P. DANYLCHENKO

GAUGE-EVOLUTIONAL INTERPRETATION OF SPECIAL AND GENERAL RELATIVITIES

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P. Danylchenko. Gauge-Evolutional Interpretation of Special and General Relativities.
It is shown, that special and general relativities reflect the gauge of effect on matter of, correspondingly, motion and gravity. This doesn't allow us to observe in intrinsic space and time of the matter any changes, appeared because of this effect. The solution of gravitational field equations that corresponds to astronomical objects, alternative to black holes, is found. The eternity of Universe existence both in the future and in the past is shown.

Данильченко П.
Д 18 **Калібрувально-еволюційна інтерпретація спеціальної та загальної теорій відносності.** Збірник статей (англ. мовою). — Вінниця: О. Власюк, 2004. — 100 с.
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Показано, що спеціальна та загальна теорії відносності відображають калібрувальність дії на речовину відповідно руху та гравітації. Це не дозволяє спостерігати у власному просторі та часі речовини будь-яких змін, що виникли через цю дію. Знайдено розв'язок рівнянь гравітаційного поля, що відповідає астрономічним тілам, які альтернативні чорним дірам. Показана вічність існування Всесвіту як у майбутньому, так і у минулому

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The nature of relativistic length shrinkage

It is shown here, that relativistic shrinkage of the length of moving body appears itself (without the influence of external forces). This shrinkage is caused by isobaric self-contraction of body matter and by propagation of the strength of inertia forces field together with the front of body proper time. A mechanism of kinetic energy filling of a body is considered and propagation of the phase waves of perturbation of gravitational field at supraluminal velocity is substantiated here.

Keywords: relativistic length shrinkage, inertia, isobaric self-contraction, supraluminal velocity, graviinertial stressed state, Einstein-Podolski-Rosen paradox, gravitational waves.

1. Introduction

Physical processes during their separate stages can be accompanied and can be not accompanied by transfer of matter or its excited state in space. In the first case, they are characterized by group velocity V of transfer of particles and quasi-particles (photons, phonons, excitons etc.). This velocity cannot exceed the velocity of light in free space (equal to one if distances are measured in light units of length). In the second case, they are characterized by phase velocity U of propagation of change of collective space-time state of matter. The change of this state of matter realizes, as suggested here, together with the change of graviinertial stressed state in a space, filled with matter. Therefore, not only propagation of change of collective space-time state of matter but also propagation of induction of strength of inertia forces field in intrinsic frame of reference of space coordinates and time (FR) of hypothetical incompressible (perfectly rigid) body will happen momentarily ($u \equiv \infty$). Phase velocity of propagation of induction of spatial distribution of the strength of inertia forces field in an incompressible body, which moves relatively to the hypothetically physically homogeneous physical vacuum (PV) at a constant velocity V, in the PVFR will not be infinitely high, but equal to: $U = c^2/V = V^{-1}$ ($c = 1$). This fact is connected with translational motion of body, in which a wave front of induction of graviinertial stressed state propagates.

2. Derivation of relativistic length shrinkage

Let the incompressible body moves uniformly in pseudo-Euclidean Minkowski space-time of the PVFR at absolute velocity V_0 (before the induction of the strength of inertia forces field in it). Also let the initial distance along the movement route between two arbitrary points (i and j) of the body in the PVFR absolute space (in which frequency of universal background is isotropic) is equal to X_{ij0}. Then after body transition into new steady state of its uniform motion at absolute velocity $V_j = V_i = V$, the distance between these two points will be equal to:

$$X_{ij} = X_{ij0} + \left(V_0 \delta T_{ij0} + \delta X_j\right) - \left(V \delta T_{ij} + \delta X_i\right) =$$

$$= \left(\Gamma_0^2 X_{ij0} + \delta X_j - \delta X_i\right)\Gamma^{-2} = \delta T_{ij} \Gamma^{-2} V^{-1}, \qquad (1)$$

where: $$\delta T_{ij0} = X_{ij0}\left(U_0 - V_0\right)^{-1} = \Gamma_0^2 V_0 X_{ij0} \qquad (2)$$

and: $$\delta T_{ij} = \left[X_{ijo} + \left(V_0 \cdot \delta T_{ij0} + \delta X_j\right) - \delta X_i\right] \cdot U^{-1} =$$

$$= V\left(\Gamma_0^2 X_{ij0} + \delta X_j - \delta X_i\right) = X_{ij}\left(U - V\right)^{-1} = \Gamma^2 V X_{ij} \qquad (3)$$

– the durations of time delay of accordingly induction and removal of the strength of inertial forces field in point j, regarding point i (equal to desynchronizations, observed in the PVFR, of all the other events, which are synchronous in these points in the inertial FR (IFR) of moving body);

δX_i and δX_j are the traversed paths in absolute space of accordingly points i and j from the moments of induction T_{i0} and T_{j0} till the moments of removal $T_i = T_{i0} + \delta T_i$ and $T_j = T_{j0} + \delta T_j$ of strengths of inertia forces field in these points; $\Gamma_0 = (1 - V_0^2)^{-1/2}$ and $\Gamma = (1 - V^2)^{-1/2}$ are characteristics of the accordingly initial and newly-formed IFR;

$U_0 \equiv V_0^{-1}$ and $U \equiv V^{-1}$ - velocities of propagation of fronts of processes of induction and removal of strengths of inertia forces field in the PVFR accordingly.

Let's assume that X_{ij} is a function just of V and depends neither on the value of V_0 nor on the law of body motion before it takes on the value of inertia motion velocity V. Then, according to (3), δT_{ij} does not depend on V_0 and on this law of body motion either. Basing on this fact and on the condition $V_0 = 0$, let's choose a uniformly accelerated motion (as the simplest law of irregular motion) of the point i of the body before it takes the value of velocity V:

$$V_i = a_i \delta T_{ij} , \tag{4}$$

where $a_i = dV_i/dT$ is the acceleration of the motion of point i. Then multiplying the left and the right parts of the equation (4) by dT and considering the immobility of the point j during the time δT_{ij} ($dX_j = 0$), we will obtain the following differential equation:

$$dX_{ij} = -dX_i = -\delta T_{ij} dV = -\Gamma^2 V X_{ij} dV , \tag{5}$$

solving which we will find: $X_{ij} = X_{ij0} \Gamma_0 / \Gamma$,

$$\delta T_{ij} = \Gamma_0 \Gamma V X_{ij0} = \delta T_{ij0} \Gamma V / \Gamma_0 V_0 . \tag{6}$$

When $V_0 = 0$: $X_{ij} = x_{ij} / \Gamma$, and $\delta T_{ij} = \Gamma V x_{ij}$, where: $x_{ij} = X_{ij}(0)$ is the distance between the points j and i, measured in the IFR of moving body and equal to the distance between them in absolute space in hypothetical state of body absolute rest relatively to the PV.

So, if an incompressible body proceeds from the state of rest relatively to the PV into a new-steady state of inertial motion, then relativistic shrinkage of body length along the direction of motion takes place. The value of this shrinkage is determined by the analytical dependence, discovered by Fitzgerald and Lorentz independently from each other, and does not depend on the law of change of strengths:

$$-G_j(x,V) = (dP_A / dt) / H_A = -(\partial \ln v_c(x,V) / \partial x)_V =$$

$$= -d(P_j / m_j) / dT = -\Gamma_j^{\,3} a_j$$

of removable gravitational (graviinertial) field, which originates in the intrinsic FR of the body. And consequently, the value of this shrinkage does not depend on the law of motion of body points during the proceeding of body from the state of rest or inertial motion into the state of inertial motion at another velocity. Here: P_A and H_A - accordingly linear momentum and invariable energy (conservative Hamiltonian) of free-falling (motionless in the PVFR) particle *A*, which are definite in intrinsic FR of the accelerating body; $v_c(x,V) = cG_i(x_i,V) \cdot G(x,V)^{-1}$

- improper values of the velocity of light in free space in body intrinsic FR (unequal in different points of physically inhomogeneous intrinsic space of body in proper time *t* of point *i*); P_j and m_j - accordingly linear momentum in the PVFR and eigenvalue of mass of the point object (particle) *j* of the body. At this, conditions:

$$\delta X_j - \delta X_i = \Gamma^2 X_{ij} - \Gamma_0^2 X_{ij0} = (\Gamma - \Gamma_0) x_{ij},$$
$$\delta T_j - \delta T_i = \delta T_{ij} - \delta T_{ij0} = (\Gamma V - \Gamma_0 V_0) x_{ij}, \quad (7)$$

which follow from (1-3), always guarantee simultaneity of removal of strengths of inertial forces field in body intrinsic FR in all body points. And consequently, they also guarantee a momentary transition in this FR (without any transient process) of an incompressible body into equilibrium state of inertial motion. And the fulfillment of these conditions is possible only at the following distribution of strength of inertia forces field along the moving body:

$$G_j(V)^{-1} = G_i(V)^{-1} + x_{ij}. \quad (8)$$

Where, as we supposed, $G_i(V)$ can vary with time according to the arbitrary law. And it specifies at that any law of body motion. At that spatial distribution of strength of graviinertial field (inertia forces field) unconditional realization of the identity will take place:

$$U = (\partial X / \partial x)_t (\partial T / \partial x)_t^{-1} \equiv V^{-1}.$$

3. Equations of irregular motion of body points

According to (8), the motion of any point of the body in the process of its transition from inertial motion at absolute velocity V_0 to inertial motion at absolute velocity V can be described by the same parametric equations as motion of the point i:

$$\delta X_i = X_i - X_{i0} = \int_{V_0}^{V} \frac{v\,dv}{G_i(v)\,\left(1-v^2\right)^{3/2}}\,, \tag{9}$$

$$\delta T_i = T_i - T_{i0} = \int_{V_0}^{V} \frac{dv}{G_i(v)\,\left(1-v^2\right)^{3/2}}\,, \tag{10}$$

or in another form by the equation:

$$\left[X_i(V) - X_c(V)\right]^2 - \left[T_i(V) - T_c(V)\right]^2 = \left[x_i - x_c(V)\right]^2 = G_i(V)^{-2} \tag{11}$$

Where: $$X_i(V) - X_c(V) = \mathit{\Gamma}(V)\left[x_i - x_c(V)\right] = \mathit{\Gamma}(V)/G_i(V), \tag{12}$$

$$T_i(V) - T_c(V) = V\left[X_i(V) - X_c(V)\right] = V\mathit{\Gamma}(V)/G_i(V), \tag{13}$$

and $$x_c(V) = x_i - G_i(V)^{-1} \tag{14}$$

is a coordinate of an asymptotic limit (singular plane) of intrinsic space of moving body, which can be considered as an observer horizon of the body FR ($G_c = \infty$);

$$X_c(V) = X_c(V_0) + \int_{x_c(V_0)}^{x_c(V)} \mathit{\Gamma}(V)\,dx_c = X_c(V_0) + \int_{V_0}^{V} \frac{dG_i}{dv} \cdot \frac{\mathit{\Gamma}(v)}{G_i(v)^2}\,dv\,, \tag{15}$$

is a coordinate in absolute space of hypothetically initial position of the observer horizon of body at the beginning of its motion ($V = 0$) on condition that distribution of strengths of inertia forces field along the body from the beginning of its motion is the same as at the given identical velocity of all its points $G_i(0) = G_i(V) = const(V)$;

$$T_c(V) = T_c(V_0) + \int_{x_c(V_0)}^{x_c(V)} V\mathit{\Gamma}(V)\,dx_c = T_c(V_0) + \int_{V_0}^{V} \frac{dG_i}{dv} \cdot \frac{\mathit{\Gamma}(v)v}{G_i(v)^2}\,dv\,, \tag{16}$$

is a hypothetical moment of absolute time, when the body motion in the absolute PV space would begin, if distribution of strengths of inertia forces field along the body were stationary. At that, $T_c(0) = T_i(0)$. And at coincidence of the points of origin in absolute space and in intrinsic space of the body in its hypothetic state of rest relatively to the *PV* ($X_i(0) = x_i(0)$) and also $X_c(0) = x_c(0)$. When dependence of strengths of inertia forces field on absolute velocities *V* of body points is weak, equation (11) corresponds to quasi-hyperbolic motion of these points. If the distribution of strengths of inertia forces field along the moving body is stationary ($G_i \equiv const\,(V)$), then all the body points perform in the PVFR not quasi-hyperbolic but definitely a hyperbolic motion. And the moving body (even if it is compressible) will be resting in an appropriate to it Möller rigid accelerating FR [1,2]. A proportional mutual synchronization of quantum clock, located in different points of physically inhomogeneous intrinsic space of this FR, is possible only in this FR. But in general case, events in different points are considered just to coincide with each other, if they happen at the same instantaneous values of absolute velocities *V* of these points. Events, not having direct cause-and-effect relations with each other, are meant here under coincident events. But in the presence of common cause, mutual correlation of coincident events can take place. These events correspond to definite collective space-time state (microphase state) of particles of body matter. And they are simultaneous according to quantum clock, only in the case of homogeneity of intrinsic time *t*, which is possible only in the case of stationarity of spatial distribution of the velocity of light in free space in co-moving FR:

$$v_{cj} = v_{ci} G_i G_j^{-1} = v_{ci}\left(1 + x_{ij} G_i\right) = const(t).$$

And it is possible only in Möller FR [1, 2].

From the condition of the absence of increment of action *S*: $dS = LdT = PdX - HdT = 0$, corresponding to invariance of collective space-time state of matter, we’ll have:

$$dX / dT = H / P = V^{-1} \equiv U,$$

where L - Lagrangian of body matter. In view of this, the front of induction of strength of inertia forces field in incompressible body (the same as the front of propagation of change of collective space-time state of matter) is identical to the front of coincident events.

According to Lorentz transformations, the front of coincident events of any body, which moves relatively to an observer at velocity v, will be moving in observer FR, as well as in the PVFR, not at infinitely high, but at finite phase velocity $u = v_c^2/v$.

4. Propagation of the changes of graviinertial stressed state and elastic deformation in compressible body

For an elastically compressible (deformable) body, the distance $\hat{x}_{ij}$ between the points i and j in its uniform and stable metrical intrinsic space (where the motion of its points in the process of elastic deformation of the body matter is observable) can be connected with the distance between them x_{ij} in inseparable from the body its nonuniform and metrically instable physical intrinsic space by the following dependence: $\hat{x}_{ij} = \alpha(V)x_{ij}$. Where: $\alpha(V)$ is a coefficient of the elastic shrinkage of body size along the direction of its motion, that depends on the velocity of the body when the strength of inertia forces field is instable ($G \neq const(V)$).

In contrast to a hypothetical incompressible body, in metrical intrinsic space of a compressible body, only microobjects (elementary particles) have purely relativistic size shrinkage along the direction of motion. It is connected with the elastic deformation of matter macroobjects that also can be observed in the body intrinsic FR. As well as in incompressible body, this shrinkage is caused by elementary particles adaptation (and by adaptation of the matter as the whole, owing to Van der Waals forces, which have electromagnetic nature) to changed conditions of elementary particles interaction. This adaptation guarantees in the first place the isotropy of interaction frequency and becomes apparent in co-moving FR at the absence of anisotropy of the radiation spectrum of radiation sources, motionless relatively to the body. Lorentz considered processes, which are connected with this adaptation, first in detail [3] on the example of electrical and electromagnetic phenomena. The possibility of such adaptation follows from the wave nature of elementary particles and of matter as the whole. That's why relativistic size shrinkage realizes at elementary particles level and is connected with longitudinal self-contraction (which is initiated by motion) of wave-like formations, which correspond to elementary particles [4].

Relativistic size shrinkage along the direction of the body motion will guarantee isotropy of the velocity of light in free space only in physical intrinsic space of the compressible body. In metrical intrinsic space (considering the observability of body deformation in it) the velocity of light in free space will be anisotropic. Moreover, in contrast to physical intrinsic space, in metrical intrinsic space definition of an interval between two world points (which is invariant to transformations of coordinates only in physical spaces), as well as the definition of energy and momentum of any objects has no physical sense. That is why the analysis of dynamics of body compression and of the motion of objects is impossible in principle in this space [5]. Dynamics of the objects can be analyzed only in physical intrinsic space of a compressed body using continuous renormalization of all the measurements and spatial characteristics, determined in it, considering their change in metrical intrinsic space of the body.

In elastic compressible body, as well as in hypothetical incompressible body, the front of induction of strengths of graviinertial field in it can be identified with a wave front of change of collective space-time state of body matter. That is why, also in an intrinsic FR of elastically compressible body the propagation not only of quantum of action, but also of change of space-time distribution of the strength of graviinertial field (the main characteristic of collective space-time state of matter), takes place momentarily in principle. This is caused by the wave nature of elementary particles of matter, which becomes apparent also in collective space-time state of matter.

Let the linear momentum and therefore velocity of an elastic compressible body increase in a result of a shock action (impact). Then in the PVFR (as well as in FR of any body that moves at another velocity) a phase soliton (phase packet) of modulation of strength of graviinertial field will run along the moving body at supraluminal phase velocity. This soliton changes the value of relativistic shrinkage of molecules of body matter and does not cause their elastic deformation. After that, a soliton (wave packet) of elastic deformation and excitation of matter molecules will run along the body at a velocity of sound. Body filling with additional kinetic energy, as it were transferred by graviinertial phase soliton at supraluminal velocity, as a matter of fact is not connected with ripple-through energy transfer in it. This filling is an inert process and realizes only due to accumulation of difference of Doppler energies of exchange virtual elementary particles and quasi-particles, which propagate in the process of interaction of elementary particles, atoms and molecules in and against the direction of soliton propagation. These are virtual pi-mesons that during the process of strong interaction maintain collective dynamic equilibrium between protons and neutrons in an atom. And these also are virtual photons that during the process of electromagnetic interaction maintain collective dynamic equilibrium between protons and electrons in an atom, as well as between electrically and magnetically polarized atoms and molecules. At this, the work is executed by the forces, which disturb the mechanical equilibrium of the matter. These forces are equal to inertia forces (they are, like gravitational forces, actually only pseudoforces [4]), but they are directed oppositely. Neither entropy nor enthalpy of the matter in the body intrinsic FR vary during the process of the body filling with kinetic energy. That is why neither free photons nor phonons or any other quasi-particles are generated and transferred in the body. And therefore, ripple-through energy transfer and energy dissipation are absent. In the contrast to total energy, Helmholtz energy of body matter increases in the PVFR not only due to increase of linear momentum and of relativistic shrinkage of molecular volume, but also due to decrease of Planck relativistic temperature. The energy of soliton of elastic deformation (which runs after the phase soliton) will be dissipated and transformed into heat after multiple reflections from the body boundaries.

