

Bethe-Bloch

$$\frac{1}{\beta^2} \text{ for } \frac{2me\beta^2r^2}{I}$$

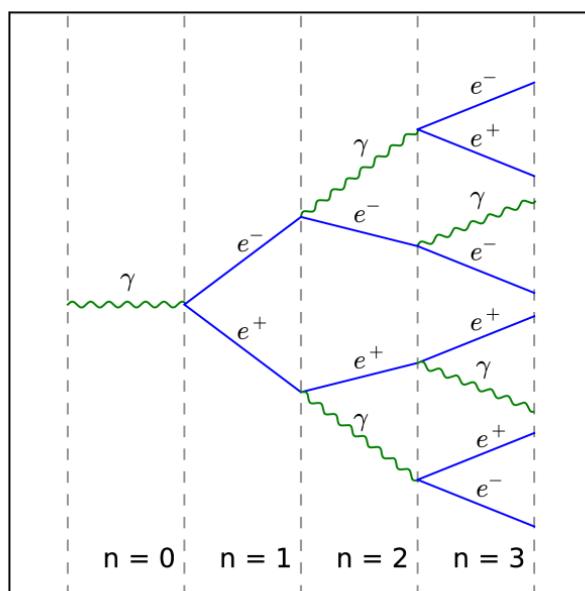
$$\frac{1}{\beta^2} \frac{1}{2} \log \frac{2me\beta^2r^2 T_{max}}{I^2}$$

$$T_{max} \approx 2me\beta^2r^2$$

approssimazione valida  
precisione del 10%

$$\frac{1}{\beta^2} \not\propto \log \frac{(2me\beta^2r^2)^2}{I^2}$$

Bransf.

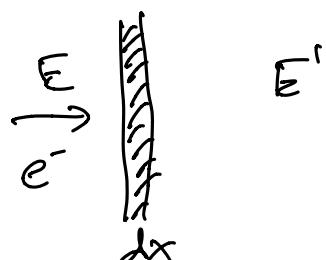


prod. d'app.

Bransstrahlung

$$E(x) = E_0 e^{-x/x_0}$$

$x_0$  lung. di rad.



$$\dot{N}_r = \int n_p \cdot n \cdot dx = n_p \underbrace{\int n \cdot dx}$$

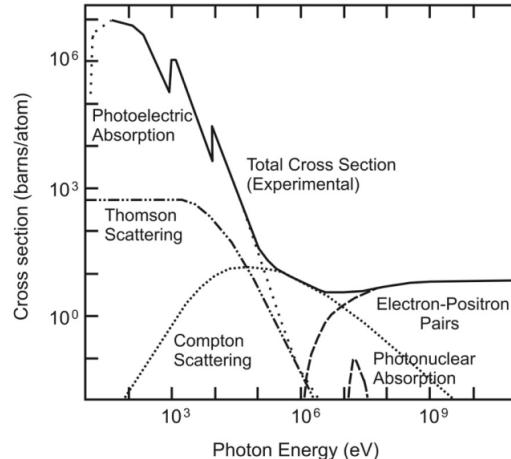
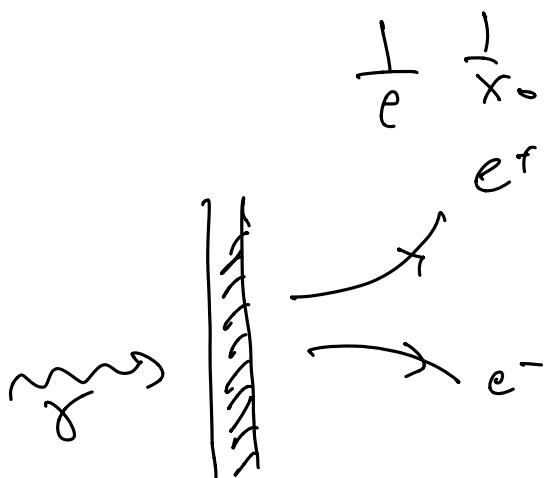
$$\text{Prattone} = \frac{\dot{N}_r}{\dot{N}_p} \quad n = \frac{\rho}{A} N_A.$$

