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The Time at the Level of a High Speed Moving Object

John Spacey

Department of Electro-Mechanical Engineering, Graduate School of Science and Engineering, ENSAM, Paris, France

E-mail address: john.spacey40@gmail.com

ABSTRACT

I think that far-away travels into Space are possible in the way that it is possible to find again people on our Earth, after the return of a very long travel into Space, not aged, like the people who have traveled inside the spacecraft. Current physics does not allow this and I have developed the following Theory which would thus complement the current Theory of General Relativity when we go to the limits of the reasoning. Current Theories like General Relativity or Quantum Mechanics are not impacted when the reasoning is not pushed to the limits. My reasoning at the limits just complements current Theories when the parameters take extreme values and thus the logic of current physics is respected.

***Keywords*:** General Relativity, dark Matter and dark Energy, negative space-time, gravity, astrophysics, astronomy, cosmology, galaxies, black-hole, Quantum Mechanics

1. INTRODUCTION

The Universe is very complex and cannot be fully explained by equations. Physics will explain, for example, that Matter is made of electrons, protons and neutrons which are themselves made of smaller particles and so on. But when we go to the "limit" of the reasoning, physics (and its equations) will not be able to explain from where the original Matter or the original Energy came from.

So, I am going to push my reasoning "to the limit" and develop my Theory, but I know that any physics theory can be complemented by pushing the limits, and I'm sure that someday someone will say that something is missing to my Theory and will change some points in order

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to continue to improve. My following Theory is an analysis of the time at the level of a fast-moving object (like a spacecraft for example) and near an external gravity. I like reasonings "to the limits". In fact, by pushing reasonings to the limits, we can see what must be improved, optimized, complemented! We can see what is lacking in a theory, in a physical explanation of a phenomenon.

There are many obstacles to make far-away travels into the Space and the time to make the travel is one of the most important. And so, I have analyzed this parameter and it is the object of my following Theory.

2. THE THEORY ON THE NEGATIVE TIME

I will analyze the effect of the gravity, combined with the effect of speed, on the time **t** inside a moving object (a spacecraft for example). I will need the following General Relativity equations to start my explanations and so I will start by a summary of the presentation of these equations:

I place myself in the relativistic area where an object moves very fast seen from our Earth, at a speed **v** which is close and lower than the speed of light **c**.

I start from the following equations from the Theory of General Relativity: Refs. [1] [2] [3].

(1) $$T = \gamma . t$$

(2) $$M = \gamma . m$$

(3) $$L = \frac{\ell}{\gamma}$$

(4) $$\gamma = \frac{1}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

(5) $$v = \frac{\ell}{T} = \frac{L}{t}$$

The parameters **M**, **T** and **L** are the parameters seen by our Earth. These parameters become **m**, **t** and $\boldsymbol{\ell}$ in the moving frame of a spacecraft for example. If I consider that an object moves at a speed **v** seen from our Earth and has a mass **m** at rest, when we are in the relativistic domain (where **v** approaches **c** and therefore when $\boldsymbol{\gamma}$ becomes much greater than 1), its relativistic mass becomes **M**. And this mass **M** increases when **v** increases. When **v** tends to **c**, $\boldsymbol{\gamma}$ tends to infinity and therefore **M** tends to infinity.

If I use the equation (**5**) above $\boldsymbol{v = \frac{\ell}{T} = \frac{L}{t}}$

I can also write that $\boldsymbol{T = \frac{\ell}{v}}$

and as $\boldsymbol{L = \frac{\ell}{\gamma}}$ see equation (**3**) we can conclude that $\boldsymbol{t} = \left(\frac{\boldsymbol{\ell}}{\boldsymbol{\gamma}}\right) . \left(\frac{\mathbf{1}}{\boldsymbol{v}}\right)$

When **v** tends to **c**, the coefficient $\boldsymbol{\gamma}$ tends to infinity (equation (**4**)), and so **L** tends to 0 and **t** tends to 0, when **v** tends to **c**.

The mass **M**, seen from our Earth, evolves like $\boldsymbol{\gamma}$ when **v** tends to **c** (equation (**2**): $\boldsymbol{M} = \boldsymbol{\gamma}.\boldsymbol{m}$) and **m** is a finite mass and therefore **M** tends towards infinity when **v** tends to **c**.

The time **T**, seen from our Earth, evolves like $\boldsymbol{\gamma}$ when **v** tends to **c** (equation (**1**): $\boldsymbol{T} = \boldsymbol{\gamma}.\boldsymbol{t}$), but **t** tends towards 0 and so the evolution of **T** is different than the evolution of **M** when **v** tends towards **c**.

From the equation (**5**) $\boldsymbol{v} = \frac{\boldsymbol{\ell}}{\boldsymbol{T}}$ we see that $\boldsymbol{T} = \frac{\boldsymbol{\ell}}{\boldsymbol{v}}$ and so when **v** tends towards **c** the time **T** will tend towards $\boldsymbol{T} = \frac{\boldsymbol{\ell}}{\boldsymbol{c}}$

In this situation, if the travel into the Space is very long, $\boldsymbol{\ell}$ will be very high and so **T** will be very high, but **T** will not tend towards infinity because $\boldsymbol{\ell}$ is a finite value, even if **v** tends towards **c**.

But **T** will be much higher than **t** because a far-away travel into Space represents a high value for $\boldsymbol{\ell}$ and also **t** tends towards 0 when **v** tends towards **c**.

As $\boldsymbol{T} = \frac{\boldsymbol{\ell}}{\boldsymbol{v}}$, **T** will depend on the length $\boldsymbol{\ell}$ of the travel and on the speed **v** of the spacecraft. **T** will increase when $\boldsymbol{\ell}$ will increase and **T** will also increase when the speed **v** will decrease.

If we consider a spacecraft of mass **m**, and moving at a speed **v**, the internal time of the spacecraft, **t**, will tend towards 0 when **v** tends towards **c**.

For current physics, inside the spacecraft, the time **t** ***will therefore be frozen*** if the spacecraft moves at a speed **v** very close to the speed of light **c**. Inside the spacecraft, the time **t** remains where it is: it is frozen (**t** tends towards 0 when **v** tends towards **c**). So we don't age at all. Only the time outside the spacecraft, **T**, changes and becomes very high when the travel into the Space is very long.

I think that the internal time **t** of the spacecraft ***does not stay fixed (it will not be frozen) but it also changes***, at the same time as the external time **T** changes.

It changes depending on the speed of the spacecraft and on the external gravity to the spacecraft. I think one equation is missing in the above **5** equations, where there would also be the effect of the external gravity to the spacecraft. And I also think that the definition of the time **t** inside the spacecraft needs to be complemented.

We must translate the fact that when **v** increases the internal time **t** inside the spacecraft decreases. ***And also,*** the fact that if the external gravity to the spacecraft increases, the internal time **t** of the spacecraft also decreases: Ref. [4].

For the effect of speed, I propose to replace the time **t** by:

$$\boldsymbol{t} \rightarrow \boldsymbol{t}.\left(\mathbf{1} - \frac{\boldsymbol{v}^2}{\boldsymbol{c}^2}\right)$$

We can verify in this complement for the time **t** (the coefficient $\left(\mathbf{1} - \frac{\boldsymbol{v}^2}{\boldsymbol{c}^2}\right)$) that when **v** = 0, **t** is unchanged (the coefficient $\left(\mathbf{1} - \frac{\boldsymbol{v}^2}{\boldsymbol{c}^2}\right)$ = **1**) and when **v** tends towards **c**, the coefficient $\left(\mathbf{1} - \frac{\boldsymbol{v}^2}{\boldsymbol{c}^2}\right)$ tends to 0 and as **t** already tends to 0 when **v** tends to **c**, this does not change anything:

the time t will just tend towards 0 faster than what is currently predicted by the current theory of General Relativity.

And when **v** increases, we have well the time **t** which decreases. Now I am going to introduce a coefficient for the external gravity to the spacecraft which follows the same logic as the coefficient for the speed $\left(\mathbf{1}-\frac{v^2}{c^2}\right)$.

I will represent the effect of gravity by a mass $\mathbf{M_G}$, external to the spacecraft. This mass can be the mass of a planet or the mass of a "black-hole" or ...

The equivalent of **v** would be $\mathbf{M_G}$ **c** represents the same quantity as **v**, and it is the maximum limit of **v**. For $\mathbf{M_G}$, I have to find an equivalent quantity (therefore a mass) and it must be the maximum limit of $\mathbf{M_G}$ and therefore infinity. I propose the following term: $\boldsymbol{m\,.\,\gamma}$ Indeed, **m** is a mass, and when **v** tends towards **c**, the coefficient $\boldsymbol{\gamma}$ tends to infinity and therefore the term $\boldsymbol{m\,.\,\gamma}$ tends towards infinity.

Remark:

$\boldsymbol{M = m\,.\,\gamma}$ represents the relativistic mass of **m**. We must therefore not replace **m** by its relativistic mass **M**, later in the equations, otherwise this would amount to replace **m** a second time by **M**.

I therefore propose to replace the time **t** with the following term: **(6)**

$$\boldsymbol{t \rightarrow t.\left(1-\frac{v^2}{c^2}\right).\left(1-\frac{{M_G}^2}{(m.\gamma)^2}\right)}$$

This equation represents the 6th equation to be added to the General Relativity and allows me to add a term to calculate the effect of an external gravity $\mathbf{M_G}$ to a mass **m**, on the internal time **t** of a moving object of mass **m** which moves at a speed **v** (like a spacecraft for example). I found a relationship between **t, v, m** and $\mathbf{M_G}$.

This equation, which I have defined, gives the new value of **t**, which will have to be replaced in all the other equations (the 5 other equations of the theory of General Relativity: see before).

We saw above that $\boldsymbol{t = \left(\frac{\ell}{\gamma}\right).\left(\frac{1}{v}\right)}$ And so $\boldsymbol{\gamma = \left(\frac{\ell}{v}\right).\left(\frac{1}{t}\right)}$

If I change **t** in this equation by the new value of **t** from the equation **(6)**, $\boldsymbol{\gamma}$ will be changed and therefore the other 5 equations of relativity will be impacted.

But we must keep the maximum limit of **v**, which is **c**, and so there is an analysis to do before replacing **t** in the equations.

This equation can also be written as follows since

$$\boldsymbol{\gamma = \frac{1}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}}$$

$$\boldsymbol{t \rightarrow t.\left(\frac{1}{\gamma^2}\right).\left(1-\frac{{M_G}^2}{(m.\gamma)^2}\right)}$$

<u>Now it is time to analyze this equation</u> **(6)**:

I'll take the following parameters for the equations:

$$A = \left(1 - \frac{v^2}{c^2}\right) = \frac{1}{\gamma^2}$$

$$B = \left(1 - \frac{{M_G}^2}{(m.\gamma)^2}\right)$$

$t = t\,.\,A\,.\,B$ (**t** is replaced by: $t\,.\,A\,.\,B$)

$C = A\,.\,B$ and so $t \rightarrow t.C$

When **v** increases, **A** is decreasing and so **t** decreases. In the same way, when $\mathbf{M_G}$ increases, **B** is decreasing and so **t** decreases. If **v** = 0 and if $\mathbf{M_G}$ = 0 , **t = t** : the time is not changed.

In the presence of external gravity $\mathbf{M_G}$ to a spacecraft of mass **m**, ***the effect of this gravity is local***. The effect of the term **B**, $\left(1 - \frac{{M_G}^2}{(m.\gamma)^2}\right)$, is present only if the mass **m** is located at a distance close to the gravity of mass $\mathbf{M_G}$.

I have not yet defined an equation to specify which parameters are involved in the local term (see below for that). But that will not change my reasoning.

Assuming therefore that the mass **m** is sufficiently close to the gravity of mass $\mathbf{M_G}$, the effect of the external gravity on the time **t** inside the spacecraft will therefore be the coefficient **B**. If the gravity $\mathbf{M_G}$ increases, we verify that **t** decreases: Ref. [5].

Likewise, if the speed **v** increases and becomes very high (very close to **c**), γ tends to infinity and therefore the effect of the external gravity $\mathbf{M_G}$ is canceled. Indeed, the coefficient **B** tends towards 1 when **v** tends towards **c**, and therefore **t** is unchanged by $\mathbf{M_G}$.

We can also notice that this coefficient **B** ***can be negative and therefore see that the time t can become negative!***

The condition for this is written as follows:

$\left(1 - \frac{{M_G}^2}{(m.\gamma)^2}\right) < 0$ because $\left(1 - \frac{v^2}{c^2}\right)$ is always positive (because **v** < **c**)

$$\left(\frac{{M_G}^2}{(m.\gamma)^2}\right) > 1$$

$$\gamma < \frac{M_G}{m}$$

$$\frac{1}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} < \frac{M_G}{m}$$

$$\mathbf{1} - \frac{v^2}{c^2} > \frac{m^2}{{M_G}^2}$$

We arrive to: **(7)**

$$v < c.\left(\sqrt{\mathbf{1} - \frac{m^2}{{M_G}^2}}\right)$$

There is therefore a maximum value for **v** so that the time **t** stays negative. This value is **v0**:

$$v_0 = c.\left(\sqrt{\mathbf{1} - \frac{m^2}{{M_G}^2}}\right)$$

This maximum value of **v** reflects the fact that when **v** increases, the coefficient γ increases and therefore $m\,.\,\gamma$ increases, reducing the effect of the gravity **MG**. We can also notice that the time **t** can only become negative with the help of the external gravity **MG**, for a moving mass **m**.

One condition is interesting to analyze:

Indeed, when the coefficient **B** is negative it is necessary that the opposite of **B** (which is positive) is less than 1 so that **t** is reduced and not increased by the effect of gravity. It is written as follows:

$$\left(\mathbf{1} - \frac{{M_G}^2}{(m.\gamma)^2}\right).(-\mathbf{1}) < \mathbf{1}$$

$$\frac{M_G}{m.\gamma} < \sqrt{\mathbf{2}}$$

$$\gamma > \frac{M_G}{\sqrt{\mathbf{2}}\,.\,m}$$

$$\frac{\mathbf{1}}{\sqrt{\left(\mathbf{1} - \frac{v^2}{c^2}\right)}} > \frac{M_G}{\sqrt{\mathbf{2}}\,.\,m}$$

We arrive to: **(8)**

$$v > c.\left(\sqrt{1 - \frac{\mathbf{2}.m^2}{{M_G}^2}}\right)$$

There is therefore a minimum value for **v** so that the time **t** is reduced when **v** and the gravity $\mathbf{M_G}$ increases. The value of **v** obtained by the equation **(8)** can be reduced by the factor $\left(1-\frac{v^2}{c^2}\right)$ which is less than 1 as **v** increases.

