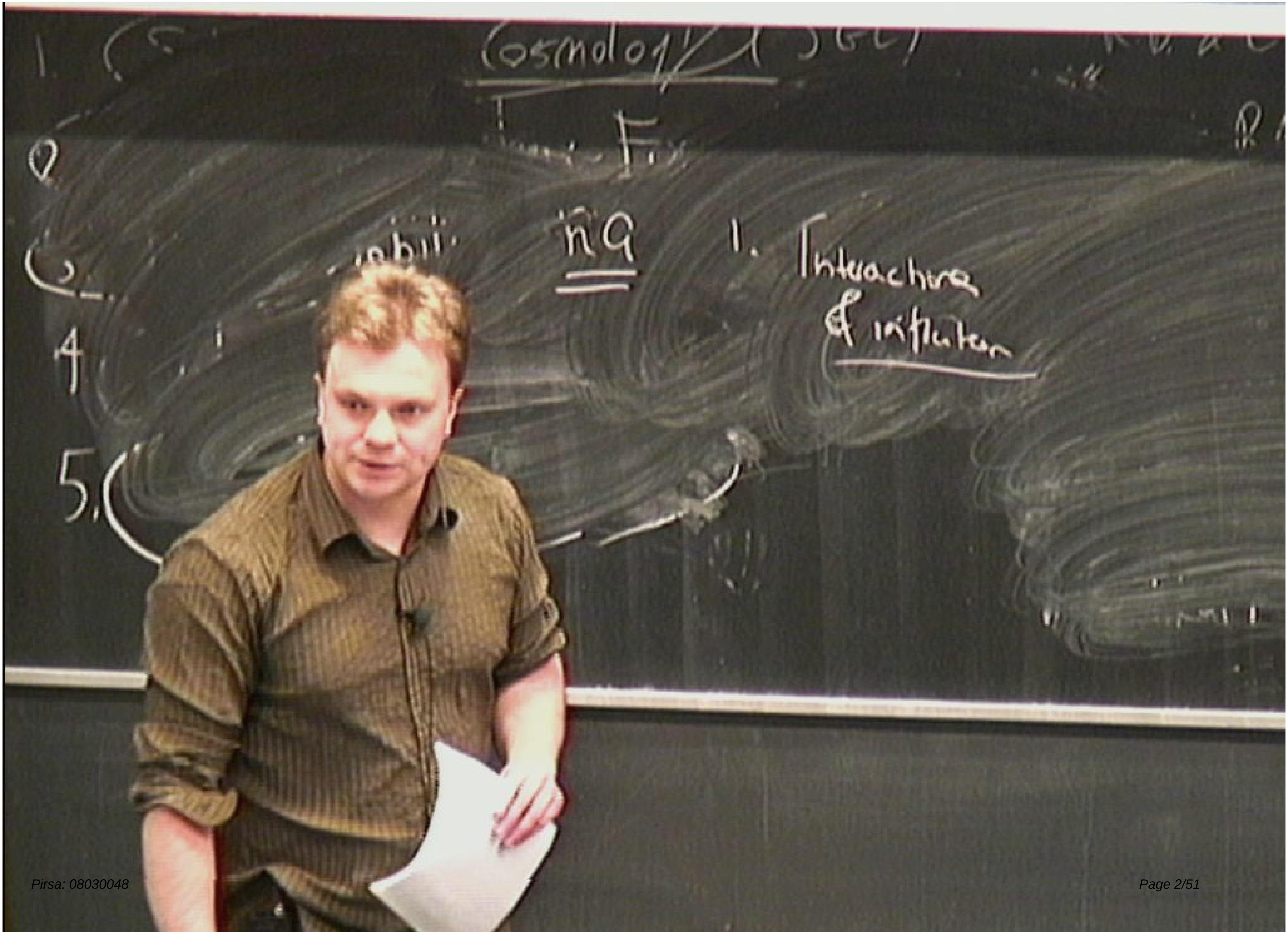
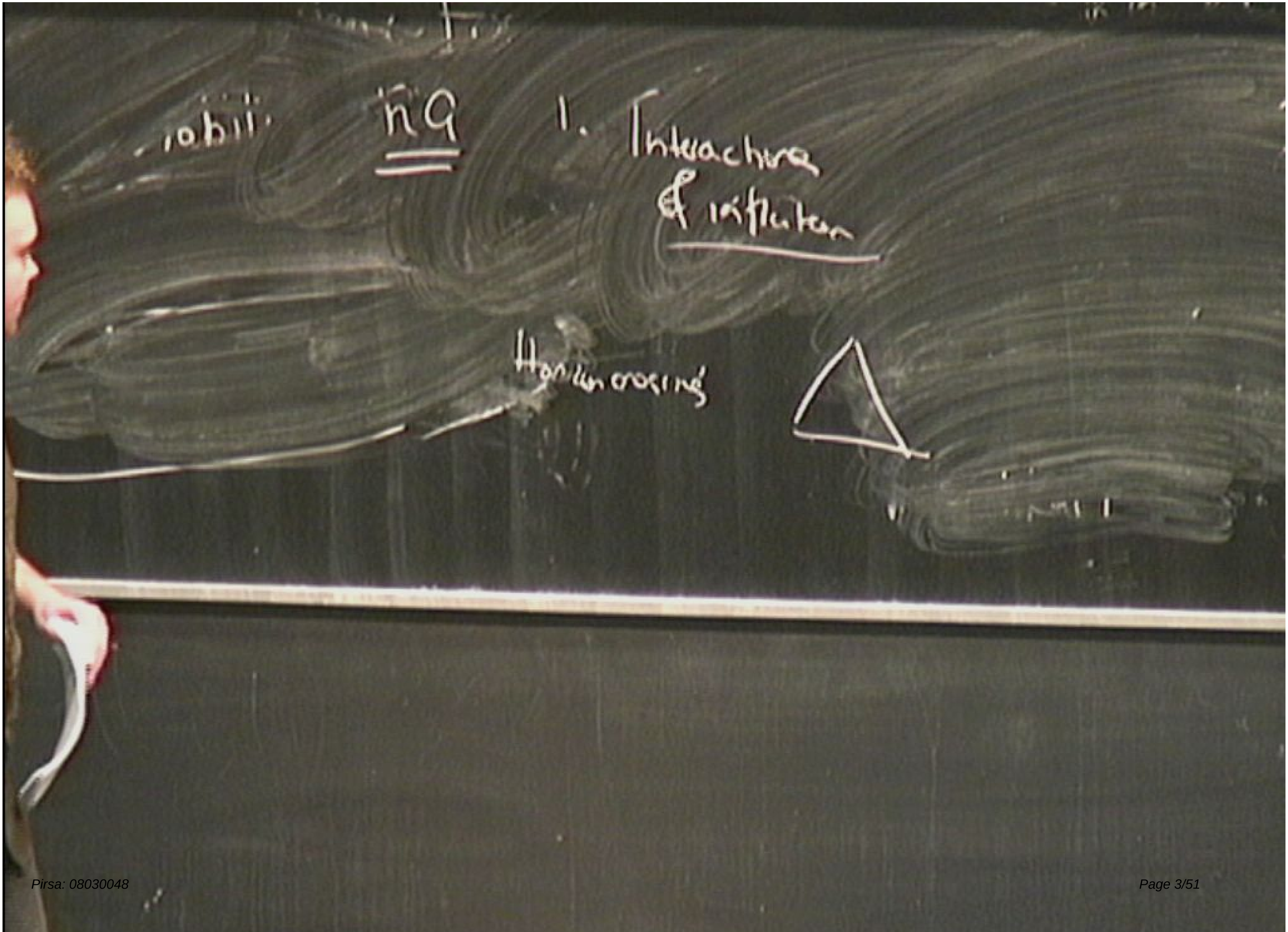
Title: Constraining initial state non-gaussianity via backreaction