$$dN = -P dx$$

$$N = N_0 e^{-\mu x} = N_0 e^{-\sigma \cdot n x}$$

$$[\sigma \cdot n] = [L]^{-1} = \frac{1}{x_0}$$

$$\frac{1}{x_0} \propto \rho \frac{N_A}{A} Z^2 \ln(18 Z^{-1/3})$$



$$\dot{N}_r = \int_{\gamma \rightarrow e^+e^-} n \cdot dx.$$

$$N_\gamma(x) = N_\gamma(0) e^{-\frac{x}{X_\gamma}}$$

$$\frac{1}{X_\gamma} = \int_{\gamma \rightarrow e^+e^-} n$$

$X_\gamma$ : lunghezza di attenuazione

s: osserva

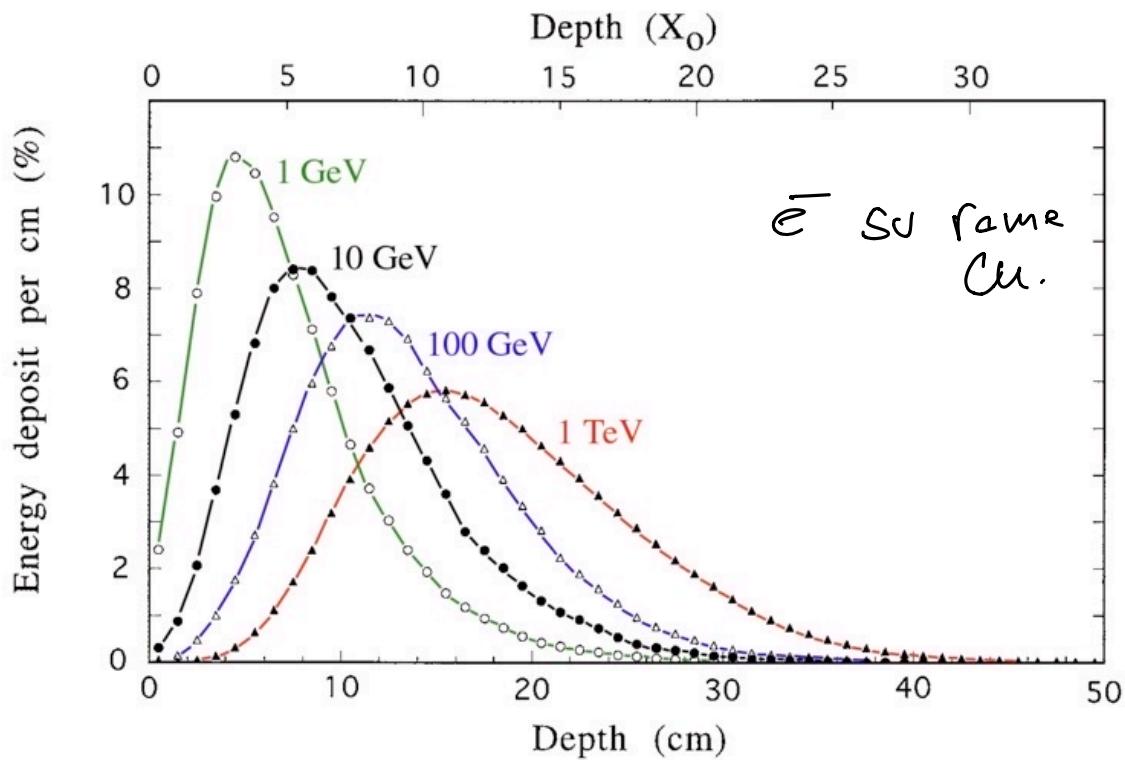
$$\frac{1}{X_\gamma} \approx \frac{Z}{g} \frac{1}{x_0}$$

$E_\gamma > 100 \text{ MeV}$   
produzione  
di coppia.



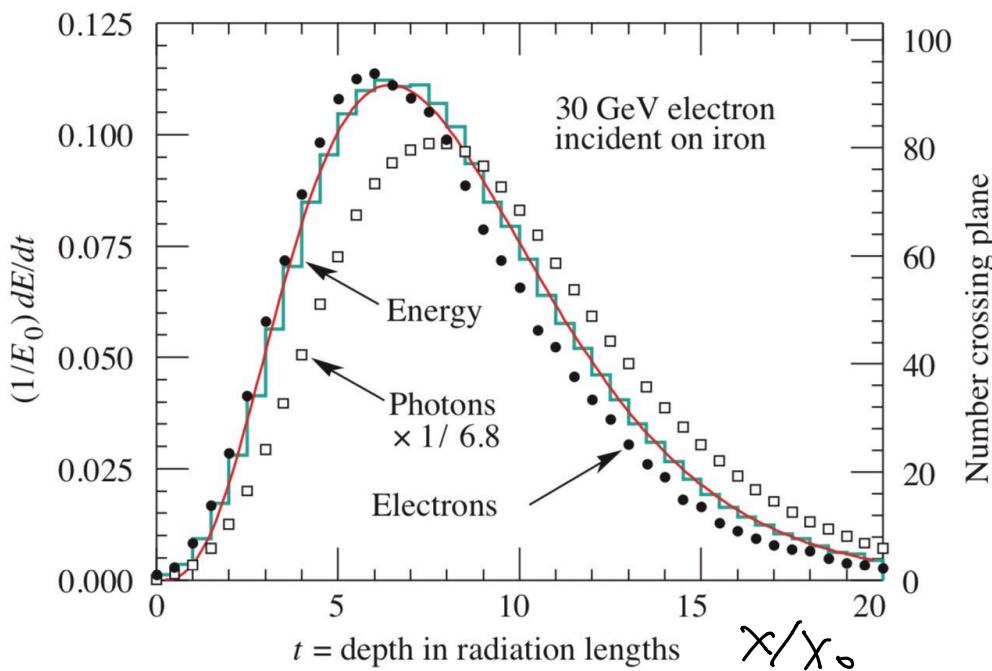
percorr. fis. dello sciamone:

