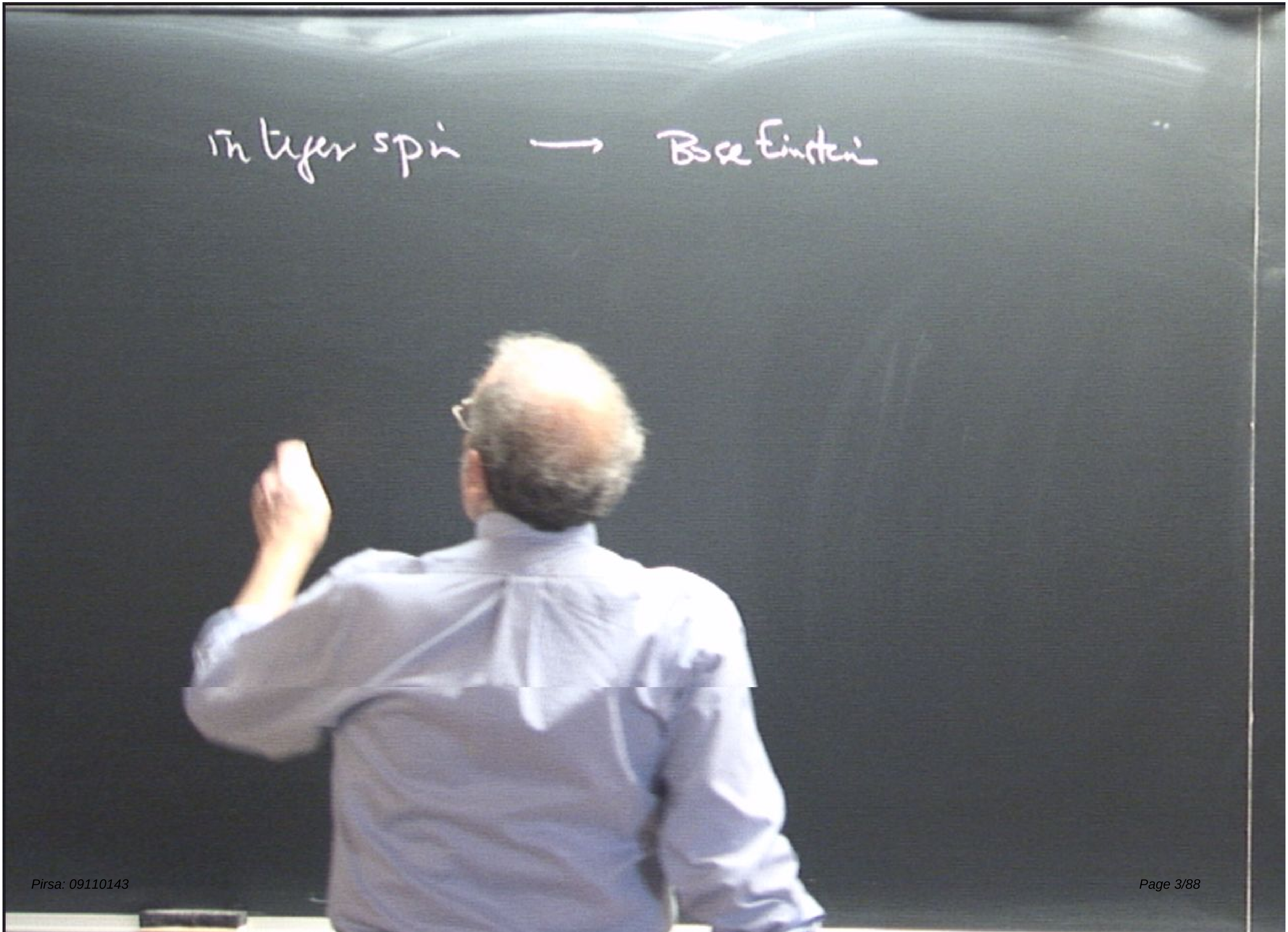
Title: Standard Model - Review (PHYS 622) - Lecture 1

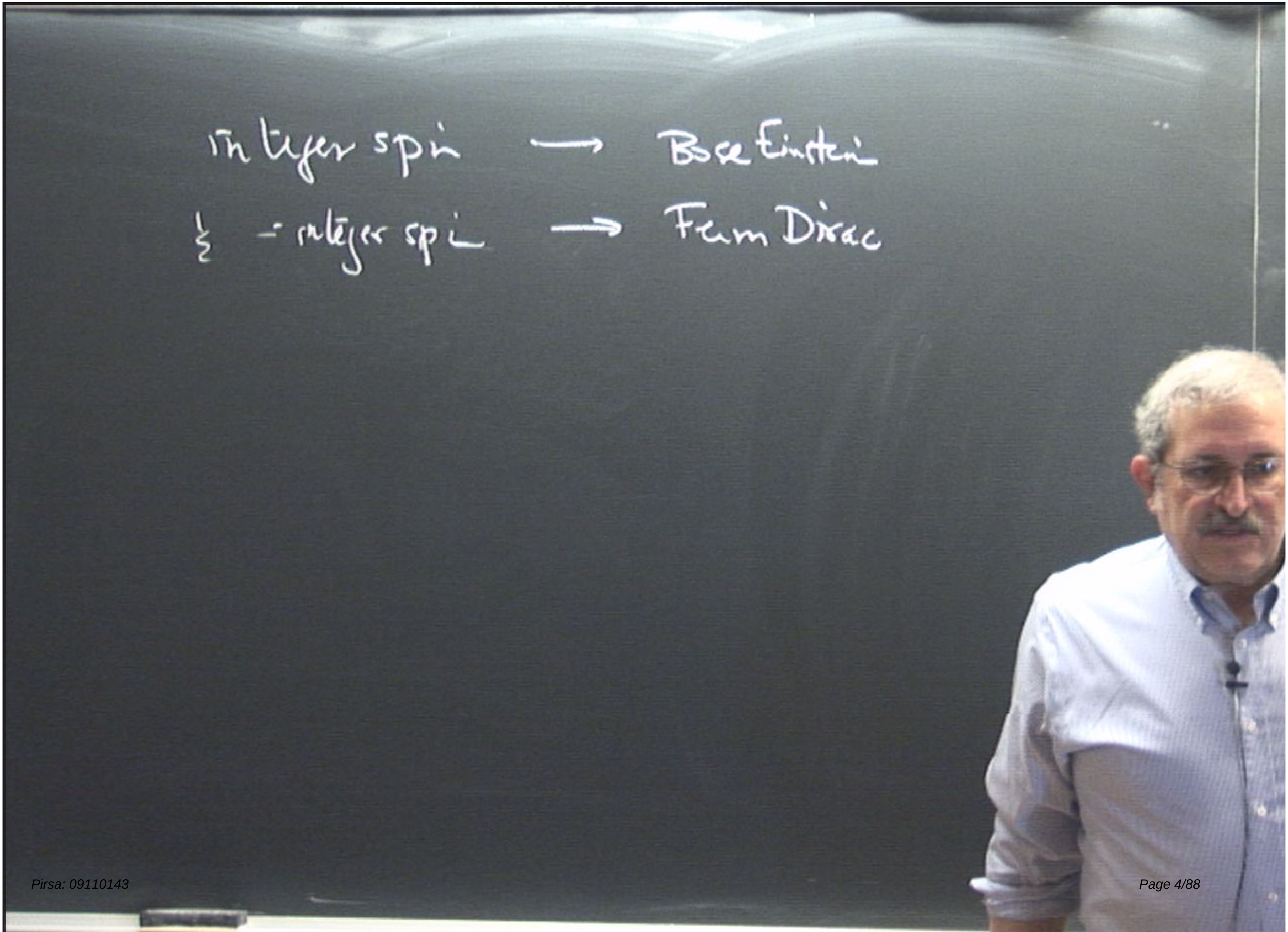
Date: Nov 30, 2009 09:00 AM

URL: http://pirsa.org/09110143

Abstract:

PERIMETER INSTITUTE FOR THEORETICAL PHYSICS


integer spin → Bose Einstein


integer spin → Bose Einstein
$\frac{1}{2}$ - integer spin → Fermi Dirac

integer spin $\longrightarrow$ Bose Einstein forces.

$\frac{1}{2}$-integer spin $\longrightarrow$ Fermi Dirac matter

integer spin $\longrightarrow$ Bose Einstein forces.

$\frac{1}{2}$ - integer spin $\longrightarrow$ Fermi Dirac matter

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Stand Model. leptons quarks.

integer spin $\longrightarrow$ Bose Einstein forces.

$\frac{1}{2}$ - integer spin $\longrightarrow$ Fermi Dirac matter

Stand Model. leptons quarks.

e^- μ^- τ^-

integer spin → Bose Einstein forces.

$\frac{1}{2}$ - integer spin → Fermi Dirac matter

Stand Model. leptons quarks.

— e^- μ^- τ^-

$m =$ 0.511 MeV 105.7 MeV 1777. MeV

integer spin $\longrightarrow$ Bose Einstein forces.

$\frac{1}{2}$ - integer spin $\longrightarrow$ Fermi Dirac matter

Stand Model. leptons quarks.

e^- μ^- τ^-

$m =$ 0.511 MeV 105.7 MeV 1777. MeV

e^+ μ^+ τ^+

integer spin $\longrightarrow$ Bose Einstein forces.

$\frac{1}{2}$ - integer spin $\longrightarrow$ Fermi Dirac matter

Stand Model. leptons quarks.

e^- μ^- τ^- spin $\frac{1}{2}$

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e^+ μ^+ τ^+

integer spin $\longrightarrow$ Bose Einstein forces.

$\frac{1}{2}$ - integer spin $\longrightarrow$ Fermi Dirac matter

Stand Model. leptons quarks.

