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RESEARCH ARTICLE

QUANTUM GRAVITY IS INDUCED BY A MECHANICAL EFFECT ELICITED BY MOMENTUM OF LIGHT'S QUANTA

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ABSTRACT

As it is known, the Schrödinger's equation describes the electron in its natural state, represented by superimposed quantum states. This is the phase *of linear unitary evolution*, or *U Phase.* Whereas, when we carry out a *measurement*, it took place a *reduction* of the *state vectors* (*R Process*): we have the *wave function collapse* of the *measured* quantum object. The *measurement*, thus, produces a big changes on the physical properties of the observed particle. How do these changes happen? We don't know. With this paper we introduce a new parameter, induced by the electro-magnetic radiation (EMR), which can help us discern the doubts about the *R Process,* and try to find a *continuity* in order to link the *U Phase* to the *R Process*, so contrasting at the moment. The new parameter is a *mechanical effect* induced by *quanta* of EMR: therefore, it is also a *quantum effect.* The photon is indispensable to carry out a M. No M can be carried out without using the EMR. It could be essentially the *gravitational mass effect* of light's *quanta* to induce the *wave function collapse* and the *Measurement Paradox* and, likely, make a starting point to a *correct quantum gravity.*

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INTRODUCTION

We learn from Chandrasekhar (2004) that "the dualism wave-particle has been demonstrated a number of times, not only for the electron, but also for protons, neutrons, atoms and molecules. This dualism is a universal and fundamental property of the matter". This dualism wave-particle has been demonstrated also for the nature of light. This question can be solved with the Quantum Mechanics (*QM*) living to the particles – rather, to *quantum objects* (QO) - a *wave function* (WF) of their own, indicated with Ψ, which describes correctly both their wave and particle character. It is well known that de Broglie (1923) proposed to give each particle a its own wave length *(λ)* depending only on the *momentum* (***p***) of the particle itself :

$$\lambda = h/\mathbf{p} \qquad (1),$$

where *h* is the Planck's constant. The WF is a *mathematical function* which depends on time (*t*) and on the position (*x*) of the particle it is referred to. "The function Ψ(x) is usually called *the wave function* because it more often than not has the form of a complex wave in its variables" (Feynman 2001, vol.3). Feynman (2001) adds:

"The WF for a single particle *is* a 'field', in the sense that it is a function of position". The WF has all the properties of de Broglie *associated wave* related to the particle itself, in fact it can also be indicated as *de Broglie wave*. Lloyd (2006) states: "A consequence of the wave nature of *QM* is that each (*quantum*) *state* corresponds to a wave, and waves can be *superimposed"*. In fact, *QM* equations imply a universal presence of *superimposed states.* The WF(Ψ), that is the *quantum state* of the particle, represents the way in which we can find the particle when it does not interacts, when it is not *disturbed*, *measured*, observed. Thus, indicating with *t* the time, and with $x^1,....x^N$ the possible positions or space coordinates of the considered particle, we have the formula:

$$\Psi = \Psi\,(x^1,........x^N,t) \qquad (2)$$

Before we search the particle, that is before we *measure* it, the particle is *spread* throughout the employable space, as if for each point there was associated a precise value of *probability density* we have to find. According to *QM*, before the *measurement* (M) "we are not able to say that a quantum system, before being observed, has well defined properties, since we cannot know them" (Zeilinger, 2005). The object we are examining is *something*, and shows a its own property only after the M. In other words, the probable wave-like aspects of

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a particle, of its WF, remain such until we decide to carry out a M in order to detect and find the particle. But then we go back to a description of particle: with the M, emerges its corpuscular aspect. The *QM* tells us that the wave or particle aspects are not at all outlined: the *square of the modulus* of the, $|\Psi|^2$, has to be interpreted as a *distribution,* as the *density of probability* to find the particle, its quantum state, in one of the several possible positions. "It is more likely to find the particle where its WF is maximum in absolute value; so the probability to find the particle in the space is 1, that is $||\Psi|| = 1$(100% of probabilities), where:

$$||\Psi|| = \int_{E^3} |\psi(x)|^2\, dx^1 \wedge dx^2 \wedge dx^3 \qquad (3)$$

that is the integral of $|\Psi|^2$ on all the space gives the total probability to find the particle in a place of the 3-dimensional physical space, with coordinates x^1, x^2, x^3. Thus, the WF is *normalized.* "With the WF of a single particle the 'rule' is the quantity $||\Psi||$, defined as the integral of $|\Psi(x)|^2$ on all the space the particle can occupy"(Penrose,2005). In the case of a particle having a spin, i.e. the electron, we can think of it as a two-state system. Suppose we choose for our base states $|1\rangle$ and $|2\rangle$ the states in which the *z*-component of the electron spin is $+\hbar/2$ and $-\hbar/2$ (where $\hbar$ is the *rationalized* Planck constant).

U PHASE* and *R PROCESS: Penrose (2005) writes: "The *normalization* condition for Ψ is that $||\Psi|| = 1$, then $|\Psi(x)|^2$ is the *density of probability* to find, with a *position measurement* (M)*,* the particle in the point *x*. This rule is related to the so called *linear unitary evolution phase U* of the quantum formalism; the same rule plays an important role in the *R phase*, or *Reduction*(*R*) *Process*", thus determining all the *probabilities* which come out. Before the M, the phase of WF gives to the QO its "wave-like character", since the WF is *diffused* in the space occupied by the particle the WF is referred to. This condition of the WF, indicated as *unitary linear phase U*, or *U Process*, has been brilliantly described by Schrödinger (1926). The first difficulty he found, was that the WF was as a function of time. How to add the difference from the time (*t*)? Indeed the classical H*amiltonian* (*H)* representing, as we know, the total energy of the examined physical system, is independent by the time. In the Hamiltonian representation the generalised condition *positions* $(x^1,.....x^N)$ are associated to the *conjugated momenta* $(p_1,....p_N)$, so the *momentum (p)* of a free particle is given by the velocity (v) of the particle, times its mass (m):

$$p = m\,v \qquad (4)$$

Thus, according to the Hamiltonian formalism, aiming to describe the total energy of the physical system we are examining, independently by the time, but by *momenta* and *positions*, we have the *Hamiltonian function*\

$$H = H\,(p_1,....p_N;x^1,.....x^N) \qquad (5)$$

As we know, along with the mathematical formalism of the *QM*, *p* can be identified by a Heaviside *differential operator* (*D*):

$$D = d/dx \qquad (6)$$

In this identification, between *p* and *D*, with the *QM* we have the *quantum momentum* (p_a):

$$p_a = i\,\hbar\; d/dx \qquad (7)$$

The new *momentum operator* (p_a)*,* typical of the quantum formalism, substitutes the *classical momentum (p)* in the *Hamiltonian classical function*, see Eq.(5), according to the process known as *canonical quantization.* The p_a in Eq.(7) was used by Schrödinger in his equation, occupying all the first member, adding the quantum state Ψ which varies according to the time (*t*) :

$$i\,\hbar\; d\,\Psi/dt = H\Psi \qquad (8)$$

The second member of the equation (8) expresses the energy of the examined system, that is of the Ψ. This energy is represented, as in the classical form, by the Hamiltonian *(H),* but in that case it is a *quantum Hamiltonian function,* as:

$$H = H\,(i\,\hbar\; d/dx^1,....i\,\hbar\; d/dx^N;x^1,.....x^N) \qquad (9)$$

We know that the complex number $\langle \Psi|\phi\rangle$ is the *conjugated complex* of $\langle\phi|\Psi\rangle$. The action on $|\psi\rangle$ from a l*inear operator L,* is written $L|\Psi\rangle$, and the scalar product of the ket $|\phi\rangle$, with $L|\Psi\rangle$, is written:

$$\langle\phi|\boldsymbol{L}|\Psi\rangle \qquad (10)$$

In the Schrodinger *evolution* $\langle\phi|\Psi\rangle$ is constant in time, that is:

$$d\langle\phi|\Psi\rangle/dt = 0 \qquad (11)$$

Thus $\langle\phi|\Psi\rangle$ remains unchanged in time. Let's analyse some evolution modalities of a quantum state. Let us suppose we have, at time $t = 0$, the *quantum states* $|\phi\rangle$ and $|\Psi\rangle$, and make them evolve, according to Schrodinger description, till time *T*, when the *states* become respectively (Penrose,2005):

$$|\phi\rangle \rightsquigarrow |\phi_T\rangle \qquad (12)$$

$$|\Psi\rangle \rightsquigarrow |\Psi_T\rangle \qquad (13)$$

$$\langle\phi|\Psi\rangle = \langle\phi_T|\Psi_T\rangle \qquad (14)$$

Therefore the equation (8), or Schrödinger equation, is an equation of temporal evolution indicating how the considered physical system, the particle, represented in its quantum state or WF, can change, develop in time. It expresses the phase of *linear evolution* of the considered particle called '*U phase*', since it is the process of *Unitary evolution*. It could say that this *U evolution* indicates a particle when it is not troubled but it *develops linearly*, normally, according to the need of the particle itself and its parameters. This situation persists in time till we observe it, till we make a *measurement* (M), or till it interacts by chance with another particle or physical system.