$$1 - \frac{X_0}{E_C} = \frac{600 \text{ MeV}}{Z}$$



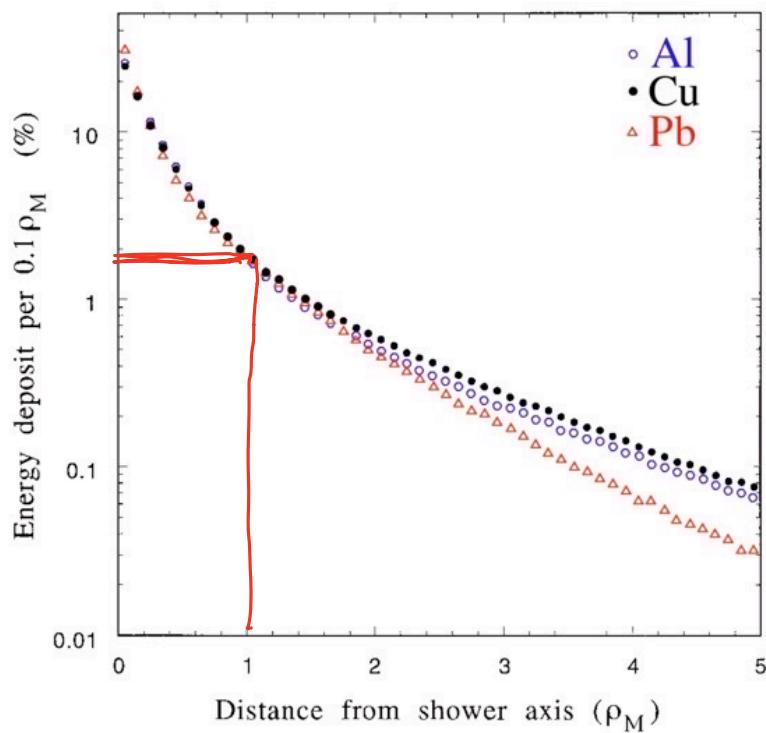
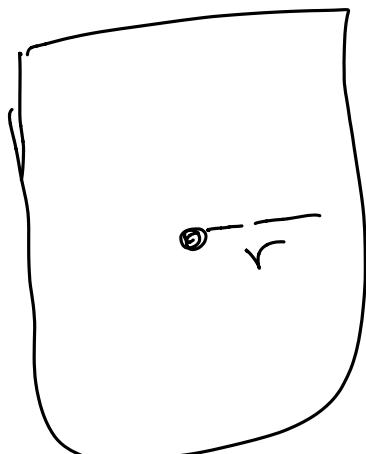
$$X_\gamma \approx \frac{9}{41} X_0$$

$$\frac{dE}{dx}$$



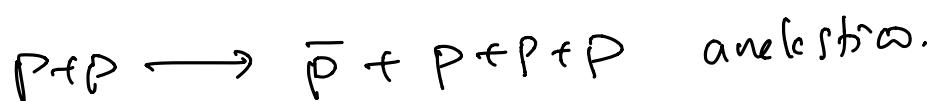
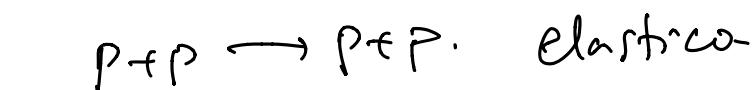
Sviluppo Rutherford: generato del rapporto di Moliere.

$$\rho_\mu = \frac{ZI}{E_c (\text{MeV})} X_0$$



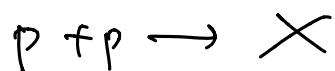
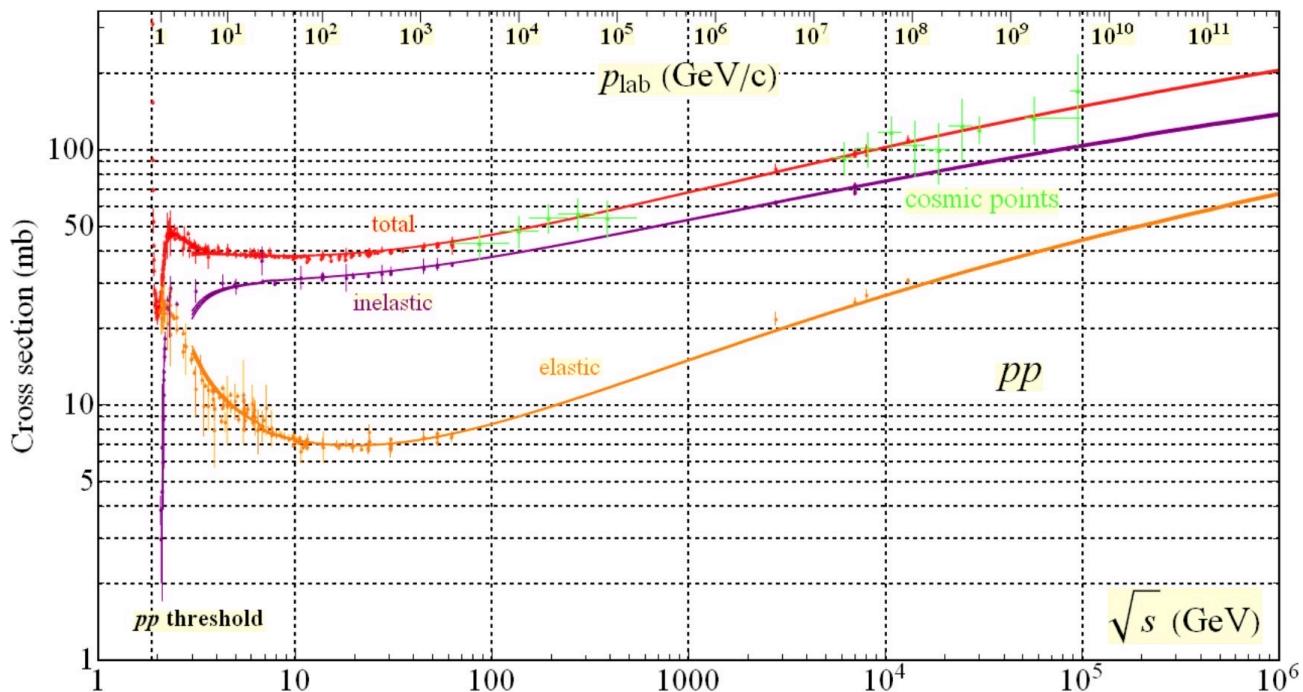
per  $r \leq \rho_\mu$  depositate 90% dell'energia.

