‘ELECTRICAL’ ANALOGY AND HYPOTHETICAL UNIVERSE. KINEMATICS.

Korotkov B.A.

Tel./fax 7(812)5288012, St. Petersburg, Russia

Выясняются кинематические свойства гипотетической Вселенной, полученной на основе предложенной автором «электрической» аналогии, с целью установления их соответствия известным свойствам наблюдаемой Вселенной.
Korotkov B. A. The kinematics properties of hypothetical Universe are investigated on the basis of the ‘electrical’ analogy analysis, offered by the author. It is highly probable that the Universe observed and the hypothetical one are built equally.

Basic hypotheses

The paper suggests a model of hypothetical Universe obtained on the basis of the ‘electrical’ analogy worked out by the author. The analogy results from the correspondence of transformation equations of current I and voltage U by the simplest electric four-terminal network and Lorenz transforms ([1], p.61) for plane space-time determined by the coordinates x and t:

$$U' = \Gamma(U - \beta R_C I), \qquad x' = \Gamma(x - Bct),$$
$$R_C I' = \Gamma(R_C I - \beta U), \qquad ct' = \Gamma(ct - Bx).$$

The transformation agree completely by numerical equality of the following parameters to be considered analogous :

voltage U, current intensity I – space coordinate x, time t,
characteristic resistance R_C – velocity of light in vacuum c,
short circuit resistance R_{SC} – velocity of coordinate system v,
transmission value g, where th$g=R_{SC}/R_C=\beta$ – parameter φ , where th$\varphi=v/c=B$,
coefficient $\Gamma=1/\sqrt{1-\beta^2}$ – relativist multiplier $\Gamma=1/\sqrt{1-B^2}$.

Basic hypotheses are reduced to the following:

1. It is known from electroengineering that the world of voltage and current $\boldsymbol{U,I}$ is the integral representation of the electromagnetic field’s world $\boldsymbol{E,H}$ spreading in the world of space-time $\boldsymbol{x,t}$. Dimensional representation of these worlds are equal, respectively, to four, three and four. The aforesaid is illustrated by the scheme where the lower indices show the dimensions of the worlds:

$$\text{world } \boldsymbol{x,t}_4 \Rightarrow \text{world } \boldsymbol{E,H}_3 \Rightarrow \text{world } \boldsymbol{U,I}_4.$$

It is suggested on analogy that the world $\boldsymbol{x,t}_4$ sensually perceived is the integral representation of the world of the space-time field $\boldsymbol{Э,N}_3$ (not considered earlier) spreading in hypothetical four-dimension world α,ω_4.: $\int_1^2 \boldsymbol{Э}d\boldsymbol{l}=x_{12}$, $\oint \boldsymbol{N}d\boldsymbol{l}=t$, where $\boldsymbol{l}$ is the directed element of the length in the world α,ω_4, $\boldsymbol{Э}$ and $\boldsymbol{N}$ – vectors of intensity of space and time fields. The abovesaid is expressed by the scheme:

$$\text{world } \alpha,\omega_4 \Rightarrow \text{world } \boldsymbol{Э,N}_3 \Rightarrow \text{world } \boldsymbol{x,t}_4.$$

2. Similar to the electromagnetic field waves which can be excited in the medium of space ***x*** of the world ***x***,*t* by the electric tuned circuit located in the same space, the waves of space-time fields are excited by the exciting out of time in the space α of the world α,ω_4 hypothetical embracing Cosmic oscillator with the supply of energy in the existing out of time homogeneous and isotrope medium of three-dimension space α,ω_4 of the world α,ω_4 that we will name ether 1. Periodic process excited by the Cosmic oscillator gives rise to the fourth coordinate of the world α,ω_4.

3. A thin spherical wave resulted almost instantly from the Cosmic oscillator and spreading in ether 1 at the ultimate velocity *c* forms the world ***Э,N₃***, called ether 2. Concentric spherical waves – whose thickness is small compared to their radius – raised sequentially by the Cosmic oscillator correspond to the collection of Universes.

The summarized dimension of the three worlds of the Universe equals eleven; however, only seven of them are independent since four coordinates of the world observed ***x***,*t* are expressed by others.

The way of realizing Universe objects motion

A spherical shell corresponding to the Universe observed is already moving in ether 1 at the ultimate velocity *c*, so, it might seem that the motion inside the Universe is not possible. However, it is not so.

