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DESCRIPTION OF PHANTOM FIELD IN DE SITTER IMPULSE SPACE

***Abstract**: We are trying to give our description of this phantom field in this paper, given that the results of scientific research in the physics of the universe and elementary particles are very closely related to the laws of the micro and macro worlds. Assuming that there are two $\hbar$ -Planck constants and c - the speed of light in vacuum for all particles and fields in the universe, as well as M -fundamental mass, we consider the 5-dimensional hypersphere in the De Sitter impulse space. In 5-dimensional space, all fields have their $\Phi(x, x^5)$ wave function, which satisfies equation (3), and are divided into two functions in ordinary space:*

$$\Phi(x, x^5) \leftrightarrow \begin{pmatrix} \Phi(x, 0) \\ \dfrac{\partial\Phi(x, 0)}{\partial x^5} \end{pmatrix} \equiv \begin{pmatrix} \Phi(x) \\ \chi(x) \end{pmatrix}$$

where $\Phi(x)$ is a simple wave function in 4-dimensional space that describes free particles and has a propagator. However, $\chi(x) = \dfrac{\partial\Phi(x, 0)}{\partial x^5}$ does not describe free particles and does not have a propagator in the 4-dimensional space, only interacting. That is why we called this function a function that describes phantom fields.

***Key words**: phantom field, fundamental quantities, De Sitter impulse space, wave function.*

***Language**: English*

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Introduction

VG Kadyshevsky and R.M. Ibadov [2,3] used the hypersphere De Sitter impulse space in the creation of the theory of new quantum fields of fundamental mass.

We know that energy is dissipated by physical particles. The matter consists of particles and fields, more precisely only quantum fields. In English physics, it was accepted that matter is only fermions, and the bases carrying the interaction are fields. So it turns out that 95% of the universe's matter is not yet clear to science. Scientists are doing a lot of research to describe this black energy and black mass. Most scientists associate these processes with the matter, which in turn is called “Phantom matter”, “Phantom Field”. But the properties of this phantom matter (field) have not been determined yet.

DESCRIPTION OF THE PHANTOM FIELD IN THE 5-DIMENSIONAL DE SITTER SPACE

According to Einstein's General Theory of Relativity (GTR) [1] the space-time in which we live has a curvature, and gravity is a manifestation of this curvature. The matter "occupies" the space around it. This bending depends on the density of the matter, the higher the density, the stronger the bending. Given that the results of scientific research in the physics of the universe and elementary particles are very closely related to the laws of the micro and macro worlds, we will try to describe this phantom field in this paper. In this case, we assume that [2,3] for all particles and areas in the universe there are two $\hbar$-Planck constants and c-the speed of light in vacuum, as well as fundamental quantities M -fundamental mass, the 5-dimensional hypersphere De Sitter impulse meditate in space. The de Sitter impulse space has two constant curvature radii:

$$p_0^2 - p_1^2 - p_2^2 - p_3^2 + p_5^2 = g^{KL} p_K p_L = M^2 \quad (1)$$

(positive curvature:

$$g^{00} = -g^{11} = -g^{22} = -g^{33} = g^{55} = 1)$$

$$p_0^2 - p_1^2 - p_2^2 - p_3^2 - p_5^2 = g^{KL} p_K p_L = -M^2 \quad (2)$$

(negative curvature:

$$g^{00} = -g^{11} = -g^{22} = -g^{33} = -g^{55} = 1)$$

here $K, L = 0,1,2,3,4,5$, M parameter is taken as the parameter "fundamental mass", $l = \frac{\hbar}{Mc}$ "fundamental length".

Substituting the quantum operators $p_\mu = i\hbar \frac{\partial}{\partial x^\mu}$ and $p_5 = i\hbar \frac{\partial}{\partial x^5}$ versions into the De-Sitter equation (2) gives the following 5-dimensional field equation:

$$\left[\frac{\partial^2}{\partial x^\mu \partial x_\mu} - \frac{\partial^2}{\partial x_5^2} - \frac{M^2 c^2}{\hbar^2} \right] \Phi\left(x^\mu, x^5\right) = 0 \quad (3)$$

$$\mu = 0,1,2,3$$

we called the fundamental equation (3) because we have written three fundamental parameters $\hbar$, c and M using one fundamental length parameter $l = \frac{\hbar}{Mc}$. All fields whose denominator dimensions are optional are subject to this equation. Here 5-dimensional $\Phi\left(x^\mu, x^5\right) = \Phi\left(x, x^5\right)$ wave function is suitable for scalar, spinor, vector and Tensor fields, respectively $\varphi\left(x, x^5\right)$, $\psi\left(x, x^5\right)$, $A_\mu\left(x, x^5\right)$ and $B_{\mu\ldots\rho}\left(x, x^5\right)$, have the appearance. The M parameter can also be very close to the Planck mass $M_P = \sqrt{\frac{\hbar c}{k}} \approx 10^{19} GeV$. For this reason, this field theory can also include quantum gravity in general. (3) In the solution of the fundamental equation, forming a class of functions $\Phi\left(p, 0\right)$ and $\frac{\partial \Phi\left(p, 0\right)}{\partial x^5}$, the Cauchy problem for the fundamental equation is correct for the variable x^5:

$$\begin{cases} \left[\frac{\partial^2}{\partial x^\mu \partial x_\mu} - \frac{\partial^2}{\partial x_5^2} - \frac{M^2 c^2}{\hbar^2} \right] \Phi\left(x^\mu, x^5\right) = 0 \\ \Phi\left(x^\mu, x^5\right)\Big|_{x^5=0} = \frac{1}{(2\pi)^{3/2}} \int e^{-ipx} \Phi\left(p, 0\right) d^4 p \\ \frac{\Phi\left(x^\mu, x^5\right)}{\partial x^5}\Bigg|_{x^5=0} = \frac{1}{(2\pi)^{3/2}} \int e^{-ipx} \frac{\Phi\left(p, 0\right)}{\partial x^5} d^4 p \end{cases} \quad (4)$$

