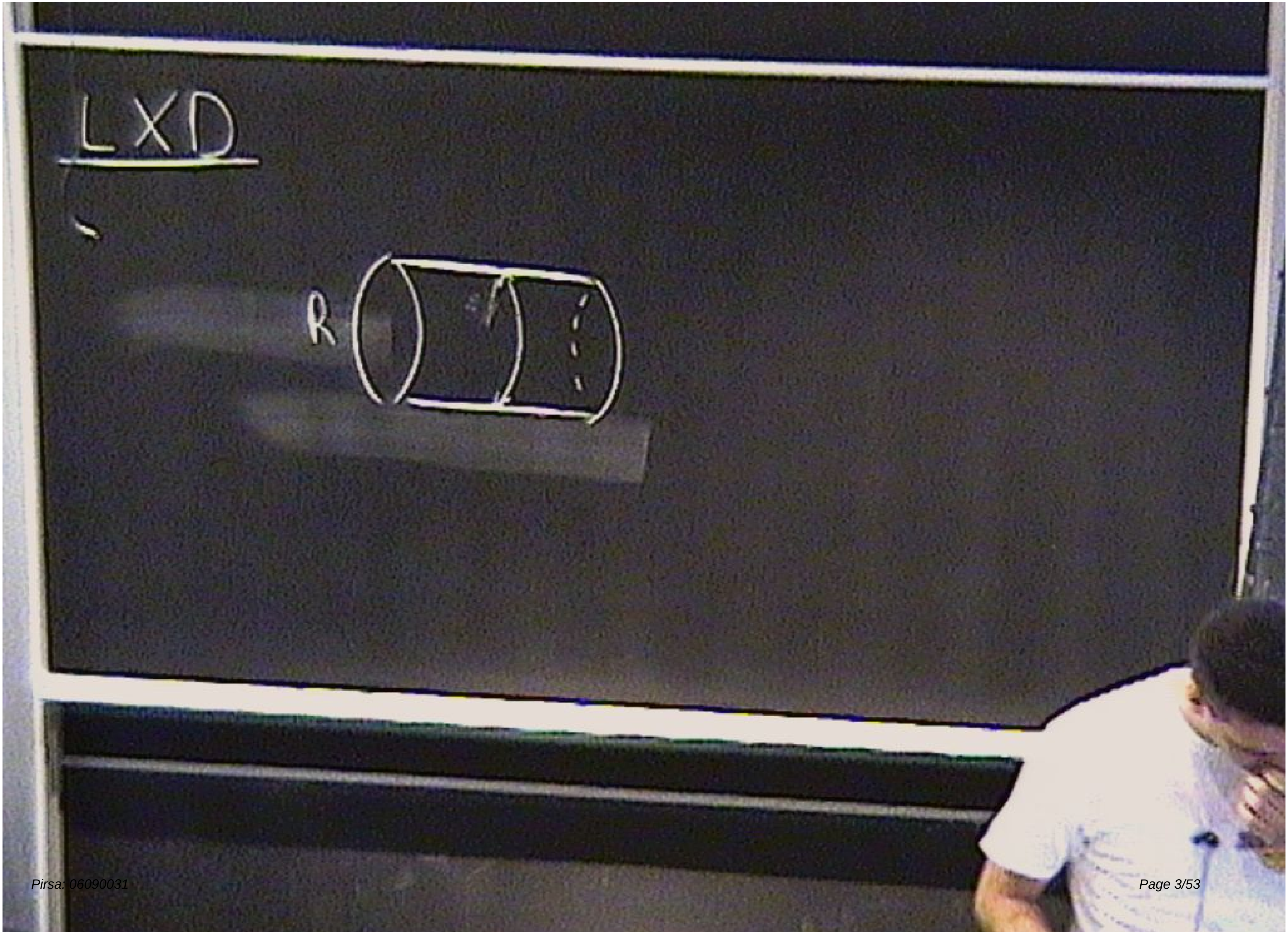
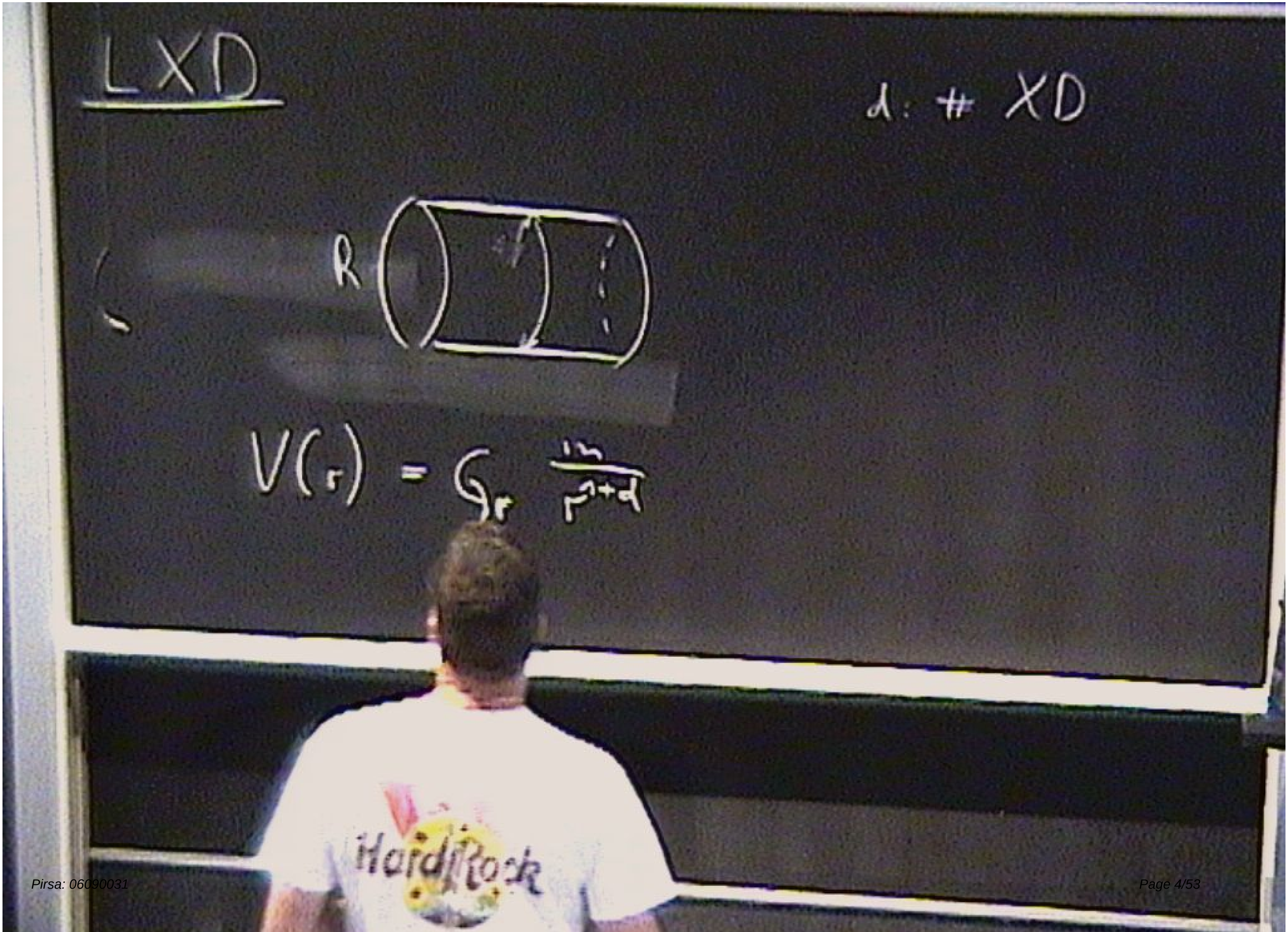
Title: Generalized Uncertainty Principle

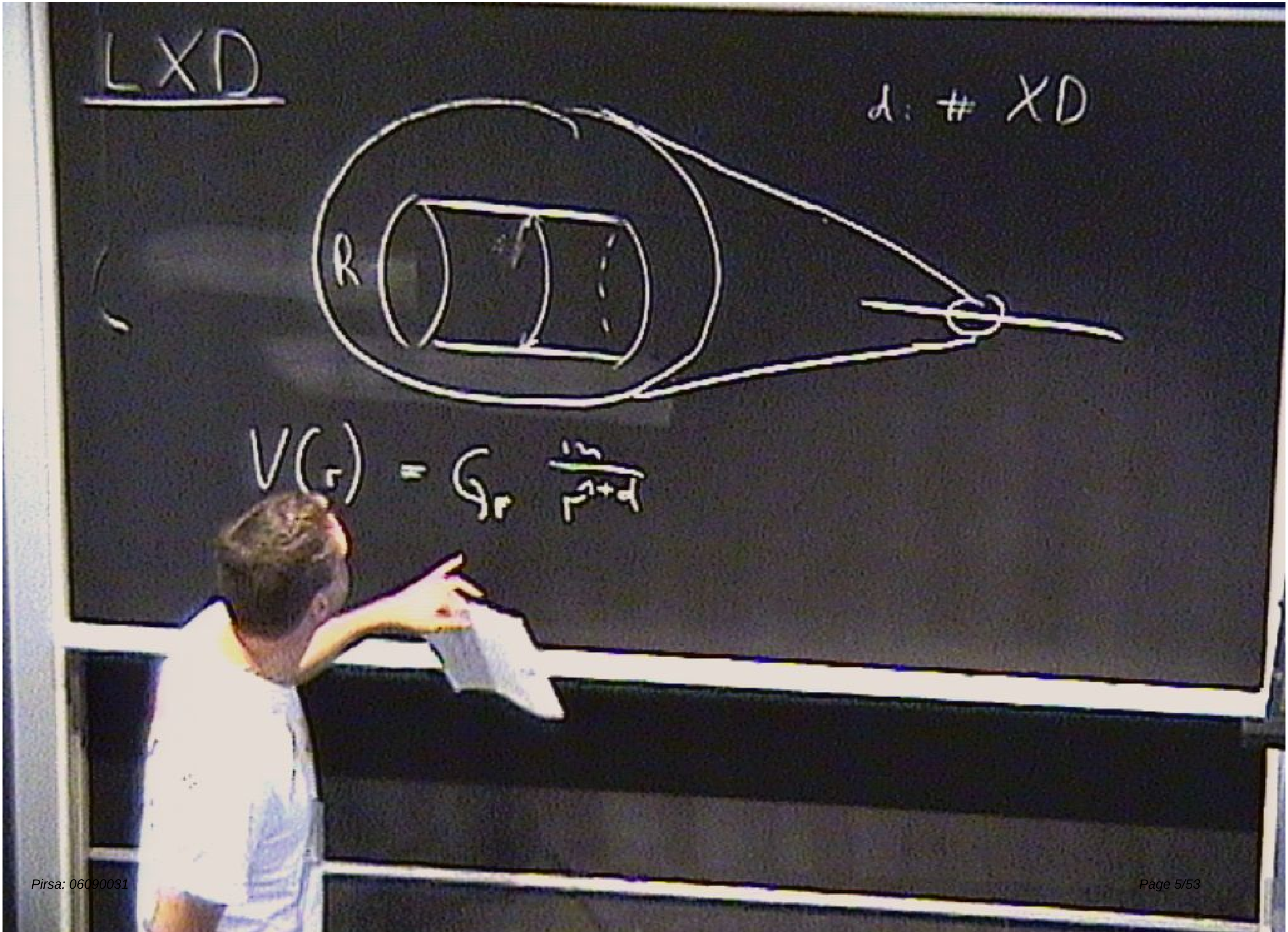
Date: Sep 08, 2006 11:00 AM

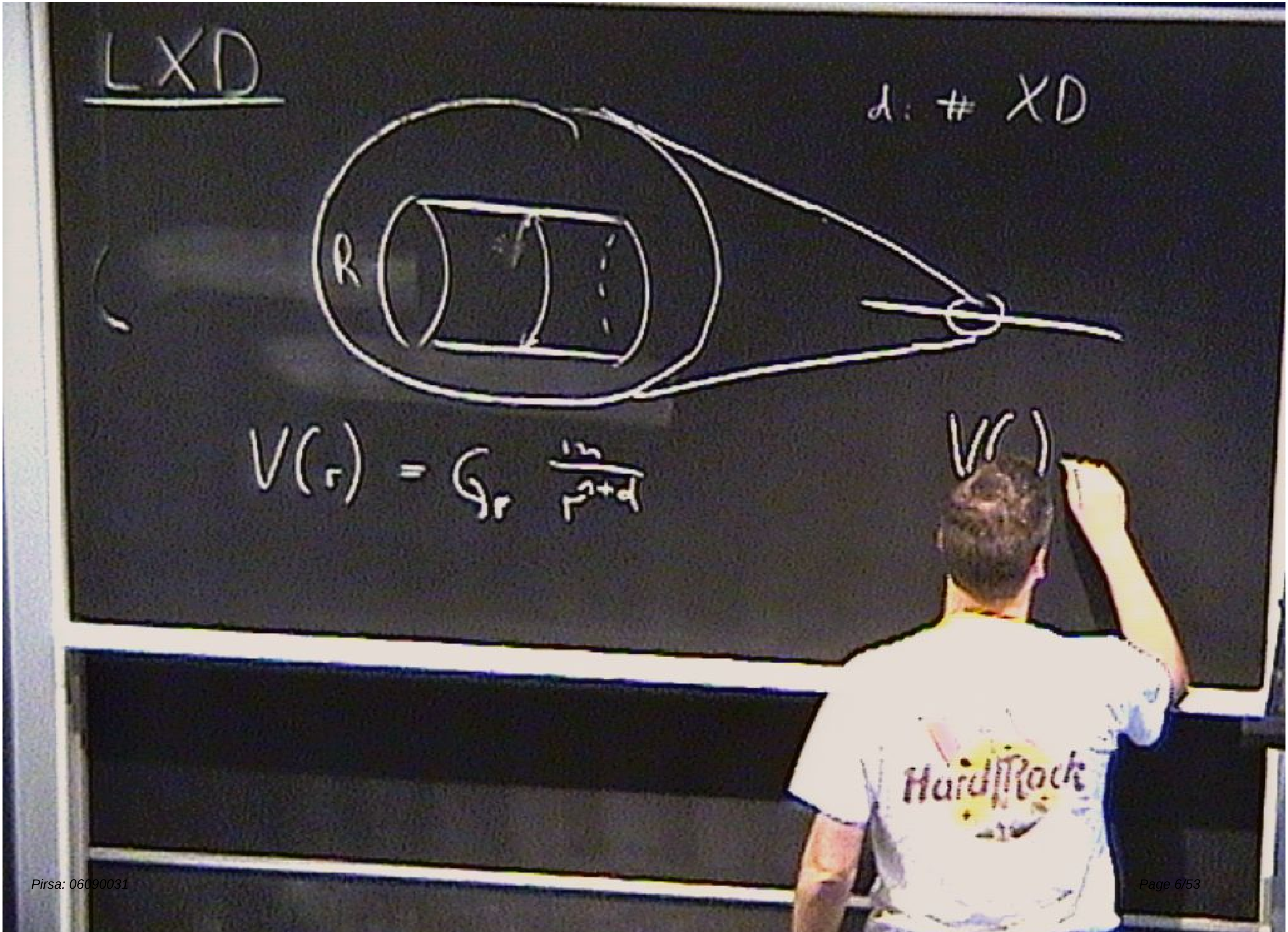
URL: http://pirsa.org/06090031

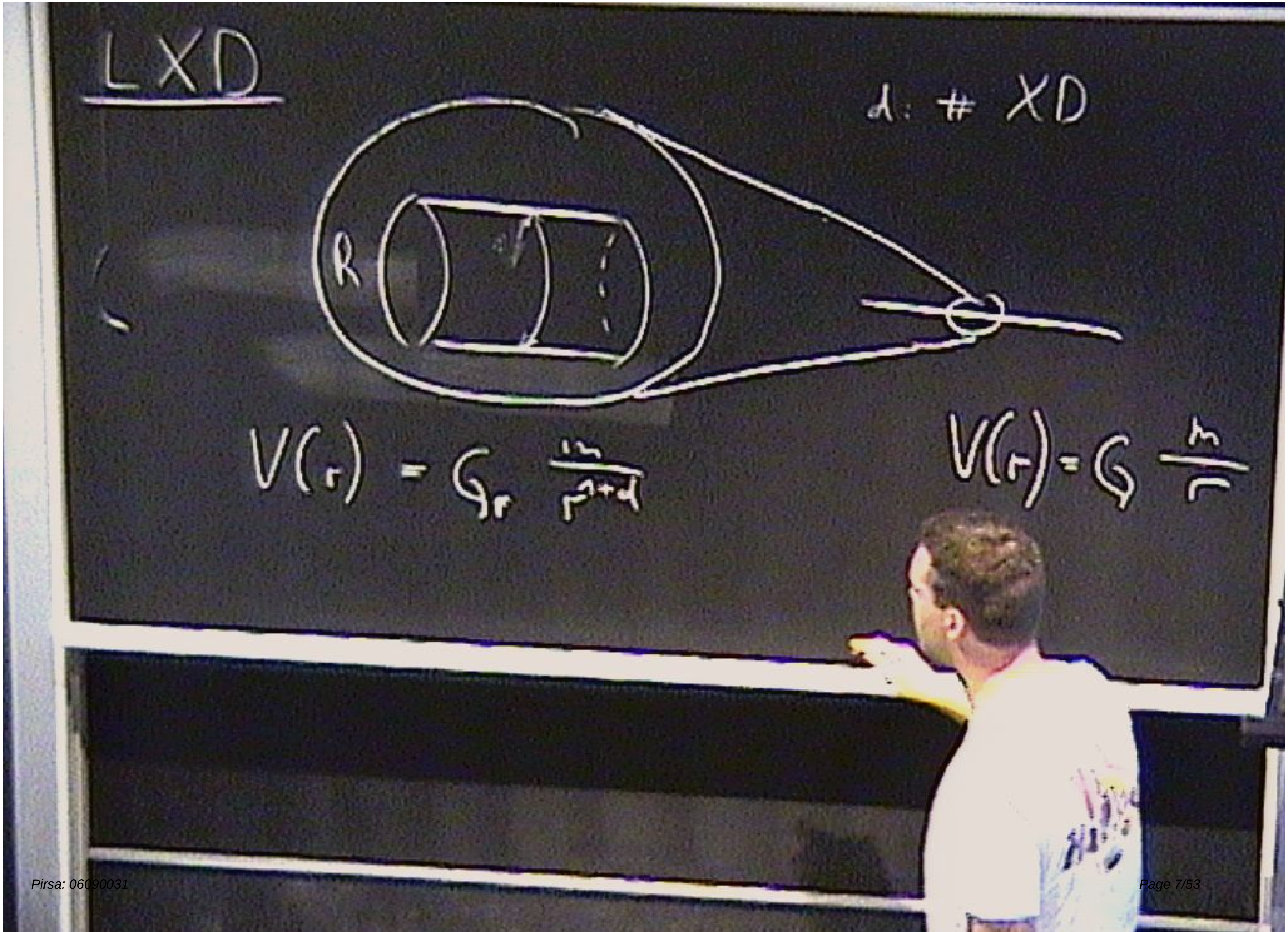
Abstract:

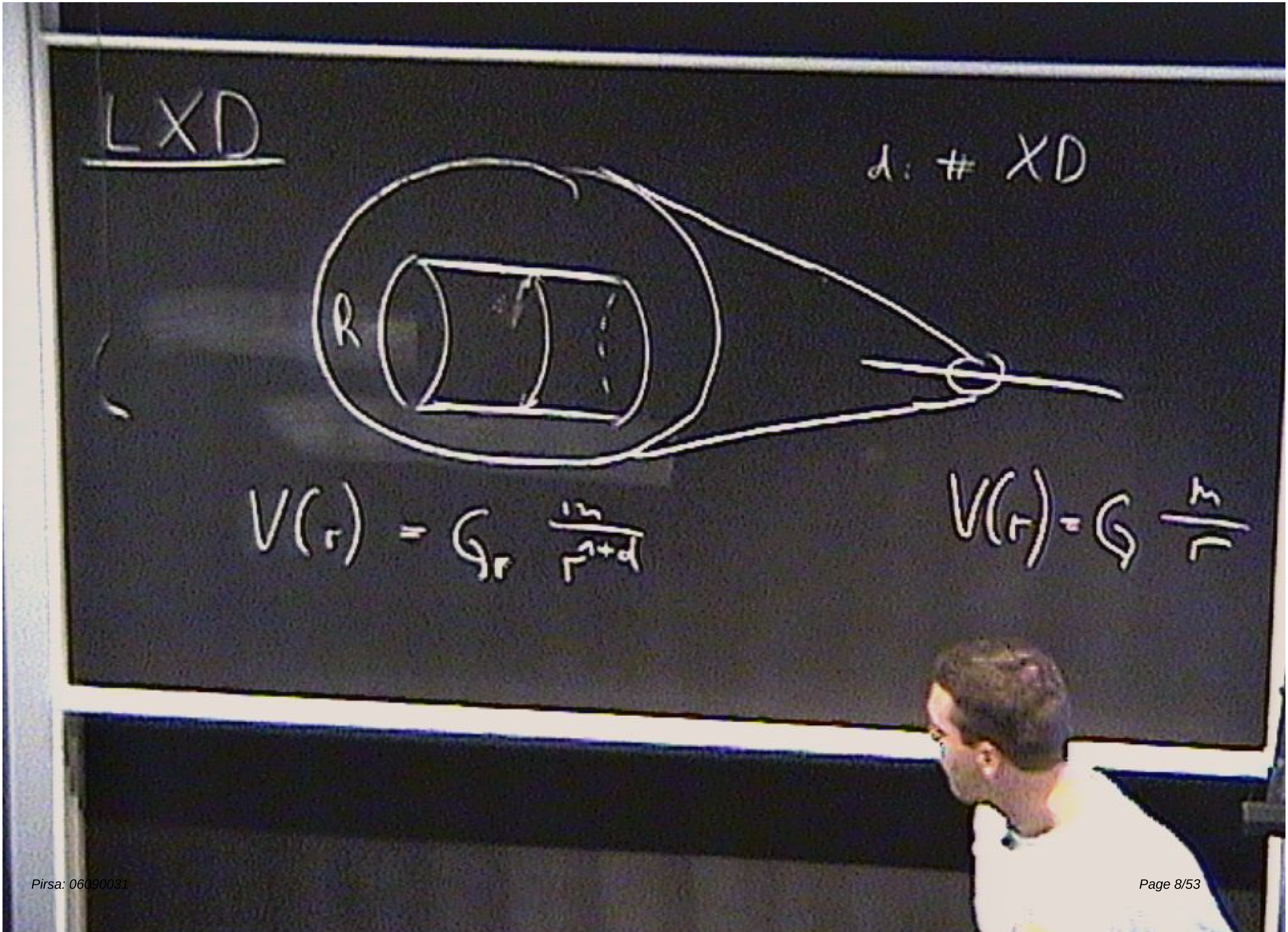

LXD
R


LXD
d: # XD
R
V(r) = G_r m/r^{1+d}
Hard Rock


LXD
d: # XD
R

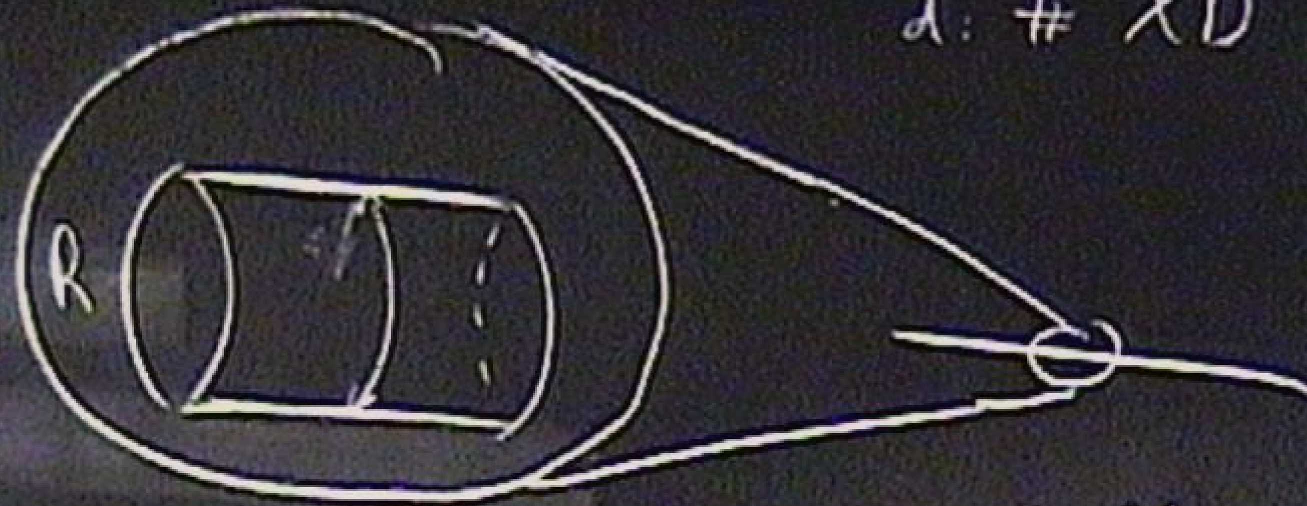

LXD
d: # XD
R
V(r) = Gr
V( )


LXD
d: # XD
R
$V(r) = G_r \frac{m}{r^{1+d}}$
$V(r) = G \frac{m}{r}$


LXD
d: # XD
R
V(r) = G_F m/r^(1+d)
V(r) = G m/r

LXD

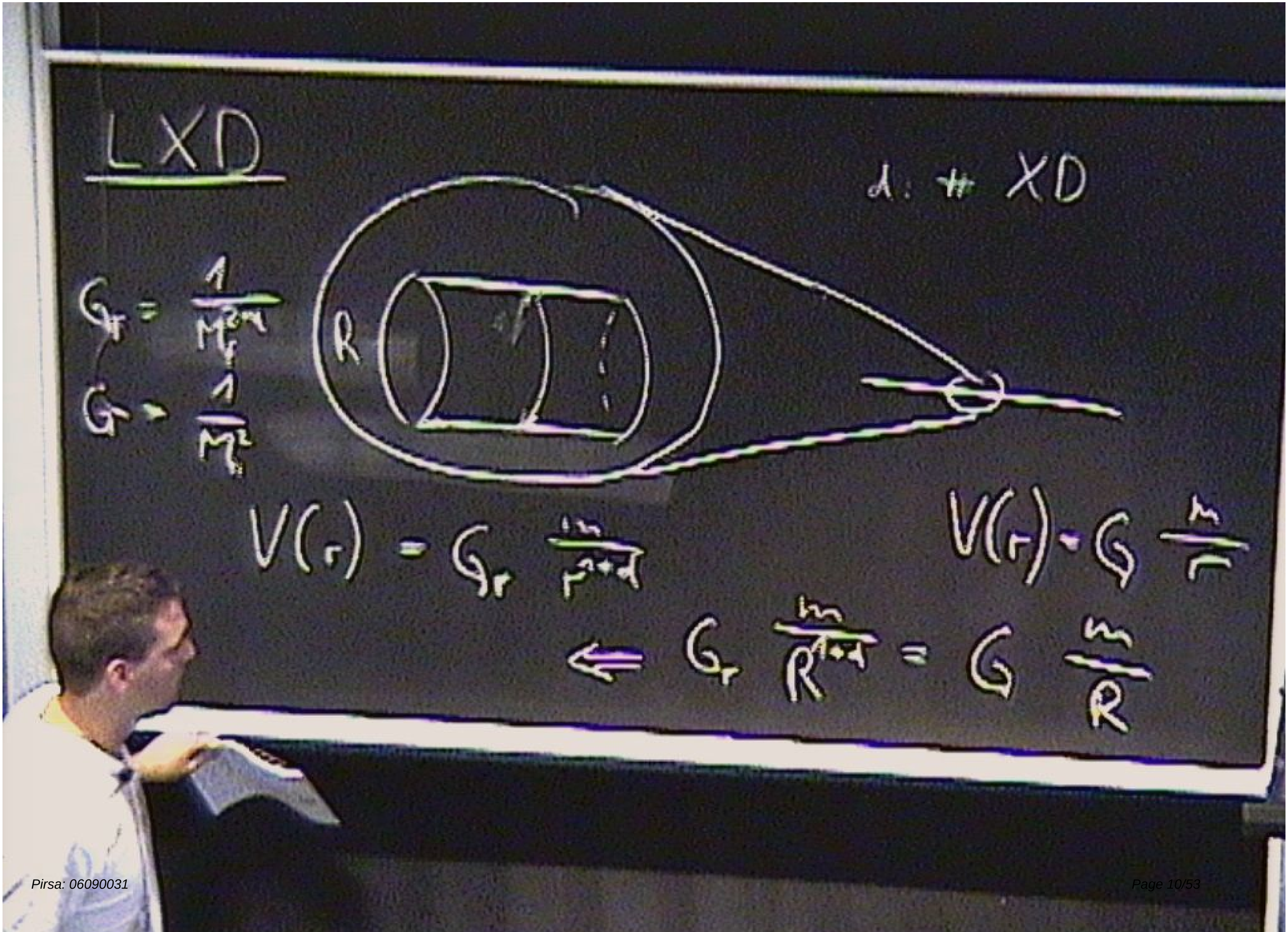
d: # XD



$$V(r) = G_F \frac{m}{r^{1+d}}$$

$$V(r) = G \frac{m}{r}$$

$$G_F \frac{m}{R^{1+d}} = G \frac{m}{R}$$

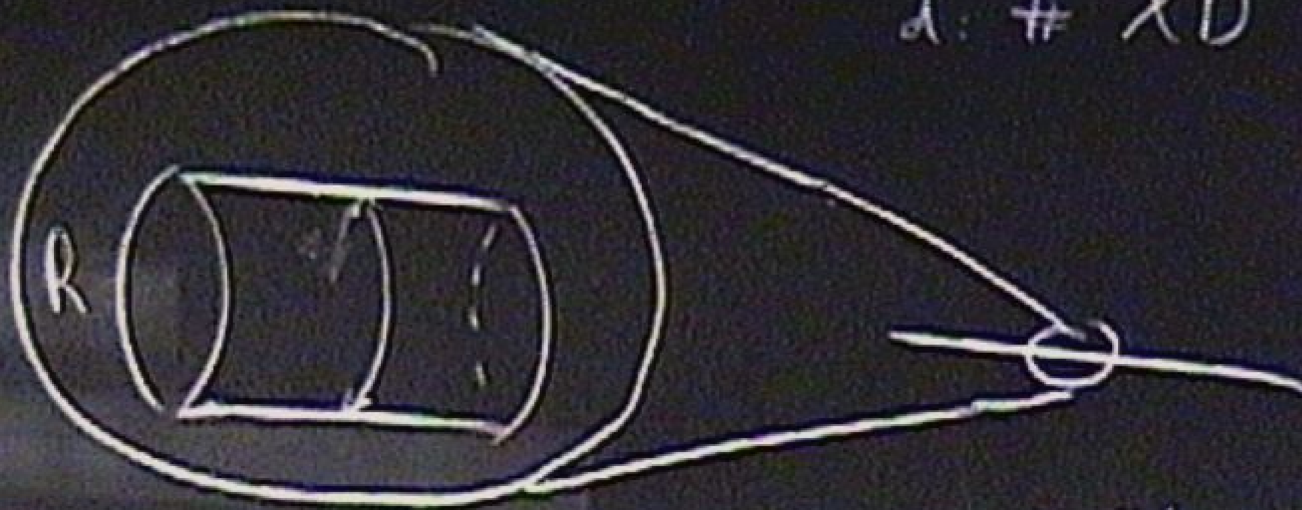

LXD
d: # XD
$G_r = \frac{1}{M_r^{2+n}}$
$G = \frac{1}{M^2}$
R
$V(r) = G_r \frac{m}{r^{1+n}}$
$V(r) = G \frac{m}{r}$
$\Leftarrow G_r \frac{m}{R^{1+n}} = G \frac{m}{R}$

LXD

d: # XD

$$G_F = \frac{1}{M_F^{2+d}}$$

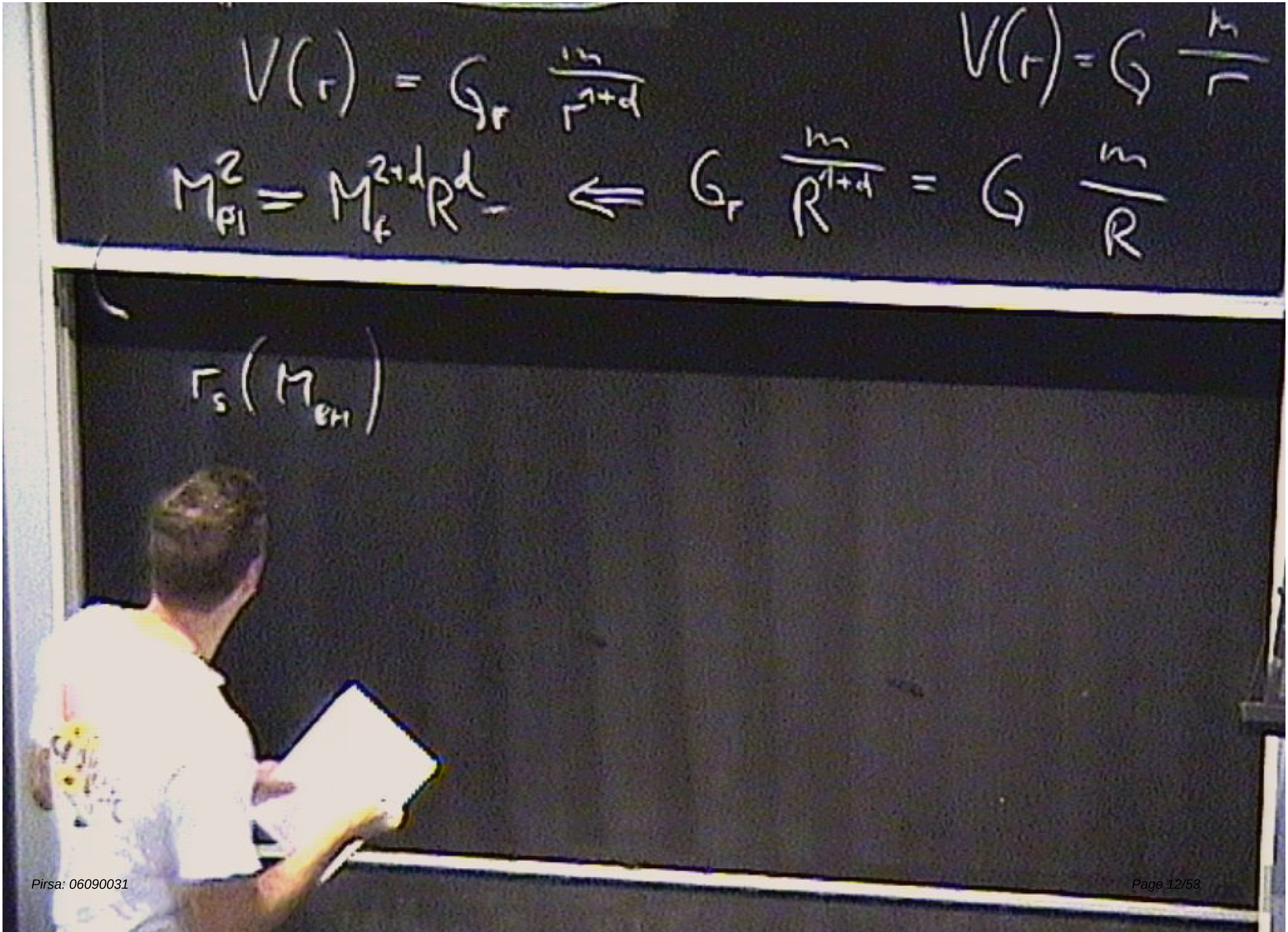
$$G = \frac{1}{M_{Pl}^2}$$



$$V(r) = G_F \frac{m}{r^{1+d}}$$

$$V(r) = G \frac{m}{r}$$

$$M_{Pl}^2 = M_F^{2+d} R^d \Longleftarrow G_F \frac{m}{R^{1+d}} = G \frac{m}{R}$$


$V(r) = G_F \frac{m}{r^{1+d}}$
$V(r) = G \frac{m}{r}$
$M_{Pl}^2 = M_F^{2+d} R^d \Longleftarrow G_F \frac{m}{R^{1+d}} = G \frac{m}{R}$
$r_s(M_{BH})$

$$V(r) = G_F \frac{m}{r^{1+d}} \qquad V(r) = G \frac{m}{r}$$

$$M_{Pl}^2 = M_F^{2+d} R^d \Longleftarrow G_F \frac{m}{R^{1+d}} = G \frac{m}{R}$$

$$r_s(M_{BH}) = \frac{1}{M_F}\left[\frac{M_{BH}}{M_F}\left(\frac{2^d \pi^{\frac{d-3}{2}} \Gamma\left(\frac{3+d}{2}\right)}{2+d}\right)\right]^{\frac{1}{1+d}}$$

