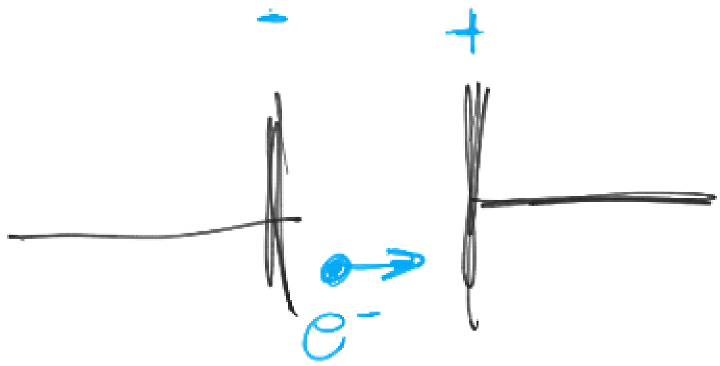
1 eV



$$E = q V = 1{,}602 \times 10^{-19} C \cdot 1 V$$

$$= 1{,}602 \times 10^{-19} J \overset{def}{=} 1 eV$$

1 eV energía electrostática que adq. un electrón al atravesar un potencial de 1 V.

1 keV = 1000 eV
1 MeV = 10^6 eV
1 GeV = 10^9 eV
1 TeV = 10^{12} eV
1 PeV = 10^{15} eV
1 EeV = 10^{18} eV

1 eV
1 meV
1 μeV

$$E = m \gamma c^2$$

$$[E] = [m] \, [c^2] \, ,$$

$$\Rightarrow [m] = [E]/c^2$$

$$[m] = eV/c^2$$

$$m_e = 511 \text{ keV}/c^2$$

$$m_p = 938{,}3 \text{ MeV}/c^2$$

$$m_\mu = 105{,}1 \text{ MeV}/c^2$$

$$\vdots$$

$$E^2 = p^2c^2 + m^2c^4$$

$$p^2 = \frac{1}{c^2}\left(E^2 - m^2c^4\right)$$

$$p^{\cancel{2}} = \sqrt{c^2\left(\frac{E^2}{c^4} - m^2\right)}$$

$$[p] = \sqrt{\frac{\cancel{c^2}\, eV^2}{c^{\cancel{4}2}} - \frac{eV^2\,\cancel{c^2}}{c^{\cancel{4}2}}}$$

$$[\ ] = \frac{eV}{}$$

$[p]$ $\overline{c}$

$[p_e]$ eV/c

$m_e = 511\ \text{keV}/c^2$

$p_e = 1\ \text{GeV}/c$

$$E = \sqrt{p^2c^2 + m^2c^4}$$

$$= \sqrt{\frac{1\ \text{GeV}^2}{\cancel{c^2}} \cdot \cancel{c^2} + \frac{(511\ \text{keV})^2}{\cancel{c^4}} \cdot \cancel{c^4}}$$

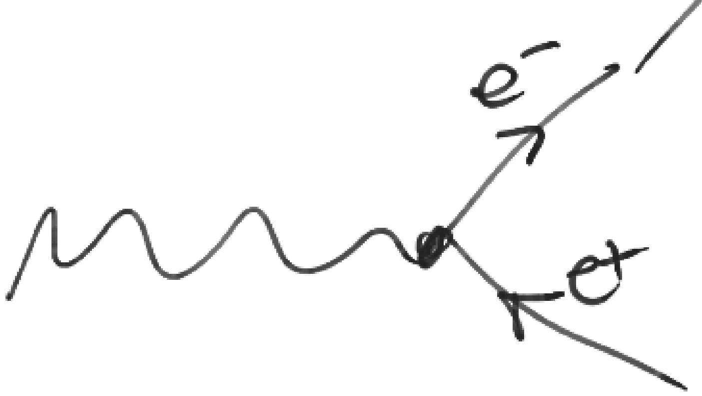
$$E = \sqrt{1000^2\ \text{MeV}^2 + 0{,}511^2\ \text{MeV}^2}$$

