Relativistic alternatives to the classical Hamiltonian and Lagrangian

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The feasibility of using in physics of relativistically invariant Newtonians of the free inertial rest energy of matter and Keplerians of the ordinary rest energy of matter, respectively, instead of relativistically non-invariant Hamiltonians and Lagrangians, has been shown. 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. And thus the presence of complete compensation of the gravitational dilation of time of the matter by its inertial motion is proved. True relativistic transformations of the increments of spatial coordinates and time are obtained. The true relativistic transformations of increments of spatial coordinates and time are presented. These transformations are based on Keplerian (which is alternative to Lagrangian) and differ from Lorentz transformations only in one parameter b_c. 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.

I. INTRODUCTION

Relativistic invariance of thermodynamics [1–6] 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*. And it is the mistaken consideration in Etherington's identity [7–9] 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 [10–13]. 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 [14]. So, the simple Lorentz transformations (and not the more general conform-Lorentz transformations [4,6,15]) of the increments of spatial coordinates and time are not inherent in the matter moving by inertia in the gravitational field, provided that its motion is described using Hamiltonians and Lagrangians. They are inherent only in the uniform motion of matter and, first of all, in the process of evolutionary self-contraction of its microobjects in comoving with expanding Universe FR (CFREU). However, even the simple transformations of increments of spatial coordinates and time (that are only similar, but not identical to Lorentz transformations) 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 described using the Newtonians [GT-Hamiltonians] and the Keplerians [GT-Lagrangians] [16]. 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 [16]. It was these pseudo-forces that could have caused the anomalous motion of the "Pioneer" spacecrafts at the edge of the Solar System [17–19].

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II. THE FEASIBILITY OF USING NEWTONIANS AND KEPLERIANS

In the Relativistic Gravithermodynamics (RGTD) [4,6], unlike General Relativities (GR), bodies that move by inertia in a gravitational field, influence (by their movement) the configuration of the dynamic gravitational field [16] surrounding them. 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 [16]. 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 $E_0 = m_{00} c v_l$ [6], 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 [6,16]) of matter of astronomical object.

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:

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

but with the Keplerian [GT-Lagrangian] momentum:

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

$$= m_{00} v c (v_l^2 + v^2)^{-1/2} = m_{00} \hat{v} ,$$

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

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

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

$$+ m_{00}^2 c^6 v_l^{-4} v^2 / (1 + v^2 v_l^{-2}) = m_{00}^2 c^6 v_l^{-2} = m_{gr0}^2 c^4 ,$$

$$\hat{v} = v b_c^{-1/2} = v c / v_{lc} = v c / v_l \hat{\Gamma}_c ,$$

$$\hat{\Gamma}_c = (1 + v^2 v_l^{-2})^{1/2} ,$$

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

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

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 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 [4–6,15]:

$$(ds_c)^2 = v_{lc}^2 (dt)^2 - (d\hat{x})^2 - (d\hat{y})^2 - (d\hat{z})^2 =$$

$$= (b c^2 + v^2)(dt)^2 - (d\hat{l})^2 = b c^2 (dt)^2 = \mathbf{invar} .$$

Here: $(ds_c)^2 = b c^2 (dt)^2 \neq \mathbf{const}(r)$ is the square of the increment of the relativistic interval; $d\hat{l} = v dt = \sqrt{(d\hat{x})^2 + (d\hat{y})^2 + (d\hat{z})^2}$, $d\hat{x} = v_x dt$, $d\hat{y} = v_y dt$, $d\hat{z} = v_z dt$ are increments of metric segments, not increments of coordinates; $b_c c^2 (dt)^2 = \mathbf{const}(r)$.

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 single 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_{lc}, b and Γ_m in thermodynamics [4–6], the parameter b_c in the RGTD is a hidden internal parameter of the moving matter. And exactly the usage of this parameter in the equations of the dynamic gravitational field of the RGTD allows us not to additionally use the velocity of matter in those equations, as well as in the equations of thermodynamics.