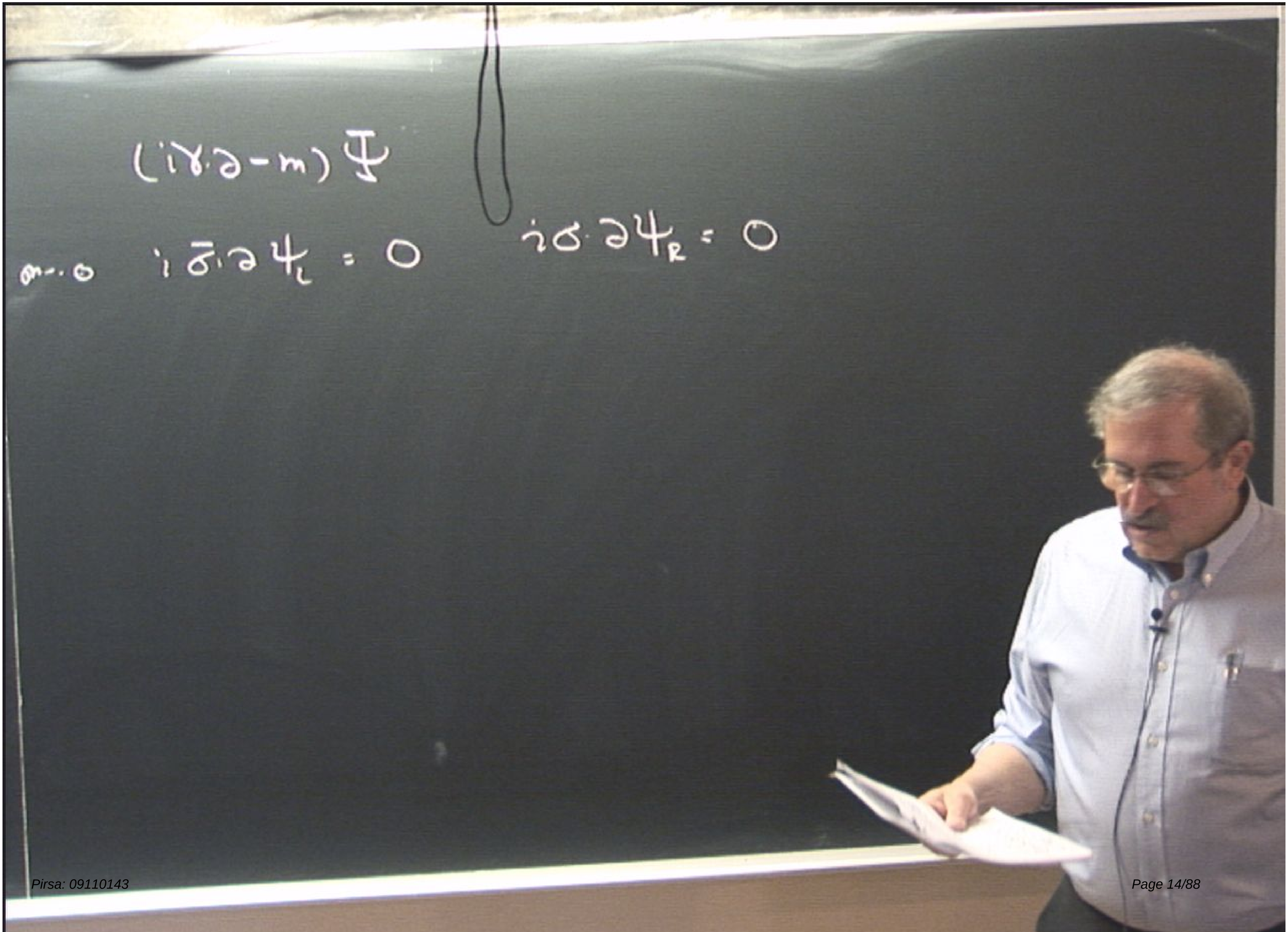
e^- μ^- τ^- spin $\frac{1}{2}$

m = 0.511 MeV 105.7 MeV 1777. MeV

e^+ μ^+ τ^+

$(i\gamma\cdot\partial - m)\Psi$

$m \to 0 \quad i\bar{\sigma}\cdot\partial\psi_L = 0 \qquad i\sigma\cdot\partial\psi_R = 0$


$(i\gamma\cdot\partial - m)\Psi$
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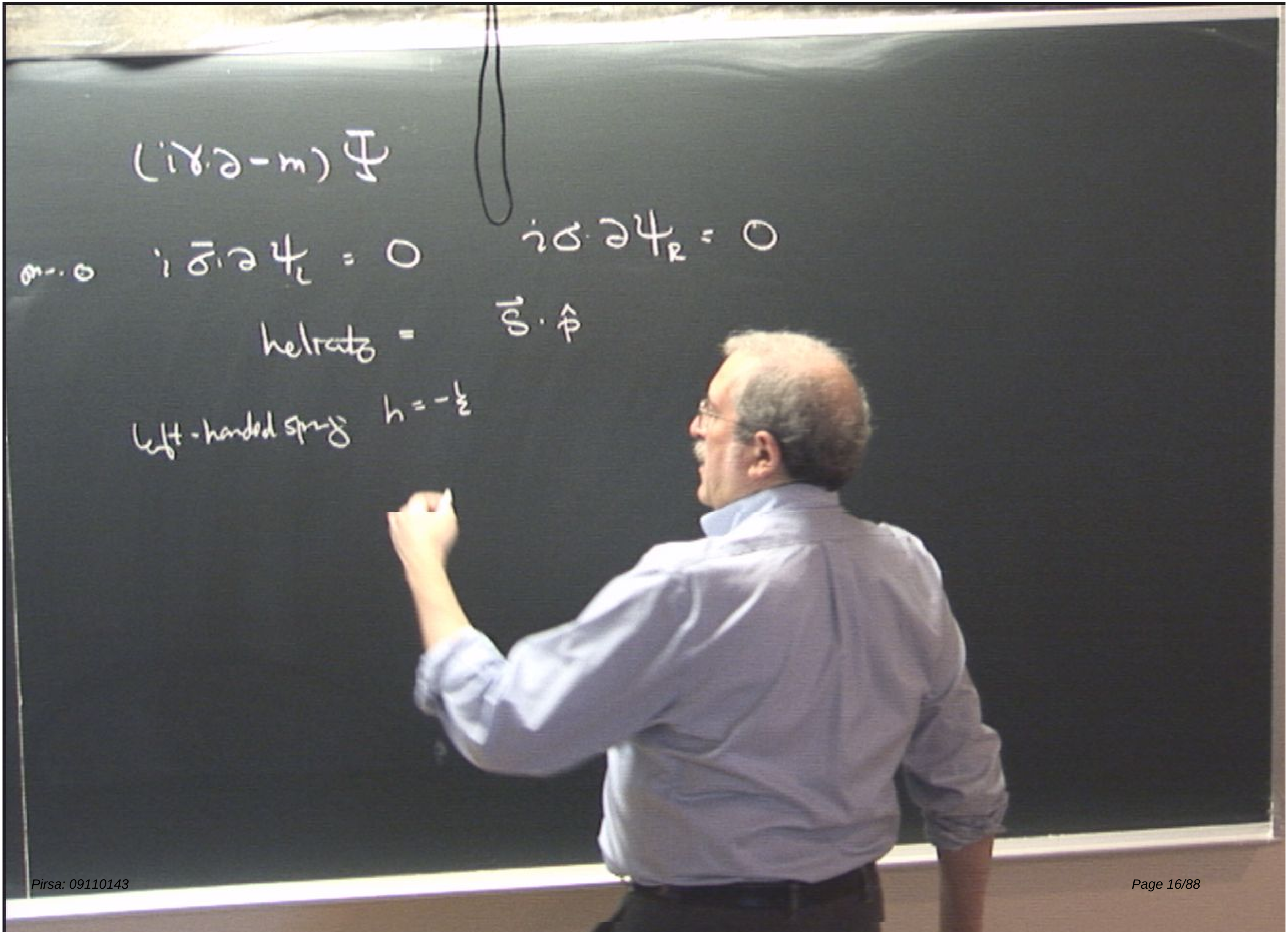
$i\sigma\cdot\partial\psi_R = 0$

$$(i\gamma\cdot\partial - m)\Psi$$

$m \to 0$ $\quad i\bar{\sigma}\cdot\partial\psi_L = 0 \qquad i\sigma\cdot\partial\psi_R = 0$

helicity $= \vec{S}\cdot\hat{p}$


$(i\gamma\cdot\partial - m)\Psi$
$m\to 0$
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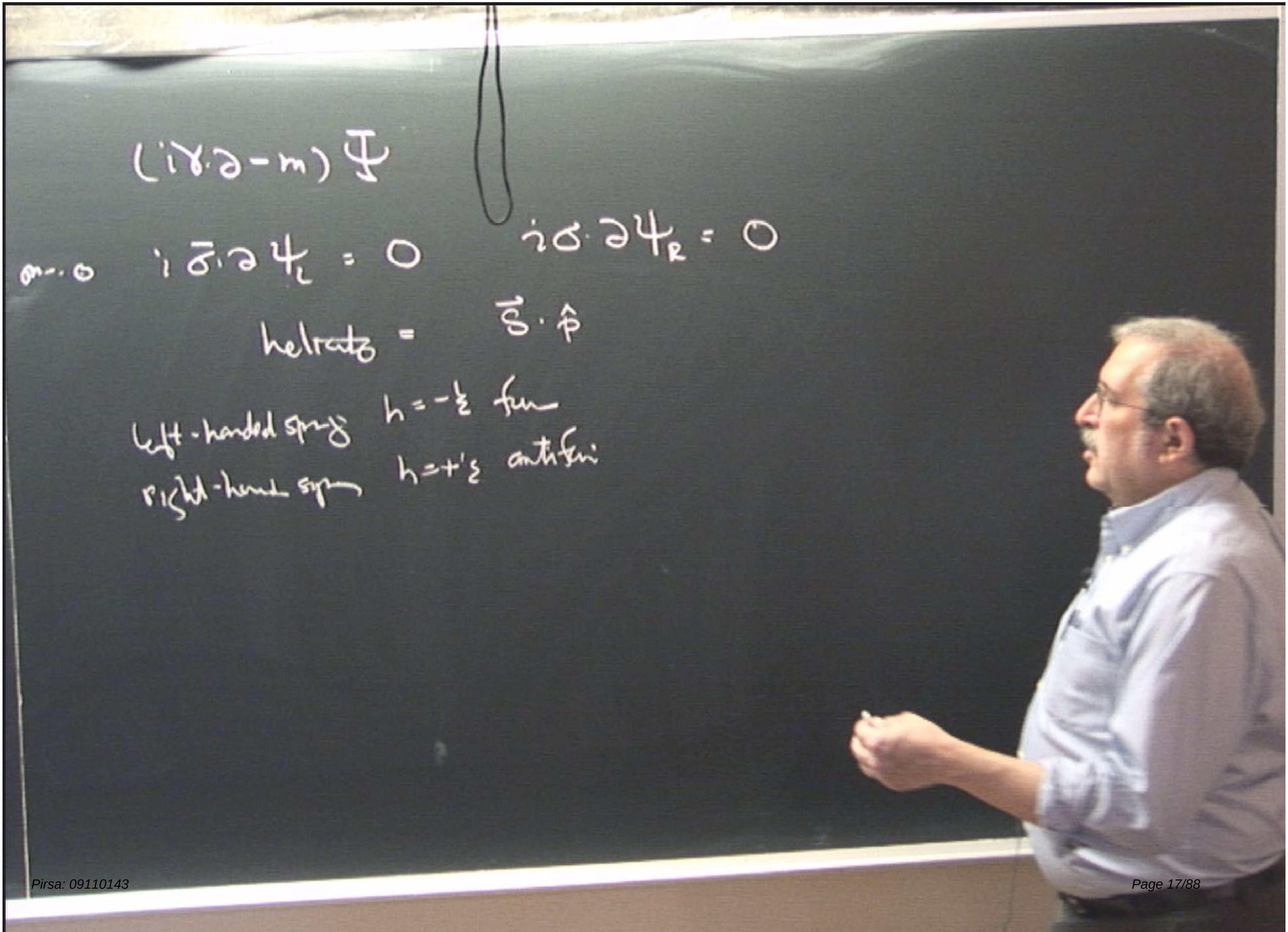
helicity = $\vec{S}\cdot\hat{p}$
left-handed spinor $h = -\frac{1}{2}$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left-handed spring $\quad h = -\frac{1}{2}$ fermion

right-handed spring $\quad h = +\frac{1}{2}$ antifermi

$e_L \qquad \bar{e}_L \qquad \nu_L$

neutrino.

$(i\gamma\cdot\partial - m)\Psi$

$\Psi = \begin{pmatrix} \psi_L \\ \hline \psi_R \end{pmatrix}$

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(?)

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neutrino.

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left-handed spin $\quad h = -\frac{1}{2}$ fer

right-hand spin $\quad h = +\frac{1}{2}$ antifer

(?)

$$\left[\begin{array}{cccc} e_L & \bar{e}_L & \nu_{eL} & \boxed{\bar{\nu}_L} \\ \mu_L & \bar{\mu}_L & \nu_{\mu L} & \boxed{\bar{\nu}_{\mu L}} \\ \tau_L & \bar{\tau}_L & \nu_{\tau L} & \boxed{\bar{\nu}_{\tau L}} \end{array}\right.$$

neutrino

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left-handed spin $h = -\frac{1}{2}$ fermion

right-handed sp... ...t's antifermion

(?)