The MEASUREMENT (M) of a QUANTUM OBJECT (QO): Let's examine as in the mathematical formalism of Quantum Mechanics (*QM*) a M of a quantum system must be represented: a 'measurable quantity' of a quantum system is represented by a certain kind of operator *Q,* called *observable.* Examples of *observables* are the 'dynamic variables': i.e. the *momentum (p)* and the *position (x)* of the particle we wish to examine. The theory requires that an *observable Q* is represented by a *linear operator L,* so that its action in Hilbert space (HS) is to make a linear transformation of HS. Every time we want to study, and try to interpret the effects induced by a M, that is, when passing from the *U phase* to the *R Process*, we must bear in mind that WF (Ψ) must be *invariant*, that is, after M, after the *wave function collapse* (WFC), the particle will have to go back to its previous state, as if, apparently, nothing had happened: this is due to the Noether theorem(1918), according to it every *symmetry* corresponds a *conservation law*. In fact, this theorem also applies to Quantum Field Theories (QFT), so WF (and theory itself) must be *invariant* for operations that change the *phase*. Thus, a QFT must be gauge-invariant. The conservation of various physical quantities comes from this *invariance*. Applying this procedure to the *fields*, we have that in case of a *gauge-invariance*, we will have a charge conservation: e.g. in the case of the *gauge invariance* of the electromagnetic field, we will have a conservation of the electrical charge, respect to:

$$\Psi \rightarrow \varepsilon^{i\,\theta}\,\Psi \qquad (15)$$

This *unobservable* transformation is the most famous gauge *transformation* where Ψ represents the WF of a electrically charged particle (such as the electron), and $e^{i\,\theta}$ is a complex unit number (with θ real), expressing a *complete* phase. In fact "if the WF describes a charged particle, then we can make *gauge transformations* of the form expressed by equation (15) where θ is an arbitrary real position function, allowing us to change the way the phase varies!" (Penrose, 2005). Maxwell's equations do not change, that is, they are *covariant*, so Weyl believed that it was possible to extend this *covariance* to the gravitational field too, as well as to General Relativity, thus trying to unify electromagnetism and gravity. In fact, bearing in mind the Noether theorem, in 1918 Weyl formulated a *gauge theory* to be applied to General Relativity (Weyl, 1918). "According to Weyl's theory, the way a clock measures time does not depend solely on its current position, but also on the previously positions. Likewise, the emission frequencies of a hydrogen atom will depend both on its current and past positions. It is like saying: the behavior of the atom will depend on its history, despite contradicting experimental evidence. However, Weyl's idea contained a fatal mistake, which Einstein clearly saw from the beginning"(Quirantes, 2016).

As Penrose points out, Noether's theorem shows various limitations in the case of Gravitational Theory: when gravity is included, there must be the *gauge invariance* appropriate to gravity, i.e. the *invariance* with respect to the coordinates, using the mathematical formalism of *tensors* (Penrose, 2005).

When we make a M, we work on the particle, i.e. on the *quantum object* (QO), not only interacting with its more external region, but also and more interacting with its internal structure, distrupting violently its inner configuration, its internal space, and so the arrangement and positioning (probably fluctuating) of *quantum superimpositions* that characterize the particle. It is the same as saying that M interferes with everything is in the HS, relative to the observed particle. So the M leads to the *collapse* of WF (WFC) of the observed particle, working in the HS relative to the same particle. However, the WFC, induced by M, could represent a real (not only hypothetical) event occurring completely in the reality, so that also the space in which the *collapse* happens could be probably a real space, not imaginary. And which is the space where the WFC occurs? It is of course the volume of space occupied by the particle before M, the space where the *superimpositions of quantum states* of the observed particle move. And this space could correspond to the HS: a 'real' space, in our opinion. According to the rules of *QM* the result of a M, related to an *operator Q,* is always one of the two *self states*: this is the *jump* of the *quantum state* (or WFC) which occurs with the *R Process*. Penrose (2005) states: "Whatever the state before the M, it *jumps* in one of the *Q* self states*,* as soon as the state (that is the particles in exam) is measured (along with the *R Process*). After the M the state gets a definite value for the *observable Q,* precisely the *self value q*. If the M is repeated, the second M will give the same *self value*, that is the same result we got with the first M". When the *observable Q* is measured on the state $|\Psi>$, the rule is that the *probability* tells us that the state *jumps* from $|\Psi>$ to one of the *Q self states*: $|\phi>$. The *jump* of the WF, or WFC, induced by any kind of M, is represented as follows:

$$|<\Psi|\phi>|^2 \qquad (16)$$

This is not true, of course, for the macroscopic world. Miller (2005) states: "If we want to make a M, as to detect the position of a falling ball, we have to see or photograph, that is we need to *light* it up. In order to do so we have to hit it with light beams, that is with a number of photons (Ps): however the Ps hits do not modify the trajectory of the ball, nor its velocity. On the contrary, let's see what would happen if the ball was a single electron. According to *QM* the falling electron can be in any position, since its WF is *diffused* throughout the space (the ball, instead, is localised since the beginning). It doesn't have any sense to wonder where the electron is, until a M is carried out, i.e. taking a picture of it: in this case we need to light it up, at least with a light quantum, which becomes part of the M system. The interaction of the single light quantum (one photon) with the electron, localises it in that moment", at the same time we have induced a particular phenomenon of the *QM*: the WFC. The contact of a single photon (P) with the electron in exam can collapse its *quantum states*, its WF. Well, the interaction between the M's system (that is also a single light quantum) and the examined physical system (the electron) induces the *R Process*:

that is the *reduction* of the electron WF (which was *diffuse*, till a moment before the M), so now it tends to converge to a certain, well defined, region of the space. That is among all the possible positions which the electron WF can occupy, as a *diffused* wave in all the space, the M process chooses one. Thus, with the M, the *quantum state* of the electron is transformed from being potentially in any position to being in a well defined position. According to *QM*, before the M, the particle may be represented by a combination of *quantum states* more or less *superimposed.* However it is thought that the M itself makes it pass to a particular state. Thus, if we consider that an electron is localized in this or that point, the *QM* tells us that it can *accumulate* the 2 possibilities, the 2 *possible states,* and become the sum of an electron which is in this or that point: with the opportunity then to pass through 2 close splits in the same time, until we don't observe it (Puccini,2012,348-352). What kind of mechanism can be concealed behind the observation, behind the M, behind this kind of interactions? No one knows. Miller (2005) adds "both Schrodinger equation and the other *quantum mechanics* fundamental equations remain mute!". However, what seems important is that "the WF does not evolve along with Schrodinger equation, after the M" (Penrose, 2002; 2005).

DISCUSSION

Only using electromagnetic radiation we can make a m: This is the crucial point: the use of the electromagnetic radiation (EMR) results in a modification of the *quantum state* of the particle observed, since it undergoes, under the action of the EMR (this topic will be clarified farther), the *jump,* the *Collapse* of its Wave Function (WFC), thus the particle, the QO*,* that used to behave as a wave will now appear as a corpuscle. This phase, called *Reduction Process* (or *R Process*), lasts just a very short moment (fractions of second), as the M effect ends the previous phase is resumed (present knowledge does not clarify why the WFC is so short). According to *QM* we will never be able to have information about the aspect and the property of a QO, until it is observed. It is thought that before the M the electron could be found potentially in one of the several points of its *wave volume*, each corresponding to probability amplitude*,* to a probability density. Therefore, with the M the WFC takes place, so now our particle will be detectable in a precise point, and at the same time the other probability amplitude, will disappear, according to them the particle could be *spread* on other points in the space it could occupy (the WFC is also called *Amplitudes Reduction*).

With the M the *state* of the particles *jumps* in a localised state: with the M the *quantum state* of the particle is an *auto vector* of the *position operator x.* Before the M, probably the particle was scattered in a wave-like way throughout the space which could be occupied (*self-state of the momentum operator* ***p***). When the electron's WF *collapses*, it is delimited in a specific point: the particle is localized, its *position* is detected. The electron will now show completely as a particle, it is in fact observed in its corpuscular aspect. A corpuscle is, indeed, something concentrated in a precise point of the space. Penrose (2005) adds: "It is clear that the WF is something more *real* than a simple *probability wave.* Schrödinger equation gives us this entity (both charged and non-charged), a precise evolution in time, an evolution which depends critically on how the phase changes from a point to another. If we ask a WF where the particle is, carrying out a position M, we have to expect we will lose this information on the phase distribution. After the M we have to restart with a new WF. If the result of the M says that *the particle is here*, the new WF has to be a very high crest in *that* position, but then it disperses quickly according to Schrödinger equation". Thus, the M induces the *collapse* of the WF particle we want to examine, so it will pass from a like-wave behaviour to a corpuscular aspect (Puccini, 2012, 348-352). Physicists wondered what was the role of the observer in the M process of a physical system. Does the chance have a role, or it doesn't, in determining the results of the M? According to Bohr we cannot talk about a particle without taking in account the interaction we, observers, can have with it (in contrast with classical physics). Bohr suggests that it does not exist a reality independent by the M apparatus:. "Indeed the finite interaction between object and *measuring* agencies conditioned by the very existence of the quantum of action entails–because of the impossibility of controlling the reaction of the object on the *measuring instruments*" (Bohr,1935). In this regard, Prigogine (1993) replies: "The *cosmic microwave background radiation*, distributed in the cosmos at 3° Kelvin, is witness to the beginning of the universe. But the idea that such radiation would be the result of M is absurd: in fact, who could or should *measure* it? It is therefore necessary in *QM* to have an intrinsic mechanism that leads to the observed statistical aspects: this mechanism is precisely instability, *chaos* ". What is particularly relevant is that to carry out a M, to observe anything in the Universe, any macroscopic object or particle, it is necessary to use an EMR, having a wave length (λ) shorter or equal to the diameter of the object to be observed. In this way the EMR hits the object and, bouncing back partially towards us will give us the information about the object examined. On the contrary, if the λ of the EMR is longer than the diameter of the particle or object to examine (i.e. a radio wave), it will go around the object, jump it, and will not show it to us. In the same way since EMR will not hit the object the WFC will not take place.

Hence, the smaller the object or particle to be examined, the smaller has to be the wave length of the EMR used, thus bigger its energy. Thus if we want to detect, observe, *measure* an electron, we need to light it, we need to point on it an EMR with a short λ*.* However in this case we hit it so deviate and modify its trajectory. Indeed, the *QM* teaches us that the observation of the microscopic world, the M, modify the physical system we want to examine. According to our opinion, it seems that the *main character in this enigma* (the M's Paradox) is the EMR. Why? The main reason is that in order to observe, to see, or make a M, we always need to use the EMR. It is the only physical mean which allows us to detect a particle, analyse and study the physical system we are interested in. Only using the EMR we can acquire the information about the state and the property of the objects of the subatomic world. No M can be made without using the EMR. Without the EMR we wouldn't be able to observe the world: both at a macroscopic and a microscopic level.

