THE EVIDENCE OF ABSENCE OF THE ACCELERATING EXPANSION OF THE UNIVERSE

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ABSTRACT. It was shown that Etherington's identity is paralogism. Etherington's identity is based on the imaginary relativistic dilation of intrinsic time of the galaxy by (1+z) times, but the presence of a relativistic anisotropy of luminosity of stars quickly moving away from it is ignored in the frame of reference of spatial coordinates and time (FR) of the observer. Etherington did not take into account the fact that the Universe is homogeneous only in the comoving FR in the expanding Universe, and recklessly made a "mix" of the phenomena and features inherent in two different FRs. It is shown that, according to General Relativity (GR), only the transverse metric distances – the transverse comoving distance and the angular diameter distance similar to it – can obey the Hubble linear dependence. The transverse comoving distance belongs to the comoving FR in the expanding Universe and is determined by the redshift *z* of the emission wavelength. The angular diameter distance belongs to the FR of observer of an expanding Universe and is determined by the redshift of the frequency of the emission wave. The luminosity distance is not the transverse metric distance and therefore its dependence on redshift is nonlinear. It is taken into account that the Hubble constant, like the length standards and the constant of the velocity of light, is a fundamentally unchangeable quantity in the rigid FRs. Its exact value is empirically found.

Key words: dark energy, Etherington's identity, General Relativity, Hubble's law, luminosity distance, redshift.

1. Introduction

Only two known solutions of equations of GR gravitational field can be juxtaposed to expanding Universe. Those are: Schwarzschild solution when the value of cosmological constant is $\Lambda=3H^2/c^2$, which corresponds to the local representation of the process of Universe expansion, and Friedman solution when $\Lambda=0$ ($\Lambda\neq0$ in ΛCDM model), which corresponds to the global representation of the process of Universe expansion.

According to Schwarzschild solution and Einstein hypothesis distant galaxies are falling free on the "event horizon" constantly moving along the geodesic lines of space-time continuum (STC) of their observer. They fundamentally cannot reach that pseudohorizon of the past because it belongs (at any moment of observer's time) to infinitely far cosmological past (in coordinate cosmological time) as well as to infinitely distant objects of the Universe in its background Euclidean space (Zel'dovich&Grishchuk, 1988). And this is, of course, related to the conformity (Penrose, 1968) of these two infinities that are mutually compensated in the gravithermodynamic FR (GT-FR) of Schwarzschild solution (Danylchenko, 2020). Exactly in this background Euclidean space of the Universe, where physical vacuum rests (Danylchenko, 2004), according to Weyl hypothesis (Weyl, 1923; 1930) galaxies perform only small peculiar moves. And standards of length are evolutionally decreasing together with all objects of matter in this space.

Friedman solution due to negligibly small values of average density of mass in the Universe (comparing to $3H^2/4\pi G$) and pressure in the outer space (comparing to $3H^2c^2/4\pi G$) is the special case of the Schwarzschild solution in the background Euclidean space of the Universe: namely in the FR of physical vacuum (Danylchenko, 2004) of identical comoving FR in the expanding Universe (CFREU) when the value of gravitational radius of astronomical object, from which the observation of Universe expansion is performed, is negligibly small. In contrast to Schwarzschild solution that includes pseudohorizon of events in the equations of Friedman solutions (as well as in the equations of Schwarzschild solution in background Euclidean space) event horizon (on which the speed of light is equal to zero) is absent. This denotes the absence of the Hubble radial motion of galaxies and, thus, the absence of relativistic effects in the space of Friedman solution. Galaxies in this space perform only small peculiar moves while distances between them are increasing in this space due to mutually proportional decreasing of the dimensions of both length standards and all material objects in this space. This, of course, requires the constant renormalization of non-normalized spatial parameters to align them with the new values of length standard.

Thus, there fundamentally cannot be any radial motion of objects in Friedman solution because of the absence of singular surface of event horizon in this solution. Therefore, Doppler effect and other relativistic effects related to motion are not applicable for this solution.