The true value of **v** mini is obtained by writing the following condition:

$$\left(1-\frac{v^2}{c^2}\right).\left(1-\frac{{M_G}^2}{(m.\gamma)^2}\right).(-1) < 1$$

Which gives the following condition: equation **(9)**

$$\frac{M_G}{m} > \sqrt{\left(1+\left(\frac{1}{\left(1-\frac{v^2}{c^2}\right)}\right)\right)} \; . \left(\frac{1}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}\right)$$

The value of **v** min obtained in the equation **(9)** is less than the value obtained with the equation **(8).**

This value is $\mathbf{v_1}$, which ensures the following equality:

$$\frac{M_G}{m} = \sqrt{\left(1+\left(\frac{1}{\left(1-\frac{v^2}{c^2}\right)}\right)\right)} \; . \left(\frac{1}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}\right)$$

This equality can be written as follows: **(10)**

$$\frac{M_G}{m} = \gamma\,.\left(\sqrt{(1+\gamma^2)}\right)$$

The equation **(10)** gives the value $\mathbf{v_1}$

This value is of particular interest to me, because the following term in equation **(6)** is equal to - 1 when $\mathbf{v} = \mathbf{v_1}$

And under this condition, the time **t** becomes **- t** and there is for me, from this speed, a passage of the mass **m** (for example a spacecraft) into a "space-time" where the time **t** is negative.

$$\left(\frac{1}{\gamma^2}\right).\left(1-\frac{{M_G}^2}{(m.\gamma)^2}\right) = -1$$

For $\mathbf{v} = \mathbf{v_1}$ the previous term becomes equal to -1 and **t** is replaced by **- t**

We can notice that $\mathbf{v_1}$ ***is less than*** $\mathbf{v_0}$

This means that the time starts to become negative when **v** is greater than $\mathbf{v_1}$ and remains negative until **v** reaches $\mathbf{v_0}$. When **v** approaches $\mathbf{v_0}$ (while remaining lower than $\mathbf{v_0}$) the time **t** tends towards 0 in a negative way. When the $\frac{M_G}{m}$ ratio is high, the value of **v** which satisfies the equation **(10)** above is very high (close to **c**).

We can also notice that when the gravity increases (when $\mathbf{M_G}$ increases), to obtain the condition where **t = - t** (where **t** becomes **- t** in fact), we must increase **v**. This is surprising, but we can explain it by the fact that **v** must be able to tend towards **c**. Indeed, when $\mathbf{M_G}$ increases and tends towards infinity, in order to respect the equality **(10)**, **v** must tend towards **c**.

If we had had an inverse condition, in the sense that when the gravity increases, to obtain the condition where **t = - t** (where **t** becomes **- t** in fact), we must decrease **v**, the gravity would limit the speed of an object moving around it. Whereas the external gravity reduces the time inside the spacecraft and therefore has the same effect as increasing the speed.

And so the equation **(10)** is consistent.

If $\mathbf{M_G}$ is very high and tends towards infinity, when the spacecraft of mass **m** enters the gravity field of the mass $\mathbf{M_G}$, it will be attracted by an enormous force and its speed **v** will tend towards **c**. We have seen that $\boldsymbol{v = \left(\frac{\ell}{\gamma}\right).\left(\frac{1}{t}\right)}$ with the help of the 5 equations of the General Relativity Theory defined at the beginning of this document. If I replace the value of **t** by $\boldsymbol{t\,.\left(\frac{1}{\gamma^2}\right)}$ when the speed of the spacecraft is higher than $\mathbf{v_0}$, I get the following result:

$$\boldsymbol{v \to \left(\frac{\ell}{\gamma}\right).\left(\frac{1}{t.\left(\frac{1}{\gamma^2}\right)}\right) = v\,.\gamma^2}$$

v becomes $\boldsymbol{v\,.\gamma^2}$ when **v** is greater than $\mathbf{v_0}$

($\mathbf{v_0}$ being the speed at which the external gravity $\mathbf{M_G}$ has no longer an effect on the moving mass **m** since the relativistic mass $\boldsymbol{m\,.\gamma}$ ***is equal to the external gravity*** $\mathbf{M_G}$ and thus the term **B** disappears and only remains the term $\boldsymbol{t\,.\left(\frac{1}{\gamma^2}\right)}$: it is linked to the high speed $\mathbf{v_0}$ of the spacecraft which increases its relativistic mass $\boldsymbol{m\,.\gamma}$).

Or else, **v** also becomes $\boldsymbol{v\,.\gamma^2}$ when there is no effect of gravity: in fact when there is no external gravity the time **t** is also replaced by the term $\boldsymbol{t\,.\left(\frac{1}{\gamma^2}\right)}$

When **v** tends to **c**, the term $\boldsymbol{v\,.\gamma^2}$ will tend towards $\boldsymbol{c\,.\gamma^2}$: everything happens as if the speed of light were exceeded. Indeed, inside the spacecraft the time is so reduced that it would correspond to exceeding the speed of light **c**. The term $\boldsymbol{\gamma}$ should be rewritten as follows since the speed of light **c** cannot be exceeded: **(11)**

$$\boldsymbol{\gamma = \frac{1}{\sqrt{\left(1 - \frac{v^2}{(c.\gamma^2)^2}\right)}}}$$

Indeed I must replace the speed limit **c** by $\boldsymbol{c\,.\gamma^2}$

On the other hand, the measured speed v cannot exceed c and therefore remains at its value v in the equation: Ref. [6].

When we measure a speed **v** (relative to our Earth), in fact for the time **t** inside the spacecraft, it is as if the spacecraft were going at the speed $\boldsymbol{v}\,.\,\boldsymbol{\gamma}^{\mathbf{2}}$ and so I have to increase the max speed of **c** in the equation.

When **v** tends to **c**, the new coefficient $\boldsymbol{\gamma}$ tends to

$$\boldsymbol{\gamma} = \frac{\mathbf{1}}{\sqrt{\left(\mathbf{1} - \frac{c^2}{(c.\gamma^2)^2}\right)}} = \frac{\mathbf{1}}{\sqrt{\left(\mathbf{1} - \frac{\mathbf{1}}{\gamma^4}\right)}}$$

When **v** tends to **c**, the old value of $\boldsymbol{\gamma}$ tends to infinity and therefore the new value of $\boldsymbol{\gamma}$ tends to **1** (see the equation above).

In fact the coefficient $\boldsymbol{\gamma}$ increases until **v** reaches $\mathbf{v_0}$ (indeed, the theoretical speed $\boldsymbol{v}\,.\,\boldsymbol{\gamma}^{\mathbf{2}}$ increases between $\mathbf{v_1}$ and $\mathbf{v_0}$ and goes from $\mathbf{v_1}$ (theoretical speed obtained for the measured speed $\mathbf{v_1}$ and equal to $\mathbf{v_1}$) to $\boldsymbol{v_0}\,.\,\boldsymbol{\gamma}^{\mathbf{2}}$) and when the speed measured from the Earth exceeds $\mathbf{v_0}$, the coefficient $\boldsymbol{\gamma}$ will decrease, until it reaches **1** when **v** tends towards **c**. When the measured **v** reaches $\mathbf{v_0}$, the theoretical speed, which corresponds to the reduction of the time **t** inside the spacecraft would be equal to $\boldsymbol{v_0}\,.\,\boldsymbol{\gamma}^{\mathbf{2}}$

Then when the speed increases further, the speed measured from our Earth would be **v** (still less than **c**) and the theoretical speed, which corresponds to the reduction of the time **t** inside the spacecraft would be equal to $\boldsymbol{v}\,.\,\boldsymbol{\gamma}^{\mathbf{2}}$

When **v** measured tends towards **c**, the theoretical speed will tend towards $\boldsymbol{c}\,.\,\boldsymbol{\gamma}^{\mathbf{2}}$

And when **v** tends to **c**, **γ** tends to **1**. And therefore, the theoretical speed will tend towards **c**: we find, at the limit when **v** tends towards **c**, the same value for the speed measured from our Earth and the theoretical speed.

Between $\mathbf{v_1}$ and $\mathbf{v_0}$ the following phenomenon will happen:

The time **t** inside the spacecraft will start to decrease from $\mathbf{v_1}$. Indeed, for the speed $\mathbf{v_1}$ measured from our Earth, the time **t** is replaced by **- t** and **- t** begins to become greater than **-1** only for a speed **v** higher than $\mathbf{v_1}$. And so the time **t** inside the spacecraft will start to decrease.

And so everything happens as if the spacecraft were going at a speed greater than v: different from $\boldsymbol{v}\,.\,\boldsymbol{\gamma}^{\mathbf{2}}$ because **t** is not only replaced by $\boldsymbol{t}\,.\left(\frac{\mathbf{1}}{\gamma^2}\right)$ but by the full term:

$$\boldsymbol{t}.\left(\frac{\mathbf{1}}{\boldsymbol{\gamma}^{\mathbf{2}}}\right).\left(\mathbf{1} - \frac{{\boldsymbol{M_G}}^{\mathbf{2}}}{(\boldsymbol{m}.\boldsymbol{\gamma})^{\mathbf{2}}}\right)$$

When **v** tends towards $\mathbf{v_0}$, the measured speed will be $\mathbf{v_0}$, but as **t** tends towards 0, we will find ourselves in the same case as when **v** tends towards **c**, ***since here too t tends towards 0***. The theoretical speed will catch up with the theoretical speed $\boldsymbol{v_0}\,.\,\boldsymbol{\gamma}^{\mathbf{2}}$ which is obtained at $\mathbf{v_0}$, when the effect of the external gravity $\mathbf{M_G}$ is canceled.

The corrected factor $\boldsymbol{\gamma}$ will compensate the effect of the reduction of the time **t** inside the spacecraft: $\boldsymbol{\gamma}$ will prevent the theoretical speed from tending towards infinity when **v** tends towards $\mathbf{v_0}$ since **t** tends towards 0 when **v** tends towards $\mathbf{v_0}$ (the calculation of the coefficient $\boldsymbol{\gamma}$ is iterative in the sense that $\boldsymbol{\gamma}$ uses its own value for its calculation).

As soon as the measured speed exceeds $\mathbf{v_0}$, the theoretical speed will be less than $\boldsymbol{v_0}\,.\,\boldsymbol{\gamma}^{\mathbf{2}}$ This will be the maximum value for the theoretical speed and also for the value of the coefficient $\boldsymbol{\gamma}$.

Then, **v** can tend towards **c**, and the theoretical value will also tend towards **c**, while γ tends towards **1**. I detail a little bit the theoretical calculation of $v_0 . \gamma^2$: When we replace the time **t** with the full term $t.\left(\frac{1}{\gamma^2}\right).\left(1-\frac{{M_G}^2}{(m.\gamma)^2}\right)$, the speed **v** will be replaced by:

$$\frac{v}{\left(\frac{1}{\gamma^2}\right).\left(1-\frac{{M_G}^2}{(m.\gamma)^2}\right)}$$

Indeed, $v = \left(\frac{\ell}{\gamma}\right).\left(\frac{1}{t}\right)$ and if I replace **t** with the full term above, we will find:

$$v \rightarrow \left(\frac{\ell}{\gamma}\right).\left(\frac{1}{t.\left(\frac{1}{\gamma^2}\right).\left(1-\frac{{M_G}^2}{(m.\gamma)^2}\right)}\right)$$

$$v \rightarrow \frac{v}{\left(\frac{1}{\gamma^2}\right).\left(1-\frac{{M_G}^2}{(m.\gamma)^2}\right)}$$

When **v** tends towards $\mathbf{v_0}$, γ is very high because $\mathbf{M_G}$ is high in front of **m**: indeed, as the effect of gravity is local, if $\mathbf{M_G}$ is not high in front of **m**, it would be necessary to be very close to the external gravity to have an effect (so that the time **t** inside the spacecraft is reduced by the external gravity). And so I consider that $\mathbf{M_G}$ is high in front of **m** (**m** being the mass of a spacecraft for example, moving with a speed measured from our Earth equal to **v**).

$$v_0 = c.\left(\sqrt{1-\frac{m^2}{{M_G}^2}}\right)$$

And so $\mathbf{v_0}$ is close to **c**.

And so, when **v** tends towards $\mathbf{v_0}$, **v** will be replaced by a term which will tend towards:

$$v_0 . \gamma^2$$

And so, when **v** tends towards $\mathbf{v_0}$, the theoretical speed will tend towards $v_0 . \gamma^2$

The maximum theoretical speed is thus obtained for $\mathbf{v_0}$ (measured speed)

Similarly, the maximum value of the coefficient γ is obtained for $\mathbf{v_0}$

<u>Calculation of the theoretical maximum speed</u>:

I call it $\mathbf{v_{3t}}$

$$v_{3t} = v_0 . \gamma^2 \quad \mathbf{(13)}$$

$$\gamma = \frac{1}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

$$v_0 = c.\left(\sqrt{1 - \frac{m^2}{{M_G}^2}}\right)$$

γ calculated for $\mathbf{v} = \mathbf{v_0}$ gives the following result:

$$\gamma = \frac{1}{\sqrt{\left(1 - \frac{{v_0}^2}{c^2}\right)}}$$

And so $\quad v_{3t} = v_0 \cdot \left(\frac{1}{\sqrt{\left(1 - \frac{{v_0}^2}{c^2}\right)}}\right)^2$

We get the following result:

$$v_{3t} = \frac{{M_G}^2}{m^2} . \left(\sqrt{1 - \frac{m^2}{{M_G}^2}}\right) . \mathrm{c} \qquad \mathbf{(13)}$$

Calculation of the maximum value for the coefficient :

$$\gamma = \frac{1}{\sqrt{\left(1 - \frac{{v_0}^2}{c^2}\right)}}$$

$$\gamma = \frac{1}{\sqrt{\left(1 - (1 - \left(\frac{m^2}{{M_G}^2}\right)\right)}}$$

$$\gamma = \frac{1}{\sqrt{\frac{m^2}{{M_G}^2}}}$$

$$\gamma = \frac{M_G}{m} \qquad \mathbf{(14)}$$

I can rewrite the equation **(13)** as follows:

$$v_{3t} = \frac{M_G{}^2}{m^2} . v_0 \qquad \textbf{(15)}$$

If $\mathbf{M_G}$ is very high, $\mathbf{v_{3t}}$ will be very high, but this maximum theoretical speed will not be infinite!