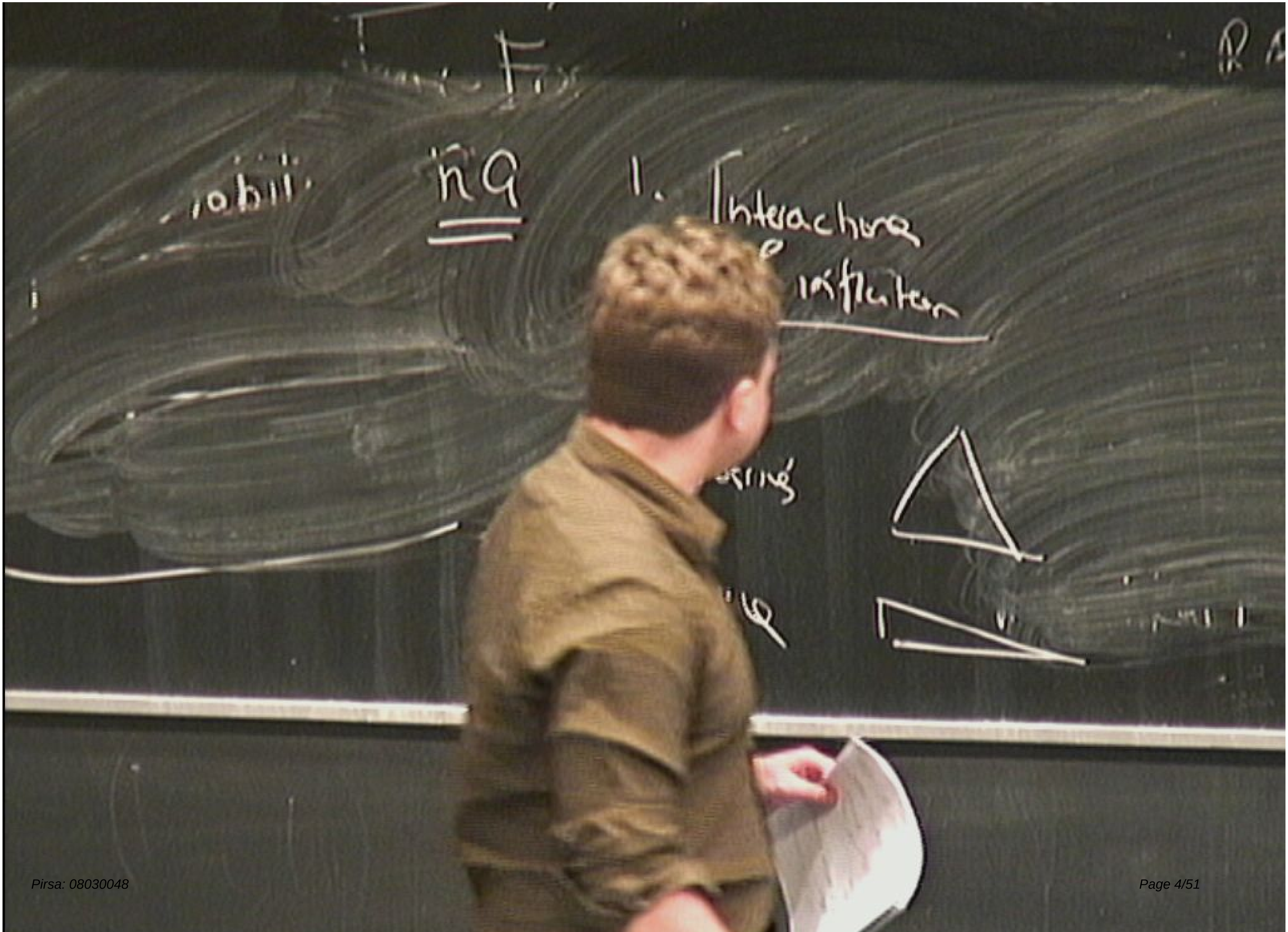
Date: Mar 07, 2008 05:30 PM

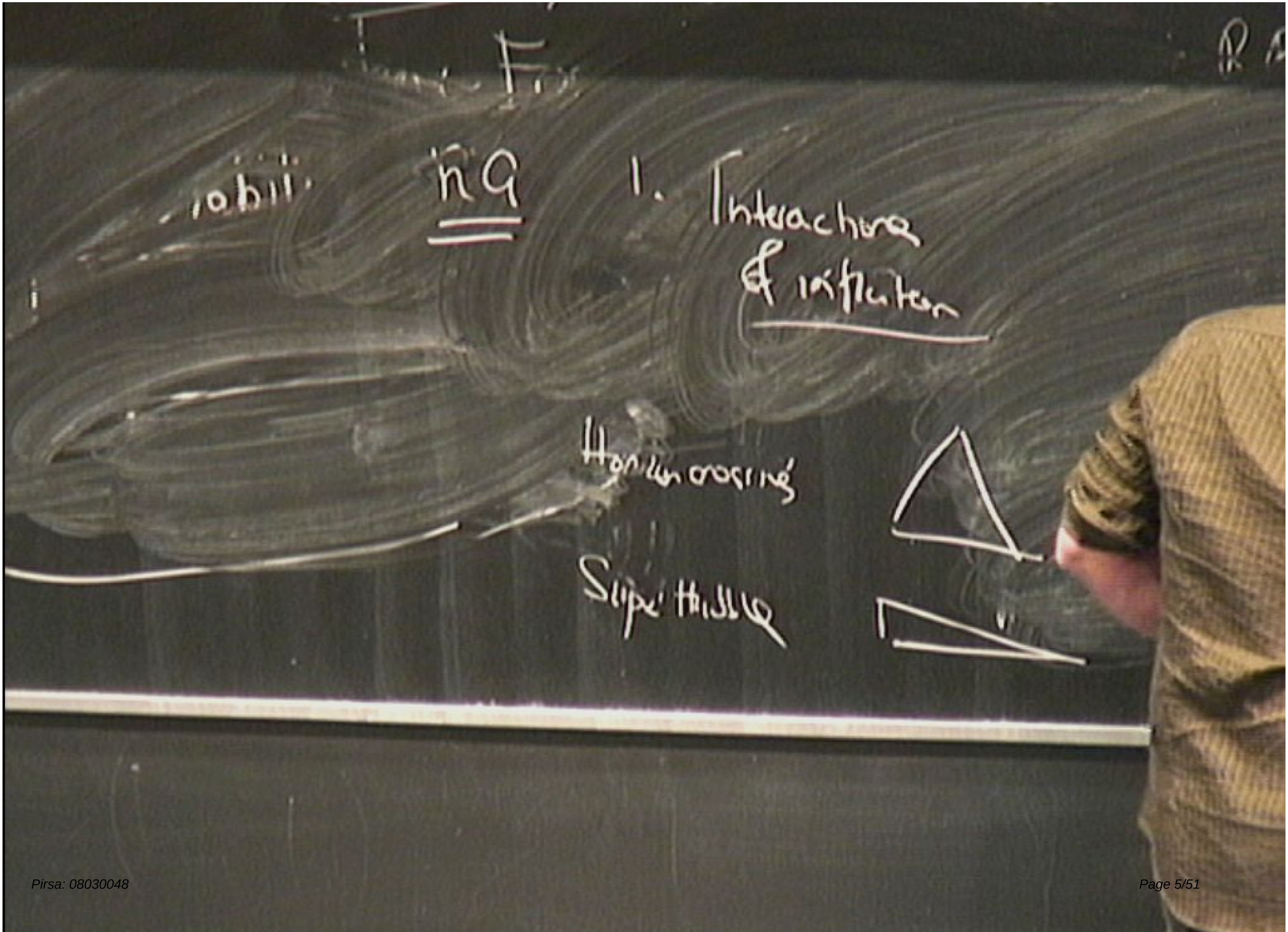
URL: http://pirsa.org/08030048

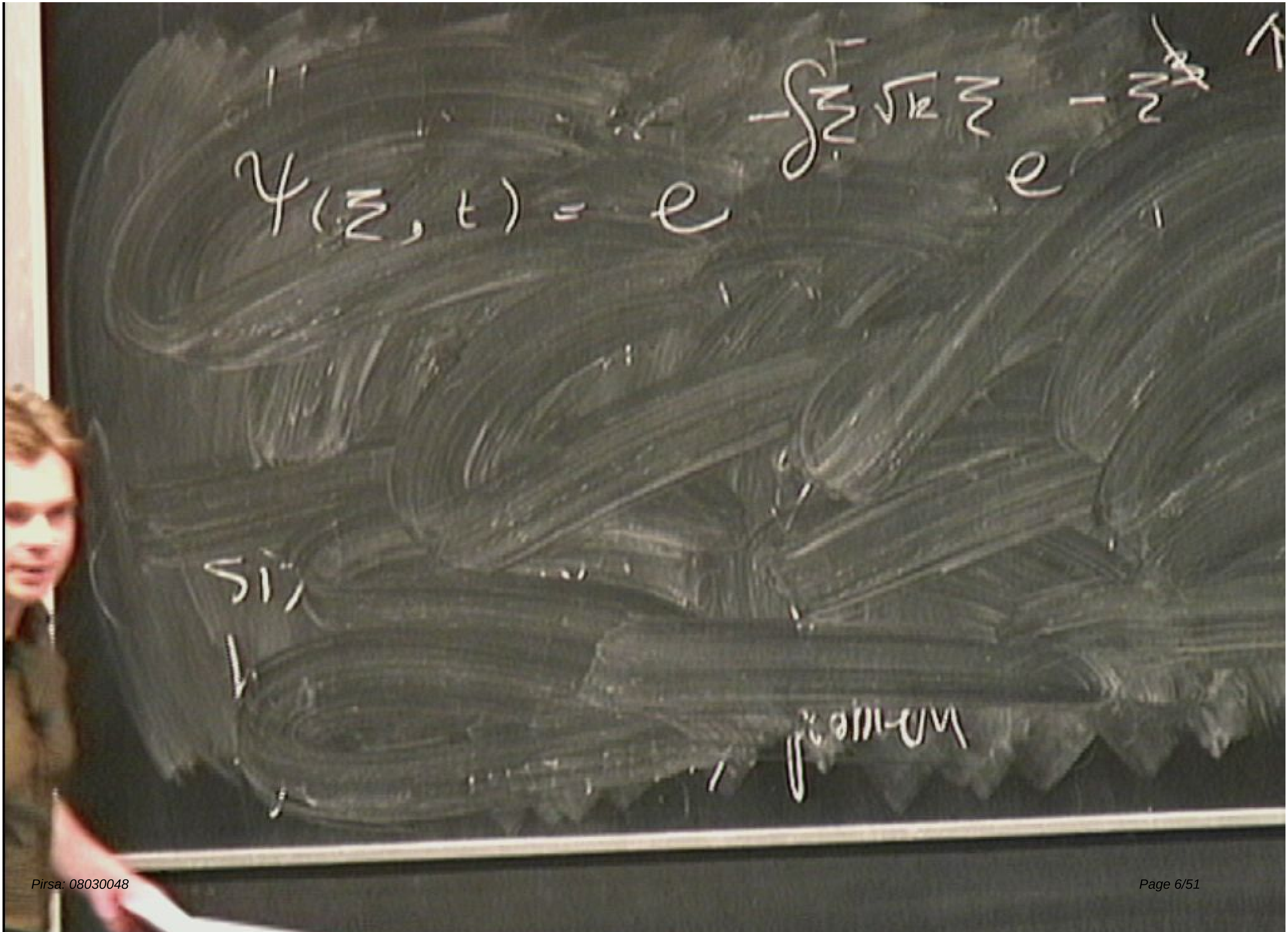
Abstract:







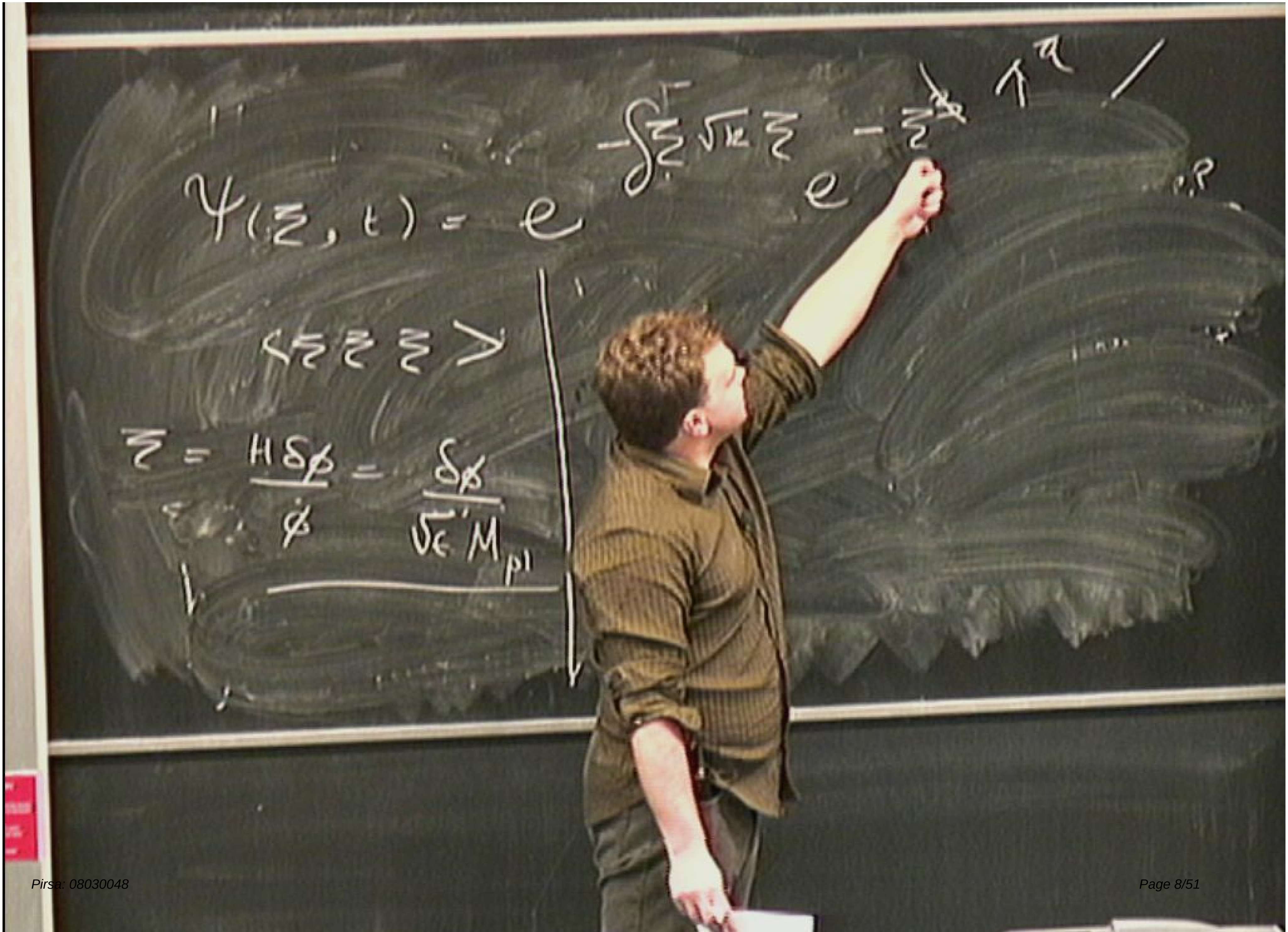

1. Interactions
& inflation


$\Psi(\xi, t) = e^{-\int^{\xi} \sqrt{k}\, \xi}\; e^{-\xi^{2}}$

$$\Psi(\zeta, t) = e^{-\int \zeta \sqrt{k}\, \zeta} \; e^{-\zeta^3}$$

$$\langle \zeta \zeta \zeta \rangle$$

$$\zeta = \frac{H\,\delta\phi}{\dot\phi} = \frac{\delta\phi}{\sqrt{\epsilon}\, M_{pl}}$$


$\langle \zeta \zeta \zeta \rangle$
$\zeta = \frac{H \delta\phi}{\dot\phi} = \frac{\delta\phi}{\sqrt{\epsilon} M_{pl}}$

$$\Psi(\zeta, t) = e^{-\int \zeta \sqrt{k}\, \zeta} \qquad e^{-\zeta^{3}}$$

$$\langle \zeta \zeta \zeta \rangle$$

$$\zeta = \frac{H\,\delta\phi}{\dot\phi} = \frac{\delta\phi}{\sqrt{\epsilon}\, M_{pl}}$$

$$\langle \Psi | T^{\mu}{}_{\nu} | \Psi \rangle < V_{inf.} < H^2 M_{pl}^2$$

$$\Psi(\zeta, t) = e^{-\int \zeta \sqrt{k}\, \zeta \;-\; \zeta^3} \quad e^{\dots}$$

$$\langle \zeta \zeta \zeta \rangle$$

$$\zeta = \frac{H\delta\phi}{\dot\phi} = \frac{\delta\phi}{\sqrt{\epsilon}\, M_{pl}}$$

$$\langle \Psi | T^{\mu}{}_{\nu} | \Psi \rangle < V_{inf.}$$

$$< H^2 M_{pl}^2$$

$$\text{Short} \quad N_{e\text{-}folds} \lesssim 70$$

$$\frac{k}{a_*} = M_* \sim M_{pl}$$

$$\Psi(\zeta, t) = e^{-\int \zeta \sqrt{k}\, \zeta} \quad e^{-\zeta^{3}}$$

$\langle \zeta \zeta \zeta \rangle$

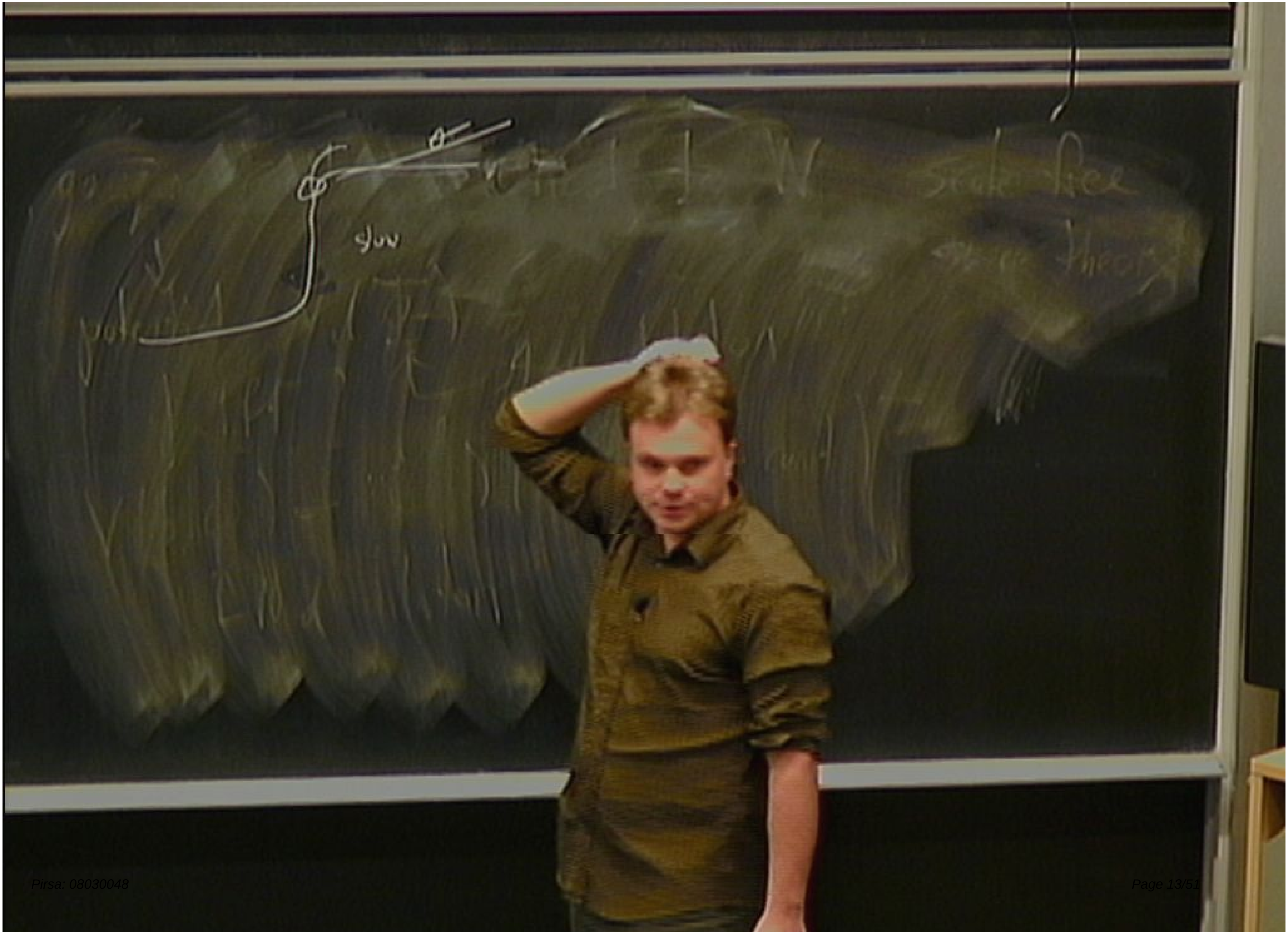
$$\zeta = \frac{H\,\delta\phi}{\dot\phi} = \frac{\delta\phi}{\sqrt{\epsilon}\, M_{pl}}$$

