A Model for Unifying Quantum Mechanics and the Theory of Relativity Based on the Principle of Reciprocity

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A conceptual unification of quantum mechanics and the general theory of relativity is arrived at by assuming that reality is caused by Mind, seeking objective expression. The reasons why QM and relativity could not be unified is illuminated and a relativistic Schrödinger equation is derived in the context of the interaction between positive (photonic) and negative (gravitonic) spacetime. The postulate of the existence of a particle of intelligence – the hoton – leads to a simple and beautiful unification of the two theories, in a tri-phase quantum mechanics governed by time, space and meaning.

Objective reality is seen as emerging out of a matrix of possibilities, as hotons limit themselves to the possibility states defined by gravitons traveling backwards in time and photons traveling forwards in time. By obeying the matrix of possibility thus created, the hotons create time and facilitate the emergence of reciprocity between particles. This allow a definite meaning to be attributed to objects creating a realm of consciousness that can be considered objective.

Finally the theory implies that a transcendent intelligence has created the universe and provides a new foundation for integrating physics and metaphysics.

Keywords: matrix of possibilities, gravity, relativistic quantum mechanics, hoton, triphase, reciprocity, cosmology, unification.

I. INTRODUCTION

Since the completion of the theories of relativity (Einstein, [1,2]) and quantum mechanics (Bohm, [3]) around 1930, attempts at unifying them conceptually have failed. This article offers a solution to the conceptual dichotomy based on a model of the electromagnetic phenomena thought to give rise to quantum mechanics. This resolve a range of issues, and offer an simple and intuitive picture of the quantum reality.

A. The true quantum dynamics

The description of quantum mechanics (QM) has essentially been about describing the interrelationship between the phases of time and space as expressed in the typical wave function:

$$\Psi_1 = A(x,t)\exp[i(kx-\omega t)] \qquad (1.1)$$

However, quantum mechanics may, as this paper will endeavor to show, be a *tri-phase* phenomena related to *time, space and meaning*. In order to develop a genuinely relativistic version of quantum mechanics, we need therefore to change our fundamental notions about reality. The new notions will be presented as postulates and their justifications will be in the solutions emerging from them.

B. Spacetime is a mode of thought

The primary postulate is that *all is one* (Bailey, [4]). Reality is an undivided realm of being, only apparently fragmented in order to enable creative processes of Mind. This is another way of stating Bohm's hypothesis of undivided wholeness (Bohm, [5-7]), except it is given a more definite meaning in this context. The ideas in this article arose from taking the idea of Wholeness literally and following it to it's logical conclusion.

This led amongst other to the realization that Einstein's assertion that

> *Time and space are modes by which we think, and not conditions in which we live*[*],

must be taken literally. From this follow the key idea that objectivity is not something that *exists*, but is something that *emerges* from the attempt of the Whole to express itself and "think". Thinking requires the creation of a realm of consciousness that obeys certain symmetries. At a minimum there must be a separation between subject and object in order to think. Something which is not the case in the undivided whole. The detailed philosophical argument for this is complex and I will refer the reader to (Bertelsen, [8] and Kant, [9]) for details hereof.

[*] Wheeler, A journey into Gravity and Spacetime, page 3.

That thought is not possible in the naked state of oneness suggests the next postulate, namely that

The laws of nature are essentially symmetries, that facilitate the emergence of objectivity and thought.

This postulate constitutes a radical departure from traditional scientific thought, but has, from a philosophical point of view, great beauty. And it makes sense, in contrast to the prevailing quantum philosophies.

C. The hoton and the matrix

Let us move on to the introduction of some of the fundamental concepts in the new theory being presented – the concepts of *hotons* and the *matrix of possibilities*.

1. The hoton

The hoton is considered the intelligence aspect of a particle, determining where in spacetime the particle appears. It can be thought of as a spark of being that performs a harmonic oscillation between being (formlessness) and non-being (form). This oscillation cannot be given any definite meaning in terms of space and time because it is the *cause* of time.

The hoton is, in its free state, assumed able to manifest anywhere in spacetime (past, present and future) in each oscillation. It is a product of Mind and has as such no spatial or temporal limitations. The effect of the hotonic oscillation is *consciousness*, which is the awareness of an ordered series of events, related to the alternating focus on object and subject, blending the two into a whole.

By limiting itself to a particular subset of the total states available, the hoton can give rise to different kinds of "realities". Objective reality is one such "reality" that emerges when the hoton honors the requirements of objectivity.

We know matter to be imbued with properties of energy and mass and consider them equivalent. They are aspects of a fundamental wholeness, but we find is useful to discriminate between them conceptually. In so doing we can associate energy with a photonic aspect, mass with a gravitonic aspect. In the present context I will add the property of intelligence and associate this with a hotonic aspect. As the present theory will show, the three are inseparable aspects of what we call matter. In fact matter turns out to be the result of the coordinated interaction between the three types of "particles". Matter is thus seen as imbued with properties of both *energy, mass and intelligence*.

The hoton is thus more properly thought of as principle rather than a particular particle and every type of particle is thought to have such a hotonic aspect (just as it possesses mass and energy). In this article I will only deal with the electron and will subsequently take "hoton" to mean *the hotonic aspect of an electron.* Thus when the hoton flips into reality, it corresponds to a manifestation of this particle at a particular point in spacetime. This "in and out of reality" dynamic explains the peculiar behavior of quantum particles that allow regions of zero probability to separate high probability regions, for instance in electron orbitals with angular momentum $\neq 0$.

2. The matrix

The matrix of possibilities is a spatial grid that define the set of choices available to a hoton in relation to other hotons. Each hoton experiences itself as the center of a matrix and perceives others in terms of this matrix. The matrix is also referred to as the *grid.*

Because the essential dynamics is considered to be the emergence of a reciprocal and objective reality among lifeforms (atomic and otherwise) I will refer to the theory as *the theory of reciprocity.*

3. Like a rainbow

A rainbow is the result of light striking tiny droplets of water in the air, producing a pattern of refraction that hits the retina of an observer. If one goes to examine where it is, there is of course nothing, as it literally dissolves into the mist when approaching it.

In reality a rainbow is a phenomenon of *interference* between light, matter and an observer. As such is it a very appropriate metaphor for the hotonic reality.

Like a rainbow, a hoton does not *exist* as such. It is more like a dynamic of interaction between sparks of intelligence giving rise to specific phenomena that we call objectivity and matter. As we will see, these phenomena arise out of the interaction between:

- An observer (a hoton),
- light/energy (a photon) , and
- mass/inertia (a graviton).

The rainbow is therefore not only an appropriate but a very accurate description of the fundamental dynamics of subatomic reality.

II. THE THEORY OF RECIPROCITY

As mentioned, the Whole is, in its naked state, incapable of thought, because there is no distance between subject and object. In order to facilitate the emergence of thought, conceptual distance is necessary. Distance implies space and it is postulated that thought is actually impossible without space.

But space alone is not enough. There must also be a principle that allow subject and object to connect. A cohesive principle that keeps things together (attraction) as well as something that separates (space).

Finally in order to experience there must be something that experiences. This something (the subject) cannot be identical to the whole. Yet because the Whole is all that IS, the subject must be a fragment of the whole, experiencing itself as separate from the whole, in order to allow it to experience other subjects as objects.

We therefore assume that:

1. **Distance** (positive spacetime) is a product of Mind, created through the laws governing photons.
2. **Cohesion** (negative spacetime) is a product of Mind created through the laws governing gravitons.
3. **Form** (objective existence in spacetime) arises through the interaction between positive and negative spacetime.
4. **Consciousness** (subjective experience of form) is created through hotonic oscillation between being (formlessness) and non-being (form).

