NON-GEOMETRICAL SIMULATION
IN THE THEORY OF NATURAL MOTIONS

«*The light velocity*» *is not the velocity.*

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There is a problem of non-correspondence between the Euclid's geometry and the actual numbers arithmetic. The new method of mathematical simulation of light kinematics and curvilinear flight of a body under action of gravitation manages without the time-space conceptions and does not resort to such notions as force and energy.

It is evident that the equation

$$x(t)=x_0+vt \qquad (\alpha)$$

motion of a material point *m*, velocity of which is *v*, by the abscissa axis of the reference system $S(x,y,z,t)$ from the position x_0 and dependent on time *t* part

$$x'=x-vt \qquad (\alpha')$$

the co-ordinates transformations in transition from *S* to the $S'(x',y',z',t)$ reference system, accompanying point *m*, is fraught with the problem of inconsistency between the Euclid's geometry and the arithmetic of real numbers, that has not been noticed by anyone up till now.

Assume, that in the equations (α) and (α'), $t=1$ and $x_0=x'=1$. Thus we get the equalities 2=1+1 and 1=2–1. However it is impossible in principle to divide the section $c=2$ (distance $x(1)=2$ or co-ordinate $x=2$) into parts *a* and *b*, in such a way that $a+b=c$. Let's prove it.

According to the postulate stipulating the mutually uniform sign consistency between real numbers and points of the numeric straight line the geometrical entity $c=2$ includes all real numbers from 0 to 2: $[0,2]\subseteq c$. It may look like, that the section $c=2$ middle has to be point corresponding with the number 1 while the symmetrical in relation to it parts *a* and *b* of this section are equal in such a way that $[0,1]\subseteq a$ and $[1,2]\subseteq b$. But in this case $[a+b]>2$, as the point denoted by «one» is introduced in the sum $a+b$ twice. Let's suppose, that $[0,1)\subseteq a$ and $(1,2]\subseteq b$. But then $[a+b]<2$, as the point «one» is excluded from the section $c=2$.

If however $[0,1]\subseteq a$ and $(1,2]\subseteq b$ or $[0,1)\subseteq a$ and $[1,2]\subseteq b$, then $a\neq b$. But in such a case the non-equal parts of the equality $a+b=c$ are not identical to each other, as one is a section, while the other - a semiinterval.

Thus, the axiom of continuity, acting in geometry, doesn't permit to divide, without logical concessions, the section *c* (distance *c* or displacement *c*) into equal (*dichotomy*) or non-equal (*diaresis*) parts *a* and *b*. That indicates on some incongruity between the geometry and arithmetic, as the latter admits equality 1+1=2 while the geometry not.

The problem of impossibility of abstract entities (distances, surfaces and volumes) division into parts non-comprising the initial whole without evident logical-mathematical problems is formally insoluble and needs to be considered in the framework of objective processes of physic-mechanical nature. One of such processes is the material point *m* motion by inertia.

It should be noted that besides continuos chronometric and geometric values t, $x(t)$, x_0 and x' the basic equations (α) and (α') contain the kinematics constant v. Let's denote it as «one» and with the use of the anew accepted scale assess the other velocities which are not vectors by definition of number 1[v]. In such a case spontaneous element A of the inertial velocities multitude we'll consider as a part of the value 1[v], that will permit to introduce an element a paired with number A<1 and such that $A+\alpha=1$.

It has to be noted, that scalars A and α don't belong by definition to the continuum of real numbers and are equal to each other ($A=\alpha$) or are equally different (by $\pm\Delta$) from their average arithmetic value $(A+\alpha)/2=1/2$, e.g. $A=(1/2)+\Delta$ and $\alpha=(1/2)-\Delta$, where $\Delta\in[0,1/2)$. Let's denote this difference as *a antisymmetry*.

