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# Time-Energy Heisenberg Principle Incertitude and Spacetime Curvature

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## Abstract

This paper gives a possible theoretical explanation for the gravity field creation from energy/matter object, and may also provides an explanation of how a wave function collapses. In our last paper "*Spacetime curvature, a potential result of the quantum mass/energy Information Entropy*" submitted to Foundation of Physics, We have defined that everything may be described by a time-dimensional signal-Information that travels certainly in time dimensions or in the *Time paths* but not necessarily in space. In each quantum field, thanks to the Heisenberg time-energy principle, virtual particles and antiparticles may exist in space during  $\Delta t$ . However, in presence of a massive object,  $\Delta t$  is transformed to a shorter  $\Delta t'$  but only for the virtual particles and not for the virtual antiparticles that their creation duration remains  $\Delta t$ . This duration time assymetry transformation is what we call the gravity effect. The  $\Delta t$  is a time duration where all the signal-Information coming from the neighboring locations may be added. It is the duration threshold of signals summation or the interference threshold duration capacity. If  $\Delta t$  is transformed to a quite shorter duration  $\Delta t'$  in the presence of a high energetic/massive object, then the summation or the interference of the signals will probably reduced or even vanish: a real particle is created from a virtual one with no interference effect and hence makes waves function collapse.

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## I. INTRODUCTION

We assume that the quantum vacuum space is a sea where potential particle-antiparticle couples may be created in their respective fields (see Quantum Field Theory QFT for example ([1],[2]...)). The question is: virtual particles and the virtual antiparticles are they created and inhibited at the same time? Thanks to the Heisenberg incertitude principle time-energy  $\Delta t \Delta E \geq \frac{\hbar}{2}$ , in each field during its respective time duration  $\Delta t$  equivalent to its  $\Delta E$  energy, virtual particles and antiparticles may appear and immediatly inhibite each other in spacetime dimensions at the same time if there is no other massive/energetic object around. This  $\Delta t$  is reduced to a quite shorter  $\Delta t'$  for the virtual particle next to a high massive/energetic object as seen in [3]. The virtual particle may have hence the possibility to exist as real particle during this shorter time  $\Delta t - \Delta t'$  thanks to the extra *energy/mass* wave function coming from the massive object. However the virtual antiparticle may not have enough time to exist as a virtual antiparticle in space dimensions before  $\Delta t'$ . It may need  $\Delta t - \Delta t'$  more time for the virtual antiparticle in its field to have the possibility to be a *real* antiparticle in space to inhibite the coupled virtual particle. So what happens between  $\Delta t'$  and  $\Delta t$  ?

- Between  $\Delta t'$  and  $\Delta t$  the transformed virtual particle to *real* particle at the location  $N_1$  has the possibility to travel in time paths in its signal-Information state (SI) and has a matter impact with its Lagrangian matter  $\mathbb{L}_m$  (see equation (7)) symmetrically everywhere to the neighboring points  $N_2$  ([3]). The potential recreated virtual particle has the ability to impact all the environment around in space and time as a real particle with a mass  $m$ . The gravity effect hence travels over space thanks to the time and space travel of the virtual particles. However if  $\Delta t - \Delta t'$  is smaller than duration of Planck time  $t_p$ , i.e. as the SI has a speed of light  $c$  and cannot exceeds this speed, therefore the virtual-real particle remains at its first location  $N_1$  and will finally be inhibited by the virtual antiparticle that may not be created until time  $\Delta t$  has passed.

- If  $\Delta t - \Delta t'$  is greater than  $t_p$ , hence the SI of the virtual particle has the possibility to propagate from  $N_1$  location to the neighboring spatial points  $N_2$  as an excitatory signal-Information SI with matter lagrangian  $\mathbb{L}_m$  and therefore has a gravity effect. The temporal asymmetry of virtual particles and virtual antiparticles creation respectively during  $\Delta t'$  and  $\Delta t$  with  $\Delta t' < \Delta t$  next to a massive/energetic object create respectively the gravitation field of the massive object and the expansion of the spacetime field of the universe.
- Also if  $\Delta t - \Delta t'$  is greater than  $t_p$ , the inhibitory SI or the possible created virtual antiparticle at  $\Delta t$  may have hence the possibility to inhibit all the correlated signals present in the neighboring positions: this is what may create the collapse effect of the wave functions in presence of an energetic/massive object.
- The initial wave function of the initial past particle next to a energetic/massive object is gradually inhibited in space further from the object: this is why the gravity impact is getting lower as the distance from the massive object is higher. However as there is a temporal asymmetry between virtual particles and virtual antiparticles, the wave function of the initial particle is never deleted totally in space as the inhibitory effect of the virtual antiparticle cannot exceed the speed of light but may be deteriorated the more we go further in space which decreases thanks to the virtual antiparticles creation delay comparing to the virtual particles ones. The remained wave function of the real initial "punctual" particle not yet deleted is the gravity effect of the particle. In other words, the gravity field of a particle is its past wave function over space and time not yet deleted due to the temporal asymmetry of the virtual particles and by the virtual antiparticles creation in the space dimension. The wave function collapse is the effect of the prematurely creation in time (thanks of the energy/mass existence) of the virtual particles in time comparing to the virtual antiparticle in the vacuum that delete the neighboring correlated information.

