Anderson + Blackett/Occhialini Discussion

(A) Who had the "better" experiment?

(1) Field: Anderson 1.7 → 2.1 T

B/O 0.3 T

"Iconic" photograph would be less so, BUT, does it matter?

⇒ look at photo, imagine $\frac{1}{5} \rightarrow \frac{1}{6}$ the curvature

or, would a 10 MeV e^+ have penetrated?

$\rho_{Pb} \sim 11$ gm/cm3

$\rho t \sim 11 \times 0.6 \sim \underline{7}$ gm/cm2

$\simeq$ 14 MeV to penetrate, no...

(2) "Trigger" A: 62/3000 ≈ 1/50 random

B/O : 80%!

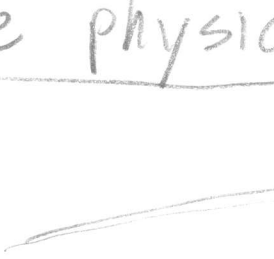
But: A's event would not have triggered B/O

(3) Complexity (B/O) vs. Simplicity (A)

(4) Knowledge (B/O) vs. Ignorance (A)

Some physics:

protons



see figure from R.P.P. 24.1

Atmosphere

earth

thickness

$P \simeq \rho g h$

$\rho h \sim \frac{P}{g}$

$\sim \frac{10^5}{10}$

$\sim 10^4 \frac{kg}{m^2} \sim 10^4 \cdot \frac{10^3}{10^4} \frac{gm}{cm^2} \sim \boxed{10^3 \ gm/cm^3}$

Do protons penetrate or sufter reactions?

$\#\,int = N\sigma\ell$ ← $\rho\ell \sim 10^3\ gm/cm^2$

$\frac{\rho}{A} N_{AV}$ $\quad \sim A^{2/3} \cdot (10^{-13})^2 cm^2$ ← $(1\ fm)^2$

$r \propto A^{1/3}$

$\frac{N_{AV}}{A} \cdot A^{2/3} \cdot 10^{-23}\ gm$

$\frac{1}{A^{1/3}} \cdot 6 \cdot 10^{23} \cdot 10^{-23}$

$\simeq 6/A^{1/3} \sim 6/14^{1/3}$

$\simeq$ 2.5 interactions!

Better: p. 110 RPP, $\lambda_T \simeq 61\ gm/cm^2$

"Nuclear Collision Lengths"

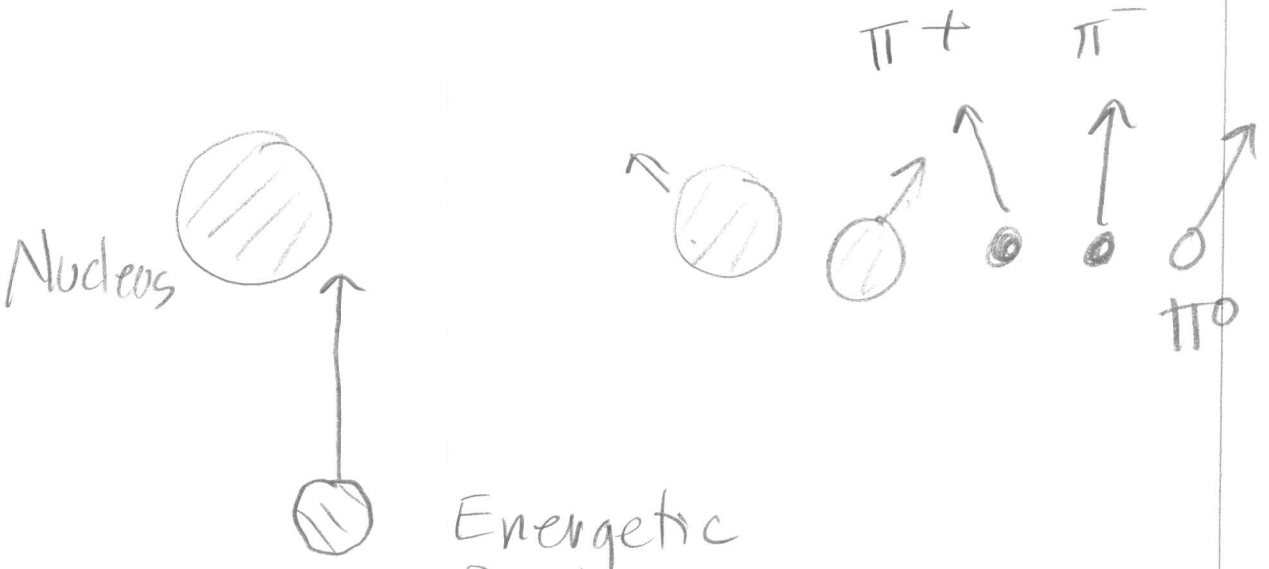
$\frac{10^3}{61} \approx$ 16 interactions