It is of interest, that particular numbers 1[v], $A\in[1/2,1)$ and $\alpha\in[1/2,0)$, existence of which is postulated by necessity, permit to avoid the problem of division, wont to the entities (α) and (α') on which is based the theory of motion.

Let's get convinced, that numeric assessment of equal and non-equal components of velocity 1[v] by means of the anew presented method (it may be denoted as *a principle of numberforming dichotomy and antisymmetrical diaresis*) significantly transforms the conventional sense of the most simple task of theoretical mechanics, traditionally decided on the basis of chronogeometrical equations (α) and (α') with doubtful content, stipulated by axiom of continuity, acting in geometry and in arithmetic of the so called material numbers.

Let's put on the straight line p, encompassing axes x and x' of the inertial reference systems S and S', the material point m^*, velocity of which in S is $v^*=const$. Then if the relative velocity of the S and S' systems is $v=const$, the m^* point velocity $v'=const$ in the reference system S' can be found as $v'=v+v^*$ (in the case that v and v^* are counter-directed) or as $v'=v^*-v$ (in the case that velocities v and v^* are uniformly directed and $v^*>v$) or otherwise as $v'=v-v^*$ (if $v>v^*$ and velocities v and v^* are also uniformly directed). However there is possibility to neglect the mutual orientation of velocities v, v^* and v' and to generalise the presented situation (Fig. 1).

At the first glance any of the addition formulas

$$v=v^*+v' \tag{a}$$

$$v^*=v+v' \tag{b}$$

$$v'=v+v^* \tag{c}$$

seems to be scalar form of classical (vectorial) law of the velocities addition. But from the point of view of arithmetic the same equalities (a), (b) and (c) act as the rules of the *v*, *v**, *v*′ values division on two equal (*dichotomy*) or unequal (*diaresis*) parts, which become the special numbers A and α, if in (a) to assume *v*=1, in (b) accept *v**=1 while in (c) define *v*′=1.

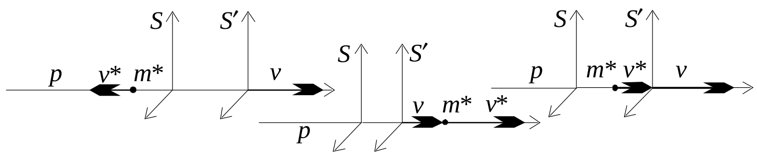

Fig. 1

From that follows, that the straight line kinematics of point *m** in the inertial reference systems *S* and *S*′ admits quantitative description by dint of the special scalars A∈[1/2,1) and α∈[1/2,0) not belonging to the so called real numbers. But it is impossible to effectuate calculation of relative velocities by means of selection of particular numbers α and A in the framework of inertial motion without taking into account its initial conditions.

Let it be that in the moment *t*=0 initial points 0 and 0′ of the reference systems *S* and *S*′ coincide, while co-ordinates x_0 and x_0' of the *m** point in these systems are «zero»: $x_0=x_0'=0$. Then (*t*>0) the material point *m** position in the systems *S* and *S*′ determines its displacement $x(t)=v^*t$ and $x'(t)=v't$ in relation to the collinear to it points 0 and 0′. And also $x(t)/x'(t)=v^*/v'=const$ irrespective of time *t*. Let's denote this case of the initial disposition of the points *m**, 0, 0′ on the straight line *p* as the special one (Fig. 2).

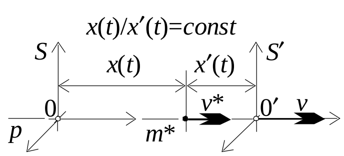

Fig. 2

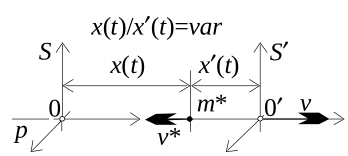

Fig. 3

Now imagine, that at the moment *t*=0 initial points 0 and 0′ of the reference systems *S* and *S*′ also coincide but the initial co-ordinates x_0 and x_0' of the point *m** are not «zero»: $x_0=x_0'=X_o\neq 0$. In this case, irrespective of mutual orientation of velocities *v*, *v**, *v*′ the polar co-ordinates $x(t)=X_0\pm v^*t$ and $x'(t)=X_0\pm v't$ of this point in relation to the points 0 and 0′ will be transforming in such a way, that $x(t)/x'(t)=var$. Let's designate this case as the general one (Fig. 3).

