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Mathematical Model of the Meeting of Chronowaves

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ABSTRACT

This paper describes a mathematical model for the encounter of a forward and backward chronowave. The proofs are based on the wave parts of dual equations derived by the author and presented in [1]. The underlying idea is to conceptualize time as two flows, each described by a forward and backward time vector. In our universe, time moves in one direction, from the past, through the present, to the future. However, the laws of physics do not change even when time flows backward. Therefore, it is logical to assume that the forward and backward directions of time can be reversed. Then, the forward direction should meet the backward direction. As a result of this encounter, an inversion of both directions of time should occur. Time that was forward becomes backward after the inversion. Conversely, backward time becomes forward after the inversion. The described process is very reminiscent of wave motion. Therefore, the author proposes considering two one-dimensional time flows as forward and backward chronowaves.

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Introduction

This article discusses chronowaves. It is based on the author's work [1]. It presents a mathematical framework for studying the forward and backward flow of time. The article concludes with a discussion of "two chronowaves arising in a scalar field formed by a temporal substance and moving toward each other. The result of their meeting is an interaction manifested in the inversion of the reverse chronowave."

The idea of the meeting of two chronowaves is developed in the proposed work. The study is based on the concept of chronowaves as one-dimensional time flows associated with the wavelengths of the graviton and bichronon. These wavelengths were defined in [2] by de Broglie's formulas.

$$\lambda_{гр} = \frac{\hbar}{\mu_{гр} c} = P = \frac{M_P G}{c^2} = 1{,}18964666 \cdot 10^{30}\,см$$ and

$$\lambda_{\chi} = \lambda_{гр} = P = \frac{h}{2\pi\mu_{гр} c} = \frac{h}{2\mu_{\chi} c} = \frac{h}{\mu_{\zeta} c}$$

Here: $\mu_{гр} = \frac{m_e}{(n_e\alpha_e)^2} = \frac{m_0}{\alpha_e{}^2 n_e{}^3} = 2{,}99 \cdot 10^{-68}\,г$ - graviton mass;

$$\mu_{\chi} = \pi\mu_{гр} = \frac{\pi m_e}{\alpha_e^2 n_e{}^2} = \frac{2\pi m_e}{2\alpha_e^2 n_e{}^2} = \frac{\tilde{M}_Z}{2n_e{}^2} = \frac{\pi m_0}{\alpha_e{}^2 n_e{}^3} = \pi\mu_{гр} = 9{,}3927 \cdot 10^{-68}\,г \text{ - chronon mass.}$$

$\mu_{\zeta} = 2\mu_{\chi}$ - mass of bichronon.

As we can see, wavelengths determine the ultimate dimensions of the future universe. We will call a chronowave a one-dimensional time flow moving along the axis of its own time.

We will distinguish between a direct chronowave, moving in the forward (positive) direction of its own time, and a reverse chronowave, moving in the opposite (negative) direction of its own time.

From the theory of 3-dimensional time it follows that the emergence of such chronowaves is associated with the meeting of two cylindrical helical flows moving towards each other along the spatial axis $\tilde{l}$ of the vertical hyperplane $\tilde{l}, \hat{s}$.

The radii of the cylinders are equal to the wavelengths of the graviton and bichronon. At the point of contact between the flows, a cross-section appears in the form of a central circle with the indicated radii in the horizontal hyperplane $\tilde{l}, \hat{s}$. The forward and reverse chronowaves begin their movement toward the center of this circle from its poles, located on the axis $\hat{s}$. The cause of their occurrence is related to processes occurring in the horizontal hyperplane after contact and is not discussed in this article.

Briefly, chronowaves carry mass-energy of opposite signs and move toward each other in narrow tunnels generated by temporal black holes. The mechanism for their occurrence is described in the author's work [2]. The consequence of this meeting is an inversion of both chronowaves. Inversions are understood as a reversal of the direction of a chronowave's motion. This results in a stratification of flat space.

In time theory, the analog of space $l = c\psi$ in a horizontal hyperplane is the coordinate of the proper time of space ψ multiplied by the speed of light. Space is considered flat if it is Euclidean and has zero curvature, i.e., its radius coincides with the direction of the axis l. This type of space occurs before the collision of chronowaves.

During a collision, flat space is stratified and curved. It is divided into two symmetric spaces with a parabolic shape. Parabolic spaces arise from the collision of chronowaves within the tunnels of a temporal black hole. The branches of both parabolas point toward the positive and negative axes of proper time. They are curved analogues of the former, straight radius of Euclidean space. The curved branches of the parabolas act on the black hole's tunnels, expanding them spatially at superluminal speeds.

The radii of curvature of both parabolas are osculating circles, with diameters at the ends of the expanded tunnels equal to the initial lengths of the chronowaves. This article is devoted to the mathematical proof of the described scenario of chronowave encounter.

Mathematical description of Direct and Reverse Time Flows
Before we begin, let us give the following definitions.
A time flow is a vector defined in two chronal coordinates of a horizontal hyperplane. The first chronocoordinate defines the proper time of $\hat{\tau}$. The second chronocoordinate defines the proper time of space ψ .

