Title: Black hole horizons and the origin of cosmic acceleration

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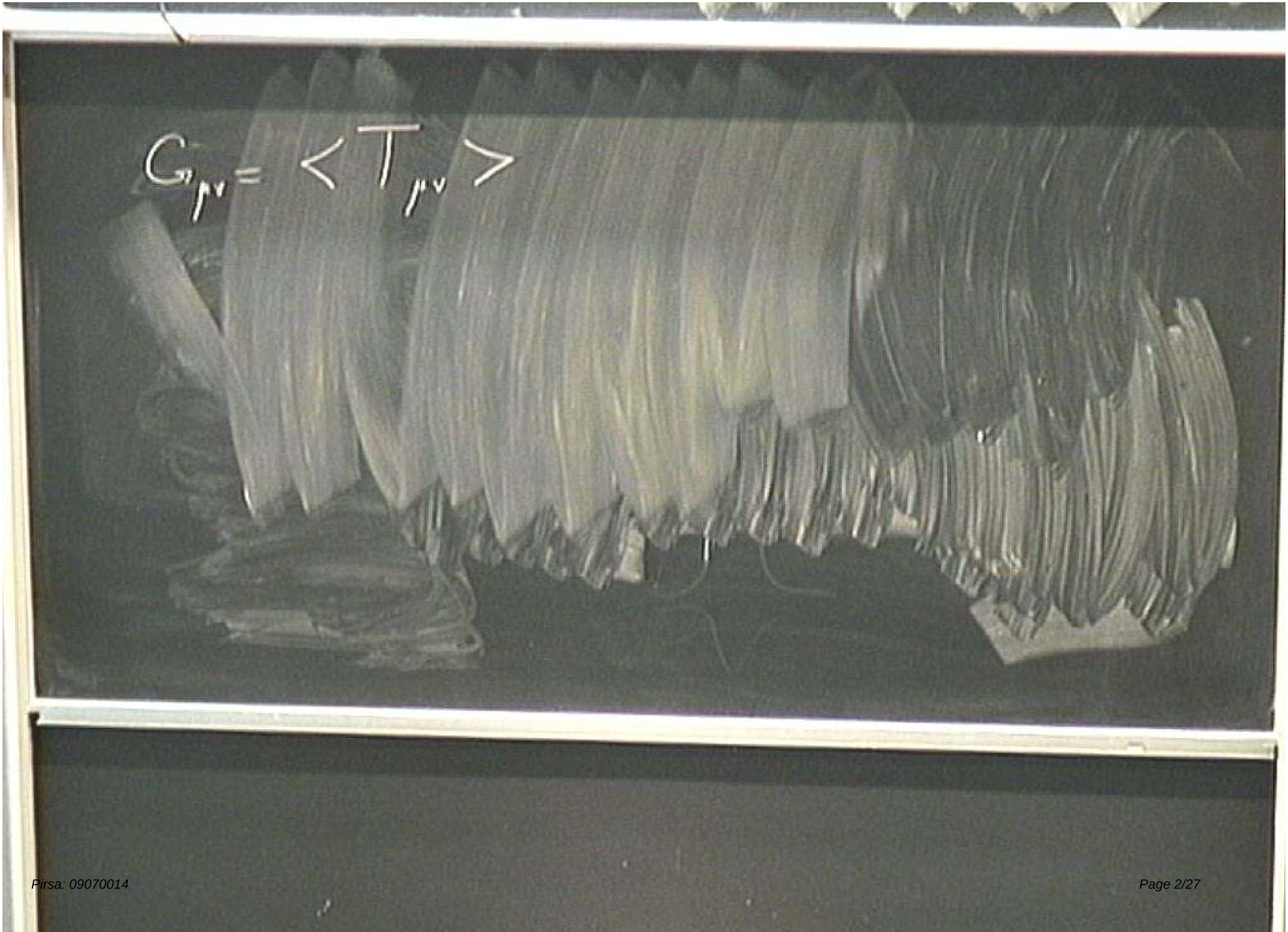
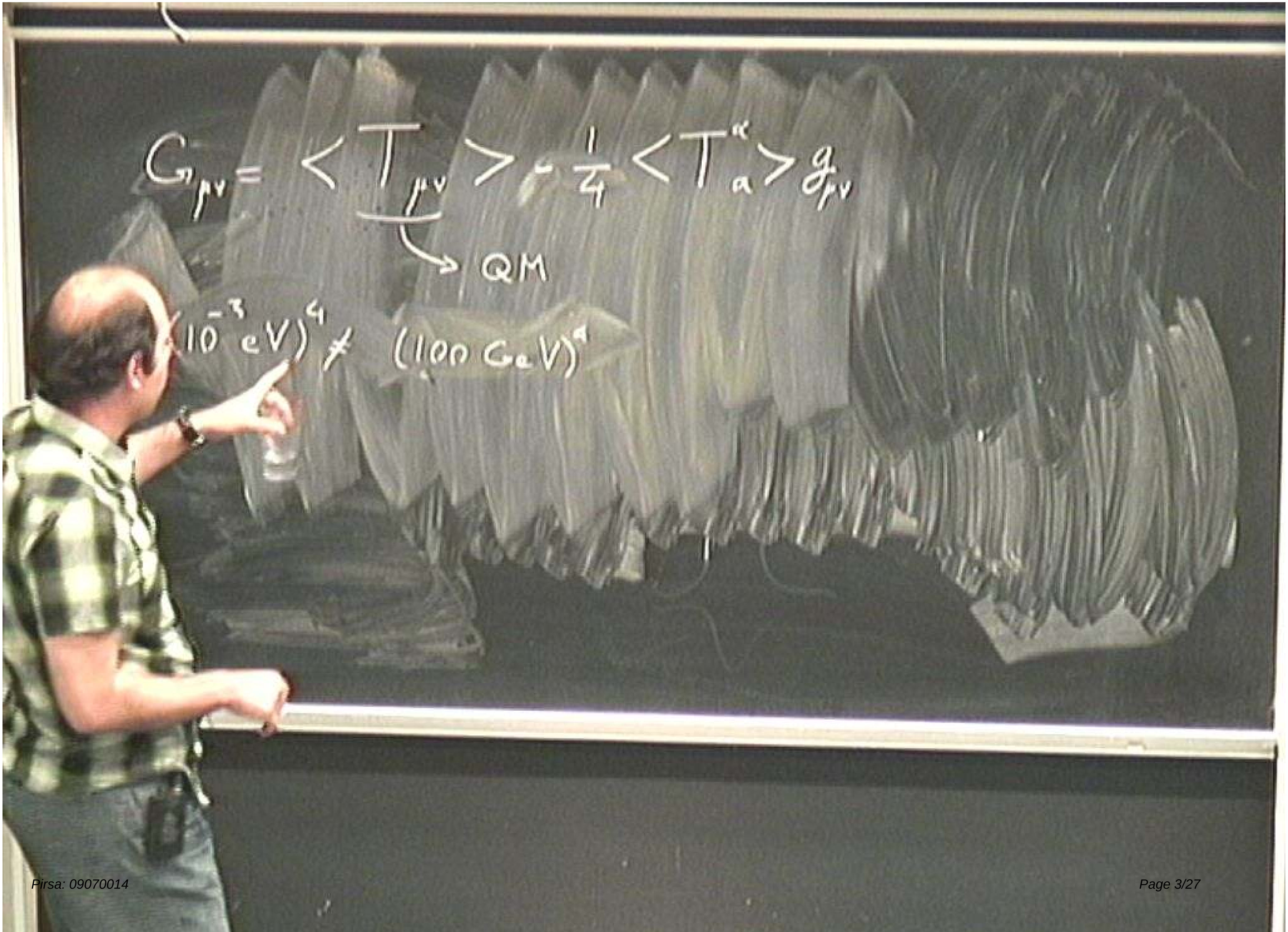
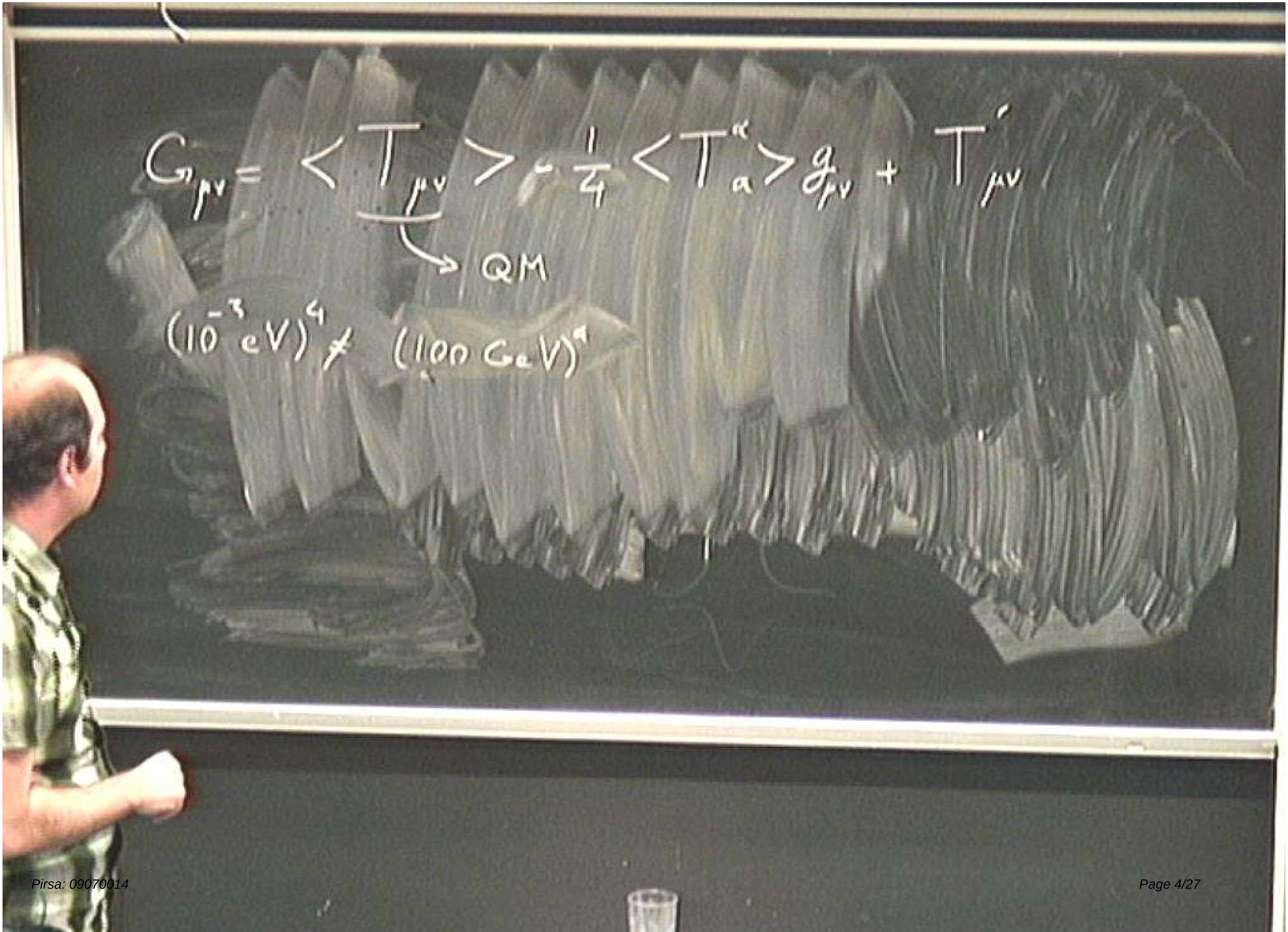
URL: http://pirsa.org/09070014

