Dynamic gravitational field and its attributes

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The correspondence of the parameter *b* of the Schwarzschild solution of the gravitational field equations to the square of the relative frequency of electromagnetic interaction of micro-objects of a stationary matter and its equivalence to the square of the maximum possible (limit) velocity of this matter on a singular surface are substantiated. The error in linking the parameter *b* with the coordinate velocity of light of the General Relativity (GR) has been exposed. It has been proven that GR can correspond to reality only if it uses a dynamic gravitational field, which ensures the invariance of the flow of the proper time of matter during its inertial motion, instead of a static one. The necessity of using in physics of relativistically invariant Newtonians of the free inert rest energy of matter and Keplerians of the ordinary rest energy of matter, respectively, instead of relativistically non-invariant Hamiltonians and Lagrangians, has been justified. It has been proven that the thing inherent to the Lorentz transformations is not the redshift, but the blueshift of the frequency of centripetal radiation from matter that is at rest in the people's world and is evolutionarily self-contracting in the frame of references of spatial coordinate and time comoving with the expanding Universe (CFREU). The suitability of Lorentz transformations for the people's world is justified only for the quasi-equilibrium motion of micro-objects of gradually cooling matter. Ordinary synchronization-compensation transformations of increments of spatial coordinate and time (OSCT) are provided. They, unlike Lorentz transformations, allow proportional synchronization of all clocks moving in a gravitational field by inertia and provide compensation (by the motion by inertia) of the concomitant change in the gravitational deceleration of the flow of time counted by these moving clocks. The redshift of the frequency of radiation from distant galaxies that are at rest in the CFREU is indeed inherent exactly to OSCT. And this is in good agreement not only with relativistically invariant thermodynamics, but also with the equations of the dynamic gravitational field of both the Solar System and flat galaxies. Newton's law of gravity is obtained directly from the condition of no change in the flow of the proper time of matter during its inertial motion in a gravitational field. The fallacy of ignoring the compensation for comoving changes in gravitational dilation of time by the inertial motion of matter is most thoroughly substantiated. Based on the analysis of the motion of the planets, the compensation by the centrifugal pseudo-force of inertia not only of the gravitational pseudo-force, but also of the pseudo-force of evolutionary self-contraction of the matter to the center of gravity is confirmed.

Keywords: Theory of Relativity, Hamiltonian, Lagrangian, Newtonian, Keplerian, dynamic gravitational field, time dilation, Lorentz transformation, redshift, blueshift, flat galaxies, stars, planets.

I. INTRODUCTION

Relativistic invariance of thermodynamics indicates the fundamental impossibility of dilation (slowing down of the flow) of proper time of the matter that moves by inertia in surrounding gravitational field at any velocity *v* [1–6]. And it is the mistaken consideration in Etherington's identity (which is actually a relativistic paralogism [7–10]) of the unrealistic and untrue dilation of the proper time of distant galaxies that led to the mistaken refutation of the invariance in time of the fundamental Hubble constant H_E [11–14]. After all, it is the fundamental invariance in time of the Hubble constant that ensures the continuity of the spatial continuum in rigid frames of references of spatial coordinates and time (FR). In addition, this led to the mistaken need for a dark energy in the Universe [15].

So, ordinary Lorentz transformations of the increments of spatial coordinates and time (OLT) are not inherent in the matter moving by inertia in the gravitational field. They (and not the more general conform-Lorentz transformations [4,6,16]) are inherent in the matter thanks to using of the Hamiltonians and Lagrangians only in case of its uniform balanced motion in the process of evolutionary self-contraction of its micro-objects in comoving with expanding Universe FR (CFREU).

However, the other ordinary transformations of increments of spatial coordinates and time (that are only similar, but not identical to OLT) can still ensure the absence of dilation of proper time of matter moving in a gravitational field by inertia. And this can only be the case if its motion is

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described using the Newtonians [GT-Hamiltonians] and the Keplerians [GT-Lagrangians] [17-19]. But they (like Hamiltonians and Lagrangians) also require taking into account the presence of not only gravitational pseudo-forces, but also pseudo-forces of evolutionary self-contraction of matter to the center of gravity [17-19]. It was these pseudo-forces that could have caused the anomalous motion of the "Pioneer" spacecrafts at the edge of the Solar System [20–22].

II. GRAVITATIONAL POTENTIAL AS A FUNCTION OF THE RELATIVE FREQUENCY OF ELECTROMAGNETIC INTERACTION OF MATTER MICRO-OBJECTS

The Hubble velocity of matter *m* at the event horizon of the Universe *h* is equal to the constant of velocity of light *c*. And this can be real only if dynamic gravitational field, according to which the velocity of light $^{h}v_{cv} = v_{lcm} = \sqrt{b_h c^2 + {}^{h}v_m^2} = c$ at the event horizon of the Universe *h* (as well as the limit (terminal) velocity $v_{lcm} = c\sqrt{b_{cm}} = c\sqrt{b_h + {}^{h}v_m^2 c^{-2}} = c$ of moving matter *m*) is also equal to the constant of velocity of light *c*, corresponds to this matter (similar to galaxies, stars and planets) [9,17-19]. Here $b_{cm} = f_{cm}^2 = f_{0h}^2 + {}^{h}v_m^2 c^{-2} = b_h + {}^{h}v_m^2 c^{-2} = 1$ and $b_h = f_{0h}^2 = 0$ are the squares of the relative frequency *f* of the electromagnetic interaction between micro-objects of matter *m* moving with a velocity *v*, and matter that is conditionally motionless in a dynamic gravitational field at the event horizon of the Universe *h*, respectively.

Therefore, the velocity of matter v_m increases as does the corresponding relative kinematic frequency f_{kin} of electromagnetic interaction. It is due to this fact that there is a further gravitational change in the relative frequency of electromagnetic interaction $(f_{cm}^2 = f_{gr}^2 + f_{kin}^2 = \mathbf{const}(t))$. And this is obviously due to the decrease in the distances of electromagnetic interaction between micro-objects of matter in the fundamental space (which is the background Euclidean space of the Universe [23]) due to the isotropic kinematic self-contraction of moving matter in it, with even a possible increase in the longitudinal dimensions of its micro-objects (i.e., due to the longitudinal compaction of its micro-objects) [4,6].

Thus, the application of the parameter $v_{cv} = c\sqrt{b}$ in the GR (according to the Schwarzschild solution of the gravitational field equation [24]) to space, and not to the matter moving in it, is inappropriate and incorrect.

After all, the mistaken identification with this parameter of the so-called coordinate velocity of light leads in the observer's FR to an absurd zero value of the velocity of light at the event horizon (due to $b_h = 0$), despite there is the maximum possible value of the Hubble velocity of matter $^{h}v_m = c$ on the event horizon in the same FR [4,6]. In addition, this ignores the fact that in fact the gravitational potential is a function of the relative frequency of electromagnetic interaction, and not only of the speed of propagation of electromagnetic waves.

That's why in the GR, not the true, but the false coordinate pseudo-vacuum velocity of light $v_{cv} = c\sqrt{b}$ is used, which is equivalent (but not identical) to the limit velocity of matter $v_l = c\sqrt{b}$ in a hypothetical static gravitational field, and therefore to the relative value of the frequency of electromagnetic interaction $f_0 \equiv \sqrt{b} = v_l / c$ in matter that is conditionally at rest in a gravitational field. It is this frequency, as well as the limit velocity of matter v_l (which can conditionally be at rest at any point in the gravitational field) that takes a zero value on the event pseudo-horizon of the Universe. The false coordinate velocity of light in the GR, in principle, cannot be less than the Hubble velocity of matter, which is equal to the constant of velocity of light *c* on the event pseudo-horizon of the Universe, and even more so cannot be equal to zero on the event pseudo-horizon of the Universe. That is why the parameter $v_{cv} = c\sqrt{b}$ was carelessly called the coordinate velocity of light in the GR.

After all, according to the proper gravity-quantum clocks of matter, the true pseudo-vacuum velocity of light is the same throughout its thermodynamically inhomogeneous space, and its coordinate false value is only hidden internal parameter of matter, which characterizes the relative frequency of electromagnetic interaction between its quasiparticles. In addition, the intensity of the gravitational field depends fundamentally not only on the propagation speed of the electromagnetic interaction, but also on the distance of interaction of

elementary quasi-particles, which during the motion of matter is significantly reduced both due to the isotropic kinematic self-contraction of matter in the Euclidean background space of the CFREU, and due to the compaction of micro-objects of matter in the CFREU.

III. MAXIMUM POSSIBLE VELOCITY OF INDIVIDUAL (SEPARATE) MOTION OF A PARTICULAR SUBSTANCE

The limitation of the velocity of physical bodies indeed exists in rarefied gas-dust matter. However, this limitation is not related to the velocity of light in the matter or in hypothetic absolute vacuum. In airspace, as well as in dense matter, the charged micro-objects (protons) can propagate faster than the velocity of light. That is confirmed by the origination of the radiation, found by Cherenkov, in this case. In addition, the value of the false coordinate pseudo-vacuum velocity of light v_{cv}, used in the GR as a gravitational potential, can be close to zero in very dense and hot stellar nuclei. And despite this, the nucleus can move at a velocity *v*, which significantly exceeds its inherent value $v_{cvn} << v$. Therefore, this false coordinate velocity of light can be considered as the limit velocity only of the relative motion of matter in the nucleus in the FR of the star, and not of its motion in the FR of a distant observer.

On the other hand, hypothetical frequency of intranuclear interaction (alternative to the false pseudo-vacuum velocity of light of GR) decreases while approaching the gravitational attraction center unlike the real frequency of electromagnetic interaction in matter, which increases. This is in a good correspondence with the fact that thermodynamic and gravity-evolutionary processes have opposite directions and is related to the fact that frequency of electromagnetic interaction in matter is greater when the temperature of the matter is greater. Due to the same reason the physical processes flow faster not on the surface but in hotter bowels of the astronomical objects despite the gravitational slowing down is predicted by GR for those processes.

The reason for limitation of velocity of physical bodies is indeed the nature of matter movement in the space. Physical vacuum is not carried away by physical body. Matter is only the non-mechanic excitement of physical vacuum (space-time modulations of its physical characteristics). Therefore, the perception of high-frequency discrete movement of the body in the space as the continuous motion is similar to cinematographic perception of discrete change of image frame. The limitation of body velocity can be related to the fact that it is impossible to reach infinitely high frequency of discrete change of Gibbs collective thermodynamic microstate (quantum "hologram") of the whole its gravithermodynamically bound (GTD-bound) matter and to the fact that it is impossible to reach the zero value of the length of spatial step shift (quantum micromovement) of the body. This frequency and this micromovement are de facto the de Broglie frequency $\boldsymbol{\nu}_B$ and wave length λ_B of the moving body. That is why instead of denying the possibility of moving body to overcome the velocity of light we should state the principal impossibility to reach the extremely big velocity $v_l = \sqrt{v v_B} = v_{B\min}$ of individual (separate) motion of its homogeneous matter. And this corresponds to the tendency of $\boldsymbol{\nu}_B$ to infinity, and tendency of $v = v_l$, $\lambda_{B\min} = v_l / \boldsymbol{\nu}_B = h / m v_l \hat{\Gamma} = 0$ ($\boldsymbol{\nu}_B = \infty$, $\hat{\Gamma} = \infty$) to zero, when phase velocity of de Broglie wave propagation v_B reaches its minimal value, equal to maximal possible velocity $v_{\max}$ of individual motion of the homogeneous matter of the body ($v_{B\min} = v_{\max} \equiv v_l$).

