# PROPOSED HYPOTHESIS OF A PROCESS LINKED TO GRAVITY AFFECTING MASS-ENERGY

NOVEMBER, 15
2017

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## ABSTRACT

**The proposal assumes that the distortion of space-time due to relative velocity (Special Relativity), and the distortion of space-time produced by gravitational fields (General Relativity) are linked to changes of state that affect to mass-energy.**

The hypothesis proposes the existence of a process linked to gravity, this phenomenon would affect mass-energy. It would be required to add an additional condition (being a more restrictive scenario) keeping the field equations that define space-time curvature, but by adding the condition linked to the proposed phenomenon, the trajectory that would follow mass-energy in that curved space-time, changes with respect to the established by the officially accepted model. The effect is negligible if the distortion of space-time caused by a gravitational field does not have a significant value. The proposed hypothesis allows to mathematically calculate the discrepancy that would exist with respect to the current model. In case of being correct, the proposal would have important implications in diverse areas of science and its effect would be determinant in the study of black holes or questions related to Cosmology.

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## BACKGROUND, PROBLEMS JUSTIFYING NEW CONTRIBUTIONS

The mathematical model of General Relativity has allowed to carry out accurate predictions and calculations, however there are certain issues about gravity that have not been resolved satisfactorily and lead to the conclusion that there is something wrong or that is not being Interpreted properly, or there is something else that is not being taken into account. Below are briefly described some of the problems concerning gravity:

- Theoretically the mathematical model of relativity predicts or gives rise to singularities at certain circumstances. The rules established by quantum mechanics require an increasing energy in order to increase the degree of confinement of a particle. However, the model defined by relativity, there is not such an impediment to that circumstance, quite the contrary, what the theory seems to indicate is that under certain conditions bodies would inexorably follow a path to singularity. Other forces such as electromagnetism where initially there were divergences at certain conditions, have been renormalized thus avoiding such divergences, which has not yet been possible with gravity. These have been some of the reasons for defining alternative models such as String Theory.

- Stephen Hawking's contributions to black-holes radiation that lead to the paradox of information loss for a body that crosses the horizon of events was a problem without a clear resolution, until the middle of the 1990s, when the Holographic Principle was proposed, which currently has the consensus and majority support of the scientific community.

- At 2012 arose a new conflict presented by Ahmed Almheiri, Donald Marolf, Joseph Polchinski and James Sully. Taking into account the officially accepted model, including the Holographic Principle, a particle would have at the same time two quantum entanglements, while being entangle with a particle that crosses the event horizon and at the same time with the duplicate information linked to that event horizon. The fact of a double quantum entanglement contravenes the quantum rules, this has generated a new conflict that has in some way divided the scientific community and still does not have a clear resolution. The proposal or solution presented by Ahmed Almheiri, Donald Marolf, Joseph Polchinski and James Sully. It included the existence of a Firewall at the event horizon of a black hole, whereby an observer on reaching the event horizon or in the vicinity of it would encounter quantum energy that would prevent the passage through the event horizon. However that proposal is yet a controversial one, critics argumenting that energy firewall seems an "Ad Hoc" solution and that firewall seems to come from nothing because only Would appear in the vicinity of the black hole.

If the proposed hypothesis at this paper is a correct one, it would have important implications and should be taken into account in relation to the phenomena described above.

## DISCUSSION

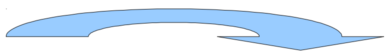
The proposal assumes that the distortion of space-time due to relative velocity (Special Relativity), and the distortion of space-time that is produced by gravitational fields (General Relativity) are linked to changes of state that affect to mass-enegy. Mass-energy would be affected, changing its state, generically denoted "State A" and "State B". The present paper establishes as reference "State A" while "State B" is taken as referenced to A (This will be the criterion followed at the paper if it is not said otherwise). Concerning relative velocity, these states correspond to relative velocities between bodies. Taking as reference "State A", if a body moves at velocity v relative to another body, we would say that the reference body is in "State A", while the other body that moves at velocity v relative to A, is in "State B". Considering General Relativity, the distortion of spacetime generated by the gravitational field will also be associated with different states, if we take as reference the state for which the gravitational field effect is zero, then "State A" would be associated with time dt, while the "State B" would be in a generic way, characterized by the proper time dτ, which would depend on the space-time distortion. That is to say, concerning relative velocity, "State B" would be generically characterized by v, meanwhile concerning gravitational fields "State B" would be generically characterized by proper time τ.