Abstract: TBA


$G_{\mu\nu} = \langle T_{\mu\nu} \rangle$


$G_{\mu\nu} = \langle T_{\mu\nu} \rangle - \frac{1}{4} \langle T^{\alpha}_{\alpha} \rangle g_{\mu\nu}$
QM
$(10^{-3}\,\mathrm{eV})^4 \neq (100\,\mathrm{GeV})^4$



$G_{\mu\nu} = \langle T_{\mu\nu} \rangle - \frac{1}{4} \langle T^{\alpha}_{\alpha} \rangle g_{\mu\nu} + T'_{\mu\nu}$
$\rightarrow$ QM
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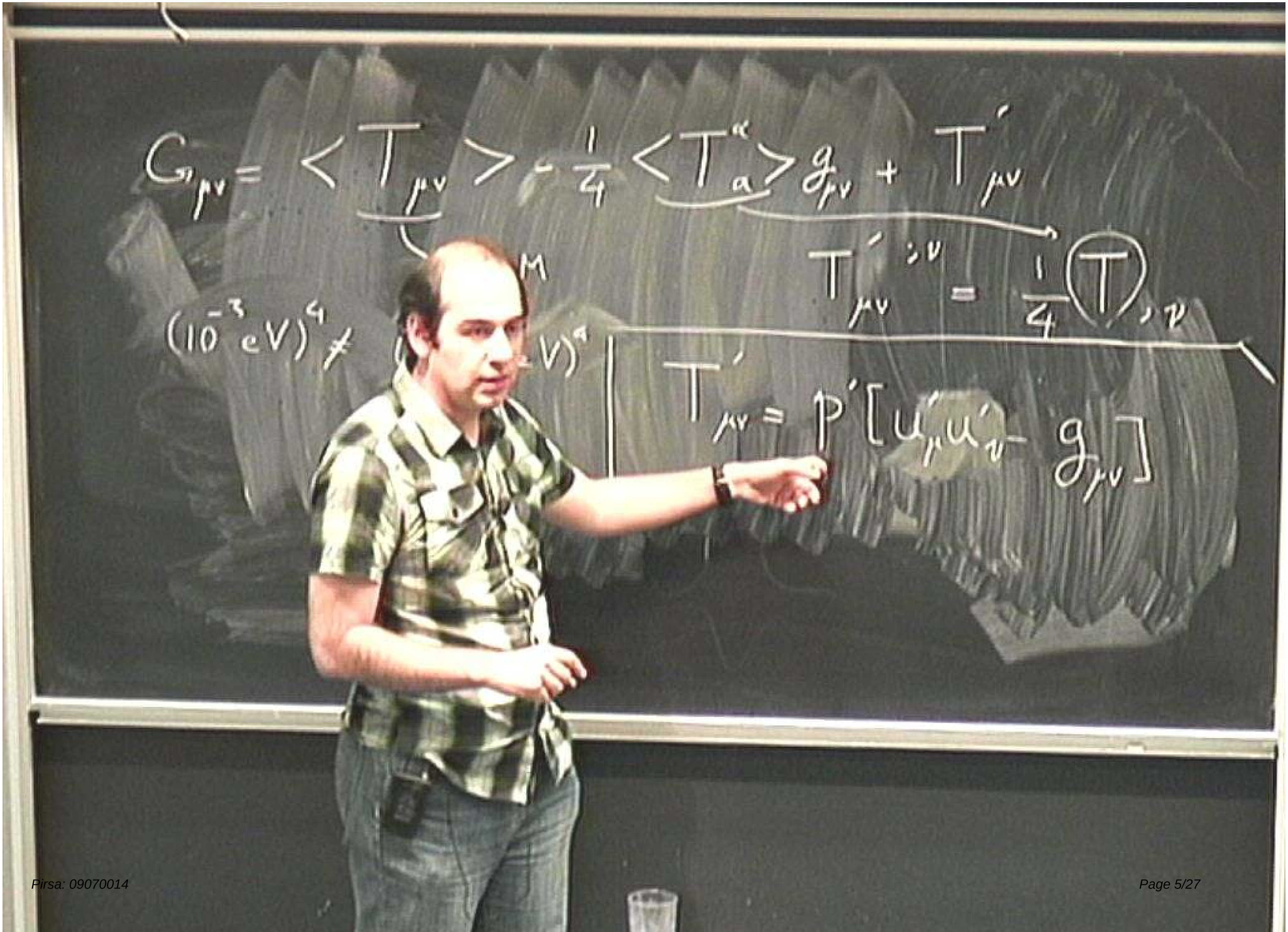
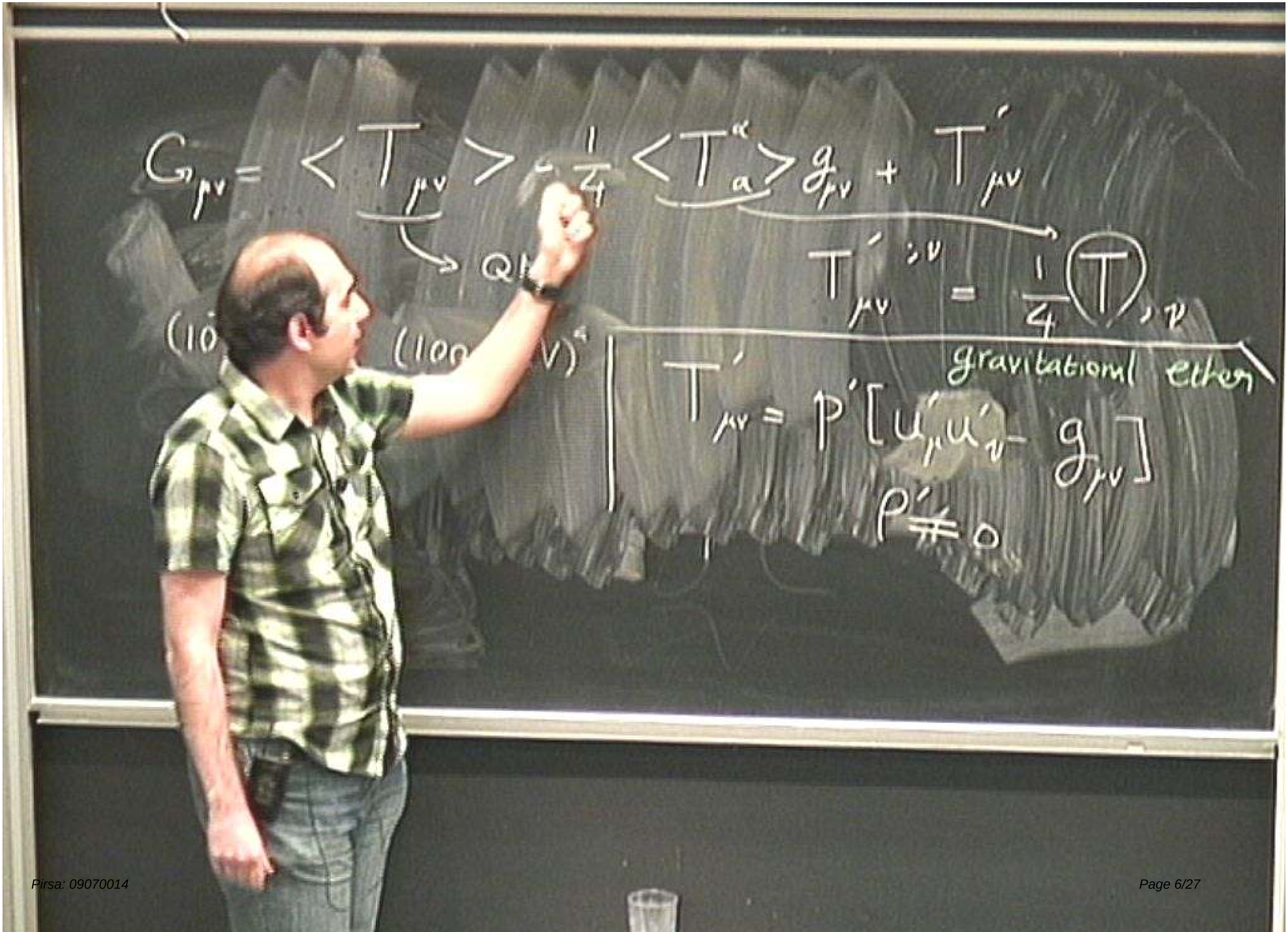
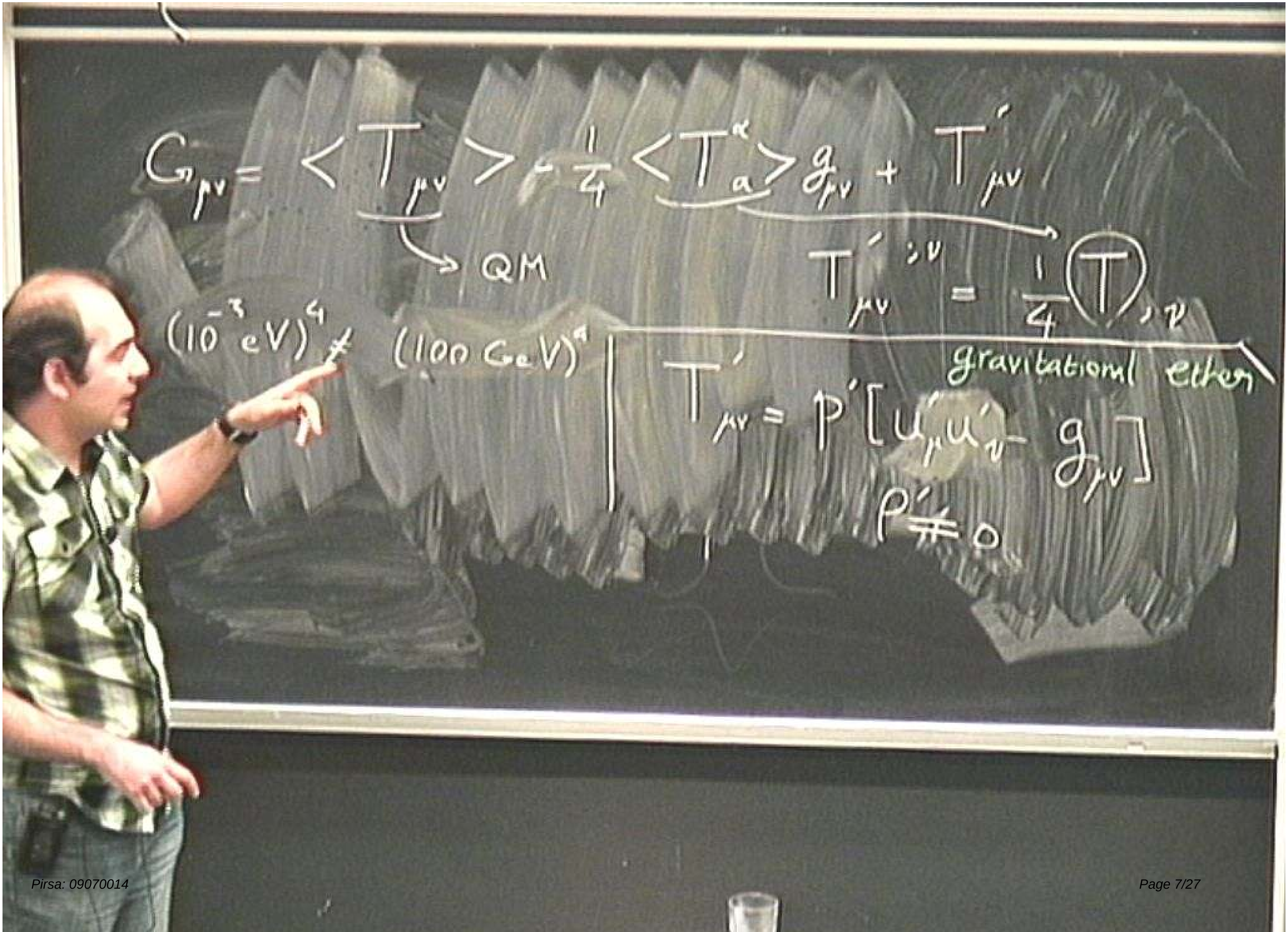