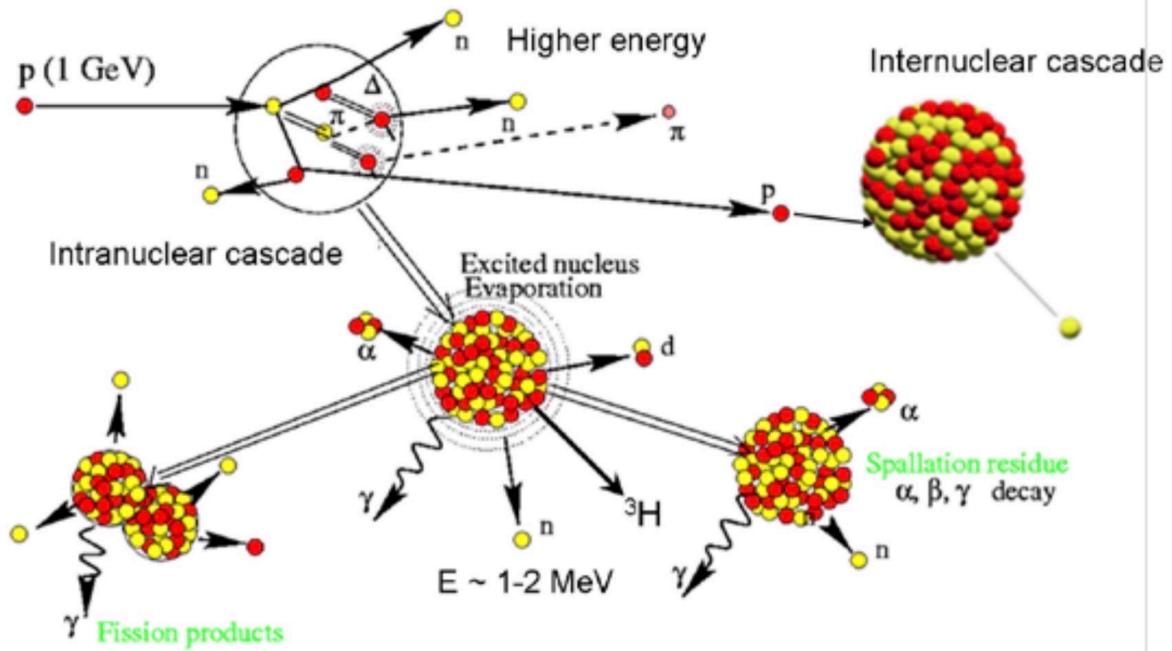
Adroni nelle materie:



Sezione d'urto nucleo:

$$\begin{aligned} A &\approx \pi R^2 = \pi (2 \text{ fm})^2 A^{2/3} \\ &\approx 3 \times 10^{-30} \text{ m}^2 A^{2/3} \\ &\approx 300 \text{ mb } A^{2/3} \end{aligned}$$





Sicure androni:  $\frac{I(x)}{I(0)} = e^{-\frac{x}{x_I}}$

$$\frac{1}{x_I} = \sigma_{\text{adron.}} \cdot n$$

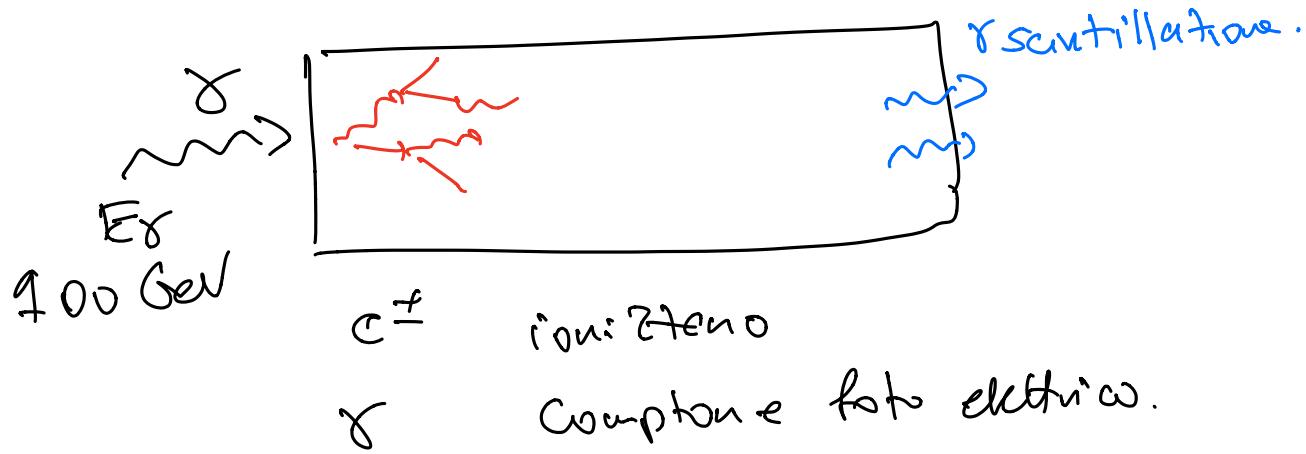
lunghezza  
d'interazione.

le dist. media fra wt. elasticici successivi:

$$\frac{1}{e} \frac{1}{x_I}$$

$\sigma_{\text{el.}} \gg \sigma_{\text{had.}}$   
 $\Rightarrow x_0 \ll x_I$

	$Z$	$A$	$\rho$	$\rho$ g/cm <sup>3</sup>	$x_0$ [cm]	$x_I$
Fe	26	56	8	8	1.8	16.8
Pb	82	207	11.3	11.3	0.6	17.6



materiali scintillanti

emissione di luce nel visibile o vicino UV.

scintillatori

organici  
artificiali.