Note: Concerning General Relativity the proposed hypothesis adds an additional condition to the system of ten non-linear partial differencial equations corresponding to the Standard Model of Relativity. As example (at this paper) of General Relativity scenario with the presence of a gravitational field, will be considered the Schwarzschild metric for the vacuum solution of the field outside the homogeneus sphere, uncharged, non rotating.

**Quantum mechanics have linked processes where particles interact, passing from an "α state" to a "β state", with a probability associated to that process. The proposal introduces a process linked to gravity, where mass-energy would be affected changing its state from A to B.**

The hypothesis proposed at this paper assumes that there is a contribution of energy between both states. That would be already taken into account by the Standard Model of Relativity for Special Relativity ($E_T=E_K$), but not for General Relativity with the presence of a gravitational field.

$E_T$

State A $E_A$  State B $E_B$ with $E_B = E_A + E_T$

$E_A = mc^2$ $E_T = (\mathbf{1/p})mc^2 - mc^2$ $E_B = (\mathbf{1/p})mc^2$

Where p is a factor that relates the referenced state (State B) to the reference state (State A).

- Concerning Special Relativity: $p = \mathbf{1/Υ}$ **Being Υ The Lorentz factor**

Then $E_T = Υmc^2 - mc^2$ kinetic energy.

$E_B = Υmc^2$ This value includes the factor $p = \mathbf{1/Υ}$, So that a relation between the reference (State A) and the state referenced to it (State B) is established, so that the value $E_B = Υmc^2$ implies that "State A" is the reference, if we take as reference "State B" and we consider it as reference to itself (for example an observer situated at "State B" observing something which is at "State B" as well) then velocity 0, $\mathbf{Υ=1}$ and the factor p=1, so $E_B = mc^2$ because the observer is at reference (State B) and the object observed is at "State B" as well and $E_T$ between them has a null value.

This case (Special Relativity) from the practical point of view, there would be no changes with respect to the current official model. The energy required to pass from one state to another would be the kinetic energy, and mass-energy at "State B" would have a value increased by the factor **Υ** with respect to "State A" and we would say that "State B" has reference at A or is relative to A. Thus this approach would be compatible with the model established by Special Relativity.

- Concerning General Relativity: "State A" is linked to dt and "State B" linked to dτ, hypothetically with no relative velocity between both states, the relation between times is given by: p=dτ/dt denoting **p= 1/ϕ ;** **Being** **ϕ= dt/dτ**

If the reference is "State B" and the referenced state is also "State B": p= dτ/dτ =1

If the reference is "State B", and "State A" is referenced to it, then p= dt/ dτ

(Both observers, one of them situated at "State A" the other at "State B" would agree on time linked to A is t, while time linked to the "State B" would be τ. Concerning relativistic velocity, both observers would take as value p for the other state as p= **1/ϒ**)

If the reference is a state associated with $d\tau_1$; and another state, with $d\tau_2$ is referenced to it, then p= $d\tau_2/ d\tau_1$

Considering "State A" as reference and B with reference at A:

$E_A= mc^2$ $E_T= (dt/d\tau)mc^2-mc^2$ $E_B= (dt/d\tau)mc^2$

**Considering an observer in "State A", and an object in State A as well, with associated energy $E_A=mc^2$. If that object passes to "State B", while the observer is sit in "State A", the value of the energy associated to that object relative to the observer fixed in "State A", changes to $E_B= (dt/d\tau)mc^2$, and the value of the energy required for that proccess to take place is $E_T= (dt/d\tau)mc^2-mc^2$**

The value of the energy $E_B$ is the value at B with reference the "State A", indicating that energy at B is with respect to A, already implies that relation, although for this concept to be explicitly represented would be required a notation of the type:

$\mathbf{E^A_A= mc^2}$ $\mathbf{E^A_B= (dt/d\tau)mc^2}$

Upper index A indicates that the reference is "State A", so the value of the energy at A with reference A has value $mc^2$ while the value at B with reference A would have value: $(dt/d\tau)mc^2$

