ON THE CONTRACTION OF SPACE
IN ELECTROMAGNETIC PHENOMENA
MASS AS A RESULT OF THE CONTRACTION OF SPACE

by

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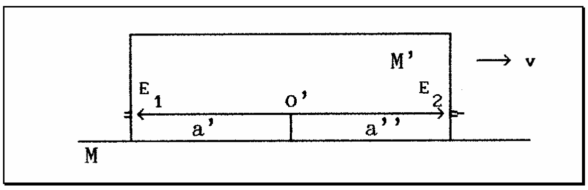
ABSTRACT: *The following article expound the calculations relating to spatial lengths according to the properties which they acquire in electromagnetic phenomena. By way of conclusion, we propose a hypothesis of the formation of mass as a concentration-densification of space.*

PACS 03.30 – Theory of Relativity, objections. Restricted Relativity. Constituent principle. Corporeal masses

0. PRENOTATIONS

0.1 Galileo´s Principle of Relativity and the Michelson-Morley Experiment.

Let a system M´ be in movement with uniform velocity *v* in relation to another system M, which we shall consider stationary in methodological effects. M´ could be likened to a train carriage, for example, which we suppose to be devoid of irregularities of movement (rocking, gyrations, etc.), and M could be likened to a platform. If two mechanical projectiles (two bullets, for example) *a´* and *a´´* are fired simultaneously from a point O´, situated in the centre of M´, towards the points E_1 and E_2 situated on each wall of the carriage respectively (fig. 1), it is established that if the velocity of both projectiles is



(fig.1)

the same, their arrival at E_1 and E_2 will be simultaneous (or, imagining their return, their arrival at O´ will also be simultaneous). This physical phenomenon occurs independently of the - uniform - velocity *v* and independently of the direction of the movement of M´ with respect to M.

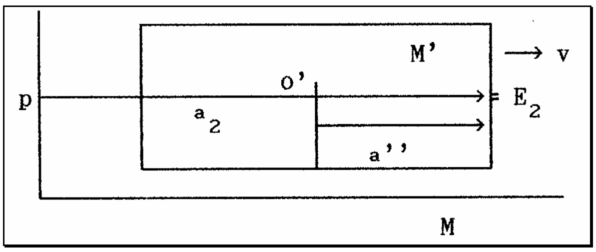
Mutatis mutandis, if their arrival is simultaneous, with their initial departure also having been so, we then derive that the velocity of the projectiles has been identical: $v_{a'} = v_{a''}$ (where $v_{a'}$ and $v_{a''}$ signify the velocities of both).

If we suppose, instead of the mechanical projectiles, the movement of two rays of light r´and r", where from O´ they are made to meet at E_1 and E_2, then the principle is also upheld: *r´*and *r*" will arrive at E_1 and E_2, and will return to the point O´ simultaneously. The Michelson-Morely experiment is thus confirmed (in which the Earth would be the equivalent of our train).

Let us now also consider the system of reference M, representable by means of coordinates, and, as we decided, likened to the platform, and which we could thus consider in a fixed position with respect to the train. In relation to a point *p* of M, the carriage could have a movement which recedes from or approaches the mathematical coordinates which determine the aforementioned system M.

Let us examine this point:

A) Let us propose a first example where, from M, the direction of movement of the mechanical projectiles coincides with that of the carriage. Let us suppose that from *p* of M, and therefore externally to M´ (fig. 2), a bullet a_2 is fired toward E_2 (which as we know, is



(fig.2)

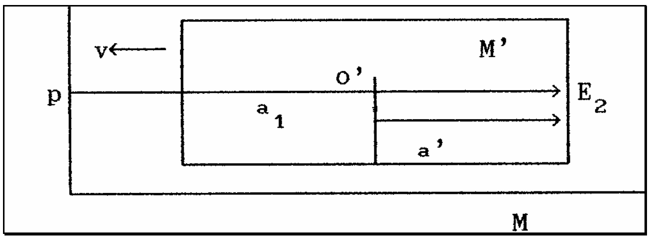
situated on the wall of the carriage). If at the instant t_0 , at the moment a_2 passes through the point O´ of M´, another projectile a" is fired from O´ in the same direction, parallel to and as close to a_2 as desired, it is established that if the arrival of both projectiles at the point E_2 is simultaneous at the instant *t*, then a_2 has had to have built up a velocity greater than that of a´´, given that during that time this bullet has travelled the distance O´E_2, while (from

M) a_2 has had to travel $O'E_2 + vt$ (where vt represents the space covered by the system M′ at velocity v with respect to M in that same time t). In this way, if v_{a2} and $v_{a''}$ represent the velocity of a_2 and of a” respectively, then

$$v_{a2} > v_{a''}$$

B) Let us propose the opposite example where the direction of the projectiles and of the movement of the carriage are opposed:

Let us suppose that the system M′ moves towards the point p of M with uniform velocity v (fig. 3). Analogously to the previous case, at the instant t_0 , when the projectile



(fig.3)