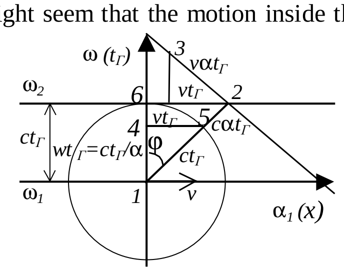

Fig. 1. Motion in ether 2.

Let us choose in ether 1 two concrete positions of the expanding spherical surface of ether 2 corresponding to two values ω_1 and ω_2 coordinates ω. In Fig. 1 horizontal straight lines ω_1 and ω_2 show the sections of two positions of ether 2 sphere by the plane of the figure. Along the line 1-6 there are parts of the radii adjacent to the spheres. The part of radius limited by two spheres in points 1 and 6 represents the trajectory in ether 1 of the stationary object in ether 2 transferred by the global displaying process. The time interval separating one position of ether 2 sphere from the other corresponds to the difference of coordinates $\omega_2 - \omega_1$. Such a time interval might be called *global time* t_Γ, being measured by immovable in ether 2 clock and satisfies the equality: $\omega_2 - \omega_1 = ct_\Gamma$. All objects located on two different spheres shown in the figure are separated by the global time in t_Γ sec.

Now let us consider two sequential positions *1* and *2* of the point object moving at a constant velocity *v* inside the spherical wave in ether 2. The resulting trajectory of the moving point object in ether 1 deviates from the radius of the sphere and travels at some angle φ with respect to it. It is achieved by means of the work of the forces rendering motion to the object. Now the global displaying process is accomplished along the resulting trajectory. As a result of the acceleration gained in ether 2 the *moving* object retains its orientation with respect to the resulting trajectory and has on sphere *2-3* of the *fictitious ether* 2 perpendicular to the resulting trajectory just the same image as the immovable object on the sphere *2-6* of ether 2. The size x' of the object image in the direction of its vector velocity in ether 2 will turn out reduced α times compared to the analogous size of x_0 of the stationary object: $x'=x_0 \cos\varphi= x_0/\alpha$. Provision of the Universe's integrity suggests the equality of volumes $V_1=ct_\Gamma$ of ether 1 flowing over time t_Γ through every individual area of the sphere of ether 2. It would be natural to suppose that *the flowing of ether 1 through the object inwards the sphere of ether 2 determines the flowing of its own time*. Then for two similar stationary and moving in ether 1 objects starting in point *1* and finishing in points 6 and *2* it will turn out that the ratio of integral quantities V_0 and V of ether 1 passed by them over the time t_Γ inwards the sphere of ether 2 is expressed by a series of equalities: $V_0/V=x_0/ x'=\alpha=t_0/t'=t_\Gamma/t'$, where $t_0=t_\Gamma$ and t' – own times of stationary and moving objects. Hence it appears that the rate of time flowing on the moving object is slowed down. Thus, size reducing and slowing down the flow of time on the moving object provide the motion of the object in ether 2 with the Universe integrity being retained.

If the lengths of the sides of the triangle *1,4,5* indicated in Fig. 1 are divided into the motion time t_Γ we will get velocities c, v and c/α measured by stationary in ether 2 clocks and stationary length scale.

In considering Fig. 1 it is difficult to get rid of delusive impression that the moving in ether 2 object will get only to the point *5* over the time t_Γ, lag behind the Universe, where the points *2* and *6* belong and drop out of it. Nevertheless, as it was shown above, this will not take place.

The motion in ether 2 is carried out at any velocity v so that for the given global time t_Γ the quantity ct_Γ^2 will remain unchanged – the product of the length of the resulting trajectory of the object in ether 1 by the own time t' spent by the object on its covering. In the 'electrical' analogy this statement means retaining power by the transformation of current and voltage – analogous to the trajectory length and own time,–by the transformer without losses having the transformation coefficient α. On analogy to the foregoing we get that *for the given global time t_Γ the product of the way covered in ether 2 by the moving object at any velocity v and own time t' of this object over which this way is covered equals vt_Γ^2*. The point of the statement is that the indicated product is the same in using the measurements of any observer – either moving and motionless.

Let us write down useful relations. The above-stated shows that velocity v is measured as the increment of the way dx_0 divided by the increment of the motion duration $dt_0=dt_\Gamma$: $v=dx_0/dt_0$.