$\bar{\nu}_L$

ν_{eL}

$\bar{\mu}_L \qquad \nu_{\mu L} \qquad \bar{\nu}_{\mu L}$

$\bar{\tau}_L \qquad \nu_{\tau L} \qquad \bar{\nu}_{\tau L}$

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(?)

$$r_e < 2\times10^{-18}\ \text{cm}$$

$$\left[\begin{array}{cccc} e_L & \bar{e}_L & \nu_{eL} & \bar{\nu}_L \\ \mu_L & \bar{\mu}_L & \nu_{\mu L} & \bar{\nu}_{\mu L} \\ \tau_L & \bar{\tau}_L & \nu_{\tau L} & \bar{\nu}_{\tau L} \end{array}\right.$$

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(?)

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$$(i\gamma\cdot\partial - m)\,\Psi \qquad\qquad \Psi = \begin{pmatrix}\psi_L \\ \psi_R\end{pmatrix}$$

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$$\mu \rightarrow \nu_\mu \, e^- \, \overline{\nu}_e \qquad \tau = 2\times10^{-6}\,\text{sec} \qquad c\tau =$$

$\mu \rightarrow \nu_\mu \, e^- \, \bar{\nu}_e$ $\quad \tau = 2 \times 10^{-6}$ sec $\quad c\tau = 659$ m

could $\mu \rightarrow e \gamma$

$\mu \to \nu_\mu e^- \bar{\nu}_e$ $\tau \approx 2\times 10^{-6}$ sec $c\tau = 659$ m

could $\mu \to e\gamma$ $BR < 1.2\times 10^{-11}$

$\mu \to \nu_\mu \; e^- \; \bar{\nu}_e$ $\quad \tau = 2\times10^{-6}$ sec $\quad c\tau = 659$ m

could $\mu \to e\gamma$ $\quad$ BR < 1.2×10^{-11}

$\tau^- \to \nu_\tau \; \mu^- \; \bar{\nu}_\mu$ $\quad \tau(\tau) = 0.29$ ps

$\nu_\tau \; e^- \; \bar{\nu}_e$

$\mu \to \nu_\mu \, e^- \, \bar{\nu}_e$ $\qquad \tau = 2\times 10^{-6}$ sec $\qquad c\tau = \underline{659}$ m

could $\mu \to e \gamma$ $\qquad BR < 1.2\times 10^{-11}$

$\tau^- \to \nu_\tau \, \mu^- \, \bar{\nu}_\mu$ $\qquad \tau(\tau) = 0.29$ ps

$\qquad \nu_\tau \, e^- \, \bar{\nu}_e$

$\mu \to \nu_\mu \, e^- \, \bar{\nu}_e$ $\quad \tau = 2\times10^{-6}$ sec $\quad c\tau = 659$ m

could $\mu \to e\gamma$ $\quad BR < 1.2\times10^{-11}$

$\tau^- \to \nu_\tau \, \mu^- \, \bar{\nu}_\mu$ $\quad \tau(\tau) = 0.29$ ps $\quad c\tau = 0.087$ mm

$\nu_\tau \, e^- \, \bar{\nu}_e$

$\mu \to \nu_\mu\, e^-\, \bar{\nu}_e$ $\tau = 2\times10^{-6}$ sec $c\tau = 659$ m

cons'd $\mu \to e\gamma$ $BR < 1.2\times10^{-11}$

$\tau^- \to \nu_\tau\, \mu^-\, \bar{\nu}_\mu$ $\tau(\tau) = 0.29$ ps $c\tau = 0.087$ mm

$\nu_\tau\, e^-\, \bar{\nu}_e$

$N_e = \#e^- - \#e^+ + \#\nu_e - \#\bar{\nu}_e$

Strongly int. particles "hadrons" $<$ mesons [illegible]. sp / baryons. [illegible]int sp

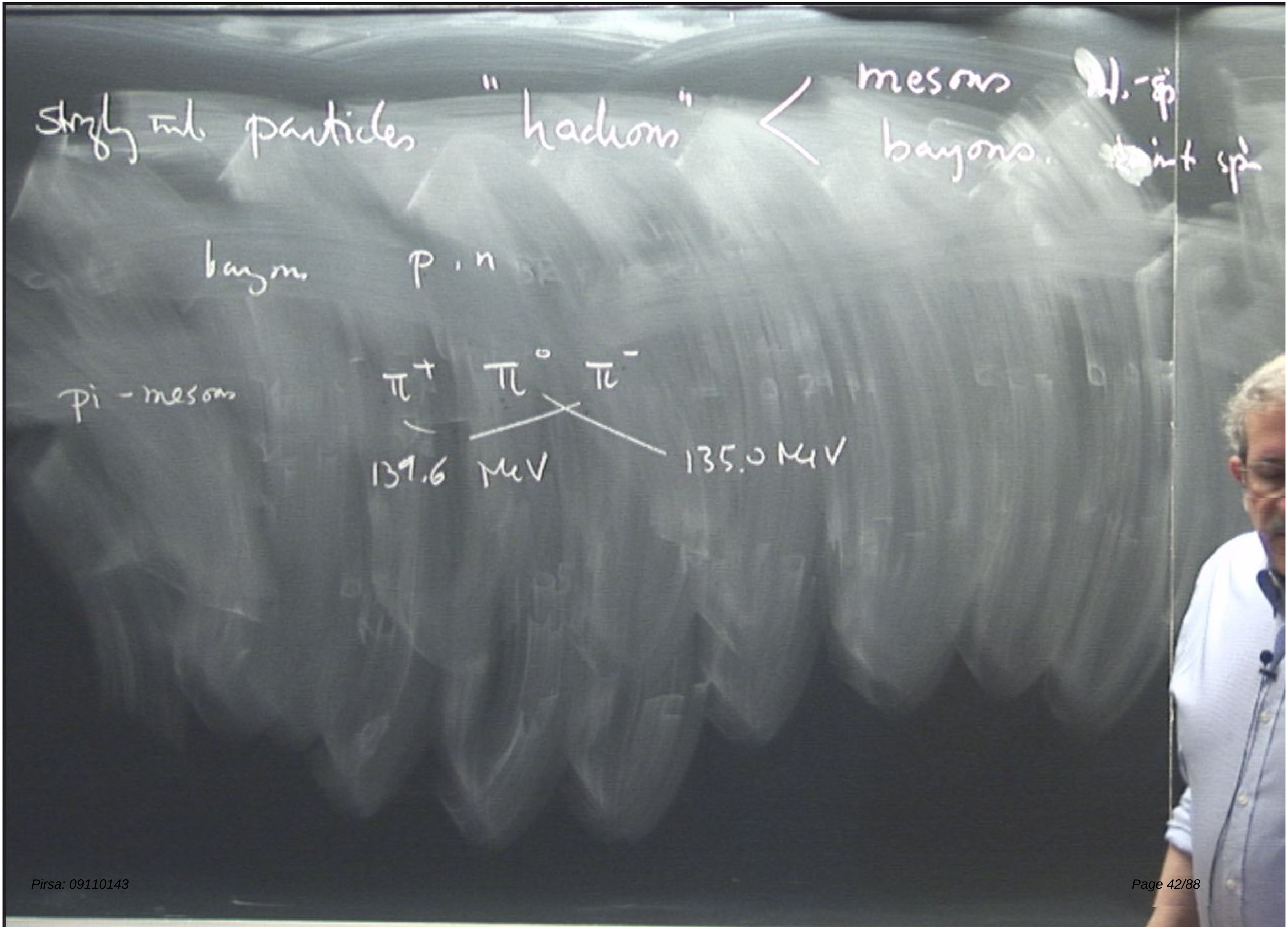
Strongly int. particles "hadrons" < mesons int. sp
baryons ½ int. spin

baryons p, n

strongly int. particles "hadrons" < mesons int.-sp / baryons. ½ int spin

baryons p, n

pi-mesons π^+ π^0 π^-


Strongly int. particles "hadrons"
mesons
baryons.
baryons p, n
pi - mesons
π^+ π^0 π^-
139.6 MeV
135.0 MeV

strongly int. particles "hadrons" < mesons int. sp / baryons half int spin

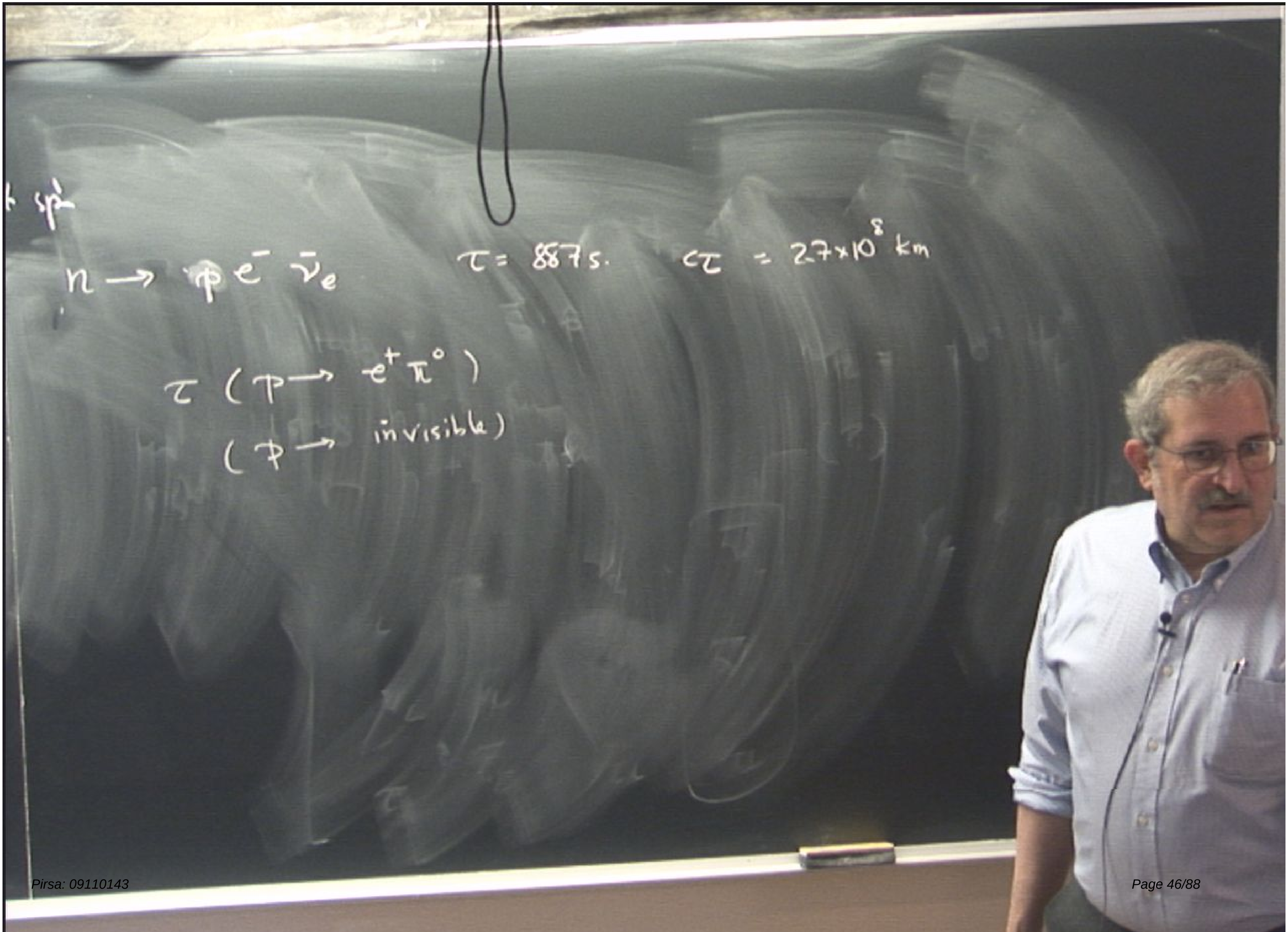
lightest baryon p, n 938 MeV 939.6 MeV

pi-mesons π^+ π^0 π^-

139.6 MeV 135.0 MeV

$n \to p\, e^- \bar{\nu}_e$ $\qquad \tau = 887\,\mathrm{s}. \qquad c\tau = 2.7\times 10^8\ \mathrm{km}$

