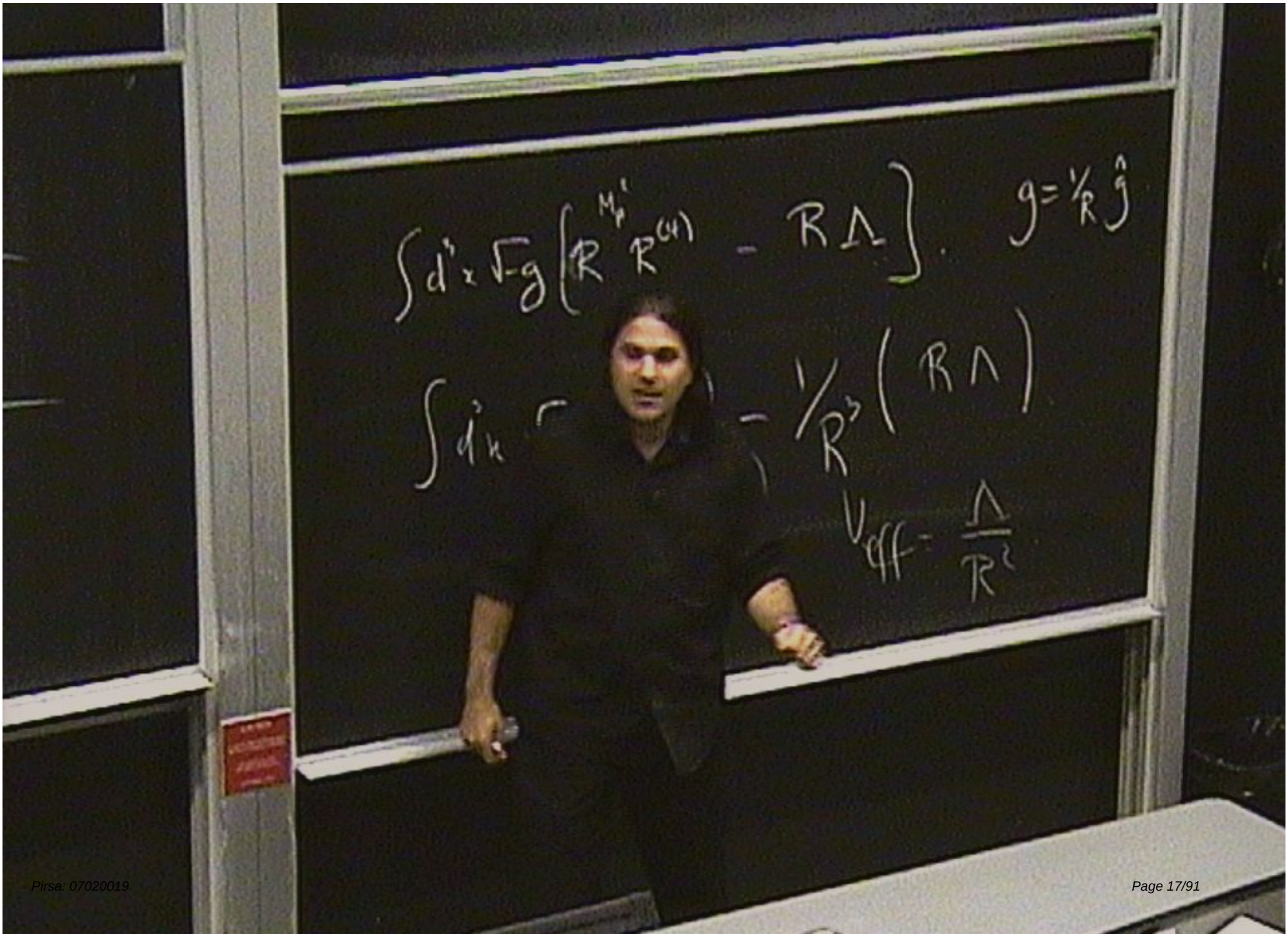
$$\int d^4x \sqrt{-g}\left(R^{(4)} + \left(\frac{\partial R}{R}\right)^2 - \frac{1}{R^2}\left(R\Lambda\right)\right)$$

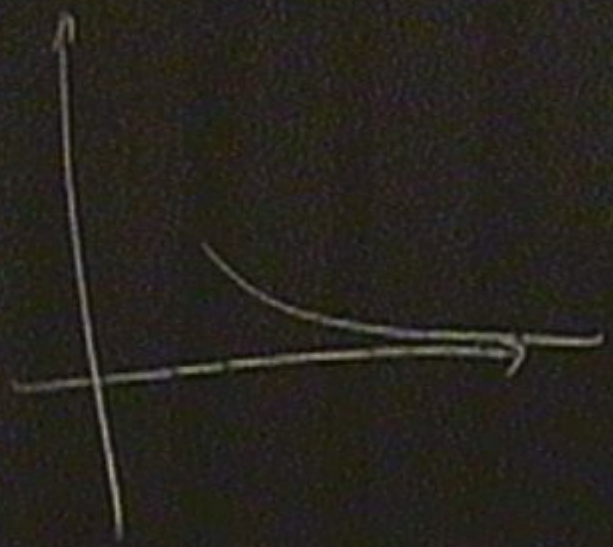
$$\int d^4x \sqrt{-g}\left[R^{4} R^{(4)} - R\Lambda\right]. \qquad g = \tfrac{1}{R}\hat{g}$$

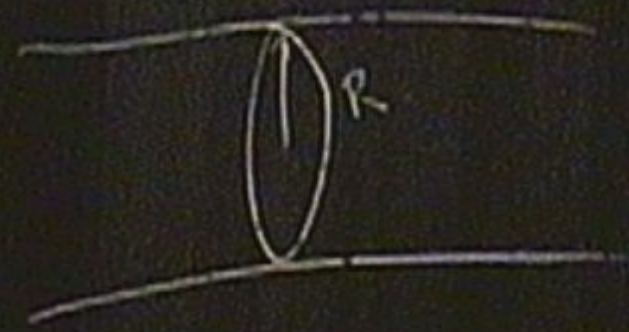
$$\int d^4x \sqrt{-g}\left[R^{(4)} - \tfrac{1}{R^3}\left(R\Lambda\right)\right]$$

$$+\left(\frac{\partial R}{R}\right)^2 \qquad V_{eff} = \frac{\Lambda}{R^2}$$

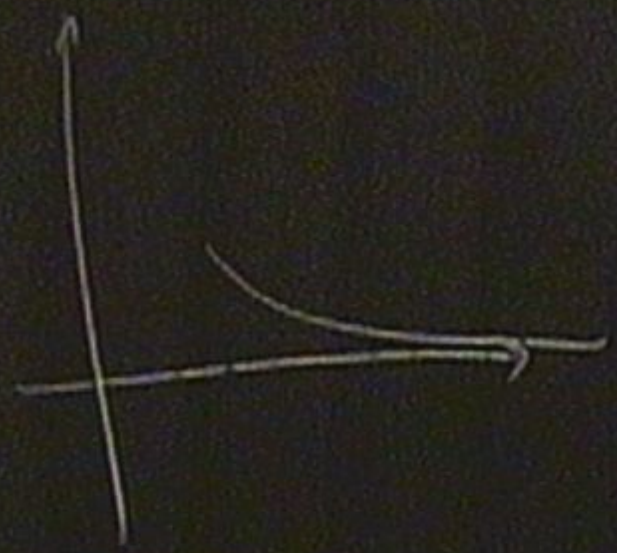

R

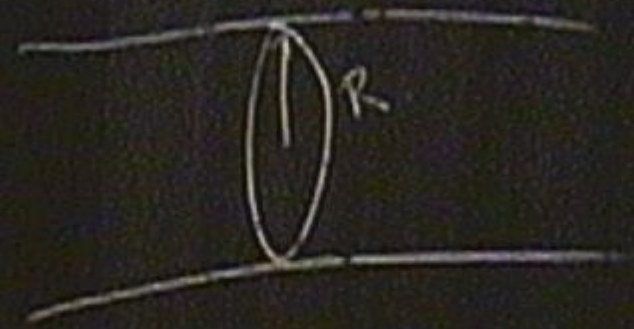

$\int d^3x \sqrt{-g} \left[R^{\mu\nu} R^{(4)} - R\Lambda \right]$
$g = \frac{1}{R} \hat{g}$
$= \frac{1}{R^3} (R\Lambda)$
$V_{eff} = \frac{\Lambda}{R^2}$





$V_{1\text{-loop}} =$



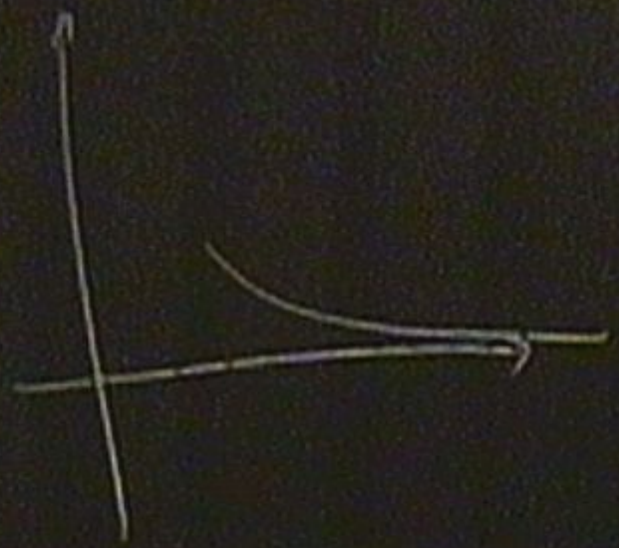


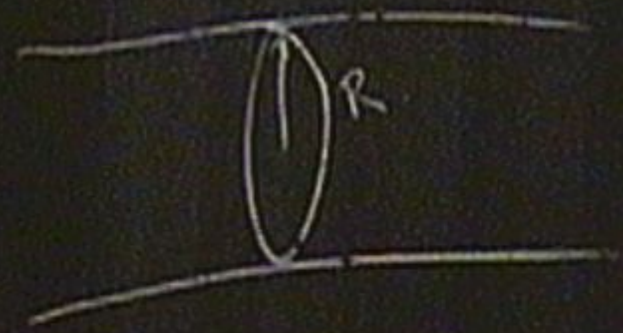
$$V_{1\text{-loop}} = -\frac{4}{R^4}$$

$$\int d^3x \sqrt{-g}\left[R^{\mu\nu} R^{(4)} - R\Lambda\right]. \qquad g = 1/R\,\hat{g}$$

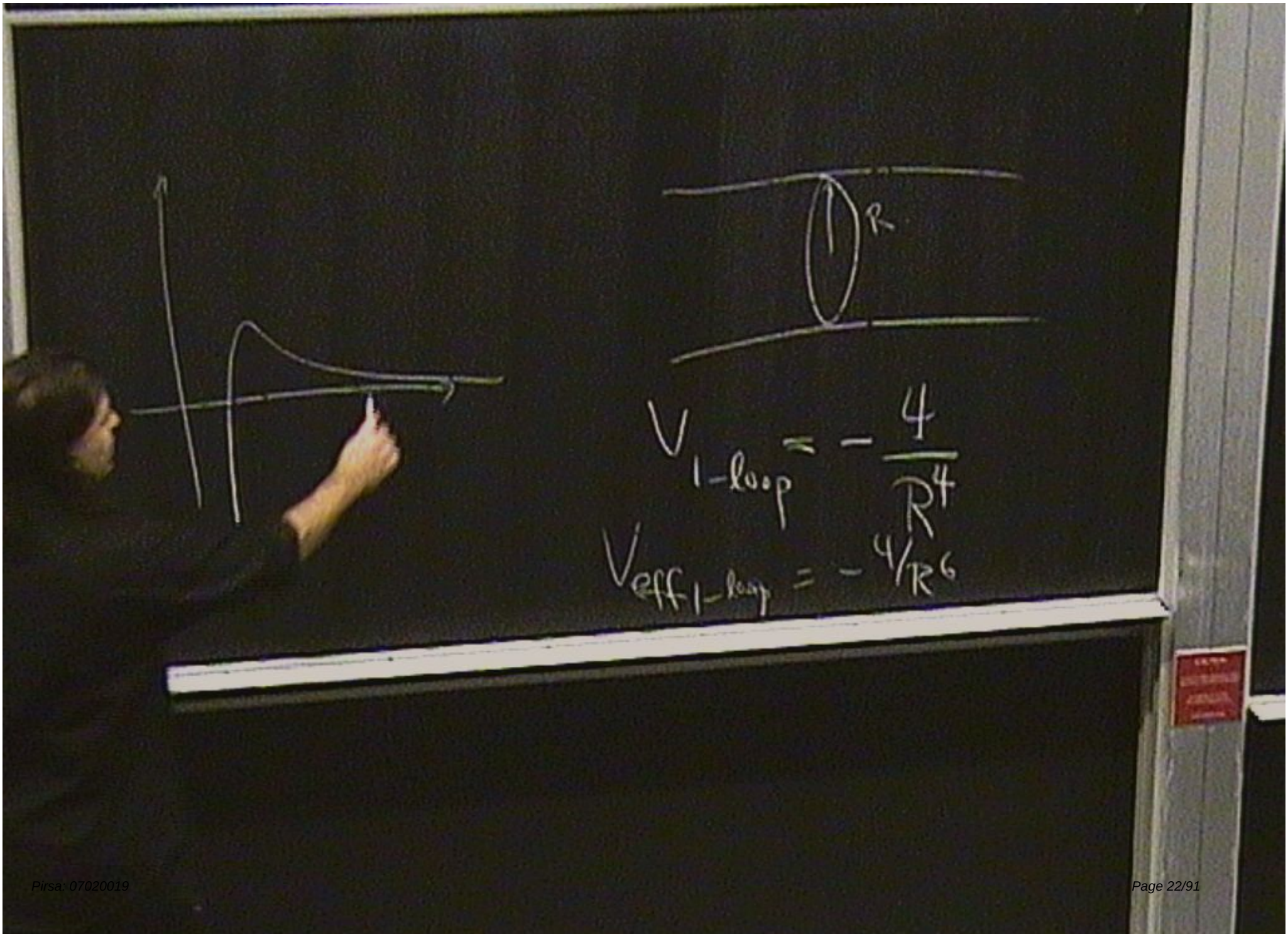
$$\int d^3x \sqrt{-g}\left(R^{(4)} - 1/R^3\,(R\Lambda)\right)$$

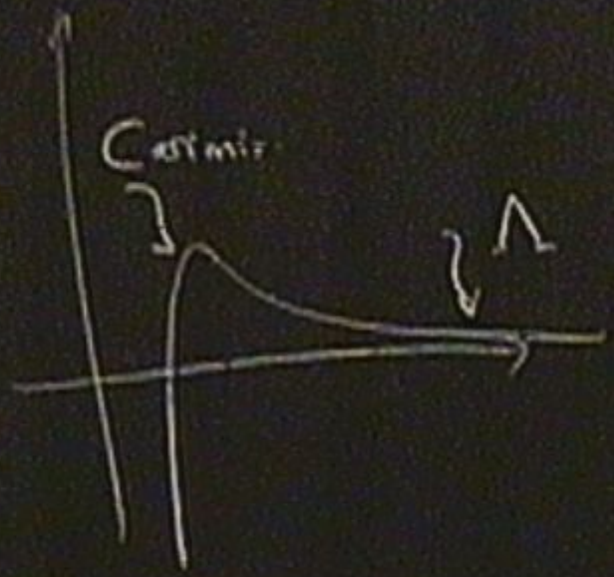
$$1\left(\frac{\partial R}{R}\right)^2 \qquad V_{eff} = \frac{\Lambda}{R^2} = 1/R^2\,V.$$

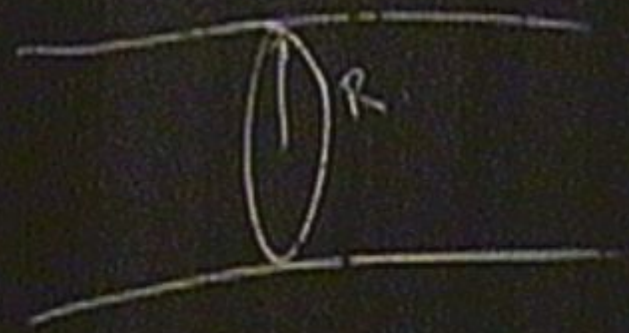




$$V_{1\text{-loop}} = -\frac{4}{R^4}$$

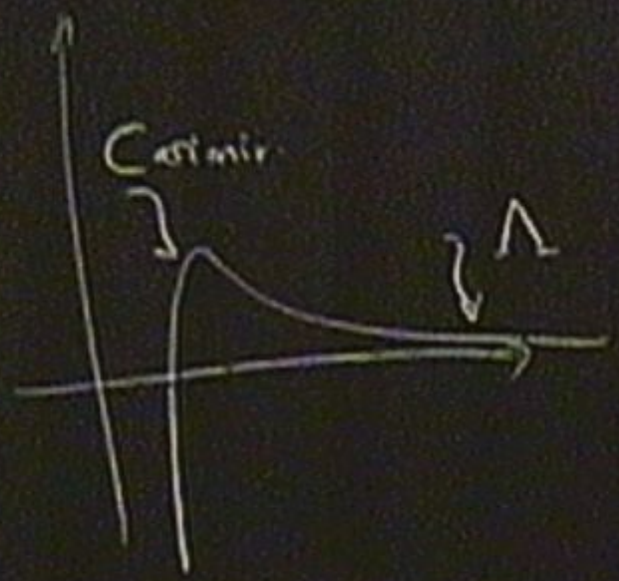

R
$V_{1\text{-loop}} = -\frac{4}{R^4}$
$V_{\text{eff}\,1\text{-loop}} = -4/R^6$

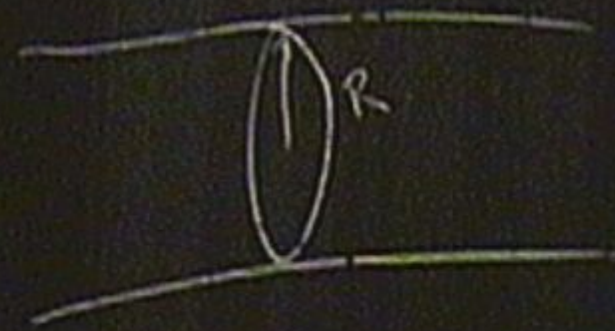




$$V_{1\text{-loop}} = -\frac{4}{R^4}$$

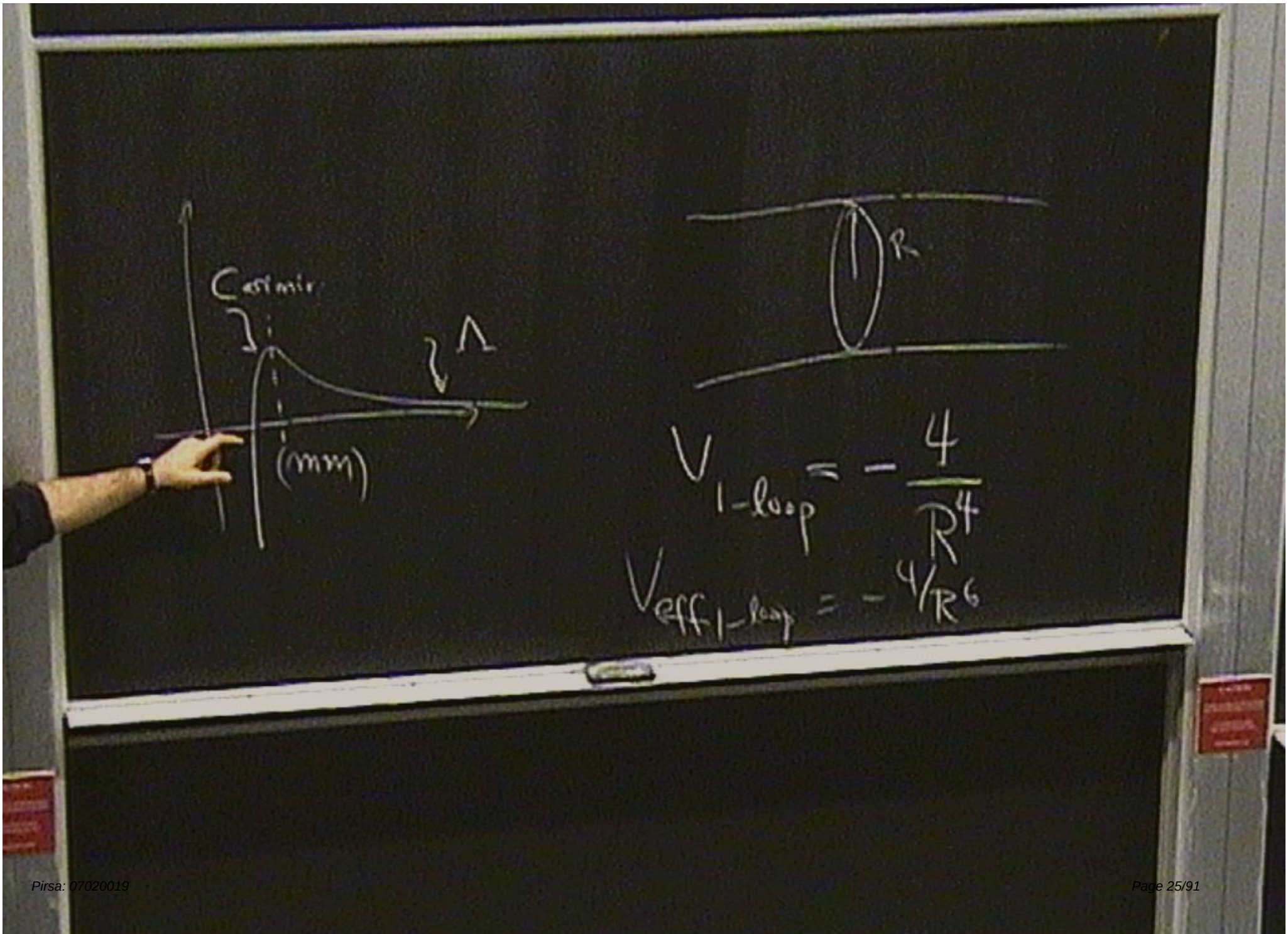
$$V_{\text{eff}\,1\text{-loop}} = -4/R^6$$

