1. INTRODUCTION

The theoretical aim of this article is to address an issue yields by general relativity. This issue may be explained : << global space's shape determination >>. This absolute space-time is the general relativity space-time, and this space deformation in space-time must be in conformity with Newton's law at least for long distances.

The adopted point of view is an Euclidean relativity. One thus places oneself in a purely Euclidean mathematical context, with 4 dimensions (three of space, x, y, z, and one of time : ct). This for restricted relativity. For general relativity of course we use the same and we extend it overall with a tensor. Except that here locally it is an *Euclidean* metric used to represent space-time.

Within this mathematical framework the physics principles are exactly those of relativity : isotropy of space, inertial frames of reference with reciprocities between those inertial frames, constancy of the speed of light in each inertial frames, moving from restricted relativity to general relativity by covariance along the geodetic trajectories of the inertial frames, etc… This for the restricted version, and of course for the general one: deformation of space-time by energy, expression of a force (gravitational …) by a space-time deformation.

There exists however a difference in the physics principles, between relativity and our approach. Indeed, here one does not seek constancy of space-time distance, in a global representation of space-time. In other words, we do not use Nimkowski's representation since we wish to remain in Euclidean representation. Hence, the basic principle of an invariant space-time length when changing inertial frames is left off.

The method used consists to postulate first that Lorentz equations are simply a consequence of a space-time deformations by energy. In other words we try to express the general relativity "deformation" principle, in the context of restricted relativity.
Once this done, physics inconsistencies are found. Of course we try to elude them. This leads to finally postulate the existence of indivisible particles, from which matter is made of. Back to our first postulate, we find a space time determination, coherent with Lorentz equations. This will be our final determination of global space's shape inside space-time.

2. RETRIEVING LORENTZ EQUATIONS

One uses the same physical context exactly as Lorentz's one. Let us point it out.
There are two inertial frames, R (O, x, y, z, ct) and R' (O', x', y', z', ct'), in uniform rectilinear motions at the << v >> speed one compared to the other, along Ox axis. X is increasing along Ox axis, and x' is decreasing along O'x' axis. One is interested only by x dimension, ct, and x', ct'. At t=x=0 there is also t'=x'=0.

In order to find Lorentz's equations within this physics framework, and since our representations are Euclidean, it is necessary to suppose that O'x' axis rocked with an α angle compared to Ox axis, with $\sin(\alpha) = v/c$. See figure 1. In the same way it is necessary to have O' coordinates equal to : ($x=vt$, and $ct = v^2t/c$).

Conversely under these conditions the reader will be able to calculate that Lorentz's equations are found. See figure 1.

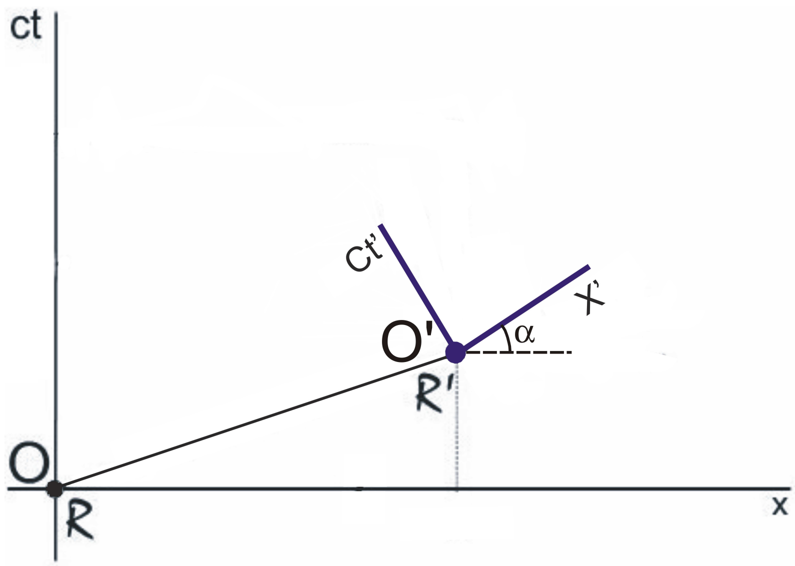

Figure 1 : Lorentz equations in the context of Euclidean relativity.

On the basis of this Euclidean model of restricted relativity, one is tempted to suppose a coherent physics postulate. This postulate is the following.

POSTULATE 1

<< Any particle with a no null mass m, moving with v speed along Ox axis, x increasing, compared to an inertial frame R (O x y z ct), deforms space-time around it with a rotation of the 0x0ct plan around the 0y0z axis, with an α angle between Ox and Ox', such as $\sin(\alpha) = v/c$.

During the displacement of this particle from O to A(x=vt, ct),a vacuum appeared inside space-time. The location of this vacuum is the (O, O', H) triangle, such as : O' coordinates are O'(vt, v^2t/c), H coordinates are H(vt, 0)>>.

In the borderline case of a photon, with v = c, the swing becomes maximum : $\alpha = \pi/2$, and the vacuum is the (O, A, H) triangle.

Figure 2 below represents the effect of postulate 1. A P particle is moving at v speed in the inertial reference frame R, parallel to Ox axis, and in the direction of x increasing. At the t instant, the particle is located coordinates x and ct in R (A point). The inertial frame R' centered on O' "is attached" to the particle. Hence R' is also moving uniformly along Ox axis.

It is the same case as the one of figure 1, except that one added the presence of the P particle on A point. See on figure 2 that the space line rocked with the α angle, locally in A.

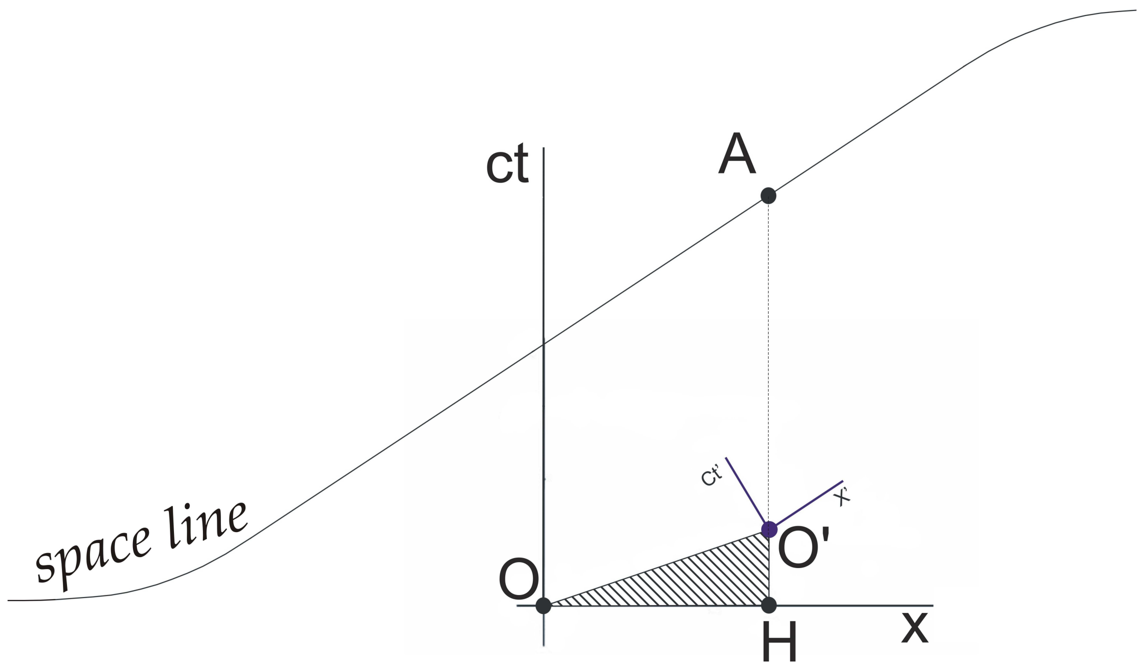

Figure 2 : Postulate 1.

On the other hand, far from A point this line of space has becomes parallel to Ox axis. This is indeed the only realistic possibility ! One does not imagine the movement of a particle deforming the entire universe this way along Ox axis.

With this postulate, the equations of Lorentz now express a local deformation of space-time, caused by the energy of the moving particle (postulate 1 above). This respect of Lorentz's equations is only *local* to the particle. In other words this respect is done only for *low values* of x' and ct' (and also for R' such as O' is close to A at the t instant).

It will be noticed that this "re-discovery" of Lorentz's equations works thanks to the positioning of O' (thus the positioning of A) indicated previously ((vt, v^2t/c) for O'). In addition it works thanks to the space-time swing indicated in the postulate above. This swing modifies with the $\cos(\alpha)$ ratio, equal to $\sqrt{[1 - \sin^2\alpha]} = \sqrt{[1 - v^2/c^2]}$, each temporal values (in ct) and space (in x). However this swing is only local, not global.

Hence one might say that restricted relativity is retrieved with the help of a simple deformation of space in space-time.
Nevertheless, it is necessary to distinguish position of space in space-time, on one hand, and representation of space-time in such or such reference frame, on the other hand.

Indeed, space line in space-time became deformed only locally within the particle. It allows localizing space-time events in a comprehensive but complicated view. This vision is complicated because space-time is not Euclidean any more but Riemannian with an Euclidean local base. Thus space lines have the shapes of curves and are no more simple straight lines like Ox axis.

Otherwise O'x' and O'ct' axis are straight lines. They represent space-time locally but does not represent it overall any more. Broadly the representation of space-time which is done by the inertial frame R', allows to see space-time in a "legal" way in the sense of relativity. This representation is the only one respecting, *locally*, the general physics principles of restricted relativity : in particular the constant speed of light in each inertial frame.