If we consider the value at B with reference B then $E^B_B= mc^2$

and the value at A with reference B would be $E^B_A= (d\tau/dt)mc^2$

The energy between two states B and C taking as reference A (with associated time t. at A):

$$E^A_C - E^A_B = \int_{dt/d\tau_B}^{dt/d\tau_C} mc^2 d\phi$$ **Energy linked to the proposed process**

$\tau_B$ proper time at B; $\tau_C$ proper time at C

When the states B and C correspond to A and B respectively, and denoting generically $\tau_B=\tau$, then: $\mathbf{E^A_B - E^A_A = (dt/d\tau)mc^2-mc^2}$

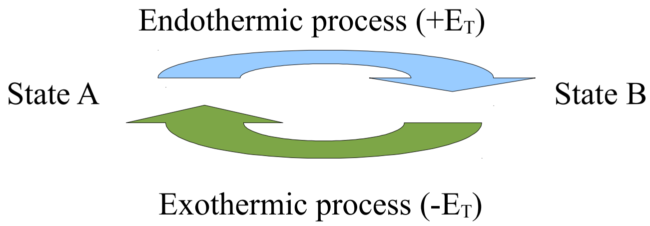
The value at B for an observer at State A $E^A_B= (mc^2)+((dt/d\tau)mc^2-mc^2) = dt/d\tau\ mc^2$

The value at A for an observer at State B $E^B_A= (mc^2)+((d\tau/dt)mc^2-mc^2) = d\tau/dt\ mc^2$

Because concerning General Relativity, both observers do agree on the values of dτ and dt, so that the parameters dτ and dt have inverse position for an observer at B.

If the observer is fixed at "State B", then the object at "State A" has associated energy $E^B_A= (d\tau/dt)mc^2$ (meanwhile, for the observer fixed at "State A" the associated energy of the object is $E^A_A= mc^2$). now for the observer fixed at "State B", when the object changes from "State A" to "State B", its associated energy would change to $E^B_B= mc^2$ being $E^B_T= mc^2-(d\tau/dt)mc^2$ the energy required (taking as reference B) for that process to take place. Considering the reverse proccess, if the object with associated energy $E^B_B= mc^2$ changes to "State A" ($E^B_A= (d\tau/dt)mc^2$), then instead of requiring energy, would be an exothermic process, having $((d\tau/dt)mc^2-mc^2)$ a negative value.

Concerning the process linked to General Relativity:




**If the object changes its state from “State A” to “State B”, the process is an endothermic one, requiring energy, the reverse proccess, changing from “State B” to “State A” is an exothermic one, releasing energy**

**The proposed process, as defined, implies an additional effect to the currently accepted model, caused by the gravitational waves. The endothermic process from A to B would be at the expense of velocity corresponding to the Kinetic Energy, while the exothermic process from B to A would increase velocities of bodies for an expansive scenario.**

**Elements involved in the proposed process:**

**- Gravitational waves, which will interact with mass-energy.**

**- Mass-energy with a starting reference value $mc^2$. (value of mass-energy at “State A” with reference the state linked to dt, $E^A_A = mc^2$ ).**

**- Potential Energy, part of it will be absorbed by the process and the rest would be transformed into the velocity term of the kinetic energy. Or equivalently, without the potential energy concept, the process from “State A” to “State B” requires energy (it is an endothermic process), that energy will be at the expense of the velocity.**

**Result (state B):**

**- Space-time distortion at the space-time position linked to the “State B” (as defined by Einstein field equations, plus the additional effect of the energy required by the process).**

**- Mass-energy with value $E^A_B = (dt/d\tau)mc^2$**

**- Kinetic energy that will have the altered mass-energy in the new state. Noticing that mass-energy of the body will depend on the reference taken, and the velocity term of that kinetic energy is modified, because the process will take place at the expense of the velocity. (value linked to $\Upsilon_{mod}$ ($\Upsilon_{mod} = 1/\sqrt{(1- v^2_{mod}/c^2)}$), while $\Upsilon = 1/\sqrt{(1- v^2/c^2)}$ would be the value corresponding to the theoretical Kinetic energy without taking into account the proposed process.**

**In order to calculate $\Upsilon_{mod}$, it is neccesary to take into account the combination of the energy required by the process and the gravitational field as defined by the E.F.E.**

**It is noteworthy that the process as described is similar to the phenomenon corresponding to the photoelectric effect (each with its own characteristics):**