In order to p, $p_n^2 = M^2$ outside the sphere $\Phi\left(p, 0\right)$ and $\frac{\partial \Phi\left(p, 0\right)}{\partial x^5}$ from the initial conditions for the Cauchy problem to be correct requires them to be exsponentially extinct. $\Phi\left(x, 0\right)$ and $\frac{\partial \Phi\left(x, 0\right)}{\partial x^5}$ Cauchy conditions are field functions in a four-dimensional space-time. So, in 5-dimensional space, all the fields (3) have their $\Phi\left(x, x^5\right)$ wave function, which satisfies the equation, and in ordinary space divides into two functions:

$$\Phi\left(x,\, x^5\right) \leftrightarrow \begin{pmatrix} \Phi(x,\,0) \\ \dfrac{\partial\Phi(x,\,0)}{\partial x^5} \end{pmatrix} \equiv \begin{pmatrix} \Phi(x) \\ \chi(x) \end{pmatrix} \qquad (5)$$

where $\Phi(x)$ is a simple wave function in 4-dimensional space that describes free particles and has a propagator. However, $\chi(x) = \dfrac{\partial\Phi(x,\,0)}{\partial x^5}$ in 4-dimensional space, only participating in interaction does not characterize free particles and does not have propagator. That is why we called this function a function that describes phantom fields. The function of these phantom fields is manifested only in their interaction with ordinary fields. The division of the field function disappears at $M \to \infty$. That is, if the fundamental mass M in our description does not exist in nature, then the phantom field $\chi(x) = \dfrac{\partial\Phi(x,\,0)}{\partial x^5}$ would not exist.

So let the initial values satisfy the Lagrange equation of motion, due to the stationary conditions of the effect:

$$S = \int d^4x L\left(\Phi(x,\,0),\, \frac{\partial\Phi(x,\,0)}{\partial x^5}\right) \qquad (6)$$

According to our description, the full-effect integral in the 5-dimensional configuration space for the Dirac (spinor) free space is as follows:

$$S = \frac{1}{2}\int d^4x \left\{ \bar\Phi\left(x,\, x^5\right)\left(i\hat\partial + M\right)\left(\frac{-i}{M}\frac{\partial}{\partial x^5}\Phi\left(x,\, x^5\right)\right) + \right.$$

$$+\left(\overline{\frac{-i}{M}\frac{\partial}{\partial x^5}\Phi\left(x,\, x^5\right)}\right)\left(i\hat\partial + M\right)\Phi\left(x,\, x^5\right) +$$

$$\left. +\left(\overline{\frac{-i}{M}\frac{\partial}{\partial x^5}\Phi\left(x,\, x^5\right)}\right)\left(\frac{-i}{M}\frac{\partial}{\partial x^5}\Phi\left(x,\, x^5\right)\right) - \bar\Phi\left(x,\, x^5\right)\left(M + \frac{\left(i\hat\partial\right)^2}{M^2}\right)\bar\Phi\left(x,\, x^5\right) \right\} \qquad (7)$$

where $\Phi\left(x,\, x^5\right)$ is the spinor field satisfying the fundamental equation (3). Based on (5), $\Phi(x,\,0) \equiv \Phi(x)$ and $\dfrac{-i}{M}\dfrac{\partial}{\partial x^5}\Phi(x,\,0) \equiv \chi(x)$. As a result, we describe $\chi(x)$ as a phantom field.

CONCLUSION

Hence, assuming that for all particles and fields in the universe there are two $\hbar$-Planck constant and c –the speed of light in a vacuum, as well as M – fundamental mass, we form a 5-dimensional field equation in the 5-dimensional hypersphere De Sitter impulse space:

$$\left[\frac{\partial^2}{\partial x^\mu \partial x_\mu} - \frac{\partial^2}{\partial x_5^2} - \frac{M^2c^2}{\hbar^2}\right]\Phi\left(x^\mu,\, x^5\right) = 0.$$

It follows that all fields in a 5-dimensional space are characterized by the wave function $\Phi\left(x^\mu,\, x^5\right)$. In turn, this wave function is divided into two parts: $\Phi\left(x^\mu,\, x^5\right) \leftrightarrow \begin{pmatrix} \Phi(x) \\ \chi(x) \end{pmatrix}$. In this case, $\chi(x)$ is a function that describes the phantom field.

Another important conclusion is that without the fundamental mass M, the $\chi(x)$ phantom field would not exist.

Considering this phantom matter in the Einstein effect integral written for gravity, it has been proven that new physical processes can lead to "black holes" and "wormholes" [4,5].

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