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True photon mileage, actual intergalactic distances and the accelerating universe hypothesis

I. In search of new interpretations

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ABSTRACT

Context. On the basis of the conclusions selectively gleaned from the history of ontological thought, it was assumed that the real geometry of the space of the Universe is the geometry of topologically fixed 3-dimensional hyper sphere.
Aims. It claims that the understanding of metaphysical principles of space formation is important, resulting in the simplest mathematical approach to the calculation of actual astronomical distances.
Methods. The comparisons of calculated lengths of trajectories of photons with the actual intergalactic distances reported by observers for different z-values are carried out using the selected assumptions. Photon mileage $L_f = f(L_z, R_D)$ don't equal to the astronomical distance L_z detected by z value if R_D is the discrete quantum length of one of 4 space dimensions, associated with the curvature of space as a whole.
Results. The research concludes there is a good agreement between data obtained this way for star brightness with experimental data, when we speak about the hypothesis presupposing an accelerating growth of the Universe and abnormal brightness of supernovae; besides conclusions imply that adjustments to this hypothesis forward in the search of the values of brightness attenuation undetectable by today's tools are needed, otherwise, it could be talk about a possible expansion of our Universe in our era without accelerating.
Conclusions.

Key words. methods: analytical – stars: distances – galaxies: distances and redshifts – cosmology: distance scale – cosmology: theory

1. Introduction

In this article, we will call metaphysics in the Aristotelian tradition any movement of thought and all ways of reasoning about Nature in the direction from the General to the particular/specific, from causes to consequences, from unity to diversity, largely based on logical deduction (Aristotle (322 BC)). Also metaphysics will be considered the very development of the early universe, duplicated in a reasoning reflecting this development. And it should be emphasized that the widespread traditional people's understanding the metaphysics as part of classical Philosophy is not valid on the proposed pages. To sum up, we call metaphysical cosmology or M-cosmology the science of the earliest epochs of the universe formation, which are not yet amenable to direct physical research and available methods of hypothesis testing.

Similarly, physics will be called methods of revealing the truth about Nature, mainly based on induction as a natural movement of thought from the particular/specific to the General, from the consequences to the causes, through the construction of hypotheses that require deductive reasoning only at a later stage. A similar division of sciences is actively supported by Leonard Susskind (2005), and we believe that it is entitled to a permanent spot in the categorical system of cosmology.

As a starting point, we use the following reasoning. If the physics of the universe are objectively has in different from zero quantity fundamental rows with absolute character, and the universe itself does not exist in an experimenter's matrix, the standard cosmology of the Universe we can oppose (of course, purely categorically) some true M-cosmology.. Conversely, if the physics is based on certain conventions of unnatural and purely relative sort, it makes no sense to search for the Theory of Everything, because such a theory should then become the theory of the Matrix, and not the Theory of Everything. Thus, the question of the existence of M-cosmology of our Universe acquires both fundamental ontological and fundamental-theoretical significance.

Thus, if the fundamentals of Physics objectively exist starting from a purely atomic absolute level and can be sooner or later discovered in direct scientific search using logical induction and provable hypotheses, that are inherent in Physics, it should be unambiguously expressed in favor of the existence of the opposite path to finding the foundations. In this case, if the movement of thought to the truth about the movements of the developing Universe is not a purely logical error, then M-cosmology will be able to build the Foundation of physics of space, combined with some primary laws. The construction of the scientific Foundation, instead of its detection in a sequence of hypotheses, will be a confirmation of the usefulness of the way proposed by Aristotle, Hegel (1812) and others. First, we should construct the

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M-cosmological model of our universe. Second, testing the result according to the same rules as accepted for hypotheses and any theory will complete the verification of the proofs of M-cosmology and put an end to some prejudices of modern science against deductive method.

To a certain extent, M-model established in this way can also be considered as a tool for testing fundamental theories. If a hypothetically established theory cannot be constructed metaphysically, it is likely to be wrong. And there is no better way to definitively test our understanding of the functioning, organizational laws, and geometric shape of the space of the universe than to construct a good metaphysical model. Thus, astronomy and astrophysics of the third Millennium in some sense will have to resort to testing some of their ideas using the methods of related disciplines. In fact, the M-cosmological model as a fruit of abstract thinking can be erroneous (but, for example, the hypothesis will be true), and then it must be replaced by another, but not discarded as unnecessary.

