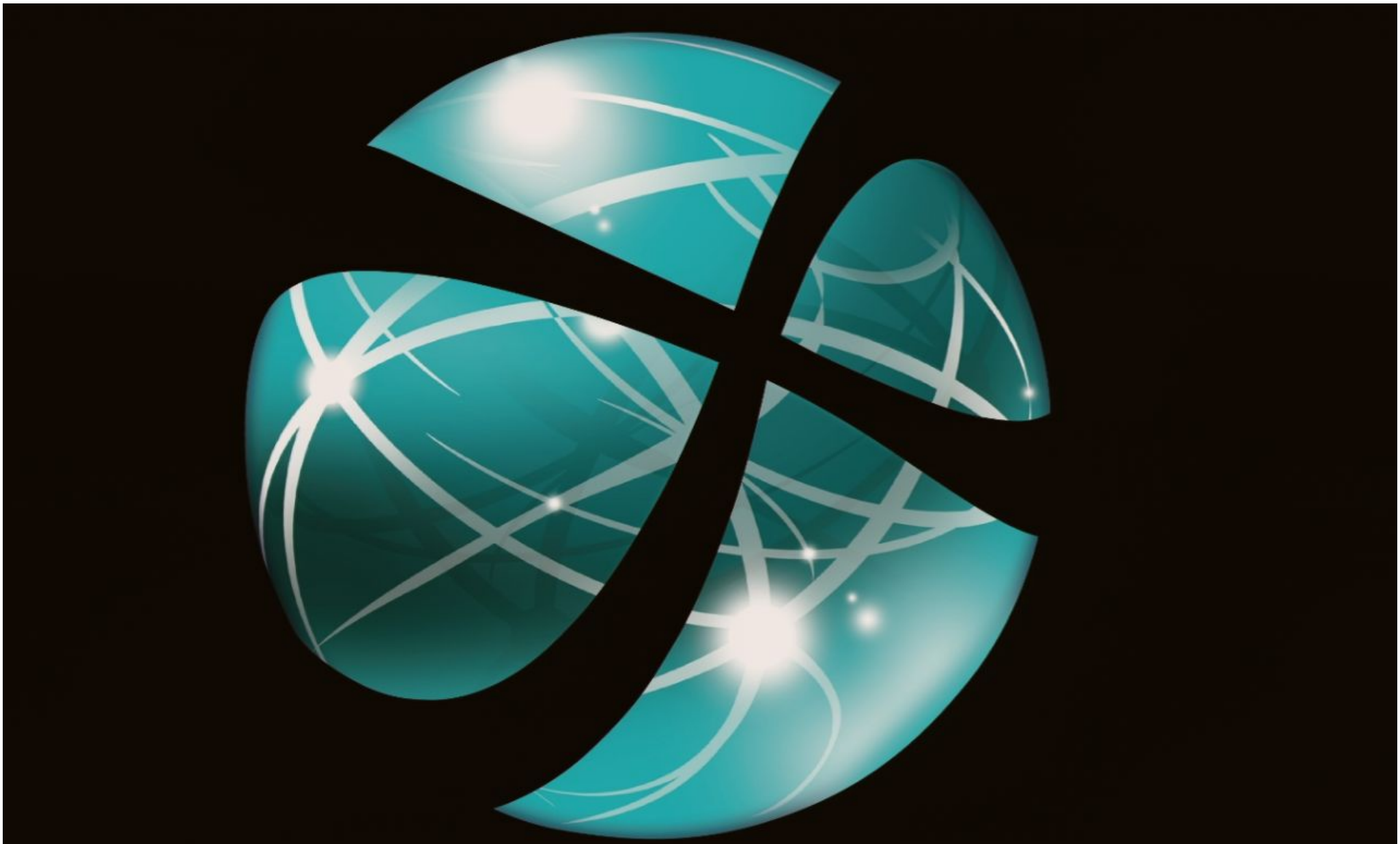
Title: Condensed Matter Review - Lecture 8

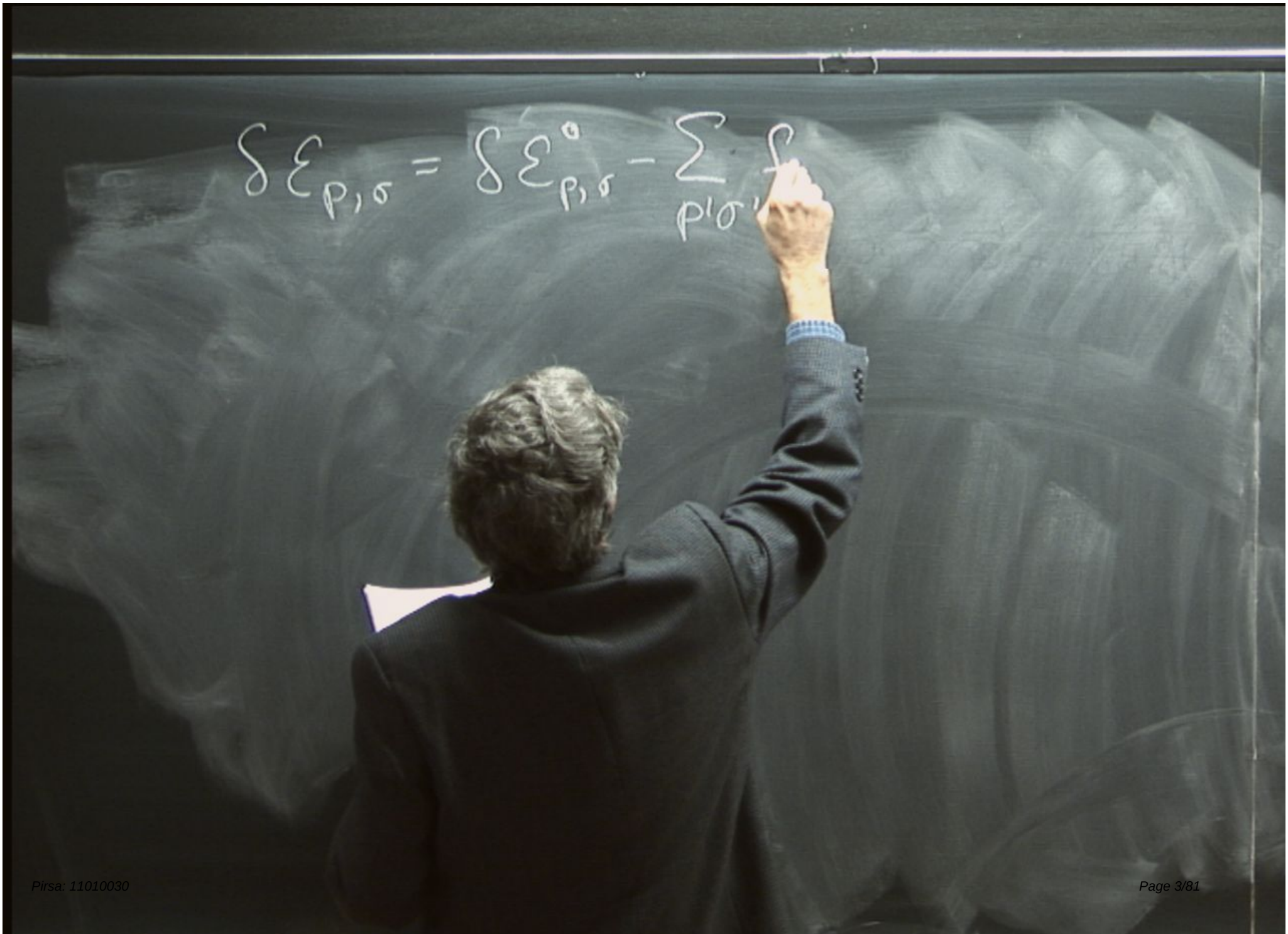
Date: Jan 12, 2011 10:15 AM

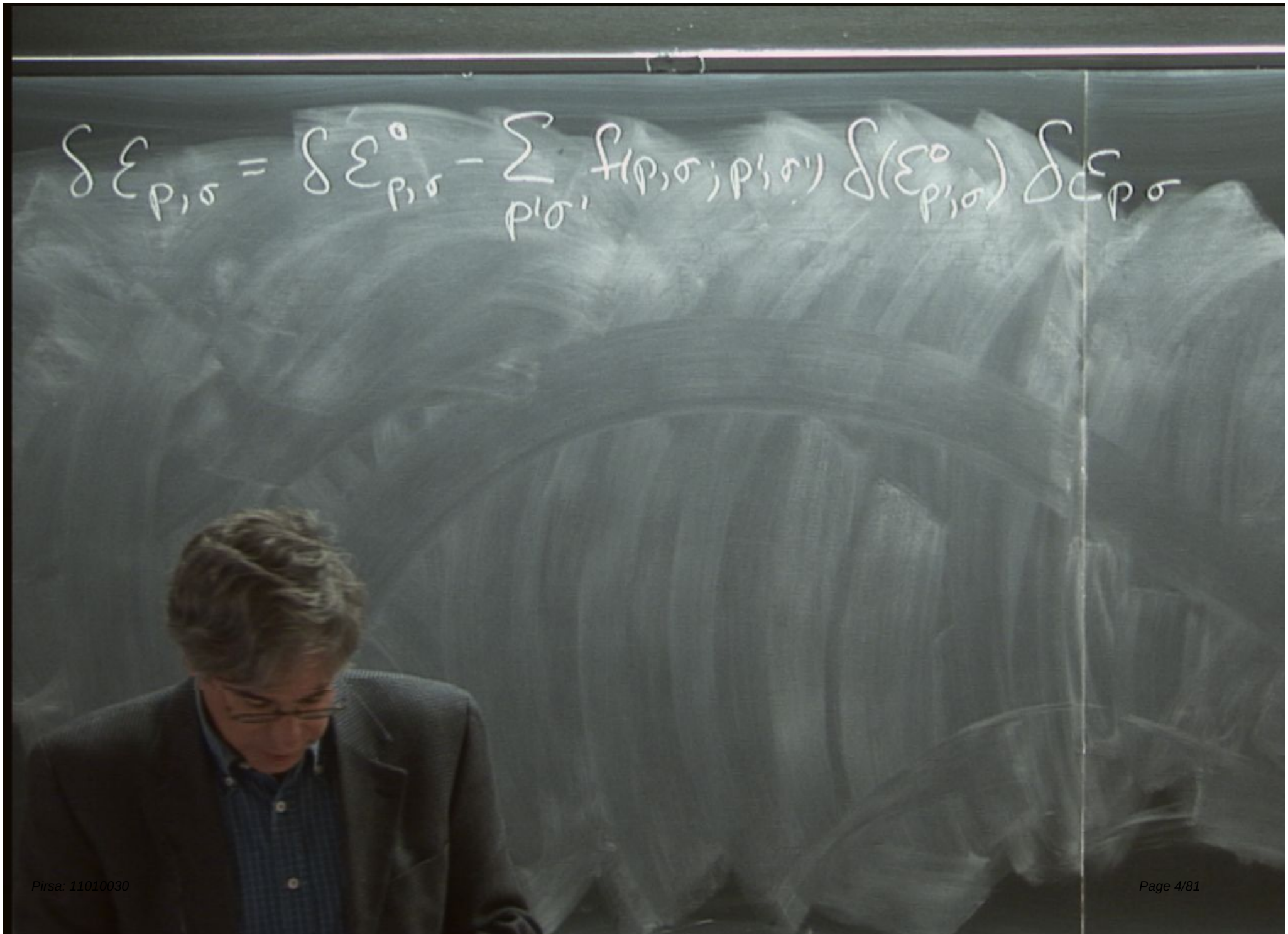
URL: http://pirsa.org/11010030

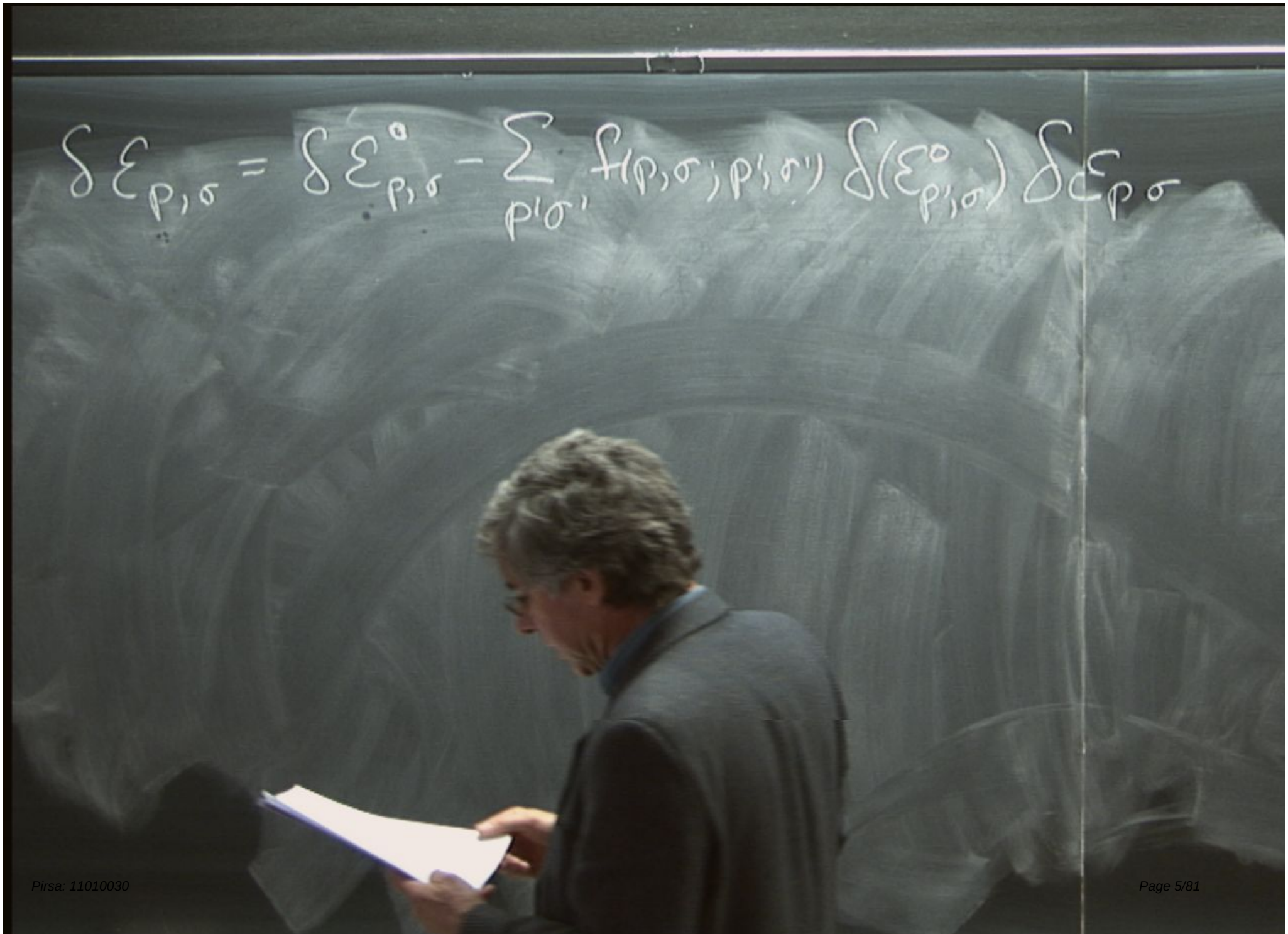
Abstract:

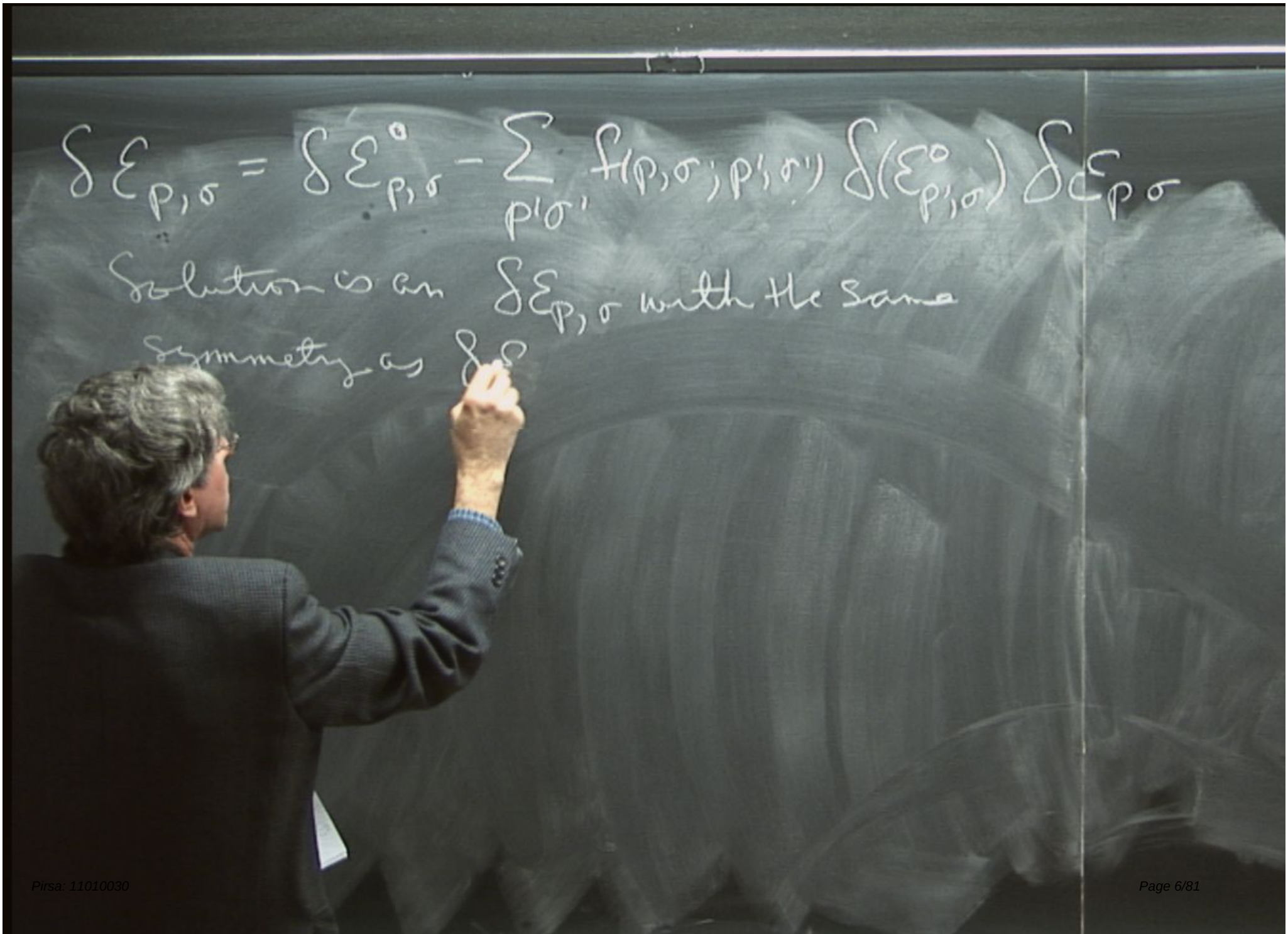


perimeter scholars international


$\delta \varepsilon_{p,\sigma} = \delta \varepsilon^{0}_{p,\sigma} - \sum_{p'\sigma'} f$


$\delta \varepsilon_{p,\sigma} = \delta \varepsilon^{0}_{p,\sigma} - \sum_{p'\sigma'} f(p,\sigma;p',\sigma') \, \delta(\varepsilon^{0}_{p',\sigma}) \, \delta\varepsilon_{p\sigma}$


$\delta \varepsilon_{p,\sigma} = \delta \varepsilon^{0}_{p,\sigma} - \sum_{p'\sigma'} f(p,\sigma;p',\sigma') \, \delta(\varepsilon^{0}_{p',\sigma}) \, \delta\varepsilon_{p\sigma}$


$\delta \varepsilon_{p,\sigma} = \delta \varepsilon^{0}_{p,\sigma} - \sum_{p'\sigma'} f(p,\sigma;p',\sigma') \, \delta(\varepsilon^{0}_{p',\sigma}) \, \delta\varepsilon_{p\sigma}$
Solution is an $\delta\varepsilon_{p,\sigma}$ with the same
symmetry as $\delta\varepsilon$

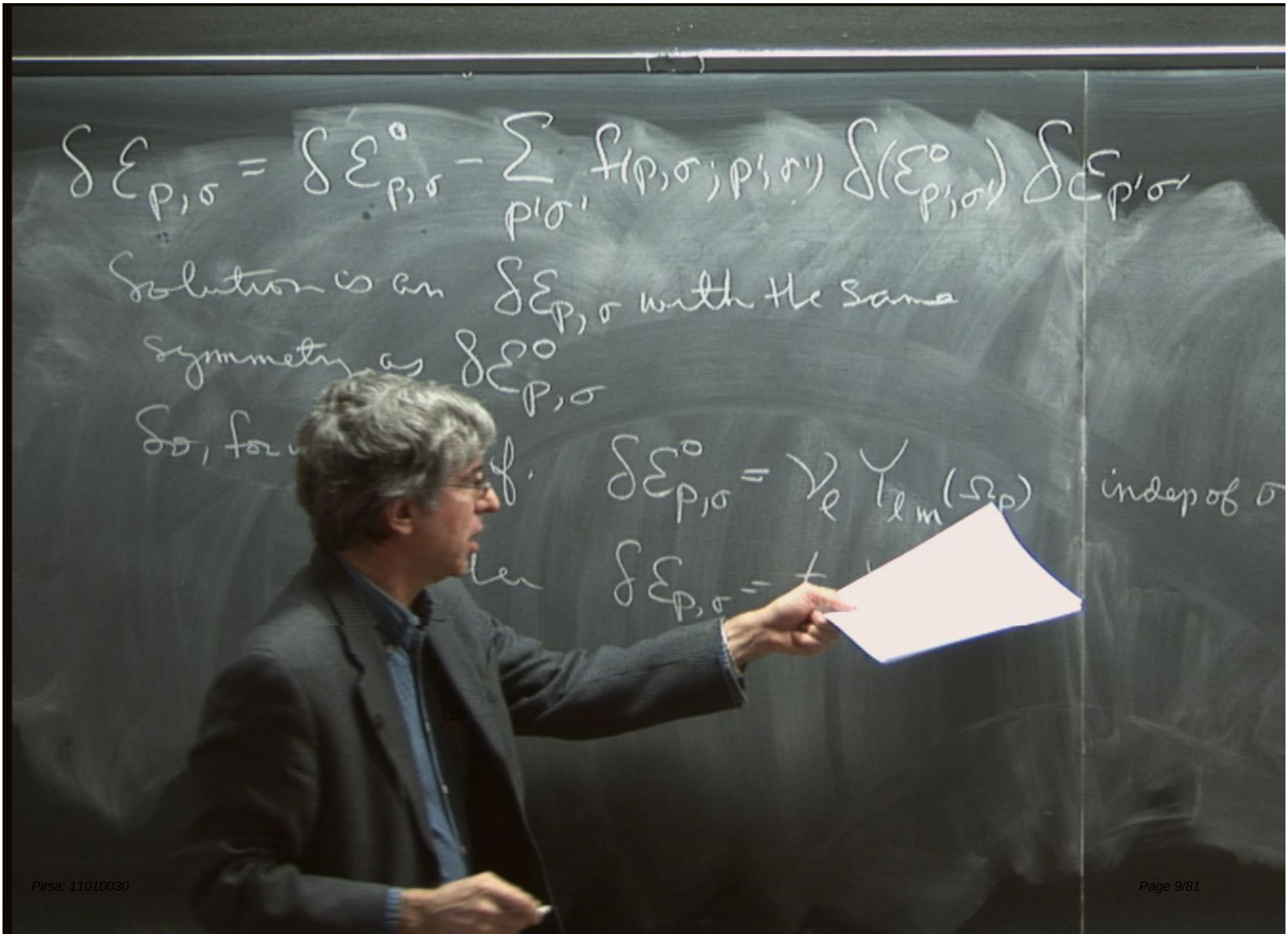
$$\delta \varepsilon_{p,\sigma} = \delta \varepsilon^{0}_{p,\sigma} - \sum_{p'\sigma'} f(p,\sigma;p',\sigma')\, \delta(\varepsilon^{0}_{p',\sigma})\, \delta\varepsilon_{p\sigma}$$

