Ghost spinors, shadow electrons and the Deutsch Multiverse

Elena V. Palesheva

Department of Mathematics, Omsk State University
644077 Omsk-77 RUSSIA

E-mail: m82palesheva@math.omsu.omskreg.ru

July 28, 2001

ABSTRACT

In this article a new solution of the Einstein-Dirac’s equations is presented. There are ghost spinors, i.e. the stress-energy tensor is equal to zero and the current of these fields is non-zero vector. Last the ghost neutrino was found. These ghost spinors and shadow particles of Deutsch are identified. And in result the ghost spinors have a physical interpretation and solutions of the field equations for shadow electrons as another shadow particles are found.
Introduction

If in General theory of relativity the right parts of the Einstein’s equations without cosmological constant are equal to zero then one speaks about empty space, or the space is empty if matter is absence. But appears a question: if a gravitational field is generated by the matter whence it appears when matter disappears? This answer is simple: this is because required to distinguish such two at first thought interchangeables each other concepts as substance and matter. Matter generates given structure of World. Herewith the matter is not obliged to have any energy that it occurs when the stress-energy tensor equal to zero. Presence of substance is on the contrary characterized by the non-zero stress-energy tensor. The actual example of matter, which in our world shows the object with zero energy and momentum, i.e. in introduced terminology it is not a substance, serves the neutrino’s ghost. About their existence we can be to speak in light of received our results and results of other authors [2, 3, 4, 5].

The world which surround us holds the ensemble of riddles, and we all time want to understand the nature of space, in which we are living. So and David Deutsch [1] makes an attempt logically to explain the phenomenon of an inter ference of quantum particles and comes to a conclusion about existence of the parallel worlds, in all set representing Multiverse [1]. More precisely speaking, the assumption of presence in our spacetime of the shadow photons, which identified by him with photons of other universe, one results him in the completed ground of observed intererential picture. But generally in this case the shadow particles have property of objects with zero stress-energy tensor – it is directly follows from the put experiences – and consequently their existence should be physically is proved. The results which are discribed in this article, namely the parallel between quantum particles ghost and corresponding shadow particles, give such ground. Some times ago the corresponding to the ghost neutrinos solutions of the Einstein-Dirac’s equations in cases plane-symmetric spacetimes [2, 3], cyclindrically-symmetric spacetimes [3], and so in case of wave gravitational field [4] were found. Herewith spacetime is curved. In [4] additionally it is showed the existence of the ghost neutrinos in a flat spacetime. The spacetime in this article also is flat.
The description of spacetime geometry and corresponding spinor fields

We consider the Einstein-Dirac’s equations

\[
\begin{cases}
    R_{ik} - \frac{1}{2} g_{ik} R = \kappa T_{ik} \\
    i \hbar \gamma^k \left( \frac{\partial \psi}{\partial x^k} - \Gamma_k \psi \right) - mc \psi = 0,
\end{cases}
\]

(1)

where

\[
T_{ik} = \frac{i \hbar c}{4} \left\{ \psi^* \gamma^{(0)} \gamma_i \left( \frac{\partial \psi}{\partial x^k} - \Gamma_k \psi \right) - \left( \frac{\partial \psi^*}{\partial x^k} \gamma^{(0)} + \psi^* \gamma^{(0)} \Gamma_k \right) \gamma_i \psi + \right.
\]

\[
\left. + \psi^* \gamma^{(0)} \gamma_k \left( \frac{\partial \psi}{\partial x^i} - \Gamma_i \psi \right) - \left( \frac{\partial \psi^*}{\partial x^i} \gamma^{(0)} + \psi^* \gamma^{(0)} \Gamma_i \right) \gamma_k \psi \right\}.
\]

(2)

Here \( \psi \) is a bispinor, symbol * means the Hermite conjugation.

Spacetime geometry are discribed by flat metric

\[
ds^2 = dx^0^2 + 2e^x^0 dx^0 dx^3 - dx^1^2 - dx^2^2.
\]

(3)

So Riemann tensor \( R^i_{klm} \) is zero and the left part of the Einstein’s equations also equal to zero. Owing to the above we receive zero spinor matter stress-energy tensor \( T_{ik} \).