A forward time flow in a horizontal hyperplane is a vector with two dimensions in chronal coordinates and directed from left to right relative to the proper time axis. A backward time flow is a vector with two dimensions in chronal coordinates and directed from right to left relative to the proper time axis.

A forward chronowave is a forward time flow whose vector coincides with its one-dimensional projection onto the proper time axis.

A backward chronowave is a backward time flow whose vector coincides with its one-dimensional projection onto the proper time axis.

In the work [1], the derivation of dual equations describing the forward $\hat{\tau}$ and reverse $\bar{t}$ flow of time was given.

$$\hat{t} = \sqrt{\hat{\tau}^2 + \psi^2} = \hat{\tau} + \psi\dot{\psi}_{пр}$$

$$\bar{t} = -\hat{t} = \sqrt{\hat{\tau}^2 + \psi^2} = \hat{\tau} + \psi\dot{\psi}_{обр}$$

As we see, the dual equations consist of two parts. The first part is the magnitude of the falling time vector. The second part was called the wave part due to the appearance of partial derivatives in the derivation of the equation, which were replaced by trigonometric functions cos φ and sin φ . Their introduction made it possible to solve dual equations and arrive at the functions of direct tempo and reverse tempo.

$$\dot{\psi}_{пр} = tg\frac{\varphi}{2} = tg\alpha$$

$$\dot{\psi}_{обр} = -ctg\frac{\varphi}{2} = -ctg\alpha \ .$$

In them, the half angle is indicated by the angle $\alpha=\varphi/2$. This angle is included in the description of the wave component. At this angle, another time vector *t*—the duration vector —is tilted, which differs from the falling vector $\hat{t}$ and is related to it by functional trigonometric relationships.

In what follows, only the wave parts of these equations will be used.

For a more visual representation, let's convert them to metric form, multiplying all time terms by the speed of light and replacing the tempos with their trigonometric equivalents. The result is a system of two equations:

$$c\hat{t} = c\hat{\tau} + c\psi \cdot tg\alpha = \hat{s} + l \cdot tg\alpha \qquad (1)$$

$$c\hat{t} = -(c\hat{\tau} + c\psi \cdot (-ctg\alpha) = -\hat{s} + lctg\alpha \qquad (2)$$

Where $\hat{s} = c\hat{\tau}$ - metric coordinate of proper time, which is the horizontal projection of the falling metric time vector $c\hat{t}$;
$l=c\psi$ - metric coordinate of the proper time of space. It is a vertical projection of both the falling time metric vector $c\hat{t}$ and the duration metric vector *ct*. In the future we will call it a spatial coordinate.

We use the resulting equations to describe the forward and reverse flow of time. The flows differ from each other by different angles: α- for direct flow and α' - for the opposite. The relationship between the angles is determined by the formula: $\alpha + \alpha' = 180°$. It follows from it:

$$\alpha = 180° - \alpha' \qquad (3)$$

To describe the flow motion, we adopt four equations. The first two equations (1) and (2) are assigned to the first quadrant, in which they are determined by the angle α. The second two equations (4a) and (4b) are assigned to the third quadrant, in which they are determined by the angle α' and coordinates s' and l' .

$$c\hat{t} = s + l \cdot tg\alpha = s' + l' \cdot tg(180° - \alpha') = s' - l' \cdot tg\alpha' \qquad (4a)$$

$$c\hat{t} = -s + lctg\alpha = -s' + l' \cdot ctg(180° - \alpha') = -s' - l' \cdot ctg\alpha' = -(s' + l' \cdot ctg\alpha') \qquad (4b)$$

Equation (1) is reduced to the first formula for the rotation of the axes, after writing it in the form:

$$c\hat{t} = \hat{s} + l \cdot tg\alpha = \hat{s} + l \cdot \frac{\sin\alpha}{\cos\alpha}$$

Multiplying by cosα, we obtain the original formula:

$$s' = c\hat{t}\cos\alpha = \hat{s}\cos\alpha + l\sin\alpha \qquad (5a)$$

Multiplying by sinα , we obtain the original formula:

$$l' = c\hat{t}\sin\alpha = -\hat{s}\sin\alpha + l\cos\alpha \qquad (5b)$$

The obtained coordinates s', l' belong to the new coordinate system, rotated relative to the old system *s*, *l* by an angleα.

We perform the same operations with equations (4a) and (4b), reducing them to formulas for rotating the axes by an angle α' in the third quadrant.

$$-s = c\hat{t}\cos\alpha' = \hat{s}'\cos\alpha' - l' \cdot \sin\alpha' \qquad (6a)$$

$$-l = -c\hat{t}\sin\alpha' = \hat{s}'\sin\alpha' + l' \cdot \cos\alpha' \qquad (6b)$$

As we can see, they are mirror images of the systems in the first quadrant (see Figure 1).

The figure shows that the resulting coordinate systems should be applied after contact between the forward and reverse chronowaves, which were moving toward each other along the axis . As a result of contact, the forward chronowave, moving from left to right, inverted and became a reverse flow. Meanwhile, the reverse chronowave, moving from right to left, after inversion, became a forward flow.

