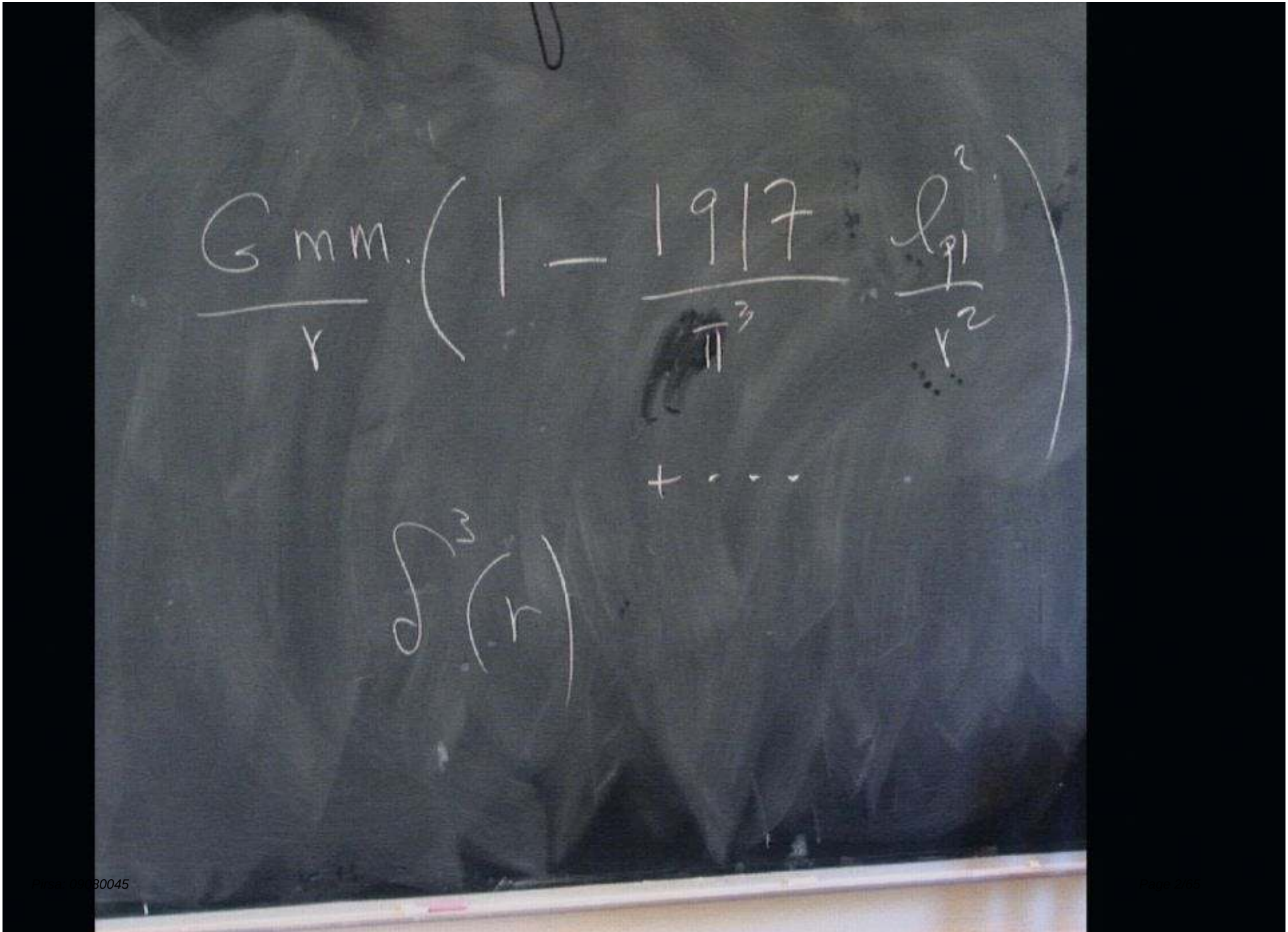
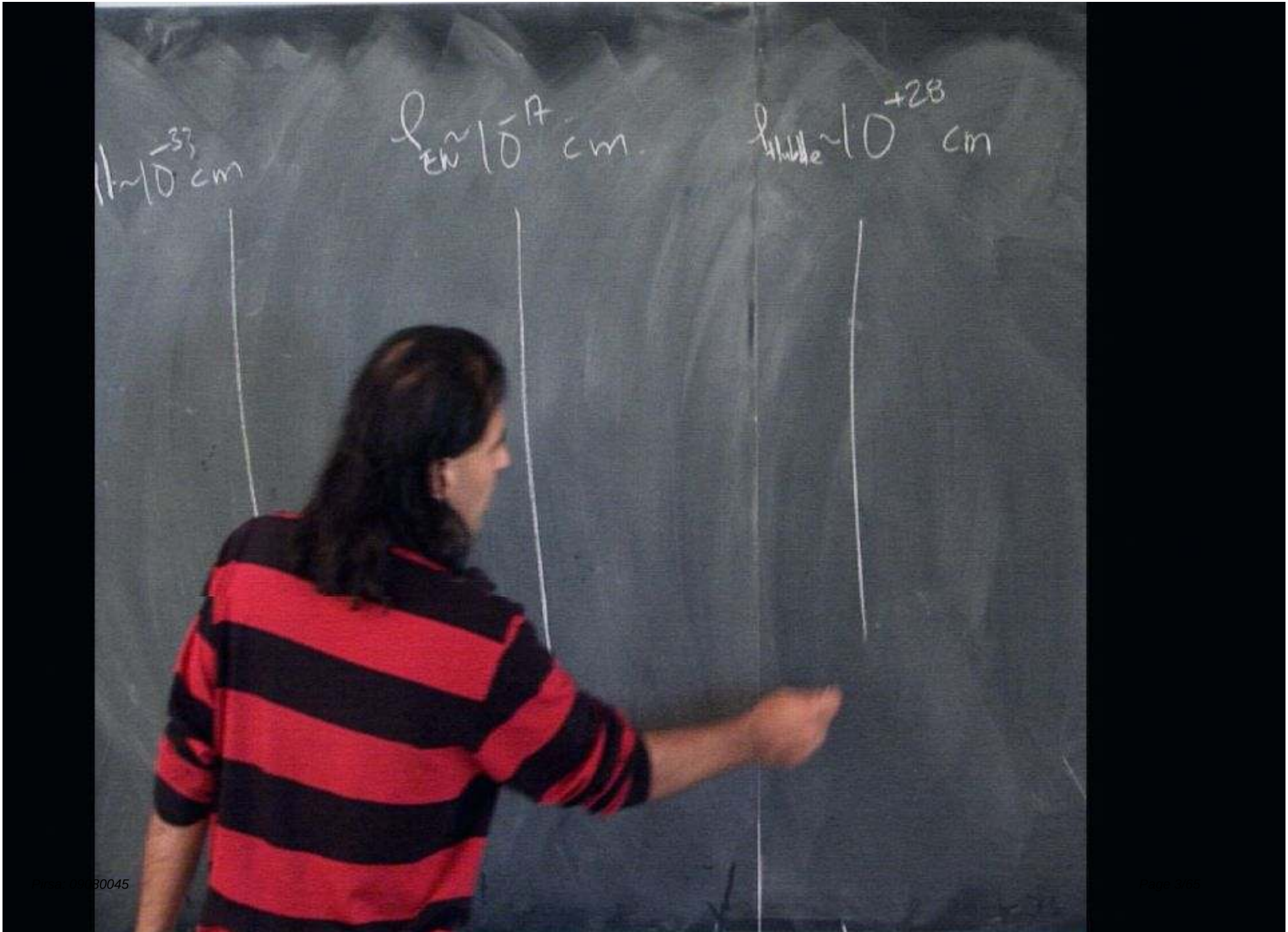
Title: PSI - Research Skills 1C

Date: Aug 24, 2009 01:00 PM

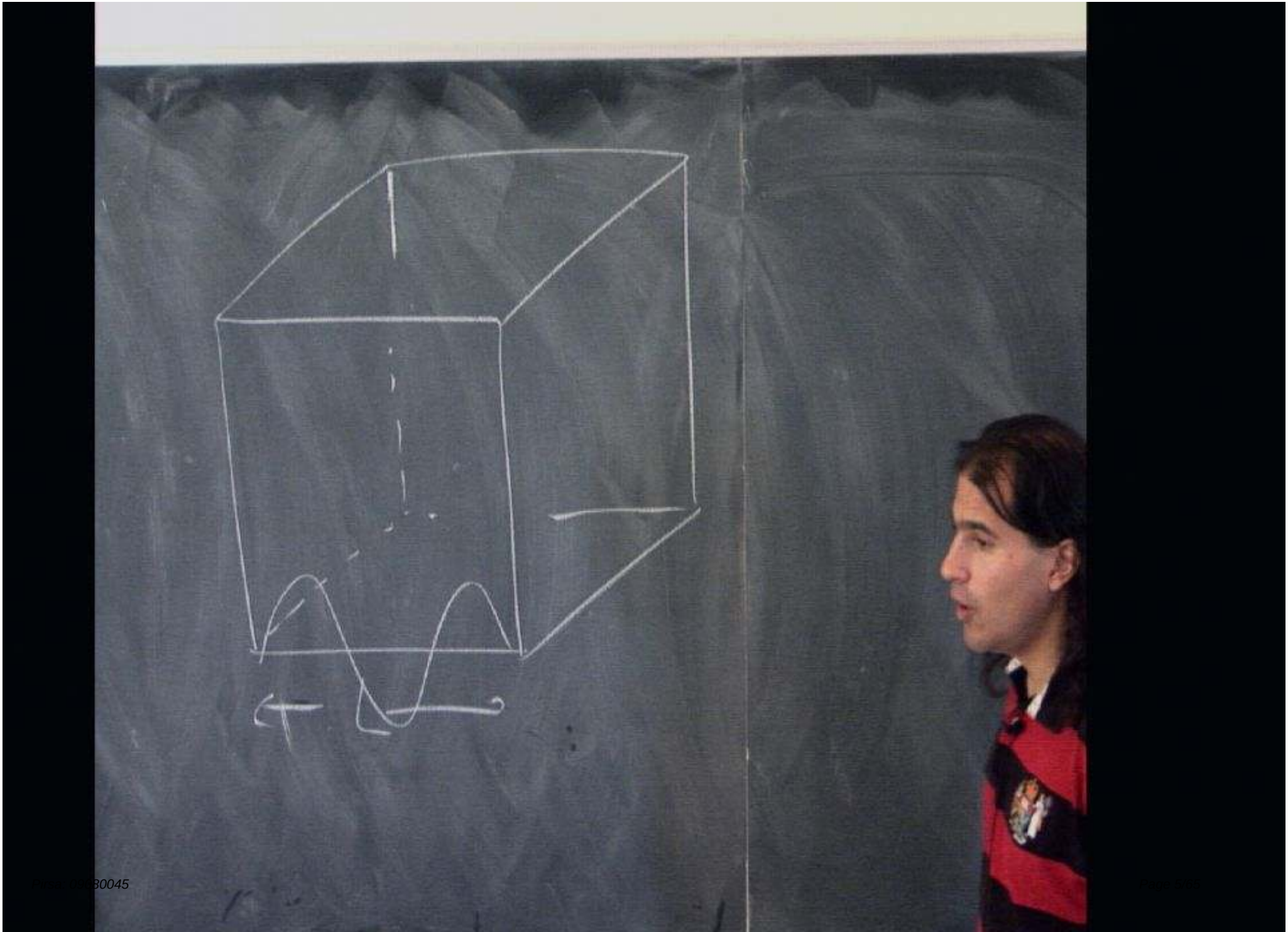
URL: http://pirsa.org/09080045

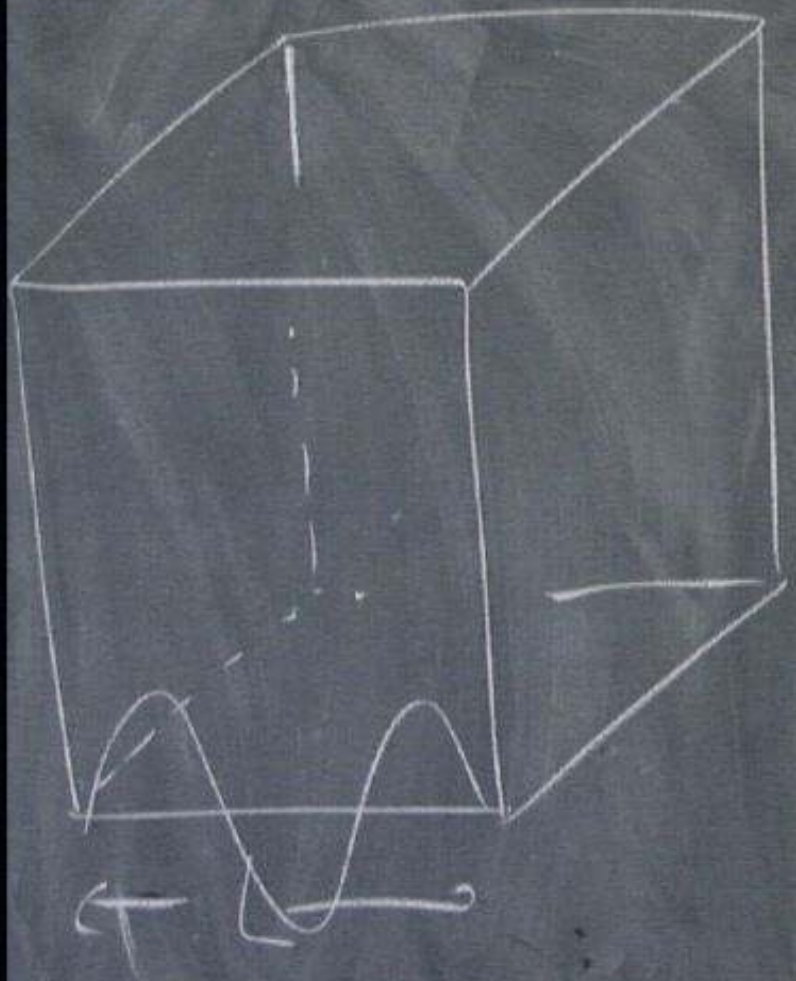
Abstract:


$\frac{Gmm}{r}\left(1 - \frac{1917}{\pi^3}\cdot\frac{l_{21}^2}{r^2}\right)$
$+ \cdots$
$\delta^3(r)$


$\ell_{EW} \sim 10^{-17}$ cm.
$\ell_{Hubble} \sim 10^{+28}$ cm

Vacuum Energy





$$\vec{p} = \frac{\vec{n}}{L}$$

$$\vec{p} = \frac{\vec{n}}{L} = \frac{(n_1, n_2, n_3)}{L}$$

$$\vec{p} = \frac{\vec{n}}{L} \quad \therefore = \frac{(n_1, n_2, n_3)}{L}$$

$$\omega = \sqrt{p^2 + m^2}$$

$$\vec{p} = \frac{\vec{n}}{L} = \frac{(n_1, n_2, n_3)}{L}$$

$$\omega = \sqrt{p^2 + m^2} = \sqrt{\left(\frac{\vec{n}}{L}\right)^2 + m^2}$$

$$E^{vac} = \sum \frac{1}{2}\omega$$

$$= \sum_{\vec{n}} \sqrt{\frac{\vec{n}^2}{L^2} + m^2}$$

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$$= \sum_{\vec{n}} \sqrt{\frac{\vec{n}^2}{L^2} + m^2}$$

$$= V \int d^3\vec{p} \sqrt{\vec{p}^2 + m^2}$$

$$\rho^{vac} = \frac{E^{vac}}{V}$$

$$= \int d^3p \sqrt{p^2 + m^2}$$

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$$\rho^{vac} = \frac{E^{vac}}{V}$$

$$= \int d^3p \sqrt{p^2 + m^2}$$

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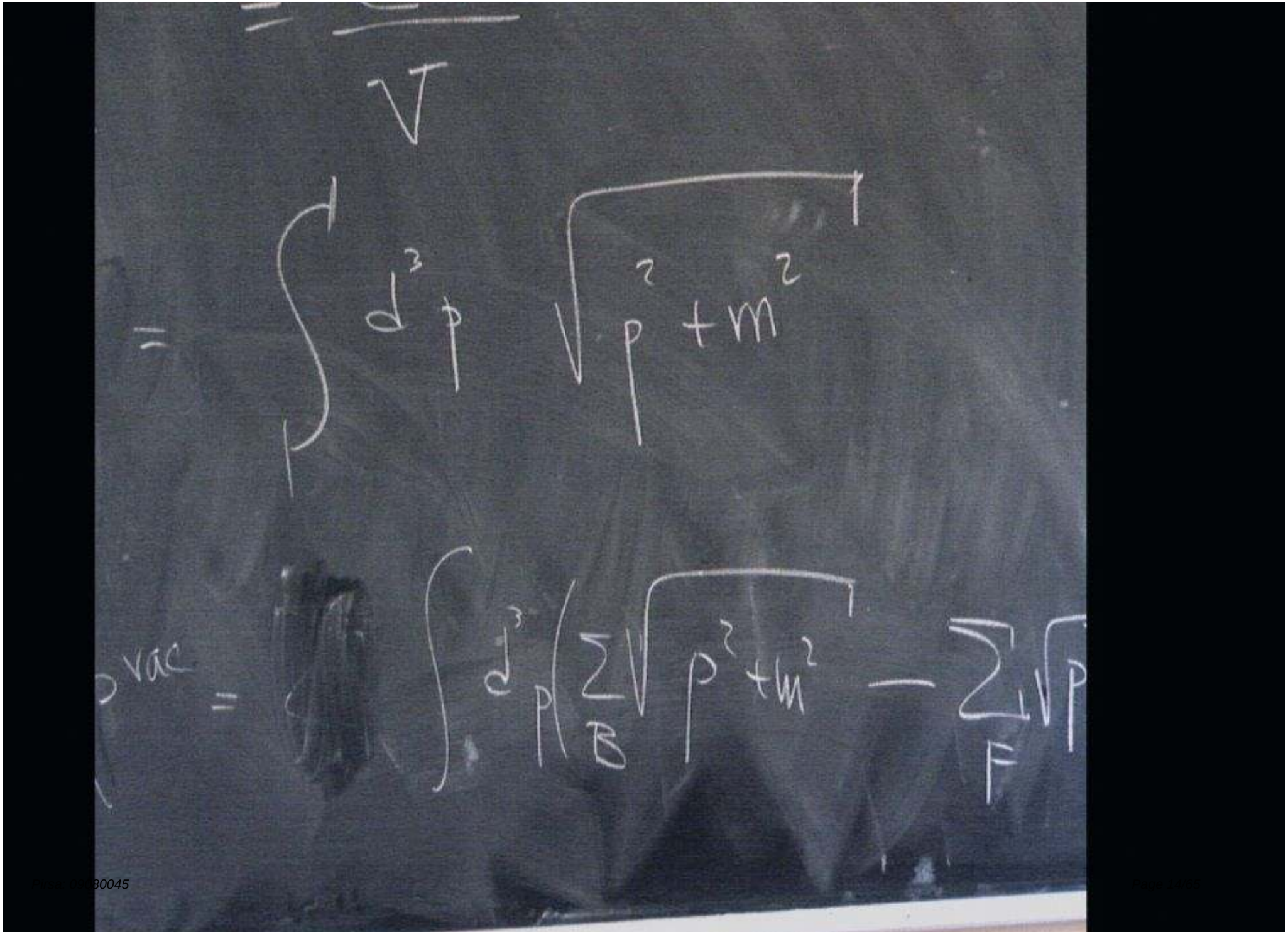
V
= ∫ d³p √(p² + m²)
ρ vac = ∫ d³p (Σ_B √(p² + m²) − Σ_F √(p

$$\rho^{vac} = \frac{E}{V}$$

$$= \int d^3p \sqrt{p^2 + m^2}$$

$$\rho^{vac} = \int d^3p \left(\sum_B \sqrt{p^2 + m^2} - \sum_F \sqrt{p^2 + m^2} \right)$$