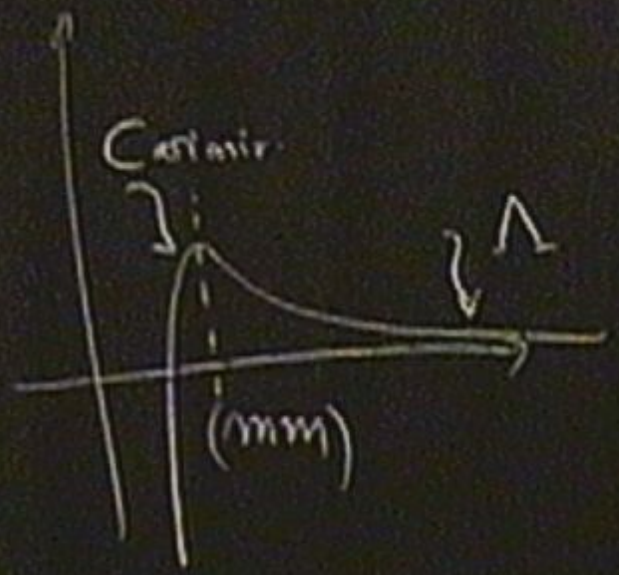


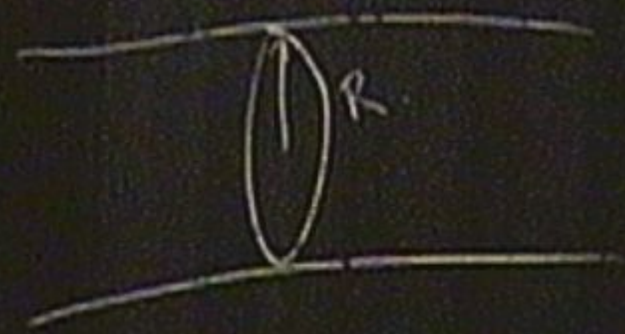


$$V_{1\text{-loop}} = -\frac{4}{R^4}$$

$$V_{\text{eff}\,1\text{-loop}} = -4/R^6$$


Casimir
~ Λ
(min)
R
$V_{1\text{-loop}} = -\frac{4}{R^4}$
$V_{\text{eff}\,1\text{-loop}} = -4/R^6$

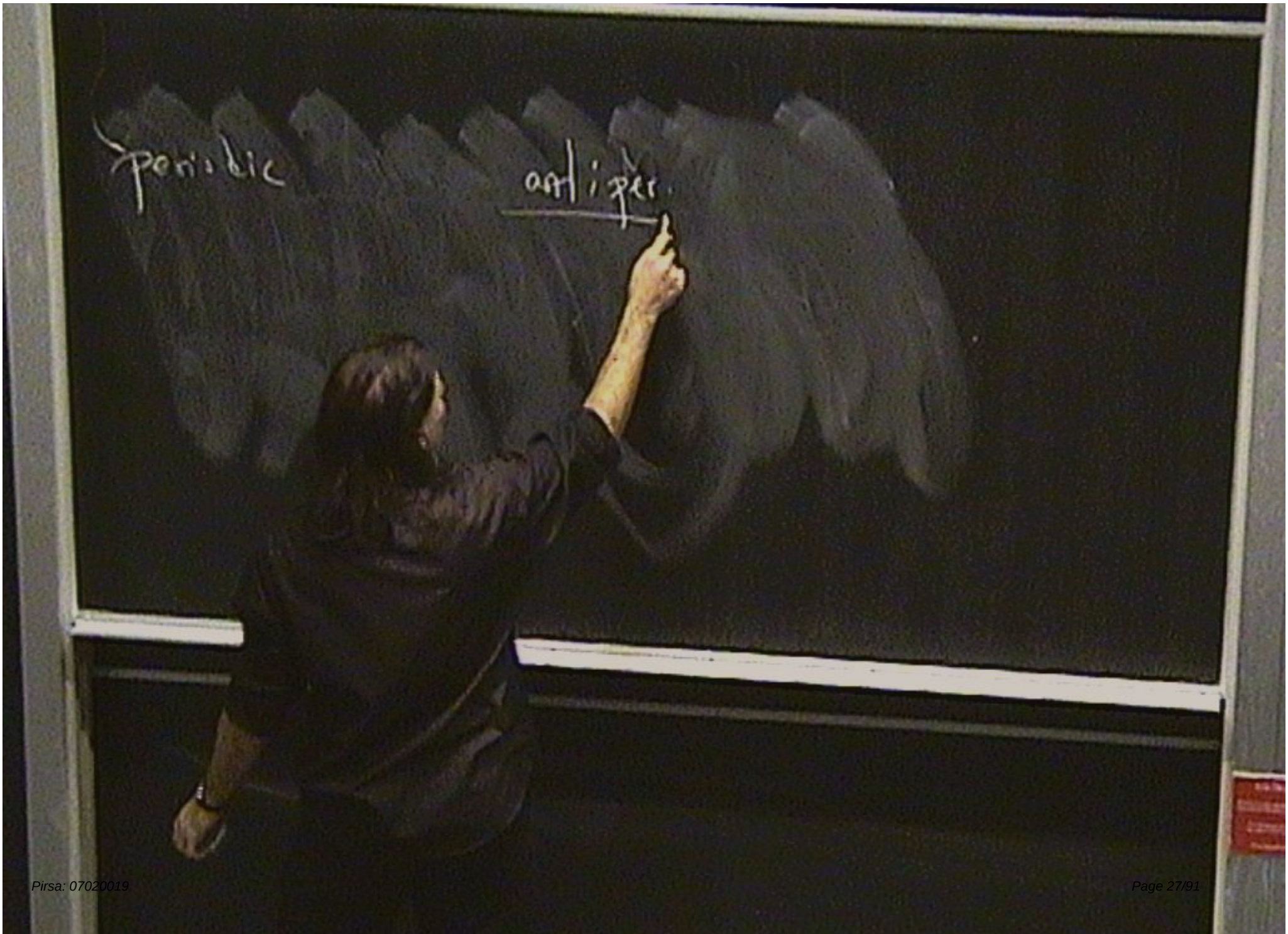


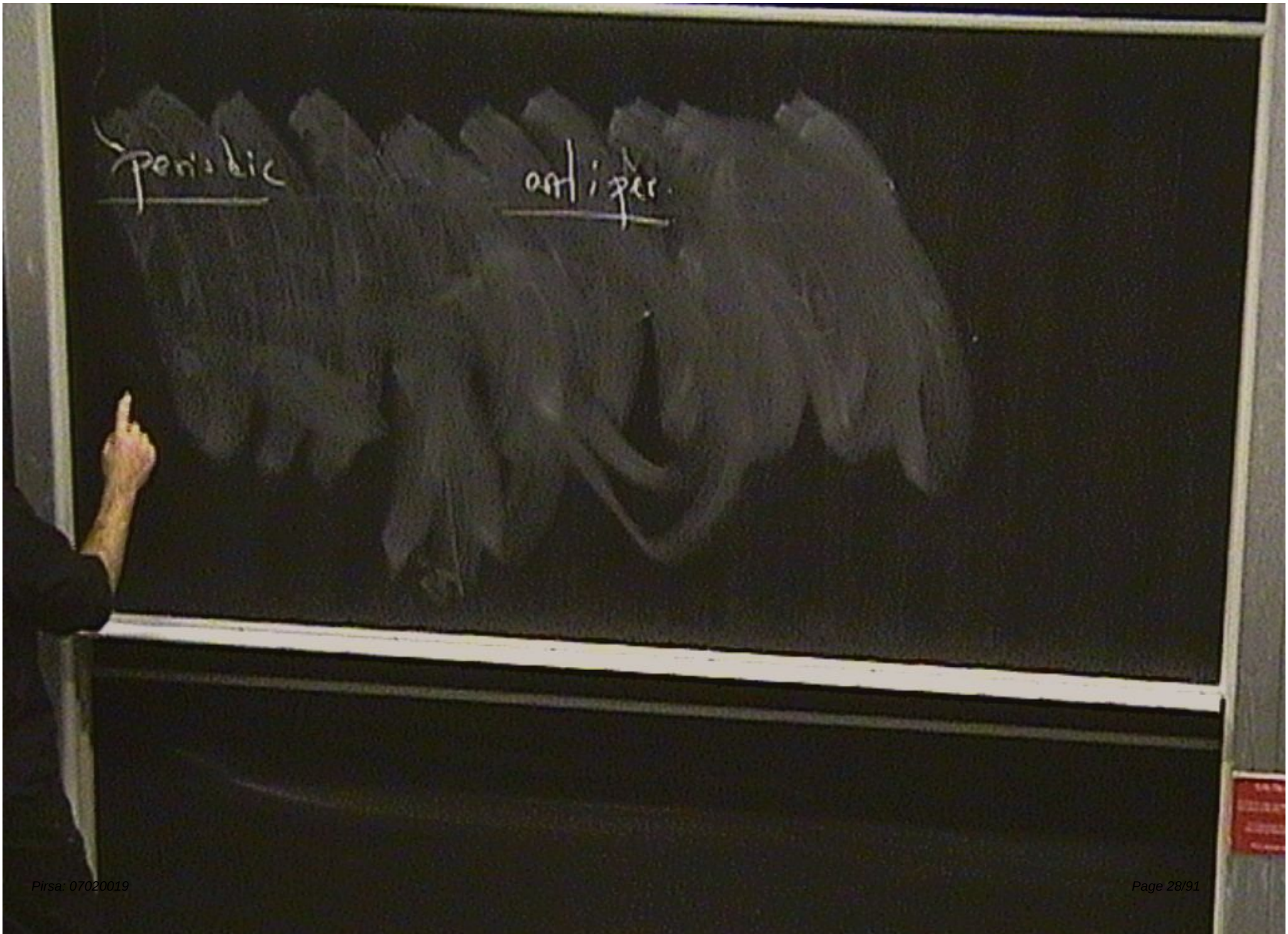


$$V_{1\text{-loop}} = -\frac{4}{R^4}$$

gravitational

$$V_{\text{eff}\,1\text{-loop}} = -4/R^6$$


periodic
antiper.


periodic
antiper.

periodic

anti per.

$R \ll m_v^{-1}$

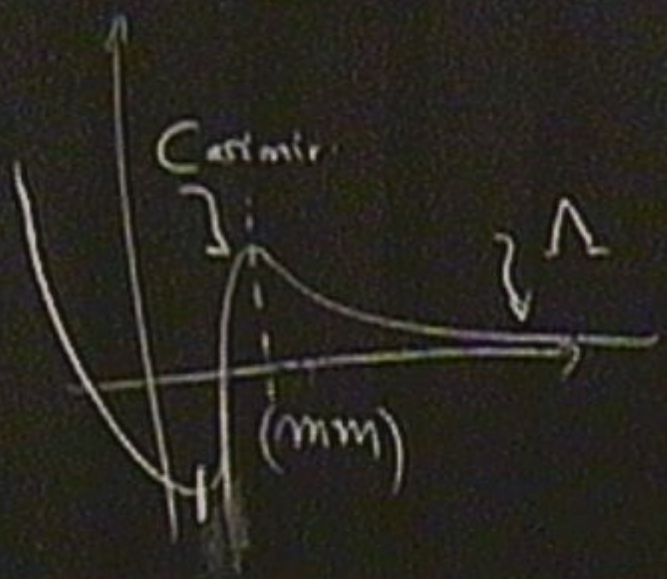
$$V_{eff}^{\text{Casimir}} = + \frac{1}{R^6}.$$

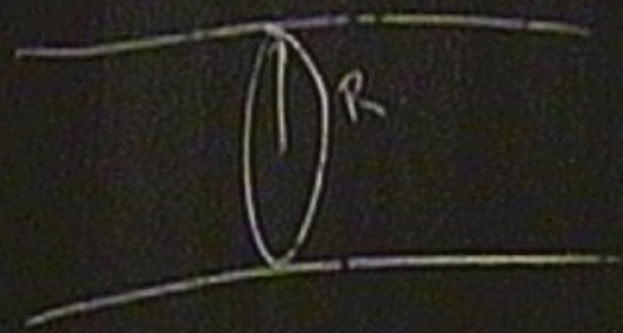
periodic

anti per.

$R \ll m_v^{-1}$

$$V_{eff}^{Casimir} = + \frac{1}{R^6} \cdot 6$$

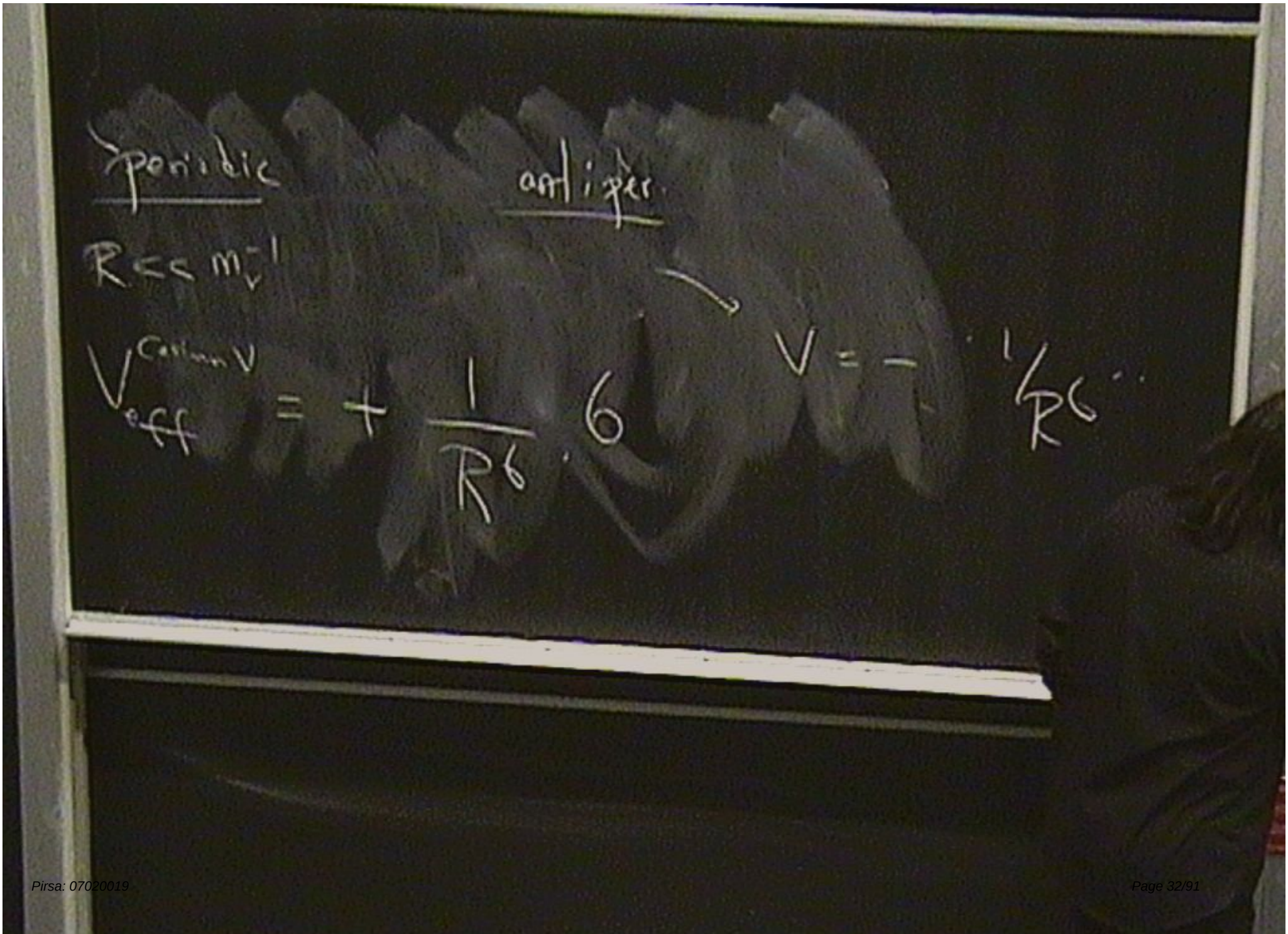


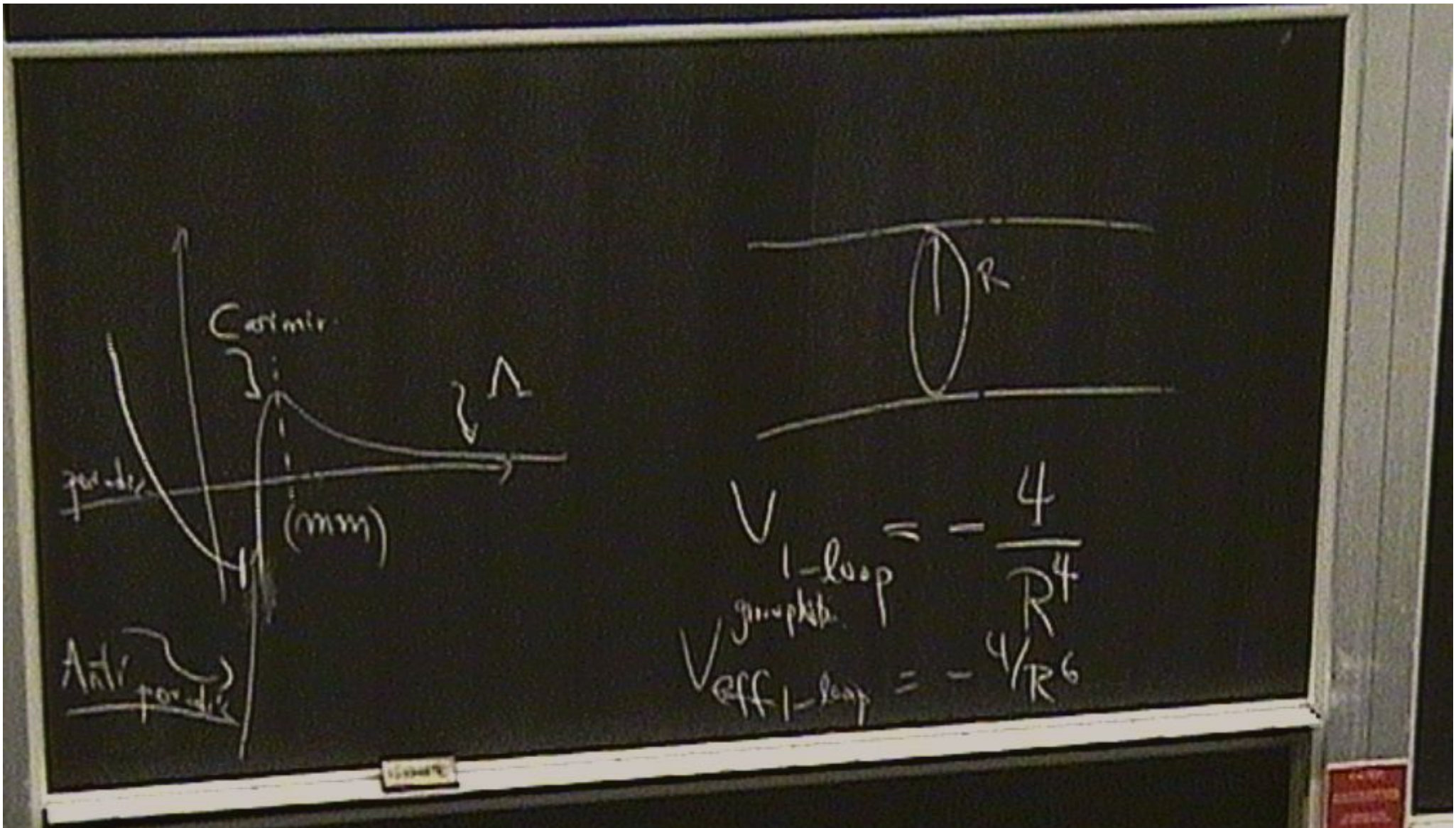


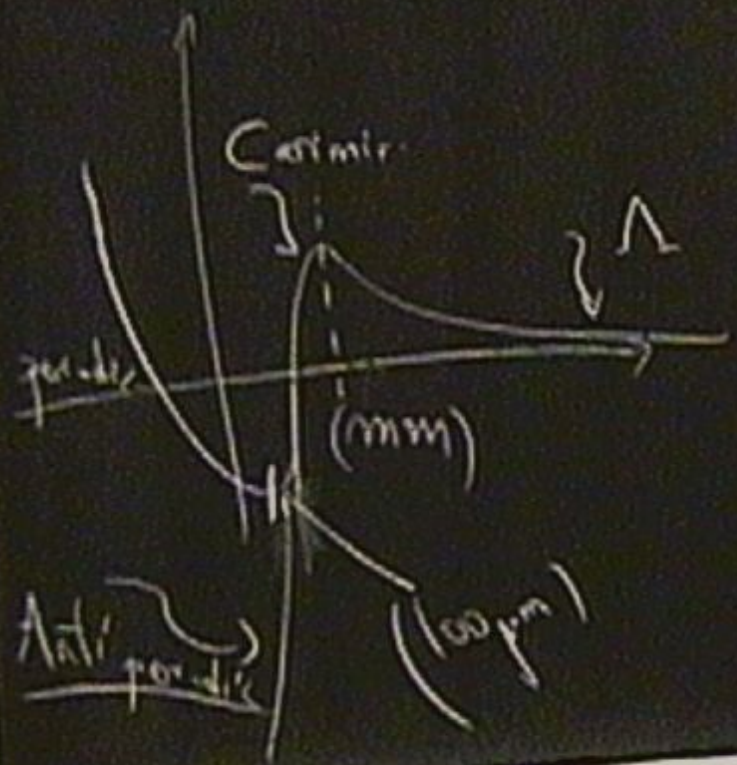
$$V_{1\text{-loop}} = -\frac{4}{R^4}$$

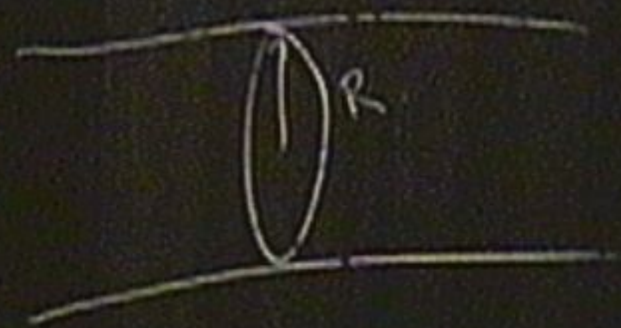
gravphilic

$$V_{\text{eff}\,1\text{-loop}} = -4/R^6$$


Spontaneous
antisym.
$R \ll m_v^{-1}$
$V_{eff}^{Casimir} = + \frac{1}{R^6} \cdot 6$
$V = - 1/R^6$


Casimir
~ Λ
(min)
Anti-periodic
R
$V_{1\text{-loop}} = -\frac{4}{R^4}$
geometric
$V_{\text{eff}\,1\text{-loop}} = -4/R^6$