$$E = m\gamma c^2 \Rightarrow \gamma = E/mc^2$$

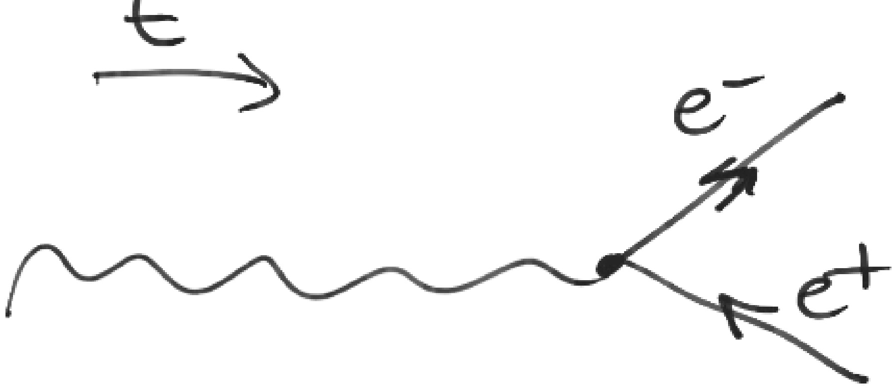
7 TeV $m \simeq 1$ GeV

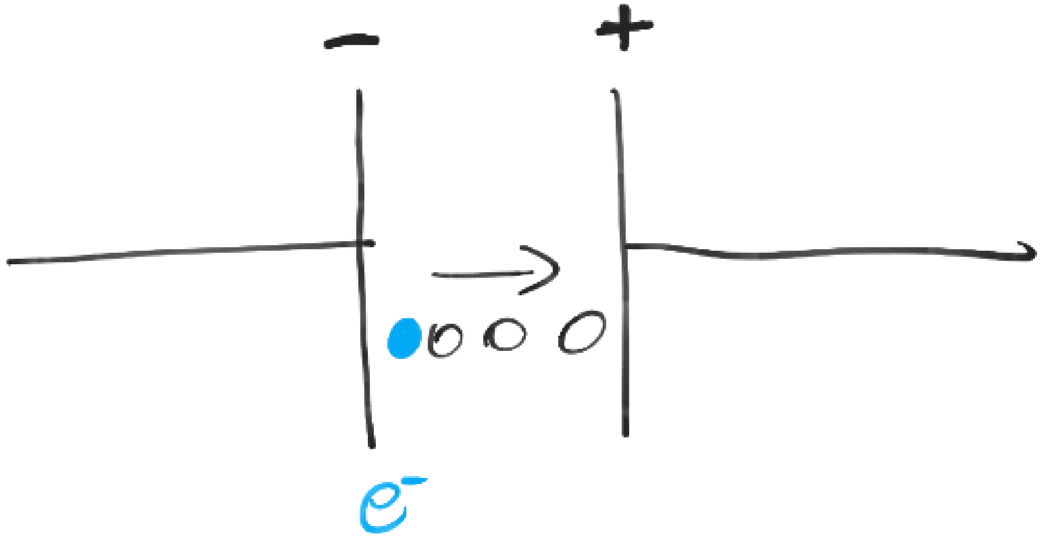
$$\gamma = \frac{7000\ \text{GeV}}{\quad} \simeq 7000$$

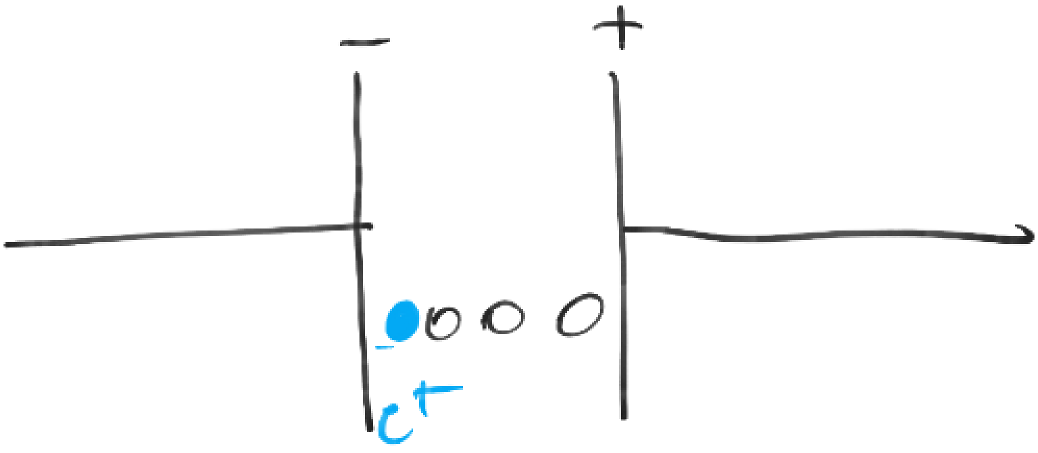
1 GeV/c^2, c^2



Vértice elemental de la Q.E.D. → Electrodinámica cuántica.







