Token 893 863

Decadimenti $\qquad a \longrightarrow b + c + nx$

urti, scattering $\qquad a + b \longrightarrow a + b \qquad\qquad$ elastico
diffusione

$\qquad a + b \longrightarrow a + b + c$

$\qquad\qquad\qquad \longrightarrow c + d + e$

$\qquad\qquad\qquad \longrightarrow f + g$
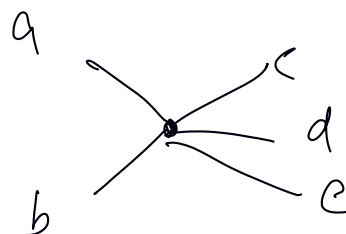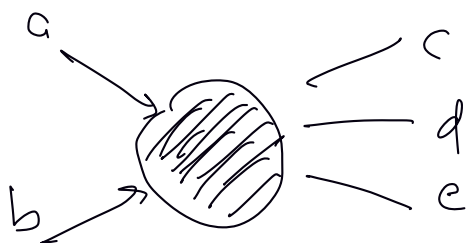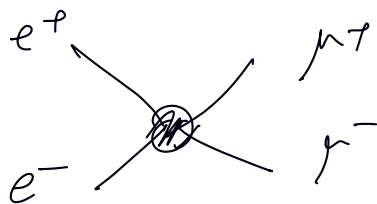

$\xrightarrow{\quad t \quad}$

$|i\rangle \longrightarrow |f\rangle$
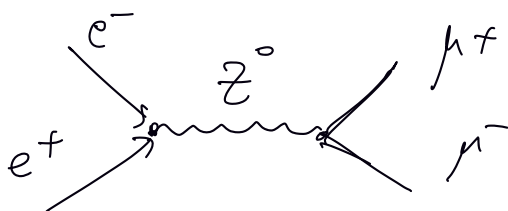
$E = 45 \text{ GeV}$

$M_{Z^0} = 91 \text{ GeV}$

urti a bersaglio fisso

fasci incrociati

$$N_B = n_b \cdot S \cdot d \implies n_b = \frac{N_B}{S \cdot d}$$
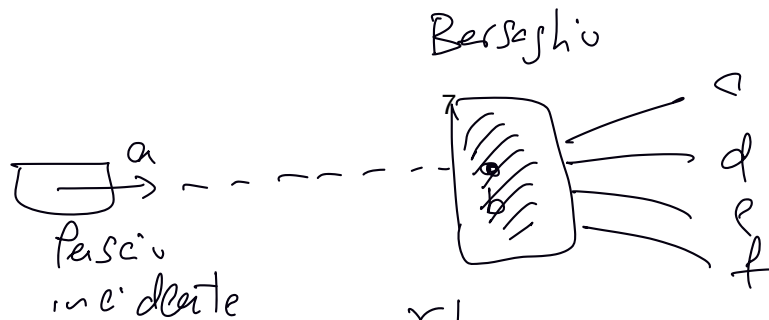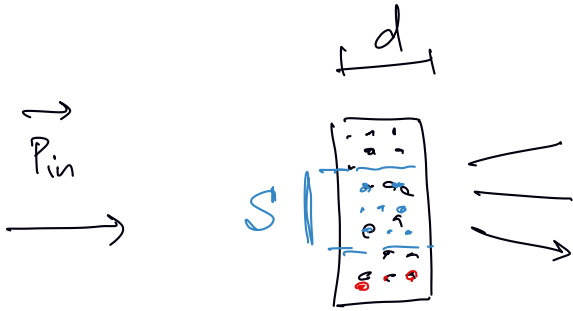
n_b: densità bersagli

#proiettili
N_P

#reazioni
N_r

$$\frac{N_P}{\Delta T} =: \frac{dN_P}{dt} \qquad \frac{N_r}{\Delta T}$$

$\hookrightarrow$ tempo finito di esperimento / osservazione

Dim:

$$\underset{T^{-1}}{\frac{dN_r}{dt}} = \underset{\sigma}{\propto} \, \underset{T^{-1}}{\frac{dN_P}{dt}} \, \underset{L^{-3}}{n_b} \, \underset{L}{d}$$

$\hookrightarrow$ sezione d'urto $\qquad [\sigma] = L^2$

prob di interazione: - non dipende dalla vicinanza tra bersagli.

