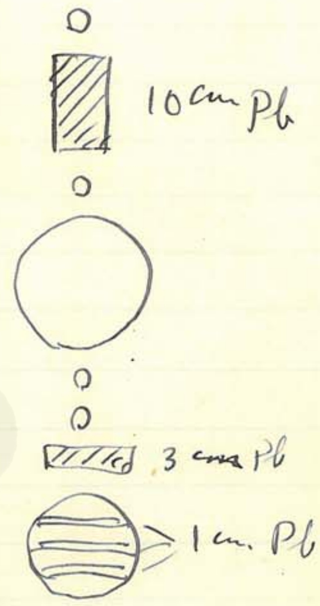
Heavy Quantum の理論と Cosmic Ray
に関する實驗結果との比較.

1) Street and Stevenson, Phys. Rev. 51, 1005, 1937.

によると,

$H\rho \times 10^{-6}$	% of Total Tracks	Fraction with Range > 3 cm Pb	Fraction with Range > 6 cm Pb
> 5	49	1.	1.
2.5 to 5	19	0.9	0.7
1.5 to 2.5	23	0.9	0.7
0.7 to 1.5	9	0.7	0.3



附記

$H\rho$ \ Kinetic energy of (in 10^6 eV)	Electron (m)	$m_u = 200\,m$ ($=10^8$ eV)	Proton (M)
10^6	300	200	50
2×10^6	600	~~190~~ 500	180
5×10^6	1,500	~~800~~ 1,400	800

Street & Stevenson に従へば proton なら $H\rho < 2.5\times10^6$ の場合 ionization density で区別が出来る筈. (實際, 2つ丈 observe された)
(全部で500程中 proton と見なしたものが)
Heavy Quantum とすると, この位の $H\rho$ では electron と区別が出来ない. Pb 中の range は

$$\int_0^E \left(-\frac{dE}{dx}\right)^{-1} dE = \frac{\quad}{N Z \phi_0 \frac{3}{4} Z^2 \frac{M}{m}}$$ (struck out)

$$-\frac{dE}{dx} = \frac{2\pi N e^4 Z}{m v^2}\left\{2\log\frac{2mv^2}{R_y(1-v^2/c^2)} - 2\frac{v^2}{c^2}\right\}$$

$$R_y = \frac{me^4}{4\pi\hbar^3} = 4.134\times10^{16}\,\mathrm{sec}^{-1}$$

~~$R_y\hbar =$~~

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宇宙線に関する磁場の研究.

$$\frac{d}{dt}(m\vec{v}) = ~~\cdot~~ - \frac{e}{c}[\vec{v}\vec{H}]$$

$$H\rho = \frac{\sqrt{E^2-(mc^2)^2}}{e} \qquad E = \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$T = E - mc^2.$$

$$H\rho = \frac{\sqrt{T(T+2mc^2)}}{e}$$

~~$(eH\rho)^2 = \frac{T(T+2mc^2)}{T+mc^2}$~~

$$E^2 = (eH\rho)^2+(mc^2)^2 \qquad E = \sqrt{(eH\rho)^2+(mc^2)^2}$$

$$mc^2 = 0.51 \text{ MEV}. \qquad T = \sqrt{(eH\rho)^2+(mc^2)^2} - mc^2.$$

$$1 \text{ EV} = 1.589 \cdot 10^{-12} \text{ erg}.$$

$$eH\rho \text{ ergs} = 300\, H\rho \cdot \text{EV} = \frac{0.3}{1000} H\rho \text{ (MEV)}$$

0.51
0.51

$m_u \cong 200m$, $m_u c^2 \cong 100$ MEV.

$H\rho$	$\sqrt{(eH\rho)^2+(mc^2)^2}-mc^2$ MEV	$\sqrt{(eH\rho)^2+(Mc^2)^2}-Mc^2$	$\sqrt{(eH\rho)^2+(m_uc^2)^2}-m_uc^2$
1,000 Gauss.cm	0.09		
10,000	2.53		
20,000	5.51		
50,000	14.50		~1,10
100,000	~~29.98~~ ~30	~0.5	~3,00
200,000	~60.	~2.0	~17.00
500,000	150.	~12.	~80,00
1,000,000 = 10^6	300.	~50.	~210,00
2×10^6	600.	~176.	~500,00
5×10^6	1,500.	~830	~1,400,
10×10^6	3,000.	~~2800~~ ~2,200	~2,900,
20×10^6	6,000.	~5,000	~5,900
50×10^6	15,000.	~15,000	~14,900

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0.51
0.51
51
0.2551
0.26.

0.3
0.3
0.09.
0.26
0.35

0.6
0.51
0.09

9
0.26
9.26

3.06
3.06
9.18
7849

3.04
3.04
3.12
1216

3.04
.51
2.53

36
0.26
36.26

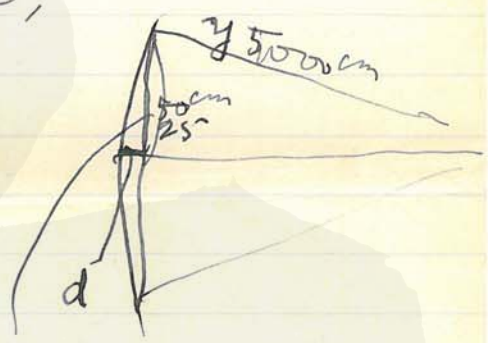
6.02
.51
5.53

25
9
225.26

15.01
15.
225.1
.51
14.50

900.
30.51

2
60.