In accord with the measurements of the moving observer the velocity v_M is as follows: $v_M=\alpha dx_0/dt'=\alpha dx_0/d(t_0/\alpha)=\alpha^2 v$. If a signal, for instance, electromagnetic one, is emitted by the object, actually at rest in ether 2, and is received by an object moving fast in it, then the velocity of signal travelling in the own coordinate system of the receiver can objectively exceed multiply the velocity being considered maximum. Perhaps, this is the explanation of N.A. Kozyrev's paradox experimentally registered.

In the electric interpretation velocities are represented by resistances and the obtained correlation of velocities is expressed by the well-known rule of reduction of resistances to different voltages of the transformer by the square of transformation coefficient.

It follows from Fig. 1 that $wt_{\Gamma}=ct_{\Gamma}/\alpha$. Taking it into account and from the triangle 1,4,5 we will get: $w=\sqrt{c^2-v^2}=c\sqrt{1-v^2/c^2}=c/\alpha$; $\alpha=c/w=1/\sqrt{1-v^2/c^2}$.

Clocking (Synchronizing)

If we synchronize two similar clocks in the stationary in ether 2 coordinate system in the immediate mutual closeness and then separate them symmetrically to different points of the space, the clocks will remain synchronized. Synchronization will not be disturbed if then the whole coordinate system together with the clocks is rendered a certain velocity. Such a clock synchronization is called *absolute*.

In the theory of relativity *conventional* clock's synchronization is accepted. It is characterized by the fact that according to their readings the velocity of light in vacuum in any inertial systems is the same. Let us consider some details.

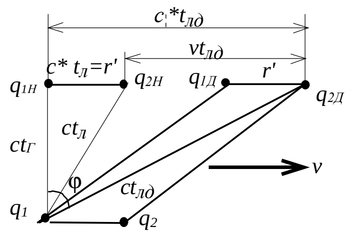

Fig. 2. To summation of velocities by longitudinal motion.

If a segment having the length x' limited by the observers moves in ether 2 at some velocity v directed in parallel to the segment, then the light pulse of the source located in the middle of the segment will not approach the observers simultaneously: at the moment of the time τ_B only the 'back' end of the segment will be lit – the one moving towards the light pulse, and only after the time Ψ at the moment of the time τ_F the light will reach the 'front' running away end of the segment, and then $\Psi=\tau_F-\tau_B$.

Referring to Fig. 2 we will get the quantity τ_F. The designations are as follows: $r'=0,5x'$ is the reduced α times due to motion distance $r_0=0,5x_0$ between the light pulse source q_1 and 'front' observer q_2, measured in ether 2 by the stationary length scale, t_{Γ} - global time separating the initial (sending light pulse) and finite (reaching the observer by the light pulse) positions of the sphere of ether 2, $vt_{\Gamma}\alpha_Д$ – the way covered by the 'front' end of the segment in ether 2 by the observer's measurements, $c_{\parallel}^{*}$ – velocity of light in ether 2 by longitudinal motion of the segment measured from the stationary in ether 2 coordinate system, $\alpha_Д$ – the resulting coefficient of time slowing down, determined by the velocity $c_{\parallel}^{*}$, α – coefficient of time slowing down, determined by the velocity v.

Firstly, we will get the coefficient $\alpha_Д$. In order to do this we will apply Pythagor theorem to the triangle $q_1q_{1Н}q_{2Д}$. On the basis of the effect of the reduction of length in motion obtained above and Michelson's experiment we consider the following equalities to be true: $r'=r_0/\alpha=c^{*}\alpha^{*}t_Л/\alpha$, and we will have: $c^2\alpha_Д^2=c^2+(c^{*}\alpha^{*}/\alpha\ +\ v\alpha_Д)^2$, where α^{*} is determined by $v=c^{*}$, and c^{*} is the velocity of light in ether 2 by stationary source and receiver. Let us solve the equation: $\alpha_Д=\alpha^*\alpha(1+c^*v/c^2$.

We will define the velocity of light $c_¦^*$ in ether 2 by the motion of the source and receiver. The length of particles' trajectory in ether 2 measured by the stationary in ether 2 devices equals $c_¦^*\, t_Г\alpha_Д$. From Fig. 2 we will get the length of such a trajectory $q_{1H}q_{2Д}$ in two ways and put the expressions obtained equal reducing by a factor of $t_Г$: $\alpha^*c^*/\alpha+v\alpha_Д = c_¦^*\alpha_Д$. From this correlation we will find: $c_¦^*=v+\alpha^*c^*/(\alpha\alpha_Д)=(c^*+ v)/(1+ c^*v/c^2)$.