2. Aims. New tests for the falsifiability of the accelerating universe theory are needed.

Based on the installations stated above, it made sense to look for a new path to the main sources of physics' laws, and, in case of failure, to conclude about the possible unnatural origin of objects being studied. In the opposite case of the failure, on the contrary, it would be possible to proceed to the completion of the Theory of Everything, which is understood to mean the set of main, fundamental laws of the universe, each having an independent value. The Theory of Everything on this basis is not all the theoretical physics, but only its fundamental part, coinciding in form with metaphysics or with traditional physics, depending on the internal language used. And part of that theory would be a complete picture of the periods and the causes of the deceleration or accelerating expansion of the Universe.

To sum up, it should be stated that in the universes where M-cosmology actually exists, the Theory of Everything in the proposed narrow sense will also exist. Conversely, in other types of universes where M-cosmology does not exist, the Theory of Everything is a successful but unverifiable hypothesis. In both case, however, we need to use a well-proven model of the universe's space of almost ToE level to get the right to declare that our hypothesis about the features of the developing space is awarded the status of a proven science.

The main point goal of the article today will be to find a model of the space formation and organization, which can be endowed with quality to become a good test of falsifiability of the hypothesis of the acceleration of the Universe, because a reliable verification test is not yet known to us. This finding will not only establish the scientific status of this hypothesis, showing directions for possible criticism, but also allow it to strengthen after the successful refutation of the verification M-model with the help of new facts and new conclusions in favor of the hypothesis.

3. Selected ontological foundations and their utility for our aims

This work uses the experience of constructing and testing such M-cosmological model both at its first constructive stage and at the stage of choosing the correct metaphysical representation of space. We will use ideas from the paper of Argazi (2001) being devoted to the Genesis and extinction of matter in a growing and physically discrete space. Eventually we will also try to apply them in purely utilitarian cosmological purposes. We will use only the conclusions that are most appropriate to the topic. It should be noted, however, that the results of their verification, which seem to be interesting and successful, were presented in the book of Argazi (2016), and this is an additional justification for combining those conclusions of its RM-theory (or Reflective Metaphysics) with the subject of the article. For simplicity, we will use in the calculations for our universe as its parameters the quantities taken from the list proposed by Argazi.

We will only be interested in representating the geometry of the Universe as the geometry of an ideal 3-dimensional hyper sphere (3-sphere). The theory also states that the laws of shape topology and the laws of expansion of the Universe in the first approximation (this is important) do not depend on its mass and energy density and roughly correspond to the laws for empty space. But the universe can definitely have some periods of acceleration and deceleration in its life caused by factors not directly related to the dark energy density.

It should be stressed that the results and conclusions are given mainly for informative purposes, and are not directly related to the essence of the mathematical approach that is used to refine our data on space distances in discrete 4D space. Looking appreciatively, their possible importance for astrophysical estimations can lie in the field of completing the full list of necessary evidence and foundations (or rejected evidence and foundations). Moreover, being the primary matter of reasoning, they do not correspond to the language of advanced astronomy or astrophysics.

The temptation to bind the validity of the proposed method of taking into account the geometry of space in the calculations of space distances to the validity of the theory leading to the conclusion about the ideal spherical shape of space should be categorically avoided. It is very important to keep in mind further that we will only be interested in taking into account the behavior of the photon within the framework of the hypothesis of the ideality of the 3-sphere of quantized space, and will not be interested in proving a completely side theory that historically served as an impetus to the main idea.

And our hypothesis today: the space of the universe as a whole is an ideal 3-dimensional hyper sphere, three dimensions of which are discrete and equal to each other in their quantum length. The development of any photon motion in such a space is, in the general case and at any moment, the sum of the leap-frogging displacements along each of the dimensions, and not the diagonal displacement within a certain parametric cube. We will check how this hypothesis corresponds to the available astrophysical data on the attenuation of supernovae luminosity with distance.

We are not at all interested in the evaluation of the RM-theory itself. Nevertheless, we bring its results and selected conclusions to the attention of the most critically-minded professionals with a keen interest in details.

Results of the verification of RM-theory:

- $R_D = 22.6973485 \times 10^9$.....length of each space Dimension, light-years,
- $R_{W4} = 45.3946970 \times 10^9$.....radius of Universe, light-years,
- $\rho_{W4} = 9.296607 \times 10^{27}$.....average density of Universe, kg/m^3,
- ρ_M:ρ_{DM}:ρ_{DE}=4.8952 : 25.8619 : 69.2429.....ordinary matter / dark matter / dark energy ratio,
- $\alpha^{-1} = 137.035999090084835866 8698\ldots$ fine-structure constant,

- $H = 72447.973\ldots$ Hubble constant, km/s/Mpc,
- $v_h = 3.36338\ldots$ growth rate of the radius of Universe, c.