CT

+	+	+
−	+	−
+	−	−
−	−	+

$$n^0 \rightarrow p^+ + e^- + q$$

missing energy channel

canal de energía perdida.

$$n^0 \rightarrow p^+ + e^- + \bar{\nu}_e + Q$$

Leptón — Aquellas partículas que no interactúan fuertemente

e^-, e^+
ν_e, $\bar{\nu}_e$ } Leptones

$$Q + p^+ \longrightarrow n^0 + e^+ + \nu_e$$

$\boxed{\text{Proceso de Poisson}}$

a) procesos independientes.

b) ocurren a una tasa constante

Dec. Um processo de Poisson.

λ — taxa de decaimento

$$[\lambda] = 1/[t] = s^{-1}$$

$$N_0 \xrightarrow{t} N(t) < N_0$$

$$N(t) = N_0 + dN$$

$$dN < 0$$

$$\frac{dN}{dt} = -N\lambda \qquad \text{E.D.O. 1ª ordem}$$

$$\int \frac{dN}{N} = \int -\lambda \, dt = -\lambda \int dt$$

$$\int \frac{1}{N} dN = \ln N$$

$$\ln N = -\lambda t + c$$

$$e^{\ln N} \qquad e^{-\lambda t + c}$$

$e \quad = e$

$$N(t) = (e^{-\lambda t}) \cdot (e^{C})$$

$$t = 0 \Rightarrow N(t=0) = e^{-\lambda t}\big|_0 \, e^{C}$$

$$\boxed{N_0 = e^{C}}$$

$$\boxed{N(t) = N_0 \, e^{-\lambda t}}$$

Ley de decaimento.

$$\boxed{\tau = 1/\lambda}$$ Vida Media

Periodo de Semidesintegração $T_{1/2}$

$1\,kg \xrightarrow{t = T_{1/2}} 0{,}5\,kg$

$$N(T_{1/2}) = N_0/2$$

$$\Rightarrow N(t) = N_0\, e^{-\lambda t}$$

$$N(t) = N_0\, e^{-t/\tau}$$

$T_{1/2} = ?$

$$N(T_{1/2}) = \cancel{N_0}\, e^{-T_{1/2}/\tau} = \frac{\cancel{N_0}}{2}$$

$$e^{-T_{1/2}/\tau} = \frac{1}{2} \Rightarrow \ln e^{-T_{1/2}/\tau} = \ln \frac{1}{2}$$