As is readily apparent, the dynamics of consciousness are inseparable from those of space, time and matter and therefore of physics. This means that we have three fundamental aspects of Mind, each is associated with a basic particle. The table below shows the relations:

Function	**Manifestation**	**Particle**	**Purpose**
Expansion	Distance	Photon	Illumination
Contraction	Form	Graviton	Emergence
Experience	Consciousness	Hoton	Evolution

The theory thus postulates the existence of two separate spacetimes:

- **A positive spacetime** governed by photons, moving forward in time at a velocity of c, giving rise to distance by defining the relation between distance and time (m/s)
- **A negative spacetime** governed by gravitons, moving backwards in time at a velocity of c^2, giving rise to cohesion/attraction by defining the relation between distance squared and time squared (m^2/s^2).

The core principle governing this is *reciprocity.* The purpose is to allow different subjects to experience the *same* reality. This must be seen in contrast to the inner realm of Mind, where we experience only our *own* reality. Given the nature of the Whole, achieving this requires the creation of certain symmetries (which define the laws of nature).

III. A NEW TAKE ON GRAVITONS

I will proceed to formulate the ideas mathematically, but only for the 1-D case, in order to focus on the ideas and keep it as simple as possible.

In the theory of reciprocity, gravitons are thought to be governed by the usual wave equation

$$\frac{\partial^2 A}{\partial t^2} = \hat{c}^2 \frac{\partial^2 A}{\partial x^2}, \quad \hat{c} = c^2, \quad [\hat{c}] = \frac{m^2}{s^2} \tag{3.1}$$

This well-known equation yields harmonic solutions (in this case traveling at a speed of c^2). In this context the gravitons are however considered as traveling backwards in time, giving rise to matter through interaction with photons moving forward in time.

Both photonic and gravitational waves are electromagnetic in nature allowing them to interact through electric and magnetic fields. As we know from electromagnetic theory, light can be considered as a field when many photons are present, yet when dealing with a single photon one must consider them as fields of potentiality with a quantum mechanical interpretation. The same is considered to be the case for gravitons. We describe the two waves as

$$\Psi_p = \exp[i(rx - \eta t)] \text{ (photon wave)} \tag{3.2}$$
$$\Psi_g = \exp[i(-qy - \mu\tau)] \text{ (graviton wave)} \tag{3.3}$$

where (r, η) is used to represent the wave-vector and angular frequency of the photon and (q, μ) similarly for the graviton. Because they are all considered to be electromagnetic in nature they obey the dispersion relations $\eta = cr$, $\mu = c^2 q$.

The negative sign in front of the y variable implies that the graviton runs in the opposite spatial direction of the photon. From the perspective of the negative (squared) universe, it is running forward in negative time (backward in positive time).

A. Mapping of spacetimes

The units of the photon and graviton "velocities" are different according to:

$$[\Psi_p] = \frac{m}{s} \qquad [\Psi_g] = \frac{m^2}{s^2} \tag{3.4}$$

Furthermore τ (with units of s^2) has the arrow of time pointed *backwards*. The variable y has the units of m^2.

In order to model the graviton in positive spacetime we must perform a shift in variables. Considering the wave as

a curve in space we can substitute (y, τ) with (x, t) according to:

$$y = x^2, \tau = -t^2 \tag{3.5}$$

However for the mapping to be valid there must exist an inverse mapping, which can be shown to be:

$$t = i\sqrt{\tau} \quad \tau > 0, t < 0 \tag{3.6}$$
$$t = \sqrt{\tau} \quad \tau < 0, t > 0$$

Since

$$t^2 = (i\sqrt{\tau})^2 = -1 \cdot \tau = -\tau \tag{3.7}$$

While for τ < 0, the negative sign of τ produces $i = \sqrt{-1}$, leading to a correct result. Similarly for x, y we have:

$$x = \sqrt{y} \qquad x > 0, y > 0 \tag{3.8}$$
$$x = -i\sqrt{y} \qquad x < 0, y < 0 \tag{3.9}$$

The mappings are different because τ changes direction (changing the arrow of time), while y doesn't as it is a spatial dimension. (Note that from a purely mathematical perspective, the i that appears in the mappings may be the cause of the i that appear in the Schrödinger equation.)

B. The linear approximation

The wave of possibility, resulting from superpositioning the fields of potentialities that arise when we consider the interaction between a single photon and a single graviton, can be described as:

$$\Psi_i = \Psi_p \Psi_g = \exp\left(i(rx - \eta t) \cdot \exp(-\hat{q}x^2 + \hat{\mu}t^2)\right)$$
$$\Psi_i = \exp\left(i\left[(rx - \hat{q}x^2) - (\eta t - \hat{\mu}t^2)\right]\right) \tag{3.10}$$

Where the "hats" over the symbols are used to indicate that their units belong in the squared spacetime.

This is a quite complicated wavefunction because the constant acceleration of gravity (represented by the squared variables) make it very hard to visualize what is going on. In order to grasp the nature of the phenomena that arises from the interaction of the graviton and the photon we will begin by making an approximation and examine this.

First of all I will make the assumption that the graviton frequency remains constant $\mu = \mu_0$. This assumption may partly be justified by the fact that the gravitonic energies are so small, that a change in frequency cannot significantly change the total energies involved (will be derived later).

Next I will consider the expressions

$$\varphi_t = \exp(i(-\hat{\mu}t^2 + \hat{\mu}\varsigma t)) \tag{3.11}$$
$$\varphi_x = \exp(i(\hat{q}x^2 - \hat{q}\chi x))$$

where ς is a constant of value 1 with the units seconds (s) and χ a constant of value 1 with units meter (m). If we multiply ψ_i with $\varphi_t\varphi_x$, and define the constants $\mu = \hat{\mu}\varsigma, q = \hat{q}\chi$ then we obtain a linear approximation

$$\Psi_a = \Psi_i \cdot \varphi_t\varphi_x = \exp\left(i\left[(r-q)x - (\eta - \mu)t\right]\right) \tag{3.12}$$

where the second order contributions have cancelled out, leaving a first order wave. This approximation (ψ_a) is valid if $\varphi_t \approx 1$ and $\varphi_x \approx 1$, in which case multiplying them to ψ_i will not significantly alter the wave. This will later be shown to be a very good approximation, in the atomic realm, in relation to the spatial dimension but less so in relation to the temporal dimension. I will return to the issue of the validity of the approximation. For now it will serve us as a way of understanding the dynamics of the graviton-photon interaction.

C. Squared spacetime

In the negative (graviton) spacetime, everything is squared. In essence negative spacetime is about defining the relation between what we can call an anchor (m^2) and acceleration (s^2), just as space is about distance and time.

This means that the units in the graviton spacetime must all be considered the squared of their positive spacetime cousins in order for the units to make sense.