Remarks:

- The equation of general relativity **(2)** $\boldsymbol{M = \gamma . m}$ allows to calculate the maximum value of **M** when **v** tends towards **c**:
  This maximum value of **M** is obtained for the measured speed $\mathbf{v_0}$ and for a maximum coefficient $\boldsymbol{\gamma}$ also obtained for $\mathbf{v_0}$.

$$M_{maxi} = \gamma_{maxi} . m$$

$$M_{maxi} = \frac{M_G}{m} . m$$

$$M_{maxi} = M_G \qquad \textbf{(16)}$$

The maximum value of the moving mass **m**, which is the relativistic mass **M**, ***will not tend towards infinity when*** **v** tends towards **c** but will tend towards the mass $\mathbf{M_G}$ of the external gravity (and this even in the presence of external gravity at proximity to the moving mass **m**, which reduces the time **t** inside the spacecraft and which therefore helps to increase **M**)!

This represents the effect of an external gravity on a moving object of mass **m** (a spacecraft for example). We can notice that the maximum value of **M** does not depend on the mass **m**. To be more precise, **M** will tend towards $\mathbf{M_G}$ when **v** will tend towards $\mathbf{v_0}$ (and so $\mathbf{M_G}$ is the maximum value of **M**) then when **v** will exceed $\mathbf{v_0}$ (and when **v** will tend towards **c**), **M** will tend towards **m**, since the coefficient $\boldsymbol{\gamma}$ will tend towards **1** when **v** tends towards **c**.

I have thus demonstrated that the maximum value of the relativistic mass **M** of **m** ($\boldsymbol{M = \gamma . m}$), ***will be at a maximum equal to the cause which gave rise to it and which is the external gravity*** $\mathbf{M_G}$: (indeed it is $\mathbf{M_G}$ which increased the speed of **m** and thus increased $\boldsymbol{\gamma}$ and which thus increased **M** until $\boldsymbol{M = M_G}$

This is one example of my reasonings "to the limits" and the results are in accordance with my logic and my intuitions and I have demonstrated it!

The results of the equations therefore seem consistent. Now I would like to analyze the case where there is no external gravity $\mathbf{M_G}$:

When **v** increases, the time **t** inside a moving object is reduced by 3 factors:

<u>1st factor</u>: by the 5 equations of the Relativity, it is the 1st term **t** below

<u>2nd factor</u>: this is the term $\left(\frac{1}{\gamma^2}\right)$

3rd factor: this is the term $\left(1 - \frac{M_G{}^2}{(m.\gamma)^2}\right)$

And the global is written as follows: (equation **(6)** which allow to replace the time **t** in the equations)

$$t \rightarrow t.\left(\frac{1}{\gamma^2}\right).\left(1 - \frac{M_G{}^2}{(m.\gamma)^2}\right)$$

When there is no external gravity, **t** is replaced only by $t\,.\left(\frac{1}{\gamma^2}\right)$

And the speed **v** becomes $v\,.\gamma^2$

The formula which defines the coefficient γ is the following:

$$\gamma = \frac{1}{\sqrt{\left(1\ -\ \frac{v^2}{c^2}\right)}}$$

This formula will remain valid until: $v\,.\gamma^2 = c$

Indeed, it is necessary to respect the condition where **v** < **c**

$v\,.\gamma^2 = c$ can be written as follows:

$$v\ .\ \frac{1}{\left(1 - \frac{v^2}{c^2}\right)} = \mathbf{c}$$

What can be written: $v^2 + c.v - c^2 = 0$

The positive value of **v** which satisfies this equation is:

$$v = \frac{(\sqrt{5}-1)}{2}\,.\,\mathbf{c} = \mathbf{0{,}618\ .\ c} \qquad \mathbf{(12)}$$

I found the ***Golden ratio***: Ref. [7].

I cannot explain by physics why I found exactly the Golden ratio and I will look at this point later.

I will name this value $\mathbf{v_2}$

When **v** exceeds $\mathbf{v_2}$, the term γ should be rewritten as follows since the speed of light **c** cannot be exceeded:

$$\gamma = \frac{1}{\sqrt{\left(1 - \frac{v^2}{(c.\gamma^2)^2}\right)}} \qquad \mathbf{(11)}$$

When there is no external gravity, the 1st term in the equation **(6)** above, which is **t**, will reduce the time inside the spacecraft up to a speed $\mathbf{v_2}$ equal to **0,618 . c**

This speed corresponds to a speed measured from our Earth.

The 2nd coefficient of the equation **(6)**, which is $\left(\frac{1}{\gamma^2}\right)$ will make it possible to reduce the time **t** more significantly than what the current General Relativity Theory provides and ***will create the notion of theoretical speed***: which is in fact the real speed seen from inside the spacecraft, corresponding to the corrected reduction of **t** by the factor $\left(\frac{1}{\gamma^2}\right)$

In this case, when the measured speed is equal to **v**, the theoretical speed is equal to $\boldsymbol{v} \,.\, \boldsymbol{\gamma}^{2}$ up to a measured speed $\mathbf{v_2}$ equal to **0,618 . c**

When **v** increases and will reach $\mathbf{v_2}$, the speed measured by the Earth will be equal to $\mathbf{v_2}$, but the theoretical speed will already be equal to **c**.

If there is no external gravity $\mathbf{M_G}$, after $\mathbf{v_2}$, the speed measured by the Earth can continue to increase up to the maximum value of **c** (unreachable limit). On the other hand, the theoretical speed, which has risen up to **c** (for a measured speed of $\mathbf{v_2}$) will stabilize at **c**.

Indeed, the new coefficient $\boldsymbol{\gamma}$ (see the equation **(11)** above) will be reduced, when **v** will increase, and will be equal to **1**, at the limit when **v** tends towards **c**.

And so the theoretical speed, which is $\boldsymbol{v} \,.\, \boldsymbol{\gamma}^{2}$, will tend towards $\boldsymbol{c} \,.\, \boldsymbol{\gamma}^{2}$ when **v** tends towards **c**. And as $\boldsymbol{\gamma}$ tends towards **1** when **v** tends towards **c**, the theoretical speed will tend towards **c** when **v** tends towards **c**. As the theoretical speed was **c** (for a measured value equal to $\mathbf{v_2}$) and as it is also equal to **c** (for a measured value equal to **c**), we see that the theoretical speed will have remained equal to **c**, when the measured speed increased from $\mathbf{v_2}$ up to **c**.

The theoretical speed can exceed **c** (which is the value obtained for $\mathbf{v_2}$ because $\boldsymbol{v_2} \,.\, \boldsymbol{\gamma}^{2} = \boldsymbol{c}$) ***only with the help of an external gravity to the moving mass m!***

And also the 3rd term of the equation **(6)** above comes in which is $\left(\mathbf{1} - \frac{M_G{}^2}{(m.\gamma)^2}\right)$

This term will reduce the time **t** from $\mathbf{v_1}$ and up to $\mathbf{v_0}$.

The analysis of this case (with the presence of an external gravity) was carried out above. There is a particular point when the measured speed approaches $\mathbf{v_1}$: for this speed the time **t** becomes **- t** and therefore the speed becomes negative with a coefficient **- 1** (the instantaneous theoretical speed remains negative between the measured speeds $\mathbf{v_1}$ and $\mathbf{v_0}$: but in fact I prefer to talk about the notion of positive speed, which uses a distance traveled so a positive value divided by a duration which is a time interval therefore also a positive value, and thus this notion of speed is no longer instantaneous but represents a positive value corresponding to an interval of time. I make the difference between the instantaneous time **t** (the time given by the clock) and a delta **t** (Δt) which is a positive value (Δt = the time corresponding to a duration, a time interval), even if **t** is negative: indeed a difference of 2 negative values is positive if we look for the positive delta between the 2).

And there is no further reduction of the time **t** inside the spacecraft since the coefficient, in positive value, is equal to **1**: and therefore at this speed, the measured speed and the theoretical speed (in positive value) ***are equal***. If I represent the positive evolution of the theoretical speed between 0 and **c**, I must specify that the theoretical speed is **c** when $\mathbf{v} > \mathbf{v_2}$ and remains equal to **c** until a speed **v** close to $\mathbf{v_1}$ (if there is an external gravity). A little before the measured speed $\mathbf{v_1}$, the theoretical speed is reduced from **c** until it is equal to $\mathbf{v_1}$ then this theoretical speed goes up to a maximum value

$\boldsymbol{v_{3t}} = \boldsymbol{v_0} \,.\, \boldsymbol{\gamma}^{2} = \frac{M_G{}^2}{m^2} \,.\, \boldsymbol{v_0}$ obtained for a measured speed equal to $\mathbf{v_0}$.

And after, when the speed **v** measured is greater than v_0, the theoretical speed drops back to **c**, obtained for a measured speed equal to **c**. The reduction of the theoretical speed around the measured speed v_1 comes from the progressive effect of the external gravity M_G. There is no discontinuity around the measured speeds v_1 and v_0 for the effect of the external gravity M_G and thus the evolution of the theoretical speed is also without discontinuity.

Remarks:

- If there is no external gravity to the moving mass **m**, the maximum theoretical speed is equal to **c**, and is reached for a measured speed v_2 which is equal to **0,618 . c**
  For the speed v_2, the coefficient γ is equal to:

$$\gamma = \frac{1}{\sqrt{\left(1 - \frac{v_2{}^2}{c^2}\right)}}$$

$$\gamma = \frac{1}{\sqrt{(1 - 0,618^2)}} = 1,27$$

- The relativistic mass **M** of the spacecraft of mass **m** (at zero speed) will therefore increase up to a maximum value equal to: 1,27.**m** (indeed $M = \gamma . m$)
  After v_2 = **0,618.c** the speed measured from the Earth can continue to increase up to **c**, and **M** will decrease from 1.27**m** until **m** (because the coefficient γ tends towards **1** when **v** tends towards **c**).
  This represents the effect of the additional reduction of the time **t** obtained by the complementary term $\left(\frac{1}{\gamma^2}\right)$ of the equation **(6)**

$$t \to t.\left(\frac{1}{\gamma^2}\right).\left(1 - \frac{M_G{}^2}{(m.\gamma)^2}\right) \qquad \textbf{(6)}$$

- The theoretical speed will not exceed **c** and **M** will be limited to 1.27**m** and therefore the energy required for a spacecraft to go from **0,618.c** to a speed measured by the Earth close to **c** ***will not be infinite!***
  The energy required between **0,618.c** and **c** should even decrease since the relativistic mass will pass from 1.27**m** to **m** when **v** will tend towards **c**.

- When the measured speed exceeds v_1 and remains lower than v_0, the time **t** is negative. The mass **m** (for example the mass of a spacecraft) would therefore be in a "space-time" where the time **t** is negative and therefore we would no longer see this mass. But it would still be there (its effect would still be present): Ref. [8]. If we want to return to the "space-time" where the time **t** is positive, it suffices to increase the measured speed (above v_0) or to reduce the speed (below v_1). If masses revolve in the universe around external gravities, at speeds between v_1 and v_0, these masses would not be visible (because they would be in a "space-time" where **t** is negative) but their effect would be present. This could perhaps explain the 94% missing mass in the universe? Each mass which would move at a speed close to $\mathbf{v_0}$, would have a maximum relativistic mass, equal to the mass $\mathbf{M_G}$ representing the external gravity! If the measured speed is less than $\mathbf{v_0}$, the relativistic mass would be less than $\mathbf{M_G}$, but it would still be high! In the presence or not of external gravity, when **v** tends towards **c**, the value of the relativistic mass **M** (which represents the relativistic value of the mass **m** in motion) does not tend towards infinity **(M** tends towards **m** when **v** tends towards **c**). And so there is an incompatibility with the Quantum Mechanics which no longer exists: indeed if the relativistic value of **M** no longer tends towards infinity when **v** tends towards **c**, the density of matter will no longer tend towards infinity in the theory of General Relativity complemented by the equation **(6)** defined above. And this corresponds to what the theory of Quantum Mechanics has demonstrated! I would like now to look at the point of the local aspect of the $\mathbf{M_G}$ gravity effect. Indeed, how to translate that the effect of gravity represented by the mass $\mathbf{M_G}$ decreases with distance? For this I started from the equation of the force of attraction between 2 masses which is as follows:

$$\boldsymbol{F = G \,.\, \frac{m \,.\, M_G}{d^2}} \qquad \textbf{(17)}$$

G being the constant of universal gravitation
G = 6,67.10^{-11}. N.m^2.kg^{-2}

F is the force of attraction between 2 masses, **m** and $\mathbf{M_G}$
d is the distance between the 2 centers of gravity of the 2 masses: **d** is expressed in **m** (meters).
F is expressed in Newtons **(N)** and the masses in **kg**
In the equation **(17),** we can notice that **F** depends on the squared distance between the 2 masses.
I propose to replace the term $\mathbf{M_G}$ by the following more complete term:

$$\boldsymbol{M_G \rightarrow M_G \,.\left(\frac{1}{1+d^2}\right)} \qquad \textbf{(18)}$$

As for the equation **(17)**, I use the square of the distance between the 2 masses **m** and $\mathbf{M_G}$**.** And I check well that when the distance **d** tends towards 0, the new value of $\mathbf{M_G}$ tends towards $\mathbf{M_G}$. **1**: that is to say, the effect of gravity is effectively 100%. And I also check that when **d** tends to infinity the new value of $\mathbf{M_G}$ tends towards 0: $\mathbf{M_G}$. 0. The effect of $\mathbf{M_G}$ also depends on the speed **v** of the mass **m** (a spacecraft for example): but we can already see this in the evolution of the theoretical speed when the measured speed approaches **c**. I am therefore not going to add an additional corrective term for $\mathbf{M_G}$ in equation **(18)** concerning the speed **v**. In particular, we can notice that when the gravity increases (when $\mathbf{M_G}$ increases), the maximum theoretical speed increases as well as $\mathbf{v_1}$ and $\mathbf{v_0}$. When the $\boldsymbol{\frac{M_G}{m}}$ ratio increases, the effect of gravity is greater and this results in the fact that the maximum theoretical speed increases: indeed if **d** decreases, the new corrected value of $\mathbf{M_G}$ increases, indicating that the effect of gravity is local, and the force of attraction between **m** and $\mathbf{M_G}$ increases, which increases the speed between **m** and $\mathbf{M_G}$. And so the maximum theoretical speed increases when the effect of gravity increases: that is to say, when **d** decreases (which increases the ratio $\frac{M_G}{m}$) ***and*** when the value of the $\mathbf{M_G}$ mass increases. And so, if a spacecraft of mass **m** is ***very close*** to a "black-hole" ***with a very high mass*** $\mathbf{M_G}$ (which tends towards infinity for example), ***and if it is moving at a very high speed measured from our Earth*** (to be close to $\mathbf{v_0}$), the theoretical speed of the spacecraft would tend towards infinity. The value of $\mathbf{M_G}$ should therefore be replaced by the next corrected value $M_G.\left(\frac{1}{1+d^2}\right)$ in all the preceding equations.