Let's conduct a study of the inverted backward chronowave to understand what properties it acquires when it becomes a forward time flow. To do this, we'll apply equations (1) and (2) and two coordinate systems (5a) and (5b) in the first quadrant.

We'll introduce notations for the forward and backward incident vectors.

$$c\hat{t}_{пр} = c\hat{t} = \hat{s} + l \cdot tg\alpha \qquad (6a)$$

$$c\hat{t}_{обр} = -c\hat{t} = \hat{s} - lctg\alpha \qquad (6b)$$

As we can see, they are mirror images of the systems in the first quadrant (see Figure 1).

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$$c\hat{t}_{обр} = -c\hat{t} = \hat{s} - lctg\alpha$$

Since the reverse chronowave is inverted, the difference between the forward and reverse flow vectors should be taken:

$$c\hat{t}_{инв} = c\hat{t}_{пр} - ct_{обр} = c\hat{t} - (-ct) = 2c\hat{t} = (s + l \cdot tg\alpha) - (s - l \cdot ctg\alpha)$$

$$= s + l \cdot tg\alpha - s + l \cdot ctg\alpha = l(tg\alpha + ctg\alpha)$$

Let's write the result as:

$$c\hat{t}_{инв} = 2c\hat{t} = l(tg\alpha + ctg\alpha) = l(\frac{tg^2\alpha + 1}{tg\alpha})\frac{2}{2} = \frac{2l}{\sin 2\alpha} = \frac{2l}{\sin\varphi} \qquad (7a)$$

As we can see, the inverted vector is positive, i.e., it points to the right. This means that the reverse chronowave has inverted into a forward flow in the first quadrant.

Let's move from the spatial coordinate to the temporal coordinate using the relationship formula:

$$l = \hat{s} \cdot tg\varphi$$

As a result we get:

$$c\hat{t}_{инв} = \frac{2l}{\sin\varphi} = \frac{2\hat{s} \cdot tg\varphi}{\sin\varphi} = \frac{2\hat{s}}{\cos\varphi} \qquad (7b)$$

Let's check the formula for the special case where φ= 0. In this case $\cos\varphi$ cos0°= 1 and the inverted vector coincides in direction with the positive proper time axis, becoming a chronowave directed from left to right and moving away from the origin.

Let's show that the inverse vector is related to the duration vector. To do this, we multiply it by cosα:

$$c\hat{t}_{инв}\cos\alpha = 2c\hat{t}\cos\alpha = ct \qquad (8a)$$

This expression was derived in time theory. Let's check it using the inverse vector function.

$$ct = 2c\hat{t}\cos\alpha = c\hat{t}_{инв}\cos\alpha = \frac{2l}{\sin 2\alpha}\cos\alpha = \frac{2l}{2\sin\alpha\cos\alpha} \cdot \cos\alpha = \frac{l}{\sin\alpha}$$

As a result, we obtained a relationship formula for the duration vector, which yields a projection onto a spatial axis in the form of a spatial coordinate. From formula (8a), it is clear that the duration vector is the first projection of the inverse vector. We find its second projection, denoting it as $ct_{гр}$.

$$c\hat{t}_{инв}\sin\alpha = 2c\hat{t} \cdot \sin\alpha = ct_{гр} \qquad (8b)$$

Thus, the modulus of the inverse vector is related to the found projections:

$$c\hat{t}'^2_{инв} = c\hat{t}^2_{инв}\cos^2\alpha + c\hat{t}^2_{инв}\sin^2\alpha = (ct)^2 + (ct_{гр})^2 \qquad (8c)$$

Figure 1 shows a diagram describing the inversion of vectors in the first and third quadrants:

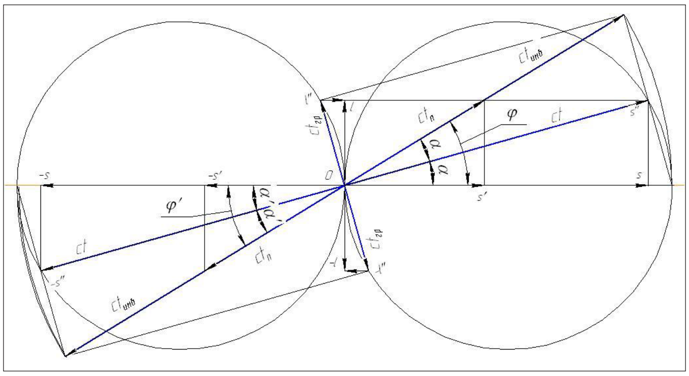

Figure 1: Diagram of time vectors after inversion in the first and third quadrants.

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Chronotrajectories described by the duration vector in the first quadrant.

