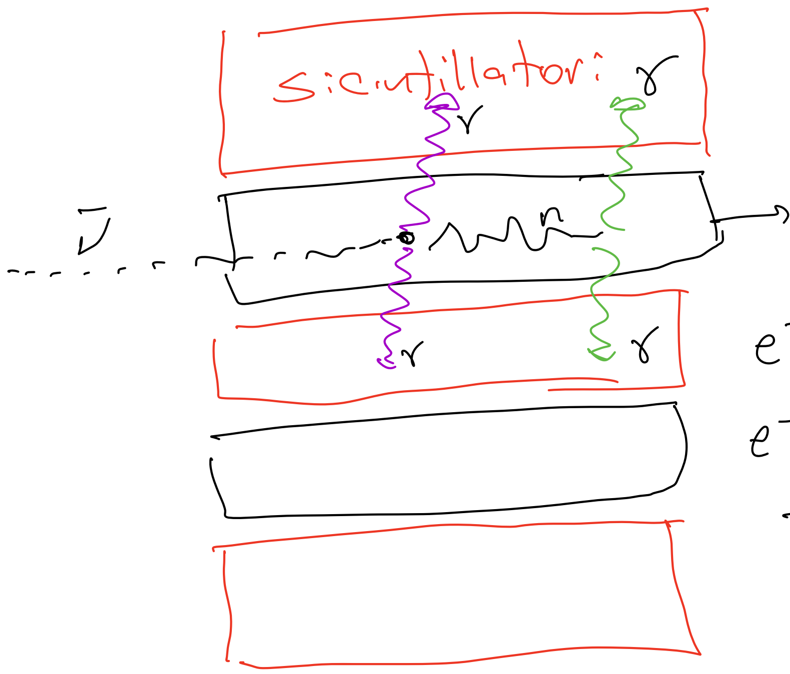
Token:431 126



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

$H_2O + CdCl_2$

e^+ perde energ.

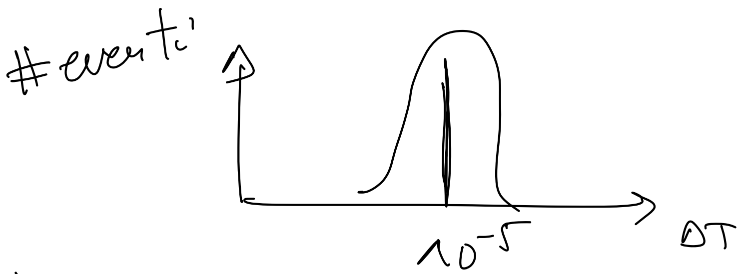
$e^+ + e^- \to$ positr. $\to 2\gamma$

$\tau \simeq 10^{-9}$ s.

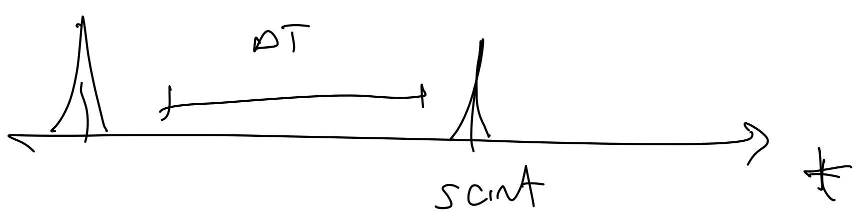
$n + Cd \longrightarrow Cd^* \longrightarrow \underbrace{Cd + \gamma + \gamma}_{\tau \,\simeq\, 10^{-5}\ \text{sec.}}$

