Gravitational waves. Wave equations

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This article was published like chapter 9 in the Leonov's book: Quantum Energetics. Volume 1. Theory of Superunification. Cambridge International Science Publishing, 2010, pp. 603-650. Waves in a cosmic vacuum can only form in an elastic medium that is a quantised space-time. This is a global electromagnetic field consisting of electromagnetic quantons whose concentration characterises the quantum density of the medium. Electromagnetic waves are transverse waves of electromagnetic polarisation of quantons and it does not lead to a change in the quantum density of the medium. Gravitational waves are longitudinal wave oscillations of a quantons inside quantised space-time and gravitational waves lead to changes in the density of the quantum medium, its compression and tension in the longitudinal direction. Such an understanding of the nature of gravitational waves allows us to create quantum generators of gravitational waves - grazers (Leonov's patent).

The Superunification theory has unified electromagnetism and gravitation through the superstrong electromagnetic interaction. The nature of gravitation and electromagnetism has been determined. If electromagnetism the result of electromagnetic polarisation of the quantised space-time, gravitation is caused by its deformation (distortion). Deformation changes the quantum density of the medium (the concentration of quantons in the volume), whereas in electromagnetic polarisation the quantum density of the medium remains unchanged. This is the large difference between gravitation and electromagnetism. Electromagnetic waves are transverse polarisation oscillations of the quantised medium. From the source of gravitational perturbation, gravity is transferred through the longitudinal deformation of the quantised space-time. Therefore, long-term search for gravitational waves, regarded as transverse waves, was a procedural error. It has been shown that gravitational waves are the longitudinal oscillations of the deformation of the quantised space-time. In August 2006, I generated and sent into the cosmic space a longitudinal gravitational wave with the power of the order of 100 W.

Chapter 9 is based, with small corrections, on the study: V.S. Leonov, *Discovery of Gravitational Waves by Prof. Veinik*, Agrokonsalt, Moscow, 2001.

9.1. Introduction

In 1991, a monograph 'Thermodynamics of Real Processes' by Prof. A.I. Veinik, Corresponding Member of The Academy of Sciences of Belarus was published in Minsk. In the book, Prof. Veinik described a number of interesting experiments, associated with the recording of previously unknown radiation on the basis of the variation of the resonance frequency of oscillations of a quartz sheet. Radiation was generated from different objects at the moment of changes of their deformation state as a result of the effect of a force on the specimen and the removal of the load from the specimen, or the fracture of the specimen itself, and also at the moment of the phase transition of the objects from one state to another, for example, in melting or solidification of metallurgical castings, and in a number of other cases. Radiation was not recorded by electromagnetic methods and was not screened [1].

For example, Fig. 9.1 shows the experimental dependence of the variation of the frequency of a quartz sheet under the effect of radiation at the moment of removal of deformation stress from a pre-loaded ceramic tube. The change of frequency was approximately 200 Hz at the resonance frequency of quartz of 10 MHz.

Veinik himself explained his experiments by the presence of chronal radiation in objects because the course of time in space changed at the moment of the change of the deformation state of the object. According to Veinik, the particle transferring chronal radiation was a hypothetical particle, 'chronon' [1, 2].

When analysing Veinik's experiments, I always believed that his theoretical explanation of the experimental results on the basis of the chronon

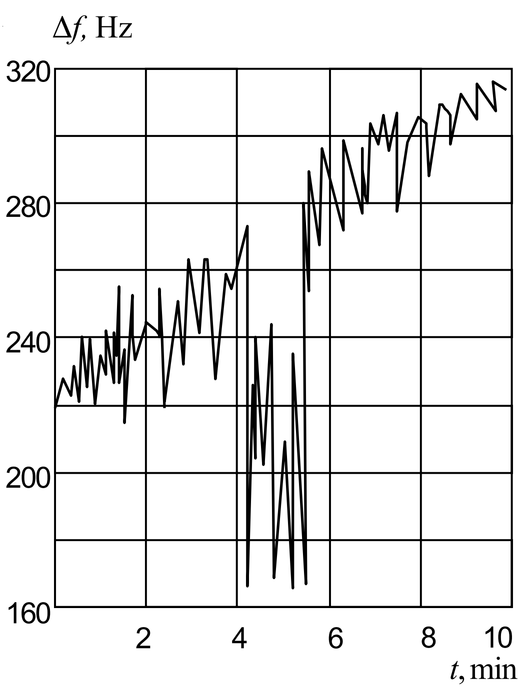

Fig. 9.1. Variation of frequency Δf of a quartz sheet under the effect of gravitational radiation as a result of a change of deformation stresses in the specimen (ceramic tube) [1, 2].

particles (time carriers) is simply invented because it did not fit the Einstein concepts of space-time. The uniqueness of space and time was not doubted and, naturally, the chronon fluxes interfered with the views of physicists. We realise that new discoveries change our views on the nature of phenomena. However, they should not break the fundamental assumptions of physics which include the uniqueness space and time.

So, how can we explain the results of Veinik's experiments? Disregarding the fact that Einstein links the unity of space and time with gravitation, I have attempted to justify the discovery by Veinik of longitudinal gravitational waves emitted by matter at the moment of deformation of the latter. This logical conclusion was reached on the basis of the analysis of the state of gravitation theory as a theory of distorted (deformed) space-time originated by Lorentz, Poincaré, Einstein and Minkovskii. At that time there was already a large amount of practical experience with the application of electromagnetic waves with the longitudinal nature of the oscillations in accordance with the Maxwell equations for the electromagnetic field in the quantised space-time.

9.2. State of the space-time theory

The unity of time and space was proposed by the mathematicians Poincaré and Minkovskii at the beginning of the 20th century, who purely formally combined the Cartesian coordinates (*x, y, z*) of space and time *t* through their increments into a single mathematical expression of the quadratic form referred to as the four-dimensional interval *ds* [3, 4]:

$$ds^2 = c^2dt^2 - (dx^2 + dy^2 + dz^2) \tag{9.1}$$

where $c \approx 3 \cdot 10^8$ m/s is the speed of light in quantised space-time (c = const).

Equation (9.1) is nothing else but another form of writing the Lorentz transformations [4] which show that the course of time *t* in space depends on the speed of movement *v* of the body (particle) in space in relation to the initial time t_0 with the relativistic factor γ taken into account:

$$t = t_0\gamma = \frac{t_0}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{9.2}$$

However, the equations (9.1) and (9.2) do not take into account the effect on the course of time of the mass of the moving body which is a reason for the distortion of the space-time, without mentioning the movement of the mass in the distorted space-time with a different perturbing mass. In order to link the distorted space-time with the gravitational source, i.e., with the mass and its speed, Einstein introduced the concept of the energy–pulse, which determines the dependence of the effect $S(R)$ of space-time on its curvature R (R is the invariant of the Ricci tensor, g_i is the determinant) [5]

$$S(R) = -\frac{1}{16\pi G}\int (dx)\sqrt{-g_i}\ R \qquad (9.3)$$

where $G = 6.67\cdot 10^{-11}$ $\mathrm{Nm^2/kg^2}$ is the gravitational constant.

Academician Sakharov criticised this Einstein's approach, saying that: 'the presence of the effect (9.3) results in the metric elasticity of space, i.e., in the formation of a generalising force, preventing distortion of space' [5]. However, this is not directly reflected in (9.3). Identical criticism was also made of the classic approach to gravitation described in the statics by the Poisson gravitational equation for the gravitational potential φ [6] because the known solutions of the Poisson equation also do not contain the component preventing distortion of space

$$\rho_m = \frac{1}{4\pi G}\text{div grad}(\varphi) \qquad (9.4)$$

$$\text{div grad}(\varphi) = \frac{\partial^2\varphi}{\partial x^2} + \frac{\partial^2\varphi}{\partial y^2} + \frac{\partial^2\varphi}{\partial z^2} \qquad (9.5)$$

Here ρ_m is the density of the matter of the perturbing mass, $\mathrm{kg/m^3}$.

If the density of matter ρ_m is concentrated in a limited volume, then outside its volume under the condition $\rho_m = 0$ the Poisson equation changes to the Laplace equation.

The absence in the solutions of the equations (9.3) and (9.4) of a second component preventing distortion of space should result in the instability of space-time, i.e. in its collapse. However, this has not been observed in experiments. The space-time is a very stable substance. This is possible only if the force preventing the distortion of space to which Sakharov referred to does really exist. However, the existence of such a force can be associated only with the existence of elastic properties of the space determined by its real structure, and taking this structure into account we can introduce the second component, preventing distortion of space, into the solution of the equations.

At the same time, it is necessary to give credit to Einstein who in the general theory of relativity developed the four-dimensional consideration, combining the space and time into a single substance whose distortion is the basis of gravitation.

9 .2. Main static equations of the deformed quantised space-time

The authors of [7, 8] proposed a method of electromagnetic quantisation of space within the framework of the stationary Lorenz absolutely elastic structure, treating the physical vacuum as a continuous medium in the form of specific quantised space-time having ideal (without friction and plasticity) elasticity [9].

The solution of the stationary problems of the formation in the elasticity theory and continuum mechanics is determined by the classic Poisson equation (9.4), and in this case we examine the situation in the replacement of the gravitational potential φ by the quantum density of the elastic continuum (particle/m^3) which characterises the number of particles (space quanta) in the unit volume of the elastic medium

$$\rho_m = k_0 \text{div grad}(\rho) \tag{9.6}$$

$$\frac{1}{k_0} = 4\pi G \frac{\rho_0}{C_0^2} \tag{9.7}$$

$$\rho = \varphi \frac{\rho_0}{C_0^2} = C^2 \frac{\rho_0}{C_0^2} \tag{9.8}$$

where $1/k_0 = 3.3 \cdot 10^{49}$ particle/kg m^2 is the constant of the quantised space-time unperturbed by deformation; C_0^2 = 8.99 10^{16} J/kg (m^2/s^2) is the gravitational potential of the unperturbed quantised space-time (C_0^2 = const); C^2 is the gravitational potential of the quantised space-time perturbed by gravitation; m^2/s^2 ($C^2 \neq$ const); $\rho_0 = 3.55 \cdot 10^{75}$ particle/m^3 is the quantum density of the unperturbed quantised space-time (ρ_0 = const) [7].

The space-time quanta form the quantised space-time. Equation (9.6) characterises the state of the elastic quantised space-time deformed by the perturbing gravitational mass m, and its solution makes it possible to find the distribution of the quantum density of the vacuum medium for both the external region ρ_1 of the deformed space-time and for the internal region ρ_2, in relation to the gravitational interface in the quantised medium. For the case of spherical deformation of the quantised space-time, as a result of integration of (9.6) we obtain the exact solution of the distribution of the quantum density of the medium in the form of a system of two equations in the statics:

$$\begin{cases} \rho_1 = \rho_0 \left(1 - \dfrac{R_g}{r}\right) \\ \rho_2 = \rho_0 \left(1 + \dfrac{R_g}{R_s}\right) \end{cases} \tag{9.9}$$

where r is the distance from the centre of the source of gravitation ($r > R_s$) m; R_s is the radius of the source of gravitation with mass m (gravitational interface in the elastic quantised medium), m; R_g is the gravitational radius of the source of gravitation (without multiplier 2), m

$$R_g = \frac{Gm}{C_0^2} \tag{9.10}$$

The gravitational radius for the elementary particles and for non-collapsing objects is a purely calculation parameter.

Solution of (9.9) makes it possible to estimate the elasticity of the quantised space-time, for example, on the basis of compression of the quantised density of the medium ρ_2 inside the surface with a radius for the gravitational interface of the Earth, the Sun and a black hole:

- for the Earth at $R_S = 6.37 \cdot 10^6\,\text{m}$, $R_g = 4.45 \cdot 10^{-3}\,\text{m}$

$$\rho_2 = 1.0000000007\ \rho_0$$

- for the Sun at $R_S = 6.96 \cdot 10^8\,\text{m}$, $R_g = 1.48 \cdot 10^3\,\text{m}$

$$\rho_2 = 1.000002\ \rho_0$$

- for the black hole $R_g = R_S \rightarrow \rho_2 = 2\rho_0$

If the Sun collapses, its matter would be compressed $1.27 \cdot 10^{16}$ times, whereas the space quantum is compressed only $\sqrt[3]{2} = 1.26$ times. In fact, here we are concerned with the quantised space-time as a superelastic medium with no analogues with the media known to science.

