

XIII INTERNATIONAL CONFERENCE

«RELAXED, NONLINEAR AND ACOUSTIC OPTICAL PROCESSES AND MATERIALS» (RNAOPM'2026)

**DEDICATED TO THE MEMORY OF
NIELS BOHR**

JUNE 16 - 19, 2026

Lesya Ukrainka Volyn National University

Міністерство освіти і науки України
Волинський національний університет імені Лесі Українки

РЕЛАКСАЦІЙНІ, НЕЛІНІЙНІ, АКУСТООПТИЧНІ ПРОЦЕСИ І
МАТЕРІАЛИ (РНАОПМ' 2026)

Матеріали
XIII міжнародної наукової конференції
(Луцьк – Світязь, 16 – 19 червня 2026 року)
Присвяченої пам'яті Нільса Бора

RELAXED, NONLINEAR AND ACOUSTIC OPTICAL PROCESSES AND
MATERIALS (RNAOPM'2026)

Proceedings
XIII International scientific conference
(Lutsk – Svityaz', 16 – 19.06.2026)
Dedicated to the memory of Niels Bohr

Луцьк
Вежа-Друк
2026

УДК 535+544

P36

Рекомендовано до друку вченою радою Волинського
національного університету імені Лесі Українки
(протокол №7 від 26 квітня 2026 року)

Organizer: Educational and Scientific Institute of Physics and Technology of Lesya Ukrainka Volyn National University; Volyn Branch of the Shevchenko Scientific Society; Krakow University of Technology (Krakow, Poland); INFN-Laboratori Nazionali di Frascati (INFN - National Laboratories of Frascati, Frascati, Italy); Jan Długosz University of Humanities and Natural Sciences in Częstochowa (Częstochowa, Poland); Gdańsk State Autonomous University of Technology (Gdańsk, Poland); Western Scientific Centre of National Academy of Sciences of Ukraine and of Ministry of Education and Science of Ukraine; NOVI NANO Lab LLC Laser Structuring Solutions (Ukraine)

- **International Program Committee:** Trokhimchuk, chair, Ukraine; O. Zamurueva, scientific secretary, Ukraine; A. Andrushchak, Ukraine; V. Galyan, Ukraine; ; Ya. Gnilitzkyi, Ukraine; R. Golovchak, USA; V. Holovatsky, Ukraine; A. Holovin, USA; O. Khyzhun, Ukraine; B. Kotur, Ukraine; O. Makhanets, Ukraine; V. Maslov, Ukraine; Anna Migalska-Zalas, Poland; L. Muravsky, Ukraine; B. Mytsyk, Ukraine; L. Nykyruy, Ukraine; O. Pastukh, Poland; M. Piasecki, Poland; L. Piskach, Ukraine; A. K. Prykarpatski, Ukraine-Poland; Ya. Romanyuk, Switzerland; Ya. Rybicki, Poland; B. Sahraoui, France; A. Svidzinskiy, USA; V. Yuhymchuk, Ukraine.

Local Organizing Committee: H. Myronchuk, chair; V. Sakhnyuk, scientific secretary; L. Gulay; A. Kevshyn; M.Khyshchun; Yu. Kogut; Y. Koval; O. Marchuk; T. Melnichuk; V. Nahod; M. Rudys; P. Shygorin; D. Shvalikovskiy; P. Trokhimchuk; A. Tretyak; O. Novosad; A. Shutovskiy; B. Venhryn; D.Zakharchuk.

Proceedings of XIII-th International Conference «Actual problems of fundamental science» – APFS’2023 are represented. These results were reported on this conference.

Edition of materials are made from author texts and prepared to printing the Program Committee and Editorial Board of conference.

Релаксаційні, нелінійні, акустооптичні процеси і матеріали: матеріали XIII Міжнар. Р 36 наук. конф. – (Луцьк – Світязь, 16–19 черв. 2026 р.) – Луцьк : Вежа-Друк, 2026. – 196 с.

ISBN 978-966-940-805-1

Подано праці XIII міжнародної наукової конференції “Релаксаційні, нелінійні, акустооптичні процеси і матеріали” – РНАОПМ’ 2026. Матеріали було заслухано на конференції.