**Photons interact with electrons, part of the energy is absorbed by the process and the rest goes to kinetic energy.**

**Hypothesis: Gravitational waves would interact with mass-energy, part of the energy is absorbed by the process, the rest goes to the velocity term of the kinetic energy.**

## Special Relativity scenario

Considering a hypothetical pure Special Relativity scenario, if a body has no velocity relative to the reference, we might say that the body is in “State A”, if it is applied kinetic energy ($\Upsilon mc^2$ $-mc^2$) to the body, then the state of the body changes (physical properties mass-energy and space-time do change) the body is now in “State B” with mass-energy $\Upsilon mc^2$ relative to the “State A” (the previous reference) and with space-time distortion relative to the “State A”.

Minkowski space $ds^2 = c^2dt^2 - dx^2 - dy^2 - dz^2$

Kinetic energy ($\Upsilon mc^2 - mc^2$)

**“STATE A”**

Physical properties of an object in “State A”:

- $E=mc^2$
- Space-time: L, t

**“STATE B” (velocity v relative to A)**

Physical properties, relative to A, of an object in “State B”:

$E' = \Upsilon mc^2$ **$\Upsilon$ the Lorentz factor**

$$\Upsilon = 1/\sqrt{(1 - v^2/c^2)}$$

Space-time: $L' = L/\Upsilon$, $t' = t^* \Upsilon$

“Considering a hypothetical pure Special Relativity scenario (with negligible gravitational fields), now taking into account the proposed hypothesis, the result would be the same: we would say that mass-energy ($mc^2$) of the body would be affected by the Kinetic energy ($\Upsilon mc^2$ $-mc^2$), as result would be obtained: Mass-Energy (**α-state**)(quantity $mc^2$ ) plus Mass-Energy (**β-state**) (quantity $\Upsilon mc^2$ $-mc^2$) with total quantity of mass-energy ($\Upsilon$ $mc^2$) and space-time distortion as defined by relativity.”

The espression “space-time distortion as defined by relativity.” means that $L' = L/\Upsilon$ and $t' = t^*\Upsilon$

There is an interrelation between the physical properties: mass-energy and space-time

(1) $E' = \Upsilon mc^2 \longleftrightarrow$ Space-time

Mass-energy is affected, being altered in accordance with what is modified the space-time, or inversely we could say as well that space-time distortion is in accordance with the alteration of mass-energy.

Knowing that $L' = L/\Upsilon$ and using the defined concepts:

(L-L´)*(total energy) = (L-L´)*(mass-energy(α-state)+mass-energy(β-state)) = (L-L/ϒ) *(ϒ $mc^2$) =L(ϒ $mc^2$-$mc^2$)=L*(mass-energy (β-state))

**then the proportion: (L-L´)/L = (mass-energy(β-state)) / (total energy)**

While (L´)*(total energy)= L($mc^2$ ) =L (mass-energy (α-state))

**then** ϒ = L/ L´=(total energy)/(mass-energy (α-state))

That is $E' = \Upsilon mc^2$ = (L/ L´) * (mass-energy (α-state))

From a practical point of view, considering a hypothetical pure Special Relativity scenario, the result is the same whether assuming the proposed process or the model corresponding to the Standard Model of Relativity. But when the gravitational fields effects are not negligible, then the proposed process establishes discrepancies with respect to the Standard Model of Relativity, that discrepancy is negligible if the graviational field is a weak one, but the discrepancy increases the stronger the graviational field.

**<u>General Relativity scenario</u>**

Standard Model of Relativity , without taking into account the proposed process:

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\Pi G}{c^4} T_{\mu\nu}$$

Einstein Field Equations corresponding to the Standard Model of Relativity.

Considering the Schwarzschild metric for the vacuum solution of a homogeneus sphere, uncharged, non rotating.

$$ds^2 = c^2 d\tau^2 = (1 - r_s/r)\ c^2 dt^2 - (1 - r_s/r)^{-1} dr^2 - r^2 (d\theta^2 + \sin^2\theta\, d\varphi^2)$$

**$\tau$: proper time** **t: time coordinate**

**r: Schwarzschild radial coordinate**

**$\theta$: colatitude** **$\varphi$: longitude**

**$r_S = 2GM/c^2$**

Energy

**"STATE A"**

Physical properties of Object in "State A" region of space-time where time is coordinate time t

**"STATE B"**

Physical properties of Object in "State B" region of space-time where time is proper time **$\tau$**

- $E=mc^2$

$E' = (dt/d\tau) mc^2$

Modified E.F. E.

