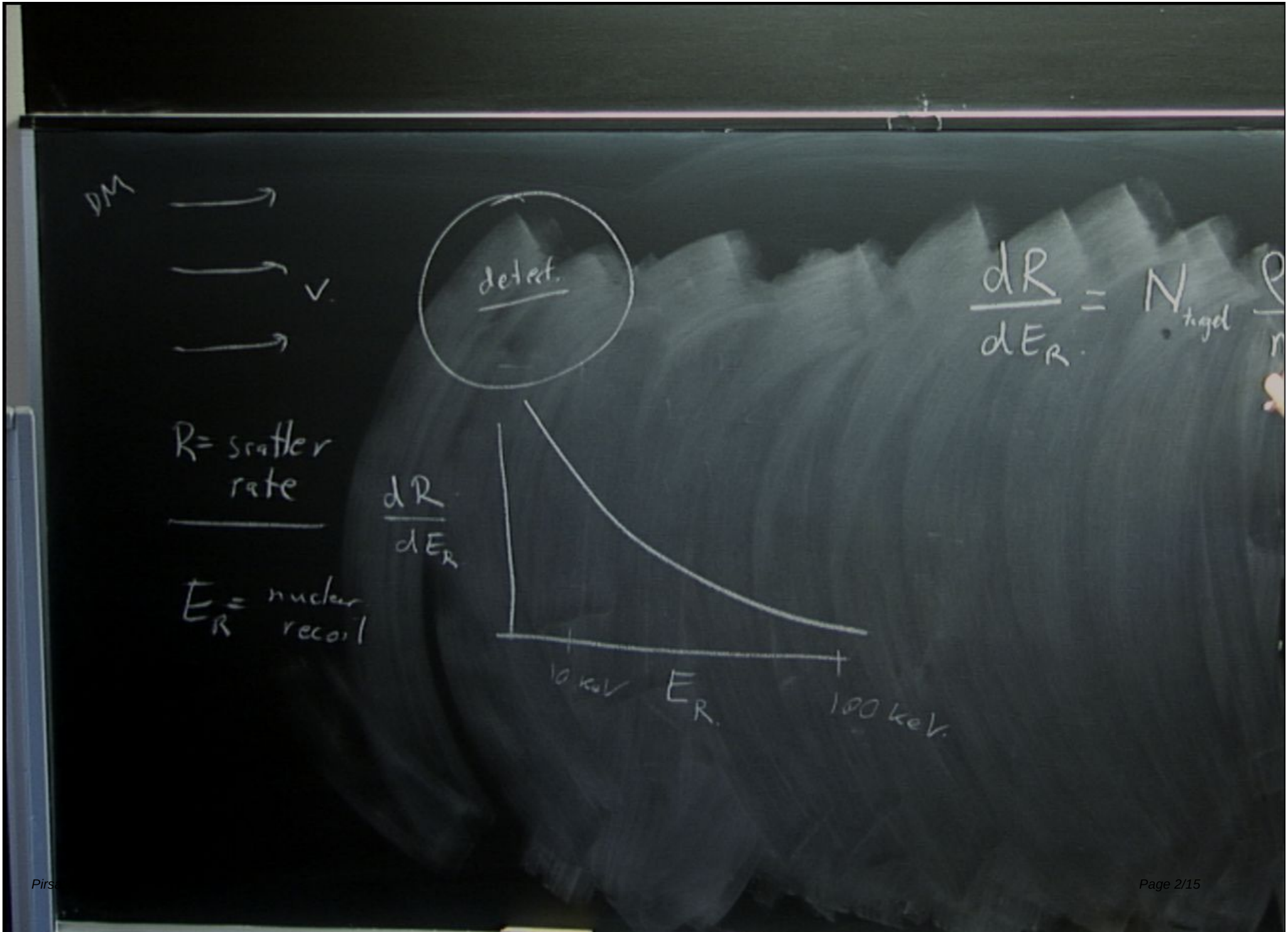
Title: Explorations in Particle Theory - Lecture 10