$$-\frac{T_{1/2}}{\tau} = \ln \frac{1}{2}$$

$$T_{1/2} = -\tau \ln 1/2$$

$$\boxed{T_{1/2} = \tau \ln 2}$$

Periodo de semidesintegración

$$A(t) = \lambda N(t)$$

$$[A] = \frac{\text{decaimientos}}{\text{tiempo}} = \frac{\text{dec.}}{s}$$

$$1\ \text{Bq} = 1\ \text{dec}/s$$

$$1\ \text{Ci} = 37\ \text{GBq}$$

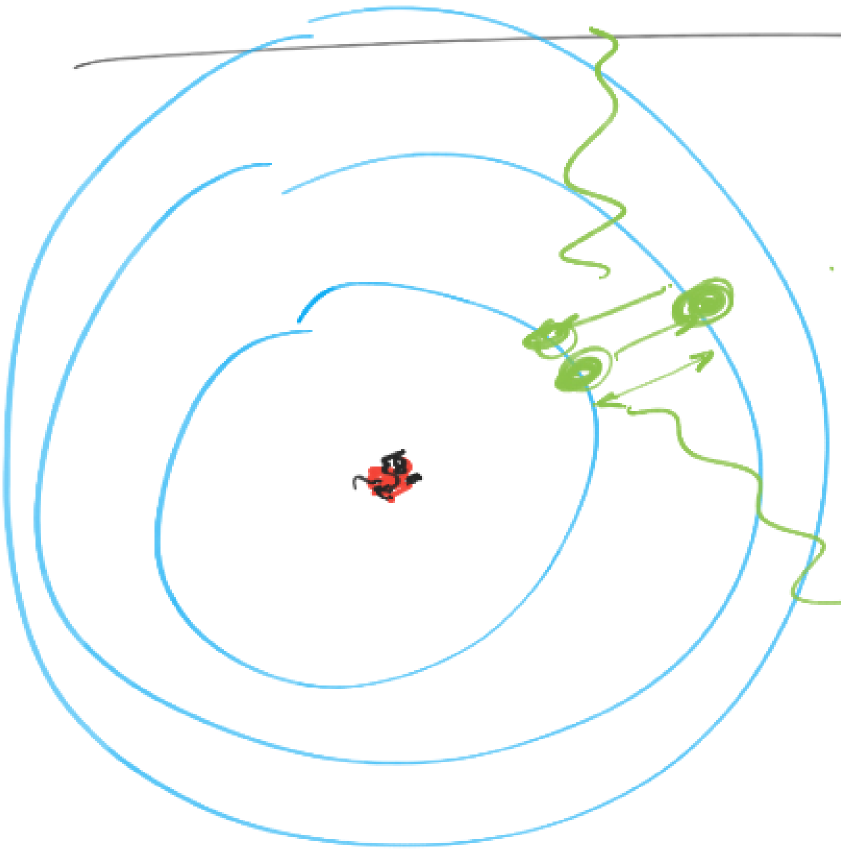
$Q > 0$ para que el dec. ocurra.

dec. β ^{210}Bi $\rightarrow Q = 1{,}16\ \text{MeV}$

$$Q = (m_{react} - m_{prod})\,c^2 > 0$$

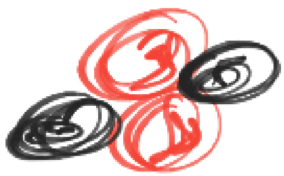
$\downarrow$

El dec. es posible.



$E_\gamma = \Delta E_{if}$

Modelo de Bohr.



${}^{A}_{N}(X)_{Z}$

Z = número Atómico

N = ✓ neutrones.