- Space-time **(dt, dr, dθ, dφ)**

(E.F.E. With negligible Gravitational Field)

Space-time E.F. E.

(No negligible G.F.)

Previous Scheme, without including the terms in red (Energy; $E' = (dt/d\tau)mc^2$ ; Modified E.F. E. ) would correspond to the Standard Model of General Relativity.

Modified Einstein Field Equations means that the Stress Energy Tensor of the E.F.E. Should include the effect of the energy required by the process to take place, so it might be denoted as well modified Stress Energy tensor of the E.F.E.

The hypothesis proposes that the physical properties of an object will change according to the region of the gravitational field that it occupies, and there would be an interrelation between mass-energy and the curvature of space-time defined by the E.F.E. (that is how it is calculated the expression $(dt/d\tau)mc^2 - mc^2$)), in a similar manner as it was defined when considering the Special Relativity scenario with

(1) $E' = \Upsilon mc^2$ ⟷ Space-time.

Considering a gravitational field scenario, mass-energy of the object would depend on the E.F.E. Being $E' = (dt/d\tau)mc^2$ That process requires Energy to take place and the counterpart effect of that energy will be the corresponding of energy opposed to the free fall of the object, which has to be included in the E.F.E. So that instead of the E.F.E. Corresponding to the Standard Model of Relativity it is defined the Modified E.F. E. which are the same E.F.E. But taking into account that effect.

Gravitational waves will interact with mass-energy, that process requires energy (it is an endothermic process), will be at the expense of reducing the velocity term so that instead of v will be $v_{mod}$. That effect is the corresponding to energy opposed to the free fall so that the factors $(1 - r_s/r)c^2$ and $(1 - r_s/r)^{-1}$ linked to $dt^2$ and $dr^2$ will be modified giving as result $v_{mod}$ instead of v.

Mass-Energy $mc^2$ (**α-state) interaction with G.W.** + **Energy**→ Mass-Energy (**α-state**)(quantity $mc^2$ ) +Mass-Energy (**β-state**) (quantity $(dt/d\tau)mc^2 - mc^2$) = **total mass-energy** (quantity $(dt/d\tau)mc^2$). Taking as reference "State A"

**Energy** ($(dt/d\tau)mc^2 - mc^2$)

**The energy required implies that the process is an endothermic one, it takes place at the expense of taking energy from the physical system. We have:**

\+ **(**$(dt/d\tau)mc^2 - mc^2$**) energy required by the process and**

- **(**(dt/dτ)**mc² -mc²) the counterpart of the energy required by the process**

The counterpart of the energy required by the process **-** **(**(dt/dτ)**mc² -mc²) has a negative value and produces the effect corresponding to energy opposed to the free fall,** so that instead of **dr** and **dτ** (values corresponding to the Standard Model of Relativity) will be $\mathbf{dr_{mod}}$ and $\mathbf{d\tau_{mod}}$ values due to the effect of the energy required by the process.

Note: $\mathbf{dr_{mod}}$ and $\mathbf{d\tau_{mod}}$ **do represent that the factors** $(1 - r_s/r)c^2$ **and** $(1 - r_s/r)^{-1}$ linked to $dt^2$ and $dr^2$ are affected by the energy linked to the proposed process, giving as result $v_{mod}$ instead of v.

If the proposed process has an effect such that there is conservation of energy, then:

$$(\Upsilon_{mod}(dt/d\tau)mc^2 - (dt/d\tau)mc^2) = (\Upsilon mc^2 - mc^2)$$

obtaining $\Upsilon_{mod} = 1 + \Upsilon * d\tau/dt - d\tau/dt$

being $\Upsilon_{mod} = 1/\sqrt{(1 - v^2_{mod}/c^2)}$

**Considering the Special Relativity scenario, There is a contribution of energy (kinetic energy) between the states, an interrelation between space-time distortion and the alteration of mass-energy, and the value of mass-energy depends on the reference taken.**