The equalities show that the absolute velocity of spreading disturbances (*the velocity of light*) in the direction of the absolute motion at the velocity v in ether 2 of the own coordinate system of the disturbance source and disturbance receiver located along the velocity vector v, *is not the universal constant* and is defined on analogy with well-known rule of relativist transformation of velocities c^* and v. *The universal constant is the velocity c of spreading disturbances in ether 1.*

It is evident that in changing the direction of the velocity v for the opposite one should put '$-v$' instead of 'v' in the formulae obtained. Taking into consideration this statement we can write down the characteristics of light motion to the 'front' and the 'back' ends of the segment (marked respectively by indexes 'F' and 'B') in the form: $\alpha_{ДF}=\alpha^*\alpha(1+c^*v/c^2)$, $c_{¦F}^*=(c+v)/(1+c^*v/c^2)$, $\alpha_{ДB}=\alpha^*\alpha\, (1-c^*v/c^2)$, $c_{¦B}^*=(c^*-v)/(1-c^*v/c^2)$.

Combining the equalities cited above we get: $\tau_F=\alpha_{ДF}t_Г= =r'\alpha^2(1+c^*v/c^2)/c^*$, $\tau_B=\alpha_{ДB}t_Г=r'\alpha^2(1-c^*v/c^2)/c^*$, $\Psi= \tau_F - \tau_B = 2\, r'\alpha^2v/c^2$.

In absolute synchronization the clocks of the observers located in the ends of a segment will indicate this difference of time in a slightly transformed form Ψ' which appears due to the time's slowing down on the moving segment: $\Psi'=\Psi/\alpha$ and due to the measurement of seeming length r by its moving shortened scale: $r= r'\alpha$; $\Psi' = \tau'_F-\tau'_B= 2\, r'\alpha v/c^2 = 2\, rv/c^2$.

If we change the readings of the clocks, synchronized absolutely, so that the difference in their readings will disappear, for example, put 'the front' clock back the time Ψ' then we will get the clocks by conventional synchronization. By these clocks the light will reach both ends of the segment at the same time.

It follows from the last formula that by having the known constant c by the measurements τ_F, τ_B and r done by the moving clocks by absolute synchronization and moving length scale we can calculate the absolute segment velocity in ether 2.

Transformations of velocity and acceleration

The definitions of velocities and basic formulae obtained above:

- real conveying velocity along the axis x: $v=x_0/t_0$,
- seeming relative velocity $u_{0xAS}=x_0/t'_{AS}$, $u_{0yAS}=y_0/t'_{AS}$ by absolute and $u_{0xCS}=x_0/t'_{CS}$, $u_{0yCS}=y_0/t'_{CS}$ conventional synchronization of clocks,
- real relative velocity $u_x=x'/t_0$, $u_y=y'/t_0=y_0/t_0$,
- real resulting velocity $v_{\Sigma x}=v+u_x=(u_{0x}+v)/(1+u_{0x}v/c^2)$, where $u_x=\alpha_{u_{0x}}u_{0x}/\left(\alpha_v\alpha_{v_{\Sigma x}}\right) = u_{0xA.C.} / \alpha_v^{\,2}$.

The last expression is the generalization of the above-obtained velocity transformations for the light signal. Index at α shows the velocity for which this coefficient is calculated. The projections of velocities onto the axis z can be described on the analogy with the expressions presented for their projections onto the axis y.

Since $t_0=\alpha_v t'_{AS}=\alpha_v(t'_{CS}+x_0v/c^2)$, then $u_y=y_0/t_0=y_0/[\alpha_v(t'_{CS}+x_0v/c^2)]= =(y_0/t'_{CS})/[\alpha_v(1+x_0v/t'_{CS}c^2)]=u_{0y}/[\alpha_v(1+u_{0x}v/c^2)]$ and $u_y= v_{\Sigma y}$. To give a complete picture of velocity transformation let us point out the correlation between the real relative velocity u_x and seeming relative velocity $u_{0xAS}=x_0/t'_{AS}$ by absolute clocking $u_x=x'/t=(x_0/\alpha_v)/(t'_{AS}\alpha_v)=u_{0xAS}/\alpha_v^2$.

Let us turn to the consideration of acceleration transformation.