Taking into account that the quantum density of the medium as a parameter of the scalar field determines the distribution of the gravitational potential in the quantised space-time, we improve the accuracy of the solution of the classic Poisson equation (9.4) for the gravitational potential. By analogy with the solution (9.9) we determine the distribution of the gravitational potentials φ_1 and φ_2 for the spherically deformed quantised space-time with respect to the gravitational interface:

$$\begin{cases} \varphi_1 = C_1^2 = C_0^2\left(1 - \dfrac{R_g}{r}\right) \\ \varphi_2 = C_2^2 = C_0^2\left(1 + \dfrac{R_g}{R_s}\right) \end{cases} \tag{9.11}$$

Thus, the new solutions (9.9) and (9.11) of the static Poisson equation (9.4) and (9.6) for the quantised space-time include the second internal components ρ_2 and φ_2 which prevent distortion of space and balance the external deformation (distortion) of the quantised space-time, determined by the parameters ρ_1 and φ_1. This approach makes it possible to avoid the collapse of space and make it stable.

In fact, if we specify some boundary in the quantised space-time and then compress this boundary uniformly to radius R_s together with the medium, the internal compression region increases the quantum density of the medium as a result of tensile loading of the external region, balancing the absolutely elastic system. This process is described by the Poisson equation as the divergence of the gradient of the quantum density of the medium or gravitational potential.

Naturally, the reason for gravity is the disruption of symmetry and of the established equilibrium of the colossal tension of the elastic quantised space-time determined by the distortion of space-time (its deformation). The Newton law of universal gravitation for the force $\mathbf{F}_n$ of two gravitating masses m_1 and m_2 originates from the first external component φ_1 of the solution (9.11) with (9.8) taken into account ($\mathbf{1}_r$ is the unit vector):

$$\mathbf{F}_n = m_2 \text{grad}\varphi_1 = m_2 \text{grad} C_0^2 \left(1 - \frac{R_g}{\mathbf{r}}\right) = G\frac{m_2 m_1}{r^2}\mathbf{1}_\text{r} \tag{9.12}$$

On the other hand, the presence of an intrinsic gravitational potential C_0^2 of the non-deformed quantised space-time enables us to determine the rest energy of the particle W_1 during its formation in the quantised space-time by the work of transfer of mass m_0 from infinity to the region of the potential C_0^2, determining the rest energy as the consequent energy of spherical deformation of the quantised space-time by the generated particle:

$$W_0 = \int_0^{C_0^2} m_0 d\varphi = m_0 C_0^2 \tag{9.13}$$

Equation (9.13) is the simplest and most convincing conclusion of the equivalence of mass and energy as an electromagnetic substance.

9.4. The balance of gravitational potentials in quantised space-time

The solutions of the Poisson equations (9.9) and (9.9) can be used to produce the exact balance of the quantum density of the medium and gravitational potentials for the external region of the deformed quantised space-time at $\rho_1 = \rho$ and $\varphi_1 = C_1^2 = C^2$ (to simplify equations)

$$\rho_0 = \rho + \rho_n \tag{9.14}$$

$$C_0^2 = C^2 + \varphi_n \tag{9.15}$$

where ρ_n is the quantum density of the medium, determined by the Newton gravitational potential φ_n, particle/m^3; φ_n is the Newton gravitational potential for the mass m, m^2/s

$$\varphi_n = \frac{Gm}{r} \tag{9.16}$$

The four-dimensional interval (1) is easily reduced to the balance of the gravitational potentials which differs from (15), assuming that the speed of light in the unperturbed (by gravitation) quantised space-time is constant, $c^2 = C_0^2$ = const, and here $c^2 \neq C^2$, where c^2 from (1), and C^2 and C_0^2 from (15)

$$\frac{ds^2}{dt^2} = | C_0^2 - \frac{(dx^2 + dy^2 + dz^2)}{dt^2} \tag{9.17}$$

from which

$$C^2 = C_0^2 - v^2 \tag{9.18}$$

$$C^2 = \frac{ds^2}{dt^2} = \varphi; \qquad v^2 = \frac{(dx^2 + dy^2 + dz^2)}{dt^2} \tag{9.19}$$

As indicated by (9.17), the four-dimensional interval (9.0) determines the gravitational potential $\varphi = C^2$ of the gravitation-perturbed quantised space-time and formally determines the approximate balance of the gravitational potentials (9.18) in the perturbed quantised space-time which can be obtained from (9.15) by incorrect replacement of the perturbing Newton potential φ_n by the square of speed v^2

$$C_0^2 = C^2 + v^2 \tag{9.20}$$

If the balance (9.15) of the gravitational potentials in the quantised space-time is the exact solution (9.11) of the Poisson equation for the deformed (distorted) quantised space-time, then the balance (9.20), reflecting Lorenz transformations, is the approximate equation for the quantised space-time. However, the balance (9.15) describes the statics and (9.20) the kinematics. In order to introduce the speed of movement into the exact solution (9.11), it is necessary to link the dynamic increase of the mass with the spectrum speed and, correspondingly, the perturbing Newton potential, through the normalised relativistic factor γ_n [7]

$$\begin{cases} \varphi_1 = C^2 = C_0^2\left(1 - \dfrac{R_g\gamma_n}{r}\right) = C_0^2\left(1 - \dfrac{\varphi_n\gamma_n}{C_0^2}\right) \\ \varphi_2 = C_0^2\left(1 + \dfrac{R_g\gamma_n}{r}\right) \end{cases} \quad (9.21)$$

From (9.21) we obtain the dynamic balance of gravitational potentials for the particle (body) moving in the entire speed range, including the speed of light

$$C_0^2 = C^2 + \varphi_n\gamma_n \quad (9.22)$$

where γ_n is the normalised relativistic factor

$$\gamma_n = \frac{1}{\sqrt{1 - \left(1 - \dfrac{R_g^2}{R_s^2}\right)\dfrac{v^2}{C_0^2}}} \quad (9.23)$$

The balance of the gravitational potentials (9.22) is determined by the general Poisson equation which describes the distribution of the gravitational potential C^2 in the deformed quantised space-time for the spherically symmetric system taking into account the speed of the solid (particle) through the normalised factor γ_n

$$\rho_m = \frac{1}{4\pi G}\text{div grad}C^2 = \frac{1}{4\pi G}\text{div grad}(C_0^2 - \varphi_n\gamma_n) \quad (9.24)$$

The solution of (9.24) is (9.21).

Fig. 9.2 see Fig. 3.11. Gravitational diagram of the distribution of t he quantum density of the medium and gravitational potential in the external ($\rho_1 = \rho$, C^2) and internal (ρ_2, C_2^2) regions of the spherically deformed (distorted) quantised space-time as a result of gravitational perturbation of the quantised space-tme by a particle (a body).

Fig. 9.2 (Fig. 3.11) shows the gravitational diagram in the form of the curve of distribution of the quantum density of the medium and gravitational potentials in the statics in accordance with the solutions (9.9) and (9.11), determining the balance of the quantum density of the medium and the gravitational potentials. As indicated, at the gravitational interface $r = R_s$ there is a jump of the quantum density $\Delta\rho$ of the medium and the gravitational potential $\Delta\varphi$, forming a gravitational well in the medium

$$\Delta\rho = 2\rho_{ns} \qquad \Delta\varphi = 2\varphi_{ns} \tag{9.25}$$

where φ_{ns} is the Newton gravitational potential at the gravitational interface R_s in the medium determined by the decrease of the quantum density of the medium ρ_{ns} on the external side of the gravitational interface in spherical deformation of the quantised space-time, m^2/s^2.

The presence of the multiplier 2 in (9.25) is determined by the physical model – the presence of two components ensuring stability of the quantised space-time as a result of its simultaneous compression and tensioning the elastic medium due to gravitational interactions. Multiplier 2 is excluded from the gravitational radius (9.8) which was erroneously introduced by Schwartzschild because the physical model of the gravitational deformation of quantised space-time was not available. The fundamental role in gravitational interactions is played by the gravitational interface R_s of the medium whose property and structure for the nucleons and the electron (positron) are described in [10].

In the dynamics, the curve in Fig. 9.2 differs from the static only by the fact that it is not determined by the static balance (9.15) of the gravitational potentials and is instead determined by the dynamic balance (9.22), retaining the spherical symmetry of the system. This greatly simplified calculations in the theory of gravity by reducing them to the principle of superposition of the fields in solving the many-body (particle) problem and in the majority of cases is not necessary to use complicated calculation apparatus with tensor analysis.

In the presence of a large number of elementary particles in a single conglomerate of the body, every particle inside the radius of its gravitational interface compresses vacuum as an elastic medium as a result of its ??? on the external side, with gravitation on the elementary level. The effect of the principle of superposition of the fields is determined. Therefore, the resultant solutions are valid not only for elementary particles but also for cosmological objects.

In fact, the mass of any cosmological object (planet, star) is formed from quantons which the mass acquires from the external region of space surrounding the given object and restricted by its volume. On the other hand, the mechanism of redistribution of the quantum density of the medium for cosmological objects operates through the elementary particles, included in the composition of the object. Each of the elementary particles forms its mass as a result of additional inclusion of quantons from the surrounding space. Since the principle of conservation of the total number of the quantons operates in the quantised space-time, the increase of the number of the quantons inside the gravitational interface by a specific number is possible only as a result of reducing the same number of the quantons outside the gravitational interface, determining the principle of superposition of the fields. Naturally, for the cosmological objects, their radius is the conventional interface R_s of the medium.

9.5. Limiting mass and energy of relativistic particles

The normalised relativistic factor (9.23) restrict the limiting mass of the particle when the particle speed reaches the speed of light. The factor results from (9.15) on the condition that the Newton potential (9.16) of the relativistic particle at its gravitational interface R_s in the limiting case cannot exceed $\varphi_n < C_0^2$. Consequently, from (9.16) we obtain that the maximum mass m_{max} of the relativistic particle cannot exceed the values (at $\varphi_n = C_0^2$ and $r = R_s$):

$$m_{max} = \frac{C_0^2}{G} R_s \tag{9.26}$$

and its limiting energy W_{max} is

$$W_{max} = \frac{C_0^4}{G} R_s \tag{9.27}$$

Thus, the establishment of the balance of the gravitational potentials in the deformed quantised space-time has made it possible to solve one of the most difficult problems of theoretical physics – determination of the limiting parameters of relativistic particles. For example, the gravitational interface of a relativistic proton is determined by its known radius $R_s = 0.81 \cdot 10^{-15}$ m, and the limiting mass in accordance with (9.26) is only 10^{12} kg. This is a higher value but is not infinite and corresponds to an iron asteroid with a diameter of the order of 1 km. In the determination of the limiting parameters for the relativistic electron whose radius does not have any distinctive gravitational interface it is necessary to take into account the dimensions of the proton with some modification [7].

It is interesting that the presence of the limiting mass (9.26) of the relativistic particles makes it possible to produce the energy balance for the particle in the entire range of the speeds, using the dynamic balance (9.22) of gravitational potentials, multiplying (9.22) by (9.26)

$$C_0^2 \frac{C_0^2}{G} R_s = C^2 \frac{C_0^2}{G} R_s + \varphi_n \gamma_n \frac{C_0^2}{G} R_s \tag{9.28}$$

It can be seen that the left-hand part of (9.28) is the limiting energy (9.27) of the particle (body). The right-hand part includes the latent energy W_v of the quantised space-time and the total energy W_s of the particle (body). Energy W_s is determined by the sum of the rest energy W_0 and the kinetic energy W_k, having the form of the sum of the energy of the spherical deformation of the quantised space-time of the gravitational interface of the medium R_s (at $R_s = r$)

$$W_v = C^2 \frac{C_0^2}{G} R_s; \qquad W_s = \varphi_n \gamma_n \frac{C_0^2}{G} R_s = m_0 C_0^2 \gamma_n \tag{9.29}$$

Taking (9.29) into account, the energy balance (9.28) can be presented conveniently in the following form, using the latent energy W_v of the quantised space-time

$$W_v = W_{\max} - m_0 C_0^2 \gamma_n \tag{9.30}$$

The energy balance (9.30) shows that the only source of energy of the particle (body) within the limits of the gravitational interface of the medium is the colossal energy, hidden in the quantised space-time. The latent energy exhausts itself completely $W_v = 0$ in the objects of the type of black hole and determines the maximum energy (9.27) of deformation of the quantised space-time by a black hole. In fact, balance (9.30) is the generalised Lagrange function which determines the energy parameters of the moving particle (body) in the quantised space-time deformed by the particle.