In this case, before coming of a soliton of elastic deformation of matter, motion of points of compressible body can be described by the same equations (8-16) as motion of points of incompressible body. Now let the body linear momentum increase due to a long-lived force. And that’s why the front of removal of the graviinertial stressed state runs along the body after the induction of a definite elastic deformation of its matter. Then motion of the body points before the front running can be described by equations, different from the ones (8-16). The distance between the points j and i $\hat{x}_{ij}$ in elastically deformated state of the body matter will be used in these equations instead of the distance x_{ij}. In this case, removal of graviinertial stressed state will realize the same way as in an incompressible body, but considering the change of the distances x_{ij} to distances $\hat{x}_{ij}$ that take place at a point in time when the front of removal of the stressed state is passing through the point j.

Relativistic shrinkage of the length of moving body realizes itself (without influence of any external forces) and its matter does not exhibit resistance to contraction. Therefore work on relativistic contraction of matter:

$$(dA)_{\tilde{\mathrm{v}}} = -p(d\,\mathrm{v})_{\tilde{\mathrm{v}}} = p\,\tilde{\mathrm{v}}\,\Gamma^{-2}d\Gamma\,,$$

executes by internal forces due to decrease of heat content (enthalpy) of moving body matter:

$$\left(-dL_{\mathbf{H}}\right)_{\mathbf{H}} = -\mathrm{H}\,\Gamma^{-2}d\Gamma = -\mathrm{U}\,\Gamma^{-2}d\Gamma - (dA)_{\tilde{\mathrm{v}}}\,,$$

where: $\mathrm{v} = \tilde{\mathrm{v}}/\Gamma$ and $\tilde{\mathrm{v}}$ - accordingly relativistic value and eigenvalue of matter molar volume; $L_{\mathrm{H}} = -\mathrm{H}/\Gamma$ - Lagrangian of enthalpy $\mathrm{H} = \mathrm{U} + p\,\mathrm{v}$, and U - internal energy of the one mole of matter. At that the energy of thermal oscillatory motion of matter molecules partially transforms into kinetic energy of their ordered motion.

5. Effects caused by equivalence of removable (graviinertial) and irremovable gravitational fields

Momentary propagation of induction of graviinertial stressed state (physical inhomogeneity of the body intrinsic space, that can be identified to a gravitational field) in the body is well matched in Einstein-Podolski-Rosen paradox [6] with a momentary intercoordination of changes in the quantum-mechanical characteristics of previously correlated photons or elementary particles after mutual self-distancing of the ones at arbitrary long spacing. This points at the possibility of momentary propagation of disturbance of proper gravitational field (in intrinsic FR) also in free space. Also this points at rigid connection in space of gravitational field to macro- or microobject, which creates it, (at the impossibility of time delay of displacement of spatial distribution of gravitational field strength relatively to displacement of this object). That is why the carriers of gravitational field in free space are photons, elementary particles and any moving macroobjects, consisting of them, but not hypothetical gravitons (their existence is impossible in principle as it was shown in [4]). Any moving macroobject (body) can be characterized by de Broglie frequency. And it lets us consider moving body also as a gravitational wave, which transfers energy.

During the rotation of a negatively charged body around a positively charged body, electromagnetic radiation is generated. But similar specific radiation is not generated during the rotation of planets around the Sun. Otherwise the planets finally would fall on the Sun due to continuous energy losses. That is why only the matter, the accretion of which happens from one star to another in a compact system of double star, can be considered as gravitational “radiation”.

Phase gravitational waves that propagate in free space at supraluminal velocity give rise to disturbance in the motion of astronomical bodies, not executing any work. At this, only transition of internal energy of the matter of astronomical bodies into kinetic energy realizes, as it does during a free fall of macroobjects in terrestrial gravitational field.

6. Conclusions

The relativistic shrinkage of the length of moving body is purely kinematics effect. This effect is connected with the change of relativistic values of matter thermodynamic parameters and not connected with matter elastic properties. At any law of body motion this shrinkage appears and varies during the process of isobaric self-contraction of matter. This process always passes ahead of the process of change of matter elastic compression. And this is caused by propagation of changes of the strength of inertia forces field together with propagation of changes of collective space-time state of matter (propagation of front of body proper time).

Phase waves of perturbation of removable (graviinertial) and irremovable gravitational fields don’t transfer energy themselves. They only create necessary conditions for energy transfer in the process of the interaction of matter elementary particles. This energy transfer realizes due to accumulation of difference of Doppler values of energies of exchange virtual elementary particles and quasi-particles, which propagate in and against the direction of the body motion. That’s why these waves can propagate at supraluminal velocity.

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The gauge foundations of special relativity

It is shown here that Lorentz transformations are caused by gauge effect of motion on matter (principle nonobservability of effect of motion on matter). This gauge effect of motion is caused by interdependence and mutual determination of propagation velocity of interaction between matter elementary particles and of rate of course of matter proper time. The Lorentz transformations are derived without any linearity assumptions and being based only on the presence of relativistic shrinkage of the length of moving body and on clock desynchronization at its slowest transfer along this body.

Keywords: Lorentz transformations, gauge effect of motion and gravity, physical vacuum, absolute space and time.

1. Introduction

A lot of publications, being prejudiced fundamental postulates of Special Relativity (SR), have appeared recently. The most important among the brought-up problems is considering such substance as the physical vacuum (PV) to be a physical reality. After all, PV substitutes absolute ether of classical physics at rest in many ways. In addition, the possibility to work out the value of peculiar velocity of absolute motion of the Solar System by anisotropy of frequency of cosmic microwave background radiation contradicts with the established in the scientific literature opinion about the absence of special absolute frame of references of coordinates and time (FR), motionless relatively to the PV.

The aim of the present work is to show that seeming mutual incompatibility of the fundamental SR postulates with the presence of the undraggable by a moving body PV and corresponding to it the unique PVFR is caused only by imperfect understanding of physical essence of Lorentz transformations. The essence of these transformations (as it will be shown below) is in the precise mathematical mapping of gauge effect on matter and its space-time continuum (STC) [1, 2]. This gauge effect is the cause of principal nonobservability of any changes, which have realized in the objects and physical processes.

2. Derivation of the Lorentz transformations

As it was first shown by Fitzgerald and Lorentz [3], at the transformation of a state of body absolute rest into the state of steady inertial body motion relatively to the PV, uniquely definable shrinkage of the body size in the direction of its motion realizes itself in the absolute space. This shrinkage is connected with isobaric self-contraction of body matter [4]. The self-contraction of matter is the result of adaptation of its molecules, atoms and elementary particles to changed conditions of their interactions.

Let the body moves at the absolute velocity $V < c$ relatively to the PV. Then longitudinal size X_{ij} of the body, and consequently, the corresponding to it size of length standard, located on the body, shrink along the direction of motion in the same quantity of times:

$$\varGamma = X_{ij0} / X_{ij} = \left(1 - V^2 / c^2\right)^{-1/2} = \left(1 - V^2\right)^{-1/2} .$$

Where: $c = 1$ considering the measuring of linear dimensions in light units of length. As a result of identical size shrinkage of measured objects, as well as of measurement instrumentation, motionless relatively to the moving body, no changes in geometry of its objects in body FR will be found out. And, consequently, transformations of linear and angular dimensions of the objects in the absolute space for the moving body and for the inertial FR (IFR), rigidly bound up with it, will be purely gauge. And the body will be gauge-self-deformed in this space. Due to such relativistic shrinkage of longitudinal sizes of the body the duration of absolute time of interaction between any two body points (or rather located there elementary particles):

$$\Delta T = \Delta T_1 + \Delta T_2 = 2\varGamma \sqrt{X_{ij0}^2 + Y_{ij0}^2 + Z_{ij0}^2} = \varGamma \cdot \Delta T_0 \ , \qquad (1)$$

will increase in Γ times, where:

$$\Delta T_1 = \Gamma^2 \left\{ \sqrt{X_{ij}^2 + \left(1 - V^2\right)\left(Y_{ij}^2 + Z_{ij}^2\right)} + VX_{ij} \right\} =$$

$$= \Gamma \left(\sqrt{X_{ij0}^2 + Y_{ij0}^2 + Z_{ij0}^2} + VX_{ij0} \right), \tag{2}$$

and:

$$\Delta T_2 = \Gamma \left(\sqrt{X_{ij0}^2 + Y_{ij0}^2 + Z_{ij0}^2} - VX_{ij0} \right), \tag{3}$$

- durations of time intervals of propagation of interaction waves accordingly in forward and reverse direction, and: X_{ij}, $Y_{ij}=Y_{ij0}$, $Z_{ij}=Z_{ij0}$ - orthogonal projections of the segment between the interacting in the process of motion body points. As we see, the increase of duration of interaction time does not depend on the values of angles between the direction of body motion and directions of propagation of electromagnetic wave (virtual photon) in the forward and reverse move. And consequently, the repetition frequency of all the periodic physical processes, realizing in the moving body, including processes that used for chronometry, will decrease in Γ times. And this means, that as the result of gauge effect of motion on matter, the time on the moving body (in the IFR, corresponding to it) will course Γ times slower than on a body, motionless relatively to the PV. However, observers and instruments, motionless relatively to the body, will find no changes in realization of physical processes, which take place directly on the moving body.

Relativistic time dilation in IFR can't be observed in principle by the intrinsic clock of IFR. Therefore, according to (2) and (3), time intervals ΔT_1 and ΔT_2 must have the following durations by the clock of IFR:

$$\Delta \tilde{t}_1 = \Delta T_1 / \Gamma = \sqrt{x_{ij}^2 + y_{ij}^2 + z_{ij}^2} + Vx_{ij}, \tag{4}$$

$$\Delta \tilde{t}_2 = \Delta T_2 / \Gamma = \sqrt{x_{ij}^2 + y_{ij}^2 + z_{ij}^2} - Vx_{ij}, \tag{5}$$

where: $x_{ij} \equiv X_{ij0}$, $y_{ij} \equiv Y_{ij0}$, $z_{ij} \equiv Z_{ij0}$ - projections dimensions of the moving body segments, observed in its IFR (in compliance with gauge transformations) with the same value as in case of their observation in state of body rest relatively to the PV. According to this, the value of the average velocity of propagation of interaction wave in the forward and reverse move will be observed in IFR the same as at its observation in the PVFR:

$$\tilde{c} = 2\sqrt{x_{ij}^2 + y_{ij}^2 + z_{ij}^2}\,/\left(\Delta\tilde{t}_1 + \Delta\tilde{t}_2\right) = 1\,,$$

This doesn’t allow us to find out mutual inequality of observed in the IFR and PVFR velocities of propagation of interaction wave or light, using location or interferometer.

Inequality of time intervals of the propagation of interaction wave in forward $\left(\Delta T_1\right)$ and reverse $\left(\Delta T_2\right)$ move to its average value:

$$\left\langle \Delta T \right\rangle = \left(\Delta T_1 + \Delta T_2\right)/\,2 = \Gamma \cdot \left\langle \Delta\tilde{t} \right\rangle,$$

is also impossible to be found out by IFR clock. After all, even in the case of slowest transfer of the clock along the shortest path from one point of the IFR to another, a mutual desynchronization of transferred and motionless in the IFR clocks realizes:

$$\delta\tilde{t}_{ij} = \lim_{\delta\mathbf{V}\to 0}\left\{\Delta T_1 \cdot \left[\sqrt{1-\left(\mathbf{V}+\delta\mathbf{V}\right)^2} - \sqrt{1-\mathbf{V}^2}\right]\right\} =$$

$$= \lim_{\delta\mathbf{V}\to 0}\left\{\left(\sqrt{1-\left(2\delta V_x \cdot V + \delta V^2\right)\Gamma^2} - 1\right)x_{ij}\,/\,\Gamma^2 \delta V_x\right\} =$$

$$= -Vx_{ij} = \left\langle \Delta\tilde{t} \right\rangle - \Delta t_1\,, \tag{6}$$

where: $$\Delta T_1 = X_{ij}\,/\,\delta V_x = x_{ij}\,/\,\Gamma \cdot \delta V_x\,,$$

and: $\delta\mathbf{V} = \mathbf{V}' - \mathbf{V}$ is Galilei difference of vectors of absolute velocities of slowly transferred $(\mathbf{V}')$ and motionless $\left(\mathbf{V}\right)$ in IFR clocks. This desynchronization is observed only in PVFR. And it compensates in the IFR the difference of the intrinsic time intervals $\Delta\tilde{t}_1$ and $\Delta\tilde{t}_2$, which proportionally synchronized with ΔT_1 and ΔT_2 correspondingly: $\Delta t_1 = \Delta\tilde{t}_1 + \delta\tilde{t}_{ij} \equiv \left\langle \Delta\tilde{t} \right\rangle = \sqrt{x_{ij}^2 + y_{ij}^2 + z_{ij}^2}$,

$$\Delta t_2 = \Delta\tilde{t}_2 - \delta\tilde{t}_{ij} \equiv \left\langle \Delta\tilde{t} \right\rangle \equiv \Delta t_1\,.$$

As a result of this, a question appears, if equality in all the IFR points of quantum proper time (which determines their “age”) really does exist according to the observations from the PVFR. After all, in the process of increase of the value of velocity (till the value of uniform velocity) the motion of different points of the body realizes at unequal velocities [4]. And this leads to the fact that “age” of different points of the body (measured by their quantum proper clock) will be unequal, according to (1). And consequently, the difference of points “age” will essentially depend on the law of motion of the body points during the process of reaching by them the equal values of absolute velocity. And as a result, standard time, determining the body points “age”, should be considered as their path-like proper time. To realize the possibility of analysis of dynamics of objects, which move in the IFR, coordinate intrinsic time (unified in all the points) [2, 5] must be introduced into it.

All of this is a sufficient reason for adoption of the conception of non-simultaneity of observation in the IFR of events, which realize simultaneously in the PVFR. The impossibility to observe in the IFR the desynchronization of the clock at its slowest transfer from one point of IFR to another:

$$\delta\tilde{t}_{ij} = \lim_{v\to 0}\left\{\Delta t\left(\sqrt{1-v^2}-1\right)\right\} = \sqrt{x_{ij}^2+y_{ij}^2+z_{ij}^2}\,\lim_{v\to 0}\left\{\left(\sqrt{1-v^2}-1\right)/v\right\} = 0$$

shows up non-triviality of gauge transformation of time intervals. Time interval between the events, fixed in different points of the IFR by its intrinsic clock (which counts IFR coordinate time), is determined in PVFR, according to (6), by the following transformation: $\Delta T = \Gamma\Delta\tilde{t} = \Gamma\left(\Delta t - \delta\tilde{t}_{ij}\right) = \Gamma\left(\Delta t + Vx_{ij}\right) = \Gamma\Delta t + \delta T_{ij}$, (7)

where: $\delta T_{ij}=\Gamma\cdot V\cdot x_{ij}$ - observed in the PVFR mutual desynchronization of events, which have simultaneously happened in the i and j points of the moving body IFR. Considering gauge transformation of size of the parallel to the direction of motion projection of segment x_{ij}, transformations of distance projections between these points at noncoinciding time moments $(\Delta T = T - T_0 \neq 0)$, will be the following: $\Delta X = X_j - X_{i0} = (x_{ij} / \Gamma) + V \cdot \Delta T = \Gamma (x_{ij} + V \cdot \Delta t)$

$$\Delta Y = Y_j - Y_{i0} = y_{ij}, \quad \Delta Z = Z_j - Z_{i0} = z_{ij}, \tag{8}$$

According to (7) and (8) projections of velocity of the moving object at the transition from the IFR into PVFR and inversely will be transformed according to Lorentz rules [5]. In that way, the velocity of light in free space will not depend in the IFR on absolute velocity of body, possessing this IFR. This, of cause, is connected with the equality of the velocity of light in free space to the velocity of propagation of the wave of electromagnetic interaction, which determines the frequency of this interaction between elementary particles of matter, and thus, the course rate of the IFR intrinsic time.

Consequently, Lorentz transformations are based on real shrinkage in absolute space of dimensions of objects along the direction of their motion, as well as on IFR intrinsic time dilation and desynchronization of slow-transferred clock, which are observed in the PVFR. Due to this, Lorentz transformations guarantee the impossibility to find out in the IFR any changes, which have happened to objects and physical processes, realizing in IFR, after the body has changed its state from absolute rest to its uniform motion relatively to the PV. In that way, the correctness of the first Einstein postulate about the sameness of realizing of all the physical phenomena in all the inertial systems is confirmed.

3. Effects, caused by Lorentz transformations

As the result of time dilation in the IFR the increase of the value of its effective velocity relatively to the PV (which is determined, according to (8), by a moving clock when $\hat{x}_{ij} = 0$) takes place:

$$v_{eff} = \Delta\hat{X} / \Delta t = V \cdot \Gamma\,. \tag{9}$$

Therefore, because of bigger in Γ times dash repetition frequency of motionless relatively to the PV linear scale, the value of its division will seem to be Γ times smaller in the IFR. And consequently, according to (7), the path ΔX, covered by the IFR in absolute space, which is observed in it as “contracted”, will be perceived in the IFR as Γ times smaller:

$$\Delta x = V \cdot \Delta\hat{t} = V \cdot \Delta\hat{T} / \Gamma = \Delta\hat{X} / \Gamma \,. \tag{10}$$

On the other hand, according to (7) and (8), at the same IFR intrinsic time $(\Delta t = 0)$ its different points will be opposed to the PV points at the moments of absolute time, mutually detached by the interval:

$$\Delta T' = \delta T_{ij} = V\Delta X' \tag{11}$$

<table>
<tr><td>Scale of the PVFR</td><td>0</td><td></td><td>1</td><td></td><td>2</td><td></td><td>3</td><td></td><td>4</td><td></td><td>5</td></tr>
<tr><td>Position of scale</td><td>I</td><td></td><td>I</td><td></td><td>I</td><td></td><td>I</td><td></td><td>I</td><td></td><td>I</td></tr>
<tr><td>Scale of the IFR</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>First position of scale</td><td>*</td><td>I</td><td>I</td><td>I</td><td>I</td><td>I</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td></td><td></td></tr>
<tr><td colspan="4">Second position of scale</td><td>I</td><td>*</td><td>I</td><td>I</td><td>I</td><td>I</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td colspan="7">Third position of scale</td><td>I</td><td>I</td><td>*</td><td>I</td><td>I</td></tr>
<tr><td rowspan="2"></td><td colspan="11">$V\Delta T' = V^2 \Delta X'$ $x_{ij}/\Gamma = X_{ij}\Gamma^{-2}$</td></tr>
<tr><td colspan="11">$\Delta X'$</td></tr>
</table>

These moments correspond (as it is shown in the figure, when $\Gamma = 2$) to different positions of the IFR relatively to the PV (events, simultaneous in the IFR, marked in the figure by the symbol "*").