Date: Apr 21, 2011 10:15 AM

URL: http://pirsa.org/11040032

Abstract:


DM
v
detect.
$\frac{dR}{dE_R} = N_{tgt}$
R = scatter rate
E_R = nuclear recoil
$\frac{dR}{dE_R}$
10 keV
E_R
100 keV

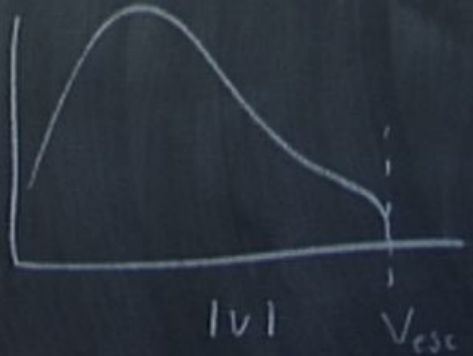
$$\frac{dR}{dE_R} = N_{target} \frac{\rho_{DM}}{m_{DM}} \int d^3v \; v \cdot f(v, v_E) \frac{d\sigma}{dE_R}$$

keV

$$= N_{target} \frac{\rho_{DM}}{m_{DM}} \int_{V_{min}(E_R)}^{V_{esc}} d^3v \; v \cdot f(v, v_E) \frac{d\sigma}{dE_R}$$ $_{DM+nuc \to DM+nuc}$

$V_{esc} \sim 500 - 600 \frac{km}{s}$

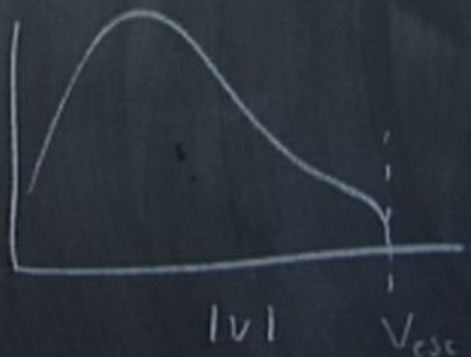
$V_{earth} \sim 220 \frac{km}{s}$



$$= N_{target} \frac{\rho_{DM}}{m_{DM}} \int_{V_{min}(E_R)}^{V_{esc}} d^3v \; v \cdot f(v, v_E) \frac{d\sigma}{dE_R}_{DM+nuc \to DM+nuc}$$

$V_{esc} \sim 500 - 600 \frac{km}{s}$

$V_{earth} \sim 220 \frac{km}{s}$

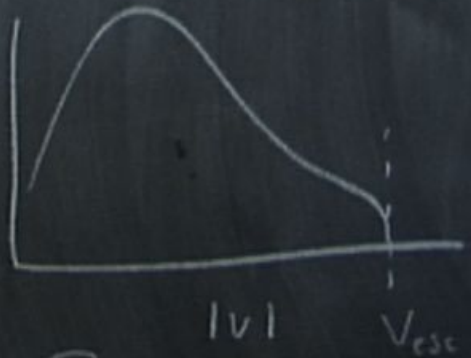


$$V_{min}(E_R) = \frac{\sqrt{2 m_{DM} E_R}}{2 \mu_{DM,N}}$$

$$= N_{target} \frac{\rho_{DM}}{m_{DM}} \int_{V_{min}(E_R)}^{V_{esc}} d^3v \; v \cdot f(v, v_E) \frac{d\sigma}{dE_R}_{DM+nuc \to DM+nuc}$$