Equation (9.30) can be used to determine the latent force F_{vT} of the surface tension of the quantised space-time inside the particle determined by the spherical deformation of the quantised space-time. Force F_{vT} is determined as the derivative with respect to the gravitational interface R_s with (9.27) taken into account, expressing the mass in (9.30) through the density of matter ρ_m

$$F_{vT} = \frac{dW_v}{dR_s} = \frac{C_0^4}{G} - 4\pi R_s^2 \rho_m C_0^2 \gamma_n \tag{9.31}$$

Equation (9.31) includes the maximum force F_{Tmax} of tensioning of the quantised space-time reached on the surface of the black hole and acting on the entire surface of the black hole:

$$F_{T\max} = \frac{dW_{\max}}{dR_s} = \frac{C_0^2}{G} = 1.2 \cdot 10^{44}\,\text{N} \tag{9.32}$$

The force $1.2 \cdot 10^{44}$ N (9.32) is a limiting force which can be reached in nature as a result of deformation of the quantised space-time.

From equation (9.31) we determine the value of the tensor of surface tension $\mathbf{T}_n$ determined by the effect in the quantised space-time of the perturbing mass with the density of matter ρ_m. The surface tension tensor $\mathbf{T}_n$ acts on the unit surface of the spherical gravitational interface R_s ($\mathbf{1}_n$ is the unit vector which is normal to the spherical surface)

$$\mathbf{T}_n = \rho_m C_0^2 \gamma_n \mathbf{1}_n \tag{9.33}$$

As indicated by (9.33), surface tension tensor $\mathbf{T}_n$ depends on the density of matter of the particle (body) and the speed of movement of the particle in the quantised space-time. For example, at a mean density of matter of $\rho_m = 5518$ kg/m^3, the value of the tension tensor of the quantised space-time on the Earth surface reaches a gigantic value of $5 \cdot 10^{20}$ N/m^2, determining the colossal deformation tension of the quantised space-time. The mean density of the Sun is lower than the mean density of the Earth and, therefore, the tension tensor on the surface of the Sun is lower in comparison with that on the Earth, but the total tension force of the quantised space-time on the entire side surface should be considerably higher than that on the Earth.

Attention should be given to the fact that in the EQM theory the dimension of the gravitational potential of the quantised space-time C_0^2 and C^{23} is determined as J/kg defining at the same time the energy aspect of the quantised space-time. The dimensions J/kg and m^2/s^2 are equivalent to each other. Since there is no unique term for the unit of measurement of the gravitational potential, it is permissible to use either of these dimensions.

Thus, analysis of the balance of the gravitational potentials makes it not only possible to determine the limiting parameters of the particle (body) in the deformed quantised space-time but also find their intermediate values in the entire range of the speed, including the speed equal to the speed of light.

9.6. Fundamentals of the physics of black holes

Undoubtedly, the new results of calculation of the deformed quantised space-time can be used to determine more accurately the parameters of the objects of the type of black holes. In particular, this relates to the physical model of the black hole. The curve of the quantum density and gravitational potentials is represented by the gravitational diagram in Fig. 9.3 (Fig. 3.12). As a result of collapse of matter, the quantum density inside the gravitational radius of the black hole reaches the limiting value equal to $2\rho_0$. This takes place as a result of extension of the medium on the external side to the zero level $\rho = 0$. The black hole is characterised by the limiting parameters of deformation of the quantised space-time.

Fig. 9.3. Refer to Fig. 3.12. Gravitational diagram of the black hole

The main property of the black holes is the disruption of continuity of the quantised space-time as a light-bearing medium, determined by the discontinuities of the quantised space-time at the gravitational interface of the black hole and the quantised space-time. The disruption of the continuity of the light-bearing medium causes that the light is not capable of both penetrating into the black hole or leaving the black hole, making the black hole completely invisible. However, the strong gravitational field of the black hole should be detected by astronomical observations.

At the gravitational interface R_s of the black hole and the medium, equal to its gravitational radius R_g (9.10) there is a 'jump' of the gravitational potential $\Delta\varphi = 2C_0^2$ (R_g (9.10) without the multiplier 2 at $R_g = R_s$). The Newton potential on the external side of the medium on the surface of the gravitational interface has the limiting value C_0^2. The same value of the Newton potential is found also on the internal side of the gravitational interface in relation to the gravitational potential C_0^2 of the non-deformed quantised space-time.

Equations (9.26) and (9.27) can be used to determine the mass and energy of the black hole as the limiting parameters of deformation of the quantised space-time at $R_s = R_g$. Equation (9.32) can be used to determine the total force of limiting tension acting on the surface of the black hole and restricted by its gravitational radius and independent of the gravitational radius.

Attention should be given to the fact that the black holes can be of three types: static, dynamic and relativistic. Static black holes are determined by collapse in the region of low speeds of movement in the quantised space-time.

An increase of speed increases the mass of the body as a result of intensifying spherical deformation of the quantised space-time pushing the system to a critical unstable state. When the system reaches a specific critical speed, accretion of matter to the centre of the system is induced followed by its collapse into a dynamic black hole.

Finally, when the particle is accelerated to the speed of light, the particle transfers into a black relativistic microhole. This black microhole has no electromagnetic radiation but carries the gravitational field which reaches the colossal strength **a** of the gravitational field on the surface of the gravitational radius (**a** is freefall acceleration – strength of the field), m/s^2, at $R_g = R_s$)

$$\mathbf{a} = \frac{C_0^2}{R_s}\mathbf{1}_r \tag{9.34}$$

For example, when the proton reaches the speed of light, it transfers into a black relativistic microhole with the strength of the gravitational field of 10^{32} m/s^2 (9.34) on the surface of the microhole whose radius is R_s. Naturally, we are now concerned with the black holes as hypothetical objects, including black microholes, and information on their physical properties will promote a more efficient search for them.

9.7. Deformation vector of quantised space-time

The balance of gravitational potentials (9.22) is an exact equation of state of quantised space-time for an elementary particle having a mass, and takes into account the effect on vacuum not only of the mass of the moving particle but also describes the movement of the mass in the quantised space-time as transfer of the deformation vector **D** of the quantised space-time [7]

$$\mathbf{D} = \text{grad}(\rho) \tag{9.35}$$

The deformation vector (9.35) can be written through the Newton gravitational potential φ_n with (9.8) and (9.7) taken into account for a spherically symmetric system

$$\mathbf{D} = \frac{\rho_0}{C_0^2}\text{grad}(C_0^2 - \varphi_n\gamma_n) = -\frac{\rho_0}{C_0^2}\text{grad}(\varphi_n\gamma_n) = \frac{1}{4\pi k_0}\frac{m_0\gamma_n}{r^2}\mathbf{1}_r \tag{9.36}$$

As indicated by (9.36), deformation vector **D** is an analogue of the strength of the gravitational field but is expressed in different measurement units (particle/m^4). The deformation vector has a physical meaning which actually describes the deformation of the quantised space-time as a result of the gravitational interaction as real distortion of the space-time.

9.8. Derivation of the equation for the speed of light

The plot in Fig. 9.2 gives information on the distribution of the quantum density of the medium and gravitational potential in the form of spherical quantised space-time with spherical symmetry. Evidently, in movement of an elementary particle (solid) in the quantised space-time, the plot in Fig. 9.2 will be transferred and the spherical symmetry of the field will not change. The moving particle (body) transfers its entire mass in space and also its gravitational field. This transfer of the gravitational field in space is not taken into account by any of the gravitational theories. Conservation of the spherical symmetry of the field results in a fundamental principle of spherical invariance which shows that the relativity principle is the fundamental property of the quantised space-time [8].

The transfer of the gravitational field in the quantised space-time is taken into account by the equation of balance of gravitational potentials (9.22). The transfer of the gravitational field during movement of a body is associated with the complicated processes in the space-time. Naturally, the leading front of the moving gravitational field carries out deformation (distortion) of quantised space-time and the trailing front removes this deformation [7]. For this reason, the speed of light, as the wave manifestation of elastic oscillations of the quantised space-time in the direction of movement of the body and in the opposite direction, ensures that it is constant in accordance with the principle of spherical invariance [8]. This has been confirmed by the experiments carried out by Michaelson and Morley. The elastic quantised space-time behaves as a spherical quantised medium, with no analogues with the known media.

This spherically symmetric model which takes into account the actual deformation of the quantised space-time during movement of the mass in it greatly simplifies all the gravitational calculations and describes the actual speed of light in the quantised space-time by the value of the gravitational potential from the balance (22)

$$C = \sqrt{\varphi} = C_0\sqrt{1 - \frac{\varphi_n \gamma_n}{C_0^2}} \tag{9.37}$$

Equation (9.37) determines the speed of light in the perturbed quantised space-time in the vicinity of the moving body (particle) and shows that with an increase of the mass of the body and its speed, the speed of light in the perturbed quantised space-time decreases. This corresponds to the experimental observations of the distortion of the trajectory of the light beam in a strong nonuniform gravitational field. In a limiting case, the light is completely arrested on the surface of a black hole at $\varphi_n \gamma_n = C_0^2$ and the black hole becomes invisible (Fig. 9.3). This is determined by the discontinuities in the quantised space-time as a light-baring medium on the surface of the black hole (its gravitational boundary).

Thus, the solution of the general Poisson equation (9.24) in the form of the balance of gravitational potentials (9.22) in the quantised space-time determines the principle of spherical invariance of space which is reflected in the fact that the speed of light (9.37) is independent in direction from the light source, moving in space together with the mass which perturbs the vacuum. In particular, the independence of the speed of light in the directions enabled Einstein to start investigations in the area of the theory of relativity and consider the concept of the unified field which is represented by the quantised space-time and is also a carrier of superstrong electromagnetic interaction (SEI).

9 .9. Distribution of time in space in the form of a chronal field

The solution of the general Poisson equation (9.24) for the deformed quantised space-time message is used to calculate the course of time in space and the distribution of this course in space in the form of a chronal field. For this purpose, we determine the limiting frequency f_0 of the natural oscillations of the elementary non-deformed space-time quantum as the elastic element defining the course of time T_0 in space and unifying space and time into a single substance:

$$f_0 = \frac{C_0}{L_{q0}} = \frac{3 \cdot 10^8}{0.74 \cdot 10^{-25}} = 4 \cdot 10^{33} \, \text{Hz} \tag{9.38}$$

$$T_0 = \frac{1}{f_0} = \frac{L_{q0}}{C_0} = 2.5 \cdot 10^{-34} \, \text{s} \tag{9.39}$$

where $L_{q0} = 0.74 \cdot 10^{-25}$ m are the dimensions of the non-deformed elementary elastic quantum of space-time (quanton) [7].

As indicated by (9.39), the minimum period T_0 is defined by the duration of passage of a wave perturbation as a result of elastic excitation of the quanton. Evidently, (9.38) determines the limiting frequency of the wave perturbations in the quantised space-time. The time is quantised and its passage is a multiple of T_0.

Equation (9.38) makes it possible to link the parameters of space-time in the form of the ratio L_{q0}/T_0 with the gravitational potential of the unperturbed quantised space-time C_0^2 or, in a general case, can be used to link the ratio of the parameters L_q/T with the gravitational potential C^2 of the quantised space-time perturbed by deformation:

$$\varphi = C^2 = \left(\frac{L_q}{T} \right)^2 \tag{9.40}$$

Substituting (9.39) into (9.24), we obtain the Poisson equation describing the field of the parameters L_q/T of space-time

$$\rho_m = \frac{1}{4\pi G} \text{div grad} \left(\frac{L_q}{T} \right)^2 \tag{9.41}$$

Equation (9.41) shows that the course of time in the quantised space-time, perturbed by gravitation, is distributed nonuniformly and depends on the deformation (distortion) of space-time.

Integration of (9.41) with respect to time T in the spherically deformed quantised space-time taking into account the deformation of the quanton gives the solution in the form of the distribution of the course of time in space in relation to the mass and the speed of its movement for the external T_1 and internal T_2 regions of the gravitational interface:

$$\begin{cases} T_1 = T_0\left(1 - \dfrac{R_g\gamma_n}{r}\right)^{-\frac{5}{6}} \\ T_2 = T_0\left(1 + \dfrac{R_g\gamma_n}{R_s}\right)^{-\frac{5}{6}} \end{cases} \tag{9.42}$$

The distribution of time (9.42) in space describes the real chronal field. Time T_1 in the external gravitational field slows down with the increase of mass and the speed of movement of the body. Time is completely arrested on the surface of the black hole on the external side of the gravitational interface at $r = R_s = R_g\gamma_n$. Time T_2 is accelerated inside the gravitational interface R_s. The exponent 5/6 = 0.833 in (9.42) is close to unity so that in the rough approximation the distribution of time in space is close to the distribution of the gravitational potentials (9.21).

As can be seen the physical nature of the space-time is hidden in the actual elasticity of the space-time and its elementary quantum – quanton which specifies the natural course of time in relation to the deformation state of the quantised space-time. The quanton is a volume elastic resonator fulfilling also the role of an ideal electronic clock with the period of the passage of time (9.39).

