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PHYSICAL NATURE OF LOBACHEVSKY PARALLEL LINES AND A NEW INERTIA SYSTEM COORDINATE TRANSFORMATION

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1 Introduction

In modern high energy physics the Lobachevsky velocity space is widely used for particle scattering processes investigations. In spite of that the physical nature of Lobachevsky parallel lines (LPL) is still absent. As the existence of LPL is based on the Euclidean V postulate denial, then a physical foundation for its violation is also absent. At the present time LPL have a geometrical interpretation only either as infinite lines on a pseudospherical surface, or as hordes on an euclidean circle [1].

An exposing a physical nature of LPL and withdrawing the first obvious consequences from established to LPL corresponding processes are results of further developing of main ideas in [2] and presented in this paper.

It is reasonable to sketch some general remarks on our approach. Let us consider light propagation on the base of the Huygens principle and on the light beams independence law. So, light phenomena of diffraction and interference are omitted. Also, let us accept the constant light velocity principle. Let us imply that anyone is familiar with Lobachevsky geometry [1, 3].

There is a special remark for Huygens principle: a time moment of emitting a secondary light sphere (halfsphere) from any point, reached by a light front, can be taken as the initial (zero) moment of time counting for that point.

Let us use the same plane light fronts as used to explain the light reflection and refraction phenomena.

2 The physical nature of Lobachevsky parallel lines

Let us have two inertia systems K and K_s and one (K_s) is moving relatively the other with some velocity V. Both systems may be associated somehow with corresponding particles. As usual, all space axises of the both systems are parallel and the motion goes along X-axis of the K. Let us assume that when the origins O and O_s of both systems coincide, then a plane light front (side beam directed from down to up in some plane, for instance in XY) hits the point O under a parallel angle to the X-axis (see Fig.1a):

$$\cos\theta_L \equiv \cos\Pi(\rho/k) = th(\rho/k) = V/c \equiv \beta, \qquad (k = c) \tag{1}$$

and a light sphere (halfsphere to the falling front) starts to spread out from the O (here β is a velocity V in units of c, ρ/k is a rapidity in units of $k = c$, $\Pi(\rho/k) \equiv \theta_L$ is a parallel angle, k is Lobachevsky constant, c is a light velocity). The second equality $\beta = th(\rho/c)$ in (1) is known from the Beltarami model [1] and used in physics to define particle rapidity:

$$\rho/c = 1/2\ln\left((1+\beta)/(1-\beta)\right). \tag{2}$$

The first equality in (1) can be rewritten in the form:

$$\theta_L \equiv \Pi(\rho/k) = 2arctg\, e^{-\rho/c}, \tag{3}$$

known as Lobachevsky function. It is seen from (1) that for any rapidity (or/and for any velocity) there is a definite angle θ_L. For negative argument of the Lobachevsky function the parallel angle is $\pi - \theta_L$ [1]. So, this case corresponds to $\cos(\pi - \theta_L) = -\cos\theta_L = -V/c$ the same velocity, but in the opposite direction.

Let us have an event $(x = Vt, t)$ in the K. Then the side beam hits a given x-point in the moment of time t_F (see Fig.1a):

$$ct_F = x\cos\theta_L = Vt\cos\theta_L = ct\cos^2\theta_L, \tag{4}$$

i.e., later than origin O, and a new light sphere starts to spread out from a given x-point. By a given moment of time t a new sphere spreads up to the distance (or radius) ct_s:

$$ct_s = ct - ct_F = ct - x\cos\theta_L = ct - xV/c, \qquad t_s = t - xV/c^2, \tag{5}$$

and for $x = Vt$:

$$ct_s = ct - ct\cos^2\theta_L = ct\sin^2\theta_L = ct(1 - V^2/c^2), \tag{6}$$

where ct is the light sphere radius from origin O, so that $ct_s < ct$. It is obvious that the origin O_s of the K_s displaces along X on the distances Vt.

Let us choose from these two spheres two light rays: one is ct from O under the angle θ_L to the X-axis in some plane, the other is ct_s from O_s (from the given x) perpendicular to the X-axis in the same plane (see Fig.1a). These three segments ct, Vt and ct_s form some kind of a rectangular triangle. But sides ct and ct_s have no common (intersection) point for any moment of time t, so they are parallel in any chosen euclidean plane. As a rapidity for c is an infinity (see (2)), then this retired triangle transforms into LPL, or more precisely, into parallel lines in one side on the Lobachevsky plane in the velocity space (see Fig.1b).

Thus, the LPL in a velocity space corresponds to the light rays ct and ct_s emitted from different points and different times and synchronized by Huygens principle with particle motion Vt. The physical reason of intersection point absence is the time delay t_F (see (4)). This time is obviously a physical foundation for V postulate denial.

To find out light rays corresponding to LPL in another side, one should use analogous consideration with a side beam directed to another side (from up to down) in the same plane (see Fig.2a and Fig.2b). To find out light rays corresponding to the LPL for negative argument of Lobachevsky function (for $V < 0$ in the both sides), one should use side beams directed oppositely X-axis, i.e. from the right to the left (the previous ones for $V > 0$ were directed from the left to the right), see Fig.2c and Fig.2d. The full picture in the euclidean plane corresponding to the LPL on a plane in the velocity space is presented in Fig.3.

Thus, a moving system ($V > 0$ or $V < 0$) is associated with a definite side light beams. For a rest system $V = 0$ and the rest system is associated with a straight beams as in this case $\theta_L = \pi/2$ (see (1) and Fig.2). The physical nature of Lobachevsky parallel lines reveals a new way to solve the main difficulty in relativity - the problem to define the moments of time for different space points.

