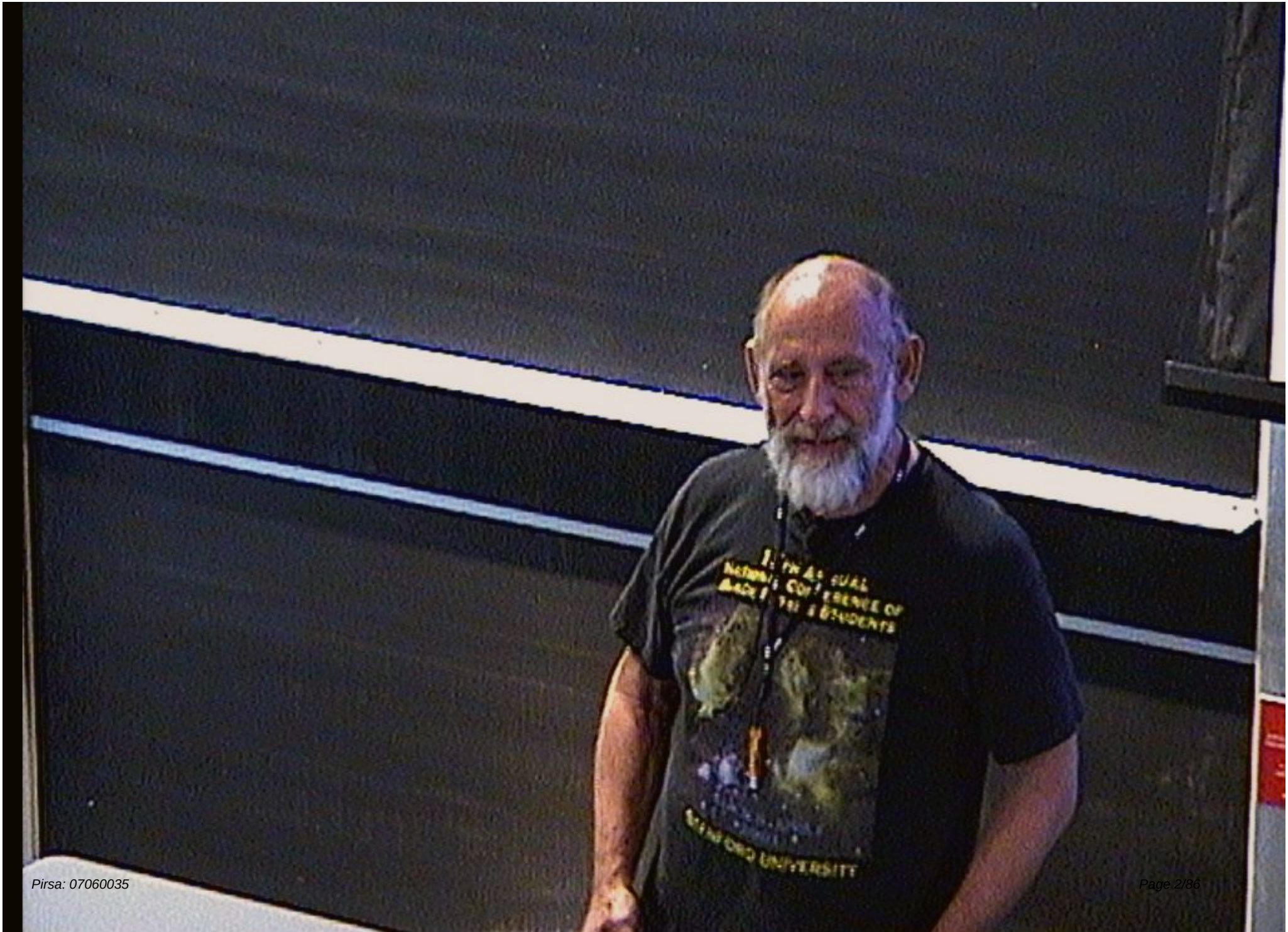
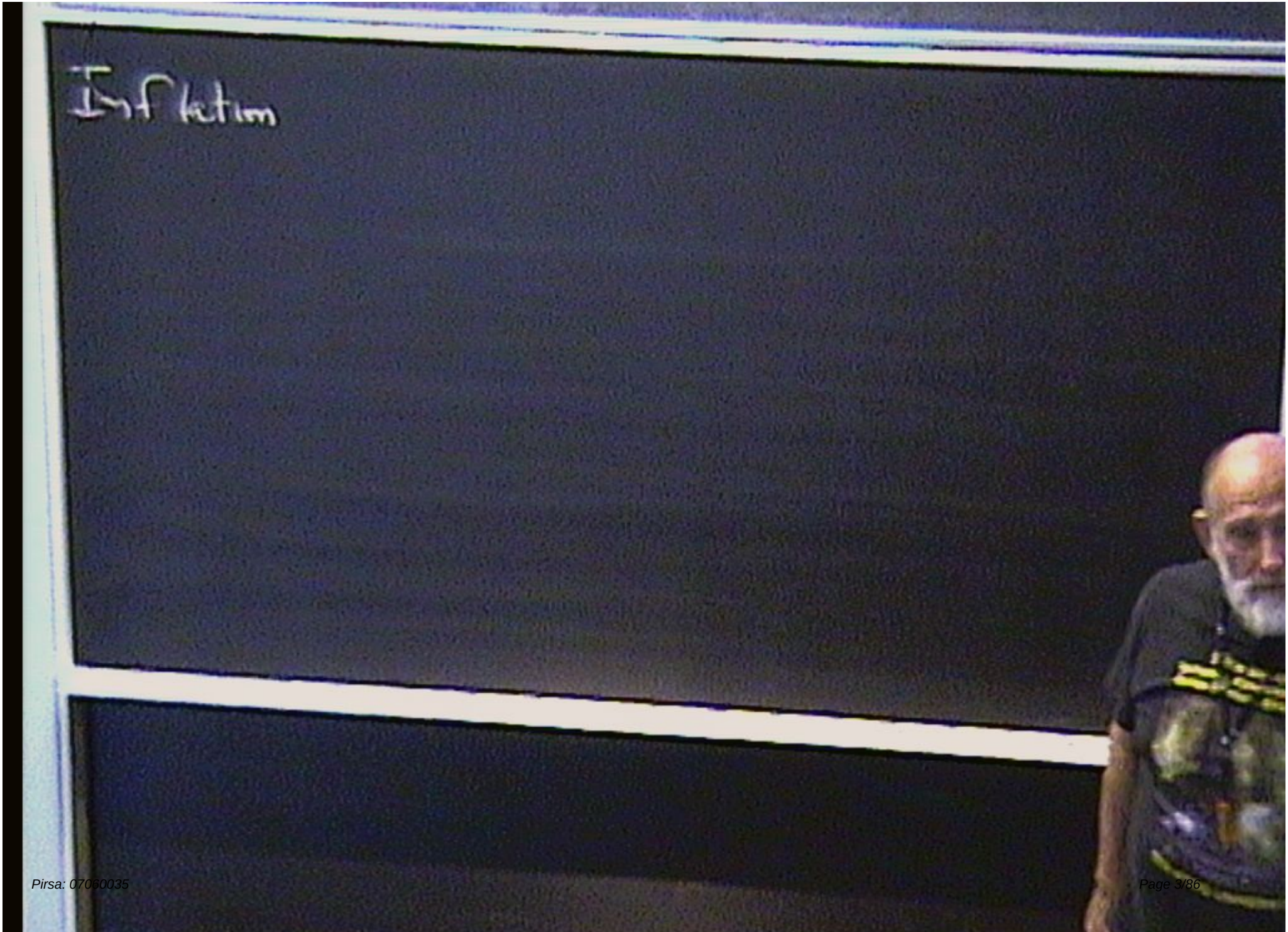
Title: Black Holes & Holography - Class 7

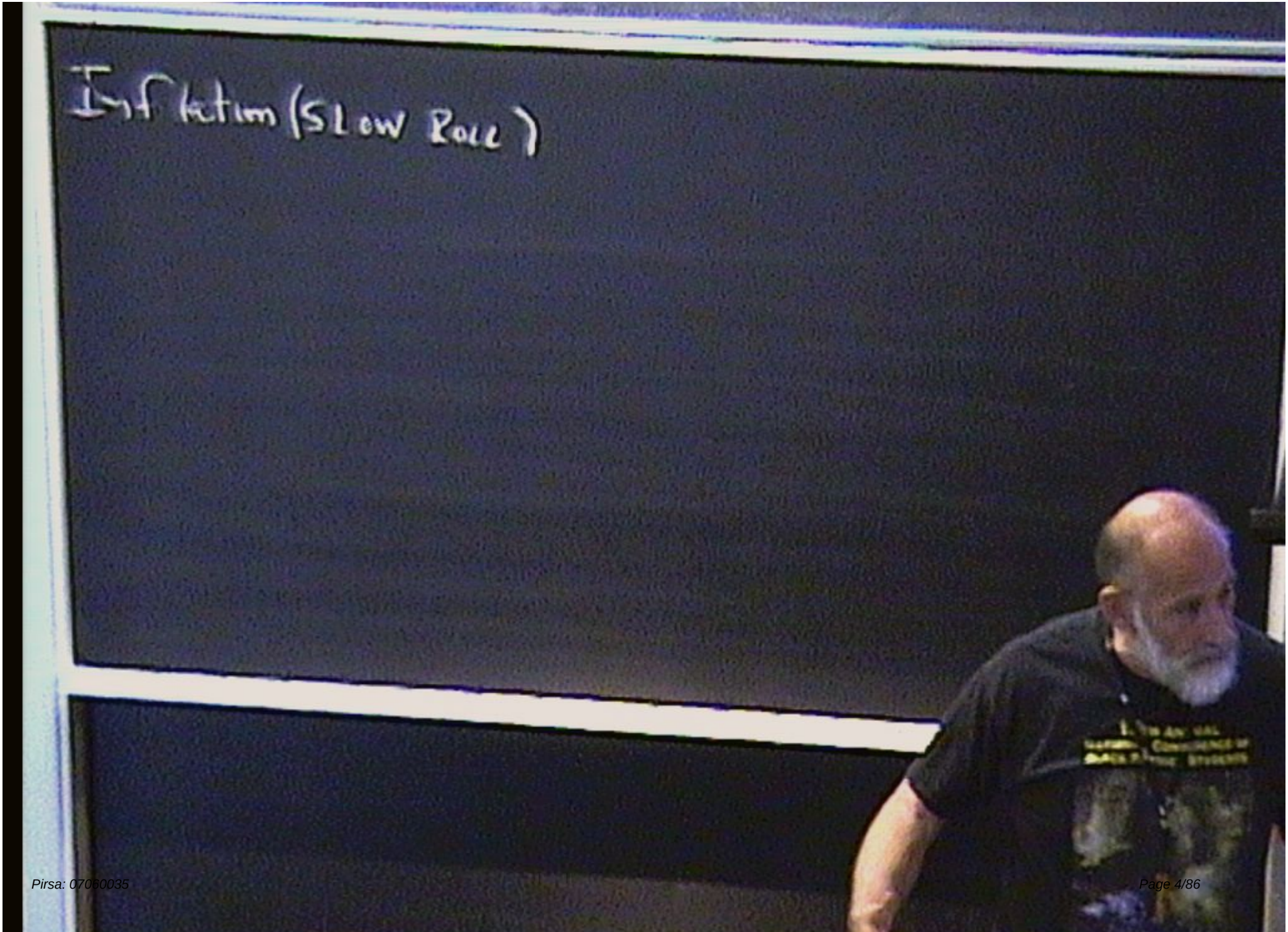
Date: Jun 08, 2007 02:00 PM

URL: http://pirsa.org/07060035

Abstract:

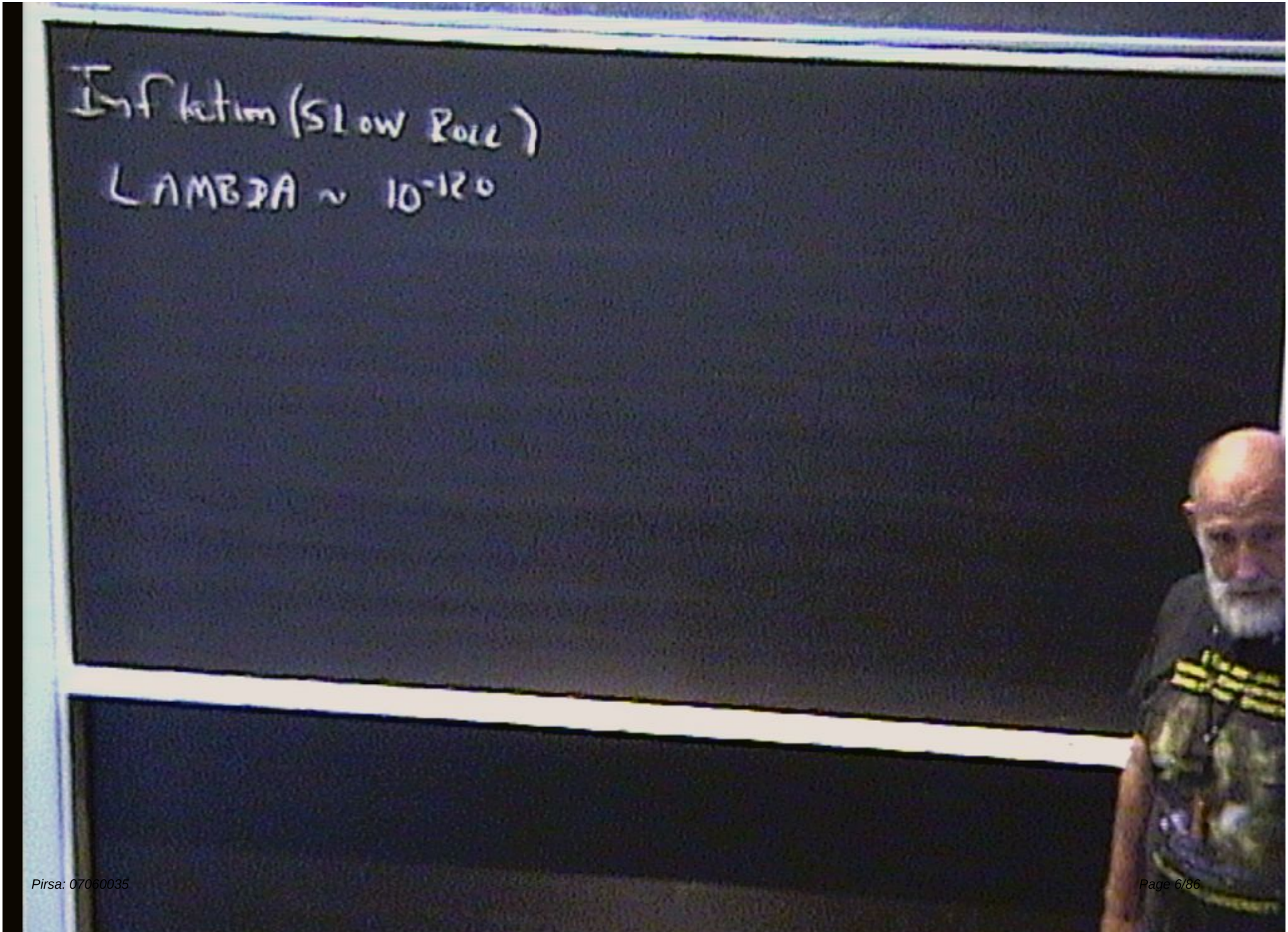


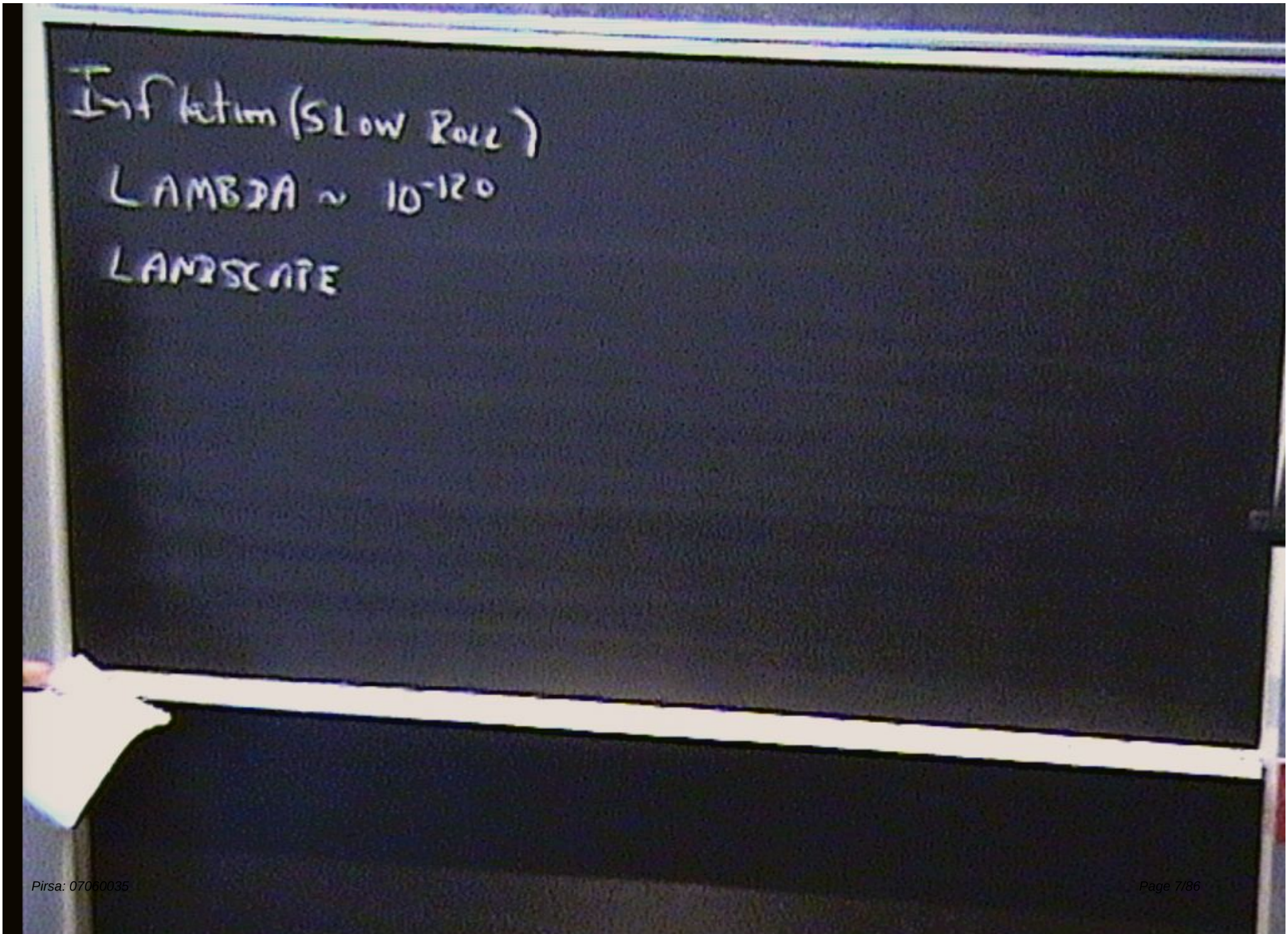

Inflation

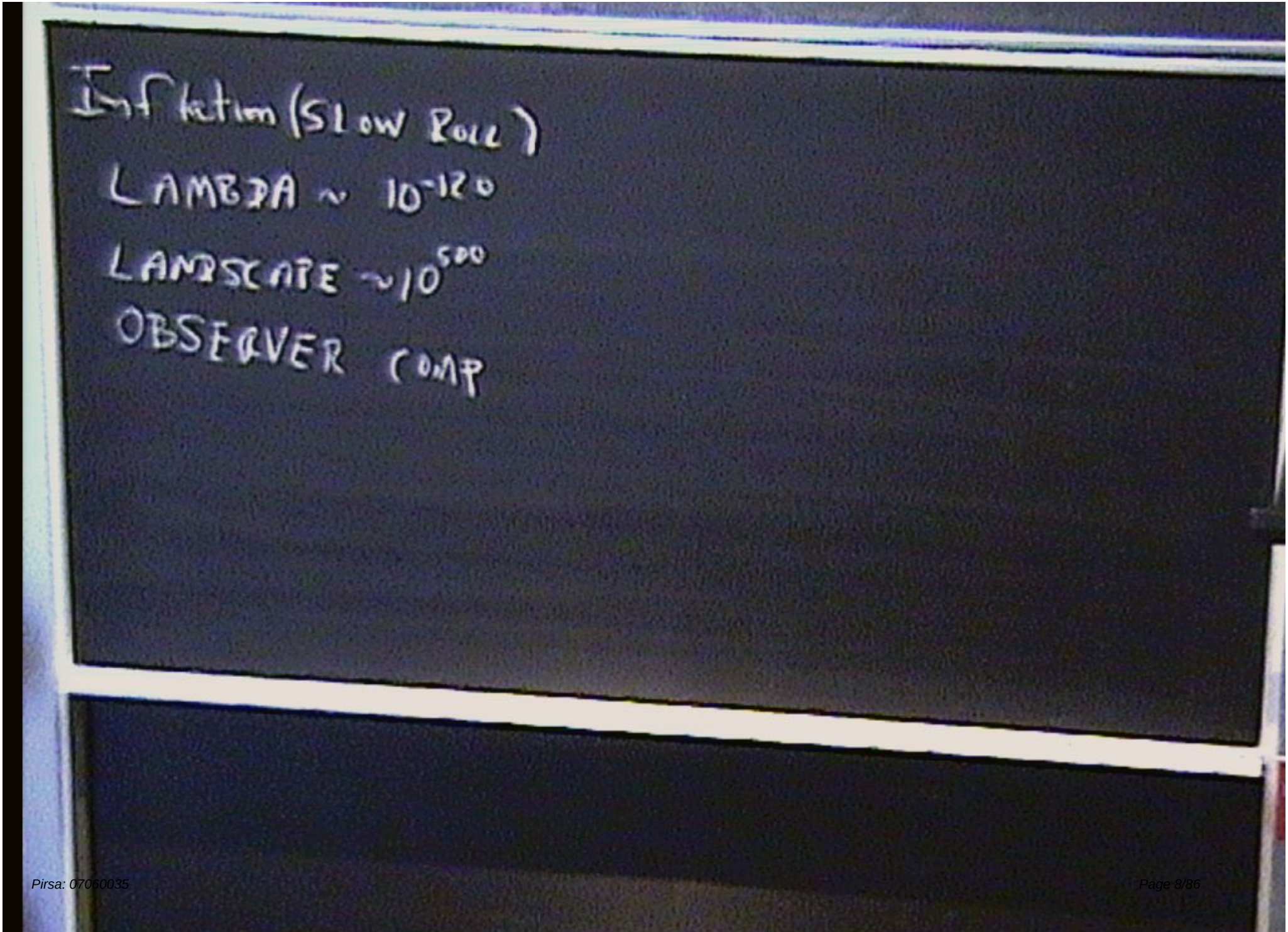

Inflation (Slow Roll)

Inflation (Slow Roll)

LAMBDA


Inflation (Slow Roll)
LAMBDA ~ 10^{-120}


Inflation (SLOW Roll)
LAMBDA ~ 10^{-120}
LANDSCAPE


Inflation (SLOW Roll)
LAMBDA ~ 10^{-120}
LANDSCAPE ~ 10^{500}
OBSERVER COMP

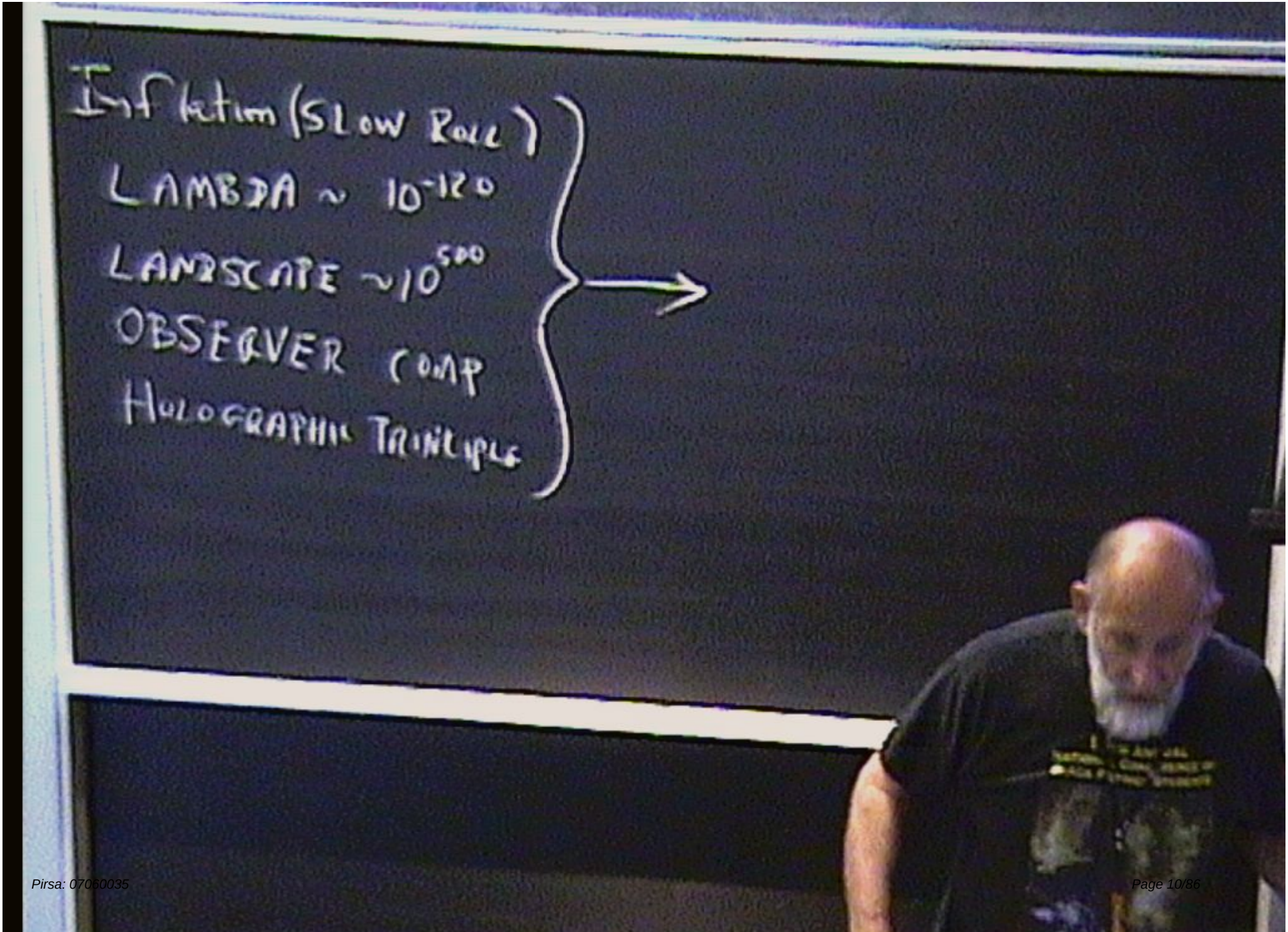
Inflation (SLOW ROLL)

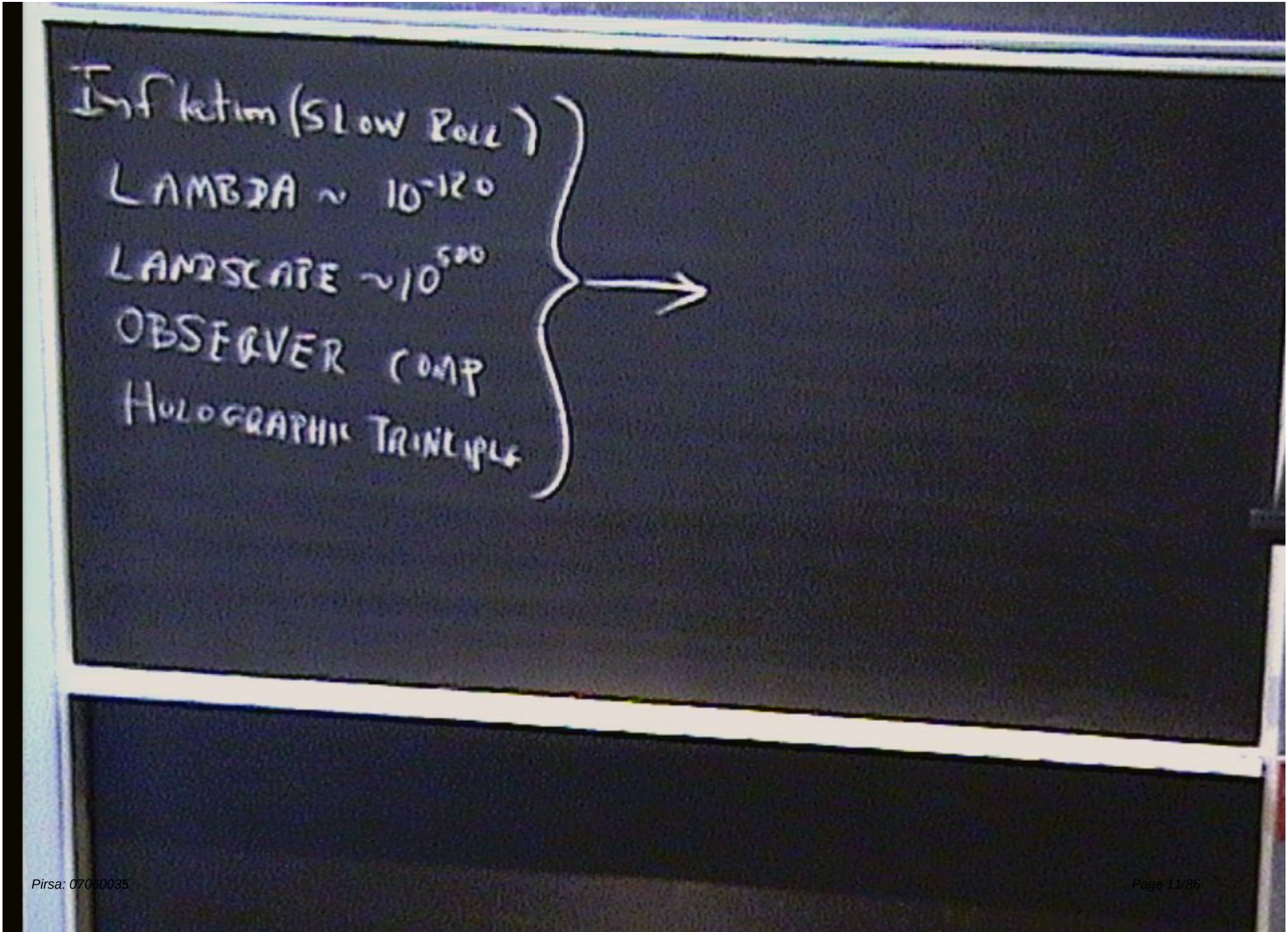
LAMBDA $\sim 10^{-120}$

LANDSCAPE $\sim 10^{500}$

OBSERVER COMP

HOLOGRAPHIC TRINITY


Inflation (SLOW Roll)
LAMBDA ~ 10^{-120}
LANDSCAPE ~ 10^{500}
OBSERVER COMP
HOLOGRAPHIC TRINCIPLE


Inflation (SLOW ROLL)
LAMBDA ~ 10^{-120}
LANDSCAPE ~ 10^{500}
OBSERVER COMP
HOLOGRAPHIC TRINCIPLE

Inflation (SLOW ROLL)