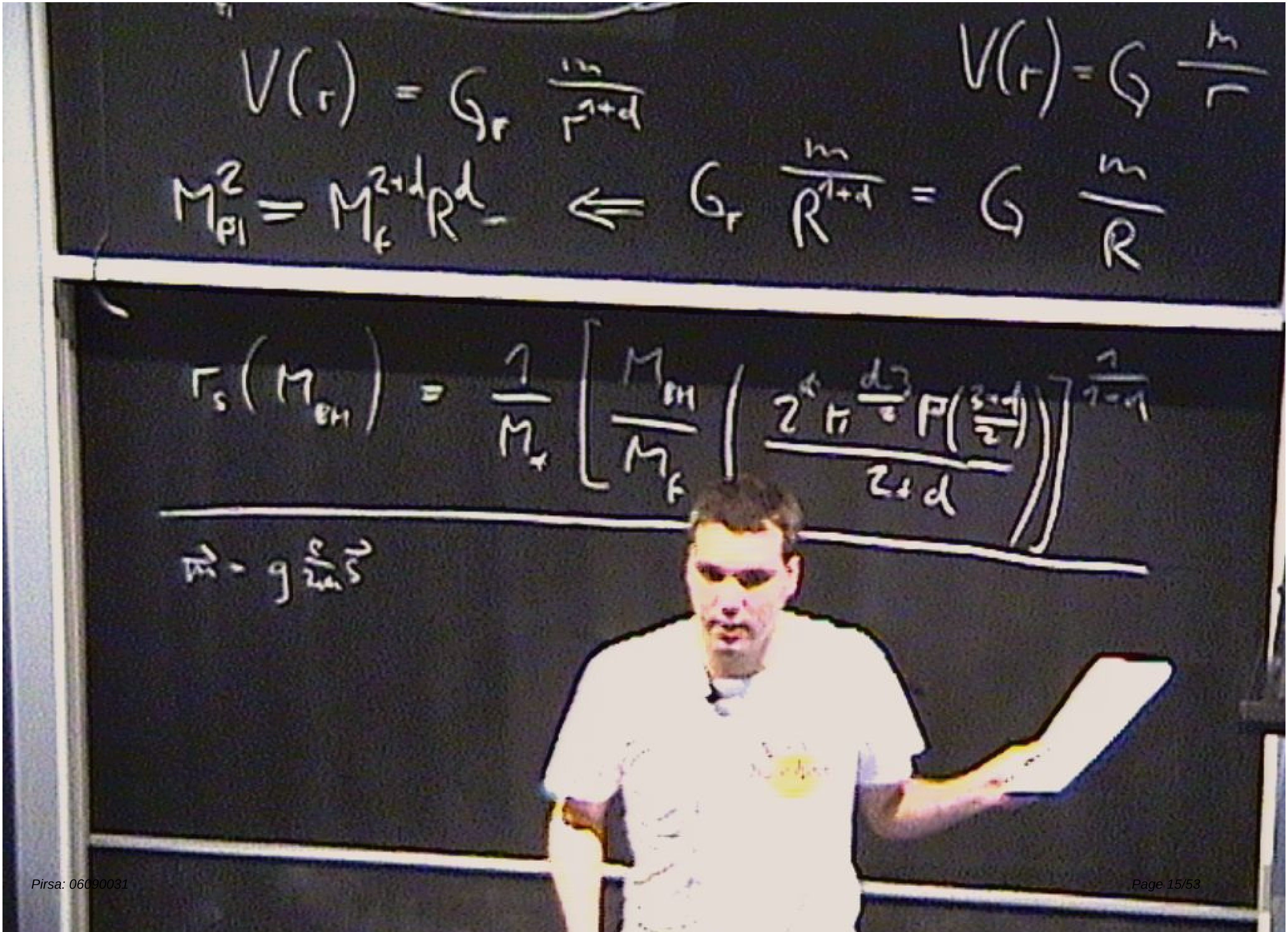
$$V(r) = G_r \frac{m}{r^{1+d}}$$

$$V(r) = G \frac{m}{r}$$

$$M_{Pl}^2 = M_*^{2+d} R^d \Longleftarrow G_r \frac{m}{R^{1+d}} = G \frac{m}{R}$$

$$r_s(M_{BH}) = \frac{1}{M_*}\left[\frac{M_{BH}}{M_*}\left(\frac{2^d \pi^{\frac{d-3}{2}} \Gamma\left(\frac{3+d}{2}\right)}{2+d}\right)\right]^{\frac{1}{1+d}}$$

$$\vec{\mu} = g \frac{e}{2m} \vec{S}$$


$V(r) = G_r \frac{m}{r^{1+d}}$
$V(r) = G \frac{m}{r}$
$M_{Pl}^2 = M_f^{2+d} R^d \Leftarrow G_r \frac{m}{R^{1+d}} = G \frac{m}{R}$
$r_s(M_{BH}) = \frac{1}{M_*}\left[\frac{M_{BH}}{M_f}\left(\frac{2^d \pi^{\frac{d-3}{2}} \Gamma\left(\frac{3+d}{2}\right)}{2+d}\right)\right]^{\frac{1}{1+d}}$

$$V(r) = G_F \frac{m}{r^{1+d}} \qquad V(r) = G \frac{m}{r}$$

$$M_{Pl}^2 = M_F^{2+d} R^d \Leftarrow G_F \frac{m}{R^{1+d}} = G \frac{m}{R}$$

$$r_s(M_{BH}) = \frac{1}{M_F}\left[\frac{M_{BH}}{M_F}\left(\frac{2^{d}\pi^{\frac{d-3}{2}}\Gamma\left(\frac{3+d}{2}\right)}{2+d}\right)\right]^{\frac{1}{1+d}}$$

$$\vec{m} = g \frac{e}{2m}\vec{S}$$

$$(\not{p}(x) - m)\varphi = 0$$

$$V(r) = G_f \frac{m}{r^{1+d}} \qquad V(r) = G \frac{m}{r}$$

$$M_{Pl}^2 = M_f^{2+d} R^d \Leftarrow G_f \frac{m}{R^{1+d}} = G \frac{m}{R}$$

$$r_s(M_{BH}) = \frac{1}{M_f}\left[\frac{M_{BH}}{M_f}\left(\frac{2^d \pi^{\frac{d-3}{2}} \Gamma\left(\frac{3+d}{2}\right)}{2+d}\right)\right]^{\frac{1}{1+d}}$$

$$\vec{\mu} = g \frac{e}{2m} \vec{S}$$

$$(\not{p}(A) - m)\varphi = 0$$

$$g = g_{SM}\left(1 - \frac{4}{3}\frac{m^2}{M_f^2}\right)$$

$$V(r) = G_F \frac{m}{r^{1+d}} \qquad V(r) = G\frac{m}{r}$$

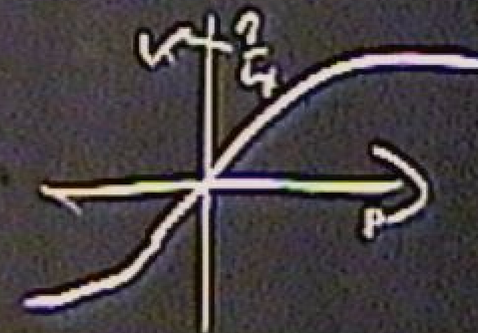
$$M_{Pl}^2 = M_F^{2+d} R^d \Longleftarrow G_F \frac{m}{R^{1+d}} = G\frac{m}{R}$$

$$r_s(M_{BH}) = \frac{1}{M_F}\left[\frac{M_{BH}}{M_F}\left(\frac{2^d \pi^{\frac{d-3}{2}}\Gamma\left(\frac{3+d}{2}\right)}{2+d}\right)\right]^{\frac{1}{1+d}}$$

$$\vec{\mu} = g\frac{e}{2m}\vec{S}$$

$$(\not{p}(\lambda) - m)\varphi = 0$$

$$g = g_{em}\left(1 - \frac{\lambda}{3}\frac{m^2}{M_F^2}\right)$$



$$V(r) = G_F \frac{m}{r^{1+d}} \qquad V(r) = G\frac{m}{r}$$

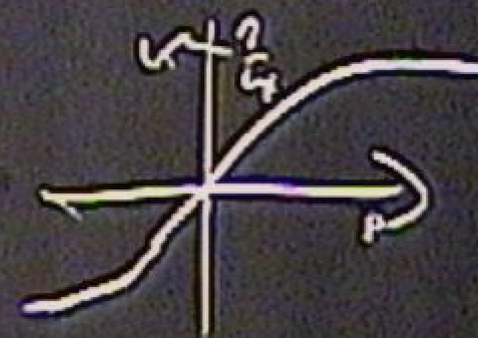
$$M_{Pl}^2 = M_F^{2+d} R^d \Leftarrow G_F \frac{m}{R^{1+d}} = G\frac{m}{R}$$

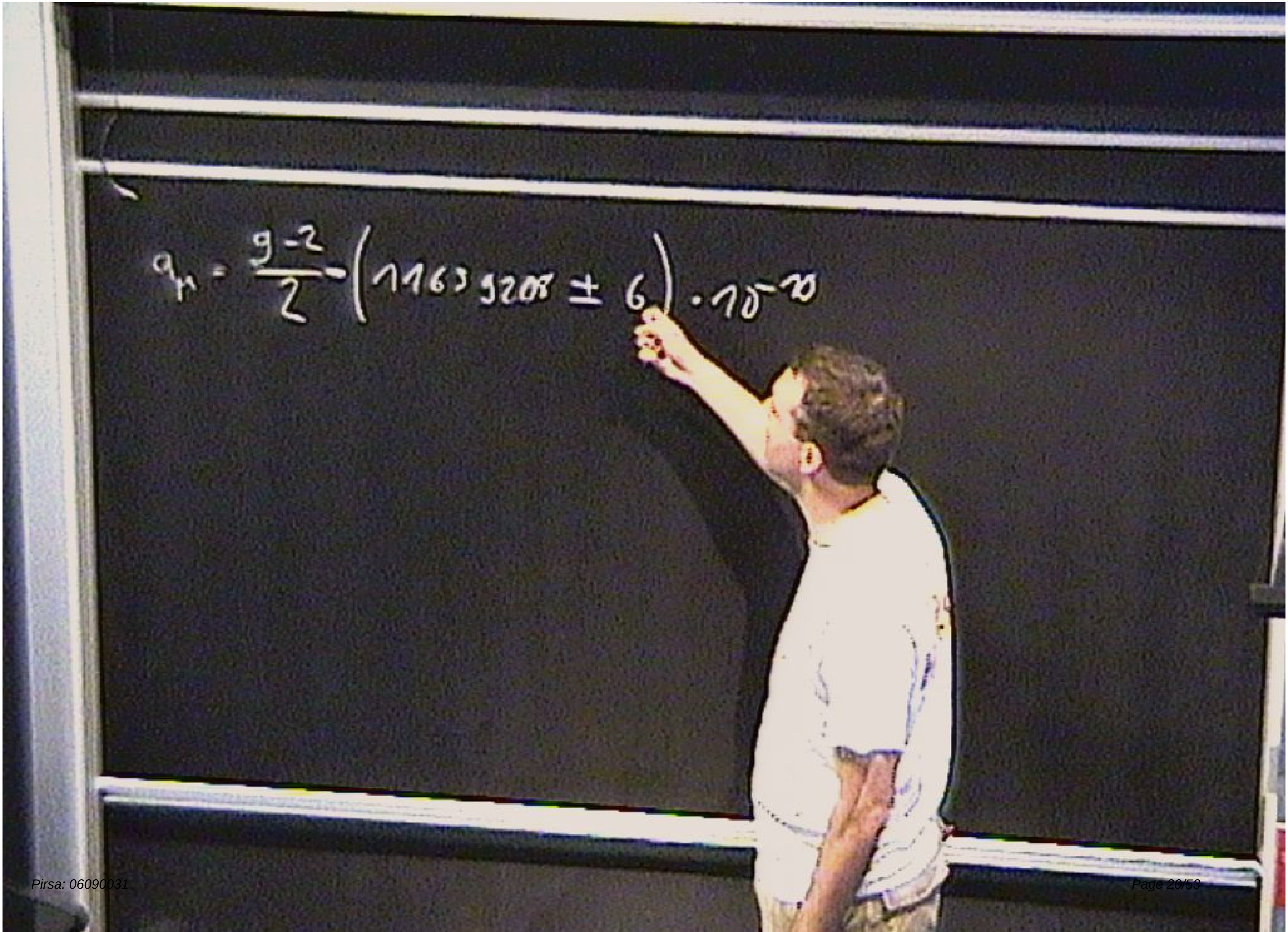
$$r_s(M_{BH}) = \frac{1}{M_F}\left[\frac{M_{BH}}{M_F}\left(\frac{2^d \pi^{\frac{d-3}{2}}\Gamma\left(\frac{3+d}{2}\right)}{2+d}\right)\right]^{\frac{1}{1+d}}$$

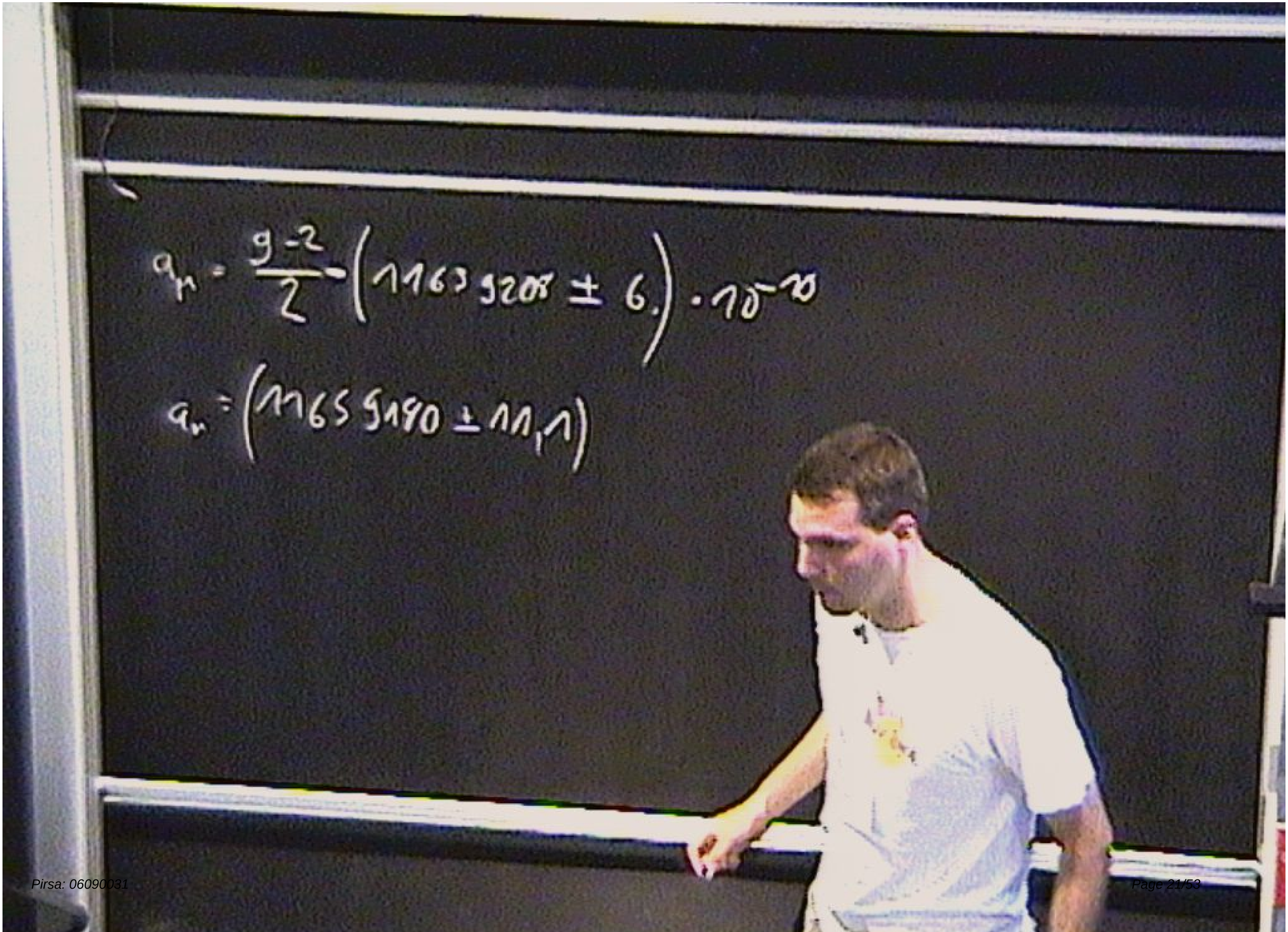
$$\vec{\mu} = g\frac{e}{2m}\vec{S}$$

$$(\not{p}(\lambda) - m)\varphi = 0$$

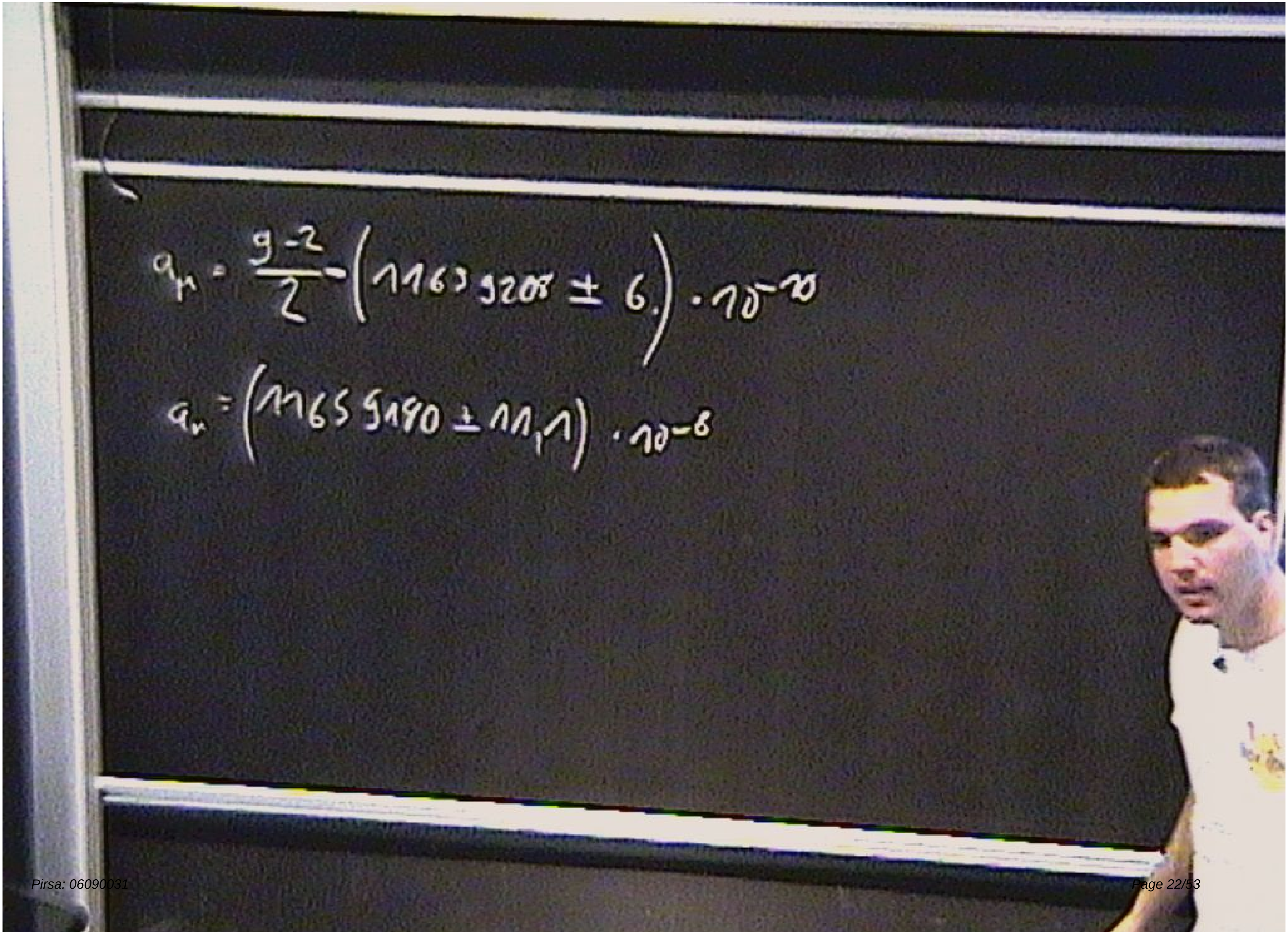
$$g = g_{SM}\left(1 - \frac{\lambda}{3}\frac{m^2}{M_F^2}\right)$$