**Considering the presence of gravitational fields, it is proposed a process that takes place at the expense of the energy from the physical system, there is as well an interrelation between space-time distortion and the alteration of mass-energy, and the value of mass-energy depends on the reference taken.**

$$E^A_C - E^A_B = \int_{dt/d\tau_B}^{dt/d\tau_C} mc^2 d\phi$$

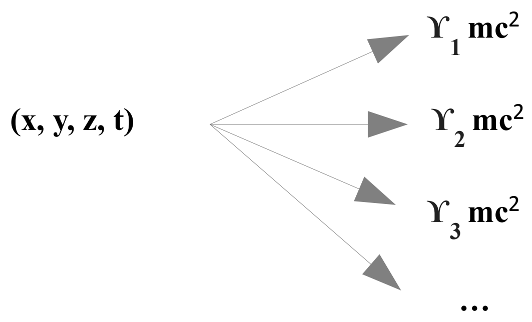
**Energy linked to the proposed process**

**p= 1/ϕ Being ϕ= dt/dτ (t coordinate time; τ proper time)**

$\tau_B$ **proper time at B;** $\tau_C$ **proper time at C**

**When the states B and C correspond to A and B respectively, and denoting generically** $\tau_B = \tau$, **then:** $E^A_B - E^A_A = (dt/d\tau)mc^2 - mc^2$

**Concerning Relativity, it is not enough the assignation of four space-time coordinates to define the properties of the physical system. For instance, considering the Special Relativity scenario.**




**Mass-energy of a body located in (x, y, z, t) depends on the reference taken.**
**$\Upsilon$ relates the "State B" (referenced state) of the body situated at (x, y, z, t) with the "State A" (the reference).**

**In order to establish the physical properties of a body, it is required to define x, y, z, t and $\Upsilon$.**

**The present paper suggests that there is not just three space-like dimensions and one time-like dimension, but four spatial dimensions and one time dimension x, y, z, w, t where the space-time framework fulfills:**

$$ds^2=c^2d\tau^2=c^2dt^2-dx^2-dy^2-dz^2=dw^2-dx^2-dy^2-dz^2$$

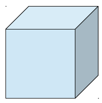
- There is a dependent relation between them as established by the expression $c^2d\tau^2=dw^2-dx^2-dy^2-dz^2$ linking the time-like coordinate to the space-like coordinates.

- The distortion of the space-like coordinate w is the same than the distortion of the time-like coordinate t. That is what is representing $c^2dt^2-dx^2-dy^2-dz^2=dw^2-dx^2-dy^2-dz^2$

- There is an interrelation between mass-energy and space-time.

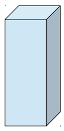
In order to explain those concepts it is used the following simplified schemes:

A) Supposing a three dimension euclidean space.



Isotropic properties, with a uniform distribution of mass-energy within a region of that euclidean 3d space.

B) Now supposing another scenario where there is distortion of space.



Contraction of one of the coordinates at the expense of dilation of another coordinate.

The value of the mass-energy distributed on scenario A) and B) is the same, but changes the configuration, it is further distributed configuring the dilated dimension at the expense of the contracted dimension.

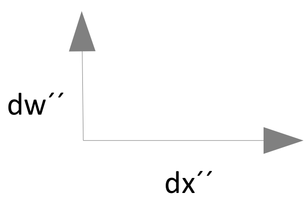
Now considering the Minkowski space-time $\mathbf{ds^2=c^2d\tau^2=c^2dt^2-dx^2-dy^2-dz^2}$ for the Special Relativity scenario and the Riemannian geometry corresponding to a curved space-time framework due to the presence of mass-energy, for instance the Schwarzschild metric for the vacuum solution of a homogeneus sphere, uncharged, non rotating.

The proposal implies that the distortion of the time coordinate is the same than the distortion of w coordinate.