The EMR is the *wire* which links the observer to the physical system to be observed. This *wire* allows us to get the M of the particle we are interested in. Without this *wire* we wouldn't have any information of the world, which would appear *dark* and unknown, and would never be able to *measure* it. To this purpose, it is very important to consider that the P is not an inconsistent and incorporeal object, but it is provided with a mechanical effect, a *pressure*: the so-called *Radiation Pressure.*

Radiation pressure: It was first pointed out by Iohanne Keplero in 1619 the concept of *Radiation Pressure* to explain the observation that a tail of a comet always points away from the Sun (Keplero). In fact, Feynman writes: "I want to emphasize that light comes in this form: particles. It is very important to know that light behaves like particles, especially for those of you who have gone to school, where you were probably told something about light behaving like waves. I'm telling you the way it DOES behave: like particles. Light is made of particle". He adds: "When light is shining on a charge and it is oscilling in response to that charge, there is a driving Force in the direction of the light beam. This *Force* is called *Radiation Pressure* or *Light Pressure* (*F*)*.* Let us determine how strong the *Radiation Pressure* is. Evidently it is that the light's force (*F*) on a particle, in a magnetic field (*B*), is given by:

$$F = q\text{v}\text{B} \tag{17}$$

and it is at right angles both to the field and to velocity (**v**); q is the charge. Since everything is oscillating, it is the time average of this, ⟨*F*⟩. We know that the strength of the magnetic field is the same as the strength of the electric field (***E)*** divided by c (the velocity of light in vacuum), so we need to find the average of the electric field, times the velocity, times the charge, times $1/c$:

$$F = q\,(vE)/c \qquad (18).$$

But the charge q times the field E is the electric force on a charge, and the force on the charge times the velocity is the work dW/dt being done on the charge! Therefore the force, the *Pushing Momentum*, that is delivered per second by the light, is equal to $1/c$ times the *energy absorbed* from the light per second! That is a general rule, since we did not say how strong the oscillator was, or whether some of the charges cancel out. *In any circumstance where light is being absorbed, there is a Pressure.* The *momentum* that the light delivers is always equal to the energy that is absorbed, divided by c:

$$F = (dW/dt)\,/c \qquad (19).$$

That light carries energy we already know. We now understand that it also carries *momentum,* and further, that the *momentum* carried is always $1/c$ times the energy. The energy (E) of a light-particle is h (the Planck's constant) times the frequency (v):

$$\mathrm{E} = h\,v \qquad (20).$$

We now appreciate that light also carries a *momentum* equal to the energy divided by c, so it is also true that these effective particles, these *photons*, carry a *momentum* (p):

$$\boldsymbol{p} = \mathrm{E}/c = hv/c \qquad (21).$$

The direction of the *momentum* is, of course, the direction of propagation of the light. So, to put it in the vector form:

$$\mathrm{E} = h\,v\;\boldsymbol{p} = hv/c \qquad (22).$$

We also know, of course, that the energy and the *momentum* of a particle should form a *four vector.* Therefore It is a good thing that the latter equation has the same constant (h) in both cases; it means that the Quantum Theory and the theory of Relativity are mutually consistent" (Feynman, 2001). And Richard Feynman says so! Let's analyze the photon's *momentum.*

The MOMENTUM (*p*) of PHOTON (P)

Fermi (1926) writes: "The P too, as other particles, is a corpuscle, a *light's quantum* and has a its own *momentum* (p), through which transfers all its energy to the hit particle". Feynman (2001) adds: "Each P has an energy and a *momentum* (p)". This p is represented in the de Broglie's formula [2]:

$$p = h/\lambda \qquad (23)$$

where λ is the wave length of the considered P (or other particles). Apparently the later equation is in contrast with the second of the equations (22): $p=hv/c$. However, from the formula of EM waves ($c=v\,\lambda$) we get that the rate v/c is the same as $1/\lambda$, thus the second of the equations (22) becomes: $p=h/\lambda$, just as Eq. (23).

The mean wave length of a P in the optical band corresponds to ~$5\cdot10^{-5}$[cm] and its p is:

$$p = 6.626\cdot10^{-27}[\mathrm{erg\cdot s}]/5\cdot10^{-5}[\mathrm{cm}] \qquad (24)$$

$$p = 6.626\cdot10^{-27}\,[\mathrm{g\cdot cm^2/s}]\,/\,5\cdot10^{-5}[\mathrm{cm}] \qquad (25)$$

$$p = 1.325\cdot10^{-22}\,[\mathrm{g\cdot cm/s}] \qquad (26)$$

Let's see how *heavy* an electron is: its mass corresponds to $9.1\cdot10^{-28}$ g, comparing these values, emerges that a running photon (P) is *heavier* than an electron (Puccini, 2005, *PIER,* vol.55). Thus, when we make a M, when we try to see and study an electron, and we shoot against it even a single P (the minimum quantity to be able to see it), what happens is that the electron is hit by a corpuscle with a mass bigger than its, most likely *succumbing* under its mass, under such a shot, thus it *collapses* (Puccini, 2011).

Wave Function Collap SE (WFC): Let's try to understand what happens. It is likely that, before the M, the electron is *not determined* and should be characterized by a *superimposition of quantum states.* Every time a M is carried out (always using the EMR), the observed particle undergoes a *probabilistic reduction of the state vector,* indicated as Reduction Process, or *R Process*, which corresponds to the "*Process* 1" described by von Neumann(1955). With the *R Process* the *state vector,* represented by |Ψ>, *jumps* to another stated vector, let's say |ϕ>, which represents one out of two or more *orthogonal* alternative possibilities: the other can be |q>*,* | X >, etc..., which depend on the kind of observation, the kind of M carried out. Thus, with the M we move immediately from the phase *U* to *R*, and the *jump of the quantum state* is induced, known as WFC. All related to the EMR. Now, with the M, thus with the WFC, it is possible to find and see the particle in a determined point. In the *R Process*, the particle shows as a corpuscle and gives us its position (Penrose, 1997). Whereas, during the *U Phase* (which corresponds to the "*Process* 2" described by von Neumann), that is before the M, the particle presented an undulating behaviour, and was not detectable: we did not have any information about its position, it was *delocalised.* The M, thus, produces a big changes on the physical properties of the observed particle, of the measured *quantum object*, as well as on its morphological configuration. How do these changes happen? What is the secret mechanism which creates the WFC? We don't know. We only know that these modifications happen any time we try to see how a physical phenomenon takes place, or when we want to study the behaviour of a particle: to do so we have to carry out a M.

Thus, the WFC takes place every time M is carried out. Which mean do we use to carry out a M? An EMR with a short wave length. Thus, it is automatic to link together the three parameters: 1)EMR; 2) M; 3)WFC. In fact the WFC happens only after a M, and the M cannot be carried out without using the EMR: it is a *conditio sine qua non.* Thus, we can infer that the WF of the observed particle, |Ψ>, *jumps* in a different quantum state (|ϕ>) when the EMR occurs. Without EMR it would not be possible to have neither the M, nor, as a consequence, the WFC! There is no other explanation. Someone may say: if it is so how does EMR induces the WFC? Well, we have stated that the EMR is not evanescent, ethereal, inconsistent, but it produces a mechanical action: the so called *radiation pressure* of Ps. For example, the solar light gives, on the earth surface, a *radiation pressure* having a weight of 1mg per mt^2 per second. We know that if a single P hits an electron changes its journey and deviates it from its trajectory. In the same way, we think that the P is able to create the WFC of the hit electron!

Mechanical effects induced by photon: This is the core of our work. Besides, the *mechanical effect* carried out by a luminous P against an electron, or against a nucleon, is not at all negligible: the electron is hit by a *crash force* equal to 10^{-22} [g·cm/s], as illustrated by equation (26), that is > 5 order of magnitude bigger than the mass of the electron itself (Puccini,2012,353-357). It is a considerable strike! There is no wonder if, after such a strike, the quantum structure of the electron (with its *superimpositions* of *quantum states*), and its morphological configuration, undergo a significant modification. It is as if under the hit with the P, the electron deformed immediately (thug just for a very short time), as if it *shrivelled* (as pinched balloon)*, reducing* its quantum states: in this way showing itself as a corpuscle, a *localised* and observable particle. Just with a single P.

The light really hit violently the electron and the atomic particles. Therefore, before being hit by EMR, in according to the *QM* the particle is a mathematical quantity known as a *quantum state*, or WF(|Ψ>), that should contain all the information necessary to describe the considered quantum system. When it exists in this phase (*U phase*), not disturbed, the particle will not give any information concerning its *look* and contents. To this purpose, Prigogine (1993) asks himself: "Does a unobserved nature, different from observed nature?". It seems so! In fact, as far as we try to see it, the observed particle immediately change its look, its quantum configuration and its trajectory. Therefore we can only try to imagine: it says that the particle occupies a volume, it goes like a wave, in a *combination of several overlapping quantum states* and widespread, spread in the whole space it can occupy, space that according to Penrose should be the HS. Feynman (2001) said: "the WF for a single particle is a *field* in the sense that it is a function of position". This field could be the space occupied by the particle, when it is not disturbed, i.e. when it is in *U phase*. We don't think to be wrong in considering the HS like the field, the space occupied by each particle, that is by its quantum superimpositions both it is a lepton and it is a hadron. Therefore the HS should be a real, *objective* space: the space to be occupied by a *quantum object* (QO). The space where an operator acts, characterize the operator in *QM*. It is known that an operator can be distinguished for its auto functions (the functions that he leaves unchanging) and its auto values: this is the spectral representation of the operator. Concerning the Schrodinger's equation (8), when we have the auto functions un(x) of the Hamiltonian operator H, we can develop the WF in these auto functions. Therefore, with M, i.e. under the action of EMR, the particle, that is its WF, jumps in a particular quantum status (ϕ, for example), giving rise to the WFC. It seems more congruent the concept that the EMR itself induces the WFC, that is the jump of the quantum status. It doesn't look rash the hypothesis that EMR can induce a *gravitational quantum effect*.