For this reason, the physical time should not be regarded as some vector, having only the forward direction. Time is a metronome which determines the rate of occurrence of some physical (including biological) processes. The clock is an integrator summing up time periods and, as an integrator, the clock has no reverse motion.

9.10. Antimatter and ideal gravitational oscillator

Thus, the variation of the course of time in space is linked with gravitation, i.e., with the distortion of space-time (its deformation), described by the Poisson equation (9.41). To change periodically the deformation vector

(9.35) of the quantised space-time and, at the same time, induce deformation oscillations of the quantised space-time, we examine an ideal gravitational oscillator which is a source of gravitational waves.

If an ideal electromagnetic oscillator could be represented by the electrical charge q_0 with the variable value of the charge q, for example, changing in accordance with the harmonic law (ω is the cyclic frequency):

$$q = q_0 \sin \omega t \tag{9.42}$$

then by analogy with the electromagnetic oscillator (9.42) the gravitational charge q_0 in the gravitational oscillator should be represented by the mass m_0 in (9.36) with the variable value m:

$$m = m_0 \sin \omega t \tag{9.43}$$

Naturally, in nature there is no charge with the variable value (9.42) but if a high-frequency current is supplied to an antenna produced in the form of a wire section, such an antenna should be regarded as an electrode with the variable charge (9.42), exciting electromagnetic waves in the quantised space-time. In radio engineering, there is a more complicated case in which the antenna is regarded as a dipole whose oscillations excite the electromagnetic field. However, in an elementary case, a charge of variable magnitude is suitable for excitation of electromagnetic radiation (9.42).

Thus, in order to induce electromagnetic waves in space, it is necessary to change periodically the polarity of the electrical charge. To excite gravitational waves in space, the polarity of the gravitational charge, i.e., mass, must be varied periodically. However, the concept of the minus mass is associated with antimatter whose presence in the balance of the gravitational potentials (22) is taken into account by the minus sign in front of the Newton potential:

$$C_0^2 = C^2 - \varphi_n \gamma_n \tag{9.44}$$

The equation (9.44) which describes the balance of the gravitational potentials for the antimatter is related to completely different physics of the formation of antiparticles from antimatter in comparison with conventional matter. If in the case of the matter the presence of the Newton potential determines the presence of the gravitational well in the external region of the quantised space-time (Fig. 2), then in the case of antimatte the Newton potential leads to an increase of the gravitational potential C^2 in the external region of space:

$$C^2 = C_0^2 + \varphi_n \gamma_n \tag{9.45}$$

which determines the distribution of the gravitational potential, both in the external region of space and inside the gravitational interface of the medium, which differs from (9.21) by the signs (+) and (-)

$$\begin{cases} \varphi = C^2 = C_0^2\left(1+\dfrac{R_g\gamma_n}{r}\right) \\ \varphi_2 = C_2^2 = C_0^2\left(1-\dfrac{R_g\gamma_n}{R_s}\right) \end{cases} \tag{9.46}$$

This approach also relates to the quantum density of the medium in the formation of an antiparticle in the quantised space-time

$$\begin{cases} \rho_1 = \rho_0\left(1+\dfrac{R_g\gamma_n}{r}\right) \\ \rho_2 = \rho_0\left(1-\dfrac{R_g\gamma_n}{R_s}\right) \end{cases} \tag{9.47}$$

Figure 9.4 (Fig. 3.19) shows the gravitation diagram (plot) of the distribution of the quantum density of the medium (9.47) and the gravitational potential (9.46) for the antiparticle. At the interface of the medium there is a 'jump' of the quantum density of the medium and the gravitational potential (9.24) as in the case of the particle. However, in contrast to the particle, the antiparticle forms as a result of ejection of the quanta (quantons) from the internal region of the gravitational interface to the external region increasing, in the external region, the quantum density of the medium and the value of the gravitational potential.

Fig. 9.4. See Fig. 3.90. Gravitational diagram of the antiparticle (antibody) in the form of the plot of the distribution of the quantum density of the medium and the gravitational potential.

Naturally, the fundamental role in all the processes of the formation of particles in antiparticles in the quantised space-time is played by the gravitational interface. For the particle, the gravitational interface should ensure spherical compression of the quantised space-time to some centre, pulling together the quantised space-time inside the gravitational interface. For the antiparticle, on the other hand, the mechanism of its formation is associated with maintaining the external tensile stresses of the quantised space-time, reducing the extent of compression of the quantons inside the gravitational boundary.

Evidently, a situation may form in the quantised space-time in which the external tension of the medium may result in local disruption of the space and the latter can be kept in the stable condition only by the gravitational interface characterised by the constriction property, e.g., representing a shell of alternating charges [7]. In this case, the jump of the gravitational potential at the interface reaches the value $2C_0^2$ describing the given formation as an antihole.

As regards all the parameters, this antihole in the form of a cosmological objects is an excellent reflector of electromagnetic radiation capable of greatly changing its trajectory and should be recorded by the appropriate astronomical devices. On the other hand, this antihole should have antigravitational properties instead of repulsive properties, like some anomalies in the universe. The presence of the antihole in the centre of our universe, possible from the viewpoint of experiments, explains the accelerated recession of the galaxies.

As regards the elementary antiparticles, analysis of the plot in Fig. 9.4 shows that the antiparticle is in a less stable state in comparison with the particle (Fig. 9.2) where the presence of the gravitational well in the external region of the quantised space-time makes this particle a relatively stable formation. In any case, analysis of the possible formation of gravitational oscillators using antiparticles should result in a completely different approach to the problem of generation of gravitational waves.

9.11. Electromagnetic quantisation of space-time

The investigations show convincingly that the vacuum space-time has an elastic structure and consists of a large number of the smallest particles – quantons – which can not be divided any further. To describe the structure of the elementary quantum of space-time, we use the Maxwell equations for the quantised space-time, writing the density of the currents of electrical $\mathbf{j}_e$ and magnetic $\mathbf{j}_m$ displacement in polarisation of the quantised space-time by the electromagnetic wave in the form of the variation of the strength of the electrical **E** and magnetic **H** fields with respect to time [10]:

$$\mathbf{j}_e = \mathrm{rot}\mathbf{H} = \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t} \tag{9.48}$$

$$\mathbf{j}_m = \frac{1}{\mu_0}\mathrm{rot}\mathbf{E} = -\frac{\partial \mathbf{H}}{\partial t} \tag{9.49}$$

where $\varepsilon_0 = 8.85 \cdot 10^{-12}$ F/m is the electrical constant; $\mu_0 = 1.26 \cdot 10^{-6}$ H/m is the magnetic constant.

Because of the symmetry of the electromagnetic wave, the densities of the currents of electrical and magnetic displacement in the quantised space-time are equivalent in relation to each other as regards the absolute value (modulus)

$$j_m = C_0 j_e \tag{9.50}$$

In (9.50) the densities of the displacement currents are connected together by a multiplier equal to the speed of light C_0 for the quantised space-time unperturbed by gravitation, or C for the quantised space-time perturbed by gravitation. This is caused by the fact that in the SI measurement system the densities of the electrical and magnetic displacement currents have different dimensions. If the dimension for the electrical displacement current is $C/m^2s = A/m^2$, then in the case of the magnetic displacement current there are problems with the dimension, because the elementary magnetic charge g is not specified.

In fact, the densities of the displacement currents can be expressed through the speed of displacement $\mathbf{v}$ of massless free elementary electrical e and magnetic g charges and the quantum density of the medium ρ_0:

$$\mathbf{j}_e = 2e\rho_0\mathbf{v} \tag{9.51}$$

$$\mathbf{j}_m = 2g\rho_0\mathbf{v} \tag{9.52}$$

The multiplier 2 is included in (9.51) and (9.52) because the charges e and g are included in the composition of the quanton in pairs with the sign (+) and (–), forming on the whole a neutral particle.

Substituting (9.51) and (9.52) into (9.50), we obtain a relationship between the elementary electrical and magnetic charges

$$g = C_0 e = 4.8\cdot 10^{-11}\,\text{A}\cdot\text{m (or Dc)} \tag{9.53}$$

where $e = 1.6\cdot 10^{-19}$ C is the elementary electrical charge.

Thus, the elementary magnetic charge (9.53) in the SI system has the value $4.8\cdot 10^{-11}$ A m in the dimension expressed in Diracs (Dc) which has not as yet been officially included in the SI system. In theoretical physics, the elementary magnetic charge (Diracs monopole) is measured in coulombs by analogy with the electrical charge [11]. This causes confusion because the magnetic quantities in electrical engineering are determined by the derivatives of electrical current, and if the dimension of the magnetic moment is $A\cdot m^2$, the magnetic charge is determined by the dimension A · m = Dc, and not C.

Thus, analysis of the Maxwell equations shows that the condition for polarisation the quantised space-time by the electromagnetic wave is the presence of electrical and magnetic displacement currents for massless electrical and magnetic charges included in the composition of the quanton.

Therefore, the quanton as an elementary quantum of the space-time should itself include four elementary charges: two electrical charges ($+1e$ and $-1e$) and two magnetic charges ($+1g$ and $-1g$) representing a static electromagnetic quadrupole which has not been studied at all in electrodynamics. We shall therefore refer to massless elementary charges as monopoles (electrical and magnetic).

In fact, in order to define the elementary volume in space on the basis of geometrical minimisation we require only four marking points. The first point is simply a point, two points form a line, three points form a surface, and only four points can be used to define the volume in space. These four points have been planned by nature itself in the form of the previously mentioned four monopoles, forming the structure of the quanton. On the whole, the quantum is an electrically neutral and massless particle having electrical and magnetic properties which become evident in polarisation of the quantised space-time in the electromagnetic wave.

Naturally, the properties of the quanton can be investigated on the basis of the analogy with the properties of the known elementary particles, for example, such as the electron which has a mass and is at the same time the carrier of the elementary electrical charge. From the viewpoint of classic electrodynamics, the four different monopoles in the quanton should collapse into a point under the effect of colossal attraction forces. However, this has not been observed. The quantised space-time is a very stable substance. This means that the monopoles, included in the quanton, have finite dimensions and determine the diameter L_q of the quanton [7]

$$L_q = \left(\frac{4}{3} k_3 \frac{G}{\varepsilon_0}\right)^{\frac{1}{4}} \frac{\sqrt{eR_s}}{C_0} = 0.74 \cdot 10^{-25}\,\text{m} \tag{9.54}$$

where $k_3 = 1.44$ is the filling coefficient of the quantised space-time by spherical quantons; $R_s = 0.18 \cdot 10^{-15}$ m is the radius of the proton (neutron).

The equation (9.54) was derived on the basis of the conditions of tensioning of the quantised space-time as a result of the interaction of the quantons with each other during the generation of the elementary particle (proton, neutron) from the quantised space-time as a result of its spherical deformation. Radius R_s is the elementary gravitational interface in the quantised medium for these elementary particles.

Figure 9.5 shows the most probable structure of the electrical and magnetic monopole. Evidently, for the monopole to satisfy the conditions of the elastic state of the quantised space-time it should have the form of a two-phase particle, consisting of the central nucleus 1, surrounded by the elastic atmosphere 2 and referred to as protoplasma (Fig. 2.3). In particular,

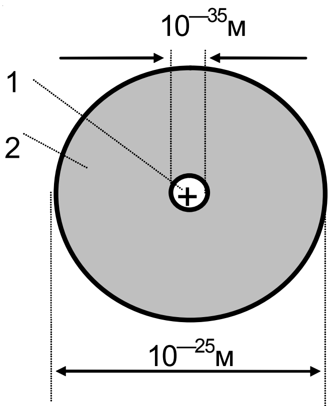

Fig. 9.5. Structure of the electrical (magnetic) monopole. 1) the nucleus of the charge, 2) the atmosphere.

the nucleus 1 is the source of the field (electrical or magnetic) in the form of a charge. It may be assumed that the nucleus of the monopole is determined by the Planck length of 10^{-35} m, and the dimensions of the monopole are of the order of 10^{-25} m [7]. The physical nature of the monopole charges and the structure of the elastic atmosphere are still unknown. It can only be assumed that the elastic atmosphere of the monopoles determines the electrical and magnetic properties of the quantised space-time and is characterised by the constants in the form ε_0 and μ_0, linking together the electrical and magnetic matter inside the quanton.

Therefore, on the basis of the physical model of the monopole charges we can analyse the process of formation of the quantum shown in Fig. 9.6 (Fig. 2.2a). Four elastic spheres–monopoles form a figure with the distribution of the nuclei in the tips of the tetrahedron resulting in the orthogonality of the electrical and magnetic axes of the neutral quanton. However, the quanton cannot remain in this state.