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

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

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

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

After all, according to Hubble's law and the Schwarzschild solution of the gravitational field equations with a non-zero value of the cosmological constant $\Lambda = 3H_E^2 c^{-2}$ and a zero value of the gravitational radius:

$v_{lg}^2 = c^2(1+2z)(1+z)^{-2} = c^2(1-\Lambda r^2/3) =$

$= c^2 - H_E^2 r^2 = c^2 - v_g^2$, $v_{l\min}^2 = v_{\max}^2 = H_E^2 r_{ct}^2 =$

$= H_E^2 R_{ct}^2 (1+z)^{-2} = c^2 z_{\max}^2 (1+z_{\max})^{-2} = v_{lc}^2/2 \equiv c^2/2$

$(v \le v_l)$, $z_{\max} = 1+\sqrt{2}$; $r_{ct} \equiv r_{\max} = c/\sqrt{2}H_E =$

$= \sqrt{3/2\Lambda} = 1.05 \cdot 10^{26}\,\mathrm{m} = 3.4\mathrm{Gpc}$ is the true value of the radius of the horizon of the distant cosmological past, which corresponds to the structured part of the Universe after the rip (gap) of its (predominantly hydrogen) gaseous continuum, and therefore, the emergence in it of both spatially inhomogeneous thermodynamic states of matter and the corresponding to them gravity, as well as the beginning of the action of the corresponding laws, $R_{ct} = r_{ct}(1+z)$ is the radius of the horizon in CFREU.

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

Thus, the Lorentz transformations of increments of spatial coordinates 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, according to the GR and RGTD, the coordinate pseudo-vacuum velocities of light for astronomical objects of these galaxies are much less than the constant velocity of light.

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:

$(ds_{cg})^2 = v_{lcg}^2 (dt)^2 - (d\hat{x})^2 - (d\hat{y})^2 - (d\hat{z})^2 =$

$= b_{cg} c^2 (dt)^2 - (d\hat{l})^2 = (v_{lg}^2 + v_g^2)(dt)^2 - (d\hat{l})^2 =$

$= b_g c^2 (dt)^2 = \mathbf{invar}$.

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:

$$v_{gr}^2 = (c^2 r\sqrt{ab}/2) d\ln b/d\hat{r} =$$

$$= (c^2/\sqrt{b})(r_g/2r - \Lambda r^2/3) \approx c^2 r_g/2r.$$

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:

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

$$=\frac{m_{00}}{r\sqrt{ab}}(v_{gr}^2-v^2)\approx\frac{m_{00}c^2r_g(2r-r_1-r_2)}{2r^2(r_1+r_2)}.$$

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:

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

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

$$=-\frac{m_{00}c^2r_g}{2r_2^2}\left(\frac{r_1-r_2}{r_1+r_2}\right)=\frac{m_{00}}{r_1}\left(\frac{c^2r_g}{2r_1}-v_1^2\right).$$

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:

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

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 in 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 ($v_2r_2=v_1r_1$):

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

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

we can find the gravitational radius of the Sun:

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

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. 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

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.

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.

And only from the condition of complete compensation of gravitational dilation of time by the inertial motion of matter ($1-r_g/r+v^2c^{-2}=$ $=1-\frac{r_g}{r_0}=\mathbf{const}(r,t)$, $v=-c\sqrt{r_g\left(\frac{1}{r}-\frac{1}{r_0}\right)}=\sqrt{a}\,\frac{dr}{dt}$) can one obtain Newtonian gravitational acceleration:

$$g=-c^2\frac{d\ln(v_c/c)}{dr}=\frac{c^2v}{v_l^2}\frac{dv}{dr}=\frac{\sqrt{a}}{b}\frac{dv}{dt}=$$

$$=\frac{-cr_gv}{2br^2\sqrt{r_g(1/r-1/r_0)}}=\frac{c^2r_g}{2br^2}=\frac{G_{00}M}{br^2}=\frac{GM}{r^2}.$$