3 x, t - coordinate transformation and light ether conception

Let us continue the previous consideration of two inertia systems K and K_s ($V > 0$). Let us assume that a straight beam hits X-axis in the same moment of time when a side beam hits a point where the both origins coincide. Then all x-points (including O) are "fired" simultaneously due to the straight beam and this moment of time is usually taken as the initial one for the K system. Relatively the side beam the initial moment of time for any x-point is shifted by the delay time t_F (see (4)). The time t_s in a given x-point (in K) by a given moment of time t (in K) is defined by (5). Thus, due to synchronization K and K_s systems any x point has two times: t and t_s. As the velocity of K_s is known then t_s depends only on a chosen event.

Let us measure time moment t in the rest frame through the distance of light ray ct emitted from the point O under the parallel angle to X-axis in some plane. Then for any event (x, t) the delay time ct_F is just a projection of the given x on the chosen light ray ct (see Fig.1-Fig.4). It is obvious, that the K_s origin displacement $Vt = ctcos\theta_L$ is just a projection of light ray ct on the X-axis. So, a given x by a given time t has a value x_s relative to the origin O_s:

$$x_s = x - Vt = x - ct\cos\theta_L\,. \tag{7}$$

For any event ($x = Vt, t$) a relative coordinate is $x_s = 0$. It means that time t_s (see (5) and (6)) is a proper time of K_s - the time "measured" by means of the "moving watch". An observer in K sees light sphere with radius ct and in the same time t a moving observer sees another light sphere with radius ct_s. Thus, for any event (x, t) in K the corresponding coordinates for K_s one can find as simple shifts (see (5) and (7)). To find out the values of shifts, one should produce the mentioned above symmetrical projections.

Let us use the established symmetry to find out Lorentz coordinates x' and t' for a moving system. To get them, one should find the crossing point O' of two perpendiculars producing the mentioned projections (see Fig.4). Then the length of the side from O' up to the x corresponds to x':

$$x' = (x - ct\cos\theta_L)/\sin\theta_L = (x - Vt)/\sqrt{1 - V^2/c^2}\,, \qquad x_s = x'\sin\theta_L\,, \tag{8}$$

and the length of the side from O' up to the ct corresponds to ct':

$$ct' = (ct - x\cos\theta_L)/\sin\theta_L = (ct - xV/c)/\sqrt{1 - V^2/c^2}\,, \qquad ct_s = ct'\sin\theta_L\,. \tag{9}$$

It is seen from (8) and (9) that primed and shifted coordinates are related as corresponding projections. But the point O' which is always accepted as the origin of the moving system does not coincide in space with O_s. It is also seen that x'-coordinate is not parallel to the X-axis. So, it seems obvious that primed values can't be accepted as coordinates of a moving system.

Now, let us see the length of a side between the given points x and ct (dashed line in Fig.4). It can be obviously written through the primed and unprimed values:

$$l^2 = c^2t^2 + x^2 - 2ctx\cos\theta_L = c^2t'^2 + x'^2 + 2ct'x'\cos\theta_L, \tag{10}$$

or as a sum of two terms, either as: $l^2 = s_1^2 + s_2^2$ (for that one should add $\pm x^2$ to the left part of (10) and $\pm x'^2$ to the right part of it), or as: $l^2 = -s_1^2 + s_3^2$ (for that one should add $\pm c^2t^2$ to the left part of (10) and $\pm c^2t'^2$ to the right part of it), where:

$$s_1^2 = c^2t^2 - x^2 = c^2t'^2 - x'^2 = \gamma^2(c^2t_s^2 - x_s^2), \qquad \gamma = 1/sin\theta_L = 1/\sqrt{1 - V^2/c^2}. \tag{11}$$

$$s_2^2 = 2x(x - ct\cos\theta_L) = 2x'(x' \pm ct'\cos\theta_L), \qquad s_3^2 = 2ct(ct - x\cos\theta_L) = 2ct'(ct' \pm x'\cos\theta_L). \tag{12}$$

Term s_1^2 is known as an invariant interval. It is seen that it is only a part of full length l^2 and, that this part is a result of cancelling of two equal values either s_2^2, or s_3^2 in the possible expressions for l^2. Terms s_2^2 and s_3^2 may differ by sign: (+) corresponds to the case when the point O' is inside and (-) when it is outside of the angle θ_L. For an event $(x = Vt, t)$ both terms are equal to zero (as $x' = x_s = 0$) and $s_1^2 \equiv l^2$. Just for this case the Lorentz coordinate transformation are usually proved in manuals (for instance, see [4]).

By using second formulas in (8-9) one can find from (12):

$$x = (x_s + ct_s\cos\theta_L)/\sin^2\theta_L = (x_s + Vt_s)/(1 - V^2/c^2), \tag{13}$$

$$ct = (t_s + x_s\cos\theta_L)/\sin^2\theta_L = (ct_s + Vx_s/c)/(1 - V^2/c^2), \tag{14}$$

just the back transformation from the moving system to the rest one. To be sure of that, one have to solve a system of (5) and (7) relatively x and ct. To make a geometrical meaning of the last formulas more clear, it is useful to insert the factor $1/sin\theta_L$ into brackets (then terms in brackets are lengths of perpendiculars corresponding the above mentioned projection symmetry).

As seen from (5),(7) and (13-14) that the straight and back transformations are different: back formulas could not be taken by changing V on $-V$. It means that one knows either that system moves, or it is in the rest. As it was shown, changing V on $-V$ one should also choose an appropriate side light beam direction for a moving system. So, if K_s moves in the backward to X direction ($V < 0$) one should change the sign in (5) and (7) and also in nominators of the back formulas (13-14). Thus, choosing the corresponding (to the known velocities) straight and side light beams, any two systems may be considered in a such way that one of them can be taken as a moving system and the other one as in the rest or vise versa.