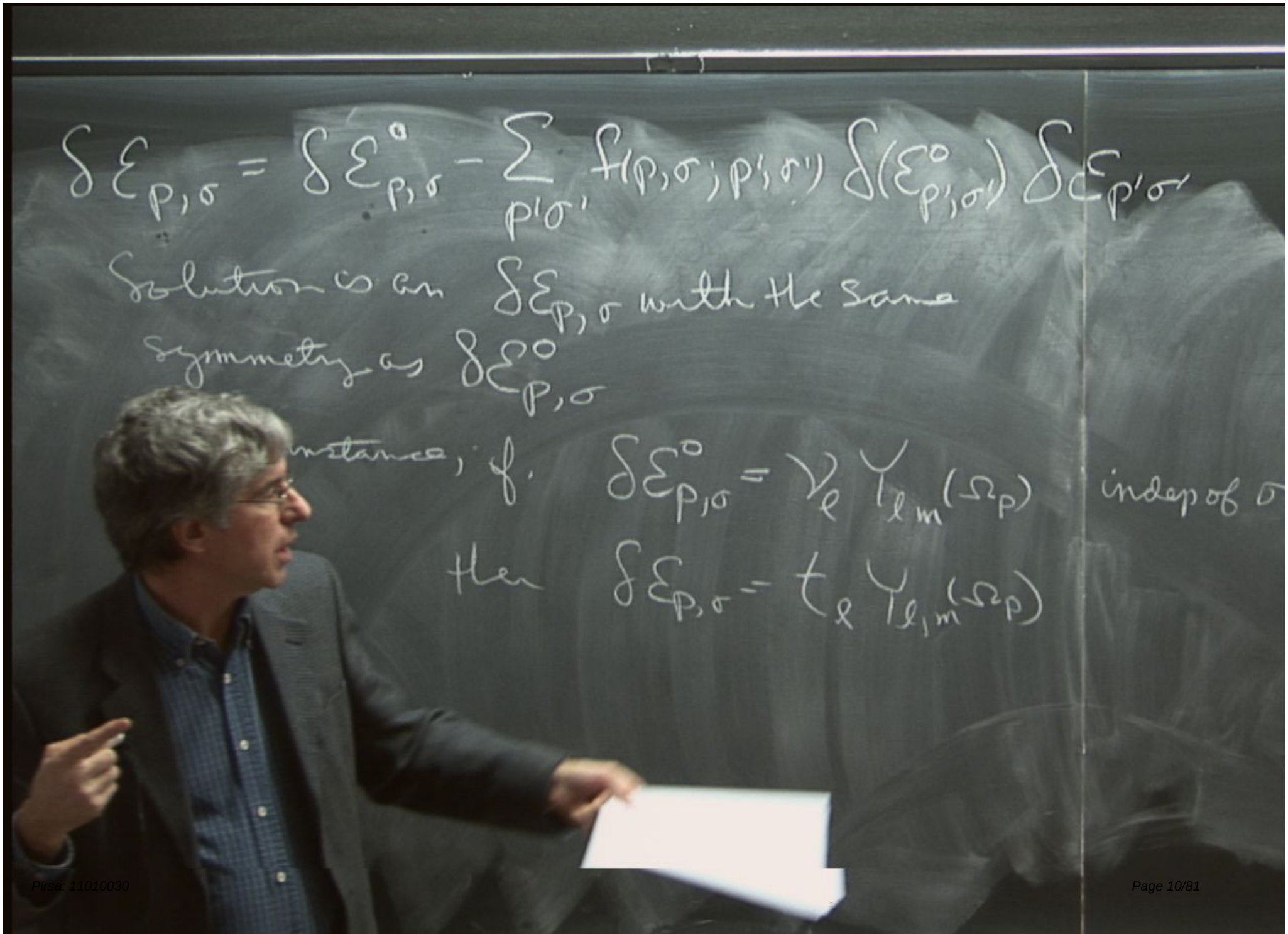
Solution is an $\delta\varepsilon_{p,\sigma}$ with the same symmetry as $\delta\varepsilon^{0}_{p,\sigma}$

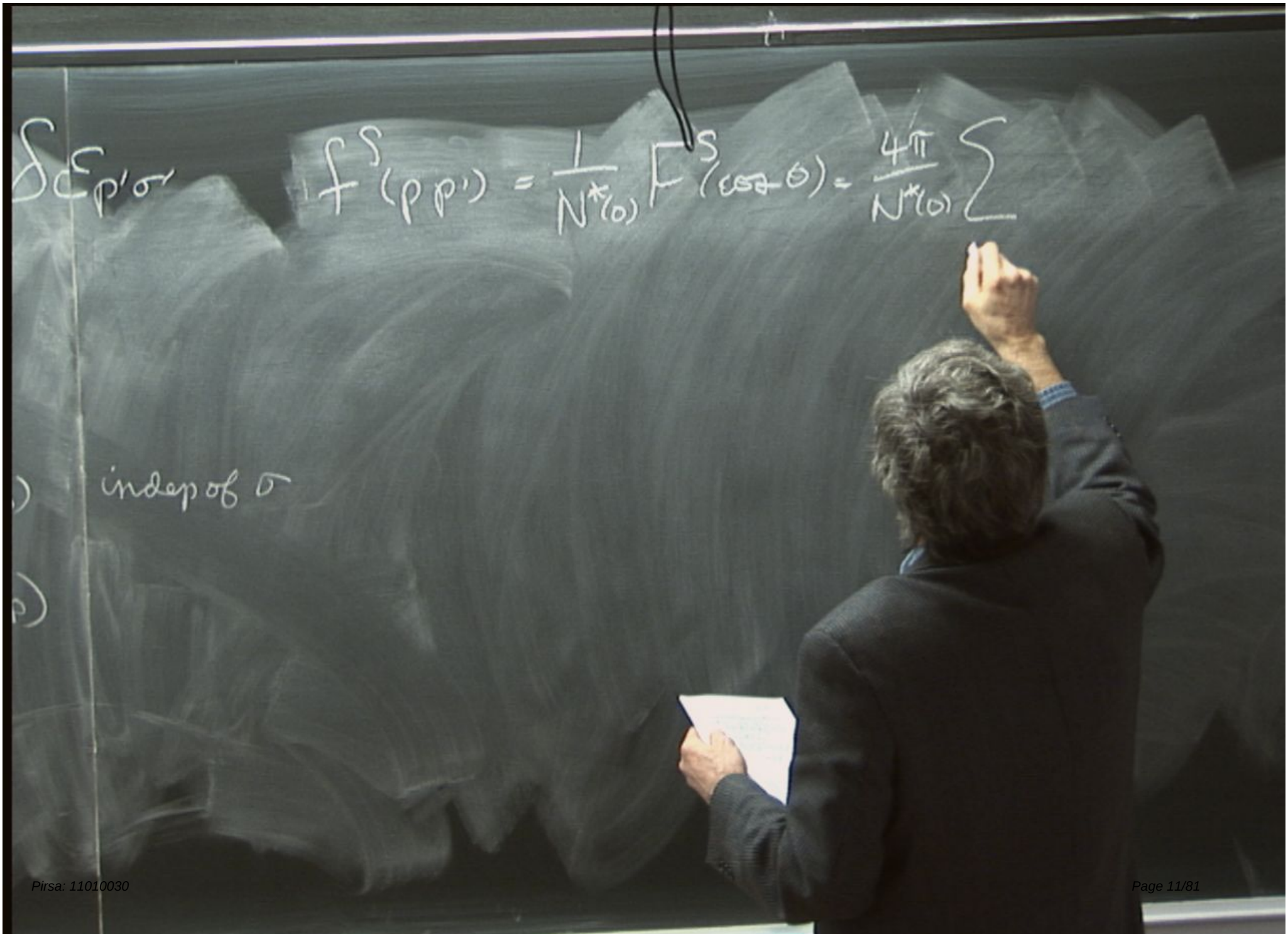
$$\delta\varepsilon_{p,\sigma} = \delta\varepsilon^{0}_{p,\sigma} - \sum_{p'\sigma'} f(p,\sigma;p',\sigma')\,\delta(\varepsilon^{0}_{p',\sigma'})\,\delta\varepsilon_{p'\sigma'}$$

Solution is an $\delta\varepsilon_{p,\sigma}$ with the same symmetry as $\delta\varepsilon^{0}_{p,\sigma}$

So, fo[illegible], [illegible] $\delta\varepsilon^{0}_{p,\sigma} = \nu_\ell\, Y_{\ell m}(\Omega_p)$


$\delta \varepsilon_{p,\sigma} = \delta \varepsilon^0_{p,\sigma} - \sum_{p'\sigma'} f(p,\sigma;p',\sigma') \, \delta(\varepsilon^0_{p',\sigma'}) \, \delta\varepsilon_{p'\sigma'}$
Solution is an $\delta\varepsilon_{p,\sigma}$ with the same
symmetry as $\delta\varepsilon^0_{p,\sigma}$
So, for
$\delta\varepsilon^0_{p,\sigma} = \nu_\ell Y_{\ell m}(\Omega_p)$
indep of σ
$\delta\varepsilon_{p,\sigma} =$


$\delta\varepsilon_{p,\sigma} = \delta\varepsilon^0_{p,\sigma} - \sum_{p'\sigma'} f(p,\sigma;p',\sigma')\,\delta(\varepsilon^0_{p',\sigma'})\,\delta\varepsilon_{p'\sigma'}$
Solution is an $\delta\varepsilon_{p,\sigma}$ with the same
symmetry as $\delta\varepsilon^0_{p,\sigma}$
instance, if $\delta\varepsilon^0_{p,\sigma} = \nu_\ell Y_{\ell m}(\Omega_p)$ indep of σ
then $\delta\varepsilon_{p,\sigma} = t_\ell Y_{\ell,m}(\Omega_p)$


$\delta\varepsilon_{p'\sigma'}$
$f^S(p\,p') = \frac{1}{N^*(0)} F^S(\cos\theta) = \frac{4\pi}{N^*(0)} \sum$
indep of σ

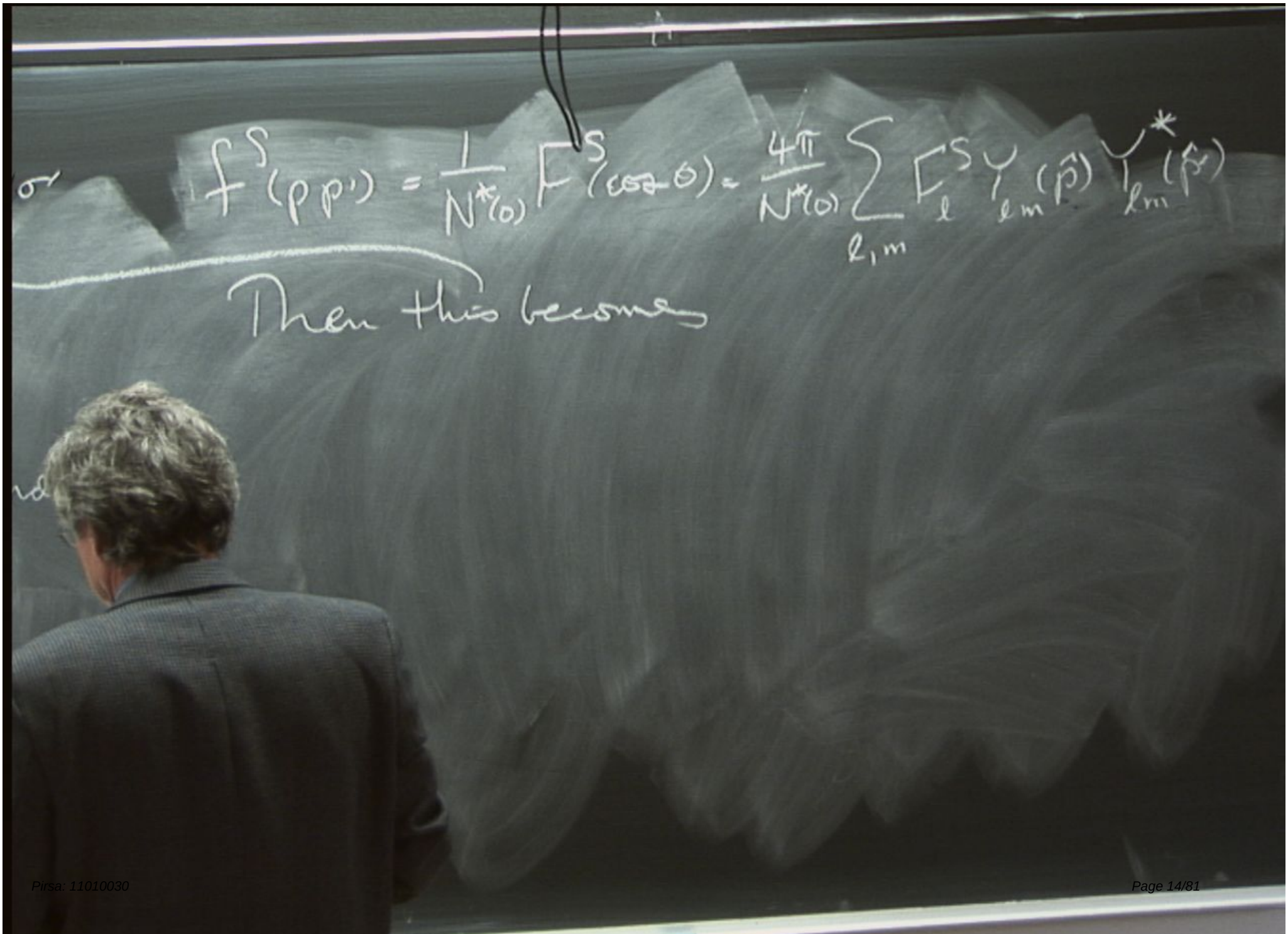
$\delta\varepsilon_{p'\sigma'}$

$$f^S(p\,p') = \frac{1}{N^*(0)} F^S(\cos\theta) = \frac{4\pi}{N^*(0)} \sum_{l,m} F_l^S Y_{lm}(\hat{p}) Y_{l}$$

indep of σ

$\delta\varepsilon_{p'\sigma'}$ $\quad f^S(p\,p') = \frac{1}{N^*(0)} F^S(\cos\theta) = \frac{4\pi}{N^*(0)} \sum_{l,m} F_l^S Y_{lm}(\hat{p}) Y_{lm}^*($

indep of σ


$f^S(pp') = \frac{1}{N^*(0)} F^S(\cos\theta) = \frac{4\pi}{N^*(0)} \sum_{l,m} F_l^S Y_{lm}(\hat{p}) Y^*_{lm}(\hat{p}')$
Then this becomes

σ

$$f^S(pp') = \frac{1}{N^*(0)} F^S(\cos\theta) = \frac{4\pi}{N^*(0)} \sum_{l,m} F_l^S Y_{lm}(\hat{p}) Y^*_{lm}(\hat{p}')$$

Then this becomes for Σ

$$-\sum_{p'} \frac{4\pi}{N^*(0)} \sum_{l'm'} F^S_{l'} Y_{l'm'} \ldots (\varepsilon^0_{p'}$$

indep of σ

σ

$$f^S(pp') = \frac{1}{N^*(0)} F^S(\cos\theta) = \frac{4\pi}{N^*(0)} \sum_{l,m} F_l^S Y_{lm}(\hat{p}) Y_{lm}^*(\hat{p}')$$

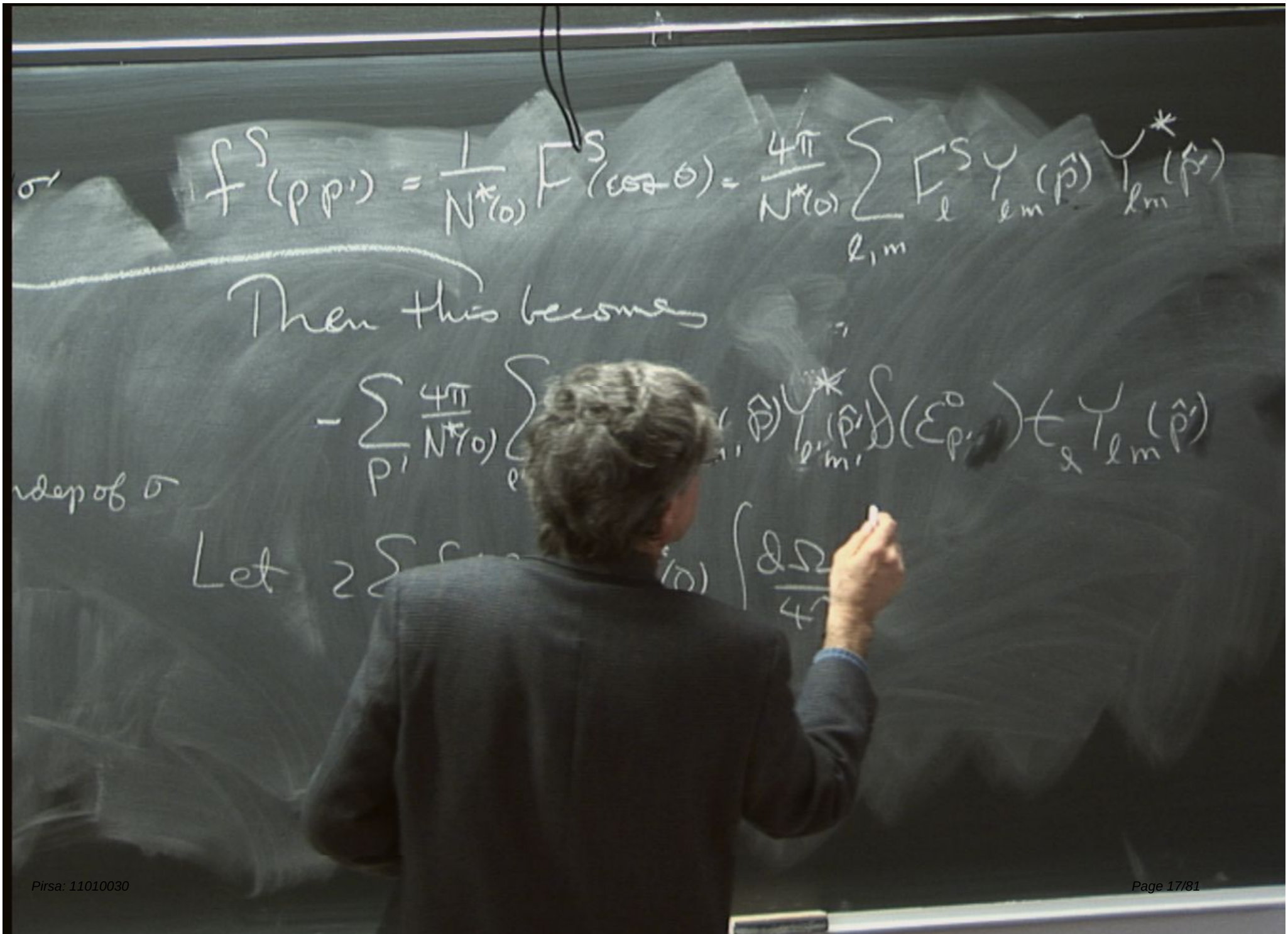
Then this becomes

from ξ_σ

$$-\sum_{p'} \frac{4\pi}{N^*(0)} \sum_{l'm'} F_{l'}^S Y_{l'm'}(\hat{p}) \, 2\, \delta(\varepsilon_{p'}^0) \, t_l Y_{lm}(\hat{p}')$$

indep of σ

Let $2\sum_{p'} \delta(\varepsilon_{p'}^0) = N^*(0) \int \frac{d\Omega_{p'}}{4\pi}$


$f^S(pp') = \frac{1}{N^*(0)} F^S(\cos\theta) = \frac{4\pi}{N^*(0)} \sum_{l,m} F_l^S Y_{lm}(\hat{p}) Y^*_{lm}(\hat{p}')$
Then this becomes
$-\sum_{p'} \frac{4\pi}{N^*(0)} \sum_{l'}$
$\delta(\varepsilon^0_{p'})$
$t_l Y_{lm}(\hat{p}')$
indep of σ
Let

σ

$$f^S(pp') = \frac{1}{N^*(0)} F^S(\cos\theta) = \frac{4\pi}{N^*(0)} \sum_{l,m} F_l^S Y_{lm}(\hat{p}) Y^*_{lm}(\hat{p}')$$

Then this becomes

$$-\sum_{p'} \frac{4\pi}{N^*(0)} \sum_{l'm'} F^S_{l'} Y_{l'm'}(\hat{p}) Y^*_{l'm'}(\hat{p}') \delta(\varepsilon^0_{p'}) \, t_l \, Y_l(\hat{p}')$$

indep of σ

$$\text{Let } 2\sum_{p'} \delta(\varepsilon^0_{p'}) = N^*(0) \int \frac{d\Omega_{p'}}{4\pi}$$

σ

$$f^S(pp') = \frac{1}{N^*(0)} F^S(\cos\theta) = \frac{4\pi}{N^*(0)} \sum_{l,m} F_l^S Y_{lm}(\hat{p}) Y^*_{lm}(\hat{p}')$$

Then this becomes

$$\left\{ -\sum_{p'} \frac{4\pi}{N^*(0)} \sum_{l'm'} F^S_{l'} Y_{l'm'}(\hat{p}) Y^*_{l'm'}(\hat{p}') \delta(\varepsilon^0_{p'}) \right\} t_l Y_{lm}(\hat{p}')$$

indep of σ

Let $2\sum_{p'} \delta(\varepsilon^0_{p'}) = N^*(0) \int \frac{d\Omega_{p'}}{4\pi}$

$$\rightarrow -F_l^S Y_{lm}(\hat{p}) t_l$$

σ

$$f^S(p p') = \frac{1}{N^*(0)} F^S(\cos\theta) = \frac{4\pi}{N^*(0)} \sum_{l,m} F_l^S Y_{lm}(\hat{p}) Y^*_{lm}(\hat{p}')$$

Then this becomes

$$\left\{ -\sum_{p'} \frac{4\pi}{N^*(0)} \sum_{l'm'} F^S_{l'} Y_{l'm'}(\hat{p}) Y^*_{l'm'}(\hat{p}') \delta(\varepsilon^0_{p'}) t_l Y_{lm}(\hat{p}') \right.$$

indep of σ

Let $2\sum_{p'} \delta(\varepsilon^0_{p'}) = N^*(0) \int \frac{d\Omega_{p'}}{4\pi}$

$$\longrightarrow -F_l^S Y_{lm}(\hat{p}) t_l \longrightarrow t_l Y_{lm}(\hat{p}) = \ldots Y_{lm}(\hat{p}) - F_l^S Y_{lm}(\ldots$$

$$f^S(pp') = \frac{1}{N^*(0)} F^S(\cos\theta) = \frac{4\pi}{N^*(0)} \sum_{l,m} F_l^S Y_{lm}(\hat{p}) Y^*_{lm}(\hat{p}')$$

Then this becomes

$$\left\{ -\sum_{p'} \frac{4\pi}{N^*(0)} \sum_{l'm'} F^S_{l'} Y_{l'm'}(\hat{p}) Y^*_{l'm'}(\hat{p}') \delta(\varepsilon^0_{p'}) t_l Y_{lm}(\hat{p}') \right.$$

Let $2\sum_{p'} \delta(\varepsilon^0_{p'}) = N^*(0) \int \frac{d\Omega_{p'}}{4\pi}$

$$\rightarrow -F_l^S Y_{lm}(\hat{p}) t_l \longrightarrow \boxed{t_l Y_{lm}(\hat{p}) = \lambda_l Y_{lm}(\hat{p}) - F_l^S Y_{lm}(\hat{p})}$$

$$_{p,\sigma} = \delta\varepsilon^{0}_{p,\sigma} - \sum_{p'\sigma'} f(p,\sigma;p',\sigma')\,\delta(\varepsilon^{0}_{p',\sigma'})\,\delta\varepsilon_{p'\sigma'} \qquad f^{S}($$

solution is an $\delta\varepsilon_{p,\sigma}$ with the same symmetry as $\delta\varepsilon^{0}_{p,\sigma}$

So, for instance, if $\delta\varepsilon^{0}_{p,\sigma} = \nu_\ell Y_{\ell m}(\Omega_p)$ indep of σ

then $\delta\varepsilon_{p,\sigma} = t_\ell Y_{\ell,m}(\Omega_p)$

$$t_\ell = \nu_\ell - F^{S}_{\ell} t_\ell \rightarrow t_\ell = \frac{\nu_\ell}{1+F^{S}_{\ell}}$$