$\tau \sim 10^{-8}$  s.

inorganici

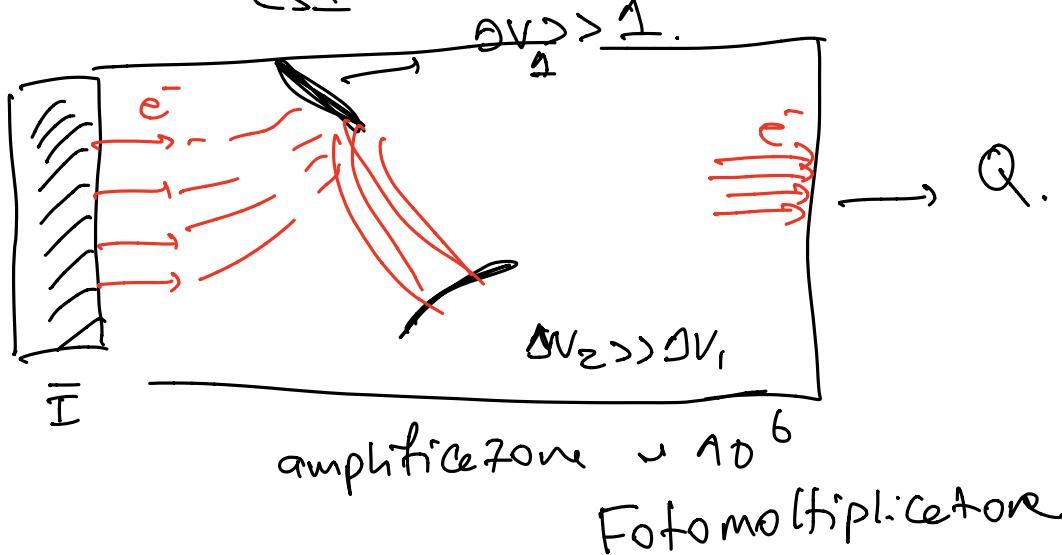
PbWO<sub>4</sub>

NaI

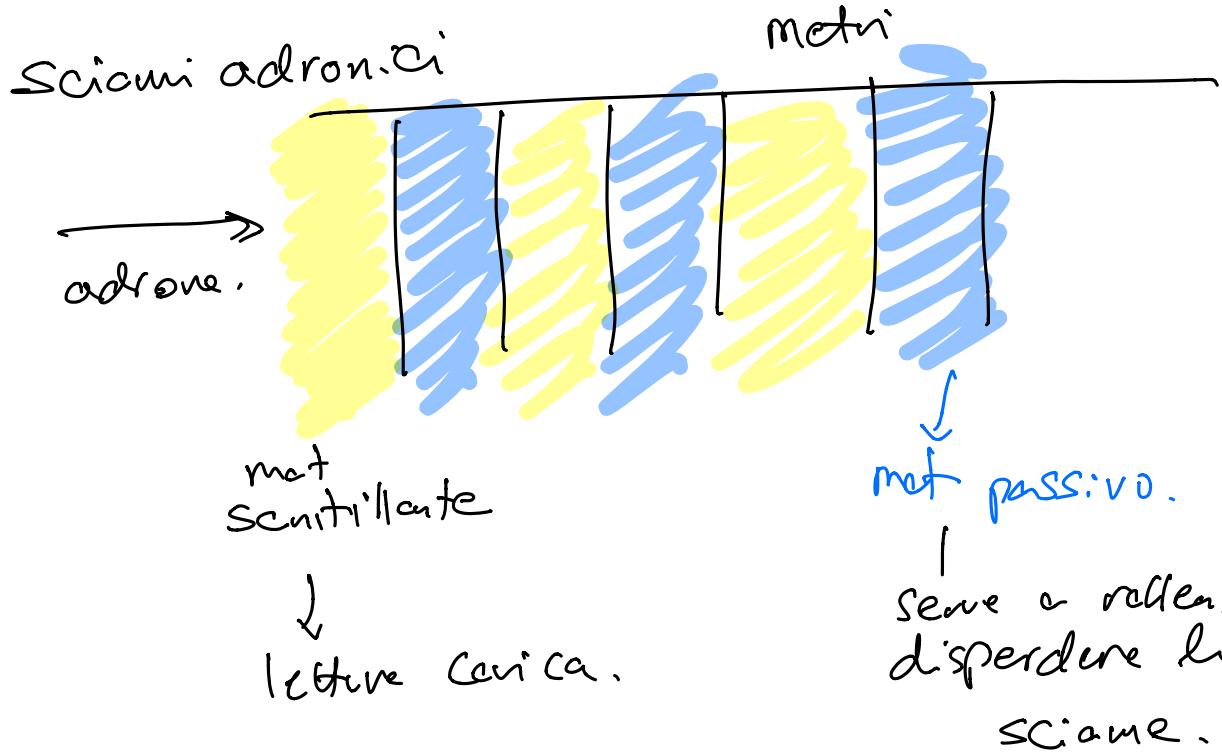
CS<sub>I</sub>

$\tau \sim 10^{-6}$  s

$\gamma$  scintillazione



Ex  $\propto$   $Q$  raccolta



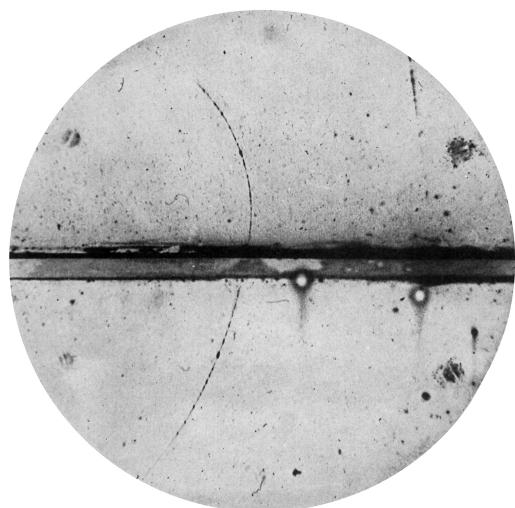
Calorimetro a Campionamento.