It should be taken into account, that this general case has not been studied in the mechanics and that it is its idiosyncratic feature that in situation of initially selected or opposite to it orientation of the interrelated velocities *v*, *v**, *v*′ on the straight line *p* inevitably comes the moment when one of the collinear points (*m**, 0 or 0′) turns out to be in the middle of the changing distance between the two others. And though such a situation in the framework of the geometry is indefinitely numeric it may be termed as *a instantaneous dichotomy* of distance between the objects which are marginal in relation to the middle one.

Let's accept the situation of instantaneous dichotomy as the initial and consider it in connection with the special case, when at the moment of direct or converted motion the points m^*, 0 and 0′ are fused into one entity. It is clear that at the given moment the distances between them become «zero» and traditional (chronogeometric) assessment of the existing motions is impossible in principle. However relative velocities v, v^* and v' don't lose its significance in the particular numbers 1[v], A and α and that is the advantage of their non-geometric (*arithmometric*) definition. So it follows that *arithmometry* is the measurement by means of number or assessment by ciphers.

Let's note that existence of special and general cases of the initial disposition of object m^* in the reference systems S and S' attests that the numeric model A+α=1 more likely insufficient for the description of the relative kinematics of the degraded triangle m^*00' apex. Therefore let's assume that the scalar form A+α=1 exhaustively models the special case and may be referred to the general case only conditionally. In this connection arises the task of numerical collation of the selected case. Let's solve it on the basis of the traditional space-time kinematics - chronogeometry, but with regard to the arithmometry alternative to it.

It can be demonstrated that elementary discussion leads to formally-mathematics (arithmometric) definition of the early unknown measure of motion by inertia. But for the beginning let's get rid of imaginary reference systems S, S' and schematically present the special case of the point m^* presence on the straight line p, marked by the points 0 and 0′.

Let it be that the point-like objects 1 and 2 mutually approach each other with relative velocity V=*const*, then at the moment t=0 the distance L between them become equal to «one»: L=1.

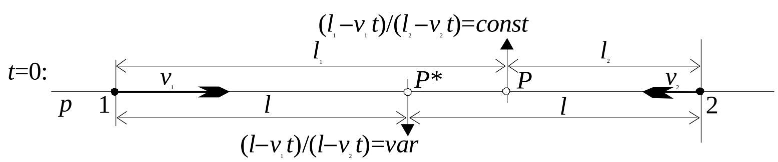

Fig. 4

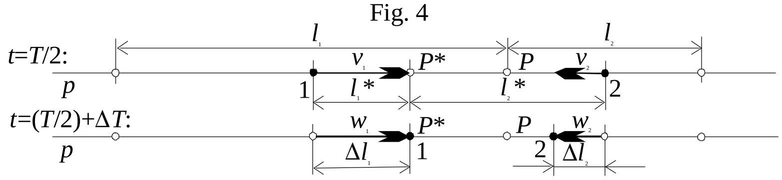

Fig. 5

Let's mentally determine on the straight line p some point P as a place of destination to which the objects 1 and 2 will arrive simultaneously in a period of time $t=T$=1 (Fig. 4). In such a case the point P will symbolise division of single velocity $V=L/T=1$ on two parts $v_1=\mathrm{A}$ and $v_2=\alpha$ in accordance with the equality $\mathrm{A}+\alpha=1$ from the particular scalars $\mathrm{A}\in[1/2,1)$ and $\alpha\in[1/2,0)$. But the same point conditionally divides the distance $L=1$ on the parts l_1 and l_2. However in such a case the additive expression $v_1+v_2=V$ simulated by means of the equality $\mathrm{A}+\alpha=1$ is an objective entity, while the geometric form $l_1+l_2=L$ is the imaginative one by the reasons adduced at the beginning. Nevertheless, it is possible to be of the opinion (with certain reservations though), that from $l_1+l_2=L$ after division by $T=1$ follows $v_1+v_2=V$, but in reality the values v_1 and v_2 if $V=1$ and they are numerically set by the particular scalars A and α.