A = número másico

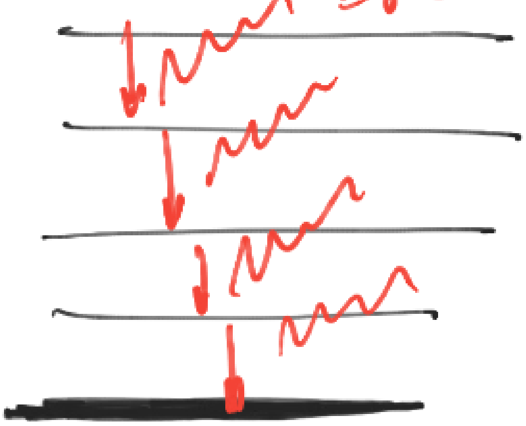
$A = Z + N$

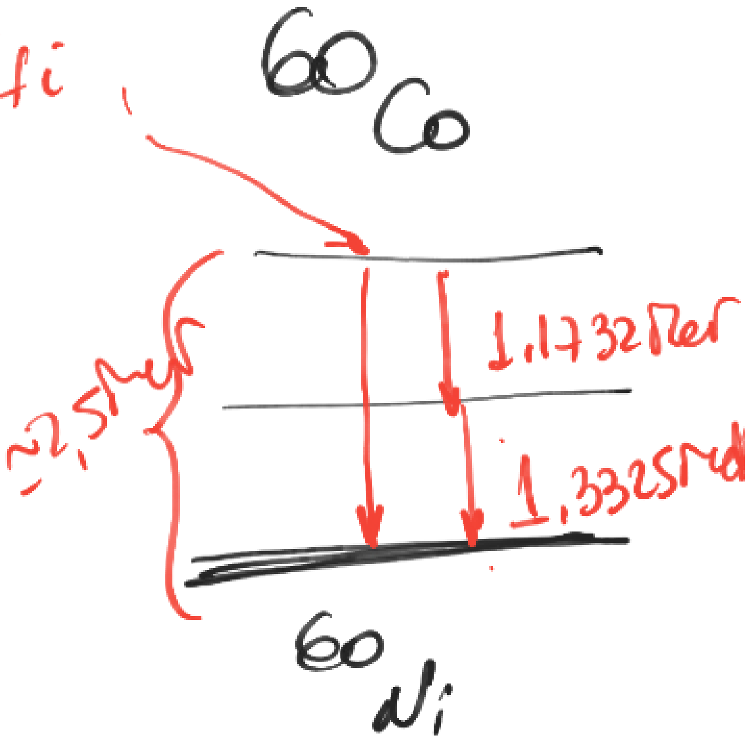
$(X)^*$

Decadimento Gamma

$$ {}^{A}_{N}(X)^{*}_{Z} \rightarrow {}^{A}_{N}X_{Z} + \gamma $$

$E_\gamma = \Delta E_{fi}$





$E_\gamma > 1{,}022\,\text{MeV}$

$$ {}^{A}_{N}X_{Z} \rightarrow {}^{A-4}_{N-2}Y_{Z-2} + {}^{4}_{2}He_{2} + Q_\alpha . $$

$Q_\alpha > 0$ $\qquad \alpha$

β^-

β $\quad {}^{A}_{N}X_{Z} \longrightarrow {}^{A}_{N-1}Y_{Z+1} + e^- + \bar{\nu}_e + Q$

$A: N \cancel{-1} + Z \cancel{+1}$

$${}^{210}_{127}Bi_{83} \rightarrow {}^{210}_{126}Po_{84} + e^- + \bar{\nu}_e + Q.$$

β^+ $\quad {}^{A}_{N}X_{Z} \longrightarrow {}^{A}_{N+1}Y_{Z-1} + e^+ + \nu_e + Q$

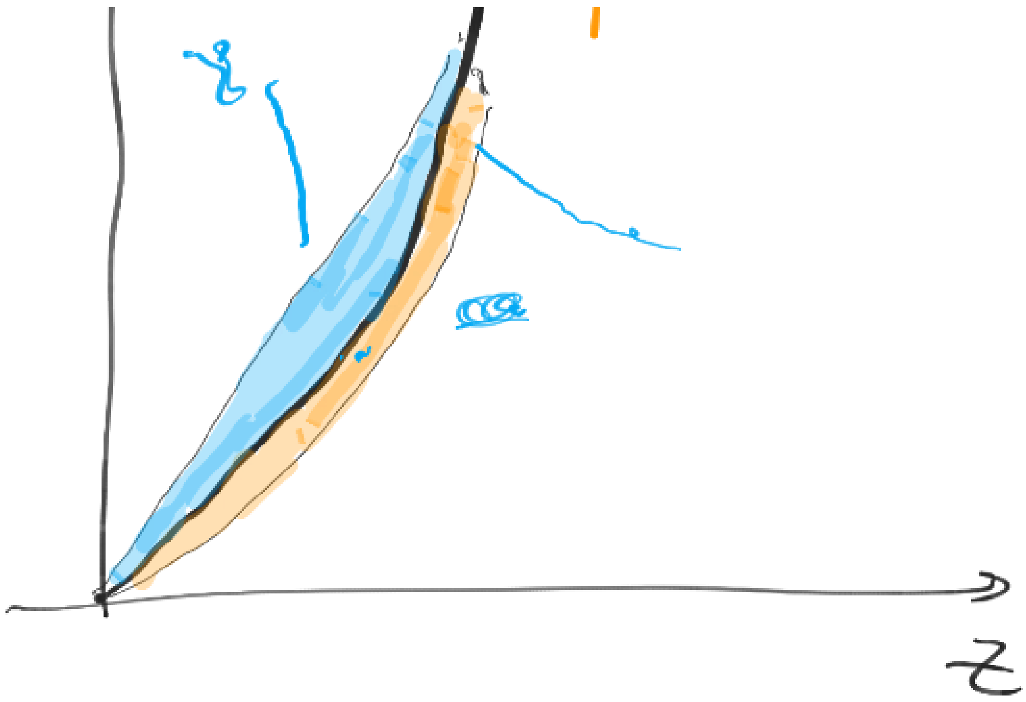
CE, ϵ

$$p^+ + e^- \rightarrow n^0 + \nu_e + Q$$

$${}^{A}_{N}X_{Z} + e^- \longrightarrow {}^{A}_{N+1}Y_{Z-1} + \nu_e + Q$$

Captura Electrónica

$N\uparrow$ $\quad \beta^-$, β^+



Di coi inty

e^-, e^+

ν_e $\bar{\nu}_e$

p, n

γ

$$\vec{F} = q\left(\vec{E} + \vec{v} \times \vec{B}\right)$$

$\vec{E}$ è il campo electr.