3. LUMINOUS POINTS

However at this stage a problem of coherence arises since one can always regard a particle as consisting of smaller particles. Indeed, how to ensure that space-time deformation generated by the movement of a big particle, composed by a heap of smaller particles, can rise from the deformations of these smaller particles ?

To ensure this coherence a solution consists in supposing that matter is made up of a restricted group of very small “indivisible” particles. These small particles must be conceived in such a way that they can explain space-time deformations generated by any other composed particle. For this explanation a simple operation must calculate the final deformation generated by the large particle, from the small particles it is made of.

Thus defined, this operation must allow, by construction, calculation of the shape of absolute curves of space, starting from the positions and energies of these “small indivisible particles”. At the same time, this operation must be, of course, compliant with postulate 1 and Lorentz equations.

From there the second postulate arises, which follows.

POSTULATE 2
<< Each particle consists of a certain number of smaller particles, called the “luminous points”. These “luminous points” are moving constantly at the c speed, inside the first particle, and with respect to any inertial frame of reference >>.

From this postulate one can determine in a single way any deformation generated by any particle. For that, one applies postulate 1 to these “luminous point” particles. For these luminous points the α angle is equal to its limit value $\pi/2$. The shape of space is thus at any moment the result of successive combinations of these small deformations caused by all these “luminous points”.

What remains to be specified is the way of combining those various deformations. This will be specified by the postulate 3 which follows. After that, one will be able to check that the α angle calculated starting from postulates 2 and 3 is well given by the formula of postulate 1.

For that let us return to Lorentz’s equations. A first mathematical observation is essential. One finds the conservation equations of the energy of restricted relativity by quantifying the luminous point trajectories lengths, inside P particle. It is what we will see.

One models the particle attached to the O' point as consisting of only one luminous point. Consequently the obtained model is the one described by figure 3. One will be able to check thereafter that the reasoning remains valid in the general case of a particle made up of several luminous points.

When the P particle moves from O point (on the figure) to A point, along OA segment, the luminous point contained follows a trajectory having a << V >> shape, that is.:

a) First stage : displacement at the speed +c along Ox, (milked in fat on the figure).

b) Second stage: displacement at the speed -c along Ox (milked in fat on the figure).

For the first stage one poses << l1 >> as displacement length, and << l2 >> (positive) displacement length of the second stage. If << x >> is the position of the A point, one has thus $x = vt = l1 - l2$. This x position is also the coordinate of P in R at this moment t. Indeed at this t moment, in R, the position of P coincides with A point.

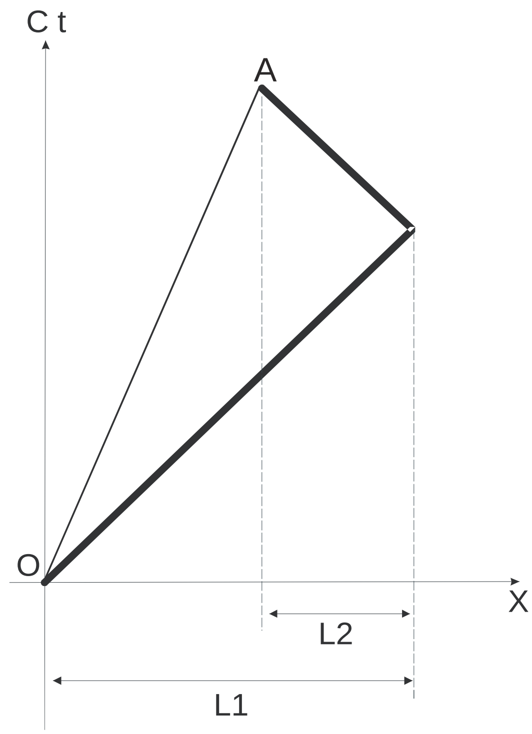

Figure 3 : Light trajectory in a moving particle.

Thus one has :

$$ct = l1 + l2$$
$$vt = l1 - l2 \qquad \textbf{(1)}$$

In addition one can write :

$$(l1 + l2)^2 /2 = (l1 - l2)^2 /2 + 2\ l1\ l2 \qquad \textbf{(2)}$$

This last equation is nothing more than relativistic equation of energy :

$$E^2 = Ec^2 + Em^2$$

with $E = mc^2/\sqrt{[1 - v^2/c^2]}$, $Ec = mvc/\sqrt{[1 - v^2/c^2]}$, and $Em = mc^2$.

To obtain the equivalent equation for the energy densities, one divide each term of this equation by the value $(l1 + l2)^2/2$ which is the value of the total energy of the particle.

$$1 = (l1 - l2)^2/(l1 + l2)^2 + \text{oper}\ (l1, l2)^2 \qquad \textbf{(3)}$$

With $\text{oper}\ (l1, l2) = \sqrt{[l1\ l2]} \ / \ (l1 + l2)/2$

The introduced operator is the relationship between the algebraic average and the arithmetic mean.

It is equal to the relativistic coefficient $\sqrt{[1 - v^2/c^2]}$.
Indeed, from (1), one has : $2\ l1/ct = 1 + v/c$, and $2\ l2/ct = 1 - v/c$, and then :

$$\sqrt{[1 - v^2/c^2]} = \sqrt{[l1\ l2]} \ / \ (l1 + l2)/2.$$

Let us remind that the equation (3) is also written : $1 = \sin^2(\alpha) + \cos^2(\alpha)$ where α is the angle of the space-time swing of postulate 1.

Finally, this last study of Lorentz's equations led us to retain an operator.
We will use this operator to postulate, finally, the mode of determination of general relativity absolute space-time. By construction, this determination will be compliant with restricted relativity.

4. RELATIVISTIC OPERATOR

This is done by the following postulate which follows. It only generalizes the preceding observation carried out on Lorentz's equations.

POSTULATE 3

<< Space shape in space-time is given at any point by the ratio of the infinitesimal space lengths, ds along space line, and dx its length projected on Ox axis. This ratio is equal at any point to the relativistic operator applied to the two following values :

a) *L1 : sum of the heights of vacuum of space-time deformations propagated in Ox direction, x increasing,*

b) *L2 : sum of the heights of vacuum of space-time deformations propagated in Ox direction, x decreasing*

>>

That is to say :

$$dx/ds = \frac{\sqrt{[L1 \; L2]}}{(L1 + L2)/2}$$

Where L1 and L2 are the 2 above-mentioned sums.
This operator is neither linear nor associative. But this doesn't matter since it is calculated once, at any point of space.

But it must be checked that this operator yields the same result when calculated in different inertial frames. That is to say that, for postulate 3, the choice of the inertial frame has no incidence on the final calculated space's slope.
In fact this is the case because of the Lorentz's equations properties, and also because this operator's value is equal to $\sqrt{[1 - v^2/c^2]}$. However, a direct check is done on appendix 5.

It is written above that L1 and L2 are the sums of the heights of vacuum of the "propagated deformations". It is necessary to describe how these "space-time deformations" are propagated.

The mechanism is very similar to waves propagated by the movement of a boat over a water surface. Let us consider the preceding diagram of figure 1. The initial deformation relates to the OxOct plan.

The propagations of this deformation in space-time are carried out on remaining space dimensions, i.e. Oy and Oz, more generally on any Or direction, half-line based on O and contained in the Oyz plan.

The form of these *propagated* deformations is each time exactly the same as the *initial* deformation. The initial deformation was done on OxOct plan (space-time swing represented figure 1). Now the propagated deformation is the same but it relates to the OrOct plan in place of OxOct plan.
The height of this propagated deformation attenuates progressively as r increases. The attenuation law, g, will be given further. At each moment, the << luminous point >> thus emits this deformation.
Therefore, like in the case of the boat, the finally overall propagated deformation is the envelope of all these propagations of deformation. (In the case of a boat this envelope has a << V >> shape which is the final shape of these waves over the water surface).

Above, one connected the space-time initial deformation to the appearance of a "space-time" vacuum. What becomes this vacuum during the propagation of this deformation ? It is propagated too. It relates to 3 dimensions y, z, and ct.

Finally the L1 sum is calculated for all the propagated and received deformations. Each of these deformations is generated by a unique luminous point. An unique deformation dl1 received is such as $dl1^2 = k \, d^2V$ where k is a constant and d^2V the vacuum propagated with the space-time deformation. In the same way for L2, except that this time the deformations come from the opposite sense of propagation (on the same axis).

Let us study the overall result of all the propagated deformations which are received in the same M point at the same moment.
The postulate 3 above express the length ratio along Ox axis only. But at one M point there are numerous such directions coming to. Hence it is necessary to calculate the relativistic operator of postulate 3 for each space direction. The final deformation is then obtained. The only question is : << what is the mode of contribution of the deformations of all these directions in order to obtain the result ? >> This result will be the resulting space-time deformation at M point. It will be thus necessary to generalize the above operator with a second more generic operator, which will take into account each space directions. The result given by this second generalized operator must be the famous final space-time deformation at M point. It will be probably useful to use a mathematical base like the quaternion for that. In this article this complexity will not be seen because fortunately not necessary.

We thus found relativity starting from postulates 1, 2, and 3. One calculates well the α angle of the postulate 1 rotation, by applying postulates 2 and 3. Overall, we obtained a way for calculating space shape inside space-time.

We can now study Newton's law.

5. FIRST MODIFICATION OF NEWTON'S LAW

The studied case is a particle of mass M isolated in a space filled uniformly with an energy density constant and weak in front of M. One supposes the particle positioned in $x = y = z = 0$ which are the coordinates of the O point in our usual inertial frame R of reference. The studied case being invariant by any rotation of center O, one is thus interested only by Ox axis with $x>0$, and the axis of times Oct.

How does evolve the local slope $tg(\alpha)$ of space, along Ox axis ?

