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The Connection between The Theory of Time and the Causal Mechanics of N.A. Kozyrev

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ABSTRACT

This paper presents mathematical proofs of N.A. Kozyrev's postulates, confirming his theory of time. To visualize the proofs, vector diagrams constructed based on the dual equations derived by the author are used. In addition to Kozyrev's time flow, the author uses another time flow, which he obtained theoretically. Furthermore, the paper utilizes the author's previous research results. Their application made the model of the cause-effect interaction process simple and understandable. An example implementing the cause-effect model is provided at the end of the article.

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Introduction

In 1958, astronomer and astrophysicist N.A. Kozyrev published his book "Causal or Asymmetric Mechanics in Linear Approximation." It outlined the postulates of a theory of time that defined time as an active principle. Regarding time as a non-nuclear energy source, the scientist used it to explain phenomena within stars and planets. He predicted volcanic activity on the Moon and discovered tectonic activity in small bodies in the solar system. He conducted a series of original experiments to determine the passage of time. Based on their results, he concluded that this value must be a universal constant equal to the fine structure constant. Other experiments were also conducted to identify causal forces. Unfortunately, the reproducibility of these experiments was low. Their results depended on the seasons. Scientists attempting to repeat them often failed to obtain the same results as before. This caused considerable controversy in the scientific community. On January 23, 1960, the Bureau of the Physical and Mathematical Sciences Department of the USSR Academy of Sciences established a commission to verify N.A. Kozyrev's theory and experiments. The research lasted approximately six months. The nine-member commission's findings were disappointing. According to the Academy of Sciences, N.A. Kozyrev's theory is currently rejected by the overwhelming majority of physicists and astronomers due to its complete lack of validity.

The author believes that this attitude toward the theory is incorrect. Its failure stems from its insufficient mathematical justification. Based on postulates, it did not provide a clear understanding of the underlying mechanism underlying the cause-and-effect relationship. The experiments conducted seemed to confirm the postulates, but also seemed to not. Their failure lay in the insufficient sensitivity of the equipment, which was unable to detect the small effects that appear when studying the active properties of time. To substantiate the validity of N.A. Kozyrev's postulates. The author developed a mathematical model of cause-effect interactions. It demonstrated that the basic postulates of causal mechanics hold true. This article describes the results of the study. They can be applied to the study of elementary particle decay events.

Model of interaction between direct and reverse time.

In his work "Causal or Asymmetric Mechanics in a Linear Approximation"

[1] N.A. Kozyrev outlined a number of postulates regarding cause and effect.

1. In causal relationships, there is always a fundamental distinction between causes and effects. This distinction is absolute, independent of point of view, that is, coordinate system.
2. Causes and effects are always separated by space. The distance between cause and effect can be arbitrarily small, but cannot be zero.
3. Causes and effects arising at the same point in space cannot differ and are identical concepts.
4. Causes and effects are always separated by time. The time interval between cause and effect can be arbitrarily small, but cannot be zero.
5. Time has a special, absolute property that distinguishes the future from the past, causes from effects, which can be called directionality or course. This property determines the distinction between causes and effects, for effects are always in the future relative to causes.

Within the framework of the introduced postulates, any process can be represented as a sequence of individual cause-and-effect links. N. Kozyrev analyzes the elementary cause-and-effect link, which consists of two material points—a cause point and an effect point—separated, according to postulates II and III, by non-zero spatial and temporal intervals. Based on these concepts, Kozyrev introduces the quantity velocity c_2 :

$$c_2 = \frac{\delta x}{\delta t}$$

He calls it the passage of time and defines it:
"The passage of time for every cause-and-effect relationship is a real physical process, which is represented by a pseudovector , which has opposite directions for cause and effect. ... The passage of time ... is equivalent to the rotation of the cause relative to the effect at a linear velocity or vice versa".

The passage of time has the dimension of speed and characterizes the speed of the transition of cause to effect in the elementary cause-and-effect link.
Based on the postulates introduced, scientists conducted experiments to determine the passage of time [1]. They showed that the passage of time is equal to the ratio

$$\frac{c_2}{c} = \alpha_e$$

Where c is the speed of light; $\alpha_e = 1/137{,}036$ is fine structure constant.

Thus, the flow of time c_2 is a fundamental constant. This quantity is the main quantitative characteristic in causal mechanics.

These are the basics of N.A. Kozyrev's theory of time. They resonate well with the dual equations of time outlined in [2].
Dual equation of direct time:

$$\hat{t} = \sqrt{\hat{\tau}^2 + \psi^2} = \hat{\tau} + \psi\dot{\psi}_{пр} \qquad (1)$$

Where $\dot{\psi}_{пр} = tg\frac{\varphi}{2} = tg\alpha$ there is a direct tempo

function; $\hat{\tau} = \hat{t}\cos\varphi$ - projection of the time vector onto the horizontal axis; $\psi = \hat{t}\sin\varphi$ - projection of the time vector onto the vertical axis.

Muzzle equation of inverse time

$$\overleftarrow{t} = -\hat{t} = \sqrt{\hat{\tau}^2 + \psi^2} = \hat{\tau} + \psi\dot{\psi}_{обр} \qquad (2)$$

Where $\dot{\psi}_{обр} = -ctg\frac{\varphi}{2} = -ctg\alpha$ - is a reverse tempo function.

The equations consist of left and right (wave) parts. Taking into account the direct tempo function, Figure 1 shows vector diagrams of times satisfying dual equations (1) and (2).