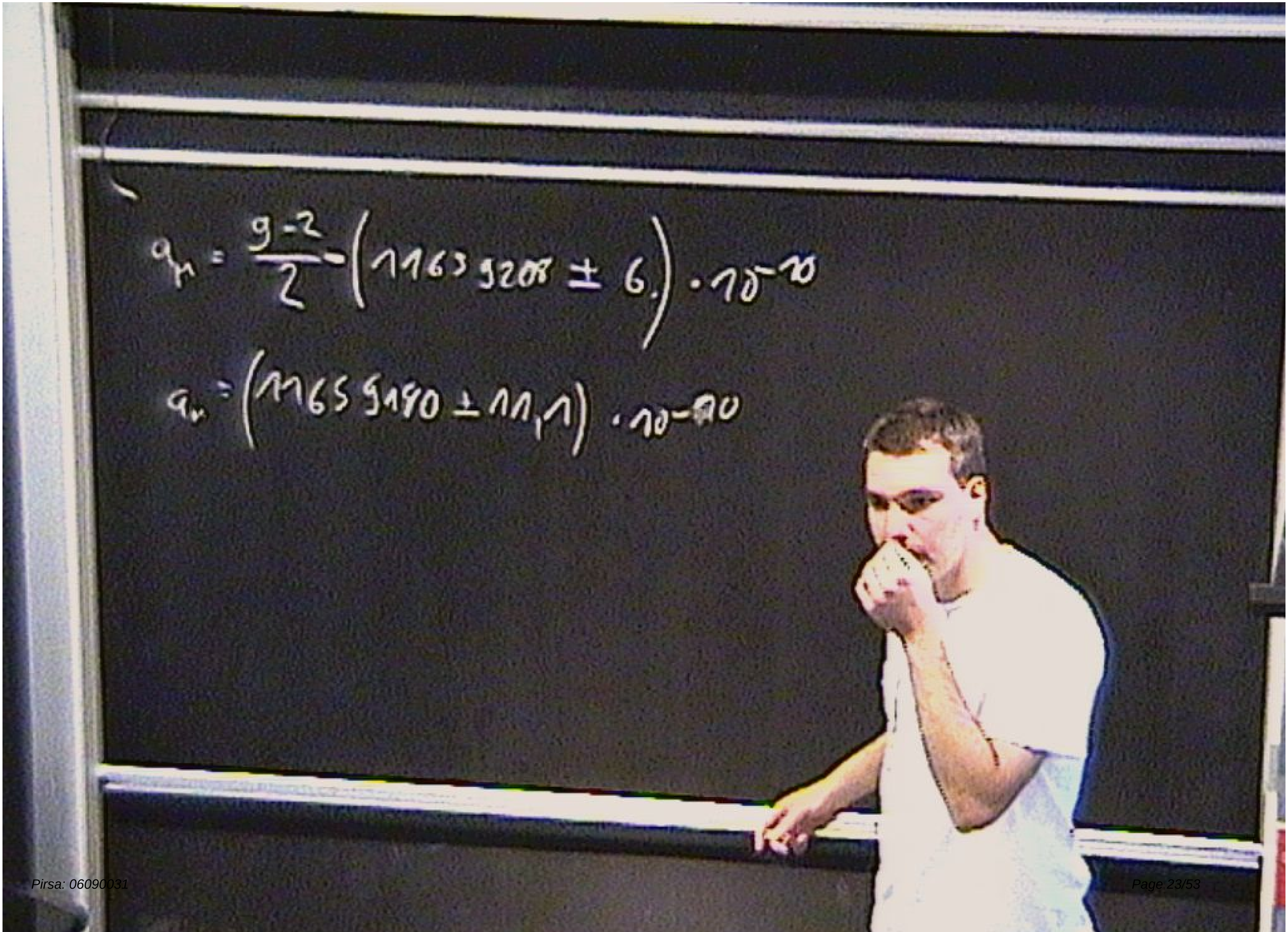

$a_\mu = \frac{g-2}{2} = (11659208 \pm 6) \cdot 10^{-10}$



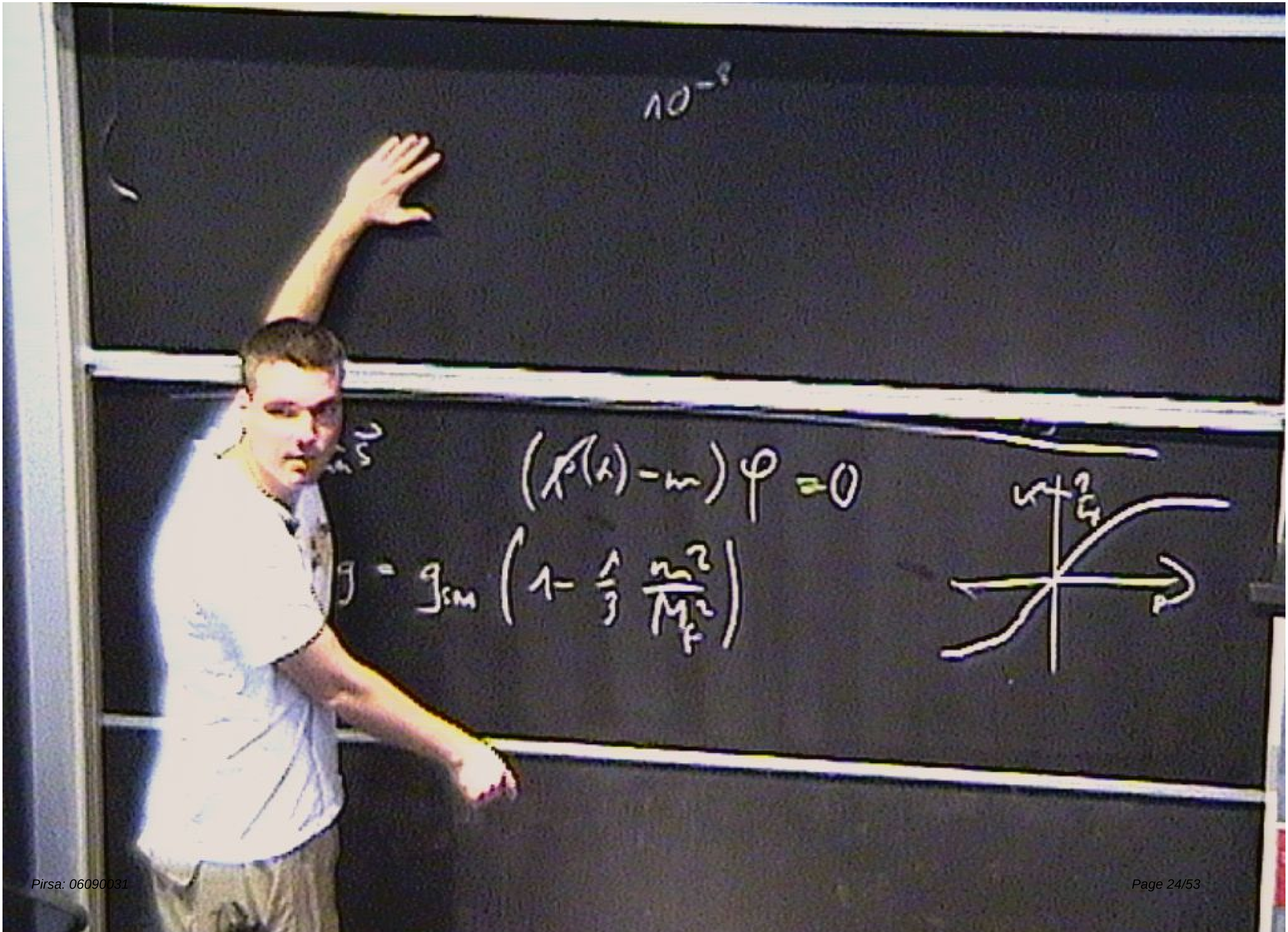
$a_\mu = \frac{g-2}{2} = (11659208 \pm 6.) \cdot 10^{-10}$
$a_\mu = (11659180 \pm 11{,}1)$

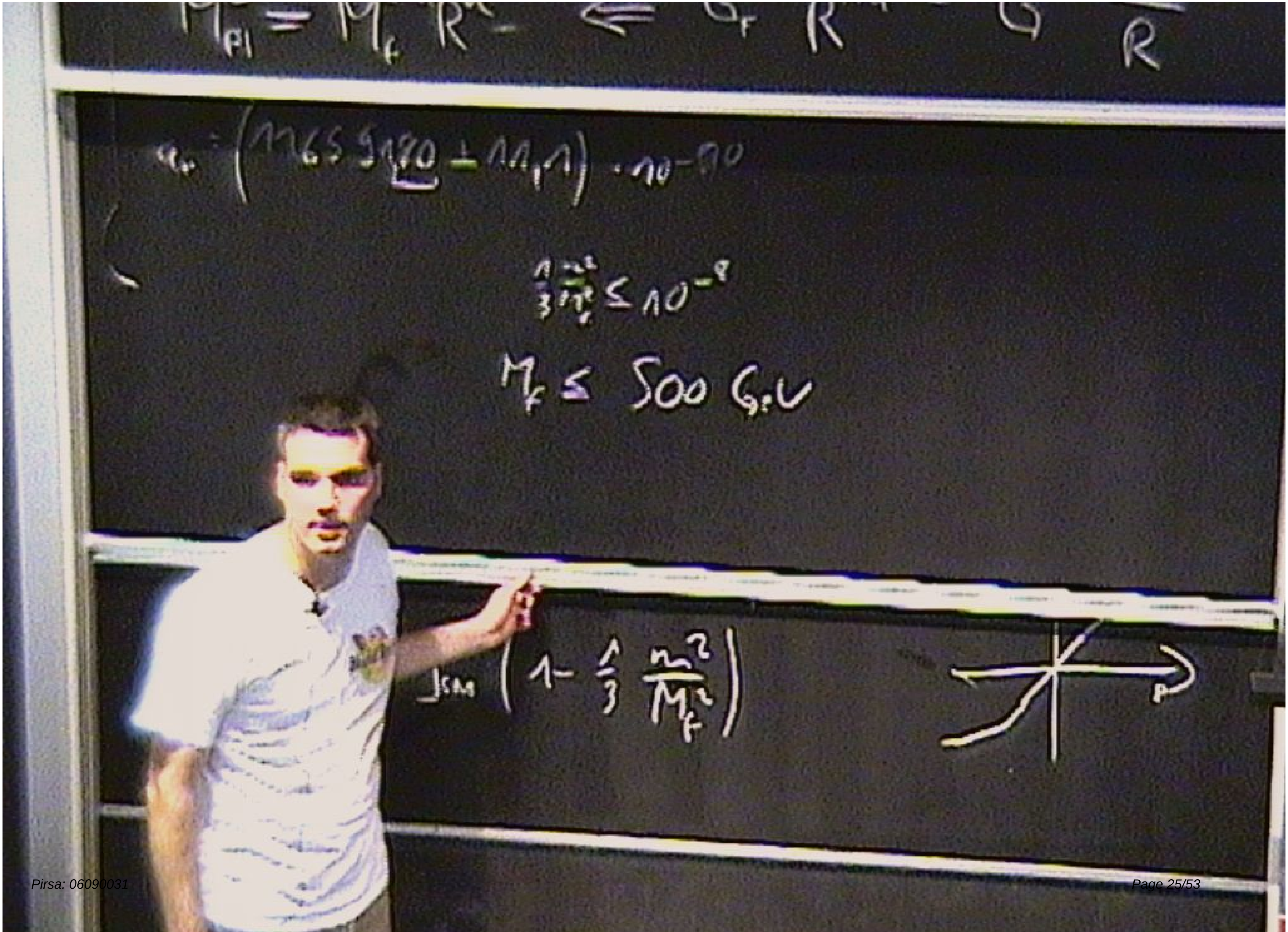


$a_\mu = \frac{g-2}{2} = (11659208 \pm 6.) \cdot 10^{-10}$
$a_\mu = (11659180 \pm 11{,}1) \cdot 10^{-8}$



$a_\mu = \frac{g-2}{2} = (11659208 \pm 6.) \cdot 10^{-10}$
$a_\mu = (11659180 \pm 11,1) \cdot 10^{-10}$


10^{-8}
$(\not{p}^2(\lambda) - m)\varphi = 0$
$g = g_{cm}\left(1 - \frac{4}{3}\frac{m^2}{M_P^2}\right)$


1/3 m²/M_f² ≤ 10^-8
M_f ≤ 500 GeV
(1 - 1/3 m²/M_f²)

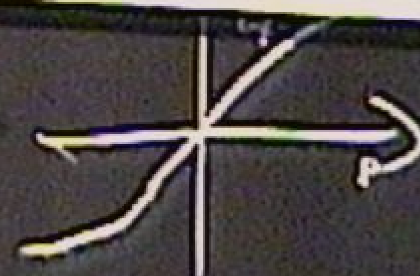
$$M_{Pl} = M_f R \Leftarrow G_f R \quad G \quad R$$

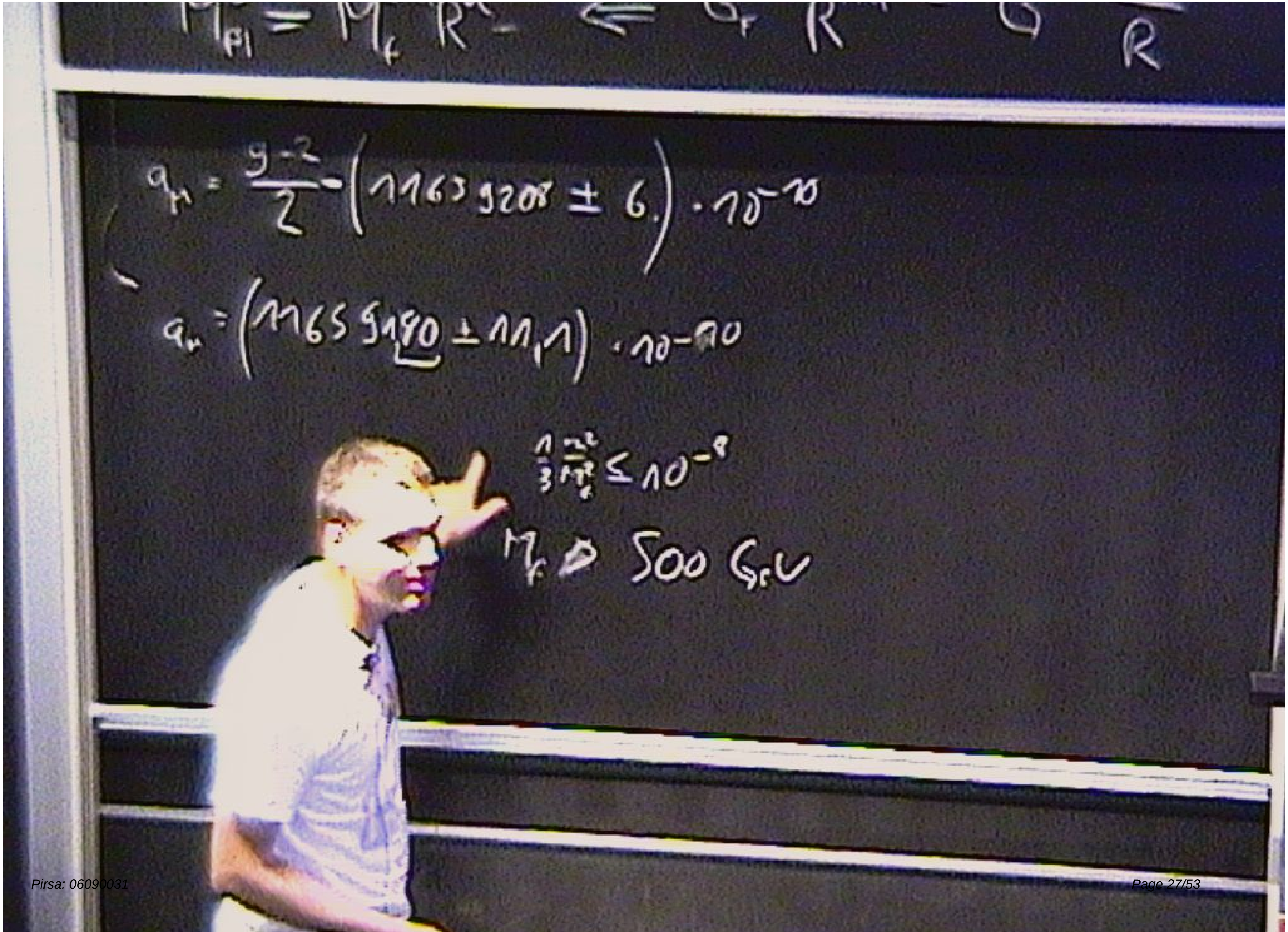
$$a_\mu = (11659180 \pm 11.1) \cdot 10^{-10}$$

$$\frac{1}{3}\frac{m^2}{M_f^2} \leq 10^{-8}$$

$$M_f \gtrsim 500 \text{ GeV}$$

$$g = g_{SM}\left(1 - \frac{1}{3}\frac{m^2}{M_f^2}\right)$$




$a_\mu = \frac{g-2}{2} \cdot (11659208 \pm 6.) \cdot 10^{-10}$
$a_\mu = (11659180 \pm 11,1) \cdot 10^{-10}$
$\frac{1}{3}\frac{m_\mu^2}{M_f^2} \le 10^{-8}$
M_f 500 GeV

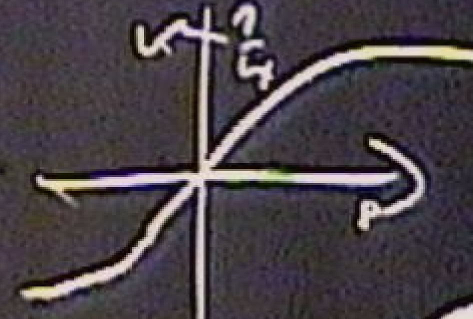
$$M_{Pl}^{2} = M_f R \Leftarrow G_f R \quad G \quad R$$