To calculate this slope the postulate 3 above is applied.

One considers a space-time P point in which comes at least one deformation from a luminous point pertaining to the M mass. We suppose P x-coordinate positive strict that is : $x>0$.

The M mass particle propagates on P point the following deformations :

$L1m = g(x)$	An attenuation function which will be given further. Propagation in the direction of x increasing.	**(4)**
$L2m = 0$	No deformation propagated in the direction of x decreasing, coming from M, because $x>0$.	

The surrounding universe with constant energy density propagates on P point the following deformations :

$L1u$	Propagation in the direction of x increasing	**(5)**
$L2u = L1u = Lu$	Same thing in the direction of x decreasing because one supposes isotropy of space-time.	

One thus has :

$$L1 = L1u + L1m = Lu + g(x)$$
$$L2 = L2u + L2m = Lu$$

One obtains :

$$dx/ds = \text{oper}\,(Lu + g(x),\ Lu) \qquad \text{application of postulate 3}$$

Let us calculate :

$$= \sqrt{[(Lu + g(x))\ Lu]}\ /\ ((Lu + g(x)) + Lu)\ /2$$
$$= \sqrt{[1 + g(x)/Lu]}\ /\ (1 + g(x)/2Lu)$$

Let us pose : $e = g(x)/Lu$ **(6)**

$$dx/ds = \sqrt{[1 + e]}\ /\ (1 + e/2) \qquad \textbf{(7)}$$

Approximation : x great, thus g(x) low in front of Lu. Thus $e<<1$.

$$\cong (1 + e/2 - e^2/8)\ (1 - e/2 + (e/2)^2)$$
$$\cong 1 + e/2 - e^2/8 - e/2 - e^2/4 + (e/2)^2$$
$$\cong 1 - e^2/8$$
$$= 1 - g(x)^2/(8Lu^2) \qquad \textbf{(8)}$$

In addition let's apply the formula of the expression of a force, to an << m >> mass moving. The traditional relativistic equation and calculation is the following one:

$F = dE/dx$ relativity formula with $E = mc^2/\sqrt{[1 - v^2/c^2]}$, and $v = dx/dt$.

$= d\{mc^2/\sqrt{[1 - v^2/c^2]}\} /dt\ dt/dx$
$= mc^2 (- ½) (1 - v^2/c^2)(-3/2) (-2v/c^2)\ \gamma\ (1/v)$
$= m\ \gamma\ (1 - v^2/c^2)(- 3/2)$
$= m\ dv/dx\ dx/dt\ (1 - v^2/c^2)(- 3/2)$
$= m\ dv/dx\ v\ (1 - v^2/c^2)(- 3/2)$

E is the energy seen in reference frame R. With $\gamma = d^2x/dt^2$, and $(1 - v^2/c^2)(- 3/2)$ is meaning : $(1 - v^2/c^2)$ power (- 3/2).

This is a very classical relativity result.

Now let us take the case of a particle with a negligible mass at rest and located infinitely far. It is with this particular case that one can apply the principle of general relativity : the trajectory of this particle will follow a space-time geodetic.

One thus has for any x, $v = c\ tg(\alpha)$ where α is the slope angle of the curve $ct = f(x)$ required. This curve is the searched space curve. Indeed this is the direct application of “follow-up of geodetic” principle in general relativity.

From where:

$$F = mc^2\ d/dx(tg(\alpha))\ tg(\alpha)\ (1 - tg(\alpha)^2)(- 3/2) \qquad \textbf{(9)}$$

With $tg(\alpha) = v/c$

However, one has :

$$\cos(\alpha) = dx/ds \qquad \text{because } \alpha \text{ is the angle of the required curve}$$
$$\cong 1 - g(x)^2/(8Lu^2) \qquad \text{coming from equation (8) above}$$

From where, for the required slope :

$$tg(\alpha)^2 = 1/\cos(\alpha)^2 - 1$$
$$\cong 1/(1 - g(x)^2/(8Lu^2))^2 - 1$$
$$\cong (1 + g(x)^2/(4Lu^2)) - 1$$
$$= g\ (x)^2/(4Lu^2)$$
$$tg(\alpha) = g(x)/(2Lu) \qquad \textbf{(10)}$$

In addition the required Newton equation is :

$$F = - m\ c^2\ R\ /\ x^2 \qquad \textbf{(11)}$$

Written with $R = MG/c^2$, the Schwarzschild ray. G is universal gravitation constant.

Let us identify equations (9) and (11).

One obtains :

$$m\ c^2\ d/dx[tg(\alpha)]\ tg(\alpha)(1 - tg(\alpha)^2)(- 3/2) = - m\ c^2\ R\ /\ x^2$$
$$d/dx\ (g(x))\ \ g(x)\ (1 - v^2/c^2)(- 3/2) = - 4\ Lu^2\ R\ /\ x^2 \qquad \text{using equation (10)}$$
$$d(g(x))/dx\ \ g(x) \cong - 4\ Lu^2\ R\ /\ x^2 \qquad \textbf{(12)}$$

Because for x large, and a particle at rest when infinitely far, there is $v<<c$.

Therefore one must have, for x large :

$$g(x) = Lu\ \sqrt{[8R/x]} \qquad \text{solution of the differential equation (12)} \qquad \textbf{(13)}$$

This equation can be justified from a physical point of view, using the model of this document, and conservation of space-time propagated vacuum. However, in this document, one will let the possible justifications of this assumption and one will be interested only in its consequences.

We will now postulate that this equation (13) is correct not only for long distances but for any values of << x >>.

Now let us remake calculations with higher orders:

$$dx/ds = \sqrt{[1 + e]} \; / \; (1 + e/2) \qquad \text{(equation (7))}$$

$$= \cos(\alpha)$$ because α is the angle between the tangent to the required curve, and Ox axis.

$$tg(\alpha)^2 = 1/\cos(\alpha)^2 - 1$$ trigonometric equation.

$$= (1 + e/2)^2/(1 + e) - 1$$ using equation of $\cos(\alpha)$ just above.

$$tg(\alpha) = \sqrt{[(1 + e/2)^2/(1 + e) - 1]} \qquad \textbf{(14)}$$

with $e = \sqrt{[8R /x]}$ according to (6) and (13). **(15)**

The equation (9) thus becomes, using (14) :

$$F = mc^2 \; d/dx\{\sqrt{[(1 + e/2)^2/(1 + e) - 1]}\} \sqrt{[(1 + e/2)^2/(1 + e) - 1]} \; (1 - v^2/c^2)(- 3/2)$$

From where finally by using the equation (15), and with $p = \sqrt{[8R]}$:

$$F = mc^2 \; d/dx\{\sqrt{[(1 + \tfrac{1}{2} p/\sqrt{x})^2/(1 + p/\sqrt{x}) - 1]}\} \sqrt{[(1 + \tfrac{1}{2} p/\sqrt{x})^2/(1 + p/\sqrt{x}) - 1]} \; \{2 - (1 + \tfrac{1}{2} p/\sqrt{x})^2/(1 + p/\sqrt{x})\}(-3/2)$$

After calculations carried out on appendix 2, equation (B) :

$$\boxed{\mathbf{F = - mc^2 \; R \; / \; x^2 \; \frac{1 + \sqrt{[2R/x]}}{\sqrt{[\; 1 + \sqrt{[8R/x]} \;]} \quad (1 + \sqrt{[8R/x]} - 2R/x)(3/2)}} \qquad \textbf{(16)}}$$

(R is the Schwarzschild ray : $R = MG/c^2$).

One will note that this equation (16) is an exact equation, and is not approximated for long distances. Even the (13) equation, which yields (16), is in fact an exact equation.

After a limited development of << e >> until order 2, carried out on appendix 2, one obtains :

$$F = - mc^2R \; / \; x^2 \quad (1 - 3\sqrt{[2R/x]} + 19R/x) \qquad \textbf{(17)}$$

One finds well Newton’s equation for the particular case of long distances :

$$F0 = - mc^2R/x^2$$

However, one notes the addition of an x(-5/2) term for the other cases :

$$F = F0 + 3\sqrt{2} \; mc^2 \; R(3/2) \quad x(-5/2)$$ as usual, where R(3/2) is R power (3/2), and x(-5/2) stands for x power (-5/2).

The gravitational force is thus weaker than the Newton force, for small distances.

However, this does not explain the mystery of velocity curve for the stars in the galaxies.
In fact, this correction appears for relativistic values only (v close to c).

6. STAR SPEED DARK MATTER MYSTERY

In order to obtain the explanation of the stars speed in a galaxy it is necessary to take into account these stars masses.

For this, one must suppose the P point located in the middle of these stars i.e. inside the studied galaxy.

We will approximate that the deformation propagated by these stars and received in P is roughly proportional to the matter density of surrounding stars around P.
We will suppose that this density of matter in a galaxy evolves following an $1/x^2$ law. (<< x >> is the distance from the galactic center).
One can thus add this additional term to L1u (see equation (5)).

The surrounding stars propagate on P the following deformations :

$$L1s = L2s = q/x \qquad \text{where } q \text{ is a constant}$$

Hence, a matter density following an $1/x^2$ rule implies that the corresponding symmetric contribution L1s = g(y) follows an 1/x rule. (<< y >> is the distance between P and a studied star, << g >> is the function of equation (13)).
That is because we now suppose, as a postulate, the value of each luminous point contribution, g(x, y), having the form : $g(x, y) = \sqrt{[8R/y]} = \sqrt{[8MG/(c^2y)]} = k\sqrt{[8(1/x^2)G/(c^2y)]}$. (<< k >> is a constant). This is equation (13) above. Hence we obtain the factor $\sqrt{M}$ and then $\sqrt{[1/x^2]} = 1/x$.