Now in order to estimate the energies involved in the photon/graviton interaction, we need to calculate the energy of the graviton. We must remember that energy = mass = inertia, since the graviton does not as much posses energy as it does inertia. We do not at this stage of development know the laws governing the graviton. All I am able to do is therefore to make an educated guess. The units of the graviton seem to suggest the following expression of graviton energy E_g:

$$E_g^2 = \hbar^2\hat{\mu} \qquad E_p = \hbar\eta \tag{3.13}$$

which means that energy squared corresponds to graviton "energy". In the case of the photon (E_p) there is a linear relationship as shown above. If this is the case, we have

$$E_g = \hbar\sqrt{\hat{\mu}} \tag{3.14}$$

We can then calculate the relationship between E_g and E_p according to the linear approximation and get:

$$\eta = \mu \Leftrightarrow \frac{E_g^2}{\hbar^2} = \frac{E_p}{\hbar} \Leftrightarrow E_g = \sqrt{\hbar E_p} \tag{3.15}$$

The photonic energy is the energy that can be released from the mass particle at any point, whereas the gravitonic energy will, when released, travel against time, so we cannot see it. It must therefore be assumed that the photonic energy at any time must equal the total relativistic energy. This gives us, at $v=0$, that

$$E_{p0} = m_0 c^2 \cong 8.181 \cdot 10^{-14} J$$
$$E_{g0} = \sqrt{\hbar E_{p0}} = \sqrt{\hbar m_0 c^2} = c\sqrt{\hbar m_0} \cong 9.26 \cdot 10^{-23} J \tag{3.16}$$

This means that the graviton energy is nine orders of magnitude smaller than the photon energy. It is counterintuitive that a graviton traveling at c^2 have such a small energy, yet it is important to remember that energy is proportional to frequency, not velocity.

D. Review of some basic wave notions

If we consider a wave equation of the form

$$\Psi(x,t) = A(x,t)\exp(i(kx - \omega t) \tag{3.17}$$

then if we were to watch how fast a peak of this wave moves, then we would realize that it moves at the speed of

$$v_p = \frac{\omega}{k} \tag{3.18}$$

which is the phase velocity. However in order to create a wave that can represent a particle, with limited spatial extent we need to create a wave packet consisting of a set of waves that is a sum (or integral) of k-vectors like

$$\int_k \exp(\varphi) f(k) dk, \qquad \varphi = i(k(x - x_0) - \omega(t - t_0)) \tag{3.19}$$

where f(k) is a bounding function in k-space that limit the number of k-vectors that contribute to the packet. This result in a constructive pattern of interference that move with a velocity called the *group velocity*. This velocity can be derived from differentiating the phase φ which enters into the wave function. Setting $\partial\varphi/\partial k = 0$ yields

$$x - x_0 = t\frac{d\omega}{dk} \tag{3.20}$$

which means that the group velocity (the speed with which the peak moves) is given by.

$$v_g = \frac{d\omega}{dk} \tag{3.21}$$

E. Exploring the approximation

It is suggested that the ψ wave emerging from the interference between the graviton and photon corresponds to the matter wave known from quantum mechanics.

We will now consider two matter waves, ψ_0 and ψ_b. The reference frame A (ψ_0) is defined to be at rest. B (ψ_b) is a particle moving relative to A with a velocity v.

The A ($v=0$) wave is

$$\Psi_0 = \exp[i((r_0 - q_0)x - (\eta_0 - \mu_0)t)] \tag{3.22}$$
$$v_p = \frac{\eta_0 - \mu_0}{r_0 - q_0} = 0 \Leftrightarrow \eta_0 = \mu_0$$

Thus ψ_0 is a pattern of interference between two very fast-moving waves (phase velocities of c and c^2) but the emerging pattern of interference has a phase velocity of zero, meaning that it is at rest if the frequencies are identical. Due to the dispersion relations for electro-magnetic waves

$$\eta = cr,\ \mu = cc_\alpha q \Leftrightarrow r = \frac{\eta}{c},\quad q = \frac{\mu}{cc_\alpha} \tag{3.23}$$

we know the wave vectors if we know the frequencies. c_α is a dimensionless constant with the value c used in order to avoid confusion concerning the units in calculations. From this we can calculate the distance between the peaks in the standing wave using the frequency (ω_0) for a photon with an energy corresponding to m_0.

$$E_0 = \hbar\omega_0 = m_0 c^2 \Leftrightarrow \omega_0 = \frac{m_0 c^2}{\hbar} \tag{3.24}$$

Since $\eta_0 = \mu_0 = \omega_0$ we have

$$r_0 - q_0 = \frac{\eta_0}{c} - \frac{\mu_0}{cc_\alpha} = \frac{1}{c}\left(\omega_0 - \frac{\omega_0}{c_\alpha}\right) \Leftrightarrow \tag{3.25}$$
$$k_0 = \frac{\omega_0}{c}\left(1 - \frac{1}{c_\alpha}\right) = \frac{m_0 c}{\hbar}\left(1 - \frac{1}{c_\alpha}\right)$$

yielding the following expression for the wave

$$\Psi_0 = \exp[i(k_0 x)]$$

With the given definitions, we have two waves running towards each other in both time and space, creating a pattern of interference. A photon interacting with a graviton of *exactly the same frequency* ($\eta = \mu$) gives rise to a standing wave in space that neither oscillates nor moves. Such an interaction essentially creates a 4D matrix in spacetime which is a stationary grid. (shown in FIG 1). If the two frequencies are not equal, their interaction will give rise to a traveling pattern of nodes, essentially a grid that moves relative to the observer.

If we interpret this interaction in quantum terms, then we must view the matrix as a matrix of possibilities, meaning that the probability of the appearance of a hoton (manifestation of an electron) is proportional to $|\psi|^2$. However this pattern of interference has nodes of value zero, and boundaries between the high possibility regions, effectively creating a *quantization of space*.

At every oscillation into reality the hoton must "decide" where to appear (corresponding to the collapse of the wave function). The governing principle is thus the coherence of the three phases of *photon, graviton and hoton*. By limiting itself to the pattern created by the graviton/photon interference, the hotons gives rise to what we call objective reality.

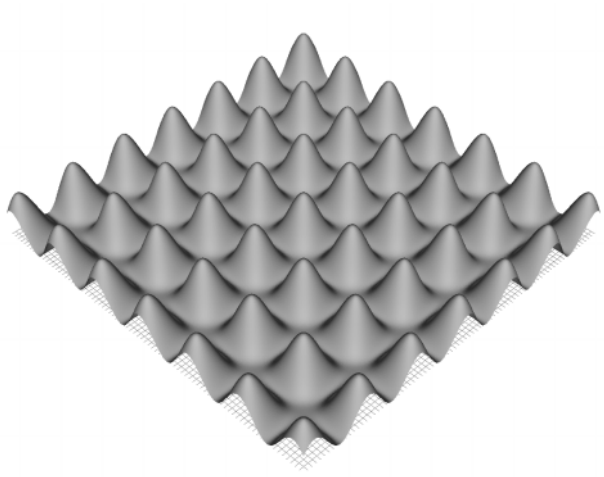

FIG 1. 2D Visualization of the linear approximation $|\psi_a|^2$ as a stationary matrix of possibilities in space, resulting from the interference between a graviton and a photon.

The matrix representing B can be described as

$$\Psi_b = \exp[i((r_b - q_b)x - (\eta_b - \mu_b)t)] \tag{3.26}$$

which is considered to move relative to A with a velocity v. In order to appreciate what happens it is crucial to understand that we are talking abut two *grids of possibilities* that are moving relative to each other. Lets go on to define a few terms that will simplify the expressions.

First the mass wave angular frequency ω as:

$$\omega = \eta - \mu \tag{3.27}$$

the total relativistic wave vector for the mass particle

$$k_t = r - q = k + k_0 \tag{3.28}$$

the wave vector for the mass wave

$$k = k_t - k_0 \tag{3.29}$$

Using the definitions we can express the wave as

$$\Psi_b = \exp[i(kx - \omega t)] \tag{3.30}$$

This wave represents a matter wave as it appears to an observer, with a non-zero relative velocity.