Using the formulas obtained, we examine the reflection of the forward and backward chronowaves. As mentioned in the introduction, chronowaves are carriers of positive and negative chronal energy. Therefore, the reflection of chronowaves is a reflection of energies. However, 100% reflection of energy from a backward chronowave into the first quadrant does not occur. This is due to the fact that chronowaves move within the narrow tunnel of a black hole. When chronowaves meet, a region with a reversed time direction is formed. This region should be considered a chronal vacuum. This region is compressed by the forward chronowave. During compression, the vacuum polarizes and transitions into the first quadrant with a reversal of time. This is discussed in more detail below. During inversion, a unique elastic "layer" emerges between the chronowaves, consisting of a combination of interacting polarized fields forming a unified field. This field is characterized by a constant. The derivation of the constant's formula is not included in this article due to its cumbersome nature. Therefore, the formula and value of this constant are provided immediately, as follows:

$$\phi = \frac{9}{128\pi^2\alpha_e} = \frac{3\pi^2}{4\pi^2}\cdot\frac{3}{32\pi^2\alpha_e} = \frac{\alpha_{GU}}{\alpha_W(q)}\cdot\frac{\alpha_e(q)}{\alpha_e} = 0,976264433 \qquad (9)$$

Here: $\alpha_{GU} = 1/4\pi^2 = 0,025330295$ - Grand Unified Field Constant;

$\alpha_W(q) = \frac{1}{3\pi^2} = 0,033773727$ - constant of electroweak interaction in polarized vacuum;

$\alpha_e(q) = \frac{3}{32\pi^2} = 9,498860966\cdot 10^{-3}$ - electromagnetic constant in a polarized vacuum

$\alpha_e = 1/137,036 = 7,297352521\cdot 10^{-3}$ - ordinary electromagnetic constant.

As we see, the constant is close to unity, but not equal to it. This field leads to an asymmetry of the inverted energy in the first quadrant, increasing the length of the duration vector in it. The energy transition is characterized by the activation of the duration vector. This vector can describe various timelines, the shape of which is determined by the type of polar equations. However, given the scenario discussed in the Introduction, we will focus on only two of them for now.

The first timeline is a parabola. To derive it, we apply formula (7a), writing it in dimensionless form and performing the following transformations:

$$\frac{c\hat{t}_{инв}}{l} = \frac{2}{\sin\varphi} = \frac{2}{\sin 2\alpha} = \frac{2}{2\sin\alpha\cos\alpha} = \frac{2\sin\alpha}{2\sin^2\alpha\cdot\cos\alpha} = \frac{2tg\alpha}{2\sin^2\alpha}$$

Two relationships follow from it:

$$\frac{1}{2\sin^2\alpha} = \frac{c\hat{t}_{инв}}{2tg\alpha\cdot l} = \frac{c\hat{t}_{инв}}{2tg\alpha\cdot ct\sin\alpha} = \frac{2c\hat{t}}{2ct\dfrac{\sin^2\alpha}{\cos\alpha}} = \frac{c\hat{t}}{ct\dfrac{\sin^2\alpha}{\cos\alpha}} \qquad (10a)$$

The numerator on the right side contains the falling vector, and the denominator contains the duration vector. When the forward and backward chronowaves are inverted, both vectors emerge, which theoretically should be equal in magnitude and have positive directions in the first quadrant. However, if they are equal, both vectors end up in different quadrants. The conclusion follows from the equation arising from the equality of the vectors:

$$ct = \frac{s}{\cos\alpha} = \frac{\hat{s}}{\cos\varphi} = c\hat{t}$$

Solving the equation with equal projections $s = \hat{s}$, we arrive at two values of the cosines:

$\cos\alpha_1 = 1$ and $\cos\alpha_2 = -0,5$. From these two values of the angle follow: $\alpha_1 = 0°$ and $\alpha_2 = -60°$.

The first angle refers to the duration vector inverted in the first quadrant as a direct chronowave. The second angle is the half-angle $\varphi_2/2$, which refers to the falling vector, which has a negative direction in the third quadrant and yields a negative projection onto the proper time axis.

The negative projection should be viewed as negative energy hidden in the resulting vacuum. The direct chronowave approaching it "compresses" this energy. Within it, resisting the compression, a combination of fields arises, forming a resulting field with a constant ϕ.

This field, in the form of an elastic "layer," shifts into the first quadrant and increases the length of the direct inverted chronowave. The magnitude of the shift becomes proportional to the constant $\phi = c\hat{t}/ct$, equal to the ratio of the vector lengths. Even though the falling vector is shifted into the first quadrant, it still tends to describe a chronotrajectory in reverse time. This is indicated by its new tilt angle. To find it, taking the shift into account, we equate ratio (10a) to a constant and obtain a system of two polar equations:

$$\phi = \frac{1}{2\sin^2\alpha} = \frac{c\hat{t}}{ct\dfrac{\sin^2\alpha}{\cos\alpha}} = \frac{\phi}{\dfrac{\sin^2\alpha}{\cos\alpha}} \qquad (10b)$$

The first equation applies to a falling vector. Therefore, we express it in terms of the angle φ and find the sine of half the angle for the minus sign in the third quadrant:

$$\sin\alpha = \sin\frac{\varphi}{2} = -\sqrt{\frac{1}{2\phi}} \qquad (10c)$$

The second equation pertains to the duration vector. We express it in terms of an angle and find the cosine of this angle from the quadratic equation:

$$1 = \frac{\sin^2\alpha}{\cos\alpha} = \frac{1-\cos^2\alpha}{\cos\alpha} \qquad (10d)$$

