On the justification for using a dynamic gravitational field in an expanding Universe

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The feasibility of using the equations of the dynamic gravitational field to reflect the expanding Universe has been proven. Only thanks to this, the Hubble velocity of matter will not exceed the velocity of light at the event horizon of the Universe. The identity of the parameter b of the Schwarzschild solution of the equations of the gravitational field to the square of the relative frequency of the electromagnetic interaction of microobjects of matter and the equivalence of the limit velocity of matter to this parameter in its state of immobility has been justified. The falsehood of associating the parameter b with the coordinate velocity of light of the General Relativity (GR) has been proven.
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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 [1], 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 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 [1]). 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 microobjects of matter m moving with a velocity v, and matter conditionally being at rest 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 the further gravitational reduction of this relative frequency is compensated $(f_{cm}^2 = f_{gr}^2 + f_{kin}^2 = \mathbf{const}(t))$. And this is obviously due to the decrease in the distances of electromagnetic interaction between microobjects of matter in the background Euclidean space of the Universe [2] due to the isotropic kinematic self-contraction of moving matter in it [1,3].

Thus, the application of the parameter $c\sqrt{b}$ in the GR (according to the Schwarzschild solution of the gravitational field equation [4]) to space, and not to the matter moving in it, is inappropriate and incorrect.

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After all, the identification with this parameter of the so-called coordinate velocity of light [3,4] leads in the frame of references of spatial coordinates and time (FR) of the observer 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. 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.

The equivalence of the gravitational interval q to the astronomical (gravithermodynamic [3]) time t when $b_0 = 1$, and the equivalence of the kinematic (non-relativistic) interval s_c to the intrinsic gravity-quantum time t' of matter in the dynamic gravitational fields of galaxies and the Solar System must also be taken into account:

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

Here: $v_{lc}^2 = \left(1 - \dfrac{r_g}{r} - \dfrac{\Lambda r^2}{3}\right)c^2 + v^2 \approx \left(1 - \dfrac{r_g}{r_{min} + r_{max}}\right)c^2$

$v_{crc}^2 = (r_g / r + \Lambda r^2 / 3)c^2 / 2$ is the square of the hypothetical circular orbital velocity of astronomical objects, $ds_c = cdt'$ is the increment of the kinematic interval; $d\widehat{l} = \sqrt{(d\widehat{x})^2 + (d\widehat{y})^2 + (d\widehat{z})^2}$, $d\widehat{x} = v_x dt$, $d\widehat{y} = v_y dt$, $d\widehat{z} = v_z dt$ are the increments of metric segments, not increments of coordinates.

According to this, it can be conditionally assumed that the ordinary Newtonian $N = m_{00}c^2(b + v^2c^{-2})^{1/2}$ [1] of the inert free rest energy $E_0 = m_{00}c^2b^{1/2}$ [3] of matter is the Pseudo-Hamiltonian of the fundamental Newtonian $N_F = m_{00}c^2(b + 2v^2c^{-2})^{1/2}$, and the ordinary Keplerian $K = m_{00}c^2(b + v^2c^{-2})^{-1/2}$ [1] of the ordinary rest energy $W_0 = m_{00}c^2b^{-1/2}$ of matter is the Pseudo-Lagrangian of the fundamental Keplerian $K_F = m_{00}c^2(b + 2v^2c^{-2})^{-1/2}$, which is inherent to matter (with ordinary mass m_{00}) in the comoving with expanding Universe FR (CFREU).

Thus, we have a twofold $(b_F = b + 2v^2c^{-2})$ kinematic increase in the relative frequency of electromagnetic interaction between microobjects of matter (due to the isotropic reduction of the distances of this interaction in the background Euclidean space [2] of the CFREU), compensated by half by the Lorentzian decrease $(b_c = b_F - v^2c^{-2} = b + v^2c^{-2})$ in it. And therefore, the kinematic interval S_c (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 ordinary (usual) Lorentz transformations of the increments of spatial coordinates and time (OLT) the conformal Lorentz transformations of the increments of spatial coordinates and time allow not only to get rid of the dilation of the proper time [3], but also to obtain the kinematic acceleration of the flow of the proper time of the matter due to its isotropic self-contraction in the background Euclidean space [2] of CFREU. In this case, the Lorentz transformations of the velocities will be the same [3,5] as in the case of OLT.

And therefore, the motion of matter actually induces an increase in the relative frequency of electromagnetic interaction between its microobjects, 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 [1,3,6] that Hubble law can operate in it.

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 [1].

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

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

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

$$g = -\frac{c^2}{\sqrt{a}}\frac{d\ln(v_l/c)}{dr} = -\frac{c^2}{2b\sqrt{a}}\frac{db}{dr} \approx -\frac{c^2 r_{g0}}{2br^2} = -\frac{G_0 M}{br^2} = -\frac{GM}{r^2},$$

$$g = \frac{dv}{dt} = \frac{1}{2\sqrt{a}}\frac{dv^2}{dr} \approx \frac{c^2}{2}\left(\frac{db_c}{dr} - \frac{r_g}{r^2}\right) = -\frac{GM}{r^2}\quad\left(\frac{db_c}{dr} = 0\right).$$

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 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 ($^i v_{li} = c$) [1,3,6], and the spatial and thus temporal dependence (on the parameter b) of the gravitational "constant" $G = G_{00}m_{gr}/m_{in} = G_{00}/b \neq \mathbf{const}(r)$ [1,3], the instability of which in time was predicted by Dirac [7].