F. The Compton wavelength

Lets examine the nature of the matrix in the case $v=0$. If we define for the photon $\eta_0 = \mu_0 = \omega_0$ then, remembering the standard relations for light $v\lambda=c$, $\omega=2\pi v$, $\lambda=1/k$, we get

$$\lambda\!\!\!^{-}_0 = 2\pi\lambda = \frac{2\pi}{k_0} = \frac{2\pi}{r_0 - q_0} = \frac{2\pi}{\frac{\eta_0}{c} - \frac{\mu_0}{cc_\alpha}} = \frac{2\pi}{\frac{\omega_0}{c} - \frac{\omega_0}{cc_\alpha}} \Leftrightarrow$$

$$\lambda\!\!\!^{-}_0 = \frac{2\pi c}{\omega_0(1-1/c_\alpha)} = \frac{\hbar}{m_0 c}\frac{1}{(1-1/c_\alpha)} \cong \lambda\!\!\!^{-}_c \tag{3.31}$$

This quantity λ_c is, in the case of the electron, known as the *Compton wavelength* and has to do with the way electrons scatter. Eq. (3.31) has a small corrective factor of order $1/c$, when compared to the usual expression of the Compton wavelength which is

$$\lambda\!\!\!^{-}_c = \frac{\hbar}{m_0 c} = 7{,}72 \cdot 10^{-9} m$$

This correction arises from the interaction between the photon and graviton and may be of sufficient magnitude that a careful measurement can determine if such a corrective factor truly exists or not. In passing it is worth noting that if the gravitons were traveling backwards at the speed of light, then the corrective factor would be of the order of unity. This suggests that if there truly are gravitons involved in creating such a quantization of space, they must travel substantially faster than light or it should have been noticed.

G. The Compton wave vector

In case of the electron with $v=0$ we define the Compton wave vector k_c (the inverse wavelength) which is the wave vector equivalent of λ_c.

$$k_c = \frac{m_0 c}{\hbar} \Leftrightarrow m_0 = \frac{k_c \hbar}{c} \qquad (3.32)$$
$$k_c \cong 4.121 \cdot 10^7 \, m^{-1}$$

We see from this that $k_c = k_0$ (from Eq. (3.25)) is the wave vector corresponding to the rest mass and furthermore that m_0 and k_0 are proportional constants. k_0 is therefore considered to be related to inertia. The reason for k_0 being inertia is obvious when considering the nature of the velocity of the mass wave, given by

$$v = \frac{\eta - \mu}{r - q} = \frac{\omega}{k_t} = \frac{\omega}{k_0 + k} \qquad (3.33)$$

From this it is clear that in the process of changing the velocity, the k_0 wave vector (corresponding to m_0) slows down the change in velocity as ω, k change. This provides a simple and intuitive explanation of the nature of inertia.

An inference that can be made from Eq. (3.33) is that if $\mu = 0$ then $q = 0$ from which follows that $v = \eta/r = c$. Thus only in the presence of a gravitational field is sub-lightspeed particles (matter) possible.

H. Understanding quantizised space

According to the model, space is quantizised due to the interaction between the photon and the graviton. However Eq. (3.33) shows that as the velocity grows, do does (r - q), meaning that the minimum distance in the spatial quantum grid drops (Visualized in FIG 2).

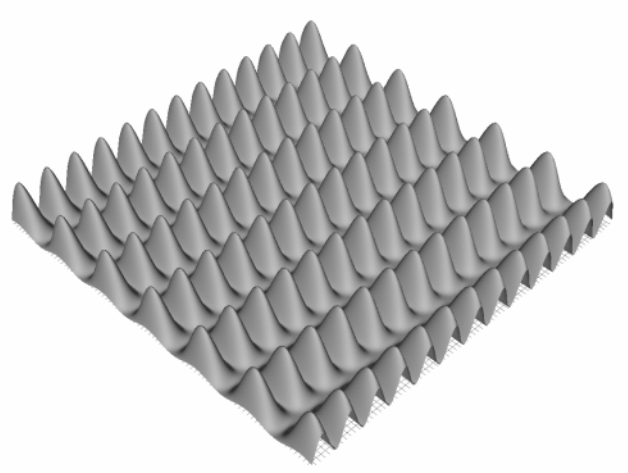

FIG 2. As the velocity grows the possible wavelengths (grid distances) get smaller in the direction of travel (see Eq. (3.25)).

The grid size is determined by the wavelength of the photon corresponding to the energy of the particle in question. If we define d as the distance between peaks in the grid (the grid size) then we have

$$d = \lambda\!\!\!^{-}_d = \frac{\hbar}{mc} = \frac{c}{\omega} = \frac{1}{k_t} \Leftrightarrow \qquad (3.34)$$
$$k_d = \frac{1}{\lambda\!\!\!^{-}_d} = \frac{\omega}{c} = k_t$$

where k_d is expressed in radians. We note that for $v = 0$ the distance is precisely the Compton wavelength (λ_c). Because of this quantization, the wave vectors (k_n) can only take on values

$$k_n = \frac{k_t}{n}, \qquad n \in N \qquad (3.35)$$
$$\lambda\!\!\!^{-}_n = nd = \frac{n}{k_t}, \qquad n \in N$$

This means that the wavelength cannot become shorter than the distance between the peaks in the grid. Small n corresponds to high energy and as $n \rightarrow \infty$ the energy tends to zero. Note that the quantization is what makes it possible to create finite relativistic QM solutions.

I. Visualizing the process

Imagine a hoton A oscillating in and out of a node in "its" matrix seeing another hoton B flying by. If B is moving at a low velocity it will perhaps be visiting every node in the matrix on its way, some perhaps more than once. This leaves plenty of opportunity for interaction (many possibilities for reconciling the two realities).

If however B is moving very fast (approaching c) then it can be conceived of as making a huge jump past A in a single hotonic oscillation and in the limit of c there will only be a single possibility for reconciling their realities.

Consider as an analogy a person standing on a platform while a train is traveling by. The person wishes to hand a note to someone aboard the train. While the train is moving slowly, the handover is easy. They may even have time to chat as the note is handed over. As the speed increases the handover must be done with greater and greater precision. As the train approaches c, there is only one quantum possibility for making the handover.

Thus when the particles are traveling at low speeds, there are many possible choices of how to match their grids. When lightspeed approaches, this condenses into one particular way the grids *must* be matched to preserve a definite meaning of time and space. In essence it means that the range of choices on behalf of the hoton is reduced and finally eliminated.

J. The reduction in uncertainty

A wave packet at non-relativistic velocities, is made up of a set of k-vectors in a region Δk in k-space (according to Eq. (3.19)). As the velocity grows, there are fewer and fewer possible wave vectors according to Eq. (3.35). As an example:

- The wave vector k_1 (of value k_d) corresponds to the velocity of c.
- The wave vector k_2 (of value $k_d/2$) corresponds to the velocity of $c/2$.

The number of possible wave vectors, a given region of velocities between v and $v+\Delta v$ thus grows rapidly and approaches infinity for $v \rightarrow 0$.

It is clear that for a particle of $v=c$, there is only a single quantum state available. Thus in this case *no uncertainty is possible*. If we measure the location of a particle at velocity c, then we know both the position and velocity/momentum of the particle. This, together with the contracting matrix, suggests that Heisenbergs uncertainty relation

$$h \leq \Delta x \Delta p_x \tag{3.36}$$

must be altered so that the uncertainty in the limit ($v \rightarrow c$) is 0. In relativistic physics the Lorentz transformation is used to calculate the dilation of time and space and is given by:

$$x' = x, \quad y' = y, \quad z' = \frac{1}{\beta}(z - vt), \quad t' = \frac{1}{\beta}\left(t - \frac{v}{c^2} z\right) \tag{3.37}$$

$$\beta = \sqrt{1 - v^2/c^2} \tag{3.38}$$

A candidate for a new uncertainty relation is therefore

$$h \leq \frac{\Delta x \Delta p_x}{\beta} \tag{3.39}$$

which uses the Lorentz contraction factor and suggests that as $v \rightarrow c$ then the possible accuracy grows and the uncertainty is eliminated. In reality what this means is that the envelope of hotonic choice is reduced to a single option in order to preserve objectivity.