Let

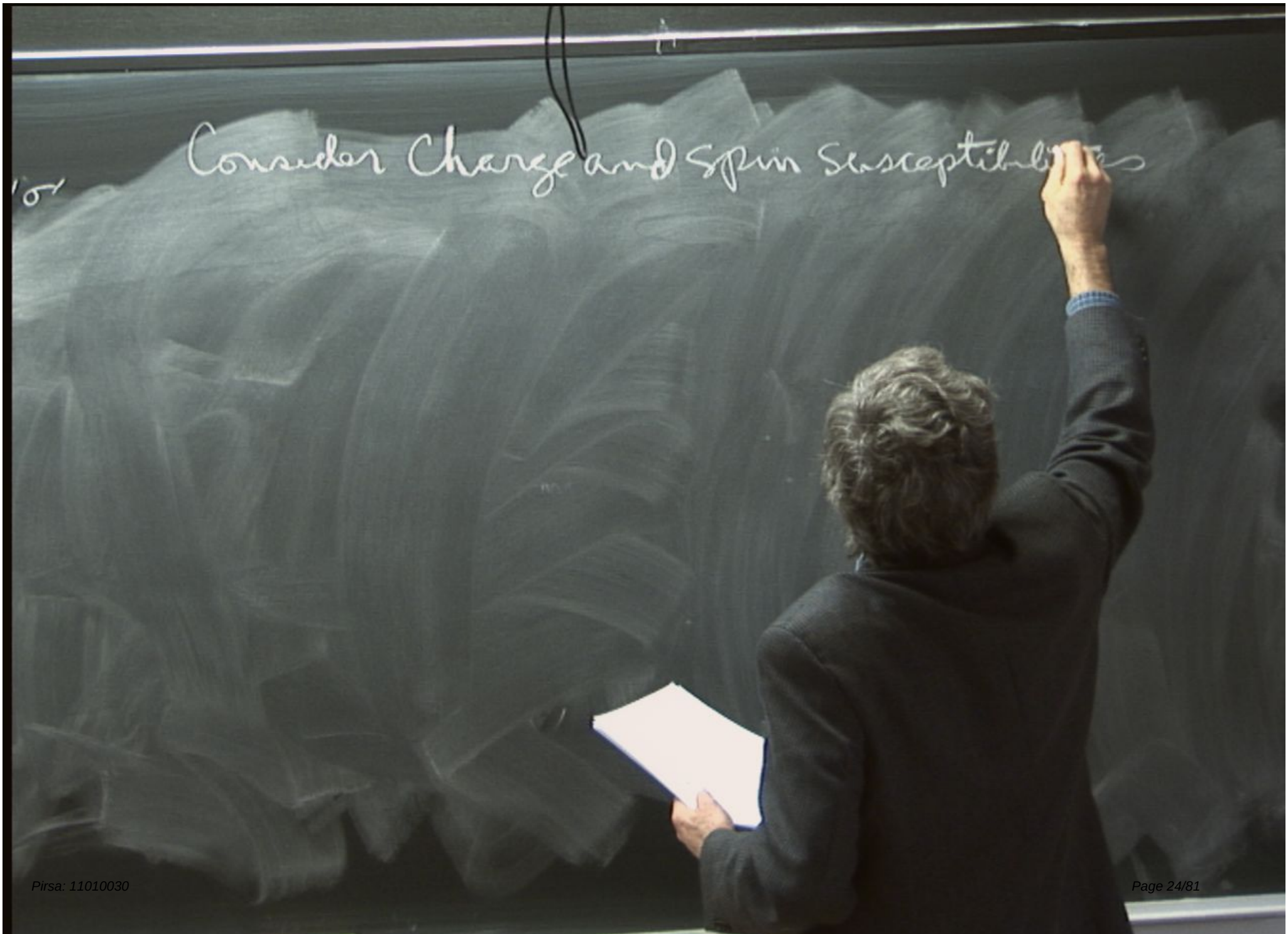
$$\delta\varepsilon_{p,\sigma} = \delta\varepsilon^{0}_{p,\sigma} - \sum_{p'\sigma'} f(p,\sigma;p',\sigma')\,\delta(\varepsilon^{0}_{p',\sigma'})\,\delta\varepsilon_{p'\sigma'}$$

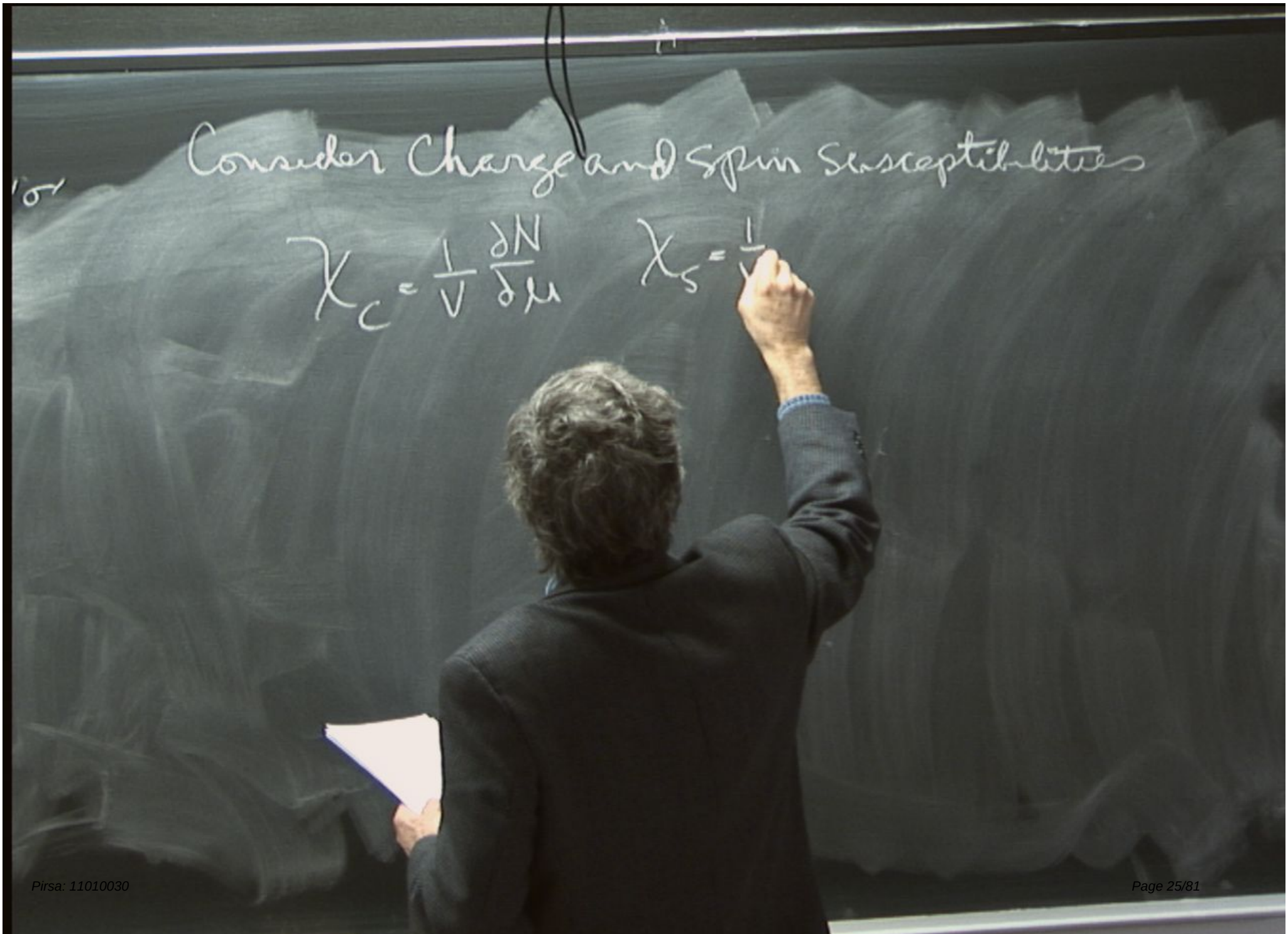
solution is an $\delta\varepsilon_{p,\sigma}$ with the same symmetry as $\delta\varepsilon^{0}_{p,\sigma}$

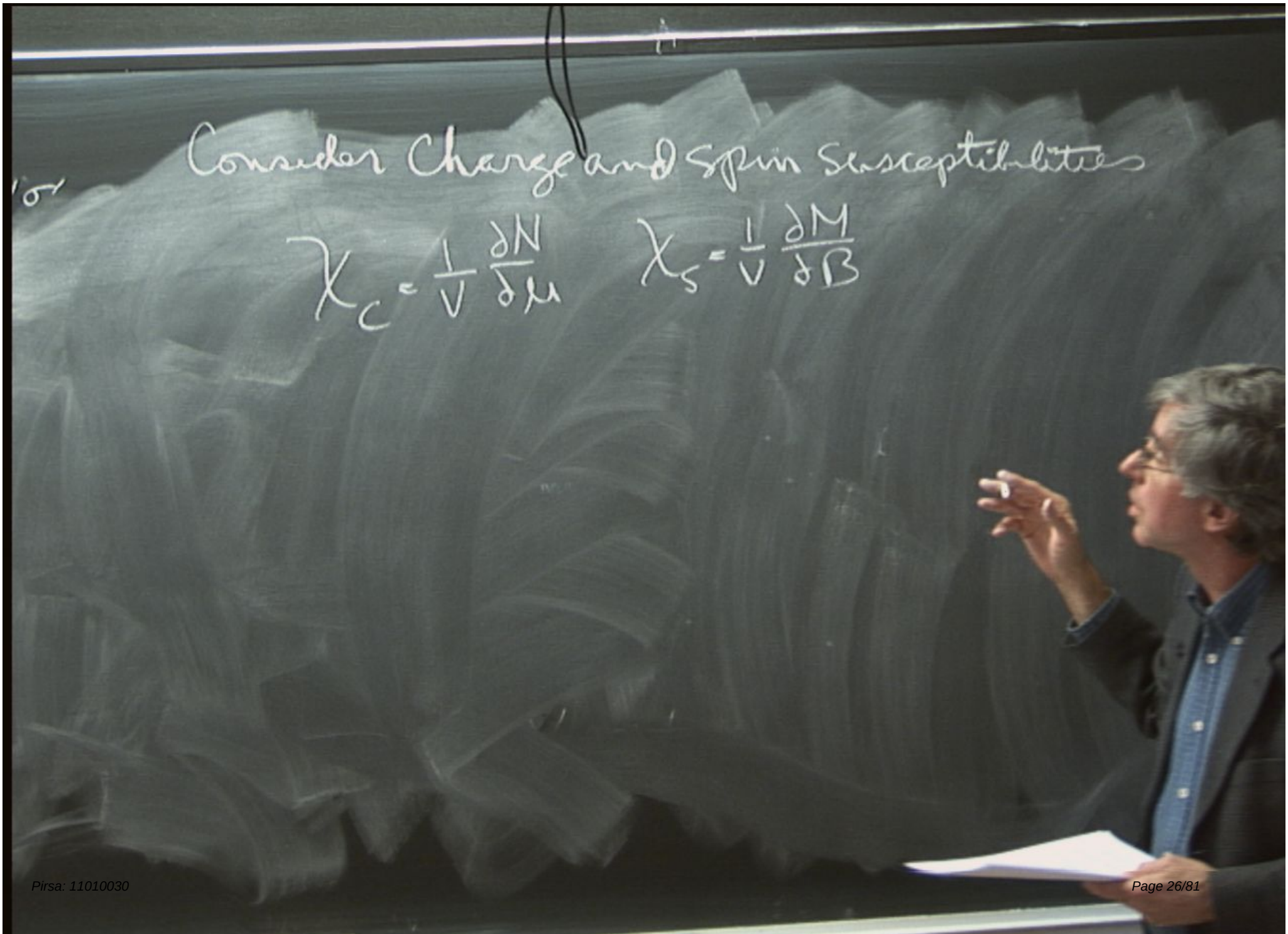
So, for instance, if $\delta\varepsilon^{0}_{p,\sigma} = \nu_\ell Y_{\ell m}(\Omega_p)$

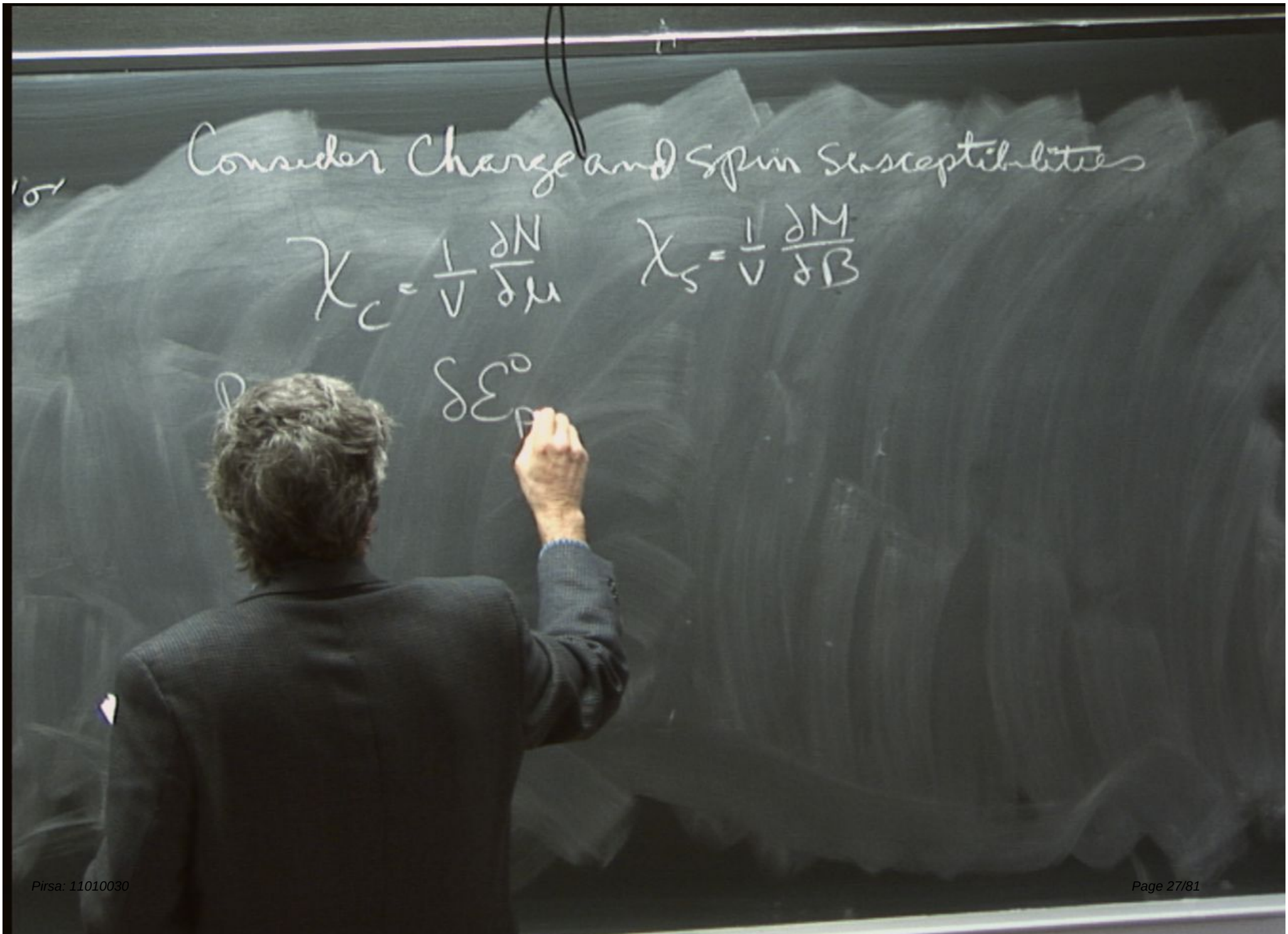
then $\delta\varepsilon_{p,\sigma} = t_\ell Y_{\ell,m}(\Omega_p)$

$$t_\ell = \nu_\ell - F^s_\ell t_\ell \rightarrow \boxed{t_\ell = \frac{\nu_\ell}{1+F^s_\ell}}$$


Consider Charge and Spin Susceptibilities


Consider Charge and Spin Susceptibilities
$\chi_c = \frac{1}{V}\frac{\partial N}{\partial \mu}$
$\chi_s = \frac{1}{V}$


Consider Charge and Spin Susceptibilities
$\chi_c = \frac{1}{V}\frac{\partial N}{\partial \mu}$ $\chi_s = \frac{1}{V}\frac{\partial M}{\partial B}$


Consider Charge and Spin Susceptibilities
$\chi_c = \frac{1}{V}\frac{\partial N}{\partial \mu}$
$\chi_s = \frac{1}{V}\frac{\partial M}{\partial B}$
$\delta \mathcal{E}^0_p$

Consider Charge and Spin Susceptibilities

$$\chi_c = \frac{1}{V}\frac{\partial N}{\partial \mu} \qquad \chi_s = \frac{1}{V}\frac{\partial M}{\partial B}$$

Pert. $\delta \mathcal{E}^0_{p\sigma} = -\delta\mu - \sigma \mu_F B$

$$\delta \mathcal{E}_{p\sigma} = -\lambda_c \delta\mu - \lambda_s \sigma \mu_F B$$

where $\lambda_c = \frac{1}{1+F_0^s} \qquad \lambda_s = \frac{1}{1+F_0^a}$

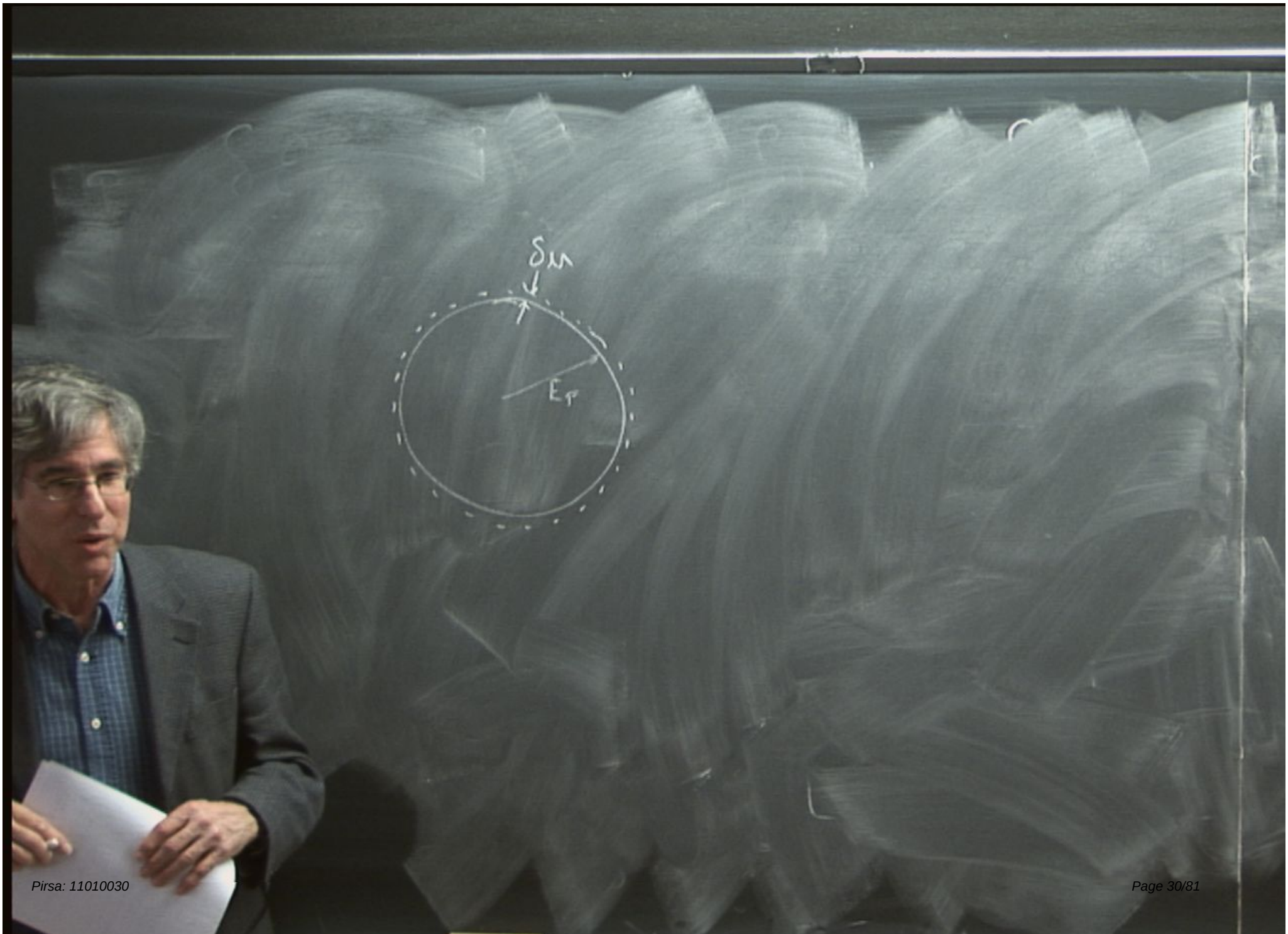
Consider Charge and Spin Susceptibilities

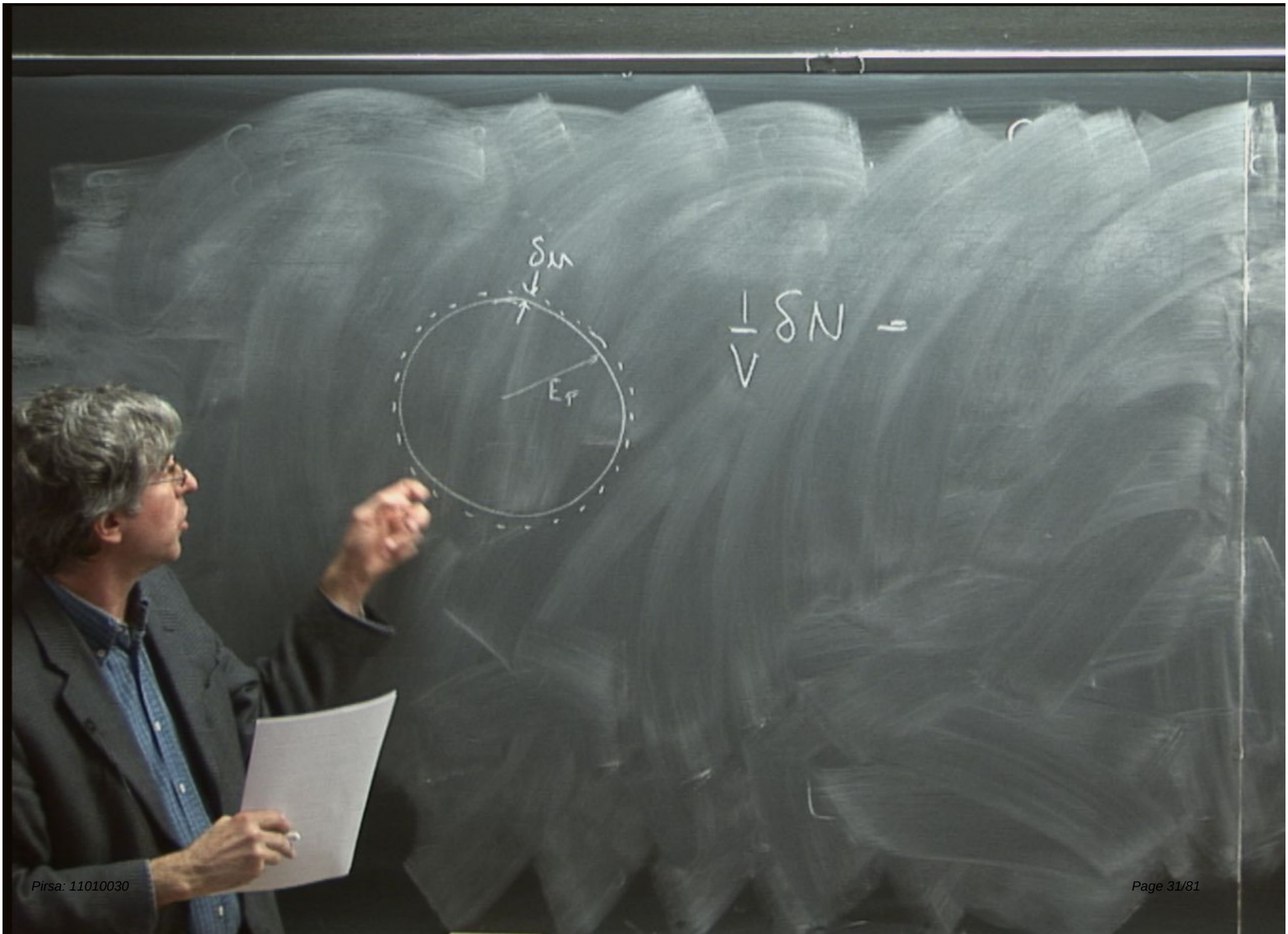
$$\chi_c = \frac{1}{V}\frac{\partial N}{\partial \mu} \qquad \chi_s = \frac{1}{V}\frac{\partial M}{\partial B}$$