$n \to p\, e^- \bar{\nu}_e \qquad \tau = 887\,s. \qquad c\tau = 2.7 \times 10^8\,km$


$n \to p\, e^- \bar{\nu}_e$
$\tau = 887\,s.$
$c\tau = 2.7 \times 10^8\ km$
$\tau\ (p \to e^+ \pi^0)$
$(p \to$ invisible$)$

$n \to p\, e^- \bar{\nu}_e$ $\quad \tau = 887\,\text{s.} \quad c\tau = 2.7 \times 10^{8}\,\text{km}$

$\tau\,(p \to e^+ \pi^0) \;>\; 1.6 \times 10^{33}\ \text{yr}$

$\tau\,(p \to \text{invisible}) \;>\; 2.1 \times 10^{29}\ \text{yr}$

strongly int. particles "hadrons" < mesons int. spin / baryons. ½ int. spin

lightest baryons p, n 938 MeV 939.6 MeV n

pi-mesons π^+ π^0 π^-

139.6 MeV 135.0 MeV

$\pi^+ \to \mu^+ \nu_\mu$

$\pi^0 \to 2\gamma$ $\tau = 0.84 \times 10^{-16}$ sec $c\tau = 25$ n strongly int. particles "hadrons" < mesons int.-spin / baryons. ½ int. spin

lightest baryons p, n 938 MeV 939.6 MeV n —

pi-mesons π^+ π^0 π^-

139.6 MeV 135.0 MeV

$\pi^+ \to \mu^+ \nu_\mu$ $\tau = 10^{-8}$ sec $c\tau = 7.8$ m

$\pi^0 \to 2\gamma$ $\tau = 0.84 \times 10^{-16}$ sec $c\tau = 25$ nm

Spin 0

Spin 1

Spin 0 nonets Spin 1

Spin 0 nonets Spin 1

$\pi^+ \, \pi^- \, \pi^0$	138 MeV
$K^- \quad K' \quad \bar{K}^0$	490 MeV
η	547.
η'	957.

$P = -1$ $\quad$ $C = +1$ for self-conj.

Spin 0	nonets	Spin 1	
$\pi^+ \pi^- \pi^0$	138 MeV	$\rho^+ \rho^- \rho^0$	770
$K^- \quad K^0 \; \bar{K}^0$	490 MeV	$K^{+*} \; K^{-*} \; K^{0*} \; \bar{K}^{0*}$	890
η	547.	ω	782
η'	957.	ϕ	1019

$P = -1$

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Spin 0	nonets	Spin 1	
$\pi^+ \pi^- \pi^0$	138 MeV	$\rho^+ \rho^- \rho^0$	770
$K^- \quad K' \quad \bar{K}^0$	490 MeV	$K^{+*} \; K^{-*} \; K^{0*} \; \bar{K}^{0*}$	890
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Spin 0 nonets Spin 1

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$K^- \quad K^+ \; \bar{K}^0$	490 MeV	$K^{+*} \; K^{-*} \; K^{0*} \; \bar{K}^{0*}$	890
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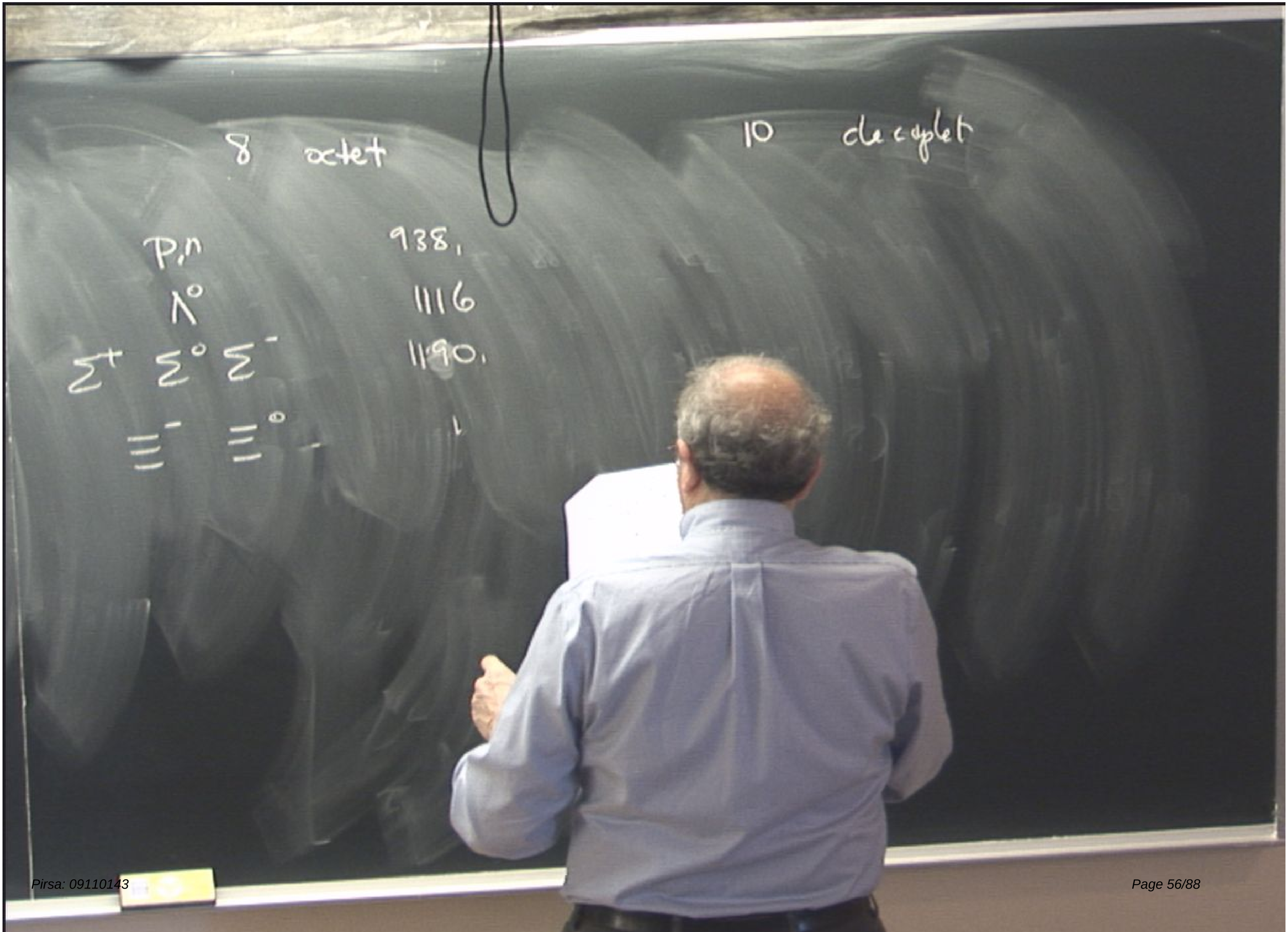
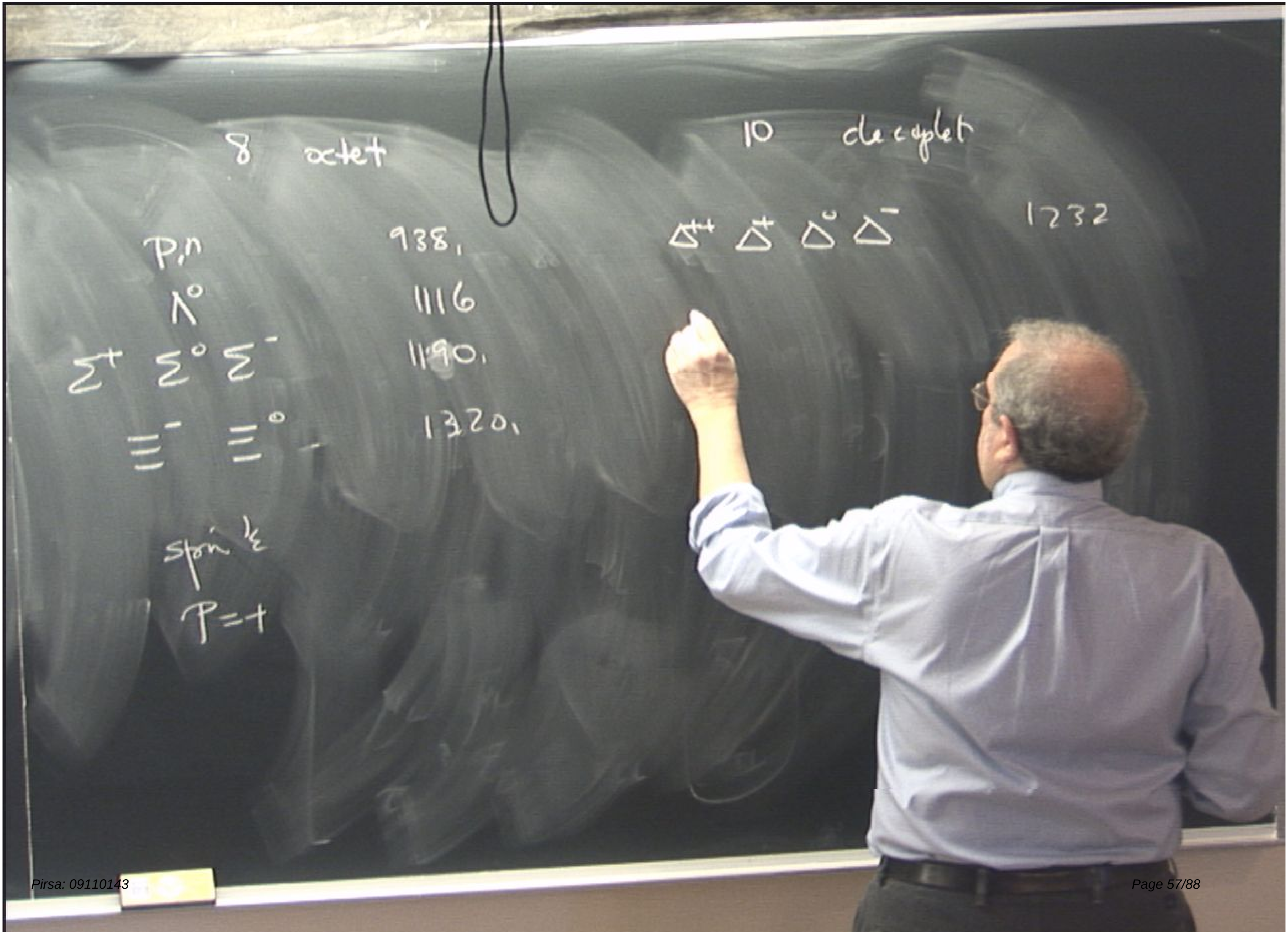

8 octet
10 decuplet
p, n 938.
Λ° 1116
Σ+ Σ° Σ- 1190.
Ξ- Ξ°


8 octet
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p,n 938.
Λ° 1116
Σ+ Σ° Σ- 1190.
Ξ- Ξ° 1320.
spin ½
P=+
Δ++ Δ+ Δ° Δ- 1232

8 octet

p, n 938.