The expressions of the quantities of deformations L1 and L2 received in the P point become :

$$L1 = L1u + L1m + L1s = Lu + g(x) + q/x$$
$$L2 = L2u + L2m + L2s = Lu + 0 + q/x$$

It is cleaner to write that in a homogeneous way, using the result of the preceding study :

$$L1 = Lu\,(1 + r/x + \sqrt{[8R/x]}) \qquad R = MG/c^2 \text{ and M is the mass of the galactic center.}$$
$$L2 = Lu\,(1 + r/x)$$

r is the "ray" from which the gravitational effect of surrounding stars is noticed.

The equation (15), giving << e >>, changes in the following way.

$$e = \frac{\sqrt{[8R/x]}}{1 + r/x} \qquad \frac{\text{received "asymmetrical" propagation}}{\text{received "symmetrical" propagations}} \tag{18}$$

The other equations remain unchanged :

$$\begin{aligned}
\cos(\alpha) &= dx/ds \\
&= \sqrt{[1 + e]} \;/\; (1 + e/2) \\
tg(\alpha) &= \sqrt{[1/\cos^2(\alpha) \;-\; 1]} \\
F &= mc^2\ d(tg(\alpha))/dx \quad tg(\alpha) \quad (1 - tg^2(\alpha))(-3/2) \\
m v^2/x &= F \qquad \text{centrifugal force in the galaxies} \\
v &= \sqrt{[\,F\,x / m\,]}
\end{aligned} \tag{19}$$

This << new Newton's law >> (expression of F, equation (19)) is complicated. One can calculate it by computer. The last program of appendix 1 carries that out.
The red curve, which follows, represents the evolution of the calculated speed << v >>.

One posed r = 1 kpc. This value was adjusted in order to obtain the best possible red curve.

The red curve represents the speed of a star in the Milky Way. This star is located between 1 and 15 kilo-parsec (kpc) from the center of the Milky Way.
X-coordinate represents this distance between the star and the Milky Way center (minus 1kpc = 3 10^9 m; that is to say that the value x=0 corresponds to a distance of 1 kpc between the star and the galactic center). The unit used for << x >> is the meter. The ordinate, << y >>, represents the speed, in meter/seconds.

The blue curve represents the speed resulting from traditional Newton's law.

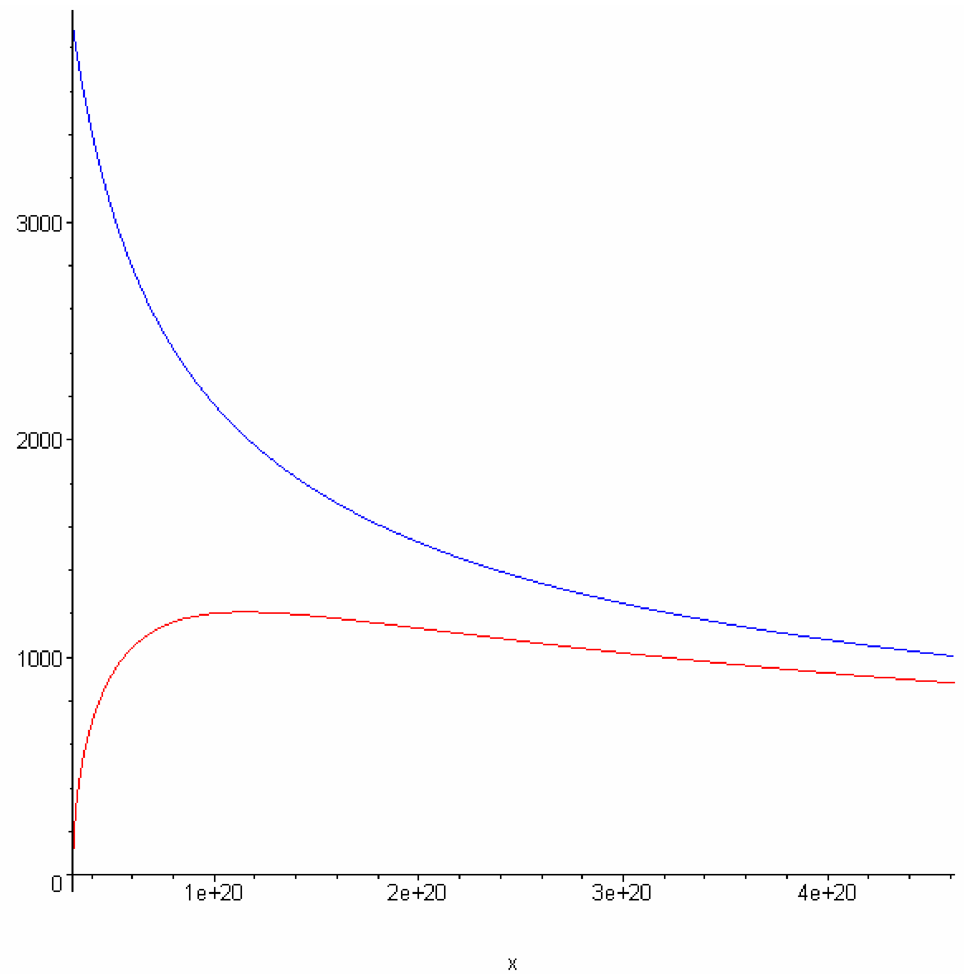

Figure 4 : Theoretical curves of the speed of the stars in the galaxy, taking in account their masses.

One explains the variation of the speed of stars in a galaxy.

In any case the explanation is good for distances x in the Milky Way ranging between 3 and 15 kpc (see on the figure between 10 ** 20 and 4 10 ** 20 meters).

However the evolution of the speed between x = 3 and 15 kpc is of 25%. It is probably not exactly the measured one.
Nevertheless, the model used to obtain that was made with a matter density following an $1/x^2$ law. This evolution is actually perhaps slower in the Milky Way.

The figure 4 above is false quantitatively. Indeed the speeds indicated for stars are approximately 1000 m/sec. However, measured speeds are actually of 220 km/sec, which is 5 times lower. It is necessary to use the measured evolution of the density of matter.

For distances higher than 15 kpc, the two curves fit exactly each other (this is visible on figure 4 but much more visible with another plot in the program. For this, use the program in appendix 1 with other boundaries for plotting, in order to see clearly this fitting of the two curves).
This recalls that, out of the vicinity of the stars, this correction of Newton’s law has no effect.

Conversely, this effect takes place in the galaxies because of the presence of a strong density of surrounding matter, inside the galaxies. This great surrounding matter density is coming from the stars of the galaxy. As we have seen, this is adding a third term for the calculation of the relativistic operator which drives space-time shape.

For this last reason, one may affirm that this Newton’s law correction explains the weak variation of speeds of stars in a galaxy.

Finally, for distances lower than 3 kpc, the theoretical curve obtained is of the same type as the measured one. Our correction of Newton’s law explains << solid >> nature of galactic center.

Refer to appendix 1 for more precise details about figure 4.

7. GALAXY SPEED DARK MATTER MYSTERY

Let us study now the case of galaxy groups. We suppose that they are moving around each other, like in the Coma or Virgo galaxy groups.

Hence we start from the classical Newton's law model of chapter 5 : the << M >> mass, and the surrounding matter modelled by a uniform density of matter.

Therefore, the equations stays unchanged. Let us remind them :

$$dx/ds = \frac{\sqrt{[L1\ L2]}}{(L1 + L2)/2}$$

In addition, equations below are just a reminder of what was done above :

dx/ds	$=$	$\sqrt{[1 + e]} \;/\; (1 + e/2)$	with $e = L1/L2 - 1$
	$\cong$	$1 - e^2/8$	as seen above
dx/ds	$=$	$\cos(\alpha)$	
	$=$	$1 / \sqrt{[1 + tg^2(\alpha)]}$	
	$\cong$	$1 - ½\ tg^2(\alpha)$	
$tg(\alpha)$	$\cong$	$e/2$	comes from just above
F	$=$	$mc^2\ d/dx(tg(\alpha))\ tg(\alpha)\ (1 - tg(\alpha)^2)(- 3/2)$	
	$\cong$	$mc^2/4\ \ e\ de/dx\ (1 - tg(\alpha)^2)(- 3/2)$	using $tg(\alpha)$ above
	$\cong$	$mc^2/4\ \ e\ de/dx$	for long distances

Hence **F** is roughly proportional to :

$e^2 = [(L1 - L2) / L2]^2$ **= [asymmetric / symmetric contributions]²**

Here the asymmetric contributions come from the << M >> mass. The symmetric contributions come from the outer space only.

However, in the case of our old Newton's law, this is different :

- asymmetric contributions are seen the same way.
- But symmetric contributions are much greater. That is because they come not only from outer space, but also from the Milky Way itself.

As a conclusion, for equal asymmetric contributions, symmetric contributions are much greater inside the Milky Way than outside any galaxy.

Therefore, the gravitational force, and with it, the G constant itself, is much greater, outside any galaxy, than, like us, inside the Milky Way.

Another way to conduct this study is to calculate the G constant. This is done on appendix 4, and gives the following result.

$$G = \frac{c^2}{8\ \rho u\ \ d^2 \ \left(\sum_{n=1}^{E(cT/d)} 1/\sqrt{n} \right)^2}$$

This formula may be written in a more generic way :

$$G = \frac{c4}{\left(\sum_{p} \sqrt{[8 \ ep / xp]} \right)^2}$$

with c^4 = c power 4.
Obtained the same way as in appendix 4. **(20)**

In this << $\sum$ >> sum above, we do not take into account the luminous points pertaining to the << M >> and << m >> masses which are concerned by Newton's law itself ($F = - GMm/x^2$).