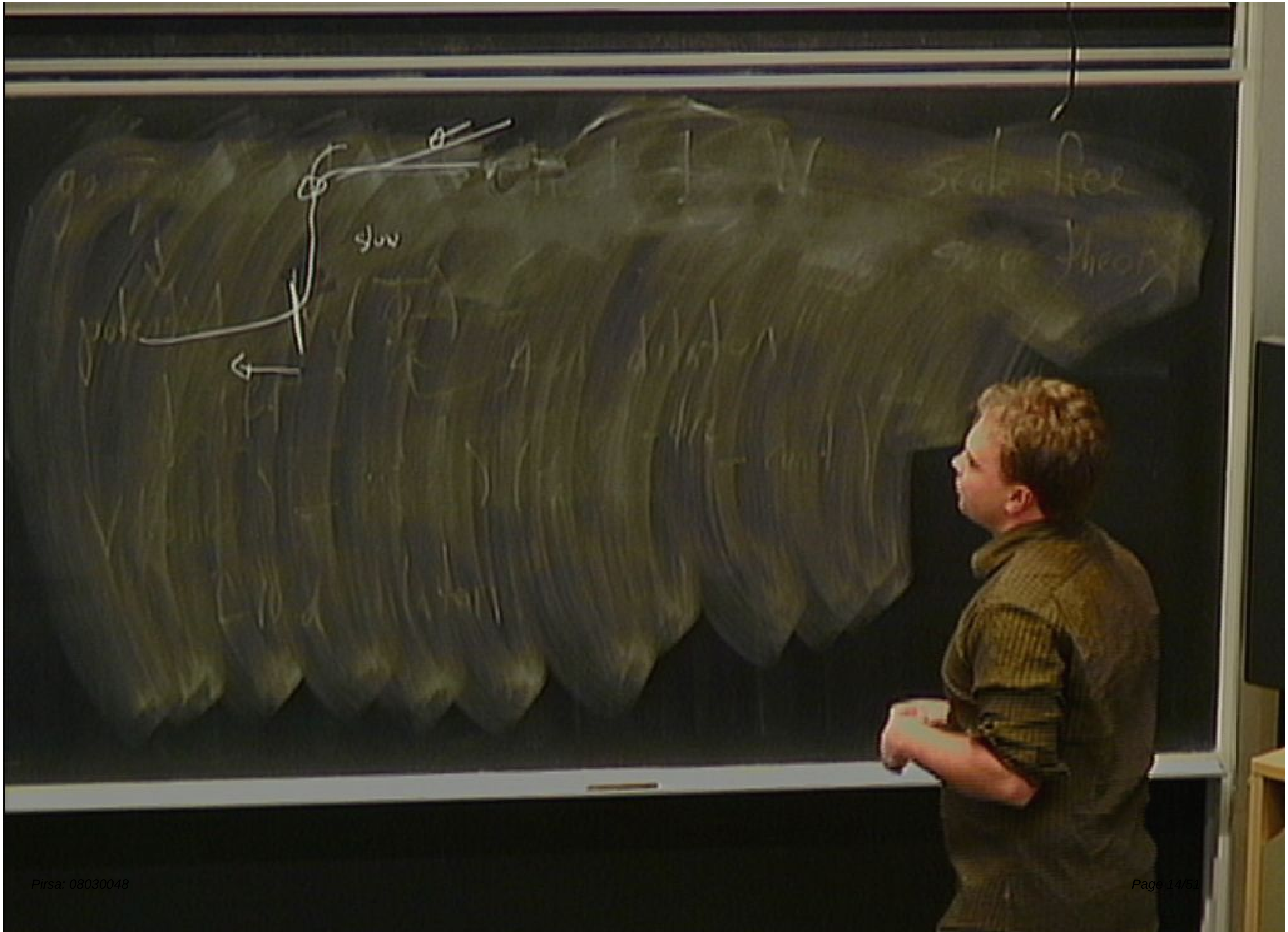
$\langle \Psi | T^{\mu}{}_{\nu} | \Psi \rangle < V_{inf.}$