Λ^0 1116

$\Sigma^+ \ \Sigma^0 \ \Sigma^-$ 1190.

$\Xi^- \ \Xi^0$ 1320.

spin ½

$P = +$

10 decuplet

$\Delta^{++} \ \Delta^+ \ \Delta^0 \ \Delta^-$ 1232

$\Sigma^* \ + \ 0 \ -$ 1385

$\Xi^{*0} \ \Xi^{*-}$ 1535

Ω^-

8 octet		10 decuplet	
p, n	938.	$\Delta^{++}\ \Delta^{+}\ \Delta^{0}\ \Delta^{-}$	1232
Λ^0	1116	$\Sigma^{*}\ +\ 0\ -$	1385
$\Sigma^+\ \Sigma^0\ \Sigma^-$	1190.	$\Xi^{*0}\ \Xi^{*-}$	1535
$\Xi^-\ \Xi^0$	1320.	Ω^-	1672

spin $\frac{1}{2}$

$P = +$

spin $\frac{3}{2}$ $P = +$

490 MeV $\quad K^{+*} \quad K^{-*} \quad K^{0*} \quad \bar{K}^{0*} \quad$ 890

$\Sigma^+ \quad \Sigma$

547. $\quad \omega \quad$ 782

Ξ^-

957. $\quad \phi \quad$ 1019.

$C = +1$ for self-conj. $\qquad P = -1 \qquad C = -1$ for self-conj.

$SU(2) \quad \begin{pmatrix} p \\ n \end{pmatrix}$

K^{*+} K^{*-} K^{*0} $\bar{K}^{*0}$ 890

ω 782

ϕ 1019

$P = -1$ $C = -1$ for self-conj.

$\begin{pmatrix} p \\ n \end{pmatrix}$ $\frac{1}{2}$ spin

Λ 1116

Σ^+ Σ^0 Σ^- 1190.

Ξ^- Ξ^0 1320.

spin $\frac{1}{2}$

$P = +$

Spin 0 nonets Spin 1

$I=1$	$\pi^+ \pi^- \pi^0$	138 MeV	$\rho^+ \rho^- \rho^0$	770
$I=\frac{1}{2}$	$\underbrace{K^+ K^-}$ $\underbrace{K^0 \bar{K}^0}_{I=\frac{1}{2}}$	490 MeV	$K^{+*} K^{-*} K^{0*} \bar{K}^{0*}$	890
	η	547.	ω	782
	η'	957.	ϕ	1019

$P=-1$ $C=+1$ for self-conj.

$P=-1$ $C=-1$ for self-conj.

SU(2) $\begin{pmatrix} p \\ n \end{pmatrix}$

isospin

8 octet

$I = \frac{1}{2}$ p, n 938.

Λ^0 1116

$\boxed{\Sigma^+ \ \Sigma^0 \ \Sigma^-}$ 1190.

$\Xi^- \ \Xi^0$ 1320.

spin $\frac{1}{2}$

$P = +$

10 decuplet

$I = \frac{3}{2}$

$\boxed{\Delta^{++} \ \Delta^+ \ \Delta^0 \ \Delta^-}$ 1232

Σ^{*} $+ \ 0 \ -$ 1385

$\Xi^{*0} \ \Xi^{*-}$ 1535

Ω^- 1672.

spin $\frac{3}{2}$ $P = +$

8 octet

$I = \frac{1}{2}$ p, n 938.

Λ^0 1116

$\boxed{\Sigma^+ \ \Sigma^0 \ \Sigma^-}$ 1190.

$\Xi^- \ \Xi^0$ 1320.

spin $\frac{1}{2}$

$P = +$

10 decuplet

$I = \frac{3}{2}$

$\boxed{\Delta^{++} \ \Delta^+ \ \Delta^0 \ \Delta^-}$ 1232

Σ^* + 0 − 1385

$\Xi^{*0} \ \Xi^{*-}$ 1535

Ω^- 1672.

spin $\frac{3}{2}$ $P = +$

$$\Delta \to (p, n)(\pi^+, \pi^0, \pi^-)$$

Spin 0 nonets Spin 1

	Spin 0		Spin 1	
$I=1$, $S=0$	$\pi^+\ \pi^-\ \pi^0$	138 MeV	$\rho^+\ \rho^-\ \rho^0$	770
$I=\frac{1}{2}$, $S=+1$; $I=\frac{1}{2}$, $S=-1$	$K^+\ K^-\ K^0\ \bar{K}^0$	490 MeV	$K^{+*}\ K^{-*}\ K^{0*}\ \bar{K}^{0*}$	890
	η	547	ω	782
$S=0$	η'	957	ϕ	1019

$P=-1$ $C=+1$ for self-conj.

$P=-1$ $C=-1$ for self-conj.

$SU(2)$ $\begin{pmatrix} p \\ n \end{pmatrix}$ Isospin

8 octet

$I=\frac{1}{2}$ p, n 938.

Λ^0 $S=-1$ 1116

$\boxed{\Sigma^+ \ \Sigma^0 \ \Sigma^-}$ 1190.

$\Xi^- \ \Xi^0$ 1320.

$S=-2$

spin $\frac{1}{2}$

$P=+$

10 decuplet

$I=\frac{3}{2}$

$\boxed{\Delta^{++} \ \Delta^+ \ \Delta^0 \ \Delta^-}$ 0 1232

$\Sigma^* \ + \ 0 \ -$ -1 1385

$\Xi^{*0} \ \Xi^{*-}$ -2 1535

Ω^- -3 1672

spin $\frac{3}{2}$ $P=+$

$\Delta \to (p, n)(\pi^+, \pi^0, \pi^-)$

strangeness

8 octet

$I=\frac{1}{2}$ p, n 938.

Λ^0 $S=-1$ 1116

$\boxed{\Sigma^+ \ \Sigma^0 \ \Sigma^-}$ 1190.

$\Xi^- \ \Xi^0$ 1320.

$S=-2$

10 decuplet

$I=\frac{3}{2}$

$\boxed{\Delta^{++} \ \Delta^+ \ \Delta^0 \ \Delta^-}$ 0 1232

Σ^* + 0 − −1 1385

$\Xi^{*0} \ \Xi^{*-}$ −2 1535

Ω^- −3 1672

spin $\frac{1}{2}$ $\pi^0 p \longrightarrow K^+\Lambda^0, K^+\Sigma^0$ spin $\frac{3}{2}$ $P=+$

$P=+$ $\not\longrightarrow K^+\Xi^0$

$\Delta \longrightarrow (p, n)(\pi^+, \pi^0, \pi^-)$

strangeness

8 octet

$I = \frac{1}{2}$ p, n 938.

Λ^0 S = −1 1116

$\boxed{\Sigma^+ \; \Sigma^0 \; \Sigma^-}$ 1190.

$\Xi^- \; \Xi^0$ 1320.