The possible way to realize these opportunities is to make assumption that in the surrounded world there are a lot of light streams of any directions, something is like ether, but not in the rest - it is a moving light ether.

4 y, z - coordinate transformation and invariants

Let us have an event $(x, y, z = 0, t)$ in K system and the side light beam falls onto X-axis in XY-plane as shown in Fig.5, i.e., it falls from down to up and hits first of all the plane point (x, y) and then a point $(x, y = 0)$ on the X-axis (if y-coordinate has an opposite sign, then one can choose another side beam falling from up to down). A secondary light sphere spreads out from the first point up to the X-axis (up to a point $(x, y = 0)$) for a time y/c. The side beam's ray hits this point in a moment of time $y\, sin\theta_L/c$ (since the moment of time when secondary sphere starts to spread out from the first point). So, there is the light way difference:

$$c\Delta t \equiv \Delta y = y - y\sin\theta_L . \tag{15}$$

To compensate this difference and for an y-coordinate (in a moving system) to be in the same time as x_s, the origin of the K_s should be shifted along the Y-axis by value Δy defined by (15). Then an y-coordinate in K_s system is:

$$y_s = y - \Delta y = y\sin\theta_L = y\sqrt{1 - V^2/c^2} . \tag{16}$$

For another transverse coordinate z_s one can get:

$$z_s = z - \Delta z = z\sin\theta_L = z\sqrt{1 - V^2/c^2} \tag{17}$$

the same way. The back transformation is obvious:

$$y = y_s/\sin\theta_L = y_s/\sqrt{1 - V^2/c^2}, \qquad z = z_s/\sin\theta_L = z_s/\sqrt{1 - V^2/c^2} . \tag{18}$$

For the noninvariant interval (see(11)) by using the last formulas one can get:

$$c^2t^2 - x^2 - y^2 - z^2 = \gamma^2(c^2t_s^2 - x_s^2 - y_s^2 - z_s^2) . \tag{19}$$

As seen from Fig.4 the point O' looks as a center of projectivity and the X-axis with the chosen light ray ct may be considered as a projective lines [3]. Let us consider x and ct values as corresponding projective coordinates. The projectivity (or a projective transformation) establishes some definite correspondence, in particular, between the points of two projective lines. The main invariant for projectivity is a complex fraction of any four elements of some two multitudes, in particular, of any four corresponding points for any two projective lines [3]:

$$(x_1, x_2, x_3, x_4) = \frac{x_3 - x_1}{x_2 - x_3} : \frac{x_4 - x_1}{x_2 - x_4} = \frac{ct_3 - ct_1}{ct_2 - ct_3} : \frac{ct_4 - ct_1}{ct_2 - ct_4} = (t_1, t_2, t_3, t_4) . \tag{20}$$

According to the main projective geometry theorem the projectivity is known if any three corresponding elements are known. It means that, in this case for any given x one can find the corresponding t from (20) and vise versa. Let us see two simple cases.

1. There are three known events: $x_1 = 0$, $t_1 = 0$, $x_2 = Vt$, $t_2 = t$, $x_4 = \infty$, $t_4 = \infty$. Then the (20) becomes [3]:

$$(x_1, x_2, x_3, \infty) = \frac{x_3 - x_1}{x_2 - x_3} = \frac{t_3 - t_1}{t_2 - t_3} = (t_1, t_2, t_3, \infty) \tag{21}$$

and for any x_3 (or t_3) one can find corresponding t_3 (or x_3):

$$t_3 = x_3 t_2/x_2 = x_3/V, \qquad x_3 = Vt_3. \tag{22}$$

Obviously, this result corresponds to the projection of the X-axis onto the ct ray (and vise versa) by the beam of lines with the center at infinity - just as a straight light beam used for K system.

2. There are the three known events: $x_1 = 0$, $t_1 = 0$, $x_2 = x$, $t_2 = x cos\theta_L/c$, $x_4 = \infty$, $t_4 = \infty$. The same way one can get:

$$t_3 = x_3 cos\theta_L/c, \qquad x_3 = ct_3/cos\theta_L. \tag{23}$$

This result corresponds to the side projections with the center at infinity and with the direction turned by $\pi/2$ as it was used for K_s system.

Comparing (5),(7) and (22-23), one can note that the coordinate transformation from the K-system to the K_s is just the difference between the given values of x and ct and the corresponding results of the considered projectivities. So, the projectivity allows one to find the shift values. Other cases require further investigations.

Let us rewrite (20) as it follows:

$$\frac{(x_1,x_2,x_3,x_4)}{(t_1,t_2,t_3,t_4)} = \frac{\beta_{31}}{\beta_{23}} : \frac{\beta_{41}}{\beta_{24}} = 1, \qquad \beta_{ik} \cdot= \frac{x_i - x_k}{c(t_i - t_k)}, \tag{24}$$

and for each event (x_i, t_i) in (24) let us substitute the corresponding values expressed through coordinates of a moving system (see (13) and (14)). Then one can find:

$$\frac{\beta_{31}}{\beta_{23}} : \frac{\beta_{41}}{\beta_{24}} = \frac{\beta'_{31}}{\beta'_{23}} : \frac{\beta'_{41}}{\beta'_{24}} = 1, \qquad \beta'_{ik} = \frac{\beta_{ik} + V/c}{1 + \beta_{ik}V/c}, \tag{25}$$

that for any four corresponding (in the meaning of projectivity) events the complex fraction of their relative velocities is equal to unity either for the K, or K_s systems. The second formula in (25) is known as the relativistic velocity summation law and it follows in a usual way from (13) and (14).