EDITORIAL BOARD: P. Trokhimchuk, Ukraine; L. Sørensen, Denmark

УДК 535+544

ISBN 978-966-940-805-1

© Волинський національний університет
Імені Лесі Українки, 2026

ORDINARY SYNCHRONIZATION-COMPENSATION TRANSFORMATIONS OF COORDINATE AND TIME INCREMENTS

Pavlo Danylchenko

SPE "GeoSystem", Vinnytsia, Ukraine, pavlo@vingeo.com

The suitability for use in the people's world of only ordinary synchronization-compensation transformations of increments of spatial coordinates and time is substantiated. These transformations, unlike the alternative to them ordinary Lorentz transformations (OLT), allow to proportionally synchronize all clocks that move in a gravitational field by inertia. The suitability of OLT (due to the inherent to OLT blueshift of the frequency of centripetal radiation instead of redshift) for use only in the comoving with expanding Universe frame of references of spatial coordinates and time is proven. The fallacy of ignoring the compensation of gravitational dilation of time by the inertial motion of matter is most thoroughly substantiated. 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.

Keywords: General Relativity, Dynamic Gravitational Field, Time Dilation, Lorentz Transformation, Redshift, Blueshift.

In General Relativity (GR), as in Relativistic Gravithermodynamics (RGTD), astronomical (gravithermodynamic) time is used to describe the motion of matter in a gravitational field. Due to this astronomical 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 frames of reference of spatial coordinates and time (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 [1-3]):

$${}^{ic}v_{lqj} = c(v_{lqj} / v_{lci})^{(v_{lci}/c)^2} = c(v_{lcoj} / v_{lcoi})^{(v_{lcoi}/c)^2} = \text{invar} \left[\ln({}^{ic}b_{qj}) = \frac{b_{ci}}{2} \ln \frac{b_{qj}}{b_{ci}} = \ln({}^{ic}b_{coj}) = \frac{b_{coi}}{2} \ln \frac{b_{coj}}{b_{coi}} = \text{invar} \right].$$

So, this is what prevents the use of OLT in FR of the people's world (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 [3-5] will be as follows:

$$\begin{aligned} d\hat{x}' &= \sqrt{\frac{b'}{b}}(d\hat{x} - v_k dt) = \frac{d\hat{x} - v_k dt}{\sqrt{1 + v_k^2 v_i'^{-2}}} = d\hat{x} - \hat{v}_k dt, \quad dt' = \sqrt{\frac{b}{b'}}(dt + v_k v_i'^{-2} d\hat{x}) = \frac{\sqrt{b}(dt + v_k v_i'^{-2} d\hat{x})}{\sqrt{b'(1 + v_k^2 v_i'^{-2})}}, \quad d\hat{y}' = d\hat{y}, \quad d\hat{z}' = d\hat{z}, \\ d\hat{x} &= \sqrt{\frac{b}{b'}}(d\hat{x}' + v_k' dt') = \frac{d\hat{x}' + v_k' dt'}{\sqrt{1 + v_k'^2 v_i'^{-2}}} = d\hat{x}' + \hat{v}_k' dt', \quad dt = \frac{\sqrt{b'}(dt' - v_k' v_i'^{-2} d\hat{x}')}{\sqrt{b(1 + v_k'^2 v_i'^{-2})}}, \quad \frac{v_y'}{\sqrt{b'}} = \frac{v_y \sqrt{1 + v_k^2 v_i'^{-2}}}{\sqrt{b(1 + v_k v_x v_i'^{-2})}}, \\ \frac{v_z'}{\sqrt{b'}} &= \frac{v_z \sqrt{1 + v_k^2 v_i'^{-2}}}{\sqrt{b(1 + v_k v_x v_i'^{-2})}}, \\ \frac{v_x'}{\sqrt{b'}} &= \frac{v_x - v_k}{\sqrt{b(1 + v_k v_x v_i'^{-2})}} = \frac{(\hat{v}_x - \hat{v}_k) \sqrt{1 + v_k^2 v_i'^{-2}}}{\sqrt{b(1 + v_k v_x v_i'^{-2})}}, \\ \frac{v_x}{\sqrt{b}} &= \frac{dx' + v_k' dt'}{\sqrt{b'}(dt' - v_k' v_i'^{-2} d\hat{x}')} = \frac{v_x' + v_k'}{\sqrt{b'}(1 - v_k' v_x' v_i'^{-2})} = \frac{(\hat{v}_x' + \hat{v}_k') \sqrt{1 + v_k'^2 v_i'^{-2}}}{\sqrt{b'}(1 - v_k' v_x' v_i'^{-2})}, \\ \frac{v'}{\sqrt{b'}} &= \frac{\sqrt{[(\hat{v}_x - \hat{v}_k)^2 + v_y^2 + v_z^2](1 + v_k^2 v_i'^{-2})}}{\sqrt{b(1 + v_k v_x v_i'^{-2})}}, \quad \frac{v}{\sqrt{b}} = \frac{\sqrt{[(\hat{v}_x' + \hat{v}_k')^2 + v_y'^2 + v_z'^2](1 + v_k'^2 v_i'^{-2})}}{\sqrt{b'}(1 - v_k' v_x' v_i'^{-2})}, \\ \frac{\hat{v}_x'}{\sqrt{b'}} &= \frac{v_x}{\sqrt{b(1 + v_k^2 v_i'^{-2})}} = \frac{v_x - v_k}{(1 + v_k v_x v_i'^{-2}) \sqrt{b(1 + v_k^2 v_i'^{-2})}} = \frac{(\hat{v}_x - \hat{v}_k)}{\sqrt{b(1 + v_k v_x v_i'^{-2})}}. \end{aligned}$$