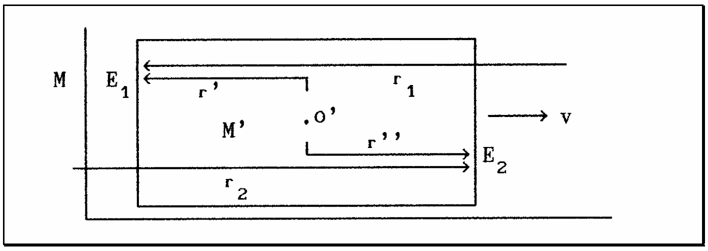
a_1 (which has originated from p towards E_2) passes through O′, another projectile a' is fired parallel to a_1, as close to it as imaginable and in the same orientation and direction. If both projectiles *arrive simultaneously* at E_2, one has to contemplate that, given that a' has had to travel the distance $O'E_2$, while (from M) a_1 has had to travel the distance $O'E_2 - vt$ (since the point E_2 “arrives at the meeting point” of a_1), then this projectile has built up a velocity lesser than that of a′. That is,

$$v_{a'} > v_{a1}$$

0.2 <u>The Property of the Unicity and the Constancy of the velocity of Light.</u>

It so happens, however, that some phenomena appear in Nature which contradict these principles of classical mechanics, insofar as they maintain the property of equality and the unicity of their velocity independently from the difference of the velocities between the systems M and M′: such is the case with the group of electromagnetic phenomena, and in particular the case of Light. Let us examine this in more detail:

If, instead of the mechanical projectiles a_1 /a_2 and a′/a′′, we consider the luminous signals r_1/r_2 and r'/r'', at the same time that we identify the system M′ with, for example, the planet Earth (fig. 4), then it experimentally occurs that, for an observer situated in the system M', a ray of light r", emitted from O´ at the moment another ray of light r_2 which originates



(fig.4)

from some point of M (for exemple, a galaxy) passes through O' , will arrive simultaneously with r_2 at any point of M´ (for example, they will both arrive simulataneously at the mirror E_2). This is all independently of the Earth´s velocity *v*, and even independently of the velocity of the source of transmission of r_2 in relation to the Earth. Let´s say the same of a ray r´ in respect to another one r_1. This is the so-called Property of the Unicity of Light. This is thus confirmed by varius experiments and observations (for example, observations regarding double stars), which also indicate that the rays are transmitted in pairs (r'/ r_1 , on r'' / r_2) as if they were *one in the same signal*, and that their velocity, as previously mentioned, is independent of the velocity that systems in movement can have (celestial bodies, galaxies, etc.).

On the other hand, if we relate this property with the Michelson-Morely Experiment, not only do we find a simultaneousness of signals which, in the same path travelled in M´, are transmitted along the same course and in the same direction regardless of the system of reference they originate from, but also that their *velocity* is the same as that of any luminous signal, independently of their point of departure or their course and direction in the system M´ , and independently of the velocity and direction of M´. Therefore, if in the inertial system M´ (fig. 4), independently of its own velocity and the direction of its movement, it holds true that

$v_{r'} = v_{r''}$ (because of the Property of Michelson);

and if

$v_{r''} = v_{r2}$ (because of the Property of Unicity),

then

$v_{r'} = v_{r2}$

Let us say the same for

$$v_{r'} = v_{r1} \text{ (because of the Property of Unicity),}$$

and therefore

$$v_{r2} = v_{r1} \text{ (because of the Michelson Property).}$$

Given that

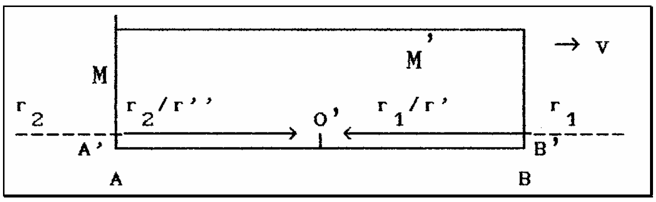
$$v_{r'} = v_{r''} = c \text{ (where } c \text{ is the velocity of light),}$$

then

$$v_{r'} = v_{r''} = v_{r1} = v_{r2} = c$$

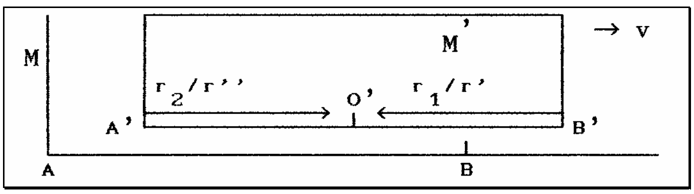
Conclusion: Light moves at the same velocity c throughout the system M′, independently of this system′s direction and velocity. One can hence state that the velocity of light is constant in M′, insofar as it is the same for M′ whatever the circumstances. At the same time, being independent of the velocity that the light source may acquire (thus c in this respect is also constant), one can state that the velocity of light is Absolute.

Because of this constancy of light speed and the consequent simultaneousness of the signals travelling the same path in the system M′, we can conclude that, if at the point where A′ of M′ coincides with A of M (and where B′ meets B), at the moment when one system passes in relation to another, a signal r' of M′ is fused/merged with another signal r_1 of M, and another signal r'' with r_2 (the property of Unicity) - fig. 5 -, so viewed from



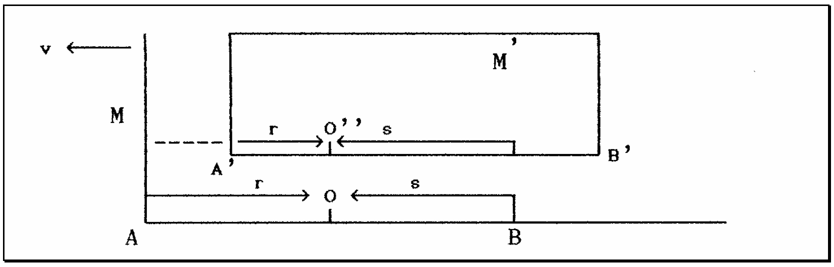
(fig.5)

the system M′, both signals have to arrive simultaneously at the mid-point O′ of M′ (fig.6).



