SUPERLUMINAL INTERACTION, OR THE SAME, DE BROGLIE RELATIONSHIP, AS IMPOSED BY THE LAW OF ENERGY CONSERVATION

PART II: GRAVITATIONALLY BOUND PARTICLES

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ABSTRACT

Previously, based on just the law of energy conservation, we figured out that, the gravitational motion, depicts a *"rest mass variation",* throughout. Consider for instance, the case of a planet in an *elliptic motion* around the sun; according to our approach, an *"infinitesimal portion of the rest mass"* of the planet, is transformed into *"extra kinetic energy",* as the planet approaches the sun, and an "*infinitesimal portion of the kinetic energy"* of it, is transformed into *"extra rest mass",* as it slows down away from the sun, while the total relativistic energy remains constant throughout.

The same applies to a motion driven by electrical charges; this constituted the topic of the preceding article (Part I of this work).

One way to conceive the mass exchange phenomenon we disclosed, is to consider a *"jet effect".* Accordingly, an object on a given orbit, through its journey, *must eject mass to accelerate,* or *must pile up mass, to decelerate.*

The speed U of the jet, strikingly points to the de Broglie wavelength λ_B, coupled with the period of time T_0, inverse of the frequency ν_0, delineated by the electromagnetic energy content $h\nu_0$, of the object; $h\nu_0$ is originally set by de Broglie, equal to the total mass m_0 of the object *(were the speed of light taken to be unity).* This makes that, *jet speed* becomes a *superluminal speed* , $U = \lambda_B / T_0 = c_0^2 \sqrt{1 - v_0^2 / c_0^2} \Big/ v_0$.

This result seems to be important in many ways. Amongst other things, it may mean that, either gravitationally interacting macroscopic bodies, or electrically interacting microscopic objects, sense each other, with a speed much greater than that of light, and this, in exactly the same way. In which case though, the interaction coming into play, excludes any *energy exchange.* Thus energy cannot of course go faster than light, but *information* can be carried without any basis of energy. Furthermore, our approach, induces immediately the quantization of the *"gravitational field",* in exactly the same manner, the *"electric field"* is quantized.

Our conjecture may be checked with isolated electric charges, sufficiently far away from each other; as unusual as it may seem, they should interact with each other, right away, electrostatically, or magnetically. Whereas it remains difficult to apply the present idea to *"communication"* faster than the speed of light *(essentially for, the "force" of concern, decreases as the square of the distance),* it appears nonetheless plausible to implement it, to computation faster than the speed of light.

1. INTRODUCTION

In the first part of this work, along our approach, we have elaborated on the motion of two electric charges vis-à-vis each other. More specifically, we have considered the closed system of an electron rotating around a proton.[1] The proton being much more massive than the electron, we supposed that, as they unite, to form the hydrogen atom, the proton remains untouched. Hence, the electron's internal dynamics weakens as much as the binding energy coming into play. The bound electron should then weigh less than the free electron, and this, as much as the binding energy. Recall that this consideration led us to a "new equation of motion", followed by a "new relativistic quantum mechanical" set up.[2,3]

The weakening of the internal energy of the electron would be hard to check; nonetheless one can well verify that the bound muon decay rate retards as compared to the free muon decay rate, and this, as much as the binding energy coming into play.[4,5,6,7,8,9] Our prediction about this occurrence, in effect, remains better than any other available predictions.[10,11]

Note that our approach, is in full compatibility with all existing quantum electrodynamical data.

In Part I, based on the framework we have set up regarding the electric interaction, we were able to derive the de Broglie relationship, thus through essentially the *law of energy conservation.* The tools we used on the way, points to a striking result. It is that, the electric interaction can take place with speeds much higher than the speed of light *(without however any exchange of energy, between interacting charges).* For static charges, the interaction seems to be spontaneous.

In this part, we are going to handle, the gravitational interaction.

In fact, at first, we had developed our approach, mainly, to describe the gravitational motion, more specifically, to describe the end results to the General Theory of Relativity (GTR).[12,13]

Thus, as a result of our approach, not only that, we are able to derive the de Broglie relationship, vis-à-vis the electric interaction, taking place within the frame of an atom, but as unusual as this may be, we can well land at it, within the frame of the gravitational interaction, too.

In a way though, this should be considered quite natural, owing to the exact similarity between Coulomb's law *(written for electric charges),* and Newton's law *(written for masses);* then again, recall that, we consider these fundamental laws for *static objects,* exclusively.

We could add this Part II, to the preceding Part I. Yet, first of all it is already voluminous. More importantly, it does not seem easy to modify, well established believes, swiftly.

Thus, it seemed more appropriate to allow the interested reader to think about the approach we presented, and try it, on the basis of the derivation of something he knows and accepts well, i.e. the usual de Broglie relationship, arising within the frame of the micro atomic world, and only then, take him to confront with a similar finding, now derived within the frame of the macro celestial world.

This is how, we hoped to overcome, the great surprise, and conservative reactions, many of us will most likely exhibit, given that, via the approach we present herein, much of our actual conception, would somehow be stunned, and perhaps modified, had our results turned out to be closer to *nature's behavior.*

Nonetheless, already at this stage, it turns out quite comforting that, our approach appears to restore the broken or non-existing links, or annoying incompatibilities, between different disciplines of atomic physics, quantum mechanics, relativity, and celestial mechanics, whereas, it is the desire of all of us to establish just a *whole complete package of conception* for the *unique nature* existing out there, whether it is question of *micro aspects,* or *macro aspects,* of it.

Thus, our approach seems to reinstate the broken link between the end results of the GTR, and Newton Mechanics. Though, it indicates that Newton's law of gravitational attraction is valid for *static masses* strictly, just like the Coulomb's law is only valid for *static charges.* In other terms, the *gravitational mass* entering Newton's law of gravitational attraction, is not the *inertial mass,* entering the Newton's description of *force,* more precisely, [force] = [inertial mass] x [acceleration], i.e. the Newton's Second Law of Motion.

These two masses turn out to be different;[2,3] it is that

$$[\text{gravitational mass}] = [\text{inertial mass}] / [\text{Lorentz dilation factor}]^2.$$

This result is evidently, against the phrasing of the *principle of equivalence* (PE) of Einstein *(which states that the two masses of concern, should be equal).* Before we present our stand point, we feel the need of elaborating on this point.

Experiment Achieved at the General Physics Institute, in Moscow, Supporting the Decrease of the Gravitational Mass with velocity

At any rate, the above relationship suggests that a moving particle in a gravitational field would weigh less than the same particle at rest, in the same location in that field. V. Andreev effectively reported at the PIRT Conference held in July 2005, in Moscow that, a pendant load irradiated at the General Physics Institute of the Russian Academy of Sciences, by high energy electrons, comes to weigh less than its untouched twin counterpart.[14] The author of the present aticle, right after Andreev's presentation, suggested that, the effect must be due to energizing, the valence electrons of the atoms of the load in consideration *(which happened to be duraliminium);* these electrons *(based on our finding vis-a-vis the gravitational mass and the inertial mass),* become practically weightless. A quick calculation indeed proves this point of view, which shall be elaborated on, in a subsequent article.

The conclusion is that, heated electrons weigh less than normally bound electrons, and this, points to a clear violation of the common interpretation of the PE.

It is not that we Question, or we Do Not Accept the Principle of Equivalence (PE), It is that we are in No Way Bound to Utilize it!