$G_{\mu\nu} = \langle T_{\mu\nu} \rangle - \frac{1}{4} \langle T^{\alpha}_{a} \rangle g_{\mu\nu} + T'_{\mu\nu}$
M
$T'^{\,;\nu}_{\mu\nu} = \frac{1}{4} T_{,\nu}$
$(10^{-3}\,eV)^4 \neq$
$V)^4$
$T'_{\mu\nu} = p'[u'_\mu u'_\nu - g_{\mu\nu}]$


$G_{\mu\nu} = \langle T_{\mu\nu} \rangle - \frac{1}{4} \langle T^{\alpha}_{\alpha} \rangle g_{\mu\nu} + T'_{\mu\nu}$
$T'_{\mu\nu}{}^{;\nu} = \frac{1}{4} T_{,\nu}$
gravitational ether
$T'_{\mu\nu} = \rho' [u'_{\mu} u'_{\nu} - g_{\mu\nu}]$
$\rho' \neq 0$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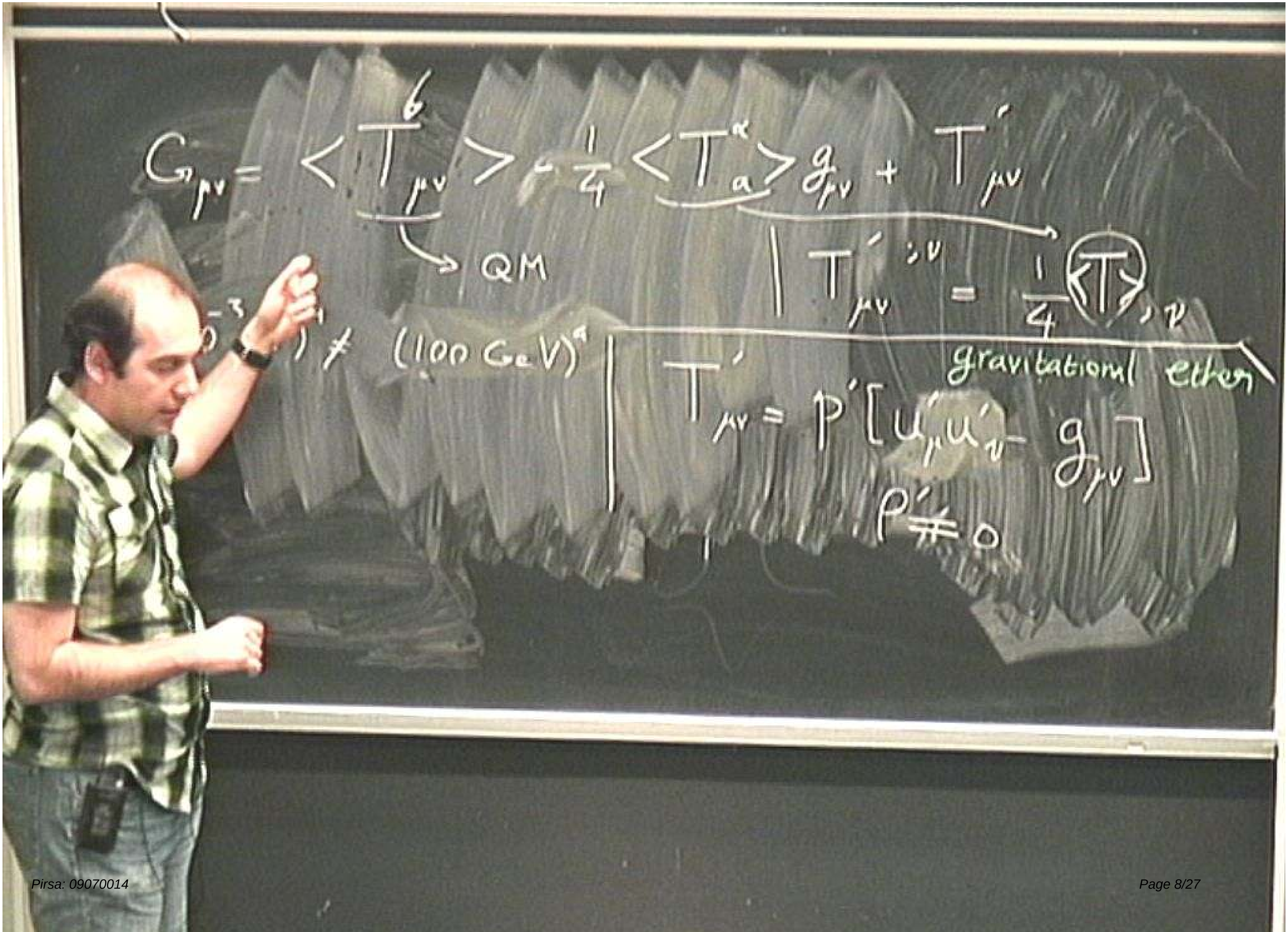

$G_{\mu\nu} = \langle T_{\mu\nu} \rangle - \frac{1}{4} \langle T^{\alpha}_{\alpha} \rangle g_{\mu\nu} + T'_{\mu\nu}$
QM
$T'^{\;;\nu}_{\mu\nu} = \frac{1}{4} \langle T \rangle_{,\nu}$
$) \neq (100\ \mathrm{GeV})^4$
gravitational ether
$T'_{\mu\nu} = \rho' [u'_\mu u'_\nu - g_{\mu\nu}]$
$\rho' \neq 0$

$$G_{\mu\nu} = \underbrace{\langle T^{b}_{\mu\nu} \rangle}_{\to \text{QM}} - \frac{1}{4} \langle T^{\alpha}_{\alpha} \rangle g_{\mu\nu} + T'_{\mu\nu}$$

$$T'^{\;;\nu}_{\mu\nu} = \frac{1}{4} \langle T \rangle_{,\nu}$$

$$(10^{-3}\,\mathrm{eV})^4 \neq (100\,\mathrm{GeV})^4$$

gravitational ether

$$T'_{\mu\nu} = \rho' [u'_{\mu} u'_{\nu} - g_{\mu\nu}]$$

$$\rho' \neq 0$$

$$G_{\mu\nu} = \langle T^{b}_{\mu\nu} \rangle - \frac{1}{4} \langle T^{\alpha}_{\alpha} \rangle g_{\mu\nu} + T'_{\mu\nu}$$