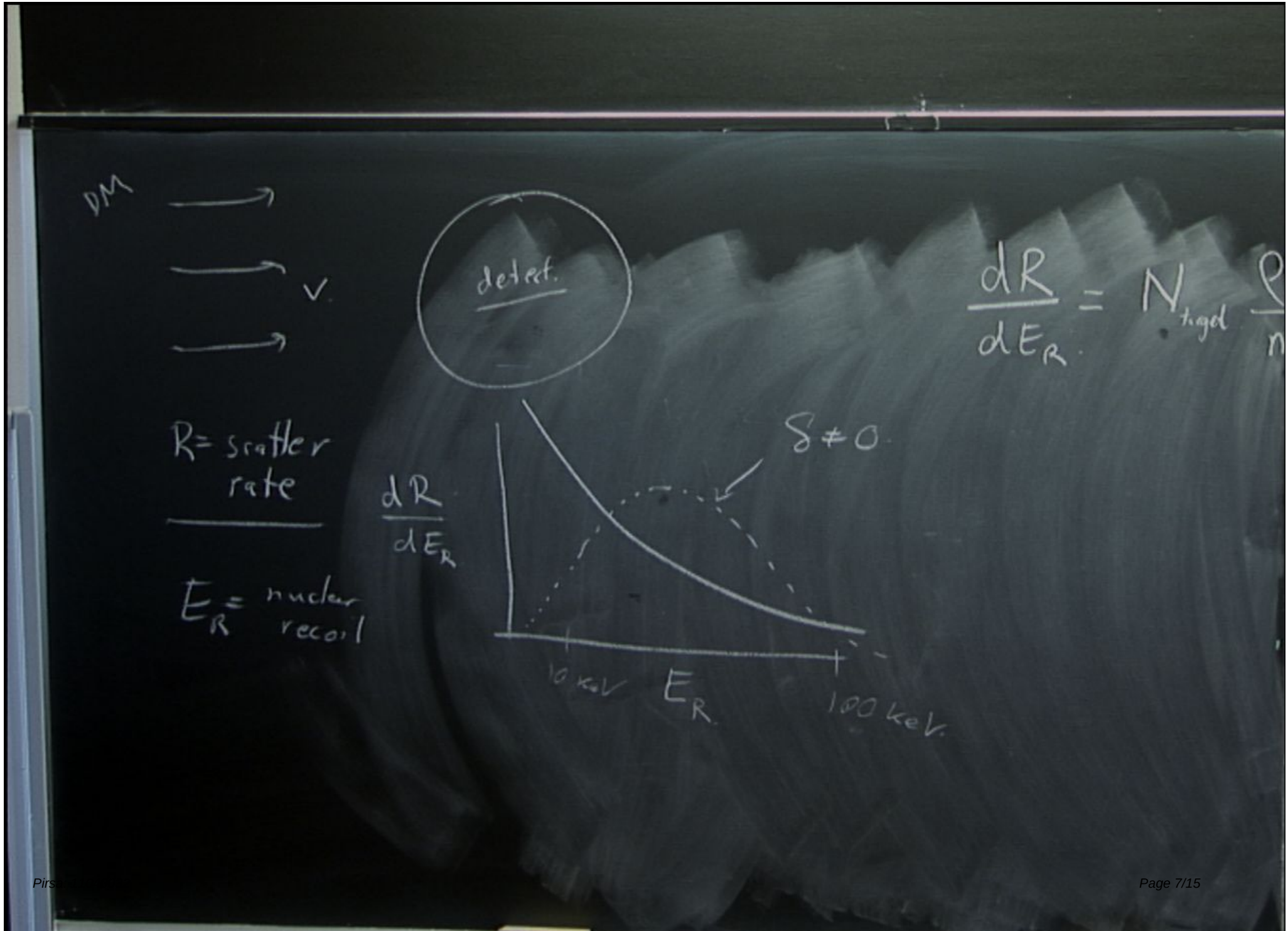
$v_{esc} \sim 500 - 600 \frac{km}{s}$

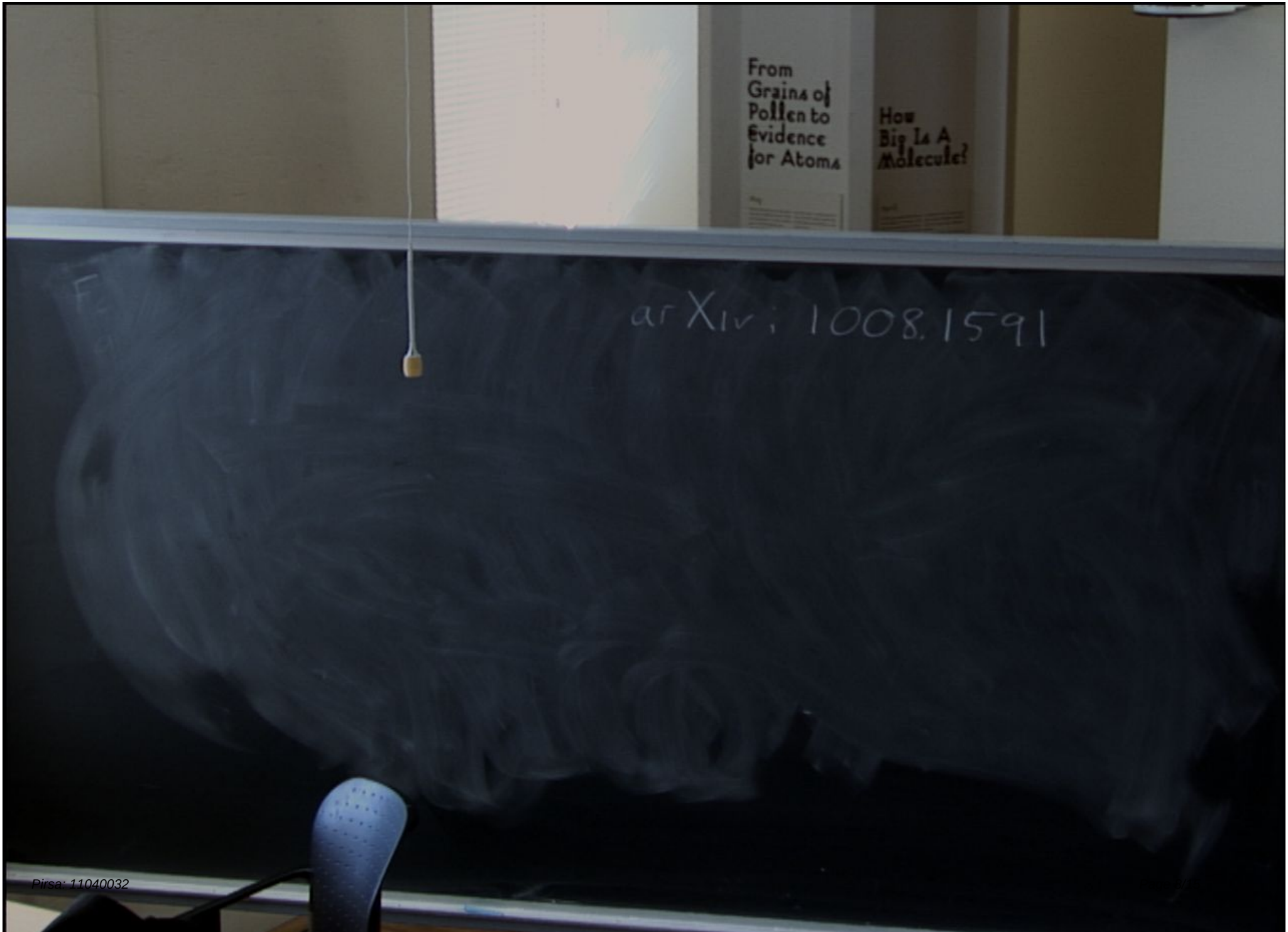
$v_{earth} \sim 220 \frac{km}{s}$



$$v_{min}(E_R) = \frac{\sqrt{2 m_{Nucleus} E_R}}{2 \mu_{DM,N}} + \frac{S}{\sqrt{2 m_{nuc} E_R}}$$