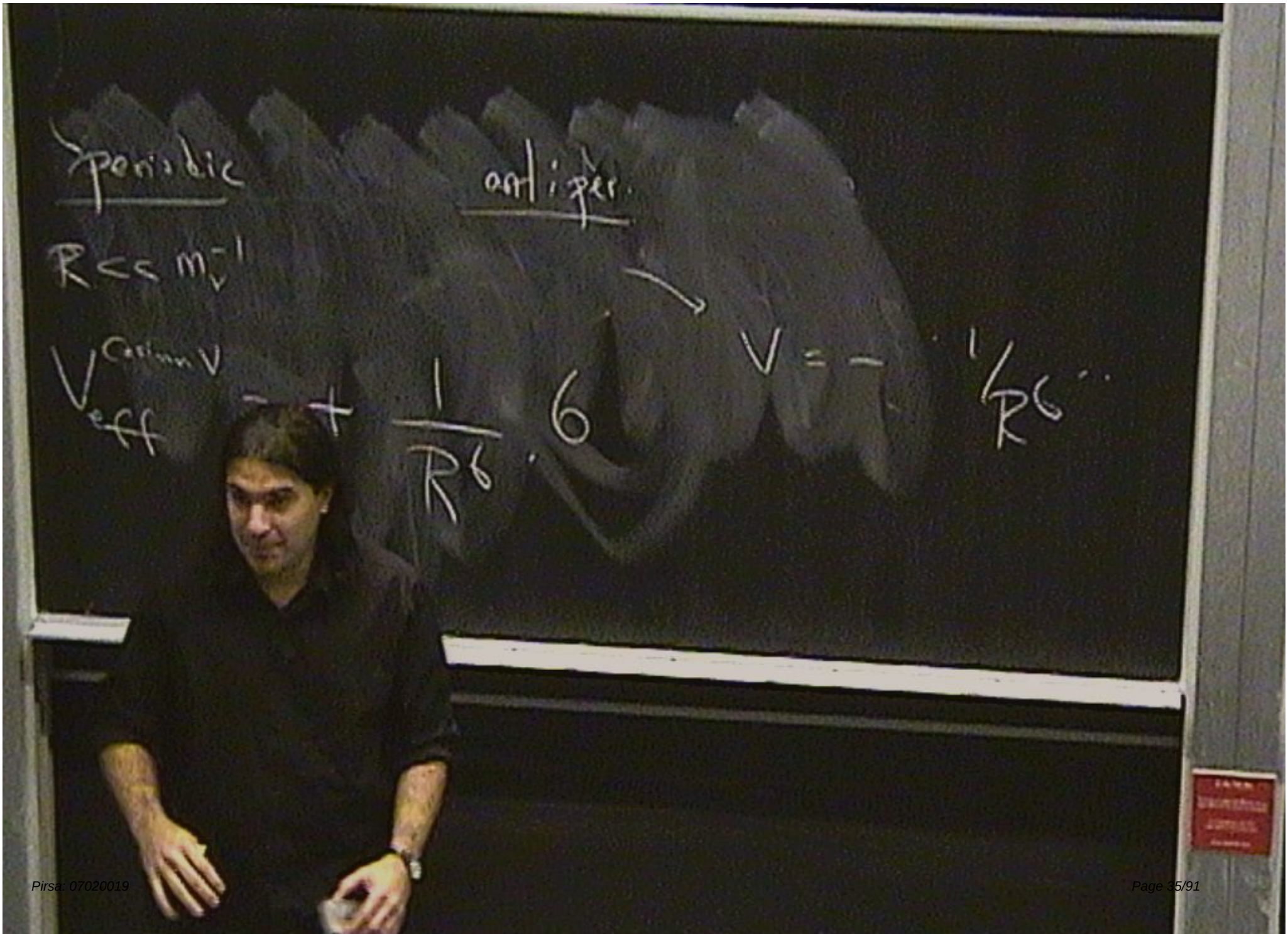


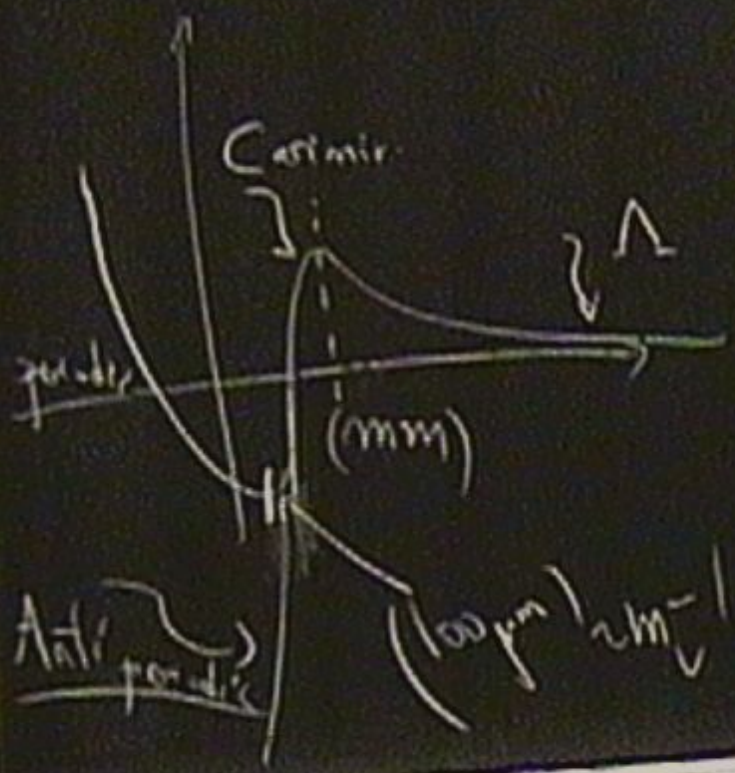


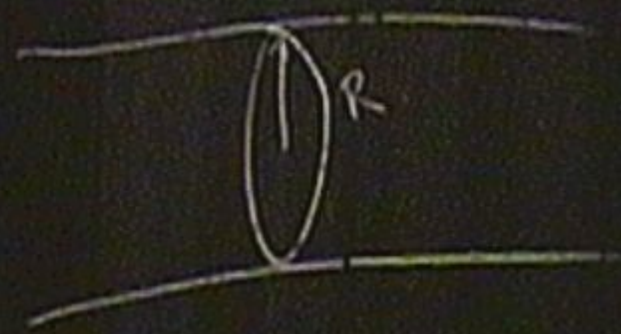
$$V_{1\text{-loop}} = -\frac{4}{R^4}$$

gravi-phobic

$$V_{\text{eff}\,1\text{-loop}} = -4/R^6$$


periodic
antiper.
R << m_v^-1
V^Casimir
V_eff = + 1/R^6 · 6
V = − 1/R^6





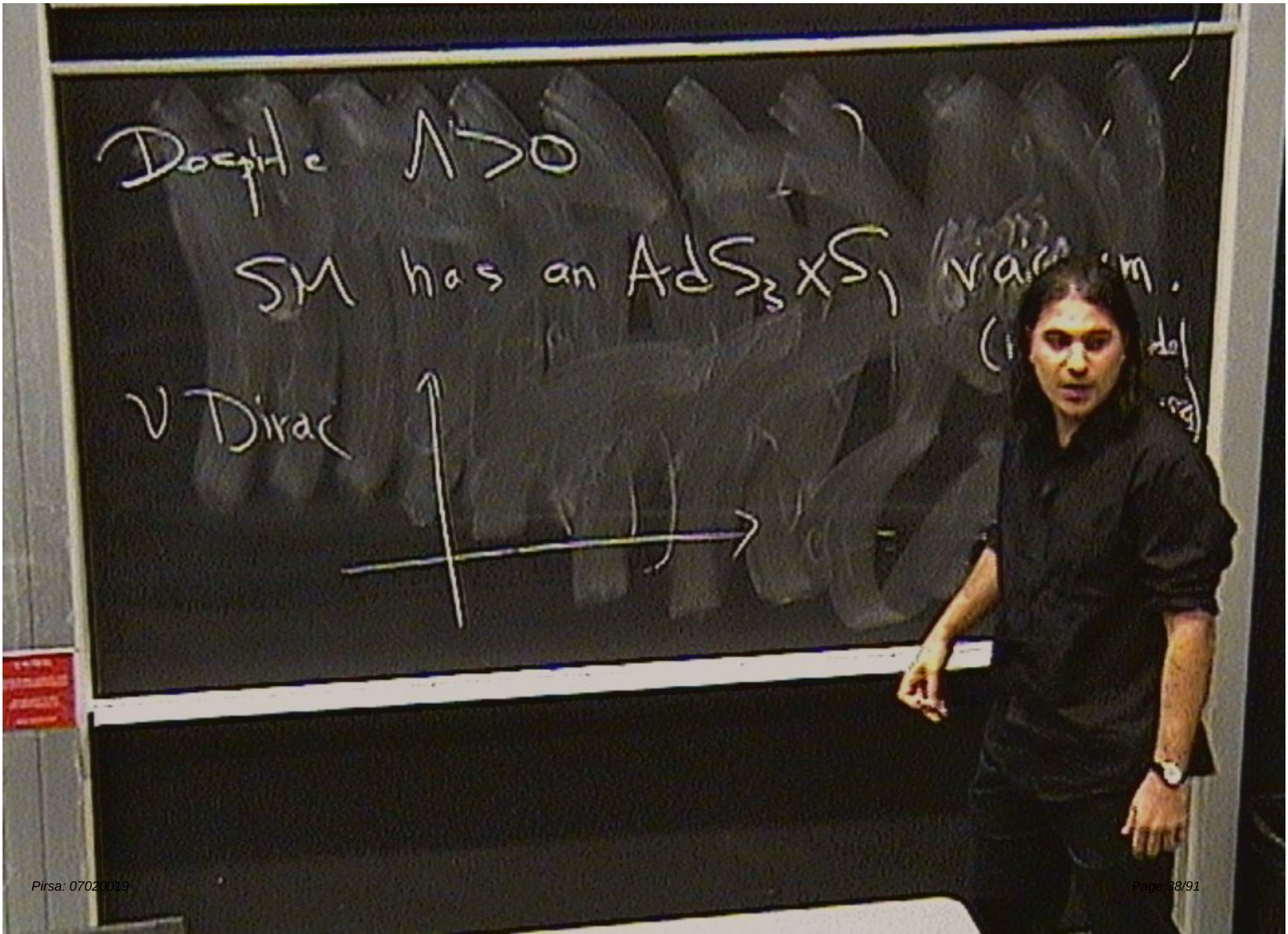
$$V_{1\text{-loop}} = -\frac{4}{R^4}$$

gravitational

$$V_{\text{eff-1-loop}} = -4/R^6$$

Despite $\Lambda > 0$

SM has an $AdS_3 \times S_1$ vacuum.

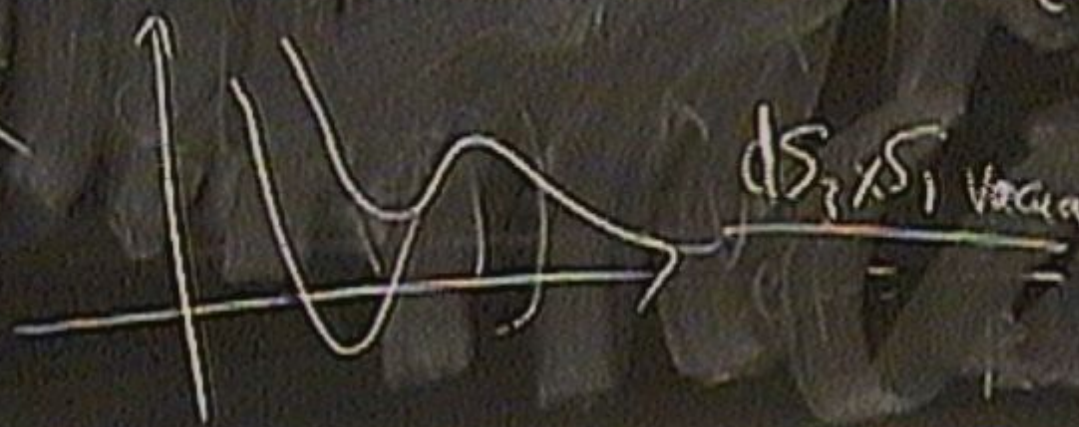

Double $\Lambda > 0$
SM has an $AdS_3 \times S_1$
ν Dirac

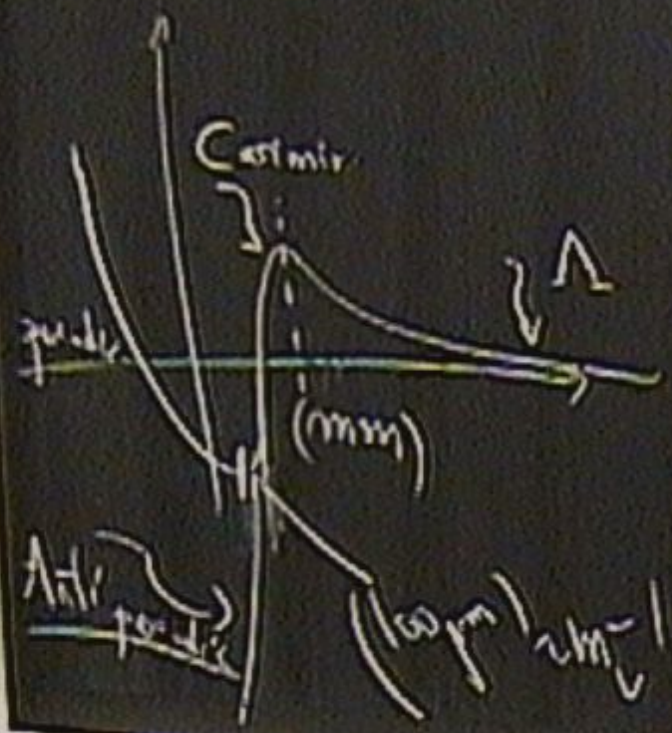
Despite $\Lambda > 0$

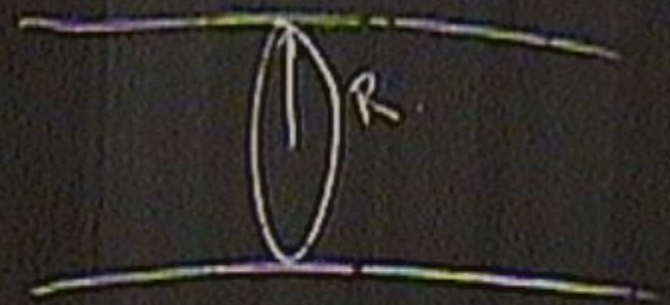
SM has an $AdS_3 \times S_1$ vacuum.

(minimal model of ν mass)

ν Dirac







$$V_{1\text{-loop}} = -\frac{4}{R^4}$$

$$V^{\text{geometric}}_{\text{eff-1-loop}} = -4/R^6$$

AdS, length big ~ Galaxy

R ~ mm.

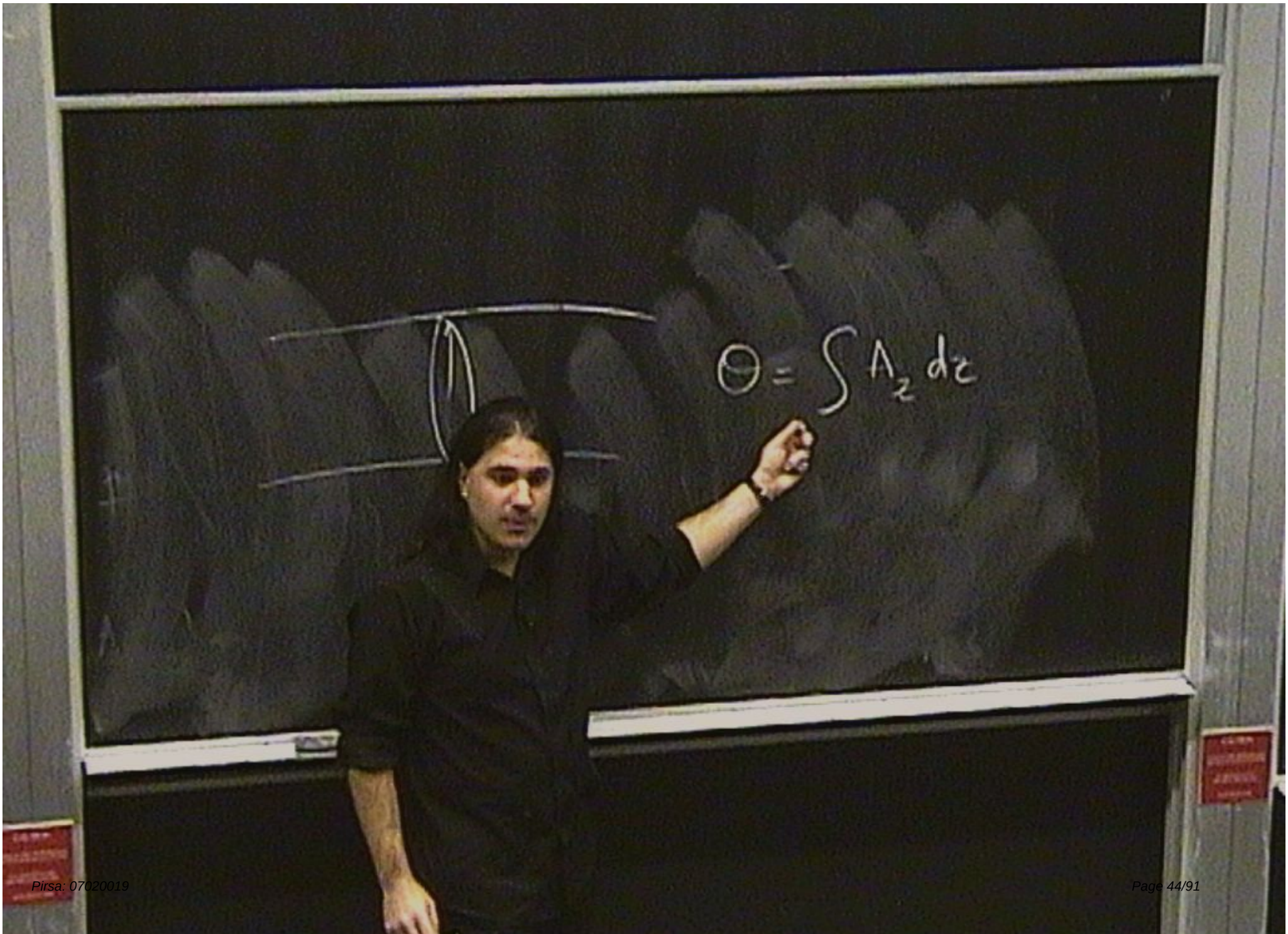
AdS, length big ~ Galaxy

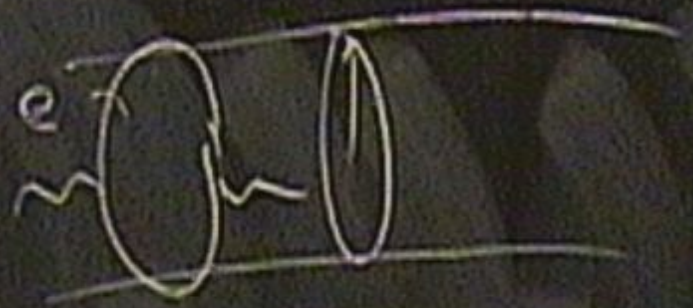
R ~ mm.

AdS, length big ~ Galaxy

$R \sim$ mm.

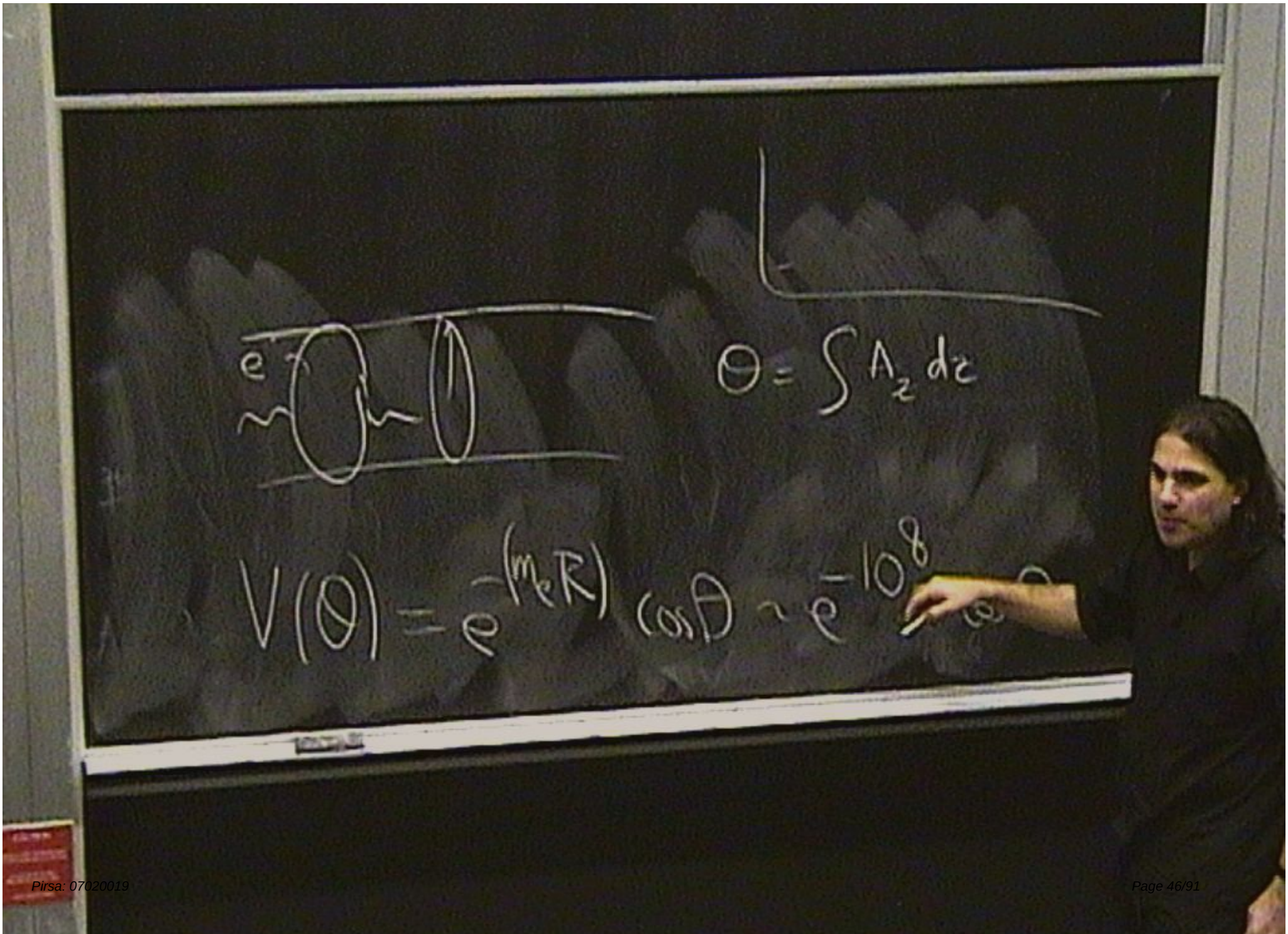
$m_R^{-1} \sim$ AdS length.