(fig.6)

However, in the same way as for M′, the properties of light are identical for any system, such as M for example, from which the signals r (the fusion of r_2/r'') and s (the fusion of r_1/r′) “should coincide” at the point O of M, corresponding to a point O” of M′ (fig. 7), which produces the well know paradox that Relativistic Physics is confronted with and that it attempts to resolve by presenting the hypothesis of a time that is different -and therefore relative- between one system and another, based on that supposed non-simultaneousness of the signals[1].



(fig.7)

This hypotesis ist analysed in a previous piece of work[2]. In that work, we tried to demonstrate that the Principle of Relativity and the properties of the Constancy and the Unicity of light require that the arrival of signals at the system M’ in movement, even if these signals originate from a point beyond that same system, takes place at the mid-point O’, and that this fact has to be *chronologically* simultaneous for any system (for example, M), for which the space of M’ would distort itself (contracting-expanding) in electromagnetic phenomena. Thus for M, even if the phenomenon took place at O’ and not at O”), the velocity of ligh would remain constant due to this rarefaction of space in M’. (We shall say the reverse when viewed from M’, for which the system in movement would be M, even if this system also received the signals from points outside it). Therefore, in the previously mentioned article, we establish the *postulate* that the signals are incorporated into the system in question as phenomena particular to that system in such a way that objectively, as seen from M, *r* and *s* coincide only at the mid-point O’, therefore rejecting all relativity of time.

From this standpoint then, we will try to describe in equational form this occurrence of the arrival of *r* and *s* at the mid-point of the system in movement, extending the theoretical field to the description that has to be rationally made of the problem, and to the subsequent theories which explain it.

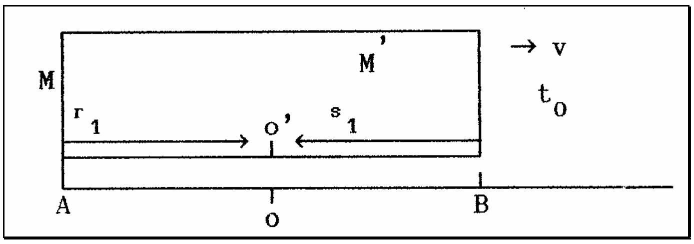
1. THE CONTRACTION / EXPANSION OF SPACE

If we establish the equations which construct the movements of these systems so that they contain the data of the aforementioned electromagnetic phenomena, we will have stated how these exceptional properties of electrical phenomena redound to the laws of the addition of velocity of those systems. In this we find different results, depending on whether the signal which is transmitted in the system in movement moves away from or draws near a determined point in the system M (which is considered stationary).

1.1. Contraction of the space of a signal which moves away in a system in movement.

1.1.1 Calculations of M´ viewed from M.

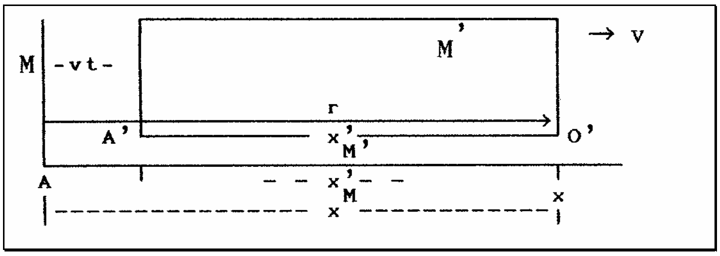
Let us suppose a moving system M´-for example, a train carriage which we take to be of sufficient length -, with a uniform velocity *v* in relation to a system M which is considered stationary. M´ moves as close to M (touching M) as can possibly be imagined. When this moving system passes through the points A and B of M, at the moment t_o , two electromagnetic signals r_1 and s_1 are launched *from M* (fig. 8), which are transmitted within the vehicle towards O´ (which constitutes its mid-point).



(fig.8)

With a view to the theory, we shall initially consider the trajectory that the first signal travels and, to this effect, one half of the carriage, beginning from the ordinate of the point A and terminating at the point O´ (which will correspond to another point O in M at the instant t_0).

If at this moment t_0 , where the signal r_1 departs from A of M, another signal r' is set in motion from the point A´ of M´(corresponding to the point A in t_0) the experimental data prove, as we have said, that both signals r_1 and r' are transmitted as a sole signal r. Thus, when at the instant t this signal r has reached the point O´ in M´ (fig. 9), the equations which measure its path, *when calculated from the system M*, are the following:



(fig.9)

a. *Mechanical calculations*:

The mechanical calculation in M of the path x is represented by the formula

$$x = x'_M + vt \qquad [1a]$$

where x is the abscissa of M corresponding to O′, and x'_M , measured from M, is the length of the carriage (x'), or in other words, projected metrically on the abscissa of M (for this reason we have written x'_M); vt is the space which the carriage travels through in the time t.

b. *Electrodynamic calculations*:

From M, light travels the distance x, so that the equation which determines such a path is

$$x = ct \qquad [1b],$$

where c is the velocity of light.

c. *Electromechanical calculations*:

Since the formula [1b] does not admit the (mechanical) movement of the system M′, it will have to integrate the formula in which that movement of this system is calculated, which is to say it must integrate the formula [1a], and thus the path of the light appears in relation to the system M′, establishing

$$ct = x'_M + vt \qquad [1c]$$

Therefore, the formula [1c] will relate this electromagnetic phenomenon with the velocity of the system in movement or, in other words, the formula makes explicit, with the unit of measurement of light, the summation of the distances travelled (we could say: the metric pattern x has been substituted by an electrodynamic unit of measurement with ct).