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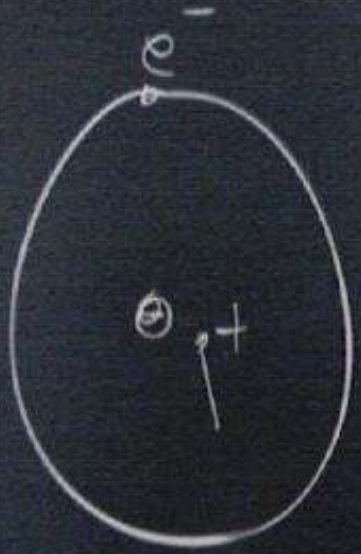
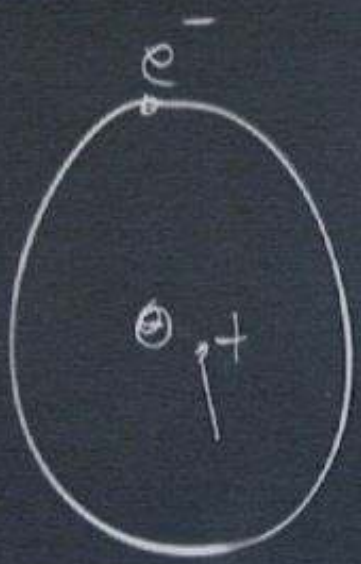


$$X^2 + P^2$$

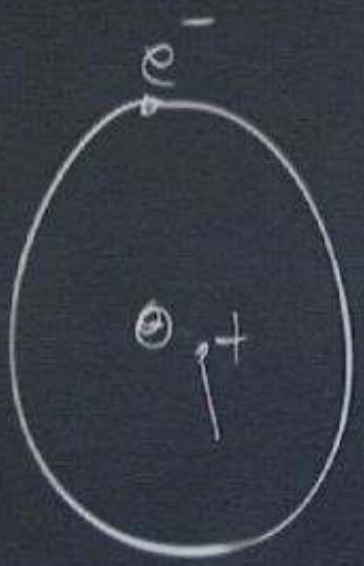
$$a a^\dagger + a^\dagger a$$



$$X^2 + P^2$$

$$\frac{1}{2}(a a^\dagger + a^\dagger a)$$

$$= a^\dagger a + \frac{1}{2}\hbar\omega.$$



$$X^2 + P^2$$

$$\frac{1}{2}(aa^\dagger + a^\dagger a)$$

$$= a^\dagger a + \frac{1}{2}\hbar\omega.$$

$$\rho^{vac} = \int d^3p \sqrt{p^2 + m^2}$$

$$\rho^{vac} = \int d^3p \sqrt{p^2 + m^2}$$

$$\int_x^y \frac{dt}{t}$$

$$\rho^{vac} = \int d^3p \sqrt{p^2 + m^2}$$

$$\int_x^y \frac{dt}{t} = \log y/x$$

$$\rho^{vac} = \int d^3p \sqrt{p^2 + m^2}$$

$$\int_x^y dt\, t \qquad \int_x^y \frac{dt}{t} = \log y/x$$

$$\rho^{vac} = \int d^3p \sqrt{p^2 + m^2}$$

$$\int_{p_{max}} d p \, p^2 \sqrt{p^2 + m^2}$$

$$\sim$$

$$\rho^{vac} = \int d^3p \sqrt{p^2+m^2}$$

$$\int_{p_{max}} d\,p\, p^2 \sqrt{p^2+m^2}$$

$$\sim p_{max}^4$$

$$\rho^{vac} = \int d^3p \sqrt{p^2 + m^2}$$

$$\int_0^{p_{max}} dp\, p^2 \sqrt{p^2 + m^2}$$

$$\sim p_{max}^4 + p_{max}^2 m^2$$

$$\rho^{vac} = \int d^3p \sqrt{p^2 + m^2}$$

$$\int_{p_{max}} dp\, p^2 \sqrt{p^2 + m^2}$$

$$\sim p_{max}^4 + p_{max}^2 m^2 + m^4$$

$$\rho^{vac} = \int d^3p \sqrt{p^2 + m^2}$$

$$\int_{p_{max}} d\,p\, p^2 \sqrt{p^2 + m^2}$$

$$\sim p_{max}^4 + p_{max}^2 m^2 + m^4 \log$$

$$\int dp\, p^3 \sqrt{1 + \frac{m^2}{p^2}}$$

$$= \int dp\, p^3 \left[1 + \frac{m^2}{p^2} + \frac{m^4}{p^4} + \cdots \right]$$

$$\int dp\, p^3 \sqrt{1 + \frac{m^2}{p^2}}$$

$$= \int dp\, p^3 \left[1 + \frac{1}{2}\frac{m^2}{p^2} - \frac{1}{8}\frac{m^4}{p^4} + \cdots \right]$$

$$\int dp\, p^2 \sqrt{1 + \frac{m^2}{p^2}} \cdot \int \frac{dp}{p}$$

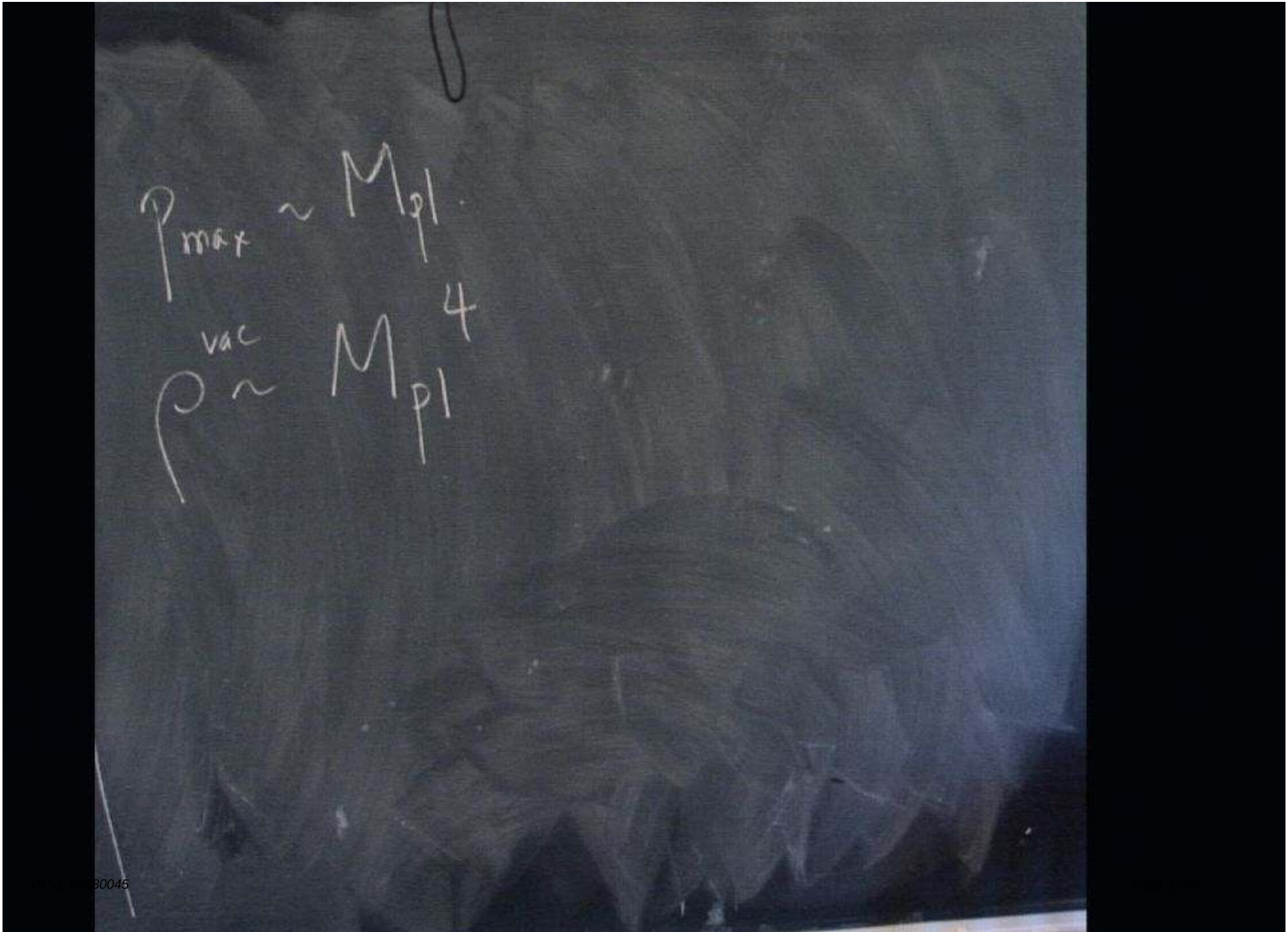
$$= \int_{p_{max}} dp\, p^3 \left(1 + \frac{1}{2}\frac{m^2}{p^2} - \frac{1}{8}\frac{m^4}{p^4} + \cdots\right)$$

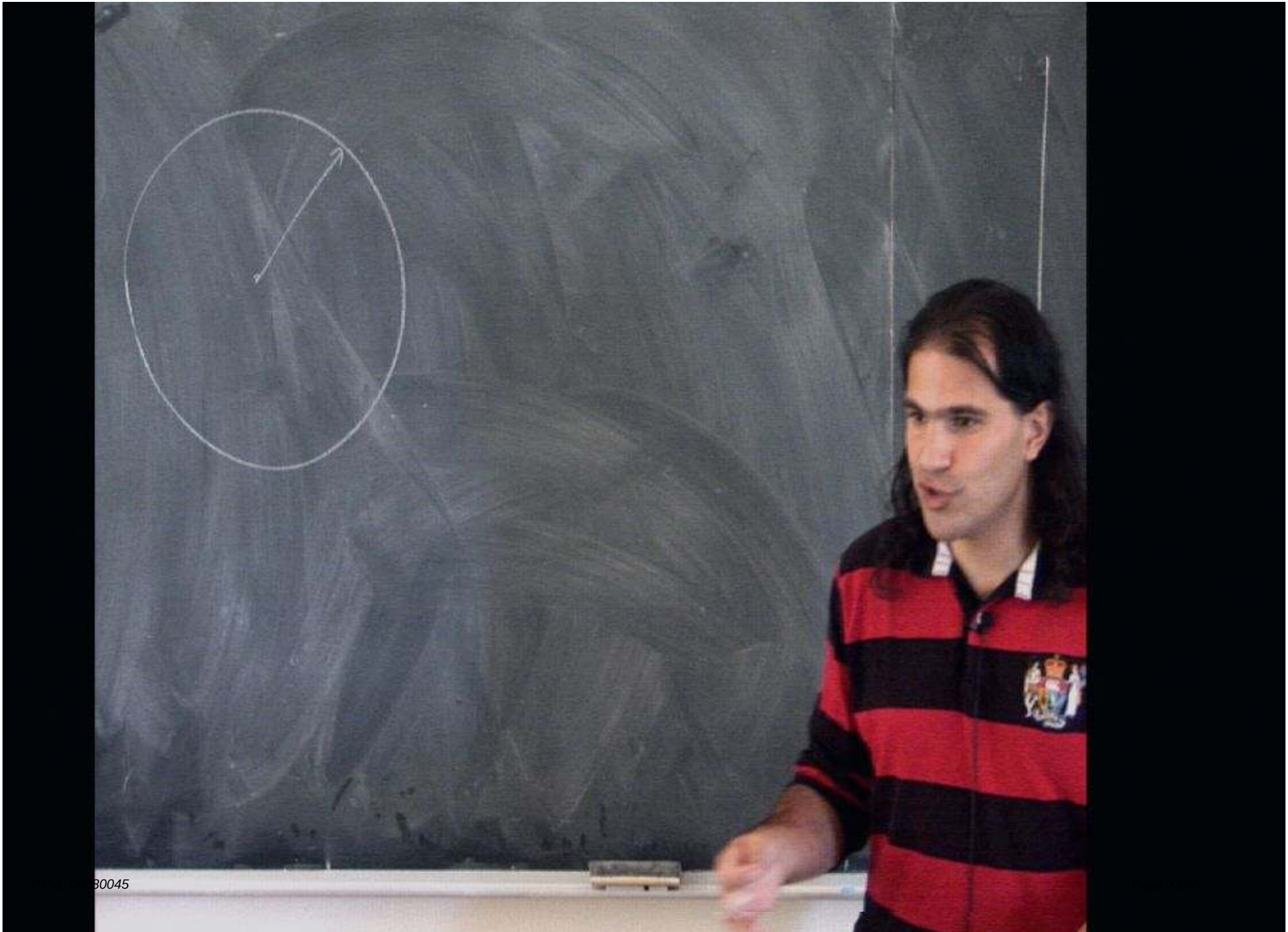
$$\sim p_{max}^4 + p_{max}^2 m^2 \cdots$$

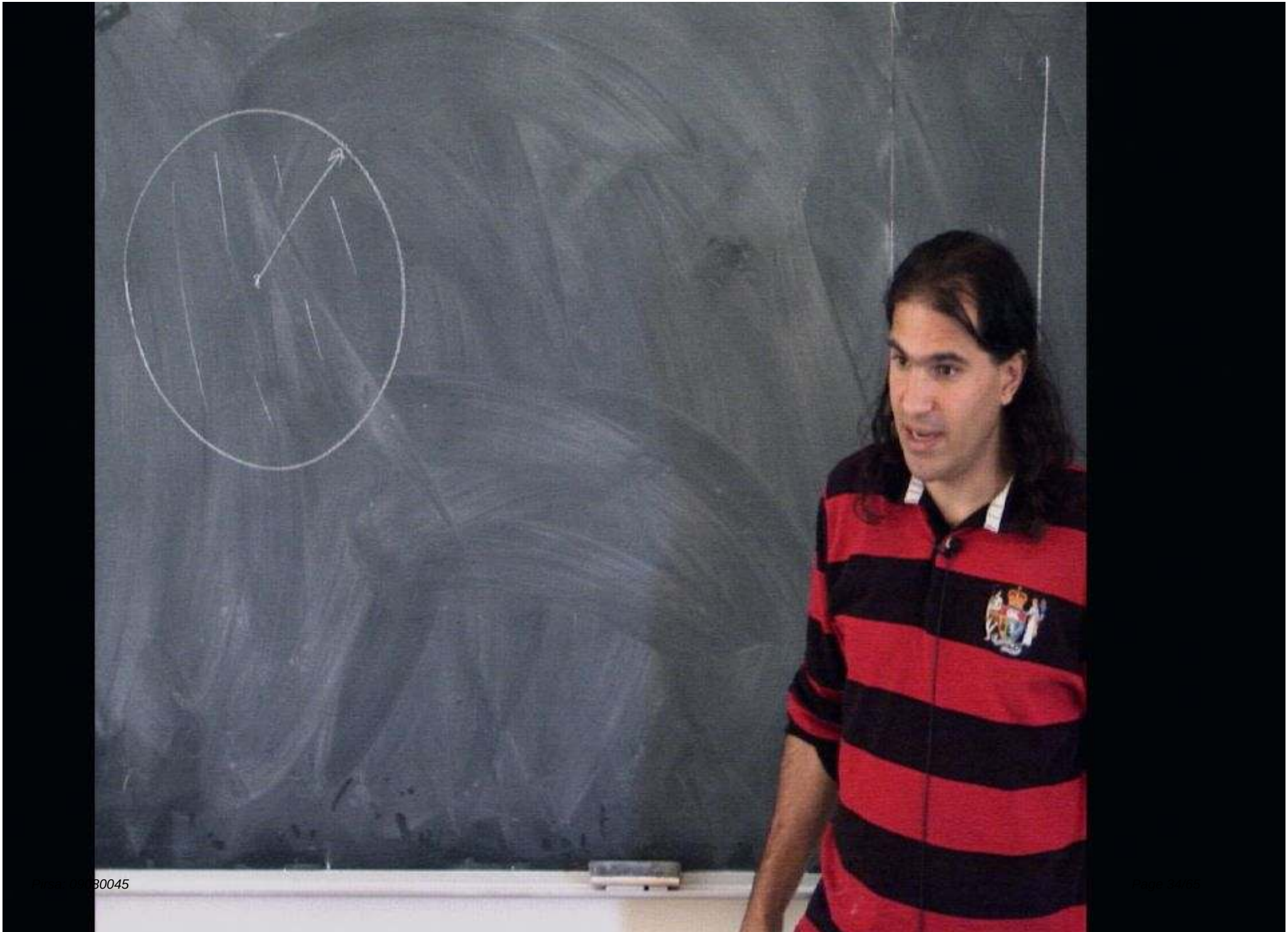
$$\int dp\, p^3 \sqrt{1+\frac{m^2}{p^2}} \cdot \int \frac{dp}{p}$$

$$= \int_{p_{max}} dp\, p^3 \left[1 + \frac{1}{2}\frac{m^2}{p^2} - \frac{1}{8}\frac{m^4}{p^4} + \cdots\right]$$