Let us assume that in orthonormalized coordinate system moving in ether 2 at a real velocity v along its axis x; at zero instant of time the accelerated motion of the point object starts in the same direction. In an infinitely short time t'_{RS} the object will have the infinitely low seeming relative velocity u_{0x}. From the acceleration definition we will find out that the seeming relative acceleration $a_{0x}=u_{0x}/t'_{CS}$. The stationary in ether 2 observer will define the real acceleration in the following way: $a_x=(v_{\Sigma x}-v)/t_0$, where $t_0=\alpha_v(t'_{CS}+x_0v/c^2)$ is the infinitely short time interval kept by the stationary in ether 2 clock. The correlation between real and seeming accelerations is established by the following series of equalities: $a_x=(v_{\Sigma x}-v)/t_0=u_x/t_0=\alpha_{u0x}u_{0x}/(\alpha_v\alpha_{v\Sigma x}t_0)=\alpha_{u0x}u_{0x}/(\alpha_v^2\alpha_{v\Sigma x}(t'_{CS}+x_0v/c^2))=$
$=\alpha_{u0x}(u_{0x}/t'_{CS})/(\alpha_v^2\alpha_{v\Sigma x}\,(1+x_0v/t'_{CS}c^2)=a_{0x}/\alpha_v^3$.

The last equality is true because the velocity u_{0x} itself and its averaged value x_0/t'_{RS} are infinitely small quantities, that is why $\alpha_{u0x}=1$ and $\alpha_{v\Sigma x}=\alpha_v$.

For the transformation of other acceleration components we will get: $a_{0y}=u_{0y}/t'$, $a_y=u_y/t$ and $a_y=u_{0y}\sqrt{1-v^2/c^2}\,/[(1+u_{0x}v/c^2)t'\alpha_v]=a_{0y}/\alpha_v^2$; on analogy $a_z=u_{0z}\sqrt{1-v^2/c^2}\,/[(1+u_{0x}v/c^2)t'\alpha_v]=a_{0z}/\alpha_v^2$.

Lorenz transforms in hypothetical Universe

Let us turn to Fig. 3. We will choose in ether 2 a stationary numerical axis and mark on it the point with coordinate x determining together with the coordinate origin 0 the segment having the length x. On the same numerical axis out of segment x, for the sake of definiteness – in the area of negative values of the coordinate we choose the moving at the velocity v towards the coordinate origin the other segment having length x', smaller than x. We will place the clocks having conventional synchronization into boundary points of both segments. The length of segments and the velocity are measured by a stationary in ether 2 observer. The initial location of the segments is shown in the upper part of the figure.

The lower part of the figure shows the situation taking place at the first moment when the moving segment is located entirely on the stationary one. Without loss of generality we may suppose that at this moment the stationary clock shows zero time, the back moving clock consistent with the left stationary one also shows zero time, while the front moving clock by conventional

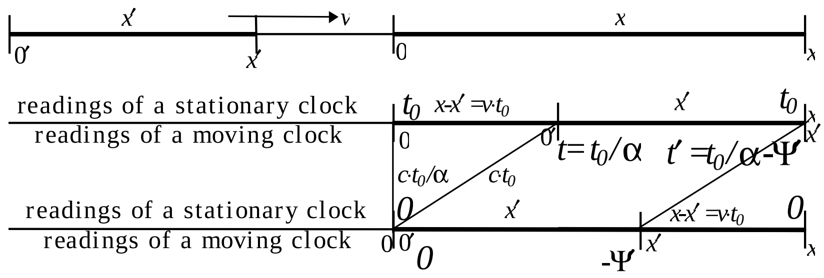

Fig.3. To the derivation of Lorenz transforms.

synchronization at that instant shows time –Ψ′.

After this moment the moving segment will go on moving for some time t_0, being located entirely inside the segment x until it overcomes the lengths' difference of segments x-x'. The values mentioned are connected by the evident correlation known as Galileo transform: $x'=x-v{\cdot}t_0$. Relative location of the segment at the moment is shown in the central part of the figure. The stationary clock shows the time t_0, the back clock slowed down due to the motion shows the time $t=t_0/\alpha$, and the front moving clock by conventional synchronization will show at this moment the time $t' = t - \Psi'$, which after substitutions can be represented in the form: $t' = t_0\sqrt{1-v^2/c^2} - x_0 v/c^2$.