It is a *gravitational effect* because it is a mechanical action, i.e., on our opinion, an effect induced by the *dynamic mass* of Ps, by the *pushing momentum* of EMR. It is a *quantum effect* because it is the P itself to elicit this effect, the P that can be identified with the quantum of light, with the quantum of EMR, the Planck granule, which energetic value corresponds to *h*, the Planck constant. We can suppose that all the described situation (or something very similar) occurs in the reality. We can say that WFC is a real event, that occurs in the realty of subatomic world, although a lot of authors suppose that WFC is only a mathematical, theoretical and not real representation. Our opinion can be overlapped with Penrose opinion, that supposes that WFC should be really realized: "The WFC is a real event, *objective*, not hypothetical. The space where the WFC exists must be real and represented by HS"(Penrose,2005). Introducing the P in this HS, that should be the space occupied by QO that goes to M, and considered that the P carries a *dynamic- mass* (and so a mechanical action) bigger than the electron itself, see Eq.(26), we can try to imagine the confusion that it will bring to the hit particle, first of all disrupting the overlapped quantum layers and making them to collapse, fall down, just a moment, in a limited and circumscribed area (WFC). According to *QM*, a physical phenomenon occurs if somebody is observing it. Therefore the act itself of observing, measuring a sub-particle, i.e. a QO, induces consequently a physical phenomenon. But in which way we can observe a particle? It is enough a EMR sufficiently energy. To this purpose Feynman (1971) said: "To observe electrons, we need a light because the light rebounding on electrons make them visible. Nevertheless the light affects the result because the result of light on is different from that of light off. We can say that the light affects electron behaviour. The electrons are very sensitive. When light is sent on an electron, it makes the electron vibrate so that the electron because of light, behaves in a different manner".

It seems that EMR is the keystone to observe a particle, to make a M. Similarly, only through the EMR we can try to reveal the mystery of Measurement Paradox (*MP*). In which way? We explained above, it could be a mechanical effect induced by Ps to play a main role with the M and its *paradox*. To this purpose it could give us a help the legendary "Lectures with four hands" that Penrose had with Hawking to the students of Isaac Newton Institute for Mathematical Sciences of Cambridge University in 1994. Penrose said: "The P can be a combination:

$$P= z|A\rangle + w|B\rangle \tag{27}$$

where *z* and *w* are complex numbers. The state of the P is exactly the complex superimposition. We can consider that P active the movement of a thick mass that if it is in a delicate situation of *unstable balance* it can fall down only after a *push* of P"(Penrose,1996;2002). The *unstable balance* described by Penrose could be the unstable balance of a particle that we can go to M. This *unstable balance* concept brings to mind the *unstable dynamic systems and phenomena* described by Prigogine (1993), who writes: "Our conceptual framework is: instability (Chaos) → probability → irreversibility. The essential condition is that the microscopic description of the universe is made through unstable dynamic systems. This representation gives us the approach to balance in Ljapunov's time and includes *temporal breakdown of symmetry*". As known, Ljapunov time describes the time limit beyond which predictions become impossible, so a dynamic system becomes *chaotic*. Prigogine adds: "The discovery of these new representations with broken symmetry constitutes, in our opinion, the solution of the *paradox of time*, as we obtain a formulation of the dynamics at the level of the distribution functions, which includes the time arrow. That's how we can correctly address the problem of the *breakdown of temporal symmetry* and demonstrate that the study of chaotic (or unstable) systems can effectively incorporate the 2nd principle of Thermodynamics. Without long-range correlations due to *non-equilibrium situations*, there would be no life, no brain, and the *constructive* role of time would not be highlighted. Irreversible phenomena do not represent a merely increase in *disorder*, entropy, but they have a very important constructive role. The *QM* has a dual structure: on a side the Schrödinger Equation (*deterministic* and reversible in the time), on the other side the WFC, bound to M, that introduce a *symmetric temporal breaking*, irreversible, and deeply *probabilistic* breaking" (Prigogine, 1993). How is it possible to carry out a M? *Only* with P! This statement is in perfect agreement with what Penrose (1996; 2002) *docet*: "A mass can fall down *only with a push of* P". The mass mentioned by Penrose can be represented by the mass itself of particle that goes to M: the electron mass, for instance. It is in fact, before M "in unstable balance as a *edge of hypothetical gorge*" (Penrose,1996; 2002). So this mass, i.e. the particle we measure*, falls down* (in figurative sense), but it *collapses* in real sense. So we assist to WFC of particle itself. In other words, the *falling in the gorge of mass* (i.e. of massive particle) we have to measure, could be the WFC of particle itself in the meanwhile we are making the measure. Because Penrose considers that *this mass falls down* (that is to say 'collapses') under P push, we can say that the 'push effect' of P (i.e. the mechanical effect induced by EMR) makes the examined particle (and that we measure) fall down (collapse).

Thus, according to Penrose, a single P can determine the falling of mass (moreover thick) that has an unstable balance, although it is considered that P is mass less. According to the basic principles of Mechanics, it should seem inconsistent that a massless particle can make a mass fall down. How can we explain this?. If we consider that P has a mass (given by its *dynamic mass*, i.e. its *momentum*: ***p***), everything seems more clear and congruent (Puccini, 2010). It could be the *dynamic mass* of P, its *momentum* to make fall down the particle considered by Penrose, that is to make collapse its WF *reducing its vectors of state* in a circumscribed and localizable space: inducing, i.e., the WFC of hit particle. Penrose says: "it seems that the like-wave aspects have to be kept until we decide to make a M to reveal the particle, then we go back to the description of the particle, where we find a discontinuous changing (*non* local) of the state – a *quantum jump* – when we pass from a description in terms of WF to the reality given by the M. Why? What is there inside the M showing process, which requires that a different (and strongly *non local*) mathematical process, different from the standard quantum evolution process given by Schrodinger equation, has to be adapted in case of M?" (Penrose, 2005). This *ungraceful event* could be induced by the stroke of the P(or Ps) against the electron. However, as for the *hidden mass* carried by P, or the "*push effect* induced by P" described by Penrose (1996;2002), we will quote just a few ones (among a large number which can be found in literature). That is why we can say that P hides its mass, which, when the P is in motion, is enclosed in its *momentum*.

On the DYNAMIC-MASS (or *HIDDEN MASS)* carried out by PHOTON: In this regard, we have the very prestigious endorsement of Feynman (2001) who says: "The momentum of P can be hidden in the EM field (EMF)". It's like saying that momentum carries, albeit *hidden*, a dynamic-mass. In short, the P cannot be considered massless. Its mass is simply, to say it with Feynman: "hidden". And it's not easy to challenge Feynman! At this point, Penrose adds: "In a conference held in Japan in 1922, Einstein said:

'If a person falls freely he will not feel his own weight'. In fact, when you are in *free fall* (like when you launch from a plane, before you open the parachute) you have the impression that the earth gravity interaction (GI) is *suspended*: the Earth's gravitational field seems to have *disappeared*. Where's the GI? Actually the GI has not vanished, it is *hidden*"(Penrose, 1997). Well, in these circumstances, we seem to be able to see a significant behavioral analogy between EMF and gravitational field. That is, it is as if in both of them something disappeared, temporarily concealed, *hidden*, during the event: 1) the dynamic-mass, transported by the *momentum* of the P (in the EMF); 2) the GI (in the gravitational field). There are many examples of mechanical effects induced by the light's quanta, by the light's *dynamic-mass,* by the *momentum* of P: typical examples are the *photo-electric effect*, the *Compton effec* and the *Raman effect*. In these phenomena the P *pushes away* the hit electron from its orbit: it seems to be just a *mechanical effect* produced by the light (Puccini,2008). We learn from an authoritative source: "According to the equation $E=mc^2$, each mass can be expressed as an equivalent energy" (Nat'l Acad.Sci.USA, 1986). Thus the opposite is true too: each energy can be expressed as an *equivalent mass.* We read: "We can substitute the concept of mass with energy, indeed according to relativity ($E = mc^2$) mass is a form of energy extremely condensed. To any form of energy corresponds a certain mass" (Enciclopedia Scienza e Tecnica,1995).

Zeilinger (2005) chases: "What is the deep meaning of a relationship like $E=mc^2$? What is hidden behind these symbols? For many physicists the equation $E=mc^2$ is to say that energy and mass are the same thing, two faces of the same medal; there is therefore *equivalence between mass and energy*: energy is just another form of mass, and vice versa, mass is another form of energy". It is interesting what Eddington said in 1919: "The simplest interpretation of the deflection of the light beam is the one that considers it as an effect of the weight of light". At the dinner of that meeting, Eddington read out some verses he had composed; we will quote the last quartine: "*We will compare the measures taken, One thing at least is* certain*,* light has weight*. One thing is* certain *and the* rest *debate.* Light *rays, when* near *the* Sun*,* do *not* go straight" (Eddington, 1919). Thus, Lord Eddington clearly points out the *mechanical effect* exerted by light, fully in accordance with our conviction that light carries with it also a mass (the *dynamic-mass* of P). In fact, as he himself says, "light has weight"(Eddington, 1919). Barrow (2003) writes: "The non-null value of the Planck constant (h) is important for the stability of matter. In the impacts between the atoms and the EMR, the value of h is large enough to take a rather strong '*stroke*' to push the electrons to the immediately higher permissible level". It seems exactly the same *stroke* given by the P (to the electron, or other QO) in the Measuring Process (M), or that described by Penrose. As it is known, h identifies with Planck 'grain, with the quantum of light, that is with P. And yet, a massless P is capable of inferring such a *stroke*, besides giving "stability to matter"(Barrow, 2003). Unless the P is not so massless. We cannot miss the Einstein and Bohr 's *light box*. It is well known that in the VI Solvay Congress (Brussels, 20-25 October 1930) Einstein proposed a new mental experiment to Bohr, represented by a box full of light.