Thus, instead of a noninvariant interval (19) there is a well known (main in the projective geometry) invariant (20) and (25).

5 Relativistic effects and wave character of the initial moment of time propagation

Let us have two events (x_1, t_1) and $x_2, t_2)$ in K system and corresponding to them two events (x_{s1}, t_{s1}) and (x_{s2}, t_{s2}) in K_s system. Then, according to a new transformation $(V > 0)$, one gets:

$$\Delta x_s = \Delta x - \Delta t cos\theta_L, \qquad c\Delta t_s = c\Delta t - \Delta x cos\theta_L, \tag{26}$$

for shifted and for unshifted coordinates:

$$\Delta x = (\Delta x_s + \Delta t_s cos\theta_L)/sin^2\theta_L, \qquad c\Delta t = (c\Delta t_s + \Delta x_s cos\theta_L)/sin^2\theta_L, \tag{27}$$

where $\Delta x_s = x_{s2} - x_{s1}$, $\Delta t_s = t_{s2} - t_{s1}$, and $\Delta x = x_2 - x_1$, $\Delta t = t_2 - t_1$. Let us also remind the relation between the primed and shifted values (see (8-9)):

$$\Delta x' = \Delta x_s / \sin\theta_L, \qquad c\Delta t' = c\Delta t_s / \sin\theta_L. \tag{28}$$

If Δx is a length of some stick in the rest system, then for the length in a moving system it is used to take (by definition) the difference of its coordinates Δx_s by the same moment of time $\Delta t_s = 0$. Then, one finds from the first formula of (27) (and using (28) for the primed values):

$$\Delta x = \gamma^2 \Delta x_s = \gamma \Delta x'. \tag{29}$$

So, (see Fig.6a) due to a new transformation, the length of a stick becomes shorter even in comparison with the primed value. But, it is seen from the second formula of (26) that the definition's requirement $\Delta t_s = 0$ leads to the fact:

$$c\Delta t = \Delta x \cos\theta_L, \tag{30}$$

that $\Delta t \neq 0$. It means that the moving system has two identical moments of times $t_{s1} = t_{s2}$ in the two different space points Vt_1 and Vt_2 corresponding to the t_1 and t_2 in K system (see Fig.6a). So, due to the used length definition the measurements of two coordinates are produced from the two (shifted) coordinate frames.

It is possible to show that the simultaneity's requirement $\Delta t_s = 0$ for the moving system expresses in reality a wave character of an initial moment of time propagation along X-axis due to the hits of the corresponding side light beam. Indeed, the wave propagation is characterized by the fact that some function (depending on x and t) has the same value in some two space points by two moments of time. Let us use time t_s (see(7)) as an argument of this function:

$$t - xV/c^2 = (t + \Delta t) - (x + \Delta x)V/c^2 \quad \Rightarrow \quad c\Delta t = \Delta x \cos\theta_L = c\Delta t_F. \tag{31}$$

i.e., if $\Delta t_s = 0$, then $\Delta t = \Delta t_F$, where Δt_F is the time delay difference for the given points x_1 and x_2 hitted by the side light beam (see (4) and Fig.6a). One gets from here:

$$\Delta x / \Delta t_F = c / \cos\theta_L = c^2 / V = c/\beta \equiv v_F > c, \tag{32}$$

where v_F is a velocity of initial moment of time propagation along X-axis. For $V = 0$ it equals to the infinity. It means that the side beam becomes the straight one and hits all points of X immediately in the same moment of time. In this case one comes to the Newton time " $--$ it is the same everywhere.

It is clear from the first equation of (26) that the stick's length is the same for the both systems: $\Delta x_s = \Delta x$, if one takes two events (x_1, t) and (x_2, t) in the rest system at $\Delta t = 0$. In this case the corresponding coordinates x_{s1} and x_{s2} in a moving system are measured in different moments of time t_{s1} and t_{s2}. It is possible to choose $t_{s1} = -t_{s2}$ and find $ct = (x_1 + \Delta x/2)\cos\theta_L$. This moment of time corresponds to the projection of the stick's center onto the ct ray (see dashed line on Fig.6a).

Now, let us have two events in a moving system in the same place $\Delta x_s = 0$ and they differ by an interval of time $\Delta t_s = t_{s2} - t_{s1}$. In K system the time interval corresponding to them is seen from the second formula of (27) (see Fig.6b):

$$\Delta t = \gamma^2 \Delta t_s = \gamma \Delta t'. \tag{33}$$

One notes that the new transformation makes an interval of time again rather shorter for a moving system. But one can see from the first formula of (26) that if $\Delta x_s = 0$, then $\Delta x = c\Delta t \cos\theta_L = V\Delta t$, i.e. $\Delta x \neq 0$ in K system. It means that a moving system has two identical coordinates $x_{s1} = x_{s2}$ in two different space points Vt_1 and Vt_2 (in K). Due to the requirement $\Delta x_s = 0$, measurements of two moments of time are produced from two coordinate frames shifted in space.

It is clear from the second equation of (26) that an interval of time for the both system is the same: $\Delta t_s = \Delta t$, if one takes two events (x, t_1) and (x, t_2) in the rest system at $\Delta x = 0$, i.e. in the same space point of K. In this case the two corresponding moments of time t_{s1} and t_{s2} in a moving system are measured from two points x_{s1} and x_{s2}. It is possible to choose $x_{s1} = -x_{s2}$ and find $x = V(t_1 + \Delta t/2) = c(t_1 + \Delta t/2)\cos\theta_L$. This x-coordinate corresponds to the projection of a middle of the given interval of time ($c\Delta t$) onto the X-axis (see dashed line on Fig.6b).