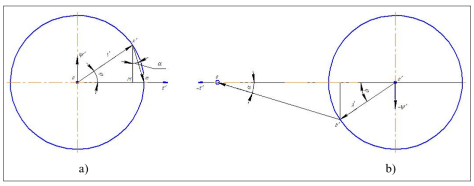

Figure 1: Vector diagrams of forward and backward time.
a) forward time flow diagram; b) backward time flow diagram.

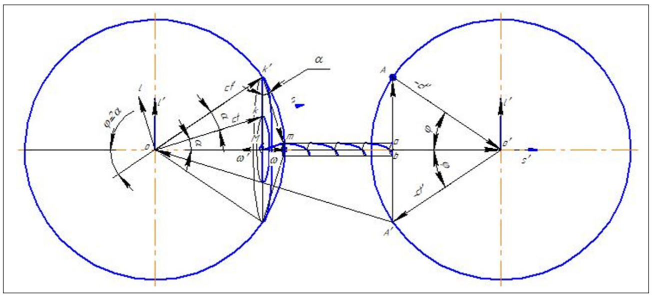

Figure 2: Interaction of forward and reverse time flows

Figure 1b) shows a vector diagram for reverse time in a coordinate system located in the third quadrant. It shows a certain material point o' with mass. A spherical chronal-graviton field, depicted as a circle with a radius of $\hat{t}$, is formed around it. The field has a distinct direction for the reverse vector, which is inclined to the horizontal axis (- $\hat{t}$) at an angle of φ and meets the surface of the field with its end. It then refracts beyond its limits in the reverse direction of proper time , forming a slope with it at an angle of $\alpha = \varphi/2$.

Figure 1a) shows a vector diagram for direct time $\hat{t}$. It shows that there is a certain material point o possessing mass. A spherical chronal-graviton field is formed around it, depicted as a circle with a radius of. Within the field, a direction is distinguished for the direct vector, which is inclined at an angle of φ to the axis $\hat{t}$. This vector comes into contact with the surface of the field with its end and is refracted within it in the direct direction of proper time $\hat{t}$, forming an inclination with the vertical axis at an angle of $\alpha = \varphi/2$.

Figure 2 shows the situation where masses o and o' interact in proper time. It can be described mathematically by adding the forward and backward vectors, described by the dual equations.

$$0 = -\hat{t} + \hat{t} = (\hat{\tau} + \psi\dot{\psi}_{обр}) + (\hat{\tau} + \psi\dot{\psi}_{пр}) = 2\hat{\tau} + \psi(\dot{\psi}_{обр} + \dot{\psi}_{пр})$$

Where does it follow from?

$$2\hat{\tau} = -\psi(\dot{\psi}_{обр} + \dot{\psi}_{пр}) = \psi(-\dot{\psi}_{обр} - \dot{\psi}_{пр}) \qquad (3)$$

As we see, when adding times, the signs of the tempos change. This means that the inverse time vector, after its apex coincides with point o, inverts, changing direction to the opposite. After this, two vectors, $ok' = c\hat{t}$ and $ok = ct$, emerge in the first quadrant. They begin to process around the horizontal axis.

The resulting situation is shown in Figure 2. It shows two cones formed by time vectors, each with a common height ΩM, which is the projection of both vectors onto the forward proper-time axis. The diameter of the outer cone's circumference intersects this axis at point M, which is the cause point in the forward proper-time flow. The role of the cause is to move in forward proper time to the effect point m. It is always in the future relative to the cause, thus confirming postulate №5.

Distance $\Delta\hat{\tau} = Mm$ is the initial cause-and-effect link arising in the chronological-graviton field of direct time. It generates a cause-and-effect chain that allows for the connection between point and point in direct time. The chain consists of elementary spatiotemporal links that form a stable structure in space, characterized by the proper time of space . From the perspective of a spatial observer, such a structure should not change over time, remaining a single stable entity. Such an entity is the hydrogen atom, consisting of a proton and an electron. It is precisely this atom that nature has chosen to form the chain of cause and effect, linking the past and the future into an unbroken chain of events.

The paper presents a mathematical description confirming the stated model of the interaction of forward and backward time and the postulates of N.A. Kozyrev.

It should be noted that the vector diagram in Figure 2 is very similar to the vector model of the hydrogen atom [4]. Therefore, Bohr's theory for the hydrogen atom was used as the basis for calculating the flow of time.

Equivalence of the Formulas for Rotation of Axes and Dual Equations of Time

Let's examine the left side of the vector diagram in Figure 2. It shows that, as a result of the interaction of times, the direct time vector can be viewed in a new coordinate system ψ,τ , rotated by an angle relative to the old system $\hat{\psi},\hat{\tau}$.

We apply the rotation formulas for the axes of the new coordinate system ψ,τ, related to the old system $\hat{\psi},\hat{\tau}$, in which time vector 3 was defined. The new system arises as a result of the inversion of the reverse flow. This results in the formation of a new vector , which coincides in direction with the new axis . We will call it the duration vector, in contrast to the first vector, which we will call the falling time vector. As can be seen from the figure, vector , in turn, is defined in the old coordinate system. Based on the resulting diagram, we write the rotation formulas for the new system of axes relative to the old one [6]:

$$\tau = \hat{\tau}\cos\alpha + \hat{\psi}\sin\alpha$$

$$\psi = -\hat{\tau}\sin\alpha + \hat{\psi}\cos\alpha$$

It can be seen from the figure that in the new coordinate system ψ,τ , the incident vector gives projections onto new axes, which are determined by the formulas:

$$\psi = \hat{t}\sin\alpha\,; \quad \tau = \hat{t}\cos\alpha$$

And also, the formula for the relationship between them.