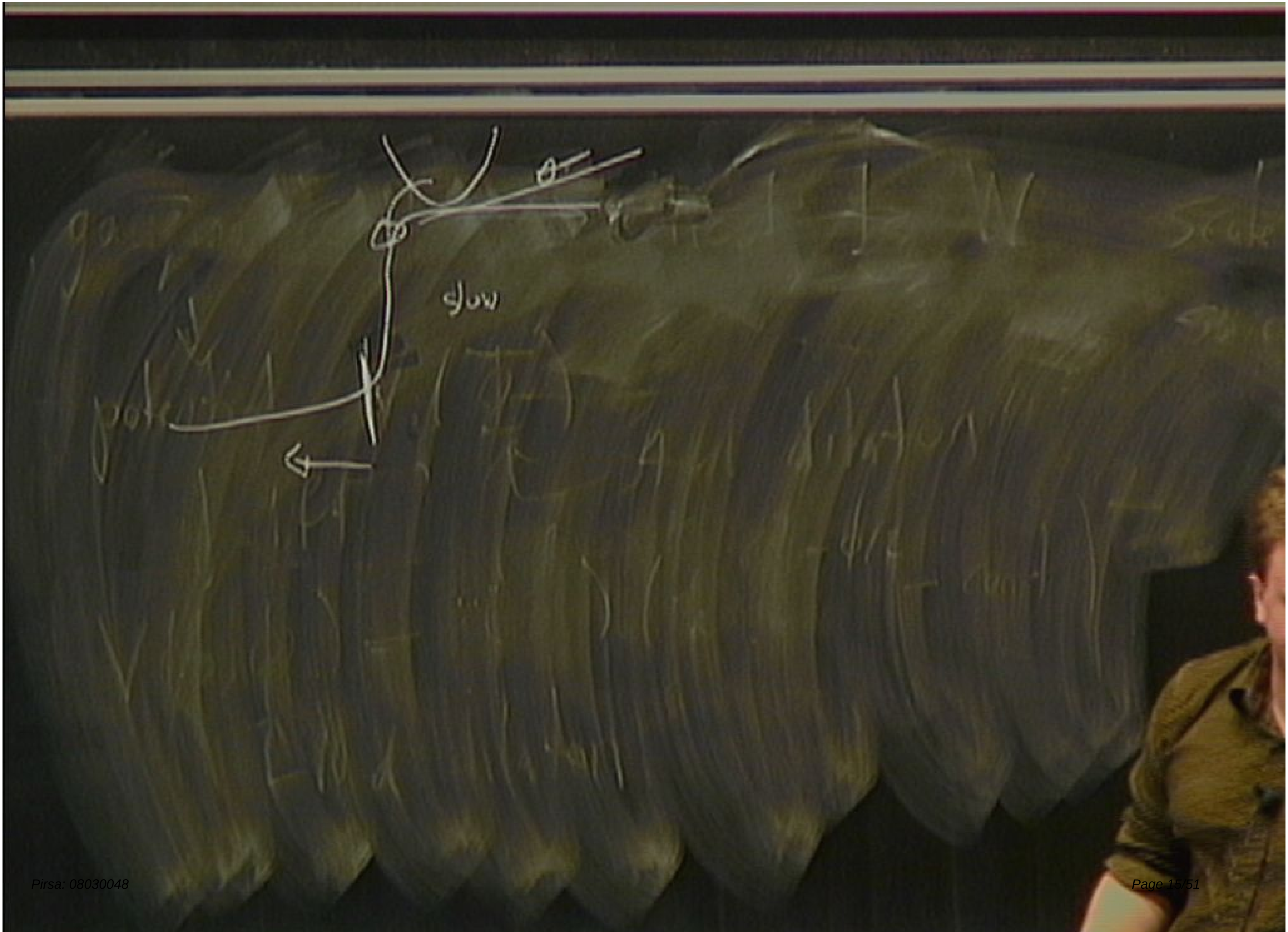
$S \epsilon - 70 < H^2 M_{pl}^2$

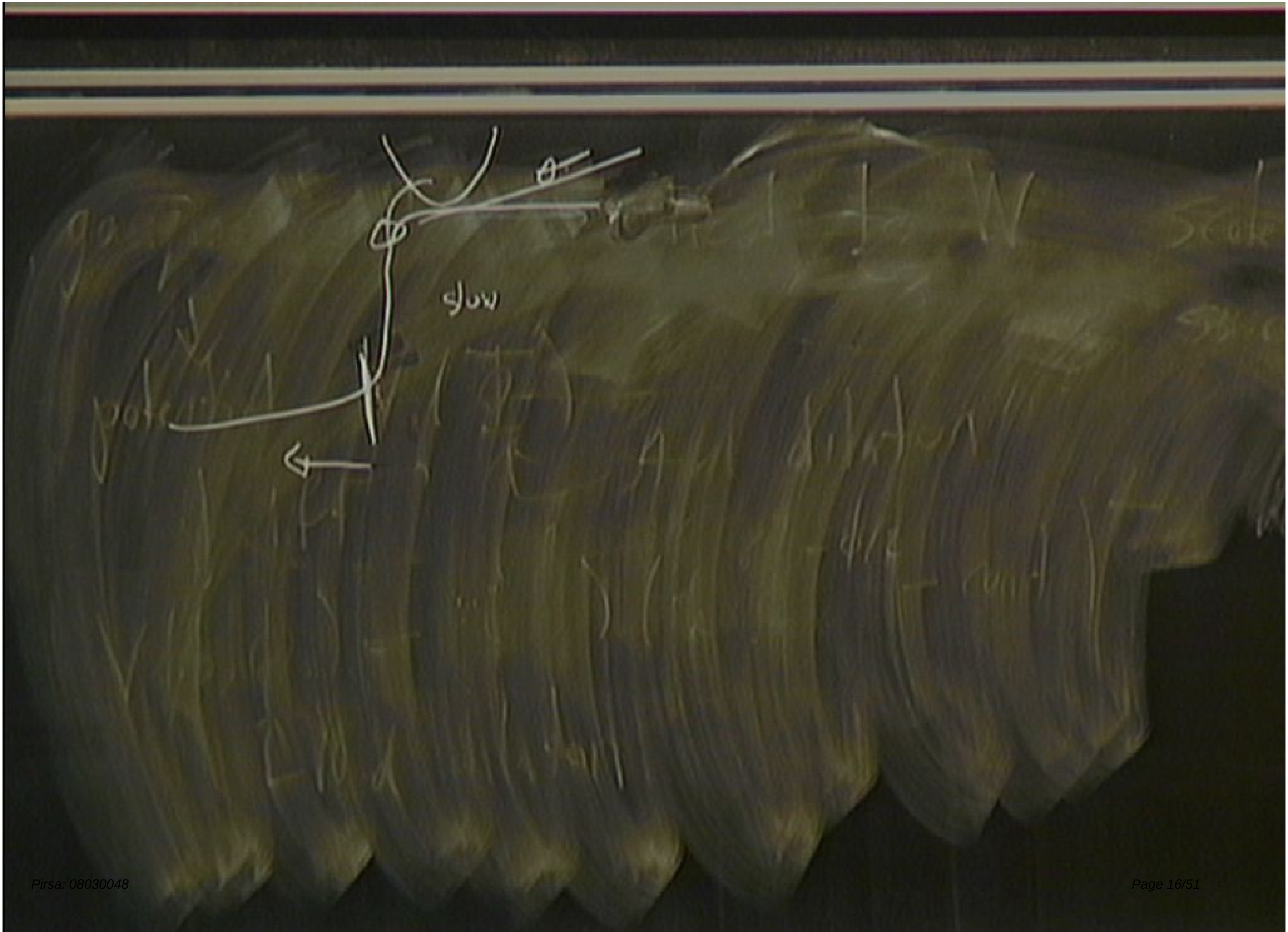
Slut $N_{e\text{-}fold} < 70$

$\frac{k}{a_*} = M_* \sim M_{pl}$


slow


Scale free


flow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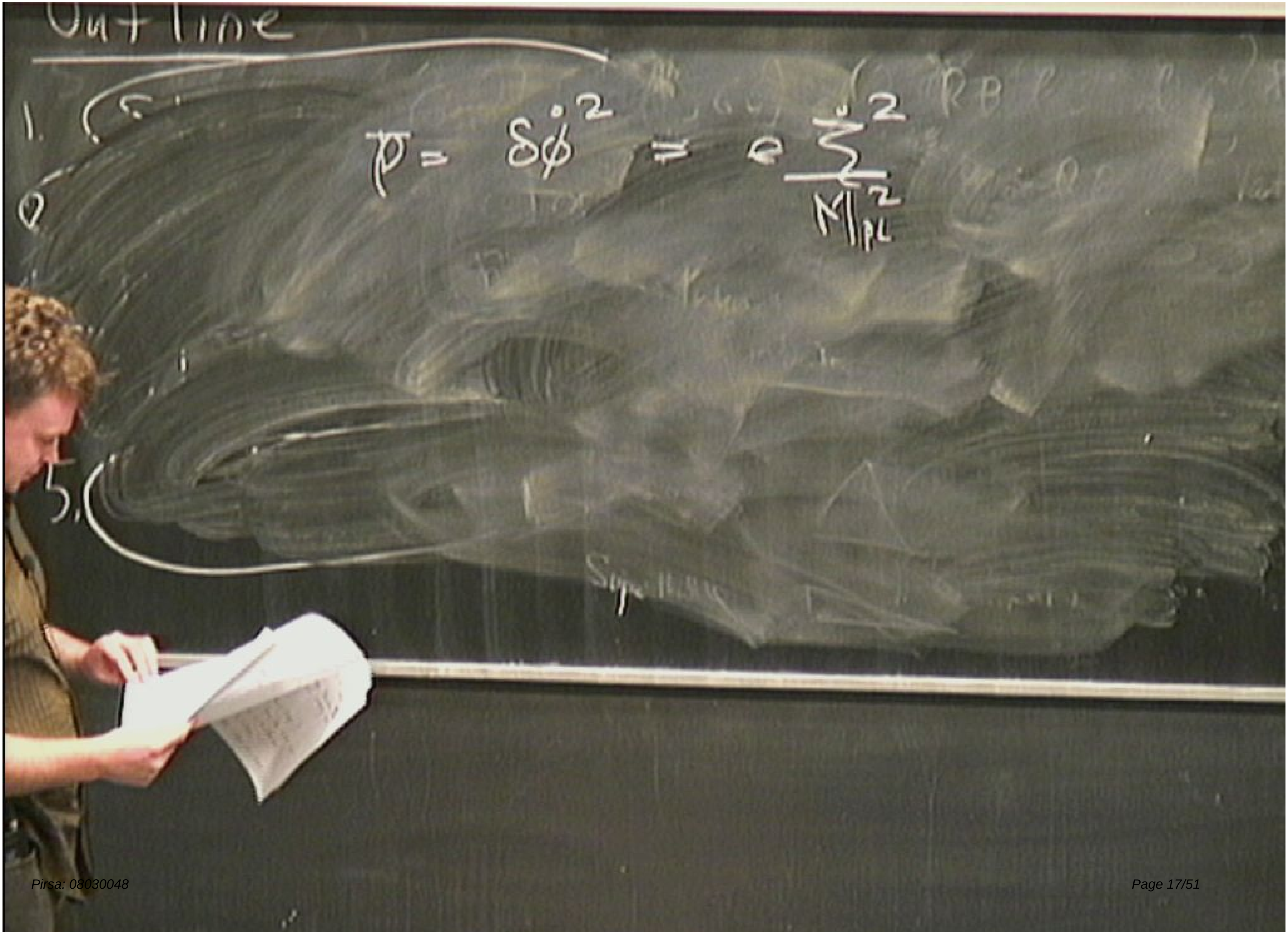

Outline
1.
5.
$\rho = \delta\dot{\phi}^2 \approx \epsilon \frac{\dot{\zeta}^2}{M_{pl}^2}$


Outline
Classical/background

...nt line

$$\rho = \delta\dot{\phi}^2 \simeq \epsilon \frac{\dot{\zeta}^2}{M_{pl}^2}$$

1. Classical/background

$$\rho_M = H^2 M_{pl}^2$$

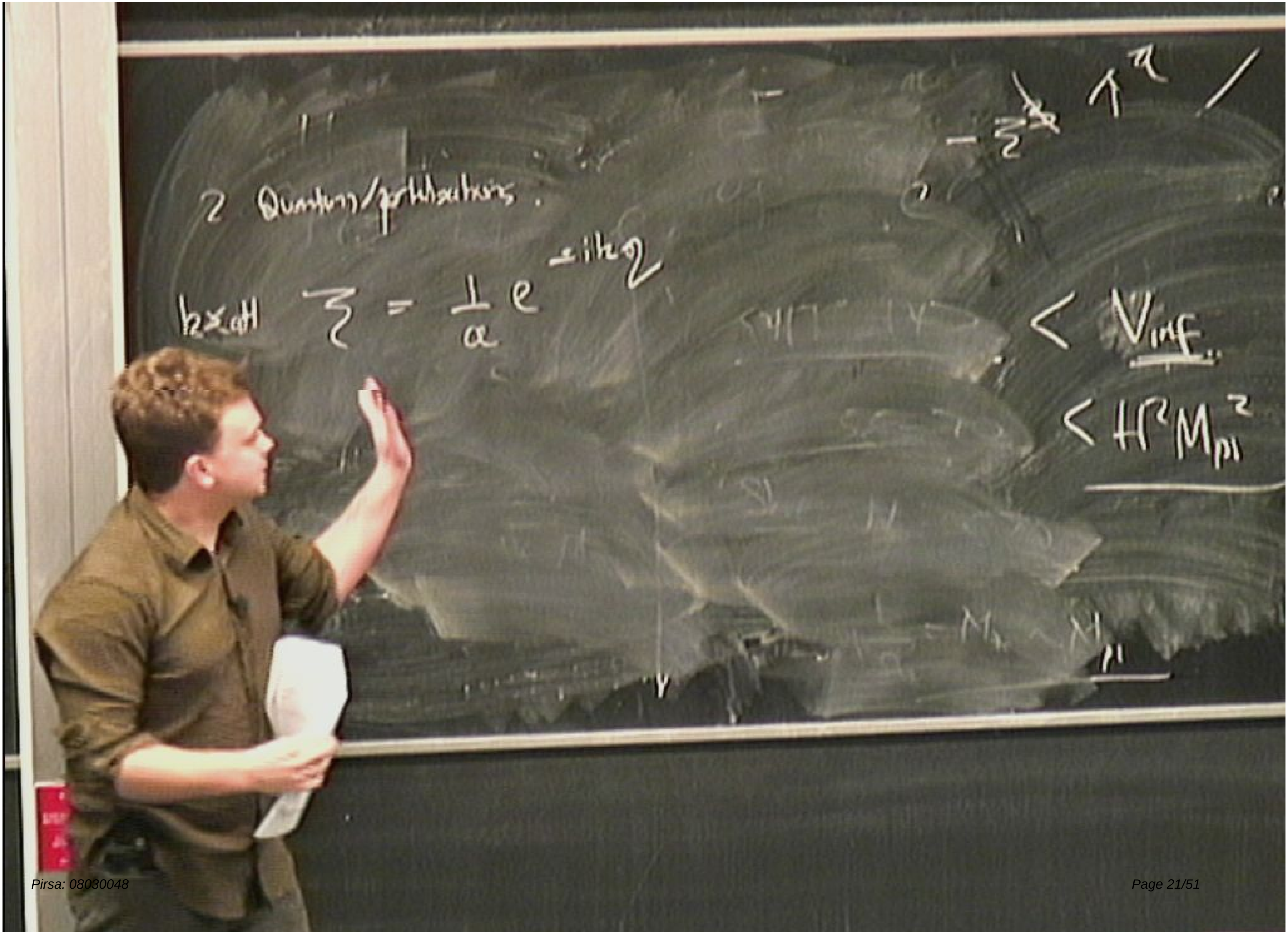
nt line

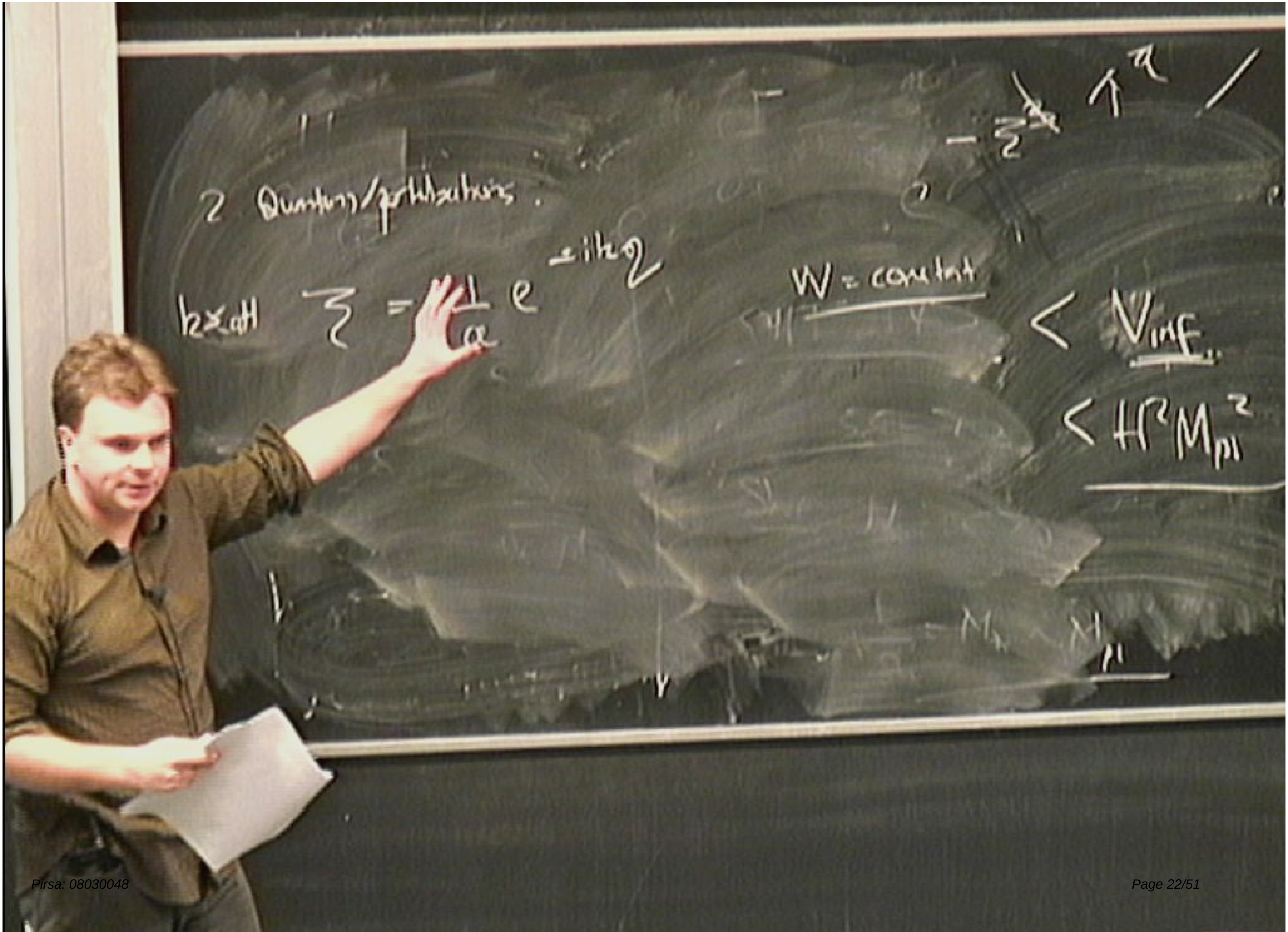
$$P = \delta\dot{\phi}^2 = \frac{e\,\dot{\xi}^2}{M_{pl}^2}$$