Thus, the nature of relativistic effects is not in changing the space or time current scales for a moving system, but it is in changing of the reference points for the space and time coordinates. The time delay $t_F = xV/c^2$ like the origin displacement Vt should be considered as a usual coordinate shift. Changing the way of measuring the space or time interval lengths, one can find the same values for them in the rest and moving frames. So, one may conclude that light beams oriented according to Lobachevsky function are fruitful tools to solve the present difficulties of relativity in a natural way.

6 Lorentz energy-momentum transformation and wave equation

Lorentz particle energy-momentum transformation is valid in this consideration as it is just a consequence of the relativistic velocity summation law or of the aditivity law for particle rapidity:

$$\rho' = \rho - \rho_o, \qquad \rho = \rho' + \rho_o, \tag{34}$$

where ρ' is a particle rapidity in the moving system and ρ - in the rest one, ρ_o is the rapidity for the velocity $\beta_o = V/c$ of a moving system (all rapidities in units of $c = 1$). So that, $\beta' = th\rho'$ and $\beta = th\rho$ are the corresponding particle velocity in the moving and in rest systems. Hyperbolic tangent of (34) leads to the relativistic summation law:

$$th\rho' = \frac{th\rho - th\rho_o}{1 - th\rho th\rho'}, \qquad th\rho = \frac{th\rho' + th\rho_o}{1 + th\rho' th\rho_o}. \tag{35}$$

The requirement for the particle velocity to be transformed according to this law is satisfied by an usual definition of the particle energy and momentum through its velocity: $\beta = th\rho = (msh\rho)/(mch\rho) = P/E$, where m is a particle mass, $P = msh\rho$ is a momentum and $E = mch\rho$ is a particle energy. One can get a Lorentz transformation by substituting these definitions for both systems into (35). Thus, the Lorentz energy-momentum transformation is a straight consequence of the relativistic velocity (rapidity) summation law.

Let us come back to the requirement $\Delta t_s = 0$ (see (32)). Due to the side beam hit some excitation in a form of the light halfsphere arises in some point x and in some moment of time t (in K-system) and then the time counting starts from zero for this point. An identical halfsphere will be exited in a distance $x + \Delta x$ by a time $t + \Delta t$, and the time counting starts again from zero for that point. So, the initial moment of time counting (initiated by the side front hits) propagates as a wave with the velocity v_F (see (33)) along X-axis. It is known [5], that a differentials wave equation is defined by the structure of an argument of the excitation function $\psi = \psi(x,t)$. As an argument of the light excitation function ψ has a form of the time t_s: $\psi(x,t) = \psi(t \pm xV/c^2)$, then this wave propagation (along X) should have an equation in the form:

$$\frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2} = \frac{1}{\beta^2}\frac{\partial^2\psi}{\partial x^2}. \tag{36}$$

At $\beta = 1$ (or $v_F = c$) it coincides with the known wave equation for light and $\psi = \psi(t \pm x/c)$. When $\beta = 0$ (or $v_F = \infty$, i.e. when the side front becomes as the straight one) the excitation function ψ does not depend on x, and the initial moment of time counting is the same for any x-point: $\psi = \psi(t)$.

7 Conclusion

• A complete correspondence has been established between Lobachevsky parallel lines in the velocity space and the processes of particle and light beams propagation in the ordinary space, synchronized by Huygens principle.
• The time delay in the emission of two light rays has been found as the physical reason for their intersection point absence and for the V postulate denial.
• New contents of the simultaneity conception, common time and proper time have been formulated.
• New inertia system coordinate transformations (as shifts) have been obtained.
• It has been shown, that relativistic effects happen due to the coordinate and time reference point shifts. Changing the way of measuring the space or time interval lengths. one can find the way when these values are the same in the rest and moving systems.
• It has been shown, that Lorentz energy-momentum transformation is a stright consequence of the relativistic velocity summation law.
• It has also been shown that Lobachevsky function is a tool to express the constant light velocity principle.
• The four elements complex fraction invariant and a possible wave equation have been proposed.

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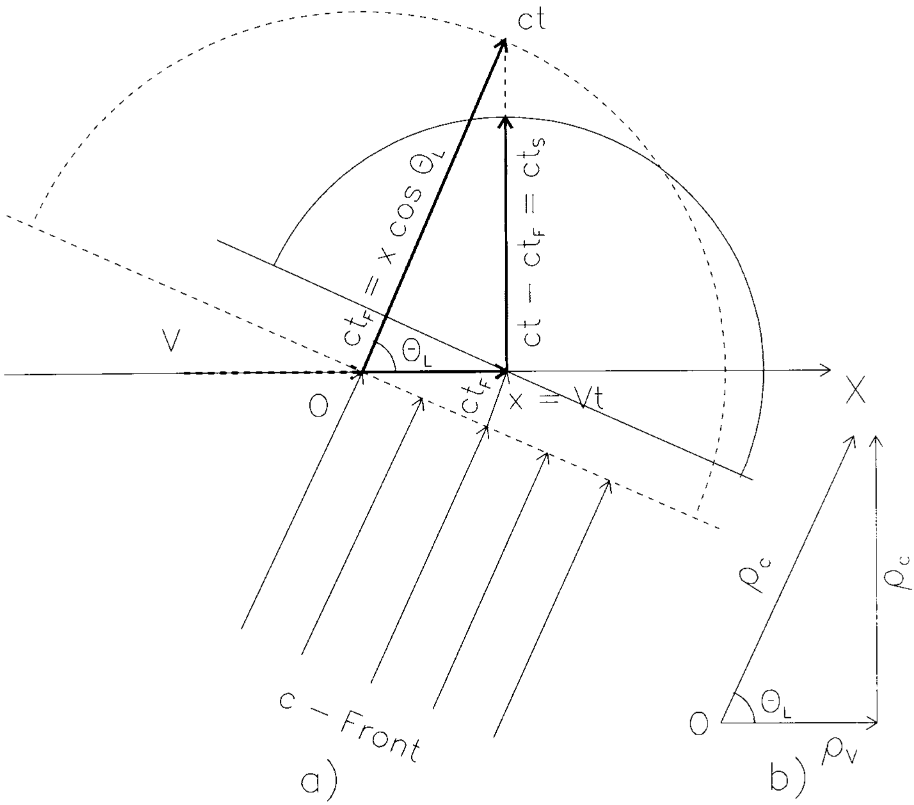

