Exploration

Why i = Square Root (-1) Exists: For We Exists

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Abstract

In this paper, we ask and answer the question why in our Universe i = square root (-1) exists and how it was created at the beginning of the Universe.

Keywords: Square root, minus one, Universe, existence, beginning.

1. Overview

The existence and evolution of our Universe relies on the existence of imaginary unit *i*. In this paper, we start from our generalized Schrodinger equation define the Planck Barrier. Only when external potential is greater than Planck Barrier Universe with unit *i* is created.

In Kozlowski & Marciak-Kozłowska, (2006), generalized Schrodinger equation for Schumann wave was derived and solved as follows:

$$i\hbar\frac{\partial\Psi}{\partial t} = V\Psi - \frac{\hbar^2}{2m}\nabla^2\Psi - \tau\hbar\frac{\partial^2\Psi}{\partial t^2}. \tag{1}$$

The new term, relaxation term

$$\tau\hbar\frac{\partial^2\Psi}{\partial t^2} \tag{2}$$

describes the interaction of the particle with mass *m* with space-time. The relaxation time τ can be calculated as:

$$\tau^{-1} = \left(\tau_{e-p}^{-1} + \ldots + \tau_{Planck}^{-1}\right) \tag{3}$$

where, for example τ_{e-p} denotes the scattering of the particle m on the electron-positron pair ($\tau_{e-p} \sim 10^{-17}$ s) and the shortest relaxation time τ_{Planck} is the Planck time ($\tau_{Planck} \sim 10^{-43}$ s).

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From equation (3) we conclude that $\tau \approx \tau_{Planck}$ and equation (1) can be written as

$$i\hbar\frac{\partial\Psi}{\partial t} = V\Psi - \frac{\hbar^2}{2m}\nabla^2\Psi - \tau_{Planck}\hbar\frac{\partial^2\Psi}{\partial t^2}, \tag{4}$$

where

$$\tau_{Planck} = \frac{1}{2}\left(\frac{\hbar G}{c^5}\right)^{\frac{1}{2}} = \frac{\hbar}{2M_p c^2}. \tag{5}$$

In formula (5), M_p is the mass Planck. Considering Eq. (5), Eq. (4) can be written as

$$i\hbar\frac{\partial\Psi}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\Psi + V\Psi - \frac{\hbar^2}{2M_p}\nabla^2\Psi + \frac{\hbar^2}{2M_p}\nabla^2\Psi - \frac{\hbar^2}{2M_p c^2}\frac{\partial^2\Psi}{\partial t^2}. \tag{6}$$

The last two terms in Equation (6) can be defined as the Bohmian pilot wave

$$\frac{\hbar^2}{2M_p}\nabla^2\Psi - \frac{\hbar^2}{2M_p c^2}\frac{\partial^2\Psi}{\partial t^2} = 0, \tag{7}$$

i.e.,

$$\nabla^2\Psi - \frac{1}{c^2}\frac{\partial^2\Psi}{\partial t^2} = 0. \tag{8}$$

It is interesting to observe that pilot wave Ψ does not depend on the mass of the particle.

With postulate (8) we obtain from equation (6)

$$i\hbar\frac{\partial\Psi}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\Psi + V\Psi - \frac{\hbar^2}{2M_p}\nabla^2\Psi \tag{9}$$

and simultaneously

$$\frac{\hbar^2}{2M_p}\nabla^2\Psi - \frac{\hbar^2}{2M_p c^2}\frac{\partial^2\Psi}{\partial t^2} = 0. \tag{10}$$

In the operator form Eq., (10) can be written as

$$\hat{E} = \frac{\hat{p}^2}{2m} + \frac{1}{2M_p c^2}\hat{E}^2, \tag{11}$$

where $\hat{E}$ and $\hat{p}$ denote the operators for energy and momentum of the particle with mass m. Equation (11) is the new dispersion relation for quantum particle with mass m.

From Equation (11), one can concludes that Schrödinger quantum mechanics is valid for particles with mass m ≪ M_P. But pilot wave exists independent of the mass of the particles.

For particles with mass m ≪ M_P = neuron mass Eq. (11) has the form

$$i\hbar\frac{\partial\Psi}{\partial t}=-\frac{\hbar^2}{2m}\nabla^2\Psi+V\Psi. \tag{12}$$

In the case when $m\approx M_p$ Eq. (12) can be written as

$$i\hbar\frac{\partial\Psi}{\partial t}=-\frac{\hbar^2}{2M_p}\nabla^2\Psi+V\Psi, \tag{13}$$

but considering Eq. (13) one obtains

$$i\hbar\frac{\partial\Psi}{\partial t}=-\frac{\hbar^2}{2M_pc^2}\frac{\partial^2\Psi}{\partial t^2}+V\Psi \tag{14}$$

or

$$\frac{\hbar^2}{2M_pc^2}\frac{\partial^2\Psi}{\partial t^2}+i\hbar\frac{\partial\Psi}{\partial t}-V\Psi=0. \tag{15}$$

We argue that Equations (14) and (15) are the master equation for the brain oscillations, Ψ. It is convenient for perspective calculation to define Planck Barrier

$$Vp=Mpc^2=10^{19}\text{GeV}$$

We look for the solution of Eq. (15) in the form

$$\Psi(x,t)=e^{-i\omega}u(x). \tag{16}$$

After substitution formula (16) to Eq. (15) we obtain

$$\frac{\hbar^2}{2M_pc^2}\omega^2-\omega\hbar+V(x)=0 \tag{17}$$

with the solution

$$\omega_1=-\frac{M_pc^2+M_pc^2\sqrt{1-\frac{2V}{M_pc^2}}}{\hbar}$$
$$\omega_2=\frac{M_pc^2-M_pc^2\sqrt{1-\frac{2V}{M_pc^2}}}{\hbar} \tag{18}$$

for $\frac{M_p c^2}{2} > V$ and

$$\omega_1 = \frac{M_p c^2 + iM_p c^2 \sqrt{\frac{2V}{M_p c^2} - 1}}{\hbar}$$
$$\omega_2 = \frac{M_p c^2 - iM_p c^2 \sqrt{\frac{2V}{M_p c^2} - 1}}{\hbar} \qquad (19)$$

for , $\frac{M_p c^2}{2} < V$. V> Planck Barrier.

It is interesting to observe for the condition

$$\frac{M_p c^2}{2} < V.$$

When the potential energy is greater than Planck Barrier in created Universe, the new mode of wave is created which is marked by the new number i = square root (-1).

That number do not exist when

$$\frac{M_p c^2}{2} > V$$

I argue that only when the Planck Barrier is crossed the new number i = square root (-1) the second part of the Universe, complex part is created.

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Reference

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