$$\sim p_{max}^4 + p_{max}^2 m^2 + m^4 \log \frac{p_{max}}{m} ,$$


$\rho_{max} \sim M_{pl}$
$\rho_{vac} \sim M_{pl}^4$

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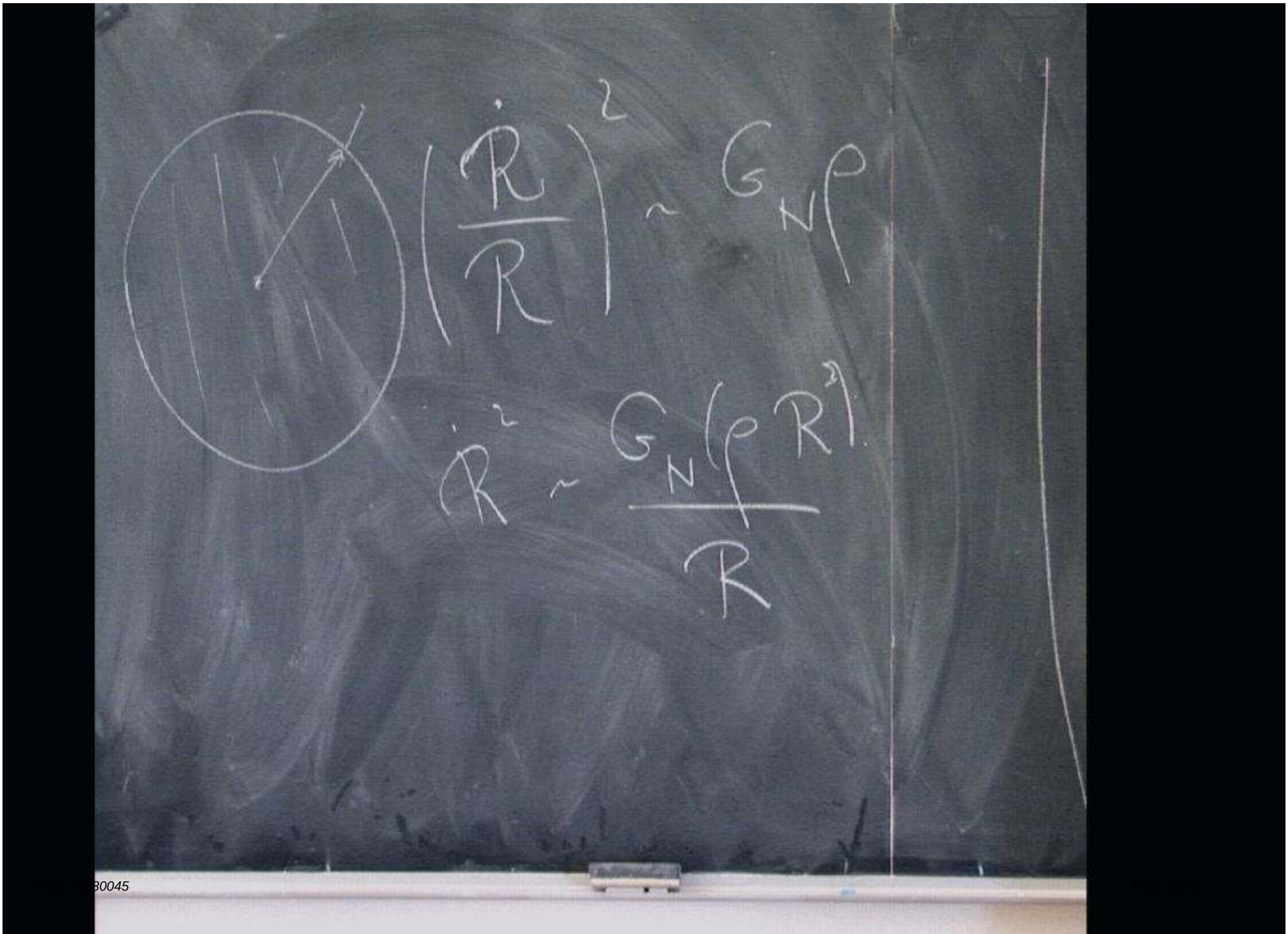
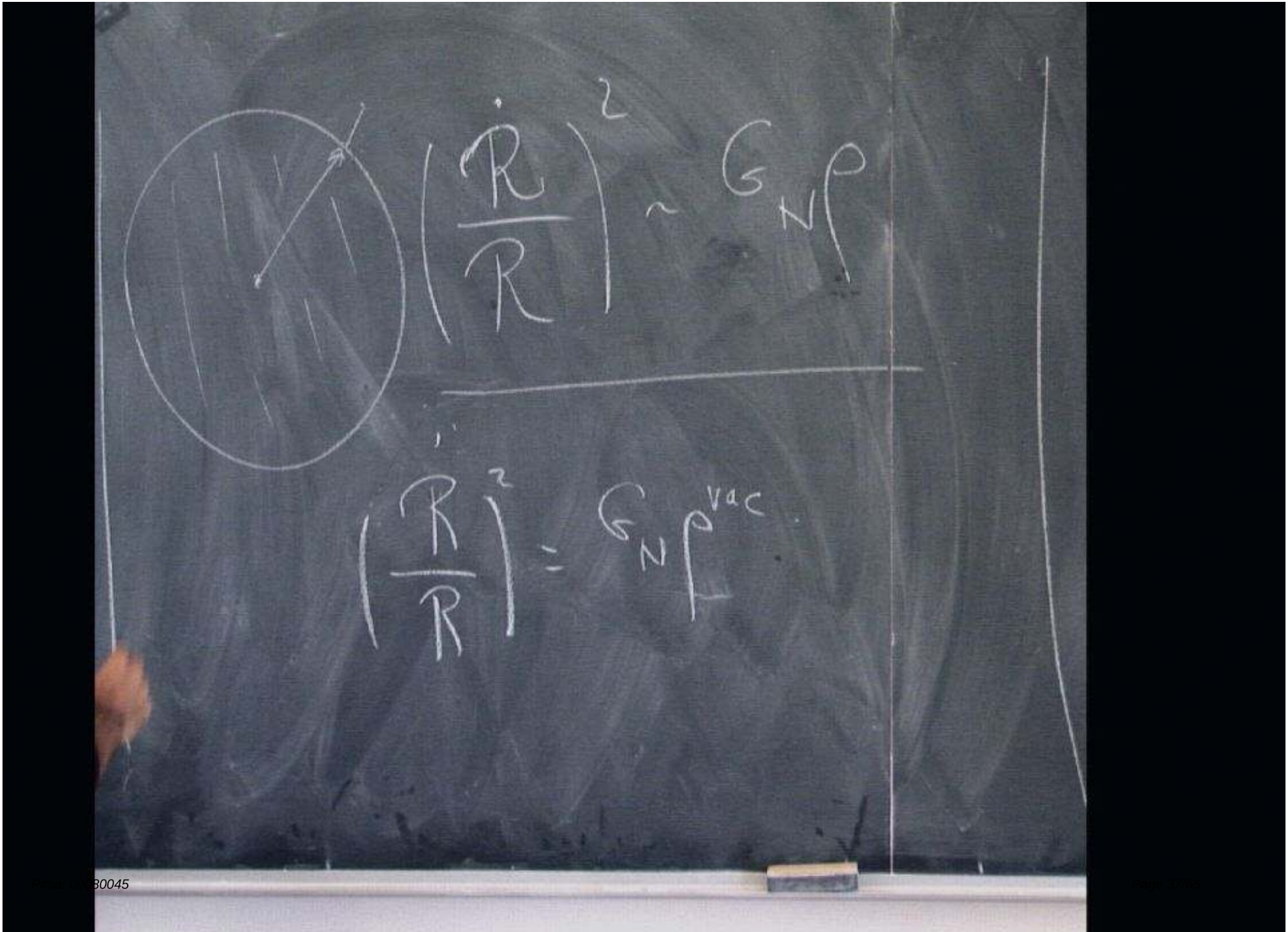
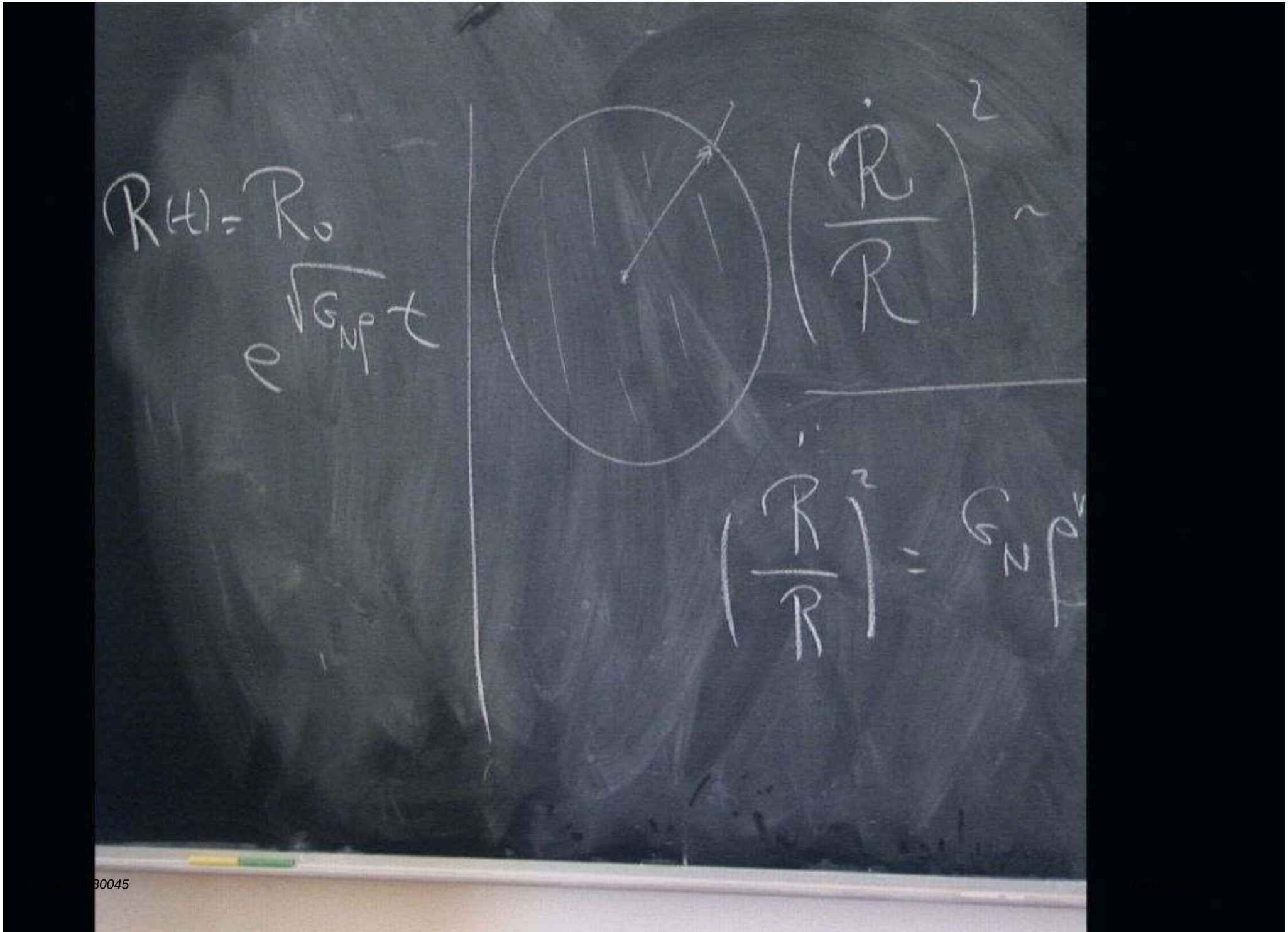
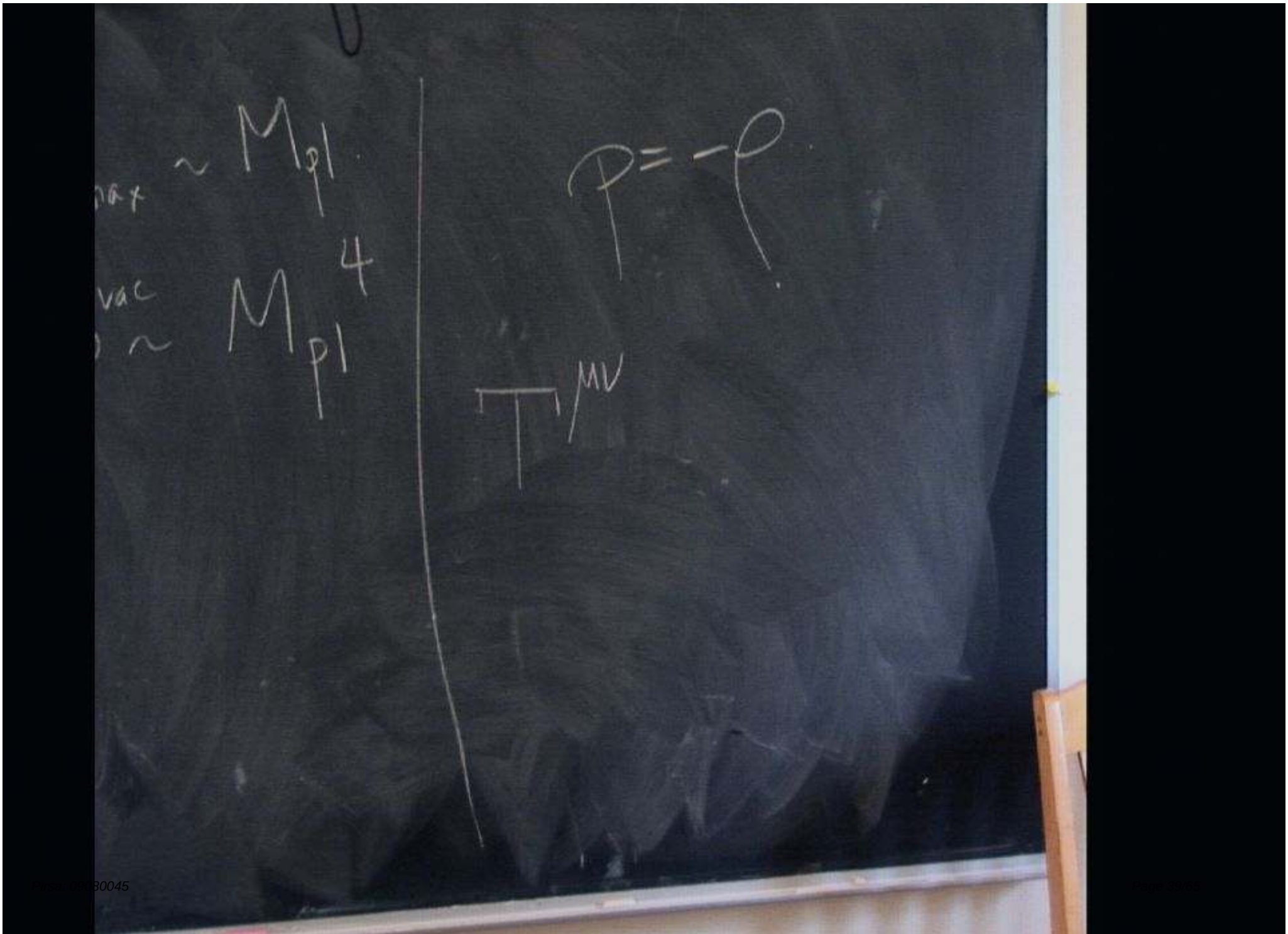
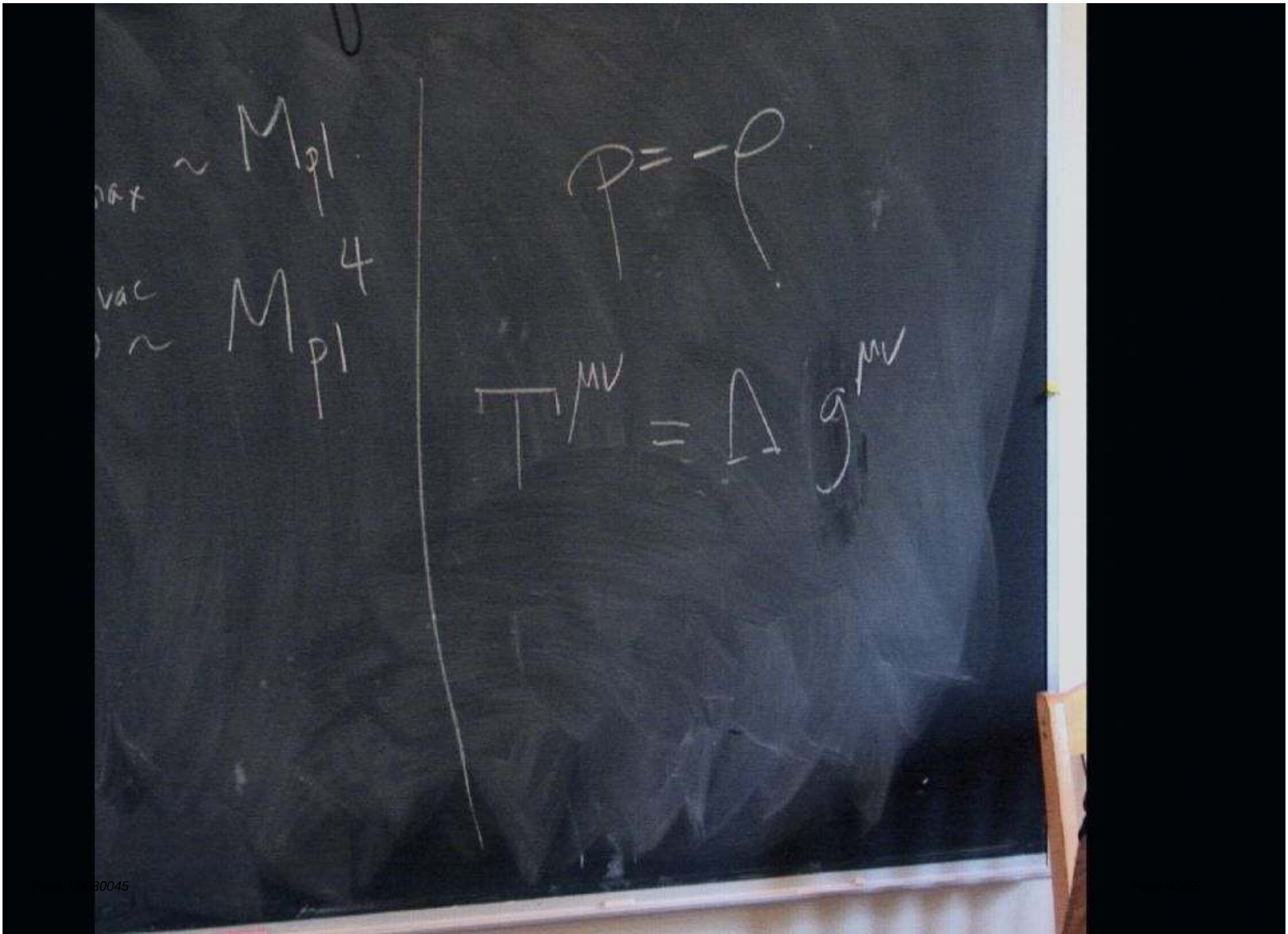
$\left(\frac{\dot{R}}{R}\right)^2 \sim G_N \rho$