$$\psi = \tau\cdot tg\alpha$$

If we substitute the found relationship formulas into the axes rotation formulas, we obtain the following equations:

$$\tau = \hat{t}\cos\alpha = \hat{\tau}\cos\alpha + \hat{\psi}\sin\alpha$$

$$\psi = \hat{t}\sin\alpha = -\hat{\tau}\sin\alpha + \hat{\psi}\cos\alpha$$

The wave part of the dual equation (1) follows from the first.

$$\hat{t} = \hat{\tau} + \hat{\psi}\frac{\sin\alpha}{\cos\alpha} = \hat{\tau} + \hat{\psi}\cdot tg\alpha = \hat{\tau} + \hat{\psi}\cdot\dot{\psi}_{np}$$

Where $\dot{\psi}_{np} = tg\alpha$ - constant value of the forward tempo in the forward flow.

For the second formula we have:

$$\hat{t} = -\hat{\tau} + \hat{\psi}\frac{\cos\alpha}{\sin\alpha} = -\hat{\tau} + \hat{\psi}\cdot ctg\alpha$$

The wave part of the dual equation (2) follows from it.

$$-\hat{t} = \hat{\tau} - \hat{\psi}\cdot ctg\alpha = \hat{\tau} + \hat{\psi}\cdot\dot{\psi}_{обр}$$

Where $\dot{\psi}_{обр} = -ctg\alpha$ - constant value of the reverse tempo in the reverse flow.

From the resulting dual equations, we find the relationship between the position of the old vector $\hat{t}$ in the new system ψ,τ and the new vector t in the old system $\hat{\psi},\hat{\tau}$.

The figure shows that the projections of a vector of duration t onto the old axes are equal to $\hat{\tau} = t\cos\alpha$ and $\hat{\psi} = t\sin\alpha$.
We substitute this into the wave part (1).

$$\hat{t} = \hat{\tau} + \hat{\psi}\cdot tg\alpha = t\cos\alpha + t\sin\alpha\cdot tg\alpha = t(\cos\alpha + \sin\alpha\cdot tg\alpha) =$$

$$= t(\cos\alpha + \frac{\sin\alpha\sin\alpha}{\cos\alpha}) = t(\frac{\cos\alpha\cdot\cos\alpha + \sin\alpha\sin\alpha}{\cos\alpha}) = \frac{ct}{\cos\alpha} = \frac{ct}{\sqrt{1-\sin^2\alpha}}$$

Thus, we arrive at a formula for time dilation that is identical in form to the formula of special relativity. Thus, we arrive at a formula for time dilation that is identical in form to the formula of special relativity.

It can be interpreted not as the movement of an inertial system relative to a stationary system, but as a rotation of the space-time axes by a constant angle α, i.e., the transition of energies transferred by vectors $\hat{t}$ and t to other realities with new coordinates ψ τ and $\hat{\psi},\hat{\tau}$.

Derivation of the Rate Equation and its Solution.

From the muzzle time equations (1) and (2), we move on to the metric dual equations by multiplying both parts of (1) by the speed of light.

$$c\hat{t} = c\hat{\tau} + c\psi\dot{\psi}_{np} = \hat{s} + l\dot{\psi}_{np} \qquad (4)$$

Reducing by $\hat{t}$, we arrive at the velocity equation.

$$c = c\cos\varphi + c\sin\varphi\cdot\dot{\psi}_{np} \qquad (5)$$

To verify the rotation of vectors $\hat{t}$ and t, we must prove the occurrence of linear velocity. We will prove this using the relation formula $\tau = t\cos\varphi$.

Differentiating the formula as a product, we obtain:

$$d\hat{\tau} = \cos\varphi\cdot d\hat{t} - \hat{t}\sin\varphi\cdot d\varphi$$

Divide by $d\hat{t}$:

$$\frac{d\hat{\tau}}{d\hat{t}} = \cos\varphi - \hat{t}\sin\varphi\cdot\frac{d\varphi}{d\hat{t}} = \cos\varphi + \omega\hat{t}\sin\varphi\cdot\frac{d\varphi}{d\hat{t}} \qquad (6)$$

Where $\omega = -\frac{d\varphi}{d\hat{t}}$ there is angular velocity.

According to the TV postulate [2], when deriving the dual equation for direct time, it follows that the speed of light remains a constant value for homogeneous time, i.e. the conditions must be satisfied $d\hat{\tau}/d\hat{t} = 1$. By equating the derivative to unity, we arrive at an equation equivalent to equation (1) after its transformation

$$1 = \cos\varphi + \omega t\sin\varphi = \cos\varphi + \dot{\psi}_{np}\sin\varphi \qquad (7)$$

It follows from this that the magnitude of the direct tempo can be written in terms of the angular velocity

$$\dot{\psi}_{np} = \omega\hat{t} = -\frac{d\varphi}{d\hat{t}}\hat{t} \qquad (8)$$

The resulting relationship is the tempo differential equation.

Multiplying the tempo by the speed of light, we obtain the velocity formula u:

$$u = c\dot{\psi}_{np} = \omega \cdot c\hat{t} \qquad (9)$$

Thus, the magnitude of the direct tempo is expressed through the angular velocity and is involved in the rotation of the vector $c\hat{t}$.

Let us give a method for determining angular velocity. To do this, we need to know the law of change of angle φ over time $\hat{t}$. This follows from the solution of equation (9), presented in differential form:

$$u = c\dot{\psi}_{np} = c \cdot tg\frac{\varphi}{2} = \omega \cdot c\hat{t} = -\frac{d\varphi}{d\hat{t}}\hat{t} \qquad (10a)$$

Separating the variables, we get:

$$-ctg\frac{\varphi}{2}d\varphi = \frac{d\hat{t}}{\hat{t}} \qquad (10b)$$

The solution depends on the initial conditions. Their choice depends on the half-period of time $\hat{t}$ in which the process of cause-effect interaction occurs.