$\Theta = \int A_z \, dz$

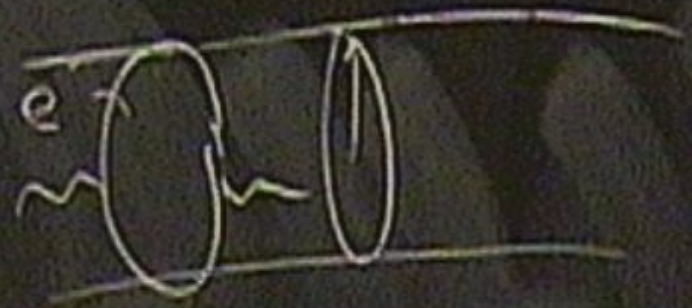


$$\theta = \int A_z \, dz$$

$$V(\theta) = e^{-(m_e R)} \cos\theta \sim e^{-10^8} \cos\theta .$$

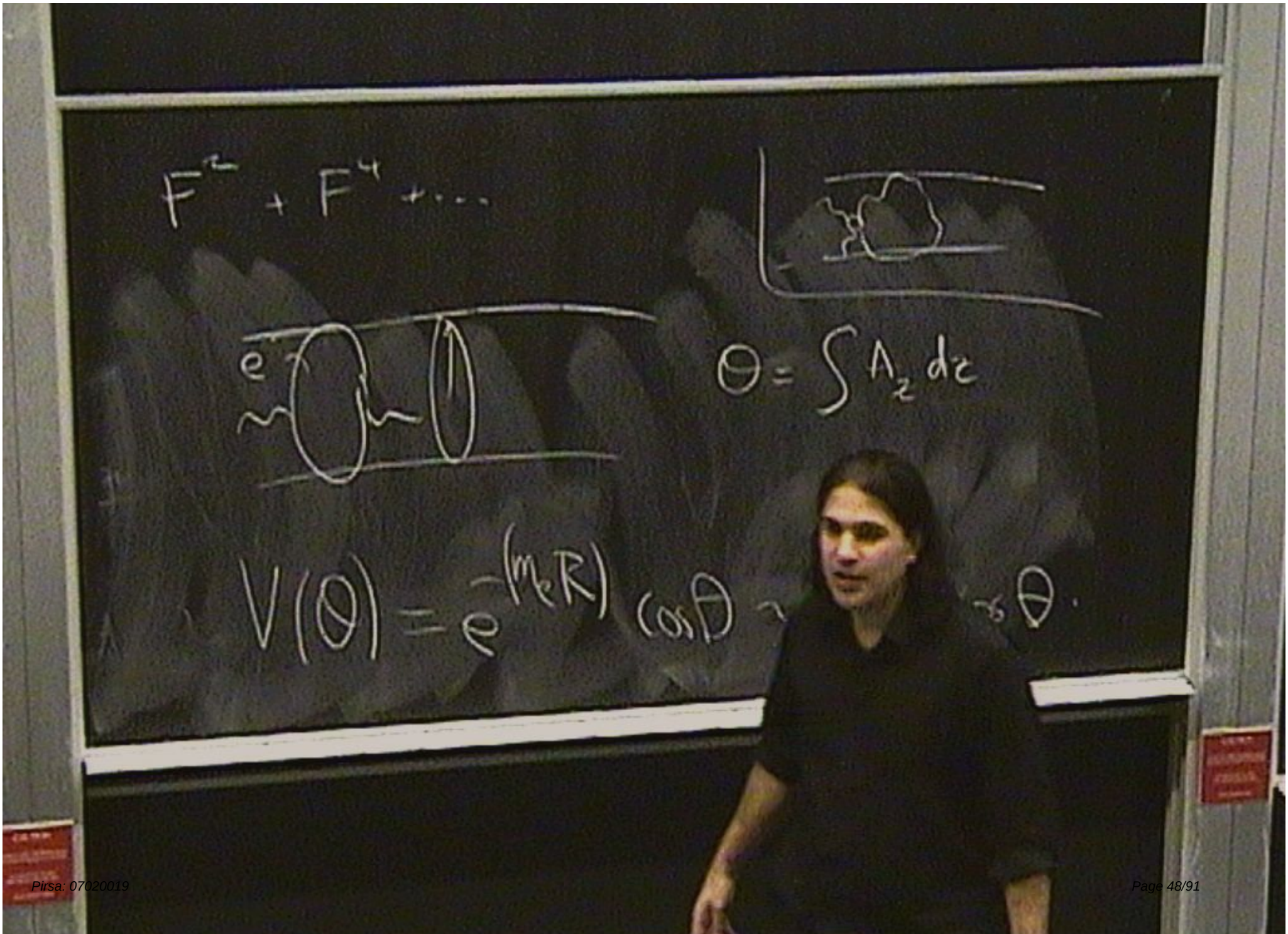

$\theta = \int A_z \, dz$
$V(\theta) = e^{-(m_e R)} \cos\theta \sim e^{-10^8}$

$F^2 + F^4 + \dots$



$\theta = \int A_2 \, dz$

$$V(\theta) = e^{-(m_e R)} \cos\theta \sim e^{-10^8} \cos\theta .$$


$F^2 + F^4 + \ldots$
$\theta = \int A_2 \, d\tau$
$V(\theta) = e^{-(m_e R)} \cos\theta$

AdS, length big ~ Galaxy

$R \sim mm.$

$m_R^{-1} \sim$ AdS length.

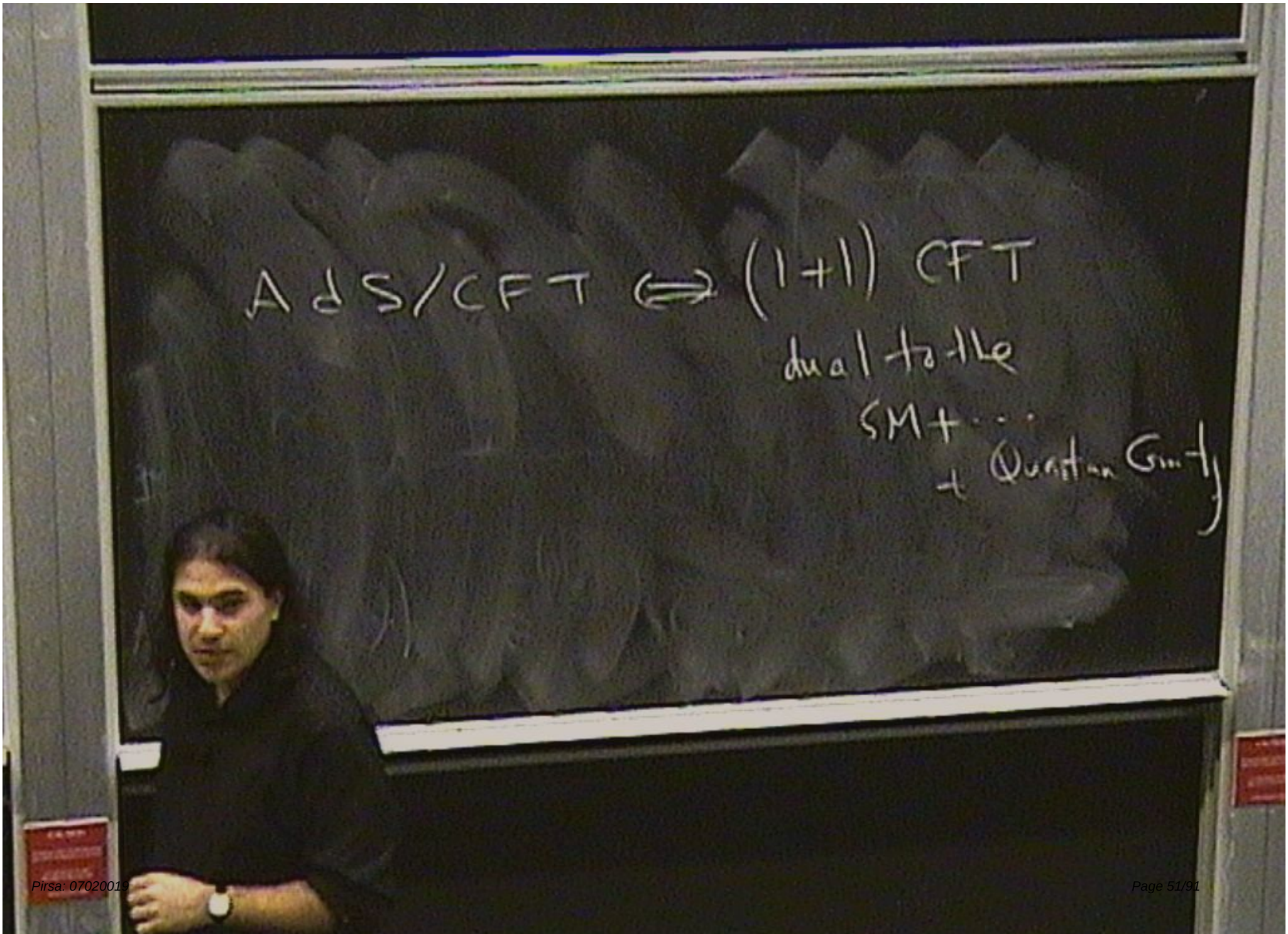
SM:
out. infinity
of
$AdS_3 \times S_1$
vacua (labeled
by $\mathcal{O}_W$).

AdS/CFT $\Longleftrightarrow$ 1+1 CFT

dual to the

SM + ...

+ Quantum Gravity


AdS/CFT ⟺ (1+1) CFT
dual to the
SM + ...
+ Quantum Gravity

AdS/CFT $\Longleftrightarrow$ (1+1) CFT

dual to the

SM + ...

+ Quantum Grav

$\theta \equiv$

AdS/CFT $\Leftrightarrow$ (1+1) CFT

dual to the

SM + ...

+ Quantum Grav

$\mathcal{O}$ $\equiv$ $T^{\mu\nu}$

AdS/CFT $\Longleftrightarrow$ (1+1) CFT

dual to the

SM + ...

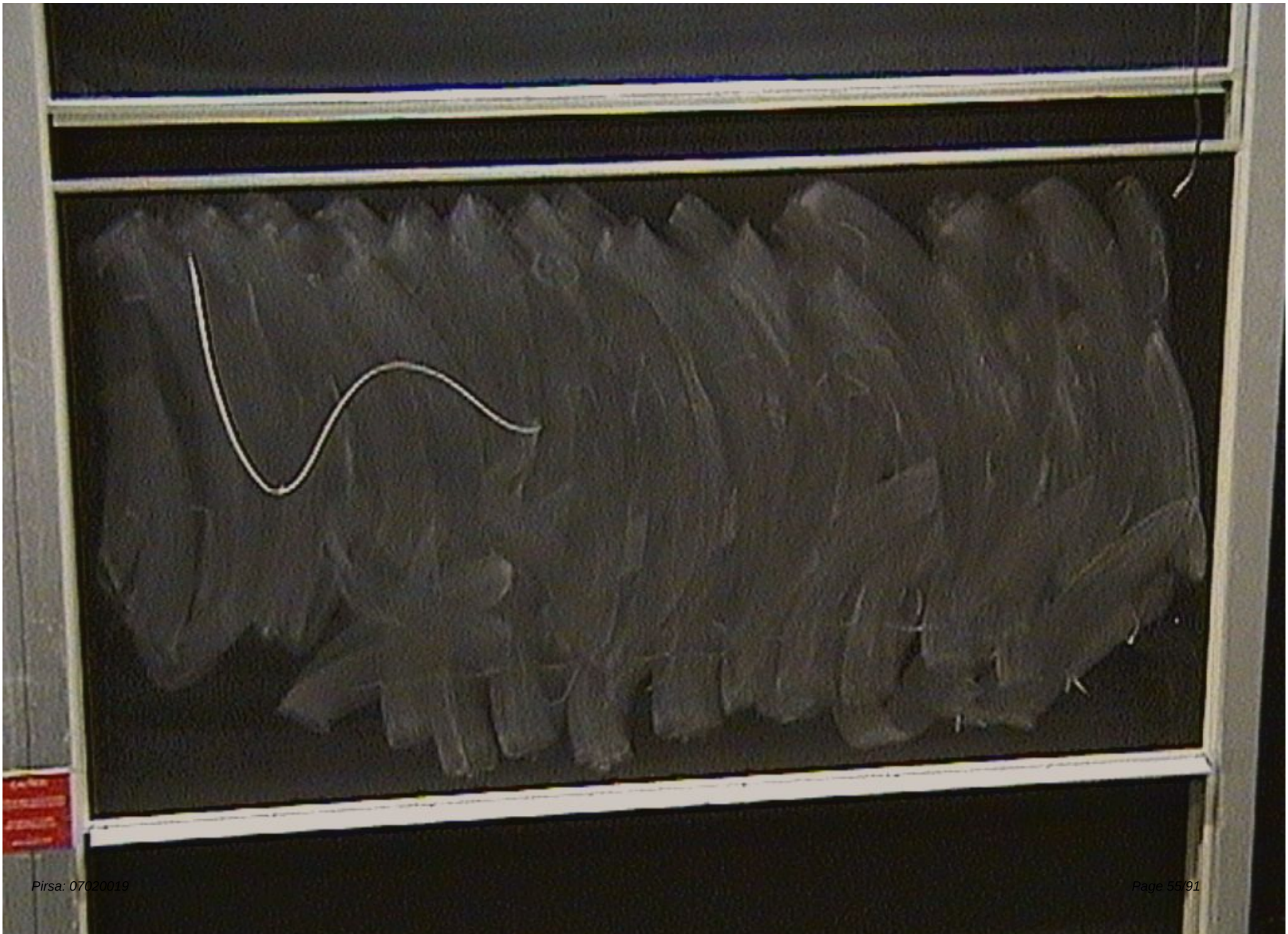
+ Quantum Gravity

$\mathcal{O}$

$T_{\mu\nu}$

$\mathcal{O}_W$

Relevant perturbation by e^{-168}

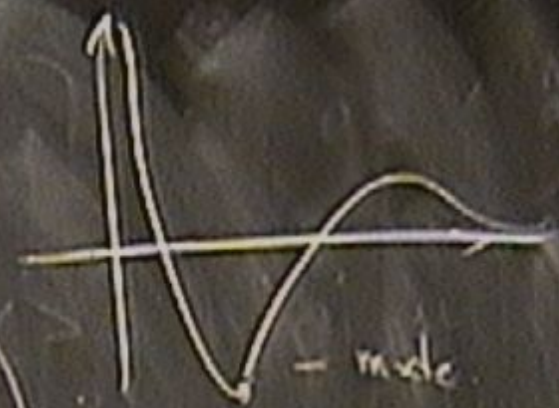


$\Delta a \sim 2\pi n$.

$$V^{axion} \sim \left(\frac{f_a^2}{R^2} n^2\right)$$

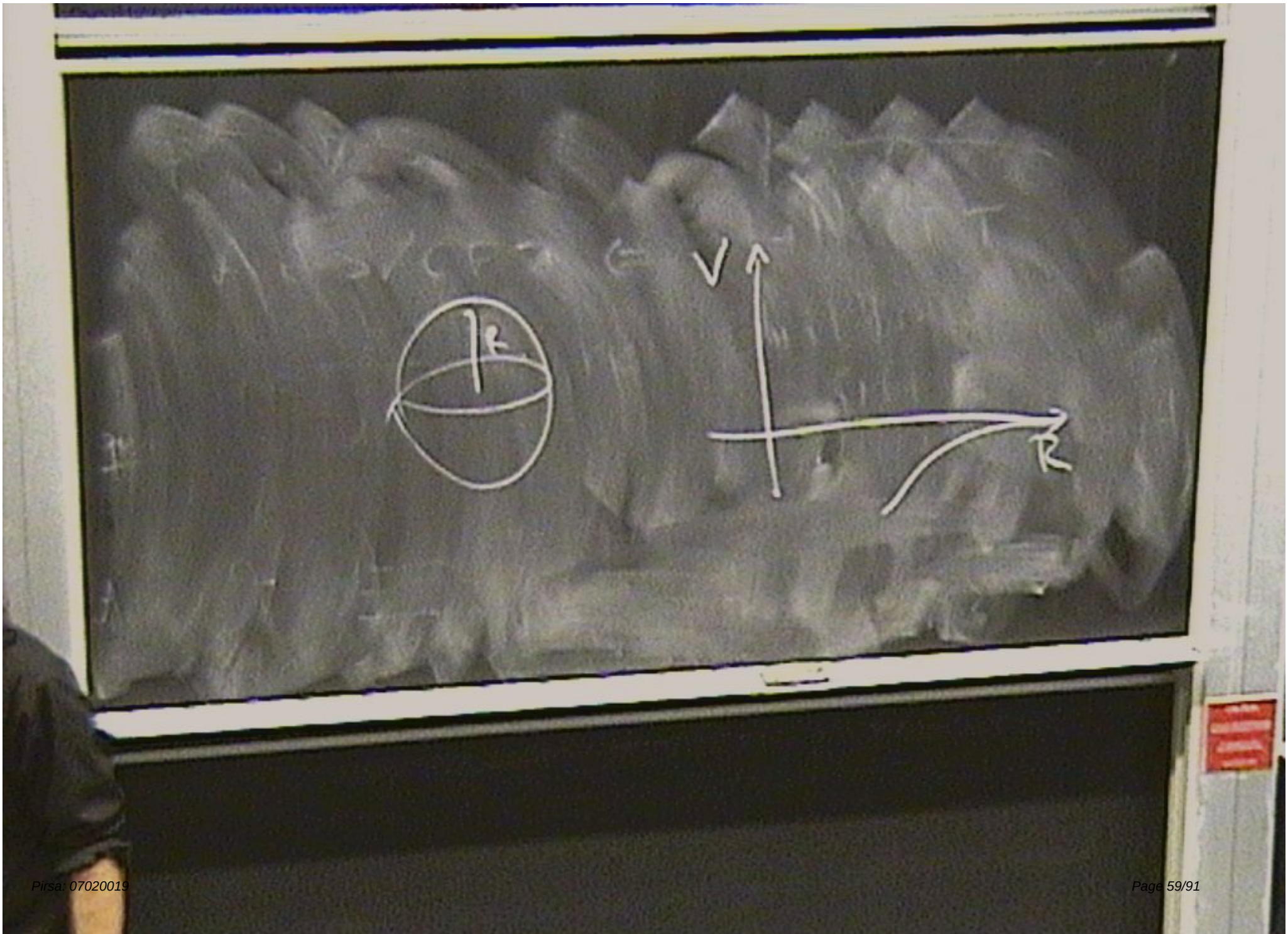
$\Delta a \sim 2\pi n$

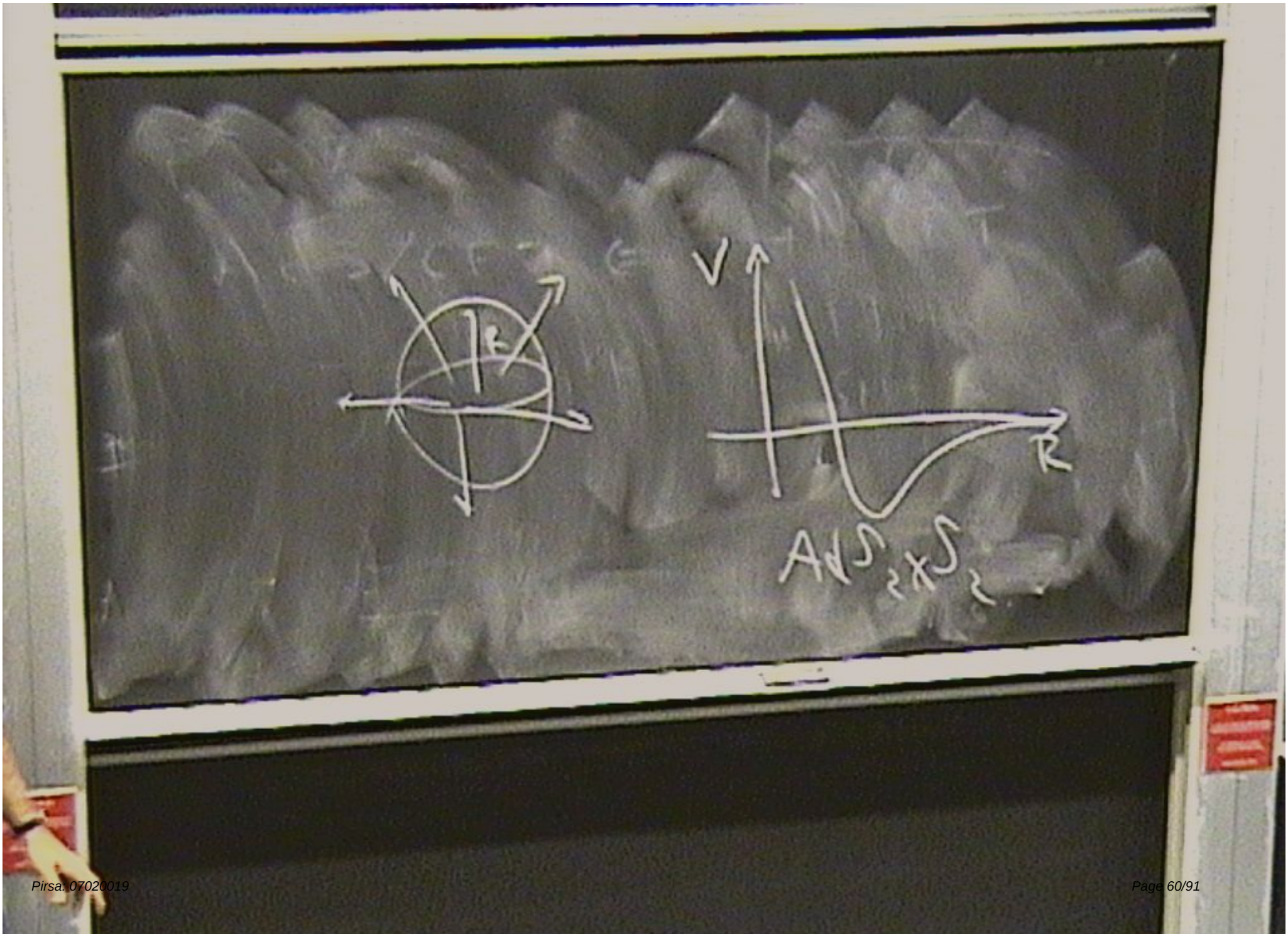
$$V^{axion} \sim \left(\frac{f_a^2}{R^2} n^2\right)$$