LAMBDA ~ 10^{-120}

LANDSCAPE ~ 10^{500}

OBSERVER COMP

HOLOGRAPHIC TRINCIPLE

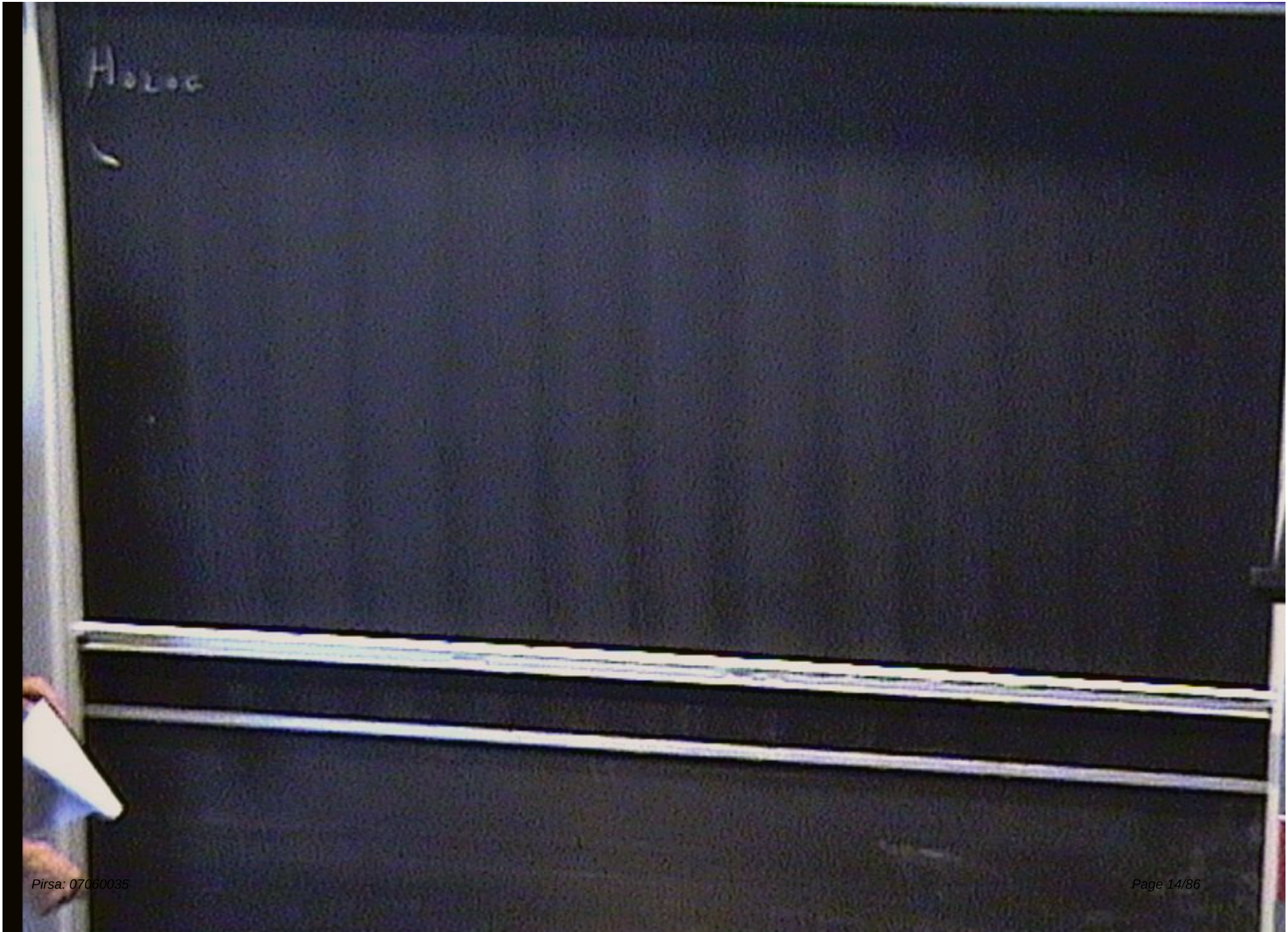
Inflation (SLOW ROLL)

LAMBDA ~ 10^{-120}

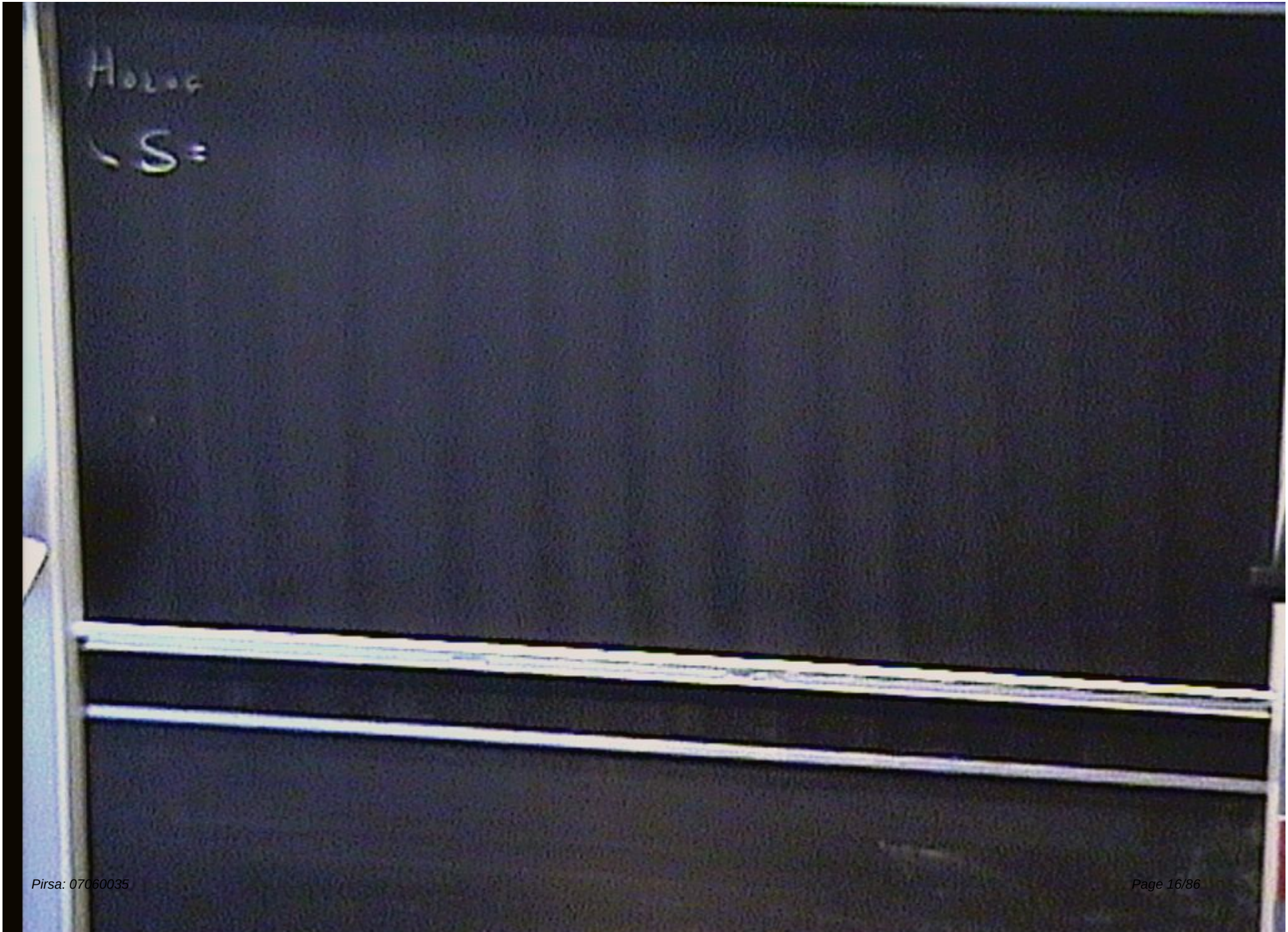
LANDSCAPE ~ 10^{500}

~~OBSERVER (ANTH~~

HOLOGRAPHIC PRINCIPLE


H₀Loc

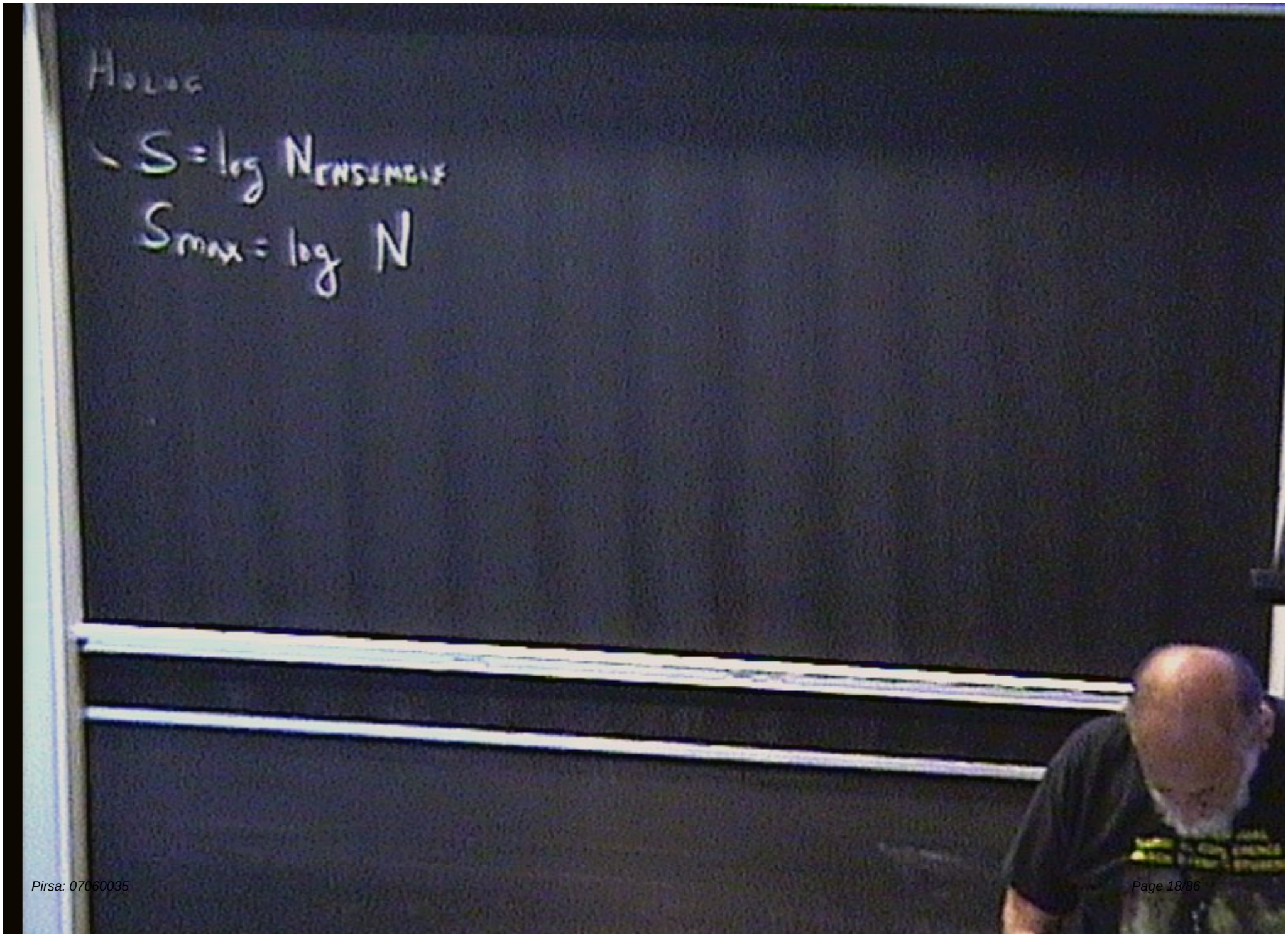

H0Loc
~S

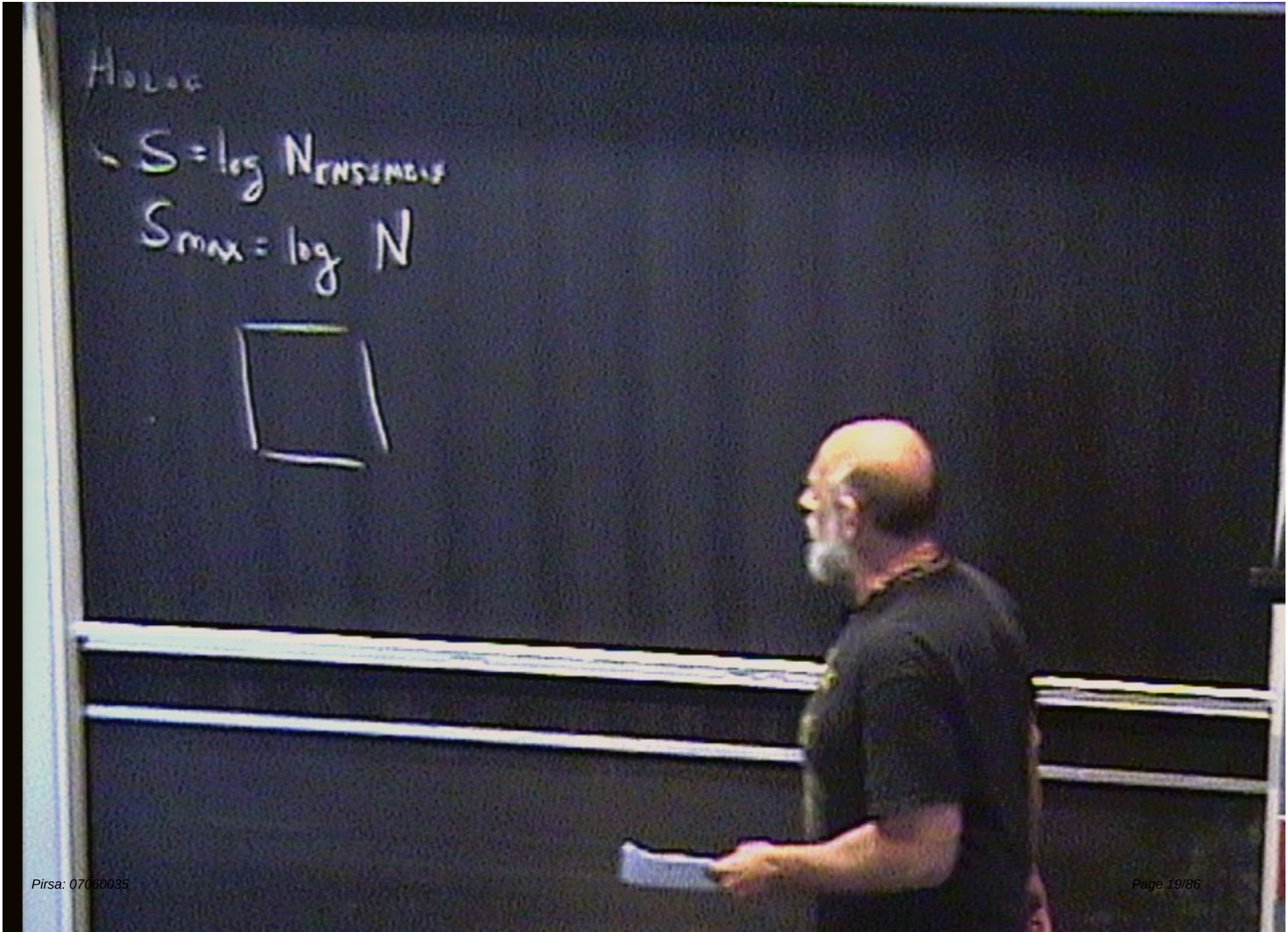

H
S=

$H_{0 \log}$

$S = \log N_{\text{ENSEMBLE}}$

$S_{max} = \log$


$S = \log N_{\text{ENSEMBLE}}$
$S_{max} = \log N$


$S = \log N_{ENSEMBLE}$
$S_{max} = \log N$

Holog

$S = \log N_{ENSEMBLE}$

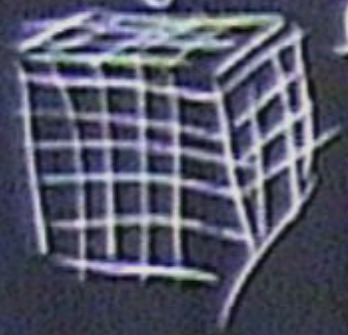
$S_{max} = \log N$

Voxel

Horac

- $S = \log N_{ENSEMBLE}$

$S_{max} = \log N$

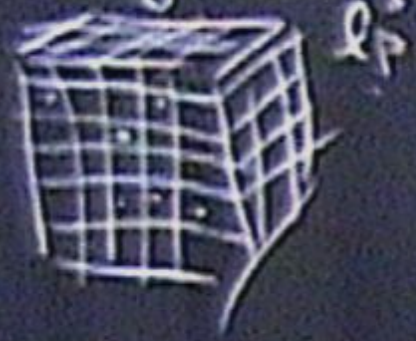
Voxel  ℓ_P^3

Holog

- $S = \log N_{\text{ENSEMBLE}}$

$S_{max} = \log N$

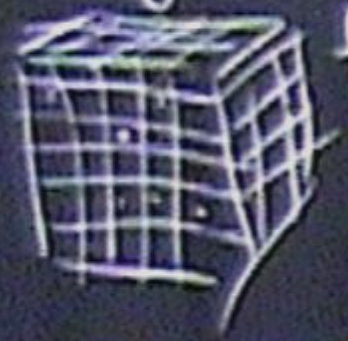
Voxel



Holog

- $S = \log N_{ENSEMBLE}$

$S_{max} = \log N$

Voxel  ℓ_p^3

$N = 2^{\frac{A}{4}}$

H_{Local}

$S = \log N_{ENSEMBLE}$

$S_{max} = \log N$

Voxel

ℓ_p^3

$N = 2^{\frac{V}{\ell_p^3}}$

$S_{max} = \frac{V}{\ell_p^3}$

H_{Log}

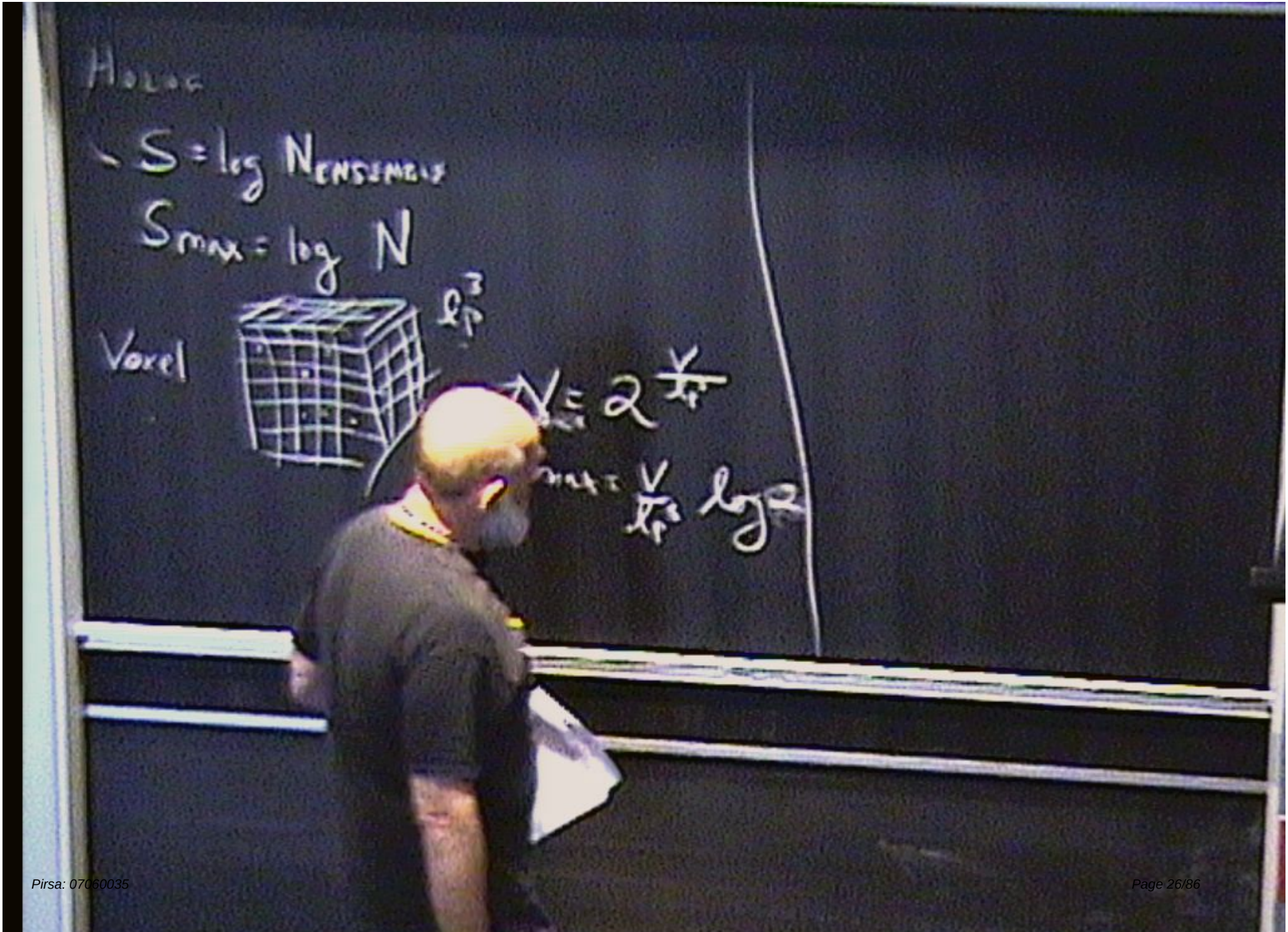
$S = \log N_{ENSEMBLE}$

$S_{max} = \log N$

Voxel  ℓ_p^3

$N = 2^{\frac{V}{\ell_p^3}}$

$S_{max} = \frac{V}{\ell_p^3} \log 2$


Holog
$S = \log N_{ENSEMBLE}$
$S_{max} = \log N$
Voxel
ℓ_p^3
$N = 2^{\frac{V}{\ell_p^3}}$
$S_{max} = \frac{V}{\ell_p^3} \log 2$

H_{Holo}

$S = \log N_{ENSEMBLE}$

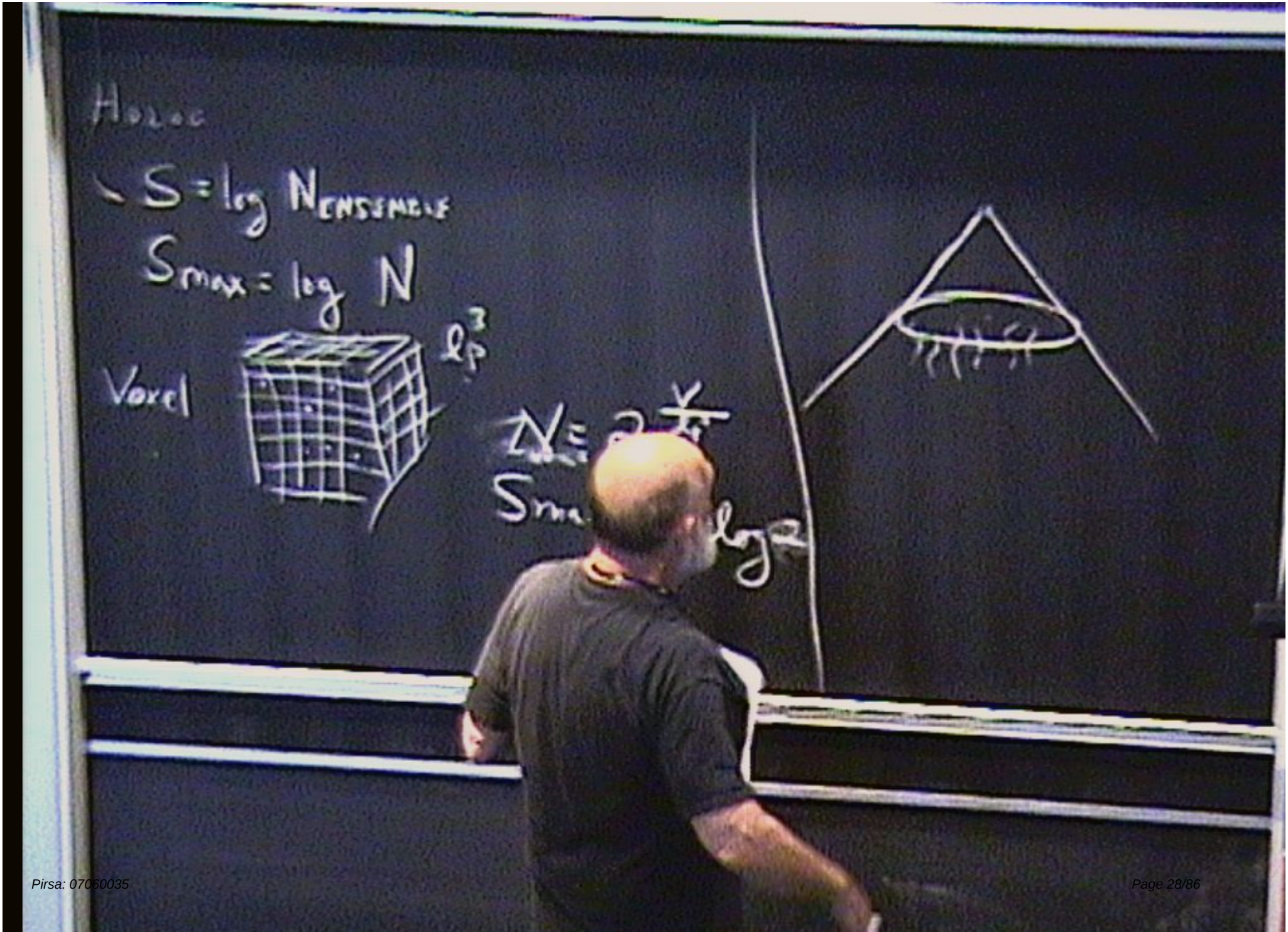
$S_{max} = \log N$

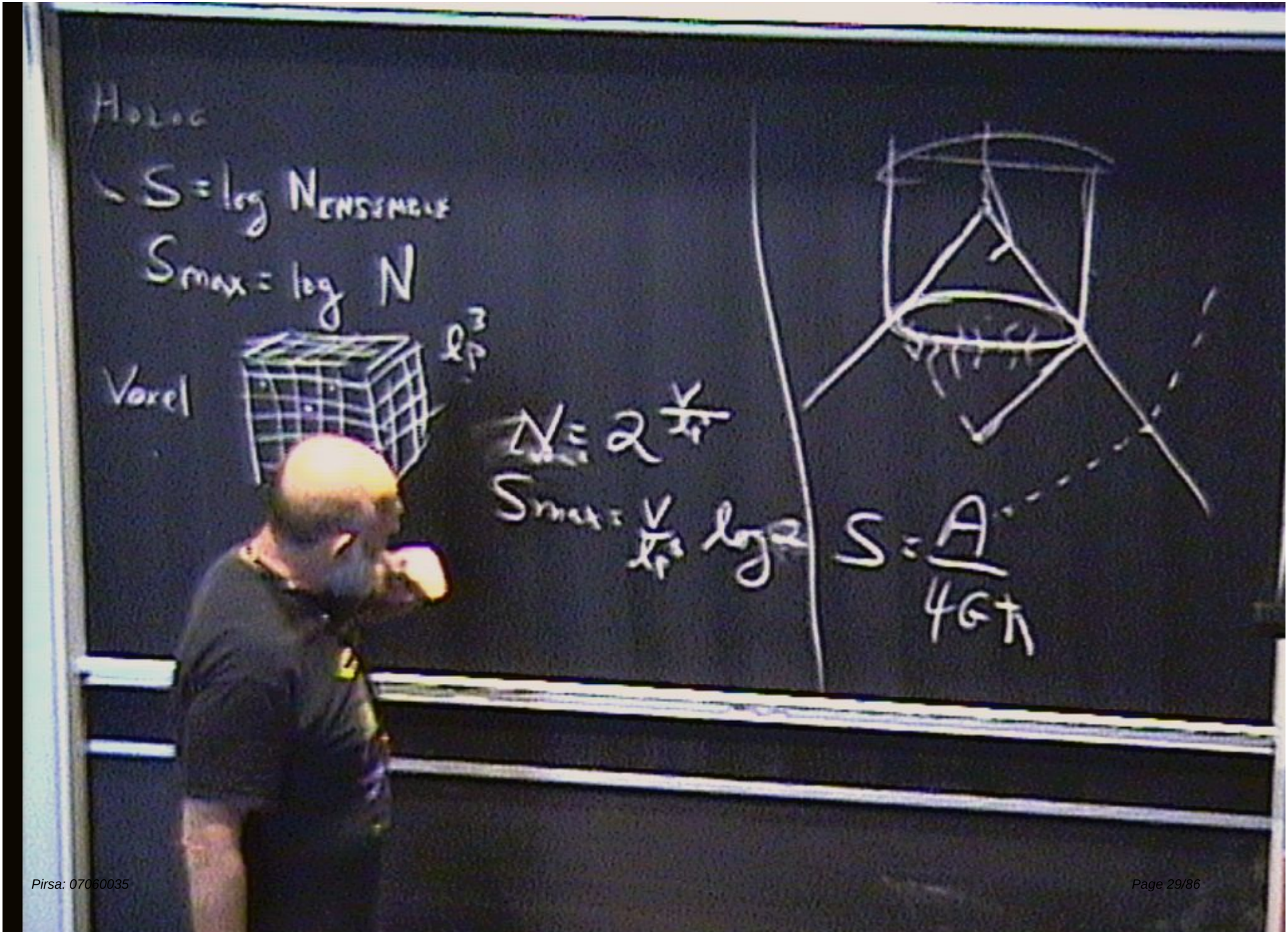
ℓ_P^3

Voxel

$N = 2^{\frac{V}{\ell_P^3}}$

$S_{max} = \frac{V}{\ell_P^3} \log 2$

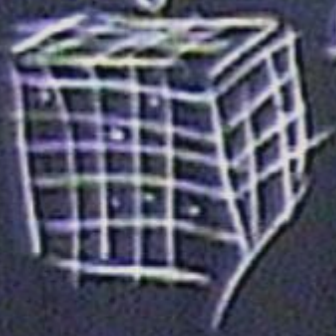

Holog
$S = \log N_{ENSEMBLE}$
$S_{max} = \log N$
Voxel
ℓ_p^3


Holog
$S = \log N_{ENSEMBLE}$
$S_{max} = \log N$
Voxel
ℓ_P^3
$N = 2^{\frac{V}{\ell_P^3}}$
$S_{max} = \frac{V}{\ell_P^3} \log 2$
$S = \frac{A}{4G\hbar}$