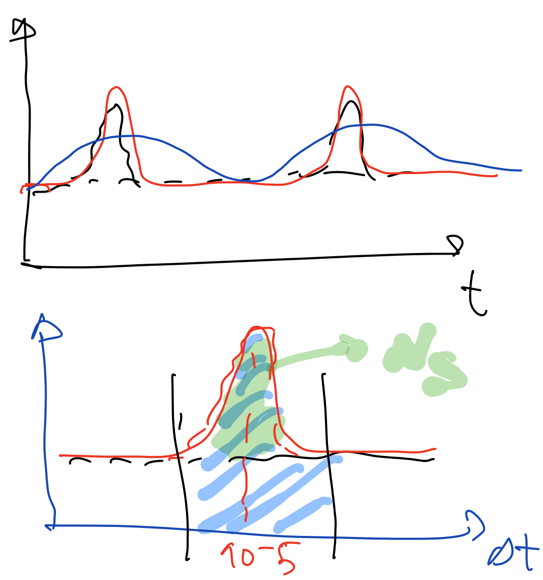
diseccit. nucleare γ decay.

1 event. 1 scint + 2 scint. $\vdash\!\!\text{———}\!\!\dashv$ $\sim 10^{-5}$ sec. ΔT scint + scint



2 scint.

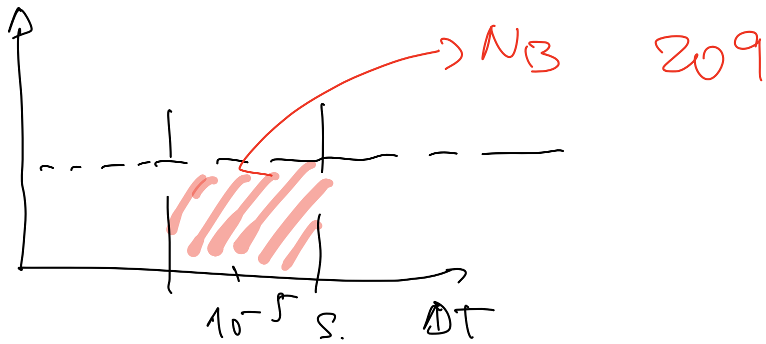




$$\underbrace{\frac{dN_r}{dt}}_{\text{osservabile nel rivelatore}} = \underbrace{\sigma}_{\text{int. } \bar{\nu}+p} \frac{dN_p}{dt}\, n_b \cdot d$$

Reattore acceso $\underbrace{567}_{N_{obs}}$ eventi.

Reattore spento: $$\frac{dN_r}{dt} = \sigma\, \cancel{\frac{dN_p}{dt}}^{\,\emptyset}\, n_b \cdot d$$



$$\hat{N}_S = N_{obs} - N_B = 358$$

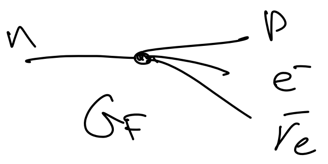
N_B, $\sqrt{N_B}$ stima fluttuazioni nel tempo.

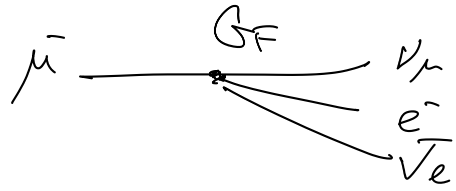
$$N_{obs} = N_S + N_B$$

$$\frac{N_{obs} - N_B}{\sqrt{N_B}} \simeq \frac{358}{\sqrt{N_B}} \simeq 25 \text{ dev. std}$$

Eccesso di eventi $\Rightarrow$ $\bar{\nu}+p$

$$\hat{\sigma}_{obs} = \frac{(N_{obs} - N_B)}{n_b \cdot d} \frac{1}{\left(\frac{dN_p}{dt}\right)} \frac{1}{T_{\text{prescelti}}}$$ confronto con σ_{th}





$H = H_0 + H_I$

autostati di H_0 $\{\psi_n\}$ E_n autovalori.