$\langle T^{b}_{\mu\nu} \rangle \rightarrow$ QM

$$T'^{\;;\nu}_{\mu\nu} = \frac{1}{4} \langle T \rangle_{,\nu}$$

$$(10^{-3}\,eV)^4 \neq (100\,GeV)^4$$

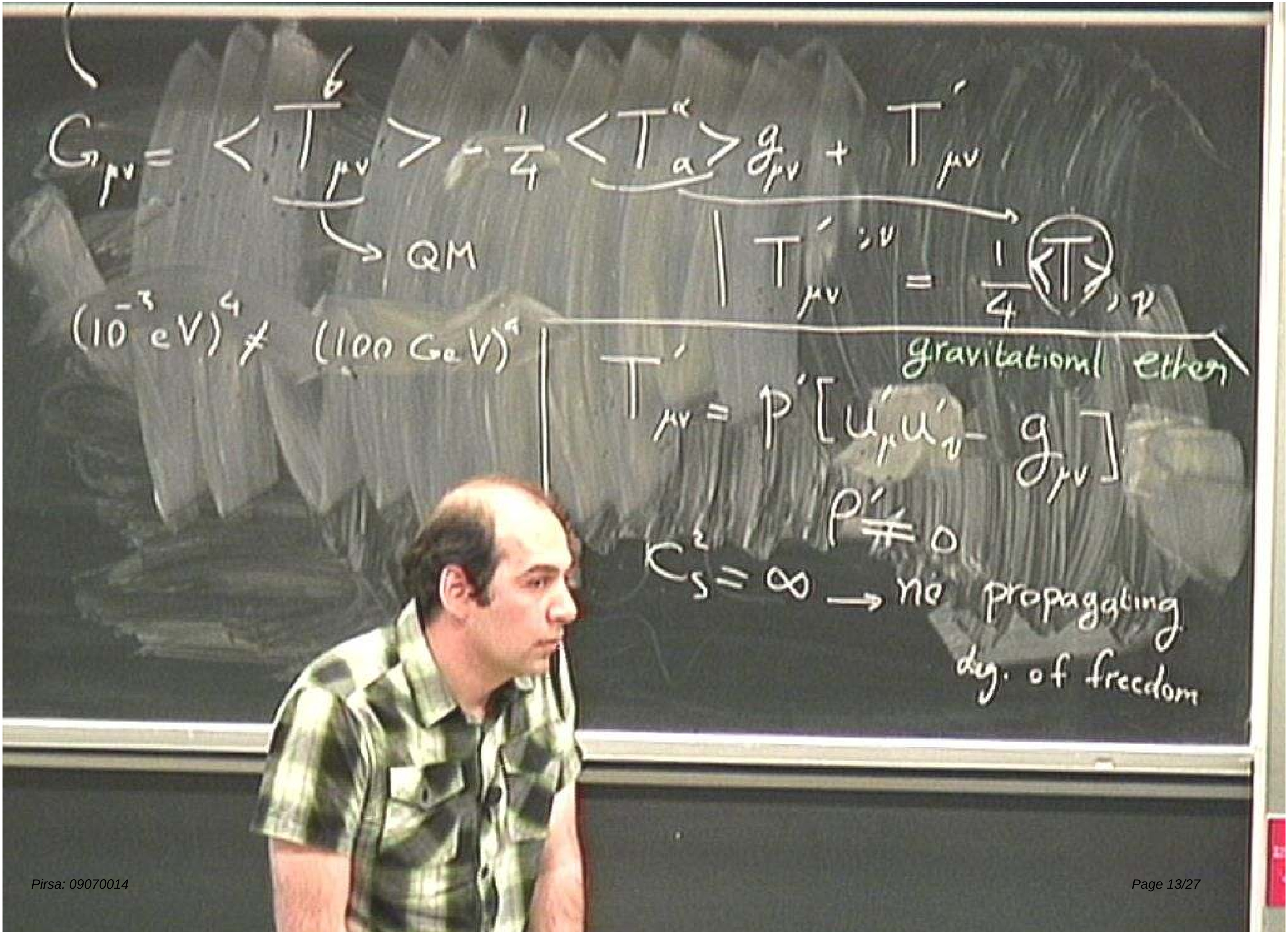
gravitational ether

$$T'_{\mu\nu} = \rho' [u'_\mu u'_\nu - g_{\mu\nu}] + \Lambda g_{\mu\nu}$$

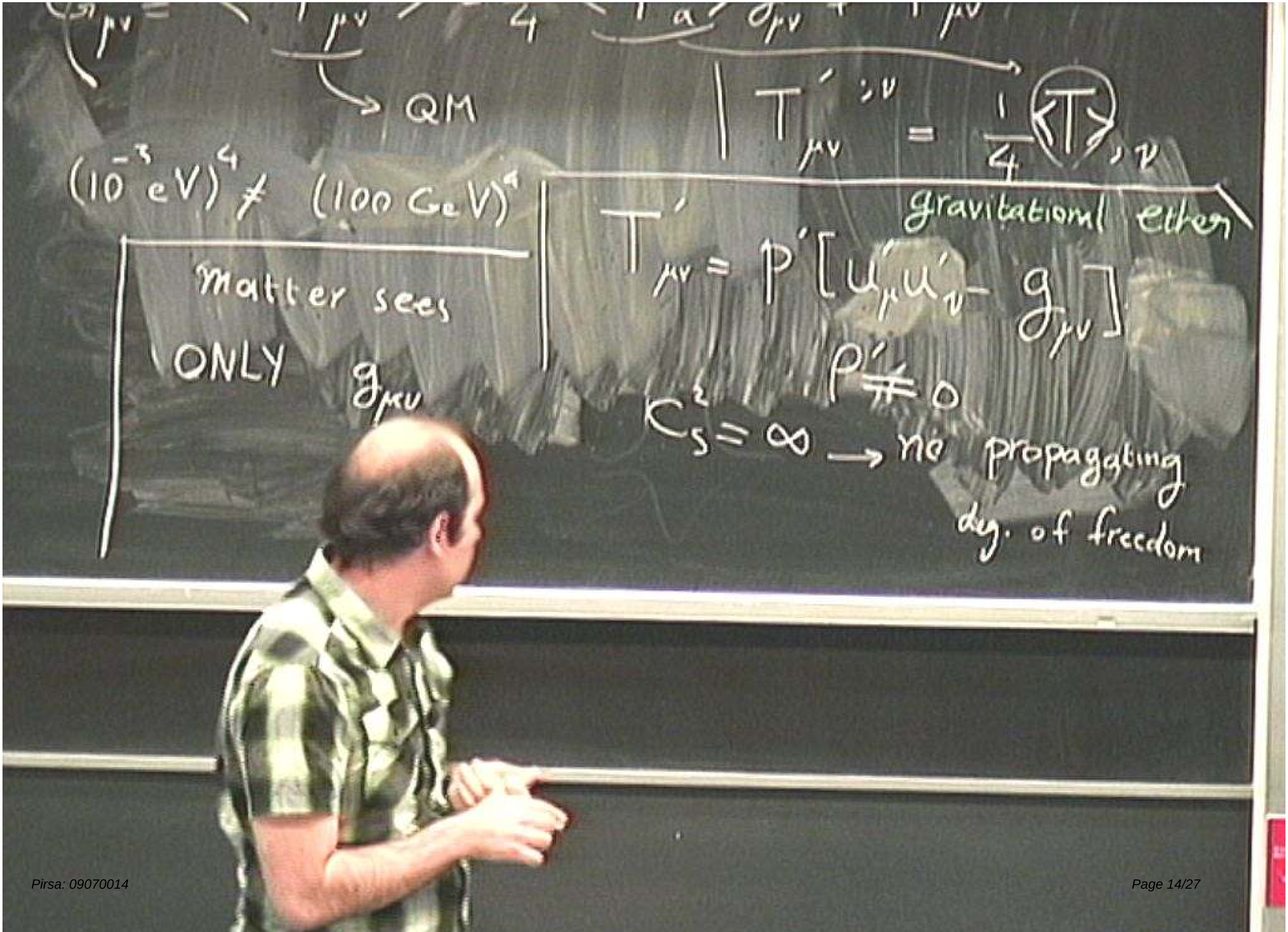
$$\rho' \neq 0$$

$$C_{\mu\nu} = T_{\mu\nu} - \frac{1}{4} T g_{\mu\nu} + P' (u'_\mu u'_\nu - g_{\mu\nu})$$