This sum is done for each luminous point, << p >>, along an infinite half-line. This half-line is centered on the location in which we want to calculate G. That is to say that, formally speaking, we take into account each luminous points in the universe, except those of the interacting masses for Newton's law.
<< ep >> is the energy of each luminous point.
<< xp >> is the distance of each luminous point from the location in which we calculate G.

On equation (20), one can see that G is inversely proportional to $(\sum \sqrt{[8 \ ep / xp]})^2$. This value differs greatly from the cases inside, and, outside the Milky Way.

Let us note also :

$$Si = \sum_{p \text{ inside the Milky Way}} \sqrt{[8 \ ep / xp]}$$ for the luminous points *inside* the Milky Way

$$So = \sum_{p \text{ outside the Milky Way}} \sqrt{[8 \ ep / xp]}$$ for the luminous points *outside* the Milky Way

Then for our case, inside the Milky Way, we can write :

$$\sum \sqrt{[8 \ ep / xp]} = Si + So \quad \textbf{(21)}$$

Now for the studied case, which is *outside* any galaxy, we can write :

$$\sum \sqrt{[8 \ ep / xp]} = So \quad \textbf{(22)}$$

If we note G' the G constant located outside any galaxy, then we have :

$$G'/G = \frac{(Si + So)^2}{So^2}$$ Coming from equations (20), (21), and (22).

$$= (1 + Si/So)^2$$

For an example, if we need 10 more mass in order to explain the measured galaxies speeds, (this factor 10 was measured for some galaxy group), then we deduce from our explanation : G'/G= 10, and then Si/So = 2,1.

Let us approximate very roughly in order to appreciate this value. If we note $Si = \sqrt{[8ei/xi]}$, and $So = \sqrt{[8eo/xo]}$, (with ei, xi, eo, and xo the corresponding "pin pointed" energies and distances corresponding to those Si and So sums) then we have :

$$(ei/xi) / (eo/xo) = 4.7 \cong 5.$$

This value does not seem to be stupid.

Hence, this value order represents the energy ratio, divided by the distances ratio, between the Milky Way, and the outer space, and along a half-line. (This half-line might be represented physically by an infinitely small solid angle).
Therefore, this ratio corresponds also to a ratio of linear matter density, between the two cases (Milky Way and outer space).

Of course the linear matter density is much greater inside the Milky Way than in the outer space. A ratio of << 5 >> for this seems possible at “first glance”.

As an intermediate conclusion, our modelling of relativity explains the “dark matter” mystery for the velocity of the galaxies inside a heap of galaxies. This explanation is based on a great increase of the G constant in such cases.
Also, this explanation is the same for the mystery of light beam deviation in the vicinity of a galaxy.

Moreover we may conclude at this point that our study explains each “dark matter” mystery.

8. UNIVERSE FINITE AGE

Finally, the study above proves a finite universe age (supposing a constant density of matter in the universe, through time and space).

Indeed, the << $\sum \rho/\sqrt{x}$ >> sum, calculated on the whole volume of the universe does not converge if this volume is infinite. (<<ρ>> is a constant proportional to the density of matter). With this sum, one expresses the value of << Lu >>, the finite coefficient which was used in preceding calculations. This coefficient represents the contribution of the energies of outer space to the deformation received on P point.

If the universe is infinite, then this value << Lu >> is infinite, and the relativistic operator is equal to 0 everywhere, which is a contradiction.

On the other hand, it is not possible to calculate the value of this finished age. Indeed, for that it would be necessary to know the value of the << ρ >> parameter. The study of this document does not make it possible to calculate this value.

9. CONCLUSION

As a conclusion, this new modelling of space-time retrieves general and restricted relativity. Nevertheless, it is more than a simple Euclidean version of relativity, as shown by postulate 1 and 2.

It is enough to add a 3^{rd} postulate in order to explain “dark matter mysteries”, which are :

- star’s speed inside galaxies, explained by our Newton’s law correction,

- speed of the galaxies themselves, inside their group, and deformation of light trajectories in the vicinity of a galaxy.

Overall, this third postulate conducts a modification of Newton’s law.

This modification is conceived in order to find exactly Newton’s law in the specific case of pin pointed masses and long distances. One uses the usual modelling of Newton’s law, with two specific masses concerned, a gravitational mass M, and an attracted mass m. One thus finds by construction the law of Newton, for long distances between m and M. However, one can see immediately a correction of Newton’s law in the case of short distances. This first correction occurs in fact for relativistic speeds (speed v of the m mass close to c).

Nevertheless, the important result of this correction of Newton’s law occurs when one utilizes the presence of galaxy’s stars in the model.

In this case, a third speaker is introduced, which is galaxy’s stars. One then notes a very strong difference with Newton’s law. The curve of the speed of stars in the galaxies, obtained with this new Newton’s law, seems to be very close to experimental measurements. This theoretical curved similarity with measured one remains even valid for the << solid >> part of the galaxy (i.e. nearest to the galactic center, in which measured speeds are almost proportional to the distance to the center).

However, this result must be refined, using an evolution of matter density more realistic. The ideal would be of course to use the exact measured value for this density of matter of the stars in the galaxies.

That is for “stars speed” “dark matter” mystery.

For the other “dark matter” mystery, which concerns the case of galaxy groups, the explanation is more direct.
This is explained by a different value of G, between our case inside the Milky Way, and the case outside any galaxy. Here again, the “third speaker”, which decrease the G constant, is the stars of our galaxy.

That is for the practical results yields by this modelling. Moreover, and from a theoretical point of view, this study finds a way for space-time determination. At any point in space-time, this determination is based upon the matter density distribution through the whole universe.

It remains also to check if the model described in this article is coherent with other actual physics theories (electromagnetism, quantum physics, etc).

As an answer to this last question one will notice that this model is in conformity with a unifying theory called “physics theory of the three elements” * and whose document is available at http://lumi.chez-alice.fr.

* : this name of the “three elements” will be changed later on.

APPENDIX 1 COMPARISON BETWEEN NEWTON'S LAWS

1) Speed of stars in a galaxy, WITHOUT taking into account the stars

In blue is the law of Newton.
In red is the law of Newton corrected WITHOUT taking into account of the effect of stars.

One uses the formula v = √[Fx/m], where F is the gravitational force.
The m mass is left in the programs equations below only for comprehension, since in fact it is always simplified.

X-coordinate (in meters) is the distance which separates the star from the center of the galaxy (minus R). The y ordinate represents the speed v (in m/s) of the star in its movement around the galactic center.

The distances lie between R (Schwarzschild's ray) and 40 R. They are thus weak compared to the total size of the galaxy. A difference appears however between the two curves. On the other hand , this difference becomes unimportant for distances ranging between 1 and 15 kpc.

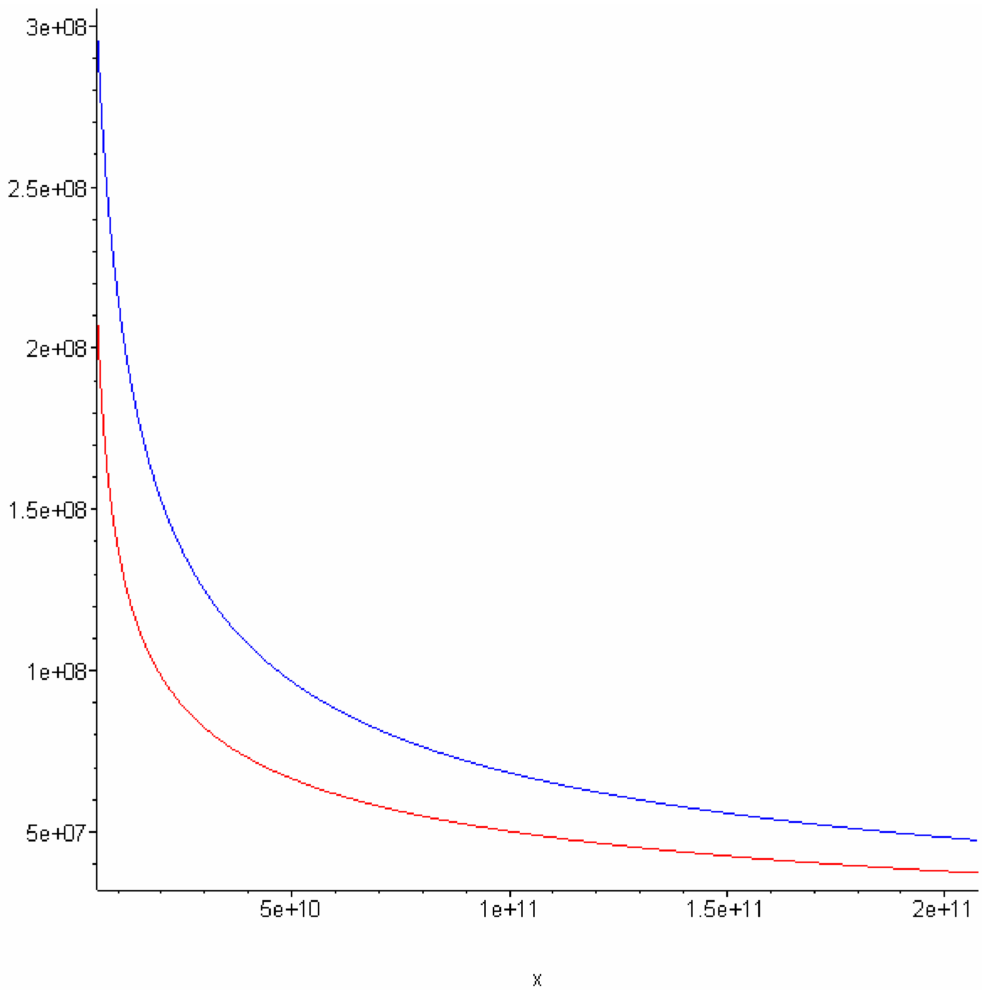

Figure 5 : Theoretical curves of the speed of the stars in the galaxy, without taking in account their masses.