From the vector diagram in Figure 2, it is clear that the action of time can be viewed as two half-periods. The first half-period is associated with the left side of the diagram. The second half-period is associated with the right side. It continues the first and completes the action of time $\hat{t}$. For further calculations, we will consider the process in the second half-period. Therefore, we select the initial conditions: $\varphi(0) = \varphi_0$, $t(0) = \theta_0$.

We integrate for the period $\hat{t}_2$:

$$-2\int_{\varphi_0}^{\varphi} ctg\frac{\varphi}{2}d(\frac{\varphi}{2}) = \int_{\theta_0}^{t_2}\frac{d\hat{t}}{\hat{t}}$$

After taking the integrals, we obtain:

$$\ln(\frac{\sin^2\frac{\varphi_0}{2}}{\sin^2\frac{\varphi}{2}}) = \ln\frac{\hat{t}_2}{\theta_0} \qquad (10v)$$

From this follows the desired dependence of time $\hat{t}_2$ on angle φ 2:

The further solution of the equation depends on the initial value of the sine of the angle. The sine is involved in the formation of the rate of time, which can be represented as the peripheral velocity.

$$c_2 = c\sin\alpha_0 = \omega_0 R\sin\alpha_0 = \omega_0 \times r \qquad (11)$$

As stated above, nature chose the hydrogen atom, consisting of a proton and an electron revolving around it in its first stationary orbit, as the unchanging structure in space. The electron's circumferential velocity is

$$v_e = c\alpha_e$$

Where $\alpha_e = 1/137{,}036$ -fine structure constant; c - speed of light.

By equating the passage of time to the specified speed, we obtain an equation for determining the sine:

$$v_e = c\alpha_e = c_2 = c\sin\alpha_0 \qquad (12)$$

It follows from this that

$$\frac{c_2}{c} = \sin\alpha_0 = \alpha_e$$

We get the value of the angle in degrees.

$$\alpha_0 = arc\sin\alpha_e arc\sin\frac{1}{137{,}036} = 1{,}273628278 \cdot 10^{-4\circ} \qquad (13)$$

And also, the initial value of the angle $\varphi_0 = 2\alpha_0$

From (12) the initial condition is found for для $\sin^2(\varphi_0/2)$:

$$\sin^2\frac{\varphi_0}{2} = \sin^2\alpha_0 = \alpha_e^2$$

Thus, N.A. Kozyrev's statement about the magnitude of the passage of time is confirmed.
From (10c) follows the dependence of the sine of angle φ on time $\hat{t}$:

$$\sin\frac{\varphi}{2} = \sqrt{\frac{\theta_0\alpha_e^2}{\hat{t}_2}}$$

From it we find the half-angle function:

$$\frac{\varphi}{2} = \arcsin\sqrt{\frac{\theta_0\alpha_e^2}{t}} = arctg(\sqrt{\frac{\theta_0\alpha_e^2}{\hat{t}_2}}\frac{1}{\sqrt{1-(\sqrt{\frac{\theta_0\alpha_e^2}{\hat{t}_2}})^2}}) = arctg(\frac{\sqrt{\theta_0\alpha_e^2}}{\sqrt{\hat{t}_2 - \theta_0\alpha_e^2}}) \qquad (14a)$$

Knowing the angle function, we determine the tangent of a half-angle. After some transformations, we arrive at the following relationship:

$$\dot{\psi}_{np} = tg\frac{\varphi}{2} = \sqrt{\frac{\theta_0\alpha_e^2}{\hat{t}_2 - \theta_0\alpha_e^2}} \qquad (14b)$$

With its help we find the angular velocity function from (10a):

$$\omega = \frac{tg\frac{\varphi}{2}}{\hat{t}_2} = \frac{\sqrt{\frac{\theta_0\alpha_e^2}{\hat{t}_2 - \theta_0\alpha_e^2}}}{\hat{t}_2} \qquad (14v)$$

Since the angle is $\frac{\varphi}{2} = \alpha$, we write the general formula (14c) as a function of the angular α

$$\omega = \frac{tg\alpha}{\hat{t}_2} = \frac{\sin\alpha}{\hat{t}_2 \cdot \cos\alpha} = \frac{c\sin\alpha}{c\hat{t}_2 \cdot \cos\alpha} \qquad (15)$$

The Magnitudes of the Time Courses Applied to the Initial Cause

From Figure 2, it is clear that the initial cause is located at point M. We associate its position with the cone formed by the rotation of the duration vector t around axis τ'. We associate the rotation of the vector with the nucleus of the hydrogen atom—the proton. The rotation occurs with a peripheral velocity c_3, which we will consider the second time course acting on cause M.