This will lead to observation in the IFR of "imaginary" shrinkage in Γ^2 times of dimensions of objects, motionless relatively to the PV. However, considering real shrinkage in absolute space of the dimensions of IFR objects in Γ times, the resulting shrinkage, observed in the IFR, of dimensions of objects, motionless relatively to the PV, will be only in Γ times:

$$x_{ij} = \Gamma\left(\Delta X' - V \cdot \Delta T'\right) = \Delta X' / \Gamma . \qquad (12)$$

That is why, the presence of real shrinkage in absolute space of dimensions of the IFR objects and the presence of "imaginary" shrinkage in the IFR space-time continuum of dimensions of objects, motionless relatively to the PV, leads to observation of dimensions of objects, motionless relatively to the IFR, in the PVFR and dimensions of objects, motionless relatively to the PV, in the IFR, as reduced in the same number of times. As the result of clock desynhronization $\delta\tilde{t}_{ij}$ at its slowest transfer into the IFR, "imaginary" absolute time dilation in Γ^2 times in the IFR STC will also take place. However, because of the presence of real IFR intrinsic time dilation in Γ times in comparison with absolute time, the resulting absolute time dilation, observed in the IFR, will be only in Γ times:

$$\Delta T = \Gamma\left(\Delta t - \delta\tilde{t}_{ij}\right) = \Gamma\left(\Delta t + V x_{ij}\right) = \Delta t / \Gamma , \qquad (13)$$

where at $\Delta X = 0$: $x_{ij} = -V\Delta t$. Consequently, the presence of real time dilation in the IFR and "imaginary" dilation of absolute time leads to mutually observed time dilation on objects, moving in any of the FR. So, mutually observed identical shrinkages of objects and time dilations in mutually opposed FR are caused only by principle lack of mutually coincidence of time moments of reading in them of one of the two counts of space coordinates and principle lack of superposition of points of reading in them of one of the two counts of coordinate-like time accordingly. Incomprehension and neglect of this (together with indiscrimination of FR coordinate-like intrinsic time and path-like proper time of objects [6]) is the cause of origination in the SR of various imaginary paradoxes. And moreover, it causes false treatment of SR by some physicists as purely mathematic theory, which allows explaining observed physical phenomena only with some degree of conventionality.

4. Conclusions

In that way, Lorentz transformations correspond to gauge self - deformation in the absolute space of STC of uniformly moving body. And at this they image the impossibility of detection of any changes, which have realized in the objects and physical processes after replacement of state of absolute rest of the body to the state of its uniform motion relatively to the PV. And consequently, they image the principle impossibility of detection, in which of the two states the body is, using direct methods. However, the equality of any IFR with the PVFR, caused by this, by no means does not deny the natural occurrence of the unique PVFR, as well as of substance, motionless in it, - the PV (the absolute ether of classical physics), in which motion of objects, possessing mass, and propagation of electromagnetic waves take place. The PVFR in the Lorentz and Poincare groups of transformations is the element of not only set of the IFR, but also of sets of any other FR types of gauge-deformed and gauge-self-deformated bodies [2]. Moreover PVFR is the unique common element of all the possible FR sets.

Gauge invariance of eigenvalue of the velocity of light (uniquely determined by matter proper quantum clock) in any of the groups of transformation is caused by interdependence and mutual determination of time course rate and of the velocity of propagation of interaction (equal to the velocity of light). In this way the interaction propagation velocity in space is set in the time. And the course rate of matter proper time, in its turn, depends on the velocity of propagation of interaction. After all, the rates of realization of any physical processes, used for chronometry, are proportional to velocity of propagation of interaction. That’s why it is impossible here to detect, which of the two physical parameters (time or the velocity of propagation of interaction) is initial (first-born). In that way, the impossibility of observing by the proper clock not only the change of course rate of time, measured by them, but also the change of velocity of propagation of interaction in the point of localization of the clock, is a property (postulated by Einstein only for IFR) of any other possible FR. And the relativity principle of SR is only the consequence of more fundamental principle – principle of gauge deformation of matter and its STC under the effect of motion and gravity [2].

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Physical essence of twins paradox

The initial cause of unambiguously younger age of the second twin than age of the first twin at the moment of their meeting is pointed. This initial cause is not the accelerated motion of the second twin, but the fact of changing of its direction or just the velocity of its motion in space itself and, consequently, the fact of its transition from one inertial reference system of spatial coordinates and time (IFR) to another. This is concerned to changing in new IFR of spatial as well as of time coordinates of events, which have realized before, including events, information about which have not come to the twin by the moment of its transition to new IFR. It is shown that imaginary twin paradox (clock paradigm) takes place in general relativity (GR) only because of the impossibility of mutual distinguishing of standard time (path-like proper time of moving object) and coordinate-like internal time of the IFR (or any other FR) and because of neglect of the necessity of re-calculation of events time coordinates as a result.

Keywords: relativistic length shrinkage, inertia, isobaric self-contraction, supraluminal velocity, graviinertial stressed state, Einstein-Podolski-Rosen paradox, gravitational waves.

1. Introduction

Many scientific, as well as popular scientific, works are dealing with the imaginary twin paradox (clock paradigm). However, its real physical essence is not fully revealed in any of them. Usually this paradox is explained by the fact that one of the twins moves at a constant velocity all the time, while the other twin at particular points of time performs accelerated movements. Such explanation points out inequivalence of conditions of motion of the twins. It does not explain why the age of the second twin is always less than the age of the first one, independently on length of the path they have passed at a constant velocity and, consequently, independently on values of age differences accumulated in the IFR of every twin at the process of this uniform motion. In fact, identical finite differences in age of the twins are to appear in all "thought experiments" with identical world lines (WL) of accelerated motion of the second twin because of this accelerated motion. And the age differences, accumulated in the process of uniform motion, in the contrary to these finite differences of age, can amount to arbitrary big value in IFR of any of the twins. And therefore, they still will lead to mutually contradictory information about the age of the twins. The reveal of the physical essence of the imaginary twin paradox is the aim of this article.

2. The initial causes of the twins paradox

As it is shown in [1], GR actually admits the possibility of existence of separate FR - that is the FR of the physical vacuum (PV), in which relict radiation frequency is isotropic. We will consider motion of objects in this PVFR, space and time of which according to Newton [2] are absolute. However, of cause, according to the principle of relativity we could as well take any IFR as basic FR. WL of uniform straight-line motions of two objects in the absolute space are shown in the picture. The first one is moving at the absolute velocity V_0. The second one is withdrawing from the first one at the relative velocity of $v_1 = (V_1 - V_0)/(1 - V_1 V_0)$, and then drawing closer to it at the relative velocity of $v_2 = (V_2 - V_0)/(1 - V_2 V_0)$. V_1 and V_2 here are the absolute velocities of motion of the second object correspondingly in direct and reverse direction. At this, for simplification of mathematical expressions it is assumed that distances and spatial coordinates are measured in light units of length. Therefore, the eigenvalue of the velocity of light is: $c = 1$.

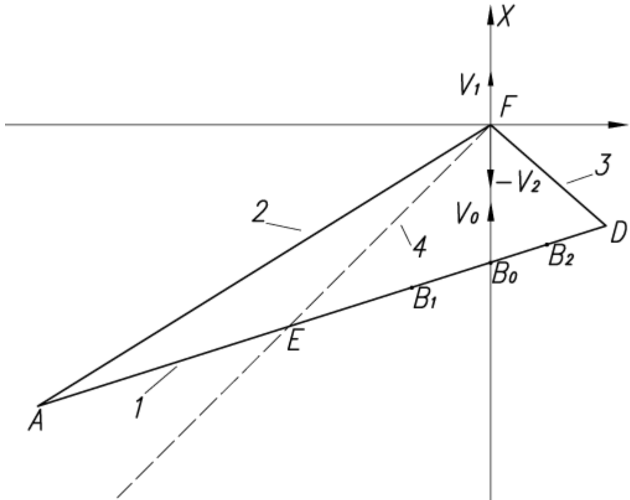

Fig.: 1 – WL of the first object; 2 – WL of the second object at the time of its withdrawing from the first one; 3 – WL of the second object at the time of its drawing closer to the first one; 4- WL of the light.

Let in the PVFR the first object comes to the B_0 point simultaneously with coming of the second object to the F point. And the proper time of motion of the second object from the A point to the F point is Δt_1. Then an interval of absolute time, corresponding to this proper time and read in the PVFR from the moment of coming of the first object to B_0 point and the second object to the F point will be the following: $T_A = -\Gamma_1 \Delta t_1$. The B_0 point coordinate, read from the F point, will be determined at this by the following dependency: $X_{B_0} = T_A(V_1 - V_0) = -\Gamma_1 \Delta t_1 (V_1 - V_0)$, where $\Gamma_1 = (1 - V_1^2)^{-1/2}$.

Intervals of absolute time between events in the B_i point on the first object and in the F point on the second object, which are simultaneous $(\Delta t = 0)$ in the IFR of the second object, depend on the value of velocity V_i of the second object in the F point: $\delta T_i = \Gamma_i V_i x_{B_i}$. x_{B_i} here is a coordinate of the first object, observed in the IFR of the second object.

Since $X_{B_i} = X_{B_0} + V_0 \delta T_i = X_{B_0} + \Gamma_i V_i V_0 x_{B_i} = \Gamma_i x_{B_i}$, then:

$$x_{B_i} = X_{B_0} / \Gamma_i \left(1 - V_i V_0\right), \tag{1}$$

and:

$$X_{B_i} = X_{B_0} / \left(1 - V_i V_0\right). \tag{2}$$

Therefore, depending on the value of absolute velocity of the second object in the F point, events corresponding to various X_{B_i} positions of the first object in the absolute space will be simultaneous with the event in the F point of the FR of the second object. So, correspondingly, at $V_i = 0$:

$$x_{B_0} = X_{B_0} = -\frac{V_1 - V_0}{\sqrt{1 - V_1^2}} \Delta t_1 = -v_1 \sqrt{\frac{1 - V_0^2}{1 - v_1^2}} \Delta t_1;$$

at $V_i = V_1$: $\quad x_{B_1} = -\dfrac{V_1 - V_0}{1 - V_1 V_0} \Delta t_1 = -v_1 \Delta t_1$,

$$X_{B_1} = -\frac{\left(V_1 - V_0\right)\Delta t_1}{\left(1 - V_1 V_0\right)\sqrt{1 - V_1^2}} = -\frac{v_1\left(1 + v_1 V_0\right)\Delta t_1}{\sqrt{\left(1 - v_1^2\right)\left(1 - V_0^2\right)}};$$

at $V_i = V_2$:

$$x_{B_2} = -\frac{V_1 - V_0}{1 - V_2 V_0} \sqrt{\frac{1 - V_2^2}{1 - V_1^2}} \Delta t_1 = -v_1 \sqrt{\frac{1 - v_2^2}{1 - v_1^2}} \Delta t_1 = x_{B_1} \sqrt{\frac{1 - v_2^2}{1 - v_1^2}},$$

$$X_{B_2} = -\frac{V_1 - V_0}{1 - V_2 V_0} \cdot \frac{\Delta t_1}{\sqrt{1 - V_1^2}} = -\frac{v_1\left(1 + v_2 V_0\right)\Delta t_1}{\sqrt{\left(1 - v_1^2\right)\left(1 - V_0^2\right)}} = X_{B_1} \frac{1 - V_1 V_0}{1 - V_2 V_0} = X_{B_1} \frac{1 + v_2 V_0}{1 + v_1 V_0}$$

Let the modules of relative velocities of motion of the objects in the process of their withdrawing and drawing closer are equal to each other $\left(v_2 = -v_1\right)$. Then changing of position of the first object by the second twin will not be observed $\left(x_{B_2} = x_{B_1}\right)$ at the moment of changing of the direction of motion by the second object. However a transition from simultaneity in the second twin FR with the moment of change of its motion of some events to simultaneity of other events on the second object corresponding to other position of the latter in the absolute space will happen at this: $X_{B_2} = X_{B_1}\left(1 - v_1 V_0\right)/\left(1 + v_1 V_0\right)$. That is, at a transition of the second object from the motion at the V_1 velocity to the motion at the V_2 velocity a change of positions of the first object considered as simultaneous with the position of the second object in the F point realizes. In that way, a drop of coordinate time (which is observed in second twin FR), corresponding to the events on the first object, occurs:

$$\delta t' = \delta T_{B_1 B_2} / \Gamma_0 = \left(X_{B_2} - X_{B_1}\right)/V_0 \cdot \Gamma_0 = -\gamma_1\left(v_2 - v_1\right)v_1 \Delta t_1, \quad (3)$$

where: $\gamma_1 = \left(1 - v_1^2\right)^{-1/2}$.

And consequently, an exception from the consideration of a part of path-like proper time of the first object, determining age of the first twin, takes place. Therefore, the second twin comes to a wrong conclusion about decreasing of total time that has run out on the first object from the moment of separation to the moment of meeting of the twins. This determines the physical essence of imaginary twin paradox (paradigm).

3. Results of direct observations

Considering the drop of coordinate time, full path-like proper time of the first object, observed by the second twin, will be the same as in the FR of the first object:

$$\Delta t' = \Delta t_1 / \gamma_1 + \Delta t_2 / \gamma_2 + \delta t' = \gamma_1 \Delta t_1\left(v_2 - v_1\right)/ v_2 = \gamma_1 \Delta t_1 + \gamma_2 \Delta t_2, \quad (4)$$

$\Delta t_2 = x_{B_2} / v_2 = -\Delta t_1 \gamma_1 v_1 / \gamma_2 v_2$ here is time duration of the motion of the second object in the reverse direction by its proper clock, and: $\gamma_2 = \left(1 - v_2^2\right)^{-1/2}$. Presence of the drop of proper time of the first object (“observed” by the second twin mediately through its two IFRs) does not at all mean that information about events, which have occurred on the first object between the B_1 and B_2 points, does not come to the second object. At the moment of changing the direction of the second object information about an event, which has happened on the first object at the moment of time when it was in the E point at some distance from the F point, arrives to it:

$$X_E = -\Gamma_1 \Delta t_1 (V_1 - V_0)/(1 - V_0) = -\gamma_1 v_1 \Gamma_0 (1 + V_0) \Delta t_1, \qquad (5)$$

Immediately after changing the direction of the second object a displacement of radiation spectrum of the first object, observed by the second twin, will also change. This can lead to a false conclusion of the second twin that the first object was withdrawing from it only during the time:

$$\Delta\tilde{t}_1 = \Delta t_1 - \delta\tilde{t}_1 = \Delta t_1 + x_{E_1} = \Delta t_1 /(1 + v_1), \qquad (6)$$

and is approaching it during $\delta\tilde{t}_2 = -x_{E_2} = -\Delta t_2 v_2 /(1 + v_2)$ time. Therefore, the full time of objects’ drawing closer will be evaluated by it this way:

$$\Delta\tilde{t}_2 = \Delta t_2 + \delta\tilde{t}_2 = \Delta t_2 /(1 + v_2) = -\Delta t_1 \gamma_1 v_1 / \gamma_2 v_2 (1 + v_2), \qquad (7)$$

Considering this, proper time intervals of the first object corresponding to mutual drawing closer and withdrawing of the objects will be regarded by the second twin with the following values:

$$\Delta\tilde{t}_1' = \Delta\tilde{t}_1 / \gamma_1 = \Delta t_1 \sqrt{(1 - v_1)/(1 + v_1)} \neq \Delta t_1 \gamma_1, \qquad (8)$$

$$\Delta\tilde{t}_2' = \Delta\tilde{t}_2 / \gamma_2 = \Delta t_2 \sqrt{(1 - v_2)/(1 + v_2)} \neq \Delta t_2 \gamma_2, \qquad (9)$$

This, of cause, does not correspond to the values, observed in the FR of the first object. However, this disagreement is explainable by incorrectness of the definition (made from a false premise about the change of direction of motion by not the first but by the second object) by the second twin of the moment of stoppage of withdrawing and starting drawing closer of the objects by the first object’s clock. In spite of this, the total value of proper time of the first object, evaluated by the second twin, will be the same as it is observed in the FR of the first object:

$$\Delta\tilde{t}\,' = \Delta\tilde{t}_1' + \Delta\tilde{t}_2' = -\Delta t_1\gamma_1(v_1 - v_2)/v_2 = \Delta t_1\gamma_1 + \Delta t_2\gamma_2 = \Delta t' .$$

And consequently, information about all events occurred on the first object arrives on the second object.

Because of the motion of the second object in the direct and reverse direction at different absolute velocities, shrinkage of distances to the objects before and after the change of its motion will be observed as dissimilar by the second twin. At $|\delta\tilde{t}_2| > |\delta\tilde{t}_1|$ change of the distance to the E point $(x_{E_2} \neq x_{E_1})$ leads to mutual pseudo-superposition of time intervals $\Delta\tilde{t}_1$ and $\Delta\tilde{t}_2$ by the clock of the second twin counting standard [3] (path-like) time. This mutual pseudo-superposition of time intervals is caused by the withdrawing of the first object from the position with the x_{E_1} coordinate to the position with the x_{E_2} coordinate at the velocity more than the velocity of light at the point of observation. “Flow of time back” concerned to the transition of the second object from one IFR to another IFR will take place at such an “observation” (mediately through the two IFRs) no matter how smoothly the transition from V_1 to V_2 will realize. Direct observation, as it was shown earlier, does not find out this. The given pseudo-effect is concerned to the calculation of $\delta\tilde{t}_1$ and $\delta\tilde{t}_2$ values on the basis of supposition about similarity of improper (coordinate) values of the velocity of light $(v_c = 1)$ in all intrinsic space of the second object, moving noninertially in the process of transition from V_1 to V_2. In fact this is not right. Improper values of the velocity of light in the points of presence of the first object in the process of its transition from the x_{E_1} distance to the x_{E_2} distance can not be less than the velocities of displacement of the first object in the FR of the second object. And these velocities noticeably exceed the velocity of light in the point of observation of radiation spectrum displacement because of the fast change of relativistic shrinkage of the distance to the first object in the FR of the second object.

