The main problem of the theory of the emergence of space-time is that how to restore the Minkowsky geometry from the original quantum structures. In this paper, we consider the reverse reaction, obtaining space-time from quantum vector fields, similarly to the electric and magnetic fields in the Maxwell equation. In addition, time itself is split into components in three-dimensional space in the form of an inductive quantum field.

First you need to introduce pairs of quantum fields that do not commute with each other

\[ \{e_k, \Omega_k\} = i \]

\[ k = 1, 2, 3 \]

\[ e_k \psi = i \frac{\partial \psi}{\partial \Omega_k} \]

These are inductive and vortex fields

\[ \vec{e} = \oint \vec{d} \vec{e} \]

\[ \vec{\Omega} = \oint \vec{d} \Omega \]

We introduce the distance in the phase space for quantum rotor fields in the form of a metric

\[ ds^2 = (l_p^2 d\Omega_x)^2 - (d\vec{e})^2 \]

\[ l_p^2 = \frac{G \hbar}{c^3} \approx 10^{-70} (m^2) \]

Where is the last conversion factor, the square of the Planck length (a suitable system of units for the occurrence of space-time).

This distance is similar to the distance for the electric and magnetic fields in Maxwell’s equations. This is the distance for vortex quantum fields in three-dimensional space.

\[ ds^2 = (l_p^2 d\Omega_x)^2 + (l_p^2 d\Omega_y)^2 + (l_p^2 d\Omega_z)^2 - (de_x)^2 - (de_y)^2 - (de_z)^2 \]
The Lorentz transformation for these fields in this case has the following form

$$\vec{e} = \frac{\vec{\varepsilon} - \frac{Gh}{c^4} [\vec{v} \times \vec{\Omega}]}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$\vec{\Omega} = \frac{\vec{\Omega} + \frac{c^2}{Gh} [\vec{v} \times \vec{\varepsilon}]}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Similarly, the Maxwell equation for these vortex quantum fields has full symmetry

$$\text{div} \, \vec{\Omega} = \nabla \cdot \vec{\Omega} = 0$$

$$\text{div} \, \vec{e} = \nabla \cdot \vec{e} = 0$$

$$\text{rot} \, \vec{\Omega} = \nabla \times \vec{\Omega} = \frac{c^2}{Gh} \frac{\partial \vec{\varepsilon}}{\partial t}$$

$$\text{rot} \, \vec{e} = \nabla \times \vec{e} = -\frac{Gh}{c^4} \frac{\partial \vec{\Omega}}{\partial t}$$

Well, now the main point in this approach. Consider an additional option, the normalization condition as a unit vector

$$|\text{rot} \, \vec{e}| = 1$$

If one of these quantum fields corresponds to vector space, then the geodesic length in space is equal to the length of the change in the quantum field.

$$dl = |d\vec{\varepsilon}|$$

$$dl^2 = (dx)^2 - (dy)^2 - (dz)^2 = (de_x)^2 - (de_y)^2 - (de_z)^2$$

$$dx \neq de_x, \quad dy \neq de_y, \quad dz \neq de_z$$

It should be noted that the components of this quantum field are not necessarily equal to the coordinates of space, the main thing is that their lengths coincide.

Then the distance in the phase space of these quantum fields can be considered as a metric space-time

$$ds^2 = (c \, dt)^2 - dl^2 = (l_x^2 \, d\Omega_x)^2 + (l_y^2 \, d\Omega_y)^2 + (l_z^2 \, d\Omega_z)^2 - (dx)^2 - (dy)^2 - (dz)^2$$

The time interval is proportional to the magnitude of the change in the vortex quantum field

$$dt = \frac{Gh}{c^4} \sqrt{(d\Omega_x)^2 + (d\Omega_y)^2 + (d\Omega_z)^2}$$

In the general case, the time flow is proportional to the length of the path of the contour of a change in the quantum field in its own space (open or closed loops).

$$t = \frac{Gh}{c^4} \int_0^L \sqrt{(d\Omega_x)^2 + (d\Omega_y)^2 + (d\Omega_z)^2}$$
This can be considered as a quantum clock of space-time itself. This quantum clock can be shown in the form of the length of the trajectory of a field change in its own space (Figure 1).

This figure gives a geometric representation of time as the length of the shape of the trajectory of a vortex field.

For the direct space-time distance in the form of a vortex quantum field metric, the following form is obtained

\[ s^2 = (ct)^2 - (x)^2 - (y)^2 - (z)^2 \]

\[ s^2 = \left( \int \sqrt{(d\Omega_x)^2 + (d\Omega_y)^2 + (d\Omega_z)^2} \right)^2 - (x)^2 - (y)^2 - (z)^2 \]

It can be noted that one of the Maxwell equations for these quantum fields gives a relativistic effect, the relativity of the simultaneity of events.

\[ c^2 \frac{\partial \tau}{\partial \tau} = \frac{\partial \tau}{\partial \tau} = \vec{v} \]

\[ c^2 \frac{t_2 - t_1}{x_1 - x_1} = v_x \]

That’s all right, because the Maxwell equations themselves contain all the symmetries of space-time of special relativity. However, later they began to consider special relativity as a separate theory of space-time based on two postulates. In this work, a reverse reaction is given, time itself has three spatial components in the form of a quantum inductive field.

Further analysis of the obtained equations makes it possible for some evaluation of various methods for the emergence of space-time based on the dual field.