The author has established that the flow of time c_3 arises in the Universe through the transition of space-time through several states, accomplished by rotating the coordinate system by a particular angle determined by a set of universal constants. During this change of state, the total mass of the Universe, concentrated at a single point, remains constant. The value of c_3 is determined by the formula:

$$c_3 = \frac{81}{4}\cdot\sqrt{\frac{\alpha_e}{3}}\cdot\frac{2}{3}c\alpha_e = 0,998727626\cdot\frac{2}{3}v_e = 0,998727626\cdot\frac{2}{3}c_2 \quad (16)$$

As we can see, it is very close to the value $c_3 = (2/3)v_e$, which we will take as the main value of the second time course. In addition to time course , time course will also act on cause M. In a hydrogen atom, it determines the circular linear velocity of the electron's rotation at the first stationary orbit $r_{1am} = r_e/\alpha_e^2$. Rotation occurs with an angular velocity , which is included in the linear velocity formula:

$$c_2 = v_e = \omega_e \cdot r_{1am}$$

and is determined by the value

$$\omega_e = \frac{v_e}{r_{1am}} \quad (17a)$$

According to the angular velocity formula (6), obtained with a minus sign, the angular velocity found has a negative sign. Its graphical representation is a pseudovector applied to the point of origin in a left-handed coordinate system. The course of time itself c_2, by definition of N. Kozyrev, is a positive pseudoscalar in a left-handed coordinate system [1].

To find the angular velocity over time $c_3 = \omega_3 r_3$, we need to know the radius of rotation of circle r_3. To find it, let's look at Figure 2. It shows that both cones have the same height, equal to the projection $oM = \hat{\tau}$ of vectors t and t. It can be expressed in two ways through the radii of both circles r_{1am} and r_3:

$$\frac{oM}{r_{1am}} = ctg\varphi \text{ и } \frac{oM}{r_3} = ctg\alpha$$

Let's make an equation:

$$oM = r_{1am}\cdot ctg\varphi = r_3\cdot ctg\alpha$$

From it we find

$$r_3 = \frac{ctg\varphi\cdot r_{1am}}{ctg\alpha} = \frac{ctg2\alpha}{ctg\alpha}\cdot r_{1am} = \frac{1-tg^2\alpha}{2tg\alpha}\cdot tg\alpha\cdot r_{1am} = \frac{1-tg^2\alpha}{2}\cdot r_{1am}$$

We apply the found value of angle $\alpha_0 = 1,273628278\cdot10^{-4\circ}$. For the tangent value, we have $tg\alpha_0 = tg(1,273628278\cdot10^{-4\circ}) = 2,22290069\cdot10^{-6}$. Squaring the tangent, we obtain approximately $5\cdot10^{-12}\to 0$ Thus, the second term in the numerator can be neglected with a high degree of accuracy. As a result, we obtain the value of the radius

$$r_3 = \frac{1}{2}\cdot r_{1am} \quad (17b)$$

We find the angular velocity from the second time course:

$$\omega_3 = \frac{c_3}{r_3} = \frac{4}{3}\frac{v_e}{r_{1am}} = \frac{4}{3}\omega_e \quad (17v)$$

The angular velocity is positive and defined as a positive pseudovector in a right-handed coordinate system.

Thus, the point of origin is affected by two angular velocities, depicted in the diagram as two oppositely directed pseudovectors along the $\hat{\tau}$-axis. We define the resulting angular velocity as the algebraic sum of the lengths of these pseudovectors:

$$\Omega_{np} = -\omega_e + \omega_3 = -\omega_e + \frac{4}{3}\omega_e = \frac{\omega_e}{3} \quad (17g)$$

We define the resulting course of time as the difference between the found courses

$$\Delta c = -c_2 + c_3 = -v_e + \frac{2}{3}v_e = -\frac{1}{3}v_e \quad (17d)$$

Let's express it in terms of linear velocity:

$$\Delta c = -\frac{1}{3}v_e = -\frac{1}{3}\omega_e r_{1am} = -\Omega_{np}\cdot r_{1am} \quad (17e)$$

As we can see, with the same radius of the atomic orbit, we have a resulting speed of time that is clearly not related to Bohr's theory.

Application of the Direct Tempo Function to study the Initial Cause-and-Effect Link

We apply the angular velocity function (15) to the initial cause-and-effect link located on the right side of the vector diagram in Figure 2. We will consider its occurrence as the result of the second half-period of time . Before applying it, we provide the following clarifications.

By $\hat{t}_2$ we mean vector $\hat{t}_2 = k'\vec{m}$, inclined to the vertical axis at an angle of α and tending to reach the effect point. The sine of angle α is the sine equal to the constant α_e.

We introduce Kozyrev's notation for intervals of time and space associated with the cause point M using the symbol δ.

$$Mk' = \delta\hat{l} = c\hat{t}_2\cdot\cos\alpha_0 = r_{1am};\ Mm = \delta\hat{s} = \delta l\cdot tg\alpha_0 = r_{1am}\cdot tg\alpha_0 \quad (18a)$$

The introduced notations can be expressed through the speed of light directed along the time vector and time intervals along these axes:

$$\delta\hat{l} = c\hat{t}_2\cdot\cos\alpha_0 = c\cdot(\hat{t}_2\cos\alpha_0) = c\cdot\Delta\psi \text{ и } \delta\hat{s} = c\hat{t}_2\cdot\sin\alpha_0 = c\cdot(\hat{t}_2\sin\alpha_0) = c\cdot\Delta\tau \quad (18b)$$

Let us check formula (15) under the initial conditions by writing it in the form:

$$\omega = \frac{tg\alpha_0}{\hat{t}_2} = \frac{c\sin\alpha_0}{c\hat{t}\cdot\cos\alpha_0} = \frac{v_e}{\delta\hat{l}} = \frac{c}{c\hat{t}_2}\sqrt{\frac{\theta_0\alpha_e^2}{\hat{t}_2 - \theta_0\alpha_e^2}} \quad (18v)$$