On a wall of the box there is a hole, with a shutter that could be opened and closed by a mechanism connected to a clock placed in the box. First we weigh the box, then we set the clock so that it opens the shutter at a certain time for a short moment, but enough to let a single P out.

Then we weigh the box again. "To calculate how much light had gone out, enclosed in a single P, Einstein used the amazing discovery he had made in 1905: $E=mc^2$, so ENERGY IS MASS and MASS IS ENERGY (Kumar,2008). Thus, by weighing the light box before and after the P escape, it was very easy to calculate the variation of the mass, using the equation:

$$E = mc^2 \tag{28}$$

As known the latter equation indicates the Principle of Equivalence Mass-Energy (MEEP). That's how Einstein commented upon his MEEP: "The value of the considered mass refers to the value of an *inertial mass"* (Galison,2005). Let's apply Eq.(28) to the P, keeping in mind that one of the three parameters is well known, that is *c*, the speed of the P in the vacuum. The 2° parameter is the Energy of the P, which is represented in equation (20). Therefore equation (28) represents the value of *minimal energy* of the particle we are considering. Besides, as Chandrasekhar reminds us "it is useful to consider a fundamental consequence of the quantum nature of the matter: the lowest energy possible for a system cannot be null, that is zero, but it needs to have a value different from zero, it is called *Zero Point Energy* (ZPE)" (Chandrasekhar,2004). On the other hand, still for the MEEP, to an "energetic" particle, carrying energy, forces etc., should correspond a *mass equivalent* to the energy carried, divided c^2. Since there is no zero energy, for the ZPE, still for the MEEP there should not be any particle carrying energy, with a zero mass. Thus, there should not be real particles, having any energy, with a zero mass. If there are, they should "subtend" a tiny mass, a *Zero Point Mass* (Puccini, 2011).

Thus, in the case of a P at the *inertial state,* that is when it interacts with another particle, so it stops running, at least for that infinitesimal moment it will oscillate much less. We will never be able to know how much! We will never be able to know with *accuracy* how much an interacting P can oscillate, that is what could be the number of oscillations [c⁄s] in that moment. Let's indicate this unknown value with 10^n[c⁄s], which is an *uncertainty factor*. The P stops running when hitting another particle, as it happens during a M, so it will not oscillate as when it was running, though it never stops running completely: it is the Heisemberg Uncertainty Principle (UP) to deny it, since in this case we would know simultaneously the *position* and the *momentum* of the particle (Heisemberg, 1927) (Puccini, 2005, *JEMWA*). Thus also in the inertial state, the oscillating frequency (ν) of the P can never be 0, but always ≥1⁄s, that is ≥ one oscillation per second (if not even ½ oscillation per s., or a fraction of its).

Thus, let's to consider the Energy (*E*) of the P:

$$E = h \cdot \nu = h \cdot 10^n \text{ [c/s]} \tag{29}$$

that is: $E = 6.626 \cdot 10^{-27}$[erg·s] $\cdot 10^n$ [c/s] (30)

hence: $E = 6.626 \cdot 10^{-27+n}$ [erg] (31)

As the *erg* value is expressed in [$g \cdot cm/s^2 \cdot cm$], that is in [$g \cdot cm^2/s^2$], we have:

$$E = 6.626 \cdot 10^{-27+n} \,[g \cdot cm^2/s^2] \tag{32}$$

In this way we can have information, with a certain approximation, about the 2nd parameter of the MEEP (equation 28), referred to the P. Hence we can easily have the 3rd parameter, the *equivalent rest-mass* or *equivalent inertial mass* (m_o) of the P:

$$m_o = E/c^2 = 6.626 \cdot 10^{-27+n} \,[g \cdot cm^2/s^2] \,/\, (2.9979 \cdot 10^{10})^2 \,[cm/s]^2 \tag{33}$$

Let us calculate this value following the *cgs* system:

$$m_o = [6.626 \cdot 10^{-27+n} / (2.9979)^2] \cdot 10^{20} \,[g \cdot cm^2/s^2] \,/\, [cm^2/s^2] \tag{34}$$

and we have:

$$m_o = [6.626 / (2.9979)^2] \cdot 10^{-27-20+n} \,[g \cdot cm^2/s^2] \cdot [s^2/cm^2] \tag{36}$$

that is: $m_o = 7.372 \cdot 10^{-48+n}$ [g]

Thus, if the value of *n* was 10^0, that is one oscillation per second, m_o would be 10^{-48}[g]. Whereas if *n* was 10^3 oscillation per second, we would have $m_o=10^{-45}$[g]. Of course in all cases it is an extremely small value, but it is ≠ 0. Besides, as we know, one of characteristics of the P is to travel most of the time, so it also gets a *momentum* (*p*). Lastly, we learn from de Broglie (1923): "I showed elsewhere that the atom of light should be considered as a moving object of a very small mass (< 10^{-50} g)". These values are almost overlapped to our calculations. It really is a very strong confirmation of our hypothesis.

The MASS *BREAKS* the SYMMETRY: One could easily object: it is not possible to attribute a mass to the P, because according to the Standard Model (*SM*) the mass breaks the symmetry! In fact the technical basis of the *SM* of elementary particles is made up of a basic principle, known as local *Gauge Invariance* or local G*auge Symmetry.* That is, as Madame Noether and Weyl had already realized the behavior of Nature is invariant under certain transformations on its fundamental constituents, such as the fields of fundamental particles. However, "Weyl's idea contained a fatal mistake" (Quirantes, 2016). In fact, Einstein pointed out that the laws of physics are not invariant under gauge transformations and the elegant electromagnetic field theory had to be abandoned. Indeed, "the observation that the laws of physics are not invariant for gauge transformations dates back to Galileo Galilei "(Maiani, April 2015). Einstein had shown that the mathematical formalism introduced by Weyl was excessively incoherent and incongruous, as well as blatantly clashing with the experimental evidence. In short, the Mathematics supported by Weyl belied and contradicted the basic principles of the Theory of Relativity! It was really unacceptable. Pauli also was in full disagreement with the Weyl's gauge theory. In this regard, he immediately published two articles. In the first, as Sparzani tells us, Pauli pointed out a sign error, "a little oversight"(Pauli, 1919, vol.20), in one of Weyl's formulas. In the 2nd article, however, there is a pitiless and dry criticism (Sparzani,2008): "In Weyl's theory we continuously work with the intensity of the field within the electron(e^-). However, for a physicist, the latter is defined as a force acting on a test field, and since there are no test bodies smaller than an e^-, the notion of an electric field internality in a mathematical point appears to be an empty function, with no content. It would be preferable to reaffirm that in physics we must introduce only quantities that are observable in principle. Thus: would we not be completely off track if we pursued a theory of continuum within the e^-?" (Pauli, 1919). Nevertheless, taking inspiration from Fock's works (1926) on the electron's wave function equation (Schrodinger), or the London's works (1927) on superconductivity, in 1929 Weyl published another work in which he attributed great importance to the Gauge Theories(Weyl,1929) . This article also fully preserves the same parameters and mathematical procedures previously contested by Einstein and Pauli, as the assumption that "in an invariant gauge theory, all the particles should have zero mass like the photon" (Maiani, 2015). The downside of the Gauge Symmetry Theories lies in the fact, really paradoxical from a logical point of view, that the introduction of a simple mass parameter, necessary to describe the mass of a particle, is in contradiction with the existence of this symmetry: it is said, that is, that the mass breaks the gauge symmetry. According to *SM* the problem can be solved by assuming that all particles have a null intrinsic mass and postulating the existence of a complex scalar field permeating the space. The re-introduction of the mass parameter causes the gauge symmetry to be no more explicit, but that is spontaneously broken: *Spontaneous Symmetry Breaking* (*SSB*). It is in this case a *symmetry hidden from the mass*.

So it was conjectures more or less at the same time, and independently by Englert and Brout (1964), by Higgs (1964), Guralnik, Hagen and Kibble (1964) that particles would tend to interact, to mate with this *complex scalar field*, now known as Higgs field (HF), acquiring an energy at rest which is not null, which for almost all respects is analogous to a value of mass at rest, then describable as a parameter mass. As it is well known, the mechanism just described is the so-called *Higgs Mechanism* (HM). The HM requires the intervention of a permeating particle the HF, i.e. the Higgs Boson (HB). It is interesting to note that the coupling between the various particles (among bosons only those bearers of weak charge) and HF (steeped in weak charge) complies with the *gauge symmetry* and explains the presence of non-null rest masses.

Although the *SSB* is the prevailing theory, various physicists and mathematicians, even authoritative, do not approve it. To this purpose, we read: "In the *SM* it is assumed that Weak Interaction and Electro-magnetic Interaction are unified in *electroweak theory*, where there is a special symmetry that connects the particles W^+ W^- and Z ° to the P: not only are these on the same plane, but they can continually be 'rotated one to the other'. It seems that this *electro-weak symmetry* is very odd and thin, since pure electromagnetism is *invariant for reflection*, involving both zig (left-handed helicity) and zag (right-handed helicity) components. In contrast, WIs only involve zig-shaped parts of the particles. Moreover, it seems that the P is clearly distinct among all the bosons of the theory, since it is a massless particle. Actually, the mass of P, if not 0, should be $<10^{-20}$ electronic masses for good observational motives, thus it is $<5\cdot10^{-26}$ of the measured mass of bosons W and Z. In addition, the bosons W have an electric charge, while the P does not have a weak charge. It would seem to emerge the impossibility of a complete symmetry between all gauge bosons. Moreover, the first point to understand is that in Feynman Diagrams there is much more hidden symmetry than what is immediately apparent; in fact, if viewed appropriately, they exhibit symmetry U(2), i.e. *electro-weak symmetry*. The asymmetry we see in the real world, compared to these particles, is born in *electro-weak theory* just because Nature chooses that certain particular combinations are realized as real free particles. But what about the other asymmetry, related to Feynman Diagrams, so that the W and Z particles can only attach to the *zig-shaped* lines of the particles, whereas the P attaches to both *zig* and *zag*? What criteria does Nature adopt in allowing us to find certain particulates as free particles, and not others? In the case of a free particle, it must be a mass *self-state*, so we need to know what determines the mass of the particles. In this case, we cannot expect complete symmetry over U(2). In other words, the mass implies some sort of *symmetry rupture*. Such asymmetry is the result of a *SSB*, which is supposed to have occurred at the very first stages of the Universe. According to *electro-weak theory* at the very high temperatures of the universe immediately after the Big Bang (BB), the *electro-weak symmetry*, like U(2) symmetry, was *exactly* valid, so that the W, Z and P particles were completely equivalent"[6]. At those temperatures, definitely > 10^{16} °K, the kinetic energy and *momentum* of the P were very high [54], so in the relativistic sense the P might have gained a considerable mass! "But already at $\leq10^{16}$ °K, at $\approx 10^{-12}$ seconds after the BB, the W, Z and P were *frozen* by this *SSB* process, so only P remains massless while the others gain mass. Maybe it is the HB to give masse to these particles, as well as to itself and quarks. And how? Really great and ingenious ideas ", Penrose comments (Penrose, 2005). Witten (2004) adds: "This proposal of the *spontaneous breaking* of *electro-weak symmetry*, or *SSB*, though simple and rebuttable with known facts, probably does not tell us the whole story".