This angle occurs during inversion and determines the slope of the duration vector in the first quadrant. Let's consider the resulting chronotrajectories it describes. We multiply both sides of (10a) by the constant value of the parameter $p = P$, which is the length of the chronowave.

$$\frac{P}{2\sin^2\alpha} = \frac{c\hat{t}\cdot P}{ct\dfrac{\sin^2\alpha}{\cos\alpha}} \qquad (10e)$$

By equating the incident vector, multiplied by a constant , we obtain a system of two polar equations:

$$\phi c\hat{t} = \frac{P}{2\sin^2\alpha} = \frac{c\hat{t}}{\dfrac{ct}{P}\dfrac{\sin^2\alpha}{\cos\alpha}} \qquad (11a)$$

The first polar equation refers to the falling vector and describes the chronotrajectory as a left parabola:

$$c\hat{t} = \frac{P}{2\phi\sin^2\dfrac{\varphi}{2}} \qquad (11b)$$

In rectangular coordinates, the polar equation has the form:

$$\hat{s} = \frac{l^2}{\dfrac{2P}{\phi}} - \frac{P}{2\phi} \qquad (11c)$$

It is precisely this chronoline that should arise under the action of an energy release at an angle $\varphi_0/2$ found from formula (10c).

Dividing by $c\hat{t}$ and transforming, we obtain the second polar equation, which describes the duration vector as a parabola with the positive direction of the axis *s*.

$$ct = \frac{P}{\phi}\cdot\frac{\cos\alpha}{\sin^2\alpha} \qquad (12a)$$

This timeline contains an angle $\alpha_0$found from (10d). Since the angle's value brings the trigonometric part of the equation to unity, we immediately obtain the value of the duration vector equal to: $ct = P/\phi$. In rectangular coordinates, the polar equation (10b) has the form:

$$s = \frac{l^2}{\dfrac{P}{\phi}} \qquad (12b)$$

As we see, the parameter has become inversely proportional to the constant ϕ , i.e., the wavelength has increased due to the inversion. Let's express the equation in terms of chronocoordinates, dividing both sides by the speed of light.

$$\frac{s}{c} = \tau = \frac{l^2}{\dfrac{cP}{\phi}} = \frac{c^2\psi^2}{\dfrac{cP}{\phi}} = \frac{\psi^2}{\dfrac{P}{c\phi}} \qquad (12c)$$

In this form, we have a "skeleton" of the parabola equation, devoid of spatial properties due to the absence of the speed of light. This "skeleton" arises instantaneously, without transmitting information to an external observer, as demonstrated by the quantity $t = P/c\phi$, which follows from (10b).

Let's consider the emergence of a second chronological line, described by a duration vector in the form of an osculating circle inscribed in a parabola.

Let's transform the original equation (11a) to the form:

$$\phi c\hat{t} = \frac{P}{2\sin^2\alpha} = \frac{c\hat{t}\cdot P\cos\alpha}{ct\sin^2\alpha}$$

We reduce it to a system of three equations:

$$\frac{\phi c\hat{t}\sin^2\alpha}{c\hat{t}} = \phi\sin^2\alpha = \frac{P}{2c\hat{t}} = \frac{P}{2c\hat{t}}\cdot\frac{\cos\alpha}{\cos\alpha} = \frac{P\cos\alpha}{ct} = \phi$$

The first polar equation is the equation of an osculating circle with an increased diameter.

$$ct = \frac{P}{\phi}\cdot\cos\alpha \qquad (13a)$$

In chrono coordinates the equation has the form:

$$t = \frac{P}{c\phi}\cdot\cos\alpha \qquad (13b)$$

The second equation yields a sine square equal to one. It refers to the falling vector. Therefore, we make a substitution $\alpha = \varphi/2$ in it and find the sine square of the half-angle :

$$\sin^2\alpha = \sin^2\frac{\varphi}{2} = 1 \qquad (13c)$$

From the equation we find $\varphi = 2\cdot\arcsin 1 = 2\cdot 90° = 180°$.

The angle value found indicates that the incident vector, after forming a left parabola, tends to occupy a position along the negative proper time direction, provided that an osculating circle is formed. This conclusion is confirmed by the third equation, which has the form:

$$\frac{P}{2c\hat{t}} = \phi$$

It follows from this that

$$c\hat{t} = \frac{P}{2\phi}$$

The sign is determined from equation (11c) at $l = 0$. In this case

$$\hat{s} = -\frac{P}{2\phi} = -c\hat{t}$$

The result indicates an attempt to rotate the falling vector in the negative time direction. However, the rotation is impeded by the forward flow, inverted in reverse time. This flow acts as an obstacle to the appearance of a left-hand parabola-shaped deflection in reverse time, and thus prevents the falling vector from tilting in this direction, which attempts to describe this chronology.