Where $c\sqrt{\dfrac{\theta_0\alpha_e^2}{\hat{t}_2-\theta_0\alpha_e^2}}=\dfrac{c\alpha_e}{\sqrt{\dfrac{\hat{t}_2}{\theta_0}-\alpha_e^2}}=\dfrac{c\alpha_e}{\sqrt{\dfrac{\theta_0}{\theta_0}-\alpha_e^2}}=\dfrac{v_e}{\sqrt{1-\sin^2\alpha_0}}=\dfrac{v_e}{\cos\alpha_0}$

As we can see, it satisfies the linear velocity formula for the first time course at $\omega=\omega_e$:

$$c_2=v_e=\omega\delta\hat{l}=\omega_e r_{1am} \qquad (18g)$$

We will connect further research with the equation of tempo (10a). We will express it in terms of the introduced intervals of space and time and the ratio of velocities

$$\dot{\psi}=\omega_e\hat{t}_2=tg\alpha_0=\frac{\delta\hat{s}}{\delta l}=\frac{c\sin\alpha_0}{c\cos\alpha_0}=\frac{c\alpha_e}{c\cos\alpha_0}=\frac{v_e}{u_0}$$

Where $v_e=c_2$ the first course of time; $u_0=c\cos\alpha_0$ - velocity directed along a spatial interval From the formula follows expression $\delta\hat{s}$ through the first course of time.

$$\delta\hat{s}=\omega_e\delta l\cdot\hat{t}_2=c_2\hat{t}_2 \qquad (18d)$$

Let us express the rate through the resulting characteristics of the cause, namely: speed Δc and angular velocity Ω_{np}.

$$tg\alpha_0=\frac{\delta\hat{s}}{\delta l}=\frac{\Omega_{np}\cdot\delta\hat{s}}{\Omega_{np}\cdot\delta l}=\frac{\Omega_{np}\cdot\delta\hat{s}}{\Delta c}=\frac{v_e}{u_0}$$

Where $\Delta c=\Omega_{np}\cdot\delta l=\Omega_{np}r_{1am}$ - the resulting course of time.

From the obtained relation we find $\delta\hat{s}$.

$$\delta\hat{s}=\Delta c\frac{v_e}{\Omega_{np}u_0}=\Omega_{np}r_{1am}\frac{v_e}{\Omega_{np}u_0}=r_{1am}\frac{v_e}{u_0}=r_{1am}\frac{c\sin\alpha_0}{c\cos\alpha_0}=\frac{r_{1am}}{\sin\alpha_0}\cdot\frac{\sin^2\alpha_0}{\cos\alpha_0} \qquad (19a)$$

Let's transform it into the form using (12e):

$$md=c\Delta t=\delta\hat{s}\cdot\sin\alpha_0=c_2\hat{t}_2\cdot\sin\alpha_0=c_2\Delta\tau=r_{1am}\cdot\frac{\sin^2\alpha_0}{\cos\alpha_0} \qquad (19b)$$

The resulting segment md is located on vector $\hat{t}_2$ and is a leg of right triangle mdM in Figure3.

Taking into account that $r_{1am}=r_e/\alpha_e^2$ we transform the obtained expression to the form:

$$c\Delta\hat{t}=\delta\hat{s}\cdot\sin\alpha_0=c_2\Delta\tau=r_{1am}\cdot\frac{\sin^2\alpha_0}{\cos\alpha_0}=\frac{r_e}{\alpha_e^2}\cdot\frac{\sin^2\alpha_0}{\cos\alpha_0}=\frac{r_e}{\alpha_e^2}\cdot\frac{\alpha_e^2}{\cos\alpha_0}=\frac{r_e}{\cos\alpha_0} \qquad (19v)$$

How do we find the height of a triangle mdM.

$$r_e=c\Delta t\cos\alpha_0=u_0\cdot\Delta t \qquad (19g)$$

In the physical plane, r_e is the classical radius of the electron.

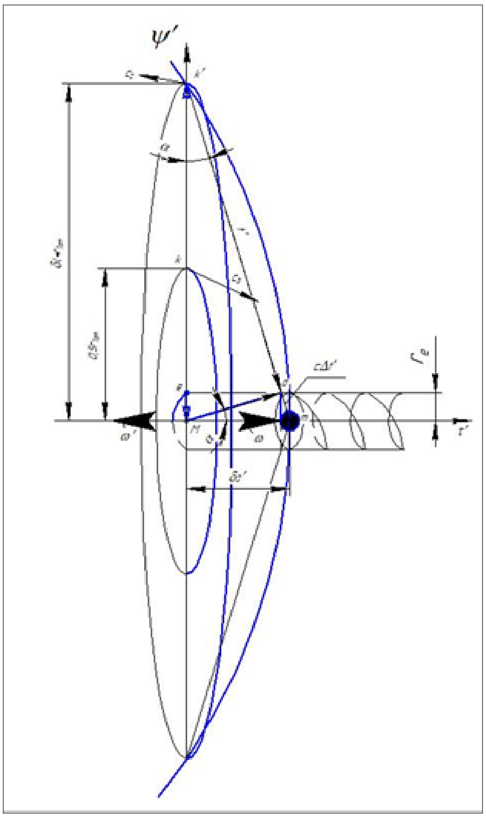

Figure 3: Initial Cause-and-Effect Link

Thus, formula (13b) proves that the time interval 1 between cause and effect is overcome with the help of the passage of time , as predicted by N. Kozyrev.

But from Figure 3, it's clear that the effect point lies on the proper time axis and can no longer participate in the formation of the cause-and-effect chain of events, since the initial link is finite in time and does not exist in space. So, what begins to form the cause-and-effect chain? The answer lies in the radius , defined by formula (13g).