Anyhow, through the approach that will be presented herein, we do not at all need to make use of the PE.

It is not that, at this stage, we question the PE. It is that for the present theory, we are in no way bound to utilize it. Whether it is valid or not, we do not really bother, with such a question. After all, to us, it represents a prodigious and useful analogy, but this is not really the point.

It happens that we still attract severe reactions, when we say we do not need the PE. Some people think we must need it *(and, as we will soon see, we really do not need it).* According to these people, *it is further silly to question whether it is right or wrong; it is surely right and no doubt we need it,* they claim.

Here is a joke elucidating this situation, the author has made with a very fine scholar and a very close friend of his, who firmly advocated this principle, and could not accept the fact that we do not need it, whereas every one else needs it:

- *All right, Dear Camarade, but you did not need any other woman than your wife, for the children, she gave you. It is not that you could not have children with another women; it is simply that, you did not need any other woman for the children, you had with her.*

This is exactly what we mean, by stating *"We do not need the PE to establish our approach".*

The fact that we do not use it, does not, on the other hand, constitute any contradiction with the theory of relativity, more precisely with the Special Theory of Relativity (STR), which constitutes our main framework.

Quite on the contrary, our approach, as will be elaborated below, remedies the inconsistencies, otherwise coming into play.

In any event, in order to dissolve the upset we unwillingly create regarding the PE, this principle ought be analyzed and clarified.

A Discussion About the Ambiguity of the PE, as Defined by Most Authors: Tuning of the Definition of the PE, for the Present Purpose

As we have just stated; according to Newton, the *"gravitational mass",* is the mass to be plugged in the expression of *"Newton's law of gravitational attraction",* whereas the *"inertial mass"* is the mass to be plugged in the expression of "Newton's Second Law of Motion".

Newton himself, before anyone else, doubted about the equality of these two masses *(and we find indeed that they are not equal).* As many very many authors openly state, the PE appears to state that these two masses are equal.

But the GTR rejects the concept of “force” which, in Newton’s description made of “mass” and “acceleration”, involves the “inertial mass”; the GTR also rejects the concept of “Newton’s law of gravitational attraction”, which involves the “gravitational mass”.

Thus the *original ground* considered by Newton, to appraise the two masses in question, is totally wiped out.

On the other hand, “inertia”, by definition, is a “characteristic”, an object develops as a “resistance” to any variation, in its motion. Thus the concept of “inertia” is associated with the change, the object undergoes, through a given “motion”. Regarding the PE, the “motion” of concern is that of the accelerated elevator, as assessed by an outside observer, fixed in regards to distant stars.

Thus, Einstein considers the “rest mass” of an object, lying on the floor of the elevator, accelerating (as assessed by the outside fixed observer) “upward” *(along the direction drawn from the floor to the ceiling of it).*

This is what constitutes the basis of the PE. Then, the “effect of acceleration” on the object of concern, is considered to be equivalent to the “effect of gravitation” (yielding the acceleration, in question). This indeed seems to be a striking, but as we show elsewhere, an inaccurate analogy.[15,16,17,18] Anyway, by analogy, so far we only describe a “rest mass sitting in a gravitational field”. We do not describe a “mass in motion, in a gravitational field” *(such as a planet around the sun, as originally visualized by Newton, in regards to the equivalence of inertial mass and gravitational mass).*

Through Einstein’s analogy, in order to describe a “mass in motion in a gravitational field”, we have to go back to the inside of the accelerated elevator, and see what happens to the object originally at rest on the floor of this, say, if it is thrown, in a given direction.

Only the comparison of the “rest mass of the object originally lying on the floor of the elevator”, and the “relativistic mass of this object brought to a given motion inside the elevator”, in regards to a given observer *(to be specified),* can *(via Einstein’s analogy)* bring an answer to the question introduced by Newton, regarding the “gravitational mass”, and the “inertial mass”; it is obvious that these are not either equal within the frame of the GTR.

Thus anyone, caring about the PE should not really be frustrated right away, when we say that the “gravitational mass” and the “inertial mass” are not really equal. It is that they are not equal in the way Newton first questioned. Unfortunately there are quite a number of books, which are inevitably misleading when they introduce the PE, through Newton’s original question, and they aim to provide an answer to it in a domain where Newton’s original tools are demolished by Einstein.

We would like to add two major points.

Few Words About the Highly Accurate Measurements Worshiped With Regards to the PE From Our Stand Point

The first one consists in the reasonably precise measurements endorsing the equivalence of the, so to say, "inertial mass" and "gravitational mass". *(We say so, because as explained above, the wording of such an equivalence, in many books, if not unacceptable, is misleading.)*

Thus, we are, by reviewers and friends, severely asked the following question:

- *How can you (if not deny), but still dare to bypass such a trustable result?*

As useful as it may be, for us, the PE is of course well thought-of, but still like "electronic tubes", that is bound to be forgotten, when replaced by transistors. It is that we do not need it anymore, within the frame of the present approach. Once again, it is of course, monumental, it served a lot, yet please we would like the reader understand it, we do not needed anymore We are truly sorry for those who are fond of it, but we have happened to show that the law of conservation of energy does all the job. That is the way it is, and we will a little bit more elaborate on this, below.

It is true that our findings puts at stake the PE, but this principle is already, scrupulously, questioned.[19,20]

The equality of the gravitational mass and the inertial mass, based on the approach presented herein, is an approximation which is acceptable, only if the velocity of the object in motion is small, as compared to the velocity of light in empty space.

It is anyway interesting to note that, all the highly precise measurements regarding the relative divergence of these two masses *(how ever they are defined),* are performed on Earth *(where the observer is moving with Earth),* so that the precision they produce, no matter how fine this may be, *according to our approach,* should be considered, as misleading. In effect, since along our finding, [gravitational mass] = [inertial mass] / [Lorentz dilation factor]^2 (the above relationship), it seems that one should not rely on the experiments in question, any more then he should count on the null result of the Michelson Morley experiment[21] *(which, being performed on Earth, fails to detect the motion of Earth around the sun, or else).* In other terms, the Galilean Principle of Relativity,[22] which is the main ingredient of the STR, forbids that we can on Earth, detect any such difference, based on the velocity of motion in question *(since otherwise we should be able to tell, how fast we are cruising in space, and we cannot).*

Not knowing that, the equality of gravitational mass and inertial mass, is only approximate, one may still insist *(just the way it is done regarding the experiments in question)* that, such an equality can well be established on Earth. But the rotational velocity v_0 of Earth around itself is 1667 km/hour. Hence one should attain a precision of v_0^2/c_0^2, i.e. better than 2.6 x 10^{-12}, whereas the highest precision reached so far, is barely, this much.

We can yet well rely, as Newton himself predicted, on measurements based on a possible polarization of Earth and the Moon, through their motion around the sun. The polarization according to our approach, must result from the fact that the speed of the Moon with respect to the sun, as the Moon rotates around Earth, varies slightly. The speed of Earth around the sun is about 30 km/s. The speed of the Moon around Earth is about 0.6 km/s. Thus the speed of the Moon with respect to the sun is about 30 km $\pm$ 0.6 km . The detection of a difference in the falls of Earth and that of the Moon toward the sun, thus requires a measurement of the distance between the Earth and the Moon, with a precision better than $(0.6^2 \text{ km}^2/\text{s}^2)/c_0^2$, i.e. $\sim 4\text{x}10^{-12}$ whereas the precision actually reached is still below this.[23,24]

Note further that, even through the fastest observable celestial motions, such as that of binary stars, around each other (where the objects move with speeds around 1000 km/s), the difference between the gravitational mass and the inertial mass, remains still undetectable.