H_{Boltz}

$S = \log N_{ENSEMBLE}$

$S_{max} = \log N$

Voxel  ℓ_P^3

$N = 2^{\frac{V}{\ell_P^3}}$

$S_{max} = \frac{V}{\ell_P^3} \log 2$

$S = \frac{A}{4G\hbar}$

Horoc

$S = \log N_{ENSEMBLE}$

$S_{max} = \log N$

Voxel

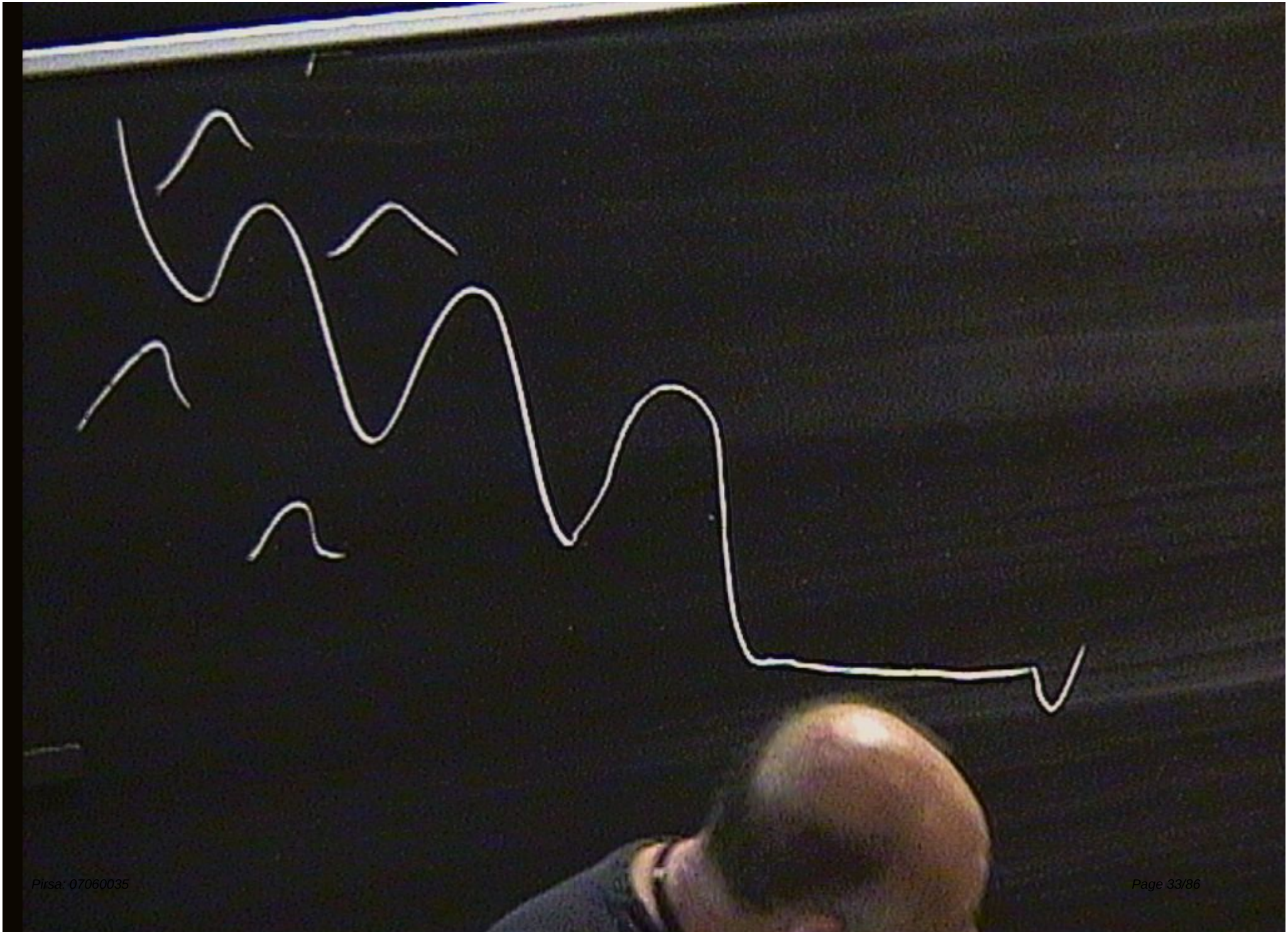
ℓ_P^3

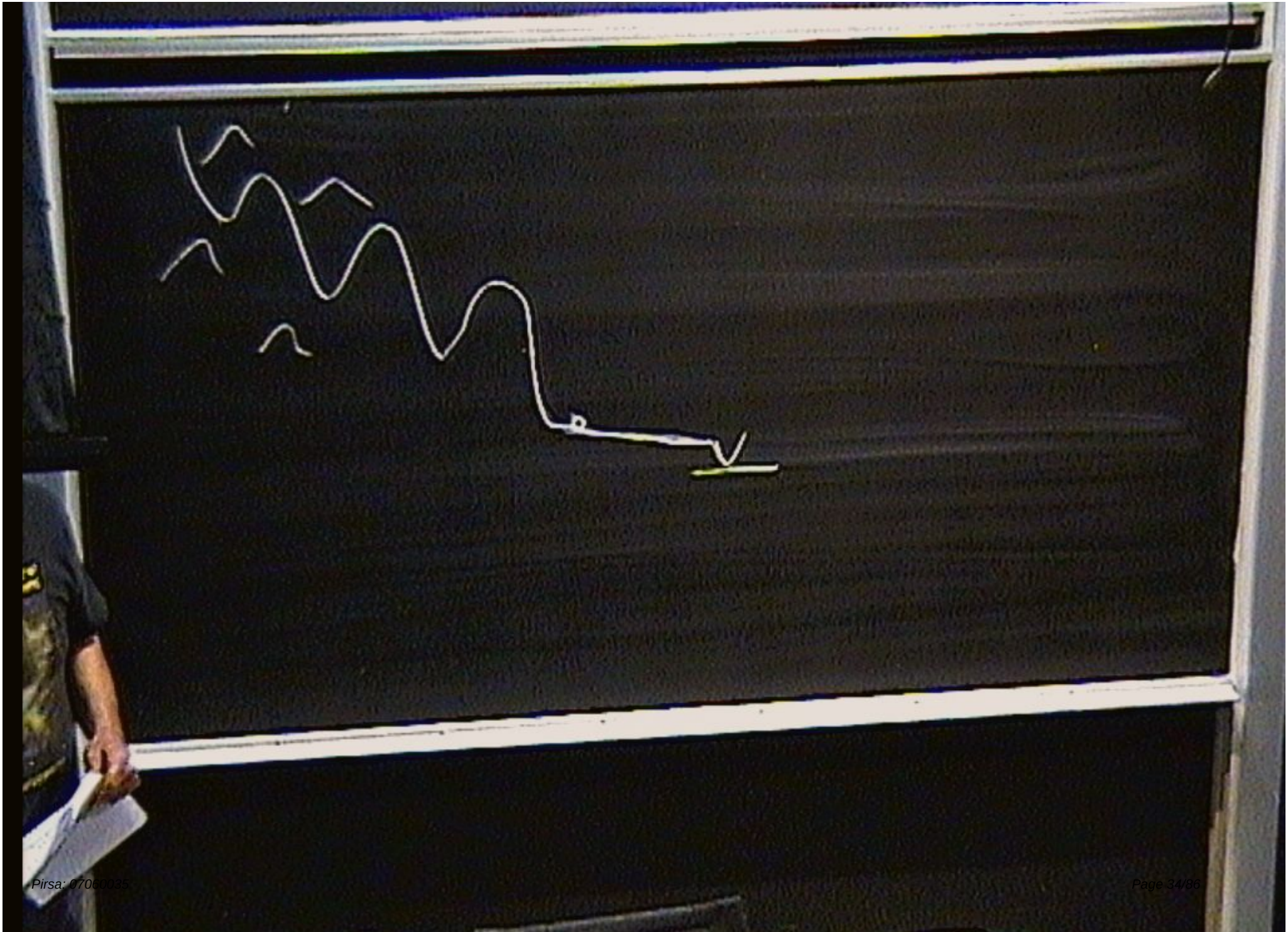
$N = 2^{\frac{V}{\ell_P^3}}$

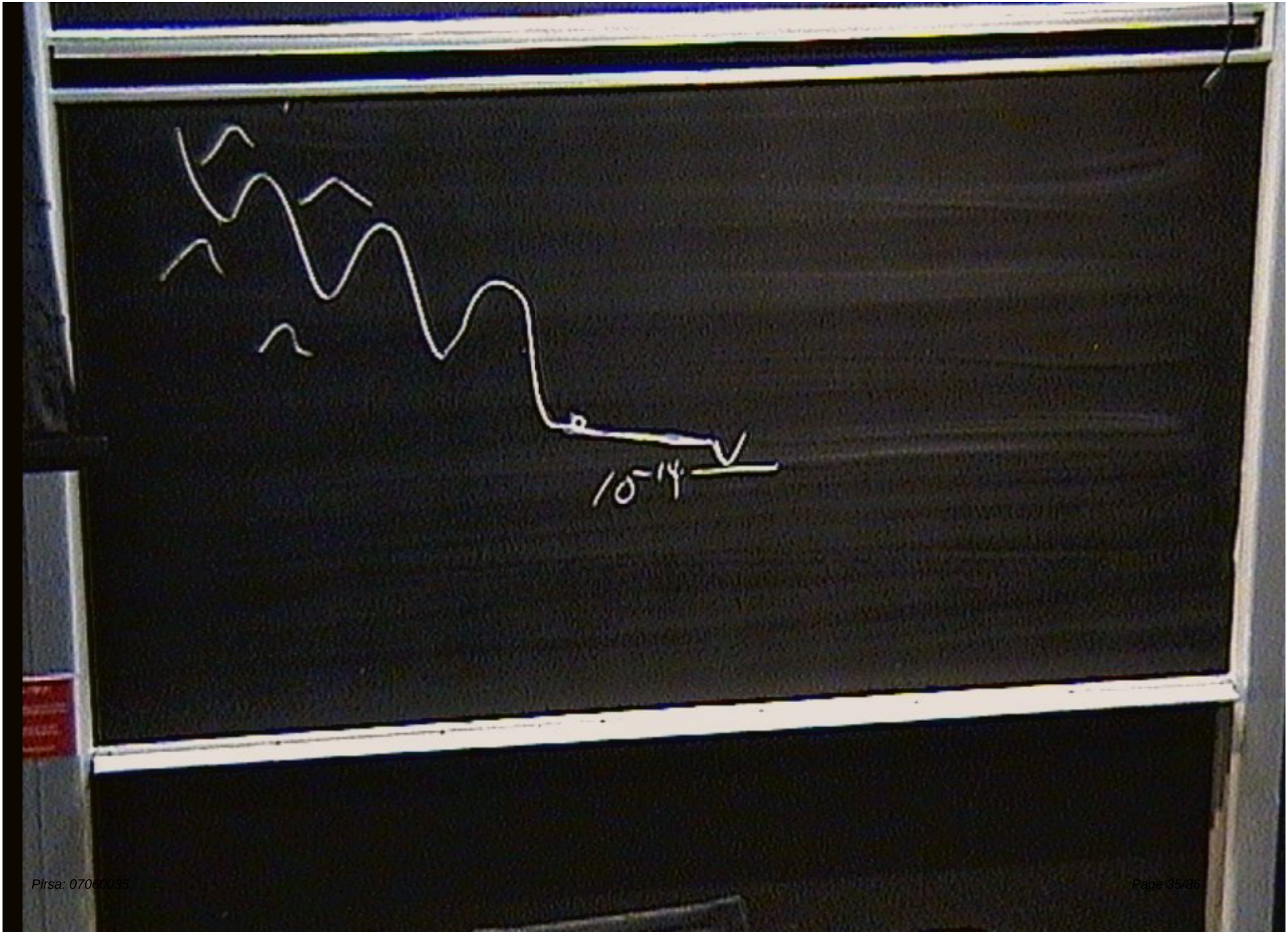
$S_{max} = \frac{V}{\ell_P^3} \log 2$

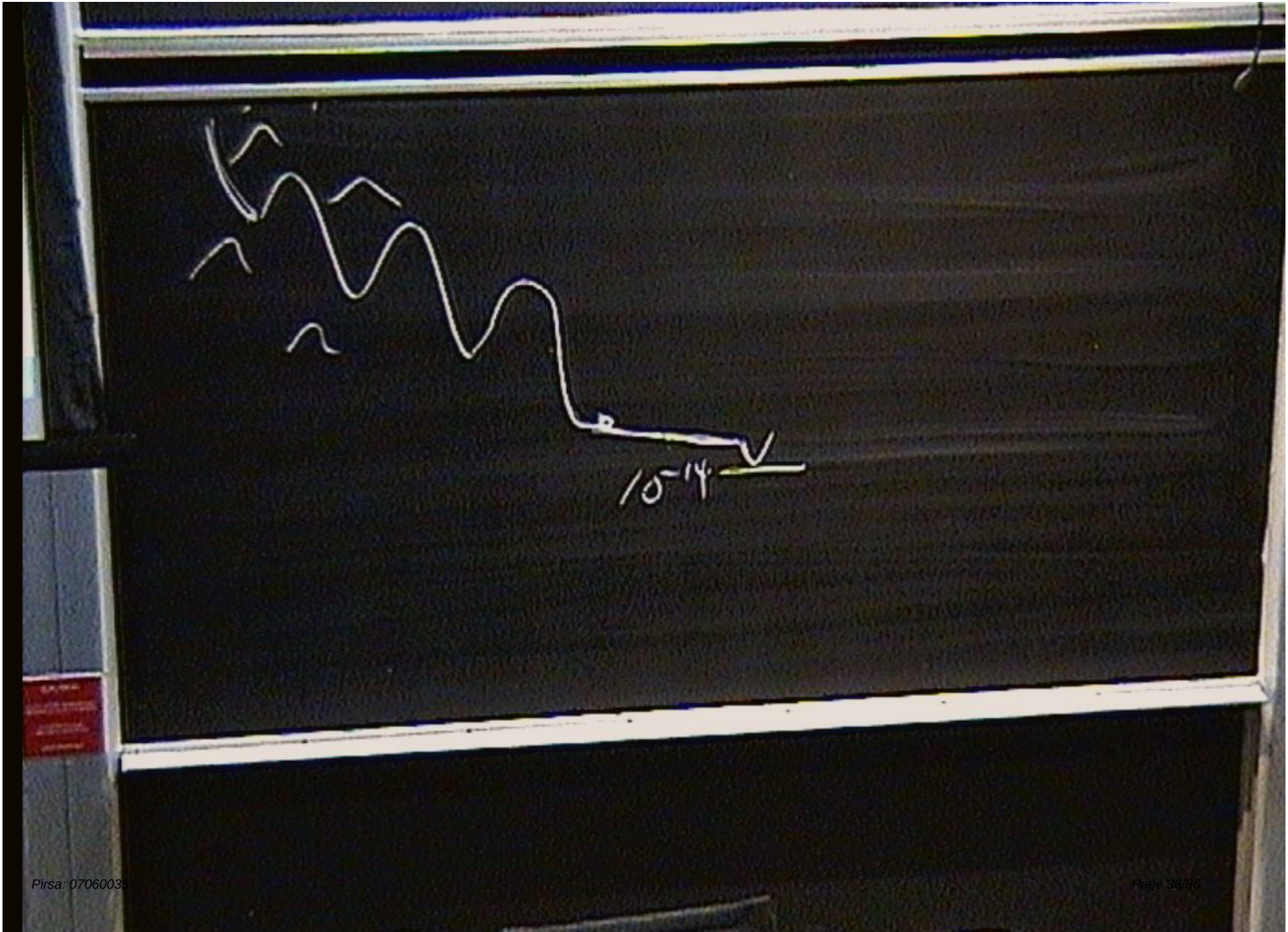
Pixelated

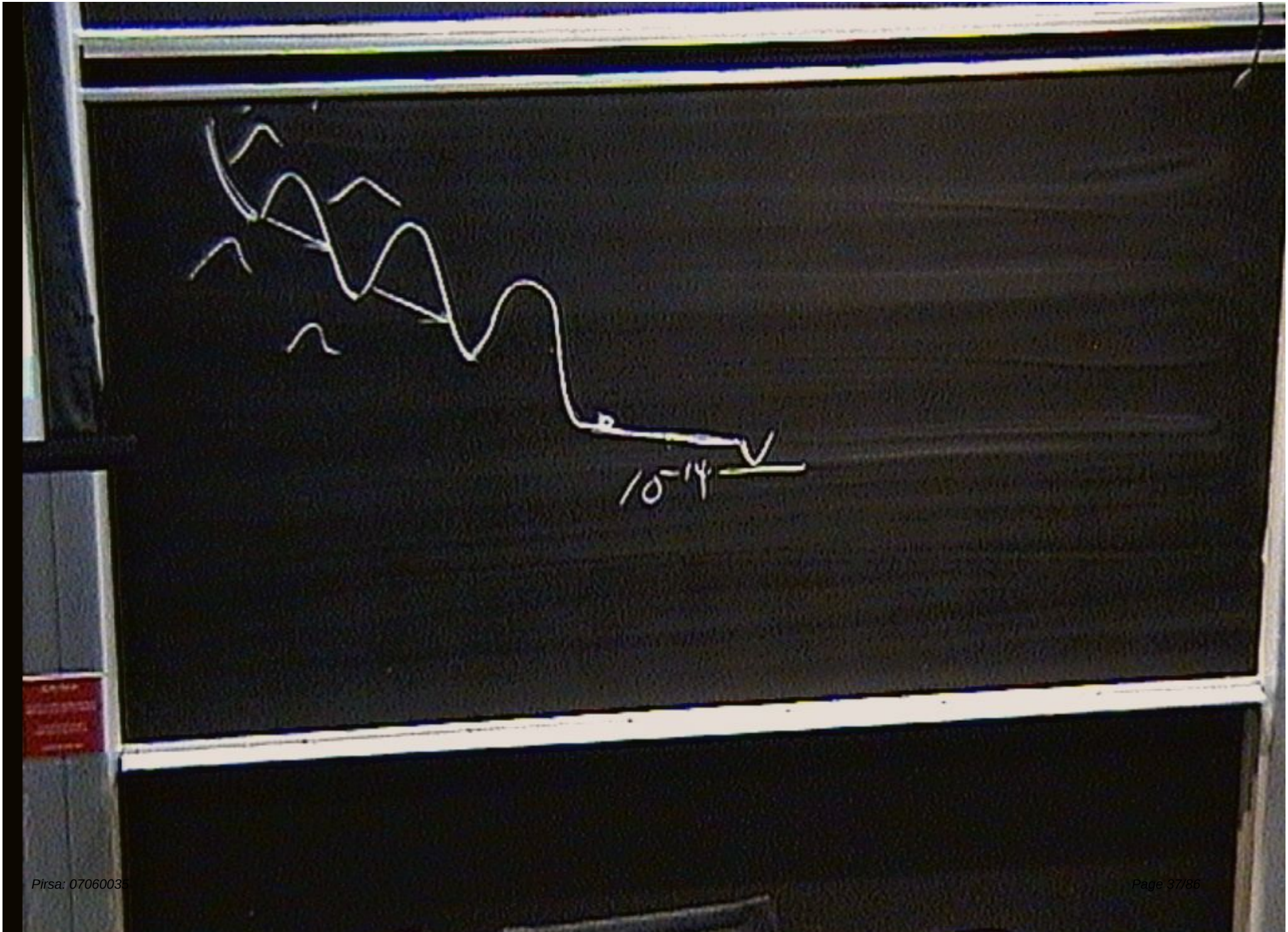
$S = \frac{A}{4G\hbar}$






10-14


10^{-14}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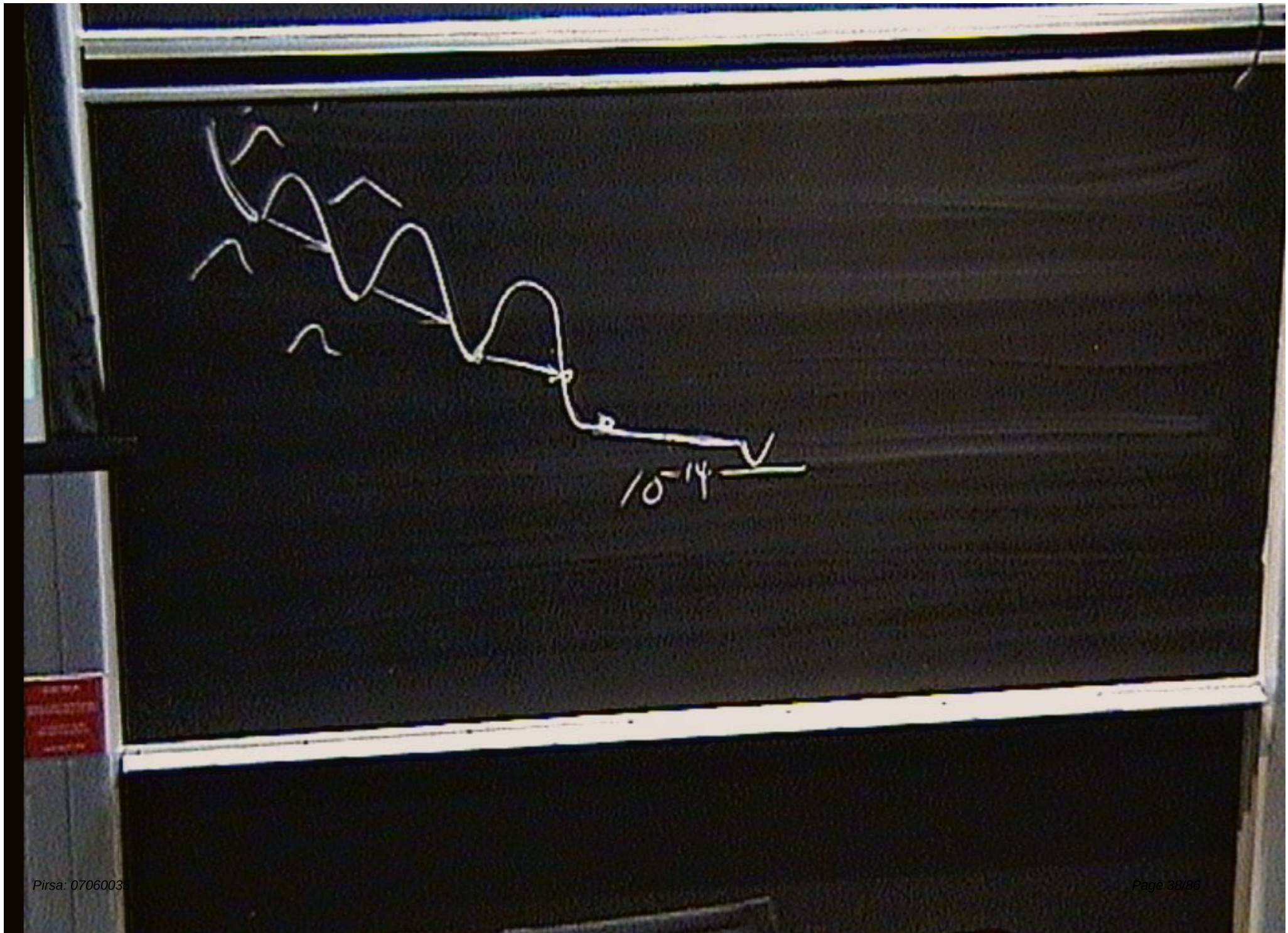
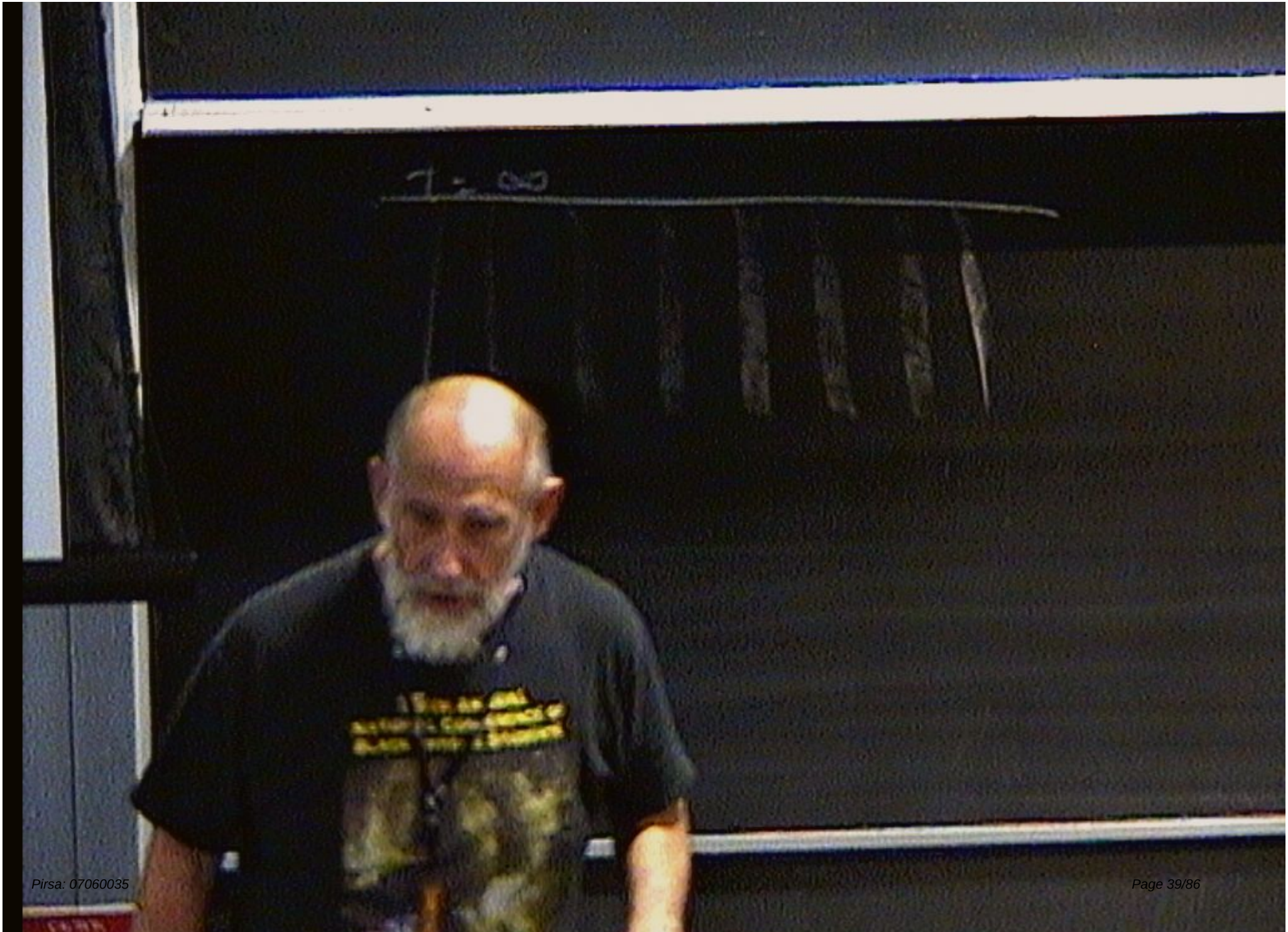
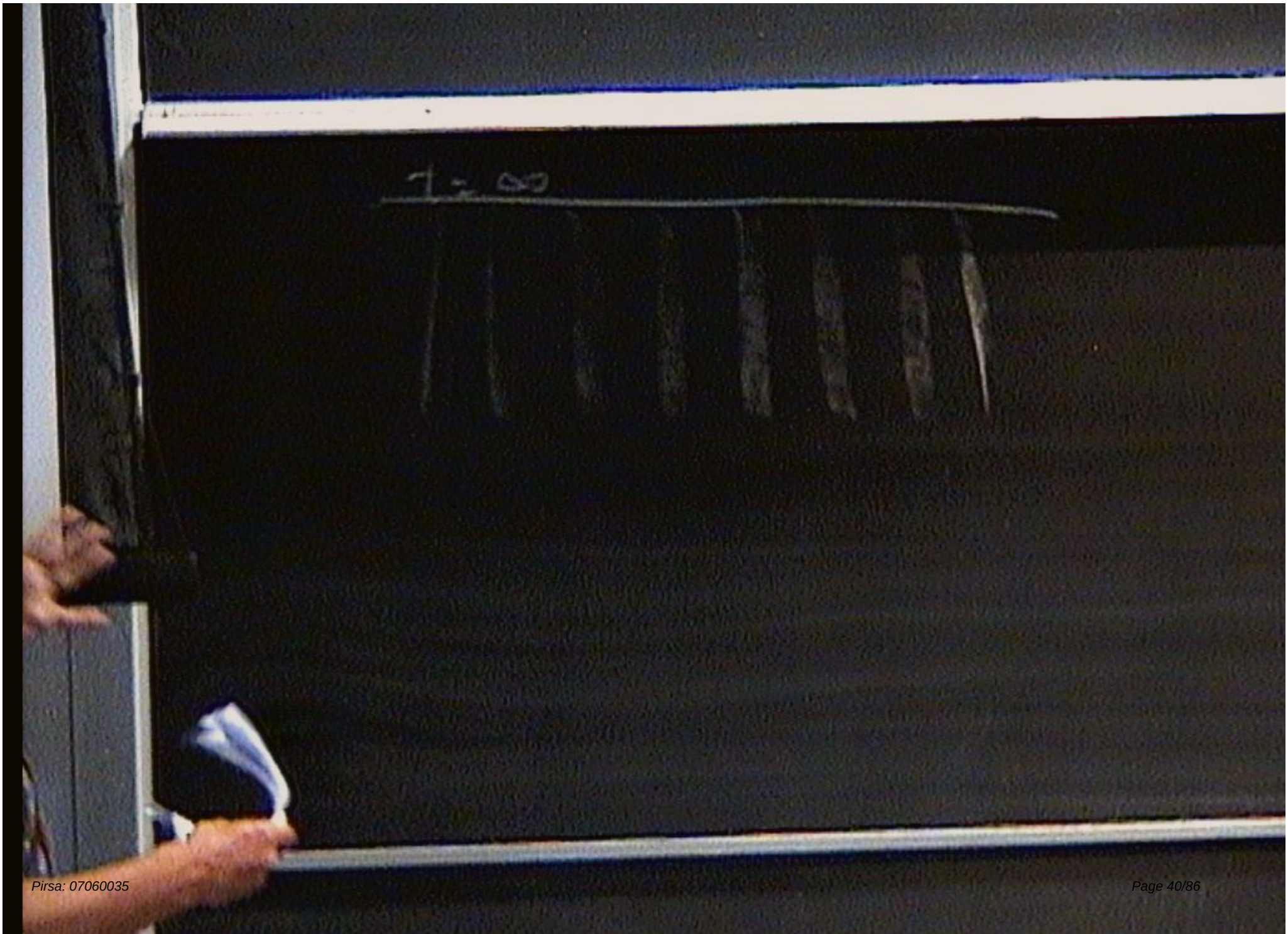