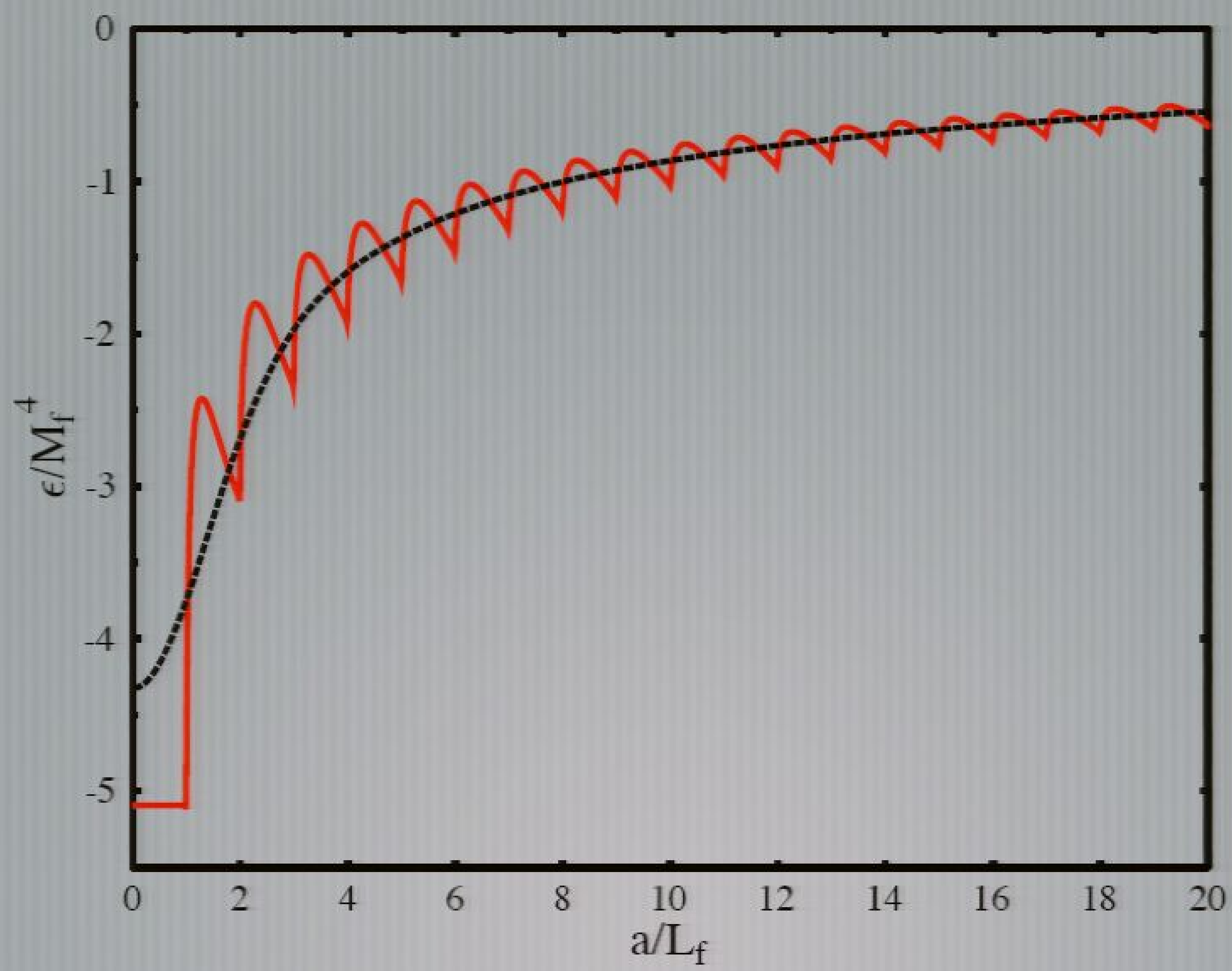
$$r_s(M_{BH}) = \frac{1}{M_f}\left[\frac{M_{BH}}{M_f}\left(\frac{2^d \pi^{\frac{d-3}{2}}\Gamma\left(\frac{3+d}{2}\right)}{2+d}\right)\right]^{\frac{1}{1+d}}$$

$$\vec{\mu} = g\frac{e}{2m}\vec{S}$$

$$(\not{p}(x) - m)\varphi = 0$$

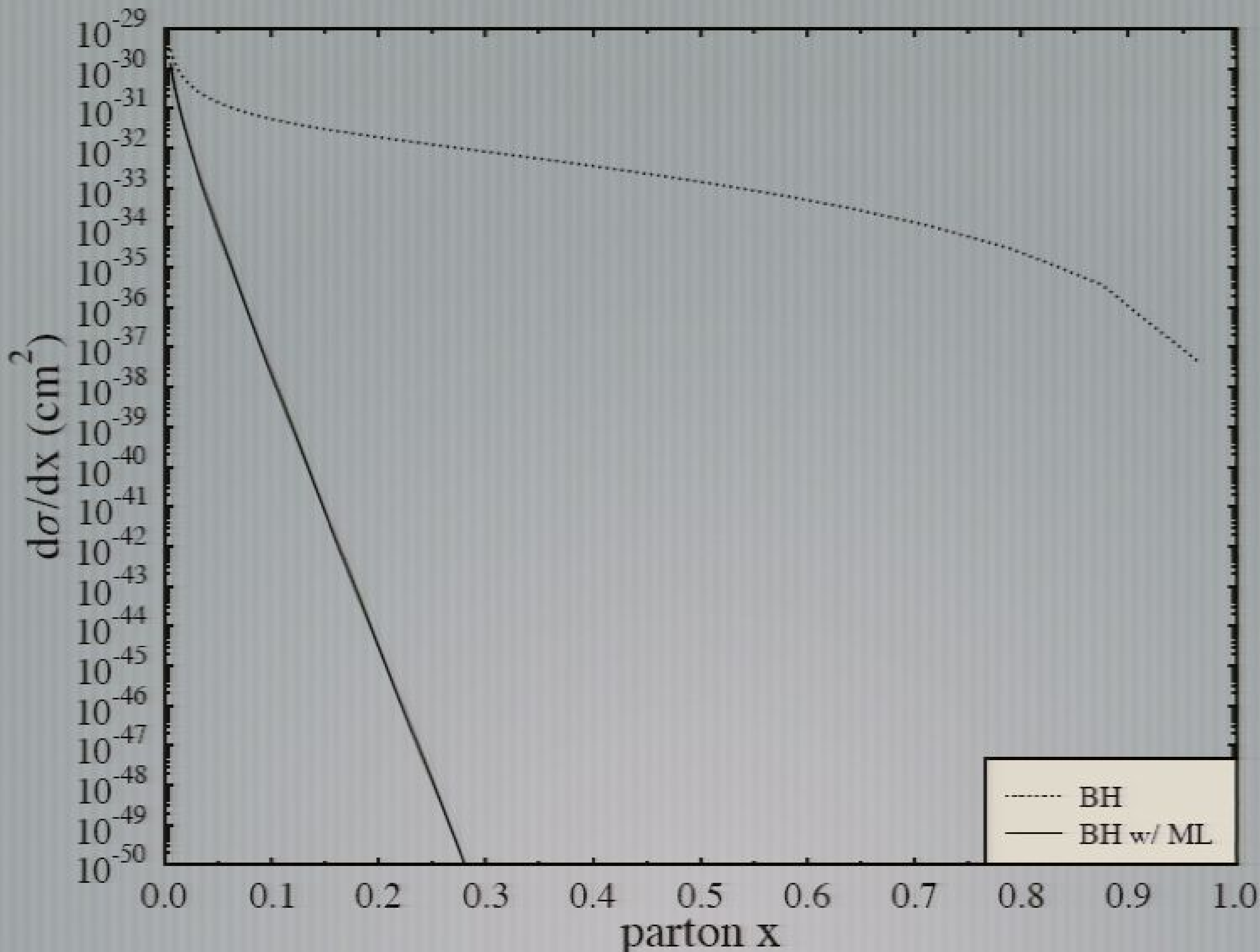
$$g = g_{SM}\left(1 - \frac{1}{3}\frac{m^2}{M_f^2}\right)$$





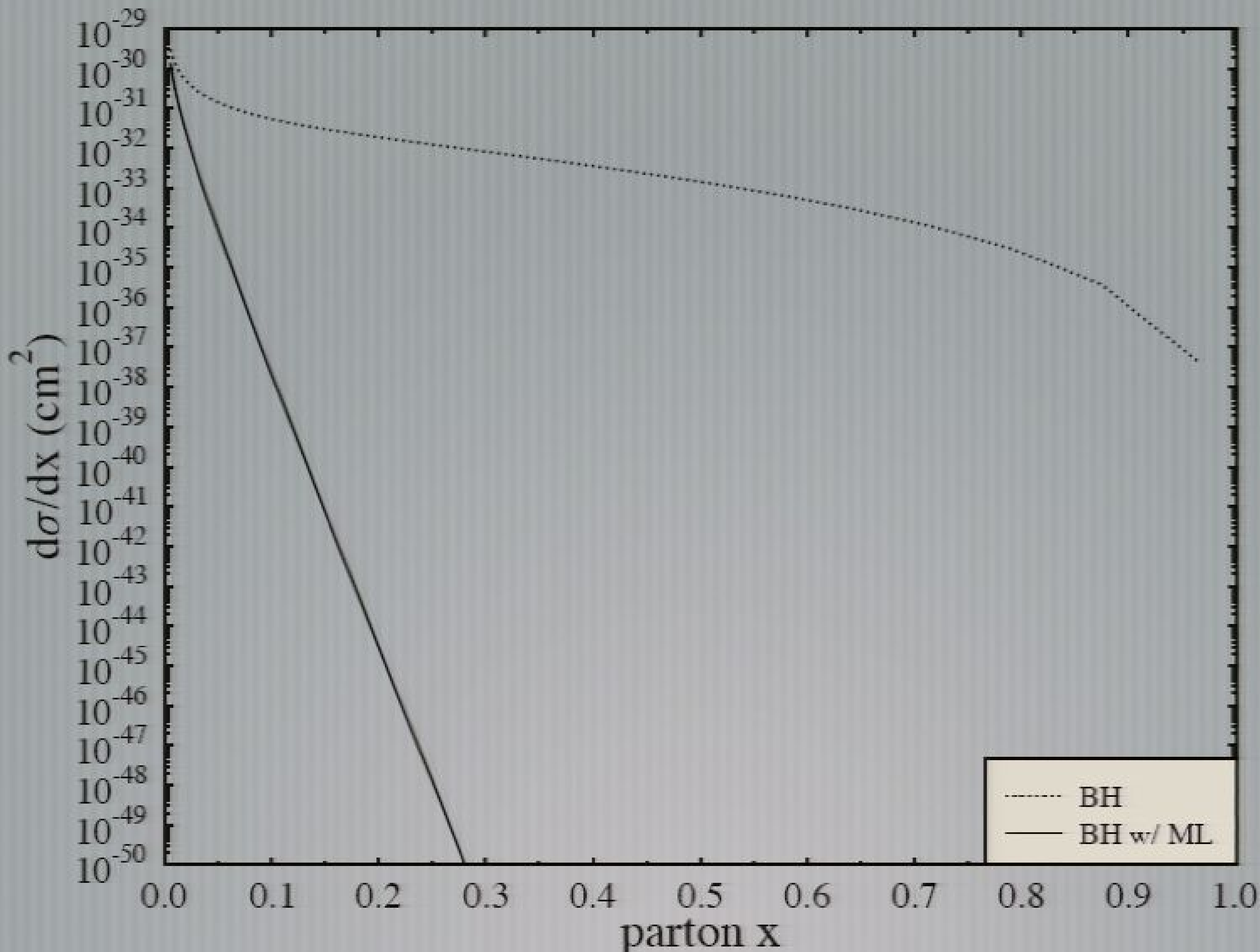
0
-1
-2
-3
-4
-5
ϵ/M_f^4
0
2
4
6
8
10
12
14
16
18
20
a/L_f

The x dependence of the BH production cross section @$E_\nu=10^8$ GeV

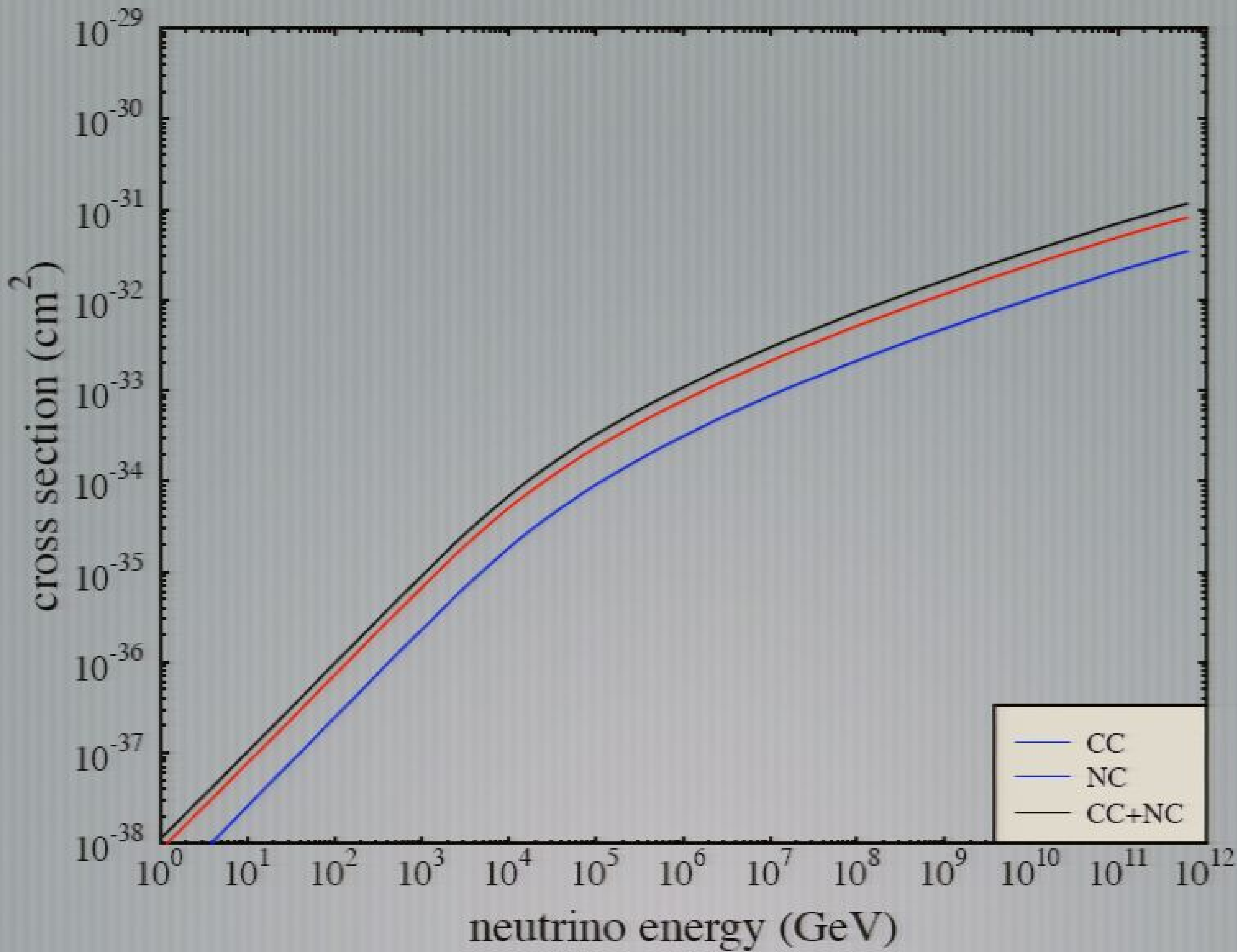


$$\sigma_{ij \to BH} = \pi r_s^2$$

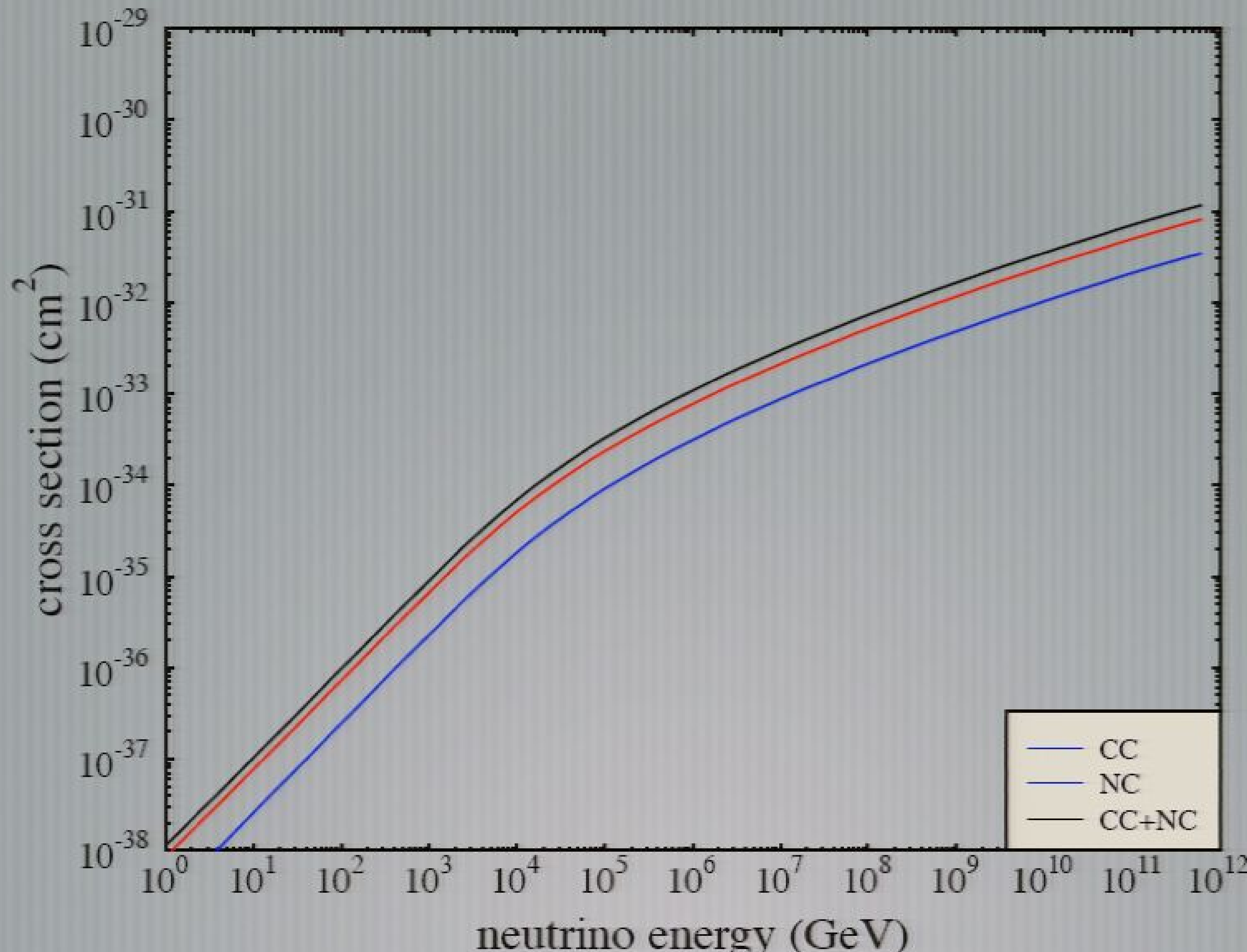
The x dependence of the BH production cross section @E_ν=10^8 GeV