Naturally, the colossal forces of electromagnetic compression should deform the quadrupole consisting of the monopoles into a spherical particle, shown in Fig. 9.7 (, Fig. 2.2b) retaining its integrity as the single particle and also retaining the orthogonality of the electrical and magnetic axes. In this case, the nuclei of the monopoles in the investigated model of the spherical quanton also remain situated at the tips of the tetrahedron inserted into the quanton. This leads to the equivalence of the electrical and magnetic effects of the fields which is determined by the equality of the Coulomb forces for the electrical F_e and magnetic F_m charges acting at the distance r equal to the face of the tetrahedron inside the quanton (on the condition $F_e = F_m$)

$$\begin{cases} F_e = \dfrac{1}{4\pi\varepsilon_0}\dfrac{e^2}{r^2} \\ F_m = \dfrac{\mu_0}{4\pi}\dfrac{g^2}{r^2} \end{cases} \tag{9.55}$$

Fig. 9.6. See Fig. 2.2a. Formation of the space quantum (quanton) for four monopole charges with the tetrahedral model of distribution of the nuclei (top view).
Fig. 9 .7. See Fig. 2.2b. Formation of the spherical form of the quanton as a result of electromagnetic compression of the monopoles into a single quadrupole (figure is rotated).

From equation (9.54) we obtain a relationship linking the electrical and magnetic monopoles:

$$\frac{e^2}{\varepsilon_0} = \mu_0 g^2 \tag{9.56}$$

Taking into account the fact that in the SI system we have the relationship

$$\varepsilon_0\mu_0 C_0^2 = 1$$

from (9.56) we obtain the required relationship between the magnetic and electrical elementary charges, corresponding to (9.53)

$$g = C_0 e$$

However, (9.56) was derived using a different procedure in comparison with (9.53). This indicates the accurate result in the calculations of parameters of the quantised space-time. The speed of light is determined by the actual quantisation of the quantised space-time by the electrical and magnetic monopoles, included in the composition of the quantons:

$$C_0 = \frac{g}{e} \tag{9.57}$$

Equation (9.57) again confirms that the light is an electromagnetic process in the quantised space-time which is a light-bearing medium.

The process of electromagnetic quantisation of a large volume of space is linked with its filling by the quantons. Because of the natural capacity for linking the charges with opposite signs, the quantons, linking with each other, form a quantised elastic medium. The tetrahedral form of the arrangement of the monopole nuclei in the quantons introduces an element of chaos into the linking of the quantons, resulting in a random orientation of the electrical and magnetic axes in space. Any preferred orientation of the axes is excluded and this results in the formation of an electrically and magnetically neutral homogeneous and isotropic medium characterised by the electrical and magnetic properties in the form of a static electromagnetic field [12–14] referred to as the quantised space-time in the EQM theory.

Fig. 9.8. See Fig. 2.4a. Simplified scheme of the interaction of four quantons in the local region of the quantised space-time presented in lines of force.

Of course, it is not possible to show the actual pattern of the static electrical and magnetic fields of the quantised medium in projection onto the plane. Figure 9.8 (Fig. 2.4a) shows a simplified model of a flat local region of the quantised space-time for four quantons in projection on a plane in the form of the lines of force of the electrical and magnetic fields. Naturally, the quantised space-time can be regarded as a discrete mesh with a discreteness of the order of 10^{-25} m consisting of the lines of force of the static electrical and magnetic fields placed on the entire universe and linking all the objects together. We live in the electromagnetic universe.

Evidently, because of the small dimensions of the quanton, the effect of the electromagnetic forces inside the quanton between the monopole charges is so strong that there are no forces in nature capable of splitting the quantum into individual monopoles. Experimentally, this is confirmed by the absence in nature of free magnetic charges, regardless of long-term search for them [11]. Some excess of the electrical charges of the positive and negative polarity is caused by the electrical asymmetry of the universe. However, in particular, this excess of electrical charges is a source of generation, from the quantised space-time, of elementary particles and of all real matter [7].

9 .12. Derivation of the Maxwell equations and electromagnetic waves

It is assumed that the electromagnetic wave is a derivative of the electrical and magnetic fields, has no intrinsic carrier and is not linked with gravitation. However, all this is only a consequence based on the laws of electromagnetic induction in which magnetism is generated from electricity through the unexplained topology of space. The electromagnetic interactions results from the disruption of the equilibrium of the discrete static electromagnetic quantised space-time which has an intrinsic carrier in the form of the elementary quantum of the space-time – the quanton, connecting together electricity and magnetism.

Evidently, the transfer of electromagnetic energy in the quantised space-time in the form of the electromagnetic wave takes place as a result of electromagnetic polarisation of the quantised space-time due to the disruption

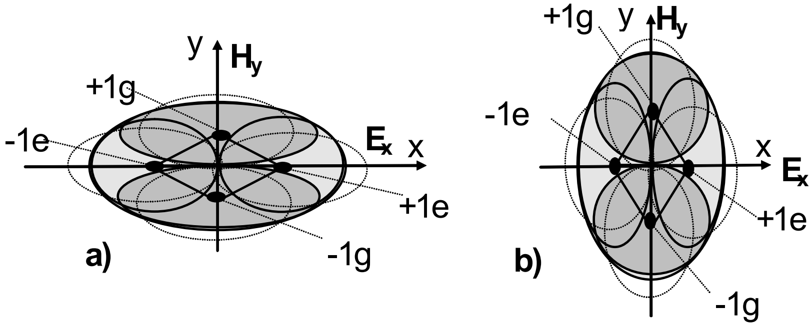

Fig. 9.9. Polarisation of an individual quanton under the effect of the electromagnetic wave on the quanton in the quantised space-time.

of electromagnetic equilibrium of the quantised medium. The quanton is only a carrier of electromagnetic radiation ensuring constancy of intrinsic energy. This has been determined by experiments on the basis of the absence of excess energy in the electromagnetic wave which does not lead to any release of the additional energy from the quantised space-time. For this reason, the polarisation of the quanton along the electrical axis is associated with the unique tensioning of the quanton along the electrical axis and with compression along the magnetic axis and, vice versa, and the internal energy of bonding between the charges remains constant (Fig. 9.9).

Since the electrical and magnetic axes of the quanton are orthogonal to each other, they are placed in the rectangular coordinate system along the axes x and y, respectively, assuming that the distance x and y between the charges inside the quanton is equal to the faces of the tetrahedron, i.e., $r = x = y$. Consequently, the binding energy of the charges interacting inside the quanton is determined by the energy of the electrical W_e and magnetic W_g:

$$W_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{x} \tag{9.58}$$

$$W_g = \frac{\mu_0}{4\pi}\frac{g^2}{y} \tag{9.59}$$

The condition of passage of the electromagnetic wave causing polarisation excitation of the quantised space-time, is determined by the constancy of the total electromagnetic energy W_q of the quanton which is the carrier of wave excitation:

$$W_q = W_e + W_g = \text{const} \tag{9.60}$$

The condition of constancy of energy (9.60) is fulfilled as a result of the fact that during polarisation of the quanton the latter is tensioned along the electrical axis (Fig. 9a) and is also compressed along the magnetic axis (Fig. 9b). The increase of the distances between the electrical charges inside the quanton reduces its electrical energy and results in an equivalent and simultaneous increase of its magnetic energy as a result of a decrease of the distance between the magnetic charges. The polarisation processes in the quantised space-time are associated with the very small displacement of the charges inside the quanton because of its superhigh elasticity. Consequently, the variation of energy during the variation of the small distance between the charges can be expressed by means of the appropriate derivatives of (9.58) and (9.59):

$$\frac{\partial W_e}{\partial x} = -\frac{1}{4\pi\varepsilon_0}\frac{e^2}{x^2} \tag{9.61}$$

$$\frac{\partial W_g}{\partial y} = \frac{\mu_0}{4\pi}\frac{g^2}{y^2} \tag{9.62}$$

The minus sign in equation (9.61) means that the energy of the electrical field of the quantum decreases, and the plus sign in (9.62) indicates that the energy of the magnetic field increases, and vice versa. The variation of the strength of the field from one charge in the region of another charge with a small change of the distance between them (small displacement) is taken into account by means of the appropriate derivatives which are determined from the field of the elementary charge ($\mathbf{1}_x$ and $\mathbf{1}_y$ are unit vectors):

$$\frac{\partial \mathbf{E}}{\partial x} = -\frac{\mathbf{1}_x}{2\pi\varepsilon_0}\frac{e}{x^3} \tag{9.63}$$

$$\frac{\partial \mathbf{H}}{\partial y} = -\frac{\mathbf{1}_y}{2\pi}\frac{g}{y^3} \tag{9.64}$$

Substituting (9.63) and (9.64) into (9.61) and (9.62) respectively, gives

$$\frac{\partial W_e}{\partial x} = \frac{1}{2}\text{ex}\frac{\partial \mathbf{E}}{\partial x} \tag{9.65}$$

$$\frac{\partial W_g}{\partial y} = -\frac{1}{2}\mu_0 gy\frac{\partial \mathbf{H}}{\partial y} \tag{9.66}$$

Taking into account that the condition (9.60) is fulfilled as a result of the equality of the variation of the energies (9.65) and (9.6) we obtain the required relationship linking together the mutual variation of the strength of the electrical and magnetic fields in the electromagnetic wave in the conditions of a small polarisation displacement of the charges in the quanton (at $x = y$):

$$e\frac{\partial \mathbf{E}}{\partial x} = -\mu_0 g \frac{\partial \mathbf{H}}{\partial y} \tag{9.67}$$

Taking into account (9.41) and the condition $\mu_0 C_0 = (\varepsilon_0 C_0)^{-1}$, from (9.67) we obtain:

$$C_0 \varepsilon_0 \frac{\partial \mathbf{E}}{\partial x} = -\frac{\partial \mathbf{H}}{\partial y} \tag{9.68}$$

Equations (9.68) is transformed to the form in which the variation of the strength of the fields is detected during time t and the speed of displacement of the charges v inside the quantons is expressed by the appropriate derivatives:

$$v = \frac{\partial x}{\partial t} = \frac{\partial y}{\partial t} \tag{9.69}$$

Taking (9.69) into account, from (9.68) we obtain the required relationship of the parameters of the field for the electromagnetic wave:

$$C_0 \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t} = -\frac{\partial \mathbf{H}}{\partial t} \tag{9.70}$$

Or, taking into account the orthogonality of the vectors **E**⊥**H**, equation (9.70) is expressed through the appropriate indexes x and y (or the unit vectors):

$$C_0 \varepsilon_0 \frac{\partial \mathbf{E_x}}{\partial t} = -\frac{\partial \mathbf{H_y}}{\partial t} \tag{9.71}$$

Comparing (9.71) with (9.48) and (9.49), we obtain a relationship identical with (9.50) for the vectors of the density of the displacement currents with the appropriate indexes, taking their orthogonality into account

$$\mathbf{j}_{my} = C_0 \mathbf{j}_{ex} \tag{9.72}$$

Further, the relationship (9.72) is reduced to the form (2.60)

$$\left[C_0 \mathbf{j}_e\right] = -\mathbf{j}_g$$

The variation of the electrical parameters of the quanton by the effect of the electromagnetic wave was analysed by taking into account changes of the field inside the quanton. However, since the quantised space-time, as a medium being in a neutral equilibrium state, leaves this state when the electromagnetic equilibrium of the quanton is disrupted, the resultant expressions also hold for the quantised space-time as a whole in electromagnetic polarisation of a set of quantons entering the region of the wave.

Thus, we have obtained rotorless equations (9.70), (9.71), (9.72) linking the electrical and magnetic parameters of the field of the electromagnetic wave in the quantised space-time and they determine the effect in the quantised space-time of laws of electromagnetic induction according to which the variation of the electrical component is accompanied by the appearance of the magnetic component, and vice versa.