Considering the change of improper value of the velocity of light in the intrinsic space of the second object in the process of its noninertial motion, time superposition in the intrinsic FR of the second object will not be observed. Standard time, determined in this FR from the quantity of wavetrains having come from the source of standard radiation of the first object will concur with its value, determined by a clock, motionless relatively to the first object.

4. Conclusions

The physical essence of imaginary twin paradox (clock paradigm) lies in neglect of necessity of re-calculation of time coordinates of events at a transition from one IFR to another. To avoid similar paradigms it is necessary to consider that improper (coordinate) values of the velocity of light [3] in FR of accelerating objects can arbitrarily exceed the eigenvalue of the velocity of light, which is a gauge–invariant quantity [1].

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About possibilities of physical unrealizability of cosmological and gravitational singularities in General relativity

The possibility to avoid physical realizability of cosmological singularity (singularity of Big Bang of the Universe) directly in the orthodoxal general theory of relativity (GR) is substantiated. This can take place in the case of counting of cosmological time in frame of reference of coordinates and time (FR) not co-moving with matter, in which by the Weyl hypothesis galaxies of the expanding Universe are motionless. The absence of any limitations of the value of mass of astronomical body, which self-contracts in Weyl FR, when it has hollow topological form in the space of Weyl FR and mirror symmetry of its intrinsic space, is shown. In view of this symmetry, both external and internal boundary surfaces of body are observed as convex. At that, in the “turned inside out” internal part of the intrinsic space (in the Fuller-Wheeler lost antiworld) unlike external part, instead of the phenomenon of expansion phenomenon of contraction of “internal universe” is observed. And there is antimatter instead of matter in this internal part of the space. Inevitability of self-organization in physical vacuum of spiral-wave structural elements, which correspond to elementary particles, is substantiated. Ultrahigh luminosity of quasars and certain types of supernovas is caused by annihilation of matter and antimatter.

Key words: General relativity, cosmological and gravitational singularities, Big Bang, Universe expansion, Weyl FR, gauge self-contraction of matter, black hole, hollow body, Fuller-Wheeler antiworld, quasar, supernova, physical vacuum, spiral-wave elements, wave front reversal, de Broglie frequency, Einstein-Podolski-Rosen paradox, antimatter, annihilation.

1. Introduction

The existence of singularities in GR is considered by Einstein [1] and later by the most authoritative specialists in this branch of physics (Ivanenko [2], Möller [3, 4], Hawking [5]) not only as the most apparent difficulty of this theory, but also as the sign of limitation of its application region. Being based on this and on the evidence of mathematical inevitability of existence of singularities in GR [6], many attempts of radical upgrade of GR applying to big densities of matter are undertaken. We have chosen another way to solve this problem.

The process of expansion of the Universe as whole can take place only, if it takes place in every single point of its infinite space. The presence of this process may be caused only by evolutional variability of the properties of physical vacuum and, therefore, by “adaptation” of matter elementary particles to continuously renewed terms of their interaction. Therefore, apparently, distances between quasi-motionless in Weyl FR galaxies (according to Weyl hypothesis [7,8], in this FR they take part only in small peculiar motions) elongate in FR, co-moving with evolutionally self-contracting matter, not because of the expansion of cosmic space into “nowhere”, but because of the continuous shrinkage of length standard in Weyl FR. The last is caused by gauge change (which is unobservable in principle in matter FR) of values of space parameters of elementary particles. This is the cause of continuous decrease of dimensions of all Universe objects in Weyl FR. The fact that process, which takes place in megaworld, is caused by the processes, which take place in microworld, is in good agreement with existence of many correspondences in correlations between atomic, gravitational and cosmological characteristics – Eddington-Dirac “high numbers” [2,9] and doesn’t contradict with modern physical notions. That’s why we can consider the expansion of the Universe, in analogy to daily solar motion on the celestial sphere, only as phenomenon that is observed in some selected FR. Already ancient Greeks (Aristarchus of Samos (ca.310 – ca.230 BC) and Seleucus of Seleucia (ca.190 - unknown BC)) presumed, that in fact Earth rotates around the intrinsic axis and around the Sun. But it took near two thousand years to make this an apparent truth for all. We can only hope, that phenomenon of Universe expansion won't have such fate.

2. Substantiation of admissibility in GR of evolutional process of gauge self-contraction of matter.

In view of motion relativity, at the first sight it seems that there is no difference if space expanses relatively to matter or matter self-contracts in space. But in fact the difference between these processes is present and this difference is very essential. World points, in which points of empty intrinsic space of self-contracting body move in Newton-Weyl absolute space with supraluminal velocity, are found beyond the limits of space-time continuum (STC) of this body. At that, empty intrinsic space becomes self-limited by observer horizon. Furthermore, inequality of relativistic shrinkages of dimensions and relativistic time dilations in different points of intrinsic space, which is caused by inequality of velocities of these points, leads to onset of curvature and physical inhomogeneity of intrinsic space of contracting body correspondingly.

The spaces, in which contraction takes place, don't have all this and may be unlimited and infinitely large. Therefore, if cosmic space expands relatively to matter, then observer horizon will limit Weyl FR space. And if, as we consider, matter contracts in cosmic space, then observer horizon will limit space of co-moving with matter FR. But, if in conditionally empty space of contracting body in region, points of which move in Weyl FR with velocities higher then light velocity, there are no physical bodies, dragged by this space, then all astronomical objects, conditionally motionless in Weyl FR, are dragged by expanding cosmic space. And at as long as desired distances from observer they can move, according to Hubble relation, with as high as desired velocities. And since velocity of physical object can't exceed light velocity in the point, where it's located, at as long as desired distances from observer improper values of light velocity must be as large as desired (which however doesn't follow from GR gravitational field equations). Otherwise observer intrinsic space must be finite, which is possible in view of singular Friedmann model of expanding Universe with its finite past, or in case of presence of observer horizon in this space. In case of eternal existence of Universe in the past, (this doesn't allow existence of cosmological singularity) there are no other known physical mechanisms, which form observer horizon of intrinsic space of any astronomical body, except relativistic shrinkage of dimensions and relativistic time dilation. Therefore, phenomenon of Universe expansion can be caused only by gauge process of evolutional self-contraction of matter in cosmic space.

Such gauge (for intrinsic observer) matter self-contraction, which becomes apparent in relativistic shrinkage of moving body dimensions, has been recognized as physically real for the first time in special theory of relativity. In GR it is caused by the influence of gravitational field and may be rather substantial in the presence of relativistic gravitational collapse. But if such gauge deformation of matter is possible in case of transposition of body in space along the force lines of gravitational field, then why it can't be possible in case of transposition of body only in time? After all, because of unification of space and time in single STC (Minkowski four-dimensional space-time) coordinate time is equal in GR to space coordinates. In this case, gravitational field may be considered as demonstration of presence of time delay of the process of gauge matter self-contraction in the points more distanced from the center of astronomical body and presence of matter influence on the properties of physical vacuum via negative feedback, realized by changes of both eigenvalue of molecules volume and eigenvalues of densities of energy and enthalpy of matter. After all, while at the stages of Universe evolution, when its whole space was filled in with matter, eigenvalue of molecules volume gradually increased and eigenvalues of densities of energy and enthalpy of matter gradually decreased, in case of advance to the center of astronomical object, on the contrary, we may observe increase of the last and decrease of eigenvalue of molecules volume.

3. Schwarzschild internal solution for ideal liquid in co-moving FR

Let's examine Schwarzschild internal solution for ideal liquid, the process of self-contraction in Weyl FR of which is equilibrium and inhomogeneous gauge and which, because of this, has intrinsic hard FR. In this FR, co-moving with contracted by the gravity liquid, linear element has static and spherically symmetric form [10]:

$$ds^2 = a(r)dr^2 + r^2\left(d\theta^2 + \sin^2\theta \cdot d\varphi^2\right) - b(r)c^2dt^2,$$

where r - luminosity radius of spherical surface, being determined by area S $\left(r^2 = S/4\pi\right)$, which value in nonempty space with curvature in principle can vary non-monotonically along metrical radial interval $\vec{r}$. Functions $a(r)$ and $b(r)$, which characterize curvature and physical inhomogeneity of liquid intrinsic space correspondingly, are connected here with eigenvalue of mass density $\tilde{\mu}(r)$ and eigenvalue of pressure $\tilde{p}(r)$ by differential equations [10]:

$$d\tilde{p}/dr + \left(\tilde{\mu}c^2 + \tilde{p}\right)b'/2b = 0 \tag{1}$$

$$b'/abr - \left(1/r^2\right)\left(1 - 1/a\right) + \lambda = \kappa\tilde{p} \tag{2}$$

$$a'/a^2r + \left(1/r^2\right)\left(1 - 1/a\right) - \lambda = \kappa\tilde{\mu}c^2. \tag{3}$$

From these equations we may find:

$$\frac{1}{a} \equiv \left(\frac{\partial r}{\partial \vec{r}}\right)^2 = 1 - \left(1 - \frac{1}{a_i} - \frac{\lambda r_i^2}{3}\right)\frac{r_i}{r} - \frac{\kappa c^2}{r}\int_{r_i}^{r} r^2\tilde{\mu}dr - \frac{1}{3}\lambda r^2 =$$

$$= 1 - r_g(r)/r - \lambda r^2/3 = 1 - r_g(r)/r - \left(1 - r_{ge}/r_c\right)r^2/r_c^2, \tag{4}$$

$$b \equiv \frac{v_c^2}{c^2} = \frac{1}{a}\exp\int_{r_e}^{r}\Phi(\mathrm{r})dr = \frac{r_e}{ra_e}\exp\int_{r_e}^{r}\varphi(r)dr, \tag{5}$$

where: $\Phi(\mathrm{r}) = (ab)' / ab = \kappa(\tilde{\mu}c^2 + \tilde{p})ar$; $\varphi(r) = (1/r^2 - \lambda + \kappa\tilde{p})ar$;

$$a_i \equiv a(r_i); \;\; a_e \equiv a(r_e) = \left[1 - r_{ge}/r_e - (1 - r_{ge}/r_c)r_e^2/r_c^2\right]^{-1};$$

$$r_g(r) = \left(1 - \frac{1}{a_i} - \frac{1}{3}\lambda r_i^2\right)r_i + \kappa c^2 \int_{r_i}^{r} r^2 \tilde{\mu} dr \qquad (6)$$

- gravitational radius of taken optionally internal part of liquid, separated from its upper external part by spherical surface with luminosity radius r ;

r_i and r_e - values of luminosity radius in optional supporting point i of liquid body and on its boundary surface correspondingly;

v_c - velocity of light, being determined in independent of space coordinates intrinsic (astronomical) time t of liquid body FR and being dependent of radial coordinate of the point of light propagation;

c - eigenvalue of light velocity, being determined in intrinsic quantum time of the point of light propagation, and, in view of this, the same in all points of matter intrinsic spaces (constant of light velocity);

κ - Einstein constant;

$\lambda = 3(1 - r_{ge}/r_c)/r_c^2$ - cosmological constant, which determines (together with gravitational radius of the whole liquid $r_{ge} \equiv r_g(r_e)$) maximal physically realized in liquid FR value of luminosity radius (radius r_c of observer horizon of conditionally empty space above liquid) and, thus, shows the presence of adiabatic gauge process (which is not being observed in this hard FR in principle) of self-contracting of molecules of liquid in cosmic space (in Weyl FR).

4. The physical essence of observer horizon and Schwarzschild sphere. Cosmological age of the Universe.

It was shown by Lemaitre [11] and independently by Robertson [12], that there is an appropriate transformation of coordinates, using which we can proceed from co-moving with matter rigid FR to not co-moving with matter FR, in which dimensions of both macro- and microobjects of matter mutually proportionally vary with time. When values of gravitational radius of small astronomical body, located far from other astronomical objects, are negligible ($r_{ge} \approx 0$, that only formally corresponds to de Sitter Universe): $r_c \approx \sqrt{3/\lambda} = c/H_e$, and linear element of body in Weyl FR will have the following form [10]:

$$ds^2 = \left(1 - r^2/r_c^2\right)^{-1} dr^2 + r^2\left(d\theta^2 + \sin^2\theta \cdot d\varphi^2\right) - \left(1 - r^2/r_c^2\right)c^2 dt^2 =$$
$$= \exp\left[2c\left(T - T_k\right)/r_c\right] \cdot \left[dR^2 + R^2\left(d\theta^2 + \sin^2\theta \cdot d\varphi^2\right)\right] - c^2 dT^2 =$$
$$= \left[1 - H_e\left(\hat{T} - \hat{T}_k\right)\right]^{-2}\left[dL^2 - c^2 d\hat{T}^2\right], \qquad (7)$$

where: $$dL = \sqrt{dR^2 + R^2\left(d\theta^2 + \sin^2\theta \cdot d\varphi^2\right)};$$

$$r \equiv R_k = R \cdot \exp\left[H_e\left(T - T_k\right)\right] = R\left[1 - H_e\left(\hat{T} - \hat{T}_k\right)\right]^{-1} < r_c \qquad (8)$$

R_k - radial coordinate in Weyl FR of optional world point of evolutionally self-contracting body STC in the time moment T_k $\left(\hat{T}_k\right)$ of calibration of the length standard dimension in Weyl FR by its dimension in intrinsic FR of this body;

$T = t + \left(r_c/2c\right)\ln\left(1 - r^2/r_c^2\right)$ - time, being counted in Weyl FR by the metrically homogeneous (calibrated) scale, by which the rate of quasi-equilibrium physical processes in matter doesn't vary (despite gradual shrinkage of distance between interacting elementary particles in this FR), and, therefore, being considered by us further as cosmological time;

$\hat{T} = \hat{T}_k + (1/H_e)[1 - \exp\{H_e(T_k - T)\}]$ - time, being counted in Weyl FR by metrically noncalibrated physically homogeneous scale [13,14], by which light velocity $\hat{V}_c = (\partial L / \partial \hat{T})_s$ and energy of photons (during the process of light propagation) don't vary, and which, in view of this, like length scale in this FR, requires continuous proportional renormalization - such, that, independently from duration of passed time, the moment of imaginary singularity (moment of matter self-contraction to zero dimensions) will be "expected" by it after the same finite time interval $\hat{T} - \hat{T}_k = H_e^{-1}$ and, therefore, in fact will never be reached (it means physical unrealizability of this singularity);

$H_e = -V_H / R$ - Hubble constant, which is determined in Weyl FR by metrically homogeneous time scale proportionality between velocity of the self-contracting body points V_H and radial distance R to this points in Euclidean space of Weyl FR (ratio $\hat{H}_e = -\hat{V}_H / R$, being determined in Weyl FR by physically homogeneous time scale, is invariant, only when it's being continuously renormalized, in analogy to invariance of light velocity, being determined in Weyl FR by metrically homogeneous time scale, only in case of its continuous renormalization).

According to this, velocities of radial motion of not only self-contracting matter points, but also of all points of conditionally empty intrinsic space of body (the process of self-contraction of which is equilibrium and inhomogeneous gauge for intrinsic observer) in Weyl FR are being determined by metrically homogeneous time scale by Hubble relation:

$$V = dR/dT = -H_e \cdot R_k \exp[-H_e(T - T_k)] = -H_e \cdot R \qquad (9)$$

and absolutely don't depend, as was shown in [13], on parameters of equations (1-3).

Taking into account relativistic time dilation, improper values of light velocities in FR of evolutionally self-contracting body (v_c) and in Weyl FR (V_c) will be connected by relationship:

$$v_c = c\sqrt{b} = V_c\sqrt{1-(V/V_c)^2}\, r/R, \qquad (10)$$

from where:

$$V_c = c\sqrt{b+(Vr/cR)^2}\, R/r = \sqrt{c^2b+H_e^2r^2}\, R/r \neq const(T). \qquad (11)$$

Front of intrinsic time t of physical body corresponds to simultaneous (when intrinsic time is inhomogeneous – to coincident [14,15]) events and propagates in body's intrinsic FR instantly in principle $(v_t = \infty)$. In Weyl FR this front will propagate, as follows from Lorentz transformation for velocities, with finite velocity:

$$V_t = dR_t/dT_t = V_c^2/V = -(c^2b+H_e^2r_t^2)R_t/H_e r_t^2 \qquad (12)$$

Since when $t(r) = const$:

$$V_t = \left(\frac{\partial R}{\partial r}\right)\frac{dr_t}{dT_t} + \frac{\partial R_t}{\partial T_t} = \left[\frac{\sqrt{ab}}{r_t\sqrt{b+r_t^2H_e^2/c^2}}\left|\frac{dr_t}{dT_t}\right| - H_e\right]R_t, \qquad (13)$$

where taking into account relativistic shrinkage of dimensions when $T(R) = const$:

$$\left|\frac{\partial R}{\partial r}\right| = \left|\frac{\partial r}{\partial r}\right|\sqrt{1-\frac{V^2}{V_c^2}}\,\frac{R}{r} = \frac{\sqrt{a}}{\sqrt{1+r^2H_e^2/c^2b}}\,\frac{R}{r},$$

then, when $\partial r/\partial R > 0$, we'll have:

$$dT_t = -\left[H_e/c\sqrt{(c^2b+H_e^2r_t^2)b/a}\right]r_t dr_t = -(v_H/v_c^2)dr_t = -dt_T, \qquad (14)$$

where: $v_H = -v_cV/V_c = H_e r/\sqrt{1+r^2H_e^2/v_c^2}$ - Hubble velocity of objects, distancing from observer in its intrinsic FR and conditionally motionless in Weyl FR space (in fact that's Newton-Weyl absolute space [14-16]), which doesn't exceed velocity of light v_c in every point of intrinsic space and is equal on the motionless observer horizon $(r = r_c)$ of conditionally empty space, the same as velocity of light, to zero:

$$v_{Hc} = (v_c r / r_c)\sqrt{(1 - r_{ge}/r_c)/(1 - r_{ge}/r)} =$$
$$= H_e r\sqrt{1 - r^3(r_c - r_{ge})/r_c^3(r - r_{ge})} = 0 .$$

From this for conditionally empty space $(ab = 1)$ we have:

$$dT_t = -\frac{H_e r_t (1 - r_{ge}/r_t)^{-1/2} dr_t}{c^2(1 - r_{ge}/r_t - r_t^2 H_e^2 / c^2)} = \frac{r_t^{5/2}(r_t - r_{ge})^{-1/2} dr_t}{H_e(r_t - r_c)(r_t - r_s)(r_t + r_c + r_s)}, \quad (15)$$

where: $r_s = \left[\sqrt{(r_c + 3r_{ge})/(r_c - r_{ge})} - 1\right] r_c / 2$ - Schwarzschild sphere radius.