$S = m^*_{DM}$

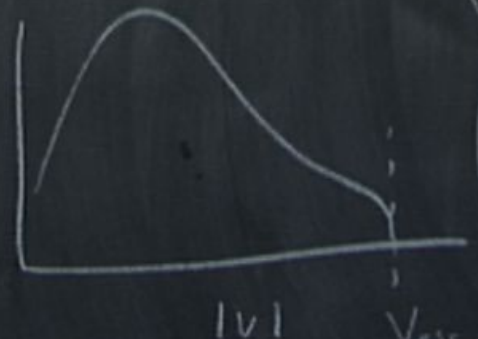

DM
v
detect.
$\frac{dR}{dE_R} = N_{target} \frac{\rho}{m}$
R = scatter rate
E_R = nuclear recoil
$\frac{dR}{dE_R}$
$\delta \neq 0$
10 keV
E_R
100 keV



$$\frac{dR}{dE_R} \propto n_{DM} \int_{V_{min}(E_R)}^{V_{esc}} d^3v \; v \cdot f(v, v_E) \frac{d\sigma}{dE_R}_{DM+nuc \to DM+nuc}$$

$V_{esc} \sim 500 - 600 \frac{km}{s}$

$V_{Earth} \sim 220 \frac{km}{s}$



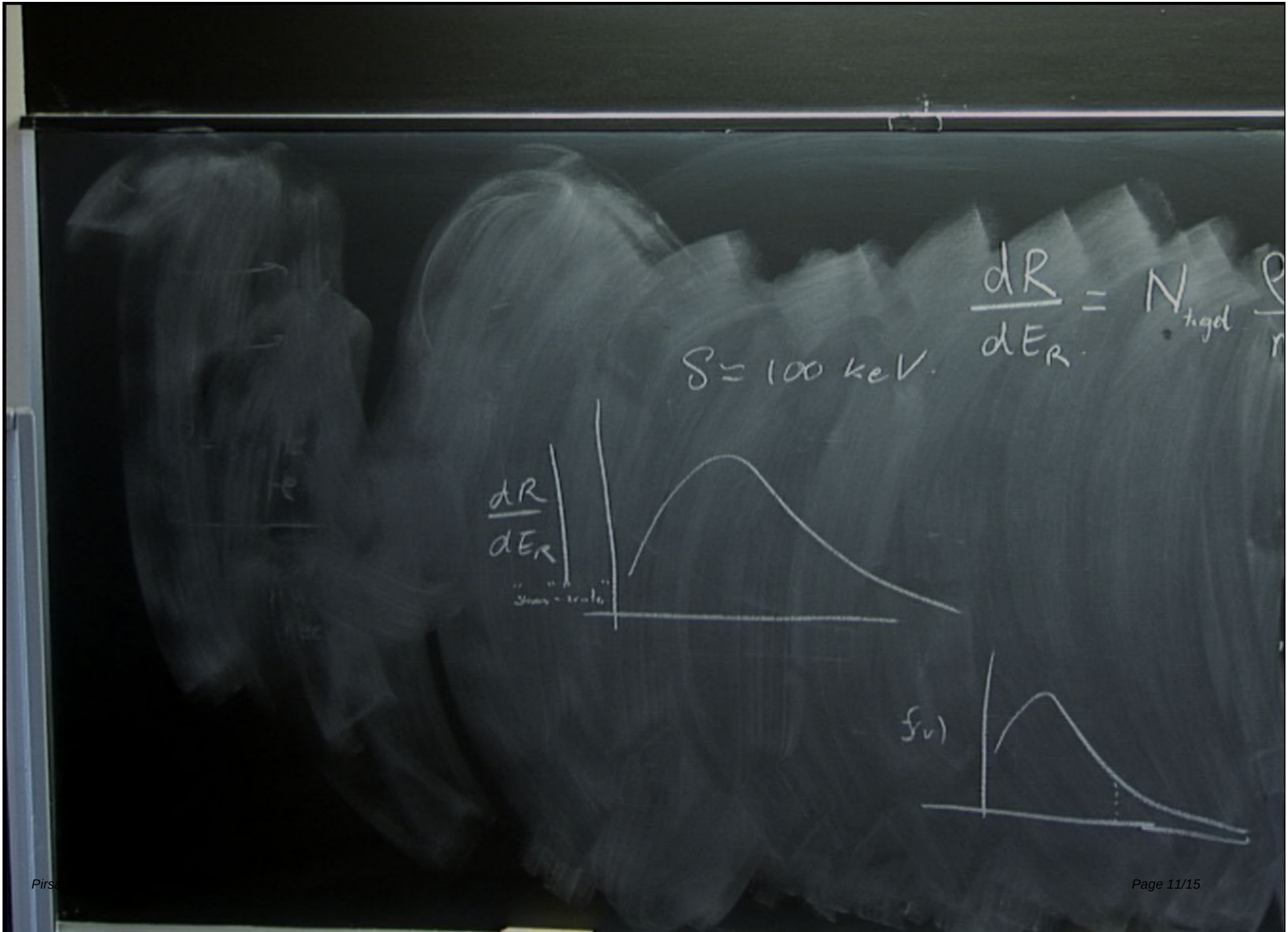
$|M|^2 \sim \frac{1}{q^4}$

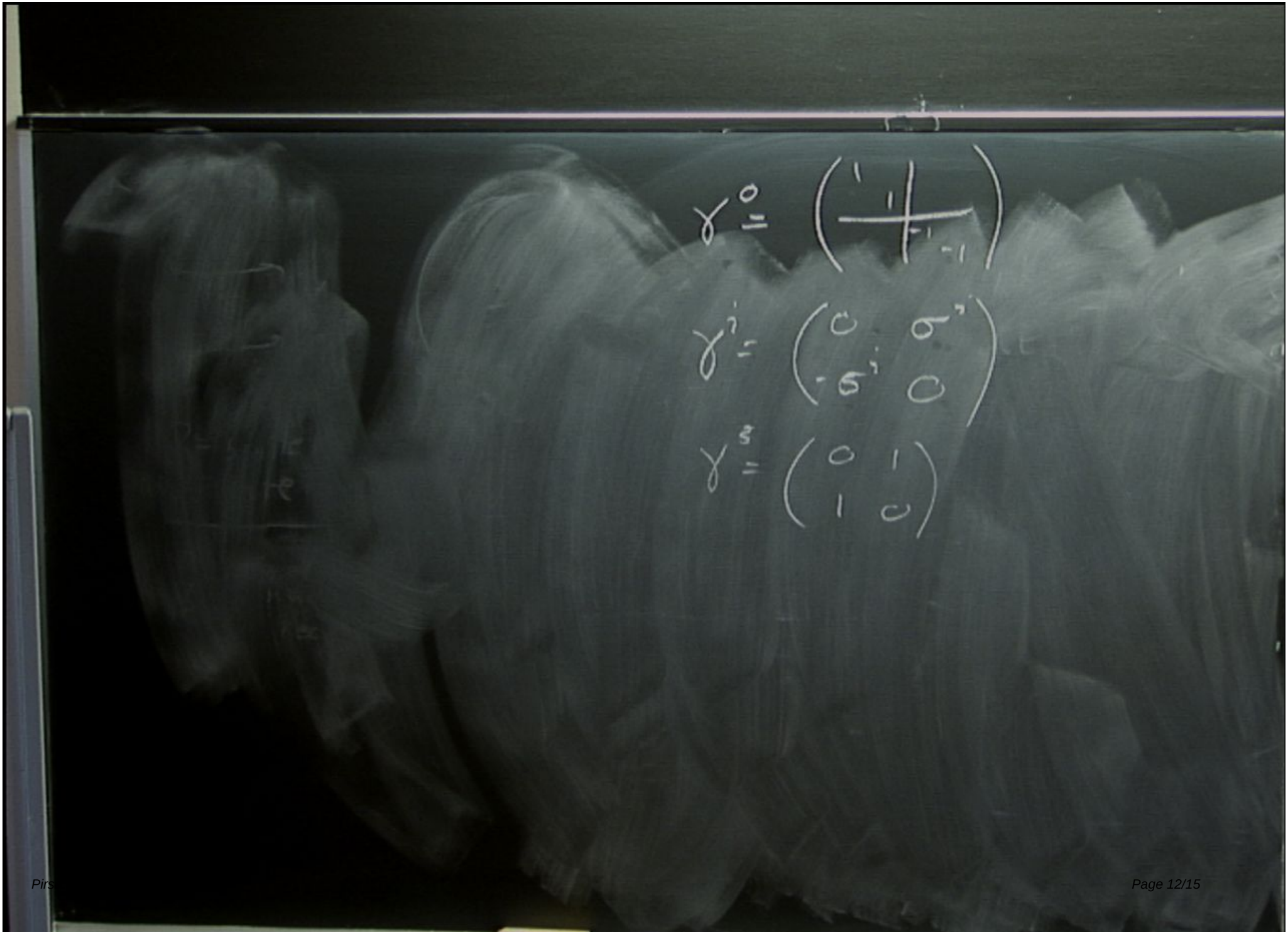
$$V_{min}(E_R) = \frac{\sqrt{2 m_{Nucleus} E_R}}{2 \mu_{DMN}} + \frac{S}{\sqrt{2 m_{nuc.} E_R}}$$