## II. WHAT IS REALLY $\Delta t$ IN HEISENBERG INCERTITUDE PRINCIPLE $\Delta t \Delta E \geq \frac{\hbar}{2}$ ?

$\Delta t$  is the time incertitude used in Heisenberg principle and it is considered as the threshold duration that an equivalent couple virtual particle, virtual antiparticle may exist in vacuum in absence of any matter/energy.  $\Delta t$  gives the maximal time during which all possible signals-Information can be aggregated at the same time.

### A. Time-Energy Heisenberg incertitude principle and wave-particle duality

In presence of mass/energy object in the neighboring positions,  $\Delta t$  is modified to a shorter  $\Delta t'$ . In fact, in the vacuum, thanks to the energy-time incertitude principle as a result of the vacuum curvature null,  $\Delta t \Delta E = \frac{\hbar}{2}$  at the position  $N_2$  which can be rewritten as follows:

$$\Delta E = \frac{h}{4\pi\Delta t} = \Delta E_p + \Delta E_a \quad (1)$$

where  $E_p$  is the virtual particle energy and  $E_a$  is the virtual antiparticle energy. As virtual particles and antiparticles are created by pairs at the same time in the vacuum (in the absence of energy/mass source) hence:

$$\Delta E_p = \Delta E_a = \frac{1}{2} \times \frac{h}{4\pi\Delta t} \quad (2)$$

One can note that from the paper [3] we have also:

$$\frac{\Delta E_a}{h} = \frac{1}{2} \times \frac{1}{4\pi\Delta t} = \delta_{inh} \quad (3)$$

$\delta_{inh}$  is a mean density/probability to have a virtual antiparticle in vacuum. However, in the presence of another energy/mass  $E_M$  source we have:

$$\Delta E + E_M = \frac{1}{2} \times \frac{h}{4\pi\Delta t} + \frac{1}{2} \times \frac{h}{4\pi\Delta t} + E_M \quad (4)$$

$E_M$  is the energy from the mass/energy object coming from the neighboring  $N_1$  location to the  $N_2$ . This  $E_M$  would give a higher density/probability of the virtual particles existence at  $N_2$  more than the coupled virtual antiparticle i.e.:

$$\Delta E + E_M = \frac{1}{2} \times \frac{h}{4\pi\Delta t} + \frac{1}{2} \times \frac{h}{4\pi\Delta t'} \quad (5)$$

where  $\Delta t'$  for the virtual particles may be defined as following:

$$\Delta t' = \frac{h\Delta t}{h + 8\pi\Delta t \times E_M} = \frac{\Delta t}{1 + \frac{8\pi\Delta t \times E_M}{h}} \quad (6)$$

which is smaller than  $\Delta t$  and that depends of  $E_M$ . The virtual particle could exist in space after  $\Delta t'$  time and may exist has the effect of a real particle during  $\Delta t - \Delta t'$ . The lower is  $\Delta t'$  the higher is the probability of the virtual particle to exist before being inhibited by its respective virtual antiparticle after  $\Delta t - \Delta t'$  time.

If  $E_M$  is very high  $\Delta t'$  would tends to zero i.e. the duration of potential summation of signals-Information (7) tends to zero. In other words the capacity of summation and so interference of the time signals-Information is null and the object that has initially wave properties does not have the possibility to interfere with itself: its wave function collapse and the object has since then particle properties.

Note that in the presence of a real antimatter/anti-energy object the  $E_M$  is replaced by  $E_{M_a}$  and would be added this time to the virtual antiparticle energy as it is the most correlated one in term of signal-Information phases.

### Implications:

Why *heavy objects* are difficult to move in space dimension? Heavy objects are objects that has an equivalent number of different particles to its mass. Each particle in order to be moved from  $N_x$  to the nearest location  $N_2$  needs an energy  $E_M$  correlated to the particle which shortens the recreation time of the particle from  $\Delta t'$  to  $\Delta t''$ . Note that the  $\Delta t'$  is due to the presence of the particle by itself which is different from the  $\Delta t$  of the existence of the similar virtual particle in the vacuum. The presence of another correlated energy  $E_M$  at  $N_2$  will probably shrink the  $\Delta t'$  to  $\Delta t''$ . However this is just for one particle. What happens if there are a set of particles that are linked to one another with different interactions? It would need more than the total interactions energy plus the mass of particles of the object, and must to be correlated to the object in terms of SI phases to deplace the object as  $\Delta t''$  is shorter to the  $\Delta t'$  of the object by itself. If the brought energy  $E_M$  is not correlated to the object (i.e. different phase of the external SI to the SI of the different particles of the object) there would not be movement of the object to  $N_2$  but the object may be transformed to other signal-Information (SI) with different phases as Infrared rays, UV rays or any other SI types.