10-14

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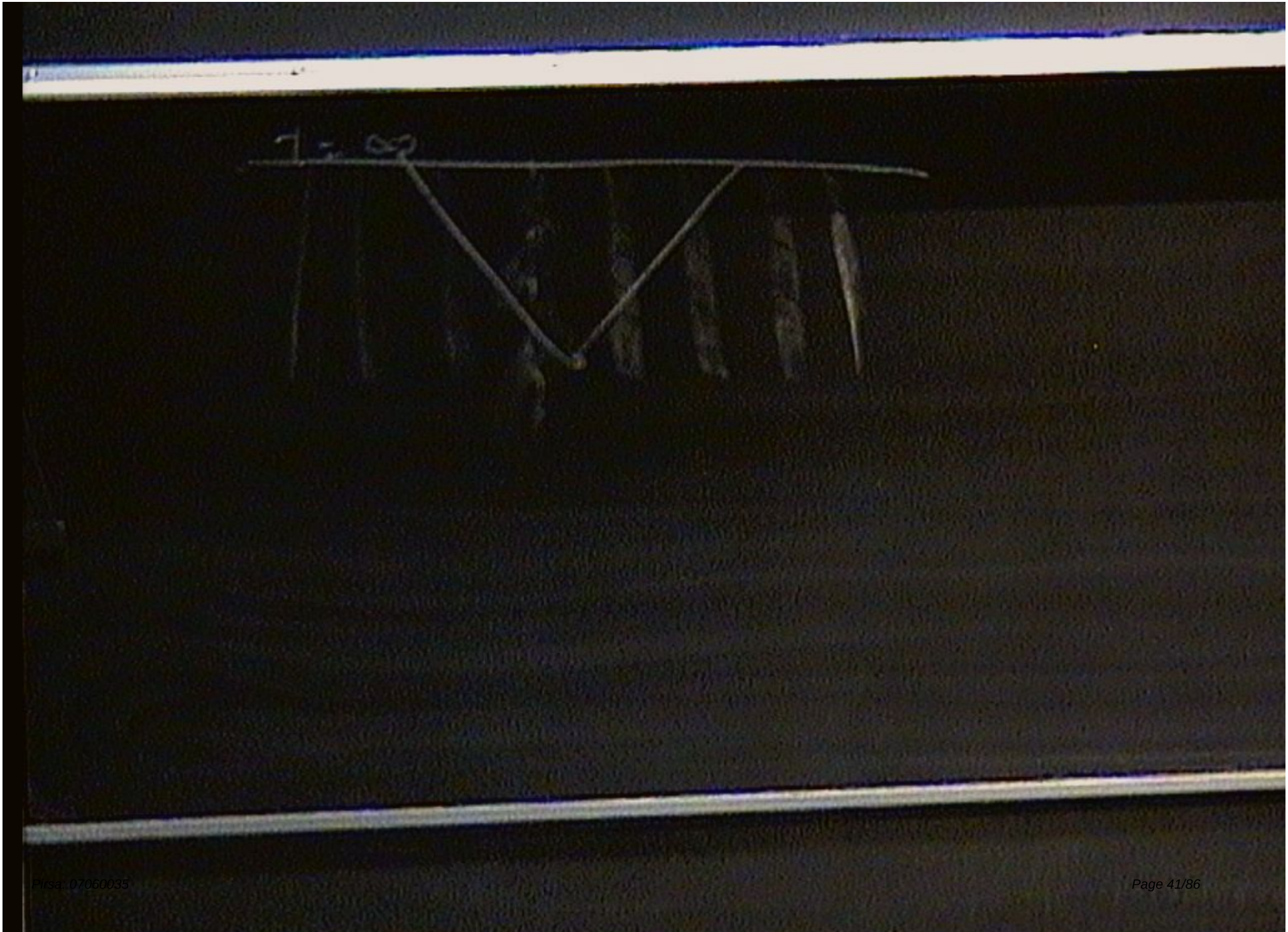
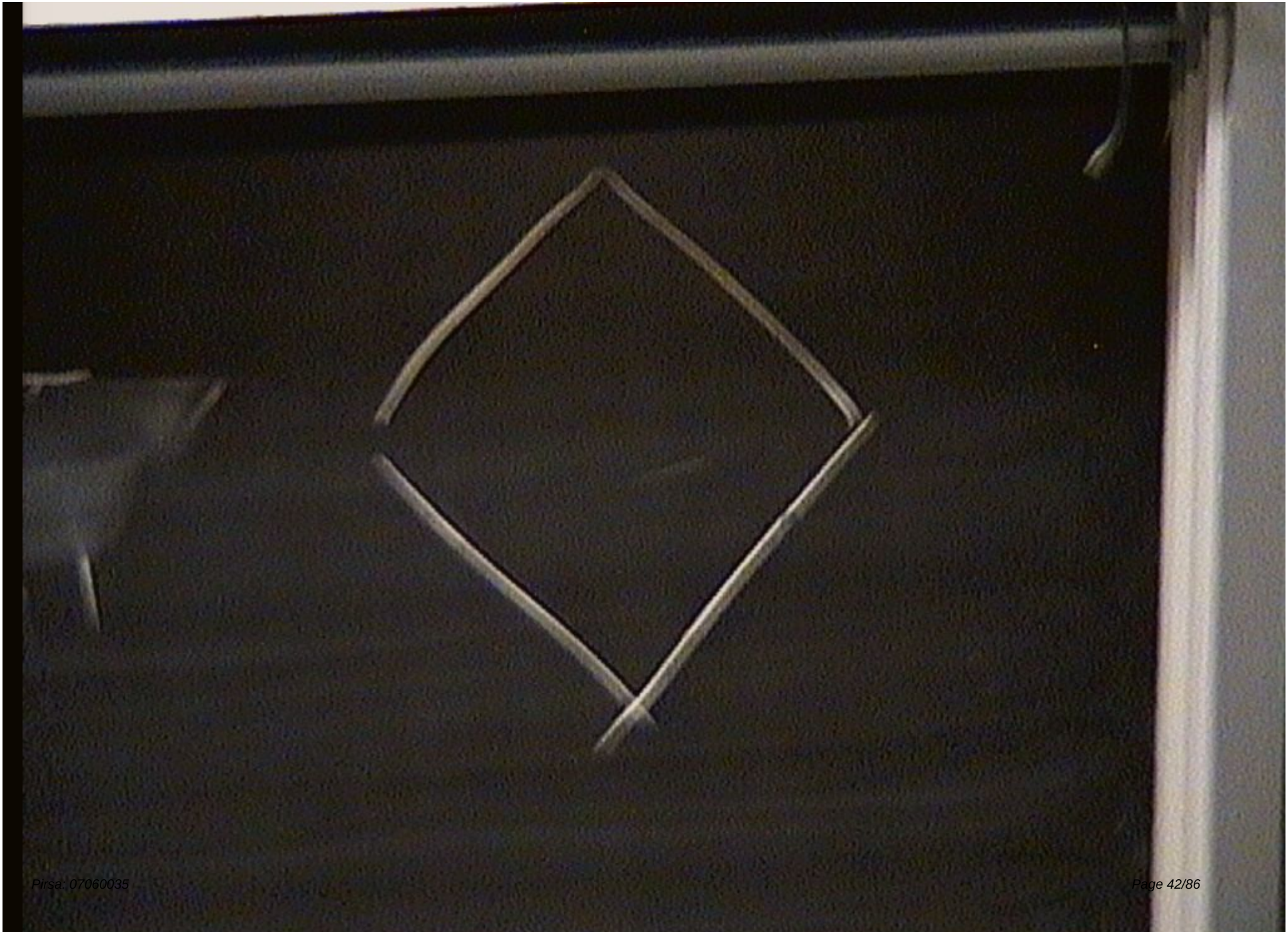
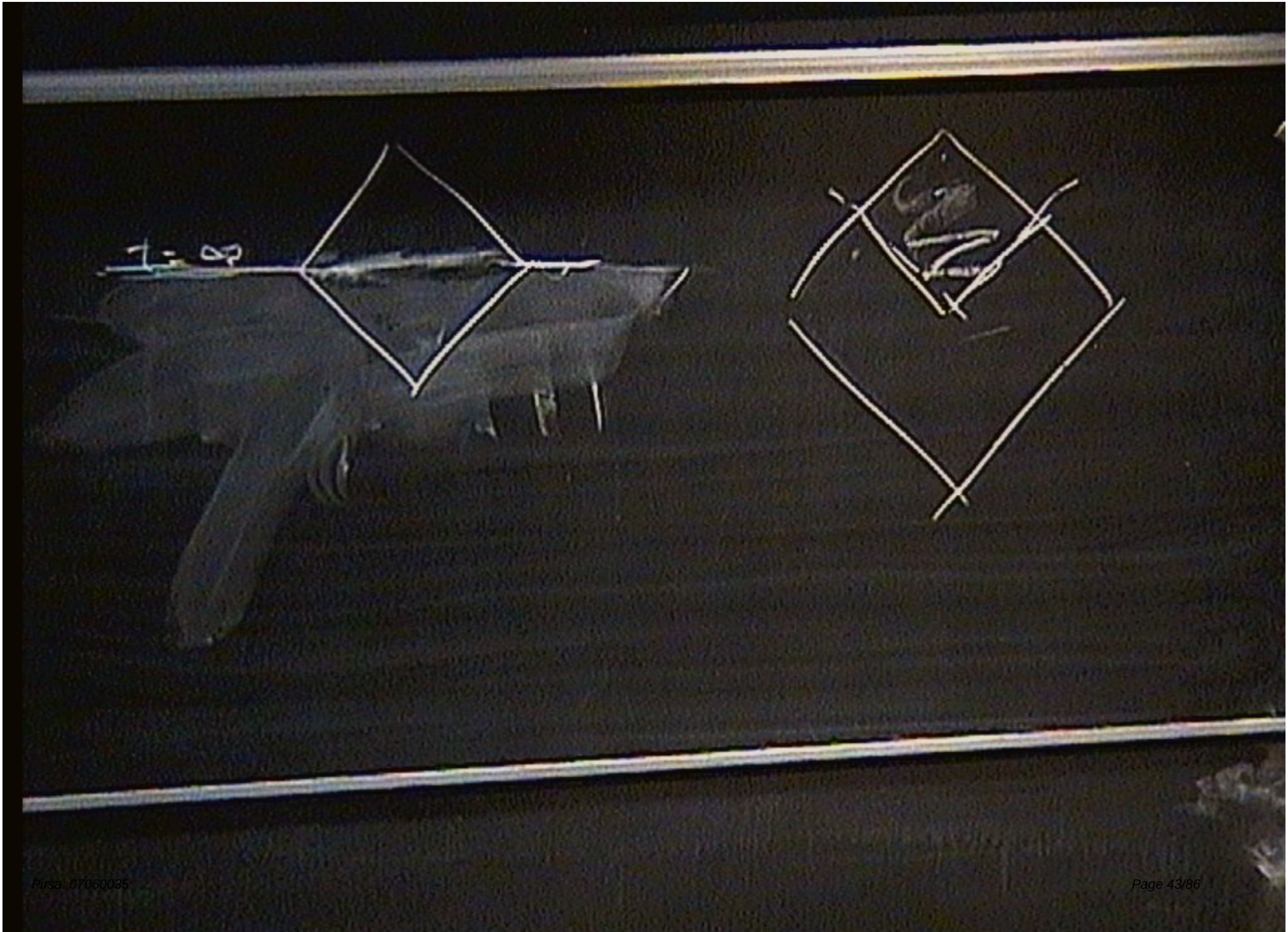
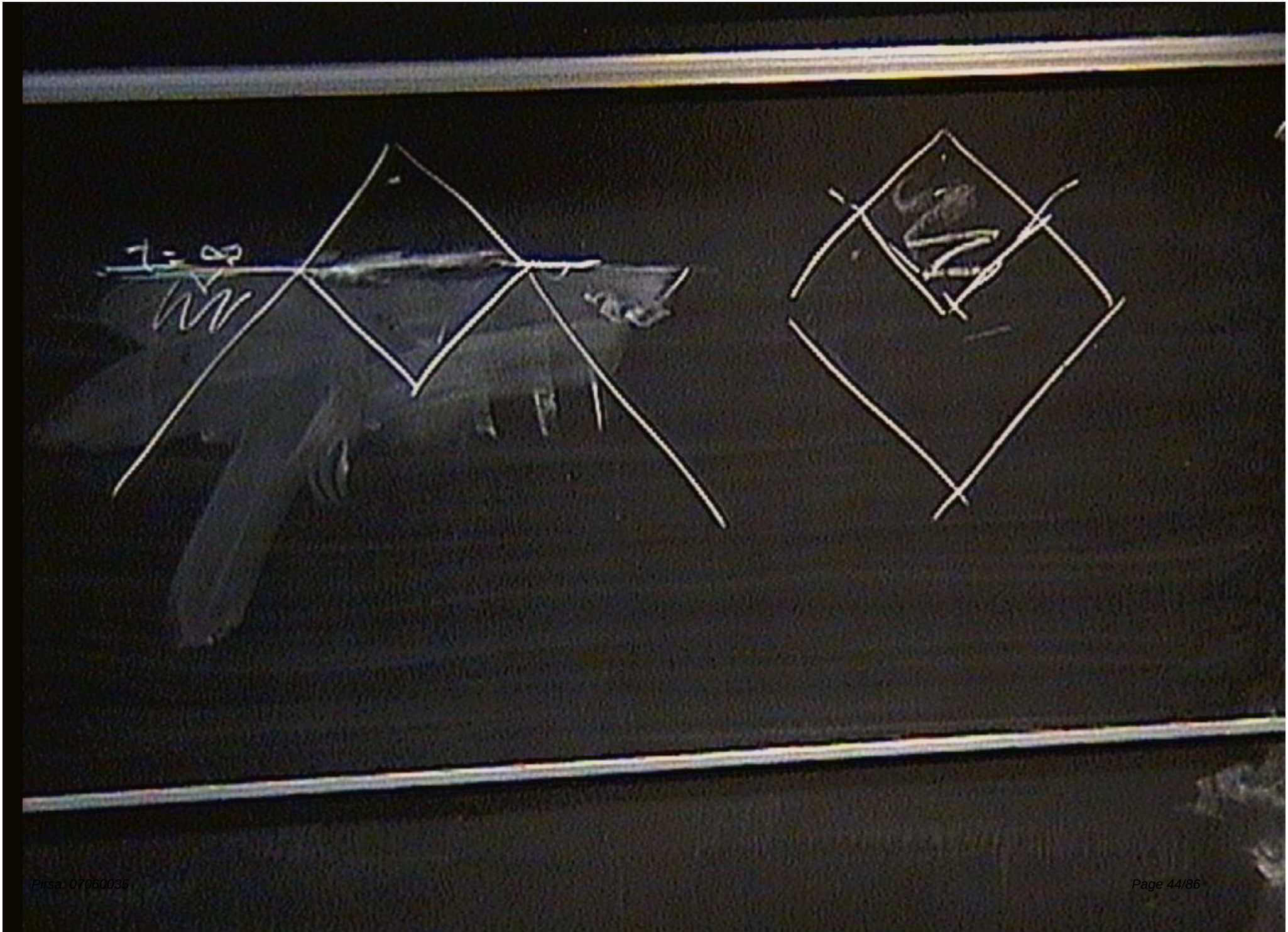
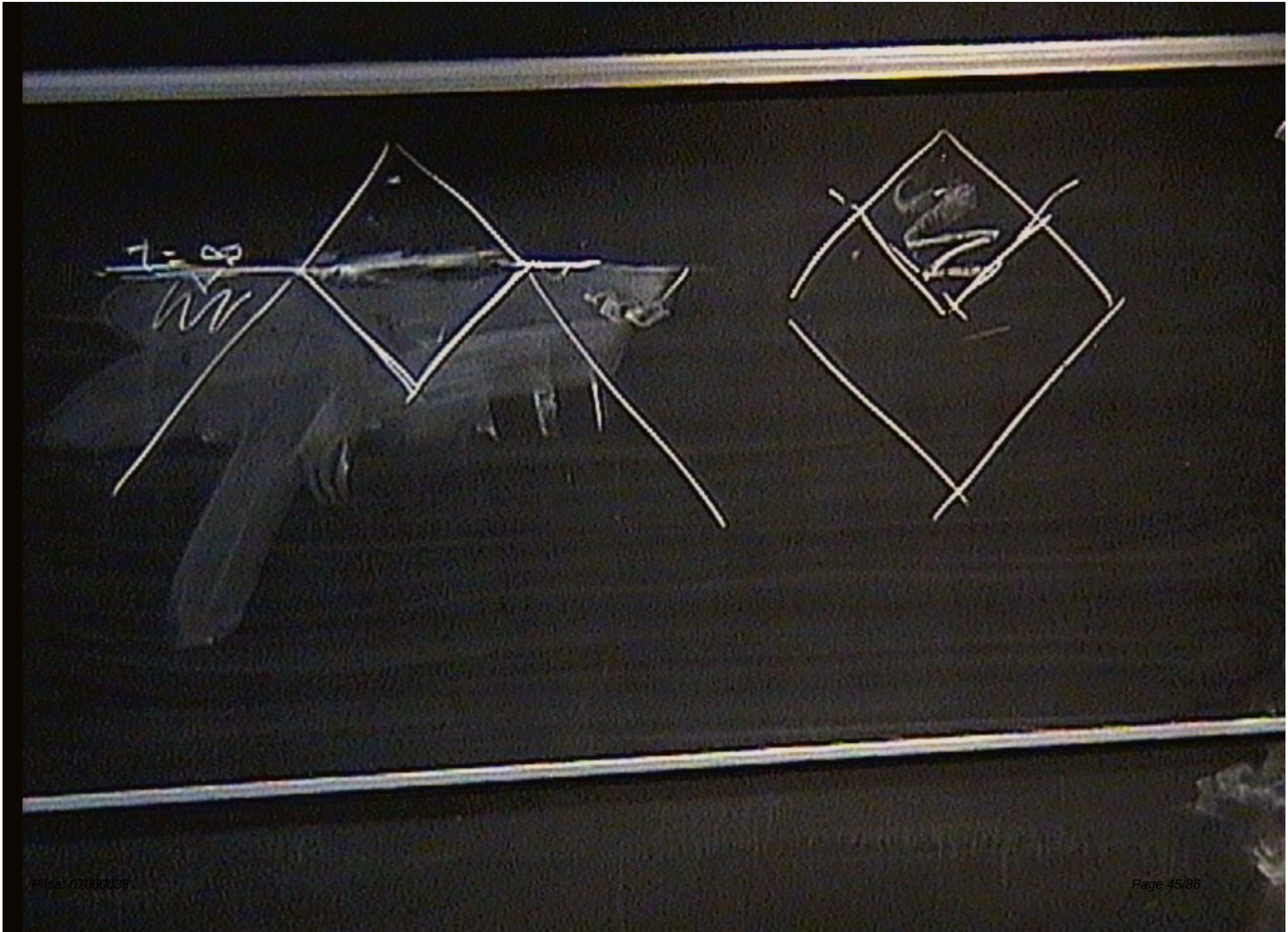
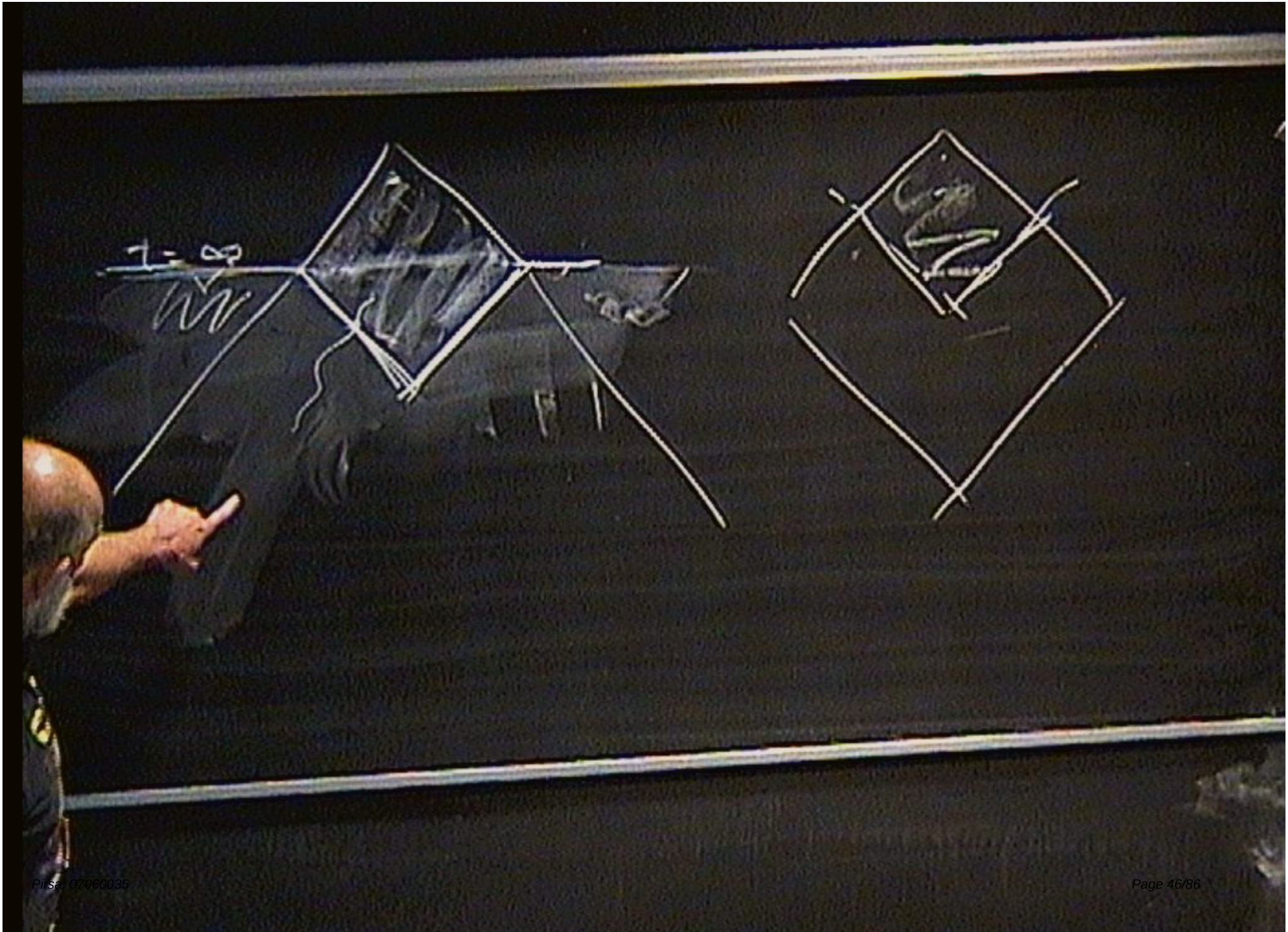