$t=0$ $\psi(x,t) = \sum_k a_k(t)\, e^{-iE_k t}\, \psi_k(x)$

$t=0$ $|i\rangle = |\psi_i\rangle$ $a_i(0) \neq 0$. $a_\ell(0) \simeq 0$. $\ell \neq i$

1
2
⋮
$i \leftarrow t=0$.
⋮
ℓ
⋮
m
n

se accendo H_I $P(i \to \ell) \neq 0$.

$$P(i \to \ell) = |\langle \ell | i \rangle|^2 = |a_\ell(t)|^2$$

$$\dot{a}_k(t) \simeq -i \underbrace{a_i(t)}_{\simeq 1} \int d^3r\, \psi_k^* H_I \psi_i\, e^{i(E_k - E_i)t}$$

$a_i(0) = 1$

$a_\ell(0) = 0$ $\ell \neq i$

$$a_f(t) = \int_0^t dt' \, M_{fi} \, e^{i(E_f - E_i)t}$$

$$M_{fi} = -i \int d^3r \, \psi_f^* H_I \psi_i = -i V_{fi}$$

$$|i\rangle \longrightarrow H_I \longrightarrow |f\rangle$$

$$\Gamma(i \to f) = 2\pi \, |M_{fi}|^2 \underbrace{\rho(E)}_{\delta(E_f - E_i)}$$

$a_k^{(2)}(t)$ secondo ordine perturbazione.

$$a_k^{(2)}(t) = -i \int_0^t dt' \, V_{ki}^{(2)} \, e^{i(E_k - E_i)t}$$

$$V_{ki}^{(2)} = \underbrace{V_{ki}^{(1)}}_{\substack{\delta_{ki} \\ \text{I° ord.}}} + \sum_{n \neq i} \frac{V_{kn}^{(1)} V_{ni}^{(1)}}{E_i - E_n}$$

$\Delta E \cdot \Delta t \simeq 1$

I ordine $\quad |i\rangle \longrightarrow |k\rangle \quad$ solo se $k = i$

II ordine $\quad |i\rangle \xrightarrow{V_{ni}} |n\rangle \xrightarrow{V_{kn}} |k\rangle$

$$\sum_n |n\rangle\langle n|$$

E_i = en. iniziale

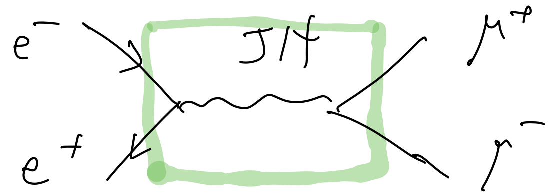
$|i\rangle \longrightarrow |k\rangle \qquad E_n \simeq E_i$

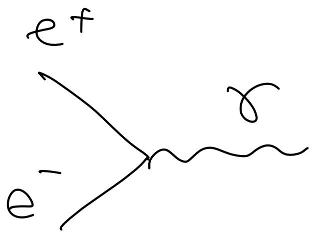
$$\langle k|i\rangle = \sum_n \langle k|n\rangle\langle n|i\rangle$$

$$\Gamma' = 2\pi \, |M_{fi}^{(2)}|^2 \, \underbrace{\rho(E)}_{\delta(E_f - E_i)}$$

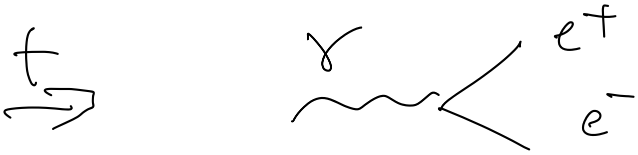
$|i\rangle \longrightarrow H_I \longrightarrow |f\rangle$

