INTRODUCTION IN PHYSICS OF TIME

Ph.D. Eng. Marcel Balşeanu

FOREWORD

Before even beginning to talk about the contents of the present paper work, we hereby find it necessary to add a few remarks. As anyone knows, time is a part of the three fundamental physical sizes in nature, namely: mass, space and time, and the outcome of the latter's correlation is represented by all the other physical sizes. Of all these three fundamental physical sizes, time is the sole size lacking a "materially tangible" character, as usually told in the language of common people, while showing a physical feature of an abstract thinking in order to understand it, being directly connected with the carrying out of various events in nature. As a definition, time as a size stands for the operating length of any given event. In the absence of any such events, the time notion loses any meaning, it actually fails to exist. Another remark that one has to make relates to the difference between one given temporal event and time as a size in itself. One temporal moment stand for a certain "temporal point" in the process of such event running, and time stands for the temporal length of such event running, just like in any given space segment, a certain space point fails to stand for the entire space.

Also, the very notion of an event that time is directly related to, is often represented in an ambiguous manner these days, which fact frequently leads to some erroneous representations of time. As you all know events are quite different: a body moving in – between two points in space, an oscillation of a given particle, the movement of a star in between two given benchmarks, the traveling of a signal in between two points, the life of a human being, the running of any individual actions, or group or social activities, etc., or of any physical – chemical phenomena or biological processes. Yet all of them have one temporal moment of beginning and one temporal moment of ending, and the running speeds of such various events can vary quite a lot. In general, events also trigger the occurrence of other such events as per the universal principle of causality.

One other matter that needs to be mentioned refers to the definition of probability of any given event by help of the theory of probabilities, for instance the probability to get a certain number when rolling the dice, which fact leads to some errors in terms of events definition. In reality, the theory of probabilities is not interested in the matter relating to the rolling of the dice, but only in the probabilistic character of the final temporal moment, and yet one makes the error of confusing the event with this final temporal moment when the number shows up, of the overall six sides of the dice.

On the other hand, the obligatory method of abstract thinking in time representation and in the scientific work with this particular size, has been the cause of this research field being left behind, as compared to other research fields which are more concrete and approachable. In this particular regard, save for few exceptions, the physics of time has remained pretty limited, with some old fashion conservatory and frequently erroneous representations.

And thus, due to practical reasons, from the very early age the issue of relative time has been reduced only to the matter of improving the way of rating the same against a basic standard in connection with the Earth's own rotation and the latter's moving around the Sun, out of which there came the second, the minute, the hour and so on and so forth. At the same time, in a correlated manner, the practical activities relating to time, have been reduced to the improvement of the instruments for measuring the latter, from clepsydra to clocks. Yet, all these have only one purely conventional character, since rating has only been made in relation to the Earth and the Sun, and in the Universe there are tens of billions of other stars with quite distinct movements. On the other hand, the Earth movement is not in itself constant for long periods of time. As of the 20th century, upon the development of top edge techniques particularly in fields such as space, atomic, electronic and experimental physics field, which required some very precise time values, this time rating system has undergone various amendments being related to the oscillation of cesium isotope , while at the same time one has also accomplished the quantum clock as one highly accurate measurement tool.

It's still at the beginning of the 20th century that one has achieved only two major breakthroughs in terms of the theoretical physics of time. The appearance of relativist mechanics has led to the discovery of relativist time t_v as related to a moving body traveling by speed v in terms of time t_0 of one external observer relatively deemed as static ($t_v > t_0$), namely the notion of `"time dilation" . That is two types of time: t_v and t_0.

The second breakthrough developed by A. Einstein refers to the theory of general relativity based on the well know relation: $s^2=x^2+y^2+z^2-c^2t^2$,

which connects the space coordinates x,y,z, with time t, that is a space having four dimensions. On this particular occasion, remarkably, there has occurred the notion relating to "space time four - vector ", namely a correlation between space and time. And this was for the first time that one has questioned the purely scalar conservatory character of time, yet without purely theoretically deepening this fact.

It is true that the well-known mandatory characteristics in a vector, namely: size, direction, direction and application point can also be found in time: size, way, direction towards the "elapse of time" and the application point corresponding to the temporal moment of beginning of any given event. The sole difference in terms of time is that it has no turning back. Lately one has put a lot of effort into theoretically quantifying time, however this issue has not been fully settled.