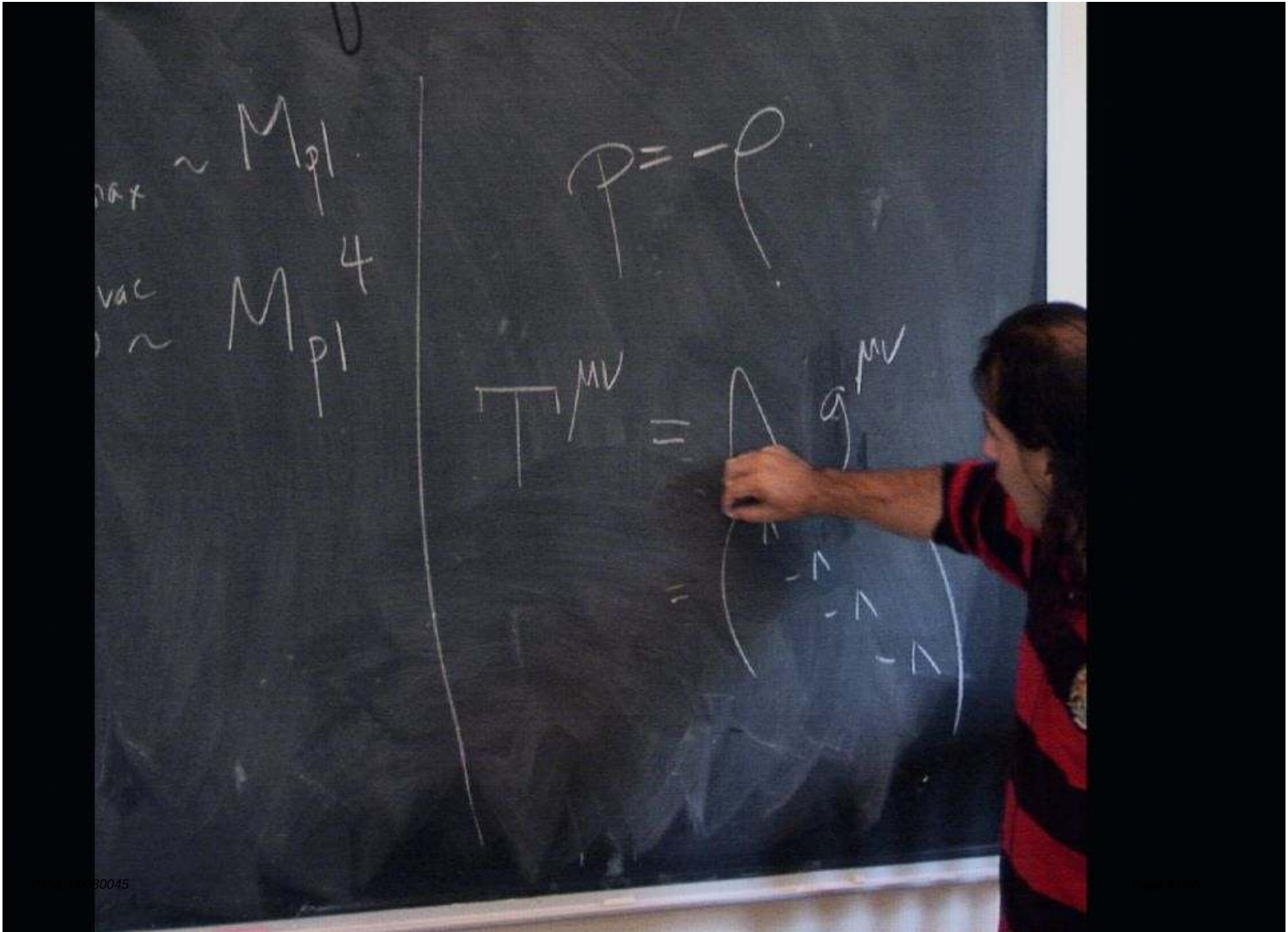

$\left(\frac{\dot{R}}{R}\right)^2 \sim G_N \rho$
$\ddot{R} \sim \frac{G_N(\rho R^3)}{R^2}$

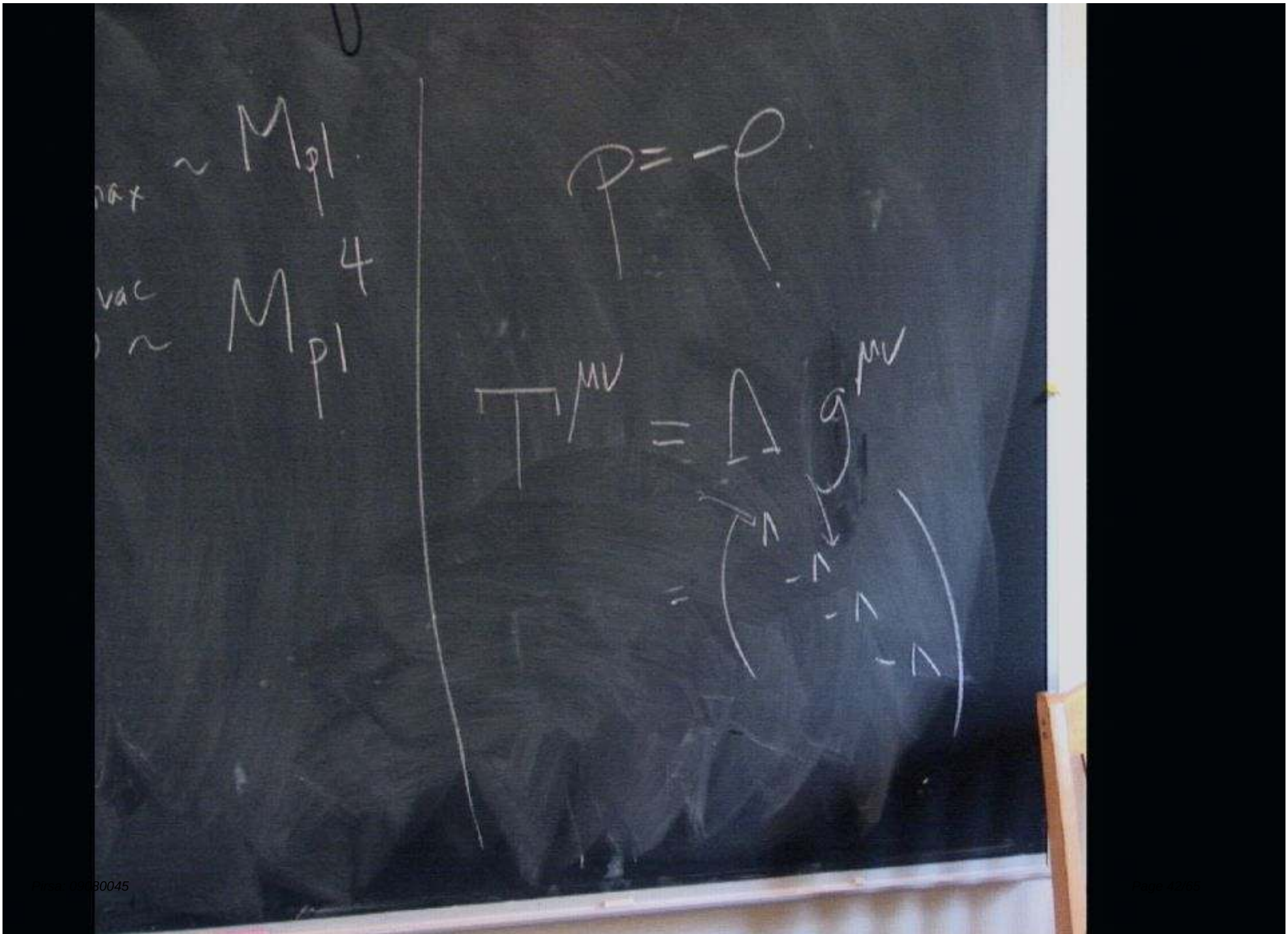

$\left(\frac{\dot{R}}{R}\right)^2 \sim G_N \rho$
$\left(\frac{\dot{R}}{R}\right)^2 = G_N \rho^{vac}$


R(t) = R₀ e^{√(G_N ρ) t}
(Ṙ/R)² ~
(Ṙ/R)² = G_N ρ


$\sim M_{pl}$
$\sim M_{pl}^4$
$p = -\rho$
$T^{\mu\nu}$

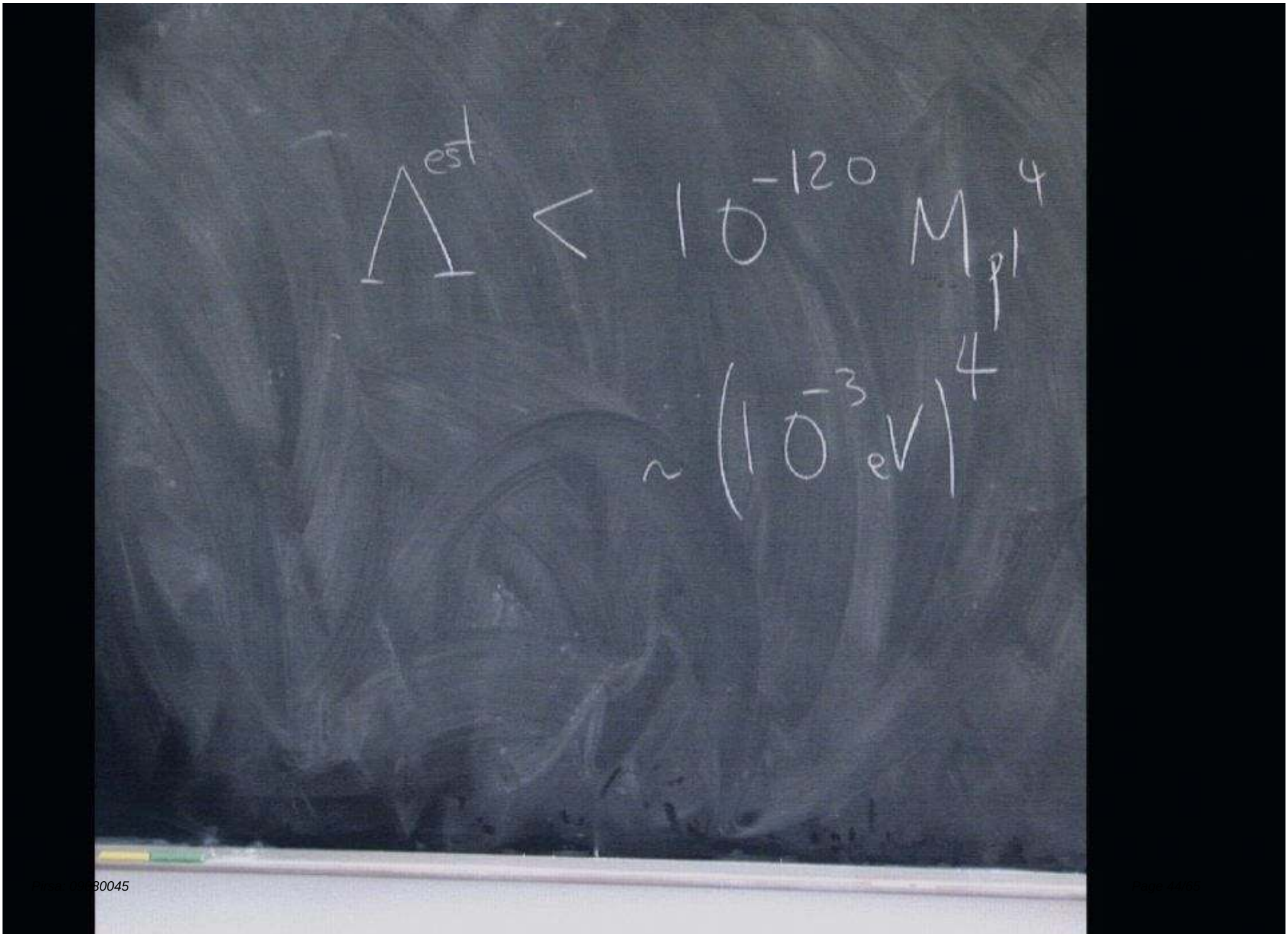

$\sim M_{pl}$
$\sim M_{pl}^4$
$p = -\rho$
$T^{\mu\nu} = \Lambda g^{\mu\nu}$

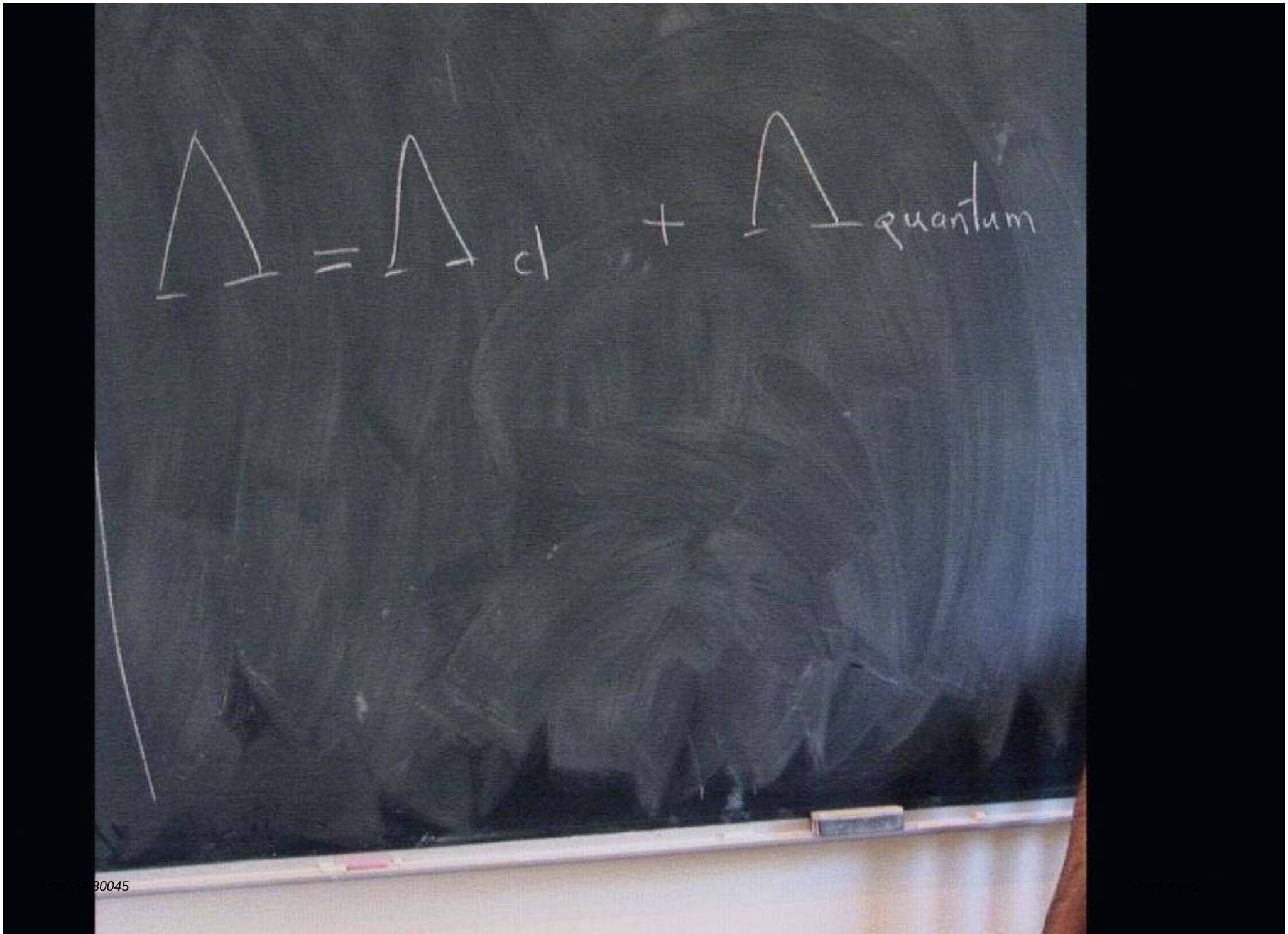

$\sim M_{pl}$
M_{pl}^4
$p = -\rho$
$T^{\mu\nu} = \Lambda g^{\mu\nu}$
Λ
$-\Lambda$
$-\Lambda$
$-\Lambda$