In our formulas

\[
\Gamma_k = \frac{1}{4} g_{ml} \left( \frac{\partial \lambda^i}{\partial x^k} \lambda_l^i - \Gamma^i_{rk} \right) s^{mr},
\]

\[
s^{mr} = \frac{1}{2} \left( \gamma^m \gamma^r - \gamma^r \gamma^m \right), \quad \gamma^k \equiv \lambda^k_{(i)} \gamma^{(i)},
\]

where \( \lambda^k_{(i)} \) – i-vector of tetrad, \( \gamma^{(i)} \) – matrices of Dirac, for which we have the next presentation with matrices of Pauli

\[
\gamma^{(0)} = \begin{bmatrix} I & 0 \\ 0 & -I \end{bmatrix}, \quad \gamma^{(\alpha)} = \begin{bmatrix} 0 & \sigma_\alpha \\ -\sigma_\alpha & 0 \end{bmatrix},
\]

\[
\sigma_1 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}, \quad \sigma_2 = \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}, \quad \sigma_3 = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}, \quad I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}.
\]
Metric tensor of spacetime can be expressed by vector’s tetrade in the following form [6, c.373]:

\[ ds^2 = \eta_{ab}(\lambda^a dx^i)(\lambda^b dx^k). \]

In this case we have

\[ \eta_{ab} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{bmatrix}. \]

Then for gravitational field (3)

\[ \lambda^{(0)}_i = (1, 0, 0, e^{x^0}), \quad \lambda^{(0)}_i = (1, 0, 0, 0), \]
\[ \lambda^{(1)}_i = (0, 1, 0, 0), \quad \lambda^{(1)}_i = (0, 1, 0, 0), \]
\[ \lambda^{(2)}_i = (0, 0, 1, 0), \quad \lambda^{(2)}_i = (0, 0, 1, 0), \]
\[ \lambda^{(3)}_i = (0, 0, 0, e^{x^0}), \quad \lambda^{(3)}_i = (-1, 0, 0, e^{-x^0}). \]

Then \( \Gamma_1 = \Gamma_2 = \Gamma_3 = 0 \) and

\[ \Gamma_0 = \frac{1}{2} \begin{bmatrix} 0 & \sigma_3 \\ \sigma_3 & 0 \end{bmatrix}. \]

2 The Ghostes

2.1 The ghost neutrinos

In this section we will consider a neutrino, i.e. in the Dirac equation (1) we must take \( m = 0 \). Herewith let us expect, that

\[ \frac{\partial \psi}{\partial x^i} = \frac{\partial \psi}{\partial x^j} = \frac{\partial \psi}{\partial x^k} = 0, \quad \frac{\partial \psi}{\partial x^a} = \alpha \psi, \]

where \( \alpha \) is a real constant. For example, the bispinor

\[ \psi = \begin{bmatrix} u_0 \\ u_1 \\ u_2 \\ u_3 \end{bmatrix} e^{ax^0+\beta} \]  (4)
satisfies this conditions, where \( u_i, \beta \) are complex constants. Then the Dirac equation (1) in our case equivalent to

\[
\begin{bmatrix}
I & -\sigma_3 \\
\sigma_3 & -I
\end{bmatrix} \psi = 0.
\]

Hereinafter we have

\[ u_0 = u_2, \quad u_1 = -u_3. \tag{5} \]

For stress-energy tensor (2) by considering the restrictions on spinor field \( \psi \) we get

\[
T_{00} = -\frac{ihc}{2} \alpha \psi^* \gamma^0 \{ \gamma_0 \Gamma_0 + \Gamma_0 \gamma_0 \} \psi
\]

\[
T_{01} = -\frac{ihc}{4} \alpha \psi^* \gamma^0 \{ \gamma_1 \Gamma_0 + \Gamma_0 \gamma_1 \} \psi
\]

\[
T_{02} = -\frac{ihc}{4} \alpha \psi^* \gamma^0 \{ \gamma_2 \Gamma_0 + \Gamma_0 \gamma_2 \} \psi
\]

\[
T_{03} = -\frac{ihc}{4} \alpha \psi^* \gamma^0 \{ \gamma_3 \Gamma_0 + \Gamma_0 \gamma_3 \} \psi
\]

\[
T_{11} = T_{12} = T_{13} = T_{22} = T_{23} = T_{33} = 0.
\]

And after some transformations

\[
T_{00} = T_{03} = 0
\]

\[
T_{01} = -\frac{ihc}{4} \alpha \left( \bar{u}_0 \bar{u}_1, \bar{u}_2, \bar{u}_3 \right) \left[ -i \sigma_2 \quad 0 \\
0 \quad i \sigma_2 \right] \psi
\]

\[
T_{02} = -\frac{ihc}{4} \alpha \left( \bar{u}_0 \bar{u}_1, \bar{u}_2, \bar{u}_3 \right) \left[ -i \sigma_1 \quad 0 \\
0 \quad i \sigma_1 \right] \psi. \tag{6}
\]