We found it necessary to briefly present you the achievements made in this field of time and the current status of the matter, so as to understand a work in such an abstract and yet existing and necessary field. Since all events (for instance the movement of a body in between two given points) run in different speeds, their running times are relativist (t_v) , while concomitantly existing also a relatively static time of a given external observer (t_0).

Working only with temporal sizes and coordinates, we have found and checked by precise calculations that all times corresponding to events “elapse” under the abstract form of a propeller type spiral, in one single direction. Whereas the multitude of events, which are quite different in terms of time, that run simultaneously, there shall be one similar multitude of overlapping propeller – type spirals, a sort of a temporal tunnel, similar to a temporal swirl, which is constantly propagating from the present to the future. We once again issue the recommendation that in order to understand how things stand in this temporal field one shall adopt the abstract thinking of this distinct physical phenomenon and the geometric forms of representation shall be exclusively considered as temporal elements and not as graphic representations or diagrams. We have also introduced for the first time the sizes of temporal speeds as well as the vector representation of temporal elements. Given the fact that the latter have one specific, particularly temporal character, I called them “tempori “ $\mapsto$ “ with the arrow above the form term: $\overset{\mapsto}{T}$, namely with a “T” at the end , for instance : $\overset{\mapsto}{v}$. Calculations checking using these representations have led to some very precise results, which fact confirms the accuracy of the theoretical elements being used.

In the new helicoidally – temporal representation of the time of events, the latter is accompanied at an axial central level by one accompanying “referential time”, theoretically derived out of the very character of the time elapse in terms of the running time of events. This should not be confused with the time t_{0r} from relativity.

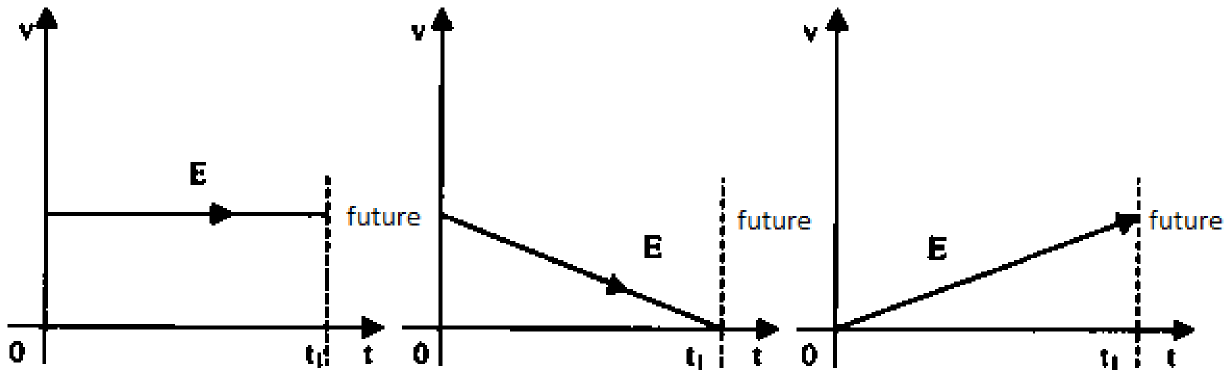
For theoretic generalization purposes, one also presents two material calculation examples, for one “non – relativist” event with low running speed.

GEOMETRIC – TEMPORAL REPRESENTATION OF EVENTS

TEMPORI AND THE TEMPORAL SWIRL

In its general form, any given event can be described as follows: E=f (a,t), (1) where *a* stands for a characteristic size of the said event, and t_v stands for the latter’s running time.