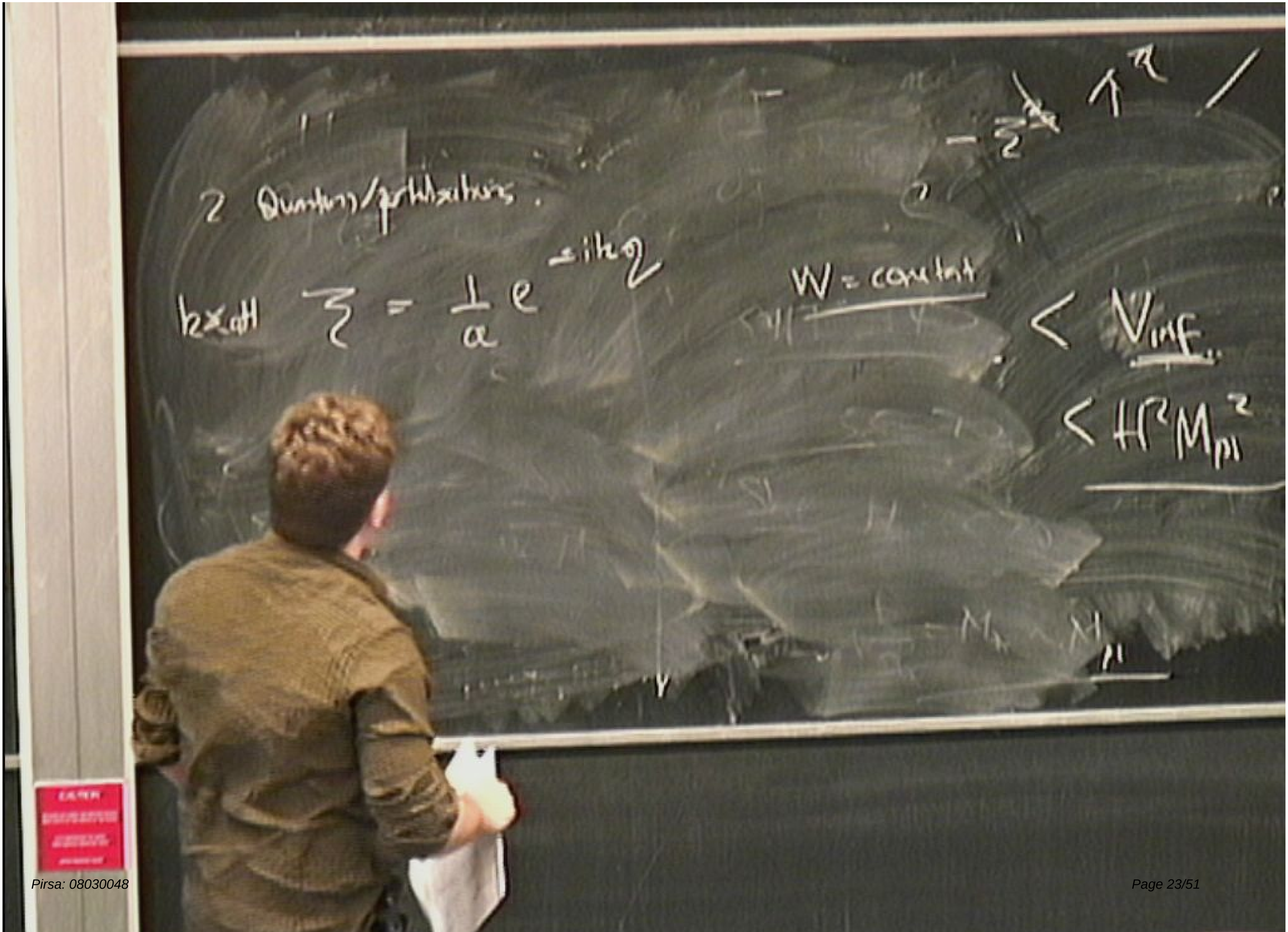
1. Classical/background

$$\rho_M = H^2 M_{pl}^2$$

$$\rho \sim \frac{1}{a^3} \quad \frac{\rho_{\Lambda}}{\rho_M} \sim e^{-180}$$


2 Quantum/perturbations.
$k \lesssim aH$ $\zeta = \frac{1}{\alpha} e^{-ik\eta}$
$< V_{inf}$
$< H^2 M_{pl}^2$


2 Quantum/perturbations
W = constant
< V_inf
< H^2 M_pl^2


2 Quantum/perturbations.
W = constant
< V_inf.
< H^2 M_pl^2

$-\dot{\zeta}^{2}$

2 Quantum/perturbations.

$k \gg aH \quad \zeta = \frac{1}{a} e^{\pm ik\eta}$

$W = $ constant

$< V_{inf}$

$< H^2 M$

$k < aH \quad \zeta = \text{const}$

$M_x \sim M_\mu$

2 Quantum/perturbations.

$k \gtrsim aH$ $\quad \zeta = \frac{1}{a} e^{\pm ik\eta}$ $\qquad \underline{W = \text{constant}}$

$\underline{k < aH}$ $\quad \underline{\zeta = \text{const}} = e^{-N_*} \zeta_*$

$\underline{SS}$

$-\zeta^{\dots} \quad \uparrow a$

2 Quantum/perturbations.

$$k \gg aH \qquad \zeta = \frac{1}{a} e^{-ik\eta} \qquad W = \text{constant} \qquad < V_{inf.}$$

$$\underline{k \ll aH} \qquad \underline{\zeta = \text{const}} = e^{-N_*} \, \mathcal{E}_* \qquad < H^2 M$$

SS

$N_* \quad N_{\mu}$

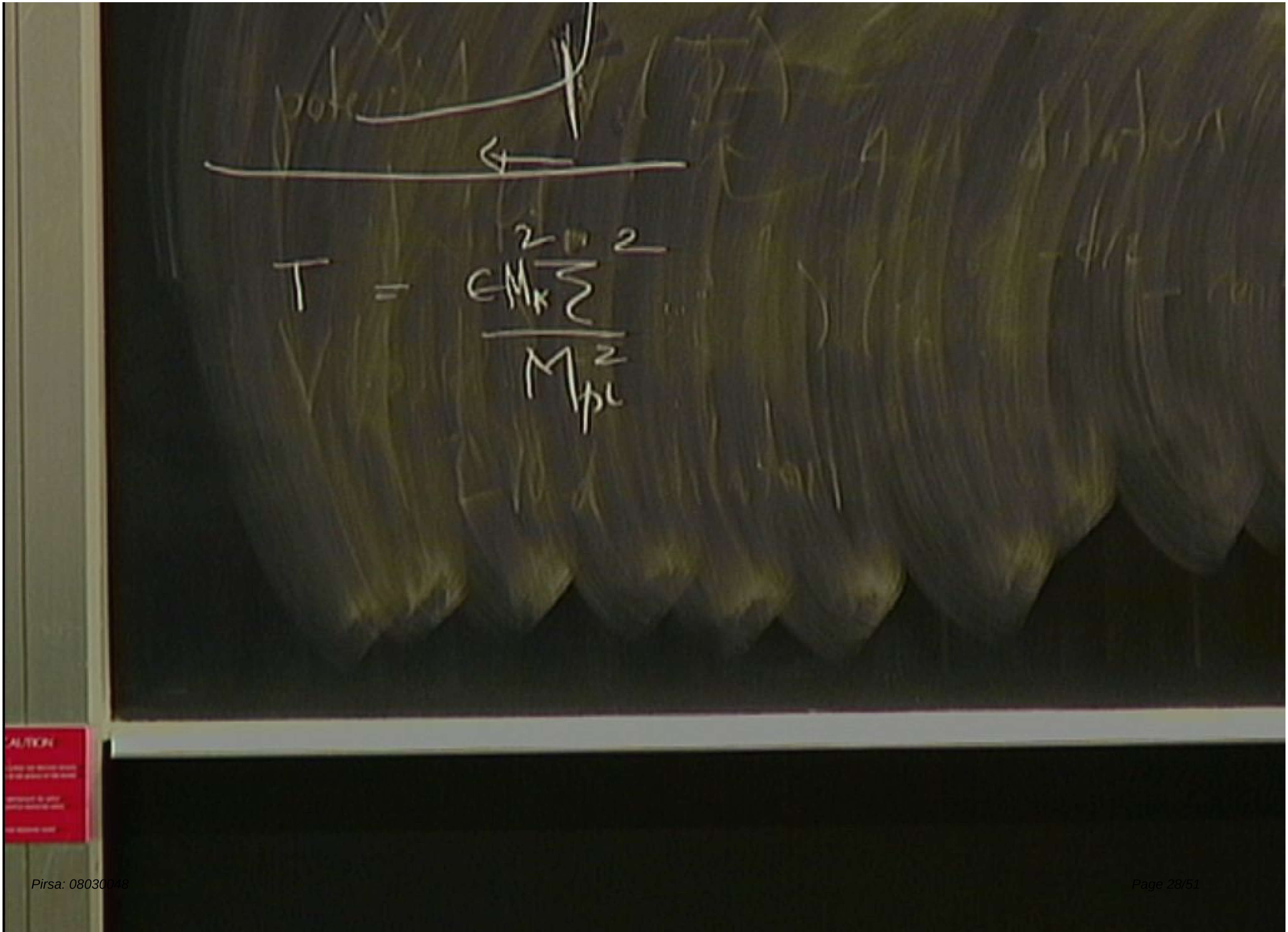
2 Quantum/perturbations.

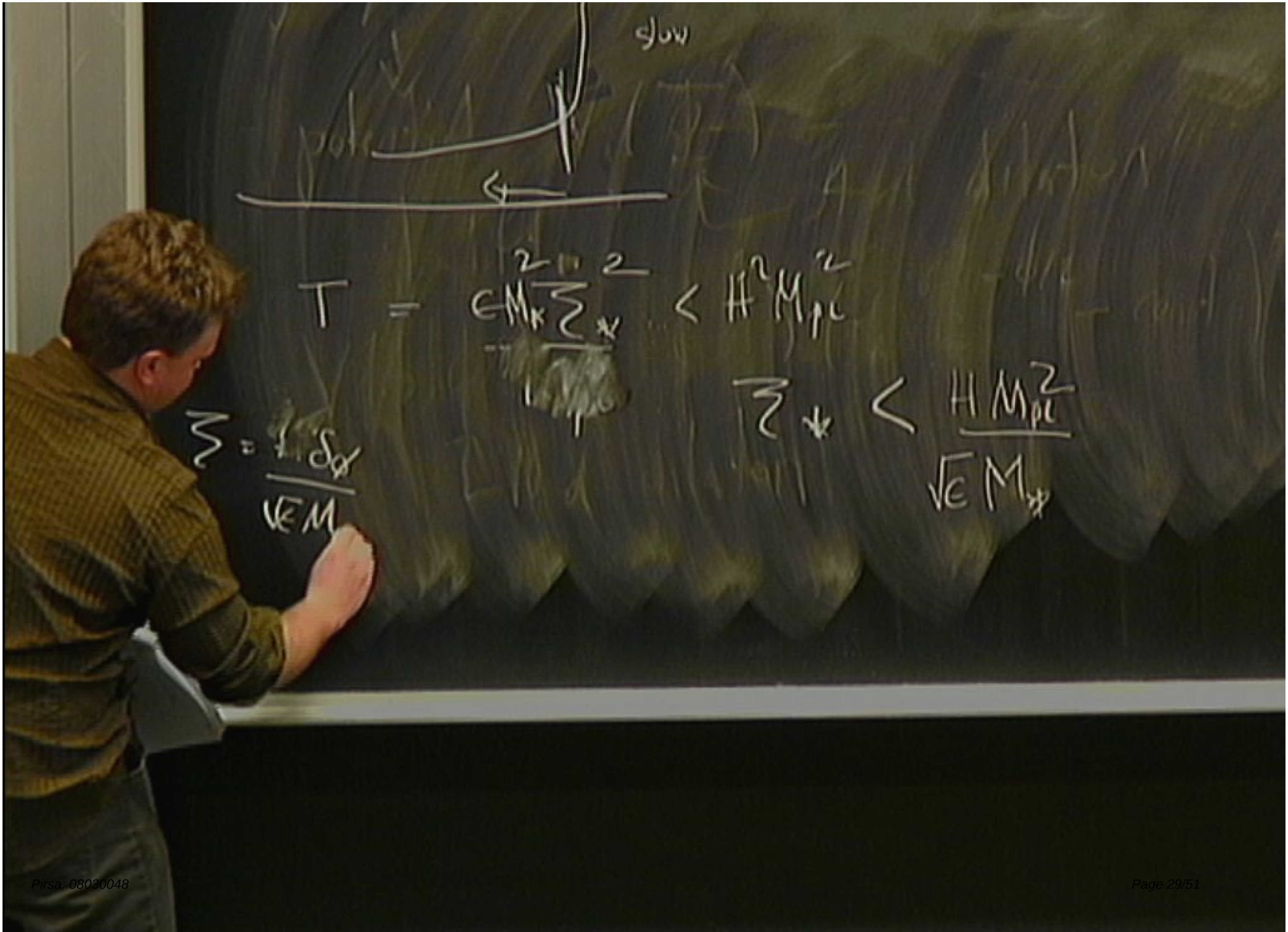
$k \gg aH$ $\quad \zeta = \frac{1}{a} e^{\pm ik\eta}$ $\qquad W = \text{constant}$