$E_i = E_f$

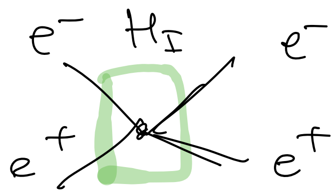




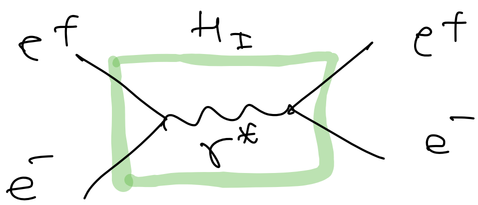
$\sqrt{s_i} \neq \sqrt{s_f}$



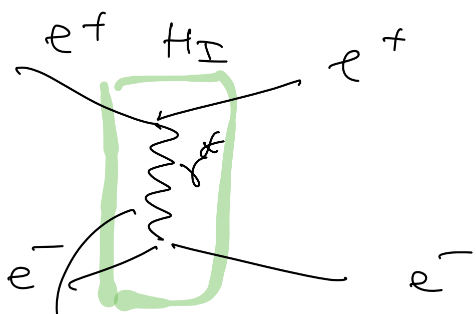
$\sqrt{s_i} \neq \sqrt{s_f}$.



$e^- + e^+ \to e^- + e^+$

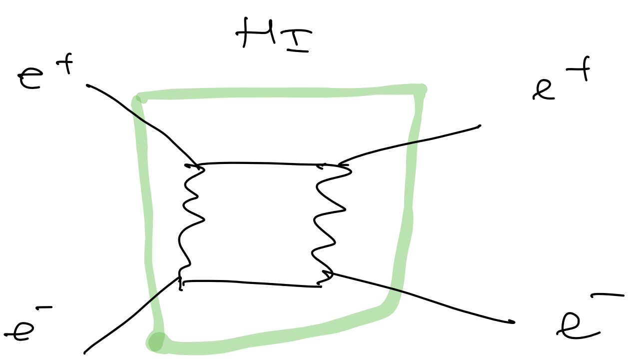


$+$



$e^+ + e^- \to e^+ + e^-$

propagatore mediatore di forze.



$e^+ + e^- \to e^+ e^-$

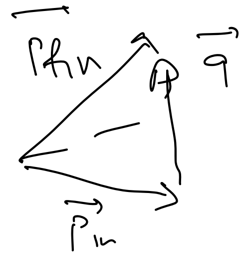
$$V_{fi} = \int d^3r \, \psi_f^* H_I \psi_i$$

$$i \xrightarrow{p_{in}} (V) \xrightarrow{p_f} f$$

onda piana per stato iniziale e finale. $\quad e^{i\vec{p}\cdot\vec{r}}$

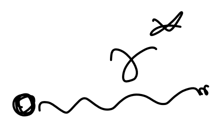
$$V_{fi} = \int d^3r \, \frac{e^{-i\vec{p}_f\cdot\vec{r}}}{\sqrt{V}} \, \frac{e^{+i\vec{p}_{in}\cdot\vec{r}}}{\sqrt{V}} \, H_I$$

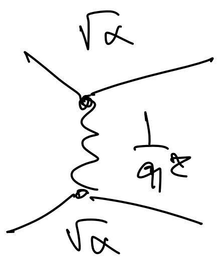
$$H_I = \frac{e^2}{4\pi}\,\frac{1}{r}$$



$$V_{fi} = \frac{e^2}{4\pi}\,\frac{1}{V}\int d^3r \, e^{-i\vec{q}\cdot\vec{r}} \, \frac{1}{r}$$

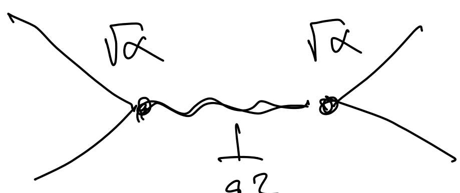
$$\propto \frac{e^2}{4\pi}\,\frac{1}{q^2} = \frac{\alpha}{q^2}$$