Penrose chases: "I question the reality of SSB! There are various *difficulties* in this idea of *SSB*. So, about 10^{-12} seconds after the BB, throughout the Universe the temperature fell just below critical value; at this point a special choice was made (W^+, W^-, Z°, and P) from the whole variety *G* with U(2) symmetry of possible set of gauge bosons. We do not expect this to happen in exactly the same way throughout the space, at the same time throughout the Universe, but in some regions a particular choice will be made, whereas in others there will be different choices. The *G* space of the possible gauge bosons is, at each point of the space-time completely U(2)-symmetrical, before the symmetry reduction occurs. As implied in the *fibrate* concept, there isn't any particular way to make an identification between the *G* space in a certain point and the *G* space in another point completely different. Therefore, there isn't a rule that tells us what element of *G* in a point is the 'same' element of some other element of *G* in another point. It seems to us that this gives us the freedom to observe the notion of 'same' as the one provided by the particular choice that *SSB* offers us. According to this point of view, the particular set (W^+ W^- Z° and P), which is *frozen* in a point can be identified with the corresponding (W^+ W^- Z ° and P) in any other point. Thus, it seems that we should not have that kind of 'inconsistency' between symmetry breaks in different points, which occurs with the iron magnetization domains. However, this point is in open contrast to the idea behind the gauge theory, according to which not only the *G* -spaces are the *fibers* of a B_G *fibrate,* whose base space is the space-time (*M*), but where the particular theory of gauge, in this case the *unbroken electroweak theory*, is defined in terms of a *connection* on this fibrate. This *connection* defines the locally significant identification (parallelism) between the various *G* - spaces when we move along any *M* curve. In general, this identification is not globally consistent when we move on closed circuits (due to the curvature of connection, which expresses the presence of a non-trivial gauge field). In any case, the randomness involved in *symmetry breaking* in different points implies that local parallelism between the *G* - spaces will not, in general, be consistent with the choices made in *SSB*" (Penrose,2005). In short, following the description of the *SM*, we find that the *breaking* of the *electroweak symmetry* (*EWSB*) is totally *asymmetric*, since the *SSB* (related to the "phase transition" triggered by the lowering of the temperature of the primordial universe) alters also the symmetry of the HF. That is, the *EWSB* means that only the W and Z° bosons acquire mass, while the P will remain massless forever. Why do we have such a dichotomous and asymmetric behavior, in a model based primarily on symmetries? According to *SM* the more a particle interacts with the HF, the greater its mass. The P, on the other hand, does not interact with the HF at all, so it will remain massless. But how is it possible to state it with such a determination? Based on what preexisting phenomenon, or assumption? How is it possible to confirm and prove this particular behavior of the HF in favor of some particles, compared to others, closely related? Why can't we apply the mathematical formalism used in favor of the bosons W and Z° to P too?

Unless we try to think that there may be another type of HM, working likely in that HF portion, asymmetric as compared to the HF, which gives mass to the bosons of the Weak Interaction. This asymmetric portion of the HF might interact with the Ps, so that even these can gain mass (though very small), and *without breaking symmetry*. It could be assumed that in such circumstances, the temporary acquisition of mass by the Ps would *overshadow symmetry*. In short, following *SM* criteria, before the phase transition (resulting in *SSB*), the bosons of Electro- Magnetic and Weak Interactions were equivalent, the two forces were unified and the HF behaved ubiquitously homogeneously, without asymmetry. Then, with the primordial *phase transition*, and consequent *SSB*, also the symmetry of the HF is altered, which starts to behave differently, i.e. asymmetric, so that it gives mass only to the bosons of the WI and not to the Ps. In integration with *SM*, and to try to justify the massive particle behavior many times shown by P, we dare to think that – through a Higgs Mechanism (HM) - the asymmetric portion of HF may succeed in give mass to P. In this case, it would be necessary to understand whether P and the W and Z ° particles gain mass through a single HB, or two distinct HBs occur: one interacting with particles with no weak charge, nor electric charge, nor color charge, as the P, whereas the other is well known. In this regard Randall (2012) states: "We have no certainty about the precise set of particles involved in the HM. For example if the *breaking of the electroweak symmetry* (*EWSB*) was to be attributed to 2 Higgs fields, rather than to one". This may be in accordance with our assumption (if we considered *SSB* as real), as well as having a consistent and congruent (symmetrical) application of HM to *SM*, so as to also explain the mass of particles such as P, as a result of *SSB*. In conclusion. why these diversity of behavior, so that HM would interact with the *weak field* and not with the *electromagnetic field* (EMF)? t is known, EMF is a quantum field capable of preserving a *local gauge symmetry*, which persists even after partial transformations of the field itself. Likewise, it seems more appropriate to assume that with the lowering of the primordial universe temperature and the subsequent *phase transition*, the HF behaved symmetrically with respect to the pre-existing electro-weak Interaction, so as to induce also the *SSB* of the EMF, so as to give a *mass parameter* to the P (though of very modest entity), just as the *SSB* of the EWF gives that big mass to the bosons W and Z°.
Therefore, it should not be surprising that the P can carry a mass, a dynamic mass, given by the HF, using the same mechanisms described by the SM in order to explain the remarkable mass the bosons of the WI acquire(Puccini,2018). In addition, as for the mathematical description of the *SSB* of the electro-weak fields, also in the case of the EMF's *SSB*, just separated from the electro-weak field, there is a similar mathematical formalism, in which the Lagrangian (or Hamiltonian) defining the physical system would be *invariant* with respect to a *group transformation*, such as rotation or translation. In this regard we report the Lagrangian globally invariant gauge (L):

$$L = ½ (\delta_\mu \boldsymbol{\varphi})^T \delta^\mu \boldsymbol{\varphi} \;\; ½ m^2 \boldsymbol{\varphi}^T \boldsymbol{\varphi} \qquad (37)$$

where $\boldsymbol{\varphi}$ is a scalar field vector, and T is the matrix that indicates the generators of the group $O(_n)$, that is, the n-dimensional orthogonal group. Randall (2012) adds: "However, there are other models that hypothesize more complex *Higgs sectors*, with even more articulated consequences. For example: Supersymmetric models provide higher number of particles in the Higgs sector. In that case we would always expect to find a Higgs Boson, but its interactions should be different from those deducible by a includes only model that one Higgs particle ". Therefore, it is not possible to exclude *a priori* that another HB, other than that found at CERN, may possibly allow the P to gain mass, according to an HM analogous to that proposed by *SM*. Even Feynman was very upset by the problem of particle masses, and so he wrote in 1985, that is 23 years after the theory proposed by *SM*: "I am convinced that at the fundamental level the origin of mass values is a very serious and interesting problem, to which an adequate solution has not been found yet"(Feynman, QED). Witten(2004) adds: "Solving the riddle of how this EWS breaks can determine the future direction of particle physics".
In short, along with Witten and many other authors, it seems that there is a need for a new Physics, yet to be understood, able to describe in what ways and by what precise mechanisms the particles can gain mass. Furthermore, it seems interesting to quote Maiani (April 2015): "The conservation of the Electric Charge finds its theoretical basis in the gauge invariance of Maxwell equations, while the conservation of the Baryonic Number is not associated with any gauge invariance and has always appeared as an artificial rule, however it applies with great precision". Actually, this leaves us perplexed because the gauge invariance does not coincide with one of the fundamental laws of Physics: the Law of Conservation of the Baryon Number. Yet this law is always preserved: it applies with great precision. It is even possible to consider that maybe something "artificial" lies in the "rules", or dogmas, which are the basis of gauge theories, after all, according to Einstein and Pauli, that Mathematics is not up to standards. In fact, with regard to *SM*, Maiani (2014) underlines: "Unfortunately, the approximate calculation methods available (the Perturbation Theory) are not completely reliable".

Conclusion

To try to describe the most relevant features of the quantum gravity (*QG*), we believe that it is necessary to meet the various requirements demanded by most Authors in order to reach a *correct QG* (*CQG*). In order to build a satisfactory response to this request, we devoted so much space and depth to the search for the *equivalent-mass* of light, as well as to the description of the various mechanical effects exercised by light, by Ps. The light, the EM radiation (EMR) should, in fact, be the crucial element in order to trace an adequate path to try to describe a *CQG*. To this end, the fundamental step should be to no longer consider the P as massless, just because of Einstein's MEEP. We read from Penrose (1997): "At present there is no good theory able to explain why particle masses must be exactly what they are, although *mass* is a concept intimately connected to that of *gravity*. The mass, in fact, only works as the *source of gravity*". Feynman (1989,QED) states: "Throughout this story there is a particularly unsatisfactory aspect: the observed values of particle masses. There is no theory that adequately explains them; they are constantly being used in the accounts but there is no idea what they are and where they come from". Penrose (1997) adds: "Maxwell EM field (EMF) delivers energy. For $E=mc^2$, it must also have a mass. Maxwell's EMF is therefore also matter! Now we must certainly accept this notion". It is pleonastic to specify that Maxwell's EMF is constituted and operated by Ps!