K. Is the matrix relativistically invariant?

A key issue with this theory is whether it is truly relativistically invariant, which is required. An intuitive reason why this is so, is the following.

The matrix emerges from the patterns of interference between gravitons and photons. Since both gravitons and photons obey normal electromagnetic laws, and they are known to be invariant, then the potential fields that emerge from their interaction must necessarily also be invariant. The matrix is a matrix of possibilities and defines where the hoton may manifest in spacetime. If the hoton obeys the possibilities defined by the matrix, the hoton behavior must be relativistically invariant.

It is important to recognize the difference between the picture offered here and the usual QM interpretation. We are considering the interaction between:

- A wholly **deterministic** matrix of possibilities, defined by the interaction between a photon and a graviton.
- A wholly **indeterministic** process of hotonic choice concerning where to manifest or interact.

The combination of these two distinct phenomena gives rise to the semi-deterministic quantum mechanics. Discriminating clearly between the two mechanisms helps clarify what is really going on. The description in terms of the electromagnetic waves can be given in an exact relativistic terminology and calculated from any particular frame of reference. Then the issue of hotonic choice can be superimposed. However as this does not influence the geometry, then the combined solution must be relativistically invariant. The quantization of space furthermore make the probability integrals finite, so that obtaining a bounded, finite and invariant QM solution is possible.

L. The reality of possibility waves

In most treatises on quantum mechanics the ψ wave is treated as something immaterial which is merely a mathematical device for calculating results. However as the present paper shows, the idea of a wave of potentiality is a very accurate description of what is real. From this can be derived the probability function, but in an ontological sense this probability is less real than ψ, because ψ implies possibilities and choice (which is the true nature of reality), whereas $P(x)$ implies a determinism which is not there.

IV. BEYOND THE APPROXIMATION

Recalling the expressions used to obtain the linear approximation

$$\varphi_t = \exp(i(-\hat{\mu} t^2 + \hat{\mu} \varsigma t)) \tag{4.1}$$

$$\varphi_x = \exp(i(\hat{q} x^2 - \hat{q} \chi x)) \tag{4.2}$$

let us examine what conditions on x and t this translates into. The requirement is that

$$\hat{\mu} \varsigma t - \hat{\mu} t^2 << 1 \qquad \textit{and} \qquad \hat{q} x^2 - \hat{q} \chi x << 1 \tag{4.3}$$

Dispensing with the units and considering the orders of the quantities involved, this yields the conditions

$$t - t^2 << \frac{1}{\mu} \qquad x^2 - x << \frac{1}{q} \tag{4.4}$$

because the expression in the parenthesis then will approach zero and the φ in Eqs. (4.1 & 4.2) will become 1. At $v=0$ we have the condition $\eta = \mu$ (according to the linear approximation) and from this we can estimate the order of η and q as

$$\hbar\hat{\mu}_0 = m_0 c^2 \Leftrightarrow \frac{1}{\hat{\mu}_0} = \frac{\hbar}{m_0 c^2} \cong 10^{-19}, \quad [\hat{\mu}_0] = s^{-2} \tag{4.5}$$

Therefore

$$x^2 - x << \frac{\hbar}{m_0} \qquad t - t^2 << \frac{\hbar}{m_0 c^2} \tag{4.6}$$

Examining this relation shows it to be satisfied if

$$x << \frac{2\hbar}{m_0} \cong 2.2 \cdot 10^{-2} \tag{4.7}$$

$$t << \frac{2\hbar}{m_0 c^2} = 2T_p \cong 2.1 \cdot 10^{-19} \tag{4.8}$$

where T_p is the period of the photonic oscillation[*].

All in all this shows that the domain of validity of the approximation is actually quite limited in regards to the temporal dimension, but a very good one for atomic system in regards to the spatial dimension.

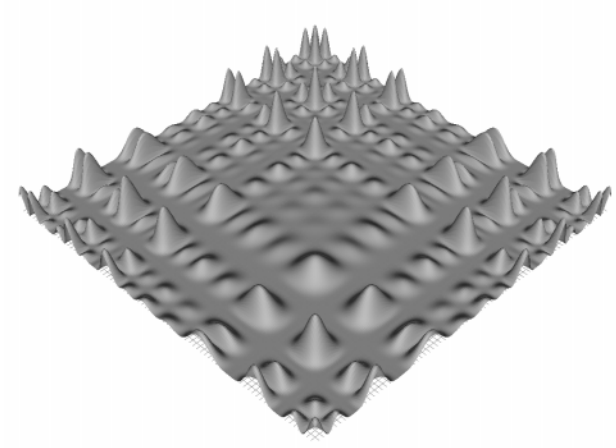

FIG 3. The actual waveform containing (x^2, t^2). One can see how the frequency of the peaks increases with x, y. This is caused by the gravitational acceleration effect.

[*] Note that the units for the expression does not match the units for μ, q. This is because we are using the positive spacetime frequency of η (s^{-1}) to estimate the magnitude of the negative spacetime frequency (s^{-2}).

A. Deriving the dispersion relation

From the basic interference pattern (Eq. 3.10), we can derive the following expression for v

$$v = \frac{\partial\omega}{\partial r} = \frac{\eta - \hat{\mu}t}{r - \hat{q}x} \tag{4.9}$$

From this can be derived the dispersion relation $\omega(k)$ or $\omega(r)$, which is equivalent since r and k are proportional. Since $\eta = cr$, the above can be written

$$\frac{\partial\omega}{\partial r} = \frac{cr - \hat{\mu}t}{r - \hat{q}x} = \frac{c(k_0 + k) - \hat{\mu}t}{k_0 + k - \hat{q}x} \tag{4.10}$$

If we make a basic approximation, ignoring the zero state energy and relativistic increase in mass, the expression is reduced to (replacing r by k)

$$\frac{\partial\omega}{\partial k} = \frac{ck}{k_0} \tag{4.11}$$

which by integration yields

$$\omega = \int \partial\omega = \int \frac{ck}{k_0} dk = \frac{ck^2}{2k_0} = \frac{\hbar k^2}{2m_0} \tag{4.12}$$

and we recognize the usual expression for the dispersion relation. However it is clear from the derivation that this is in fact a an approximation that will only hold in the non-relativistic domain.

B. Deriving the exact dispersion relation

When going beyond the approximation, ω is no longer a constant, but a function of t, as k is a function of x. In this derivation I will be using the wave vector r, corresponding to the total photonic momentum because it makes the math easier. Since $r = (k + k_0 - q_0)$ they are identical except for a constant. Using r means that we are referring to the absolute motion of the particle, not the relative movement (relative to $v=0$).