The Classical Approach, Developed on the Basis of the PE, is Somewhat Equivalent to the Present Approach - Taking into Account the Mass Decrease due to Static Binding - in Describing an Object Sitting in a Gravitational Field

The next major point we would like to bring to the attention of the reader, at this stage, is the following: The classical approach developed on the basis of the PE, is somewhat equivalent to the present approach, in describing, the changes an object sitting *(at rest)* in a gravitational field, would display. Indeed, following our approach, as will be summarized, below, an object brought quasistatically into a gravitational field, suffers a mass deficiency, and this, as much as the gravitational binding energy coming into play. The concept of *binding energy* is worked out in Part I, of this work, with regards to the closed system chiefly made of the pair of proton and electron. The idea is exactly the same, with regards to the closed system made of the pair of a celestial body and an object bound to it.

Such a decrease of rest mass is, owing to the law of conservation of energy, broadened to embody the equivalence of mass & energy drawn by the STR, nothing else, but a decrease of the overall rest relativistic energy of the object in hand. This yields, a *weakening* of the *internal energy* of the object, at hand; thus the *classical red shift,* which is substantially, the same result yeld by the GTR. More generally, along with our approach, we consider the stationary quantum mechanical description of the object in consideration. Now, if we inject in this description an arbitrary decrease of different masses taking place in there, and this, by the same amount, to represent the mass decrease the object would display in the gravitational field, then quantum mechanically, we find that, the total energy of the object, or the same, the eigenvalue of the quantum mechanical description of it, decreases just as much. Thus, the *red shift.* Concomitantly, the *size of the object stretches,* as much.

What we would like to stress here, is that, in fact such a procedure, virtually achieves, what the PE does, with regards to the object sitting on the floor of the accelerated elevator, assumed to represent the gravitational field.

This is exactly why, we affirm that we do not need the PE, since we are well able to get the end results of the GTR *(up to a precision, actual measurements delineate),* via essentially, the law of conservation of energy.

There are though characteristic differences between our approach and the GTR *(although, as mentioned, the end results, are very similar).*

The major difference is that the PE can be applied to an object, subject to a gravitational attraction, exclusively, whereas our approach can be applied to any object, subject to any force.

This makes that, whereas the stick meter contracts in a gravitational field, only if it is lied, parallel to the attraction direction, in our approach, it is stretched just as much, and this uniformly, in all directions. *(Recall that in the GTR, originally, only if the stick meter is lied along a direction perpendicular to the gravitational attraction, as assessed by a distant observer, it remains untouched.)*

Furthermore, the mass of the object in the GTR increases in the gravitational field, whereas in our approach it decreases.

But then, all that with regards to the GTR, yields not only incompatibilities, and possibly a violation of the laws of energy conservation and momentum conservation, but also blocks the association of the gravitational attraction, with any other force field, for one is unable to conceive a PE with regards to forces, other than the gravitational attraction *(since, there is no such thing as electric mass, or nuclear mass, that can be visualized like the "gravitational mass").* It is furthermore important to recall that the GTR does not allow the quantization of the gravitational effect.

These problems do not really constitute the topic of this article. How ever, being targeted with conservative reactions, we are somewhat obliged to mention them.

We are accordingly bound to present a clue as to what, differences between the GTR and our approach occur, although both theories, end up with practically the same results.

Clue to the Question of How Come that our Results are the Same as the End Results of the GTR, But Still Display Characteristic Differences

To make things easy, let us consider a rotating disc. The PE, tells us that a clock nailed to the disc and rotating with it, is equivalent to its twin sitting on a gravitational ground, supposing that the centrifugal acceleration of the disc and the gravitational acceleration, affecting respectively both clocks, are equal.

The centrifugal acceleration of the disc and the gravitational acceleration, separately, delineate respectively the *"accelerational world"* which we call AW, and the *"gravitational world"* which we call GW.

Elsewhere[15,16] we have proven that the classical PE is based on a non-conform analogy, i.e. it does not embody a *one to one correspondence* between the AW and the GW. Although it furnishes good results, it appears to be totally erroneous.

For one thing, the PE overlooks the *rest mass deficiency the object brought to the force field should undergo,* and this constitutes a clear violation of the law of energy conservation.

Recall that, Kündig, almost half a century ago, measured the time dilation of an object in rotation, and published results that were claimed to be firmly in agreement with the classical prediction.[17] However, decidedly he has misprocessed the data,[18] and the measured time dilation effect, turns out to be much greater than that predicted by the classical theory.

The remedial of the classical PE, leaves it unnecessary. We do not need it. On the contrary we can straight, derive it, based on our approach.

Thus, we state it like this:

- *Both gravitation and acceleration alters the rest mass in the same manner; the rest mass decreases as much as the energy necessary to furnish to the object in order to remove it from the force field*.

Thus gravitation is not a privileged field, at all. Any field, even that caused by a centripetal force due to a rotational motion, does the same.

Thence the gravitational theory the author of the present article, has developed, well covers, the end results of the GTR, and beyond, since it turns out to be valid *(not only for gravitation, but)* for all fields. It excludes any singularity, and treats the photon like any ordinary object. The decrease of the mass of the bound particle, via our quantum mechanical theorem *(we will soon recall),* applied to the internal dynamics of the particle in hand, changes both the period of time, and the size of space to be associated with the internal dynamics in question, in exactly the same manner, at either an atomistic scale, or a celestial scale.

Our approach yet, leads to a different metric than that of the GTR. Thus, briefly, the mass of an object embedded in a gravitational field *(in fact, any field, it can interact with),* is decreased as much as the binding energy coming into play. *(According to the GTR, it increases.)* The length of it, according to our approach stretches, just as much, and this uniformly. *(According to the GTR, it contracts, and this, originally, along the direction of attraction, only.)* The period of time associated with the object, dilates along our approach. *(According to the GTR, it dilates just as much, but also delineates a singularity.)*

How ever, our approach remedies the splitting between Newton's approach and Einstein's approach It restores the incompatibilities arising between the STR, and the GTR, such as the breaking of the fundamental relativistic result, [energy] = [mass] x [speed of light]^2. Along the same line, it does not allow the law of energy conservation, nor the law of momentum conservation to break down *(contrary to, as pointed out, what happens within the frame of the GTR).*

Furthermore, because it leaves unnecessary the usage of the PE, i.e. the basis of the GTR, it provides us with a whole different horizon. We come to be able to establish a natural link between our approach and quantum mechanics, otherwise badly hindered by the GTR.

In effect, the frame we draw, describes in an extreme simplicity, both the atomic scale, and the celestial scale, on the basis of respectively, Coulomb force *(written for static electric charges only),* and Newton's force *(written for static masses only).* Thus the frame we draw, yields exactly the same metric change and quantization, at both atomic and celestial scales.