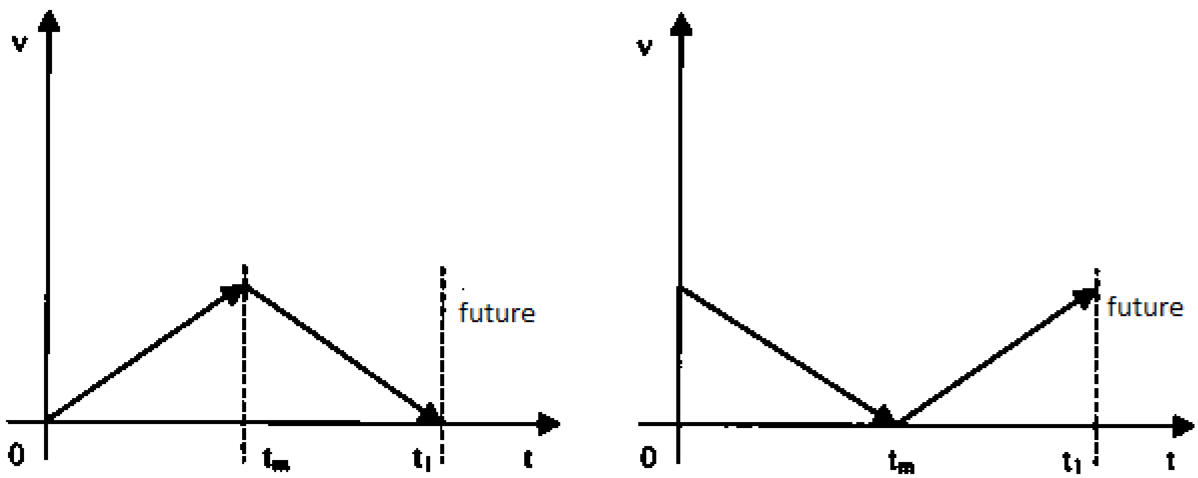
Out of the large number of distinct events, below there is a schematic representation of the axiomatically temporal forms of various types of events.



a) b) c)

v - the speed of event
t – the time

a) Event with constant running speed (e.g. uniform movement of a body with sudden stopping)
b) Event with downward running speed (e.g. vertically throwing of a body under the action of gravity)
c) Event with upward running speed (e.g. falling of a body under the action of gravity)



d) e)

e) Event with upward intensity until time t_m , after which dropping to zero intensity
f) Event with dropping running speed until time t_m followed by an increase of speed until time t_1 (e.g. ballistic movement of a given body)

Fig.1. where v = running speed of an event; t=time

For simplification purposes we shall go on analyzing an event with constant running speed (fig. 1a). We shall use the well-known axiomatic working method that is less laborious, namely we shall deem a priori the elapse of time of the events running in the form of a propeller, then by comparative calculations we shall check this very fact. In fig. 2 we present a section which is diametrically perpendicular through this propeller of time where all sizes are temporal.

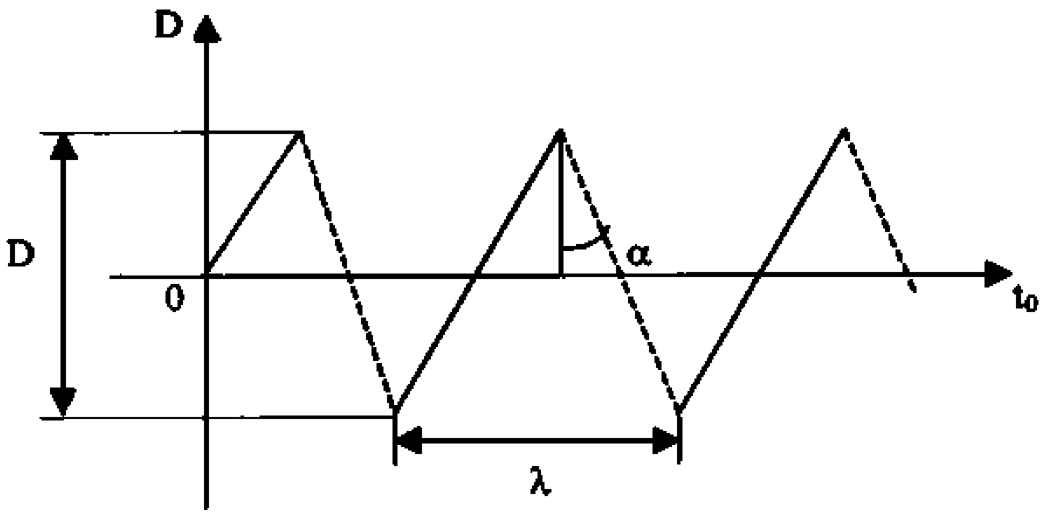


Fig . 2

This running time of the event is (according to fig. 2) the length of the propeller, t_0 being the referential time. The time elapse direction is deemed to be to the right along the axis t_0, therefore both t_0 time and t_v go in the same direction. According to the helicoidally representation of t_v time, one may notice that: $t_v > t_0$.