Thus, the greater the gravitational mass $m_{gr0} = m_{00} c / v_l$ of an astronomical body, the greater the frequency with which de Broglie waves run on him, and therefore, the greater the frequency with which step-by-step movement of this body can be carried out. And this means that the inertial mass $m_{in0} = m_{00} v_l / c = m_{gr} v_l^2 c^{-2}$ of an astronomical body, on the contrary, becomes as many times smaller. And therefore, the inertial mass of matter can be identical to its gravitational mass only according to the own clock of matter, when $v_l = c$. According to this, the GR currently actually uses an inertial mass that is equivalent only to the inert free energy $E_0 = m_{in} c^2 = m_{00} c v_l$ of matter, instead of a gravitational mass that is equivalent to the ordinary rest energy $W_0 = m_{gr} c^2 = m_{00} c^3 / v_l$, identical to the multiplicative component of the thermodynamic Gibbs free energy of matter.

In addition, gravitational fields set only the gradients of the intrinsic values of the limit velocity of individual (separate) motion of a particular substance, and not the intrinsic values of the limit velocity of individual motion of matter

themselves, which are determined purely by the thermodynamic parameters of matter. And this also applies to distant galaxies due to the logarithmic potential $\varphi_H = c^2 \ln(v_{lcH}/c)$ of the dynamic gravitational field [17-19]. And, therefore, the thermodynamic parameters and potentials, which are determined purely by the intrinsic values of the limit velocity $v_{lcH} = v_l \hat{\Gamma}_H = \sqrt{v_l^2 + v_H^2} = v_{l0} = \mathbf{const}(t)$ of individual (separate) motion of a particular substance, are not only relativistically, but also gravitationally invariant. Here $\hat{\Gamma}_H = (1 + v_H^2 v_l^{-2})^{1/2}$, $v_H = H_E r$ is Hubble velocity of the radial motion of the galaxy. Similarly, we have $v_{lc} = \sqrt{v_l^2 + c^2 T_{00}^2 (T_0^{-2} - T^{-2})} = v_{l0} = \mathbf{const}(r)$ for both the initial continuous medium of the hot Universe and the interior of astronomical bodies, where: $T_{00} = T_0 v_{l0}/c = T v_l / c = \mathbf{const}(r)$ is a constant that is inherent to a specific substance and is independent on external gravitational fields [25]. Since the constant T_{00ind} can be different for different substances, then at the same point in space at the same temperature T these substances will have different values of the limit v_{lHind} velocity of the individual (separate) motion of a particular substance of the galaxy.

Thus, the gravitational decrease in the flow of the proper time of matter is completely compensated not only by its directed motion by inertia, but by the chaotic thermal motion of its micro-objects. And this is what ensures the inherentness of a single gravithermodynamic (astronomical) time for all GTD-bound matter of astronomical objects. After all, the change in the collective thermodynamic Gibbs microstates of all GTD-bound matter is carried out with the same de Broglie frequency, and therefore, without dependence on the unequal rate of flow of its proper gravity-quantum time at different radial distances from the center of the astronomical object.

Dense substances, in which the limit velocities of individual (separate) motion are less than the actual velocity, cannot move separately. They must be pushed by substances, in which the limit velocities of individual motion are greater than the actual velocity of their collective motion. Therefore, very dense substances must be contained mainly in the bowels of planets, stars and galaxies, so that they can move at extremely high velocities. And therefore, it is not at all accidental that very dense neutron stars are located only in the centers of galaxies. Because of this, the frequency of de Broglie waves that fall on them corresponds not only to their mass, but to the mass of the entire galaxy.

This is what allows the use of a single limit velocity of motion (in the Relativistic Gravithermodynamics (RGTD) for the group motion of many substances), which is inherent, for example, to the most common substance – the hydrogen that is the surface layer of stars (similar to the use of a single false coordinate pseudo-vacuum velocity of light, which is supposedly inherent to all substances, in the GR). If such a limit velocity of group motion is known, for example, for a star moving with a known maximum orbital velocity, then the equations of the gravitational field of the galaxy allow us to determine the limit velocities of group motion of a similar substance for stars moving with other orbital velocities.

Thus, not only local spatial features (the presence of own gravitational fields for the stars), but also the non-identity of individual constants T_{00ind} for different substances is not taken into account in the universal equations of the galaxy gravitational field. And this takes place both in the GR and the RGTD. After all, according to the solutions of the equations of the gravitational field of the galaxy, the same values of the parameter $b_{lc} = (v_l \hat{\Gamma}/c)^2$ correspond to both the matter of the stars and to almost empty space that surrounds them. That is, hydrogen and other substances are supposedly dispersed in the space surrounding stars and planets, rather than concentrated inside them. But these solutions of the equations of the galaxy gravitational field reflect the general tendencies realistically.

In distant galaxies which are not conditionally cooled, as well as in any bodies moving in a gravitational field by inertia, the value $v_{lHind} = c T_{00ind}/T = \mathbf{const}(t)$, corresponding to a particular substance will be the same as in the same substance on Earth only at the same absolute temperature. In the hot matter of distant galaxies, as in the matter in the bowels of the Earth, it is much smaller and gradually increases with a decrease in its temperature. And the much smaller value v_{lH} in the matter of distant galaxies is well

consistent with the gradual cooling of the very hot matter of the Universe in the distant past.

Unlike gases, the internal energy of solid matter includes not only thermal energy, but also consists of many products of intensive and extensive thermodynamic parameters. Therefore, it would seem logical to identify gravitational energy, which is equivalent to the gravitational mass of matter, with it. But in fact, it is not this energy at all, and not even enthalpy (which is identified with the energy of an expanded system [1]), but only the multiplicative component of Gibbs free energy, which does not include the released thermal energy $W_T = ST$, can be considered identical to gravitational energy, and therefore equivalent to the gravitational mass of matter. After all, many experiments have proven that heated bodies have a weight that is not at all greater, but, on the contrary, less than a weight of cold bodies [26,27].

Since all thermodynamic potentials of substances are inversely proportional to their individual limit velocities, their invariance in the process of motion of substances in a gravitational field by inertia can be ensured only by the invariance of their individual limit velocities $v_{lci} = (v_{l0i}^2 + {}^i v_j^2)^{1/2} = v_{l0j} = T_{00j} / T_j = \mathbf{const}\ (r,t)$, which, moreover, depend on the absolute temperature T of substances. Therefore, the gravitational field must provide for different substances different spatial distributions of individual limit velocities of motion and their corresponding gravitational time decelerations, which must be stabilized by the spatial distributions of the observed individual kinematic accelerations of the flows of proper time of substances that move together in the gravitational field by inertia:

$$d^i t_j = (1 - {}^i v_j^2 v_{l0j}^{-2})^{-1/2} dt_{0j} = (1 + {}^i v_j^2 v_{l0i}^{-2})^{1/2} dt_{0j} =$$

$$= (v_{l0j} / v_{l0i}) dt_{0j} = \mathbf{const}\ (r,t),$$

$${}^i v_{lcj} = v_{l0i} (1 - {}^i v_j^2 v_{l0j}^{-2})^{-1/2} = v_{l0i} \sqrt{1 + {}^i v_j^2 v_{l0i}^{-2}} =$$

$$= \sqrt{v_{l0i}^2 + {}^i v_j^2} = v_{l0j} = T_{00} / T_{0j},\ \ v_{l0i} = \sqrt{v_{l0j}^2 - {}^i v_j^2},$$

$$-c^2 \frac{d[\ln(v_{l0i} / c)]}{d\hat{r}} = \frac{{}^i v_j c^2}{v_{l0i}^2} \frac{d^i v_j}{d\hat{r}} = \frac{1}{b_i} \frac{d^i v_j}{dt} = \frac{G}{G_{00}} {}^i g_j,$$

where: $b_i = v_{l0i}^2 c^{-2}$, $G_i = G_{00} / b_i$ is the true value of the gravitational coefficient, G_{00} is Newton's gravitational constant, ${}^i g_j$ is the acceleration of free fall at point *i* of the body that was at rest at point *j*.

The obtained identity clearly indicates not only the independence of the gravitational acceleration of free fall of a substance from its mechanical and thermodynamic characteristics, but also allows different substances to have different limit velocities of individual (separate) motion, which are inversely proportional to their absolute temperatures [4,6,25,28].

Thus, the acceleration of free fall of a body due to the invariance of the thermodynamic parameters of all its substances ($v_{l0j} = \mathbf{const}(r,t)$) is determined only by the radial dependence of its velocity. And in fact, as Tolman showed, the gravitational field is a field of a spatially inhomogeneous thermodynamic state of matter and of an arbitrarily highly rarefied gas-dust substance of the cosmic vacuum [25].

Due to the rather narrow range of temperatures used in the observers' clocks, as well as the possibility of proportional synchronization of their readings with those of standard clocks, the problem of the presence of diversity of both the rates of flow of proper time in different substances and the corresponding values of gravitational coefficients ("constants") G is solved by introducing time counting by standard clocks and using the corresponding Newton's gravitational constant G_{00}. But when delving into the depths of stars and planets, as well as into the distant cosmological past of the hot Universe, the proportionality of the gravitational coefficient to the square of the absolute temperature must be taken into account [6,8,9,17]. Otherwise, we will not be able to rid the Universe of both the false Big Bang and non-baryonic dark matter.

IV. THE FEASIBILITY OF USING NEWTONIANS AND KEPLERIANS

$H_E = -V_H / R$ is Hubble constant, which determines in CFREU by metrically homogeneous time scale the proportionality between velocity of the points of self-contracting body $V_H = dR / d\tau$ and radial distance R to these points in Euclidean space of CFREU. The value of H_E does not evolutionary vary and, consequently, does not depend on the averaged value of density of matter in expanding Universe. Therefore, precise determination of the average value of this density, as well as the related problem of existence of hidden mass or so called dark non-

baryonic matter in the Universe, are irrelevant. Only continuously renormalized (in compliance with evolutional decreasing of material length standard) value of the limit velocity of matter is invariant by the metrically homogeneous time scale in CFREU.