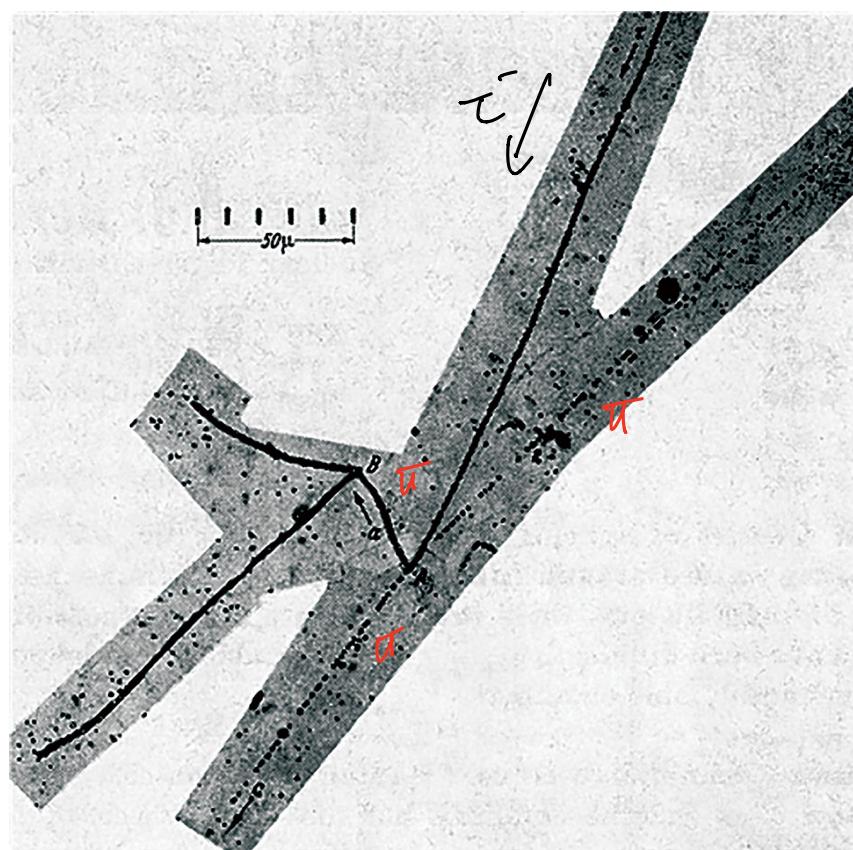
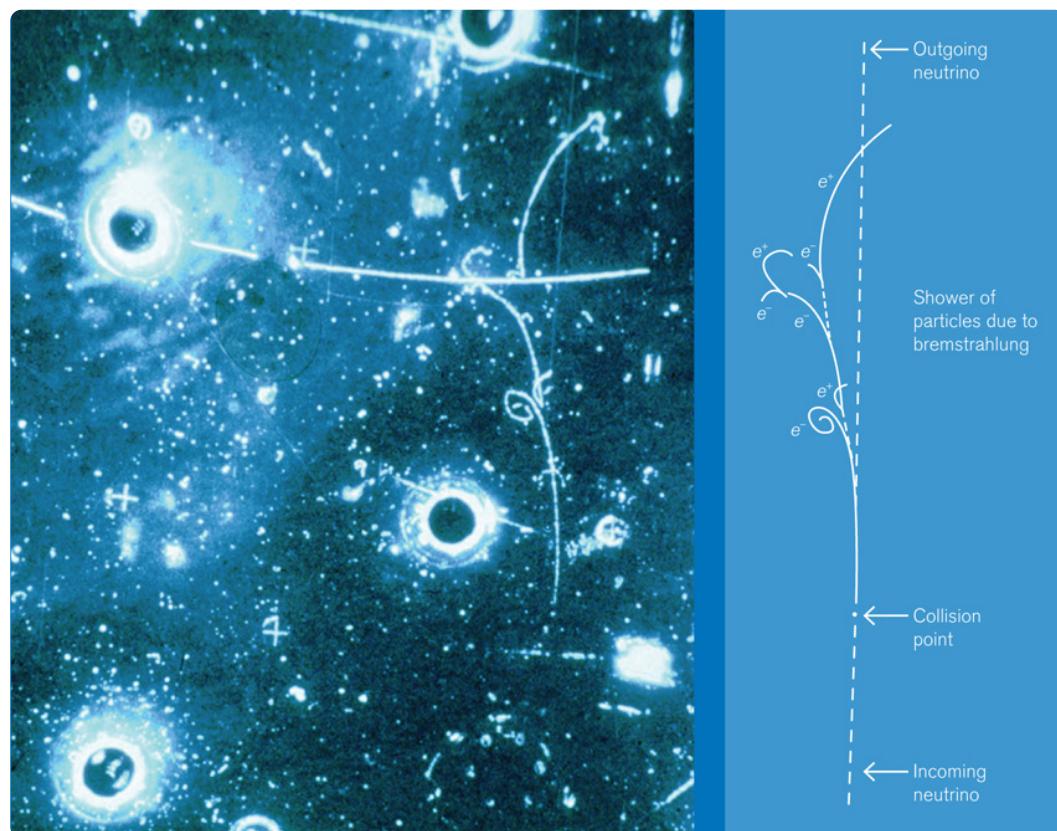
Calorimetri: misure di energia