Program MAPPLE having posted this figure :

```
Digits := 20; m:=1; M := 7 * 10**36 ; G := 6.6742867 *  10**(-11); c := 3 * 10**8;
R := M*G/c**2;                                          # Initialisations.
e := sqrt(8*R/x) ;                                      # Famous "relativistic coefficient".
cos2 := (1 + e) / ((1 + e/2)**2) ;                      # Square of the relativistic operator.
tg := sqrt( 1/cos2  -   1)  ;                           # Slope of space inside space-time.
F := - m * c**2 * diff(tg,x) * tg * (1  -   tg**2)**(-3/2) ;     # Our "Newton's law".
FN := m * c**2 * R / x**2 ;                             # Classical "Newton's law".
v := sqrt( F * x / m ) ;                                # Centrifugal force and tangential speed v.
vn := sqrt( FN * x / m  ) ;                             # The same for classical Newton's law.
plot([v(x), vn(x)], x=R..40*R, color=[red,blue], style=[line,line], numpoints=1000);
                                                        # Plotting the 2 curves from R to 40 R.
```

2) Speed of stars in a galaxy, TAKING into account the stars

In blue is Newton's law..
In red is our corrected Newton's law, corrected TAKING into account the effect of the stars.

One uses the formula v = √[Fx/m], where F is the gravitational force.
One posed r = 1 kpc. This value was adjusted in order to obtain the best possible red curve.

X-coordinate (in meters) is the distance which separates the star from the center of the galaxy. The y ordinate (in m/s) represents the speed v of the star in its movement around the center of the galaxy.

The distances considered lies between 1 and 15 kpc, they are those of the stars in the Milky Way. This time the difference between the two curves is very clear.

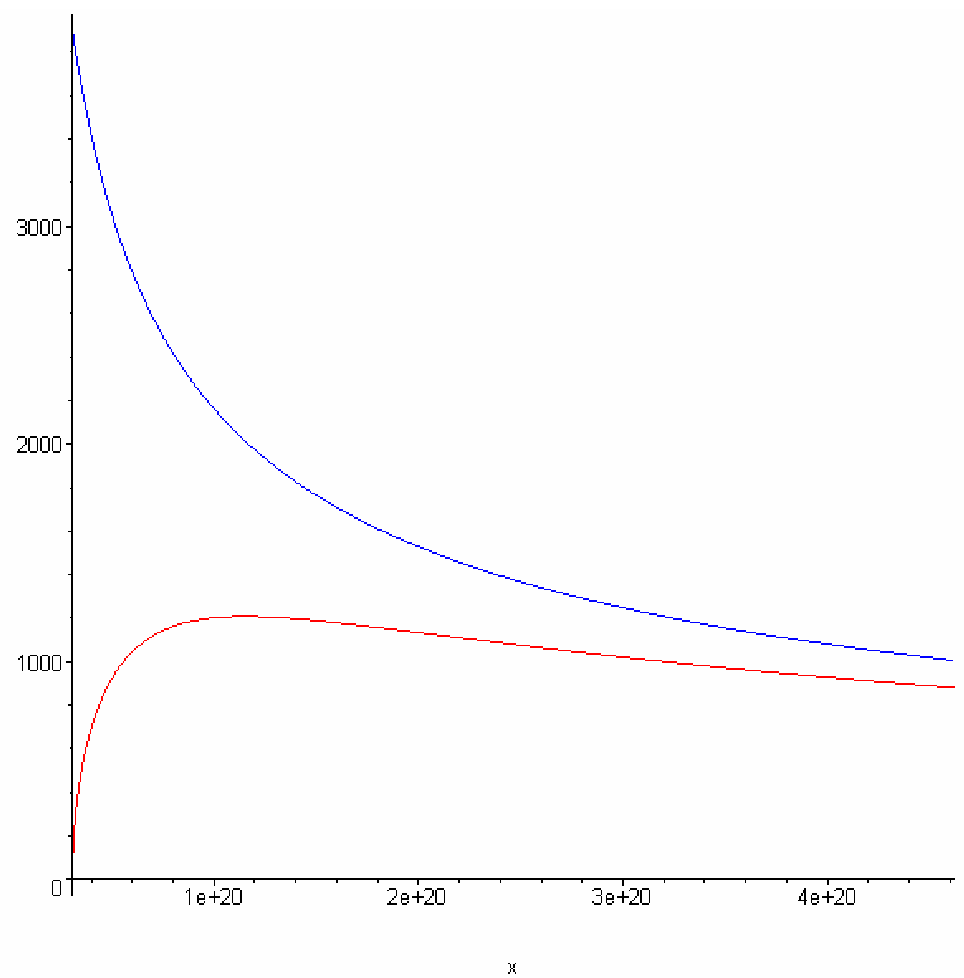

Figure 6 : Theoretical curves of the speed of the stars in the galaxy, taking in account their masses.

Program MAPPLE having posted this figure :

```
Digits := 30; m:=1; M := 7 * 10**36 ; G := 6.6742867 *  10**(-11); c := 3 * 10**8;
R := M*G/c**2; kpc := 3.08  * 10**19 ;                    # Initialisations.
r := 1 * kpc;            # Value fitted progressively  in order to obtain the best possible red curve.
e := sqrt(8*R/x) / (1 + r/x) ;                            # Famous "relativistic coefficient".
cos2 := (1 + e) / ((1 + e/2)**2) ;                        # Square of the relativistic operator.
tg := sqrt( 1/cos2  -  1 )  ;                             # Slope of space inside space-time.
F := - m * c**2 * diff(tg,x) * tg * (1  -  tg**2)**(-3/2) ;     # Our "Newton's law".
FN := m * c**2 * R/(x**2) ;                               # Classical "Newton's law".
v := sqrt( F * x / m ) ;                                  # Centrifugal force and tangential speed v.
vn := sqrt( FN * x / m ) ;                                # The same for classical Newton's law.
plot([v(x),vn(x)], x=1*kpc..15*kpc, color=[red,blue], style=[line,line], numpoints=1000);
                                                          # Plotting from 1 to 15 kpc.
```

3) Comparison with the measured speed of the stars of the galaxies

See figure 7 below. The shape of the red curve of figure 6 is similar to the one below.

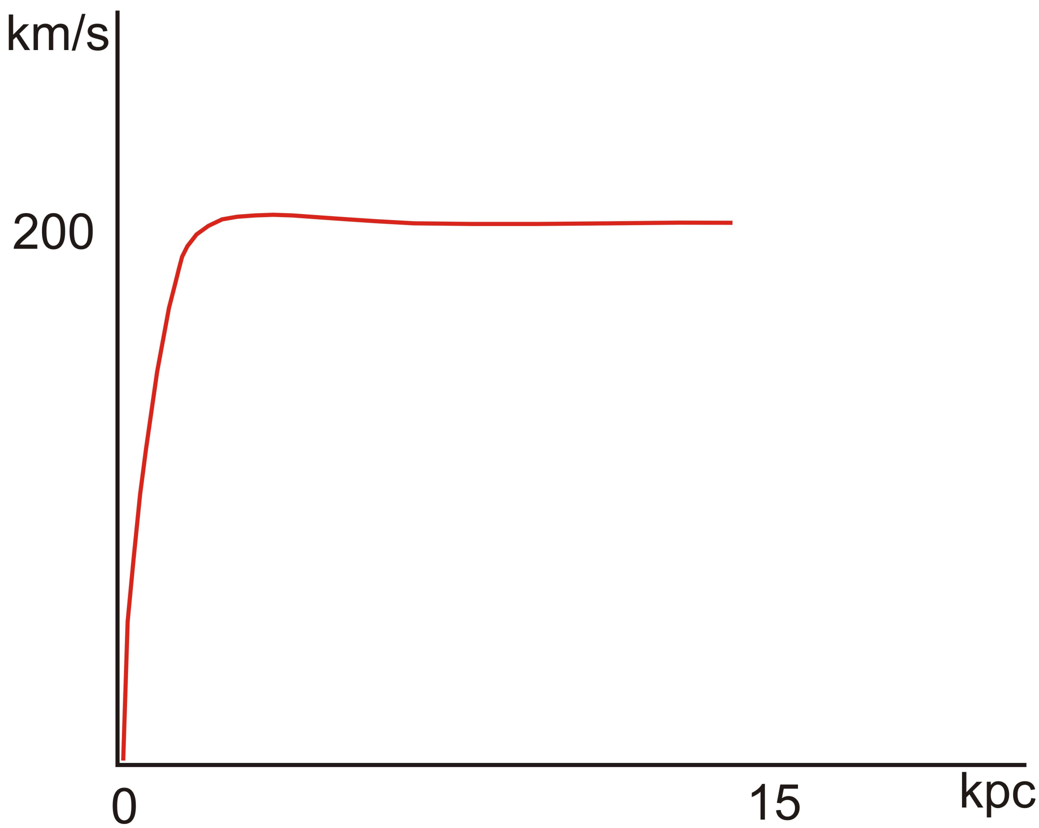

Figure 7 : Curve of the measured speed of stars in a galaxy.