Integration of (9.71) gives a relationship linking the strength of the electrical and magnetic fields in the electromagnetic wave in the quantised space-time which change in accordance with the harmonic law (with a dot):

$$C_0 \varepsilon_0 \dot{\mathbf{E}}_{\mathbf{x}} = -\dot{\mathbf{H}}_{\mathbf{y}} \tag{9.73}$$

Taking into account that the speed of light C_0 in (9.73) determines the direction of the electromagnetic wave and is the vector $\mathbf{C}_0$, the equation (9.73) can be presented in a more convenient form of the vector product

$$\varepsilon_0 \left[\mathbf{C}_0 \dot{\mathbf{E}}_{\mathbf{x}} \right] = -\dot{\mathbf{H}}_{\mathbf{y}} \tag{9.74}$$

Equation (9.74) shows that all the three vectors $\mathbf{E}_x$, $\mathbf{H}_y$, $\mathbf{C}_0$ are orthogonal in relation to each other. This means that the vectors $\mathbf{E}_x$ and $\mathbf{H}_y$ are situated in the plane normal to the speed vector $\mathbf{C}_0$ and determine the electromagnetic wave as the wave of transverse polarisation of the quantised space-time (Fig. 9.10). Attention should be given to the fact that the vectors $\mathbf{E}_x$ and $\mathbf{H}_y$ exist simultaneously in the electromagnetic wave. This eliminates one of the old mistakes regarding the nature of the electromagnetic wave, i.e., that the rotor of the electrical field generates the rotor of the magnetic field, and vice versa. Rotors have not been found in the flat electromagnetic wave in the quantised space-time in experiments.

The simultaneous existence of $\mathbf{E}_x$ and $\mathbf{H}_y$ rules out the rotor hypothesis

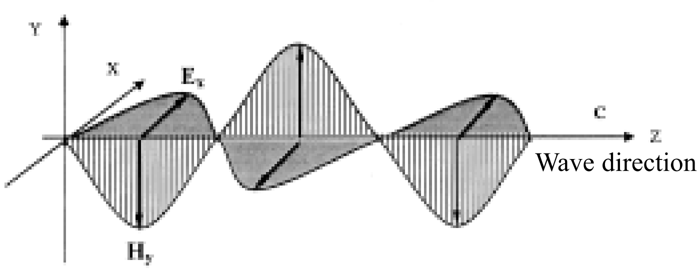

Fig. 9.10. Electromagnetic wave with transverse polarisation of the quantised space-time.

of propagation of electromagnetic wave in the quantised space-time. Only the electromagnetic polarisation of the quantons provides accurate explanation of the presence of electromagnetic field in the quantised space-time whose carrier is the quantised space-time. This fact is that the experimental confirmation of the conclusion that the vacuum has the structure in the form of quantised space-time. Consequently, it was possible for the first time to derive analytically the Maxwell equations which were written by Maxwell in the purely empirical form. For the quantised space-time, the relationship between the strength of the electrical and magnetic fields is reduced to only one equation (9.74) confirming the symmetry between electricity and magnetism in the quantised space-time.

For the gravitation-perturbed quantised space-time, the vector of the speed of light $\mathbf{C}_0$ in (9.74) transforms to the vector $\mathbf{C}$ from (9. 37). The nature of formation of the rotors of the strength of the electrical and magnetic fields in the quantised space-time is associated with the orientation polarisation of the quantons and has been investigated in [7, 8] for increasing distance from the radiation source. However, these rotors are secondary and do not explain the nature of the electromagnetic wave. Rotors are also found in the region of the emitting antenna in the form of a section of a conductor through which a high-frequency current passes. However, this is a line with the distributed parameters. The rotors are found in transformers, by the electromagnetic field of the transformer is not the electromagnetic field in the quantised space-time.

Naturally, polarisation of the quantised space-time is associated with both the deformation and orientation polarisation of the quantons themselves which are a carrier of the electromagnetic field and the electromagnetic energy of the emitting antenna. On the whole, the electromagnetic wave forms as a result of the disruption of the equilibrium of the quantised space-time caused by the electromagnetic polarisation of the quantons ensuring that they retain their intrinsic energy and, the same time, the effect of the laws of electromagnetic induction in the quantised space-time. However, the rotorless nature of electromagnetic induction for the electromagnetic wave in the quantised space-time differs, as shown, from the rotor nature of the electromagnetic induction for a transformer

9.13. Equivalence of electromagnetic and gravitational energies

In order to understand the energetics of the wave processes taking place in the quantised space-time, when, it would appear, the identical phenomena are associated, for example, with a mass defect, in one case we are concerned with electromagnetic radiation and in another case with gravitational waves, it is necessary to remove one of the paradoxes of theoretical physics permitting the simultaneous existence of two, it would appear, mutually excluding types of principles.

On the one hand, it is the principle of equivalence of electromagnetic energy and mass, determined by expression (9.13). However, as confirmed previously, the mass of a particle (a body) is a gravitational charge, i.e., it is a parameter of the gravitational field whose energy is determined by the energy of the spherical deformation of quantised space-time (9.13). Thus, the principle of equivalence of mass and energy determines the equivalence of the energy of the electromagnetic and gravitational fields.

On the other hand, in the theory of gravitation in has been believed that the energy of the gravitational field of, for example, an electron, is incommensurably smaller in comparison with its electrical energy. In fact, the standard equations for the energy of the gravitational W_m and electrical W_e (9.58) fields of the electron can be used to determine their ratio:

$$W_m = \frac{Gm_e^2}{r} \tag{9.75}$$

$$W_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r} \tag{9.76}$$

where $m_e = 0.91 \cdot 10^{-30}$ kg is the rest mass of the electron.

Dividing (9.76) by (9.75), we obtain the sought relationship:

$$\frac{W_e}{W_m} = \frac{1}{4\pi\varepsilon_0 G}\left(\frac{e}{m_e}\right)^2 = 4.2 \cdot 10^{42} \tag{9.77}$$

In general, equation (9.77) is inaccurate in its basis and is based on the forces of electrical interaction being considerably greater than the gravitational forces. However, the force acting on a free electron in the quantised space-time must be regarded as a derivative of energy (9.31). Consequently, the force integral gives the required value of energy which, if the integration constant is correctly selected, differs from (9.75). In calculations, no account is made of the gravitational energy of the deformation of the quantised space-time by the electron and, consequently, the integration constant was inaccurately determined resulting in the incorrect derivation of (9.77).

In fact, the energy of the gravitational field of the free electron is determined by the energy of spherical deformation of the quantised space-time because only the presence of spherical deformation of the quantised space-time by the particle is the reason for gravitation. On the other hand, the energy of the electrical field of the electron is determined by the energy of electrical polarisation of the spherically deformed quantised space-time. These interactions can be taken into account by the method of mirror imaging on a sphere in which the energy of interaction of the electron with the vacuum field is taken into account by the interaction with the second electron with mass m_e, imaged on a sphere, with the charge e. In this case, the main electron perturbing the vacuum generates in the quantised space-time the gravitational potential $\varphi = C^2$ from (9.15) and the electrical potential φ_e which also determines the energy of the gravitational and electrical fields of the electron

$$W_m = \int_0^{C^2} m_e d\varphi = m_e C^2 = m_e C_0^2 - m_e \varphi_n = m_e C_0^2 - \frac{Gm_e^2}{r} \quad (9.78)$$

$$W_e = \int_0^{\varphi_e} e d\varphi_e = \frac{1}{4\pi\varepsilon_0} \frac{e^2}{r} \quad (9.79)$$

Equation (9.17) was derived by the method of re-normalisation of the gravitational potential where the fictitious Newton potential is replaced by the actual gravitational potential C^2 (the action potential) of the spherically deformed quantised space-time (Fig. 9.2).

As shown by (9.78) the equation for the energy of the gravitational field of the electron with the spherical deformation of the quantised space-time taking into account greatly differs from the well-known expression (9.75), and the energy of the electrical field (9.79) coincides completely with (9.76). A paradox is that the energy of the gravitational field, like the energy of the electrical field, is determined by the value of the potential which in the case of the gravitational field decreases on approach to the gravitational interface of the medium (Fig. 9.2). The Newton potential plays the role of a fictitious potential, and the actual potential of the quantised space-time is defined as C^2.

However, the equations (9.78) and (9.79) are already comparable in the magnitude of energy and have a common point of intersection of the dependences on the distance, accepted as the classic radius of the electron r_e where the energy of the gravitational field is fully balanced with the energy of the electrical field of the free electron in the quantised space-time, i.e. $W_m = W_e$

$$m_e C_0^2 - \frac{Gm_e^2}{r_e} = \frac{1}{4\pi\varepsilon_0} \frac{e^2}{r_e} \quad (9.80)$$

From (9.80) we obtain the exact value of the classic electron radius r_e

$$r_e = \frac{\dfrac{e^2}{4\pi\varepsilon_0} + Gm_e^2}{m_e C_0^2} = \frac{e^2}{4\pi\varepsilon_0 m_e C_0^2} + \frac{Gm_e}{C_0^2} \tag{9.81}$$

The second component included in the solution (9.81) determines the gravitational radius R_g of the electron (9.10) which was previously not taken into account in physical calculations in determination of r_e. However, R_g is incommensurably small in comparison with r_e. For this reason, the classic electron radius r_e can be determined by the well-known equation, albeit approximate

$$r_e = \frac{e^2}{4\pi\varepsilon_0 m_e C_0^2} = 2.8 \cdot 10^{-15}\,\mathrm{m} \tag{9.82}$$

In fact, the gravitational potential C_0^2 of the quantised space-time has the role of the calibration potential in (9.80) and balances the energy of the gravitational and electrical fields of the electron. Still, in all previously mentioned considerations there is a certain indeterminacy with respect to the physics of the phenomenon and not mathematics. The energy of the gravitational field of the electron in accordance with (9.78) is almost completely independent of the distance to the electron and at infinity is equal to $m_e C_0^2$. This is incorrect because the effect of the gravitational field of the electron cannot extend to infinity without attenuation.

This shortcoming of the theory is eliminated as a result of the further application of the method of renormalisation of the gravitational potential. Taking into account the equivalence of the energies of the gravitational (9.78) and electrical (9.79) fields, we determine the equality taking into account the actual gravitational potential C^2 which satisfies the condition of equivalence of the energy of the gravitational and electrical fields of the electron:

$$m_e C^2 = e\varphi_e \tag{9.83}$$

Taking (9.82) into account, from (9.83) we determine the distribution of the actual gravitational potential C^2 of the electron, represented by the ratio r_e/r

$$C^2 = \frac{e\varphi_e}{m_e} = C_0^2 \frac{r_e}{r} \tag{9.84}$$

Taking into account (9.84), from (9.78) we determine the actual energy of the gravitational field of the electron equivalent to its electrical energy (9.76)

$$W_m = \int_0^{C^2} m_e d\varphi = m_e C_0^2 \frac{r_e}{r} \tag{9.85}$$

Equation (9.85) determines the distribution of the gravitational energy of the electron in the quantised space-time. As indicated by (9.85), within the limits of the boundary of the classic electron radius at $r = r_e$, its gravitational energy corresponds to the rest energy meC_0^2, and with increase of the distance from the electron the energy of its gravitational field weakens in inverse proportion to the distance, like the energy of the electrical field.

In this respect, the classic electron radius r_e has the function of the gravitational interface of the medium R_S (Fig. 9.2). In a general case, the distribution of the energy of the gravitational field of the elementary particle (or a body) can be expressed by the ratio R_S/r and the rest energy

$$W_m = m_0 C_0^2 \frac{R_s}{r} \tag{9.86}$$

9.14. Electron structure

Naturally, the calculations of the equivalence of the energy of the gravitational and electrical fields of the electron with the electromagnetic structure of the quantised space-time taken into account help to describe the electron structure. This is important for understanding the processes of emission by the electron of not only photon electromagnetic radiation but also for understanding the difference between the electromagnetic and gravitational waves in the quantised space-time.

As shown, the quantised space-time is a static electromagnetic field fully filled with quantons with a discreteness of the order of 10^{-25} m (Fig. 9.8). It is now assumed that an elementary massless electrical monopole charge with negative polarity ($-1e$) is introduced into the quantised space-time. The situation actually forms in the generation of a pair of particles – electron and positron – in the quantised space-time. Of course, the quantised space-time reacts to the introduction of the electrical monopole, mostly by electrical polarisation of the quantons.

Actually, the radial electromagnetic field of the monopole charge tries to unfold the quantons by the electrical axis along the line of force of the radial electrical field of the monopole ($-e$) and 'stretch' the quanton along the electrical axis, carrying out the processes of orientational and deformation polarisation (Fig. 9.11). It may be seen that in the immediate vicinity of the central monopole charge, in the region of the very strong electrical fields,

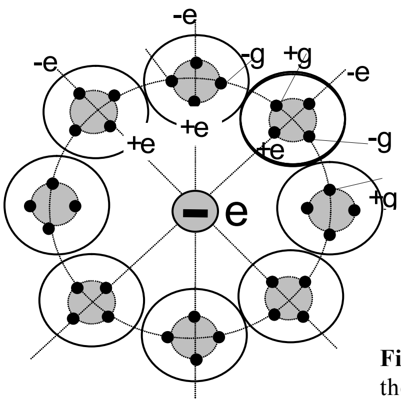

Fig. 9.11. Induction of the spherical magnetic field of the electron by its radial electrical field.

the quantons are oriented by their electrical axis in the direction of the radial field of the monopole charge. Since the magnetic axis of the quanton is normal to its electrical axis, then a group of quantons around the central monopole charge ($-1e$) forms a magnetic field closed on the sphere which is similar to a rotor although there are some differences.