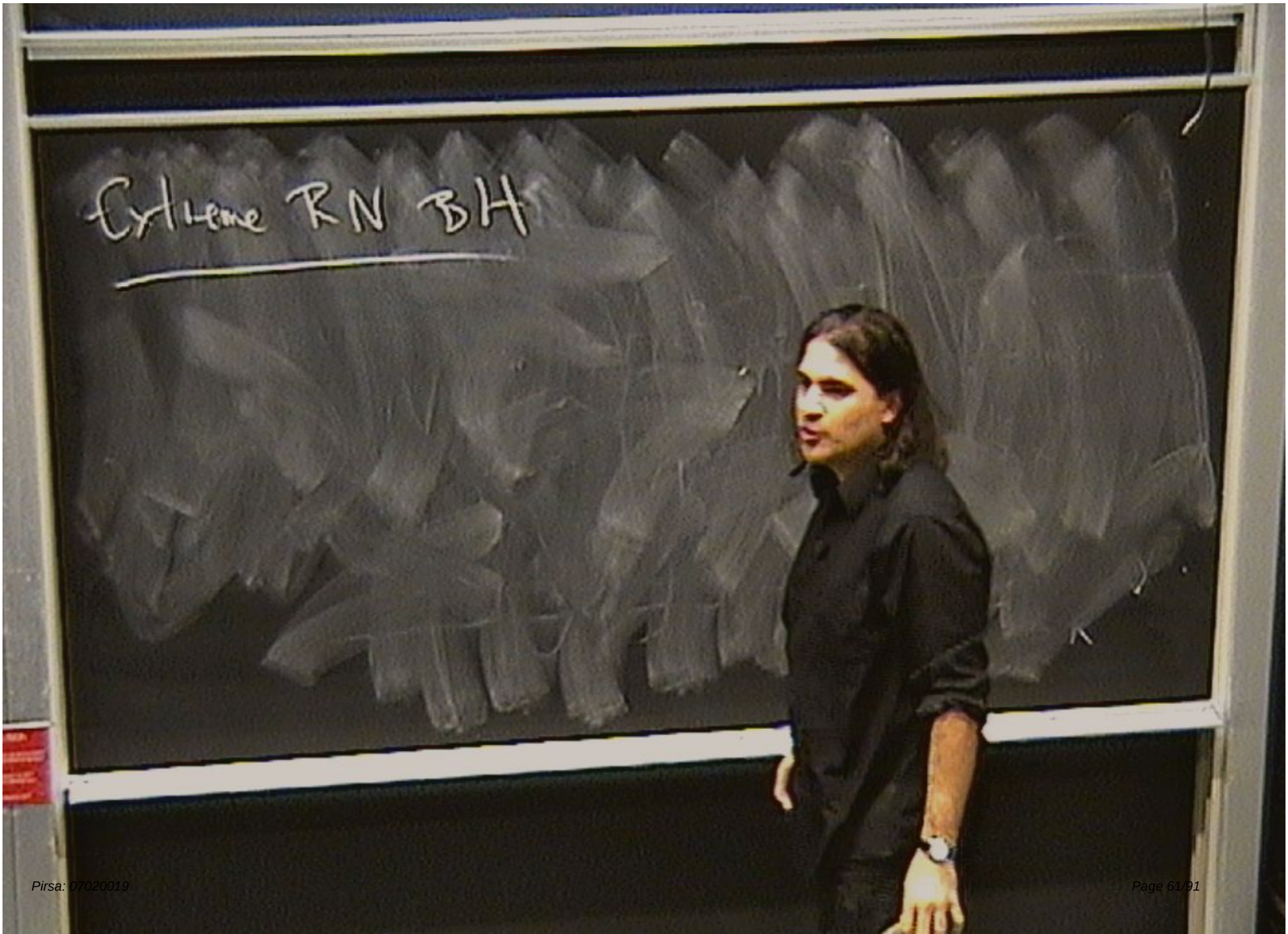


$AdS_3 \times S_1$

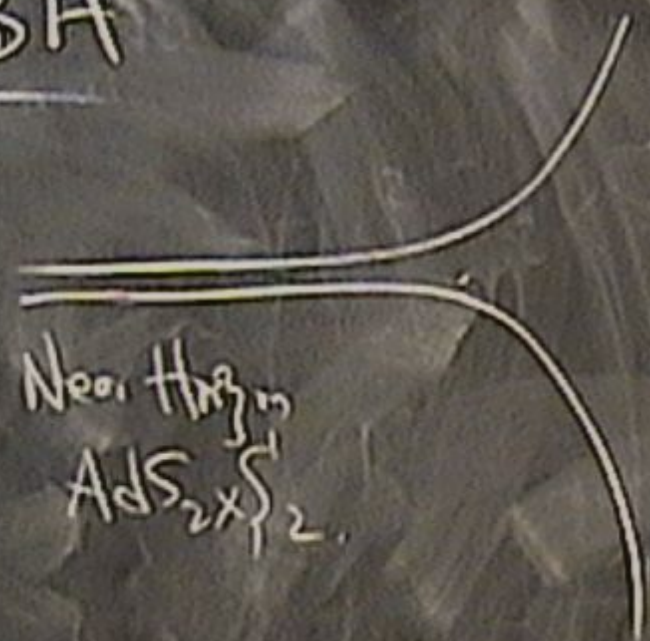
(VI) Connections?


R
V
R


V
R
AdS2xS2

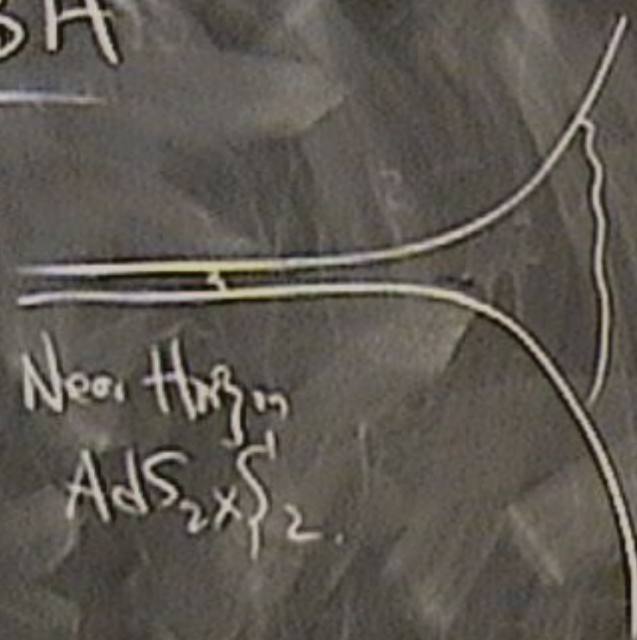

CxHeme RN BH

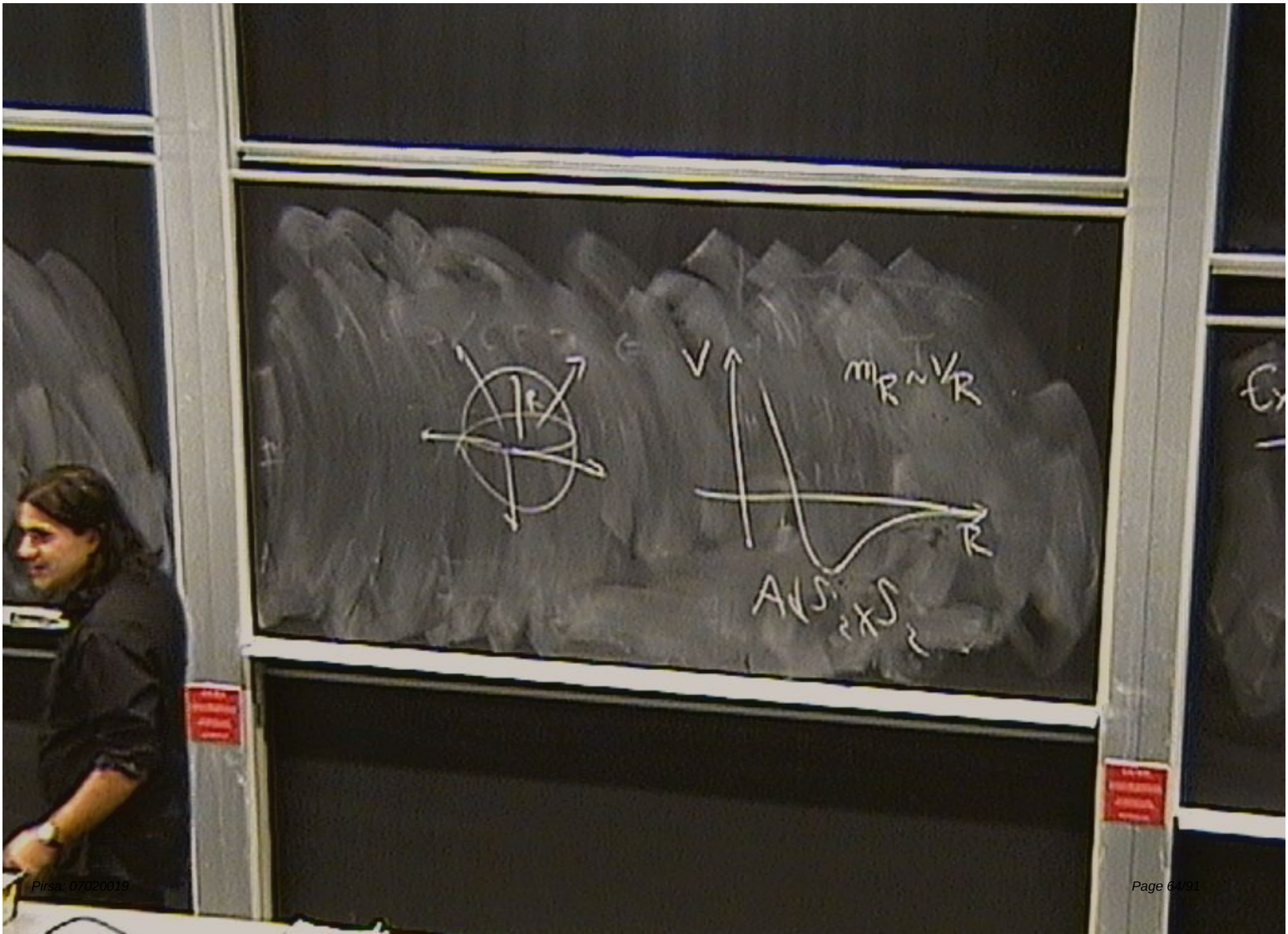
Extreme RN BH

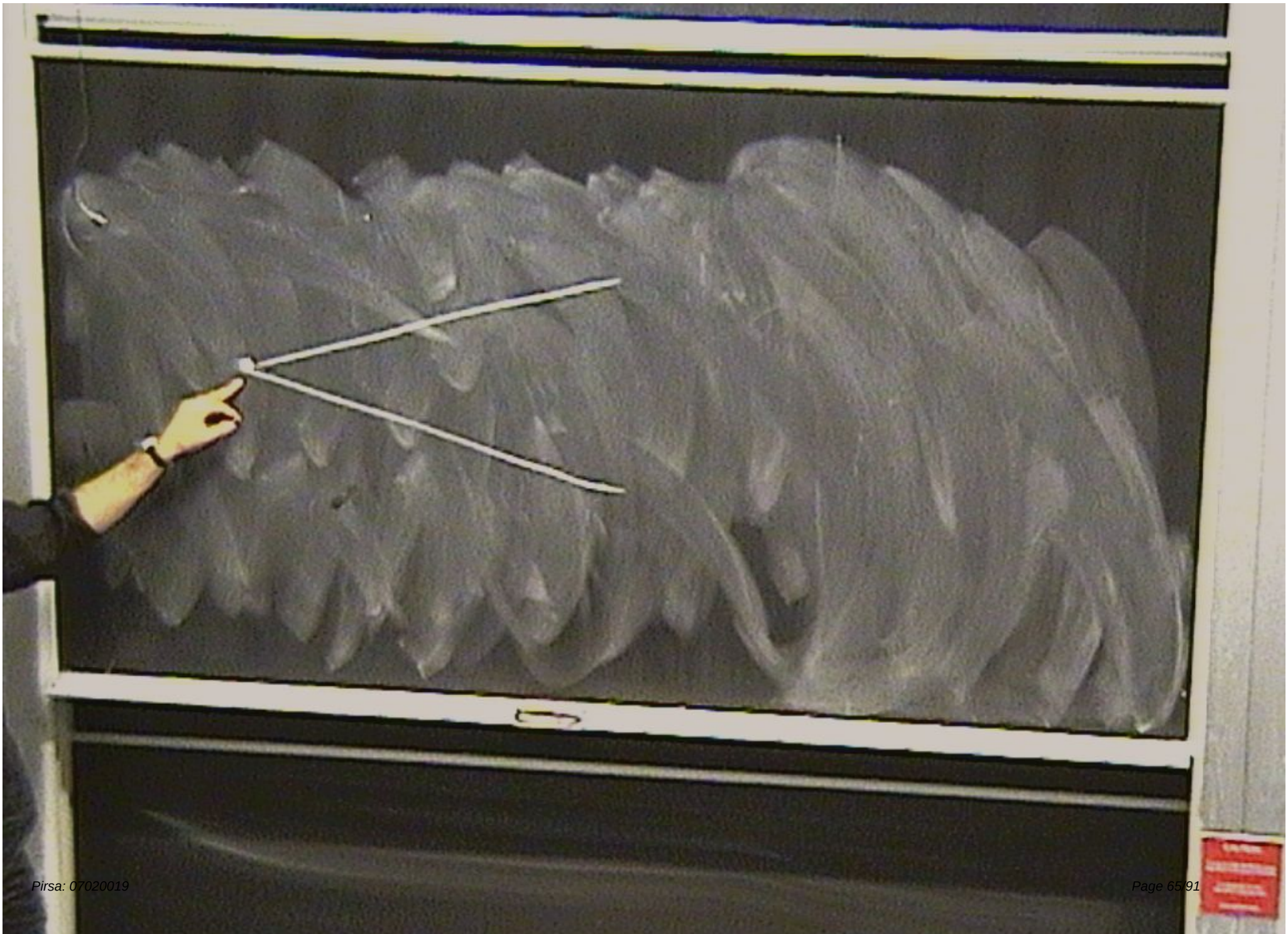


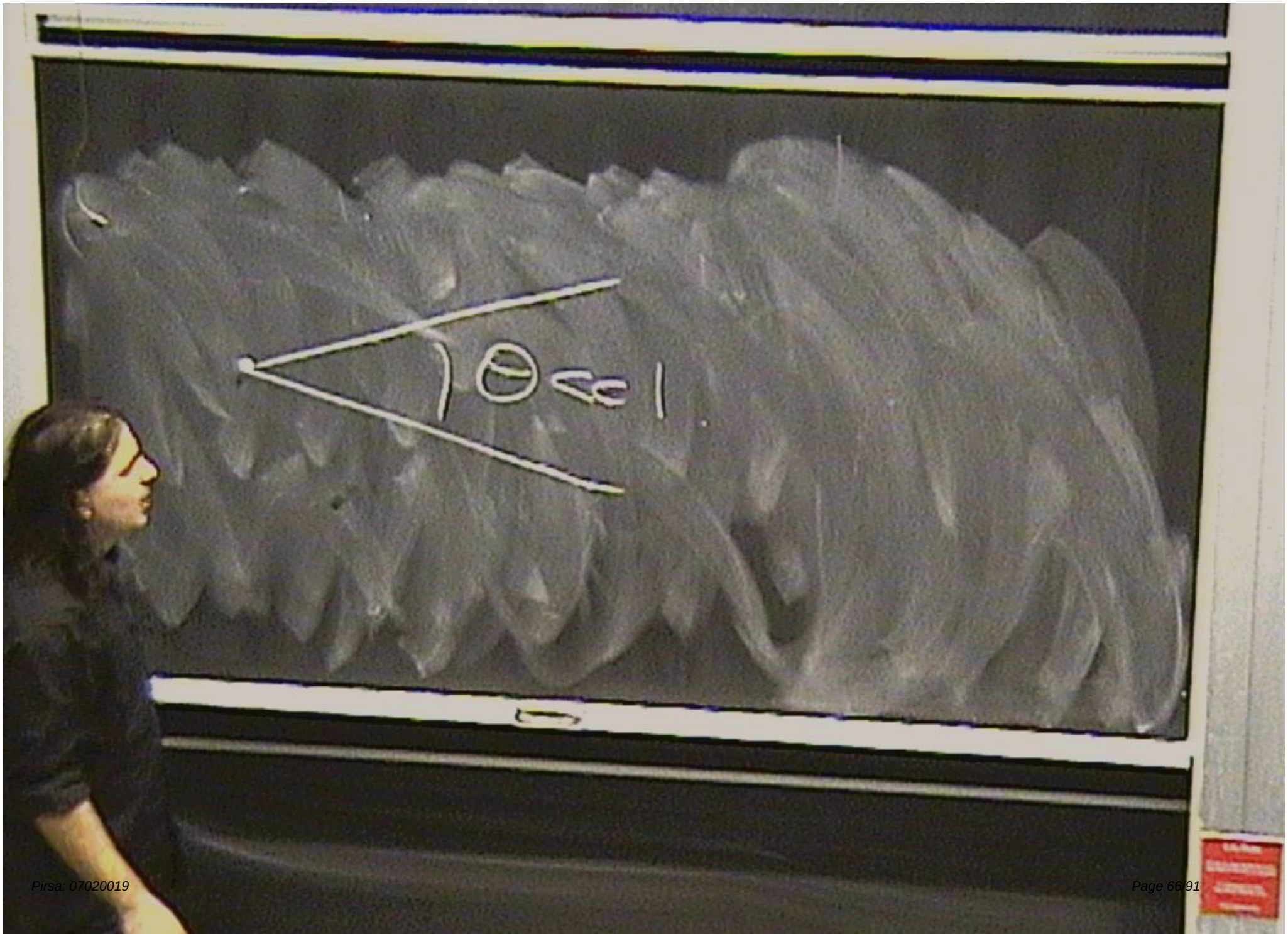
Near Horizon
$AdS_2 \times S_2$.