In particular, gravitationally bound clocks shall, according to our approach, retard as implied by the amount of the gravitational binding energy coming into play; thus not only this, but, *"clocks anyway bound to any field"*, they interact with, should also retard. For instance, an electrically charged clock, bound to an electric field, must come to slow down, just like clocks bound to gravitational field, slow down. More specifically, a muon decay's rate, when bound to an atomic nucleus, as pointed out above, retards as much as the binding energy, coming into play. This shows that, the *metric change* induced by protons nearby a nucleus is exactly the same as the metric change induced by the mass nearby a celestial body.

These happen to be the heartening harvests of our approach.

Most important of all, our approach (based on just the law energy conservation, broadened to embody the mass & energy equivalence of the STR), allows, as we will elaborate throughout, the derivation of de Broglie relationship, just based on the law of energy conservation, with regards to the gravitational field (just like we did it, with regards to the electric field), thus indeed, the quantization of the gravitational field (not any different than the quantization of the electric field).

This is what we will undertake in this article.

About the de Broglie Relationship

In the previous Part 1, we have formulated the de Broglie relationship as

$$\lambda_B = \lambda_0 \frac{c_0}{v_0}\sqrt{1-\frac{v_0^2}{c_0^2}} \qquad \text{[Eq.(6) of Part I]} \; ; \tag{1}$$

λ_B is the de Broglie wavelength; λ_0 is given by

$$h\nu_0 = m_0 c_0^2 \quad ; \tag{2}$$

m_0 is the rest mass of the object in consideration; c_0 is the speed of light in empty space; ν_0 is the frequency of the electromagnetic radiation, were the object in hand (totally) annihilated.

By definition, we have

$$c_0 = \frac{\lambda_0}{T_0} = \lambda_0 \nu_0 \, ; \tag{3}$$

thus, T_0 is the period of time of the wave coming into play.

Eqs. (2) and (3) lead

$$\lambda_0 = \frac{h}{m_0 c_0} \quad . \tag{4}$$

Dividing the two sides of Eq.(1), by T_0, yields

$$\frac{\lambda_B}{T_0} = \frac{\lambda_0}{T_0}\frac{c_0}{v_0}\sqrt{1-\frac{v_0^2}{c_0^2}} = \frac{c_0^2}{v_0}\sqrt{1-\frac{v_0^2}{c_0^2}} \quad \text{[Eq.(7-a) of Part I]} \ . \tag{5}$$

Let us define for convenience, the LHS, as U_B:

$$U_B = \frac{\lambda_B}{T_0} \quad . \tag{6}$$

Thus U_B, via Eq.(2), becomes

$$U_B = \frac{c_0^2}{v_0}\sqrt{1-\frac{v_0^2}{c_0^2}} \quad \text{[Eq.(7-c) of Part I]} \ . \tag{7}$$

Eqs. (5) and Eq.(6), tell us that, through a motion, such as the Bohr rotational motion of, say the electron around the proton, in the hydrogen atom, each time the inherent periodic phenomenon of the electron (assumed by de Broglie, and) described by λ_0, beats; something else too beats all the way through the stationary orbit of perimeter λ_B. In other words the de Broglie wavelength, becomes the wavelength of the pulse of frequency $\nu = \nu_0 / \sqrt{1 - v_0^2 / c_0^2}$, propagating with the speed c_0^2 / v_0 * [cf. Eq.(6-b) of Part I], where ν_0 is the inverse of T_0.

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Below, we first summarize our previous work, which led to a novel equation of gravitational motion (Section 2). Then, we describe our "jet model", simulating the gravitational interaction (Section 3). Next, based on our approach, and essentially the law of energy conservation, we derive the de Broglie relationship, for gravitational interaction (Section 4). A general conclusion, regarding both the electric interaction and the gravitational interaction, is drawn, afterwards (Section 5).

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* $\frac{c_0^2}{v_0} = \lambda_B \nu = \lambda_B \frac{\nu_0}{\sqrt{1-\frac{v_0^2}{c_0^2}}}$. [Eq.(6-b) of Part I]

2. PREVIOUS WORK: A NOVEL APPROACH TO THE EQUATION OF GRAVITATIONAL MOTION

In a previous work,[2,3,12,13] a whole new approach to the derivation of the Celestial Equation of Motion was achieved; this, well led to all crucial end results of the GTR(in a few lines only, and already in an integrated form).

Thus, we had started with the following postulate, essentially, in perfect match with the "relativistic law of conservation of energy", thus embodying in the broader sense the concept of "mass", though we will have to precise, accordingly, the notion of "field".

Postulate: The rest mass of an object bound to a celestial body amounts to less than its rest mass measured in empty space, the difference being, as much as the mass, equivalent, to the binding energy coming into play.

A mass deficiency conversely, via quantum mechanics yields the stretching of the size of the object at hand, as well as the weakening of its internal energy, via quantum mechanical theorems proven elsewhere,[25] still in full conformity with the STR. An easy way to grasp this is to consider Eq.(2). If the mass is decreased due to binding, so will be the frequency. Thus the red shift. Eq.(4) makes that the size is accordingly stretched.

In order to calculate the binding energy of concern, we make use of the classical Newtonian gravitational attraction law, yet with the restriction that, it can only be considered for static masses.

Luckily we are able to derive the 1/distance^2 dependency of the gravitational force between two static masses, still just based on the STR.[26]

Thus, the framework in consideration fundamentally lies on the STR.

Henceforth, one does not require the *principle of equivalence* assumed by the GTR, as a precept, in order to predict the end results of this theory.

Let then m_0 be the mass of the object in consideration, at infinity. When this object is bound at rest, to a celestial body of mass $\mathcal{M}$, assumed for simplicity infinitely more massive as compared to m_0, this latter mass will be diminished as much as the binding energy coming into play, to become m(r), so that[10]

$$m(r) = m_0 e^{-\alpha(r)} \ , \tag{8}$$

(mass of the bound object at rest)

where $\alpha(r)$ is

$$\alpha(r) = \frac{G\mathcal{M}}{rc_0^2} \ ; \tag{9}$$

G is the universal gravitational constant; r is the distance of m(r) to the center of $\mathcal{M}$, as assessed by the distant observer; recall that, after all, G is not as universal as one may think it is, since we have shown that it depends on the location.[13]

Note that, as Eq.(8) delineates, the present theory excludes singularities, thus black holes.[10]

Now suppose that the object of concern is in a given motion around $\mathcal{M}$; the motion in question, can be conceived as made of two steps:

i) Bring the object quasistatically, from infinity to a given location r, on its orbit, but keep it still at rest.

ii) Deliver to the object at the given location, its motion on the given orbit.

The first step yields a decrease in the mass of m_0 as delineated by Eq.(8). The second step yields the Lorentz dilation of the rest mass m(r) at r, so that the overall mass $m_\gamma(r)$, or the same, the total relativistic energy of the object in orbit becomes

$$m_\gamma(r)c_0^2 = \frac{m(r)c_0^2}{\sqrt{1-\frac{v_0^2}{c_0^2}}} = m_0 c_0^2 \frac{e^{-\alpha(r)}}{\sqrt{1-\frac{v_0^2}{c_0^2}}} \; ; \tag{10}$$

(overall mass, or the same, total energy of the bound object, on the given orbit)

v_0 is the local tangential velocity of the object at r.