There are conditions for the following equations:

$$c.\left(\sqrt{1-\frac{m^2}{{M_G}^2}}\right)$$

$$v_{3t} = \frac{{M_G}^2}{m^2}.v_0$$

$\mathbf{v_{3t}}$ is the maximum theoretical speed
$\mathbf{v_1}$ is the value of the measured speed **v** which satisfies the following equation:

$$\frac{M_G}{m} = \sqrt{\left(1+\left(\frac{1}{\left(1-\frac{v^2}{c^2}\right)}\right)\right)} \;.\; \left(\frac{1}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}\right)$$

The conditions are as follows:

For $\mathbf{v_0}$, the value under the root must be positive: and therefore $\mathbf{M_G}$ must be greater than **m**.

For $\mathbf{v_1}$, the above equation has a solution only if $M_G > \sqrt{2}\,.m$ (I have determined this value with Excel software).

The equations are therefore usable only for the highest condition which is

$$M_G > \sqrt{2}\,.m$$

The minimum values of $\mathbf{v_1}$, $\mathbf{v_0}$ and $\mathbf{v_{3t}}$ are as follows:

$$\frac{m}{M_G} = \frac{1}{\sqrt{2}} = 0,707$$

$\mathbf{v_0}$ = 0,7071 **. c**

$\mathbf{v_1}$ = 2,67. 10^{-5} . **c** (we push back $\mathbf{v_1}$ to 0)

$\mathbf{v_{3t}}$ = 1,414 . **c**

And these values are only valid if **m** (the spacecraft for example) is at a small distance from the mass gravity M_G. Indeed, if **d** increases between **m** and M_G, the value of M_G decreases and as soon as $M_G < \sqrt{2}\,.\,m$, the condition is no longer met and the equations cannot be used.

In the equation of v_0, we cannot replace **m** by **M** (**M** being the relativistic mass of **m**: $M = \gamma . m$), but we can replace M_G by the new value of M_G which is a function of **d**.

The local effect of gravity imposes a maximum distance between **m** and M_G: after this distance the gravity has no longer an effect on the reduction of the time **t** inside a spacecraft of mass **m**, which moves at a measured speed **v** relative to our Earth. And also it is necessary that the mass of the gravity M_G (counted at 100% of its value therefore assuming that **d** = 0) is high in front of **m** to have an effect of the gravity.

If these 2 conditions are not met, the equations are no longer valid because the local aspect is no longer valid (distance too great and mass of gravity M_G too low compared to **m**).

v_{3t} = 1,414 . **c** is the minimum effect of gravity, and when **m** is moving at a speed v_0 equal to 0,7071. **c**

This minimum theoretical speed v_{3t} is obtained at a distance **d** which would have reduced M_G because of the distance between **m** and M_G.

We can write it as follows to get the maximum distance **d**:

$$M_G\,.\left(\frac{1}{1+d^2}\right) = \sqrt{2}\,.\,m$$

$$1 + d^2 = \frac{M_G}{\sqrt{2}\,.m} \qquad \textbf{(19)}$$

Remark:

In the equation above, **d** is positive and therefore $1 + d^2$ is greater than **1**. And so $\frac{M_G}{\sqrt{2}\,.m} > 1$ and therefore $M_G > \sqrt{2}\,.\,m$

We find again the condition previously found between M_G and **m**: everything seems logical!

If I take the example of our Earth as being an external gravity to an object of mass **m** = 1 kg, I can calculate the distance **d** from which this gravity no longer reduces the time **t** inside the object of mass **m** in movement at a speed **v**.

The mass of the Earth is $5{,}972.10^{24}$ kg (= M_G). By replacing these values in the equation **(19)** I find a distance **d** equal to 2.10^9 km. This distance of 2.10^9 km is the distance from which the Earth's gravity has no longer an effect on reducing the time **t** at the level of **m** (and this even if **m** is moving at a speed close to **c**). I would like now to calculate the force of attraction between the 2 masses M_G and **m**, at a distance of 2.10^9 km, by using the equation **(17)**:

$$F = G\,.\,\frac{m\,.\,M_G}{d^2}$$

By substituting the numeric values in the equation, I find a force **F** equal to $9{,}96.10^{-11}$ Newtons (**N**). This force is very low and also shows that the effect of the Earth's gravity becomes negligible at this distance of 2.10^9 km.

The equation **(17)** shows that the Force **F** is present until infinity for **d**: and when **d** tends towards infinity, **F** tends towards 0. There is no theoretical limit for the value of **d**. But in practice, for our Earth, it is considered that its attraction stops after 900 000 km. And this distance can be up to several million of km in the case of a massive planet. If I calculate the force **F**, for a mass m of 1 Kg, located at 900 000 km from the Earth, I find, with the equation **(17)**, a force **F** = $0{,}49.10^{-3}$ **N**

This value is indeed low but remains higher than the previous value of $9{,}96.10^{-11}$ **N**.

And so it is coherent to specify that my equation **(19)** ***gives the true value of the distance between 2 masses m and M_G, from which the gravity represented by the mass M_G has no longer an effect***: the force of attraction between these 2 masses becomes negligible and the gravity $\mathbf{M_G}$ no longer reduces the time **t** at the level of the mass **m**! And the equation **(19)** gives the value of **d** for the ratio $\frac{M_G}{m}$

We cannot say that it is easier to pass in the "space-time" where the time **t** is negative if the external gravity $\mathbf{M_G}$ to the moving mass **m** is high or not because the passage in the negative time **t** depends of $\mathbf{v_0}$ and of $\mathbf{v_1}$ and therefore of the ratio $\frac{m}{M_G}$ **AND** also of the distance **d** between **m** and $\mathbf{M_G}$. If **d** is high, the effect of $\mathbf{M_G}$ decreases and therefore the transition to the negative time **t** is not possible (even if the speed of **m** is very high and if the value of $\mathbf{M_G}$ for a distance **d** equal to 0 is very high!).

On the other hand if $\mathbf{M_G}$ is very low (for a value of **d** equal to 0), the distance from which the gravity represented by the mass $\mathbf{M_G}$ has no longer an effect will be very low (see equation **(19)**) and since the effect of external gravity is necessary to have a transition to the negative time **t**, it will still be more difficult than when $\mathbf{M_G}$ is greater: indeed the distance range **d** will be greater for the mass **m** which is in movement with a speed **v** and thus the mass **m** will have more distance to remain in a negative time **t** with its speed **v** when $\mathbf{M_G}$ is high.

In addition, if $\mathbf{M_G}$ is higher, the maximum theoretical speed will be higher, which makes it possible to obtain a higher amplification coefficient (see below).

Remarks:

- For light, photons have no mass (**m** = 0). And so **F** calculated by equation **(17)** is equal to 0. There is no effect of an external gravity, represented by a mass $\mathbf{M_G}$, on photons. There is therefore no notion of $\mathbf{v_1}$ and $\mathbf{v_0}$. And the theoretical speed of the photons is limited to **c**. Everything is consistent. There is no effect of an external gravity which increases the theoretical speed up to the value of $\frac{{M_G}^2}{m^2}.\boldsymbol{v_0}$!
- What is the practical use of the notion of theoretical speed? To answer to this question I must specify that the speed measured from our Earth is always lower than the speed of light, **c**. On the other hand, the theoretical speed can exceed **c**, and will have a maximum value when the speed **v** of a spacecraft (for example) reaches the measured speed $\mathbf{v_0}$ This theoretical speed would be, when $\mathbf{v} = \mathbf{v_0}$, equal to $\frac{{M_G}^2}{m^2}.\boldsymbol{v_0}$ This value of the maximum theoretical speed can be very high if the external gravity $\mathbf{M_G}$ to the mass **m** is very high and if **m** is located at a distance very close to the gravity represented by the mass $\mathbf{M_G}$

  Being able to exceed **c** and being able to reach a very high speed value makes it possible to lengthen the distances traveled into space (distance carried out by **m** at a speed much greater than **c**!: ***the theoretical speed represents the real speed of the spacecraft, seen from inside the spacecraft!***). The Time **T** of this trip, seen from the Earth will also be increased, but it will be compensated by the passage in negative time **t** when **m** is moving at a speed **v** between $\mathbf{v_1}$ and $\mathbf{v_0}$. The outward and return journeys made at a positive time **t** will be compensated by the passage in a negative time **t** and the spacecraft will be able to return to our Earth at the same moment of its departure (people on Earth will not have aged). There would also be another advantage in being able to exceed **c**, with the notion of theoretical speed: Indeed, a spacecraft of mass **m** could approach a "black-hole" at a distance less than the radius of Schwarzschild **Rs**. The Schwarzschild radius **Rs** is proportional to the mass of the "black-hole" and inversely proportional to the square of **c**.

$$\boldsymbol{R_s = 2 \,.\, \frac{G\,.\,M}{c^2}}$$

G is the gravitational constant
M is the mass of the "black-hole"

Indeed, for a distance equal to this radius **Rs**, a spacecraft must reach the speed of light **c** to free itself from the attraction of the "black-hole": as the measured speed cannot exceed **c**, the spacecraft cannot approach at a distance less than this radius: if it does so, it will no longer be able to free itself from the attraction of the "black-hole". With the notion of theoretical speed which can greatly exceed **c**, the spacecraft will be able to approach at a distance less than **Rs** and it will then be able to free itself from the attraction of the "black-hole" because its speed will be sufficient for that. This advantage will allow a spacecraft to be able to enter a "black-hole" by approaching at a distance less than **Rs**, to be able to examine what is happening inside where nothing is visible from the outside, then the spacecraft will be able to go out and free itself from the attraction of the "black-hole" thanks to a theoretical speed greater than **c**!
This point is remarkable because the current physics does not allow it, and the interior of a "black-hole" will remain a mystery if we cannot see what is going on there.
By entering the "black-hole", at a distance less than **Rs**, the spacecraft must be into the "space-time" where the time **t** is negative so that the people inside the spacecraft can withstand the extreme conditions inside the "black-hole" (very high gravity and therefore risk of dislocation between the feet and the head created by the difference in gravity, very high temperatures, etc.): being at a negative time **t** makes it possible to not disappear, since time goes backwards, and therefore if we were alive before, we remain so when **t** goes back. And to stay at a negative time **t** inside the "black-hole", the spacecraft will have to stay between speeds $\mathbf{v_1}$ and $\mathbf{v_0}$. Indeed, only in this speed interval, the external gravity represented by the mass $\mathbf{M_G}$ allows the time to become negative inside the spacecraft, as explained before. A planet cannot free itself from the attraction of a "black-hole" when it begins to enter its field of gravity: indeed, the planet has no engine like a spacecraft which could make it change the trajectory or change the speed. And so the planet is attracted little by little by the “black-hole”.
And when a "black-hole" sucks a planet, the mass of the planet will increase the mass of the "black-hole" and so the gravity field of the "black-hole" will have a greater range: the "black-hole” may attract more and more distant planets. Moreover if the aspirated planet is driven by the "black-hole" at a very high speed, close to $\mathbf{v_0}$, the relativistic mass

of this planet would be at a maximum equal to the mass of the "black-hole" and thus the global mass of the "black-hole" will be increased by a very large value, which will further extend the distance **d** from which the "black-hole" can suck up planets.
This maximum distance **d** can be calculated with the following equation **(19)**:

$$1 + d^2 = \frac{M_G}{\sqrt{2}\,.m}$$

And it will be necessary to update each time the value of the mass $\mathbf{M_G}$ of the "black-hole" by adding to it the mass of the aspirated planets and by considering the relativistic mass of these aspirated masses which depends on their speeds (and can reach the mass of the "black-hole" at a maximum for each of them).
The distance **d** will also depend on the mass **m** of the planet which begins to enter the field of gravity of the "black-hole".
We can notice that as **m** increases, the effect of external gravity on **m** is reduced, and therefore **d** decreases. The "black-hole" will easily suck planets of low mass, looking for them further away (**d** increases when **m** decreases).
When $\mathbf{M_G}$ attracts **m**, the relativistic mass of the mass **m** increases as its speed increases and so the mass **m** will attract other masses, which in turn will be attracted by the external gravity represented by the mass $\mathbf{M_G}$ because these masses will gradually enter the field of gravity of the mass $\mathbf{M_G}$. Thus, the mass $\mathbf{M_G}$ attracts more and more planets, or masses **m**.

There would also be another interest to be able to exceed the speed of light **c**, with the notion of theoretical speed: Indeed, the energy of the moving mass **m** will be amplified by the increase of the theoretical speed, and will be maximum when the measured speed **v** is equal to the speed $\mathbf{v_0}$, which is the measured speed where the theoretical speed is maximum.
The total energy of the moving mass **m** is equal to:

$$\mathrm{E} = \gamma \cdot m \cdot c^2$$

This equation is given by the current General Relativity theory. But after the measured speed $\mathbf{v_0}$, I have complemented the theory of General Relativity, with the equations presented before, and so the previous formula must also be modified: indeed, the limit speed is no longer **c** but must be replaced by $c\,.\gamma^2$
And so the total energy of the moving mass **m** becomes:

$$\mathrm{E} = \gamma\,.m\,.\,(c\,.\gamma^2)^2$$

$$\mathrm{E} = \gamma\,.m\,.c^2.\gamma^4$$

with $\gamma\,.m\,.\,c^2$ which is the energy calculated by the current General Relativity theory. **E** should be replaced by $E\,.\gamma^4$

$$E \rightarrow E\,.\,\gamma^4 \qquad \textbf{(20)}$$

On the other hand, the total energy of the mass **m** does not tend towards infinity, when **v** tends towards **c**, as the equations of the current General Relativity theory demonstrate. Indeed, in this theory the coefficient $\boldsymbol{\gamma}$ tends towards infinity when **v** tends towards **c** and therefore **E** tends towards infinity.