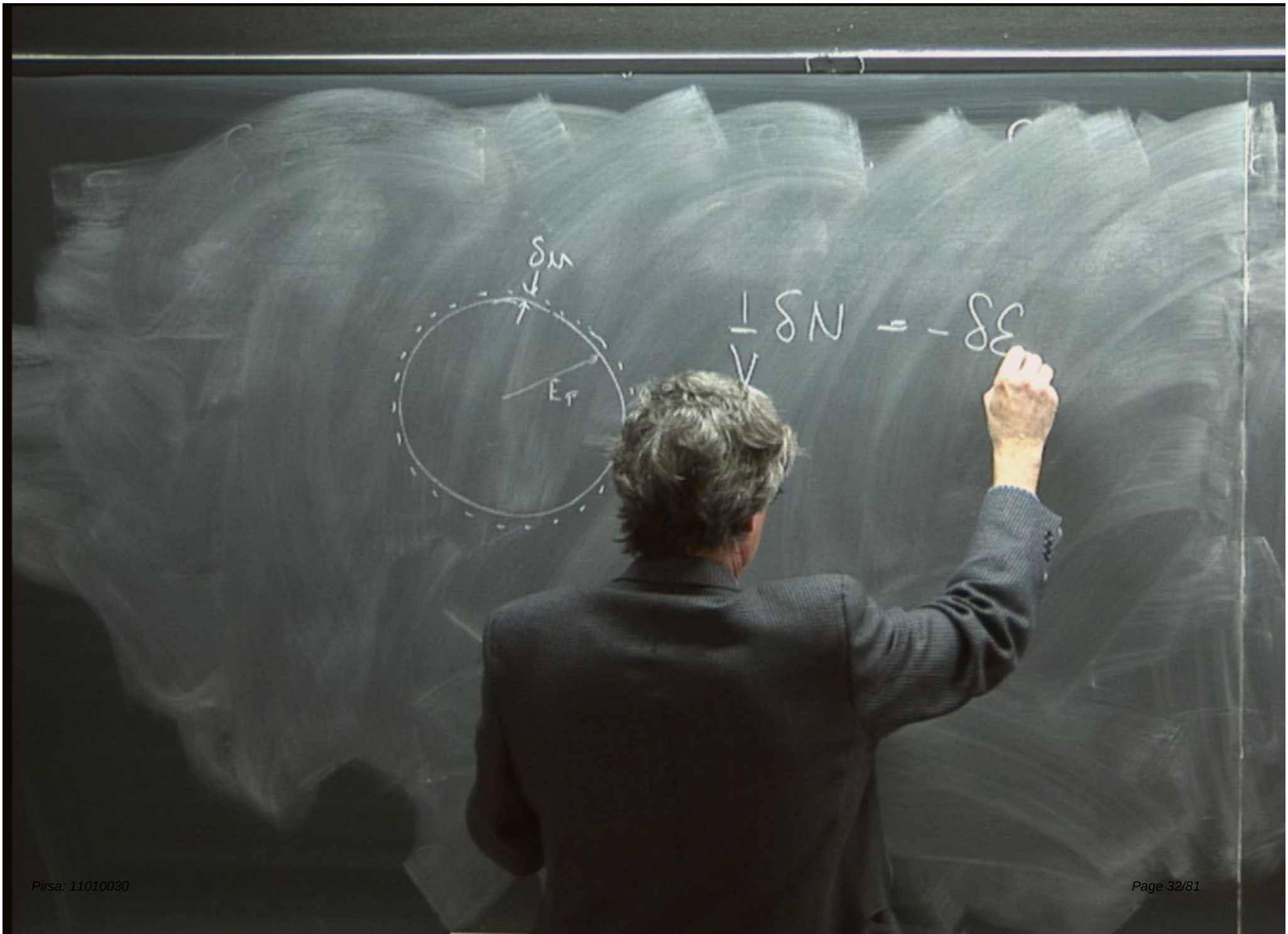
Pert. $\delta\varepsilon^0_{p\sigma} = -\delta\mu - \sigma\mu_F B$

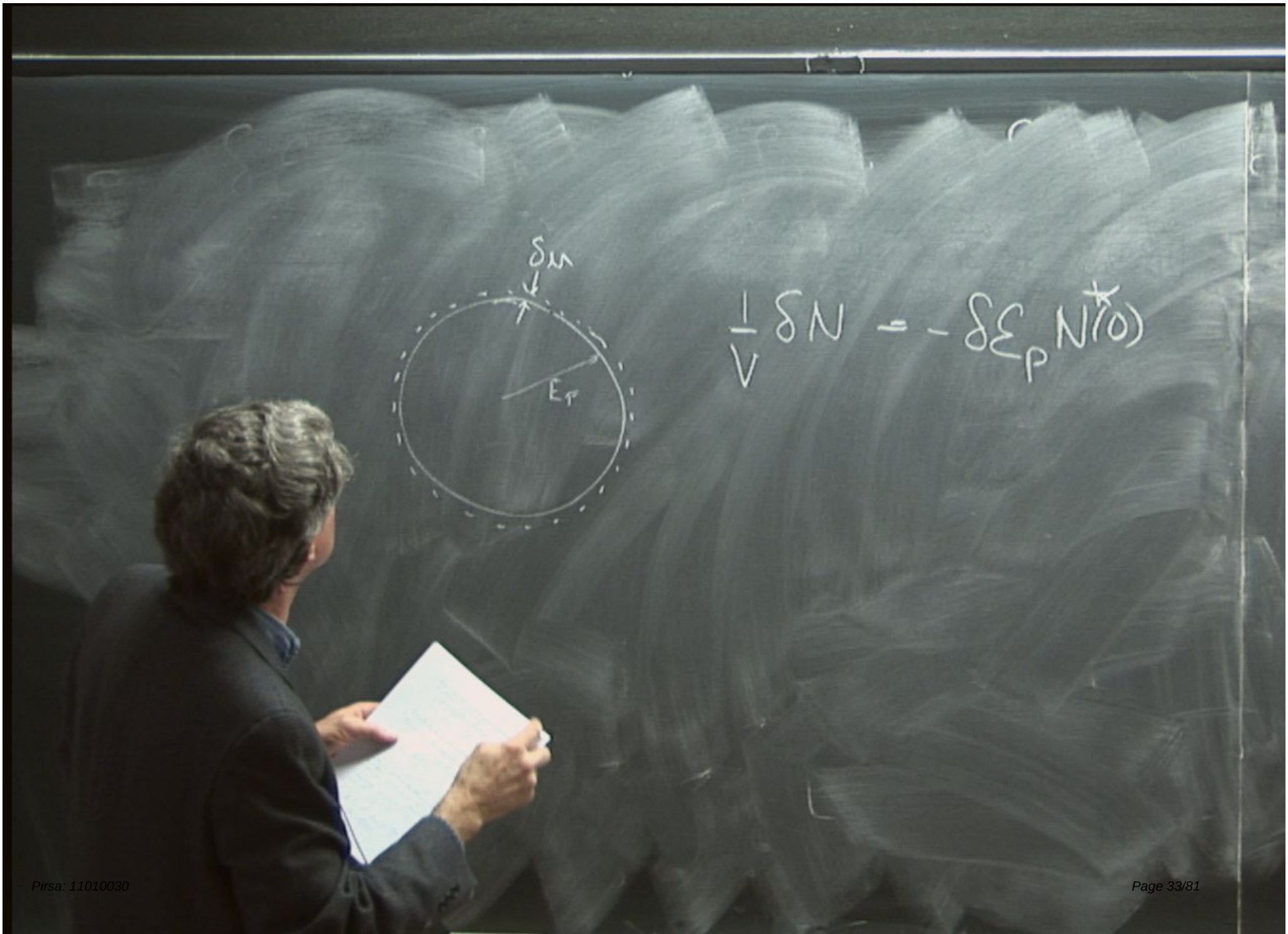
$$\delta\varepsilon_{p\sigma} = -\lambda_c\,\delta\mu - \lambda_s\,\sigma\mu_F B$$

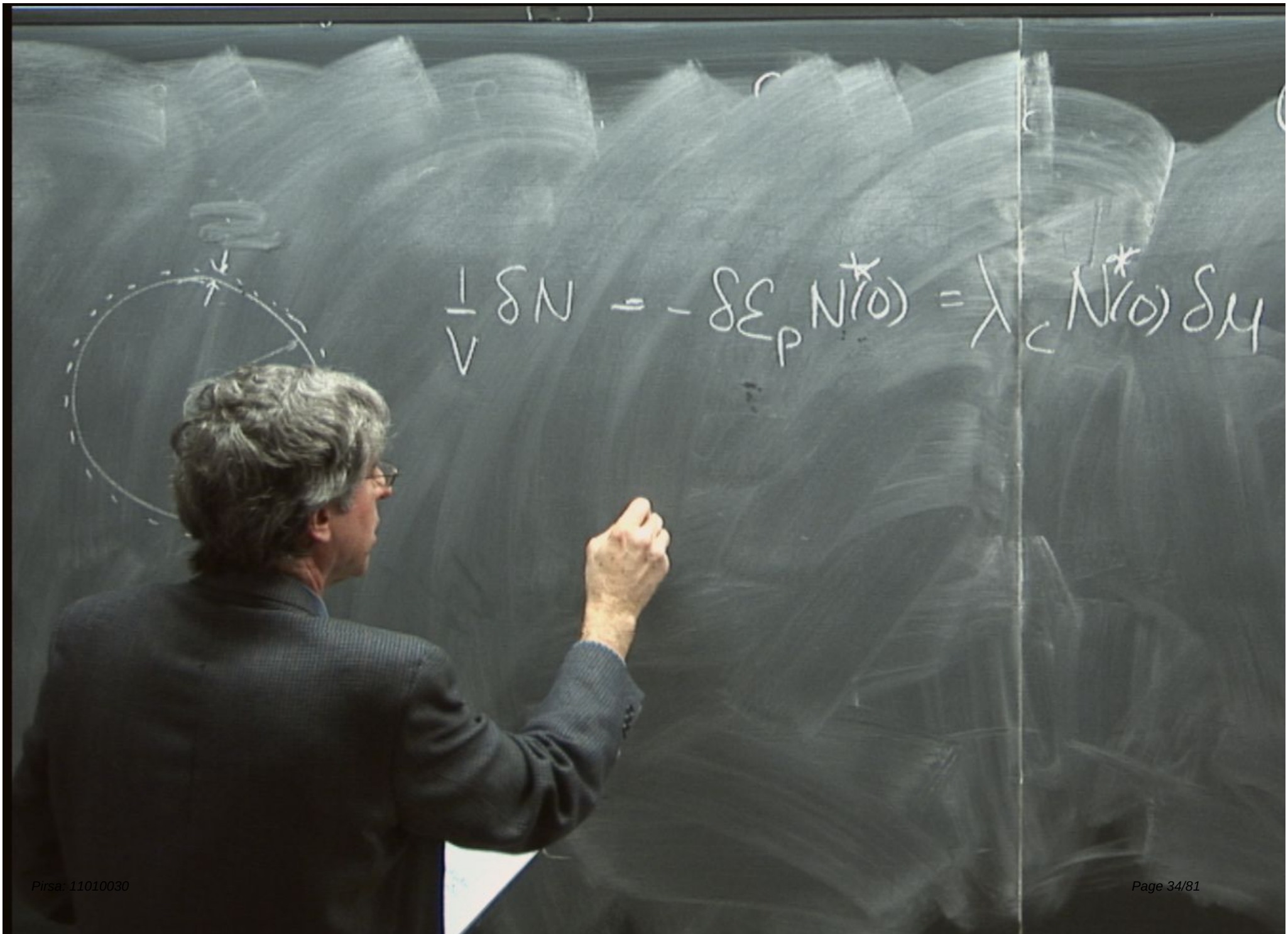
where $\lambda_c = \dfrac{1}{1+F_0^s} \qquad \lambda_s = \dfrac{1}{1+F_0^a}$

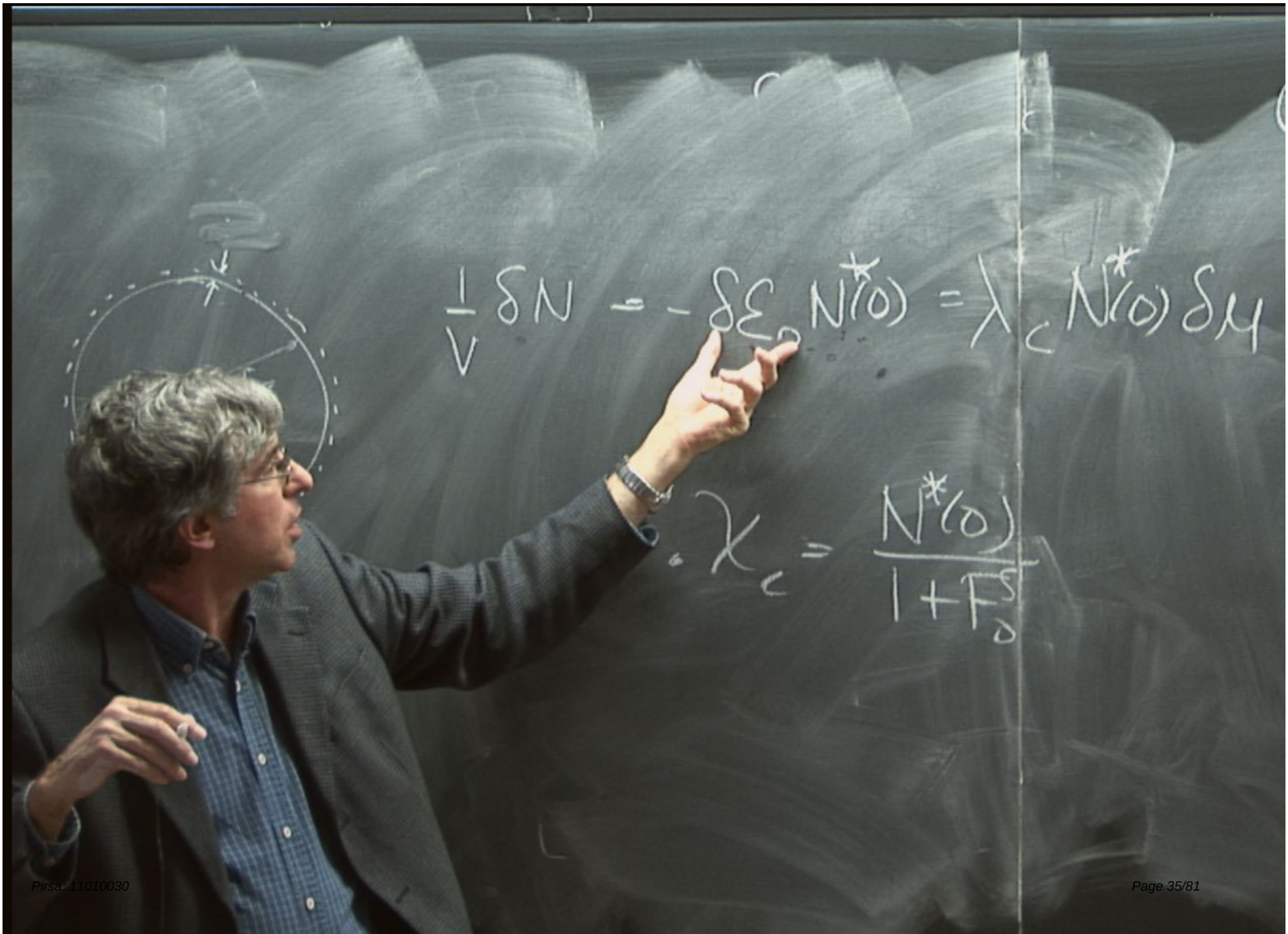

$\delta\Lambda$
E_Φ

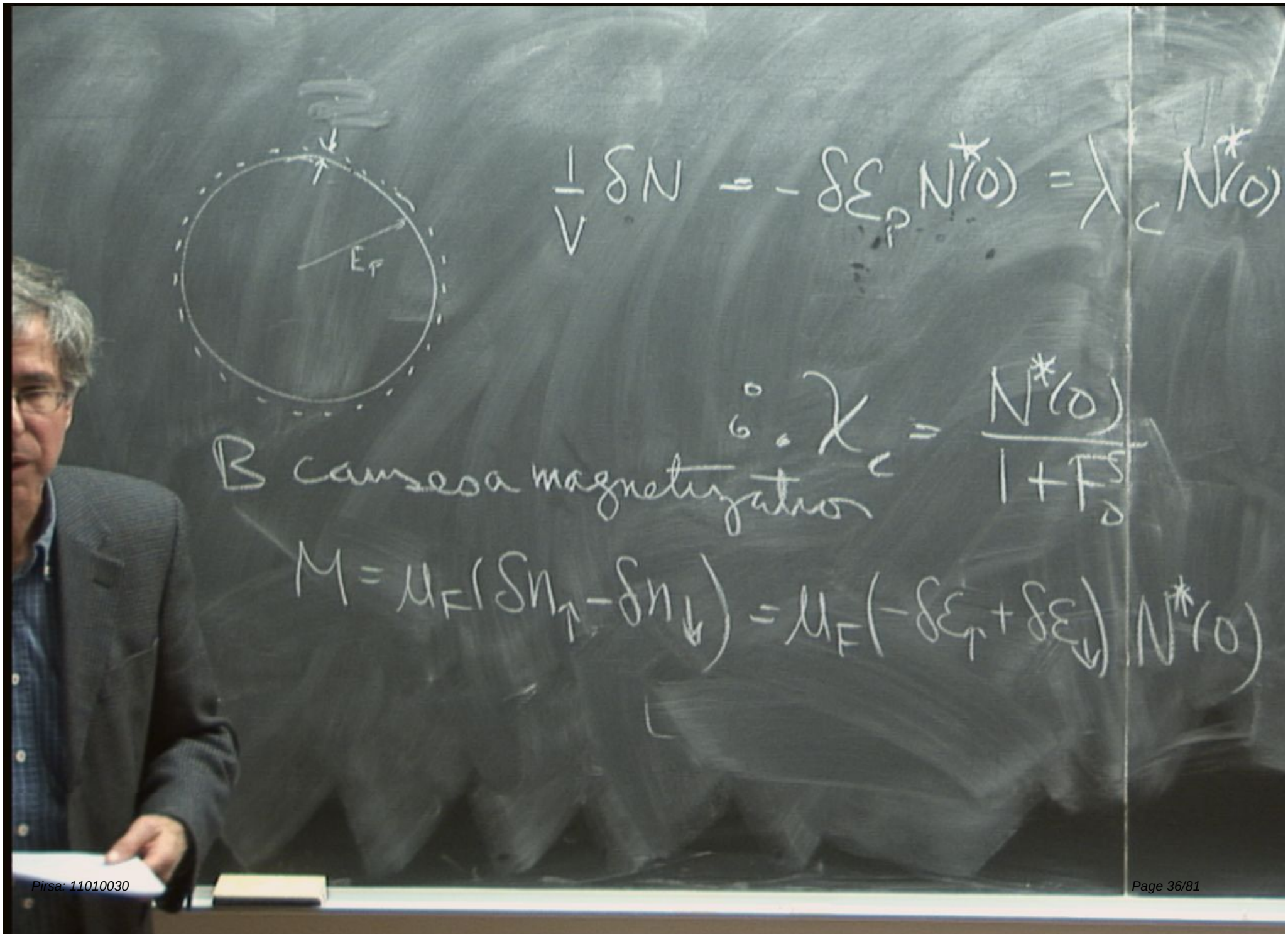

δk
E_F
1/V δN =

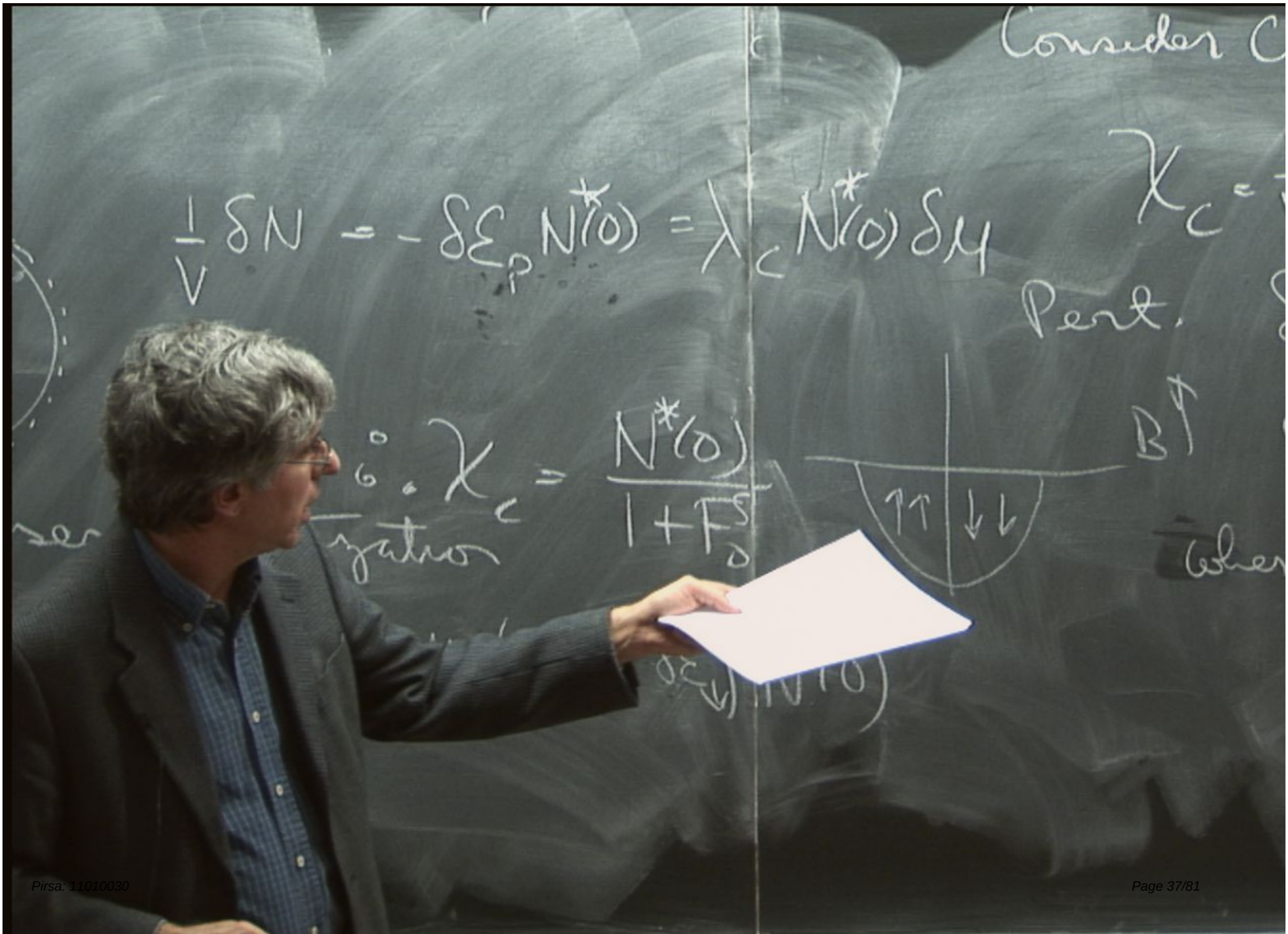

δm
E_F
1/V δN = −δε

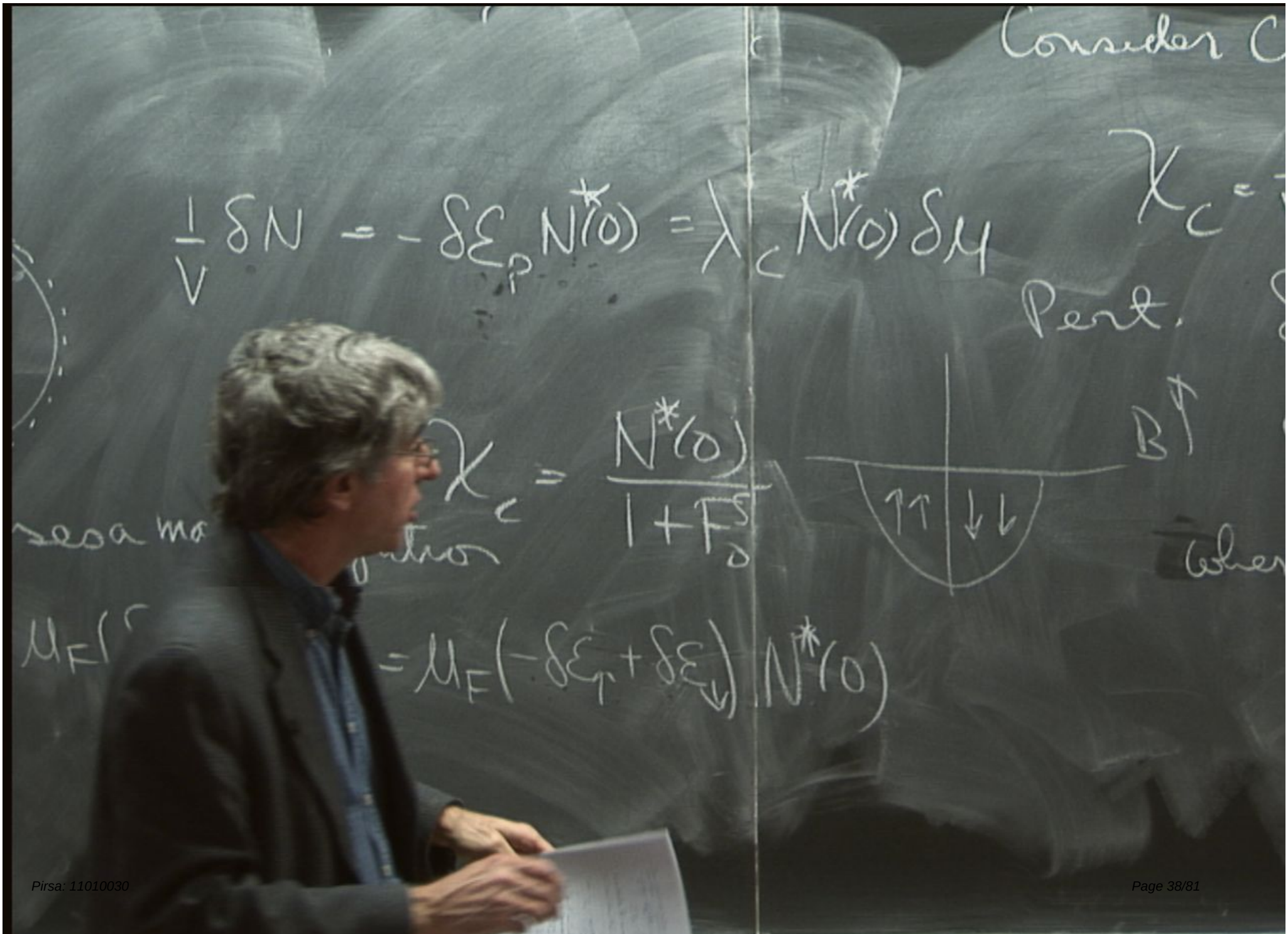

δΩ
E_F
1/V δN = − δε_p N*(0)