— max 1 interazione tra ciascun proiett. e un bersaglio

$$\frac{dN_r}{dt} = \sigma \frac{dN_P}{dt} \frac{N_B}{S \cdot \cancel{d}} \cancel{d} = \sigma \frac{dN_P}{dt} \frac{1}{S} N_B$$

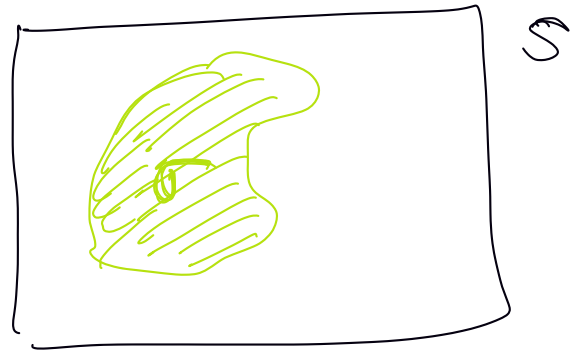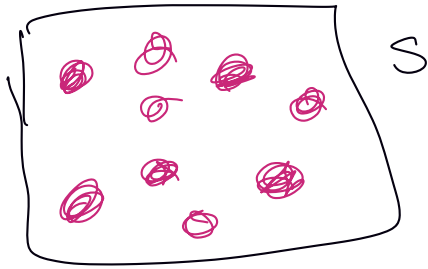$$\frac{\dfrac{dN_r}{dt}}{\dfrac{dN_P}{dt}} = \frac{\sigma}{S} N_B$$

tempo finito T

$$N_P = \frac{dN_P}{dt} \cdot T$$

$$N_r = \frac{dN_r}{dt} T$$

Supponiamo $N_B = 1$

$$P(reazione) = \frac{N_r}{N_P} = \frac{\sigma}{S}$$

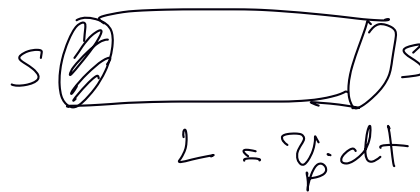$$\frac{\frac{dN_r}{dt}}{dN_P/dt} \quad \frac{1}{N_B} = \frac{\sigma}{S}$$

$$\frac{dN_r}{dt} = \sigma \cdot \frac{dN_P}{dt} \cdot \frac{N_B}{S}$$

$$\frac{dN_P}{dt} \frac{1}{S} = \phi_P$$
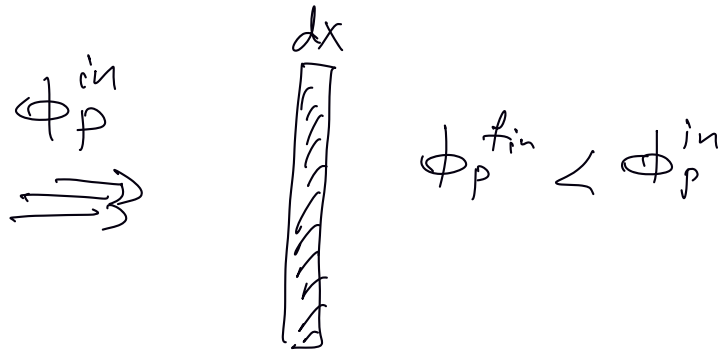
$$N_P = n_P \cdot L \cdot S$$
$$= n_P \cdot \upsilon \, dt \, S$$