In my theory, the coefficient $\boldsymbol{\gamma}$ tends towards **1** when **v** tends towards **c** and therefore **E** tends towards $\mathbf{E} = \boldsymbol{\gamma}\,.\,\boldsymbol{m}\,.\,(\boldsymbol{c}\,.\,\boldsymbol{\gamma}^{2})^{2}$ with $\boldsymbol{\gamma}$ which tends towards **1** and therefore **E** tends towards $\boldsymbol{m}\,.\,\boldsymbol{c}^{2}$ when **v** tends towards **c** (with an external gravity, represented by a mass $\mathbf{M_G}$, to the mass **m** or without an external gravity, as explained previously), and therefore **E** does not tend to infinity.

Without the external gravity $\mathbf{M_G}$ the following term $\boldsymbol{t}.\left(\frac{\mathbf{1}}{\boldsymbol{\gamma}^{2}}\right).\left(\mathbf{1}-\frac{\boldsymbol{M_G}^{2}}{(\boldsymbol{m}.\boldsymbol{\gamma})^{2}}\right)$ is reduced to $\boldsymbol{t}.\left(\frac{\mathbf{1}}{\boldsymbol{\gamma}^{2}}\right)$. The term $\left(\frac{\mathbf{1}}{\boldsymbol{\gamma}^{2}}\right)$, which modifies the time **t** in the equations of the General Relativity, allows by itself to prevent the energy **E** from tending towards infinity! This point justifies by itself that this term exists: it complements the current theory of the General Relativity.

After this, I have added the following term related to gravity, $\left(\mathbf{1}-\frac{\boldsymbol{M_G}^{2}}{(\boldsymbol{m}.\boldsymbol{\gamma})^{2}}\right)$, which is the equivalent of the effect of the speed **v** on the time **t**. I have defined this term in the same way as the term $\left(\frac{\mathbf{1}}{\boldsymbol{\gamma}^{2}}\right)$ to keep the reasoning consistent (see the paragraph linked to this point in this document).

Everything thus seems logical and justified to me and this in a physical way (that is to say, which corresponds to a logic justified by physical equations).

In my theory, the energy is maximum for the speed $\mathbf{v_0}$ and is amplified for this speed $\mathbf{v_0}$ by comparing $\boldsymbol{E}\,.\,\boldsymbol{\gamma}^{4}$ to the total energy **E** of the moving mass **m** calculated with the current theory of the General Relativity. The coefficient $\boldsymbol{\gamma}$ is maximum for v = $\mathbf{v_0}$. And for the speed $\mathbf{v_0}$, $\boldsymbol{\gamma}$ is equal to $\frac{\boldsymbol{M_G}}{\boldsymbol{m}}$

And so the maximum energy of the moving particle is:

$$\boldsymbol{E} \rightarrow \boldsymbol{E}\,.\,\frac{\boldsymbol{M_G}^{4}}{\boldsymbol{m}^{4}} \qquad \mathbf{(21)}$$

The total energy **E** of the moving mass **m**, calculated with the equations of the current General Relativity theory is amplified by the effect of the external gravity to the mass **m**, represented by the mass $\mathbf{M_G}$ and is multiplied by $\frac{\boldsymbol{M_G}^{4}}{\boldsymbol{m}^{4}}$ when the measured speed reaches the speed $\mathbf{v_0}$. And at this speed $\mathbf{v_0}$, the amplification of the total energy is maximum.

When the measured **v** exceeds $\mathbf{v_0}$, the total energy of the moving mass **m** will decrease and will go from $\boldsymbol{E}\,.\,\frac{\boldsymbol{M_G}^{4}}{\boldsymbol{m}^{4}}$ to $\boldsymbol{m}\,.\,\boldsymbol{c}^{2}$

Indeed, the total energy of the mass **m** will be at the limit equal to $\boldsymbol{m}\,.\,\boldsymbol{c}^{2}$ when the measured **v** tends towards **c**, and therefore will not tend to infinity. I have made a numerical application for an hydrogen atom which consists of a nucleus (a proton) around which an electron revolves.

The external gravity is represented here by the proton of mass $\mathbf{M_G}$ = $1{,}672649.10^{-27}$ kg

The moving mass, **m**, is here represented by the electron of mass **m** = $9{,}109.10^{-31}$ kg

$\frac{\boldsymbol{M_G}}{\boldsymbol{m}}$ = $1{,}83.10^{3}$

The calculated value of $\mathbf{v_0}$ is: $\mathbf{v_0}$ = 0,999…99 . **c** (7 digits 9)

The maximum amplification of the total energy **E** of the moving mass **m**, calculated with the equations of the current General Relativity theory, is a multiplying factor equal to $\frac{M_G{}^4}{m^4}$ when the measured speed reaches the speed $\mathbf{v_0}$. This multiplying factor is therefore equal to: $(1,83.10^3)^4 = 1,12.10^{13}$

There is therefore an enormous amplification factor of the total energy of the moving electron around the nucleus for the measured speed $\mathbf{v_0}$: this is linked to the effect of the external gravity to the electron and which is represented by the mass of the proton.

It sounds like a resonance in mechanics

It is thus necessary to aim for the measured speed $\mathbf{v_0}$ to make the most of this amplification of energy by exciting the electrons so that they reach the measured speed $\mathbf{v_0}$: this opens up avenues of research to optimize lasers for example or in particles accelerators in order to make collisions between protons at optimized velocities $\mathbf{v_0}$ to take advantage of the maximum kinetic energy of the particles on impact.

The speed $\mathbf{v_0}$ must be exceeded a little so as not to reduce too much the total energy of the moving mass **m**, and being at a measured speed greater than $\mathbf{v_0}$, the mass **m** would be in a "space-time" where the time **t** is positive and therefore we could see this mass **m**.

This amplifying coefficient equal to $1,12.10^{13}$ must be reduced a little because the effect of external gravity is local and therefore the distance between the electron and the proton must be introduced. We must use the following equation and replace the value of the mass of the external gravity $\mathbf{M_G}$:

$$M_G \rightarrow M_G \cdot \left(\frac{1}{1+d^2}\right)$$

but the distance **d** is small in the example of the hydrogen atom and therefore the influence of **d** is considered negligible.

The distance **d** between the proton and the electron is equal to 53.10^{-12} m. The distance from which the gravity of the proton has no longer an influence is calculated with the following equation:

$$1 + d^2 = \frac{M_G}{\sqrt{2}\,.m}$$

With $\frac{M_G}{m} = 1,83.10^3$

I find a $\mathbf{d}_{\text{maxi}}$ value equal to 35,958 m (meter) 53.10^{-12} m is therefore very negligible compared to 35,958 m and there is therefore no reason to correct the amplifying coefficient equal to $1,12.10^{13}$

I can summarize the previous elements by the following graphic:

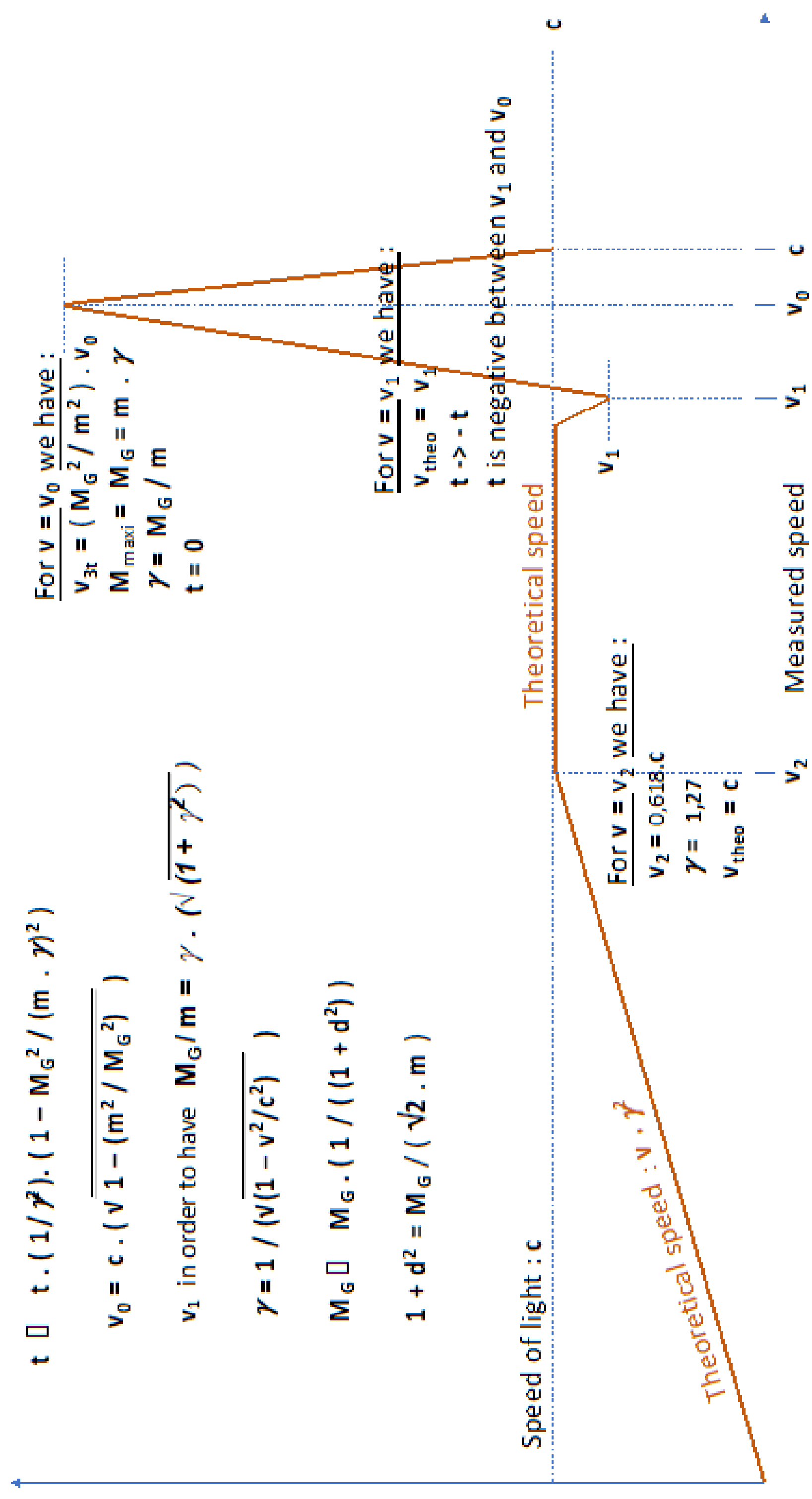

Figure 1. Measured speed and Theoretical speed.

I will now approach more precisely the complements that I wish to bring to my equation on the time **t** at the level of a moving mass **m**, located in the field of gravity (therefore close) to an external mass $\mathbf{M_G}$ and this part will therefore complement my following equation defined before:

$$\boldsymbol{t \rightarrow t.\left(\frac{1}{\gamma^2}\right).\left(1 - \frac{{M_G}^2}{(m.\gamma)^2}\right)} \qquad \mathbf{(6)}$$

I have to introduce the parameter **Rs** which is the ***Schwarzschild radius*** to explain why I want to add a term to the previous equation. **Rs** is linked to the presence of Gravity (some masses) into the Space and in particular to the presence of ***"black-holes"***: Refs. [9] [10] [11] [12] [13].

"Black-holes", like any Gravity, have a theoretical border: This boundary is demarcated by the Schwarzschild radius which defines a surface called the "horizon".

The phenomena get complicated when the "black-holes" are in rotation: this is Kerr's metric. But the conclusions are the same as the Schwarzschild metric ("black-hole" not rotating and therefore static) when we cross the horizon also called "the horizon of events": Ref. [14].

The "black-hole" is characterized by an enormous mass and causes an enormous Gravity which distorts the "space-time" all around. The speed of release of a planet revolving around a "black-hole", equal to the speed of light, **c**, allow to calculate the radius of Schwarzschild **Rs**: at this distance from the center of a "black-hole" a planet can escape from the "black-hole" only if its speed is equal to **c**. For a distance less than this radius, the release speed must be greater than **c** and therefore as this is impossible, nothing can come out of it.

The Schwarzschild radius **Rs** is proportional to the mass of the "black-hole" (or a Gravity, such as the mass of a Planet for example) and inversely proportional to the square of **c**.

$$\boldsymbol{R_s = 2\,.\,\frac{G\,.M_G}{c^2}}$$

G is the gravitational constant
G = $6{,}67.10^{-11}.\ \mathrm{N.m^2.kg^{-2}}$
$\mathbf{M_G}$ is the mass of the "black-hole"

We can notice that **Rs** ***does not depend*** on the mass of the Planet which revolves around the "black-hole" (or of a spacecraft). If a spacecraft approaches the "black-hole" and drops below the Schwarzschild radius it is said that the spacecraft is crossing the "horizon of events". Everything behind the "horizon" has no way for going out and increases the mass of the "black-hole". The most astonishing properties are those which concern the distortion of time around a "black-hole". Time passes more slowly in a strong gravitational field. It is in the extreme case of a "black-hole" that this kind of effect is particularly spectacular. As you approach a "black-hole", the time **t** inside the spacecraft will decrease (as if you were increasing the speed of the spacecraft). The time **t** will tend to 0 if the spacecraft approaches the "horizon of events". If the spacecraft crosses the "horizon of events" the time will become zero (time will seem to stop) and if the spacecraft continues to approach the center of the "black-hole" the time will become negative. Indeed, gravity is so strong that a speed greater than the speed of light will be needed to escape from the "black-hole", below the Schwarzschild radius: and as **c** cannot be exceeded, it is the time **t** that will become negative by continuity. The time inside the spacecraft decreases as it approaches the Schwarzschild radius, cancels itself when reaching this radius and then continues to decrease (and so the time becomes negative) when the spacecraft crosses the Schwarzschild radius and approaches the center of the “black-hole” because Gravity is still increasing.