According to this, velocities of radial motion not only of macroparticles of self-contracting matter of the body, but also of all points of conventionally empty intrinsic space of gauge-self-contracting body (fundamentally unobservable in the FR of the people's world (FRPW) [29]) are determined in CFREU by metrically homogeneous time scale via Hubble relation:

$$V = dR/d\tau = -H_E r \exp\left[-H_E(\tau-\tau_k)\right] = -H_E R .$$

Taking into account relativistic time dilation, values of limit velocities of matter in FR of evolutionally self-contracting body (v_l) and in CFREU (V_l) will be connected by the relation:

$$v_l = c\sqrt{b} = V_l\sqrt{1-(V/V_l)^2}\, r/R \quad (r = R(\tau_k)),$$

from where:

$$V_l = c\sqrt{b+\left(\frac{Vr}{cR}\right)^2}\,\frac{R}{r} = \sqrt{c^2 b + H_E^2 r^2}\,\frac{R}{r} = \sqrt{b_c}\,cN \neq \mathbf{const}(\tau)$$

is the value of the limit velocity of motion of matter in the CFREU, which is actually a metrically renormalized ($N = R/r = V_l/v_{lc}$) value of the limit velocity of matter $v_{lc} = c\sqrt{b_c} = \sqrt{c^2 b + H_E^2 r^2}$ in the dynamic gravitational field of the FRPW [6,9,17-19,29].

It should be kept in mind here that relativistic time dilation, like the OLT in general, is related only to the equilibrium process of the evolutionary self-contraction of matter in the CFREU and is related only to the rate of a hypothetical, absolutely motionless clock in the FRPW [29]. This relativistic time dilation should be considered gravitational in the FRPW. Astronomical objects moving by inertia in the dynamic gravitational field of the Universe do not experience this time dilation, since the inertial motion of matter compensates for the gravitational change in the rate of time flow [6,9,17-19]. Therefore, distant galaxies that move away from the observer at high velocity do not experience relativistic time dilation. After all, they are freely falling by inertia toward the event pseudo-horizon of the Universe. This is a significant difference between the non-uniform inertial motion of matter in a dynamic gravitational field and its uniform equilibrium motion during the process of evolutionary self-contraction of its size in the CFREU [6,9,17-19].

And thus, only a physically homogeneous unified gravithermodynamic (universal astronomical) time, which is based on the correspondence of the dynamic (and not static) gravitational field of the Universe to the true general covariance of physical laws, can be metrically homogeneous. The assumption that the metrically inhomogeneous (exponential) scale of proper time currently used in cosmology is physically homogeneous and, therefore, ensures the general covariance of physical laws is actually completely false. And therefore, the general covariance of physical laws in the FRPW is actually ensured by matter and the corresponding dynamic gravitational field of the Universe, and not at all by the hypothetical empty space and the corresponding static gravitational field. And this is confirmed both by the motion of the planets of the Solar System and by the gravitational-relativistic invariance of the thermodynamic parameters and potentials of matter. And that is why the relativistic transformations of the energy (which is fundamentally invariant in the FRPW), of matter, moving in a gravitational field by inertia, do not correspond to reality.

In the RGTD, unlike GR, bodies that move by inertia in a gravitational field, influence (by their movement) the configuration of the dynamic gravitational field that surrounds them [4,6,17-19]. At the same time, in equilibrium processes, instead of the usage of classical Hamiltonians H and Lagrangians L, in GR and RGTD (which is just an improved version of the GR) it is advisable to use relativistic Newtonians N and Keplerians K [17-19]. Therefore, in RGTD for matter that cools quasi-equilibrially the Newtonian four-momentum is formed not by the Hamiltonian of enthalpy, but by the Newtonian of the inert free rest energy $E_0 = m_{00}cv_l$, and Keplerian four-momentum is formed by the Keplerian of ordinary rest energy $W_0 = m_{00}c^3/v_l$ (multiplicative component of thermodynamic Gibbs free energy [6,28]) of matter of astronomical object [17-19].

The Keplerian [GT-Lagrangian] of the ordinary rest energy of the matter:

$$\mathrm{K} = W_0 c/v_{lc} = m_{gr0}c^2(1+v^2 v_l^{-2})^{-1/2} =$$
$$= m_{gr}c^2 = m_{00}c^3/v_{lc} = \mathrm{N}/b(1+v^2 v_l^{-2}) = \mathrm{N}/b_c$$

forms the four-momentum not with the Newtonian [GT-Hamiltonian] momentum:

$$\mathbf{P}_{\mathrm{N}} = m_{in0}c^2 v_l^{-2} v = m_{00}cv/v_l ,$$

but with the Keplerian [GT-Lagrangian] momentum:

$$\mathbf{P}_{\mathrm{K}} = m_{gr0} v(1+v^2 v_l^{-2})^{-1/2} = m_{00} vc / v_{lc} =$$
$$= m_{00} vc(v_l^2 + v^2)^{-1/2} = m_{00}\hat{v},$$

where: $\mathrm{N} = E_0 v_{lc} / c = m_{in} c^2 = m_{00} c\sqrt{v_l^2 + v^2}$,

$$E_0^2 = \mathrm{N}^2 - v_l^2 \mathbf{P}_N^2 = m_{00}^2 c^2 v_l^2 = m_{in0}^2 c^4,$$

$$W_0^2 = \mathrm{K}^2 + c^4 v_l^{-2} \mathbf{P}_{\mathrm{K}}^2 = m_{00}^2 c^6 v_l^{-2} / (1+v^2 v_l^{-2}) +$$
$$+ m_{00}^2 c^6 v_l^{-4} v^2 / (1+v^2 v_l^{-2}) = m_{00}^2 c^6 v_l^{-2} = m_{gr0}^2 c^4,$$

$$\hat{v} = \frac{v}{\sqrt{b_c}} = \frac{vc}{v_{lc}} = \frac{vc}{v_l \hat{\Gamma}},\ \hat{\Gamma} = \sqrt{1+v^2 v_l^{-2}},$$

$$v_{lc}^2 = b_c c^2 = bc^2 + v^2 = v_l^2 + v^2 = \mathbf{const}(t);$$

$$b_c = b\hat{\Gamma}^2 = (v_l^2 + v^2)c^{-2} = b + v^2 c^{-2} = v_{lc}^2 c^{-2}$$

is the parameter that strictly corresponds to a certain spatially inhomogeneous collective thermodynamic state of matter and whose invariance during its inertial motion in a gravitational field ensures the conservation of both the Newtonian of its inert free rest energy E_0 and the Keplerian of its ordinary rest energy W_0; v_l is the maximum possible (limit) velocity of collective motion of all gravithermodynamically bound matter, which is equivalent to the false coordinate pseudo-vacuum velocity of light of the GR; m_{00}, $m_{in} = m_{in0}(1+v^2 v_l^{-2})^{1/2} = m_{00} v_{lc} / c$ and $m_{gr} = m_{gr0}(1+v^2 v_l^{-2})^{-1/2} = m_{00} c / v_{lc}$ are the ordinary, inertial and gravitational masses of matter respectively.

And therefore, the condition of quasi-equilibrium precisely in the dynamic gravitational field of the galaxy of all its objects moving by inertia leads to both the absence of relativistic dilation of their proper time t' and the invariance of their proper time with respect to relativistic transformations [4–6,16]. The equivalence of the gravitational interval q to the universal astronomical (unified gravithermodynamic [4,6]) time t, and the equivalence of the kinematic (non-relativistic) interval s_c to the proper time t' of matter in the dynamic gravitational fields of galaxies and the Solar System must also be taken into account:

$$(dq)^2 = v_{lc}^2 (dt)^2 + (d\hat{l})^2 = (bc^2 + v_{crc}^2)(dt)^2 + (d\hat{l})^2 =$$
$$= (v_l^2 + 2v_{crc}^2)(dt)^2 = c^2 (dt)^2 = \mathbf{invar},$$

$$(ds_c)^2 = (bc^2 + 2v^2)(dt)^2 - (d\hat{l})^2 = v_{lc}^2 (dt)^2 =$$
$$= (bc^2 + v^2)(dt)^2 = b_0 c^2 (dt)^2 = c^2 (dt')^2 = \mathbf{invar}.$$

Here: $v_{lc}^2 = b_c c^2 = v_l^2 + v^2 = v_{l0}^2 = \mathbf{const}(t)$ is the square of the limit velocity of matter (which the matter can reach at the event horizon when falling freely onto it), $v_l = f_0 c \equiv \sqrt{bc}$ is the limit velocity of motion of a true or hypothetical stationary matter, which is equivalent to the relative frequency f_0 of the electromagnetic interaction of its micro-objects and therefore, unlike the false coordinate velocity of light of GR, can be arbitrarily less than the true velocity of any other matter at the same point in space, $v_{crc}^2 = (r_g / r + \Lambda r^2 / 3)c^2 / 2$ is square of the hypothetical circular orbital velocity of astronomical objects, $ds_c = cdt'$ is the increment of the kinematic interval; $d\hat{x} = v_x dt$, $d\hat{y} = v_y dt$, $d\hat{z} = v_z dt$, $d\hat{l} = v dt = \sqrt{(d\hat{x})^2 + (d\hat{y})^2 + (d\hat{z})^2}$ are the increments of metric segments, not increments of coordinates.

According to this, it can be conditionally assumed that the ordinary Newtonian $\mathrm{N} = m_{00} c^2 (b + v^2 c^{-2})^{1/2}$ of the inert free rest energy $E_0 = m_{00} c^2 b^{1/2}$ of matter is the Pseudo-Hamiltonian of the fundamental Newtonian $\mathrm{N}_F = m_{00} c^2 (b + 2v^2 c^{-2})^{1/2}$, and the ordinary Keplerian $\mathrm{K} = m_{00} c^2 (b + v^2 c^{-2})^{-1/2}$ of the ordinary rest energy $W_0 = m_{00} c^2 b^{-1/2}$ of matter is the Pseudo-Lagrangian of the fundamental Keplerian $\mathrm{K}_F = m_{00} c^2 (b + 2v^2 c^{-2})^{-1/2}$, which is inherent to matter (with ordinary mass m_{00}) in the CFREU [6,16-19].

Thus, we have a twofold $(b_F = b + 2v^2 c^{-2})$ kinematic increase in the frequency of electromagnetic interaction between micro-objects of matter (due to the isotropic reduction of the distances of this interaction in the background Euclidean space of the CFREU [23]), compensated by half by the Lorentzian decrease $(b_c = b_F - v^2 c^{-2} = b + v^2 c^{-2})$ in it. And therefore, the kinematic interval (as opposed to the relativistic interval) corresponds to the kinematic acceleration of the flow of the proper time of matter instead of its deceleration (dilation). Indeed, unlike the OLT the conformal Lorentz

transformations of the increments of spatial coordinates and time of matter moving in equilibrium allow not only to get rid of the relativistic dilation of the proper time, but also to obtain the relativistic acceleration of the proper time of the matter due to its isotropic self-contraction and self-compaction in the background Euclidean space of CFREU [3,23]. In this case, the Lorentz transformations of the velocities of equilibrium and quasi-equilibrium motions of matter will be the same as in the case of OLT [4,6].

And therefore, the motion of matter actually induces an increase in the frequency of electromagnetic interaction between its micro-objects, which leads to compensation for its further gravitational reduction. And this, of course, can be considered only as a compensation for the further gravitational dilation of the proper time of matter, and not as a compensation for the action of the external gravitational field in general. It is precisely due to this compensation that the Hubble velocity of matter is equal to the constant of velocity of light *c* at the event horizon of the Universe, despite the zero value of the relative frequency of electromagnetic interaction *b* in the hypothetical static gravitational field of the Universe. Therefore, it is only due to the presence of a dynamic gravitational field in the Universe that Hubble law can operate in it [6,8,17-19].