A part of cosmologically-beneficial conclusions of RM-theory:

1. Space is orthonormally discrete (quantized) in each of its dimensions.
2. The space of the universe in the rank of "everything" does not change its size with its development, but increases the quantization parameter as a measure of the discreteness and quantum saturation of the volume. It is impossible to speak about space expansion, but it is necessary to speak about the crushing of the object constant in sizes.
3. As a result of the discretisation of the space and the matter, the space of the universe passes from the state of the physical nothing to the state of the physical vacuum, which should be called the quantized state of the primary nothing-substance.
4. The amount of the substance remains unchanged, which, as a consequence, provides the Universe with all kinds of conservation laws.
5. The quantum scale factor of the modern Universe's space maintains in direct proportion to time, when the ordinary (wave) scale factor $a(t)$ maintains in usual proportion: $a(t) \propto t^{\frac{2}{3}}$.
6. The form of time-space modus is studied in the separate theory of time. In short, one cycle of early space development consists of 4 different temporal modi, each representing an instantaneous three-dimensional state of the universe. Geometrically each modus-sector represents a cylinder, however, when accounting for the pairwise interaction of sectors in each such case we should talk about spaces of toroidal form as the geometric multiplications of the coordinate circles in the 4-dimensional space.
7. The quantum volume of each individual torus differs from its volume in Euclidean geometry by the absence of the factor π. Thus, due to the specificity of the model, its space can be represented as the sum of two congruent volumes bounded by Clifford tori with Euclidean surface of each of them equal to $2\pi^2 R^2$ but discrete surface of each of them equal to r^2 (if $R^2 = 2r^2$). The radius r of the torus generatrix is equal to the parametric quantum length of each of the 5 vectors-dimensions of the four-modus 3-dimensional time-space.
8. Thus, as the sum of two congruent 2-tori which are laid in the space towards one another, like the external space towards inner space of the body, we have the case of the space characterized by topology and shape of the three-dimensional hyper sphere (or 3-sphere) with radius of $R = \sqrt{2}r$. But we have 4 modi of time-space and therefore it is possible to talk about a kind of alternation of two types of 3-spheres of time-space in each cycle of space transformation, or of two local "branes" (positive and negative).

In order to develop the proposed vision in the direction closer to the topic stated in the article, we will add the list of the next worth-mentioning necessary points:

- Each of the two 3-spheres is equipped with a set of r pairs of 2-tori, since r is the quantization parameter of space, and each instantaneous state of the universe can be considered as a superposition of two 3-spheres of the opposite sign. Those spheres are composed by, as the flat space in a layering by planes, a set of non-intersecting 2-tori.
- Conclusions about the number of modi and spheres in the space of the model universe we omit as insignificant for our purposes. We will be satisfied with the conclusion (hypothesis in our case) about the hypersphericity of this space, as well as the hypothesis of the independence of three discrete dimensions of the 3-sphere from each other in their interaction with the photon choosing the direction of motion.
- The integral geometry of universe's space depends in no way on its material density. This is because this density in the model is always equal to the critical density, and the geometry of the space, invariably hyper-spherical, is determined by other factors and is in no way related to the global slowdown or speedup of growth. The cosmological constant from Einstein's equations (Einstein (1918); Riess (1998) at al.), of cause in the first approximation case, corresponds to the constant growth of the quantization parameter of space and matter as a result of the constancy of the action of metaphysical Time. The action of Einstein's General relativity laws extends to arbitrarily large local areas of the universe, but not the universe as a whole.
- We talk about the independence of the geometry of the universe as a whole from the density parameters, and at any distances smaller than the whole scale, the laws and dependencies of Einstein's General relativity come into effect. The influence of the general geometry of the universe to the trajectory of photon will be superimposed on the gravitational dependence.
- It is the temporal nature of the separating boundaries in the process of the quantization of the substance that naturally leads to the single-modus' three-dimensionality of time-space. Physical space is endowed with a kind of instantaneous three-dimensionality due to the three-dimensionality of the time generating it. Hyper-spherical roundness of the spatial form is the "cost" of the 4-tiered complexity of the metaphysical space, and not the result of a possession of a certain energy density.
- So, we place the universe with all its quanta on the surface of three-dimensional spheres located in two four-dimensional spaces, that is, in a certain five-dimensionality. This five-dimensionality, however, can be simplified to four-dimensionality, if we assign a sign to each of the two superpositioning spheres in the in the Argazi model. This conclusion allows us to unambiguously imagine the space of the universe as a whole, though peculiar, hyper sphere.
- Space operates four temporal 3-dimensional modi and eventually becomes 4-dimensional.
- At the same time, taking into account that the quantum Genesis occurs at every moment, while the time itself as the duration becomes discrete, and the generated quanta are evenly distributed throughout the space, we have no way to get a dedicated coordinate system tied to any, even one of the three, "direction" of "3-time". We are faced with the chaos of 2-tori twinkling in time, constantly changing their locations, and only within one stopped moment can we see the order in which it is possible to choose any pair of tori as a dedicated coordinate system.