$$\begin{aligned}\frac{\tilde{v}_x}{\sqrt{b}} &= \frac{v'_x + v'_k}{(1 - v'_k v'_x v_l'^{-2}) \sqrt{b'(1 + v_k'^2 v_l'^{-2})}} = \frac{(\tilde{v}'_x + \tilde{v}'_k)}{\sqrt{b'(1 - v'_k v'_x v_l'^{-2})}}, \quad \frac{v_{ly}}{\sqrt{b}} = \frac{v'_{ly} \sqrt{1 + v_k'^2 v_l'^{-2}}}{\sqrt{b'(1 - v'_k v'_x v_l'^{-2})}}, \quad \frac{v_{lz}}{\sqrt{b}} = \frac{v'_{lz} \sqrt{1 + v_k'^2 v_l'^{-2}}}{\sqrt{b'(1 - v'_k v'_x v_l'^{-2})}}, \\ \frac{v_{lx}}{\sqrt{b}} &= \frac{v'_{lx} + v'_k}{\sqrt{b'(1 - v'_k v'_x v_l'^{-2})}} = \frac{(\tilde{v}'_{lx} + \tilde{v}'_k) \sqrt{1 + v_k'^2 v_l'^{-2}}}{\sqrt{b'(1 - v'_k v'_x v_l'^{-2})}}, \quad \frac{v'_{lx}}{\sqrt{b'}} = \frac{v_{lx} - v_k}{\sqrt{b}(1 + v_k v_{lx} v_l'^{-2})} = \frac{(\tilde{v}_{lx} - \tilde{v}_k) \sqrt{1 + v_k'^2 v_l'^{-2}}}{\sqrt{b}(1 + v_k v_{lx} v_l'^{-2})}, \\ \frac{v_{li}}{\sqrt{b}} &= \frac{v'_{li}}{\sqrt{b'}} \left(\frac{v'_{li} - v'_p}{v'_{li} + v'_p} \right) = \frac{v'_{li}}{\sqrt{b'}} \left(\frac{v_{li} + v_k}{v_{li} - v_k} \right), \quad \frac{\tilde{v}_{li}}{\sqrt{b}} = \frac{\tilde{v}'_{li}}{\sqrt{b'}} \left(\frac{v_{li} - v_p}{v_{li} + v_p} \right) \text{ and } \frac{v'_{li}}{\sqrt{b'}} = \frac{v_{li}}{\sqrt{b}} \left(\frac{v_{li} - v_k}{v_{li} + v_k} \right) \text{ (when: } v_{ly} = 0 \text{ and } \\ &v_{lz} = 0); \\ \frac{v_l - v_k}{v_l + v_k} &= \frac{v'_l - v'_k}{v'_l + v'_k}, \quad dt_k = \frac{dt'_k}{\sqrt{b_k(1 + v_p'^2 v_l'^{-2})}} = \frac{dt'_p}{\sqrt{b_k + v_k^2 c^{-2}}}, \quad dt'_p = \sqrt{b_k(1 + v_k'^2 v_l'^{-2})} dt_k = \sqrt{b_k + v_k^2 c^{-2}} dt_k \text{ (when:}\end{aligned}$$