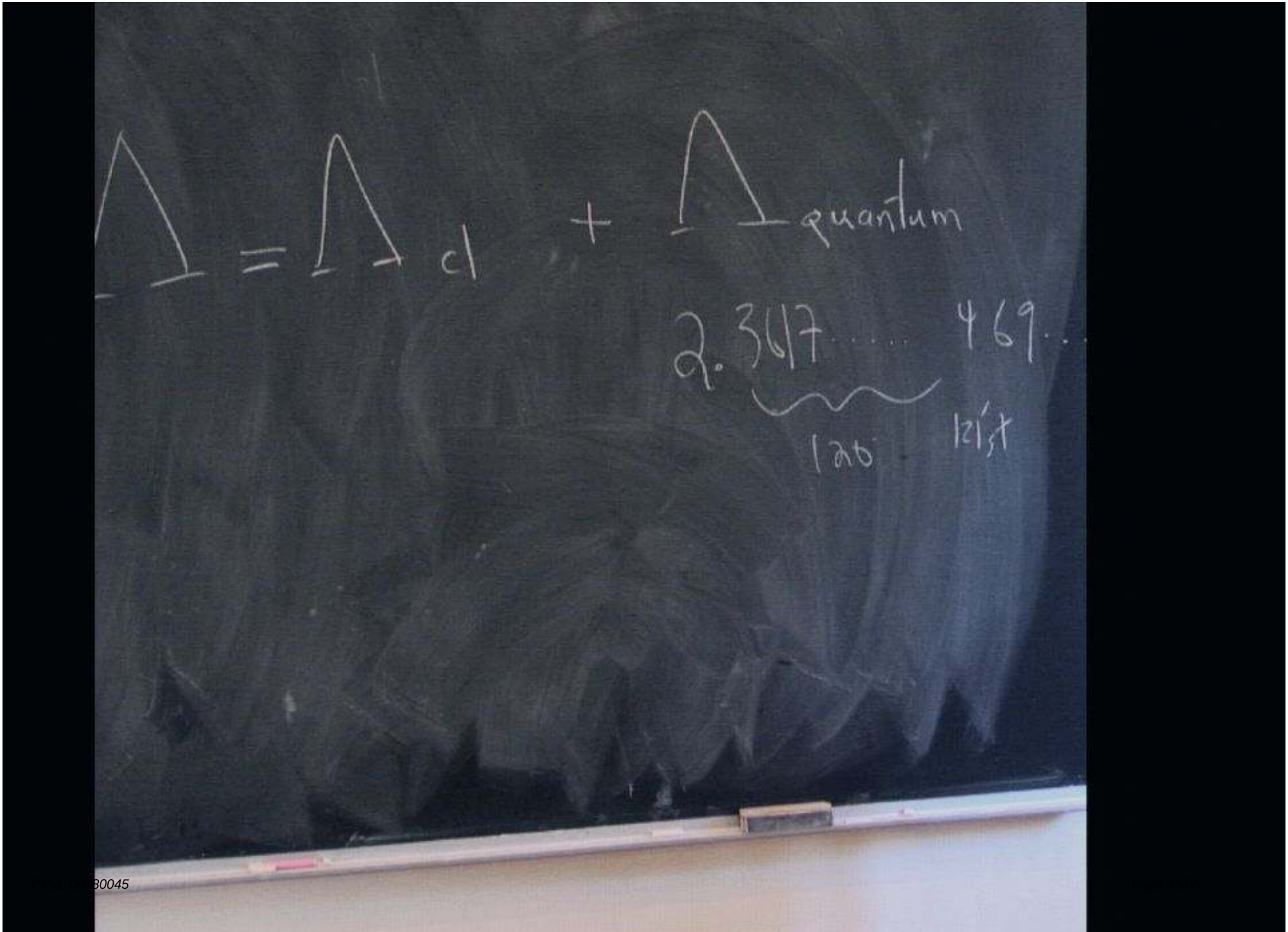

$\sim M_{pl}$
M_{pl}^4
$p = -\rho$
$T^{\mu\nu} = \Lambda g^{\mu\nu}$
Λ
$-\Lambda$
$-\Lambda$
$-\Lambda$

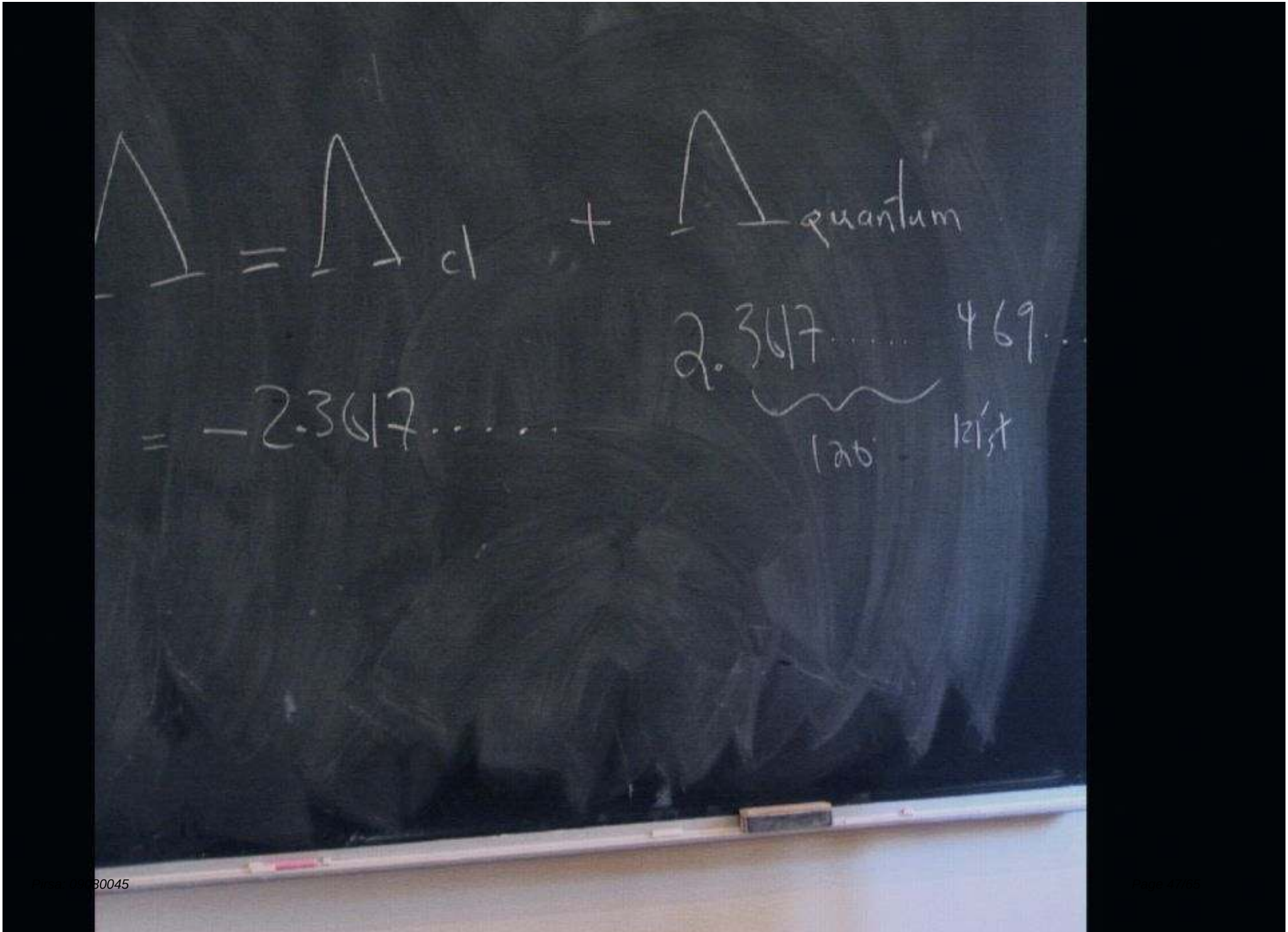
$$\Lambda < 10^{-120} M_{pl}^4$$

$$\sim (10^{-3}\,\mathrm{eV})^4$$

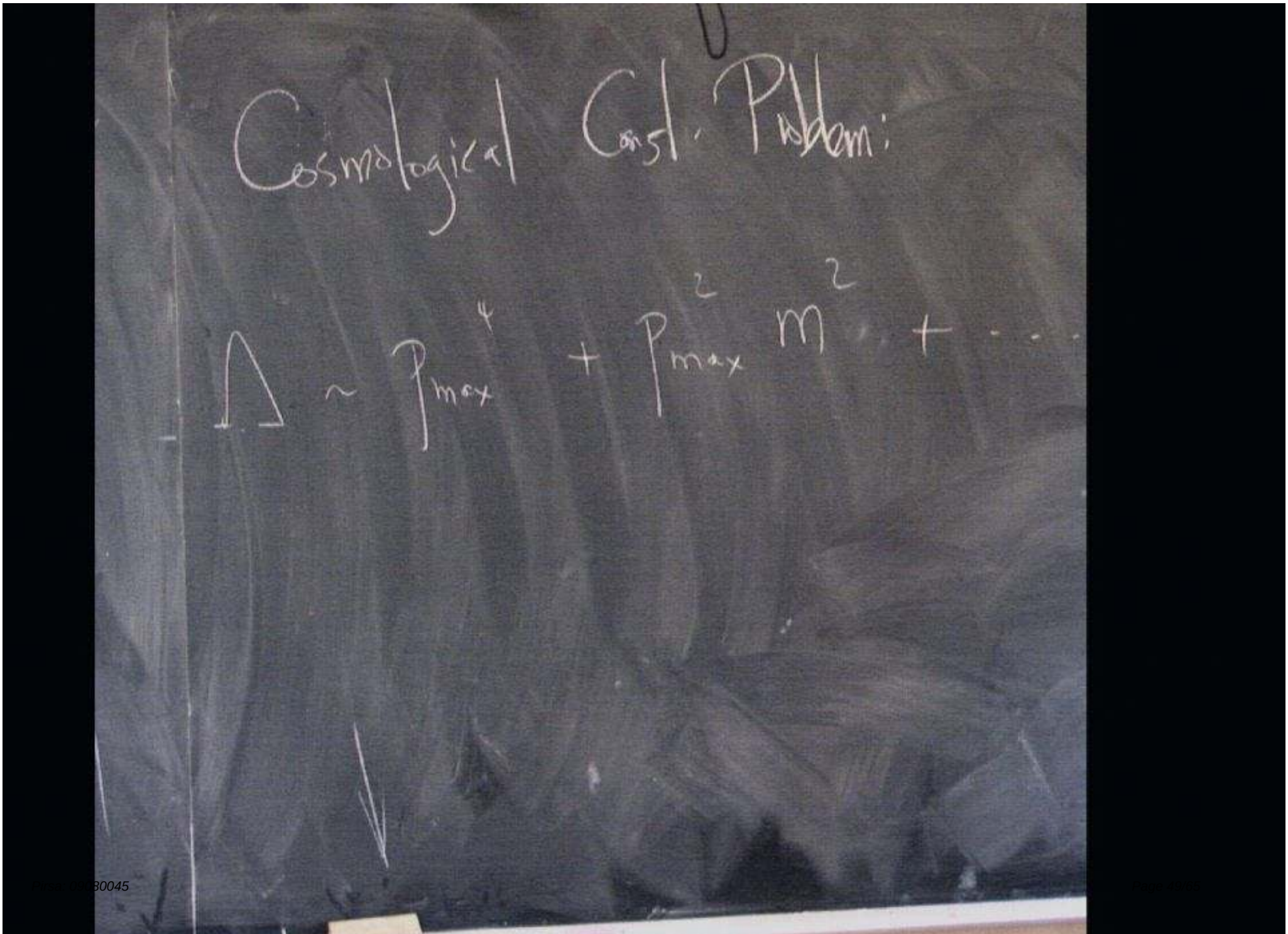

$\Lambda^{est} < 10^{-120} M_{pl}^4$
$\sim (10^{-3}\,eV)^4$

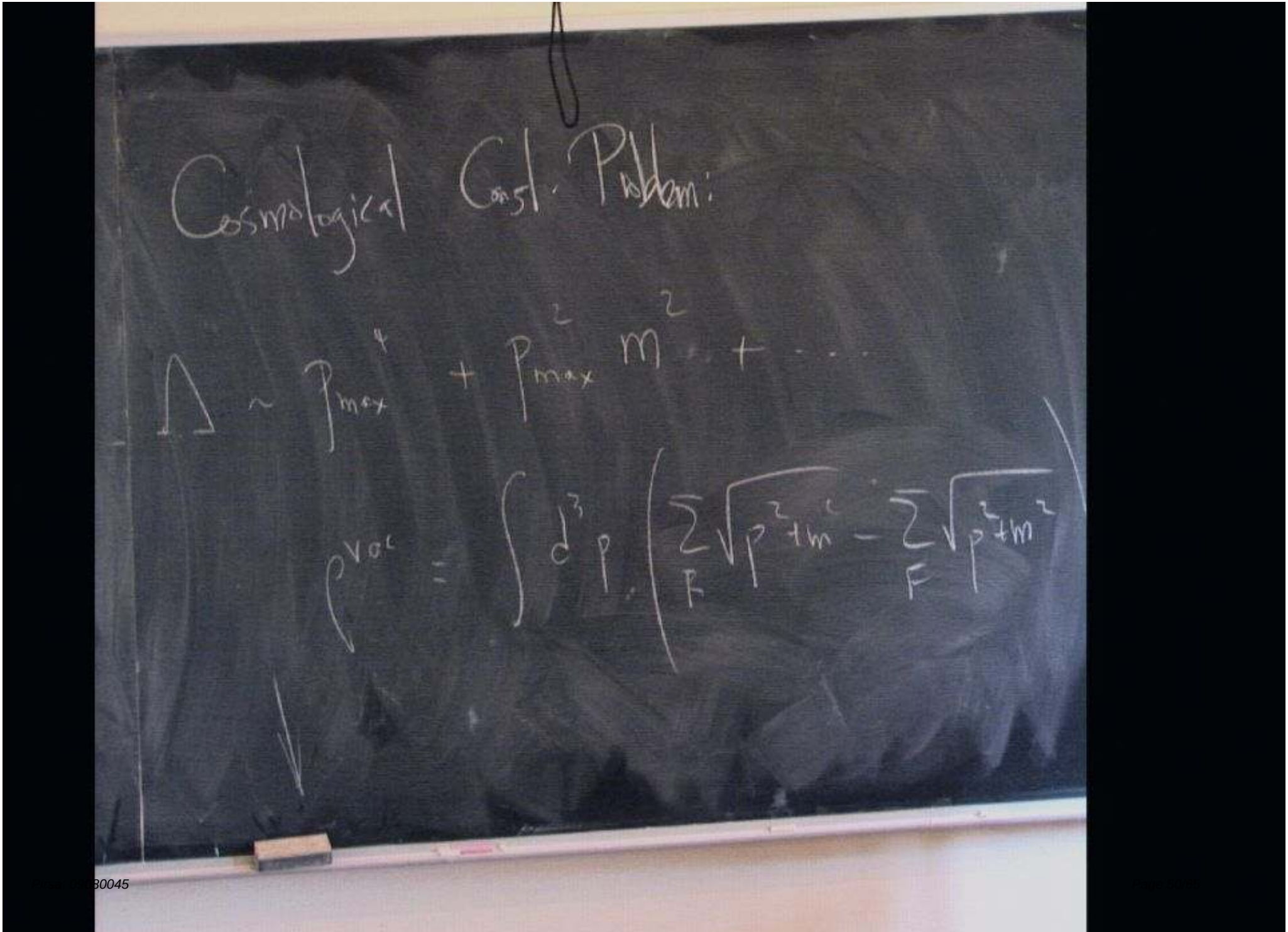

$\Lambda = \Lambda_{cl} + \Lambda_{quantum}$

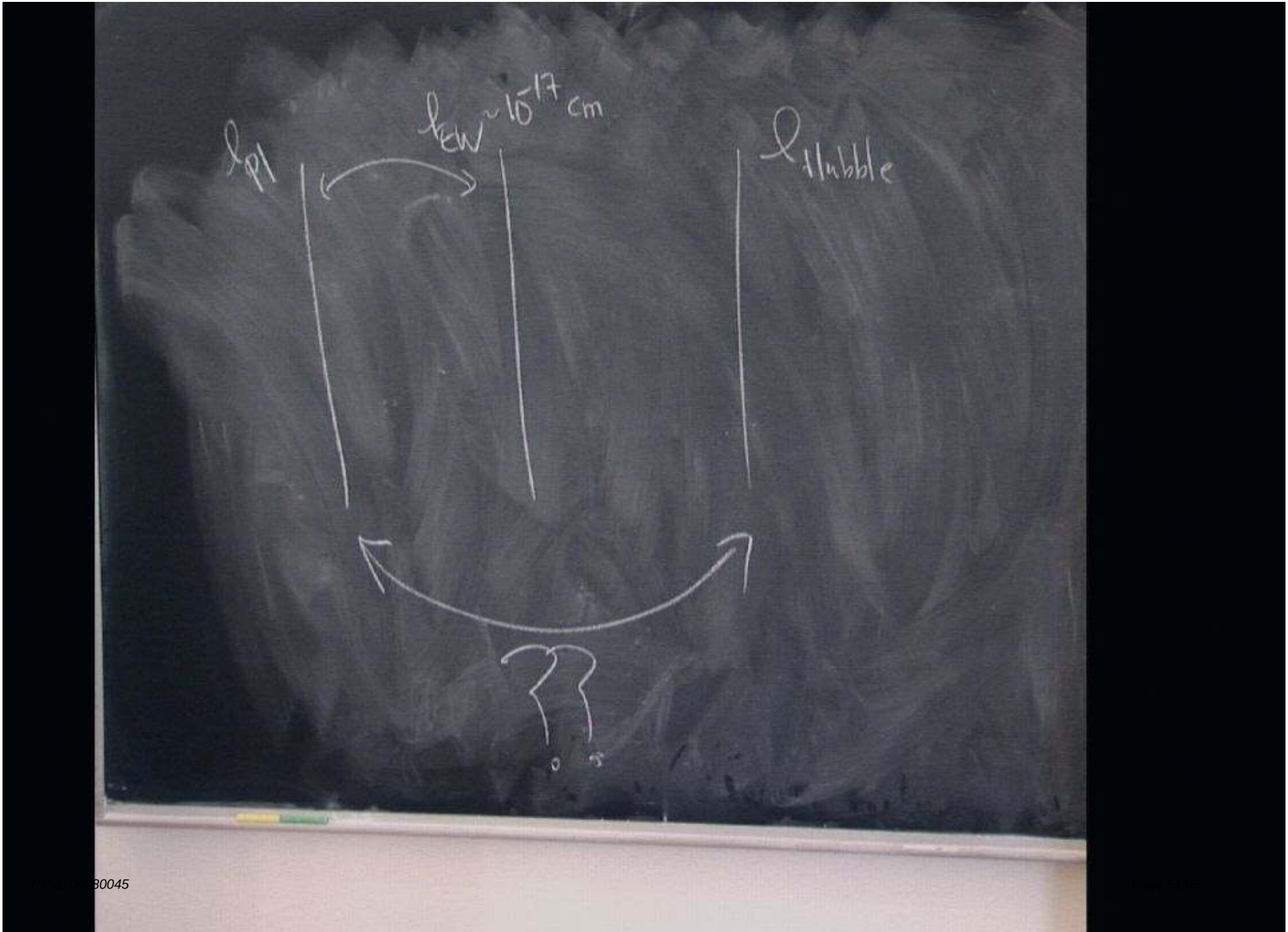

$\Lambda = \Lambda_{cl} + \Lambda_{quantum}$
2.3617.... 469...
120
121st


$\Lambda = \Lambda_{cl} + \Lambda_{quantum}$
$= -2.3617\ldots$
$2.3617\ldots\ldots 469\ldots$
120
121st

Cosmological Const. Problem:


Cosmological Const. Problem:
$\Lambda \sim p_{max}^4 + p_{max}^2 m^2 + \ldots$


Cosmological Const. Problem:
$\Delta \sim p_{max}^4 + p_{max}^2 m^2 + \dots$
$\rho^{vac} = \int d^3p \left(\sum_F \sqrt{p^2+m^2} - \sum_F \sqrt{p^2+m^2} \right)$