S = −2

10 decuplet

$I = \frac{3}{2}$

$\boxed{\Delta^{++} \; \Delta^+ \; \Delta^0 \; \Delta^-}$ 0 1232

Σ^* + 0 − −1 1385

$\Xi^{*0} \; \Xi^{*-}$ −2 1535

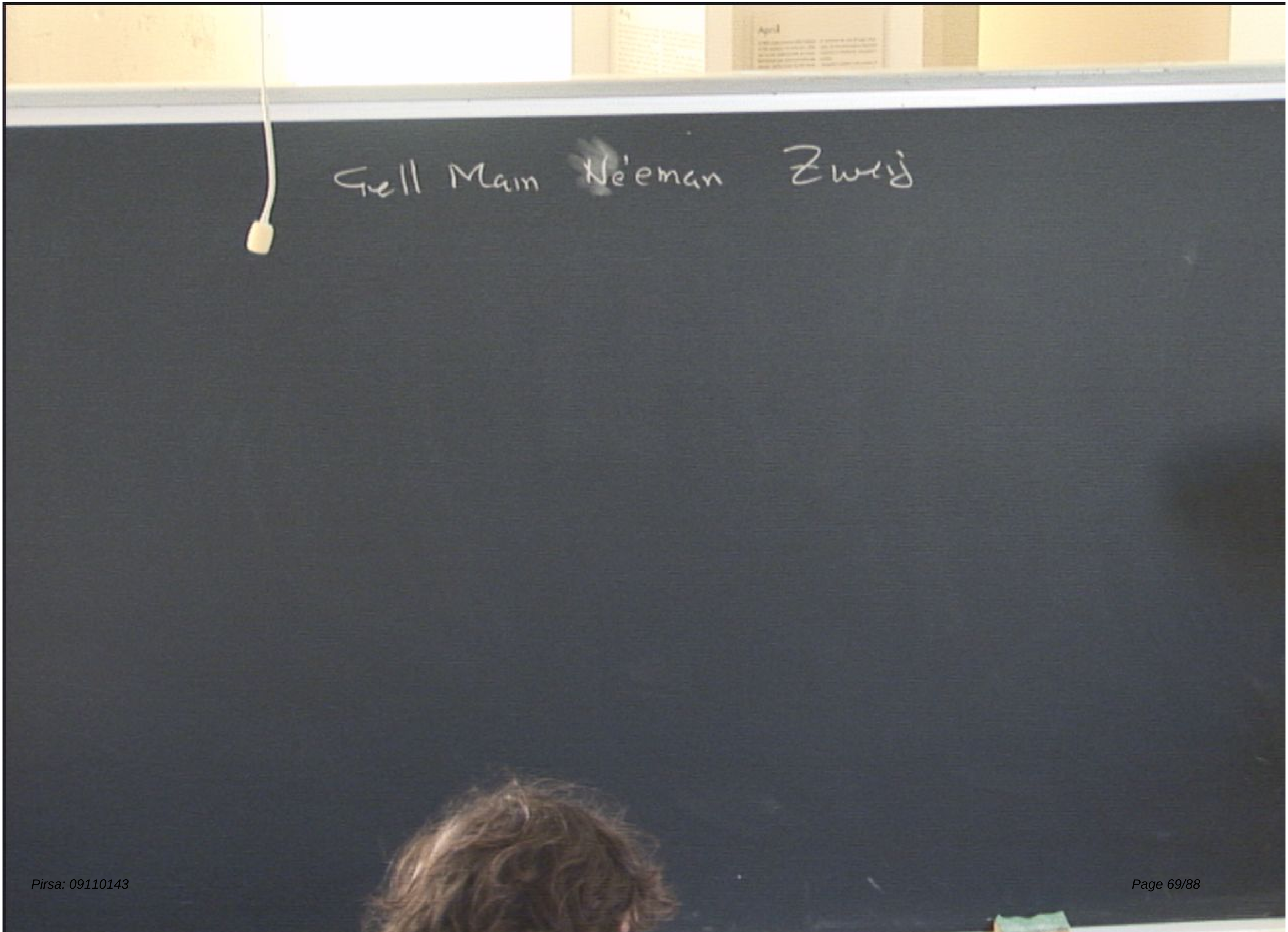
Ω^- −3 1672

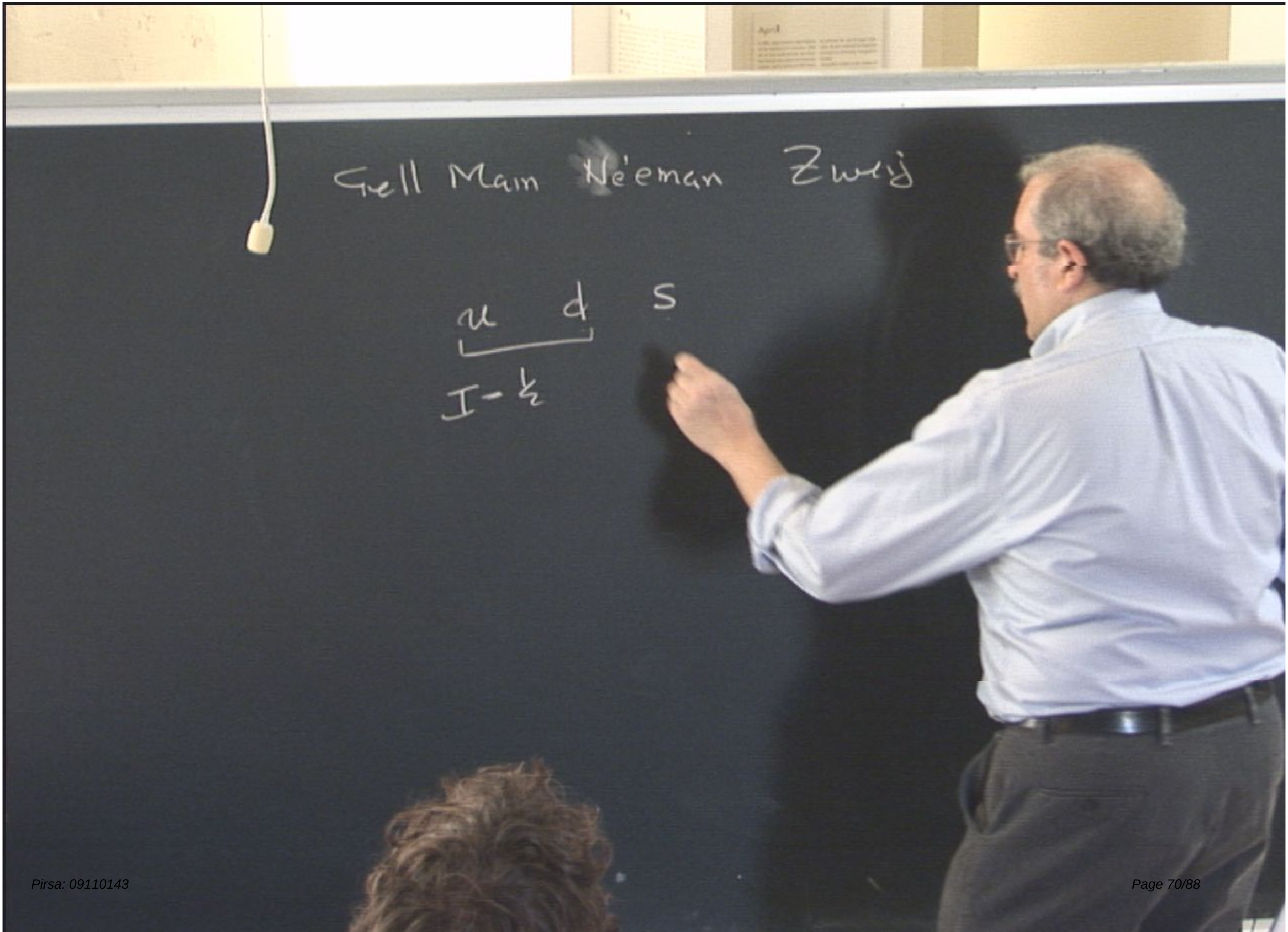
spin ½ $\pi^- p \longrightarrow K^+\Lambda^0, K^+\Sigma^0$ spin 3/2 P = +

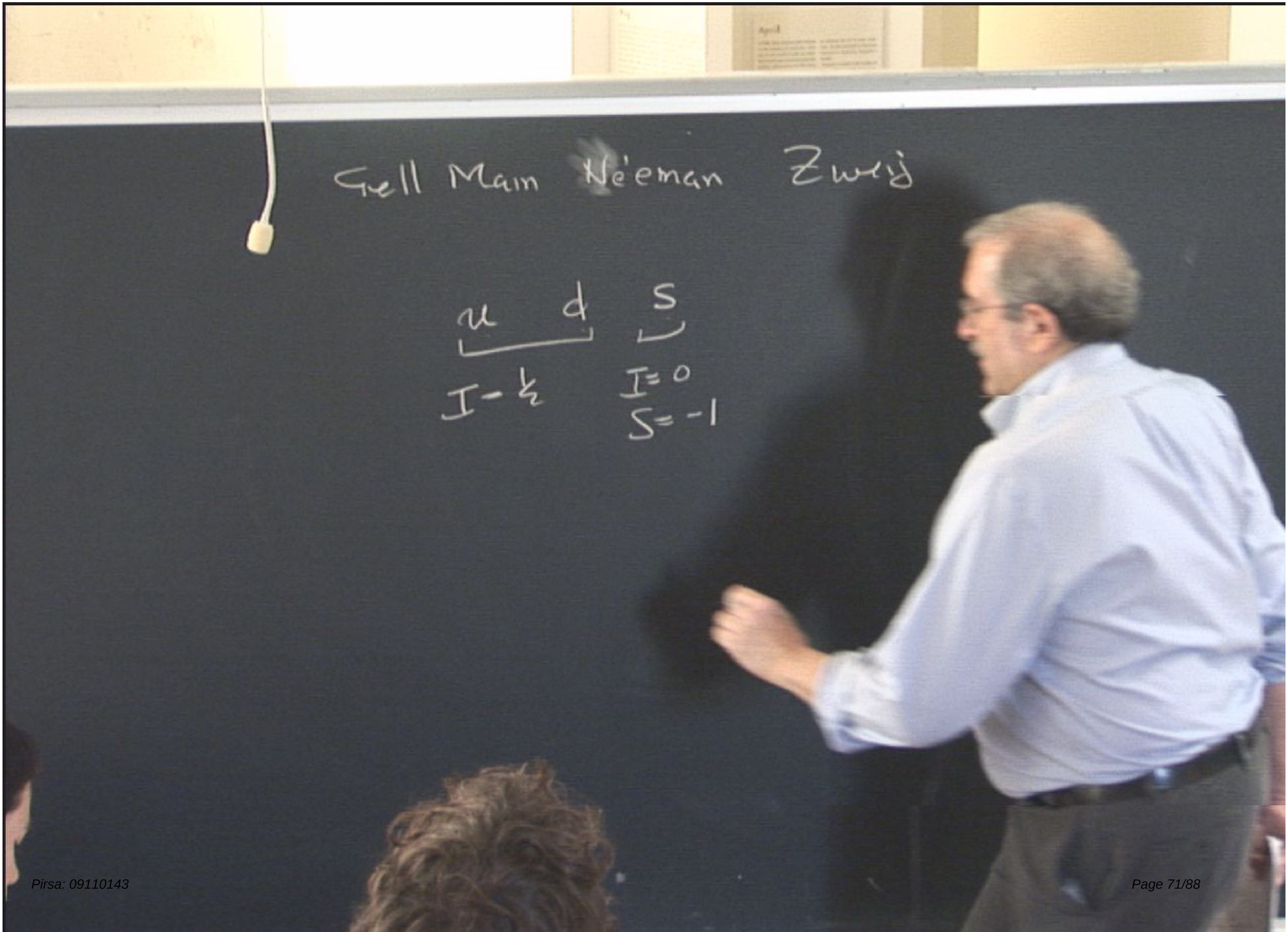
P = + $\not\longrightarrow K^+\Xi^0$

$\Delta \longrightarrow (p, n)(\pi^+, \pi^0, \pi^-)$

strangeness

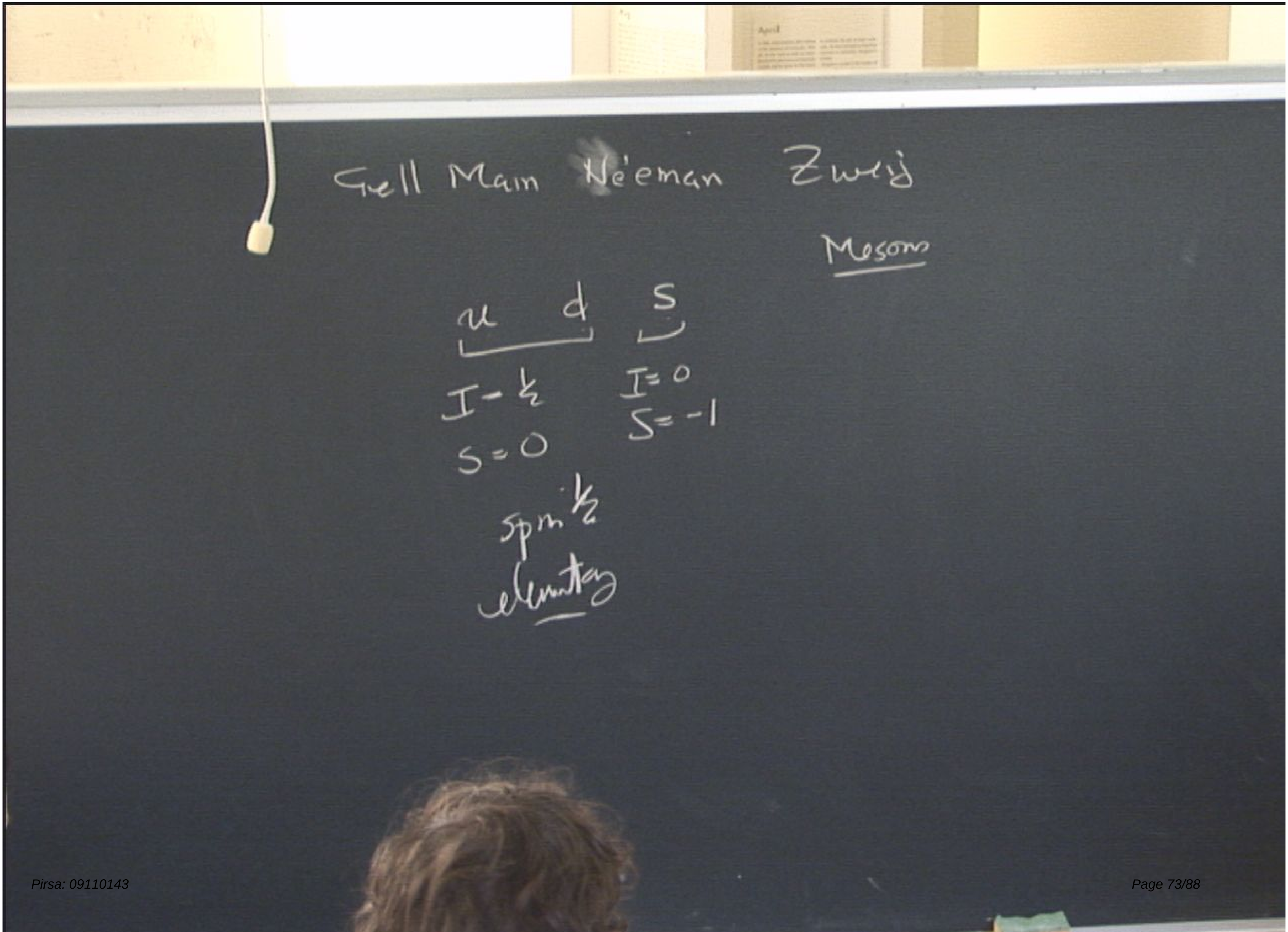

Gell Mann Ne'eman Zweig


Gell Mann Ne'eman Zweig
u d s
I = 1/2


Gell Mann Ne'eman Zweig
u d s
I = ½
I = 0
S = -1

Gell Mann Ne'eman Zweig

$$\underbrace{u \quad d}_{\substack{I = \frac{1}{2} \\ S = 0}} \qquad \underbrace{s}_{\substack{I = 0 \\ S = -1}}$$