$b'_p=1$, $dx=v_k dt_k$ and $dx'=0$); where: $b=v_l^2 c^{-2}$, $b_c=(v_l^2+v_k^2)c^{-2}=b+v_k^2 c^{-2}$, $v'_{lj}=c(v_{lj}-v_k)/(v_{lj}+v_k)$ (when: $b'_j=1$ and $b=v_j^2 c^{-2}$), $v'_k=-v'_p=v_k v'_l/v_l=v_k c/v_{lc}=(b v_k'^{-2}+c^{-2})^{-1/2}$; $v'_l=v_l c/v_{lc}$ ($b'=b/b_c$), $v_{lc}^2=v_l^2+v_k^2=c^2$ ($b'_c=b'+v_k'^2 c^{-2}=1$); $d\tilde{x}_k=(1+v_k'^2 v_l'^{-2})^{-1/2} d\tilde{x}_k \leq d\tilde{x}_k$ and $d\tilde{x}'_p=(1+v_p'^2 v_l'^{-2})^{-1/2} d\tilde{x}'_p \leq d\tilde{x}'_p$ are increments of fundamentally invariable metric segments in space, which has a kinematic "curvature" [2], $d\tilde{x}$ and $d\tilde{x}'$ 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 in different points of the gravitational field of a body moving with the velocity v_k and in the gravitational field of the observer of its motion.

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 $b_c=b+v_k^2 c^{-2}=b_0=\text{const}(t,r)$ 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 ordinary synchronization-compensation transformations of increments of spatial coordinates and time (OSCT). In this case, it is precisely the motion by inertia that actually provides compensation for the gravitational deceleration or acceleration of the rate of flow of time of objects moving in this way in the gravitational field.

Therefore, due to the a priori equality (by any clock) 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 $b \approx b'_c = b'(1 + v_k'^2 v_l'^{-2}) \approx 1$ 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: $\Delta\nu/\nu' = -v_k/c = -z/(1+z) = -H_E R/c = -H_E D_A/c$, $\Delta\lambda/\lambda'_0 = z = H_E R/c = H_E D_M/c$.

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 with 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 of matter in galaxies [1, 2]). 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 [1, 2, 5].

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 CFREU. 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:

$$v_L = v'_L (dt'/dt) = v'_L (1 + v_k/c)\Gamma, \quad \Delta v_L/v'_L = (v_L - v'_L)/v'_L \approx v_k/c = z/(1+z) = H_E D_A/c, \\ \Delta\lambda_L/\lambda'_0 = -z = -H_E D_M/c.$$

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 is isotropic. Its coordinate anisotropy is inherent only to the intrinsic spaces of matter.

Conclusion

Thus, we should finally recognize the cardinal difference and mutual harmonious coherence of the phenomena and patterns that occur in the FRPW and in the CFREU:

1. 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 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 OLT related to CFREU, and the considered here OSCT related to FRPW, in which the mutually proportional evolutionary reduction in the sizes of all objects of the Universe is fundamentally unobservable.

2. Indeed, on the physically homogeneous scale of cosmological time [3-5] 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). 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).

3. 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.

4. 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.

5. Only due to the conservation of the Newtonian of inert free rest energy [2] and the Keplerian [3-5] 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.