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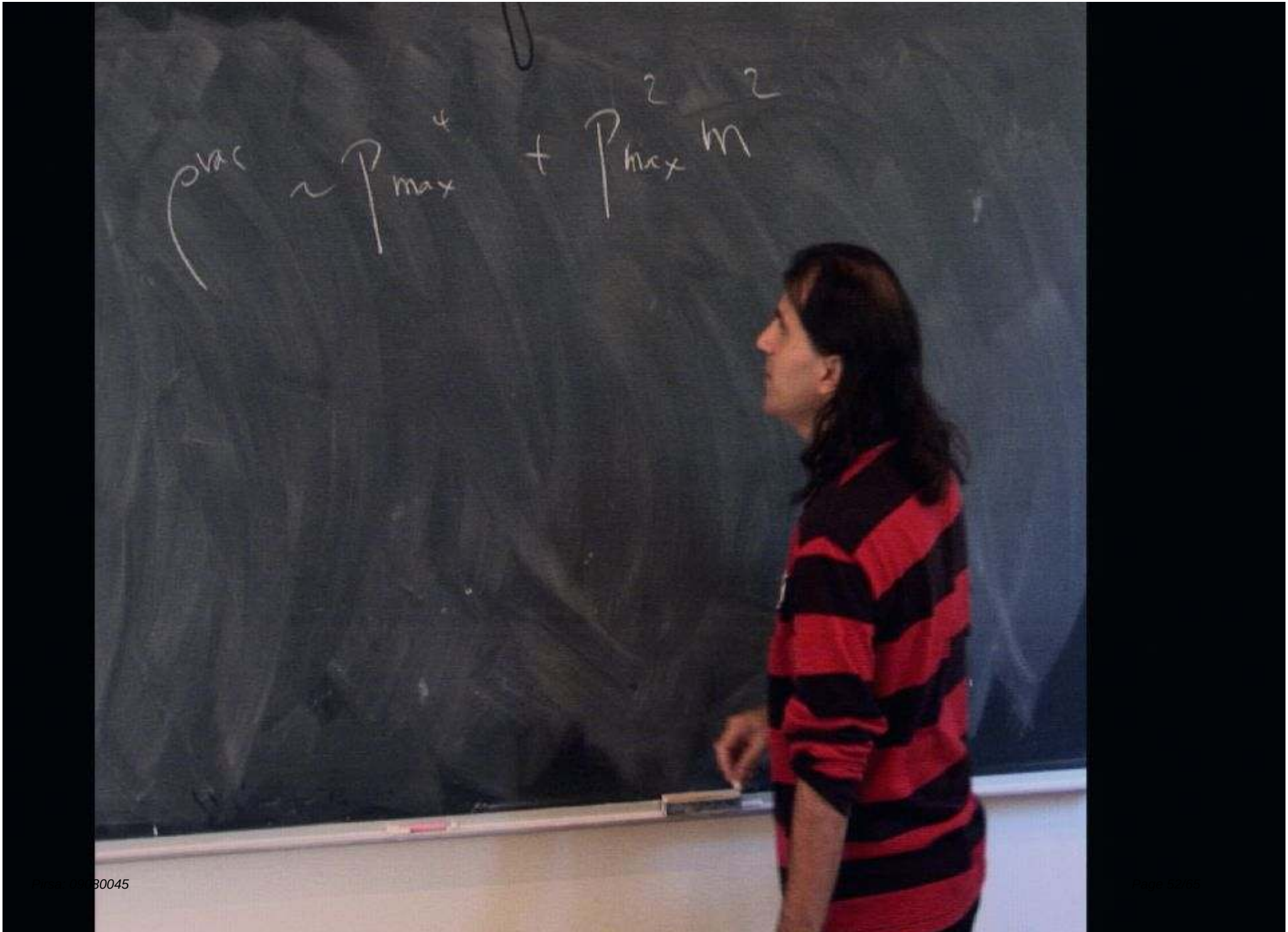

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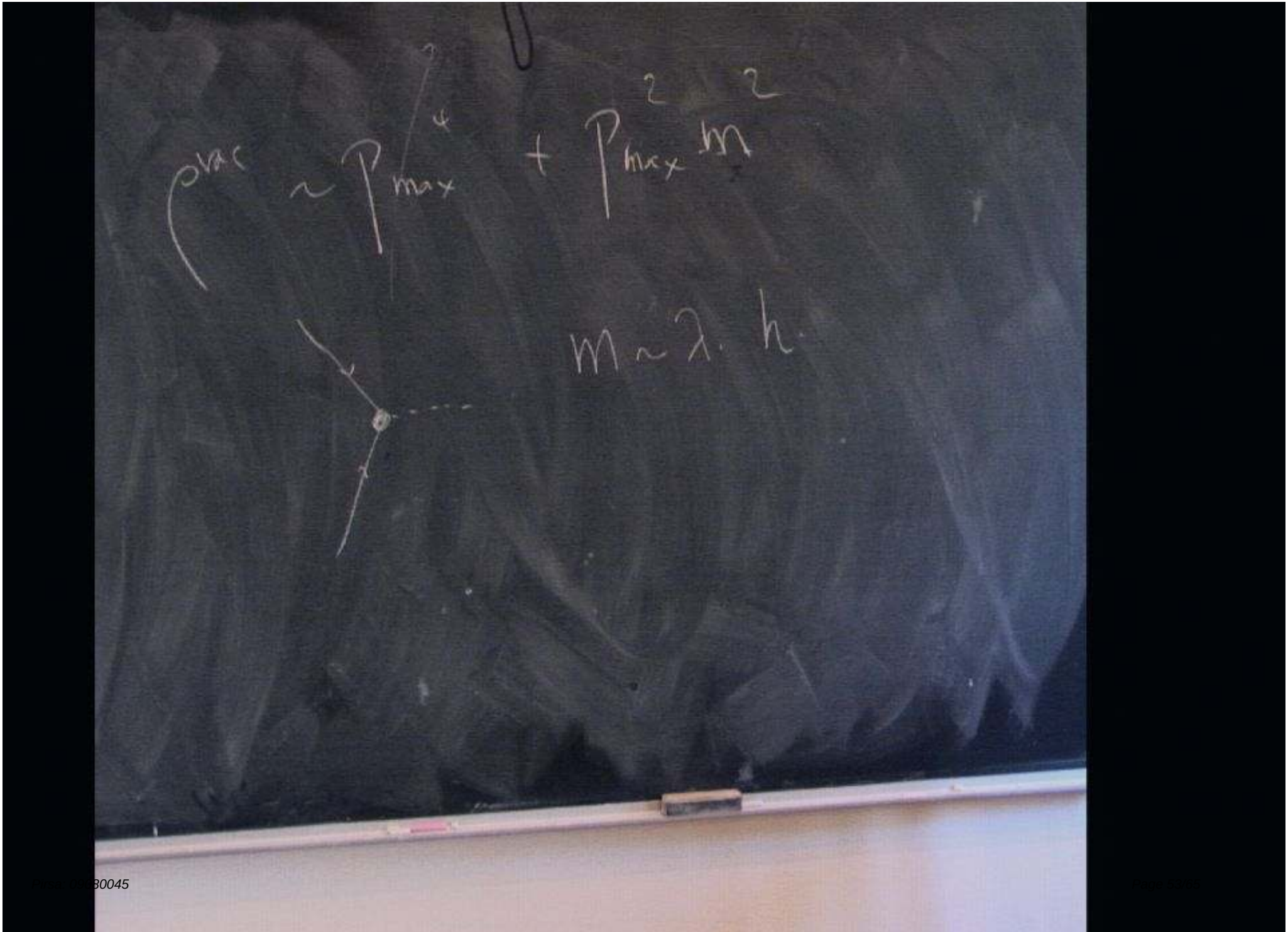
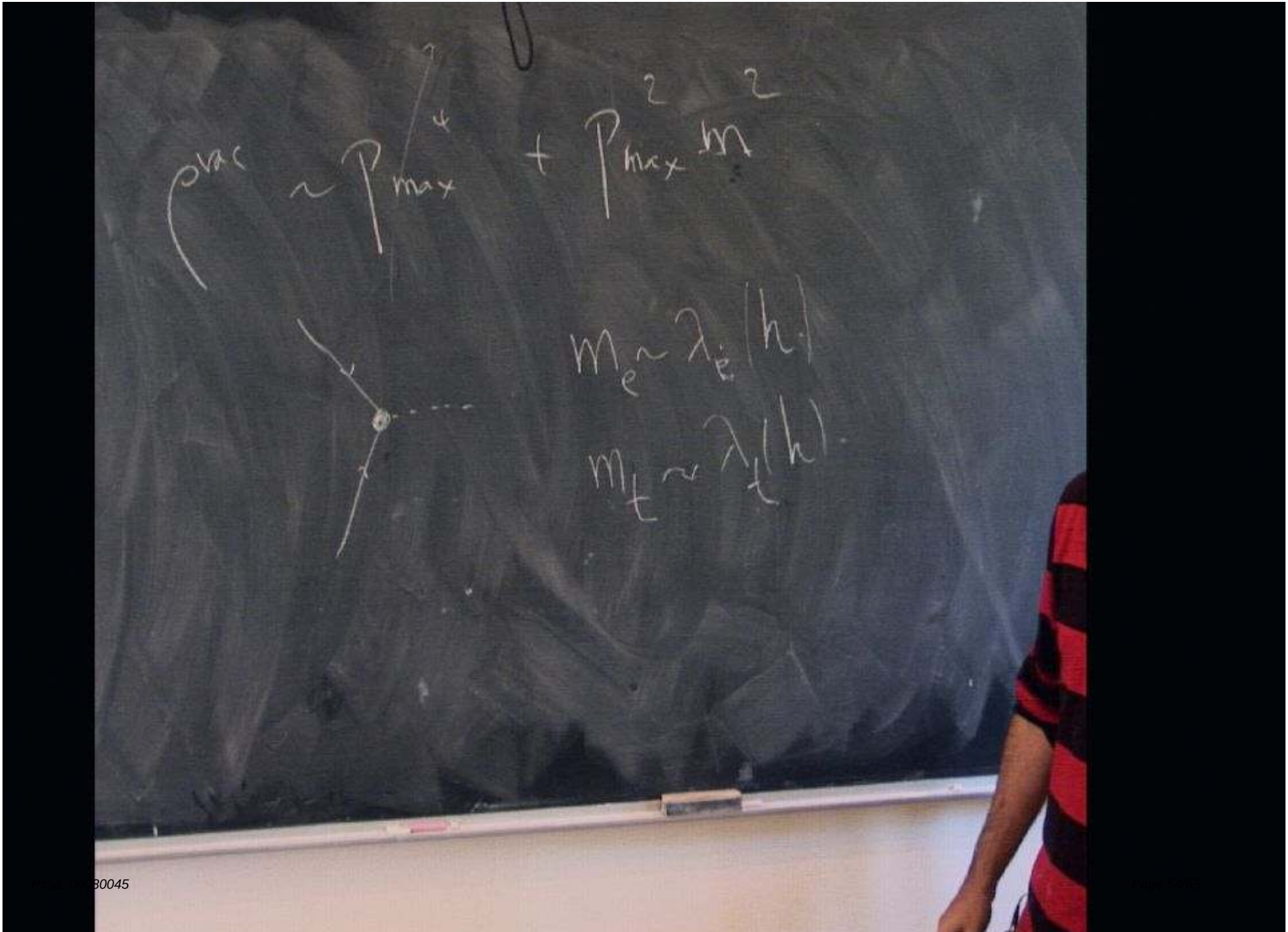
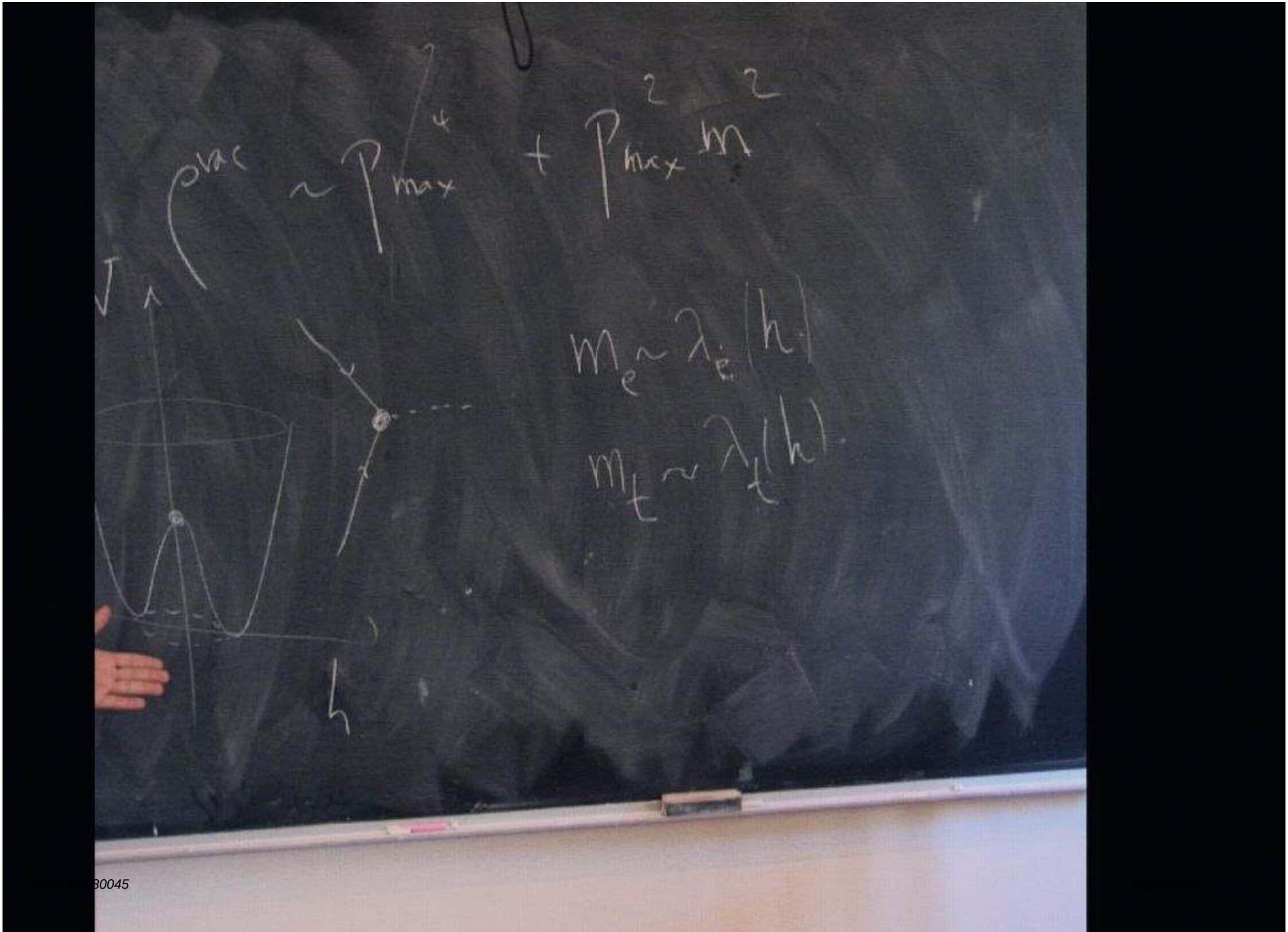
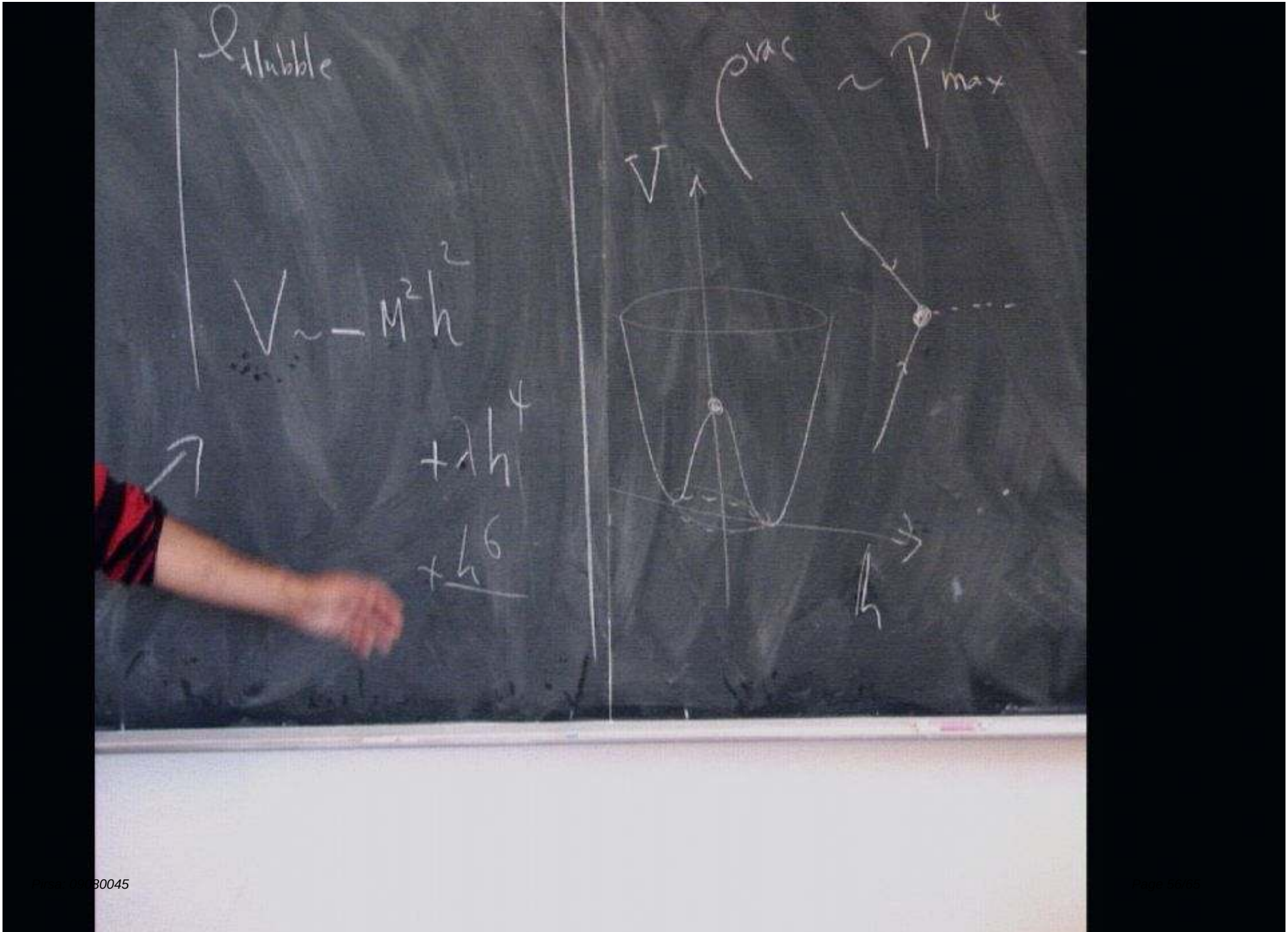
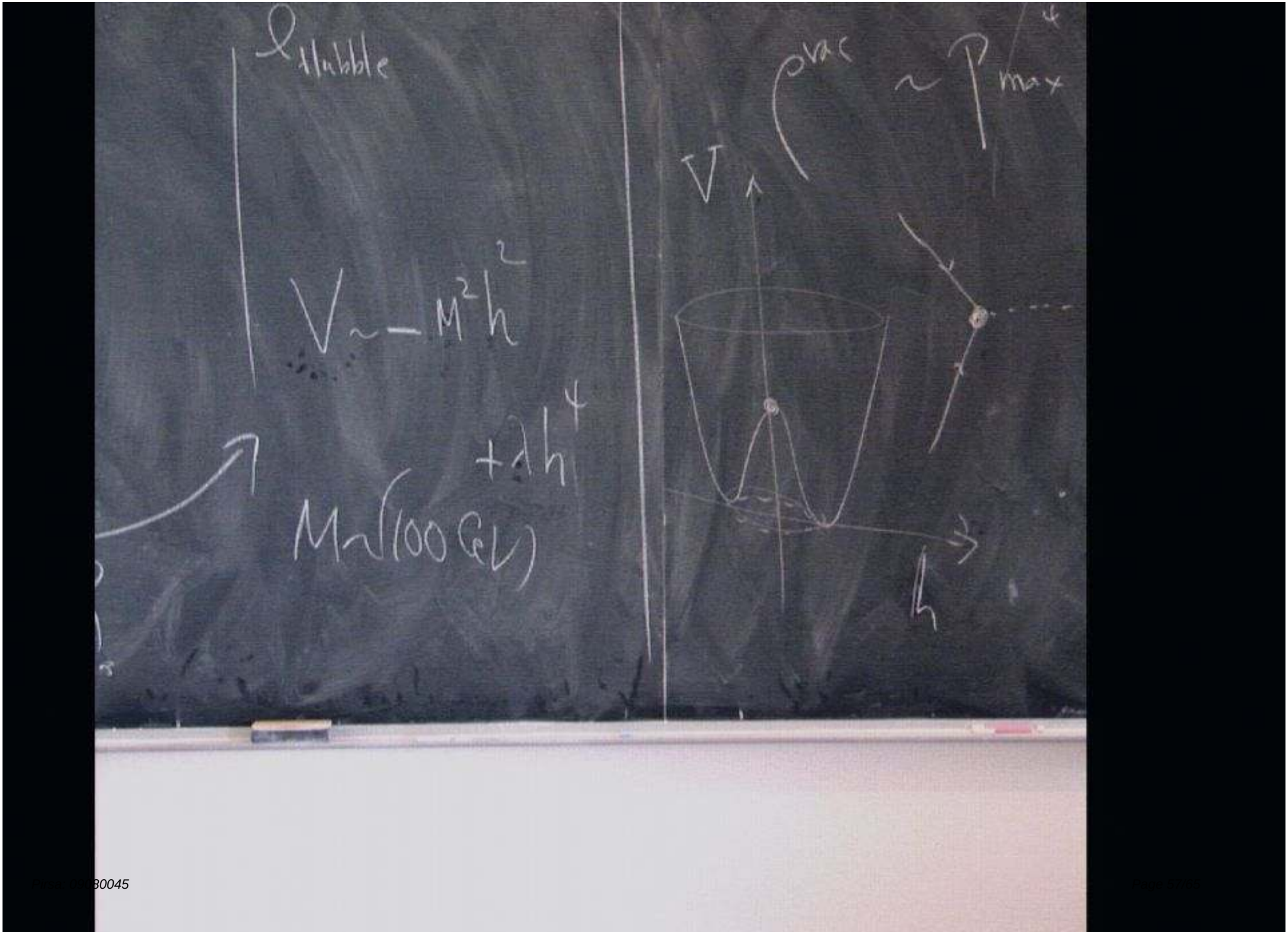