2. Imaginary Etherington's Paradigm

Luminosity of astronomical objects of fast moving galaxies is isotropic only in their intrinsic FRs. However, this luminosity is also considered as isotropic in the intrinsic FR of any far observer during the astronomical photometric calculations. Therefore, relativistic transformations of angular coordinates are ignored in those calculations (Danylchenko, 2008; Weisskopf, 1972). Thereby, distances to galaxies are not determined by those calculations in the GT-FR (Danylchenko, 2020), comoving with the matter of observer's planet. They are, in fact, determined in the CFREU. Only in CFREU the luminosity of all galaxies is isotropic and the Universe itself is uniform. However, the imaginary Etherington's identity (Etherington, 1933) for uncorrected luminosity distance D_L and for imaginary value of angular diameter distance ${}^{i}D_A$, that corresponds to it, in the calculations is also taken into account:

$$D_L = {}^{i}D_A(1+z)^2.$$

Etherington's identity is based on the imaginary relativistic dilation of intrinsic time of the galaxy by (1+z) times (Hogg, 2000). That time dilation (inherent to GT-FR) is actually absent in CFREU when using the CTMHS. The primary frequency of radiation of the galaxy is the same as the frequency of identic to it radiation in nearby vicinity of observer in CFREU by CTMHS. That frequency is only progressively decreasing in "ontogenesis" (in the process of propagation of that radiation) together with decreasing of velocity of light in CFREU in accordance with metrically homogeneous scale of cosmological time (CTMHS) (Danylchenko, 2004).

Such imaginary time dilation by (1+z) times takes place in CFREU by physically homogeneous scale of cosmological time (CTFHS). The velocity of light does not change during its propagation when using the CTFHS, in contrast to CTMHS. The frequency of radiation that is lesser by (1+z) times corresponds to "phylogenesis" (to the process of the emission of that radiation). The infinitely far future becomes finite when using the exponential CTFHS.

Thus, we are dealing with the Etherington's paralogism. This paralogism is caused by the mixing of observations in two different FRs – in CFREU and in GT-FR. The Universe is observed in CFREU, as uniform (monotonous), with the single for all its objects cosmological time and without the presence of global relativistic effects. Consequently, the relativistic time dilation on the astronomical objects moving away from each other in the expanding Universe, which is observed in the GT-FR of each of the objects, is imaginary (fictive) for CFREU (and, therefore, for the global perception). The Universe is non-uniform (not monotonous) in GT-FR. And not only relativistic time dilation on far astronomical objects, but also relativistic anisotropy of their luminosity is observed in the GT-FR. That relativistic anisotropy of luminosity was ignored by Etherington in contrast to relativistic time dilation. We go deeper into the cosmological future, the rate of physical processes increases according to CTMHS. That is, for sure, similar to the imaginary increasing of the rate of physical processes while deepening into cosmological past, caused by the use of the exponential scale of the cosmological time (CTES). This CTES is currently used in cosmology. Infinitely far cosmological past imaginarily becomes finite by that CTES.

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The similar imaginary effect of mutually observed time dilation in two inertial FRs (IFRs) takes place in the clocks paradox in Special Relativity (SR). This is due to the fact that events at different points are not simultaneous events in the observer's IFR, although they are simultaneous events in the IFR of the observed moving body. And such resultant time dilation becomes true only for the observer that transits from one IFR to another IFR that moves in opposite direction in order to make re-meeting possible. In the case of mutual observation of time dilation for two distant galaxies that are mutually distancing only in GT-FR and resting in CFREU such difference between these galaxies is absent. That is why time dilation is fictive (seeming) for both distant galaxies.

It is worth to mention, that Lorentz transformations in SR are only the transformations of increments of the coordinates and not of the increments of metrical intervals (segments) (Danylchenko, 2020). That is, apparently, why relativistic dilation of only coordinate time, and not metric time, takes place in distancing galaxies when observations are performed in GT-FR of that galaxies. Intrinsic time dilation in distancing galaxies, which is defined based on the redshift of radiation spectrum, is just the imaginary phenomenon. That time dilation is the similar to such imaginary phenomenon as the movement of the Sun across the earthly sky. And, of course, it is the similar to the phenomenon of Universe expansion in people's world "from nothing" and "into nowhere". That is why relativistic decreasing of the quantity of radiation quanta, which are registered by observer, is determined in its GT-FR by the (z+1) factor, and not by $(z+1)^2$ factor, which is declared by unreliable Etherington's identity.