Although we should not exclude the possibility that the gravitational field is actually weaker, and therefore that the centrifugal pseudo-forces of inertia actually compensate not only for the half-weaker gravitational pseudo-forces, but also for the centripetal pseudo-forces of evolutionary self-contraction of matter towards the center of gravity, which are equal in magnitude to gravitational pseudo-forces [17-19].

And only from the condition of complete compensation of the further gravitational dilation of time by the inertial motion of matter ($v=\sqrt{a_c}\,dr/dt\approx -c\sqrt{b_c-1+r_g/r}=-c\sqrt{r_g(1/r-1/r_0)}$,

$b_c=1-\frac{r_g}{r}+\frac{v^2}{c^2}-\frac{\Lambda r^2}{3}=1-\frac{r_g}{r_0}-\frac{\Lambda r_0^2}{3}=\mathbf{const}(r,t)$,

$b=1-r_g/r-\Lambda r^2/3$) can one obtain Newtonian gravitational acceleration:

$$g=-\frac{c^2}{\sqrt{a_c}}\frac{d\ln(v_{lc}/c)}{dr}=-\frac{c^2}{2b_c\sqrt{a_c}}\left(\frac{db_c}{dr}\right)_v\approx$$

$$\approx-\frac{c^2r_{g0}}{2b_cr^2}=-\frac{G_0M}{b_cr^2}=-\frac{G_0M}{b_ca_cR^2}=-\frac{GM}{r^2},\ \left(\frac{db_c}{dr}=0\right)$$

$$g=\frac{dv}{dt}=\frac{1}{2\sqrt{a_c}}\frac{dv^2}{dr}\approx\frac{c^2}{2}\left(\frac{db_c}{dr}-\frac{r_g}{r^2}\right)=-\frac{GM}{r^2},$$

where: $G=G_0/b$; $R=r/\sqrt{a_c}\approx r\sqrt{b_c}$ is a radial coordinate in the background Euclidean space of CFREU, which under the condition of hypothetical emptiness of space $(b_ca_c=1)$ takes a zero value $R_h=0$ on singular surfaces $(b_c=b=0)$.

And therefore, in the absence of complete compensation of the further gravitational dilation of time by the kinematic acceleration of the flow of time $(db_c/dr\neq 0)$, the gravitational acceleration of a freely falling body will not correspond to reality. Therefore, ignoring the invariance of the time dilation of matter moving by inertia in a gravitational field, based on the imaginary relativistic dilation of proper time of matter, is unacceptable. From the same condition follows the necessity of using the logarithmic gravitational potential and the identity of the inertial mass $m_{in}=m_{00}v_{lc}/c=m_{00}\sqrt{b_c}$ to the gravitational mass $m_{gr}=m_{00}c/v_{lc}=m_{00}/\sqrt{b_c}$ only according to the proper gravity-quantum clock of matter ($^iv_{lci}=c$), and the spatial and thus temporal dependence (on the parameter $b_c=b+v^2c^{-2}$) of the gravitational "constant" $G=G_0m_{gr}/m_{in}=G_0/b_c\neq\mathbf{const}(r)$ [4,6,17-19], the instability of which in time was predicted by Dirac [30].

Due to the fact that the event horizon of the Universe always belongs only to the infinitely distant cosmological past, the size of the length standard on it in the hypothetical empty space is always equal to infinity, as is the size of the fundamental space of the Universe itself. And because of this, it can really be assumed that the radius of the hypothetical empty Universe was equal to zero according to the GR in those distant times. This is why the false theory of the Big Bang of the Universe arose. In fact, the Universe has never been empty and therefore, according to the GR, due to $b_ca_c\neq 1$ and due to the maximum possible Hubble velocity $v_{mh}=c$ of the distancing of protomatter from the observer, we have on it $b_{ch}=b_h+v_{mh}^2c^{-2}=1$. We have the same for the

false singular Schwarzschild sphere, on which only the infinitely distant cosmological future always resides.

And thus, only the Newtonians and the Keplerians (and not the alternative Hamiltonians and Lagrangians) of astronomical objects moving by inertia in the surrounding gravitational field can strictly correspond to the standard Special Relativity (SR).

The spatial homogeneity of the rate of intrinsic time in entire gravithermodynamically bound matter is consistent with the general de Broglie's frequency of change of its collective spatially inhomogeneous Gibbs microstates, which is not affected by either a decrease (during approaching gravity center) in the frequency of intranuclear interaction or an increase (during approaching gravity center) in the frequency of extranuclear intermolecular interactions. Moreover, this is ensured even without conformal transformations of the space-time interval *s*. Therefore, like the parameters v_l, v_{ls}, b, b_s and Γ_m in thermodynamics, the parameters v_l, v_{lc}, b, b_c and $\hat{\Gamma}$ in the RGTD are hidden internal parameters of the moving matter [4-6,17-19]. And exactly the usage of parameters b_s and b_c in the equations of the dynamic gravitational field of the RGTD (instead of parameter *b* in the equations of the static gravitational field of the GR) allows us not to additionally use the velocity of matter in those equations, similar to its non-use in the equations of thermodynamics.

V. CORRESPONDENCE TO REALITY OF THE NEWTONIAN OF INERT FREE REST ENERGY AND THE KEPLERIAN OF ORDINARY REST ENERGY

A similar dependence of the parameter v_{lcg} on the motion velocity $v_g = H_E r$ when $v_{lg0} = 1$ also occurs for distant galaxies that are in the state of free fall onto the event pseudo-horizon of the expanding Universe: $v_{lcg}^2 \equiv c^2 = v_{lg}^2 + v_g^2 =$

$$= c^2(1 - \Lambda r^2/3) + H_E^2 r^2 = \mathbf{const}(r,t),$$

$$b_{cg} = b_g + v_g^2 c^{-2} \equiv 1,\ m_{grg} = m_{ing} = m_{00g}.$$

And therefore, the inertial mass of any galaxy is equal to its gravitational mass in the observer's FR.

Thus, the OLT are suitable only for the parameters of dynamic gravitational fields $(v_{lcg}^2 \equiv c^2 = v_{lg}^2 + v_g^2)$, and not at all for the hypothetical static gravitational fields $(v_g = 0)$ of galaxies on their periphery. And this also applies to our galaxy, which moves in the Universe with enormous speed $v_g = 230$ km/s. But these transformations are unsuitable for transforming these parameters even for dynamic gravitational fields inside of galaxies. After all, the false coordinate velocities of light in the GR and the limit velocities of matter in the RGTD within astronomical objects of these galaxies are much less than the constant of velocity of light *c*.

And therefore, thanks to the Newtonian and the Keplerian, the relativistic invariance of the flow of proper time of distant galaxies is guaranteed by the invariance of the relativistic interval s_{cg} for all observers moving at different velocities:

$$(ds_{cg})^2 = (b_g c^2 + 2v_g^2)(dt)^2 - (d\overset{\frown}{l})^2 = v_{lcg}^2 (dt)^2 =$$

$$= (b_g c^2 + v_g^2)(dt)^2 = b_{g0} c^2 (dt)^2 = c^2 (dt')^2 = \mathbf{invar}.$$

Thus, avoiding not only the relativistic non-invariance of the parameters and potentials of thermodynamics, but also the false presence of relativistic dilation of proper time in distant galaxies is entirely possible only if modern physics uses the relativistic Newtonian and the relativistic Keplerian instead of the classical Hamiltonian and Lagrangian, respectively.

And for planets that move only by inertia around stars this dependence $v_{lc}^2 = v_l^2 + v^2 = \mathbf{const}(t,r)$ also works.

After all, according to Kepler's laws, which are actually based on Newton's theory of gravity, it is not the Hamiltonians and the Lagrangians that are conserved in the process of planetary motion, but rather the Newtonians of inert free rest energy:

$$\mathrm{N} = E_0 v_{lc}/c = m_{00} c v_{lc} = m_{00} c \sqrt{v_l^2 + v^2} \approx$$

$$\approx m_{00} c^2 \sqrt{1 - r_g/(r_1 + r_2)} = \mathbf{const}(t,r)$$

and the Keplerians of ordinary rest energy:

$$\mathrm{K} = W_0 c / v_{lc} = m_{00} c^3 / v_{lc} = m_{00} c^3 / \sqrt{v_l^2 + v^2} \approx$$

$$\approx m_{00} c^2 / \sqrt{1 - r_g/(r_1 + r_2)} = \mathbf{const}(t,r)$$

of the planetary matter. Here r_1 and r_2 are the radii of the planet's elliptical orbit at aphelion and perihelion, respectively, and r_g is the gravitational radius of the Sun.

At the same time, since:

$$b_c = v_{lc}^2 c^{-2} = b + v^2 c^{-2} = 1 - r_g / r + v^2 c^{-2} =$$
$$= 1 - r_g /(r_1 + r_2) = \mathbf{const}(t, r),$$

the squares of the true velocities $v^2 \approx c^2 r_g [1/r - 1/(r_1 + r_2)]$ of the planets significantly differ from their gravitational values:

$$v_{gr}^2 = (c^2 r \sqrt{ab}/2) d \ln b / d\tilde{r} =$$
$$= (c^2 / \sqrt{b})(r_g / 2r - \Lambda r^2 / 3) \approx c^2 r_g / 2r .$$

which allow centrifugal pseudo-forces of inertia to compensate for only gravitational pseudo-forces. And therefore, the centrifugal pseudo-forces of inertia indeed compensate not only for gravitational pseudo-forces, but also for the pseudo-forces of evolutionary self-contraction of matter in the CFREU, which force planets to move in the observer's FR not in circular, but in elliptical orbits:

$$\mathbf{F}_{ev} \approx \frac{m_{00} c^2}{r\sqrt{ab}} \left[\frac{1}{\sqrt{b}} \left(\frac{r_g}{2r} - \frac{\Lambda r^2}{3} \right) - r_g \left(\frac{1}{r} - \frac{1}{r_1 + r_2} \right) \right] =$$
$$= \frac{m_{00}}{r\sqrt{ab}} (v_{gr}^2 - v^2) \approx \frac{m_{00} c^2 r_g (2r - r_1 - r_2)}{2r^2 (r_1 + r_2)} .$$

These pseudo-forces act in such a way that at perihelion the Sun is a little closer to the planet, and at aphelion, on the contrary, a little farther from the planet:

$$\mathbf{F}_{ev(aph)} \approx \frac{m_{00} c^2 r_g \eta}{2r_1^2} = \frac{m_{00} c^2 r_g}{2r_1^2} \left(\frac{r_1 - r_2}{r_1 + r_2} \right) =$$
$$= \frac{m_{00}}{r_1} \left(\frac{c^2 r_g}{2r_1} - v_1^2 \right), \quad \mathbf{F}_{ev(per)} \approx -\frac{m_{00} c^2 r_g \eta}{2r_2^2} =$$
$$= -\frac{m_{00} c^2 r_g}{2r_2^2} \left(\frac{r_1 - r_2}{r_1 + r_2} \right) = \frac{m_{00}}{r_1} \left(\frac{c^2 r_g}{2r_1} - v_1^2 \right).$$

Since the compensation of the gravitational and evolutionary pseudo-forces by centrifugal pseudo-forces of inertia occurs only at the aphelions and perihelions of planets, for all planets and other independent objects we obtain a single dependence of the pseudo-forces of evolutionary self-contraction of all matter of the Solar System to its center on the radial distance to the center and on the velocities of orbital motion at aphelions and perihelions:

$$\mathbf{F}_{ev} = -(\mathbf{F}_{gr} + \mathbf{F}_{in}) \approx m_{00} c^2 \left(\frac{r_g}{2r^2} - \frac{2\Lambda r}{3} - \frac{v^2}{c^2 r} \right).$$

The values of the velocities of orbital motion of independent objects of the Solar System at aphelions and perihelions are determined by the initial conditions of their inclusion inside the Solar System, or even by the conditions of their formation directly inside the Solar System.