This equation and the two obtained above: $x'=x_0\sqrt{1-v^2/c^2}$ and $x'=x-v{\cdot}t_0$ connect the space x and time t_0 coordinates in the stationary coordinate system with space x_0 and time t' coordinates of the same point in the moving coordinate system measured by the moving devices. Eliminating x' from the first two equalities and solving the equations with respect to x_0 and t', we get Lorenz transforms in the hypothetical Universe: $x_0=\frac{x-vt_0}{\sqrt{1-v^2/c^2}}$; ; $t'=\frac{t_0-vx/c^2}{\sqrt{1-v^2/c^2}}$.

The derivation of the expressions obtained relied mainly on the idea of the two ethers – introduced for the first time – and different velocities c and c^* of spreading disturbances in them. If we take up the position of modern science giving up the idea of the two ethers temporarily and consider the velocity of spreading disturbances in the Universe to be equal to $c=c^*$, then the expressions obtained turn into the well-known Lorenz transforms. This confirms the accomplishment of the principle of correspondence.

We will get Lorenz transforms by absolute timing, that is by $\Psi' = 0$:

$$x_0=(x-v{\cdot}t_0)/\sqrt{1-v^2/c^2}\,;\quad t'=t_0\sqrt{1-v^2/c^2}\,.$$

Basic formulae of kinematics variables transformation

The basic formulae obtained are represented in Table 1.

Table 1. Kinematics variables transformations

Parameter name	***x***	***y***	***z***
Own time in MCS	t'		
The same time by the clock of SCS, AS	$t_0=\alpha_v t'$		
The same time by the clock of SCS, CS	$t_0=\alpha_v(t'+x_0 v/c^2)$		
Own distance in MCS	x_0	y_0	z_0
The same distance in SCS	$x'=x_0/\alpha_v$	$y'=y_0$	$z'=z_0$
Real conveying velocity MCS	v	0	0
Seeming relative velocity	$u_{0x}=x_0/t'$	$u_{0y}=y_0/t'$	$u_{0z}=z_0/t'$
Real relative velocity, AS	$u_{xAS}=u_{0xAS}/\alpha_v^2$	$u_{yAS}=u_{0yAS}/\alpha_v$	$u_{zAS}=u_{0zAS}/\alpha_v$
Real relative velocity, CS (all velocities are taken by CS)	$u_x=\dfrac{u_{0x}}{\alpha_v^2(1+u_{0x}v/c^2)}$	$u_y=\dfrac{u_{0y}}{\alpha_v(1+u_{0x}v/c^2)}$	$u_z=\dfrac{u_{0z}}{\alpha_v(1+u_{0x}v/c^2)}$
Summation of velocities by AS	$v_{\Sigma xAS}=v+u_{xAS}$	$v_{\Sigma yAS}=u_{yAS}$	$v_{\Sigma zAS}=u_{zAS}$
Summation of velocities by CS	$v_{\Sigma x}=v+u_x$ $v_{\Sigma x}=\dfrac{u_{0x}+v}{1+u_{0x}v/c^2}$	$v_{\Sigma y}=u_y$	$v_{\Sigma z}=u_z$
Seeming relative acceleration	$a_{0x}=\Delta u_{0x}/t'$	$a_{0y}=\Delta u_{0y}/t'$	$a_{0z}=\Delta u_{0z}/t'$
Real acceleration	$a_x=\Delta u_x/t_0$ $a_x=a_{0x}/\alpha_v^3$	$a_y=\Delta u_y/t_0$ $a_y=a_{0y}/\alpha_v^2$	$a_z=\Delta u_z/t_0$ $a_z=a_{0z}/\alpha_v^2$
Lorenz transforms in AS	$x_0=\dfrac{x-vt_0}{\sqrt{1-v^2/c^2}}$	$y_0=y'$	$z_0=z'$
	$t'=t_0\sqrt{1-v^2/c^2}$		
Lorenz transforms in CS	$x_0=\dfrac{x-vt_0}{\sqrt{1-v^2/c^2}}$	$y_0=y'$	$z_0=z'$
	$t'=\dfrac{t_0-vx/c^2}{\sqrt{1-v^2/c^2}}$		

MCS (SCS) – moving (stationary) in ether 2 coordinate system,
AS (CS) – absolute synchronization (conventional synchronization, accepted in the theory of relativity).

REFERENCES

1. Ugarov V.A. Special theory of relativity. M., ‘Nauka’, 1969, 304 p. (Rus.)