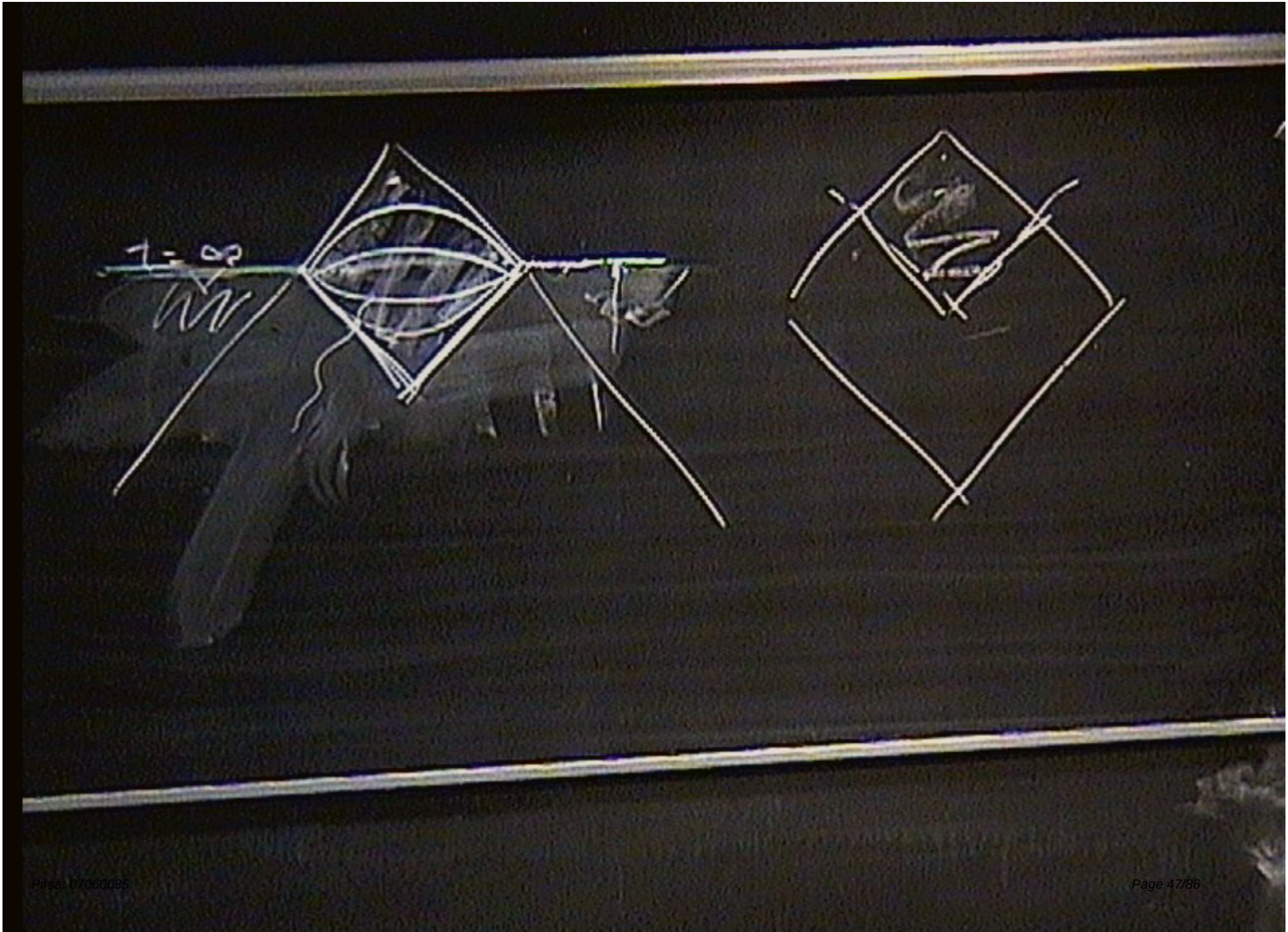


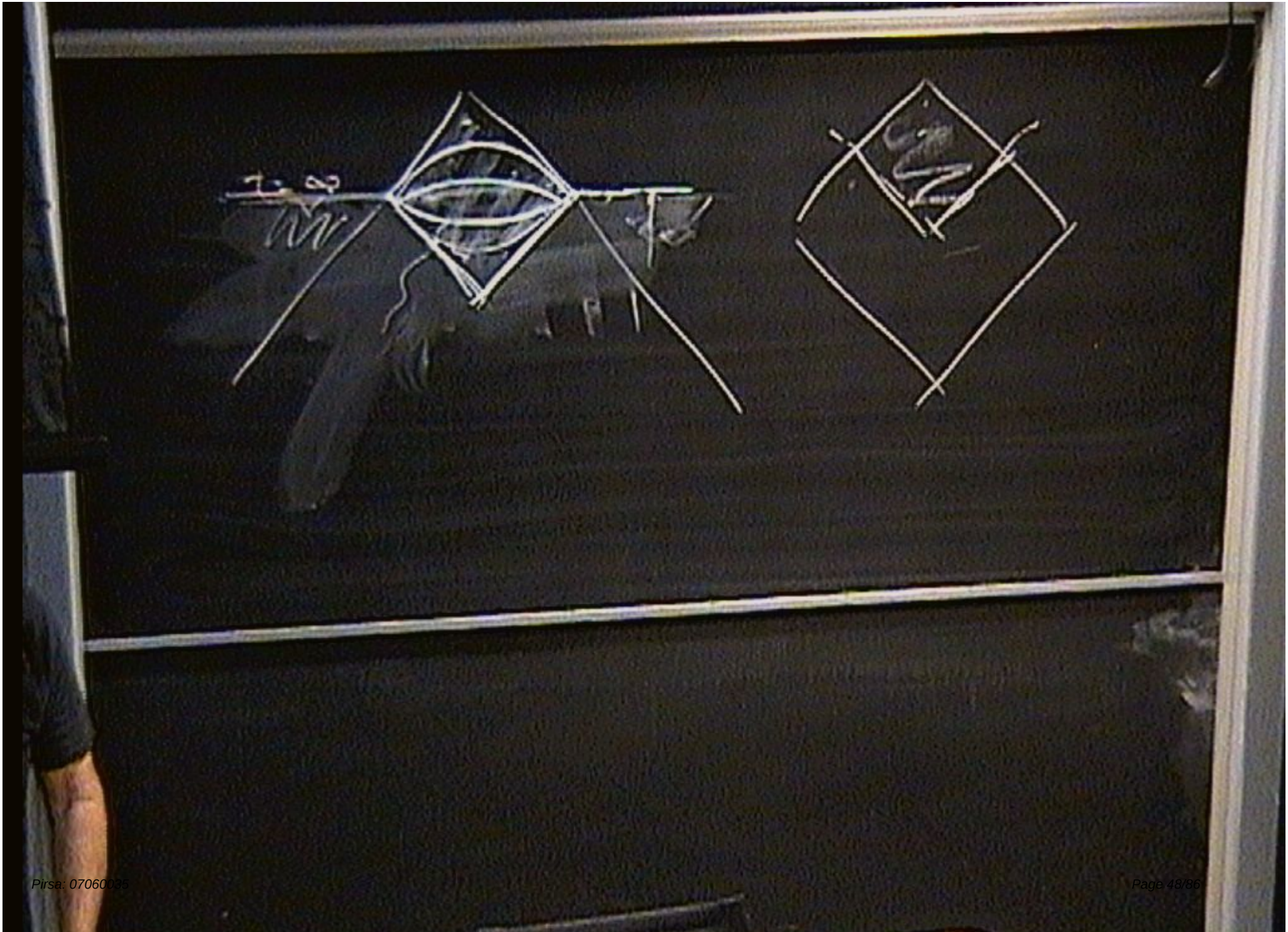


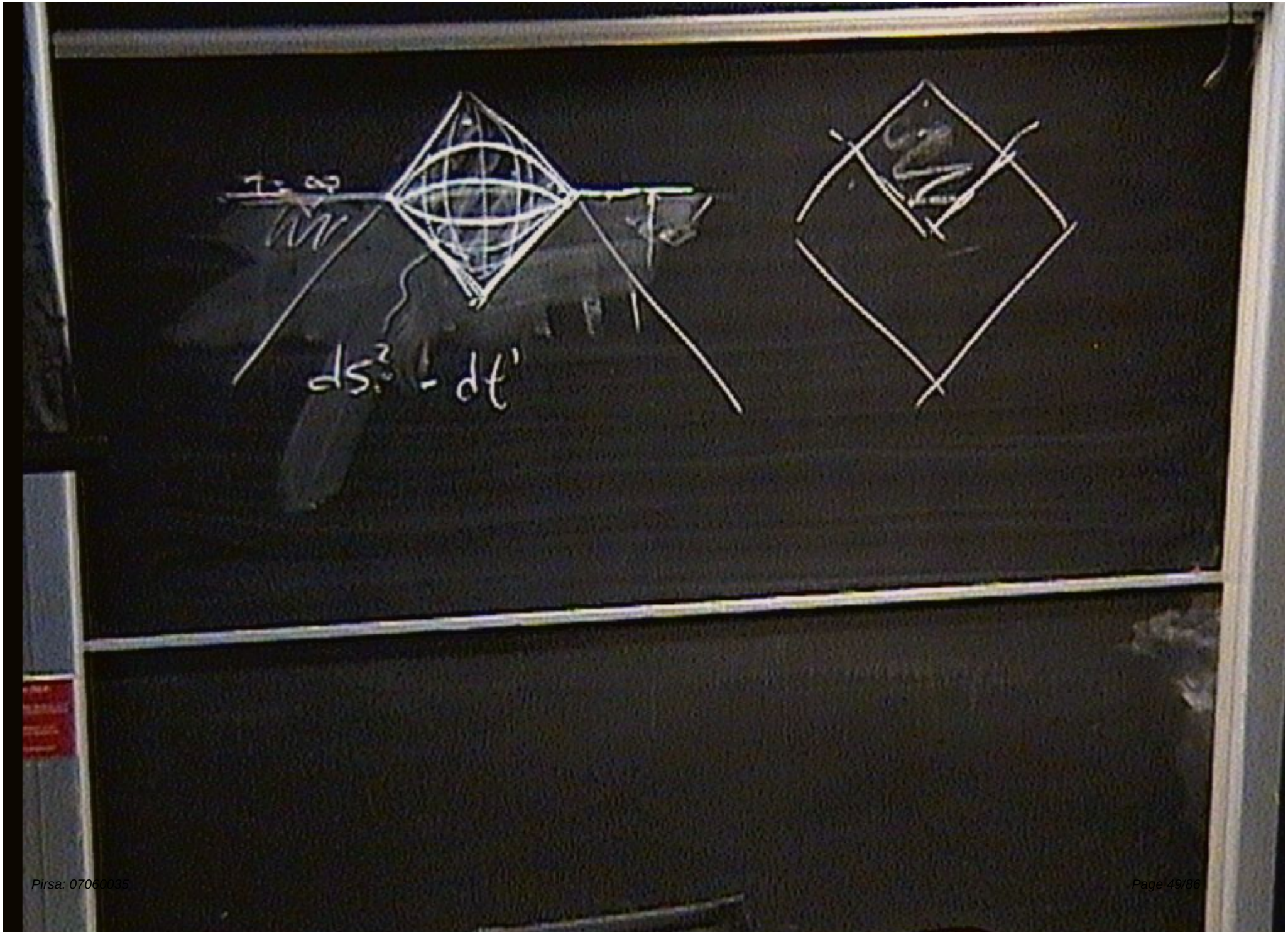


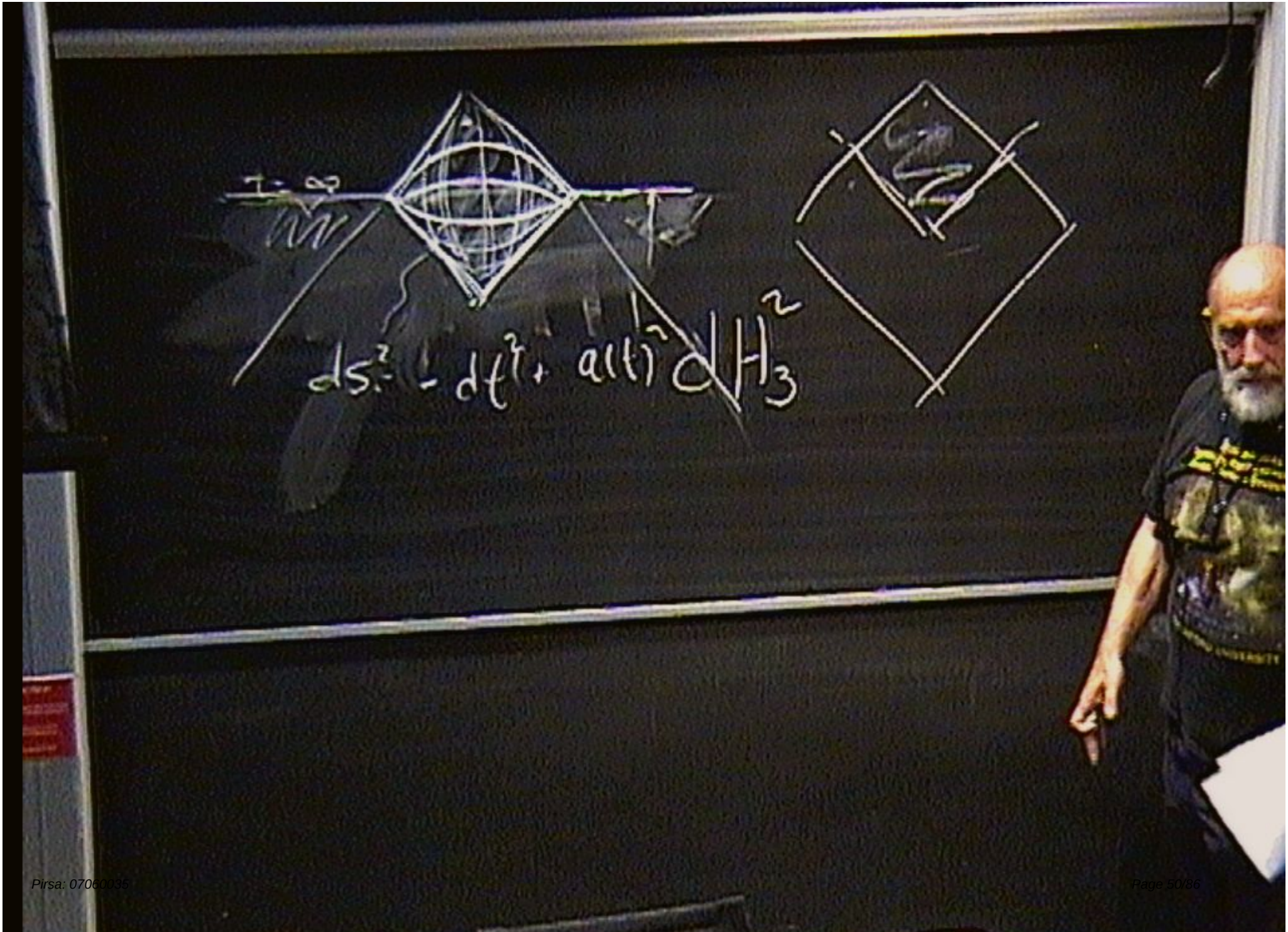






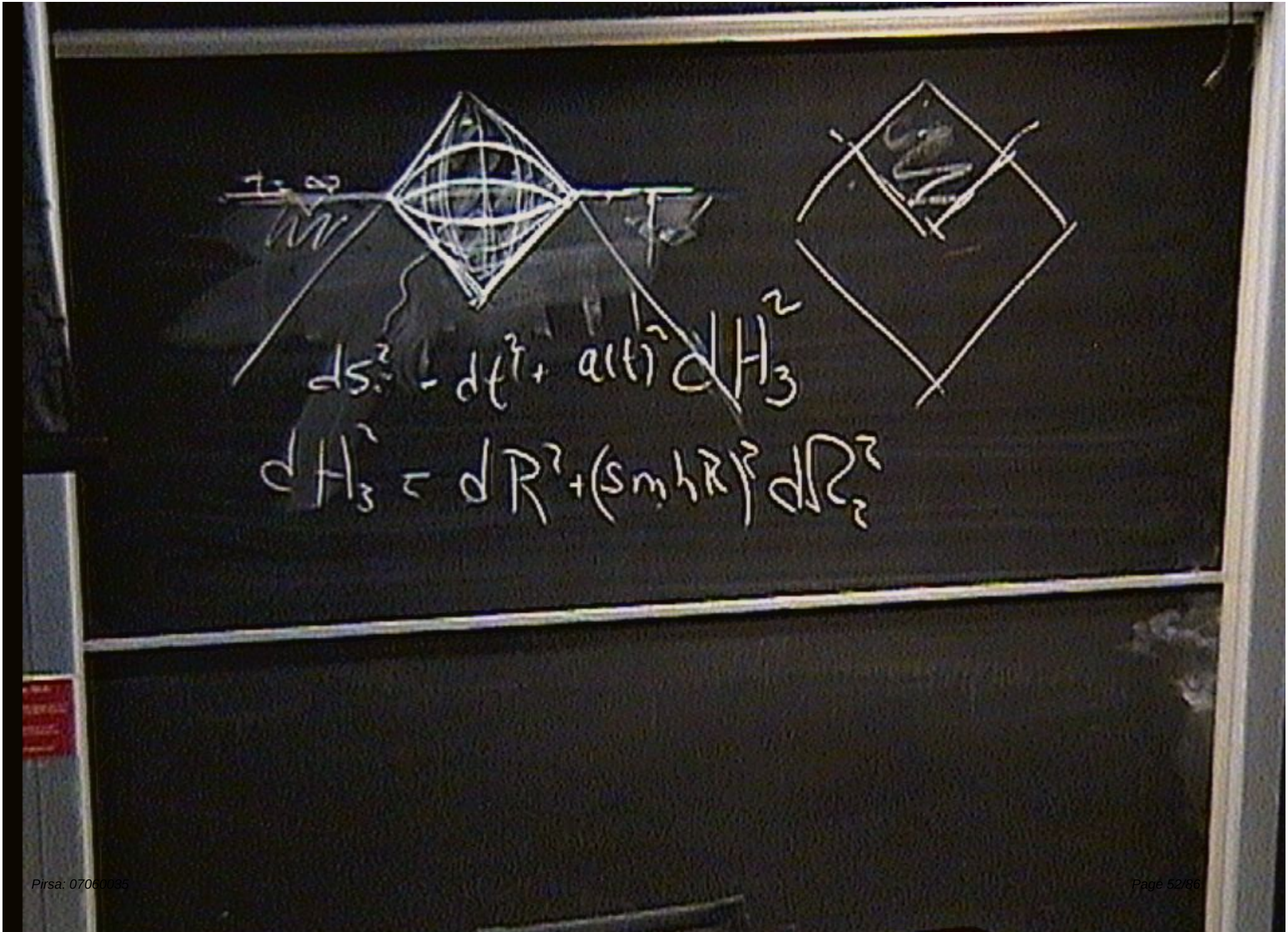


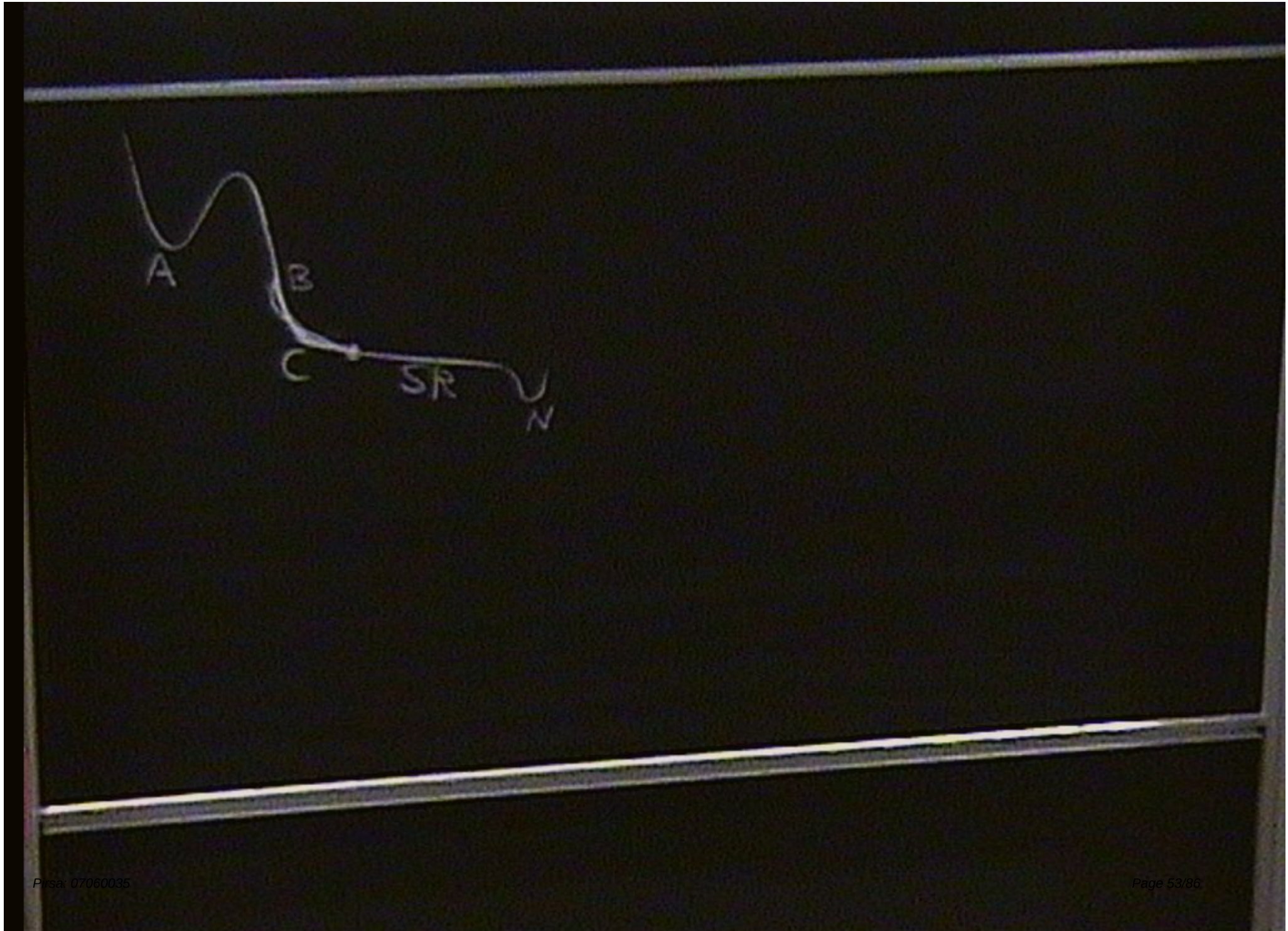

$ds^2 = -dt'$

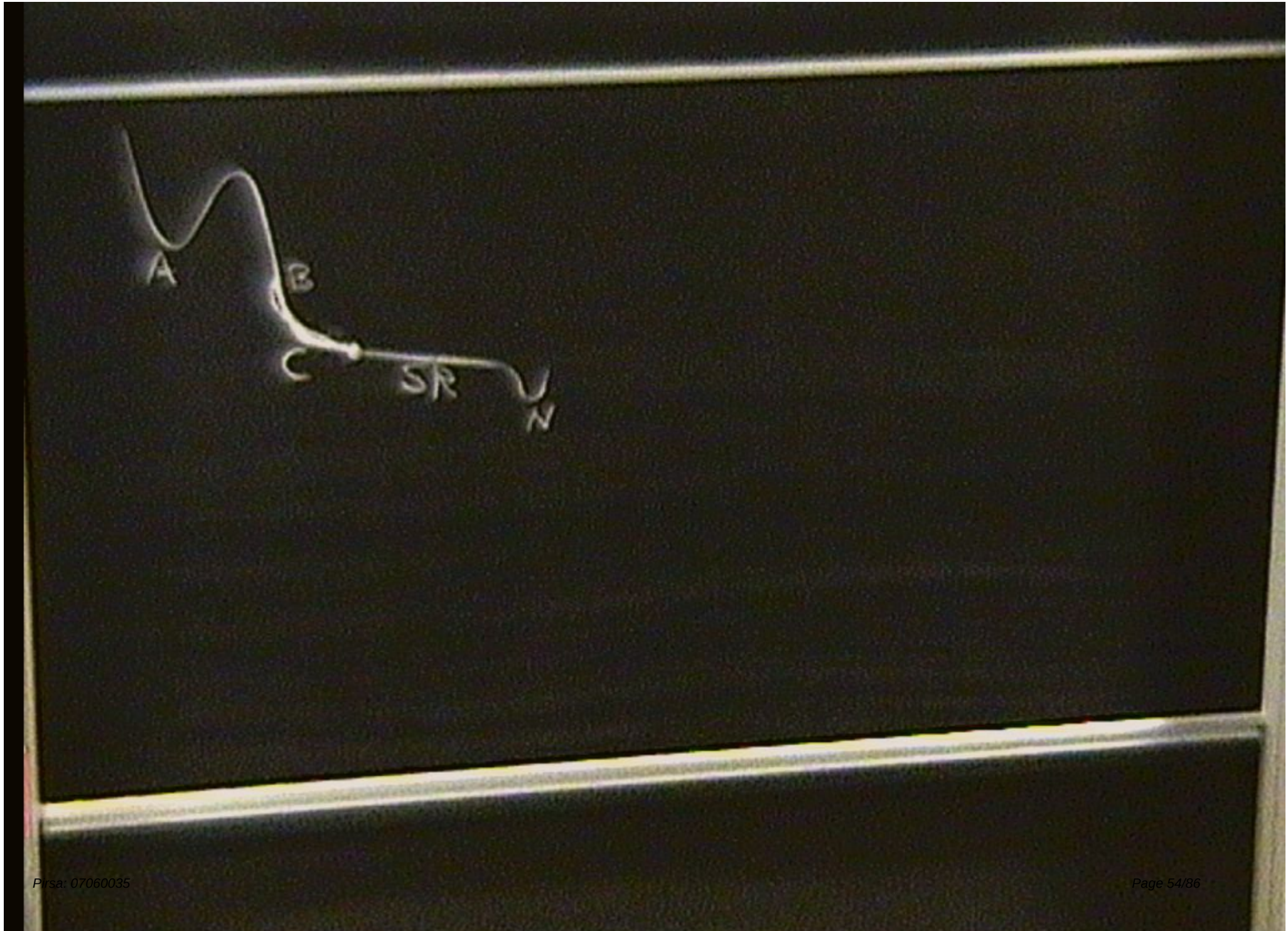

$ds^2 = -dt^2 + a(t)^2 dH_3^2$

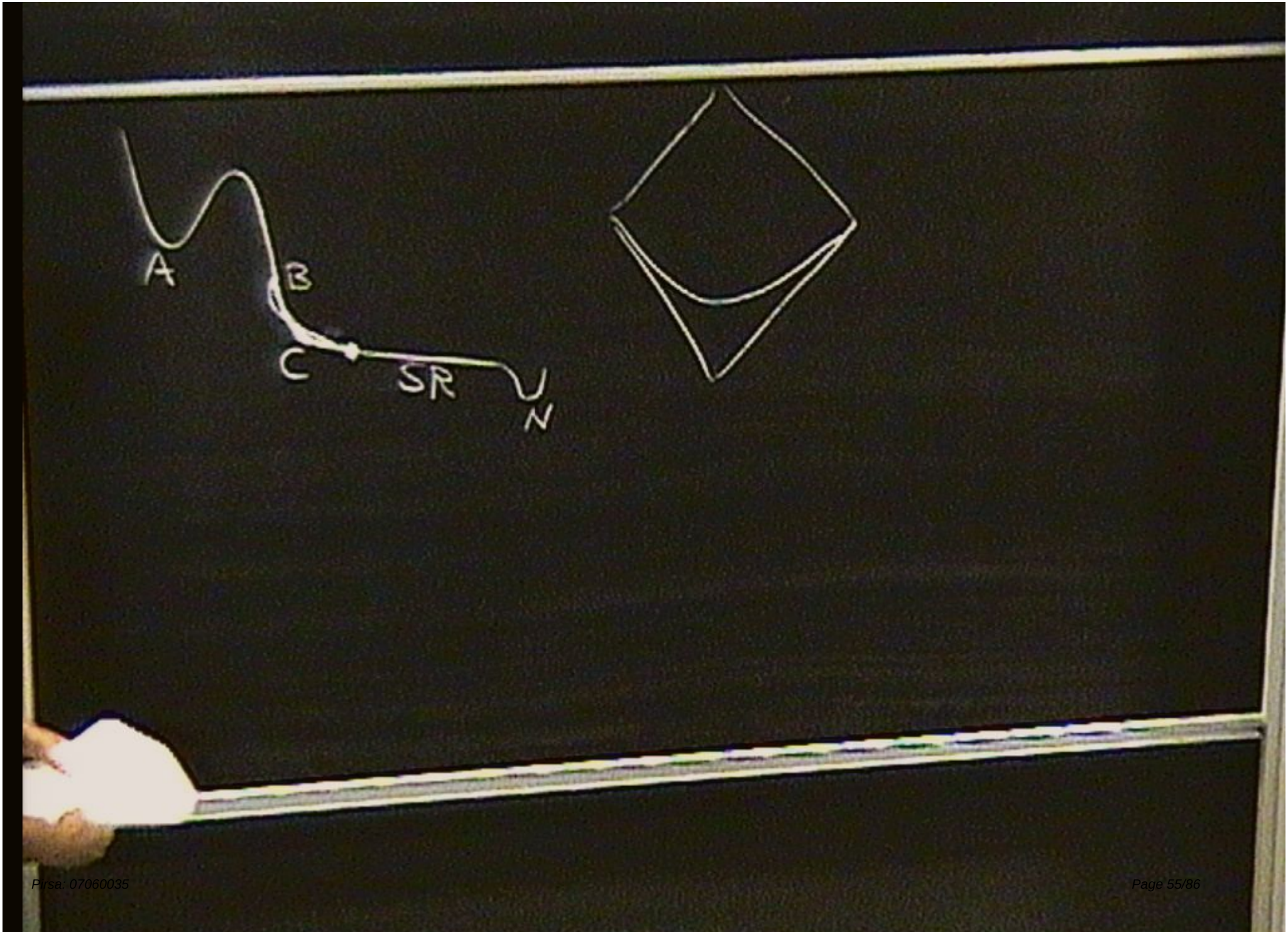
$$ds^2 = -dt^2 + a(t)^2 dH_3^2$$

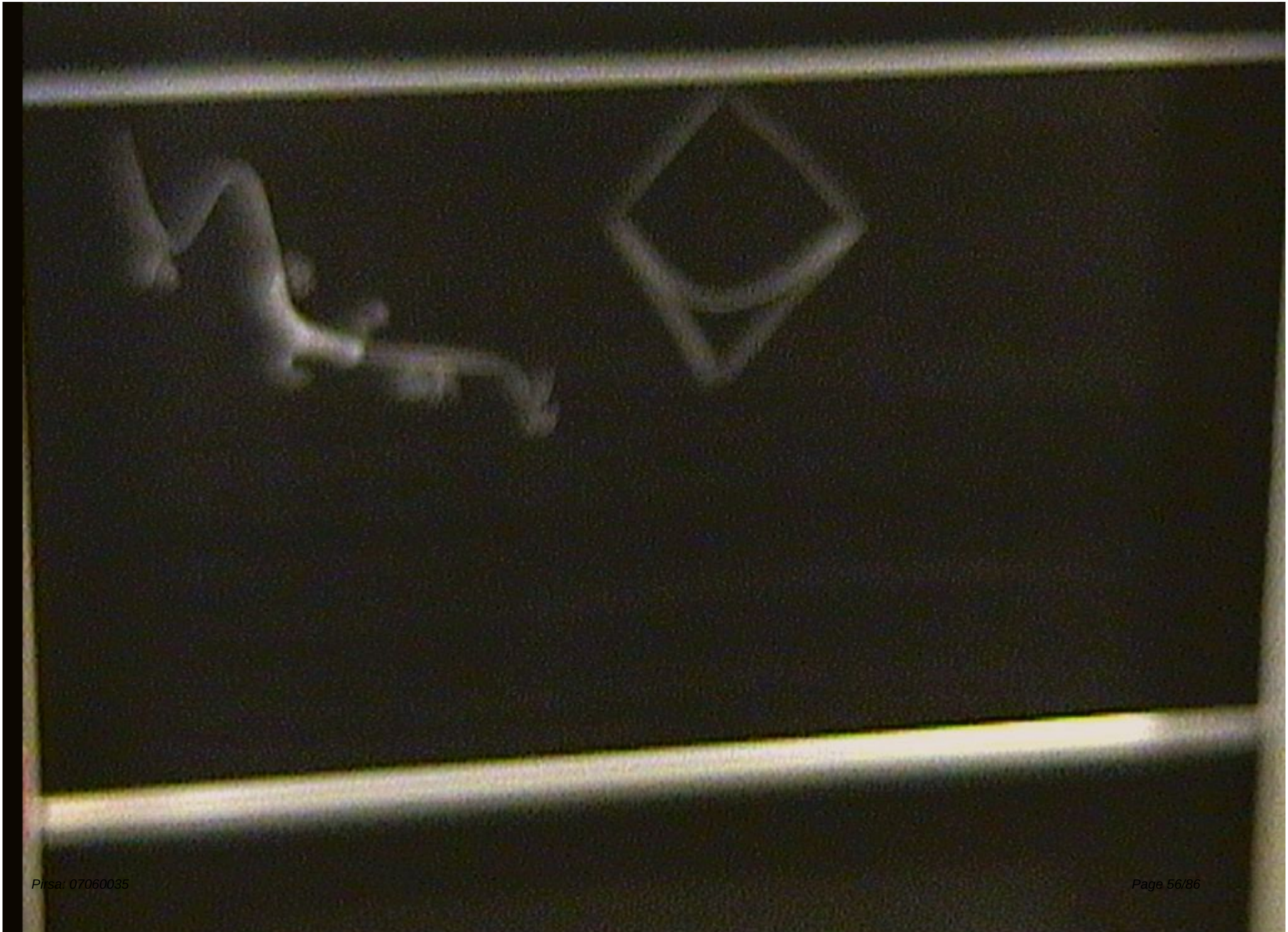
$$dH_3^2 = dR^2 + (\sinh R)^2 d\Omega_2^2$$