Calculation show that the nonuniform electrical field of the monopole charge produces the gradient force $\mathbf{F}_e$ acting on the quanton and directed along the radius of the centre of the monopole charge ($-e$):

$$\mathbf{F}_e = \frac{1}{6\pi\varepsilon_0}\frac{e^2}{r^2}\left(\frac{L_q}{r}\right)^3 \mathbf{1}_r \qquad (9.87)$$

The magnetic field, closed on the sphere, also acts on the quantons, pulling them to the centre of the monopole charge ($-e$) with force N_g:

$$\mathbf{N}_g = \frac{\mu_0}{8}\frac{g^2}{r^2}\frac{L_q}{r}\mathbf{1}_r \qquad (9.88)$$

Dividing (9.88) by (9.87) and taking into account (9.53), we obtain an equation which shows that the dominant factor in pulling the quantons to the centre of the monopole charge is the induced magnetic field, closed on the sphere at $r = r_e$ (9.82)

$$\frac{N_g}{F_e} = \frac{3}{4}\pi\left(\frac{L_q}{r_e}\right)^2 = 3.6\cdot 10^{20} \qquad (9.89)$$

Later, the relationship (9.89) was made more accurate in (4.154)

$$\frac{F_{qg}}{F_{qe}} = \frac{\pi}{2}\left(\frac{r_e}{L_{q0}}\right)^2 = \frac{\pi}{2}\left(\frac{r_e}{L_{q0}}\right)^2 = 2.3\cdot 10^{21} \qquad (4.154)$$

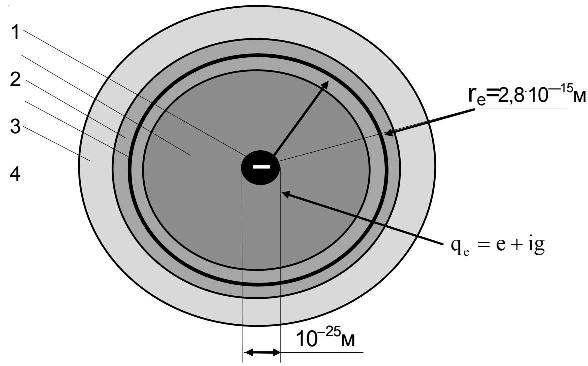

Fig. 9.12. The structure of the electron in the quantised space-time. 1) the electron nucleus (electrical monopole with negative polarity), 2) the region of compression of the quantised space-time by the spherical magnetic field, 3) transition region, 4) conventional interface (classic electron radius), 5) the region of ??? the quantised space-time.

Thus, the induced magnetic field, closed on the sphere, carries out spherical deformation of the quantised space-time, forming the electron mass whose structure is shown in Fig. 9.12 (more accurately in Fig. 4.3). The centre of the electron contains a nucleus in the form of a central monopole charge. Around the monopole charge there is a region of spherical deformation of the quantised space-time whose gravitational interface does not have any distinctive boundary with the quantised medium and appears to be 'blurred' in relation to the classic electron radius forming a transition region. This is followed by the region of extension of the quantised space-time.

The spherically closed magnetic field of the electron is a physical analogue of spin (similar to the anapole moment, only more complicated), giving to the electron both electrical and magnetic properties which can be expressed by a complex charge q_e (i is the imaginary unit)

$$q_e = e + ig \tag{9.90}$$

Equation (9.19) can be used to calculate the electrical and magnetic parameters of the fields of the electron in the appropriate measurement units, regarding the magnetic component as imaginary. The measurement unit (9.90) can be reduced to the unique value by means of (9.53). In any case, vector analysis in the field theory should be supplemented by new functions, describing the spherically closed fields (spher$\mathbf{A}_1$), induced by radial fields (rad$\mathbf{A}_2$), linked by specific relations together (here $\mathbf{A}$ is the vector of the strength of the field).

In this case, the electron field can be described by the complex strength $\mathbf{E} + i\mathbf{H}$, whose parameters are connected together by the relationship:

$$\text{rad}\mathbf{E} = -C_0\mu_0\text{spher}(i\mathbf{H}) \tag{9.91}$$

The imaginary unit in (9.91) indicates that the vector **H** is orthogonal to vector **E**, i.e., **H**⊥**E**. From (9.90) or (9.91) we determine the imaginary value of the strength of the spherical magnetic field of the electron

$$iH = \frac{1}{4\pi}\frac{g}{r^2} \tag{9.92}$$

The difference between the radial electrical field of the electron and its spherical magnetic field is that the electrical field disrupts the electrical equilibrium of the quantised space-time and is manifested externally (can be measured), whereas the spherical magnetic field does not disrupt the magnetic equilibrium of the medium and results only in changes of the quantised space-time forming a spherically closed magnetically ordered system.

During the lattice movement of the electron in the external magnetic field the spherical symmetry of its magnetic field is disrupted and the field transforms to a rotor field (9.48). It may be assumed that accelerated movement of the electron (and movement by jumps) disrupts the spherical symmetry of the magnetic field of the electron. During uniform movement of the electron in the quantised space-time unperturbed by other fields, the disruption of the spherical symmetry of the magnetic field of the electron should not take place and the situation is governed by the principle of spherical invariance. The relativity theory provides for visible elliptical compression of the field in the direction of movement in relation to a stationary observer. However, this is a paradox of relative measurements and does not relate to the actual position of the spherical field in the quantised space-time.

Naturally, the movement of the electron in the space is associated with the transfer of its monopole charge and transfer of fields: electrical, magnetic, gravitational. The energies of these fields are equivalent to each other, and their summation is not permitted. Each of the energies is the manifestation of the unified electromagnetic essence of the quantised space-time. For the electron, this uniqueness is reflected in the primary electrical polarisation of the quantised space-time and the secondary induction of the spherical magnetic field. The result of these effects is the formation of spherical deformation of the quantised space-time and the formation of a gravitational field. In particular, this secondary gravitational field of the deformed quantised space-time is regarded as the electron mass. The mass is the secondary manifestation of electromagnetism in quantised space-time.

In fact, the EQM theory includes the law of gravitational–electromagnetic induction, with the result of this induction being the generation of the electron mass from electromagnetism in the quantised space-time. This can be expressed in the form of a sequence of operations in the quantised space-time:

1. Formation of a radial electrical field **E** under the effect of a central monopole charge (–1*e*) on the quantised space-time;
2. Formation of a spherically closed magnetic field **H** (9.91);
3. Formation of the electron mass m_e as the function of the spherical deformation of the quantised space-time **D**:

$$\mathbf{E} \rightarrow i\mathbf{H} \rightarrow m_e(\mathbf{D}) \tag{9.93}$$

Evidently, as the speed of the electron in the quantised space-time increases, the monopole charge starts to interact with larger and larger numbers of the quantons, intensifying the processes of polarisation of the quantised space-time and, consequently, intensifying its spherical deformation and, in the final analysis, increasing the electron mass.

In [7] attention was given to the behaviour of an orbital electron in a gravitational well on a stationary elliptical orbit with no electron emission and also at the moment of emission of a photon as a result of its mass defect, and the structure of the positron and nucleons was also investigated.

9.15. Gravitational waves in quantised space-time

Returning to the analysis of the gravitational waves, it is assumed that they greatly differ by their properties from the additional transverse electromagnetic waves. However, these waves are of the same nature associated with the wave manifestation of quantised space-time. It may be assumed that the variation of time in space in Veinik's experiments is not associated with the effect of the flux of hypothetical chronons to a quartz sheet but it is caused by the deformation of the quantised space-time. This can take place as a result of the deformation of matter when the mechanical stresses in the matter change, and can also take place during phase transitions from one state of matter to another leading to the generation, in the quantised space-time, of longitudinal oscillations representing gravitational waves.

As already shown, the structure of the matter is linked inseparably with the structure of the quantised space-time. The generation of mass m is determined by spherical deformation of the quantised space-time, starting with elementary particles. This conclusion results from the Poisson equation (9.6) with (9.35) taken into account. In transition to the Gauss theorem, we determine the mass by the flow of the deformation vector (9.35) which penetrates the surface S in the spherically deformed quantised space-time

(where m_0 is the rest mass of the particle, kb)

$$m = m_0 \gamma_n = k_0 \oint_S \mathbf{D} dS \tag{9.94}$$

Experiments have confirmed that the mass of the specimen also changes slightly in the static deformation of the specimen of matter [21]. The deformation vector of the quantised space-time **D** is directed along the radius from the centre of mass of every elementary particle in the specimen of matter and, on the whole, is determined by the superposition principle, which adds up the effect of the entire set of the particles. For this reason, the variation of the mass of the specimen in deformation of matter results in a change of vector $\Delta\mathbf{D}_a$ (perturbation amplitude) of the quantised space-time outside the specimen, changing the total longitudinal flow Ψ of the deformation vector of the perturbed quantised space-time penetrating the closed surface around the specimen. These changes can be expressed by, for example, the harmonic law

$$\Psi = \oint_S (\mathbf{D} + \Delta\mathbf{D} \sin \omega t) dS = \frac{1}{k_0}\left[m_0 \gamma_n + \Delta(m_0 \gamma_n) \sin \omega t\right] \tag{9.95}$$

For the excitation in the quantised space-time of longitudinal oscillations of the quantum density of the medium, as the change of the flow of the deformation vector (9.95), it is necessary to change periodically the perturbation component $\Delta(m_0\gamma_n)$. Evidently, this can be carried out by changing the mass of the specimen and/or the direction and magnitude of its speed included in the normalised relativistic vector γ_n (9.32). The main factor for the excitation of the longitudinal oscillations of the quantised space-time in the region of non-relativistic speeds is the variation of the mass Δm of the specimen which, in a general case, can be described by the periodic law as the variation of the amplitude Δm_a, accepting in this manner a solid with a variable mass as a source of gravitational waves (9.43):

$$\Delta m = \Delta m_a \sin \omega t \tag{9.96}$$

This approach makes it possible to write the wave equation of the gravitational wave through the quantum density of the medium ρ in the quantised space-time, regarding the gravitational waves as the moving areas of longitudinal compression and the decrease of the quantum density of the medium in the quantised space-time from the source (9.96) with speed C (3.146):

$$\frac{\partial^2 \rho}{\partial t^2} = C^2 \left(\frac{\partial^2 \rho}{\partial x^2} + \frac{\partial^2 \rho}{\partial y^2} + \frac{\partial^2 \rho}{\partial z^2} \right) \tag{9.97}$$

The solution of equation (9.97) can be presented conveniently in the form of the variation of the magnitude and direction of the instantaneous value of the longitudinal deformation vector $\mathbf{D}_r$ of the quantised space-time at the distance **r** from the radiation source for the amplitude $\mathbf{D}_a$, for example, in accordance with the harmonic law (θ is the phase shift):

$$\mathbf{D}_r = \mathbf{D}_a \sin(\omega t - \theta) \tag{9.98}$$

Naturally, in the ideal case the gravitational waves should not be generated by the source (9.95) and should be generated by some other source in accordance with the EQM theory, forming a communication channel on the gravitational waves (Fig. 9.13). However, this task requires a technical solution. This communication channel will not have any electromagnetic screening and electromagnetic interference.

Evidently, in deformation of the specimen in Veinik's experiments, small changes of the mass of the specimen resulted in excitation in the quantised space-time of longitudinal oscillations of the medium in the form of gravitational waves which were also recorded on the basis of the variation of the frequency of oscillations of a quartz sheet as a change of time. Taking into account the nonuniformity of the material of the specimen, it can be assumed that in deformation loading of the specimen a large number of local zones (dislocations) form inside the specimen and they are capable of exciting gravitational waves forming their spectrum attenuating with time. Evidently, the electromagnetic radiation spectrum should also be detected in this case at the same time.