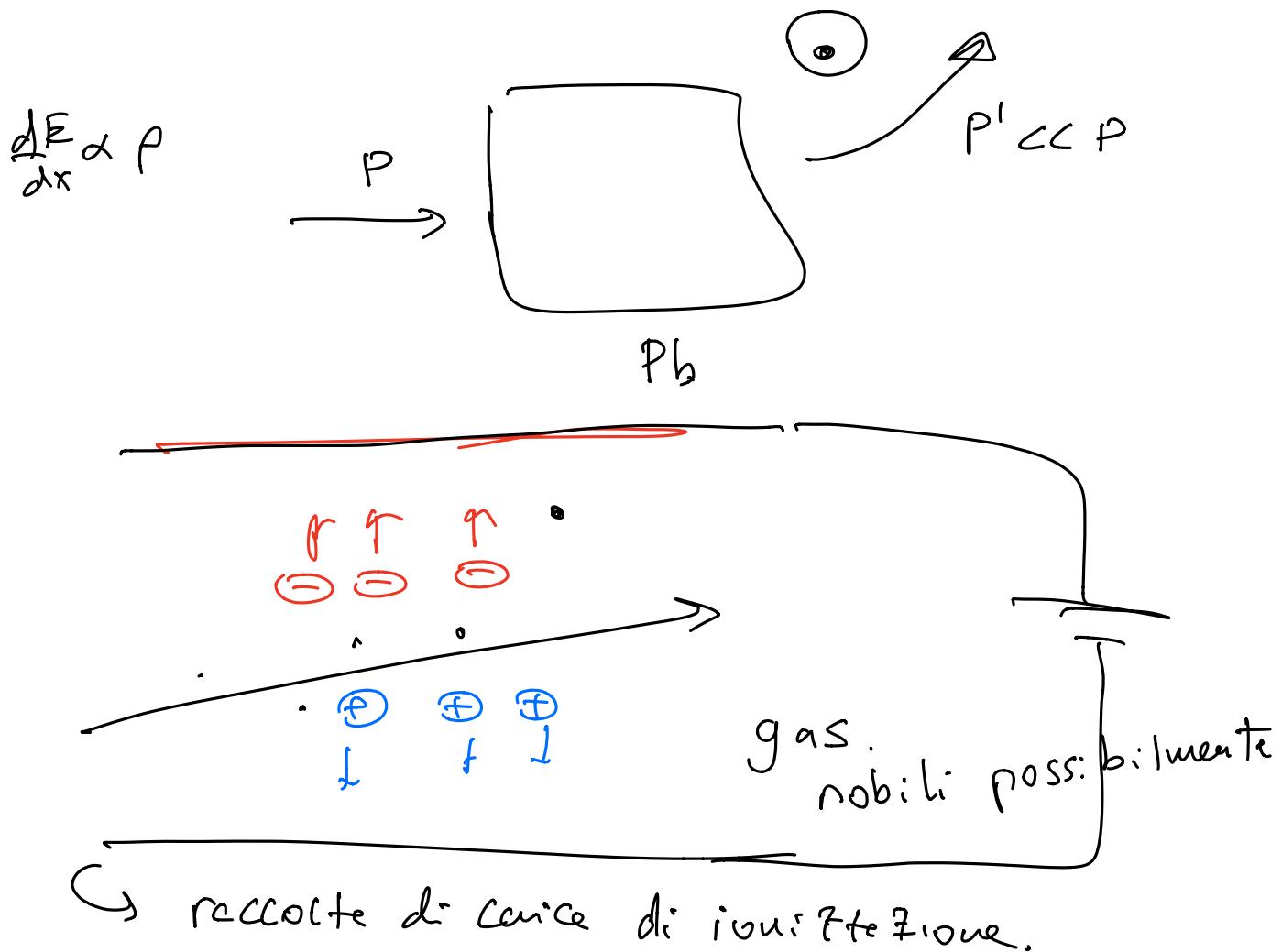
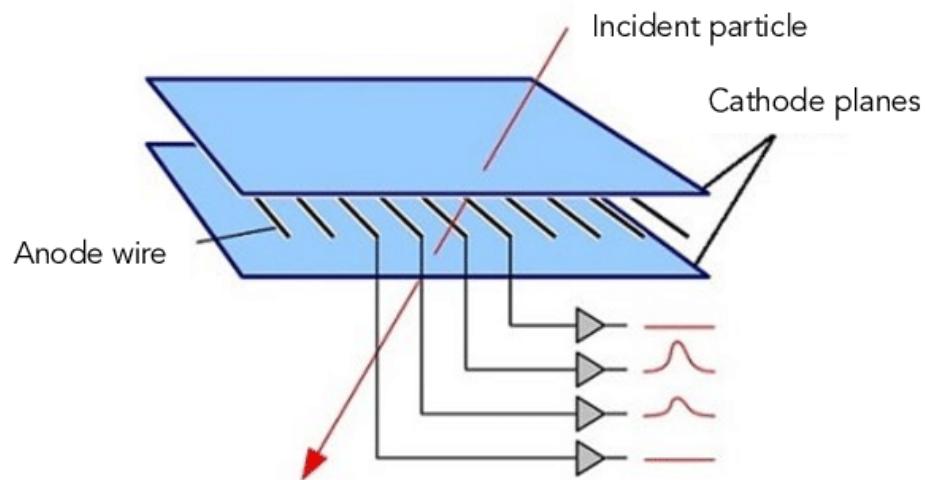
Tracciatori: misuratori di impulso.