$$L = \upsilon_P \cdot dt$$

$$\Rightarrow \quad \phi_P = \frac{N_P}{dt \cdot S} = n_P \cdot \upsilon_P$$

$$\frac{dN_r}{dt} = \sigma \cdot n_P \, \upsilon_P \, N_B$$

$$\Phi_P^{in} \implies \quad \boxed{}^{dx} \quad \Phi_P^{fin} < \Phi_P^{in}$$

$$\frac{dN_r}{dt} = \sigma \cdot \frac{dN_p}{dt} \; n_b \cdot (dx)$$

$$P(inter) = \frac{\dfrac{dN_r}{dt}}{\dfrac{dN_p}{dt}} = \sigma \cdot n_b \cdot dx$$
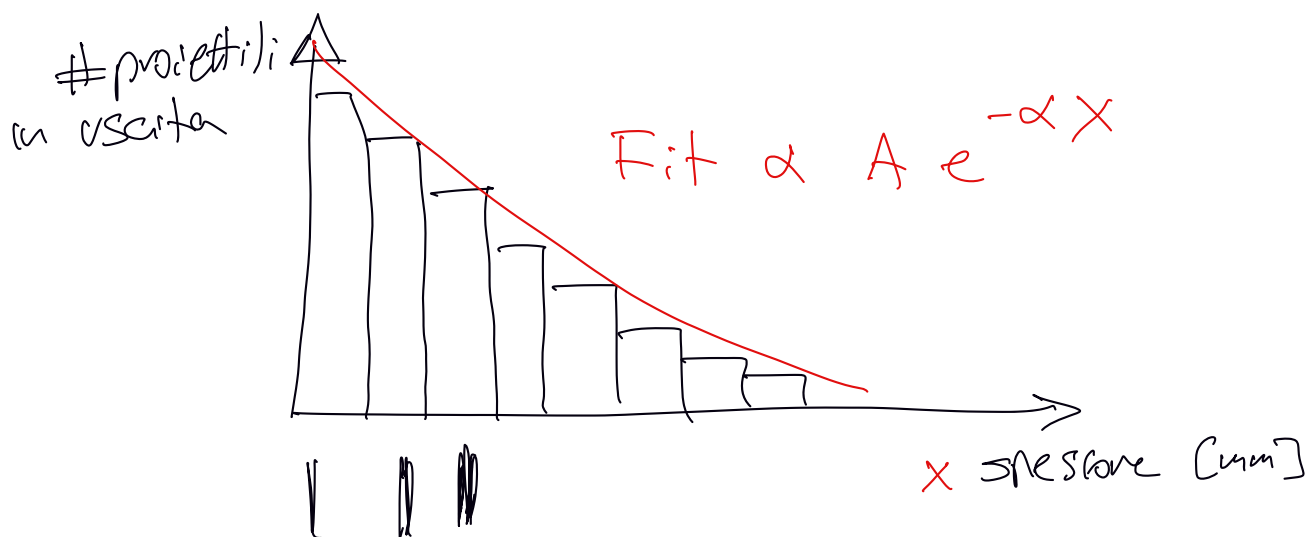
$$d\phi = - (\sigma \cdot n_b \cdot dx) \phi$$

$$\phi_P = \phi_P(0) \cdot e^{-\mu x} \qquad \mu = \sigma \cdot n_b \cdot$$

$$[\mu] = L^{-1} \quad \text{coeff di attenuazione.}$$

$$\frac{1}{\mu} = \lambda \quad \text{lunghezza di attenuatore.}$$

$$\lambda = \frac{1}{\sigma \cdot n_b} \qquad \text{esperimenti con dx variabile.}$$

#proiettili
in uscita

Fit α $A \, e^{-\alpha x}$

x spessore [mm]

$$\sigma_{mis} = \sigma, n_b.$$

$$\alpha \pm \delta\alpha \qquad\qquad n_b \text{ note} \Rightarrow \text{misure di } \sigma$$

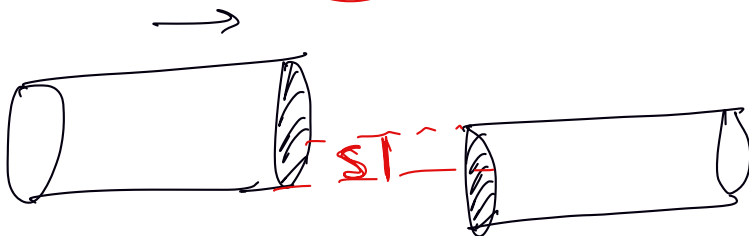$$1 \text{ barn} = 10^{-28} \, m^2 = 10^{-24} \, cm^2$$

$$1 \, nb = 10^{-9} \, b$$
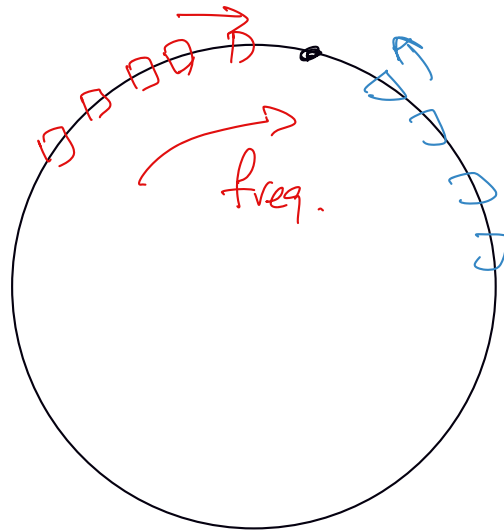
$$\frac{dN_r}{dt} = \sigma \left(\frac{dN_P}{dt} \cdot \frac{N_B}{S} \right) = \sigma \, \Phi_P \cdot N_B = \sigma \, n_P \cdot \vartheta_P \, N_B$$

$$\Phi_P = \frac{dN_P}{dt \cdot S} = \frac{N_P}{S} f \hookrightarrow \text{freq. di collisione.}$$