Therefore, ignoring complete compensation of gravitational dilation of time by inertial motion of matter on the basis of an imaginary relativistic dilation of proper time of matter is unacceptable. From this same condition follows the necessity of using the logarithmic gravitational potential and the identity of the inertial mass $m_{in}=m_{00}v_l/c=m_{00}\sqrt{b}$ to the gravitational mass $m_{gr}=m_{00}c/v_l=m_{00}/\sqrt{b}$ only according to the proper gravity-quantum clock of matter ($^iv_{li}=c$) [4,6,8], and the spatial and thus temporal dependence (on the parameter b) of the gravitational "constant" $G=G_{00}m_{gr}/m_{in}=G_{00}/b\neq$ $\neq\mathbf{const}(r)$ [4,6,16], the instability of which in time was predicted by Dirac [20].

The impossibility of exceeding of the coordinate pseudo-vacuum velocity of light $v_{cv}=v_l$ by the velocity of a falling body indicates that the value of the coordinate pseudo-vacuum velocity of light in empty space cannot be less than $v_{l\min}=c/\sqrt{2}$. And therefore, the existence of black holes is unreal and untrue. They are now taken for extremely massive neutron stars, which have the topology of a hollow body and mirror symmetry of their intrinsic space. And the coordinate pseudo-vacuum velocity of light can tend to zero only if the temperature and pressure inside the matter tend to infinity.

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

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

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

$$\approx m_{in}v^2/b_cr-2m_{in}v^2r/b_cv^2(r_c^2-r^2),$$

which "balances" (compensates for) the gravitational pseudo-force in a rigid FR of matter, depends in GR and RGTD on the cosmological fundamental constant $\Lambda=3H_E^2c^{-2}=\mathbf{const}(t)$ 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: $\mathbf{F}_{in0}=m_{in}v^2/b_cr$ is ordinary (unreduced) centrifugal pseudo-force of inertia;

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

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 microobjects, 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 [21]) Euclidean space of comoving with expanding Universe FR, and not by the weak gravitational pseudo-forces at the edge of the galaxy [16].

The dependence of Λ-reduced centrifugal pseudo-force of inertia exactly on the intrinsic value of the object's velocity $\hat{v}=vc/v_{lc}=v/\sqrt{b_c}$

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 [16].

V. TRUE RELATIVISTIC TRANSFORMATIONS OF COORDINATE AND TIME INCREMENTS

In GR, as in RGTD, astronomical (gravithermodynamic) time is used to describe the motion of matter in a gravitational field. Due to this astronomical (gravithermodynamic) time the coordinate pseudo-vacuum velocity of light and the alternative maximum possible (limit) velocity of matter motion 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. In addition, they are based on the 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 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 [16] will be as follows:

$$dx = \frac{\sqrt{b}}{\sqrt{b_c}}(dx' - v'_k dt') = \frac{dx' - v'_k dt'}{\sqrt{1+v'^2_k v'^{-2}_l}} = d\widehat{x}' - \widehat{v}'_k dt',$$

$$dt = \frac{dt' + v'_k v'^{-2}_l dx'}{\sqrt{1+v'^2_k v'^{-2}_l}}, \quad dy = dy', \quad dz = dz',$$

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

$$dt' = \frac{dt - v_k v_l^{-2} dx}{\sqrt{1+v^2_k v^{-2}_l}}, \; v'_y = \frac{v_y\sqrt{1+v^2_k v^{-2}_l}}{1-v_k v_x v^{-2}_l}, \; v'_z = \frac{v_z\sqrt{1+v^2_k v^{-2}_l}}{1-v_k v_x v^{-2}_l},$$

$$v_x = \frac{dx' - v'_k dt'}{dt' + v_k v_l^{-2} dx'} = \frac{v'_x - v'_k}{1+v'_k v'_x v'^{-2}_l} = \frac{(\widehat{v}'_x - \widehat{v}'_k)\sqrt{1+v'^2_k v'^{-2}_l}}{1+v'_k v'_x v'^{-2}_l},$$