After integrating (15), we'll receive formula for difference between cosmological ages of events, simultaneous in FR of evolutionally self-contracting physical body, in optional points j and i $(r_j > r_i)$ of intrinsic conditionally empty space of this body:

$$\Delta T_{ij} = T_{tj} - T_{ti} = \frac{2}{\tilde{H}_e}\left\{\ln\left|\frac{\left(\sqrt{r_j} + \sqrt{r_j - r_{ge}}\right)}{\left(\sqrt{r_i} + \sqrt{r_i - r_{ge}}\right)}\right| - \frac{(r_c + r_s)^{5/2}}{(2r_c + r_s)(r_c + 2r_s)\sqrt{r_c + r_s + r_{ge}}} \times\right.$$
$$\times \ln\left|\frac{\sqrt{r_i + r_c + r_s}\left[\sqrt{r_j(r_c + r_s + r_{ge})} + \sqrt{(r_c + r_s)(r_j - r_{ge})}\right]}{\sqrt{r_j + r_c + r_s}\left[\sqrt{r_i(r_c + r_s + r_{ge})} + \sqrt{(r_c + r_s)(r_i - r_{ge})}\right]}\right| +$$
$$+ \frac{r_s^{5/2}}{(r_c - r_s)(r_c + 2r_s)\sqrt{r_s - r_{ge}}} \times \ln\left|\frac{\sqrt{r_i - r_s}\left[\sqrt{r_j(r_s - r_{ge})} + \sqrt{r_s(r_j - r_{ge})}\right]}{\sqrt{r_j - r_s}\left[\sqrt{r_i(r_s - r_{ge})} + \sqrt{r_s(r_i - r_{ge})}\right]}\right| -$$
$$\left. - \frac{\sqrt{r_c(r_c - r_{ge})}}{(2r_c - 3r_{ge})}\ln\left|\frac{\sqrt{r_c - r_i}\left[\sqrt{r_j(r_c - r_{ge})} + \sqrt{r_c(r_j - r_{ge})}\right]}{\sqrt{r_c - r_j}\left[\sqrt{r_i(r_c - r_{ge})} + \sqrt{r_c(r_i - r_{ge})}\right]}\right|\right\}, \quad (16)$$

where $\tilde{H}_e = H_e$ when $\partial r / \partial R > 0$ and $\tilde{H}_e = -H_e$ when $\partial r / \partial R < 0$.

According to (16), for any values of r_{ge}, and, thus, for any values of mass of physical body, events in points of observer horizon of this body's intrinsic space took place in cosmological time in infinitely far past (when $\partial r / \partial R > 0$ and $r_j = r_c : \Delta T_{ij} = -\infty$). And this means, that observer horizon of any evolutionally contracting body, as it was shown in [13,14], covers all infinite absolute space (according to (8) and (16) when $t = const$: $R_c = \infty$). Higher concentration of astronomical objects near observer horizon, caused by this, and finiteness of intrinsic space of physical body, however, are not being observed. This is connected with the fact, that in process of astronomical observations distances to distant objects are being estimated by their luminosity, starting from assumption about isotropy of their brightness (which is valid, of course, for Euclidean absolute space, but not for intrinsic space of matter, which has curvature), and directly by their concentration in certain solid angle. But it means, that in fact not metrical radial distances $\acute{r}$ to distant objects in finite noneuclidean intrinsic metrical space of body, from surface of which observation is taking place, but continuously renormalized radial distances $\hat{r}_k \equiv R_k$ to these objects in infinite Euclidean absolute space are being determined.

Simultaneity in matter FR of infinitely far past on observer horizon (when distances between interacting elementary particles of protomatter in absolute space were as long as desired) with every concrete event in any point of matter intrinsic space causes the finiteness of metrical distance in intrinsic space to its observer horizon. The fact, that this horizon covers all infinite absolute space explains impossibility for radiation to reach this horizon and to come from horizon to observer within as long as desired but finite time interval (when $r_j = r_c$: $\Delta t_{cij} = \infty$), because in conditionally empty space:

$$\Delta t_{cij}=\int\limits_{r_i}^{\breve{r}_j}\frac{d\breve{r}}{v_c}=\frac{1}{c}\int\limits_{r_i}^{r_j}\sqrt{\frac{a}{b}}dr=$$

$$=\frac{c}{H_e^2}\int\limits_{r_i}^{r_j}\frac{rdr}{(r_c-r)(r-r_s)(r+r_c+r_s)}=\frac{c}{H_e^2}\left[\frac{r_c}{(2r_c+r_s)(r_c-r_s)}\times\right.$$

$$\times\ln\frac{(r_c-r_i)}{(r_c-r_j)}+\frac{r_s}{(r_c+2r_s)(r_c-r_s)}\ln\frac{(r_j-r_s)}{(r_i-r_s)}+$$

$$\left.+\frac{(r_c+r_s)}{(r_c+2r_s)(2r_c+r_s)}\ln\frac{(r_j+r_c+r_s)}{(r_i+r_c+r_s)}\ln\frac{(r_c-r_i)}{(r_c-r_j)}\right]. \qquad (17)$$

If observer horizon of matter intrinsic space is in fact a pseudohorizon of past, then Schwarzschild sphere, according to (16) and (17), is a pseudohorizon of future of matter. Events, taking place on this sphere, simultaneous in physical body FR with every event on the surface and in any other points of this body, will take place in cosmological time in infinitely far future (when $r_i=r_s:\Delta T_{js}=-\Delta T_{ij}=\infty$ and $\Delta t_{cij}=\infty$). There is nothing inside the fictive Schwarzschild sphere in that “moment” of cosmological time, and thus, in any moment of intrinsic time of physical body, because, according to (16) and (8), when $t=const$ and $r_i=r_s$: $\Delta T_{js}=T_s-T_{kj}=\infty$, and $R_s=0$ (and thus $\breve{r}_s=0$, despite value of r_s is nonzero). This, of course, is connected with principal conservation of finite eigenvalues of matter dimensions, when its dimensions are as large as desired or as small as desired (hypothetically – conditionally “zero” in infinitely far future) in absolute space.

The presence of negative feedback between eigenvalue of dimension (stabilizable output parameter) and length unit, which is being determined in absolute space by the material length standard, becomes apparent here. This negative feedback prevent from catastrophical decrease not only intrinsic dimensions of self-cooling astronomical objects, but also rates of physical processes in matter (which is possible because of the decrease of absolute value of the velocity of light) and, thus, guarantees the stable existence of matter. Moreover it causes the self-organization and stable existence of spiral-wave structural elements (matter elementary particles) in physical vacuum, which gauge-evolves (becomes older) and is the dissipative medium in Weyl FR. Analogous phenomena take place in thermodynamics (Le Chatelier – Brown principle), in electromagnetic phenomena (Lenz rule) and in the process of motion (relativistic shrinkage of length [15]). The character of any physical law or phenomenon is being determined by the presence of explicit and implicit (hidden from observation in principle) negative feedbacks, which are being formed between parameters and characteristics of matter in the process of its self-organization and are aimed at the maintaining of stability of steady phase state of matter. Revelation of global topology of direct communications and feedbacks between parameters and characteristics of matter is the supreme aim of physics.

All arguments, shown here, show the principal impossibility of finiteness of the Universe cosmological age both in the past and in the future, and so impossibility of birth of Universe from “nothing” and its expansion into “nowhere”. Conception of Big Bang of Universe is based on use in cosmology instead of metrically homogeneous scale exponential scale of cosmological time $\hat{t} = \hat{t}_k - (1/H_e)[1 - \exp\{H_e(t - t_k)\}]$, which requires continuous proportional renormalization of all time intervals and is inverse to physically homogeneous time scale in Weyl FR (if by the last in any moment of time $\hat{T}_k$ singularity will be realized in future after time interval $\hat{T} - \hat{T}_k = H_e^{-1}$, then by it in any moment of time $\hat{t}_k$ singularity distanced from present into past for the same time interval $\hat{t} - \hat{t}_k = -H_e^{-1}$, invariant only due to its renormalization). In view of this, such conception substitutes infinitely long evolutional development of the Universe by revolutionary event, which took place “not known where and inside of what”. Rejection of it, however, doesn’t deny the possibility of hot condition of matter at early evolutional stages and other results in Universe evolution research, achieved by cosmology (only some remaking sense of this results is required). This follows from the fact that this rejection leads only to metrical transformations of STC, which have no influence on sequence of cause and effect in evolutional physical processes.

According to physical notions stated here, exponential slowing down of all physical processes by used now in cosmology time scale is provided, and, all the more, exponential slowing down of matter self-contraction in the Newton-Weyl absolute space is provided too, which is equal to exponentially quick Universe expansion. Therefore, these notions are in good agreement with inflationary cosmology [17], based on the scenario of inflatory Universe.

Despite this, use of metrically inhomogeneous exponential time scale in cosmology in most cases may be expedient, the same as the use of metrically inhomogeneous logarithmical time scale in physics sometimes. But we must remember, that cosmological singularity, born in this case, is fictive.

5. Black holes and astronomical objects, which are alternative to them.

According to (2), during the setting up of physical, and so metrical, singularities on the surface of the body ($1/a_e = b_e = 0$): the following condition takes place: $b'_e = \left[1 - 3(H_e \cdot r_e / c)^2\right] / r_e > 0$. In view of this, when values of functions $a(\breve{r})$ and $b(\breve{r})$ are nonnegative the value of luminosity radius mustn’t decrease ($\partial r / \partial \breve{r} \leq 0$) in case of advance from the surface of the body to its center. The change of signature of linear element ($a \leq 0$ and $b \leq 0$) is not examined here, because it doesn’t correspond to primordially accepted in GR physical notions about space and time.

However, monotone decrease $(\partial r / \partial \breve{r} < 0)$ of function $r(\breve{r})$ in the layer near surface is also impossible. Since if it were possible gravitational forces would be directed from within of ideal liquid to its surface $(db / d\breve{r} < 0)$ and balanced by nothing, in view of conditionally zero value of pressure above this surface. And furthermore, by the same reason, physical singularity can't arise on the surface of body before it is set up in the whole its volume. Therefore, in intrinsic space of such body its spherocylindrical metrics ($\partial r / \partial \breve{r} = 0$ when $\breve{r} \leq \breve{r}_e$), which guarantees the possibility of propagation of physical singularity in the whole body volume ($b(\breve{r}) = 0$ when $\breve{r} \leq \breve{r}_e$), must be formed.

According to (14), and taking into account $a_{\min} > 1$, let's find lower limit of values of difference between cosmological ages of simultaneous events in nonempty space of any physical body, and so, inside of examined by us ideal liquid:

$$\left|\Delta T_{ij}\right| > \left| \frac{H_e}{c} \int_{r_i}^{r_j} \sqrt{\frac{a_{\min}}{b_{\max}\left(c^2 b_{\max} + H_e^2 r_t^2\right)}}\, r_t \, dr_t \right| >$$

$$> \frac{1}{cH_e \sqrt{b_{\max}}} \left| \sqrt{c^2 b_{\max} + H_e^2 r_j^2} - \sqrt{c^2 b_{\max} + H_e^2 r_i^2} \right|. \qquad (18)$$

According to obtained relation, condition $\left|\Delta T_{ij}\right| \neq \infty$ for as small as desired values of $\Delta \breve{r}_{ij}$ is fulfilled when $b(\breve{r}) = 0$ and also only in case of presence of spherocylindrical metrics of internal intrinsic body space. From all these follows the absence of both gravitation inside such "body" and radial pressure drop $\left(d\tilde{p} / d\breve{r} = 0\right)$ in its "matter", elementary particles of which, in view of equality of their hamiltonians to zero, have radiated all their energy with quasi-particles and, therefore, have proceeded from actual state into virtual and in fact have destroyed themselves (for exterior observer). And therefore, only "dead" black hole (energy of which is concentrated only in electromagnetic radiation, which propagates in Weyl FR with Hubble velocity) can correspond to GR gravitational field equations, if values of functions $a(\breve{r})$ and $b(\breve{r})$ are only nonnegative.

Let's examine also compatibility of existence of black holes with presence of Weyl FR. Motionless in intrinsic space observer horizon ($v_{Hc} = 0$) of physical body moves in Weyl FR with light velocity. Therefore, this body's matter, which has inertia, can't be on this horizon in principle. There necessarily must be a layer of empty space between the surface of the body and its external observer horizon (which, as was shown before, is a pseudohorizon of past). But, according to (8) and (16), as it was shown by Danyl'chenko [13,14], any as "photometrically" thin ($r_c - r_e \to 0$ in sprite of the fact that $\breve{r}_c - \breve{r}_e >> 0$) as desired layer of external conditionally empty part of physical body intrinsic space contains whole Universe. In other words, both on and outside observer horizon of as massive as desired physical body no other physical objects can be in principle. Ultralow gravitational field strength, being created in absolute space near its observer horizon by astronomical body with as small as desired mass, doesn't prevent other astronomical objects near this horizon from spontaneous motion in it. And if observer horizon of body intrinsic space didn't cover whole infinite absolute space by itself, then when it's "passing by" these astronomical objects they would be observed in this body intrinsic space as distancing from observer with light velocity. Therefore, no physical body can be self-isolated from Universe by singular surface, which is located in empty space or at least contacts with this space.

And this means, that (according to physical notions taken here) such hypothetic astronomical objects as black holes can't exist in principle. Impossibility of moving in absolute space with light velocity of surface of evolutionally self-contracting in this space astronomical body is imposing substantial restriction both on the value of luminosity radius of this surface in intrinsic space and on the value of body gravitational radius. So, for example, for hypothetical absolutely incontractable ideal liquid (in whole volume of which both eigenvalues of mass density $\left(\tilde{\mu} = const(r)\right)$ and, according to (1), improper values of enthalpy density $\left(\sigma = \tilde{\sigma}\sqrt{b} = \left(\tilde{\mu}c^2 + \tilde{p}\right)\sqrt{b} = \tilde{\mu}c^2\sqrt{b_e} = const(r)\right)$ are constant) when $r_0 = 0$:

$$v_{ce} \equiv \sqrt{b_e} = \sqrt{1-\left(\kappa\tilde{\mu}c^2 + \lambda\right)r_e^2 / 3} = 1-(2/3)\left(1+\lambda/\kappa\tilde{\mu}c^2\right)\left(1-\sqrt{b_0}\right)$$

and takes its minimal value $(v_{ce})_{\min} = \left(1-2\lambda/\kappa\tilde{\mu}c^2\right)/3$ for the value:

$$(r_e)_{\max} = 2\sqrt{\left(2\kappa\tilde{\mu}c^2 - \lambda\right)/3} / \kappa\tilde{\mu}c^2,$$

which corresponds to onset of gravitational singularity ($\tilde{p}_0 = \infty$; $a_0 \cdot b_0 = 0$) in liquid center of gravity. Further growth of r_e, and so growth of liquid mass for present (normal: $a_0 = 1$) configuration of its STC, is impossible in principle, because it leads to negative values of not only b_0, but also $\tilde{p}_0$ and $\tilde{\sigma}_0$. And furthermore, when $\tilde{\mu} = 6H_e^2/\kappa c^4$: $r_e = r_s = r_c = \lambda^{-1/2} = c/\sqrt{3}H_e$ and intrinsic space of liquid (both inside and outside it) has spherocylindrical metrics, and velocity of light v_c not only inside the liquid, but also in conditionally empty space above it takes on a zero value.

Like in all other solutions of equation (3), in this solution integration begins only from zero value of luminosity radius of physical body. In view of this, upper layers (even when they're as massive as desired) have no direct effect on the curvature of intrinsic space of body in lower layers of matter, while lower layers have direct effect on the curvature of this space in upper layers. For hypothetic absolutely incontractable liquid function $a(r)$ of linear argument (determines curvature of its intrinsic space) in the points of lower liquid layers doesn't depend on presence of liquid higher than these layers at all, because pressure of upper layers of contracting liquid has no effect on distribution of eigenvalue of its density in lower layers. This is not only a paradox, but not always may be a physical reality. Matter upper layers, when their mass is very big, must have direct effect on body space curvature in lower layers by some integral characteristics. According to (3), this is possible only if we consider that in intrinsic spaces of very massive astronomical bodies physically realized values of luminosity radius may be limited not only from top $(r_{\max} \equiv r_c \neq \infty)$, but also from bottom $(r_{\min} \equiv r_0 \neq 0)$. This limitation from bottom of value of luminosity radius of body with strong gravitation field may be connected with existence of metrical singularity $(a_0 = \infty)$ inside the body. It takes place in the case of nonmonotone radial change of gravitational field strength in absolute space and space co-moving with it. For such spatial distribution of gravitational field strength, with decrease of value of metrical radial distance $\breve{r}$ luminosity radius r at first decreases $(\partial r / \partial \breve{r} > 0)$ to its minimal value r_0, and then begins to increase $(\partial r / \partial \breve{r} < 0)$) inside nonempty intrinsic space of this body. Physical singularity $(b(r_0) = 0)$, which, according to (5), always accompanies metrical singularity, will take place only in infinitely small neighborhood of the surface with luminosity radius r_0. Therefore, it can be expected that this singularity will be smeared by quantum fluctuations of STC inhomogeneous structure and it doesn't completely disturb the interaction between matter of internal and external parts of such body, due to probable tunneling of formally absolutely thin barrier, formed by it. According to quantum-mechanic notions, the motion of matter is not its mechanic transposition, but quasi-continuous change of its space-time states. Therefore, such singular surface can't be an absolutely insuperable barrier for penetration of matter through it.