Gell Main Ne'eman Zweig
Mesons
u d s
I = ½
S = 0
I = 0
S = -1
spin ½
elementary

Gell Mann Ne'eman Zweig

Mesons

$$q_f = (\underbrace{u \quad d}_{I = \frac{1}{2}} \quad \underbrace{s}_{I=0})$$

"flavor"

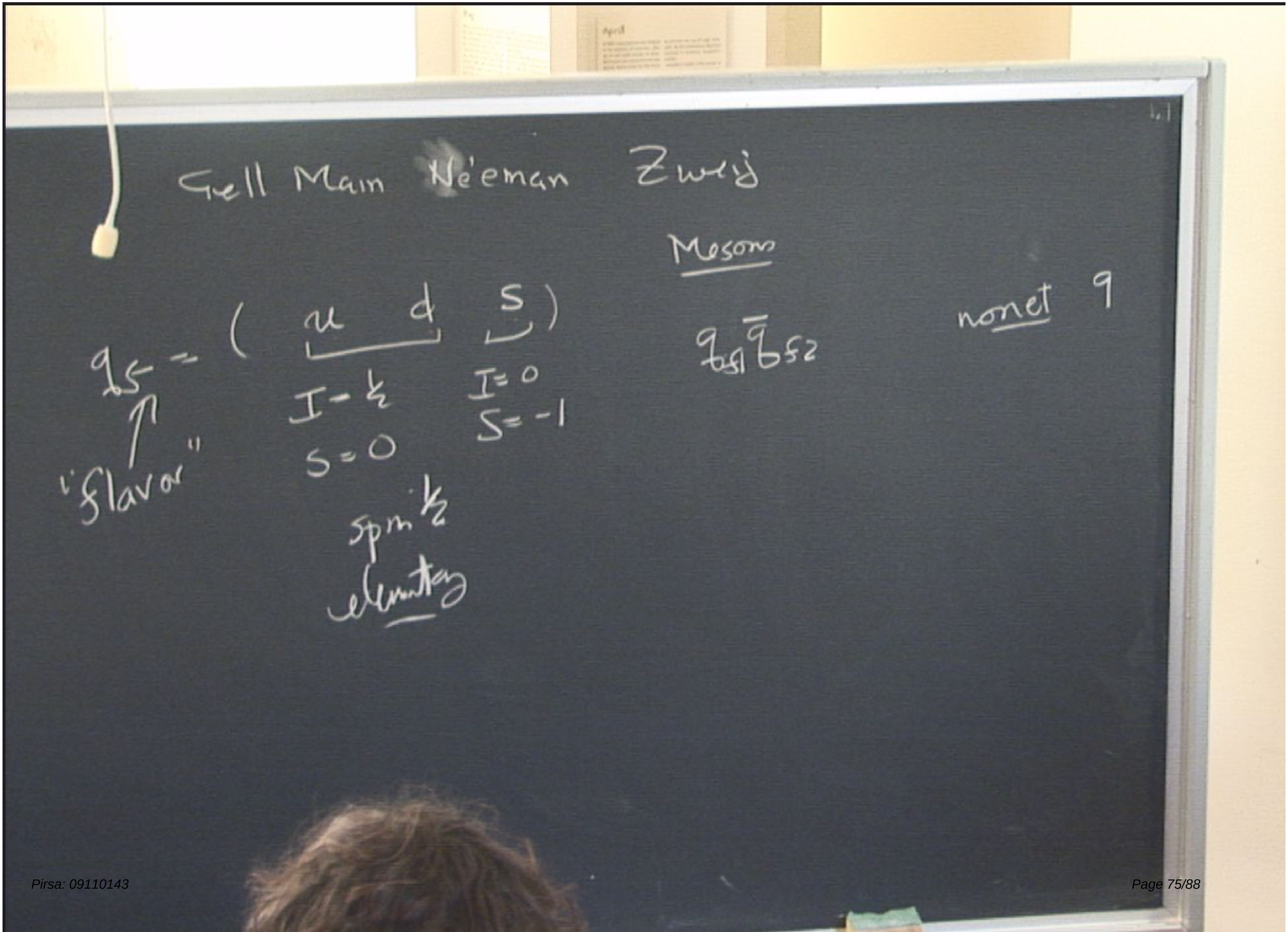
$I = \frac{1}{2}$, $S = 0$

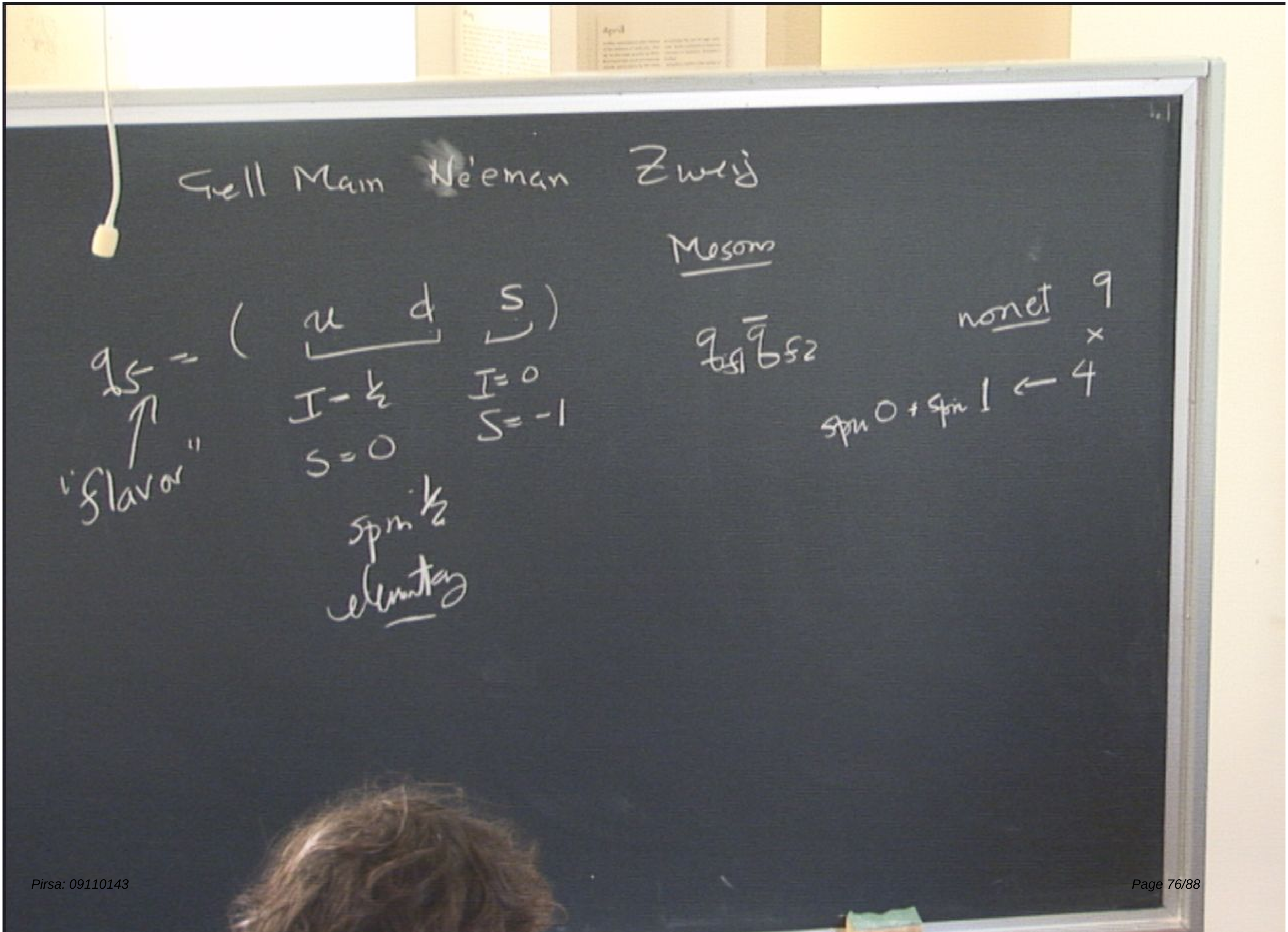
$I = 0$, $S = -1$

spin $\frac{1}{2}$

elementary

$q \bar{q}$


Gell Mann Ne'eman Zweig
Mesons
nonet 9
qf = (u d s)
qf1 q̄f2
I = 1/2
S = 0
I = 0
S = -1
"flavor"
spin 1/2
elementary


Gell Mann Ne'eman Zweig
Mesons
q_f = (u d s)
I = ½
S = 0
I = 0
S = -1
"flavor"
spin ½
elementary
q_f1 q̄_f2
nonet 9
×
spin 0 + spin 1 ← 4

Spin 0 nonets Spin 1

$S=0$ $u\bar{d}\uparrow$

$\pi^+ \pi^- \pi^0$ 138 MeV $\rho^+ \rho^- \rho^0$ 770

$K' \; \bar{K}^0$ 490 MeV $K^{+*} \; K^{-*} \; K^{0*} \; \bar{K}^{0*}$ 890

$I=\frac{1}{2}$ $I=1$

η 547. ω 782

$S=-1$

η' 957. ϕ 1019

$S=0$

$P=-1$ $C=+1$ for self-conj. $P=-1$ $C=-1$ for self-conj.

$SU(2)$ $\begin{pmatrix} p \\ n \end{pmatrix}$ isospin

$I=$

$\boxed{\Sigma}$

spin 0 nonets spin 1

$u\bar{d}\uparrow$

$S=0$

$\pi^+ \; \pi^- \; \pi^0$ 138 MeV $\rho^+ \; \rho^- \; \rho^0$ 770

$K^+ \; K^- \; K^0 \; \bar{K}^0$ 490 MeV $K^{+*} \; K^{-*} \; K^{0*} \; \bar{K}^{0*}$ 890

$I = \frac{1}{2}$ $I=1$

η 547. ω 782

$S=-1$

η' 957. ϕ 1019

$S=0$

$P=-1$ $C=+1$ for self-conj. $P=-1$ $C=-1$ for self-conj.

$SU(2)$ $\begin{pmatrix} p \\ n \end{pmatrix}$ isospin

$d\bar{d}\uparrow$ Spin 0 nonets Spin 1

$S=0$ $u\uparrow\bar{d}\uparrow$

$\pi^+ \; \pi^- \; \pi^0$ 138 MeV $\rho^+ \; \rho^- \; \rho^0$ 770

$K^+ \; K^- \; K^0 \; \bar{K}^0$ 490 MeV $K^{+*} \; K^{-*} \; K^{0*} \; \bar{K}^{0*}$ 890

$I=\frac{1}{2}$

η 547. ω 782 $I=1$

$S=-1$

η' 957. $s\uparrow\bar{s}\uparrow$ ϕ 1019

$S=0$

$P=-1$ $C=+1$ for self-conj. $P=-1$ $C=-1$ for self-conj.

$SU(2)$ $\begin{pmatrix} p \\ n \end{pmatrix}$ Isospin

Gell Mann Ne'eman Zweig

<u>Mesons</u>

$$q_f = (\underbrace{u \quad d}_{} \quad \underbrace{s}_{})$$

$I = \frac{1}{2}$ $\quad$ $I = 0$

$S = 0$ $\quad$ $S = -1$

"flavor"

spin $\frac{1}{2}$

<u>elementary</u>

$q_{f1} \bar{q}_{f2}$

<u>nonet</u> 9

$\times$

spin 0 + spin 1 $\leftarrow$ 4

$m(s) - m(u,d) \sim$ <u>120-150</u> MeV

8 octet

$I=\frac{1}{2}$ p, n 938.