The temporal propeller also includes three other terms: the diameter D of the propeller, which also has a temporal meaning, the gradient angle of spires α and the number of spires "n" of the propeller. The step λ between two spires is rendered by the relation: $t_0 = n \cdot \lambda$ (2).

Further on, we shall define the temporal speed sizes and the tempori (temporal vectors), since the very temporal speeds have a character of such tempori. In fig .3 we provide the three dimensional representation of the temporal propeller.

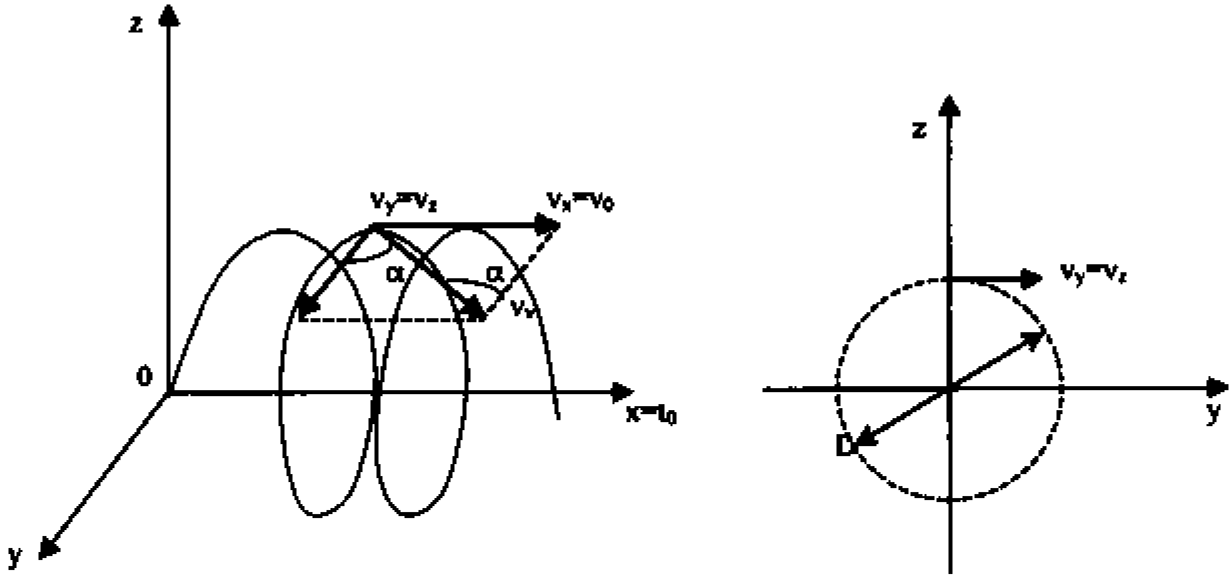


Fig.3

Analogous to any movement, including the uniform movement and the elapse of time, one may assign a temporal speed, which in all cases is related to the time t_0.

Thus: $\vec{v}_0 = \frac{t_0}{t_0} = 1$ (3) is oriented to the direction of the elapse of time; $\vec{v}_0$ has in all cases a constant value equal the unit. Also, the helicoidally time t_v of the running of events has the temporal speed: $\vec{v}_v = \frac{\vec{t}_v}{t_0}$ (4) directed tangentially at the propeller in any point of the latter into its moving direction.

Just like common vectors, the "tempor" $\vec{v}_v$ can decompose into two component elements:

$\vec{v}_y = \vec{v}_z$ parallel with plane yoz and $\vec{v}_x = \vec{v}_0$ guided into the direction $x = t_0$. Their values shall be:

$$\vec{v}_y = \vec{v}_z = \vec{v}_v cos\alpha \qquad (5)$$

and $\vec{v}_x = \vec{v}_0 = \vec{v}_v sin\alpha$ (6)

According to the equation (3), equation (6) one can write down as follows:

$$\vec{v}_v sin\alpha = 1 \qquad (7)$$

By replacing the size $\vec{v}_v$ with its value from the equation (4), equation (7) shall become:

$\frac{t_v}{t_0} sin\alpha = 1$ (8), therefore: $t_v = \frac{t_0}{sin\alpha}$ (9). This equation (9), connects time t_v with t_0.