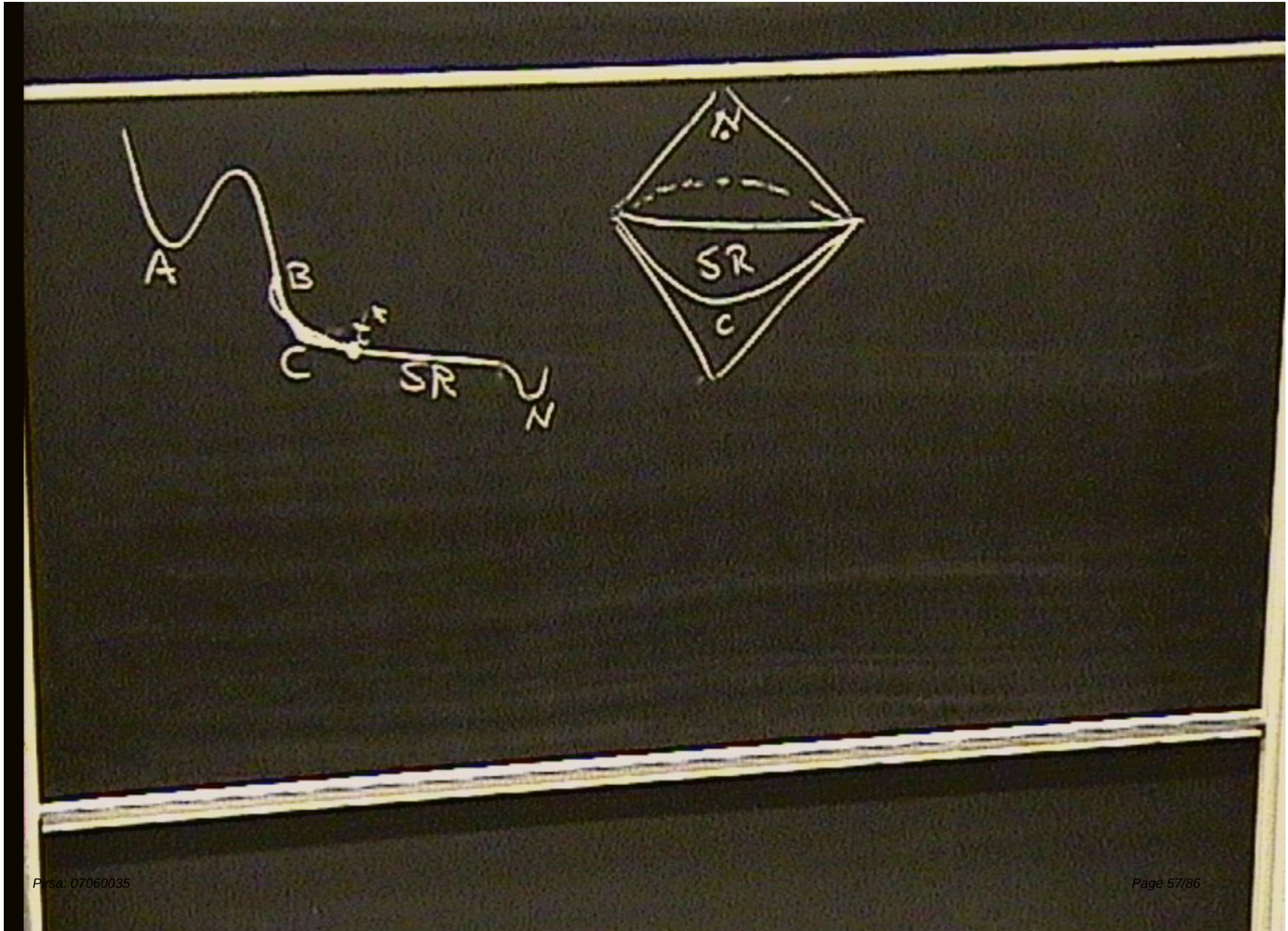

$ds^2 = -dt^2 + a(t)^2 dH_3^2$
$dH_3^2 = dR^2 + (\sinh R)^2 d\Omega_2^2$

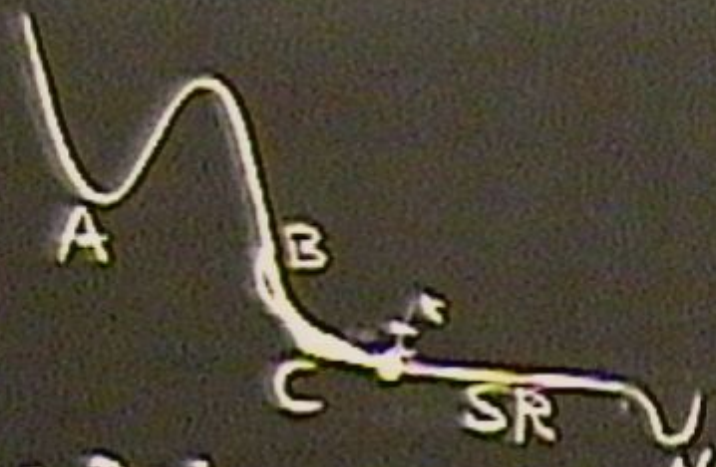

A
B
C
SR
N


A
B
C
SR
N

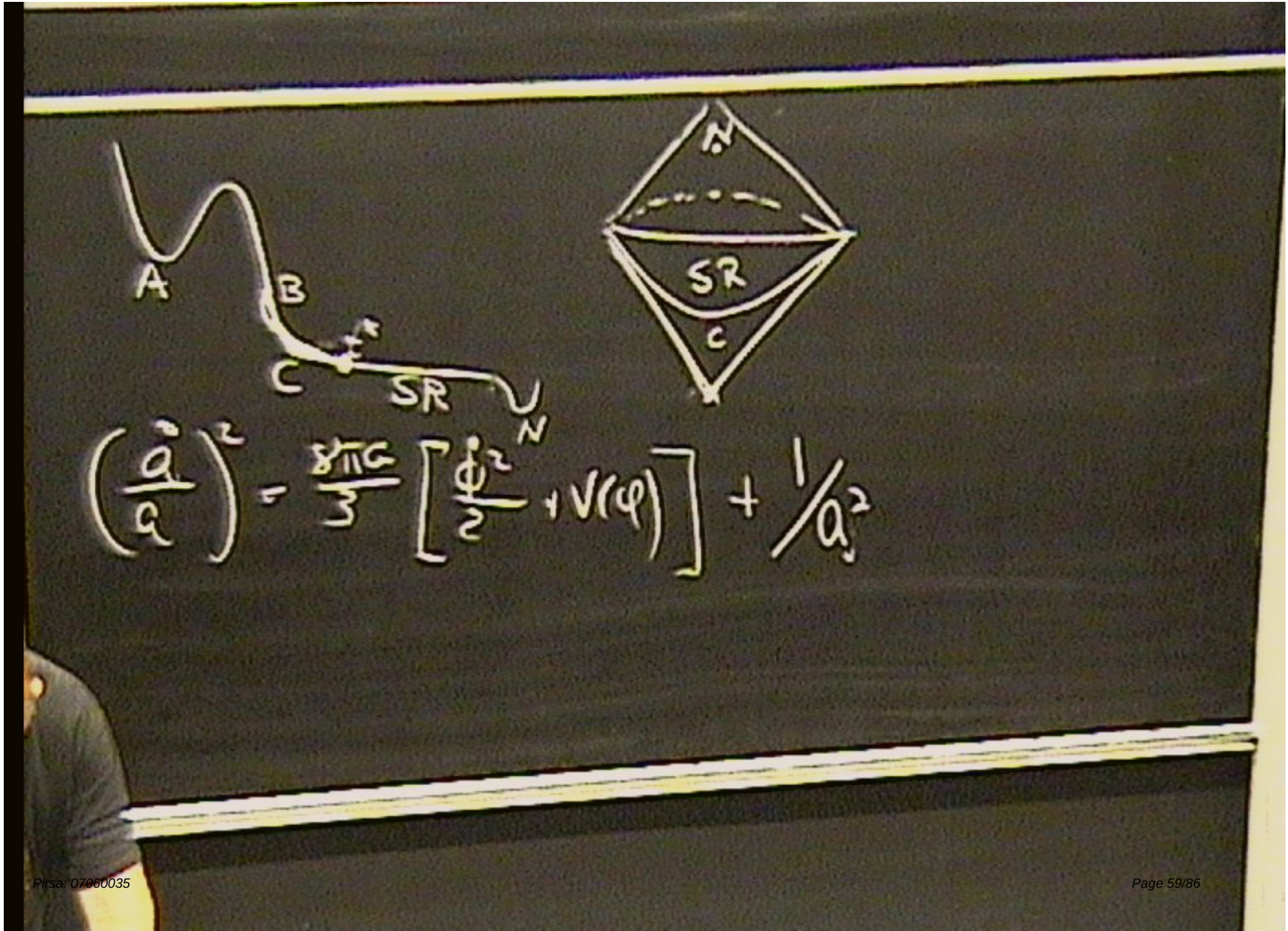

A
B
C
SR
N



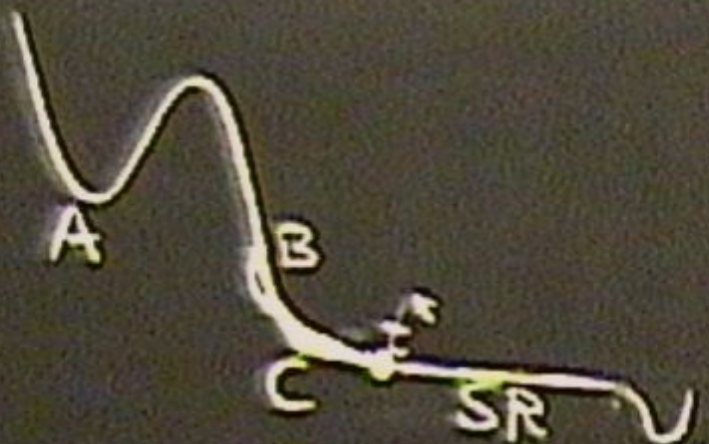

A
B
C
SR
N
N
SR
C



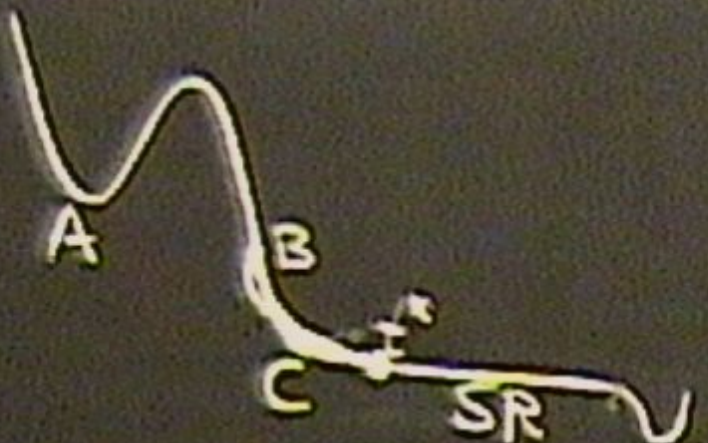
$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\varphi)\right]$$



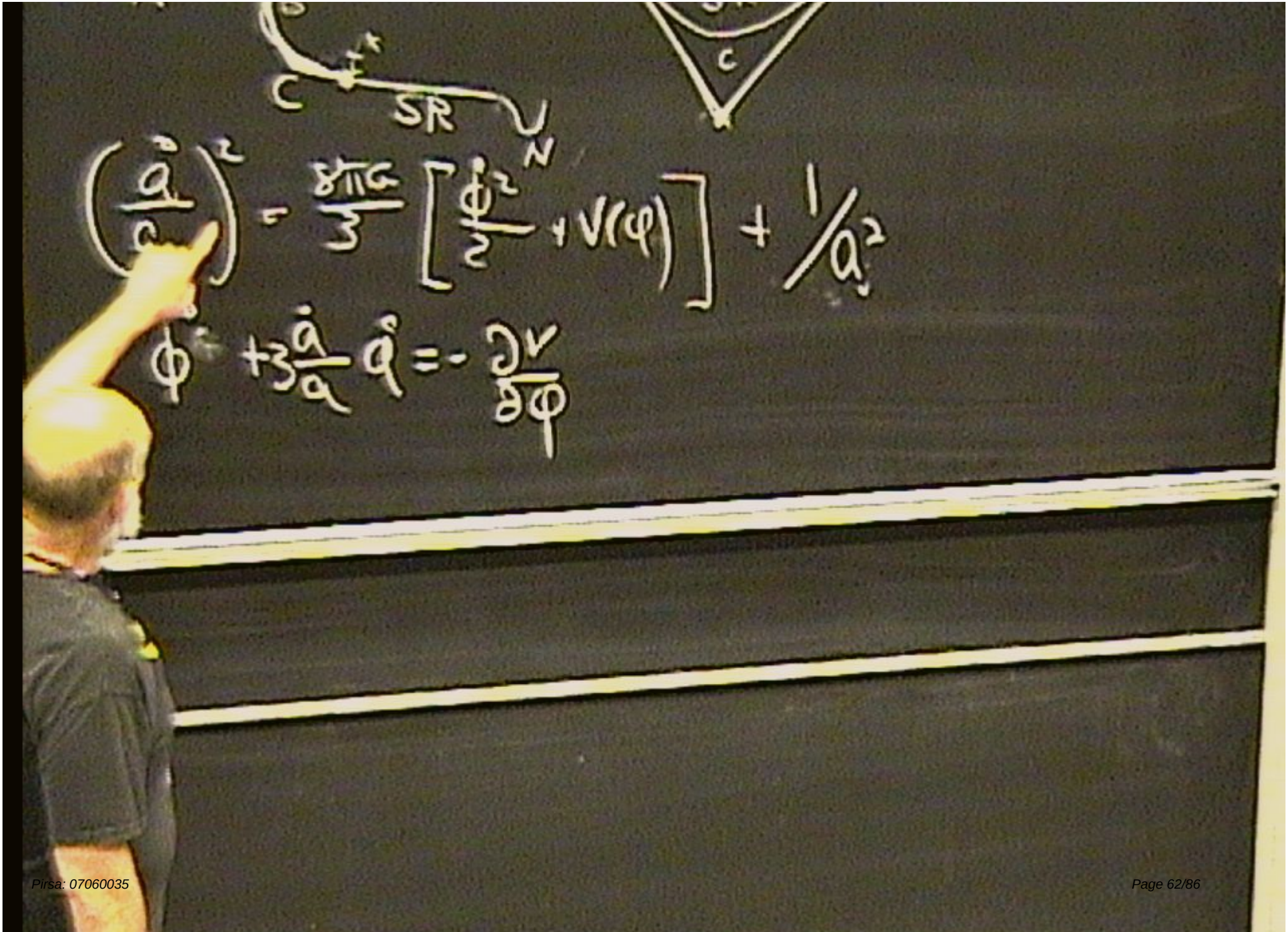
$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\phi)\right] + \frac{1}{a^2}$$

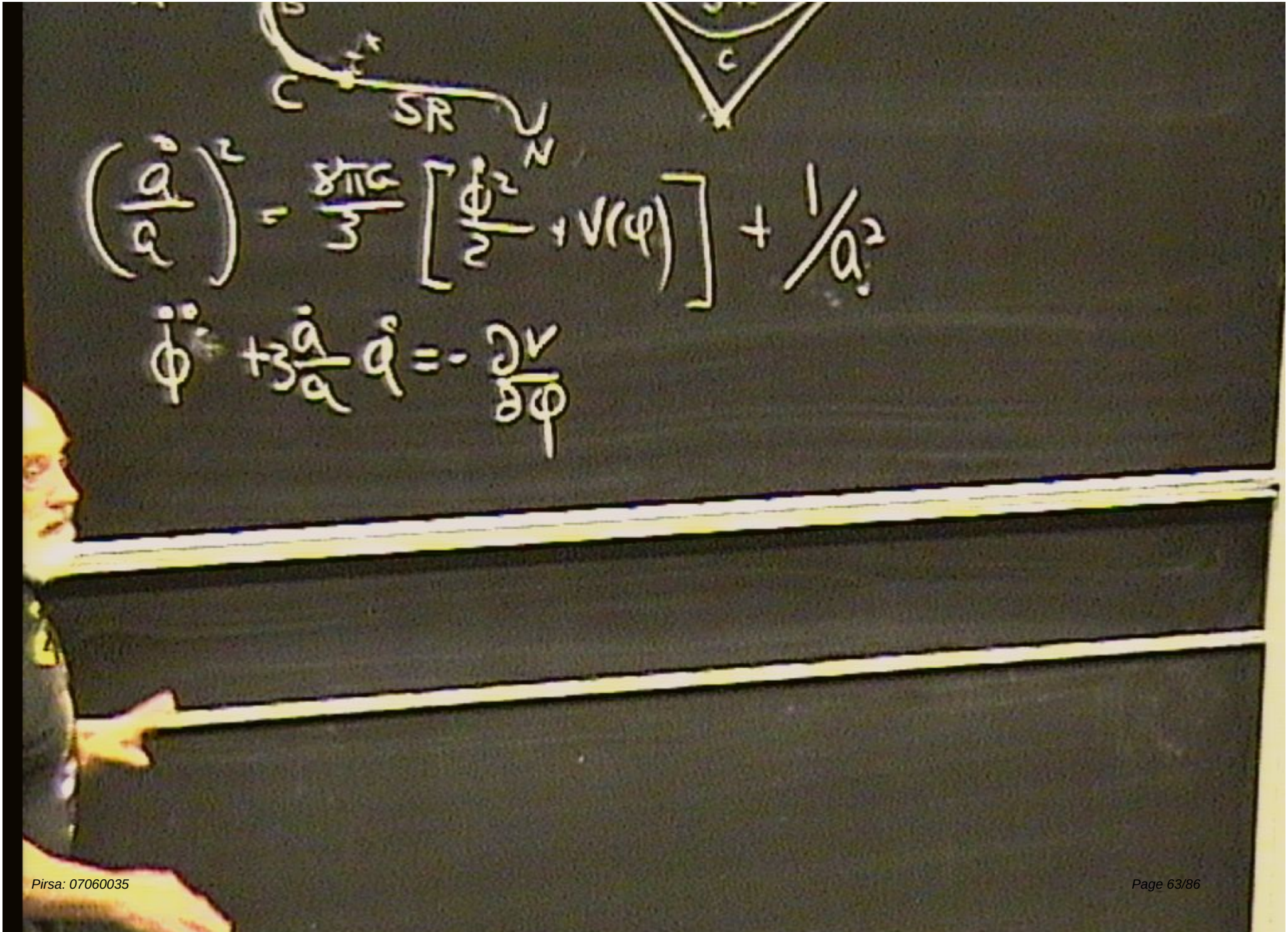


$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\phi)\right] + \frac{1}{a^2}$$



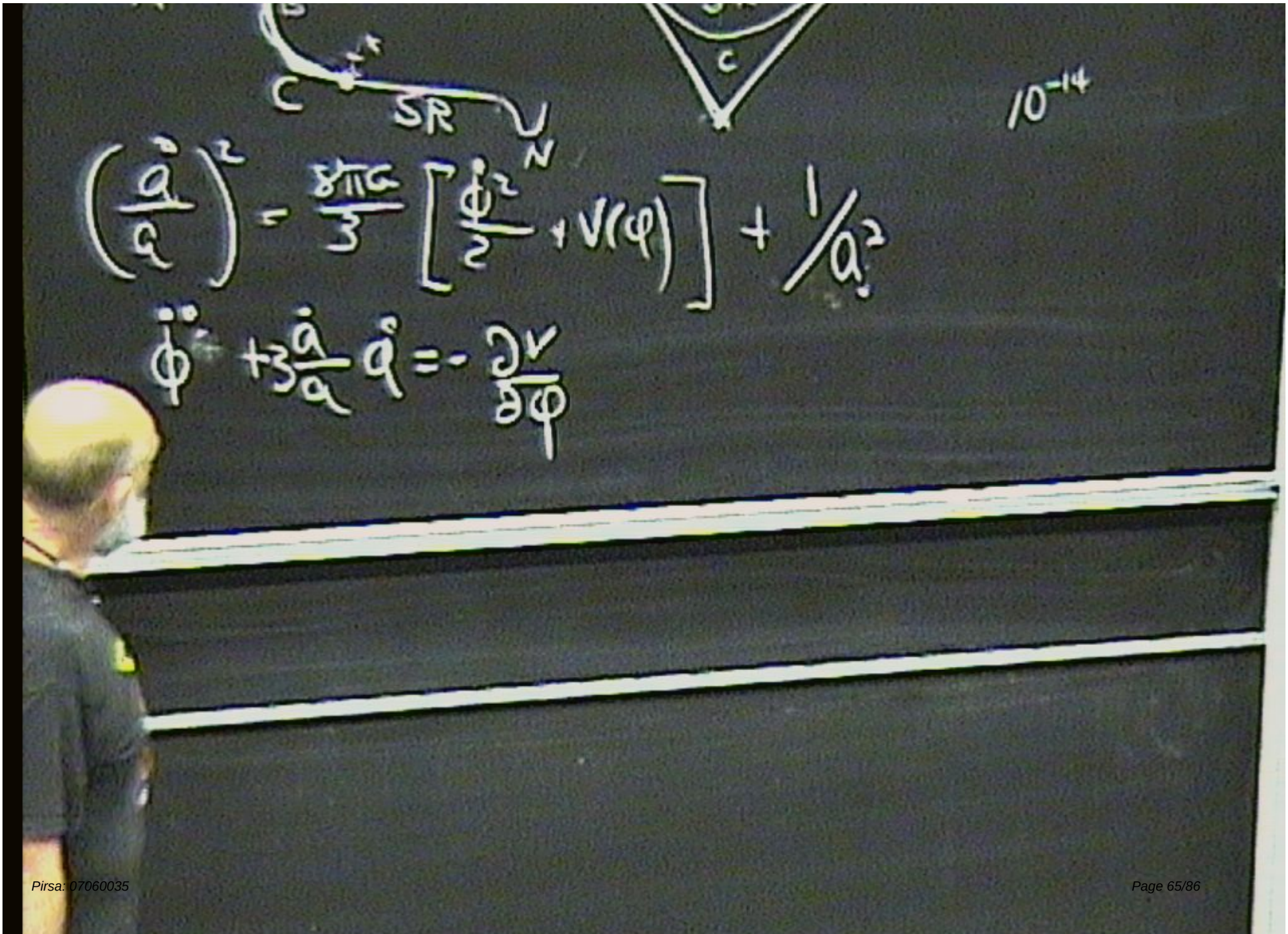
$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\varphi)\right] + \frac{1}{a^2}$$


C
SR
C
$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\phi)\right] + \frac{1}{a^2}$
$\ddot{\phi} + 3\frac{\dot{a}}{a}\dot{\phi} = -\frac{\partial V}{\partial \phi}$


C
SR
C
$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\phi)\right] + \frac{1}{a^2}$
$\ddot{\phi} + 3\frac{\dot{a}}{a}\dot{\phi} = -\frac{\partial V}{\partial \phi}$

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\phi)\right] + \frac{1}{a^2}$$

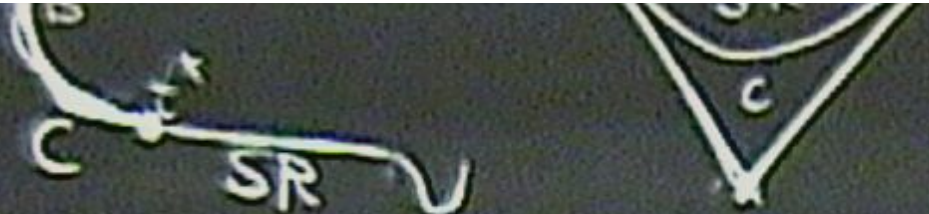
$$\ddot{\phi} + 3\frac{\dot{a}}{a}\dot{\phi} = -\frac{\partial V}{\partial \phi}$$


C
SR
C
10^{-14}
$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\phi)\right] + \frac{1}{a^2}$
$\ddot{\phi} + 3\frac{\dot{a}}{a}\dot{\phi} = -\frac{\partial V}{\partial \phi}$

$10^{-14} \approx \frac{1}{a^7}$

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\phi)\right] + \frac{1}{a^2}$$

$$\ddot{\phi} + 3\frac{\dot{a}}{a}\dot{\phi} = -\frac{\partial V}{\partial \phi}$$



$10^{-14} = \frac{1}{a^2}$

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\phi)\right] + \frac{1}{a^2}$$

$a = t$

$$\ddot{\phi} + 3\frac{\dot{a}}{a}\dot{\phi} = -\frac{\partial V}{\partial \phi}$$