Based on the mutual equality of the values of all parameters at aphelion and perihelion of the planet (precisely values of the both Newtonians, values of the both Keplerians, and the values of the both angular momenta ($v_2 r_2 = v_1 r_1$):

$$b_c = v_{lc}^2 c^{-2} \approx (1 - r_g / r_2) + v_1^2 r_1^2 r_2^{-2} c^{-2} =$$
$$= (1 - r_g / r_2) + v_2^2 c^{-2} \approx (1 - r_g / r_1) + v_1^2 c^{-2}),$$

we can find the gravitational radius of the Sun:

$$r_g \approx v_1^2 c^{-2} r_1 (1 + r_1 / r_2) = v_2^2 c^{-2} r_2 (1 + r_2 / r_1).$$

TABLE I. Parameters of planets and the Sun.

Planet	r_1 mln. km	r_2 mln. km	v_1 km/s	r_g km
Mercury	69.82	45.90	38.85	2.96
Venus	108.94	107.48	34.78	2.95
Earth	152.09	147.10	29.29	2.95
Mars	249.23	206.60	21.98	2.96
Jupiter	816.62	740.52	12.44	2.96
Saturn	1505.4	1353.6	9.10	2.93
Uranus	3006	2740	6.50	2.96
Neptune	4537	4456	5.39	2.96
Pluto	7375	4437	3.68	2.96

Table I shows exactly those known approximate values of the orbital parameters and velocities at aphelions of various planets that allowed us to obtain calculated values of the Sun's gravitational radius with the smallest deviation from its most probable actual value.

This table shows that the calculated values r_g of the Sun's gravitational radius are almost identical.

And this takes place despite the neglect (in the calculations) of the presence of both a slight evolutionary weakening (Λ-reduction) of centrifugal pseudo-forces of inertia, and the influence of planets on each other. And this confirms not only the correspondence of the Newtonians and the Keplerians to these planets, but also the absence of relativistic time dilation in them.

Table II shows the calculated values of the planetary parameters for the orbital radii of the

planets indicated in Table I and for the gravitational radius of the Sun $r_g = 2.96$ km.

TABLE II. Theoretical parameters of planets.

Planet	v_1 km/s	v_2 km/s	η	$(1-b_c)$ **x**10^{10}
Mercury	38.88	59.14	0.2067	255.9
Venus	34.83	35.30	0.0067	136.7
Earth	29.33	30.32	0.0167	98.92
Mars	22.00	26.54	0.0935	64.92
Jupiter	12.45	13.73	0.0489	19.00
Saturn	9.15	10.18	0.0531	10.35
Uranus	6.50	7.13	0.0463	5.15
Neptune	5.39	5.49	0.0091	3.29
Pluto	3.68	6.12	0.2487	2.51

By clarifying both the value of the gravitational radius of the Sun and the values of the radii of the planets at aphelion and perihelion, it is possible to obtain corresponding to them more accurate values of the velocities of the planets.

Since stars that conventionally move in galaxies in circular orbits have $v^2 = c^2 r_g / 2r$, and therefore, $b_c = 1 - r_g / 2r = 1 - r_{gc} / r$, and $r_{gc} = r_g / 2 = GM$, then for them in the gravitational field equations of both the GR and the RGTD it is possible to use the parameter b_c of the dynamic gravitational field instead of the parameter b of the hypothetical static gravitational field. Therefore, it is not excluded that in the stars of galaxies, as in the planets of the Solar System, the centrifugal pseudo-forces of inertia actually compensate not only for the gravitational pseudo-forces, but also for the almost the same in magnitude centripetal pseudo-forces of evolutionary self-contraction of matter to the center of gravity, which ensure their rotation in convergent spiral orbits in the CFREU [17-19].

Only the Newtonians and Keplerians (and not the alternative to them classical Hamiltonians and Lagrangians [17-19]) of astronomical objects moving by inertia in the surrounding gravitational field are both invariant in time and identical in synchronized readings of any clocks that count the universal astronomical time (unified gravithermodynamic time [4,6]) of all GTD-bound matter of the Solar System.

And therefore, only they can strictly correspond to the reality, RGTD and also the modernized SR and GR. Relativistic transformations of increments of spatial coordinates and time in the FRPW must be consistent with the conservation of the Newtonians and Keplerians of matter in the process of its motion by inertia. It is the Newtonians of inert free rest energy and Keplerians of the ordinary rest energy of matter and the ordinary synchronization-compensation transformations of the increments of spatial coordinates and time (OSCT) built on their basis (and not the Hamiltonians, Lagrangians, and not OLT) that accurately correspond to astronomical observations.

VI. THE EFFECT OF EVOLUTIONARY CENTRIPETAL PSEUDO-FORCES ON THE STARS OF GALAXIES

The Λ-reduced (evolutionarily weakened) centrifugal pseudo-force of inertia [16]:

$$\mathbf{F}_{in} = m_{in}\hat{v}^2(1-\Lambda r^2)/r(1-\Lambda r^2/3) = \mathbf{F}_{in0} + \mathbf{F}_{inE} \approx$$
$$\approx m_{in}v^2/b_c r - 2m_{in}v^2 r/b_c v^2(r_c^2 - r^2),$$

which "balances" (compensates for) the gravitational pseudo-force in a rigid FR of matter, depends in GR and RGTD on the cosmological fundamental constant $\Lambda = 3H_E^2 c^{-2} = \mathbf{const}(t)$ and, therefore, on the Hubble fundamental constant $H_E = \mathbf{const}(t)$. The fundamental invariance of these constants in the intrinsic time *t* of matter ensures the continuity of the intrinsic space of a rigid FR [4,6]. Here: $\mathbf{F}_{in0} = m_{in}v^2/b_c r$ is ordinary (unreduced) centrifugal pseudo-force of inertia;

$$\mathbf{F}_{inE} = -\frac{2\Lambda m_{in}\hat{v}^2 r}{3-\Lambda r^2} = \frac{-2H_E^2 m_{in}v^2 r}{b_c(c^2 - H_E^2 r^2)} \approx \frac{-2m_{00}v^2 r}{\sqrt{b_c}(r_c^2 - r^2)}$$

is centripetal evolutionary pseudo-force, which pushes matter towards the center of the galaxy, thereby compensating within the galaxy (when $r<\Lambda^{-1/2}$) for the centrifugal gravitational pseudo-force, which is responsible for the evolutionary distancing of other galaxies from it according to Hubble's law; $r_c \approx c/H_E$ is the radius of the event pseudo-horizon, which covers the entire infinite fundamental space of the Universe in the FR of any matter due to the fundamentally unobservable in FR of people's world evolutionary self-contraction (in fundamental space) of matter spiral-wave micro-objects, which are the so-called elementary particles.

Therefore, astronomical objects in distant galaxies move in stationary, rather than divergent spiral orbits precisely due to the presence (in the observer's FR) of the action on them not only of gravitational, but also of evolutionary centripetal pseudo-force. And it is precisely this evolutionary

centripetal pseudo-force that causes these same astronomical objects to move in convergent spiral orbits in the CFREU.

At the edge of the galaxy ($r\approx\Lambda^{-1/2}$), the excessively strong ordinary (unreduced) centrifugal pseudo-forces of inertia are compensated mainly by centripetal pseudo-forces of evolutionary self-contraction of matter in the fundamental (background Euclidean [23]) space of comoving with expanding Universe FR, and not by the weak gravitational pseudo-forces at the edge of the galaxy [17-19].

The dependence of Λ-reduced centrifugal pseudo-force of inertia exactly on the intrinsic value of the object's velocity $\bar{v}=vc/v_{lc}=v/\sqrt{b_c}$ actually compensates for the non-identity of its inertial mass $m_{in}=m_{gr}b_c$ to the much larger gravitational mass m_{gr} and thereby provides the possibility of using a single galactic value ${}^{g}G_{00}$ of the gravitational constant in the FR_g of the galaxy [17-19].

VII. ORDINARY SYNCHRONIZATION-COMPENSATION TRANSFORMATIONS OF COORDINATE AND TIME INCREMENTS IN THE PEOPLE'S WORLD

In GR, as in RGTD, universal astronomical (unified gravithermodynamic) time is used to describe the motion of matter in a gravitational field. Due to this astronomical (gravithermodynamic) time the false coordinate pseudo-vacuum velocity of light in the GR and the alternative maximum possible (limit) velocity of matter in the RGTD can take any values less than the constant of the velocity of light in different FRs. Lorentz transformations of velocity are designed to preserve the value of the velocity of light in any inertial FRs and, therefore, use not gravithermodynamic, but gravity-quantum time to describe the motion of matter. Gravity-quantum clocks are fundamentally unsuitable for use in these gravitational theories due to the impossibility of their proportional synchronization (which is caused by the nonlinearity of the spatial distributions of their readings [4,6,17-19]):

$$ {}^{ic}v_{lcj}=c\left(\frac{v_{lcj}}{v_{lci}}\right)^{(v_{lci}/c)^2}=c\left(\frac{v_{lc0\,j}}{v_{lc0i}}\right)^{(v_{lc0i}/c)^2}=\mathbf{invar}$$

$$\left[\ln({}^{ic}b_{cj})=\frac{b_{ci}}{2}\ln\frac{b_{cj}}{b_{ci}}=\ln({}^{ic}b_{c0\,j})=\frac{b_{c0i}}{2}\ln\frac{b_{c0\,j}}{b_{c0i}}=\mathbf{invar}\right]\cdot$$

So, this is what prevents the use of OLT in FRPW both in GR and in RGTD. In addition, they are based on classical Hamiltonians and Lagrangians, and not on the relativistic Newtonians and Keplerians considered here, and therefore are not suitable for a true reflection of reality in the FRPW both in GR and RGTD.