Chronotrajectories described by the duration vector in the third quadrant.

By analogy with the derivation of chronotrajectory equations in the first quadrant, we derive the formulas for chronotrajectories in the third quadrant.

We introduce the notations in formulas (4a) and (4b) for the forward and backward incident vectors for the third quadrant.

$$c\hat{t}'_{пр} = c\hat{t} = s' - l' \cdot tg\alpha'$$

$$c\hat{t}'_{обр} = -c\hat{t} = s' + l' \cdot ctg\alpha'$$

Since the direct chronowave inverts in the third quadrant, the difference between the vectors of the reverse and direct flow should be taken:

$$c\hat{t}'_{инв} = ct'_{обр} - c\hat{t}'_{пр} = (-ct - c\hat{t}) = -2c\hat{t} = (s' + l' \cdot ctg\alpha') - (s' - l' \cdot tg\alpha') = l'(ctg\alpha' + tg\alpha')$$

Let's write the obtained result as follows:

$$c\hat{t}'_{инв} = -2c\hat{t} = l'(ctg\alpha' + tg\alpha') = l(\frac{tg^2\alpha' + 1}{tg\alpha'})\frac{2}{2} = \frac{2l'}{\sin 2\alpha'} = \frac{2l'}{\sin\varphi'} \quad (14a)$$

The formula shows that the inverted vector is negative, i.e., left-handed. The result implies that the forward chronowave has inverted into a reverse flow in the third quadrant.

We move from the spatial coordinate to the temporal coordinate using the relationship formula for the third quadrant:

$$l' = \hat{s}' \cdot tg\varphi'$$

As a result, we get:

$$c\hat{t}'_{инв} = \frac{2l'}{\sin\varphi'} = \frac{2\hat{s}' \cdot tg\varphi'}{\sin\varphi'} = \frac{2\hat{s}'}{\cos\varphi'} \quad (14b)$$

Let's check the formula for a special case when $\varphi' = 180°$. As a result we get $\cos\varphi' = \cos 180° = -1$ and the inverted vector coincides in direction with the negative axis of proper time, becoming a chronowave directed from right to left and moving from the origin.

We will show the relationship between the inverted vector and the duration vector by multiplying it $\cos\alpha$

$$c\hat{t}'_{инв} \cos\alpha' = -2c\hat{t} \cos\alpha' = ct \quad (15a)$$

From the formula, it is clear that the duration vector is the first projection of the inverse vector. We find its second projection, denoting it as $ct_{гр}$.

$$c\hat{t}'_{инв} \sin\alpha' = -2c\hat{t} \cdot \sin\alpha' = ct_{гр} \quad (15b)$$

Thus, the modulus of the inverse vector is related to the found projections:

$$c\hat{t}'^2_{инв} = c\hat{t}'^2_{инв} \cos^2\alpha' + c\hat{t}'^2_{инв} \sin^2\alpha' = (ct)^2 + (ct_{гр})^2 \quad (15c)$$

The energy transition to the third quadrant is characterized by the activation of the duration vector. This vector describes mirror timelines relative to the timelines in the first quadrant.

The first timeline is a parabola. To derive it, we apply formula (14a), writing it in dimensionless form and performing the same transformations as for the first quadrant:

$$\frac{c\hat{t}'_{инв}}{l'} = \frac{2}{\sin\varphi'} = \frac{2}{\sin 2\alpha'} = \frac{2}{2\sin\alpha'\cos\alpha'} = \frac{2\sin\alpha'}{2\sin^2\alpha' \cdot \cos\alpha'} = \frac{2tg\alpha'}{2\sin^2\alpha'}$$

From this follows two polar relationships, which we transform by applying the relationship formula for the coordinate $l' = -ct\sin\alpha'$ in the third quadrant:

$$\frac{1}{2\sin^2\alpha'} = \frac{c\hat{t}'_{инв}}{2tg\alpha' \cdot l'} = \frac{c\hat{t}_{инв}}{2tg\alpha' \cdot (-ct\sin\alpha')} = -\frac{2c\hat{t}}{(-2ct)\dfrac{\sin^2\alpha'}{\cos\alpha'}} = -\frac{c\hat{t}}{(-ct)\dfrac{\sin^2\alpha'}{\cos\alpha'}} \quad (16)$$

The numerator on the right-hand side contains the falling vector, and the denominator contains the duration vector. A distinctive feature of the inversion in the third quadrant is that no elastic "layer" is formed there, since it has moved to the first quadrant, and the constant ϕ is not involved in this process. Therefore, both vectors are equal to each other $-c\hat{t} = -ct$. We reflect this feature by equating the resulting ratios to unity.

$$1 = \frac{1}{2\sin^2\alpha'} = -\frac{c\hat{t}}{(-ct)\dfrac{\sin^2\alpha'}{\cos\alpha'}} = \frac{\cos\alpha'}{\sin^2\alpha'} \quad (17a)$$