Let's show that it is associated with screw motion. To prove its occurrence, consider formula (10c). Apply the initial condition found for the angle to it $\frac{\varphi_0}{2}=\alpha_0$. The formula will look like this:

$$\hat{t}_2=\frac{\theta_0\sin^2\alpha_0}{\sin^2\alpha}$$

Let's transform it into the form:

$$\frac{\hat{t}_2}{\theta_0}=\frac{\sin^2\alpha_0}{\sin^2\alpha}=\frac{c^2\sin^2\alpha_0}{c^2\sin^2\alpha}=\frac{c^2\alpha_e^2}{c^2\sin^2\alpha}=\frac{v_e^2}{c^2\sin^2\alpha}$$

Where

$$\frac{c^2\sin^2\alpha}{c\theta_0}=\frac{c\sin^2\alpha}{\theta_0}=\frac{c\theta_0\sin^2\alpha}{\theta_0^2}=\omega_0^2\cdot c\theta_0\sin^2\alpha=\omega_0^2\cdot r_y=\frac{v_e^2}{c\hat{t}} \qquad (20a)$$

Here: $r_y=c\theta_0\sin^2\alpha$ is the radius of the cylindrical helix;

$c\hat{t}=c\theta_0$ is the radius of curvature of the helical line.

Thus, we arrive at the equation for acceleration in a helical line.

To finally determine the parameters, we introduce the following notation:

$$r_ц = c\theta_0 \sin^2 \alpha = r_e; \quad \sin^2 \alpha_0 = \alpha_e^2; \quad \frac{1}{\theta_0} = \omega_0$$

From the formula for $r_ц$ we find θ_0:

$$\theta_0 = \frac{r_ц}{c \sin^2 \alpha} = \frac{r_e}{c\alpha_e^2} = \frac{r_{1am}}{c}$$

Where,

$$c\hat{t} = c\theta_0 = r_{1am} \qquad и \qquad \frac{1}{\theta_0} = \omega_0 = \frac{c}{r_{1am}}$$

Then the acceleration equation (20a) in a helical line will take the form:

$$\omega_0^2 \cdot r_e = \frac{v_e^2}{r_{1am}} \tag{20b}$$

Between radii r_e and r_{1am} the condition for a helical line is satisfied:

$$\sin^2 \alpha = \frac{r_e}{r_{1am}} = \frac{r_e}{\frac{r_e}{\alpha_e^2}} = \alpha_e^2 = \sin^2 \alpha_0$$

Which particle is moving along a helical line? To answer this question, we multiply both sides by the electron's mass and arrive at the force equation.

$$m_e\omega_0^2 \cdot r_e = \frac{m_e v_e^2}{r_{1am}} \tag{20v}$$

As a result, we obtained a force equation for an atom involving an electron.

It lacks the square of the electric charge. This can be obtained by rearranging the right-hand side:

$$\frac{m_e v_e^2}{r_{1am}} = m_e c^2 \frac{\alpha_e^2}{r_{1am}} = \frac{e^2}{r_e} \cdot \frac{\alpha_e^2}{r_{1am}} = \frac{e^2}{\frac{r_e}{\alpha_e^2}} \cdot \frac{1}{r_{1am}} = \frac{e^2}{r_{1am}^2} \tag{20g}$$

The situation is similar with the left side:

$$m_e\omega_0^2 \cdot r_e = m_e c^2 \cdot \frac{r_e}{r_{1am}^2} = \frac{e^2}{r_e} \cdot \frac{r_e}{r_{1am}^2} = \frac{e^2}{r_{1am}^2} \tag{20d}$$

Thus, we arrive at the condition of force equilibrium in a hydrogen atom located in the first stationary orbit. The equation states that the electron is simultaneously involved in two motions. The first motion is in space with a linear velocity equal to the passage of time c_2. The second motion is helical in time $\hat{\tau}$, in which c_2 is the absolute velocity of motion along a helical line with a radius of curvature equal to the radius of the first stationary orbit.

Thus, the electron's helical motion forms a cause-and-effect chain of events, ensuring the atom's stability in space-time.

Unfortunately, the above reasoning doesn't fit into a vector cause-and-effect diagram. It shows that the electron must be in two places simultaneously: rotating in a circle of radius r_{1am} and moving to a circle of radius r_e, separated from the first by a distance proportional to the initial cause-and-effect link $\Delta\hat{\tau}$.

This contradiction can be resolved if we assume that it is not the electron but the antineutrino that is involved in the formation of the cause-and-effect link. An antineutrino always appears paired with an electron. It is a particle devoid of electric charge and has a very small mass. The author in [3] has already given a value for the mass of an antineutrino equal to

$$\mu_\nu = m_e \alpha_e^2 \tag{21}$$

Taking this into account, equation (20d) can be transformed as follows:

$$m_e\omega_0^2 \cdot r_e = \frac{m_e v_e^2}{r_{1am}} = \frac{m_e c^2 \alpha_e^2}{r_{1am}} = \frac{\mu_\nu c^2}{r_{1am}}$$

Then the left side will look like this:

$$m_e\omega_0^2 \cdot r_e = \frac{m_e}{r_{1am}^2} c^2 \cdot r_e = \frac{m_e}{r_{1am}\frac{r_e}{\alpha_e^2}} c^2 \cdot r_e = \frac{m_e\alpha_e^2}{r_{1am} r_e} c^2 \cdot r_e = \frac{\mu_\nu}{\frac{r_e}{\alpha_e^2} r_e} c^2 \cdot r_e = \mu_\nu \frac{c^2\alpha_e^2}{r_e^2} \cdot r_e = \mu_\nu \omega_\nu^2 \cdot r_e \tag{22}$$

Where

$\omega_\nu^2 = \frac{c^2\alpha_e^2}{r_e^2} = \frac{v_e^2}{r_e^2} = \frac{c^2\alpha_e^2}{\alpha_e^2 n_e^2 \ell_0^2} = \frac{c^2}{n_e^2 \ell_0^2}$ the square of the angular velocity of an antineutrino when moving along a helical cylindrical line:

Here: ℓ_0 - Planck length; n_e - number of electron masses in the Planck mass [3].