So, nowadays Etherington's identity is only the imaginary Paradigm. The real astronomic identity should, of course, be taken instead of it:

$$D_L = D_A(1+z)^{3/2}.$$

This identity, in fact, connects the luminosity distance D_L with corrected photometric distance (Schwarzschild radius) in GT-FR $r=D_A$. This corrected photometric distance is used in the Schwarzschild solution of GR gravitational field equations.

According to imaginary Etherington's identity (paralogism) only imaginary (wrong) value of transverse comoving distance to the galaxy is determined nowadays in astronomical photometric calculations:

$${}^{i}D_M = D_L/(1+z).$$

It is $(1+z)^{1/2}$ times smaller than the right (real) value of transverse comoving distance to the galaxy:

$${}^{r}D_M = D_L(1+z)^{-1/2}.$$

And, therefore, it is $(1+z)^{1/2}$ times smaller than the radial coordinate $R={}^{r}D_M$ of the galaxy in Euclidean space of CFREU in the moment of registration of its radiation (Danylchenko, 2004). And it is also $(1+z)^{1/2}$ times bigger that the Schwarzschild radius of the galaxy in GT-FR:

$$r = R_0 = {}^{r}D_A = {}^{i}D_A\sqrt{1+z} = D_L(1+z)^{-3/2}.$$

This radius is equal to radial coordinate R_0 of the galaxy in CFREU in the moment of radiation emission. And, therefore, it is identical to corrected photometric distance to the galaxy in GT-FR and is equal to the right (real) value of angular diameter distance ${}^{r}D_A$. That is because of:

$${}^{r}D_M/{}^{r}D_A = R/r = R/R_0 = 1+z.$$

3. Imaginary Dark energy

Equations of GR gravitational field, in fact, describe the isolated from outer world states of matter and of its STC. Spatial distribution of the mass of matter in those equations specifies how the STC should be curved, while the STC specifies in what spatially inhomogeneous thermodynamic state matter should be.

Consequently, the external gravitational influence on that isolated matter and on its STC is not taken into account in those equations. That external influence can be reflected in the tensor of energy-momentum due to the normalization (calibration) of gravitational constant that is the part of the expression for the Einstein's constant:

$$\kappa = 8\pi\, c^{-2}({}^{u}v_{\cos}^{-2})G,$$

where: ${}^{u}v_{\cos}$ is the coordinate velocity of light in the outer space of Universe, G is the Newton's gravitational constant.

It can be reflected in the tensor of space-time curvature only using the normalization of cosmological Λ-part. That is because in contrast to coordinate velocities of light that are defined by the tensor of energy-momentum:

$$v_{cj} = c\sqrt{1+2z_j}/(1+z_j)$$

the constant of the velocity of light c (which is used in the space-time curvature tensor) cannot be normalized. It is the spatially-temporal invariant.

It is obvious, that the increment of logarithm of Hubble's parameter defined by the Λ-part may be connected by certain proportionality coefficient m with the increment of gravitational potential of outer space:

$$\varphi_{os} = c^2\ln({}^{u}v_{\cos}/c).$$

And, probably, this increment can be also connected by proportionality coefficient n with the increment at the distant point j of GT-FR of gravitational Hubble's potential:

$$\varphi_H = -c^2\ln(v_{cj}/c),$$

$$\frac{d\ln(H/H_0)}{dz} = m\frac{d\varphi_{os}}{dz} = -k\frac{d\varphi_H}{dz}.$$

Then, evolutional change of Hubble's parameter can be defined by the following empirical dependency:

$$H = H_0\left(\frac{v_{cj}}{c}\right)^k = H_0\left(\frac{\sqrt{1+2z}}{1+z}\right)^k.$$

The dependency of the increment of metrical value of comoving distance ${}^{r}D_M$ to distant galaxy in CFREU on the increment of redshift z of radiation spectrum will be the following:

$$\frac{d({}^{r}D_M)}{dz} = \frac{c}{H_0}\left(\frac{1+z}{\sqrt{1+2z}}\right)^k.$$