We could also say, however, that the phenomenon *ct* has been measured with the metric unit insofar as it equates / is reduced to the terms of the distance $x'_M + vt$. (Note that, seen from M, we cannot say that this sole ray *r* has travelled the distance A'O', given that it has travelled the distance AO' from M, so that there is no case here for presenting the phenomenon in the form of $x = ct + vt$, etc.)

From [1c] we derive :

$$ct - vt = x'_M$$

$$t(c-v) = x'_M$$

$$t = \frac{x'_M}{c - v}$$

$$t = \frac{x'_M}{c(1-(v/c))}$$

$$tc = \frac{x'_M}{1-(v/c)}$$

Since, viewed from M, $tc = x$, so

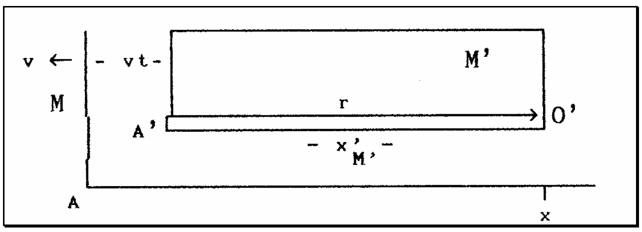
$$\boxed{x = \frac{x'_M}{1-(v/c)}} \qquad [2]$$

or equally, $x'_M = x(1-(v/c))$.

Therefore, this is the equation which, from M, links the distances x'_M and x according to the velocities of light *c* and the system in movement *v*. Put another way, it is the formula of the movement of light in relation to the uniform movement of the systems and their respective distances travelled.

1.1.2. Calculations of M´ viewed from M´.

As previously mentioned, since absolute movement does not exist in Nature as there is no fixed system of reference, it must be the system M which *from M´* moves away (fig. 10). As a consequence, for an observer in the system M´, the path travelled by the light ray



(fig.10)

r must have been $x'_{M'}$ (x'measured from the system M´). From this viewpoint, we find that the sets of equations of the calculations made from these systems will have a parallel development to those made viewed from M:

a. *Mechanical calculations:*

$$x = x'_{M'} + vt \qquad [3a]$$

b. *Electrodynamic calculations:*

In M′ the path travelled by signal *r* is $x'_{M'}$, which implies that

$$x'_{M'} = ct \qquad [3b]$$

since the velocity of light here also has the same value *c* (in agreement with the Michelson Property and that of Unicity).

c. *Electromechanical calculations:*

Applying the previous data in [3a], we find

$$x = ct + vt \qquad [3c]$$

from where

$$x = t(c + v)$$

$$t = \frac{x}{c(1+(v/c))}$$

$$ct = \frac{x}{1+(v/c)}$$

As $ct = x'_{M'}$ in M′ , therefore

$$x'_{M'} = \frac{x}{1+(v/c)}$$

or in other words

$$\boxed{x = x'_{M'}(1+(v/c))} \qquad [4]$$ [3]

1.1.3.Conclusion. Space contracts.

If , because of what we have previously said, the electromechanical measurements which an observer of M determines of the distance travelled are

$$x = \frac{x'}{1-(v/c)} \qquad [2]$$

while an observer of M′ determines the measurements

$$x = x'(1+(v/c))[4],$$

then with regard to the measurements that each one makes in his own system (and x´, the length of the train carriage, can be considered the unit of measurement for each of them) we find a distortion factor between both measurements: In effect, equating [2] and [4],

$$\frac{x'_M}{(1-(v/c))} = x'_{M'}\,(1+(v/c))$$

we obtain

$$\frac{x'_M}{x'_{M'}} = 1-(v^2/c^2)$$

We shall name the factor $1-(v^2/c^2)$ ratio δ, and this indicates that the measurements of x' effected from M (i.e: x'_M) or from M´ (i.e.: $x'_{M'}$) are not the same for the electromagnetic phenomenon and are subject to the variation shown. Thus, the formula

$$\boxed{x'_M = x'_{M'}\,\delta} \qquad [5]$$

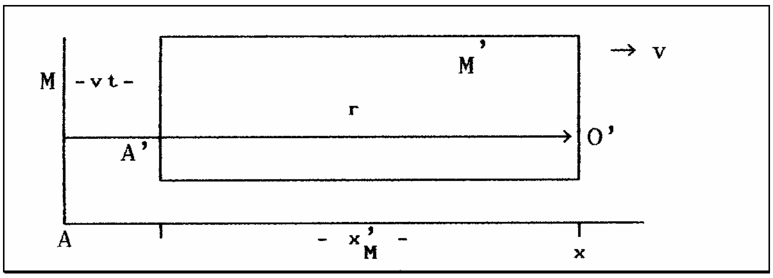
which is another expression of the previous one, relates the measurements of x' determined both from M and from M´, equating them by means of the ratio δ. So then, as $1-(v^2/c^2)$ is a ratio which depends on the velocity v (being the assumed constant c), then this ratio δ (whose value is $\delta < 1$) decreases as the velocity v of M´ increases. This implies that whatever product which contains δ as a factor *is reduced* according to the increase in velocity of the system in movement.