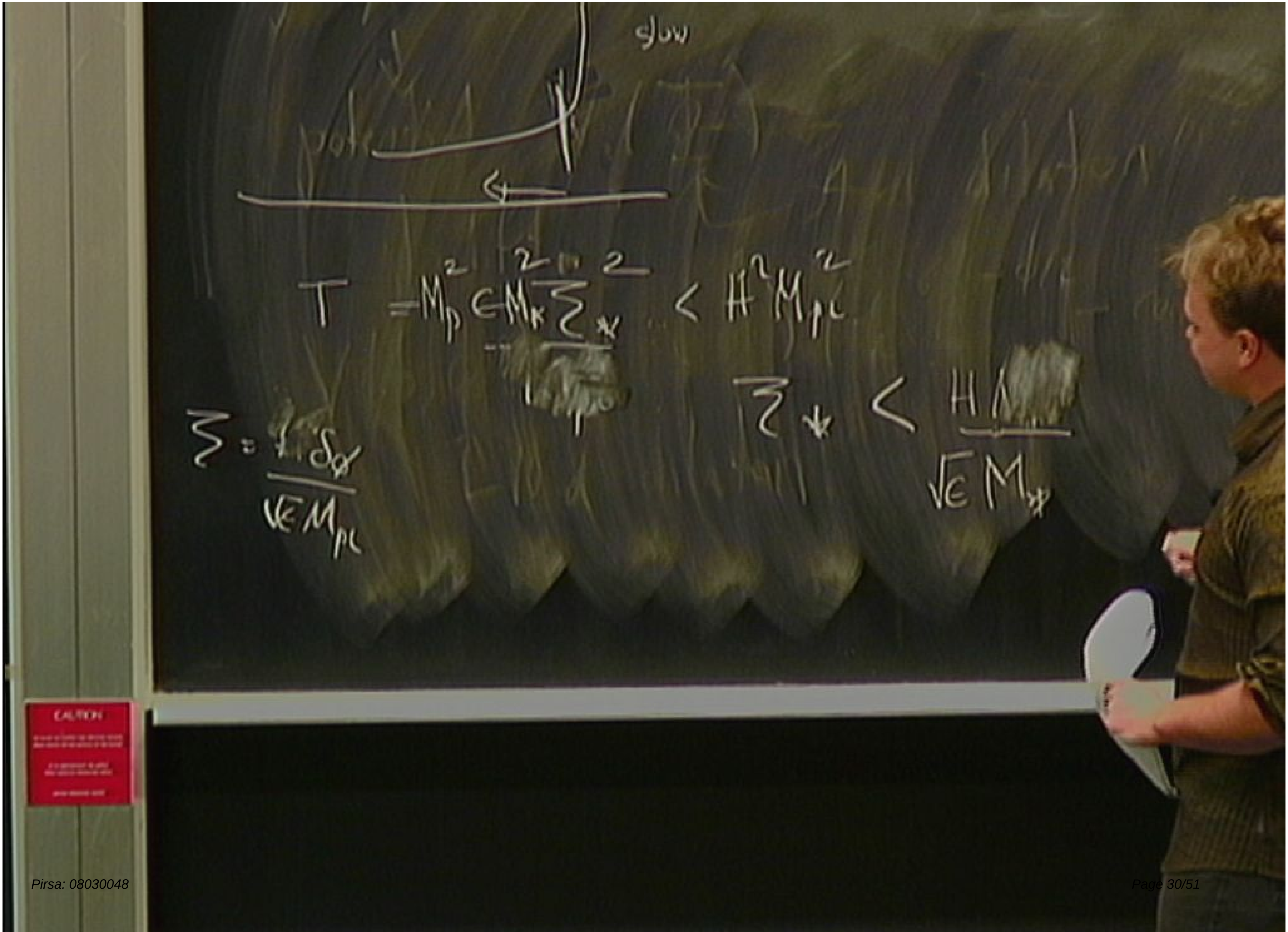
$k \ll aH$ $\quad \zeta = \text{const} = e^{-N_*} \zeta_*$

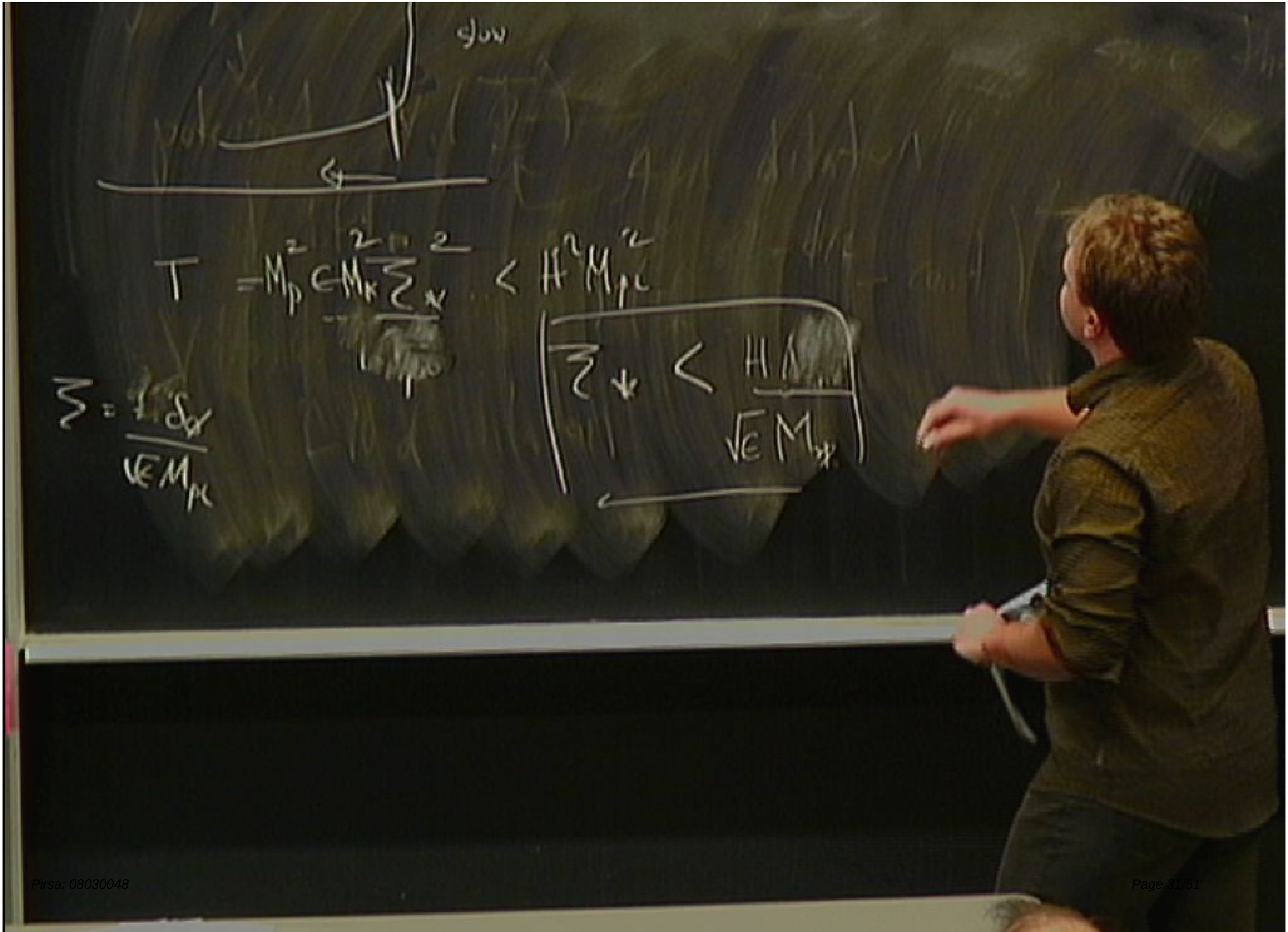
SS $= \left(\frac{H}{M_*}\right) \zeta_* \qquad M_* = \frac{k}{a_*}$

$M_* \gg H$


$T = \frac{\epsilon M_*^2 \Sigma^2}{M_{pl}^2}$


slow
$T = \epsilon M_*^2 \Sigma_*^2 < H^2 M_{pl}^2$
$\Sigma_* < \frac{H M_{pl}^2}{\sqrt{\epsilon} M_*}$
$\Sigma = \frac{1}{\sqrt{\epsilon} M} \delta\phi$


slow
T = M_p^2 ε M_*^2 Ξ_*^2 < H^2 M_pl^2
Ξ = δφ / (√ε M_pl)
Ξ_* < H / (√ε M_*)
CAUTION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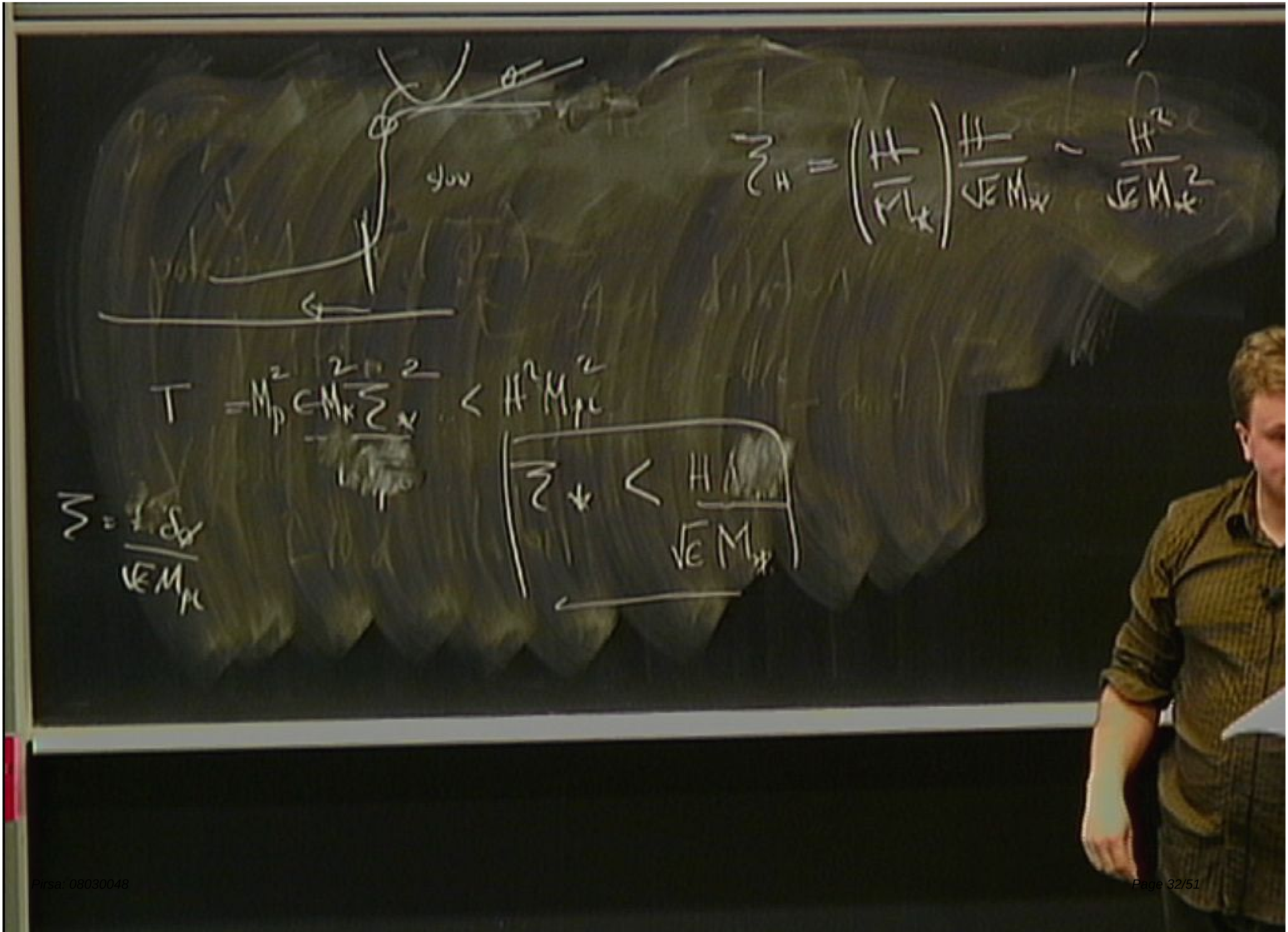
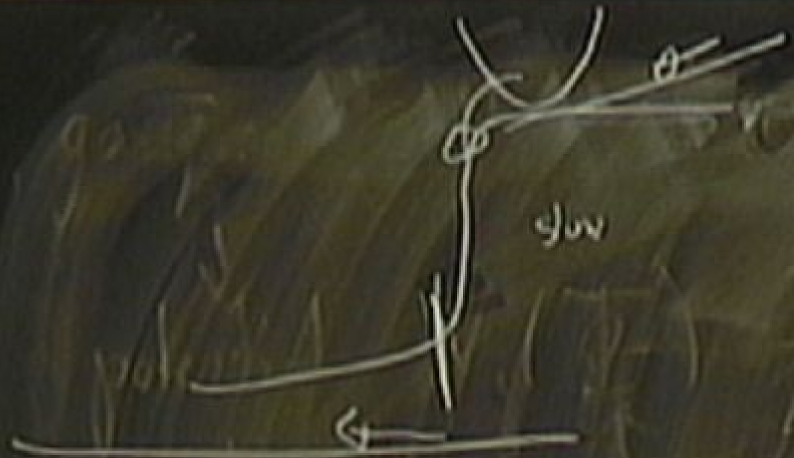

slow
ζ_H = (H/M_*) H/(√ε M_*) ~ H²/(√ε M_*²)
T = M_p² ε M_*² ζ_*² < H² M_pl²
ζ_* < H Λ/(√ε M_*)
ζ = δφ/(√ε M_pl)



$$\zeta_H = \left(\frac{H}{M_*}\right)\frac{H}{\sqrt{\epsilon} M_*} \sim \frac{H^2}{\sqrt{\epsilon} M_*^2}$$

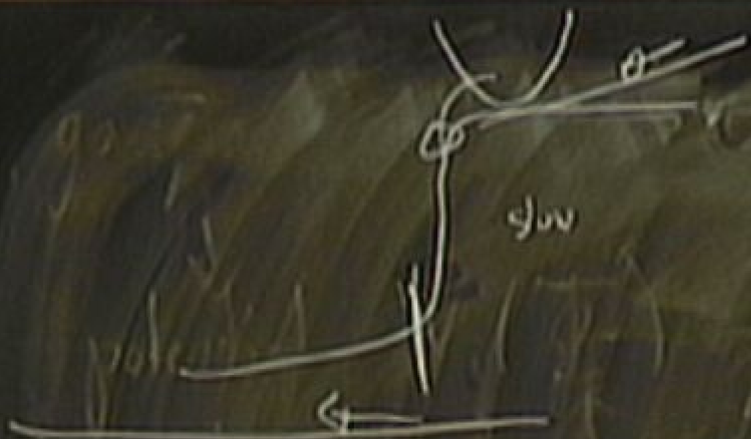
$$\zeta_0 = \frac{H}{\sqrt{\epsilon} M_{pl}}$$

$$T = M_p^2 \epsilon M_*^2 \zeta_*^2 < H^2 M_{pl}^2$$

$$\zeta = \frac{\delta\sigma}{\sqrt{\epsilon} M_{pl}}$$

$$\boxed{\zeta_* < \frac{H M_{pl}}{\sqrt{\epsilon} M_*}}$$

$$\frac{\delta P}{P} = \frac{H M_{pl}}{M_*^2}$$



$$\zeta_H = \left(\frac{H}{M_*}\right)\frac{H}{\sqrt{\epsilon}M_W} \sim \frac{H^2}{\sqrt{\epsilon}M_*^2}$$