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

$$v = \frac{\sqrt{[(\widehat{v}'_x - \widehat{v}'_k)^2 + v'^2_y + v'^2_z](1+v'^2_k v'^{-2}_l)}}{1+v'_k v'_x v'^{-2}_l},$$

$$v' \neq \frac{\sqrt{[(\widehat{v}_x + \widehat{v}_k)^2 + v^2_y + v^2_z](1+v^2_k v^{-2}_l)}}{1-v_k v_x v^{-2}_l}, \; \widehat{v}_x = \frac{v_x}{\sqrt{1+v'^2_k v'^{-2}_l}} =$$

$$= \frac{v'_x - v'_k}{(1+v'_k v'_x v'^{-2}_l)\sqrt{1+v'^2_k v'^{-2}_l}} = \frac{(\widehat{v}'_x - \widehat{v}'_k)}{1+v'_k v'_x v'^{-2}_l},$$

$$v_{ly} = \frac{v'_{ly}\sqrt{1+v'^2_k v'^{-2}_l}}{1+v'_k v'_{lx} v'^{-2}_l}, \; v_{lz} = \frac{v'_{lz}\sqrt{1+v'^2_k v'^{-2}_l}}{1+v'_k v'_{lx} v'^{-2}_l},$$

$$v_{lx} = \frac{v'_{lx} - v'_k}{1+v'_k v'_{lx} v'^{-2}_l} = \frac{(\widehat{v}'_{lx} - \widehat{v}'_k)\sqrt{1+v'^2_k v'^{-2}_l}}{1+v'_k v'_{lx} v'^{-2}_l};$$

$$v_l = v'_l\left(\frac{v'_l - v'_k}{v'_l + v'_k}\right) = v'_l\left(\frac{v_l - v_k}{v_l + v_k}\right), \; \widehat{v}_l = \widehat{v}'_l\left(\frac{v_l - v_k}{v_l + v_k}\right)$$

and $v'_l = v_l\left(\frac{v_l + v_k}{v_l - v_k}\right)$ (when $v_{ly} = 0$ and $v_{lz} = 0$);

$$dt_p = \frac{dt'_k}{\sqrt{1+v'^2_k v'^{-2}_l}}, \quad dt'_k = \frac{dt_p}{\sqrt{1+v^2_k v^{-2}_l}},$$

where: $v'_k = -v'_p = v_k v'_l / v_l = v_k(1+v^2_k v^{-2}_l)^{-1/2} < v_k$, $b = v^2_l c^{-2}$; $d\widehat{x}_k = (1+v^2_k v^{-2}_l)^{-1/2} dx_k < dx_k$ and $d\widehat{x}'_p = (1+v'^2_p v'^{-2}_l)^{-1/2} dx'_p = (1+v^2_k v^{-2}_l)^{-1/2} dx'_p$ are increments of fundamentally invariable metric segments in space, which has a kinematic "curvature" [6].

In these transformations, as in the Lorentz transformations, there is mutual observation, but not at all a slowdown, but an acceleration of the flow of time of the opposite observed object that moves with speed v_k or v'_k accordingly. But in fact, the flow of time is accelerated only for a body that is freely falling onto a massive planet that has a gravitational field. After all, the gravitational time dilation (deceleration of the flow of time) of the falling body is actually compensated due to the high speed of the fall of the body.

This is also facilitated by the additional isotropic self-contraction of the moving matter in the CFREU. But due to the fundamental unobservability (in the observer's FR) of this additional isotropic self-contraction of the matter in the CFREU, it is not reflected by these transformations of the increments of spatial

coordinates and time. It manifests itself in the observer's FR only in the form of an additional kinematic curvature of the part of space in which the moving matter is instantaneously located.