Thus for a correct interpretation of [5], the following has to be taken into account: Firstly, the expression $x'_M = x'_{M'}\,\delta$ is not really a calculation of x'_M nor of $x'_{M'}$, since in both terms it is the same length x' which acts as a parameter, since considered from M or from M´ (in the formulas [2] and [4], the value of x' is actually calculated by other parameters that are different from x'). What [5] really expresses is a relation of identity, or of *equality* (it could be said to be of proportionality, if the term did not lend itself to ambiguity) regarding the *same length* x'(which we must not forget is a length of M´), according to an observer in M or in M´.

From this perspective, taking into account that this is actually concerning a relation of equality about one same length, we find that one of the terms is affected by the factor δ, which could only be interpreted as that x'_M is equal to aṣ δ -times $x'_{M'}$ (i.e. δ -times the measurement x' determined in M´) or, in other words, that x'_M is a smaller measurement of the measurement $x'_{M'}$ determined in M′, and implies in turn that $x'_{M'}$ is in itself larger but it "appears" / is measured / is perceived as being reduced (with the value x'_M) in M (in the way that, *mutatis mutandis*, M must have been applied the "overdimensionator" factor 1/ δ to itself in order to equate the measurement x′ determined in M′). In short, the formula expresses that x_M is the same as $x'_{M'}$ insofar as the latter is reduced by δ, or in other words, that x'_M is the measurement of a contracted length of M′: all of which equates to saying that the lengths which constitute M′ appear as contracted to an observer in M.

One must therefore conclude from all this that *for M the length of M′ is reduced* for M according to the velocity *v* of M′, but moreover, and by the same degree, the length is also larger in M′ than as it is perceived / is calculated / is measured in M. This would also be equivalent to saying that the measurements of *x′* from M are smaller than those determined in M′, or that the measurements of *x′* in M′ are expanded in respect to the measurements *x′* in M, or that the length in itself, in the system M′, is expanded, etc[4]. Finally, as *x′* can be considered in itself one same unit as much for M′ as for M, and that in one case this unit is larger than the other (inasmuch as they are the same, being affected by the factor δ), this can only be interpreted as a change in the dimensions of that unit for the electromagnetic phenomenon in one system with respect to another.

The fact that *x′* appears contracted for M, and being in itself expanded, it is also logical in the fact that, situated in M, the propagation of r_1 and *r′* as one sole signal *r* (and therefore at the same velocity *c*) requires a dilation of *x′* in M′, which is metrically smaller that the distance that same signal covers in the system M (fig. 11)[5].



(fig.11)

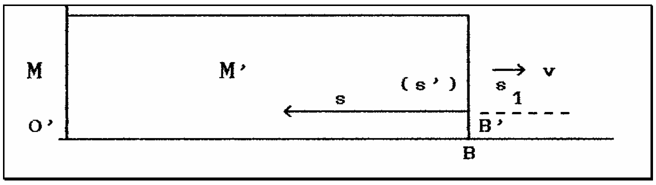
On the other hand, if $x'_M = x - vt$, then from [5] we get

$$x'_{M'} = \frac{x - vt}{1 - (v^2/c^2)} \qquad [L]$$

which is one of the Lorentz equations, except for the fact that the ratio δ is not as a square root, nor should it be, because of the evidence given thus far. We have therefore assigned it the symbol [L].

1.2. The dilation of the space of the approaching signal in a system in movement.

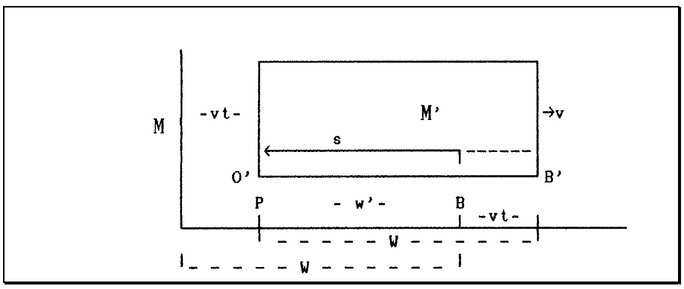
Granted the initial example of the rays *r* and *s* which are propagated in a system M´ in uniform movement with respect to another system M considered stationary, let us now focus on the opposite case to the one studied in §1.1. With a view to theory, we shall considerer the distance travelled by signal *s,* that, in the same way as we assumed for *r,* is formed by the fusion of a signal s_1, outside the system M´, with another signal *s´* of the system M´ (according to the property of the Unicity of Light). With this intention we shall firstly consider the remaining half of the supposed train carriage (fig. 8) which has served us as an example in the previous deductions, when the signal *s´* began its journey fused with s_1 from the point B´ at the moment t_0 , in which it coincides with B of M (fig. 12).



(fig.12)

1.2.1. Calculations of M´ from M.

At the moment *s* arrives at O´ (where with a view to making a more intelligible reasoning, the carriage has "come off" the rail -fig. 13-) an observer situated in M will have



(fig.13)

measured/perceived that the signal has travelled the distance BO′ (where O′ is the point which corresponds to another point P of the system M), so that, seen from M, the equations described by the systems are the following:

a) *Mechanical Calculations:*

The mechanical calculation from M of the length w is determined by the formula

$$w = w'_{\mathrm{M}} + vt$$

(where w is the length of the carriage from M and w'_{M} is the distance between the point B, where the fusion of s_1 and s' occurs, and the point O′, which, don′t forget, we assume to be infinitesimally close to P, as is the signal itself).

b) *Electrodynamic Calculations:*

If, seen from M, the distance travelled by s is w', then for an observer of this system,

$$w'_{\mathrm{M}} = ct$$

c) *Electromechanical Calculations:*

Including the previous equation in the calculations which describe the movement of the systems, we find:

$w = ct + vt$. That is,

$$w = t\,(c + v)$$

$$t = \frac{w}{c(1+(v/c))}$$

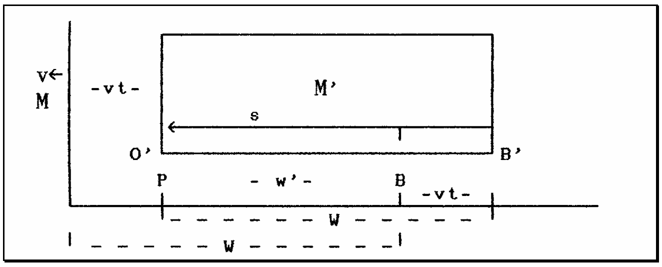
$$tc = \frac{w}{1+(v/c)}$$

As, from M, $tc = w'_{\mathrm{M}}$, then

$$w'_M = \frac{w}{1+(v/c)} \Rightarrow \boxed{w = w'_M\,(1+(v/c))} \qquad [6]$$

1.2.2. <u>Calculations of M´ from M´.</u>

Seen from M´, the system which moves away is M (fig. 14). Therefore, from M´,



(fig.14)

the following calculations must be made:

a. *Mechanical Calculations:*

In relation to the movement of M (since, in short, it concerns equationally relating both systems):

$$w'_{M'} = w - vt$$

$$w = w'_{M'} + vt$$

b. *Electrodynamic Calculations:*

From M',

$$w = ct$$

c. *Electromechanical Calculations:*

$ct = w'_{M'} + vt$, from which

$$ct - vt = w'_{M'}$$

$$t = \frac{w'_{M'}}{c - v}$$

$$tc = \frac{w'_{M'}}{1 - (v/c)}$$

As, from M´, $tc = w$, then

$$\boxed{w = \frac{w'_{M'}}{1 - (v/c)}} \qquad [7]$$

1.2.3. <u>Conclusion.: Space expands</u>.

If the measurements that an observer situated in M makes are

$$w = w'(1+ (v/c)) \qquad [6]$$

whereas those which an observer of M´ makes are

$$w = \frac{w'}{1-(v/c)} \quad [7],$$

so in equating them we find the distortion ratio between the measurements of both systems:

$$w'_{M}(1+(v/c)) = \frac{w'_{M'}}{1-(v/c)} \Rightarrow w'_{M'} = w'_{M}(1-(v^2/c^2))'$$

Which is to say

$$\frac{w'_{M'}}{w'_{M}} = \delta$$

or else

$$\boxed{w'_{M} = \frac{w'_{M'}}{\delta}} \qquad [8]$$

where again we find the distortion ratio δ applied in the reverse sense to [5], as it would correspond to the reversal of the direction of movement of the light rays.

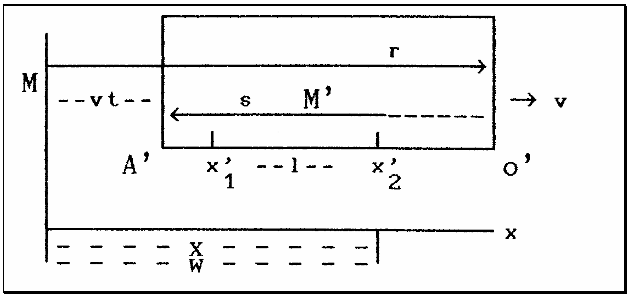
As in the case of signal *r* , in order to have a correct interpretation of [8] it must be taken into account that this essentially expresses an equality/identity regarding the same length *w*´, rather than a calculation (which would be determined by the intervention of other parameters, as is the case of [6] and [7]). The equality [8] expresses that w'_M is an expanded measurement of $w'_{M'}$, insofar as w'_M is equal to $w'_{M'}$ affected by the factor 1/δ, or in other words the measurement that M´ makes of itself is increased by 1/ δ. This implies that the length *w*´ is perceived/appears as expanded in M, or, metaphorically speaking, that the signal in M´ *expands* by the ratio 1/ δ "in order that" M perceives it as w'_M , etc. All of this amounts to saying that the lengths contained in M´ appear as expanded to an observer in M. On the whole, one must not forget the considerations which were also made for the case of *r*, bearing in mind always that what is actually calculated is the behaviour of *r* and *s* in M´, which is always compared with the measurements made from M.

On the other hand, given that $w'_M = w - vt$, the equation [8] is equivalent to $w'_{M'} = (w - vt)\,\delta$ [9].

Lastly, observe that inasmuch for §1.1 as for §1.2, this capacity of contraction/expansion of space is in accordance with its property of continuity. If space didn´t expand or contract it would have to be broken up into discontinuous fragments, which would contradict the fact - not only the theoretical property - that space is infinitely divisible.

CONCLUSION AND FINAL HYPOTHESIS: MASS AS A DENSIFICATION OF SPACE.

We shall consider now for methodological purposes, in that half of the train carriage that we have exemplified, that the signals travel through it in both directions in such a way that we could say that *s* travels the distance O´A´, and *r* the distance A´O´ (fig. 15).