Representing just the space-like distorted coordinate and the coordinate w:

Special Relativity scenario, Minkowski space-time, velocity on x direction $\mathbf{dw^2-dx^2-dy^2-dz^2}$

(1) "State A" (2) "State B"

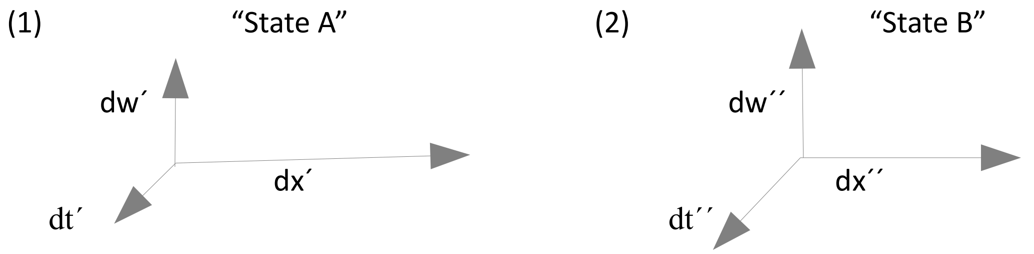




The scheme represents that there is space distortion producing contraction on the space-like distorted coordinate and dilation of the w coordinate. Considering those four space-like dimensions (without taking into account the time coordinate) the value of mass-energy is the same at (1) and (2), just changes the distribution of mass-energy.

The value of mass-energy (considering those four space-like dimensions) is $mc^2$ in both cases (1) and (2), but changes de distribution of that energy, increasing the quantity of energy linked to the w coordinate in case (2), that situation would correspond with the quantity of mass-energy (β-state) in "State B".

The proposal implies that there is an interrelation between the quantity of mass-energy that changes to mass-energy (β-state) and the distortion of space-time.

Time has to be taken into account, with distortion of time coordinate the same than distortion of w.




Taking into account now the effect due to the distortion of the time coordinate, the amount of mass-energy will be:

**$mc^2$** value of mass-energy corresponding to "State A"

**$\Upsilon mc^2$** value of mass-energy corresponding to "State B" relative to "State A"

Similarly to the Special Relativity Scenario, will be the General Relativity Scenario with the presence of gravitational fields.

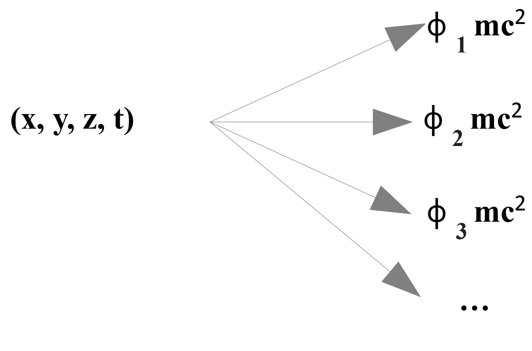
**$mc^2$** value of mass-energy corresponding to "State A" being space-time region with negligible gravitational field effect where time is coordinate time t.

**$(dt/d\tau)mc^2$** value of mass-energy corresponding to "State B" being **τ** proper time in "State B"

The energy required to change from one physical state to another is **$(dt/d\tau)mc^2-mc^2$**

Denoting $\phi$=**$(dt/d\tau)$**

The hypothesis proposed implies that considering gravitational fields scenarios, it is not enough the coordinates (x, y, z, t) to define the properties of the physical system.




The value of mass-energy will depend on the reference taken.

It is needed to define (x, y, z, t) plus $\phi$, required to characterized a value with the coordinates (w, x, y, z, t).

## Probabilistic approach

It is defined the following Physical System: Special Relativity Scenario.

A radioactive element that has a hypothetical uniform distribution of mass, dm/(dxdydz) homogeneus density throught a region of space-time between (0, 0, 0) and (x, y, z).

The decay of that radioactive element over a period of time t (0 starting point of the expeeriment and t moment of the measurement, with dt time element for the time coordinate), follows the Poisson´s distribution: Ƥ(λ,x) where λ represents the frequency of occurrence of a given event (this case, the decay of the radioactive element) and x would represent the amount or number of events in an interval.

The Poisson distribution is related to another discrete probability distribution, the binomial distribution. Considering n Bernoulli statistical trials, each of them with probability p · P that a certain event takes place, fulfilling the following conditions:

$0<p\cdot P \ll 1$ very small probability of success.

n↑↑ very high number of statistical trials.

$n\cdot p\cdot P = \lambda$ The product of the number of statistical events multiplied by the probability associated with each of the trials is equal to the frequency of occurrence λ

If these three conditions are met, both distributions give very similar values, at the limit when $n\to\infty$ are equivalent ones.