Assuming $q=q_0$ and $\mu=\mu_0$ are constant we get a better approximation for ω through integrating Eq. (4.10) which yields:

$$\omega = \int \partial\omega = \int \frac{cr - \hat{\mu}_0 t}{r - \hat{q}_0 x} dr \tag{4.13}$$

performing the substitution $r=\kappa_t r_0$, ($r_0 = k_0 + q_0$) being the wave vector corresponding to $v=0$) we get the integral in the dimensionless variable κ_t

$$\omega = r_0 \int \frac{c\kappa_t - \hat{\mu}_0 / r_0\, t}{\kappa_t - \hat{q}/r_0\, x}\, d\kappa_t \tag{4.14}$$

which upon defining

$$\hat{\mu}_r = \frac{\hat{\mu}_0}{r_0} \qquad [\hat{\mu}_r] = ms^{-2} \tag{4.15}$$

$$\hat{q}_r = \frac{\hat{q}_0}{r_0} \qquad [\hat{q}_r] = m^{-1} \tag{4.16}$$

reduces to

$$\omega = r_0 \int \frac{c\kappa_t - \hat{\mu}_r t}{\kappa_t - \hat{q}_r x}\, d\kappa_t \tag{4.17}$$

$$\omega = r_0 \left[c\kappa_t + (c\hat{q}_r x - \hat{\mu}_r t) \ln(\kappa_t - \hat{q}_r x) \right] \tag{4.18}$$

which, recalling the dispersion relations Eq. (3.23) can be expressed as

$$\omega = r_0 \left[c\kappa_t + \hat{\mu}_r (x/c - t) \ln(\kappa_t - \hat{q}_r x) \right] \tag{4.19}$$

This is the exact dispersion relation based on the ideas presented in this article. It behaves correctly in the limits but whether or not it conforms in all respects to what is already known of relativistic quantum field theory (QFT) is beyond my expertise to determine.

Even if it does not conform entirely to current theories (i.e. the standard model and QFT), this does not necessarily mean that the fundamental ideas herein are wrong. It may simple mean that they are not yet complete and certain additions needs to be made in order to obtain the correct results.

C. Deriving the exact relativistic wave equation

Now the general Schrödinger equation is given by

$$i\hbar \frac{\partial \Psi}{\partial t} = \left(H + V(x) \right) \Psi$$

where $H(\psi)$ represents the total energy of movement for the particle. Setting $H = \hbar\omega$ from Eq. (4.19) we get the following candidate for a relativistic wave equation:

$$i\hbar \frac{\partial \Psi}{\partial t} = r_0 \left(c\hbar \frac{\partial}{i r_0 \partial x} + \hbar \hat{\mu}_r \left(\frac{x}{c} - t \right) \ln\left(\frac{\partial}{i r_0 \partial x} - \hat{q}_r x \right) + \frac{V(x)}{r_0} \right) \Psi \tag{4.20}$$

where κ_t has been replaced by the appropriate operator according to

$$p = \hbar \kappa_t r_0 \Leftrightarrow \kappa_t = \frac{p}{\hbar r_0} \tag{4.21}$$

$$\overline{p} = \frac{\hbar \partial}{i \partial x} \Rightarrow \overline{\kappa} = \frac{\partial}{i r_0 \partial x} \tag{4.22}$$

D. Reproducing the classical expression

Comparing to the usual Schrödinger equation,

$$i\hbar \frac{\partial \Psi}{\partial t} = -\frac{\hbar^2}{2m_0} \frac{\partial^2 \Psi}{\partial x^2} \tag{4.23}$$

we notice that Eq. (4.20) is a first order equation in both t and x, whereas Eq. (4.23) is of first order in t, but second order in x.

The analysis on the validity of the approximation showed the spatial approximation to be valid for the subatomic realm. We are therefore justified in ignoring the contributions relating to x in Eq. (4.19) and ω can be re-expressed (approximately) as

$$\omega = r_0 \left(c\kappa_t - \hat{\mu}_r t \ln(\kappa_t) \right) \tag{4.24}$$

where $\kappa_t = \kappa_0 + \kappa$ is the total wave vector in units of r_0 ($k_0 = r_0 - q_0$ so $r_0 = k_0 + q_0$), while κ_0 corresponds to the zero state and κ to the momentum (in r_0 units). This leads to the approximation:

$$i\hbar \frac{\partial \Psi}{\partial t} = r_0 \left(c\hbar \frac{\partial}{i r_0 \partial x} - \hbar \hat{\mu}_r t \ln\left(\frac{\partial}{i r_0 \partial x} \right) \right) \Psi + V(x) \Psi \tag{4.25}$$

In order to understand the relationship between the new (approximate) Schrödinger equation Eq. (4.25) and the traditional one Eq. (4.23), it is instructive to consider how the latter evolve out of the former as a further approximation.

Consider the value of μ_r (from Eq. 4.15). When recalling that $r_0 \approx k_0$ (ignoring q_0) we get (given the linear approximation) that

$$\hat{\mu}_r = \frac{\hat{\mu}_0}{r_0} \approx \frac{m_0 c^2 / \hbar}{m_0 c / \hbar} = c \tag{4.26}$$

Eliminating t from Eq. (4.24) by setting $t=1s$, and inserting μ_r from above it reduces to

$$\omega = r_0 \left(c\kappa_t - c \ln(\kappa_t) \right) \tag{4.27}$$

Recalling that $\kappa_t = \kappa_0 + \kappa$ and that $\kappa_0 = 1$ in the natural (r_0) units, we can make a second order Taylor expansion of the above expression as:

$$\omega = cr_0\left(\kappa_0 + \kappa - (\kappa - \frac{\kappa^2}{2})\right) \Leftrightarrow \quad (4.28)$$

$$\omega = cr_0\kappa_0 + \frac{cr_0\kappa^2}{2} \quad (4.29)$$

We identity the two parts of the equation as

$$\hbar(cr_0\kappa_0) = \hbar c\frac{m_0 c}{\hbar}\cdot 1 = m_0c^2 = E_0 \quad (4.30)$$

$$\frac{\hbar(cr_0\kappa^2)}{2} = E_{kin} \quad (4.31)$$

The kinetic energy can be transformed into an operator using Eq. (4.22) yielding

$$E_{kin} = \frac{\hbar cr_0}{2}\left(\frac{\partial}{ir_0\partial x}\right)^2 = -\frac{\hbar c}{2}\frac{1}{r_0}\frac{\partial^2}{\partial x^2} \Leftrightarrow \quad (4.32)$$

$$E_{kin} = -\frac{\hbar c}{2}\frac{\hbar}{m_0 c}\frac{\partial^2}{\partial x^2} = -\frac{\hbar^2}{2m_0}\frac{\partial^2}{\partial x^2} \quad (4.33)$$

Which, when compared to Eq. (4.23), shows that the new equation produces the classical equation as an approximation.

V. DERIVING QUANTUM MOMENTUM

A final issue is the challenge of defining the particle *momentum wave vector* (k_p) and the *relative photonic momentum wave vector* ($k = k_t - k_0$) in a consistent manner.

In the theory of relativity, mass is defined as

$$m = \frac{m_0}{\sqrt{1 - v^2/c^2}} \quad (5.1)$$

in order that the momentum $p=mv$ remains relativistically invariant.

We have in Eq. (3.32) identified k and m as equivalent and can generalize this into the relativistic expression

$$m = \frac{\hbar k_t}{c} = \frac{\hbar(k + k_0)}{c} \quad (5.2)$$

then Eq. (5.1) becomes

$$\frac{\hbar k_t}{c} = \frac{\hbar k_0}{c\sqrt{1 - v^2/c^2}} \Leftrightarrow k_t = \frac{k_0}{\sqrt{1 - v^2/c^2}} \quad (5.3)$$

if we move the square-root to the k_t side, squaring it all, multiplying by $(\hbar c)^2$ and rearranging the terms, we obtain

$$(c\hbar k_t)^2 = (v\hbar k_t)^2 + (c\hbar k_0)^2 \quad (5.4)$$

Recognizing this as equivalent to the relativistic energy equation

$$E^2 = (pc)^2 + E_0^2 \quad (5.5)$$

it implies that

$$pc = v\hbar k_t \Leftrightarrow c\hbar k_p = v\hbar k_t \Leftrightarrow k_p = k_t\frac{v}{c} \quad (5.6)$$

This is yet another symmetry of nature. However it has important implications because we so far have made en implicit identification between

- the *relative photon wave vector* k as in $k_t = (k_0 + k)$, which is the part of the photon wave vector related to movement (k_0 corresponds to the zero state energy E_0).
- the *momentum wave vector* k representing velocity and kinetic energy as in $p=\hbar k$ (this wave vector is henceforth called k_p).