APPENDIX 2 FIRST NEWTON'S LAW CORRECTION

This appendix contains the calculations used to retrieve the first correction of Newton's law of chapter 5 (the case of a planetary system).

$$F = mc^2 \; d/dx\{\sqrt{[(1 + ½\, p/\sqrt{x})^2/(1 + p/\sqrt{x}) - 1]}\} \; \sqrt{[(1 + ½\, p/\sqrt{x})^2/(1 + p/\sqrt{x}) - 1]} \; \{2 - (1 + ½\, p/\sqrt{x})^2/(1 + p/\sqrt{x})\}^{(-3/2)}$$

1) Calculation of derived formula :

$d/dx\{ \sqrt{[(1 + ½\, p/\sqrt{x})^2/(1 + p/\sqrt{x}) - 1]} \}$

$= ½[(1 + ½\, p/\sqrt{x})^2/(1 + p/\sqrt{x}) - 1]^{(-1/2)} \qquad (f'g - fg')/g^2$

$= ½[(1 + ½\, p/\sqrt{x})^2/(1 + p/\sqrt{x}) - 1]^{(-1/2)} \qquad (f'g - fg')/g^2$

$f = (1 + ½\, p/\sqrt{x})^2$

$f' = 2(1 + ½\, p/\sqrt{x})\; p/2\; (-1/2)\; x^{(-3/2)}$

$= -\, p/2\; (1 + ½\, p/\sqrt{x})\; x^{(-3/2)}$

$g = (1 + p/\sqrt{x})$

$g' = p\; (-1/2)\; x^{(-3/2)}$

$= -\, p/2\; x^{(-3/2)}$

$(f'g - fg')/g^2 = [\, -p/2\; (1 + ½\, p/\sqrt{x})\; x^{(-3/2)}\; (1 + p/\sqrt{x}) - (1 + ½\, p/\sqrt{x})^2\; (-\, p/2)\; x^{(-3/2)}\,] \;/\; (1 + p/\sqrt{x})^2$

$= (p/2)\; (1 + ½\, p/\sqrt{x})\; x^{(-3/2)}\; [\, -(1 + p/\sqrt{x}) + (1 + ½\, p/\sqrt{x})\,] \;/\; (1 + p/\sqrt{x})^2$

$= (p/2)\; (1 + ½\, p/\sqrt{x})\; x^{(-3/2)}\; (-½)\; p/\sqrt{x} \;/\; (1 + p/\sqrt{x})^2$

$= -\, (p/4)\; (1 + ½\, p/\sqrt{x})\; x^{(-3/2)}\; p \;/\; \sqrt{x}\; (1 + p/\sqrt{x})^2$

$= -\, (p^2/4)\; (1 + ½\, p/\sqrt{x})\; x^{(-3/2)} \;/\; [(1 + p/\sqrt{x})^2\; \sqrt{x}]$

$d/dx\{\sqrt{[(1 + ½\, p/\sqrt{x})^2/(1 + p/\sqrt{x}) - 1\,]}\}$

$= ½[(1 + ½\, p/\sqrt{x})^2/(1 + p/\sqrt{x}) - 1]^{(-1/2)}\; [\, -\, (p^2/4)\; (1 + ½\, p/\sqrt{x})\; x^{(-3/2)}\,] \;/\; [(1 + p/\sqrt{x})^2\; \sqrt{x}]$

$= -\, (p^2/8)\; [\,(1 + ½\, p/\sqrt{x})^2/(1 + p/\sqrt{x}) - 1]^{(-1/2)}\; [(1 + ½\, p/\sqrt{x})\; x^{(-3/2)}\,] \;/\; [(1 + p/\sqrt{x})^2\; \sqrt{x}]$

$F = -\, mc^2\; p^2/8\; \{\, [\, (1 + ½\, p/\sqrt{x})^2/(1 + p/\sqrt{x}) - 1]^{(-1/2)}\; [(1 + ½\, p/\sqrt{x})\; x^{(-3/2)}\,] \;/\; [(1 + p/\sqrt{x})^2\, \sqrt{x}]\, \}$
$\sqrt{[(1 + ½\, p/\sqrt{x})^2/(1 + p/\sqrt{x}) - 1]}\; \{2 - (1 + ½\, p/\sqrt{x})^2/(1 + p/\sqrt{x})\}^{(-3/2)}$

2) Simplification :

Let's us say : $e = p/\sqrt{x}$. Then :

$F = -\, m\, c^2p^2/8\sqrt{x}\; [\, (1 + ½\, e)^2\, (1 + e)^{(-1)} - 1]^{(-1/2)}\; (1 + ½\, e)\; x^{(-3/2)}\; ((1 + e)^{(-2)})$
$\sqrt{[(1 + ½\, e)^2\, ((1 + e)^{(-1)}) - 1]}\; [2 - (1 + ½\, e)^2\, ((1 + e)^{(-1)})]^{(-3/2)}$

$F = -\, m\, c^2p^2/8\sqrt{x}\; (1 + ½\, e)\; x^{(-3/2)}\; ((1 + e)^{(-2)})$ Great simplification here
$[2 - (1 + ½\, e)^2\, ((1 + e)^{(-1)})]^{(-3/2)}$

$F = -\, m\, c^2p^2/8x^2\; (1 + ½\, e)\; ((1 + e)^{(-2)})\; [2 - (1 + ½\, e)^2\, ((1 + e)^{(-1)})]^{(-3/2)}$ **(A)**

$$F = -\, mMG / x^2 \; \frac{1 + ½\, e}{(1 + e)^2 \quad [2 - (1 + ½\, e)^2/(1 + e)]^{(3/2)}}$$

$$F = -\, mMG / x^2 \; \frac{1 + ½\, e}{(1 + e)^2 \quad [(2(1+e) - (1 + ½\, e)^2) / (1 + e)]^{(3/2)}}$$

$$F = -\ mMG / x^2 \quad \frac{1 + ½\, e}{(1 + e)^2 \quad [(2+2e \ - \ 1 - e - ¼\, e^2) \ / \ (1 + e)](3/2)}$$

$$F = -\ mMG / x^2 \quad \frac{1 + ½\, e}{(1 + e)^2 \ [(1+ e - ¼\, e^2) /(1 + e)] \ (3/2)}$$

$$F = -\ mMG / x^2 \quad \frac{1 + ½\, e}{\sqrt{[1 + e]} \quad (1+ e - ¼\, e^2)(3/2)}$$

With $e = p/\sqrt{x} = 2\sqrt{[2MG]} \ / \ c\sqrt{x}$:

$$F = -\ mMG / x^2 \quad \frac{1 \ + \ \sqrt{[2MG]} / c\sqrt{x}}{\sqrt{[1 +2\sqrt{[2MG]} / c\sqrt{x}]} \quad (1+ 2\sqrt{[2MG]} /c\sqrt{x} - ¼(2\sqrt{[2MG]}/(c\sqrt{x}))^2)(3/2)}$$

$$\mathbf{F = -\ mMG / x^2 \quad \frac{1 \ + \ \sqrt{[2R]} /\sqrt{x}}{\sqrt{[1 \ + \ 2\sqrt{[2R]} /\sqrt{x}]} \quad (1 + \ 2\sqrt{[2R]}/\sqrt{x} \ - \ 2R/x)(3/2)} \qquad (B)}$$

R Schwarzschild length : $R = MG/c^2$.

3) Limited Taylor development :

From (A) equation :

$$F = -\ mc^2p^2/8x^2 \quad (1 + ½\, e) \ (1 -2\, e + (-2)(-3)/2\, e^2) \quad [2 \ - \ (1 + e +1/4\, e^2) (1 – e + e^2)] (-3/2)$$
$$F = -\ mc^2p^2/8x^2 \quad (1 + ½\, e) \quad (1 - 2e + 3e^2) \quad [2 \ - \ (1 - e + e^2 + e(1 - e + e^2) +1/4\, e^2)] (-3/2)$$
$$F = -\ mc^2p^2/8x^2 \quad ((1 + ½\, e) - 2e(1 + ½\, e) + 3e^2) \quad [2 \ - \ (1 - e + e^2 + e – e^2 + 1/4\, e^2)] (-3/2)$$
$$F = -\ mc^2p^2/8x^2 \quad (1 – 3/2\, e + 2e^2) \quad [1 - 1/4\, e^2] (-3/2)$$
$$F = -\ mc^2p^2/8x^2 \quad (1 – 3/2\, e + 2\, e^2) \ (1 + 3/8\, e^2)$$
$$F = -\ mc^2p^2/8x^2 \quad (1 + 3/8\, e^2 \ - 3/2\, e + 2\, e^2)$$

With $e = p/\sqrt{x}$, that is :

$$F = -\ mc^2p^2/8x^2 \quad (1 - 3/2\, p/\sqrt{x} \ + 19/8\, p^2/x)$$
$$F = -\ mc^2p^2/8x^2 \quad (1 \ – \ (3p/2)/\sqrt{x} \ + \ (19p^2/8)/x)$$

APPENDIX 3 COSMOLOGICAL VALUES

These are the cosmological values, used in this document :

G	=	6, 6742867 10**(-11) m3 kg(-1) s(-2)	universal gravitation constant,
1 year light	=	365 . 24 . 3600 . 3 10**8 m	
	=	9.46 10**15 m	
1 parsec	=	3.26 year-light	
	=	3.26 9.46 10**15 m	
	=	30.8 10**15 m	
	=	3.08 10**16 m	
1 kpc	=	1000 parsec	
	=	3.08 10**19 m	
M0	=	2 10**30 kg	sun mass,
M	=	3.5 10**6 M0	mass of the Milky Way center,
	=	7 10**36 kg.	

APPENDIX 4 CALCULATION OF G

The aim of this appendix is to calculate the value of G, the universal constant of gravitation.

We will use << Lu >>, value which has been used in this document (equation (5)).
<< Lu >> is representing the contribution of outer space matter, for the calculus of relativistic operator. Let us remind that the relativistic operator allows the determination of space shape, inside space-time, for each point of space.