$\frac{1}{V}\delta N = -\delta\varepsilon_p N^*(0) = \lambda_c N^*(0)\,\delta\mu$


$\frac{1}{V}\delta N = -\delta\varepsilon_0 N^*(0) = \lambda_c N^*(0)\,\delta\mu$
$\lambda_c = \frac{N^*(0)}{1+F_0^s}$


E_F
$\frac{1}{V}\delta N = -\delta\varepsilon_F N^*(0) = \lambda_c N^*(0)$
$\therefore \chi_c = \frac{N^*(0)}{1+F_0^s}$
B causes a magnetization
$M = \mu_F(\delta n_\uparrow - \delta n_\downarrow) = \mu_F(-\delta\varepsilon_\uparrow + \delta\varepsilon_\downarrow) N^*(0)$


Consider C
$\frac{1}{V}\delta N = -\delta\varepsilon_p N^*(0) = \lambda_c N^*(0)\delta\mu$
$\chi_c =$
Pert.
$\therefore \chi_c = \frac{N^*(0)}{1+F_0^s}$
B
↑↑ ↓↓
when


Consider C
$\frac{1}{V}\delta N = -\delta\varepsilon_p N^*(0) = \lambda_c N^*(0)\,\delta\mu$
$\chi_c =$
Pert.
$\chi_c = \frac{N^*(0)}{1+F_0^s}$
B
$\uparrow\uparrow$ $\downarrow\downarrow$
$\mu_F = \mu_F(-\delta\varepsilon_\uparrow + \delta\varepsilon_\downarrow)\,N^*(0)$

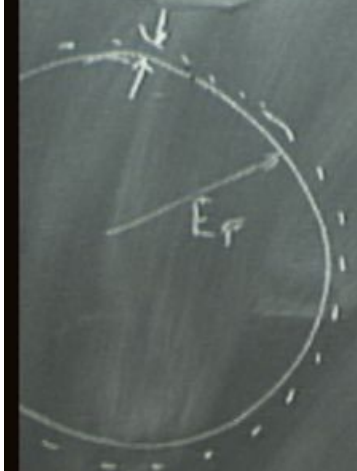
$$N^*(0) = \lambda_c N^*(0)\,\delta\mu$$

Pert.

$$= \frac{N^*(0)}{1 + F_0^S}$$

where

$$N^*(0)$$



$$\frac{1}{V}\delta N = -\delta\varepsilon_F N^*(0) = \lambda_c N^*(0)\,\delta\mu$$

$$\therefore \chi_c = \frac{N^*(0)}{1+F_0^s}$$

causes a magnetization

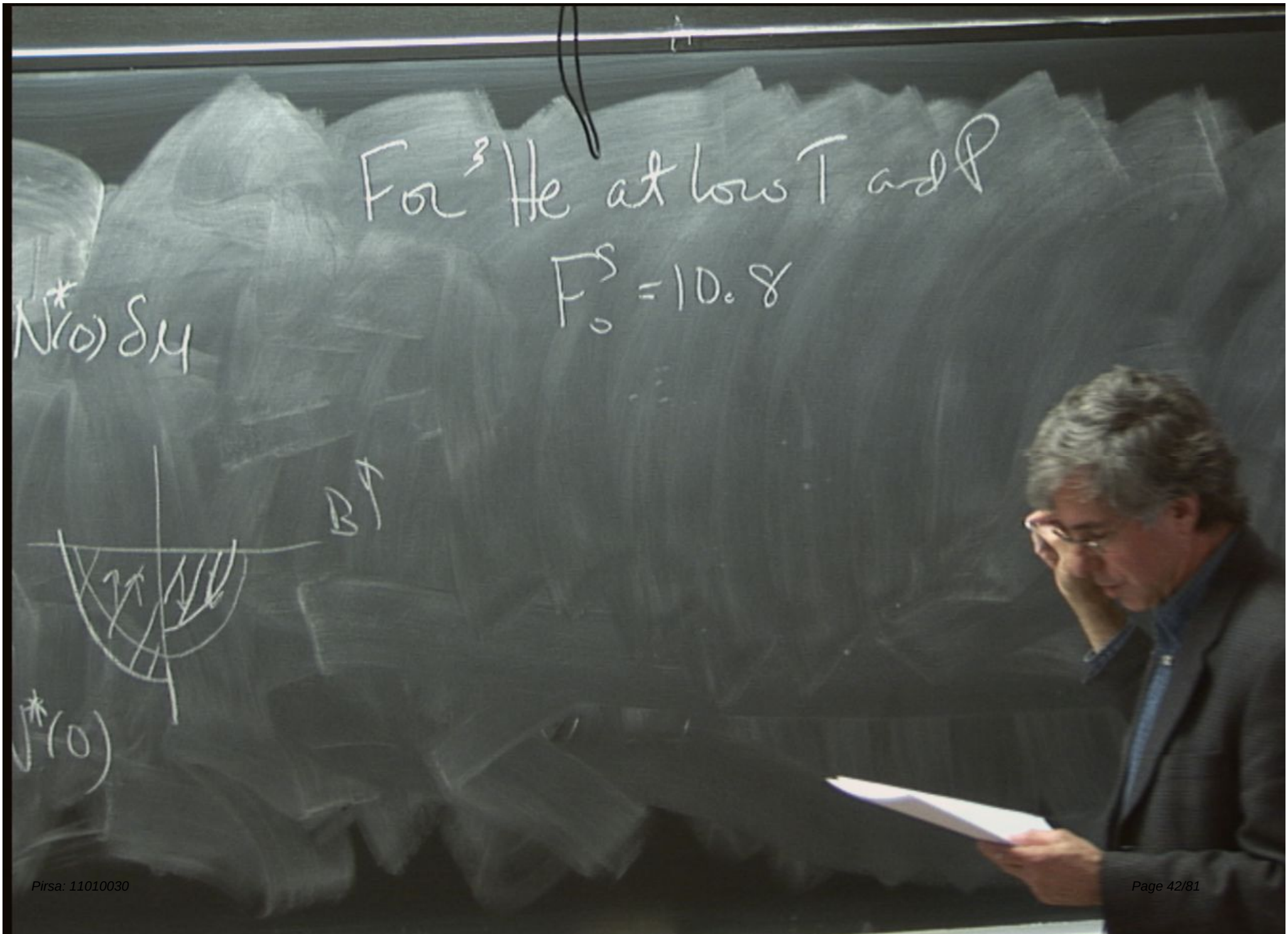
$$M = \mu_F(\delta n_\uparrow - \delta n_\downarrow) = \mu_F(-\delta\varepsilon_\uparrow + \delta\varepsilon_\downarrow)\,N^*(0)$$

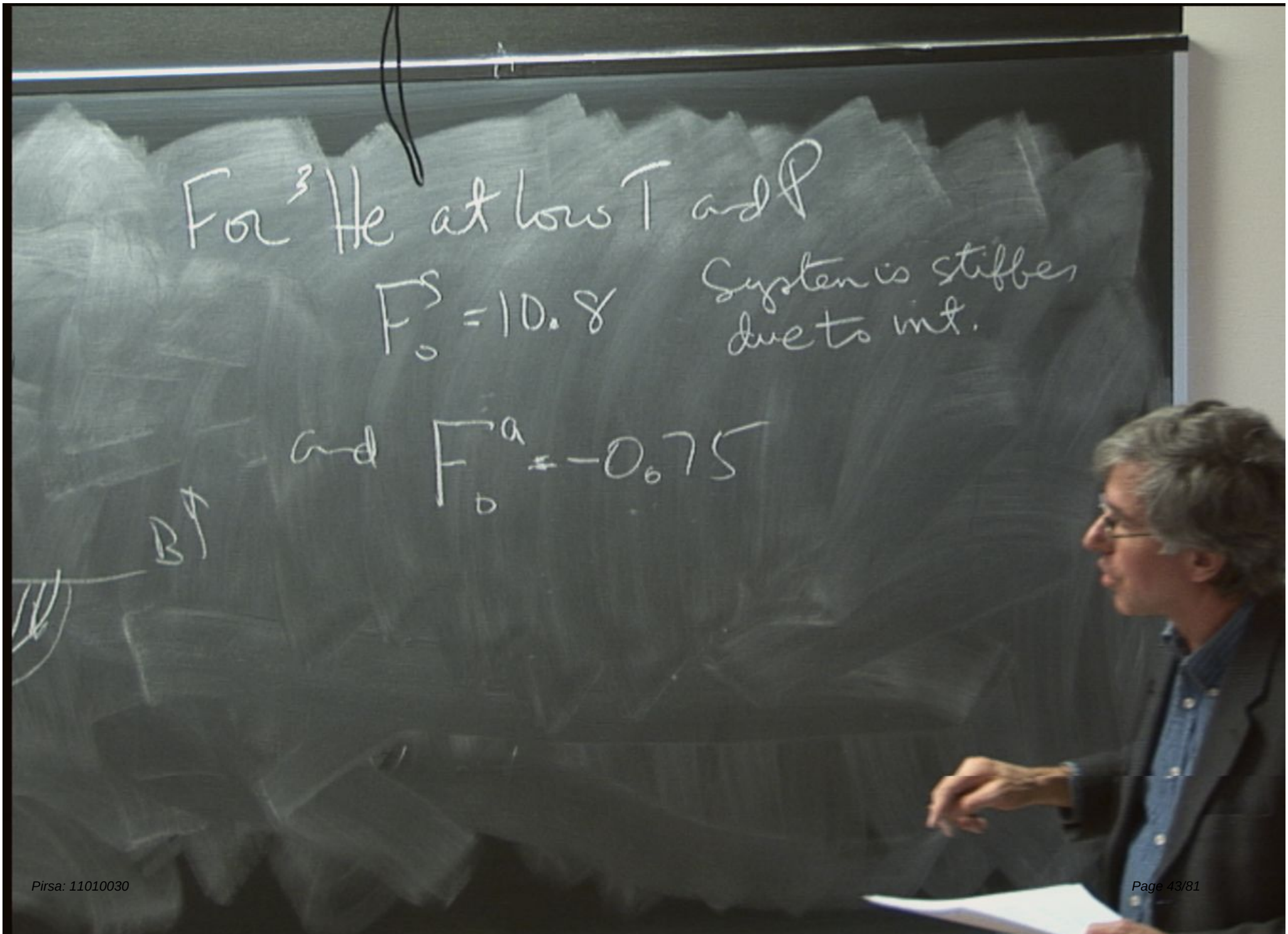
$$\chi_s = \frac{\mu_F^2 N^*(0)}{1+F_0^a}$$

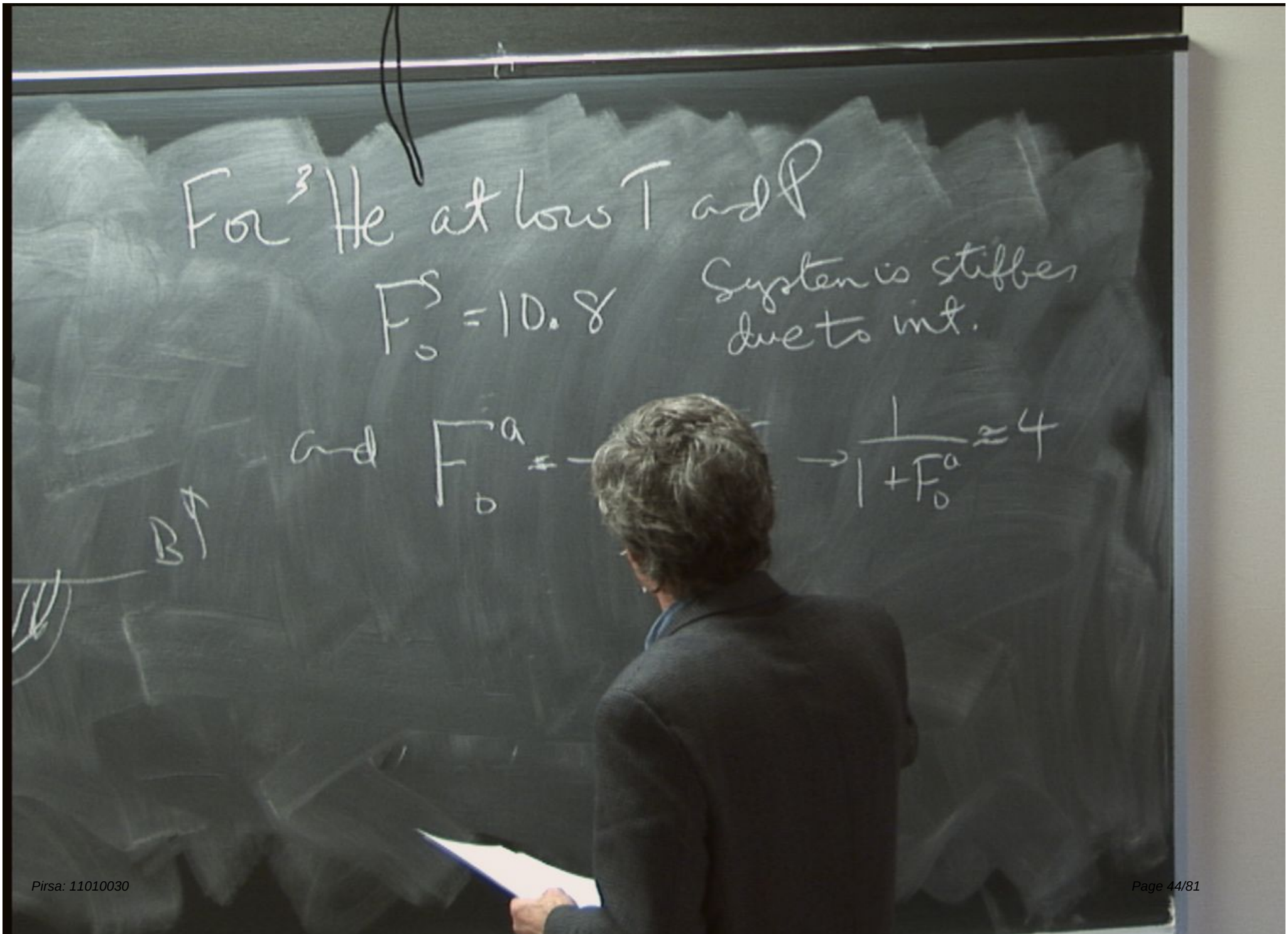
For ^{3}He at low T and P

$N^*(0)\,\delta\mu$

$J^*(0)$


For ^{3}He at low T and P
$F_0^s = 10.8$
$N^*(0)\,\delta\mu$
B↑
$N^*(0)$


For ^{3}He at low T and P
$F_0^s = 10.8$
System is stiffer due to int.
and $F_0^a = -0.75$
B↑


For ^{3}He at low T and P
$F_0^s = 10.8$
System is stiffer due to int.
and $F_0^a = -$ $\rightarrow \frac{1}{1+F_0^a} \approx 4$
B

For ^{3}He at low T and P

$F_0^s = 10.8$ System is stiffer due to int.

and $F_0^a = -0.75 \rightarrow \frac{1}{1+F_0^a} \approx 4$

$B \uparrow$

Tendency toward ferromagnetism

For ^{3}He at low T and P

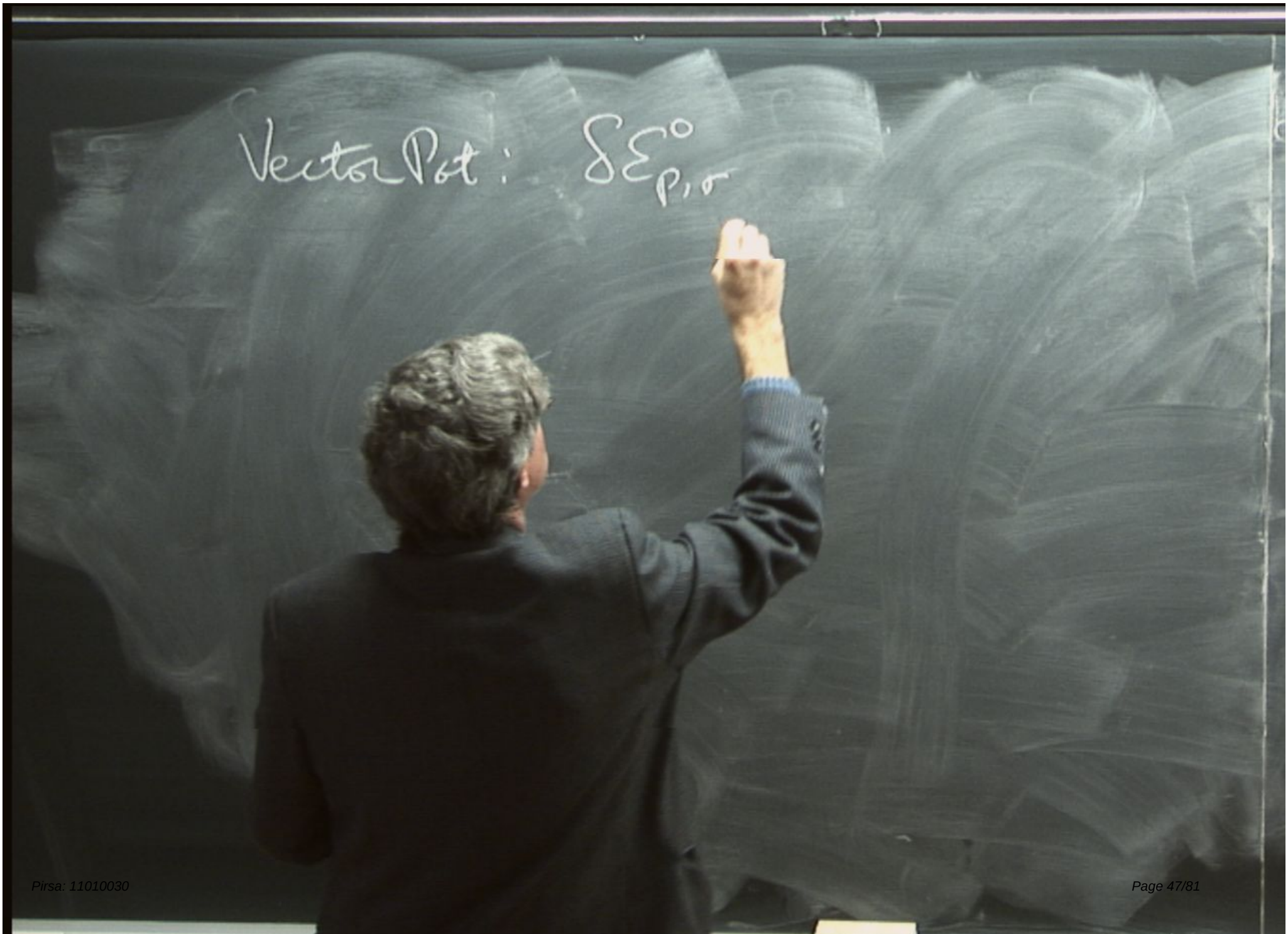
$F_0^s = 10.8$ System is stiffer Stoner Enhan

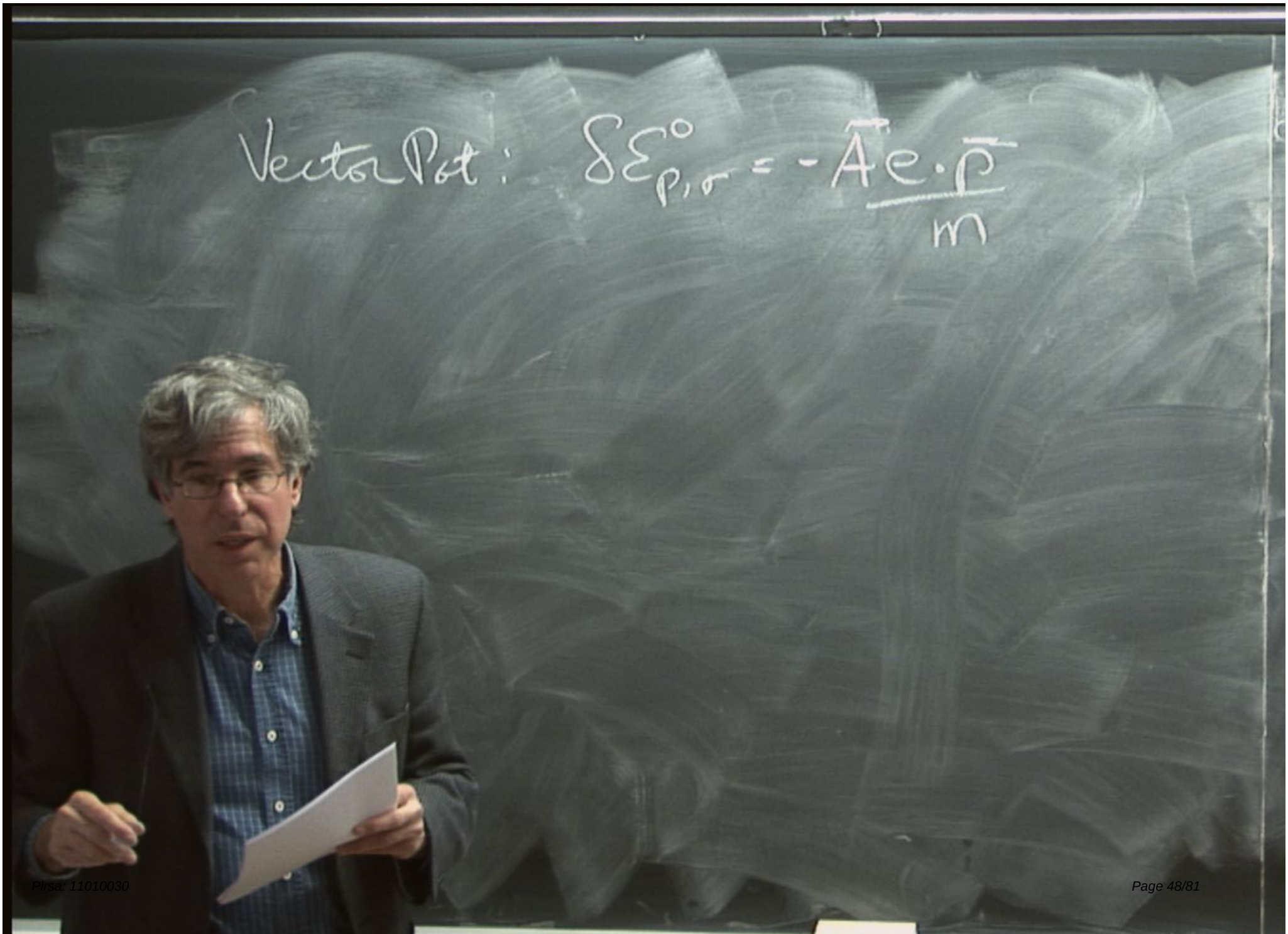
due to int.