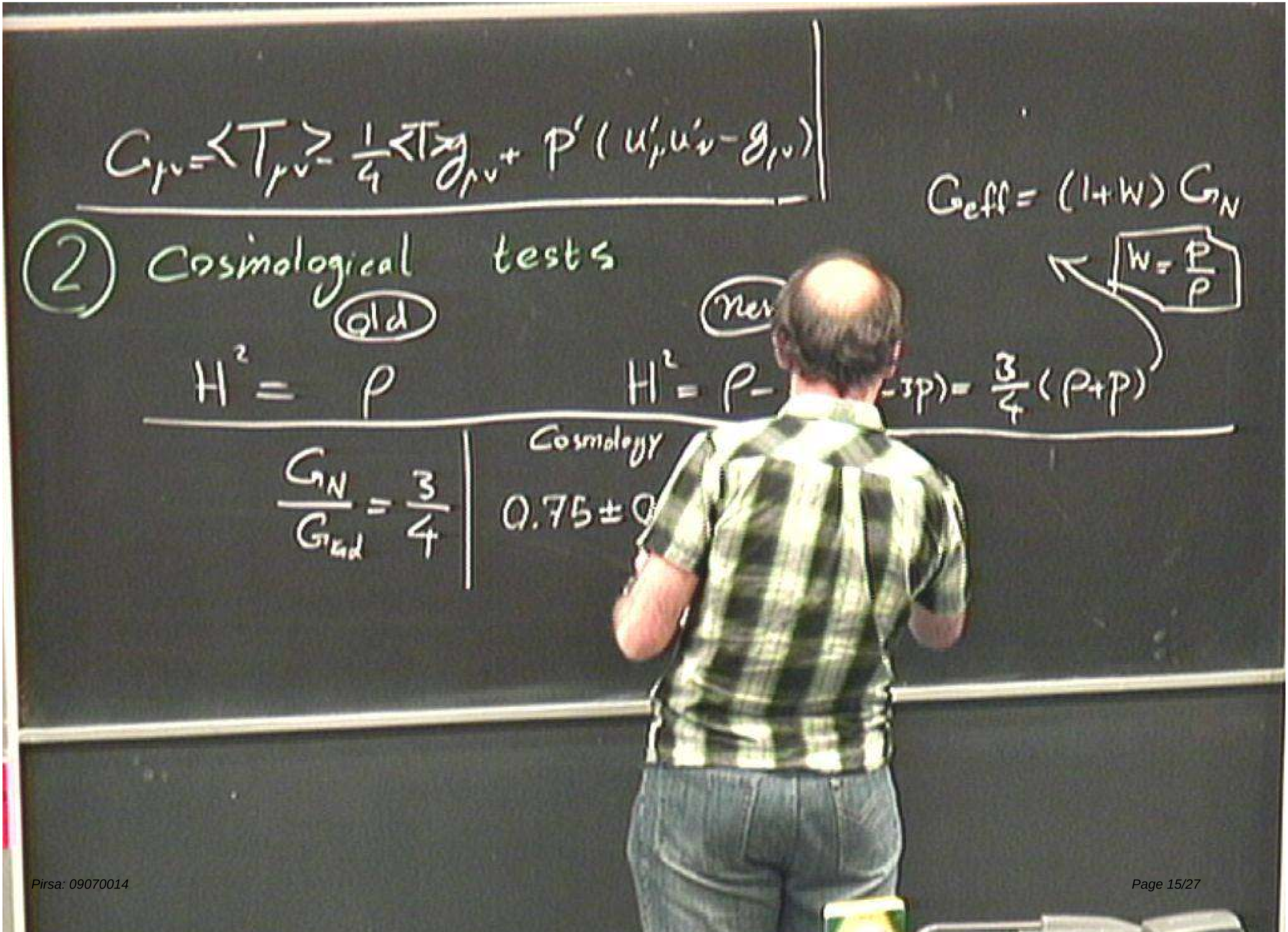
$$G_{\mu\nu} = \langle T_{\mu\nu} \rangle - \frac{1}{4} \langle T \rangle g_{\mu\nu} + p' (u'_\mu u'_\nu - g_{\mu\nu})$$



$G_{\mu\nu} = \langle T_{\mu\nu} \rangle - \frac{1}{4} \langle T^{\alpha}_{\alpha} \rangle g_{\mu\nu} + T'_{\mu\nu}$
$\rightarrow$ QM
$T'^{;\nu}_{\mu\nu} = \frac{1}{4} \langle T \rangle_{,\nu}$
$(10^{-3}\,eV)^4 \neq (100\,GeV)^4$
gravitational ether
$T'_{\mu\nu} = \rho' [u'_\mu u'_\nu - g_{\mu\nu}]$
$\rho' \neq 0$
$c_s^2 = \infty \rightarrow$ no propagating deg. of freedom



$\to$ QM
$T'^{\;;\nu}_{\mu\nu} = \frac{1}{4}\langle T\rangle_{,\nu}$
$(10^{-3}\,eV)^4 \neq (100\,GeV)^4$
gravitational ether
$T'_{\mu\nu} = \rho'[u'_\mu u'_\nu - g_{\mu\nu}]$
matter sees
ONLY $g_{\mu\nu}$
$\rho' \neq 0$
$c_s^2 = \infty \to$ no propagating deg. of freedom


Gμν = <Tμν> - 1/4 <T> gμν + p' (u'μ u'ν - gμν)
Geff = (1+w) GN
w = p/ρ
2 Cosmological tests
old
new
H² = ρ
H² = ρ-
-3p) = 3/4 (ρ+p)
Cosmology
GN/Gold = 3/4
0.75±

$$G_{\mu\nu} = \langle T_{\mu\nu} \rangle - \frac{1}{4}\langle T \rangle g_{\mu\nu} + p'(u'_\mu u'_\nu - g_{\mu\nu})$$

$$G_{eff} = (1+w)\, G_N$$

$$\boxed{w = \frac{p}{\rho}}$$

(2) Cosmological tests

old

$$H^2 = \rho$$

new

$$H^2 = \rho - \frac{1}{4}(\rho - 3p) = \frac{3}{4}(\rho + p)$$

	Cosmology	BBN ^4He	^7Li
$\frac{G_N}{G_{cd}} = \frac{3}{4}$	0.75 ± 0.07 WMAP5, SDSS Ly-α	0.97 ± 0.09	<0.8

Inflation is almost untouched

$$V(\varphi) = \frac{1}{2} m^2 \varphi^2 \ , \qquad \zeta \sim \frac{H}{M_p \cancel{\epsilon}}$$

(3) precision tests.

Inflation is almost untouched

$$V(\varphi) = \frac{1}{2} m^2 \varphi^2 \,, \qquad \zeta \sim \frac{H}{M_p \cancel{\epsilon}}$$