$p^{vac} \sim p_{max}^4 + p_{max}^2 m^2$
$m \sim \lambda \cdot h$


$\rho^{vac} \sim P_{max}^4 + P_{max}^2 m^2$
$m_e \sim \lambda_e \langle h \rangle$
$m_t \sim \lambda_t \langle h \rangle$


$\rho^{vac} \sim \rho_{max}^4 + \rho_{max}^2 m^2$
$m_e \sim \lambda_e \langle h \rangle$
$m_t \sim \lambda_t \langle h \rangle$
V
h


ℓ_{Hubble}
$V \sim -M^2 h^2$
$+\lambda h^4$
$+ h^6$
$\rho_{vac} \sim \rho_{max}$
V
h


ℓ_{Hubble}
$V \sim -M^2 h^2$
$+\lambda h^4$
$M \sim (100\ GeV)$
$\rho_{vac} \sim \rho_{max}$
V
h

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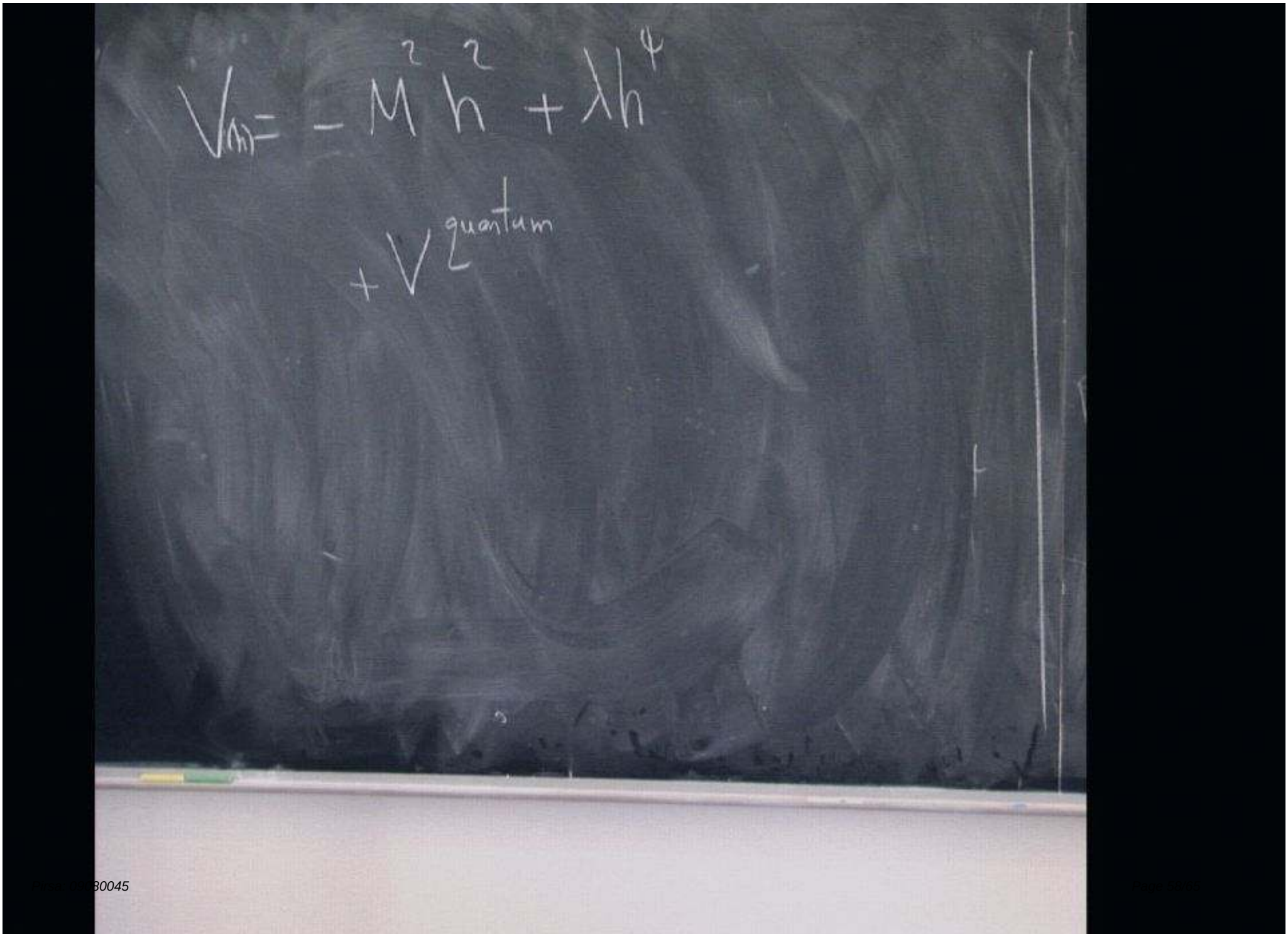
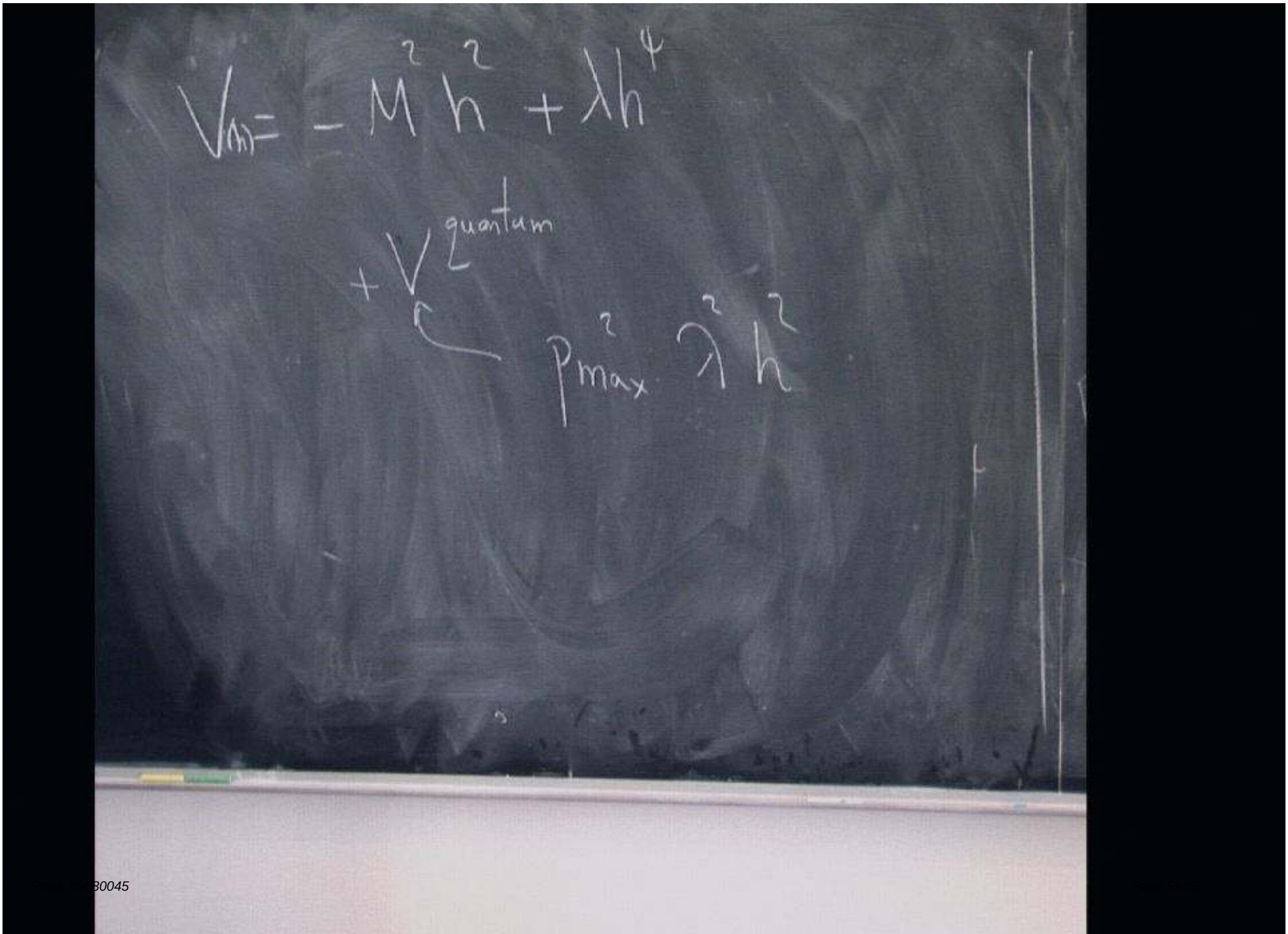
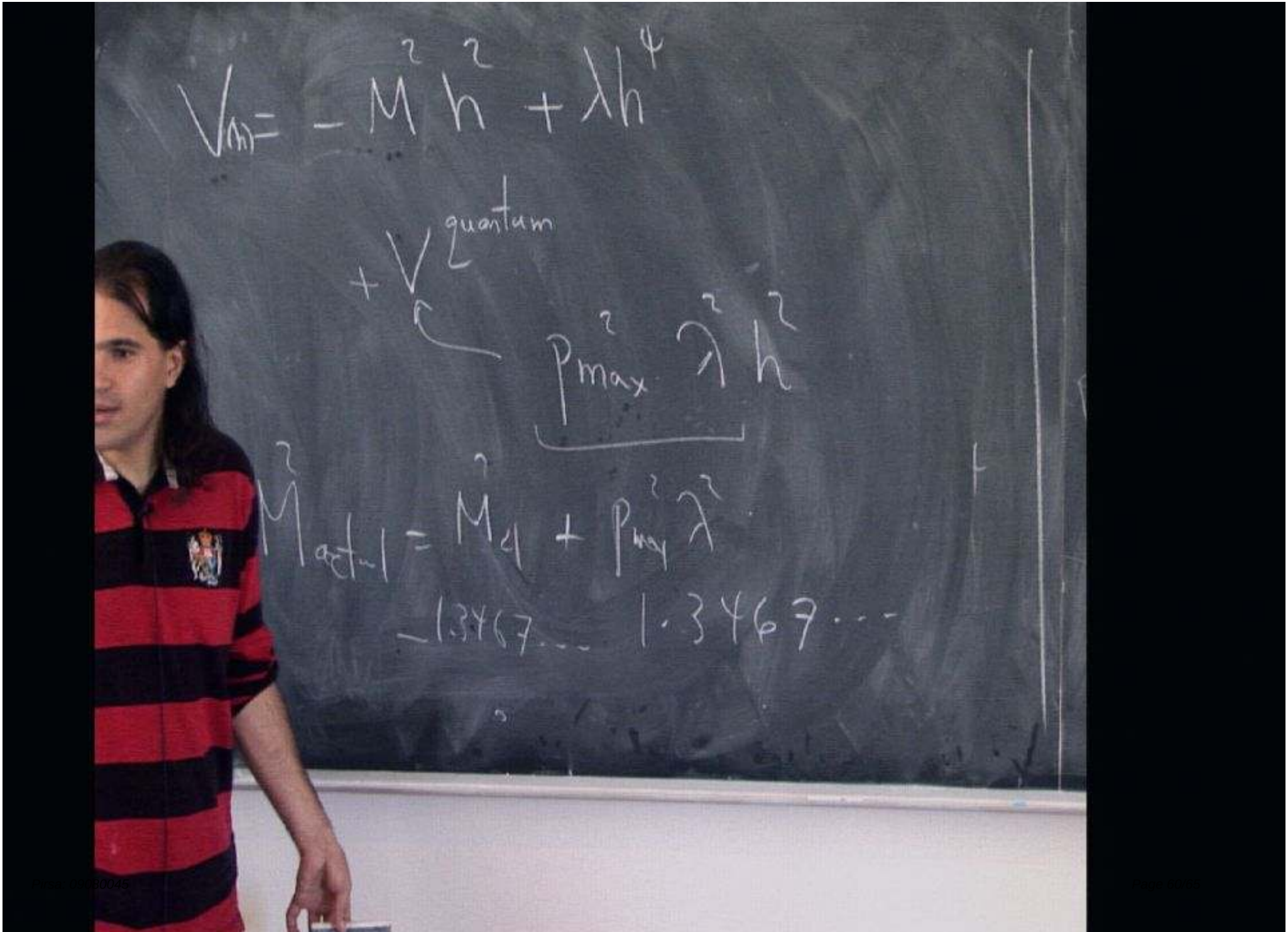
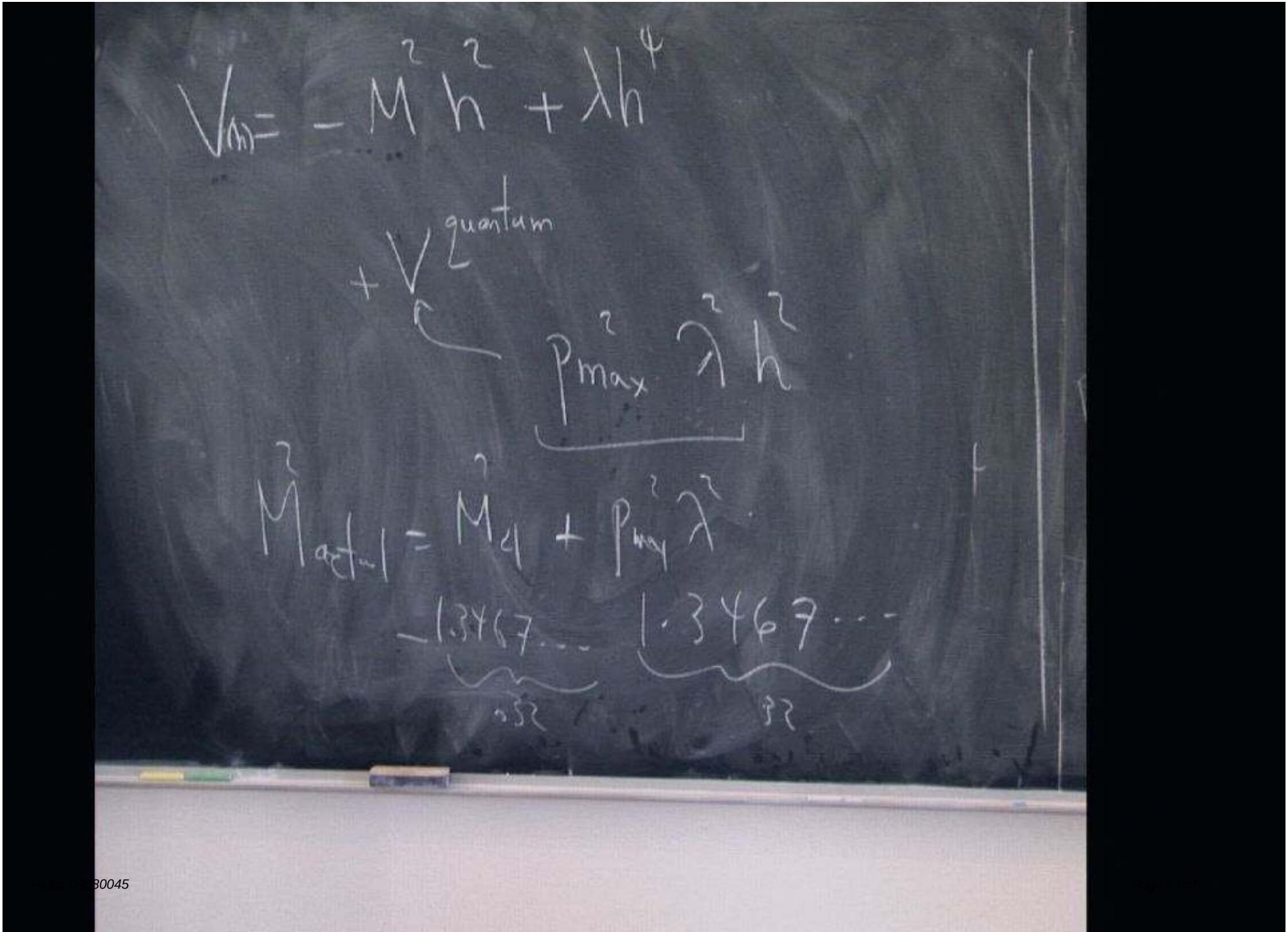
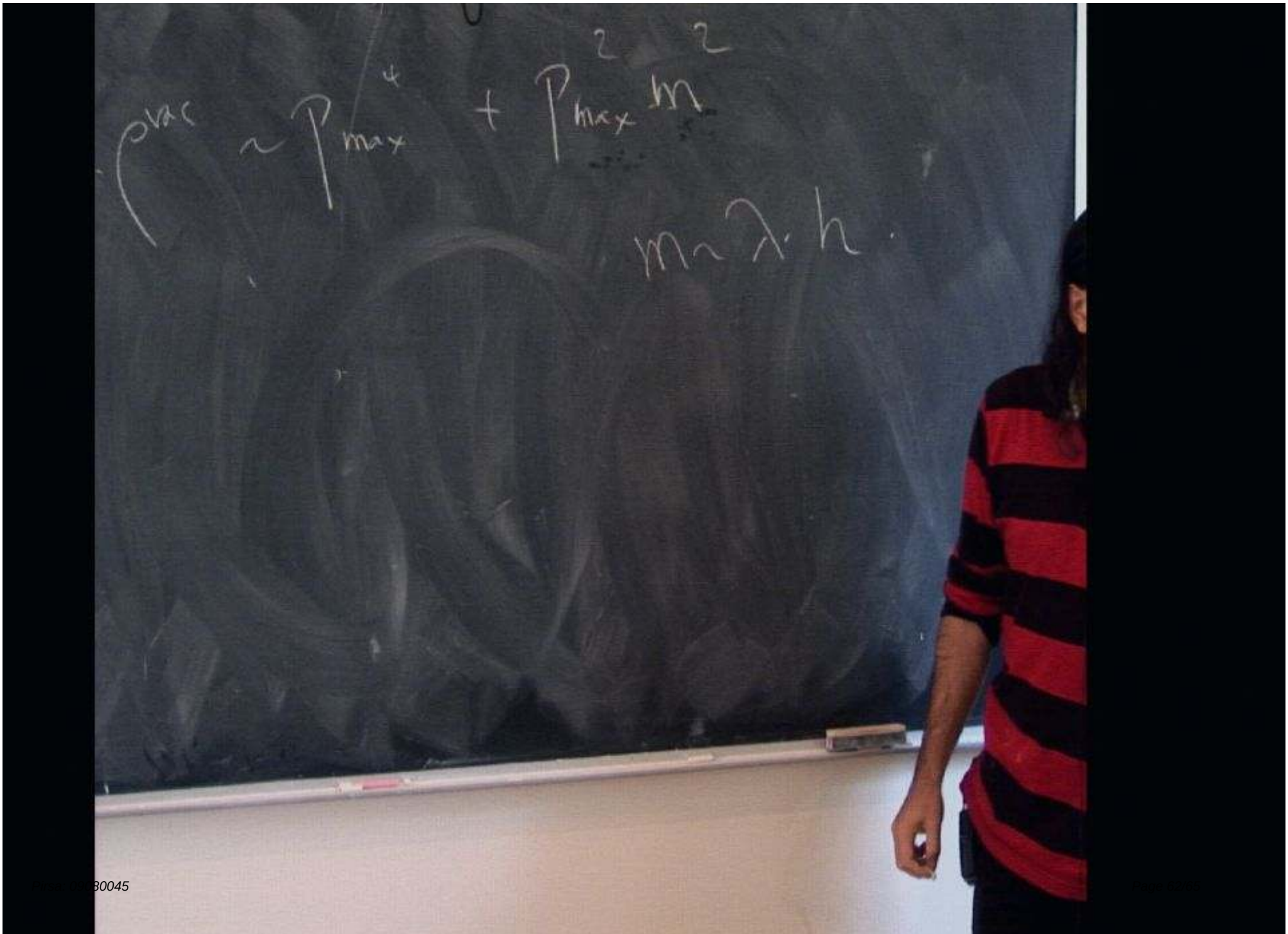
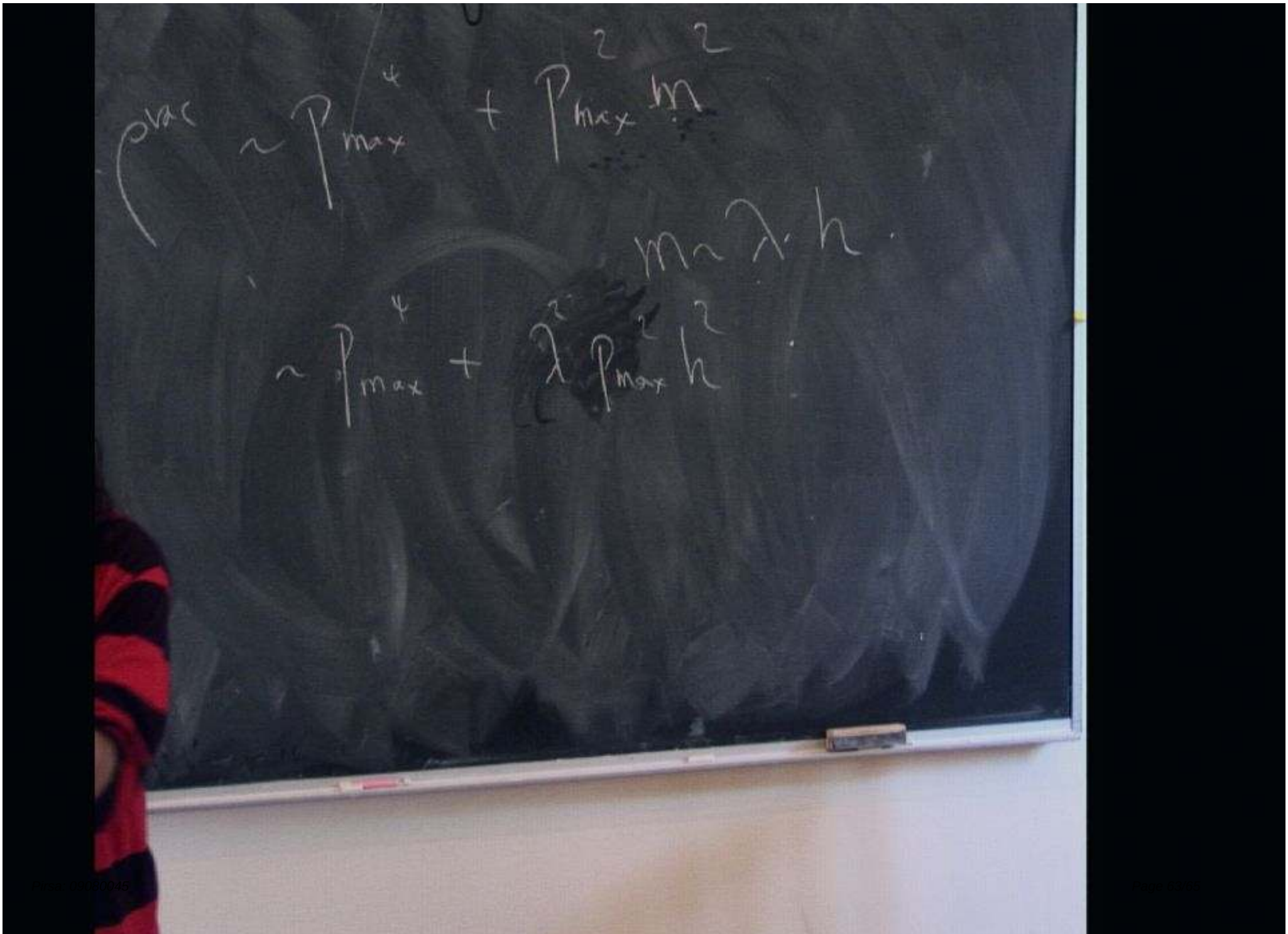