Subsequent mathematical constructions are stipulated by logically necessary differentiation of the space-time ($v_1=l_1/T$, $v_2=l_2/T$, $V=L/T$) and arithmometric ($v_1=\mathrm{A}$, $v_2=\alpha$, $V=1$) definitions of relative velocities v_1, v_2, V, as well as existence of the special and general cases of the initial disposition of objects m^*, 0 and 0′ on the straight line p.

Let's add the general case to the special one, represented by the points 1, 2 and P. For that let's plot (at the moment $t=0$) on the straight line p point P^* conditionally dividing distance $L=l_1+l_2$ into two equal parts, length of which $l=(l_1+l_2)/2$. Such a division was aforementioned as *instantaneous dichotomy*.

Let's accept, that in the initial position points P and P^* are based on the line p, while objects 1 and 2 ($t=0$) start off wict velocities of encounter $v_1=\mathrm{A}$ and $v_2=\alpha$, after that variable distances between moving points 1, 2 and points P, P^* diminish in compliance with rules $(l_1-v_1t)/(l_2-v_2t)=const$ and $(l-v_1t)/(l-v_2t)=var$ and that differs the special and general cases of initial disposition of material point m^* in the inertial reference systems S and S'.

It may seem that during the observed motion of points 1 and 2 in relation to the points P, P^* on the straight line p acts the unique law $v_1+v_2=V$, modified above as $\mathrm{A}+\alpha=1$ and traditionally (chronogeometrically) expressed as

$$(l_1/T)+(l_2/T)=L/T. \qquad (1)$$

However the space-time model (1) undoubtedly refers the summed up velocities $v_1=l_1/T$ and $v_2=l_2/T$ to the point P, while in relation to the point P^* maybe acts some other rule of division $V=1$ into two equal (*dichotomy*) or unequal (*diaresis*) parts. For that there are quite definite formal-mathematics premises.

It should be noted that in process of the head-on motion of points 1 and 2 inevitably arises moment $t=T/2$, when they turn out to be displaced from the point P^* at distances l_1^* and l_2^* such as $l_1^*/l_2^*=l_2/l_1$ (Fig. 5). Let it be that after period of time ΔT point 1 confluence's with point P^*. In this case its velocity in relation to this point can be determined as $w_1=l_1^*/\Delta T=\Delta l_1/\Delta T=v_1$.

It is clear that point 2 will «run» for the period ΔT distance $\Delta l_2=\Delta l_1(v_2/v_1)$ and its velocity may be determined as $w_2=\Delta l_2/\Delta T=v_2$. After that let's introduce in relation to the point P^* the rule $w_1+w_2=V$, the «space-time» form of which is

$$(\Delta l_1/\Delta T)+(\Delta l_2/\Delta T)=L/T, \qquad (2)$$

by its numeral form it doesn't differ from the expression (1). However kinematics law $w_1+w_2=V$ is not quite identical to the rule $v_1+v_2=V$, presented as $\mathrm{A}+\alpha=1$ in the particular numbers $\mathrm{A}\in[1/2,1)$ and $\alpha\in[1/2,0)$.