In result by using (5) we insert (4) in (6) and then \( T_{01} = T_{02} = 0. \)

And finally we receive that \( T_{ik} \equiv 0 \), i.e. we find a solution of the Einstein-Dirac's equation corresponding to ghost neutrinos as the current which as known calculated by formula:

\[
j^{(k)} = \lambda_i^{(k)} \psi^* \gamma^0 \gamma^i \psi, \tag{7}
\]

is non-zero:

\[
j^{(k)} = \left( 2(u_0^2 + u_2^2)e^{2\alpha x^0 + 2\beta}, 0, 0, 2(u_0^2 + u_1^2)e^{2\alpha x^0 + 2\beta} \right).
\]
2.2 The ghost spinors

As \( \Gamma_1 = \Gamma_2 = \Gamma_3 = 0 \) then Dirac’s equation takes the following form

\[
\frac{i \hbar}{\gamma^k \frac{\partial \psi}{\partial x^k} - \gamma^0 \Gamma_0 \psi} - mc \psi = 0, \tag{8}
\]

After some transformation we get

\[
\begin{bmatrix}
I & -\sigma_3 & \frac{\partial \psi}{\partial x^0} \\
\sigma_3 & -I & 0 \\
-\sigma_3 & 0 & \frac{\partial \psi}{\partial x^1} \\
\end{bmatrix} + \begin{bmatrix}
0 & \sigma_1 & \frac{\partial \psi}{\partial x^2} - e^{-x_0} \\
-\sigma_2 & 0 & \sigma_3 \\
-\sigma_3 & \sigma_2 & 0 \\
\end{bmatrix} \begin{bmatrix} 0 & 0 \\
0 & -\sigma_3 & 0 \\
\end{bmatrix} \frac{\partial \psi}{\partial x^3}
\]

Then after non-difficult calculations we have

\[
\begin{cases}
\partial u_{3,1} + u_{1,1} - i(u_{3,2} + u_{1,2}) + e^{-x_0}(u_{2,3} + u_{1,3}) = -\frac{imc}{\hbar} (u_0 - u_2) \\
u_{0,0} - u_{2,0} + iu_{1,2} - u_{1,1} - e^{-x_0}u_{1,3} + \frac{1}{2}u_0 - \frac{1}{2}u_2 = -i \frac{mc}{\hbar} u_2 \\
u_{2,1} - u_{0,1} + i(u_{2,2} - u_{0,2}) - e^{-x_0}(u_{3,3} - u_{0,3}) = -i \frac{mc}{\hbar} (u_1 + u_3) \\
u_{1,0} - u_{3,0} - iu_{0,2} - u_{0,1} + e^{-x_0}u_{0,3} - \frac{1}{2}u_1 - \frac{1}{2}u_3 = -\frac{mc}{\hbar} u_3
\end{cases}
\]

where \( u_{i,k} \) is a partial derivation with respect to \( x^k \). Now let us assume that \( u_0 = u_2, u_1 = -u_3 \). Then we have only following restrictions

\[
\begin{cases}
(u_2 + u_1)_3 = 0 \\
-u_{1,1} + iu_{1,2} - e^{-x_0}u_{1,3} = -i \frac{mc}{\hbar} u_2 \\
(u_3 - u_0)_3 = 0 \\
-u_{0,1} - iu_{0,2} + e^{-x_0}u_{0,3} = -i \frac{mc}{\hbar} u_3
\end{cases}
\]

Besides this let us take the following condition: \( u_0 = -u_1 = u_2 = u_3 = u \). And we find

\[
\begin{cases}
\frac{\partial u}{\partial x^i} = 0 \\
-\frac{i}{\hbar} \frac{\partial u}{\partial x^2} + \frac{e^{-x_0}}{\hbar} \frac{\partial u}{\partial x^3} = -i \frac{mc}{\hbar} u
\end{cases}
\]

Let \( \frac{\partial u}{\partial x^3} = 0 \). Then

\[
\frac{\partial u}{\partial x^2} = \frac{mc}{\hbar} u,
\]
and $\partial u / \partial x^0$ is free. Herewith
\[
  u = \exp \left( \frac{mc}{\hbar} x^2 + \alpha(x^0) \right),
\]
or in more general form
\[
  \psi = \begin{bmatrix}
    1 \\
    -1 \\
    1 \\
    1
  \end{bmatrix} e^{\frac{mc}{\hbar} x^2 + \alpha(x^0)}.
\]  
(9)

The (9) is ghost iff $T_{ik} \equiv 0$. Take $Im \left[ \alpha(x^0) \right] = 0$. Then $T_{ik} \equiv 0$. Hence we have a ghost spinor. If $m = 0$ then it is ghost neutrino, which is addition to ghost in previous section.