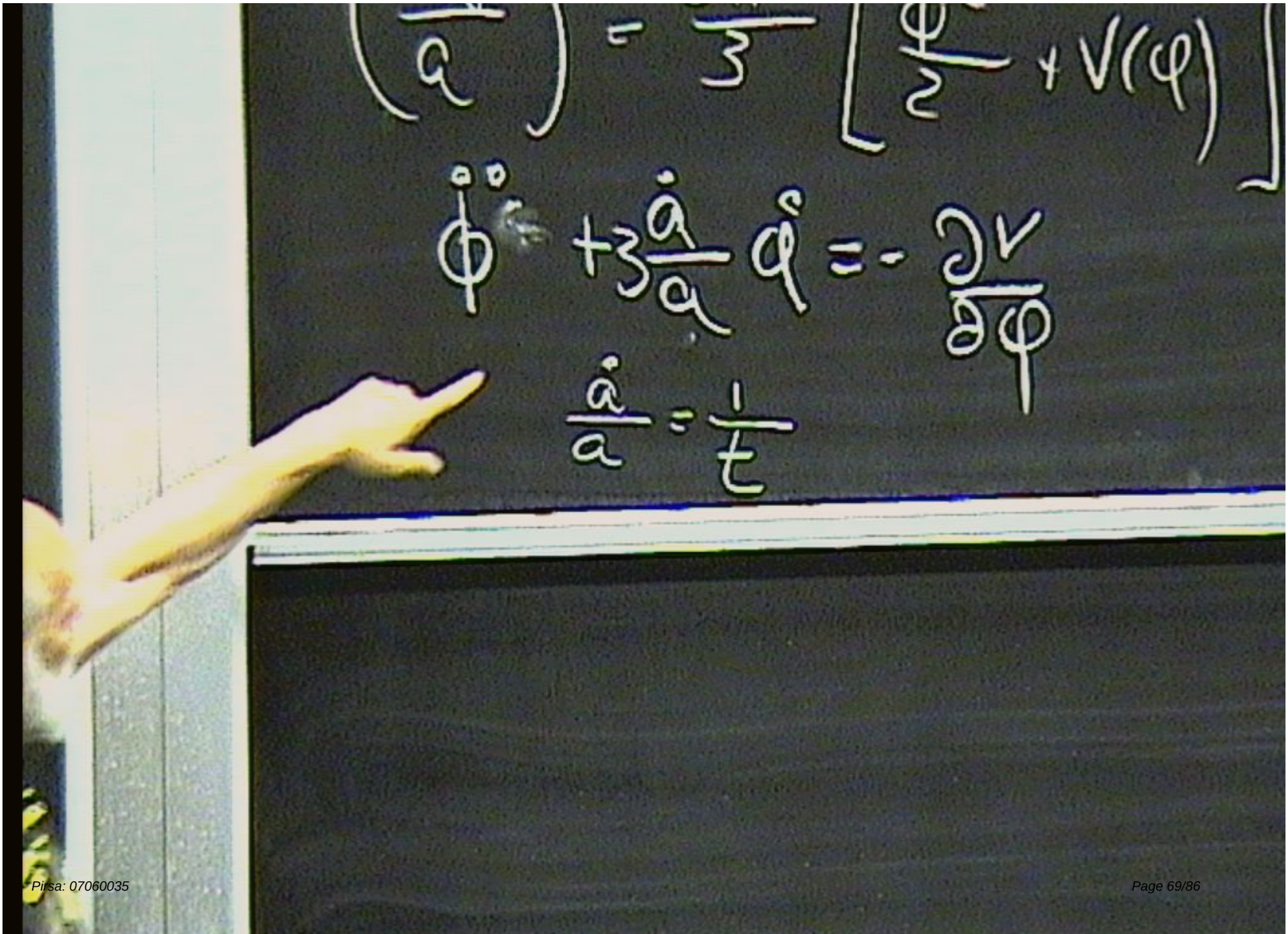
$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\varphi)\right] + \frac{1}{a^2}$$

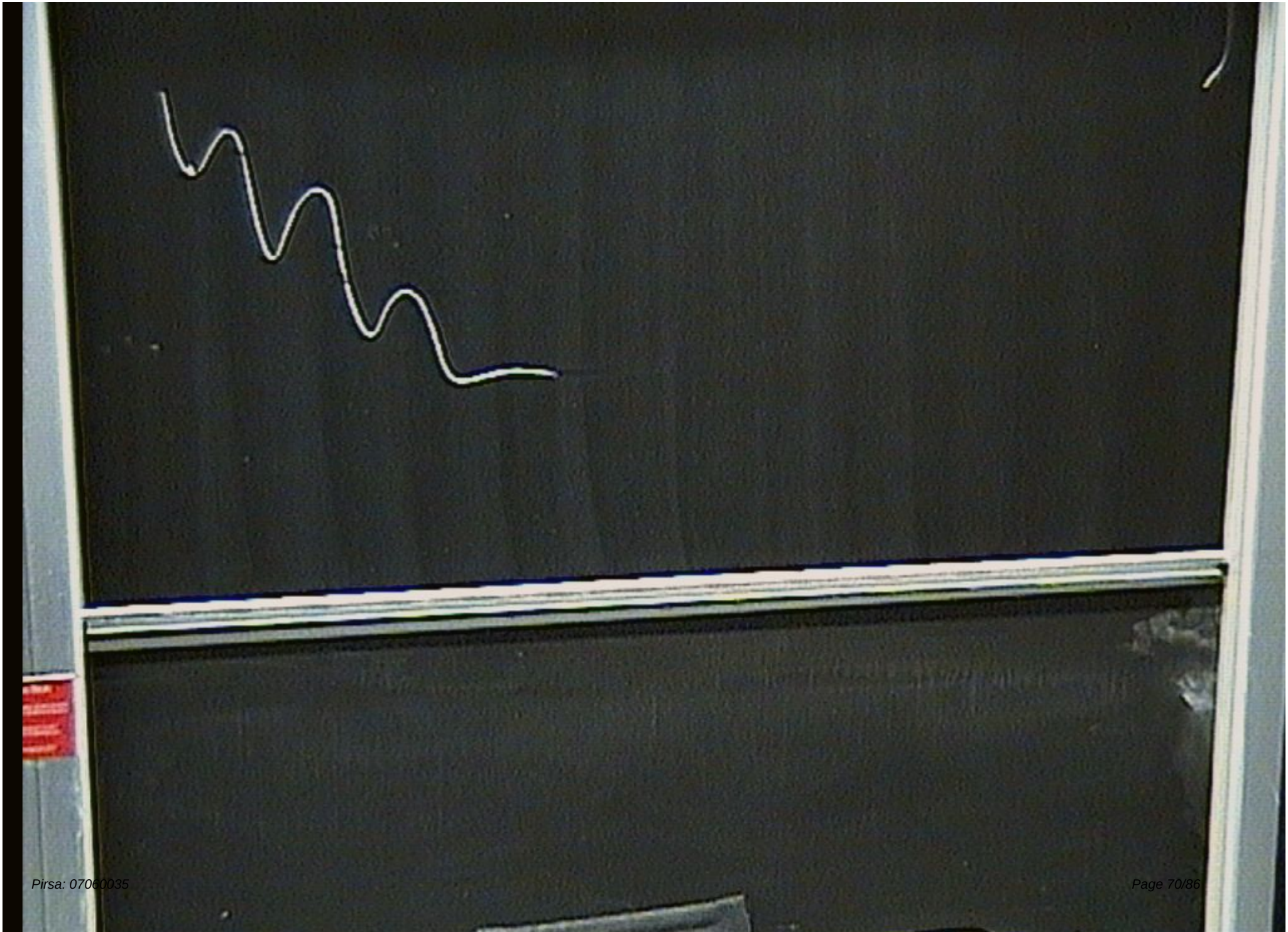
$$\ddot{\phi} + 3\frac{\dot{a}}{a}\dot{\phi} = -\frac{\partial V}{\partial \phi}$$

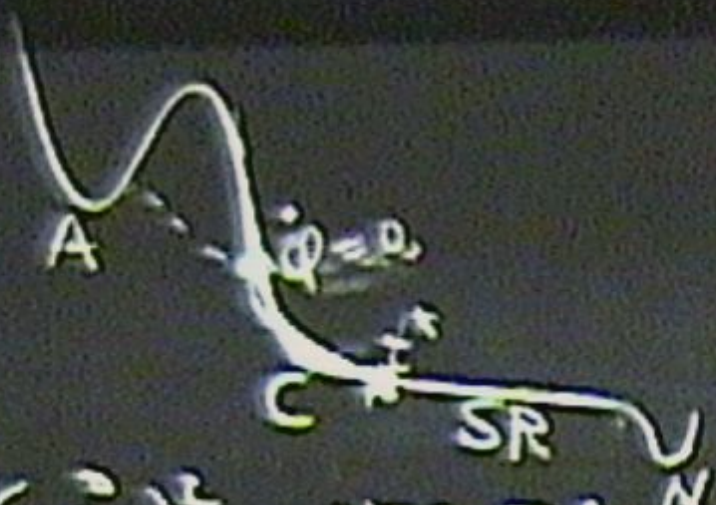
$10^{-14} = \frac{1}{a}$

$a = t$

$t = 10^7$


$\left(\frac{\dot{a}}{a}\right)^2 = \frac{1}{3}\left[\frac{\dot{\varphi}^2}{2} + V(\varphi)\right]$
$\ddot{\varphi} + 3\frac{\dot{a}}{a}\dot{\varphi} = -\frac{\partial V}{\partial \varphi}$
$\frac{\dot{a}}{a} = \frac{1}{t}$





$10^{-14} = \frac{1}{a^2}$

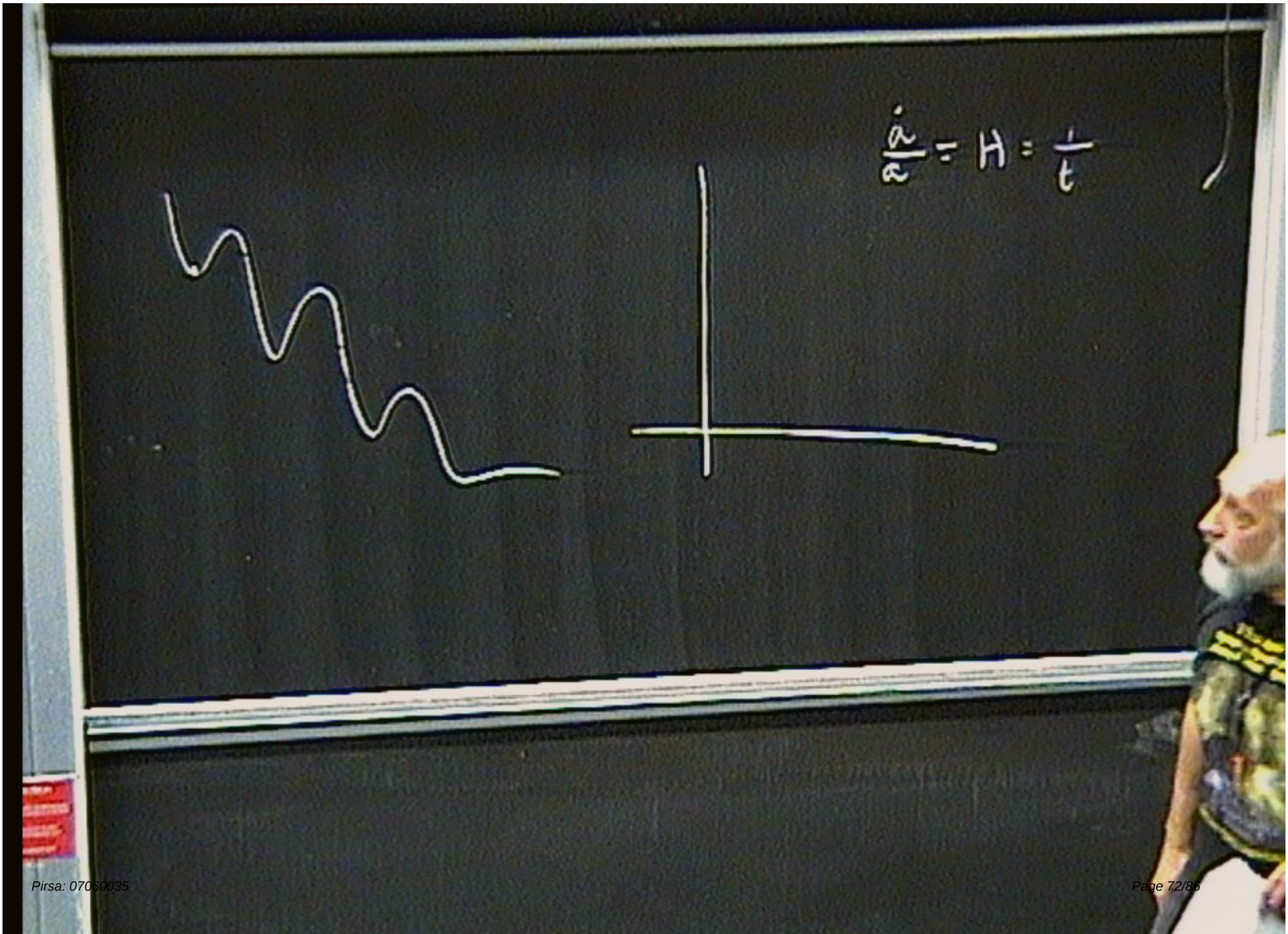
$$\left(\frac{\dot a}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot\varphi^2}{2} + V(\varphi)\right] + \frac{1}{a^2}$$

$a = t$

$t^2 \cdot 10^7$

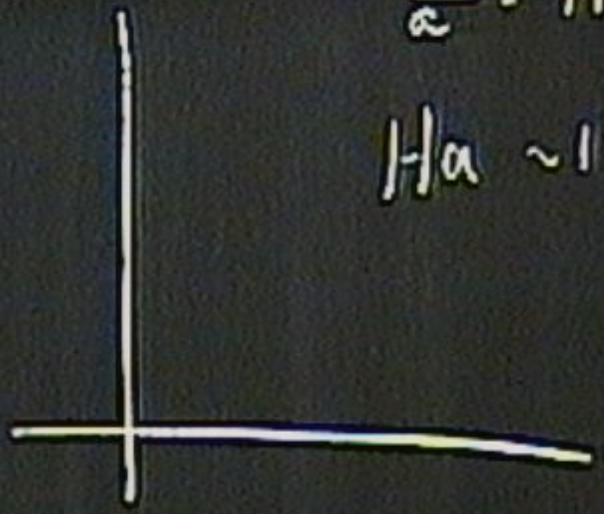
$$\ddot\varphi + 3\frac{\dot a}{a}\dot\varphi = -\frac{\partial V}{\partial \varphi}$$