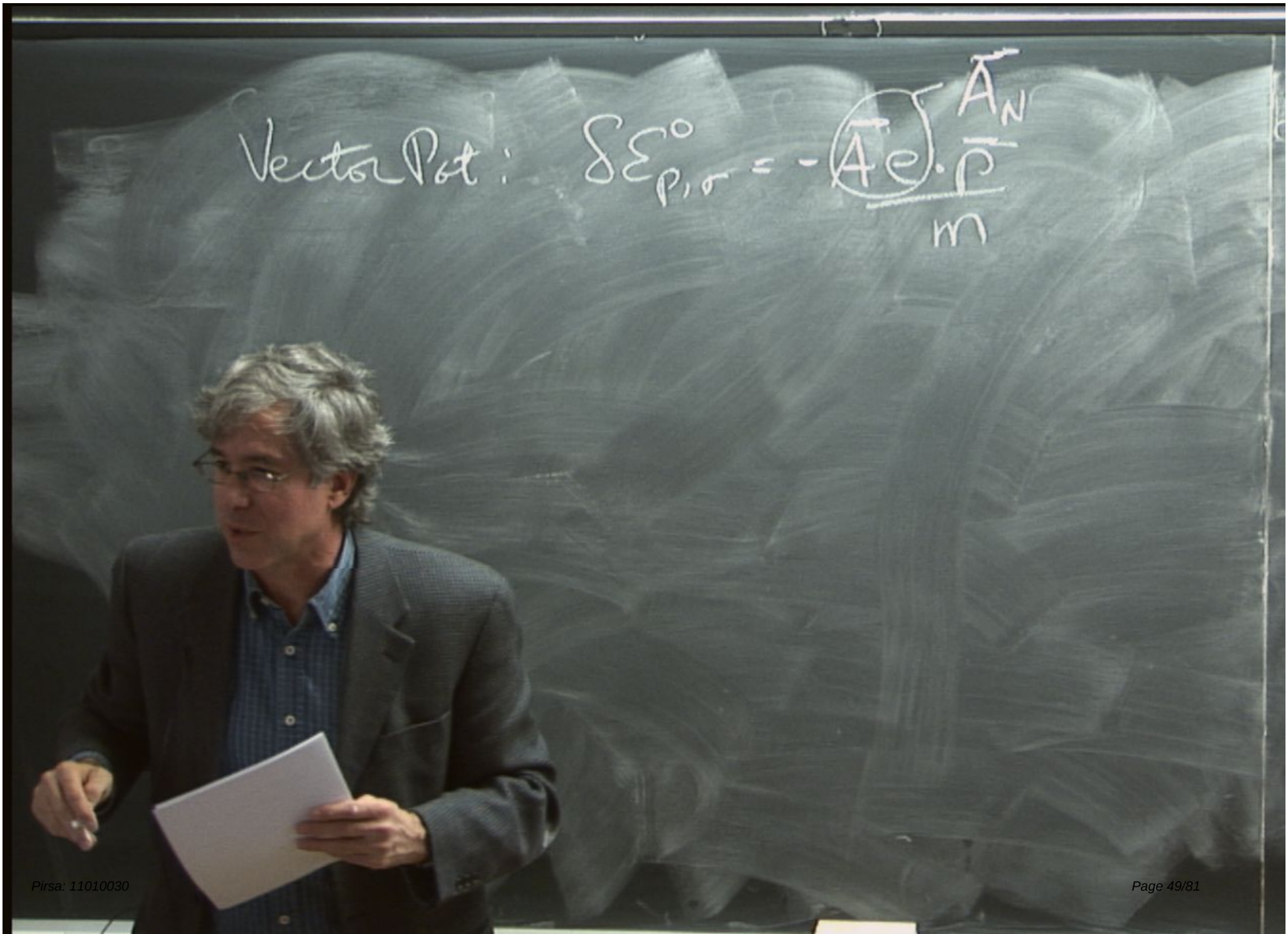
and $F_0^a = -0.75 \rightarrow \frac{1}{1+F_0^a} \approx 4$

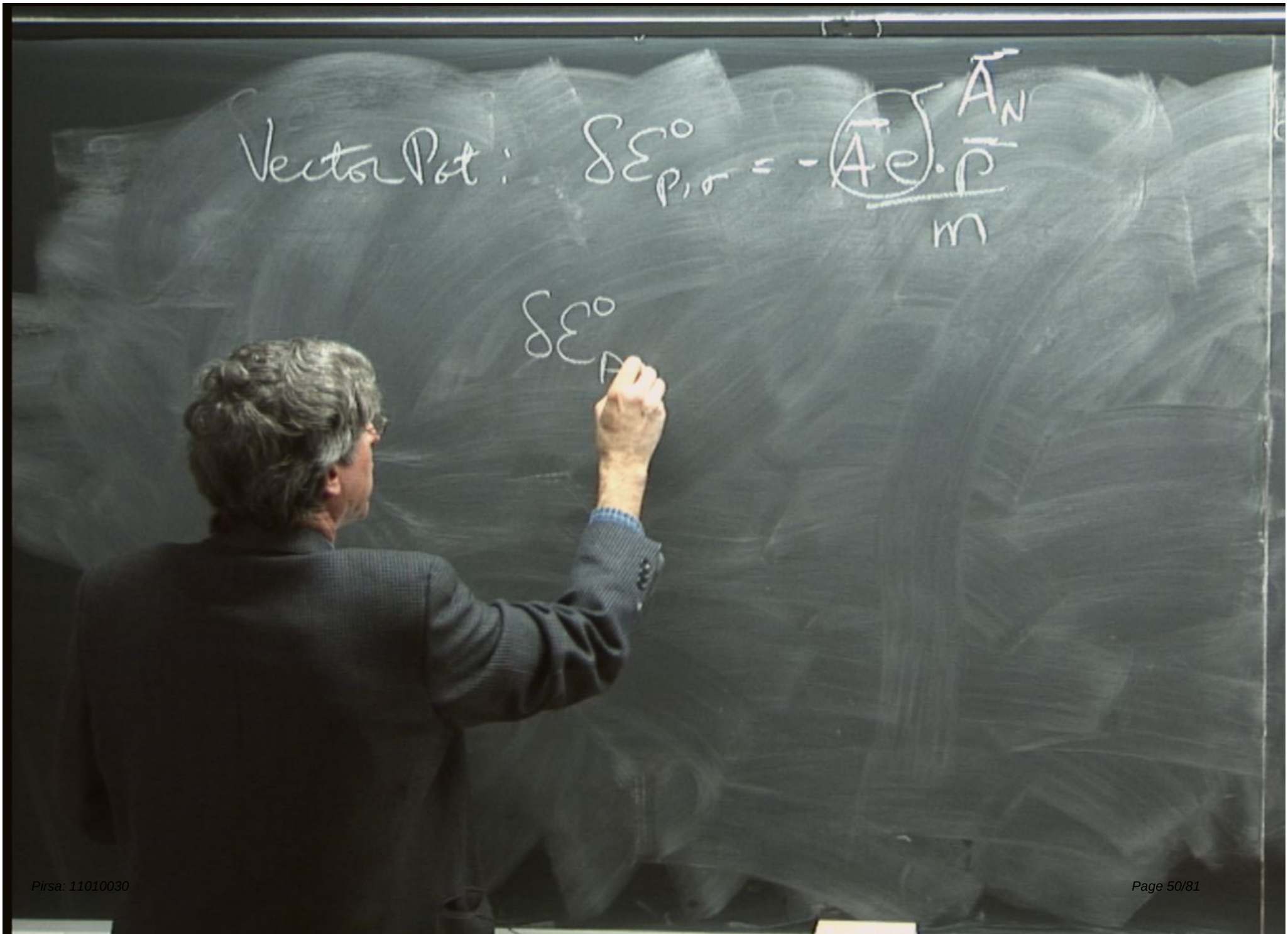
$B\uparrow$

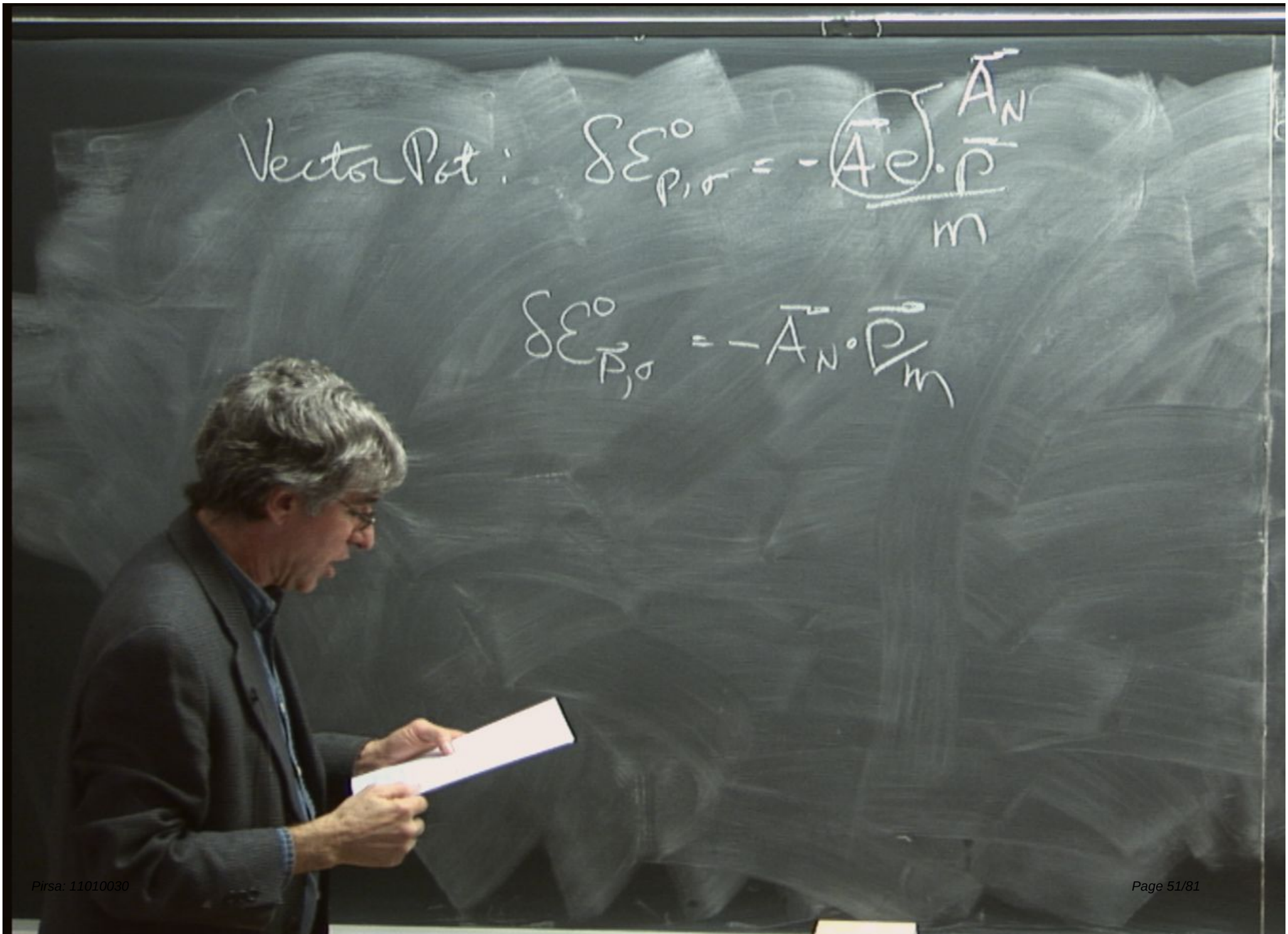
Tendency toward ferromagnetism

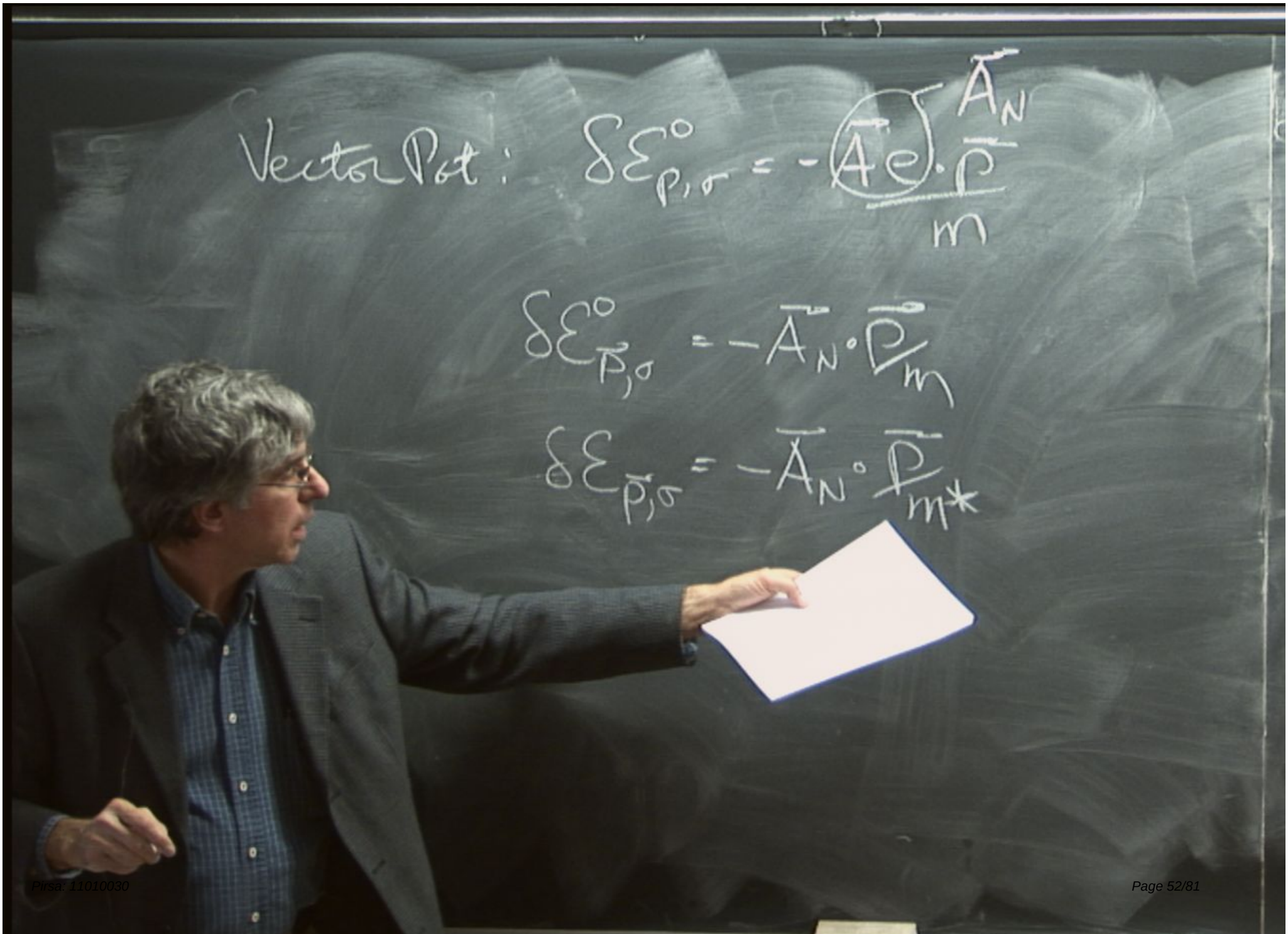

Vector Pot: $\delta \mathcal{E}^0_{p,\sigma}$

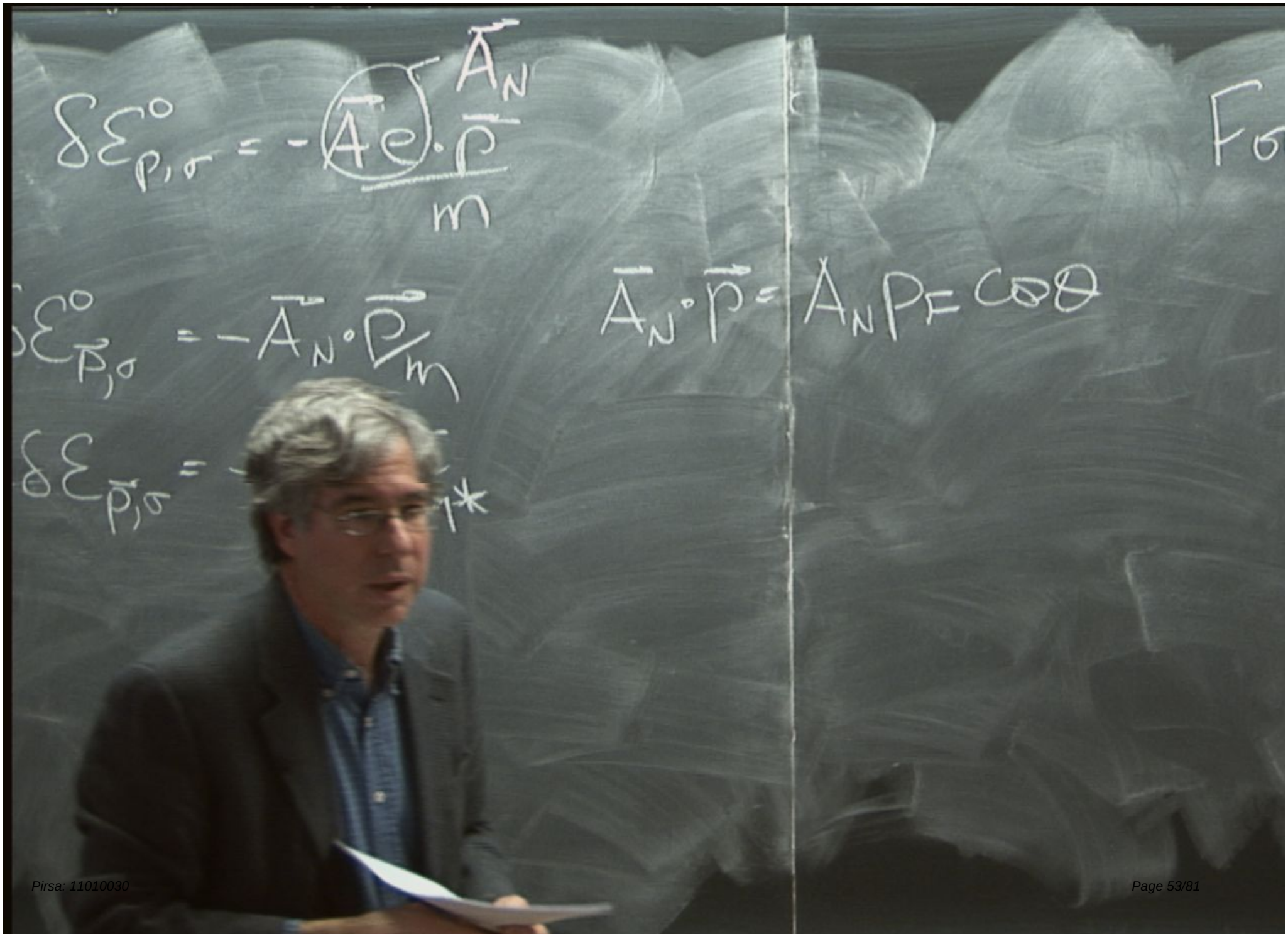

Vector Pot: $\delta \mathcal{E}^{0}_{p,\sigma} = -\frac{\vec{A}e \cdot \vec{p}}{m}$


Vector Pot: $\delta \mathcal{E}^{0}_{p,\sigma} = -\frac{\vec{A}_N e \cdot \vec{p}}{m}$


Vector Pot: $\delta\mathcal{E}^{0}_{p,\sigma} = -\frac{\vec{A}_N e \cdot \vec{p}}{m}$
$\delta\mathcal{E}^{0}_{p}$


Vector Pot: $\delta\mathcal{E}^0_{p,\sigma} = -\frac{\vec{A}e \cdot \vec{p}}{m}$
$\vec{A}_N$
$\delta\mathcal{E}^0_{\vec{p},\sigma} = -\vec{A}_N \cdot \vec{p}/m$


Vector Pot: $\delta\varepsilon^{0}_{p,\sigma} = -\vec{A}_N \cdot \frac{\vec{p}}{m}$
$\delta\varepsilon^{0}_{\vec{p},\sigma} = -\vec{A}_N \cdot \vec{p}/m$
$\delta\varepsilon_{\vec{p},\sigma} = -\vec{A}_N \cdot \vec{p}/m^*$


$\delta\mathcal{E}^0_{p,\sigma} = -\frac{\vec{A}e \cdot \vec{p}}{m}$
$\vec{A}_N$
$\vec{A}_N \cdot \vec{p} = A_N p \cos\theta$

$$\frac{e\,\vec{A}_N \cdot \vec{p}}{m}$$

$$\vec{p}/m$$

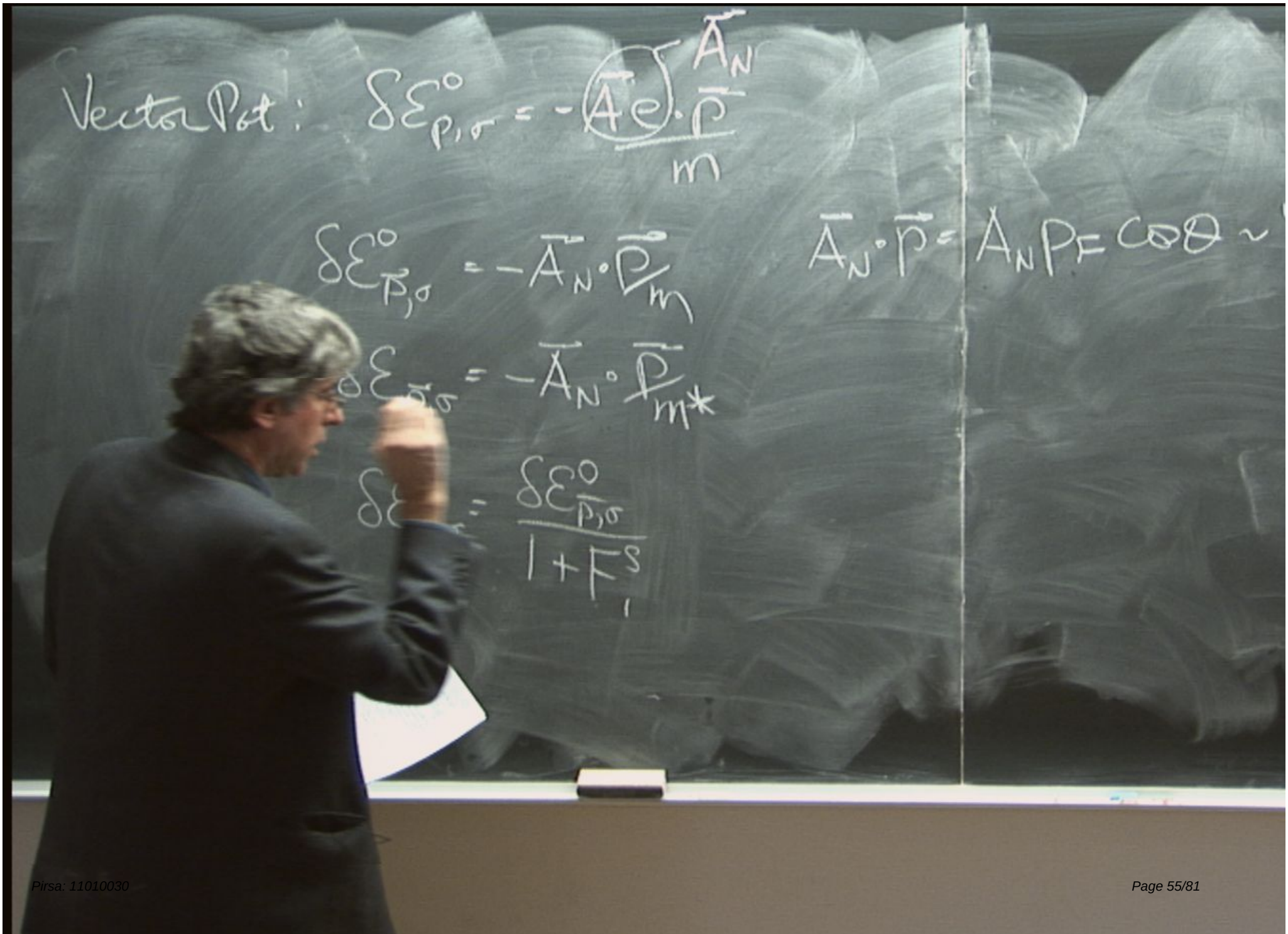
$$\vec{p}/m^*$$

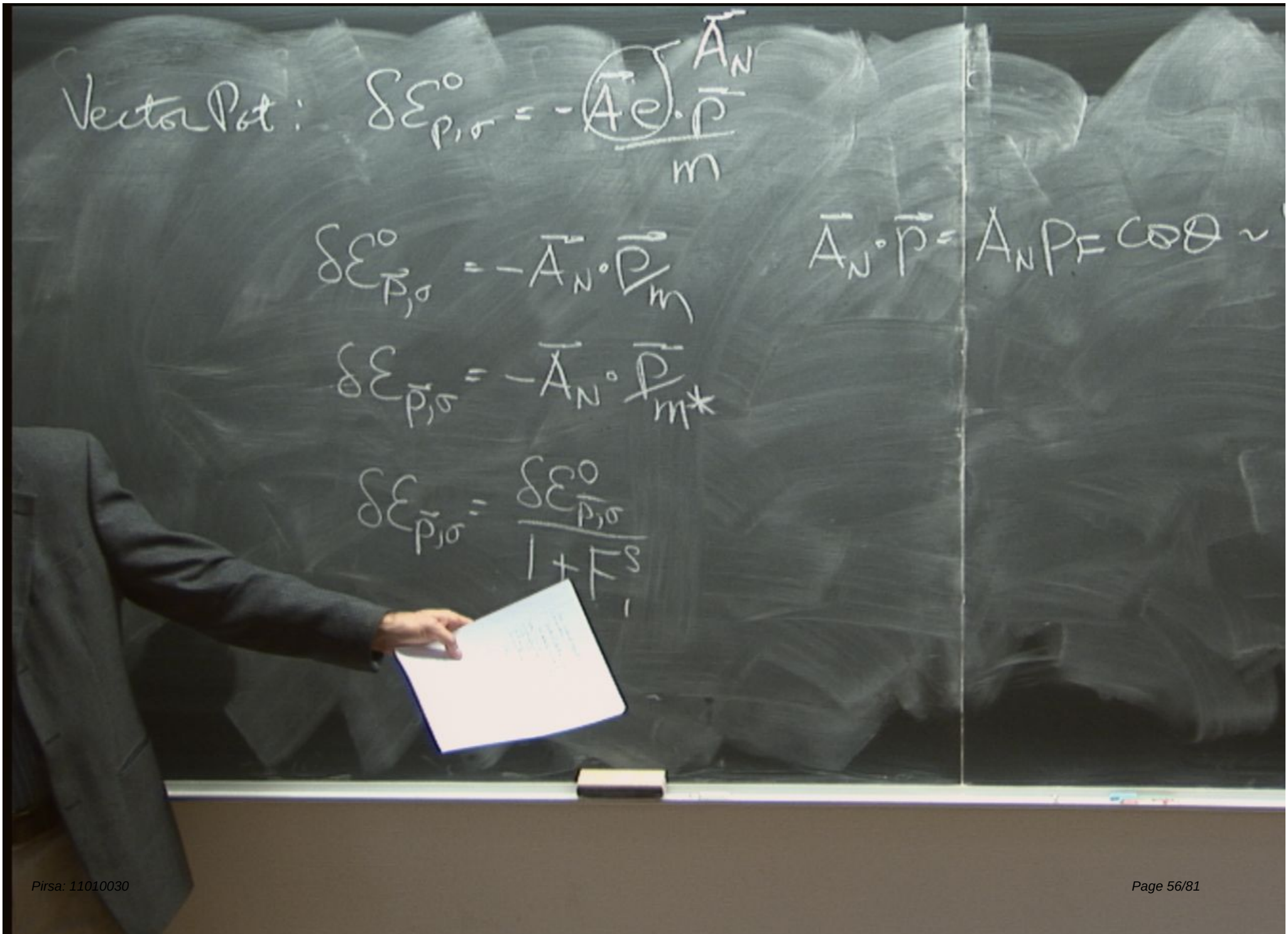
$$\vec{A}_N \cdot \vec{p} = A_N p \cos\theta \sim Y_{10}(\hat{p})$$