This happens when the spacecraft has a zero speed when approaching the “black-hole”. And seen from the outside, the spacecraft will take an infinite time **T** to cross the Schwarzschild radius (because **v** seems to be equal to 0 and $\boldsymbol{T = \frac{\ell}{v}}$). But if the spacecraft arrives with a speed **v** close to **c** it is the same thing: if it crosses the “horizon of events”, it will not be able to go back. Current physics therefore considers that when a spacecraft of mass **m** is going to be at a distance **d** equal to **Rs** from a "black-hole", the time in the spacecraft would seem frozen: **t = 0**.

Inside the spacecraft, the time would seem to be frozen as we passed through the Schwarzschild's radius, and we would not even notice it (it would take a time **t** equal to 0).

These points are therefore missing in my equation on the time **t** at the level of a moving mass, close to an external Gravity.

I must therefore ***add an additional term*** to the equation **(6)** above which takes into account **Rs** and **d**:
I propose the following complementary term:

$$\left(\boldsymbol{1 - \frac{Rs^2}{d^2}}\right)$$

The equation **(6)** thus becomes the following equation **(22)**:

$$\boldsymbol{t \rightarrow t.\left(\frac{1}{\gamma^2}\right).\left(1 - \frac{M_G{}^2}{(m.\gamma)^2}\right).\left(1 - \frac{Rs^2}{d^2}\right)}$$

We check well the following points:

- When **d = Rs**, the coefficient $\left(\boldsymbol{1 - \frac{Rs^2}{d^2}}\right)$ is equal to 0 and so the time **t** = 0
- When **d** < **Rs**, the coefficient $\left(\boldsymbol{1 - \frac{Rs^2}{d^2}}\right)$ is less than 0 and the term becomes negative, therefore **t** becomes negative. More precisely, the coefficient $\left(\boldsymbol{1 - \frac{Rs^2}{d^2}}\right)$ ***will change the sign of* t** when **d** < **Rs**: if **t** was positive before, it would become negative and also if **t** was negative before, it would become positive.

  The fact that the coefficient $\left(\boldsymbol{1 - \frac{Rs^2}{d^2}}\right)$ makes it possible to change the sign of **t** when **d** becomes less than **Rs *is conform to current physics***. Indeed, some physicists have shown that something happens when we cross the Schwarzschild radius **Rs**, and in particular that the time **t** could become negative: Refs. [15] [16] [17].

- When **d** > **Rs**, the coefficient $\left(\boldsymbol{1 - \frac{Rs^2}{d^2}}\right)$ is between **1** and **0**: it well reduces the time **t** and approaches **1** when **d** becomes high. When **d** becomes high, **Rs** has no longer an effect on the time **t**, which is logical: the gravity of the “black-hole” has no effect on the

time **t** when we are far from the "black-hole" and ***the current physics is so not modified*** when the spacecraft remains close to our Earth for example.
In other words, the effect of a planet is very small on the reduction of the time **t** at the level of a close spacecraft, following the addition of the term $\left(\mathbf{1}-\frac{\boldsymbol{Rs}^2}{\boldsymbol{d}^2}\right)$, because the planet's gravity is not high enough: it is necessary to reach the mass of a "black-hole" for example to see an effect on the reduction of **t** when approaching.
I will make a numerical application to confirm this point after the following remarks.

Remarks:

- It should be noted that the coefficient $\left(\mathbf{1}-\frac{\boldsymbol{Rs}^2}{\boldsymbol{d}^2}\right)$ becomes less than **-1** when **d** < 0,707. **Rs**
  The effect of gravity ***is a local term*** and we can thus consider that when the coefficient is less than **-1**, it does not reduce **t** and therefore the coefficient no longer has an effect. Everything would happen as if the term $\left(\mathbf{1}-\frac{\boldsymbol{Rs}^2}{\boldsymbol{d}^2}\right)$ no longer exists when
  d < 0,707. **Rs**
  And so the time **t** would be negative (in fact the sign of the time **t** will change) only when **d** is between 0,707. **Rs** and **Rs**. When **d** is less than 0,707. **Rs**, the time **t** would become positive again (more precisely, the coefficient $\left(\mathbf{1}-\frac{\boldsymbol{Rs}^2}{\boldsymbol{d}^2}\right)$ ***would not change the sign*** of **t** when **d** < 0,707. **Rs** with respect to the sign of **t** when **d** > **Rs**).

- The term $\left(\mathbf{1}-\frac{\boldsymbol{Rs}^2}{\boldsymbol{d}^2}\right)$ respects the structure of the other terms of the equation **(6)**: they are all in the form (**1** - a ratio of 2 terms squared and these 2 terms are of the same nature with one of the 2 terms which tends towards the limit of the other term). In the case of the term $\left(\mathbf{1}-\frac{\boldsymbol{Rs}^2}{\boldsymbol{d}^2}\right)$, the numerator and the denominator are both distances and we look at the effects of **d** when **d** increases or decreases, up to the limits (**d** tending towards infinity and towards **0**).
  As a reminder, the 1st term of the equation on the time **t** is $\left(\frac{\mathbf{1}}{\boldsymbol{\gamma}^2}\right)$ and as
  $\boldsymbol{\gamma}=\frac{\mathbf{1}}{\sqrt{\left(\mathbf{1}-\frac{\boldsymbol{v}^2}{\boldsymbol{c}^2}\right)}}$, this term is therefore equal to: $\left(\frac{\mathbf{1}}{\boldsymbol{\gamma}^2}\right)=\left(\mathbf{1}-\frac{\boldsymbol{v}^2}{\boldsymbol{c}^2}\right)$ and thus this term also respects the shape of the previous structure.

- The term $\left(\mathbf{1}-\frac{\boldsymbol{Rs}^2}{\boldsymbol{d}^2}\right)$ is very close to **1** if the external gravity is created by a low mass. For example, if we take our Earth as an external gravity to a spacecraft landed on the Earth, as **Rs** of the Earth is very small (**Rs** = 8,869 mm), we cannot reach it because **Rs** is a lower distance than the radius of the Earth! And **d**, even on the surface of the Earth, will be very high in front of **Rs** and therefore the term $\left(\mathbf{1}-\frac{\boldsymbol{Rs}^2}{\boldsymbol{d}^2}\right)$ will be very close to **1**. The term $\left(\mathbf{1}-\frac{\boldsymbol{Rs}^2}{\boldsymbol{d}^2}\right)$ becomes small in front of **1** only when the mass of the external gravity $\mathbf{M_G}$ is very high, like the mass of a "black-hole" for example. I will now make a numerical application with our Earth as being the external gravity $\mathbf{M_G}$ to a spacecraft of mass **m** landed on the Earth and I will calculate the effect of the term $\left(\mathbf{1} - \frac{\boldsymbol{Rs^2}}{\boldsymbol{d^2}}\right)$ on the reduction of the time **t** at the level of the spacecraft.

Numerical Application:

Calculation of the reduction of the time **t** by the term $\left(\mathbf{1} - \frac{\boldsymbol{Rs^2}}{\boldsymbol{d^2}}\right)$ at the level of a spacecraft of mass **m** landed on our Earth:

$$\boldsymbol{R_s = 2 \, . \, \frac{G \, . M_G}{c^2}}$$

G is the gravitational constant
G = $6{,}67.10^{-11}$. $N.m^2.kg^{-2}$
$\mathbf{M_G}$ is the mass of our Earth

The mass of our Earth $\mathbf{M_G}$ is equal to: $\mathbf{M_G}$ = $5{,}972.10^{24}$ Kg
c is the speed of light
c = 300 000 km/s

The calculation of **Rs**, by replacing the terms of the equation $\boldsymbol{R_s = 2 \, . \, \frac{G \, . M_G}{c^2}}$ by the preceding numerical values, leads to the following result: **Rs =** $8{,}869 \, . \, 10^{-3}$ m = 8,869 mm

It can be noticed that the calculation of **Rs** does not depend on the mass **m** of the spacecraft **d =** 6371 km = 6 371 000 m (this is the radius of our Earth)

We can thus calculate the value of the complete term $\left(\mathbf{1} - \frac{\boldsymbol{Rs^2}}{\boldsymbol{d^2}}\right)$

$$\left(\mathbf{1} - \frac{\boldsymbol{Rs^2}}{\boldsymbol{d^2}}\right) = \left(\mathbf{1} - \frac{(8{,}869 \, .10^{-3})^2}{6\,371\,000^{\,2}}\right)$$

$$\left(\mathbf{1} - \frac{\boldsymbol{Rs^2}}{\boldsymbol{d^2}}\right) = 1 - (1{,}9379 \, . \, 10^{-18})$$

The term $1{,}9379 \, . \, 10^{-18}$ is very small in front of **1**, so that the coefficient $\left(\mathbf{1} - \frac{\boldsymbol{Rs^2}}{\boldsymbol{d^2}}\right)$ is very close to **1**, and remains less than **1**. In other words, the time **t** is hardly reduced at the level of the spacecraft landed on our Earth by the coefficient $\left(\mathbf{1} - \frac{\boldsymbol{Rs^2}}{\boldsymbol{d^2}}\right)$. I have described before the concept of theoretical speed which can exceed the speed of light, **c**. Indeed, the speed of light **c** is a measured speed and cannot be exceeded. On the other hand, the theoretical speed can exceed **c**, and I refer you to my explanations before.

The theoretical speed represents the actual speed of the spacecraft, seen from inside the spacecraft!, in relation to the complete and corrected reduction of the time **t** with my equation.

The equation presented before on the time **t** is modified by the term $\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)$, but this does not change the reasoning for theoretical speed.

In particular, I wrote the following paragraph before and I would like to come back to this point:

"There would also be another advantage in being able to exceed **c**, with the notion of theoretical speed: Indeed, a spacecraft of mass **m** could approach a "black-hole" at a distance less than the radius of Schwarzschild **Rs**.

Indeed, for a distance equal to this radius, a spacecraft must reach the speed of light **c** to free itself from the attraction of the "black-hole": as the measured speed cannot exceed **c**, the spacecraft cannot approach at a distance less than this radius: if it does so, it will no longer be able to free itself from the attraction of the "black-hole". With the notion of theoretical speed which can greatly exceed **c**, the spacecraft will be able to approach at a distance less than **Rs** and it will then be able to free itself from the attraction of the "black-hole" because its speed will be sufficient for that. This advantage will allow a spacecraft to be able to enter a "black-hole" by approaching at a distance less than **Rs**, to be able to examine what is happening inside where nothing is visible from the outside, then the spacecraft will be able to go out and free itself from the attraction of the "black-hole" thanks to a theoretical speed greater than **c**!

This point is remarkable because the current physics theory does not allow it, and the interior of a "black-hole" will remain a mystery if we cannot see what is going on there.

By entering the "black-hole", at a distance less than **Rs**, the spacecraft must be into the "space-time" where the time **t** is negative so that the people inside the spacecraft can withstand the extreme conditions inside the "black-hole" (very high gravity and therefore risk of dislocation between the feet and the head created by the difference in gravity, very high temperatures, …): being at a negative time **t** makes it possible to not disappear, since time goes backwards, and therefore if we were alive before, we remain so when **t** goes back.

And to stay at a negative time **t** inside the "black-hole", the spacecraft will have to stay between speeds $\mathbf{v_1}$ and $\mathbf{v_0}$. Indeed, only in this speed interval, the external gravity represented by the mass $\mathbf{M_G}$ allows the time **t** to become negative inside the spacecraft, as explained before".

I would like now to return to what I wrote before:

" Everything would happen as if the term $\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)$ no longer exists when **d** < 0,707. **Rs**
And so the time **t** would be negative (in fact the sign of the time **t** will change) only when **d** is between 0,707. **Rs** and **Rs**."

I have indeed shown that if a spacecraft (for example) crosses the Schwarzschild radius **Rs**, the time **t** will become negative (would change it's sign in fact), and this depending on the speed of the spacecraft:

If the speed **v** of the spacecraft is zero, or less than $\mathbf{v_1}$, (I am not replacing $\mathbf{v_1}$ by $\mathbf{v_4}$ here otherwise I would count by doing this 2 times the effect of the term $\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)$: $\mathbf{v_4}$ is defined later in this document), the spacecraft is into the "space-time" where the time **t** is positive and if it crosses **Rs**, it will pass into the "space-time" where the time **t** is negative. But as its speed is less than $\mathbf{v_1}$, the maximum theoretical speed for $\mathbf{v} < \mathbf{v_1}$ is equal to **c** (see the synthesis before) and as **d** < **Rs**, a speed greater than the speed of the light **c** would be needed to come out of **Rs**… And therefore we will no longer be able to come out of **Rs**, even if we remain alive since we are into the "space-time" where the time **t** is negative, since **d** would be between 0,707. **Rs** and **Rs**. If, on the other hand, the speed of the spacecraft is greater than $\mathbf{v_1}$, but remains lower than $\mathbf{v_0}$, the spacecraft is into the "space-time" where the time **t** is negative and if it crosses **Rs**, it will change again the "space-time" since the term $\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)$ is negative… and the spacecraft will now be into the "space-time" where the time **t** is positive: and in this case we will no longer remain alive inside the spacecraft because the exterior conditions would be extreme (gravity and temperature too high +…).

And so there too, if the speed of the spacecraft is between $\mathbf{v_1}$ and $\mathbf{v_0}$, we could not enter **Rs** (**d** cannot be less than **Rs**).

Now it remains the case where the speed, measured from our Earth, of the spacecraft would be greater than $\mathbf{v_0}$: in this case, the spacecraft would be into the "space-time" where the time **t** is positive and crossing **Rs**, it would be into the "space-time" where the time **t** is negative. The theoretical speed is greater than **c** when $\mathbf{v} > \mathbf{v_0}$ (see the synthesis before) and therefore the spacecraft could come out of the "black hole"!

The spacecraft should not go to **d** < 0,707. **Rs** otherwise it would return into the "space-time" where the time **t** would be positive and living conditions would be impossible. We thus find again the condition **d** > 0,707. **Rs**

And so, by pushing the reasoning to the limit, this case would be the only possible case! and thus it would be theoretically possible to cross **Rs** (**d** can be less than **Rs**) and we could come out of the "black-hole"!