But not all collisions destroy the the proton ----

$\lambda_I \simeq 90\ gm/cm^2$ $\quad \frac{10^3}{90} \simeq$ 11 interactions.

"Nuclear Interactions" $\quad$ Whew! (might die)

What happens ?



Initial

Final

(1) More π^+ than π^- ...

P is positively charged.

(2) $\pi^0 \rightarrow \underbrace{\gamma\gamma}$

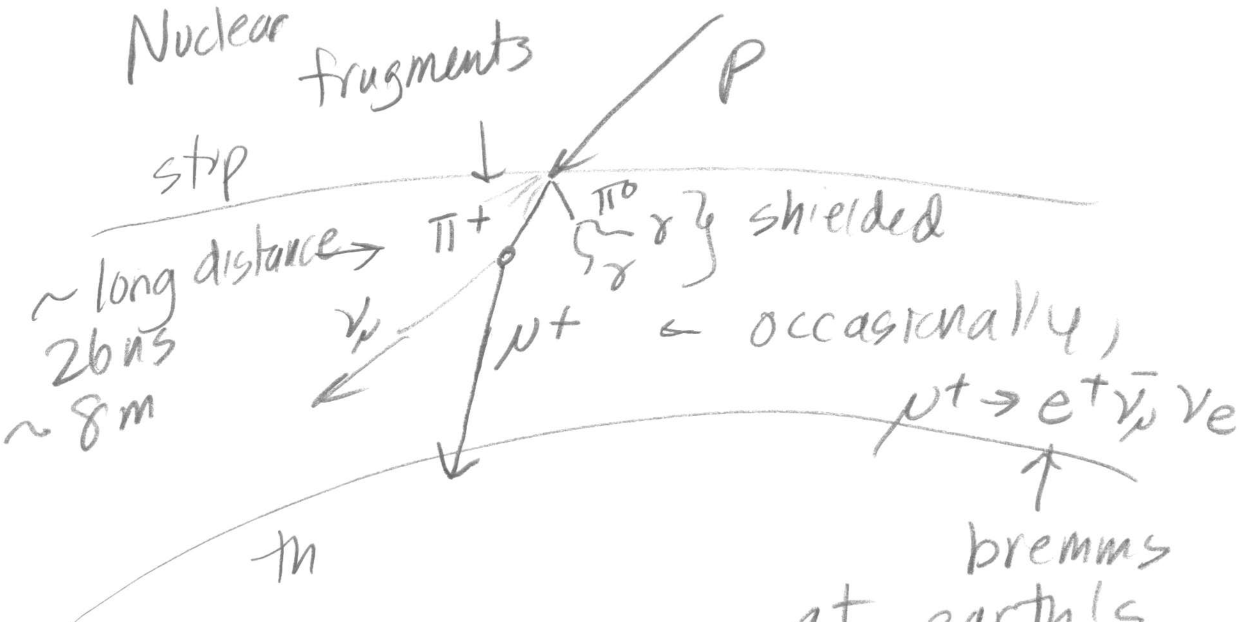
these tend to be sources of positrons.

Radiation Lengths of Atmosphere

Air : $X_0 = 37 \ \text{gm}/\text{cm}^2$

$$\frac{10^3}{X_0} \simeq 27$$

better electromagnetic shield than



at earth's surface, dominant source of γ's, e^+, e^-

Back to Anderson

$\mu^{\pm}$ discovery (at the time, could be $\pi^{\pm}$!)

→ replace Pb with Pt: $1X^{\circ} \rightarrow 3X^{\circ}$

→ introduce trigger

→ Show Photos of showers

→ not all shower, and little energy lost in plate ...

See scatter plot in "Discovery of μ"

→ Street + Stevenson get the "golden event"