(fig.15)

From this assumption, which would not alter the previous calculations, we can establish the ratio of the *measurements* of a length of M´ effected from M (considered the stationary system) at the measurements which, from M', are established for this same length, for each of the signals (*r* and *s*), in a way that the distortion factor can be established for the lengths between both systems, *depending on the direction of those signals*, in electromagnetic phenomena:

In itself, the abscissa of the system M', that is, $x'_{M'}$ (or $w'_{M'}$) of the paradigms analysed in § 1.1 and § 1.2, can be considered as a length, and thus as such is able to be related to its projection in the abscissa of M: it is the measurement *x*´ (or *w*´) which M makes of *x*´(or of *w*´). Taking this into account, we have calculated that between both lengths of one system and another the relation

$x'_M = x'_{M'}\,\delta$ [5] exists for signal *r* , and

$w'_M = \dfrac{w'_{M'}}{\delta}$ [8] exists for signal *s*

Nonetheless, by following the method of other similar calculations, we will work according to the customary way of the studies concerning these problems. Thus, let x'_2 and x'_1 be two points on the abscissa of the system M´ (fig. 15), in a way that they constitute a length *1* (that is, $x'_2 - x'_1 = 1_{M'}$):

<u>From M</u>, and for a <u>signal *r*</u> in M´, a distance from A´ to O´, which for previous cases we called x' (and which for M we called x'_M), is determined by the general formula

$$x'_M = x - vt$$

Since $x'_M = x'_{M'}\,\delta$ [5], then

$$x'_{M'} = \frac{x - vt}{\delta} \quad 6$$

Hence from this general formula, and specifying the abscissa x as x_2 and x_1 for each one of the corresponding points, the equalities

$$x'_2 = \frac{x_2 - vt}{1-(v^2/c^2)} \quad and \quad x'_1 = \frac{x_1 - vt}{1-(v^2/c^2)}$$

are established. Therefore,

$$l_{M'} = \frac{x_2 - vt}{1-(v^2/c^2)} - \frac{x_1 - vt}{1-(v^2/c^2)} = \frac{x_2 - x_1}{1-(v^2/c^2)}$$

If $x_2 - x_1$ form the length *1* from M, then we can call it 1_M and thus express the previous equality by the following representation

$$l_{M'} = \frac{l_M}{\delta}$$

or, abbreviating, $1_{M'}$ by means of the symbol *1´*, and 1_M by means of *1*, at the same time that we add the subscript *r* to refer to the corresponding signal, the previous expression will end up formalized as

$$\boxed{l_r = l'_r\,\delta} \qquad [9]$$

(in the understanding that this always concerns the length of M´, even if perceived from M or from M´).

Regarding the <u>signal *s*</u>: Since, from M, $x'_M = x - vt$

and $$x'_M = \frac{x'_{M'}}{\delta} \qquad [8],$$

in substituting this formula we find

$$\frac{x'_{M'}}{\delta} = x - vt$$

that is, $x'_{M'} = (x - vt)\,\delta$

In a way that $x'_2 - x'_1 = (x_2 - vt)\,\delta - (x_1 - vt)\,\delta$

$$1'_s = (x_2 - x_1)\,\delta$$

That is, $1'_s = 1_s\,\delta \quad \Rightarrow \quad \boxed{l_s = \frac{l'_s}{\delta}} \qquad [10]$

In accordance with this, the distortion factor between one direction and another of the signals in relation to its perception in M (that is, the ratio between the factors of expansion and contraction of the lengths in M´ in relation to M) will be determined in turn by the equations

$$\frac{l_r}{l_s} = \frac{l'_r\,\delta}{\frac{l'_s}{\delta}} \Rightarrow \boxed{\frac{l_r}{l_s} = \frac{l'_r}{l'_s}\,\delta^2} \qquad [11]$$ [7]

Conclusion: The relation of *1* with itself in the system M (that is, $1_r / 1_s$) is, in principle, the unit: nevertheless, in the system M' that relation is affected by the factor δ^2. So then, given that $\delta^2 < 1$, then δ^2 is a factor which reduces the relation of the measurements of M´ up to the edge of the unit of M or, in other words, that the ratio between the lengths themselves (in M´) "is manifested" as reduced *-as l-* in M, or else *1* in M is a reduced measurement of a length *1'* in M´ and is therefore the contracted view of this (a contraction which has been considered objective for these electromagnetic phenomena). Regarding this matter, see all the considerations made in §1.1.

We must not forget that, as long as we are situated in M, the system which is being measured is M´, which is a system in movement in relation to another that is considered stationary (M). This implies that the *perception* of the lengths *in movement* corresponds to M, because otherwise if the perception of the measurements corresponded to M´, it would be M that moved (in which the case would be identical, only in reverse). Consequently, the stationary system is the one which establishes the unit by which to measure the other system that moves in relation to it. Thus, the interpretation that the unit of M´ is equal to the unit of M increased by the ratio $1/\delta^2$ would not be appropriate, because insofar as the calculations are made starting from M, the unit is that of M, which is the standard unit of reference.

We wish to emphasize with all of this that a length (l) with a velocity v does not so much contract (l'') and appear in M as l_1, but rather, making a measurement l from M, this measurement is the reduction by the value $\delta^2$of a length l' (which implies that this length in M' is, in itself, greater than as it appears in M). In short, the lengths of M´ are contracted in electromagnetic phenomena by the ratio δ^2, and that reduced length is what is perceived by M (and wich perceives it as l).

DERIVED HYPOTHESES.

Prior consideration:

A determined length of space *is a space* of/in that same length, and we can thus consider this length as the space contained between both extremes, and can even consider these as pure spatial points.