$\vec{v}$ è la vel.

$$\vec{F} = q\left(\vec{v} \times \vec{B}\right)$$

$m a = q(\vec{v} \times \vec{B})$ $\vec{B}$ campo mag.

m/q o q/m

Esiste una particula $q/m \simeq 200\, q/m$

μ^- $m \simeq 200\, m_e$

muón

μ^+ μ^- μ^+

$\pi^+ \rightarrow \mu^+$ $\pi^- \rightarrow \mu^-$

$\pi^- \rightarrow \mu^- + \bar{\nu}_\mu$

$\pi^+ \rightarrow \mu^+ + \nu_\mu$

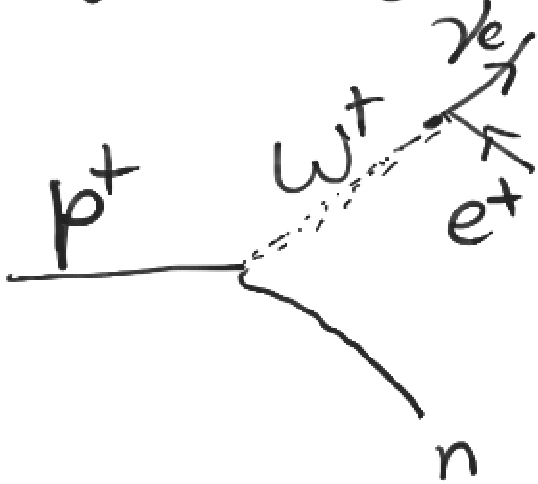
$m_n = 939,6\ MeV/c^2$

$m_p = 938,3$ MeV/c^2

$m_e = 0,5$ MeV/c^2

$$p^+ = \begin{pmatrix} u \\ u \\ d \end{pmatrix} \qquad n^0 = \begin{pmatrix} u \\ d \\ d \end{pmatrix} \qquad +Q.$$