4. Selected mathematical foundations for the determination of long cosmic distances and the photon mileage

Any 3-sphere can be divided into two congruent toroidal parts by a surface of a 2-torus, and we have the case of two kinds of such tori of different orientation in Argazi model, each corresponding to a different cross-section of the "snapshot" of the 4-modus space. The area of the plane square sweep of the Clifford torus in quantum terms is $0.5R^2$, if $R = \sqrt{2}r$ is the radius of the 3-sphere inscribing 2-tori.

The Euclidean surface area of the same sweep does not correspond to our representation, as we know from the geometry. However, a quantum surface area of the 2-torus is easily obtained from the Euclidean ($2\pi^2 R^2$) by dividing by $4\pi^2$, as each of the circumferences of the torus as a member of the geometric multiplication is devoid multiplier 2π in the sense of its quantum length:

$$S_{q_{2T}} = \frac{S_{2T}}{4\pi^2} = 0,5R^2 = r^2 \quad (1)$$

where r corresponds to the radii of the equal multiplied circles of the 2-torus representing the coordinate axes in the metaphysics of the 4-modus time-space, as well as to the quantization parameter of both the circle and the universe itself, that is, r corresponds to the discrete size of any of its coordinate axes.

Clifford tori are flat figures of a 4-dimensional space, and we can match them in this respect to planes of a 3-dimensional Euclidean space. Let us choose any pair of such 2-tori, ideally inscribed within a certain 3-sphere as congruent figures, as two orthogonal coordinate planes of a 4-dimensional space containing a 3-sphere. Similar to our ideas about the 3-dimensional case in such a 4-space two points can be spaced at a distance determined by Pythagorean Theorem (if the plane dimensions are orthonormal) as $\sqrt{2}r$, if r is a distance that a point body can only run along one of the planes. (Here we do not take into account the second dimension of each plane, because for any rectilinear motion of a point or photon, we can always choose the location of a pair of tori within a 3-sphere, so that the movement becomes normal towards this dimension.)

However, in quantized space, diagonal motion inside any cube or square is impossible. The test point, or photon, can only move along edges of the cube (sides of the square in the "matched" case of special choosing), making two "short" movements instead of one diagonal. Thus, if the space is discrete, then there is a decrease in the speed of the photon by another $\sqrt{2}$ times, and the distance visible to the photon, which it can overcome between the points maximally spaced in the 3-sphere, becomes equal to $2r$ if r is a discrete size of one dimension.

It can be noted that the known relationship between the radius of the Clifford torus r and the radius of the 3-sphere $R = \sqrt{2}r$, due to a quasi-accidental reason are better than anything suited for placing the discrete natural space of the universe into a 3-sphere. In view of the features of the quantized (separated by discrete moments of events) motion, one necessary separation of the most distant point objects of the sphere at the distance of $2r$ requires a radius R equal to exactly $\sqrt{2}r$ in this case. We should assume meanwhile that the Meridian of the 3-sphere also has a discrete non-Euclidean length R, since the 4-modus time-space does not take into account the difference in quantization of the lengths of circles and their radii, which in the Euclidean case lies in using the factor π.

Since two geometric points of two galaxies separated by a maximum distance can be separated by the distance along the shortest path lying on the minimum surface with the area of r^2, this trajectory in the 4-dimensional space will lie on the surface of a Clifford torus. However, the photon does not move along such an ideal trajectory of a specially selected 2-torus (which does not exist in Nature), but mixes in its motion along a straight (geodesic) line two different movements, and this process requires more time.

Having imagined the sweeps of orthogonal tori (2-tori of one pair, mutually external to each other inside one 3-sphere) with the sides r of the square $0,5R^2 = r^2$ in both cases, in the form of two flat surfaces of three-dimensional Euclidean space, we can understand how the motion of a photon replaces the ideal. Since according to the Pythagorean Theorem photon has the ability to fly between galaxies some shortest distance equal to $\sqrt{2}r$, it means the greater separating distances than decorated with such two planes do not exist in the visible Euclidean space of the universe. The observer receives a signal transmitted only by the photons that have accidentally passed the necessary "straight" distance in the 3-sphere. The distance is determined by this theorem and the rules of discrete movement. Meanwhile, other photons get past a detector. In other words, in the space of the universe it is always possible to find two points separated by such planes, or, conversely, to find two thus located planes that separate the most distant points and set the length of the minimum trajectory of the "conventionally rectilinear" motion of the photon.