$$S = m^*_{DM} - m_{DM}$$

$\frac{dR}{dE_R} = N_{target}$

$S \simeq 100\ keV.$


$\frac{dR}{dE_R} = N_{tgd}$
$S \simeq 100\ keV.$
$\frac{dR}{dE_R}$
f_{v_1}

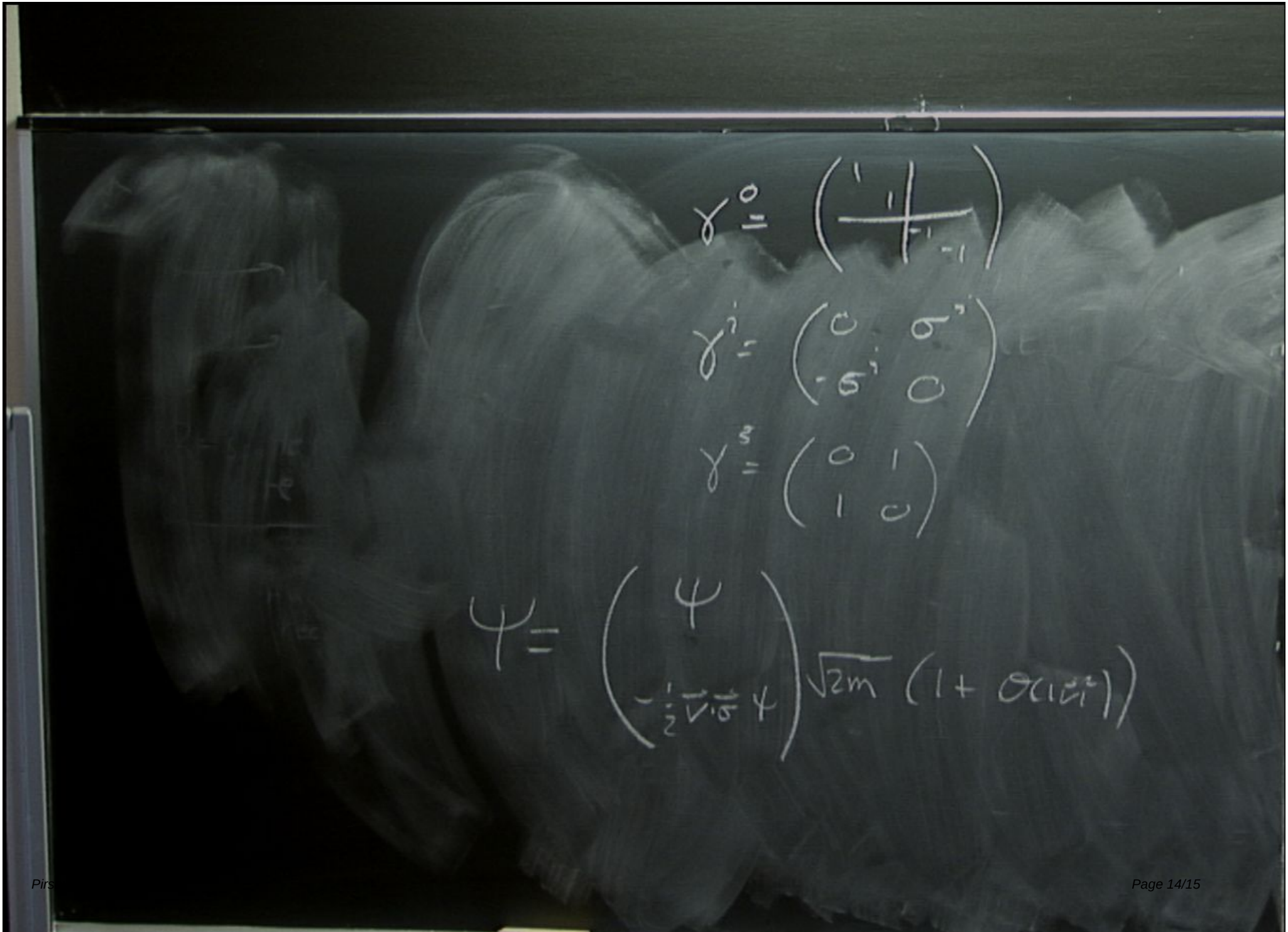

$\gamma^0 = \begin{pmatrix} 1 & & & \\ & 1 & & \\ & & -1 & \\ & & & -1 \end{pmatrix}$
$\gamma^i = \begin{pmatrix} 0 & \sigma^i \\ -\sigma^i & 0 \end{pmatrix}$
$\gamma^5 = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

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

$$m(\not{v} - 1)\psi = 0 \qquad v^0 = 1 - \frac{|\vec{v}|^2}{2} + \Theta(|\vec{v}|^3)$$

$$(\not{v} - 1)\begin{pmatrix}\psi\\ \chi\end{pmatrix} = \left[(v^\mu\gamma^0 - 1) + \vec{v}\cdot\vec{\gamma}\right]\begin{pmatrix}\psi\\ \chi\end{pmatrix}$$

$$\begin{pmatrix} -\frac{|\vec{v}|^2}{2} & \vec{v}\cdot\vec{\sigma} \\ -\vec{v}\cdot\vec{\sigma} & -2 + \Theta(|\vec{v}|^2)\end{pmatrix}\begin{pmatrix}\psi\\ \chi\end{pmatrix} = 0 \longrightarrow \chi = -\frac{1}{2}\vec{v}\cdot\vec{\sigma}\,\psi\left(1 + \Theta(|\vec{v}|^2)\right)$$


$\gamma^0 = \begin{pmatrix} 1 & & & \\ & 1 & & \\ & & -1 & \\ & & & -1 \end{pmatrix}$
$\gamma^i = \begin{pmatrix} 0 & \sigma^i \\ -\sigma^i & 0 \end{pmatrix}$
$\gamma^5 = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$
$\Psi = \begin{pmatrix} \psi \\ -\frac{1}{2}\vec{\nabla}\cdot\vec{\sigma}\,\psi \end{pmatrix} \sqrt{2m}\,(1 + O(|\vec{v}|^2))$