Let's divide the conditional equality (2) into l_2*, that'll make the expressions (1) and (2) proportionate to the coefficient $\rho=1/l_2*$. From that follows

$$[(\Delta l_1/l_2*)/\Delta T]+[(\Delta l_2/l_2*)/\Delta T]=(L/l_2*)/T, \qquad (2')$$

it can be concluded, taking into account that $\Delta l_1/l_2*=l_1*/l_2*=l_2/l_1=v_2/v_1$ and $\Delta l_2/l_2*=\Delta l_1(v_2/v_1)/l_2*=(v_2/v_2)^2$, the following

$$(v_2/v_1)+(v_2/v_1)^2=(L/l_2*)/(T/\Delta T). \qquad (2'')$$

Let's recall that values v_1 and v_2 have been designated by the particular scalars $\mathrm{A}=v_1$ and $\alpha=v_2$, so that $\mathrm{A}+\alpha=1$. From that (2″) follows that $\alpha/\mathrm{A}^2=(L/l_2*)/(T/\Delta T)$ or $\alpha A/\mathrm{A}^2=L/T=1$.

It may seem that this last expression can be construed in such a way that kinematics characteristic $v_1=\mathrm{A}$ is the average proportion of values $\alpha=v_2$ and $A=l_2*/\Delta T$ with measurement [v]. Velocity A is the imaginative value, though in one case when $l_2*=L/4$ and $\Delta T=T/2$ it is numeral equal to α. It is of interest that $A=\alpha=1/2$ corresponds to the coincidence of points P and P* on the straight line p.

Let's recall that point P geometrically symbolises division in half of relative velocity $V=1$ of points 1 and 2. That is why the equality $\alpha^2/\mathrm{A}^2=1^2$, where $\alpha=\mathrm{A}$, supposes that point P* coinciding with P incarnates dichotomy of other unit $1^2[\mathrm{v}^2]$ of mechanical motion, which thereafter will be termed as *quadrovelocity*. In this situation quadrovelocity $W=1^2$ gets the same correct arithmometric definition as above has been given to scalar velocity $V=1$.

It maybe of importance to collate numerically arithmometric scales 1[v] and $1^2[\mathrm{v}^2]$ on the chronogeometric basis.

It is noteworthy, that if $v_1=v_2$, then it follows from (2″) that $1+1^2=2$, i.e. $1^2+1^2=2*$. Let's consider the latter as formally expressed possibility of division of $W*=2*[\mathrm{v}^2]$ value in half.

So it is clear, that equal velocities $v_1=\mathrm{A}=1/2$ and $v_2=\alpha=1/2$ are twice as small as additive quadrovelocities $w_1=1^2$ and $w_2=1^2$ representing the equal parts of value $W*=1^2+1^2=2*[\mathrm{v}^2]$. That can be expounded by means of chronogeometric consideration as well as by the fact that the scale values 1[v] and $1^2[\mathrm{v}^2]$ differ from each other twofold.

Let's now return to the expression (2′) and note, that $\Delta l_1\to0$, $\Delta l_2\to0$, $\Delta T\to0$ and $l_2*\to L/2$, when $v_2=0$ and correspondingly $v_1\to V=1$. Therefore, if $v_2=0$ and on the straight line p remains only motion with velocity $V=1$, equality (2′) acquires form of uncertainty (0/0)+(0/0)=2 and looses proportionality with the equality (1), which for $l_1=L=1$, $l_2=0$ and $T=1$ accepts understandable form (1/1)+(0/1)=1.

This mathematical fact should be considered as one more evidence of formal difference of single units V=1[v] and $W=1^2[v^2]$, which can be expressed by the identity W=2V, the latter is objective, if not to take into account physical measurement of scales 1 and 1^2, as in arithmometrics it is not necessary.

Thus, relative motion of points 1 and 2, assessed by velocity V=1, can be also assessed by quadrovelocity $W^*=2^*[v^2]$, i.e. earlier unknown characteristic of mechanical motion, the unit $1^2[v^2]$ of which is twice as great as the scale value 1[v]. In this case quadrovelocity 1^2 doesn't permit the «space-time» definition, though it can be easily revealed in some phenomenon's which are studied in the framework of secondary school physics and mechanics curriculum. Let's consider two such phenomenon's and on this basis try to predict the third one.