This leads to the proposal that at the Physical System is taking place the occurrence of statistical events each one with probability p · P of being successful. That is to say, during the period of time dt, it takes place n statistical events, P representing the probability of an event taking place at a particular trial, this case corresponds to the decay of the radioactive element, meanwhile p is a factor (which depends on distortion of space-time) that modifies the value of P. The value of p will be linked to the alteration of mass-energy, if all the mass-energy corresponds to mass-energy **(α-state)** then the value of p is 1 (that is the case for a reference frame with no velocity), when there is velocity, the kinetic energy do alter the state of mass-energy. The higher the quantity of mass-energy that is affected changing to **(β-state),** the lower the value of p, the value of mass-energy corresponding to mass-energy **(α-state)** is p · P, while the corresponding to mass-energy **(β-state)** is q · P= (1-p)· P . Each of the n statistical events will have associated a value for mass-energy **(α-state)** and mass-energy **(β-state),** the quantity of mass-energy **(β-state)** is linked to the dilation of the w coordinate and the contraction of the coordinate corresponding to the direction of velocity.

p and n are dimensionless factors that depend on distortion of space-time, the product of both is a constant value. "State A" (1, n) "State B" (p, n´) with $1\cdot n = p\cdot n'$ then p=n/n´=t/t´

The value of p for the "State A" (no velocity) is 1, the value of p for the "State B" is linked to the quantity of mass-energy **(α-state)**, but increasing the number of statistical events to n´ instead of n, the physical system reaches the same total amount of mass-energy **(α-state)**

where $n\cdot 1\cdot P = \lambda = n'\cdot p\cdot P$

**"State A" "State B"**

The kinetic energy alters the amount of mass-energy (α-state), and that value is linked to the distortion of space-time. Considering scenarios with presence of gravitational fields, it is proposed that the curvature of space-time is linked to the alteration of mass-energy, so knowing the E.F.E. might be calculated the alteration of mass-energ and in turn the energy required for that alteration to take place, which is responsible of an additional distortion of space-time.

This way it is linked the curvature of space-time with the probability of events taking place.

## CONCLUSIONS

**Quantum mechanics is characterized by processes where particles interact, passing from an "α state" to a "β state".**

**Considering the phenomenon corresponding to the photoelectric effect :**

**Photons interact with electrons, part of the energy is absorbed by the process and the rest goes to kinetic energy.**

**The hypothesis at this paper proposes that the interaction between Gravitational waves and mass-energy requires a contribution of energy,**

**The proposal defines a process linked to gravity where mass-energy would be affected changing its state from A to B. Gravitational waves would interact with mass-energy, part of the energy is absorbed by the process and the rest goes to the velocity term of the kinetic energy.**

**Factor p (which depends on time distortion) relates "State B" to "State A"**

**The energies linked to Special Relativiy and General Relativity would follow a similar pattern:** $E_B = E_A + E_T$

$$E_A = mc^2 \qquad E_T = (1/p)mc^2 - mc^2 \qquad E_B = (1/p)mc^2$$

**Considering the process linked to gravitational fields, both observers do agree on the values of dt and dτ corresponding to "State A" and "State B" respectively.**

**The value of the energy at B with reference A:** $E^A{}_B = (dt/d\tau)mc^2$

**The value of the energy at A with reference B:** $E^B{}_A = (d\tau/dt)mc^2$

**The process linked to gravitational fields is endothermic from A to B and exothermic from B to A. the endothermic process would be at the expense of reducing velocity of the kinetic energy, meanwhile the reverse process would be an exothermic one, increasing the velocity of the body that passes from "State B" to "State A". Expansive scenarios would show velocities higher than expected.**

**A free fall body follows a trajectory in a curved space-time framework towards the source of the gravitational field. The trajectory is defined by applying the Euler-Lagrange equations to Einstein field equations. The effect proposed implies that the body would not follow the geodesic of a "free fall body" what we consider as a "free fall body" in fact would be forced by the effect proposed. The effect is negligible insofar the distortion of time does not reach a siginificant value. Considering the officially accepted model, nothing prevents from a free fall body reaching the horizon event and inevitably ending in a Singularity. The proposal forces the body out of that geodesic, the energy required to follow that geodesic at the event horizon would be infinite.**

**The proposal allows to mathematically calculate the discrepancy between both scenarios.**

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"Black Holes:Complementarity or Firewalls? doi: 10.1007/JHP02(2013)062