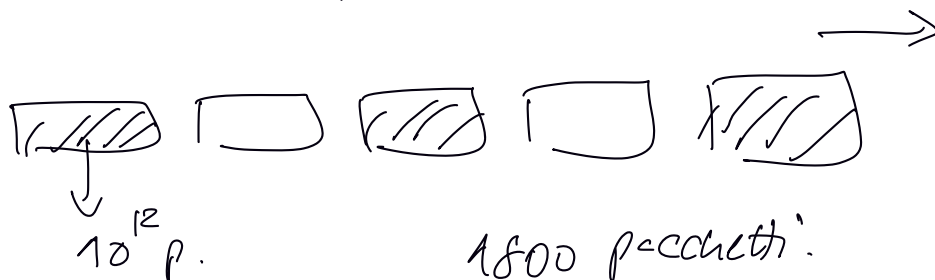$$\frac{dN_r}{dt} = \sigma \, \frac{N_P \cdot}{\boxed{S}} f \, N_B$$

non ottimale.

S

S

$$\frac{dNr}{dt} = \sigma \, \frac{N_p \, N_B}{S} \, f$$

LHC: $f = 40$ MHz

1 int. ogni 25 nS

@ LHC: $n_p \simeq 10^{12}$ P/bunch.

10^{12} p.   1800 pacchetti.

$$N_P = \#\text{pacchetti} \times \frac{\#\text{protoni}}{\text{pacchetto}}$$

$$\frac{dNr}{dt} = \sigma \cdot \mathcal{L}_{inst}$$

luminosità istantanea.

T^{-1} L^2 $L^{-2} T^{-1}$

$$Nr \overset{?}{=} \sigma \cdot \mathcal{L}_{inst} \cdot \Delta T$$
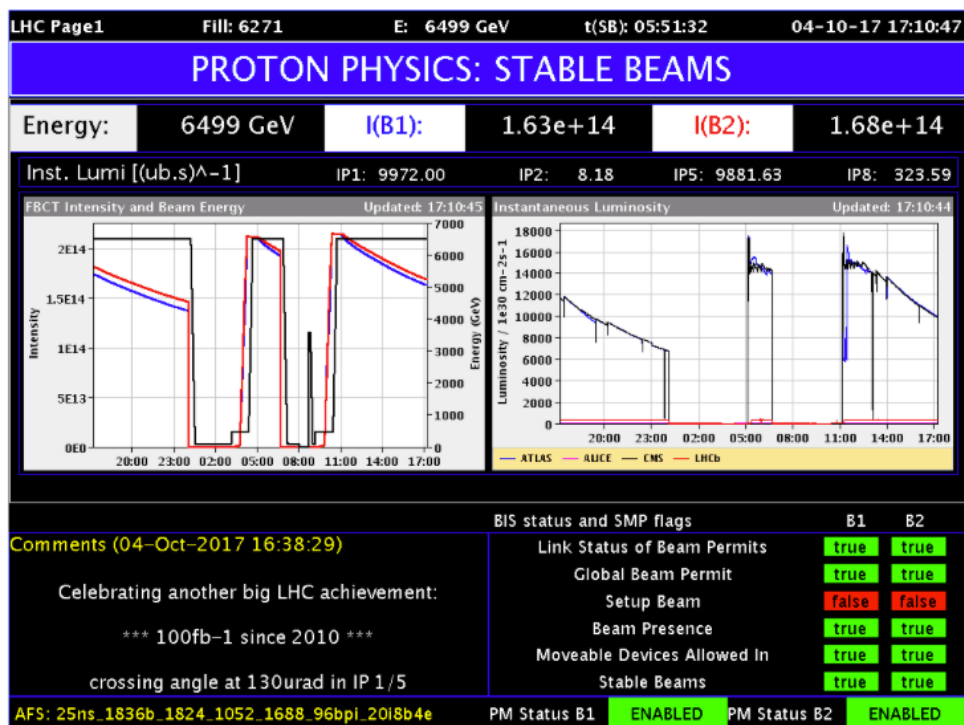
$$L_{tot} = \int_{\Delta T} L_{inst} \cdot dt$$

$$N_r = \sigma \cdot \int L \cdot dt = \sigma \cdot L_{int}$$

$$[L_{int}] = L^{-2}$$

$$100 \; fb^{-1} = 10^2 \, (10^{-15} \, b)^{-1} = 10^2 \, 10^{15} \, b^{-1}$$

$$= 10^{17} \, b^{-1}$$

processo con $\sigma = 1 \, b$

$$N_r = 10^{17} \, b^{-1} \times \underset{\sigma}{1 \, b} = 10^{17}$$

spazio disco $= 10^{17} \times 10^6 \, B = 10^{23} \, B$