Tori of different signs, alternating in time of one 4-cycle, are themselves the space offered to photon for movement. The photon has to move in one direction and in another, that is, along the hypotenuse of the triangle. However, not in 3-dimensional Euclidean, but in 4-dimensional discrete space the photon will not move along the nonexistent quantum diagonal R_{WE}, but along the legs of a triangle on the surface of the 3-sphere, alternating directions, and will make a path R_{W4} equal to $2r$, not to $\sqrt{2}r$, if we are talking about the full size of the universe and maximum distances.

$$R_{W4} = \sqrt{2}R_{WE} = 2r_{WT} = 2Q_W \quad (2)$$

$$R_{W4} = T_W H_e \quad (3)$$

where Q_w is the quantization parameter, or the discrete size of each dimension of the space associated directly with the age of the universe equal to T_W and with the epoch-averaged Hubble constant H_e, related to the radius R_{W4} as a visible, seeming size of the universe.

Thus, although the 3-sphere offers the inscribed 2-torus space, limited in the Euclidean sense only by $\sqrt{2}$ times longer radius, distant galaxies in such a space can be located at a distance of 2 times greater than that which corresponds to the radius of the Clifford torus and the discrete capacity of each axis of time-space dimensions.

We are faced with a kind of hidden twisting of the photon trajectory into a spiral. By combining the direction to the galaxy with the diagonal of a three-dimensional coordinate cube, we obtain projections on its edges, corresponding in their discrete length to Euclidean representations, but the cost of time to overcome such distances will be different from typical times, just as the length of the arcs differs from the length of the chords, linking the same points of the circle. If we imagine that two galaxies of a 4-dimensional ball, circumscribed by a 3-sphere, are separated by the shortest distance (chord) but a photon can move only by the shortest distances on the surface of a 3-sphere, then the diagonal of the metric tensor of its motion, written for a 4-dimensional Euclidean space as

$$1, 1, 1, 1[for X, Y, Z, R; R = H_e T_W], \quad (4)$$

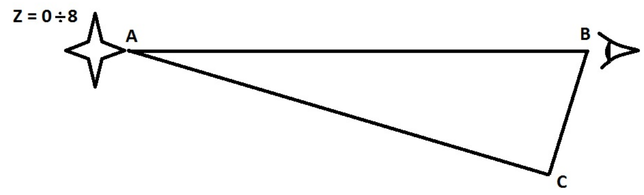

Fig. 1. Right-angled Parametric triangle: a distance between galaxies and a real photon's mileage in a steady universe. The length of the photon trajectory AC + CB is longer than the distance between galaxies AB.

for the three-dimensional space of the sphere is written as

$$1 + \frac{x}{R_x}, 1 + \frac{y}{R_y}, 1 + \frac{z}{R_z}, \tag{5}$$

and

$$s^2 = (x(1 + \frac{x}{R_x}))^2 + (y(1 + \frac{y}{R_y}))^2 + (z(1 + \frac{z}{R_z}))^2 \tag{6}$$

since $\frac{1}{R_{W4}} = \frac{1}{2R_i} = \frac{1}{2r}$, where R_i and r are respectively the discrete length of each dimension and the quantization parameter of a space, and the values of x, y and z in an orthonormal system with the diagonal of the cube as the direction to the galaxy cannot each exceed the values of $\frac{R_{W4}}{\sqrt{3}}$. In this case, x_i in the expression (4) would correspond, in the 4-dimensional case, to the true values of the quantization parameter Q of the universe on each axis (or its part equal to the value of $\frac{x_i}{R_i}$), and x, y and z in the expression (6) for the 3-sphere would require recalculation with a factor of $\frac{2}{\sqrt{3}}$:

$$Q_i = \frac{\sqrt{3}}{2} x_i \tag{7}$$

Comparing with the usual 3-metric with the diagonal of the tensor as (1,1,1), we see that the farther galaxies are spaced in the space, the greater the additional contribution to the separating distance is made by the astronomical warp of space associated with the cosmological curvature which is independent of the density of matter. We took this fact into account in a simple proportion based on the assumption that at the maximum distance in the 3-sphere opposite galaxies will be separated by the distance, or photon mileage, doubled with respect to the discrete length of any space dimension and the universe quantization parameter ($R_{W4} = 2R_i = 2Q_W$), although, at smaller distances, we mistakenly believe they will be separated by the hypotenuse of the parametric triangle in the Figure 1. As the universe expands, the triangle will grow, but the aspect ratio will not change and the accuracy of calculations will not suffer.