Heavy objects has a high  $\Delta E$  and hence a short  $\Delta t'$ . Particles in this object has hence a summation/interference capacity in time ( $\Delta t'$ ) shorter. Massive object has a very short possibility to interfere with itself as the time summation of its SI is very low which prevents its interference to a high level. The heavier the objects the less they have the right to interfere with themselves (their  $\Delta t'$  is quite short) and therefore to have the wave property of particles or very light objects. This happens also to the particles with wave properties that to the SI, if we bring a kind of correlated energy while observing it will give a very short  $\Delta t''$  to this particle in this location and the particle will be a real particle, the wave function collapses with the remaining SI waves that are transformed to a gravity field (which is initially is the gravity wave) of the particle that will shorten the  $\Delta t$  in space for others correlated SI.

### B. Vacuum spacetime curvature and Heisenberg energy-time principle

From [3], we remind that the total signal-Information function received during  $\Delta t$ , the incertitude duration in Heisenberg principle, at  $N_2$  space location with virtual surface boundary  $\partial\Omega$  is :

$$\psi(N_2, t_f) = \int_{\partial\Omega} \int_{\Delta t} |\psi(N^r, t)| e^{i\frac{1}{h} \int^t \frac{1}{2} mc^2 du - \delta_{inh,r,t} \pi + \mathbf{L}_{m,r}} D[q_r(t)] dt dr \quad (7)$$

where  $\frac{1}{2}mc^2$  is the *time* kinetic energy of virtual particle or virtual antiparticle in the time paths, that may exist during  $\Delta t$  thanks to the Heisenberg principle.  $-\delta_{inh,r,t}\pi$  is the effect of the virtual antiparticles with the mean of  $\delta_{inh,r,t}$  is  $\frac{1}{2} \times \frac{1}{4\pi\Delta t}$  (see [3]).  $\delta_{inh,r,t} = 1$  if the time path *brings* virtual antiparticles and  $\delta_{inh,r,t} = 0$  if the time path  $q_r$  is excitatory i.e. brings virtual particles.  $D[q_r(t)]dt dr$  is the measure of the time path  $q_r$  arriving with incidence  $r$  in the  $N_2$  point. One may suppose that it is a constant if all the paths are equivalent.  $|\psi(N^r, t)|$  is the initial wave function module coming from the virtual point  $N^r$  respectively to the path  $q_r$  since time  $t$  where we recall that  $|\psi(N^r, t)| = 1_T + |\psi(N_x, t)|$  with  $1_T = 1_{r, Time Dimensions}$  in the Time dimensions the wave function Vacuum virtual particles/antiparticles (thanks to Heisenberg time-energy principle) in the case where there is no incoming mass/energy from neighboring spatial location, and  $|\psi(N_x, t)|$  the module of the SI existing in 3D space neighboring locations  $N_x$  at time  $t$ .  $\mathbf{L}_{m,r}$  is the standard

model Lagrangian density divided by  $\hbar$  that describes the particles located at the neighboring positions  $N_x$  at time  $t$  and all their interactions with the other quantum fields.

The signal-Information SI function (7) can be rewritten by fixing  $\Delta t$  only for the virtual antiparticle effect as it is supposed to not be modified by matter nor real energy and only by the incertitude principle, and we modify  $mc^2$  by  $m(\frac{dq_r}{du})^2$  by fixing the  $\Delta t$  same of the virtual antiparticle. Hence we will have if  $\Delta t$  is transformed to shorter  $\Delta t'$  in presence of a non-null  $\mathbb{L}_{m_r}$ ,  $\frac{1}{2}m(\frac{dq_r}{du})^2$  will be higher than  $\frac{1}{2}mc^2$  which includes not only the time kintic energy but also the spatial kinetic energy of the real particle that has been moved from  $N_x$  to  $N_2$ .