On the other hand, in fig. 2 one can notice that:

$\lambda = 2Dtg\alpha$ (10), where $\lambda = \frac{t_0}{n}$ (11) , λ being the step of the temporal propeller and *n* being the latter's number of spires for any given event, namely : $t_0 = 2nDtg\alpha$ (12). By replacing the value of t_0 from equation (12) in equation (9), one shall get as follows :

$$t_v = \frac{2nDtg\alpha}{sin\alpha} = \frac{2nD}{cos\alpha} \qquad (13)$$

which includes only temporal factors, just like in the equation (12).

The helicoidally geometrical running of time t_v is analogous with the physical swirl, and thus one may write down the temporal swirl:

$$\vec{\Omega t_v} = 2\vec{\omega} = \frac{2\vec{v_v}}{R} = rot\vec{v_v} = \nabla \Lambda \vec{v_v} = \bar{i}\lambda_i + \bar{j}\mu_j + \bar{k}\gamma_i = \begin{vmatrix} i & j & k \\ \frac{\delta}{\delta x} & \frac{\delta}{\delta y} & \frac{\delta}{\delta z} \\ v_x & v_y & v_z \end{vmatrix} =$$

$$= \bar{i}\left(\frac{\delta v_z}{\delta y} - \frac{\delta v_y}{\delta z}\right) + \bar{j}\left(\frac{\delta v_z}{\delta x} - \frac{\delta v_x}{\delta z}\right) + \bar{k}\left(\frac{\delta v_y}{\delta x} - \frac{\delta v_x}{\delta y}\right) \qquad (14)$$

where ω is the angular speed.

In the equation (14), the temporal values of the terms are:

$v_z = v_0 = 1$; $v_y = v_z = v_v cos\alpha$ *and* $x = \frac{Dtg\alpha}{2}$; $y = z = \frac{D}{2}$, *and* $\frac{2v_v}{R} = \frac{4}{Dsin\alpha} = 2\omega$

By replacing the terms in equation (14) and noticing that $\delta 1 = 0$, it follows:

$$\vec{\Omega t_v} = 2\vec{\omega} = \frac{4}{Dsin\alpha} = \bar{j}\frac{2cos\alpha\, v_v}{tg\alpha\, \delta D} + \bar{k}\frac{2cos\alpha\, \delta v_v}{tg\alpha\, \delta D}_i = \frac{2cos\alpha}{tg\alpha} \cdot \frac{\delta v_v}{\delta D}(\bar{i} + \bar{j}) \qquad (15)$$

Out of this equation it follows:

$$\frac{\delta v_v}{\delta D}(\bar{i} + \bar{j}) = \frac{2}{Dcos^2\alpha} \qquad (16)$$

COMPUTATION ELEMENTS FOR THE TEMPORAL GEOMETRY SIZES

As anyone knows, the vector product of two vectors is one perpendicular vector. Analogous is also the case with the multiplying of two tempori:

$\overset{\mapsto}{v}_y \frac{D}{2} = \overset{\mapsto}{v}_x$ (17) , where: $\overset{\mapsto}{v}_y = \overset{\mapsto}{v}_v cos\alpha$ and: $\overset{\mapsto}{v}_x = \overset{\mapsto}{v}_v sin\alpha = 1$

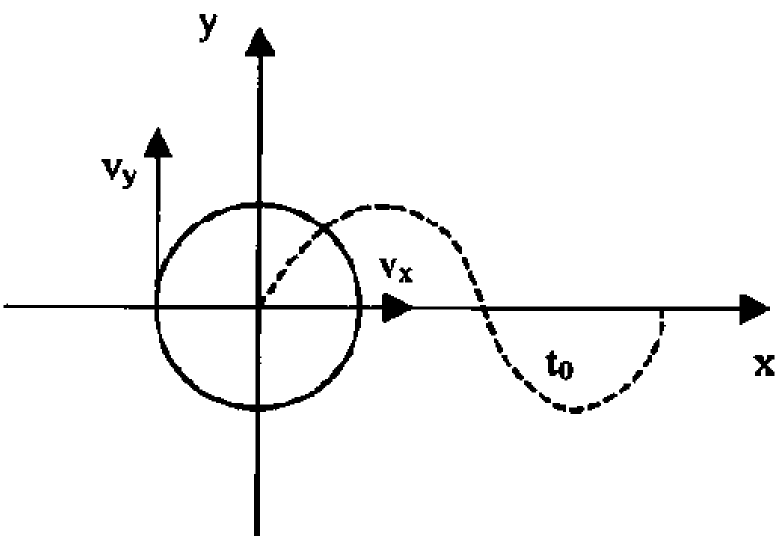


Fig .4

By replacing in the equation (17) , it follows : $\frac{v_v D cos\alpha}{2} = 1$ (18)