Thus, determining the distance to the star by indirect methods, that is, by the time of radiation arrival, it should be taken into account that in fact the star at the time moment called "now" is at a distance L_0 from us (we are talking about a static space with 3-dimensional Euclidean geometry) which is $f(1 + \frac{2L_0}{R_W})$ times smaller. In this embodiment of the metaphysics (as stated by Argazi (2016)) the value of R_{W4} ($R_{W4} = 45.394697 \times 10e^9$ light-years) is known with a precision of eight significant figures, so the calculation does not represent complexity.

We should understand the distance L_0 as an Euclidean diagonal of the parametric triangle and the radius of the conventional 2-sphere of a radiation scattering with the center in the source galaxy at the time of receiving the radiation by the observer. Together with this diagonal, which represents in the vector sum of 3-space the motion along the Euclidean straight line, we calculate the quantum diagonal L_g of this motion, which is equal to the sum of the legs (L_k and $L_k \frac{2L_k}{R_{W4}}$) situated on the surfaces of two 2-tori of the 4-coordinate system. The distance

$$L_g = L_k(1 + \frac{2L_k}{R_{W4}}) \tag{8}$$

we must understand as the real path taken by the photon in accordance with the cosmological curvature. The mileage L_g in the most exact case should include additional terms associated with the loss of time during lensing or interacting with dust, which, if necessary, will need adjustments to the calculations. The path (8) of L_g will be different from the path (9) of L_h calculated by the rules of Euclidean geometry:

$$L_h{}^2 = (L_g - L_k)^2 + L_k{}^2, \tag{9}$$

and

$$k_w = L_h / L_g, \tag{10}$$

where k_w is the attenuation coefficient for the brightness of a galaxy or a supernova on the scattering sphere as a result of the lag photons effect on the stretching trajectory, and L_k and $L_g - L_k$ are two legs of the Euclidean triangle.

Thus, it should be taken into account that if the parameters of the quadratic attenuation of the signal on the 2-sphere, with the correct recalculation, only depend on the radius L_h of this 2-sphere, the contribution of the photons' lag to this weakening on the trajectory stretching during the motion will depend linearly on the ratio of the radii L_g and L_h. The radius L_g, in turn, experiences relative growth with the growth of the primary leg L_k according to the expression (8). Therefore, this suggests the need to take this factor into account when choosing hypotheses about the acceleration of the spatial growth of the universe: its contribution acts during calculations sense like the apparent acceleration (distant signals are disproportionately weaken).

In the metric of our quasi-Hilbert space, the component $\frac{2}{R_{W4}}$ will correspond to the twisting index, that the trajectory reaches on a limited area of the photon motion (the full rotation is a case when the spiral of this motion covers the distance of the maximum distancing of galaxies in the 3-sphere, equal to R_{W4} which is the apparent radius of the universe with the size $r = \sqrt{2}R$. It is obvious that the photon cannot move only on some two fixed 2-torus (with radii r) of 4-space (with radius R), but will fall on the surfaces of random ones encountered on the way. However, the total number of quantum steps of motion between the galaxies in case of the photon, which accidentally reached the observer, will be equal to determined as if the photon was moving in a strict coordinate system, represented by two fixed 2-tori inscribed in the 3-sphere, swelling over time in proportion to the growth of the universe. The likewise calculated length of the photon trajectory corresponds to a kind of idealized quantum capacity of a given line segment in a given space. The path of a photon from any star includes an extra factor depending on both the distance shown by the Euclidean system and the value of R_{W4}.

We'll give examples of calculations. The aim will be to determine the radius of the scattering sphere with the center in the radiating star at the time of reception of the signal by the Earth observer and then to compare the results obtained by the rules of Euclidean and quantum geometries. In the latter case, this radius will be equal to the sum of the legs of the triangle, the diagonal of which is determined in Euclidean geometry by the Pythagorean Theorem. The scattering coefficient of the light power on the sphere will directly depend on the Euclidean radius, while the delay of photons on the lengthening trajectory will depend on the quantum one.

To calculate the distance and the travel time of the photon moving in the expanding universe, we use the following expressions:

$$\frac{\partial l}{\partial t} = \frac{c}{a_Q(t)} = \frac{c}{c + \frac{v}{c}dt} = [if w = \frac{v}{c}; c = 1] = \frac{1}{1 + wdt} \qquad (11)$$

$$k_L = \frac{L_1}{L_0} = e^{\frac{v}{c}} \qquad (12)$$

$$k_T = \frac{T_L}{L_0} = e^{\frac{v}{c}} - 1, \qquad (13)$$

where v is the the linear growth rate of of the distance between galaxies, k_L is the space growth factor by the passage of light of the primary distance L_0 during time T_L, k_T is the time-consuming factor, and $a_Q(t) = a(t)^{\frac{3}{2}}$ is a quantum scale factor (when ordinary scale factor $a(t) \propto t^{\frac{3}{2}}$).