$$u \to d + e^- + \bar{\nu}_e$$

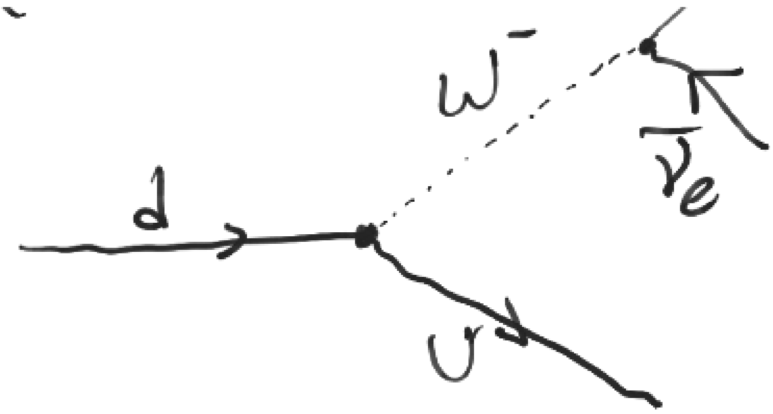


Dec Beta
x Fermi

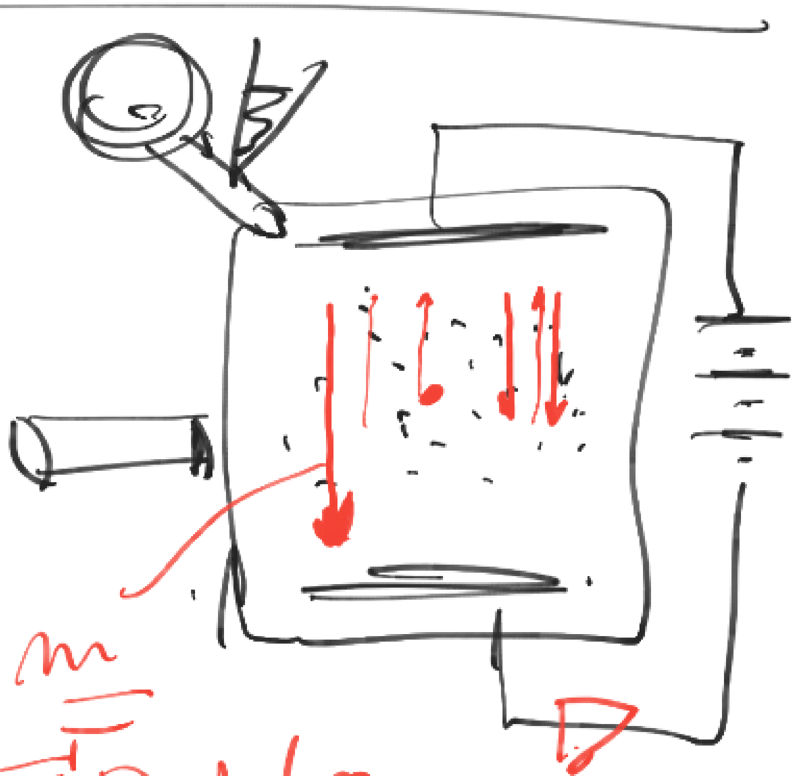
$$n^0 \to p^+ + e^- + \bar{\nu}_e + Q$$

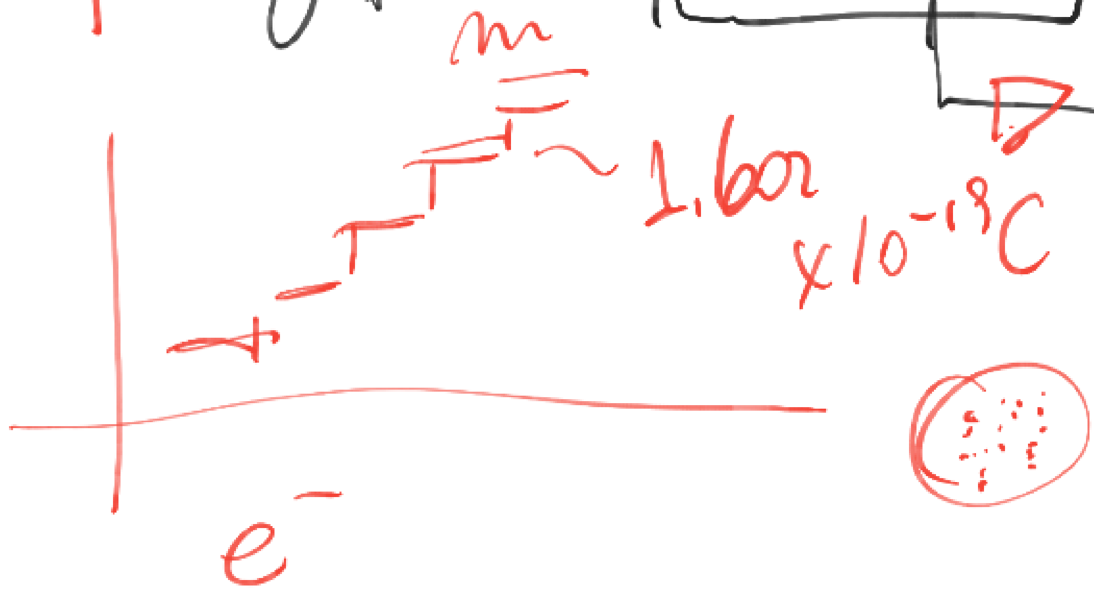
$$\begin{pmatrix} u \\ d \\ d \end{pmatrix} \to \begin{pmatrix} u \\ d \\ u \end{pmatrix}$$

e^-



Quarks





$$n \to e^- + p^+ + \bar{\nu}_e$$

Quarks $1/3$

e^-, μ^-, τ^- Leptones

Hadrones formados x quarks $\rightarrow$ Bariones $\rightarrow$ 3 quarks

$\hookrightarrow$ Mesones $\rightarrow$ 2 quarks

1° Generación

$(u, d)_1$

$u: +2/3|e|$

$d: -1/3\ |e|$

$p^+ = \begin{pmatrix} u \\ u \\ d \end{pmatrix}$ Bariones (3q)

$n^0 = \begin{pmatrix} u \\ d \\ d \end{pmatrix}$

$(u)\ +2/3$ $(\bar{u})\ -2/3$

Mesones $\pi^+ : \begin{pmatrix} u \\ \bar{d} \end{pmatrix}$ $+1/3$ $\pi^- : \begin{pmatrix} \bar{u} \\ d \end{pmatrix}$ $-1/3$

$\pi^0 : \begin{pmatrix} u \\ \bar{u} \end{pmatrix}$ $\pi^0 : \begin{pmatrix} d \\ \bar{d} \end{pmatrix}$

(s, c)

$c : +2/3$

$s : -1/3$

(t, b)

$t : +2/3$

$b : -1/3$