M_*

$$\zeta_0 = \frac{H}{\sqrt{\epsilon}M_{pl}}$$

$$T = M_p^2\,\epsilon M_*^2 \zeta_*^2 < H^2 M_{pl}^2$$

$$\zeta = \frac{1\,\delta r}{\sqrt{\epsilon}M_{pl}}$$

$$\boxed{\zeta_* < \frac{H\Lambda}{\sqrt{\epsilon}M_*}}$$

$$\frac{\delta P}{P} = \frac{H M_{pl}}{M_*^2}$$

$$\zeta_H = \left(\frac{H}{M_*}\right)\frac{H}{\sqrt{\epsilon}M_*} \sim \frac{H^2}{\sqrt{\epsilon}M_*^2}$$

$$M_* \sim He^{N_*}$$

$$\zeta_0 = \frac{H}{\sqrt{\epsilon}M_{pl}}$$

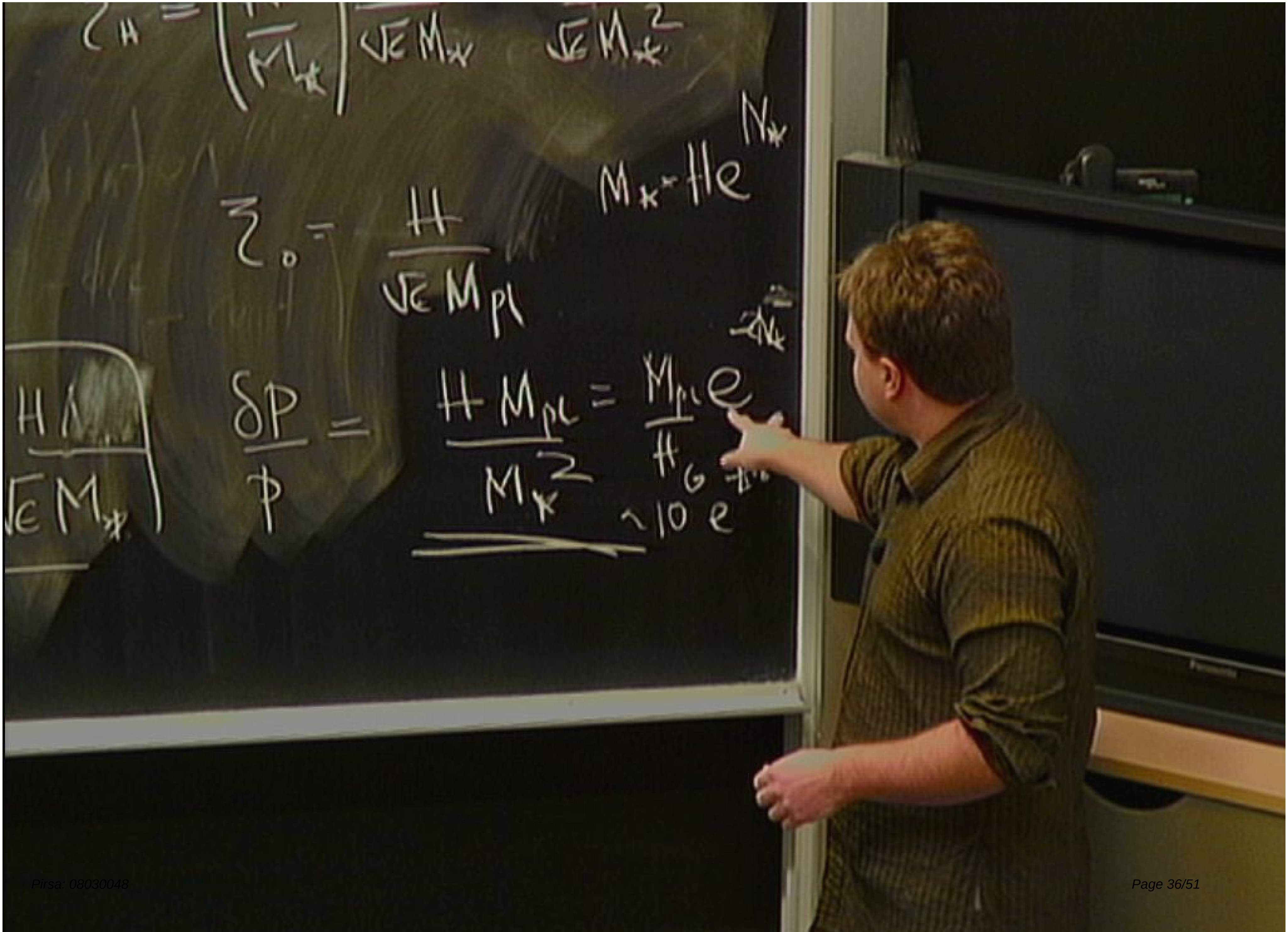
$$T = M_p^2 \epsilon M_*^2 \zeta_*^2 < H^2 M_{pl}^2$$

$$\zeta = \frac{\delta\phi}{\sqrt{\epsilon}M_{pl}}$$

$$\zeta_* < \frac{H M_{pl}}{\sqrt{\epsilon}M_*}$$

$$\frac{\delta P}{P} =$$

$$\frac{H M_{pl}}{M_*^2} = \frac{M_{pl}}{H}e^{-2N_*} \sim 10^6 e^{-2N_*}$$



$$T = -M_p^2 \epsilon M_*^2 \xi_*^2 < H^2 M_{pl}^2$$

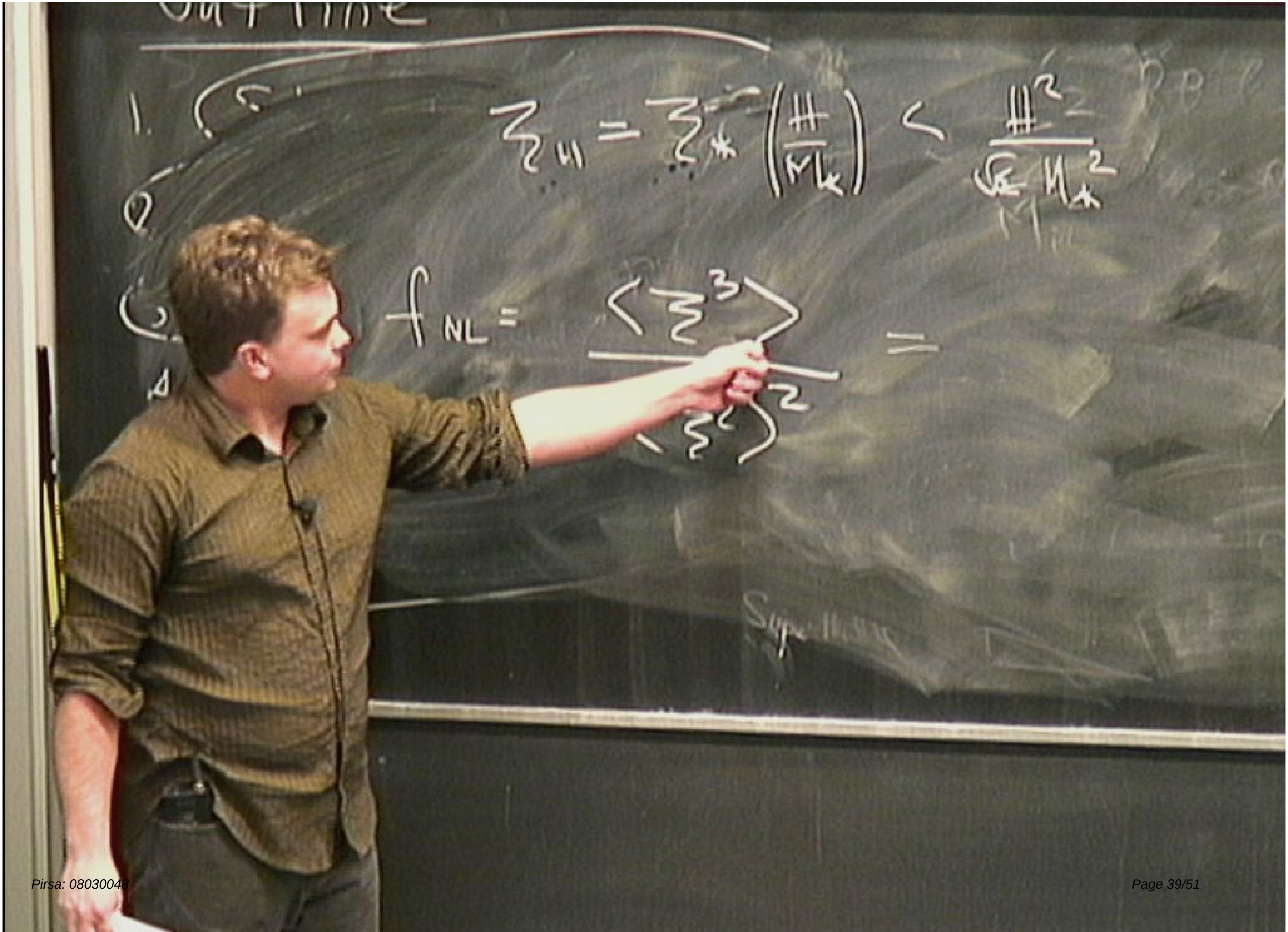
$$\boxed{\xi_* < \frac{H\Lambda}{\sqrt{\epsilon}\, M_*}}$$

$$\xi = \frac{\delta\phi}{\sqrt{\epsilon}\, M_{pl}} \qquad \frac{\delta p}{p} \sim \beta_k$$

$$\int d^3k \; k\, |\beta_k|^2 \in H^2 M_{pl}^2$$

line

$$\zeta_{H} = \zeta_{*}\left(\frac{H}{M_{*}}\right) < \frac{H^{2}}{\sqrt{\epsilon}\, M_{*}^{2}}$$


$\zeta_H = \zeta_* \left(\frac{H}{M_*}\right) < \frac{H^2}{\sqrt{2} M_*^2}$
$f_{NL} = \frac{\langle \zeta^3 \rangle}{\langle \zeta^2 \rangle^2} =$

ine

$$\zeta_H = \zeta_* \left(\frac{H}{M_*}\right) < \frac{H^2}{\sqrt{\epsilon}\, M_*^2}$$

$$f_{NL} = \frac{\langle \zeta^3 \rangle}{\langle \zeta^2 \rangle^2} = \frac{\dfrac{H^6}{\epsilon^{3/2} M_*^6}}{\dfrac{H^4}{\epsilon^2 M_p^4}}$$

$$= \frac{\sqrt{\epsilon}\, H^2 M_{pl}^4}{M_*^6}$$

$$M_* = H e^{N_*}$$

$$f_M \sim \frac{\sqrt{\epsilon}\, M_{pl}^4}{H^4 e^{6N_*}}$$

$$\sim 10^{-3} \times$$

$$-\xi^{3/2} \quad \uparrow^{?}$$

$$< \frac{V_{inf}}{\beta M_{pl}}$$

$$M_* = H e^{N_*}$$

$$f_{NL} \sim \sqrt{\epsilon}\, \frac{M_{pl}^4}{H^4 \, e^{6N_*}}$$

$$\sim 10^{-1} \times 10^{24} \times e^{-6N_*}$$

$$\sim e^{(53 - 6N_*)}$$

$$N_* > 8.8$$

$$< V_{inf}$$

$$M_* = H e^{N_*}$$

$$f_{NL} \sim \sqrt{\epsilon}\,\frac{M_{pl}^4}{H^4 e^{6N_*}}$$

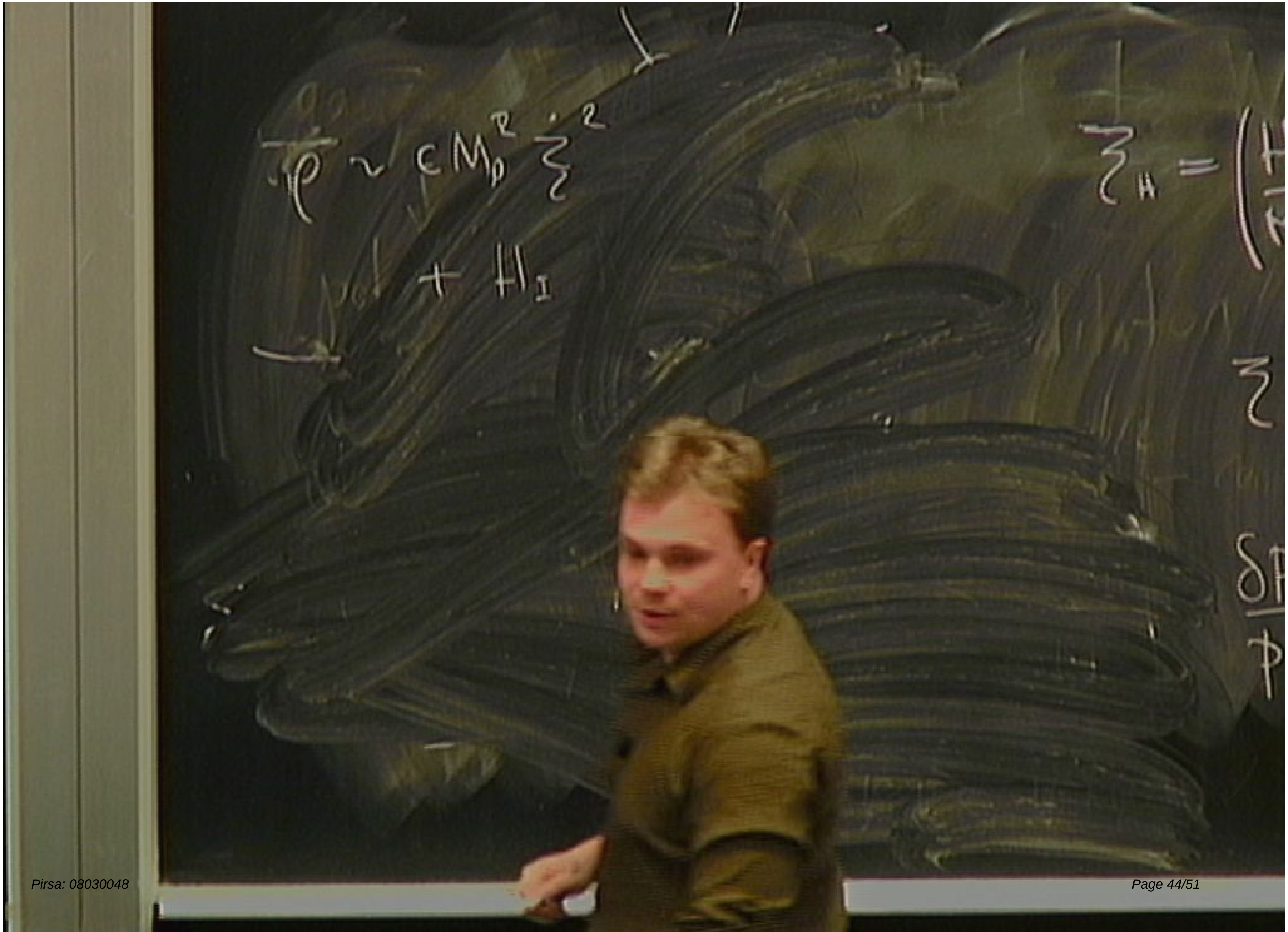
$$\sim 10^{-1} \times 10^{24} \times e^{-6N_*}$$