Λ^0 $S=-1$ 1116

$\boxed{\Sigma^+ \ \Sigma^0 \ \Sigma^-}$ 1190.

$\Xi^- \ \Xi^0$ 1320.

$S=-2$

10 decuplet

$I=\frac{3}{2}$

$\boxed{\Delta^{++} \ \Delta^+ \ \Delta^0 \ \Delta^-}$ 0 1232

Σ^* + 0 − −1 1385

$\Xi^{*0} \ \Xi^{*-}$ −2 1535

Ω^- −3 1672

spin $\frac{1}{2}$

$P=+$

$\pi^- p \longrightarrow K^+\Lambda^0, K^+\Sigma^0$

$\not\longrightarrow K^+\Xi^0$

spin $\frac{3}{2}$ $P=+$

$\Delta \longrightarrow (p,n)(\pi^+,\pi^0,\pi^-)$

strangeness

baryons are system of 3 quarks in a totally
symmetric w.f.:

I=

Σ

Stra

baryons are system of 3 quarks in a totally
symmetric w.f.:

$u\uparrow u\uparrow u\uparrow$ $d\uparrow d\uparrow d\uparrow$

spin $\frac{3}{2}$

$s\uparrow s\uparrow s\uparrow$

I=

Σ

Stra

baryons are system of 3 quarks in a totally symmetric w.f.

$u\uparrow u\uparrow u\uparrow \qquad d\uparrow d\uparrow d\uparrow$

spin $\frac{3}{2}$

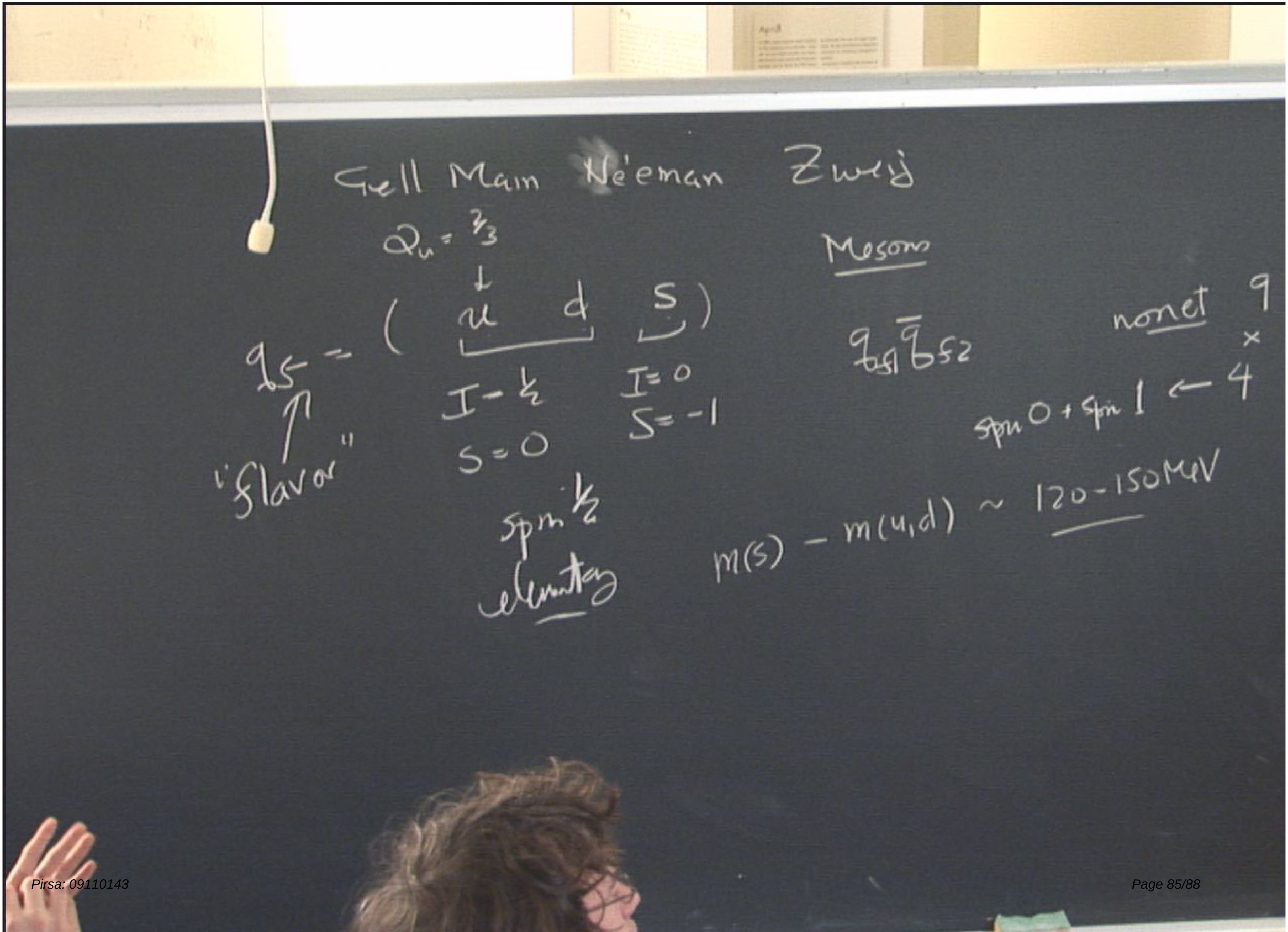
$s\uparrow s\uparrow s\uparrow$

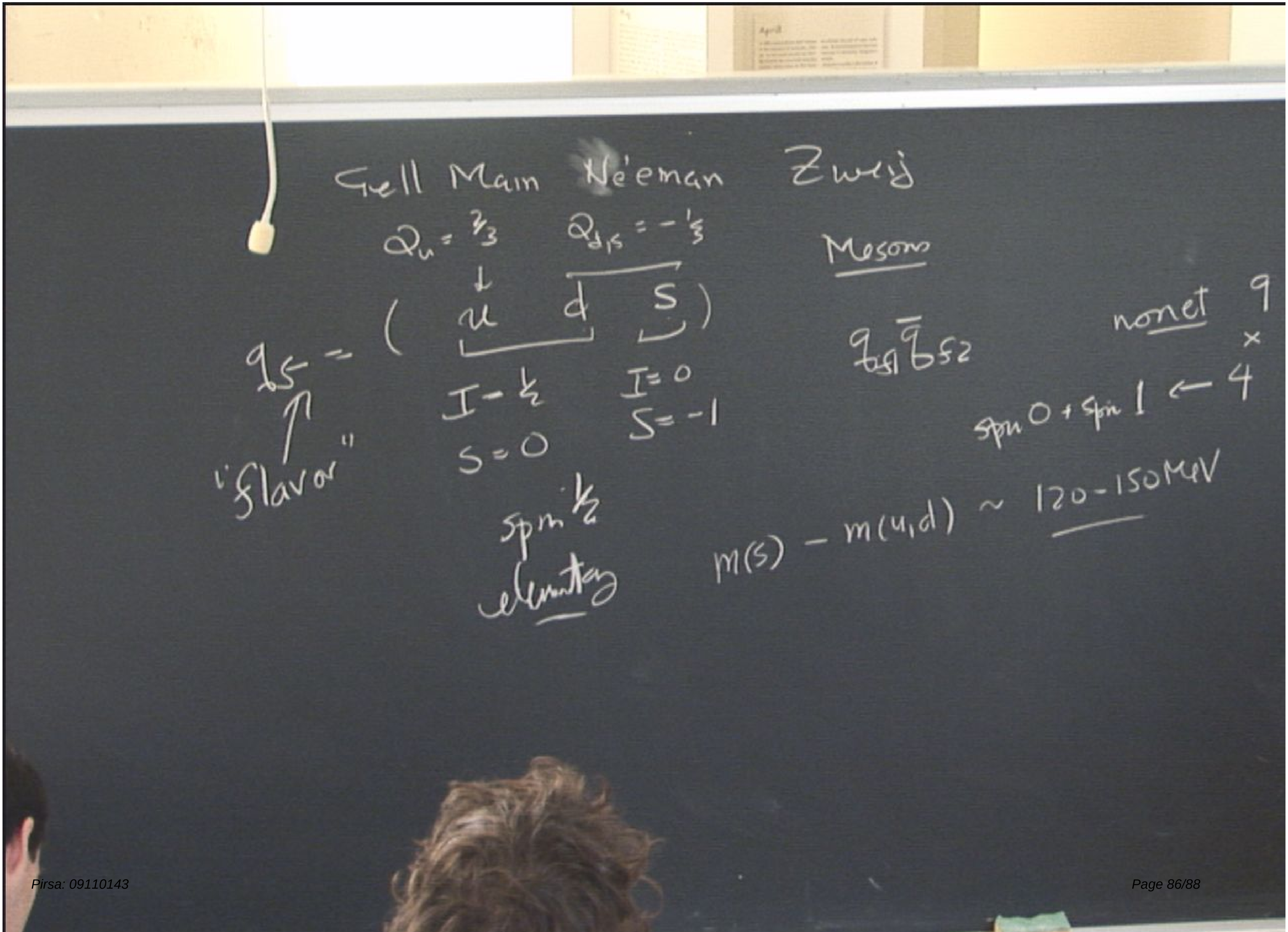
$$\frac{6\cdot 7\cdot 8}{3!} = 56 = \underbrace{2}_{\text{spin } \frac{1}{2}}\cdot 8 + \underbrace{4}_{\text{spin } \frac{3}{2}}\cdot 10$$

I=

$\boxed{\Sigma}$

Stra


Gell Main Ne'eman Zweig
Qu = 2/3
qf = (u d s)
I = ½
S = 0
I = 0
S = -1
"flavor"
spin ½
elementary
Mesons
qf1 q̄f2
nonet 9
spin 0 + spin 1 ← 4
m(s) - m(u,d) ~ 120-150 MeV


Gell Mann Ne'eman Zweig
Qu = 2/3 Qd,s = -1/3
Mesons
qf = (u d s)
I = ½
S = 0
I = 0
S = -1
"flavor"
spin ½
elementary
qf1 q̄f2
nonet 9
spin 0 + spin 1 ← 4
m(s) - m(u,d) ~ 120-150 MeV

baryons are: System of 3 quarks in a totally symmetric w.f.:

$u\uparrow u\uparrow u\uparrow$ $\qquad$ $d\uparrow d\uparrow d\uparrow$

spin $\frac{3}{2}$

$s\uparrow s\uparrow s\uparrow$

$$\frac{6\cdot 7\cdot 8}{3!} = 56 = \underbrace{2}_{\text{spin } \frac{1}{2}}\cdot 8 + \underbrace{4}_{\text{spin } \frac{3}{2}}\cdot 10$$

I=

Σ

baryons are system of 3 quarks in a totally symmetric w.f.:

$u\uparrow u\uparrow u\uparrow$ $\qquad$ $d\uparrow d\uparrow d\uparrow$

spin $\frac{3}{2}$

$s\uparrow s\uparrow s\uparrow$

$$\frac{6\cdot 7\cdot 8}{3!} = 56 = \underbrace{2}_{\text{spin } \frac{1}{2}}\cdot 8 + \underbrace{4}_{\text{spin } \frac{3}{2}}\cdot 10$$

I=

Σ

Stra