Thanks to these transformations, there will be no dilation of astronomical time for any body (of the Solar System) moving in a gravitational field by inertia. After all, all astronomical bodies came from the distant outskirts of the Solar System, where their velocity was low, and the parameter $b \approx b_c \approx 1$. 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 speed of their orbital motion and by the increase in the velocity of light $v_l = v'_l[(v'_l + v'_k)/(v'_l - v'_k)]$ at perihelions and aphelions caused by it, they did not experience gravitational dilation of their time. Therefore, in the gravity-quantum 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 [21] (fundamental [4,6]) space of the CFRUE 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.

Due to the high speed of rapid distancing from the observer p of distant galaxies $(dx = d\hat{r} = \sqrt{a}dr)$, the gradual decrease in the coordinate pseudo-vacuum velocity of light 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. According to these transformations, there is also mutual observation, but not a reduction, but an increase (along the direction of motion) of the increments of the coordinates (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 [21] of CFREU. Instead of the relativistic deformation of moving bodies, one should consider the presence of a kinematic "curvature" [6] 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 a comprehensive isotropic reduction in their size, similarly to how it occurs near the center of gravity.

Similar relativistic Lorentz transformations, which use (instead of the parameter b_c) the parameter $b_w = 1/b_s = \Gamma^{-2}/b = (1 - v_k^2 c^{-2}/b)/b$ [16] not identical to this parameter b_c, do not guarantee this. 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 Lorentz transformations, under which, when the y' and z' axes are orthogonal to axis x', the axes y and z are also not orthogonal to axis x, are suitable only for uniform (pseudo-inertial) motion of matter in the process of its evolutionary self-contraction in the background Euclidean space [21] of the CFREU or during artificial acceleration of quasiparticles in accelerators.

VI. CONCLUSION

The dilation of the proper time of matter moving in a gravitational field by inertia is fundamentally impossible. It is incompatible with the relativistic invariance of thermodynamic parameters and potentials of matter. 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 in time. After all, only its invariance 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.

Only the relativistic Newtonians [GT-Hamiltonians] and Keplerians [GT-Lagrangians] (and not the alternative to them classical

Hamiltonians and Lagrangians) of astronomical objects moving by inertia in the surrounding gravitational field can strictly correspond to the reality and the modernized SR. Relativistic transformations of increments of spatial coordinates and time must be consistent with the conservation of the Newtonians and Keplerians of matter in the process of motion by inertia. It is the Newtonians of inert free rest energy and Keplerians of the ordinary rest energy of matter and the relativistic transformations of the increments of spatial coordinates and time built on their basis (and not the Hamiltonians, Lagrangians and Lorentz transformations) that accurately correspond to astronomical observations.

When planets move in circular orbits, the relativistic dilation of their proper time is fully compensated by the dynamic components of the gravitational field. When planets move in elliptical orbits, not only the relativistic, but also the gravitational dilation of their proper time is fully compensated not only by the dynamic components of the gravitational field, but also by the evolutionary self-contraction of the planets towards the center of gravity [16]. The same thing happens with the free fall of bodies in a gravitational field.

The coordinate pseudo-vacuum velocity of light of the GR and the equivalent limit velocity of matter of the RGTD cannot in principle be less than $v_{les\min} = c/\sqrt{2}$ in empty space due to the impossibility of exceeding this value by the velocity of matter ($v_{m\max} = c/\sqrt{2}$). And therefore, fictitious singular surfaces ($v_l = 0$), corresponding to the infinitely distant cosmological future (Schwarzschild sphere) and the past (sphere of event pseudo-horizon) can be contained only in the middle of continuous matter. The true singular surface ($v_l \approx 0$), which separates the external matter from the internal antimatter, can be contained only inside extremely massive neutron stars (which are now mistakenly taken for unreal "black holes" [4,6,8]) and quasars, which have the topology of a hollow body and mirror symmetry of their intrinsic space [22].