We therefore rewrite the SI function as following:

$$\psi(N_2, t_f) = \int_{\partial\Omega} \int_{\Delta t} |\psi(N^r, t)| e^{i\frac{1}{\hbar} \int^t \frac{1}{2} m(\frac{dq_r(u)}{du})^2 du - \delta_{inh,r,t} \pi + \mathbb{L}_{m_r}} D[q_r(t)] dt dr \quad (8)$$

As any kind of information has its entropy, we have considered in our last paper [3] a complex entropy where its imaginary part describes the paths entropy or in other words the time entropy. This time entropy has been demonstrated to be equivalent to the spacetime curvature described in general relativity. Without the Lagrangian of the matter and without all the constants, we have that the time entropy of the time paths is:

$$\mathbb{S}[D(q_R(T))] = \int_{\partial\Omega} \int_{\Delta t} -P(r, t) \times [\frac{1}{\hbar} \int^t \frac{1}{2} m(\frac{dq_r}{du})^2 du - \delta_{inh,r,t} \pi] dt dr \quad (9)$$

In the vacuum (where the  $\mathbb{L}_m = 0$ ) the time entropy is equal to 0 i.e. there is no any kind of time i.e.  $\Delta t$  is not modified and which means that:

$$\frac{1}{\hbar} \int_{\partial\Omega} \int_{\Delta t} P(r, t) \int^t \frac{1}{2} mc^2 du dt dr - \int_{\partial\Omega} \int_{\Delta t} P(r, t) \pi \delta_{inh,r,t} dt dr \quad (10)$$

where  $P(r, t) = 1_T^2$  and  $\frac{1}{2}m(\frac{dq_r}{du})^2 = \frac{1}{2}mc^2$  are supposed constant over time and virtual space if there is no matter neither energy in the neighboring spacetime locations and  $\delta_{inh,r,t} = \frac{1}{2 \times 4\pi \Delta t}$  [3]. By computing the integrals in the time entropy (9), we have:

$$\frac{1}{\hbar} \times \frac{1}{2} mc^2 \times \frac{\Delta t^2}{2} \partial\Omega \times P - \frac{\pi}{2 \times 4\pi \Delta t} \times \Delta t \partial\Omega \times P = 0 \quad (11)$$

Simplifying the previous equation, we have:

$$\frac{mc^2 \Delta t}{\hbar} \times \Delta t \times \frac{1}{4} - \frac{1}{8} = 0 \quad (12)$$

the  $\Delta t$  of  $mc^2 \Delta t$  is not a real time but a quantity of time that does not have the time unity. Here we have  $mc^2 \Delta t = \Delta E$  as we supposed that the energy of a virtual particle/antiparticle is  $\frac{\Delta E}{2} = \frac{1}{2} mc^2$ . Hence the previous equation leads to:

$$\frac{\Delta E}{\hbar} \times \Delta t = \frac{1}{2} \quad (13)$$

And one can recognize the Heizenberg incertitude principle using the spacetime entropy:

$$\Delta E \times \Delta t = \frac{\hbar}{2} \quad (14)$$

Hence from the time entropy in the vacuum which is equivalent to the spacetime curvature of the vacuum, we proved the time-energy Heisenberg incertitude.

### III. WHAT IS REALLY GRAVITY OR GRAVITY FIELD?

Gravity effect is the result of the time assymetry of the potential virtual particles existence in the space dimension and its respective virtual antiparticle existence. In the presence of the energy/massive object  $E_M$  (section II-A) the virtual particles has higher probability, thanks to the summation of signal Information (7) coming from the massive object  $\mathbb{L}_{m_r}$ , to exist a longer time during  $\Delta t - \Delta t'$  than the virtual antiparticles in their particular quantum fields. The time existence assymetry of the virtual particles influences the neighbor locations  $N_2$  in the future. Their signal-Information travel in the time paths to influence the nearest neighboring locations  $N_2$  as they were real matter. Which makes the effect of the gravity travels in space step by step.

In the presence of  $E_M$  in the neighboring locations  $N_x$ , at time  $t + t_p + \Delta t'$  in  $N_2$  virtual particles have the possibility to exist longer time than the associated virtual antiparticle that may exist after time  $t + t_p + \Delta t$  after a longer time than  $t + t_p + \Delta t'$ . In the case of the absence of matter/energy, the time of creation for virtual particles and antiparticles is equivalent and they inhibit each other as soon as they appear in space dimensions.

The potential presence of virtual particles during  $\Delta t - \Delta t'$  without being inhibited by the virtual antiparticles as they are probably not existing yet in space dimension ensures the gravity effect or the spacetime curvature in the vacuum next to the massive/high energy object. In the *nearest locations* to the heavy object,  $\Delta t'$  is very small comparing to  $\Delta t$  hence the gravity effect or the spacetime curvature is higher next to the object. The more one moves away from the massive object, the more the  $\Delta t'$  increases and hence  $\Delta t - \Delta t'$  decreases which reduces the potential existence in space dimension of virtual particles and so their *gravity effect* in the neighboring location as they act as real objects with mass in  $N_x$  during  $\Delta t - \Delta t'$  with their  $\mathcal{L}_{m_r}$  on the SI function summation (7) in the neighboring location  $N_2$ .

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