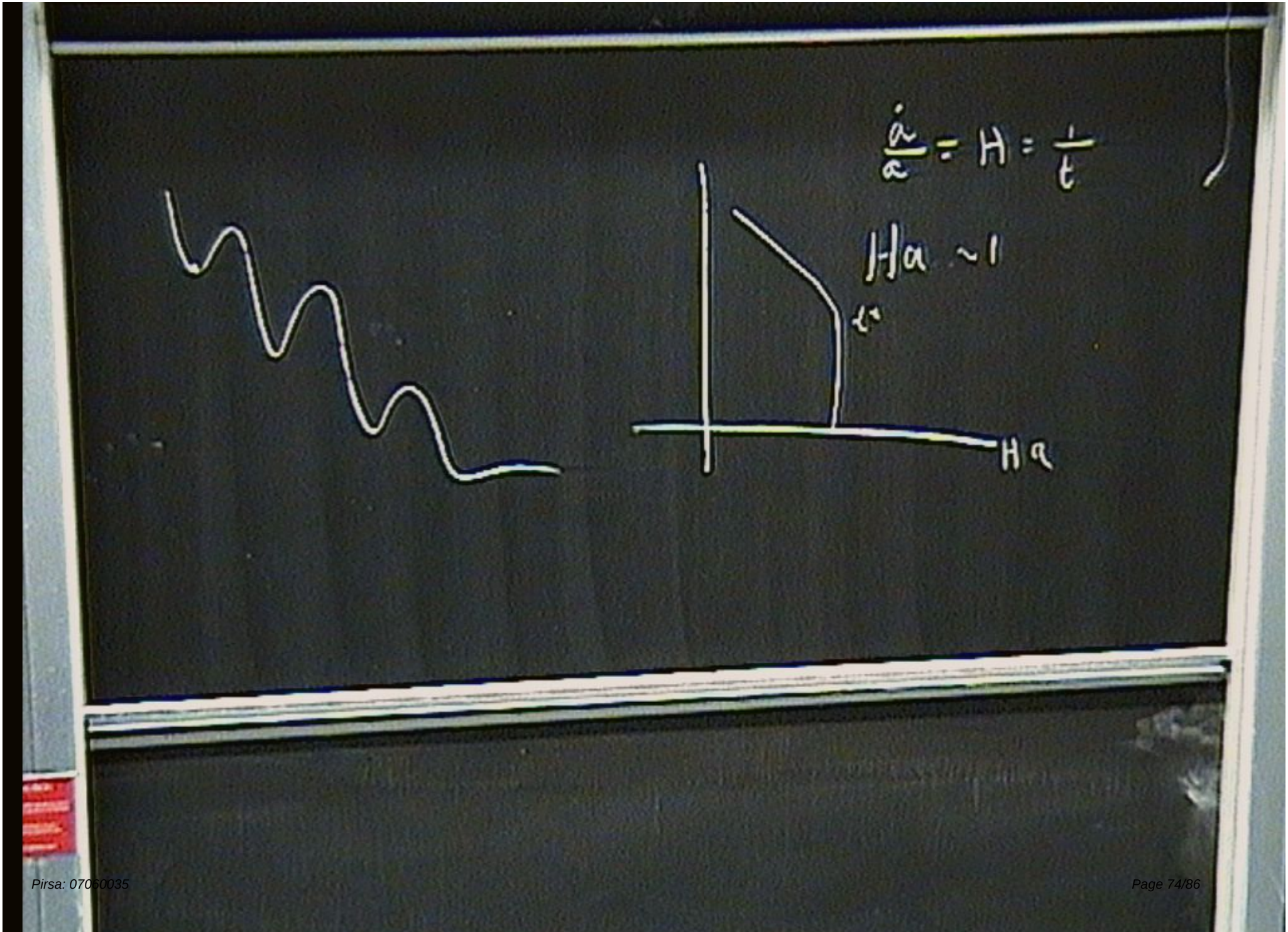
$$\frac{\dot a}{a} = \frac{1}{t}$$

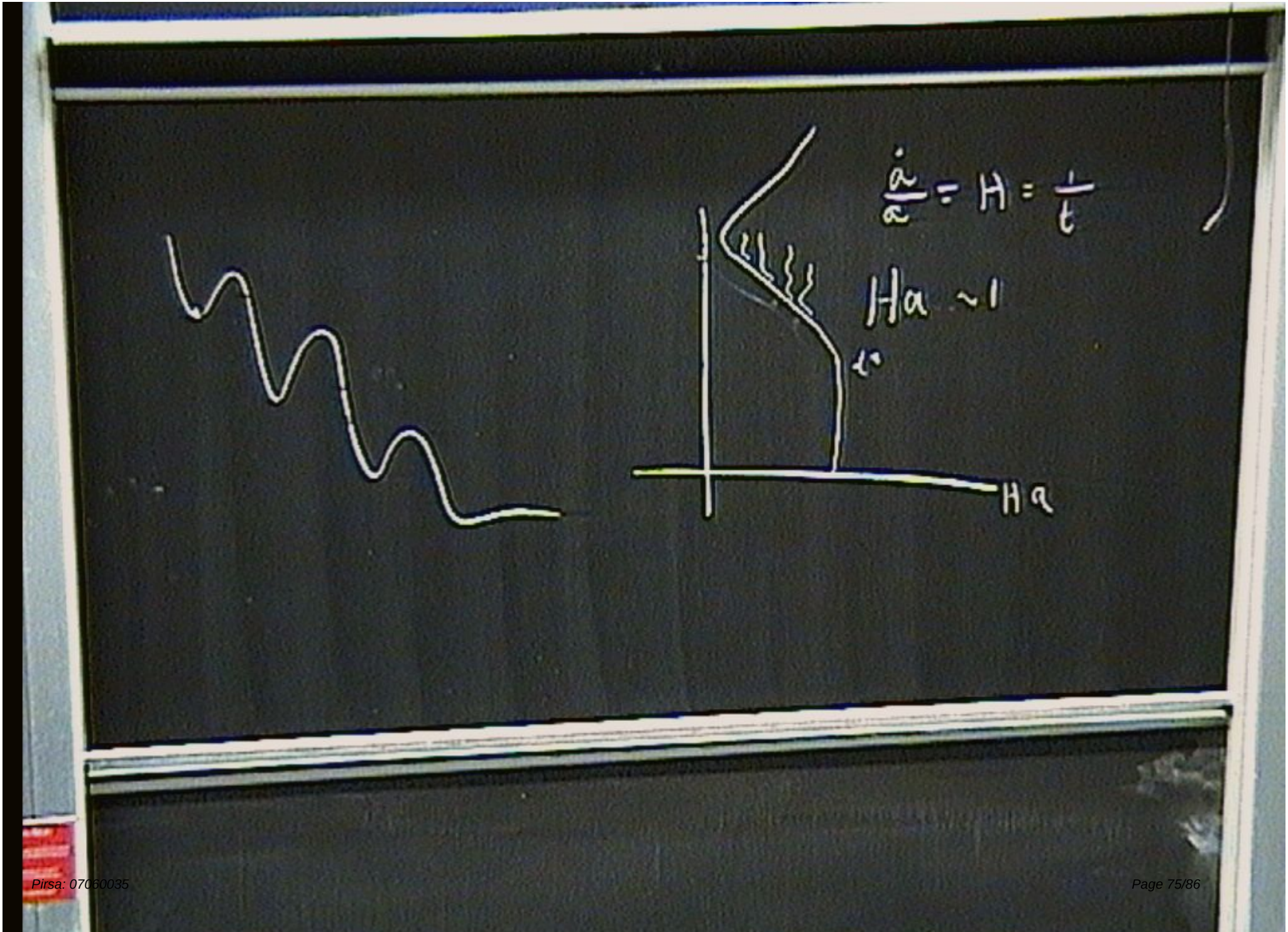

$\frac{\dot{a}}{a} = H = \frac{1}{t}$

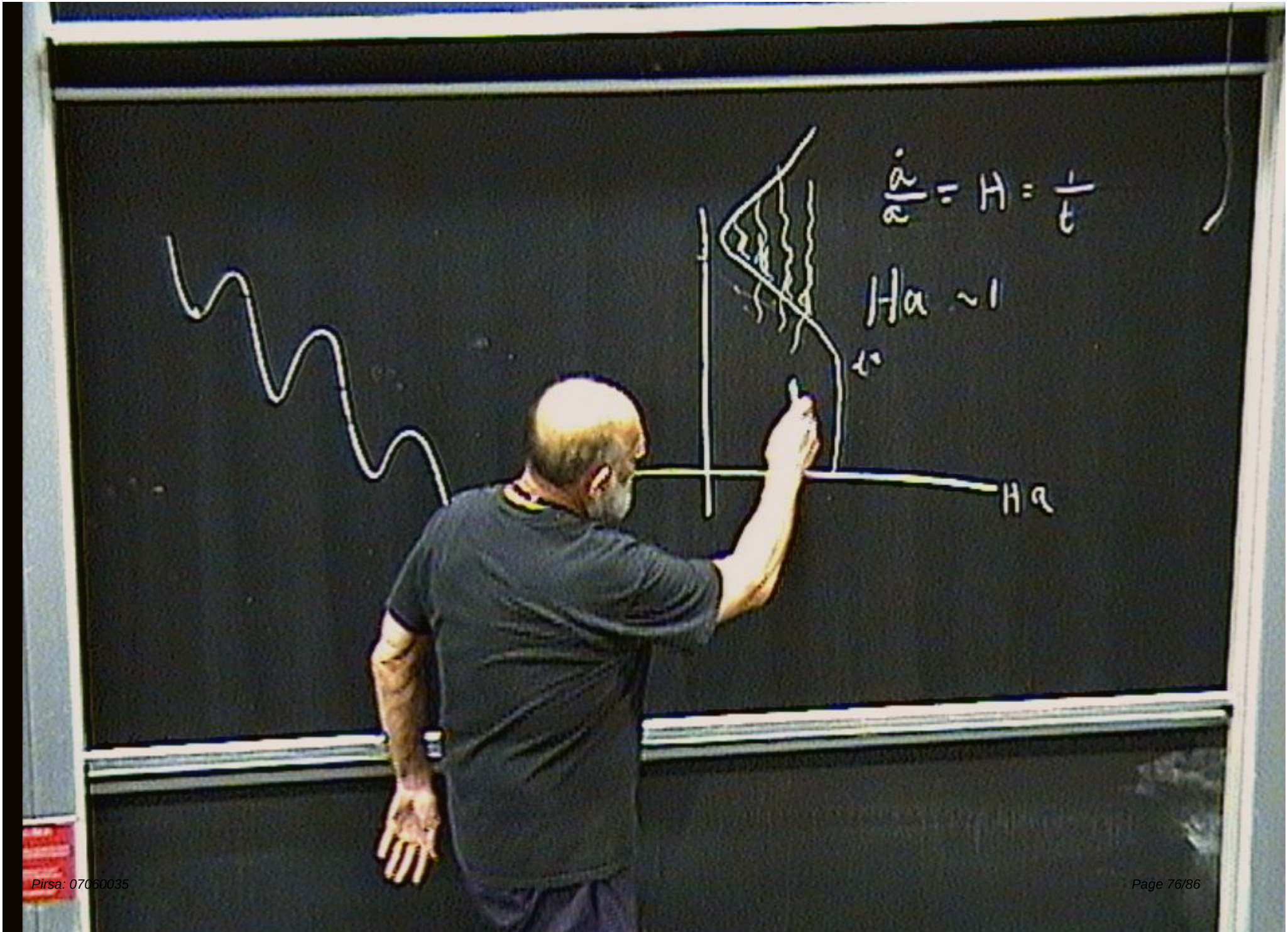
$\frac{\dot{a}}{a} = H = \frac{1}{t}$

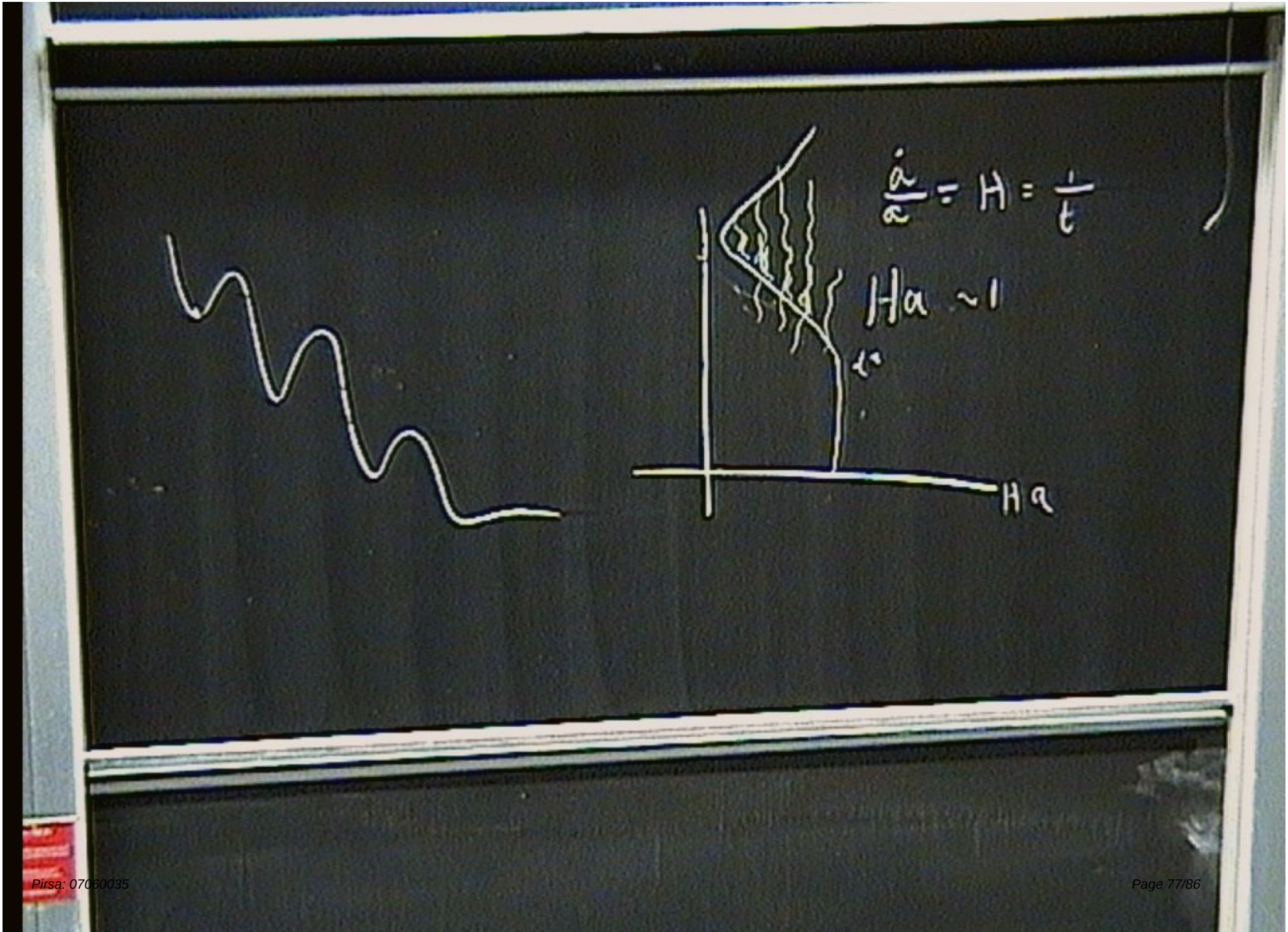
$Ha \sim 1$

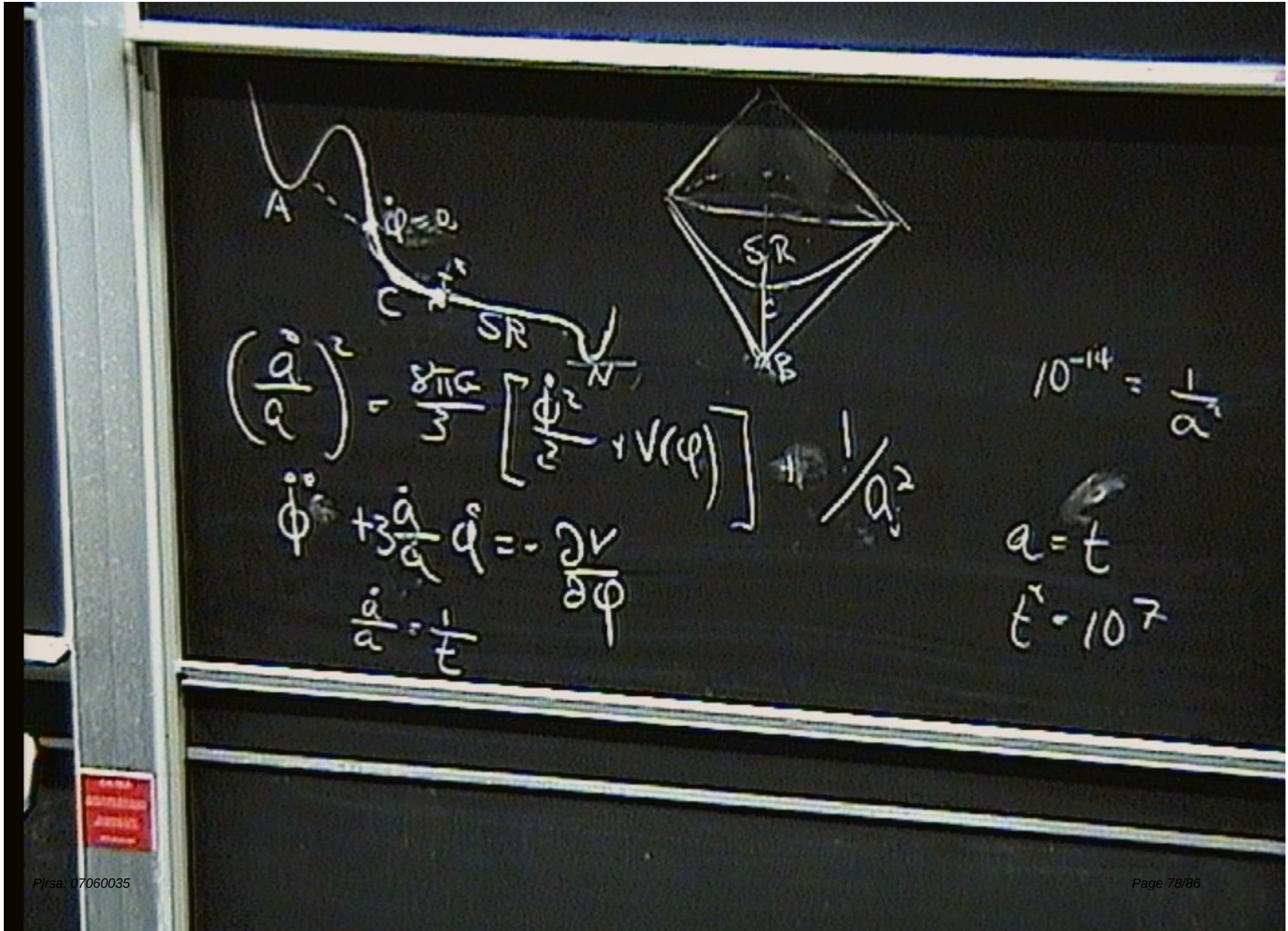


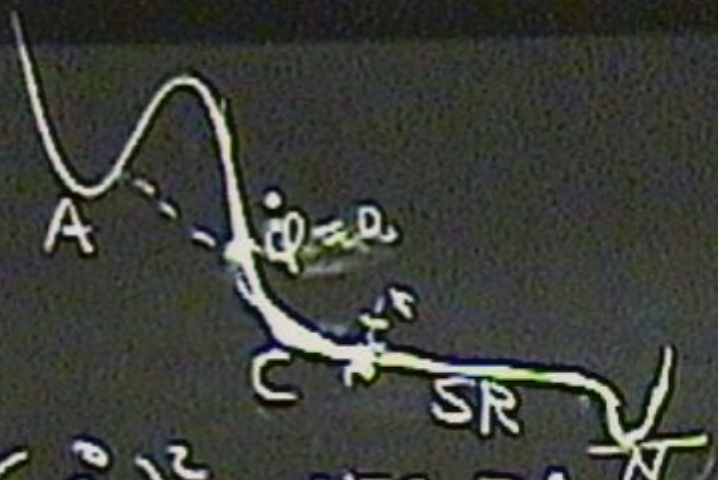

$\frac{\dot{a}}{a} = H = \frac{1}{t}$
$Ha \sim 1$
t^*
Hq


$\frac{\dot{a}}{a} = H = \frac{1}{t}$
$Ha \sim 1$
t^*
Hq


$\frac{\dot{a}}{a} = H = \frac{1}{t}$
$Ha \sim 1$
t^*
Hq


$\frac{\dot{a}}{a} = H = \frac{1}{t}$
$Ha \sim 1$
t^*
Ha


A
$\dot\varphi = 0$
C
SR
N
SR
B
$\left(\frac{\dot a}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot\varphi^2}{2} + V(\varphi)\right] + \frac{1}{a^2}$
$\ddot\varphi + 3\frac{\dot a}{a}\dot\varphi = -\frac{\partial V}{\partial \varphi}$
$\frac{\dot a}{a} = \frac{1}{t}$
$10^{-14} = \frac{1}{a}$
$a = t$
$t = 10^7$



$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\phi)\right] + \frac{1}{a^2}$$

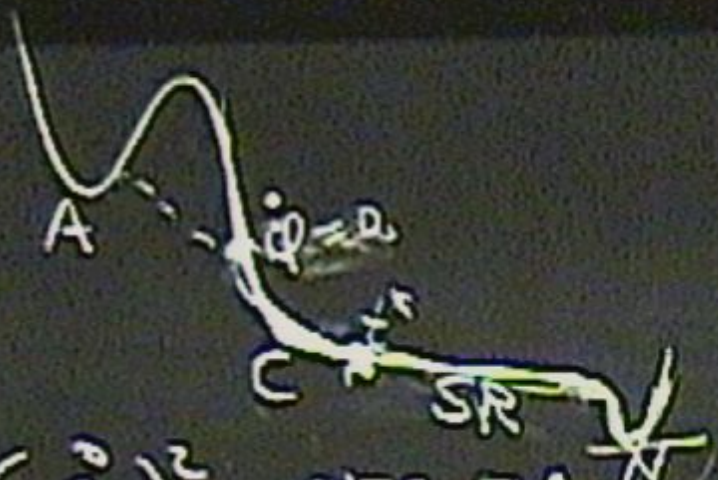
$$\ddot{\phi} + 3\frac{\dot{a}}{a}\dot{\phi} = -\frac{\partial V}{\partial \phi}$$

$$\frac{\dot{a}}{a} = \frac{1}{t}$$

$10^{-14} = \frac{1}{a}$

$a = t$

$t \sim 10^7$



$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\varphi}^2}{2} + V(\varphi)\right] + 1/a^2$$

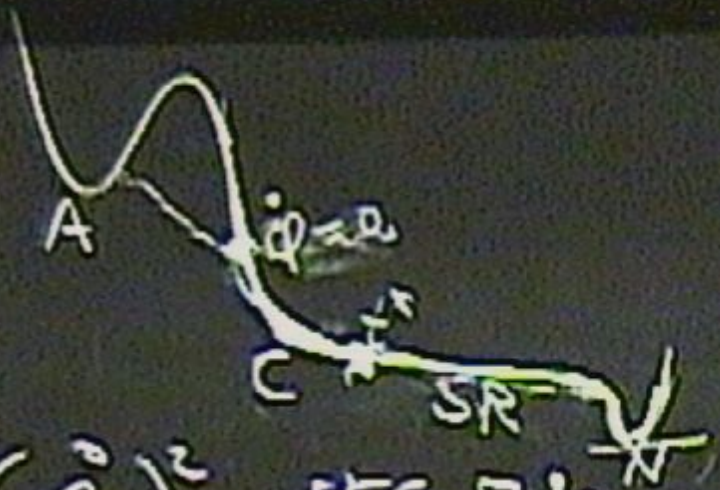
$$\ddot{\varphi} + 3\frac{\dot{a}}{a}\dot{\varphi} = -\frac{\partial V}{\partial \varphi}$$

$$\frac{\dot{a}}{a} = \frac{1}{t}$$

$10^{-14} = \frac{1}{a}$

$a = t$

$t \sim 10^7$



$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\varphi}^2}{2} + V(\varphi)\right] + \frac{1}{a^2}$$

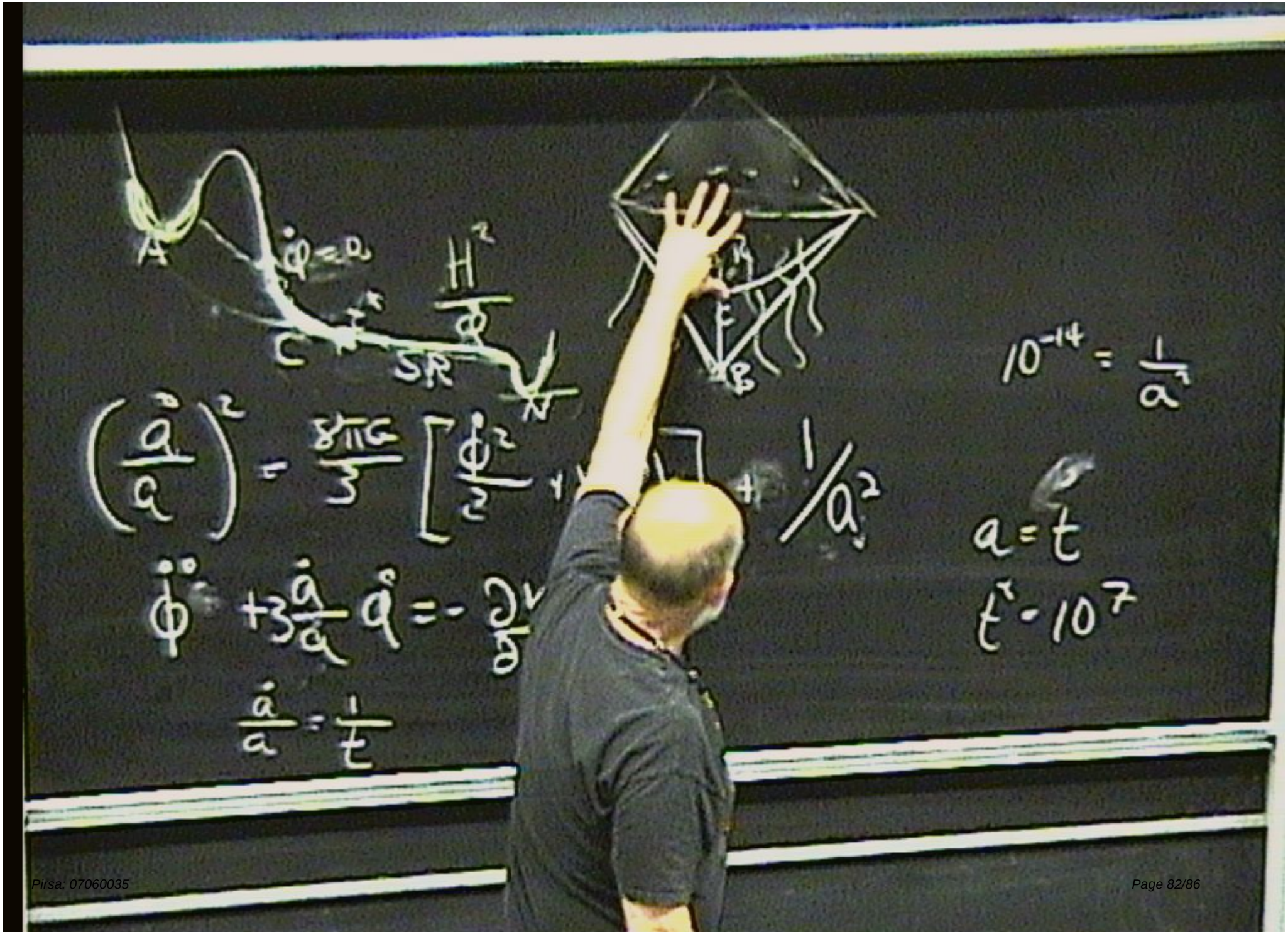
$$\ddot{\varphi} + 3\frac{\dot{a}}{a}\dot{\varphi} = -\frac{\partial V}{\partial \varphi}$$

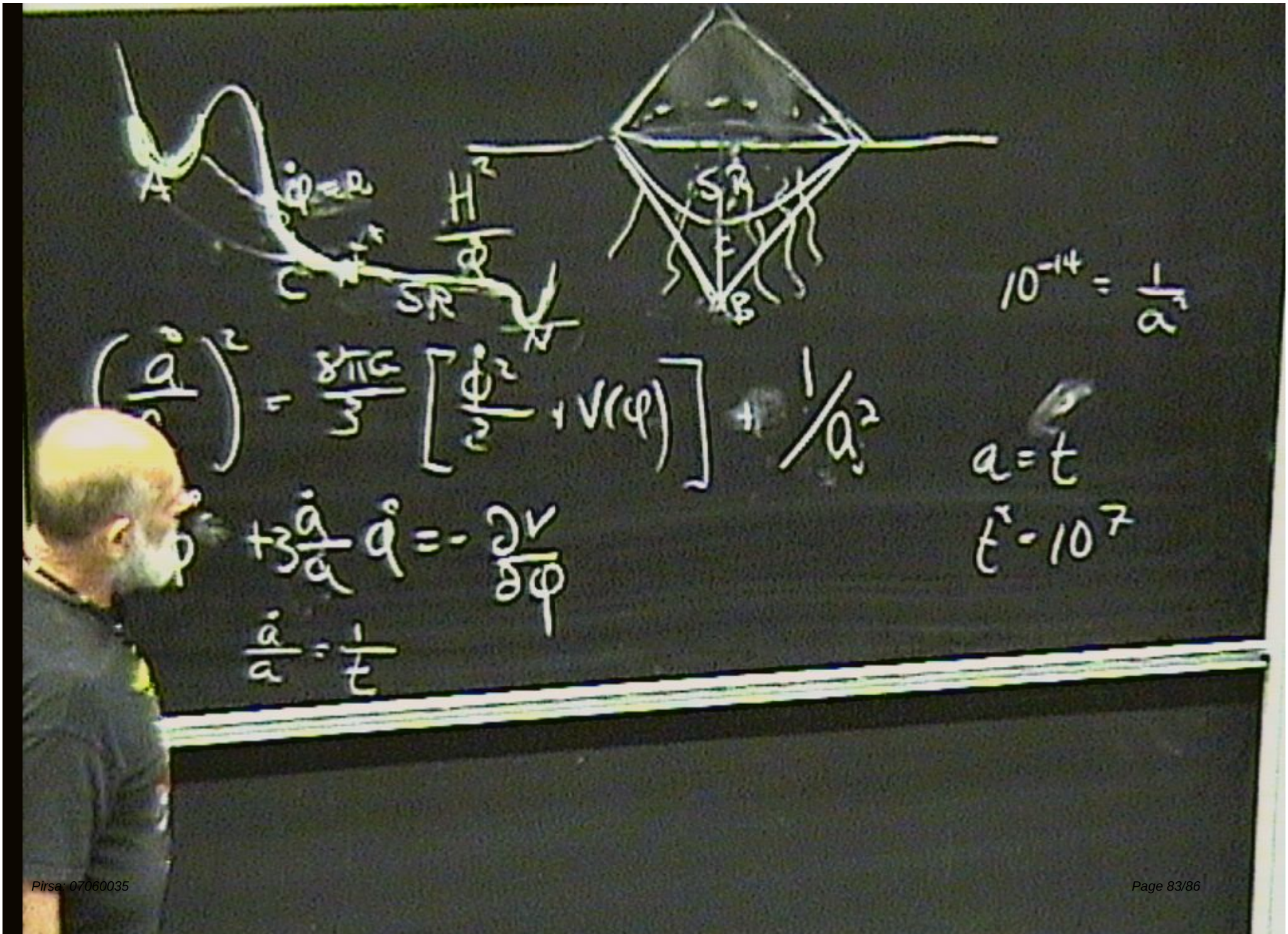
$$\frac{\dot{a}}{a} = \frac{1}{t}$$

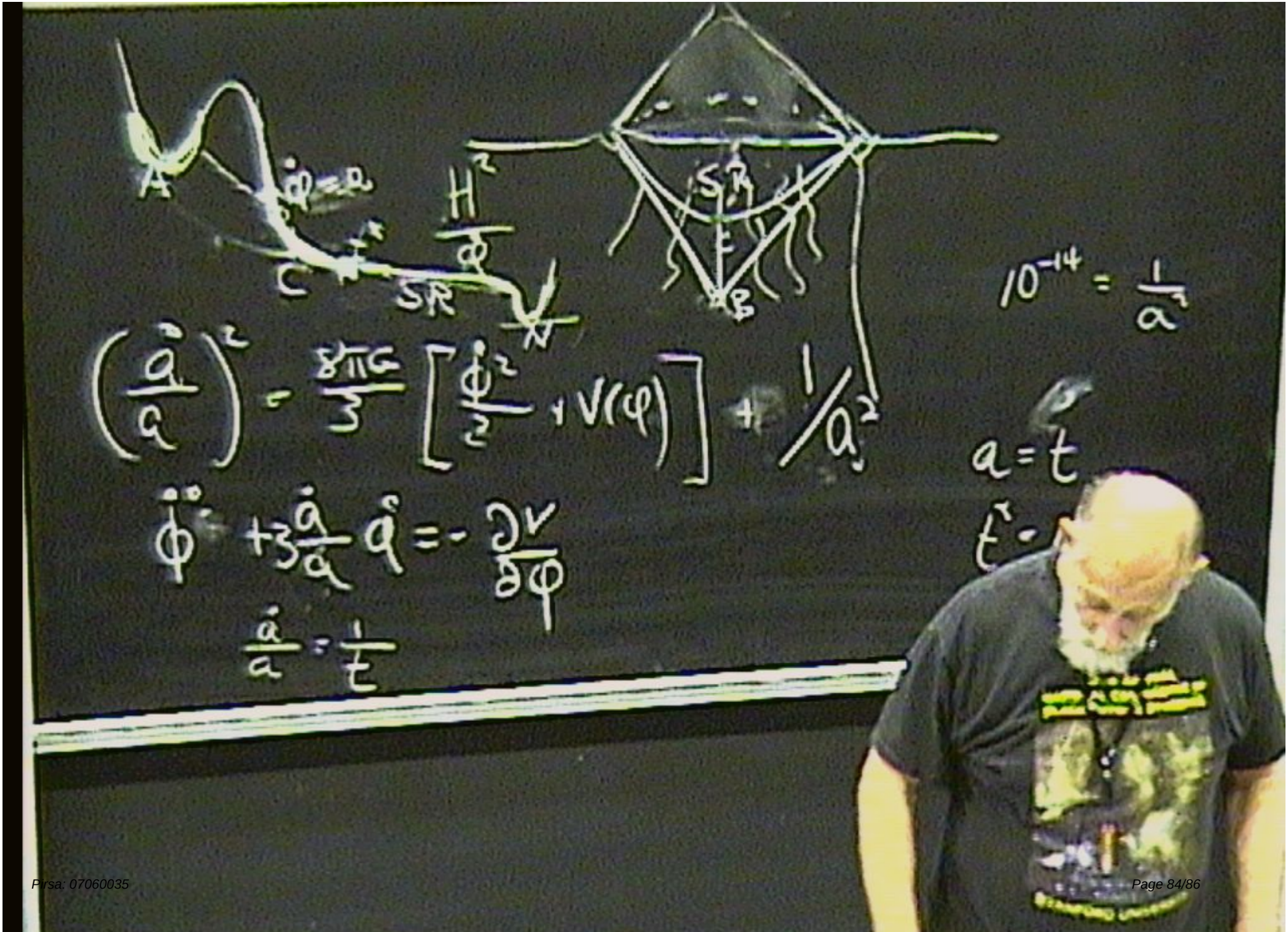
$10^{-14} = \frac{1}{a^2}$

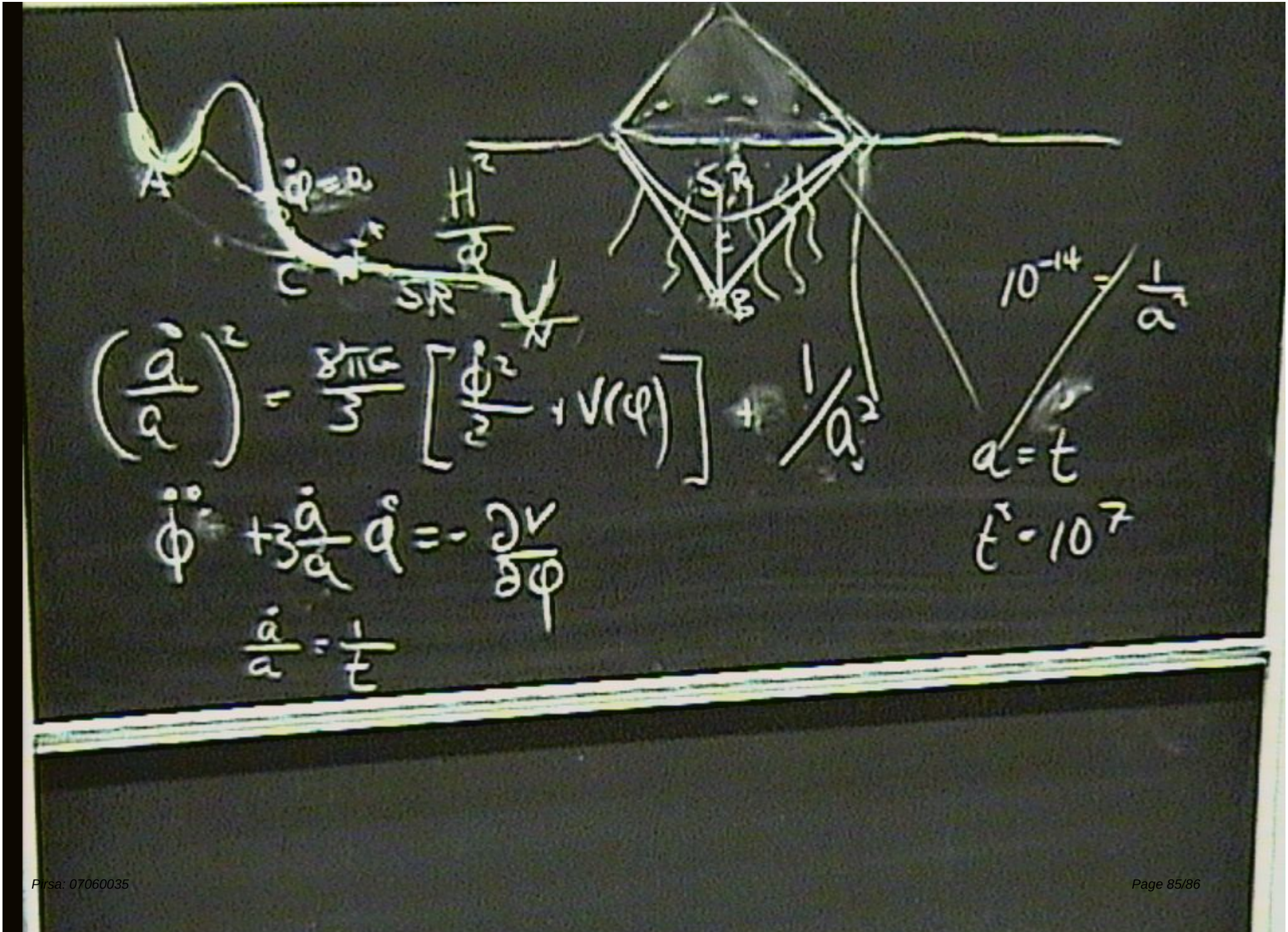
$a = t$

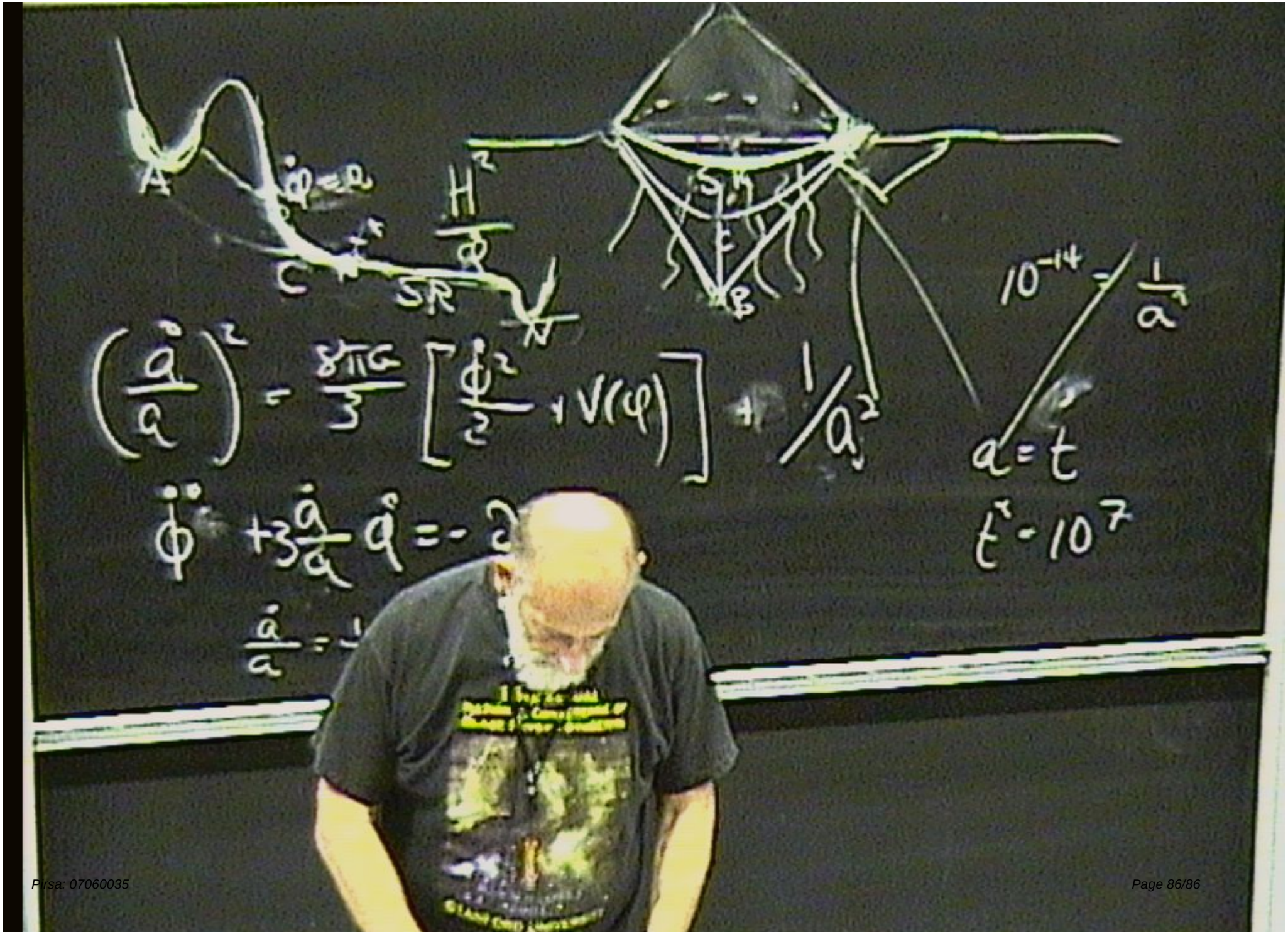
$t \sim 10^7$


A
C
SR
B
F
$\dot{\varphi} = p_\varphi$
H^2
$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + \right] + \frac{1}{a^2}$
$\ddot{\phi} + 3\frac{\dot{a}}{a}\dot{\phi} = -\frac{\partial V}{\partial \phi}$
$\frac{\dot{a}}{a} = \frac{1}{t}$
$10^{-14} = \frac{1}{a^7}$
$a = t$
$t^7 \cdot 10^7$


A
C
SR
H²
SR
F
B
$10^{-14} = \frac{1}{a^2}$
$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\varphi}^2}{2} + V(\varphi)\right] + \frac{1}{a^2}$
$a = t$
$t^2 \sim 10^7$
$\ddot{\varphi} + 3\frac{\dot{a}}{a}\dot{\varphi} = -\frac{\partial V}{\partial \varphi}$
$\frac{\dot{a}}{a} = \frac{1}{t}$


A
B
C
SR
SR
SR
$\dot{\varphi}=0$
H^2
$\frac{\kappa}{a^2}$
$10^{-14} = \frac{1}{a}$
$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\varphi}^2}{2} + V(\varphi)\right] + \frac{1}{a^2}$
$a = t$
$\ddot{\varphi} + 3\frac{\dot{a}}{a}\dot{\varphi} = -\frac{\partial V}{\partial \varphi}$
$\frac{\dot{a}}{a} = \frac{1}{t}$


A
C
SR
H
SR
B
$10^{-14} = \frac{1}{a}$
$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\phi)\right] + \frac{1}{a^2}$
$a = t$
$t \sim 10^7$
$\ddot{\phi} + 3\frac{\dot{a}}{a}\dot{\phi} = -\frac{\partial V}{\partial \phi}$
$\frac{\dot{a}}{a} = \frac{1}{t}$


A
C
SR
B
H^2
$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\left[\frac{\dot{\phi}^2}{2} + V(\phi)\right] + \frac{1}{a^2}$
$\ddot{\phi} + 3\frac{\dot{a}}{a}\dot{\phi} = -$
$\frac{\dot{a}}{a} =$
10^{-14}
$\frac{1}{a}$
$a = t$
$t \sim 10^7$