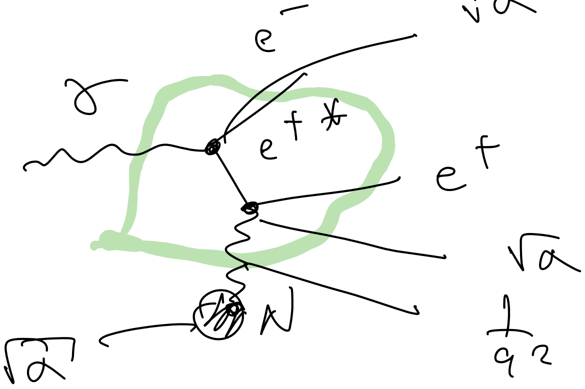


$$M_{fi} \propto \frac{\alpha}{q^2}$$

$$\sigma \propto \left(\frac{\alpha}{q^2}\right)^2 = \frac{\alpha^2}{q^4}$$



$\frac{\alpha}{q^2}$ = propagatore + 2 vertici.

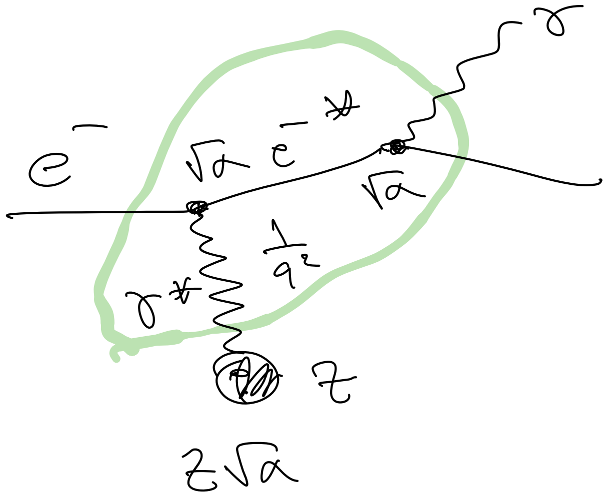


$$\gamma + N \longrightarrow e^+ + e^- + N$$

$$Z\,\frac{\alpha^{3/2}}{q^2} = M_{fi}$$

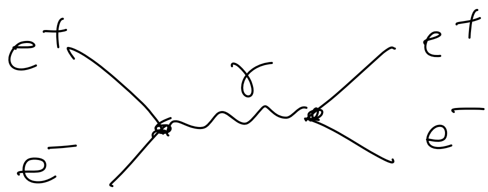
$$\sigma \propto |M_{fi}|^2 \propto \frac{Z^2\alpha^3}{q^4}$$

$$V = \frac{Ze^2}{4\pi}\frac{1}{r}$$



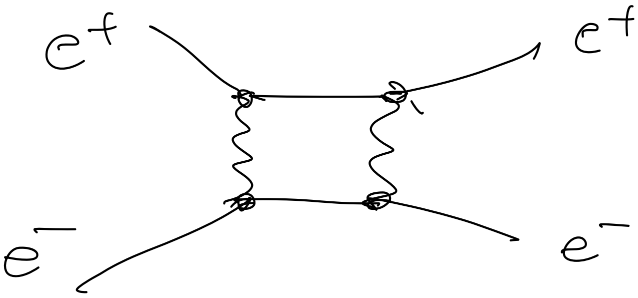
$$e^- + N \to e^- + \gamma + N.$$

$$M_{fi} = Z\,\frac{\alpha^{3/2}}{q^2}$$



$$M_{fi} \propto \frac{\alpha}{q^2}$$

$$\Rightarrow \sigma \propto \frac{\alpha^2}{q^4}$$



$e^- + e^+ \to e^+ + e^-$

$$M_{fi} = \frac{\sqrt{\alpha}\sqrt{\alpha}\sqrt{\alpha}\sqrt{\alpha}}{q^4}$$

$$= \frac{\alpha^2}{q^4}$$

$$\sigma \propto \frac{\alpha^4}{q^4}$$

processi non fisici