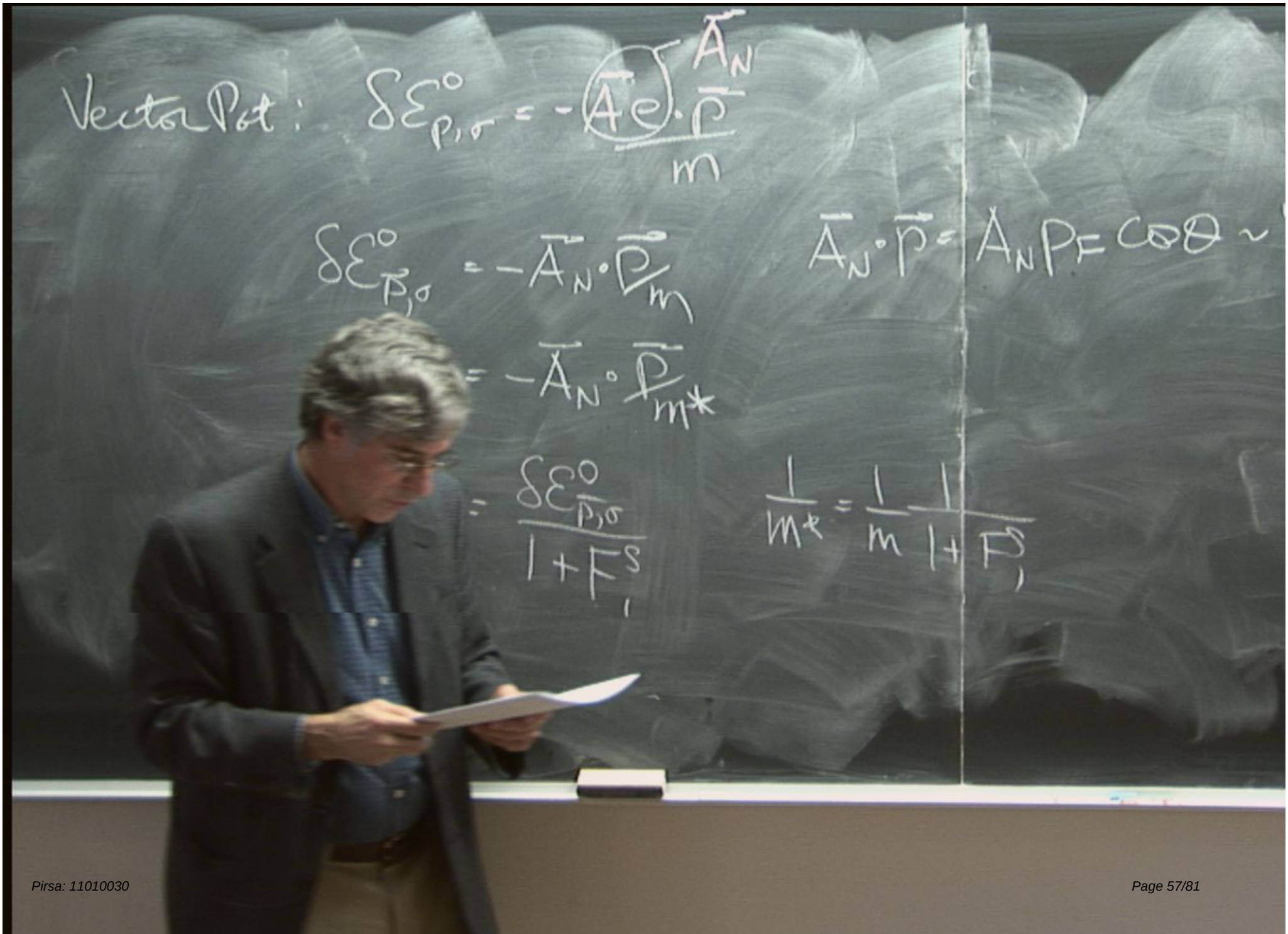
For ^{3}He a

$F_0^S =$

and F


Vector Pot: $\delta\varepsilon^0_{p,\sigma} = -\frac{\vec{A}e\cdot\vec{p}}{m}$
$\vec{A}_N$
$\delta\varepsilon^0_{\vec{p},\sigma} = -\vec{A}_N\cdot\vec{p}/m$
$\vec{A}_N\cdot\vec{p} = A_N p F \cos\theta \sim$
$\delta\varepsilon_{\vec{p},\sigma} = -\vec{A}_N\cdot\vec{p}/m^*$
$\delta\varepsilon = \frac{\delta\varepsilon^0_{\vec{p},\sigma}}{1+F^s_1}$


Vector Pot: $\delta\varepsilon^0_{p,\sigma} = -\frac{\vec{A}e\cdot\vec{p}}{m}$
$\vec{A}_N$
$\delta\varepsilon^0_{\vec{p},\sigma} = -\vec{A}_N\cdot\vec{p}/m$
$\vec{A}_N\cdot\vec{p} = A_N p_F \cos\theta \sim$
$\delta\varepsilon_{\vec{p},\sigma} = -\vec{A}_N\cdot\vec{p}/m^*$
$\delta\varepsilon_{\vec{p},\sigma} = \frac{\delta\varepsilon^0_{\vec{p},\sigma}}{1+F^s_1}$


Vector Pot: $\delta\varepsilon^0_{p,\sigma} = -\frac{\vec{A}e\cdot\vec{p}}{m}$
$\vec{A}_N$
$\delta\varepsilon^0_{\vec{p},\sigma} = -\vec{A}_N\cdot\vec{p}/m$
$\vec{A}_N\cdot\vec{p} = A_N p \cos\theta \sim$
$= -\vec{A}_N\cdot\vec{p}/m^*$
$= \frac{\delta\varepsilon^0_{\vec{p},\sigma}}{1+F^s_1}$
$\frac{1}{m^*} = \frac{1}{m}\frac{1}{1+F^s_1}$

Vector Pot: $\delta\varepsilon^{0}_{p,\sigma} = -\frac{\vec{A}e\cdot\vec{p}}{m}$ $\quad \vec{A}_N$

$$\delta\varepsilon^{0}_{\vec{p},\sigma} = -\vec{A}_N\cdot\vec{p}/m$$

$$\vec{A}_N\cdot\vec{p} = A_N p_F \cos\theta \sim$$

$$\delta\varepsilon_{\vec{p},\sigma} = -\vec{A}_N\cdot\vec{p}/m^*$$

$$\delta\varepsilon_{\vec{p},\sigma} = \frac{\delta\varepsilon^{0}_{\vec{p},\sigma}}{1+F^s_1}$$

$$\frac{1}{m^*} = \frac{1}{m}\frac{1}{1+F^s_1}$$

$$m^* = m(1+F^s_1)$$

Vector Pot: $\delta\varepsilon^{0}_{p,\sigma} = -\frac{\vec{A}e\cdot\vec{p}}{m}$ $\quad \vec{A}_N$

$$\delta\varepsilon^{0}_{\vec{p},\sigma} = -\vec{A}_N\cdot\vec{p}/m$$

$$\vec{A}_N\cdot\vec{p} = A_N p_F \cos\theta \sim$$

$$\delta\varepsilon_{\vec{p},\sigma} = -\vec{A}_N\cdot\vec{p}/m^*$$

$$\delta\varepsilon_{\vec{p},\sigma} = \frac{\delta\varepsilon^{0}_{\vec{p},\sigma}}{1+F^s_1}$$

$$\frac{1}{m^*} = \frac{1}{m}\frac{1}{1+F^s_1}$$

eff mass

$$m^* = m(1+F^s_1)$$

$$= -\frac{\vec{A}_N e \cdot \vec{p}}{m}$$

$$= -\vec{A}_N \cdot \vec{p}/m$$

$$= -\vec{A}_N \cdot \vec{p}/m^*$$

$$= \frac{\delta \varepsilon^0_{\vec{p},\sigma}}{1+F_1^s}$$

$$\vec{A}_N \cdot \vec{p} = A_N p = \cos\theta \sim Y_{10}(\hat{p})$$

$$\frac{1}{m^*} = \frac{1}{m}\frac{1}{1+F_1^s}$$

$$m^* = m(1+F_1^s)$$

eff mass enhancement due to int

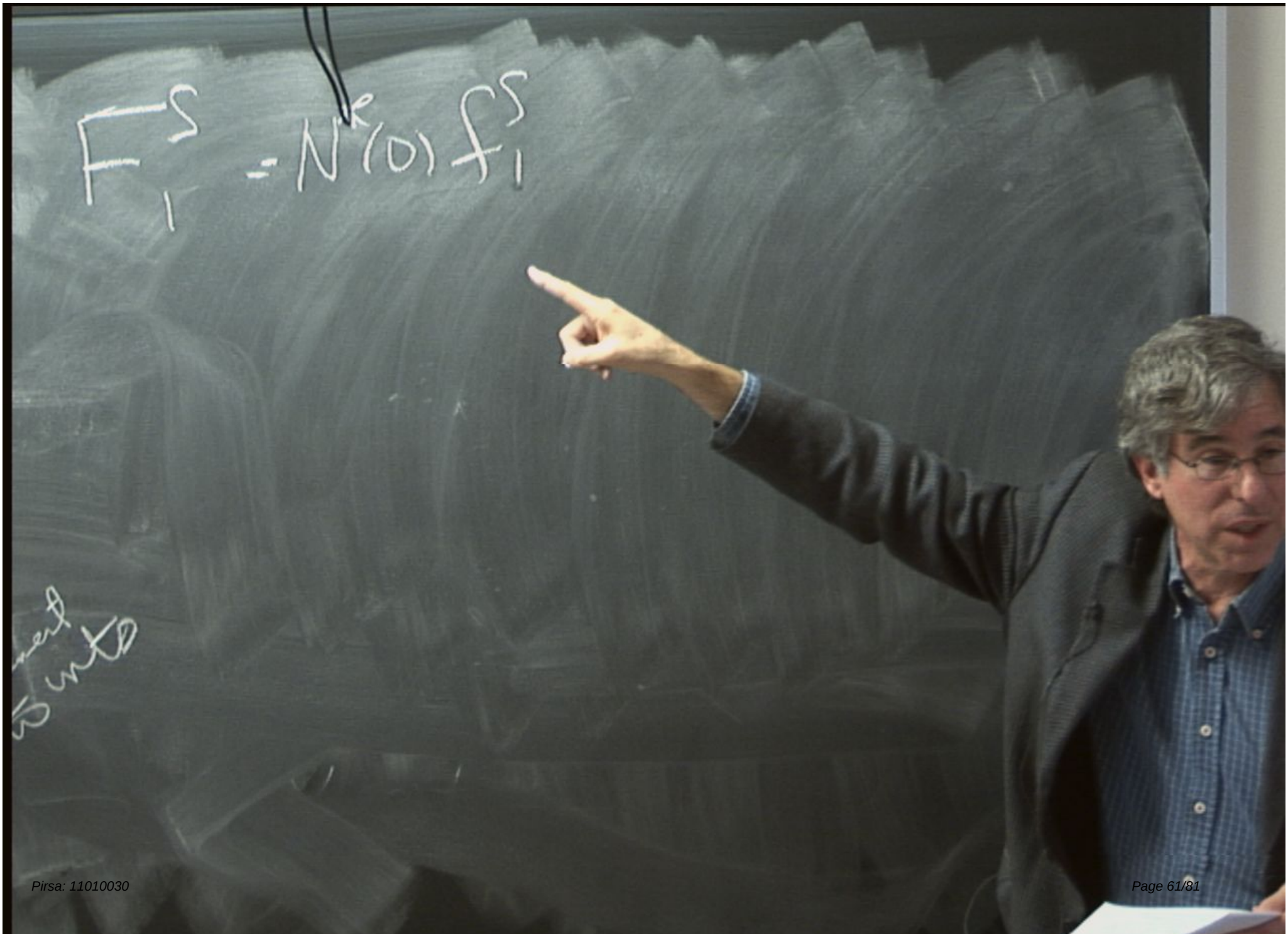
For ^{3}He at low T

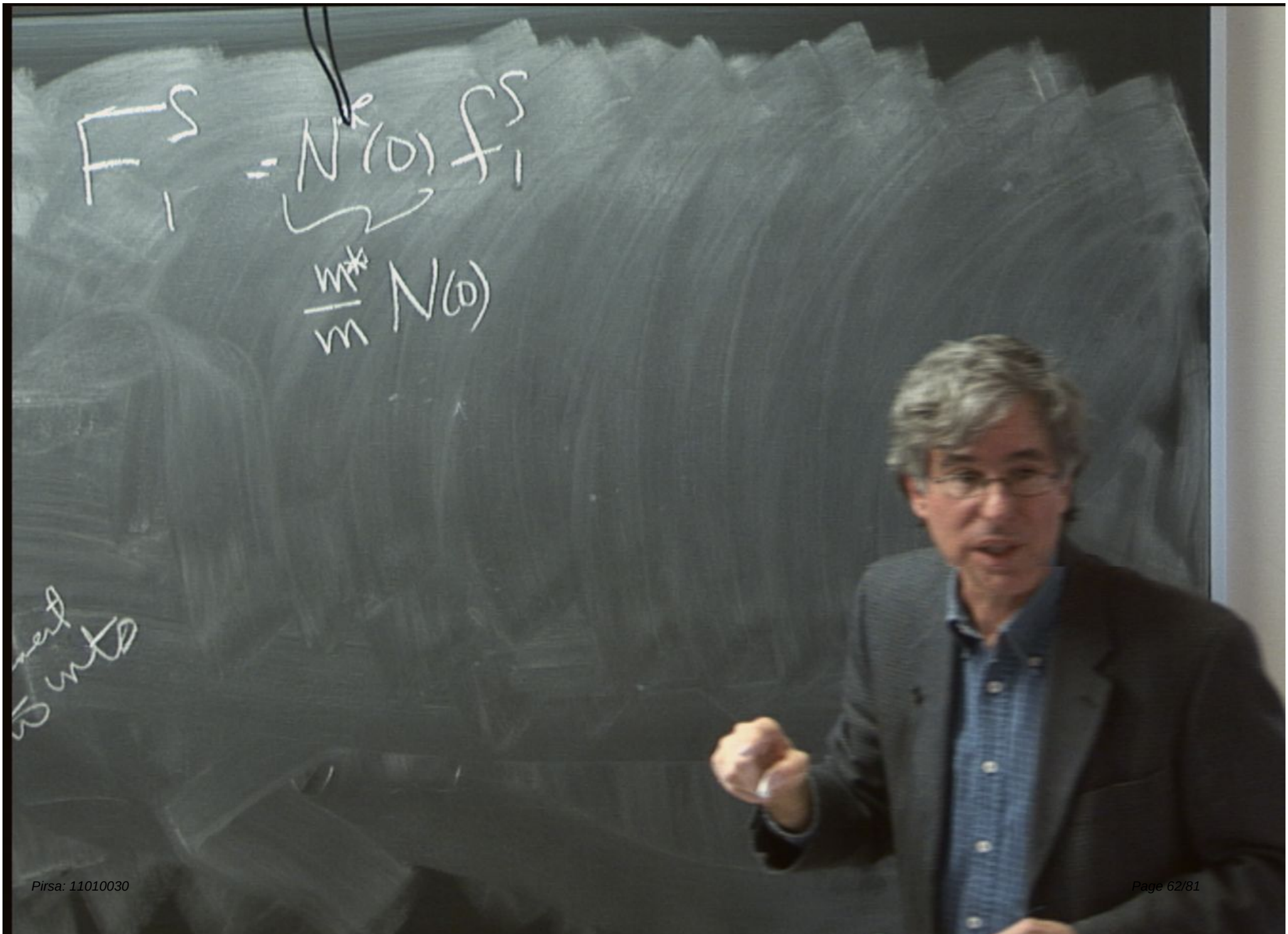
$$F_0^s = 10.8$$

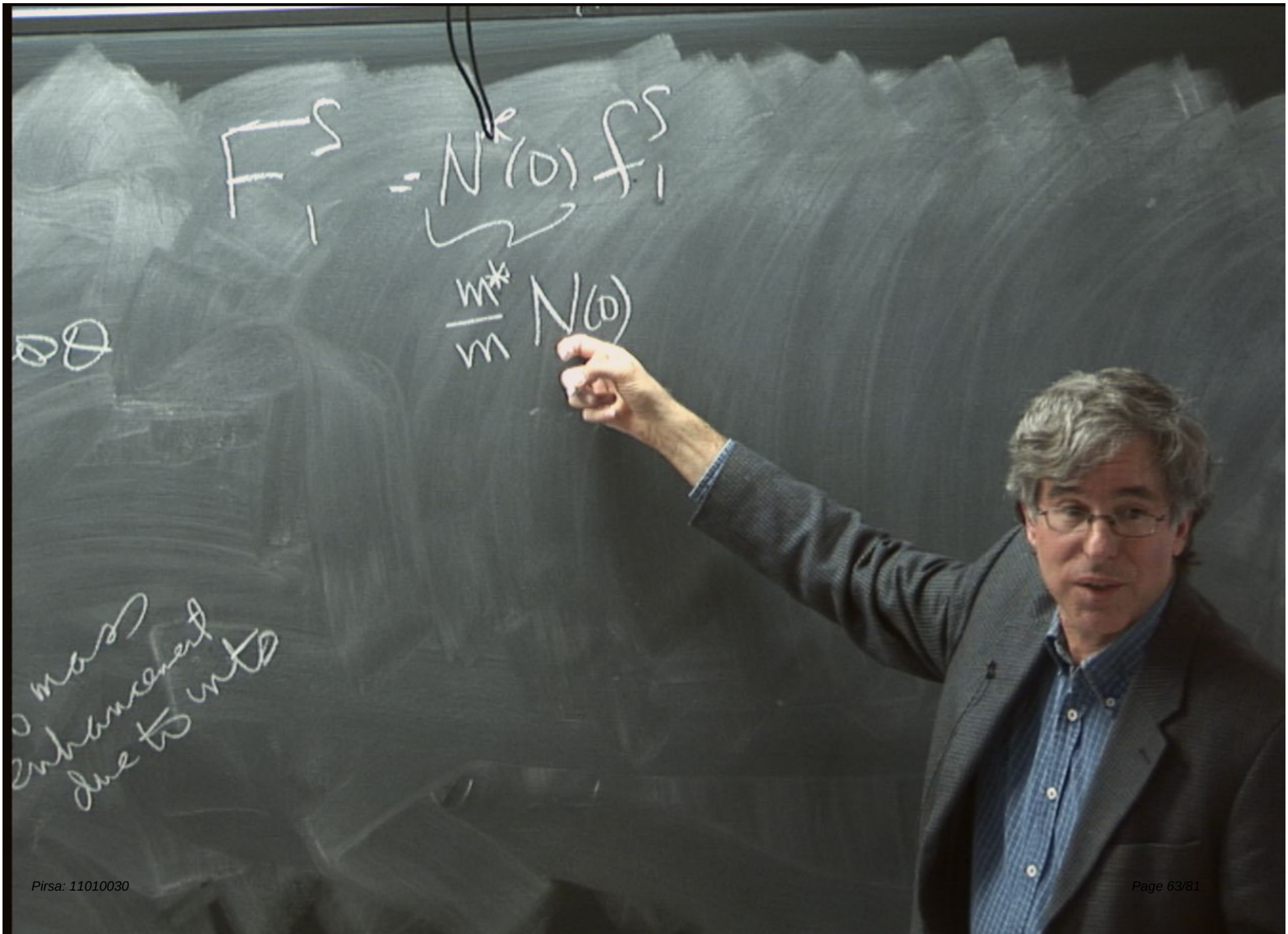
and $F_0^a = -0.$

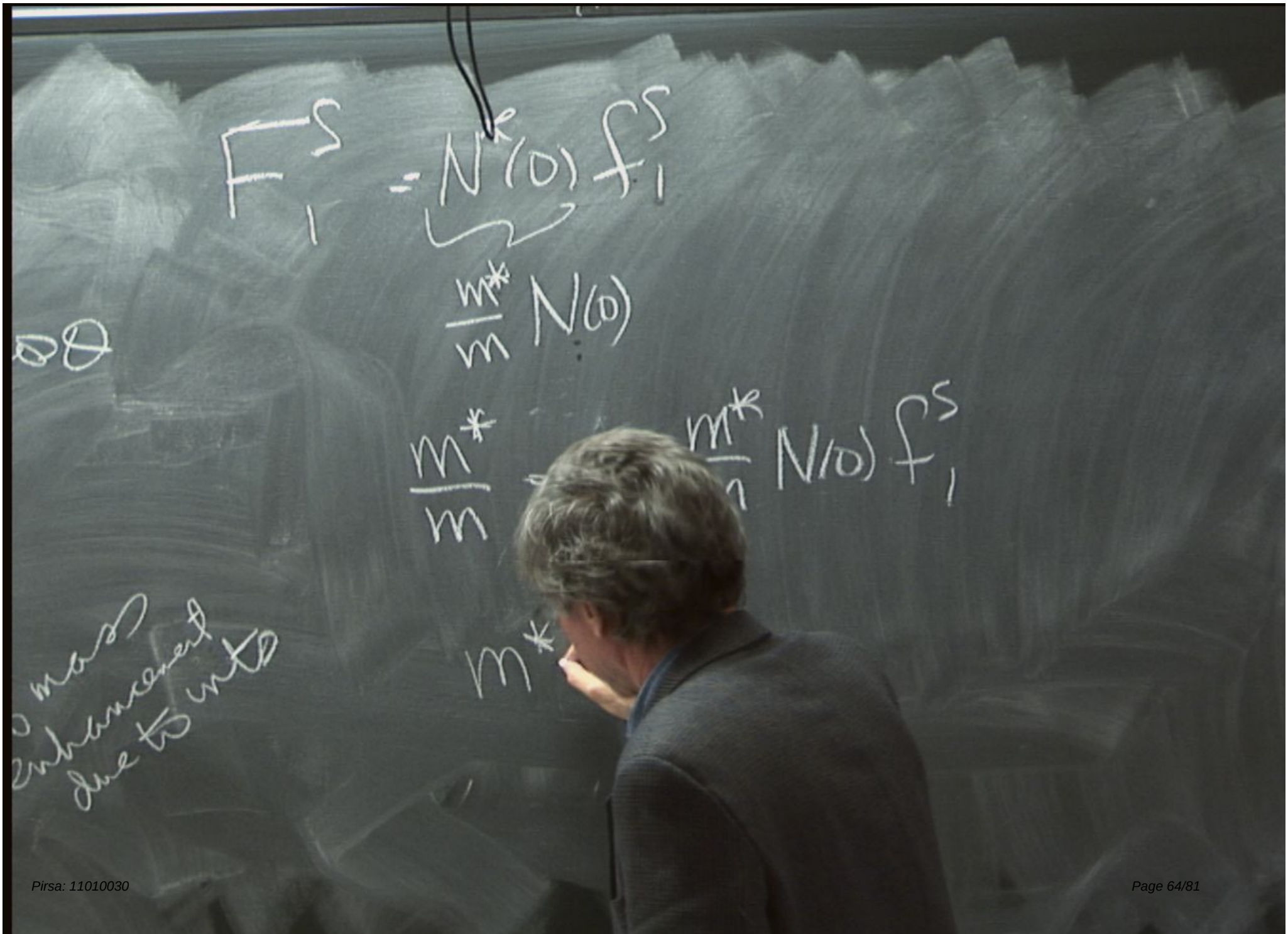
Ter

f


$F_1^S = N^e(0) f_1^S$


$F_1^S = N^*(0) f_1^S$
$\frac{m^*}{m} N(0)$


$F_1^s = N^*(0) f_1^s$
$\frac{m^*}{m} N(0)$
mass
enhancement
due to int


$F_1^s = N^*(0) f_1^s$
$\frac{m^*}{m} N(0)$
$\frac{m^*}{m} = \frac{m^*}{m} N(0) f_1^s$
m^*
mass enhancement due to int