Here, the reason for which we refer to the distance r, as measured by the distant observer, is that, we consider the Newton's law of gravitational attraction, specifically in that frame.[6]

The total energy of the object in orbit [i.e. $m_\gamma(r)c_0^2$] must remain constant, so that for the motion of the object in a given orbit, one finally has

$$m_\gamma(r)c_0^2 = m_0 c_0^2 \frac{e^{-\alpha}}{\sqrt{1-\frac{v_0^2}{c_0^2}}} = \text{Constant} = m_\gamma \quad . \tag{11}$$

(total energy written by the author, for the object in motion around the sun)

This is in fact, the integrated form of the general equation of motion, we will furnish right below; it is interesting to note that we have arrived at it, in just three lines [i.e. Eqs. (8), (10) and (11)].

The differentiation of the above equation leads to

$$-\frac{G\mathcal{M}}{r^2}\left(1-\frac{v_0^2}{c_0^2}\right)dr = v_0 dv_0 \ . \tag{12-a}$$

[differential form of Eq.(11),
leading to the equation of motion]

This equation can be put into the form

$$-\frac{G\mathcal{M}}{r^2} m_0 e^{-\alpha_0} \sqrt{1-\frac{v_0^2}{c_0^2}}\, \frac{\underline{r}_0}{r_0} = m_\gamma \frac{d\underline{r}_0^2(t_0)}{dt_0^2} \ , \tag{12-b}$$

or in the form

$$-\frac{G\mathcal{M}}{r_0^2}\left(\frac{e^{-\alpha_0}}{1+\alpha_0}\right)\left(1-\frac{v_0^2}{c_0^2}\right)\frac{\underline{r}_0}{r_0} = \frac{d\underline{r}_0^2(t_0)}{dt_0^2} \ , \tag{12-c}$$

[vectorial equation written based on Eq.(12-a), *or the same,*
equation of motion written by the author, via the law of energy conservation,
extended to cover the relativistic "mass & energy equivalence"]

written in terms of the *proper quantities* only, via the relationship

$$r = r_0 e^{\alpha} \cong r_0 e^{\alpha_0} \ , \tag{12-d}$$

(length stretched in the gravitational field)

as induced by Eq.(8), and a theorem proven elsewhere[21] [which can be quickly cross checked via Eq.(4)]; $\underline{r}_0$ is the vector bearing the magnitude r_0, and directed outward.

It should be recalled that, though consisting in a totally different set up, than that of the GTR, Eq.(11), thus Eq.(12-a) and (12-c), amazingly yields results identical to those of this theory, within the frame of the second order of the corresponding Taylor expansions,[13] yet in an incomparably easier manner.

Eq.(12-b) is the same relationship as that proposed by Newton, except that the gravitational force intensity is now decreased by the factor $e^{-\alpha_0}\sqrt{1-v_0^2/c_0^2}$.

Note that our approach, just like the classical Newtonian approach, leads to the *"law of linear momentum conservation",* as well as the *"law of angular momentum conservation" (contrary to what is drawn within the frame of the GTR, where these classical laws are broken).*

It is peculiar to show how our approach leads in general to the *"law of linear momentum conservation"*.

Nonetheless it does not take long to show how it leads to the *"law of angular momentum conservation"*. One can see this readily, by multiplying the vector Eq.(12-c), by the vector $\underline{r}_0$. Thus the related cross product becomes:

$$m_\gamma(r_0)\underline{r}_0 \times \frac{d\underline{v}_0(t_0)}{dt_0} = 0 \quad . \tag{12-e}$$

[the cross product of Eq.(12-b) *by* $\underline{r}_0$ *]*

The integration of this equation yields

$$\underline{r}_0 \times \underline{v}_0(t_0) = \text{Constant} \quad . \tag{12-f}$$

(Angular Momentum Conservation law derived from the author's set up)

This result is important, since it tells us that, our approach is quite compatible with Kepler's laws.[27,28]

Furthermore, we find it remarkable that within the frame of our approach, we are able to treat a "light photon" just like any other particle. Thus Eqs. (11), (12-a), (12-b) and (12-c) are perfectly valid for a photon, just like any object affected by the gravitational field.

This has two interesting consequences:

1) The first one is that the photon as small as this may be, bears a kernel; de Broglie speculates on this point in his doctorate thesis, and calculates the *"rest mass of the photon"* to be 10^{-44} grams, if an electromagnetic wave of wavelength of 1 kilometer, moves with a speed, relatively 10^{-2} times faster than an electromagnetic wave of wavelength of 30 kilometers.[29]

2) Secondly, yes, there is a ceiling to the propagation of the velocity of light in *"empty space"*, yet this is, the speed of a photon of practically *"infinite energy"*. This is the *"Lorentz invariant velocity of light"* c_0, which enters our equations.

At this stage it seems useful to draw the following table displaying the differences between our approach and the standard approach.

Table 2 Differences Between the "Standard Approach" and "Present Approach", Based on the Pair of Sun and Planet

	Standard Approach	**Present Approach**
Force Between the Sun and the Planet, Altogether at Rest	$G\dfrac{\mathcal{M}m_0}{r^2}$	$G\dfrac{\mathcal{M}m_0 e^{-\alpha}}{r^2}$ *(as assessed, by the distant observer)*
Total Energy of the Statically Bound Planet	$m(r_0)c_0^2 = m_0 c_0^2 - \dfrac{G\mathcal{M}}{r}$ *(Newtonian Approach)* $m(r_0)c_0^2 = m_0 c_0^2\sqrt{1-2\alpha}$ *(Einsteinian Approach)*	$m(r_0)c_0^2 = m_0 c_0^2 e^{-\alpha}$
Total Dynamic Energy	Rest Energy + Potential Energy + Kinetic Energy *(Newtonian Approach)*	The concept of *potential energy*, as considered classically, is misleading.
Total Dynamic Energy of the Sun and the Planet in Motion	$m_\gamma(r_0)c_0^2 = m_0 c_0^2 \dfrac{\sqrt{1-2\alpha}}{\sqrt{1-\dfrac{v_0^2}{c_0^2}}}$ *(The Einsteinian total energy)*	$m_\gamma(r_0)c_0^2 = m_0 c_0^2 \dfrac{e^{-\alpha}}{\sqrt{1-\dfrac{v_0^2}{c_0^2}}}$
Force Between the Sun and the Moving Planet	$G\dfrac{\mathcal{M}m_0}{r^2}$ *(Newtonian Approach)*	$\dfrac{G\mathcal{M}}{r^2} m_0 e^{-\alpha_0}\sqrt{1-\dfrac{v_0^2}{c_0^2}}$

In order to circumvent conservative reactions, we better spell few words regarding the discrepancy (as small as this may be), displayed by the raw before the last one, in the above table, between our result and the corresponding result yeld by the GTR,[30] i.e.

$$m_\gamma(r)c_0^2 = m_0 c_0^2 \frac{\sqrt{1-2\alpha}}{\sqrt{1-\frac{v_0^2}{c_0^2}}} = Constant, \text{ versus } m_\gamma(r_0)c_0^2 = m_0 c_0^2 \frac{e^{-\alpha}}{\sqrt{1-\frac{v_0^2}{c_0^2}}} = Constant \quad . \qquad (12\text{-k})$$

(total relativistic energy of a given object,
predicted by the GTR, versus that predicted by our approach)

Our result, coincides up to the second order of the corresponding Taylor expansion, with the result furnished by the GTR (i.e. the first relationship, written above).