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 [8] and Arzelies [9]) of the possibility of an alternative relativistic interpretation of thermodynamics, which finally confirmed the relativistic invariance of thermodynamics.

CONCLUSION

1. The gravitational field is a spatial distribution of the relative frequency of electromagnetic interaction between microobjects of a motionless matter and the equivalent limit velocity of motion of a real or hypothetical matter that could be conditionally at rest at a certain point in space.

2. The vacuum velocity of light is the same at all points of the gravitational field and is equal to the constant c even on singular surfaces on which the relative frequency of electromagnetic interaction and the equivalent to it limit velocity of the matter are zero. And it is on the basis of the condition of equality of the velocity of light to the constant c that the metric of the inrinsic space of matter moving at any velocity is formed. Therefore, the entire infinite fundamental space of the CFREU, in which the value of the velocity of light is evolutionary decreasing, is limited by a pseudo-horizon of events (of the infinitely distant cosmological past) in the FR of matter.

3. The fundamental invariance of the velocity of light propagation according to the readings of any clocks 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 relative 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 [10]. Any other justifications for this fact are unnecessary. After all, they can lead to false conclusions, similar to the imaginary slowing down of the flow of proper time in a moving matter.

4. The sameness in different FRs (moving relative to each other) and the a priori invariance of the velocity of light both in time and in space require the introduction of only the kinematic curvature of the part of space occupied by the moving body, and do not require the transformation of time increments. And therefore, space-time transformations are needed only for true and limit values of the velocities of matter.

5. The velocity of matter cannot exceed only its limit velocity, but it can exceed the limit velocities of other substances whose limit velocities are lower than its own. This is what distinguishes it fundamentally from the false coordinate velocity of light, which cannot be exceeded by the velocity of matter.

6. Changing the magnitude of 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.

7. The relative frequency of electromagnetic interaction between microobjects of matter, and therefore the rate of flow of its proper time and the limit velocity do not change in the process of motion of matter by inertia, provided that its thermodynamic state is unchanged. And this takes place due to the conservation (in the process of motion by inertia) of the Newtonian [1] of inert free rest energy [3] and the Keplerian [1] of ordinary rest energy of the matter, which are built on the basis of the parameter $b_c = b + v^2 c^{-2} = \mathbf{const}(t)$ of the dynamic gravitational field [1]. And this is ensured by the corresponding isotropic self-contraction of the matter in the background Euclidean space [2] of FR comoving with the expanding Universe.

8. The dynamic gravitational field, like the Newtonians and the Keplerians, strictly corresponds to both galaxies that are radially moving away from the observer at high velocity, and to the stars of the galaxies and the planets of the Solar System [1].

9. It is precisely due to the action of the dynamic gravitational field that the gravitational interval q when $b_0 = 1$ actually corresponds to the single astronomical (gravithermodynamic [3]) time $(dq \equiv cdt)$ of the entire Solar (or any other gravitational) system. After all, the gravitational dilation of the intrinsic (proper) gravity-quantum time of planets moving in elliptical orbits $(b \neq \mathbf{const}(t))$ could be formed only in their hypothetical state of rest. The fundamental invariance of the magnitude of the dilation of the proper time of planets is fully ensured precisely by the peculiarities of their inertial motion.

10. The strength of the gravitational field would not correspond to reality if the parameter $b_c = b + v^2 c^{-2}$, and therefore the flow of the proper time of matter, were to change during its inertial motion in a dynamic gravitational field.

11. 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 [11-13].

12. The SR does not take into account the presence of gravitational fields in the Universe, in the absence of which, according to the dynamic gravitational field considered in the article, matter could not move independently in space at all. And the absence of spatial movement of matter really took place in the Universe before the rip (gap) of its continuous gas continuum, and therefore before the emergence of gravitational fields in it [3,6]. Therefore, the SR in principle cannot correspond to the presence of dynamic gravitational fields in the Universe, and thus to reality, which is confirmed by the relativistic invariance of thermodynamic parameters and potentials of matter.

13. The use of the OLT instead of more general transformations of increments of spatial coordinates and time (which ensure the invariance of the magnitude of the dilation of the proper time of matter) is not justified in the SR. And therefore, the SR is not able to refute the relativistic invariance of the thermodynamic parameters and potentials of matter. Moreover, in the SR it is fundamentally impossible to find out in which FR the dilation of proper time actually occurs, and in which it is actually absent and is only an observed illusion in that FR, which actually experiences the dilation of proper time. And therefore, it should be considered that this theory corresponds only to the observed facts and is fundamentally incapable of establishing the truth. And therefore, the OLT are suitable only for uniform equilibrium (pseudo-inertial) motion of matter in the process of its evolutionary self-contraction [3] in the background Euclidean space [2] of the CFREU or during artificial acceleration of quasiparticles in accelerators.

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