6. Internal solution of GR equations for ideal liquid in Weyl FR

Because of covariance of GR gravitational field equations, their internal solution for ideal liquid may be received also in Weyl FR, when nonzero components of metric tensor are the following:

$$g_{11}=N^2(R,T)=r^2(R,T)/R^2,\quad g_{22}=r^2(R,T),$$

$$g_{33}=r^2(R,T)\sin^2\theta,$$

$$g_{44}=-f^2(R,T)c^2=-N^2(R,T)V_c^2(R,T),$$

Eigenvalue of radial coordinate $r(R,T)$ is being determined by intrinsic length standard in the point with following coordinates of matter and identically equal to the value of luminosity radius in FR, co-moving with ideal liquid. Relation $N(R,T)=r/R$ determines inequality of dimensions of identical matter objects in different points of Weyl FR Euclidean space, and so characterizes metrical inhomogeneity of this space for matter. Average statistical value of frequency of interaction of matter elementary particles $f(R,T)=NV_c/c$ determines inequality of rates of identical physical processes in different points of Weyl FR space, and so characterizes physical inhomogeneity of this space for matter.
According to this gravitational field equations for ideal liquid [10]:

$$M_i^k=G_i^k-Gg_i^k/2-\lambda g_i^k=-\kappa T_i^k=-\kappa\left[\left(\tilde{\mu}+\tilde{p}/c^2\right)U_iU^k+\tilde{p}\delta_i^k\right]$$

in pseudoeuclidean Minkowski space of Weyl FR will have the following form:

$$M_1^1=-\frac{2R^2}{r^3f}\frac{\partial f}{\partial R}\frac{\partial r}{\partial R}-\frac{2}{rc^2f^3}\frac{\partial f}{\partial T}\frac{\partial r}{\partial T}+\frac{2}{rc^2f^2}\frac{\partial^2 r}{\partial T^2}+$$

$$+\frac{1}{r^2c^2f^2}\left(\frac{\partial r}{\partial T}\right)^2-\frac{R^2}{r^4}\left(\frac{\partial r}{\partial R}\right)^2+\frac{1}{r^2}-\lambda=$$

$$= -\kappa\left[\tilde{\mu}c^2V^2 / V_c^2 + \tilde{p}\right]\left(1 - V^2 / V_c^2\right)^{-1}$$

$$M_1^4 = -\frac{r^2}{R^2c^2f^2}M_4^1 = \frac{2}{rc^2f^2}\left[\frac{1}{f}\frac{\partial f}{\partial R}\frac{\partial r}{\partial T} + \frac{1}{r}\frac{\partial r}{\partial R}\frac{\partial r}{\partial T} - \frac{\partial^2 r}{\partial R \partial T}\right] =$$

$$= -\frac{\kappa Vr\left(\tilde{\mu}c^2 + \tilde{p}\right)}{cV_c fR\left(1 - V^2/V_c^2\right)},$$

$$M_3^3 = M_2^2 = -\frac{R^2}{r^2 f}\frac{\partial^2 f}{\partial R^2} - \frac{R}{r^2 f}\frac{\partial f}{\partial R} - \frac{2}{rc^2f^3}\frac{\partial f}{\partial T}\frac{\partial r}{\partial T} +$$

$$+ \frac{2}{rc^2f^2}\frac{\partial^2 r}{\partial T^2} + \frac{1}{r^2c^2f^2}\left(\frac{\partial r}{\partial T}\right)^2 -$$

$$- \frac{R^2}{r^3}\frac{\partial^2 r}{\partial R^2} + \frac{R^2}{r^4}\left(\frac{\partial r}{\partial R}\right)^2 - \frac{R}{r^3}\frac{\partial r}{\partial R} - \lambda = -\kappa\tilde{p},$$

$$M_4^4 = \frac{3}{r^2c^2f^2}\left(\frac{\partial r}{\partial T}\right)^2 - \frac{2R^2}{r^3}\frac{\partial^2 r}{\partial R^2} + \frac{R^2}{r^4}\left(\frac{\partial r}{\partial R}\right)^2 - \frac{2R}{r^3}\frac{\partial r}{\partial R} + \frac{1}{r^2} - \lambda =$$

$$= \frac{\kappa[\tilde{\mu}\mathrm{c}^2 + \tilde{p}V^2/V_c^2]}{\left(1 - V^2/V_c^2\right)}.$$

From these equations, taking into account (9,12,14) and rigidity of intrinsic FR of ideal liquid ($r = const(T), f(r) = const(T),$ $\tilde{\mu}(r) = const(T), \tilde{p}(r) = const(T)$) we find by the metrically homogeneous scale of cosmological time T ($dT \equiv dt = d\tilde{t} / \sqrt{b}$ when $dr = 0$) following dependences:

$$\frac{V}{V_c} = -\sqrt{\frac{\lambda}{3}}\frac{r}{f} = const(T) \qquad (19)$$

$$\left(\frac{\partial r}{\partial T}\right)_R = H_e \cdot R\left(\frac{\partial r}{\partial R}\right)_T = \tilde{H}_e \cdot r / \sqrt{a\left(1 - \left(V/V_c\right)^2\right)} =$$

$$= \tilde{H}_e \cdot r / \sqrt{a\left(1 - \left(H_e \cdot r / cf\right)^2\right)} = \tilde{H}_e \cdot rf\,(ab)^{-1/2},$$

$$V = -H_e \cdot R, \qquad f = \sqrt{b + \lambda \frac{r^2}{3}} = \sqrt{\frac{1}{a} \exp \int_{r_e}^{r} \kappa\left(\tilde{\mu} c^2 + \tilde{p}\right) a r dr + H_e^2 \frac{r^2}{c^2}}$$

and directly when $1/a_0 = 0$:

$$\frac{1}{a} = \frac{1}{r}\left[\left(r - r_0\right) - \kappa c^2 \int_{r_0}^{r} r^2 \tilde{\mu} dr - H_e^2\left(r^3 - r_0^3\right)/c^2\right],$$

$$T(r,t) = T_k + \frac{\left(\tilde{t} - \tilde{t}_k\right)}{\sqrt{b}} - \frac{\tilde{H}_e}{c^2} \int_{r_k}^{r} \sqrt{\frac{a}{b}} \frac{r}{f} dr = T_k + \left(t - t_k\right) - \frac{\tilde{H}_e}{c^2} \int_{r_k}^{r} \sqrt{\frac{a}{b}} \frac{r}{f} dr, \quad (20)$$

$$R(r,T) = R(r,T_k)\exp\left[-H_e\left(T - T_k\right)\right] =$$

$$= r_k \exp\left[-H_e\left(\left(T - T_k\right) - \frac{1}{\tilde{H}_e} \int_{r_k}^{r} \frac{\sqrt{ab}}{fr} dr\right)\right],$$

$$R(r,t) = R(r,\tilde{t}_k)\exp\left[-\frac{H_e \cdot \left(\tilde{t} - \tilde{t}_k\right)}{\sqrt{b}}\right] = r_k \exp\left[-H_e\left(\left(t - t_k\right) - \frac{1}{\tilde{H}_e} \int_{r_k}^{r} \sqrt{\frac{a}{b}} \frac{f}{r} dr\right)\right], \quad (21)$$

where: r_0 - minimal physically realizable value of luminosity radius, which corresponds to locus (spherical surface), in the points of which there is no gravitational field strength $\left(db/dr\right) \equiv b_0' / \sqrt{a_0} = 0)$, and: $f_0 = H_e \cdot r_0 / c$, $V_{c0} = H_e \cdot R_0$;

t_k and $\tilde{t}_k = \sqrt{b} t_k$ - moment of single for whole liquid intrinsic (astronomical) time and proper quantum time correspondingly in FR, co-moving with ideal liquid, when in the point with radius r_k (separately for $R_k > R_0(T_k)$ and for $R_k < R_0(T_k)$) dimension of length standard is calibrated in Weyl FR by its dimension in co-moving FR $\left(R(r_k, T_k) \equiv R(r_k, t_k) \equiv r_k\right)$;

$\tilde{H}_e = H_e$ for the region of Weyl RS space $R \in (R_0; \infty)$, where $\partial r / \partial \breve{r} > 0$, and $\tilde{H}_e = -H_e$ for the region $R \in (0; R_0)$, where $\partial r / \partial \breve{r} < 0$.

It should be noted here, that despite $db / d\breve{r} = 0$ when $r = r_0$, the value of db / dr is nonzero $(b_0' \neq 0)$, the same as, according to (5), $a_0 b_0 \neq 0$. Therefore, according to (2), $\tilde{p}_0 \neq \infty$, even if the value of liquid mass is as large as desired, and for compact astronomical formations the value of $r_0 << (\lambda - \kappa\tilde{p}_0)^{-1/2}$ may be guaranteed.

In view of presence in this internal solution (the same as in external solution [13]) of principal possibility of function $R(r)$ two-valuedness, function $\breve{r}(r)$ may also be two-valued. This means, that GR gravitational field equations really admit the possibility of existence of metrical singularity $(a_0 = \infty)$ inside physical body and, according to (21), in any moments of cosmological and intrinsic time guarantee correspondence of eigenvalues of luminosity radius r, not smaller than r_0 $(r \geq r_0 > r_{ge})$, to whole infinite Euclidean space of Weyl FR $(R \in (0; \infty))$. Therefore, no region of Weyl FR space can correspond to Schwarzschild solution for $r < r_{ge}$, when $a \leq 0$ and $b \leq 0$ [18]. At the same time, velocity of motionless in Weyl FR objects both in external ($R > R_0$) and internal ($R < R_0$) conditionally empty intrinsic liquid spaces is determined by Hubble relation:

$$v_H = \tilde{H}_e \cdot r\sqrt{1 - (V_e / V_c)^2} = \tilde{H}_e \cdot r\sqrt{1 - r^3 (r_c - r_{ge}) / r_c^3 (r - r_{ge})}.$$

7. Extraordinary configuration of STC of ideal liquid, at which the minimum of enthalpy of the liquid takes place.

Such singular solution of GR gravitational field equations corresponds to hollow spherically symmetrical body with mirror symmetrical intrinsic space and many centers of gravity $\left(db/d\breve{r}=0\right)$ in the points of metrical singularity, which are located on the spherical surface, concentric to external and internal boundary body surfaces. When $\lambda=0$ such configuration of intrinsic space consists of two asymptotically Euclidean half-spaces, connected by narrow gullet. This configuration is obtained by Fuller and Wheeler [19,20], being based on geometrodynamic model of mass. When $\lambda \neq 0$, internal empty space of massive astronomical body is limited by fictive sphere of the pseudohorizon of future. In this internal space, which is as it were «turned inside-out» by very strong gravitational field, instead of the Universe expansion phenomenon, phenomenon of contraction of "internal universe" may be "observed" and also internal planet system may be formed. In intrinsic FR of these planets internal boundary surface of this astronomical body will be observed as convex (the same as external boundary surface), because luminosity radiuses of their orbits will be longer than luminosity radius of this surface. Only absence of distant stellar systems in internal empty space will give the opportunity to differ it from external space.

The value of luminosity radius in the center of gravity is being determined unambiguously, if the configuration of liquid STC is ordinary ($r_0=0$ when $a_0=1$), and becomes indeterminate from GR equations, if the configuration is extraordinary $\left(a_0=\infty\right)$. In view of this, one should agree with the statement of Hawking [5], that GR itself (without use of additional laws, obtained in classical physics) "doesn't provide field equations with boundary conditions in singular points" and, therefore, "becomes incomplete" near these points.

Stability of equilibrium conditions of held by gravitational field matter, when entropy and external pressure are constant, demands such space distribution of function $r\left(\breve{r}\right)$, for which minimum of enthalpy lagrangian of whole matter of liquid body is being reached in Weyl FR. This lagrangian is equal to enthalpy in FR, co-moving with liquid, and is being determined by the following formula:

$$E_e(r_0, r_e) = 4\pi \int_{R_{\min}}^{R_{\max}} \sigma N^3 R^2 \left(1 - V^2 / V_c^2\right)^{-1/2} dR = 4\pi \int_{R_{\min}}^{R_{\max}} \tilde{\sigma} f N^3 R^2 dR =$$

$$= 4\pi n \int_{r_0}^{r_e} \left(\tilde{\mu} c^2 + \tilde{p}\right) \sqrt{ab}\, r^2 dr . \qquad (22)$$

For concrete permanent quantity of whole homogeneous liquid matter (eigenvalue of mass of whole body

$$\tilde{m}_e = 4\pi n \int_0^{r_e} \tilde{\mu} r^2 dr = 4\pi n \int_{r_0}^{r_e} \tilde{\mu} \sqrt{a}\, r^2 dr) \qquad (23)$$

this is being realized:

$$\frac{dE_e}{dr_0} = \frac{\partial E_e}{\partial r_0} + \frac{\partial E_e}{\partial r_e} \frac{dr_e}{dr_0} = \frac{\partial E_e}{\partial r_0} - \left(\frac{\partial E_e}{\partial r_e} \frac{\partial \tilde{m}_e}{\partial r_0} \right) \left(\frac{\partial \tilde{m}_e}{\partial r_e} \right)^{-1} = 0$$

in case of realization of the following term: $r_0^2 = \left(\sqrt{a_e}\,\sigma_0 - c^2 \tilde{\mu}_0\right)^{-1} \times$

$$\times \lim_{r_i \to r_0} \left\{ \frac{1}{\sqrt{a(r_i)}} \int_{r_i}^{r_e} \left[\left(\sqrt{a_e} \frac{\partial \sigma}{\partial r_0} - c^2 \frac{\partial \tilde{\mu}}{\partial r_0} \right) + \frac{1}{2a} \left(\sqrt{a_e}\,\sigma - c^2 \tilde{\mu} \right) \frac{\partial a}{\partial r_0} \right] \sqrt{a}\, r^2 dr \right\} \geq 0 , \qquad (24)$$

which takes into account direct influence of both upper and lower matter layers on the values of functions $a(r, r_0)$ and $b(r, r_0)$. Spatial distributions of improper (coordinate) value of enthalpy density $\sigma(r, r_0)$ and eigenvalue of mass density $\tilde{\mu}(r, r_0)$ are obtained by solution of both GR gravitational field equations and equations of thermodynamic state of matter. These solutions can be found for solid (when of $n = 1$) and for hollow (when $n = 2$) spherically symmetrical bodies, due to equality of radial distributions of eigenvalues of physical characteristics of homogeneous ideal liquid in internal and external half-layers of hollow body in its rigid intrinsic FR. In nonrigid intrinsic FR of self-cooling hollow body, which has unequal temperatures of external and internal boundary surfaces, eigenvalues of mass of internal and external half-layers of hollow body will be also unequal. And, consequently, fulfillment of the condition, which takes into account values of these temperatures, will be required instead of the fulfillment of the condition (24). Therefore, GR should be considered as component part of gravithermodynamics that takes into account additional intensive and extensive parameters, which characterize gauge effect on the state of matter motion and gravitation.

When quantity of matter doesn't exceed its critical value, function $E_e(r_0, r_e)$ doesn't have minimum and zero value of luminosity radius $(r_0 = 0)$ corresponds to the smallest value of this function. In view of this, physical body can be only solid globular. When mass of astronomical body is close to critical value, solid spherically symmetrical topological form becomes unstable even to small perturbations of gravitational field strength. This may lead to its transformation into hollow spherically symmetrical topological form $(r_0 \neq 0)$, which corresponds to body enthalpy minimum and, therefore, is absolutely gravitationally stable. In view of decrease of r_e value, such catastrophical change in body topology may be considered as relativistic gravitational collapse of matter. But in contrast to the black hole, this catactrophical change is not accompanied by matter self-closure inside the sphere of physical singularity $(b_e \equiv 1/a_e >> 0)$. Such hollow body (which contains Fuller-Wheeler lost world) at the completion stage of its evolution is alternative to hypothetical black hole. It can be, for example, very massive neutron star, which doesn't differ from black hole by external observable features and is the result of smooth cooling down of quasar. Very large values of energy and mass of quasars point on the fact that they have hollow topological form. Quick loss of energy of quasars (due to their huge luminosity) makes their active life short. At the present moment of cosmological time all of them, apparently, proceed to the new forms of their existence. Very long distances to quasars point on this. However, only the small amount of quasars were transformed into hollow neutron stars. The most part of quasars gradually turned into the stars, which can't keep the stability of hollow topological form in future due to big energy loss. As soon as their energy exceeds the critical value, they are being transformed into supernovas. After supernova sheds external layer of its matter, which is surplus for ordinary (not hollow) topological form of star, its evolution continues with new configuration of intrinsic STC.

According to its spiral-wave nature [21], elementary particles and matter that consists of them are stable only in external empty space, in which phenomenon of Universe expansion takes place, and in external half-layer of hollow body. In the internal empty space, in which contraction of "internal Universe" takes place, and in internal half-layer of hollow body, otherwise, only antiparticles and matter that consists of them are stable. In view of this, median singular surface of hollow body is a natural barrier between matter and antimatter, which preserve them from catastrophical annihilation. Sporadic leakage of matter and antimatter through this barrier is possible in principle (even without bringing in quantum-mechanical notions about motion), because of incompletely mutually coordinating (without this leakage) self-cooling of external and internal parts of nonabsolutely cold hollow body. This self-cooling distorts the total balance and thus leads to radial migration of singular surface relatively to matter and antimatter. Due to matter and antimatter annihilation, which is the cause of this leakage, unlimited in time maintaining of weak radiant emittance of hollow body with as cold as desired boundary surfaces is possible. In nonrigid and quasirigid internal FR of self-cooling hollow bodies photometrical radius of median singular surface continuously decreases $\left(r_0 \neq const(t)\right)$. And all events, which coincide one with another in internal FR of matter, may be compared to every specific value of this radius (and also to the value of radius of observer horizon [15,22]). Because of the gradual displacement of median singular surface of self-cooling hollow body in its intrinsic space, the value of the velocity of light on this surface (the same as, according to (27) on the singular surfaces of the pseudohorizons of past and future [22]) in nonrigid and quasirigid FR may be as small as desired, but nonzero. And for quasars this value is rather big. This conditions the possibility of unimpeded one-way penetration through the barrier between matter and antimatter, in particular – the possibility of continuous penetration only of antimatter to the matter (to the external half-layer of hollow body). In that way, continuity of gradual annihilation of matter and antimatter in hot hollow bodies is guarantied. And, consequently, the main source of energy of hollow bodies is annihilation of matter and antimatter. This annihilation is the cause of long-continued ultrahigh luminosity of quasars and short-time ultrahigh luminosity of supernovas.