There is no easy way to interpret the singularity appearing in the numerator of the Einsteinian equation appearing above, whereas not only that it is possible to ascertain what the numerator of our expression is all about, but also the set up of it, is almost evident. We would like to recall that, in fact, the singularity arises because of the non-conformal analogy between the accelerational world and the gravitational world, leading to the set up of the GTR.[15]

Thus we are not a bit disappointed not to have obtained identical same results in comparison with the GTR. The two approaches are based on completely different setups. And as pointed out, although the GTR furnishes good results, it seems to be totally erroneous. For one thing, it overlooks the *rest mass deficiency the object brought to the force field should undergo,* and this is a clear violation of the law of energy conservation. Strikingly, it catches up with this, through a serie of mistakes, devilishly compensating each other.

Thence the discrepancy coming into play does not a bit disfavor our approach, up against the one worked out within the frame of the GTR.

What about the singularity, yielding to the “black hole” concept, and so very many accompanying works. Too bad! There is no singularity underlined by the present approach.

Recall that our result is yet fully consistent with what Yilmaz would have written,[31,32] in the same way as that presented by Landau and Lifshitz leading to the GTR’s relationship, then with the exponential correction, Yilmaz proposed to Einstein’s metric, i.e.

$$m_\gamma(r)c_0^2 = m_0 c_0^2 \frac{e^{-\alpha}}{\sqrt{1-\frac{v_0^2}{c_0^2}}} = Constant \quad , \qquad (12\text{-l})$$

(relationship that would have been written by Yilmaz, had he followed
the same way as that presented by Landau and Lifshitz, with regards
to the GTR, thus along with the correction he proposed to Einstien’s metric)

though the set up would still be very different. Further, we would like to mention that, likewise, Logunov landed at a similar result, with no singularity, whatsoever.[33]

3. MASS *SUBLIMES* INTO KINETIC ENERGY, AND KINETIC ENERGY *CONDENSES* INTO MASS, THROUGHOUT THE MOTION: A JET MODEL

According to our approach, $c_0^2\, m_{0\gamma}(r_0)$ of Eq.(11) (i.e. the total relativistic energy of the planet) ought to be constant, all along the planet's journey around the sun.

As the planet speeds up nearby the sun, it is that, an "infinitesimal part of its rest mass", somehow "sublimes" into "extra kinetic energy" (the planet acquires, as it accelerates). In other words, the extra kinetic energy coming into play, is fueled by an equivalent rest mass.

As the planet slows down away from the sun, through its orbital motion, it is that, a "portion of its kinetic energy", somehow "condenses" into "extra rest mass", on the orbit. In other words, the rest mass spent previously to fuel the extra kinetic energy, is now brought back.

One way of conceiving this phenomenon, is to think in terms of a "jet effect". Thus, within the frame of such a modeling, in order to accelerate, the planet would throw out an infinitesimal "net mass" from the "back", just like an accelerating rocket. Conversely, in order to decelerate, it would absorb an infinitesimal "net mass", from the "front".

Whether in reality, the whole thing works out this way or not, we do not know it. For the present purpose, we do not need to know it, either. Though, we came to be able to refer to a mechanism which can provide us, with the end result we have disclosed (i.e. the rest mass change throughout), that we require, in order to take care of the variation of the kinetic energy, in relation to the variation of the static gravitational binding energy, thus in relation to the variation of the rest mass of the bound object (imposed by the law of energy conservation). Hence, we can well base ourselves on it, to make useful predictions.

Now refer to Eq.(12-a). Thus suppose that around the location r, the planet of rest mass m(r), and velocity v_0, accelerates as much as dv_0, through an infinitely small period of time dt_0, around the time t_0.

This occurrence, according to our approach, is insured by an amount of jet of mass -dm(r) thrown by the planet, through the period of time dt_0, with a *tangential jet velocity* U, with respect to the fixed sun. The law of momentum conservation requires that *(cf. the derivation provided in Part I, regarding an electric motion, whose frame turns out to be strictly identical to that of the gravitational motion),*

$$m_\gamma(r)dv_0 = -Udm(r)\,; \qquad (13\text{-a})$$

(kick received by the planet due to the jet effect, on a rectilinear motion)

note that the quantity dm(r), by definition,[†] is negative [so that –dm(r) is a positive quantity].

[†] dm(r) = m(r+dr)-m(r) < 0, when the planet accelerates via throwing out mass; m(r) is the planet's mass at r.

Recall that above, we happened to have associated the jet speed U with the "rest mass variation" $\left|dm(r_0)\right|$, the planet displays on the way. We did it on purpose, just the way we did on the level of Eq.(16-a) of Part I. The reason is that, as we will see, it is the rest mass $\left|dm(r_0)\right|$ that can be determined directly, here, from the related static gravitational binding energy; moreover, $dm(r_0)$ may well be zero, while U still remains defined.

At any rate, here again, not to yield misinterpretations, the "jet momentum" $U\left|dm(r_0)\right|$, should better be written, as

$$\left|dm(r_0)\right|U = \frac{\left|dm(r_0)\right|}{\sqrt{1-\frac{V^2}{c_0^2}}}V = \gamma_V\left|dm(r_0)\right|V = \left(\gamma_V\left|dm(r_0)\right|\right)V = \left|dm(r_0)\right|\left(\gamma_V V\right) , \qquad (13\text{-b})$$

(momentum of the jet expressed in different terms)

where γ_V is

$$\gamma_V = \frac{1}{\sqrt{1-\frac{V^2}{c_0^2}}} \quad , \qquad (13\text{-c})$$

and V is the jet speed of the "relativistic mass" $\gamma_V\left|dm(r_0)\right|$, so that

$$\gamma_V V = U \ . \qquad (13\text{-d})$$

Eq.(13-b) is remarkable, given that the RHS of it, i.e. $\gamma_V\left|dm(r_0)\right|V$ can be read either as $\left(\gamma_V\left|dm(r_0)\right|\right)V$, or as $\left(\gamma_V V\right)\left|dm(r_0)\right|$. In the former case the *relativistic mass* $\left(\gamma_V\left|dm(r_0)\right|\right)$ multiplies the speed V to yield the *relativistic momentum* of the jet in consideration. The latter case becomes interesting, as we will see, for the case where $dm(r_0)$ is zero, pointing to an interaction with *"no net mass variation";* in this case, the product $\gamma_V V = U$ is to be considered as *a whole;* in any case, the product $\gamma_V V$, is to be considered as a whole, since it turns out that we will end up with U, as just *one specific quantity,* and not separately γ_V and V.

This outcome is remarkable, because, as simple as it may look, along with our approach, it underlines the *particle-wave duality (not only for the atomistic world, as discussed in the previous* Part I, *but)* for the celestial world, as well: The relativistic momentum $\left(\gamma_V\left|dm(r_0)\right|\right)V$, evidently points to a *particle character* of the electron, whereas $\gamma_V V = U$ as *a whole,* taking place in the product $\left|dm(r_0)\right|\left(\gamma_V V\right)$ *(as we will soon discover)* indeed works as the key of the *wave-like character* of the object in hand; this becomes particularly evident when $dm(r_0)$ vanishes.

For the gravitational interaction too, we will discover that $U = (c_0^2 / v_0)\sqrt{1 - v_0^2 / c_0^2}$, and $V = c_0\sqrt{1 - v_0^2 / c_0^2}$; for this reason we propose to call U the *“wave-like jet speed”,* or the *“superluminal jet speed”,* and V the *“relativistic jet speed”;* wherever we write just *“jet speed”,* we will mean the tangential wave-like speed U.