Phenomenon 1.

It is accepted to think that system of mutually gravitated bodies 1 and 2 (like the one that is comprised by Earth and Moon) rotates around its own centre of masses. In this case the law

$$T^2/R^3=(2\pi)^2/G(m_1+m_2), \qquad \text{(A)}$$

simulating kinematics of such system can be presented (if $R=const$) in the following form

$$(2\pi R/T)^2=(Gm_2/R)+(Gm_1/R), \qquad \text{(A}'\text{)}$$

all members of which have measurement of velocity quadrate. G here stands for the gravitational constant, T - period of dipole circulation (m_1+m_2) in stars.

Let's underline, that by some considerations (including the geometrical ones) the values $v_1^2=Gm_2/R$ and $v_2^2=Gm_1/R$, which are such, that

$$v_1^2+v_2^2=v^2 \qquad \text{(A*)}$$

(here $v=2\pi R/T$ - velocity of some of the masses m_1 and m_2, observed from the side opposite to the motionless centre) can't be quadrates of orbital velocities of mutually gravitated bodies 1 and 2.

It would be objective to infer from it, that material points 1 and 2 are motionless in relation to each other ($R=const$) because motion in quantity $v^2=2^*$ is divided between them in inverse proportion to its masses. On that also indicates interrelation $v_1^2/v_2^2=m_2/m_1$, presented in the chronogeometrical law of I.Kepler (A), modified in the sense of arithmometry as (A*).

Thus, formula (A*) maybe considered as rule of division of quadrovelocity $v^2=W^*=2^*[v^2]$ into equal (*dichotomy*) or unequal (*diaresis*) part $v_1^2=w_1=\Gamma$ and $v_2^2=w_2=\gamma$. In this case antisymmetric scalars $\Gamma=1^2+\Delta^*$ and $\gamma=1^2-\Delta^*$ $(\Delta^*\in[0,1^2))$, thus that $\Gamma+\gamma=2^*$, will be particular metrologies numbers, not belonging to multitude of real numbers of the 2nd grade by means of definition.

Let's note once more, that new method of motion simulation based on *the principle of numberforming dichotomy and antisymmetric diaresis* represents an alternative to the geometric one, charged by problem of incongruity between Euclid's geometry and classical arithmetic. Thus it is clear, that the proposed principle can be realised in kinematics of centrally-symmetric gravitation.

Phenomenon 2.

In 1851 I.Fiso effectuated the measurements, which demonstrated that motion of light can't be added as a vector, i.e. geometrically to motion of lucid medium (irrespective of motion direction). That gives pretext to apply to non-geometric kinematics - *arithmometry*, the elements of which have been presented above. Let's apply to the Fiso experiment the anew-formulated notion of *quadrovelocity*. For that it is necessary to redefine into corresponding values of quadrovelocity the light velocity c_n in lucid medium with the absolute coefficient of refraction n and velocity v of this medium in relation to the light source.

In preparation of his experiment I.Fiso calculated (using formula $\Delta=c\cdot\delta t$) difference of the light rays passage in the air ($n\approx1$), passed through the laboratory apparatus: contrary to the water flow (–) and in the same direction with it (+) - through two parallel tubes, length of each was L=1.4875 m (c - light velocity in vacuum).

In conformity with classical (vectorial) rule of realised in the experiment velocities v=7.059 m s^{-1} (water in the tubes) and $c_n=c/n$ (light in water with the refraction coefficient n=1,33) $\delta t=[2L/(c_n-v)]-[2L/(c_n+v)]= (2L)(2v/v^2)/[(c_n/v)^2-1^2]$.