Fig.1: a) synhronization of light rays (ct and ct_s) propagations and the K_s-motion Vt by the Huygens principle due to the side light beam; b) Lobachevsky parallel lines in the velocity space plane corresponding to synchronic motions of ct, ct_s and Vt (in the euclidean plane).

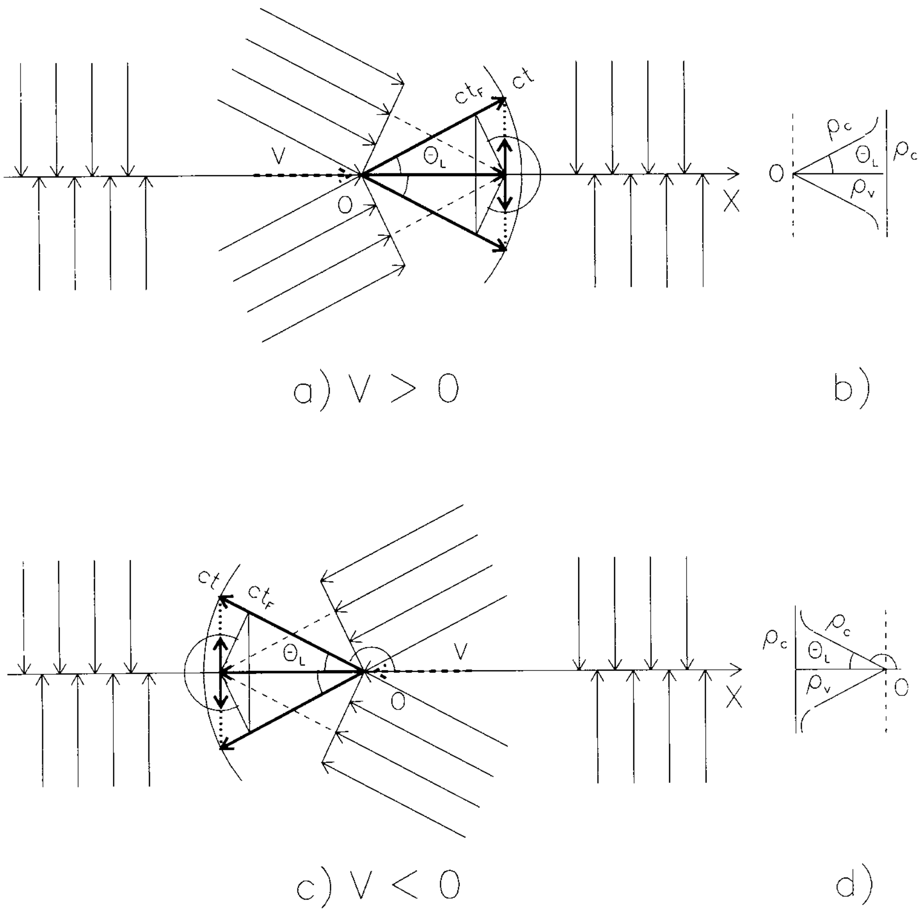

Fig.2: a) two side light beams (for $V > 0$) give arrising a two pairs of light rays ct and ct_s for both sides of the plane (up and down), synchronic with a K_s-motion Vt; b)parallel lines in both sides on Lobachevsky plane, corresponding to synhronic motions in a); c) and d) are the same one as in a) and b), but for $V < 0$.