The contribution << Lp >> of each luminous point, used for the calculation of << Lu >> final value, is given by equation (13) applied in the case of a luminous point :

$$Lp = k \sqrt{[Rp/x]}$$

Where $Rp = mp\ G/c^2$, with $mp = ep\ /c^2$, and <<ep>> is the energy, supposed constant, here, of each luminous point.

<< k >> is a constant whom value is not of great importance, because it will always be simplified later on where calculating relativistic operator.

<< x >> is the distance between the luminous point and the P point, P point where this contribution Lp is received.

<< Lu >> is the sum of each << Lp >> contribution, for each luminous point along a half-line. This half-line is centered on P point. On this P point we wish to calculate the shape of space in space-time.

That is to say :

$$Lu = k \sum_{\text{On the half-line}} Lp$$

Here we will make important approximations. We will now "forget" the Milky Way in this sum. Because the aim here is to obtain a *formal* simple equation.

Moreover, the sum will be roughly evaluated here : we will consider that matter is regularly distributed to form a grid of luminous points, with a distance of << d >> between each luminous points.

With such hypothesis, the equation of Lu becomes :

$$Lu = k \sum_{n=1}^{E(cT/d)} \sqrt{[Rp\ /(nd)]}$$

E(x) is the first decimal number smaller than x.
d is the mean distance between two luminous points.
T is the age of the universe.

$$= k \sum_{n=1}^{E(cT/d)} \sqrt{[mp\ G\ /\ (c^2 nd)]} \qquad \textbf{(A)}$$

We also get, if ρu is the universe matter density :

$$\rho u = (1/d)3 \quad mp$$

Actual mass in a cubic meter.

Then :

$$mp = \rho u\ d3 \qquad \textbf{(B)}$$

Then, replacing mp by this value in equation (A) :

$$Lu = k \sum \sqrt{[\rho u\ d^2\ G\ /\ (c^2 n)]}$$

$$= k\ d/c\ \sqrt{[\rho u\ G]} \sum 1/\sqrt{n} \qquad \textbf{(C)}$$

Same way, for an << m >> mass, the << Lm >> contribution is :

$$Lm = k \sqrt{[R/x]} \qquad \text{With } R = mG/c^2. \qquad \textbf{(D)}$$

Other way, we have, coming from equation (13) :

$$Lm = Lu \sqrt{[8R/x]} \qquad \textbf{(E)}$$

Then using (D) and (E) :

$$k \sqrt{[R/x]} = Lu \sqrt{[8R/x]}$$

That is :

$$k \sqrt{[R/x]} = k\ d/c\ \sqrt{[\rho u\ G]} \sum 1/\sqrt{n}\ \sqrt{[8R/x]} \qquad \text{Using (C).}$$

This equation is, eliminating k, R and x and using (B) :

$$G = \frac{d\ c^2}{8\ mp \left(\sum_{n\,=\,1}^{E(cT/d)} 1/\sqrt{n}\right)^2} \qquad \textbf{(F)}$$

We note that G is proportional with d and inversely proportional with mp.

Hence, matter density in the universe leads the symmetric contributions for relativistic operator.
Let us remind that the symmetric part << Lsymmetric >>, of the contribution, is such as : e = Lasymmetric / Lsymmetric.
(Refers to equation (6), with << e >> such as : oper(L1, L2) = $\sqrt{[1 + e]}$ / (1 + e/2) from equation (7)).

Therefore, a great symmetric part leads to a weaker << e >>, and then leads to increase the relativistic operator oper(L1, L2) (as we see from equation (7)). Conversely, a low asymmetric part leads to decrease it.

Of course the value of this relativistic operator leads directly the value of the attracting forces, and leads the value of G. The weaker the relativistic operator dx/ds, the greater the generated force.

Finally, consequently, the more surrounding universe matter density is great, the weaker is G.

Let us rewrite G from (B) and (F) :

$$\boxed{G = \frac{c^2}{8\ \rho u\ d^2 \left(\sum_{n\,=\,1}^{E(cT/d)} 1/\sqrt{n}\right)^2} \qquad \textbf{(G)}}$$

T	Universe age.
ρu	Universe average mean matter density.
d	Universe average mean distance between 2 luminous points.
c	Speed of light.
G	Gravitation universal constant.

We deduce from there, the value of << d >>.

This must yields the number of luminous points in each particle (photon, electron, quark, etc ..).

APPENDIX 5 INVARIANCE OF THE RELATIVISTIC OPERATOR

1) Aim

The aim of this appendix is to check, directly with calculation, that the final space's shape is the same when calculating in another inertial frame.
That means checking that the choice of the inertial frame, made by postulate 3, has no incidence on its final result.

That is to say, also, that the relativistic operator is a space-time invariant through inertial frames.

This invariance is a direct consequence of :

- Lorentz equations properties :
  - constancy of speed of light through Lorentz's transformation,
  - multiplication of relativistic coefficients when composing Lorentz transformations,
- and the fact that the relativistic operator is always equal to $\sqrt{[1 - v^2/c^2]}$, where << v >> is particle's speed inside R inertial frame.

Nevertheless, we will prove this by direct calculation.

2) Modeling

Let's take two inertial frames R (O x y z ct) and R' (O' x' y' z' ct'), like in the construction of classical Lorentz equations.
We suppose then O' point moving at constant speed << v >> along Ox axis, parallel to O'x' axis, and we suppose O(0,0) in R when and where O'(0,0) in R'.

We use also the same model as the one used in figure 3. We draw L1 and L2 trajectories inside R inertial frame. We must also draw those trajectories in R', this time noted L1' and L2'.

We suppose a P particle at a constant w speed along Ox axis in R, and w' speed compared to R'.
At t=0 in R we suppose P particle position at x=0.
At t in R we suppose P particle position at x such as $l1 + l2 = ct$ and $l1 - l2 = wt$.

Hence this is figure 3 drawing. We have also a second figure, constructed from figure 3 and replacing L1 trajectory by L1', L2 by L2', and R(O x y z ct) by R' (O' x' y' z' ct').

Also we have the equations of Lorentz transformation from R to R' :

$$x' = \gamma\ (x - vt) \qquad \text{with } \gamma = 1 / \sqrt{[1 - v^2/c^2]} \qquad \textbf{(A)}$$
$$ct' = \gamma\ (-(v/c)x + ct) \qquad \textbf{(B)}$$

3) From L1 to L1'

At the end of the L1 segment, the (x, ct) coordinates in R are the following : (l1 l1).
In R' those coordinates become (l1', ct1') such as :

$$l1' = \gamma\ l1\ (1 - v/c) \qquad \text{using equation (A) with } x = ct = l1 \qquad \textbf{(C)}$$

But also we have :

$$l1 = (ct/2\ )\ (1 + w/c)$$ using equation (1) located at the beginning of this document, after replacing << v >> by << w >> in these equations (particle's speed in R).

Hence, (C) equation is modified :

$l1' = \gamma ct/2 \quad (1 + w/c)\ (1 - v/c)$ **(D)**

Using (B) equation we retrieve the same value. Hence finally :

$ct1' = l1'$ of course, constancy of light speed through Lorentz transformation

4) From L2 to L2'

The (x, ct) coordinates of the A point, located at the end the L2 segment inside R frame, are : (l1-l2, l1+l2). These coordinates in R' became (x2', ct2') such as :

$x2' = \gamma\ (l1\text{-}l2 - vt)$ using (A) equation
$ct2' = \gamma\ [-(v/c)(l1\text{-}l2) + ct]$ using (B) equation

$x2' = \gamma\ (w - v)\ t$ using équation (1) **(E)**
$ct2' = \gamma\ ct\ (1 - vw/c^2)$ idem

Then we can calculate l2' :

$l2' = x1' - x2'$
$= \gamma ct/2\ (1 + w/c)\ (1 - v/c) - \gamma\ (w - v)\ t$ using (D), (E), and x1' = l1'
$= \gamma ct/2\ (1 + v/c)\ (1 - w/c)$ **(F)**

The same way :

$l2' = ct1' - ct2'$ using now the equation for time,
$= \gamma ct/2\ (1 + w/c)\ (1 - v/c) - \gamma\ ct\ (1 - vw/c^2)$ this yields of course
$= \gamma ct/2\ (1 + v/c)\ (1 - w/c)$ the same result.

5) Calculating the relativist operator in R'

Let's write again the results above :

$l1' = \gamma ct/2 \quad (1 - v/c)\ (1 + w/c)$
$l2' = \gamma ct/2 \quad (1 + v/c)\ (1 - w/c)$

We can now calculate the relativistic operator in R' frame :

$$\text{oper}(l1', l2') = \sqrt{[\, l1'\, l2'\,]}\ /\ (l1' + l2')/2$$

$$= \frac{\sqrt{[\ (1 - v/c)\,(1 + w/c)\,(1 + v/c)\,(1 - w/c)\ ]}}{[(1 - v/c)\,(1 + w/c) + (1 + v/c)\,(1 - w/c)]\ /\ 2}$$

$$= \frac{\sqrt{[1 - v^2/c^2]}\ \sqrt{[1 - w^2/c^2]}}{1 - vw/c^2} \qquad \textbf{(G)}$$

We must use the relativistic speed composition formula, because we are in the case of two Lorentz transformations to compose :

$$w = \frac{v + w'}{1 + vw'/c^2}$$

Hence, the (G) equation becomes :

$$\text{oper}(l1', l2') = \frac{\sqrt{[1 - v^2/c^2]}\quad \sqrt{[1 - ((v + w')/(1 + vw'/c^2))^2/c^2\,]}}{1 - [(v + w')/(1 + vw'/c^2)]v/c^2}$$

$$= \sqrt{\left[1 - w'^2/c^2 \right]}$$

Which is the expected result.

FIGURES

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