Therefore, since the P is a *quantum of energy*, according to the MEEP, it must inherently have an *equivalent mass* (Puccini, 2011), though *concealed* and not easily detectable. Penrose(1997) specifies: "The *mass of P* is an impalpable type: it is pure energy". In fact, a well-known principle of Quantum Mechanics (*QM*), the Bohr Complementarity Principle, states that each *quantum object* can show both its corpuscular and wave-like behavior but, *conditio sine qua non*, only one at a time: never simultaneously! (Bohr,1928). Therefore, until the P is in motion, it can show only its wave side. On the contrary, in the very short time the P interacts, we may indirectly detect some aspects of its corpuscular behavior through its quantum-mechanical effects: *push effect* induced by the P, as well as the *radiation pressure*, or the 'solar sail', or the photoelectric-Compton- and Raman *effects*, or the substantial "*stroke*" with which a single P blasts an electron into another orbit, as Barrow (2003) reminded us. In short, we think that we cannot longer ignore the value of the Planck's *constant*, which as indicated by equation (36) corresponds to $7.372 \cdot 10^{-48}$[g], multiplied by the frequency of the considered P. In this regard, one might object: the mass of P *breaks the symmetry*! For the related *discussion* see paragraph 2.7. In addition, it seems to interesting to add along with Penrose (2005): "All these attempts by Physicists to exploit this type of *symmetry breaking* (*SB*), regardless of their popularity, still have to be judged very speculative. We should be very critical and skeptical about propositions of this nature, to avoid to be dragged too easily ".

In turn, Feynman (1971) reminds us: "With a bit of skill any experimental result can be shot so that it seems like a predicted consequence, a bit like it happens in Psychology. In Physics we have examples of this kind. We have these *approximate symmetries* that work roughly like this. You have an *approximate symmetry* and count a number of consequences, assuming it is perfect, but when compared to experiments it does not work. It is obvious: the *symmetry* you have to expect is *approximate*, so if the result is pretty good you may says: nice! On the contrary, if it is not good you may say: Well, this must be particularly sensitive to the *symmetry breaking* (*SB*). Just laugh! The same thing happens for the proposition of *symmetry* in Physics and Psychology. It's easy to fall into the mood with this kind of vague theory: it's hard to prove it is wrong, and it takes some skill and experience to avoid being tricked ".

***QG* could *REMOVE INFINITIES*:** It is known that *quantum electro-dynamics* (QED) is a *Quantum Theory* of the EM field (EMF), which also includes *Restricted Relativity*. The QED describes all phenomena relating to electrically charged particles interacting through EM Interaction (EMI). It seems interesting to note that m*athematically* the QED presents the structure of an *Abelian* gauge theory, with a group of gauge U(1), where, *physically*, it means that charged particles interact with each other by the exchange of null-mass particles: the Ps. The spinorial QED is represented as follows:

$$L_{QED} = -1/4\, F^{\mu\nu} F_{mn} + \overline{\psi}\,(1/2\, i\, \partial - M + e\, A\!\!\!/)\, \psi \qquad (38)$$

It describes the interactions between a quantized material spinorial field (i.e. the electronic field) and a non-massive vector field that describes the EM radiation (EMR), i.e. the EMF managed by the Ps (considered massless). The first formulation of a *quantum theory* describing the interaction between radiation and matter (i.e. between Ps and electrons) is Dirac's (1927). Later, in the 30s of the last century, scientists began to notice that in the equations of perturbative development of the QED infinites emerged, which were considered un-eliminable. Oppenheimer (1930) demonstrated that at the origin of the *infinite* there was the term expressing the interaction between the electronic current and the EMF produced by the electron. That is, the self-interaction of the electron, considering the processes in which the electron emits and resets a P, causes an infinite shift (with quadratic *divergence*). Obviously this occurs because in the equations a point value for the radius of the electron (a) is introduced, thus $a \rightarrow 0$ (which is as to give the value a = 0). Consequently, the calculation results in an infinite shift: for $a \rightarrow 0$ diverges as $1/a^2$ (Peruzzi, 2015).

Other *divergences* (in the perturbative development of QED) emerged from Feynman's diagrams. In fact, 'an integral on a loop', a *closed path* in a Feynman diagram, leads to clearly divergent expressions. These divergences are due to the "non-integrable" behavior of the integrating function for high *momenta*: these are *ultraviolet divergences*, correlated to *vacuum polarization*. Other types of divergence, due to singularities in expression, emerge in theories like QEDs that provide non-massive particles: the Ps((Sinigardi,2009). In this case, *infrared divergences* appear, for *momenta* tending to zero. Obviously, to give mathematical and predictive meaning to Quantum Field Theories (QFTs), these problematic terms had to be removed. To this end, so-called *renormalization* techniques have been studied. As for other *divergences* that emerge from perturbative calculations of QED, such as when a P is given a 0 mass (the most striking example is *infrared divergence*), in order to eliminate the infinites, it would be necessary to replace a massless P, with the value of the Planck constant (*h*), equal to $7.372 \cdot 10^{-48}$[g], multiplied by the value of the frequency of the considered P: see equation (35).We could add from literature, with Penrose: "The supreme Quantum Field Theory(QFT) is the QED, that is, the theory of electrons and Ps. However, QED is a somewhat confused - and not entirely consistent – theory, since it gives *infinite solutions* at first, which make no sense. These must be eliminated, what happens through a procedure, the *renormalization*, but not all

QFTs can be *renormalized* (Penrose, 1997). Feynman, who for Renormalization received the Nobel Prize, almost 40 years later writes: "This *compass game*, made with the value of the electron rest mass and the value of its 'charge' (i.e. its amplitude of interaction with Ps), is called with a technical language *renormalization*: a fine name for what remains an absurd process! Having had to resort to such prestigious games made it impossible to prove the internal coherence of QED. It is, in fact, surprising that this coherence is still undemonstrated and personally suspect that renormalization is not a mathematically legitimate process. What is certain is that we do not have a good mathematic basis to formulate QED theory "(Feynman, QED). On the contrary, in our opinion, the *removal of the infinites* emerging from the perturbative study of QED and the other QFTs, can be obtained with 2 modes:1) replacing in the equations of such theories the value of 0 of a P massless, with the real energy value of P, as represented by Equation (35); 2) replacing in the equations of the QFTs the point value attributed to the radius of the electron, therefore $\rightarrow 0$, with the real value of its radius.

To this purpose, Feynman (1989) comforts us: "Maybe the idea that two points may be infinitely close is incorrect, it is false the assumption that geometry will continue to be invariably unchanged". He adds: "But if instead of including all the possible points of interaction until a 0 distance, the calculation is *cut off* when the distance between the points is very small, there exist defined values of the mass of the electron and of the its charge, such that the calculated mass coincides with the value of the mass of the electron measured experimentally, and the calculated charge coincides with the experimental value of the electric charge of the electron "(Feynman, QED). Obviously, being massive particles. The electrons can in no way occupy a void or punctiform volume of space, that is, equal to 0. Besides, considering the value of the minimum distance two particles can come close, no infinites should emerge from perturbative calculations of QED. In addition, we read: "With reference to the *problem of infinites*, just think about the energy of the electric field of a charged sphere, which radius (r) tends to zero: $r\rightarrow 0$; i.e. the energy $\rightarrow\infty$, diverges, such as $1/r$. For the theory of Special Relativity, part of the mass of the sphere comes from the (divergent!) energy contained in the surrounding EMF. However, one might think that no electrical charge is actually *punctiform* and that the problem is simply due to a *mathematical abstraction* "(Passera,2016).

Qg* shows a continuity between *u phase* and *r process: With this paper we try to introduce a new parameter, induced by the EMR, which can help us discern the doubts about the *R Process,* and at the same time try to find a *continuity* in order to link the *U process* to the *R process*, so contrasting at the moment. The contrast comes both on the physical side and on the mathematical formalism. Indeed, "the quantum mechanical equations, including Schrodinger's, are *mute* about the *R Process"*(Miller,2005), not being able to interpret it. The new parameter could be the *gravity and quantum effect*, represented by the *mass effect*, the mechanical action induced by the P (the *quantum* of EMR), when we try to make a *measurement* (M) of a physical system of the subatomic world. It is not easy to find the right mathematical formalism to introduce this parameter, the *gravity action of the light*, of the P's *dynamical-mass*, influencing the particle we want to observe. It may be easier, and more congruous at the same time, "to write Schrodinger's equation for a single particle with a mass m, moving in an external field, which energy contribution indicated with V, where V = V(x,y,z), considering x,y,z the three space coordinates"(Penrose,2005).

We have:

$$\boldsymbol{H}\Psi = \mathrm{i}\,\hbar\, d\Psi/d\,t = (-\,\hbar^2/2m)\cdot\nabla^2\,\Psi + V\,\Psi \qquad (39)$$

where ∇^2 is the differential operator of 2° order, called *Laplacian.* In 3-dimentional field it is represented as follows:

$$\nabla^2 = d^2/dx^2 + d^2/dy^2 + d^2/dz^2 \qquad (40)$$

In equation (39), it is also likely to find that highly sought-after continuity between *U Phase* (illustrated by the first and second member of the equation) and *R Process* (third member) separated just from a sign of equality. In addition, this sign of equality, which represents the transition from *U Phase* to *R Process* (and *vice versa*), could also express reversibility, as saying a bi-directionality between *U* and *R*. Moreover, it is known that, immediately after *Measurement* (M), i.e. after the *R Process*, the *measured* particle retrieves the previous quantum state (as stated by the Noether theorem) restoring the *U Phase*. In Eq. (40) it may also not be possible to find that marked incompatibility between the two basic *QM* procedures: the *U* and *R* procedures. Incompatibility represented by the unitary *deterministic* linear evolution (brightly described by Schrodinger) of the *U Phase*, and the peculiar *reduction of* the strictly probabilistic *state vector* of the *R Process*, induced suddenly by M, with immediate *wave function collapse*(WFC) of the examined *quantum object* (QO). The QO, in fact, with M collapses immediately, and indeterministically, in another *wave function*(WF), represented by Ψ. It is as if, probably, Ψ travelled backward along the equation, moving from the third member to the previous ones. That is, terminated (in a fraction of a second) the *R Process*, illustrated with the 3rd member, a situation similar to the previous is restored, so it is as if from now, Ψ (again in *U Phase*) was described through the other two members (where it is likewise represented), namely through the Schrodinger deterministic mathematical formalism.