These two are emphatically *not* identical. This implicit identification lies at the heart of the problems of unifying relativity and quantum mechanics. An intuitive reason for their difference is that, when considering the total energy of the particle at low velocities (E_{kin} correspond to the relativistic difference in mass), expressed as a function of the photon wave vector (k)

$$\Delta E_{kin} = E - E_0 = c\hbar(k_t - k_0) = c\hbar k$$

whereas in the case of the momentum, it follows k_p-squared according to

$$\Delta E_{kin} = \frac{p^2}{2m} = \frac{(\hbar k_p)^2}{2m} \quad (5.7)$$

Equating the two expressions of ΔE_{kin} to each other (using Eq. (5.2)) results in the following relation between k and k_p

$$c\hbar k = \frac{(\hbar k_p)^2}{2m} = \frac{c\hbar k_p^2}{2k_t} \Leftrightarrow \quad (5.8)$$

$$k_p = \sqrt{2kk_t} = \sqrt{2(k^2 + kk_0)} \Leftrightarrow \quad (5.9)$$

$$k = \frac{\hbar k_p^2}{2mc} = \frac{k_p^2}{2k_t} \quad (5.10)$$

which clarifies the relations between the different wave vectors involved in describing the dynamics. We also recognize Eq. (5.10) as equivalent to the usual dispersion relation (shown in Eq. (4.12)). Discriminating between the two wave vectors in Eq. (5.10) is ultimately what allows us to integrate QM and relativity, since

- One (k) describes the movement of the matrix, while
- the other (k_p) describes the quantum momentum, i.e., the quantum eigen state of the particle.

Finally equating the wave vector k_p to the expression of the quantum state wave vector from Eq. (3.35) and using Eq. (5.6) we get an expression for $n(v)$

$$k_p = \frac{k_t}{n} \Leftrightarrow n = \frac{k_t}{k_p} \Leftrightarrow \tag{5.11}$$

$$n = \frac{c}{v} \tag{5.12}$$

Using this we can determine the momentum quantum number from the velocity recalling that Eq. (5.12) is a continuous approximation to $n(v)$ since n is discrete. The above expression matches our expectations, remembering that for instance the state k_2 corresponds to a velocity of c/2 and k_1 corresponding to the velocity c.

This concludes the derivations.

VI. REFLECTIONS ON THE THEORY.

As should be clear, the idea of graviton/photon interference gives rise to phenomena that are very similar to the matter waves known from quantum mechanics. It is the postulate that the photon/graviton interaction is in fact the cause of matter.

The idea behind the theory is simple and consistent, and offers an intuitive explanation of the quantum mechanical phenomena in terms of electromagnetic waves. It provides us with a quantum number for momentum that can be calculated from the velocity, allowing finite and bounded probability description of relativistic quantum mechanics to be obtained. I have not formulated such explicit solutions in this article, but it should be apparent that such a description is possible within the current framework.

From a metaphysical point of view the theory is suggestive in its simplicity and elegance, which lends it a measure of aesthetic credibility.

A. The dichotomy between QM and relativity

A key issue in conceptually unifying relativity and QM has been that they are incompatible in their very nature. The theory of relativity assumes reality to be *local, continuous and deterministic,* while quantum mechanics is *non-local, discontinuous, and indeterministic.* The present theory explains how these dichotomies are overcome.

The issue of *determinism vs. indeterminism* is resolved through the introduction of the modified uncertainty relation. The quantization of space means that as a particle reach relativistic velocities, the number of quantum momentum states available drops rapidly, reducing to a single state in the limit. In the relativistic limit there is therefore zero uncertainty, which implies complete determinism.

The issue of *locality vs. non-locality* is resolved on the conceptual level. In the theory of reciprocity all is considered to be one. Distance is a state of Mind, and non-locality is simply one of natures symmetries required in order to attain objectivity. The assumption of locality as a fundamental characteristic of the laws of nature is therefore considered to be wrong.

The final issue of *continuity vs. discontinuity* finds its resolution in the way discontinuity arises out of continuous phenomena. Both photonic and gravitonic realities are “continuous” in the sense that relativity assumes reality to be “continuous”. Yet through their *interaction* they give rise to a discrete reality in the form of the matrix. This in turn gives rise to the discontinuities of quantum mechanics.

The theory of reciprocity thus explains the issues dividing QM and relativity and provides the conceptual basis for unifying these two pillars of modern physics.

B. Two possible interpretations

Interpretation has always been an important part of quantum physics leading to at least eight different pictures of the quantum world (Herbert, [10]). The reason may be that meaning and consciousness have not been *explicitly* integrated into the theory, thus yielding this bewildering variation in interpretation.

A key issue in the interpretations of classical QM is that the measurement situation and the observer (the person performing a measurement) must be *explicitly* considered as part of the theory, in order to make it consistent. The notable exception is the Everett many-world interpretation, which has its own awkwardness, because it requires the creation of an infinite number of universes every moment.

In the theory of reciprocity the issue of the observer is resolved by assuming the existence of the hoton – the intelligence aspect of particles. However, the theory *can* be formulated without this assumption, but it will then retain

all the current ambiguities and paradoxes of quantum mechanics. This type of "classic" quantum mechanical interpretation may accept the ideas of the matrixes and quantum momentum, but simply view it as a new way of calculating probabilities. From a philosophical and aesthetic perspective it is of course awkward and the assumption of hotonic intelligence offers a simpler and more elegant solution.

Perhaps the greatest weakness of the classic interpretation is that it offers no explanation for the nature of consciousness and the origin of life. The existence of life and consciousness can hardly be denied, and in choosing between two interpretations, one of which explains only matter, whereas the other explains both matter and consciousness, the latter clearly seems preferable.

Using Ockhams razor on the two interpretations would favor the one including the existence of hotonic intelligence, because it explains more with fewer assumptions. It is possible however that this issue cannot be settled either way by a decisive experiment or logical argument and may forever remain a matter of philosophy to be settled by intuition.

C. The unifying interpretation

The interpretation suggested in this article embraces the philosophical implication that all that IS, is an expression of Mind. This resolves all the physical paradoxes while opening the door to a new set of issues related to the mystery of life. This interpretation accepts that relativistic quantum physics describes the mathematical envelope that objective life must obey, but it understands that within this envelope life evolves.

An analogy is to consider the physical limits of motion of a human being. These limitations certainly define the boundary conditions, but within these boundaries the arena of human life and civilization unfolds. Human consciousness is only partially defined by these laws. The same must be the case for "life" at scales other than human (atomic, cellular, planetary, celestial etc.).

D. Laws of negative spacetime

The fact that the relative change in photon frequency is related to our perception of relative motion suggests that something similar may be the case for the graviton. Only in negative spacetime, it is the relative attraction that would be governed by this property.

In fact one would expect that a complete formulation of the laws of physics, in terms of negative spacetime should be possible. Such a formulation would likely shed much light on the interaction between positive and negative spacetime and therefore on the dynamics governing reality at a deeper level, where both past and future enter into the calculation of probabilities.