The first equation refers to a falling vector. Therefore, we express it in terms of the angle and find the sine of half the angle, choosing it with the plus sign:

$$\sin\alpha' = \sin\frac{\varphi'}{2} = \sqrt{\frac{1}{2}} \quad (17b)$$

The second equation concerns the duration vector. We find the cosine of this angle from the quadratic equation:

$$1 = \frac{\sin^2\alpha'}{\cos\alpha'} = \frac{1 - \cos^2\alpha'}{\cos\alpha'} \quad (17c)$$

As we see, we have identical equations for the angles for both the first and third quadrants. After solving them, we find identical angle values. This fact indicates complete mirror symmetry of the duration vectors arising during inversion. And, therefore, the mirror image of the chronotrajectories they describe. We prove this by reducing (16) to a system of two polar equations:

$$-c\hat{t} = \frac{P}{2\sin^2\alpha'} = -\frac{Pc\hat{t}}{(-ct)\dfrac{\sin^2\alpha'}{\cos\alpha'}} \quad (18)$$

The first polar equation belongs to the falling vector, which tries to describe the chronoline as a right parabola at $\alpha = \phi / 2$.

$$c\hat{t} = -\frac{P}{2\phi \sin^2 \frac{\varphi}{2}} \qquad (19a)$$

In rectangular coordinates, the polar equation has the form:

$$\hat{s} = \frac{P}{2} - \frac{l^2}{2P} \qquad (19b)$$

Dividing by $c\hat{t}$ and transforming (18), we obtain the second polar equation, which describes the duration vector as a parabola with a negative axis s direction.

$$ct = -P\cdot\frac{\cos\alpha'}{\sin^2\alpha'} \qquad (20a)$$

The angle α_0 found from (17c) arises in this timeline. Since the angle's value brings the trigonometric part of the equation to unity, we immediately obtain the value of the duration vector equal to: $ct = -P$. In rectangular coordinates, the polar equation (20a) has the form:

$$s = -\frac{l^2}{P} \qquad (20b)$$

The appearance of a second chronological line, described by a duration vector in the form of an osculating circle inscribed in a parabola, also follows from (18), which we reduce to a system of three equations:

$$-\frac{c\hat{t}\sin^2\alpha'}{-c\hat{t}} = \sin^2\alpha' = \frac{P}{2(-ct)} = \frac{P\cos\alpha'}{(-ct)} = 1$$

The first polar equation is the equation of an osculating circle:

$$ct = -P\cdot\cos\alpha' \qquad (21a)$$

The second equation yields a sine square equal to one. It refers to the falling vector. Therefore, we make a substitution in it $\alpha' = \varphi'/2$ and find the sine square of the half-angle $\varphi'/2$:

$$\sin^2\alpha' = \sin^2\frac{\varphi'}{2} = 1 \qquad (21b)$$

From the resulting equation we find

$\varphi' = -2\cdot\arcsin 1 = -2\cdot 90° = -180° = 0°$

The angle value found indicates that the incident vector, after forming a right parabola, tends to occupy a position along the positive direction of the proper time axis, provided that a reverse osculating circle is formed. This conclusion is confirmed by the third equation, which has the form:

$$-\frac{P}{2c\hat{t}} = 1$$

It follows from this that the inverse falling vector is equal to

$$-c\hat{t} = c\bar{\bar{t}} = \frac{P}{2}$$

The direction of the reverse vector is determined from equation (19 b) at l=0. In this case

$$\hat{s} = \frac{P}{2} = c\bar{\bar{t}}$$

The result indicates an attempt to rotate the falling vector in the positive direction of proper time. However, the rotation is impeded by the reverse flow, which is inverted in forward time. This reverse flow prevents the appearance of a deflection in the form of a right parabola in forward time, and thus prevents the falling vector, which attempts to describe this chronoline, from tilting in this direction.

From all of this, the conclusion follows: the movement of chronowaves toward each other leads to their inversion and the formation of mirror-image parabolic time flows, described by duration vectors directed in the forward and backward directions of proper time.

The flow graphs are shown in Figure 2.

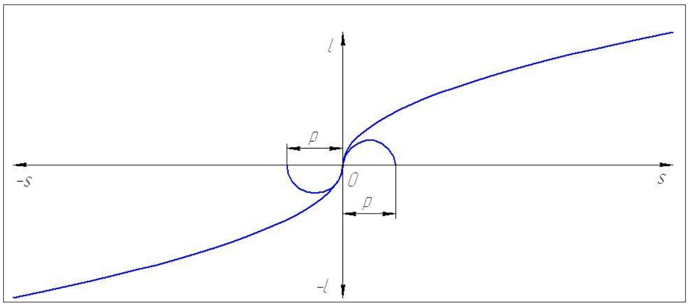

Figure 2: Forward and reverse parabolic flow of time duration

The figure shows that in the first quadrant, only the positive regions of the parabola and circle are defined in the forward flow. In the third quadrant, only the negative regions of the parabola and circle are defined in the reverse flow.

A single chronotrajectory described by a duration vector

The scenario in Section 1 described chronowaves propagating through the black hole's narrow time tunnels. Their encounter results in an inversion of the chronowaves and their transformation into parabolic temporal flows of duration. Naturally, the branches of the parabolas begin to act on the tunnel walls, pushing them apart spatially along the same time-duration. At the same time, the tunnel walls curve and generate a gravitational field within themselves.