QG* and the *temporal asymmetry* between *u phase* and *r process: Therefore, it seems important to note that, instead of a specific asymmetry of time between the two phases, there is only, or essentially, a *quantitative temporal asymmetry* between the real duration of the *R Process* (which we have with the WFC) and the duration of the *U phase*. In fact the *R Process* is very short, just the time the WFC is carried out. After that the particle goes back to its quantum representation typical of a *U phase*. From a corpuscular behaviour it goes back to a undulating behaviour. On the contrary the *U phase* lasts all the time until the particle is observed, disturbed, measured again! So, with our paper, we try to highlight both a possible *continuity* between *U* and *R Process*, as well as a *quantitative temporal asymmetry* between the two processes. One could also find, through equation (39), a *continuity* between Newtonian Mechanics, Relativistic Gravity and *QM*, that is, to relate the classical level to the relativistic and quantum level of the physical description of the world.

QG and the gravitational effects induced by emr: We can see that the 1st and the 2nd member in equation (39) corresponds exactly to Schrodinger equation: see equation (8). The first member, as we know, represents the energy of an examined particle, i.e. an electron, considering Ψ its WF, whereas *H* indicates the energy. The 2nd member, of course, indicates as this "undisturbed" particle evolves normally, *linearly,* in the time. This evolution is known as *U phase*, or Schrodinger *linear unitary evolution*. In fact the 2nd member follows the *quantum momentum* (p_a) represented in equation (7), which later Schrodinger develops in his equation. Penrose stresses that: "all this replacing *momentum* and energy with differential operators, seems an incomprehensible mathematical ritual, it is important to wonder if it has something to do with the *momentum* given by the punch of a boxer. Yes! According to *QM* the key topic about the *momentum* is that it is saved, and the effect of a stroke is just an inevitable consequence. The *momentum* has to move somewhere, it cannot just disappear, because it is saved. It is the same for the energy" (Penrose, 2005).

We think this is just what happens with the *measurement* (M): the *momentum* (***p***) of photon (P) is transferred to the stroked particle, respecting the *Momentum* Conservation Law. It should just be the moving of the P's *momentum* to the particle undergoing a M, to make the *collapse* of its wave function (WFC) and make less enigmatic the Measurement's Paradox (MP). Let us consider now that our electron, or another QO, represented by its WF(Ψ), is disturbed during its ***U** phase*, thus forced to interact. What does it interacts with? In order to see the electron, we need to use the light, the Ps, thus the electron will interact with the P. Let us try to represent mathematically the interaction between the electron and the P. Equation (39) is helpful; the 3rd member can represent the particle interacting with our electron (Ψ): *m* shows its mass and *V* the energy. Thus the P modifies – just for a moment – the *linear **U** phase* of the electron, that is the particle we are *measuring*.

We may think that this is not possible because the particle in the third member in equation (39) has a mass, whereas the P is mass less! This is correct. But if we start not to consider the P as massless any more, since calculations show that the P has an *inertial mass* of $7.372\cdot10^{-48+n}$ grams, see equation (36), and that an optic P hits the electron with a *dynamic mass* of $1.325\cdot10^{-22}$ [g·cm/s] –see equation (25) – then we can introduce the P in equation (39). We have:

$$\boldsymbol{H}\Psi = i\,\hbar\, d\Psi/dt = -\,\hbar^2/2.65(10^{-22})\ [\text{g}\cdot\text{cm/s}]\cdot\nabla^2\Psi + V\Psi \qquad (41)$$

Let us try to represent mathematically the action of a particle as a luminous P which interacts with an electron during its *linear evolution phase U*. This interaction induces the WFC of the examined electron which, just after the M, will return to the previous phase, as in the second member of equation (39). At the same time with the 3rd member of equation (39), we have a sort of *quantum gravitational effect* which operates on the particle undergoing the M. What is this effect represented by? By the *light radiation pressure*, by the *momentum* carried by each single P. It is a *gravitational effect,* since it is a *mass-effect*, a *mechanical effect* on the measured particle, the QO which is lighted with the M. Especially if the incident particle has a total mass bigger than the hit particle. Feynman (2001) confirms: the momentum is "a *mechanical quantity*". As it happens when the P interacts with the electron (Ψ). It is also a *quantum effect* since it is carried out by the P, that is a quantum particle, the *Planck's grain*. Thus, we can infer it is a *quantum gravitational effect* to induce the WF collapse(WFC) of the QO undergoing the M.

QG could explain wfc and measurement's paradox (mp): With equation (41) we try to introduce the *dynamic mass* of light, relative to the *momentum* of a single P of the optical band, since the EMR has proved indispensable and irreplaceable to make a M. This is just a *conditio sine qua non*: without using the light you will never be able to examine, frame, *measure* a QO! It happens, however, that light, as Feynman (one of the deepest connoisseurs of light) has repeatedly mentioned, vibrates the illuminated electron, deviates its trajectory, removes it, alters the state of its WF, that is, Ψ(Feynman, 1971). Obviously, the values of the *momentum* (*p*) of light are to be introduced into the 3rd member, since the other two, together, perfectly reproduce the Schrodinger equation describing the *U Phase*. They are values that are not meaningless, but correspond to a mass of impact of various orders of magnitude greater than the electron *restmass*, as shown in equation (26). That is why the *push-effect* induced by a P is so violent, to induce the immediate WFC of the *measured* QO (Puccini, 2011). Moreover, these described are not isolated calculations. Feynman specifies: "Suppose that light is coming from a source and is acting on a charge and driving that charge up and down. The magnetic field (*B*) acts on the charge (say an electron) only when it is moving; but the electron is moving, it is driven by the electric field, so the two of them work together and there is a force on it. This force (*F*) is called *radiation pressure*. Let us determine how strong the *light pressure* is. Evidently it is: $F=B\,q\,v$, as shown in Eq.(17), where *v* is the velocity of propagation of the light beam and *q* is the electronic charge or, since everything is oscillating, it is the *time average* of this: $\langle F\rangle$. Therefore the force (*F*) is the *pushing momentum*, that is delivered per second by the light"(Feynman,2001).

Neither can we omit to point out the *arm wrestle* which take place uninterruptedly in the depths of stellar core between gravity (GI) and *Photonics Pressure*. In fact, the GI and the *Radiation Pressure* of the Ps can *fight* for a long time as it happens in the star's core. From an authoritative source, we read: "In ordinary stars such as our Sun, the inward force of gravity is balanced by the outward hydrodynamic pressure of the hot gasses and, to a lesser extent, by the *radiation pressure of photons*" (Nat'l Acad,Sci.USA,1986). Thus, the photons (Ps) contribute to counterbalance the huge gravitational pressure which pushes from the outward external layers of the star to the internal layers. In order to perform this action, this compression, Ps have to "base it on something", as though they had an equivalent mass (equivalent to the energy of the Planck's grain, the light quantum, divided c^2). That is, it could be the *equivalent mass* of lots of billion of billion.. of *Ps*, which summed up may contribute, together with the "hydrodynamic pressure of the hot gases", to prevent the Sun from collapsing or the collapse of the other stars, at least for a long time. Ps therefore have a *mechanic effect*, probably a mass effect acting as "counter pressure" to the considerable GI expressed by the remarkable gravitational mass which inexorably pushes towards the inside of the star. In short, it could be essentially the *mechanical* action represented by the momentum (*p*) and *gravitational mass effect* of light's *quanta* to induce the WFC, and *light* us on what happens during a M and make a starting point of a CQG. The *momentum* of P (say the P's *pushing momentum*) may explain the WFC and the Measurement's Paradox (MP) in the subatomic world (Puccini, 2011). The MP is the most intricate puzzle of Quantum Physics (Feynman, 1971), a problem still unresolved.

Basically, when we try to make a measurement (M), we involuntarily but inevitably modify the subatomic system we are trying to measure. To *measure* (M), observe a subatomic particle, we are forced to frame it, to illuminate it. For us it is just the light, the EMR to trigger these phenomena, that is to induce the MP, since it is clear from our calculations that the visible band Ps, rather than behaving as massless particles, affect the measured particle with an impact force determined by their momentum (***p***), equal to10^{-22} [g·cm/s], as shown in equation (26). That is, the particle is hit by a radiation pressure equal to that of 100 protons all together, or comparable to that of over 100000 electrons. That is why, in our view, the measured particle undergoes such a drastic change in its physical properties and, likewise, of its morphological and structural configuration.

There is, then, a clear mechanical-relativistic and quantum effect, driven by the *dynamic mass* transported by the light quanta. This could be used to represent a unification between Newtonian Mechanics, General Relativity and *QM*, as well as to show a possible continuity and reversibility between the unitary linear evolution phase of a QO (***U** phase*) and the Reduction of Status Vectors (***R** Process*) and, probably, constitute the foundations for a *Correct Quantum Gravity* theory. Lastly, it seems very interesting to quote what Penrose writes: "Actually, the mass of P, if it is not zero, should be $<10^{-20}$ electronic masses for good observational motives"(Penrose, 2005). The mass of the electron is $9.1\cdot10^{-28}$g, so if the P is $<10^{-20}$ electronic masses, we have: $9.1\cdot10^{-28-20}$[g], thus according to Penrose a P which is not massless must have a mass very close to $< 9.1\cdot10^{-48}$ [g]. Penrose's calculations, among the greatest living mathematicians, are completely superimposable on ours: $7.372\cdot10^{-48}$ [g]. This is of great honour for us and greatly comforts us.

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