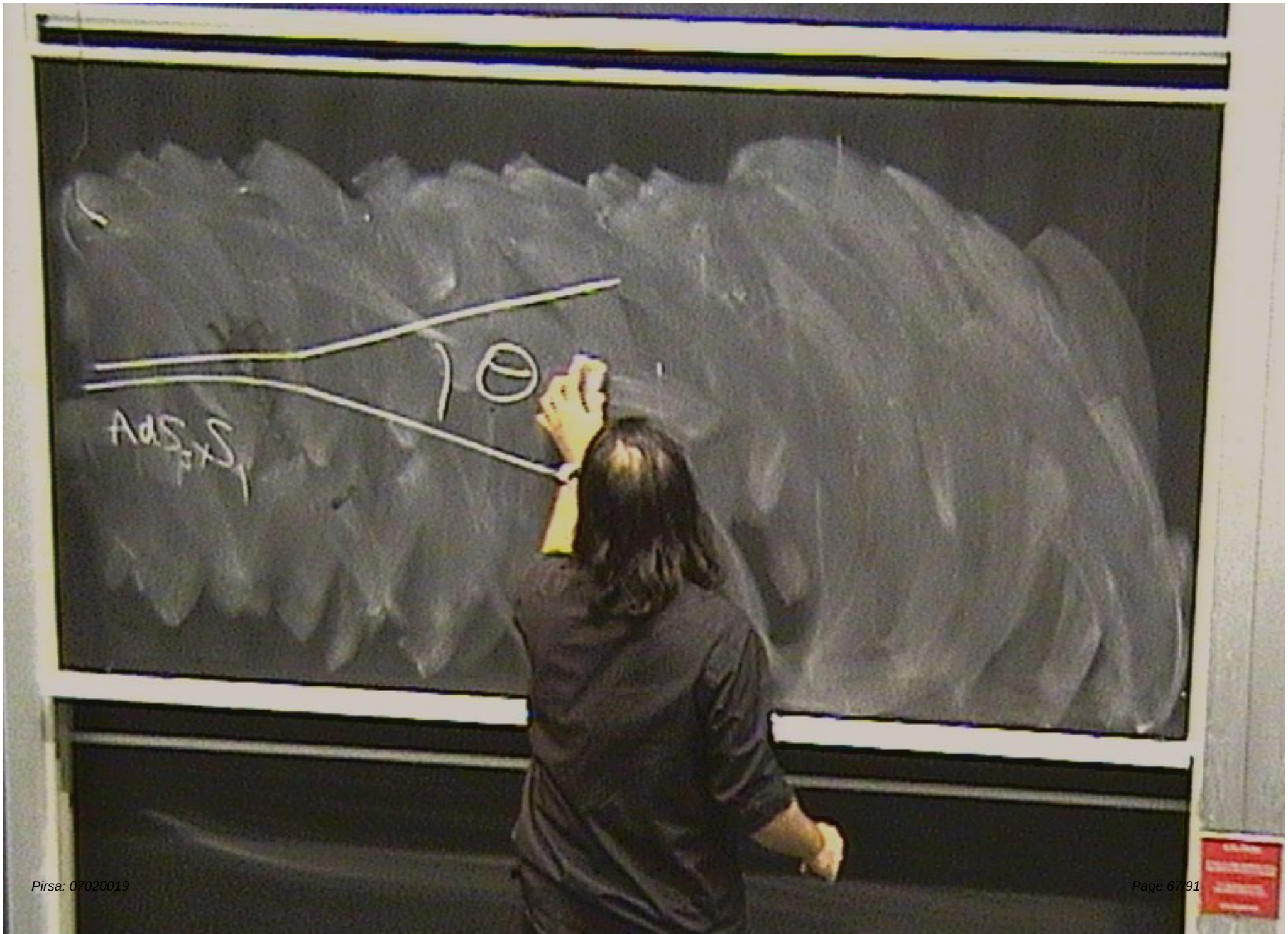
Extreme RN BH

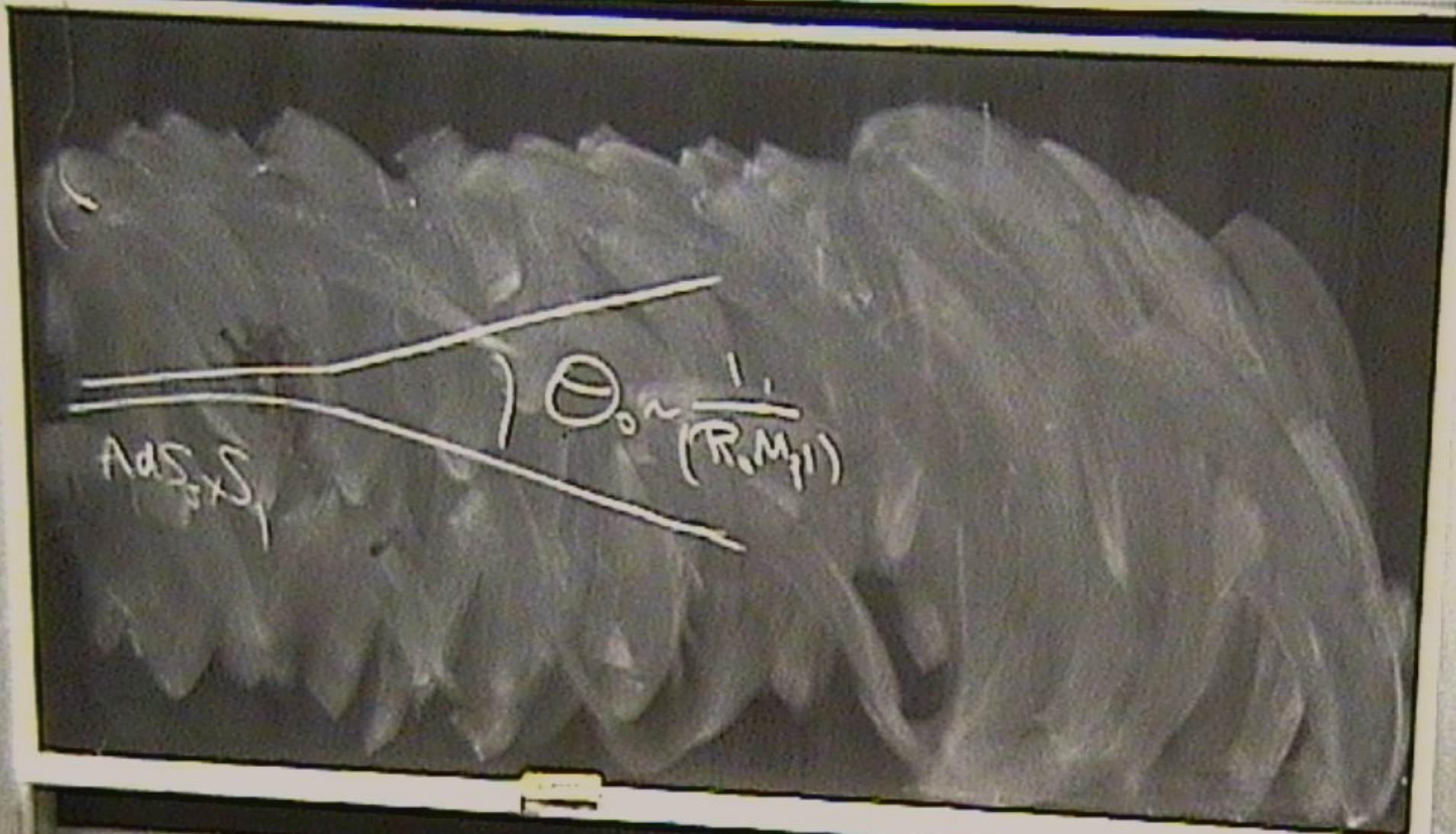


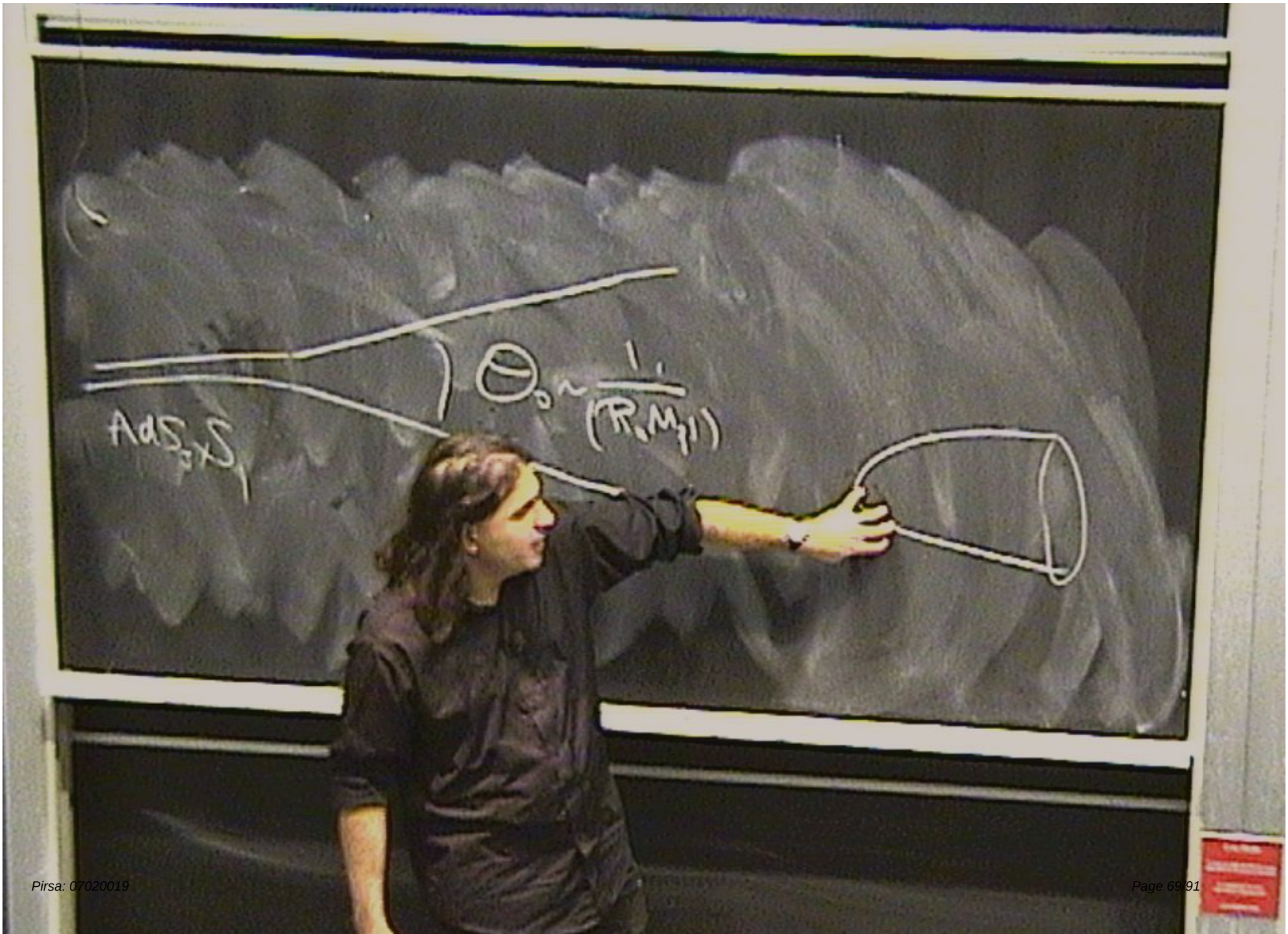

V
$m_R \sim 1/R$
R
$AdS_2 \times S_2$



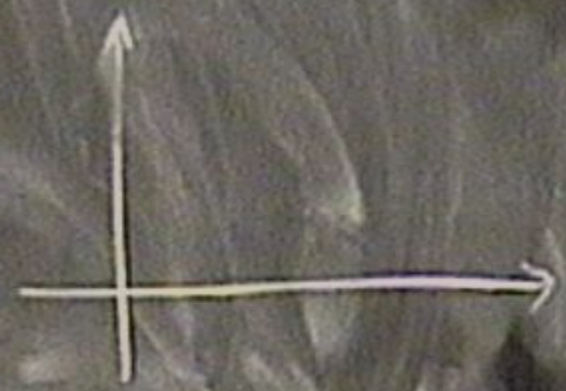

$|\theta| \ll 1$


$AdS_5 \times S_1$

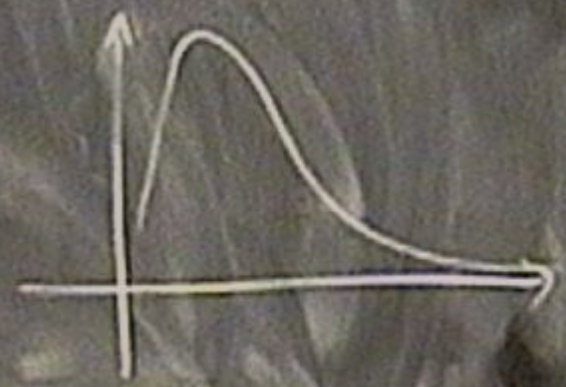

$\Theta_0 \sim \frac{1}{(R_s M_{pl})}$
$AdS_5 \times S_1$


$AdS_5 \times S_1$
$\Theta_0 \sim \frac{1}{(R_5 M_{pl})}$

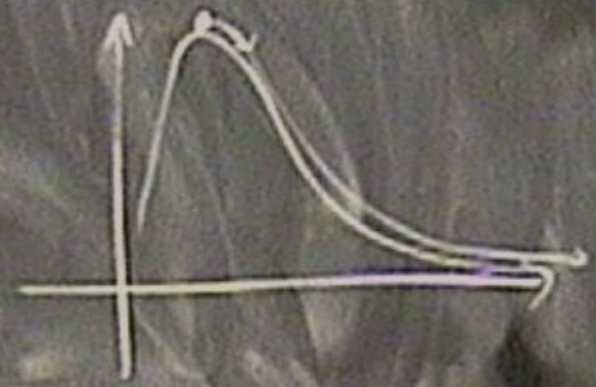
$$ds^2 = -R(r)^2\, dt^2 + dr^2 + R^2(r)\, d\theta^2$$



$$ds^2 = -R(r)^2\, dt^2 + dr^2 + R^2(r)\, d\theta^2$$



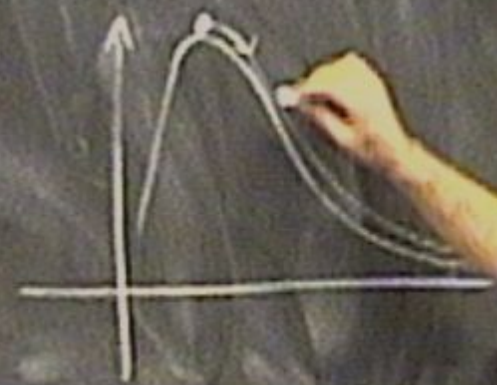
$$ds^2 = -R(r)^2\, dt^2 + dr^2 + R^2(r)\, d\theta^2$$

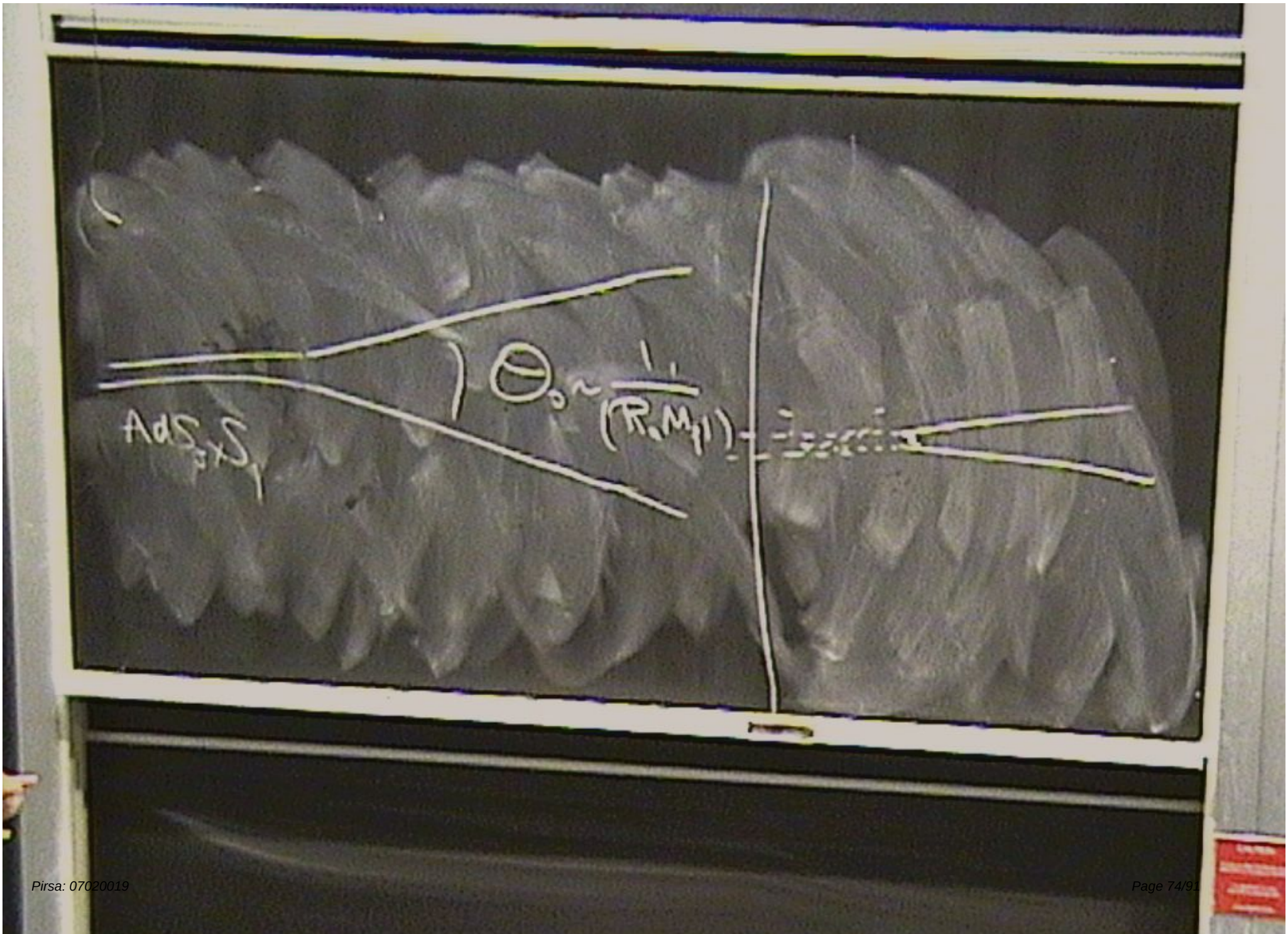


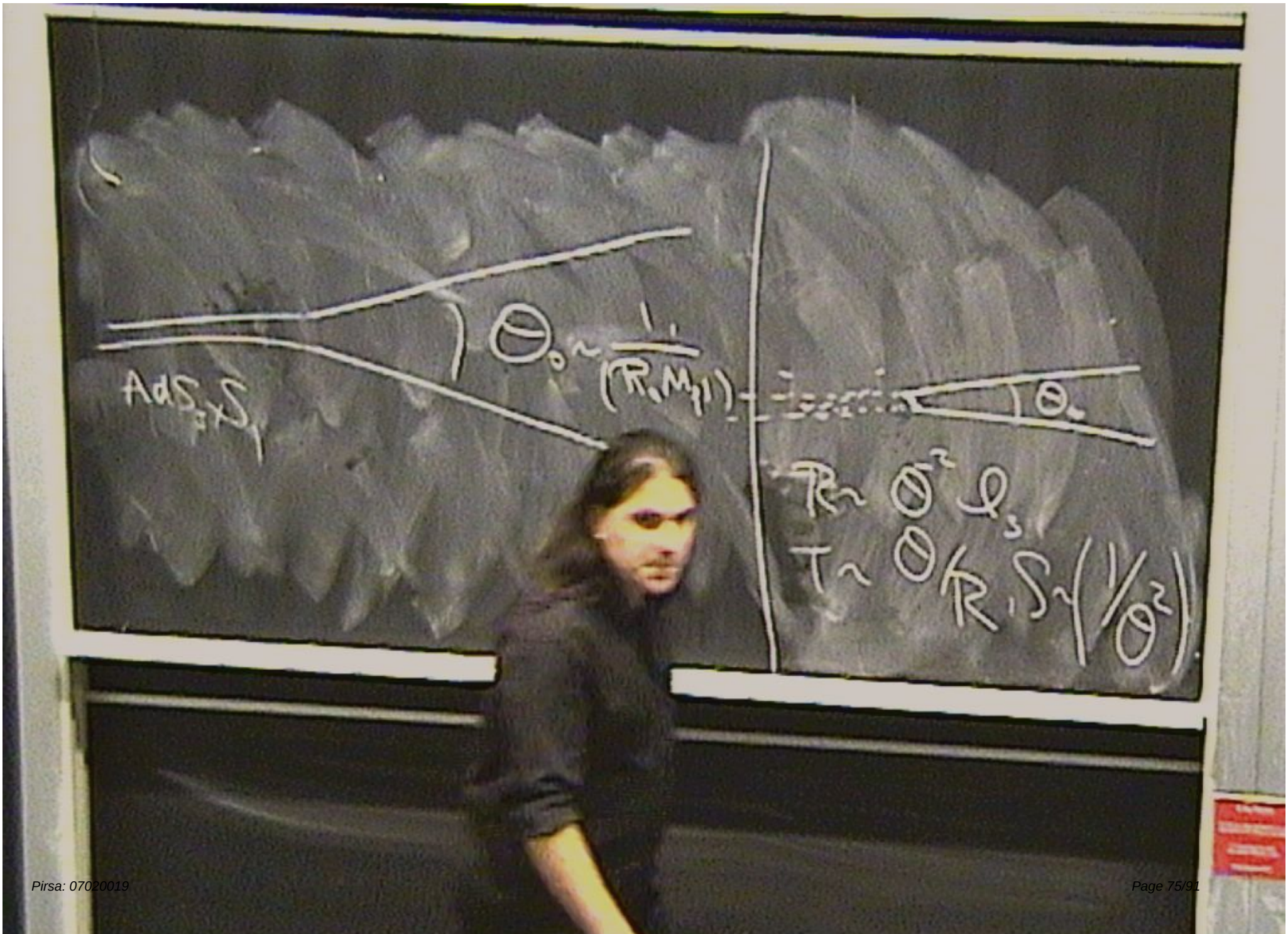
$$ds^2 = -R_{(r)}'^2\, dt^2 + dr^2 + R^2(r)\, d\theta^2$$

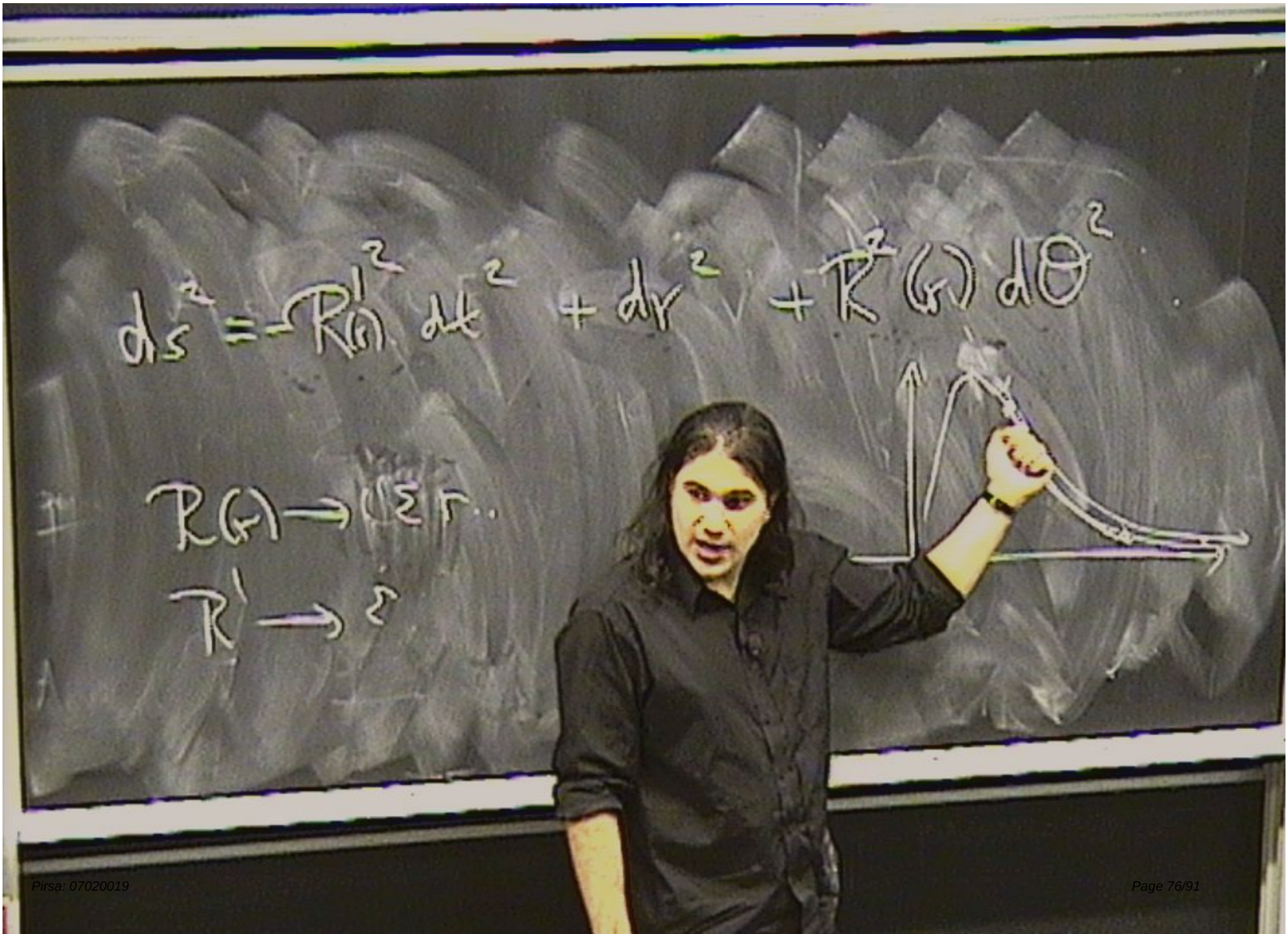
$R(r) \to (\Sigma r$

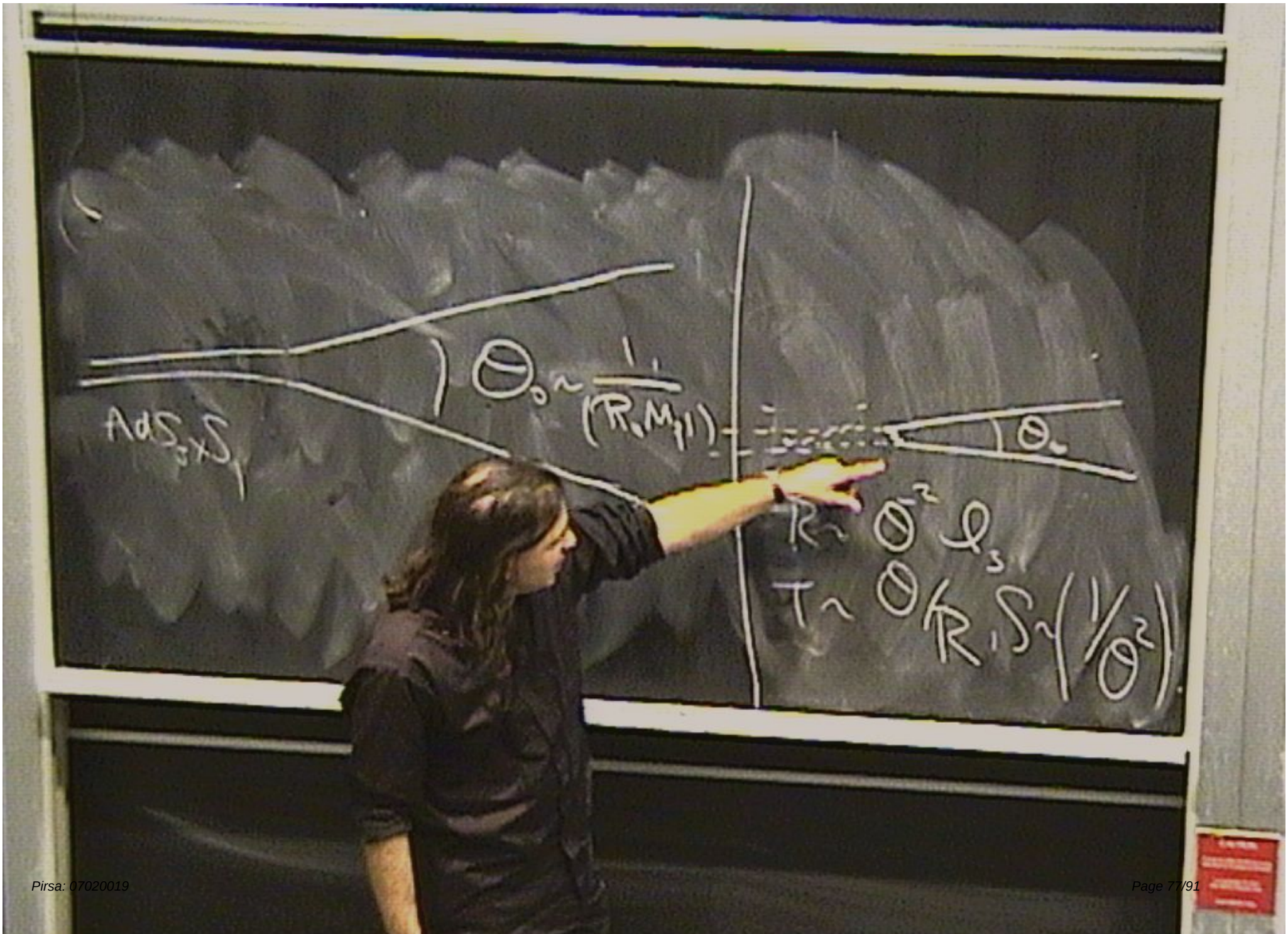
$R' \to \Sigma$




$\Theta_0 \sim \frac{1}{(R_0 M_{11})}$
$AdS_3 \times S_1$


AdS5 x S1
Θ0 ~ 1/(R1M1)
Θ0
R ~ Θ^2 ℓs
T ~ Θ/R1 S ~ (1/Θ^2)