$$\sim e^{(53-6N_*)}$$

$N_* > 8.8$

$55 + 8.8 \sim 64$

$< V_{inf}$


ρ̇ ~ εM_p² ζ̇²
+ H_I
ζ_H = (H

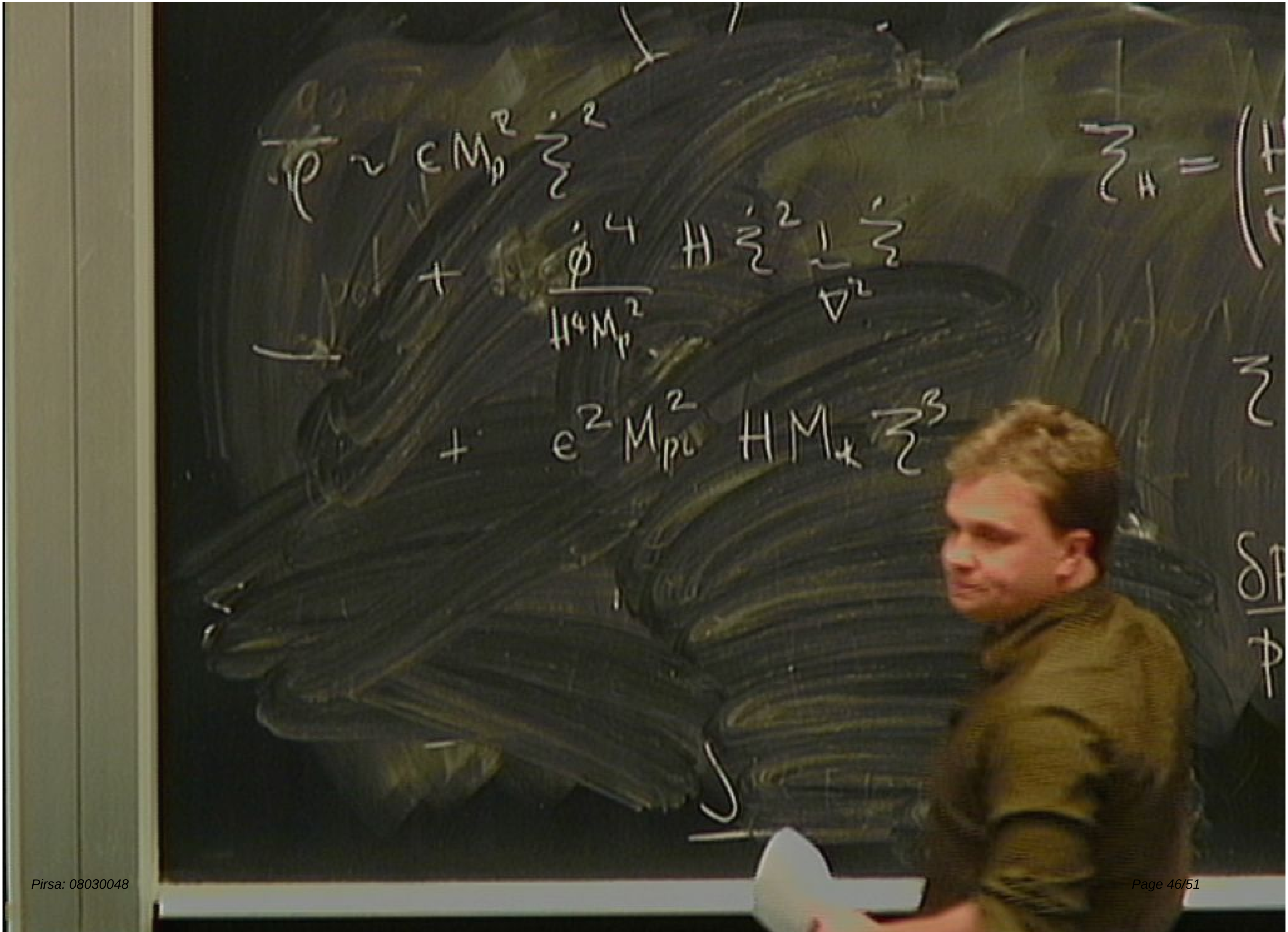
$$\rho \sim \epsilon M_p^2 \dot{\zeta}^2$$

$$+ \frac{\dot{\phi}^4}{H^4 M_p^2} \; H \dot{\zeta}^2 \frac{1}{\nabla^2} \dot{\zeta}$$

$$\zeta_H = \Big($$

ζ

$\frac{\delta\rho}{\rho}$


$\dot\rho \sim \epsilon M_p^2 \dot\zeta^2$
$+ \frac{\dot\phi^4}{H^4 M_p^2} H \dot\zeta^2 \frac{1}{\nabla^2} \dot\zeta$
$+ \epsilon^2 M_{pl}^2 H M_* \zeta^3$
$\zeta_H = ($

$$\mathcal{L} \sim \epsilon M_p^2 \dot{\zeta}^2$$

$$+ \frac{\dot{\phi}^4}{H^4 M_p^2} H \dot{\zeta}^2 \frac{1}{\nabla^2} \dot{\zeta}$$

$$+ \epsilon^2 M_{pl}^2 H M_* \zeta^3$$

$$\zeta_H = \Big(\frac{H}{\cdots}$$

$$\zeta$$

$$\frac{\delta P}{P}$$

$$\dot{\varphi} \sim \epsilon M_p^2 \dot{\zeta}^2$$

$$+ \frac{\dot{\phi}^4}{H^4 M_p^2} H \dot{\zeta}^2 \frac{1}{\nabla^2} \dot{\zeta}$$

$$+ \epsilon^2 M_{pl}^2 H M_* \zeta^3 < H^2 M_{pl}^2$$

$$\zeta_H = \left(\frac{H}{M_*}\right) \frac{H}{\sqrt{\epsilon}}$$

$$\zeta_0 = \frac{H}{\sqrt{\epsilon}}$$

$$\frac{\delta P}{P} =$$

$$\delta\rho \sim \epsilon M_p^2 \dot{\zeta}^2 + \frac{\dot{\phi}^4}{H^4 M_p^2} H \dot{\zeta}^2 \frac{1}{\nabla^2} \dot{\zeta}$$

$$+ \epsilon^2 M_{pl}^2 H M_* \zeta_*^3 < H^2 M_{pl}^2$$

$$\zeta_* = \epsilon^{-2/3} \left(\frac{H}{M_*}\right)^{1/3}$$

$$\zeta_H = \left(\frac{H}{M_*}\right)$$

$$\zeta_0 =$$

$$\frac{\delta P}{P} =$$

$$\rho \sim c M_p^2 \dot{\zeta}^2$$

$$+ \frac{\dot{\phi}^4}{H^4 M_p^2} \quad H \dot{\zeta}^2 \frac{1}{\nabla^2} \dot{\zeta}$$

$$+ \; c^2 M_{pl}^2 \; H M_* \zeta_*^3 < H^2 M_{pl}^2$$

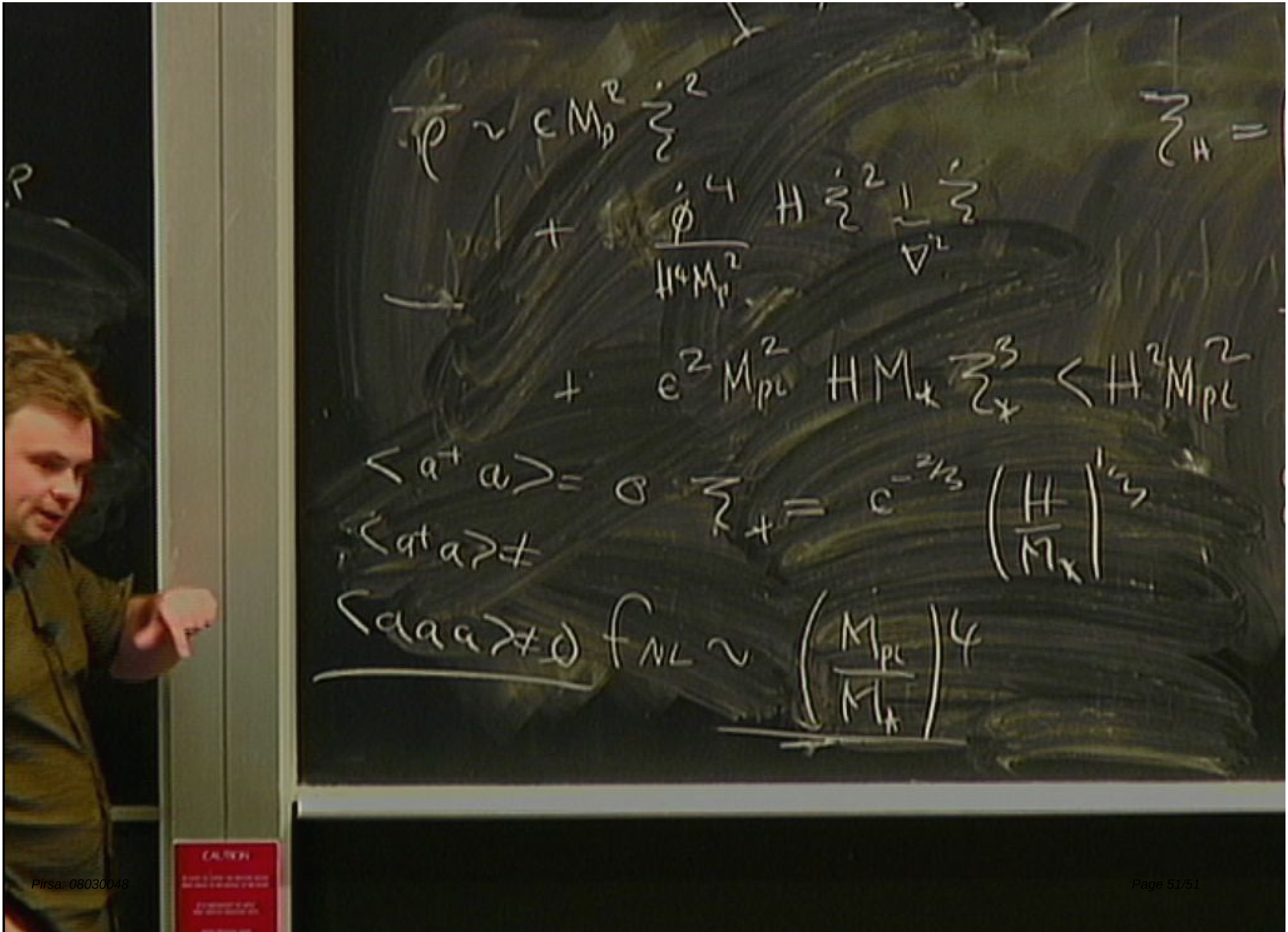
$$\zeta_H = \left(\frac{H}{M_*}\right)$$

$$\zeta_0 =$$

$$\zeta_* = c^{-2/3} \left(\frac{H}{M_*}\right)^{1/3}$$

$$\frac{\delta P}{P} =$$

$$f_{NL} \sim \left(\frac{M_{pl}}{M_*}\right)^4$$


$\dot\phi \sim c M_p^2 \dot\zeta^2$
$+ \frac{\dot\phi^4}{H^4 M_p^2} H \dot\zeta^2 \frac{1}{\nabla^2} \dot\zeta$
$+ c^2 M_{pl}^2 H M_* \zeta_*^3 < H^2 M_{pl}^2$
$\zeta_H =$
$\langle a^+ a \rangle = 0$
$\zeta_* = c^{-2/3} \left(\frac{H}{M_*} \right)^{1/3}$
$\langle a^+ a \rangle \neq$
$\langle aaa \rangle \neq 0$
$f_{NL} \sim \left(\frac{M_{pl}}{M_*} \right)^4$