$$P = 0.3 \times \left(\frac{q}{e}\right) \times B(T) \times R(m).$$

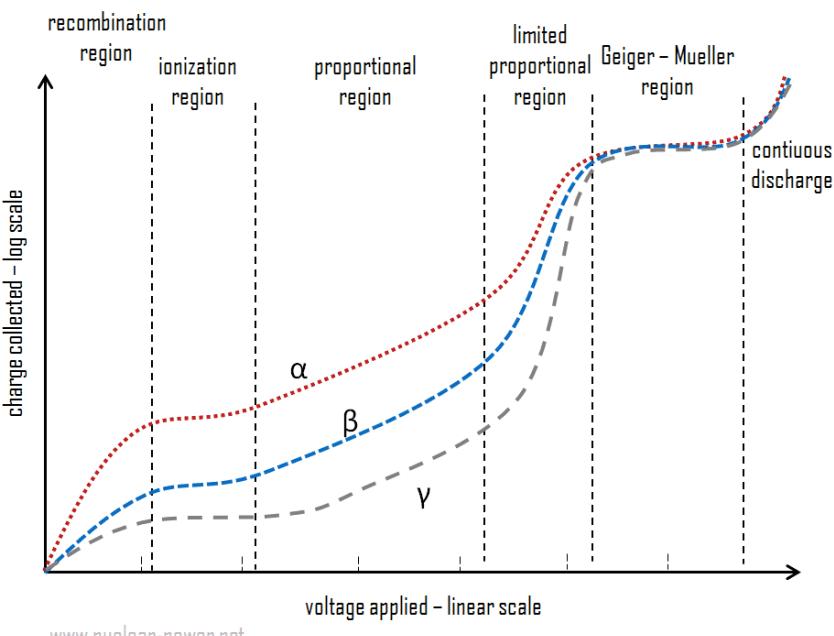
[GeV]





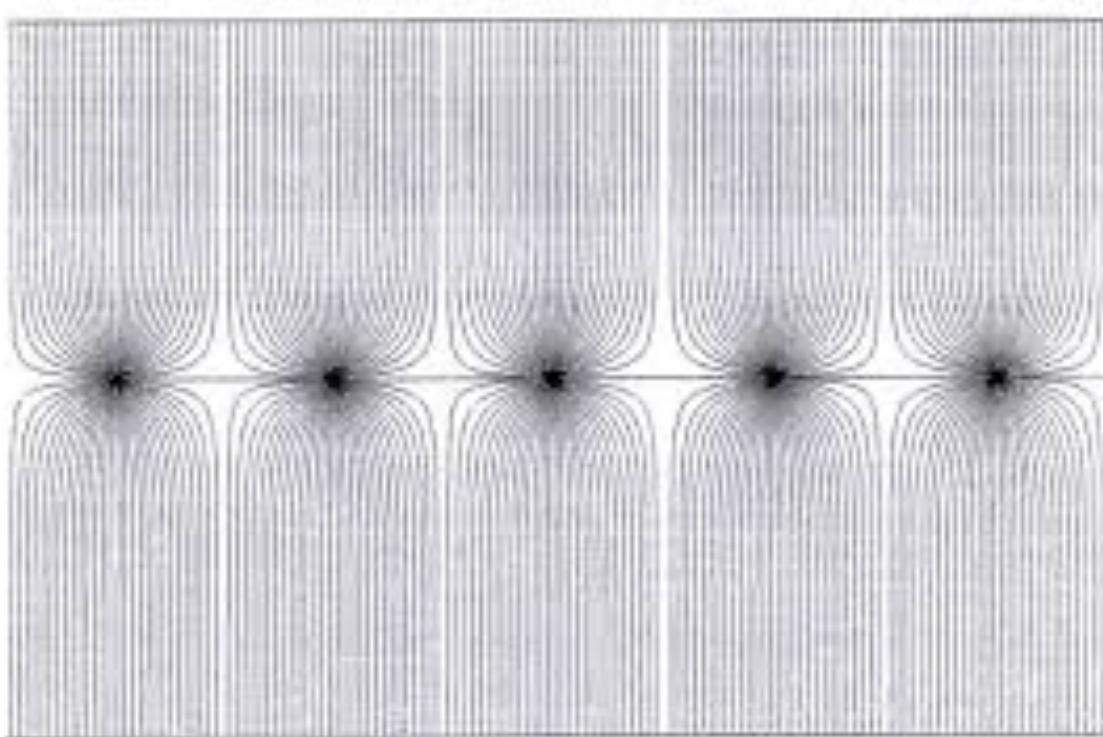


### Regions of Gaseous Ionization Detectors

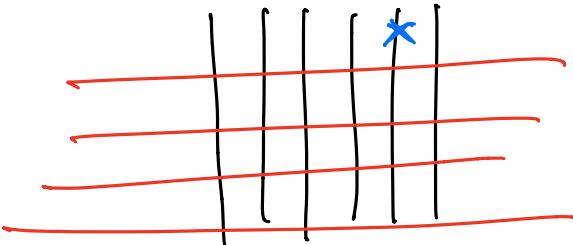


ΔV applicable  
from anode  
to cathode.

Chopak: multiwire chamber.



$H_{\text{at min}}$



$$r = \frac{l}{\sqrt{2}} = 300 \mu\text{m}$$