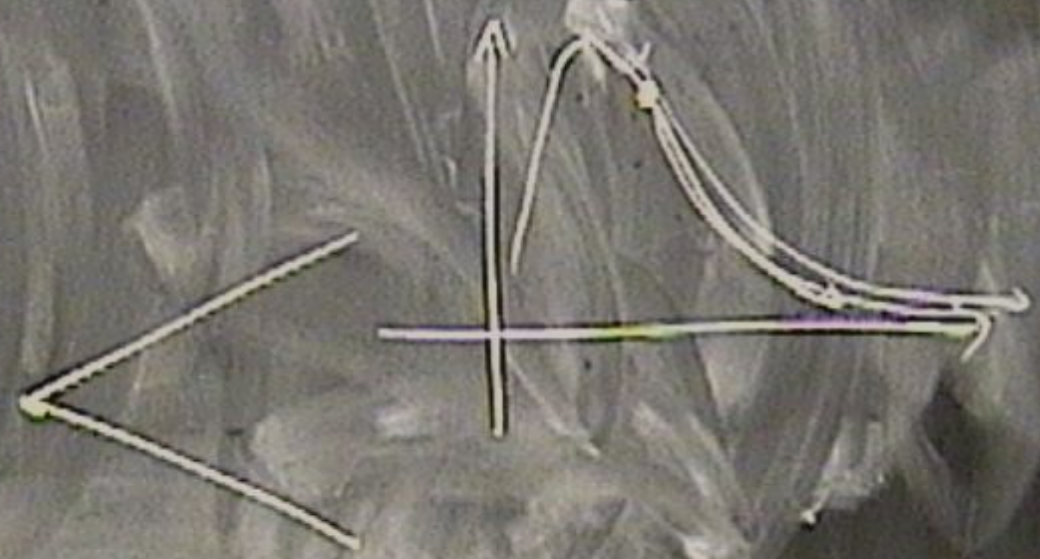

$ds^2 = -R'^2(r)\,dt^2 + dr^2 + R^2(r)\,d\theta^2$
$R(r) \to (\Sigma r$
$R' \to \Sigma$

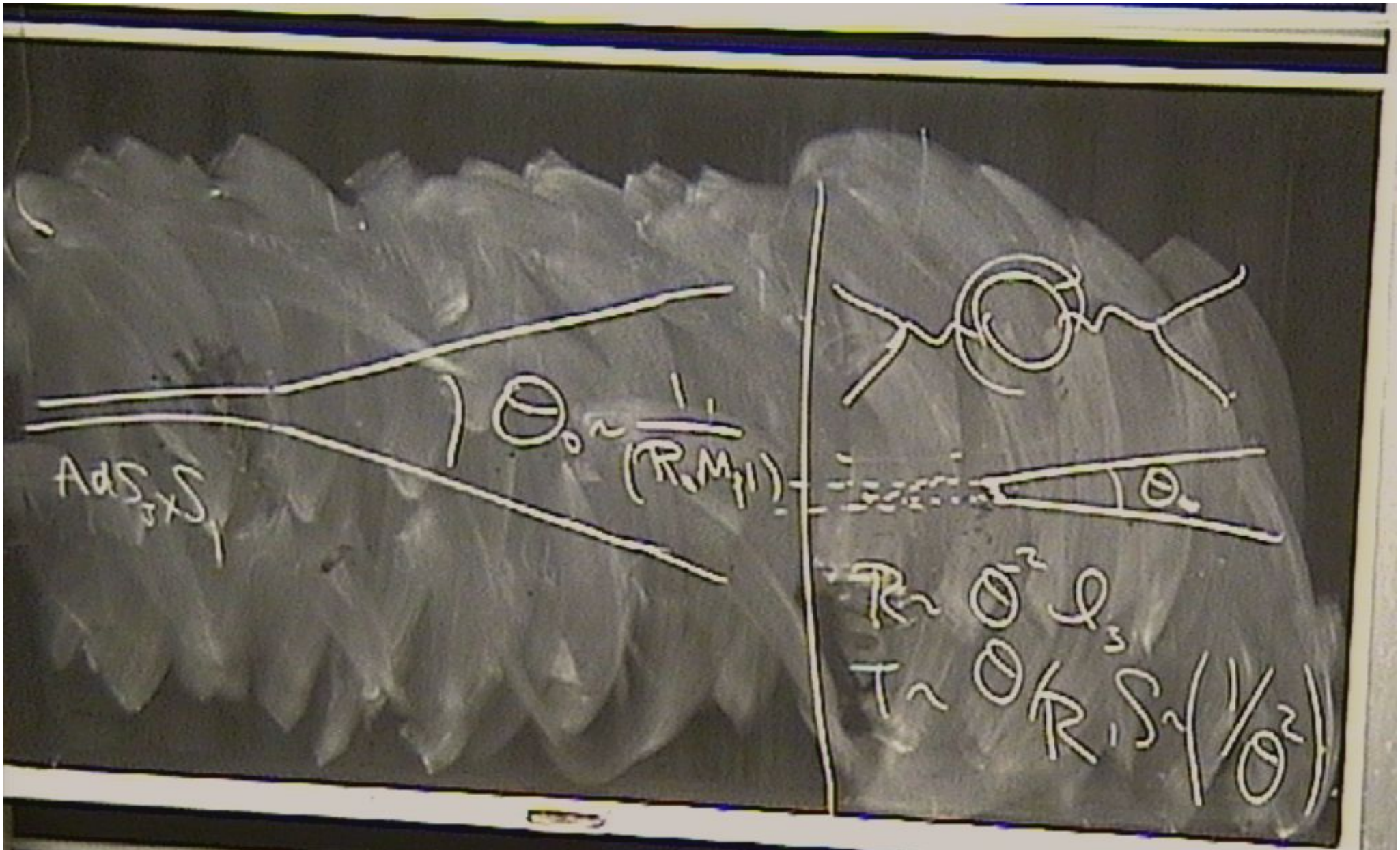

AdS3×S1
θ0 ~ 1/(R1M11)
θ0
R ~ θ^-2 ℓs
T ~ θ/R1 S ~ (1/θ^2)

$$ds^2 = -R'(r)^2\, dt^2 + dr^2 + R^2(r)\, d\theta^2$$

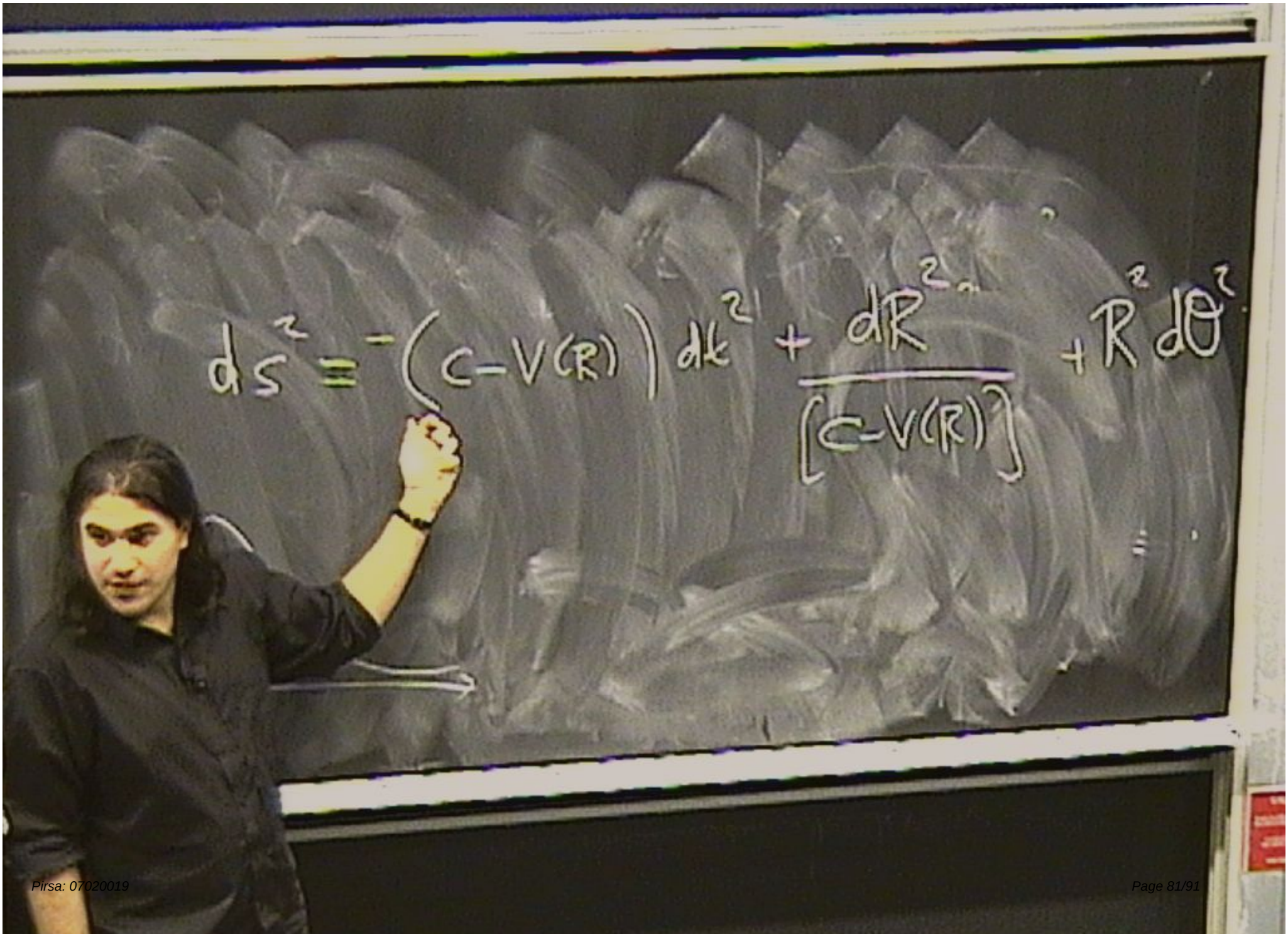
$R(r) \to \sqrt{\Sigma}\, r$

$R' \to 2$

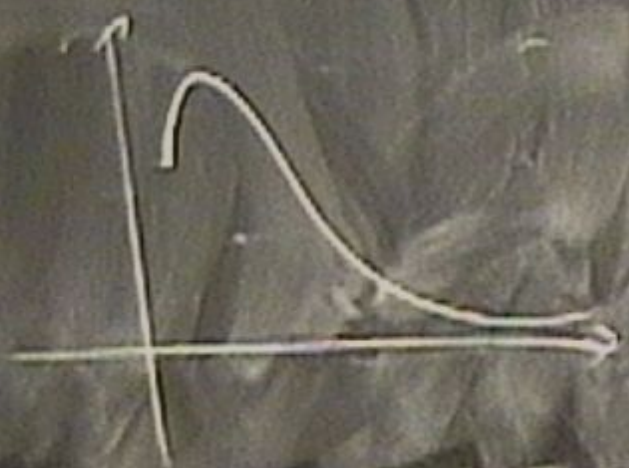



$AdS_3 \times S_1$
$\theta_0 \sim \frac{1}{(R M_{11})}$
θ_0
$R \sim \theta^2 \ell_s$
$T \sim \theta R_1 S \sim (1/\theta^2)$

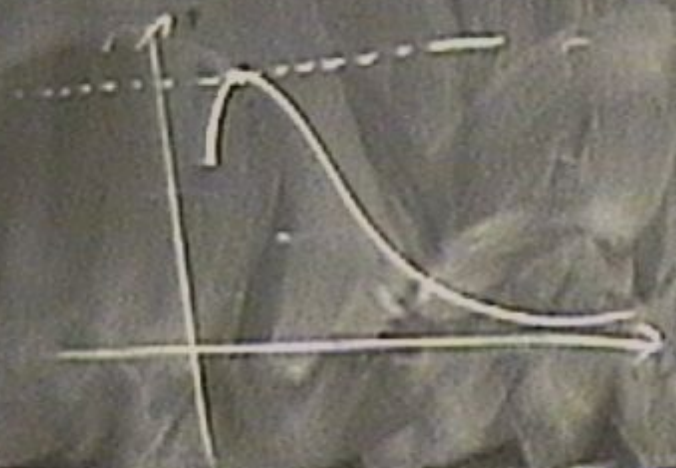
$$ds^2 = -\left(c - V(R)\right) dt^2 + \frac{dR^2}{\left[c - V(R)\right]} + R^2 d\theta^2$$

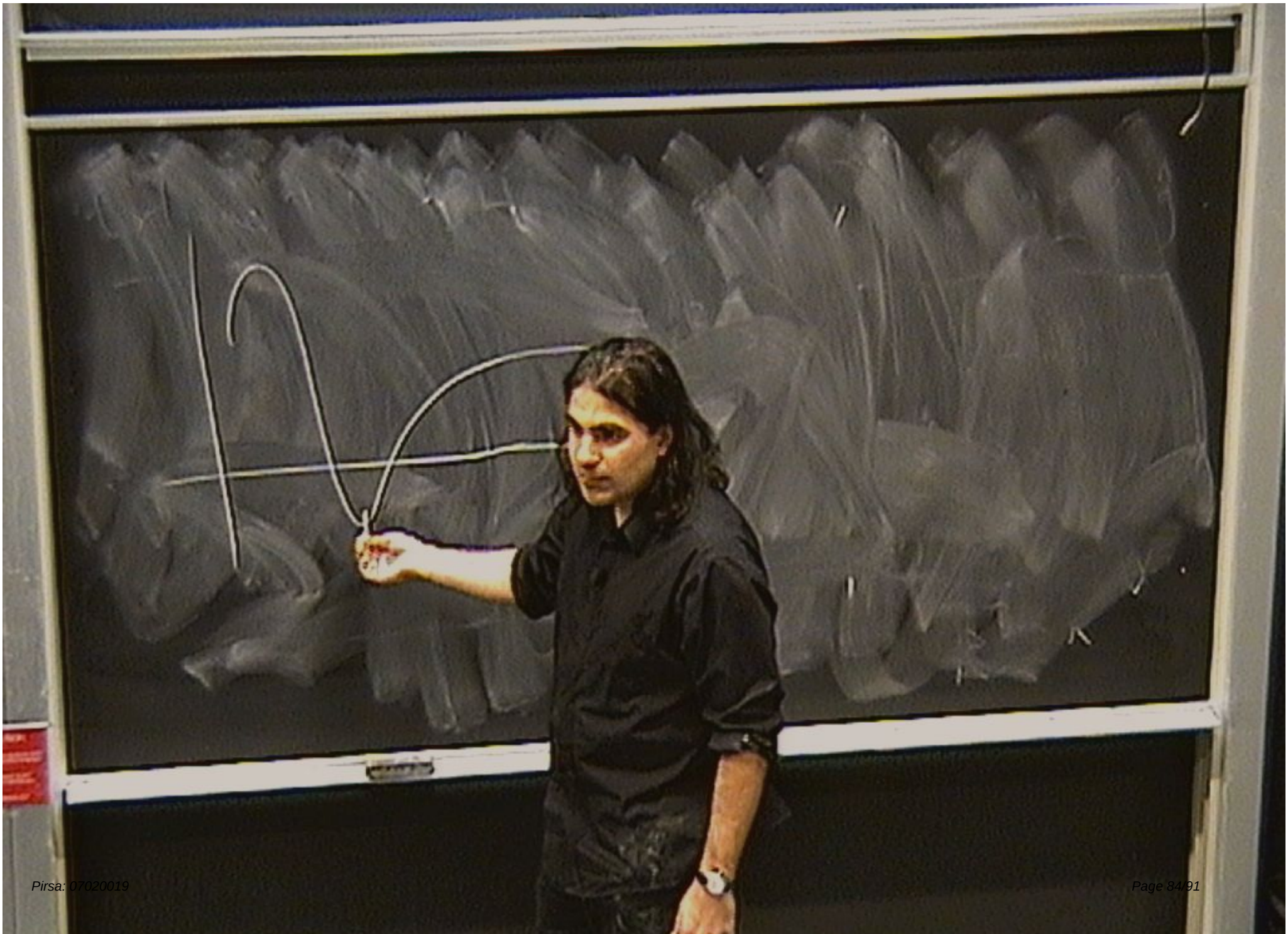

$ds^2 = -(c - V(R))\,dt^2 + \frac{dR^2}{[c - V(R)]} + R^2 d\theta^2$

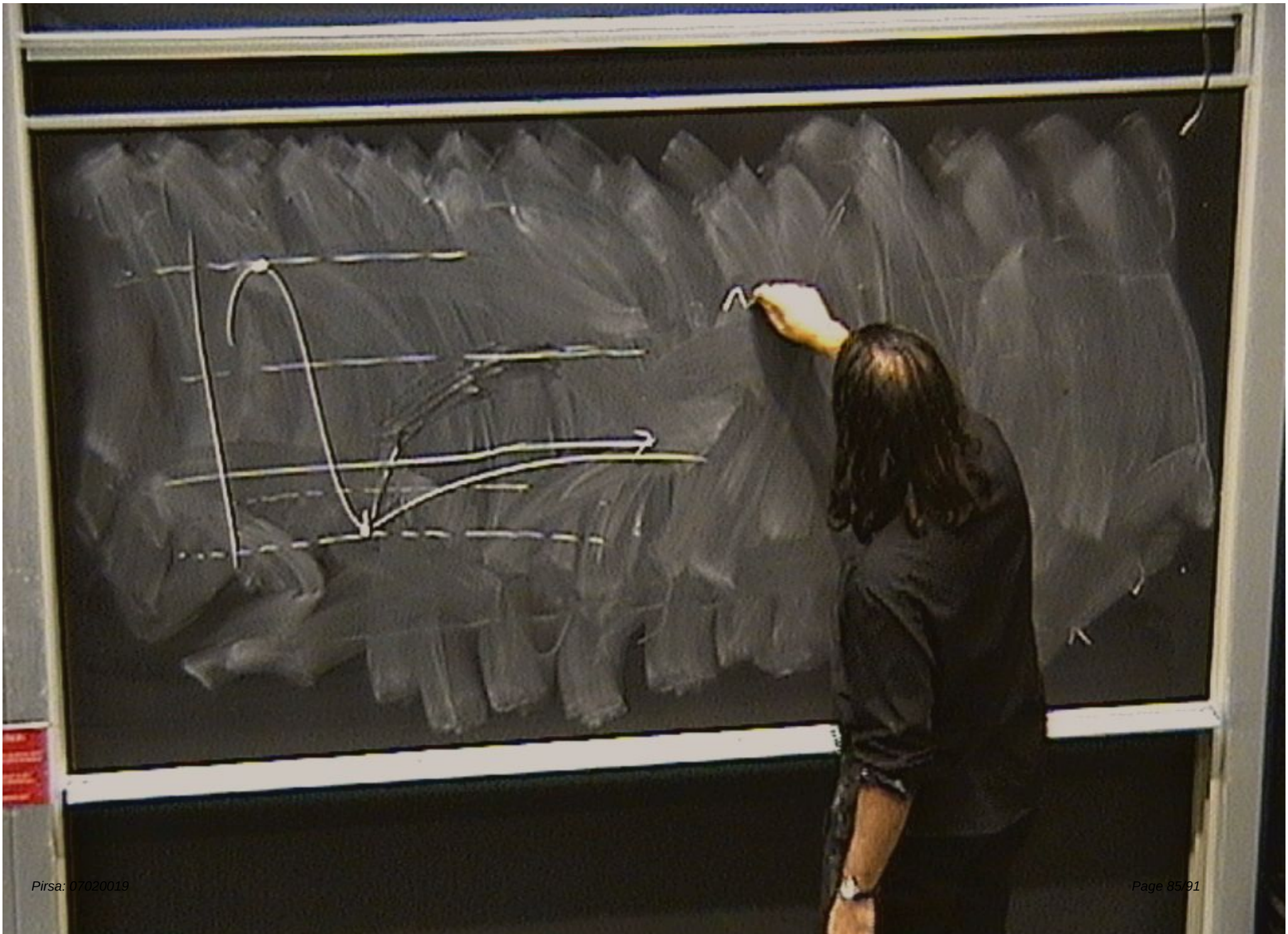
$$ds^2 = -\left(c - V(R)\right) dt^2 + \frac{dR^2}{\left[c - V(R)\right]} + R^2 d\theta^2$$