Under the condition of non-uniform motion of matter, the transformations of the increments of spatial coordinates and time based on the parameter of the dynamic gravitational field used in the Newtonian and the Keplerian will be as follows:

$$d\hat{x}'=\sqrt{\frac{b'}{b'_c}}(d\hat{x}-v_k dt)=\frac{d\hat{x}-v_k dt}{\sqrt{1+v_k'^2v_l'^{-2}}}=d\hat{x}-\hat{v}_k dt\,,\ d\hat{y}'=d\hat{y}\,,$$

$$d\hat{z}'=d\hat{z}\,,\ dt'=\sqrt{\frac{b}{b'_c}}(dt+v_k v_l^{-2}d\hat{x})=\frac{\sqrt{b}(dt+v_k v_l^{-2}d\hat{x})}{\sqrt{b'(1+v_k'^2v_l'^{-2})}},$$

$$d\hat{x}=\sqrt{\frac{b}{b_c}}(d\hat{x}'+v'_k dt')=\frac{d\hat{x}'+v'_k dt'}{\sqrt{1+v_k^2v_l^{-2}}}=d\hat{x}'+\hat{v}'_k dt'\,,$$

$$dt=\frac{\sqrt{b'}(dt'-v'_k v_l'^{-2}d\hat{x}')}{\sqrt{b(1+v_k^2v_l^{-2})}}\,,\ \frac{v'_x}{\sqrt{b'}}=\frac{v_x-v_k}{\sqrt{b}(1+v_k v_x v_l^{-2})}=$$

$$=\frac{(\hat{v}_x-\hat{v}_k)\sqrt{1+v_k^2v_l^{-2}}}{\sqrt{b}(1+v_k v_x v_l^{-2})}\,,\ \frac{v'_y}{\sqrt{b'}}=\frac{v_y\sqrt{1+v_k^2v_l^{-2}}}{\sqrt{b}(1+v_k v_x v_l^{-2})}\,,$$

$$\frac{v'_z}{\sqrt{b'}}=\frac{v_z\sqrt{1+v_k^2v_l^{-2}}}{\sqrt{b}(1+v_k v_x v_l^{-2})}\,,\ \frac{v_x}{\sqrt{b}}=\frac{dx'+v'_k dt'}{\sqrt{b'}(dt'-v_k v_l^{-2}dx')}=$$

$$=\frac{v'_x+v'_k}{\sqrt{b'}(1-v'_k v'_x v_l'^{-2})}=\frac{(\hat{v}'_x+\hat{v}'_k)\sqrt{1+v_k'^2v_l'^{-2}}}{\sqrt{b'}(1-v'_k v'_x v_l'^{-2})},$$

$$\frac{v'}{\sqrt{b'}}\neq\frac{\sqrt{[(\hat{v}_x-\hat{v}_k)^2+v_y^2+v_z^2](1+v_k^2v_l^{-2})}}{\sqrt{b}(1+v_k v_x v_l^{-2})},$$

$$\frac{v}{\sqrt{b}}=\frac{\sqrt{[(\hat{v}'_x+\hat{v}'_k)^2+v_y'^2+v_z'^2](1+v_k'^2v_l'^{-2})}}{\sqrt{b'}(1-v'_k v'_x v_l'^{-2})},$$

$$\frac{\hat{v}'_x}{\sqrt{b'}}=\frac{v_x}{\sqrt{b(1+v_k^2v_l^{-2})}}=\frac{v_x-v_k}{(1+v_k v_x v_l^{-2})\sqrt{b(1+v_k^2v_l^{-2})}}=$$

$$=\frac{(\hat{v}_x-\hat{v}_k)}{\sqrt{b}(1+v_k v_x v_l^{-2})}\,,\ \frac{\hat{v}_x}{\sqrt{b}}=\frac{v'_x+v'_k}{(1-v'_k v'_x v_l'^{-2})\sqrt{b'(1+v_k'^2v_l'^{-2})}}=$$

$$=\frac{(\hat{v}'_x+\hat{v}'_k)}{\sqrt{b'}(1-v'_k v'_x v_l'^{-2})}\,,\ \frac{v_{ly}}{\sqrt{b}}=\frac{v'_{ly}\sqrt{1+v_k'^2v_l'^{-2}}}{\sqrt{b'}(1-v'_k v'_{lx} v_l'^{-2})},$$

$$\frac{v_{lz}}{\sqrt{b}}=\frac{v'_{lz}\sqrt{1+v_k'^2v_l'^{-2}}}{\sqrt{b'}(1-v'_k v'_{lx} v_l'^{-2})},$$

$$\frac{v_{lx}}{\sqrt{b}}=\frac{v'_{lx}+v'_k}{\sqrt{b'}(1-v'_k v'_{lx} v_l'^{-2})}=\frac{(\hat{v}'_{lx}+\hat{v}'_k)\sqrt{1+v_k'^2v_l'^{-2}}}{\sqrt{b'}(1-v'_k v'_{lx} v_l'^{-2})};$$

$$\frac{v'_{lx}}{\sqrt{b'}}=\frac{v_{lx}-v_k}{\sqrt{b}(1+v_kv_{lx}v_l^{-2})}=\frac{(\widehat{v}_{lx}-\widehat{v}_k)\sqrt{1+v_k^2v_l^{-2}}}{\sqrt{b}(1+v_kv_{lx}v_l^{-2})},$$

$$\frac{v_{li}}{\sqrt{b}}=\frac{v'_{lj}}{\sqrt{b'}}\left(\frac{v'_{lj}-v'_p}{v'_{lj}+v'_p}\right)=\frac{v'_{lj}}{\sqrt{b'}}\left(\frac{v_{li}+v_k}{v_{li}-v_k}\right),$$

$$\frac{\widehat{v}_{li}}{\sqrt{b}}=\frac{\widehat{v}'_{lj}}{\sqrt{b'}}\left(\frac{v_{li}-v_p}{v_{li}+v_p}\right) \text{ and } \frac{v'_{lj}}{\sqrt{b'}}=\frac{v_{li}}{\sqrt{b}}\left(\frac{v_{li}-v_k}{v_{li}+v_k}\right)$$

(when: $v_{ly}=0$ and $v_{lz}=0$);

$\frac{v_l-v_k}{v_l+v_k}=\frac{v'_l-v'_k}{v'_l+v'_k}$, $dt_k=\frac{dt'_k}{\sqrt{b_k(1+v'^2_pv'^{-2}_l)}}=\frac{dt'_p}{\sqrt{b_k+v_k^2c^{-2}}}$,

$dt'_p=\sqrt{b_k(1+v_k^2v_l^{-2})}dt_k=\sqrt{b_k+v_k^2c^{-2}}\,dt_k$ (when: $b'_p=1$, $dx=v_kdt_k$ and $dx'=0$), where: $b=v_l^2c^{-2}$, $b_c=(v_l^2+v^2)c^{-2}=b+v^2c^{-2}$, $v'_{lj}=c(v_{lj}-v_k)/(v_{jl}+v_k)$ (when: $b'_j=1$ and $b=v_j^2c^{-2}$), $v'_k=-v'_p=v_kv'_l/v_l=v_kc/v_{lc}=(bv_k^{-2}+c^{-2})^{-1/2}$; $v'_l=v_lc/v_{lc}$ $(b'=b/b_c)$, $v'^2_{lc}=v'^2_l+v'^2_k=c^2$ $(b'_c=b'+v'^2_kc^{-2}=1)$; $d\hat{x}_k=(1+v_k^2v_l^{-2})^{-1/2}d\hat{x}_k\le d\hat{x}_k$ and $d\hat{x}'_p=(1+v'^2_pv'^{-2}_l)^{-1/2}d\hat{x}'_p\le d\hat{x}'_p$ are increments of fundamentally invariable metric segments in space, which has a kinematic "curvature"; $d\hat{x}$ and $d\hat{x}'$ are the increments of metric segments in spaces with gravitational curvature, before introducing a kinematic "curvature" in these spaces; the velocities of translational motions v_k and v'_k, as well as the parameters b and b', by which they are determined, are not the same according to the gravity-quantum clocks of different points of the gravitational field of a body moving with the velocity v_k and of the gravitational field of the observer of its motion [6,17-19].

In these transformations, unlike the OLT, in the universal astronomical time of the gravitational system, there is an observation not of kinematic deceleration at all, but on the contrary, kinematic acceleration of the rate of flow of proper time of the observed objects moving by inertia at any velocity v_k. In addition, due to the invariance of the parameter $b_c=b+v_k^2c^{-2}=b_0=\mathbf{const}(t,r)$ in time, the possibility of proportional synchronization of the rates of flow of proper time of all astronomical objects moving in the gravitational field by inertia is ensured. And therefore, mutually observed kinematic acceleration of the rate of flow of proper time can not exist in principle, as is confirmed by these OSCT. In this case, it is precisely the motion of objects by inertia that actually provides compensation for the motion-correlated (comoving) change in gravitational deceleration or acceleration of the rate of flow of time of objects moving in this way in the gravitational field.

And therefore, thanks exactly to OSCT, there will actually be no kinematic dilation and no further motion-correlated gravitational dilation of proper time (because $dt/dt'_k=\sqrt{b'/b_0}=\mathbf{const}(t)$ and $dt'/dt_p=\sqrt{b/b'_{k0}}==\mathbf{const}\ (t')$ due to $b_c=b+v_k^2c^{-2}=b_0\approx1=\mathbf{const}(t)$ and $b'_c=b'+v'^2_kc^{-2}=b'_0\approx1=\mathbf{const}\ (t')$, respectively) for any body (of the Solar System) moving in a gravitational field by inertia. Moreover, all astronomical bodies came from the distant outskirts of the Solar System, where their velocity was low, and the parameter $b_0\approx b_c\approx1$. And therefore, thanks to the preservation (in the process of movement by inertia) of their rapid peripheral rate of flow of gravity-quantum time, supported now by the high velocity of their orbital motion, they did not experience big gravitational dilation of their time. Therefore, in proper time of conditionally stationary clocks located along their orbit of movement, instead of slowing down of the flow of their proper time, there is on the contrary its acceleration. And this acceleration of the flow of the proper time of matter is guaranteed by the isotropic reduction of its dimensions in the background Euclidean (fundamental [4,6]) space of the CFREU together with the increase in the velocity of matter. The anisotropy of the reduction or, conversely, the increase in the coordinate (not metric) dimensions of a moving matter arises only in the intrinsic FRs of matter.

And the correspondence of the OSCT to reality is confirmed not only by the motion of the planets of the Solar System according to the laws of Newton and Kepler, but also by the gravitational-relativistic invariance of thermodynamic parameters and potentials [6,17-19].

Obviously, all this provides additional isotropic self-contraction in the CFREU of the moving matter, with even a possible increase in the longitudinal dimensions of its micro-objects (i.e., due to the longitudinal compaction of its micro-

objects) [4,6]. But due to the fundamental unobservability of this additional isotropic self-contraction of the matter in the CFREU (in the FR of the observer of motion), it is not reflected by these transformations of the increments of spatial coordinates and time. It only manifests itself in the observer's FR in the form of an additional kinematic curvature of the part of space in which the moving matter is instantaneously located.