E. Reflections on self-organization

The idea that a transcendent being is the cause of creation is controversial, as recent scientific debate shows. One of the arguments used to argue against such a presence is the self-organizing behavior of matter. However as the present article shows, such self-organizing behavior may well be a result of hotonic intelligence intrinsic to matter. This type of argument can therefore not be used to refute the existence of a transcendent cause, and consequently intelligent design, in nature.

F. Points of criticism

Initial feedback on the article has indicated that the results presented herein may not conform entirely to what is known as the "standard model".

This indicates one of two things, i.e. that:

- the fundamental ideas are flawed, or
- the theory is incomplete.

There is no doubt that the theory is incomplete and criticizing it based on lack of conformance to quantum field theory or the "standard model" is therefore misplaced. This article presents a fundamental new way at looking at the universe and regardless of the completeness of the current results, it may lead to important new insights if there is a measure of truth in the premises on which it is founded. Further research is required to determine whether a genuine unification of relativity and QM is possible based on the ideas presented herein.

G. What is new in this theory?

This article has introduced a range of new concepts and equations. The key innovations in the theory are summarized below.

- The theory provides a conceptual foundation able to unify general relativity and quantum mechanics.
- A new theory of gravity is formulated, whereby gravitons move backwards in time with a velocity of c^2.
- Consciousness is explicitly integrated in a physical theory for the first time, represented by the hoton.
- A relativistic version of the dispersion relation and wave equation has been derived, showing the classical equation to be an approximation hereof.
- The quantization of space emerging from the interaction between photon and graviton allow finite relativistic QM solutions to be obtained.

- The concept of quantum momentum has been articulated, showing that movement even in "continuous" space is actually a discrete phenomena, with well-defined quantum numbers *n*.
- It has been shown that uncertainty is reduced at high velocities and eliminated in the relativistic limit.
- The particle mass (m) and wave vectors (k_l) are shown to be equivalent and an intuitive cause of inertia is offered.
- It is suggested that QM and relativity define the mathematical envelope of life, and the fact that matter is intelligent and self-organizing derive from hotonic intelligence.

VII. METAPHYSICAL REFLECTIONS

In addition to the findings in relation to physics presented here, many important philosophical insights concerning the nature of life, consciousness and being arise from the theory of reciprocity. It is beyond the scope of this article to venture into this, so I will limit myself to some very brief observations and leave the rest for another occasion.

All major metaphysical thought systems consider the transcendent reality to be triadic. In many systems of thought referred to as the mother, the father and the child. In Christian thought we encounter it as the Father, the Son and the Holy spirit. The following triadic correspondences are worth considering:

Father	Mother	Child
Photons	Gravitons	Hotons
Light	Darkness	Life
Cause	Resistance	Effect
Power	Attraction	Experience
Energy	Inertia	Movement
Being	Form	Consciousness
Order	Chaos	Creativity
Power	Wisdom	Love

From the metaphysical perspective, time is an illusion. Time is considered as the consciousness of form. It is a result of "imprisoning" the unlimited spirit (the father) into a particular form (the mother). Thus life (the child) emerges from the union between the father and the mother.

In the theory of reciprocity photons and gravitons are defining the mathematical envelope of life

- Photons give rise to space, through distance.
- Gravitons give rise to form, through attraction.
- Form in space creates a vehicle through which the child (awareness) can be born.

Thus interference between the father (light) and the mother (gravity) literally births the child (consciousness). This unifies physics and metaphysics in a beautiful manner. Too beautiful not to be true.

A. The nature of attraction

In the context of a theory where Mind plays a prominent role, the apparent importance of the graviton in subatomic dynamics (at least in regards to the temporal dimension) gives rise to reflection. One way of viewing the dynamics of cause and effect is to conceive of the process of actualizing potential as triadic.

Actualizing certainly involves the influence of past events. However the idea of graviton influence suggest a similar dynamic coming from the future, as if the NOW is the product of causes from the past *and* the future, defining the options available to the hoton.

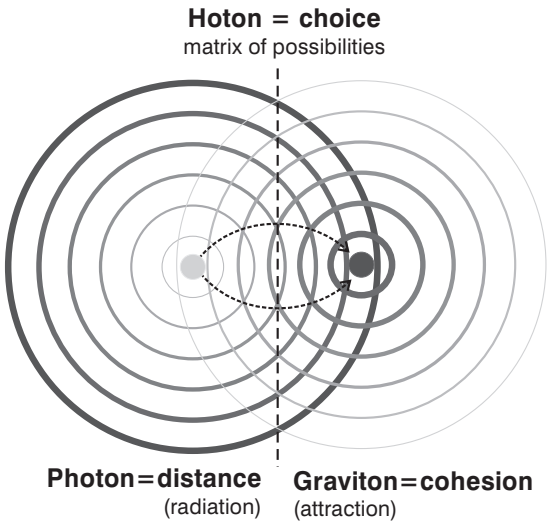

FIG 4. Symbolic illustration of cause and effect viewed as a triad of past events, future attraction and current choice.

These three factors together determine the actualization process, or the collapse of the wavefunction as it is frequently referred to. In this picture the collapse happens in every oscillation of the hoton, and the paradoxes of when the collapse happens are completely absent from the theory of reciprocity. However it leaves open the question of what determines the hoton choice.

Perhaps that which determines the choice of the hoton is the attraction of the greater life that it is part of. For instance, the atoms in a human cell are oriented towards the awareness represented by the cell, the cell is oriented towards the human being, the human being is oriented

towards the planetary "being" and so on. Thus is established an infinite chain of influence thought to govern life, from the greatest whole, to the smallest particle.

This dynamic lends credence to the notion of *synchronicity*, or "*meaningful coincidences*" governed by an "*acausal connecting principle*" as espoused by the terms inventor, psychiatrist C. G. Jung [11], who was very occupied by this phenomenon and recounted a number of extraordinary examples thereof.

VIII. CONCLUSION

The postulates made in the beginning result in a treatment of relativistic quantum mechanics that illuminates the nature of ψ as possibility waves and sheds light on how the interaction of waves of gravity and light is thought to give rise to matter. The current article may represent a first step towards a genuine conceptual unification of QM and relativity. Further work is, however, needed in order to see if the theory can be formulated in such a way that it conforms to what is currently known to be true (i.e. quantum field theory and the "standard model").

The ideas presented herein offers a resolution to several conceptual paradoxes in quantum mechanics and implies that the universe has been created by a transcendent intelligence. In so doing it has created a firm ground for unifying physics and metaphysics. The fact that insights into physics have emerged from metaphysical considerations highlights the importance of grasping principles of a transcendent nature in modern science. It is the opinion of the author that many other symmetries in science have their roots in metaphysics and that a systematic exploration of this domain would yield considerable insight.

In earlier periods of scientific investigations, discoveries were often made because theories did not match experience (or experiments). Following the advent of quantum mechanics and relativity, there are no physical experiments (narrowly defined) that cannot be explained. This lack of tension (between theory and results) is in my mind part of the reason why making progress in relation to the underlying concepts of quantum physics and relativity has been so long in coming.

I believe that concerning the fundamental issues, the greatest tension at this time is to be found between physics and metaphysics. As before with discrepancies between theory and experiments, we can compare our physical and metaphysical insight and where there are differences, we know new insights are awaiting. However given the current atmosphere and tradition in science, this requires a major reorientation along new lines of thinking. It requires developing faculties and research environments truly conducive to intuition, which is to metaphysical studies what intellect is to physics. To my knowledge there exist no such environments in universities or research institutions today.

Individuals that share this basic sentiment, and wish to contribute to such a reorientation are welcome to contact the author through www.gaia-institute.org.

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