③ precision tests. $\qquad W = \text{const.}$

$$G.R \qquad G_{eff} = (1+W)\, G_N$$

Inflation is almost untouched

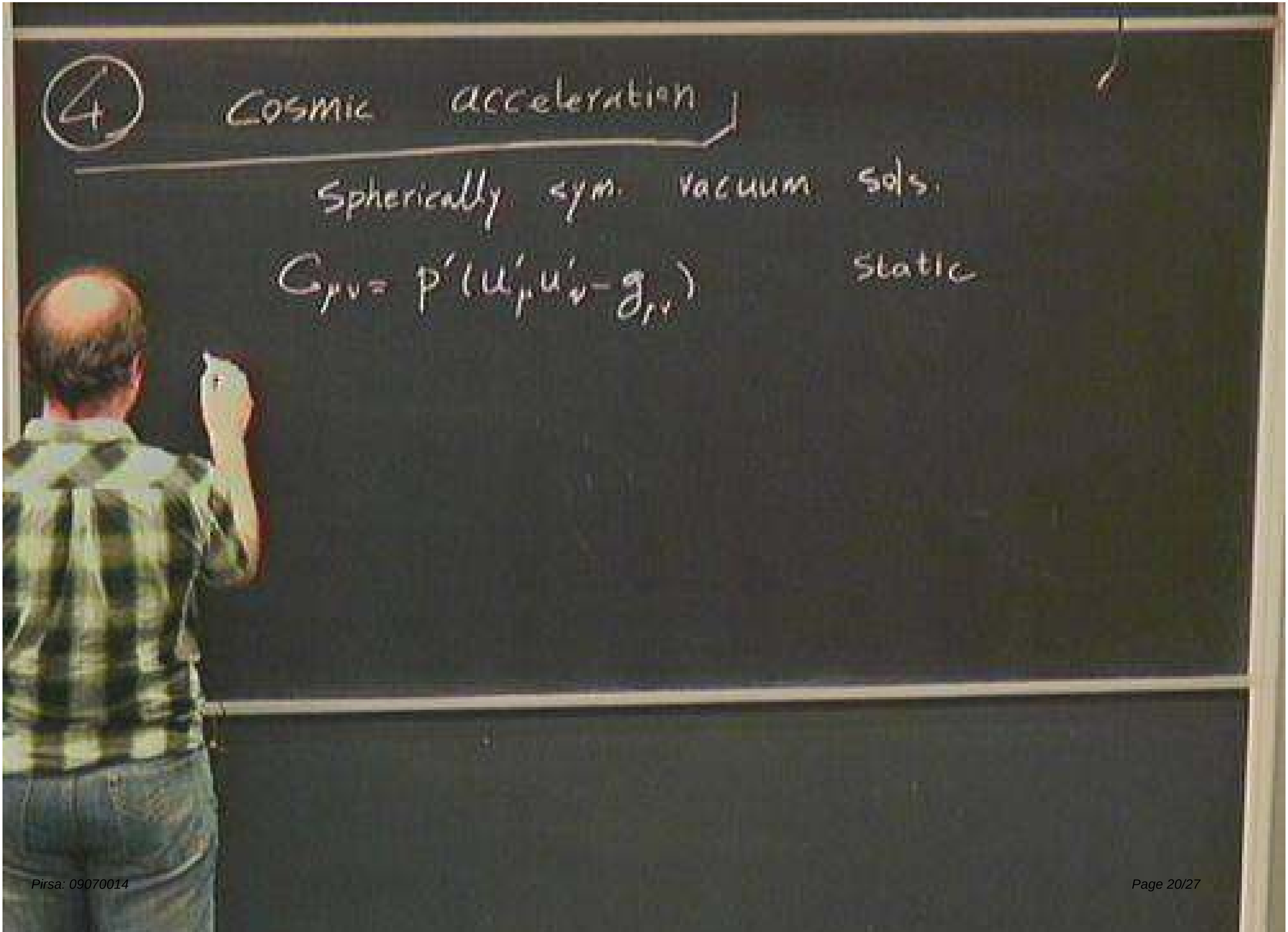
$V(\varphi) = \frac{1}{2} m^2 \varphi^2$, $\zeta \sim \frac{H}{M_p \cancel{\epsilon}}$

③ precision tests. $W = \text{const.}$

G.R . $G_{eff} = (1+W) G_N$

⊗ rotation : gravito magnetic effect

$\boxed{\text{Gravity Probe B}}$


4
Cosmic acceleration
Spherically sym. vacuum sols.
$G_{\mu\nu} = p'(u'_\mu u'_\nu - g_{\mu\nu})$
static

(4) Cosmic acceleration

Spherically sym. vacuum sols.

$$G_{\mu\nu} = p'(u'_\mu u'_\nu - g_{\mu\nu})$$ Static

$$ds^2 = e^{2\phi} dt^2 - \left(1 - \frac{2m}{r}\right)^{-1} dr^2 - r^2 d\Omega^2$$

$$e^{\phi} = \sqrt{1 - \frac{2m}{r}} \left(1 + 4\pi p_0 f(r)\right) \quad \boxed{p' = p_0 e^{-\phi}} \rightarrow \text{hydro. equil.}$$

$$f(r) = \begin{cases} \frac{r^2}{2} & r \gg 2m \\ -\frac{8\sqrt{2}\, m^{5/2}}{\sqrt{r - 2m}} & r - 2m \ll 2m \end{cases}$$

④ Cosmic acceleration

Spherically sym. vacuum sols.

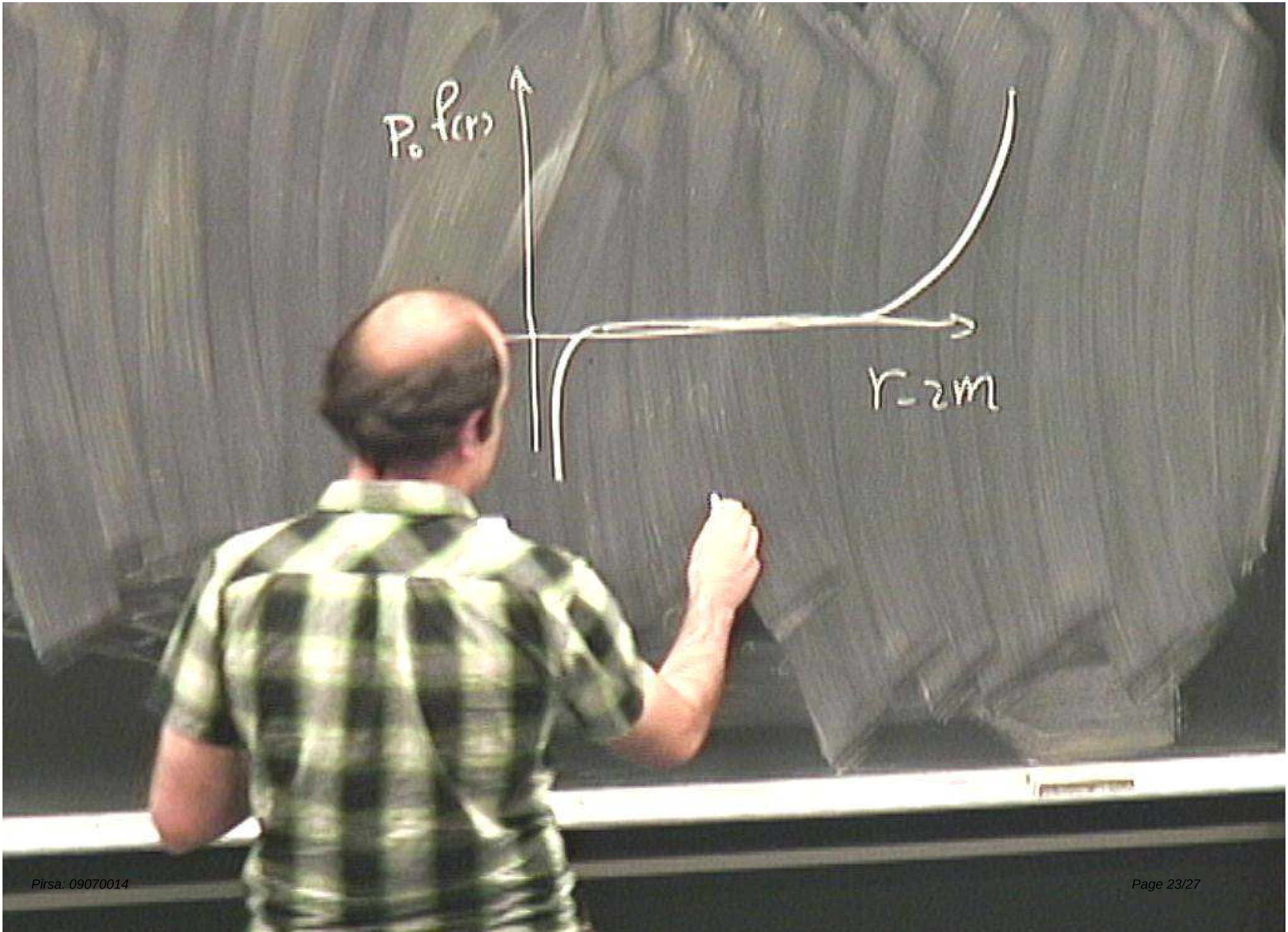
$$G_{\mu\nu} = p'(u'_\mu u'_\nu - g_{\mu\nu})$$ Static