To determine the type of chronoline corresponding to the wall geometry, we use equation (10e), equating it to half the duration vector.

$$\frac{ct}{2} = \frac{P}{2\sin^2\alpha} = \frac{2c\hat{t}\cdot P}{2ct\frac{\sin^2\alpha}{\cos\alpha}}$$

Let's transform the right side of the equation, taking into account its left side:

$$\frac{2c\hat{t}}{2ct}\frac{P}{\frac{\sin^2\alpha}{\cos\alpha}} = \frac{2c\hat{t}}{ct}\cdot\frac{P}{2\sin^2\alpha}\cos\alpha = \frac{2c\hat{t}}{ct}\cdot\frac{ct}{2}\cdot\cos\alpha = c\hat{t}\cdot\cos\alpha = \frac{ct}{2}$$

Here, the relation formula (8a) is used, proving the identity of the introduced notation. Based on this, we obtain the polar equation of a single chronoline describing the expanded space-time of the tunnel.

$$ct = \frac{P}{2\sin^2\alpha} \quad (22)$$

The shape of the chronoline is shown in Figure 3 at $y=1$ and $x=s$.

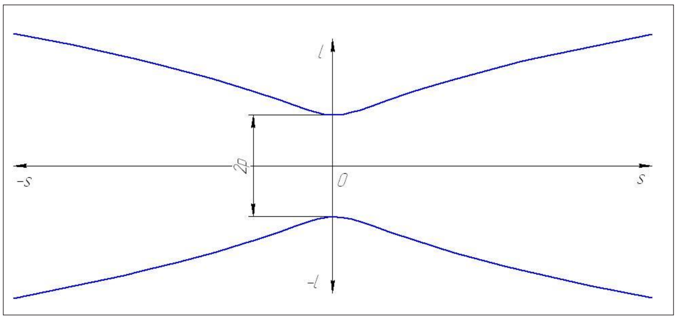

Figure 3: Graph of a single chronology line

The chronoline is called unified because within it, parabolic chronotrajectories of the forward and reverse flow of time exist. The overall graph of all the chronolines considered is shown in Figure 4.

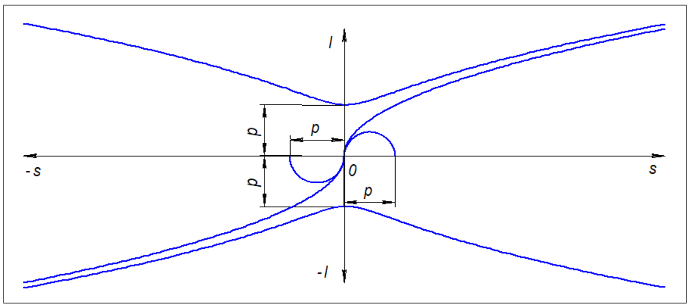

Figure 4: Graphs of parabolic chronolines, arising in a single chronoline

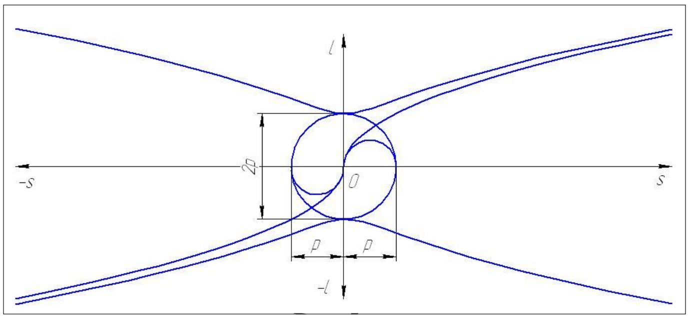

Figure 5: 5-dimensional sphere in hyperspace

How should the image shown in Figure 5 be understood? It presents a mathematical model of interacting chronowaves in a horizontal hyperplane in a visual form. If the model is interpreted physically, as is customary in modern physics, then additional spatial dimensions must be included. With this approach, the interaction of the forward and backward parabolic flows leads to the formation of a 5-dimensional sphere. This sphere is placed in hyperspace described by a single chronoline. Within the 5-sphere are two internal, touching hemispheres, described by duration vectors (see Figure 5). The diameter of the left sphere is equal to the graviton wavelength. The diameter of the right sphere is proportional to the bichronon length and takes into account the constant – the field formed when the chronowaves meet.

Conclusion

The mathematical model of the encounter of two chronowaves discussed above can be applied as a model for the formation of the Metagalaxy. The de Broglie wavelengths of the graviton and bichronon have their own gravitational structure when represented through gravitational radii. These radii, in turn, are expressed through gravitational masses, which can be expressed through interaction field constants. The gravitational interaction of masses leads to processes that occur in the resulting continuum, known as spacetime in modern physics.

In concluding the article, the author hopes that the proposed model can help solve problems in cosmology. It can also help us reflect on the structure of the universe and answer the philosophical question: "What lies beyond the universe?"

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