Relation of Gamma-ray and Yukawa Wave Function, Wave Equation

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ABSTRACT

Unstable atom's nucleus radiate alpha-ray, beta-ray and gamma-ray. We study the relation of Yukawa wave function (new definition from Yukawa potential) and the gamma-ray for this unstable nucleus. We make Klein-Gordon equation (is satisfied by Yukawa potential) 4-dimensional wave equation of Yukawa wave function.

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1. Introduction

Unstable atom's nucleus radiate α -ray, β -ray and γ -ray. We study the relation of Yukawa wave function from Yukawa potential) and the γ -ray for this unstable nucleus. We make Klein-Gordon equation (is satisfied by Yukawa potential) 4-dimensional wave equation of Yukawa wave function.

At first, Yakawa potential V describes nucleus's combine force in semi-classical method.

$$V = -\frac{kQ}{r}\exp(-\frac{m_{\pi}rc}{\hbar})$$

m_{π} is the meson's mass (1)

Klein-Gordon equation is satisfied by Yukawa potential V .

$$\partial_{\mu}F^{\mu\upsilon} + \frac{m^2c^2}{\hbar^2}A^{\upsilon} = -\partial_i\partial^iV + \frac{m^2c^2}{\hbar^2}V = -\nabla^2V + \frac{m_{\pi}{}^2c^2}{\hbar^2}V = 0$$

$$V = -\frac{kQ}{r}\exp(-\frac{m_{\pi}rc}{\hbar}) \quad (2)$$

2. Yukawa wave function and wave equation from Klein-Gordon equation

If we focus Klein-Gordon equation make 4-dimential partial differential equation about Yukawa potential,

$$\frac{m^2c^2}{\hbar^2}A^{\upsilon} = \frac{m_{\pi}{}^2c^2}{\hbar^2}\tilde{V} = \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\tilde{V} = \nabla^2\tilde{V} \quad (3)$$

Hence, the 4-partial differential equation do the 4-dimensional wave equation. Therefore, Yukawa potential V do Yukawa wave function $\tilde{V}$.

$$\tilde{V} = -\frac{kQ}{r}\exp[\frac{m_{\pi}c}{\hbar}i(t-\frac{r}{c})] = -\frac{kQ}{r}\exp[i\omega(t-\frac{r}{c})]$$

Frequency $\omega = \frac{m_{\pi}c}{\hbar}$, i is imaginary number (4)

Absolutely, if we calculate, Eq(3) is satisfied by Eq(4). Because Yukawa wave function $\tilde{V}$ is the complex number, we can use Yukawa wave function ϕ .

$$\phi = -\frac{kQ}{r}\sin\frac{m_{\pi}c}{\hbar}(t-\frac{r}{c}) = -\frac{kQ}{r}\sin\omega(t-\frac{r}{c}) \text{, Frequency } \omega = \frac{m_{\pi}c}{\hbar} \quad (5)$$

According to Eq(4), Yukawa wave function $\tilde{V}$ spreads in light velocity. Therefore, first, Yukawa potential is concerned to nucleus force, second, Yukawa wave function spreads in light velocity.

Hence, we think Yukawa wave function represent γ -ray of unstable nucleus..

3. Conclusion

We found Yukawa wave function is maybe γ -ray.

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