A very large redshift $z > 1+\sqrt{2}$ of the radiation spectrum can have a predominantly gravithermodynamic or even purely thermodynamic nature. After all, gravity arose in the Universe only after the gas continuum "Creative Rip", which first ensured the formation of spatially inhomogeneous thermodynamic states of infinite set of separate objects of initial gaseous matter, and then the formation of the entire natural diversity of the Universe instead of a homogeneous gaseous medium. The increase in transparency of the spatially homogeneous gaseous medium of the Universe apparently took place much earlier than the "Creative Rip". This is indicated by the very large redshift ($z_{\max} \approx 1100$) of the wavelengths of the so-called cosmic microwave background radiation. But it is not excluded that this radiation was formed in the process of interaction of quasiparticles of rarefied cold cosmic plasma, which were still capable of losing quanta of their electromagnetic energy at that distant time.

It is behind this horizon that the Hubble velocity of matter exceeds the coordinate pseudo-vacuum velocity of light of the hypothetical static gravitational field of the GR. But it does not exceed the limit velocity of matter in the true dynamic gravitational field of the RGTD. And therefore, it does not exceed the true velocity of light in the RGTD beyond this horizon. Therefore, this event horizon of GR does not prevent the observer from receiving information from more distant regions of the Universe. After all, the Universe exists eternally [4,6,8]. And therefore, this Hubble pseudo-horizon of GR may not be a true horizon and may not even correspond to the "Creative Rip" of the continuous gaseous medium of the Universe.

Thus, in the GR, not the true, but the hypothetical coordinate pseudo-vacuum velocity of light, 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 $f \equiv \sqrt{b} = v_l/c$ in matter 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 on a zero value on the event pseudo-horizon of the Universe. The 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.

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 due to the isotropic kinematic self-contraction of matter in the Euclidean background [21] space of the CFREU. In the FR of the people´s world, as well as in the intrinsic FR of a moving matter, the reduction 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 $a_c = (d\breve{l}/dl)^2 = 1/(1+v^2v_l^{-2}) = b/b_c$, and the dynamic gravitational field, which is characterized by the parameter $b_c = v_{lc}^2c^{-2} = b + v^2c^{-2} = b(1+v^2v_l^{-2})$. And thus, with an increase in the velocity of matter, along with an increase in its kinematic self-contraction, the limit velocity of matter also increases. An increase in the coordinate velocity of light in the GR due to this could not be in principle. After all, the coordinate velocity of light is a characteristic of the space in which the movement occurs, and not at all a characteristic of the moving matter.

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 FR of people's world 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 [21] (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].

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 and the Keplerians of ordinary rest energy.

It is exactly the Newtonians and the Keplerians that can also explain the inertial motion of stars in the gravitational field of a galaxy [16].

The centrifugal pseudo-forces of inertia depend also on the cosmological fundamental constant $\Lambda = 3H_E^2c^{-2} = \mathbf{const}(t)$ and therefore on Hubble fundamental constant.

Not only the dynamic component of the gravitational field, but also the centripetal evolutionary self-contraction of stars towards the center of gravity of the galaxy provide full compensation for the relativistic dilation of their time even in case of the circular rotation of the stars relative to this center.

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. In fact, all length standards in this space are evolutionary decreasing due to the spiral-wave nature of all non-fictitious elementary quasiparticles [23-25]. That is why the Lorentz transformations 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. 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 transformations of spatial coordinates and time of the SR are suitable for describing

reality only in the gravity-quantum proper time of matter, in which the velocity of light is fundamentally invariable. And therefore, they are absolutely unsuitable for describing reality in the gravithermodynamic (astronomical) time (intrinsic to matter), in which on hypothetical singular surfaces namely the frequency of electromagnetic interaction in matter (and not the coordinate velocity of light of the GR) can take even 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 in the dynamic gravitational field of the Universe [16]. And it is the use in thermodynamic potentials of such a hidden variable parameter as the maximum possible (limit) velocity of matter (which is not identical to the coordinate pseudo-vacuum velocity of light of the GR) that is a guarantee of the gravitational-relativistic invariance of thermodynamics [4,5,26].

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 gravitational dilation of 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 is similar to the discovery (by Ott [27] and Arzelies [28]) of the possibility of an alternative relativistic interpretation of thermodynamics, which finally confirmed the relativistic invariance of thermodynamics.

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