It is clear, that non-measurable member 1^2 of the received expression serves as a scale for value $(c_n/v)^2$ and may turn out to be the denominator of $2v/v^2$ relation, presented as $2T/l$, where l - water run in the tube for the period T=1 s. From that follows $\delta t=T(2L/l)(2V/W)/(c_n/v)^2-1^2]$, where V=1 - velocity, $W=1^2$ - single quadrovelocity, which by arifmometric definition is twice as much as V. Therefore, assuming $2V/W$=1, it follows that $\delta t^*=T(2L/l)/[(c_n/v)^2-1^2]$, i.e. twofold less then the calculated value δt.

It should be only underlined, that in his experiment I.Fiso really observed some shift in the interferential picture, which was twofold less than the one calculated by the classical law $c_n\pm v$ of velocities c_n and v summation. In this case the O.Frenel calculation formula $c_n\pm kv$ (here $k=1-1/n^2$), based on the hypothesis of partitial intensification of light by moving lucid body and correlated with it (if $v<<c_n$) relativistic law of water and light velocities addition, gives the shift value only approximately near to the one received by I.Fiso.

Phenomenon 3.

Thus, quadrovelocity 1^2, which got formal definition in the framework of arithmometry explicitly demonstrate itself also in formula, which simulates the kinematics of gravitation as well as in the experiment on light propagation in moving lucid body. That permits to hope, that the further described experiment and its result corresponding with calculation made by arithmometry formulas will serve as a proof of objective existence of quadrovelocity, i.e. anew discovered measure of mechanical motion.

Experiment, based on radiolocation of the Moon effectuated from the near-Earth orbit may be presented in the following way. Let's imagine, that radar 0* generates short radioimpulse «+» at the moment when velocity vector of an orbital space station is directed «towards» the Moon. Let's suppose that portion of immited signal returns to the radar after reflection from the Moon in a period ΔT^+ (Fig. 6).

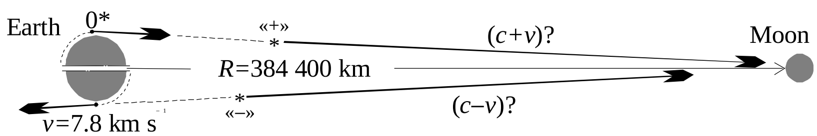

Fig. 6

Similar experiment is conducted when vector of orbital velocity of the space ship is oriented on the side «from» the Moon. Let's assume, that duration of the signal passage «–», i.e. R=384 400 km (distance to the Moon) and back is equalled to ΔT^-. Let's now estimate the proposed experiment theoretically.

As it turns out that $\Delta T^+ < \Delta T^-$, then it will mean that velocity of electromagnetic radiation in vacuum depends on the motion of its source and that the second postulate of the special theory of relativity is not correct. However it doesn't mean that velocity of light in vacuum (c=300 000 km s^{-1}) interacts with velocity of an orbital station (v=7.8 km s^{-1}) in conformity with the classical rule $c \pm v$. Nevertheless let's use this rule and calculate supposed periods $\Delta t^+ = [R/(c+v)] + R/c$ and $\Delta t^- = [R/(c-v)] + R/c$ of the signals travelling time «+» and «–» to the Moon and back. Let's assume, that they differ in some way from the easured values ΔT^+ and ΔT^- due to formal inequality of velocities and quadrovelocities.

Let's underline that *theory of quadrovelocities* would get some experimental corroboration if it turned out that calculated value $\delta t = \Delta t^- - \Delta t^+$ is twice as great as the experimental one $\delta t^* = \Delta T^- - \Delta T^+$. The grounds for such supposition can be found in the I.Fiso experiment, presented above as an action with participation of quadrovelocities of light and in such a modification of the 3rd law of I.Kepler, which formally determines orbital quadrovelocities of two mutually gravitating bodies.

It is possible to get acquainted more detail with arithmometry fundamentals and its application in the theory of motion and in theoretical physics through my articles and monographs, which named in the next publication.