$x^2+(y-d)^2$
$=y^2$

$x^2=2yd$

$d=\frac{x^2}{2y}=\frac{(100)^2}{2\times5000}$ cm

$=\frac{(100)^2}{4^2\times(100)^2}=\frac{1}{4^2}$ cm.

939.
939
8451
2817
8451
881721

6×10^2
360000

1840
0.5
184
920
9384

1000000
9.00
881721
225.00
939+0.5
45+212
900000
1114.4
9384
176

9
36.00
225.00
1111.44

881721
360000
1241721

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225
88172 1
3,131,721,

1770
939
830

900
88172 1
988,17,21
3143.4
938.4
2205

3600
88
3688

60729
938.4
5 | 34,5

22500
88

$\sqrt{\left(\frac{0.3}{1.000}Hp\right)^2+(100)^2}-100 = \sqrt{9\times(Hp)^2+10^4}-100$

10^4 353

10000
225
101.

10009
10

10000
900
103,0

13600
117

22500
10000
32500

180

90000
10000
100000
31

Pair Production by ~~Neutrino~~ of light and heavy Particles.

i) initial state — intermediate state — final state

A. φ_λ, ν_i → I. $\psi_\mu, \varphi_\kappa, u_j$ → E. $\psi_\mu, \varphi_\nu, \nu_k$

$\vec{p}_\lambda \varepsilon_\lambda, \vec{P}_i' E_i'$ → $\vec{p}_\mu' \varepsilon_\mu', \vec{P}_j E_j$ → $\vec{p}_\mu' \varepsilon_\mu', \vec{P}_k' E_k'$

$\vec{p}_\kappa' \varepsilon_\kappa'$, $\vec{p}_\kappa' \varepsilon_\kappa'$, $\vec{p}_\nu \varepsilon_\nu$,

$\vec{p}_\lambda + \vec{P}_i = \vec{p}_\mu + \vec{P}_k$

II. $\psi_\mu, \varphi_\nu, \nu_k$

$\vec{p}_\mu' \varepsilon_\mu', \vec{P}_k' E_k'$

$\vec{p}_\kappa' \varepsilon_\nu$,

$\lambda, \kappa, i, \mu, j, \nu, k, \ell$

(24)

(8) $\vec{p}_\lambda + \vec{P}_i' = \vec{p}_\mu' + \vec{P}_j$, $\vec{p}_\kappa' + \vec{P}_j = \vec{p}_\nu + \vec{P}_k'$

~~$\vec{P}_k' = \vec{p}_\ell'$ and $E_k' = \varepsilon_\ell'$~~

(1) $\varepsilon_\lambda + E_i' + \varepsilon_\kappa' = \varepsilon_\mu' + \varepsilon_\nu + E_\ell'$!!!

(18) (16)-indepent parameters for initial and final states, ~~neutron~~ proton state i を含めれば

(19) $= \delta(\lambda, \kappa) + \delta(\mu, \nu) + 2(E_\ell')$

$H = H_0 + g(\tau_1 \tau_3 + \tau_2 \tau_3) + V_3$ .....

$$H_{AE} = \sum_{A,I,II} \frac{H_{AI} H_{III} H_{IIF}}{(E_A - E_I)(E_A - E_{II})}$$

$$\sigma = \frac{2\pi}{\hbar} |H_{AE}|^2 \rho$$

$$\rho d\Omega_\ell = \frac{d\vec{p}_\lambda}{(2\pi\hbar c)^3} \cdot \frac{d\vec{p}_\kappa'}{(2\pi\hbar c)^3} \cdot \frac{d\vec{p}_\mu'}{(2\pi\hbar c)^3} \cdot \frac{d\vec{p}_\nu}{(2\pi\hbar c)^3} \cdot \frac{dE}{(2\pi\hbar c)} \cdot \frac{4\pi p_\ell^2 \, d\vec{p}_\ell \, d\Omega_\ell}{(2\pi\hbar c)^3 \, d\varepsilon_\ell}$$

$$e^{i\vec{k}\vec{r}} = e^{i\frac{\vec{p}\vec{r}}{\hbar}} = \frac{d\vec{k}_\lambda}{(2\pi)^3} \cdot \cdots\cdots$$

1R

$$\frac{1}{\eta\, 200\pi^4}\int_{\frac{E_n}{T}}^{\infty}\left(\frac{E_n}{T}\right)^6 \qquad E_0 = \frac{\hbar c}{\sqrt{t}}$$

$$\frac{2\pi}{\hbar c}\cdot\frac{g^4}{(2\pi\hbar c)^4}\cdot 4\pi\cdot k^{\cdots}\cdot\frac{N}{k^4}\cdot dk_x\, dk_x'\, dk_y'\, dp$$