$V_{(h)} = -M^2 h^2 + \lambda h^4$
$+ V^{quantum}$

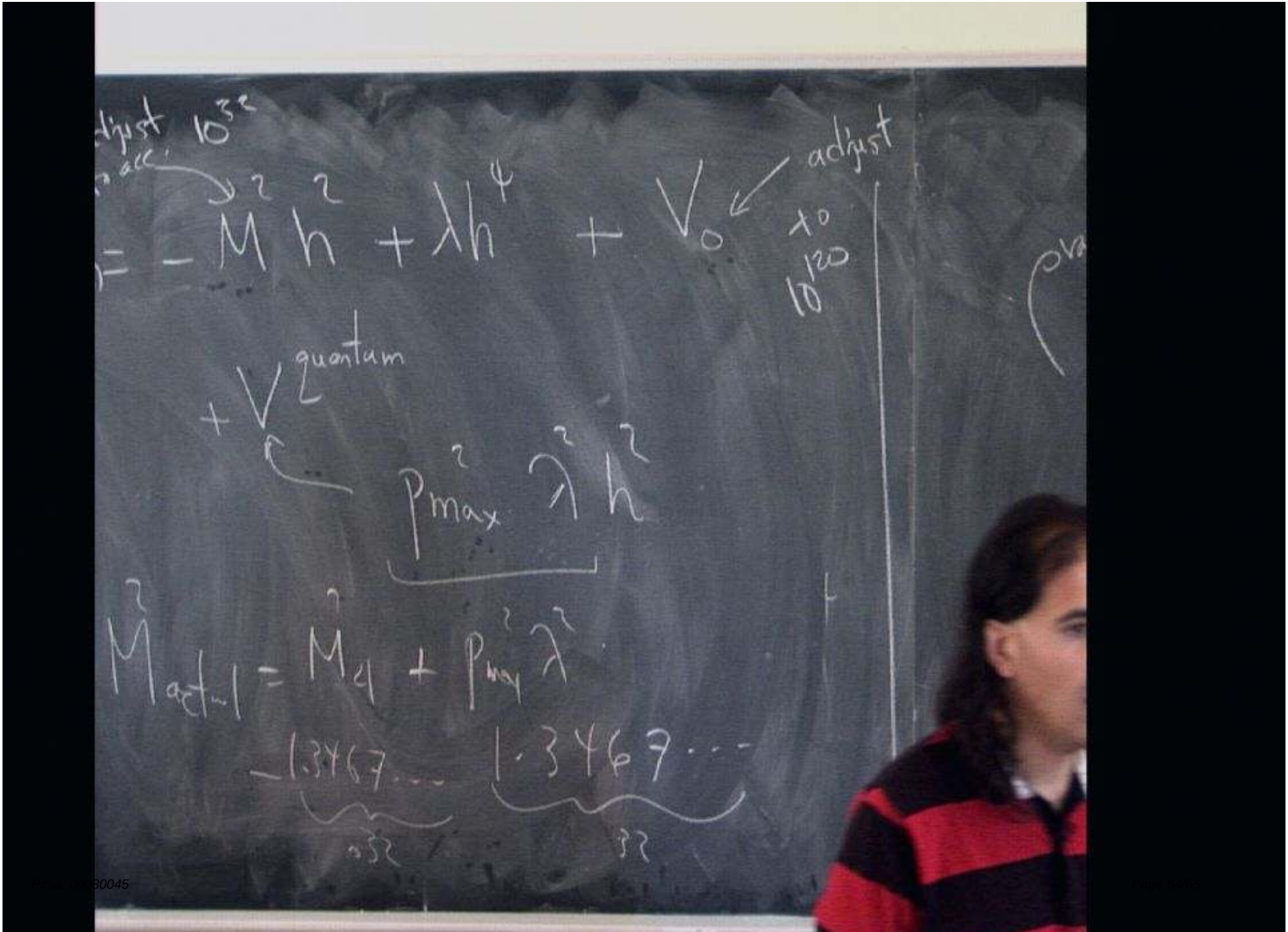

$V_{(h)} = -M^2 h^2 + \lambda h^4$
$+ V^{quantum}$
$p_{max}^2 \lambda^2 h^2$

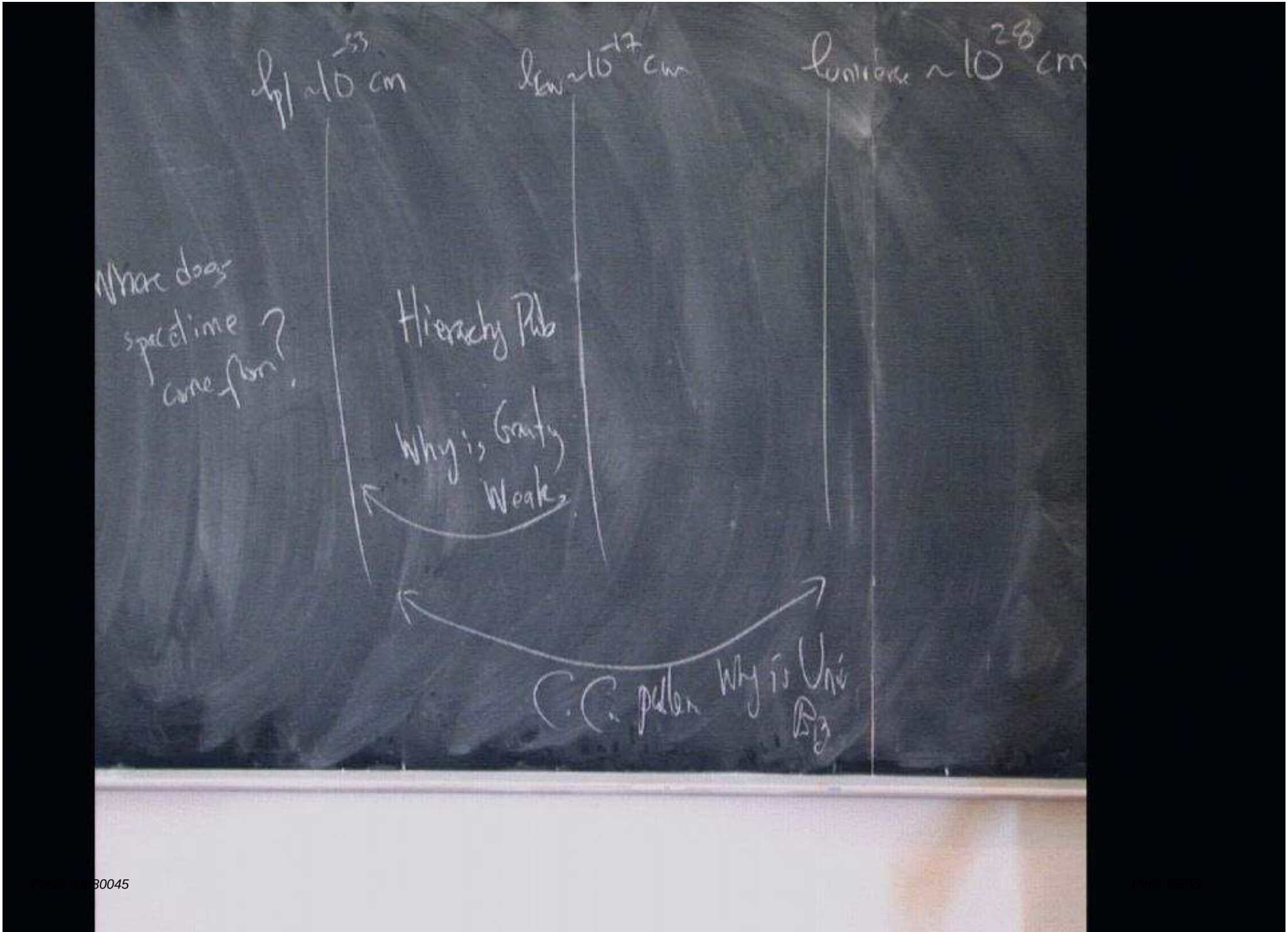

$V_{(h)} = -M^2 h^2 + \lambda h^4$
$+ V_L^{quantum}$
$p_{max}^2 \lambda^2 h^2$
$\hat{M}^2_{actual} = \hat{M}^2_{cl} + p^2_{max} \lambda^2$
$-1.3467\ldots \quad 1.3467\ldots$


$V_{(h)} = -M^2 h^2 + \lambda h^4$
$+ V^{quantum}$
$p_{max}^2 \lambda^2 h^2$
$M^2_{actual} = M_4 + p^2_{max} \lambda^2$
$-1.3467\ldots \quad 1.3467\ldots$


$\rho^{vac} \sim p_{max}^4 + p_{max}^2 m^2$
$m \sim \lambda \cdot h$


$\rho^{vac} \sim \rho_{max}^4 + \rho_{max}^2 m^2$
$m \sim \lambda \cdot h$
$\sim \rho_{max}^4 + \lambda^2 \rho_{max}^2 h^2$


adjust 10^{32}
$= -M^2 h^2 + \lambda h^4 + V_0$
adjust
to
10^{120}
quantum
$+V$
$p_{max}^2 \lambda^2 h^2$
$M^2_{actual} = M^2_{cl} + p^2_{max} \lambda^2$
$-1.3467\ldots$
$1.3467\ldots$
32
32


$l_{pl} \sim 10^{-33}$ cm
$l_{EW} \sim 10^{-17}$ cm
$l_{universe} \sim 10^{28}$ cm
Where does spacetime come from?
Hierarchy Pb
Why is Gravity Weak
C.C. problem
Why is Univ Big