Due to the high speed of rapid distancing of distant galaxies $(dx = d\hat{r} = \sqrt{a}dr)$ from the observer *p*, the gradual decrease of frequency of electromagnetic interaction in a hypothetical stationary matter (and the limit velocity of matter, which is equivalent to this frequency) is also compensated along with their approach to the pseudo-horizon of the infinitely distant cosmological past. And that is why distant galaxies do not experience a dilation of their proper time. It is precisely because of the greater homogeneity of matter in the CFREU in the distant past that all galaxies have on their outskirts the maximum possible limit velocity of their matter, which is almost equal to the constant of the velocity of light $v_{lc} \approx c$ $(b_c \approx 1)$. And therefore, precisely the Galilean (and not the Lorentz) transformations of the velocities of galaxies correspond to all galaxies on their outskirts (provided that we switch to observations from another galaxy).

And due to the a priori equality (by any clock [31]) of the velocity of light to the constant $c = \lambda\nu$, only the wavelengths λ and frequencies ν of radiation waves are transformed by these transformations both when observed from another point of the gravitational field and when observed from another FR of a moving body. And this is due to the use of proportionally synchronized local gravithermodynamic clocks in both the RGTD and the GR.

Thus, thanks to $b \approx b'_c = b'(1 + v'^2_k v'^{-2}_l) \approx 1$ and $v'_l \approx c$ at $d\hat{r}/dt \equiv d\hat{x}/dt = -v'_l \approx -c$ and $dt' \approx (1 - v_k/c)dt$ OSCT clearly demonstrate the redshift $\hat{z} = -z/(1+z)$ of the frequency $\nu = \nu'(dt'/dt) \approx 1 - v_k/c$ and the corresponding shift *z* of the wavelength of the centripetal emission radiation from galaxies that are almost at rest in the CFREU and move away from the observer in the FRPW:

$$\frac{\Delta\nu}{\nu'} = \frac{(\nu - \nu')}{\nu'} = -\frac{v_k}{c} = -\frac{z}{1+z} = -\frac{H_E r}{c} \equiv -\frac{H_E D_A}{c},$$

$$\Delta\lambda / \lambda'_0 = z = H_E R/c = H_E D_M / c.$$

And this shift is purely pseudo-Dopplerian and is connected by the Hubble dependence with the distance along the angular diameter D_A and with the transverse distance D_M of the comoving motion in the CFREU (and not at all to the luminosity distance $D_L = D_A(1+z)^{3/2} = D_M(1+z)^{1/2} = z(1+z)^{1/2}c/H_E$, which actually significantly less exceeds these Hubble distances due to the absence of gravitational-kinematic deceleration of the flow of the proper time in galaxies [4,6]). And that is why the continuity of the spatial continuum of rigid FRs is actually ensured by the invariance in time of the fundamental Hubble constant [4,6,8].

OLT clearly demonstrate not a redshift at all, but on the contrary a blueshift of the frequency and wavelength of the centripetal radiation from molecules of matter that are almost at rest in the FRPW and approach the center of gravity in the process of self-contraction of matter in the CSFREU. After all, at the centripetal velocity $dr/dt \equiv dx/dt = -c$ of light, according to the dependence

$$dt' = (dt - v_k c^{-2} dx)\Gamma = (1 + v_k/c)(1 - v_k^2 c^{-2})^{-1/2} dt$$

of the OLT, the following takes place:

$$\nu_L = \nu'_L(dt'/dt) = \nu'_L(1 + v_k/c)\Gamma,$$

$$\Delta\nu_L/\nu'_L = (\nu_L - \nu'_L)/\nu'_L \approx v_k/c = z/(1+z) = H_E D_A/c,$$

$$\Delta\lambda_L/\lambda'_0 = -z = -H_E D_M/c.$$

And therefore, the OLT of the SR correspond to reality only in the CFREU, and not in the FRPW. Moreover, in the CFREU, the OLT correspond to the same gravithermodynamic state of matter, and therefore to the same moment of the proper time of matter, and not to the same moment of cosmological time. After all, at the same moment of cosmological time, the kinematic, as well as the gravitational unobservable deformation of micro-objects of matter in the CFREU is isotropic. Its coordinate anisotropy is inherent only to the intrinsic spaces of matter.

Due to the equivalence of the relative frequency of electromagnetic interaction to the limit velocity of matter, we can obtain such its shift by the clock, which is conditionally at rest at the point of instantaneous position of the matter that moves by inertia $(b = b')$:

$y = \Delta f_{lc}/f_l = (f_{lc} - f_l)/f_l = \sqrt{1 + v_k^2 v_l^{-2}} - 1$, where:

$f_{lc} = f'_{lc} = \sqrt{v_l^2 + v_k^2}/c = v_{l0}/c = \mathbf{const}(t)$, $f_l = v_l/c$.

According to these transformations, there is also mutual observation, but not a reduction, but an increase (along the direction of motion [32–35]) of the increments of the coordinates of the observed moving objects in a gravitationally curved space $d\hat{x} = \sqrt{1 + v'^2_k v'^{-2}_l}\, d\hat{x}'$ (and not metric segments $d\hat{x}$ and $d\hat{x}'$ of the observed moving objects). After all, the relativistic increase (or Lorentz reduction) of the sizes of bodies in the FR of people's world should be considered fundamentally unobservable, as well as their isotropic gravitational decrease in the background Euclidean space of CFREU [23]. Thus, instead of the relativistic deformation of moving bodies, one should consider the presence of a gravitational-kinematic "curvature" of the observer's intrinsic space created by the motion of the bodies. But in the comoving space of the expanding Universe, moving bodies, on the contrary, undergo an isotropic kinematic reduction in their size, similarly to how isotropic gravitational reduction occurs near the center of gravity [6].

Similar OLT, which use in denominator (instead of the parameter $\hat{\Gamma} = (b_c/b)^{1/2}$) the parameter $1/\Gamma = (b/b_s)^{1/2} = (1 - v^2 c^{-2}/b)^{1/2}$ not identical to this parameter $\hat{\Gamma}$, do not guarantee all of this [16]. After all, according to them, during the free fall of a body in a gravitational field, which is a motion by inertia, kinematic effects do not compensate for the gravitational dilation of its proper time, but on the contrary increase the dilation. And therefore, the OLT, under which, when the y' and z' axes are orthogonal to axis x', the axes y and z are similarly not orthogonal to axis x, are suitable only for uniform equilibrium (pseudo-inertial) motion of matter in the process of its evolutionary self-contraction in the background Euclidean space of the CFREU or during artificial acceleration of quasiparticles in accelerators.

VIII. CONSEQUENCES OF THE APPLICATION OF DYNAMIC GRAVITATIONAL FIELDS IN THE UNIVERSE

The main consequences of the application of dynamic gravitational fields are the deprivation of the Universe of the need for such superfluous substances as dark non-baryonic matter and dark energy [6,8,17-19]. The final justification of the gravitational-relativistic invariance of thermodynamic parameters and potentials of matter (on the basis of those dynamic gravitational fields) is also important.

After all, the dilation of the proper time of matter that moves in a gravitational field by inertia is fundamentally impossible. And it is incompatible not only with the relativistic invariance of thermodynamic parameters and potentials of matter, but also with the equations of motion of the planets of the Solar System. It is the failure to take this into account that leads to the imaginary slowing down of the process of the expansion of the Universe in the FR of the people's World. The idea of astronomers that the Universe, on the contrary, is expanding at an accelerated rate is the result of their mistaken use of the luminosity distance to stars instead of the transverse comoving distance in the Hubble dependence. And the Hubble constant is actually fundamentally invariant. After all, only its invariance in time ensures the continuity of the spatial continuum in rigid FRs [6,8].

In addition, the rotational motion of the planets and the high-speed movement of galaxies away from the observer, on the contrary, ensure a more rapid flow of their proper time than in the surrounding environment, which is at rest. Because of this, planets are supposedly located at a greater distance from the center of gravity of the Sun, and distant galaxies only differ slightly in properties from those close to us.

The discovery of the fact that the centrifugal pseudo-forces of inertia compensate not only for gravitational pseudo-forces, but also for centripetal pseudo-forces of evolutionary self-contraction of matter to the center of gravity is also important [17-19]. After all, this is what allows us not only to confirm the spiral-wave nature of matter, but also to finally refute the naive theory of the Big Bang of the Universe [8,17-19,36-38].

The OSCT, as the OLT of SR, should be considered as transformations of increments of only spatial and temporal coordinates, and not at all of the actually spatially homogeneous metric segments of both space and time. And therefore, it is reasonable to assume that the motion of matter by inertia, as well as the equilibrium (uniform pseudo-inertial) motion of matter, induces the kinematic curvature of intrinsic space of matter. Then there will be no mutual "observation" of increase in longitudinal dimensions of the moving matter [32–35]. Otherwise, these mutually "observed" increases in longitudinal

dimensions of matter should be considered not as true phenomena, but only as illusions, which are similar to the rotation of the Sun around the Earth.

In the FR of the people's world, as well as in the intrinsic FR of a moving matter, the increase in the size of this matter is not observed in principle, but is manifested only in the presence of the kinematic curvature of the part of the space occupied by this matter.

Therefore, a moving matter induces (in the FR of the observer) both the kinematic curvature of this space, which is characterized by the parameter of compensation of the all-round self-contraction and by the parameter of undercompensation of the self-contraction of the matter in the direction of its movement $a_c = (d\breve{l}/dl)^2 = 1/(1+v^2 v_l^{-2}) = b/b_c$, and the dynamic gravitational field, which is characterized by the parameter $b_c = v_{lc}^2 c^{-2} = b + v^2 c^{-2} = b(1+v^2 v_l^{-2})$.

But the expansion of the Universe itself is just as much an illusion in the people's world as the rotation of the Sun around the Earth. In fact, distant galaxies, moving in the CFREU only peculiarly, are continuously moving away from the observer due to the evolutionary decrease of all length standards in the CFREU.

And therefore, the large radius of the sphere of pseudo-horizon of the infinitely distant cosmological past $(v_l = 0)$ in the FRPW indicates both the fundamental impossibility of the emergence of the Universe from a hypothetical "point" state, and the gradual evolutionary reduction of the sizes of all length standards, and therefore of all micro-objects of matter in the background Euclidean [23] (fundamental) space of the CFREU. And this is obviously related to the spiral-wave nature of matter and the Universe as a whole [4,6,8,36–38].

Simultaneity in matter FR (FRPW) of infinitely far past on event (observer) pseudo-horizon (when distances between interacting elementary quasiparticles of protomatter in fundamental (absolute) space were as long as desired) with every concrete event in any point of matter intrinsic space causes the finiteness of pseudo-metrical distance in intrinsic static space to its event (observer) pseudo-horizon (the possibility of this was shown earlier by Penrose [39]).

The true metric distance to the pseudo-horizon of events should be calculated not at all in the static space of the observer, but in its dynamic space that is comoving with the matter of the expanding Universe. After all, not only are the radial dimensions of stars lengthening, but the radial distances between stars in galaxies and between galaxies themselves are increasing as well.