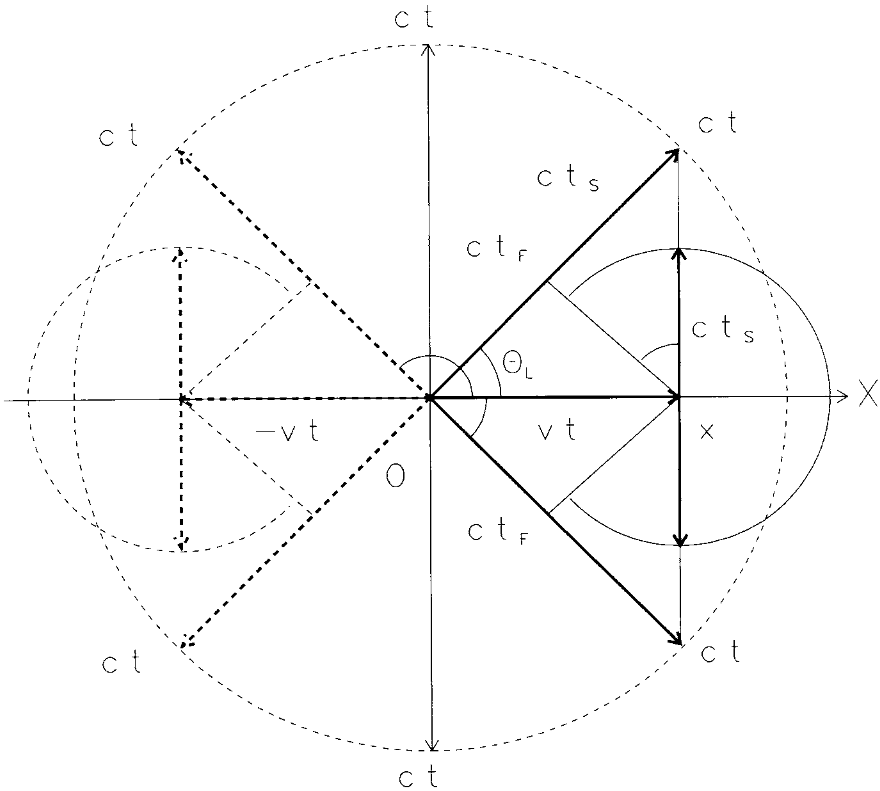

Fig.3 A summary diagram to illustrate of Huygens's synchronization of corresponding light rays and two motions ($V > 0$ and $V < 0$) in K-system.

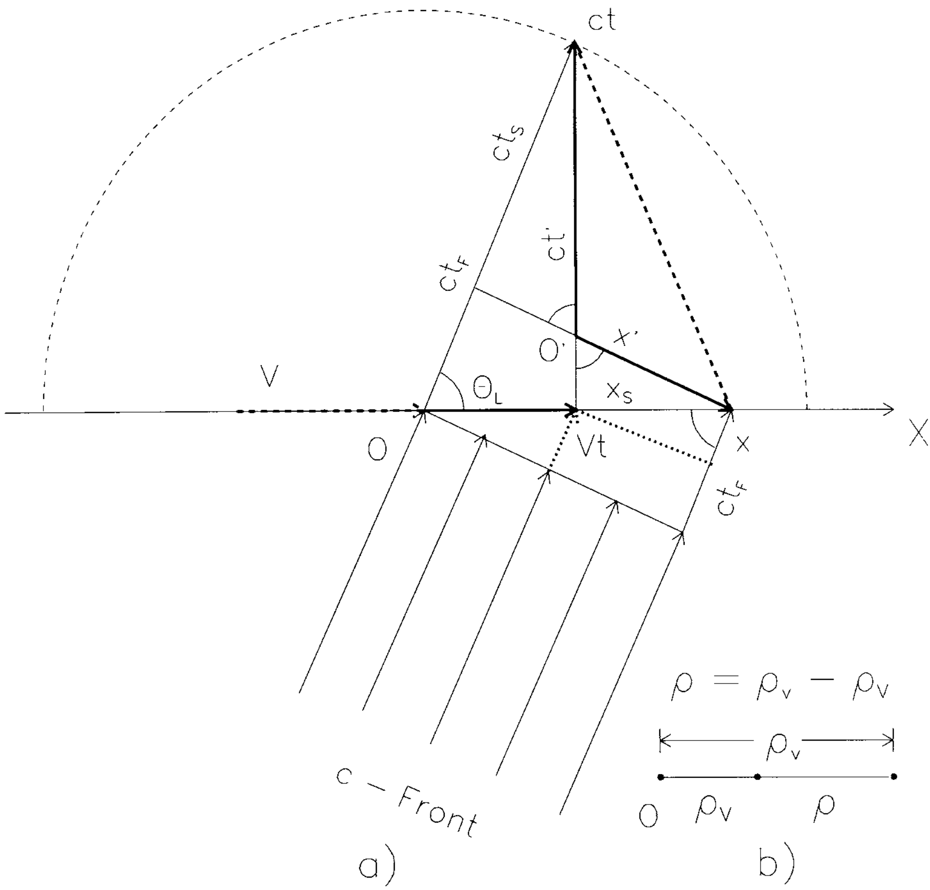

Fig.4: a) an illustration for the inertia system x and t coordinate transformation (including Lorentz transformation); b) a velocity space diagram corresponding to x and t shifts (by the moment of time t a given x coordinate is assumed as x-position of a particle, moving with a velocity $v = x/t$ in K-system).