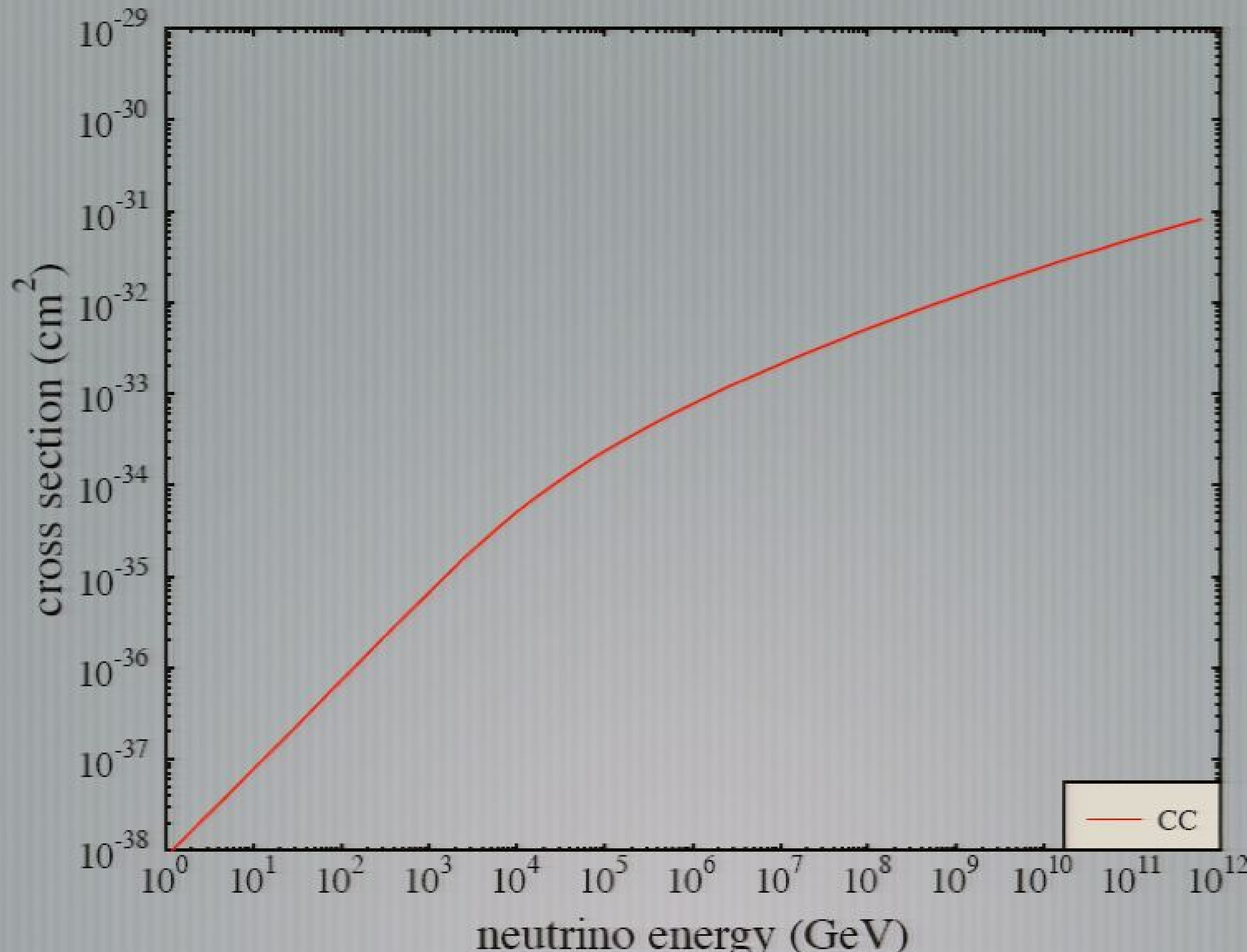
The neutrino - nucleon cross section



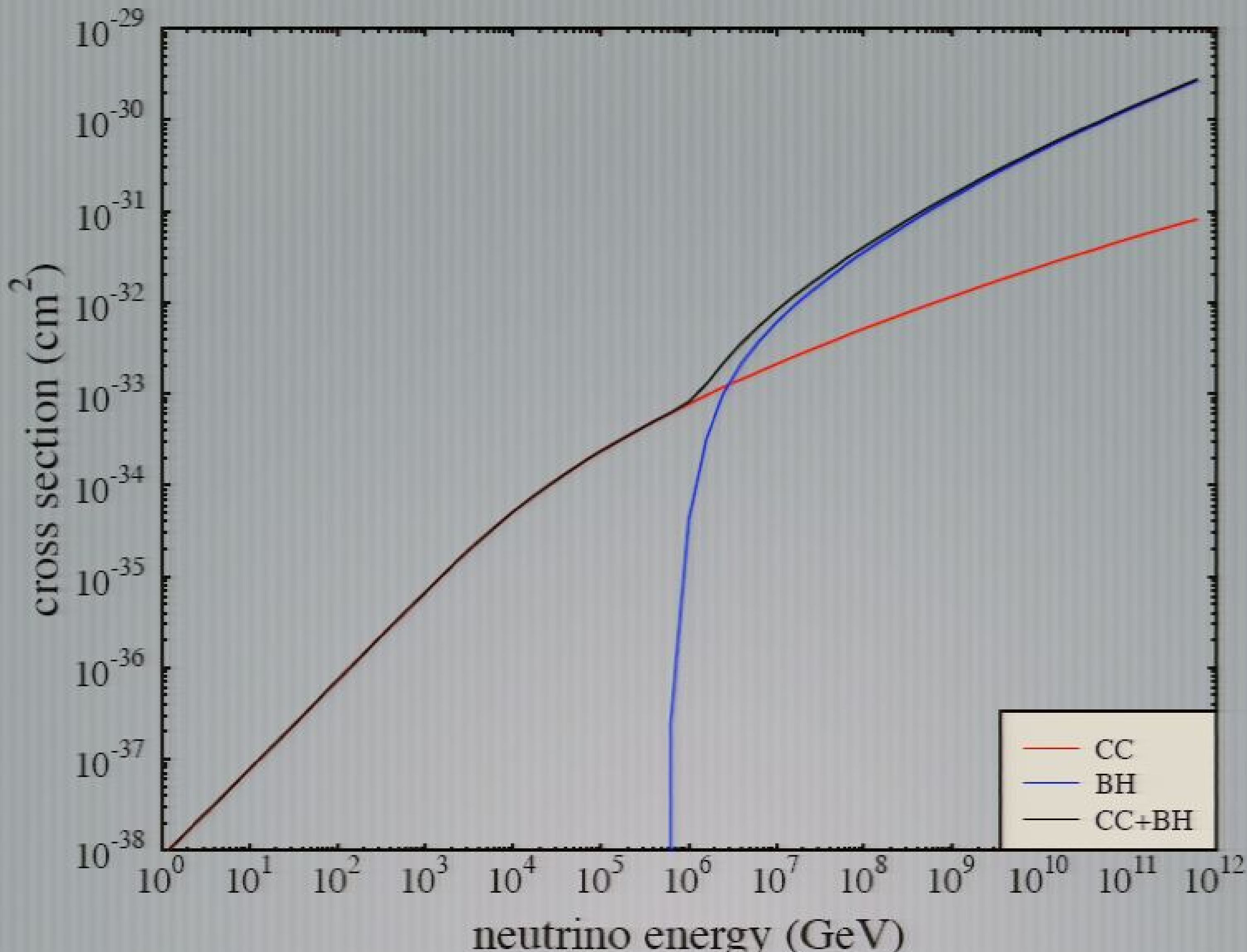
The neutrino - nucleon cross section



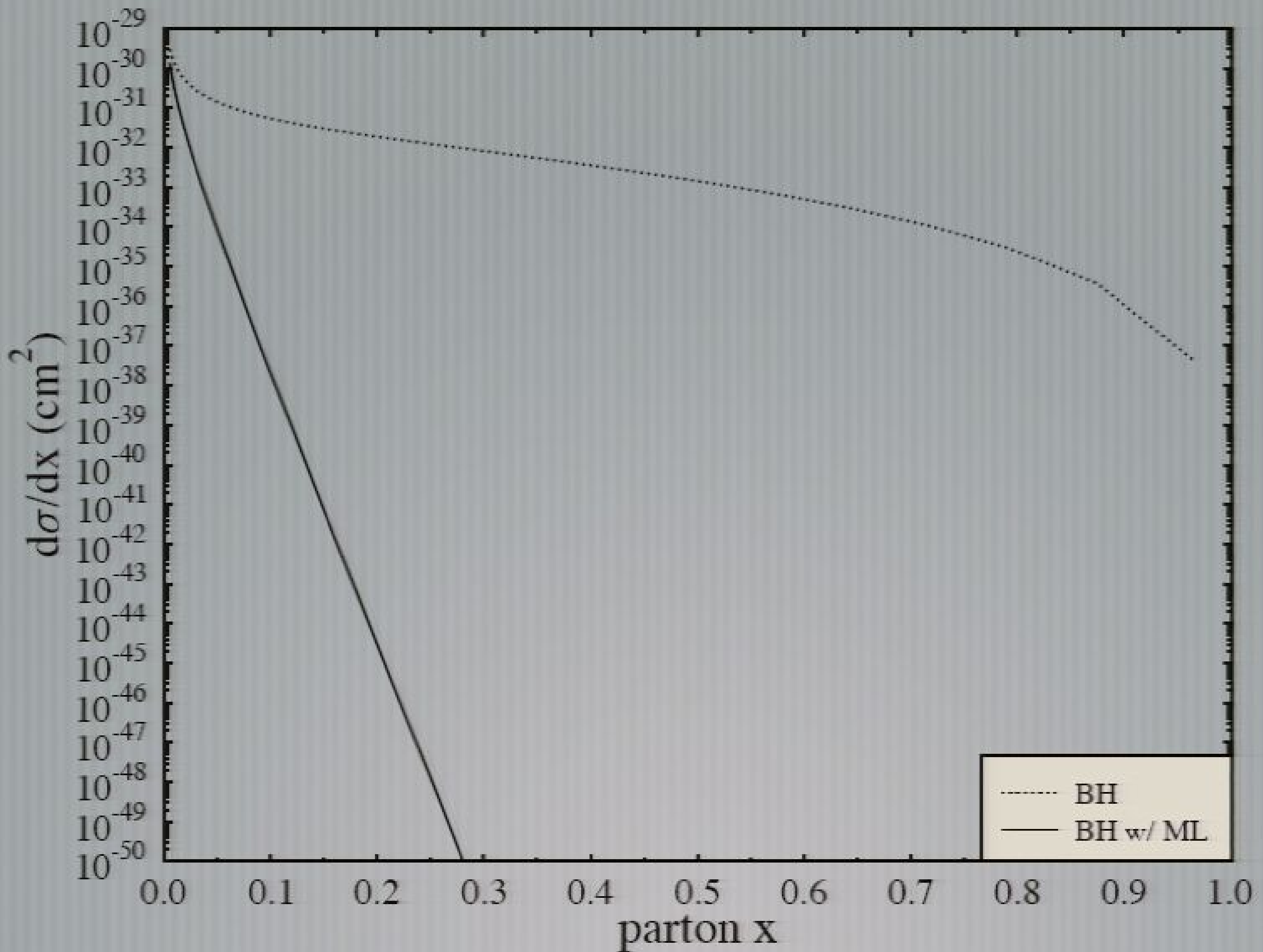
The neutrino - nucleon cross section

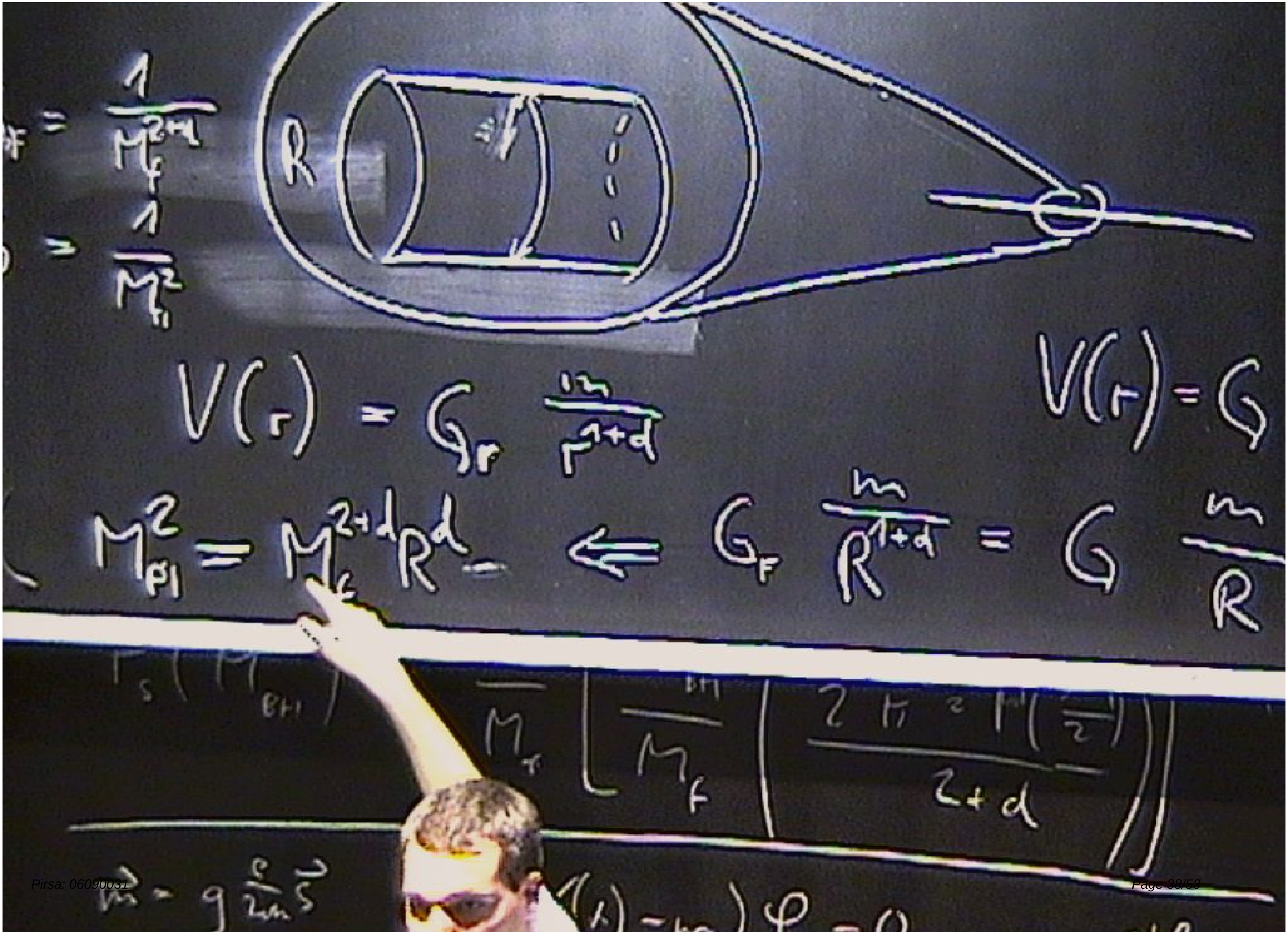


The neutrino - nucleon cross section

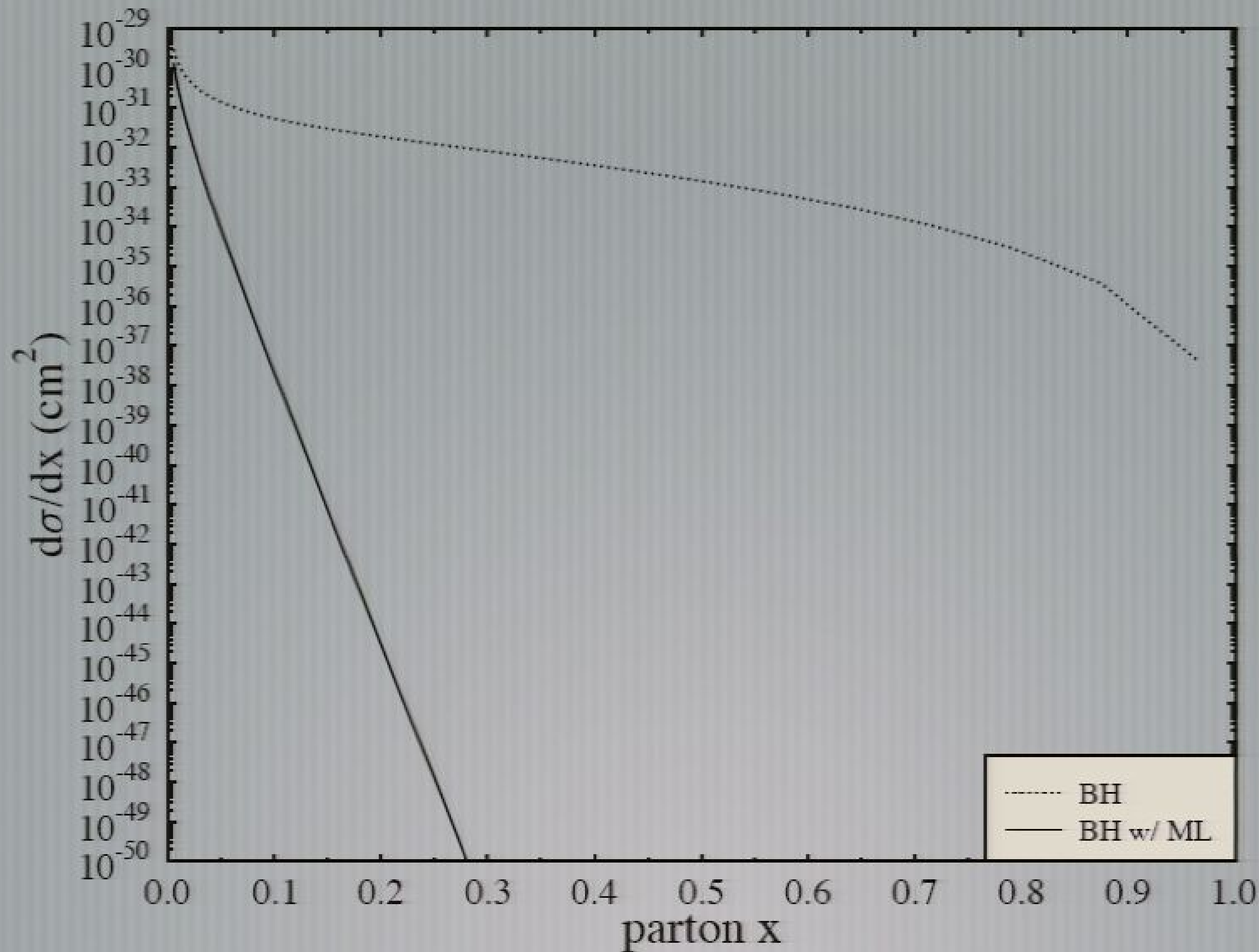


The x dependence of the BH production cross section @$E_\nu=10^8$ GeV

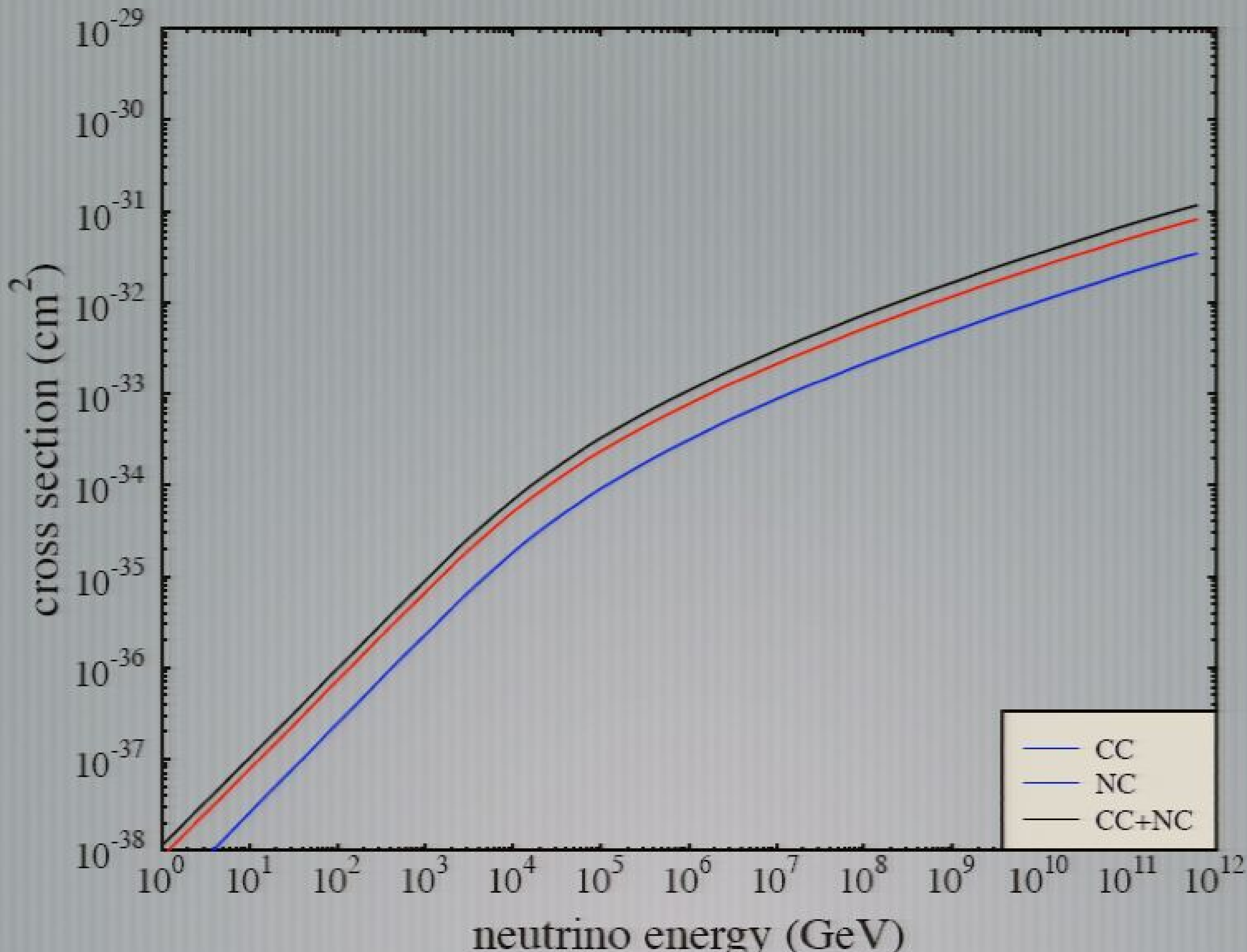



R
V(r) = G_r m/r^{1+d}
V(r) = G
M_{Pl}^2 = M_f^{2+d} R^d ⟸ G_F m/R^{1+d} = G m/R
2 + d