Taking into account not only the curvature of the static space (which is given by the parameter a of the Schwarzschild solution of the gravitational field equations), but also the kinematic elongation (in the dynamic gravitational field of the expanding Universe) of the metric segments comoving with matter, we will have the following ratio of the increment of the radial metric segment $d\hat{r} \equiv d\breve{R}$ in the dynamic space of the global dynamic FRPW (GDFRPW) to the increment of the Schwarzschild radial coordinate, which is given by the parameter a_{cH}:

$$\sqrt{a_{cH}} = d\hat{r}/dr \equiv d\breve{R}/dr = \sqrt{a(b + v_H^2 c^{-2})/b} = \\ = a\sqrt{b_{0H}/ab} \approx a \approx (1 - r^2 r_c^{-2})^{-1},$$

where: $b_{0H} \equiv b_{cH} = b + v_H^2 c^{-2} \approx 1 = \mathbf{const}(r)$, $ab = 1$ (for a conditionally empty space);
$r_c \approx c/H_E$ is the radius of the event pseudo-horizon in the static FRPW (SFRPW).

Hence, we have:

$$\hat{r} \equiv \breve{R} = (r_c/2)[\ln(1 + r/r_c) - \ln(1 - r/r_c)],$$

$$\hat{r}(r_c) \equiv \breve{R}(r_c) = \infty.$$

And therefore, the indicator $\sqrt{a_{cH}} = d\hat{r}/dr \approx a$ of the global dynamic curvature of the space of the Universe, in contrast to the indicator $\sqrt{a} = d\breve{r}/dr$ of its static curvature, ensures that the pseudo-horizon of events of the SFRPW covers both the entire infinite dynamic space of GDFRPW and the entire (equivalent to it) infinite Euclidean fundamental space of CFREU. And this is due to the correspondence of the dynamic gravitational field to the metrically homogeneous time of matter, which is almost identical to the beginningless cosmological time. And thus, the GDFRPW outside our galaxy is actually equivalent to the CFREU.

But the dynamic gravitational field corresponds not only to the GDFRPW, but also to the SFRPW, which is inherent only to the stars of our galaxy and the planets of the Solar System. And therefore, only the dynamic gravitational field can correspond to the general covariance of physical laws.

IX. CONCLUSION

Thus, we should finally recognize the cardinal difference and mutual harmonious coherence of the phenomena and patterns that occur in the FR of the people's world (FRPW) and in the comoving with expanding Universe FR (CFREU):

1. In the FRPW, the unified gravithermodynamic (universal astronomical) time, which applies to all gravithermodynamically related substances, is in effect. The complete compensation of the gravitational deceleration of the flow of this time is carried out simultaneously by both the directed and chaotic thermal motion of all macro- and micro-objects of these substances, which are spiral-wave self-formations [18,36-38].

2. The true general covariance of all physical laws is ensured by the use (in the Universe) of a dynamic gravitational field and a corresponding metrically homogeneous cosmological time scale, which is identical to the gravithermodynamic time scale (instead of the exponential time scale of matter currently used in cosmology, which corresponds to a static gravitational field). The infinite dynamic space of the Universe together with the beginningless cosmological time form the global dynamic FRPW (GDFRPW), which is equivalent to the CFREU.

3. There are two types of similar transformations of increments of spatial coordinates and time, which do not deny the existence of each other, but on the contrary harmoniously complement each other. After all, they mainly relate to different FRs of these increments in objects moving in one FR and at rest in another FR. Namely, these are well known to all the ordinary Lorentz transformations (OLTs) related mainly to CFREU, and the considered here ordinary synchronization-compensation transformations (OSCT) related mainly to FRPW, in which the mutually proportional evolutionary reduction in the sizes of all objects of the Universe is fundamentally unobservable. In addition, the OLT and conformal Lorentz transformations relate mainly to the equilibrium (balanced) and quasi-equilibrium motions of matter, and the OSCT apply mainly to the motion of matter by inertia. During the directed and rotational inertial motions of cooling astronomical bodies in the FRPW, a coordinated combined application of these transformations of increments of spatial coordinates and time takes place.

4. Indeed, on the physically homogeneous scale of cosmological time all macro-objects of matter move uniformly in the process of their evolutionary self-contraction in CFREU (similar to the uniform motion of "inertial" FRs of the SR [31]) [17-19]. And due to the evolutionary decrease in the CFREU of the distances between the mutually motionless in the FRPW objects, there is an inherent to OLT blueshift of the centripetal radiation frequency (which is directed towards the center of evolutionary self-contraction of matter, which is also the center of its gravity).

5. Due to the unobservability in the FRPW of the evolutionary decrease in the CFREU of the sizes of all objects in the Universe, distant galaxies move away in the FRPW from the center of evolutionary self-contraction of matter, and the centripetal radiation from them has an inherent to OSCT redshift of its frequency [17-19,28].

6. It is precisely because of the inherent to OLT blueshift of the centripetal radiation frequency that OLT are not suitable for use in the FRPW. And therefore, the conclusions regarding the relativistic dilation of proper time of matter moving in a gravitational field by inertia should be considered false.

7. Only due to the conservation of the Newtonian of inert free rest energy and the Keplerian of ordinary rest energy of matter, and therefore, the absence of dilation of the proper time of this matter moving in a gravitational field by inertia, we have the correspondence of the gravitational acceleration of the motion of matter to Newton's gravitational law and the gravitational-kinematic invariance of the thermodynamic parameters and potentials of matter [6,17-19].

8. Only the invariance in time of the fundamental Hubble constant ensures the continuity of the spatial continua of rigid FRs [6]. Therefore, the conclusions about its variability based on both ignoring the absence of dilation of the proper time of galaxies and the improper use of the luminosity distance (instead of metric distances) in Hubble's dependencies are incorrect. And therefore, the so-called dark energy is not needed in the Universe.

9. The intensity of the gravitational field depends fundamentally not only on the propagation speed of the electromagnetic interaction, but also on the distance of interaction of elementary quasi-particles, which during the motion of matter is significantly reduced due to the isotropic kinematic self-contraction of matter in the Euclidean background space of the CFREU [23].

10. The correspondence of OSCT to reality in the people's world is confirmed by the parameters of the motion of both stars in galaxies and planets in the Solar System, and therefore by the laws of Kepler and Newton [17-19].

11. The kinematic, as well as the gravitational deformation of micro-objects of matter is fundamentally unobservable in the FRPW and therefore, instead of it, it is necessary to use the comoving kinematic local curvatures of the space of the observer of the motion of matter.

12. The vacuum velocity of light (propagation of electromagnetic waves in space) in any FR and at any point of the gravitational field is a priori equal to the constant *c* and therefore is not subject to any transformations of velocities. After all, it is given in time, the rate of flow of which is determined by this very speed of propagation of electromagnetic waves. Only the frequency and length of electromagnetic waves are subject to transformation. And therefore, the gravitational field is a spatial distribution not of the speeds of propagation of electromagnetic waves at all, but of the frequencies of electromagnetic interaction between micro-objects of any identical motionless matter under standard conditions.

13. On singular surfaces, it is not the speed of propagation of electromagnetic waves that is zero, but the frequency of electromagnetic interaction in a hypothetical motionless and absolutely cooled matter. Therefore, the Hubble velocity of matter on the pseudo-horizon of the infinitely distant cosmological past can theoretically be equal to the constant of velocity of light.

14. Both the chaotic thermal motion of micro-objects of hot matter and the directed motion of matter itself compensate for the gravitational (gravity-quantum) deceleration of the flow of its proper time for all GTD-bound matter. Therefore, the change in the collective thermodynamic Gibbs microstates of all GTD-bound matter occurs with the same frequency, which determines the rate of flow of the unified gravithermodynamic (universal astronomical) time of this matter.

15. The gravitational field is only a manifestation of the spatially inhomogeneous thermodynamic state of matter. Before the breakup of the single gas continuum of the Universe, gravity (which is associated with the electromagnetic interaction of elementary quasiparticles) was completely absent in it.

16. The true value of the gravitational coefficient ("constant") is proportional to the square of the absolute temperature of the environment. Therefore, in the early (hot) Universe, the gravitational "constant" was significantly larger than Newton's gravitational constant.

17. The Universe has existed from the beginning and its further existence cannot be limited by anything. After all, the tendency towards zero dimensions of elementary quasiparticles in the CFREU is asymptotic.

18. Conformal Lorentz transformations of increments of spatial coordinates and time (which ensure the invariance of the flow of proper time of matter moving in quasi-equilibrium) are suitable for use in FRPW to reflect the quasi-equilibrium cooling down of matter [4-6,16].

19. It is advisable to distinguish between true and merely observed phenomena and facts. For example, we know well that the daily motion of the Sun relative to the Earth's surface is untrue. After all, it is actually a consequence of the Earth's rotation relative to its axis. And the expansion of the Universe, which is observed in the people's world, can be considered, if not unreal, then at least "untrue". After all, its fundamental (absolute according to Newton) space does not expand anywhere, as Hermann Weyl already understood well [40,41]. In fact, all length standards in this space are evolutionary decreasing due to the spiral-wave nature of all non-fictitious elementary quasiparticles [37,42-44].

That is why the OLT should be considered as corresponding only to some observed facts, and not as corresponding to the majority of real (true) phenomena. After all, the fundamental invariance of the velocity of light propagation according to the readings of any clocks, confirmed by these transformations, is related only to the dependence of the rate of time flow on the velocity of light itself [31]. If the velocity of light were to increase, then the rate of time flow would inevitably increase due to the increase in the frequency of electromagnetic interactions in matter. And therefore, it would not be possible in principle to detect this increase in the velocity of light propagation at the new rate of time flow.

Thus, the OLT of the SR are suitable for describing reality only in the local gravity-quantum proper times of matter, in which the velocity of light is fundamentally invariable. And therefore, they are absolutely unsuitable for describing reality in the global unified gravithermodynamic (universal astronomical)

time, in which on hypothetical singular surfaces it is the frequency of electromagnetic interaction in hypothetical stationary matter (and not the false coordinate velocity of light of the GR) can even take a zero value. The realization of this in gravity-quantum time on the pseudo-horizon of the infinitely distant cosmological past is prevented by the complete compensation of the gravitational dilation of time on it by the kinematic acceleration of time flow (caused by chaotic thermal or hypothetical directed motion of micro-objects of matter) in the dynamic gravitational field of the Universe [17-19,28,31,45]. And it is the use in thermodynamic potentials of such a hidden variable parameter as the maximum possible (limit) velocity of matter (which is almost identical to the false coordinate pseudo-vacuum velocity of light of the GR) that is a guarantee of the gravitational-relativistic invariance of thermodynamics [4,5,17-19,28,31,45].

Deriving Newton's law of gravity directly from the condition of no change in the flow of proper time of matter during its inertial motion in a gravitational field clearly indicates the presence of complete compensation of the change in the magnitude of the gravitational dilation of proper time of matter by its inertial motion.

The discovery of new relativistic transformations of increments of spatial coordinates and time that comply with Newton's and Kepler's laws, and thus finally confirmed the gravitational-relativistic invariance of thermodynamics, is similar to the discovery (by Ott and Arzelies [46,47]) of the possibility of an alternative relativistic interpretation of thermodynamics.

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