$$F_1^s = \underbrace{N^*(0)}_{\frac{m^*}{m}N(0)} f_1^s$$

$$\frac{m^*}{m} = 1 + \frac{m^*}{m} N(0) f_1^s$$

$$m^* = \frac{m}{1 - N(0) f_1^s}$$

mass enhancement due to int

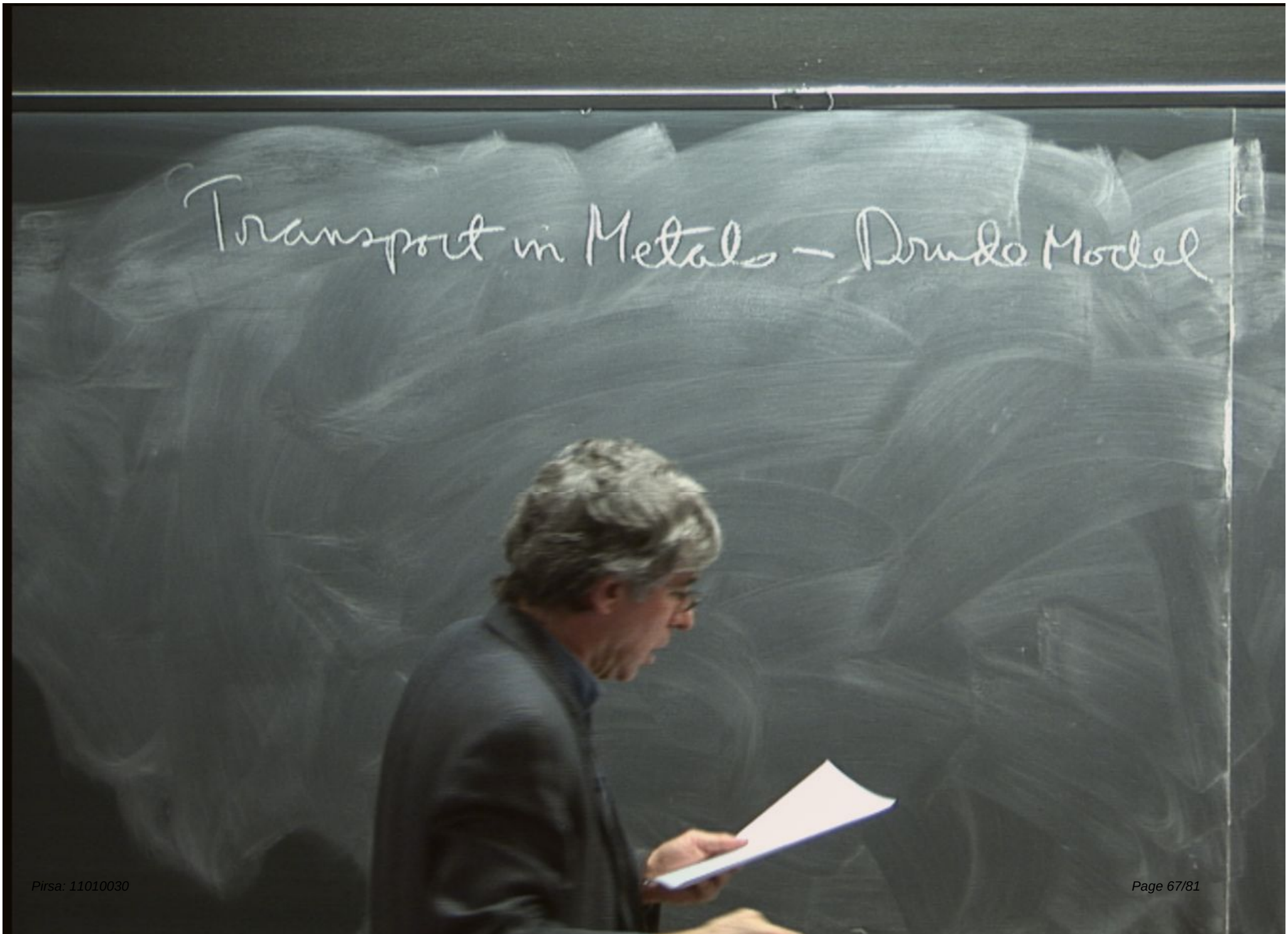
$$F_1^s = \underbrace{N^*(0)}_{\frac{m^*}{m} N(0)} f_1^s$$

$$\frac{m^*}{m} = 1 + \frac{m^*}{m} N(0) f_1^s$$

$$m^* = \frac{m}{1 - N(0) f_1^s}$$

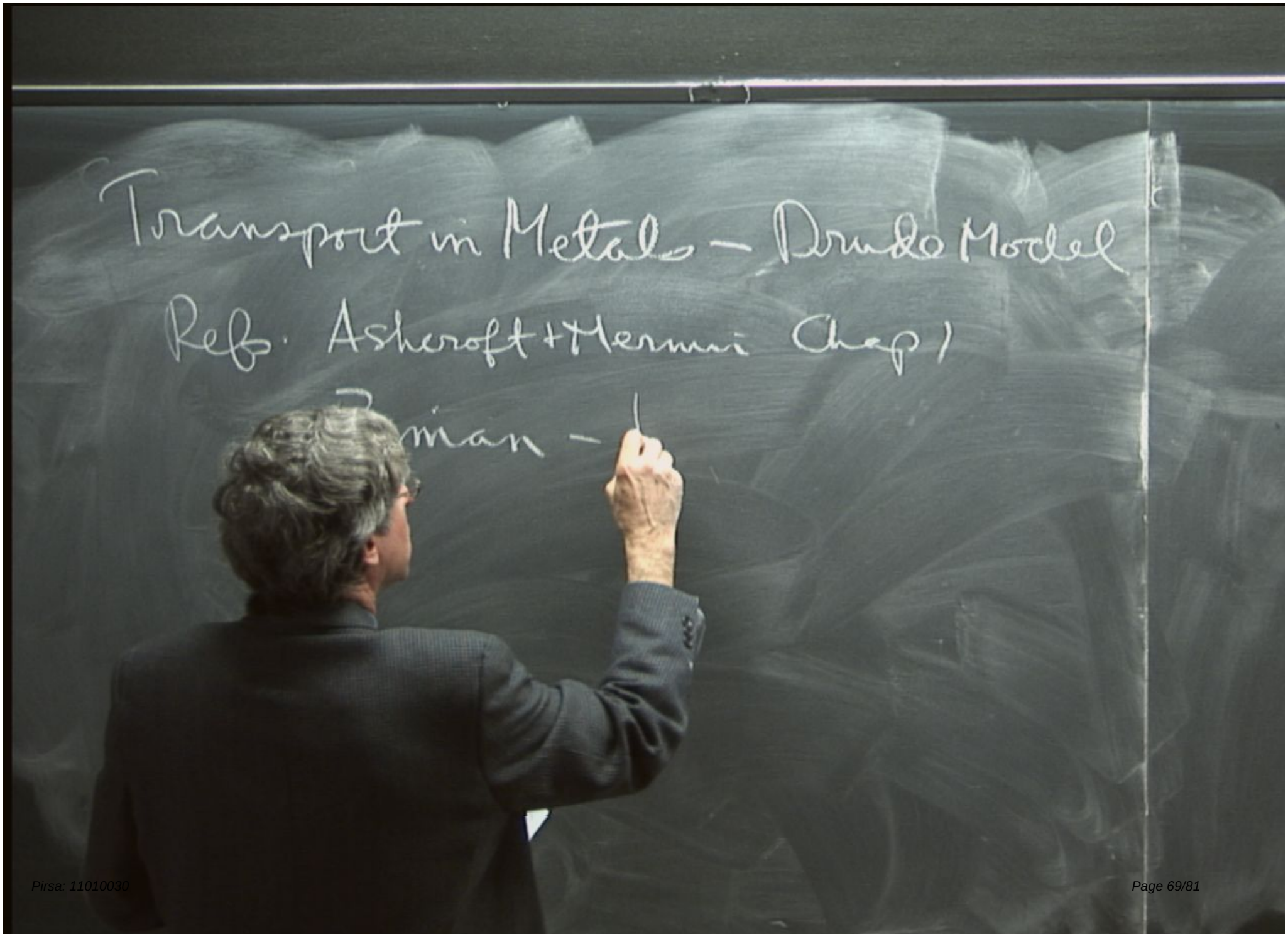
Can diverge as $N(0) f_1^s \to 1$

mass enhancement due to int


Transport in Metals – Drude Model

Transport in Metals – Drude Model

Refs. Ashcroft + Mermin Chap 1


Transport in Metals – Drude Model
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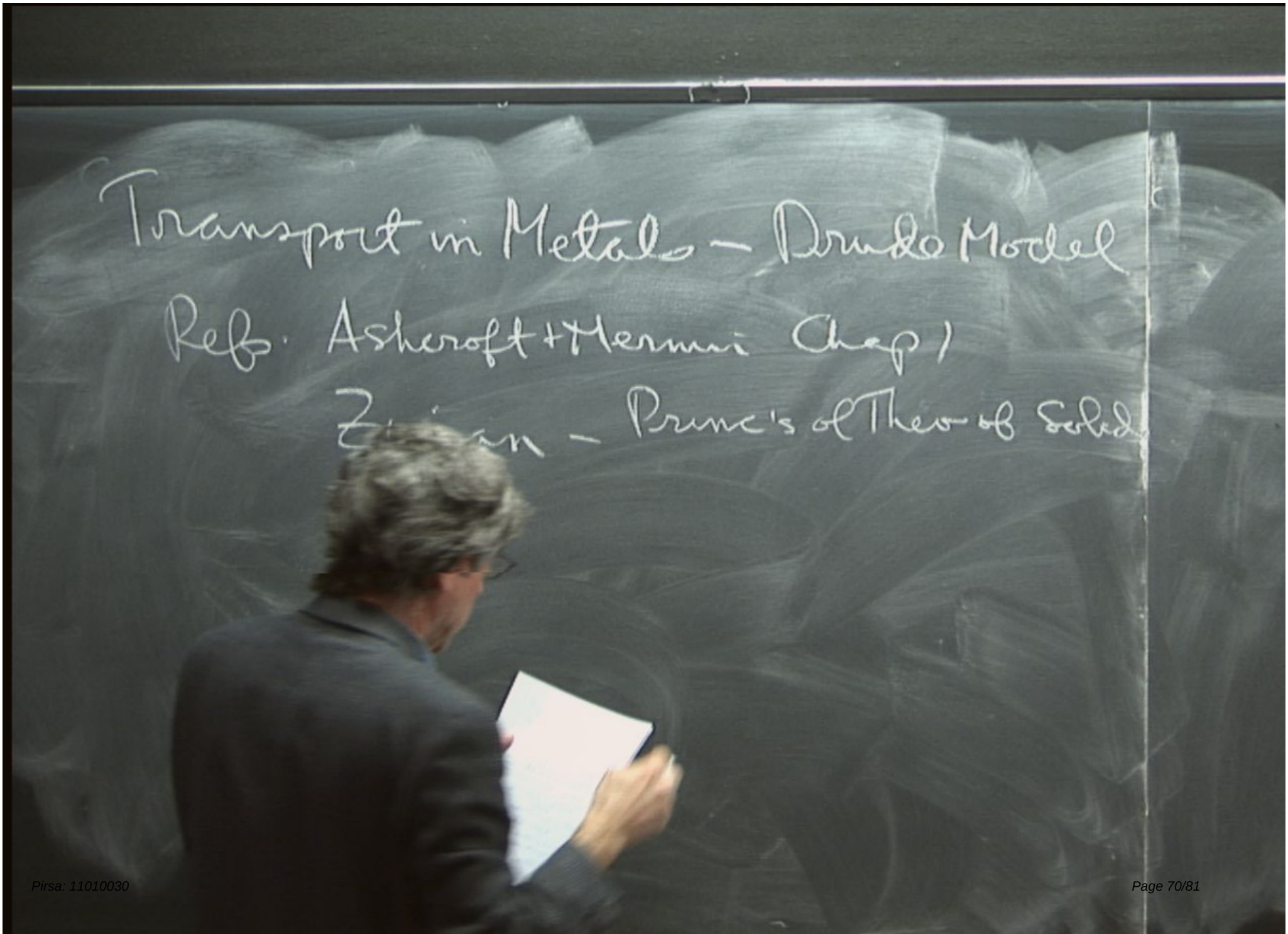
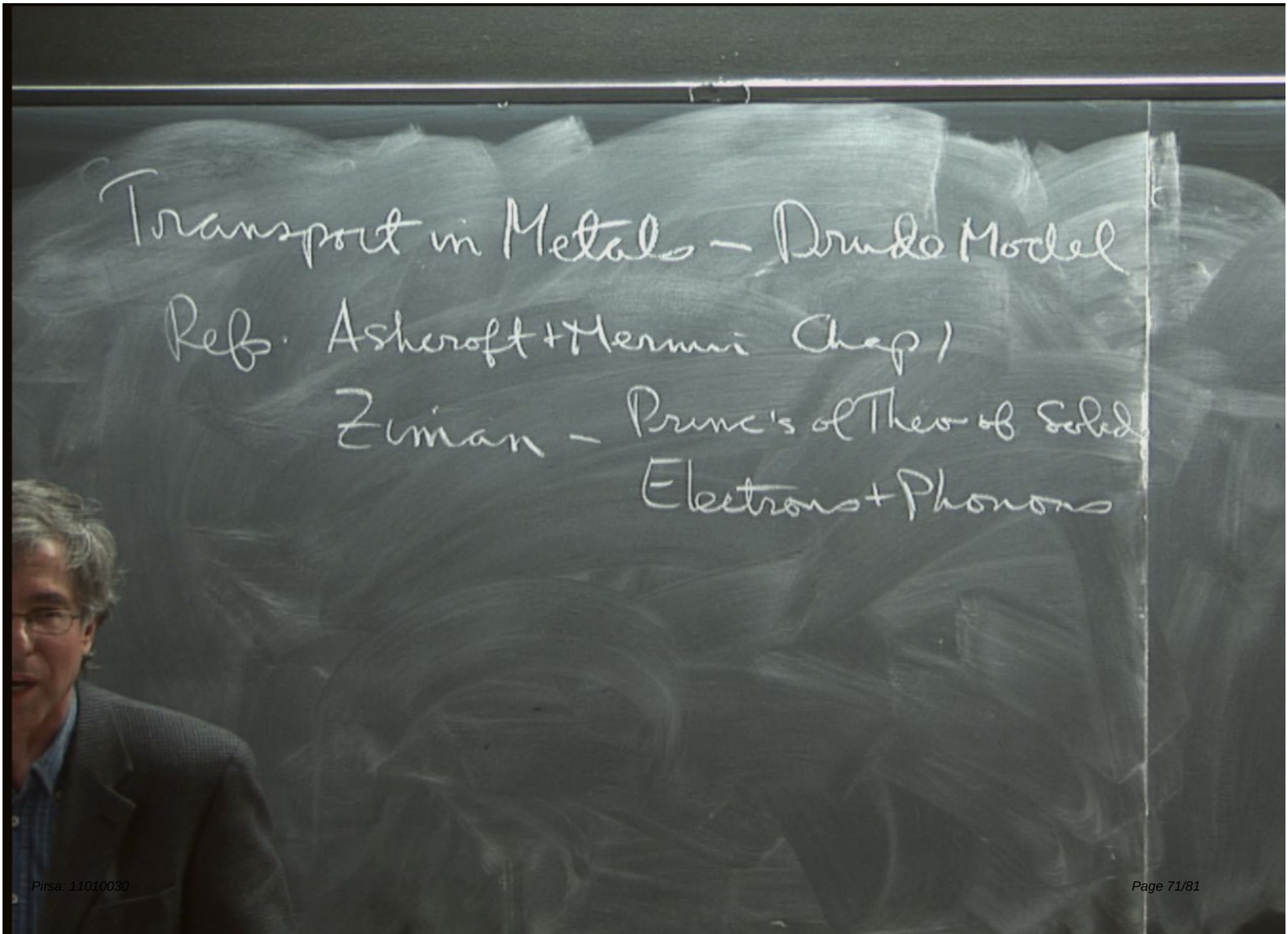

Transport in Metals – Drude Model
Refs. Ashcroft + Mermin Chap 1
Ziman – Princ's of Theo of Solids


Transport in Metals – Drude Model
Refs. Ashcroft + Mermin Chap 1
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Electrons + Phonons

Transport in Metals – Drude Model

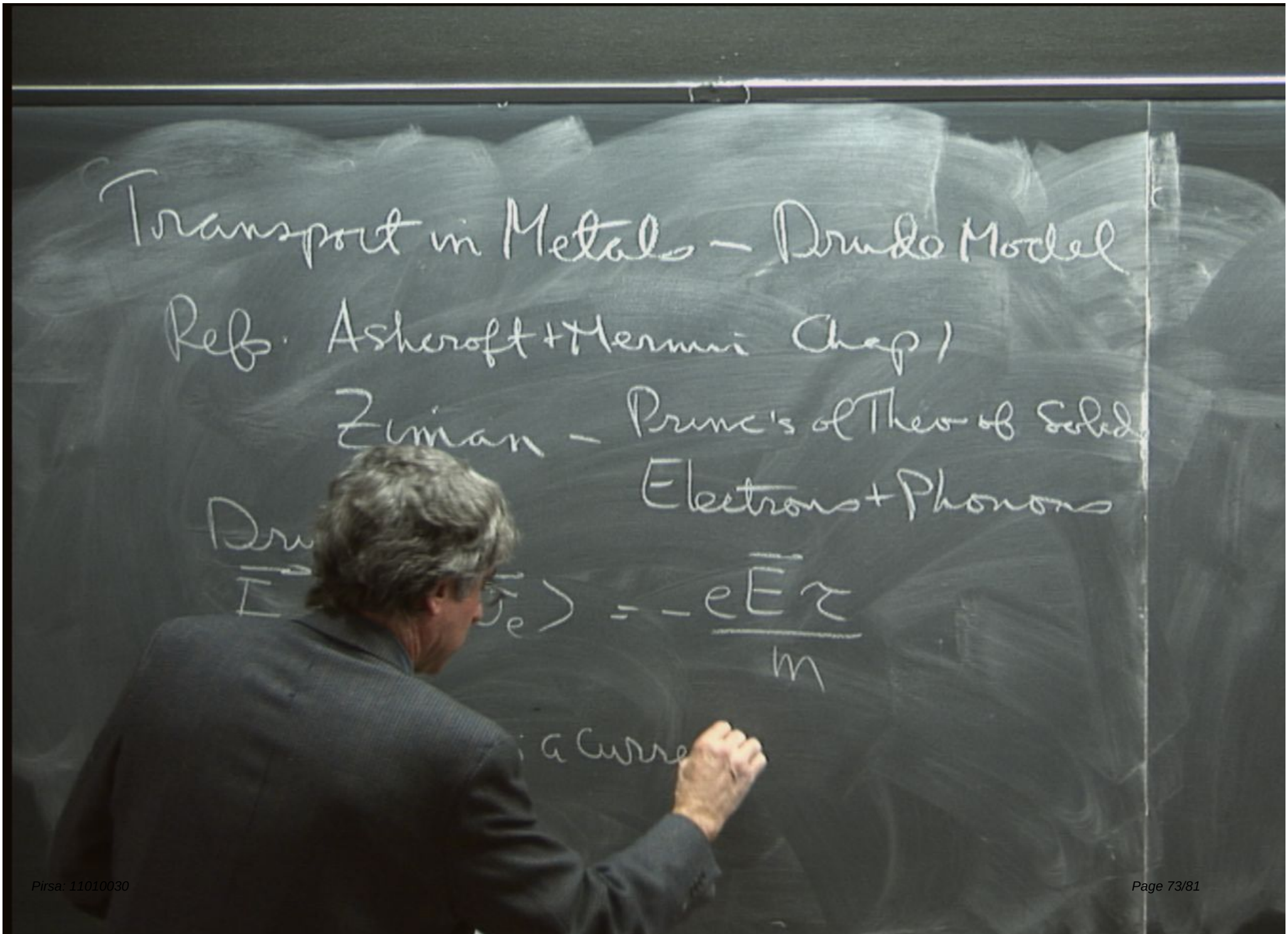
Refs. Ashcroft + Mermin Chap 1

Ziman – Princ's of Theo of Solids

Electrons + Phonons

Drude

$\vec{E} \rightarrow \langle \vec{v}_e \rangle$


Transport in Metals – Drude Model
Refs. Ashcroft + Mermin Chap 1
Ziman – Princ's of Theo of Solids
Electrons + Phonons
$\langle \vec{v}_e \rangle = -\frac{e\vec{E}\tau}{m}$
a Curre

Transport in Metals – Drude Model

Refs. Ashcroft + Mermin Chap 1

Ziman – Princ's of Theor of Solids

Electrons + Phonons

Drude

$$\vec{E} \rightarrow \langle \vec{v}_e \rangle = -\frac{e\vec{E}\tau}{m}$$

Gives a current $\vec{j} = -n e \langle \vec{v}_e \rangle$

Transport in Metals – Drude Model

Refs. Ashcroft + Mermin Chap 1

Ziman – Princ's of Theor of Solids

Electrons + Phonons

Drude

$$\vec{E} \rightarrow \langle \vec{v}_e \rangle = -\frac{e\vec{E}\tau}{m}$$

Gives a current $\vec{j} = -\langle n e \vec{v}_e \rangle = \frac{ne^2}{m}$

density of elec.

ransport in Metals – Drude Model

Refs. Ashcroft + Mermin Chap 1

Ziman – Princ's of Theor of Solids

Electrons + Phonons

Drude

$$\vec{E} \rightarrow \langle \vec{v}_e \rangle = -\frac{e\vec{E}\tau}{m}$$

Gives a current $\vec{j} = -\langle n e \vec{v}_D \rangle = \frac{ne^2\tau}{m}\vec{E}$

density of el's

ransport in Metals – Drude Model

Refs. Ashcroft + Mermin Chap 1

Ziman – Princ's of Theor of Solids

Electrons + Phonons

Drude

$$\vec{E} \rightarrow \langle \vec{v}_e \rangle = -\frac{e\vec{E}\tau}{m}$$

Gives a current $\vec{j} = -\langle n e \vec{v}_e \rangle = \frac{ne^2\tau}{m}\vec{E}$

density of elec

σ

σ relates $\vec{J}$ to $\vec{E}$

$$\vec{J} = \sigma \vec{E} \rightarrow \sigma = \frac{ne^2\tau}{m}$$

for $\omega = 0$ (dc)

$$\frac{ne^2\tau}{m}\vec{E}$$

σ relates $\vec{J}$ to $\vec{E}$

$$\vec{J} = \sigma \vec{E} \rightarrow \sigma = \frac{ne^2\tau}{m}$$

for $\omega = 0$ (dc)

$$\frac{\tau}{m}\vec{E}$$

σ relates $\vec{J}$ to $\vec{E}$

$$\vec{J} = \sigma \vec{E} \rightarrow \sigma = \frac{ne^2\tau}{m}$$

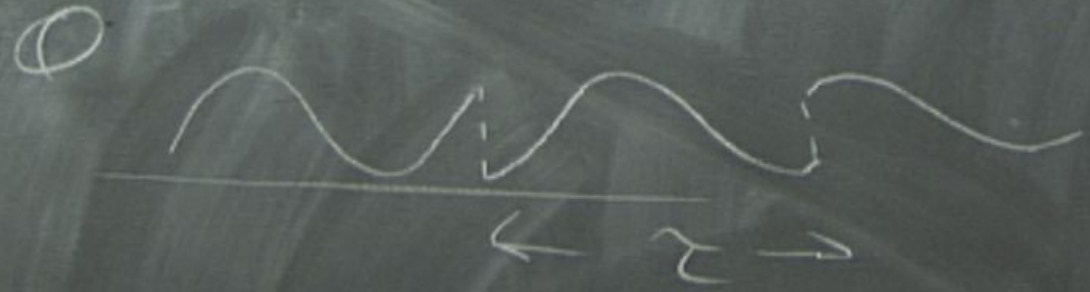
for $\omega = 0$ (dc)

$\vec{E}$

σ relates $\vec{J}$ to $\vec{E}$

$$\vec{J} = \sigma \vec{E} \rightarrow \sigma = \frac{ne^2\tau}{m}$$

for $\omega = 0$ (dc)



$\vec{E}$