$\boxed{\text{EX PER CASA}}$

Fascio di π^+ $\quad 10^{12}\ \pi/s$

$p = 2\ \text{GeV}$

Intensità di corrente del fascio dopo 120 m ?

$m(\pi) \sim 140\ \text{MeV}$

$\tau_0(\pi) = 2.6 \cdot 10^{-8}\ s$

$$I_\pi(t=0) = e\,\dot{N}_\pi = 1.6 \cdot 10^{-19}\ C \cdot 10^{12}\ s^{-1} = 0.16\ \mu A$$

$$N(t) = N_0\, e^{-t/\tau} \xrightarrow{\text{dilatazione tempi}} N_0\, e^{-t/\gamma\tau}$$

ma io voglio $N(\underline{x})$

$$N(x) = N_0\, e^{-x/\lambda}$$

con $\quad \lambda = v\,(\overbrace{\gamma\tau_0}^{t}) = \beta c \gamma \tau_0$

$$\Rightarrow N(x) = N_0\, e^{-x/\beta\gamma c\tau_0}$$

$$\Rightarrow \frac{N(x)}{N_0} = e^{-x/\beta\gamma c\tau} \xrightarrow{x=120\,m} \frac{N(x)}{N_0} = e^{-120m/\beta\gamma c\tau_0}$$

quali sono β e γ del π^+

$$\beta = \frac{p}{E}$$

$$E = \sqrt{m^2 + p^2} = \sqrt{0.140^2 + 2^2} = 2.005 \text{ GeV}$$

$$\Rightarrow \beta = \frac{2}{2.005} = 0.9976 \leftarrow \text{qui } \beta \sim 1 \ \underline{\underline{\text{NO}}} \ (\gamma \to +\infty)$$

$$\gamma = \frac{1}{\sqrt{1-\beta^2}} = 14.4$$

$$\Rightarrow \frac{N(x=120m)}{N_0} = e^{-120m / 0.9976 \cdot 14.4 \cdot 3 \cdot 10^{8} \cdot 2.6 \cdot 10^{-8}} = 0.33$$

$$\Rightarrow I(x=120m) = 0.33 \cdot I_0 = 0.053 \ \mu A$$

LE CIFRE SIGNIFICATIVE!

$\boxed{\text{ALTRO EX}}$

Abbiamo 10^{10} μ^+ con $p = 200$ GeV in anello di accumulazione con $R = 100$ m

$$\tau_0(\mu) = 2.2 \cdot 10^{-6} \text{ s} \qquad m_\mu = 106 \text{ MeV}$$

Quante rivoluzioni prima che corrente si riduce di fattore 10^6?

vita media nel LAB: $\tau = \gamma \tau_0$

$$\gamma = \frac{E}{m} = \frac{\sqrt{p^2+m^2}}{m} = \frac{\sqrt{200^2+0.106^2}}{0.106} \sim \frac{200}{0.106}$$

$$\gamma \sim 1887$$

$$\beta \sim 1$$

$$\tau = \gamma\tau_0 = 1887 \cdot 2.2 \cdot 10^{-6}\ s \sim 4.2 \cdot 10^{-3}\ s$$

Assumendo $v \sim c$ $(\beta \sim 1)$

$$\frac{N(x)}{N_0} = e^{-x/\beta\gamma c\tau_0}$$

$$10^{-6} = e^{-x/\beta\gamma c\tau_0}$$

$$\Leftrightarrow \quad x = -\beta\gamma c\tau_0 \ln(10^{-6}) =$$

$$= -1 \cdot 1887 \cdot 3 \cdot 10^{8} \cdot 2.2 \cdot 10^{-6} \cdot (-13.8)$$

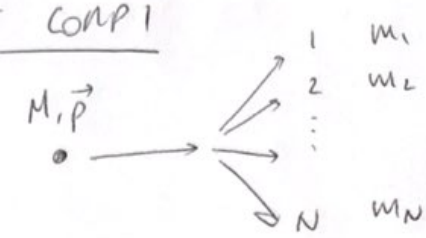
$$= 17.2 \cdot 10^{6}\ m$$

1 giro è $2\pi R = 2 \cdot 3.14 \cdot 100m = 628\ m$

$$\Rightarrow N_{riv} = \frac{x}{2\pi R} = \frac{17.2 \cdot 10^{6}}{628} = 27.4 \cdot 10^{3}$$