Yet, according to equation (4): $v_v = \frac{t_v}{t_0}$, therefore: $\frac{t_v}{t_0} D cos\alpha = 2$ (19)

Also, according to equation (8): $\frac{t_v}{t_0} = \frac{1}{sin\alpha}$. By replacing in equation (19), it follows $D = 2tg\alpha$ (20). Also, by replacing this size (rel. 20) in equation of the referential time "t_0" (12), it follows:

$$t_0 = 2nDtg\alpha = nD^2 \quad (21)$$

We know from the previous equation of the temporal swirl (15) that:

$$\overset{\mapsto}{\Omega t_v} = 2\overset{\mapsto}{\omega} = \frac{4}{Dsin\alpha} \quad \text{that is:} \quad \omega = \frac{2}{Dsin\alpha} = \frac{2\pi n}{t_0} ,$$

out of which it follows: $t_0 = \pi nDsin\alpha$ (22)

Equalizing the equation (21) and (22): $nD^2 = \pi nDsin\alpha$, it follows: $D = \pi sin\alpha$ (23)

Also, equalizing the equation (20) with (23), it follows: $2tg\alpha=\pi sin\alpha$, out of which it follows .

$$cos\,\alpha = \frac{2}{\pi} = const. \quad (24)$$

Thus, by help of the equations (24) and (23) one can calculate the following sizes: $\sphericalangle\alpha$ and D. Out of the temporal equation (13) $t_v = \frac{2nD}{cos\alpha}$, one can determine the number "n " of spires of the temporal propeller : $n = \frac{t_v cos\alpha}{2D}$ (25)

Thus one can also calculate t_0 in equation (21).

We shall carry out a couple of exemplifying checking calculations. We consider the non – relativist movement of a given body, for the time of t_v=10s , with uniform speed of : v=300m/s=$3\cdot10^4$ cm/s, during which time it goes over a distance of s= 3000m = $3\cdot10^5$ cm.

In order to determine the temporal propeller of this moving event, namely its characteristic sizes, we shall use the previously determined temporal equation.

From (24): $cos\,\alpha = \frac{2}{\pi}$ =0,6366 , there deriving: $\sphericalangle\alpha$ =$50^0 50'$

With the equation (23): $D = \pi sin\alpha$, it follows D =2,42413

Also with the equation (25), it follows the number "n" of the temporal propeller:

$n = \frac{t_v cos\alpha}{2D} = \frac{10\cdot0,6366}{2\cdot2,42413} = 1,313$ whirls.

It follows the referential time (21): $t_0=nD^2=1,313\cdot2,42413^2=7,716s$

For checking purposes, we shall recalculate the time "t_v" with the temporal equation (13): $t_v = \frac{2nD}{cos\alpha} = 9,999s \cong 10s$, which precisely checks the initial time of the said event.

Another calculation example is that of one relativist event, namely the relativist movement of a body with the speed: v=0,8c , where c stands for the speed of light, the time of t_v = 10s

In such case, since: $\cos\alpha = \frac{2}{\pi} = 0,6366$ and D=πsinα=2,42413 , namely: $\sphericalangle\alpha = 50^0 50'$, it follows: $n = \frac{t_v}{\pi D} = 1,313$ whirls and $t_0=nD^2$=7,716 s.

The equality of results in the two examples might seem surprising, yet according to the equation:

$t_v = \frac{s}{v}$, since in both examples time t_v is the same, the speeds and spaces gone through by the two bodies do not count, but only their report t_v which is similar. One can also notice that by varying the running time of a given event, the geometrically temporal size that varies is the number "n" of spires of the relevant temporal propeller. Since in all cases the running speed of time v_x=1=const. all events shall run in time with the same temporal speed, therefore concomitantly.