Based on our jet model, henceforth, there seems reason to believe that, even when the *“jet mass”* is null, which happens to be the case for a circular motion [cf. Eqs. (16), (17) and (22) of Part I], whatever is the *information* we would expect to be carried by the jet speed, this information is still transferred. It is that, when there is no change in the speed of the moving object, the *“jet mass”* is accordingly zero. But as we will once again derive *(here, vis-à-vis the gravitational motion),* U ultimately depends only on the velocity v_0 of the moving object. Thus even if the jet mass is null, U is finite. In other words, whatever is the information carried by the jet speed U, this information can still be transferred, along with *“no mass”,* thus *“no energy”* transfer, whatsoever. This is interesting since we came to say that:

- *The gravitational information, just like the electric information, can well be transferred with no need of energy exchange.*

4. DERIVATION OF THE DE BROGLIE RELATIONSHIP, AND SUPERLUMINAL SPEEDS

Let us now multiply Eq.(13-a) by c_0^2:

$$c_0^2 m_\gamma(r) dv_0 = -c_0^2 U dm(r) . \tag{14}$$

The law of energy conservation requires that, the quantity $-c_0^2 dm(r)$, appearing at the RHS of this equation, must come to be equal, to the change in the corresponding kinetic energy, which in return, must be equal to the change in the corresponding gravitational static binding energy [cf. Eq.(8)].

Thus

$$c_0^2 dm(r) = G\frac{\mathcal{M} m(r)}{r^2} dr \quad . \tag{15}$$

(variation of the rest mass, in terms of the static, gravitational binding energy)

Note, on the other hand that, when the planet accelerates, it gets closer to the sun; in this case dr [just like, dm(r)], turns out to be a negative quantity.

Equating the LHS of Eq.(14), with the product of the RHS of Eq.(15) and U [via Eq.(10)], leads to

$$c_0^2 m_0 \frac{e^{-\alpha}}{\sqrt{1 - \frac{v_0^2}{c_0^2}}} dv_0 = -UG\frac{\mathcal{M} m_0 e^{-\alpha}}{r^2} dr \quad . \tag{16}$$

Here, we can replace dv_0, by the same quantity, furnished by Eq.(12-a).

Thence, the jet velocity U, as assessed by the distant observer, turns out to be

$$U = \frac{c_0^2}{v_0}\sqrt{1-\frac{v_0^2}{c_0^2}} \quad . \tag{17}$$

(the jet speed as referred to the outside fixed observer)

This equation is amazingly the same as Eq.(7), if the jet velocity U is taken to be same as U_B, of this latter equation. It only depends on the velocity of the object of concern.

We can, anyway, write Eq.(17) as

$$U = \frac{\lambda_0}{T_0}\frac{c_0}{v_0}\sqrt{1-\frac{v_0^2}{c_0^2}} \quad , \tag{18}$$

via the usual definition of the velocity of light, i.e. Eq.(3).

Now, if we propose to write the jet velocity U, in question, in terms of the period of time T_0, of the electromagnetic wave, we associate with the mass m_0, along Eq.(2); we come to the expression of a wavelength λ, in terms of λ_0, i.e.

$$\frac{\lambda}{T_0} = \frac{\lambda_0}{T_0}\frac{c_0}{v_0}\sqrt{1-\frac{v_0^2}{c_0^2}} \quad , \tag{19}$$

which is nothing else, but the de Broglie wavelength [cf. Eq.(1)]:

$$\lambda = \lambda_B = \lambda_0 \frac{c_0}{v_0}\sqrt{1-\frac{v_0^2}{c_0^2}} \quad ; \tag{20}$$

(de Broglie wavelength obtained from the wave-like jet speed, derived in here)

recall that we did not have to allow any restriction, while landing at this relationship.

Tough it remains interesting to tackle with it, primarily for a constant velocity, thus for a circular motion.

For such a motion, for the nth level, one can write (cf. the concluding footnote in the Introduction of Part I):

$$\lambda_{Bn} = n\lambda_0 \frac{c_0}{v_{0n}} \sqrt{1 - \frac{v_{0n}^2}{c_0^2}} = \frac{nh}{m_0 v_{0n}} = 2\pi r_n \ , \tag{21}$$

(de Broglie wavelength on the n^{th} orbit)

r_n, being the radius of concern.

This relationship, numerically would serve, to calculate n, if other quantities are given:

$$n = \frac{2\pi r_n m_0 v_{0n}}{h} \quad ; \tag{22-a}$$

n, for earth rotating around the sun, for instance, approximately becomes

$$n \approx 122 \mathrm{x} 10^{72} \quad . \tag{22-b}$$

This number appears to be very large; yet this affects in no way the validity of the foregoing approach. The fact that a relationship similar to Eq.(20), can be obtained, on the basis of an electric interaction (the way it was achieved in Part I), already constitutes a direct derivation of the usual de Broglie relationship.

We can, on the other hand, calculate the velocity u of the jet velocity, with respect to the planet. As a rough approximation, one can write,

$$u \approx U + v_0 \ , \tag{23}$$

where v_0 is the speed of the electron, with respect to the proton (assumed at rest); we will call u the *superluminal jet speed*, since, as clarified right below, it is always greater than the speed of light. (Note that in our approach the ceiling c_0 cannot be reached, unless the photon bears an infinite amount of energy.[13])

Obviously we do not know the rule regarding the addition of superluminal velocities, with velocities lying under the speed of light. Nonetheless, the examination of Eq.(17), makes our task easy. The two interesting cases indeed occur for $v_0 = 0$ and $v_0 = c_0$. For $v_0 = 0$, $U = \infty$; thus one can, right away guess that, in this case, u must be infinite. For $v_0 = c_0$, $U = 0$; thus one can guess that, in this case u must be c_0.

Hence, in conformity with the usual conception regarding the *tachyon postulation,*[34,35] we can well establish that, the superluminal interaction speed u (with respect to the object in question), varies between ∞ (for the object of concern, at rest), and c_0 (for the object moving with the speed of light). As tautological as it may seem, this yields the fact that, light cannot interact with anything, via a speed above the speed of light (since its superluminal jet speed is, at best, c_0).

One final remark should consist in the following:

Our approach seems to bring an answer to the quest of *"gravitational interaction achieved with a speed much faster than the speed of light"*. The fact that the sun and the planets must interact with each other with a speed at least a hundred and nine times larger than the speed of light, is to be known, since Laplace.[36] The French Scientist, more than two centuries ago, had discovered that if the gravitational field propagates with the mere speed of light, then the sun and the planets would get torn apart. This would yield the doubling of the Earth's distance from the sun, in 1200 years. Amazingly this discovery of Laplace, no doubt, because it is considered to contrary theory of relativity, does not take place in very many text books. It is unfortunate that many physicists, are accordingly unaware of Laplace's findings. Via the same considerations, one with recent data, can conclude that the speed of propagation of gravity comes to amount even much greater velocities.[37,38]

5. GENERAL CONCLUSION

Herein, based on just energy conservation, we figured out that, the gravitational motion, just like the electric motion, depicts some sort of *rest mass exchange,* throughout. One way to conceive this phenomenon is to consider a *jet effect*. Accordingly, an object on a given orbit, through its journey, must eject mass to accelerate, or must pile up mass, to decelerate.