Taking into account, that intrinsic values of mass density of liquid inside the body exceed value of this density on the surface $(\tilde{\mu} \geq \tilde{\mu}_e)$, let's find, according to (23), the lower limit for integral eigenvalue of whole hollow body mass:

$$\tilde{m}_e > 8\pi\tilde{\mu}_e \int_{r_0}^{r_e} \frac{r^{5/2}dr}{\sqrt{(r-r_0) - \kappa c^2 \tilde{\mu}_e \int_{r_0}^{r} r^2 dr - H_e^2 (r^3 - r_0^3)/c^2}} >$$

$$> \frac{8\pi\tilde{\mu}_e}{\sqrt{1 - r_0^2 (\kappa c^2 \tilde{\mu}_e + 3H_e^2/c^2)}} \int_{r_0}^{r_e} \frac{r^{5/2}dr}{\sqrt{r-r_0}} = \frac{\pi\tilde{\mu}_e}{\sqrt{1 - r_0^2 (\kappa c^2 \tilde{\mu}_e + 3H_e^2/c^2)}} \times$$

$$\times \left[\frac{1}{3}\sqrt{r_e(r_e - r_0)}\left(8r_e^2 + 10r_e r_0 + 15r_0^2\right) + 5r_0^3 \ln\left(\sqrt{r_e/r_0} + \sqrt{r_e/r_0 - 1}\right)\right], \quad (25)$$

where:

$$\sqrt{1 - r_0^2 (\kappa c^2 \tilde{\mu}_e + 3H_e^2/c^2)} \geq \sqrt{1 - (r^2 + r_0 r + r_0^2)(\kappa c^2 \tilde{\mu}_e/3 + H_e^2/c^2)}.$$

As it was expected, according to (25), when the value of the relation r_e / r_0 is as large as desired, hollow spherical body may have as big as desired mass.

For ideal absolutely incontractable liquid the value of its enthalpy is $E_e = 4\pi n\sigma \int_{r_0}^{r_e} \sqrt{a} r^2 dr = \tilde{m}_e \sigma / \tilde{\mu}$. Therefore, equation (24) transforms into identity, and the value of minimal luminosity radius becomes indeterminate. This shows the degeneracy of such state for ideal liquid. In view of this, equilibrium state of absolutely incontractable liquid will be absolutely stable for any values of r_0, and as large as desired quantity of absolutely incontractable liquid may be contained inside of hollow body, when the value of r_e is as small as desired (when $r_0 \to 0$, according to (25), $\tilde{m}_e \to \infty$). This is physically unreal, the same as existence of absolutely incontractable liquid. And, consequently, such result may be considered as one more sign of degeneracy of state of ideal liquid, and so as apparent confirmation of validity of selected by us criterion for determination of minimally possible value of luminosity radius of physical body when it has hollow topology.

8. Conclusions

So, avoidance of physical realizability of cosmological singularity in GR is possible, if we postulate counting of cosmological time in Weyl FR and if in gravitational field equations cosmological constant λ is nonzero (and thus, if we admit physical reality of infinitely long gauge process of matter self-contraction in absolute space of Weyl FR).

Avoidance of physical realizability of gravitational singularity ($\tilde{p}_0 = \infty$; $a_0 b_0 = 0$) for very massive astronomical body is possible, if we supplement gravitational field equations with condition of reaching the minimum of enthalpy of the whole body matter and if we admit physical reality of mathematically inevitable its hollow topology and corresponding to this topology configuration of STC with "turned inside out" internal intrinsic space.

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Phenomenological justification of linear element of Schwarzschild solution of GR gravitational field equations

The possibility of getting a linear element (interval) of Schwarzschild frame of reference of spatial coordinates and time (FR) is shown, founded on the existence of Newton absolute space, which is formally independent on matter and is only a container for it [1]. In addition to it, the presence of evolutionary changeability and spatial inhomogeneity of properties of the physical vacuum (PV), filling all this absolutely rigid (nonexpanding) Euclidean (noncurved) infinite space, is assumed.

KEY WORDS: Schwarzschild FR, absolute space, evolutional variability of the properties of PV, Hubble relation, de Sitter Universe.

1. Introduction

It was shown in papers [2-4] that evolutionary changeability in the PVFR of propagation velocity in absolute space of electromagnetic interaction between matter elementary particles (equal to the velocity of light in free space), as well as the effect of a physical body motion on the velocity of light [5], is unobservable in principle by the matter FR proper clock. The cause of this is mutual dependence and mutual determination of the course rate of matter proper time and of the velocity of propagation of interaction in the matter FR. Matter "adaptation" to evolutionary change of conditions of interaction of its elementary particles (consisting in persistent decrease of the value of the absolute velocity of light) leads to gauge (unobservable in principle in the matter FR) equilibrium self-compression of physical bodies in absolute space [2-4]. This self-compression of physical bodies is realizing at elementary particles level and is the cause of persistent moving away of distant astronomic objects from an observer, i.e. of the effect of expansion of the Universe in matter intrinsic space. Spatial irregularity of aging of the PV leads to the physical inhomogeneity of absolute space, which is identified here with gravitational field. This physical inhomogeneity of space becomes apparent as inequality in its different points of rates of identical physical processes (which are set by unequal average values of interaction frequencies of elementary particles of identical matters, participating in these processes), and consequently, it becomes apparent as inequality of course rate in them of proper quantum time of matter. And this is accompanied by metrical inhomogeneity (irregularity) of absolute space for matter, which partially compensates the effect of spatial inhomogeneity of the absolute velocity of light on physical inhomogeneity of space. This metrical inhomogeneity consists in unequal degree of inelastic self-compression of matter in different points of absolute space (considering the “adaptation” of elementary particles of the matter to unequal conditions of interaction) and becomes apparent at the presence of curvature of matter intrinsic space.

2. Linear element of body, possesing rigid intrinsic FR

Let ΔL_j and Δl_j be standard values (universe means) of distance between interacting elementary particles of reference substance, which is situated in an arbitrary point j of spherically symmetric gravitational field. These standard values of the distances of interaction are being determined via standard average statistical frequency of interaction and propagation velocity of the wave of interaction (between exchange virtual particles and quasiparticles). Also let R_j and r_j be photometrical radiuses of the j point (distances to this point from the center of gravity of a body, possessing a gravitational field), being determined via the spherical surface area, correspondingly by a hypothetically rigid metrical scale, common for Euclidean absolute space, and by matter intrinsic metrical scale, evolutionary compressing together with the substance. Because of this, Δl_j, in contrast to ΔL_j, is the same at all the identical standards and, consequently, vary neither in space nor in time $(\Delta l = const(r,t))$. Then in absolute space the standard normalized value of spatial frequency N_j (which is set by standard average statistical value of the interaction distance ΔL_j) and the standard normalized value of the frequency f_j of interaction of reference substance elementary particles can be determined in the following way:

$$N_j = N_{ja} / n_a = \Delta l / \Delta L_j = r_j / R_j, \tag{1}$$

$$f_j = N_{ja} \cdot V_{cj} / n_a c = N_j \cdot V_{cj} / c = V_{cj/c} r_j / R_j, \tag{2}$$

where $N_{ja} = 1/\Delta L_j$ and $n_a = 1/\Delta l$ are absolute (not normalized) values of spatial frequencies correspondingly in absolute and intrinsic matter spaces;

$V_{cj/c} = V_{cj} / c$ is a normalized value in the j point of the velocity of propagation of interaction, which is a dimensionless quantity (as well as standard normalized values of spatial frequency (N_j) and frequency of events (f_j));

V_{cj} is the absolute value of the velocity of propagation of interaction;

c is the light velocity constant (the eigenvalue of the velocity of light). The rate of the process of evolutionary self-compression of matter in the space-time continuum (STC) of PV is characterized by a relative change of the value of an unobservable (hidden) parameter N. That's why in every point of physically inhomogeneous absolute space this rate must be proportional (as well as rates of any observable physical processes) to standard normalized value in it of interaction frequency:

$$\left|(\partial N / \partial T)_R\right| / N = \left|(\partial \ln r / \partial T)_R\right| = H(r) \cdot f, \tag{3}$$

where the $H(r)$ function, independent on cosmological time T, depends on spatial distribution in the matter of the eigenvalue of its enthalpy density. In space free from matter this function (as it will be seen from the following) is gauge-unchangeable eigenvalue of Hubble constant H_e.

It is necessary to renormalize continuously the distances in absolute space accordingly to continuous recalibration of rigid metrical scale of absolute space by a certain evolutionary decreasing in PVFR material scale. Using of a metrically homogeneous scale ($f_j = const(T)$, when $r_j = const$) of absolute time (MHSAT) [2], based on proportional synchronization of course rate of this time with course rates of the FR proper time of every point of all the gauge-self-compressing bodies (that is why it is a metrically homogeneous scale of cosmological time), allows avoiding continuous renormalization of absolute (cosmological) time. And, consequently, this allows considering not relative, but absolute value of time increment:

$$dT = \left[1 - H_e\left(\hat{T} - \hat{T}_k\right)\right]^{-1} d\hat{T}\,, \qquad (4)$$

where: $$\hat{T} = \hat{T}_k + (1/H_e)\left[1 - \exp\{H_e(T_k - T)\}\right] \qquad (5)$$

is the absolute time, read by an exponential (nonuniform for matter) physically homogeneous scale of absolute time (PHSAT) [2,3], which guarantees invariability of the value of absolute velocity of light $\hat{V}_c$ in every point of gauge-self-compressing matter, but requires at this continuous renormalization of reading time. Reading of this time begins from the moment of matter hypothetical compression in absolute space to "zero" values of interaction distances of its elementary particles. By the MHSAT this moment of time will set in infinitely distant future and therefore is not realizing physically. In that way, using of MHSAT allows considering absolute changes (instead of relative) of standard normalized value of interaction frequency. Analogously (3), the "speed" of radial change of standard values of interaction frequency must be proportional in every point of absolute space to the values of spatial frequencies N in them. And, besides this, it must be – inversely proportional to the square of eigenvalue (i.e. value, renormalized according to eigenvalue of material length standard) of radial distance, identically equal to photometrical radial distance in intrinsic FR of a physical body. This is caused by decrease in three-dimensional homogeneous space by this dependence of density of a flux of the source of any physical effect, which is not weakened by anything. Therefore, analogously to Poisson equation [6]:

$$\left(\partial f / \partial R\right)_T = \eta(r) N / r^2 = \eta(r) / NR^2 , \tag{6}$$

where $\eta(r)$ is a parameter, depending in general on quantity of matter, confined in a sphere with radius r, as well as on pressure in the matter. Beyond the bounds of a physical body (in a conditionally free space), this parameter is a constant value $\left(\eta_e = const(r, R, T)\right)$ that determines the power of the source of gravitational induction of the PV properties spatial inhomogeneity.

The stability of values of relativistic exceedings of shrinkages of radial dimensions above the shrinkage of matter meridian dimensions is the necessary condition of energy conservation by gauge self-compressing of matter as well as the condition of homogeneity of cosmological time, considered here. These exceedings of shrinkage of radial dimensions take place only in absolute space (as well as metrical inhomogeneity of matter) and they are unobservable in principle in matter intrinsic space. The stability of the values of these exceedings is guaranteed only in the case of stability of the values of ratio between absolute velocities of radial motion of points of an evolutionary self-compressing body (and its intrinsic physical space, rigidly connected with it) and velocities of light in the same points:

$$V_j = dR_j / dT = cV_{j/c}(r) V_{cj/c} = cV_{j/c}(r) f_j R_j / r_j = -\breve{H}_j(r) R_j , \tag{7}$$

where $V_{j/c}(r) = V_j / V_{cj} = const(R, T)$ and $\breve{H}_j(r) = -cV_{j/c} f_j / r_j = const(R, T)$ are functions of eigenvalues of radial coordinates of body points. Consequently:

$$R_j = R_{jk} \exp\left[-\breve{H}_j \left(T - T_k\right)\right], \tag{8}$$

$$V_j = -\breve{H}_j R_{jk} \exp\left[-\breve{H}_j \left(T - T_k\right)\right], \tag{9}$$

$$V_{cj/c} = V_{cjk/c} \exp\left[-\breve{H}_j \left(T - T_k\right)\right]. \tag{10}$$

However, from the condition of continuity of intrinsic space of self-compressing physical body:

$$\left|\left(\partial R / \partial \breve{r}\right)_T\right| = \left(\partial r / \partial \breve{r}\right)\left|\left(\partial R / \partial r\right)_T\right| = \sqrt{1 - V^2 / V_c^2}\, R / r, \tag{11}$$

follows that $\breve{H} = const(r)$ and therefore is a universal constant. And more over, from the condition of permanency of the absolute velocity of light $\hat{V}_c$, determined by the PHSAT (5), the value of this constant is equal to the eigenvalue of Hubble constant $\left(\breve{H} \equiv H_e\right)$. This takes place because of independence on cosmological time of the value of radial coordinate of point j $R_{jk} \equiv r_j$, determined at the moment of time T_k of calibration of the size of the length standard in the PVFR by its size in the matter FR, as well as of:

$$\partial R_k / \partial r = \sqrt{1 - V^2 / V_c^2}\, \partial \breve{r} / \partial r - R_k \left(T - T_k\right) \partial \breve{H} / \partial r = const(T) \tag{12}$$

Where ∂r and $\partial \breve{r}$ are increments in physical body intrinsic space of accordingly photometrical and metrical radial intervals. Considering the stationarity of relativistic exceeding of shrinkage in absolute space of radial dimensions above the shrinkage of meridian dimensions of the matter (gauge- evolutionary self-compressing in absolute space) velocity of interaction of propagation, and consequently, improper (coordinate) value of the velocity of light are constant not only in proper quantum time of points, where they propagate. They are also permanent while taking time readings by a clock of any other points of this space, and consequently, they are permanent in astronomic time t of a physical body:

$$v_{cj/c} = v_{cj} / c = V_{cj}\sqrt{1-V_{j/c}^2}\, r_j / R_j = f_j \sqrt{1-V_{j/c}^2} = \sqrt{f_j^2 - r_j^2 H_e^2 / c^2}\ . \quad (13)$$

Exactly this determines physical as well as metrical (due to principle metrical homogeneity of the matter intrinsic space) homogeneity of proper time of a body, gauge self-compressing in the absolute space. According to (13), this also allows using of normalized improper value of the velocity of light $v_{cj/c}$ instead of standard normalized value of interaction frequency as average statistical characteristic of physical inhomogeneity of the matter intrinsic space. From the condition of unobservability in a rigid body intrinsic space of its gauge deformation in the PVFR $\left(r_j = const(T)\right)$ and accordingly to (3):

$$\left|(\partial r / \partial R)_T\right| = \left|(1/V_j)(\partial r / \partial T)_R\right| = \left|(\partial r / \partial T)_R\right| / H_e R_j = N_j f_j H(r) / H_e . \quad (14)$$

Therefore, the ratio between the increments of photometrical and metrical radial intervals, determining the curvature of physical body intrinsic space, according to (11) and (14), in free space $\left(H = H_e\right)$ will be equal by absolute value to normalized value of the velocity of light in it:

$$\left|\partial r / \partial \breve{r}\right| = \left|(\partial r / \partial R)_T\right| \sqrt{1-V_{j/c}^2} / N_j = f_j \sqrt{1-V_{j/c}^2}\, H / H_e = v_{cj/c} H / H_e . \quad (15)$$

This means that the equality to unity of product of $a_j(r) \equiv \left(\partial \breve{r}_j / \partial r_j\right)^2$ and $b_j(r) \equiv v_{cj/c}^2$ functions of linear element [4,6]:

$$dS^2 = a(r)dr^2 + r^2\left(d\theta^2 + \sin^2\theta \cdot d\varphi^2\right) - b(r)c^2 dt^2 \quad (16)$$

in Schwarzschild external solution is caused directly by the presence of matter evolutionary self-compression in the absolute space and is caused by the realization of this process accordingly to the dependence (3).

Accordingly to (6) and (14): $\partial f / \partial r = \eta(r) H_e / H(r) f r^2$. Therefore, for a conditionally free space $\left(\eta(r) = \eta_e = const; H(r) = H_e = const\right)$ we have:

$f = \sqrt{2\eta_e(1/r_{ge} - 1/r)}$. The body gravitational radius $r_{ge} \equiv r_{\min}$ (critical minimal value of photometrical radial coordinate in a intrinsic conditionally free space of the body [6]) corresponds to a hypothetical absence of interaction between elementary particles of its matter $(f_{ge} = 0)$ in the case of hypothetical concentration of all the matter on a spherical surface with this radius (R_{ge} radius in the absolute space [4]). This corresponds to convolution in the matter (with the help of Dirac surface δ-function) of not the three spatial dimensions, as it does at idealized punctual representation of extensive objects, but of only one spatial dimension.

At the direction of parameter r_{ge} to zero (that responds to decreasing to a zero value of power of the source of gravitational induction of the spatial inhomogeneity PV properties) the average statistical interaction frequency of elementary particles, connected to this in the absolute free space lacking gravitational field, must remain finite by value. Besides, identical objects (frequency standards) must have identical frequencies in all space $(f = 1)$. And it is possible only when $\eta_e = r_{ge}/2$. Therefore:

$$f = \sqrt{1 - 2\eta_e / r} = \sqrt{1 - r_{ge}/r}\,. \tag{17}$$

Accordingly to (14) and (17), for a conditionally free space $(r_g = r_{ge})$ we have:

$$|\partial R| / R_j = |\partial r| / r_j \sqrt{1 - r_{ge}/r_j}\,.$$

Considering this, at $T = const$, we have:

$$R_j = R_e \frac{r_j\left(1 + \sqrt{1 - r_{ge}/r_j}\,H/H_e\right)^2}{r_e\left(1 + \sqrt{1 - r_{ge}/r_e}\,H/H_e\right)^2} = R_{ge} r_j \left(1 + \sqrt{1 - r_{ge}/r_j}\,H/H_e\right)^2 / r_{ge}, \tag{18}$$

and correspondingly to this:

$$r_j = r_{ge}\left(R_j + R_{ge}\right)^2 / 4R_j R_{ge}, \tag{19}$$

where $H=-H_e$ when $R<R_{ge}$ and $H=H_e$ when $R>R_{ge}$;

R_e and $R_{ge}=r_{ge}\exp[-H_e(T-T_k)]$ (20)

are continuously decreasing values in the absolute conditionally free space correspondingly of the radius of external surface (r_e) and body gravitational radius (r_{ge}).