We shall conduct the correlation between referential time "t_0" and the relatively static time "t_{0r}" of an external observer, in the relativist equation: $t_{0r} = t_v\sqrt{1-\beta^2}$ (26)

Since according to equation (21): t_0= 2nDtgα , by dividing this equation to the equation (26) , it follows:

$$t_0 = t_{0r}\frac{2nDtg\alpha}{t_v\sqrt{1-\beta^2}} \quad (27\ )$$

Since according to (13): $t_v = \frac{2nD}{cos\alpha}$, by replacing in (27), it follows:

$$t_0 = t_{0r}\frac{\sin\alpha}{\sqrt{1-\beta^2}} \quad (28)$$

which stands for the correlation between referential time and the relativist relation of time.

In this particular equation (28), by replacing the referential time t_0= 2nDtgα , it follows:

$t_{0r}\frac{\sin\alpha}{\sqrt{1-\beta^2}}$ =2nDtgα , of which: $t_{0r} = \frac{2nD\sqrt{1-\beta^2}}{cos\alpha}$ (29)

One can notice in equation (29) just like in the cases of the non – relativist events, when: $v \ll c$, therefore β≅0: $t_{0r} = t_v = \frac{2nD}{cos\alpha}$ (30) , *which is correct.*

We shall carry out a couple of exemplifying checking calculations. Thus, by taking the previous example of a body moving in time for t_{0r}= 10s with relativist speed v=0,8·c≅ $2{,}4 \cdot 10^{10} cm/s$ we have previously determined: $\measuredangle\alpha = 50^0 50'$; tgα = 1,212 ; n= 2,18848 whirls and D=2,42413. By replacing the values from the temporal equation (27) we shall determine the referential time: $t_0 = t_{0r}\frac{2nDtg\alpha}{t_v\sqrt{1-\beta^2}}$,

Where: $t_v = \frac{t_{0r}}{\sqrt{1-\beta^2}} = 16{,}666s$ and $\sqrt{1-\beta^2} = 0{,}6$ ($\beta = \frac{v}{c}$)

By replacing: t_0 = 12,8604 s

The value of t_0 temporicaly calculated is t_0= 2nDtgα= 12,8604 s, which coincides with the value found above.

We shall also determine the referential time t_0 in the case of the previous example of the non–relativist movement of a body with the speed v = 300 m/s= $3\cdot10^4$ cm/s for a time of t_{0r} = 10s. For this particular case one has found the following values: $\measuredangle\alpha = 50^0 50'$; tgα = 1,212; n=1,313; D = 2,42413; $t_v \cong t_{0r}$, i.e. $\sqrt{1-\beta^2} = 1.$`

We shall calculate the referential time $t_0 = t_{0r}\frac{2nDtg\alpha}{t_v\sqrt{1-\beta^2}}$ = 7,716 s , which, as anyone can see, coincides with the one calculated with the equation t_0= 2nDtgα.

Can observe that: $\frac{t_v}{t_0} = 1{,}295967 = constant$

Thus, the correlation we have proposed is correct.

Bibliography

1. Takeo Tati – Concepts of space-time in physical theories –Research institute for theoretical physics, Hiroshima University, Japan, 1976
2. E. Taylor, I. Wheeler – Space-time physics, San Francisco – London, Freeman, 1966
3. G. Mc. Vittie – Distance and time in cosmology –Encyclopedia of physics, vol.III, Springer Verlag, Berlin 1959
4. M. Johnstone – Time, knowledge and the nebulae. An introduction of the meanings of time in physics, astronomy and philosophy and the relativistic of Einstein and of Milne –London, Faber 1945
5. V. Fok – Teoria spatiului, timpului si gravitatiei, Ed.Academiei-Bucuresti , 1962
6. Roll, Knotkow, Dicke-Annals of Physics, 1964
7. H. Alfen –On the origin of the scalar system, Oxford, 1954
8. O. Onicescu, G. Mihoc, C. Ionescu Tulcea –Calculul probabilitatilor, Ed. Academiei, Bucuresti, 1956
9. I. Placinteanu-Mecanica vectoriala si analitica, Ed. Tehnica, Bucuresti, 1958
10. N. Arjanikov, V.Maltev - Aerodynamics, Moscova, 1954
11. I.Zsako-Chimie fizica, Ed. Didactica, Bucuresti, 1973
12.Landau et Lifchitz –Theorie des champs, Moscova, 1970