5. Results. A sequence of expressions for calculating the true photon mileage and the brightness reduction for distant stars and galaxies

We provide a simple illustrative example of a standard calculation as well as a summary table for different redshift values.

Given: $z = 0.1$; $R_{W4} = 45.3947 \times 10^9$ light-years; H = 72.448 km/s/Mpc; $c = 299792.458$ km/s; $v_H = 3.36338$ c; $T_W = 13.49675 \times 10^9$ years (the notional age of the universe without regard to acceleration/deceleration periods).

1. $N = z + 1 = 1.1\ldots$ index of broadening of the wave.
2. $K_N = N^{\frac{3}{2}} = 1.15369\ldots$ growth index of the universe's radius.
3. $R_0 = \frac{R_{W4}}{K_N} = 39.3474 \times 10^9\ldots$ starting size of the universe, light-years.
4. $r_W = R_{W4} - R_0 = 6.0473 \times 10^9\ldots$ increasing the universe's radius, light-years.
5. $T_f = \frac{r_W}{v_H} = 1.79798 \times 10^9\ldots$ travel time of the photon by red shift, years.
6. $v_t = \frac{v_N}{c} = \ln K_N = [\text{from (12)}] = 0.14296\ldots$ relative growth rate of the photon trajectory.
7. $r_0 = R_0 \frac{vt}{vH} = 1.67251 \times 10^9\ldots$ starting length of the future photon trajectory, light-years.
8. $r_{gf} = K_N r_{0f} = 1.92956 \times 10^9\ldots$ finish-length (hyper radius of the scattering sphere).
9. $L_{k1}(1 + 2\frac{L_{k1}}{R_{w4}}) = r_{gf}$; $L_{k1} = 1.78861 \times 10^9\ldots$ primary leg; from the quadratic equation, light-years.
10. $L_{k2} = r_{gf} - L_{k1} = 0.14094 \times 10^9\ldots$ secondary offset leg, light-years.
11. $r_{hf} = \sqrt{L_{k_1}^2 + L_{k2}^2} = 1.79416 \times 10^9\ldots$ radius of the scattering sphere (Euclidean hypotenuse), light-years.
12. $k_w = \frac{P_{gf}}{P_{hf}} = \frac{r_{hf}}{r_{gf}} = 0.9298\ldots$ brightness reduction factor.
13. $A_{01} = 2,5\log\frac{P_{hf}}{P_{gf}} = 0.07899\ldots$ change in the apparent magnitude, mag.

Table 1. Apparent magnitude balance at different redshift values compared to "Empty Cosmos model" of a flat space

z	0.1	0.3	0.5	1.0	3.0	8.414
R_{now}/R_0	1.154	1.482	1.837	2.828	8	28,884
A, mag	0.079	0.174	0.228	0.297	0.362	0.376

And the main equation of the method for the 4-dimensional spaces [for $R_D = 0.5R_{W4}$] is

$$k_w^{-1} = \frac{r_{gf}}{r_{hf}} = \frac{P_{hf}}{P_{gf}} = \frac{1 + \frac{L_k}{R_D}}{\sqrt{1 + \frac{L_k^2}{R_D^2}}} \qquad (14)$$

6. Discussion. The coincidence of the calculated results for the 3-spherical RM-model with the experimentally known seems promising but requires the different interpretation of cosmic distances

The values of the apparent magnitude balance given in the Table 1 at various redshifts and ratios R_{now}/R_0 of the today's universe size to the starting size at the time of photon emission are close to those found in the works of Perlmutter (2012) for a differences between theoretical values for empty space and averaged experimental values lying on the best fit curve for the model implying an accelerating cosmic expansion for the mass density of about $\rho_c/3$ plus a vacuum energy density twice that large. Taking into account the data from Table 1 the calculated stellar values of the apparent magnitude in a z-range from 0.1 to 0.4 fall very well on the curve obtained for similar distances in the article of Perlmutter (2003), where they have been explained by the so-called acceleration of the expansion of the universe (and by the slowing of the fall of the Hubble constant's value). Meanwhile the values in a z-range from 0.4 to 1 given by RM-curve on Figure 2 limit the top magnitude values for model involving quantum cosmological curvature of ideal 3-sphere, described by the RM-model in the absence of added accelerating expansion of the universe. There is no direct relationship between the density of matter or energy and the growth rate of the universe's space of a certain size in this model (at large spatial scales). Non-anomalous space development should correspond to the curve for empty space (see Figure 2) in the flat three-dimensional case and to the RM-curve in the case of 3-sphere space geometry. At higher values of apparent magnitude we can talk about the accelerating growth of the universe. It should be assumed that up to redshift values of less than 1, the universe does not experience a noticeable acceleration during the growth of its space.