The velocity U of the jet (as referred, not to the object, but to the fixed outside observer), strikingly delineates the de Broglie wavelength, coupled with the period of time T_0, displayed by the corresponding electromagnetic energy content of the object [as required by Eq.(2)]. This result seems to be important, in many ways.

- We were able to derive the de Broglie wavelength, in regards to both the electric motion (Part I) and to the gravitational motion (Part II); this makes that, the objects interacting via gravitational charges, do behave in exactly the same way, as that displayed by quantum mechanical objects, interacting via electric charges. It is interesting to note that our approach can be generalized to any force field existing in nature.

- Our approach appears to be capable to remove, at least partly, the assumption about the "unpredictability", or "indeterminism" to be made, to cover the "quantum weirdness", such as that displayed by the EPR experiment.[39] The "immediate action" at a distance induced by the feature we disclosed, vis-à-vis de Broglie wavelength, indeed seems to take care of it. It is that, Einstein seemingly rejected to believe in quantum mechanics, because the gedanken *(then verified)* EPR experiment, pointed to an *"action at a distance",* occurring with a *speed much faster than the speed of light.* However, we have disclosed throughout that, such an action is possible. Note that recent measurements seem to back up our arresting deduction.[40, 41]

- Regarding an EPR type of experiment, the question of *"How the subsequent quantum collapse occurs?"*, remains to be elaborated on. Nonetheless we feel we have discovered a clue to dig with, in it. It is that the superluminal jet velocity $U = \gamma_V V$ is made of the relativistic jet speed $V = c_0 \sqrt{1 - v_0^2 / c_0^2}$, and the Lorentz dilation factor $\gamma_V = c_0 / v_0$. U, appears to operate as an independent single quantity, though. Yet, this seems to assume no interference from the *outside,* with the interacting objects. Any interference seemingly would destroy the *entirety* of U, and induce its components γ_V and V to get decoupled from each other. This may be a clue for the mysterious *quantum mechanical duality.* Recall that, the *uncertainty,* is a mathematical implication of quantum mechanics, whereas the *unpredictability*, still remains as an assumption, to take care of the *quantum collapse,* followed by the measurement coming into play. Thus, at this stage, we come to understand that an immediate action at a distance is possible, and it seems to be connected to the wave-particle duality. The *quantum collapse* phenomenon could perhaps be elaborated on, based on the latter point.

- There appears reason to believe that, even when the *jet mass* is null, which is the case for an object at rest, or in a circular rotation around an attraction center, whatever is the information *(we would expect to be)* carried by the jet of speed, this information still transferred instantaneously. In other words, the information in question can be transferred, along with no mass exchange in between interacting bodies, whatsoever. One can accordingly conjecture that, were the conditions favorable, information can be transferred with no need of energy, at all.

- At any rate, the wave-like jet speed U, we have introduced, appears to be quite physical, though it varies between infinity *(when the velocity* v_0 *of the object is zero),* and null *(when the velocity* v_0 *of the object is* c_0*, the speed of light).*

- On the other hand, the jet speed u with respect to *(in our latter example)* the planet, in a rotational motion around the sun, in conformity with the *definition of tachyons*, varies between ∞ *(were the object in consideration at rest),* and c_0 *(if the object in consideration moved with the speed of light).*

- Thus, our approach seems to bring an answer to the quest of *"gravitational interaction achieved with a speed much faster than the speed of light",* disclosed more than two centuries ago, by the French Scientist, Pierre-Simon Laplace.

- Our approach can be equally applied to a macro system or a micro system. For the latter case, it induces yet, the fact that, the mass of the electrically bound electron *(contrary to the general wisdom)* must decrease, just like the mass of the gravitationally bound celestial object decreases *(or vice versa).*

- But then, the metric must change nearby a nucleus, just like it is altered nearby a celestial body.

- The de Broglie wavelength, for a rectilinear motion or, along the ground state of an elliptic orbit, that may come into play, within the frame of a bound system, happens to be equal to [c_0 / v_0 x (the wavelength λ_0) x $\sqrt{1-v_0^2/c_0^2}$ (i.e. the Lorentz contraction factor, due to the motion)]. It is infinitely long, if there is no motion.

- Every beat delineated by Eq.(4), on the basis of the mass m_0, thus coming into play through the intrinsic period of time T_0, covers, not only a space of size λ_0, but concurrently, a space of size λ_B (the de Broglie wavelength).

- This, somehow seems to draw, a *"factual tachyonic"* type of interaction.

- This means that, either gravitationally interacting macroscopic bodies, or electrically interacting microscopic objects, moving with relatively low velocities, interact through an almost immediate action at a distance, and this, in essentially the same way.

- Thus practically everything in the universe, must affect each other, from very far distances, and this, at speeds much greater than the speed of light

Our conjecture, is in full compatibility, with the established theory of Quantum Mechanics, and the Special Theory Relativity.

It may be checked, with isolated electric charges, sufficiently far away from each other; they should interact with each other, immediately, were the isolation in question, removed. Screening and unscreening, at will *(just like Morse coding),* then, may constitute a *"communication mean",* seemingly faster than the speed of light. At any rate, it would be wise to consider such a statement with care.

In effect, it seems legitimate to consider the *interaction* as a process through which the two objects of concern somehow *sense* each other. Thus a *given information* should insure the *sensing mechanism* coming into play. According to our approach, whatever this information is, it is supposed to flow with a speed much greater than the speed of light, and with an infinite speed, if the two objects are at rest.

However, we are talking about a *closed system.*

Hence the following question arises:

- *Can we extend the concept of "interaction" to the usual engineering concept of "communication"?*

In fact, to *communicate,* i.e. to *exchange information* at will, one has to have a control on the *encoding* (i.e. embedding the information) and *decoding* (i.e. extracting the information) of the *information* one wishes to transfer.

Whether this whole process, based on the findings we have presented throughout, can be achieved with speeds faster than the speed of light, should still be elaborated on.

In other words, it seems true that two particles at rest, interact at an infinite superluminal speed. But once we attempt to extract the information from a closed system, we need a *control* over it, and we cannot avoid disturbing it. Therefore, whether our finding can be used, as the basis of a *communication* faster than light, should be considered with care.

Although this problem lies beyond the scope of this article; we can still guess that, our finding can be used as the basis of a communication faster than the speed of light, provided that, it is *light,* we use for the goal.

Obviously, the strength of the force of concern, decreases with the square of the distance; thus even if our prediction turns out to be valid, the range of application of it, seems relatively restricted. It seems nonetheless plausible to implement it, to computation faster than the speed of light.

We can on the other hand, conjecture the following:

Although the energy is conserved, say on an orbit, in the atom, or in the solar system, or elsewhere in a celestial *closed system,* because energy *by nature* aims to get minimized, the electron or the planet on a *level other than the ground level,* tends to get closer to the attraction center *(here assumed for simplicity infinitely more massive than the companion in question).* We then have a situation exactly in accordance with Bohr's postulate, i.e. the electron (or the same the planet) radiates only if it jumps to a lower state!.. And, all other things being equal, it should *(perhaps, following a complete rotation on the given orbit),* keep on jumping to lower states, until it reaches the ground state, as induced by the *minimum energy* requirement.

Here may be the cause for the *gravitational radiation.*

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