Considering this, in the absolute conditionally free space we have:

$$f_j=(R_j-R_{ge})/(R_j+R_{ge}), \tag{21}$$

$$N_j=r_{ge}(R_j+R_{ge})^2/4R_{ge}R_j^2=\left(1+\sqrt{1-r_{ge}/r_j}\,H/H_e\right)^{-2}\exp[H_e(T-T_k)]. \tag{22}$$

Radial distribution of value of the absolute velocity of light is set by the dependence:

$$V_{cj/c}=4R_{ge}R_j^2(R_j-R_{ge})/r_{ge}(R_j+R_{ge})^3. \tag{23}$$

But in intrinsic conditionally free space of evolutionary gauge-self-compressing body, the radial distribution of normalized value of the velocity of light, accordingly to (13) and considering (2) and (7), will be the following:

$$v_{cj/c}=(\partial r/\partial \hat{r})\equiv 1/\sqrt{a_j}=\sqrt{1-r_{ge}/r_j-r_j^2H_e^2/c^2}\,. \tag{24}$$

This fully corresponds to the distribution of value of the velocity of light in the space of Schwarzschild external solution of the GR gravitational field equations:

$$v_{cj/c}\equiv\sqrt{b_j}=\sqrt{1-r_{ge}/r_j-r_j^2\lambda/3}=\sqrt{1-r_{ge}/r_j-(1-r_{ge}/r_c)r_j^2/r_c^2}\,,$$

where $\lambda=3H_e^2/c^2=3(1-r_{ge}/r_c)/r_c^2$ is the cosmological constant and r_c is the radius of observer horizon of the body intrinsic space.

According to (18), two regions of absolute space (internal and external) correspond to a conditionally free space of a body, possessing a linear element of Schwarzschild external solution:

$$dS^2=N_j^2\left[-c^2V_{cj/c}^2dT^2+dR^2+R_j^2\left(d\theta^2+\sin^2\theta\cdot d\varphi^2\right)\right]=$$

$$= -c^2\left(1 - r_{ge}/r_j\right)dT^2 +$$

$$+\frac{\exp\left[2H_e\left(T - T_k\right)\right]}{\left(1+\sqrt{1-r_{ge}/r_j}\,H/H_e\right)^4}\left[dR^2 + R_j^2\left(d\theta^2 + \sin^2\theta \cdot d\varphi^2\right)\right] =$$

$$= -c^2\frac{\left(R_j - R_{ge}\right)^2}{\left(R_j + R_{ge}\right)^2}dT^2 + \frac{r_{ge}^2\left(R_j + R_{ge}\right)^4}{16R_{ge}^2R_j^4}dR^2 +$$

$$+\frac{r_{ge}^2\left(R_j + R_{ge}\right)^4}{16R_{ge}^2R_j^2}\left(d\theta^2 + \sin^2\theta \cdot d\varphi^2\right) =$$

$$= -c^2\left(1 - r_{ge}/r_j - r_j^2H_e^2/c^2\right)dt^2 + \left(1 - r_{ge}/r_j - r_j^2H_e^2/c^2\right)^{-1}dr^2 +$$

$$+ r_j^2\left(d\theta^2 + \sin^2\theta \cdot d\varphi^2\right). \qquad (25)$$

The regions are mutually separated by Schwarzschild sphere and practically do not differ from one another in the matter FR. Despite of physical impossibility of realization of Schwarzschild sphere, this is not accidental. In hollow astronomical bodies [4] these regions correspond to real physical spaces – external $\left(R > R_{ge}, H = H_e\right)$ and internal $\left(R < R_{ge}, H = -H_e\right)$. In physically homogeneous space, inertial pseudo-force "equilibrates" the force, accelerating the body motion, and can be expressed in terms of parameters of motion by the following way:

$$F_{in} = -\left(\partial P/\partial t\right)_{\tilde{m}} = -\tilde{m}\Gamma^3\ddot{x} = -v\left(\partial P/\partial x\right)_{\tilde{m}} = -\mathrm{H}\partial\ln\Gamma/\partial x. \qquad (26)$$

Here: $P = \tilde{m}v\left(1 - v^2/c^2\right)^{-1/2} = \tilde{m}c^2\sqrt{\Gamma^2 - 1}$ and $\tilde{m}$ are correspondingly a linear momentum and an eigenvalue of mass of a moving body;

$\mathrm{H} = \tilde{m}c^2\left(1 - v^2/c^2\right)^{-1/2} = \tilde{m}c^2\Gamma$ is the body Hamiltonian, equivalent to its relativistic mass $m = \tilde{m}\Gamma = \mathrm{H}/c^2$;

$\Gamma = \left(1 - v^2 / c^2\right)^{-1/2}$ is the parameter, determining relativistic shrinkage of dimensions of a moving body, and consequently, its velocity of motion;

$\partial \ln \Gamma / \partial x = -F_{in} / \mathrm{H} = -F_{in} / mc^2$ is the hamiltonian (energetic) intensity of inertial force, equivalent to the acceleration of the motion $\ddot{x} = dv / dt$ of classical physics.

During the body free fall in the gravitational field (that is inertial motion of the body in physically inhomogeneous space) inertial pseudoforce $F_{in} = -\mathrm{H}\partial \ln \Gamma / \partial \hat{r}$ "equllibrates" the gravitational pseudoforce [2, 3]:

$$F_g = -\mathrm{H}\left(\partial \ln v_c / \partial \hat{r}\right) = -\mathrm{H}\left(\partial \ln b / \partial r\right) / 2\sqrt{a} =$$

$$= -\mathrm{H}\left(r_{ge} - 2r^3 H_e^2 / c^2\right) / 2r^2 \sqrt{1 - r_{ge} / r - r^2 H_e^2 / c^2} . \qquad (27)$$

Therefore, at the invariance of eigenvalue of the free falling body mass $(\tilde{m} = const)$ its Hamiltonian $\mathrm{H} = \tilde{m} c v_c \Gamma$ also stays invariable:

$$\left(\partial \ln \mathrm{H} / \partial \hat{r}\right)_{\tilde{m}} = \partial \ln v_c / \partial \hat{r} + \partial \ln \Gamma / \partial \hat{r} = -\left(F_g + F_{in}\right) / \mathrm{H} = 0 .$$

Hamiltonian conservability at the process of inertial motion of the body in some cases makes the usage of $\chi_k = \ln v_c$ instead $\chi_g = \left(-g_{44} - 1\right)c^2 / 2 = \left(v_c^2 - c^2\right) / 2$ as scalar potential of gravitational field more expedient. In fact, χ_g determines the strength of gravitational pseudoforces relatively to general relativistic mass $\hat{m} = \tilde{m}\Gamma c / v_c = \mathrm{H} / v_c^2$, nonconservating at the body free fall in the gravitational field (so at inertial motion of the body in physically inhomogeneous space). At this:

$$\partial \chi_g / \partial \hat{r} = v_c^2 \left(\partial \chi_k / \partial \hat{r}\right).$$

Hamiltonian strength of the gravitational field in the matter can be determined analogically:

$$k = -\partial \chi_k / \partial \hat{r} = -b' / 2b\sqrt{a} = \left(a' / 2a + H' / H\right) / \sqrt{a} =$$

$$= -\left[r_g - \left(\kappa c^2 \tilde{\mu} + 2H_e^2 / c^2\right) r^3\right] \sqrt{a} / 2r^2 + H' / H \sqrt{a} \,. \qquad (28)$$

Here, correspondingly to (15): $ab = H_e^2 / H^2$;

$b' \equiv \partial b / \partial r = -b(2H' / H + a' / a)$;

$$a' \equiv \partial a / \partial r = -\frac{r_g - r r_g' - 2r^3 H_e^2 / c^2}{r^2 \left(1 - r_g / r - r^2 H_e^2 / c^2\right)^2} = -\left[r_g - \left(\kappa c^2 \tilde{\mu} + 2H_e^2 / c^2\right) r^3\right] a^2 / r^2 , \quad (29)$$

and: $r_g' \equiv \partial r_g / \partial r = \partial\left[(1 - 1/a) r - r^3 H_e^2 / c^2\right] / \partial r =$

$$= r a' / a^2 + (1 - 1/a) - 3r^2 H_e^2 / c^2 = \kappa c^2 \tilde{\mu} r^2 \qquad (30)$$

(accordingly to (24) and to Poisson equation [6]);

$\tilde{\mu}$ is an eigenvalue of matter mass density;

$\kappa = 8\pi\gamma / c^4$ is Einstein constant; y is the gravitational constant.

Gravitational forces affecting an object are determined only by its Hamiltonian or hamiltonian strength of the gravitational field. Therefore, they do not depend directly on proper value of energy density, and consistently, on proper value of density of matter mass of the object. This corresponds not only to the objects situated in the free space, but also to the objects that are component parts of physical bodies (bodies possessing a gravitational field). According to (29), not only strength of gravitational field in a matter, but also the curvature of proper space of the matter, which is characterized by the $a(r)$ function, does not depend directly on eigenvalue of density of the matter mass:

$$da(r) / d\tilde{\mu} = 0 \,.$$

Therefore, from the condition:

$$dk / d\tilde{\mu} = \kappa c^2 \sqrt{a} r / 2 + \left(1 / \sqrt{a}\right) d(H' / H) / d\tilde{\mu} = 0$$

we have: $(H' / H) - (H' / H)_0 = -\kappa c^2 a r (\tilde{\mu} - \tilde{\mu}_0) / 2$.

In general case, the velocity of propagation of interaction in the matter is to depend on spatial distribution of eigenvalue of the matter enthalpy density $\tilde{\sigma} = \tilde{\mu} c^2 + \tilde{p}$. At hypothetical isobaric decreasing of eigenvalue of enthalpy density to zero (which cannot be realized only locally at $b \neq 0$, as it is shown below) enthalpy is to be determined by standard normalized value of interaction frequency of elementary particles in the PV, the same as for practically free space:

$$f(r) = \sqrt{1 - r_g(r)/r}\,.$$

Then, considering that at $\tilde{\sigma}_0(r) = 0$: $\tilde{\mu}_0 = -\tilde{p}/c^2$, and $(H'/H)_0 = 0$ $(H(r) = H_e = const(r))$, we have:

$$ab = H_e^2 / H^2 = \exp\int_{r_e}^{r} \kappa\left(\tilde{\mu}c^2 + \tilde{p}\right) ardr\,. \qquad (31)$$

Here at $r = r_e$: $ab = 1$, that is in good agreement with Schwarzschild external solution. Therefore, considering (30) we see that hamiltonian strength of gravitational field:

$$k = -\left[r_g + \left(\kappa\tilde{p} - 2H_e^2 / c^2\right) r^3\right]\sqrt{a} / 2r^2\,, \qquad (32)$$

as it was supposed to be, does not depend on eigenvalue of matter mass density also in nonvacuous space. At that:

$$rb'/ab - (1 - 1/a) + 3r^2 H_e^2 / c^2 = \kappa\tilde{p}r^2\,. \qquad (33)$$

At the cosmological constant $\lambda = 3H_e^2 / c^2$ the expressions (30) and (33) are identical to the GR gravitational field equations for intrinsic FR of ideal liquid [6]. This points at full correspondence of physical model, considered here, to mathematical model of STC of GR. The equations of GR gravitational field for the ideal liquid, determined in the PVFR correspondingly to this physical model, are given in [4].

3. Analysis of cosmological models of Universe

Improper value (determined in the astronomic time) of p_j pressure, created in the matter by gravitational forces, is connected with its proper value $\tilde{p}_j$ by the following dependence:

$$p_j = \tilde{p}_j \varepsilon_j / \tilde{\varepsilon}_j = \tilde{p}_j v_{cj/c} = \tilde{p}_j f_j \sqrt{1 - V_{j/c}^2} = \tilde{p}_j H_e / H_j \sqrt{a_j} \ .$$

Here: $\varepsilon_j = \tilde{\mu}_j \cdot c v_{cj}$ and $\tilde{\varepsilon}_j = \tilde{\mu}_j c^2$ are matter energy densities, determined in its proper FR correspondingly in astronomical and proper quantum time of the j point. Hence:

$$\partial p / \partial \grave{r} = (v_c / c) \partial \tilde{p} / \partial \grave{r} + (\tilde{p} / c) \partial v_c / \partial \grave{r} = \varepsilon k = -c \tilde{\mu} \partial v_c / \partial \grave{r} \ , \quad (34)$$

$$\tilde{p}' \equiv \partial \tilde{p} / \partial r = -\left(\tilde{p} + \tilde{\mu} c^2\right) b' / 2b = -\tilde{\sigma} b' / 2b \ , \quad (35)$$

and:

$$\tilde{p} = -\frac{c^2}{2\sqrt{b}} \int_{b_e}^{b} \frac{\tilde{\mu}}{\sqrt{b}} db = -\frac{c^2}{v_c} \int_{v_{ce}}^{v_c} \tilde{\mu} dv_c \quad (36)$$

Considering this:

$$(ab)' = \kappa\left(\tilde{\mu} c^2 + \tilde{p}\right) r a^2 b = \kappa \left(\tilde{\mu} c^2 - \frac{c^2}{2\sqrt{b}} \int_{b_e}^{b} \frac{\tilde{\mu}}{\sqrt{b}} db \right) r a^2 b = \kappa c^2 r a^2 \sqrt{b} \int_{\tilde{\mu}_0}^{\tilde{\mu}} \sqrt{b} d\tilde{\mu} \ ,$$

$$\left[(ab)' / r a^2 \sqrt{b} \right]' = \kappa c^2 \sqrt{b} \tilde{\mu}' = \kappa \left(\partial \varepsilon / \partial r \right)_b \ ,$$

$$ab = \exp \int_{r_e}^{r} \left[\frac{\kappa c^2 r a}{\sqrt{b}} \int_{r_e}^{r} \sqrt{b} \frac{\partial \tilde{\mu}}{\partial r} dr \right] dr \ . \quad (37)$$

Correspondingly to (35) and according to (31) and (37) at $\tilde{\sigma} = 0$ both $\partial \tilde{p} / \partial \grave{r} = 0$ and $\partial \tilde{\mu} / \partial \grave{r} = 0$. This confirms the principal impossibility of only local fulfillment of the condition $\tilde{\sigma} = 0$ at $1/a \neq 0$, and correspondingly at $b \neq 0$ [4], at which $\partial \tilde{\sigma} / \partial \grave{r} = 0$ as well as $\partial H / \partial \vec{r} = 0$. The fulfillment of the $\left(\partial \tilde{p} / \partial \vec{r}\right)_t = 0$ and $\left(\partial \tilde{\mu} / \partial \vec{r}\right)_t = 0$ conditions is impossible in principle in the matter FR, which uniformly filled whole absolute space in the far past and at this evolutionary-gauge self-compressing in this space. It is connected with the lack of simultaneity in the PVFR of events, simultaneous in the FR of matter molecules, and is caused by presence of synchronism in whole absolute space of evolutionary change in cosmological time (read in not the matter FR, but in the PVFR [4]) of pressure in the matter and its mass density eigenvalue. Therefore, the condition $\tilde{\sigma} = 0$ $\left(\tilde{p} = -\tilde{\mu} c^2\right)$, corresponding to so-called vacuum-like state of physical environment [7] and de Sitter universe [6-8] is impracticable in principle in intrinsic FR of any protomatter. And, consequently, it can be considered only as hypothetical.

The initiation of gravitational macrofields in the Universe, as it was shown in [3,4], is caused by evolutionary self-compression of the matter in the absolute space and by the presence of electromagnetic interaction between elementary particles of neighboring atoms and molecules of the matter. Van der Waals forces of intermolecular interaction cased the breakage of the whole gas environment of the Universe into separate aggregates of gas molecules in the process of recombination of protons and electrons and made these molecules evolutionary selfcompress in common. If these forces did not exist, every atom would continue compress by itself in absolute space the way galaxies do. And consequently, physical macroinhomogeneity of this space, identifiable here with gravitational macrofields, would not take place. But in the FR of every single atom (molecule) of gas all the rest of atoms (molecules) would continue to continuously inertialy distancing from it at the Hubble velocity. Therefore, it is not possible in principle to build a globally static (without the effect of expansion) model of the Universe with metrically stable intrinsic space either at semi-uniform distribution of the matter density in the absolute space, nor at real uniform $\left(r_g \approx 0\right)$ distribution of the density of a gaseous matter, filling uniformly all Universe in its far past. Considering metrical macrohomogeneity of the absolute space in the far past, the linear element (25) of evolutionary gauge-self-compressing gaseous matter fully corresponded to the linear element, found by Lemetre [6,9] and (independently on him) by Robertson [6,10] for pseudoeuclidean STC of FR, not comoving with matter. In this STC (practically corresponding to the absolute space and Newton absolute time) according to Weyl hypothesis [11, 12] galaxies rest, if their small individual velocities are not taken into account. The linear element in intrinsic spaces of evolutionary self-compressing gas molecules in the far past only formally corresponded to the linear element of de Sitter universe [4, 7]. Considering presence of physical and metrical microinhomogeneities of intrinsic spaces of single molecules (their gravitational radiuses are equal to zero not identically), still STC metric of the molecules should be considered as singular Schwarzschild metric. In de Sitter mathematical model of the Universe, supplemented in [6] by Weyl hypothesis, the curvature of intrinsic space of the matter (uniformly distributed in absolute space of Newton-Weyl) can be caused by relativistic exceeding of shrinkage in the absolute space of radial dimensions of evolutionary self-compressing molecules of matter over the shrinkage of their meridian dimensions. But in Einstein model of the Universe curvature of intrinsic space of matter has no physical sense. The effect of the Universe expansion is not directly envisaged in this model. And consequently, the lack in matter proper time of simultaneity of events simultaneous in cosmological time is not envisaged in this model, and thus nonuniformity of average density of matter in the Universe in intrinsic space of matter at the same moment of proper time of the matter is not envisaged either. This does not let consider Einstein model of the Universe as authentic even at a very rough approximation.

4. Conclusions

Physical model of evolutionary change of collective space-time state of the matter based on the main principles of gauge-evolutionary theory [2-4] and fully corresponding to the mathematical model of STC of GR, allows studying physical processes in matter realizing on the level of its elementary particles and therefore hidden from observation in principle. This model reveals physical entity of equations of GR gravitational field and gives an objective and internally consistent explanation to basic features of this relativistic theory of gravitation. At this, as it was shown in [4], in contrast to other well-known GR interpretations, it is devoid of paradox phenomena as well as of paradox physical objects.

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Наукове видання

P. DANYLCHENKO
GAUGE-EVOLUTIONAL INTERPRETATION OF SPECIAL AND GENERAL RELATIVITIES

Collection of articles

ДАНИЛЬЧЕНКО ПАВЛО ІВАНОВИЧ

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