The neutrino equation perfectly explains the causal chain of events occurring along the proper time axis. The chain consists of a number of antineutrino revolutions separated by a helical pitch. The pitch of the helical pitch is determined by the formula:

$$h = 2\pi r_e ctg\alpha_0$$

Where $ctg\alpha_0 = ctg(1,273628278 \cdot 10^{-4\circ}) = 449862,6523$

Then

$$h = 2\pi r_e ctg\alpha_0 = 2\pi \cdot 2,817938 \cdot 10^{-13} \cdot 449862,6523 = 7,965100159 \cdot 10^{-7} см \tag{23}$$

Let us show that the formation of a helical line is associated with the curvature of spacetime near the causal point. Before solving differential equation (10b), we already mentioned that the result depends on the choice of initial conditions. Initial condition $t(0) = \theta_0$ was chosen, resulting in a solution in the form of function (10c). This choice marks the end of the second half-period of time, which was considered in examining the right-hand side of the vector diagram. Its result was motion along a cylindrical helical line.

Let's now consider the changes that occurred during the first half-period on the left side of the diagram. To do this, we solve differential equation (10b) under the initial conditions $\varphi(0) = \varphi_0$ $t(0) = \theta_0 / 2$ · As a result, we obtain a solution in the form

$$\hat{t}_1 = \frac{\theta_0 \sin^2 \alpha_0}{2\sin^2 \frac{\varphi}{2}} \tag{24a}$$

Using the found values $c\theta_0 = r_{1am}$ and $\sin\alpha_0 = \alpha_e$, let's write the function as follows:

$$c\hat{t}_1 = \frac{r_{1am}\alpha_e^2}{2\sin^2 \frac{\varphi}{2}} = \frac{r_e}{2\sin^2 \frac{\varphi}{2}} \tag{24b}$$

Vector $c\hat{t}_1$ should be considered a polar radius—a vector defined in coordinates $\hat{s}$ and $\hat{l}$ We'll show that in this form it describes a left-hand parabola. We'll place the coordinate origin at point M. We'll transform the function to the following form:

$$c\hat{t}_1 = \frac{r_e}{2\sin^2 \frac{\varphi}{2}} = \frac{r_e}{1-\cos\varphi} = \frac{r_e}{1-\frac{\hat{s}}{c\hat{t}_1}} = \frac{r_e}{c\hat{t}_1 - \hat{s}} c\hat{t}_1$$

Reducing, we get:

$$c\hat{t}_1 = \sqrt{\hat{s}^2 + \hat{l}^2} = \hat{s} + r_e$$

After the transformation, we arrive at the left parabola function:

$$\hat{s} = \frac{\hat{l}^2}{2r_e} - \frac{r_e}{2} \tag{25}$$

For the first half-period, we consider only the upper left part of the parabola, bounded on the spatial axis by segment Me . Then the origin, placed at point M of the cause, will be its focus. From a physical perspective, a curvature of space-time arises on the left side of the point of the cause, i.e., in the first half-period. This curvature causes an emission of energy in the form of an antineutrino from the focal point, where the cause is located. The emission is shown in Figure 3 as vector $\vec{Md}$. Vector reaches the line of action of vector ct_2 and intersects it. The vertical projection of vector $\vec{Md}$ is equal to dimension r_e, which in this case is the radius of the cylindrical helix. The antineutrino then begins to move along the cylindrical helix.

Conclusion

The considered model of the interaction between cause and effect can be compared with the process of neutron decay [5]. As is known, the neutron is an unstable particle with a lifetime of about 15 minutes. The reason for its decay is unknown. It is only known that its decay occurs with the participation of an intermediate vector boson in the following manner. First, the neutron, whose mass is concentrated at the point emits a negatively charged boson W^-. On the diagram it is at the cause point M. After this, the neutron turns into a proton:

$$n \rightarrow p + W^-$$

Due to its large mass, boson W^- curves space-time into the upper part of a left-hand parabola and transforms into energy. The energy is reflected from point located on the spatial axis, to the focus of the parabola and is emitted from the point of origin as the energies of an electron and antineutrino:

$$W^- \rightarrow e^- + \tilde{\nu}_e$$

Where is the antineutrino moving? From the vector diagram in Figure 2, it is clear that the helical motion is directed into the future along the positive direction of axis $\hat{\tau}$. In the future is the chronal graviton field surrounding the mass concentrated at point o'. This is the mass of the antineutron. The antineutrino seeks to compensate for the spatial energy of this field, which was initially expended to establish a temporal connection with mass o, which is the mass of the neutron. The diagram shows this compensation as the arrival of an antineutrino along a helical line on spatial axis $\hat{l}$. The energy of the antineutrino $\mu_e c^2$ then travels to point A on the sphere. From there, the energy is reflected to the center of the sphere as vector Ao', where the antineutron's mass is concentrated. From the center of the sphere, the antineutron again reflects energy, but this time as a neutrino along vector $o'A'$.

From the above, it follows that the cause of the decay of a neutron in the past is its causal relationship with an antineutron in the future. The material carriers of this relationship are neutrinos and antineutrinos.

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