崩壊幅

n粒子への崩壊を考える。

Sテラリは

$$|\langle f|S-1|i\rangle|^2=(2\pi)^4\lim_{\substack{t\to\infty\\V\to\infty}} tV\delta(E_f-E_i)\delta^{(3)}(\mathbb{P}_f-\mathbb{P}_i)|\langle f|T|i\rangle|^2$$

崩壊幅 = 単位時間あたりの遷移確率

⇓

$$\Gamma=(2\pi)^4\cdot V\int\frac{d^3q_1}{(2\pi)^3}\cdots V\int\frac{d^3q_n}{(2\pi)^3}\sum_{\substack{\text{final}\\\text{state}}}V\delta\left(\sum_n E_f-E\right)\delta^{(3)}\left(\sum_n q_n-\mathbb{P}\right)|\langle f|T|i\rangle|^2$$

$$=\frac{V^{n+1}}{(2\pi)^{3n-4}}\int d^3q_1\cdots\int d^3q_n\sum_{\text{spin}}\delta\left(\sum_n E_f-E\right)\delta^{(3)}\left(\sum_n q_n-\mathbb{P}\right)|\langle f|T|i\rangle|^2$$

$$=\frac{1}{(2\pi)^{3n-4}\cdot 2E}\int\frac{d^3q_1}{2E_{q_1}}\cdots\int\frac{d^3q_n}{2E_{q_n}}\delta\left(\sum_n E_f-E\right)\delta^{(3)}\left(\sum_n q_n-\mathbb{P}\right)$$

$$\times 2E_{q_1}\cdots 2E_{q_n}V^{n+1}|\langle f|T|i\rangle|^2$$

Branching ratio B の定義.

$$B=\frac{\Gamma}{\sum\Gamma}$$

total decay rate

粒子の寿命

$$\tau=\frac{1}{\sum\Gamma}=\frac{B}{\Gamma}$$