There would also be another constraint by approaching **Rs**: indeed if I take the case of the "black-hole" of our Galaxy, **Rs** calculated for the "black-hole" Sagittarius A is equal to 7,8 millions of km. But the value of its radius measured by physicists would be 22 millions of km! And so before arriving at **Rs**, we might encounter some Matter, which would physically prevent us from being able to get closer to **Rs**!

We would find ourselves in the same case as for our Earth, where the value of **Rs** is $8{,}869.10^{-3}$ m and the radius of the Earth is 6 371 000 m ! The condition for entering **Rs** has therefore changed now compared to what I have written before: "To stay at a negative time **t** inside the "black-hole", the spacecraft will have to stay between speeds $\mathbf{v_1}$ and $\mathbf{v_0}$. Indeed, only in this speed interval, the external gravity represented by the mass $\mathbf{M_G}$ allows the time to become negative inside the spacecraft ".

Now, by adding the coefficient $\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)$ I have shown ***that a speed greater than*** $\mathbf{v_0}$ ***is needed*** for the spacecraft to be able to move in and out of **Rs**. But in the case of a "black-hole", the value of $\mathbf{v_0}$ is very close to **c**, and it will be necessary to be careful ***to always stay above*** $\mathbf{v_0}$ (speed measured from our Earth) to stay alive: the condition is therefore more severe than at the beginning of this document.

We remain consistent with current physics, which states that we cannot go to a distance **d** less than **Rs**, otherwise we can no longer come out of the "black-hole". I proved above that we could theoretically do it, but the conditions to get there are very difficult to meet: we could go there, at the limit, but the caution here would be to stay at **d** > **Rs** ! (risk of contact with Matter +…).

As soon as a planet enters the gravitational field of a "black-hole", it can no longer escape and it is sucked in. On the other hand a spacecraft, which has an engine, could come out of **Rs** of a "black-hole" if its motorization allows it to go at a speed measured from our Earth higher than $\mathbf{v_0}$ so as to be able to have a theoretical speed higher than **c**. If I take the example of the "black-hole" of our galaxy, Sagittarius A, the gravitational field stops at 6,34 light-years for a spacecraft with a mass of 1000 Kg (for example). Any mass of less than 1000 kg located at less than 6,34 light-years of Sagittarius A will be sucked in and will not be able to escape. Our Earth is located at 25 640 light-years from Sagittarius A and therefore there is no risk of being sucked into this “black-hole” (and also, as the mass of the Earth is greater than 1000 Kg, the distance of 6,34 light-years would be reduced because the effect of the external gravity of the “black-hole” is reduced on an increasing mass).

If I push the reasoning to the limit, any planet which would be sucked by a "black-hole" will arrive at **Rs** with a speed very near to **c**, because the “black-hole” has attracted the planet since a long time and has increased continuously it’s speed until tending to reach the maximum speed of **c**. And so by crossing **Rs**, since the speed of the planet is greater than $\mathbf{v_0}$, the planet will go from a positive time **t** to a negative time **t**. As the speed of the planet is very close to **c**, its relativistic mass will be equal to its mass at rest (see before) and its repulsive gravitational force (since **t** is negative at its level : see after for this point) will be less than the attractive gravitational force of the "black-hole"! and thus the planet will continue to be sucked by the "black-hole".

Then when **d** will become less than 0,707. **Rs**, the sign of the time **t** will change again and will become positive.

The mass of the planet, **m**, will thus become attractive again, will be visible, and will increase the mass of the “black-hole”. The "increase" in mass of the “black-hole” will be equal to the resting mass of the planet and not its relativistic mass (otherwise it would be infinite since **v** is equal to **c**, ***at the limit***, according to current physics).

The mass of the planet at rest will thus increase the mass of the "black-hole" which will have sucked this planet, ***which is consistent with current physics.***

Adding the coefficient $\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)$ able us to find conditions for any speed **v**, between 0 and **c**, so that a mass **m** moving at **v** is at a negative time **t**!

Indeed, when **d** > **Rs**, the speed **v** of a spacecraft (for example) would have to be between $\mathbf{v_1}$ and $\mathbf{v_0}$ for the time **t** to be negative.

If **d** < **Rs** and as long as **d** > 0,707. **Rs**, the time **t** would be negative if the speed **v** is between 0 and $\mathbf{v_1}$.

If **d** < **Rs** and as long as **d** > 0,707. **Rs**, the time **t** would be negative if the speed **v** is greater than $\mathbf{v_0}$.

On the other hand, adding the coefficient $\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)$, ***do not change my initial reasoning***: it is the passage of the mass **m** (a spacecraft for example) to a negative time **t**, during a part of the travel, which would allow us to be able to make a far-away travel into Space, at high speed, and to be able to find unaged people on our Earth when we return, such as people who have traveled into the spacecraft. This is not possible with current physics: the people who remained on Earth would have aged much more than those who traveled into the spacecraft moving at high speed (close to **c**). I will now analyze in more detail what the addition of the coefficient $\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)$ to my equation on the time **t** has changed for the conditions for which a mass **m** (a spacecraft for example) could be found into a “space-time” where the time **t** would be negative, in particular for the calculations of speeds $\mathbf{v_1}$ and $\mathbf{v_0}$. For the calculation of the speed $\mathbf{v_0}$, ***this does not change anything***, because of the definition of the speed $\mathbf{v_0}$. The calculations presented before are therefore correct. On the other hand, for the speed $\mathbf{v_1}$, there is a modification to make and I will explain myself on this point: The value of $\mathbf{v_1}$ is the speed which allows the following equality, which transforms **t** into **- t**:

$$\left(\frac{1}{\gamma^2}\right).\left(1-\frac{{M_G}^2}{(m.\gamma)^2}\right) = -1$$

but now with the addition of the term $\left(1-\frac{Rs^2}{d^2}\right)$ the equation **(6)** before has become the equation **(22)**:

$$t \rightarrow t.\left(\frac{1}{\gamma^2}\right).\left(1-\frac{{M_G}^2}{(m.\gamma)^2}\right).\left(1-\frac{Rs^2}{d^2}\right)$$

And so the speed $\mathbf{v_1}$ would now be the speed $\mathbf{v_4}$ ***which would also allow the following equality***, and which transforms **t** into **- t**:

$$\left(\frac{1}{\gamma^2}\right).\left(1-\frac{{M_G}^2}{(m.\gamma)^2}\right).\left(1-\frac{Rs^2}{d^2}\right) = -1$$

This speed would be the speed $\mathbf{v_4}$ and when the speed of the spacecraft will be greater than $\mathbf{v_4}$ the time **t** would start to become negative at the level of the spacecraft of mass **m**, and this up to the speed $\mathbf{v_0}$. And when the speed will be greater than $\mathbf{v_0}$, the time **t** at the level of the spacecraft will become positive again.

If I develop the previous equality I end up with:

$$\left(\frac{1}{\gamma^2}\right)-\left(\frac{{M_G}^2}{m^2.\,\gamma^4}\right) = -\frac{1}{\left(1-\frac{Rs^2}{d^2}\right)}$$

$$\frac{{M_G}^2}{m^2.\,\gamma^4} = \left(\frac{1}{\gamma^2}\right)+\frac{1}{\left(1-\frac{Rs^2}{d^2}\right)}$$

$$\frac{{M_G}^2}{m^2} = \gamma^2 + \gamma^4\,.\,\frac{1}{\left(1-\frac{Rs^2}{d^2}\right)}$$

$$\frac{M_G}{m} = \gamma\,.\left(\sqrt{\left(1+\gamma^2.\frac{1}{\left(1-\frac{Rs^2}{d^2}\right)}\right)}\right) \qquad \mathbf{(23)}$$

This equation has a solution only if **d** > **Rs**. I find again the condition mentioned earlier in this part of the book where it is theoretically possible to go to **d** < **Rs** but there would be some obstacles (presence of Matter, need to stay very close to the speed of light, …). And so, as I consider that the spacecraft would stay at a distance greater than **Rs** from the center of the "black-hole", this equation would have a solution and we will find a speed $\mathbf{v_4}$ from which the time **t** at the level of the spacecraft will start to become negative. When **v** is greater than $\mathbf{v_4}$, the time **t** at the level of the spacecraft will start to become negative and will remain negative until the speed reaches $\mathbf{v_0}$ which is greater than $\mathbf{v_4}$.

It is now necessary to consider the speed v_4 instead of the speed v_1, each time the speed v_1 is mentioned and so replace v_1 by v_4

The speed $\mathbf{v_4}$ ***is lower*** than the value of the speed $\mathbf{v_1}$ presented before. And under these conditions, when the speed $\mathbf{v}$ is less than $\mathbf{v_4}$, the following term:

$$\left(\frac{1}{\gamma^2}\right).\left(1-\frac{M_G{}^2}{(m.\gamma)^2}\right).\left(1-\frac{Rs^2}{d^2}\right)$$

will become less than **- 1** and will therefore no longer reduce the time **t** at the level of the moving mass **m** close to the external gravity $\mathbf{M_G}$.

The effect of gravity ***is a local term*** and we can thus consider that when the above term is less than **- 1**, it does not reduce **t** and therefore the term related to gravity no longer has an effect. Everything would happen as if the terms $\left(1-\frac{M_G{}^2}{(m.\gamma)^2}\right).\left(1-\frac{Rs^2}{d^2}\right)$ no longer exist when the effect of gravity is too weak. And under these conditions the following equation **(22)** will be reduced:

$$t \to t.\left(\frac{1}{\gamma^2}\right).\left(1-\frac{M_G{}^2}{(m.\gamma)^2}\right).\left(1-\frac{Rs^2}{d^2}\right)$$

The equation **(22)** above will be reduced to the following equation when **v** is less than $\mathbf{v_4}$:

$$t \to t.\left(\frac{1}{\gamma^2}\right)$$

So that the time **t** can become negative, it is thus necessary that the external gravity $\mathbf{M_G}$ to the moving mass **m** is sufficiently high compared to **m** and that the speed of **m** is also sufficient: these conditions result in the condition $\mathbf{v > v_4}$ (**v** being the speed of **m**, a spacecraft for example). And so that the external gravity $\mathbf{M_G}$ to the moving mass **m** is sufficiently high compared to **m**, the distance **d** between **m** and $\mathbf{M_G}$ must be sufficiently small. Indeed, there is a relation, which I have presented before which shows how the value of $\mathbf{M_G}$ corrected changes with the distance **d**:

$$M_G \;\to\; M_G.\left(\frac{1}{1+d^2}\right) \qquad \mathbf{(18)}$$

The new $\mathbf{M_G}$ value therefore decreases as **d** increases, and it is this corrected $\mathbf{M_G}$ value that must be used in the term $\left(1-\frac{M_G{}^2}{(m.\gamma)^2}\right)$ of the following equation **(22)**:

$$t \to t.\left(\frac{1}{\gamma^2}\right).\left(1-\frac{M_G{}^2}{(m.\gamma)^2}\right).\left(1-\frac{Rs^2}{d^2}\right)$$

In other words, the distance **d** between **m** and the external mass $\mathbf{M_G}$ will impact the calculation of the speed $\mathbf{v_4}$, which is the condition from where the time **t** can start to become negative at the level of **m**.

Indeed, $\mathbf{v_4}$ is the speed which allows the following equality

$$\frac{M_G}{m} = \gamma \cdot \left(\sqrt{\left(1 + \gamma^2 \cdot \frac{1}{\left(1 - \frac{Rs^2}{d^2}\right)}\right)} \right) \qquad \textbf{(23)}$$

And the speed **v** of the moving mass **m** (a spacecraft for example) must be greater than $\mathbf{v_4}$ so that the time **t** can pass into the "space-time" where the time **t** is negative. To take into account the distance **d** in the previous equality, we must consider the corrected value of $\mathbf{M_G}$. And therefore replace $\mathbf{M_G}$ by $M_G \cdot \left(\frac{1}{1+d^2}\right)$ in the 1st term of the equality above. The equation **(23)** thus becomes the following equation **(24)**:

$$\frac{M_G}{m} \cdot \left(\frac{1}{1+d^2}\right) = \gamma \cdot \left(\sqrt{\left(1 + \gamma^2 \cdot \frac{1}{\left(1 - \frac{Rs^2}{d^2}\right)}\right)} \right) \qquad \textbf{(24)}$$

In order for the time **t** to begin to become negative at the level of **m** and so that the terms ***will reduce the time***, the following terms of the equation **(22)** must be greater than **– 1**

$$\left(\frac{1}{\gamma^2}\right) \cdot \left(1 - \frac{M_G{}^2}{(m.\gamma)^2}\right) \cdot \left(1 - \frac{Rs^2}{d^2}\right) > -1$$

If I develop this equation I come to

$$\frac{M_G}{m} < \gamma \cdot \left(\sqrt{\left(1 + \gamma^2 \cdot \frac{1}{\left(1 - \frac{Rs^2}{d^2}\right)}\right)} \right)$$

And if I replace $\mathbf{M_G}$ by $M_G \cdot \left(\frac{1}{1+d^2}\right)$, I find the following equation **(25)**:

$$\frac{M_G}{m} \cdot \left(\frac{1}{1+d^2}\right) < \gamma \cdot \left(\sqrt{\left(1 + \gamma^2 \cdot \frac{1}{\left(1 - \frac{Rs^2}{d^2}\right)}\right)} \right)$$

We can notice that when **d** tends towards **Rs** (in higher value), the right term tends towards infinity and therefore this inequality would always be true, even if the speed **v** of the moving mass **m** would be equal to 0: there would be no more minimum speed condition $\mathbf{v_4}$ so that **m** can go to a negative time **t**. This value of **d** can be calculated with the preceding inequality.

We can therefore calculate the value of **d**, to satisfy the previous inequality, by taking **v = 0** for this calculation.

$\boldsymbol{\gamma}$ = **1** when **v = 0** because $\boldsymbol{\gamma} = \frac{\mathbf{1}}{\sqrt{\left(\mathbf{1}-\frac{v^2}{c^2}\right)}}$ and thus the equation **(25)** becomes the following equation **(26)**:

$$\frac{M_G}{m} < (\mathbf{1}+d^2)\cdot\left(\sqrt{\left(\mathbf{1}+\frac{\mathbf{1}}{\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)}\right)}\right)$$

The value of **M_G** in the preceding equation is not the corrected value of **M_G**.