References

- [1] Pavlo Danylchenko, Foundations and consequences of Relativistic Gravithermodynamics, Vinnytsia, Ukraine: Nova knyga, 5 (2020).
- [2] Pavlo Danylchenko, Foundations of Relativistic Gravithermodynamics. Vinnytsia, Ukraine: TVORY (2022).
- [3] Pavlo Danylchenko, Solutions of the Standard Differential Equation of the Dynamic Gravitational Field of a Flat Galaxy, Crystal Journal of Physics, 1, Iss. 1, 1-16 (2025).
- [4] Pavlo Danylchenko, Alternatives to the Hamiltonian and Lagrangian, Curr Res Traffic Transport Eng, 4(1), 01-05 (2026).
- [5] Pavlo Danylchenko, Ignoring the Compensation of Gravitational Time Dilation by Inertial Motion of Matter and Other Theoretical Misconceptions and Imaginary Entities in Physics, Astronomy, and Cosmology. Int Nat Sci Int Rese, 1(1), 01-46 (2026).

ORDINARY SYNCHRONIZATION-COMPENSATION TRANSFORMATIONS OF COORDINATE AND TIME INCREMENTS

Pavlo Danylchenko

SPE "GeoSystem", Vinnytsia, Ukraine, pavlo@vingeo.com

The suitability for use in the people's world of only ordinary synchronization-compensation transformations of increments of spatial coordinates and time is substantiated. These transformations, unlike the alternative to them ordinary Lorentz transformations (OLT), allow to proportionally synchronize all clocks that move in a gravitational field by inertia. The suitability of OLT (due to the inherent to OLT blueshift of the frequency of centripetal radiation instead of redshift) for use only in the comoving with expanding Universe frame of references of spatial coordinates and time is proven. The fallacy of ignoring the compensation of gravitational dilation of time by the inertial motion of matter is most thoroughly substantiated. 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.

Keywords: General Relativity, Dynamic Gravitational Field, Time Dilation, Lorentz Transformation, Redshift, Blueshift.

In General Relativity (GR), as in Relativistic Gravithermodynamics (RGTD), astronomical (gravithermodynamic) time is used to describe the motion of matter in a gravitational field. Due to this astronomical 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 frames of reference of spatial coordinates and time (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 [1-3]):

$${}^{ic}v_{l_{cj}} = c(v_{l_{cj}}/v_{l_{ci}})^{(v_{l_{ci}}/c)^2} = c(v_{l_{c0j}}/v_{l_{c0i}})^{(v_{l_{c0i}}/c)^2} = \mathbf{invar} \left[\ln({}^{ic}b_{cj}) = \frac{b_{ci}}{2} \ln \frac{b_{cj}}{b_{ci}} = \ln({}^{ic}b_{c0j}) = \frac{b_{c0i}}{2} \ln \frac{b_{c0j}}{b_{c0i}} = \mathbf{invar} \right].$$

So, this is what prevents the use of OLT in FR of the people's world (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 [3-5] will be as follows:

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

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

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

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

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

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

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

$$\frac{v_{li}}{\sqrt{b}} = \frac{v'_{ij}}{\sqrt{b'}} \left(\frac{v'_{ij} - v'_p}{v'_{ij} + v'_p} \right) = \frac{v'_{ij}}{\sqrt{b'}} \left(\frac{v_{li} + v_k}{v_{li} - v_k} \right), \quad \frac{\hat{v}_{li}}{\sqrt{b}} = \frac{\hat{v}'_{ij}}{\sqrt{b'}} \left(\frac{v_{li} - v_p}{v_{li} + v_p} \right) \quad \text{and} \quad \frac{v'_{ij}}{\sqrt{b'}} = \frac{v_{li}}{\sqrt{b}} \left(\frac{v_{li} - v_k}{v_{li} + v_k} \right) \quad (\text{when: } v_{ly} = 0 \text{ and } v_{lz} = 0);$$

$$\frac{v_l - v_k}{v_l + v_k} = \frac{v'_l - v'_k}{v'_l + v'_k}, \quad dt_k = \frac{dt'_k}{\sqrt{b_k(1 + v_p'^2 v_l'^{-2})}} = \frac{dt'_p}{\sqrt{b_k + v_k^2 c^{-2}}}, \quad dt'_p = \sqrt{b_k(1 + v_k^2 v_l'^{-2})} dt_k = \sqrt{b_k + v_k^2 c^{-2}} dt_k \quad (\text{when: } b'_p = 1, \quad dx = v_k dt_k \text{ and } d\hat{x}' = 0);$$