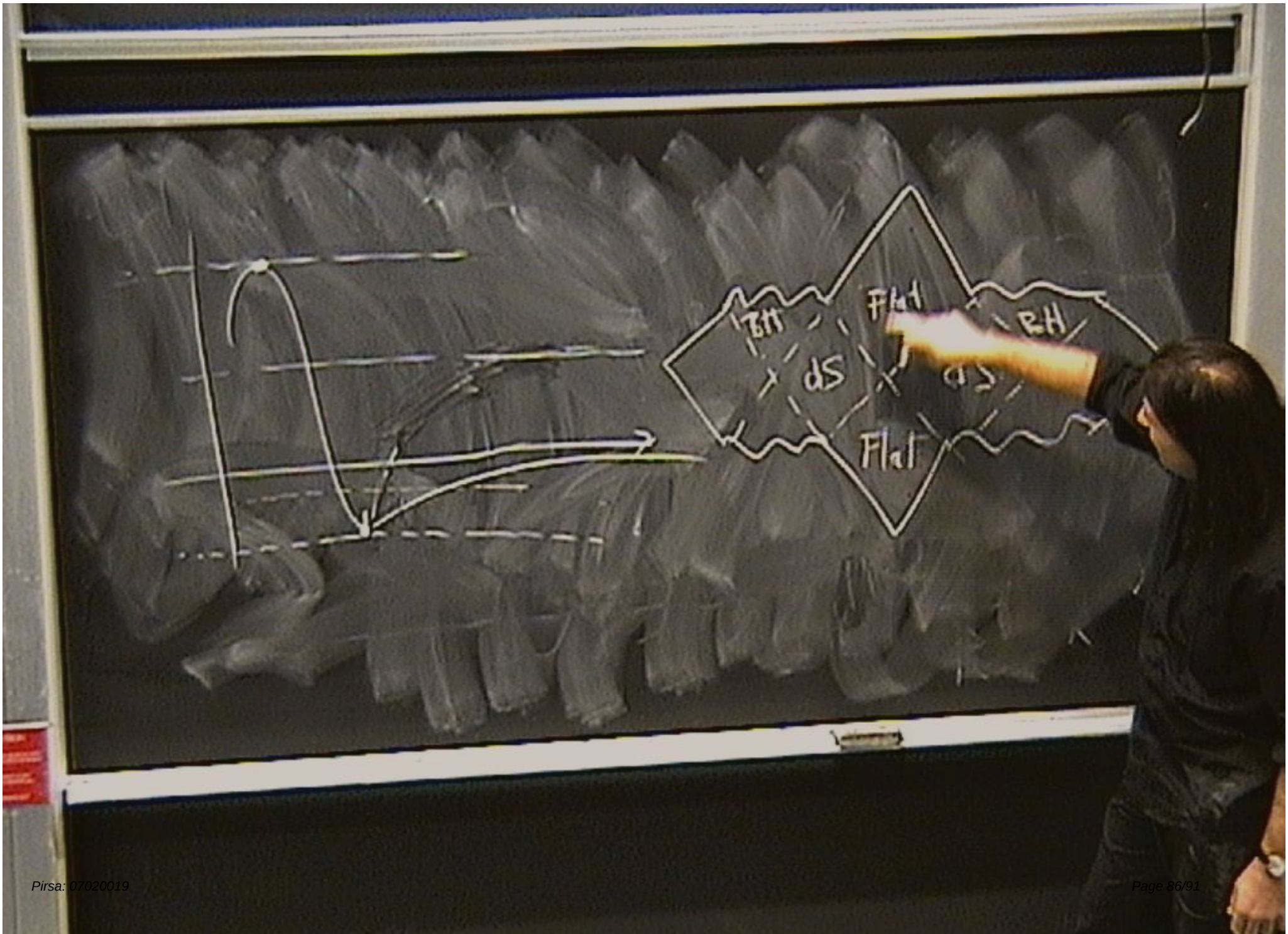


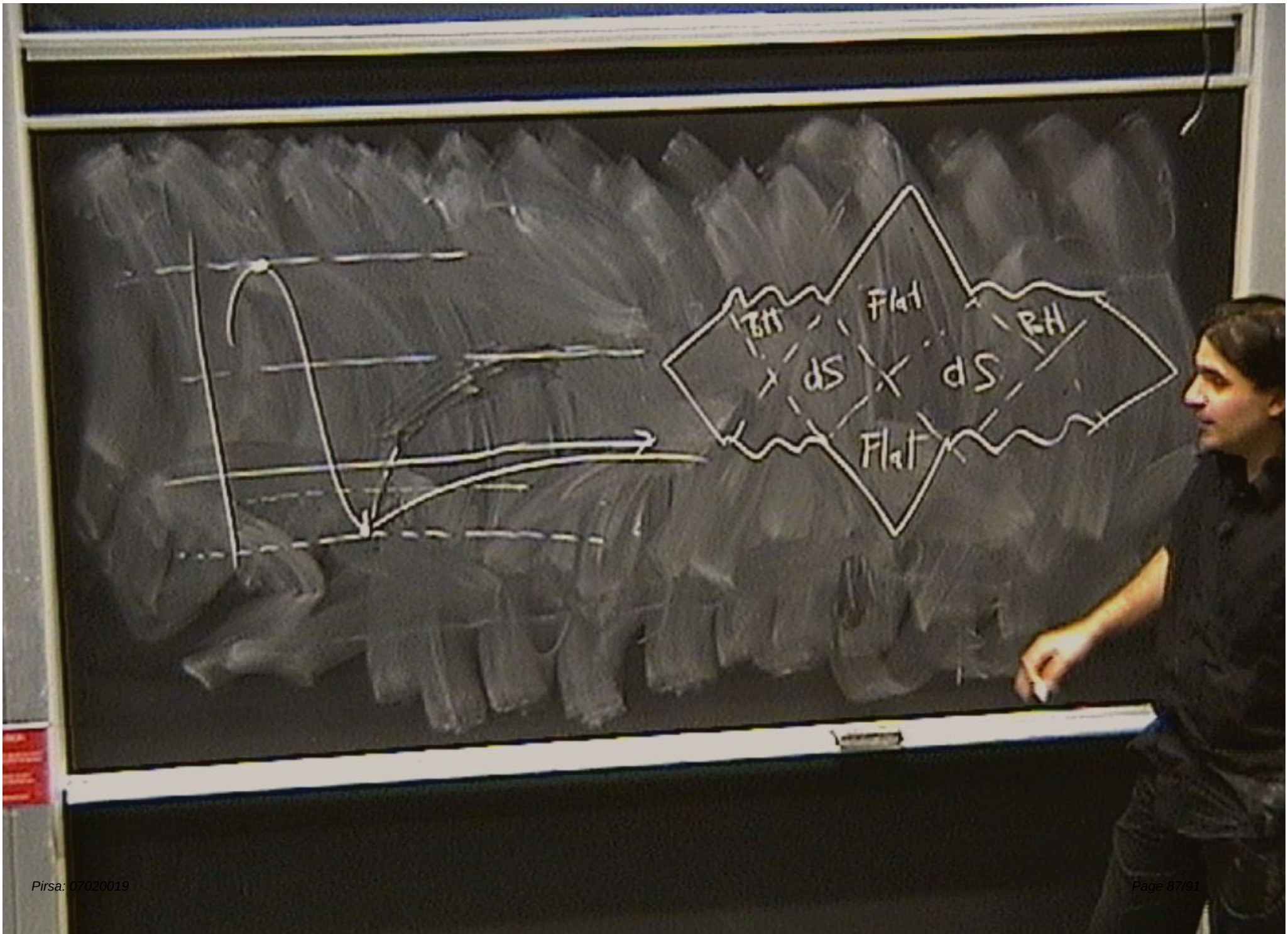
$$ds^2 = -\left(c - V(R)\right) dt^2 + \frac{dR^2}{\left[c - V(R)\right]} + R^2 d\theta^2$$








BH
Flat
BH
dS
dS
Flat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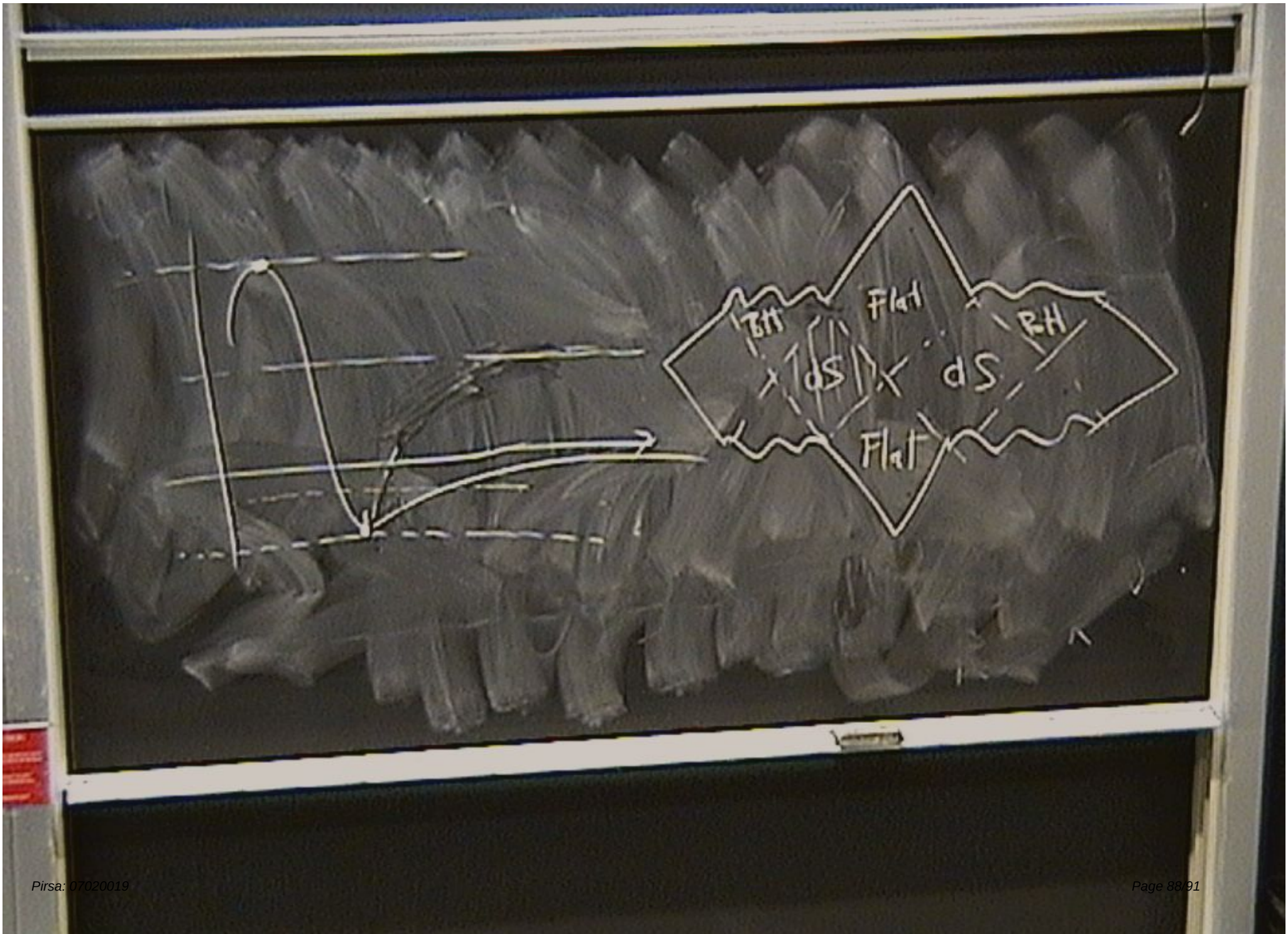
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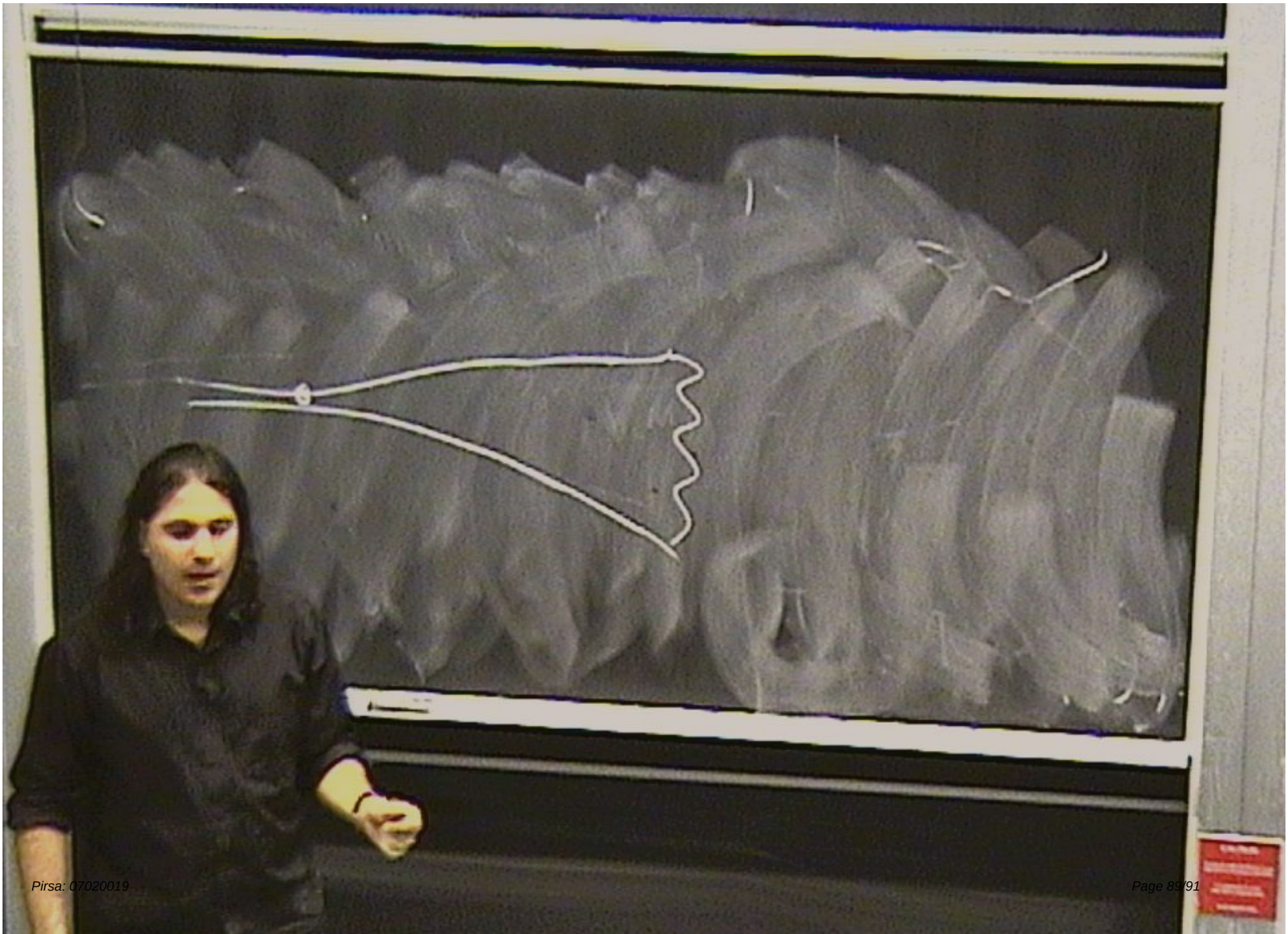

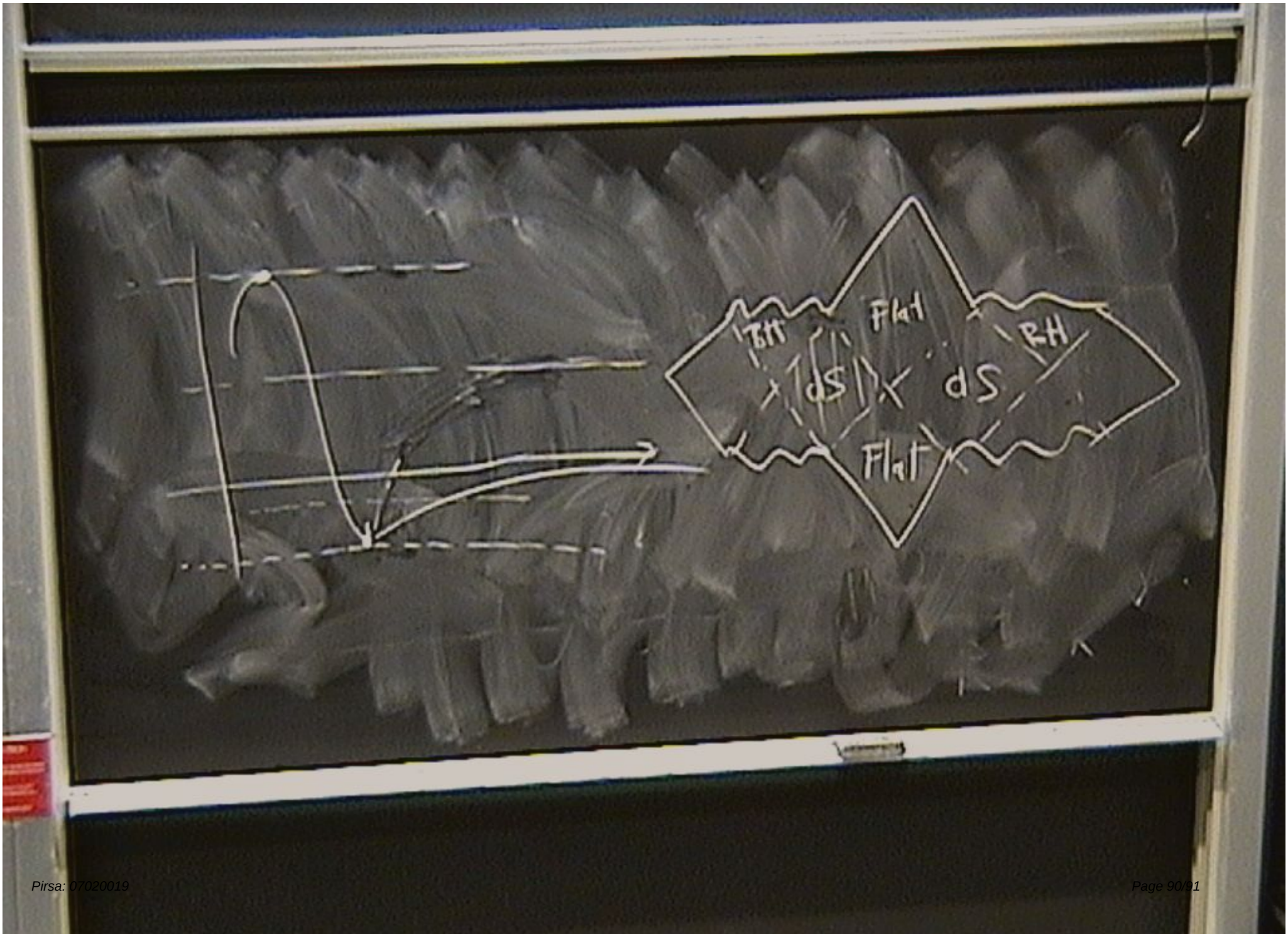
BH
Flat
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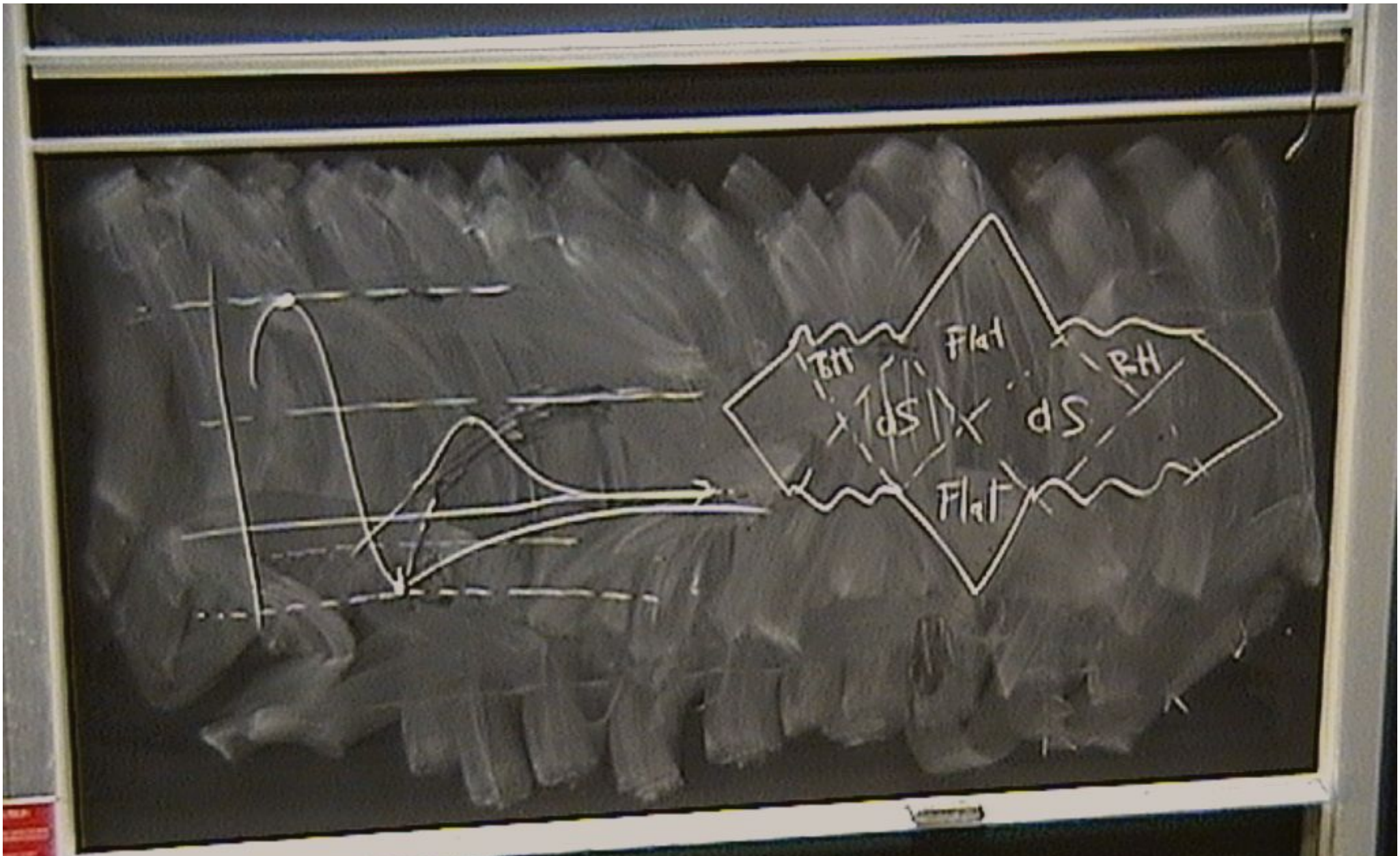
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