By using (7) we get that density of current is non-zero:
\[
  j^{(k)} = \left( 4e^{2\frac{mc}{\hbar} x^2 + 2\alpha(x^0)}, 0, 0, 4e^{2\frac{mc}{\hbar} x^2 + 2\alpha(x^0)} \right),
\]
i.e. in spacetime (3) there exist the flowes with zero energy and momentum.

3 Parallel Universes

In [1] the some experiments with light interferentiation are described. The main point of the Deutsch explanation of these experiments is suggestion about existance of shadow photons, whence Deutsch come to the conclusion about partition of the multiverse on set of parallel worlds. The logically building sequence of discourses and conclusions about presence of set of parallel universes is clearly brought. Though there are some problems with interaction of worlds between itself. In particular very difficult to agree with conclusion about interaction of particles with their own shadow particles only. Actually this is only desired suggestion, which from nowhere does not follow. Except this there is one more minus in offered explanation: if shadow photon acts upon real moreover thereby that given influence is reflected on results of experiment – exactly on interferential picture moreover direct image – then must be the equations, describing this interaction. Furthermore and suggestion about existance of such photons can be incorrect. Really, the fact of that no sensors could not fix presence of shadow photon as well as a straight line dependency from it received interferential picture, results in conclusion about a zero energy of its and, as a result, zero stress-energy tensor. All this seamingly
speaks about impossibility like to situations. But for full understanding of the presented position let us postpone aside photons. After all in beginning the problem stood in understanding of interferential natures in general quantum particles. Simply Deutsch considered the case with photons. Since the interference of quantum particles runs equally then conclusion from [1] about parallel universes can generalise, for instance, on the spinor fields. But again for this we need the equations, describing a shadow spinor fields, which, as was spoken above, in view of zero energy have and zero stress-energy tensor. But this now does not difficult problem! Because there are so-called the ghost spinors! Thereby, we get at first, a physical interpretation of the ghost spinors – this is a corresponding spinor fields in the parallel universes, and at secondly, a physical motivation of shadow particles – the equations its describing are found. Moreover, we now have got the possibility to do wholly legal transition to statement about existance of parallel universes. Really, since all bodies are consisted by atoms, but atoms are consisted by electrons, neutrons and protons, which are described by the Dirac’s equation, then a presence in space of ghosts for these particles draws a presence of ghosts and for each body, i.e. we get the set of parallel worlds.

Conclusion.

In this article the ghost spinors were found, and also its physical interpretation which takes for basis a parallel worlds is done. But moreover we have to say that hereafter the matter and substance are not a synonyms. So-called ghosts as once are a matter and are not a substance, i.e. there are a flows of particles which not have a characters of the last.

Come back to the question about photons we consider that shadow photons in change from real photons are can not discribed by the Makswell’s equations. This is because from the zero stress-energy tensor following a absence of electric-magnetic field in our spacetime. But here contradictions are absented! After all the real photon is nor than other as a carrier of a certain energy, but energy a shadow photon is a zero. As once in this fact it consists the difference between photons and particles with half-whole spin. May be the problem is solved by the finding for photons the field equations with greater degrees of freedom than the Makswell’s equations.

References
[1] Deutsch, D. *The Fabric of Reality*. Allen Lane. The Pengguin Press, 1999.

[2] Davis, T.M., Ray, J.R. *Ghost neutrinos in plane-symmetric spacetimes*. // J. Math. Phys. 1975. V.16. No.1. P.75-79.

[3] Davis, T.M., Ray, J.R. *Neutrinos in cylindrically-symmetric spacetimes*. // J. Math. Phys. 1975. V.16. No.1. P.80-81.

[4] Guts, A.K. *A new solution of the Einstein-Dirac equations*. // Izvestia vuzov. Fizika. 1979. No.8. P.91-95 (Russian).

[5] Pechenick, K.R., Cohen, J.M. *New exact solution to the Einstein-Dirac equations* // Phys. Rev., 1979. D 19, No.6. P.1635-1640.

[6] Landau, L.D., Lifshits, E.M. *Theory of field*. Moscow.: Nauka, 1973.