where: $b = v_l^2 c^{-2}$, $b_c = (v_l^2 + v^2) c^{-2} = b + v^2 c^{-2}$, $v'_{lj} = c(v_{lj} - v_k)/(v_{lj} + v_k)$ (when: $b'_j = 1$ and $b = v_j^2 c^{-2}$), $v'_k = -v'_p = v_k v'_l / v_l = v_k c / v_{lc} = (b v_k^2 + c^{-2})^{-1/2}$; $v'_l = v_l c / v_{lc}$ ($b' = b / b_c$), $v_{lc}^2 = v_l^2 + v_k^2 = c^2$ ($b'_c = b' + v_k^2 c^{-2} = 1$); $d\hat{x}_k = (1 + v_k^2 v_l'^{-2})^{-1/2} d\hat{x}_k \leq d\hat{x}_k$ and $d\hat{x}'_p = (1 + v_p'^2 v_l'^{-2})^{-1/2} d\hat{x}'_p \leq d\hat{x}'_p$ are increments of fundamentally invariable metric segments in space, which has a kinematic "curvature" [2], $d\hat{x}$ 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 in different points of the gravitational field of a body moving with the velocity v_k and in the gravitational field of the observer of its motion.

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 $b_c = b + v_k^2 c^{-2} = b_0 = \text{const}(t, r)$ 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 ordinary synchronization-compensation transformations of increments of spatial coordinates and time (OSCT). In this case, it is precisely

the motion by inertia that actually provides compensation for the gravitational deceleration or acceleration of the rate of flow of time of objects moving in this way in the gravitational field.

Therefore, due to the a priori equality (by any clock) 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 $b \approx b'_c = b'(1 + v_k'^2 v_l'^{-2}) \approx 1$ 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: $\Delta\nu/\nu' = -v_k/c = -z/(1+z) = -H_E r/c \equiv -H_E D_A/c$, $\Delta\lambda/\lambda'_0 = z = H_E R/c = H_E D_M/c$.

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 with 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 of matter in galaxies [1, 2]). 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 [1, 2, 5].

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 CFREU. 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:

$$\nu_L = \nu'_L(dt'/dt) = \nu'_L(1 + v_k/c)\Gamma, \quad \Delta\nu_L/\nu'_L = (\nu_L - \nu'_L)/\nu'_L \approx v_k/c = z/(1+z) = H_E D_A/c, \quad \Delta\lambda_L/\lambda'_0 = -z = -H_E D_M/c.$$

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 is isotropic. Its coordinate anisotropy is inherent only to the intrinsic spaces of matter.

Conclusion

Thus, we should finally recognize the cardinal difference and mutual harmonious coherence of the phenomena and patterns that occur in the FRPW and in the CFREU:

1. 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 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 OLT related to CFREU, and the considered here OSCT related to FRPW, in which the mutually proportional evolutionary reduction in the sizes of all objects of the Universe is fundamentally unobservable.

2. Indeed, on the physically homogeneous scale of cosmological time [3-5] 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). 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).

3. 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.

4. 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.

5. Only due to the conservation of the Newtonian of inert free rest energy [2] and the Keplerian [3-5] 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.

References

- [1] Pavlo Danylchenko, Foundations and consequences of Relativistic Gravithermodynamics, Vinnytsia, Ukraine: Nova knyga, 5 (2020).
- [2] Pavlo Danylchenko, Foundations of Relativistic Gravithermodynamics. Vinnytsia, Ukraine: TVORY (2022).
- [3] Pavlo Danylchenko, Solutions of the Standard Differential Equation of the Dynamic Gravitational Field of a Flat Galaxy, Crystal Journal of Physics, 1, Iss. 1, 1-16 (2025).
- [4] Pavlo Danylchenko, Alternatives to the Hamiltonian and Lagrangian, Curr Res Traffic Transport Eng, 4(1), 01-05 (2026).
- [5] Pavlo Danylchenko, Ignoring the Compensation of Gravitational Time Dilation by Inertial Motion of Matter and Other Theoretical Misconceptions and Imaginary Entities in Physics, Astronomy, and Cosmology. Int Nat Sci Int Rese, 1(1), 01-46 (2026).