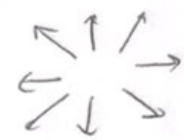
DECADIMENTO IN DUE CORPI

IN GENERALE



Nel SdR solidale con la p.lla:

$M, \vec{p} = 0$



stato iniziale

stato finale

Conservazione del 4-impulso

stato iniziale

CdM

$$\begin{pmatrix} M \\ \vec{0} \end{pmatrix} = \sum_i \begin{pmatrix} E_i^* \\ \vec{p}_i^* \end{pmatrix}$$

la p.lla è a riposo $\Leftrightarrow p = 0$

$$\Leftrightarrow E = \sqrt{M^2 + p^2} = M$$

$$\rightarrow \begin{cases} M = \sum_i E_i^* \\ \vec{0} = \sum_i \vec{p}_i^* \end{cases}$$

$$M = \sum_i E_i^* = \sum_i \sqrt{m_i^2 + |\vec{p}_i^*|^2} \geq \sum_i m_i$$

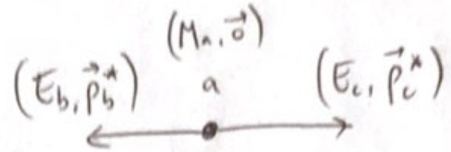
$$\Leftrightarrow \sum_i m_i \leq M$$

serve molta energia!

consideriamo $a \to b + c$

$M_a \quad m_b \quad m_c$

mettiamoci nel SdR solidale con a



$$\begin{pmatrix} M_a \\ \vec{0} \end{pmatrix} = \begin{pmatrix} E_b^* + E_c^* \\ \vec{p}_b^* + \vec{p}_c^* \end{pmatrix}$$

$$M_a = E_b^* + E_c^*$$

$$\vec{0} = \vec{p}_b^* + \vec{p}_c^* \iff \vec{p}_b^* = -\vec{p}_c^* \equiv \vec{p}^* \qquad \underline{\underline{\text{back-to-back}}}$$

$$M_a = \sqrt{(p^*)^2 + m_b^2} + \sqrt{(p^*)^2 + m_c^2}$$

$$\iff M_a - \sqrt{(p^*)^2 + m_b^2} = \sqrt{(p^*)^2 + m_c^2} \qquad \text{e quadro!}$$

$$\Rightarrow M_a^2 + (\cancel{(p^*)^2} + m_b^2) - 2M_a\sqrt{(p^*)^2 + m_b^2} = \cancel{(p^*)^2} + m_c^2$$

$$\iff M_a^2 + (m_b^2 - m_c^2) = 2M_a\sqrt{(p^*)^2 + m_b^2} \qquad \text{e quadro!}$$

$$\Rightarrow M_a^4 + (m_b^2 - m_c^2)^2 + 2M_a^2(m_b^2 - m_c^2) = 4M_a^2((p^*)^2 + m_b^2)$$

$$\iff M_a^4 + (m_b^2 - m_c^2)^2 + 2M_a^2 m_b^2 - 2M_a^2 m_c^2 = 4M_a^2 (p^*)^2 + 4M_a^2 m$$

$$\iff M_a^4 + (m_b^2 - m_c^2)^2 - 2M_a^2(m_b^2 + m_c^2) = 4M_a^2 (p^*)^2$$

$$\Rightarrow \quad p^* = \sqrt{\frac{M_a^4 + (m_b^2 - m_c^2)^2 - 2M_a^2(m_b^2 + m_c^2)}{4M_a^2}}$$

MONOCROMATICO !

e quindi anche $E^*_{b/c} = \sqrt{m_{b/c}^2 + (p^*)^2}$

$\boxed{EX}$ RICAVARE

$$E_b^* = \sqrt{m_b^2 + (p^*)^2} = \frac{M_a^2 + (m_b^2 - m_c^2)}{2M_a}$$

$$E_c^* = \sqrt{m_b^2 + (p^*)^2} = \frac{M_a^2 + (m_c^2 - m_b^2)}{2M_a}$$