Dependencies of luminosity distance D_L to supernovas of type Ia on the redshift z of their radiation spectrum have been modeled (Riess et al, 1998; Semiz & Çamlibel, 2015; Dempsey, 2016; Soloviev, 2016) based on the results of astronomical observations of supernovas of type Ia (Perlmutter et al, 1999; Riess et al, 1998). According to graphs of that dependencies (q.v. Fig.) evolutionary change of Hubble's parameter is almost not observed (k=0). That is because in case we use the most suitable values of Hubble constant the values of luminosity distance ${}^{g}D_L$ shown on graphs (q.v. Table) are very slightly different from their calculated values:

$$D_L = {}^{r}D_M\sqrt{1+z} = (c/H)z\sqrt{1+z}.$$

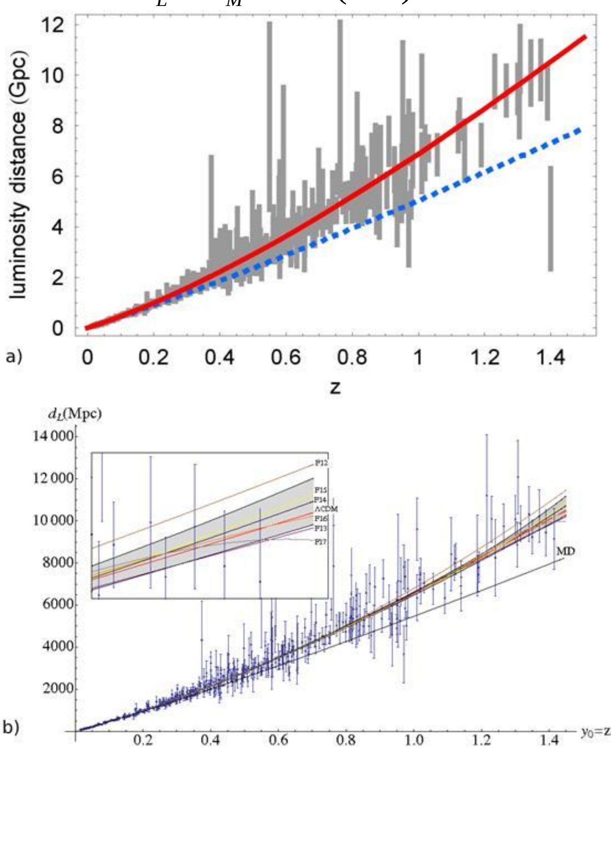

Figure: Dependencies of distances to astronomical objects on the redshift of radiation of astronomical objects z:

a) luminosity distance D_L (red solid line) to those objects (Soloviev, 2016) and metrical transverse comoving distance ${}^rD_M$ (blue dotted line) to astronomical objects in CFREU, as it is justified here;

b) graphical MD (straight) and ΛCDM (curve) models, and the one-sigma confidence-levels. The inset shows the right end, magnified (Semiz & Çamlibel, 2015).

Table: Dependencies of distances to astronomical objects on the redshift at different values of H [$km/sMpc$].

H	D, Gpc	z						
		0,2	0,4	0,6	0,8	1,0	1,2	1,4
62,164	${}^r\boldsymbol{D_M}$	0,96	1,93	2,89	3,86	4,82	5,79	6,75
	${}^r\boldsymbol{D_A}$	0,80	1,38	1,81	2,14	2,41	2,63	2,81
	$\boldsymbol{D_L}$	1,06	2,28	3,66	5,18	6,82	8,58	10,5
62,295	${}^r\boldsymbol{D_M}$	0,96	1,92	2,89	3,85	4,81	5,77	6,74
	${}^r\boldsymbol{D_A}$	0,80	1,37	1,80	2,14	2,41	2,62	2,81
	$\boldsymbol{D_L}$	1,05	2,28	3,65	5,17	6,81	8,57	10,4
	a) ${}^g\boldsymbol{D_L}$	1,03	2,25	3,65	5,2	6,9	8,65	10,5
65	${}^r\boldsymbol{D_M}$	0,93	1,85	2,77	3,69	4,62	5,54	6,46
	${}^r\boldsymbol{D_A}$	0,77	1,33	1,73	2,05	2,31	2,52	2,69
	$\boldsymbol{D_L}$	1,01	2,18	3,50	4,95	6,52	8,21	10,0
	b) ${}^g\boldsymbol{D_L}$	1,00	2,16	3,50	4,95 -5,0	6,4-6,8	8,2-8,8	9,9-11,0

Thus, teams of astronomers leaded by Perlmutter and Riess indeed confirmed (with high precision) the linearity of the dependence of redshift of radiation wavelength of distant galaxies on transverse commoving distance to them. And this their achievement is not at all less than attributed to them "discovery" (in reality – false one) of accelerated expansion of the Universe.