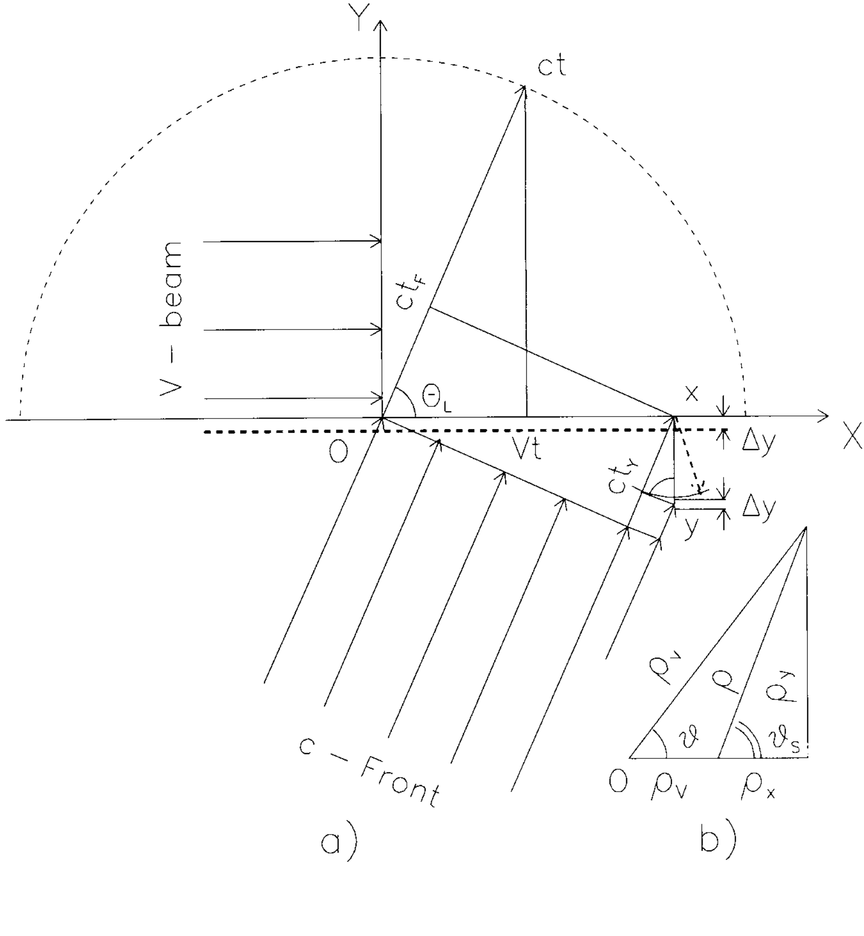

Fig.5: a) an illustration to arising of Δy-shift due to the light way difference; b) the velocity space diagram corresponding to a) (see note in Fig.4b).

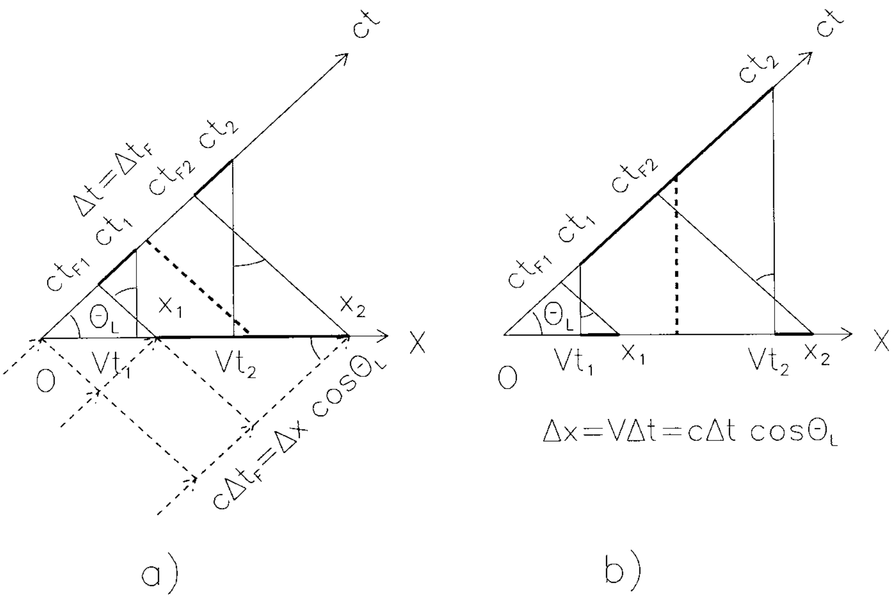

Fig.6 Illustrations of reductions: a) for a length - two simultaneous events (x_{s1}, t_s) and (x_{s2}, t_s) in a moving system; b) for the time interval - two events (x_s, t_{s1}) and (x_s, t_{s2}) in the same place in a moving system.

References

[1] Chernikov N.A. – Lobachevsky geometry and relativistic mechanics, in Particles and Nucleus, 1973. v.4, part.3, p.733;

[2] Fadeev N.G. - The inertia system coordinate transformation based on the Lobachevsky function, in Proceedings of the Int. Conf. on "New Trends in High-Energy Physics", Yalta (Crimea), September 22-29, 2001, Kiev-2001, p.282;

[3] Efimov N.V. The highest geometry, M.: Science, 1978, p.90,107,304,343,393;

[4] Landau L.D. and Lifshitz E.M. Theory of field, M: Fizmatgiz, 1962, p.20;

[5] Landsberg G.S. - Optics, M.: Gostekhizdat, 1952, p.26;

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Фадеев Н. Г. E2-2003-181

Физический смысл параллельных Лобачевского и новые преобразования координат инерциальных систем

Обнаружено, что процессы распространения пучков частиц и пучков света, синхронизованных на основе принципа Гюйгенса, являются физической основой для отрицания пятого постулата и для определения параллельных Лобачевского в пространстве скоростей. Физический смысл параллельных Лобачевского открывает новый подход к решению основной трудности теории относительности — задачи определения времени в различных точках пространства.

Представлены первые очевидные следствия из установленного физического соответствия, включая понятия одновременности, собственного времени, преобразование координат инерциальных систем, инвариантные величины, релятивистское сложение скоростей и релятивистские эффекты.

Работа выполнена в Лаборатории физики частиц ОИЯИ.

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Physical Nature of Lobachevsky Parallel Lines and a New Inertia System Coordinate Transformation

Processes of the particle and light beams propagation synchronized by Huygens principle have been found as the physical nature for the fifth postulate denial and for the Lobachevsky parallel lines definition in the velocity space. The physical nature of Lobachevsky parallel lines reveals a new way to solve the main difficulty in relativity — the problem to define the moments of time for different space points.

The first obvious consequences from the established physical correspondence, including simultaneity, proper time, inertia system coordinate transformation, invariant values, relativistic velocity summation law and relativistic effects, are presented in this paper.

The investigation has been performed at the Laboratory of Particle Physics, JINR.

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