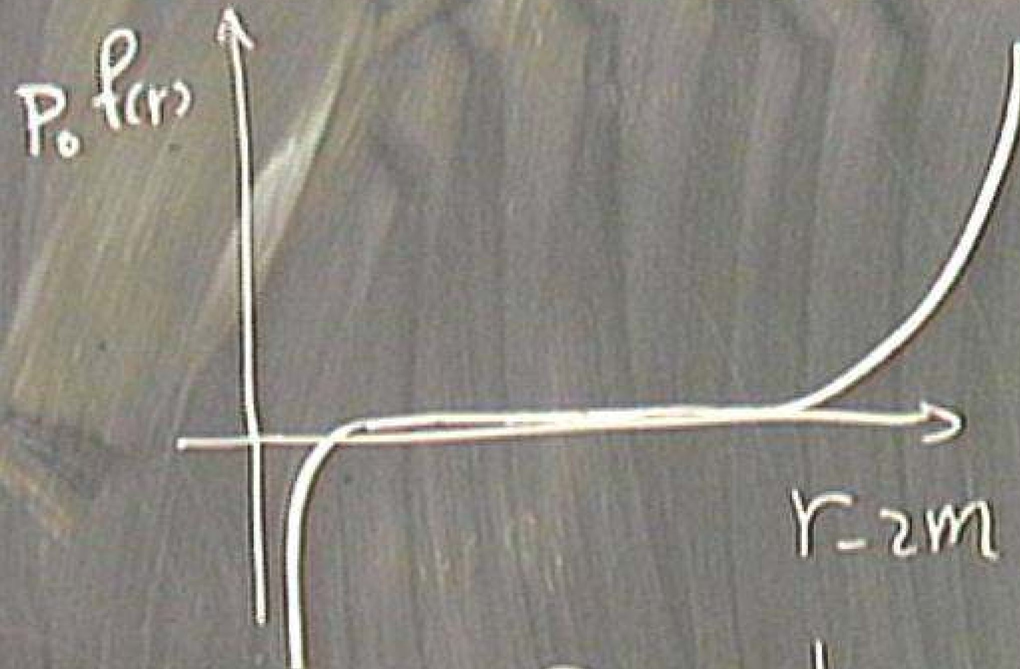
$$ds^2 = e^{2\phi} dt^2 - \left(1 - \frac{2m}{r}\right)^{-1} dr^2 - r^2 d\Omega^2$$

$$e^{\phi} = \sqrt{1 - \frac{2m}{r}} \left(1 + 4\pi p_0 f(r)\right)$$ $\boxed{p' = p_0 e^{-\phi}} \rightarrow$ hydro. equil.

$$f(r) = \begin{cases} \frac{r^2}{2} & r \gg 2m \\ -\frac{8\sqrt{2}\, m^{5/2}}{\sqrt{r-2m}} & r - 2m \ll 2m \end{cases}$$

$\boxed{\text{Static horizon} \longleftrightarrow \text{Singularity}}$


P₀ f(r)
r-2m



$$\rho_0 \simeq \frac{1}{m^3} = \text{observed } \rho_{DE}$$

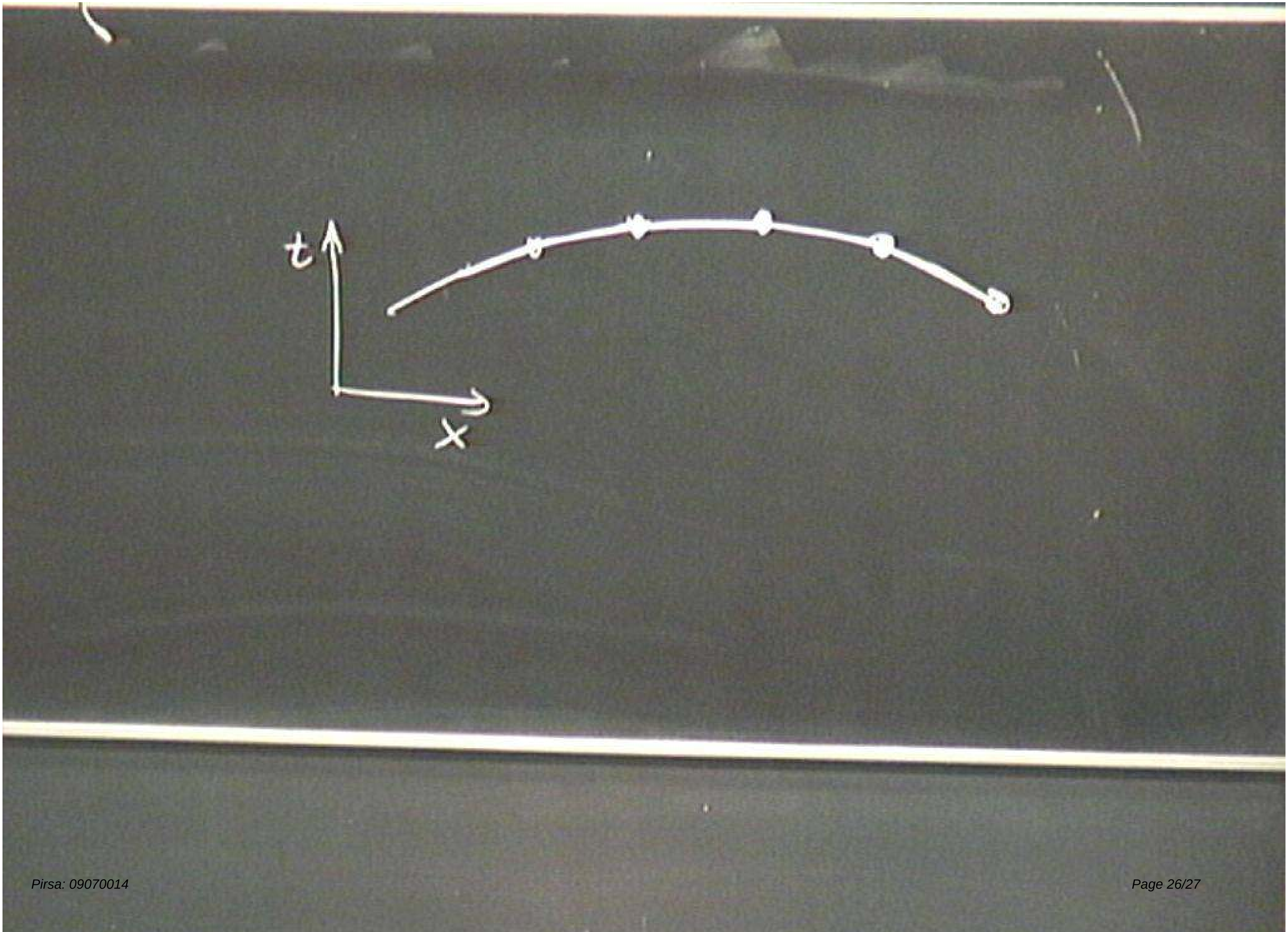
$$\boxed{m = 73\ M_\odot}$$

aether

$$ds^2 = -(1 + 2\pi\rho_0 r^2)^2 dt^2 + dr^2$$

de-Sitter

$$ds^2 = -\left(1 - \frac{8\pi\rho_\Lambda r^2}{3}\right) dt^2 + \left(1 - \frac{8\pi\rho_\Lambda r^2}{3}\right)^{-1} dr^2$$


t
x

average Friedmann eq