As indicated by the decrease of the frequency of quartz in the experiment in Fig. 9.1, the effect of the gravitational wave results in the formation of a specific asymmetry determined evidently by the anisotropic susceptibility of quartz to part of the wave with the reduced quantum density of the medium. The instability of the results of measurements of frequency of the quartz is evidently explained by the impact effect of the gravitational wave, excited by the non-periodic variation of the deformation state of the specimen. An effect is also exerted by the random phase shift between the oscillations which should result in a stochastic 'wobbling' of the frequency but at the moment it is not possible to determine the exact frequency of the gravitational wave and we can determine only the duration of restoration

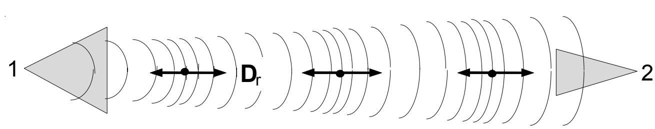

Fig. 9.13. Scheme of a possible communication channel on longitudinal gravitational waves in quantised space-time: 1) radiation source, 2) receiver.

of the deformation equilibrium of the specimen after removing the load. It can be assumed that the frequency of gravitational radiation is in the radio-frequency range and in the Veinik's experiments it was in the frequency range smaller than 10 MHz.

Evidently, the first scientist to predicted gravitational waves as early as in 1905 was French mathematician Poincaré. The possibility of formation of gravitational waves in the quantised space-time was subsequently investigated by Einstein in 1918 who erroneously assumed that by analogy with electromagnetic waves the gravitational waves are transverse waves and lead to acceleration of the solid [15]. A large number of attempts was made in the 20th century to detect experimentally the transverse gravitational waves. These experiments were not successful, regardless of the considerable effort applied to them [16]. Veinik recorded longitudinal gravitational waves of elastic deformation of the quantised space-time which did not fit the well-known Einstein concepts. For this reason, Veinik's discovery could not be understood for more than 10 years.

Actually, the source of the gravitational wave is the perturbation component $\Delta(m_0\gamma_n)$ in (9.95) inside which the acceleration factor is determined by the variation of speed in γ_n (9.23). This factor may prove to be significant if the solid acquires rapidly the speed close to the speed of light and also rapidly slows down in the reverse direction, repeating cyclically the process. No natural objects have as yet been detected in nature and they cannot be produced artificially. The bremsstrahlung of the relativistic electrons is well known but this phenomenon occurs in the region of the electromagnetic range of x-ray and gamma radiation.

As shown by analysis, the oscillating mass may be a source of gravitational waves (9.95). These oscillations inside the quantised space-time may be caused by periodic oscillations of the mass. The defect of variable mass, detected in this case, is found in the frequency range considerably lower than the frequency of quantum manifestations of electromagnetic radiation. For this reason, the oscillating mass in the gravitational radiation regime does not emit photon radiation which is detected, for example, as a result of the mass defect of the orbital electron in transition to a stationary orbit in the atom, determining the equivalence of the gravitational and electromagnetic energy [7].

Evidently, Veinik's discovery have something in common with a discovery by astrophysicist N. Kozyrev who also recorded the radiation of unknown nature of originating from stars which was then reliably reproduced in investigations by other scientists [17]. It should be noted that Kozyrev's radiation is considerably faster (according to the author) than the speed of light. I have two hypotheses in this case:

The first hypothesis: Kozyrev discovered fluxes of neutral particles – tachions of the electronic neutrino type not connected with the wave properties with the quantised space-time because these particles have no mass and their movement in space does not require transfer, together with the particle, of spherical deformation of the quantised space-time as a single wave, for example, of the soliton type. The speed of tachions, as particles not associated with the way properties of the quantised space-time, can greatly exceed the speed of light. The speed of light itself is a wave function in the quantised space-time for transversely polarised waves and is connected with the quantum density of the medium (gravitational potential C^2). Unfortunately, because of the absence of experimental procedures and appropriate equipment, we do not know the distribution of these neutral particles (of the electronic neutrino type) with respect to concentration, speed and direction of the flows.

In fact, the EQM theory regards the structure of the electronic neutrino in the form of an electrical dipole consisting of massless charges of positive and negative polarity with the distances between them considerably smaller than the classic electron radius. At these distances between the charges in the quantised space-time it is not possible to ensure the spherical deformation of the quantised space-time around the charges and form some mass. For this reason, the electronic neutrino does not have any mass [7].

The second: Kozyrev discovered gravitational radiation from stars whose speed is determined by the wave speed of perturbation of the quantised space-time and its magnitude coincides with the speed of light (or is close to it). Consequently, the results showing that the new radiation and the light emitted by the stars are recorded on the celestial sphere with different coordinates, can be explained by different trajectories of gravitational and light radiation of the stars determined by the curvature of the space-time. This curvature determines the topology of space, for example, by analogy with the distortion of the quantised space-time by the spherical magnetic field of the electron (Fig. 9.9). In this case, the trajectories of propagation of the longitudinal gravitational and transverse electromagnetic radiations do not coincide and in observations they appear as the radiation emitted by different objects.

However, this is possible only if the space of our universe is not flat but is convex (distorted). This disputable question requires extensive investigations, both theoretical and experimental, of a peculiar region of cosmology. In fact, the topology of the cosmic space with its quantised structure taken into account has not been examined.

In a general case, the presence of the elastic static electromagnetic structure of the quantised space-time shows that it contains three types of wave perturbations and their combinations:

1. Transverse oscillations. This type of oscillation in the quantised space-time is manifested in the form of an electromagnetic wave determined by the electrical and magnetic polarisation of the quantised space-time (electrical and magnetic displacement currents). Since the electromagnetic waves do not change the quantum density of the medium, these waves appear only as transverse waves.

2. Longitudinal oscillations. This type of oscillation is manifested in the form of a gravitational wave in the quantised space-time and is described by the wave equation (9.97). The solution of (9.97) can be conveniently presented in the form of the harmonic function (9.98) of the variation of the magnitude and direction of the instantaneous value of the longitudinal deformation vector $\mathbf{D}_r$ of the quantised space-time:

$$\mathbf{D}_r = \mathbf{D}_a \sin(\omega t - \theta)$$

3. Torsional oscillations. This complicated and insufficiently examined type of oscillation in the quantised space-time is sometimes referred to as torsional radiation and evidently contains the main tangential (transverse) components, forming the rotor of the deformation vector rot**D** in the medium in combination with the radial (longitudinal) component representing the variety of the gravitational wave.

As regards the torsional oscillations in the quantised space-time (torsional radiation), I do not support attempts to present the theory of these oscillations from the general theory of relativity (GTR) in a study by G. Shipov [18] because they do not consider in the calculations the structure of the quantised space-time and complicate physical understanding of the actual processes. Shipov, rejecting GTR, proposed a geometrical theory of absolute parallelism. It was proposed that two parallel lines never intersect in space but they are capable of twisting along a helical line. However, in the EQM theory, the torsional component of the longitudinal gravitational wave is taken into account by the tangential component of the deformation vector in (9.98). Taking into account that the torsional oscillations take place, I highly value the studies by G. Shipov and his colleague A. Akimov who devoted a considerable effort to the development of the new direction and its defence the scientific world.

All types of oscillations in the quantised space-time can be regarded as quantum fluctuations of the balanced static quantised space-time as a result of disruption of the steady equilibrium [5, 19]. In addition to this, I personally, as an experimentator, reproduced part of Veinik's experiments and greatly increased the sensitivity of recording equipment. This enabled me, as a theoretician in this case, to be fully certain about the validity of the EQM theory, also taking into account the fact that the results of Veinik's experiments have been reproduced by other investigators [20, 21]. However, in reproducing Veinik's experiments, there are considerable problems associated with the very small strength of the observed effect and with the effect of electromagnetic component on the results.

9.16. Report by V. Leonov on the generation of a gravitational wave

On August 16, 2006, I managed to send for the first time to the cosmic space a gravitational wave with a power of ~100 W. I greatly treasure my reputation of a scientist who has made fundamental discoveries which would determine the development of science and technology for many years to come. Therefore, I am fully confident about my discovery, taking into account the fact that the method of generation and of reception of gravitational radiation, and also devices used for this purpose, are already protected by a patent with know-how.

The experiment itself is greatly interesting because of the complete coincidence of the theoretical assumptions and the results. A receiver gravitational radiation has not as yet been constructed and it was therefore necessary to record gravitational radiation indirectly. The experiments was based on the following procedure:

The volume of the emitter of the gravitational wave (activator) is very small, no more than 0.2 l (200 cm^3). The emitter is screened with a steel screen and is earthed. This prevents any electromagnetic radiation. Direct current is supplied to the emitter. The DC intensity and voltage determine the power required by the emitter which was approximately 100 W.

Why am I so sure that this energy is used for generating gravitational radiation and is carried with it into the cosmos? The answer is simple. Electromagnetic radiation is screened. If the supplied energy is transformed into the electromagnetic field inside the emitter, the electromagnetic field should heat the emitter. This was not so. The emitter remained cold. This is possible only if the supplied energy inside the emitter is transformed into gravitational radiation and carried into the space without heating the emitter. Initially, the device was constructed as a source of gravitational radiation on the basis of the EQM and Superunification theories..

The observed slight heating of the system is determined by the efficiency of conversion lower than 100% at the required power of the order of 100 W. If a heater with a power of 100 W (soldering iron) is placed instead of the gravitational emitter inside a steel screen with the volume of 0.2 l, the system is rapidly heated. In particular, the gravitational emitter tranfers energy into space without allowing the system to heat.

The first conclusion fully confirms theoretical predictions. **The electromagnetic screen does not screen gravitational radiation.** The gravitational wave is characterised by a colossal penetrating capacity. I did not feel any harm to my health. I assume that around us there is a large number of gravitational waves from different sources and we are simply not capable of recording them, as we could not record electromagnetic radiation in the past. So far I have not constructed a receiver of gravitational waves (but could not do this because of objective reasons) and I have decided not to reveal all the fine details of the experiment for repetition in other laboratories. In fact, they can be repeated quite easily, if one penetrates into the principle of the EQM and Superunification theories (see Russian Federation patent No. 2184384 'Method of generating and receiving gravitational waves and device for this purpose (variants), Bulletin No.18, 2002).

At present, fundamental science has a real possibility of carrying out unique experiments in comparing the speeds of light and gravitational radiation and at the same time stop all the scientific discussions in this problem.

The applied aspects of application of gravitational waves are manysided..

9.17. Conclusions for chapter 9

The nature of gravitational waves can be determined by the theory of the elastic quantised medium (EQM) (or Superunification theory) which at present is the most powerful analytical apparatus for investigating the matter and most complicated physical phenomena. The EQM theory is the theory of the unified field whose principles were predicted by Einstein within the framework of the general theory of relativity (GTR). It has been established that the quantised space-time is governed by the principle of spherical invariance and the relativity principle is the fundamental property of the quantised space-time. The theory represents a further development of the quantum theory and quantum considerations regarding the nature of matter from the viewpoint of electromagnetism. The discovery of the electromagnetic structure of the quantised space-time has enabled us for the first time to determine the superstrong electromagnetic interaction (SEI), i.e., the fifth force, combining gravitation, electromagnetism, nuclear and weak forces.

On the basis of the analysis of the wave oscillations in the elastic quantised medium (quantised space-time) it can be assumed that Veinik recorded for the first time in experiments the longitudinal gravitational waves in the form of moving zones of compression and of the decrease of the quantum density of the vacuum medium emitted at the moment of a change in the deformation-stress state of matter. The Veinik results were reproduced by other investigators. However, the Veinik experiments are characterised by low stability and a low recorded strength of the signal comparable with the level of noise and interference. It is important to develop completely new methods of generating and receiving gravitational waves.

The scientific fundamentals of these developments are provided by the EQM theory which describes for the first time the structure of the quantised space-time regarding it as an elastic quantised medium, being a carrier of wave perturbations in the quantised space-time. Analysis of the wave perturbation of the quantised space-time shows that there are three types of wave oscillations in it: transverse, longitudinal and torsional. All three types of the wave oscillations of the quantised space-time have been observed in experiments.

Transverse oscillations. This type of oscillations in the quantised space-time is manifested in the form of an electromagnetic wave generated by the transverse electrical and magnetic polarisation of the quantised space-time (electrical and magnetic bias currents).

Longitudinal oscillations. These oscillations are manifested in the form of a gravitational wave as longitudinal displacement of the zones of compression and of the decrease of the quantum density of the medium in the quantised space-time.

Torsional oscillations. This complicated, insufficiently examined type of oscillations in the quantised space-time is associated with the formation of torsional oscillations.

Thus, it has been shown for the first time that the gravitational waves are characterised by the longitudinal oscillations of the quantised space-time. Knowledge of the nature of gravitational radiation makes it possible to develop completely new devices for excitation of gravitational waves.

In the area of communications, one can expect the development of completely new and unusual channels for sending and receiving information which differ from the channels based on conventional electromagnetic waves. This expands the range of investigations of matter, including biological systems in medicine and agriculture. Naturally, Veinik's discovery is constantly utilised by astronomers and astrophysicists who have been expecting for a long time the discovery of an effective method of recording gravitational waves.

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