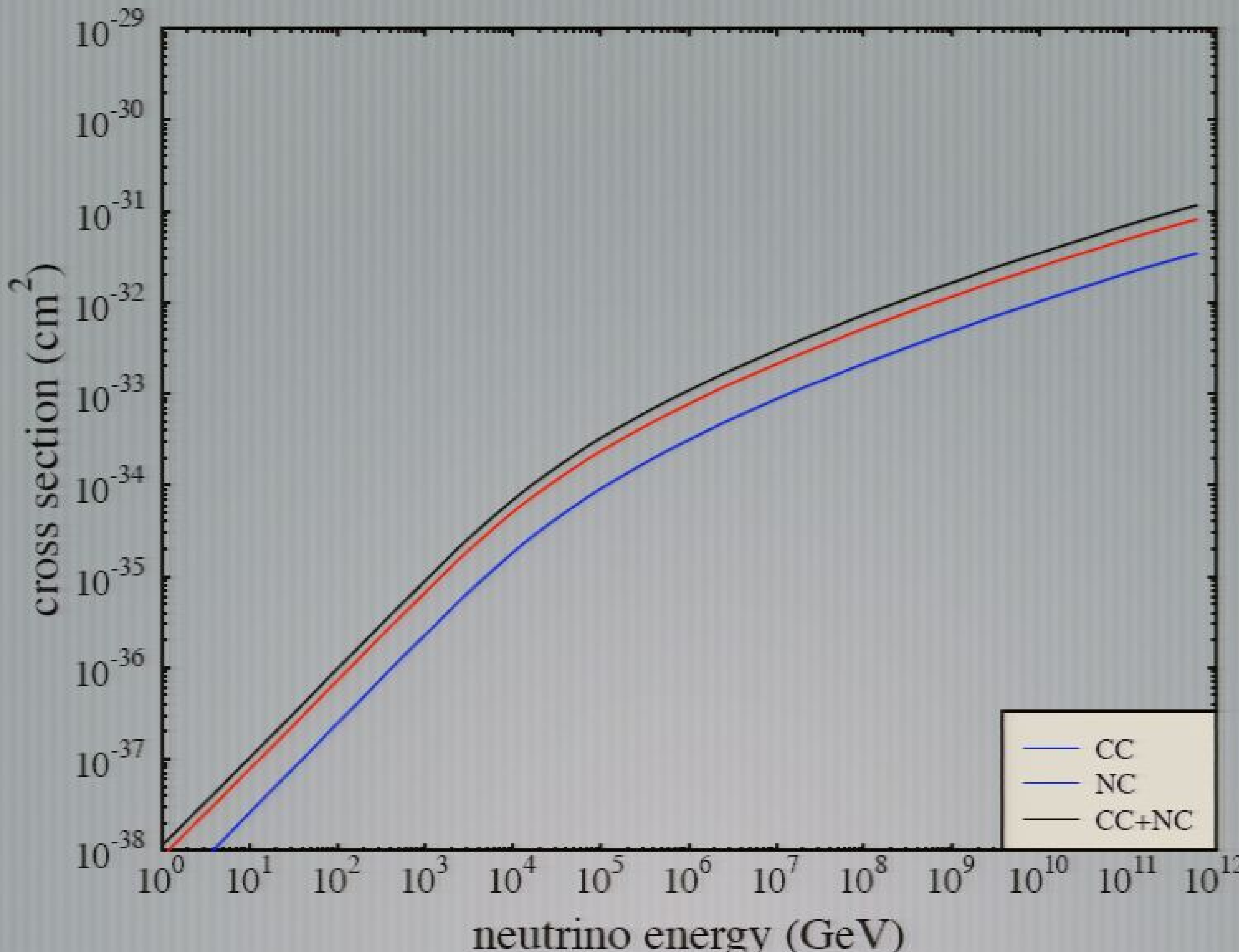
The x dependence of the BH production cross section @$E_\nu=10^8$ GeV



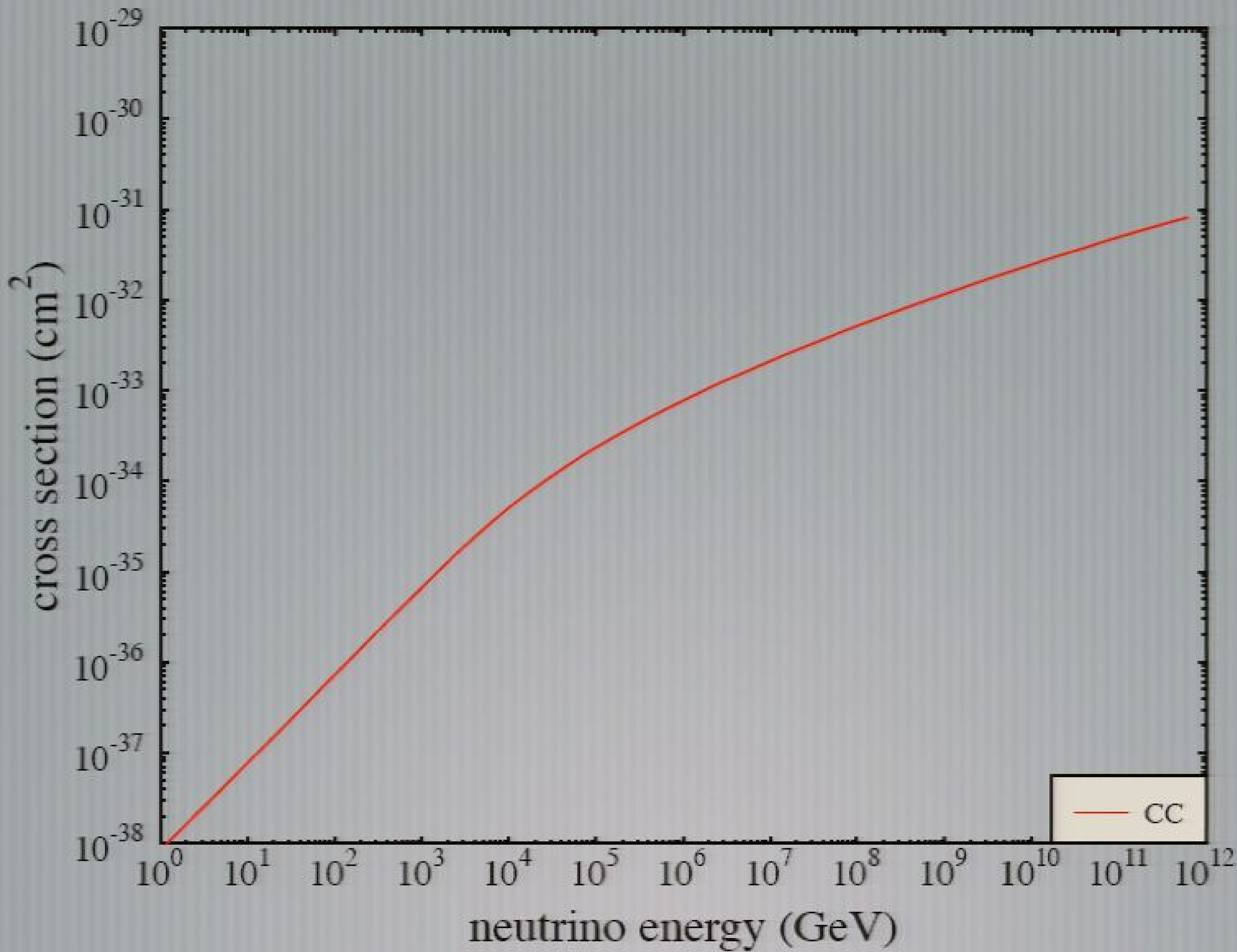
The neutrino - nucleon cross section



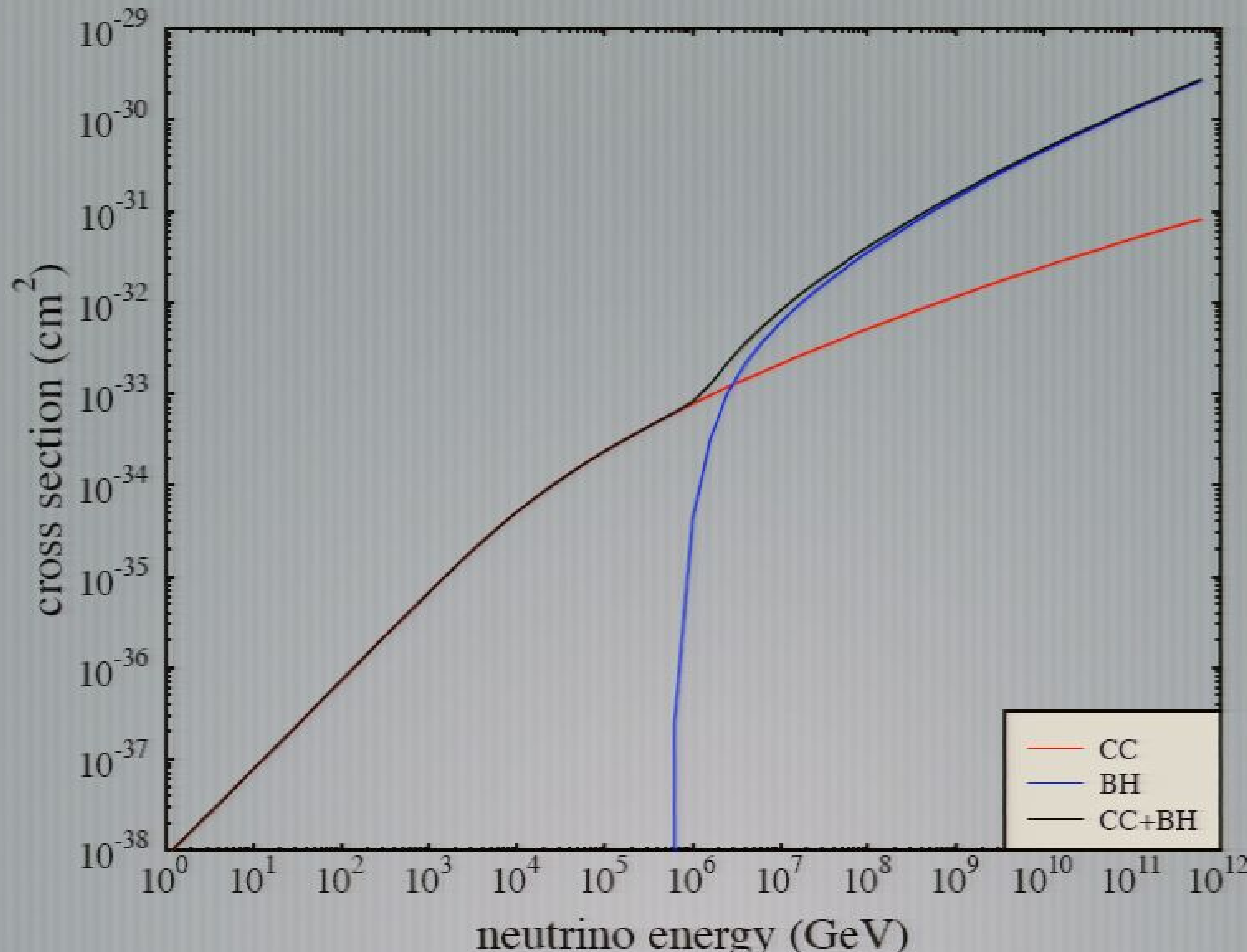
The neutrino - nucleon cross section



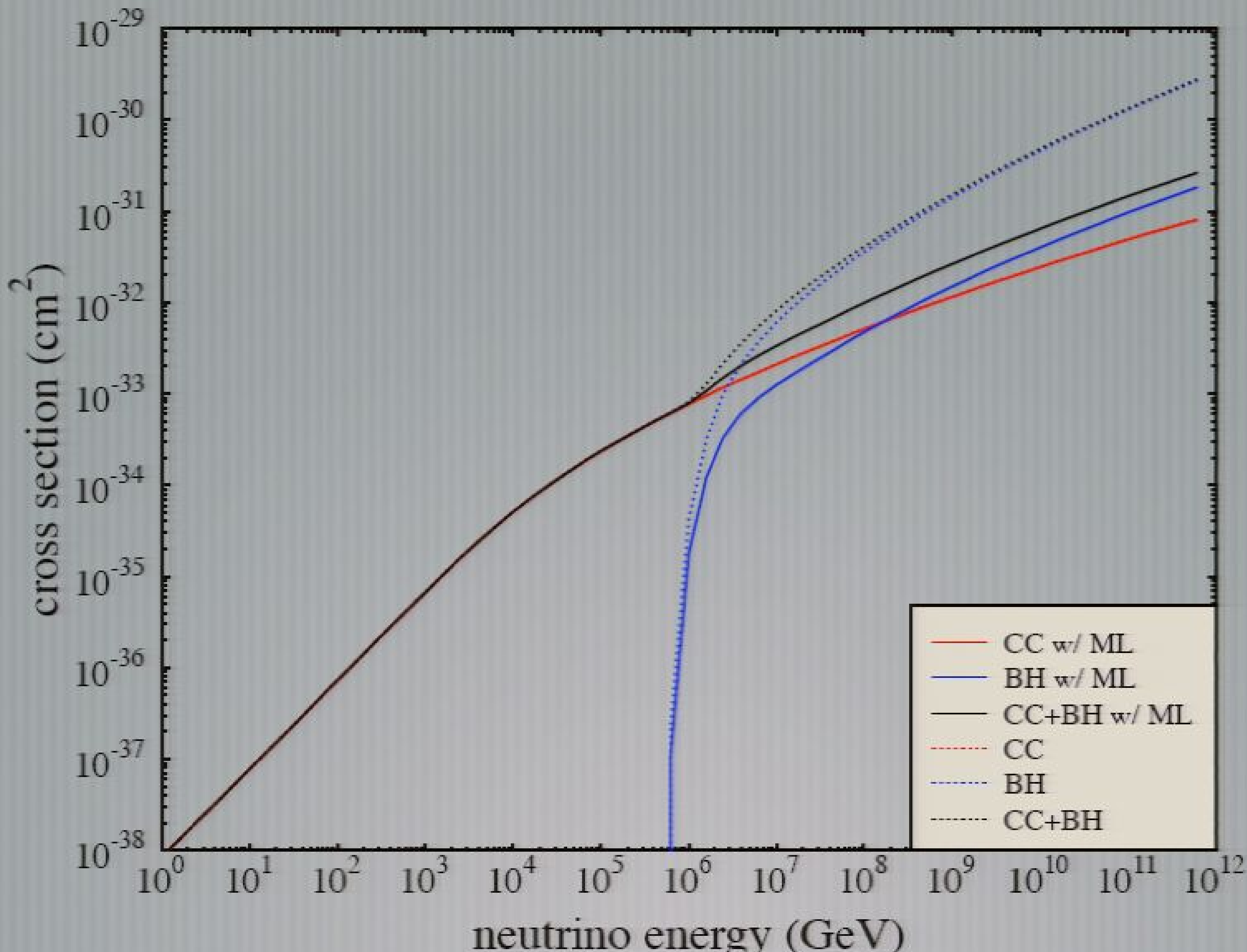
The neutrino - nucleon cross section



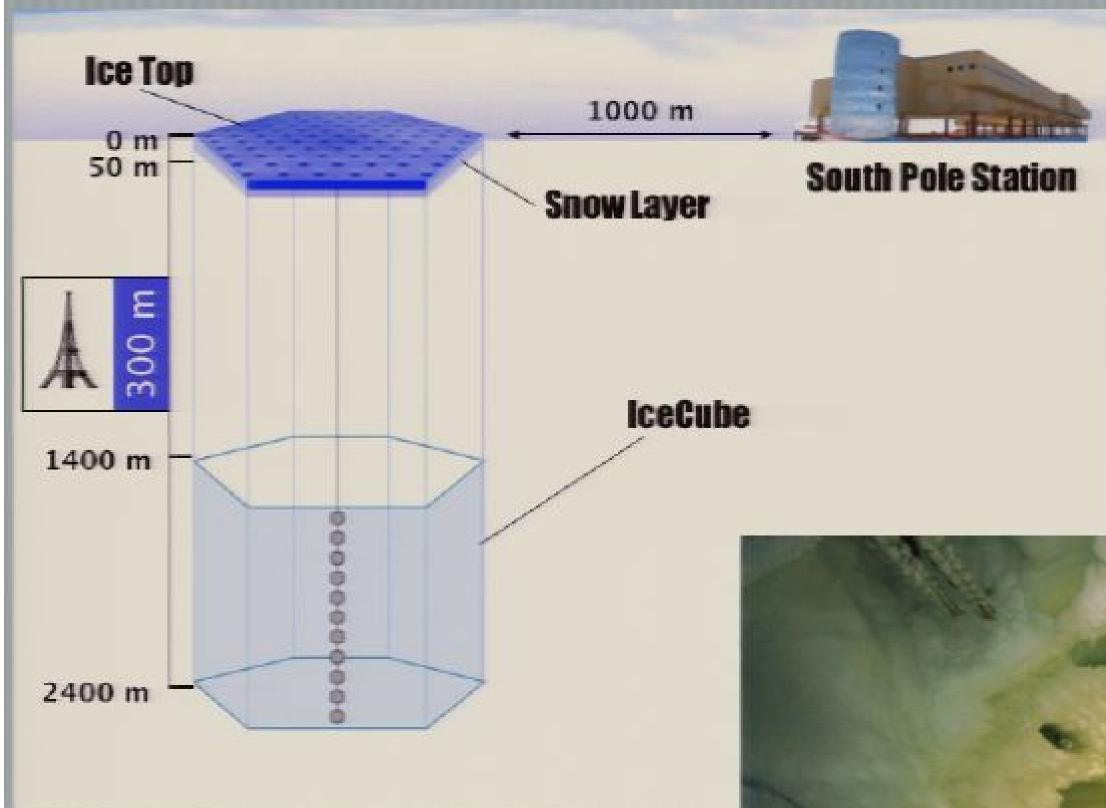
The neutrino - nucleon cross section



The neutrino - nucleon cross section



Predictions for ICECUBE



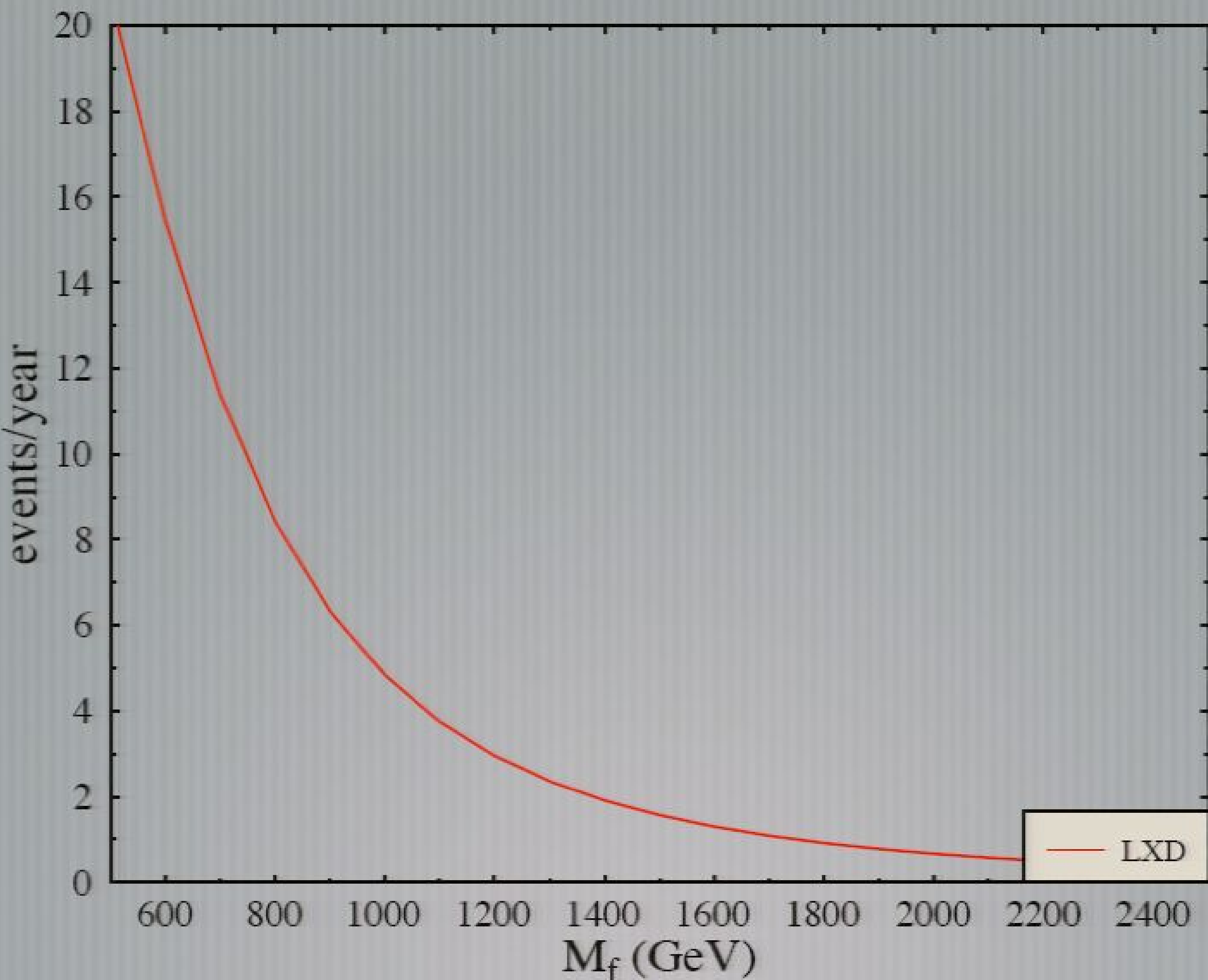
Predictions for ICECUBE

- Calculate the number of black hole events @ICECUBE:

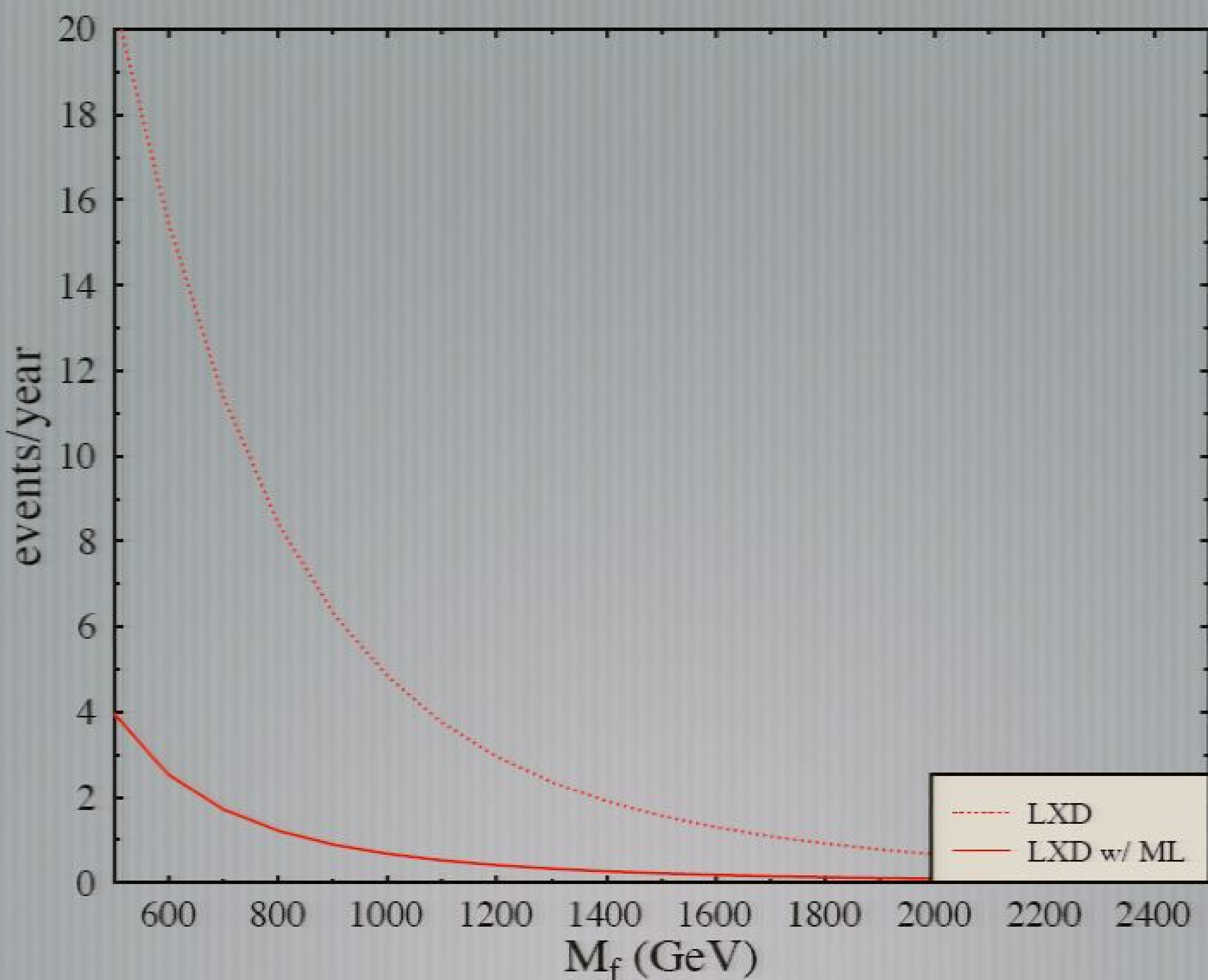
$$\frac{d^2 N_{BH}}{dt\, d\Omega} = \frac{\rho V}{m_N} \int_{E_{th}}^{\infty} F_\nu(E_\nu) \sigma_{\nu N \to BH}(E_\nu) \exp(-\sigma_{\nu N \to X}(E_\nu) X(\theta)/m_N) dE_\nu$$

- Integration over all angles and 1 year yields....

The number of black hole events per year @ICECUBE

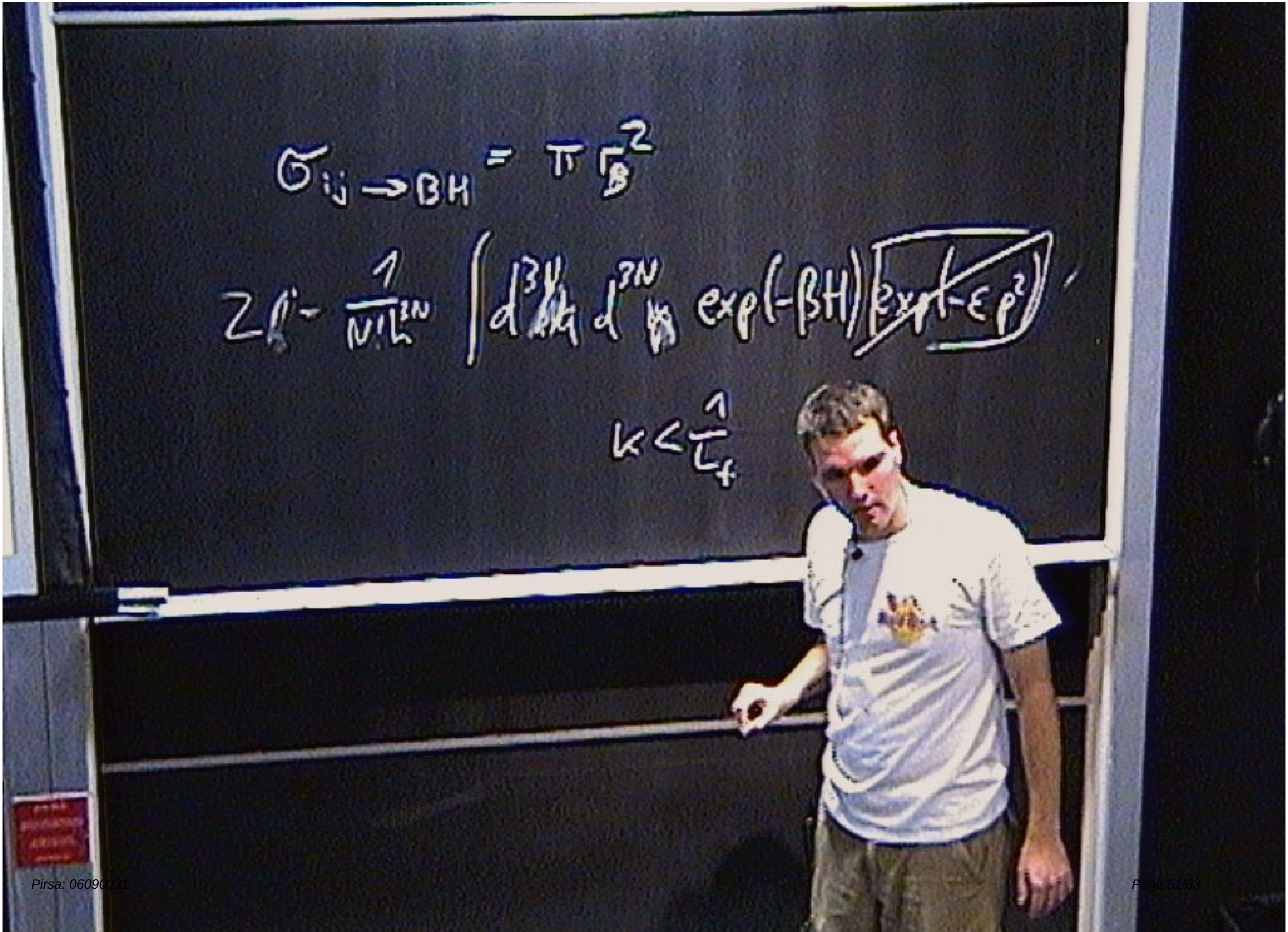


The number of black hole events per year @ICECUBE

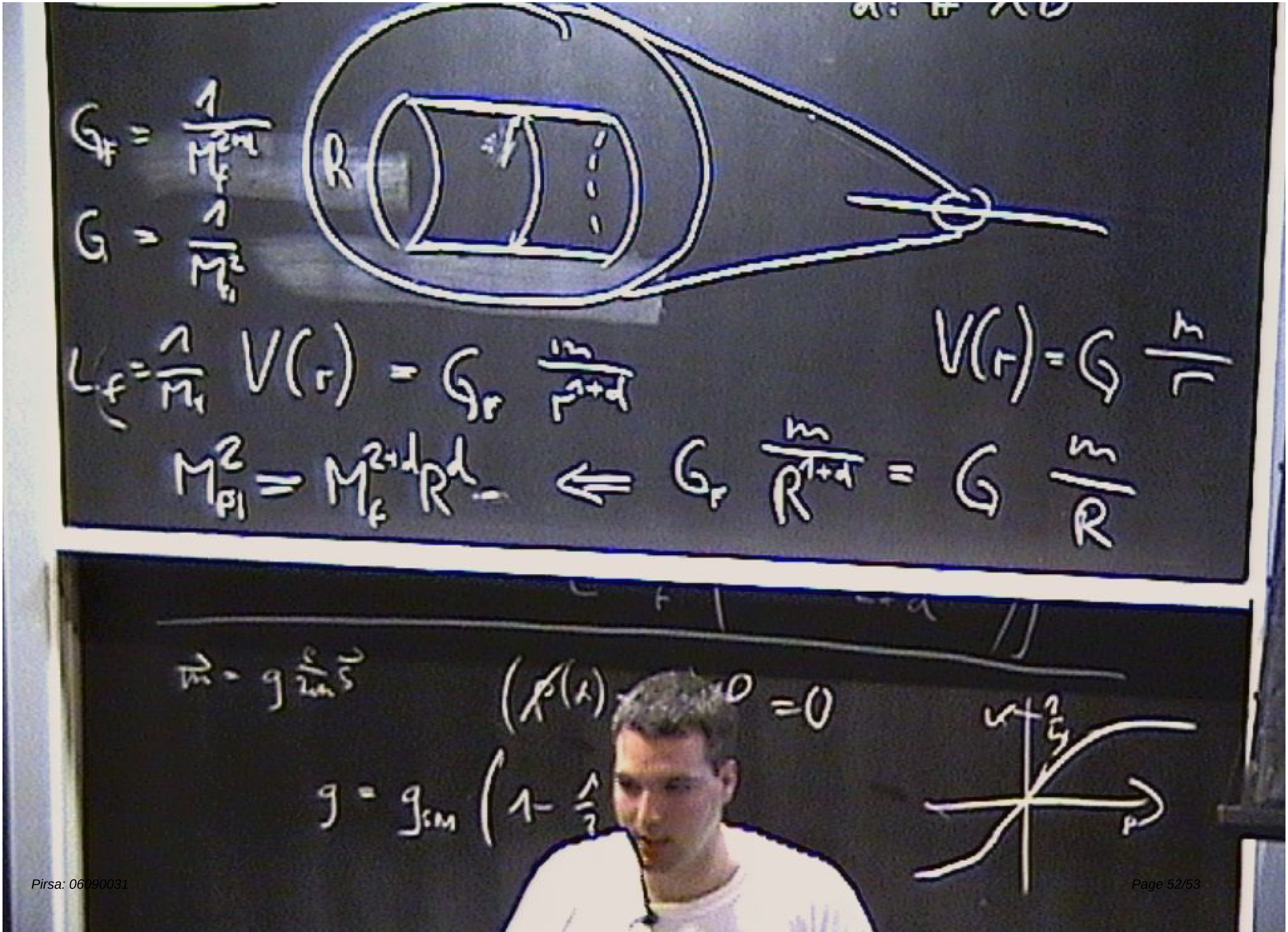


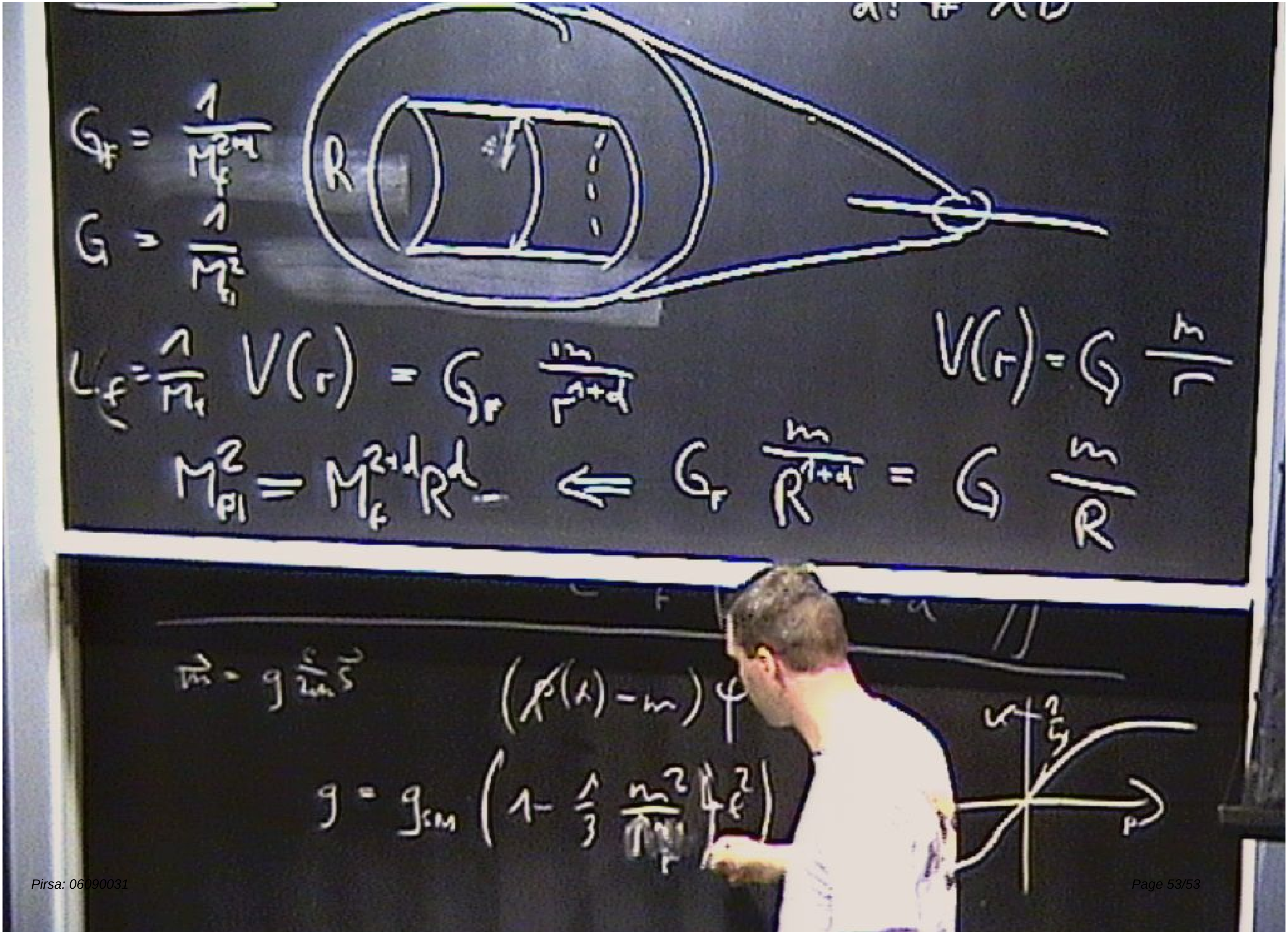
$$\sigma_{ij \to BH} = \pi r_s^2$$

$$Z\beta = \frac{1}{N!\, h^{3N}} \int d^{3N}q \, d^{3N}p \, \exp(-\beta H) \exp(-\varepsilon p^2)$$



σ ij → BH = π r_B^2
k < 1/L_f


$G_F = \frac{1}{M_F^{2+d}}$
$G = \frac{1}{M_{Pl}^2}$
R
$L_F = \frac{1}{M_F}$
$V(r) = G_F \frac{m}{r^{1+d}}$
$V(r) = G \frac{m}{r}$
$M_{Pl}^2 = M_F^{2+d} R^d \Leftarrow G_F \frac{m}{R^{1+d}} = G \frac{m}{R}$
$=0$


G_F = 1/M_F^{2+d}
G = 1/M_Pl^2
R
L_F = 1/M_F
V(r) = G_F m/r^{1+d}
V(r) = G m/r
M_Pl^2 = M_F^{2+d} R^d
G_F m/R^{1+d} = G m/R
(p(A) − m) ψ
g = g_SM (1 − 1/3 m^2 ...)