In case of $z = 8.414$, for example, we obtain $r_{1f} = 45.3947 l \times 10^9$ light-years; $K_N = 28.886663$; $r_{0f} = 1.571476 \times 10^9$ light-years and A $= 2,5\log\sqrt{2} = 0.376$ mag.

In this latter case, we are dealing with the quantum scattering horizon of 45.3947 billion light-years, equal to the quantum radius of the universe today, which corresponds to the visible event horizon for the young universe with a size of 1.571476 billion light-years. Signals emitted in such a universe from distances smaller than its quantum radius have already passed the

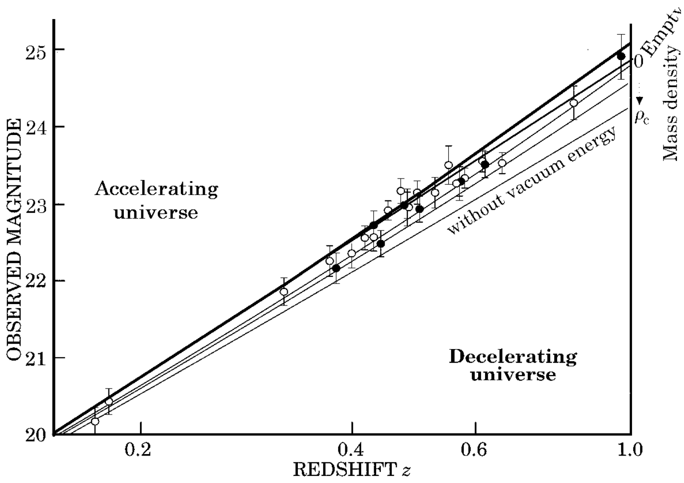

Fig. 2. Observed and calculated magnitude versus redshift for type Ia supernovae and RM approach respectively. Constructed on the basis of Figure 3 from the article of Perlmutter (2003). Up to redshifts close to $z = 0.4$, the Perlmutter's "best fit curve" almost coincides with RM-curve. The upper bold line corresponds to the RM-curve. The medium line corresponds to the Perlmutter's best fit curve. Three light lines represent models with zero vacuum energy and mass densities ranging from the critical density ρ_c down to zero (an empty cosmos).

Earth and no longer give us the opportunity to be detected. Universe's age was equal to 0.467 billion years, and Universe had a Euclidean radius equal to 1.111 billion light-years (while the Euclidean radius of the universe (its 3-sphere) at the moment "now" is equal to 32.1 billion light-years). We do not receive direct radiation signals from the universe of such dimensions except those that reach us, starting from its distant boundaries. From an even younger universe, we only receive secondary signals carried by photons making a second or more semicircle in their journey through the universe. Since they will pass the horizon of the "universe-1.111", we will perceive them as emitted from this horizon, but by older stars.

7. Conclusions

1. As stated above, the stellar values of the apparent magnitude in the z-range from 0.1 to 1 calculated in quantum M-cosmological model for the universe with ideal 3-sphere topology fall quite well on the curve obtained experimentally for similar distances in the works of Perlmutter, Riesse and others where it has been explained by the so-called accelerating of the expansion of the universe.
2. It could be concluded now that the possible contribution to the brightness attenuation phenomenon of a true accelerating of the Universe expansion has, against the background of the contribution of the quantum geometric origin, a value that requires the observer to use the variety of techniques of highest precision for detection.
3. It should be assumed that up to redshift values of less than 1, the universe does not experience a noticeable accelerating during the growth of its space.
4. To construct refined graphs of apparent magnitude versus z for abstract flat 3-dimensional space, in this case, the values obtaining by Perlmutter, Riesse and others should be reduced by the balance values determined mathematically using the RM-approach or given in the table proposed in the paper.

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References

Argazi V., 2001, Death and Time, Primstroy-M, Moscow

Argazi, V., 2016, Mission Aristotle and the Higgs' Trap, Chimera, Kyustendil, 277

Aristotle, Translated by W.D. Ross, 1924, Metaphysics. Oxford Univ. Press, London

Hegel G., Translated by G. di Giovanni, 2010, The Science of Logic. Cambridge Univ. Press, Cambridge

Einstein. A., 1918, Ann. der Phys., 360 (4), 241.

Perlmutter, S., 2003, Phys. Today, 56 (4), 53.

Perlmutter S., 2012, Rev. Mod. Phys., 84, 1127

Riess, A. G., Filippenko, V. A., Challis, P. at all, 1998, Astron. J. 116, 1009 (1998)

Susskind L., 2005, The Cosmic Landscape: String Theory and the Illusion of Intelligent Design. Little, Brown, NY