Thesis: Granted that it seems inadmissible to postulate the existence of a universal physical-material element, in the usual sense of the word, through which electromagnetic signals can actuate or be transmitted (ether, etc.) , dismissing in this way the methodological assumption of a body as a system of reference in which establishing all the previous mathematical relations, these can be established for pure space (that is, where in principle it does not mean the velocity v of the mechanical system M´ is zero, but rather such a system does not exist and therefore it cannot contain any parameter of velocity). From this position we can admit the notion of any signals propagating in all directions in that space (of which in methodological purposes we have only considered in the previous analysis the signals r and s) which would *appear* to an observer in a limited space (a space of which neither could we say is either one of the other moving system , but rather a pure space *frame*, which we could identify with the space taken in by the eye).

So then, the inexistence of a mechanical system of reference a priori does not imply that the signal does not travel a length in Space, which would appear in our perceptive frame of reference with a determined length x' (which would imply that the electromagnetic signal with its path constitutes its own system of reference), a length, which, because of the previous calculations, must be the result of a contraction in relation to the space itself that this signal travelled, since this concentration (this perception as a contraction) is a peculiar phenomenon of the very nature of the signal and the space travelled. This is to say, that if in the process of the movement of these signals some go in one direction (let us assume that they move away from the viewpoint of the observer, which equates to the direction of our signals *r*) and if others move closer (which equates to the signals *s* of our calculations), then the factor δ^2 can be applied to the space-lengths (here this concept has to be merged) that the signals have travelled. In other words, the space travelled by the signals has experienced a contraction -appearing as a contraction for the observer- to the value of the indicated factor δ^2 (at least longitudinally, which has been the case dealt with up to now, but is also applicable to the other dimensions).

But it is here that the concentration in a unit of which is in fact larger than that unit can be called a phenomenon of densification, or in general, concentration. In this case the densification or concentration of space. Thus, if we consider pure space as zero density, a greatest concentration could be considered as a densification which constitutes a *mass* distinguished from that zero density, and therefore, which begins to be perceptible as soon as it starts to be differentiated from general space, as say, a denser nucleus within it; in other words, as something detectable or determinable, that is, as *a substance*. In short, this concentration of electromagnetic space can be postulated as the principle of the constitution of what is tangible, or of the differentiated within undifferentiated space.

From these postulations we can, consequently, establish the <u>First Hypothesis:</u>

Space "densifies", or concentrates, in electromagnetic phenomena and such a densification is formed in non densified space, that is to say in pure space, which for methodological effects we consider to be of zero density.

Initially, given the methodological base of the established calculations, it would appear that this concentration of space would be the result of electromagnetic phenomena, but this priority would be a question of pure methodology (which is derived from what is the only point from which we could initiate the analysis of the problem). The question could be the contrary: that electromagnetic phenomena were the result of spatial concentration. In any case, even accepting that the cause of spatial densification were electromagnetic phenomena, the "prime material" of which such densification would need to be constituted is space, so that the corporeal masses, as electromagnetic "cores", are formed by a concentration of space, or in other words, by a spatial density. This final remark is our standpoint and our Second Hypothesis:

Masses are the result of densifications of space, in the way that their constituent material is space.

Moreover, the fact is that the question of the previously indicated priority between electromagnetic phenomena and space is resolved by itself: without space there are no electromagnetic phenomena, since space is ontologically antecedent to all its phenomena and, as we have elsewhere proven[8], is the necessary primordial reality, which cannot not be, among all existing things. That it to say, it is the only real entity by/of/in which something could be formed.

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Notes

1. This is not usually initially presented from M´, but rather from M: Thus, viewed from this system, insofar as the velocity is constant for M, the signals will have to arrive at the point O´´ corresponding to the mid-point O of M (fig. 7), etc. So it is said that simultaneousness does not exist with M´, etc.

2. E. L. Medina: "A propos de l'inconséquence de l'Hypothèse de la Relativité du Temps". *The Toth-Maatian Review*, volume 13, number 4, 1997; pp.6309-21.
(http://www.solotxt.com/opinatio2/SOBREingl.htm)

3. Perhaps someone could insist here on a relative time and suppose a different time *t´* for the system M´. This supposition, although it has been rejected in the previous pages, would not affect the established results:
In effect, if we were to consider a time t´ for M´, then $x'_{M'} = ct'$, so
$$x = ct' + vt' \quad (*)$$
$$x = t'(c + v)$$
$$t' = \frac{x}{(c+v)}$$
$$ct' = \frac{x}{1+(v/c)}$$
As $ct' = x'_{M'}$,therefore
$$x'_{M'} = \frac{x}{1+(v/c)}$$
which coincides with [4].

   (*) In this case we would have postulated that the path travelled by a system is *vt´* for M´, that is, in the time *t´*, identical to the one in which light has travelled through M´. To say otherwise would be to lose all sense of logic.

4. In this line, the observations regarding the possible interpretations of the phenomenon, wich were indicates in the previus article, make perfect sense.

5. With respect to this, see the criticism of the Einsteinian interpretation of Lorentz´s equations in the article: E. L. Medina, "Remarks on an equation by Lorentz". *The Toth Maatian Review*, volume 12, number 4, July 1995; pp 5787-95.

6. One must not overlook the fact that in this calculation *x´* is measured with parameters of M (x, for example) and that *x´* is always a length of the system M´.

7. N.B: the ratio must always be in the sense $1_r / 1_s$ because the perception of metric space - the length - travelled by *r* is larger than the space travelled by *s*. In any case, the equational ratio is always established with the signal *r* even in the contrary assumption:

$$\frac{l_s}{l_r} = \frac{l'_s}{l'_r\,\delta^2}$$

8. E. López Medina: *Prima Philosophia Ordine Geometrico Meditata*. Ed. P.P.U. Barcelona, 1989.