It is taken into account that the Hubble constant, like the length standards and the constant of the velocity of light, is a fundamentally unchangeable quantity in the rigid FRs. And this follows from the condition of continuity of spatial continuum in rigid FRs. (Danylchenko, 1994). The most corresponding to astronomical observations value of Hubble constant is the value determined by the following empiric dependencies of it on the well known physical constants and characteristics:

$$H=c\sqrt{\Lambda/3}=\frac{\pi^4\alpha}{8N_{Dn}}\nu_{Bn}=\frac{2}{3}\pi\alpha\; t_p^2\left(\frac{\pi}{2}\nu_{Bn}\right)^3=\frac{2}{3}\pi Ge^2\left(\frac{m_n}{4\eta}\right)^3=$$
$$=2{,}018859\cdot10^{-18}[s^{-1}]=62{,}29548\left[km(sMpc)^{-1}\right],$$

where: Λ is the cosmological constant, N_{Dn}=1,5$(t_p\nu_{Bn})^2$= $3\pi chm_n^{-2}/G$=0,999885•10^{40} is the neutron large Dirac number, $\alpha=e^2/c\hbar$ is the fine structure constant, $\nu_{Bn}=m_nc^2/2\pi\hbar$ is the de Broglie wave frequency of the neutron, $t_p=(c^5\hbar G)^{1/2}$ the Planck time, $\hbar=h/2\boldsymbol{\pi}$ is the Dirac-Planck constant, e is the electric charge of the proton and electron, m_n is the mass of neutron.

However, the value of Hubble constant $H=(\pi^4\alpha/8N_{DH})\nu_{BH}$=62,16420 [$km/sMpc$] (Λ=1,35457·$10^{-52}$ [m^{-2}]), that corresponds to the de Broglie wave frequency of hydrogen atom $\nu_{BH}=m_Hc^2/2\pi\hbar$=2,270262·$10^{23}$ [s^{-1}] (m_H=1,67375·10^{-27} [kg], N_{DH}=1,5$(t_p\nu_{BH})^{-2}$=1,001292·10^{40}), only for small distances guarantees slightly worse correspondence to the data of graphical extrapolation of the results of astronomical observations. It is possible that Hubble constant took "hydrogen" value only after spontaneous transformation of quark or neutron medium of the Universe into hydrogen medium. However, of course, it was impossible before that to metrically characterize its continuous protomatter and, therefore, it is senseless to characterize it by "neutron" Hubble constant. Therefore, the final choice of one of these two close values of Hubble constant can be done based on the more precise results of astronomical observations.

It is obvious that supposed need in the presence of dark energy in The Universe is based not only on the taking into account the imaginary (fictive) dilation of the time on distant astronomical objects (postulated by Etherington's identity), but also on the wish to have the linear dependence of redshift of radiation spectrum z on luminosity distance D_L to those objects. In fact, according to GR (Danylchenko, 2004; 2008) the redshift is linearly dependent only on the transverse comoving distance D_M:

$$z=\Delta\lambda_D/\lambda_0=HR/c=HD_M/c$$

and on the angular diameter distance:

$$\hat{z}=\Delta\nu_D/\nu_0=-z/(1+z)=-Hr/c=-HD_A/c.$$

Moreover, the supposed dark energy could not be a certain physical entity at all. It could be just the effect of ubiquitous negative feedback. The deceleration of evolutionary self-contraction of matter in CFREU could take place in the distant past due to the presence of this negative feedback. Thus, evolutionary decrease of the velocity of light in CFREU using CTMHS in the distant past would also be decelerated. This deceleration, of the outer space course, could have been the greater the smaller the coordinate velocity of light ${}^u v_{cos}$ in the outer space in GT-FR had been in distant past.

However, it is quite probable that Hubble's parameter is indeed unchangeable in time, as we had to make sure of it here. It even can be a spatially-temporal invariant alike the proper value of the velocity of light. The value of Hubble's constant can be precised after the more accurate processing of results of astronomical observations.

4. Conclusions

The Hubble constant is a fundamentally unchangeable quantity similar to the length standard and to the constant of the velocity of light. Therefore, the law, discovered by Hubble, is immutable. The dark energy and the Etherington's identity are paralogisms.

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