A numerical application (see below) has shown that **d** must be very close to **Rs** (in higher value), so that equation **(26)** is respected and therefore **v₄** will tend towards 0 when **d** will tend towards **Rs** but **v₄** will not be equal to 0 since we cannot reach **Rs** (we are in the case where **d** is always greater than **Rs**: see above). The value 0 is therefore a limit value for **v₄**, when we push our reasoning to the limit.

I have added the following coefficient to the equation on the reduction of the time **t** at the level of a moving mass **m**: $\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)$

This coefficient has no consequence when the mass **m** (a spacecraft for example) is far from the external gravity **M_G** to **m** (**M_G** being a "black-hole" like Sagittarius A for example).

In the numerical application below, I have calculated that if **d** = 752,56 **. Rs** (a limit for excel), the coefficient $\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)$ would be equal to 0,9999982 and so very close to **1**.
(indeed, the coefficient $\frac{\mathbf{1}}{\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)}$ for the value of **d** equal to 752,56**. Rs** is equal to 1,0000018 in the numerical application).

A distance **d** = 752,56 **. Rs**, represents $6{,}2.10^{-4}$ light-years and the distance between the "black-hole" Sagittarius A and our Earth is 25 640 light-years. And so a distance **d** = 752,56 **. Rs**, represents only $2{,}4.10^{-6}$ % of the travel Earth to Sagittarius A.

This calculation is showing that for **d** = 752,56 . **Rs**, the spacecraft would be very close to Sagittarius A, which would be the external gravity **M_G** to the moving mass **m** (the spacecraft). **m** is thus very close to **M_G**, for **d =** 752,56 . **Rs**, and yet the coefficient $\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)$ is very close to **1** (equal to 0,9999982): thus this coefficient does not change anything to the equation on the time **t** defined before (without this coefficient), when **m** is not very very close to **M_G**.

And yet there is a very big difference which shows me that my equation on the time t defined with the coefficient $\left(\mathbf{1}-\frac{Rs^2}{d^2}\right)$ is better than the equation without it.

Let me explain this point which is very important to me:

Without the coefficient, the more the distance between a spacecraft of mass **m** approached an external Gravity **M_G** (a "black-hole" for example), the more **v₀** increased and also the more **v₁** increased, until becoming very close to **c** when **M_G** is very high and **d** is very small (**d** being the distance between **m** and **M_G**).

As the time **t** can only start to become negative when the speed **v** of the mass **m** is greater than **v₁**, it was necessary that **v** be close to **c** when **m** approached very close to **M_G**.

And so, the external gravity $\mathbf{M_G}$ to the moving mass **m** ***did not seem to help for the transition to a negative time*** **t**, even when approaching $\mathbf{M_G}$.

Indeed, the more **m** got closer to $\mathbf{M_G}$, the more **m** had to go fast! And that didn't make sense to me. But with my equation on the time **t**, at the level of **m**, presented with the addition of the coefficient $\left(\mathbf{1-\frac{Rs^2}{d^2}}\right)$, ***this point has changed!***

Indeed, with the addition of this term, I have shown (see above) that when **d** decreases and approaches **Rs** by greater value, $\mathbf{v_4}$ tends towards **0**. And so, the more **m** approaches an external gravity $\mathbf{M_G}$, the more the minimum speed from which the time **t** can start to become negative (which is $\mathbf{v_4}$) decreases (until it reaches **0**, as I have shown above). And so the external gravity $\mathbf{M_G}$ helps for the passage in a negative time **t**, at the level of **m**, when **m** approaches $\mathbf{M_G}$!

The logic is thus respected thanks to the addition of the term $\left(\mathbf{1-\frac{Rs^2}{d^2}}\right)$, to the equation on the time **t** at the level of a moving mass **m** close to $\mathbf{M_G}$.

In other words the external gravity M_G to a moving mass m has less and less a need for the speed v of m to allow the conditions so that the mass m can pass into the "space-time" where the time t is negative! and at the limit, ***the gravity M_G alone*** would allow the passage of the mass **m** to a negative time **t**: indeed, $\mathbf{v_4}$ would be equal to **0** when **d** would be close to **Rs** (by higher value). We could ***summarize*** the previous points as follows:

A moving mass **m** (a spacecraft for example) could pass into the "space-time" where the time **t** would be negative ***only if there is an external gravity*** $\mathbf{M_G}$ to the mass **m**: and this gravity $\mathbf{M_G}$ must be close enough to **m**. And there is also a condition of minimum speed $\mathbf{v_4}$ for **m** to allow the passage of **m** to a negative time **t**: ***this is the cumulative effect*** of the external gravity $\mathbf{M_G}$ to **m** and the speed **v** of **m**.

A high speed of the moving mass **m** (close to the speed of light, **c**), ***without an external gravity to*** **m**, would ***not*** be enough for **m** to pass into a negative time **t**!

And if **m** is very close to $\mathbf{M_G}$ (low value for **d**), the minimum speed condition $\mathbf{v_4}$ no longer exists: in other words, even with a zero speed $\mathbf{v_4}$ (***but that would be at the limit***, when **d** tends towards **Rs** by higher value), **m** could pass into a negative time **t**. It is the external gravity $\mathbf{M_G}$ to **m** that allows this.

I would like to come back to the coefficient $\boldsymbol{\gamma}$ which has a lot of influence in the theory of General Relativity.

In the theory of General Relativity $\boldsymbol{\gamma}$ is defined as the following quantity:

$$\boldsymbol{\gamma} = \frac{\mathbf{1}}{\sqrt{\left(\mathbf{1-\frac{v^2}{c^2}}\right)}} = \boldsymbol{\gamma_1}$$

I will call this coefficient $\boldsymbol{\gamma_1}$

When there is no external Gravity $\mathbf{M_G}$ to a mass **m** moving at a speed **v**, when **v** tends towards **c**, the coefficient $\boldsymbol{\gamma_1}$ tends towards infinity. And this makes it possible to freeze the time **t** at the level of the mass **m** (a spacecraft for example): indeed, **t** tends towards 0, under these conditions. When there is an external Gravity $\mathbf{M_G}$ to the moving mass **m**, I have introduced the theoretical speed before.

The theoretical speed is in fact the real speed seen from inside the spacecraft of mass **m**, ***corresponding to the reduction of the time*** **t** at the level of the moving spacecraft moving at a speed **v**.

The theoretical speed is equal to $\boldsymbol{v\,.\,\gamma^2}$

The measured speed **v** of the spacecraft of mass **m** relative to our Earth cannot exceed the speed of light, **c**.

On the other hand, ***the theoretical speed*** may exceed **c**.

In this case, when ***the measured speed*** is equal to **v**, ***the theoretical speed*** is equal to $\boldsymbol{v\,.\,\gamma^2}$

And so, when there is an external gravity **MG** to the moving mass **m**, I have introduced a new coefficient $\boldsymbol{\gamma}$. This coefficient $\boldsymbol{\gamma}$ would be the following coefficient $\boldsymbol{\gamma_2}$:

$$\boldsymbol{\gamma_2} = \frac{1}{\sqrt{\left(1 - \frac{v^2}{(c.\gamma_1{}^2)^2}\right)}}$$

with $$\boldsymbol{\gamma_1} = \frac{1}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

We can notice that when **v** tends toward **c**, $\boldsymbol{\gamma_1}$ tends to infinity, and therefore **t** tends to **0**. And also $\boldsymbol{\gamma_2}$ will tend to **1**, since $\boldsymbol{\gamma_1}$ will tend to infinity. And in this case, when there is an external gravity $\mathbf{M_G}$ to the moving mass **m**, since $\boldsymbol{\gamma_2}$ will tend towards **1** when **v** tends towards **c**, it is no longer the coefficient $\boldsymbol{\gamma_2}$ which makes it possible to freeze the time **t** into the spacecraft of mass **m**, but this is the effect of the external gravity $\mathbf{M_G}$.

$\boldsymbol{\gamma_1}$ ***becomes*** $\boldsymbol{\gamma_2}$ when there is an external gravity $\mathbf{M_G}$ to **m**.

On the other hand, there is a need to have a high speed to be close to **t** = 0, when you also want to be into the "space-time" where the time **t** is negative.

Indeed, if the spacecraft of mass **m** has a speed **v** close to $\mathbf{v_4}$ the time **t** modified by my equation would be close to **- t** and the time would not be frozen as it is when **t** tends towards **0**. It is necessary to be close to $\mathbf{v_0}$ for this, when there is an external gravity $\mathbf{M_G}$.

And by staying at $\mathbf{v} < \mathbf{v_0}$, we would stay at a negative time **t**!

If $\mathbf{M_G}$ is very high, $\mathbf{v_0}$ would be close to **c**.

But, if we are far from the center of gravity of $\mathbf{M_G}$, the corrected $\mathbf{M_G}$ value would be low so $\mathbf{v_0}$ will be reduced and if we stay at $\mathbf{v} < \mathbf{v_0}$, but very close to $\mathbf{v_0}$ the time **t** will tend towards **0** and therefore we will also freeze the time **t** inside the spacecraft.

In summary, when a mass **m** is moving at a negative time **t**, in the presence of gravity $\mathbf{M_G}$ external to the moving mass **m** (**m** being a spacecraft for example), to freeze the time **t** inside the spacecraft (and thus for having **t** close to **0**, by negative value), the spacecraft ***will have to adjust its speed*** **v** to the speed $\mathbf{v_0}$ ***which depends on the distance*** **d** between **m** and the center of gravity of the external gravity $\mathbf{M_G}$ (a “black-hole” for example).

My Theory explains that it is the passage of the mass **m** (a spacecraft for example) to a negative time **t**, during a part of the travel, that would allow people to be able to make a far-away travel into Space, at high speed, and to be able to find unaged people on our Earth when they return, such as people who have traveled into the spacecraft.

This is not possible with current physics: the people who remained on Earth would have aged much more than those who traveled into the spacecraft moving at high speed (close to **c**). My theory could explain also some other points concerning physics such as the following points: these points are not the main objective of this document where I want to present my Theory but I just want to summarize the ideas because I think it is interesting!

The first point is linked to the reconciliation of the General Relativity and the Theory of Quantum Mechanics: Refs. [18] [19].

The main characteristic of the General Relativity Theory is often described by the following sentence: "gravitation is a deformation of space-time".

The main characteristic of the Theory of Quantum Mechanics is often described by the following sentence: "It is impossible to know simultaneously the speed and the position of a quantum particle". For the characteristic of the Theory of General Relativity, I retain the 2 words: ***gravity*** (coming from the term gravitation) and ***time*** (coming from the term "space-time"). For the characteristic of the Theory of Quantum Mechanics, I retain the 2 words: ***speed*** and ***position***. The position is linked to a distance and the speed is a distance traveled during a given time. And so, position and speed are linked by the ***time***. The common point of the 2 theories thus seems to be the ***time* t**, which is a parameter which is found in the two characterizations of the 2 theories. My Theory can explain how the time parameter **t** could bring together the 2 following theories which are the General Relativity and Quantum Mechanics.

The Theory of General Relativity is interested in the infinitely large and is opposed to the Theory of Quantum Mechanics which is interested in the infinitely small. But, at the origin of the universe the 2 notions of infinitely small and infinitely large come together and the 2 theories must therefore come together. The complement that I propose in order to modify the theory of General Relativity concerns the time **t**, at the level of the mass **m** in motion.

The main modification, for the theory of Quantum Mechanics, concerns in fact the replacement of the time parameter, **t**, by ***the same equation*** that I have proposed for the theory of General Relativity:

$$\boldsymbol{t \rightarrow t.\left(\frac{1}{\gamma^2}\right).\left(1-\frac{{M_G}^2}{(m.\gamma)^2}\right).(1-\frac{Rs^2}{d^2})}$$

The second point is linked to dark Matter and dark Energy: Refs. [20] [21].

For the first point my Theory could explain how the time seems to be the link to bring together the two theories of theoretical physics which are the theory of General Relativity and the theory of Quantum Mechanics. Physicists today believe that in order to achieve a complete unification of the two theories we must understand and explain in a scientific way what the concepts of dark Matter and dark Energy are: points 1 and 2 are linked in fact: Refs. [22] [23].

These two concepts (dark Matter and dark Energy) are used today, by current physicists, to explain why the Universe is expanding and why this expansion is accelerating: Refs. [24] [25] [26] [27] [28] [29] [30] [31] [32]. My Theory could explain what could be dark Matter and dark Energy: this is also linked to the possibility for Matter to go into a “space-time” where the time **t** is negative, the same point that allow me to explain the reconciliation of the General Relativity and the Theory of Quantum Mechanics. And to be able to go to a negative time **t**, I have defined the new value of the time **t** at the level of the moving mass **m** (a spacecraft for example): see the equation above.

These modifications on the parameter **t** allowed me to successfully quantify the effect of gravity in the sense that I can calculate the effect of external gravity on the internal time **t** of a moving object (like a spacecraft for example). I found a relationship between **t**, **v**, **m** and $\mathbf{M_G}$.

I thus specified the influence of an external gravity to a moving mass **m**, represented by its mass $\mathbf{M_G}$, on the relativistic parameters like time, mass, distances, the total energy of a moving mass **m**, …: Refs. [33] [34] [35] [36].

I have also quantified the fact that the effect of the gravity $\mathbf{M_G}$ is local and I thus defined the maximum distance where gravity has no more effect and I have also defined an equation to quantify the relationship between gravity and the distance **d** between the masses **m** and $\mathbf{M_G}$.

3. CONCLUSIONS

I have succeeded in proving that the time **t** can become negative and I have defined the conditions in the universe to make this possible, in particular the conditions on the speed of the moving mass **m** (a spacecraft for example) and on the presence of an external gravity to the moving mass **m**, which is represented by its mass $\mathbf{M_G}$.

I have also succeeded in quantifying the local effect of the external gravity to the moving mass **m** represented by the mass $\mathbf{M_G}$.

This possibility of being able to change the "space-time" for a moving mass **m**, under certain conditions, makes it possible to bring together the 2 theories which are the theory of General Relativity and the theory of Quantum Mechanics and could also explain what could be dark Matter and dark Energy. And mainly, my Theory explains that it is the passage of the mass **m** (a spacecraft for example) to a negative time **t**, during a part of the travel, ***that would allow people to be able to make a far-away travel into Space***, at high speed, and to be able to find unaged people on our Earth when they return, such as people who have traveled into the spacecraft. And this fantastic travel could be theoretically feasible, thanks to my Theory.

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